Monographiae Botanicae 111

Vegetation of Middle Asia

with a special reference to Tajikistan

Wrocław 2025

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Immense steppes dominated by *Stipa krylovii* in the Lake Issyk-kul Basin in the eastern Kyrgyzstan in the foothills of Kuylyuto Mts. Photo: A. Nowak.

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Arkadiusz Nowak & Marcin Nobis

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Pseudosteppes of *Vulpio persicae-Caricion pachystylidis* in early April near Vose, Khatlon Province, Tajikistan (ca. 880 m a.s.l.). Photo: A. Nowak.

ENDPAPERS

First: The Iskander-kul Lake in western Zeravshan Mts. Photo: A. Nowak.
Second: Thermophilous open woods with *Cercis griffithii* near Nurek in the Sarsarak Mts, Tajikistan (ca. 1,190 m a.s.l.). Photo: A. Nowak.

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ABSTRACT
Middle Asia, which includes countries such as Tajikistan, Kyrgyzstan, Kazakhstan, Uzbekistan and Turkmenistan, is one of the world's richest floristic regions. More than 10,000 species of vascular plants can be found here. At the same time, it is a very diverse region in terms of habitats and rich in a variety of vegetation types that were of little interest to geobotanists in the 20th century. In 2006, a team of Polish researchers began a long-term programme of geobotanical exploration in Tajikistan and neighbouring countries. After conducting some 56 expeditions and collecting about 6,000 records of almost all vegetation types, the research was summarised and the first comprehensive catalogue of vegetation communities for this area is presented in a hierarchical system. A total of 552 vegetation types (297 associations, 16 subassociations and 239 plant communities) were distinguished, grouped into 45 vegetation classes, 51 orders and 87 alliances. A schematic geobotanical map was also prepared with 29 main zonal vegetation types. The results of the work are the basis for further research in the field of vegetation ecology and syntaxonomy of Tajikistan and Middle Asia, and also form the foundation for planning a conservation system of the phytocoenotic diversity of this unique region.

STRESZCZENIE
Środkowa Azja obejmująca przede wszystkim takie kraje jak Tadżykistan, Kirgistan, Kazachstan, Uzbekistan i Turkmenistan, jest jednym z najbogatszych florystycznie regionów Ziemi. Występuje tu ponad 10 000 gatunków roślin naczyniowych. Jednocześnie jest to obszar bardzo zróżnicowany pod względem siedliskowym i bogaty w rozmaite typy roślinności, które w XX wieku nie były przedmiotem szczególnego zainteresowania geobotaników. W roku 2006 zespół polskich badaczy rozpoczął wieloletni program eksploracji geobotanicznej Tadżykistanu i sąsiednich krajów. Po odbyciu ok. 56 wypraw i zebraniu ok. 6 000 rekordów niemal wszystkich typów roślinności, dokonano podsumowania badań przedstawiając pierwszy dla tego obszaru katalog zbiorowisk roślinnych ujętych w hierarchiczny system. Łącznie wyróżniono 552 typy roślinności (297 zespołów, 16 podzespołów i 239 zbiorowisk roślinnych), zgrupowanych w 45 klasach roślinności, 51 rzędach i 87 związkach. Przygotowano także schematyczną mapę geobotaniczną z 29 głównymi zonalnymi typami roślinności. Wyniki pracy są podstawą dalszych badań z zakresu ekologii roślinności i syntaksonomii Tadżykistanu i Azji Środkowej, i stanowią także podstawę planowania systemu ochrony różnorodności fitocenotycznej tego unikalnego regionu.

KEY WORDS
Central Asia, geobotany, Middle Asia, Pamir, Pamir-Alai, plant communities, Tian Shan, vegetation classification.

SŁOWA KLUCZOWE
Azja Centralna, Azja Środkowa, geobotanika, klasyfikacja roślinności, Pamir, Pamir-Ałaj, Tien-Szan, zbiorowiska roślinne.

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This book is dedicated to Jerzy Rzędowski-Rotter (1926-2023),
an eminent Polish-Mexican phytosociologist, Botanist of the Millenium,
who made landmark contributions to the knowledge
of the vegetation of Mexico

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Part I

Introduction

The survey of the vegetation of Middle and Central Asia has a long tradition and was conducted by Russian and later by many others local botanists already in the first half of the 20th century (Afanasjev 1940; Koroleva 1940; Grigorev 1944; Ovchinnikov 1948a, 1948b). This survey continued in the following decades and was mainly concerned with forest, shrubland and grassland vegetation (e.g. Sidorenko 1953; Afanasjev 1956; Golovkova 1959; Ashirova 1960; Korovin 1961, 1962; Dzhuraev 1970, 1972a, 1972b; Melnikova 1971; Zapryagaeva 1976; Stanyukovich 1982; Agakhanjanz, Breckle 2003; Safarov 2018). It was carried out using the so-called Russian school which was based on groups of dominant species (Sukachev 1929; Shennikov 1964; Aleksandrova 1978). The political turmoil of the late 20th century, particularly in Tajikistan, led to a period of stagnation and suspension of many research projects. In addition, the research results of local botanists were not published in international journals, resulting in large gaps in knowledge about the vegetation of this world hotspot of biodiversity. Middle Asia is an extremely important phytogeographical region. It is characterised by numerous boundaries, such as those between Central and Middle Asia, and between the Irano-Turanian and temperate climates. It should be emphasized that **Middle Asia** includes areas of Tajikistan, Kyrgyzstan, Uzbekistan, Turkmenistan, southern Kazakhstan, northern Afghanistan and western China, while **Central Asia** covers the more continental and temperate territories of Kazakhstan, Mongolia and China (Cowan 2007). The region's altitudes vary significantly, ranging from less than 150 in desert lowlands up to ca. 7,500 m a.s.l. in Pamir and central Tian Shan. For these reasons, we decided in 2006 to initiate a research programme to increase our knowledge of the vegetation diversity of the floristically richest areas of Middle Asia in Tajikistan and Kyrgyzstan, to review the achievements of local geobotanists and to take steps forward by applying modern methods of numerical analysis of plant communities, and to supplement our knowledge of vegetation diversity, in particular of chasmophytic vegetation. A sound description of the variability of plant communities in Tajikistan, our main study area, also required surveys in neighbouring regions, the most accessible of which were those in Kyrgyzstan, western Uzbekistan and southern Kazakhstan. We also included data from researchers working in Pakistan, Afghanistan, Iran and Mongolia for comparative analyses. After 19 years of work, during which we have carried out one to four research expeditions each year and published more than 100 papers on the vegetation of Middle Asia, it is time for a first summary. The submitted book describes 552 vegetation types (297 associations, 16 subassociations and 239 communities), grouped into 45 vegetation classes. This is certainly not the final list and does not complete the syntaxonomic research in this area. Middle Asia, including Tajikistan and adjacent territories, is home to one of the richest flora in the world. Tajikistan alone harbours up to 4,300 native vascular plant species (Nowak, Nobis 2020). Middle Asia is a land of extremely varied topography and habitats, where the influences of the Himalayas and Karakoram from the south-east, the hot continental deserts of Central Asia from the east (e.g. Taklamakan) and west (Karakum, Kyzylkum) and the mountains with a typically Mediterranean character in terms of bedrock and climate, are particularly strong. Although not all corners of this fascinating area have been surveyed by our team, and some vegetation types still need to be studied in detail (e.g. river-bar vegetation, therophyte-rich zoogenic vegetation of mammal lairs, aquatic vegetation, thermophilous vegetation on boulders), the picture of Middle Asian vegetation on the example of Tajikistan and to some extent Kyrgyzstan and its hierarchical arrangement is already clearly outlined. This gives us the opportunity to make an important update of the vegetation map of Tajikistan, which has both theoretical and practical significance. The diversity of habitats and plant communities should be of particular concern to the international conservation community, and such a study provides the foundation for effective conservation and prioritisation of efforts. Vegetation typology answers

many practical and academic questions and is widely used not only in conservation but also in many basic studies, including those dealing with global warming (Oehri et al. 2022). Vegetation is the home of the most species, so to effectively protect life, biodiversity and traditional uses, we need to know how diverse, distinct, well developed, stable or degraded, and with what extent and range a particular vegetation type is.

This work is intended for professional botanists, ecologists and conservationists, but also for nature enthusiasts, students and tourists visiting Middle Asia or wishing to broaden their knowledge of the unique and rich vegetation of this region. To enhance the appeal of the publication, we have included hundreds of photographs showing the lush, colourful and unique vegetation. We hope that this will encourage our successors and, above all, especially the botanists of Middle Asia to work hard to complete, update and above all protect this wonderful natural heritage.

Floristics and biogeography of Middle Asian vegetation on the example of Tajikistan

The extraordinary complexity of climatic influences, phytogeographical divisions and diverse land geomorphology enhances the floristic composition and richness of plant species of Tajikistan and its adjacent areas. Despite the fact that the territory of Tajikistan is far from being sufficiently studied in terms of floristics and taxonomy, it is accepted that the vascular flora of Tajikistan consists of about 4,300 spontaneously occurring species assigned to 116 families, of which the taxonomically richest are: Asteraceae, Fabaceae, Poaceae, Brassicaceae and Apiaceae. High species richness was observed for some of the 994 known genera, e.g. *Astragalus* (276 species), *Cousinia* (121), *Allium* (100), *Taraxacum* (60) and *Oxytropis* (58). The number of vascular plants of the region is not yet final, as some new taxa from Tajikistan have recently been published (e.g. Nobis 2013; Nobis et al. 2013, 2017a, 2020). They mainly belong to feathergrasses (e.g. *Stipa* ×*brevicallosa*, *S.* ×*fallax*, *S.* ×*tadzhikistanica*, *S. zeravshanica*), bulbs (e.g. *Allium intradarvazicum*, *A. khozratense*, *A. oreotadzhikorum*, *A. vallivanchense*) and sainfoins (e.g. *Onobrychis dushanbensis*; Ranjbar et al. 2010). Several species have also been discovered in the country only recently (e.g. Nobis, Nowak 2011; Nobis et al. 2023; Volkova et al. 2024). These include a number of alien taxa such as *Amorpha fruticosa*, *Acalypha australis* and Middle Asian native plants known from neighbouring areas such as *Nanorrhinum ramosissimum*, *Myriophyllum sibiricum*, *Gypsophila floribunda*, *Neottia ovata*, *Stipa gracilis* or *Zygophyllum miniatum*. According to Lazkov and Sultanova (2014), 3,927 species of wild and adventive vascular plants from 834 genera belonging to 114 families are listed for the territory of Kyrgyzstan. Among them, 81 species are introduced or naturalised from cultivation in Kyrgyzstan, with 38 genera and 7 families represented only by adventive species. In total, 396 species (approx. 10% of the entire flora) are considered endemic to the country (Lazkov, Sultanova 2014). This is comparable to the endemism of the flora of Kazakhstan, which has about 8% of exclusive vascular plants (Kubentaev 2024).

In Tajikistan, the degree of endemism in the flora is much higher and is a measure of its uniqueness and should therefore be used in assessing the conservation of plant diversity. Approximately 30% of the vascular plant species known from Pamir-Alai are generally accepted as endemic or sub-endemic (Nowak et al. 2011). Many of these species have very limited ranges restricted to a single valley or a mountain massif (e.g. *Anemone zeravshanica*, *Sergia regelii* or *Scutellaria juzepczukii*).

Because of its floristic richness, Tajikistan, as a core area of the Central Asian Mts, is recognised by Conservation International as a biodiversity hotspot and one of the eleven most important focal points for future plant diversity studies and conservation (Mittermeier et al. 2006; Giam et al. 2010). At the same time, it is considered the most vulnerable area in the world to climate change and biodiversity loss, yet only twelve species from this country are listed as globally threatened (e.g. Darvaz dogwood *Swida darvasica* and wild apple *Malus sieversii*). In addition, the mountainous temperate forests and steppes of Central Asia are considered one of the most vulnerable ecoregions in the world (Olson, Dinerstein 1998). A recent analysis of the degree of endangerment of Tajik flora reveals significant threats to its richness (Nowak et al. 2020a). The study shows that of 4,269 native species confirmed in Tajikistan, 1,627 taxa (38.11%) are threatened and 23 (0.54%) are extinct.

Tajikistan, like the whole Middle Asia, is a mountainous, phytogeographically complex country with a wide variety of climates, landscapes and habitats. Located between the continental Asian deserts in the west, south and north-east (Karakum, Kyzylkum, Taklamakan), the *solonchak* plains of the Iranian plateau, and the great mountain ranges of the Tian Shan, Kunlun, Hindu Kush and Karakoram

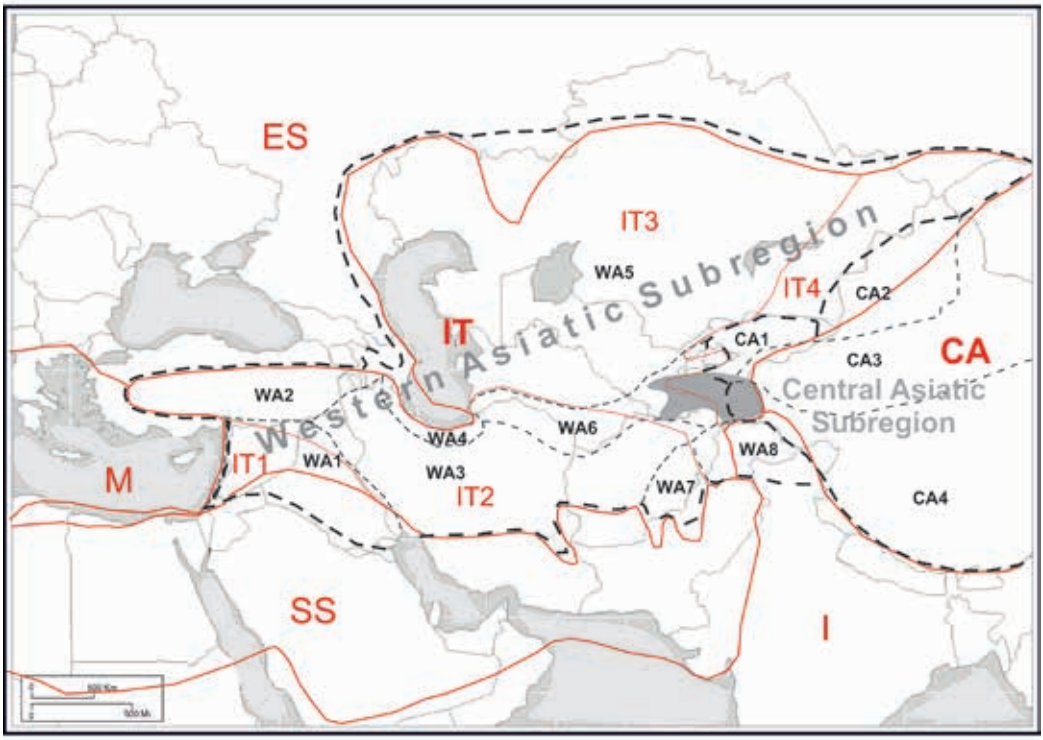

Fig. 1. Phytogeographical division of Middle and Central Asia according to Grubov (2010) and Takhtajan (1986) (black dashed lines); WA1 – Mesopotamian Province, WA2 – Central Anatolian Province, WA3 – Armeno-Iranian Province, WA4 – Hyrcanian Province, WA5 – Turanian Province, WA6 – Turkestanian Province, WA7 – Northern Baluchistanian Province, WA8 – Western Himalayan Province, CA1 – Central Tian-Shan Province, CA2 – Dzhungar-Tian-Shan Province, CA3 – Mongolian Province, CA4 – Tibetan Province. Bioclimatic regionalisation follows the approach of Djamali et al. (2012; red lines).

Explanations: SS – Saharo-Sindian Region, IT – Irano-Turanian Region (with four subregions (IT1-IT4), CA – Central Asian Region, ES – Eurosiberian Region, I – Indian Region. The Pamir-Alai area is marked with a grey polygon.

in the north, east and south-east, and with all elevation belts from hot to permafrost deserts, it offers a magnificent range of biotopes for plants and vegetation. With one of the world's largest elevation amplitudes, extreme rainfall and temperature ranges, considerable glacial cover and diverse geology, the country supports a large number of plant species and their communities. It is also important to note that the Pamir-Alai, which makes up the majority of Tajikistan's territory, lies on the border between two major geographical regions: the Central Asian (with significant boreal and continental influences) and the West Asian subregions (with stronger affinities to the Mediterranean climate). This partitioning is to some extent reflected in the phytogeographical division of the Irano-Turanian Province, which according to Grubov (2010) and Takhtajan (1986) is divided into the West Asian subregion (with the Turkestan province encompassing western and central Tajikistan) and the Central Asian subregion (with the Tibetan province encompassing eastern Pamir; Fig. 1). In addition, it is worth noting that the Pamir-Alai in the territory of Tajikistan straddles three major climatic regions: the Central Asian in the east and the Irano-Turanian in the west, with some Indian and Saharo-Sindian influences from the south (Djamali et al. 2012).

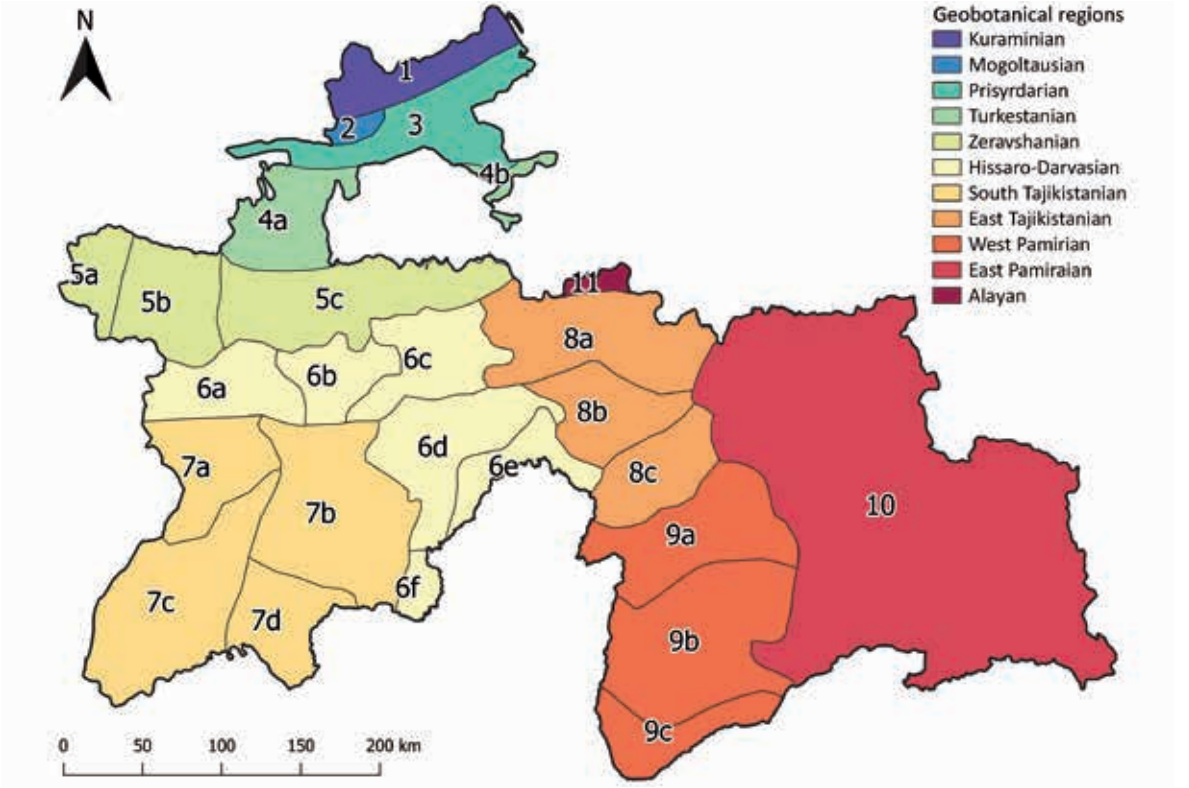

Fig. 2. The phytogeographical division of Tajikistan: 1 – Kuraminian; 2 – Mogoltausian; 3 Prisyrdarian; 4a – Turkestanian A, 4b – Turkestanian B; 5a – Zeravshanian A, 5b – Zeravshanian B, 5c – Zeravshanian C; 6a – Hissaro-Darvasian A, 6b – Hissaro-Darvasian B, 6c – Hissaro-Darvasian C, 6d – Hissaro-Darvasian D, 6e – Hissaro-Darvasian E, 6f – Hissaro-Darvasian F; 7a – South Tajikistanian A, 7b – South Tajikistanian B, 7c – South Tajikistanian C, 7d – South Tajikistanian D; 8a – East Tajikistanian A, 8b – East Tajikistanian B, 8c – East Tajikistanian C; 9a – West Pamirian A, 9b – West Pamirian B, 9c – West Pamirian C; 10 – East Pamirian; 11 – Alayan (according to Ovchinnikov 1957 after Goncharov 1937).

This phytogeographical division of Middle Asia is also reflected in the division of Tajikistan into 26 subregions that was proposed by Goncharov (1937) and Ovchinnikov (1957; Fig. 2).

The geography of Tajikistan is conducive to high floristic diversity. This has led to the speciation of many altitudinal and ecological vicariants, often found in a single isolated valley or mountain ridge (e.g. the genera *Scutellaria*, *Nepeta*, *Allium* and *Cousinia*). Moreover, the evolutionary and geologic foundation for the country's extraordinary plant richness is also related to the climate aridification, decrease in average temperatures and mountain orogenesis that occurred during the last 2–5 million years (late Neogene and Quaternary; Raduła et al. 2021).

Phytogeographic composition of the flora of Tajikistan

The flora of Tajikistan is clearly characterised by the dominance of Irano-Turanian species, similar to other countries of Middle Asia. This group accounts for about 65% of the total number of species. In addition, the Central Asian species (the group of Irano-Turanian element with the eastern distribution ranges in continental and highly elevated Central Asia) brings another 5.3%. Altogether, the Irano-Turanian element strongly predominates with more than 70% of the total number of vascular plant species. In addition to the 1,487 endemic taxa in the flora of Tajikistan, there are a number of plants restricted to the area between the south-western part of Tajikistan and the Iranian uplands (e.g. *Allochrusa paniculata*, *Amygdalus bucharica*, *Iris sogdiana*, *Ferula bucharica*, *Malva bucharica*, *Piptatherum sogdianum*, *Prangos bucharica*, *Pyrus bucharica*). In the group of eastern Irano-Turanian species, which are found in the mountains, steppes and high plateaus of Central Asia, the most common species in Tajikistan include *Acantholimon diapensioides*, *Ajania tibetica*, *Cousinia semidecurrens*, *Dilophia salsa*, *Ephedra tibetica*, *Leontopodium nanum*, *Parrya eriocalyx*, *Ranunculus badachshanicus*, *Saussurea leucophylla*, *Stipa glareosa* and *Youngia diversifolia*).

A significant proportion of the flora of Tajikistan (10.6%) belongs to species with their main distribution in the Mediterranean Region (Fig. 3). This is related to the similarity of climatic conditions and the origin of Irano-Turanian floras (see Kamelin 2017). They prefer to occupy the lower alpine, montane and submontane belts of the western parts of the Pamir-Alai mountain ranges. Examples of typical Mediterranean taxa are *Avena meridionalis*, *Brassica campestris*, *Cressa cretica*, *Cynoglossum creticum*, *Lallemantia iberica*, *Papaver orientale*, *Phleum graecum*, *Rochelia retorta* and *Salix aegyptiaca*.

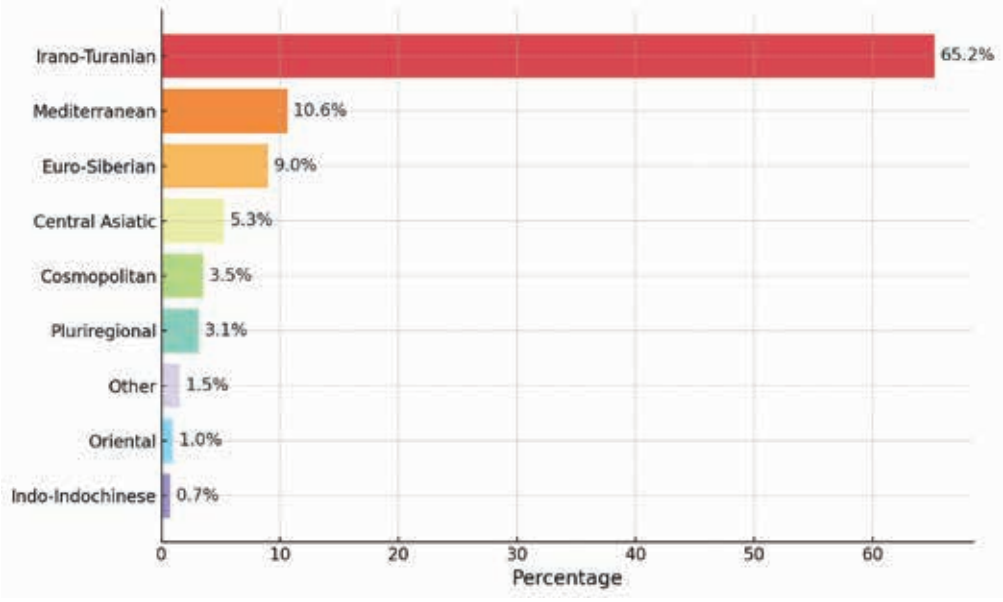

Fig. 3. Phytogeographical composition of the flora of Tajikistan. Source: Authors.

The next compositional group of the Tajik flora are the species with a core distribution in the temperate Euro-Siberian region. They reach the southernmost limits of their range in the northern Pamir-Alai and Tian Shan Mts, often inhabiting relatively cold subalpine and alpine belts. Examples of this group of taxa include *Asparagus officinalis*, *Carex diandra*, *Rumex thyrsiflorus*, *Salix pentandra*, *S. triandra*, *Stipa capillata* and *Trifolium repens*.

Pluriregional species are less numerous, accounting for 3.5% of the total flora. They are distributed throughout the Old World, especially in the Euro-Siberian, Mediterranean, Irano-Turanian, East Asian, Indo-Chinese, North African and sometimes Circumboreal provinces. Examples include *Alliaria petiolata*, *Centaurium pulchellum*, *Echium vulgare*, *Erodium cicutarium*, *Holosteum umbellatum*, *Hypericum perforatum*, *Plantago major*, *Prunella vulgaris*, *Rubus caesius* and *Vicia angustifolia*.

In addition, cosmopolitan species with a worldwide distribution due to adaptation to anthropogenic habitats are still not so numerous in the flora of Tajikistan. They are often associated with anthropogenic habitats such as fields, roadsides or ruderal areas in human settlements. Many of them are aquatic or littoral with a high potential for intercontinental spread. An interesting addition to the flora of Tajikistan are species representing the East Asian element (Oriental), including *Eucommia ulmoides*, *Morus alba*, *Muhlenbergia huegelii*, *Polygonum alatum*, *P. orientale*, *Pyrus ussuriensis*, and reported from rice fields, *Sagittaria trifolia*. Rice fields and other crops are the main habitat for species of Indian and Indo-Chinese origin. The most common are weedy taxa of rice fields such as *Ammania auriculata*, *A. multiflora*, *Dopatrium junceum*, *Eriocaulon sieboldianum*, *Rotala indica*, *Schoenoplectus juncoides* and *Sphenoclea zeylanica*. Some examples of this group, which originated in south-east Asia, are now distributed throughout tropical and subtropical zones in man-made habitats, e.g. *Ammania baccifera*, *Eleusine indica*, *Najas graminea* and *Ludwigia perennis*.

The south-western fringes of the Pamir-Alai mountain range, e.g. the Hazratishokh, Aktau or Babatag Mts, provide suitable habitats for Saharo-Sindian taxa whose core distribution lies far to the west in southern Iraq, Egypt and other desert areas of northern Africa. Examples include *Gossypium herbaceum*, *Heliotropium supinum*, *Nanorrhinum ramosissimum* and *Sorghum sudanense*.

Other geographical groups of species have much lower numbers. Arctic-alpine species are represented by *Carex microglochin*, *Chamaerion latifolium*, *Lloydia serotina*, *Luzula spicata*, *Melandrium apetalum*, *Oxygraphis glacialis*, *Saxifraga hirculus*, *Sagina saginoides*, *Saxifraga oppositifolia*, *Torularia humilis* and *Trichophorum pumilum*. These plants grow at the highest altitudes in the chionophilous grasslands or fens of the Eastern Pamir and are sometimes restricted to the mountain peaks. Another group of species that prefer the highest altitudes are plants with a range along the Himalayan Mts. Examples are *Aconitum rotundifolium*, *Alopecurus himalaicus*, *Bergenia stracheyi*, *Rumex nepalensis*, *Saxifraga stenophylla*, *Sedum ewersii*, *Sibbaldia tetrandra* and *Silene wallichiana*.

Geology and soils of Middle Asia

The mountain systems of Middle Asia (Fig. 4), were uplifted during the Cenozoic and are part of the long orogenic belt of Asia along the western part of the Himalayas, Karakoram and Hindu Kush line. The sedimentary deposits, which are about 20-25 km thick, have been displaced northwards by about 300 km. This massive crustal shift is undoubtedly the result of a continental collision. Nevertheless, the Indian subcontinent is causing the Pamir plateau to slide northwards by 20 mm per year via the Alai fault (Lohr 2001). The Pamir is characterised by a thick continental crust of about 70 km (Holt, Wallace 1990). Geophysical observations show an oblique subduction zone beneath the Pamir that dips to the SSE (Billington et al. 1977). This subduction zone is indicative of a large Mesozoic thrust fault in the Trans-Alai range.

The geological profile of the Pamir-Alai is one of the most complex and difficult to interpret. Between the Tajik and Tarim basins there are many faults, suture and subduction zones, and areas of sedimentation. As a result, the geological outline of the study area is very complex, with outcrops of rocks formed from the Precambrian to the present. The rocks that make up the territory of the country are very diverse in age, composition and structure. Few geological surveys have been published for Middle Asia (see Nedzvedskiy 1968; Lohr 2001). For Tajikistan, in the northern part of the country (Trans-Alai and Alai mountain ranges), mainly of Carboniferous igneous and sedimentary rocks of oceanic origin have been identified; these are mainly mafic rocks and tholeiitic basalts covered by limestone, siltstone and sandstone (Leven 1981; Budanov, Pashkov 1988). In the south-western part of the system – in the Darvaz Range – serpentinite melange occurs accompanied by basalts, conglomerates and limestones (Pospelov 1987). The montane and alpine zones of the Hissar Mts are largely composed of intrusive rocks, mainly granite, granitoid and syenite. The Peter the First and Hazratishokh mountain ranges contain deformed and metamorphosed Precambrian and Palaeozoic deposits of sandstone, limestone and marl. In the Rushan-Pshart zone, there is a Perm/Trias alternation of marine sediments, mainly limestones and radiolarites. In addition, outcrops of extrusive rocks of igneous origin such as pillow basalt, andesite, tuffs and lenses of ultramafic rocks have been reported.

The southern ranges of the Pamir-Alai system are composed of metamorphic Precambrian rocks and Mesozoic and Paleogene granites (Pashkov, Budanov 1990). The oldest rocks, such as Late Carboniferous to Early Permian sandstone, siltstone, clay and limestone, are overlain by Triassic limestone, radiolarite and siltstone with intrusions of basaltic lava and tuff.

Towards the southwest, the Pamir-Alai mountain range dips into the Tajik Sedimentary Basin. During the Early Cretaceous, marine sediments of limestone, marl and clay were deposited in this area. The sedimentary sequence is up to 1,400 metres thick and contains sandstone, gypsum, clay, limestone and conglomerates (Lohr 2001). In the outer Pamir, along the Zeravshanian and Turkestanian ranges, Cambrian and Silurian sediments predominate. The rocks here are generally limestone (micritic, bituminous, marly and dolomitic coral limestone), marble, dolomite, dolomitic shale, clay shale, phyllitic schist and shale.

The soils of the Middle Asian Mts are strongly influenced by the relief (30% of the area has slopes of about 20° or more) and the geological history of each site. In addition, precipitation and the associated vegetation cover have a significant effect on soil type. The soils are mostly initial, containing debris of various sizes, ranging from sand to coarse gravel and stones in the mountains. It is only in the depressions and valley bottoms that fine materials (mainly loess and silt) predominate, forming fine-grained substrates. The typical soils of the montane and subalpine belts of the Pamir-Alai are kastanozems, with a considerable content of organic matter that preferably is covered by rich steppe vegetation.

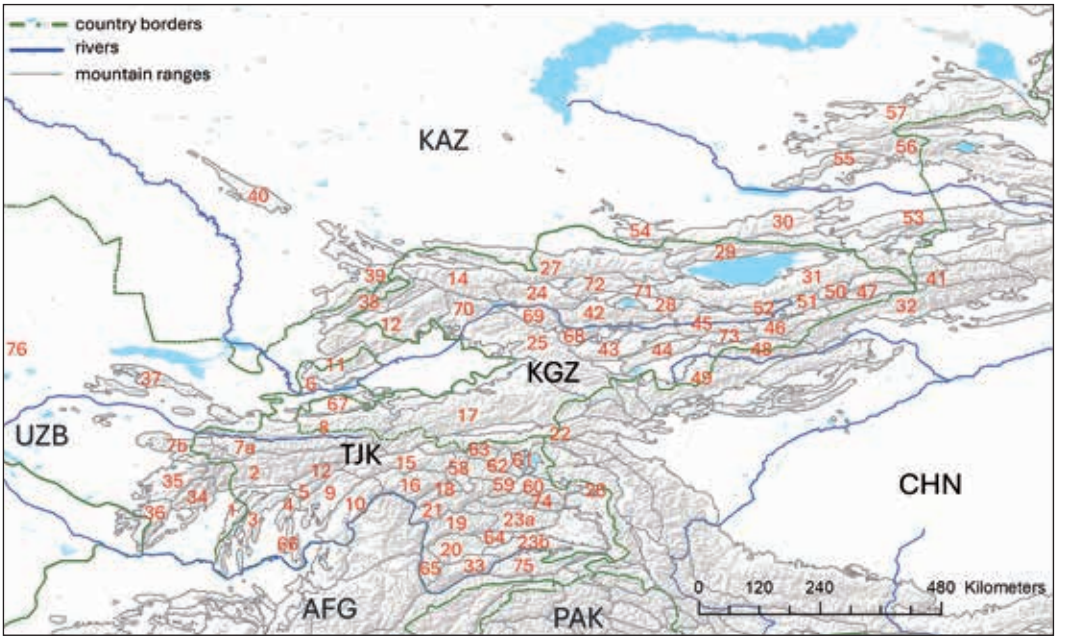

Fig. 4. The main mountain ranges in Middle Asia including Tajikistan (TJK), Kyrgyzstan (KZG), Uzbekistan (UZB) and Kazakhstan (KAZ): 1 – Babatag Mts, 2 – Hissar Mts, 3 – Aktau Mts, 4 – Karatau Mts, 5 – Sarsarak Mts, 6 – Mogoltau Mts, 7 – Zeravshan Mts (7a Fann Mts, 7b Zeravshan Mts), 8 – Turkestan Mts, 9 – Vakhsh Mts, 10 – Hazratishokh Mts, 11 – Kuraminian Mts, 12 – Chatkal Mts, 13 – Karateginian Mts, 14 – Talas Mts, 15 – Peter the First Mts, 16 – Darvaz Mts, 17 – Alai Mts, 18 – Vanch Mts, 19 – Rushan Mts, 20 – Shugnan Mts, 21 – Yazgulem Mts, 22 – Trans-Alai Mts, 23 – Alichur Mts, 24 – Suusamyr Mts, 25 – Fergana Mts, 26 – Sarikol Mts, 27 – Kyrgyz Ala-Too Mts, 28 – Song-köl Mts, 29 – Kyungey Ala-Too Mts, 30 – Trans-Ili Alatau Mts, 31 – Terskey Ala-Too Mts, 32 – Kakshaal Too Mts, 33 – Shakhdara Mts; 34 – Baysuntau Mts; 35 – Chakchar Mts; 36 – Koytendag Mts; 37 – Nuratau Mts; 38 – Pskem Mts; 39 – Ugam Mts; 40 – Karatau Mts; 41 – Sary Jaz Mts; 42 – Moldo Too Mts; 43 – Baybiche Too Mts; 44 – Atbashi Mts; 45 – Naryn Too Mts; 46 – Borkoldoy Too Mts; 47 – Inylchek Too Mts; 48 – Kuokexiale Mts; 49 – Maidan Tagh Mts; 50 – Kuylyuto Mts; 51 – Akshiyrak Mts; 52 – Dzhetimbel Mts; 53 – Ketmen Mts; 54 – Shule Mts; 55 – Altyn-Emel Mts; 56 – Borohoro Mts; 57 – Dzungarian Alatau; 58 – Academy of Sciences Mts; 59 – Tanymas Mts; 60 – Zortoshkol Ridge Mts; 61 – Kara-kul Mts; 62 – Zulumart Mts; 63 – Beleuli Mts; 64 – Bakchigir Massif; 65 – Ishkoshim Mts; 66 – Sarikol Mts; 67 – Kara Tash Mts; 68 – Chartash Mts; 69 – Këk-Irim-Too Mts; 70 – Atoynak Mts; 71 – Karkatty Mts; 72 – Jumgal Too; 73 – Jany-Jer Mts; 74 – Muzkol Mts; 75 – Nicholas Mts; 76 – Aktau Mts (after Snethlage et al. 2022a, 2022b and Esri 2025, modified).

In the more extreme climatic conditions – in the lower foothills and highest altitudes of the eastern Pamir – burozems and grey soils predominate, with a thinner topsoil layer and a higher content of rock debris or sand deposits. These soil types support the so-called desert or cryophilous steppes and alpine meadows. The topsoils are low in organic matter and high in minerals, reflecting the aridity. In the sandy regions of the Fergana Basin and the Tajik Depression, and in the mountain semi-deserts of the eastern Pamirs, arenosols and even poor sandy dunes can develop. According to Leontieva (1968), there are four main soil zones in Tajikistan: the grey soils of the highlands and montane areas (mainly brown calcareous), the soils of the moderately high mountains (generally brown acidophilous), the soils of the alpine mountain belts with steppes and glaciers (weakly developed leptosols), and the underdeveloped soils of the high mountain deserts. In the lowest depressions and in some parts of the high plateaus, the climatic conditions, low precipitation and high evapotranspiration lead to the formation of spatially restricted solonchak and solonetz soils.

Climate of Middle Asia

According to the Köppen-Geiger climate classification, Middle and Central Asia, particularly Tajikistan and Kyrgyzstan, is a tangle of different climatic zones (Fig. 5). Looking for a general pattern, the central, mountainous part of the region is characterised by a warm continental climate (Dsa, e.g. Tavildara district, TJ) and a warm Mediterranean climate (Csa, e.g. Dushanbe district, TJ). Towards the east and west, a cold semi-arid zone begins (BSk, e.g. Pandzhikent, TJ and Kara-kul Lake area, TJ), and then the highlands of the Eastern Pamir and the Alai Valley are typically cold desert (BWk, e.g. BWk, TJ). Further east-north, the climate changes from humid continental (Dsa, e.g. Jalalabad district, KG) to warm continental (Dfa, e.g. Sopukorgon district, KG) and temperate continental (Dsb, e.g. At-bashi district, KG). Further west and north-west, where the desert conditions of the Karakum and Kyzylkum lowlands prevail, a zone of cold desert climate dominates (BWk; Nurota, UZ). However, this is only a generalised pattern of climatic zonation. In many places, local conditions predominate, and the characteristics of the climate classify them in other types, e.g. the dry, hot desert climate of the Shartuz region in south-western Tajikistan (BWh), which is clearly characterised by desert vegetation with *Haloxylon aphyllum* shrublands. There is also a polar tundra in the highlands of the western Pamir or central Tian Shan (ET), and a polar frost climate in the glaciated areas of the highest altitudes (EF). In the deep valleys of the Pamir,

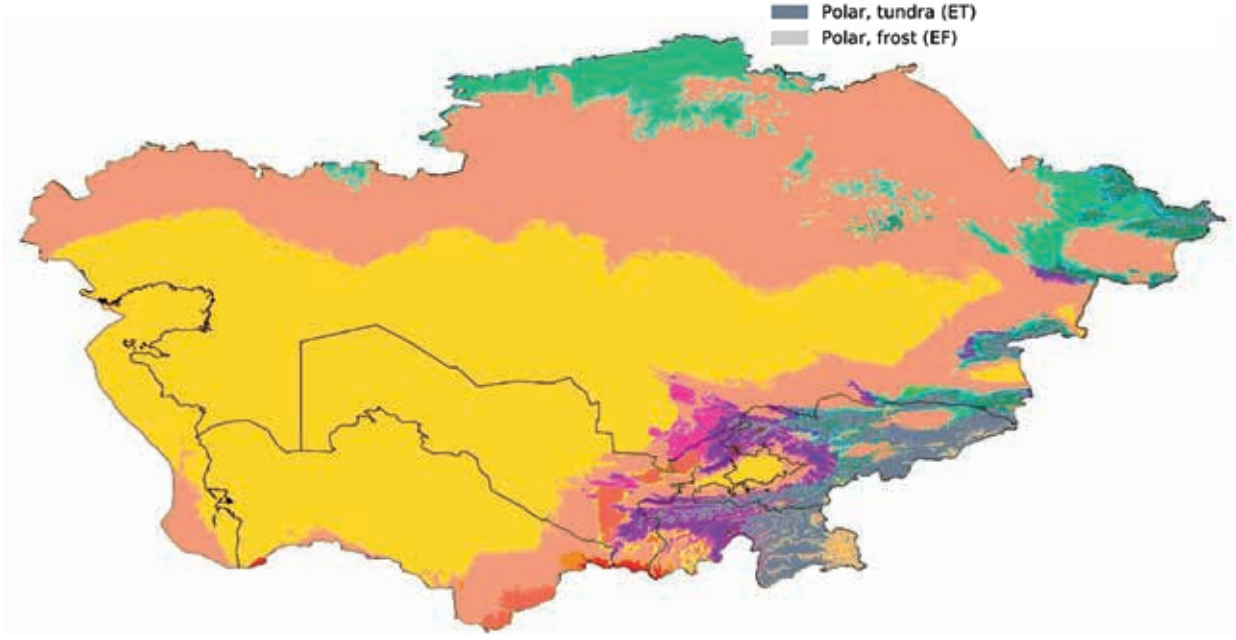

Fig. 5. Climate zones of Middle and Central Asia according to the Köppen-Geiger climate classification (source: Beck et al. 2018).

especially in its southern part, the prevailing climate is cold with dry and cold summers (e.g. Vrang area in the Vakhan Corridor, TJ; Beck et al. 2018).

According to the bioclimatic classification, which mainly considers precipitation and temperature values, most of Middle Asia (Tajik Depression, Fergana Valley) can be assigned to the Mediterranean type of macrobioclimate (Rivas-Martínez et al. 2011). This type of climate is characterised by summer drought lasting at least two consecutive months with P < 2T. In addition, other bioclimatic characteristics of the study area place it within the Mediterranean macrobioclimate. The mean annual temperature is below 25°C (approx. 2°C) and the Compensated Thermicity Index is below 580 (approx. 80). The Continentality Index is about 31, so our study area is of the continental type (eu-continental subtype), which is known to be suitable for treeless steppe vegetation. The ombrotype index (ca. 14) limits the study area to the upper, humid horizon (with the exception of the eastern Pamir-Alai, which is quite arid). Recent research on the bioclimate of Southwest and Central Asia suggests that the Irano-Turanian bioclimatic zone should be distinguished from the Mediterranean by higher continentalism, lower precipitation (especially in winter), a longer dry season and lower winter temperature minima. It also differs from the Central Asian climate by lower and uneven precipitation (with an apparent spring peak), a drier summer season and lower continentalism (Djamali et al. 2012). The area generally has high solar radiation (2,090-3,160 hours of sunshine), low cloud cover, high annual temperatures, and moderate humidity and precipitation, except in spring when there is significant rainfall. In the alpine belt of the high mountains, the climate is much harsher, with average temperatures in July ranging from 9.7°C to 13.5°C. Annual rainfall ranges from about 350 mm/year in the western Pamir-Alai (Zeravshan Mts) to about 600 mm/year in the Hissar Range (up to 2,000 mm/year in some places). In the western part of the country, the lower limit of permanent snow is at an elevation of 3,500-3,600 m a.s.l., in the eastern regions at 5,800 m a.s.l. (Latipova 1968; Narzikulov, Stanyukovich 1968; Safarov 2003).

Development and current status of phytosociological research in Middle Asia and neighbouring territories

In recent decades, vegetation classification has been substantially developed and refined with the use of numerical methods, which have rapidly become common analytical tools in vegetation ecology and its practical applications (De Cáceres et al. 2015; Guarino et al. 2022; Luebert, Pliscoff 2022). In addition, the Ecoinformatics Working Group of IAVS facilitates access to large data by establishing standard tools for the identification, integration, storage and analysis of vegetation data. The numerical approach has dominated the classification and ordination procedures in multidimensional space, responding to the need for a common language, standardisation and formalisation of classification procedures (Mucina 1997). This structuring of the method, but also the vast amount of vegetation samples from the field, helped to convince administrative bodies to use phytosociology in the definition and identification of habitats. Habitat typology based on the vegetation classification method has been

implemented since the 1990s. In 1992, the European Communities adopted the Habitat Directive (92/43/EEC), which became the basic legislative document for the implementation of nature conservation in the European Union and the creation of the Natura 2000 system of protected areas. For habitat identification, quality assessment and restoration, the phytocenological method is probably the most appropriate, as it is based on detailed analyses of the species compsition of the vegetation, knowledge of which is crucial for the conservation of biodiversity.

Unfortunately, nature and biodiversity conservation outside Europe suffers from a lack of consistent, harmonised knowledge of vegetation in many regions (Dengler et al. 2008). Despite some successes in this regard in Russia (e.g. Mirkin, Naumova 2012; Plugatar et al. 2020), South America (Galán de Mera, Orellana 2006; Galán de Mera et al. 2020; Peyre et al. 2022), Mexico (Rzędowski 2006), Africa (Mucina, Rutherford 2006; Brown et al. 2013; Natta et al. 2003; Alvarez et al. 2021), Australia (e.g. Bridgewater 1982; Pignatti, Pignatti 1997), and finally Asia (Hartmann 1968, 1995, 1997; Miyawaki 1980-1989; Fujiwara 1996; Peer 2000; Peer et al. 2007; Dvorský et al. 2011; Miehe et al. 2011; Hukushima et al. 2013; Guo et al. 2018), there are still many areas that do not have complete hierarchical vegetation classification systems. One such area is Middle Asia.

Most of Middle Asia was part of the former Soviet Union, and its vegetation was partly described according to the Russian school of phytosociology, with dominant species as one of the most important determinants (Sukachev 1929; Shennikov 1964). The limited communication between scientists from the former Soviet republics of Middle and Central Asia and research centres in the rest of the world has resulted in the relative scarcity and lack of dissemination of vegetation studies devoted to this region. In particular, the last few decades have been marked by a stagnation of geobotanical research in Tajikistan, which may be linked to the civil war, the destabilisation of the country and the underfunding of research. Recently, however, there has been a gradual increase in interest in vegetation as an object of scientific research (e.g. Safarov 2018).

A geobotanical survey aimed at a detailed description of the vegetation in Tajikistan and Kyrgyzstan using the Braun-Blanquet (1964) cover-abundance scale was initiated in 2006 by a team of scientists from the University of Opole and the Jagiellonian University in Kraków. In the following years, researchers from the University of Ostrava, the University of Wroclaw and the Polish Academy of Sciences were involved in the research. Segetal and littoral phytocoenoses were first described (e.g. Nowak S., Nowak A. 2013; Nowak S. et al. 2013a, 2013b), followed by the study of aquatic, littoral, petrophytic and screes vegetation with the first insights into forest communities (e.g. Nowak, Nobis 2012, 2013; Nowak et al. 2014a, 2014b, 2014c; Nowak et al. 2015a; Nowak et al. 2015b; Nowak et al. 2015c). Recent phytosociological studies in Tajikistan and Kyrgyzstan focus on fens, bogs, grass and forb steppes, halophytic vegetation, chasmophytic vegetation, alpine grasslands, chionophilous vegetation, open forests, shrublands and deciduous forest plant communities (Nowak et al. 2016a, 2016b, 2016c, 2016d, 2016e; Nowak et al. 2017a; Świerszcz et al. 2021; Świerszcz et al. 2022 Świerszcz et al. 2023; Nowak et al. 2022a, Nowak et al. 2022b; Nowak et al. 2023; Nowak S. et al. 2024; Swacha et al. 2023). In addition, a phytosociological study of epiphytic moss communities was conducted in Kyrgyzstan (Nowak et al. 2016d). In addition to the data collected by the Polish authors, important phytosociological information from the region has been reported by other botanists from Germany (Vanselow 2016; GIVD ID: AS-KG-001; GIVD ID: AS-TJ-001).

After 19 years of surveys, with a total of 56 research expeditions to Tajikistan, Kyrgyzstan and Uzbekistan, lasting from two to five weeks and focusing on specific vegetation types and various seasons, it is time to summarise and make a first attempt to establish a comprehensive classification system for the entire vegetation of Tajikistan and the surrounding areas, mainly in Kyrgyzstan.

It should be added that this summary is also possible thanks to the work of many authors, mainly in neighbouring regions. Much information on the diversity of Pamir vegetation is provided by the work

of Vanselow (2011, 2016), Vanselow et al. (2016), Agakhanjanz, Breckle (2003) and Breckle, Wucherer (2006). Comparisons of units at a higher level were possible thanks to the studies of Eberhardt (2004) in northern Pakistan, Epple (2001) in Kyrgyzstan, Hartmann (1968, 1972, 1983, 1995, 1997, 1999) in Karakoram and Ladakh, Wagner (2009) in Kyrgyzstan, Zibzeev (2008), Zibzeev, Nedovesova (2015), Zibzeev et al. (2018) and Ermakov, Zibzeev (2012) in the Altai Mts, Ermakov (2012) in southern Siberia and Mongolia, Ermakov et al. (2009) in the Altai-Sayan region, Dvorskỳ et al. (2011) in Ladakh, Gilli (1971) in Afghanistan, von Wehrden et al. (2009) in southern Mongolia, Hilbig (1995, 2000) in Mongolia, Gadghiev et al. (2002) in Central Asia, Borchardt et al. (2011) in Kyrgyzstan, Zohary (1973) in the Middle East, Pfeiffer et al. (2020) in Mongolia, Memariani et al. (2016) and Mishchenko (1960) in Turkmenistan, Dimeyeva et al. (2016) in eastern Kazakhstan, Gladyshev (1986) in the Amu-darya River Valley, Maylun (1973) and Melnikova (1971) in Uzbekistan, Usmanov (1953) in southern Uzbekistan, Taran (1997) in southern Siberia, Zakirov (1955, 1984) in Uzbekistan, Zapryagaeva (1976) in Pamir-Alai, Ravanbakhsh et al. (2016, 2018) in northern Iran, Pavlov (1967, 1980) in Tian Shan, Ovchinnikov (1971), Fet (1994) in Kopet-Dagh Mts, Freitag (1971) in Afghanistan, Ermakov et al. (2006) in Altai and Sayan Mts, Zlotin (1994) in Turkmenistan, Popov (1974) in Uzbekistan, Kamelin (1995) in southern Middle Asia, Kamelin, Rodin (1989) in eastern Turkmenistan, Breckle (2004) in Afghanistan, Taran (2005, 2015, 2020) in southern Siberia, Thevs (2005) in western China, Akhani (2004) in Iran, Akzhigitova (1973) in Uzbekistan, Lysenko (2014) in the Volga Valley, Rukhlenko 2012a, 2012b, 2014) in southern Russia and Middle Asia, Miehe et al. (2008, 2011) in Tibet, Sarangzai et al. (2012) in Balochistan-Pakistan, Lavrenko et al. (1991) in Central Asia, Korolyuk, Makunina (2009) in the Altai-Sayan region, Korolyuk, Namzalov (1994) in southern Siberia, Mamahatova (2013) in the Altai, Dieterle et al. (1973) in central Afghanistan, Cheng et al. (2008, 2013) in Mongolia, Hilbig, Bumžaa (1985) in Mongolia, Gilli (1975) in Afghanistan, Yamalov et al. (2007) in Bashkiria, Peer (2000) in Hindu Kush, Peer et al. (2001) in Hindu Kush, Peer et al. (2007) in northern Pakistan, Rachkovskaya, Bragina (2012) in Kazakhstan, Rustamov (1994) in Turkmenistan, Kürschner (1986) in Southwest Asia, Taft et al. (2011) in Tian Shan, Wesche et al. (2016) in the Palaearctic, Yunatov (1946, 1974) in Mongolia, Zhen et al. (2013) in Inner Mongolia, Ermakov et al. (2000) in Siberia, Heim, Chepinoga (2019) in Siberia, Klein (1987, 1988) in Iran, Rubtsov (1952) in Kazakhstan, Parolly (1998) in Anatolia, Noroozi et al. (2014) in Iran, Hein et al. (1998) in Turkey, Polyakova (2010) and Polyakova, Valachovič (2019) in Altai, Kojima (1990) in Nepal, Naqinezhad, Esmailpoor (2017) in Iran, Zibzeev, Igai (2019) in the Altai-Sayan region.

Methods

Geographic extent of the survey and the dataset

The phytosociological studies were mainly carried out in Tajikistan, evenly distributed throughout the country. In order to make the system more comprehensive, surveys were also carried out in the eastern part of Uzbekistan (mainly the Hissar Mts and SW Tian Shan Mts) and in almost all of Kyrgyzstan. The Vegetation of Middle Asia database currently includes records from three countries: Tajikistan (n = 4,130), Kyrgyzstan (n = 1,681) and Uzbekistan (n = 43).

As Tajikistan is a high-altitude, mountainous country, the research focused on several mountain ranges of the Pamir-Alai mountain system: the Zeravshan Mts, Hissar Mts, Hazratishokh Mts, Darvaz Mts, Turkestan Mts, Karateginian Mts, Babatag Mts, Aktau Mts, Sarsarak Mts, Vakhsh Mts and Karatau Mts. The next studies were also carried out in the northern part of the country in the Tian Shan: the Kuraminian and Mogoltau Mts. We are also concentrating our survey efforts in the Pamirs, including the Eastern Pamir Plateau. We collected relevés in the Rushan Mts, Vanch Mts, Peter the First Mts, Yazgulem Mts, Alichur Mts, Shugnan Mts, Trans-Alai Mts and Sarikol Mts. In 2009, we started phytosociological studies in Uzbekistan and Kyrgyzstan. In Uzbekistan, we collected only a limited number of relevés (ca. 13) in ruderal and aquatic habitats of Tashkent and Samarkand. In 2024 this survey was supplemented by additional 30 plots sampled in semi-deserts of Bukhara region and chasmophytic communitities with *Dyonysia hissarica* in Hissar Mts. In Kyrgyzstan our projects covered almost the whole country. To date, we have studied the Kyrgyz Mts, Kakshaal Mts, Trans-Ili Alatau Mts, Kyungey Ala-Too Mts, Talas Mts, Suusamyr Mts, Terskey Ala-Too Mts, Song-köl Mts, Fergana Mts, Alai Mts and Chatkal Mts (Fig. 4).

There is no consistent species checklist available for whole Middle Asia. An up-to-date checklist was recently prepared for Kyrgyzstan only (Lazkov, Sultanova 2014). For this reason, we used the Plants of the World Online (POWO 2023), with some necessary amendments due to recent descriptions of new taxa (Lazkov 2008; Nobis 2013; Nobis et al. 2013, 2020; Baiakhmetov et al. 2020; Sinaga et al. 2024; Pimenov, Klyuklov 2015). In certain cases of problematic genera, we used additionally Cherepanov list (Cherepanov 1995), The World Flora Online (WFO 2023) or other sources like e.g. Nobis et al. (2020) for *Stipa* spp. The bryophyte nomenclature follows Ignatov et al. (2006) and Ros et al. (2013). The VMA database consists of 3,037 vascular plant species belonging to 863 genera and 28 families. The database is stored and managed in TURBOVEG (Hennekens, Schaminée 2001) as the most suitable and comprehensive software for preservation of the phytosociological information and for communication with other databases. Plant material collected during field studies is deposited in the Herbarium of the Middle Asia Mts, stored in OPUN (University of Opole, Poland) and KRA (Jagiellonian University, Poland).

We used standard plot sizes of 10 m^2 for grassland, salt marsh, segetal vegetation, aquatic and littoral vegetation, tall forbs and screes, 100 m^2 for shrubland, 200 m^2 for open woodland and 400 m^2 for forest vegetation. Due to the great variability of chasmophytic habitats in Middle Asia, rock vegetation was sampled in 0.4 to 3 m^2 plots, depending on the size of the crack or ledge and the proportion of dwarf shrubs. In all surveys, vascular plant and bryophyte species were recorded using the Braun-Blanquet cover-abundance scale (Westhoff, van der Maarel 1973). Geographical coordinates were mostly measured using a GPSMAP 60CSx device with an accuracy of ±5 m and a WGS84 reference frame. All data were stored in the Vegetation of Middle Asia database, registered in the Global Index of Vegetation-Plot Databases under the code AS-00-003 (Nowak et al. 2017b).

During classifications that were carried out, regardless of the method subsequently used, the cover values were first transformed. The Braun-Blanquet cover-abundance scale was transformed into percentages as follows: r (0.1%), + (1%), 1 (3%), 2 (13%), 3 (38%), 4 (63%) and 5 (88%). Then, depending on the characteristics of the data, the interpretability of the results and the history of the survey of the particular vegetation type, different methods were implemented to cluster the dataset, mainly including hierarchical unsupervised or semi-supervised classification. Among others, we used a modified TWINSPAN analysis with downweighting of rare species and chord distance as a measure of cluster heterogeneity (Hill 1979; Roleček et al. 2009). Unsupervised or semi-supervised k-means analysis with Hellinger transformation was used to classify pseudosteppe, fen, mire and spring vegetation (see Naqinezhad et al. 2021; Świerszcz et al. 2021). For alpine grasslands, we used the agglomerative hierarchical Ward's method (Jongman et al. 1997; Podani 2000) in the PC-ORD program ver. 7.08 (McCune, Mefford 2011), using the Euclidean distance measure.

In almost all of the original vegetation type definitions, the diagnostic, constant and dominant species were presented. Diagnostic species were determined using the phi coefficient as a measure of fidelity (Chytrý, Tichý 2003), after statistical validation by the Fisher exact test ($p < 0.01$). In each work, the shortened and full synoptic tables were presented with the constancy of all diagnostic species.

With the release of successive editions of the International Code of Phytosociological Nomenclature (ICPN; Weber et al. 2000; Theurillat et al. 2021), as well as progressive changes in publication policy, many of the syntaxa names entered into the system required correction and validation. These difficulties were related to the effective publication of newly established syntaxa, which were often *nomen ineditum* (if the paper was fully published online before 2021) or *nomen nudum* (if the typus relevés were distributed only as online appendices before 2021), or due to a simple error in the conjugation of the Latin names of the syntaxa. According to the ICPN, in each case of discrepancy with the ICPN, the validation was carried out according to the latest version of the Code (Theurillat et al. 2021). In a few cases of species name changes, typing errors or misidentification of critical taxa (*Phlomoides*, *Eremostachys*, *Astragalus* and *Delphinium*), it was necessary to correct the name of the syntaxon (*Astragalo pamirensis-Leymetum secalini*, *Phlomoidetum tadshikistanicae*, *Eremuretum sogdiani delphinietosum ovczinnikovii*, *Stipetum margelanicae*).

Verbal diagnosis of the syntaxon

Verbal diagnoses were provided as short textual descriptors of accepted syntaxa, a kind of condensed surrogate for a definition of the unit. These diagnoses give (1) the physiognomy of the vegetation classified within the given unit (e.g. forest, open forest, grassland, shrubland, aquatic vegetation), sometimes with an indication of the dominant plant species (e.g. pistachio open wood) or growth form (e.g. forb steppe); (2) their unifying ecological context (e.g. mesic, nutrient-poor soils, segetal, pseudosteppe); and (3) their distribution (e.g. Irano-Turanian, Pamiro-Alaian, Middle Asian).

Ordering and grouping of classes

To distinguish and define vegetation classes, we applied the Cocktail method. Although this method is particularly useful for areas with a long tradition of vegetation surveys, we believe that after almost twenty years of research it is also suitable for Tajikistan in terms of class ranking. The Cocktail method is a supervised classification method that uses formal rules to match relevés to predefined vegetation units and uses the explicit definition of a given vegetation unit that corresponds to the concept of that unit (Bruelheide 1997, 2000). We proposed formal definitions of vegetation classes as an expert system (ES) for the automatic assignment of relevés to syntaxa (see Noble 1987). In developing the ES, species recognised only at the genus level were removed from the dataset. Species records from multiple layers were merged and classified into four categories: (i) tree layer – included trees recorded in a tree layer, (ii) shrub layer – included shrubs and trees recorded in the shrub layer, (iii) herb layer – comprised vascular plants recorded in the herb layer (including seedlings and juveniles of woody species), and (iv) moss-lichen layer – included non-vascular plants and lichens. We excluded from the dataset moss vegetation samples,

so we included a total of 2,790 vascular plant species and 5,350 relevés in the database. Formal definitions of classes were created using a discriminating species groups (Landucci et al. 2015; Tichý et al. 2019), which are a list of species that characterize a vegetation class. The ES uses the ratios between the sum of the square-root covers of the species in the discriminating species group over another group. The discriminating species groups (Appendix 1) contain an a priori defined list of diagnostic species for a given class, statistically expressed by the phi coefficient (Chytrý et al. 2002) or based on our expert knowledge and our previous publications, significantly increased the classification success. Additionally, we created two discriminating species groups: shrub layer species and tree layer species. The formal definition of a given class consisted of discriminating groups combined by logical operators AND, OR, and NOT (Bruelheide 1997). For final definitions of the classes and species groups see Nowak A. et al. (2024b).

We allowed species to be shared between more than one vegetation classes only if one of the class represented non-forest vegetation, while another class was forest or open-wood vegetation (e.g. *Pistacietea* open woodland and *Stipo capensis-Trachynietea distachyae* pseudosteppe).

The hierarchy of the system of plant communities

The European phytosociological school recognizes four main hierarchical levels (ranks) of phytosociological units (syntaxa), which differ by the endings of their Latin names. The ranks, arranged from the lowest to the highest, are as follows: association (ending *-etum*), alliance (*-ion*), order (*-etalia*) and class (*-etea*). In addition to syntaxa, we also present rankless plant communities that have been mentioned in our previous works or in the wider literature (e.g. Ovchinnikov 1957-1981; Kinzikaeva 1988; Kochkareva 1986; Rasulova 1991). The nomenclature of these syntaxa is governed by the International Code of Phytosociological Nomenclature (ICPN; hereafter referred to as the Code; Theurillat et al. 2021). For the simplicity of the scheme, we only use four main hierarchical ranks, namely class, order, alliance and association. Additionally, to express internal variability of the main vegetation types we include also subassociations and variants in the hierarchical system of plant communities.

For the purpose of the coding of vegetation units in our list and databases, all vegetation units used are given unique codes, which simultaneously reflect their rank in the classification hierarchy, e.g. PRU-AB02 or PRU-AAc01. The meaning of these abbreviations is as follows: – the first three capital letters indicate the class (e.g. *Crataego-Prunetea*); – the next capital letter after the hyphen is given in the alphabetical order and indicates the order (in the case of *Crataego-Prunetea* the letter A indicates the order *Crataegetalia ponticae*; the next capital letter, also given in alphabetical order, indicates the alliance within the order (in the case of *Crataegetalia ponticae* it is *Rosion kokanicae* coded by the letter A). Finally, the two-digit number indicates the association within the alliance (e.g. "01" in PRU-AB01 indicates *Aveno ludovicianae-Rhoetum coriariae* association in *Ranunculo tenuilobi-Cotoneastrion hissarici* alliance). The letter "c" before the last two digits indicates a rankless community (e.g. community of *Rosa kokanica* in PRU-AA-c01), and the small letter in alphabetical order after the last two digits indicates subassociations (e.g., *Pistacietum verae cercidetosum griffithii* subassociation in PIV-AA01a). We have refrained for additional characters and variant coding for the sake of clarity in the scheme.

Conservation

The protection of vegetation diversity in Middle Asia varies considerably between countries. Tajikistan is a good example of the problems with the effectiveness of biodiversity conservation in the region. Even with reference to the old Russian vegetation typology and vegetation maps, there are no regulations for specific, targeted protection of any vegetation type. Of course, forests or open woodlands of juniper or pistachio are often mentioned in large-scale areas of nature conservation, but there are no specific provisions in the laws establishing nature reserves. The local population speaks with great respect about the need to protect vegetation, especially pastures (as grazing land) and forests (as a source of fuel). In practice, this is a declarative attitude, and the entire territory of Tajikistan is one big pasture with increasing grazing, the intensity of which is completely uncontrolled. In recent years, there have been a number of projects funded by various international organisations in which vegetation is a conservation target (Nowak et al. 2021a). However, these are local actions, targeting individual valleys or ridges, with little national significance. The Pamir-Alai Mts are particularly sensitive to climate change due to the low adaptive capacity of their ecosystems, and have already been affected by glacial melting associated with mean temperature increases (Makhmadaliev et al. 2003a, b). Such phenomena are likely to threaten many vegetation types, particularly nival and semi-desert plant communities. Unfortunately, without accurate vegetation mapping and good legislation, it is difficult to diagnose needs and effectively protect vegetation diversity. An estimate of the extent of the threat suggests that the three most threatened habitats are riparian forests, deciduous forests and open alpine juniper forests (Nowak et al. 2011). In addition, gallery forests are under considerable threat from clear cutting and unrestricted use by local people. Only the Tigrovaya Balka National Park effectively protects *Populus pruinosa* stands and associated habitats. As a result, Tajikistan's natural heritage is severely threatened by climate change, habitat fragmentation and degradation. Around 50% of the country's forests have disappeared in the last 100 years, leading to massive soil erosion and an increased risk of landslides. Several types of riparian forest, such as stands of *Fraxinus sogdiana*, *Populus pruinosa* and *Platanus orientalis*, have all but disappeared. In recent years, the government of Tajikistan has also begun to invest in hydropower and road construction. The country's population continues to grow. Unsustainable use of the country's natural resources is still a growing factor, with a third of the population living below the poverty line.

In recent decades, large protected areas have been established in the Pamir-Alai, covering approx. 22% of the country's territory (Safarov 2003). In addition, a number of programmes and strategies have been developed to improve biodiversity conservation and protected area management. In practice, however, they are insufficiently managed. The most important areas – representing category Ia of IUCN conservation areas – are Strict Nature Reserves, so-called *zapovedniki*, with staff and headquarters dedicated to the conservation of the area. In Tajikistan, four Strict Nature Reserves have been established: 1) Tigrovaya Balka NR, dedicated to the protection of subtropical riparian habitats, the former habitat of the Caspian tiger; 2) Romit NR, aimed at preservation of mid-altitude mountain ecosystems with extremely rich flora and fauna, 3) Dashtidjum NR, designed to protect one of the most precious and unique biocoenoses in Middle Asia, with pistachio open woods, mesic shrublands and woods, riverbed thickets and tall-forbs; 4) Zorkul NR, established to protect cryophilous steppes and marshland bird habitats.

In addition, nineteen Species Management Areas have been established on the territory of Tajikistan, but unfortunately none of them are particularly dedicated to vegetation conservation. The prominent exceptions are Saivotin, Childukhtaron, Kusavlisai and Dashtijum Zakaznik, which were established

partly for juniper open woods protection and Zeravshan Zakaznik with the aim of preserving riverbar vegetation.

To increase the effectiveness of conservation in the Pamir-Alai, urgent action plans are needed, with specific priorities for vegetation diversity hotspots. It is necessary to identify some micro-hotspots within the global hotspot of the Middle Asian Mts, especially for the most threatened and intensively used ecosystems such as forests and grasslands. The need for stronger national administration to deal with biodiversity conservation must be emphasised, including the provision of financial support from international organisations. At the national level, the system of nature conservation should be improved to take better account of centres of endemism, improve the connectivity of the ecological network and enhance the adaptive capacity of the most sensitive areas by ensuring a balance between traditional management practices and local economic growth. None of this would be possible without a thorough inventory of the current distribution of species, analyses of their population sizes and changes in phenology. This knowledge is an essential, but still neglected, step in conservation efforts in Tajikistan.

Outlook

We hope that this publication will improve the study of vegetation and stimulate the classification of plant communities in and around Middle Asia. We also hope that our proposal will motivate botanists and ecologists to focus on vegetation diversity, increase research, and improve the syntaxonomic system of Asia as a whole. We are aware of the weaknesses of our proposal and emphasise that this is a first step to be presented to a wider audience and to stimulate interest in Middle Asian vegetation. We hope that this will usher in a new phase of intensive research aimed at understanding both the ecological and evolutionary processes that shape Asia's vegetation patterns, focusing on syntaxonomic typology to fill gaps in the system, and seeking new ways to influence resource management and conservation. Our team will continue to conduct research in Middle Asia. In the near future, we hope to survey the area around the Fedtschenko Glacier, the vegetation of the southern Altai and the Karakoram Mts in northern Pakistan. We are also planning an expedition to the deserts and semi-deserts of Uzbekistan around the Aral Sea and Bukhara. Above all, we want to encourage and involve young Tajik, Kyrgyz, Kazakh and Uzbek geobotanists in our research programme.

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Part II

Vast steppes dominated by *Stipa arabica* in the broad Alai Valley in southern Kyrgyzstan (ca. 3,300 m a.s.l.). Photo: A. Nowak.

Conspectus of the syntaxa dominated by vascular plants in Middle Asia

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Oak, mixed deciduous and conifer open forests of warm regions in the cool-temperate nemoral zone of montane belt of the Hindu Kush Mts (Pakistan)

Quercetea pubescentis Doing-Kraft ex Scamoni et Passarge 1959 54

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Crataego-Prunetea Tx. 1962 56

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Junipero-Pinetea sylvestris Rivas-Martínez 1965 78

Cryophilous juniper stands in the upper montane belt of Middle and Central Asia

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Festuco-Puccinellietea Soó ex Vícherek 1973 176

Tragacanthic, wind-swept vegetation of the alpine and subnival belts of the Irano-Turanian Region

Onobrychidetea cornuto-echidnae Nowak et al. 2025 185

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Semi-desert shrublands of the Irano-Turanian Region
Haloxyletea ammodendri Asri 2003 242
Halophytic thermophilous scrub vegetation on dry solonetz and solonchak soils in arid zones of southern Middle Asia
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Shrubby vegetation on mobile screes and rock ledges in continental and temperate Central Asia
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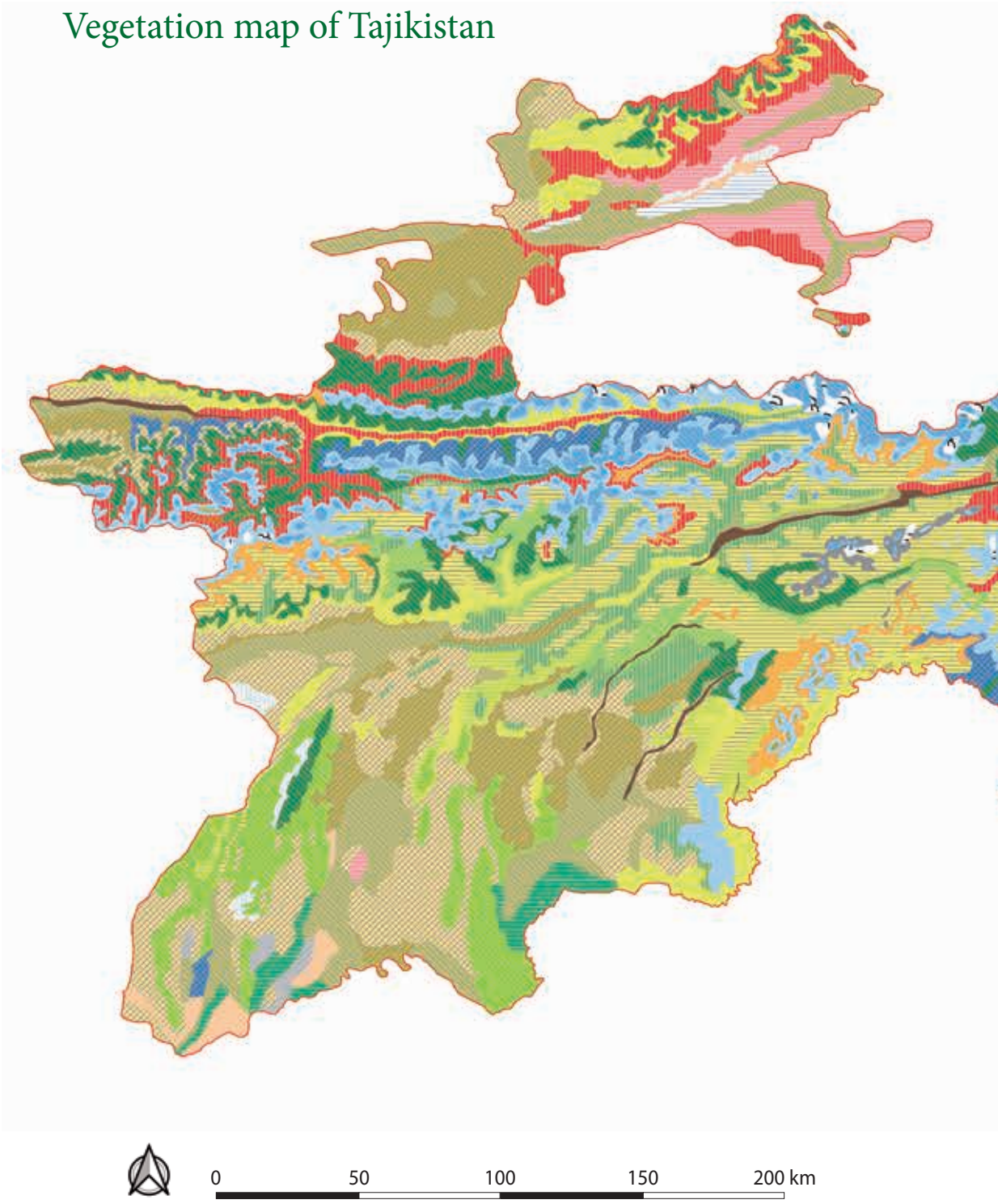

Fig. 6. Map of the main vegetation types of Tajikistan. Source: Authors on the basis of Latipova 1968.

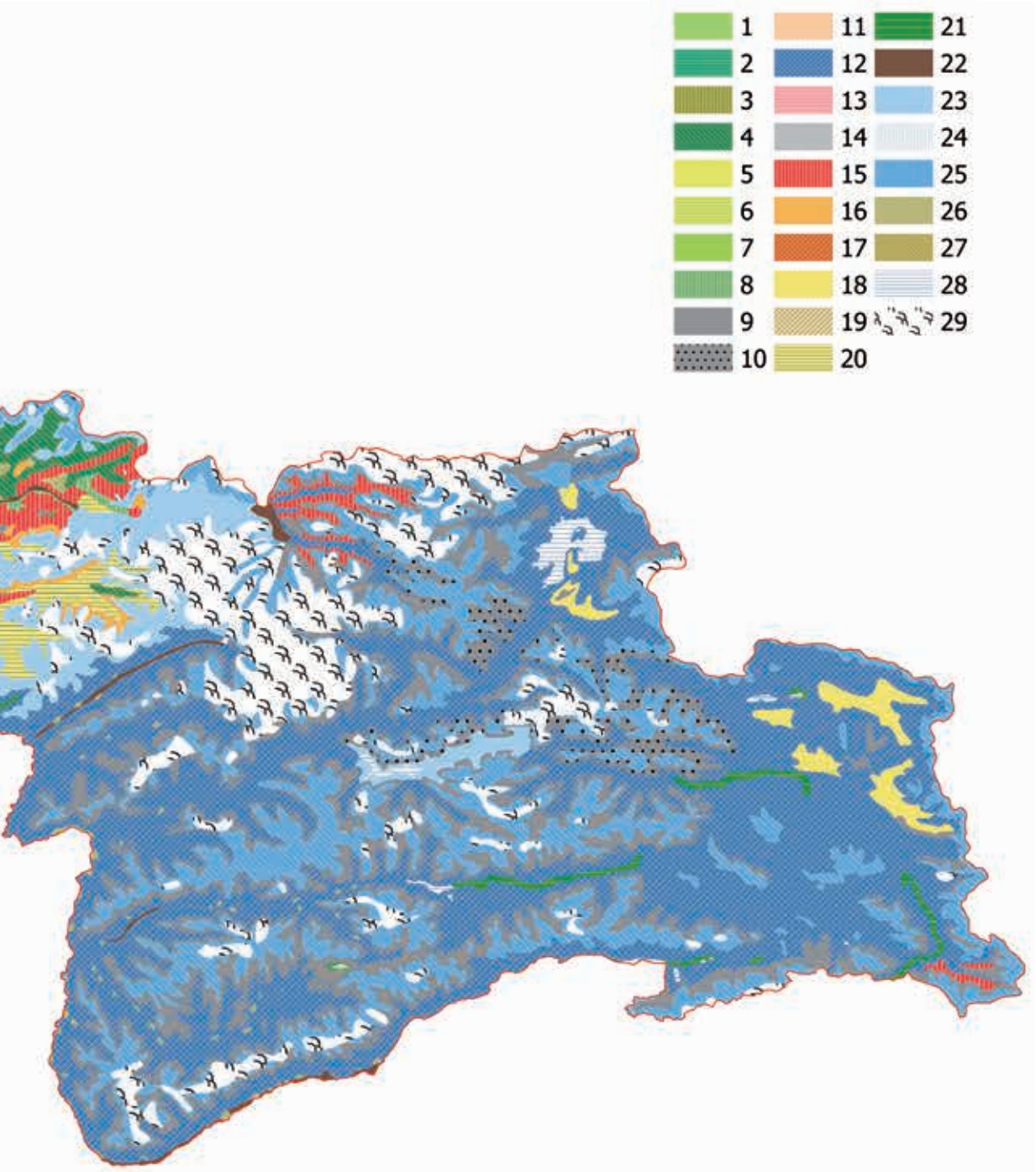
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Fig. 6. Map of the main vegetation types of Tajikistan.

Explanation: 1 – zonal, mesophilous, broad-leaved forests – *Carpino-Fagetea sylvaticae* Jakucs ex Passarge 1968; 2 – gallery forests in lowland river valleys – *Populetea laurifolio-suaveolentis* Hilbig 2000; 3 – riparian forests of montane and subalpine river valleys – *Betulo-Populetalia talassicae* Nowak, Nobis 2013; 4 – thermophilous and cryophilous juniper stands – *Juniperetalia seravschanicae* Nowak et al. 2024 and *Juniperetalia pseudosabinae* Mirkin et al. 1986; 5 – scrub and mantle vegetation seral or marginal to broad-leaved forests in the nemoral zone of the Irano-Turanian Region – *Crataegetalia ponticae* Nowak et al. 2024 – shiblyak; 6 – scrub vegetation of subhumid and nutrient-rich habitats – *Ranunculo tenuilobi-Cotoneastrion hissarici* Nowak et al. 2022; 7 – Irano-Turanian open woodlands in warm, subtropical, semi-arid to sub-humid climate – *Pistacietea verae* Nowak et al. 2024; 8 – xeric scrub on nutrient poor soils on screes and slopes in Middle Asia (so called Rosaria) – *Rosion kokanicae* nom. prov; 9 – chionophilous summit graminoid and dwarf-scrub mountain tundra in the alpine and subnival belts – *Kobresietalia capilliformis* Tsepkova 1987; 10 – tragacanthic, wind-swept vegetation of the alpine and subnival belts of the Irano-Turanian Region – *Onobrychidetea cornutae* Nowak et al. 2025; 11 – semi-desert shrublands of the Irano-Turanian Region – *Haloxyletea ammodendri* Asri 2003; 12 – high altitude desert steppes and cold semi-deserts of Central Asia – *Krascheninnikovio ceratoidis-Stipetalia orientalis* Nowak, Świerszcz, S. Nowak, Nobis 2023; 13 – hypersaline alluvial temporary flooded swards in the semi-desert and desert zones on solonchak soils – *Climacopteretea crassae* Akhani ex Świerszcz et al. 2021; 14 – Halophytic thermophilous scrub vegetation on dry solonetz and solonchak soils inthe arid zones of southern Middle Asia – *Haloxylo-Salsoletea tomentoae* Akhani 2004; 15 – dry, thermophilous steppes of montane and subalpine belt of Middle Asia – *Artemisio persicae-Stipetea drobovii* Nowak, Świerszcz, S. Nowak, Nobis et M. Nobis in Nowak et al. 2024; 16 – Irano-Turanian subalpine forb steppes – *Eremogono griffithii-Nepetetea podostachyos* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2024; 17 – mesophilous steppic pastures of the upper montane to subalpine belts in the Pamir-Alai Mts – *Artemision dracunculi* Nowak, Świerszcz, Nobis, Swacha, S. Nowak 2023 in Świerszcz et al. 2023; 18 – mountain steppes of semi-arid to subhumid areas of Central Asia – *Cleistogenetea squarrosae* Mirkin et al. ex Korotkov, Morozova, Belonovskaja 1991; 19 – thermophilous secondary perennial grasslands on deep calcareous soils of colline and montane belts in mediterranean-like climates (including Irano-Turanian) with long dry summer period – *Stipo capensis-Trachynietea distachyae* Brullo in Brullo et al. 2001; 20 – Irano-Turanian thermophilous, mesic tall-forb vegetation – *Prangetea ulopterae* Klein 1987; 21 – fens of continental, eastern Irano-Turanian subregion, including Pamir – *Alopecurion mucronati* Nowak, Naqinezhad, Nobis, S. Nowak, Świerszcz et Hájek 2021 in Naqinezhad et al. 2021; 22 – buckthorn and willow scrub vegetation on the submontane to subalpine river bars in the mountains of Middle Asia – *Salici capusii-Hippophaeetalia rhamnoidis* Nowak et al. 2024; 23 – chasmophytic vegetation of montane and alpine rock faces of Middle and Central Asia – *Carici koshewnikowii-Asperuletea oppositifoliae* Nowak, Świerszcz, S. Nowak, Nobis, M. Nobis 2024; 24 – vegetation of rock crevices of submontane and colline zone in the Pamir-Alai and Tian Shan Mts – *Caricion koshevnikovii* (Nowak, S. Nowak, Nobis, A. Nobis 2014) Nowak, S. Nowak, Nobis, A. Nobis 2016; 25 – high-altitude tundra with sparse lichen-dominated vegetation; 26 – segetal vegetation on irrigated lands; 27 – segetal vegetation; 28 – aquatic vegetation of open waters; 29 – snow-covered areas without vegetation. Source: Authors.

In line with the methodology adopted, below is the list of vegetation types with simplified descriptions. Full descriptions can be found in the source publications, especially if the vegetation type has syntaxonomic rank and was described according to the ICPN. For about 85% of the plant communities, we also present a photograph that was taken during our research expeditions to Middle Asia, or photographs provided by botanists from neighbouring countries.

In view of the print size of the book, we present a schematic map of the main vegetation types (Fig. 6). In addition, we include a schematic layout of the main vegetation types in the five mountainous regions of Tajikistan (Fig. 7). Due to the importance of chasmophytic vegetation and, at the same time, the difficulty of presenting it on a two-dimensional geobotanical map, we also include below a schematic diagram of the vertical distribution of the main syntaxa of the rock and scree vegetation (Fig. 8).

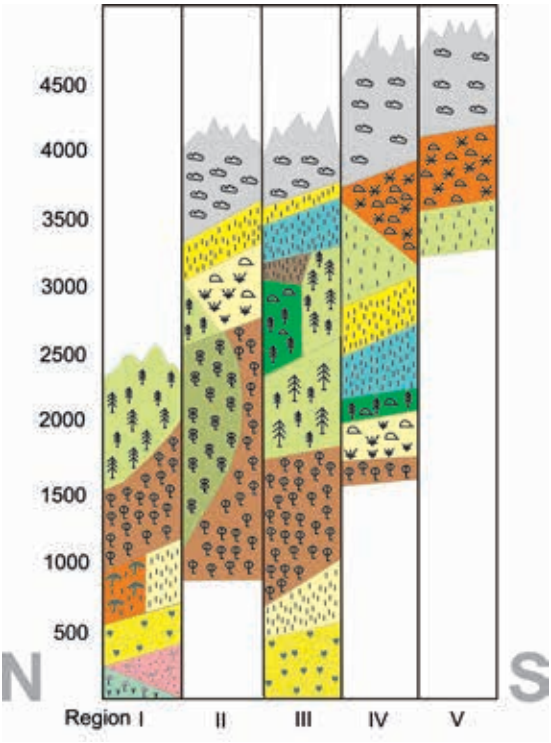


Fig. 7. Main zonal vegetation types of Tajikistan in five main phytogeographical regions: I – South-western region, II –Hissaro-Darvasian region, III – Zeravshanian-Turkestanian region, IV – Western Pamirian region, V – Eastern Pamirian region. Source: Authors.

Riparian open wood vegetation of saline and subsaline alluvial habitats along mainly intermittent rivers and oases – *Populetea euphraticae* Zohary 1962

Halophytic thermophilous scrub vegetation on dry solonetz and solonchak soils in the arid zones of southern Middle Asia – *Haloxylo-Salsoletea tomentosae* Akhani 2004

Hot semi-deserts; Irano-Turanian semi-deserted hyperarid and continental habitats – *Pegano harmalae-Salsoletea vermiculatae* Br.-Bl. et O. de Bolos 1958

Irano-Turanian open woodlands in warm, subtropical, semi-arid to sub-humid climate – *Pistacietea verae* A. Nowak, S. Świerszcz, A. Naqinezhad, S. Nowak, M. Nobis 2024

Thermophilous secondary perennial grasslands on deep calcareous soils of colline and montane belts in mediterranean-like climates (including Irano-Turanian) with long dry summer period – *Stipo capensis-Trachynietea distachyae* S. Brullo in S. Brullo et al. 2001

Xeric shrublands of the Irano-Turanian Region (so called šhiblyak) – *Crataego-Prunetea* Tx. 1962

Thermophilous Zeravshan juniper stands in the lower montane belt of Middle Asia – *Junipero-Pinetea sylvestris* Rivas-Mart. 1965

Zonal, mesophilous, broad-leaved forests *Carpino-Fagetea sylvaticae* Jakucs ex Passarge 1968

Irano-Turanian thermophilous, mesic tall-forb vegetation *Prangetea ulopterae* Klein 1987

Mesic grasslands of the alpine belt of the Middle and Central Asia *Festucetea alaico-krylovianae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis et M. Nobis 2024

High altitude subnival rupiculous and snowbed vegetation *Didymophyso aucheri-Dracocephaletea aucheri* Noroozi et al. 2017

Cryophilous juniper stands in the upper montane belt of Middle and Central Asia *Junipieretea pseudosabinae* Mirkin et al. 1986

Dry, thermophilous steppes of montane and subalpine belt of Middle Asia *Artemisio persicae-Stipetea drobovii* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis et M. Nobis in A. Nowak et al. 2024

Irano-Turanian subalpine forb steppes *Eremogono griffithii-Nepetetea podostachyos* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska et M. Nobis 2024

High altitude desert steppes and cold semi-deserts of Central Asia *Ajanio-Cleistogenetea songoricae* (Mirkin B. in Kashapov R. et al. 1987) Mirkin B., Alimbekova L., Kashapov R., Onischenko L. 1988

Tragacanthic, wind-swept vegetation of the alpine and subnival belts of the Irano-Turanian Region *Onobrychidetea cornutae* Nowak et al. 2025

Fig. 8. Distribution of the main chasmophytic (rocks and screes) vegetation types of Tajikistan.

Explanation: *Asperulo albiflorae-Campanulion lehmannianae* – chasmophytic vegetation of upper montane and alpine rock faces of Middle Asia; *Caricion koshevnikovii* – chasmophytic vegetation of submontane and colline belts in the Pamir-Alai and Tian Shan Mts.; *Ferulo foetidissimae-Vicion kokanicae* – scree vegetation of the alpine belt of the Pamir-Alai Mts and western Tian Shan; *Alceion nudiflorae* – scree, mesic vegetation of montane belt of subhumid zone of Middle Asia; *Hippolytion darvasicae* – rock vegetation of the eastern Pamir-Alai and Western Pamir; *Ferulion grigoriewii* – scree vegetation of alpine and subalpine belts of eastern Middle Asia; *Drabo pamiricae-Androsacetalia akbaitalensis* – subnival and alpine vegetation of screes and snow-beds of Middle Asia; *Eritrichion pamirico-subjacquemontii* – vegetation of rock ledges and clefts in highly elevated semiarid zone of the Pamir. Source: Authors.

Holarctic coniferous forests on oligotrophic soils at high altitudes

Juniperus seravschanica stands in upper reaches of Maykhura Valley in Hissar Mts, western Tajikistan (ca. 2,600 m a.s.l.). Photo: A. Nowak.

ZONAL AND INTRAZONAL VEGETATION

ZONAL BOREAL AND HEMIBOREAL FORESTS

Holarctic coniferous forests on oligotrophic and leached soils in the boreal zone and at high altitudes of mountains in the nemoral zone of Eurasia

VAC. *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939
O. unknown
All. unknown

VAC-XXc01. Community of *Picea schrenkiana* subsp. *tianshanica* (Fig. 9)

Diagnostic species: *Picea schrenkiana* subsp. *tianschanica*.
Geographical range: The native range of *Picea schrenkiana* subsp. *tianschanica* is the Tian Shan range in Kyrgyzstan to Xinjiang. Particularly the northern slopes in eastern and central part of Kyrgyzstan, namely Kakshaal Too, Kyrgyz Ala-Too and Kyungey Ala-Too are considerably covered by stands of Tianshanian spruce. Also the northern ranges of Xinjang in central Tian Shan are grown by *Picea schrenkiana* subsp. *tianschanica* from the northern side. It forms a zonal, dense vegetation cover in the montane belt.
Habitat characteristics: This community is characterised by a high cover of the Tianschanian spruce. It occurs most often at elevations of 1,300–2,600 m a.s.l. in places with accumulation of thick snow cover on the northern slopes of tianschanian mountain ranges. The snow cover protects vegetation from winter frosts, delays the start of the growing season and improves soil water supply. In most plots it is a species-poor vegetation, however, in wetter and more fertile sites it can have a lushy forb undergrowth.

Fig. 9. Stand of *Picea schrenkiana* subsp. *tianschanica* in Ak-Bulun Valley, eastern Kyrgyzstan (ca. 2,250 m a.s.l.). Photo: A. Nowak.

Fig. 10. *Abies sibirica* subsp. *semenovii* in Naryn River Valley near Kurpsay, Kyrgyzstan (ca. 2,100 m a.s.l.). Photo: A. Nowak.

Remarks: We have too little phytosociological material from the Sary-Chelek National Park and the Ak-Bulun Valley from Tianshanian spruce stands and cannot fully present the diversity of this coniferous forest. The data will be supplemented in the near future.

VAC-XXc02. Community of *Abies sibirica* subsp. *semenovii* (Fig. 10)

Diagnostic species: *Abies sibirica* subsp. *semenovii*.

Geographical range: The native range of *Abies sibirica* subsp. *semenovii* is restricted only to Kyrgyzstan. It occurrs in central part of the country in the Talas, Chatkal and Suusamyr ranges of the western Tian Shan (Farjon 2001). *Abies semenovii* subsp. *semenovii* forests are considered relic remains of mesophyte forests of the Tertiary period (Orlova et al. 2016).

Habitat characteristics: *Abies sibirica* subsp. *semenovii* forms rarely pure stands. It grows mostly as admixture to *Picea schrenkiana* subsp. *tianschanica* community, however still some plots consisting only of fir in Talas Mts are known. It makes a montane bely of western Tian Shan, generally occupying V-shaped valleys and gorges at 1,200-2,800 m a.s.l. Our phytosociological documentaion originates mainly from Sary-Chelek Lake surrounding and Naryn River Valley near Kurpsay.

Remarks: We still do not have enough phytosociological material from the Sary-Chelek National Park and the Naryn Valley of Semenov fir stands to fully describe the diversity of this coniferous forest. The data will be completed in the near future.

Zonal, mesophilous, temperate broad-leaved forests

Vegetation of the nemoral forest zone

Zonal, mesophilous, temperate broad-leaved forests

FAG. *Carpino-Fagetea sylvaticae* Jakucs ex Passarge 1968

FAG-A. *Aceretalia turkestanici* Nowak, Świerszcz, S. Nowak, Nobis et M. Nobis 2023 (mesic broad-leaved forests of Middle Asia) (Fig. 11)

This order includes typical mesic broad-leaved forest vegetation on hills and slopes of montane belt in Middle Asia. The habitat of this vegetation is relatively fertile, however with rather shallow, lithomorphic soils with no strong drainage or moisture deficiency even during summer. There are no permanent or ephemeral inundations, however in some plots the ground water level is fairly high (e.g. *Swido darvasicae-Platanetum orientalis*). Currently, this type of vegetation called traditionally in Middle Asia a "black forests" (from Russian chernolese) occupies mainly northern slopes in the Hissar, Darvaz, Hazratishokh, Peter the First, Fergana, Kyrgyz and Chatkal ranges in Tajikistan and Kyrgyzstan. This mesic forests have not been glaciated during recent cooling episodes and are therefore the refuge of many relict and endemic species such as *Ostrovskia magnifica* and *Swida darwazica*.

FAG-AA. *Acero turkestanici-Juglandion regiae* Nowak, Nobis et S. Nowak in Nowak et al. 2017 (mesophilous deciduous forests of Irano-Turanian Region) (Fig. 12)

Diagnostic species: *Acer regelii*, *Alliaria petiolata*, *Asyneuma attenuata*, *A. baldshuanica*, *Brachypodium sylvaticum*, *Clinopodium integerrimum*, *Cotoneaster insignis*, *Cousinia umbrosa*, *Crataegus*

Fig. 11. Stands representing *Aceretalia turkestanici* woods in Varzob Valley in Hissar Mts, Tajikistan (ca. 1,850 m a.s.l.). Photo: A. Nowak.

Fig. 12. Mesic forests with *Juglans regia, Acer turkestanica, Malus sieversii* in Childukhtaron, Hazratishokh Mts, Tajikistan (ca. 1,700 m a.s.l.). Photo: A. Nowak.

turkestanica, *Exochorda albertii*, *Malus sieversii*, *Poa nemoralis*, *Trifolium pratense*, *Viola suavis.*

Geographical range: Middle Asia (Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan and Tajikistan).

Habitat characteristics: *Acero turkestanici-Juglandion regiae* is a typical forest vegetation on hills and mountain slopes with relatively well developed and fertile soils, without signs of drainage or lack of moisture. At present, well-developed plots are generally found on the northern slopes of the Hissar, Darvaz and Peter the First ranges in Tajikistan.

FAG-AA01. *Juglandetum regiae* Nowak, Nobis et S. Nowak in Nowak et al. 2017 (mesophilous walnut woods of montane belt in Irano-Turanian Region) (Fig. 13)

Diagnostic species: *Bromus macrostachys, Cardamine impatiens, Carex otrubae, Juglans regia, Millium effusum.*

Constant species: *Brachypodium sylvaticum, Impatiens parviflora, Juglans regia, Poa nemoralis.*

Geographical range: According to the literature and our own observations, *Juglans regia* occurs in the whole Tajikistan except eastern Pamir, at elevation of approx. 1,000–3,000 m a.s.l. It was mainly noted in the Hissar, Darvaz and Peter the First Mts. Sporadically, it also was recorded on slopes in the Karateginian, Vanch, Yazgulem and Zaravshan Mts (Ovchinnikov 1968; Zapryagaeva 1968, 1976; Nowak et al. 2017a). Rarely, is it planted as an ornamental or for timber production in orchards, groves and village parks across the whole of Tajikistan. The association *Juglandetum regiae* was documented in colline and montane belts at elevation of about 990–1,880 m a.s.l. *Juglans regia* is also a common forest species in Middle Asia and other Irano-Turanian areas in Asia Minor, Iran, Afghanistan, China and other countries of South-East Asia (Ovchinnikov 1968; Zapryagaeva 1976). Thus, the potential range of the association could be much wider (Nowak et al. 2017a).

Fig. 13. *Juglandetum regiae* in Takob Valley, Hissar Mts, Tajikistan (ca. 1,800 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: The *Juglandetum regiae* prefers humid or fresh, fertile, deep soils with high organic matter content. It occupies river valley slopes that are not unexposed to strong winds and avalanches (Nowak et al. 2017a).

FAG-AA02. *Aceretum turkestanici* Nowak, Nobis et S. Nowak in Nowak et al. 2017 (mesophilous turkestan maple woods of western Middle Asia and Kopet-Dagh Mts) (Fig. 14)

Diagnostic species: *Acer turkestanicum*, *Allium rosenbachianum*, *Asparagus neglectus*, *Cicerbita seravschanica*, *Dictamnus tadshikorum*, *Gallium vassilczenkoi*, *Ostrowskia magnifica*.

Geographical range: According to previous records (Zapryagaeva 1976; Ovchinnikov 1981) and our own data, *Acer turkestanicum* occurs within an elevation amplitude of 900–3,000 m a.s.l. It has been recorded in the whole area of Tajikistan, except for the eastern Pamir. Sporadically, small stands of *Acer turkestanicum* have also been found in the Zeravshan and Turkestan Mts (e.g. Fedorov 1942). *Aceretum turkestanici* may also occur in other regions of Middle Asia and in Iran within the Irano-Turanian Province (Zapryagaeva 1976; Ovchinnikov 1981).

Habitat characteristics: *Aceretum turkestanici* generally occupies fairly fertile habitats, but with rather shallow, lithomorphic soils with considerable gravel or rock content. Some sites show signs of periodic water shortages, especially in late summer and autumn. Stands of *Acer turkestanicum* grow in close association with *Juglandetum regiae*, but require higher, steeper sites or those with shallow soils on rocky outcrops.

FAG-AA03. *Violo suavis-Populetum albae* Nowak, Nobis et S. Nowak in Nowak et al. 2017 (mesophilous deciduous poplar forests on wet and fertile soils of the central Pamir-Alai Mts, mainly Darvaz Mts) (Fig. 15)

Fig. 14. *Aceretum turkestanici* in Sary-Khosor National Park, Hazratishokh Mts, Tajikistan (ca. 2,200 m a.s.l.). Photo: A. Nowak.

Fig. 15. *Violo-Populetum albae* on the northern slopes of Obikhingou River Valley, Darvaz Mts, Tajikistan (ca. 2,000 m a.s.l.). Photo: A. Nowak.

Fig. 16. *Swido darvasicae-Platanetum orientalis* in the Panj River Valley near Qualaikhum, Darvaz Mts, Tajikistan (ca. 1,500 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Astragalus holosericeus, Aflatunia ulmifolia, Crepis sibirica, Leonurus turkestanicus, Picris nuristanica, Populus alba*, *Rhamnus dolichophylla.*

Geographical range: The diagnostic species of the association grows in Tajikistan at elevation between 1,500 and 2,000 m a.s.l. on the slopes of the Hissar, Darvaz and Peter the First Mts (Zapryagaeva 1976). Despite the wide global range of *Populus alba* (e.g. Komarov 1936; Tutin et al. 1964) and the more restricted range of *Viola suavis*, the distribution of the association is limited to southern Middle Asia due to the unique floristic composition and habitat characteristic of this forest type.

Habitat characteristics: Within the *Acero-Juglandion*, the *Violo suavis-Populetum albae* requires the wettest soils. It occurs on slope depressions with deep, moist and slightly alkaline soils. Within the plots some trickling waters or small brooks were noted.

FAG-AA04. *Swido darvasicae-Platanetum orientalis* Nowak, Nobis et S. Nowak in Nowak et al. 2017 (mesophilous oriental plane forests of montane belt on fertile habitats in river valleys) (Fig. 16)

Diagnostic species: *Diospyros lotus*, *Epipactis royleana*, *Geranium collinum, Melissa officinalis, Ophioglossum bucharicum, Platanus orientalis*, *Scrophularia nodosa, Stellaria neglecta, Swida darvasica*, *Zizyphus jujuba.*

Geographical range: This type of forest is distributed in southern Middle Asia at elevation of 1,000–1,500 m a.s.l. within the range of *Swida darvasica*, an endemic plant of southern Darvaz and Hissar Mts. *Swido darvasicae-Platanetum orientalis* is one of the rarest and disappearing forest types in Middle Asia due to timber demand and deforestation by local people.

Habitat characteristics: The *Swido darvasicae-Platanetum orientalis* association occupies the warmest, most humid and fertile sites in the river valleys of southern Tajikistan. It was found in a few plots in the valley bottoms or on gentle slopes facing south.

Oak, mixed deciduous and conifer open forests of Hindu Kush

Oak, mixed deciduous and conifer open forests of warm regions in the cool-temperate nemoral zone of montane belt of the Hindu Kush Mts (Pakistan)

PUB. *Quercetea pubescentis* Doing-Kraft ex Scamoni et Passarge 1959
O. unknown
All. unknown

PUB-XXc01. Community of *Quercus baloot* (evergreen sclerophyllous oak forest of the north-eastern Hindu Kush and the western Himalayas)

Diagnostic species: *Quercus baloot.*
Geographical range: The native range of *Quercus baloot* is the northern and eastern parts of the Hindu Kush Mts and the western Himalayas, between 1,200 and 2,300 m a.s.l., mainly in the submontane belt. The distance to the borders of Tajikistan of the northernmost sites of this type of forest is only less than 100 km (Chitral province in northern Pakistan).
Habitat characteristics: *Quercus baloot* occasionally forms dense stands, but generally it has an open woodland character with *Pinus roxburghii* and *Cedrus deodara* (sometimes also *Pinus gerardiana*, *Olea ferruginea* and *Monotheca buxifolia*). It mainly occurs at elevations between 1,200 and 2,000 m a.s.l. in the subhumid zone of dry temperate areas (Rahman et al. 2022). Above 2,000 m a.s.l., it occurs on dry soils in association with *Pinus gerardiana* (le Hardÿ de Beaulieu, Lamant 2010; eFloras 2024).
Remarks: This type of forest is certainly not found in Tajikistan, but due to its occurrence on the southern edge of Middle Asia, we decided to include it in this work. It is worth noting that this forest is one of the most threatened due to climate change, goat grazing and increasing deforestation.

PUB-XXc02. Community of *Quercus dilatata* (humid mixed deciduous and laurophyllous oak forest)

Diagnostic species: *Quercus dilatata, Q. semecarpifolia, Acer cappadocicum, Aesculus indica.*
Geographical range: The native range of *Quercus dilatata* is the eastern Hindu Kush and the western Himalayas. The stands of this oak occur in the montane to upper montane belt (2,000–2,900 m a.s.l.) of northern Pakistan (Nuristan, Dir, Swat and Kalasha districts).
Habitat characteristics: This community is typical of the montane forest belt, which is characterised by low tree cover. In the vicinity of the Pamir, it occurs in the upper montane belt at an elevation of about 2,200–2,800 m a.s.l. in the subhumid zone. *Q. dilatata* stands are usually found in humid temperate areas of Pakistan, where the influence of the monsoon is stronger.
Remarks: As a former community, this forest type has been reported from northern Pakistan as one of the most threatened vegetation types due to goat grazing, logging and climate change.

Xeric shrublands of the Irano-Turanian Region

Intrazonal scrub and woodlands of the nemoral zone

Xeric shrublands of the Irano-Turanian Region

PRU. *Crataego-Prunetea* Tx. 1962

PRU-A. *Crataegetalia ponticae* Nowak, S. Świerszcz, S. Nowak, Nobis et M. Nobis 2023 (scrub and mantle vegetation seral or marginal to broad-leaved forests in the nemoral zone of the Irano-Turanian Region)

PRU-AA. All. *Rosion kokanicae* nom. prov. (xeric scrub on nutrient-poor soils on screes and slopes in Middle Asia – so called Rosaria)

This is still a poorly studied vegetation type inhabiting steep slopes, often stable scree throughout whole Middle Asia. It is composed by numerous species of *Rosa* spp., *Berberis* spp., *Rhamnus* spp., *Caragana* spp., *Crataegus* spp., *Spiraea* spp. and others. During our research on thermophilous scrub and mantle vegetation, screes and thermophilous open woodlands, several communities were separated into distinct groups.
Geographical range: Montane and subalpine belts of the Middle Asian mountains (Uzbekistan, Turkmenistan, Kyrgyzstan, Tajikistan, northern Afghanistan, southern Kazakhstan).
Habitat characteristics: This vegetation type develops mainly on shallow to moderately deep soils. Sometimes it occurs on scree slopes with different inclinations. Plant communities that are included in this alliance are supposed to grow at elevations of approximately 1,000–2,500 m a.s.l., and consist mainly of species of the Irano-Turanian distributional range. They are mostly a natural vegetation of mountain slopes, but include also the secondary scrublands that developed after clear cuttings of woody vegetation at lower elevations in the valley of the warmer and more humid areas.

Fig. 17. Schrubland of *Rosa kokanica* on slopes near Khovalling in Hazratishokh Mts, Tajikistan (ca. 1,950 m a.s.l.). Photo: A. Nowak.

Fig. 18. Scrublands on screes and stony aprons with *Caragana alaica* in the Alai Mts, Isfayransay River Valley, south-western Kyrgyzstan (ca. 1,500 m a.s.l.). Photo: A. Nowak.

PRU-AAc01. Community of *Rosa kokanica* (xeric scrub on nutrient-poor soils on screes and slopes in Middle Asia) (Fig. 17)

Diagnostic species: *Astragalus lancifolius, A. nobilis, Origanum vulgare* subsp. *gracile, Potentilla multifida* subsp. *multifida, Rosa kokanica.*
Geographical range: Plots representing this community were found in the Fann Mts in the central Zeravshan Range and in the upper reaches of the Takob Valley in the Hissar Mts. The natural distribution of *Rosa kokanica* includes a wider area in the Irano-Turanian Province from Iran in the west, through Middle Asia to Xinjiang in the east (eFloras 2024).
Habitat characteristics: The community inhabits relatively dry, stony slopes in the subalpine elevations (2,380–2,470 m a.s.l.). Plots representing this community were sampled within large pasturelands on south-east and west-facing slopes with an inclination of 10° to 40°.
Remarks: In terms of habitat conditions, the community is related to continental and subalpine scrub, described in Russian literature (e.g. Golovkova 1959) as Rosaria, composed mainly of roses and species of the genera *Cotoneaster*, *Spiraea* and *Rhamnus*.

PRU-AAc02. Community of *Caragana alaica* (xeric scrub on nutrient-poor soils on screes and slopes of northern slopes of the Alai Mts) (Fig. 18, 19)

Diagnostic species: *Caragana alaica.*
Geographical range: *Caragana alaica* scrub has been found in a small area of the northern slopes of the Alai Mts, in the borderland between Kyrgyzstan and Tajikistan. This community occurs along streams and rock walls in valley

and gorge bottoms (Abshyr-Ata, Kara-Kozuu, Chauvay). It is an endemic type of scrubland vegetation of southern Kyrgyzstan.

Habitat characteristics: The community inhabits dry, stony slopes, aprons and screes in the montane elevations (1,600–1,900 m a.s.l.). The plots representing this community were sampled in narrow valleys and canyons with intensive grazing, on different rocky deposits with a calcareous character and an inclination between 0° and 25°.

Remarks: As a result of heavy grazing, the community is losing compactness and areal extent. At present, it does not form extensive thickets along mountain streams, but only fragmented smaller patches.

PRU-AAc03. Community of *Prunus verrucosa* (xeric scrub on nutrient-poor soils on screes and slopes of Middle Asia) (Fig. 20)

Diagnostic species: *Prunus verrucosa.*

Geographical range: *Prunus verrucosa* scrub is one of the most common vegetation types on dry habitats of screes, gravelly slopes, aprons and fans. They have been recorded in almost all of Tajikistan, especially in areas with low rainfall, such as the Zeravshan Mts. They are also found throughout the western Tian Shan. Scrublands with *Prunus verrucosa* can develop along a broad elevational gradient from the colline to the subalpine belt, with a preferred elevation of approximately 1,800–2,600 m a.s.l.

Habitat characteristics: The community inhabits dry, stony slopes, aprons and screes, mainly in montane areas. Occasionally, it grows on rocky ledges and shelves, usually on calcareous substrates.

Remarks: The community with *Prunus verrucosa* rarely occurs as a large, landscape-scale stand. Rather, it develops in patches, and *Prunus verrucosa* itself also enters many other scrub

Fig. 19. *Caragana alaica* in the Abshyr-Ata Canyon, south-western Kyrgyzstan (ca. 1,300 m a.s.l.). Photo: A. Nowak.

Fig. 20. Scrub with *Prunus verrucosa* in Pastrud-darya River Valley, Zeravshan Mts, Tajikistan (ca. 2,000 m a.s.l.). Photo: A. Nowak.

communities. It is not excluded that it is a central community in the dry scrublands of Middle Asia.

PRU-AB. *Ranunculo tenuilobi-Cotoneastrion hissarici* Nowak, Nobis, S. Nowak, Kotowski, Klichowska, A. Nobis et Świerszcz 2022 nom. corr. (scrub vegetation of subhumid and nutrient-rich habitats)

Diagnostic species: *Amygdalus bucharica, Ranunculus tenuilobus, Cotoneaster hissaricus, Caragana turkestanica, Astragalus darwasicus, Asyneuma argutum* subsp. *baldshuanica*, *Neopaulia ovczinnikovii*, *Prunus sogdiana*.

Geographical range: Montane belt of the Middle Asian Mts (Uzbekistan, Turkmenistan, Kyrgyzstan, Tajikistan, southern Kazakhstan).

Habitat characteristics: These shrublands develop on deep, fertile soils, mainly on northern slopes with different inclinations in the Middle Asian Mts. They prefer elevations of approx. 1,000–2,100 m a.s.l. within the belt of deciduous forests, occasionally extending to the drier habitats of subalpine juniper woods or rose bushes, or descending to the colline and lower montane belt to the warmer habitats of *Pistacia vera* groves. They are mainly composed of species from the Irano-Turanian range. In the upper montane belt and on steep slopes or landslide cones, they are a natural vegetation. In lower or flatter areas, they form secondary scrublands that have developed after the deforestation.

Remarks: The *Ranunculo tenuilobi-Cotoneastrion hissarici* includes the mesophilous shrublands composed of Irano-Turanian species and dominated by deciduous woody plants. It occurs as a seral vegetation to the deciduous mesophilous forests (mainly *Juglans regia* and *Acer turkestanica* forests) in subhumid zone in montane and subalpine belts in Middle Asia.

Fig. 21. Scrubland of *Aveno ludovicianae-Rhoetum coriariae* near Novobod in Hissar Mts, Tajikistan (ca. 1,400 m a.s.l.). Photo: A. Nowak.

PRU-AB01. *Aveno ludovicianae-Rhoetum coriariae* Nowak, Nobis, S. Nowak, Kotowski, Klichowska, A. Nobis et Świerszcz 2022 nom. corr. (Fig. 21)

Diagnostic species: *Anagallis arvensis*, *Callipeltis cucullaris*, *Echium biebersteinii*, *Leptorhabdos parviflora*, *Medicago lupulina*, *Pimpinella puberula*, *Rhus coriaria*, *Salvia sclarea*.
Geographical range: The general distribution of *Rhus coriaria* is very wide, covering the Mediterranean, the Middle East and almost all of Irano-Turanian Regions (Ovchinnikov 1981). In Tajikistan, the species was naturally distributed in the warmest and driest areas in the western and south-western parts of the country. Due to overgrazing and deforestation, it is now only sporadic in the colline and lower montane belts of the Zeravshan, Hissar, Aktau, Babatag and Hazratishokh Mts.

Habitat characteristics: The community inhabits dry, steep slopes, sometimes rocky, unstable debris in the lower montane elevation at approx. 1,200 m a.s.l. The community forms a dense thicket on the southern and south-western slopes, with inclination ranging from 25 to 45° in the subhumid Irano-Turanian climate.

PRU-AB02. *Calophacetum grandiflorae* Nowak, Nobis, S. Nowak, Kotowski, Klichowska, A. Nobis et Świerszcz 2022 (scrub vegetation of subhumid and nutrient-rich habitats of central Tajikistan) (Fig. 22)

Diagnostic species: *Calophaca grandiflora*, *Cercis griffithii*, *Eremurus comosus*, *E. stenophyllus*, *Vinca erecta*.
Geographical range: *Calophaca grandiflora* is an endemic shrub of central Tajikistan. Its range extends along the montane belt

of the Darvaz, Hazratishokh and western Hissar Mts with the main hotspots in the Yakhsu, Surkhob and Tavildara districts. The species forms a dense and distinct shrubland on the southern and eastern slopes in the subhumid zone, mainly between 1,100 and 1,800 m a.s.l. (Ovchinnikov 1978).

Habitat characteristics: The vegetation, dominated by *Calophaca grandiflora*, develops in the warm and subhumid regions of central Tajikistan. It is typical of the montane belt (1,190 to 1,950 m a.s.l.) on southern to eastern slopes with various inclinations up to 80°. The *Calophacetum grandiflorae* is a distinct type of zonal vegetation in the Hazratishokh and Vakhsh ranges in the central regions of Tajikistan (Khatlon Province). On the southern and eastern slopes of the Yakhsu and Obikhinghou River Valleys it forms an extensive, zonal vegetation in the montane belt.

Remarks: The association reveals a clear seasonality with distinct spring aspect with blooming *Calophaca grandiflora* and late summer aspect of withering of the herb layer and leaf dropping of shrubs.

PRU-AB03. *Fraxinetum raibocarpae* Świerszcz, Nobis, Nowak, Kotowski, Klichowska, A. Nobis et A. Nowak 2022 (shrubland vegetation of subhumid and nutrient-rich habitats of the colline and lower montane belts of Middle Asia) (Fig. 23)

Diagnostic species: *Artemisia baldshuanica*, *Astragalus quisqualis*, *Cousinia grigoriewii*, *Crambe cordifoli*a subsp. *kotschyana*, *Crucianella gilanica*, *Dictamnus albus*, *Elaeosticta bucharica*, *Erigeron khorossanicus*, *Fraxinus raibocarpa*, *Inula grandis*, *Thalictrum minus* subsp. *maxwellii*.

Geographical range: In Middle Asia the distribution of *Fraxinus raibocarpa* is limited to the south-western Pamir-Alai in Tajikistan

Fig. 22. Zonal shrubland of *Calophacetum grandiflorae* near Khovalling in the Hazratishokh Mts, Tajikistan (ca. 1,300 m a.s.l.). Photo: A. Nowak.

and the north-western Hindu Kush in Afghanistan (Chukavina 1984). Plots of this community have been found in the area of the Shurobod and Dashtijum National Parks in the southern part of the Hazratishokh Mts.

Habitat characteristics: The *Fraxinetum raibocarpae* was found in the montane belt in shrubland and open woodland landscapes of the southwestern Pamir-Alai ranges (1,000–2,200 m a.s.l.). The stands grow on slopes (mean ca. 30°) with northern, northeastern and western exposure. The herbaceous cover is relatively high, ranging from 55 to 90%. The most common species are *Colutea paulsenii* subsp. *orbiculata*, *Fraxinus raibocarpa*, *Brachypodium sylvaticum* and *Punica granatum*.

Remarks: This thicket-like formation is relatively rare and is sometimes a secondary vegetation formed after forest clearance, but also occurs as natural scrub on relatively steep and dry slopes.

PRU-AB04. *Pruno sogdianae-Crataegetum turkestanicae* Świerszcz, Nobis, Nowak, Kotowski, Klichowska, A. Nobis et A. Nowak 2022 (shrublands of subhumid and nutrient-rich habitats of the montane belt of Tajikistan) (Fig. 24)

Diagnostic species: *Crataegus pontica*, *C. turkestanica*, *Prunus sogdiana*, *Galium nupercreatum*, *Pimpinella peregrina*, *Vicia tenuifolia*.

Geographical range: The range of this shrubland vegetation extends from the Kopet-Dagh Mts. to the western Tian Shan and Pamir-Alai ranges. The diagnostic species *Prunus sogdiana* in an endemic to Middle Asia, and the centre of its distribution is the Fergana Valley. Among other diagnostic species, *Crataegus turkestanica* is distributed along the montane belts from the borderland of Iran and Turkmenistan to the western Pamir-Alai and Tian Shan. In Tajikistan, it occurs in the Kuraminian, Zeravshanian, Hissaro-Darvazian and Southtajikista-

Fig. 23. Bush of *Fraxinus raibocarpa* near Chilishtak (Shurobod district) in southern Tajikistan (ca. 1,600 m a.s.l.). Photo: A. Nowak.

Fig. 24. Shrublands of *Pruno sogdianae-Crataegetum turkestanicae* near Baljuvon in spring aspect, Khatlon Province, Tajikistan (ca. 1,400 m a.s.l.). Photo: A. Nowak.

nian phytogeographical regions (Ovchinnikov 1975) and occupies the montane belt mainly on northern slopes at an elevation between 970 and 1,800 m a.s.l.

Habitat characteristics: *Pruno sogdianae-Crataegetum turkestanicae* is typical of the lower montane belt of the subhumid mountain ranges of western and central Tajikistan. It occurs on well developed, moderately deep, loess or loamy soils with high organic matter content. It prefers slopes with moderate inclinations between 10° and 45° and northern exposures.

Remarks: *Prunus sogdiana* is considered a typical broadleaved forest species (Ovchinnikov 1975), most commonly found as an admixture in broadleaved mesophilous forests of *Juglans regia*. At present, this species is observed mainly in shrublands, which is related to deforestation and the dynamic and spatial relationship of *Pruno sogdianae-Crataegetum turkestanicae* with the so-called Chernolesya (black forest – mesophilous deciduous forests). The diagnostic taxon *Crataegus turkestanica* is considered to be a typical and often dominant species in mesophilous shrubs that shed their leaves in winter. It is representative of fringe vegetation or occurs in zonal belts on slopes.

PRU-AB05. *Aflatunio ulmifoliae-Caraganetum turkestanicae* Świerszcz, Nobis, Nowak, Kotowski, Klichowska, A. Nobis et A. Nowak 2022 (shrubland vegetation of subhumid and nutrient-rich habitats of Middle Asia) (Fig. 25)

Diagnostic species: *Aflatunia ulmifolia*, *Berberis heteropoda*, *B. integerrima*, *Caragana turkestanica*, *Celtis occidentalis*, *Chaerophyllum nodosum*, *Ferula clematidifolia*, *Fritillaria eduardii*, *Malus sieversii*, *Ranunculus tenuilobus*, *Rhamnus dolichophylla*.

Geographical range: The two main diagnostic species (*Caragana turkestanica* and *Alfatunia ulmifolia*) are distributed throughout Middle Asia, mainly in the montane belts of Pamir-Alai and western Tian Shan (Ovchinnikov 1975, 1978). *Caragana turkestanica* extends its range further east, with some occurrences in Dzhungar, Kashgar and Kuldzha provinces. Both species share a very similar elevational range, growing between 1,200 and 2,400 m a.s.l. in the montane belt. Many of the sampled plots with dominance of these two species occur in the vicinity of deciduous forests and a mantle or seral vegetation to the stands of *Juglans regia* or *Acer turkestanica*.
Habitat characteristics: *Aflatunio ulmifoliae-Caraganetum turkestanicae* is a typical montane shrubland vegetation that occurs in subhumid zones in close proximity to mesophilous broadleaf forests. It develops on fertile, brown soils with a high organic matter content. It occupies gentle or moderately steep slopes with an average slope of between 5 and 45°. As observed for forest vegetation, the *Aflatunio-Caraganetum turkestanicae* prefers northern exposures.
Remarks: Classification using the Twinspan algorithm resulted in two variants that differ significantly in terms of habitat condition and floristic composition:

- variant with *Ferula clematidifolia* – plots of this variant occupy lower locations (mean elevation ca. 1,330 m a.s.l.), in warmer areas on very fertile soils,
- variant with *Malus sieversii* – typical for higher montane belt (mean elevation ca. 1,700 m a.s.l.) in cooler and more humid areas on drier places with shallow, ranker soil.

PRU-ABc01. Community of *Rosa ecae* (scrub vegetation of subhumid and nutrient-rich, heavily grazed habitats of Middle Asia) (Fig. 26)

Fig. 25. Shrublands of *Aflatunio ulmifoliae-Caraganetum turkestanicae* near Yavroz in Hissar Mts, Central Tajikistan (ca. 1,500 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Draba huetii*, *Euphorbia inderiensis*, *Ferula kokanica*, *Festuca valesiaca*, *Lactuca orientalis*, *Rosa ecae*, *Trigonella gontscharovii*.

Geographical range: In Middle Asia the distribution of *Rosa ecae* is restricted to the Pamir Alai and Talas Mts in northern Tian Shan and northern Afghanistan (Ovchinnikov 1975). We found only a few patches of this community in the northern foothills of the Turkestan Mts (near Buragen), in the Zeravshan River Valley near Pardarok and in the Sanglokh Mts near Nurek.

Habitat characteristics: The community of *Rosa ecae* occupies the upper montane and subalpine belts in the pastoral landscapes of the western Pamir-Alai ranges (1,950–2,450 m a.s.l.). The stands grow on gentle north-facing slopes (average of about 35°) with compacted soils and a considerable amount of organic matter.

Remarks: The community of *Rosa ecae* is another example of a typical rose thicket vegetation in Tajikistan. It probably developed as a result of secondary scrub after the clearing of juniper stands and intensive grazing. It seems to be among the most common types of dry scrub vegetation in the rangelands of Middle Asia.

PRU-ABc02. Community of *Cotoneaster nummularioides* (shrublands of subhumid and nutrient- rich habitats of colline and lower montane belts of Tajikistan) (Fig. 27)

Diagnostic species: *Cotoneaster nummularioides.*

Constant species: *Cotoneaster nummularioides.*

Geographical range: The diagnostic species of this community grows in Tajikistan at elevation between 650 and 2,000 m a.s.l. on the slopes of the Hissar, Darvaz, Zeravshan and Rushan Mts. Its general distribution extends from the Caucasus,

Fig. 26. Shrublands of *Rosa ecae* near Shahriston, Turkestan Mts, northern Tajikistan (ca. 1,750 m a.s.l.). Photo: A. Nowak.

Fig. 27. Shrublands of *Cotoneaster nummularioides* near Sary-Khosor, Hazratishokh Mts, Khatlon Province, Tajikistan (ca. 1,950 m a.s.l.). Photo: A. Nowak.

through northern Iran, Kopet-Dagh to the western Tian Shan. The community of *Cotoneaster nummularioides* has its potential range in the colline and montane belts across all mountain ranges of Middle Asia.

Habitat characteristics: The community of *Cotoneaster nummularioides* prefers fertile, deep soils in the subhumid zone of the colline and lower montane belts of the Middle Asian Mts. It occurs on warm, south-facing sites with other shrub species (shiblyak) such as *Cotoneaster hissaricus*, *Amygdalus bucharica* or *Celtis caucasica*).

PRU-ABc03. Community of *Exochorda racemosa* subsp. *racemosa* (shrublands of subhumid and nutrient-rich habitats of the submontane and montane belts of Middle Asia)
(Fig. 28)

Diagnostic species: *Exochorda racemosa* subsp. *racemosa.*

Geographical range: This shrubland vegetation extends in the montane belt of the Pamir-Alai and Tian Shan Mts. Previously it was recognised as endemic to Pamir-Alai, because before the revision of the genus it was related to the synonymous *Exochorda albertii* Regel. The current distribution of *Exochorda racemosa* subsp. *racemosa* indicates that the potential distribution of this mesophilous shrubland is wider, including eastern China. In Tajikistan, this vegetation grows at elevation between 1,200 and 2,500 m a.s.l. on the slopes of the Hissar, Darvaz and Peter the First Mts.

Habitat characteristics: The community of *Exochorda racemosa* subsp. *racemosa* is associated with mesophilous, fertile soils with natural deciduous forest vegetation (mainly *Juglans regia* stands). Due to deforestation of large areas, especially on the northern slopes of the Hissar and Darvaz Mts, an extensive secondary shrubland has developed, dominated by *Exochorda* (called Eksohordniki by local

Fig. 28. Shrublands of *Exochorda racemosa* subsp. *racemosa* near Khoburobot Pass, Darvaz Mts, Tajikistan (ca. 2,750 m a.s.l.). Photo: A. Nowak.

Fig. 29. Shrublands of *Sorbus persica* near Poymazor in Vanch River Valley, Western Pamir, Tajikistan (ca. 2,710 m a.s.l.). Photo: A. Nowak.

botanists). It has many geographical, habitat or successional variants with different species composition.

PRU-ABc04. Community of *Sorbus persica* (short shrubland of the upper montane and subalpine belts of the Irano-Turanian Mts) (Fig. 29)

Diagnostic species: *Sorbus persica.*
Geographical range: This shrubland vegetation extends in the montane and subalpine belts of the Pamir-Alai and western Tian Shan Mts. It also occurs in northern Iran (GBIF 2024). In Tajikistan, this vegetation grows at elevation between 2,500 and 3,000 m a.s.l. on the slopes of the Zeravshan, Turkestan, Hissar, Hazratishokh, Karateginian, Darvaz, Vanch and Peter the First Mts (Ovchinnikov 1975).
Habitat characteristics: The community of *Sorbus persica* grows with a complex of juniper stands and forms its own stands on gentle slopes with relatively high soil content. It is associated with mesophilous, fertile habitats.

Irano-Turanian open woodlands in warm, semi-arid to sub-humid climate

Irano-Turanian open woodlands in warm, subtropical, semi-arid to sub-humid climate

PIV. *Pistacietea verae* Nowak, Świerszcz, Naqinezhad, S. Nowak et Nobis 2024

This type of vegetation extends from south-eastern Georgia through Azerbaijan, Iran, Turkmenistan, Uzbekistan, western Kyrgyzstan to Afghanistan and Tajikistan. It has a physiognomy of open woodlands with *Pistacia vera*, *P. atlantica* or *P. khinjuk*. This kind of woodland vegetation refers to Redkolese or Pistacieta vegetation or less commonly (and incorrectly) to Shiblyak described in Russian language literature (Nowak et al. 2024a).

PIV-A. *Pistacietalia verae* Nowak, Świerszcz, Naqinezhad, S. Nowak et Nobis 2024 (thermophilous open woodlands of the Pamir-Alai, Hindu Kush and Kopet-Dagh Mts in Middle Asia) (Fig. 30)

This vegetation includes open woodlands with *Pistacia vera* giving them the characteristic appearance of sparse stands with small umbrella-crowned trees or shrubs. This physiognomy resembles savanna-like vegetation similar to the *Olea europaea* or *Sideroxylon spinosum* open woodlands typical for the Mediterranean Region. The density of the canopy depends on the intensity of grazing and browsing, as well as on the use of trees by the local population. This vegetation is well developed in the eastern part of the Irano-Turanian Region, where the genus *Pistacia* originated. The shrub layer is poorly developed and the understorey is dominated by herbaceous species, often associated with pseudosteppes. Dense forb grasslands develop as a kind of mantle around trees or groups of trees (Nowak et al. 2024a).

PIV-AA. *Pistacion verae* Nowak, Nobis, S. Nowak, Kotowski, Klichowska, A. Nobis et Świerszcz

Fig. 30. Open pistachio woodland near Nurek, Vakhsh Mts, Tajikistan in autumn (ca. 985 m a.s.l.). Photo: A. Nowak.

Fig. 31. Open woodland representing the *Pistacion verae* vegetation near Nurek, Vakhsh Mts, Tajikistan (ca. 1,250 m a.s.l.). Photo: A. Nowak.

2022 (thermophilous open woodlands of southern Middle Asia) (Fig. 31)

Diagnostic species: *Acer pentapomicum, Aegilops triuncialis, Amygdalus bucharica, Artemisia baldshuanica, Asparagus bucharicus, Avena sterilis* subsp. *ludoviciana, Brachypodium distachyon, Bromus popovii, Cousinia grigoriewii, Eremurus roseolus, Ferula tadshikorum, Galagania tenuisecta, Inula orientalis, Medicago rigidula, Phlomoides hissarica, Pistacia vera, Prunus verrucosa, Taeniatherum caput-medusae, Vicia sativa* subsp. *nigra, Vulpia myuros.*
Constant species: *Brachypodium distachyon, Crepis pulchra, Euphorbia franchetii, Hordeum bulbosum, Ferula tadshikorum, Lolium temulentum, Vulpia myuros.*
Geographical range: Middle Asia (Afghanistan, Uzbekistan, Turkmenistan, Kyrgyzstan and Tajikistan). It is a typical open wood vegetation that forms a zonal belt in the colline and lower montane elevations of the Middle Asian mountain ranges.
Habitat characteristics: It develops mainly on fertile or moderately fertile soils, in semi-arid to subhumid climatic zones (Nowak et al. 2022a; Nowak et al. 2024a).

PIV-AA01. *Pistacietum verae* Nowak, Nobis, S. Nowak, Kotowski, Klichowska, A. Nobis et Świerszcz 2022 (*Pistacia vera* thermophilous open woodlands in south-western Tajikistan) (Fig. 32)

Diagnostic species: *Aegilops triuncialis, Artemisia baldshuanica, Bromus popovii, Cercis griffithii, Hordeum bulbosum, H. spontaneum, Inula grandis, Pistacia vera.*
Constant species: *Aegilops triuncialis, Cercis griffithii, Pistacia vera.*
Geographical range: The species diagnostic for this vegetation are distributed across

Fig. 32. Spring woodland of the *Pistacietum verae* association growing near Sharshar, Sarsarak Mts, Tajikistan (ca. 1,080 m a.s.l.). Photo: A. Nowak.

the colline and lower montane belts of the Middle Asian Mts, mainly the Kopet-Dagh, Pamir-Alai, western Tian Shan and northern Hindu Kush. Phytocoenoses are distributed between 400 and 2,000 m a.s.l., but at ca. 900 to 1,800 m a.s.l. they form zonal open woodlands. In Tajikistan, *Pistacia vera* has been reported from the foothills of the Mogoltau, Zeravshan, Hissar, Sarsarak, Sangloh, Aktau, Babatag, Darvaz and Hazratishokh Mts (Ovchinnikov 1981). Patches of this association were found mainly in the Dashtijum, Sarsarak and Nurek provinces (Nowak et al. 2022a).

Habitat characteristics: *Pistacietum verae* association is a typical open woodland vegetation of colline and lower montane belts, which occurs in arid to sub-humid climates with hot summers and mild winters. The vegetation patches develop on fertile loess soils, on gentle or moderately steep slopes with mean inclination of 25° without any preferences in terms of exposure (Nowak et al. 2022a).

PIV-AA01a. *Pistacietum verae typicum* Nowak, Nobis, S. Nowak, Kotowski, Klichowska, A. Nobis et Świerszcz 2022 (Fig. 32)

Diagnostic species: *Aegilops triuncialis, Bromus popovii, Hordeum bulbosum, H. spontaneum, Inula grandis, Pistacia vera.*

Constant species: *Aegilops triuncialis, Pistacia vera.*

Geographical range: This subassociation is distributed within the range of *Pistacietum verae* vegetation.

Habitat characteristics: The habitat of this subassociation is consistent with the habitat of the core association in terms of both humidity and temperature conditions (Nowak et al. 2022a).

PIV-AA01b. *Pistacietum verae cercidetosum griffithii* Nowak, Nobis, S. Nowak, Kotowski, Klichowska, A. Nobis et Świerszcz 2022 (Fig. 33, 34)

Fig. 33. Spring aspect of the *Pistacietum verae cercidetosum griffithii* subassociation near Nurek, Sangloh Mts, Tajikistan (ca. 1,850 m a.s.l.). Photo: A. Nowak.

Fig. 34. Open woodland of the *Pistacietum verae cercidetosum griffithii* subassociation growing near Nurek, Sangloh Mts, Tajikistan (ca. 1,400 m a.s.l.). Photo: M. Nobis.

Fig. 35. Open woodland of the *Pistacietum khinjuk* association found near Shahr-e Kord, Zagros Mts, Iran (ca. 2,200 m a.s.l.). Photo: A. Naqinezhad.

Geographical range: Woodlands representing this subassociation were found mainly on the southern slopes of the Hazratishokh Mts along the border with Afghanistan. It occupies foothills within an elevation range of 600–1,400 m a.s.l. The range of *Cercis griffithii* mainly overlaps with the range of *Pistacia vera*, which occurs in the Kopet-Dagh, western Pamir-Alai, Tian Shan and northwestern foothills of the Hindu Kush (Ovchinnikov 1978). Patches of the subassociation with *Cercis griffithii* were found mainly in the Panj River Valley near the Dashti-Jum Nature Reserve and near the village of Zigar (Nowak et al. 2022a).

Habitat characteristics: The subassociation with *Cercis griffithii* occupies the driest sites compared to the typical ones. It often develops on shallow soils with rocky debris, sometimes almost on pebble screes (Nowak et al. 2022a).

PIV-AA02. *Pistacietum khinjuk* Nowak, Świerszcz, Naqinezhad, S. Nowak et Nobis 2024 (thermophilous pistachio open woods of the Hindu Kush and Zagros Mts) (Fig. 35)

Diagnostic species: *Achillea nobilis* subsp. *neilreichii, Arum rupicola, Centaurea intricata, Cirsium syriacus, Lepidium chalepense, Nepeta macrosiphon, Pistacia eurycarpa, Pistacia khinjuk, Pyrus glabra.*

Constant species: *Nepeta macrosiphon, Pistacia eurycarpa, P. khinjuk, Pyrus glabra.*

Geographical range: This association of pistachio open woodlands is distributed in the native range of *Pistacia khinjuk* and *P. atlantica*. It mainly covers the colline and montane belts of the Zagros Mts, Alborz Mts, and ranges of central and southern Iran. Forest-steppes of pistachio occur at lower altitudes in the Zagros and other mountains of central Iran down to 750 m a.s.l. This vegetation expands to elevation between 1,300 and 1,800 m a.s.l. in Alborz and rarely higher than 3,000 m a.s.l. with a dominance of either *Pistacia atlantica* or *Prunus eburnea* (Syn. *Amygdalus*

scoparius) (Ravanbakhsh et al. 2013, 2016, Ravanbakhsh, Moshki 2016). In the southern Hindu Kush (Afghanistan), the community of *Salvia cabulica-Pistacia khinjuk* was recorded, which can probably be considered as another vegetation unit with the association rank after the completion of the survey in the whole Irano-Turanian Region (Freitag 1971).

Habitat characteristics: The *Pistacia khinjuk* community in Iran is a zonal vegetation inhabiting semi-arid to sub-humid climates. In general, the *Pistacia-Prunus* (*Amygdalus*) shrubland forms a vegetation belt around the Zagros oak woodland, this belt being wider in the eastern Zagros foothills facing the Central Iranian Plateau (Djamali et al. 2009). Pistachio shrubland is better adapted to drier habitats and can withstand long summer droughts. The oak woodland, however, requires a shorter dry period during the summer and more rain in the spring. The lower limit of the shrubland is determined by the amount of precipitation received (300-350 mm/year).

PIV-AAc01. Community of *Zygophyllum darvasicum* (thermophilous scrub of southern Darvaz in Tajikistan)

Diagnostic species: *Zygophyllum darvasicum.*
Constant species: *Zygophyllum darvasicum.*
Geographical range: This thermophilous vegetation occurs exclusively in western Pamir-Alai and western Pamir at an elevation of 1,500–1,800 m a.s.l.
Habitat characteristics: This shrubby vegetation is probably a secondary vegetation in open pistachio woodlands, but after analysing its detailed distribution in Tajikistan, it can probably develop stands in drier places (e.g. the lowest part of the Vanch River Valley). It was mentioned by Ovchinnikov (1981) without detailed characterisation.

PIV-AAc02. Community of *Punica granatum* (thermophilous scrub of the southern Pamir-Alai Mts) (Fig. 36)

Fig. 36. The patch of the *Punica granatum* community near Yakhchi Mina, Panj River Valley, Darvaz Mts, Tajikistan (ca. 930 m a.s.l.). Photo: A. Nowak.

Diagostic species: *Punica granatum.*
Constant species: *Punica granatum.*
Geographical range: *Punica granatum* shrublands were observed in the colline and lower montane belts, in the pistachio open woodlands zone, often in wetter sites near springs or small watercourses. Stands of pomegranate inhabit southern Tajikistan from Aktau to western Pamir Mts at an elevation of 600–1,800 m a.s.l. (Ovchinnikov 1981).
Habitat characteristics: The shrubland dominated by *Punica granatum* is probably a secondary vegetation in the open pistachio woodland zone. The species is often planted and used as a fruit shrub, so its natural range and community composition in Tajikistan are difficult to determine. It seems to grow with *Ziziphus jujuba*, *Ficus afghanica* and other xeromorphic taxa of *Amygdalus*, *Cercis* and *Rhus* (Ovchinnikov 1981).

PIV-AAc03. Community of *Pistacia atlantica* (thermophilous open woodlands of the southern and western Hindu Kush Mts)

Diagnostic species: *Pistacia atlantica.*
Constant species: *Acantholimon polystachyum, A. fasciculare, Acanthophyllum squarrosum, Amygdalus erioclada, A. brahuica, Allium griffithianum, A. mirum, A. regelii, Anemone tschernaewii, Astragalus mokurensis, Cercis griffithii, Convolvulus leiocalycinus, Cousinia myriotoma, C. stocksii, Echinophora scabra, Euphorbia osyridea, Ephedra intermedia, E. sarcocarpa, Gagea circumplexa, Gaillonia afghanica, Iris stocksii, I. cabulica, Ixiolirion tataricum, Limonium cabulicum, Onobrychis dasycephala, Pistacia atlantica, P. khinjuk, Rhinopetalum gibbosum, Salvia leriifolia, S. macrosiphon, Tulipa aitchisonii, T. polychroma.*
Geographical range: The community of *Pistacia atlantica* has been recorded in the colline and lower montane belts of the western and southern Hindu Kush in Afghanistan. The stands dominated by this species inhabit slopes and hilltops at an elevation of 1,150–1,800 m a.s.l.
Habitat characteristics: This shrubland or open woodland is distributed along the foothills and the montane belts of the Hindu Kush. It grows on the alkaline soils and is intensively grazed. The cover of shrubs and small trees varies considerably according to the intensity of grazing.

PIV-AAc04. Community of *Ziziphus jujuba* and *Acacia modesta* (thermophilous, open woodlands of the southern Hindu Kush Mts in Afghanistan and Peshawar Mts in Pakistan)

Diagnostic species: *Ziziphus jujuba, Acacia modesta.*
Constant species: *Acacia modesta, Capparis decidua, Otostegia limbata, Tecomella undulata, Ziziphus jujuba.*
Geographical range: This arid vegetation is distributed in the southern foothills of the Hindu Kush. It develops in the colline and lower montane belts at an elevation up to approx. 1,000 m a.s.l. It develops between the zonal vegetation of *Ziziphus nummularia* (semi-deserts) and *Sideroxylon mascatense* (uphill, sclerophyllous evergreen woodlands).
Habitat characteristics: The community develops on the slopes of mid-altitude mountain ranges, preferring fairly steep slopes of various aspects. It grows on chestnut-brown soils and is adapted to a Mediterranean-like climate with winter rains and a considerable continental component.

Thermophilous Zeravshan juniper stands in the montane belt of Middle Asia

Vegetation of the nemoral orosystems

Thermophilous Zeravshan juniper stands in the montane belt of Middle Asia

PIJ. *Junipero-Pinetea sylvestris* Rivas-Martínez 1965

This type of open woodlands occupies an extensive zone in the mountains of the Irano-Turanian area and stretches around the Tibetan highlands, giving way to juniper cryophilous woodlands in the north in the Tian Shan and Alai Mts and to the south on the Tibetan side of the Himalayas.

PIJ-A. *Juniperetalia seravschanicae* Nowak, Nobis, S. Nowak, Kotowski et Świerszcz 2024

(thermophilous Zeravshan juniper open woods in colline and montane belts of Turkestanian province) (Fig. 37)

Diagnostic species: *Berberis integerrima, Campanula glomerata, Juniperus polycarpos* var. *seravschanica, Oxytropis capusii, Nepeta podostachys, Thalictrum sultanabadense, Pedicularis dolichorrhiza, P. krylowii, Poa fragilis, P. nemoraliformis, P. trivialis, Seseli schrenkianum, Silene tachtensis, Veronica rubrifolia.*

Constant species: *Asyneuma argutum* subsp. *argutum, Geranium regelii, Lonicera nummulariifolia, Ligularia thomsonii, Poa pratensis, Rosa webbiana, R. kokanica.*

Geographical range: The phytocoenoses assigned to this order occur across western part of Middle Asia (western Tian Shan, Pamir-Alai, western Hindu Kush, and probably also in Kopet-Dagh Mts (Turkmenistan), Baluchistan (Pakistan), Hazarmaysh Mts (Afghanistan) and Kuyhitang Mts (Uzbekistan). Main vertical range in the montane belt between 1,500 and 2,700 m a.s.l., occasionally descending to lower altitudes, especially in the southwest.

Habitat characteristics: The communities of the order develop on the slopes of mid-altitude mountain

Fig. 37. Thermophilous Zeravshan juniper open woods representing the *Juniperetalia seravschanicae*, to the west of Marguzor village, Zeravshan Mts, Tajikistan (ca. 2,500 m a.s.l.). Photo: M. Nobis.

Fig. 38. Zeravshan juniper open woods near Marguzor, Pastrud-darya River Valley, Tajikistan (ca. 2,430 m a.s.l.). Photo: A. Nowak.

ranges, preferring fairly steep slopes of various aspects. They grow on chestnut-brown soils and are adapted to a Mediterranean-like climate with winter rains and a considerable continental component (Nowak et al. 2022b; Nowak et al. 2024b).

PIJ-AA. *Juniperion seravschanicae* Nowak, Nobis, S. Nowak, Kotowski et Świerszcz 2022 (thermophilous Zeravshan juniper open woods in colline and montane belts of the western Pamir-Alai and Tian Shan Mts) (Fig. 38)

Diagnostic species: *Berberis integerrima, Campanula glomerata, Juniperus polycarpos* var. *seravschanica, Oxytropis capusii, Nepeta podostachys, Thalictrum sultanbadense, Pedicularis dolichorhiza, P. krylowii, Poa fragilis, P. nemoraliformis, P. trivialis, Seseli schrenkianum, Silene tachtensis, Veronica rubrifolia*.

Constant species: *Asyneuma argutum* subsp. *argutum, Geranium regelii, Lonicera nummulariifolia, Ligularia thomsonii, Poa pratensis, Rosa webbiana, R. kokanica*.

Geographical range: The phytocoenoses assigned to this alliance occur in the western part of Middle Asia (western Tian Shan, Pamir-Alai, western Hindu Kush, and also in Kopetdagh (Turkmenistan), Balochistan (Pakistan), Hazarmaysh Mts (Afghanistan) and Kuyhitang Mts (Uzbekistan). The largest forest complexes of Zeravshan juniper extend into Zeravshan, Hissar, Babatag, Vakhsh, Sarsarak, Hazratishokh, Kuraminian Mts in Tajikistan, the Hindu Kush in Afghanistan and the western Tian Shan Mts in Kyrgyzstan. The stands of this alliance occur in the montane belt, mainly in Tajikistan and Kyrgyzstan. Thermophilous juniper forests grow in the Pamir-Alai at elevation of (1,300–) 1,700–2,200(–2,700) m a.s.l.

Habitat characteristics: This vegetation occurs in areas with an average rainfall of 500–700 mm/year and an average annual temperature of about 12–15°C. Winter temperatures often fall below

Fig. 39. Stand of the *Juniperetum seravschanicae* association near Alaudin Lake, Fann Mts, Tajikistan (ca. 2,650 m a.s.l.). Photo: A. Nowak.

-25°C. The stands occupy shallow to moderately deep soils (sometimes on scree) with topsoil becoming very dry during the hot summer periods. This vegetation type develops on slopes with different gradients and aspects and is not strongly associated with northern exposure, as is the case with *Juniperus pseudosabina* stands. The plant communities included in this association are mainly composed of species from the Irano-Turanian range (Nowak et al. 2022b).

PIJ-AA01. *Juniperetum seravschanicae* Nowak, Nobis, S. Nowak, Kotowski et Świerszcz 2022 (thermophilous Zeravshan juniper stands in the Zeravshan, Darvaz, Hazratishokh and Aktau Mts) (Fig. 39)

Diagnostic species: *Berberis integerrima, Brachythecium collinum, Eremogone griffithii, Hedysarum denticulatum, Juniperus polycarpos* var. *seravschanica, Oxytropis glabra, Pedicularis dolichorrhiza, Poa nemoraliformis, Primula lactiflora, Seseli schrenkianum, Silene tachtensis.*

Constant species: *Hypnum cupressiforme, Juniperus polycarpos* var. *seravschanica*, *Lonicera nummulariifolia, Geranium regelii, Ligularia thomsonii.*

Geographical range: Plots of this community were sampled in the Zeravshan Mts, mainly in the Pastrud-darya, Imat and Iskander-darya River Valleys (Fann Mts). It is the core distribution area of the main diagnostic taxon and its *locus classicus*.

Habitat characteristics: The community inhabits relatively dry, often stony slopes in the montane belt (1,800–2,800 m a.s.l.). Plots of the association were sampled within large juniper complexes on slopes with inclinations up to 40° and only occasionally on flat land. Aspects were variable with predominantly western and northern exposures. Two association variants have been distinguished, one with *Hedysarum denticulatum* and *Oxytropis glabra*, the other with *Primula lactiflora* and *Brachythecium collinum*. The first is characterised by slightly higher rainfall (especially in winter), lower slopes (wide glacial valleys) and more diverse aspects, also to the south and west. The second develops on steeper slopes, usually facing north. Grazing is less intensive and the soil is less fertile (Nowak et al. 2022b).

Cryophilous juniper stands in the upper montane belt of Middle and Central Asia

Cryophilous juniper stands in the upper montane belt of Middle and Central Asia
JUP. *Juniperetea pseudosabinae* Mirkin, Manibazar, Muchametsina, Alimbekova et Onishchenko 1986

This type of juniper woodland is found at the upper montane belt in Middle Asia and is more typical of temperate climates with summer rainfall peaks. It extends from the higher elevations of the Hindu Kush, through the Pamir-Alai, Tian Shan, Altai to the mountains of southern Siberia.

JUP-A. *Juniperetalia pseudosabinae* Mirkin, Manibazar, Muchametsina, Alimbekova et Onishchenko 1986

This type of mountain vegetation extends from the Hindu Kush, through the Pamir-Alai, Tian Shan, Altai, Karakoram to the mountains of southern Siberia. Scattered stands also occur in the Himalayas, Kunlun Mts and Tibet. The vegetation forms more or less dense woodlands or krummholz in the upper montane zone.

JUP-AA. *Juniperion pseudosabinae* Mirkin, Manibazar, Muchametsina, Alimbekova et Onishchenko 1986 (cryophilous juniper open woods in the upper montane belt of Middle and Central Asia) (Fig. 40)

Diagnostic species: *Carex turkestanica, Cerastium dichotomum* subsp. *inflatum, Codonopsis clematidea, Erigeron seravschanicus, Gentianella turkestanorum, Helictotrichon hookeri, Hypnum cupressiforme, Juniperus pseudosabina, Oxytropis ovczinnikovii, Phleum phleoides, Sanionia uncinata, Thalictrum kuhistanicum.*
Constant species: *Carex turkestanica, Geranium regelii, Hypnum cupressiforme, Juniperus pseudosabina, Ligularia thomsonii, Lonicera nummulariifolia, Sanionia uncinata, Thymus seravschanicus.*

Fig. 40. Sparse woodland representing the *Juniperion pseudosabinae* alliance in the upper Kara-Balta River Valley, Kyrgyz Mts, Kyrgyzstan (ca. 2,600 m a.s.l.). Photo: A. Nowak.

Geographical range: The vegetation of this alliance extends from the northern Pamir-Alai, through a large territory of the western and central Tian Shan, Altai, to the Sayan Mts. In Tajikistan, this *Juniperus pseudosabina* is distributed in the upper montane belt, mainly in Turkestan, Peter the First, Kuraminian and Zeravshan Mts at elevations between 2,000 and 3,600 m a.s.l., but the highest outposts of the community resemble rather subalpine krummholz with patchy shrub vegetation.

Habitat characteristics: Woodlands dominated by *Juniperus pseudosabina* occur in moderately warm and cold regions of Tajikistan. They develop in the upper montane to subalpine belts, mainly on northern slopes (Nowak et al. 2022b).

JUP-AA01. *Carici turkestanicae-Juniperetum pseudosabinae* Nowak, Nobis, S. Nowak, Kotowski et Świerszcz 2022 (cryophilous juniper open woods in the montane belt of western Middle Asia) (Fig. 41)

Diagnostic species: *Carex turkestanica, Cerastium dichotomum* subsp. *inflatum, Codonopsis clematidea, Erigeron seravschanicus, Gentianella turkestanorum, Helictotrichon hookeri, Hypnum cupressiforme, Juniperus pseudosabina, Oxytropis ovczinnikovii, Phleum phleoides, Sanionia uncinata, Thalictrum kuhistanicum.*

Constant species: *Carex turkestanica*, *Geranium regelii, Hypnum cupressiforme, Juniperus pseudosabina, Ligularia thomsonii, Lonicera nummulariifolia, Sanionia uncinata, Thymus seravschanicus.*

Geographical range: The vegetation of *Juniperus pseudosabina* was surveyed mainly in the Ohtangi Valley and around the Shahristan Pass in the Turkestan Mts. It occupies the upper montane belt between 2,000 and 3,100 m a.s.l., but a few patches of the dwarf form of *J. pseudosabina* have also been found at elevation of about 3,700 m a.s.l. in the Peter the First Mts. The tree stands of *Juniperus pseudosabina* are associated with the upper montane belt of the northern ranges in central Tajikistan (Nowak et al. 2022b).

Fig. 41. Stand of the *Carici turkestanicae-Juniperetum pseudosabinae* association near Shahriston Pass, Turkestan Mts, Tajikistan (ca. 2,600 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: The association occurs on brown mountain soils with poorly developed profile. It prefers moderately sloping sites (mean inclination approx. 25°) and with exposure from north-east to north-west (Nowak et al. 2022b).

JUP-AA02. *Androsaco baltistanicae-Juniperetum pseudosabinae* Eberhardt 2004 nom. invers. (juniper scrub of the subalpine belt of the Karakoram and Kunlun Mts)

Diagnostic species: *Androsace baltistanica*, *Juniperus pseudosabina, Gentiana tianschanica, Plantago gentianoides* subsp. *griffithii, Draba lanceolata.*
Constant species: *Androsace baltistanica*, *Juniperus pseudosabina, Ephedra gerardiana, Leontopodium brachyactis.*

Geographical range: Considering the range of diagnostic species, this vegetation type can be found in the Karakoram and Western Himalayas, mainly in northern Pakistan, and in Jammu-Kashmir and Himal Pradesh in India (e.g. Batura, Boibar, Shaujerav, Kirilgoza Valley; Eberhardt 2004). The districts of Gilgit and Chitral-Baltistan in northern Pakistan, where this association has a potential range, are only 20–40 km from Tajikistan, separated by the Vakhan Corridor. However, the probability of this vegetation occurring in the eastern Pamir is low due to the arid climate.
Habitat characteristics: Like other vegetation types formed by *Juniperus pseudosabina*, the *Androsaco baltistanicae-Juniperetum pseudosabinae* occurs in the subalpine belt at elevation higher than 3,000 m a.s.l. The lobed, loose physiognomy of this vegetation is characteristic of both the shrub and herbaceous layers (Eberhardt 2004).

Fig. 42. Patch of the *Juniperus sabina* community in Kyrgyz Mts, Kyrgyzstan (ca. 2,900 m a.s.l.). Photo: A. Nowak.

Fig. 43. Cryophilous short shrubs consisting of *Juniperus sibirica* near Poymazor, Vanch River Valley, Western Pamir, Tajikistan (ca. 3,600 m a.s.l.). Photo: A. Nowak.

JUP-AAc01. Community of *Juniperus sabina* (subalpine scrub of the western Tian Shan Mts) (Fig. 42)

Diagnostic species: *Juniperus sabina.*
Constant species: *Juniperus sabina.*
Geographical range: The range of this subalpine vegetation in Middle Asia is limited to eastern and central Kyrgyzstan and further north-east into Central Asia.
Habitat characteristics: This plant community has a patchy structure, occurring in subalpine belts at elevation of 2,800–3,700 m a.s.l. Depending on the intensity of grazing, the density of juniper shrubs and herbaceous layer may be considerably different.

JUP-AAc02. Community *of Juniperus sibirica* (cryophilous shrub vegetation of the central Tajikistan) (Fig. 43)

Diagnostic species: *Juniperus sibirica.*
Constant species: *Juniperus sibirica.*
Geographical range: The compact range of this community occurs in Central Asia, e.g. in the Altai and Sayan Mts. Tajikistan is located at the southern limit of this vegetation. The largest stands have been recorded in the subalpine belt of the Peter the First Mts and in the upper sections of the Vanch Valley in the Western Pamir.
Habitat characteristics: Like the previous two communities, stands of *Juniperus sibirica* form loosely structured vegetation. They often occupy rocky outcrops or coarse scree at elevation from about 2,600 to about 3,500 m a.s.l.

JUP-AB. *Juniperion semiglobosae* Eberhardt 2004 (cryophilous juniper scrublands and open woods in the subalpine belt of the Karakoram, Kunlun, Hindu Kush and western Himalayas)

We have not found pure stands of *Juniperus semiglobosa* in Tajikistan, nor have the vegetation types formed by this species been reported in the Russian literature. Eberhardt (2004) reports several communities and associations within the *Juniperion semiglobosae* alliance, whose range includes the borderland with the Vakhan Corridor. These are listed below without detailed description, referring the reader to Eberhardt's work. This juniper open woodland vegetation is similar to the *Juniperetum seravschanicae*, but at higher elevation (ca. 3,600–4,000 m a.s.l.) in the Hindu Kush and Karakoram.

JUP-AB01. *Ephedro regelianae-Loniceretum microphyllae* Eberhardt 2004 (short scrub in the river valley sides in the subalpine belt of the Karakoram Mts)

Diagnostic species: *Lonicera microphylla*, *Ephedra regeliana*, *Stipa himalaica*, *Artemisia salsoloides*, *Ribes orientale*, *Orostachys thyrsiflora*, *Carex pseudofoetida*, *Saussurea jacea*, *Heracleum thomsonii*.
Constant species: *Acantholimon lycopodioides*, *Artemisia brevifolia, Hedysarum falconeri*.
Geographical range: Central section of the southern Karakoram (Eberhardt 2004).
Habitat characteristics: Valley floors and west or south-west facing slopes between 3,070 and 3,120 m a.s.l.

JUP-AB02. *Comaro salesovianae-Juniperetum semiglobosae* Eberhardt 2004

Diagnostic species: *Comarum salesovianum*, *Campanula pallida* var. *tibetica*, *Brachyactis roylei*, *Spiraea lasiocarpa*, *Psychrogeton andryaloides*.
Constant species: *Acantholimon lycopodioides*, *Artemisia brevifolia, Hedysarum falconeri*.
Geographical range: Batura Valley in the Karakoram in Gilgit-Baltistan, Pakistan (Eberhardt 2004).
Habitat characteristics: Talus cones and fans at the foot of the rocky walls or on moraines between 3,200 and 3,350 m a.s.l.

JUP-AB03. *Eritrichio fruticulosae-Juniperetum semiglobosae* Eberhardt 2004

Diagnostic species: *Eritrichium fruticulosum*, *Oxytropis humifusa*, *Leymus secalinus*.
Constant species: *Koeleria cristata*, *Scorzonera virgata, Poa sterilis, Thymus linearis, Galium verum, Tanacetum senecionis*.
Geographical range: Batura Valley in the Karakoram in Gilgit-Baltistan, Pakistan (Eberhardt 2004).
Habitat characteristics: South facing slopes at an elevation of 3,150–3,700 m a.s.l.

JUP-AB04. *Androsacae thomsonii-Juniperetum semiglobosae* Eberhardt 2004

Diagnostic species: *Androsace thomsonii*, *Krascheninnikovia ceratoides*, *Tetracme quadricornis*.
Constant species: *Juniperus semiglobosa, Artemisia brevifolia, Rosa webbiana, Elymus cognatus, Silene kunawarensis, Polygonum rottboellioides*.
Geographical range: Batura Valley in the Karakoram in Gilgit-Baltistan, Pakistan (Eberhardt 2004).
Habitat characteristics: Sunny, south-west facing slopes at an elevation of 3,250-3,450 m a.s.l.

JUP-ABc01. Community of *Scrophularia dentata* and *Juniperus semiglobosa*

Diagnostic species: *Linaria odora*, *Scrophularia dentata*, *Serratula procumbens*.
Constant species: *Linaria odora*, *Scrophularia dentata*.
Geographical range: The Chupursan and Khunjerab Valleys in the Karakoram in Gilgit-Baltistan, Pakistan (Eberhardt 2004).
Habitat characteristics: Talus slopes in river valleys, south-west facing slopes between 3,600 and 4,000 m a.s.l.

Krummholz vegetation in the subalpine belt of Middle Asia and the Himalayas

Krummholz vegetation in the subalpine belt of Middle Asia and the Himalayas

The upper tree line vegetation of Central Asia has been reported from the Karakoram (Eberhardt 2004). This woody vegetation is exposed to fierce, icy winds and heavy and prolonged snow cover in winter. We did not find typical krummholz vegetation in Tajikistan, but *Salix karelinii* stands are known from the Peter

the First Mts in Tajikistan and the borderland of the Eastern Pamir (Badakhshan Region in Afghanistan and the Tirich-mir range in Pakistan), so we decided to include the vegetation reported by Eberhardt without a detailed description. In our opinion, the upper tree-line shrub vegetation composed of *Salix* spp., *Betula* spp., *Pieris* spp. and *Rhododendron* spp. is typical of the Himalayas, Hindu Kush and Karakoram Mts and needs detailed study.

Fig. 44. Vegetation dominated by *Salix fedtschenkoi* in Abduqakhor Valley in the Western Pamir, Vanch Mts, Tajikistan (ca. 3,300 m a.s.l.). Photo: A. Nowak.

XXX-XA. *Salicion karelinii* Eberhardt 2004 (krummholz vegetation in the subalpine belt of the Hindu Kush, Karakoram and the Himalayas)

This shrubby krummholz vegetation extends in the subalpine belt from the Hindu Kush, across the Karakoram, Himalayas, Hengduan Mts to the Qinghai-Tibet mountain ranges. Several associations have been established only for northern Pakistan in the Karakoram Mts. For details see Eberhard's work (2004). This vegetation type needs to be studied thoroughly in the whole area of the Central Asian Mts. The main woody taxa forming krummholz vegetation in Central Asia are *Salix* spp., *Juniperus* spp. and *Betula* spp.

XXX-XA01. *Carici nivalis-Salicetum karelinii* Eberhardt 2004 (subalpine krummholz vegetation on damp, gravelly slopes of the Hindu Kush and the Karakoram Mts)

XXX-XA02. *Hylotelephio ewersii-Salicetumkarelinii* Eberhardt 2004 (subalpine krummholz vegetation of the eastern Hindu Kush and the Karakoram Mts)

XXX-XA03. *Vicatio wolffianae-Salicetum karelinii* Eberhardt 2004 (subalpine forb krummholz vegetation of the eastern Hindu Kush and the eastern Karakoram Mts)

XXX-XAc01. Community of *Juniperus squamata* (subalpine juniper krummholz vegetation of the eastern Hindu Kush, the Karakoram and the Himalayas)

XXX-XB. All. *Salicion fedtschenkoi* nom. prov. (subalpine chionophilous dwarf heaths of Middle Asia)

This vegetation type is found at the highest altitudes of the subalpine belt, close to the tree line. It forms fairly dense patches in the land depressions (along brooks and streams), often in a complex with fen and snow-bed vegetation. *Salix fedtschenkoi* vegetation is known from elevation of 3,000 to 3,900 m a.s.l. from the Peter the First Mts and the Western Pamir. It is a vicariant vegetation with *Salicion karelinii* from the eastern Hindu Kush and Karakoram Mts.

XXX-XBc01. Community of *Salix fedtschenkoi* (subalpine and alpine silicicolous chionophilous dwarf heaths of Central Asia) (Fig. 44)

Diagnostic species: *Salix fedtschenkoi.*
Constant species: *Salix fedtschenkoi.*
Geographical range: This vegetation type, endemic to Middle Asia, is known from the Peter the First Mts and the Western Pamir. It is also likely to occur throughout the whole Badakhshan region, including northern Afghanistan and Xinjang in western China.
Habitat characteristics: It inhabits wet depressions and stream courses in the upper tree-line zone of the subalpine belt at an elevation of about 3,000–4,000 m a.s.l. (Ovchinnikov 1968).

Irano-Turanian subalpine forb steppes

Vegetation of the steppe zone

Irano-Turanian subalpine forb steppes

NEP. *Eremogono griffithii-Nepetetea podostachyos* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2024 (Fig. 45)

This class includes subalpine grasslands with a significant proportion of dicots and graminoids in the Irano-Turanian Region.

Diagnostic species: *Calamagrostis anthoxanthoides*, *Cousinia franchetii*, *Delphinium oreophilum*, *Eremogone griffithii*, *Gentiana olivieri*, *Geranium regelii*, *Geum kokanicum*, *Leymus alaicus*, *Ligularia thomsonii*, *Nepeta podostachys*, *Pedicularis krylowii*, *Poa bucharica*, *P. fragilis*, *P. zaprjagajevii*, *Potentilla grisea*, *Rhodiola heterodonta*, *Semenovia dasycarpa*.

Geographical range: This vegetation type occurs throughout the Pamir-Alai, western and southern Tian Shan, western Hindu Kush and Kopet-Dagh Mts.

Habitat characteristics: *Eremogono griffithii-Nepetetea podostachyos* grasslands occupy stony slopes with relatively fertile soils. This forb steppe vegetation is most commonly used extensively as pasture, often on land that has been cleared of open juniper woodland. Peak flowering occurs between June and early July (Nowak et al. 2024b).

NEP-A. *Nepetetalia podostachyos* Nowak, Świerszcz, Nobis, Swacha et S. Nowak in Świerszcz et al. 2023 (montane and subalpine forb steppe of the eastern Irano-Turanian origin in subalpine belt of the Pamir-Alai Mts) (Fig. 46)

Diagnostic species: *Calamagrostis anthoxanthoides, Cousinia franchetii, Delphinium oreophilum, Eremogone griffithii, Gentiana olivieri, Geranium collinum, G. regelii, Geum kokanicum, Leymus alaicus, Ligularia thomsonii, Nepeta podostachys, Pedicularis krylowii, Poa bucharica, P. fragilis, P. pratensis, P. zaprjagajevii, Potentilla grisea, Rhodiola heterodonta, Semenovia dasycarpa.*

Fig. 45. Forb-steppes representing the *Eremogono griffithii-Nepetetea podostachyos* class near Tajikobod, Peter the First Range, Tajikistan (ca. 3,200 m a.s.l.). Photo: A. Nowak.

Constant species: *Eremogone griffithii, Gentiana olivieri, Geum kokanicum, Ligularia thomsonii, Nepeta podostachys.*
Geographical range: Eastern Irano-Turanian phytogeographical region (Iran, Afghanistan, Uzbekistan, Kyrgyzstan and Tajikistan). In particular, the subalpine belts of the Pamir-Alai, Tian Shan and Hindu Kush Mts (Świerszcz et al. 2023).
Habitat characteristics: This order includes subalpine forb steppes dominated by species from the Irano-Turanian range. The plant communities of this order are part of the forest-steppe vegetation and occur in mosaics with juniper stands. They are in close contact with typical alpine grasslands, cryophilic steppes and high areas of juniper clear-fell. The vegetation is characterised by a high proportion of herbs and develops mainly on fertile to moderately fertile soils in subhumid climates. The abundance and frequency of undergrowth is strongly influenced by grazing (Świerszcz et al. 2023).

NEP-AA. *Ligulario thomsonii-Geranion regelii* Nowak, Świerszcz, S. Nowak et Nobis 2021 (forb rich mesophilous grasslands of the Pamir-Alai and Tian Shan Mts) (Fig. 47)

Diagnostic species: *Ligularia thomsonii, Centaurea ruthenica, Fritillaria regelii, Geranium regelii, Galium turkestanicum, Myosotis alpestris, Potentilla sericea.*
Constant species: *Ligularia thomsonii, Geranium regelii, Galium turkestanicum.*
Geographical range: This alliance includes forb steppes of the western part of the Pamir-Alai and the vegetation of the warmest slopes of the south-western Tian Shan. The plant communities of this alliance develop in the gaps of sparse juniper stands in their upper occurrence belt and in subalpine pastures.
Habitat characteristics: Characteristic features of these habitats include a high proportion of stone and gravel debris and a relatively high seasonality, manifested by reduced biomass

Fig. 46. Forb steppe representing the *Poo bucharicae-Nepetetalia podostachyos* order near Cholok-Kaiylyn, Fergana Mts, Kyrgyzstan (ca. 2,000 m a.s.l.). Photo: A. Nowak.

Fig. 47. Species-rich, forb, mesophilous grassland with *Ligularia thomsonii* near Anzob, Hissar Mts, Tajikistan (ca. 3,250 m a.s.l.). Photo: A. Nowak.

Fig. 48. Grazed grassland of the *Morinetum coulterianae* association near Anzob Pass, Hissar Mts, Tajikistan (ca. 3,400 m a.s.l.). Photo: A. Nowak.

production in midsummer (dry period). This alliance includes typical pastoral, intensively grazed vegetation characterised by spiny plants (e.g. *Morina coulteriana* and *Scorzonera acanthoclada*) (Świerszcz et al. 2023). These tall-forb communities grow mainly in the alpine belt of the western Pamir-Alai ranges on deep and moist fertile soils with calcareous bedrock. They form lush vegetation on slopes and plains. Only *Heracleetum lehmannianii* appears to be restricted to river banks and occasional slope water outflows. The composition of this vegetation is dominated by large herbs, with a high proportion of *Geranium* spp., *Phlomoides* spp., *Polygonum* spp., *Eremurus* spp., *Anthriscus* spp. and *Nepeta* spp. (Nowak et al. 2020b; Nowak et al. 2021b).

NEP-AA01. *Morinetum coulterianae* Nowak, Świerszcz, Nobis, Swacha et S. Nowak in Świerszcz et al. 2023 (intensively grazed alpine grassland of Middle Asia on slightly rupicolous habitats) (Fig. 48)

Diagnostic species: *Angelica ternata, Artemisia rutifolia, Cousinia mulgediifolia, Dianthus darvazicus, Eremopoa persica, Erigeron umbrosus, Lipskya insignis, Morina coulteriana, Papaver pavoninum, Scorzonera inconspicua, Trigonella gontscharovii, Veronica capillipes.*
Constant species: *Artemisia dracunculus, Eremopoa persica, Euphorbia sarawschanica, Festuca olgae, Ligularia thomsonii, Morina coulteriana, Nepeta podostachys, Papaver pavoninum, Scorzonera inconspicua, Taraxacum raikoviae, Veronica capillipes, Ziziphora pamiroalaica.*
Geographical range: The range of the main diagnostic taxon, *Morina coulteriana*, includes Afghanistan, Middle Asia and the western Himalayas (POWO 2023). The species has been recorded

Fig. 49. Grassland of the *Phlomoidetum sarawschanicae* association growing in the upper section of the Intar Valley, Fann Mts, Tajikistan (ca. 3,150 m a.s.l.). Photo: A. Nowak.

on stony but fertile slopes at elevation 2,000–3,800 m a.s.l. (Kinzikaeva 1988; Nowak, Nobis 2020). During surveys in 2014 and 2021, stands of *Morinetum coulterianae* were found at alpine altitudes on the southern and south-eastern slopes around the Anzob Pass in the Hissar Mts in western Tajikistan and on the western and north-western slopes of the Turkestan Mts (Świerszcz et al. 2023).
Habitat characteristics: *Morinetum coulterianae* is an alpine pasture in slightly rupicolous habitats, used for sheep grazing, recorded between 2,550 and 3,360 m a.s.l. (mean approx. 2,904 m), mainly on western and south-eastern aspects with an inclination of 20°–40° (Świerszcz et al. 2023).

NEP-AA02. *Phlomoidetum sarawschanicae* Nowak, Świerszcz, Nobis, Swacha et S. Nowak in Świerszcz et al. 2023 nom. mut. propos. (alpine rupicolous grassland of the Zeravshan range in western Pamir-Alai Mts) (Fig. 49)

Diagnostic species: *Artemisia korovinii, Astragalus bornmuellerianus, Phlomoides sarawschanica, Scorzonera acanthoclada.*
Constant species: *Artemisia dracunculus, A. korovinii, Astragalus bornmuellerianus, Cousinia franchetii, Eremogone griffithii, Euphorbia sarawschanica, Festuca valesiaca, Geranium regelii, Ligularia thomsonii, Nepeta podostachys, Phlomoides sarawschanica, Poa bucharica, P. litvinoviana, Taraxacum raikoviae, Veronica rubrifolia, Ziziphora pamiroalaica.*
Geographical range: This association, with the main diagnostic species, *Phlomoides sarawschanica* endemic to Tajikistan, occurs mainly in the Zeravshan Mts (Kochkareva 1986).
Habitat characteristics: *Phlomoidetum sarawschanicae* inhabits south-eastern and eastern slopes with an inclination of about 15°–25° at an elevation of approx. 3,300–3,600 m a.s.l. (Świerszcz et al. 2023).

Fig. 50. Grassland with *Phlomoides sarawschanica* on stony slope near Iskander-kul Lake, Fann Mts, Tajikistan (ca. 3,050 m a.s.l.). Photo: A. Nowak.

NEP-AA02a. *Phlomoidetum sarawschanicae typicum* Nowak, Świerszcz, Nobis, Swacha et S. Nowak in Świerszcz et al. 2023 (Fig. 50)

The description is the same as for the previous type.

NEP-AA02b. *Phlomoidetum sarawschanicae scorzoneretosum acanthocladae* Nowak, Świerszcz, Nobis, Swacha et S. Nowak in Świerszcz et al. 2023 (intensively grazed alpine rupicolous grassland of the Zeravshan range) (Fig. 51)

Diagnostic species: *Scorzonera acanthoclada.*
Constant species: *Scorzonera acanthoclada.*
Geographical range: Zeravshan and Hissar Mts in the western Pamir-Alai.
Habitat characteristics: The subassociation *Phlomoidetum sarawschanicae scorzoneretosum acanthocladae* inhabits the southern slopes of the Anzob Pass in the Hissar Mts and the southeastern slopes of the Zeravshan Mts, at elevations between 3,140 and 3,240 m a.s.l. The inclination of slopes ranged from 10° to 35° (Świerszcz et al. 2023).

NEP-AA03. *Alopecuro himalaici-Veronicetum gorbunovii* Nowak, Świerszcz, Nobis, Swacha et S. Nowak in Świerszcz et al. 2023 (moderately grazed subalpine and alpine grasslands of the Hissar and Zeravshan Mts) (Fig. 52)

Diagnostic species: *Alopecurus himalaicus, Aulacospermum roseum, Draba rosularis, Ferula karategina, Oxytropis michelsonii, Phlomoides oreophila, Primula kaufmanniana, Ranunculus rufosepalus, Veronica gorbunovii.*
Constant species: *Allium hymenorhizum, Alopecurus himalaicus, Aulacospermum roseum, Calamagrostis anthoxanthoides, Cousinia franchetii, Delphinium oreophilum, Eremogone griffithii,*

Fig. 51. Heavily grazed grassland of the *Phlomoidetum sarawschanicae scorzoneretosum acanthocladae* subassociation on the southern slopes near Kalon, Hissar Mts, Tajikistan (ca. 2,850 m a.s.l.). Photo: A. Nowak.

Fig. 52. Grassland of the *Alopecuro himalaici-Veronicetum gorbunovii* association found near Iskander-kul Lake, Fann Mts, Tajikistan (ca. 3,350 m a.s.l.). Photo: A. Nowak.

Helictotrichon hookeri, Ligularia thomsonii, Myosotis alpina, Nepeta podostachys, Oxytropis michelsonii, Phlomoides oreophila, Poa bucharica, P. bulbosa, Potentilla algida, P. tephroleuca, Veronica gorbunovii.

Geographical range: The distribution of *Veronica gorbunovii* is limited to the Pamir-Alai in Tajikistan, while *Alopecurus himalaicus* has a wider distribution extending from Bulgaria eastwards through Iran and Afghanistan to Kashmir and southern Middle Asia (Ovchinnikov 1957; Kochkareva 1986; POWO 2023). *Alopecuro himalaici-Veronicetum gorbunovii* inhabits the subalpine and alpine belts of the Hissar and Zeravshan Mts at elevation ranging from 2,970 to 3,500 m a.s.l. (Świerszcz et al. 2023).

Habitat characteristics: Patches of this vegetation grow on the northern and north-eastern slopes with a moderate inclination of about 10°–35° (Świerszcz et al. 2023).

NEP-AAc01. Community of *Cousinia outichaschensis-Lepechiniella sarawschanica* (alpine to subnival low forb steppe of the western Pamir-Alai Mts) (Fig. 53)

Diagnostic species: *Juniperus polycarpos* var. *seravschanica, Androsace caduca, Bunium persicum, Cousinia outichaschensis, Ephedra minuta, Gypsophila fedtschenkoana, Lepechiniella sarawschanica, Oxytropis lehmannii, Potentilla orientalis, P. pamiroalaica, Rochelia leiocarpa, Semenovia furcata.*

Constant species: *Cousinia outichaschensis, Geranium regelii, Lepechiniella sarawschanica, Oxytropis lehmanni, Poa relaxa, Potentilla pamiroalaica, P. tephroleuca.*

Geographical range: The native range of *Cousinia outichaschensis* includes Middle Asia, mainly the mountainous areas of Tajikistan, Kyrgyzstan, Uzbekistan and Turkmenistan. This species occurs

Fig. 53. Community of *Cousinia outichaschensis-Lepechiniella sarawschanica* with *Oxytropis lehmannii* on stony scree near the Anzob Pass in the Hissar Mts, Tajikistan (ca. 3,450 m a.s.l.). Photo: A. Nowak.

Fig. 54. Vegetation patch of the *Cousinia stephanophora* community found near Omskiy Pass, Fann Mts, Tajikistan (ca. 3,750 m a.s.l.). Photo: A. Nowak.

in Pamir-Alai at an elevation of 1,700–3,600 m a.s.l. (Rasulova 1991; POWO 2023). *Lepechiniella sarawschanica* is endemic to northwestern Tajikistan, reported from stony, fine-grained slopes at elevation of 2,500–4,200 m a.s.l. (Chukavina 1984).

Habitat characteristics: The community was recorded in rupicolous alpine habitats used as pastures, mainly for sheep, located on the gentle slopes of the Zeravshan Mts, at elevation between 2,850 and 2,950 m a.s.l. This vegetation prefers northern exposures with low slopes up to 15° (average about 10°) or flat ground (Świerszcz et al. 2023).

In addition, several plant communities, often dominated by *Cousinia* spp., have been noted within the *Ligulario thomsonii-Geranion regelii* vegetation of subalpine grasslands, especially in its upper range or the drier climatic zone. These require further detailed study and are only briefly mentioned below.

NEP-AAc02. Community of *Cousinia fedtschenkoana* – subalpine forb steppes of central Tajikistan (Zeravshan, Hissar and Hazratishokh Mts)

NEP-AAc03. Community of *Cousinia splendida* – subalpine, intensively grazed forb steppes of the Zeravshan, Hissar and Hazratishokh Mts

NEP-AAc04. Community of *Cousinia stephanophora* – upper montane to alpine, grazed forb steppes of the Zeravshan, Hissar, Peter the First and Hazratishokh Mts in central Tajikistan (Fig. 54)

NEP-AAc05. Community of *Cousinia semilacera* – thorny tragacanthic subalpine forb steppe of semi-arid habitats in the Pamir Mts (Badakhshan) (Fig. 55)

NEP-AAc06. Community of *Lophanthus elegans* (subalpine to alpine forb steppe of the eastern Pamir-Alai Mts) (Fig. 56)

Fig. 55. Vegetation of the *Cousinia semilacera* community inhabiting gravel slope in the Ghunt Valley, Shugnan Mts, Tajikistan (ca. 3,250 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Lophanthus elegans.*
Constant species: *Lophanthus elegans.*
Geographical range: This community was found in the eastern part of the Karateginian Mts, the Hissar Mts and the western Pamir Mts. Outside Tajikistan, it is also found in Hindu Kush in northern Afghanistan.
Habitat characteristics: It occurs in a zone of species-rich forb steppe at elevation from 2,200 to about 4,000 m a.s.l. and develops on stony slopes or high mountainous initial soils, often in the vicinity of *Betula*, *Juniperus* or *Lonicera* trees or shrubs (Kochkareva 1986).

Fig. 56. Vegetation patch representing the community of *Lophanthus elegans* and developed on a stony slope near Arzing, Obikhingou River Valley, Peter the First Range, Tajikistan (ca. 2,650 m a.s.l.). Photo: A. Nowak.

NEP-AAc07. Community of *Oxytropis glabra* (forb grasslands of the valley bottoms in the montane to alpine belts of the Pamir-Alai Mts)

This community occurs throughout Middle Asia. It also forms distinct communities in Central Asia, southern Siberia and western China. Further phytosociological studies are needed, but it seems to be a kind of fen-meadow plant community. We have not recorded patches of this vegetation, but follow the classification given by Ovchinnikov (1978).

NEP-AAc08. Community of *Semenovia dasycarpa* (herb-rich grasslands of the subalpine and alpine belts in the northern Pamir-Alai and western Tian Shan Mts) (Fig. 57)

Diagnostic species: *Semenovia dasycarpa.*
Constant species: *Semenovia dasycarpa.*

Geographical range: *Semenovia dasycarpa* is found in various vegetation types, most often at the margins of mesophilous shrublands and alpine grasslands. It is distributed mainly in central Tajikistan (Peter the First Mts, Vanch Mts, Karateginian Mts and Hissar Mts) as well as western Tian Shan.
Habitat characteristics: As a result of shrubland clearing or overgrazing, the species forms lush and species-rich grasslands with high biomass. These occur at an elevation of about 2,100–3,300 m a.s.l.

NEP-AAc09. Community of *Patrinia intermedia* and *Salvia bucharica* (subalpine and montane scree vegetation of the Pamir-Alai and western Tian Shan Mts) (Fig. 58)

Diagnostic species: *Patrinia intermedia, Salvia bucharica.*
Constant species: *Patrinia intermedia, Salvia bucharica.*

Fig. 57. *Semenovia dasycarpa* forming a community near Poymazor, Vanch River Valley, Western Pamir-Alai Mts, Tajikistan (ca. 3,650 m a.s.l.). Photo: A. Nowak.

Fig. 58. Southern slopes of Turkestan Mts covered by the community of *Salvia bucharica*, near Gusar, Tajikistan (ca. 1,350 m a.s.l.). Photo: M. Nobis.

Geographical range: This heterogeneous community has its range in the whole Middle and Central Asia, however, *Salvia bucharica* covers the southern part (including Tajikistan and the Hindu Kush), while *Patrinia intermedia* inhabits the Alai Mts, Tian Shan, Altai, Sayan and southern Siberian Mts (Kochkareva 1986). This vegetation grows mainly in the montane belt from 800 to 2,400 m a.s.l. (Ovchinnikov 1975).
Habitat characteristics: This vegetation develops in the transitional zone between thermophilous steppes and rupiculous scree vegetation. It inhabits slopes with a high organic matter content in the substrates, often gravelly in the outer layer, in the warm zone of the montane belt of Middle Asia. The final classification of this steppe-like, rupiculous community requires further research.

NEP-AB. *Artemision dracunculi* Nowak, Świerszcz, Nobis, Swacha et S. Nowak in Świerszcz et al. 2023 (mesophilous steppic pastures of the upper montane to subalpine belts in the Pamir-Alai Mts) (Fig. 59)

Diagnostic species: *Achillea millefolium, Artemisia dracunculus, Bromus inermis, Carex turkestanica, Festuca valesiaca, Galium pamiroalaicum, Geranium regelii, Onobrychis arenaria, Phleum pratense, Potentilla asiatica, Stachys betoniciflora, Stipa capillata.*
Constant species: *Artemisia dracunculus, Carex turkestanica, Festuca valesiaca, Galium pamiroalaicum, Geranium regelii, Myosotis asiatica.*
Geographical range: Middle and Central Asia.
Habitat characteristics: The communities of this alliance develop in relatively humid habitats with a well-developed soil profile, most often in river and stream valleys of the Tian Shan and Pamir-Alai Mts. These communities develop in flat areas on mountain slopes with an inclination of approx. 5–45° and additionally

Fig. 59. Anthropogenic grassland dominated by *Onobrychis viciifolia* representing the *Artemision dracunculi* alliance near Cholok-Kaiylyn, Fergana Mts, Kyrgyzstan (ca. 1,950 m a.s.l.). Photo: A. Nowak.

on mountain tops and passes at an elevation of approx. 1,900–3,500 m a.s.l. (Swacha et al. 2023).

NEP-AB01. *Erigeronto seravschanici-Eremuretum hissarici* Nowak, Świerszcz, Nobis, Swacha et S. Nowak in Świerszcz et al. 2023 (mesophilous steppic forbs of the subalpine belt of the Zeravshan and the Hissar Mts, used as intensive pastures) (Fig. 60)

Diagnostic species: *Agrostis canina, Astragalus corydalinus, Campanula glomerata, Eremurus hissaricus, Hypericum scabrum, Iris hoogiana, Rumex paulsenianus.*

Constant species: *Aconogonon coriarium, Artemisia dracunculus, Astragalus corydalinus, Eremurus hissaricus, Erigeron seravschanicus, Euphorbia sarawschanica, Geranium regelii, Hypericum scabrum, Ligularia thomsonii, Nepeta podostachys, Pedicularis krylowii, Petrorhagia alpina, Poa bucharica, P. fragilis, Rumex paulsenianus.*

Geographical range: *Eremurus hissaricus* is an endemic plant of Tajikistan occuring in the western Pamir-Alai. It inhabits rupicolous and mesic slopes, at elevation of 2,000–3,000 m a.s.l (Ovchinnikov 1963). *Erigeron seravschanicus* has a wider distribution than the previous species, covering Middle Asian countries and Xinjiang (Kinzikaeva 1988; POWO 2023). Most of the *Erigeronto seravschanici-Eremuretum hissarici* stands were found on the slopes around the Anzob Pass in the Hissar Mts. The association was also recorded in the Fann Mts on the slopes of the Imat Valley and near Sarytag at elevations between 2,500 and 3,100 m a.s.l. (Świerszcz et al. 2023).

Fig. 60. Grazed grassland of the *Erigeronto seravschanici-Eremuretum hissarici* association found near Anzob Pass, Hissar Mts, Tajikistan (ca. 3,250 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: It seems to be indifferent to exposure, but often occurs on south-western, northern and northeastern aspects. The inclination of the slopes ranges from 15° to 35° (Świerszcz et al. 2023).

NEP-AB02. *Onobrychido arenariae-Stachyetum betoniciformae* Swacha, Świerszcz, Nowak, Nobis et A. Nowak 2023 nom. corr. (mesophilous steppic meadows of the western Tian Shan and northern Pamir-Alai Mts in Middle Asia) (Fig. 61)

Diagnostic species: *Achillea millefolium, Artemisia dracunculus, Bromus inermis, Carex turkestanica, Festuca valesiaca, Galium pamiroalaicum, Geranium regelii, Onobrychis arenaria, Phleum pratense, Potentilla asiatica, Stachys betoniciforma, Stipa capillata.*

Constant species: *Carex turkestanica, Festuca valesiaca, Galium pamiroalaicum, Geranium regelii, Myosotis asiatica.*

Geographical range: The association of *Onobrychideto arenariae-Stachyetum betoniciformae* has a wide distribution range in Kyrgyzstan. It has been recorded from every mountain range except the At-Bashy Range in southern Kyrgyzstan (Swacha et al. 2023).

Habitat characteristics: It develops over a wide range of elevation from 1,850 to 3,450 m a.s.l. (Swacha et al. 2023).

NEP-ABc01. Community of *Dracocephalum formosum* (upper montane low forb steppe of the western Pamir-Alai Mts) (Fig. 62)

Diagnostic species: *Alchemilla hissarica, Allium weschniakowii, Carex stenophylla* subsp.

Fig. 61. Patch of forb-rich meadows of the *Onobrychideto arenariae-Stachyetum betoniciformae* association found between Aral and Jalalabad, Fergana Mts, Kyrgyzstan (ca. 1,950 m a.s.l.). Photo: A. Nowak.

Fig. 62. Vegetation of the community of *Dracocephalum formosum* found in the Mura River Valley, Hissar Mts, Tajikistan (ca. 2,750 m a.s.l.). Photo: A. Nowak.

Fig. 63. Vegetation of the *Allium giganteum* community found in Sari-Khosor National Park near Khosh-Ob, Vakhsh Range, Tajikistan (ca. 1,950 m a.s.l.). Photo: A. Nowak.

stenophylloides, Dracocephalum formosum, Myosotis cespitosa.

Constant species: *Alchemilla hissarica, Allium weschniakowii, Artemisia dracunculus, Carex stenophylla* subsp. *stenophylloides, Dracocephalum formosum, Gentiana olivieri, Geranium collinum, Koeleria pyramidata, Ligularia thomsonii, Medicago lupulina, Myosotis cespitosa, Pedicularis verae, Petrorhagia alpina, Potentilla asiae-mediae.*

Geographical range: This community was rarely recorded in the Fann Mts near Sarytag at an elevation of about 2,660 m a.s.l., within the range of the main diagnostic species *Dracocephalum formosum*, a Middle Asian narrow endemic plant limited to western Tajikistan (Kochkareva 1986; POWO 2023).

Habitat characteristics: It grows in gaps within juniper stands (Świerszcz et al. 2023).

NEP-ABc02. Community of *Allium giganteum* (*Allium giganteum* stands on humid and fertile habitats in Middle Asia) (Fig. 63)

Diagnostic species: *Allium giganteum, Barbarea vulgaris* subsp. *arcuata, Corydalis darwasica, Lamium album, Silene vulgaris, Solenanthus circinnatus, Thermopsis alpina.*

Constant species: *Aconogonon coriarium, Allium giganteum, Asyneuma argutum, Elaeosticta hirtula, Lamium album, Nepeta podostachys, Pedicularis krylowii, Phlomoides lehmanniana, Poa bulbosa, P. pratensis, Prangos pabularia, Rumex paulsenianus, Silene vulgaris, Solenanthus circinnatus, Thermopsis alpina.*

Geographical range: The patches of the community dominated by *Allium giganteum*, a species native to Tajikistan, Turkmenistan, Uzbekistan, Afghanistan and Iran, were recorded in the southwestern Pamir-Alai and Kopet-Dagh (Ovchinnikov 1963; POWO 2023).

Habitat characteristics: They form relatively homogeneous stands dominated by *Allium giganteum*, which prefers wet and fertile habitats and occurs on well-watered slopes near the village of Kosh-Ob (Świerszcz et al. 2023).

NEP-ABc03. Community of *Adonis turkestanica* (intensively grazed pastures of the subalpine belt in Middle Asia) (Fig. 64)

Diagnostic species: *Adonis turkestanica.*
Constant species: *Adonis turkestanica*, *Lagotis korolkowii.*
Geographical range: This community occurs mainly in the western Pamir-Alai in eastern Uzbekistan and western Tajikistan, and in the Peter the First Mts and Darvaz Mts in central Tajikistan.
Habitat characteristics: The community is a typical pasture with an intensive grazing system. Its occurrence optimum is in the alpine belt at an elevation of 2,300–3,500 m a.s.l.

NEP-ABc04. Community of *Chorispora sibirica* (intensively grazed nitrophilous pastures of the subalpine belt in Middle Asia) (Fig. 65)

Diagnostic species: *Chorispora sibirica.*
Constant species: *Chorispora sibirica.*
Geographical range: This community occurs in Central Asia, Southern Siberia, the Karakoram and the Hindu Kush Mts.
Habitat characteristics: *Chorispora sibirica* often forms extensive and species-poor mats in high mountain pastures or river valleys at elevation of 1,000–3,800 m a.s.l. It is often found in anthropogenic habitats such as roadsides, embankments or ditches.

NEP-ABc05. Community of *Crocus korolkowii* (intensively grazed grasslands of the subalpine and alpine belts in Middle Asia) (Fig. 66)

Diagnostic species: *Crocus korolkowii.*
Constant species: *Crocus korolkowii.*
Geographical range: This community has its range in the western Pamir-Alai and Hindu Kush Mts.
Habitat characteristics: *Crocus korolkowii* often forms large mats in river valley bottoms at montane elevations between 1,000 and 2,000 m a.s.l. It also inhabits pastures and shrublands on the slopes

Fig. 64. Community of *Adonis turkestanica* in the Saminie River Valley near Sarytag settlement., northern Hissar Mts, Tajikistan (ca. 2,700 m a.s.l.). Photo: M. Nobis.

Fig. 65. Intensively grazed grassland of the *Chorispora sibirica* community found near Chagyr, Alai Mts, Kyrgyzstan (ca. 2,600 m a.s.l.). Photo: A. Nowak.

Fig. 66. Grassland of the *Crocus korolkowii* community found in the bottom of Varzob River Valley near Majhura, Hissar Mts, Tajikistan (ca. 1,850 m a.s.l.). Photo: A. Nowak.

of the Hissar, Karateginian, Aktau and Babatag Mts (Ovchinnikov 1963).

NEP-ABc06. Community of *Eremurus regelii* (intensively grazed subalpine vegetation in the northern Pamir-Alai and western Tian Shan Mts) (Fig. 67)

Diagnostic species: *Eremurus regelii.*
Constant species: *Eremurus regelii.*
Geographical range: The forb steppe of *Eremurus regelii* has its range in the western Pamir-Alai and the western Tian Shan Mts.
Habitat characteristics: This vegetation inhabits gravelly slopes in the montane to alpine belts at elevations between ca. 1,000 and 3,000 m a.s.l. (Ovchinnikov 1963).

NEP-ABc07. Community of *Allium hymenorhizum* (subalpine and alpine dried up forb vegetation of Middle and Central Asia) (Fig. 68)

Diagnostic species: *Allium hymenorhizum, Lomatocarpa albomarginata, Angelica ternata, Asperula pamirica, Astragalus saratagius, A. skorniakowii, Asyneuma argutum, Cousinia outichaschensis, C. pannosa, Eremogone griffithii, Euphorbia jaxartica, Ferula ovina, Gypsophila cephalotes, Nepeta podostachys, Pedicularis grigorjevii, Phlomoides seravschanica, Polygonum coriarium, Rosa divina.*
Constant species: *Allium hymenorhizum, Eremogone griffithii, Nepeta podostachys, Pedicularis grigorjevii, Polygonum coriarium.*
Geographical range: Patches of this vegetation have been found in the alpine belt at an elevation of ca. 2,800 m a.s.l. (Nowak et al. 2020b).
Habitat characteristics: The stands of *Allium hymenorhizum* occur in different habitats in terms of environmental conditions, particularly humidity. It prefers organic, well-watered soils, sometimes in contact with typical fens, but generally inhabits slopes with typical tall-forb, meadow-like or grassy vegetation across the whole Tajikistan. It inhabits gentle slopes with 5° to 15° inclination and northern exposure (Nowak et al. 2020b).

Fig. 67. Forb steppe with *Eremurus regelii* in the Imat Valley, Fann Mts, Tajikistan (ca. 2,680 m a.s.l.). Photo: A. Nowak.

Fig. 68. Forb vegetation dominated by *Allium hymenorhizum* and developed near Sary-Tash, Alai Valley, Kyrgyzstan (ca. 3,550 m a.s.l.). Photo: A. Nowak.

Fig. 69. Forb pasture vegetation with *Phlomoides pratensis* developed on gentle slopes near Naryn, Kyrgyzstan (ca. 2,300 m a.s.l.). Photo: A. Nowak.

NEP-ABc08. Community of *Phlomoides pratensis* (montane to subalpine forb steppe vegetation of the Tian Shan Mts) (Fig. 69)

Diagnostic species: *Phlomoides pratensis*
Constant species: *Phlomoides pratensis*
Geographical range: Patches of this vegetation have been found in the upper montane belt at an elevation of ca. 2,300 m a.s.l. in Central Kyrgyzstan near Naryn.
Habitat characteristics: The stands of *Phlomoides pratensis* occur in intensively used pastures on gentle slopes with mesic substrate conditions.

The riverside group

NEP-AB03. *Heracleetum lehmannianii* Nowak, Świerszcz, S. Nowak et Nobis 2021 (riverside alpine fringe vegetation of Middle Asia) (Fig. 70)

Diagnostic species: *Allium elatum, Carum carvi, Cousinia pseudarctium, Cynoglossum viridiflorum, Dactylis glomerata, Euphorbia lamprocarpa, Heracleum lehmannianum, Mentha asiatica, Poa pratensis, Ranunculus brevirostris, Trifolium pratense.*
Constant species: *Cousinia pseudarctium, Heracleum lehmannianum.*
Geographical range: This distinct association is formed by the endemic to Middle Asia *Heracleum lehmannianum*, which is distributed throughout the Pamir-Alai and western Tian Shan. The phytocoenosis has a fairly wide elevational amplitude across the montane and alpine belts, inhabiting the range between 1,500 and 3,500 m a.s.l. (Nowak et al. 2020c). The vegetation has been recorded in the Zeravshan, Hissar, Hazratishokh and Western Pamir ranges (Nowak et al. 2020b).
Habitat characteristics: *Heracleetum lehmannianii* mainly occurs along mountain rivers

Fig. 70. Tall-forb vegetation of the *Heracleetum lehmannianii* association found near Marguzor Lake, Haft Kul, Fann Mts, Tajikistan (ca. 2,150 m a.s.l.). Photo: A. Nowak.

Fig. 71. Grassland dominated by *Ligularia heterophylla* in the Karakol River Valley, Kyrgyz Mts, Kyrgyzstan (ca. 2,350 m a.s.l.). Photo: A. Nowak.

Fig. 72. Grassland dominated by *Ligularia talassica* in the Aksu-Zhabagly National Park , Ulken-Kaundy Valley, Kazakhstan (ca. 2,600 m a.s.l.). Photo: A. Nowak.

and streams, rarely inhabiting water outflows on slopes. The association prefers deep, well-drained soils with a small gravel component. Patches of this vegetation inhabit mainly flat land, but sometimes they can be found on relatively steep slopes, up to 30° (mean approx. 15°), where it prefers northern aspects (Nowak et al. 2020b).

NEP-ABc08. Community of *Ligularia heterophylla* (subalpine to alpine intensively grazed grassland of river valley bottoms in Middle Asia) (Fig. 71)

Diagnostic species: *Ligularia heterophylla.*
Constant species: *Ligularia heterophylla.*
Geographical range: Subalpine and alpine belts in the Pamir-Alai and Tian Shan Mts.
Habitat characteristics: This type of vegetation mainly inhabits river and mountain stream valleys at alpine elevations at approx. 2,000–3,400 m a.s.l. It forms dense stands on valley slopes, maintaining its physiognomy throughout the growing season because it is not eaten by livestock.

NEP-ABc09. Community of *Ligularia talassica* (subalpine to alpine grazed grassland of gentle slopes in the Tian Shan Mts, Kyrgyzstan) (Fig. 72)

Diagnostic species: *Ligularia talassica.*
Constant species: *Ligularia talassica.*
Geographical range: Subalpine and alpine belts in the western Tian Shan Mts.
Habitat characteristics: Dense stands of *Ligularia talassica* inhabit gentle slopes in the alpine valley of the Talas Alatoo Mts. It occurs at an elevation of approx. 1,800–3,300 m a.s.l.

Mountain steppes of semi-arid to subhumid areas of Central Asia

Mountain steppes of semi-arid to subhumid areas of the northern Middle and Central Asia

CLE. *Cleistogenetea squarrosae* Mirkin et al. ex Korotkov, Morozova et Belonovskaja 1991

CLE-A. *Stipetalia krylovii* Kononov, Gogoleva et Mironova 1985 nom. inval. (montane to subalpine steppes of subhumid to semi-arid zones of the northern Middle and Central Asia) (Fig. 73)

This extensive typical steppe vegetation covers a vast area from the Azov, Don and Volga river Valleys through all of Kazakhstan, Central Asia, Mongolia to northern China. In Middle Asia, this type of steppe vegetation reaches its southern limits, with a larger area of occurrence in northern Kyrgyzstan and mainly in Kazakhstan.

CLE-AA. *Stipion krylovii* Kononov, Gogoleva et Mironova 1985 nom. inval. (montane to subalpine steppes of the zone of the northern Middle and Central Asia)

This vegetation covers a vast grassland of the eastern part of the steppe zone from Middle Asia, through Central Asia, Mongolia, southern Siberia up to the Yablonovyi and Stanovoy mountain ranges in the Russian Far East.

CLE-AA01. *Astragalo lithophili-Stipetum zalesskii* Nowak, Nobis, S. Nowak et M. Nobis 2018 (mesic, species-rich, cryophilous steppe of the western Tian Shan Mts) (Fig. 74)

Diagnostic species: *Artemisia dracunculus, A. maracandica, Astragalus lithophilus, A. mucidus, Eremurus fuscus, Erysimum diffusum, Euphrasia regelii, Festuca valesiaca, Helichrysum maracandicum, Pedicularis olgae, Poa pratensis, Potentilla canescens, Pseudosedum condensatum, Stipa capillata, S. zalesskii, Thymus proximus.*

Fig. 73. Steppe dominated by *Stipa krylovii* near Kongurlen, Issyk-kul District, Kyrgyzstan (ca. 2,000 m a.s.l.). Photo: M. Nobis.

Fig. 74. Cryophilous steppe of the *Astragalo lithophili-Stipetum zalesskii* association found in the Suusamyr Valley, Kyrgyzstan (ca. 2,350 m a.s.l.). Photo: A. Nowak.

Fig. 75. Steppe of the *Littledaleo alaicae-Stipetum trichoidis* association found near Sary-Tash, Alai Valley, Kyrgyzstan (ca. 3,050 m a.s.l.). Photo: M. Nobis.

Constant species: *Artemisia dracunculus, Erysimum diffusum, Euphrasia regelii, Festuca valesiaca, Stipa capillata, S. zalesskii.*
Geographical range: Plant communities dominated by *Stipa zalesskii* were found at several locations in the central Tian Shan, mainly in the hilly areas of the Suusamyr Valley. They occur at alpine altitudes on flat or slightly sloping sites (Nowak et al. 2018).
Habitat characteristics: Phytocoenoses grow on well-developed soils with an inconsiderable amount of gravel debris in the upper layer. This is the densest and most forage-efficient steppe type in the research area (Nowak et al. 2018).

CLE-AA02. *Littledaleo alaicae-Stipetum trichoidis* Nowak, Nobis, S. Nowak et M. Nobis 2018

(mesic cryophilous steppe of the subhumid zone in the northern Pamir-Alai Mts) (Fig. 75)

Diagnostic species: *Artemisia sieversiana, Astragalus kokandensis, Festuca rupicola, Littledalea alaica, Galium tianschanicum, Stipa trichoides.*
Constant species: *Carex turkestanica, Stipa trichoides.*
Geographical range: This grassland vegetation develops at high elevations in the alpine belt of the Alai Mts in Kyrgyzstan (Nowak et al. 2018). It was also spotted on the grazed highlands of the Peter the First Mts in Tajikistan.
Habitat characteristics: *Littledaleo alaicae-Stipetum trichoidis* is a typical alpine sparse grassland used for grazing. The association inhabits mainly flat areas with the physiognomy of grassy steppe. *Littledaleo alaicae-Stipetum trichoidis* prefers sites with a well-developed organic soil layer and little gravel debris (Nowak et al. 2018).

CLE-AA03. *Helictotricho fedtschenkoi-Stipetum kirghisori* Nowak, Nobis, S. Nowak et M. No-

Fig. 76. Steppe of the *Helictotricho fedtschenkoi-Stipetum kirghisori* association found near Sary-Tash, Alai Valley, Kazakhstan (ca. 3,050 m a.s.l.). Photo: M. Nobis.

bis 2018 (mesic steppe of the subhumid zone in the western Tian Shan Mts) (Fig. 76)

Diagnostic species: *Artemisia pamirica, Festuca valesiaca, Helictotrichon fedtschenkoi, Leontopodium ochroleucum, Stipa kirghisorum.*
Constant species: *Carex turkestanica, Festuca valesiaca, Stipa kirghisorum.*
Geographical range: This association was found in the Suusamyr and Alai Valleys of the central Tian Shan and the eastern Alai Mts in Kyrgyzstan (Nowak et al. 2018).
Habitat characteristics: The phytocoenoses prefer habitats with a well-developed topsoil layer and a low content of gravel debris (Nowak et al. 2018).

CLE-AA04. *Stipetum kazachstanicae* Nobis, Klichowska et Nowak in A. Nowak et al. 2024 (mesic steppe of the colline to montane belts of the central and eastern Tian Shan Mts) (Fig. 77)

Diagnostic species: *Centaurea ruthenica*, *Gypsophila patrinii*, *Stipa macroglossa* subsp. *kazachstanica*, *Erysimum diffusum*, *Potentilla recta.*
Constant species: *Centaurea ruthenica*, *Eremopyrum bonaepartis*, *Erysimum diffusum*, *Stipa macroglossa* subsp. *kazachstanica*, *Erysimum diffusum*, *Potentilla recta, Ziziphora clinopodioides.*
Geographical range: This association has been found in south-eastern Kazakhstan and north-eastern part of Kyrgyzstan, within the range of the nominal species *Stipa macroglossa* subsp. *kazachstanica* (Nobis et al. 2020). Larger areas of this steppe are found in eastern Kazakhstan. It occurs in the colline and montane belts of the central and eastern Tian Shan (Nowak et al. 2024b).
Habitat characteristics: Phytocoenoses prefer habitats with a well-developed topsoil layer and a low content of gravel debris. It is a typical Central Asian grassland that covers an extensive area in the northern foothills of the Tian Shan

Fig. 77. Steppe of the *Stipetum kazachstanicae* association found on a hill near Sary-Tologoy, Issyk-kul District, Kyrgyzstan (ca. 1,950 m a.s.l.). Photo: M. Nobis.

at about 1,500–2,500 m a.s.l. It is moderately species-rich, with an average of about 30 taxa in a 10 m^2 plot (Nowak et al. 2024b).

CLE-AAc01. Community of *Stipa sareptana* (continental steppe grasslands of lowlands and the colline belt in northern Middle and Central Asia and southern Siberia) (Fig. 78)

In contrast to the former association, this community has its main range in the western and central part of the Asian steppe zone. It reaches its eastern limit in Middle Asia. Plots of this steppe type have been found in the Naryn River Valley in Kyrgyzstan. It prefers dry, semi-arid habitats in the colline and montane belts at an elevation of about 1,000–2,200 m a.s.l.

CLE-AAc02. Community of *Stipa lessingiana* (continental steppe grasslands of lowlands and the colline belt of the north-western Irano-Turanian Region) (Fig. 79)

This is the most westerly type of the steppe, with its centre of distribution in the area around Azov See, and the valleys of Don and Volga rivers. It was described from Romania as *Jurineo arachnoideae-Stipetum lessingianae* (Dobrescu 1974) Chifu, Mânzu et Zamfirescu 2006 (Chirilă 2021) and included in the dry grasslands of *Festuco-Brometea*. Similarly, in Ukraine, the *S. lessingiana* grasslands are a part of the *Stipo lessingianae-Salvion nutantis* Vynokurov 2014 alliance (with the association *Bellevalio-Stipetum lessingianae* Vakarenko 1997; Vynokurov 2019). *Stipa lessingiana* has its eastern limits in northern Middle Asia and in Central Asia in Kazakhstan, but the syntaxonomic status requires detailed investigation.

CLE-AAc03. Community of *Stipa capillata* (steppe of lowlands and the colline belts of the northern Middle Asia, Central Asia and southern Siberia) (Fig. 80)

Fig. 78. Steppe with *Stipa sareptana* in the Naryn River Valley, Kyrgyzstan (ca. 1,950 m a.s.l.). Photo: A. Nowak.

Fig. 79. Steppe dominated by *Stipa lessingiana*, NW of Almaty, Kazakhstan (ca. 600 m a.s.l.). Photo: M. Nobis.

Fig. 80. Steppe dominated by *Stipa capillata* in the Suusamyr Valley, Kyrgyz Mts, Kyrgyzstan (ca. 2,300 m a.s.l.). Photo: A. Nowak.

The steppe dominated by *Stipa capillata* is widespread throughout the Eurasian steppe zone. In Middle Asia it reaches the Pamir-Alai and the Hindu Kush Mts. It does not form vast grasslands here, but rather small patches within the open juniper woodlands in tree stand gaps. We have found several small patches of this community, but further detailed phytosociological studies of grassland vegetation are needed.

Semi-arid group

CLE-AA05. *Stipetum bungeanae* Nowak, Nobis, S. Nowak et M. Nobis 2018 (steppe grasslands of the semi-arid zone in the montane belt of the western Tian Shan Mts) (Fig. 81)

Diagnostic species: *Artemisia kuschakewiczii, Peganum harmala, Plantago minuta, Salsola drobovii, S. orientalis, Stipa bungeana, S. glareosa, Trigonella arcuata.*

Constant species: *Artemisia kuschakewiczii, Stipa bungeana, S. glareosa.*

Geographical range: *Stipetum bungeanae* has been found in the upper montane belt on gentle slopes at approx. 1,400–1,900 m a.s.l. It prefers dry, moderately or strongly compacted soils in the arid areas of the central Tian Shan. The largest patches of this association have been recorded in the area of Lake Issyk-kul (Nowak et al. 2018), where the nominal species reaches the westernmost limit of its general distribution (Baiakhmetov et al. 2020; Nobis et al. 2020).

Habitat characteristics: In this area, the soil is almost devoid of organic matter and is covered by tiny rocky debris and gravel. It is windswept and resembles a smooth, sometimes densely packed pavement typical of semi-desert conditions (Nowak et al. 2018).

CLE-AAc04. Community of *Astracantha pterocephala-Dracocephalum bipinnatum* (xerophytic

Fig. 81. Arid steppe of the *Stipetum bungeanae* association found near Tamchy, northern shore of the Issyk-kul Lake, Kyrgyzstan (ca. 1,700 m a.s.l.). Photo: M. Nobis.

Fig. 82. Vegetation of the *Astracantha pterocephala-Dracocephalum bipinnatum* community growing on gravel slope near Kyzyl-Korgon, Alai Mts, Kyrgyzstan (ca. 1,720 m a.s.l.). Photo: A. Nowak.

Fig. 83. Steppe of the *Stipa krylovii-Stipa breviflora* community near Bokonbayev, Issyk-kul District, Kyrgyzstan (ca. 1,970 m a.s.l.). Photo: A. Nowak.

steppe grasslands in the western Tian Shan Mts) (Fig. 82)

Diagnostic species: *Allium pallasii, Astracantha pterocephala, Dracocephalum bipinnatum, Elaeosticta ferganensis, Hedysarum pavlovii, Jurinea abolinii, Melica secunda, Patrinia intermedia, Rosularia borissovae, Ziziphora clinopodioides.*
Constant species: *Artemisia rutifolia, Dracocephalum bipinnatum, Ziziphora clinopodioides.*
Geographical range: This community occurs in eastern Kyrgyzstan within the colline belt near the eastern side of the Issyk-kul Lake and around Osh in the foothills of the Alai Mts (Nowak et al. 2018).
Habitat characteristics: Among the presented plant communities, this one is the most scree-like, with a low cover of organic topsoil and a considerable amount of gravel and rock debris on the ground (Nowak et al. 2018).

CLE-AAc05. Community of *Stipa krylovii-Stipa breviflora* (xerophytic steppes in lowland to colline belts of the Central and Eastern Asia) (Fig. 83)

Diagnostic species: *Achnatherum splendens, Allium veschnjakovii, Agropyron cristatum, Artemisia hedinii, Chenopodium aristatum, Cleistogenes squarrosa, Heteropappus canescens, Stipa breviflora, S. krylovii, Torularia korolkovii.*
Constant species: *Achnatherum splendens, Heteropappus canescens, Stipa breviflora, Stipa krylovii.*
Geographical range: A number of plots of this community were recorded on the southern slopes and plains of the Issyk-kul Basin and in the Naryn Valley at elevations of approx. 1,200–1,950 m a.s.l. (Nowak et al. 2018).
Habitat characteristics: Plots with domination of *Stipa breviflora* and *S. krylovii* occur on gentle slopes or flat land with a high amount of organic matter, with little gravel debris or sand in the topsoil layer (Nowak et al. 2018).

Dry, thermophilous steppes of the montane and subalpine belts of Middle Asia

Dry, thermophilous steppes of montane and subalpine belts of Middle Asia

AST. *Artemisio persicae-Stipetea drobovii* Nowak, Świerszcz, S. Nowak, Nobis et M. Nobis in A. Nowak et al. 2024 (Fig. 84)

This class includes thermophilous steppes on summer-dry, often stony slopes in the montane and subalpine belts of the Middle Asian Mts. In Tajikistan, this steppe is common in the Zeravshan, Turkestan, Kuraminian, Karateginian and Peter the First Mts. Also, it occurs on the driest slopes of the Hissar, Hazratishokh and Darvaz Mts. However, since the distribution ranges of the diagnostic species of this class are typically Irano-Turanian, this vegetation is thought to occur in the vast areas of the western Irano-Turanian geobotanical region. Plots of this vegetation were sampled in all mountain types, from the foothills to the upper montane belt. In Tajikistan, they were mainly found at an elevation of 1,300–2,500 m a.s.l. This type of steppe is moderately species-rich compared to other types of steppe vegetation, with an average of about 20 species per plot (Nowak et al. 2024b).

AST-A. *Carici stenophylloidis-Stipetalia drobovii* Nowak, Świerszcz, S. Nowak, Nobis et M. Nobis 2024 (thermophilous steppes of montane and subalpine belt of western Middle Asia) (Fig. 85)

This order includes thermophilous steppes on summer-dry, often gravelly slopes in the western Pamir-Alai Mts. It extends in the montane and subalpine belts of the Zeravshan, Turkestan, Hissar, Kuraminian, Hazratishokh, Karateginian and Peter the First Mts. However, as the range of diagnostic species of this order is typically Irano-Turanian, it probably covers extensive areas of the western Irano-Turanian geobotanical region. This vegetation has been observed at elevation between 1,300 and 2,700 m a.s.l. (Nowak et al. 2024b).

Fig. 84. Steppe with *Stipa arabica* representing the *Artemisio persicae-Stipetea drobovii* class, developed in the Zeravshan River Valley near Ayni, Tajikistan (ca. 1,550 m a.s.l.). Photo: M. Nobis.

Fig. 85. Steppe with *Stipa macroglossa* located near Sarytag, Zeravshan Mts, Tajikistan (ca. 2,500 m a.s.l.). Photo: M. Nobis.

Fig. 86. Thermophilous steppe with *Prangos zeravshanica* and *Artemisia glanduligera* near Urmetan, Zeravshan River Valley, Tajikistan (ca. 1,290 m a.s.l.). Photo: A. Nowak.

AST-AA. *Poo bulbosae-Artemision persicae* Nowak, S. Nowak, Nobis et M. Nobis 2016 (thermophilous steppes on rupicolous habitats of montane and subalpine belts of the western Pamir-Alai Mts) (Fig. 86)

Diagnostic species: *Bromus danthoniae, Cousinia mulgediifolia, Glaucium elegans, Meniocus linifolius, Piptatherum songaricum, Poa bulbosa, Stipa arabica, Trigonella orthoceras.*
Constant species: *Alyssum desertorum, Artemisia ferganensis, A. persica, Carex stenophylloides, Festuca valesiaca, Centaurea squarrosa, Cousinia mulgediifolia, Oxytropis capusii, Poa bulbosa, Veronica intercedens.*
Geographical range: This alliance groups phytocoenoses of the Middle Asian steppes occurring in several mountain ranges of the Pamir-Alai and Tian Shan Mts. In Tajikistan, it was recorded mainly from the Zeravshan, Hissar, Hazratishokh, Darvaz, Turkestan, Peter the First and Karateginian Mts (Nowak et al. 2016a).

Habitat characteristics: The phytocoenoses of the *Poo bulbosae-Artemision persicae* alliance were observed in different mountain types in terms of land relief (Nowak et al. 2016a).

AST-AA01. *Stipetum drobovii* Nowak, S. Nowak, Nobis et M. Nobis 2016 (subalpine steppe on the gravely slopes of the western Pamir-Alai Mts) (Fig. 87)

Diagnostic species: *Stipa drobovii* var. *drobovii, S. drobovii* var. *iskanderkulica, Artemisia porrecta.*
Constant species: *Artemisia porrecta, A. persica, Stipa drobovii* var. *drobovii, S. drobovii* var. *iskanderkulica, Veronica intercedens.*
Geographical range: The stands of *Stipetum drobovii* have been documented in a number of localities, mainly in the central part of the Zeravshan and Turkestan ranges (Nobis et al. 2020). It occupies relatively high elevations from 1,350 to 2,250 m a.s.l., forming a low, not particular-

Fig. 87. Steppe of the *Stipetum drobovii* association inhabiting gravel slope near Iskander-kul Lake, Zeravshan Mts, Tajikistan (ca. 2,250 m a.s.l.). Photo: A. Nowak.

ly dense vegetation inclose contact with alpine scree phytocoenoses and semi-deserts (Nowak et al. 2016a).

Habitat characteristics: Stands with *Stipa drobovii* were found on gentle, fairly stabilised slopes with an inclination of 0°–45° and generally with northern, southern and north-western exposures. This community is the most scree-like, with the lowest cover of organic top soils (mean cover ca. 10% per plot), with a considerable cover of fine-grained debris (1-11 cm in diameter) coming down from the scree (Nowak et al. 2016a).

AST-AA02. *Stipetum lipskyi* Nowak, S. Nowak, Nobis et M. Nobis 2016 (thermophilous, species rich montane steppe of the western Pamir-Alai and Tian Shan Mts) (Fig. 88)

Diagnostic species: *Aphanopleura capillifolia, Arnebia coerulea, Boissiera squarrosa, Chardinia orientalis, Eremopyrum bonaepartis, Stipa lipskyi, S. hohenackeriana, Taeniatherum crinitum, Vulpia persica, Ziziphora tenuior.*

Constant species: *Artemisia persica, Poa bulbosa, Stipa arabica, S. hohenackeriana, S. lipskyi, Vulpia persica, Ziziphora tenuior.*

Geographical range: *Stipetum lipskyi* is thought to occur in the montane belt of the western Pamir-Alai in Tajikistan and the western Tian Shan. The main diagnostic species is a Middle Asian endemic, occurring mainly in western Tajikistan, eastern Uzbekistan, south-western Kyrgyzstan and southern Kazakhstan (Nobis 2013; Nobis et al. 2020). Stands of this association have been recorded fairly frequently along the northern slopes of the Hissar Mts and the central parts of the Zeravshan and Turkestan Mts. The elevational range of the association is from approx. 1,100 to 1,700 (at the extreme 2,300) m a.s.l., mostly in the montane belt (Nowak et al. 2016a).

Habitat characteristics: The association of *Stipetum lipskyi* occurs on slopes with a considerable

Fig. 88. Vegetation of the *Stipetum lipskyi* inhabiting loess slope in the Veshan Valley, the Zeravshan Mts, Tajikistan (ca. 1,440 m a.s.l.). Photo: A. Nowak.

amount of organic matter and very little gravel. Plots of *Stipetum lipskyi* have been found on moderately sloping hills and mountains with an average slope of about 30°. This association prefers north and south-east exposure (Nowak et al. 2016a).

AST-AA03. *Stipetum jagnobicae* Nowak, S. Nowak, Nobis et M. Nobis 2016 (upper montane to subalpine thermophilous steppe of the Zeravshan Mts) (Fig. 89)

Diagnostic species: *Astragalus saratagius, Ceratocephala testiculata, Rochelia cardiosepala, Stipa richteriana* subsp. *jagnobica.*
Constant species: *Ceratocephala testiculata, Rochelia cardiosepala, Stipa richteriana* subsp. *jagnobica.*
Geographical range: Phytocoenoses of *Stipetum jagnobicae* have been found in the upper montane and alpine belts at elevation ranging from 1,700 to 2,450 m a.s.l. in the Zeravshan Mts and northern slopes of Hissar Mts (Nowak et al. 2016a; Nobis et al. 2020).

Habitat characteristics: The association includes plots on relatively gentle slopes with firm, stable surfaces. It develops on soils covered with a thin layer of organic matter and gravel debris of fine rock material. *Stipetum jagnobicae* generally occurs on northwestern aspects with a slope range of about 2°–40°. However, the association has also been observed on eastern, southern and western aspects (Nowak et al. 2016a).

AST-AA04. *Convolvuletum spiniferi* Nowak, Nobis, S. Nowak et M. Nobis 2018 (semi-arid, thermophilous steppes of the colline and lower montane belts of the northern Pamir-Alai and western Tian Shan Mts) (Fig. 90)

Diagnostic species: *Alyssum campestre, Artemisia persica, Bromus lanceolatus, Convolvulus spinifer, Eremurus sogdianus, Erysimum diffusum, Sanguisorba alpina, Scabiosa olivieri, Stipa drobovii* var. *iskanderkulica, Taeniatherum crinitum.*
Constant species: *Alyssum campestre, Artemisia persica, Bothriochloa ischaemum, Centaurea*

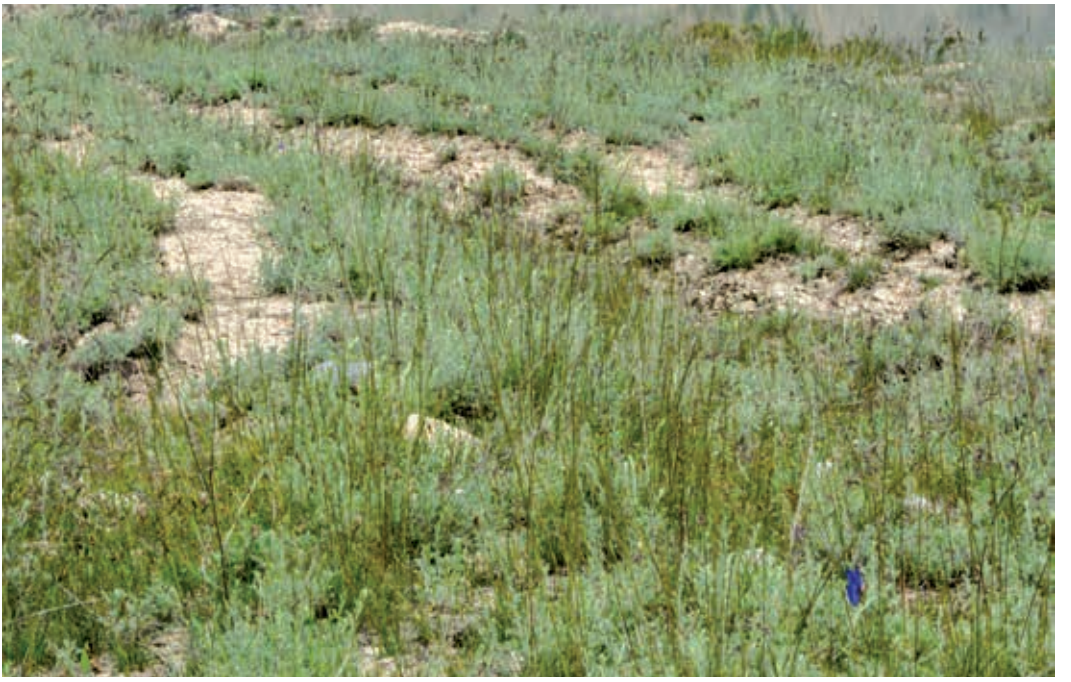


Fig. 89. Steppe of the *Stipetum jagnobicae* association found near Kshtut, Fann Mts, Tajikistan (ca. 1,950 m a.s.l.). Photo: M. Nobis.

squarrosa, Convolvulus spinifer, Taeniatherum crinitum.

Geographical range: *Convolvuletum spiniferi* was found rarely in the valleys of the Fergana Mts (e.g. Kara-kol vicinity) and in the western Alai Mts (near Kara-bulak) (Nowak et al. 2018).

Habitat characteristics: It occurs in the montane and colline belts in warm and relatively dry sites. The substrate is almost devoid of an organic soil layer and the ground is covered by stable rocky debris. In terms of the topsoil substrate conditions, these sites resemble scree habitats (Nowak et al. 2018).

AST-AA05. *Stipo magnificae-Otostegietum olgae* Nowak, Nobis, S. Nowak et M. Nobis 2018 (semi-arid, thermophilous steppes of the colline and lower montane belts of the western Tian Shan Mts) (Fig. 91)

Diagnostic species: *Aegilops cylindrica, Arnebia coerulea, Artemisia kochiiformis, Bromus danthoniae, Carthamus lanatus, Elytrigia ferganensis, Eremodaucus lehmannii, Glaucium squamigerum, Haplophyllum ferganicum, Otostegia olgae, Silene brahuica, Stipa arabica, S. hohenackeriana, S. magnifica, Strigosella trichocarpa, Ziziphora tenuior.*

Constant species: *Aegilops triuncialis, Artemisia kochiiformis, Centaurea squarrosa, Otostegia olgae, Stipa magnifica.*

Geographical range: Stands of this community occurred on the southern shores of the Toktogul Lake and in the colline belt of the central and western Alai Mts (Nowak et al. 2018; Nobis et al. 2020).

Habitat characteristics: Due to erosion and denudation, the organic soil is scarce and the substrate is loamy, deep, and often reddish in colour (Nowak et al. 2018).

AST-AA06. *Stipetum margelanicae* Nowak, S. Nowak, Nobis et M. Nobis 2016 corr. (thermophilous montane steppe of the northern Pamir-Alai Mts) (Fig. 92)

Fig. 90. Dwarf shrub steppe of the *Convolvuletum spiniferi* association found near Karakol, Kyrgyzstan (ca. 770 m a.s.l.). Photo: A. Nowak.

Fig. 91. Dwarf shrub steppe of the *Stipo magnificae-Otostegietum olgae* association found near Kok-Dzhetyk, Osh Region, Kyrgyzstan (ca. 1,050 m a.s.l.). Photo: A. Nowak.

Fig. 92. Montane steppe of the *Stipetum margelanicae* association found near Dzhaligan, Tajikistan (ca. 2,000 m a.s.l.). Photo: M. Nobis.

Diagnostic species: *Allium barsczewskii, Astragalus filicaulis, A. krauseanus, A. mucidus, Carex dimorphotheca, Cousinia mulgediifolia, Erysimum diffusum, Ferula violacea, Poa bulbosa, Scabiosa songarica, Stipa margelanica.*
Constant species: *Artemisia persica, Carex dimorphotheca, Poa bulbosa, Prangos pabularia, Scabiosa songarica, Stipa margelanica.*
Geographical range: This association was found in the northern Pamir-Alai (Nowak et al. 2016a; Nowak et al. 2020b; Nobis et al. 2020). It has been found in the alpine belt within an elevational range between 1,800 and 2,250 m a.s.l. in the Peter the First and Turkestanian Mts.
Habitat characteristics: Stands of this vegetation occupy gentle slopes in the upper montane belt (average about 15°) and have only been sporadically found on steeper slopes of up to 40°. It prefers south-eastern and eastern exposures (Nowak et al. 2020b).

AST-AA07. *Helianthemetum songarici* Nowak, Świerszcz, S. Nowak et Nobis 2021 (thermophilous steppe on fine debris scree-like slopes of the montane to subalpine belts in the western Pamir-Alai Mts) (Fig. 93)

Diagnostic species: *Allium setifolium, Allium weschniakowii, Alyssum linifolium* (= *Meniocus linifolius*), *Astragalus oxyglottis, Dracocephalum heterophyllum, Helianthemum songaricum, Koeleria macrantha* (= *Koeleria cristata), Salsola drobovii, S. gemmascens, Scorzonera pubescens, Stipa caucasica.*
Constant species: *Helianthemum songaricum, Stipa caucasica.*
Geographical range: *Helianthemetum songarici* is distributed across the alpine belt of the Pamir-Alai and western Tian Shan ranges, with additional occurrences in northeastern China and Mongolia (eFloras 2024). In Tajikistan and Kyrgyzstan this association has a considerable elevation range from about 1,500 to 2,800 m a.s.l. Plots of this association have been found in the Zeravshan, Turkestan, Fergana and Terskey Ala-Too ranges (Nowak et al. 2021c).

Fig. 93. Fine debris scree vegetation of the *Helianthemetum songarici* association found near Marzich, Hissar Mts, Kyrgyzstan (ca. 1,950 m a.s.l.). Photo: A. Nowak.

Fig. 94. Vegetation patch of the *Bromus tectorum-Stipa arabica* community found near Kara-Kabak, Alai Valley, Kyrgyzstan (ca. 2,700 m a.s.l.). Photo: M. Nobis.

Habitat characteristics: This vegetation occurs on gently sloping hills with sunny exposures. It occupies rather gentle slopes with a mean inclination of approx. 15° in the north-western and southern exposures. The substrate is predominantly alkaline rock, mainly limestone or dolomite. The tiny gravel fragments (about 1 cm in diameter) creep down and are mixed with clay and silt deposits with low soil content (Nowak et al. 2021c).

AST-AAc01. Community of *Bromus tectorum-Stipa arabica* (thermophilous steppes of the montane belt of Irano-Turanian Region) (Fig. 94)

Diagnostic species: *Bromus tectorum, Bunium intermedium, Eremopyrum distans, Jurinea olgae, Phlomoides desertorum, Stipa arabica, S. drobovii.*
Constant species: *Artemisia persica, Bromus tectorum, Eremopyrum distans, Glaucium elegans, Stipa arabica, S. drobovii.*

Geographical range: The community has been recorded mainly in the lower montane elevations of Tajikistan, possibly in the Zeravshan, Turkestan, Mogoltau, Alai and western Pamir Mts within the range of *Stipa arabica*. In Tajikistan, it was mainly recorded at an elevation of (1,000–) 1,500–1,700 m a.s.l. (Nowak et al. 2016a).
Habitat characteristics: Stands of this vegetation can be observed in different ranges, from the foothills to the subalpine belts, as well as in man-made habitats such as roadsides, escarpments and fallows (Nowak et al. 2016a).

AST-AAc02. Community of *Artemisia tenuisecta* (thermophilous mugwort steppe of the montane and subalpine belts of the western Pamir-Alai Mts) (Fig. 95)

This community inhabits a montane belt and occurs in gaps of the juniper open woods or slopes of the Zeravshan and Hissar Mts

Fig. 95. Thermophilous mugwort steppe of *Artemisia tenuisecta* near Ayni in Zeravshan Mts, Tajikistan (ca. 1,550 m a.s.l.). Photo: A. Nowak.

(Kinzikaeva 1988). This rupiculous steppe vegetation needs further research in the western Pamir-Alai and northern Hindu Kush to be well classified in the system of montane steppes of Middle Asia.

AST-AAc03. Community of *Stipa richteriana* (continental steppes of lowlands to montane belt of north-eastern Irano-Turanian Region; mainly Kazakhstan, north-western China) (Fig. 96)

This steppe community is distributed in Kazakhstan (Nobis et al. 2020; Gudkova et al. 2022). It forms vast grasslands mainly in the central and western part of the country, but the syntaxonomic status requires further investigation. The community develops on soils covered with a layer of organic matter and gravel remains of rock material. It usually occurs in flat or slightly sloping areas with variable exposure.

AST-AB. *Bassio prostratae-Artemision ferganensis* nom. prov. (lowland desert steppes and semi-deserts of eastern Irano-Turanian Region) (Fig. 97)

Diagnostic species (provisional): *Artemisia ferganensis, Bassia prostrata, Diarthron vesiculosum, Festuca orientalis, Filago paradoxa, Galium ghilanicum, Heliotropium ellipticum, Holosteum umbellatum* subsp. *glutinosum, Medicago monantha, Peganum harmala, Ziziphora tenuior, Vulpia persica*.
Geographical range: Lowlands and the colline belt of Fergana Valley, and plains and foothills of the Pamir-Alai in western Middle Asia (Uzbekistan, Kyrgyzstan and Tajikistan).
Habitat characteristics: This diffuse vegetation develops on gravelly, barren, rocky and sandy semi-deserts. It prefers elevation of about 380–1,250 m a.s.l. with scarce rainfall of about 150 mm per year. The arid steppes and semi-deserts that occur between

Fig. 96. Continental steppe of the *Stipa richteriana* community found to the west of Saryozek, Kazakhstan (ca. 1,040 m a.s.l). Photo: M. Nobis.

the Mogoltausian and Kuraminian Mts extend to the west, and probably this type of vegetation has a much wider distribution towards the Aral Sea, and the eastern limits in the Fergana Valley (Nowak et al. 2023).

AST-ABc01. Community of *Artemisia namanganica-Artemisia mogoltavica* (thermophilous mugwort steppe of the colline and montane belts of northern Pamir-Alai and the western Tian Shan Mts) (Fig. 98)

Diagnostic species: *Arenaria serpyllifolia, Artemisia mogoltavica, A. namanganica, Avena sterilis* subsp. *ludoviciana, Diarthron vesiculosum, Herniaria hirsuta, Poa bulbosa, Taeniatherum caput-medusae* subsp. *crinitum, Vulpia persica.*

Fig. 97. *Bassia prostrata*, one of the diagnostic species of the *Bassio prostratae-Artemision ferganensis* alliance near Issyk-kul, Kyrgyzstan (ca. 1,650 m a.s.l.). Photo: A. Nowak.

Constant species: *Artemisia mogoltavica.*
Geographical range: Both name-giving species of the community have their range restricted to the northern Pamir-Alai and south-western Tian Shan Mts, inhabiting mainly warm and dry lowlands and foothills around the Fergana Valley and adjacent river valleys (Kinzikaeva 1988). In 2019, several sites with this community were recorded on the Mogoltausian Mts, northeast of Khujand and SW Tajikistan. The elevational range of the sites was from 380 to 1,250 m a.s.l. (Nowak et al. 2023).
Habitat characteristics: The stands with *Artemisia namanganica* and *A. mogoltavica* occur on gravel ground, flat or on gentle slopes with the mean inclination of ca. 10°. The community develops on substrates with a low organic matter content, with abundance of gravel, sand or loess content in the topsoil.

AST-ABc02. Community of *Artemisia ferganensis* (thermophilous mugwort steppe of the colline and montane belts of the western Pamir Alai and western Tian Shan Mts)

This community has been recorded in northern Tajikistan, but is more widespread in the western Tian Shan. It inhabits gentle slopes, river valleys and anthropogenic sites in the warm climatic zone of the colline to subalpine belts up to approx. 2,500 m a.s.l. (Kinzikaeva 1988). We still have too few samples to make a firm classification of this community, but we are sure that this vegetation should be included in the arid steppes of the warm Irano-Turanian climate.

AST-ABc03. Community of *Otostegia fedtschenkoana* (thermophilous steppe of colline and lower montane belts of the south-western Pamir-Alai Mts) (Fig. 99)

This vegetation develops on escarpments and loess slides in southern Tajikistan. Several plots of this community have been recorded

Fig. 98. Vegetation of the *Artemisia namanganica-Artemisia mogoltavica* community found near Khamirabod, Fergana Valley, Tajikistan (ca. 720 m a.s.l.). Photo: A. Nowak.

on the southern slopes of the Sarsarak Mts and its southern foothills. The community occurs on colline and montane belts at elevation of about 500–1,700 m a.s.l. It forms sparse, shrubby communities on warm, sunny and unstable slopes of south-western Pamir-Alai (Kochkareva 1986).

AST-ABc04. Community of *Artemisia glanduligera* (thermophilous mugwort steppe of the colline and montane belts of the western Pamir-Alai and western Tian Shan Mts) (Fig. 100)

This community is distributed in the warm areas of south-western Tajikistan, the Syr-darya River Valley, the Fergana Basin and the western Tian Shan. Several localities of this community have been noted around the Toktogul Lake and Naryn River Valley in Kyrgyzstan. It inhabits gentle slopes and river valleys in the colline to upper montane belts up to about 2,200 m a.s.l. The community prefers semi-arid, warm sites with gravelly substrates. It has been found in intensively grazed areas. Due to insufficient sampling, the community is not ranked, but should be included in the deserted steppes of semi-arid habitats (Kinzikaeva 1988).

AST-ABc05. Community of *Artemisia prolixa* (thermophilous mugwort steppe of the colline and lower montane belts of the western Pamir-Alai and western Tian Shan Mts)

It is a thermophilous mugwort steppe of the mesic habitats of the northern Pamir-Alai and western Tian Shan. It inhabits slopes with grazed grasslands in the lower montane to subalpine belts at elevation of about 1,200–2,600 m a.s.l. It occurs in transitional habitats between semi-desert grasslands and pseudo-steppes that prefer more fertile substrates (Kinzikaeva 1988).

Fig. 99. Patchy vegetation of *Otostegia fedtschenkoana* on a sliding clayey slope near Ok-Mazor, southern Tajikistan (ca. 920 m a.s.l.). Photo: A. Nowak.

Fig. 100. Vegetation of the *Artemisia glanduligera* community found near Chkalovk, Toktogul District, Kyrgyzstan (ca. 970 m a.s.l.). Photo: A. Nowak.

Fig. 101. Semi-desert community of *Astragalus vvedenskyi* and *A. oldenburgii* recorded in the foothills near Teshik-Tash, Aktau Mts, Tajikistan (ca. 360 m a.s.l.). Photo: A. Nowak.

Fig. 102. Community of *Stipa aktauensis* on rock ledges in Aktau Mts, Uzbekistan (ca. 600 m a.s.l.). Photo: M. Nobis.

AST-ABc06. Community of *Artemisia turanica* (thermophilous mugwort steppe of lowlands and colline belts on semi-arid habitats in the south-western Pamir-Alai Mts)

It is an extremely thermophilous mugwort vegetation of semi-desert character. It forms sparse stands in the river valleys and lowlands of south-western Tajikistan at elevation of 500–1,100 m a.s.l. This vegetation is also found in northern Afghanistan, southern Uzbekistan and Iran often on gravelly substrates (Kinzikaeva 1988).

AST-ABc07. Community of *Astragalus vvedenskyi* and *A. oldenburgii* (thermophilous desert steppe of lowlands of the south-western Pamir-Alai Mts) (Fig. 101)

This semi-desert or pseudosteppe vegetation is limited only to the south-west Tajikistan. It inhabits the warm, dry zone mainly around the Aktau Mts in the foothills, colline and lower montane belt up to about 1,500 m a.s.l. *Astragalus oldenburgii* also contributes to *Calligonum* spp. or *Haloxylon persicum* vegetation, so probably this community should be included in semi-deserts. Further detailed phytosociological studies are needed to answer this question.

AST-ABc08. Community of *Stipa aktauensis* (chasmophytic semi-desert vegetation of the colline belt of the Aktau Mts in Uzbekistan) (Fig. 102)

This semi-desert or chasmophytic vegetation is restricted to the area of the Aktau Mts in Uzbekistan. It occupies the gravelly rocky outcrops in the dry zone of the colline and montane belts up to about 1,400 m a.s.l. Further detailed phytosociological studies are needed to clarify the position of this community in the system of Central Asian vegetation, particularly in the semi-deserts of the Kyzylkum Desert and the chasmophytic vegetation of the Aktau and Nuratau Mts in central Uzbekistan.

High altitude desert steppes and cold semi-deserts of Central Asia

High altitude desert steppes and cold semi-deserts of Central Asia

AJA. *Ajanio-Cleistogenetea songoricae* (Mirkin in Kashapov et al. 1987) Mirkin, Alimbekova, Kashapov et Onishchenko 1988 (Fig. 103)

This vegetation includes one of the most conspicuous and widespread desert steppe and semi-desert plant communities in Central Asia. The *Ajanio-Cleistogenetea songoricae* vegetation includes the species-poor vegetation of the subalpine and alpine belts of high Asia, including the Pamir, Karakoram, Kunlun-Shan and Hindu Kush Mts which are influenced by the non-monsoon but transitional Irano-Turanian – temperate rainfall pattern with no clear peaks in either winter or summer. The range of this vegetation extends in arid zones of Central Asia, and is dominated by species of *Artemisia* spp., *Stipa* spp., *Salsola* spp., *Braya* spp., *Christolea* spp., *Roegneria* spp., *Zerna* spp., *Leymus* spp.

AJA-A. *Krascheninnikovio ceratoidis-Stipetalia orientalis* Nowak, Świerszcz, S. Nowak et Nobis 2023 (high altitude cryophilous steppes and desert steppes of Central Asia) (Fig. 104)

Diagnostic species: *Acantholimon diapensioides, A. tianschanicum, Ajania tibetica, Artemisia kuschakewiczii, A. leucotricha, Christolea crassifolia, Elymus schrenkianus, Klasea procumbens, Knorringia pamirica, Krascheninnikovia ceratoides, Lepidium cordatum, Leymus lanatus, Lindelofia stylosa, Oxytropis microphylla, O. trichosphaera, Polygonum mezianum, Stipa glareosa.*
Constant species: *Krascheninnikovia ceratoides, Stipa orientalis.*
Geographical range: High alpine plateaus of Central Asia (Eastern Pamir Mts in Tajikistan, southern Kyrgyzstan).
Habitat characteristics: These desert steppes develop on underdeveloped arid soils in the high plateaus of Central Asia and the surrounding mountain ranges. They are found at elevations

Fig. 103. High-altitude semi-desert with *Ajania tibetica* near Murgab, Eastern Pamir, Tajikistan (ca. 4,100 m a.s.l.). Photo: A. Nowak.

Fig. 104. High-altitude semi-desert with *Stipa orientalis* near Alichur, Eastern Pamir, Tajikistan (ca. 3,900 m a.s.l.). Photo: M. Nobis.

of approx. 2,800–4,500 m a.s.l. within the belt of alpine meadows and mats (Nowak et al. 2023).

AJA-AA. *Artemision rhodantho-skorniakovii* Nowak, Świerszcz, S. Nowak et Nobis 2023 nom. corr. (high-altitude desert steppes and semi-deserts of the eastern Pamir Mts) (Fig. 105)

Diagnostic species: *Acantholimon pamiricum, Ajania tibetica, Allium oreoprasum, Artemisia glaucina, A. kuschakewiczii, A. lehmanniana, A. leucotricha, A. skorniakovii, Astragalus chomutovii, A. pamirensis, A. muschketovii, Atriplex pamirica, Braya pamirica, Christolea crassifolia, Cicer acanthophyllum, Ephedra regeliana, Eremopyrum distans, Hedysarum minjanense, Knorringia pamirica, Lepidium cordatum, Leymus secalinus, Lindelofia stylosa, Oxytropis chiliophylla, O. microsphaera, O. trichosphaera, Poa glauca* subsp. *glauca, Polygonum mezianum.*
Constant species: *Acantholimon pamiricum, Artemisia kuschakewiczii, A. lehmanniana, Christolea crassifolia, Hedysarum minjanense, Oxytropis chiliophylla, O. trichosphaera, Polygonum mezianum, Stipa glareosa, S. orientalis.*
Geographical range: High alpine plateaus of the Pamir and adjacent areas (e.g. Alai Valley in Kyrgyzstan, Vakhan Corridor in Afghanistan, northern Hindu Kush in Afghanistan).
Habitat characteristics: This vegetation occurs in the harshest and driest territories of high Central Asia. It tolerates one of the lowest rainfall amounts of ca. 100 mm/year (Dickoré, Miehe 2002). The communities develop in relatively flat areas, often with almost no organic matter in the topsoil, at elevation of approx. 2,800–4,500 m a.s.l. (Nowak et al. 2023).

AJA-AA01. *Cousinio pannosae-Artemisietum skorniakovii* Nowak, Świerszcz, S. Nowak et Nobis 2021 (desert steppe of the alpine belt in the eastern Pamir Mts) (Fig. 106, 107)

Diagnostic species: *Acantholimon velutinum, Ajania tibetica, Artemisia skorniakovii* (= *Seriphidium skorniakovii*), *Astragalus lasiosemius,*

Fig. 105. High-altitude desert steppe with *Artemisia rhodantha* near Alichur, Eastern Pamir, Tajikistan (ca. 3,800 m a.s.l.). Photo: A. Nowak.

Fig. 106. Desert stepe of the *Cousinio pannosae-Artemisietum skorniakovii* association found near Jelandy, Eastern Pamir, Tajikistan (ca. 3,700 m a.s.l.). Photo: A. Nowak.

Cousinia pannosa, Linaria sessilis, Oxytropis trichosphaera, Polygonum mezianum.
Constant species: *Artemisia skorniakovii, Cousinia pannosa.*
Geographical range: This association is restricted to the arid zone of the high Pamir region. This vegetation is closely related to the cold steppes and semi-deserts of the highest plateaus of Central Asia. It is also thought to occur in Tibet, northern Pakistan and Afghanistan. Stands of *Cousinio pannosae-Artemisietum skorniakovii* inhabit the alpine belt in the Pamir, preferring gentle hills with sparse vegetation at elevations of ca. 3,700–4,300 m a.s.l. (Nowak et al. 2021c).
Habitat characteristics: The phytocoenoses were scattered on coarse or fine debris cones of fans, aprons, taluses and other landforms. The community develops on gently sloping screes with a mean inclination of about 15°. *Cousinio pannosae-Artemisietum skorniakovii* mainly inhabits slopes with southern and eastern exposition (Nowak et al. 2021c).

AJA-AA02. *Artemisio glaucinae-Salsoletum paulseni* Nowak, Świerszcz, S. Nowak et Nobis 2021
(semi-desert vegetation of alpine belt of eastern Pamir and Hindu Kush Mts; Vakhan Corridor) (Fig. 108)

Diagnostic species: *Anabasis salsa, Artemisia glaucina, Salsola australis, S. paulsenii.*
Constant species: *Anabasis salsa, Artemisia glaucina.*
Geographical range: This semi-desert vegetation has only been recorded on the southern slopes of the Shakhdara Mts along the Pamir River Valley. In the eastern Pamir, the association occurs in the alpine belt at an elevation of 2,600–2,950 m a.s.l. (Nowak et al. 2023).
Habitat characteristics: This territory is one of the driest and most arid zone, with precipitation of about 100-150 mm per year, exceeding 200 mm only exceptionally on selected slopes. Under these conditions, semi-desert vegetation prevails on extensive stony slopes. In the eastern

Fig. 107. Desert steppe dominated by *Cousinia pannosa* in the Pamir River Valley near Zorkul Lake in the Eastern Pamir, Eastern Pamir, Tajikistan (ca. 4,100 m a.s.l.). Photo: A. Nowak.

Fig. 108. Semi-desert vegetation of the *Artemisio glaucinae-Salsoletum paulseni* association found near Zoogvand, Shakhdara Range, Eastern Pamir, Tajikistan (ca. 3,200 m a.s.l.). Photo: A. Nowak.

Pamir it prefers coarse-grained scree of limestone, shale and dolomite. The plots of the community were found on moderately sloping hills with a slight inclination (approx. 25°). The community inhabits rather warm areas with an average annual temperature of ca. -1°C, compared to other vegetation types of the High Pamir.

AJA-AA03. *Acantholimetum pamirici* Nowak, Świerszcz, S. Nowak et Nobis 2023 nom. corr. (semi-desert, tragacanthic steppe of the alpine belt of the eastern Pamir Mts) (Fig. 109)

Diagnostic species: *Acantholimon pamiricum, Artemisia lehmanniana, Cousinia semilacera, Ephedra intermedia, Lactuca orientalis.*
Constant species: *Acantholimon pamiricum, Ephedra intermedia.*
Geographical range: *Acantholimon pamiricum* is an endemic species of Tajikistan, distributed in the highlands of the Pamir and the Peter the First Mts (Kochkareva 1986). It has also been recorded in the Ghunt Valley, the Vakhan Corridor (Pamir River Valley), and around Alichur and Murgab. The phytocoenoses of *Acantholimon pamiricum* were found mainly in the alpine belt of the Eastern Pamir at elevation between 3,200 and 3,650 m a.s.l. (Nowak et al. 2023).
Habitat characteristics: The phytocoenoses occupy flat lands or gentle slopes with dry, firm and often gravelly soils. The average slope is 17° and exceptionally it can reach up to 55°. It develops in windswept and arid habitats.

AJA-AA04. *Astragalo chomutowii-Stipetum subsessiliflorae* Nowak, Nobis, S. Nowak et M. Nobis 2018 (desert steppe, cryophylous vegetation of the alpine to subnival belts of Central Asia) (Fig. 110)

Diagnostic species: *Acantholimon hedinii, A. tianschanicum, Androsace dasyphylla, Ephedra regeliana, Eremopyrum orientale, Euphorbia tibetica, Stipa subsessiliflora.*

Fig. 109. High-altitude semi-desert of the *Acantholimetum pamirici* association found near Jelandy, Eastern Pamir, Tajikistan (ca. 3,690 m a.s.l.). Photo: A. Nowak.

Constant species: *Artemisia kuschakewiczii, Ephedra regeliana, Stipa subsessiliflora.*

Geographical range: This association has been described from the Alai Valley in southern Kyrgyzstan (Nowak et al. 2018). This sparse desert steppe vegetation occurs in Central Asia on high alpine plateaus up to ca. 5,200 m a.s.l. (Nobis et al. 2020; eFloras 2024). *Astragalo chomutowii-Stipetum subsessiliflorae* was found at several sites in the eastern part of the Alai Valley, in the Keng-Suu area of central Kyrgyzstan and in the northern ranges of the eastern Pamir Plateau. The patches were found at elevation ranging from 2,900 to more than 3,950 m a.s.l. (Nowak et al. 2023).

Habitat characteristics: The association occupies flat lands, exceptionally slopes up to 20°. The habitat is characterised by relatively high humidity, due to the long-lasting snow cover and relatively high annual precipitation (mean annual over 400 mm/year).

AJA-AA05. *Atriplici pamiricae-Lepidietum cordatae* Nowak, Świerszcz, S. Nowak et Nobis 2023 (semi-desert, halophytic vegetation of alpine belt of the eastern Pamir Mts and Kashgaria) (Fig. 111)

Diagnostic species: *Atriplex pamirica, Corydalis gortschakovii, Lepidium cordatum, Puccinellia hackeliana.*

Constant species: *Lepidium cordatum.*

Geographical range: The main distribution range of *Atriplex pamirica* is the eastern Pamir and Kashgaria (Ovchinnikov 1968). *Lepidium cordatum* has a wider range, extending from western Kazakhstan to Inner Mongolia (eFloras 2024). Stands of this association were found in the alpine, arid zone at elevations from 3,550 to 4,100 m a.s.l. (Nowak et al. 2023).

Habitat characteristics: *Atriplici pamiricae-Lepidietum cordatae* inhabits flat, muddy, saline and wet habitats with almost no organic material in the topsoil layer.

Fig. 110. Semi-desert grassland of the *Astragalo chomutowii-Stipetum subsessiliflorae* association found near Sary-Tash, Alai Valley, Kyrgyzstan (ca. 3,160 m a.s.l.). Photo: A. Nowak.

Fig. 111. Semi-desert vegetation of the *Atriplici pamiricae-Lepidietum cordatae* association growing on saline soils near Bulunkul Lake, Eastern Pamir, Tajikistan (ca. 3,760 m a.s.l.). Photo: A. Nowak.

AJA-AA06. *Astragalo pamirensis-Leymetum secalini* Nowak, Świerszcz, S. Nowak et Nobis 2023 (semi-desert steppe of the alpine and subnival belts in the eastern Pamir Mts and adjacent areas on sandy and gravelly substrates) (Fig. 112)

Diagnostic species: *Astragalus pamiriensis, Leymus secalinus, Oxytropis chiliophylla, O. hirsutiuscula, O. lapponica, Puccinellia pamirica, Taraxacum murgabicum.*
Constant species: *Astragalus pamiriensis, Leymus secalinus, Oxytropis chiliophylla, Oxytropis lapponica, Taraxacum murgabicum.*
Geographical range: This is one of the widely distributed semi-desert vegetation of the eastern Pamir and adjacent areas. *Leymus secalinus* grows in arid, gravelly, often sandy bars, wastelands and barrens of Central Asia (eFloras 2024). *Astragalus pamirensis* is an endemic species of the alpine belt of the Gorno-Badakshanskyi Autonomous Region in Tajikistan and northern Afghanistan (Ovchinnikov 1981). This phytocoenosis has been found in a number of locations in the Alichur and Murgab districts in the Eastern Pamir at elevations of 3,750–4,100 m a.s.l. (Nowak et al. 2023).
Habitat characteristics: This psammophilous phytocoenosis prefers gravelly hills, roadsides, sandy dunes or gravel bars in wide river valleys, often with deep sand deposits.

AJA-AA07. *Leymetum lanati* (Nowak, Świerszcz, S. Nowak et Nobis 2021) Nowak, Świerszcz, S. Nowak et Nobis 2023 (semi-desert vegetation on coarse-grained substrates in high alpine and subnival belts of the eastern Pamir Mts (Fig. 113)

Diagnostic species: *Arnebia euchroma, Cicer acanthophyllum, Leymus lanatus, Linaria sessilis, Scrophularia pamirica.*
Constant species: *Krascheninnikovia ceratoides, Leymus lanatus.*

Fig. 112. Vegetation of the *Astragalo pamirensis-Leymetum secalini* association found near Muzkol, Eastern Pamir, Tajikistan (ca. 4,160 m a.s.l.). Photo: A. Nowak.

Geographical range: *Leymus lanatus* is an endemic plant of the highlands of Central Asia with its range restricted to the highlands of Murgab and Alichur districts. Its stands inhabit the highest elevations of the Eastern Pamir in the upper alpine belt at elevation of 3,650–4,150 m a.s.l. (Nowak et al. 2023).
Habitat characteristics: The association prefers coarse-grained, unstable scree of granitic rocks, but it has also been found on flattened foothills or in wide gravel bars. The plots of the association were found on slopes with moderate inclinations from 0° to 45° (mean approx. 20°) and with southern or south-eastern expositions (Nowak et al. 2023).

AJA-AA08. *Brayo pamiricae-Stipetum glareosae* Świerszcz, Nobis, Swacha, Kącki, Dembicz, Waindzoch, Nowak et A. Nowak 2020 (desert steppe of alpine belt of the Eastern Pamir) (Fig. 114)

Diagnostic species: *Ajania tibetica, Braya pamirica, Stipa glareosa.*

Constant species: *Stipa glareosa, S. orientalis.*
Geographical range: *Braya pamirica* is a narrowly distributed endemic of the eastern Pamir (Ovchinnikov 1978). The *Brayo pamiricae-Stipetum glareosae* association was described from Tajikistan by Świerszcz et al. (2020) from gravelly barelands of the high Pamir Plateau. Stands of this association were recorded in Alichur, Murgab and Muzkol vicinity, in the zone of continental, cold and extremely arid climate (Nowak et al. 2023). It occupies flatlands and only occasionally inhabits gentle slopes at an elevations from ca. 2,950 to 4,150 m a.s.l.
Habitat characteristics: Plots of this association develop on compact gravelly or rocky terraces with a very low organic matter content. The landscape of *Brayo pamiricae-Stipetum glareosae* is very barren, sometimes without any vegetation cover.

AJA-AA09. *Artemisio skorniakovii-Acantholimetum diapensioides* Nowak, Świerszcz, S. Nowak et Nobis 2023 (semi-desert, tragacanthic vegetation of high Pamir in Central Asia) (Fig. 115)

Fig. 113. Arid, cobble scree vegetation of the *Leymetum lanati* association found in Shakhdara Range, Eastern Pamir, Tajikistan (ca. 4,250 m a.s.l.). Photo: A. Nowak.

Fig. 114. Vegetation patch of the *Brayo pamiricae-Stipetum glareosae* association found east of Alichur, Kurteskei Valley, Tajikistan (ca. 3,850 m a.s.l.). Photo: A. Nowak.

Fig. 115. Vegetation of the *Artemisio skorniakovii-Acantholimetum diapensioides* association found near Ak-Baital Pass, Eastern Pamir, Tajikistan (ca. 4,250 m a.s.l.). Photo: A. Nowak.

Fig. 116. Sparse vegetation of the *Limonium suffruticosum-Brachanthemum kirghisorum* community growing on badlands near Kara-koo, Issyk-kul District, Kyrgyzstan (ca. 1,950 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Acantholimon diapensioides, Artemisia skorniakovii, Delphinium oreophilum, Elymus schrenkianus, Hedysarum poncinsii, Poa glauca* subsp. *glauca, P. lipskyi, Rhodiola recticaulis.*
Constant species: *Acantholimon diapensioides, Artemisia skorniakovii.*
Geographical range: *Acantholimon diapensioides* is a Gorno-Badakhshan species distributed across mountain ranges in northern Afghanistan, western China and eastern Pamir. It is considered a typical semi-desert plant, occurring sporadically on screes and mountain slopes. It forms its own community in the highest limits of Pamir vegetation (Kochkareva 1986). The range of this community is limited to the arid zone of the high Pamir. It is a transitional vegetation between cryophilous semi-deserts, desert steppe and cushion communities in the highest plateaus of Central Asia. Plots of *Artemisio skorniakovii-Acantholimetum diapensioides* inhabit the alpine belt in a typical Pamir landscape of gentle hills with sparse vegetation at an elevation of ca. 3,850–4,300 m a.s.l. (Nowak et al. 2023).

AJA-AAc01. Community of *Limonium suffruticosum-Brachanthemum kirghisorum* (semi-desert vegetation of the Issyk-kul Basin in the montane to subalpine belts on gravelly bedrock) (Fig. 116)

Diagnostic species: *Brachanthemum kirghisorum, Helianthemum songaricum, Limonium suffruticosum, Neopallasia pectinata, Neotrinia splendens, Oreosalsola drobovii, O. montana, Oxytropis microsphaera, Reaumuria songarica, Zygophyllum miniatum.*
Constant species: *Allium oreoprasum, Brachanthemum kirghisorum, Limonium suffruticosum, Stipa glareosa.*
Geographical range: *Brachanthemum kirghisorum* is an endemic plant of Kyrgyzstan while *Limonium suffruticosum* is distributed in the step-

pe zone from Ukraine to Mongolia (Ikonnikov et al. 1993). Phytocoenoses of *Limonium suffruticosum-Brachanthemum kirghisorum* have occasionally been found along the southern shore of Lake Issyk-kul in Kyrgyzstan (Nowak et al. 2023).

Habitat characteristics: Both diagnostic species occur in deserted lands along rivers, lake shores and other arid and often halophytic habitats. The community occurs in the upper montane and subalpine belts at elevation from 1,900 to 2,350 m a.s.l. with relatively high mean annual temperature (mean 4.3°C). The plots were documented on slopes up to 45°. The habitat of this vegetation is compact, gravelly barren with rocky debris and a mean gravel size of ca. 1–3 cm in diameter with a low coarse fraction (Nowak et al. 2023).

AJA-AAc02. Community of *Acantholimon velutinum* (desert steppe vegetation in alpine belt of the Pamir-Alai Mts) (Fig. 117)

Diagnostic species: *Acantholimon velutinum.*
Constant species: *Acantholimon velutinum.*
Geographical range: This species is mainly distributed in the western Pamir-Alai, but also has scattered stands in the Pamir (Kochkareva 1986).

Habitat characteristics: This vegetation inhabits wind-swept slopes and passes in the highest alpine and subnival belts of the Pamir-Alai and Pamir Mts. It has been recorded at approx. 2,300–4,600 m a.s.l. on gravelly, dry substrates (Kochkareva 1986).

AJA-AAc03. Community of *Artemisia korshinskyi* (alpine mugwort steppe of the Pamir-Alai Mts)

Diagnostic species: *Artemisia korshinskyi.*
Constant species: *Artemisia korshinskyi.*
Geographical range: This species has its range throughout the Pamir-Alai and Western Pamir, including the Pamir River Valley. Outside Tajikistan, it also occurs in northern Afghanistan (Gorno Badakhshan; Kochkareva 1986).

Fig. 117. Cushion vegetation of *Acantholimon velutinum* near Kargush, Eastern Pamir, Tajikistan (ca. 3,930 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: This desert steppe vegetation inhabits mesic or dry slopes in the alpine belt at approx. 2,200–3,900 m a.s.l. It prefers poorer ranker soils with a high gravel content (Kinzikaeva 1988).

AJA-AAc04. Community of *Dracocephalum heterophyllum* (semi-desert vegetation of alpine and subnival belts on sandy or gravelly substrates of Central Asia) (Fig. 118)

Diagnostic species: *Dracocephalum heterophyllum.*
Constant species: *Dracocephalum heterophyllum.*
Geographical range: The sparse community, dominated by *Dracocephalum heterophyllum*, has been recorded from the high alpine belt of Central Asia. In Tajikistan, it is distributed exclusively in the highlands of the Eastern Pamir at elevation of approx. 3,400–4,300 m a.s.l. (Kochkareva 1986).
Habitat characteristics: This community inhabits dry semi-deserts of the highlands with gravelly or sandy soils. It often grows in river bars on the large, wide wings of the alpine, often ephemeral rivers of the Pamir.

AJA-AAc05. Community of *Limbarda salsoloides* (halophytic semi-desert on sandy habitats of the Central Asian river valleys) (Fig. 119)

Diagnostic species: *Limbarda salsoloides.*
Constant species: *Limbarda salsoloides.*
Geographical range: This species is distributed in the Eastern Pamir, Tibet, Takla Makan and the Gobi Desert. In Tajikistan, we have only recorded one stand of this community in the Wakhan Corridor, near the village of Vrang at around 2,750 m a.s.l. This is one of the most easterly occurrences of *Limbarda salsoloides.*
Habitat characteristics: This community inhabits dry river bars and sand dunes or sediments with high salt content at different elevations with the optimum in the alpine belt.

AJA-AAc06. Community of *Salsola gemmascens* (Irano-Turanian semi-desert vegetation on sandy or gravelly substrates)

Diagnostic species: *Salsola gemmascens.*
Constant species: *Salsola gemmascens.*
Geographical range: This species inhabits arid, semi-desert or desert steppe habitats in Middle and Central Asia. In Tajikistan, it occupies a wide range of elevational belts from lowland to high alpine (350–3,050 m a.s.l.), mainly in the western Pamir-Alai.
Habitat characteristics: This community inhabits arid areas with sparse, semi-desert vegetation. Often contributing to subhalophytic or desert stands of other Chenopodiaceae species. Freitag (1971) established a community of *Salsola gemmascens-Seidlitzia rosmarinus* in northern Pakistan.

AJA-AAc07. Community of *Artemisia korovinii* (desert mugwort steppe of the subalpine to alpine belts of semi-arid habitats in the eastern Pamir-Alai Mts)

Diagnostic species: *Artemisia korovinii.*
Constant species: *Artemisia korovinii.*
Geographical range: This dwarf-shrub mugwort species inhabits gravelly and mesic slopes, mainly in the Western Pamir in central Tajikistan, at the alpine elevations of approx. 2,300–3,600 m a.s.l.
Habitat characteristics: This community inhabits rocky slopes, alpine river bars and barrens in the mountains of central Tajikistan (e.g. Vanch, Yazgulem, Peter the First, Shugnan). It prefers relatively dry conditions and has been recorded also in desert areas in the Wakhan Corridor (Kinzikaeva 1988).

AJA-AAc08. Community of *Neotrinia splendens* (intensively grazed grassland of the subalpine to alpine belts of semi-arid habitats in Central Asia)(Fig. 120)

Diagnostic species: *Neotrinia splendens.*
Constant species: *Neotrinia splendens.*

Fig. 118. Semi-desert vegetation with *Dracocephalum heterophyllum* near Murgab, Tajikistan (ca. 3,900 m a.s.l.). Photo: A. Nowak.

Fig. 119. Vegetation of the *Limbarda salsoloides* community found near Vrang, Wakhan Corridor, Eastern Pamir, Tajikistan (ca. 2,750 m a.s.l.). Photo: A. Nowak.

Geographical range: This species is widely distributed (Nobis et al. 2019) and its community is known from Central Asia, the Karakoram, Tian Shan, Gobi and Takla Makan areas, and the western Himalayas (GBIF 2024). It forms high alpine pastures. In Tajikistan, it has only been recorded in the Eastern Pamir at elevation of about 3,400–3,900 m a.s.l.
Habitat characteristics: This community inhabits gentle slopes of wide river valleys, relatively humid due to water percolation in the soil. The community is often heavily grazed, with only tussocks of *Neotrinia splendens* remaining.

AJA-AB. *Piptathero gracilis-Artemision brevifoliae* Eberhardt 2004 (semi-desert vegetation of the Pamir, Hindu Kush and Karakoram Mts in Central Asia)

Remarks: This semi-desert vegetation was originally described from the Hindu Kush Mts in northern Pakistan (Eberhardt 2004; Peer et al. 2007). It inhabits arid, high mountain plateaus. The vegetation has sparse cover (approx. 5–45%) and low species richness (approx. 3–15) and often has dwarf-shrub or cushion physiognomy. Among the species adapted to such harsh environments that contribute to Central Asian screes are: *Acantholimon diapensioides, Corispermum hilariae, Elymus schugnanicus (= Roegneria schugnanica), Krascheninnikovia ceratoides, Oxytropis chiliophylla, Semenovia pamirica, Stipa glareosa*.

Several plant communities were included in the alliance *Piptathero gracilis-Artemision brevifoliae* Eberhardt 2004 as a mountain dwarf-shrub steppe of high Central Asia:

AJA-AB01. *Artemisio salsoloides-Ephedretum regelianae* Eberhardt 2004
AJA-AB02. *Stipo orientalis-Krascheninnikovietum pungentis* Eberhardt 2004 (Fig. 121)
AJA-AB03. *Krascheninnikovia ceratoides-Artemisietum brevifoliae* Eberhardt 2004
AJA-AB04. *Androsaco thomsonii-Stipetum himalaicae* Eberhardt 2004
AJA-AB05. *Stachyo tibeticae-Stipetum himalaicae* Eberhardt 2004
AJA-AB06. *Oxytropido humifusae-Artemisietum brevifoliae* Eberhardt 2004
AJA-AB07. *Artemisietum salsoloides* Eberhardt 2004
AJA-AB08. *Polygono rupestris-Artemisietum brevifoliae* Eberhardt 2004
AJA-AB09. *Leontopodio brachyactis-Oxytropidetum humifusae* Eberhardt 2004
AJA-AB10. *Calamagrostio stoliczkae-Hedysaretum falconeri* Eberhardt 2004
AJA-AB11. *Semenovio lasiocarpae-Hedysaretum falconeri* Eberhardt 2004.
AJA-AB12. *Drabo cachemiricae-Bistortetum affinis* Eberhardt 2004
AJA-AB13. *Oxytropido humifusae-Dianthetum anatolici* Eberhardt 2004
AJA-AB14. *Oxytropido microphyllae-Artemisietum santolinifoliae* Eberhardt 2004
AJA-AB15. *Poo suruanae-Festucetum kashmirianae* Eberhardt 2004
AJA-AB16. *Epilobio angustifolii-Bistortetum affinis* Eberhardt 2004

AJA-ABc01. Community of *Salsola maracandica* (semi-desert vegetation of the alpine belt of the Hindu Kush Mts in Afghanistan)

Diagnostic species: *Anabasis macroptera*, *Arthrophytum pallidiflorum, Haloxylon griffithii* subsp. *wakhanicum*, *Salsola maracandica*, *S. tomentosa*.
Constant species: *Acantholimon* spp., *Arthrophytum pallidiflorum, Haloxylon griffithii* subsp. *wakhanicum*, *Salsola maracandica*, *S. tomentosa*.
Geographical range: This semi-desert community inhabits the slopes of the alpine belt of the Hindu Kush Mts, mainly at an elevation of approx. 2,000–2,700 m a.s.l.
Habitat characteristic: Community of *Salsola maracandica* develops on subhalophytic, alkaline habitats in the arid zone of the Hindu Kush Mts with an average annual rainfall of ca. 150–200 mm per year. The vegetation cover is max. 10–15% and is max. 30 cm high.

Fig. 120. Intensively grazed grassland with *Neotrinia splendens* located near Ak-Bosogo, Alai Mts, Kyrgyzstan (ca. 2,950 m a.s.l.). Photo: A. Nowak.

Fig. 121. Deserted steppe of the *Stipo orientalis-Kraschenninnikovietum pungentis* association found near Alichur, Eastern Pamir, Tajikistan (ca. 3,775 m a.s.l.). Photo: A. Nowak.

We do not have detailed data from our own survey regarding the habitat conditions of above mentioned vegetation types. They are described in Eberhardt (2004) and Freitag (1971), to which we refer the reader. The ranges of many of the diagnostic species pass into the territory of the eastern Pamir, or extend into the Wakhan Corridor, so we decided to include them in the list of plant communities.

Thermophilous secondary grasslands on deep soils of the colline and montane belts with long dry summer period in Middle Asia

Thermophilous secondary perennial grasslands on deep calcareous soils of colline and montane belts in mediterranean-like climates (including Irano-Turanian) with long dry summer period.

TRA. *Stipo capensis-Trachynietea distachyae* Brullo in Brullo et al. 2001 (Fig. 122)

This vegetation type includes secondary grasslands in areas with a Mediterranean climate type, i.e. with a distinct peak in precipitation outside the growing season (in winter or, in the case of Middle Asia, in early spring). The pseudosteppe communities have been provisionally included in *Stipo capensis-Trachynietea distachyae*, although we believe that they will form a new class together once knowledge of similar vegetation in other areas of Middle Asia is completed (San Miguel 2008; Mucina et al. 2016; Świerszcz et al. 2020).

TRA-A. *Ptilostemono stellati-Vulpietalia ciliatae* Mucina ined. (thermophilous secondary perennial pseudosteppes on deep soils of colline and montane belts in Mediterranean and Irano-Turanian Regions) (Fig. 123)

These secondary grasslands occur throughout Middle Asia in the colline and hilly zones around the main mountain ranges. The largest areas of this thermophilous and heavily grazed vegetation are in the Fergana Valley and Khatlon Province in south-western Tajikistan. These communities have a clear seasonality with a peak of development in spring (March-April) and a strong withering and almost complete disappearance of vegetation in late summer (August-September). The secondary pseudosteppes of Tajikistan require further detailed study and comparative analysis, and possibly the establishment of a new class for the Irano-Turanian Region.

TRA-AA. *Vulpio persicae-Caricion pachystylidis* Świerszcz, Nobis, Swacha, Kącki, Dem-

Fig. 122. Pseudosteppe with *Eremurus alberti* developed on the southern slopes of the Kara-tau Mts, Panj District, Tajikistan (ca. 775 m a.s.l.). Photo: A. Nowak.

Fig. 123. Pseudosteppes of *Vulpio persicae-Caricion pachystylidis* in early April near Vose, Khatlon Province, Tajikistan (ca. 880 m a.s.l.). Photo: A. Nowak.

bicz, Waindzoch, Nowak et A. Nowak 2020 (thermophilous secondary perennial pseudosteppes on deep soils of colline and montane belts in Irano-Turanian Region) (Fig. 124)

Diagnostic species: *Aphanopleura capillifolia, Artemisia kochiiformis, Astragalus kabadianus, Carex pachystylis, Convolvulus subhirsutus, Elytrigia intermedia, Gagea ova, G. paedophila, G. vegeta, Galium ghilanicum, Goldbachia pendula, Haplophyllum dubium, Hypecoum trilobum, Korovinia tenuisecta, Lolium persicum, Medicago orbicularis, Phlomis bucharica, Poa bulbosa, Ranunculus pinnatisectus, R. sewerzowii, R. tenuilobus, Vicia ervilla, Vulpia persica.*

Geographical range: In Middle Asia this vegetation occurs in the western foothills of the Pamir-Alai, the Fergana Valley and the western slopes of the Tian Shan Mts.

Habitat characteristics: These grasslands grow mainly in colline and montane belts on loess or organic, fertile soils with calcareous bedrock, where the terminal stage of vegetation is open woodland or scrub. In this area, the average annual temperature is above 10°C, winters are mild, with the minimum temperature falling rarely below -5°C, and the beginning of the vegetation season is relatively humid compared to other areas, particularly the eastern, highly elevated plateaus of the Pamir. Precipitation peaks one or two months earlier than in the Central Asian regions, where the highest rainfall occurs in the summer. The structure of this pseudosteppes is apparently determined by grasses, however, the perennial and bulbous plants of Irano-Turanian origin (e.g., *Eremurus* spp., *Phlomoides* spp., *Elaeosticta* spp., *Tulipa* spp., *Ungernia* spp.) have a considerable share. This vegetation can be considered as an eastern (Irano-Turanian)

Fig. 124. Pseudosteppe dominated by *Carex pachystylis* and located near Ardarak, Turkestan Mts, Sughd Province, Tajikistan (ca. 1,880 m a.s.l.). Photo: A. Nowak.

Fig. 125. Spring aspect of pseudosteppes with *Eremurus bucharicus* near Vose, Khatlon Province, Tajikistan (ca. 880 m a.s.l.). Photo: A. Nowak.

outpost of the Mediterranean communities of *Cymbopogono-Brachypodietalia ramosi* Horvatič 1963 (Świerszcz et al. 2020).

TRA-AA01. *Eremuretum bucharici* Świerszcz, Nobis, Swacha, Kącki, Dembicz, Waindzoch, Nowak et A. Nowak 2020 (intensively grazed mesic pseudosteppe of colline belt in the south-western Pamir-Alai Mts) (Fig. 125)

Diagnostic species: *Allium bucharicum, Consolida leptocarpa, Cymatocarpus popovii, Eremurus bucharicus, Gagea graminifolia, Haplophyllum griffithianum, Heterocaryum subsessile, Jurinea bucharica, Koelpinia macrantha, Leptaleum filifolium, Nonea macropoda, Phlomoides baldschuanica, Russowia sogdiana, Solenanthus plantaginifolius.*
Constant species: *Avena trichophylla, Bromus lanceolatus, Diarthron vesiculosum, Phlomis bucharica, Poa bulbosa, Vulpia persica.*

Geographical range: This is the most thermophilous community distributed in the south-western part of Tajikistan, occurring exclusively in the colline belt (average elevation ca. 650 m a.s.l.; Świerszcz et al. 2020).
Habitat characteristics: The average annual temperature is around 18°C, however, the precipitation is still quite high, reaching ca. 500 mm throughout the year. The community develops on fertile, deep, loess soils (Świerszcz et al. 2020).

TRA-AA02. *Hordeo bulbosi-Astragaletum retamocarpi* Świerszcz, Nobis, Swacha, Kącki, Dembicz, Waindzoch, Nowak et A. Nowak 2020 (moderately grazed mesic grassland of the colline and montane belts of the south-western Pamir-Alai Mts) (Fig. 126)

Diagnostic species: *Aegilops triuncialis, Astragalus retamocarpus, Crupina vulgaris, Echium*

Fig. 126. Pseudosteppe of the *Hordeo bulbosi-Astragaletum retamocarpi* association found near Gargara, Khatlon Province, Tajikistan (ca. 920 m a.s.l.). Photo: A. Nowak.

biebersteinii, Elaeosticta allioides, E. hirtula, Ferula gigantea, Hordeum bulbosum, Hypericum perforatum, Medicago denticulata, M. orbicularis, M. rigidula, Pseudohandelia umbellifera, Rochelia cardiosepala, Tragopogon capitatus, Tulipa subquinquefolia, Vicia angustifolia.
Constant species: *Astragalus retamocarpus, Carex turkestanica, Ferula kuhistanica, Medicago rigidula, Poa bulbosa.*
Geographical range: This association has been described from the montane belt of the southwestern Pamir-Alai as the pseudosteppe vegetation (Świerszcz et al. 2020). It was mainly found in hilly landscapes of the Hissaro-Darvasian geobotanical subregion of Tajikistan in the montane belt of Aktau, Karatau, Karateginian and the southern foothills of the Hissar Mts (Świerszcz et al. 2020). A few additional plots of this vegetation were found in the Peter the First Range in the alpine pasture zone between 1,900 and 2,200 m a.s.l. (Nowak et al. 2020b).

Habitat characteristics: It occurs on gentle slopes with an average inclination of approx. 14° at western or southern aspects (Nowak et al. 2020b).

TRA-AA03. *Potentillo orientalis-Eremuretum fusci* Świerszcz, Nobis, Swacha, Kącki, Dembicz, Waindzoch, Nowak et A. Nowak 2020 (intensively grazed mesic pseudosteppe of montane and subalpine belts of the western Pamir-Alai and western Tian Shan Mts) (Fig. 127)

Diagnostic species: *Eremurus brachystemon, E. fuscus, Gymnospermium albertii, Scorzonera tadshikorum, Veronica arguteserrata.*
Constant species: *Eremurus fuscus.*
Geographical range: This association has been described from the alpine belt of the western Pamir-Alai as intensively grazed grassland vegetation (Świerszcz et al. 2020). Additional plots of this vegetation were found in central and north-

Fig. 127. Pseudosteppe of the *Potentillo orientalis-Eremuretum fusci* association found in the Suusamyr Valley, Kyrgyz Mts, Kyrgyzstan (ca. 2,280 m a.s.l.). Photo: A. Nowak.

Fig. 128. Pseudosteppe of the *Achnathero caraganae-Delphinietum semibarbati* association found on southern slopes of the Fergana Mts, near Karakol, Kyrgyzstan (ca. 1,200 m a.s.l.). Photo: A. Nowak.

eastern Tajikistan as well as in the Kyrgyz and Talas Alatau Mts in Kyrgyzstan. This association prefers vast open habitats in the alpine pasture zone between 1,850 and 2,500 m a.s.l.

Habitat characteristics: It occurs on gentle slopes with an average inclination of approx. 20°. *Potentillo orientalis-Eremuretum fusci* seems to be indifferent to slope or exposure, but often occurs on southern or northwestern slopes. It prefers mesic, loamy soils (Nowak et al. 2020b).

TRA-AA04. *Achnathero caraganae-Delphinietum semibarbati* Świerszcz, Nobis, Swacha, Kącki, Dembicz, Waindzoch, Nowak et A. Nowak 2020 (moderately grazed montane pseudosteppe in the north-west Pamir-Alai Mts and Fergana Valley surroundings) (Fig. 128)

Diagnostic species: *Achnatherum caragana, Artemisia kochiiformis, Carex pachystylis, Delphinium semibarbatum, Kochia iranica, Taeniatherum asperum, T. crinitum.*

Constant species: *Bothriochloa ischaemum, Carex pachystylis, Diarthron vesiculosum, Poa bulbosa.*

Geographical range: The plots of the association were found in colline and montane belts in dry and warm locations around the Fergana Valley, the Zeravshan River Valley and the southern foothills of the Hissar range (Świerszcz et al. 2020).

Habitat characteristics: *Achnathero caraganae-Delphinietum semibarbati* prefers mesic, loamy or loess soils with a well-developed organic soil layer and sometimes considerable gravel debris (Świerszcz et al. 2020).

TRA-AA05. *Eremuro tianschanici-Delphinietum biternati* Świerszcz, Nobis, Swacha, Kącki, Dembicz, Waindzoch, Nowak et A. Nowak 2020

Fig. 129. Vegetation patch of the *Eremuro tianschanici-Delphinietum biternati* association found near Toktogul, Kyrgyzstan (ca. 1,350 m a.s.l.). Photo: A. Nowak.

(moderately grazed mesic pseudosteppe of the central and western Tian Shan Mts) (Fig. 129)

Diagnostic species: *Bromus squarrosus, Delphinium biternatum, Elaeosticta ferganensis, E. samarkandica, Eremurus tianschanicus, Hymenolyma trichophyllum, Korovinia ferganensis.*
Constant species: *Bothriochloa ischaemum, Bromus squarrosus, Delphinium biternatum, Elytrigia trichophora.*
Geographical range: This community occurs mainly in southern and central Kyrgyzstan in the montane and colline belts (average elevation of 1,100 m a.s.l.) of the Fergana and Alai ranges (Świerszcz et al. 2020).
Habitat characteristics: It prefers mesic habitats with deep loess or loamy soils in warm locations (Świerszcz et al. 2020).

TRA-AAc01. Community of *Cousinia sclerophylla* (intensively grazed sclerophyllous vegetation in warm zone of the colline belt of the south-western Tajikistan) (Fig. 130)

Diagnostic species: *Cousinia sclerophylla.*
Constant species: *Cousinia sclerophylla.*
Geographical range: This community occurs only in the Khatlon Province in south-western Tajikistan. It has an elevational range from ca. 600 to 1,400 m a.s.l. (Świerszcz et al. 2020).
Habitat characteristics: It prefers mesic habitats with deep loess or loamy soils in warm locations. It inhabits slopes that are often quite eroded and exposed to heavy grazing in spring and early summer (Świerszcz et al. 2020).

TRA-AAc02. Community of *Phlomis bucharica* (ephemeral, intensively grazed grasslands on deep, loessic soils in the southern Pamir-Alai Mts) (Fig. 131)

Diagnostic species: *Phlomis bucharica.*
Constant species: *Phlomis bucharica.*

Fig. 130. Community of *Cousinia sclerophylla* near Dangara in Khatlon Province, south-western Tajikistan (ca. 600 m a.s.l.). Photo: A. Nowak.

Fig. 131. Grassland with *Phlomis bucharica* found near Vose, southern Tajikistan (ca. 830 m a.s.l.). Photo: A. Nowak.

Geographical range: *Phlomis bucharica* is one of the most widespread species in the warm areas of south-western Tajikistan (Khatlon Province). This community may be a central one in pseudosteppe vegetation, but after the survey we do not have sufficient data to coin the separate association. This pseudosteppe vegetation is also known from northern Afghanistan. It occurs in colline, hilly areas within an elevation belt at about 500–1,800 m a.s.l.

Habitat characteristics: It prefers mesic habitats with deep loess or loamy soils in warm locations. It has a higher vegetation cover with a less pronounced seasonality, but it is still one of the most important spring pastures in the country (Świerszcz et al. 2020).

TRA-AAc03. Community of *Meristotropis bucharica* (intensively grazed secondary grasslands in the southern Pamir-Alai Mts) (Fig. 132)

Diagnostic species: *Meristotropis bucharica.*

Constant species: *Meristotropis bucharica.*

Geographical range: *Meristotropis bucharica* has a wide geographical range from Iran, throughout Uzbekistan, Afghanistan, southern Tajikistan, to Tibet and Xinjang in China (GBIF 2024). The community with the dominance of this species has been recorded in southern Tajikistan around Dashtijum National Park. It forms a distinct stand at colline elevations of ca. 900 m a.s.l.

Habitat characteristics: This vegetation prefers mesic habitats with deep loess or loamy soils in hot, south-facing locations. It is moderately grazed and covers the ground throughout the whole season.

TRA-AAc04. Community of *Inula macrophylla* (dense forb vegetation on mesic habitats in montane belt of Middle Asia) (Fig. 133)

Fig. 132. Vegetation patch dominated by *Meristotropis bucharica* inhabiting southern slopes within Dashti-Jum Nature Reserve, Khatlon Region, Tajikistan (ca. 900 m a.s.l.). Photo: A. Nowak.

Fig. 133. Forb vegetation with a large share of *Inula macrophylla* found near Guliston, Tajikistan (ca. 1,300 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Artemisia ferganensis, A. glanduligera, Astragalus alopecias, A. sieversianus, Bromus oxyodon, Carex turkestanica, Convolvulus pseudocantabrica, Delphinium biternatum, Eremurus tianschanicus, E. turkestanicus, Eulophus ferganensis, Galium pamiroalaicum, Inula macrophylla, Microthlaspi perfoliatum, Perovskia abrotanoides, Serratula lyratifolia, Spiraea hypericifolia, Stipa caucasica, Stubendorffia orientalis.*
Constant species: *Bromus oxyodon, Carex turkestanica, Convolvulus pseudocantabrica, Galium pamiroalaicum, Inula macrophylla, Prangos pabularia, Serratula lyratifolia, Stubendorffia orientalis.*
Geographical range: Stands of *Inula macrophylla* are relatively common in the Pamir-Alai, but it seems that the species is only a contributor to other vegetation types. It is widespread throughout Middle Asia and also occurs in the Tarbagatai Mts in Kazakhstan (Kinzikaeva 1988). The vegetation was recorded in the Fergana and Talas Alatau Mts in Kyrgyzstan and in southwestern Tajikistan at an elevation from 1,200 to 1,700 m a.s.l. (Nowak et al. 2020b).
Habitat characteristics: This vegetation type occurs on deep, nutrient-rich soils overlying limestone bedrock. This community inhabits relatively steep slopes with a mean inclination of approx. 30°, with a preference for northern exposures (Nowak et al. 2020b).

TRA-AAc05. Community *of Elytrigia trichophora-Linum corymbulosum* (thermophilous forb pseudosteppe of montane belt Irano-Turanian Region) (Fig. 134)

Diagnostic species: *Achillea biebersteinii, Alyssum dasycarpum, Anagallis arvensis, Bothriochloa ischaemum, Bromus japonicus, B. oxyodon, Centaurea squarrosa, Centaurium pulchellum, Elaeosticta hirtula, Elytrigia trichophora, Eremurus tianschanicus, Linum corymbulosum, Medicago*

Fig. 134. Community of *Elytrigia trichophora* and *Linum corymbulosum* on gentle slope near Sudzhina, Zeravshan River Valley, Tajikistan (ca. 1,125 m a.s.l.). Photo: A. Nowak

sativa, Plantago lanceolata, Sideritis montana, Velezia rigida, Ziziphora interrupta.

Constant species: *Alyssum dasycarpum, Bothriochloa ischaemum, Centaurea squarrosa, Diarthron vesiculosum, Elytrigia trichophora, Linum corymbulosum.*

Geographical range: This vegetation shows a certain transitional character between steppe and pseudosteppe, as it also occurs within the woodland zone. It is a widespread vegetation occurring in the shiblyak zone in southwestern Tajikistan and around the Fergana Valley (Nowak et al. 2018).

Habitat characteristics: The documented plots were found on substrates with a well-developed organic soil layer with a small amount of gravel debris (Nowak et al. 2018).

TRA-AAc06. Community of *Artemisia baldshuanica* (thermophilous mugwort pseudosteppe of the colline and montane belts of the south-western Pamir-Alai Mts; Khatlon district)

This community was found in the zone of pistachio open woodlands in southern Tajikistan (Kinzikaeva 1988). It occurs in gaps between trees, along roads, on gentle slopes and hilltops. *Artemisia baldshuanica* is distributed in the lowlands and colline belts of western Pamir-Alai and northern Hindu Kush. The community is probably widespread in this warm, subhumid climate zone. Due to insufficient sampling, this vegetation needs further study as one of the potential mugwort pseudosteppe types.

TRA-AAc07. Community of *Eremurus olgae* (thermophilous pseudosteppe of the colline and montane belts of the south-western Pamir-Alai Mts; Khatlon district) (Fig. 135)

Fig. 135. Community of *Eremurus olgae* in the foothills of Dashtijum Mts in the Shurobod county, south-western Tajikistan (ca. 450 m a.s.l.). Photo: A. Nowak.

This community is widespread in south-western Tajikistan, particularly in the Shurobod district in the zone of open pistachio forests. It sometimes grows in gaps between trees on gentle slopes. In the foothills, however, it forms dense and large stands on aprons and fans or on extensive pseudosteppe pastures. The community is often dominant in the lowest zones of the Dashtijum range. The community is probably widespread in this warm, subhumid climate zone, but due to military restrictions and lack of access to this border zone, resulting in insufficient sampling, this vegetation needs further study.

TRA-AB. *Diantho humilis-Velezion rigidae* Korzhenevskii et Klyukin ex Didukh et Mucina 2014 (circum-Mediterranean and Irano-Turanian calciphilous annual and ephemeroid grasslands) (Fig. 136)

This alliance, established for the southern Ukrainian therophytic vegetation with two dormant seasons (hot summer and cold winter), is proposed to include similar vegetation of southern Tajikistan, although its seasonality is slightly different. The winter season here is not too severe, and the minimum temperature of the coldest month very rarely falls below -5°C. However, the proliferation of therophytes is enhanced by heavy grazing, and in plots of this vegetation, particularly in late summer and autumn, the ground is almost bare. To finalize the classification of the therophytic vegetation of pseudosteppes and semi-deserts in southern Tajikistan, further studies are required.

TRA-AB01. *Cryptosporo falcatae-Brachypodietum distachyi* Świerszcz, Nobis, Swacha, Kącki, Dembicz, Waindzoch, Nowak et A. Nowak 2020 (ephemeral grasslands in colline and lower

Fig. 136. Spring aspect of grassland with *Cryptospora falcata* and *Astragalus ovczinnikovii* representing the *Diantho humilis-Velezion rigidae* alliance, found near Obikiik, Khuroson District, Tajikistan (ca. 1,040 m a.s.l.). Photo: A. Nowak.

Fig. 137. Vegetation of the *Cryptosporo falcatae-Brachypodietum distachyi* association, found near Panj, Karatau Mts, Tajikistan (ca. 420 m a.s.l.). Photo: A. Nowak.

montane belts in the south-western Pamir-Alai Mts) (Fig. 137)

Diagnostic species: *Aphanopleura capillifolia, Aristida adscensionis, Brachypodium distachyon, Cryptospora falcata, Eremurus suworowii.*
Constant species: *Avena trichophylla, Brachypodium distachyon, Cryptospora falcata, Cynodon dactylon, Euphorbia franchetii, Koelpinia linearis, Medicago rigidula, Vicia angustifolia.*
Geographical range: Like the *Eremuretum bucharici* association, this community occupies the warmest habitats in Tajikistan, however, at slightly higher elevations, mainly in the montane belt (mean elevation ca. 900 m a.s.l.) (Świerszcz et al. 2020).
Habitat characteristics: It grows on much steeper slopes within zone with higher precipitationat ca. 650 mm per year (Świerszcz et al. 2020).

TRA-ABc01. Community of *Epilasia mirabilis* (ephemeral grasslands on deep, loess soils in the Aktau and Babatag Mts in south-western Tajikistan) (Fig. 138)

Diagnostic species: *Epilasia mirabilis.*
Constant species: *Arnebia decumbens*, *Epilasia mirabilis, Koelpinia linearis, Medicago rigidula.*
Geographical range: *Epilasia mirabilis* is distributed from the Kopet-Dagh foothills in Turkmenistan to the southern Pamir-Alai in Tajikistan and the northern Hindu Kush in Afghanistan. It occurs in lowlands and the colline belt, only occasionally reaching the lower montane belt at elevation 400–1,200 m a.s l.
Habitat characteristics: This vegetation prefers the hottest, often semi-desert habitats in south-western Tajikistan. It prefers loose, permeable soils and develops stands on the border between semi-deserts and therophytic pseudosteppes. Occasionally, the large stands of *Epilasia mirabilis* have been found in anthropogenic sites such as cemeteries.

Fig. 138. Vegetation dominated by *Epilasia mirabilis* found near Panj, Aktau Mts, Tajikistan (ca. 650 m a.s.l.). Photo: M. Nobis.

Fig. 139. Thermophilous ephemeral grasslands of *Eremurus ambigens* found near Gandzhina, Tajikistan (ca. 960 m a.s.l.). Photo: F. Kuklinski.

TRA-ABc02. Community of *Eremurus ambigens* (thermophilous ephemeral grasslands of the colline belt in the south-western Pamir-Alai Mts) (Fig. 139)

Diagnostic species: *Eremurus ambigens.*
Constant species: *Arnebia decumbens*, *Eremurus ambigens, Koelpinia linearis.*

Geographical range: This community is probably distributed in the colline belt of the western Pamir-Alai, mainly in the hilly lands of the south-west Tajikistan and south-east Uzbekistan. It occurs at an elevation of ca. 350–600 m a.s.l.
Habitat characteristics: This vegetation prefers dry to mesic habitats, often with deep loess deposits. This vegetation is intensively grazed and its area of occupancy gradually decreasing.

High altitude arid halophytic graminoid vegetation

High altitude arid halophytic graminoid vegetation

PUC. Cl. *Festuco-Puccinellietea* Soó ex Vicherek 1973 (Fig. 140)

This halophytic vegetation is found throughout Central Asia, with some outposts also further west in Middle Asia, which is the warmer part of the Irano-Turanian Region with a clear Mediterranean rainfall pattern. High levels of solar radiation and salinity in the bedrock cause severe salinisation of habitats. Large salt pans, marshes and lakes are suitable habitats for halophytes and halophytic vegetation.

PUC-A. *Artemisietalia pauciflorae* Golub et Karpov in Golub, Karpov, Sorokin et Nikolaychuk 2005 (saline steppes and semi-desert grasslands in continental regions of Asia) (Fig. 141)

This halophytic vegetation inhabits the high plateaus of Central Asia, mainly the Eastern Pamir in Tajikistan and Tibet in China. It is also found in the Alai Valley, the mid-valleys of the Terskey Ala-Too Mts, and many other highly elevated locations in Central Asia. This sparse vegetation prefers alpine elevation of approx. 3,000–4,500 m a.s.l. and is mainly composed of species of the genera *Puccinellia* spp., *Taraxacum* spp., *Suaeda* spp. and *Atriplex* spp. It prefers harsh, continental climates and semi-desert conditions.

PUC-AA. *Taraxacion murgabici* Świerszcz, Nobis, Wróbel, Klichowska, Nowak et A. Nowak 2021 (halophytic, xerophytic grasslands on solonchak soils in the eastern Pamir Mts) (Fig. 142)

Diagnostic species: *Taraxacum murgabicum, Glaux maritima (= Lysimachia maritima), Carex pseudofoetida.*
Constant species: *Taraxacum murgabicum.*

Fig. 140. High altitude arid, subhalophytic vegetation with *Puccinellia humilis* and *Artemisia alba* near Yashil Lake, Kyrgyzstan (ca. 3,800 m a.s.l.). Photo: A. Nowak.

Fig. 141. Semi-desert grasslands with *Puccinellia* spp. developed on saline soils in the Eastern Pamir, Tajikistan (ca. 3,800 m a.s.l.). Photo: A. Nowak.

Fig. 142. Halophytic grasslands dominated by *Taraxacum murgabicum*, found near Murgab, Eastern Pamir, Tajikistan (ca. 3,800 m a.s.l.). Photo: A. Nowak.

Fig. 143. Halophytic vegetation of the *Knorringietum sibiricae* found near Alichur, Eastern Pamir, Tajikistan (3,650 m a.s.l.). Photo: A. Nowak.

Fig. 144. Halophytic vegetation of the *Knorringietum sibiricae* found near Murgab, Eastern Pamir, Tajikistan (3,700 m a.s.l.). Photo: M. Nobis.

Geographical range: The phytocoenoses of the *Taraxacion murgabici* alliance have been recorded in the eastern Pamir-Alai Mts and southwestern Tian Shan. They probably also occur in Tibet, northern Pakistan and northern Afghanistan on the highest plateaus.

Habitat characteristics: The communities of *Taraxacion murgabici* occupy saline habitats in humid locations in the semi-desert zone of Central Asia, mainly between (2,800–) 3,500–4,500 m a.s.l. The phytocoenoses of the alliance are typical vegetation in continental climates and extremely harsh conditions (Świerszcz et al. 2021).

PUC-AA01. *Knorringietum sibiricae* Świerszcz, Nobis, Wróbel, Klichowska, Nowak et A. Nowak 2021 (halophytic, xerophytic vegetation on gravelly substrates along rivers in the eastern Pamir Mts) (Fig. 143, 144)

Diagnostic species: *Ajania tibetica, Atriplex pamirica, Carex pseudofoetida, Dilophia salsa, Oxytropis boguschii, Knorringia sibirica* (= *Polygonum sibiricum* var. *thomsonii, P. pamiricum, Knorringia pamirica*), *Puccinellia humilis, Taraxacum murgabicum.*

Constant species: *Knorringia sibirica.*

Geographical range: Spots of this vegetation have been found in the high alpine belt with a mean elevation of approx. 4,000 m a.s.l. in the eastern Pamir (Świerszcz et al. 2021).

Habitat characteristics: This species-poor xerohalophytic vegetation occupies the driest habitat of the Eastern Pamir highlands, in close contact with mesic communities of *Puccinellia pamirica* and typical marsh species: *Carex pseudofoetida, Blysmus rufus* and *Triglochin maritimum*. It often occupies hyperhalophytic sites with gravelly or sandy substrates along small brooks and rivulets (Świerszcz et al. 2021).

PUC-AA02. *Puccinellietum pamiricae* Świerszcz, Nobis, Wróbel, Klichowska, Nowak et A. Nowak 2021 (halophytic desert vegetation on solonchak soils and muddy sediments of the Pamir Mts) (Fig. 145)

Fig. 145. Halophytic vegetation of the *Puccinellietum pamiricae* inhabiting salt pans near Alichur, Eastern Pamir, Tajikistan (3,850 m a.s.l.). Photo: A. Nowak.

Cryophilous steppe of *Stipa kirghisorum* in the Alai Valley with the view of Peak Kurumdy, Kyrgyzstan (6,614 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Chenopodium iljinii, Oxytropis lehmanni, Puccinellia pamirica, Saussurea famintziniana.*
Constant species: *Puccinellia pamirica.*
Geographical range: This type of halophilous vegetation was found to be common in the highlands of the Eastern Pamir. The average elevation of the sampled plots was ca. 3,700 m a.s.l. (Świerszcz et al. 2021).
Habitat characteristics: *Puccinellietum pamiricae* occupies more mesic habitats compared to *Knorringietum sibiricae*. It also tolerates droughts and extremely xeric periods (Świerszcz et al. 2021).

PUC-AAc01. Community of *Hordeum turkestanicum* (halophytic grassy vegetation around alpine lakes in the Pamir Mts) (Fig. 146)

Hordeum turkestanicum is a widespread species throughout Middle and Central Asia. Its optimal habitat is in the alpine belt of the Pamir-Alai and Tian Shan Mts, where it often forms a species-poor community. Particularly in the sub-halophilous habitats of the Eastern Pamir, it is a dominant species in wet marshes in the surroundings of salt lakes. It then occurs in a mosaic with cryophilous desert steppe, salt marsh and fen vegetation. The syntaxonomic position of this community is still unclear, so we highlight it in order to draw attention to its sites and to collect more data for its correct and definitive classification.

PUC-AAc02. Community of *Halerpestes sarmentosa* (halophyte mats along watercourses, alpine lakes and salt pans in Middle Asia) (Fig. 147)

Diagnostic species: *Glaux maritima, Halerpestes sarmentosa, Hygroamblystegium varium, Juncus heptopotamicus, J. turkestanicus, Lotus krylovii,*

Fig. 146. Sub-halophilous vegetation with *Hordeum turkestanicum* in the vicinity of Kara-kul Lake, Eastern Pamir, Tajikistan (ca. 3,930 m a.s.l.). Photo: A. Nowak.

Fig. 147. Halophytic vegetation dominated by *Halerpestes sarmentosa*, found in the shallow waters of Bulunkul Lake, Eastern Pamir, Tajikistan (3,750 m a.s.l.). Photo: A. Nowak.

Philonotis fontana, Potentilla anserina, Puccinellia hackeliana, Veronica anagalloides.
Constant species: *Halerpestes sarmentosa.*
Geographical range: A number of plots of the community were recorded across the alpine belts of the Pamir-Alai and Tian Shan. It has its optimum of occurrence in the upper montane and subalpine belt (mean about 1,800 m a.s.l.) (Świerszcz et al. 2021).
Habitat characteristics: The community forms dense mats around shallow, saline ponds. Sometimes, after seasonal flooding, it has a floating character similar to that of *Ranunculus natans*. It often occupies sites frequently trampled by ungulate herds, although it is relatively useless for grazing (Świerszcz et al. 2021).

PUC-AAc03. Community of *Paracolpodium leucolepis* (halophytic sparse grasslands on gravelly substrates in alpine and subnival belts of the Pamir and Tian Shan Mts)

Diagnostic species: *Cerastium pusillum, Paracolpodium leucolepis* (= *Colpodium leucolepis, = C. altaicum*), *Trollius komarovii* (= *Hegemone micrantha*), *Ranunculus pseudohirculus* (= *R. longicaulis* var. *pseudohirculus*), *Taraxacum jaschilkuliense, Valeriana minuta.*
Constant species: *Paracolpodium leucolepis.*
Geographical range: Plots of this community have been recorded in the highest reaches of the Dzhilusu Valley in the Terskey Ala-Too Mts in Kyrgyzstan with a continental, very cold but humid climate (Świerszcz et al. 2021).
Habitat characteristics: This vegetation occupies flat, muddy terraces along watercourses with low organic matter content (Świerszcz et al. 2021).

Tragacanthic, wind-swept vegetation of the alpine and subnival belts of the Irano-Turanian Region

Shrubland with *Juniperus sibirica* on the northern slopes of Kyrgyz Mts, Kyrgyzstan (ca. 2,900 m a.s.l.). Photo: A. Nowak.

Tragacanthic, wind-swept vegetation of the alpine and subnival belts of the Irano-Turanian Region

ONO. *Onobrychidetea cornuto-echidnae* Cl. nov. hoc loco

Nomenclatural type: *Onobrychidetalia echidnae* O. nov. hoc loco.

Alpine tussock grasslands of the wind-swept, semiarid habitats in the Irano-Turanian Region.

ONO-A. *Onobrychidetalia cornuto-echidnae* O. nov. hoc loco

Nomenclatural type: *Onobrychidion echidnae* All. nov. hoc loco.

This type of vegetation is found in the alpine belt of the entire Irano-Turanian Region. It is characterised by long periods of snow cover, a harsh continental climate, relatively severe summer drought and strong winds that dry out the topsoil. The dominant species that make up the physiognomy of this vegetation are often spiny, rounded, dense, and small shrubs, often known as cushion-plants. Several species belong to the *Astragalus* sect. *Tragacantha*, also known as a separate genus, *Astracantha* Podlech. Therefore, the whole formation is often referred to as tragacanth vegetation (Zohary 1973, Shmida 1977). In Middle Asia, this vegetation is mostly composed of species of the genera *Onobrychis*, *Acantholimon* and *Astaragalus*. In addition, species of the genera *Gypsophila*, *Minuartia*, *Ononis*, *Acanthophyllum* and *Euphorbia* are the most prominent contributors to this vegetation (Zohary 1973). This type of vegetation extends from Israel, through the Zagros Mts, Alborz Mts, Kopet-Dagh Mts, Pamir-Alai, Hindu Kush Mts, reaching the Tian Shan Mts in the east. Zohary divided this vegetation into three separate units: Astragaleta mediterranea, Astragaleta armeno-turcica and Astragaleta iranica, however in our opinion only two separate large units can be established for the Mediterranean and Irano-Turanian phytogeographical regions.

ONO-AA. *Onobrychidion echidnae* All. nov. hoc loco

Nomenclatural type: *Onobrychidetum echidnae* Nowak et al. 2023.

This vegetation includes the tragacanthic cushion vegetation of the mountain ranges from the Kopet-Dagh Mts, Pamir-Alai, Hindu Kush to the Tian Shan. This vegetation type needs further survey and comparative analysis, especially with dry alpine grasslands (e.g. with *Nepeta pamirica* and *Oxytropis immersa, O. savellanica*) and cryophilous desert steppes and semi-deserts (with *Stipa orientalis*, *S. glareosa*, *Ajania* spp.).

ONO-AA01. *Onobrychidetum echidnae* Nowak, Świerszcz, Nobis, Swacha et S. Nowak in Świerszcz et al. 2023 (cushion-tragacanthic alpine grasslands of the Pamir-Alai Mts; Fig. 148)

Diagnostic species: *Lomatocarpa steineri, Onobrychis echidna, Scrophularia griffithii.*
Constant species: *Cousinia franchetii, Crepis pulchra, Eremogone griffithii, Erigeron cabulicus, E. seravschanicus, Euphorbia sarawschanica, Festuca alaica, F. olgae, Gastrolychnis longicarpophora, Ligularia thomsonii, Lomatocarpa steineri, Morina coulteriana, Onobrychis echidna, Oxytropis lehmannii, Pedicularis krylowii, Poa bucharica, P. fragilis, Potentilla algida, Rhodiola heterodonta, Scrophularia griffithii, Taraxacum raikoviae.*
Geographical range: The range of *Onobrychis echidna*, the main diagnostic species, is limited to Middle Asia and Afghanistan (POWO 2023). It occurs in the Pamir-Alai and Tian Shan Mts on stony, rupicolous slopes, at elevation of 2,400–3,900 m a.s.l. (Ovchinnikov 1978). *Onobrychidetum echidnae* develops on wind-swept passes and mountain summits in Middle Asia.
Habitat characteristics: This association has been recorded mainly on the western slopes of the Anzob Pass, and the northern slope of the Peter the First Mts, at elevation ranging from 3,100 to 3,500 m a.s.l. with varying inclinations from 10° to 35° (Świerszcz et al. 2023).

Fig. 148. Alpine grassland of the *Onobrychidetum echidnae* growing near Anzob Pass, Hissar Mts, Tajikistan (3,600 m a.s.l.). Photo: A. Nowak.

Fig. 149. Vegetation of the *Acantholimetum diapensioidis* association, inhabiting gentle slope west of Murgab, Eastern Pamir, Tajikistan (ca. 4,300 m a.s.l.). Photo: A. Nowak.

Fig. 150. *Acantholimon hilariae* on a gravel slope near Jelandy, Shugnan Mts, Western Pamir, Tajikistan (ca. 3,600 m a.s.l.). Photo: A. Nowak.

ONO-AA02. *Acantholimetum diapensioidis* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (low cushion-tragacanthic alpine to subnival sparse grasslands of the high Pamir Mts) (Fig. 149)

Diagnostic species: *Acantholimon diapensioides, Draba pamirica, Lagotis decumbens, Oxytropis savellanica, Potentilla multifida.*
Constant species: *Poa litvinoviana.*
Geographical range: *Acantholimetum diapensioidis* can be defined as an alpine cushion vegetation that develops on the gentle slopes of the Kyrgyz Ala-Too Range in the North Tian-Shan (N Kyrgyzstan), and on the gentle slopes and flattened barelands of the Eastern Pamir (e.g. Shugnan Mts, Muzkol Mts) (Nowak S. et al. 2024).
Habitat characteristics: The association occurs on slopes of various exposures with an inclination of 3° to 20°, at elevation from 3,050 to 4,700 m a.s.l. (Nowak S. et al. 2024).
Remark: Within this association, a habitat variant with *Lagotis decumbens* stands out. Sites with this species develop in wetter depressions or near watercourses near Dzhiland or Akbaital Pass, at high elevation from 4,225 to 4,285 m a.s.l. They resemble subnival wet rupicolous vegetation (Nowak S. et al. 2024).

ONO-AAc01. Community of *Acantholimon hilariae* (tragacanthic vegetation of semi-arid zone in alpine belt of the eastern Pamir Mts) (Fig. 150)

Diagnostic species: *Acantholimon hilariae.*
Constant species: *Acantholimon hilariae.*
Geographical range: Community of *Acantholimon hilariae* inhabits wind-swept habitats in subhumid climate, mainly in the eastern Pamir.

Fig. 151. Cushion vegetation with *Acantholimon alatavicum* inhabiting the northern slope of Terskey Ala-Too Range, near Barskoon, Kyrgyzstan (ca. 2,950 m a.s.l.). Photo: A. Nowak.

It has also been recorded in the northern Hindu Kush in Afghanistan. The elevational amplitude of the community is in the alpine belt between 2,700 and 4,300 m a.s.l.

Habitat characteristics: The community prefers slopes and passes with gravelly skeletal soil or stable screes.

ONO-AAc02. Community of *Acantholimon alatavicum* (tragacanthic vegetation of semi-arid zone in montane and subalpine belts of the western Tian Shan Mts) (Fig. 151)

Diagnostic species: *Acantholimon alatavicum.*

Constant species: *Acantholimon alatavicum.*

Geographical range: Community of *Acantholimon alatavicum* inhabits stony slopes, mainly in the western and central Tian Shan. It is a typical species of continental climate of Central Asia. The elevation range of this community is in the alpine belt between 2,400 and 4,100 m a.s.l.

Habitat characteristics: The community prefers slopes and passes with gravelly skeletal soil or stable screes.

Mesic grasslands of the alpine belt of Middle and Central Asia

Vegetation of the irano-turanian alpine grasslands and forbs

Mesic grasslands of the alpine belt of Middle and Central Asia

FEA. *Festucetea alaico-krylovianae* Nowak, Świerszcz, S. Nowak, Nobis et M. Nobis 2024
(Fig. 152, 153)

This vegetation is structurally and ecologically similar to the European vicariant alpine and subalpine calcicolous swards of the nemoral mountain ranges of *Elyno-Seslerietea* Br.-Bl. 1948 or, to some extent, *Juncetea trifidi* (Mucina et al. 2016). In Middle and Central Asia, there is a noticeable difference in the distribution of this vegetation between Tajikistan, which is mainly outside the nemoral zone, and Kyrgyzstan, which has a typical coniferous forest belt in many mountain ranges. The specificity of alpine grasslands in Kyrgyzstan is well indicated by the proportion of endemic species, such as *Aconitum nemorum*, *Alfredia acantholepis*, *Artemisia aschurbajewi*, *Astragalus nivalis*, *Festuca alatavica*, *Hedysarum kirghisorum*, *Oxytropis ochroleuca*, *Phlomoides pratensis*, *Saussurea sordida*, *Seseli valentinae* and many others. The mesic grasslands of the alpine belt of Middle and Central Asia in the western and central Tian Shan are closely related to those further north and east, particularly in the Altai and Sayan Mts. They are species-rich and distinct, but also have a characteristic use, which is relatively intensive grazing by sheep and goats. The compositional relationship to the hemiboreal regions is reflected by a significant proportion of genera such as *Trisetum*, *Oxytropis*, *Aconitum*, *Seseli*, *Geranium*, *Bistorta*, *Phlomoides*, *Primula*. This class should include the Altai-Sayan order of alpine grasses *Festucetalia krylovii* and the Pamir-Alai-Western

Fig. 152. Alpine grasslands with *Festuca alaica* and *Trisetum spicatum* near Okmok Pass, Kyrgyzstan (ca. 3,250 m a.s.l.). Photo: A Nowak.

Fig. 153. Alpine grasslands of *Geranio saxatilis-Festucetalia alaicae* with *Paeonia intermedia* near Khoburobot Pass, Tajikistan (ca. 3,400 m a.s.l.). Photo: A. Nowak.

Tian Shan order *Geranio saxatlilis-Festucetalia alaicae* (Ermakov, Zibzeev 2012; Zibzeev, Nedovesova 2015; Nowak S. et al. 2024).

FEA-A. *Geranio saxatilis-Festucetalia alaicae* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (mesic, continental grasslands of the alpine belt of Middle and Central Asia) (Fig. 154)

Diagnostic species: *Allium oreophilum, Androsace dasyphylla, Aspicilia fruticulosa, Carex alajica, C. orbicularis, Cerastium pusillum, Dichodon cerastoides, Draba alajica, D. altaica, Dracocephalum nutans, Erigeron allochrous, E. heterochaeta, E. tianschanicus, Eritrichium villosum, Festuca alaica, F. brachyphylla, Gentiana algida, G. kirilowii, G. squarrosa, Gentianella turkestanorum, Geranium saxatile, Helictotrichon tianschanicum, Koeleria pyramidata, K. spicata, Lagotis ikonnikovii, Lomatocarpa albomarginata, Minuartia biflora, Oxytropis globiflora, O. immersa, Papaver croceum, Poa attenuata, Potentilla flabellata, P. hololeuca, P. pamiroalaica, Primula algida, Pyrethrum karelinii, Ranunculus alberti, Schmalhausenia nidulans, Schulzia crinita, Stipa trichoides, Taraxacum kovalevskiae, Trollius komarovii.*

Constant species: *Bistorta elliptica, Carex orbicularis, Dichodon cerastoides, Erigeron allochrous, Festuca alaica, Koeleria spicata, Leontopodium ochroleucum, Poa alpina, Poa litvinoviana, Schulzia crinita.*

Geographical range: Alpine belt of the northern and eastern ranges in the Irano-Turanian Region (mainly Kyrgyzstan, northern Tajikistan, Kazakhstan, Xinjang in China) (Nowak S. et al. 2024).

Habitat characteristics: This vegetation occurs in mesic habitats in the alpine belts of the Middle and Central Asian mountain ranges. These communities develop on gentle slopes or flat areas with an inclination of approx. 0–30°,

Fig. 154. Alpine short grasslands with *Festuca alaica* and *Poa litvinoviana* near Borskoon, Kyrgyzstan (ca. 3,300 m a.s.l.). Photo: A. Nowak.

well watered with mean precipitation between 500 and 1,500 mm/year. The main elevational distribution of these alpine grasslands in Middle Asia is between approx. 3,200 and 3,600 m a.s.l. (Nowak S. et al. 2024).

FEA-AA. *Poo alpinae-Bistortion ellipticae* Świerszcz, Nobis, Swacha, Nowak et A. Nowak 2023 (alpine swards and grasslands of Middle and western Central Asia) (Fig. 155)

Diagnostic species: *Carex alajica, Dichodon cerastoides, Draba altaica, Erigeron allochrous, Eritrichium villosum, Festuca alaica, Gentiana squarrosa, Koeleria spicata, Minuartia biflora, Omalotheca supina, Oxytropis immersa, Papaver croceum, Potentilla flabellata, P. hololeuca, Primula algida, Ranunculus alberti, Schulzia crinita.*
Constant species: *Androsace darvasica, Anemonastrum protractum, Astragalus kokandensis, Aulacospermum roseum, Calamagrostis anthoxanthoides, Erigeron vicarius, Geranium regelii, Helictotrichon hookeri, Myosotis alpina, Oxytropis immersa, Poa alpina, P. bucharica, Polygonum vvedenskyi, Potentilla grisea, P. vvedenskyi, Rhodiola heterodonta.*
Geographical range: *Poo alpinae-Bistortion ellipticae* includes short alpine grasslands distributed in the northern Pamir-Alai and Tian Shan Mts. This vegetation is a vicariant of the West Asian and European vegetation of the *Poion alpinae*.
Habitat characteristics: Communities of this alliance develop in relatively humid and fertile habitats of the alpine belt of many mountain ranges of Middle Asia, excluding the Eastern Pamir (Świerszcz et al. 2023). They are used as summer pastures for sheep and goats, and less commonly for horses and yaks. Patches belonging to this alliance are generally characterised by high species richness and high cover of herbs and mosses if compared with the other two alliances (Nowak S. et al. 2024).

Fig. 155. Alpine swards of *Poo alpinae-Bistortion ellipticae* near Song-köl Lake, Kyrgyzstan (ca. 3,250 m a.s.l.). Photo: A. Nowak.

FEA-AA01. *Poo alpinae-Swertietum graciliflorae* Świerszcz, Nobis, Swacha, Nowak et A. Nowak 2023 (alpine sward on moist habitats in the Hissar Mts)

Diagnostic species: *Androsace darvasica, Anemonastrum protractum, Erigeron vicarius, Klasea algida, Minuartia litwinowii, Oxytropis immersa, Poa alpina, Polygonum vvedenskyi, Potentilla crantzii, P. vvedenskyi, Swertia graciliflora.*
Constant species: *Androsace darvasica, Anemonastrum protractum, Astragalus kokandensis, Aulacospermum roseum, Calamagrostis anthoxanthoides, Cousinia franchetii, Eremogone griffithii, Erigeron vicarius, Geranium regelii, Helictotrichon hookeri, Klasea algida, Oxytropis immersa, Pedicularis krylowii, Poa alpina, P. bucharica, Polygonum vvedenskyi, Potentilla grisea, P. vvedenskyi, Rhodiola heterodonta, Swertia graciliflora.*
Geographical range: This association was found on the slopes around the Anzob Pass in the Hissar Mts at elevation between 3,100 and 3,150 m a.s.l. (Świerszcz et al. 2023).
Habitat characteristics: *Poo alpinae-Swertietum graciliflorae* forms a sward vegetation on humid habitats. It grows on slopes of varying exposure with an inclination of 20° to 30° (Świerszcz et al. 2023).

FEA-AA02. *Astragalo alpini-Linetum olgae* Świerszcz, Nobis, Swacha, Nowak et A. Nowak 2023 (subalpine mesic forb grassland of relatively dry habitats in the western and central Pamir-Alai Mts) (Fig. 156)

Diagnostic species: *Astragalus alpinus, Asyneuma argutum, Bupleurum exaltatum, Crepis darvazica, Dracocephalum integrifolium, Erysimum odoratum, Hedysarum tenuifolium, Linum olgae, Myosotis stricta, Phleum phleoides, Potentilla pedata, Silene tachtensis, Thesium alatavicum, Thymus diminutus, Tragopogon turkestanicus.*

Fig. 156. Forb-rich grassland of the *Astragalo alpini-Linetum olgae* found in the Serima River Valley, Fann Mts, Tajikistan (ca. 2,650 m a.s.l.). Photo: A. Nowak.

Constant species: *Aconogonon coriarium, Allium hymenorhizum, Asyneuma argutum, Aulacospermum roseum, Bupleurum exaltatum, Carex turkestanica, Cousinia stephanophora, Eremurus kaufmannii, Erigeron pseudoseravschanicus, Erysimum odoratum, Euphorbia sarawschanica, Gentiana olivieri, Geranium regelii, Gypsophila cephalotes, Helictotrichon hookeri, Linum olgae, Myosotis stricta, Petrorhagia alpina, Phleum phleoides, Poa pratensis, Potentilla pedata, Saussurea sordida, Stachyopsis oblongata, Stipa kirghisorum, Thesium alatavicum, Thymus diminutus, Tragopogon turkestanicus.*

Geographical range: *Astragalo alpini-Linetum olgae* is a typical alpine mesic forb grassland found on the slopes of the Fann Mts, Hissar Mts and the Peter the First Mts, at elevation from 2,600 to 3,100 m a.s.l. (Świerszcz et al. 2023).

Habitat characteristics: This vegetation forms colourful grasslands on slopes with mesic soils and moderate gravel content. It is found mainly on northern and north-eastern exposures on slopes with moderate inclinations from 15° to 30° (Świerszcz et al. 2023).

FEA-AA03. *Ligulario alpigenae-Solenanthetum karategini* Świerszcz, Nobis, Swacha, Nowak et A. Nowak 2023 (subalpine mesic to moist grassland in the western and central Pamir-Alai Mts) (Fig. 157)

Diagnostic species: *Alopecurus apiatus, Artemisia leucotricha, Astragalus lasiosemius, Bistorta elliptica, Helictotrichon tianschanicum, Ligularia alpigena, Solenanthus karateginus, Taraxacum kovalevskiae.*

Constant species: *Aconitum seravschanicum, Aconogonon coriarium, Alopecurus apiatus, Carex turkestanica, Cousinia stephanophora, Erigeron pseudoseravschanicus, Geranium regelii,*

Helictotrichon tianschanicum, Leymus alaicus, Ligularia alpigena, Myosotis alpina, Pedicularis verae, Poa bucharica, P. litvinoviana, Potentilla asiae-mediae, Pulsatilla campanella, Rhodiola heterodonta, Saussurea sordida, Solenanthus karateginus, Stachyopsis oblongata.

Geographical range: Plots of this phytocoenosis were found in the Peter the First Mts at elevation ranging from 2,850 m to 3,300 m a.s.l., in the vicinity of the village of Koshtegirmen (Świerszcz et al. 2023).

Habitat characteristics: They mainly occupy northeastern slopes with an inclination of 3° to 35° (Świerszcz et al. 2023).

FEA-AA04. *Papavero crocei-Ranunculetum popovii* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (mesic alpine grasslands of Central Asia) (Fig. 158)

Diagnostic species: *Carex alajica, Cerastium pusillum, Draba altaica, Leontopodium ochroleucum, Minuartia biflora, Papaver croceum, Potentilla flabellata, Ranunculus popovii, Schmalhausenia nidulans, Schulzia crinita, Taraxacum strizhoviae,* and *Aspicilia fruticulose.*

Constant species: *Erigeron allochrous, Festuca alaica, Gastrolychnis uralensis, Koeleria spicata, Oxytropis immersa, Poa alpina, P. litvinoviana.*

Geographical range: *Papavero crocei-Ranunculetum popovii* forms a patchy alpine grasslands used as pastures at elevation from 3,100 to 3,550 m a.s.l. on the flat areas of hilltops and passes of the Terskey Ala-Too Mts south of Lake Issyk-kul (NE Kyrgyzstan) and the Alai range (SW Kyrgyzstan) as well as on the gentle slopes of the Kyrgyz Ala-Too Mts in the North Tian-Shan (N Kyrgyzstan) (Nowak S. et al. 2024).

Fig. 157. Vegetation of the *Ligulario alpigenae-Solenanthetum karategini* found near Koshtegirmen, Peter the First Range, Tajikistan (ca. 3,200 m a.s.l.). Photo: A. Nowak.

Fig. 158. Vegetation of the *Papavero crocei-Ranunculetum popovii* found near Barskaun Pass, Terskey Ala-Too Range, Kyrgyzstan (ca. 3,550 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: This vegetation prefers south-eastern exposures and slight slope inclinations of approx. 2°–15° (Nowak S. et al. 2024).

FEA-AA05. *Poo attenuatae-Callianthemetum alatavici* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (alpine snowbed vegetation of the Tian Shan Mts) (Fig. 159)

Diagnostic species: *Bistorta vivipara, Calliantemum alatavicum, Festuca brachyphylla, Gagea michaelis, Gentiana algida, G. kirilowii, Hedysarum kirghisorum, Oxytropis trichocalycina, Poa attenuata, Ranunculus alberti, Thalictrum alpinum.*
Constant species: *Carex orbicularis, Dichodon cerastoides, Eritrichium villosum, Koeleria spicata, Leontopodium ochroleucum.*
Geographical range: *Poo attenuatae-Callianthemetum alatavici* can be classified as an alpine snow-bed vegetation. This association has been sampled in north-eastern Kyrgyzstan in the Jeti-Ögüz district of the Terskey Ala-Too Range at an elevation of 3,100 to 3,900 m a.s.l. (Nowak S. et al. 2024).
Habitat characteristics: This vegetation grows on gentle slopes or flatlands with an average inclination of approx. 9°, most often with a southern exposure. It prefers wet habitats in the close relationship with the alpine fen vegetation (Nowak S. et al. 2024).

FEA-AA06. *Drabo alajicae-Omalothecetum supinae* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (alpine short grassland of the eastern Pamir-Alai Mts (Peter the First Range) (Fig. 160)

Diagnostic species: *Aconogonon coriarium, Androsace dasyphylla, Carex turkestanica, Draba*

Fig. 159. Vegetation of the *Poo attenuatae-Callianthemetum alatavici* found in the Karakol River Valley, Kyrgyz Mts, Kyrgyzstan (ca. 3,350 m a.s.l.). Photo: A. Nowak.

Fig. 160. Vegetation of the *Drabo alajicae-Omalothecetum supinae* association found near Barskaun Pass, Terskey Ala-Too Range, Kyrgyzstan (ca. 3,450 m a.s.l.). Photo: A. Nowak.

alajica, Erigeron cabulicus, Geranium collinum, Lagotis korolkowii, Omalotheca supina, Polygonum vvedenskyi, Potentilla crantzii.

Constant species: *Eritrichium villosum, Festuca alaica, Poa litvinoviana.*

Geographical range: *Drabo alajicae-Omalothecetum supinae* forms an alpine short grassland that has been recorded in Tajikistan in the Peter the First Mts near Koshtegirman and Mok at an elevation of 3,200 to 3,500 m a.s.l. (Nowak S. et al. 2024).

Habitat characteristics: This vegetation prefers the northeastern aspect with a gentle inclination of 2° to 20° (Nowak S. et al. 2024).

FEA-AA07. *Bistorto ellipticae-Pedicularietum korolkowii* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (species-rich, dense subalpine to alpine grasslands of the western and central Tian Shan Mts) (Fig. 161)

Diagnostic species: *Bistorta elliptica, Cerastium pusillum, Crepis oreades, Draba subamplexicaulis, Dracocephalum nutans, Erigeron allochrous, E. tianschanicus, Euphorbia alatavica, Gentiana squarrosa, Koeleria spicata, Minuartia biflora, Oxytropis immersa, Pedicularis korolkowii, Poa alpina, Potentilla hololeuca, Primula algida, Rumex acetosa, Schulzia crinita.*

Constant species: *Festuca alaica, Geranium saxatile, Leontopodium ochroleucum.*

Geographical range: *Bistorto ellipticae-Pedicularietum korolkowii* is an alpine grassland that is used mainly as summer pasture for sheep. This association has been recorded on the gentle slopes of the Kyrgyz Ala-Too range (Chüy and Naryn regions in northern Kyrgyzstan) at heights ranging from 3,100 to 3,400 m a.s.l. with inclinations from 2° to 30° (mean = 10°) (Nowak S. et al. 2024).

Habitat characteristics: This vegetation grows on slopes with different exposures, mainly northeast (Nowak S. et al. 2024).

Fig. 161. High-mountain grassland of the *Bistorto ellipticae-Pedicularietum korolkowii* association found in the western part of the Karakol River Valley, Kyrgyz Mts, Kyrgyzstan (ca. 3,150 m a.s.l.). Photo: A. Nowak.

FEA-AA08. *Poo bucharicae-Oxytropidetum savellanicae* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2023 (alpine, sparse grassland of the Pamirian badlands) (Fig. 162)

Diagnostic species: *Aconogonon hissaricum, Dichodon cerastoides, Oxytropis savellanica, Poa bucharica, P. hissarica, Ranunculus rubrocalyx, R. rufosepalus, Rheum fedtschenkoi, Taraxacum raikoviae.*
Constant species: *Festuca alaica.*
Geographical range: *Poo bucharicae-Oxytropidetum savellanicae* is an alpine grassland used mainly for sheep grazing. The association has been recorded on gentle slopes and flat areas in the Zeravshan Mts (near Ayni) and the Hissar Mts (near Kalon) (Nowak S. et al. 2024).
Habitat characteristics: Plots of this phytocoenosis occupy mostly northeastern slopes with an inclination of 2° to 30° (approx. 10° on average), at elevation from 3,400 to 3,650 m a.s.l. (Nowak S. et al. 2024).

FEA-AAc01. Community of *Trollius komarovii-Erigeron heterochaeta* (alpine grassland on damp habitats in the Pamir-Alai and western Tian Shan Mts) (Fig. 163)

Diagnostic species: *Erigeron heterochaeta, Oxytropis gorbunovii, Scrophularia griffithii, Trollius komarovii.*
Constant species: *Aster alpinus* var. *serpentimontanus, Carex orbicularis, Geranium saxatile, Ranunculus alberti.*
Geographical range: The community of *Trollius komarovii-Erigeron heterochaeta* can be defined as alpine wet grassland. Patches of this phytocoenosis were found in north-eastern Kyrgyzstan in the Ak-Suu and Jeti-Ögüz districts on flatlands and the gentle slopes of the Terskey Ala-Too Range east and south of Lake Issyk-kul,

Fig. 162. Alpine grassland of the *Poo bucharicae-Oxytropidetum savellanicae* association found near the Jelandy Pass, Pamir, Tajikistan (ca. 3,550 m a.s.l.). Photo: A. Nowak.

at elevation ranging from 2,600 to 3,850 m a.s.l. (Nowak S. et al. 2024).

Habitat characteristics: This vegetation develops mainly on the north-western slopes with a slight inclination of 5° to 15° or on flatlands (Nowak S. et al. 2024).

FEA-AAc02. Community of *Phlomoides oreophila* (subalpine and alpine grasslands of the central and western Tian Shan Mts) (Fig. 164)

Diagnostic species: *Alchemilla bungei, Astragalus alpinus, Aulacospermum simplex, Cerastium tianschanicum, Festuca alatavica, Geranium regelii, Myosotis asiatica, Pedicularis ludwigii, Phlomoides oreophila, Thalictrum foetidum, Valeriana dubia, Veronica porphyriana.*

Constant species: *Geranium regelii, Phlomoides oreophila.*

Geographical range: Plots of this association were recorded in the alpine belt of the Kyrgyz and Talas Ranges in Kyrgyzstan. It was found between 2,100 and 3,500 m a.s.l. (Nowak et al. 2020b).

Habitat characteristics: It occupies gently sloping mountains in a vast area that make up the sheep pastures. It grows on fertile, deep and well-hydrated soils, often in a close relationship with mire vegetation with *Primula auriculata*, or the alpine windswept mats of *Kobresia pamiroalaica* (Nowak et al. 2020b).

FEA-AAc03. Community of *Carum carvi-Hordetum turkestanicum* (alpine grassland on damp habitats in the Pamir-Alai and Tian Shan Mts) (Fig. 165)

Diagnostic species: *Alopecurus pratensis, Carum carvi, Hordeum turkestanicum, Potentilla asiaemediae, Tragopogon turkestanicus.*

Constant species: *Alopecurus pratensis, Carum carvi, Festuca pratensis, Geranium regelii, Hordeum turkestanicum, Medicago falcata, Poa pratensis.*

Fig. 163. Vegetation patch of the community with *Trollius komarovii* and *Erigeron heterochaeta* found near Ikazak, Alai Valley, Kyrgyzstan (ca. 3,480 m a.s.l.). Photo: A. Nowak.

Fig. 164. Vegetation of *Phlomoides oreophila* community found near Otmok Pass, Suusamyr Valley, Kyrgyz Mts, Kyrgyzstan (ca. 2,750 m a.s.l.). Photo: A. Nowak.

Fig. 165. Alpine grassland of the *Carum carvi-Hordetum turkestanicum* community, found near Kara-Unkur, On-Archa River Valley, Kyrgyzstan (ca. 2,480 m a.s.l.). Photo: A. Nowak.

Geographical range: The community of *Hordeum turkestanicum* creates dense stands at the upper montane belt in the Pamir-Alai and Tian Shan Mts.
Habitat characteristics: This vegetation occupies the wettest sites in the valley bottoms or on flat terraces and gentle slopes with peaty soils. This community shows considerable resemblance to fen vegetation (Świerszcz et al. 2020).

FEA-AAc04. Community of *Oxytropis incanescens* (subnival to alpine swards of the eastern Pamir Mts)

Diagnostic species: *Oxytropis incanescens.*
Constant species: *Oxytropis incanescens.*
Geographical range: The community has been recorded in the high alpine and subnival belt (3,800–4,700 m a.s.l.) of the Eastern Pamir in Tajikistan (Ovchinnikov 1978).
Habitat characteristics: The community of *Oxytropis incanescens* inhabits loamy or gravelly slopes at the highest elevations in the harsh, continental climate of the Pamirian Plateau.

FEA-AAc05. Community of *Oxytropis lehmannii* (subnival to alpine swards of the western Pamir-Alai Mts) (Fig. 166)

Diagnostic species: *Oxytropis lehmannii.*
Constant species: *Oxytropis lehmannii.*
Geographical range: It is a vicariant type of high alpine matt community to the previous one. It inhabits the high alpine belt between 2,300 and 4,000 m a.s.l. of the Pamir-Alai ranges (Ovchinnikov 1978).
Habitat characteristics: The community of *Oxytropis lehmannii* inhabits gravelly or loamy slopes in the subhumid, but still summer dry zone, mainly of the Zeravshan, Hissar, Karateginian,

Fig. 166. Subnival sward of *Oxytropis lehmannii* near Mutnoe Lake in Fann Mts, Tajikistan (ca. 3,600 m a.s.l.). Photo: A. Nowak.

Fig. 167. *Lloydia serotina* growing on a gentle slope near Mutnoe Lake, Fann Mts, Tajikistan (ca. 3,500 m a.s.l.). Photo: A. Nowak.

Peter the First and Hazratishokh Mts. Further surveys and revisions are required for the final classification of these communities as they occur in similar habitats such as the tragacanth cushion vegetation of the Irano-Turanian Region.

FEA-AAc06. Community of *Oxytropis michelsonii* (subnival to alpine swards of the Zeravshan Mts)

Diagnostic species: *Oxytropis michelsonii.*
Constant species: *Oxytropis michelsonii.*
Geographical range: Like the previous two communities, stands of *Oxytropis michelsonii* inhabit the high alpine belt of the western Pamir-Alai Mts, occupying slightly lower locations between 2,100 and 3,300 m a.s.l. of the Pamir-Alai ranges (Ovchinnikov 1978).
Habitat characteristics: The community of *Oxytropis michelsonii* inhabits gravelly or loamy slopes in the subhumid, summer dry zone, mainly of the Zeravshan Mts. The community exhibits some common features with the tragacanth vegetation of the alpine, wind-swept habitats of the Irano-Turanian Region.

FEA-AAc07. Community of *Lloydia serotina* (subnival to alpine swards of the snow-beds in Middle and Central Asia) (Fig. 167)

Diagnostic species: *Lloydia serotina.*
Constant species: *Lloydia serotina.*
Geographical range: This small patchy meadow-like short grassland is scattered throughout the mountains of Middle and Central Asia. It inhabits slopes and summits in the alpine belt between 3,500 and 4,000 m a.s.l. (Ovchinnikov 1963).
Habitat characteristics: The community of *Lloydia serotina* inhabits mesic, loamy slopes, close to the snow bed or *Kobresia* mat vegetation.

FEA-AB. *Aconito rotundifolii-Potentillion pamiroalaicae* Nowak, Swacha, Świerszcz, S. Nowak et Nobis in Swacha et al. 2023 (mesic alpine and subalpine grasslands of Irano-Turanian Region, mainly northern and eastern Middle Asia) (Fig. 168)

Diagnostic species: *Alchemilla tianschanica, Bistorta elliptica, Cerastium pusillum, Erigeron tianschanicus, Geranium saxatile, Pedicularis korolkowii, Potentilla nervosa, P. pamiroalaica, Primula algida, Thalictrum simplex, Trisetum spicatum.*
Constant species: *Bistorta elliptica, Geranium saxatile, Myosotis asiatica, Phlomoides oreophila.*
Geographical range: Alpine and subalpine belts of the northern and eastern ranges of the Irano-Turanian Region (mainly Kyrgyzstan, northern Tajikistan, Kazakhstan).

Habitat characteristics: This vegetation occurs in the mesic habitats of the subalpine and alpine belts of Middle Asian mountain ranges, mainly the Tian Shan, the northern Pamir-Alai, and probably also the Altai. The communities develop on slopes with an inclination of approx. 5–40° and also on mountain summits and passes at an elevation of approx. 1,900–3,700 m a.s.l. (Swacha et al. 2023).

FEA-AB01. *Potentillo pamiroalaicae-Pedicularidetum allorramphae* Swacha, Świerszcz, Nowak, Nobis et A. Nowak 2023 (short alpine swards of the central Tian Shan Mts in Kyrgyzstan) (Fig. 169)

Diagnostic species: *Cerastium tianschanicum, Galium turkestanicum, Pedicularis allorrhampha, Trifolium repens.*
Constant species: *Agrostis turkestanica, Alchemilla tianschanica, Astragalus alpinus, Cerastium*

Fig. 168. Subalpine grasslands with *Helictotrichon hookeri* and *Phlomoides oreophila* near Sary-Bulak, Kyrgyzstan (ca. 2,850 m a.s.l.). Photo: A. Nowak.

Fig. 169. Vegetation of the *Potentillo pamiroalaicae-Pedicularidetum allorramphae* association found north of Kazan-Kuyganin, Ters-suu Valley, Naryn District, Kyrgyzstan (ca. 3,170 m a.s.l.). Photo: A. Nowak.

tianschanicum, Dracocephalum nutans, Euphorbia alatavica, Galium turkestanicum, Minuartia biflora, Pedicularis allorrhampha, P. korolkowii, Potentilla pamiroalaica, Primula algida, Thymus incertus, Trifolium repens, Trisetum spicatum.

Geographical range: Stands of this association have been found at an elevational range of 2,300–3,350 m a.s.l. in northeastern (Talas Alatau Mts, Fergana Mts, and Kyrgyz Mts) and central Kyrgyzstan (near alpine lake Song-köl) (Swacha et al. 2023).

Habitat characteristics: This association usually occupies gentle slopes and sporadically develops on slopes with steeper inclinations (Swacha et al. 2023).

FEA-AB02. *Scutellario oligodontae-Hedysaretum narynense* Swacha, Świerszcz, Nowak, Nobis et A. Nowak 2023 (species rich alpine swards of warmer habitats in the central Tian Shan Mts) (Fig. 170)

Diagnostic species: *Adenophora himalayana, Androsace lactiflora, Carex stenophylla* subsp. *stenophylloides, Cirsium sieversii, Dracocephalum discolor, D. nodulosum, Elymus czimganicus, Elytrigia gmelinii, Erysimum altaicum, Festuca amblyodes, Hedysarum narynense, Helictotrichon hookeri, Ligularia knorringiana, Pedicularis ludwigii, Plantago arachnoidea, Potentilla asiae-mediae, P. nervosa, Psathyrostachys kronenburgii, Pyrethrum karelinii, Scutellaria oligodonta, Thalictrum simplex, Thesium alatavicum.*

Constant species: *Androsace lactiflora, Artemisia viridis, Aster alpinus* var. *serpentimontanus, Bupleurum densiflorum, Carex stenophylla* subsp. *stenophylloides, Cirsium sieversii, Dracocephalum discolor, D. nodulosum, Elymus czimganicus, Elytrigia gmelinii, Festuca amblyodes, Galium pamiroalaicum, Geranium saxatile, Hedysarum narynense, Helictotrichon hookeri, Leontopodium ochroleucum, Ligularia knorringiana, Lomelosia alpestris, Oxytropis globiflora, Pedicularis ludwigii,*

Fig. 170. Alpine swards of the *Scutellario oligodontae-Hedysaretum narynense* found near Sary-Bulak, Terskey Ala-Too Range, Kyrgyzstan (ca. 2,800 m a.s.l.). Photo: A. Nowak.

Phlomoides oreophila, Plantago arachnoidea, Potentilla asiae-mediae, P. nervosa, Pyrethrum karelinii, Scutellaria oligodonta, Thalictrum simplex, Thesium alatavicum.

Geographical range: Stands of this association have been reported from the Dolon Pass, which is located in the alpine and subalpine belts between the Song-köl Too Mts and the Bayduluu Range in the Naryn region, near Lake Song-köl in central Kyrgyzstan. This vegetation type was found within a very narrow elevation range of 2,800–3,000 m a.s.l. (Swacha et al. 2023).

Habitat characteristics: The association was recorded on steep slopes with mesic topsoil and moderate inclination of ca. 20–30° (Swacha et al. 2023).

FEA-AB03. *Aulacospermo tianschanici-Pulsatilletum campanulae* Swacha, Świerszcz, Nowak, Nobis et A. Nowak 2023 (species-rich subalpine to alpine grassland of the Tian Shan and northern Pamir-Alai Mts) (Fig. 171)

Diagnostic species: *Aulacospermum tianschanicum, Elymus czimganicus, Helictotrichon desertorum, Jurinea lanipes, Oxytropis melanotricha, Poa litvinoviana, Pulsatilla campanella, Thymus incertus.*

Constant species: *Artemisia viridis, Aulacospermum tianschanicum, Elymus czimganicus, Erigeron tianschanicus, Euphrasia drosophylla, Festuca alaica, Gentiana kirilowii, G. squarrosa, Gentianella turkestanorum, Geranium saxatile, Helictotrichon desertorum, Kobresia persica, Leontopodium ochroleucum, Myosotis asiatica, Oxytropis globiflora, O. melanotricha, Pedicularis korolkowii, Phlomoides oreophila, Poa litvinoviana, Potentilla asiae-mediae, Pulsatilla campanella, Silene graminifolia, Thymus incertus.*

Geographical range: This association is distributed in the northern parts of Kyrgyzstan in the alpine belt of the Kyrgyz range, around the Dolon Pass near Lake Song-köl and Terskey Ala-Too

Fig. 171. High-mountain grassland of the *Aulacospermo tianschanici-Pulsatilletum campanulae* found near Otmok Pass, Suusamyr Valley, Kyrgyz Mts, Kyrgyzstan (ca. 2,900 m a.s.l.). Photo: A. Nowak.

Fig. 172. High-mountain grassland of the *Seselio tallasici-Caricetum alajicae* found near Manas, Talas Mts, Kyrgyzstan (ca. 3,200 m a.s.l.). Photo: A. Nowak.

to the south of Lake Issyk-kul at elevations ranging from 2,700–3,200 m a.s.l. (Swacha et al. 2023).
Habitat characteristics: The vegetation occurs on slopes of varying inclinations from almost flat surfaces to moderately steep slopes up to 25° (Swacha et al. 2023).

FEA-AB04. *Seselio tallasici-Caricetum alajicae* Swacha, Świerszcz, Nowak, Nobis et A. Nowak 2023 nom. corr. (mesic alpine and subalpine grasslands mainly on northern slopes of the western and central Tian Shan Mts) (Fig. 172)

Diagnostic species: *Allium hymenorhizum, Astragalus alpinus, Campanula glomerata, Carex alajica, Delphinium oreophilum, Ligularia thomsonii, Phlomoides oreophila, Rumex acetosa, Seseli talassicum, Trollius dschungaricus.*
Constant species: *Allium hymenorhizum, Bistorta elliptica, Carex alajica, Galium pamiroalaicum, Geranium saxatile, Myosotis asiatica, Parnassia laxmannii, Phlomoides oreophila, Poa pratensis, Seseli talassicum, Thalictrum simplex.*
Geographical range: The association is widespread across Kyrgyzstan and is one of the most common plant communities in the group of mesic alpine and subalpine grasslands. It occurs in the subalpine and alpine belts over a wide elevational range from 2,355–3,299 m a.s.l. (Swacha et al. 2023).
Habitat characteristics: The association develops mainly on north-facing moderately steep slopes with an inclination of about 20° (Swacha et al. 2023).

FEA-AB05. *Poo alpinae-Eritrichietum villosae* Swacha, Świerszcz, Nowak, Nobis et A. Nowak 2023 (species rich, moderately dense subalpine to alpine sward of the western Tian Shan Mts, mainly Kyrgyz and Talas Mts) (Fig. 173)

Fig. 173. Vegetation of the *Poo alpinae-Eritrichietum villosae* found in the Barskoon Valley, Terskey Ala-Too Range, Kyrgyzstan (ca. 2,850 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Aconitum rotundifolium, Alchemilla sibirica, Carex orbicularis, Cerastium pusillum, Crepis oreades, Dichodon cerastoides, Draba subamplexicaulis, Dracocephalum nutans, Eremogone meyeri, Erigeron allochrous, E. aurantiacus, Eritrichium villosum, Euphrasia drosophylla, Festuca alaica, Lomatocarpa albomarginata, Minuartia biflora, Oxytropis melanotricha, Papaver croceum, Pedicularis korolkowii, Potentilla hololeuca, P. pamiroalaica, Primula algida, Rumex acetosa, Trisetum spicatum.*

Constant species: *Aconitum rotundifolium, Bistorta elliptica, Carex orbicularis, Cerastium pusillum, Crepis oreades, Dracocephalum nutans, Erigeron allochrous, E. tianschanicus, Eritrichium villosum, Euphorbia alatavica, Euphrasia drosophylla, Festuca alaica, Gastrolychnis uralensis, Gentiana squarrosa, Gentianella turkestanorum, Geranium saxatile, Leontopodium ochroleucum, Ligularia alpigena, Minuartia biflora, Myosotis asiatica, Oxytropis melanotricha, Papaver croceum, Pedicularis korolkowii, Poa alpina, Potentilla pamiroalaica, Primula algida, Rumex acetosa, Trisetum spicatum.*

Geographical range: This association is distributed mainly in the Kyrgyz Mts but has also been recorded in the surroundings of Lake Song-köl in Central Kyrgyzstan. It was found at an elevation range from 2,800 to 3,350 m a.s.l. (Swacha et al. 2023).

Habitat characteristics: The vegetation occurs on slopes with different inclinations, from flat to very steep with an inclination of 40° (Swacha et al. 2023).

FEA-AB06. *Kobresio capillifoliae-Hedysaretum kirghisori* Swacha, Świerszcz, Nowak, Nobis et A. Nowak 2023 (forb mat vegetation of the alpine belt of the central and western Tian Shan Mts) (Fig. 174)

Fig. 174. Vegetation of the *Kobresio capillifoliae-Hedysaretum kirghisori* found between the Song-köl Too Mts and the Bayduluu Range, Naryn District, Kyrgyzstan (ca. 3,200 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Bistorta vivipara, Festuca alatavica, Hedysarum kirghisorum, Kobresia capillifolia, Myosotis asiatica, Parnassia laxmannii, Ptilagrostis malyschevii, Sibirotrisetum sibiricum.*
Constant species: *Bistorta vivipara, Euphorbia alatavica, Festuca alatavica, F. amblyodes, Gastrolychnis uralensis, Kobresia capillifolia, Leontopodium ochroleucum, Ligularia alpigena, Myosotis asiatica, Oxytropis globiflora, Parnassia laxmannii, Phlomoides oreophila.*
Geographical range: The association has been recorded mainly from the vicinity of Song-köl alpine lake in central Kyrgyzstan, but also from several sites in the Terskey Ala-Too and At-Bashy ranges at an elevational of 2,865–3,470 m a.s.l. (Swacha et al. 2023).
Habitat characteristics: It develops on gentle slopes, usually with an inclination of about 10°, on shallow and dry soils (Swacha et al. 2023).

FEA-AB07. *Seselio valentinae-Oxytropidetum atbaschi* Swacha, Świerszcz, Nowak, Nobis et A. Nowak 2023 nom. corr. (species-poor, intensively grazed alpine grassland of the southern Tian Shan Mts) (Fig. 175)

Diagnostic species: *Allium oreoprasum, Androsace fedtschenkoi, Artemisia viridis, Astragalus nivalis, Eremopyrum distans, Goniolimon orthocladum, Hedysarum krylovii, Lappula stricta, Oxytropis atbaschi, O. ruebsaamenii, Poa relaxa, Seseli valentinae, Stipa caucasica, S. subsessiliflora.*
Constant species: *Allium oreoprasum, Androsace fedtschenkoi, Artemisia viridis, Astragalus nivalis, Eremopyrum distans, Lappula stricta, Oxytropis atbaschi, O. ruebsaamenii, Potentilla pamiroalaica, Seseli valentinae, Stipa caucasica, S. subsessiliflora.*
Geographical range: This association has been recorded in the At-Bashy Mts in southern Kyr-

Fig. 175. Alpine grassland of the *Seselio valentinae-Oxytropidetum atbaschi* found in the Tash Rabat Valley, At-Basi Mts, Kyrgyzstan (ca. 3,150 m a.s.l.). Photo: A. Nowak.

Fig. 176. Vegetation of the *Oxytropis globiflora* and *Leontopodium ochroleucum* community found near Barskoon, Terskey Ala-Too Range, Kyrgyzstan (ca. 3,450 m a.s.l.). Photo: A. Nowak.

gyzstan within a narrow elevation range of 2,917–3,105 m a.s.l. (Swacha et al. 2023).

Habitat characteristics: It develops on stony and overgrazed habitats on gentle and moderately steep slopes with an inclination of 10–20° (Swacha et al. 2023).

FEA-ABc01. Community of *Oxytropis globiflora* and *Leontopodium ochroleucum* (short and moderately dense swards on gravelly habitats of alpine to subnival belts of the western and central Tian Shan Mts) (Fig. 176)

Diagnostic species: *Androsace lactiflora, Leontopodium ochroleucum, Oxytropis globiflora, Potentilla tephroleuca.*

Constant species: *Artemisia viridis, Aster alpinus* var. *serpentimontanus, Erigeron tianschanicus, Euphrasia drosophylla, Festuca amblyodes, Gentiana squarrosa, Gentianella turkestanorum, Geranium saxatile, Helictotrichon hookeri, Kobresia persica, Leontopodium ochroleucum, Oxytropis globiflora, Potentilla asiae-mediae, Potentilla tephroleuca, Pulsatilla campanella.*

Geographical range: This widespread plant community has been recorded in all mountain ranges except the Kyrgyz Range. It develops in the alpine belt at elevations ranging from 2,890 to 3,700 m a.s.l. (Swacha et al. 2023).

Habitat characteristics: The community usually develops on flat surfaces or gentle slopes in the alpine belt (Swacha et al. 2023).

Group of shrubby subalpine chionophilous heaths of Middle Asia (Fig. 177)

FEA-AB08. *Caraganetum jubatae* Swacha, Świerszcz, Nowak, Nobis et A. Nowak 2023

Fig. 177. Slopes of the Suusamyr Valley covered with shrub vegetation of the *Caraganetum aurantiacae* association, Suusamyr Valley, Kyrgyzstan (ca. 2,200–3,400 m a.s.l.). Photo: A. Nowak.

(chionophilous shrubland of wet habitats of the northern Pamir-Alai and Tian Shan Mts) (Fig. 178)

Diagnostic species: *Aconitum nemorum, Aconogonon alpinum, Astragalus lepsensis, Caragana jubata, Carex melanantha, C. regeliana, Elymus longearistatus, Festuca pratensis, Geranium saxatile, Lonicera semenovii, Phlomoides pratensis, Polygonatum roseum, Valeriana ficariifolia.*
Constant species: *Bistorta elliptica, Campanula glomerata, Caragana jubata, Codonopsis clematidea, Elymus longearistatus, Festuca alatavica, Geranium saxatile, Hordeum brevisubulatum, Lamium album, Ligularia alpigena, Myosotis asiatica, Papaver croceum, Parnassia laxmannii, Phlomoides oreophila, P. pratensis, Valeriana ficariifolia.*
Geographical range: *Caraganetum jubatae* occurs in the subalpine and alpine belts around Lake Song-köl and the Terskey Ala-Too Mts at elevations of 2,608–3,431 m a.s.l. Its general range may include the Altai, the southern Siberian Mts, the Himalayas and Qinghay-Tibet (Swacha et al. 2023).
Habitat characteristics: The association mainly develops on steep slopes with inclinations ranging from 10 to 35° (Swacha et al. 2023).

FEA-AB09. *Caraganetum aurantiacae* Swacha, Świerszcz, Nowak, Nobis et A. Nowak 2023 (chionophilous shrubland of wet habitats of the western Tian Shan Mts (mainly Suusamyr Valley) (Fig. 179)

Diagnostic species: *Aconitum leucostomum, A. soongaricum, Allium fedtschenkoanum, Alopecurus pratensis, Bryum pseudotriquetrum, Caragana aurantiaca, Carex karoi, C. orbicularis, Cerastium falcatum, Galium tianschanicum, Hygroamblystegium varium, Ligularia heterophylla, Philonotis fontana, Rumex paulsenianus,*

Fig. 178. Thorny shrubs of the *Caraganetum jubatae* found near Karakyr Pass, Terskey Ala-Too Range, Kyrgyzstan (ca. 3,450 m a.s.l.). Photo: M. Nobis.

Fig. 179. Dense thicket vegetation of the *Caraganetum aurantiacae* association, found near Alabel Pass, Suusamyr Valley, Kyrgyz Mts, Kyrgyzstan (ca. 2,500 m a.s.l.). Photo: A. Nowak.

Seseli mucronatum, Thalictrum simplex, Valeriana ficariifolia.

Constant species: *Aconitum leucostomum, A. soongaricum, Allium fedtschenkoanum, Alopecurus pratensis, Artemisia dracunculus, Bryum pseudotriquetrum, Campanula glomerata, Caragana aurantiaca, Carex karoi, C. orbicularis, Cerastium falcatum, Galium pamiroalaicum, G. tianschanicum, Geranium saxatile, Hygroamblystegium varium, Ligularia heterophylla, Myosotis asiatica, Philonotis fontana, Phleum pratense, Poa pratensis, Rumex paulsenianus, Seseli mucronatum, Thalictrum simplex, Valeriana ficariifolia.*

Geographical range: This association was only recorded from the Kyrgyz Mts within a narrow elevational range of 2,550–2,650 m a.s.l. It can also occur in the Hindu Kush and throughout the Tian Shan (Swacha et al. 2023).

Habitat characteristics: *Caraganetum aurantiacae* is mostly situated on gentle and east-facing slopes. This association prefers peaty soils that retain moisture throughout the year. It also forms dense thickets along mountain streams in U-shaped glacial valleys (Swacha et al. 2023).

Chionophilous summit graminoid and dwarf-scrub mountain tundra in the alpine and subnival belts

Chionophilous summit graminoid and dwarf-scrub mountain tundra in the alpine and subnival belts

KOB. *Carici rupestris-Kobresietea bellardii* Ohba 1974 (Fig. 180)

This vegetation extends around the Arctic zone of the globe and in the alpine belts of the temperate and Mediterranean mountain ranges. In Middle and Central Asia, these wind-swept short mats and grasslands are found mainly in the northern part of the region, with a predominance in the horse husbandry area (Kyrgyzstan and Kazakhstan). However, smaller areas of this vegetation have also been recorded in the Pamir-Alai mountain ranges, which have a typically Mediterranean climate.

KOB-A. *Kobresietalia capilliformis* Tsepkova 1987 (chionophilous graminoid and dwarf-shrub tundra in the alpine and subnival belts) (Fig. 181)

These typical Kobresia-dominated mats are found across Tian Shan and northern Pamir-Alai. In this area *Kobresia capillifolia*, *K. pamiroalaica*, *K. stenocarpa* and *K. persica* have their ranges and are the main contributors to this dense mats. This vegetation is mainly grazed by horses and yaks.

KOB-AA. *Stipo regelianae-Ptilagrostion malyschevii* Nowak, Swacha, Świerszcz, S. Nowak et Nobis in Swacha et al. 2023 (mat grasslands of alpine and subnival belts of the eastern Irano-Turanian Region) (Fig. 182)

Diagnostic species: *Aster alpinus* var. *serpentimontanus, Bistorta vivipara, Gentiana kirilowii, Gentiana squarrosa, Kobresia persica, Leontopodium ochroleucum, Oxytropis globiflora, Plantago griffithii, Potentilla moorcroftii, P. tephroleuca, Ptilagrostis malyschevii, Thalictrum alpinum, Trisetum altaicum.*
Constant species: *Aster alpinus* var. *serpentimontanus, Festuca amblyodes, Gentiana kirilowii,*

Fig. 180. Vegetation of *Carici rupestris-Kobresietea bellardii* dominating the landscape north of Kazan-Kuyganin, Ters-suu Valley, Naryn District, Kyrgyzstan (ca. 3,000–3,500 m a.s.l.). Photo: A. Nowak.

Fig. 181. Chionophilous graminoid matt of *Kobresia persica* and *K. pamiroalaica* in the alpine belt of Terskey Ala-Too Mts near Barskoon, Kyrgyzstan (ca. 3,500 m a.s.l.). Photo: A. Nowak.

Fig. 182. Grassland vegetation of the *Stipo regelianae-Ptilagrostion malyschevii* alliance near the Song-köl Lake, Kyrgyzstan (ca. 3,300 m a.s.l.). Photo: M. Nobis.

G. squarrosa, Kobresia persica, Leontopodium ochroleucum, Myosotis asiatica, Oxytropis globiflora, Parnassia laxmannii, Potentilla tephroleuca.
Geographical range: Alpine belt of the northern and eastern mountain ranges in the Irano-Turanian Region (mainly Kyrgyzstan, northern Tajikistan, Kazakhstan) (Swacha et al. 2023).
Habitat characteristics: This vegetation occurs in mesic habitats in the alpine belts of Middle and Central Asian mountain ranges, mainly Tian Shan, northern Pamir-Alai, and also Altai. The communities develop on slopes with an inclination of approx. 5–30° and additionally on mountain summits and passes at an elevation of approx. 2,200–4,000 m a.s.l. It also occurs in alpine U-shaped valleys of brooks and streams. It covers vast areas and dominates the landscape of northern Middle and Central Asia (Swacha et al. 2023).

KOB-AA01. *Potentillo moorcroftii-Stipetum tremulae* Swacha, Świerszcz, Nowak, Nobis et A. Nowak 2023 (graminoid swards of the alpine and subnival belts of the central and eastern Tian Shan Mts) (Fig. 183)

Diagnostic species: *Bistorta vivipara, Kobresia persica, Plantago griffithii, Potentilla moorcroftii, Stipa tremula, Thalictrum alpinum.*
Constant species: *Aster alpinus* var. *serpentimontanus, Bistorta vivipara, Gentiana kirilowii, G. squarrosa, Kobresia persica, Leontopodium ochroleucum, Oxytropis globiflora, Potentilla moorcroftii, Pulsatilla campanella.*
Geographical range: *Potentillo moorcroftii-Stipetum tremulae* is the vegetation of alpine belts at elevations ranging from 2,850–3,450 m a.s.l. This association has been documented in the area of the Dolon Pass between the Song-köl Too Mts and the Bayduluu Mts, and in the area of the Sarymoynak Pass to the south of Issyk-kul Lake in the Terskey Ala-Too Mts in Kyrgyzstan, within the range of diagnostic species *S. tremula* (Nobis et al. 2022; Swacha et al. 2023).

Fig. 183. Alpine sward vegetation of the *Potentillo moorcroftii-Stipetum tremulae* found near Barskoon, Terskey Ala-Too Range, Kyrgyzstan (ca. 3,250 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: It develops on gentle slopes and flat surfaces. It forms compact, dense mats that are relatively intensively grazed by sheep (Swacha et al. 2023).

KOB-AA02. *Ptilagrostio malyschevii-Trisetetum altaici* Swacha, Świerszcz, Nowak, Nobis et A. Nowak 2023 (graminoid swards of the alpine belt of the central Tian Shan Mts) (Fig. 184)

Diagnostic species: *Artemisia aschurbajewi, Carex stenocarpa, Euphorbia alatavica, Festuca amblyodes, Gastrolychnis uralensis, Gentiana kirilowii, Helictotrichon hookeri, Kobresia persica, Leontopodium ochroleucum, Parnassia laxmannii, Poa litvinoviana, Potentilla tephroleuca, Ptilagrostis malyschevii, Ranunculus rubrocalyx, Trisetum altaicum, Trollius dschungaricus.*
Constant species: *Artemisia aschurbajewi, Bistorta elliptica, Carex alajica, Euphorbia alatavica, Euphrasia drosophylla, Festuca alatavica, F. amblyodes, Galium pamiroalaicum, Gastrolychnis uralensis, Gentiana kirilowii, G. squarrosa, Helictotrichon hookeri, Kobresia capillifolia, K. persica, Leontopodium ochroleucum, Ligularia alpigena, Myosotis asiatica, Oxytropis globiflora, Parnassia laxmannii, Pedicularis korolkowii, Poa litvinoviana, P. pratensis, Potentilla tephroleuca, Ptilagrostis malyschevii, Ranunculus rubrocalyx, Trisetum altaicum, Trollius dschungaricus, Tulipa dasystemon.*
Geographical range: This association of *Ptilagrostio malyschevii-Trisetetum altaici* has only been recorded from the near vicinity of the alpine Song-köl Lake in central Kyrgyzstan at a narrow elevational range of 3,100–3,200 m a.s.l. (Swacha et al. 2023).
Habitat characteristics: It develops on shallow soils around limestone rock outcrops on gentle slopes and flat surfaces with an average inclination of 3° (Swacha et al. 2023).

KOB-AA03. *Violo thianschanicae-Stipetum regelianae* Nowak, Świerszcz, Nobis, Swacha

Fig. 184. Vegetation of the *Ptilagrostio malyschevii-Trisetetum altaici* association found near Song-köl Lake, Kyrgyzstan (ca. 3,080 m a.s.l.). Photo: A. Nowak.

et A. Nowak 2024 (graminoid short swards of the alpine and subnival belts on damp habitats of the central Tian Shan and the Pamir Mts) (Fig. 185)

Diagnostic species: *Astragalus lepsensis, Bryum pseudotriquetrum, Carex haematostoma, C. melanantha, Dasiphora parvifolia, Draba oreades, Gentiana tianschanica, Helictotrichon mongolicum, Kobresia capilliformis, K. pamiroalaica, Leontopodium ochroleucum, Oxytropis gorbunovii, Parnassia laxmannii, Phlomoides pratensis, Ptilagrostis malyschevii, Sanguisorba officinalis, Stipa regeliana, Thalictrum alpinum, Viola thianschanica.*
Constant species: *Bistorta elliptica.*
Geographical range: *Violo thianschanicae-Stipetum regelianae* forms alpine and subnival mats or short grasslands dominated by graminoids. This vegetation serves as alpine summer pasture of the Terskey Ala-Too Range (the Jeti-Ögüz and Ak-Suu districts of the Issyk-kul Region) and near Kara-Unkur (the Kochkor district of the Naryn region). The plots were sampled at an elevation of 2,800–3,450 m a.s.l., with varying slope exposures in northeastern Kyrgyzstan (Nowak S. et al. 2024).
Habitat characteristics: The inclination of the slopes was low and ranged between 3° and 35° (Nowak S. et al. 2024).

KOB-AAc01. Community of *Festuca tianschanica* (graminoid swards of the alpine belt of Central Asia – mainly the Hindu Kush, Karakoram and Tian Shan Mts) (Fig. 186)

Diagnostic species: *Festuca tianschanica.*
Constant species: *Festuca tianschanica.*
Geographical range: This community is quite common in northern Kyrgyzstan and throughout the central Tian Shan. It develops in the alpine belt at an elevation of 2,500–3,750 m a.s.l. on gentle slopes with varying exposures.

Fig. 185. Vegetation of the *Violo thianschanicae-Stipetum regelianae* found north of Kazan-Kuygan, Naryn District, Kyrgyzstan (ca. 3,450 m a.s.l.). Photo: A. Nowak.

Fig. 186. Community of *Festuca tianschanica* in alpine belt of Terskey Ala-Too Mts, Kyrgyzstan (ca. 3,500 m a.s.l.). Photo: A. Nowak.

Fig. 187. Community of *Leucopoa olgae* on steep, stony slope in the alpine belt of Terskey Ala-Too Mts, Kyrgyzstan (ca. 3,400 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: Community of *Festuca tianschanica* forms stands on gentle or moderately steep, mesic slopes, in the alpine belt of Central Asia. Occasionally it also inhabits the pebble screes or even a boulder fields. This vegetation is mainly grazed by horses and yaks.

KOB-AAc02. Community of *Leucopoa olgae* (intensively grazed swards of the alpine belt of Central Asia – mainly the Hindu Kush, Karakoram and Tian Shan Mts) (Fig. 187)

Diagnostic species: *Leucopoa olgae.*
Constant species: *Leucopoa olgae.*

Geographical range: This community inhabits southern Tian Shan ranges, Karakoram, Eastern Pamir, Western Himalayas and northern Hindu Kush Mts. It develops in the alpine belt at an elevation of ca. 2,500–4,000 m a.s.l. on steep slopes with varying exposures.
Habitat characteristics: Community of *Leucopoa olgae* develops on grazed slopes with considerable inclination. It inhabits places with stony topsoil in the alpine and sometiomes also subnival belts of Central Asia. Occasionally, it also inhabits the boulder fields or rock ledges. This vegetation is mainly grazed by yaks and horses.

Irano-Turanian thermophilous, mesic tall-forb vegetation

Irano-Turanian thermophilous, mesic tall-forb vegetation

PRA. *Prangetea ulopterae* Klein 1987 (Fig. 188)

This vegetation type, very characteristic of the Irano-Turanian Region, has been described firstly in Iran (Zohary 1973). It is one of the most species-rich and diverse vegetation types in Middle Asia, which requires further careful phytosociological studies. The vegetation has a characteristic physiognomy associated with the frequent occurrence of large plants of the Apiaceae family, such as *Ferula* spp., *Prangos* spp. or *Megacarpea* spp. They inhabit large mountain slopes with different gradients and soil substrate fertility. They differ from typical scree vegetation in that there is a deep layer of fertile soil shallowly beneath the layer of overlying stones, and from typical mountain tall-forbs in that the vegetation cover is generally lower and the ground surface is not flat, hence water, especially in summer, is scarcely available.

PRA-A. O. *Prangeto pabulariae-Feruletalia kuhistanicae* O. nov. hoc loco (thermophilous, mesic tall-forb vegetation of the eastern Irano-Turanian subregion) (Fig. 189)

Nomenclatural type: *Rheion maximowiczii* Nowak et al. 2021

This group of Irano-Turanian alpine tall-forbs is established and is dedicated to the eastern subregion which includes Pamiro Alai, western and central Tian Shan and Hindu Kush Mts. This vegetation needs further comparative studies with alpine grasslands and scree vegetation for final classification.

PRA-AA. *Rheion maximowiczii* Nowak, Świerszcz, S. Nowak et Nobis 2021 (tall-forb vegetation on rupicolus slopes in the eastern Irano-Turanian Region) (Fig. 190)

Diagnostic species: *Bunium persicum, B. badachschanicum, Eremurus stenophyllus, Ferula kokanica, Plantago lanceolata, Poterium polygamum, Rheum maximowiczii.*

Fig. 188. Tall-forb vegetation with a significant proportion of *Ferula kuhistanica* and *Eremurus stenophyllus* near Kuranch, Obikhingou Valley, Darvaz Mts, Tajikistan (ca. 1,460 m a.s.l.). Photo: A. Nowak.

Fig. 189. Tall-forb vegetation with contribution of *Ferula kokanica*, *Lathyrus mulkak* and *Prangos pabularia* near Poymazor, Vanch Valley, Western Pamir, Tajikistan (ca. 2,600 m a.s.l.). Photo: A. Nowak.

Fig. 190. Tall-forb vegetation representing the *Rheion maximowiczii* alliance developed on a pebble slope near Khorogh, Eastern Pamir, Tajikistan (ca. 2,200 m a.s.l.). Photo: A. Nowak.

Constant species: *Bunium persicum, B. badachschanicum, Eremurus stenophyllus, Ferula kokanica, Lathyrus mulkak, Plantago lanceolata, Poterium polygamum, Rheum maximowiczii.*

Geographical range: In Middle Asia, communities of this type occur across the Pamir-Alai and western Tian Shan Mts, and are particularly common in the Zeravshan, Vanch, Rushan, Hissar, Alai and Fergana Mts. Plots of the phytocoenoses were sampled at elevations between 1,500 and 3,300 m a.s.l. (Nowak et al. 2020b).

Habitat characteristics: This tall-forb vegetation grows mainly in the montane and subalpine belts on gravelly scree-like slopes, with the soil often covered by coarse rock debris. The soil profile is relatively deep and nutrient-rich, however, in some cases it is almost completely covered by unstable rock debris. Patches of this vegetation inhabit slopes with an inclination of 3°–45°. They can withstand periodic droughts of the habitats during hot summers (Nowak et al. 2020b; Nowak et al. 2021b).

PRA-AA01. *Phlomoidetum kaufmannianae* Nowak, Świerszcz, S. Nowak et Nobis 2021 (tall-forb vegetation of screes and aprons of the Zeravshan and Turkestan Mts) (Fig. 191)

Diagnostic species: *Alcea nudiflora, Anisantha tectorum, Bunium persicum, Crambe kotschyana, Lindelofia macrostyla, Nardurus krausei, Neurotropis kotschyana, Papaver pavoninum, Perovskia virgata, Phlomoides kaufmanniana, Piptatherum kokanicum, Scandix stellata, Scrophularia scabiosifolia, Taeniatherum crinitum, Valerianella ovczinnikovii, Bryum caespiticium, Encalypta vulgaris.*

Constant species: *Papaver pavoninum, Perovskia virgata, Phlomoides kaufmanniana, Bryum caespiticium, Encalypta vulgaris, Pohlia nutans.*

Geographical range: *Phlomoides kaufmanniana* is a narrowly distributed forb species

Fig. 191. *Phlomoidetum kaufmannianae,* a tall-forb vegetation inhabiting screes in the Haft-kul Valley near Nofin, Zeravshan Mts, Tajikistan (ca. 1,700 m a.s.l.). Photo: M. Nobis.

of the western Pamir-Alai. Its stands have been found only in a few valleys of the Zeravshan and Turkestan Mts in Tajikistan (Kochkareva 1986). It has been recorded in the montane belt at an elevation of approx. 1,500–1,700 m a.s.l. (Nowak et al. 2020b).

Habitat characteristics: This vegetation prefers western aspects with a moderate inclination of about 5°–35° (Nowak et al. 2020b; Nowak et al. 2021b).

PRA-AA02. *Eremuretum stenophyllo-comosi* Nowak, Świerszcz, S. Nowak et Nobis 2021 nom. corr. (montane to subalpine mesic forb vegetation of intensively grazed pastures in the Pamir-Alai, mainly Hissar and Darvaz Mts)
(Fig. 192)

Diagnostic species: *Berberis nummularia, Colutea paulsenii, Rosa ovczinnikovii, R. popovii, Eremurus comosus, E. stenophyllus, Ferula transiliensis, Poterium polygamum.*

Constant species: *Eremurus comosus.*

Geographical range: This is one of the most common communities of the scree-like forbs in the eastern Irano-Turanian subregion, but it can also occur in gently sloping or flat pastures with negligible rock debris. The association has been recorded mainly in the Hissar Mts (e.g. Mayhura Valley) and the Darvaz Mts (e.g. Obikhingou Valley). *Eremurus stenophyllus* is a typical Irano-Turanian element distributed from Iran to Central Asia, but *E. comosus* is considered an endemic plant of the western Pamir-Alai Mts (Ovchinnikov 1963). The community forms distinct stands on large areas within the montane belt. The stands of the association have been found at an elevation between 1,450 and 2,000 m a.s.l. (Nowak et al. 2020b).

Habitat characteristics: This vegetation mainly inhabit south-eastern and southern slopes, with varying inclinations from 5° to 40° (average approx. 23°) (Nowak et al. 2020b; Nowak et al. 2021b).

Fig. 192. Vegetation of the *Eremuretum stenophyllo-comosi* found on a southern slope near Childara, Peter the First Range, Tajikistan (ca. 1,470 m a.s.l.). Photo: A. Nowak.

PRA-AA03. *Lathyretum mulkaki* Nowak, Świerszcz, S. Nowak et Nobis 2021 (forb vegetation on screes in subalpine and alpine belts of the western Pamir-Alai Mts) (Fig. 193)

Diagnostic species: *Iris darwasica, Lathyrus mulkak, Lophanthus elegans, Nepeta olgae.*
Constant species: *Cousinia pseudarctium, Ferula kokanica, Lathyrus mulkak.*
Geographical range: This tall-forb vegetation occurs mainly in the Darvaz and Hissar Mts in the alpine belt with relatively high precipitation (up to 1,000 mm per year). The documented plots occupied steep slopes at the alpine elevations in the western Pamir-Alai Mts. They were noted at ca. 1,900–3,300 m a.s.l. (Nowak et al. 2020b).
Habitat characteristics: The association inhabits mainly the southern and south-western slopes with an inclination of 10° to 55° (Nowak et al. 2020b; Nowak et al. 2021b).

PRA-AA04. *Feruletum sumbuli* Nowak, S. Nowak, Nobis et A. Nobis 2015 (forb grassland on rocky coarse debris and blocks in the western Pamir-Alai Mts) (Fig. 194)

Diagnostic species: *Astragalus kabadianus, Asyneuma attenuatum, Ephedra intermedia, Euphorbia transoxana, Ferula sumbul, Hedysarum flavescens, Thalictrum kuhistanicum.*
Constant species: *Artemisia persica, Centaurea ruthenica, Ephedra intermedia, Euphorbia transoxana, Ferula sumbul, Hedysarum flavescens, Ligularia thomsonii, Thalictrum kuhistanicum.*
Geographical range: *Ferula sumbul* is an endemic plant of the western Pamir-Alai, occurring in Tajikistan, preferably in the Zeravshan and Fann Mts (Nowak et al. 2020b). Occasionally, it occurs in forest openings and alpine meadows, but it forms the community in the valley bottoms, especially in sites with coarse blocks from eroded rock walls. The association was described as the forb community from scree aprons in the Fann Mts (Nowak et al. 2015a). Its stands are distributed in the alpine belt within the range of elevations from 2,050 to 3,300 m a.s.l. (Nowak et al. 2020b).

Fig. 193. Forb vegetation of the *Lathyretum mulkaki* found on a southern slope near Majhura, Hissar Mts, Tajikistan (ca. 2,650 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: It prefers calcareous bedrock and alkaline soil substrates. Patches of this association have been found on relatively gentle slopes (foothills of large boulder fields) with a mean inclination of approx. 10°. The association inhabits different slopes with northern, southern and western exposures (Nowak et al. 2020b).

PRA-AA05. *Feruletum tenuisectae* Nowak, S. Nowak, Nobis et A. Nobis 2015 (rupicolous, forb vegetation of the western Tian Shan Mts) (Fig. 195)

Diagnostic species: *Ferula tenuisecta.*
Constant species: *Ferula tenuisecta, Prangos pabularia.*
Geographical range: *Ferula tenuisecta* is an endemic plant of the western Tian Shan, occurring in Tajikistan only in the Kuraminian Mts. The vegetation of *Ferula tenuisecta* occurs in southern Kazakhstan, western Uzbekistan and northern Tajikistan at the montane elevations from 1,100 to 2,100 m a.s.l.

Habitat characteristics: It prefers mesic, moderately stony habitats in subhumid zone with varying inclinations from 5° to 35°.

Tall-forb communities of the upper montane to alpine belts of the eastern Irano-Turanian Region

PRA-AB. *Scabioso songaricae-Phlomoidion lehmannianae* Nowak, Świerszcz, S. Nowak et Nobis 2021 (tall-forb communities of the upper montane to alpine belts of the central Tajikistan) (Fig. 196)

Diagnostic species: *Gentiana olivieri, Onobrychis baldshuanica, Phlomoides lehmanniana, Poterium lasiocarpum, Rumex paulsenianus, Inula macrophylla, Rochelia peduncularis, Solenanthus circinnatus.*
Constant species: *Eremurus korshinskyi, Gentiana olivieri, Onobrychis baldshuanica, Phlomoides lehmanniana, Poterium lasiocarpum, Rochelia peduncularis, Solenanthus circinnatus.*

Fig. 194. Tall-forb vegetation of the *Feruletum sumbuli* association found on a scree near Nofin, Haftkul Valley, Zeravshan Mts, Tajikistan (ca. 1,950 m a.s.l.). Photo: A. Nowak.

Fig. 195. Rupicolous forb vegetation of the *Feruletum tenuisectae* association found in the Ushozen River Valley, Turkestan Region, Kazakhstan (ca. 600 m a.s.l.). Photo: P. Gorbunov.

Fig. 196. Tall-forb vegetation of the *Scabioso songaricae-Phlomoidion lehmannianae* alliance found between Sangvor and Arzing, Peter the First Range, Tajikistan (ca. 2,620 m a.s.l.). Photo: A. Nowak.

Geographical range: In Middle Asia, the communities of this type occur across the Pamir-Alai and western Tian Shan Mts, and are particularly frequent in the Darvaz, Hissar, Peter the First, Vanch, Alai and Fergana Mts. The plots comprising this phytocoenoses were sampled in montane and subalpine belts at an elevation between 1,300 and 3,250 m a.s.l. (Nowak et al. 2020b; Nowak et al. 2021b).
Habitat characteristics: This vegetation inhabits slopes with an inclination of up to 55° on mesic, relatively nutrient-rich soil in humid, alpine belt (Nowak et al. 2020b). Patches of this vegetation have been found in micromosaic situations, mainly with thermophilous shrublands (shiblyak), scree vegetation and alpine grasslands.

PRA-AB01. *Eremuretum robusti* Nowak, Świerszcz, S. Nowak et Nobis 2021 (tall-forb vegetation of humid slopes of the Hissar, Darvaz, Hazratishokh and Peter the First Mts) (Fig. 197)

Diagnostic species: *Cousinia umbrosa, Eremurus robustus, Phlomoides arctiifolia, Vicia tenuifolia.*
Constant species: *Eremurus robustus, Ferula kuhistanica, Prangos pabularia.*
Geographical range: This is one of the most spectacular tall-forb vegetation types in Pamir-Alai, occurring mainly on the humid slopes of the Hissar, Darvaz, Hazratishokh and Peter the First Mts. It forms tall stands in the upper montane and alpine belts within an elevational range between 1,500 and 2,600 m a.s.l. (Nowak et al. 2020b; Nowak et al. 2021b).
Habitat characteristics: It grows on flat, deep, well-watered soils in wide river valleys or occasionally, on gentle slopes with an inclination up to 25°. However, it always occurs in a moist, deep and fertile soil substrate, without any preferred aspect (Nowak et al. 2020b).

PRA-AB02. *Phlomoido lehmannianae-Onobrychidetum grandis* Nowak, Świerszcz, S. Nowak

Fig. 197. Tall-forb vegetation of the *Eremuretum robusti* association found on a southern slope near Chishun, Darvaz Mts, Tajikistan (ca. 2,520 m a.s.l.). Photo: A. Nowak.

et Nobis 2021 (tall-forb vegetation of mesic slopes of the Pamir-Alai Mts in Middle Asia) (Fig. 198)

Diagnostic species: *Onobrychis grandis, Phlomoides lehmanniana.*
Constant species: *Ferula kuhistanica, Phlomoides lehmanniana, Poa bulbosa, Prangos pabularia.*
Geographical range: This association is one of the most widespread in central Tajikistan, mainly in the Darvaz, Peter the First and Hissar Mts. It also has some outliers in the Zeravshan, Turkestan Mts and ranges of the western Pamir. The Pamir-Alai is an exclusive range of *Phlomoides lehmanniana*, an endemic of these mountains. The association patches inhabit moderately fertile slopes within the upper montane and alpine belts, between ca. 1,700–2,700 m a.s.l. (Nowak et al. 2020b).
Habitat characteristics: Phytocoenoses of this vegetation have been recorded on flat lands in wide valleys, as well as on relatively steep, mainly south-facing slopes, up to 45° (average approx. 17°) (Nowak et al. 2020b; Nowak et al. 2021b).

PRA-AB03. *Eremuretum kaufmannii* Nowak, Świerszcz, S. Nowak et Nobis 2021 (tall-forb vegetation of the alpine belt of the western Pamir-Alai, mainly the Zeravshan and Hissar Mts) (Fig. 199)

Diagnostic species: *Artemisia dracunculus, Astragalus nuciferus, Dictamnus angustifolius, Eremurus kaufmannii, Iris hoogiana, Lonicera nummulariifolia, Paeonia intermedia, Poa urssulensis, Restella alberti.*
Constant species: *Artemisia dracunculus, Eremurus kaufmannii, Ligularia thomsonii, Prangos pabularia.*
Geographical range: This is a typical alpine tall-forb vegetation of the Pamir-Alai Mts. *Eremurus kaufmannii* occurs in northern Tajikistan and northern Afghanistan forming its own

Fig. 198. Tall-forb vegetation of *Phlomoido lehmannianae-Onobrychidetum grandis* with *Onobrychis grandis* and *Phlomoides arctiifolia* near Arzing, Peter the First Mts, Tajikistan (ca. 2,600 m a.s.l.). Photo: A. Nowak.

association on gentle slopes in the alpine pasture zone (Ovchinnikov 1963). The patches of this vegetation have been recorded in the Zeravshan and Hissar Mts at an elevation of ca. 2,400 m a.s.l. (ranging between 2,100 and 2,850 m a.s.l.) (Nowak et al. 2020b).

Habitat characteristics: The association occurs on gentle slopes ranging from 10° to 40° (mean ca. 20°) inclination and preferably with a northern aspect (Nowak et al. 2020b; Nowak et al. 2021b).

PRA-AB04. *Anthriscetum glacialis* Nowak, Świerszcz, S. Nowak et Nobis 2021 nom. corr. (intensively grazed tall-forb vegetation of subalpine and alpine belts of the western and central Pamir-Alai Mts, mainly Hissar and Peter the First Mts) (Fig. 200)

Diagnostic species: *Anemonastrum protractum, Anthriscus glacialis, Astragalus aksuensis, Asyneuma baldshuanicum, Crepis darvazica, Draba huetii, Elytrigia repens, Euphorbia sarawschanica, Leonurus turkestanicus, Ligularia alpigena, Oberna wallichiana, Pedicularis olgae, Phleum pratense, Picris nuristanica, Polygonum hissaricum, Rumex nepalensis, Tanacetum pseudachillea.*

Constant species: *Anthriscus glacialis, Ferula kuhistanica, Geranium regelii, Ligularia thomsonii.*

Geographical range: *Anthriscus glacialis* is a widespread alpine species across the whole Pamir-Alai and western Tian Shan Mts (Chukavina 1984). We recorded the stands of this species mainly in the central part of the Darvaz Range around the Khoburobot Pass. Stands of this vegetation have been recorded in the upper alpine belt between 2,500 and 3,300 m a.s.l. (Nowak et al. 2020b).

Habitat characteristics: The association prefers gentle slopes or flat areas in the vast pastures, sometimes in close vicinity to villages (so-called letovki – summer cottages) with mean

Fig. 199. Tall-forb vegetation of the *Eremuretum kaufmannii* association found near Artuch Mountain Base Camp, Zeravshan Mts, Tajikistan (ca. 2,550 m a.s.l.). Photo: M. Nobis.

Fig. 200. *Anthriscus glacialis* – a species characteristic for tall-forb vegetation near Khoburobot Pass, Darvaz Mts, Tajikistan (ca. 3,250 m a.s.l.). Photo: A. Nowak.

Fig. 201. Tall-forb vegetation of the *Feruletum kuhistanicae* association found near Khoburobot Pass, Darvaz Mts, Tajikistan (ca. 3,150 m a.s.l.). Photo: A. Nowak.

inclination of approx. 12°. It occurs preferably on western and south-western exposures (Nowak et al. 2020b, Nowak et al. 2021b).

PRA-AB05. *Feruletum kuhistanicae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (mesic tall-forbs of the subalpine to alpine belts of the Pamir-Alai Mts) (Fig. 201)

Diagnostic species: *Ferula kuhistanica.*
Constant species: *Anthriscus glacialis, Ferula kuhistanica, Prangos pabularia.*
Geographical range: The main diagnostic species of the association is commonly found in Tajikistan, with the exception of the Eastern Pamir and the northern part of the country (Chukavina 1984). *Ferula kuhistanica* also grows in the Tian Shan and northern Afghanistan. The stands of *Feruletum kuhistanicae* were found in several locations in the valleys of the Varzob, Takob, Sarday-Myena, Obikhingou and in the Seven Lakes Valley. It forms a widespread tall-forb vegetation in upper montane and alpine belts at elevation from 2,250 to 3,300 m a.s.l. (Nowak et al. 2016b).
Habitat characteristics: This association grows on gentle slopes in the subhumid zone of Pamir-Alai and Tian Shan alpine landscapes. The association develops on various exposures, mesic, deep soils with occasionally rock debris sliding on the surface. The approximate mean inclination was ca. 35°, ranging from 15° to 40° (Nowak et al. 2016b).

PRA-ABc01. Community of *Rumex paulsenianus* (subalpine intensively grazed forb grassland on wet or mesic slopes in western Middle Asia) (Fig. 202)

Diagnostic species: *Rumex paulsenianus.*
Constant species: *Rumex paulsenianus.*
Geographical range: This community develops on fertile, deep and moist soils in the alpine belt, mainly in the western and southern Pamir-Alai

Fig. 202. Tall-forb vegetation dominated by *Rumex paulsenianus* found near Rohu in Obikhingou River Valley, Peter the First Range, Tajikistan (ca. 3,050 m a.s.l.). Photo: A. Nowak.

Fig. 203. Subalpine grasslands with *Dictamnus albus* near Koshtegirmen, Peter the First Mts, Tajikistan (ca. 2,900 m a.s.l.). Photo: A. Nowak.

and Hindu Kush Mts. It has been recorded at elevation of approx. 1,800–3,600 m a.s.l. (Ovchinnikov 1968).

Habitat characteristics: Similar to a temperate vicariant of *Rumex alpinus*, the stands of *R. paulsenianus* are typical nitrophilous vegetation of the alpine belt, growing close to alpine shelters and summer settlements (so called letovki) or in the pastures that are heavily grazed by cows, sheep or horses.

PRA-ABc02. Community of *Cousinia umbrosa* (forb vegetation on wet habitats in montane and subalpine belt of Middle Asia) (Fig. 203)

Diagnostic species: *Cousinia umbrosa.*

Constant species: *Cousinia umbrosa.*

Geographical range: This community develops on fertile, deep and relatively dry soils in the montane to alpine belts throughout the Irano-Turanian Region. In Tajikistan, this community has been recorded in many different habitats at elevation of approx. 700–3,200 m a.s.l. (Rasulova 1991).

Habitat characteristics: This community inhabits moderately fertile and relatively dry soils. It often contributes to the woody vegetation as the undergrowth, forming a dense stand in gaps.

Hot semi-deserts of Irano-Turanian Region

Vegetation of the continental desert & semi-desert zone

Hot semi-deserts; Irano-Turanian semi-desertic hyperarid and continental habitats

PEG. *Pegano harmalae-Salsoletea vermiculatae* Br.-Bl. et O. de Bolos 1958 (Fig. 204)

The *Pegano-Salsoletea* class includes halo-nitrophilous plant communities colonising mainly alkaline, gravelly or clayey substrates and evaporitic sediments in the Mediterranean, Saharan-Atlantic and Macaronesian regions, especially under thermo-xeric climatic conditions (Rivas-Martìnez et al. 2002). This vegetation is characterised by high contribution of succulent Chenopodiaceae taxa with a chamaephytic to nanophanerophytic life form. The most common are *Salsola* (*S. oppositifolia*, *S. vermiculata*), *Suaeda* (*S. vera*, *S. pruinosa*), *Atriplex* (*A. halimus*, *A. glauca*), often found together with other species belonging to the genera *Peganum* (*P. harmala*), *Artemisia* (*A. arborescens*, *A. herba-alba*, *A. campestris*), *Anabasis* (*A. articulata*) and *Limonium* spp.

PEG-XX.
O. unknown
All. unknown

In the eastern sub-region of the Irano-Turanian zone, no detailed studies have been carried out on this halo-nitrophilous, semi-desert vegetation. Large areas in the Syr-darya and Amu-darya River Valleys are suitable for the colonisation of Chenopodiaceae species, as well as *Peganum harmala*. We found a number of stands on the barelands, badlands and gravel bars of large rivers, sometimes also escarpements and screes with the *Peganum harmala* stands. It remains to be resolved whether these stands belong to this arid, nitrophilous vegetation class. They play an important role as a late

Fig. 204. Hot semi-deserts with *Girgensohnia oppositiifolia* near Khudhand, Sogdh District, Tajikistan (ca. 350 m a.s.l.). Photo: A. Nowak.

Fig. 205. The *Peganum harmala* community inhabiting badland areas near Khoruh-Dayron, Syr-darya River Valley, Tajikistan (ca. 550 m a.s.l.). Photo: A. Nowak.

Fig. 206. The *Anabasis truncata* community, found in badland area near Asht, Syr-darya River Valley, Tajikistan (ca. 560 m a.s.l.). Photo: A. Nowak.

winter and early summer pastures for all types of livestock.

PEG-XXc01. Community of *Peganum harmala* (Irano-Turanian hot semi-deserts often as nitrophilous badland) (Fig. 205)

Diagnostic species: *Peganum harmala.*
Constant species: *Anabasis turkestanica, Peganum harmala, Salsola orientalis.*
Geographical range: This community develops on badlands and barrens in different elevation from 450 to 3,700 m a.s.l. throughout the whole Middle, and particularly Central Asia (Ovchinnikov 1968).
Habitat characteristics: This community inhabits permeable gravelly, sandy substrates with initial soils. It occurs in the arid, semi-desert or even desert areas.

PEG-XXc02. Community of *Anabasis truncata* (continental semi-desert of lowlands, colline and montane belts of the northern Pamir-Alai Mts and Central Asia) (Fig. 206)

Diagnostic species: *Anabasis truncata.*
Constant species: *Anabasis turkestanica, Anabasis truncata, Salsola orientalis.*
Geographical range: This community develops on dry barrens and badlands in the northern part of Middle Asia. It inhabits lowlands or the colline belt at elevation from 600 to 2,000 m a.s.l. It has also been recorded in Kashgaria and Xinjang in China (Ovchinnikov 1968).
Habitat characteristics: This community inhabits permeable gravelly, sandy substrates with very low organic matter content soils. It prefers arid, semi-desert or desert areas.

Semi-desert shrublands of the Irano-Turanian Region

Semi-desert shrublands of the Irano-Turanian Region

HAL. *Haloxyletea ammodendri* Asri 2003 (Fig. 207)

This sparse shrubland vegetation is distributed throughout the Irano-Turanian semi-desert zone and additionally in the Gobi, Takla-Makan and Arabian deserts and semi-deserts (often in oases). The communities of this class develop on loose, sandy or gravelly substrates in arid climates with precipitation between 100 and 250 mm/year. In Middle Asia, this vegetation, despite *Haloxylon persicum*, is made up of species of the genera *Calligonum*, *Erodium*, *Eminium*, *Halothamnus*, *Leptaleum* and *Salsola*.

HAL-A. *Haloxyletalia ammodendri* Asri 2003 (semi-desert shrublands of the Irano-Turanian Region) (Fig. 208)

This vegetation comprises the semi-desert shrubland communities of the Irano-Turanian region, including Middle Asia. The communities of this association form loose thickets up to 3–4 m high, colonising semi-arid and arid habitats with permeable substrates. In Tajikistan, they have been almost completely destroyed, with only a few small patches remaining in the south of the country around Tigrovaya Balka National Park and in the Shartuz district.

HAL-AA. *Carici physodes-Haloxylion persici* Nowak, Świerszcz, S. Nowak et Nobis 2024 (hot semi-desert of the south-western Pamir-Alai Mts; Kachakum, Kurdzhalak, Ravonkul) (Fig. 209)

Diagnostic species: *Haloxylon persicum, Alyssum dasycarpum, Astragalus campylorrhynchus, A. filicaulis, Calligonum griseum, Carex pachystylis, C. physodes, Ceratocephala orthoceras, Cousinia pygmaea, Cutandia memphitica, Eminium alberti,*

Fig. 207. Habitat of semi-desert shrubland vegetation representing the *Haloxyletea ammodendri* class in Shartuz District, south-western Tajikistan (ca. 330-900 m a.s.l.). Photo: A. Nowak.

Fig. 208. Typical spring aspect of semi-desert vegetation of *Haloxyletalia ammodendri* with abundant *Carex physodes* near Bukhara Province, Uzbekistan (ca. 300 m a.s.l.). Photo: A. Nowak.

Fig. 209. Sandy semidesert Karakum with *Haloxyletalia ammodendri* vegetation, central Uzbekistan (ca. 300 m a.s.l.). Photo: M. Nobis.

Eremopyrum bonaepartis, Erodium ciconium, E. litwinowii, Garhadiolus papposus, Halocharis hispida, Hypecoum parviflorum, Leptaleum filifolium, Medicago orthoceras, Microcephala lamellata, Poa bulbosa, Schismus arabicus, Strigosella stenopetala, Tetracme bucharica, Trisetaria loeflingiana.

Constant species: *Haloxylon persicum, Alyssum dasycarpum, Astragalus filicaulis, Bromus tectorum, Carex pachystylis, Cutandia memphitica, Eminium alberti, Erodium ciconium, Filago arvensis, Hordeum leporinum, Hypecoum parviflorum, Poa bulbosa, Schismus arabicus, Vulpia ciliata.*

Geographical range: Lowland semi-deserts of the western Irano-Turanian Region (semi-deserts of Turkmenistan, Uzbekistan, Tajikistan, Afghanistan and Kyrgyzstan) (Nowak et al. 2024c).

Habitat characteristics: This vegetation occurs in the hot and arid territories of lowland Middle Asia. It tolerates one of the lowest rainfall of ca. 120-250 mm per year. The communities develop on dunes, bare lands, gravelly substrates in river valleys, at elevation of approx. 300–1,000 m a.s.l. (Nowak et al. 2024c).

HAL-AA01. *Eminio lehmannii-Haloxyletum persici* Nowak, Świerszcz, S. Nowak et Nobis 2024 (hot semi-desert of the eastern Karakum, Kachakum and Kurdzhalak) (Fig. 210)

Diagnostic species: *Alyssum dasycarpum*, *Carex physodes*, *Ceratocephala orthoceras*, *Cousinia pygmaea*, *Cutandia memphitica*, *Eminium lehmannii*, *Ephedra strobilacea*, *Erodium ciconium*, *Garhadiolus papposus*, *Haloxylon persicum*, *Hypecoum parviflorum*, *Medicago orthoceras*, *Psylliostachys suworowii*, *Schismus arabicus*, *Trisetaria loeflingiana.*

Constant species: *Haloxylon persicum, Alyssum dasycarpum, Bromus tectorum, Carex physodes, Ceratocephala orthoceras, Cutandia memphitica, Eminium lehmannii, Erodium ciconium, Garha-*

Fig. 210. Semi-desert shrubland vegetation of the *Eminio lehmannii-Haloxyletum persici* association found near Teshik-Tash in south-western Tajikistan (ca. 300 m a.s.l.). Photo: A. Nowak.

diolus papposus, Hordeum leporinum, Hypecoum parviflorum, Medicago orthoceras, Poa bulbosa, Schismus arabicus, Trisetaria loeflingiana, Vulpia ciliata.

Geographical range: *Eminium lehmannii* is an endemic species to Middle Asia, known only from the borderlands of Tajikistan, Uzbekistan and Afghanistan (Ovchinnikov 1963). It occurs mainly in semi-deserts and has only occasionally been reported in open woods and pseudosteppes. Phytocoenosis of *Eminio lehmannii-Haloxyletum persici* have been found in the foothills of the Aktau Range in Shartuz district (Nowak et al. 2024c).

Habitat characteristics: This area has a hot semi-arid climate according to the Köppen classification (mean temperature 17.2°C, mean precipitation 235 mm/year). The habitat of this vegetation is a loose, sandy deposit or dunes, rarely gravelly river valley embankments. Cover of the herb layer ranged between 15 and 75% (mean approx. 45%), and for shrubs between 20 and 70% (mean approx. 45%; Nowak et al. 2024c).

HAL-AA02. *Leptaleo filifolii-Calligonetum grisei* Nowak, Świerszcz, S. Nowak et Nobis 2024

(warm semi-desert of the colline belt of the south-west Pamir-Alai Mts) (Fig. 211)

Diagnostic species: *Allium caspium* subsp. *baissunense*, *Amberboa bucharica*, *Arnebia decumbens*, *Astragalus campylorrhynchus*, *Calligonum griseum*, *Carex pachystylis*, *Cymatocarpus heterophyllus, Epilasia mirabilis*, *Erodium ciconium*, *E. litwinowii*, *Leptaleum filifolium*, *Tetracme bucharica*, *Zygophyllum gontscharovii.*

Constant species: *Alyssum dasycarpum, Astragalus campylorrhynchus, A. filicaulis, Bromus tectorum, Calligonum griseum, Carex pachystylis, Erodium ciconium, E. litwinowii, Filago arvensis, Hordeum leporinum, Leptaleum filifolium, Microcephala lamellata, Poa bulbosa, Strigosella stenopetala, Tetracme bucharica.*

Fig. 211. Semi-desert vegetation of *Leptalaeo filifolii-Calligonetum grisei* found near Komsomol, south-western Tajikistan (ca. 460 m a.s.l.). Photo: A. Nowak.

Geographical range: This sparse semi-desert vegetation occurs in Tajikistan in the foothills of the Karatu and Babatag Mts, on gentle slopes (max. 25°) or plains in the valleys of the Kofarnikhon, Vakhsh and Panj rivers. The patches were found at elevation from 390 to 550 m a.s.l. (mean ca. 420 m a.s.l.). The unclear taxonomy of the genus *Calligonum* makes it difficult to determine the distribution of the individual species as well as classification of semi-desert vegetation. Based on the work of Ovchinnikov (1968), Amirabadi-Zadeh (2012), Maassoumi (2011), we consider the taxon *C. griseum* as accepted and occurring in the Irano-Turanian area up to Middle Asia. This semi-desert vegetation type has a marginal position in Tajikistan. It is much more diverse towards the east and south. In Afghanistan, for example, a number of desert vegetation types are mentioned, e.g. with *Calligonum tortile*, *C. turkestanicum*, *C. comosum*, *C. intertextum*, *C. amoenum*, *C. microcarpum* or *C. griseum* (Freitag 1971).

Habitat characteristics: The cover of the herbaceous layer in this semi-desert vegetation reaches moderate values from 40 to 75%, with a mean of ca. 55%. This species-poor vegetation has a very distinct physiognomy, with loose dwarf-shrubs and an ephemeral, early spring undergrowth that disappears as early as May. It occurs only in hot and dry climatic zone (Nowak et al. 2024c).

HAL-AAc01. Community of *Halocharis hispida-Microcephala lamellata* (ephemeral vegetation of semi-deserts of the Karakum, Kyzylkum, and other sandy habitats in lowlands and the colline belt of the Irano-Turanian Region) (Fig. 212)

Diagnostic species: *Descurainia sophia*, *Euclidium syriacum*, *Halocharis hispida*, *Herniaria glabra*, *Hordeum leporinum*, *Microcephala lamellata*, *Papaver pavoninum*, *Salsola praecox*, *Strigosella stenopetala*, *Veronica campylopoda*.
Constant species: *Descurainia sophia, Erodium cicutarium, Euclidium syriacum, Garhadiolus pap-*

Fig. 212. Vegetation of the *Halimocnemis hispida-Microcephala lamellata* found near Garawuti, south-western Tajikistan (ca. 470 m a.s.l.). Photo: A. Nowak.

posus, Halocharis hispida, Herniaria glabra, Hordeum leporinum, Microcephala lamellata, Papaver pavoninum, Poa bulbosa, Schismus arabicus, Strigosella stenopetala.

Geographical range: This type of semi-desert vegetation has only been found in the Shartuz district of south-western Tajikistan, but the main diagnostic taxa are widespread throughout Middle Asia (Ovchinnikov 1968; Kinzikaeva 1988; GBIF 2024).

Habitat characteristics: This vegetation inhabits vast areas of semi-deserts and grows on the clay and gypsum slopes of the Aktau, Karatau and Babatag Mts in Tajikistan. The community is very seasonal and can disappear completely as early as mid-May, although some species repeat flowering in October and November. It occupies gentle slopes and roadsides in the colline belt and in the lowlands at elevation of approx. 500–600 m a.s.l. In spring, i.e. in March to April, the community has a rather abundant herb cover of 55% to 70% (Nowak et al. 2024c).

HAL-AAc02. Community of *Halothamnus subaphyllus* (continental, subhalophytic semi-desert of Middle Asia and Iran)

This community is distributed throughout the Irano-Turanian Region. In Tajikistan, it grows from the lowlands to the montane belts (350–2,000 m a.s.l.) of the hottest climates in the Syrdarya and Amu-darya River Valleys. It prefers semi-desert habitats with low rainfall and sporadic grazing. The stands of *Halothamnus subaphyllus* (= *Aelenia subaphylla, Salsola subaphylla*) need further detailed studies for final classification.

HAL-AAc03. Community of *Calligonum elegans-Calligonum leucocladum* (continental, subhalophytic semi-desert of southern Middle Asia and Afghanistan) (Fig. 213)

This vegetation is typical of the semi-desert habitats of southern and northern Tajikistan. Several areas of this community have been found

Fig. 213. Semi-desert vegetation of the *Calligonum elegans-Calligonum leucocladum* found near the Oxus Temple, south-western Tajikistan (ca. 425 m a.s.l.). Photo: A. Nowak.

along the Vakhsh and Amu-darya rivers. It occurs in lowlands (400–600 m a.s.l.), mainly on gentle slopes and aprons, but also on gravel bars of wide, lowland rivers. It is a typical seasonal vegetation with the peak of development in spring (March). Due to considerable difficulties in identifying species of the genus *Calligonum*, this vegetation requires further study with the assistance of a taxonomist specializing in this genus.

HAL-AAc04. Community of *Salsola laricifolia* (subhalophytic semi-desert vegetation of the colline belt of Middle Asian mountains)

This community extends from the central part of the Irano-Turanian Region, through Middle and Central Asia, to the Gobi Desert in China. In Tajikistan, stands of *Salsola laricifolia* have been recorded in the Syr-darya and Amu-darya River Valleys in the north-western and south-western, lowland or colline corners of the country. It grows at elevation of 800–1,200 m a.s.l. on plains, aprons and gravel bars. It inhabits dry, permeable and sub-halophytic habitats.

HAL-AAc05. Community of *Salsola orientalis* (subhalophytic semi-desert vegetation on loamy or gravelly soils in the colline to alpine belts of Middle Asian mountains) (Fig. 214)

Diagnostic species: *Salsola orientalis.*
Constant species: *Halogeton glomeratus, Salsola montana*, *S. orientalis.*
Geographical range: Semi-arid and arid habitats in the colline to montane belts throughout Middle and Central Asia. The community is also distributed in dry territories throughout the Irano-Turanian Region. In Tajikistan, this community occurs mainly in the montane belt of the western part of the country.
Habitat characteristics: This community occurs in the arid and sub-halophytic habitats in the southern and northern part of Tajikistan and in the rainfall leeward side of the Zeravshan

Fig. 214. Semi-desert vegetation of *Salsola orientalis* community, found near Anzob, Yagnob River Valley, Zeravshan Mts, Tajikistan (ca. 2,000 m a.s.l.). Photo: A. Nowak.

and Turkestan Mts. It inhabits slopes, aprons and landslides with low organic matter content.

HAL-AAc06. Community of *Zygophyllum oxianum* (subhalophytic semi-desert in river valley sediments of Middle Asia) (Fig. 215)

Diagnostic species: *Zygophyllum oxianum.*
Constant species: *Anabasis turkestanica, Salsola arbuscula*, *S. orientalis, Zygophyllum oxianum.*
Geographical range: This semi-desert vegetation inhabits the lowest areas in the Syr-darya and Amu-darya River Valleys in the north-western and south-western parts of Tajikistan. It grows between 300 and 600 m a.s.l. As *Zygophyllum oxianum* is a common species in the desert zones of Turkmenistan, Uzbekistan and Afghanistan, the community is probably more widespread.
Habitat characteristics: Community of *Zygophyllum oxianum* inhabits relatively humid habitats in the lowland river valleys in the hot Irano-Turanian climate. It prefers halophytic, sandy soils with low organic matter content.

HAL-AAc07. Community of *Salsola montana-Halogeton glomeratus* (subhalophytic, montane to subalpine scrub vegetation of arid habitats of the western Pamir-Alai Mts) (Fig. 216)

Diagnostic species: *Artemisia tenuisecta, Capparis spinosa* var. *herbacea*, *Halogeton glomeratus*, *Salsola gemmascens*, *S. montana*, *S. orientalis.*
Constant species: *Ephedra intermedia*, *Artemisia tenuisecta, Capparis spinosa* var. *herbacea, Halogeton glomeratus, Salsola gemmascens, S. montana.*
Geographical range: Semi-arid and arid habitats in montane to alpine belts throughout Middle and Central Asia. In Tajikistan, this community occurs mainly in the highlands of the Eastern Pamir.
Habitat characteristics: This is one of the widely distributed semi-desert vegetation in the Eastern Pamir and adjacent areas. It was also found

Fig. 215. *Zygophyllum oxianum* – a species dominating semi-desert vegetation developed on alluvial plains of the Vakhsh River near Tigrovaya Balka Nature Reserve, Khatlon Province, Tajikistan (ca. 370 m a.s.l.). Photo: A. Nowak.

Fig. 216. Semi-desert vegetation of *Salsola montana-Halogeton glomeratus* community near Anzob, Zeravshan Mts, Tajikistan (ca. 1,650 m a.s.l.). Photo: A. Nowak.

Fig. 217. Semi-desert vegetation dominated by *Salsola arbuscula* found in Naryn River Valley, Kyrgyzstan (ca. 860 m a.s.l.). Photo: A. Nowak.

in the Zeravshan Mts near the village of Anzob. The community inhabits a southern slope (up to 30°) with a lot of mudslides covered by pioneer, sparse vegetation. The plots of the association were documented at elevations of 1,750–1,900 m a.s.l. This species-poor phytocoenosis prefers slopes and gravel debris on arid bare lands walled off from moisture from the south, as it lies in rain shadow. The species-poor vegetation have various cover of 10 to 20%.

HAL-AAc08. Community of *Salsola arbuscula* (subhalophytic, colline to montane scrub vegetation of arid habitats of Central Asia) (Fig. 217)

Diagnostic species: *Salsola arbuscula.*
Constant species: *Salsola arbuscula.*
Geographical range: This community is dominated by *Salsola arbuscula*, a widespread species from the Iranian deserts, through Turkmenistan, Uzbekistan, Afghanistan, Tajikistan, Kazakhstan, Mongolia, to the Gobi and Takla Makan in China. In Middle Asia, the community has been recorded in the Naryn River Valley at ca. 860 m a.s.l. in the deserted steppe zone.
Habitat characteristics: Community of *Salsola arbuscula* inhabits halophytic or sub-halophytic, relatively humid habitats with semi-desert or steppe vegetation. It prefers sub-humid climates, but can also grow in typical dry and arid regions.

HAL-AAc09. Community of *Astragalus villosissimus* and *Ferula assa-foetida* (semi-desert vegetation of the Kyzylkum in lowlands and the colline belt of Uzbekistan) (Fig. 218)

Diagnostic species: *Astragalus villosissimus*, *Ferula assa-foetida.*
Constant species: *Astragalus villosissimus*, *Ferula assa-foetida.*
Geographical range: This community is widespread from the Iranian deserts, through Turkmenistan, Uzbekistan and Kazakhstan,

Fig. 218. Semi-desert vegetation of *Ferula assa-foetida* and *Astragalus villosissimus* found near Chontabay, Bukhara Province, Uzbekistan (ca. 300 m a.s.l.). Photo: A. Nowak.

mainly in the Karakum and Kyzylkum deserts, occurring at low elevations, but can extend to the colline belt in small mountains such as Aktau in Uzbekistan.

Habitat characteristics: Community of *Astragalus vilosissimus* and *Ferula assa-foetida* inhabits semi-desert areas, preferring compacted, gravelly, permeable substrates in arid regions of Central and Middle Asia.

Halophytic thermophilous scrub vegetation on dry solonetz and solonchak soils in arid zones of southern Middle Asia

Halophytic thermophilous scrub vegetation on dry solonetz and solonchak soils in arid zones of southern Middle Asia

SAT. *Haloxylo-Salsoletea tomentosae* Akhani 2004

This hypersaline scrub vegetation on solonetz soils was first described in Iran (Akhani 2004). It inhabits arid areas on loamy or gravelly soils with high salinity. It is a quite common vegetation type in Middle Asia, particularly in the lowlands and in the colline belt. This halophytic vegetation has a low cover (ca. 15–35%) and is mainly composed of shrubby, woody or hemicrytophytic species, often succulent C4 chenopods.

SAT-XX.
O. unknown
All. unknown

The order and alliance of this vegetation should be established for Central Asia, i.e. for the semi-deserts of Kyrgyzstan, Kazakhstan, Mongolia and western China. Unfortunately, we do not have a sufficient data base, so further sampling is needed to provide a comprehensive and stable syntaxonomic system for halophytic, thermophilous scrub vegetation (Świerszcz et al. 2021).

SAT-XX01. *Carici physodis-Zygophylletum gontscharovii* Świerszcz, Nobis, Wróbel, Klichowska, Nowak et A. Nowak 2021 (halophytic shrublands on solonetz soils in the colline belt of the western Pamir-Alai Mts; the Fergana Valley, and Khatlon) (Fig. 219)

Diagnostic species: *Amberboa turanica, Artemisia eremophila* (= *Seriphidium eremophilum*), *Carex physodes, Climacoptera brachiata, Cymatocarpus popovii* (= *C. heterophyllus*), *Echinops knorringianus, Erodium oxyrrhynchum* (= *E. oxyrrhynchum* subsp. *oxyrrhynchum*), *Lachnoloma lehmannii, Lappula mogoltavica, Loliolum subulatum, Salsola montana, Sisymbrium subspinescens, Strigosella scorpioides, Tanacetopsis santoana, Zygophyllum gontscharovii.*

Fig. 219. Halophytic shrubland vegetation of the *Carici physodis-Zygophylletum gontscharovii* association, found near Samgar, northern Tajikistan (ca. 860 m a.s.l.). Photo: A. Nowak.

Constant species: *Zygophyllum gontscharovii.*
Geographical range: Patches of the association have been recorded in south-western Tajikistan and in the Syr-darya River Valley (Świerszcz et al. 2021).
Habitat characteristics: This association occupies gentle slopes with northern and eastern exposures. It prefers typical solonetz soils and occurs in colline and foothill belts (Świerszcz et al. 2021).

SAT-XX02. *Zygophylletum ferganensis* Świerszcz, Nobis, Wróbel, Klichowska, Nowak et A. Nowak 2021 (hiperhalophytic shrublands on solonetz, gravelly or sandy soils in the colline belt around Fergana Valley) (Fig. 220)

Diagnostic species: *Anabasis truncata, Astragalus spinescens, Echinops nanus, Ephedra strobilacea, Girgensohnia oppositiflora, Reaumuria turkestanica, Salsola turkestanica, Silene glaucescens, Strigosella strigosa* (= *Malcolmia strigosa*), *Zygophyllum ferganense.*
Constant species: *Zygophyllum ferganense.*
Geographical range: This is one of the most thermophilous communities of shrubby continental halophyte vegetation in Middle Asia distributed in the Fergana Basin in the colline belt (average elevation ca. 500 m a.s.l.) (Świerszcz et al. 2021).
Habitat characteristics: The community develops on deep hypersaline solonetz in hilly lands (Świerszcz et al. 2021).

SAT-XXc01. Community of *Limonium otolepis* (halophytic grasslands on sandy solonetz soils in large river valley of the northern Pamir-Alai foothills) (Fig. 221)

Diagnostic species: *Limonium otolepis.*
Constant species: *Limonium otolepis.*
Geographical range: This halophytic vegetation has only been recorded in the valley of the Syr-darya River near Asht, at an elevation of ca. 450 m a.s.l. The main diagnostic

Fig. 220. Halophytic shrubland vegetation of the *Zygophylletum ferganensis* association, found near Karakon, Syr-darya River Valley, Tajikistan (ca. 538 m a.s.l.). Photo: A. Nowak.

Fig. 221. *Limonium otolepis* – a species characteristic for halophytic grasslands in the Syr-darya River Valley near Asht, Tajikistan (ca. 450 m a.s.l.). Photo: A. Nowak.

species is distributed throughout the Irano-Turanian Region in salt marshes and halophytic vegetation, including shrublands.

Habitat characteristics: This community inhabits humid, occasionally inundated halophytic vegetation in the zone of *Tamarix* spp. shrublands or even riparian gallery forests. Sometimes it forms stands on anthropogenic habitats. It prefers damp, solonchak soils with a high salt content.

SAT-XXc02. Community of *Atriplex ornata-Heliotropium ellipticum* (sparse halophytic grasslands on sandy substrates in large river valley of the Pamir-Alai Mts) (Fig. 222)

Diagnostic species: *Alhagi canescens, Atriplex ornata, Chenopodium botrys, Chrozophora hierosolymitana* (= *Ch. tinctoria*), *Eremopyrum triticeum, Gastrocotyle hispida, Heliotropium ellipticum, Hyoscyamus pusillus, Salsola pestifer, Tribulus terrestris.*

Constant species: *Heliotropium ellipticum.*

Geographical range: This vegetation has only been recorded in the vicinity of the Rabat in the Syr-darya River Valley, on the sand deposits of the river at an elevation of ca. 450 m a.s.l. It may inhabit an extensive hot semi-desert zone of the whole Middle Asia (Świerszcz et al. 2021).

Habitat characteristics: This community inhabits sandy sediments in the Syr-darya River Valley. This community occupies the weathered slopes with high salinity (Świerszcz et al. 2021).

SAT-XXc03. Community of *Phlomis betonicifolia* (subhalophytic grassland on arid solonetz soils in the south-west Pamir-Alai Mts)

Diagnostic species: *Phlomis betonicifolia.*

Constant species: *Phlomis betonicifolia.*

Geographical range: This vegetation inhabits the colline and montane belt of the south-western ranges of Pamir-Alai (Babatag, Aktau, Aruk-Tau), at an elevation of about 600 to 2,000 m a.s.l. (Kochkareva 1986).

Habitat characteristics: This vegetation inhabits transitional habitats between hot semi-deserts and pseudosteppes. It forms sparse stands on escarpments, landslides and slopes in south-western Tajikistan, occupying loamy soils. This area is intensively grazed by sheep and goats in spring.

SAT-XXc04. Community of *Zygophyllum bucharicum* (halophytic shrublands in the colline belt of the Aruk-Tau Mts in the south-western Pamir-Alai Mts)

Diagnostic species: *Zygophyllum bucharicum.*

Constant species: *Zygophyllum bucharicum.*

Geographical range: This semi-desert sub-halophytic vegetation is known only from south-western Tajikistan, from the foothills of Aruk-Tau Mts near Tartki-Sovetobod. It also occurs in north-western Hindu Kush in Afghanistan. It is a colline vegetation occurring at approx. 650–750 m a.s.l.

Fig. 222. Halophytic sparse vegetation of *Atriplex ornata-Heliotropium ellipticum* near Asht, northern Tajikistan (ca. 500 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: This vegetation inhabits the semi-desert zone of south-western Tajikistan, occupying loamy soils on gentle slopes. This area is intensively grazed in early spring.

SAT-XXc05. Community of *Cephalorhizum popovii* (halophytic sparse vegetation of gypsum and salt outcrops in the south-western Pamir-Alai in the colline belt of the Aruk-Tau Mts in the south-western Pamir-Alai Mts)
(Fig. 223)

Diagnostic species: *Cephalorhizum popovii, Andrachne virgatenuis.*
Constant species: *Cephalorhizum popovii, Andrachne virgatenuis.*
Geographical range: This vegetation forms ephemeral stands of halophytes in thermophilous lowlands. It has only been recorded in one locality on the Hodzha-Mumin salt mountain, in a small eroded ephemeral water circus (Świerszcz et al. 2021)
Habitat characteristics: This vegetation inhabits escarpments, barrens and landslides in the hot semi-desert belt at an elevation of ca. 680 m a.s.l. in south-western Tajikistan**.**

SAT-XXc06. Community of *Seidlitzia rosmarinus* and *Salsola gemmascens* (semi-desert vegetation of the southern Hindu Kush Mts in Afghanistan)

Diagnostic species: *Salsola gemmascens, Seidlitzia rosmarinus.*
Constant species: *Carex physodes, Eremurus inderiensis, Horaninovia ulicina, Salsola richteri, S. gemmascens, S. vvedenskyi, S. transoxana, S. longistylosa, Seidlitzia rosmarinus, Tamarix ramosissima, Tulipa sogdiana.*

Fig. 223. Community of *Cephalorhizum popovii* on gypsum outcrops in Hodzha-Mumin salt mountain, southern Tajikistan (ca. 680 m a.s.l.). Photo: A. Nowak.

Geographical range: This vegetation forms species-poor communities in the lowland and mountainous areas with extreme aridity and continental climate. It is mainly distributed in Afghanistan, but the diagnostic species have a much wider range (Freitag 1971).
Habitat characteristics: This vegetation inhabits sandy soils with a high salt content in the topsoil. It prefers dry, permeable substrates and occurs mainly on solonchak soils of pH 7.5–8.5 (Freitag 1971).

SAT-XXc07. Community of *Salsola subaphylla* and *Salvia santolinifolia* (semi-desert vegetation of the Hindu Kush foothills)

Diagnostic species: *Salvia santolinifolia, Salsola subaphylla.*
Constant species: *Acantholimon longiflorum, Allium longicollum, Andrachne rotundifolia, Astragalus oligophyllus, Fortuynia bungei, Gaillonia bruguieri, Gymnarrhena micrantha, Halarchon vesiculosum, Salvia santolinifolia, S. trichocalycina, Salsola subaphylla, Scorzonera pusilla, S. circumflexa.*
Geographical range: This species-poor, semi-desert vegetation occurs in the lowland and mountainous areas of the Hindu Kush in Afghanistan (Freitag 1971).
Habitat characteristics: This vegetation inhabits poor, skeletal soils with a high salt content in the topsoil. The vegetation has max. cover of approx. 15% and stands up to 40 cm high (Freitag 1971).

SAT-XXc08. Community of *Cousinia arida* (semi-desert vegetation of the colline belt of the southern and western Hindu Kush Mts in Afghanistan and Iran)

Diagnostic species: *Cousinia arida.*
Constant species: *Cousinia arida, Ephedra scoparia, Merendera robusta, Salsola arbuscula, Tulipa lehmanniana.*
Geographical range: This species-poor, semi-desert vegetation occurs in the deep valleys, colline and montane belts of the Hindu Kush in Afghanistan (Freitag 1971).
Habitat characteristics: This vegetation inhabits barren, grey soils, with an alkaline reaction (pH around 8). The vegetation is sparse and has a cover of max. 15% (Freitag 1971).

SAT-XXc09. Community of *Reaumuria stocksii* (semi-desert subhalophytic scrubland vegetation of the colline and lower montane belts of the south-western Hindu Kush Mts in Afghanistan)

Diagnostic species: *Reaumuria stocksii.*
Constant species: *Anabasis setifera, Atriplex dimorphostegia, Brachypodium distachyon, Fagonia parviflora, Plantago ciliata, Reaumuria stocksii.*
Geographical range: This species-poor, semi-desert vegetation occurs in the foothills of the Hindu Kush in Afghanistan (Freitag 1971).
Habitat characteristics: This vegetation occupies barren, sandy or gravelly soils, with an alkaline reaction (pH around 7.8–8.3). The vegetation is extremely sparse, with a cover of max. 5% (Freitag 1971).

SAT-XXc10. Community of *Ferula asa-foetida* (semi-desert vegetation from lowlands to the lower montane belt of the Irano-Turanian Region)

Diagnostic species: *Ferula asa-foetida.*
Constant species: *Allium fibrosum, A. caspium, Carex physodes, Dorema aitchisonii, Eremostachys regeliana, Ferula asa-foetida, F. badrakema, Iris songarica, Krascheninnikovia ceratoides, Salsola arbuscula, S. subaphylla, Stipa szowitsiana.*
Geographical range: This vegetation occurs in the montane belt of the Hindu Kush Mts in northern Afghanistan (Freitag 1971).
Habitat characteristics: This is quite rupiculous vegetation with domination of *Artemisia* and Apiaceae species, which make it similar to *Prangetea ulopterae* vegetation of screes. However, due to the harsh, arid and continental climatic conditions, the vegetation cover is only up to 30% in spring, and then decreases sharply. It occurs on alkaline, grey soils (Freitag 1971).

SAT-XXc11. Community of *Amygdalus eburnea* and *A. erioclada* (scrublands of the semi-desert, subhumid belt of the southern Middle Asia)

Diagnostic species: *Amygdalus eburnea, A. erioclada.*
Constant species: *Acanthophyllum squarrosum, Arnebia decumbens, A. linearifolia, Astragalus anisacanthus* subsp. *anisacanthus, A. anisacanthus* subsp. *schurabicus, Carex stenophylla, Clypeola aspera, Cousinia stocksii, Erysimum stocksianum, Euphorbia osyridea, Gaillonia afghanica, G. dubia, Stipa szowitsiana, Cymbopogon olivieri, Aellenia auricula* var. *acutifolia, Allium griffithii, A. stocksianum, Gagea bergii, Goldbachia laevigata, Isatis minima, Poa bulbosa, Sameraria armena, Octoceras lehmannianum, Pachypterygium stocksii, Pyrarnidium griffithianum, Reichardia tingitana, Stachys trinervis, Tetracme contorta, Torularia aculeolata, T. torulosa, Tulipa lehmanniana.*
Geographical range: This vegetation occurs in the colline belt at an elevation of approx. 950–1,200 m a.s.l. of the Hindu Kush Mts in northern and central Afghanistan (Freitag 1971).
Habitat characteristics: This community occurs in arid areas and inhabits alkaline, grey soils in the area with 150–250 mm/year of annual rainfall. The cover of the main shrub layer is up to 10%, and the dwarf-shrubs form a layer of ca. 15–25% (Freitag 1971). This semi-desert scrub is changing towards *Amygdalus spinosissima* stands in southern Tajikistan.

SAT-XXc12. Community of *Amygdalus brahuica* (semi-desert scrublands of the arid zone of eastern Afghanistan and northern Pakistan).

Diagnostic species: *Amygdalus brahuica.*
Constant species: *Amygdalus brahuica, Astragalus anisacanthus, Gaillonia macrantha, Lactuca orientalis.*

Geographical range: This community occurs in the arid areas of eastern and central Afghanistan and inhabits the upper montane and alpine belts at elevations of approx. 1,800–2,800 m a.s.l. (Freitag 1971).
Habitat characteristics: This vegetation prefers arid, semi-desert conditions with an annual rainfall of ca. 150–250 mm/year. It forms a sparse, species-poor scrub (Freitag 1971).

SAT-XXc13. Community of *Ziziphus nummularia* (thermophilous open scrub of the Hindu Kush in Afghanistan and other southern semi-deserts of the Irano-Turanian Region)

Diagnostic species: *Ziziphus nummularia.*
Constant species: *Acacia modesta, Aerva javanica, Aellenia acutifolia, Aristida adscensionis, A. ciliata, A. pogonoptila, Brachypodium distachyon, Ceropegia edulis Chrysopogon aucheri, Cleome neoana, Convolvulus pyrrhotrichus, C. spinosus, Cymbopogon parkeri, Diplotaxis griffithii, Eleusine flagellifera, Ephedra ciliata, Fagonia parviflora, Farsetia edgeworthii, Haloxylon salicornicum, Isatis harsukhii, Periploca aphylla, Rhazya stricta, Salvia trichocalycina, S. aegyptiaca, Stipa capensis, Withania coagulans, Ziziphus nummularia.*
Geographical range: This community occurs in the arid areas of deserts and semi-deserts in lowlands and the colline belt of southern and central Afghanistan, at an elevation of around 600–800 m a.s.l. (Freitag 1971).
Habitat characteristics: This vegetation prefers subtropical, hot climate with the annual rainfall at ca. 150–250 mm/year. It forms a sparse, species-poor scrub on skeletal, alkaline soils (Freitag 1971).

Sclerophyllous and thermophilous scrub vegetation of arid habitats on large rock ledges, screes and badlands of the Irano-Turanian Region

Sclerophyllous and thermophilous scrub vegetation of arid habitats on large rock ledges, screes and badlands of the Irano-Turanian Region

EPH. *Ephedretea intermedio-equisetinae* Cl. nov. hoc loco (Fig. 224)

Nomenclatural type: *Ephedretalia intermediae* Nowak et al. 2024

This vegetation class is established to cover the sclerophyllous shrub and dwarf-shrub communities of semi-arid and arid chasmophytic and rupiculous habitats in the montane to alpine belts of Middle Asia. We propose the class *Ephedretea*, which in our opinion is a distinct and widespread semi-desert vegetation in the arid ecosystems across the world. In Middle Asia this vegetation inhabits mainly large rock shelves, rock blocks and screes, rocky deserts and anthropogenic embankments and dumps (Nowak et al. 2024c).

EPH-A. *Ephedretalia intermediae* Nowak, Świerszcz, S. Nowak et Nobis 2024 (montane and subalpine shrubby chasmophytic vegetation on arid habitats of the Pamir-Alai and western Tian Shan Mts) (Fig. 225)

Diagnostic species: *Artemisia rutifolia*, *A. tenuisecta*, *Atraphaxis pyrifolia*, *Ephedra intermedia*, *Clematis songorica*, *Koelpinia linearis*, *Krascheninnikovia ceratoides*, *Lagochilus seravschanicus*, *Piptatherum songaricum*, *Prunus verrucosa*, *Salsola arbuscula*, *S. gemmascens*, *S. montana*, *Silene brahuica*, *Stipa caucasica*.

Constant species: *Ephedra intermedia*, *Artemisia rutifolia*, *Krascheninnikovia ceratoides*.

Geographical range: Montane to alpine belts of Middle and Central Asian Mts, Karakoram, Hindu Kush (Uzbekistan, Turkmenistan, Afghanistan, Kyrgyzstan, Tajikistan, Pakistan, eastern and northern China, Mongolia, Kazakhstan).

Fig. 224. Badland covered with *Ephedra intermedia* located on the northern shore of Issyk-kul Lake, Kyrgyzstan (ca. 1,750 m a.s.l.). Photo: A. Nowak.

Fig. 225. Stand of *Ephedra intermedia* in Zimtut Valley near Voru, Zeravshan Mts, Tajikistan (ca. 2,150 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: This vegetation type develops mainly in semi-arid to subhumid habitats in the montane to subalpine belts. *Ephedra* communities form a sparse shrub vegetation on rock ledges, shelves, clefts, on pebble cones and aprons, gravelly badlands and barelands in the Irano-Turanian continental climate zone. The main environmental factors that define this vegetation are arid conditions and low content of organic matter in the substrate. The plant communities that are included in this order are supposed to grow at elevations of approx. (1,000–)1,500–2,500(–3,000) m a.s.l., and consist mainly of species of the Irano-Turanian distribution range. They are mostly a natural vegetation of the rocky mountainous landscape, but also include the secondary scrublands that developed after clear cuttings of semi-desert vegetation (Nowak et al. 2024c).

EPH-AA. *Ephedro glaucae-Spiraeion baldshuanicae* Nowak, S. Nowak, Nobis et A. Nobis 2016

(montane and subalpine shrubby chasmophytic vegetation on arid habitats of the Pamir-Alai and western Tian Shan Mts)

Diagnostic species: *Ephedra glauca* (= *E. heterosperma), E. intermedia, Spiraea baldshuanica.*
Constant species: *Artemisia rutifolia, Callipeltis cucullaris, Clypeola jonthlaspi, Poa relaxa, Rhamnus coriacea, Pentaphylloides parvifolia, Stipa caucasica* subsp. *nikolai.*
Geographical range: The *Ephedro glaucae-Spiraeion baldshuanicae* phytocoenosis has been recorded in the western Pamir-Alai Mts, mainly in the Hissar, Zeravshan and Turkestan ranges, and less frequently in the Darvasian and Peter the First Mts. The community plots occur between (1,200–)1,500–2,500(–3,000) m a.s.l. The Hissar and Babatag ranges are mainly inhabited by *Spiraeetum baldshuanicae,* while the more arid mountains like Zeravshan serve as habitat for *Rhamnetum coriaceae* and *Pentaphylloidetum parvifoliae* (Nowak et al. 2016c).

Habitat characteristics: This vegetation develops on large shelves and rock ledges in the arid zone of the Pamir-Alai Mts. There are distinct communities found on slopes and walls with high precipitation and those with lower amounts of rainfall (Nowak et al. 2016c).

EPH-AA01. *Spiraeetum baldshuanicae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (montane dwarf shrub vegetation on rock ledges of the western Pamir-Alai Mts) (Fig. 226)

Diagnostic species: *Spiraea baldshuanica.*
Constant species: *Bromus tectorum, Carex koshewnikowii, Poa bulbosa, P. relaxa, Spiraea baldshuanica.*
Geographical range: The phytocoenosis of *Spiraeetum baldshuanicae* have been found in several sites in the Hissar Mts, mainly on the eastern and southern slopes of the Varzob, Takob, Khondara, Maychura, Sorbo and Sarday-Myena River Valleys. *Spiraea baldshuanica* is an endemic species of the western Pamir-Alai Mts, distributed in the south-western sections of the Hissar Range at an elevation of 1,100–2,300 m a.s.l. (Ovchinnikov 1975). The elevational distribution of the association corresponds to this amplitude. Samples were collected in the colline belt at an elevation of 1,000–1,950 m a.s.l. (Nowak et al. 2016c).
Habitat characteristics: The association inhabits granite and granodiorite rocks (mean pH 6.6), strongly eroded and generally loose. Its plots were found mainly on western and southern exposures with inclinations of approx. 75° (Nowak et al. 2016c).

EPH-AA02. *Rhamnetum coriaceae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (upper montane to subalpine dwarf shrub vegetation of rocky slopes of the western Pamir-Alai and western Tian Shan Mts) (Fig. 227)

Diagnostic species: *Rhamnus coriacea.*

Fig. 226. Rock ledges vegetation of *Spiraeetum baldschuanicae* in Vakhsh River Valley, Hissar Mts, Tajikistan (ca. 1,500 m a.s.l.). Photo: M. Nobis.

Constant species: *Artemisia rutifolia, Centaurea squarrosa, Ephedra glauca, Silene brahuica, Stipa caucasica.*

Geographical range: *Rhamnus coriacea* is an endemic species of Middle Asia, distributed in western Pamir-Alai and western Tian-Shan. In Tajikistan, it occurs mainly in the Zeravshan, Turkestan and southern part of the Darvasian mountain ranges at an elevation of 1,300–2,600 m a.s.l. (Ovchinnikov 1981). The association of *Rhamnus coriacea* was found in a few locations of the valley of Iskander-darya River in the Zeravshan Mts. The phytocoenosis develops at moderate elevations within the lower alpine belt. Mean elevation value for research plots was approx. 1,750 m a.s.l. (Nowak et al. 2016c).

Habitat characteristics: The phytocoenoses were found almost exclusively on limestone, rarely on dolomite shale (pH 7.4–8.0). The association prefers slope rocks with southeastern sunny exposure and inclinations of 20°–70° (Nowak et al. 2016c).

EPH-AA03. *Pentaphylloidetum parvifoliae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (alpine dwarf shrub vegetation of rock faces and ledges on mainly northern expositions in the Pamir-Alai Mts) (Fig. 228)

Diagnostic species: *Pentaphylloides parvifolia.*

Constant species: *Callipeltis cucullaris, Campanula incanescens, Veronica capillipes, V. rubrifolia.*

Geographical range: *Pentaphylloides parvifolia* is a chasmophytic species with a wide geographical distribution, known from Middle Asia, the Altai Mts, Siberia, Mongolia and western China (Ovchinnikov 1975). In Tajikistan, the species occurs along the main ridge of the Zeravshan Mts at elevations of approx. 1,600–3,000 m a.s.l., reaching here the southern limit of its natural range. The phytocoenosis develops on relatively high elevations in the alpine belt with a cool microclimate. The observed elevational range of the community was

Fig. 227. Shrub vegetation of the *Rhamnetum coriaceae* inhabiting limestone ledges near Khayronbed, Zeravshan Mts, Tajikistan (ca. 1,800 m a.s.l.). Photo: A. Nowak.

Fig. 228. Shrub vegetation of the *Pentaphylloidetum parvifoliae* association, found on marble ledges near Kante, Zeravshan Mts, Tajikistan (ca. 2,560 m a.s.l.). Photo: A. Nowak.

Fig. 229. *Spiraeetum pilosae* developed on rock outcrops in the Darvaz Mts, Tajikistan (ca. 1,800 m a.s.l.). Photo: A. Nowak.

between 1,850 to 3,000 m a.s.l. (Nowak et al. 2016c).

Habitat characteristics: This vegetation was found exclusively on limestone and marble rocks of solid structure with coarse crevices and ledges (pH 7.5–8.4). The association develops on sloping rock ledges and terraces with an inclination of between 55° and 80° (mean approx. 60°). *Pentaphylloidetum parvifoliae* was generally found on shady, northern and north-western slopes (Nowak et al. 2016c).

EPH-AA04. *Spiraeetum pilosae* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2022 nom. corr. (montane chasmophytic dwarf scrub vegetation on rock ledges and clefts in the western and central Pamir-Alai and Tian Shan Mts) (Fig. 229)

Diagnostic species: *Psychrogeton andryaloides, Spiraea pilosa.*

Constant species: *Spiraea pilosa.*

Geographical range: *Spiraea pilosa* is widely distributed in Middle Asia. Patches of the *Spiraeetum pilosae* were found in the montane belt, mainly in the Alai and Terskey Ala-Too Mts of Kyrgyzstan. It is also found in the Darvaz Mts of Tajikistan. It occurs at an elevation of approx. 900–2,100 m a.s.l. (mean 1,400 m; Nowak et al. 2022c).

Habitat characteristics: This vegetation inhabits different rock substrates such as limestone, slate, shales and even mudstones. It forms dwarf-shrub vegetation on eroded rocks with large shelves and ledges. Its stands were noted on slopes with an inclination of between 30° and 85° and southern or south-western exposition (Nowak et al. 2022c).

EPH-AA05. *Clematido songoricae-Ephedretum intermediae* Nowak, Świerszcz, S. Nowak et Nobis 2024 nom. corr. (screes vegetation of upper montane to alpine belt of the western Pamir-Alai Mts) (Fig. 230)

Fig. 230. Scrubland of *Clematido songoricae-Ephedretum intermediae* near Sarytag in the Fann Mts, Tajikistan (ca. 2,250 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Atraphaxis pyrifolia*, *Ephedra intermedia*, *Artemisia rutifolia*, *Clematis songorica*, *Koelpinia linearis*, *Krascheninnikovia ceratoides*, *Piptatherum songaricum, Poa relaxa*, *Prunus verrucosa, Silene brahuica*, *Stipa caucasica* subsp. *nikolai*, *Stipa richteriana* subsp. *jagnobica*.
Constant species: *Artemisia rutifolia, Ephedra intermedia, Koelpinia linearis, Krascheninnikovia ceratoides, Stipa caucasica* subsp. *nikolai.*
Dominant species: *Ephedra intermedia.*
Geographical range: The main distribution range of both name-giving taxa include Middle and Central Asia from the western Hindu Kush, through Pamir-Alai, Tian Shan towards the Altai ranges. The patches of the association were found in rocky ledges and screes within the upper montane and subalpine arid zone at elevations from 1,550 to 2,200 m a.s.l. (Nowak et al. 2024c).
Habitat characteristics: Rock ledges, pebble screes, boulder fields and barelands of Middle Asia. Particularly suitable habitats occur in eroded, semi-dry to subhumid zones in the upper montane and subalpine belts of the Zeravshan, Turkestan, Fergana and Hazratishokh ranges. The *Clematidi songoricae-Ephedretum intermediae* inhabits dry habitats with almost no organic matter in the topsoil. The association is characterised by a low abundance of the herb layer with a mean value close to 25%. The shrub layer, consisting mainly of *Ephedra intermedia*, *Atraphaxis pyrifolia* and *Prunus verrucosa,* reaches up to 60% (Nowak et al. 2024c).

EPH-AAc01. Community of *Ephedra glauca* (alpine scrub on rock shelves and rocky slopes in the western Pamir-Alai Mts)

Diagnostic species: *Ephedra glauca.*
Constant species: *Ephedra glauca.*
Geographical range: *Ephedra glauca* has its optimum occurrence in high, alpine elevations and in arid areas, e.g. in the Zeravshan and Turkestan ranges. The collected sample contains a few relevés representing a dwarf shrub vegetation dominated by *Ephedra glauca*. All relevés were collected in the central part of the Zeravshan Mts (1,600–2,200 m a.s.l.) (Nowak et al. 2016c).
Habitat characteristics: Large rock shelves, pebble screes and boulder fields in the arid zone of Zeravshan Mts (Nowak et al. 2016c).

EPH-AAc02. Community of *Sageretia thea* (scree and rocky slopes scrub vegetation of colline and montane belts of the south-western Pamir-Alai Mts)

Diagnostic species: *Sageretia thea.*
Constant species: *Sageretia thea.*
Geographical range: This vegetation has been recorded in Middle Asia only in western Pamir-Alai and northern Hindu Kush in Afghanistan. In Tajikistan, plots with *Sageretia thea* were observed in the zone of *Pistacietea* open woodlands, on rock outcrops, boulder fields and eroded rock screes at an elevation of ca. 650–2,200 m a.s.l. (Ovchinnikov 1981).
Habitat characteristics: Large rock shelves, pebble screes, rock faces and boulder fields in the arid zone of the Zeravshan, Hissar, Babatag, Aktau and Hazratishokh Mts.

EPH-AB. *Ephedrion regeliano-fedtschenkoi* Nowak, S. Nowak, Nobis et A. Nobis 2016 (chasmophytic dwarf shrub vegetation in semi-arid zone of the Pamir Mts)

Diagnostic species: *Ephedra regeliana, E. fedtschenkoi, E. gerardiana.*
Constant species: *Artemisia rutifolia, Melissitus pamiricus, Paraquilegia anemonoides, Pentaphylloides dryadanthoides, Poa relaxa, Roegneria czimganica.*
Geographical range: The plots of the *Ephedrion regeliano-fedtschenkoi* were recorded almost exclusively in the highest elevations of the Eastern Pamir (in the eastern part of Tajikistan). Few samples representing the community with *Rhamnus minuta* were also recorded in the central part of the Darvaz Mts. It is possible that the plots representing *Ephedrion regeliano-fedtschenkoi* also occur in the arid plateau of the Eastern Pamir, in the western Pamirian ranges (e.g. Vanch,

Rushan and Shugnan Mts) as well as in the more humid Darvazian region. The plots were sampled at elevation of 3,150–4,300 m a.s.l. Based on the distribution ranges of both *Ephedra* species, the alliance could be delimited to the Pamir, Tian Shan, Karakoram and western Himalayan ranges (Nowak et al. 2016c).

Habitat characteristics: It includes plant communities adapted to the harshest conditions in the arid, alpine and nival belts of the southern ranges of Central Asia (Nowak et al. 2016c).

EPH-AB01. *Pentaphylloidetum dryadanthoidis* Nowak, S. Nowak, Nobis et A. Nobis 2016 (chasmophytic dwarf shrub vegetation on limestone rocks in the alpine belt of the eastern Pamir Mts) (Fig. 231)

Diagnostic species: *Pentaphylloides dryadanthoides.*

Constant species: *Artemisia rutifolia, Ephedra fedtschenkoi, Melissitus pamiricus, Onosma dichroantha, Paraquilegia anemonoides, Roegneria czimganica.*

Geographical range: The distribution of *Pentaphylloides dryadanthoides* is limited to the highest elevations of the Pamir Plateau and in the surrounding mountains, in Tajikistan and western China (Ovchinnikov 1975). The species was found in several sites in the central part of the Eastern Pamir, in Murgab and Alichur River Valleys, in the Muzkol and Psharskyi mountain ranges. The association prefers elevations in the high alpine and nival belts, within an elevation range between 3,800 and 4,300 m a.s.l. (Nowak et al. 2016c).

Habitat characteristics: The phytosociological research confirmed that the species forms its own association, which develops on relatively firm and solid limestone rocks (pH 7.6–8.8). The phytocoenosis develops on rocks with small or medium-sized crevices, on sloping walls, rock faces or on rock summits. The noted inclination values varied significantly between 50° and 65°. *Pentaphylloides*

Fig. 231. Dwarf shrub vegetation of the *Pentaphylloidetum dryadanthoidis* inhabiting limestone rocks near Murgab, Eastern Pamir, Tajikistan (ca. 3,950 m a.s.l.). Photo: A. Nowak.

Fig. 232. *Rhamnus minuta* – a species forming dwarf shrub vegetation on limestone rocks near Khoburobot Pass, Darvaz Mts, Tajikistan (ca. 3,250 m a.s.l.). Photo: A. Nowak.

dryadanthoides generally prefers southeastern, sunny exposures (Nowak et al. 2016c).

EPH-ABc03. Community of *Rhamnus minuta* (chasmophytic dwarf shrub vegetation on limestone rocks in the alpine belt of the Pamir and Pamir-Alai Mts) (Fig. 232)

Diagnostic species: *Rhamnus minuta.*
Constant species: *Rhamnus minuta.*
Geographical range: *Rhamnus minuta* is a rare species in Tajikistan, with its range restricted to a few mountain ranges in the Eastern Tajikistanian and Pamirian geobotanical regions. The species is also known from Kashgaria in western China. Plots of the community were found on a few limestone outcrops near the Khaburabot Pass, at an elevation of approx. 3,150 m a.s.l. (Nowak et al. 2016c).
Habitat characteristics: They develop on solid limestone rocks with western exposures and moderate inclinations (ca. 65°) (Nowak et al. 2016c).

EPH-ABc04. Community of *Erigeron vicarius* and *Ephedra regeliana* (chasmopytic vegetation of alpine to subnival belts on rock ledges of the Trans-Alai Mts) (Fig. 233)

Diagnostic species: *Ephedra regeliana, Erigeron vicarius, Lophanthus virescens, Macrotomia cana, Onosma gmelinii.*
Constant species: *Artemisia rutifolia, Erigeron vicarius.*
Geographical range: This high alpine chasmophyte community is poorly documented and needs to be surveyed more widely. In 2015 we found only two plots in the Trans-Alai Mts (Nowak et al. 2022d). Considering the range of the two main diagnostic taxa, this vegetation type can be expected to occur in the mountains of Central Asia, including the Tian Shan in eastern China (Xinjiang Province) and the margins of Eastern Pamir.
Habitat characteristics: The community has been recorded on calcareous rock ledges

Fig. 233. Community of *Ephedra regeliana* and *Erigeron vicarius* near Jelandy, Gunt Valley, Pamir, Eastern Tajikistan (ca. 3,600 m a.s.l.). Photo: A. Nowak.

Fig. 234. Rocky slope covered with *Ribes villosum* near Jelandy, Eastern Pamir, Tajikistan (ca. 3,550 m a.s.l.). Photo: A. Nowak.

in semi arid zone of the northern Pamir-Alai (Nowak et al. 2022d).

EPH-ABc05. Community of *Ribes villosum* (scree and rocky slope scrub vegetation of high alpine desert zone of the Pamir and northern Hindu Kush Mts) (Fig. 234)

Diagnostic species: *Ribes villosum.*
Constant species: *Ribes villosum.*

Geographical range: This vegetation inhabits arid areas in the Eastern Pamir and northern Hindu Kush (Gorno Badakhshan), and also the Karakoram Mts in Pakistan. It occurs at high alpine elevation about 3,600–4,600 m a.s.l. (Ovchinnikov 1975).
Habitat characteristics: This community prefers dry, arid and cold areas in the highlands of Central Asia. It forms sparse stands on pebble screes or gravel bars and banks of the rivers.

Riparian forests of continental Central Asia with strong influences of temperate climate

Kuli Moron (= Serimadarun) Lake in Fann Mts with the view on *Populus talassica* stand and Bolshoya Gonza Peak (5,307 m a.s.l.). Photo: A. Nowak.

AZONAL VEGETATION

Alluvial forests and scrub

Riparian forests of continental Central Asia with strong influences of temperate climate

POL. *Populetea laurifolio-suaveolentis* Hilbig 2000 (riparian gallery forests of north-eastern outskirts of Irano-Turanian Region)

The *Populetea laurifolio-suaveolentis* class consists in Middle and Central Asia of plant communities occupying the wings of river valleys, mostly mountainous (at least not in the broad low-lying valleys of large rivers), with a high proportion of meadow species in the herb layer and the relatively low tree density. The distribution range of this class is not fully known, but undoubtedly includes Central Asia with the Altai Mts and north-eastern Kazakhstan (Nowak et al. 2015b).

POL-A. *Populetalia laurifolio-suaveolentis* Mirkin, Manibazar, Muchametshina, Alimbekova et Onishchenko ex Hilbig 2000 (poplar riparian forests from upper reaches of Ob River in the foothills of the Altai Mts)

The phytosociological survey of riparian forests in the Altai region (Charysh, Biya, Katun rivers) and southern Siberia, has identified several riparian forests that penetrate the Irano-Turanian Region, especially Central Asia from the north. Although we did not observe this vegetation, it has been reported to occur in Central Asia and classified within *Populetea laurifolio-suaveolentis*. Therefore, we chose to include these communities in this study and refer the reader to Taran's work for more detailed information (e.g. Taran 2015, Taran 2017). This vegetation includes with the reference to the Altai region:

POL-AA. *Populion laurifoliae* Mirkin et al. ex Hilbig 2000;
POL-AA01. *Artemisio dracunculi-Populetum laurifoliae* Mirkin et al. ex Hilbig 2000;
POL-AA02. *Populetum laurifolio-nigrae* Taran 1997;
POL-AA03. *Viburno opuli-Populetum laurifoliae* Taran 2017;
POL-AA04. *Brunnero sibiricae-Populetum laurifoliae* Taran 2016.

POL-B. *Betulo-Populetalia talassicae* Nowak et Nobis 2013 (riparian forests of montane and subalpine river valleys of Middle Asia) (Fig. 235)

The vegetation of the order *Betulo-Populetalia talassicae* is composed of many species belonging to a circumboreal element, however, as diagnostic for the vegetation units in Tajikistan, the species with an Irano-Turanian distribution have been assigned. Riparian forests are relatively common along mountain rivers and form so-called bielolesya – riparian stands of *Betula seravschanica, B. ovczinnikovii, B. procurva* subsp. *sogdiana, B. turkestanica, B. saposhnikovii* subsp. *murgabica* and *B. tianschanica* (Nowak, Nobis 2013; Nowak et al. 2015b). In the herb layer of these forests in the Pamir-Alai and Tian Shan, the most important diagnostic plants are *Poa pratensis* and *Vicia tenuifolia* (Nowak et al. 2015b).

Upper montane group

POL-BA. *Populion talassicae* Nowak et Nobis 2013 (poplar, birch and ash forests of montane and subalpine belts along rivers with high discharge or in the estuary areas of mountainous lakes in Middle Asia) (Fig. 236)

Diagnostic species: *Astragalus tibetanus, Calamagrostis pseudophragmites, Festuca rubra, Lonicera stenantha, Populus talassica.*
Constant species: *Astragalus tibetanus, Ligularia thomsonii, Poa pratensis, Polygonatum roseum, Populus talassica, Vicia tenuifolia.*
Geographical range: This alliance includes poplar, birch and ash forest communities that develop in the higher montane and subalpine elevations along rivers with high discharge or in the estuaries of mountain lakes of the Pamir Alai Mts. In this alliance, *Populetum talassicae* and *Populetum pamiricae,* as well as *Salicetum*

Fig. 235. Riparian forest of *Populus talassica* growing near the mouth of a tributary stream of the Iskander-kul Lake, Fann Mts, Tajikistan (ca. 2,200 m a.s.l.). Photo: A. Nowak.

Fig. 236. *Populus talassica* on the shore of the Lake Iskander-kul, Fann Mts, Tajikistan (ca. 2,200 m a.s.l.). Photo: A. Nowak.

turanico-pycnostachyae are included that are distributed throughout eastern Uzbekistan, western Kyrgyzstan, Tajikistan and northern Afghanistan (Nowak et al. 2017a).

Habitat characteristics: *Populion talassicae* forests grow on the bottoms of mountain stream valleys. However, they prefer shallow soils with relatively high organic matter content and alkaline pH. This type of vegetation is well adapted to periodic flooding and the deposition of gravel on the ground. This vegetation can reach the timber line, which in Pamir-Alai is at about 4,000 m a.s.l. (Nowak, Nobis 2013; Nowak et al. 2017a).

POL-BA01. *Populetum pamiricae* Nowak et Nobis in Nowak et al. 2015 (*Populus pamirica* riverside woods of the eastern Pamir Mts) (Fig. 237)

Diagnostic species: *Hippophae rhamnoides, Lactuca tatarica, Populus pamirica, Rosa huntica.*

Constant species: *Agrostis alba, Calamagrostis pseudophragmites, Hippophae rhamnoides, Populus pamirica.*

Geographical range: According to the literature, the diagnostic species is distributed along the river valley bottoms at higher elevations of approx. 2,500–3,800 m a.s.l. It was found mainly in eastern Pamir, and rarely in the western Pamir and the Darvaz Mts (Ovchinnikov 1968; Zapryagaeva 1976; Nowak et al. 2015b). Outside Tajikistan, the species occurs in northeastern Afghanistan (Hindu Kush) and western China (Kun-Lun Shan, Tibetan Plateau). Our detailed surveys of eastern Pamir and southern Kyrgyzstan in 2014–2015 confirmed that this association is actually restricted to the middle section of the Gunt River Valley, so the area of occupancy of this association continues to decrease (Nowak et al. 2017a). Phytocoenosis of the *Populetum pamiricae* forms green riverine belts along the margins of alpine rivers and streams.

Fig. 237. Stand of *Populetum pamiricae* in the Gunt Valley, Tajikistan (ca. 3,400 m a.s.l.). Photo: A. Nowak.

Fig. 238. Stand of *Populetum talassicae* at the Serimadarun Lake, Fann Mts, Tajikistan (ca. 2,200 m a.s.l.). Photo: A. Nowak.

These consist of small thickets in several sections of the Bartang, Gunt, Garam Chashma, and Shakhdara rivers (Nowak et al. 2015b).

Habitat characteristics: *Populetum pamiricae* is a typical high mountain forest community found in the subalpine zone (at an elevation of 2,600–3,400 m a.s.l.) close to the upper treeline. It develops within the river valley floors close to the river beds. The humus layer in the soils is usually underdeveloped (max. 10 cm) or even completely absent (pure gravel deposits). In general, the community develops in areas of flooding, mainly caused by spring thaw. This results in an intensive deposition of gravel, making it difficult for plants to colonise. In all cases, the soil environment is alkaline, sometimes with a pH well above 8 (Nowak et al. 2015b; Nowak et al. 2017a).

POL-BA02. *Populetum talassicae* Nowak et Nobis 2013 (*Populus talassica* riverside wood of the western Pamir-Alai and south-western Tian Shan Mts) (Fig. 238)

Diagnostic species: *Carex karoi, Neottia camtschatea, Pedicularis dolichorrhiza, Populus talassica.*

Constant species: *Astragalus tibetanus, Poa pratensis, Populus talassica, Polygonatum roseum, Vicia tenuifolia.*

Geographical range: *Populus talassica*, is endemic to Middle Asia and is restricted to the western fringes of the Tian Shan and Pamir-Alai ranges. In Tajikistan, it occupies river valleys in the Zeravshan, Hissar and Peter the First Mts (Komarov 1936; Nowak, Nobis 2013). *Populetum talassicae* is a riparian community endemic to the central part of Middle Asia, occurring at an elevation of 2,200–2,750 m a.s.l. It develops mainly in the alpine landscape of the valley floors and mountain streams in the coastal zone of mountain lakes (Nowak et al. 2017a).

Habitat characteristics: In Middle Asia the community of *Populetum talassicae* occurs in the valleys of mountain rivers and on the shores of mountain lakes, in the zone of episodic or periodic flooding. The humus layer in the soils is either very thin (10 cm) or completely absent (skeletal or residual soils). In general, the studied vegetation develops in areas of inundation and flooding, caused mainly by spring thaw. This led to, among others, intensive deposition of pebble material, which explains why the herb layer in many sites is poorly developed. In all cases, the soil substrate is alkaline (Nowak, Nobis 2013).

POL-BA02a. *Populetum talassicae caricetosum orbicularis* Nowak et Nobis 2013 (fen-related type of *Populus talassica* stands, mostly growing in a mountain lake shores) (Fig. 239)

This subassociation differs from the typical stands in that it has more fen species in the herb layer, mainly *Dactylorhiza umbrosa*, *Carex orbicularis*, *Carex karoi* or *Equisetum arvense*. This particular situation occurs when the stand is very close to the lake and grows on the peaty substrate which can be up to 1 m thick (Nowak, Nobis 2013).

Lower montane group

POL-BB. *Populion afghanicae* Nowak, Nobis et S. Nowak in Nowak et al. 2017 (riparian forests of montane stream and river valleys) (Fig. 240)

Diagnostic species: *Equisetum arvense, Populus afghanica, Armeniaca vulgaris, Euonymus koopmannii, Berberis integerrima.*
Constant species: *Fraxinus sogdiana, Galium aparine, Impatiens parviflora, Mentha asiatica, Poa pratensis, Polygonatum roseum, Populus afghanica, Rubus caesius.*

Fig. 239. Fen subassociation of *Populetum talassicae caricetosum orbicularis* at the Serimadarun Lake, Fann Mts, Tajikistan (ca. 2,200 m a.s.l.). Photo: A. Nowak.

Fig. 240. Riparian forests along the Obighingou Valley and humid slope forest near Childara, Tajikistan (ca. 1,550 m a.s.l.). Photo: A. Nowak.

Geographical range: *Populion afghanicae* has been distinguished in the mesophilous riparian forests of Middle Asia, with an elevational centre of occurrence in the montane belt. The phytocoenoses of this alliance occupy the valley bottoms of streams and mountain brooks, sometimes also on gentle slopes with water outflows (Nowak et al. 2017a). This vegetation occurs in the whole Middle Asia (Afghanistan, Uzbekistan, Turkmenistan, Kyrgyzstan and Tajikistan) (Nowak et al. 2017a).
Habitat characteristics: It is a typical forest vegetation associated with moderately fertile habitats with moving groundwater in valley bottoms. The sites are frequently inundated by melting spring water or heavy summer rainfall, but the floods are not long-lasting. As in other forest types of the region, the strong influence of grazing determines the abundance and frequency of meadow species in this vegetation type (Nowak et al. 2017a).

POL-BB01. *Fraxinetum sogdianae* Nowak, Nobis et S. Nowak in Nowak et al. 2017 (stands of *Fraxinus sogdiana* in deep, narrow, montane river valleys of the Pamir-Alai and western Tian Shan Mts) (Fig. 241)

Diagnostic species: *Arctium leiospermum, Lonicera korolkowii, Fraxinus sogdiana.*
Constant species: *Fraxinus sogdiana, Galium aparine, Impatiens parviflora, Poa pratensis.*
Geographical range: In Middle Asia, the distribution of *Fraxinus sogdiana* is limited to Pamir-Alai, south-western Tian Shan, northern Afghanistan and eastern Kopet-Dagh (Chukavina 1984). It has been reported between 1,000 and 2,000 m a.s.l. in the Hissar, Darvaz, Karateginian, Vakhsh and Peter the First Mts. Sporadically, it has been found in drier regions such as Zaravshanian and Turkestanian (Zapryagaeva 1976; Chukavina 1984). Several plots with dominance of *Fraxinus sogdiana* were sampled in the Kshtut, Takob and Poymazor

Fig. 241. Riparian forests of *Fraxinetum sogdianae* along the Zimtut River Valley near Voru, Tajikistan (ca. 1,950 m a.s.l.). Photo: A. Nowak.

river valleys in the Zeravshanian and Hissar ranges (Nowak et al. 2017a).

Habitat characteristics: *Fraxinetum sogdianae* was found exclusively in deeply eroded, narrow river valleys close to the watercourses. The stands often grow on steep slopes with some rock blocks and other signs of erosion. It prefers fertile, relatively deep and alkaline soils with a high organic matter content. The groundwater table is fairly shallow (Nowak et al. 2017a).

POL-BB02. *Betuletum turkestanico-tianschanicae* Nowak, Nobis et S. Nowak in Nowak et al. 2017 (birch woods in montane to subalpine belts in bottoms of V-shaped river valleys) (Fig. 242)

Diagnostic species: *Aquilegia atrovinosa, Betula tianschanica* (= *B. pamirica*), *B. turkestanica, Carex decaulescens, Galium turkestanicum, Iris sogdiana, Polygonatum roseum, Solidago kuhistanica.*

Constant species: *Codonopsis clematidea, Ligularia thomsonii, Polygonatum roseum, Populus afghanica, Rubus caesius.*

Geographical range: The distribution of both diagnostic species includes the eastern part of the Irano-Turanian Province, the Pamir-Alai and Tian Shan Mts. Both birch species occupy the montane and subalpine elevation belts. In Tajikistan, *Betula tianschanica* grows in the Zeravshan Mts at 2,300–2,500 m a.s.l. *Betula turkestanica* has a wider amplitudinal range and has been noted at 1,200–3,000 m a.s.l. in the Hissar, Karateginian, Darvaz and Peter the First ranges (Ovchinnikov 1968; Zapryagaeva 1976). Riparian forests dominated by *Betula tianschanica* and *B. turkestanica* were found mainly in the Zeravshan, Hissar and Karateginian Mts in deep, V-shaped river valleys (Nowak et al. 2017a).

Habitat characteristics: *Betuletum turkestanico-tianschanicae* prefers the bottoms of the V-shaped

Fig. 242. Birch stand of *Betuletum turkestanico-tianschanicae* in Obighingou River Valley near Arzing, Tajikistan (ca. 2,650 m a.s.l.). Photo: A. Nowak.

mountain rivers and streams in montane and subalpine zones. It occupies the river banks without significant deposits of riverbed gravels and with a relatively well-developed soil profile (Nowak et al. 2017a).

OL-BBc01. Community of *Ulmus pumila* (montane elm woodlands of Middle Asia)

Diagnostic species: *Ulmus pumila, Ferula kelleri, Acer semenovii.*
Constant species: *Galium aparine, Poa pratensis, Solenanthus circinnatus, Ulmus pumila.*

Geographical range: Plots of this community were found on the south-western slopes of the Tian Shan Mts, close to the Fergana Valley. The natural range of the *Ulmus pumila* is restricted to eastern Asia, with some outposts located in Central Asia (Wesche et al. 2011). Our stands were found close to the inhabited area, probably planted (Nowak et al. 2017a).
Habitat characteristics: The community inhabits river valley bottoms in the montane elevations. Like other riparian forests in Middle Asia, this forest type prefers the slopes of deeply eroded valleys of mountain rivers with frequent but not prolonged inundations. Plots of the community were sampled on deep soils with moderate organic matter content (Nowak et al. 2017a).

Riparian gallery forests and thickets of the Irano-Turanian Region

Riparian gallery forests and thickets of the Euro-Siberian, Mediterranean and Irano-Turanian Region

POA. *Alno glutinosae-Populetea albae* Fukarek et Fabijanič 1968

POA-A. *Salicetalia purpureae* Moor 1958 (riparian gallery forests of the eastern Irano-Turanian Region under the influence of temperate climate)

These hygrophilous gallery forests are mainly found in the northern parts of the Irano-Turanian Region, Kazakhstan and Mongolia. They are strongly influenced by the temperate climate. The vegetation of *Alno-Populetea albae* doesn't occur in Tajikistan and Kyrgyzstan, so we refrain from constructing the syntaxonomic system of this class for the whole Middle and Central Asia. However, we find it useful to mention three alliances and one association recently noted for Kazakhstan (Taran 1997; Taran 2005; Taran 2017), and then to focus on the typical vegetation of the mountainous Middle and Central Asia, a buckthorn thicket on alpine river bars. The vegetation recorded for the gallery alluvial forests of northern Kazakhstan is as follows:

POA-AA. *Rubio dolichophyllae-Populion albae* Taran 2005 (white poplar riparian gallery forests of upper Irtysh watershed in Kazakhstan)

POA-AB. *Equiseto hyemalis-Populion nigrae* Taran 1997 (black poplar riparian gallery forests of upper Irtysh watershed in Kazakhstan)

POA-AB01. *Equiseto hyemalis-Populetum nigrae* Taran 2017 (black poplar riparian gallery forests of upper Irtysh watershed in Kazakhstan)

POA-AC. *Salicion albae* Soó 1951 (willow alluvial woods on gravel bars of middle Irtysh in Kazakhstan)

POA-B. *Salici capusii-Hippophaeetalia rhamnoidis* Nowak, Świerszcz, S. Nowak, Nobis et M. Nobis 2024 (buckthorn and willow scrub vegetation on the submontane to subalpine river bars in the mountains of Middle Asia)

The large river valleys of the Pamir-Alai, the Pamir and the Tian Shan in Middle and Central Asia are characterised by extensive bars with thick deposits of gravel. Very often, despite frequent flooding, they are covered with dense thickets of buckthorn and willow and, closer to the water, stands of *Myricaria* spp. This vegetation was first described from the Karakoram in northern Pakistan (Eberhardt 2004). This type of vegetation is found throughout the Irano-Turanian Region at different elevation, from montane to subalpine belt, at around 1,000 to 3,000 m a.s.l. Although this vegetation seems to be very different from the poplar stands of the temperate zones of Central Asia, we decided to include it in the *Alno glutinosae-Populetea albae* because of the habitat similarities (Nowak et al. 2024b).

POA-BA. *Hippophaeion rhamnoidis* Eberhardt 2004 nom. corr. (buckthorn and willow scrub on the gravelly stream banks in the montane to subalpine belts of the mountains of Middle Asia)

Diagnostic species: *Hippophae rhamnoides, Salix capusii, S. pycnostachya, Calamagrostis pseudophragmites, Halimodendron halodendron.*
Constant species: *Hippophae rhamnoides, Salix capusii, S. pycnostachya, S. turanica, Calamagrostis pseudophragmites, Halimodendron halodendron.*
Geographical range: This vegetation is distributed throughout Middle Asia, including Hindu Kush and Karakoram Mts. It occurs mainly in alpine river valleys in the montane belt, but sometimes it descends to the colline or ascends to the subalpine belts. The dense thickets, called by local people thugai, can be found mainly in the central Tajikistan (e.g. valleys of the river Vanch, Pamir, Surkhob).
Habitat characteristics: This thicket-like vegetation inhabits gravelly stream banks in the montane to subalpine belts of the mountains of Middle Asia).

POA-BA01. *Salici pycnostachyae-Hippophaetum rhamnoidis* Eberhardt 2004 nom. corr. (river-bar willow bushes of the Pamir-Alai, Kopet-Dagh and Tian Shan Mts) (Fig. 243)

Fig. 243. Willow vegetation of the *Salici pycnostachyae-Hippophaeetum rhamnoidis* found near Margeb, Yagnob River Valley, Tajikistan (ca. 2,150 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Hippophae rhamnoides, Salix pycnostachya.*
Constant species: *Hippophae rhamnoides, Campanula pallida* var. *tibetica, Myricaria elegans, Rosa webbiana, Salix capusii, S. pycnostachya, S. turanica, Calamagrostis pseudophragmites.*
Geographical range: This is the central community of the alliance. It covers the whole of Middle Asia with the adjacent mountain ranges in northern Afghanistan, northern Pakistan, and in the Tian Shan. The association of *Salici pycnostachyae-Hippophaeetum rhamnoidis* grows in alpine river valleys in the montane and subalpine belts at an elevations of ca. 1,400 to 3,150 m a.s.l.
Habitat characteristics: This association develops on the gravel bars of alpine rivers with large and wide deposits. The wide valley provides shallow water even during floods or diurnal intensive melting of snow, making the habitat suitable for the development of vegetation.

POA-BA02. *Calamagrostio pseudophragmito-Hippophaeetum rhamnoidis* Eberhardt 2004 nom. prov. (buckthorn thickets on river-bars of the alpine rivers in the Karakoram Mts and the Pamir Mts) (Fig. 244)

Diagnostic species: *Hippophae rhamnoides, Calamagrostis pseudophragmites.*
Constant species: *Hippophae rhamnoides, Chenopodium botrys, Tanacetum baltistanicum, Perovskia abrotanoides, Rosa webbiana, Salix capusii, S. pycnostachya.*
Geographical range: Like the previous community, this vegetation is distributed throughout Middle and Central Asia, including northern Pakistan. It develops in valleys with strong currents or on small alluvial islands in the montane and subalpine belts at elevation between 1,200 and 3,000 m a.s.l.
Habitat characteristics: This association develops on the sandy sediments or gravel bars of alpine

Fig. 244. Buckthorn thickets of the *Calamagrostio pseudophragmito-Hippophaeetum rhamnoidis* inhabiting river bars near Vrang, Pamir River Valley, Gorno-Badakhshan Province, Tajikistan (ca. 2,760 m a.s.l.). Photo: A. Nowak.

Fig. 245. Willow riparian vegetation of the *Salicetum turanico-pycnostachyae* found near Poymazor, Vanch River Valley, Tajikistan (ca. 2,700 m a.s.l.). Photo: A. Nowak.

rivers. The large stony deposits provide a suitable habitat for the development of vegetation.

POA-BA03. *Salicetum turanico-pycnostachyae* Nowak, Nobis et S. Nowak in Nowak et al. 2017 (river-bar willow bushes of the Pamir-Alai, Kopet-Dagh and Tian Shan Mts) (Fig. 245)

Diagnostic species: *Agrostis canina, Hordeum brevisubulatum, Salix blakii, S. pycnostachya.*
Constant species: *Astragalus tibetanus, Poa pratensis, Salix blakii, S. pycnostachya, Taraxacum officinale.*
Geographical range: The main diagnostic taxon, *Salix pycnostachya*, occupies the lower terraces of mountain streams within an elevational amplitude from 2,000 to 4,000 m a.s.l. The species is widely distributed across Tajikistan and the whole Middle Asia. It has been reported from the Pamir-Alai, western Tian Shan, Kopet-Dagh and Ala-Tau Mts in Kyrgyzstan, China, Iran, Afghanistan and Kazakhstan (Ovchinnikov 1968; Zapryagaeva 1976). Stands of *Salix turanica* are scattered from the montane zone up to tree line (from ca. 1,400 to 3,800 m a.s.l.) across the Karateginian, Darvaz, and Peter the First Mts as well as in the western and eastern Pamir (Ovchinnikov 1968; Zapryagaeva 1976)
Habitat characteristics: *Salicetum turanico-pycnostachyae* is closely associated with mountain rivers and streams. The soil profile is poorly developed and has a strongly alkaline reaction (pH ca. 7.9). In the absence of river or human influence, the association is replaced by poplar or birch forests through natural succession. This type of phytocoenosis does not reach a significant age. There are no known stands older than 50 years (Zapryagaeva 1976; Nowak et al. 2017a).

POA-BA04. *Tussilagini farfarae-Calamagrostietum pseudophragmitae* Pawłowski et Walas 1949 (Eurasian river-bar grassy vegetation dominated by *Calamagrostis pseudophragmites*) (Fig. 246)

Fig. 246. Vegetation patch of the *Tussilagini farfarae-Calamagrostietum pseudophragmitae* found near Dekh, Panj River Valley, Tajikistan (ca. 1,700 m a.s.l.) Photo: A. Nowak.

Diagnostic species: *Calamagrostis pseudophragmites, Tussilago farfara.*
Constant species: *Calamagrostis pseudophragmites*, *Tussilago farfara.*
Geographical range: This is a typical gravel-bar vegetation distributed in river bed habitats throughout Eurasia. In Middle Asia, extensive stands of *Calamagrostis pseudophragmites* develop on sand sediments and gravel bars of all rivers (Ovchinnikov 1957).
Habitat characteristics: Stands of *Calamagrostis pseudophragmites* develop on sand sediments, gravel bars and occasionally anthropogenic sandy habitats throughout a country. Particularly dense stands inhabit river islands surrounded by strong currents and often flooded. In such conditions *Calamagrostis pseudophragmites* is a stronger competitor for the shrubby vegetation of *Salix* spp. or *Hippophae rhamnoides*.

All the communities listed below were found within the borders of Tajikistan, mainly in the Surkhob, upper Vakhsh, Vanch, Panj, Pamir and Zeravshan River Valleys. Some of them form secondary stands on the river bars, having their main habitats on the adjacent screes and aprons or on small tributaries (e.g. *Incarvillea olgae*, *Chondrilla phaecocephala*).

POA-BAc01. Community of *Salix capusii* (river-bar willow bushes of the Pamir-Alai, Kopet-Dagh and Tian Shan Mts) (Fig. 247)

Diagnostic species: *Salix capusii.*
Constant species: *Lactuca tatarica*, *Salix capusii.*
Geographical range: The main diagnostic taxon, *Salix capusii*, occupies river gravel bars at approx. 1,900–3,400 m a.s.l. The species is widely distributed throughout Tajikistan, mainly in the Pamir-Alai. It also occurs in the Tian Shan in Kyrgyzstan and Kazakhstan, and in the Hindu Kush in northern Afghanistan (Ovchinnikov 1968).
Habitat characteristics: This community forms a narrow belt of the shrubby vegetation close

Fig. 247. River bar vegetation dominated by *Salix capusii* in Kshtut Valley, Zeravshan Mts, Tajikistan (ca. 1,785 m a.s.l.). Photo: A. Nowak.

to stands of *Myricaria* spp. and occurs in a mosaic with *Salicetum turanico-pycnostachyae* on gravel sediments of alpine rivers.

POA-BAc02. Community of *Chondrilla phaeocephala*

This community is a scree-river bar type of vegetation that was mentioned by Rasulova (1991). The species form a species-poor stands in the beds of the alpine rivers on gravel bars, but also along natural or anthropogenic escarpments. It is known from the Pamir-Alai, Pamir and Tian Shan in the alpine belt at elevation of ca. 2,400–3,900 m a.s.l.

POA-BAc03. Community of *Incarvillea olgae* (Fig. 248)

Diagnostic species: *Incarvillea olgae.*
Constant species: *Calamagrostis pseudophragmites*, *Incarvillea olgae*.
Geographical range: The community is distributed in the valley bottoms of the montane and alpine belts of the Pamir-Alai, western Pamir and northern Hindu Kush.
Habitat characteristics: Stands of *Incarvillea olgae* develop on river gravel bars or on stony aprons and colluvial cones in the bottoms of alpine valleys throughout Middle Asia. It was noted mainly in montane and alpine belts at elevation of ca. 800–2,800 m a.s.l. (Kochkareva 1986).

POA-BAc04. Community of *Saccharum spontaneum* (Fig. 249)

Diagnostic species: *Saccharum spontaneum.*
Constant species: *Calamagrostis pseudophragmites*, *Saccharum spontaneum*.
Geographical range: This gravel bar vegetation is distributed in the river bed habitats of the subtropical and tropical zones of Africa and Asia. In Middle Asia, large stands of this species occupy the river beds of the Syr-darya and Amu-darya

Fig. 248. Gravel bars covered by *Incarvillea olgae*, found near Dashtishur, Obikhingou River, Tajikistan (ca. 1,650 m a.s.l.). Photo: A. Nowak.

Fig. 249. Gravel bar vegetation dominated by *Saccharum spontaneum*, located near Kishti-Poyon, Panj River Valley, Tajikistan (ca. 820 m a.s.l.). Photo: A. Nowak.

in the lowlands and in the colline belt of Pamir-Alai and Hindu Kush Mts (Ovchinnikov 1957).
Habitat characteristics: Stands of *Saccharum spontaneum* develop on the gravel bars of large rivers. Sometimes they form large stands that completely cover islands and wide alluvial plains of lowland rivers (e.g. Panj River in south-western Tajikistan; Kochkareva 1986).

POA-BAc05. Community of *Saccharum ravennae* (Fig. 250)

Diagnostic species: *Saccharum ravennae.*
Constant species: *Saccharum ravennae.*
Geographical range: *Saccharum ravennae* is a Mediterranean-Irano-Turanian species, mainly distributed in the southern part of Middle Asia. It occupies gravel bars in the river beds in the warm Mediterranean-like climates. Large stands of *Saccharum ravennae* have been recorded in the lowlands of Middle Asia. In Tajikistan, the largest stands of this community occur in the south-western part of the country, in the confluence area of the Panj, Vakhsh and Kofarnikhon rivers (Ovchinnikov 1957).
Habitat characteristics: *Saccharum ravennae* stands develop on the gravel bars of large rivers in the zone of warm, Mediterranean-like climates. It also develops along drainage ditches and occasionally on seepage slopes).

POA-BAc06. Community of *Pennisetum orientale*

Diagnostic species: *Pennisetum orientale.*
Constant species: *Pennisetum orientale.*
Geographical range: This vegetation was only noted in southern Tajikistan, in the narrow valley of the Panj River in the southern part of the Hazratishokh Mts. It has also been reported from the Aruk-Tau Mts, from the valley of the Kofarnikhon River. It is a typical scree or river gravel bar vegetation occupying river beds and aprons or screes of the eroded rock faces. The species

Fig. 250. Community of *Saccharum ravennae* on the gravel banks of the Dzhilikul Lake, Vakhsh River Valley, southern Tajikistan (ca. 350 m a.s.l.). Photo: A. Nowak.

is distributed throughout the Irano-Turanian Region, but its main occupation range is in the Hindu Kush (Ovchinnikov 1957; GBIF 2024).
Habitat characteristics: *Pennisetum orientale* stands develop on the screes, aprons and gravel bars of rivers in the zone of warm, Mediterranean-like climate at an elevation of about 700–1,500 m a.s.l.

POA-BAc07. Community of *Berberis nummularia* (Fig. 251)

Diagnostic species: *Berberis nummularia.*
Constant species: *Berberis nummularia.*
Geographical range: This shrubby vegetation has been recorded in the river beds of the Pamir-Alai in the montane belt, at an elevation of about 1,500–2,500 m a.s.l. This vegetation is also known in the Tian Shan (Ovchinnikov 1975; GBIF 2024).
Habitat characteristics: Stands of *Berberis nummularia* develop on alluvial sediments of the alpine rivers. They are resistant to heavy grazing by sheep and goats, thus occurring in the areas with intensive livestock grazing.

POA-BAc08. Community of *Halimodendron halodendron* (Fig. 252)

Diagnostic species: *Halimodendron halodendron.*
Constant species: *Halimodendron halodendron, Salix capusii, Hippophae rhamnoides.*
Geographical range: The centre of occurrence of *Halimodendron halodendron* is Middle and Central Asia. The species has been recorded in river valleys in the colline to alpine belts at elevation of about 300–2,600 m a.s.l. (Ovchinnikov 1968).
Habitat characteristics: This vegetation forms patchy stands in the wide river beds in the zone of Mediterranean-like climates. It also grows along drainage ditches, canals and irrigated fields, often on sub-halophytic soil.

Fig. 251. Shrub vegetation of the community of *Berberis nummularia* found near Rushan, Panj River Valley, Tajikistan (ca. 1,950 m a.s.l.). Photo: A. Nowak.

Fig. 252. Shrub vegetation of *Halimodendron halodendron* found near Sudzhina, Zeravshan River Valley, Tajikistan (ca. 1,010 m a.s.l.). Photo: A. Nowak.

POA-BAc09. Community of *Glycyrrhiza glabra* (Fig. 253)

Diagnostic species: *Glycyrrhiza glabra*.
Constant species: *Cynodon dactylon*, *Glycyrrhiza glabra*.
Geographical range: *Glycyrrhiza glabra* stands have been recorded in many places in Middle Asia. It inhabits river beds, seepage slopes, ditches and other anthropogenic sites influenced by irrigation. The community has been recorded in river valleys in the colline to montane belts at elevation of about 350–1,600 m a.s.l. (Ovchinnikov 1978).
Habitat characteristics: This vegetation forms dense stands in river beds, often occupying subhalophytic soils. It also grows along drainage ditches, canals, irrigated fields and roadsides.

POA-BAc10. Community of *Datisca cannabina* (gravel aprons, humid gorge and ravine vegetation of Middle Asia) (Fig. 254)

Diagnostic species: *Datisca cannabina*.
Constant species: *Datisca cannabina*.
Geographical range: This community inhabits riversides and gravel bars throughout the Mediterranean and Irano-Turanian Region, mainly in Turkey, Pamir-Alai and Hindu Kush. It occurs in the colline to upper montane belt at elevation of about 600–2,300 m a.s.l. (Ovchinnikov 1978).
Habitat characteristics: Stands of *Datisca cannabina* develop along small streams and tributaries of larger rivers in the colline and montane belt. It often grows on seepage slopes or ephemeral watercourses on mountain slopes, ravines and gorges. Sporadically *Datisca cannabina* stands have also been recorded on boulder fields with high groundwater level.

POA-BAc11. Community of *Salix iliensis* (subalpine vegetation of aprons, screes and river bars in Middle Asia) (Fig. 255)

Diagnostic species: *Salix iliensis*.

Fig. 253. Vegetation patch of *Glycyrrhiza glabra* found near Vanch, Panj River Valley, Tajikistan (ca. 1,550 m a.s.l.). Photo: A. Nowak.

Fig. 254. Vegetation of the *Datisca cannabina* community, found near Khushon, Sarday-Myona River Valley, Hissar Mts, Tajikistan (ca. 1,410 m a.s.l.). Photo: A. Nowak.

Fig. 255. Vegetation of *Salix iliensis*, found in Abduqakhor Valley, Vanch Mts, Tajikistan (ca. 3,300 m a.s.l.). Photo: A. Nowak.

Constant species: *Salix iliensis.*
Geographical range: This shrub vegetation has been recorded in the river beds of the Western Pamir-Alai in the subalpine section of the Abduquakhor Valley, at an elevation of about 2,900–3,700 m a.s.l. This vegetation is also known in the subalpine belt of the Tian Shan, Hindu Kush and Karakoram Mts (GBIF 2024).
Habitat characteristics: Stands of *Salix iliensis* develop on alluvial coarse deposits of the alpine rivers. They have also been observed on block and boulder screes nearby the water courses or in wet places on slopes.

POA-BB. *Myricarion bracteato-squamosae* nom. prov. (submontane to alpine river bar scrub of Middle Asia)

This shrubby vegetation of river bars is common in the valleys of Middle Asian rivers. The mountainous landscape causes a high precipitation in the alpine and nival belts, especially in spring. Additionally, the summer storms and snow melt fed the great rivers that originate in Middle Asia (e.g. Amu-darya, Syr-darya). These rivers eroded huge beds and valleys that are suitable habitats for *Myricaria* shrublands. This type of vegetation inhabits the close-to-water bars, which are frequently flooded. Like almost all vegetation types in Middle Asia, it is intensively grazed by livestock.

POA-BBc01. Community of *Myricaria squamosa* (alpine, early successional river bar scrub of Middle Asia) (Fig. 256)

Diagnostic species: *Myricaria squamosa.*
Constant species: *Myricaria squamosa.*
Geographical range: This community develops on massive gravel bars of all river valleys in Middle and Central Asia, and additionally in Tibet, Xijiang and Quingai provinces in China (Ovchinnikov 1978; GBIF 2024). It occurs in the alpine belt at elevation of about 2,500–4,000 m a.s.l. (Ovchinnikov 1978).

Fig. 256. Shrub vegetation of the *Myricaria squamosa,* growing on river bars near Kara-Kabak, Alai Valley, Kyrgyzstan (ca. 2,800 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: Stands of *Myricaria squamosa* develop within gravel beds of the alpine rivers. They prefer habitats along rivers, often inundated by meltwater or spring floods.

POA-BBc02. Community of *Myricaria bracteata* (submontane to alpine, early successional river bar scrub of Middle Asia) (Fig. 257)

Diagnostic species: *Myricaria squamosa.*
Constant species: *Myricaria squamosa, Tamarix arceuthoides, Salix capusii.*
Geographical range: This river bar vegetation is distributed throughout the Caucasus and Irano-Turanian Regions. It develops on gravel bars of rivers flowing in montane and alpine belts, approx. at 1,100 to 3,900 m a.s.l. (Ovchinnikov 1978).
Habitat characteristics: Stands of *Myricaria bracteata* form shrubs similar to the previous community as an early-successional stage of river bed vegetation. It seems to prefer lower altitudes, but the final classification and habitat description requires further research.

POA-BBc03. Community of *Lonicera stenantha* (mid-successional river-bed vegetation of subalpine to alpine belts of Middle Asia) (Fig. 258)

Diagnostic species: *Lonicera stenantha.*
Constant species: *Lonicera stenantha*, *Salix pycnostachya, S. capusii, Hippophae rhamnoides.*
Geographical range: This shrub community inhabits river bars at the alpine belt in Middle Asia (Pamir-Alai and western Tian Shan). In Tajikistan, it occurs mainly in the central part of the country at an elevation of 2,200–3,000 m a.s.l. Plots of the community have been recorded in upper Zeravshan Valley in the Matcha district (Kinzikaeva 1988).
Habitat characteristics: Stands of *Lonicera stenantha* form dense shrubs as a mid-successional

Fig. 257. Gravel bar vegetation of the *Myricaria bracteata*, found near Gusar, Zeravshan River Valley, Tajikistan (ca. 1,050 m a.s.l.). Photo: A. Nowak.

Fig. 258. Scrub of *Lonicera stenantha* on gravel bars of Surkhob River near Tajikobod, Tajikistan (ca. 1,620 m a.s.l.). Photo: A. Nowak.

stage of river-bed vegetation. It prefers alpine altitudes and is resistant to moderate grazing, but still its final classification and habitat description require further research.

POA-BC. *Chamaenerion latifolii* nom. prov. (vegetation of montane-subalpine river bars and gravel terraces of Middle and Central Asia)

This alliance groups plant communities that occur in alpine elevations on the river gravel bars of alpine streams in their highest reaches. This herb vegetation occupies narrow strips, often in the middle of the bars with large stones and boulders at elevation of ca. 2,500–4,200 m a.s.l. Communities with *Chamaenerion latifolii* are distributed mainly in Central Asia

Fig. 259. Gravel bar vegetation of the *Clematis tangutica*, found near Chatyr-Tashin, Eastern Pamir, Tajikistan (ca. 3,895 m a.s.l.). Photo: A. Nowak.

Fig. 260. Gravel bar vegetation of the *Chamaenerion latifolium*, found near Jelandy, Eastern Pamir, Tajikistan (ca. 3,450 m a.s.l.). Photo: A. Nowak.

along the Pamir ranges, Hindu Kush, Karakoram and Tian Shan Mts. It is a common vegetation type in the holarctic region.

POA-BCc01. Community of *Clematis tangutica* (vegetation of river beds periodically filled with water in the dry climate of the eastern Pamir Mts) (Fig. 259)

Diagnostic species: *Clematis tangutica.*
Constant species: *Clematis tangutica.*
Geographical range: This vegetation develops mainly in the Pamir Mts, in arid, highly elevated habitats. The stands of *Clematis tangutica* community have been recorded in the eastern Pamir in river beds and slopes with gravelly or stony substrates, at an elevation of approx. 3,400–4,000 m a.s.l. (Kinzikaeva 1988).
Habitat characteristics: Stands of *Clematis tangutica* form sparse vegetation on dry, permeable river bed substrates and occur only occasionally on slopes, in any case on substrates with low organic matter content.

POA-BCc02. Community of *Chamaenerion latifolium* (vegetation of river beds with coarse gravel bars periodically filled with water in the dry climate of the eastern Pamir Mts) (Fig. 260)

Diagnostic species: *Chamaenerion latifolium.*
Constant species: *Chamaenerion latifolium.*
Geographical range: This is the most typical vegetation of high alpine river bars in Central Asia, occurring in Tajikistan only in the Eastern Pamir. It has been recorded in several mountain streams near Jelandy at an elevation of approx. 3,500–3,900 m a.s.l.
Habitat characteristics: Stands of *Chamaenerion latifolium* develop on coarse gravel in the central part of the river beds with periodically flowing water (Ovchinnikov 1975).

Riparian open wood vegetation of saline and subsaline alluvial habitats along mainly intermittent rivers and oases

Vegetation of the continental desert & semi-desert zone

Riparian open wood vegetation of saline and subsaline alluvial habitats along mainly intermittent rivers and oases

POP. *Populetea euphraticae* Zohary 1962 nom. inval.

POP-A. *Populetalia pruinoso-euphraticae* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2024 (riparian galley open woodlands of alluvial habitats in Irano-Turanian and eastern Mediterranean Region)
(Fig. 261)

This riparian gallery open woodlands are established to classify the forests with *Populus pruinosa* and *P. diversifolia* in the Irano-Turanian Region. It occurs as woodland or woodland-thickets vegetation on alluvial plains in the warmest climatic zone of the Irano-Turanian Region. It groups plant communities such as *Populetum pruinosae,* which thrives on wet, marshy and frequently inundated river terraces with increased salinity. It occupies river valleys at elevations of approx. 200–450 m a.s.l. with shallow ground water table and numerous oxbow lakes, ditches and marshlands. The range of this vegetation includes southern regions of Middle Asia (S Uzbekistan, Turkmenistan, SW Tajikistan, N Afghanistan). The diagnostic species for this type of vegetation are: *Populus pruinosa*, *P. euphratica*, *Elaeagnus angustifolia*, *Erianthus ravennae*, *Cynanchum acutum*, *Elaeagnus angustifolia*, *Erianthus ravennae*, *Glycyrrhiza glabra*, *Limonium raeniformae*, *Tamarix ramosissima*, *T. meyeri*, *T. hispida*, *Zygophyllum oxianum* (Nowak et al. 2024b).

Fig. 261. Marshlands of the Kofarnikhon River with open gallery riparian forest dominated by *Populus pruinosa*, Dzhilikul, southern Tajikistan (ca. 350 m a.s.l.). Photo: A. Nowak.

POP-AA. *Elaeagno angustifoliae-Populion pruinosae* Nowak, Nobis et S. Nowak in Nowak et al. 2017 (galley open forests and thickets of the large river floodlands in the lowland Middle Asia) (Fig. 262)

Diagnostic species: *Arundo donax, Karelinia casia, Limonium reniforme, Saussurea kabadiana.*
Constant species: *Elaeagnus angustifolia, Erianthus ravennae, Glycyrrhiza glabra, Populus pruinosa, Tamarix ramosissima, Zygophyllum oxianum*.
Geographical range: It covers the southern regions of Middle Asia (Uzbekistan, Turkmenistan, Kyrgyzstan and Tajikistan) (Nowak et al. 2017a).
Habitat characteristics: This vegetation type develops on the vast confluences of large rivers in southern Tajikistan and northern Afghanistan, at elevations of approx. 200–450 m a.s.l. It occupies low river terraces with a shallow ground water table and numerous oxbow lakes, ditches and marshlands (Nowak et al. 2017a).

POP-AA01. *Populetum pruinosae* Nowak, Nobis et S. Nowak in Nowak et al. 2017 (riparian open woods of large river valleys of Syr-darya, Amu-darya, Vakhsh, Panj, Tarim)

Diagnostic species: *Elaeagnus angustifolia, Erianthus ravennae, Populus pruinosa, Trachomitum scabrum, Zygophyllum oxianum.*
Constant species: *Cynanchum acutum, Elaeagnus angustifolia, Erianthus ravennae, Glycyrrhiza glabra, Limonium raeniformae, Populus pruinosa, Tamarix ramosissima, Zygophyllum oxianum.*
Geographical range: According to the literature, the main diagnostic taxon of the association is distributed in Tajikistan along the lowest reaches of the rivers: Panj, Surkhob, Kyzyl-Su, Vakhsh, Kofarnikhon, Syr-darya and Amu-darya. Throughout Middle Asia, it has also

Fig. 262. *Elaeagno angustifoliae-Populion pruinosae* riparian woodland in Tigrovaya Balka National Park, southern Tajikistan (ca. 340 m a.s.l.). Photo: A. Nowak.

been recorded in southern Kazakhstan, Iran, Afghanistan and western China (Ovchinnikov 1968; Zapryagaeva 1976). The largest forest in Tajikistan is protected in the Tigrovaya Balka National Park (Nowak et al. 2017a).

Habitat characteristics: *Populetum pruinosae* occurs in the warmest regions of Tajikistan, with the lowest rainfall and a long dry season during the hot summer. It develops in the lowest reaches of large rivers, often on islands or within the barely accessible confluence areas of the Panj and Vakhsh rivers (Nowak et al. 2017a).

POP-AA02. *Populetum euphraticae* Zohary 1951 nom. inval. (riparian and oasis open woods of the Tarim River Valley in semi-arid climate)

We have not recorded this vegetation in Middle Asia. It is a typical Irano-Turanian gallery forest dominated by *Populus euphratica*. It is distributed from Israel, through Mesopotamia, Middle and Central Asia to Tarim Basin and Qinghai province in China. This community, which occurs in inhabited but very arid areas, is extremely threatened by logging for fuel or building material.

Riparian scrub communities of saline and subsaline alluvial habitats along mainly lowland rivers

Saline marshlands around Sasyk-kul Lake in the Eastern Pamir, near Alichur (ca. 3,700 m a.s.l.). Photo: A. Nowak.

Riparian scrub communities of saline and subsaline alluvial habitats along mainly lowland rivers

TAM. *Tamaricetea arceuthoidis* Akhani et Mucina 2015

This vegetation consists of *Tamarix* shrublands in saline and sub-saline river bed habitats of the Irano-Turanian Region.

TAM-A. *Elaeagno turcomanicae-Tamaricetalia ramossissimae* Akhani et Mucina 2015 (riparian subsaline river bar thickets of Irano-Turanian Region) (Fig. 263)

Diagnostic species: *Elaeagnus angustifolia, Tamarix ramosissima.*
Constant species: *Elaeagnus angustifolia, Tamarix ramosissima*.
Geographical range: These scrubs inhabit large, lowland river beds throughout Middle and Central Asia. They occur in riparian zone, on gravel bars away from the main water flow.
Habitat characteristics: This type of vegetation develops in warm Mediterranean-like or Irano-Turanian climates, in the river beds of large lowland rivers (e.g. Amu-darya, Syr-darya, Zeravshan).

TAM-AA. *Agropyro fragilis-Tamaricion ramosissimae* Golub in Barmin 2001 (riparian subsaline bushes of Central Asia) (Fig. 264)

Diagnostic species: *Agropyron fragile, Tamarix ramosissima.*
Constant species: *Agropyron fragile, Cynodon dactylon, Lycium ruthenicum, Tamarix ramosissima*.
Geographical range: This scrub vegetation is distributed throughout Central Asia. It inhabits higher elevations than the previous community, with the optimum in the colline and montane belts at approx. 800–2,900 m a.s.l.

Fig. 263. Riparian shrub dominated by *Elaeagnus angustifolia* and *Tamarix ramosissima* found near Kyzylkala, Vakhsh River Valley, Tajikistan (ca. 400 m a.s.l.). Photo: A. Nowak.

Fig. 264. Riparian shrub dominated by *Tamarix ramosissima,* found near Kumok, Zeravshan River Valley, Tajikistan (ca. 1,100 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: This type of vegetation develops in continental Irano-Turanian climates, on gravelly alluvial sediments of the various mountain rivers of Central Asia.

TAM-AAc01. Community of *Tamarix florida* (halophytic shrublands along large rivers in the western Pamir-Alai and western Tian Shan Mts) (Fig. 265)

Diagnostic species: *Chaenorhinum spicatum, Climacoptera turcomanica, Halostachys belangeriana, Limonium otolepis, Orobanche mongolica, Polygonum equisetiforme, Rumex halacsyi* (*R. dentatus* subsp. *halacsyi), Tamarix florida.*
Constant species: *Halostachys belangeriana, Tamarix florida.*
Geographical range: This community was found in only one area – around the village of Rabat in the Syr-darya River Valley (Świerszcz et al. 2021).
Habitat characteristics: It occupies extensive muddy or moderately sandy alluvial deposits of the river near Lake Oksukon (Świerszcz et al. 2021).

TAM-AAc02. Community of *Cynodon dactylon-Tamarix ramosissima* (intensively grazed river-bar shrublands of Tajikistan) (Fig. 266)

Diagnostic species: *Alhagi kirghisorum, Artemisia stenocephala, Cynanchum sibiricum* (= *C. acutum* subsp. *sibiricum*), *Cynodon dactylon, Elaeagnus angustifolia, Erianthus ravennae* (= *Saccharum ravennae*), *Limonium reniforme, Medicago lupulina, Tamarix ramosissima.*
Constant species: *Cynodon dactylon, Tamarix ramosissima.*
Geographical range: This community was found mainly in south-western Tajikistan, mainly in the valleys of the Amu-darya, Vakhsh, Kofarnikhon and other smaller rivers of the hot climatic zone (Świerszcz et al. 2021).
Habitat characteristics: It inhabits the edges of canals, ditches, river valleys and intermittent

Fig. 265. Riparian shrub of the *Tamarix florida* community found near Rabat, Syr-darya River Valley, northern Tajikistan (ca. 440 m a.s.l.). Photo: A. Nowak.

Fig. 266. Riparian shrub dominated by *Tamarix ramosissima*, found near Kalanak, Surkhob River Valley, central Tajikistan (ca. 1,360 m a.s.l.). Photo: A. Nowak.

watercourses. It has also been found on escarpments with seeping water. It is a typical lowland thicket community of subsaline habitats (Świerszcz et al. 2021).

TAM-AAc03. Community of *Tamarix hohenackeri* (riparian subsaline river bar bushes of western and central Tajikistan)

Diagnostic species: *Tamarix hohenackeri.*
Constant species: *Tamarix hohenackeri.*
Geographical range: This typical gravel bar *Tamarix* scrub inhabits lowland and colline river bar habitats in the Syr-darya, Vakhsh, Kofarnikhon and Zeravshan River Valleys at an elevation of about 700–900 m a.s.l. (Ovchinnikov 1981).
Habitat characteristics: The community of *Tamarix hohenackeri* develops in the Irano-Turanian climate, on gravelly alluvial sediments of the various fast-flowing rivers, mainly of Central Asia.

TAM-AAc04. Community of *Tamarix arceuthoides* (riparian subsaline river bed bushes of south-western Tajikistan) (Fig. 267)

Diagnostic species: *Tamarix arceuthoides.*
Constant species: *Myricaria bracteata, Salix blakii, Tamarix arceuthoides.*
Geographical range: These sparse bushes are distributed throughout the Irano-Turanian Region. In Tajikistan, this vegetation occupies mainly the montane belt in Turkestan, Zeravshan, Hissar, Karateginian and Peter the First Mts at an elevation of ca. 1,200–3,000 m a.s.l.
Habitat characteristics: This type of vegetation develops in the Irano-Turanian climate, on gravelly alluvial sediments of the various mountain rivers of Middle and Central Asia (Ovchinnikov 1981).

TAM-AAc05. Community of *Trachomitum lancifolium* (bushes and fringe vegetation on the river banks and plains in Tajikistan) (Fig. 268)

Fig. 267. Community of *Tamarix arceuthoides* on gravel bars of Surkhob River near Gharm, Tajikistan (ca. 1,340 m a.s.l.). Photo: A. Nowak.

Fig. 268. Community of *Trachomitum lancifolium* on gravel bars of the Zeravshan River near Pandzhikent, Tajikistan (ca. 950 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Trachomitum lancifolium*.
Constant species: *Trachomitum lancifolium*.
Geographical range: *Trachomitum lancifolium* forms relatively dense thickets in the Syrdarya River Valley. It is a Central Asian species with a distribution range in northern Tajikistan, Kazakhstan and Xinjiang province in China (Chukavina 1984; GBIF 2024). In Tajikistan, the community grows in the colline belt at an elevation of about 600–900 m a.s.l.
Habitat characteristics: This type of vegetation develops in the continental, Irano-Turanian climate, on gravelly alluvial sediments of large rivers (Chukavina 1984).

TAM-AAc06. Community of *Vitex agnus-castus* (riparian patchy vegetation on river bars in western Tajikistan) (Fig. 269)

Fig. 269. Riparian shrubs dominated by *Vitex agnus-castus*, found near Dushanbe, Kofarnikhon River Valley, central Tajikistan (ca. 700 m a.s.l.). Photo: A. Nowak.

Fig. 270. Riverine vegetation with *Atraphaxis pyrifolia* found near Mullokoni, Surkhob River Valley, Baljuvon District, central Tajikistan (ca. 1,550 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Vitex agnus-castus.*
Constant species: *Vitex agnus-castus.*
Geographical range: This community is mainly distributed in western and south-western Tajikistan, but the diagnostic species is widespread throughout the Mediterranean and Irano-Turanian Regions. It forms patchy bushes on the margins of river beds. It has been recorded in the valleys of Kofarnikhon, Amu-darya and Surkhob rivers at an elevation of about 700–1,200 m a.s.l.
Habitat characteristics: This type of vegetation develops in the warm Irano-Turanian climate, on gravelly alluvial sediments of large and medium-sized rivers (Chukavina 1984).

TAM-AAc07. Community of *Atraphaxis pyrifolia* (scree-like vegetation on river bars in central Tajikistan) (Fig. 270)

Diagnostic species: *Atraphaxis pyrifolia.*
Constant species: *Atraphaxis pyrifolia*.
Geographical range: *Atraphaxis pyrifolia* is a widespread species in Middle and Central Asia, mainly inhabiting screes. However, in large river beds of central Tajikistan (e.g. Surkhob, Obikhingou rivers) it forms stands on gravel bars at elevation of ca. 1,200–1,800 m a.s.l.
Habitat characteristics: This type of vegetation develops in the montane, continental Irano-Turanian climate, on gravelly alluvial sediments of medium-sized rivers (Ovchinnikov 1968).

Hypersaline alluvial temporary flooded swards in the semi-desert and desert zones on solonchak soils in the Irano-Turanian Region

Hypersaline alluvial temporary flooded swards in the semi-desert and desert zones on solonchak soils in the Irano-Turanian Region

CLI. *Climacopteretea crassae* Akhani ex Świerszcz, Nobis, Wróbel, Klichowska, Nowak et A. Nowak 2021 nom. corrigend. (Fig. 271)

This class was originally coined for annual therophytes where succulents with C4 metabolism predominate (Akhani 2004). The vegetation of *Climacopteretea crassae* consists mainly of chenopod species, with the predominance or frequent occurrence of *Suaeda arcuata*, *S. altissima*, *S. aegyptiaca*, *Climacoptera* spp., *Petrosimonia glauca*, *Halanthium rarifolium*, *Atriplex tatarica*, *Bienertia cycloptera* or *Cornulaca monacantha*. The vegetation prefers moderately to highly saline habitats in the lowlands of the Irano-Turanian Region. It inhabits river banks, saline depressions (sabkha) or flooded plains with clay or loamy-clay substrates (Akhani et al. 2003). It tolerates natural disturbances such as floods or anthropogenic disturbances such as trampling or heavy grazing. Compared to *Thero-Salicornietea*, this vegetation inhabits more saline and drier habitats. *Climacopteretea crassae* communities often occur with close relation to *Tamaricetea*, *Salicornietea fruticosae* or *Haloxylo-Salsoletea* vegetation (Akhani 2004).

CLI-A. *Psylliostachyetalia spicato-leptostachyae* Świerszcz, Nobis, Wróbel, Klichowska, Nowak et A. Nowak 2021 (hypersaline grasslands dominated by annuals on solonchak soils, often flooded areas in river valleys of Middle and Central Asia) (Fig. 272)

Diagnostic species: *Aeluropus littoralis, Heliotropium olgae, Lachnoloma lehmannii, Limonium reniforme, Psylliostachys leptostachya, P. spicatus,*

Fig. 271. *Salsola leptoclada* – a species forming saline vegetation (*Climacopteretea crassae* class) found near Hudzhant, Mogoltau Mts, Tajikistan (ca. 850 m a.s.l.). Photo: A. Nowak.

Fig. 272. Saline marshes dominated by *Psylliostachys leptostachya* and *P. suworowii* near Vose, southern Tajikistan (ca. 560 m a.s.l.). Photo: A. Nowak.

Salsola leptoclada, Atriplex tatarica, Climacoptera transoxana.

Constant species: *Heliotropium olgae, Limonium reniforme, Psylliostachys leptostachya, P. spicata, Salsola leptoclada, Atriplex tatarica, Climacoptera transoxana*.

Geographical range: Phytocoenoses belonging to this order are found across the Irano-Turanian Region - in Iran, the Caspian Basin, Turkmenistan, Uzbekistan, Kazakhstan, Tajikistan and Kyrgyzstan. Most of their vertical range is in lowland, colline, and only occasionally montane belts, from 200 to 1,600 m a.s.l. (Świerszcz et al. 2021).

Habitat characteristics: The order includes phytocoenoses characterised by a high proportion of salt-tolerant annual plants of an Irano-Turanian distribution. They form ephemeral vegetation on solonchak or sometimes solonetz soils and also on anthropogenic habitats. Communities of the new order develop on flat lands such as pond basins, salt pans, pond banks, fields and gentle slopes (Świerszcz et al. 2021).

CLI-AA. *Climacopterion lanatae* Berdiev et Golub in Golub 1995 (hypersaline grasslands dominated by annuals on solonchak soils of Middle and Central Asia)

This vegetation forms low mats and grasslands on solonchak, moist soils in the Irano-Turanian Region. It withstands periods of relatively severe drought and high anthropogenic impact. It consists mainly of annual species and resists relatively heavy grazing.

CLI-AA01. *Sphenopodo-Climacopteretum glaberrimae* Rukhlenko 2014 (halophytic vegetation of lowlands and colline belt of the western Pamir-Alai and western Tian Shan Mts) (Fig. 273)

Diagnostic species: *Frankenia pulverulenta, Galium decaisnei, Halimocnemis mollissima, Herniaria hirsuta, Microcephala lamellata, Plantago coronopus, Psylliostachys leptostachya, P. myosuroides, Sagina micropetala, Spergularia maritima*

Fig. 273. *Psylliostachys myosuroides* – a species dominating the halophytic vegetation of the *Sphenopodo-Climacopteretum glaberrimae* association, Sambuli, Panj District, Tajikistan (ca. 420 m a.s.l.). Photo: A. Nowak.

(= *S. marginata*), *S. microsperma, Sphenopus divaricatus, Strigosella stenopetala, Tetradiclis tenella, Veronica campylopoda, Vulpia hirtiglumis* (= *V. villosa*).

Constant species: *Frankenia pulverulenta, Plantago coronopus, Psylliostachys leptostachya, P. myosuroides.*

Geographical range: The plots of the association were found in lowland and colline zones of subhumid and warm locations in the surroundings of south-western Tajikistan and the Fergana Valley at an elevation of approx. 350–850 m a.s.l. (Świerszcz et al. 2021).

Habitat characteristics: This ephemeral vegetation is composed mainly of annual plants and occupies riverine plains, gentle slopes, and even ruderal sites, such as sediment ponds or ditches (Świerszcz et al. 2021).

CLI-AAc01. Community of *Aeluropus littoralis-Salsola leptoclada* (halophytic mats of flooded river valleys and damp anthropogenic habitats of the western Pamir-Alai and western Tian Shan Mts) (Fig. 274)

Diagnostic species: *Aeluropus littoralis, Climacoptera transoxana, Cressa cretica, Parapholis incurva, Salsola leptoclada, Suaeda paradoxa.*

Constant species: *Aeluropus littoralis, Salsola leptoclada.*

Geographical range: The range of this community in Tajikistan is limited to the lowlands of Syr-darya and the south-western semi-desert zone of the country. However, it probably occurs as far west as the desert zone of Turkmenistan, Uzbekistan and north-west Afghanistan.

Habitat characteristics: This fairly common vegetation inhabits flat, seasonally inundated lands in the warm zones of Middle Asia. In Tajikistan, it occurs on moist soils on gentle slopes in the foothills of the Aktau and Babatag Mts, but not higher than 600 m a.s.l. (Świerszcz et al. 2021).

Fig. 274. Vegetation patch of the *Aeluropus littoralis-Salsola leptoclada*, found on a southern slope near Obikiik, Aktau Mts, Tajikistan (ca. 1,100 m a.s.l.). Photo: A. Nowak.

Fig. 275. Community of *Halostachys belangeriana* on wastelands near Kiik Mazor, Tajikistan (ca. 600 m a.s.l.). Photo: A. Nowak.

Fig. 276. Patch of halophytic vegetation dominated by *Salicornia europaea,* found on the floodplain near Komsomol, Vakhsh River Valley, Tajikistan (ca. 350 m a.s.l.). Photo: A. Nowak.

CLI-AAc02. Community of *Halostachys belangeriana* (halophytic vegetation of flooded river valleys and damp anthropogenic habitats of the western Pamir-Alai and western Tian Shan Mts) (Fig. 275)

Diagnostic species: *Halostachys belangeriana.*
Constant species: *Halostachys belangeriana.*
Geographical range: Occurrences of this vegetation have been recorded throughout the Irano-Turanian Region. In Tajikistan, this community is distributed in the valleys of the Amu-darya, Kofarnikhon, lower Vakhsh and Syr-darya rivers at elevation of around 320–800 m a.s.l. (Ovchinnikov 1968).
Habitat characteristics: This is a fairly common vegetation that inhabits flat, saline often flooded areas in the warm zones of Middle Asia.

CLI-AAc03. Community of *Salicornia europaea* (halophytic vegetation of flooded river valleys of the western Pamir-Alai and western Tian Shan Mts) (Fig. 276)

Diagnostic species: *Salicornia europaea.*
Constant species: *Salicornia europaea.*
Geographical range: This community inhabits alluvial wet sediments in the valleys of the Kofarnikhon, Vakhsh and Amu-darya rivers. It forms a species-poor stands of varying densities at elevation of about 320–800 m a.s.l. (Ovchinnikov 1968).
Habitat characteristics: It is a patchy vegetation that inhabits flat, saline, often flooded areas in the warm zones of Middle Asia. Occasionally, it inhabits anthropogenic habitats such as factory sedimentation ponds or extensively used cotton fields.

Pioneer ephemeral dwarf-grass vegetation in periodically flooded saline habitats of Eurasia

Pioneer ephemeral dwarf-grass vegetation in periodically flooded saline habitats of Eurasia CRY. *Crypsietea aculeatae* Vicherek 1973

This continental vegetation of annual halophilous grasses is found throughout the Irano-Turanian Region. The class comprises species-

Fig. 277. Subhalophytic vegetation of *Cypero-Spergularion salinae* on muddy alluvium of Syr-darya River near Dehmoy, Tajikistan (ca. 320 m a.s.l.). Photo: A. Nowak.

poor stands of annual graminoids supported by saline, sometimes hypersaline habitats. This vegetation type is typical of saline lake environments in the steppe zone of south-eastern Europe and the steppe and semi-desert zone of Asia. This vegetation is dependent

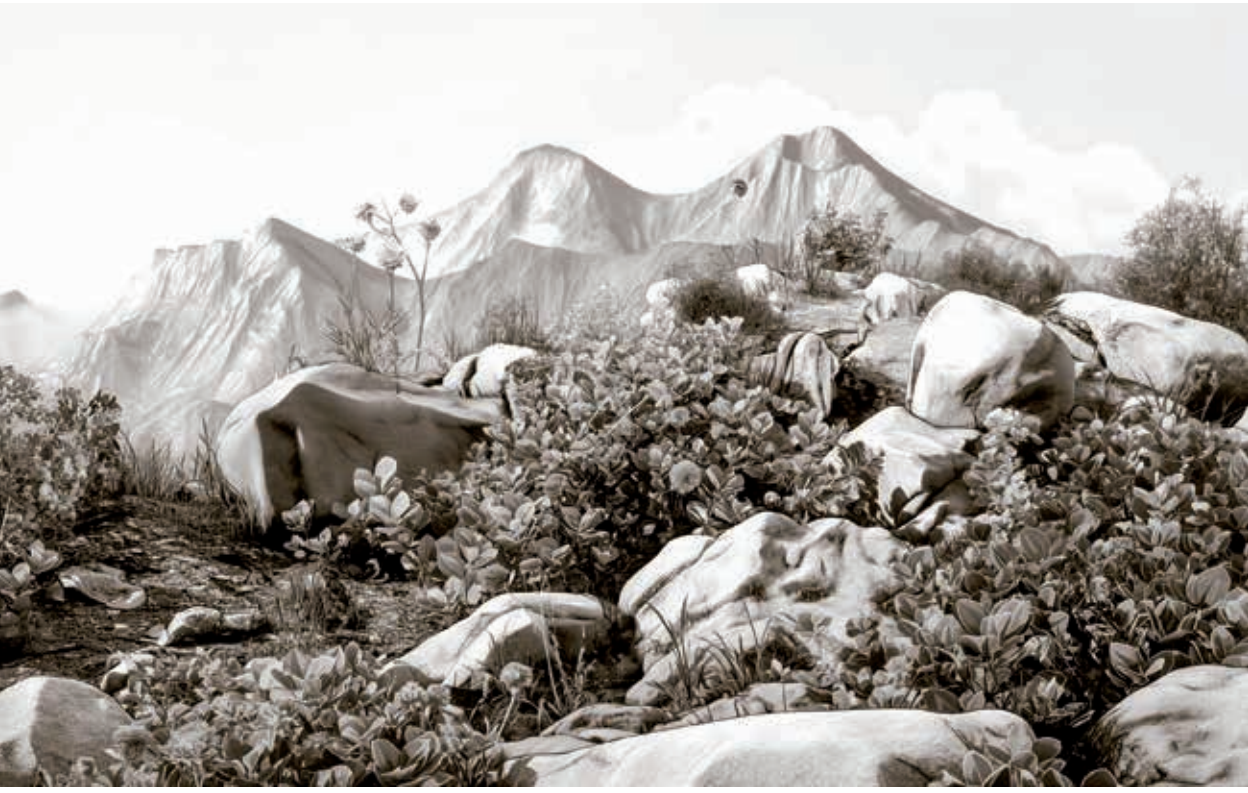
on fluctuating saline water levels throughout the year. Only one community is provisionally classified in this class, which belongs to the order *Puccinellietalia limosae* and *Cypero-Spergularion salinae* alliance.

CRY-A. *Puccinellietalia limosae* (Soó 1968) Géhu et Rivas-Martínez 1982
CRY-AA. *Cypero-Spergularion salinae* Slavnić 1948 (Fig. 277)

CRY-AA01. *Heleochloëtum schoenoidis* Ţopa 1939 (ephemeral vegetation of muddy sediments within rice fields in western Tajikistan)

Diagnostic species: *Heleochloa schoenoides* (= *Crypsis schoenoides*).
Constant species: *Heleochloa schoenoides*.
Geographical range: The range of this association includes primarily the Pontic-Pannonian Region (Vicherek 1973). So far, the association is known from Slovenia, Hungary, Romania and Mongolia. Probably, it occurs also in southern Russia and Ukraine (Eliáš et al. 2008). This community is rare in the rice fields of northern Tajikistan in the Syr-darya Valley near Khudzhand. It has been recorded at an elevation of about 320 m a.s.l. (Nowak S. et al. 2013a).
Habitat characteristics: The association inhabits muddy, alkaline soils (pH 7.3–7.7). The association of *Heleochloëtum schoenoidis* grows in small patches on bare sites where rice occurs in low abundance, or as a lower level of phytocoenosis when *Oryza sativa* reaches significant densities. It is therefore relatively light tolerant. All patches of this community have been found on saline soils, which are almost dry in the second half of the growing season (Nowak S. et al. 2013a).

Shrubby vegetation on mobile screes and rock ledges in continental and temperate Central Asia



Vegetation of rock outcrops, crevices and screes

Shrubby vegetation on mobile screes and rock ledges in continental and temperate Central Asia

BER. *Artemisio santolinifoliae-Berberidetea sibiricae* Ermakov, Chytrý et Valachovič 2006 (subalpine chasmophytic vegetation of cold and arid habitats in Central Asia)

The Central Asian rupicolous communities of *Artemisio santolinifoliae-Berberidetea sibiricae* Ermakov et al. 2006 are widely distributed across southern Siberia, Mongolia and north-eastern limits of Middle Asia (Polyakova 2010). They occupy rock outcrops and screes in the Altai, Tian Shan, Sayan and Tarbagatai Mts and develop in the strongly continental climate. A typical feature of this class is the predominance of drought-adapted shrubs and semi-shrubs forming a layer with a cover of ca. 10–60%. Herb species are represented by perennial, obligate or facultative petrophytic plants, which are never dominant. Bryophytes and lichens never form a distinct layer. In Tajikistan, this vegetation occurs in the northern Pamir-Alai, mainly in semi-arid habitats of rock ledges and boulder fields (Nowak et al. 2021c).

Fig. 278. Dwarf, prostrate *Lonicera semenovii* on steep, gravelly slope near Turgen-Jailoo in Terskey Ala-Too Mts, Kyrgyzstan (ca. 2,800 m a.s.l.). Photo: A. Nowak.

BER-A. *Artemisio santolinifoliae-Berberidetalia sibiricae* Ermakov, Chytrý et Valachovič 2006 (subalpine and upper montane chasmophytic vegetation of warm and arid zone in northern Middle and Central Asia)

BER-AX.
All. unknown

This alliance is intended to group the petrophytic vegetation with a considerable contribution of shrubs in the southern part of Central Asia, it is in central Tian Shan and northern Pamir-Alai. Further comparative studies are required to establish a final classification of this vegetation.

BER-AXc01. Community of *Scutellaria oligodonta-Lonicera semenovii* (scree vegetation of the alpine belt of the central Tian Shan Mts) (Fig. 278)

Diagnostic species: *Dasiphora parvifolia* (= *Potentilla parvifolia*), *Lonicera semenovii, Poa albertii* subsp. *albertii* (= *Poa litvinoviana*), *Scutellaria oligodonta, Semenovia transiliensis, Spiraea hypericifolia, Valeriana ficariifolia.*
Constant species: *Lonicera semenovii.*
Geographical range: This vegetation is composed of typical Central Asian species, some of which are restricted to central Tian Shan (Kyrgyzstan and Xinjiang in China, e.g. *Scutellaria oligodonta* (eFloras 2024). It occupies the typical screes of the alpine belt in Akshyyrak and Terskey Ala-Too Mts. It was recorded between 3,300 and 3,650 m a.s.l (mean approx. 3,500 m a.s.l.), mainly on stony debris (mean stone size was about 12 cm) (Nowak et al. 2021c).
Habitat characteristics: The community prefers steep slopes up to 60° (mean ca. 37°) with southern exposures (Nowak et al. 2021c).

Relict chomophytic and chasmophytic vegetation in the shaded and water-splashed habitat of Middle Asia

Fann Mts, Pastrud-darya River Valley, near Marguzor, Tajikistan (ca. 2,350 m a.s.l.). Photo: A. Nowak.

Relict chomophytic and chasmophytic vegetation in the shaded and water-splashed habitats of the Mediterranean, the Atlantic islands, North Africa, Middle East and Middle Asia

ADI. *Adiantetea capilli-veneris* Br.-Bl. in Br. Bl., Roussine et Nègre 1952 (chasmophytic thermophilous and water splashed vegetation of shaded rock walls of Middle Asia)

This vegetation is represented by only two associations that are included in one order and one alliance.

ADI-A. *Adiantetalia capilli-veneris* Br.-Bl. ex Horvatić 1934

ADI-AA. *Adiantion capilli-veneris* Br.-Bl. ex Horvatić 1934

ADI-AA01. *Soncho transcaspici-Adiantetum capilli-veneris* Nowak, S. Nowak, Nobis et A. Nobis 2015 (chasmophytic thermophilous and water splashed vegetation of shaded rock walls of the Pamir-Alai Mts) (Fig. 279)

Diagnostic species: *Adiantum capillus-veneris, Hygrohypnum luridum.*
Constant species: *Adiantum capillus-veneris, Hygrohypnum luridum, Brachythecium mildeanum, Bryum pseudotriquetrum.*
Geographical range: *Soncho transcaspici-Adiantetum capilli-veneris* was found at five locations in the Zeravshan, Hissar, Turkestan, Darvaz and Shugnan ranges. The phytocoenosis has been recorded in valley bottoms in colline and submontane zones at the relatively low elevation of 500 to 1,400 m a.s.l. (Nowak et al. 2015c).
Habitat characteristics: The association inhabits mainly conglomerates and river gravel sediments, occasionally also limestone rock walls of a relatively low cohesion and acidity, pH 6.5-7.6.

Fig. 279. Vegetation patch of the *Soncho transcaspici-Adiantetum capilli-veneris* association, found on an escapement in Maykatta, Pandzhikent District, Tajikistan (ca. 1,050 m a.s.l.). Photo: A. Nowak.

Fig. 280. *Cryptogrammetum stelleri* on the margin of a waterfall near Margeb, Zeravshan Mts, Tajikistan (ca. 2,300 m a.s.l.). Photo: A. Nowak.

The community develops mainly on south-facing slopes, but always under overhanging, shaded sites. The approx. mean inclination is ca. 90°, ranging from 85° to 160°. The plots of the association occur on wet or humid habitats with dripping water (Nowak et al. 2015c).

ADI-AA02. *Cryptogrammetum stelleri* Nowak, S. Nowak, Nobis et A. Nobis 2015 (chasmophytic, cosmopolitan, water splashed vegetation of shaded rock clefts of Middle Asia) (Fig. 280)

Diagnostic species: *Cryptogramma stelleri.*
Constant species: *Aquilegia vicaria, Brachythecium mildeanum, Bryum pseudotriquetrum, Cortusa turkestanica, Cryptogramma stelleri, Hygrohypnum luridum.*

Geographical range: The phytocoenosis inhabits relatively high elevations in the alpine zone, from 2,100 to 3,000 m a.s.l. (Nowak et al. 2015c).
Habitat characteristics: The phytocoenoses of *Cryptogrammetum stelleri* have been noted on limestone and dolomite with alkaline reaction (pH ca. 7.5). The association is the most common on rock faces with large fissures close to waterfalls or in the area of sprayed or dripping water. *Cryptogrammetum stelleri* develops on rock faces and at the base of rock walls, often in coarse fissures with the mean inclination value of around 70° and different exposures (Nowak et al. 2015c).

Chasmophytic vegetation of montane and alpine rock faces of Middle and Central Asia

Chasmophytic vegetation of montane and alpine rock faces of Middle and Central Asia

ASO. *Carici koshewnikowii-Asperuletea oppositifoliae* Nowak, Świerszcz, S. Nowak, Nobis et M. Nobis 2024

This class includes phytocoenoses characterised by a high proportion of chasmophytic and rupicolous taxa with an Irano-Turanian distribution range. Many of the species typical of this syntaxon are endemic to Tajikistan or Middle Asia (Nowak et al. 2024b).

ASO-A. *Campanuletalia incanescentis* Nobis, Nowak et A. Nobis ex Nowak, S. Nowak, Nobis et A. Nobis 2024 (chasmophytic vegetation of montane and alpine rock faces of Middle Asia) (Fig. 281)

Diagnostic species: *Campanula incanescens.*

Constant species: *Artemisia rutifolia, Campanula lehmanniana, Poa relaxa, Sergia regelii, Scutellaria orbicularis.*

Geographical range: It has a wide elevational range, from 400 to 3,600 m a.s.l. and can therefore be observed in all belts of mountain vegetation (colline, montane, alpine, subnival). The species ranges cover all major mountain ranges of Middle Asia (e.g. Tian-Shan, Kopet-Dagh, Pamir-Alai, Pamir) and the Iranian province (Elburs, Zagros Mts; Schischkin, Bobrov 1957; Kinzikaeva 1988; Nowak et al. 2014a).

Habitat characteristics: The phytocoenoses assigned to this order occur on various types of geological substrates, such as limestone, dolomite, marble, granite, syenite, schist and gneiss. *Campanula incanescens* can grow on alkaline, neutral and acidophilous substrates. It prefers small crevices and fissures in rock or the faces of monoliths. However, it frequently occurs on rock ledges, coarse cracks and friable rocks.

Fig. 281. *Campanula incanescens* – a characteristic species of chasmophytic vegetation of montane and alpine rock faces of Middle Asia. Varzob Valley, Hissar Mts, Tajikistan (ca. 1,750 m a.s.l.). Photo: A. Nowak.

Occasionally, *Campanula incanescens* has been observed on screes and taluses. Communities of this order develop on all exposures and inclinations from 50° to more than 90° (Nowak et al. 2014a).

ASO-AA. *Asperulo albiflorae-Campanulion lehmannianae* Nobis, Nowak et A. Nobis ex Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of upper montane and alpine rock faces of Middle Asia)

Diagnostic species: *Campanula lehmanniana, Asperula albiflora, A. czukaviniae, A. pauciflora.*
Constant species: *Artemisia rutifolia, Asperula albiflora, Campanula lehmanniana, Poa relaxa, Sergia regelii.*
Geographical range: This vegetation has a wide elevational range, from 1,300 to 3,700 m a.s.l., mainly in alpine belt of all major mountain ranges of Middle Asia (e.g. Tian-Shan, Kopet-Dagh, Pamir-Alai; Nowak et al. 2014a; Nowak et al. 2024b).
Habitat characteristics: The phytocoenoses of this alliance occur on various types of geological substrates, such as limestone, dolomite, marble, granite, syenite, schist and gneiss. It prefers small crevices and fissures or the solid faces of monoliths. Communities of this alliances develop on all exposures and inclinations from 70° to more than 90° (Nowak et al. 2014a).

Western Pamir-Alai group

ASO-AAa. *Campanulenion lehmannianae* Nowak, S. Nowak, Nobis et A. Nobis 2014

Diagnostic species: *Campanula lehmanniana, Scutellaria orbicularis, S. rubromaculata*, *Sergia regelii, Silene samarkandensis.*

Fig. 282. *Sergietum regelii* on dolomite rocks in Kshtut Valley, near Zimtut, Zeravshan Mts, Tajikistan (ca. 2,240 m a.s.l.). Photo: A. Nowak.

Constant species: *Campanula lehmanniana, Scutellaria orbicularis, S. rubromaculata*, *Sergia regelii, Silene samarkandensis.*
Geographical range: Western Pamir-Alai, western and central Tian Shan.
Habitat characteristics: In addition to altitude, geology and rock structure play an important role in distinguishing associations. Within *Asperulo albiflorae-Campanulion lehmannianae*, the phytocoenoses can be divided into two groups according to the microrelief of the rock surface. The first one (representing the *Campanulenion lehmannianae* suballiance) comprises a group of species that prefer firm and solid rocks with very fine fissures. These sites are often almost completely bare, with little or no soil sediment. The moss layer is also relatively poorly developed in terms of the number and richness of species (Nowak et al. 2014a).

ASO-AA01. *Sergietum regelii* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation on solid limestone walls of the upper montane belt in the Fann Mts; mainly Haft-kul Valley) (Fig. 282)

Diagnostic species: *Sergia regelii.*
Constant species: *Sergia regelii.*
Geographical range: The diagnostic species is a very narrow endemic of the western Pamir-Alai Mts. The association is distributed in several alpine valleys: Zimtut, Kshtut, Dukdon, Kashkuital-Zanbar, Mazari-Sharif, Seven Lake and Voru in the central and northern parts of the Zeravshan and the Hissar Mts, respectively. The association develops at relatively low elevations, from 1,450 to 2,700 m a.s.l. (Nowak et al. 2014a).
Habitat characteristics: Patches with *Sergia regelii* have been found on different alkaline (pH 7.2–8.6) rocky substrates, such as micrite limestone, marly limestone, dolomitic limestone and dolomite. The association prefers steep cliffs (slope 70–90°), with small and medium-sized crevices, generally with northern and western exposures (Nowak et al. 2014a).

ASO-AA02. *Scutellarietum megalodontae* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation on dolomite and conglomerate rocks in subalpine and alpine belts of the western Pamir-Alai Mts) (Fig. 283)

Diagnostic species: *Scutellaria megalodonta.*
Constant species: *Campanula incanescens, Grimmia pulvinata, Orthotrichum crenulatum Parietaria judaica, P. serbica, Pentanema albertoregelia, Scutellaria megalodonta, Stipa zeravshanica.*
Geographical range: The association has been rarely recorded in the central part of the Zeravshanian Mts (Zeravshan B geobotanical region). It occurs within the range of elevation from 1,430 to 2,700 m a.s.l., mostly in alpine and subalpine zone (Nowak et al. 2014a).
Habitat characteristics: This association occurs on different exposures and vertical inclinations (mean approx. 85°). It prefers rock solid faces with very fine fissures. The phytocoenoses have been observed on dolomite, marly limestone and dolomitic coral limestone with pH 8.0–8.8 (Nowak et al. 2014a).

ASO-AA03. *Scutellarietum rubromaculatae* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation on solid limestone walls of the alpine belt in western valleys of the Fann Mts) (Fig. 284)

Diagnostic species: *Scutellaria rubromaculata.*
Constant species: *Artemisia rutifolia, Asperula pauciflora, A. scabrella, Campanula incanescens, C. lehmanniana, Grimmia pulvinata, Orthotrichum crenulatum, Parietaria judaica, Sergia regelii, Syntrichia ruralis.*
Geographical range: *Scutellaria rubromaculata* is considered an endemic species, known only from the central Zeravshan Mts. It was found in a few alpine valleys, e.g. Kshtut, Pastrud-darya, Mogien and also in the Seven Lakes Valley. The association was recorded at relatively low elevations in the subalpine zone, mainly between 1,560 and 2,100 m a.s.l. (Nowak et al. 2014a).
Habitat characteristics: The species has formed its own association developing on alkaline rock

Fig. 283. *Scutellarietum megalodontae* on dolomite rocks near Iskander-kul Lake, Zeravshan Mts, Tajikistan (ca. 2,250 m a.s.l.). Photo: A. Nowak.

Fig. 284. *Scutellarietum rubromaculatae* on dolomite rocks near Nofin, Haft-kul Valley, Zeravshan Mts, Tajikistan (ca. 1,730 m a.s.l.). Photo: A. Nowak.

substrates (pH 8.0–8.6), mainly on limestone (micrite limestone, marly limestone) and marble. The phytocoenoses develop on fractured rocks with medium sized crevices, often quite friable. The community develops on steep rock faces, sometimes overhanging. *Scutellarietum rubromaculatae* generally prefers western and north-western exposures (Nowak et al. 2014a).

ASO-AA04. *Scutellarietum orbicularis* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation on often overhanging limestone faces in the montane and subalpine belts of the central Zeravshan Mts (mainly Kshtut and Dukdon Valleys) (Fig. 285)

Diagnostic species: *Scutellaria orbicularis.*
Constant species: *Campanula incanescens, Grimmia pulvinata, Orthotrichum crenulatum, Pentanema albertoregelia, Sergia regelii.*
Geographical range: The phytocoenoses of *Scutellarietum orbicularis* have been found sporadically in the central part of the Zeravshan Mts, mainly in the valleys of the Mogien-darya, Kshtut and Dukdon Rivers. The association is distributed in subalpine zone at relatively low elevation from 1,450 to 2,300 m a.s.l. (Nowak et al. 2014a).
Habitat characteristics: It prefers friable or cohesive rocks with fine or medium sized fissures. In a few cases the patches of association have also been noted on small ledges or medium sized cracks. The phytocoenoses have been observed on limestone and fine-grained conglomerates with pH 7.0–8.3. The association occurs on different exposures (mainly south-east and north-east) and on almost vertical inclinations (mean approx. 85°) (Nowak et al. 2014a).

ASO-AA05. *Campanuletum lehmannianae* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of solid limestone faces of the western Hissar and Zeravshan Mts) (Fig. 286)

Fig. 285. *Scutellarietum orbicularis* on dolomite rocks near Veshan, foothills of Zeravshan Mts, Tajikistan (ca. 1,380 m a.s.l.). Photo: A. Nowak.

Fig. 286. *Campanuletum lehmannianae* on solid limestone faces near Margeb, Yagnob River Valley, Zeravshan Mts, Tajikistan (ca. 2,150 m a.s.l.). Photo: M. Nobis.

Diagnostic species: *Campanula lehmanniana.*
Constant species: *Artemisia rutifolia, Asperula albiflora, Campanula incanescens, Orthotrichum crenulatum, Poa relaxa, Stipa zeravshanica, Syntrichia ruralis.*
Geographical range: *Campanula lehmanniana* is a widespread rupicolous species, generally known from the alpine belt of the Pamir-Alai and Tian Shan Mts (Kinzikaeva 1988). In Tajikistan, it occurs quite often in the Zeravshan and Hissar Mts. The association formed by *Campanula lehmanniana* was found in several sites in the Seven Lakes, Mogien, Iskander-darya, Yagnob, Kshtut, Pastrud-darya, Mogien, Varzob, Dzhidzhikrut, Remon and several other valleys. Its patches develop on relatively high elevations in the alpine belt, within an elevational range between 1,850 to 3,350 m a.s.l. (Nowak et al. 2014a).
Habitat characteristics: The phytocoenoses have been found almost exclusively on alkaline limestones and marly limestones with pH 7.8–9.0. The association prefers solid rock faces with small fissures, but in some cases also inhabits small ledges and medium-sized cracks and crevices. The community develops on steep and slightly sloping rock faces. *Campanuletum lehmannianae* association generally inhabits north-eastern and north-western exposures (Nowak et al. 2014a).

ASO-AA06. *Violetum majchurensis* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of solid limestone faces of the central Hissar and Zeravshan Mts, mainly Chore and Maykhura Valleys) (Fig. 287)

Diagnostic species: *Viola majchurensis.*
Constant species: *Arabis kokanica, Campanula lehmanniana, Grimmia pulvinata, Poa relaxa, Schistidium apocarpum.*
Geographical range: The phytocoenoses of *Violetum majchurensis* have been spotted very

Fig. 287. *Viola majchurensis* – a species growing in marble rock crevices near Chore, Zeravshan Mts, Tajikistan (ca. 2,750 m a.s.l.). Photo: A. Nowak.

rarely in the central part of the Maykhura Valley in Hissar Mts and the Zeravshan Mts, in few sites in Chore Valley. The diagnostic species is considered as a narrow endemic of western Pamir-Alai. It is known from a few places in the alpine belt of the Zeravshan and Hissar Mts. In Chore and Maykhura Valleys the association is distributed on northern cliffs at the relatively high elevation of 2,550 to 2,650 m a.s.l. (Nowak et al. 2014a).

Habitat characteristics: It prefers cohesive and solid dolomite rocks with medium sized crevices. The community was found only in fissures with a small amount of humid and alkaline (pH 7.7–8.7) soil. The phytocoenoses were observed on northern and northwestern exposures and on almost vertical inclinations (mean approx. 85°) (Nowak et al. 2014a).

Fig. 288. *Andrachnetum fedtschenkoi* in fissures of solid limestone rock close to Mazor near Gusar, Fann Mts, Tajikistan (ca. 1620 m a.s.l.). Photo: A. Nowak.

ASO-AA07. *Andrachnetum fedtschenkoi* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of tiny limestone fissures on solid faces in montane belt of the Zeravshan and Turkestan Mts) (Fig. 288)

Diagnostic species: *Andrachne fedtschenkoi.*
Constant species: *Bryum argenteum, Lophanthus virescens, Pentanema albertoregelia, Poa bulbosa, P. relaxa.*
Geographical range: The diagnostic species of the association is a narrowly distributed species, endemic to the Zeravshan and Turkestan Mts in the western Pamir-Alai mountain system. It occurs in the montane belt at an elevation from 1,200 to 1,800 m a.s.l. (Ovchinnikov 1981). The patches of *Andrachnetum fedtschenkoi* association were found near the village of Mazari-Sharif in the central part of the Zeravshan Mts (Nowak et al. 2014a).
Habitat characteristics: This vegetation has been found almost exclusively on alkaline dolomite and metamorphic mudstone rocks (pH. ca. 8.4). The association prefers solid rock faces with very fine fissures or crevices. The community develops on vertical cliffs with close to 90° inclinations. *Andrachnetum fedtschenkoi* mainly inhabits walls with north-western exposures. As it is typical for solid and cohesive substrate, unsuitable for plant colonisation, its patches are characterised by a very low number and abundance of species (Nowak et al. 2014a).

ASO-AA08. *Achoriphragmetum turkestanici* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of limestone clefts and ledges of the northern and western Pamir-Alai ranges) (Fig. 289)

Diagnostic species: *Achoriphragma turkestanicum* (Syn. *Neuroloma turkestanicum, Parrya turkestanica*).
Constant species: *Achoriphragma turkestanicum, Grimmia pulvinata, Minuartia litwinowii,*

Fig. 289. *Achoriphragmetum turkestanici* on dolomite rocks near Iskander-kul, Zeravshan Mts, Tajikistan (ca. 3,500 m a.s.l.). Photo: A. Nowak.

Orthotrichum crenulatum Poa relaxa, Syntrichia ruralis.

Geographical range: *Achoriphragma turkestanicum* is considered as an endemic species for the Pamir-Alai mountain system. It is distributed throughout Zeravshanian, Hissaro-Darvasian, Eastern Tajikistanian and Western Pamirian geobotanical regions. Several sites have also been reported from the Eastern Pamir (Ovchinnikov 1978). Patches of the *Achoriphragmetum turkestanici* association have been found in the subnival zone of the upper part of the Pastrud-darya River Valley and around Lake Iskander-kul at an elevation of 3,300–3,600 m a.s.l. Together with the *Minuartio-Phaeonychietum* association, it forms the highest saxatile vegetation in the Pamir-Alai Mts (Nowak et al. 2014a).

Habitat characteristics: The phytocoenoses have been found on alkaline limestone, marly limestone and dolomite (pH 7.5–8.4). The community occurs on both solid and friable rocks, sometimes it was also observed on fine-grained and compacted screes and taluses. The association develops on steep or vertical walls of northern exposures (Nowak et al. 2014a).

ASO-AA09. *Minuartio litwinowii-Phaeonychietum surculosi* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of overhanging walls in alpine and subnival belts of the western Pamir-Alai Mts (mainly Zeravshan and Hissar Mts) (Fig. 290)

Diagnostic species: *Minuartia litwinowii, Phaeonychium surculosum.*

Constant species: *Arabis kokanica, Artemisia rutifolia, Poa relaxa, Psychrogeton andryaloides.*

Geographical range: The association of *Minuartio litwinowii-Phaeonychietum surculosi* is a typical community of subnival vegetation. Its patches have been found in the central part of the Zeravshan Mts (so called Fann Mts) in the upper part of Pastrud-darya River

Fig. 290. *Phaeonychium surculosum* on overhanging limestone wall near Mutnoe Lake, Zeravshan Mts, Tajikistan (ca. 3,500 m a.s.l.). Photo: A. Nowak.

Valley (surrounding the Mutnoe Lake in Chimtarga Massif). The second site of *Minuartio litwinowii-Phaeonychietum surculosi* was noted near the Khoburobot Pass in the Darvaz Mts. The association has been found in the subnival belt at the relatively high elevation from 3,100 to 3,550 m a.s.l. (Nowak et al. 2014a).

Habitat characteristics: The phytocoenosis has been noted on alkaline limestone, marly limestone and dolomite (pH 7.8–8.2). Plots have been sampled on solid, firm rocks, sometimes also on metamorphic intrusions. The association develops on steep or almost vertical walls (mean approx. 80°) of western and south-western exposures (Nowak et al. 2014a).

ASO-AA10. *Silenetum samarcandensis* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation on limestone, marl and dolomite rocks in subalpine to alpine belts of the western Pamir-Alai Mts) (Fig. 291)

Diagnostic species: *Silene samarkandensis.*

Constant species: *Artemisia rutifolia, Campanula incanescens, Grimmia pulvinata, Orthotrichum crenulatum, Poa relaxa.*

Geographical range: *Silene samarkandensis* is a moderately common species growing on alkaline rocks in the alpine and subalpine belts of the Pamir-Alai Mts (Ovchinnikov 1968). In Tajikistan, it is quite frequent in the Zeravshanian, Turkestanian, Hissaro-Darvasian, eastern Tajikistanian and eastern Pamirian geobotanical regions. The association of *Silenetum samarcandensis* was found in several sites in the valleys of the Seven Lakes, Mogien, Kara-kul, Iskanderdarya, Yagnob, Kshtut, Pastrud-darya, Mogien, Varzob, Dzhidzhikrut, Remon and several other rivers. The association develops in alpine belt, within an elevational range between 1,630 and 3,350 m a.s.l. (Nowak et al. 2014a).

Habitat characteristics: The phytocoenoses of this community have been found almost exclusively on alkaline limestone, marly limestone

Fig. 291. Vegetation of the *Silenetum samarcandensis* inhabiting limestone rock clefts near Iskander-kul Lake, Zeravshan Mts, Tajikistan (ca. 2,690 m a.s.l.). Photo: A. Nowak.

and different types of dolomites (pH 7.4–8.8). The association inhabits solid and firm rock faces with very fine fissures, small crevices and overhanging rock walls. The *Silenetum samarcandensis* association generally inhabits the slopes of north eastern and eastern exposures (Nowak et al. 2014a).

ASO-AA11. *Eritrichietum turkestanici* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of limestone solid faces in alpine belt of the Fann Mts) (Fig. 292)

Diagnostic species: *Eritrichium turkestanicum.*
Constant species: *Artemisia rutifolia, Campanula lehmanniana, C. incanescens, Lophanthus virescens, Poa relaxa.*
Geographical range: The association has rarely been noted in the alpine and subnival belts of the Zeravshan Mts. Sites of the association were found in the upper parts of the Arch, Kara-kul, Pastrud-darya and Yagnob River Valleys. The recorded distribution corresponds almost entirely to the range of the diagnostic species (Chukavina 1984). The elevational range of the sampled plots is limited to the upper belt of the alpine belt between 2,150 and 2,500 m a.s.l. (Nowak et al. 2014a).
Habitat characteristics: The association inhabits mainly northern and northwestern rock faces with a relatively low inclination of about 65°. It occurs on solid and coherent rock, but the community has also been observed in medium-sized crevices and cracks with little soil. The phytocoenoses were observed on bituminous limestone, dolomite and marly dolomite with pH 7.8–8.4 (Nowak et al. 2014a).

ASO-AAc01. Community of *Andrachne pygmaea* (chasmophytic vegetation of tiny fissures of limestone rock outcrops near Osh in the Fergana Valley) (Fig. 293)

Diagnostic species: *Andrchne pygmaea, Galium verticillatum.*
Constant species: *Andrachne pygmaea, Syntrichia ruralis, Grimmia pulvinata.*

Fig. 292. *Eritrichium turkestanicum* on limestone rock clefts in Arch Valley, Zeravshan Mts, Tajikistan (ca. 2,650 m a.s.l.). Photo: A. Nowak.

Fig. 293. Vegetation patch of *Andrachne pygmaea,* found on limestone outcrops in Osh, Alai Mts, Kyrgyzstan (ca. 1,090 m a.s.l.). Photo: A. Nowak.

Geographical range: *Andrachne pygmaea* is a rupicolous, endemic species, with a distribution limited to southern Kyrgyzstan. It was recorded on limestone rock outcrops in a very restricted area near Osh in the Fergana Valley. Only a few plots of this community were found on a single mountain. They develop within the submontane belt (mean elevation approx. 1,100 m a.s.l. (Nowak et al. 2022c).
Habitat characteristics: Phytocoenoses representing this community have been found on solid rock faces with very tiny fissures and an insignificant amount of soil. The community develops on steep rock faces with a mean inclination of approx. 85°. Its patches were noted on eastern and northern exposures (Nowak et al. 2022c).

Eastern Pamir-Alai group

ASO-AA12. *Achoriphragmetum darvazici* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of limestone faces and ledges of the eastern Pamir-Alai ranges, mainly Darvaz and Vanch Mts) (Fig. 294)

Diagnostic species: *Achoriphragma darvazicum* (= *Neuroloma darvazicum, Parrya darvazica)*
Constant species: *Achoriphragma darvazicum, Artemisia rutifolia, Campanula incanescens, C. lehmanniana, Grimmia pulvinata, Orthotrichum crenulatum, Poa relaxa, Pseudosedum condensatum.*
Geographical range: The association has been rarely recorded in the Eastern Pamir-Alai Mts, within the restricted range of the diagnostic taxon – *Achoriphragma darvazicum* (Darvaz and Vanch Mts). The patches of the association have been found in the alpine belt at elevation from 2,250 to 3,200 m a.s.l. (Nowak et al. 2014a).
Habitat characteristics: This community inhabits eastern and south-western rock faces with almost vertical inclinations (mean approx. 85°). It prefers solid and coherent rocks,

Fig. 294. *Achoriphragma darvazicum* (= *Neuroloma darvazicum*) on limestone rock in Khoburobot Pass, Darvaz Mts, Tajikistan (ca. 3,200 m a.s.l.). Photo: A. Nowak.

but with medium sized crevices and cracks, sometimes with little soil. The phytocoenoses were observed on basalts, dolomitic shales and conglomerate with pH 7.2–7.6 Nowak et al. 2014a).

ASO-AA13. *Asperuletum fedtschenkoi* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of limestone solid faces in upper montane and alpine belts of the eastern Pamir-Alai, mainly Darvaz and Vanch Mts) (Fig. 295)

Diagnostic species: *Asperula fedtschenkoi.*
Constant species: *Lophanthus virescens, Orthotrichum crenulatum, Parietaria judaica, Poa relaxa, Syntrichia ruralis.*
Geographical range: The phytocoenoses of *Asperuletum fedtschenkoi* have been found in a few locations in the Darvaz and Vanch Mts in the south-eastern part of the Hissaro-Darvasian and West Pamir geobotanical regions and in Fergana Mts in Kyrgyzstan. *Asperula fedtschenkoi* is a narrow endemic of the Eastern Pamir-Alai Mts, so the association also has a very restricted distribution. It was found in the alpine belt at moderate elevation of 1,750–2,450 m a.s.l. (Nowak et al. 2014a).
Habitat characteristics: The association prefers cohesive and solid limestone and dolomite rocks (pH 8.2–8.5) with fine fissures and crevices. Only occasionally *Asperula fedtschenkoi* has been observed on steep slopes with fine-grained gravels (taluses). The patches of the association were mainly found on south-eastern and western exposures with almost vertical inclinations (mean approx. 90°; Nowak et al. 2014a).

ASO-AA14. *Parryetum schugnanae* Nowak, Świerszcz, S. Nowak, Plášek, Nobis, Klichowska et M. Nobis 2022 (chasmophytic vegetation on limestone and schist rocks in the alpine to subnival belts of the eastern Pamir-Alai; mainly Schugnan, Vanch and Rushan Mts) (Fig. 296)

Fig. 295. *Asperula fedtschenkoi* on limestone rock ledges near Qualaikhum, Darvaz Mts, Tajikistan (ca. 1,620 m a.s.l.). Photo: A. Nowak.

Fig. 296. *Parryetum schugnanae* on granite rock ledges near Jelandy, Pamir, Tajikistan (ca. 3,600 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Parrya schugnana, Potentilla moorcroftii, Pyrethrum pyrethroides, Semenovia heterodonta.*
Constant species: *Parrya schugnana.*
Geographical range: *Parrya schugnana* is an endemic species with the core area of distribution in the alpine belt of the western Pamir ranges (in particular Schugnan, Vanch, and Rushan Mts; Ovchinnikov 1978). *Parryetum schugnanae* is a typical rock wall chasmophyte community in the eastern Pamir-Alai, found in cracks and ledges at an elevation between 3,100 and 3,850 m a.s.l. (Nowak et al. 2022d).
Habitat characteristics: The plots were found on southern or south-western exposures and were located on steep rock faces (50°–80°) (Nowak et al. 2022d).

ASO-AA15. *Corydalido bucharicae-Hippolytietum schugnanicae* Nowak, Świerszcz, S. Nowak, Plášek, Nobis, Klichowska et M. Nobis 2022 nom. corr. (chasmophytic vegetation on schist, granite and mudstone rocks in the alpine belt of the eastern Pamir-Alai, mainly Schugnan, Vanch and Rushan Mts) (Fig. 297)

Diagnostic species: *Corydalis bucharica, Hippolytia schugnanica, Piptatherum sogdianum, Scrophularia pamirica.*
Constant species: *Hippolytia schugnanica.*
Geographical range: Both name giving taxa are considered to be endemic to the Tajik-Afghan border region of the western Pamir. *Corydalido bucharicae-Hippolytietum schugnanicae* was recorded in the alpine belt of the Schugnan and Rushan ranges. The phytocoenoses develop in the alpine belt at an elevation from 2,600 to 3,200 m a.s.l. (Nowak et al. 2022d).
Habitat characteristics: This vegetation prefers steep rock faces with mean inclination of approx. 80°, sometimes growing also under the overhanging rocks. The patches of *Corydalido bucharicae-Hippolytietum schugnanicae* were mainly found in the western and south-western exposures. This association prefers schale, granite, and mudstone rocks and inhabits warmer, well exposed sites. Due to strong sunlight, the phytocoenosis almost dries up and disappears in late summer. It has been found on rock faces with crevices and cracks, sometimes also small ledges (Nowak et al. 2022d).

Fig. 297. Vegetation patch of *Corydalido bucharicae-Hippolytietum schugnanicae* found on mudstone rock near Pasthuf, Western Pamir, Tajikistan (ca. 3,250 m a.s.l.). Photo: A. Nowak.

ASO-AA16. *Drabetum darvasicae* Nowak, Świerszcz, S. Nowak, Plášek, Nobis, Klichowska et M. Nobis 2022 (chasmophytic vegetation of limestone rock crevices and small ledges in the alpine belt of Darvaz Mts) (Fig. 298)

Diagnostic species: *Cystopteris fragilis, Draba darwasica, Erigeron brachyspermus, Hymenolaena nana, Hyssopus seravschanicus, Rhodiola heterodonta, Sedum ewersii.*
Constant species: *Draba darwasica.*
Geographical range: This vegetation develops in the Darvaz and Peter the First Mts, standing between the High Pamir and the western Pamir-

Alai, in particular the area around Khoburobot Pass in the Darvaz Range. *Drabetum darvasicae* inhabits the rock ledges and fissures in the alpine belt at mean elevation of approx. 2,900 m a.s.l. (Nowak et al. 2022d).

Habitat characteristics: The association prefers crevices in solid rock faces and small ledges with insignificant amount of soil. *Drabetum darvasicae* has been recorded on steep rock faces with mean inclination of approx. 70°. It prefers south-western and southern exposures (Nowak et al. 2022d).

ASO-AA17. *Paraquilegietum anemonoidis* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of solid rock faces in the alpine belt of Pamir-Alai and Tian Shan Mts) (Fig. 299)

Diagnostic species: *Draba lanceolata, Gagea olgae, Paraquilegia anemonoides, Taphrospermum altaicum, Viola allochroa.*

Constant species: *Paraquilegia anemonoides.*

Geographical range: This typically chasmophytic association of solid rock faces was first described from the Pamir-Alai (Nowak et al. 2014b). As the diagnostic species has a wide geographic range, it was expected that the range of the community would expand to include the alpine belt of the eastern and western Tian Shan. The patches of this vegetation have been found at elevation ranging from 2,400 to 3,200 m a.s.l. on different exposures (Nowak et al. 2014b, Nowak et al. 2022d).

Habitat characteristics: As in the western Pamir-Alai, the community inhabits fairly solid rock faces with almost vertical inclinations (mean approx. 80°). It prefers coherent rocks with small fissures with low organic matter content (Nowak et al. 2022d).

ASO-AA18. *Psychrogetonetum andryaloidis* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of limestone clefts and

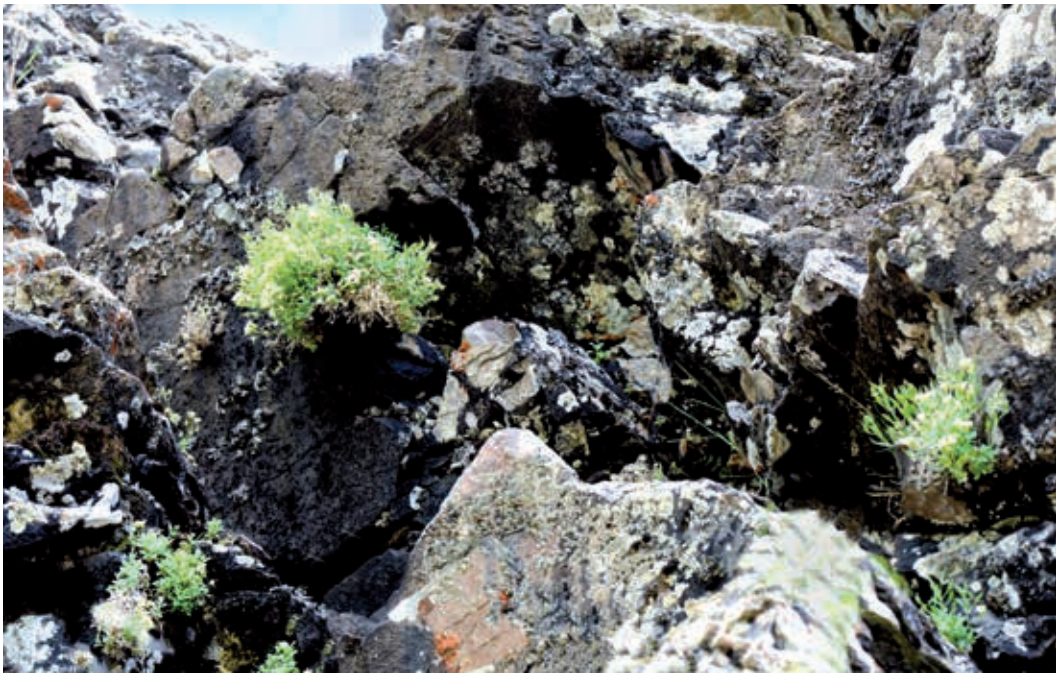


Fig. 298. Vegetation of the *Drabetum darvasicae* association, found on limestone ledges near the Khoburobot Pass, Darvaz Mts, Tajikistan (ca. 3,200 m a.s.l.). Photo: A. Nowak.

Fig. 299. Vegetation of *Paraquilegietum anemonoidis* found on limestone rock near Sary-Tash, Kyrgyzstan (ca. 3,150 m a.s.l.). Photo: A. Nowak.

ledges of the eastern Pamir-Alai; Peter the First and Vanch Mts) (Fig. 300)

Diagnostic species: *Psychrogeton andryaloides.*
Constant species: *Psychrogeton andryaloides.*
Geographical range: The patches of *Psychrogetonetum andryaloidis* have been found in a number of sites, mainly in the Eastern Tajikistanian geobotanical region on limestone, marl and shale. Its phytocoenoses develop at moderate elevations in the upper montane and alpine belts, between 2,000 and 3,000 m a.s.l. (Nowak et al. 2022d).
Habitat characteristics: This association prefers fissured, cracked or solid rocks. It inhabits large cracks and clefts with little soil substrate. The community develops on walls with different steepness, from 15° to 90°. The mean inclination of the sampled plots was approx. 70°. The association prefers well exposed to the sunlight south-western slopes (Nowak et al. 2022d).

ASO-AA19. *Asperulo oppositifoliae-Achnatheretum jacquemontii* Nobis, Klichowska et Nowak in Nobis et al. 2023 (chasmophytic vegetation of alkaline rocks of the eastern Pamir-Alai, mainly Alai and eastern Zeravshan Mts) (Fig. 301)

Diagnostic species: *Achnatherum jacquemontii, Asperula oppositifolia.*
Constant species: *Achnatherum jacquemontii, Artemisia rutifolia, Asperula oppositifolia, Pentanema albertoregelia.*
Geographical range: *Asperulo oppositifoliae-Achnatheretum jacquemontii* plant association occurs in rock crevices and ledges on steep rock faces, especially in the rocky gorges of several river valleys. The association has been recorded in the Isfara, Sokh, Kshtut, Taraty, and Kyzyl-Suu River Valleys in Kyrgyzstan and Tajikistan. Sites of this association have been found in the montane and subalpine belts of both the Alai and Turkestan Mts, mainly at an elevation of 1,600–2,200 m a.s.l.

Fig. 300. Vegetation of the *Psychrogetonetum andryaloidis* association, found on rock clefts near Zakhiaboy, Obikhingou River Valley, Tajikistan (ca. 1,690 m a.s.l.). Photo: A. Nowak.

Fig. 301. Vegetation of the *Asperulo oppositifoliae-Achnatheretum jacquemontii* association growing on a limestone face south of Syrt, Alai Mts, Tajikistan (ca. 2,010 m a.s.l.). Photo: M. Nobis.

Habitat characteristics: The association develops on skeletal alkaline organic matter in rock crevices and shelves on different lithologies (Nobis et al. 2023).

ASO-AAc02. Community of *Potentilla malacotricha* and *Waldheimia glabra* (chasmophytic vegetation of alpine to subnival belts of the Pamir Mts) (Fig. 302)

Diagnostic species: *Acantholimon lycopodioides, Draba altaica, Potentilla malacotricha, Rhodiola coccinea, Roegneria schugnanica, Waldheimia glabra.*
Constant species: *Waldheimia glabra*.
Geographical range: This rock ledges vegetation was found in the highest, subnival elevations of the subhumid zone, exclusively in the Eastern Pamir. Plots recorded in the Pamir were found between 3,850 and 4,150 m a.s.l. (Nowak et al. 2022d).

Habitat characteristics: Plots of this community inhabit sloping walls and screes with the mean inclination of approx. 65°, ranging from 45° to 85°. The phytocoenoses generally occur on eastern exposures. The community prefers eroded ledges, and large clefts with relatively high organic matter content and water availability (Nowak et al. 2022d).

ASO-AAc03. Community of *Jurinea darvasica* (chasmophytic vegetation of clefts and rock ledges in alpine to subnival belts of the Pamir Mts) (Fig. 303)

Diagnostic species: *Jurinea darvasica.*
Constant species: *Jurinea darvasica.*
Geographical range: This chasmophytic vegetation was found in the highest, subnival elevations of the Western Pamir, in the Abduqakhor Valley. Plots recorded in the Pamir were found around the old Russian geological station at about 3,200 m a.s.l.

Fig. 302. *Waldheimia glabra* on a rock ledge near Tagarkaty Pass, Eastern Pamir, Tajikistan (ca. 4,450 m a.s.l.). Photo: A. Nowak.

Fig. 303. Community of *Jurinea darvasica* under the overhanging rock, in the Abduqakhor Valley, Western Pamir, Tajikistan (ca. 3,200 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: *Jurinea darvasica* has been reported from a few locations in the alpine belt of the Darvaz, Rushan and Peter the First Mts (Rasulova 1991). The stands of this community inhabit overhanging rocks, large cracks, clefts and ledges. The diagnostic species has also been observed on screes (Rasulva 1991), but in our opinion it is a sporadic situation, where the fallen seeds have found an ephemeral habitat to germinate and then disappeared due to unfavourable conditions and competition from other scree species.

ASO-AAb. *Pentanemenion albertoregeliae* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of rock ledges and clefts with organic substrates in the Pamir-Alai Mts)

Diagnostic species: *Brachythecium albicans, B. velutinum, Bryum caespiticium, Pentanema albertoregelia.*

Constant species: *Inula glauca, Pentanema albertoregelia, Rhinactinidia popovii, Saussurea ovata, Stipa zeravshanica.*

Geographical range: This vegetation inhabits large shelves and rock ledges in the Pamir-Alai and western Tian Shan. It probably also occurs in the Hindu Kush in Afghanistan at montane and subalpine elevation ranging from approx. 1,700 to 2,900 m a.s.l.

Habitat characteristics: The plant communities of the *Pentanemenion* suballiance occupy rock ledges and coarse crevices of rock faces with considerable amounts of soil sediment, i.e. places of relatively high nutrient availability. These trophic conditions have consequences for the species structure of the phytocoenoses, in particular they affect moss cover (Nowak et al. 2014b).

ASO-AA20. *Pentanemetum albertoregeliae* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of rock ledges and clefts

of the montane belt in the western Pamir-Alai Mts) (Fig. 304)

Diagnostic species: *Pentanema albertoregelia.*

Constant species: *Pentanema albertoregelia.*

Geographical range: The phytocoenoses of *Pentanemetum albertoregeliae* have been found in several locations in the Zeravshan Mts, mainly in the Seven Lakes, Veshan, Pastrud-darya, Kshtut, Yagnob and Iskander-darya River Valleys within the central and western Zeravshanian geobotanical subregions. *Pentanema albertoregelia* is a species distributed throughout Pamir-Alai and western Tian Shan Mts (Kinzikaeva 1988), so the association should have a wider distribution range than the Zeravshanian Region. It has been found in the alpine zone at the relatively low elevation of 1,420 to 2,265 m a.s.l. (mean approx. 1,900) (Nowak et al. 2014b).

Habitat characteristics: The association prefers limestone and dolomite rocks (pH 8.0–8.5) with coarse fissures and crevices. The community was mainly found on the south-eastern, eastern and southern exposures with almost vertical inclinations (mean approx. 80°) (Nowak et al. 2014b).

Fig. 304. Vegetation of *Pentanemetum albertoregeliae* on limestone rock clefts near Shing, Tajikistan (ca. 1,550 m a.s.l.). Photo: A. Nowak.

ASO-AA21. *Saussureetum ovatae* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of rock ledges and clefts of the alpine to subnival belts in the western Pamir-Alai Mts) (Fig. 305)

Diagnostic species: *Saussurea ovata.*

Constant species: *Minuartia litwinowii, Poa relaxa, Saussurea ovata.*

Geographical range: *Saussurea ovata* is a widespread rupicolous species, generally known from the alpine and subnival belts of the Pamir-Alai and Tian Shan Mts (Rasulova 1991). In Tajikistan, it was previously reported only from the eastern Pamir-Alai, near the Kara-Shura settlement. The association formed by *Saussurea ovata* was found at several sites at subnival elevations in the Chimtarga Massif (around Lake Mutnoe) and in the Yagnob Valley. The phytocoenosis develops at relatively high elevations in the subnival belt, within a narrow elevational range with a mean value of approx. 3,600 m a.s.l. (Nowak et al. 2014b).

Habitat characteristics: The phytocoenosis has been found almost exclusively on alkaline limestone and marly limestone (pH 8.2–8.4). The association prefers coarse clefts and ledges with a considerable amount of soil. Sometimes the association has been noted in shady places. The community develops on steep or slightly sloping rock faces (mean inclination of approx. 80°). *Saussureetum ovatae* generally inhabits northeastern and southern exposures (Nowak et al. 2014b).

ASO-AA22. *Rhinactinidietum popovii* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of rock ledges of the alpine belt in thewestern Pamir-Alai Mts) (Fig. 306)

Diagnostic species: *Rhinactinidia popovii.*

Constant species: *Campanula incanescens, Poa relaxa, Rhinactinidia popovii.*

Fig. 305. Vegetation of *Saussureetum ovatae* on limestone rock clefts near Mutnoe Lake, upper reaches of Pastrud-darya Valley, Tajikistan (ca. 3,500 m a.s.l.). Photo: A. Nowak.

Fig. 306. Vegetation of *Rhinactinidietum popovii* on limestone ledges near Veshan, Zeravshan Mts, Tajikistan (ca. 1,800 m a.s.l.). Photo: A. Nowak.

Geographical range: The distribution of the association is fully consistent with the range of the diagnostic species. *Rhinactinidia popovii* is a widely distributed species in the subalpine and alpine belts of the Pamir-Alai and Tian Shan Mts (Kinzikaeva 1988). The association develops at an elevational range between 1,460 and 3,600 m a.s.l. (Nowak et al. 2014b). Plots of the phytocoenosis have been found in the Kara-kul, Kshtut, Iskander-darya, Seven Lakes and Kashkuytal-Zanbar River Valleys.

Habitat characteristics: The phytosociological research carried out in this area confirms that the species has formed its own association, which develops on alkaline rock substrates (pH 7.7–8.4), mainly limestone (marly limestone), marble and dolomitic shale. The phytocoenosis develops on medium sized cracks, ledges, wall corners and coarse clefts. The community develops generally on steep rock faces, but often uses sloping parts or even almost flat parts of rock ledges. The noted inclinations ranged from 35° to 85°. *Rhinactinidietum popovii* generally prefers northwestern and northeastern exposures (Nowak et al. 2014b).

ASO-AA23. *Asperulo albiflorae-Stipetum zeravshanicae* Nobis, Nowak et A. Nobis 2013 (chasmophytic vegetation of small limestone rock ledges of the alpine belt in the Zeravshan and Alai Mts) (Fig. 307)

Diagnostic species: *Stipa zeravshanica.*

Constant species: *Artemisia rutifolia, Asperula albiflora, Brachythecium albicans, Bryum caespiticium, Poa relaxa, Stipa caucasica* subsp. *nikolai, S. zeravshanica.*

Geographical range: The phytocoenoses of *Asperulo albiflorae-Stipetum zeravshanicae* have been found quite frequently in the central part of the Zeravshan Mts, mainly in the Yagnob, Iskander-darya, Seven Lakes Valley, Archamaidan

Fig. 307. Vegetation of the *Asperulo albiflorae-Stipetum zeravshanicae* association, found on rock clefts and ledges near Marzich, Yagnob River Valley, Zeravshan Mts, Tajikistan (ca. 2,150 m a.s.l.). Photo: A. Nowak.

Fig. 308. Vegetation of the *Achoriphragmetum pinnatifidi* association found on rock ledges near Jelandy, Eastern Pamir, Tajikistan (ca. 3,750 m a.s.l.). Photo: A. Nowak.

and Kshtut River Valleys. The association is distributed in the montane, subalpine and alpine belts at elevation ranging from 1,450 to 2,700 m a.s.l. (Nobis et al. 2013; Nowak et al. 2014b).

Habitat characteristics: This association prefers rock ledges and coarse clefts on steep walls, often within the river gorges. In a few cases the plots have been also recorded on rocky outcrops on steep slopes. The phytocoenoses have been observed on limestone and dolomite substrates with a pH 7.1–8.6 (Nobis et al. 2013). The association is found on different exposures. Due to different relief of the ledges and shelves, the sites *Asperulo albiflorae-Stipetum zeravshanicae* plots have a significantly diversified slope, from 10° to 80° (Nobis et al. 2013; Nowak et al. 2014b).

ASO-AA24. *Achoriphragmetum pinnatifidi* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of rock clefts and overhanging rocks on limestone and marl faces in the Pamir-Alai, Tian Shan and Altai ranges) (Fig. 308)

Diagnostic species: *Achoriphragma pinnatifidum.*

Constant species: *Brachythecium albicans, Bryum caespiticium, Campanula incanescens, C. lehmanniana, Poa relaxa.*

Geographical range: *Achoriphragma pinnatifidum* is a chasmophytic species widely distributed in the alpine and subnival belts of the Pamir-Alai, Tian Shan and the western Altai (in Chineese Dzhungaria; Ovchinnikov 1978). In Tajikistan, *Achoriphragma pinnatifidum* is commonly found in the Turkestan, Zeravshan, Hissar, Peter the First and Rushan Mts. The association of *Achoriphragma pinnatifidum* has been found at several sites in the alpine and subnival elevations of the Seven Lake, Iskander-darya, Yagnob, Karakul and Pastrud-darya River Valleys. The phytocoenosis develops at elevations from montane to high alpine belts, from 1,350 to 3,600 m a.s.l. (Nowak et al. 2014b; Nowak et al. 2022c).

Habitat characteristics: The phytocoenosis has been found almost exclusively on alkaline limestone, marly limestone and schist (pH 7.7–8.8).

The association prefers fractured, sometimes friable rocks. Populations of *Achoriphragma pinnatifidum* inhabit large crevices and coarse clefts with considerable amount of soil substrate. The community develops on steep and sloping walls, but has also been observed under the overhanging rock benches or on almost flat terraces or boulders. The mean slope of the sampled plots was approx. 90°, ranging from 70° to 120°. *Achoriphragmetum pinnatifidi* generally inhabits the western and northwestern exposures (Nowak et al. 2014b).

ASO-AA25. *Inuletum glaucae* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation of rock clefts and overhanging rocks on limestone and marl faces in upper montane to subalpine belts of the western Pamir-Alai Mts) (Fig. 309)

Fig. 309. Vegetation of *Inuletum glaucae* developed on rocky limestone clefts near Chore, Zeravshan Mts, Tajikistan (ca. 1,530 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Inula glauca.*
Constant species: *Brachythecium albicans, Bryum caespiticium, Campanula incanescens, Carex koshewnikowii, Poa relaxa.*
Geographical range: The phytocoenoses of *Inuletum glaucae* have been sporadically recorded in the central part of the Zeravshan range, at a few sites in the valleys of Chore, Yagnob, Iskanderdarya and Dzhidzhikrut rivers. The diagnostic species belongs to endemics of the Pamir-Alai and is known from several sites in the montane and alpine belts of the Zeravshan Hissar, Darvaz, Babatag and Peter the First ridges (Kinzikaeva 1988). It has also been found in two places in the western Pamir. It has an elevational range from approx. 1,550 to 2,250 m a.s.l. (Nowak et al. 2014b).
Habitat characteristics: Like *Achoriphragmetum pinnatifidi,* this association prefers fissured rocks with large crevices and coarse clefts. Plots of the association were found in wall corners, sometimes in the shade, but in all cases with a considerable amount of soil substrate. The phytocoenosis inhabits the limestone and dolomite rocks with an alkaline reaction (pH 7.4–8.2). The phytocoenosis was generally observed on shaded walls with northern, northeastern and northwestern exposures and almost vertical inclinations (mean approx. 85°) (Nowak et al. 2014b).

Vegetation of rock crevices of submontane and colline zone in the Pamir-Alai and Tian Shan Mts

ASO-AB. *Caricion koshewnikowii* Nowak, S. Nowak, Nobis et A. Nobis 2016 (chasmophytic vegetation of submontane and colline belts in the Pamir-Alai and Tian Shan Mts) (Fig. 310)

Diagnostic species: *Carex koshewnikowii, Silene schugnanica.*
Constant species: *Campanula incanescens, Dionysia involucrata, Scutellaria baldshuanica, S. hissarica, S. schugnanica, S. zaprjagaevii, Tylosperma lignosa***.**

Fig. 310. Vegetation of *Caricion koshewnikowii* on limestone walls near Toktogul, Fergana Mts, Kyrgyzstan (ca. 1,600 m a.s.l.). Photo: A. Nowak.

Geographical range: The phytocoenoses of the *Caricion koshewnikowii* alliance have been recorded in the western Pamir-Alai Mts and less frequently in the Kuraminian range (SW Tian Shan) and eastern Pamir. The communities occur mainly between (750)–1,000 and 2,000–(2,250) m a.s.l. (Nowak et al. 2014c, 2016e).
Habitat characteristics: This chasmophytic vegetation develops on different rock types, all possible exposures and colline to the lower montane belts of the Pamir-Alai and Tian Shan Mts.

ASO-AB01. *Scutellarietum hissaricae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (chasmophytic vegetation of granite rock ledges of the montane belt in Hissar Mts) (Fig. 311)

Diagnostic species: *Scutellaria hissarica.*
Constant species: *Bromus tectorum*, *Campanula incanescens*, *Carex koshewnikowii*, *Schistidium apocarpum*, *Scutellaria adenostegia*, *Syntrichia ruralis*.
Geographical range: The phytocoenoses of *Scutellarietum hissaricae* have been found in several locations in the Hissar Mts, mainly on the southern slopes of the Varzob, Takob, Khondara, Shirkent and Karatag River Valleys. *Scutellaria hissarica* is an endemic species of the western Pamir-Alai Mts scattered in the southern part of the Hissar range at an elevation of 1,100–1,700 m a.s.l. (Kochkareva 1986). The elevational distribution of the association corresponds with this amplitude. The samples have been collected in the colline belt at an elevation of 1,100–1,600 m a.s.l. (Nowak et al. 2014c, 2016e).
Habitat characteristics: The association prefers limestone and dolomite rocks (pH 7.8-8.5) with coarse crevices and clefts. *Scutellarietum hissaricae* was found mainly on southern and western exposures with a mean inclination of approx. 80° (Nowak et al. 2014c).

Fig. 311. Vegetation of *Scutellarietum hissaricae* on granite clefts and ledges in Romit State National Reserve, Hissar Mts, Tajikistan (ca. 1,650 m a.s.l.). Photo: M. Nobis.

Fig. 312. Vegetation of *Scutellarietum zaprjagaevii* developed on granite rock walls near Varzob, Hissar Mts, Tajikistan (ca. 1,205 m a.s.l.). Photo: A. Nowak.

ASO-AB02. *Scutellarietum zaprjagaevii* Nowak, S. Nowak, Nobis et A. Nobis 2016 (chasmophytic vegetation of montane belt on granite friable rocks of the montane belt in Hissar Mts) (Fig. 312)

Diagnostic species: *Scutellaria zaprjagaevii.*
Constant species: *Bryum argenteum, Campanula incanescens, Carex koshewnikowii, Grimmia pulvinata, Schistidium apocarpum, Syntrichia ruralis.*
Geographical range: *Scutellaria zaprjagaevii* is a chasmophytic and stenochoric species with distribution restricted to rock outcrops in southwestern Tajikistan, mainly in the Hissar Mts (Kochkareva 1986). The association was found almost exclusively in the valleys of the Varzob, Takob, Khondara, Horongkong and Syoma rivers between Dushanbe and the Anzob Pass.
Habitat characteristics: The phytocoenosis has been found almost exclusively on acidic granitic rocks of loose structure (pH 5.8–6.8). The association prefers friable, fissured rocks, often with a typical pink colour. The vegetation plots dominated by *Scutellaria zaprjagaevii* occupy fine crevices without considerable amounts of soil substrate. The phytocoenosis develops at relatively low elevations in the colline belt with a warm microclimate. The observed elevational range was between 1,080 and 1,450 m a.s.l. The association develops on steep rock faces with the mean inclination of approx. 85°. *Scutellarietum zaprjagaevii* generally inhabits southwestern exposures (Nowak et al. 2014b).

ASO-AB03. *Scutellarietum baldshuanicae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (chasmophytic vegetation of colline and montane belts in the south-western Pamir-Alai; mainly Sarsarak, Darvaz and Hazratishokh Mts) (Fig. 313)

Diagnostic species: *Scutellaria baldshuanica.*
Constant species: *Campanula incanescens, Carex koshewnikowii, Galium verticillatum, Grimmia pulvinata, Perovskia virgata, Silene schugnanica,*

Fig. 313. *Scutellaria baldshuanica* in granite rock crevices near Bidarak, Aktau Mts, Tajikistan (ca. 650 m a.s.l.). Photo: A. Nowak.

S. brahuica, Schistidium apocarpum, Syntrichia ruralis.

Geographical range: *Scutellarietum baldshuanicae* is a plant association formed by a narrow endemic of southwestern Pamir-Alai Mts, known only from southern slopes of Hazratishokh, Babatag and Darvaz ranges. Plots of this chasmophytic vegetation have been found on rock faces along the Panj River and in the surroundings of Shurobod. The phytocoenosis inhabits low elevations in colline and submontane belts, within an elevation range between 400 and 1,400 m a.s.l. (Nowak et al. 2014c).

Habitat characteristics: The phytocoenosis has been found on conglomerates, limestone, marble and schist of different reaction (pH 6.5–8.0). The association prefers rock faces with fine fissures and small crevices with little organic matter. The plots of *Scutellarietum baldshuanicae* develop on steep walls, very rarely overhanging, with the mean inclination of approx. 85°, ranging from 80° to 100°. The phytocoenoses generally inhabit southern and southeastern exposures (Nowak et al. 2014c).

ASO-AB04. *Tylospermetum lignosae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (chasmophytic vegetation of granite and gneiss rocks, often overhanging, of the montane belt in Hissar Mts) (Fig. 314)

Diagnostic species: *Tylosperma lignosa.*

Constant species: *Scutellaria hissarica, Campanula incanescens Carex koshewnikowii, Anaphalis darvasica*.

Geographical range: *Tylosperma lignosa* is known only from a few locations scattered in the central part of the Hissar Mts. However, the species is widely distributed in the lower montane belt of the western Pamir-Alai as well as in the mountains of Iran (Ovchinnikov 1975). The distribution of the association is limited to the central

Fig. 314. Vegetation of *Tylospermetum lignosae* on granite rock crevices near Pugus, Varzob River Valley, Hissar Mts, Tajikistan (ca. 1,350 m a.s.l.). Photo: M. Nobis.

part of the Varzob River Valley and several small, unnamed side valleys. The association prefers elevations between 1,200 and 1,800 m a.s.l. (Nowak et al. 2014c).

Habitat characteristics: This association develops on acidic rock substrates (pH 6.2–6.8), mainly on granite and gneiss. The phytocoenosis develops on rocks with small or medium crevices, often under the overhanging ledges. The community generally develops on vertical walls with an average inclination close to 90°. Unlike the closely related *Dionysietum involucratae*, *Tylospermetum lignosae* generally prefers north-western and northern, shady exposures (Nowak et al. 2014c).

ASO-AB05. *Dionysietum involucratae* Nowak, M. Nobis, S. Nowak et A. Nobis 2014 (chasmophytic vegetation of granite rocks of the colline and montane belts in the central Hissar Mts) (Fig. 315)

Diagnostic species: *Dionysia involucrata.*

Constant species: *Bryum argenteum, Campanula incanescens, Carex koshewnikowii, Grimmia pulvinata, Scutellaria hissarica.*

Geographical range: *Dionysia involucrata* is an endemic species from the central part of the Hissar range, mainly known from several locations in the Varzob River Valley (Nowak et al. 2014d). The plots of *Dionysietum involucratae* were found in five locations of the main diagnostic species in the valleys of the Varzob and Takob rivers. The phytocoenosis has been found in colline and montane zones at the relatively low elevation of 1,100–1,800 m a.s.l. (Nowak et al. 2014c).

Habitat characteristics: The association inhabits granite rocks with relatively low cohesion and acidity (pH 6.0–6.5). Sporadically it has also been found on compact limestone with fine crevices and fissures. The community develops mainly on south-western and southern exposures with almost vertical, or even overhanging, walls.

Fig. 315. Vegetation of *Dionysietum involucratae* on a granite rock wall near Pugus, Varzob River Valley, Hissar Mts, Tajikistan (ca. 1,320 m a.s.l.). Photo: A. Nowak.

The approximate mean inclination is ca. 90° (Nowak et al. 2014c; Nowak et al. 2014d).

ASO-AB06. *Nanorrhinetum ramosissimi* Nowak, S. Nowak, Nobis et A. Nobis 2016 (chasmophytic vegetation of limestone rocks of the colline and montane belts in the southern Darvaz and Hazratishokh Mts) (Fig. 316)

Diagnostic species: *Nanorrhinum ramosissimum.*
Constant species: *Andrachne rotundifolia, Bromus tectorum, Carex koshewnikowii, Galium verticillatum, Scariola orientalis.*
Geographical range: The phytocoenoses of *Nanorrhinetum ramosissimi* have been sporadically reported in the central part of the Panj River Valley on the southern slopes of Hazratishokh and Darvaz Mts. The diagnostic species was recently found to be new to Tajikistan (Nobis, Nowak 2011). Its distribution range includes northeastern Africa, southwestern and southern Asia (e.g. Somalia, Sudan, Iran, Afghanistan, Pakistan, India, Nepal and Bhutan; Ghebrehiwet 2000; Qureshi, Bhatti 2008). The association was found in the colline belt at the relatively low elevations of approx. 1,000 m a.s.l. (Nowak et al. 2014c).
Habitat characteristics: *Nanorrhinetum ramosissimi* prefers fissured rocks with coarse crevices and small clefts. Plots of the association have been found in wall corners, sometimes in a shade, as well as on very sunny, south-facing rocks. In some cases, the population of *Nanorhinum ramosissimum* was also observed on screes. The phytocoenosis inhabits the limestone and dolomite rocks with an alkaline reaction (pH 7.6–8.4). The phytocoenoses were generally observed on steep faces with inclinations of approx. 85° (Nowak et al. 2014c).

ASO-AB07. *Campanuletum albertii* Nowak, S. Nowak, Nobis et A. Nobis 2016 (chasmophytic

Fig. 316. *Nanorrhinum ramosissimum* on limestone rock near Zigar, Panj River Valley, Darvaz Mts, Tajikistan (ca. 1,030 m a.s.l.). Photo: A. Nowak.

vegetation of limestone rocks of the montane belts in the western Tian Shan Mts) (Fig. 317)

Diagnostic species: *Asperula oppositifolia, Atraphaxis virgata, Campanula stevenii* subsp. *alberti* (= *C. alberti*), *Seseli tenuisectum, Silene nevskii* (= *S. bogdanii*).
Constant species: *Campanula incanescens, Carex koshewnikowii, Pseudoclausia kuramensis, Syntrichia ruralis.*
Geographical range: *Campanula stevenii* subsp. *alberti* is one of the most widespread chasmophytes in Middle and Central Asia (Pamir-Alai, Tian Shan, Kazakhstan; Kinzikaeva 1988). In Tajikistan, the species has been found on rock faces of the Kuraminian Mts in the northern periphery of the country. The association is distributed in the colline and montane belts. The association develops at elevations of approx. 1,200–1,600 m a.s.l. (Nowak et al. 2014c).

Fig. 317. *Campanula stevenii* subsp. *alberti* in granite rock crevices near Guldara, Kuraminian Mts, Tajikistan (ca. 1,710 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: Plots of the phytocoenosis have been found on solid granite and schist with an acid reaction (pH 5.8–6.8). The phytocoenosis develops on medium-sized crevices and ledges, and sometimes coarse clefts. The community generally inhabits steep rock faces, but also uses flat parts of rock ledges. The inclinations of the walls were from 80° to 90° (Nowak et al. 2014c).

ASO-AB08. *Asperulo albiflorae-Kafirniganietum hissaricae* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2022 (chasmophytic vegetation of granite, crumbly rocks in the montane belt of Sardai-Miyona Valley, Hissar Mts) (Fig. 318)

Diagnostic species: *Asperula albiflora, Bupleurum lipskyanum, Carex koshewnikowii, Kafirnigania hissarica, Scutellaria zaprjagaevii, Silene conformifolia.*
Constant species: *Carex koshewnikowii.*
Geographical range: The association has been recorded mainly in the Sarday-Myona River Valley (Hissar Range). The main diagnostic species is an endemic plant with a distribution range restricted to the central Hissar Mts in only two neighbouring valleys (Chukavina 1984). The association's plots have been found at elevation between 1,370 and 1,870 m a.s.l. (Nowak et al. 2022a).
Habitat characteristics: It forms distinct populations on granular, crumbly granite rocks within the montane belt. They inhabit mainly southwestern, southern and eastern slopes with relatively steep inclinations (mean approx. 80°) (Nowak et al. 2022a).

ASO-AB09. *Scrophularietum glabellae* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2022 (chasmophytic vegetation of limestone and gypsum rock ledges in colline and montane belts of the Aktau and Babatag Mts)

Diagnostic species: *Galium tenuissimum, Scrophularia glabella, Sedum bucharicum.*
Constant species: *Asperula albiflora, Scrophularia glabella, Sedum bucharicum.*

Fig. 318. Vegetation of *Asperulo albiflorae-Kafirniganietum hissaricae* found on limestone rocky clefts in Sarday-Myona River Valley, Hissar Mts, Tajikistan (ca. 1,390 m a.s.l.). Photo: A. Nowak.

Geographical range: The endemic species *Scrophularia glabella* forms its association in the lowest elevations of the Aktau and Babatag Mts in south-western Tajikistan. Its stands are distributed in the colline belt of the southernmost section of these two mountain ranges close to the border with Afghanistan (Kochkareva 1986). It has been recorded, although rarely, within the range of elevation from 450 to 1,550 m a.s.l. on limestone, gypsum and conglomerate outcrops (Nowak et al. 2022a).
Habitat characteristics: This association is typical for tiny rock ledges and crevices or solid, sloping rock plates. Patches of this association were found on relatively steep rocky slopes with a mean inclination of approx. 70°. The association prefers southern and south-western exposures (Nowak et al. 2022a).

ASO-AB10. *Scutellarietum immaculatae* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2022 (chasmophytic vegetation on solid rock faces with tiny fissures and crevices in montane and subalpine belts in the western Alai Mts) (Fig. 319)

Diagnostic species: *Androsace bryomorpha, Asperula botschantzevii, Pentanema albertoregelia, Rhamnus minuta, Scutellaria immaculata, Seseli calycinum.*
Constant species: *Scutellaria immaculata.*
Geographical range: This chasmophytic vegetation is endemic to the surroundings of the Fergana Valley. It occurs in the northern Pamir-Alai and south-western Tian Shan (Kochkareva 1986). The association patches include a number of species considered endemic to this part of Middle Asia (e.g. *Scutellaria immaculata* and *Asperula botschantzevii*). The documented plots occupied steep solid rock faces with tiny fissures and crevices in upper montane and subalpine belts of the western Alai Mts. They were

Fig. 319. *Scutellaria immaculata* in limestone rock fissures near Maydan, Alai Mts, Kyrgyzstan (ca. 1,350 m a.s.l.). Photo: A. Nowak.

recorded at ca. 1,200 to 2,500 m a.s.l. (Nowak et al. 2022a).

Habitat characteristics: The association occurs mainly on eastern and south-eastern exposures on rock cliffs with steep inclination (mean approx. 83°) (Nowak et al. 2022a).

ASO-AB11. *Campanuletum eugeniae typicum* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2022 (chasmophytic vegetation of limestone rock faces and ledges in montane and subalpine belts of the Kyrgyz, Talas and Fergana Mts) (Fig. 320)

Diagnostic species: *Campanula eugeniae, Fumariola turkestanica, Stipa gracilis*.
Constant species: *Campanula eugeniae, Stipa gracilis*.

Fig. 320. Vegetation of *Campanuletum eugeniae* growing on solid limestone wall north of Toktogul, Fergana Mts, Kyrgyzstan (ca. 1,600 m a.s.l.). Photo: M. Nobis.

Geographical range: This fairly homogenous rupicolous vegetation is found mainly in the Kyrgyz, Talas and Fergana ranges, with some isolated localities in neighbouring areas. In the western Tian Shan, this association is found in montane to subalpine belts at ca. 800 to 2,100 m a.s.l. (Nowak et al. 2022a).
Habitat characteristics: The typical patch of this community occupies small ledges or solid rock faces. The association prefers limestone substrates and steep, sometimes overhanging, walls with a mean inclination of approx. 75° and variable exposures (Nowak et al. 2022a).

ASO-AB11a. *Campanuletum eugeniae fumarioletosum turkestanicae* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2022 (chasmophytic vegetatation of shaded solid limestone faces – gorges, river rock narrowings – in the central Alai Mts) (Fig. 321)

Diagnostic species: *Fumariola turkestanica.*
Constant species: *Fumariola turkestanica.*
Geographical range: The vegetation occupies vertical or even overhanging walls in narrow, shady gorges at upper montane and subalpine elevation, mainly in Alai Mts, between ca. 1,100 and 2,050 m a.s.l. (Nowak et al. 2022a).
Habitat characteristics: This vegetation develops on solid limestone faces in lower montane, warm and strongly shaded gorges or rock walls (Nowak et al. 2022a).

ASO-AB12. *Silenetum kuschakewiczii* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2022 (chasmophytic vegetation of upper montane and subalpine belts of the western Pamirian and Darvazian ranges) (Fig. 322)

Diagnostic species: *Artemisia porrecta, Clypeola jonthlaspi, Rosularia lutea, Silene kuschakewiczii.*

Fig. 321. Vegetation of the *Campanuletum eugeniae fumarioletosum turkestanicae* subassociation growing in rock fissures near Abshir-Ata Gorge, Alai Mts, Kyrgyzstan (ca. 1,500 m a.s.l.). Photo: A. Nowak.

Fig. 322. Vegetation of *Silenetum kuschakewiczii* inhabiting rock fissures near Rivak in Gunt, Tajikistan (ca. 2,400 m a.s.l.). Photo: A. Nowak.

Constant species: *Silene kuschakewiczii.*
Geographical range: This association is distributed across the semi-arid zone of the western Pamir. Plots of *Silenetum kuschakewiczii* were found in the upper montane and subalpine belt of the Pamirian and Darvazian ranges, between approx. 1,750 and 2,400 m a.s.l. (Nowak et al. 2022a).
Habitat characteristics: Its patches inhabit walls and outcrops of different origin, mainly limestone, with a preference for solid faces with tiny fissures and crevices. The association was recorded in sites with different slopes (from 10° to 90°) and an average inclination of ca. 65°. Its patches prefer southern exposures (Nowak et al. 2022a).

ASO-AB13. *Rosularietum platyphyllae* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2022 (chasmophytic vegetation on ledges and shelves in montane belt of semi-arid zones of the Fergana, Terskey Ala-Too and Kyungey Ala-Too Mts) (Fig. 323)

Diagnostic species: *Allium oreoprasum*, *Crepidifolium akagii* (= *Youngia tenuicaulis*), *Potentilla parviflora* (= *Dasiphora parvifolia*), *Dracocephalum nodulosum, Pyrethrum pyrethroides, Rosularia platyphylla, Stipa caucasica.*
Constant species: *Allium oreoprasum*, *Crepidifolium akagii*, *Dracocephalum nodulosum, Pyrethrum pyrethroides, Rosularia platyphylla, Stipa caucasica.*
Geographical range: This rather heterogeneous association was noted in the semi-arid zones of western Kyrgyzstan in the Fergana, Terskey Ala-Too and Kyungey Ala-Too Mts. They were located in the upper montane and subalpine belt, between ca. 1,650 and 2,500 m a.s.l., with a mean of ca. 2,050 m a.s.l. (Nowak et al. 2022a).
Habitat characteristics: The association prefers gently sloping shelves and ledges on granite

Fig. 323. *Rosularia platyphylla* inhabiting rock ledges near Cholpon-Ata, Kyrgyzstan (ca. 2,000 m a.s.l.). Photo: A. Nowak.

or schist rock outcrops and walls. The patches of the association were found between friable rocks with a significant amount of soil. The association occupies slopes with a mean inclination of 70° on south-eastern, north-eastern and eastern exposures (Nowak et al. 2022a).

ASO-AB14. *Silenetum lithophilae* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2022 (chasmophytic vegetation of schist rock faces in the montane and subalpine belts of Talas and Kyrgyz Mts) (Fig. 324)

Diagnostic species: *Silene lithophila.*
Constant species: *Silene lithophila.*
Geographical range: The association is restricted to the humid zone of the Kyrgyz and Talas ranges in northern Kyrgyzstan. We also found patches of vicariant *Silene ladyginae* in the Fergana Valley. The association patches inhabit solid walls with tiny fissures and crevices within montane and subalpine belts, between ca. 800 and 2,100 m a.s.l. (Nowak et al. 2022c).
Habitat characteristics: The phytocoenoses were found on schists and mudstones. The association develops on steep rock cliffs with an inclination ranging from 60° to 90°. *Silenetum lithophilae* was noted on slopes with various exposures, preferring south-western and southern (Nowak et al. 2022a).

ASO-AB15. *Rhinactinidietum limoniifoliae* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2022 (chasmophytic vegetation of limestone rock ledges in montane and subalpine belts in the western Tian Shan Mts) (Fig. 325)

Diagnostic species: *Artemisia rutifolia, Pyrethrum transiliense, Rhinactinidia limoniifolia.*
Constant species: *Artemisia rutifolia.*
Geographical range: Widely distributed in northern Kyrgyzstan, *Rhinactinidia limoniifolia* is a vicariant species of *Rhinactinidia*

Fig. 324. Sparse vegetation of *Silenetum lithophilae* inhabiting solid schist wall in Kara-Balta Valley, Kyrgyzstan (ca. 2,200 m a.s.l.). Photo: A. Nowak

popovii known from Pamir-Alai in central and western Tajikistan. *Rhinactinidietum popovii* was described from ledges and clefts with a considerable amount of soil in the Hissar and Zeravshan Mts (Nowak et al. 2014a). Similarly, *Rhinactinidia limoniifolia* forms an association in the Talas Alatau, Kyrgyz and Terskey Ala-Too Mts that are typical for large rock ledges with a high soil content. The association develops in the montane and subalpine belts within an elevation range between 1,500 and 2,400 m a.s.l. (Nowak et al. 2022a).

Habitat characteristics: It often grows on steep rock walls, but also occupies the sloping parts or even almost flat parts of rock ledges and brinks. The noted inclinations were between 40° and 90° (mean value approx. 75°). *Rhinactinidietum limoniifoliae* prefers northern and north-western exposures (Nowak et al. 2022a).

Fig. 325. *Rhinactinidia limoniifolia* on a limestone ledge near Karakol, Talas Alatau Mts, Kyrgyzstan (ca. 850 m a.s.l.). Photo: A. Nowak.

ASO-ABc01. Community of *Scutellaria comosa* (chasmophytic, thermophilous vegetation of the colline and lower montane belts of the Fergana Valley)

Diagnostic species: *Aegilops crassa, Alyssum alyssoides* (= *A. campestre, A. calycinum*), *Boissiera squarrosa, Conyza canadensis* (= *Erigeron canadensis), Gagea delicatula, Lactuca serriola, Medicago minima, Scutellaria comosa, Silene brahuica, Velezia rigida.*
Constant species: *Scutellaria comosa.*
Geographical range: *Scutellaria comosa* occurs on limestone outcrops in the colline belt of the south-western Tian Shan and northern Pamir-Alai (mainly in the vicinity of the Fergana Valley; Kochkareva 1986). Only three patches of this community in Namazkana (near Jalalabad in Kyrgyzstan) were found. The patches were noted in cracks and small ledges of midfield rock outcrop at an elevation of ca. 1,100 m a.s.l. (Nowak et al. 2022a).
Habitat characteristics: Recorded patches occur on southern slopes and were located on steep rock walls (Nowak et al. 2022a).

ASO-ABc02. Community of *Pterocephalus afghanicus* (chasmophytic, thermophilous vegetation of the colline and lower montane belts of the western Pamir-Alai Mts) (Fig. 326)

Diagnostic species: *Pterocephalus afghanicus.*
Constant species: *Pterocephalus afghanicus.*
Geographical range: This vegetation is distributed in the montane and alpine belts of southern ranges of Middle Asia, mainly in Khatlon Province of Tajikistan, northern Hindu Kush and eastern Uzbekistan. The patches were noted in small ledges and clefts at an elevation of ca. 1,000–2,800 m a.s.l. (Nowak et al. 2022a).
Habitat characteristics: This vegetation prefers southern exposure and is located on gently sloping walls and ledges (Nowak et al. 2022a).

Fig. 326. Community of *Pterocephalus afghanicus* inhabiting limestone ledges near Nurek, Tajikistan (ca. 1,250 m a.s.l.). Photo: A. Nowak.

Fig. 327. Community of *Rosularia glabra* found on limestone rock top near Qualaikhum, Tajikistan (ca. 1,850 m a.s.l.). Photo: A. Nowak.

ASO-ABc03. Community of *Rosularia glabra* (rock ledges and boulders in the colline and lower montane belts of the western Pamir-Alai Mts in warm climatic zone) (Fig. 327)

Diagnostic species: *Rosularia glabra.*
Constant species: *Rosularia glabra.*
Geographical range: This community is distributed in the montane and alpine belts of eastern Pamir-Alai and western Tian Shan Mts in Middle Asia. The patches of the community were noted on ledges, boulders and rock tops at an elevation of ca. 1,500–4,000 m a.s.l.
Habitat characteristics: This vegetation prefers southern, sunny exposures and develops on flat or gently sloping rock walls and boulders.

ASO-ABc04. Community of *Rosularia lutea* (rock ledges and boulders in the montane and alpine belts of the Pamir-Alai Mts) (Fig. 328)

Diagnostic species: *Rosularia lutea.*
Constant species: *Rosularia lutea.*
Geographical range: This community is endemic to Pamir-Alai. It is distributed mainly in the Darvaz and Vanch Mts. The patches of the community were noted on solid rock faces and rock ledges at an elevation of ca. 2,500–3,000 m a.s.l.
Habitat characteristics: This vegetation prefers sunny exposures and develops on stepp or sloping rock walls and ledges.

ASO-ABc05. Community of *Dionysia hissarica* (chasmophytic vegetation of sandstone rocks of the montane belt of the western Hissar Mts) (Fig. 329)

Diagnostic species: *Dionysia hissarica.*
Constant species: *Campanula lehmanniana, Dionysia hissarica.*

Fig. 328. Community of *Rosularia lutea* inhabiting limestone rock ledge near Khoburobot Pass, Darvaz Mts, Tajikistan (ca. 3,150 m a.s.l.). Photo: A. Nowak.

Fig. 329. Community of *Dionysia hissarica* inhabiting sandstone ledges near Sangardak, Hissar Mts, Uzbekistan (ca. 1,550 m a.s.l.). Photo: A. Nowak.

Geographical range: This chasmophytic vegetation is distributed only in the area of Boysun Mts. and Sangardak Valley in south-western Hissar Mts. It was found at an elevation of ca. 1,500–1,650 m a.s.l.
Habitat characteristics: The community inhabits sandstone rocks with relatively low cohesion and alkaline reaction. Sporadically it has also been found on compact limestone with fine crevices and fissures. The community develops on different exposures with almost vertical, or even overhanging, walls. The approximate mean inclination is ca. 90°.

ASO-ABc06. Community of *Scutellaria chodshakasiani* (chasmophytic vegetation of colline and montane belts in the south-western Pamir-Alai; mainly Khojaqoziyon, Tuyun-Efn, Koiki-Toy Mts.) (Fig. 330)

Diagnostic species: *Scutellaria chodshakasiani.*
Constant species: *Scutellaria chodshakasiani.*

Geographical range: This endemic vegetation type is distributed only in the south-western corner of the country in the south-western tips of the Pamir-Alai Mts. We found plots of this community near Teshiktosh towards the ancient Takhti-Sangin excavations at an elevation of ca. 400–550 m a.s.l.
Habitat characteristics: The community inhabits limestone rocks on warm sites, mainly on the northern expositions.

ASO-AC. *Eritrichion pamirico-subjacquemontii* Nowak, Świerszcz, S. Nowak, Plášek, Nobis, Klichowska et M. Nobis 2024 (vegetation of rock ledges and clefts in highly elevated semi-arid zone of the Pamir Mts) (Fig. 331)

Diagnostic species: *Eritrichium pamiricum*, *E. subjacquemontii*, *Lonicera humilis*, *Roegneria schugnanica*, *Rubia tibetica*, *Androsace villosa* var. *dasyphylla*, *Allium tianschanicum*, *Crepidifolium tenuifolium.*

Fig. 330. Community of *Scutellaria chodshakasiani* near Takhti-Sangin excavations in south-western Tajikistan (ca. 450 m a.s.l.). Photo: A. Nowak.

Constant species: *Eritrichium pamiricum*, *E. subjacquemontii*, *Lonicera humilis*, *Roegneria schugnanica*, *Rubia tibetica*.

Geographical range: Vegetation of this alliance inhabits rock clefts, larger cracks and shaded ledges in the Rushan, Yazgulem, Ishkashim, Vakhan, Alichur, Muzkol, and Schugnan ranges. It has been recorded mainly at high alpine elevations between (3,200–)3,500–4,700(–5,500) m a.s.l. (Nowak et al. 2022d; Nowak et al. 2024b).

Fig. 331. Vegetation of *Eritrichion pamirico-subjacquemontii* on granite rocks near Alichur, Eastern Pamir, Tajikistan (ca. 4,200 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: This type of high alpine vegetation is distributed across the subarid zone of the Eastern Pamir, but can also be found on the highest, windswept peaks of the Western Pamir. It can withstand an extremely continental climate with annual temperature amplitude ranging between −40 in winter and +50 in summer. This vegetation is particularly species-poor, with a very short blooming season in July–August (Nowak et al. 2022d; Nowak et al. 2024b).

ASO-AC01. *Crepidifolio tenuifolii-Stipetum tianschanicae* Nowak, Świerszcz, S. Nowak, Plášek, Nobis, Klichowska et M. Nobis 2022 (vegetation of rock ledges and clefts in the alpine belt of the eastern Pamir Mts) (Fig. 332)

Diagnostic species: *Ajania gracilis, Allium tianschanicum, Crepidifolium tenuifolium, Crepis flexuosa, Dracocephalum stamineum, Krascheninnikovia ceratoides, Roegneria schrenkiana, Stipa tianschanica.*

Constant species: *Allium tianschanicum, Crepidifolium tenuifolium, Crepis flexuosa, Krascheninnikovia ceratoides, Roegneria schrenkiana, Stipa tianschanica.*

Geographical range: Both name giving plants (*Crepidifolium tenuifolium* and *Stipa tianschanica*) are widespread in Central Asia in semi-arid chasmophytic habitats (Rasulova 1991; Nobis 2014, Nobis et al. 2020). *Crepidifolium tenuifolium* (= *Youngia diversifolia*) is additionally distributed in the southern Siberian ranges. In Tajikistan, the main distribution area of this community includes the Eastern Pamir with some scattered locations also in the Western Pamir. It grows mainly on large ledges and crumbling rocks in dry, deserted slopes of Alichur, Schugnan and Sarikol Mts (Rasulova 1991). Probably, it can also grow on ephemeral alpine stream bars and steep screes or boulder fields. The patches of the association have been recorded quite frequently within the range of elevation from 2,600 to 4,200 m a.s.l., mainly on limestone substrates (Nowak et al. 2022d).

Habitat characteristics: This association inhabits relatively steep rocky slopes (35°–85°) with the mean inclination of approx. 70°. It was found mainly on eastern and northern exposures (Nowak et al. 2022d).

Fig. 332. Vegetation of the *Crepidifolio tenuifolii-Stipetum tianschanicae* association inhabiting limestone ledges near Murgab, Eastern Pamir, Tajikistan (ca. 4,150 m a.s.l.). Photo: A. Nowak.

ASO-ACc01. Community of *Androsace villosa* var. *dasyphylla* (vegetation of rock ledges, clefts and screens in the alpine and subnival belts of the eastern Pamir Mts) (Fig. 333)

Diagnostic species: *Androsace villosa* var. *dasyphylla, Asperula oppositifolia, Stipa orientalis.*
Constant species: *Androsace lehmanniana, A. villosa* var. *dasyphylla, Stipa orientalis.*
Geographical range: *Androsace villosa* var. *dasyphylla* (= *Androsace dasyphylla*) is scattered across the alpine chasmophytic habitats of the Pamir-Alai and Tian Shan ranges. In Tajikistan, it is mostly found in the high altitudes of the Eastern Pamir, and occasionally in the Hissar and Kuraminian Mts (Chukavina 1984). In 2015, the community was found in the Pamir alpine belt between 2,500 and 4,500 m a.s.l. (Nowak et al. 2022d).
Habitat characteristics: *Androsace villosa* var. *dasyphylla* community was mainly found on granite or limestone rock ledges and clefts with accumulated soil. It inhabits mainly southern and south-western exposures with relatively gentle inclinations (40°–85°) (Nowak et al. 2022d).

ASO-AD. *Hippolytion darvasicae* Nowak, Świerszcz, S. Nowak, Plášek, Nobis, Klichowska et M. Nobis 2022 (rock vegetation of the eastern Pamir-Alai and western Pamir Mts) (Fig. 334)

Diagnostic species: *Arabis karategina, Hippolytia darvasica, Inula schmalhausenii, I. schischkinii, Ribes heterotrichum, Silene microphylla, S. schugnanica, Piptatherum vicarium.*
Constant species: *Hippolytia darvasica, Inula schmalhausenii, Silene microphylla, S. schugnanica, Piptatherum vicarium.*
Geographical range: It is distributed mainly in the southern, open to the south valleys of the Pamir, mainly in the southern parts of the Vanch, Rushan, Yazgulem, Ishkashim, Vakhan, and Schugnan ranges. However, it also occurs in the warmest areas of the southern

Fig. 333. The community of *Androsace villosa* var. *dasyphylla* in rock clefts near Murgab, Eastern Pamir, Tajikistan (ca. 4,450 m a.s.l.). Photo: A. Nowak.

Fig. 334. Chasmophytic vegetation representing the *Hippolytion darvasicae* alliance, inhabiting calcareous rock ledge near Khorogh, Shugnan Mts, Tajikistan (ca. 2,550 m a.s.l.). Photo: A. Nowak.

slopes of Darvaz and possibly the Peter the First Mts. Communities of *Hippolytion darvasicae* inhabit mainly montane and alpine elevations between (1,400–)1,700 and 2,800(–3,700) m a.s.l. (Nowak et al. 2022d).

Habitat characteristics: This type of chasmophytic vegetation is a vicariant one of the western Pamir-Alai phytocoenoses of *Asperulo albiforae-Poion relaxae*. It occurs in the sub-humid zone in the deep valleys of the western Pamir and the eastern Pamir-Alai mainly in the montane to alpine belts.

Fig. 335. *Silene kuhistanica* on calcareous rock near Nofin, Fann Mts, Tajikistan (ca. 1,850 m a.s.l.). Photo: A. Nowak.

ASO-AD01. *Silenetum kuhistanicae* Nowak, S. Nowak, Nobis et A. Nobis 2014 (chasmophytic vegetation on conglomerates and limestone rocks in montane and subalpine belts of the Pamir-Alai Mts) (Fig. 335)

Diagnostic species: *Alyssum campestre*, *Eremurus comosus*, *Melica jacquemontii*, *Polygonum polycnemoides*, *Silene kuhistanica*, *Thalictrum isopyroides*.

Constant species: *Campanula incanescens, Carex koshewnikowii, Grimmia pulvinata, Orthotrichum crenulatum, Pseudosedum condensatum, Silene kuhistanica, Syntrichia ruralis, Thymus zeravshanicus.*

Geographical range: This chasmophytic community was first reported from the core area of occurrence in western Pamir-Alai. Phytocoenoses of the association have been found in the valleys of the Seven Lake, Kshtut, Voru and Yagnob rivers (Nowak et al. 2014c). In the eastern Pamir-Alai, *Silene kuhistanica* occurs sporadically scattered in the Darvaz and Peter the First ranges in the alpine belt.

Habitat characteristics: This chasmophytic vegetation develops at relatively low elevations, within an elevational range between 1,620 and 2,320 m a.s.l. Plots with *Silene kuhistanica* have been found on different alkaline (pH 7.6–8.5) rock substrates, such as limestone, marly limestone, dolomitic limestone or dolomite. The community develops on small rock ledges, medium-sized crevices and cleaves, often with soil deposits. The association prefers not very steep slopes with an inclination of 40–75°, generally with north-east and north-west exposures (Nowak et al. 2014a; Nowak et al. 2022d).

ASO-AD02. *Scutellarietum schugnanicae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (chasmophytic vegetation of upper montane to alpine belts in Schugnan, Vanch and Rushan ranges, eastern Pamir-Alai Mts) (Fig. 336)

Diagnostic species: *Carex koshewnikowii, Potentilla evestita, Scutellaria schugnanica.*
Constant species: *Carex koshewnikowii, Scutellaria schugnanica.*
Geographical range: This association is one of the most widespread along the Panj River Valley, particularly in the western Pamir ranges (Schugnan, Vanch and Rushan Mts; Kochkareva 1986). The main diagnostic species is endemic with a narrow range restricted to southern Tajikistan. The elevational amplitude of the association is quite wide, ranging from colline elevations (ca. 1,300 m a.s.l.) to the high alpine belt (ca. 3,600 m a.s.l.). *Scutellarietum schugnanicae* was found in the lowest alpine and montane elevations with the mean of approx. 1,950 m a.s.l. (Nowak et al. 2022c).
Habitat characteristics: This association prefers crevices and clefts on different rock substrates, mainly granite, schist, dolomite, or conglomerate rocks (see Nowak et al. 2014c). The community develops on steep rock faces with mean inclination of approx. 85° on southern or southwestern exposures (Nowak et al. 2022c). It prefers crevices of different size with insignificant soil amount (Nowak et al. 2014c).

ASO-AD03. *Acantholimetum alexeenkoani* Nowak, Świerszcz, S. Nowak, Plášek, Nobis, Klichowska et M. Nobis 2022 nom. corr. (chasmophytic vegetation of limestone clefts and ledges in montane to subalpine belts of the Shakhdara, Wakhan and Ishkashim ranges, southern Pamir Mts) (Fig. 337)

Fig. 336. *Scutellarietum schugnanicae* on limestone rock near Pasthuf, Shugnon District, Western Pamir, Tajikistan (ca. 2,150 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Acantholimon alexeenkoanum, Astragalus longistipitatus, Hippolytia darvasica, Minuartia litwinowii, Piptatherum alpestre, Rosa huntica, Rosularia glabra, Tanacetopsis mucronata.*
Constant species: *Acantholimon alexeenkoanum, Hippolytia darvasica.*
Geographical range: This association is found within the range of the name giving species *Acantholimon alexeenkoanum,* which is endemic to Pamirs. It is distributed in the relatively dry valleys of Shakhdara, Wakhan, and Ishkashim ranges. It has been found at an elevations ranging from ca. 2,000 to 2,750 m a.s.l. (Nowak et al. 2022d).
Habitat characteristics: Its patches develop on limestone clefts and ledges, preferring slopes with different inclinations ranging from 55% to 90%, and occasionally also under overhanging galleries. The phytocoenoses recorded were usually exposed to the west (Nowak et al. 2022d).

ASO-AD04. *Inuletum schmalhausenii* Nowak, Świerszcz, S. Nowak, Plášek, Nobis, Klichowska et M. Nobis 2022 (chasmophytic vegetation on solid granite faces, often overhanging, in the alpine belt of Rushan, Yazgulem, Gunt, Shakhdara, and Bartang Valleys in the Pamir Mts) (Fig. 338)

Diagnostic species: *Hippolytia darvasica, Inula schischkinii, Inula schmalhausenii, Silene microphylla.*
Constant species: *Hippolytia darvasica, Silene microphylla.*
Geographical range: This vegetation inhabits the alpine belt at an elevation of ca. 2,000–2,900 m. a.s.l.
Habitat characteristics: *Inuletum schmalhausenii* is a very heterogeneous association that

Fig. 337. *Acantholimetum alexeenkoani* on rocky limestone clefts near Pish, Ishkashim Range, Western Pamir, Tajikistan (ca. 2,250 m a.s.l.). Photo: A. Nowak.

inhabits different rocky substrates, but prefers granite ledges and clefts. The phytocoenoses develop on slopes with very different inclinations (ranging from 45° to 110°), with a mean of approx. 80°. *Inuletum schmalhausenii* inhabits slopes with different exposures, with some preference to the northwest and west (Nowak et al. 2022d).

ASO-ADc01. Community of *Rosularia alpestris* (chasmophytic vegetation on boulders and rock ledges in the alpine belt of the Pamir Mts)

Diagnostic species: *Clypeola jonthlaspi, Rosularia alpestris, Silene brahuica, Stellaria alsinoides, Ziziphora bungeana.*
Constant species: *Rosularia alpestris.*
Geographical range: *Rosularia alpestris* is a rare plant species in Middle Asia, scattered from western Pamir-Alai to eastern Tian Shan. Plots of this vegetation were found in a few locations in the western part of the Alai Mts. They inhabit limestone rock ledges at an elevation of about 2,100 m a.s.l. (Nowak et al. 2022d).
Habitat characteristics: This vegetation inhabits gently sloping rock ledges or large boulders, relatively flat (inclination up to 10°–20°) with predominantly northern exposures (Nowak et al. 2022d).

ASO-AD-c02. Community of *Silene schugnanica* (chasmophytic vegetation in montane to subalpine belts in the eastern Pamir-Alai (mainly Shugnan and Darvaz Mts)

Diagnostic species: *Campanula incanescens, Cheilanthes persica, Corydalis gortschakovii, Kudrjaschevia allotricha, Parietaria judaica, Silene schugnanica.*
Constant species: *Silene schugnanica.*

Fig. 338. Vegetation of *Inuletum schmalhausenii* inhabiting limestone ledges near Vodge, Western Pamir, Tajikistan (ca. 2,400 m a.s.l.). Photo: A. Nowak.

Chasamophytic habitats on rocky walls in Darvaz Mts near Tavildara in Obikhingou River Valley (ca. 1,950 m a.s.l.). Photo: A. Nowak.

Geographical range: *Silene schugnanica* occupies the southern slopes of the Darvaz Mts, Peter the First and Western Pamir ranges. Several plots of this vegetation were found near Qualaikhum on the southern, steep (80° inclination) slopes of the Darvaz Mts (Nowak et al. 2022d)
Habitat characteristics: *Silene schugnanica* is endemic to Tajikistan, inhabiting the lower parts of the limestone walls, screes, and sometimes also ruderal sites along roads.

ASO-ADc03. Community of *Cephalopodum badachshanicum* (chasmophytic vegetation of large crevices and ledges of the montane and alpine belts of the Western Pamir Mts) (Fig. 339)

Diagnostic species: *Cephalopodum badachshanicum*.
Constant species: *Cephalopodum badachshanicum*.

Geographical range: This rock ledges vegetation was found in the montane and lower alpine belts, mainly of the Western Pamir. It has been recorded in Darvaz, Yazgulem and Vanch Mts between 1,600 and 2,200 m a.s.l. (Nowak et al. 2022c).
Habitat characteristics: Stands of this community inhabit large ledges and clefts in the south-facing rocks with the mean inclination of approx. 75°.

ASO-B. *Potentilletalia caulescentis* Br.-Bl. in Br.-Bl. et Jenny 1926

This vegetation inhabits calcareous habitats on limestone cliffs or outcrops of other rocks. It can also be found on walls containing calcium in the mortar. Typical species are the calcicole ferns *Asplenium ruta-muraria* and *Gymnocarpium robertianum* and those with a broader tolerance to calcium content, such as *Cystopteris fragilis*.

Fig. 339. Community of *Cephalopodum badachshanicum* on limestone rock walls near Rushan, Western Pamir, Tajikistan (ca. 2,750 m a.s.l.). Photo: A. Nowak.

ASO-BA. *Cystopteridion fragilis* Richard 1972 (chasmophytic vegetation of shaded rocks and screes in Eurasia)

ASO-BA01. *Asplenio-Cystopteridetum fragilis* Oberdorfer 1938 (chasmophytic vegetation of shaded rocks and screes in the Pamir-Alai and Tian Shan Mts) (Fig. 340-341)

Diagnostic species: *Cystopteris fragilis, Asplenium viride.*
Constant species: *Campanula incanescens, Poa relaxa.*
Geographical range: The plant association formed by *Cystopteris fragilis* was found at many sites in the Hissar, Zeravshan, Turkestan, Karateginian, Rushan, Darvaz, Shugnan and Vanch Mts (Nowak et al. 2015c).
Habitat characteristics: This phytocoenosis has been found on different rock substrates, mainly on limestone, marble and schist, but also on dolomite and conglomerate rocks (pH 6.8–7.7). The association is most common in crevices of different sizes and with different organic matter content. The phytocoenosis develops on steep rock faces with mean inclination of approx. 85°, within a wide elevational range in the colline, montane and alpine belts at 1,300–3,200 m a.s.l. Occasionally the community was found on gently sloping rock taluses. *Asplenio-Cystopteridetum fragilis* is associated with northwestern and northern exposures with moderate solar radiation (Nowak et al. 2015c).

ASO-BA02. *Asplenietum trichomano-rutae-murariae* Tüxen 1937 (chasmophytic vegetation of shaded, limestone rocks in Eurasia, including Pamir-Alai and Tian Shan Mts)
(Fig. 342)

Fig. 340. *Asplenium viride* – a species characteristic for chasmophytic vegetation of shaded rocks and screes observed near Iskander-kul, Tajikistan (ca. 2,000 m a.s.l.). Photo: A. Nowak.

Fig. 341. *Gymnocarpium robertianum* – a species characteristic for chasmophytic vegetation of shaded rocks and screes observed near Margeb in the Yagnob River gorge, Tajikistan (ca. 2,200 m a.s.l.). Photo: A. Nowak.

Fig. 342. *Asplenietum trichomano-rutae-murariae* in limestone crevices near Narvad, Pastrud-darya River Valley, Tajikistan (ca. 2,200 m a.s.l.). Photo: A. Nowak.

Fig. 343. Community of *Asplenium septentrionale* in limestone crevices near Toktogul, Kyrgyzstan (ca. 1,830 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Asplenium ruta-muraria, Asplenium trichomanes.*
Constant species: *Asplenium ruta-muraria, Asplenium trichomanes, Encalypta vulgaris Tortula muralis.*
Geographical range: In the Pamir-Alai Mts, the association is mainly formed by *Asplenium ruta-muraria*. Patches with dominance of this species have been recorded mainly in the Zeravshan, Hissar, Darvaz and Rushan ranges. *Asplenietum trichomano-rutae-murariae* develops at relatively high elevations in the montane and alpine belts with cold microclimate; between 1,450 and 2,600 m a.s.l. (Nowak et al. 2015c).
Habitat characteristics: This phytocoenosis has been found in most cases on limestone and dolomite, rarely on schist or conglomerate rocks (pH 6.8–7.8). In the valley of Pastrud-darya River, the community has also been recorded on the northern side of solitary boulders. The association mostly occurs on rather solid rocks, with different inclinations, ranging from 50° up to overhanging rocks (140°), occasionally occurring on friable substrates (Nowak et al. 2015c).

ASO-BAc01. Community of *Asplenium septentrionale* (vegetation on acidic rocks in shaded habitats of the alpine belt of Middle and Central Asia) (Fig. 343)

Diagnostic species: *Asplenium septentrionale.*
Constant species: *Asplenium septentrionale.*
Geographical range: This species-poor vegetation is widespread in the alpine belt of the northern Pamir-Alai, Tian Shan, Hindu Kush and western Himalayas. It has been recorded at an elevation range between 1,950 and 2,900 m a.s.l.
Habitat characteristics: This vegetation inhabits crevices and fissures in walls of different lithologies, however mainly acidic. It grows mainly in the shade of rocks or under the canopy of the forest.

High altitude subnival rupicolous and snow-bed vegetation

DRA. *Didymophyso aucheri-Dracocephaletea aucheri* Noroozi, Hülber et Willner 2017

This vegetation was established for the Iranian subnival vegetation. In the eastern part of the Irano-Turanian Region, it includes the subnival rupicolous and snow-bed vegetation. It is mainly distributed in the Central Asian Mts. The communities of this order form sparse and short grasslands or cushions, composed mainly of *Nepeta* spp., *Oxytropis* spp., *Paraquilegia* spp., *Sibbaldia* spp., *Festuca* spp., *Poa* spp., and *Richteria* spp. This vegetation inhabits rupicolous, often eroded and gravelly habitats in the extremely harsh environments of Middle and Central Asia alpine semi-deserts and cryophilous grasslands (Nowak S. et al. 2024).

DRA-A. *Drabo pamiricae-Androsacetalia akbaitalensis* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (subnival and alpine vegetation of screes and snow-beds of Middle Asia)

Diagnostic species: *Bryum intermedium, Distichium capillaceum, Draba pamirica, Nepeta pamirensis, Paraquilegia anemonoides, Potentilla multifida, Richteria pyrethroides, Schistidium apocarpum, Sibbaldia tetrandra.*
Constant species: *Poa litvinoviana, Festuca alatavica, Richteria pyrethroides, Bryum intermedium, Schistidium apocarpum.*
Geographical range: Alpine and subnival belts of the northern and eastern ranges of the Pamir-Alai and and Tian Shan (mainly Kyrgyzstan, northern Tajikistan, Kazakhstan, Xinjiang in China) (Nowak S. et al. 2024).
Habitat characteristics: This vegetation occurs in mesic high alpine and subnival habitats in mountain ranges, mainly Tian Shan, northern and eastern Pamir-Alai and the Altai Mts. These communities develop at an elevation of approx. 2,600–4,700 m a.s.l. on slopes with an inclination of 2–95°, within the zone of mean annual temperature below zero and precipitation from 180 to 1,200 mm/year (Nowak S. et al. 2024).

DRA-AA. *Oxytropido savellanicae-Nepetion pamiricae* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (high-elevation grasslands in relatively dry habitats with often patchy structure in the eastern Pamir and western Tian Shan Mts) (Fig. 344)

Diagnostic species: *Bryum intermedium, Distichium capillaceum, Nepeta pamirensis, Paraquilegia anemonoides, Richteria pyrethroides, Schistidium apocarpum.*
Constant species: *Bryum intermedium, Distichium capillaceum, Nepeta pamirensis, Paraquilegia anemonoides, Richteria pyrethroides, Schistidium apocarpum.*
Geographical range: Phytocoenoses of this alliance occur over a wide elevational range, occupying sites from 2,600 to 4,700 m a.s.l. in the northern Pamir-Alai and Tian Shan.
Habitat characteristics: This alliance includes grasslands in relatively dry areas, often with patchy vegetation. It is a transitional vegetation between dense alpine swards and mats (in places with higher rainfall) and cushion-tragacanthic vegetation, which mostly occupies drained slopes and eroded passes. Patches of these communities are very often adjacent to screes, rocky communities, or badlands, which means that they often occupy rupicolous habitats with poorly developed soil profiles. The vegetation of this alliance is characterised by fairly low species richness of vascular plants compared with the communities of the other two alliances. The patches of the *Oxytropido savellanicae-Nepetion pamiricae* phytocoenoses are rather sparse and have a quite low cover of the herb layer (Nowak S. et al. 2024).

DRA-AA01. *Violo acutifoliae-Potentilletum biflorae* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (rupicolous vegetation of gravelly damp screes, glacier moraines and rocks in the alpine to subnival belts of the eastern Pamir-Alai and the northern and central Tian Shan Mts) (Fig. 345)

Diagnostic species: *Aulacospermum tenuisectum, Bryum intermedium, Paraquilegia anemonoides,*

Fig. 344. Seasonally dry alpine grassland representing *Oxytropido savellanicae-Nepetion pamiricae* developed in the highlands of the Eastern Pamir, Tajikistan (ca. 3,700 m a.s.l.). Photo: A. Nowak.

Fig. 345. Chasmophytic vegetation of the *Violo acutifoliae-Potentilletum biflorae* association, inhabiting rock ledges near the Karakyr Pass, Terskey Ala-Too Range, Kyrgyzstan (ca. 3,550 m a.s.l.). Photo: A. Nowak.

Potentilla biflora, Tortella tortuosa, Viola acutifolia.
Constant species: *Bryum intermedium, Paraquilegia anemonoides, Potentilla biflora, Tortella tortuosa.*
Geographical range: *Violo acutifoliae-Potentilletum biflorae* is a subnival rupicolous vegetation found in northeastern Kyrgyzstan in the Ak-Suu and Jeti-Ögüz districts of the Issyk-kul region on the slopes of the Terskey Ala-Too and Kakshaal Too ranges, at elevations between 3,000 and 3,750 m a.s.l. (Nowak S. et al. 2024).
Habitat characteristics: The association develops on slopes with varying exposures, but mostly with a north-western aspect. The inclination of the slopes ranges from 12° up to 90° (mean 75°) (Nowak S. et al. 2024).

DRA-AA02. *Carici stenocarpae-Androsacetum akbaitalensis* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (subnival rupicolous vegetation of rocky and gravelly slopes of the Pamirs Mts) (Fig. 346)

Diagnostic species: *Androsace akbaitalensis, Carex stenocarpa, Eritrichium pamiricum.*
Constant species: *Poa litvinoviana, Richteria pyrethroides.*
Geographical range: *Carici stenocarpae-Androsacetum akbaitalensis* is a subnival rupicolous vegetation recorded in the Pamirs of eastern Tajikistan (Gorno-Badakhshan) (Nowak S. et al. 2024).
Habitat characteristics: This association develops on steep slopes with an inclination of 45° to 80° (mean 64°), most often with a north-western and northern exposure, at alpine elevations ranging from 4,100 to 4,350 m a.s.l. (Nowak S. et al. 2024).

DRA-AA03. *Dracocephaletum imberbe* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (subnival to alpine rupicolous vegetation on gravelly slopes and screes or rock ledges of the central Tian Shan Mts) (Fig. 347)

Diagnostic species: *Bryum intermedium, Allium atrosanguineum, Distichium capillaceum, Draba*

Fig. 346. Vegetation of the *Carici stenocarpae-Androsacetum akbaitalensis* association inhabiting rock walls near Ak-baital Pass, Eastern Pamir, Tajikistan (ca. 4,700 m a.s.l.). Photo: A. Nowak.

parviflora, Dracocephalum imberbe, Kobresia persica, Schistidium apocarpum.
Constant species: *Poa litvinoviana.*
Geographical range: *Dracocephaletum imberbe* is a subnival rupicolous vegetation, growing in northern Kyrgyzstan, in the Chüy and Issyk-kul regions and in north-central Kyrgyzstan in the Kochkor district. The association develops in the western Tian-Shan at high elevation ranging from 2,750 to 3,700 m a.s.l. (Nowak S. et al. 2024).
Habitat characteristics: This association occurs most often on the southwestern, southern and southeastern slopes with an inclination of about 15°–85° (Nowak S. et al. 2024).

DRA-AA04. *Dracocephaletum nodulosi-Rosularietum borissovae* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (alpine rupicolous vegetation of gravelly slopes, rock ledges and moraines in the central and western Tian Shan Mts) (Fig. 348)

Diagnostic species: *Allium talassicum, Androsace aflatunensis, Bupleurum aitchisonii, Dracocephalum nodulosum, Ferula transiliensis, Grimmia tergestina, Hylotelephium ewersii, Oxytropis trichosphaera, Potentilla asiae-mediae, Pyrethrum kovalevskiae, Rosularia borissovae, R. vvedenskyi, Schistidium apocarpum, Stipa caucasica, Syntrichia ruralis.*
Constant species: *Poa litvinoviana, Dracocephalum nodulosum, Pyrethrum kovalevskiae, Rosularia borissovae.*
Geographical range: The *Dracocephaletum nodulosi-Rosularietum borissovae* association is a typical alpine rupicolous vegetation. Plots of this phytocoenosis have been noted in the Kochkor district of the Naryn region (north-central Kyrgyzstan) (Nowak S. et al. 2024).
Habitat characteristics: They occupy step slopes with an inclination of 55° to 90°, mostly with a south-west facing, at an elevation of 2,650 to 3,050 m a.s.l. (Nowak S. et al. 2024).

Fig. 347. Rupicolous vegetation of the *Dracocephaletum imberbe* association inhabiting screes near Karakyr Pass, Terskey Ala-Too Range, Kyrgyzstan (ca. 3,250 m a.s.l.). Photo: A. Nowak.

DRA-AA05. *Nepetetum longibracteatae* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (subnival vegetation of rupicolous habitats of Central Asia and Himalaya) (Fig. 349)

Diagnostic species: *Didymophysa fedtschenkoana, Elymus czimganicus, Erigeron pamiricus, Nepeta longibracteata, Parrya stenocarpa.*
Constant species: *Richteria pyrethroides.*
Geographical range: *Nepetetum longibracteatae* is a typical subnival rupicolous vegetation. It has been recorded in the Gorno-Badakhshan region, near the Verkhniy Muzhkul Nature Reserve, at the highest elevation of 4,300–4,750 m a.s.l. (Nowak S. et al. 2024).
Habitat characteristics: Plots of this association were found mainly on the south-western and southern slopes with varying inclinations from 45° to 80°. Despite the subnival altitude, this area is characterised by low annual precipitation (Nowak S. et al. 2024).

DRA-AA06. *Nepeto pamirensis-Rhodioletum recticaulis* Nowak, Świerszcz, Nobis, Swacha et A. Nowak 2024 (alpine and subnival patchy swards of the Pamir and central Tian Shan Mts) (Fig. 350)

Diagnostic species: *Grimmia funalis, Hymenolaena nana, Nepeta pamirensis, Rhodiola recticaulis.*
Constant species: *Poa litvinoviana.*
Geographical range: Patches of *Nepeto pamirensis-Rhodioletum recticaulis* have been recorded in the Pamir Mts in the Shughnon district (central-western part of Gorno-Badakhshan) in eastern Tajikistan and in the Kyrgyz Ala-Too range in the North Tian-Shan (Chüy region). The association forms alpine and subnival patchy swards at elevations of 3,100–4,350 m a.s.l. (Nowak S. et al. 2024).

Fig. 348. Gravelly slope covered with vegetation of *Dracocephaletum nodulosi-Rosularietum borissovae* found near Sarybulak, Terskey Ala-Too Range, Kyrgyzstan (ca. 3,200 m a.s.l.). Photo: A. Nowak.

Fig. 349. Vegetation of *Nepetetum longibracteatae* inhabiting rupicolous subnival habitats near Ak-Baital Pass, Eastern Pamir, Tajikistan (ca. 4,650 m a.s.l.). Photo: A. Nowak.

Fig. 350. Rupicolous sward of *Nepeto pamirensis-Rhodioletum recticaulis* found near Alichur, Eastern Pamir, Tajikistan (ca. 3,550 m a.s.l.). Photo: A. Nowak.

Fig. 351. Stand of *Ajania trilobata* – a species diagnostic for subnival rupicolous vegetation found near Markansu, Eastern Pamir, Tajikistan (ca. 4,200 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: This association inhabits slopes with an average inclination of approx. 45°, ranging from 3° to 95°, mostly with a north-western and western exposure (Nowak S. et al. 2024).

DRA-AAc01. Community of *Leiospora bellidifolia-Ajania trilobata* (subnival rupicolous vegetation of the central Tian Shan Mts) (Fig. 351)

Diagnostic species: *Ajania trilobata, Alopecurus apiatus, Leiospora bellidifolia, Oxytropis coelestis, Ranunculus alberti.*
Constant species: *Festuca alaica.*
Geographical range: The community has a subnival rupicolous vegetation character and has been recorded in the western Tian Shan at an elevation of approx. 3,650 m a.s.l. in the Jeti-Ögüz district of the Issyk-kul region in north-eastern Kyrgyzstan (Nowak S. et al. 2024).

Habitat characteristics: Rupicolous, scree habitats in high alpine and subnival belts with low rainfall and arid, harsh, continental climate (Nowak S. et al. 2024).

DRA-AAc02. Community of *Oxyria digyna* (alpine to subnival rupicolous vegetation of damp habitats in the western Tian Shan Mts) (Fig. 352)

Diagnostic species: *Allium tianschanicum, Oxyria digyna, Saxifraga hirculus.*
Constant species: *Allium tianschanicum, Oxyria digyna.*
Geographical range: The *Oxyria digyna* community is an alpine and subnival rupicolous vegetation recorded in the western Tian Shan Mts in the Jeti-Ögüz district of the Issyk-kul region (north-eastern Kyrgyzstan), in the Kochkor district of the Naryn region (north-central Kyrgyzstan) and in the Pamirs in the Gorno-Badakhshan region (eastern Tajikistan) at elevations

Fig. 352. Community of *Oxyria digyna* on landslide near Anzob Pass, Hissar Mts, Tajikistan (ca. 3,050 m a.s.l.). Photo: A. Nowak.

ranging from 3,050 to 4,050 m a.s.l. (Nowak S. et al. 2024).

Habitat characteristics: The community was mainly noted on the northeastern and northwestern slopes at varied inclination from 5° to 85° (Nowak S. et al. 2024).

DRA-AAc03. Community of *Dracocephalum oblongifolium* (alpine to subnival rupicolous vegetation of the Pamir-Alai, Tian Shan and Altai Mts) (Fig. 353)

Diagnostic species: *Dracocephalum oblongifolium.*

Constant species: *Dracocephalum oblongifolium.*

Fig. 353. Community of *Dracocephalum oblongifolium* on screes near Politehnik Peak, Fann Mts, Tajikistan (ca. 3,250 m a.s.l.). Photo: A. Nowak.

Fig. 354. Scree vegetation dominated by *Dracocephalum stamineum* found south of Murgab, Eastern Pamir, Tajikistan (ca. 3,600 m a.s.l.). Photo: M. Nobis.

Geographical range: This community inhabits alpine and subnival screes or rock ledges in Pamir-Alai and western Tian Shan Mts at elevations ranging from 2,200 to 4,100 m a.s.l. (Kochkareva 1986).
Habitat characteristics: The community was reported from various chasmophytic habitats, including typical screes (Kochkareva 1986).

DRA-AAc04. Community of *Dracocephalum stamineum* (alpine grasslands on screes and gravelly aprons of the central Tian Shan and the Pamir Mts) (Fig. 354)

Diagnostic species: *Dracocephalum stamineum.*
Constant species: *Dracocephalum stamineum.*
Geographical range: This community inhabits alpine and subnival screes, river bars and moraines in the Pamir-Alai, Tian Shan, Hindu Kush, Karakoram and Himalayas at elevations ranging from 2,800 to 4,600 m a.s.l. (Kochkareva 1986).
Habitat characteristics: The community was reported from various chasmophytic habitats, including typical screes and river bars (Kochkareva 1986).

DRA-AAc05. Community of *Oxytropis tianschanica* (alpine to subnival swards of the northern Pamir-Alai and Tian Shan Mts)

Diagnostic species: *Oxytropis tianschanica.*
Constant species: *Oxytropis tianschanica.*
Geographical range: This community inhabits alpine and subnival chasmophytic habitats and dry, deserted high elevation steppes in the Pamir-Alai and central Tian Shan, at elevations ranging from 3,500 to 5,000 m a.s.l. (Ovchinnikov 1978).
Habitat characteristics: The community was reported from various chasmophytic habitats,

including typical screes, river bars and deserted steppes (Ovchinnikov 1978).

DRA-AAc06. Community of *Richteria leontopodium* (alpine to subnival rupicolous vegetation of rock ledges and moraine in the central Tian Shan Mts) (Fig. 355)

Diagnostic species: *Richteria leontopodium.*
Constant species: *Richteria leontopodium.*
Geographical range: This community inhabits alpine and subnival rocky habitats of central Tian Shan at elevations ranging from 3,500 to 5,200 m a.s.l. (Adylov, Zuckerwanik 1993).
Habitat characteristics: The community was reported from various chasmophytic habitats, including typical screes river bars and moraines (Adylov, Zuckerwanik 1993).

DRA-AAc07. Community of *Calamagrostis anthoxanthoides* (subalpine to alpine rupicolous vegetation of screes, river bars and moraines in the eastern Pamir-Alai Mts)

Diagnostic species: *Calamagrostis anthoxanthoides.*
Constant species: *Calamagrostis anthoxanthoides.*
Geographical range: This community inhabits subalpine and alpine chasmophytic habitats and dry, deserted cryophilous steppes in the Eastern Pamir-Alai, at elevations ranging from 2,000 to 3,400 m a.s.l. (Ovchinnikov 1957).

Fig. 355. Community with *Richteria leontopodium* inhabiting rock ledges near the Chon-Ashu Pass, Tian Shan, Kyrgyzstan (ca. 3,750 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: The community was reported from chasmophytic, high altitude habitats, including typical screes, escarpments, deserted steppes and moraines (Ovchinnikov 1957).

Scree vegetation of montane and subalpine belts of Irano-Turanian Region

Scree vegetation of montane and subalpine belts of Irano-Turanian Region

PAC. *Trichodesmo incani-Pachypterygietea brevipes* Nowak, Świerszcz, S. Nowak, Nobis et M. Nobis 2024

Similarly to the chasmophytic vegetation of rock faces, the communities inhabiting screes of the Middle Asian Mts are characterised by a high degree of endemism. These habitats (gravel, pebbles, boulders) have different humus content of the parent material, elevation or slope inclination, which is also related to the rate of sliding. The mountainous relief of Middle Asia, the specificity of its phytogeography, species richness and high degree of endemism require the description of the scree vegetation of the montane and alpine belts of the Irano-Turanian Region as a separate vegetation class.

PAC-A. *Sileno brahuicae-Lactucetalia orientalis* Nowak, Świerszcz, S. Nowak et Nobis 2021 (scree vegetation of alpine and subalpine belts of western Middle Asia)

This order was established for vegetation developed on unstable sediments of taluses and screes dominated by species with an Irano-Turanian distribution range. This biogeographical distinctiveness is in our opinion the crucial argument for establishing the order for scree vegetation with the main compositional element related to western Tajikistan, southern Uzbekistan, Turkmenistan, Iran and other countries of the Irano-Turanian Region. The clear differences in climate (see Djamali et al. 2012), especially the continentality and precipitation influence not only the species composition, but also the weathering patterns and erosion, which are important factors in creating habitats for scree vegetation. The relief of the mountains of the Middle Asian subregion, with low precipitation, low snow cover and high temperature amplitude, controls the habitat profile and its availability for chasmophytic plants (Nowak et al. 2021c).

Diagnostic species: *Callipeltis cucullaris, Eremopoa persica, Lactuca orientalis* (= *Scariola orientalis*), *Pachypterygium brevipes, Papaver pavoninum, Polygonum polycnemoides, Scutellaria intermedia, Silene brahuica, Trichodesma incanum.*
Constant species: *Callipeltis cucullaris, Eremopoa persica, Lactuca orientalis* (= *Scariola orientalis*), *Pachypterygium brevipes, Papaver pavoninum, Polygonum polycnemoides, Scutellaria intermedia, Silene brahuica, Trichodesma incanum.*
Geographical range: The communities were found from colline to alpine belts between 800 and 4,300 m a.s.l. (mean 2,400) in different exposures and slopes (Nowak et al. 2021c).
Habitat characteristics: This phytocoenoses inhabit various types of geological substrates, such as limestone, dolomite, marble, granite, syenite, schist or gneiss, and show a weak affinity to a particular bedrock type. The main diagnostic species have been observed on alkaline, neutral and, rarely, on acidic substrates. They grow on various forms of down-sloping rock debris or colluvial deposits or on solid rocky screes. The scree substrate material can vary considerably from large rock blocks up to 150 cm in diameter, cobbles (25–35 cm in diameter), pebbles (10–25 cm), coarse and fine gravel (1–10 cm) (Nowak et al. 2021c).

PAC-AA. *Ferulo foetidissimae-Vicion kokanicae* Nowak, S. Nowak, Nobis et A. Nobis 2015 (scree vegetation of the alpine belt of the Pamir-Alai and western Tian Shan Mts) (Fig. 356)

Diagnostic species: *Allium polyphyllum, Atraphaxis pyrifolia*, *Euphorbia polytimetica, E. cyrtophylla, Ferula foetidissima*, *Melica inaequiglumis, Prunus verrucosa* (= *Cerasus verrucosa*), *Vicia kokanica*.
Constant species: *Atraphaxis pyrifolia*, *Eremopoa persica*, *Ferula foetidissima*, *Prunus verrucosa* (= *Cerasus verrucosa*), *Vicia kokanica*.
Geographical range: This chasmophytic vegetation has been recorded on the taluses and screes of the western Pamir-Alai ranges: the Zeravshan, Hissar, Fann, Hazratishokh, Darvaz, Vanch, Turkestan, Peter the First and Karateginian. Consi-

Fig. 356. Scree vegetation with *Vicia kokanica* found near Nofin, Fann Mts, Tajikistan (ca. 1,700 m a.s.l.). Photo: A. Nowak.

dering the distribution of the main diagnostic species, this type of vegetation can inhabit mountains with alpine relief throughout Middle Asia. The stands were mainly found in the subalpine and alpine belts. Exceptionally, a few stands were found below 1,750 m a.s.l. (Nowak et al. 2015a; Nowak et al. 2021c).

Habitat characteristics: The phytocoenoses of the *Ferulo foetidissimae-Vicion kokanicae* inhabit moderately sloping and compact gravel screes, sometimes also flat gravel terraces. Rarely, they also inhabit small-sized loose screes with small or medium sized screes of different parent materials (Nowak et al. 2021c).

PAC-AA01. *Anaphallidetum zeravschanicae* Nowak, S. Nowak, Nobis et A. Nobis 2015 (fine scree vegetation of alpine belt of the western Pamir-Alai Mts) (Fig. 357)

Diagnostic species: *Anaphalis zeravschanica.*

Constant species: *Artemisia persica, Euphorbia cyrtophylla, Hordeum turkestanicum, Semenovia furcata, Ziziphora pamiroalaica.*

Geographical range: The diagnostic species is known only from Middle Asia and inhabits an elevation of 2,850–3,700 m a.s.l. in the western Pamir-Alai and northern Hindu Kush Mts (Kinzikaeva 1988). The association has been found in several sites in the Zeravshan range. It occupies relatively high elevations, from 2,850 to 3,450 m a.s.l. (Nowak et al. 2015a).

Habitat characteristics: Plots of *Anaphalis zeravschanica* have been found on alkaline (pH 8.0–8.8), fine-grained (1–3 cm in diameter) scree of different rocky substrates, mainly limestone, marly limestone and dolomite. The association prefers gently sloping screes, that are relatively well stabilised with 5°–20° inclination and generally

Fig. 357. Scree vegetation of *Anaphallidetum zeravschanicae* found near Alaudin Lake, Fann Mts, Tajikistan (ca. 3,100 m a.s.l.). Photo: A. Nowak.

with a northern and western exposure (Nowak et al. 2015a).

PAC-AA02. *Angelicetum ternatae* Nowak, S. Nowak, Nobis et A. Nobis 2015 (scree vegetation on colluvial cones and slopes with coble or pebble material in the alpine belt of the Pamir-Alai Mts) (Fig. 358)

Diagnostic species: *Angelica ternata.*
Constant species: *Artemisia persica, Aulacospermum roseum, Calamagrostis laguroides, Cousinia outichaschensis, Euphorbia cyrtophylla, Galium spurium* subsp. *spurium, Poa relaxa.*
Geographical range: *Angelicetum ternatae* is supposed to be distributed in the alpine belt of the mountain ranges of the western Pamir-Alai in Tajikistan and the northern Hindu Kush in Afghanistan. However, this association has been recorded quite frequently along the entire range of the Zeravshan Mts. It occurs within the range of elevation from 2,400 to 3,150 m a.s.l., mostly in alpine zone (Nowak et al. 2015a).
Habitat characteristics: This association occurs on colluvial cones with cobble or pebble material approx. 6-30 cm in diameter. Plots of *Angelicetum ternatae* have been found on relatively gently sloping aprons or fans with a mean inclination of approx. 15°. The association prefers western and north-eastern exposures. The phytocoenoses were observed on dolomite, schist and shale debris (Nowak et al. 2015a).

PAC-AA03. *Feruletum foetidissimae* Nowak, S. Nowak, Nobis et A. Nobis 2015 (alpine vegetation on compacted rock debris in the Pamir-Alai Mts) (Fig. 359)

Diagnostic species: *Ferula foetidissima.*
Constant species: *Artemisia persica, Atraphaxis pyrifolia, Cerasus verrucosa, Eremostachys speciosa, Hypericum scabrum, Polygonum polycnemoides, Serratula sogdiana, Vicia kokanica.*

Fig. 358. Scree vegetation of *Angelicetum ternatae* on a slope in Matcha county (upper reaches of Zeravshan River Valley), Turkestan Mts, Tajikistan (ca. 2,550 m a.s.l.). Photo: A. Nowak.

Fig. 359. Vegetation of *Feruletum foetidissimae* in Pastrud-darya River Valley, Zeravshan Mts, Tajikistan (ca. 2,350 m a.s.l.). Phot: A. Nowak.

Geographical range: *Feruletum foetidissimae* is distributed across the western Pamir and western Tian Shan mountain ranges. In Tajikistan, this association has a potential range over the whole western part of the country. During the study, areas with the typical association were found in the Zeravshan and Yazgulem Mts. The association was recorded at relatively low elevations in the alpine zone, mainly between 2,000 and 2,400 m a.s.l. (Nowak et al. 2015a).
Habitat characteristics: *Ferula foetidissima* formed its own association occupying alkaline rock substrates (pH 7.9–8.6), mainly on limestone and dolomite. The phytocoenoses were found on steep slopes with gravel debris that creeps down on hard slopes covered with clay and silt deposits with some soil content. The community develops on moderately steep slopes with eastern and south-eastern exposures (Nowak et al. 2015a).

PAC-AA03a. *Feruletum foetidissimae mediasietosum macrophyllae* Nowak, S. Nowak, Nobis et A. Nobis 2015 (upper montane to alpine rupicolous vegetation with endemic *Mediasia macrophylla* in the western Pamir-Alai Mts) (Fig. 360)

Diagnostic species: *Mediasia macrophylla.*
Constant species: *Artemisia persica, Callipeltis cucullaris, Centaurea squarrosa, Cerasus verrucosa, Galium spurium* subsp. *spurium, Hypericum scabrum, Seseli lehmannianum, Silene brahuica.*
Geographical range: The phytocoenoses of this subassociation are sporadically found in the central part of the Zeravshan Mts, mainly in Iskanderdarya, Yagnob and Seven Lakes Valleys. One plot was also found in the montane zone in the Varzob Valley in Hissar Mts. The association is generally distributed in montane and alpine zo nes at moderate elevation ranging from 1,850 to 2,450 m a.s.l. with the exception of the plot located in Hissar Mts (Nowak et al. 2015a).
Habitat characteristics: It prefers coarse-grained, loose gravel scree, not so compact in comparison to the typical form of the association. The phyto-

Fig. 360. *Feruletum foetidissimae mediasietosum macrophyllae* on a scree near Anzob, Hissar Mts, Tajikistan (ca. 2,200 m a.s.l.). Photo: A. Nowak.

coenoses were observed on limestone and dolomite gravels with pH 8.2–8.5. Plots in the Hissar Mts were found on granite gravels with pH 7.4. The subassociation generally occurs on southeastern exposures with sloping rate of approx. 15°–65° (Nowak et al. 2015a).

PAC-AA03b. *Feruletum foetidissimae typicum* Nowak, S. Nowak, Nobis et A. Nobis 2015

Diagnostic species: *Ferula foetidissima.*
Constant species: *Artemisia persica, Atraphaxis pyrifolia, Cerasus verrucosa, Eremostachys speciosa, Hypericum scabrum, Polygonum polycnemoides, Serratula sogdiana, Vicia kokanica.*
Geographical range: The subassociation *typicum* includes plots from the Zeravshan Mts (Nowak et al. 2015a).
Habitat characteristics: *Feruletum foetidissimae typicum* occurs on relatively gentle slopes and compact, stabilised surfaces. The habitat characteristic, diagnostic species and floristic composition of this subassociation are the same as for the association (Nowak et al. 2015a).

PAC-AA04. *Feruletum koso-poljanskyi* Nowak, S. Nowak, Nobis et A. Nobis 2015 (loose scree vegetation with deep gravel deposits in upper montane and alpine belt of Pamir-Alai) (Fig. 361)

Diagnostic species: *Ferula koso-poljanskyi.*
Constant species: *Artemisia persica, Bromus tectorum, Centaurea squarrosa, Colutea paulsenii, Echinops chloroleucus, Glaucium elegans, Nepeta olgae, Piptatherum songaricum, Silene brahuica, Sisymbrium brassiciformae, Trichodesma incanum.*
Geographical range: *Ferula koso-poljanskyi* is a narrowly distributed scree species, generally known from the montane and alpine zones of the Pamir-Alai Mts in western Tajikistan. This species has also been recorded in the Hissar and Peter the First Mts (Chukavina 1984). During the present study, the phytocoenoses of *Fe-*

Fig. 361. Scree vegetation of *Feruletum koso-poljanskyi* inhabiting large scree near Utogar, Turkestan Mts, Tajikistan (ca. 1,850 m a.s.l.). Photo: A. Nowak.

ruletum koso-poljanskyi were found in the Zeravshan and Turkestan Mts. Plots of this vegetation were found at relatively low elevations, between 1,700 and 2,300 m a.s.l. (Nowak et al. 2015a).

Habitat characteristics: The phytocoenoses have been found almost exclusively on alkaline schist and rarely on limestone screes. The association prefers coarse- and fine-grained, deep gravel deposits, with a high rate of surface runoff. There are apparently no visible traces of soil or even clay particles on the scree surface. The habitat is arid. The community develops on steep screes and generally inhabits southern exposures (Nowak et al. 2015a).

PAC-AA05. *Hedysaretum flavescentis* Nowak, S. Nowak, Nobis et A. Nobis 2015 (screes and mesic steep slope vegetation in the alpine belts of western Pamir-Alai, mainly Hissar and Zeravshan Mts) (Fig. 362)

Diagnostic species: *Hedysarum flavescens.*

Constant species: *Artemisia persica, Geranium regelii, Glaucium fimbrilligerum, Lactuca orientalis, Pachypterygium brevipes, Piptatherum songaricum, Polygonum coriarium.*

Geographical range: *Hedysarum flavescens* is assigned as an exclusive element of the Pamir-Alai and western Tian Shan Mts. In Tajikistan, it is distributed throughout the Zeravshanian, Hissaro-Darvasian, Eastern and Southern Tajikistanian and Western Pamirian geobotanical regions. Several occurrences have also been reported from the Eastern Pamir (Ovchinnikov 1978). Sites of *Hedysaretum flavescentis* have been found in the alpine zone of the Zeravshan and Hissar ranges at elevation of 2,400–3,300 m a.s.l. (Nowak et al. 2015a).

Habitat characteristics: The phytocoenoses have been found on alkaline limestone or dolomite coarse gravel or pebbles (pH 7.6–8.8). The plots occupy screes in close proximity to the gravel beds

Fig. 362. Scree vegetation of *Hedysaretum flavescentis* inhabiting south-western slopes in Dzhidzhikrut Valley, Hissar Mts, Tajikistan (ca. 2,750 m a.s.l.). Photo: A. Nowak.

of alpine streams and to some extent resemble the vegetation of *Epilobion fleischeri* in Europe. The association develops on moderately steep slopes with generally northern exposures (Nowak et al. 2015a).

PAC-AA06. *Stellarietum turkestanicae* Nowak, S. Nowak, Nobis et A. Nobis 2015 (fine scree vegetation on deep gravel deposits of the alpine belt of the western Pamir-Alai Mts) (Fig. 363)

Diagnostic species: *Stellaria turkestanica.*
Constant species: *Arabis kokanica, Euphorbia cyrtophylla, E. polytimetica.*
Geographical range: The phytocoenoses of *Stellarietum turkestanicae* have been found in a few locations in the upper belts of the Zeravshan Mts in the central and eastern sections of the Zeravshanian geobotanical region. *Stellaria turkestanica* is a Middle Asiatic species distributed throughout the alpine belts of the Pamir-Alai and Tian Shan Mts (Ovchinnikov 1968). During the study several plots of phytocoenoses of *Stellaria turkestanica* were found in the upper alpine zone at an elevation 3,100–3,750 m a.s.l. (Nowak et al. 2015a).
Habitat characteristics: The association prefers crumbling, deep, fine-grained screes of limestone and dolomite particles (pH 8.0–8.8). Plots of this association were mainly found on south- and northeastern exposures with rather gentle inclinations (mean approx. 30°) (Nowak et al. 2015a).

PAC-AA07. *Tetrataenietum olgae* Nowak, S. Nowak, Nobis et A. Nobis 2015 (scree vegetation on coarse debris in the alpine belt of the western Pamir-Alai Mts) (Fig. 364)

Diagnostic species: *Tetrataenium olgae.*
Constant species: *Artemisia persica, Atraphaxis pyrifolia, Chondrilla maracandica, Hypericum*

Fig. 363. *Stellaria turkestanica* – a species characteristic of alpine mobile, fine grain scree, found near Mutnoe Lake, Fann Mts, Tajikistan (ca. 3,250 m a.s.l.). Photo: A. Nowak.

Fig. 364. Vegetation of *Tetrataenietum olgae* inhabiting large cobble scree near Shing, Zeravshan Mts, Tajikistan (ca. 1,600 m a.s.l.). Photo: A. Nowak.

scabrum, Lactuca orientalis, Lindelofia macrostyla, Melica inaequiglumis.

Geographical range: The range of the diagnostic species is restricted to the Pamir-Alai Mts in Tajikistan and the northern ridges of the Hindu Kush in Afghanistan. In Tajikistan, it is fairly common in the alpine belt in the Zeravshanian, Hissaro Darvasian, Eastern-Tajikistanian and West- and East-Pamirian geobotanical regions (Chukavina 1984). Plots of *Tetrataenietum olgae* are clearly distinct in the alpine landscape of the Pamir-Alai occupying colluvial deposits at elevation of 1,800–2,500 m a.s.l. Only occasionally the association descends to 1,200 m a.s.l. or reaches up to 3,000 m a.s.l. The phytocoenoses of *Tetrataenietum olgae* were found on relatively coarse cobbles and pebbles in the colluvial cones of the Iskander-darya, Seven Lakes, Kante, Kshtut and Huf River Valleys (Nowak et al. 2015a).

Habitat characteristics: They are generally found on various bedrock, usually alkaline dolomite, schist, shale, marble and metamorphic mudstone rocks (pH. 7.8–8.7). The community develops on moderately sloping screes with a mean inclination of about 40°. *Tetrataenietum olgae* mainly inhabits taluses with west and southwest exposures (Nowak et al. 2015a).

PAC-AA08. *Feruletum bucharicae* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2022 (chasmophytic, thermophilous vegetation of eroded rocky slopes and screes of the south-western Pamir-Alai Mts) (Fig. 365)

Diagnostic species: *Eremurus comosus, Handelia trichophylla, Ferula bucharica* (= *Ladyginia bucharica*), *Piptatherum microcarpum,* (= *Piptatherum vicarium*), *Scrophularia strizhoviae, Scutellaria adenostegia.*

Constant species: *Ferula bucharica.*

Geographical range: The range of *Ferula bucharica* (= *Ladyginia bucharica*) includes south-

Fig. 365. *Feruletum bucharicae* on a rock slope near Murza-Khan, Savroda River Valley, Karateginian Mts, Tajikistan (ca. 1,590 m a.s.l.). Photo: A. Nowak.

western Tajikistan. Occasionally, the species has been recorded in the Zeravshan Mts and in northern Afghanistan (Chukavina 1984; Pimenov 2020). It prefers unstable, eroded rocks and screes of coarse debris (ca. 20–50 cm in diameter), in the warm colline and montane belts of Darvaz, Hissar, Babatag and Aktau ranges. It was noted between 700 and 1,350 m a.s.l., mainly on stony, crumbly slopes with deep soil developed in subhumid climatic zone of South-tajikistanian and Darvazian phytogeographical subregions (Nowak et al. 2022c).

Habitat characteristics: The association inhabits mainly southern and south-eastern exposures with relatively gentle inclinations (40°–80°). They have been found, although rarely, on anthropogenic road escarpments with compacted gravelly substrate (Nowak et al. 2022c).

PAC-AA09. *Perovskietum scrophulariifoliae* Nowak, Świerszcz, S. Nowak et Nobis 2021

(montane vegetation of aprons, talus cones and river bar gravel sediments of Middle Asia)

Diagnostic species: *Arenaria serpyllifolia, Artemisia tenuisecta, Ferula koso-poljanskyi, Incarvillea olgae, Medicago lupulina, Moluccella fedtschenkoana* (= *Otostegia fedtschenkoana*), *Perovskia scrophulariifolia, Plantago lanceolata.*
Constant species: *Arenaria serpyllifolia.*
Geographical range: The phytocoenoses of *Perovskietum scrophulariifoliae* have rarely been recorded on aprons and talus cones of southern Kyrgyzstan in the Fergana and Alaian Mts. Occasionally, it has also been noted on alluvial fans of the Zeravshan River in Tajikistan or on typical screes on moderately steep slopes. Phytocoenoses of *Perovskietum scrophulariifoliae* have been found at moderate elevations from 800 to 2,000 m a.s.l. (Nowak et al. 2021c).

Habitat characteristics: The association prefers gentle and planar cones with medium sized stones and rock debris. The mean diameter of limestone or dolomite cobbles was approx. 12 cm. The phytocoenoses were generally observed on south-western and western exposures on slopes with moderate inclinations (mean approx. 25°) (Nowak et al. 2021c).

PAC-AA10. *Eremuretum turkestanicae* Nowak, Świerszcz, S. Nowak et Nobis 2021 (scree forb vegetation of alpine belt of the western Tian Shan Mts) (Fig. 366)

Diagnostic species: *Artemisia namanganica, Bromus scoparius, B. tectorum* (= *Anisantha tectorum*), *Ceratocephalus testiculatus, Eremurus sogdianus, E. turkestanicus, Filago paradoxa, Galium verticillatum, Lactuca undulata, Lappula squarrosa* (= *Lappula consanguinea*), *Linaria popovii, Picnomon acarna.*

Constant species: *Bromus tectorum, Eremurus turkestanicus.*

Geographical range: The association has been recorded mainly in northern Tajikistan in the Kuraminian range, which belongs to south-western Tian Shan. The stands of the association have been found at elevations between 1,150 and 1,600 m a.s.l. (Nowak et al. 2021c).

Habitat characteristics: The community inhabits mainly southeastern and northeastern slopes with relatively gentle inclinations (mean approx. 25°). The majority of sites are old, fairly stabilised taluses and fans. It prefers moderately compacted debris with pebbles and cobbles of the mean size of ca. 20 cm in diameter (Nowak et al. 2021c).

PAC-AA11. *Smelowskio calycinae-Dracocephaletum scrobiculati* Nowak, Świerszcz, Nobis, Swacha et S. Nowak in Świerszcz et al. 2023

Fig. 366. Vegetation of *Eremuretum turkestanicae* inhabiting cobble scree near Zambarak, Kuraminian Mts, Tajikistan (ca. 1,820 m a.s.l.). Photo: A. Nowak.

Fig. 367. Grassland of the *Smelowskio calycinae-Dracocephaletum scrobiculati* association, found near Dzhonat Pass, Fann Mts, Tajikistan (ca. 3,850 m a.s.l.). Photo: A. Nowak.

(rupicolous alpine sward of the Pamir-Alai Mts) (Fig. 367)

Diagnostic species: *Dichodon cerastoides, Draba alticola, Dracocephalum scrobiculatum, Oxytropis savellanica, Poa hissarica, Richteria pyrethroides, Smelowskia calycina, Taraxacum minutilobum.*

Constant species: *Cousinia franchetii, Dichodon cerastoides, Dracocephalum scrobiculatum, Eremogone griffithii, Erigeron cabulicus, Geranium regelii, Ligularia thomsonii, Lomatocarpa albomarginata, Nepeta podostachys, Oxytropis lehmanni, O. microsphaera, O. savellanica, Poa hissarica, Potentilla grisea, Taraxacum minutilobum.*

Geographical range: *Smelowskia calycina* is a relatively widespread species throughout the Pamir-Alai and Tian Shan ranges, as well as the Dzungarian Alatau, Tarbagatai and Hindu Kush, growing mainly in the subalpine and subnival belts (POWO 2023). In Tajikistan, it has been recorded at elevation of 2,500–4,900 m a.s.l. (Ovchinnikov 1978; Nowak, Nobis 2020). The distribution of *Dracocephalum scrobiculatum* is more restricted than that of the previous species and includes Tajikistan, Kyrgyzstan and Uzbekistan, with sites distributed throughout the Pamir-Alai and western Tian Shan, inhabiting mainly gravelly slopes at elevation of 2,900–3,800 m a.s.l. (Kochkareva 1986; POWO 2023). The association forms rupicolous alpine grasslands, which serve as pastures at the highest elevations of the Zeravshan and Hissar Mts (Świerszcz et al. 2023).

Habitat characteristics: It covers gentle slopes with an average inclination of approx. 13°, most often with a north-eastern and northern aspect at elevations of 3,320–3,640 m (Świerszcz et al. 2023).

Fig. 368. Scree vegetation dominated by *Ferula ovina* found on southern slopes of Zeravshan Mts near Sarytag, Tajikistan (ca. 2,850 m a.s.l.). Photo: A. Nowak.

Fig. 369. Scree vegetation of the *Astragalus macropterus* community found near Arzing, Obikhingou River Valley, Peter the First Range, Tajikistan (ca. 2,650 m a.s.l.). Photo: A. Nowak.

PAC-AAc01. Community of *Ferula ovina* (typical scree vegetation on deep gravel deposits in the western Pamir-Alai Mts) (Fig. 368)

Diagnostic species: *Ferula ovina.*
Constant species: *Ferula ovina, Galium verticillatum, Lactuca serriola*, *Linaria popovii.*
Geographical range: This vegetation has been recorded on extensive screes in the Zeravshan, Turkestan, Mogoltau, Hissar and Karateginian Mts of western Tajikistan. Stands of this community have been noted in the montane and alpine belts at an elevation of 1,200–2,800 m a.s.l.
Habitat characteristics: This community prefers large screes of medium-sized pebble material, not fully stabilised. Plots of this vegetation have been mainly found on south-facing slopes with rather steep inclinations (Chukavina 1984).

PAC-AAc02. Community of *Astragalus macropterus* (mesic steep slopes and scree vegetation of Middle and Central Asia) (Fig. 369)

Diagnostic species: *Astragalus macropterus.*
Constant species: *Astragalus macropterus.*
Geographical range: Stands of *Astragalus macropterus* occur throughout Middle and Central Asia. The species is also distributed in southern Siberia, Karakoram and the Himalayas. Plots of this community have been noted in the montane and alpine belts at an elevation of 1,600–3,900 m a.s.l.
Habitat characteristics: This community has been recorded between juniper stands, xerophytic shrublands and tall-forbs. However, patches of *Astragalus macropterus* were very common on screes and gravel landslides. Further surveys are needed for a final classification of this community.

PAC-AAc03. Community of *Atraphaxis seravschanica* (scree and steep slope rupicolous vegetation of the semi-arid zone in upper montane to alpine belt in the western Pamir-Alai Mts) (Fig. 370)

Fig. 370. Vegetation of the *Atraphaxis seravschanica* community inhabiting cobble screes near Marzich, Zeravshan Mts, Tajikistan (ca. 3,150 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Atraphaxis seravschanica.*
Constant species: *Atraphaxis seravschanica.*
Geographical range: Stands of this vegetation occur in western Tajikistan, mainly in the Zeravshan Mts. Several plots have also been noted in Turkestan and Hissar Mts. Plots of this community have been recorded in the montane and alpine belts at an elevation of 1,100–2,600 m a.s.l.
Habitat characteristics: This community develops on screes and gravel aprons with moderate slopes. It prefers alkaline, marble or limestone substrates (Ovchinnikov 1968).

PAC-AAc04. Community of *Glaucium squamigerum* (nitrophilous scree vegetation of the montane belt of the western Pamir-Alai Mts) (Fig. 371)

Diagnostic species: *Glaucium squamigerum.*
Constant species: *Glaucium squamigerum, Parietaria judaica.*
Geographical range: The community of *Glaucium squamigerum* has been found in several localities in the Zeravshan Mts. It also occurs in Mogoltau, Turkestan and Peter the First Mts. It prefers alpine elevations and has been recorded between 2,000 and 2,800 m a.s.l. (Ovchinnikov 1975).
Habitat characteristics: This community develops on screes and gravel escarpments. It was also noted on gravel bars in the alpine river beds. The final classification of this community requires further surveys and detailed analyses (Ovchinnikov 1968).

PAC-AA-c05. Community of *Rheum fedtschenkoi* (alpine rupicolous vegetation of the Pamir-Alai Mts) (Fig. 372)

Diagnostic species: *Rheum fedtschenkoi.*
Constant species: *Rheum fedtschenkoi.*

Fig. 371. Community of *Glaucium squamigerum* on an unstable escarpment near Iskander-kul Lake in Pastrud-darya Valley, Zeravshan Mts, Tajikistan (ca. 2,350 m a.s.l.). Photo: A. Nowak.

Fig. 372. Gravel slope covered by the community of *Rheum fedtschenkoi* near the Laudan Pass, Fann Mts, Tajikistan (ca. 3,600 m a.s.l.). Photo: A. Nowak.

Geographical range: This community inhabits gravelly slopes and screes in the alpine belt of the Pamir-Alai. It has been recorded between 3,100 and 3,700 m a.s.l. (Ovchinnikov 1968).
Habitat characteristics: Sparse stands of *Rheum fedtschenkoi* develop on screes and gravel slopes, where the substrate contains the soil under the stony outer layer. The final classification of this community requires further surveys and detailed analyses (Ovchinnikov 1968).

PAC-AAc06. Community of *Alajja afghanica* (alpine scree vegetation of the western and southern Pamir-Alai Mts)

Diagnostic species: *Alajja afghanica.*
Constant species: *Alajja afghanica.*
Geographical range: This community inhabits screes and gravelly slopes in the alpine belt of the Pamir-Alai. It also occurs in the Hindu Kush and generally grows between 3,200 and 4,100 m a.s.l. (Kochkareva 1986).
Habitat characteristics: Stands of *Alajja afghanica* develop rarely on screes and gravel slopes in high alpine rupiculous vegetation or in complex with tragacanthic communities (Ovchinnikov 1968).

PAC-AA-c07. Community of *Euphorbia cyrtophylla* (alpine vegetation on compact screes and talus cones of western Pamir-Alai) (Fig. 373)

Diagnostic species: *Euphorbia cyrtophylla.*
Constant species: *Euphorbia cyrtophylla.*
Geographical range: This is a typical scree and apron community of the Zeravshan Mts. It forms sparse stands on medium-sized gravel scree at the foots of rock walls or on slope screes. The community has been recorded at elevation of about 2,500–3,600 m a.s.l. (Ovchinnikov 1981).

Fig. 373. Community of *Euphorbia cyrtophylla* on scree apron near the Serimadarun Lake, Fann Mts, Tajikistan (ca. 3,200 m a.s.l.). Photo: A. Nowak.

Fig. 374. Community of *Euphorbia pamirica* on scree apron near Poymazor, Vanch Valley, Tajikistan (ca. 2,800 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: Stands of *Euphorbia cyrtophylla* develop on typical screes among high alpine rupicolous vegetation (Ovchinnikov 1981).

PAC-AAc08. Community of *Euphorbia pamirica* (alpine vegetation on screes, aprons and talus cones of the Pamir Mts) (Fig. 374)

Diagnostic species: *Euphorbia pamirica.*
Constant species: *Euphorbia pamirica.*
Geographical range: This community is a geographical vicariant to the previous one. It occurs mainly in the Western Pamirian geobotanical subregion in the Vanch, Darvaz, Yazgulem, Shugnan and Shahdarian Mts. It forms sparse stands on medium- and fine sized gravel screes at the foot of rock faces or on slope screes. The community has been recorded at elevation of about 2,300–4,100 m a.s.l. (Ovchinnikov 1981).
Habitat characteristics: Stands of *Euphorbia pamirica* develop on mobile or stabilised screes among high alpine rupicolous vegetation (Ovchinnikov 1981).

PAC-AAc09. Community of *Melissitus pamiricus* (alpine vegetation on screes, aprons and talus cones of the Eastern Pamir) (Fig. 375)

Diagnostic species: *Melissitus pamiricus.*
Constant species: *Melissitus pamiricus.*
Geographical range: This community is limited to the Pamir. It occurs in the alpine belt of the western, but mainly the Eastern Pamir at elevation of about 2,800–4,300 m a.s.l. (Ovchinnikov 1978).
Habitat characteristics: Stands of *Melissitus pamiricus* develop on boulder fields, screes, river gravel bars and gravel slides in the arid zone of the Pamir (Ovchinnikov 1978).

PAC-AAc10. Community of *Eremurus korshinskyi* (scree forb vegetation of alpine belt of Middle Asia) (Fig. 376)

Fig. 375. Gentle scree slope covered by the community of *Melissitus pamiricus* near Zorkul Lake, Pamir River Valley, Eastern Pamir, Tajikistan (ca. 4,230 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Eremurus korshinskyi.*
Constant species: *Eremurus korshinskyi.*
Geographical range: This community is restricted to southern Tajikistan, mainly to the Darvaz, Peter the First, Hazratishokh, Vanch, Rushan and Shugnan mountain ranges. The range of this community also includes northern Hindu Kush. It occurs in the montane and alpine belts at elevation of about 1,500–3,000 m a.s.l. (Ovchinnikov 1963).
Habitat characteristics: Stands of *Eremurus korshinskyi* develop on gravel aprons, stabilised screes, sometimes also tall-forbs (Ovchinnikov 1963).

NEP-AAc11. Community of *Senecio saposhnikovii* (forb steppe of the gravelly slopes in the northern Pamir-Alai Mts; Kyrgyzstan) (Fig. 377)

Diagnostic species: *Anaphalis racemifera, Artemisia santolinifolia, Berberis heterobotrys, Cirsium badakhschanicum, Cotoneaster nummularioides, Dracocephalum diversifolium, Gentianella turkestanorum, Senecio saposhnikovii, Thalictrum isopyroides, Thymus proximus.*
Constant species: *Senecio saposhnikovii.*
Geographical range: The only patch of vegetation representing *Senecio saposchnikovii* was recorded in the Alai range near the village of Uch-tube. It occurs on steep, loose scree at an elevation of approx. 2,500 m a.s.l., with the soil underlying gravel (Nowak et al. 2020b).
Habitat characteristics: The community grows on exposed western slopes with an inclination of approx. 35° (Nowak et al. 2020b).

NEP-AAc12. Community of *Cousinia batalinii* (subalpine to alpine forb steppe on the gravelly slopes in the Hissar and Darvaz Mts, and western Pamir Mts)

Fig. 376. Gentle scree slope covered by the community of *Eremurus korshinskyi* in the Khuf Valley, Western Pamir, Tajikistan (ca. 2,700 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Acantholimon parviflorum, Astragalus lasiosemius, Bunium badachschanicum, Cousinia batalinii, Ephedra gerardiana, Eremopoa persica, Euphorbia pamirica, Kudrjaschevia allotricha, Lappula badachschanica, Linaria sessilis, Piptatherum sogdianum, Tulipa dasystemon.*
Constant species: *Ferula kokanica.*
Geographical range: *Cousinia batalinii* is endemic to the Hissar and Darvaz ranges and only sporadically occurs in the western Pamir (Rasulova 1991). Plots of this vegetation have been recorded in the alpine belt at an elevation of 1,950–3,300 m a.s.l. (Nowak et al. 2020b).
Habitat characteristics: The patches were recorded on slopes with an inclination of 10°–45°, preferably in the south-western and southern aspects (Nowak et al. 2020b).

PAC-AB. *Ferulion grigoriewii* Nowak, Świerszcz, S. Nowak et Nobis 2021 (scree vegetation of alpine and subalpine belts of eastern Middle Asia) (Fig. 378)

Diagnostic species: *Ferula grigoriewii*, *Nepeta daenensis, Rochelia peduncularis, Rosularia glabra.*
Constant species: *Crambe schugnana*, *Lagochilus seravschanicus, Nepeta daenensis, Rochelia peduncularis, Rosularia glabra, Stipa turkestanica.*
Geographical range: This scree vegetation includes phytocoenoses inhabiting the alpine belt of the Pamir. They occupy immense areas of extensive slopes in the western and eastern Pamir, especially in the lower elevations of the alpine belt in the river valleys. Stands of *Ferulion grigoriewii* were recorded in Alichur, Vakhan, Schugnan and Schahdarian Mts. Considering the distribution of the main diagnostic species, the patches of this vegetation could be expected in the Hindu Kush Mts of northern Afghanistan.

Fig. 377. Vegetation of *Senecio saposhnikovii* community inhabiting scree slope near Uch-Tyube, Alai Mts, Kyrgyzstan (ca. 2,650 m a.s.l.). Photo: A. Nowak.

The patches of *Ferulion grigoriewii* were mainly noted at elevations of (1,100–)2,100–2,300(–2,550) m a.s.l. (Nowak et al. 2021c).

Habitat characteristics: They grow on typical screes in a dry, continental climate of transitional character between Central and Middle Asia (Nowak et al. 2021c).

PAC-AB01. *Crambo schugnanae-Feruletum grigoriewii* Nowak, Świerszcz, S. Nowak et Nobis 2021 (scree vegetation in semi-arid zone in alpine belt of the eastern Pamir Mts) (Fig. 379)

Diagnostic species: *Artemisia korshinskyi* (= *Seriphidium korshinskyi*), *Cousinia mulgediifolia,*

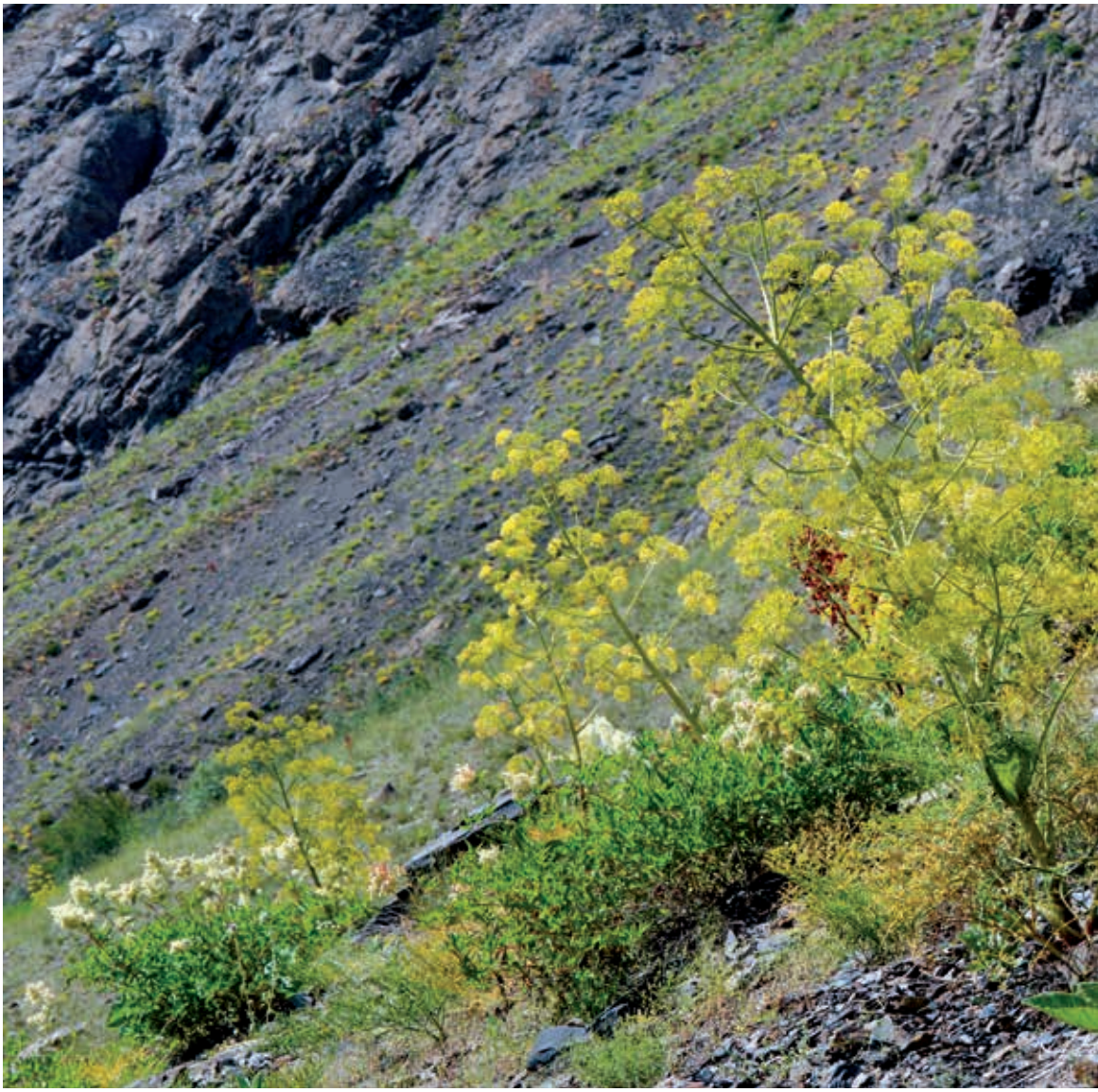


Fig. 378. Scree vegetation of *Ferulion grigoriewii* with *Ferula grigoriewii*, *Nepeta daenensis* and *Rochelia peduncularis* near Pastkhuf in Western Pamir, Tajikistan (ca. 2,650 m a.s.l.). Photo: A. Nowak.

C. semilacera, Crambe schugnana, Ferula grigoriewii, Filago arvensis, Polygonum fibrilliferum, Tytthostemma alsinoides (= *Stellaria alsinoides*).
Constant species: *Artemisia korshinskyi, Ferula grigoriewii.*
Geographical range: Plots of the *Crambo schugnanae-Feruletum grigoriewii* have been found in the alpine belt of the Pamir ranges at elevations of approx. 1,100–2,500 m a.s.l. (mean 2,100 m) (Nowak et al. 2021c).
Habitat characteristics: The phytocoenosis has been found on alkaline limestone or dolomite coarse gravels or cobbles about 15 cm in diameter. The association inhabits moderately steep slopes (20°–65° with the average of ca. 40°) and prevailing north-western, southern and south-western exposures (Nowak et al. 2021c).

PAC-AB02. *Allietum galanthii* Nowak, Świerszcz, S. Nowak et Nobis 2021 (scree vegetation on deep gravel deposits of montane belt in the central Tian Shan Mts) (Fig. 380)

Diagnostic species: *Agropyron cristatum* (= *Agropyron pectinatum), Allium galanthum, Asperula ferganica, Chesneya ferganensis, Cicer songaricum, Dracocephalum diversifolium, Isatis minima, Linaria bungei* (= *Linaria transiliensis), Piptatherum latifolium, Scutellaria adenostegia, Silene quadriloba* (= *Melandrium quadrilobum*).
Constant species: *Agropyron cristatum, Allium galanthum, Chesneya ferganensis, Scutellaria adenostegia.*
Geographical range: The main diagnostic species of this association is distributed in Central Asia and inhabits loose screes in the montane belt at elevations of 500–2,000 m a.s.l. in Kyrgyzstan, Mongolia, north-eastern China and southern Siberia (Kovalevskaya 1968). The association was found in the Kyzyl-Oy Valley in Kyrgyz Mts on northern, mostly on north-eastern slopes at elevations of 1,700–1,900 m a.s.l. (Nowak et al. 2021c).
Habitat characteristics: Plots have been found on gravel or cobble screes (1–30 cm in diameter) of limestone rocks with an inclination of approx. 40°. The association prefers northern aspects of sunny, unstable screes (Nowak et al. 2021c).

PAC-AB03. *Nepetetum floccosae* Nowak, Świerszcz, S. Nowak et Nobis 2021 (scree, rupicolous vegetation in semi-arid zone of the alpine belt in the Pamir Mts) (Fig. 381)

Fig. 379. Scree vegetation of *Crambo schugnanae-Feruletum grigoriewii* in the middle section of the Khuf Valley, Western Pamir, Tajikistan (ca. 2,550 m a.s.l.). Photo: A. Nowak.

Fig. 380. Scree vegetation of *Allietum galanthii* found near Kyzyl-Oy, Kyokyomeren River Valley, Kyrgyzstan (ca. 1,650 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Artemisia pamirica, Cousinia buphthalmoides, Elymus schrenkianus* (= *Roegneria schrenkiana*), *Lonicera pamirica, Nepeta floccosa* (= *N. vakhanica*), *Ribes heterotrichum.*
Constant species: *Nepeta floccosa.*
Geographical range: *Nepetetum floccosae* is thought to occur in the alpine belt of the Eastern Pamir in Tajikistan as well as in the northern Hindu Kush in Afghanistan and the Kunlun Shan in Xinjiang and Xizang provinces in China (eFloras 2024). Plots of this association have rarely been recorded along the upper part of the Vakhan Valley. It has been recorded in the range of elevations from 3,450 to 3,750 m a.s.l., in the alpine belt of semi-desert vegetation of the Central Asian phytogeographical region (Nowak et al. 2021c).
Habitat characteristics: Plots of *Nepetetum floccosae* have been found on relatively gently sloping escarpments with the mean inclination of approx. 27°. The association prefers south-eastern and southern expositions. The phytocoenoses were observed on limestone and dolomite shale rubble. This association occurs on fine debris screes (mean gravel size ca. 8 cm) (Nowak et al. 2021c).

PAC-ABc01. Community of *Bunium badachschanicum* (scree vegetation on deep rock gravel deposits in alpine belt of Badakshan region)

Diagnostic species: *Acantholimon lycopodioides, Bunium badachschanicum, Ephedra intermedia, Minuartia litwinowii, Nepeta daenensis, Silene brahuica, Tanacetopsis mucronata.*
Constant species: *Bunium badachschanicum, Minuartia litwinowii.*
Geographical range: The plots of the community were found in the Shugnan and Shakhdarian ranges on unstable, deep and coarse gravel scree. Sampling was carried out in the alpine belt at ca. 2,000 to 2,800 m a.s.l. (Nowak et al. 2021c).
Habitat characteristics: The community occupies slopes of moderate inclination (mean 35°)

Fig. 381. *Nepeta floccosa* – a species forming scree vegetation found near Vrang, Shakhdarian Mts, Tajikistan (ca. 2,550 m a.s.l.). Photo: A. Nowak.

with south-western and western exposures (Nowak et al. 2021c).

PAC-ABc02. Community of *Lagochilus seravschanicus* (scree vegetation of alpine and subalpine belts of the Pamir-Alai Mts) (Fig. 382)

Diagnostic species: *Lagochilus seravschanicus.*
Constant species: *Lagochilus seravschanicus.*
Geographical range: The plots of the community have been recorded throughout the mountainous areas of Middle Asia. It occurs in Pamir-Alai, Pamir, Tian Shan, Hindu Kush and Karakoram. The main elevational range of this community is in the alpine belt, however, it can also be noticed in the montane belt, at around 1,600 to 3,900 m a.s.l. (Kochkareva 1986).
Habitat characteristics: The community occupies screes and gravel slides in the vicinity of stony steppes and tragacanthic vegetation (Kochkareva 1986).

PAC-ABc03. Community of *Corydalis fimbrillifera* (scree and escarpment vegetation of the semi-arid zone of the Pamir Mts)

Diagnostic species: *Artemisia porrecta, Corydalis fimbrillifera, Rosularia lutea.*
Constant species: *Corydalis fimbrillifera.*
Geographical range: Only a few plots of this community were found in the western Pamir Mts. Sampling was carried out in the subalpine belt at ca. 1,900 m a.s.l. in the arid zone (Nowak et al. 2021c).
Habitat characteristics: Plots of the community were found on dry, compact, steep road escarpments or natural steep slopes composed of fine gravelly sediments. The community occupies slopes of the inclination up to 70° with northern exposure (Nowak et al. 2021c).

PAC-ABc04. Community of *Stipa turkestanica* (scree and apron vegetation of the subalpine and alpine belts of the western Pamir) (Fig. 383)

Fig. 382. Community of *Lagochilus seravschanicus* on scree near Jelandy, Tajikistan (ca. 3,750 m a.s.l.). Photo: A. Nowak.

Fig. 383. Vegetation patch dominated by *Stipa turkestanica* inhabiting cobble slope near Mardz, Ghunt River Valley, Western Pamir, Tajikistan (ca. 3,400 m a.s.l.). Photo: M. Nobis.

Diagnostic species: *Stipa turkestanica.*
Constant species: *Stipa turkestanica, Artemisia lehmanniana, A. skorniakovii.*
Geographical range: This community has its range in the Western Pamir. The largest areas of this cryophilous, rupicolous steppe have been found in Ghunt Valley around Jelandy and further down to Khorogh. Stands of the community develop in the subalpine and alpine belts at around 2,200–3,900 m a.s.l. (Ovchinnikov 1957).
Habitat characteristics: Community of *Stipa turkestanica* inhabits gravelly slopes and screes on moderately steep slopes in subhumid to arid zone of the Western Pamir (Ovchinnikov 1957).

PAC-AC. *Alceion nudiflorae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (scree, mesic, thermophilous vegetation of montane belt of subhumid zone of Middle Asia) (Fig. 384)

Diagnostic species: *Alcea nudiflora, Trichodesma incanum, Piptatherum songaricum, Pulicaria salviifolia.*
Constant species: *Alcea nudiflora*, *Artemisia persica*, *Callipeltis cucullaris*, *Sanguisorba alpina*, *Salvia sclarea*, *Hypericum scabrum*, *Lactuca orientalis*, *Piptatherum songaricum*, *Scrophularia scabiosifolia*, *Trichodesma incanum.*
Geographical range: The *Alceion nudiflorae* alliance was coined for scree vegetation of the western Pamir-Alai Mts, occurring mainly in the Zeravshan, Hissar, Hazratishokh, Peter the First, Turkestan, Darwaz and Vakhsh ranges. It occurs at (350–)1,200–1,900(–2,400) m a.s.l. (Nowak et al. 2016b). The phytocoenoses of *Alceion nudiflorae* are moderately rich in species, with a slightly higher number of species per plot compared to the alpine scree phytocoenoses of the *Ferulo foetidissimae-Vicion kokanicae* (Nowak et al. 2015a). A considerable portion of the species composing the alliance have

Fig. 384. Scree forb vegetation of *Alceion nudiflorae* inhabiting shale scree in Maykhura Valley, Hissar Mts, Tajikistan (ca. 1,900 m a.s.l.). Photo: A. Nowak.

Fig. 385. Vegetation of the *Cousinietum corymbosae* inhabiting fine grain granite scree near Pugus, Varzob River Valley, Hissar Mts, Tajikistan (ca. 1,410 m a.s.l.). Photo: A. Nowak.

the Irano-Turanian distribution type (Nowak et al. 2016b).

Habitat characteristics: The communities of this alliance are developed on various rock substrates (generally limestone, marble, dolomite, schists and granite) of different sizes (cobbles, pebbles, coarse and fine grained gravel) (Nowak et al. 2016b).

Calcifuge group

PAC-AC01. *Cousinietum corymbosae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (scree, rupicolous vegetation on fine granite debris in the montane and subalpine belts of the Hissar Mts) (Fig. 385)

Diagnostic species: *Cousinia corymbosa, Ferula equisetacea.*

Constant species: *Alcea nudiflora, Bromus tectorum, Callipeltis cucullaris, Hypericum scabrum, Origanum tyttanthum, Scrophularia scabiosifolia, Sanguisorba alpina, Piptatherum songaricum.*

Geographical range: The phytocoenoses of *Cousinietum corymbosae* have been found at several sites in the Hissar Mts, mainly on the western and south-western slopes in the Varzob, Takob and Romit River Valleys. *Cousinia corymbosa* is a narrow endemic of the Hissar Mts, scattered in a few sites near the villages of Maychura, Varzob, Khokhu and Romit on gravel deposited at the hillslope base, at elevations of 1,200–2,400 m a.s.l. (Rasulova 1991). The elevational distribution of the association does not fully correspond to this amplitude. Samples were collected in the colline and montane belts at elevations from 1,230 to 1,850 m a.s.l. (Nowak et al. 2016b).

Habitat characteristics: The association prefers granite, relatively loose and fine-grained scree. *Cousinietum corymbosae* was found mainly on western and south-western exposures with a mean inclination of approx. 35° (Nowak et. al. 2016b).

PAC-AC02. *Phlomoidetum tadshikistanicae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (scree, rupicolous, thermophilous vegetation in the upper montane to subalpine belts of western Pamir-Alai Mts) (Fig. 386)

Diagnostic species: *Achillea biebersteinii, Geranium divaricatum, Hedysarum denticulatum, Phlomoides canescens, P. tadshikistanica* (= *Eremostachys tadshikistanica*), *Ranunculus muricatus, Trichodesma incanum.*

Fig. 386. Scree vegetation of *Phlomoidetum tadshikistanicae* on steep, gravelly slope near Varmanik, Takob Valley, Hissar Mts, Tajikistan (ca. 1,850 m a.s.l.). Photo: A. Nowak.

Constant species: *Phlomoides tadshikistanica, Plantago lanceolata, Trichodesma incanum.*
Geographical range: *Phlomoides tadshikistanica* is an endemic species of the Hissar, Darvaz and Aktau ranges in the western Pamir-Alai (Kochkareva 1986). This community is typical montane scree vegetation with optimum of occurrence at ca. 1,200–1,900 m a.s.l. (Nowak et al. 2016b; Nowak et al. 2020b).
Habitat characteristics: The phytocoenoses have been found mainly on granite and schist scree, with some admixture of dolomite that creeps downslope. The association inhabits screes with fine- or coarse gravel and little soil. The community develops on fairly steep screes with mean inclination of approx. 45°. *Phlomoidetum tadshikistanicae* is strictly related to southern exposures with very high solar radiation (Nowak et. al. 2016b; Nowak et al. 2020b).

PAC-AC03. *Cousinietum refractae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (rupicolous, thermophilous vegetation in montane belt of the Hissar, Aktau and Karatau Mts) (Fig. 387)

Diagnostic species: *Cousinia refracta.*
Constant species: *Aegilops triuncialis, Alcea nudiflora, Astragalus varzobicus, Avena trichophylla, Centaurea squarrosa, Eremurus olgae, Hordeum bulbosum, Pimpinella puberula, Sanguisorba alpina, Salvia sclarea, Trichodesma incanum.*
Geographical range: *Cousinia refracta* is a stenochoric species with a range restricted to screes and slopes in south-western Tajikistan, mainly in the Hissar, Aktau and Karatau Mts (Rasulova 1991). The association develops in the valleys Khonaka and Khondara rivers and near Gusgarf. The phytocoenosis develops at relatively low elevations in the colline zone with warm microclimate. The observed elevational range was between 1,350 and 1,650 m a.s.l. (Nowak et. al. 2016b).
Habitat characteristics: The association was found in the montane zone on the warmest

Fig. 387. Thermophilous vegetation of *Cousinietum refractae* found on a southern slope near Ardzhinak, Hissar Mts, Tajikistan (ca. 1,400 m a.s.l.). Photo: A. Nowak.

slopes in close contact with pseudosteppes and shrublands. It was found exclusively on granite, moderately compacted screes. In comparison to the other plant communities, a considerable amount of clayey soil was found in the research plots. The rock particles were relatively fine and compact here. The community develops on moderately steep screes with the mean inclination of approx. 35°. *Cousinietum refractae* generally inhabits south-western exposures (Nowak et. al. 2016b).

Calcicole group

PAC-AC04. *Caccinietum dubiae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (scree vegetation of schist and limestone debris in montane to subalpine belts of the Kuraminian, Turkestan and Zeravshan Mts) (Fig. 388)

Diagnostic species: *Caccinia dubia.*

Constant species: *Alcea nudiflora, Bromus tectorum, Centaurea squarrosa, Cousinia ferghanensis, Echinops chloroleucus, Nepeta olgae, Pulicaria salviifolia, Lactuca orientalis, Trichodesma incanum.*

Geographical range: *Caccinia dubia* is a species of wider distribution in Middle Asia, known from screes of the Pamir-Alai and Tian Shan Mts. In Tajikistan, the species is known from the northernmost ranges (Kuraminian, Turkestan and Zeravshan) from montane and lower alpine elevations (Chukavina 1984). The association occurs at moderate elevations in montane zones, within the range between 1,400 and 2,050 m a.s.l. (Nowak et. al. 2016b).

Habitat characteristics: The association was found mainly on schists and shales with alkaline reaction. However, field observations and literature confirm the occurrence of *Caccinia dubia* on neutral or acidic substrates (Chukavina 1984). The association prefers scree with almost no soil component, with relatively large rock pebble

Fig. 388. Scree vegetation of *Caccinietum dubiae* found near Iskodar, Turkestan Mts, Tajikistan (ca. 1,430 m a.s.l.). Photo: A. Nowak.

and cobble colluvial slides. The community inhabits the driest areas. Plots of *Caccinietum dubiae* develop on fairly steep screes, with the mean inclination of approx. 45°. The phytocoenosis generally inhabits southern exposures (Nowak et. al. 2016b).

PAC-AC05. *Eremuretum sogdiani* Nowak, S. Nowak, Nobis et A. Nobis 2016 (rupicolus, thermophilous vegetation of montane belt in the western Pamir-Alai and south-western Tian Shan Mts) (Fig. 389)

Diagnostic species: *Eremurus sogdianus.*
Constant species: *Alcea nudiflora, Artemisia persica, Bromus tectorum, Cousinia radians, Crambe kotschyana, Koelpinia linearis, Perovskia virgata, Lactuca orientalis, Scutellaria intermedia, Trichodesma incanum.*
Geographical range: *Eremurus sogdianus* is commonly distributed along the foothills of the south-western Tian Shan and northern Pamir-Alai. Only in the Zeravshan Mts does the species penetrate deeper into the northern valleys (Ovchinnikov 1963; Kovalevskaya 1971). The distribution of the association is limited to the lower sections of the northern valleys of the Turkestan and Zeravshan ranges. The association prefers elevations in the montane zone, within an elevational range between 1,200 and 1,800 m a.s.l. (Nowak et. al. 2016b).
Habitat characteristics: *Eremuretum sogdiani* association develops on alkaline rock debris, mainly on dolomite and limestone scree. The community inhabits colluvial deposits with coarse gravel with mean grain size of approx. 4 cm. The community develops on gently sloping screes with mean inclination close to 30°. Unlike other plant communities of the *Alceion nudiflorae* vegetation, *Eremuretum sogdiani* prefers generally north-western and western, slightly shaded exposures (Nowak et. al. 2016b).

Fig. 389. Rupicolus vegetation of *Eremuretum sogdiani* found near Shing, Fann Mts, Tajikistan (ca. 1,450 m a.s.l.). Photo: A. Nowak.

PAC-AC05a. *Eremuretum sogdiani typicum* Nowak, S. Nowak, Nobis, A. Nobis 2016 (see description of the previous type – *Eremuretum sogdiani*)

PAC-AC-05b. *Eremuretum sogdiani delphinietosum ovczinnikovii* Nowak, S. Nowak, Nobis et A. Nobis 2016 (rupicolus vegetation with domination of *Delphinium ovczinnikovii* in the astern Zeravshan Mts) (Fig. 390)

Diagnostic species: *Delphinium ovczinnikovii*.
Constant species: *Bromus tectorum*, *Delphinium ovczinnikovii*, *Reseda lutea*.
Geographical range: This subassociation was found sporadically in the lower part of the Seven Lakes Valley in the western part of the Zeravshan Mts. The vegetation is distributed in the montane zone at moderate elevation from 1,650 to 1,770 m a.s.l. (Nowak et. al. 2016b). It was initially misnamed after *Delphinium decoloratum*, and here the name of the subassociation has to be corrected according to the Art. 43 of ICPN (Theurillat et al. 2021).
Habitat characteristics: It prefers coarse-grained, moderately compact gravel screes. The community has been observed on limestone rubble. The subassociation occurs generally on eastern and northern exposures with slope of approx. 30°–45°. It inhabits shaded sites in narrow gorges of the Zeravshan range (Nowak et. al. 2016b).

PAC-ACc01. Community of *Ampelopsis vitifolia* (typical mantle scree vegetation on loose debris in the Pamir-Alai Mts) (Fig. 391)

Diagnostic species: *Ampelopsis vitifolia*.
Constant species: *Ampelopsis vitifolia*.
Geographical range: Community of *Ampelopsis vitifolia* is commonly distributed in the Pamir-Alai, Western Pamir and northern Hindu Kush. It grows from the lower montane to the upper

Fig. 390. Rupicolus vegetation of the *Eremuretum sogdiani delphinietosum ovczinnikovii* subassociation found near Rashna, Shing River Valley, Fann Mts, Tajikistan (ca. 1,610 m a.s.l.). Photo: A. Nowak.

Fig. 391. Vegetation of the *Ampelopsis vitifolia* community growing along channel of an ephemeral stream near Daraiob, Khatlon Province, Tajikistan (ca. 1,490 m a.s.l.). Photo: A. Nowak.

montane belt of southern Middle Asia, between 800 and 1,500 m a.s.l. (Ovchinnikov 1981).
Habitat characteristics: This vegetation inhabits screes, aprons, fans and taluses with the moderately stable gravel cones. Occasionally, it also inhabits river bars.

PAC-ACc02. Community of *Comarum salesovianum* (scree and rupicolus vegetation on limestone debris in alpine belt of the Pamir-Alai Mts) (Fig. 392)

Diagnostic species: *Comarum salesovianum.*
Constant species: *Comarum salesovianum.*
Geographical range: Community of *Comarum salesiovianum* is found throughout Middle and Central Asia, the Karakoram, the Himalayas, the Altai and southern Siberian mountains. In Tajikistan, this vegetation grows on screes in the alpine belt from 1,900 to 4,200 m a.s.l. (Ovchinnikov 1975).
Habitat characteristics: This vegetation inhabits screes, aprons, colluvial cones and various gravel slides. Occasionally, it also inhabits alpine river bars.

PAC-ACc03. Community of *Scutellaria adenostegia* (scree vegetation in upper montane to subalpine belts of Middle Asia)

Diagnostic species: *Scutellaria adenostegia.*
Constant species: *Scutellaria adenostegia.*
Geographical range: *Scutellaria adenostegia* is a widely distributed species in Pamir-Alai as well as in Tian Shan Mts. In Tajikistan, it inhabits mainly the rock faces in Hissar, Zeravshan, Turkestan and Darvaz mountain ranges between 1,000 and 2,000 m a.s.l. During our surveys, the plots of the association have been found in Hissar and Zeravshan Mts on granite and schist rocks (pH 6.0–6.5) within the montane zone at elevation from 1,200 to 1,400 m a.s.l. (mean approx. 1,250) (Nowak et. al. 2014c).

Fig. 392. Community of *Comarum salesovianum* on gravel river bar and escarpents of Pastrud-darya River near Narvad, Tajikistan (ca. 1,950 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: The community inhabits mainly south-western rocky slopes with different inclinations, from 65° to 90° (mean approx. 85°). It prefers non-coherent rocks with medium-sized and coarse crevices and clefts with moderate amount of soil substrate (Nowak et. al. 2014c).

Scree vegetation of colline and montane belt of arid and warm zones in Middle Asia

PAC-AC06. *Zygophylletum atriplicoidis* Nowak, S. Nowak, Nobis et A. Nobis 2016 (scree, rupicolus, thermophilous scrub on coarse-gravel and pebble deposits with very scarce soil ingredient in Irano-Turanian Region) (Fig. 393)

Diagnostic species: *Zygophyllum atriplicoides.*
Constant species: *Capparis spinosa, Erodium oxyrrhynchum, Kraschenninnikovia ceratoides, Salsola gemmascens, Zygophyllum atriplicoides.*

Geographical range: *Zygophylletum atriplicoidis* has been spotted sporadically in the central section of the Yagnob and Zeravshan River Valleys on the southern slopes of the Turkestan, Zeravshan and Peter the First Mts. The diagnostic species represents the Irano-Turanian distribution type and is known from foothills of the Caucasus, Iran, northern Afghanistan, Tajikistan and western Kyrgyzstan (Ovchinnikov 1981). The association prefers the driest sites in the colline and montane elevational zones at elevations of ca. 1,550 m a.s.l. (Nowak et. al. 2016b).
Habitat characteristics: *Zygophylletum atriplicoidis* occurs on coarse gravel and pebble deposits with very scarce soil component. Occurrences of this association were found on open, well exposed and warm habitats. The community inhabits the limestone and dolomite screes of alkaline reaction (pH 8.2–8.5). It was generally observed on southern exposures with steep

Fig. 393. Thermophilous shrub vegetation of *Zygophylletum atriplicoidis* found near Margeb, Yagnob River Valley, Zeravshan Mts, Tajikistan (ca. 1,550 m a.s.l.). Photo: A. Nowak.

Fig. 394. Community of *Echinops nanus* near Arsy, Kyrgyzstan (ca. 1,850 m a.s.l.). Photo: A. Nowak.

inclinations (mean approx. 40°) (Nowak et. al. 2016b).

PAC-ACc05. Community of *Echinops nanus* (subhalophytic vegetation of semi-desert screes and badlands of Middle Asia) (Fig. 394)

Diagnostic species: *Echinops nanus.*
Constant species: *Echinops nanus.*
Geographical range: The *Echinops nanus* community forms sparse vegetation in the arid zones of the colline and montane belts of Middle Asia. It has also been recorded in western China and southern Siberia. This badland vegetation grows mainly at elevation from 450 to 2,500 m a.s.l. (Ovchinnikov 1975).
Habitat characteristics: This vegetation develops in the transitional zone between thermophilous steppes, semi-deserts and rupiculous scree vegetation. It inhabits flat sites or gentle slopes with low organic matter content in the substrates. The final classification of this community requires further research (Nowak et al. 2016b).

PAC-ACc06. Community of *Glaucium elegans* (scree vegetation of alpine belt of the western Pamir-Alai and Tian Shan Mts) (Fig. 395)

Diagnostic species: *Glaucium elegans.*
Constant species: *Glaucium elegans.*
Geographical range: *Glaucium elegans* is a widespread species throughout the Irano-Turanian Region, and also in the Himalayas and southern Siberia. It inhabits a variety of habitats at a wide elevational range from about 400 to 3,000 m a.s.l. (Ovchinnikov 1975).
Habitat characteristics: *Glaucium elegans* contributes to different vegetation types, including steppes, sub-halophytic grasslands, rupicolous vegetation of screes and gravel slides, and anthropogenic vegetation. However, only on fine-grained screes does it form distinct stands with relatively high cover. The final classification of this community

Fig. 395. Community of *Glaucium elegans* on mobile scree near Sarytag, Tajikistan (ca. 2,350 m a.s.l.). Photo: A. Nowak.

Fig. 396. Community of *Chondrilla gibbirostris* on mobile scree near Shurpast, Tajikistan (ca. 1,925 m a.s.l.). Photo: A. Nowak.

Fig. 397. Scree vegetation dominated by *Tetracme bucharica* found near Teshik-Tash, Aktau Mts, Tajikistan (ca. 620 m a.s.l.). Photo: A. Nowak.

Fig. 398. Community of *Olgaea chodshamuminensis* on screes in gypsum karst area on Mount Khodzhamumin, Tajikistan (ca. 1,280 m a.s.l.). Photo: A. Nowak.

needs further surveys and comparative analyses (Nowak et al. 2016b).

PAC-ACc07. Community of *Chondrilla gibbirostris* (scree vegetation of montane belt of the Pamir-Alai Mts) (Fig. 396)

Diagnostic species: *Chondrilla gibbirostris.*
Constant species: *Chondrilla gibbirostris.*
Geographical range: This vegetation is found all over Middle and Central Asia. The stands of *Chondrilla gibbirostris* have been recorded at montane and alpine elevation from about 900 to 2,000 m a.s.l. (Rasulova 1991).
Habitat characteristics: *Chondrilla gibbirostris* vegetation develops on screes and gravel bars in river alluvium. Occasionally, it also inhabits stony fields or road embankments and ditches (Rasulova 1991; Nowak et. al. 2016b).

PAC-ACc08. Community of *Tetracme bucharica* (thermophilous scree and steep slope vegetation of south-western Pamir-Alai Mts) (Fig. 397)

Diagnostic species: *Tetracme bucharica.*
Constant species: *Tetracme bucharice.*
Geographical range: This vegetation is distributed in hot, lowland areas of Middle Asia, particularly in south-western Tajikistan, southern Uzbekistan and the Fergana Basin. The stands of *Tetracme bucharice* have been recorded at lowland to colline elevation from about 400 to 900 m a.s.l. (Ovchinnikov 1978).
Habitat characteristics: This vegetation develops on screes, gypsum outcrops, rupicolous badlands and sandy dunes in the semi-desert zone of Middle Asia. Its final classification needs further study (Ovchinnikov 1978).

PAC-ACc09. Community of *Olgaea chodshamuminensis* (scree-like thermophilous scrub of colline and montane belts in south-western Tajikistan) (Fig. 398)

Fig. 399. Community of *Echinops chloroleucus* on sandy dunes in Panj River Valley near Vanch, Western Pamir, Tajikistan (ca. 1,550 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Olgaea chodshamuminensis.*
Constant species: *Olgaea chodshamuminensis.*
Geographical range: This endemic community is known from only one location on Mount Khodzhamumin near Vose in Khatlon district. It develops on gypsum and salt screes at an elevation of about 900–1,300 m a.s.l. (Rasulova 1991).
Habitat characteristics: This vegetation develops on eroded gypsum and salt screes, occurring on gravel and rock slides, also on aprons and colluvial cones (Ovchinnikov 1978).

PAC-ACc11. Community of *Echinops chloroleucus* (Fig. 399)

Diagnostic species: *Echinops chloroleucus.*
Constant species: *Echinops chloroleucus.*
Geographical range: This community is known from the Panj, Vanch, Rushan, Shugnan and Shahdarian Valleys in the western Pamir. It inhabits the slopes of the valleys at an elevation of about 1,550–3,100 m a.s.l. (Kinzikaeva 1988).
Habitat characteristics: This vegetation develops on aprons, colluvial cones, sandy dunes and gravel bars in arid climatic zone of the western Pamir (Kinzikaeva 1988).

Thermophilous chasmophytic vegetation of walls and road verges in subcontinental regions of Middle Asia

Thermophilous chasmophytic vegetation of walls and road verges in subcontinental regions of temperate Europe, Middle East, Middle Asia and North Africa

CYM. *Cymbalario-Parietarietea diffusae* Oberdorfer 1969 (Fig. 400)

The *Cymbalario-Parietarietea* class resembles *Asplenietea trichomanis*, as both contain vegetation found on rock outcrops and walls. However, *Cymbalario-Parietarietea* thrives in more nutrient-rich habitats and includes many nutrient-demanding and calcicole species. The Irano-Turanian Region is its centre of origin, especially dry, rocky areas, where nutrient-rich dust accumulates on the rocks without being washed away. This vegetation consists of small ferns, mosses and seed plants like *Corydalis* and *Parietaria*.

CYM-A. *Tortulo-Cymbalarietalia* Segal 1969 (Fig. 401)

This vegetation develops mainly on walls and escarpments throughout the Irano-Turanian Region (as well as in the Mediterranean and temperate Europe). It combines species of *Asplenietea trichomanis* (e.g., small ferns) with diagnostic species of the *Cymbalario-Parietarietea*.

CYM-AA. *Parietario judaicae-Hyoscyamion aurei* Brullo et Guarino 1999 (Fig. 402)

This vegetation is distributed throughout Middle Asia. It prefers shady places at the base of rock walls, with nutrient-rich, moist and nitrophilous soil. It preferably inhabits lowland, colline and lower montane belts.

CYM-AA01. *Corydalidetum kashgaricae* Nowak, S. Nowak, Nobis et A. Nobis 2016 (rupicolous and scree vegetation of arid zone of Central Asia) (Fig. 403)

Diagnostic species: *Corydalis kashgarica.*
Constant species: *Parietaria judaica*, *Corydalis kashgarica.*

Fig. 400. Typical sparse vegetation of *Cymbalario-Parietarietea diffusae* on compacted escarpments and eroded landslides with *Parietaria judaica* near Narvad, Pastrud-darya River Valley, Tajikistan (ca. 2,250 m a.s.l.). Photo: A. Nowak.

Fig. 401. Community of *Parietaria serbica* at the base of the granite wall near Takob, Tajikistan (ca. 1,750 m a.s.l.). Photo: A. Nowak.

Fig. 402. Vegetation of *Parietario judaicae-Hyoscyamion aurei* with *Parietaria judaica* on limestone rock near Nofin, Haft-kul Valley, Tajikistan (ca. 1,800 m a.s.l.). Photo: A. Nowak.

Fig. 403. *Corydalis kashgarica* on gravel deposits near Sary-Tala, Peter the First Range, Tajikistan (ca. 1,860 m a.s.l.). Photo: A. Nowak.

Geographical range: *Corydalis kashgarica* is a widespread scree plant across the whole Middle Asia (Pamir-Alai, Tian Shan, Kunlun Mts; Ovchinnikov 1975). In Tajikistan, the species was found on steep conglomerate screes in the central section of the Zeravshan Mts in the valleys of Pastrud-darya and Yagnob rivers. The association is distributed in the upper montane zone at elevations of approx. 1,500–2,200 m a.s.l. (Nowak et. al. 2016b).
Habitat characteristics: It was found on a conglomerate steep and compact screes of undercut colluvial cones. It was noted on limestone and dolomite debris of alkaline reaction. The association generally inhabits the western exposures with almost vertical inclinations of approx. 75–85° (Nowak et. al. 2016b).

CYM-AA01a. *Corydalidetum kashgaricae trigonelletosum gontscharovii* Nowak, Świerszcz, S. Nowak et Nobis 2021 (rupicolous vegetation on screes or steep slopes of the eastern Pamir-Alai and Darvaz Mts) (Fig. 404)

Diagnostic species: *Astragalus trachycarpus, Corydalis kashgarica, Pulicaria salviifolia, Trigonella gontscharovii* (= *Melilotoides gontscharovii, Melissitus gontscharovii*).
Constant species: *Glaucium squamigerum, Pulicaria salviifolia, Trigonella gontscharovii.*
Geographical range: The community with *Trigonella gontscharovii* was found on steep, crumbly scree mainly in the Darvaz Mts. Plots of the vegetation were found mainly in the montane belt, within elevation range between 1,350 and 2,250 m a.s.l. (Nowak et al. 2021c).
Habitat characteristics: The subassociation occurs on very steep screes and landslides with high rate of surface runoff (ca 80° on average). The community develops mainly on southern and south-eastern exposures (Nowak et al. 2021c).

CYM-AB. *Cymbalario muralis-Asplenion* Segal 1969 (chasmophytic vegetation of thermophilous, lowland to colline shaded habitats in Eurasia, including Middle Asia)

Fig. 404. Community of *Trigonella gontscharovii* inhabiting escarpments near Childara, Darvaz Mts, Tajikistan (ca. 1,450 m a.s.l.). Photo: A. Nowak.

This nitrophilous, thermophilous chasmophytic vegetation occurs throughout Middle Asia and southern parts of Central Asia. Often it occurs on man-made habitats. It is often found in man-made habitats. It prefers shady sites with high levels of dust containing organic matter and mineral nutrients.

CYM-AB-01. *Asplenio fontani-Ceterachetum officinarum* Gillet ex Ferrez 2009 (chasmophytic thermophilous vegetation of shaded clefts and crevices of Middle Asia) (Fig. 405)

Diagnostic species: *Asplenium ceterach* (= *Ceterach officinarum*).
Constant species: *Asplenium ceterach, Brachythecium albicans, Encalypta vulgaris, Galium spurium, Geranium divaricatum, G. rotundifolium, Grimmia pulvinata, Hypnum cupressiforme, Syntrichia ruralis, Tortula muralis.*
Geographical range: In Tajikistan, *Asplenium ceterach* has been reported from several locations

Fig. 405. *Asplenio fontani-Ceterachetum officinarum* in shaded rock cleft near Romit, Tajikistan (ca. 1,270 m a.s.l.). Photo: A. Nowak.

Fig. 406. *Cheilanthes persica* on a rock wall in Vagashtan near Haft Kul Valley, Zeravshan Mts, Tajikistan (ca. 1,300 m a.s.l.). Photo: A. Nowak.

in the western part of the country. The distribution of the association is restricted to the lower and middle elevations of the Zeravshan, Hissar and Karateginian ranges. It was recorded in submontane and colline zones, within an elevation range of 900–1,900 m a.s.l. (Nowak et al. 2015c).
Habitat characteristics: Community of *Asplenium ceterach* occurs most frequently on alkaline rock substrates mainly on limestone and dolomite (pH 7.2–8.4). This vegetation has been found in coarse rock crevices, often under the overhanging ledges. It generally develops on vertical walls, sometimes overhanging, with a mean inclination close to 90°. This association generally occurs on northwestern and northern exposures, but it was also present on the southern sides of shaded rock faces (Nowak et al. 2015c).

CYM-AB02. *Cheilanthetum persicae* A. Nowak, S. Nowak, Nobis et A. Nobis 2015 (chasmophytic thermophilous vegetation of shaded clefts, crevices and anthropogenic habitats of Middle Asia) (Fig. 406)

Diagnostic species: *Cheilanthes persica.*
Constant species: *Brachythecium albicans, Carex koshewnikowii, Cheilanthes persica, Encalypta vulgaris, Geranium divaricatum, Hypnum cupressiforme, Poa bulbosa, Tortula inermis, T. muralis.*
Geographical range: The phytocoenosis of *Cheilanthetum persicae* has been found at several sites in the Hissar, Zeravshan, Turkestan and Karateginian Mts, at elevation of 1,000 to 1,700 m a.s.l. (Nowak et al. 2015c).
Habitat characteristics: The association often occurs in limestone and dolomite rocks (pH 7.7–8.5) with coarse crevices and clefts. It has also been found on man-made walls. *Cheilanthetum persicae* was found mainly on south-western exposures with mean inclinations of approx. 90°. Compared to other fern communities, the patches of *Cheilanthethum persicae* occupy less shaded places, sometimes overgrowing very sunny walls or faces on western or southeastern exposures (Nowak et al. 2015c).

Vegetation of rooted floating or submerged macrophytes of stagnant mesotrophic, eutrophic and brackish freshwater bodies and slowly flowing shallow streams

Freshwater aquatic vegetation

Vegetation of rooted floating or submerged macrophytes of stagnant mesotrophic, eutrophic and brackish freshwater bodies and slowly flowing shallow streams

POT. *Potamogetonetea* Klika in Klika et Novák 1941

The class *Potamogetonetea* includes aquatic macrophyte vegetation rooted in the bottom of water bodies or streams. Most of these plants are perennial, submerged or having natant leaves. Some types of vegetation within this class require high water levels throughout the year, while some others tolerate or even require short-term exposure of the bottom, but not its complete drying out. This cosmopolitan class is not particularly diverse in Middle Asia, but is represented here by two orders (*Potametalia* and *Zannichellietalia*) and four alliances (*Nymphaeion*, *Potamion*, *Ranunculion aquatilis* and *Batrachion fluitantis*).

POT-A. *Potametalia* Koch 1926

POT-AA. *Nymphaeion* Oberdorfer 1957 (aquatic vegetation of large macrophytes of mesotrophic to eutrophic waters) (Fig. 407)

The *Nymphaeion albae* alliance includes vegetation dominated by large dicot aquatic macrophytes (e.g. *Nymphaea*, *Nuphar*) that are rooted in the bottom and have leaf rosettes or individual leaves floating on the water surface. Most of the dominant species have large insect-pollinated flowers. This vegetation occurs in shallow, meso- to eutrophic, still or slow-flowing waters in temperate and boreal zones. In the successional sequence of aquatic macrophyte vegetation, it replaces submerged macrophyte vegetation and its high biomass production contributes to rapid terrestrialization.

Fig. 407. An oxbow lake near Dusti with *Nymphaea odorata*, Tajikistan (ca. 370 m a.s.l.). Photo: A. Nowak.

POT-AAc01. Community of *Nymphaea odorata* (Fig. 408)

Diagnostic species: *Nymphaea odorata.*
Constant species: *Nymphaea odorata.*
Geographical range: One site of this community has been recorded in the old channel of the river Panj near Dusti at an elevation of ca. 380 m a.s.l. Situated in a built-up area, it is used as a reservoir for field irrigation and as a local bathing place.
Habitat characteristics: The stands of *Nymphaea odorata* develop in eutrophic water of an oxbow lake and in the nearby channels (Volkova et al. 2024).

POT-AB. *Potamion* Miljan 1933 (vegetation of rooted floating-leaf macrophytes of sheltered nutrient-rich freshwaters)

This group includes vegetation types dominated by species of *Potamogeton*, *Myriophyllum* and *Najas*. Most of them have narrow submerged leaves or leaflets, although some have large entire leaves, which are either submerged or with blades floating on the water surface. This type of vegetation produces less biomass than *Nymphaeion albae* vegetation, although the dominant species frequently occupies the entire water column. Dominant species of the *Potamion* communities have small, inconspicuous flowers, either water-pollinated or emerging above the water surface and pollinated by wind.

POT-AB01. *Potametum denso-nodosi* de Bolós 1957 (aquatic vegetation of shallow paddy fields and lakes in western Tajikistan) (Fig. 409)

Diagnostic species: *Potamogeton nodosus.*
Constant species: *Potamogeton nodosus.*
Geographical range: This community is relatively common in the rice fields of Tajikistan. It has been found at elevation around 700 to 1,000 m a.s.l. in the valley of the Ze-

Fig. 408. Community of *Nymphaea odorata* near Dusti, Tajikistan (ca. 370 m a.s.l.). Photo: A. Nowak.

Fig. 409. Aquatic vegetation of *Potametum denso-nodosi* in shallow waters of paddy fields near Garibak, Zeravshan River Valley, Tajikistan (ca. 950 m a.s.l.). Photo: A Nowak.

ravshan and Khanaka rivers (Nowak S. et al. 2013a).
Habitat characteristics: The association of *Potamogeton nodosus* develops in alkaline waters (pH 7.3–8.2) relatively deep (20–25 cm), on muddy soils with a relatively high sand content (Nowak S. et al. 2013a).

POT-AB02. *Potametum lucentis* Hueck 1931 (aquatic vegetation of lakes and ponds in western Tajikistan)

Diagnostic species: *Potamogeton lucens.*
Constant species: *Potamogeton lucens.*
Geographical range: This association has been recorded in lakes and anthropogenic ponds in western Tajikistan (Zeravshanian, Hissaro-Darvasian, East-Tajikistanian and South-Tajikistanian and East-Pamirian geobotanical regions) at elevation up to 4,000 m a.s.l. It has recently been confirmed in the Muminobod area (Volkova et al. 2024).
Habitat characteristics: Still water bodies and lakes from oligo- to eutrophic.

POT-AB03. *Potametum natantis* Hild 1959 (aquatic vegetation of eutrophic ponds, artificial reservoirs and paddy fields in Middle Asia) (Fig. 410)

Diagnostic species: *Potamogeton natans.*
Constant species: *Potamogeton natans.*
Geographical range: This association has been recorded in the Syr-darya River Valley in northern Tajikistan at an elevation of about 360 m a.s.l. (Ovchinnikov 1957).
Habitat characteristics: Still, eutrophic water bodies, ditches and slow flowing rivers.

POT-AB04. *Potametum perfoliati* Miljan 1933 (aquatic vegetation of eutrophic ponds and artificial reservoirs in Middle Asia) (Fig. 411)

Fig. 410. Vegetation of *Potametum natantis* developed in shallow channels of Syr-darya River near waters of paddy fields near Dehmoy, Tajikistan (ca. 330 m a.s.l.). Photo: A Nowak.

Fig. 411. Aquatic vegetation of *Potametum perfoliati* found in Kuli Moron Lake, Zeravshan River Valley, Tajikistan (ca. 2,210 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Potamogeton perfoliatus.*
Constant species: *Potamogeton perfoliatus.*
Geographical range: This association has been recorded throughout Tajikistan in the valleys of the Syr-darya, Vakhsh, Amu-darya, Zeravshan, Surkhob, Panj rivers and in alpine lakes of the Eastern Pamir (Ovchinnikov 1957).
Habitat characteristics: Various, still or flowing, meso- to eutrophic water bodies, lakes and rivers.

POT-AB05. *Stuckenio pectinati-Myriophylletum spicati* Rivas Goday 1964 (aquatic vegetation of alpine lakes and ponds in Tajikistan) (Fig. 412)

Diagnostic species: *Myriophyllum spicatum.*
Constant species: *Myriophyllum spicatum.*
Geographical range: This association has been recorded throughout Tajikistan in the springs, alpine lakes and old channels in Zeravshanian, South-Tajikistanian, Hissaro-Darvasian and East Pamirian regions at an elevation of ca. 400–4,100 m a.s.l. (Ovchinnikov 1981).
Habitat characteristics: Various, still, oligo- to mesotrophic water bodies, lakes and springs.

POT-AB06. *Myriophylletum verticillati* Gaudet ex Šumberová in Chytrý 2011 (aquatic vegetation of alpine lakes and ponds in Tajikistan)

Diagnostic species: *Myriophyllum spicatum.*
Constant species: *Myriophyllum spicatum.*
Geographical range: This association has been recorded in northern and central Tajikistan in lakes and alpine ponds in the valley of Syr-darya and in the Peter the First Mts, at an elevation of ca. 400–3,900 m a.s.l. (Ovchinnikov 1981).
Habitat characteristics: Various, still, meso- to eutrophic waters of lakes and alpine ponds.

POT-AB07. *Potametum crispi* von Soó 1927 (aquatic vegetation of eutrophic ponds and artificial reservoirs in Middle Asia (Fig. 413)

Diagnostic species: *Potamogeton crispus.*

Fig. 412. Aquatic vegetation of *Stuckenio pectinati-Myriophylletum spicati* found in Kuli Moron Lake, Tajikistan (ca. 2,210 m a.s.l.). Photo: A. Nowak.

Fig. 413. *Potametum crispi* found in Syr-darya River near Khujand, Tajikistan (ca. 340 m a.s.l.). Photo: A. Nowak.

Constant species: *Potamogeton crispus.*
Geographical range: Stands of *Potametum crispi* have been recorded in the valleys of Syr-darya, Amu-darya and Vakhsh rivers and additionally in alpine lakes in the Eastern Pamir at an elevation of ca. 330–3,800 m a.s.l. (Ovchinnikov 1981). Recently the species was also found in the vicinity of Nurek and Kulob (Volkova et al. 2024).
Habitat characteristics: Various, stagnant, meso- to eutrophic lakes and alpine ponds.

POT-ABc01. Community of *Ludwigia peploides* subsp. *stipulacea* (anthropogenic vegetation of rivers, ditches and eutrophic pools of the Pamir-Alai foothills) (Fig. 414)

Diagnostic species: *Ludwigia peploides* subsp. *stipulacea.*
Constant species: *Ludwigia peploides* subsp. *stipulacea.*
Geographical range: Large stands of this species have been noted in the Kofarnikhon River and in anthropogenic pools and paddles in the southern suburbs of Dushanbe. *Ludwigia peploides* subsp. *stipulacea* has recently been found in Tajikistan as a newcomer (Nobis et al. 2015).
Habitat characteristics: Various stagnant or flowing water in rivers, pools and paddles, occasionally city irrigated lawns.

POT-ABc02. Community of *Myriophyllum sibiricum*

Diagnostic species: *Myriophyllum sibiricum.*
Constant species: *Myriophyllum sibiricum.*
Geographical range: This aquatic vegetation has recently been found in the Eastern Pamir, in Bulunkul, Chakankul and Mukurchilyob lakes and in the oxbow of an alpine stream, at an elevation of about 3,800–4,200 m a.s.l. (Volkova et al. 2024).

Fig. 414. *Ludwigia peploides* subsp. *stipulacea* in shallow waters of Kofarnikhon River near Sunbula, Tajikistan (ca. 680 m a.s.l.). Photo: A Nowak.

Habitat characteristics: Oligo- to mesotrophic alpine lakes and streams of the harsh, continental climatic zone.

Vegetation of crosswort rooted macrophytes in shallow stagnant freshwaters

POT-AC. *Ranunculion aquatilis* Passarge ex Theurillat in Theurillat et al. 2015

The *Ranunculion aquatilis* includes aquatic vegetation of shallow, often periodic, still or slow-flowing waters with significant seasonal fluctuations of water level. In Middle Asia this vegetation occurs mainly in natural habitats such as alpine ponds and streams. It is less common in man-made channels and ditches.

POT-AC01. *Potametum graminei* Lang 1967 (vegetation of shallow alpine lakes in the Pamir-Alai Mts) (Fig. 415)

Diagnostic species: *Potamogeton gramineus.*
Constant species: *Potamogeton gramineus.*
Geographical range: In Middle Asia this species has been recorded in Darvaz, Peter the First, the Pamir Mts (Tajikistan), and Transalai Mts (Kyrgyzstan). It inhabits shallow alpine ponds at an elevation of about 2,200–3,900 m a.s.l. (Volkova et al. 2024).
Habitat characteristics: Oligotrophic, shallow alpine ponds with cold, well oxygenated water.

POT-AC02. *Potametum pusilli* von Soó 1927 (aquatic vegetation of eutrophic ponds, artificial reservoirs and paddy fields of Middle Asia) (Fig. 416)

Diagnostic species: *Potamogeton pusillus.*
Constant species: *Potamogeton pusillus.*
Geographical range: The community is relatively rare in rice fields of Tajikistan, although the diagnostic taxon, *Potamogeton pusillus*

Fig. 415. Aquatic vegetation of *Potametum graminei* found in shallow waters of Tulpar-Kul Lake, Alai Valley, Kyrgyzstan (ca. 3,600 m a.s.l.). Photo: A. Nowak.

Fig. 416. *Potamogeton pusillus*, a diagnostic species for the *Potametum pusilli* association, in eutrophic waters of rice paddies, near Khujand, Syr-darya River Valley, Tajikistan (ca. 330 m a.s.l.). Photo: M. Nobis.

s. str., occurs more commonly in this country (Ovchinnikov 1957; Nobis et al. 2010). A patch of this association was found in the shallow water of rice fields north of Pandzhikent in the valley of the Zeravshan River (Nowak S. et al. 2013a).
Habitat characteristics: It occurs in alkaline waters with a pH reaction of around 7.8. The association develops in localities where *Oryza sativa* forms less dense stands, in both peripheral and central parts of crop stands (Nowak S. et al. 2013a).

POT-AC03. *Potametum berchtoldii* Krasovskaja 1959 (aquatic vegetation of eutrophic ponds, artificial reservoirs and paddy fields of Middle Asia) (Fig. 417)

Diagnostic species: *Potamogeton berchtoldii.*
Constant species: *Potamogeton berchtoldii.*
Geographical range: In Tajikistan, this species has been recorded in the Syr-darya Valley, the Hissor area and Lake Serimadarun near Iskander-kul, at an elevation of about 400–2,250 m a.s.l. (Nobis et al. 2010).
Habitat characteristics: Oligotrophic to eutrophic lakes and ponds, sporadically slow-flowing waters.

POT-AC04. *Ranunculetum natantis* nom. prov. (aquatic vegetation of alpine shallow lakes and pools in the eastern Pamir Mts) (Fig. 418)

Diagnostic species: *Ranunculus natans.*
Constant species: *Ranunculus natans.*
Geographical range: In Tajikistan, this vegetation has been recorded in alpine ponds at highly elevated plateaus and valleys, at an elevation of about 2,600–4,300 m a.s.l. (Ovchinnikov 1968).
Habitat characteristics: Oligotrophic alpine ponds, pools within a fen or mire complex.

POT-AC05. *Potametum filiformis* Koch 1926 (syn. *Charo-Potametum filiformis* Spence 1964) (vegetation of shallow alpine lakes and pools in Middle Asia) (Fig. 419)

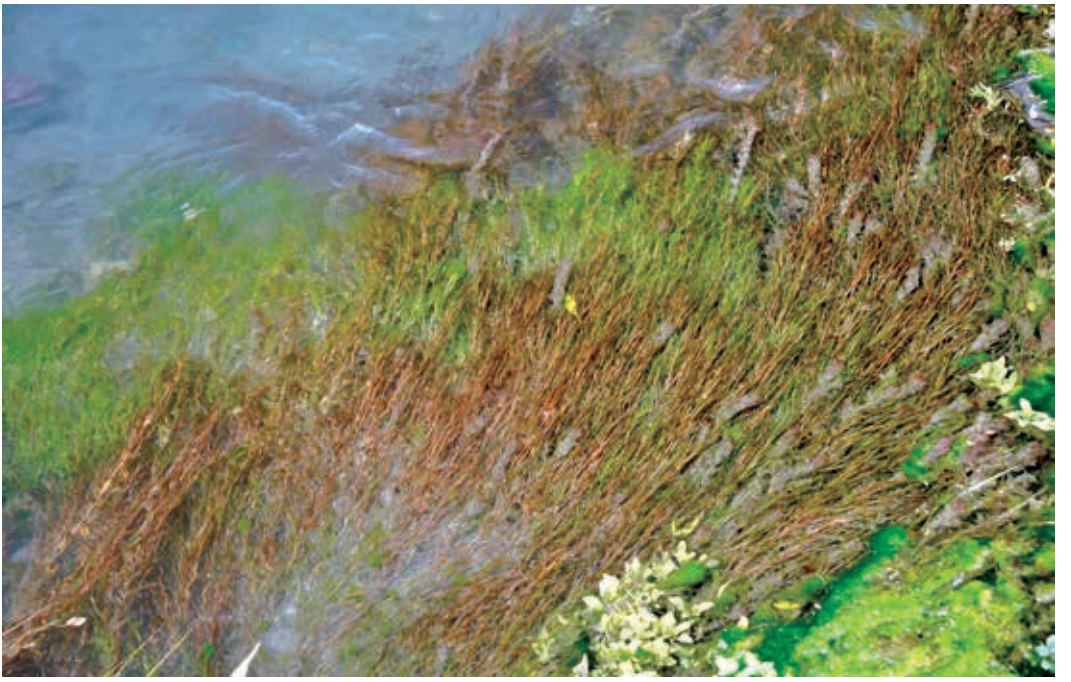


Fig. 417. Vegetation of *Potametum berchtoldii* in a stream near Durman village, Zeravshan River Valley, Tajikistan (ca. 900 m a.s.l.). Photo: M. Nobis.

Fig. 418. Aquatic vegetation of *Ranunculetum natantis* in a shallow pool near Yashil-Kul Lake, Terskey Ala-Too Mts, Kyrgyzstan (ca. 3,770 m a.s.l.). Photo: A. Nowak.

Fig. 419. Aquatic vegetation of the *Potametum filiformis* association in an alpine pool near Sarytag, Terskey Ala-Too Mts, Kyrgyzstan (ca. 3,770 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Potamogeton filiformis.*
Constant species: *Potamogeton filiformis.*
Geographical range: This aquatic association has been recorded mainly in the alpine belt of the Fann Mts and in the eastern Pamirian lakes. It inhabits standing or slow-flowing streams at an elevation of about 2,200–4,200 m a.s.l. (Ovchinnikov 1968).
Habitat characteristics: Oligotrophic alpine ponds, pools and streams with still or slow-flowing waters.

Vegetation of crowfoot and milfoil rooted macrophytes in shallow moving freshwaters

POT-AD. *Batrachion fluitantis* Neuhäusl 1959

The vegetation of the *Batrachion fluitantis* alliance includes communities dominated by species of *Batrachium* (*Ranunculus* subgen. *Batrachium*), *Callitriche*, and other submerged aquatic macrophytes adapted to fast-flowing water. They inhabit rivers usually with fluctuating water levels, mesotrophic with sandy or gravelly bottoms. Plants of this vegetation have roots or rhizomes anchored to the bottom, elastic and firm stems, and leaves with blades divided into long, narrow parts. Some species also have leaves that float on the water surface. In addition to generative reproduction, the species are often spread by vegetative fragments. This vegetation occurs mainly in the upper and middle sections of rivers or in larger streams, but also in some clean still waters.

POT-AD01. *Stuckenietum amblyophyllae* Nowak et Nobis 2012 (vegetation of shallow alpine lakes and brooks in the Pamir-Alai Mts) (Fig. 420)

Diagnostic species: *Stuckenia amblyophylla.*
Constant species: *Stuckenia amblyophylla.*
Geographical range: Patches of the *Stuckenietum amblyophyllae* association occur in the Pamir-Alai Mts at elevation from about 1,900 to almost

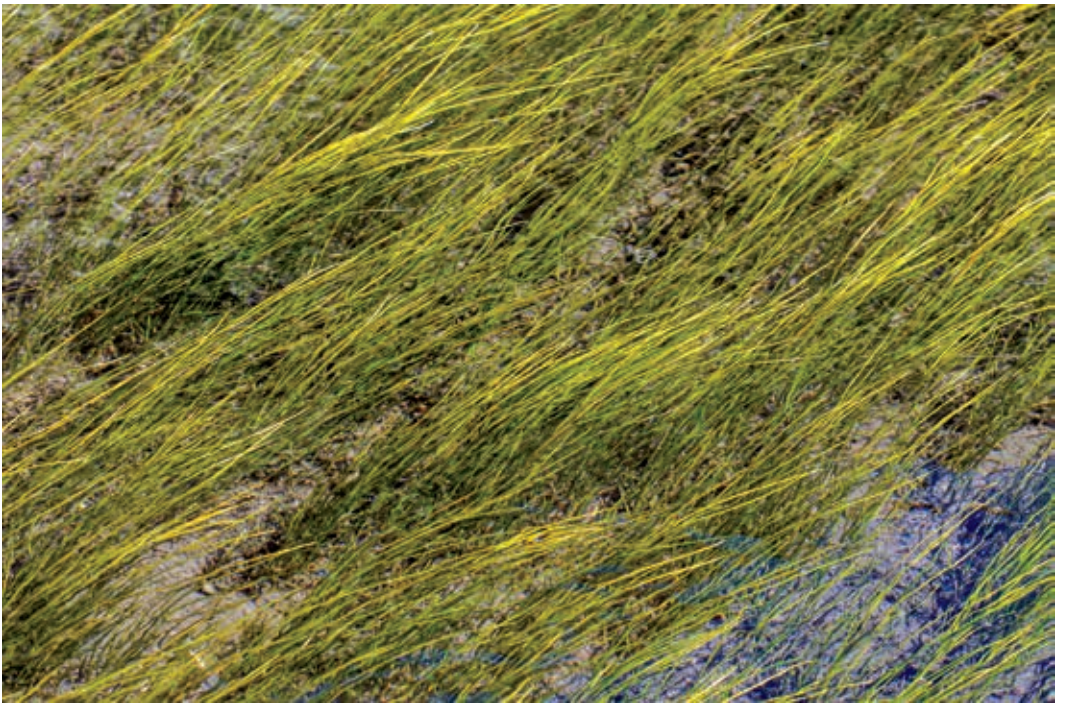


Fig. 420. Dense stand of *Stuckenietum amblyophyllae* in alpine stream near Iskander-kul, Fann Mts, Tajikistan (ca. 2,200 m a.s.l.). Photo: A. Nowak.

3,000 m a.s.l. (Nowak, Nobis 2012). This association can also occur in alpine waters of the whole Middle Asia.

Habitat characteristics: Stands of this new association occur in high alpine landscapes in cool streams with medium flow velocities. They were mostly found in small streams in U-shaped, flattened valleys eroded by glaciers. The patches of the community occurred mostly in waters that were clean, transparent and oligotrophic waters, although it was found to be able to withstand relatively high siltation (Nowak, Nobis 2012).

POT-AD02. *Stuckenietum pectinati* Carstensen ex Hilbig 1971 (aquatic vegetation of eutrophic ponds and artificial reservoirs in Middle Asia) (Fig. 421)

Diagnostic species: *Stuckenia pectinata.*
Constant species: *Stuckenia pectinata.*
Geographical range: Sites of this vegetation are scattered across Tajikistan and occur in various waters, mainly in alpine streams and lakes, but also in lowland rivers such as Syr-darya or Khavzi Kainar Lake near Kulob (Volkova et al. 2024). This vegetation inhabits mainly running waters at an elevation from about 400 to almost 3,000 m a.s.l. This association can also occur in alpine waters throughout Middle and Central Asia.

Habitat characteristics: Stands of this new association occur mainly in fast running, cool streams and ditches. Only two stands have been recorded in the Syr-darya River near Khujand and Khavzi Kainar Lake near Kulob.

POT-ADc01. Community of *Stuckenia pamirica* (vegetation of shallow alpine lakes and brooks in the eastern Pamir Mts) (Fig. 422)

Diagnostic species: *Stuckenia pamirica.*
Constant species: *Stuckenia pamirica.*

Fig. 421. Stand of *Stuckenietum pectinati* in Syr-darya River near Khujand, Tajikistan (ca. 360 m a.s.l.). Photo: A. Nowak.

Fig. 422. Community of *Stuckenia pamirica* in shallow waters of small ponds near Alichur, Eastern Pamir, Tajikistan (ca. 3,600 m a.s.l.). Photo: A. Nowak.

Geographical range: Stands of this vegetation have only been recorded around Alichur in the Eastern Pamir, in small or medium-sized streams at an elevation of about 3,600 m a.s.l. The range of this community is probably much wider, as the diagnostic species has been reported from the Tian Shan, Himalayas and Qinghai Province in China (Ovchinnikov 1957; GBIF 2024).
Habitat characteristics: Vegetation dominated by *Stuckenia pamirica* forms dense stands in cool, fast-running waters in the alpine belt of the Pamir.

POT-B. *Zannichellietalia pedicellatae* Schaminée, Lanjouw et Schipper ex Mucina et Theurillat ined. (vegetation of rooted macrophytes in meso-eutrophic brackish waters)

This vegetation occurs in shallow, warm, stagnant or slowly flowing waters throughout Middle Asia. It consists of species anchored to the bottom of the water body. In Tajikistan and adjacent territories, this vegetation inhabits mainly rice paddy fields in the valleys of large rivers such as the Syr-darya, Amu-darya, Zeravshan and others. It is grouped in only one alliance – *Zannichellion pedicellatae*.

POT-BA. *Zannichellion pedicellatae* Schaminée, Lanjouw et Schipper ex Passarge 1996 (vegetation of rooted macrophytes in meso-eutrophic, shallow, warm, brackish waters)

POT-BA-01. *Najadetum graminae* Nowak, S. Nowak et Nobis 2013 (vegetation of shallow paddy fields in western Tajikistan, mainly Syr-darya and Zeravshan River Valleys) (Fig. 423)

Diagnostic species: *Najas graminea.*
Constant species: *Najas graminea.*
Geographical range: This community is rare in the rice fields of Tajikistan. It was found

Fig. 423. *Najadetum graminae* in eutrophic, warm waters of rice paddies near Pandzhikent, Tajikistan (ca. 960 m a.s.l.). Photo: A. Nowak.

in the valley of the Zeravshan River near Pandzhikent and Sudzhina at an elevation of about 950–1,050 m a.s.l. This community prefers medium elevations and was not found in the lowlands of large river valleys (Nowak S. et al. 2013a).

Habitat characteristics: The association of *Najadetum graminae* develops in alkaline (pH 7.5–7.7), shallow waters (10-15 cm) on muddy substrates. The community develops in warm waters where *Oryza sativa* does not significantly shade the water surface (Nowak S. et al. 2013a).

POT-BA02. *Parvo-Potamo-Zannichellietum pedicellatae* De Soó 1947 (vegetation of shallow paddy fields in western Tajikistan, mainly Syrdarya and Zeravshan River Valleys)

Diagnostic species: *Zannichellia palustris.*
Constant species: *Zannichellia palustris.*
Geographical range: The community is relatively rare in the rice fields of Tajikistan. It was found only in the valley of the Zeravshan River at an elevation of about 900 to 1,000 m a.s.l. (Nowak S. et al. 2013a).

Habitat characteristics: The *Parvo-Potamo-Zannichellietum pedicellatae* association develops in alkaline waters (pH around 8.2), that are relatively deep (ca. 20 cm), on muddy soils with considerable sand content. The association develops in localities where the crop is not dense, in both peripheral and central parts of crop fields (Nowak S. et al. 2013a).

POT-BA03. *Ceratophyllo-Azolletum filiculoidis* Nedelcu 1967 (vegetation of shallow paddy fields in western Tajikistan) (Fig. 424)

Diagnostic species: *Azolla filiculoides.*
Constant species: *Azolla filiculoides.*
Geographical range: This community rarely occurs in the rice fields of Tajikistan. It was identified at an elevation of ca. 900 m a.s.l. in the valley

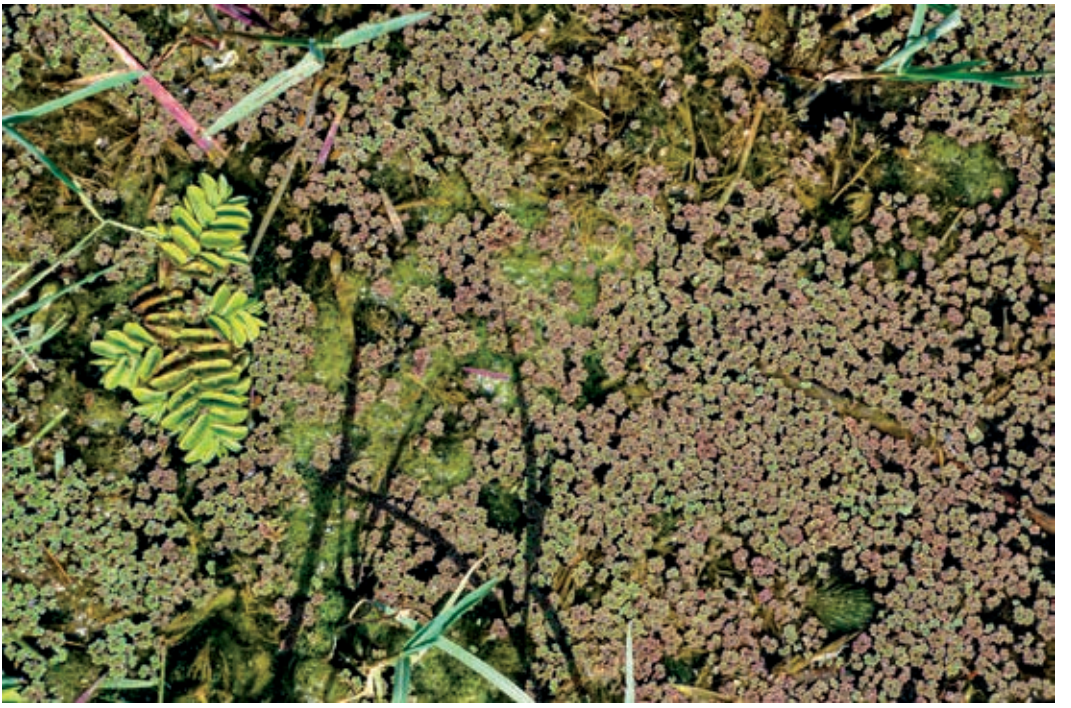


Fig. 424. *Ceratophyllo-Azolletum filiculoidis* dominated by *Azolla filiculoides* in shallow, eutrophic waters of rice paddies near Garibak, Tajikistan (ca. 950 m a.s.l.). Photo: A. Nowak.

of the Syr-darya River near Khudzhand. The main diagnostic species of the association, *Azolla filiculoides*, is a new, alien, recently found taxon in the flora of Tajikistan (Nobis, Nowak 2011; Nowak S. et al. 2013a).

Habitat characteristics: This vegetation develops in fertile, intensively used paddy fields. It forms dense floating mats in warm, alkaline (pH 7.9–8.1) and deep (about 35 cm) waters in fields with deep muddy substrate (Nowak S. et al. 2013a).

Spring and fen vegetation of the montane and alpine belts of Middle Asia

Vegetation of freshwater springs, shorelines and Swamps

Spring and fen vegetation of the montane and alpine belts of Middle Asia

Spring vegetation

MON. *Montio-Cardaminetea* Br.Bl. et Tüxen ex Klika et Hadač 1944

This vegetation class includes plant communities that develop in springs with cold and well oxygenated water. Low nutrient levels reduce the productivity of vascular plants, but promote increasing bryophyte cover. With increasing distance from a spring, flow rates and oxygenation decrease and the spring vegetation is replaced by other communities, typically mire and fen vegetation of the class *Scheuchzerio palustris-Caricetea nigrae*. This vegetation occurs in Middle Asia, mainly in the alpine belt, in zones of subhumid and humid climate with sufficient rainfall. It includes only one order – *Montio-Cardaminetalia*.

MON-A. *Montio-Cardaminetalia* Pawłowski in Pawłowski et al. 1928

MON-AA. *Cirsio hygrophili-Cortusion turkestanicae* Naqinezhad, Nowak, Nobis, S. Nowak, Świerszcz et Hájek 2021 (forb vegetation of water outflows in upper montane and alpine belts of the Irano-Turanian Mts)

Diagnostic species: *Cardamine uliginosa, Cirsium hygrophilum, Cortusa turkestanica, Mentha asiatica, Philonotis calcarea, Philonotis fontana, Stellaria fontana.*
Constant species: *Cardamine uliginosa, Cirsium hygrophilum, Mentha asiatica, Philonotis calcarea, Philonotis fontana, Stellaria fontana.*
Geographical range: The Pamir-Alai region and the Alborz Mts in the west Irano-Turanian Region (Naqinezhad et al. 2021).
Habitat characteristics: Springs and lateral outflows of cool and well-oxygenated water of mostly alkaline pH in montane to subalpine belts of the Middle Asian ranges (Naqinezhad et al. 2021).

MON-AA01. *Codonopsio clematidi-Cortusetum turkestanicae* Nowak, Nobis, S. Nowak et Plášek 2016 (forb vegetation of water outflows in the Pamir-Alai Mts) (Fig. 425)

Diagnostic species: *Aquilegia vicaria, Cardamine densiflora, Carex philocrena, Codonopsis clematidea, Cortusa turkestanica, Epilobium hirsutum, Hygroamblystegium tenax, Mentha asiatica, Palustriella decipiens, Philonotis calcarea, Poa trivialis, Silene vulgaris.*
Constant species: *Agrostis alba, Aquilegia vicaria, Brachythecium mildeanum, Bryum pseudotriquetrum, Calliergonella cuspidata, Cardamine densiflora, Carex philocrena, Carum carvi, Codonopsis clematidea, Cortusa turkestanica, Epilobium hirsutum, Equisetum arvense, Euphrasia pectinata, Festuca rubra, Galium turkestanicum, Heracleum lehmannianum, Hygroamblystegium tenax, H. varium, Ligularia thomsonii, Palustriella decipiens, Philonotis calcarea, Poa trivialis, Salix schugnanica, Stellaria fontana, Swertia juzepczukii, S. lactea, Veronica anagallis-aquatica.*
Geographical range: This association has been documented at several sites in the Zeravshan and Turkestan Mts. It has also been observed in the Hissar Mts near Romit village and in Alai range. It occupies relatively high elevations, ranging from 2,100 to 3,400 m a.s.l. and forms a lush vegetation on the margins of water outflows on gentle slopes (Nowak et al. 2016d).
Habitat characteristics: This association occupies rather nutrient-rich flushes on side water outflows on gentle slopes, close to tall-herb vegetation (Nowak et al. 2016d).

MON-AA02. *Epilobio tianschanici-Bryetum schleicheri* Nowak, Nobis, S. Nowak et Plášek 2016 (herbaceous vegetation of flat spring basins and headwaters with abundant bryophyte cover in the Pamir-Alai Mts) (Fig. 426)

Diagnostic species: *Agrostis alba, Bryum bimum, Bryum schleicheri, Epilobium tianschanicum,*

Fig. 425. Vegetation of the *Codonopsio clematidi-Cortusetum turkestanicae* association on a slope with a water outflow in Abshyr-Ata Valley, Alai Mts, Kyrgyzstan (ca. 2,650 m a.s.l.). Photo: A. Nowak.

Fig. 426. Vegetation patch of *Epilobio tianschanici-Bryetum schleicheri* inhabiting the spring basin in Artuch Valley, Zeravshan Mts, Tajikistan (a. 1,840 m a.s.l.). Photo: A Nowak.

Equisetum arvense, Philonotis calcarea, Scrophularia alata, Veronica beccabunga.

Constant species: *Agrostis alba, Barbarea arcuata, Bryum bimum, Bryum pseudotriquetrum, Bryum schleicheri, Carex orbicularis* subsp. *orbicularis, Catabrosa capusii, Epilobium minutiflorum, Epilobium tianschanicum, Equisetum arvense, Festuca rubra, Hygroamblystegium tenax, Juncus articulatus, Mentha asiatica, Palustriella decipiens, Philonotis calcarea, Philonotis fontana, Poa supina, Stellaria fontana, Trifolium repens, Veronica anagallis-aquatica, Veronica beccabunga.*

Geographical range: *Epilobio tianschanici-Bryetum schleicheri* is a typical spring phytocoenosis distributed in the alpine belt of mountain ranges of the western Pamir-Alai, Tian Shan and Ala-Tau Mts of Middle Asia. The association has rarely been recorded along the ranges of the Zeravshan and Hissar Mts. The phytocoenosis occurs within 1,800 to 2,800 m a.s.l. in the alpine zone (Nowak et al. 2016d; Naqinezhad et al. 2021).

Habitat characteristics: This association occurs exclusively in a crenic zone, sometimes extending downwards along the alpine brooks and rivulets. Plots of the phytocoenosis were found on alkaline substrates with very clear water of low conductivity (pH approx. 7.5, conductivity ca. 65 µS). The association sites are rather flat with inclination rarely exceeding 5° (Nowak et al. 2016d).

MON-AA03. *Clementsietum semenovii* Nowak, Nobis, S. Nowak et Plášek 2016 (herbaceous vegetation of flat flanks of the alpine rivulets in the Pamir-Alai and Tian Shan Mts) (Fig. 427)

Diagnostic species: *Angelica komarovii, Clementsia semenovii, Geranium regelii, Ligularia heterophylla, Philonotis fontana, Ranunculus rufosepalus.*

Constant species: *Angelica komarovii, Blysmus compressus, Bryum pseudotriquetrum, Bryum*

Fig. 427. Vegetation of *Clementsietum semenovii* growing alongside small tributary of the Pastrud-darya River near the Alaudin Lakes, Fann Mts, Tajikistan (ca. 2,650 m a.s.l.). Photo: A Nowak.

schleicheri, Carex orbicularis subsp. *orbicularis, Carum carvi, Clementsia semenovii, Kobresia persica, Festuca rubra, Geranium regelii, Heracleum lehmannianum, Mentha asiatica, Philonotis fontana, Primula olgae, Ranunculus rufosepalus, Stellaria fontana, Trifolium repens, Veronica beccabunga.*

Geographical range: *Clementsietum semenovii* has a potential range over the whole Pamir-Alai and western Tian Shan Mts, and is common in Tajikistan and Kyrgyzstan, as well as eastern Uzbekistan and western China (Ovchinnikov 1975). This association has been observed in the Zeravshan, Hissar, Turkestan and Darvaz Mts of western Pamir-Alai. It inhabits the highest elevations in the alpine zone, up to 3,500 m a.s.l. (Nowak et al. 2016d).

Habitat characteristics: Plots of the phytocoenosis were mainly found in the vicinity of spring outflows and along the uppermost brook channels with clear, cold water. The phytocoenosis usually occupies a verge along the rivulet bank. *Clementsia semenovii* has its own association occupying neutral habitats in terms of substrate reaction (mean pH 6.5) with moderate conductivity of ca. 150 µS. Only in a few cases were the plots of this association found on sloping ground (Nowak et al. 2016d).

MON-AA04. *Cirsio hygrophili-Myosotidetum rivularis* Naqinezhad, Nowak, Nobis, S. Nowak, Świerszcz et Kamrani in Naqinezhad et al. 2021

(spring vegetation of base-poor and slightly acidic to neutral habitats in the montane and alpine belt of the Central Alborz Mts) (Fig. 428)

Diagnostic species: *Cirsium hygrophilum, Myosotis sylvatica* subsp. *rivularis*, *Phalaris arundinacea.*

Constant species: *Alchemilla persica, Cardamine uliginosa, Carex orbicularis* subsp. *kotschyana, Cirsium hygrophilum, Cratoneuron commutatum, Juncus inflexus, Mentha longifolia, Myosotis sylvatica* subsp. *rivularis, Phalaris arundinacea.*

Fig. 428. Fen vegetation of *Cirsio hygrophili-Myosotidetum rivularis* along alpine brook in the alpine belt of Central Alborz Mts, Iran (ca. 2,300 m a.s.l.). Photo: A. Naqinezhad.

Geographical range: This vegetation occurs in the montane and alpine belt of the Central Alborz range in Iran (Naqinezhad et al. 2021).
Habitat characteristics: This association is one of the most common base-poor and slightly acidic to neutral spring vegetation types. A permanent source of water (including snowmelt) is necessary for its development (Naqinezhad et al. 2021).

MON-AA04a. *Cirsio hygrophili-Myosotidetum rivularis typicum* Naqinezhad, Nowak, Nobis, S. Nowak, Świerszcz et Kamrani in Naqinezhad et al. 2021
All data as in previous one – *Cirsio hygrophili-Myosotidetum rivularis.*

Fig. 429. Vegetation of *Cirsio hygrophili-Myosotidetum rivularis scrophularietosum umbrosae* along alpine brook in the alpine belt of Central Alborz Mts, Iran (ca. 1,850 m a.s.l.). Photo: A. Naqinezhad.

MON-AA04b. *Cirsio hygrophili-Myosotidetum rivularis scrophularietosum umbrosae* Naqinezhad, Nowak, Nobis, S. Nowak, Świerszcz et Kamrani in Naqinezhad et al. 2021 (Fig. 429)

Diagnostic species: *Cardamine uliginosa, Scrophularia umbrosa.*
Constant species: *Cardamine uliginosa, Carex orbicularis* subsp. *kotschyana, Cirsium hygrophilum, Juncus inflexus, Mentha longifolia, Poa pratensis, Scrophularia umbrosa, Veronica beccabunga.*
Geographical range: This type of vegetation ranges elevationally from 1,850 to 3,120 m a.s.l. (Naqinezhad et al. 2021).
Habitat characteristics: This subassociation is distinguished by *Scrophularia umbrosa* and occurs mostly around cold spring heads where a higher stagnant surface water supports more aquatic species such as *Veronica beccabunga* and *Phragmites australis* (Naqinezhad et al. 2021).

MON-AA05. *Epilobio pontici-Barbaretum plantagineae* Naqinezhad, Nowak, Nobis, S. Nowak, Świerszcz et Kamrani in Naqinezhad et al. 2021
(spring vegetation of (sub)montane to subalpine rivulets and in spring heads with stagnant and running water in the western Alborz Mts) (Fig. 430)

Diagnostic species: *Barbarea plantaginea, Epilobium ponticum, Mentha longifolia, Nasturtium officinale, Plantago major, Rumex crispus, Tanacetum balsamita* subsp. *balsamitoides, Trifolium pratense, Veronica anagallis-aquatica.*
Constant species: *Cardamine uliginosa, Carex orbicularis* subsp. *kotschyana, Cirsium arvense, Epilobium ponticum, Glyceria notata, Juncus inflexus, Mentha longifolia, Nasturtium officinale, Plantago major, Poa trivialis, Ranunculus amblyolobus, Rumex crispus, Tanacetum balsamita* subsp. *balsamitoides, Trifolium pratense, Trifolium repens, Veronica anagallis-aquatica.*
Geographical range: The vegetation ranges elevationally from 1,300 to 3,200 m a.s.l. (average 2,500 m; Naqinezhad et al. 2021).

Fig. 430. Fen vegetation of *Epilobio pontici-Barbaretum plantagineae* in the montane river valley in Alborz Mts, Iran (ca. 2,150 m a.s.l.). Photo: A. Naqinezhad.

Habitat characteristics: This association occurs mainly along small (sub)montane rivulets and in spring heads with stagnant and running water, and is restricted to the western parts of the Alborz Mts of Iran (Naqinezhad et al. 2021).

MON-AA06. *Ligularietum persicae* Naqinezhad, Nowak, Nobis, S. Nowak, Świerszcz et Kamrani in Naqinezhad et al. 2021 (spring vegetation of stream flanks and small steep rivulets or fringes of alpine fens in the Alborz Mts) (Fig. 431)

Diagnostic species: *Cirsium creticum, Heracleum persicum, Ligularia persica*.

Constant species: *Alchemilla persica, Cirsium hygrophilum, Cratoneuron commutatum, Heracleum persicum, Ligularia persica, Mentha longifolia, Poa pratensis, Ranunculus amblyolobus.*

Geographical range: This association ranges elevationally from 1,800 to 3,120 m a.s.l. (average 2,600 m) in the Alborz Mts (Naqinezhad et al. 2021).

Habitat characteristics: This association is found along streams and small steep rivulets and on the fringes of alpine spring fens. The dominance of the Alborz endemic *Ligularia persica* characterises this association, together with *Heracleum persicum*, another Irano-Turanian endemic wetland species (Naqinezhad et al. 2021).

Fig. 431. Spring fen vegetation of *Ligularietum persicae* along rivulet flank in the alpine belt of Alborz Mts, Iran (ca. 2,450 m a.s.l.). Photo: A. Naqinezhad.

MON-AAc01. Community of *Stellaria fontana* and *Catabrosa capusii* (pioneer vegetation of spring outflows and rivulet heads of Middle Asia) (Fig. 432)

Diagnostic species: *Catabrosa capusii, Stellaria fontana.*

Constant species: *Catabrosa capusii, Stellaria fontana.*

Geographical range: This one of the most widespread communities of small rivulets with fine gravel beds. It occurs mainly in the alpine belt, but has also been observed in the montane belt across the whole Middle Asian Mts (Nowak et al. 2016d).

Habitat characteristics: *Stellaria fontana* and *Catabrosa capusii* form almost monospecies stands on shallow waters of uppermost sections of rivulets or near spring basins, or on slopes with seepage water (Nowak et al. 2016d).

Fig. 432. Vegetation of the *Stellaria fontana* and *Catabrosa capusii* community, found in shallow waters of a small rivulet near Saripul, Zeravshan Mts, Tajikistan (ca. 2,650 m a.s.l.). Photo: A. Nowak.

Vegetation of free floating aquatic plants

Vegetation of free floating aquatic plants

LEM. *Lemnetea* de Bolós et Masclans 1955

This vegetation includes the species-poor aquatic vegetation of free-floating macrophytes that are not rooted in the bottom. They can be either natant (floating on the water surface) or submerged. Natant species include small lemnids, aquatic ferns and liverworts. Submerged floating macrophytes include *Lemna* spp., *Ceratophyllum* spp., *Utricularia* spp. and liverworts. This vegetation is one of the rarest in Middle Asia and occurs in eutrophic to mesotrophic shallow pools, oxbows and alpine lakes in the montane and alpine rivers. It includes only one order (*Lemnetalia minoris*) and one alliance (*Utricularion vulgaris*).

Fig. 433. Community of *Utricularia minor*, found near Poymazor, Vanch River Valley, Tajikistan (ca. 2,450 m a.s.l.). Photo: A Nowak.

LEM-A. *Lemnetalia minoris* (R. Tx. 1955) de Bolós et Masclans 1955

LEM-AA. *Utricularion vulgaris* Passarge 1964 (vegetation of bladderworts in mesotrophic to eutrophic water bodies)

This vegetation consists of communities of floating, submerged or natant plants inhabiting meso- to eutrophic, shallow water bodies. In Tajikistan, this vegetation has been recorded in a few places, mainly oxbows and temporary pools in alpine river valleys.

LEM-AAc01. Community of *Utricularia minor* (Fig. 433)

Diagnostic species: *Utricularia minor.*

Constant species: *Utricularia minor.*
Geographical range: This one of the rarest communities, found mainly in western and eastern Tajikistan from the Zeravshan Mts to the Eastern Pamir. It has been recorded in ponds and shallow lakes at elevation from 800 to 3,650 m a.s.l. (Nowak, Nobis 2020; Volkova et al. 2024).
Habitat characteristics: This community grows mainly in shallow, meso- and eutrophic pools, oxbows and small lakes in the montane and alpine valleys of central Tajikistan. It prefers calcium-rich, summer-warm habitats in alluvial valleys.

LEN-AAc02. Community of *Salvinia natans* (Fig. 434)

Diagnostic species: *Salvinia natans.*
Constant species: *Salvinia natans.*
Geographical range: Dense mats of *Salvinia natans* have been recorded on the banks of the Syr-darya River, in ditches and rice paddies near Khujand, at an elevation of about 400 m a.s.l.
Habitat characteristics: Eutrophic, stagnant or slow-flowing waters, sometimes among littoral vegetation.

Fig. 434. Community of *Salvinia natans* in shallow waters of rice paddy fields near Khujand, Tajikistan (ca. 390 m a.s.l.). Photo: A Nowak.

Reed swamp, sedge bed and herbland vegetation of freshwater or brackish water bodies and streams of Eurasia

Reed swamp, sedge bed and herbland vegetation of freshwater or brackish water bodies and streams of Eurasia

PHR. *Phragmito-Magnocaricetea* Klika in Klika et Novák 1941

This species-poor vegetation is formed of large perennial grasses, tall sedges, and in some cases also of broad-leaved herbs, which occurs in shallow, freshwater or brackish wetlands. It develops on unstable, muddy, and often flooded substrates, and is able to spread fastly. Most stands of these vegetation types are dominated by a single, often tall species, that produces large amounts of biomass, and contributes significantly to terrestrialisation. The mountainous areas of Middle and Central Asia are not particularly suitable for the diversity of reed vegetation, however in lowland river valleys it can occur on extensive areas in the littoral zones of still water bodies (e.g. oxbows), but specific types also occur on stream banks. *Phragmito-Magnocaricetea* is a globally widespread vegetation in the temperate zone, but it also occurs in areas with the Mediterranean-like climate. In Tajikistan, this vegetation is represented by one order (*Phragmitetalia australis*) and six alliances (*Phragmition austalis*, *Arundion collinae*, *Eleocharito palustris-Sagittarion sagittifoliae*, *Glycerio-Sparganion*, *Phalaridion arundinaceae* and *Magno-Caricion gracilis*).

PHR-A. *Phragmitetalia australis* Koch 1926 (reed vegetation of pond and lake littoral zone in Tajikistan)

PHR-AA. *Phragmition austalis* Koch 1926 (reed vegetation of pond and lake littoral zone in Tajikistan)

The *Phragmition australis* includes monodominant stands of tall grasses and other grass-like plants, which spread both clonally through rhizomes as well as by seed. This reed vegetation occurs in the littoral zones of lakes, ponds, rivers, streams and various wet anthropogenic habitats. This vegetation type is distributed across lowland and the colline zone of Middle and Central Asia.

PHR-AA01. *Typhetum angustifoliae* Pignatti 1953 (reed vegetation of alpine lakes in Tajikistan) (Fig. 435)

Diagnostic species: *Typha angustifolia.*
Constant species: *Typha angustifolia*.
Geographical range: *Typha angustifolia* dominated stands develope in the whole Middle Asia. In Tajikistan, this association has been noted mainly in the Syr-darya, Zeravshan, Kofarnikhon and Vakhsh River Valleys, mostly at elevation of 1,000–1,700 m a.s.l. (Nowak et al. 2014e).
Habitat characteristics: *Typhetum angustifoliae* spreads along river banks and ditches and, sporadically, in rice fields (Nowak S. et al. 2013a). The association develops in muddy and alkaline habitats, with medium water depth (Nowak et al. 2014e).

PHR-AA02. *Typhetum latifoliae* Nowiński 1930 (reed vegetation of eutrophic ponds, ditches and flooded areas in Tajikistan) (Fig. 436)

Diagnostic species: *Typha latifolia.*
Constant species: *Typha latifolia.*
Geographical range: As in the case of *Typhetum angustifoliae*, the association of *Typhetum latifoliae* is quite widely distributed in Tajikistan. It was found only in the Syr-darya and Zeravshan River Valleys. Only a single site was recorded at the edge of a rice field near Khudzhand (Nowak et al. 2014e).
Habitat characteristics: In general, this vegetation occupies river banks and ditches. The stands develop in muddy soils with a high clay content, on an alkaline substrate (Nowak S. et al. 2013a; Nowak et al. 2014e).

PHR-AA03. *Typhetum laxmannii* (Ubrizsy 1961) Nedelcu 1968 (vegetation of ditches, ponds and rice paddies with a static water level in Tajikistan) (Fig. 437)

Diagnostic species: *Typha laxmannii.*

Fig. 435. *Typhetum angustifoliae* growing in a littoral zone of the shallow pond near Sudzhina, Tajikistan (ca. 1,015 m a.s.l.). Photo: A. Nowak.

Constant species: *Typha laxmannii*, *Rumex crispus*.

Geographical range: *Typhetum laxmannii* is widespread in Tajikistan and the whole Middle Asia. A number of plots with *Typhetum laxmannii* have been found in the valleys of the Zeravshan, Syr-darya, Amu-darya, Vakhsh, Kofarnikhon, Surkhob and Panj rivers at elevation of ca. 950–1,650 m a.s.l. (Nowak et al. 2014e).

Habitat characteristics: The association occurs in various types of habitats close to water, mainly in roadside ditches, irrigation and drainage ditches, stagnant water bodies and streams (Nowak S. et al. 2013a). The association develops in places with temporary fluctuations in water depth during the vegetation period, on muddy, clayey substrates. It occurs in shallow (up to 10 cm depth) alkaline waters (Nowak et al. 2014e).

Fig. 436. Stand of *Typhetum latifoliae* found in a ditch near Tajikobod, Surkhob River Valley, Tajikistan (ca. 1,520 m a.s.l.). Photo: A. Nowak.

Fig. 437. Stand of *Typhetum laxmannii* found in a ditch near Khorbog, Tajikistan (ca. 1,170 m a.s.l.). Photo: A. Nowak.

Fig. 438. Stand of *Phragmitetum australis* inhabiting a ditch near Vose, Khatlon Province, Tajikistan (ca. 560 m a.s.l.). Photo: A. Nowak.

Fig. 439. Stand of *Scirpetum triqueteri* inhabiting a ditch near Vose, Khatlon Province, Tajikistan (ca. 560 m a.s.l.). Photo: A. Nowak.

PHR-AA04. *Phragmitetum australis* Savič 1926 (reed vegetation of eutrophic ponds, ditches and flooded areas in Tajikistan) (Fig. 438)

Diagnostic species: *Phragmites australis.*
Constant species: *Phragmites australis*.
Geographical range: *Phragmitetum australis* is one of the most common reed communities in Tajikistan and the whole Middle Asia. It is widely distributed in different elevational belts and has been observed in all investigated river valleys at elevation ranging from ca. 600 to 2,300 m a.s.l. (Nowak et al. 2014e).
Habitat characteristics: The association occurs in both natural (river banks, oxbow lakes) and anthropogenic (mining areas, rice fields) habitats. The phytocoenoses develop on muddy soils, sometimes with a significant admixture of gravel, in an alkaline substrate (Nowak S. et al. 2013a; Nowak et al. 2014e).

PHR-AA05. *Scirpetum triqueteri* Zonneveld 1955 (vegetation of eutrophic ponds and ditches in Tajikistan) (Fig. 439)

Diagnostic species: *Scirpus triqueter* (= *Schoenoplectus triqueter*).
Constant species: *Scirpus triqueter, Rumex crispus*.
Geographical range: This community is very rare along the watercourses and in Kofarnikhon the rice fields of Tajikistan. It has been found in the lower sections of the Syr-darya, Zeravshan and Panj River Valleys at elevation of ca. 320 to 900 m a.s.l. (Nowak S. et al. 2013a; Nowak et al. 2014e).
Habitat characteristics: *Scirpetum triqueteri* develops in shallow alkaline waters, in muddy substrates (Nowak S. et al. 2013a; Nowak et al. 2014e).

PHR-AA06. *Scirpetum triquetriformis* Nowak, S. Nowak et Nobis 2013 (vegetation of rice paddy fields in south-western Tajikistan)

Diagnostic species: *Scirpus triquetriformis* (= *Schoenoplectus triquetriformis*).
Constant species: *Scirpus triquetriformis*.
Geographical range: This association is very rare, in the rice fields of Tajikistan. It was found at an elevation of ca. 730 m a.s.l. in the valley of the Khanaka River, south of Hissar. Patches of the association have also been recorded near rice fields in the Hissar area and in south-western Tajikistan, in the valley of the Kofarnikhon River. *Scirpus triquetriformis* is known only from Middle Asia, from the lower elevations of the Fergana Valley, the western Pamir-Alai and Turkmenistan (Nowak et al. 2014e).
Habitat characteristics: *Scirpetum triquetriformis* develops in near-neutral, shallow waters (sometimes dried up areas) in muddy substrates (Nowak et al. 2014e). In Tajikistan, *Scirpus triquetriformis* occurs mainly in stagnant waters and ditches. This species has not been previously recorded in rice fields (Ovchinnikov 1963), but has recently been noted by Nowak S. et al. (2013a).

PHR-AA07. *Scirpetum hippolytii* Nowak, S. Nowak et Nobis 2014 (vegetation of rice paddy fields in western Tajikistan)

Diagnostic species: *Scirpus hippolyti* (= *Schoenoplectus validus*).
Constant species: *Scirpus hippolyti*.
Geographical range: This association was found in only two locations, in the valleys of Surkhob and Panj rivers in the geobotanical regions of the Eastern Tajikistan and Western Pamir, at relatively high elevation of 1,500–1,600 m a.s.l. (Nowak et al. 2014e).
Habitat characteristics: The association develops in muddy, alkaline river alluvia with considerable

Fig. 440. Stand of *Cyperetum longi* inhabiting a margin of a rice paddy near Hissor, Tajikistan (ca. 820 m a.s.l.). Photo: A. Nowak.

gravel admixtures. Most patches were found in very shallow waters up to 5 cm deep (Nowak et al. 2014e).

PHR-AA08. *Cyperetum longi* Micevski 1957 (vegetation of rice paddy fields in western Tajikistan)(Fig. 440)

Diagnostic species: *Cyperus longus.*
Constant species: *Cyperus longus.*
Geographical range: This association is very rare in Tajikistan. It has only been found on the margins of rice fields and in adjacent irrigation ditches in the central section of the Kofarnikhon River Valley at an elevation of approx. 740–850 m a.s.l. (Nowak et al. 2014e).
Habitat characteristics: *Cyperetum longi* stands develop in shallow alkaline waters (depth ca. 10 cm), in muddy, clayey substrates. *Cyperetum longi* occupies those places where *Oryza sativa* reaches a relatively low density (Nowak S. et al. 2013a; Nowak et al. 2014e).

PHR-AA09. *Cyperetum serotini* Krausch 1965 (= ***Juncelletum serotini* Krausch 1965**) (vegetation of rice paddy fields, ditches and other anthropogenic pools in western Tajikistan) (Fig. 441)

Diagnostic species: *Cyperus serotinus.*
Constant species: *Cyperus serotinus.*
Geographical range: This association is relatively rare in the irrigation ditches and rice fields of Tajikistan. It was only found in the lowest part of the Zeravshan, Khanaka, Syr-darya and Kofarnikhon River Valleys at an elevation of about 350–1,000 m a.s.l. (Nowak et al. 2014e). It is likely to be much more widespread throughout the whole of Middle Asia.
Habitat characteristics: *Cyperetum serotini* develops in alkaline, shallow waters (5–10 cm) in muddy substrates with a relatively high clay content, often within rice paddies (Nowak S. et al. 2013a; Nowak et al. 2014e).

Fig. 441. Vegetation of *Cyperetum serotini* found in rice paddy fields near Maykatta, Zeravshan River Valley, Tajikistan (ca. 1,030 m a.s.l.). Photo: A Nowak.

PHR-AB. *Arundion collinae* Brullo, Giusso, Guarino et Sciandello in Brullo et al. 2010 (thermophilous reed vegetation of southern Tajikistan)

This thermophilous vegetation is dominated by large reeds (*Arundo collina*, *A. donax*), that grow on marly-clayey sites, characterised by deep soils with a high groundwater level for most of the year.

PHR-ABc01. Community of *Arundo donax* (thermophilous vegetation of flooded areas in large river valleys, ditches and anthropogenic pools in south-western Tajikistan) (Fig. 442)

Diagnostic species: *Arundo donax.*
Constant species: *Arundo donax.*
Geographical range: This community is relatively rare in Tajikistan, occurring mainly in the Amu-darya alluvium and along its tributaries in southern Tajikistan. It has been recorded at an elevation of about 350–900 m a.s.l.

Fig. 442. Stand of *Arundo donax* near Jilikul, Khatlon Province, Tajikistan (ca. 345 m a.s.l.). Photo: M. Nobis.

Habitat characteristics: The *Arundo donax* community develops in lowland marshes and swamps with muddy, alluvial soils, in the floodplains of large rivers.

PHR-AC. *Eleocharito palustris-Sagittarion sagittifoliae* Passarge 1964 (helophyte vegetation of shallow pools and ponds in Tajikistan)

This alliance includes vegetation types dominated by perennial or biennial wetland herbs such as *Alisma* spp., *Butomus* spp., *Oenanthe* spp., *Rorippa* spp. and *Sagittaria* spp., or graminoids. They occur in habitats where water level changes periodically, typically in shallow littoral zones, rice fields or anthropogenic pools. Many species regenerate from seed or vegetatively on exposed bottoms, and develop maximum biomass when the period of exposure is followed by a period of shallow flooding. Some species typical of this vegetation have adapted to water level fluctuations by developing dimorphic leaves, with different morphologies produced in submerged and emergent conditions. These vegetation types usually occur in habitats of short duration and soon disappear, either due to deeper flooding or to the succession of tall reeds. This vegetation is rather rare in Tajikistan and Middle Asia, occurring mainly in lowlands and colline belts.

PHR-AC01. *Eleocharitetum uniglumis* W. Braun 1968 (helophyte vegetation of shallow pools, ponds and wet grasslands in Tajikistan)

Diagnostic species: *Eleocharis uniglumis.*
Constant species: *Eleocharis uniglumis.*
Geographical range: The *Eleocharitetum uniglumis* association was recorded quite frequently, especially in the montane elevations of the Zeravshan, Yagnob, Iskander-darya and Pastrud-darya River Valleys (Nowak et al. 2014e).

Habitat characteristics: It prefers small bodies of water and develops on the shallow margins of puddles and pools, as well as on the edges of rice fields. The association has also been noted along the edges of periodic water bodies and slow-flowing drainage and irrigation ditches. Substrates are clayey sediments with a strong alkaline reaction (Nowak S. et al. 2013a; Nowak et al. 2014e).

PHR-AC02. *Eleocharitetum mitracarpae* Nowak, S. Nowak et Nobis 2014 (helophyte vegetation of shallow pools, ponds and damp habitats in Tajikistan) (Fig. 443)

Diagnostic species: *Eleocharis mitracarpa* (= *Eleocharis turcomanica*).
Constant species: *Eleocharis mitracarpa.*
Geographical range: The *Eleocharitetum mitracarpae* association occurs sporadically in Tajikistan. Plots of this association have been found within a narrow range of elevation, from approx. 850 to 1,500 m a.s.l. It has been noted mainly in the montane zone of alpine river valleys: Zeravshan, Yagnob and Iskander-darya (Nowak et al. 2014e).
Habitat characteristics: Stands of this association usually develop on loess or muddy soils with a pronounced alkaline reaction (mean value of pH ca. 8). The association prefers small, shallow water bodies as well as margins of rice puddles (Nowak et al. 2014e).

PHR-AC03. *Eleocharitetum argyrolepis* Nowak, S. Nowak et Nobis 2014 (helophyte vegetation of shallow pools, ponds and damp habitats in Tajikistan) (Fig. 444)

Diagnostic species: *Eleocharis argyrolepis.*
Constant species: *Eleocharis argyrolepis.*
Geographical range: The compilation of all available relevés from different habitat types in the territory of Tajikistan allows the definition of the *Eleocharitetum argyrolepis* association,

Fig. 443. Stand of *Eleocharitetum mitracarpae* near Hissor, Tajikistan (ca. 860 m a.s.l.). Photo: A. Nowak.

Fig. 444. Stand of *Eleocharitetum argyrolepis* near Pastigov, Zeravshan Mts, Tajikistan (ca. 1,830 m a.s.l.). Photo: A. Nowak.

Fig. 445. Vegetation of the *Eleocharito palustris-Hippuridetum vulgaris* found near Alichur, Eastern Pamir, Tajikistan (ca. 3,630 m a.s.l.). Photo: A. Nowak.

which has been noted in the Zeravshan, Pastrud-darya, Yagnob, Vakhsh and Iskander-darya River Valleys at the relatively high elevations of approx. 1,200–2,300 m a.s.l. *Eleocharis argyrolepis* commonly occurs in Tajikistan, mainly in the alpine zone (Nowak et al. 2014e).

Habitat characteristics: *Eleocharis argyrolepis* occurs in loamy, alkaline substrates. The short stands of *Eleocharis argyrolepis* were also noted along the shallow margins of small puddles, in irrigation ditches and, rarely, in rice fields. The association often develops on the shores of periodic water bodies (Nowak et al. 2014e).

PHR-AC04. *Eleocharito palustris-Hippuridetum vulgaris* Passarge 1964 (emerging helophyte vegetation of lakes and ponds, mainly in the alpine belt of the Pamir) (Fig. 445)

Diagnostic species: *Hippuris vulgaris.*
Constant species: *Hippuris vulgaris.*
Geographical range: Stands of *Hippuris vulgaris* have been found in Tajikistan mainly in the Pamir. This association inhabits lakes and river oxbows in the alpine belt at an elevation of about 2,300 to 4,100 m a.s.l.
Habitat characteristics: *Eleocharito palustris-Hippuridetum vulgaris* inhabits shallow, cool, stagnant waters in the alpine belt of the Pamir (Nowak et al. 2014e).

PHR-AC05. *Juncetum brachytepali* Nowak, S. Nowak et Nobis 2014 (helophyte vegetation of fens and swampy grasslands in western Tajikistan)

Diagnostic species: *Juncus brachytepalus.*
Constant species: *Juncus brachytepalus.*
Geographical range: The *Juncetum brachytepali* association occurs sporadically in Tajikistan. Patches of this association have been found within a narrow range of elevation, within the subalpine zone at approx. 1,700 m a.s.l. The association

Fig. 446. Stand of *Scirpetum tabernaemontani* found near Marguzor, Zeravshan Mts, Tajikistan (ca. 2,000 m a.s.l.). Photo: A. Nowak.

has been recorded in the Zeravshan, Pastrud-darya and Iskander-darya River Valleys (Nowak et al. 2014e).
Habitat characteristics: *Juncetum brachytepali* occurs on sandy and loamy, neutral or alkaline substrates. This type of rush vegetation develops on the margins of alpine rivers close to peat bogs or peat meadows (Nowak et al. 2014e).

PHR-AC06. *Scirpetum tabernaemontani* De Soó 1947 (helophyte vegetation of shallow pools and ponds on deep muddy substrates in Tajikistan) (Fig. 446)

Diagnostic species: *Scirpus tabernaemontani.*
Constant species: *Scirpus tabernaemontani.*
Geographical range: The *Scirpetum tabernaemontani* association occurs sporadically in Tajikistan. It has been found in the Pastrud-darya River Valley at an elevation of approx. 2,000 m a.s.l. (Nowak et al. 2014e).
Habitat characteristics: The association occupies typical rush habitats on the banks of alpine rivers or small water bodies. The phytocoenosis prefers alkaline substrates (pH ca. 8.2) with a considerable admixture of gravel in the soil (Nowak et al. 2014e).

PHR-AC07. *Rorippo palustris-Alismatetum graminei* Nowak, S. Nowak et Nobis 2014 (helophyte grasslands in pools, ditches and paddies with unstable water in western Tajikistan)

Diagnostic species: *Alisma gramineum, Rorippa palustris.*
Constant species: *Alisma gramineum, Rorippa palustris.*
Geographical range: This community, dominated by *Alisma gramineum*, was found in only two places, in the middle section of the Varzob and Zeravshan River Valleys at an elevation of approx. 1,300 m a.s.l. (Nowak et al. 2014e).
Habitat characteristics: This association was found at all sites in small artificial ponds dammed by road embankments. *Rorippo palustris-Alismatetum graminei* develops in relatively deep (10–20 cm), close to near-neutral waters with pH around 7.0. The association develops on muddy, clayey substrates and grows to heights typical of small reeds, around 0.3–0.5 m (Nowak et al. 2014e).

PHR-AC08. *Bolboschoenetum glauci* Grechushkina, Sorokin et Golub 2011 (thermophilous, subhalophytic reed vegetation of shallow pools and ponds in Tajikistan) (Fig. 447)

Diagnostic species: *Bolboschoenus glaucus.*
Constant species: *Bolboschoenus glaucus.*
Geographical range: The *Bolboschoenetum glauci* association is widespread in Tajikistan and throughout a variety of Middle Asian habitats. It occurs in a wide range of elevation, from approx. 400 to 1,500 m a.s.l. (Nowak et al. 2014e).
Habitat characteristics: It mostly overgrows shallow, temporary pools, irrigation and drainage ditches, and sporadically develops in riparian vegetation. It is also found in rice fields. *Bolboschoenetum glauci* occurs in alkaline shallow waters (mean depth, approx. 10 cm) with a pH 7.0–8.7. In several places the association has been observed in completely dried-up sites. The association develops on muddy clay substrates and grows to heights typical for medium-sized reeds, i.e. around one metre (Nowak et al. 2014e).

PHR-AC09. *Bolboschoenetum affinis* Nowak et M. Nobis in Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2024 (thermophilous, subhalophytic reed vegetation of anthropogenic shallow pools in northern Middle and Central Asia) (Fig. 448)

Diagnostic species: *Bolboschoenus affinis.*
Constant species: *Bolboschoenus affinis.*
Geographical range: This vegetation has been recorded in Tajikistan in the floodplains of the Syr-darya, Vskhsh and Amu-darya rivers. Stands of this association also grow in anthropogenic habitats such as ditches and canals. *Bolboschoenetum affinis* occurs in the lowlands and in the colline belt at elevation, from about 300 to 900 m a.s.l.
Habitat characteristics: Stands of *Bolboschoenus affinis* inhabit subsaline habitats, on muddy, clayey and wet soils (Nowak et al 2024b).

Fig. 447. Large stand of *Bolboschoenetum glauci* found in an anthropogenic pool near Komsomolabad, Karateginian Mts, Tajikistan (ca. 1,130 m a.s.l.). Photo: A. Nowak.

Fig. 448. *Bolboschoenus affinis* – a character species growing on muddy sediments of the Karasuu River near Aktuidu, Kyrgyzstan (ca. 890 m a.s.l.). Photo: A. Nowak.

PHR-AC10. *Caricetum pamirensis* Nowak et M. Nobis in Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2024 (littoral vegetation of shallow alpine lakes and ponds in the eastern Pamir Mts) (Fig. 449)

Diagnostic species: *Carex pamirensis.*
Constant species: *Carex pamirensis.*
Geographical range: This vegetation type forms mono-species coastal rushes dominated by the main diagnostic species. The community is a typical alpine rush inhabiting the riparian zone of lakes and ponds of the Eastern Pamir (e.g. around Murgab or Bulunkul) or the Transalayan range (e.g. Tulpar Lake). It occurs also in Hindu Kush and southern Siberia (GBIF 2024). It is a species-poor vegetation found in the alpine belt at elevation of 2,700 to 4,200 m a.s.l. (Nowak et al 2024b).

Fig. 449. Littoral vegetation of the *Caricetum pamirensis* association near Ak-Bulak, Eastern Pamir, Tajikistan (ca. 3,890 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: Stands of *Caricetum pamirensis* inhabit littoral zone of shallow and cold alpine ponds and lakes.

PHR-ACc01. Community of *Pycreus flavidus* (thermophilous vegetation on muddy habitats of pools, alluvial sediments or wet fields)

Diagnostic species: *Pycreus flavidus* (= *P. globosus*).
Constant species: *Pycreus flavidus*.
Geographical range: The *Pycreus flavidus* community was distinguished in several patches of the rice fields in the valley of the Zeravshan River near Pandzhikent (elevation 950-1,000 m a.s.l.) and in the valley of the Syr-darya River near the village Proletarska (approx. 320 m) (Nowak S. et al. 2013a).
Habitat characteristics: The community develops in shallow places, on alkaline river mud, probably, where root crops used to grow (in rotation). The community of *Pycreus flavidus* is not typical within rice puddles. According to our observations, it has an optimal occurrence in weed communities of root crops (Nowak S. et al. 2013a).

PHR-AD. *Glycerio-Sparganion* Br.-Bl. et Sissingh in Boer 1942 (hygrophilous herblands of shallow pools and lakes)

The vegetation of *Glycerio-Sparganion* includes vegetation of short marshes or dense carpet-like stands, which may float on the water surface. This vegetation occurs on fine-grained fluvial sediments of streams or small rivers, in drainage ditches, rice fields and anthropogenic pools. The dominant species are weak competitors, and therefore occur on frequently disturbed sites. They are usually outcompeted by tall reed vegetation without disturbance.

PHR-AD01. *Leersietum oryzoidis* Eggler 1933 (hygrophilous reeds of shallow lakes and ditches with stable water) (Fig. 450)

Diagnostic species: *Leersia oryzoides.*
Constant species: *Leersia oryzoides.*
Geographical range: *Leersietum oryzoidis* appears to be very rare in Tajikistan and was found exclusively in rice fields in the valley of the Syrdarya River north of Proletarska at an elevation of around 320 m a.s.l. (Nowak et al. 2014e).
Habitat characteristics: The *Leersietum oryzoidis* association develops in places with shallow water (up to 5–10 cm) with alkaline reaction, on a muddy substrate. The noted plots occupied not only field margins, but also a significant area of the inner parts of puddles (Nowak S. et al. 2013a; Nowak et al. 2014e).

PHR-AD02. *Helosciadietum nodiflori* Maire 1924 (herbland vegetation of the margins of river bars in western Tajikistan) (Fig. 451)

Diagnostic species: *Apium nodiflorum.*
Constant species: *Apium nodiflorum.*
Geographical range: *Helosciadietum nodiflori* was found in only one locality in the lower section of the Zeravshan River Valley, north of Pandzhikent (Nowak S. et al. 2013a; Nowak et al. 2014e).
Habitat characteristics: A single plot of this phytocoenosis was detected in a small depression within a river gravel bed at an elevation of ca. 1,500 m a.s.l. The association has developed on a small area along the margins of a poorly managed rice field, in a place with a large amount of gravel. The water here was very shallow and, together with the muddy soil, had an alkaline reaction (Nowak et al. 2014e).

PHR-AD03. *Beruletum erectae* Roll 1938 (hygrophilous herblands of shallow pools and ditches in lowlands and colline belt of Tajikistan) (Fig. 452)

Fig. 450. Stand of the *Leersietum oryzoidis* association near Proletarska, Tajikistan (ca. 320 m a.s.l.). Photo: A. Nowak.

Fig. 451. Vegetation with *Apium nodiflorum* inhabiting gravel bars of the Zeravshan River near Sudzhina, Tajikistan (ca. 1,500 m a.s.l.). Photo: A Nowak.

Fig. 452. Stand of *Berula erecta* inhabiting ditch in Urmetan, Zeravshan River Valley, Tajikistan (ca. 1,250 m a.s.l.). Photo: A Nowak.

Diagnostic species: *Berula erecta.*
Constant species: *Berula erecta.*
Geographical range: This association was especially frequent in the submontane elevations of the Zeravshan, Yagnob, Iskander-darya, Pastrud-darya, Vakhsh, Surkhob and Vanch River Valleys at elevation of 900–1,300 m a.s.l. (Nowak et al. 2014e).
Habitat characteristics: It prefers small and shallow water bodies and develops on the margins of puddles and pools, as well as on the edges of rice fields. The association has also been noted along the margins of periodic water bodies and slow-flowing drainage and irrigation ditches. *Beruletum erectae* develops on clayey sediments with an alkaline reaction (Nowak et al. 2014e).

PHR-AD04. *Mentho asiaticae-Nasturtietum microphylli* Nowak, S. Nowak et Nobis 2014 nom. corr. (hygrophilous herblands of shallow pools and ditches in lowlands and colline belt of Tajikistan) (Fig. 453)

Diagnostic species: *Nasturtium microphyllum, Mentha asiatica.*
Constant species: *Nasturtium microphyllum, Mentha asiatica.*
Geographical range: This community, dominated by *Nasturtium microphyllum*, is widely distributed all over the study area. It was frequently found in the montane belt of the Varzob, Pastrud-darya, Iskander-darya, Yagnob, Panj and Zeravshan River Valleys at elevation of approx. 1,000 to 1,400 m a.s.l. (Nowak et al. 2014e).
Habitat characteristics: The association was found on the banks of the alpine rivers, as well as in the marginal zones of rice fields and in irrigation ditches. *Mentho asiaticae-Nasturtietum microphylli* develops in moderately deep (5–15 cm), alkaline waters. The association develops in muddy, clayey substrates, and grows to heights typical of small reeds, around 0.2–0.4 m (Nowak et al. 2014e).

PHR-AD05. *Sparganietum stoloniferi* Nowak, S. Nowak et Nobis 2014 (hygrophilous herblands

Fig. 453. *Mentho asiaticae-Nasturtietum microphylli* dominated by *Nasturtium microphyllum* near Sudzhina in Zeravshan River Valley, Tajikistan (ca. 1,010 m a.s.l.). Photo: A Nowak.

of shallow pools and ditches in lowland Tajikistan) (Fig. 454)

Diagnostic species: *Sparganium stoloniferum.*
Constant species: *Sparganium stoloniferum.*
Geographical range: *Sparganietum stoloniferi* occurs very sporadically in Tajikistan. Plots of this association were found in the upper section of the gravel alluvium of the Surkhob and Kofarnikhon River Valleyes within an elevational range of approx. 850–1,700 m a.s.l. (Nowak et al. 2014e).
Habitat characteristics: The association has been noted in a few places, in almost completely dry depressions within wide riverbed gravels. *Sparganietum stoloniferi* develops on sandy and loamy, near-neutral substrates with a considerable degree of gravel fraction and a low humic content (Nowak et al. 2014e).

Fig. 454. Stand of *Sparganietum stoloniferi* in a pond 3 km SW of Vakhdat city center, upper Surkhob River, Tajikistan (ca. 1720 m a.s.l.). Photo: M. Nobis.

PHR-AD06. *Sparganietum erecti* Roll 1938 (hygrophilous herblands of shallow pools and ditches in lowland Tajikistan)

Diagnostic species: *Sparganium erectum.*
Constant species: *Sparganium erectum.*
Geographical range: This association is rare in Tajikistan, corresponding to the frequency of the diagnostic species in the country (Ovchinnikov 1957). Only one stand of *Sparganium erectum* was found in the valley of the Khanaka River south of Hissor at an elevation of ca. 740 m a.s.l. (Nowak et al. 2014e).
Habitat characteristics: *Sparganietum erecti* communities have been noted in margins of rice paddies and in irrigation ditches. The association develops in alkaline, shallow waters (approx. 10 cm), in muddy soils (Nowak et al. 2014e).

PHR-AD07. *Glycerietum notatae* Kulczyński 1928 (hygrophilous herblands of shallow pools, anthropogenic ponds and ditches in lowland Tajikistan) (Fig. 455)

Diagnostic species: *Glyceria notata.*
Constant species: *Glyceria notata.*
Geographical range: *Glycerietum notatae* is one of the most widespread reed communities in Tajikistan. It is distributed across the montane and subalpine elevational belts and was observed in all investigated river valleys from 1,400 to 1,800 m a.s.l. (Nowak et al. 2014e).
Habitat characteristics: The association occurs in both natural (oxbow lakes) and anthropogenic (rice fields, road verges, irrigation ditches) habitats. The phytocoenoses develop in muddy and loamy soils, in alkaline substrates (Nowak et al. 2014e).

Fig. 455. Vegetation patch representing the *Glycerietum notatae* association on the wet roadside near Aini, Zeravshan River Valley, Tajikistan (ca. 1,425 m a.s.l.). Photo: M. Nobis.

PHR-AE. *Phalaridion arundinaceae* Kopecký 1961 (reed vegetation of freshwater flowing and seasonally fluctuating of Eurasia) (Fig. 456)

The vegetation of the *Phalaridion* alliance includes reed and tall-sedge vegetation along river banks and lake shores, mainly in the floodplain, colline and submontane areas, often dominated by *Phalaris arundinacea, Calamagrostis pseudophragmites* or *Typha minima*. It occurs on gravelly, sandy or loamy-sandy alluvial sediments on river banks or on islets in river channels. It is frequently disturbed by flooding.

Fig. 456. *Phalaris arundinacea* on the bank of Kara-Balta River, Kyrgyz Mts, Tian Shan, Kyrgyzstan (ca. 1,600 m a.s.l.). Photo: M. Nobis.

PHR-AE01. *Calamagrostio pseudophragmitae–Typhetum minimae* Dihoru 1971 (hygrophilous reeds of the river bed margins or the surrounding of oxbow lakes in montane belt of Tajikistan) (Fig. 457)

Diagnostic species: *Typha minima.*
Constant species: *Calamagrostis pseudophragmites, Typha minima.*
Geographical range: Phytocoenoses dominated by *Typha minima* were noted relatively often

Fig. 457. Reed vegetation of the *Calamagrostio pseudophragmitae-Typhetum minimae* association found near Gezanin, Mogien Valley, Zeravshan Mts, Tajikistan (ca. 1,420 m a.s.l.). Photo: A. Nowak.

throughout the study area. The association was frequent in the submontane belts of the Zeravshan, Yagnob, Iskander-darya, Pastrud-darya, and Vakhsh River Valleys at elevation of 1,000–1,450 m a.s.l. (Nowak et al. 2014e).

Habitat characteristics: This association prefers small and very shallow water bodies or develops on the dry margins of alpine river beds. *Calamagrostio pseudophragmitae-Typhetum minimae* develops mainly on gravel sediments with low humic content, on alkaline substrates (Nowak et al. 2014e).

PHR-AF. *Magno-Caricion gracilis* Géhu 1961 (sedge-bed marsh vegetation on mesotrophic-organic sediments of Eurasia)

The *Magno-Caricion gracilis* alliance includes marshes dominated in Tajikistan by tall wetland graminoids such as rhizomatous sedges like *Carex acutiformis* or *C. riparia* or the cespitose sedge *C. paniculata*. The stands are usually species-poor due to the high cover of dominant species. Vegetation belonging to this alliance occurs in the shallow littoral zones of fishponds, oxbows, alluvial pools, depressions in wet meadows and on the banks of rivers. The vegetation of the *Magno-Caricion gracilis* generally occurs in nutrient-rich habitats and at lower altitudes, up to lower montane belt.

PHR-AF01. *Caricetum ripariae* Máthé et Kovács 1959 (sedge-bed marsh vegetation in littoral zone of lakes and ponds in montane and colline belts of Tajikistan)

Diagnostic species: *Carex riparia.*
Constant species: *Carex riparia.*
Geographical range: This vegetation was found in only one site in the upper part of the Surkhob River Valley at an elevation of ca. 1,400 m a.s.l. (Nowak et al. 2014e). *Carex riparia* is a rare species in Middle Asia, but its stands may be more common in the northern parts of the region, in Kazakhstan and Uzbekistan. Kyrgyzstan and Uzbekistan (Ovchinnikov 1963).
Habitat characteristics: Vegetation dominated by *Carex riparia*, developed on the banks of an artificial pond used as a watering place for cattle. The association was found in alkaline, shallow water (approx. 10 cm), on muddy substrates (Nowak et al. 2014e).

PHR-AFc01. Community of *Carex melanostachya* (sedge-bed marsh vegetation in littoral zone of lakes and ponds in western Tajikistan)

Diagnostic species: *Carex melanostachya.*
Constant species: *Carex melanostachya.*
Geographical range: This vegetation has been recorded in western Tajikistan, mainly in the montane river valleys at an elevation of about 900–2,500 m a.s.l. (Ovchinnikov 1963).
Habitat characteristics: Vegetation dominated by *Carex melanostachya* occurs in the littoral zones of ponds and lakes, along river banks, and in river alluvium, but only rarely in wet forest plots or ditches.

PHR-AFc02. Community of *Carex diluta* (sedge-bed marsh vegetation on peaty substrates of lake littoral zone in western Tajikistan)

Diagnostic species: *Carex diluta.*
Constant species: *Carex diluta.*
Geographical range: This vegetation has been recorded in western and central Tajikistan, in the floodplains and river beds from lowlands to the montane belt, at an elevation of about 350–2,500 m a.s.l. (Ovchinnikov 1963).
Habitat characteristics: The vegetation dominated by *Carex diluta* forms small stands on river banks, lake and pond shores or in shallow pools. It forms a littoral zone of different water bodies in the river alluvium, rarely on wet slopes and artificial ditches.

Fen and mire vegetation of boreal and hemiboreal Eurasia

Vegetation of bogs and fens

Fen and mire vegetation of boreal and hemiboreal Eurasia

SCH. *Scheuchzerio-Caricetea nigrae* Tüxen 1937

SCH-A. *Caricetalia orbicularis* Naqinezhad, Nowak, Nobis, S. Nowak, Świerszcz et Hájek in Naqinezhad et al. 2021 (fens of the alpine and upper montane belts of mountain ranges in the Irano-Turanian Region) (Fig. 458)

This vegetation is mainly distributed in the alpine and upper montane belts throughout the mountain ranges of the Irano-Turanian Region, at least from the Alborz to the Tian Shan (Naqinezhad et al. 2021). Similar fen vegetation with *Carex orbicularis* probably also occurs in the Caucasus, the Sayan Mts, the Himalayas and the Qinghai Province of China (see GBIF 2024). In Tajikistan, the patches of this vegetation have been recorded in the Zeravshan, Hissar, Fann, Hazratishokh, Darvaz, Vanch, Turkestan, Shugnan, Yazgulem, Vanch, Peter the First and Karateginian Mts. They occupy peaty, neutral to alkaline soils.

SCH-AA. *Dactylorhizo umbrosae-Caricion orbicularis* Nowak, Nobis, S. Nowak et Plášek 2016 (fen and mire vegetation of the Irano-Turanian Region) (Fig. 459)

Diagnostic species: *Alchemilla persica, Carex orbicularis* subsp. *orbicularis, Carex orbicularis* subsp. *kotschyana, Dactylorhiza umbrosa, Parnassia laxmannii, Primula iljinskii, P. olgae, Ranunculus amblyolobus.*
Constant species: *Alchemilla persica, Bryum pseudotriquetrum, Carex orbicularis* subsp. *orbicularis, Carex orbicularis* subsp. *kotschyana, Dac-*

Fig. 458. Fen vegetation of the *Caricetalia orbicularis* order inhabiting peaty slope near the Anzob Pass, Hissar Mts, Tajikistan (ca. 2,850 m a.s.l.). Photo: A Nowak.

Fig. 459. Fen vegetation with *Dactylorhiza umbrosa* near Marguzor, Pastrud-darya River Valley, Zeravshan Mts, Tajikistan (ca. 2,550 m a.s.l.). Photo: A. Nowak.

tylorhiza umbrosa, Parnassia laxmannii, Philonotis calcarea, Primula iljinskii, P. olgae, Ranunculus amblyolobus, Trifolium repens.

Geographical range: These fens are mainly distributed in the alpine and upper montane belts across all mountain ranges in the Irano-Turanian Region. The alliance is distributed at an elevation of ca. 1,550–3,750 m a.s.l. In Tajikistan, the patches of this vegetation have been recorded in the Zeravshan, Hissar, Fann, Hazratishokh, Darvaz, Vanch, Turkestan, Peter the First and Karateginian Mts (Nowak et al. 2016d; Naqinezhad et al. 2021).

Habitat characteristics: This vegetation occurs on peaty soils with a pH ranging from slightly acidic to slightly alkaline. It develops on flat or gently sloping surfaces in open, highly insolated fens with minimal or no shrub presence, except for *Salicetum schugnanicae* (Nowak et al. 2016d).

SCH-AA01. *Allietum fedtschenkoani* Nowak, Nobis, S. Nowak et Plášek 2016 (fen vegetation of the alpine passes and flat valleys in the western Pamir-Alai and central Tian Shan Mts) (Fig. 460)

Diagnostic species: *Allium fedtschenkoanum, Bryum pseudotriquetrum, Carex decaulescens, Carex orbicularis* subsp. *orbicularis, Cerastium tianschanicum, Kobresia persica, Cratoneuron filicinum, Epilobium palustre, Euphrasia pectinata, Gentiana leucomelaena, Gentiana olgae, Gentianella turkestanorum, Hygroamblystegium varium, Juncus brachytepalus, Juncus macrantherus, Parnassia laxmannii, Pedicularis peduncularis, Philonotis fontana, Phleum alpinum, Plantago minuta, Potentilla gelida, Primula iljinskii, Primula olgae, Ranunculus alajensis, Trollius komarovii.*

Constant species: *Allium fedtschenkoanum, Blysmus compressus, Bryum pseudotriquetrum, Carex orbicularis* subsp. *orbicularis, Cerastium tianschanicum, Kobresia persica, Cratoneuron filicinum, Dactylorhiza umbrosa, Eleocharis quinqueflora, Epilobium palustre, Euphrasia pectinata, Gentiana leucomelaena, Gentianella turkestanorum,*

Fig. 460. Fen vegetation of the *Allietum fedtschenkoani* association found near the Khoburobot Pass, Darvaz Mts, Tajikistan (ca. 3,100 m a.s.l.). Photo: A Nowak.

Hordeum brevisubulatum, Hygroamblystegium varium, Juncus brachytepalus, Juncus macrantherus, Palustriella decipiens, Parnassia laxmannii, Pedicularis peduncularis, Philonotis fontana, Phleum alpinum, Plantago gentianoides subsp. *griffithii, Potentilla gelida, Primula iljinskii, Primula olgae, Ranunculus alajensis, Trifolium repens, Trollius komarovii.*

Geographical range: The phytocoenoses of *Allietum fedtschenkoani* have been rarely observed in the Kuli-Kalon area (Zeravshan Mts), in Hissar and in the Darvaz ranges, mainly on the Khoburobot Pass (3,232 m a.s.l.). Phytocoenoses of *Allietum fedtschenkoani* were found within the high alpine belt from 2,700 to 3,200 m a.s.l. (Nowak et al. 2016d). This rather species-rich vegetation of gently sloping or flat fens was recorded in the western Pamir-Alai (Zeravshan, Hissar and Darvaz ranges, up to 3,600 m a.s.l.) and Tian Shan (Kyrgyz and Talas Mts) (Naqinezhad et al. 2021).

Habitat characteristics: The community prefers gently sloping or flat fens with a relatively low mean pH. The phytocoenoses were generally observed on peaty substrates with moderate conductivity of 140 0 µS (Nowak et al. 2016d).

SCH-AA02. *Eleocharito quinqueflorae-Primuletum iljinskii* Nowak, Nobis, S. Nowak et Plášek 2016 nom. corr. (Fen vegetation on gentle slopes and valley bottoms in alpine belt of the western Pamir-Alai Mts) (Fig. 461)

Diagnostic species: *Carex arcatica, Cirsium esculentum, Eleocharis quinqueflora, Inula rhizocephala, Oxytropis microsphaera, Palustriella decipiens, Parnassia laxmannii.*

Constant species: *Blysmus compressus, Bryum pseudotriquetrum, Carex orbicularis* subsp. *orbicularis, Carum carvi, Kobresia persica, Dactylorhiza umbrosa, Eleocharis quinqueflora, Equisetum arvense, Equisetum ramosissimum, Euphra-*

Fig. 461. Fen vegetation of the *Eleocharito quinqueflorae-Primuletum iljinskii* association found near Sarytag, Fann Mts, Tajikistan (ca. 2,650 m a.s.l.). Photo: A. Nowak.

sia pectinata, Festuca rubra, Geranium collinum, Juncus articulatus, Mentha asiatica, Palustriella decipiens, Parnassia laxmannii, Pedicularis peduncularis, Poa supina, Primula iljinskii, P. olgae, Trifolium repens.

Geographical range: This is the most common and widely distributed fen association in alpine and subalpine belts in Tajikistan. It has been recorded frequently in the Zeravshan, Darvaz, Fann, Peter the First, Hissar and Turkestan Mts. The plots of the association have been mainly found at elevation ranging from 1,500 to 3,100 m a.s.l. (Nowak et al. 2016d; Naqinezhad et al. 2021).

Habitat characteristics: This association inhabits fens, often on slopes of up to 35°. It prefers neutral, slightly acidic or slightly alkaline substrates with shallow, peaty soils (Nowak et al. 2016d).

SCH-AA03. *Primulo auriculatae-Caricetum kotschyanae* Naqinezhad, Nowak, Nobis, S. Nowak, Świerszcz et Kamrani in Naqinezhad et al. 2021 (mire vegetation of montane and alpine belts of the Alborz Mts)

Diagnostic species: *Carex orbicularis* subsp. *kotschyana.*

Constant species: *Blysmus compressus, Carex orbicularis* subsp. *kotschyana, Eleocharis uniglumis, Equisetum palustre, Juncus articulatus, Lotus corniculatus* subsp. *corniculatus, Mentha longifolia, Primula auriculata, Ranunculus amblyolobus, Stellaria persica, Trifolium pratense, Trifolium repens.*

Geographical range: This vegetation occupies a wide elevational range in the Alborz Mts from ca. 1,500 to 3,200 m a.s.l. (Naqinezhad et al. 2021).

Habitat characteristics: This is a widespread association of highly waterlogged and rather flat mires (Naqinezhad et al. 2021).

SCH-AA04. *Primulo auriculatae-Pedicularietum rotundatae* Naqinezhad, Nowak, Nobis, S. Nowak, Świerszcz et Kamrani in Naqinezhad et al. 2021 (dense fen swards in the alpine belt of the Alborz Mts)

Diagnostic species: *Alchemilla persica, Carex pseudofoetida, Deschampsia flexuosa, Epilobium frigidum, Pedicularis rhinanthoides* subsp. *rotundata, Plantago gentianoides* subsp. *griffithii, Primula auriculata, Stellaria persica, Trifolium repens, Triglochin palustris.*
Constant species: *Alchemilla persica, Blysmus compressus, Carex orbicularis* subsp. *kotschyana, Carex pseudofoetida, Eleocharis uniglumis, Epilobium frigidum, Equisetum palustre, Inula thapsoides, Juncus articulatus, Pedicularis rhinanthoides* subsp. *rotundata, Phalaris arundinacea, Plantago gentianoides* subsp. *griffithii, Primula auriculata, Ranunculus amblyolobus, Stellaria persica, Trichophorum pumilum, Trifolium repens, Triglochin palustris.*
Geographical range: This vegetation forms short fen swards in the Alborz Mts in the montane and alpine belts (Naqinezhad et al. 2021).
Habitat characteristics: It grows in both flat and steeply sloping fens on peaty, shallow substrates (Naqinezhad et al. 2021).

SCH-AA05. *Primulo auriculatae-Trichophoretum pumili* Naqinezhad, Nowak, Nobis, S. Nowak, Świerszcz et Kamrani in Naqinezhad et al. 2021 (sparse, grazed fen vegetation of the Alborz Mts)

Diagnostic species: *Trichophorum pumilum.*
Constant species: *Blysmus compressus, Carex orbicularis* subsp. *kotschyana, Eleocharis quinqueflora, Festuca rubra, Lotus corniculatus* subsp. *corniculatus, Primula auriculata, Ranunculus amblyolobus, Trichophorum pumilum.*
Geographical range: This vegetation has been recorded in the Alborz Mts in the alpine belt at elevation from ca. 2,500 to 3,000 m a.s.l. (Naqinezhad et al. 2021).
Habitat characteristics: This association occurs on mountain slopes with relatively high grazing pressure. It has also been affected by peat extraction (Naqinezhad et al. 2021).

SCH-AA06. *Pediculari sibthorpii-Ranunculetum amblyolobi* Naqinezhad, Nowak, Nobis, S. Nowak, Świerszcz et Kamrani in Naqinezhad et al. 2021 (fen vegetation on the mineral and base-rich, sometimes subhalophytic alluvial flats of large mountain rivers and gentle slopes in the Alborz Mts)

Diagnostic species: *Juncus gerardi* subsp. *libanoticus, Pedicularis sibthorpii, Ranunculus amblyolobus.*
Constant species: *Carex diluta, Carex orbicularis* subsp. *kotschyana, Carex songorica, Dactylorhiza umbrosa, Eleocharis uniglumis, Equisetum palustre, Juncus inflexus, Lotus corniculatus* subsp. *corniculatus, Mentha longifolia, Pedicularis sibthorpii, Phragmites australis, Ranunculus amblyolobus, Trifolium pratense.*
Geographical range: This vegetation occurs in the Alborz Mts in the alpine belt at an elevation ranging from ca. 2,100 to 3,200 m a.s.l. (Naqinezhad et al. 2021).
Habitat characteristics: This association occurs on the mineral- and base-rich, or even salt-rich alluvial flats of large mountain rivers and gentle slopes at fen margins. Vegetation is often grazed or mowed, or encroached by *Phragmites australis* (Naqinezhad et al. 2021).

SCH-AA07. *Swertio longifoliae-Caricetum iranicae* Naqinezhad, Nowak, Nobis, S. Nowak, Świerszcz et Kamrani in Naqinezhad et al. 2021 (fens on base-rich substrates on wet alluvial fans, bottoms of U-shaped valleys or in less waterlogged sloping springs in the high montane or subalpine belts of the central Alborz Mts)

Diagnostic species: *Brachypodium sylvaticum, Carex demissa* subsp. *iranica, Gentiana septemfida, Juncus alpinus, Linum catharticum, Swertia longifolia, Trichophorum alpinum.*
Constant species: *Brachypodium sylvaticum, Carex demissa* subsp. *iranica, Carex orbicularis* subsp. *kotschyana, Cirsium hygrophilum, Dactylorhiza umbrosa, Eleocharis quinqueflora, Gentiana*

septemfida, Juncus articulatus, Juncus inflexus, Linum catharticum, Lotus corniculatus subsp. *corniculatus, Mentha longifolia, Phragmites australis, Plantago lanceolata, Primula auriculata, Ranunculus amblyolobus, Swertia longifolia, Trichophorum alpinum.*

Geographical range: This vegetation type occurs in the high montane or subalpine belt of the central Alborz Mts at an elevation of about 1,600–2,300 m (Naqinezhad et al. 2021).

Habitat characteristics: This rather species-rich association occurs on base-rich fen soils on wet alluvial fans, the bottoms of U-shaped valleys or in less waterlogged sloping springs. Peat accumulation is low, perhaps due to presumably high mineralisation rates (Naqinezhad et al. 2021).

SCH-AAc01. Community of *Oxytropis riparia* (forb fen vegetation of montane to alpine belts of the western Pamir-Alai Mts)

Diagnostic species: *Oxytropis riparia.*

Constant species: *Oxytropis riparia.*

Geographical range: This community has been reported from the river beds of central Tajikistan. According to Ovchinnikov (1978), stands of *Oxytropis riparia* develop in the montane belt, at an elevation of about 1,100–2,100 m a.s.l.

Habitat characteristics: Stands of this community occupy the floodplains, gravel bars and riparian zones of montane rivers.

SCH-AAc02. Community of *Inula rhizocephala* (heavily grazed mires and fens in flats of U-shaped valleys in Middle Asia) (Fig. 462)

Diagnostic species: *Distichium capillaceum, Inula rhizocephala, Lagotis korolkowii, Crepis multicaulis.*

Constant species: *Crepis multicaulis, Distichium capillaceum, Inula rhizocephala, Lagotis korol-*

Fot. 462. *Inula rhizocephala* – a species typical for intensively grazed fen vegetation, Marguzor, Pastrud-darya Valley, Tajikistan (ca. 2,550 m a.s.l.). Photo: A. Nowak.

Fig. 463. Fen vegetation of the *Triglochin maritima* and *Blysmus compressus* community, found near Sarytag, Kanchoch Valley, Tajikistan (ca. 2,550 m a.sl.). Photo: A. Nowak.

kowii, Ligularia thomsonii, Primula iljinskii, Ranunculus botschantzevii.
Geographical range: This community has been found sporadically in a central section of the Zeravshan Mts, mainly in the valleys of Iskander-darya and Pastrud-darya rivers, and the Kuli-Kalon Plateau (Nowak et al. 2016d). However, it is probably widespread throughout Middle Asia.
Habitat characteristics: Te stands of this community occupy the flat stream valleys in the alpine zone, on peaty substrates. This vegetation is resistant to heavy grazing and generally occurs near the main grazing areas of cattle and livestock (Nowak et al. 2016d).

SCH-AAc03. Community of *Triglochin maritima* and *Blysmus compressus* (initial fen vegetation on peaty substrates with water outflows of the Pamir-Alai Mts) (Fig. 463)

Diagnostic species: *Blysmus compressus, Carex divisa, Triglochin maritima.*
Constant species: *Blysmus compressus, Carex orbicularis* subsp. *kotschyana, Eleocharis uniglumis, Juncus articulatus, Phragmites australis, Triglochin maritima.*
Geographical range: This vegetation is widespread in the Pamir-Alai, occurring mainly in the depressions of the grazing areas in the wide alpine valleys at an elevation of ca. 1,900–3,300 m a.s.l.
Habitat characteristics: This species-poor community occurs in highly waterlogged, high elevation flat fens with a considerable depth of peat (ca. 1 m) (Naqinezhad et al. 2021).

SCH-AAc04. Community of *Blysmus compressus* and *Philonotis fontana* (initial fen vegetation on peaty substrates with water outflows of the Pamir-Alai Mts)

Diagnostic species: *Blysmus compressus*, *Philonotis fontana*.
Constant species: *Blysmus compressus*, *Philonotis fontana*.
Geographical range: Stands of this vegetation have been found in the alpine belt of western

Tajikistan, mainly Zeravshan and Hissar Mts, at an elevation of about 2,100–2,800 m a.s.l. According to the ranges of the diagnostic species, the range of this community includes Middle and Central Asia.

Habitat characteristics: Vegetation formed by *Blysmus compressus* and *Philonotis fontana* grows on a peaty substrate with stable water outflow. The community forms short mats in the alpine belt on flat sites or gentle slopes.

SCH-AAc05. Community of *Allium atrosanguineum* (subalpine and alpine fen vegetation of Middle and Central Asia) (Fig. 464)

Diagnostic species: *Allium atrosanguineum.*
Constant species: *Allium atrosanguineum.*
Geographical range: In Tajikistan, small stands of this vegetation have been recorded in the alpine belt of the Turkestan Mts, Zeravshan Mts, Peter the First Mts, western and eastern Pamir ranges. This community is distributed also in Tian Shan Mts, southern Siberia (Altai, Sayan, Yablonove Mts), Qinghai and Yunnan Provinces in China (GBIF 2024). The elevational amplitude of this vegetation is between 3,000 and 4,250 m a.s.l.

Habitat characteristics: This vegetation includes fens or wet grasslands on the peaty soils. Only occasionally stands of *Allium atrosanguineum* were found in juniper woodland gaps (Ovchinnikov 1963).

Shrubby group

SCH-AA08. *Salicetum schugnanicae* Nowak et Nobis in Nowak et al. 2013 (alpine, groundwater-fed shrubby fen vegetation of the western Pamir-Alai Mts) (Fig. 465)

Fig. 464. High mountain fen vegetation of the *Allium atrosanguineum* community found near the Otmok Pass, Talas Mts, Kyrgyzstan (ca. 3,150 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Alchemilla hissarica, Brachythecium mildeanum, Calliergonella cuspidata, Carex karoi, Carex orbicularis* subsp. *orbicularis, Cratoneuron commutatum, Dactylorhiza umbrosa, Equisetum arvense, Galium turkestanicum, Geranium collinum, Lathyrus pratensis, Pedicularis dolichorrhiza, Salix schugnanica, Swertia juzepczukii.*
Constant species: *Alchemilla hissarica, Blysmus compressus, Brachythecium mildeanum, Bryum pseudotriquetrum, Calliergonella cuspidata, Carex orbicularis* subsp. *orbicularis, Carum carvi, Cortusa turkestanica, Cratoneuron commutatum, Dactylorhiza umbrosa, Eleocharis quinqueflora, Equisetum arvense, Euphrasia pectinata, Festuca rubra, Galium turkestanicum, Geranium collinum, Lathyrus pratensis, Salix schugnanica, Swertia juzepczukii.*
Geographical range: *Salicetum schugnanicae* is a typical shrubby plant community occurring in an alpine belt of western Pamir-Alai at elevation between 2,500 and 2,900 m a.s.l. The potential range of the *Salicetum schugnanicae* must be congruent with the range of its main diagnostic species (Nowak et al. 2013, 2016d). *Salix schugnanica* has been reported from the Pamir-Alai Mts (Tajikistan) and Tian Shan Mts (Kyrgyzstan, northeast China). In Tajikistan, the species has been noted in the alpine and subalpine elevational belts (2,300–4,300 m a.s.l.) in Zeravshan, Hissar, Peter the First, Darvaz, Shugnan, Alichur, Muzkol and Sarykol ranges (Ovchinnikov 1968). This alpine, groundwater-fed shrubby fen vegetation is the final stage of fen succession on the gentle peaty slopes of the western Pamir-Alai (Naqinezhad et al. 2021).
Habitat characteristics: It inhabits mainly gently sloping fens with percolating groundwater and peaty, neutral to alkaline substrates (Nowak et al. 2016d).

Fig. 465. Shrubby fen of the *Salicetum schugnanicae* association found in the Dzhidzhikrut Valley, Hissar Mts, Tajikistan (ca. 3,500 m a.s.l.). Photo: A. Nowak.

Fig. 466. Fen vegetation dominated by *Salix caesia* near the Chon-Ashu Pass, Turgen-Aksu River Valley, Kyrgyzstan (ca. 3,050 m a.s.l.). Photo: A. Nowak.

SCH-AAc07. Community of *Salix caesia* (dwarf shrub alpine vegetation on rivulets banks and flats in the Tian Shan Mts) (Fig. 466)

Diagnostic species: *Salix caesia.*
Constant species: *Salix caesia.*
Geographical range: Phytocoenoses of this community have been recorded in Terskey Ala-Too in Kyrgyzstan, the eastern Hindu Kush, the Karakoram, the Himalayas, the Altai Mts, the Sayan Mts and the Yablonove Mts. Additionally, plots of this community were noticed in Xinjiang and Tibet in China. This dwarf-shrub fen vegetation occurs in the alpine belt in wet, peaty habitats along rivers and streams. In Tajikistan, this community has been noticed in the Peter the First Mts and the Eastern Pamir at about 3,000–4,200 m a.s.l. (Ovchinnikov 1968).
Habitat characteristics: This vegetation inhabits peaty fens, often along the brooks and rivulets in the subalpine elevations of the Eastern Pamir-Alai and Tian Shan Mts.

SCH-AB. *Alopecurion mucronati* Nowak, Naqinezhad, Nobis, S. Nowak, Świerszcz et Hájek in Naqinezhad et al. 2021 (fens of continental, eastern Irano-Turanian subregion, including the Pamir Mts) (Fig. 467)

Diagnostic species: *Alopecurus mucronatus, Carex microglochin, Eritrichium villosum, Gentiana pygmaea, Lomatogonium carinthiacum, Melandrium apetalum, Melandrium brachypetalum, Pedicularis rhinanthoides* subsp. *rhinanthoides.*
Constant species: *Alopecurus mucronatus, Carex microglochin, C. pseudofoetida, Eritrichium villosum, Gentiana pygmaea, Lomatogonium carinthiacum, Melandrium apetalum, Melandrium brachypetalum, Pedicularis rhinanthoides* subsp. *rhinanthoides.*

Fig. 467. Fen vegetation of *Alopecurion mucronati* inhabiting wet slopes near Murgab (ca. 3,900 m a.s.l., Murgab River Valley, Tajikistan). Photo: M. Nobis.

Geographical range: Phytocoenoses of this alliance have been recorded specifically in the alpine belt of the high plateaus of the eastern Pamir Mts in Tajikistan and the upper reaches of the Alai Valley in Kyrgyzstan (and probably also in Tibet), at an elevation of ca. 2,460–4,500 m a.s.l. (Naqinezhad et al. 2021).

Habitat characteristics: This alliance characterises permanently wet or periodically drying terrestrial wetland habitats in the eastern Irano-Turanian Mts. It is associated with the continental, harsh climate of the Central Asian phytogeographical subregion. It occurs on the flat or gently sloping surfaces of U-shaped valleys. It is associated with the lowest mean annual temperature of all mire vegetation. Its communities develop on saline substrates and can occur in close contact with salt-marsh vegetation of *Artemisietalia pauciflorae* Golub et Karpov in Golub et al. 2005 and *Taraxacion murgabici* S. Świerszcz et al. 2021. The amount of soil organic matter is low (Naqinezhad et al. 2021).

SCH-AB01. *Swertio marginatae-Caricetum regelianae* Nowak, Naqinezhad, Nobis, S. Nowak et Świerszcz in Naqinezhad et al. 2021 (alpine fens of flat bottoms of river valleys and post-glacial flattening in the eastern Tajikistan and the central and western Tian Shan Mts) (Fig. 468, 469)

Diagnostic species: *Carex orbicularis* subsp. *orbicularis, Carex regeliana, Gentiana algida, Gentiana falcata, Juncus triglumis, Leontopodium ochroleucum, Lomatogonium carinthiacum, Melandrium apetalum, Oxytropis albovillosa, Pedicularis cheilanthifolia, Pedicularis rhinanthoides* subsp. *rhinanthoides, Polygonum viviparum, Salix caesia, Saxifraga hirculus, Swertia marginata.*

Constant species: *Bryum pseudotriquetrum, Carex orbicularis* subsp. *orbicularis, C. regeliana, Cerastium tianschanicum, Kobresia capillifolia,*

Fig. 468. Sparse stands of *Swertio marginatae-Caricetum regelianae* inhabiting wet, subsaline habitats near Akbaital Pass, Eastern Pamir, Tajikistan (ca. 4,200 m a.s.l.). Photo: A. Nowak.

Fig. 469. Fen vegetation of *Swertio marginatae-Caricetum regelianae* with a large proportion of *Saxifraga hirculus* found near Alichur, Eastern Pamir, Tajikistan (ca. 3,550 m a.s.l.). Photo: A. Nowak.

Kobresia persica, Festuca rubra, Festuca santyvesii, Gentiana algida, Gentiana falcata, Leontopodium ochroleucum, Oxytropis albovillosa, Palustriella decipiens, Pedicularis rhinanthoides subsp. *rhinanthoides, Poa calliopsis, P. supina, Polygonum viviparum, Salix caesia, Saxifraga hirculus, Swertia marginata.*

Geographical range: This vegetation has been recorded in eastern Tajikistan and the central and western Tian Shan at the alpine elevation of ca. 3,500–4,500 m a.s.l. (Naqinezhad et al. 2021).

Habitat characteristics: This association occurs on the flat, broad bottoms of river valleys and postglacial flattenings (Naqinezhad et al. 2021).

SCH-AB02. *Caricetum pseudofoetidae* Nowak, Nobis, S. Nowak et Plášek 2016 (alpine species-poor fens of neutral peaty soils in flat valley bottoms of the Pamir and the eastern Pamir-Alai Mts) (Fig. 470)

Diagnostic species: *Blysmus rufus, Carex enervis, C. pseudofoetida, Euphrasia cyclophylla, Oxytropis hirsutiuscula, Poa calliopsis, Potentilla dealbata, Primula pamirica, Puccinellia vachanica, Ranunculus longicaulis, Schulzia crinita, Stellaria alsinoides, Taraxacum murgabicum.*

Constant species: *Blysmus compressus, B. rufus, Bryum pseudotriquetrum, Carex orbicularis* subsp. *orbicularis, C. parva, C. pseudofoetida, Kobresia persica, Oxytropis hirsutiuscula, Palustriella decipiens, Poa calliopsis, Potentilla dealbata, Primula pamirica, Puccinellia vachanica, Ranunculus longicaulis, Taraxacum murgabicum.*

Geographical range: This vegetation occupies the highest elevations in the Zeravshan, Hissar and Darvaz Mts, within an elevation 2,500–3,600 m a.s.l. (Nowak et al. 2016d). Additionally, it forms a species-poor vegetation on neutral peaty soils in flat valley bottoms of the eastern Pamir (Naqinezhad et al. 2021).

Fig. 470. Alpine fen of the *Caricetum pseudofoetidae* association found near Alichur, Eastern Pamir, Tajikistan (ca. 3,550 m a.s.l.). Photo: A Nowak.

Habitat characteristics: *Caricetum pseudofoetidae* was found on flat fen lawns on a neutral, peaty, thin substrate layer. It often grows in close relationship with halophytic vegetation on saline habitats. The parent rock material was in all cases alkaline (marl, limestone) (Nowak et al. 2016d).

SCH-AB03. *Pediculari rhinanthoidis-Primuletum pamiricae* Nowak, Naqinezhad, Nobis, S. Nowak et Świerszcz in Naqinezhad et al. 2021 (alpine to subnival fens of the eastern Pamir Mts) (Fig. 471)

Diagnostic species: *Alopecurus mucronatus, Carex orbicularis* subsp. *orbicularis, Carex parva, Carex pseudofoetida, Gentiana leucomelaena, Pedicularis rhinanthoides* subsp. *rhinanthoides, P. uliginosa, Primula pamirica, Triglochin maritima.*

Constant species: *Alopecurus mucronatus, Blysmus compressus, Bryum pseudotriquetrum, Carex microglochin, Carex orbicularis* subsp. *orbicularis, Carex parva, C. pseudofoetida, Kobresia persica, Eleocharis quinqueflora, Gentiana leucomelaena, Glaux maritima, Palustriella decipiens, Pedicularis rhinanthoides* subsp. *rhinanthoides, Pedicularis uliginosa, Primula pamirica, Saxifraga hirculus, Triglochin maritima.*

Geographical range: This association occurs in the highest elevations of the eastern Pamir mountain plateaus (Murgab, Sary-kol and Alichur), generally above 3,400 m a.s.l. (Naqinezhad et al. 2021).

Habitat characteristics: Stands of this association have often been reported in close proximity to saline high mountain lakes (Naqinezhad et al. 2021).

SCH-ABc01. Community of *Oxytropis humifusa* (initial fens of the rivulet courses of the alpine

Fig. 471. Fen vegetation of the *Pediculari rhinanthoidis-Primuletum pamiricae* association found around Sasyk-Kul Lake, Eastern Pamir, Tajikistan (ca. 3,810 m a.s.l.). Photo: A. Nowak.

and subnival belt in the eastern Pamir and Tian Shan Mts)

Diagnostic species: *Oxytropis humifusa.*
Constant species: *Oxytropis humifusa.*
Geographical range: This association occurs at the highest elevations, mainly in the Eastern Pamir, with some additional sites in the western Pamir and Peter the First Mts. It inhabits the alpine belt, at about 3,600–4,500 m a.s.l. (Ovchinnikov 1968).
Habitat characteristics: Stands of this community develop on wet habitats in the alpine humid zone, often within the *Kobresia* mats or fen vegetation. Final classification of this vegetation needs further surveys and comparative analyses.

SCH-ABc02. Community of *Trollius liliacinus* (initial fens of the rivulet courses of the alpine belt in the central and eastern Tian Shan Mts) (Fig. 472)

Diagnostic species: *Trollius liliacinus.*
Constant species: *Trollius liliacinus.*
Geographical range: This association occurs in the alpine elevations of the central Tian Shan, Altai and Sayan Mts. The community occurs mainly at elevation between 2,400 and 3,700 m a.s.l.
Habitat characteristics: Stands of this community develop on wet habitats in the complex of fens, alpine grasslands and *Kobresia* mat vegetation. The final classification of this vegetation needs further surveys and comparative analyses.

SCH-ABc03. Community of *Ranunculus alaiensis* (intensively grazed fens in alpine belt of the Pamir-Alai and western Tian Shan Mts) (Fig. 473)

Fig. 472. Alpine fen of the community with *Trollius liliacinus* in Kuylyutau Mts, Kyrgyzstan (ca. 3,610 m a.s.l.). Photo: A. Nowak.

Fig. 473. Intensively grazed, alpine fen community of *Ranunculus alaiensis* near Peak Agasis, Peter the First Range, Tajikistan (ca. 3,420 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Ranunculus alaiensis.*
Constant species: *Ranunculus alaiensis.*
Geographical range: This typical alpine fen and snowbed vegetation occurs in the alpine belt of the Pamir-Alai and Tian Shan at elevation between 2,400 and 4,500 m a.s.l.

Habitat characteristics: Stands of this community develop on wet habitats in the complex of fens and alpine grasslands. It often grows in the areas with intensive summer grazing, sometimes resisting even the heavy trampling around goats and sheep shelters.

Annual weed vegetation of arable crops, gardens and vineyards in the cool-temperate and boreal zones of Eurasia

Anthropogenic vegetation

Annual weed segetal vegetation of arable crops, gardens and vineyards in the cool-temperate and boreal zones of Eurasia

PAR. *Papaveretea rhoeadis* Brullo, Scelsi et Spaminato 2001 (Fig. 474)

PAR-A. *Turgenio latifoliae-Roemerietalia refractae* Nowak, A. Nowak, Nobis et A. Nobis 2013 (annual weed vegetation of arable crops, gardens and vineyards in Irano-Turanian Region) (Fig. 475)

Diagnostic species: *Acroptilon repens, Anthemis altissima, Brassica campestris, Galium tricornutum, Roemeria refracta, Turgenia latifolia, Lepyrodiclis holosteoides, Galium spurium, Fumaria vaillantii, Scandix pecten-veneris, Vaccaria hispanica, Sinapis arvensis, Silene conoidea, Vicia villosa, Heterocaryum macrocarpum, Vicia sativa, Cirsium incanum, Lathyrus sativus.*

Constant species: *Galium spurium, Lepyrodiclis holosteoides, Vaccaria hispanica, Brassica campestris, Scandix pecten-veneris, Sinapis arvensis, Vicia villosa.*

Geographical range: This vegetation occurs throughout the Irano-Turanian Region and adjacent areas.

Habitat characteristics: Communities of this order develop on fertile or poor, moderately humid or fairly dry, calcium and carbonate-rich soils in areas with a Mediterranean-type climate. They occur in crop phytocoenoses, mainly in triticale, rye and wheat, both summer and winter varieties (Nowak S. et al. 2013b).

PAR-AA. *Lathyrion sativi* Nowak, A. Nowak, Nobis et A. Nobis 2013 (weed vegetation of cereal crops on sandy soils in the Pamir Mts) (Fig. 476)

Fig. 474. A stand of *Papaver pavoninum* in a wheat crop near Khirtab, Yagnob River Valley, Zeravshan Mts, Tajikistan (ca. 2,350 m a.s.l.). Photo: A. Nowak.

Fig. 475. A weed community representing the *Turgenio latifoliae-Roemerietalia refractae* vegetation near Koshana, Zeravshan River Valley, Tajikistan (ca. 1,350 m a.s.l.). Photo: A. Nowak.

Fig. 476. Farmland landscape near Shugnan, Panj River Valley, Afghanistan (ca. 2,100 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Lathyrus sativus, Pisum arvense, Arenaria serpyllifolia.*
Constant species: *Lathyrus sativus*, *Pisum arvense*, *Arenaria serpyllifolia*, *Vicia hirsuta*.
Geographical range: This vegetation occurs throughout the highlands of the whole Middle Asia.
Habitat characteristic: It inhabits mesic or poor, moderately humid or rather dry, calcium- and carbonate-rich soils in the highlands of Middle Asia. They grow in stands of triticale, rye and wheat, both summer and winter varieties (Nowak S. et al. 2013b).

PAR-AA01. *Lathyretum sativi* Nowak, A. Nowak, Nobis et A. Nobis 2013 (weed vegetation of cereal crops on sandy soils in the southern Pamir Mts) (Fig. 477)

Diagnostic species: *Lathyrus sativus.*
Constant species: *Fagopyrum tataricum, Lathyrus sativus, Brassica campestris, Pisum arvense, Chenopodium album, Convolvulus arvensis, Arenaria serpyllifolia, Vicia sativa, Potentilla orientalis.*
Geographical range: This vegetation is associated with crop fields situated at higher elevations, within an elevational range between 1,700 and 3,000 m a.s.l. throughout the Irano-Turanian Region (Nowak S. et al. 2013b).
Habitat characteristics: *Lathyretum sativi* develops mainly in triticale, wheat and rye crops. It is typical of sandy, slightly alkaline, moderately fertile and mesic soils.

PAR-AAc01. Community of *Scleranthus annuus* (weed vegetation of cereal crops on sandy, poorly developed soils) (Fig. 478)

Diagnostic species: *Scleranthus annuus.*
Constant species: *Scleranthus annuus*.
Geographical range: The community of *Scleranthus annuus* was observed in one locality (ca. 50 km east of the city of Khorogh) situated

Fig. 477. Vegetation of *Lathyretum sativi* near Pinyon, Zeravshan Mts, Tajikistan (ca. 1,750 m a.s.l.). Photo: A. Nowak.

Fig. 478. Community of *Scleranthus annuus* near Shivrozh, Gunt River Valley, Western Pamir, Tajikistan (ca. 2,280 m a.s.l.). Photo: A. Nowak

in the western Pamir, at an elevation of about 2,300 m a.s.l. (Nowak S. et al. 2013b).

Habitat characteristics: The community with constant presence of *Scleranthus annuus* has been developed in ×*Triticale rimpaui* stands. Patches of the community occur on poor, sandy soils (Nowak S. et al. 2013b).

PAR-AB. *Cirsion incani* Al. nov. hoc loco (weed vegetation of cereal crops on poor, sandy or gravelly soils in Middle Asia)

Nomenclatural type: *Asperugini procumbentis-Cannabietum ruderalis* Nowak et al. 2013

Diagnostic species: *Asperugo procumbens, Cannabis ruderalis, Cirsium incanum.*

Constant species: *Asperugo procumbens, Cannabis ruderalis, Cirsium incanum, Papaver rhoeas, Vicia villosa.*

Geographical range: The communities of this alliance are situated in mountainous areas with a Mediterranean-type climate, at medium elevation, i.e. between 500 and 2,600 m a.s.l. (Nowak S. et al. 2013b).

Habitat characteristics: *Cirsion incani* phytocoenoses occur on moderately fertile loess and sandy soils with medium moisture. The *Cirsion incani* alliance includes weed communities that develop on alkaline, sometimes irrigated soils (Nowak S. et al. 2013b). Phytocoenoses belonging to this alliance are characterised by a relatively high participation of ruderal species, with the participation of a large group of taxa from the order *Turgenio-Roemerietalia* (Nowak S. et al. 2013b).

PAR-AB01. *Asperugini procumbentis-Cannabietum ruderalis* Nowak, A. Nowak, Nobis et A. Nobis 2013 nom. corr. (weed vegetation of cereal crops on poor, sandy or loessic soils)

Diagnostic species: *Asperugo procumbens, Cannabis ruderalis.*

Constant species: *Asperugo procumbens, Cannabis ruderalis, Sclerochloa dura.*

Fig. 479. Weed vegetation representing the *Aveno trichophyllae-Euphorbion falcatae* alliance in wheat cultivation near Tezgar, Tajikistan (ca. 970 m a.s.l.). Photo: A. Nowak.

Geographical range: The *Aperugini-Cannabietum* association is widespread in Tajikistan. Patches of this association occur within a wide range of elevation, from 500 to 2,600 m a.s.l. (Nowak S. et al. 2013b).

Habitat characteristics: It has been noted in different types of crops, mostly in rye, less frequently in barley, triticale and wheat. Patches of this association usually develop on sandy or loess soils of moderate fertility. The soil substrate is generally relatively wet, but due to the high content of sand or gravel content, the upper layer of the soil profile often dries out (Nowak S. et al. 2013b).

PAR-AC. *Aveno trichophyllae-Euphorbion falcatae* Nowak, A. Nowak, Nobis et A. Nobis 2013 (weed, calcicole vegetation of crops in Middle Asia) (Fig. 479)

Diagnostic species: *Avena trichophylla, Euphorbia falcata, Centaurea depressa, Heterocaryum szovitsianum, Papaver pavoninum, Anchusa italica, Strigosella trichocarpa, Ranunculus arvensis, Cnicus benedictus, Alhagi kirghisorum, Eremodaucus lehmannii.*

Constant species: *Avena trichophylla, Euphorbia falcata, Centaurea depressa, Heterocaryum szovitsianum, Papaver pavoninum, Anchusa italica, Strigosella trichocarpa, Ranunculus arvensis, Cnicus benedictus, Alhagi kirghisorum, Eremodaucus lehmannii.*

Geographical range: Phytocoenoses placed within the alliance have been observed mainly in the southern part of Tajikistan, as well as in the Hissar and Zeravshan Mts (Nowak S. et al. 2013b).

Habitat characteristics: They develop in the warmest regions of Tajikistan, mostly in the lowest sections of river valleys, often on their southern slopes (Nowak S. et al. 2013b). *Aveno trichophyllae-Euphorbion falcatae* includes the phytocoenoses of warm places on alkaline substrates

in Middle Asia, influenced by an Irano-Turanian climate (Nowak S. et al. 2014). They are the most species-rich of all segetal phytocoenoses recorded in Tajikistan.

PAR-AC01. *Caucalido platycarpi-Vicietum michauxii* Nowak, A. Nowak, Nobis et A. Nobis 2014 (calcicole weed vegetation of cereal crops on gravelly soils in Middle Asia) (Fig. 480)

Diagnostic species: *Vicia michauxii, Caucalis platycarpos.*
Constant species: *Alyssum desertorum, Caucalis platycarpos, Thlaspi perfoliatum, Litwinowia tenuissima, Vicia michauxii, Ranunculus arvensis.*
Geographical range: This association prefers relatively low elevation, mostly between 600 and 900 m a.s.l. Patches of the phytocoenoses were found in the foothills of the Tian Shan Mts, gently sloping to the north (Nowak S. et al. 2014). The potential range of *Caucalido platycarpi-Vicietum michauxii* includes the area of central and northern Tajikistan, eastern Uzbekistan and southern Kyrgyzstan as well as the northern limits of the Irano-Turanian and Mediterranean provinces.
Habitat characteristics: The *Caucalido-Vicietum* association occurs exclusively on arable fields in the central part of Middle Asia, which determines its syntaxonomic position within

Fig. 480. Weed vegetation of *Caucalido platycarpi-Vicietum michauxii* with *Vicia michauxii* in wheat cultivation near Tezgar, Tajikistan (ca. 970 m a.s.l.). Photo: A. Nowak.

the *Papaveretea rhoeadis* class. It develops on loose, clayey, alkaline, fertile and fresh soils (Nowak S. et al. 2014).

PAR-AC02. *Vicietum hyrcanico-peregrinae typicum* Nowak, A. Nowak, Nobis et A. Nobis 2013 (calcicole weed vegetation on brown, clayey soils in Middle Asia) (Fig. 481)

Diagnostic species: *Vicia hyrcanica, V. peregrina, Neslia apiculata.*
Constant species: *Anagallis foemina, Avena trichophylla, Centaurea depressa, Euphorbia falcata, Galium spurium, Lycopsis orientalis, Neslia apiculata, Lepyrodiclis holosteloides, Ranunculus arvensis, Scandix pecten-veneris, Turgenia latifolia, Vaccaria hispanica, Vicia villosa.*

Fig. 481. *Vicia peregrina* in a wheat stand near Ayni, Tajikistan (ca. 1,200 m a.s.l.). Photo: A. Nowak.

Geographical range: The association has been recorded quite often in the Hissar-Darvazian and Zeravshanian geobotanical regions. It occurs in the range of elevation from 1,100 to 1,900 m a.s.l. mostly in rye and triticale (Nowak S. et al. 2013b).
Habitat characteristics: *Vicietum hyrcanico-peregrinae typicum* prefers warm sites. It develops on compact, clayey, alkaline, fertile and mesic soils (Nowak S. et al. 2013b).

PAR-AC02a. *Vicietum hyrcanico-peregrinae garhadioletosum angulosi* Nowak, A. Nowak, Nobis et A. Nobis 2013

Diagnostic species: *Garhadiolus angulosus, Cephalaria syriaca.*
Constant species: *Anagallis foemina, Centaurea depressa, Euphorbia falcata, Galium spurium, Garhadiolus angulosus, Lycopsis orientalis, Ranunculus arvensis, Turgenia latifolia, Vaccaria hispanica, Vicia villosa.*
Geographical range: This subassociation has been observed only in the western part of the Zeravshan Mts (in the valley of the Mogien River). It has been found in a range of elevation from 1,000 to 1,650 m a.s.l. (Nowak S. et al. 2013b).
Habitat characteristics: It prefers south-facing slopes of low and gentle hills. It is typical of loose and low triticale and wheat cultivation. Phytocoenoses of the subassociation develop on sandy soils with a high content of gravel and stones. This subassociation is characterised by a high participation of thermophilous species including *Garhadiolus angulosus* or *Cephalaria syriaca*, which prefer warm sites throughout the area of its occurrence in the Irano-Turanian Region in mid-elevation mountainous areas (Nowak S. et al. 2013b).

PAR-AC02b. *Vicietum hyrcanico-peregrinae anchusetosum italicae* Nowak, A. Nowak, Nobis et A. Nobis 2013 (Fig. 482)

Diagnostic species: *Anchusa italica, Conringia orientalis.*
Constant species: *Anagallis foemina, Anchusa italica, Euphorbia falcata, Galium spurium, Ly-*

Fig. 482. *Anchusa italica* – a species diagnostic for the *Vicietum hyrcanico-peregrinae anchusetosum italicae* subassociation near Khushikat, Ayni District, Tajikistan (ca. 1,430 m a.s.l.). Photo: A. Nowak.

copsis orientalis, Ranunculus arvensis, Turgenia latifolia, Vicia villosa.

Geographical range: Its phytocoenoses were observed both in the Zeravshan and South Tajikistanian regions, in an elevational range between 950 and 1,800 m a.s.l., in triticale and wheat (Nowak S. et al. 2013b).

Habitat characteristics: This subassociation has higher habitat requirements but is more frequent than the previous one. It usually occurs on relatively fertile brown soils of loess origin, characterised by a high content of organic matter and a relatively low content of gravel and stones (Nowak S. et al. 2013b).

PAR-AC03. *Eremodauco lehmannii-Lagonychietum farcti* Nowak, A. Nowak, Nobis et A. Nobis 2013 (thermophilous weed vegetation of cereal crops and wastelands in southern Middle Asia) (Fig. 483)

Diagnostic species: *Lagonychium farctum, Eremodaucus lehmannii, Alhagi kirghisorum, Stizolophus balsamita, Sewerzowia turkestanica, Onobrychis pulchella.*

Constant species: *Alhagi kirghisorum, Centaurea squarrosa, Cnicus benedictus, Eremodaucus lehmannii, Strigosella africana, Papaver pavoninum.*

Geographical range: This vegetation occurs mainly in southern Tajikistan, in regions with a warm Irano-Turanian climate at elevation of 450 to 1,800 m a.s.l. (Nowak S. et al. 2013b).

Habitat characteristics: This association develops mainly in triticale and rye crops. Its phytocoenoses are associated with infertile, poor and highly alkaline brown soils and rankers, which are often very stony and compacted. The association is the most thermophilous segetal syntaxon of all those recorded in Tajikistan. The *Eremodauco lehmannii-Lagonychietum*

Fig. 483. Weed vegetation of the *Eremodauco lehmannii-Lagonychietum farcti* association found in the cereal cultivation near Hissor, Tajikistan (ca. 750 m a.s.l.). Photo: A. Nowak.

farcti association is clearly dominated by the participation of species typical of the Irano-Turanian, continental type of distribution (Nowak S. et al. 2013b).

PAR-ACc01. Community of *Chenopodium glaucum* and *Ch. rubrum* (weed vegetation of cereal crops in flooded fields in the river valleys) (Fig. 484)

Diagnostic species: *Chenopodium glaucum, Chenopodium rubrum.*
Constant species: *Chenopodium glaucum, Chenopodium rubrum.*

Fig. 484. Weed community with *Chenopodium glaucum* and *Ch. rubrum* near Rushan, Panj River Valley, Western Pamir, Tajikistan (ca. 1,970 m a.s.l.). Photo: A. Nowak.

Geographical range: The community was sporadically observed in the Western Pamir at an elevation of approx. 2,000 m a.s.l. (Nowak S. et al. 2013b).
Habitat characteristics: It has been developed in rye plantations on fertile, moist, brown soils. The community includes phytocoenoses dominated by two halophilous species of the genus *Chenopodium*, i.e. *Chenopodium rubrum* and *Ch. glaucum*. Apart from diagnostic species, other species associated with high salinity habitats were observed within its patches, e.g. *Salsola collina, Puccinellia gigantea* and *Glaux maritima* (Nowak S. et al. 2013b).

PAR-ACc02. Community of *Scandix pecten-veneris* (weed vegetation of cereal crops on calcareous habitats) (Fig. 485)

Diagnostic species: *Scandix pecten-veneris.*
Constant species: *Scandix pecten-veneris.*

Geographical range: The community was frequently observed in the whole Middle Asia at different elevations mainly from ca. 500 to 2,800 m a.s.l.
Habitat characteristics: This community is developed on ranker, alkaline, mesic soils. It prefers field margins and occurs also in ruderal habitats.

PAR-AD. *Spergulo arvensis-Erodion cicutariae* Tüxen in Passarge 1964 (weed vegetation of root crops on brown, moderately fertile soils in eastern and central Tajikistan) (Fig. 486)

This alliance includes weed vegetation with considerable contribution of C4 grasses such as *Digitaria sanguinalis, Echinochloa crus-galli* and *Setaria* spp. It occurs on dry, sandy soils in warm lowland areas. It develops mainly in arable fields and in vineyards, or on roadsides and other anthropogenic habitats.

Fig. 485. Weed community of *Scandix pecten-veneris* near Veshan, Zeravshan Mts, Tajikistan (ca. 1,650 m a.s.l.). Photo: A. Nowak.

Fig. 486. Hand weeding of a field near Ayni, Tajikistan (ca. 1,250 m a.s.l.). Photo: A. Nowak.

Fig. 487. Weed vegetation of *Convolvulo arvensis-Cyperetum rotundi* in an irrigated strawberry plantation near Khudzhand, Tajikistan (ca. 400 m a.s.l.). Photo: A. Nowak.

PAR-AD01. *Convolvulo arvensis-Cyperetum rotundi* Carretero et Aguilella ex Ninot, Font, Masalles et Vigo 2011 (irrigated or flooded weed vegetation of maize, potato, tomato, cotton, leek and, rarely, in parsley plantations) (Fig. 487)

Diagnostic species: *Cyperus rotundus.*
Constant species: *Cyperus rotundus.*
Geographical range: The *Convolvulo arvensis-Cyperetum rotundi* association is one of the most common in Tajikistan. The phytocoenoses developed mainly in the middle reaches of the alpine rivers, among others, the Syr-darya, Pastrud-darya, Yagnob, Zeravshan, Kafirnighan and Vakhsh rivers, mostly at elevation of ca. 400–900 m a.s.l. (Nowak S., Nowak 2013).
Habitat characteristics: *Convolvulo arvensis-Cyperetum rotundi* occurs mainly in maize, potato, tomato, cotton, leek and, rarely, in parsley plantations. The association develops on moist, fertile, brown soils with near-neutral reactions. The fields are mostly irrigated (Nowak S., Nowak 2013).

PAR-AD01a. *Convolvulo arvensis-Cyperetum rotundi kochietosum scopariae* Nowak et A. Nowak 2013 (weed vegetation of root crops in irrigated fields on poor sandy soils in western Tajikistan) (Fig. 488)

Diagnostic species: *Kochia scoparia.*
Constant species: *Kochia scoparia.*
Geographical range: This vegetation may be found throughout Central Asia.
Habitat characteristics: *Kochia scoparia* in Tajikistan occurs both in segetal and ruderal habitats; however, it forms frequent and constant compositions in segetal root-crop communities on sandy soils and fields close to road or railway verges, towns or villages (Nowak S., Nowak 2013).

Fig. 488. Weed vegetation of *Convolvulo arvensis-Cyperetum rotundi kochietosum scopariae* in a potato cultivation near Uzun, Tajikistan (ca. 800 m a.s.l.). Photo: A. Nowak.

Fig. 489. Weed vegetation of *Daturo stramonii-Hibiscetum trioni* in a cotton field near Uyali, Tajikistan (ca. 500 m a.s.l.). Photo: A. Nowak.

Fig. 490. Weed vegetation of *Setario pumilae-Sorghetum halepensi* in a sunflower field near Vahdat, Tajikistan (ca. 900 m a.s.l.). Photo: A. Nowak.

PAR-AD02. *Daturo stramonii-Hibiscetum trioni* Bagrikova (1996) 1997 (weed vegetation on irrigated fields with mainly cotton plantations in Tajikistan) (Fig. 489)

Diagnostic species: *Datura stramonium, Hibiscus trionum.*
Constant species: *Amaranthus retroflexus, Abutilon theophrasti, Convolvulus arvensis, Portulaca oleracea, Solanum nigrum, Xanthium italicum.*
Geographical range: This association has been observed mainly in the Southtajikistanian and Prisyrdarian geobotanical regions. The phytocoenoses were recorded in a range of elevation from ca. 500 to 1,000 m a.s.l. (Nowak S., Nowak 2013).
Habitat characteristics: *Daturo stramonii-Hibiscetum trioni* is a thermophilous association typical of arable root crops. It is characterised by the loose cultivation of maize, cotton, lentils, onions, beans and, occasionally, carrots. The community prefers warm, deep, brown soils with little gravel or sand. The reaction of the substrate is neutral or slightly alkaline. The fields are often irrigated (Nowak S., Nowak 2013).

PAR-AD03. *Setario pumilae-Sorghetum halepensi* Ştefan et Oprea 1997 (weed vegetation on irrigated fields with mainly potato or lentil plantations in Tajikistan) (Fig. 490)

Diagnostic species: *Sorghum halepense, Setaria pumila.*
Constant species: *Cyperus rotundus, Echinochloa crus-galli, Helianthus tuberosus, Xanthium italicum.*

Geographical range: The association occurs sporadically in the geobotanical region of southern Tajikistan. It prefers medium elevations, between 800 and 1,000 m a.s.l. (Nowak S., Nowak A. 2013).
Habitat characteristics: It develops mainly in potato and lentil cultivations. Its phytocoenoses are associated with fertile, relatively dry, neutral or slightly alkaline soils, often with high sand content and quite loose (Nowak S., Nowak A. 2013).

PAR-AD04. *Equiseto arvensis-Xanthietum italici* Kolev 1976 (weed, thermophilous vegetation in maize, lentil, potato, sunflower, and tomato plantations in the south-western Pamir-Alai Mts) (Fig. 491)

Diagnostic species: *Xanthium italicum.*
Constant species: *Cichorium intybus, Chenopodium album, Convolvulus arvensis, Galium spurium, Echinochloa crus-galli, Setaria viridis.*

Geographical range: The association is very different from other segetal weed communities noted in Tajikistan. This vegetation is situated at medium elevations within an elevational range of 500 to 1,200 m a.s.l. (Nowak S., Nowak 2013).
Habitat characteristics: It is mainly associated with maize, lentil, potato, sunflower, and tomato fields. The association develops on relatively dry, sandy soils, or substrates with a high proportion of gravel or stones. The soil is neutral or slightly alkaline, moderately fertile, and sporadically irrigated (Nowak S., Nowak A. 2013).

PAR-ADc01. Community of *Chrysanthemum coronarium* (weed, thermophilous vegetation of lentil, potato, sunflower, and tomato plantations in the eastern Irano-Turanian Region) (Fig. 492)

Diagnostic species: *Chrysanthemum coronarium.*

Fig. 491. Weed vegetation of *Equiseto arvensis-Xanthietum italici* in a cotton field near Sarband, Tajikistan (ca. 500 m a.s.l.). Photo: A. Nowak.

Fig. 492. Community of *Chrysanthemum coronarium* near Tangai, Tajikistan (ca. 900 m a.s.l.). Photo: A. Nowak.

Constant species: *Amaranthus retroflexus, Chrysanthemum coronarium, Convolvulus arvensis, Portulaca oleracea, Solanum nigrum.*
Geographical range: The community of *Chrysanthemum coronarium* is extremely rare in Tajikistan. Plots of this community were found in only one site in the valley of the Vakhsh River at an elevation of ca. 1,000 m a.s.l. (Nowak S., Nowak 2013).
Habitat characteristics: It was recorded in *Lens culinaris* and *Solanum tuberosum* plantations on deep, brown, loess and slightly alkaline soils. The substrate was generally dry, but it is supposed that the field is irrigated irregularly (Nowak S., Nowak 2013).

PAR-AE. *Oxalidion fontanae* Passarge 1978 (weed vegetation on mesic soils and wastelands of Middle Asia) (Fig. 493)

This alliance includes weed vegetation of cereal fields, root crops and home gardens. It occurs mainly from the lowlands to the montane belt on nutrient-rich, neutral to slightly acidic soils, which are wetter than those of the *Veronico-Euphorbion* or *Scleranthion annui* alliances.

PAR-AE01. *Galinsogo-Setarietum* (Tüxen et Becker 1942) Tüxen 1950 (weed vegetation of different crop types and ruderal habitats in western Tajikistan)

Diagnostic species: *Galinsoga parviflora, Galinsoga ciliata.*
Constant species: *Galinsoga parviflora, Kochia scoparia, Oxalis fontana, Polygonum persicaria, P. aviculare.*
Geographical range: The association was only found in a few places in Tajikistan, in sandy fields, mainly around Dushanbe in southern Tajikistan. Plots of the phytocoenosis were noted at elevation of ca. 1,000–1,200 m a.s.l. (Nowak S., Nowak 2013).

Fig. 493. Ruderal vegetation representing *Oxalidion fontanae* in southern quarters of Dushanbe, Tajikistan (ca. 850 m a.s.l.). Photo: A. Nowak.

Fig. 494. Weed vegetation of the *Brassico campestris-Lamietum amplexicauli* association in a rye field near Pajwar, Western Pamir, Tajikistan (ca. 1,970 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: It was mainly found in potato cultivations. Its phytocoenoses are associated with moderately fertile, mesic dry and neutral (pH 6.8–7.2) brown soils with a high content of sand or gravel fractions (Nowak S., Nowak 2013).

PAR-AF. *Veronico-Euphorbion* Sissingh ex Passarge 1964 (weed vegetation of different root crops in western Tajikistan)

This weed vegetation is dominated by annuals that develop in root crops on base-rich loamy or clayey soils in warm areas. Depending on the type of planted crop and agricultural management, it may temporally alternate with *Caucalidion* vegetation. It prefers nutrient-rich, fertile soils.

PAR-AF-01. *Brassico campestris-Lamietum amplexicauli* Nowak et A. Nowak 2013 (weed vegetation of root and cereal crops in central and eastern Tajikistan) (Fig. 494)

Diagnostic species: *Brassica campestris, Lamium amplexicaule.*

Constant species: *Brassica campestris, Chenopodium album, Convolvulus arvensis, Lamium amplexicaule.*

Geographical range: *Brassico campestris-Lamietum aplexicauli* is one of the phytocoenoses occurring at the highest elevations occupied by root crops in the Pamir-Alai Mts (ca. 1,900–3,000 m a.s.l.). It occurs mainly in the Zeravshanian, Hissar-Darvasian and eastern Tajikistanian geobotanical regions at relatively high altitudes. Recorded plots were sometimes observed on northern slopes of alpine river valleys (e.g. Yagnob, Pastrud-darya, Iskander-darya) (Nowak S., Nowak A. 2013).

Habitat characteristics: The association is the least thermophilous syntaxon of all those recorded in root crops in Tajikistan. *Brassico campestris-Lamietum aplexicauli* develops mainly in potato cultivations. Its phytocoenoses are associated with nutrient-poor, neutral or moderately alkaline, grey soils and rankers, which are often very stony and loose (Nowak S., Nowak A. 2013).

Weed vegetation of the rice fields of Eurasia

Weed vegetation of the rice fields of Eurasia

ORY. *Oryzetea sativae* Miyawaki 1960 (Fig. 495)

This class of weedy vegetation consists mainly of annuals that can survive the unsuitable periods of drought, ploughing or flooding in a paddy field. This vegetation is generally found in tropical and subtropical climates with sufficient water for rice production. However, the development of weedy phytocoenoses in rice fields is also possible

Fig. 495. Zeravshan River Valley with paddy fields near Chubot, Tajikistan (ca. 925 m a.s.l.). Photo: A. Nowak.

in temperate and Mediterranean climates. In Middle Asia, rice fields can be found in large river valleys, such as the Syr-darya and Amu-darya, or in smaller ones, such as the Zeravshan River. This vegetation is represented in this area by one order (*Cypero-Echinochloetalia oryzoidis*) and one alliance (*Oryzo sativae-Echinochloion oryzoidis*), which are globally distributed.

ORY-A. *Cypero-Echinochloetalia oryzoidis* Bolòs et Masclans 1955 (Fig. 496)

Fig. 496. Rice paddy fields near Khujand i Syr-darya River Valley, Tajikistan (ca. 320 m a.s.l.). Photo: A. Nowak.

ORY-AA. *Oryzo sativae-Echinochloion oryzoidis* Bolòs et Masclans 1955 (= ***Oryzion sativae* Koch 1954**) (weed vegetation of eutrophic to hypertrophic waters of rice fields in Middle Asia)

ORY-AA01. *Oryzo sativae-Echinochloetum cruris-galli* Soó ex Ubrizsy 1948 (weed vegetation of eutrophic rice paddy fields in Tajikistan)

Diagnostic species: *Echinochloa crus-galli, Cyperus difformis.*
Constant species: *Echinochloa crus-galli, Cyperus difformis, C. iria.*
Geographical range: This association is relatively rare in the rice fields of Tajikistan and has been recorded only in the valley of the Zeravshan river (height around 970–1,030 m a.s.l.), in warmer areas of the valley of the rivers Syr-darya (ca. 320 m) and Khanaka (ca. 700 m) (Nowak S. et al. 2013a). The *Oryzo sativae-Echinochloetum cruris-galli* association is the central one in the class *Oryzetea sativae*, although in Tajikistan it does not seem to have optimal conditions for development, at least as evidenced by the comparatively low covers of the diagnostic species and the general rarity. Probably, the area of Middle Asia is situated close to the eastern outskirts of the range of this vegetation. The distribution centre of *Oryzo sativae-Echinochloetum cruris-galli* is the Mediterranean area, where it has been reported mainly from Spain (Carretero 1989; Pla 2006; Garcia, Benzal 2009), Italy (Koch 1954; Piccoli, Gerdol 1981), Crimea (Bagrikova 2011) and the Black Sea area of Russia (Korotkov et al. 1991).
Habitat characteristics: The community develops on muddy soils with a high sand content, sometimes even on stony substrates. The reaction is always alkaline, with values ranging between 7.3 and 7.6 (Nowak S. et al. 2013a).

Fig. 497. Weed vegetation of *Ammanietum auriculato-multiflorae* in a rice stand near Kokayty, Tajikistan (ca. 375 m a.s.l.). Photo: A. Nowak.

ORY-AA02. *Ammanietum auriculato-multiflorae* Nowak, S. Nowak et Nobis 2013 (thermophilous weed vegetation of shallow rice paddy fields in southern Tajikistan) (Fig. 497)

Diagnostic species: *Ammannia auriculata, A. multiflora.*
Constant species: *Ammannia auriculata, A. multiflora, Cyperus difformis, C. iria.*
Geographical range: The community is relatively common in the rice fields of south-western Tajikistan, which is influenced by a subtropical climate. The vast majority of patches were found in southern Tajikistan in the valleys of Kofarnikhon and Amu-darya rivers. A few patches occurring in western Tajikistan in the lowest sections of the Zeravshan Valley were also included in this type of phytocoenosis, although *Ammannia auriculata* does not occur here, being replaced by *A. multiflora*. The community has been noted at lower and middle elevations (340–1,000 m a.s.l.) (Nowak S. et al. 2013a).
Habitat characteristics: This association develops in alkaline waters (pH 7.3–8.0), which are shallow (0–20, average 6 cm), on muddy bottoms (Nowak S. et al. 2013a).

ORY-AA03. *Bolboschoenetum planiculmis* Miyawaki 1960 (weed vegetation of rice paddy fields and pools in Middle Asia) (Fig. 498)

Diagnostic species: *Bolboschoenus planiculmis* (= *B. koshewnikowii, Scirpus planiculmis*).
Constant species: *Bolboschoenus planiculmis*, *Echinochloa crus-galli.*
Geographical range: This community occurs relatively often in the rice fields of the Zeravshan region. It was found at average elevation (950–1,050 m a.s.l.), in the higher reaches of the Zeravshan River Valley (Nowak S. et al. 2013a).

Fig. 498. A stand of *Bolboschoenus planiculmis* – a species dominating reed vegetation in rice paddy fields near Garibak, Tajikistan (ca. 960 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: The association of *Bolboschoenetum planiculmis* develops in alkaline (pH 7.4–8.3), shallow waters (0–15 cm), on muddy bottoms with a relatively high sand content. Phytocoenoses formed by *Bolboschoenus planiculmis* were found mainly in anthropogenic reservoirs; mainly rice fields. In other reservoirs, e.g. temporary puddles, roadside ditches mainly *B. glaucus* prevails (Nowak S. et al. 2013a).

ORY-AA04. *Typho angustifoliae-Scirpetum mucronati* Tallon 1950 (weed vegetation of eutrophic rice paddy fields in western Tajikistan) (Fig. 499)

Diagnostic species: *Scirpus mucronatus* (= *Schoenoplectus mucronatus*).
Constant species: *Cyperus difformis, Scirpus mucronatus.*
Geographical range: The community is relatively rare in the rice fields of Tajikistan, although the diagnostic species is widespread in the river valleys, especially in the western parts of the country (Ovchinnikov 1957; Nowak et al. 2011). Stands dominated by *Scirpus mucronatus* were found in the valley of the Zeravshan River near Pandzhikent, located at an elevation of 950 m a.s.l., and on the Khanaka River to the south of Hissar at an elevation of 740 m a.s.l. (Nowak S. et al. 2013a).
Habitat characteristics: The association *Typho angustifoliae-Scirpetum mucronati* develops in alkaline (pH 7.4–7.6), shallow waters (about 10 cm), on muddy soils (Nowak S. et al. 2013a).

ORY-AA05. *Sagittarietum trifoliae* Nowak, S. Nowak et Nobis 2013 (weed vegetation of eutrophic rice paddy fields in western Tajikistan) (Fig. 500)

Diagnostic species: *Sagittaria trifolia.*
Constant species: *Sagittaria trifolia.*
Geographical range: This association occurs sporadically in the rice fields of Tajikistan. It was

Fig. 499. Vegetation of *Typho angustifoliae-Scirpetum mucronati* in a rice fallow near Hissor, Tajikistan (ca. 860 m a.s.l.). Photo: A. Nowak.

Fig. 500. The vegetation of *Sagittarietum trifoliae* found in a rice paddy field near Garibak, Tajikistan (ca. 960 m a.s.l.). Photo: A. Nowak.

Fig. 501. Community of *Paspalum distichum* in rice paddy fallow land near Khujand in Syr-darya River Valley, Tajikistan (ca. 330 m a.s.l.). Photo: A. Nowak.

found in the valley of the Zeravshan River, at an elevation of about 930 m a.s.l., and also in the valley of the Khanaka River at an elevation of ca. 730 m a.s.l. (Nowak S. et al. 2013a).

Habitat characteristics: The phytocoenoses of *Sagittarietum trifoliae* develop in alkaline (pH 7.6–8.2), relatively deep waters (20-35 cm), on muddy soils with a moderate sand content. The community *Sagittarietum trifoliae* occupies areas of relatively deep fields, where *Oryza sativa* does not form compact stands (Nowak S. et al. 2013a).

ORY-AAc01. Community of *Paspalum distichum* (Fig. 501)

This vegetation has been recorded in the rice paddies in the Syr-darya Valley in the Fergana Basin near Boston and Osh. It forms dense mats in the loose rice stands. This community is probably more widespread in Middle Asia.

Subcosmopolitan therophyte-rich dwarf-herb vegetation of trampled habitats

Subcosmopolitan therophyte-rich dwarf-herb vegetation of trampled habitats

POE. *Polygono arenastri-Poëtea annuae* Rivas-Martínez 1975 corr. Rivas-Martínez et al. 1991

This class includes the vegetation of disturbed, often trampled habitats, formed mostly by annuals with a ruderal or stress-tolerant life strategy. Most species are short, with prostrate growth, tough stems, creeping runners or leaf rosettes. Most produce many seeds, which are dispersed on human or animal feet or on vehicle wheels. Trampling leads to soil compaction, especially on loamy soils where long periods of drought may alternate with short periods of surface waterlogging. In Middle Asia, this vegetation is common in urban and rural areas, occupying roadsides, lawns, pavements and squares. This vegetation is represented in Tajikistan and adjacent areas by one order – *Polygono arenastri-Poetalia annuae*.

POE-A. *Polygono arenastri-Poetalia annuae* Tx. in Géhu et al. 1972 corr. Rivas-Martínez et al. 1991

POE-AA. *Saginion procumbentis* Tüxen et Ohba in Géhu et al. 1972 (widespread annual vegetation of wetter, trampled habitats with considerable share of bryophytes in Tajikistan)

This alliance occurs in relatively wetter and cooler habitats than the next alliance – *Polygono-Coronopodion*. It therefore occurs at higher altitudes, mainly in montane or even subalpine belts. This vegetation prefers wetter soils, nutrient-poorer and more acidic habitats, and these conditions favour the occurrence of more bryophytes and perennial vascular plants.

POE-AA01. *Sagino procumbentis-Bryetum argentei* Diemont et al. 1940 (widespread therophyte vegetation of trampled habitats of Tajikistan) (Fig. 502)

Diagnostic species: *Arenaria serpyllifolia*, *Cardamine hirsuta*, *Cerastium semidecandrum*, *Erophila verna, Lamium amplexicaule*, *Poa annua, Potentilla supina*, *Sagina micropetala*, *Sonchus oleraceus*, *Stellaria media*, *Veronica persica*, *Veronica polita, Bryum argenteum*.
Constant species: *Cerastium semidecandrum*, *Poa annua, Sagina micropetala, Sonchus oleraceus, Stellaria media, Bryum argenteum.*
Geographical range: Lowlands and river valleys of south-western Tajikistan, Syr-darya Valley and Fergana Basin. Likely widely distributed throughout Middle Asia and the entire Irano-Turanian Region (Nowak et al. 2024c).
Habitat characteristics: It is one of the most common anthropogenic communities in Tajikistan. However, due to the limited occurrence of pavements and squares with concrete blocks, it is mainly found in cities. Our records come from Dushanbe and Dangara, although the assemblage has also been observed in Hudhand, Kulob, Vose and Qurghanteppa. The elevational amplitude of the plots was also fairly narrow, from 600 to 850 m a.s.l. As is the case throughout its global range, the community occurs in unweeded pavement crevices. It is characterised by moderately abundant herb layer ranging from 15% to 80%. Mosses can reach up to 30% (Nowak et al. 2024c).

POE-AB. *Polygono-Coronopodion* Sissingh 1969

This alliance includes the vegetation of disturbed, often trampled habitats with the dominance or frequent occurrence of *Polygonum arenastrum*, which is mostly found in lowlands and colline belts, on warm and dry sites.

POE-AB01. *Coronopodo procumbentis-Sclerochloetum durae* Br.-Bl. in Br.-Bl., Gajewski, Wraber et Walas 1936 (vegetation of trampled road verges in Eurasia, including Middle Asia) (Fig. 503)

Diagnostic species: *Coronopus procumbens, Sclerochloa dura.*

Fig. 502. Vegetation of *Sagino procumbentis-Bryetum argentei* on trampled pavement, Rudaki Street in Dushanbe, Tajikistan (ca. 800 m a.s.l.). Photo: A. Nowak.

Fig. 503. Vegetation of *Coronopodo procumbentis-Sclerochloetum durae* on road verge near Ak-Dzhol, Kyrgyzstan (ca. 690 m a.s.l.). Photo: A. Nowak.

Fig. 504. Vegetation of *Cynodonto dactyli-Atriplicetum tataricae* on road verge near Jilikul, Tajikistan (ca. 365 m a.s.l.). Photo: A. Nowak.

Constant species: *Capsella bursa-pastoris*, *Coronopus procumbens, Sclerochloa dura, Senecio vulgaris.*
Geographical range: Lowlands and colline zone of the whole Irano-Turanian Region.
Habitat characteristics: Fallow lands, roadsides, urban lawns; dry and sandy soils throughout Middle Asia.

POE-AC. *Atriplicion* Passarge 1978

This anthropogenic vegetation inhabits trampled, often irrigated and disturbed by heavy grazing habitats in semi-desert zone of Eurasia, including Middle Asia.

POE-AC01. *Cynodonto dactyli-Atriplicetum tataricae* Morariu 1943 (nitrophilous, often irrigated vegetation of road verges in southern Tajikistan) (Fig. 504)

Diagnostic species: *Cynodon dactylon*, *Atriplicetum tataricae.*
Constant species: *Capsella bursa-pastoris*, *Coronopus procumbens*, *Sclerochloa dura*, *Senecio vulgaris.*
Geographical range: Lowlands and colline zone of the whole Irano-Turanian Region.
Habitat characteristics: Fallow lands, roadsides, urban lawns; dry and sandy soils throughout Middle Asia.

Thermophilous grass-rich anthropogenic vegetation rich in summer-annual C4 species

The upper reaches of the Pastrud-darya River Valley with the "Alplagier" camp near the Allaudin Lakes, surrounded by stands of *Juniperus seravshanica*, Tajikistan (ca. 2,300 m a.s.l.). Photo: A. Nowak.

Thermophilous grass-rich anthropogenic vegetation rich in summer-annual C4 species

DIG. *Digitario sanguinalis-Eragrostietea minoris* Mucina, Lososová et Šilc in Mucina et al. 2016

This vegetation includes thermophilous communities occurring on sandy or gravelly soils and composed of low-growing species adapted to occasional trampling. The dominant species in most stands are annual grasses, many of which have a C4 metabolism. This vegetation reaches its maximum biomass during the dry and hot periods of midsummer. The range of this association extends from the lowlands to the montane belt of the Irano-Turanian Region. In Tajikistan, this vegetation includes four associations and nine plant communities, grouped into one order (*Euphorbietalia prostratae*) and one alliance (*Euphorbion prostratae*).

DIG-A. *Euphorbietalia prostratae* Vicedo et al. 1997

DIG-AA. *Euphorbion prostratae* Rivas- Martínez 1976 (thermophilous vegetation of anthropogenic, often trampled habitats in Middle Asia) (Fig. 505)

DIG-AA01. *Amarantho blitoidis-Tribuletum terrestris* Dubyna, Dziuba et Vakarenko 2018 (thermophilous vegetation of pavements, road verges and crop fields in Tajikistan) (Fig. 506)

Diagnostic species: *Amaranthus blitum*, *Bromus gracillimus*, *B. sterilis*, *Capsella bursa-pastoris*, *Cirsium arvense, Eragrostis pilosa*, *Erodium cicutarium*, *Geranium pusillum*, *G. pyrenaicum, Lactuca serriola*, *Medicago lupulina*, *M. orbicularis, Melilotus officinalis*, *Microthlaspi perfoliatum, Poa bulbosa, Senecio vulgaris*, *Tribulus terrestris*, *Vulpia persica*.

Fig. 505. Vegetation representing the *Euphorbion prostratae* alliance on a trampled road verge, south of Dushanbe (ca. 770 m a.s.l.). Photo: M. Nobis.

Fig. 506. Vegetation of *Amarantho blitoidis-Tribuletum terrestris* on field margin near Ayni, Zeravshan Mts, Tajikistan (ca. 1,450 m a.s.l.). Photo: M. Nobis.

Constant species: *Bromus tectorum, Capsella bursa-pastoris, Erodium cicutarium, Hordeum leporinum, Lactuca serriola, Poa bulbosa, Polygonum aviculare, Senecio vulgaris, Tribulus terrestris, Vulpia persica.*
Geographical range: Lowland, fellow lands and man-made habitats across the entire Middle Asia (Nowak et al. 2024c).
Habitat characteristics: This is a widespread plant community in arid and semi-arid regions and anthropogenic habitats across the world. It has been described from Ukraine (Dubyna et al. 2018). In Tajikistan, as in the rest of Middle Asia, it is common in arid habitats in urbanised areas, roadsides, and less frequently on railways or embankments in agricultural areas. The plots of the community were sampled in Dushanbe, both in the city centre and in the suburbs. It prefers moderately trampled sites with a clayey, sparsely or not watered habitat. The plots of the community have a moderately abundant herb cover, ranging between 35% and 85%. The phytocoenoses growing on the trackways in Dushanbe are characterised by the occurrence of new, expansive species in the territory of Middle Asia, such as *Geranium pyrenaicum* or *Senecio vulgaris* (Nowak et al. 2024c).

DIG-AA02. *Malvo neglectae-Chenopodietum vulvariae* Gutte 1972 (thermophilous and nitrophilous vegetation of ground roads and backyards in Tajikistan) (Fig. 507)

Diagnostic species: *Chenopodium vulvaria, Malva neglecta.*
Constant species: *Chenopodium vulvaria, Malva neglecta.*
Geographical range: Lowland, urban habitats, and other man-made habitats across the entire Middle Asia.
Habitat characteristics: This is a widespread plant community in arid and semi-arid regions

Fig. 507. Vegetation of *Malvo neglectae-Chenopodietum vulvariae* on the margin of ground road in the eastern part of Dushanbe city, Tajikistan (ca. 880 m a.s.l.). Photo: A. Nowak.

and anthropogenic habitats throughout Tajikistan and adjacent areas. The stands of the association inhabit nutrient-rich and nitrophilous habitats of ground roads, backyards, livestock lairs, hedgerows and urban lawns.

DIG-AA03. *Portulacetum oleraceae* Felföldy 1942 (helo-thermophilous vegetation of pavements and road verges in Tajikistan) (Fig. 508)

Diagnostic species: *Portulaca oleracea.*
Constant species: *Eragrostis minor, Polygonum aviculare, Portulaca oleracea.*
Geographical range: The association of *Portulacetum oleracei* is one of the most widespread in Tajikistan (Nowak S., Nowak 2013).
Habitat characteristics: Phytocoenoses dominated by *Portulaca oleracea* developed mainly at mid-elevations of river valleys in the South-tajikistanian and Prisyrdarian geobotanical regions, mostly at elevation of ca. 750–950 m a.s.l. *Portulacetum oleracei* occurs mainly in potato plantations. The association develops on moist and fertile, deep, brown soils with a relatively high content of sand or gravel. The substratum is close to neutral (pH approx. 7.2–7.5). The fields are located in sunny places, and are sometimes irrigated (Nowak S., Nowak A. 2013).

DIG-AA04. *Cynodontetum dactyli* Gams 1927 (anthropogenic, often watered mats on road verges, city parks and irrigated fields) (Fig. 509)

Diagnostic species: *Cynodon dactylon.*
Constant species: *Cynodon dactylon.*
Geographical range: This is a common vegetation throughout Middle and Central Asia, especially in lowland areas with warm climates.
Habitat characteristics: This is a widespread plant community in wet or irrigated habitats.

Fig. 508. Vegetation of *Portulacetum oleraceae* on the field margin near Vakhdat, Tajikistan (ca. 900 m a.s.l.). Photo: A. Nowak.

Fig. 509. Vegetation of *Cynodontetum dactyli* on the fallow land near Zargar, Tajikistan (ca. 385 m a.s.l.). Photo: A. Nowak.

It has been recorded in rice and cotton fields, irrigated urban lawns and in the grazed river floodplains.

DIG-AAc01. Community of *Alhagi kirghizorum-Chrozophora tinctoria* (ruderal, nitrophilous vegetation of road verges and backyards in lowlands and colline belt of Tajikistan) (Fig. 510)

Diagnostic species: *Ailanthus altissima, Alhagi kirghisorum, Centaurea iberica*, *Convolvulus arvensis*, *Cynodon dactylon*, *Eleusine indica*, *Malva neglecta*, *Oxalis dillenii*, *Polygonum aviculare*.
Constant species: *Amaranthus blitoides*, *Convolvulus arvensis*, *Cynodon dactylon*, *Polygonum aviculare*, *Sonchus oleraceus*.
Geographical range: Lowland and colline belts in the Middle Asian mountains (Uzbekistan, Turkmenistan, Kyrgyzstan and Tajikistan) (Nowak et al. 2024c).
Floristic and habitat characteristics: This is the most internally heterogeneous group in our classification. Sites of this vegetation occur in a typically Irano-Turanian climate, in habitats with permeable soils and low rainfall. They are found at elevations of approx. 450–950 m a.s.l. in the vicinity of hot semi-deserts or ruderal habitats within urbanised areas. *Alhagi kirghizorum* forms an extensive phytocoenoses along roadsides, on fellow lands or in degraded pseudosteppes. *Amaranthus deflexus* prefers urbanised habitats and inhabits the tarmac pavements or ditch banks. The total cover of the herb layer of this vegetation varies between 15 and 75% with mean value of approx. 35%. Due to the high heterogeneity and lack of data this vegetation type is not ranked, and designated for further research (Nowak et al. 2024c).

DIG-AAc02. Community of *Malva neglecta* (nitrophilous ruderal vegetation of trampled habitats) (Fig. 511)

Fig. 510. Community of *Alhagi kirghizorum-Chrozophora tinctoria* on the roadside near Nurek, Tajikistan (ca. 1,020 m a.s.l.). Photo: A. Nowak.

Fig. 511. Community of *Malva neglecta* along the wall in Dushanbe, Tajikistan (ca. 830 m a.s.l.). Photo: A. Nowak.

Diagnostic species: *Malva neglecta.*
Constant species: *Malva neglecta.*
Geographical range: This is a common vegetation throughout Middle and Central Asia. It inhabits anthropogenic habitats from the lowlands to the alpine belt.
Habitat characteristics: This community occurs on nitrophilous and often trampled habitats such as ground roads, roadsides and around cattle shelters.

DIG-AAc03. Community of *Chenopodium murale* (ruderal, nitrophilous vegetation of road verges and backyards in Tajikistan) (Fig. 512)

Diagnostic species: *Chenopodium murale.*

Fig. 512. *Chenopodium murale* near Kishti-Poyon, Panj River Valley, Tajikistan (ca. 2,330 m a.s.l.). Photo: M. Nobis.

Constant species: *Chenopodium murale.*
Geographical range: This vegetation is still quite common in the urbanised habitats of Middle and Central Asia. It inhabits anthropogenic habitats from the lowlands to the montane belt.
Habitat characteristics: This community occurs in nitrophilous habitats such as hedgerows, railway tracks, roadsides and around cattle shelters.

DIG-AAc04. Community of *Dysphania botrys* (nitrophilous vegetation of gravelly habitats on road verges, escarpments and in backyards in Tajikistan) (Fig. 513)

Diagnostic species: *Dysphania botrys.*
Constant species: *Dysphania botrys.*
Geographical range: This vegetation occurs mainly on screes and escarpments in the montane and alpine belts of Tajikistan and adjacent areas. It probably is very common throughout the Irano-Turanian Region.
Habitat characteristics: This community inhabits rupicolous habitats such as screes, gravel slides, escarpments or roadsides in Tajikistan.

DIG-AAc05. Community of *Eragrostis cilianensis* (ruderal vegetation of road verges in northern Tajikistan and Central Asia) (Fig. 514)

Diagnostic species: *Eragrostis cilianensis.*
Constant species: *Eragrostis cilianensis.*
Geographical range: This vegetation occurs mainly on road verges in montane and subalpine of Tajikistan. It probably occurs commonly throughout the Irano-Turanian Region.
Habitat characteristics: This community inhabits dry, ruderal habitats along roads and in built-up areas in Tajikistan.

Fig. 513. Community of *Dysphania botrys* in southern Dushanbe, Tajikistan (ca. 720 m a.s.l.). Photo: M. Nobis.

Fig. 514. *Eragrostis cilianensis* in the Panj River Valley, Tajikistan (ca. 2,100 m a.s.l.). Photo: M. Nobis.

Fig. 515. Vegetation dominated by *Duchesnea indica* developed along a road verge in the southern part of Dushanbe, Tajikistan (ca. 770 m a.s.l.). Photo: A. Nowak.

Fig. 516. Vegetation patch dominated by *Geranium sibiricum* on a railway track in the central railway station in Dushanbe, Tajikistan (ca. 780 m a.s.l.). Photo: A. Nowak.

DIG-AAc06. Community of *Duchesnea indica* (ruderal, often watered vegetation of lawns, flowerbeds and urban green areas) (Fig. 515)

Diagnostic species: *Duchesnea indica.*
Constant species: *Duchesnea indica.*
Geographical range: This vegetation occurs mainly on city lawns and road verges throughout the whole Middle Asia.
Habitat characteristics: This community inhabits dry, ruderal, often irrigated habitats of lawns, gardens, roadsides and built-up areas in Tajikistan.

DIG-AAc07. Community of *Geranium sibiricum* (ruderal, anthropogenic vegetation of railways, road verges and urban green areas) (Fig. 516)

Diagnostic species: *Geranium sibiricum.*
Constant species: *Geranium sibiricum.*
Geographical range: This vegetation occurs mainly on dry, permeable gravel or cobble deposits, dikes and escarpments like railway tracks. This community was first recorded in Dushanbe in 2022.
Habitat characteristics: This community inhabits dry, ruderal, permeable escarpments and embankments such as railway tracks.

DIG-AAc08. Community of *Xeranthemum longepapposum* (ruderal, anthropogenic vegetation of railways, road verges and urban green areas) (Fig. 517)

Diagnostic species: *Xeranthemum longepapposum.*
Constant species: *Xeranthemum longepapposum.*
Geographical range: This vegetation occurs mainly on dry roadsides and ditch escarpments in the northern part of Middle Asia.
Habitat characteristics: This community inhabits dry, ruderal habitats such as roadsides, field margins and city lawns.

Fig. 517. Ruderal vegetation dominated by *Xeranthemum longepapposum* growing along a road verge near Dzeek, Bishkek District, Kyrgyzstan (ca. 760 m a.s.l.). Photo: A. Nowak.

Fig. 518. Vegetation dominated by *Acalypha australis* growing in a ditch in the southern districts of Dushanbe, Tajikistan (ca. 850 m a.s.l.). Photo: A. Nowak.

Fig. 519. Community of *Ipomoea purpurea* overgrowing rice paddy fallow near Kulanbash, Syr-darya River Valley, Tajikistan (ca. 320 m a.s.l.). Photo: A. Nowak.

Fig. 520. Vegetation dominated by *Hordeum geniculatum* developed within urban lawns in Dushanbe, Tajikistan (ca. 700 m a.s.l.). Photo: M. Nobis.

DIG-AAc09. Community of *Acalypha australis* (ruderal, anthropogenic vegetation of railways, road verges and urban green areas) (Fig. 518)

Diagnostic species: *Acalypha australis.*
Constant species: *Acalypha australis.*
Geographical range: This vegetation occurs mainly on city lawns and road verges throughout the southern part of Middle Asia. It was firstly recorded in Dushanbe in 2011 (Nobis, Nowak 2011).
Habitat characteristics: This community inhabits ruderal, often irrigated habitats of lawns, gardens, roadsides and ditches in Tajikistan.

DIG-AAc10. Community of *Ipomoea purpurea* (ruderal, anthropogenic vegetation of railways, road verges and urban green areas) (Fig. 519)

Diagnostic species: *Ipomoea purpurea.*
Constant species: *Ipomoea purpurea.*
Geographical range: This vegetation occurs mainly in rice paddy fields, along ditches and other ruderal habitats throughout Middle Asia, especially in the lowlands and colline belt.
Habitat characteristics: This community inhabits wet ruderal and segetal habitats, often irrigated lawns, gardens, roadsides, paddy fields and ditches in Tajikistan.

DIG-AAc10. Community of *Hordeum geniculatum* (ruderal, anthropogenic vegetation of road verges and urban green areas) (Fig. 520)

Diagnostic species: *Hordeum geniculatum.*
Constant species: *Hordeum geniculatum.*
Geographical range: This vegetation occurs mainly on dry roadsides and ditch escarpments throughout Middle Asia.
Habitat characteristics: This community inhabits dry, ruderal habitats such as roadsides, field margins, backyards and city lawns.

Perennial xerophytic ruderal vegetation

Perennial xerophytic ruderal vegetation

ART. *Artemisietea vulgaris* Lohmeyer et al. in Tx. ex von Rochow 1951

The class *Artemisietea vulgaris* includes thermophilous vegetation of sunny and dry habitats. It is composed mainly of biennial and perennial species, although some annuals also contribute to this vegetation. It occurs mainly in ruderal habitats in and around human settlements, but some species are also found in semi-natural habitats.

ART-A. *Elytrigio repentis-Dittrichietalia viscosae* Mucina in Mucina et al. 2016

This vegetation includes semi-natural and ruderal phytocoenoses of dry habitats with a high proportion of perennial grasses, some with extensive root or rhizome systems. Natural habitats of this vegetation type are slopes with occasional landslides or solifluction, especially on soft sediments such as loess. This vegetation prefers loamy and clayey soils, often with high calcium content. These plant communities are distributed in dry and warm areas of the whole Irano-Turanian Region.

ART-AX. All. Unknown

ART-AX-01. *Artemisio annuae-Dittrichietum graveolens* Nowak, Świerszcz, S. Nowak et Nobis 2024 (xerophytic, ruderal vegetation of road verges in western Tajikistan) (Fig. 521)

Diagnostic species: *Aegilops triuncialis*, *Amaranthus blitoides*, *Amaranthus retroflexus*, *Artemisia annua*, *Bromus lanceolatus*, *Carthamus lanatus*, *Chenopodium album*, *Cynodon dactylon*, *Dittrichia graveolens*, *Heliotropium ellipticum*, *Hordeum marinum* subsp. *gussoneanum*, *Lolium*

Fig. 521. Vegetation of *Artemisio annuae-Dittrichietum graveolens* growing along concrete wall in the southern part of Dushanbe, Tajikistan (ca. 720 m a.s.l.). Photo: A. Nowak.

perenne, Phleum graecum, *Polygonum aviculare*, *Setaria viridis*, *Silybum marianum*, *Verbena officinalis, Vulpia persica*.

Constant species: *Amaranthus blitoides, Artemisia annua, Bromus tectorum, Chenopodium album, Cynodon dactylon, Dittrichia graveolens, Heliotropium ellipticum, Hordeum leporinum, Hordeum marinum* subsp. *gussoneanum, Phleum graecum, Polygonum aviculare, Setaria viridis, Vulpia persica.*

Geographical range: In ruderal habitats in urbanised areas. New species to Middle Asia, known only from Dushanbe dumping places (Nobis et al. 2023).

Habitat characteristics: The species is only found in the southern part of the city of Dushanbe on roadsides, landfills, settling ponds and along gutters. As populations of *Dittrichia graveolens* are located at Tajikistan's main transportation hub, the species is expected to expand rapidly in the country's warmest province of Khatlon. The phytocoenoses occupy flat lands with dry, permeable and firm topsoil. It develops on typically ruderal and arid habitats. *Artemisio annuae-Dittrichietum graveolens* has the total cover of herb layer quite abundant, ranging from 25 to 85%. The phytocoenosis is characterised by low to moderate species richness (Nowak et al. 2024c).

ART-AX02. *Hyoscyamo nigri-Conietum maculati* Slavnić 1951 (ruderal, nitrophilous vegetation of backyards and dumping places) (Fig. 522)

Diagnostic species: *Conium maculatum, Hyoscyamus niger.*

Constant species: *Conium maculatum, Hyoscyamus niger.*

Geographical range: This vegetation is found throughout Middle Asia, especially in the lowlands and the colline belt. In Tajikistan, it also reaches the sub-alpine belt, about 2,200 m a.s.l.

Fig. 522. Vegetation of *Hyoscyamo nigri-Conietum maculati* growing on the roadside near Navdonek village, Hissar Mts, Tajikistan (ca. 1,400 m a.s.l.). Photo: M. Nobis.

Fig. 523. Community of *Rubus praecox* growing in a wasteland near central railway station in Dushanbe, Tajikistan (ca. 860 m a.s.l.). Photo: A. Nowak.

Fig. 524. Community of *Urtica cannabina* growing in intensive pasture near Oi-tal, Issyk-kul District, Kyrgyzstan (ca. 1,610 m a.s.l.). Photo: A. Nowak.

Habitat characteristics: This vegetation inhabits nitrophilous, fertile habitats of backyards, gardens, forest edges and villages.

ART-AXc01. Community of *Rubus praecox* (ruderal hedgerows on road verges, along walls and fences) (Fig. 523)

Diagnostic species: *Rubus praecox.*
Constant species: *Rubus praecox.*
Geographical range: This vegetation occurs mainly on dry roadsides, backyards, gardens and other urban habitats throughout Middle Asia.
Habitat characteristics: This community inhabits dry, ruderal habitats such as roadsides, city walls, railway escarpments, backyards, gardens and other urban areas.

ART-AXc02. Community of *Urtica cannabina* (ruderal, nitrophilous vegetation of backyards and dumping places in Central Asia) (Fig. 524)

Diagnostic species: *Urtica cannabina.*
Constant species: *Urtica cannabina.*
Geographical range: This vegetation is found throughout the northern part of Middle and Central Asia. It was found in Kyrgyztsan, in colline and montane belts of the Tian Shan Mts at an elevation of ca. 1,200–2,100 m a.s.l.
Habitat characteristics: This vegetation inhabits nitrophilous, fertile habitats of backyards, gardens and intensively grazed pastures and animal lairs.

ART-AXc03. Community of *Onopordum acanthium* (ruderal, helo-xerophytic vegetation of roadsides and other arid habitats in Tajikistan) (Fig. 525)

Diagnostic species: *Onopordum acanthium.*
Constant species: *Onopordum acanthium.*
Geographical range: This vegetation is found throughout the whole Middle and Central Asia. It was found in colline, montane and subalpine

Fig. 525. Community of *Onopordum acanthium* growing on a road verge near Humdon, Peter the First Mts, Tajikistan (ca. 1,210 m a.s.l.). Photo: A. Nowak.

belts of the Pamir-Alai, Pamir and the Tian Shan Mts at an elevation of ca. 800–2,200 m a.s.l.
Habitat characteristics: This vegetation inhabits nitrophilous, fertile habitats of backyards, gardens and road verges.

ART-AXc04. Community of *Onopordum leptolepis* (ruderal, helo-xerophytic vegetation of roadsides and other arid habitats in Tajikistan) (Fig. 526)

Diagnostic species: *Onopordum leptolepis.*
Constant species: *Onopordum leptolepis.*
Geographical range: This vegetation is found throughout the whole Middle and Central Asia. It was found in colline, montane and alpine belts of the Pamir-Alai, Pamir and the Tian Shan Mts at an elevation of ca. 600–3,600 m a.s.l. (Rasulova 1991).
Habitat characteristics: This vegetation inhabits ruderal and segetal habitats. Additionally, it occurs on gravel bars and screes in the bottoms of river valleys (Rasulova 1991).

ART-AXc05. Community of *Silybum marianum* (ruderal, nitrophilous vegetation of backyards and dumping places) (Fig. 527)

Diagnostic species: *Silybum marianum.*
Constant species: *Silybum marianum.*
Geographical range: This vegetation is found throughout the whole Middle and Central Asia. It was found in colline to subalpine belts of the Pamir-Alai and Tian Shan Mts at an elevation of ca. 800–2,300 m a.s.l. (Rasulova 1991).
Habitat characteristics: This vegetation inhabits nitrophilous, fertile habitats of backyards, gardens, crop fields, intensively grazed pastures and animal lairs (Rasulova 1991).

ART-AXc06. Community of *Crambe orientalis* (ruderal vegetation of wastelands and fallow lands in Tajikistan) (Fig. 528)

Diagnostic species: *Crambe orientalis.*

Fig. 526. Ruderal vegetation of the *Onopordum leptolepis* community in Shishkant, Zeravshan Mts, Tajikistan (ca. 1,300 m a.s.l.). Photo: M. Nobis.

Fig. 527. Community of *Silybum marianum* on ruderal habitat in Dushanbe, Tajikistan (ca. 720 m a.s.l.). Photo: M. Nobis.

Fig. 528. Community of *Crambe orientalis* in a fallow field near Gezani-Poyon, Fann Mts, Tajikistan (ca. 1,440 m a.s.l.). Photo: A. Nowak.

Fig. 529. Community of *Aster salignus* in a roadside near fallow field near Gargara, Tajikistan (ca. 860 m a.s.l.). Photo: A. Nowak.

Constant species: *Crambe orientalis.*
Geographical range: This vegetation is found in the western part of Middle Asia. It was firstly reported from the Haft-kul Valley near Shing (Gezani-Poyon) at the montane elevation of ca. 1,440 m a.s.l. (Nobis et al. 2016).
Habitat characteristics: This vegetation inhabits fallow lands and crop fields, probably also ruderal habitats in Middle and Central Asia (Nobis et al. 2016).

ART-AX-c07. Community of *Aster salignus* (ruderal vegetation of roadsides and fallow lands in Tajikistan) (Fig. 529)

Diagnostic species: *Aster salignus.*
Constant species: *Aster salignus.*
Geographical range: The community of *Aster salignus* was found along road verges and dry ditches in central Tajikistan, in colline and montane belts. Probably this vegetation is common throughout Middle Asia.
Habitat characteristics: This community inhabits dry, ruderal habitats such as roadsides, field margins and city lawns.

Therophyte-rich zoogenic vegetation of mammal lairs under stone overhangs in the mountains of Europe, Middle East, Central Asia and southern Africa

Therophyte-rich zoogenic vegetation of mammal lairs under stone overhangs in the mountains of Europe, Middle East, Central Asia and southern Africa

SIS. *Sisymbrietea* Gutte et Hilbig 1975

The vegetation includes several associations of medium-tall to tall erect annual herbs (mainly from the Brassicaceae, Chenopodiaceae or Asteraceae), which occur in ruderal habitats. They occur on recently disturbed sites with exposed bare soils as initial stages of secondary succession, e.g. in construction areas or around farms. Soils are mostly mesic and available nutrients are moderate. This vegetation is widespread and common across Europe and Irano-Turanian Region of south-west Asia.

Fig. 530. Community of *Galium verticillatum* and *Asperugo procumbens* at the livestock shelter near Sarytag, Fann Mts, Tajikistan (ca. 2,450 m a.s.l.). Photo: A. Nowak.

SIS-A. *Hackelio deflexae-Blitetalia foliosi* Mucina in Mucina et al. 2016

This vegetation occurs naturally in disturbed sites such as mammal lairs. It often occurs in small patches, under rock overhangs. They exemplify a precious relict of the pre-historic zoo-anthropogenic plant communities. The diagnostic species of the order are among others: *Bromus tectorum*, *Asperugo procumbens*, *Blitum foliosum*, *Corydalis capnoides*, *Cynoglossum officinale*, *Descurainia sophia*, *Erysimum wittmannii*, *Hackelia deflexa* and *Poa nemoralis*.

SIS-AX. All. unknown

SIS-AXc01. Community of *Galium verticillatum* and *Asperugo procumbens* (nitrophilous vegetation of sheep and goat lairs under the rock walls or along summer barns in Middle Asia) (Fig. 530)

Diagnostic species: *Galium verticillatum*, *Asperugo procumbens.*
Constant species: *Galium verticillatum*, *Asperugo procumbens.*
Geographical range: Zoogenic habitats, and other man-made sites throughout Middle and Central Asia.
Habitat characteristics: This is a widespread vegetation in the warm and semi-arid regions throughout Tajikistan and adjacent areas. The stands of the association inhabit nutrient-rich and nitrophilous habitats of animal lairs, rock overhangs and backyards in the villages, particularly temporary summer settlements, so called letovki.

Summer-annual pioneer vegetation of seasonally flooded nutrient-rich river alluvia, lacustrine banks and heavily nutrient loaded anthropogenic habitats of Eurasia

Summer-annual pioneer vegetation of seasonally flooded nutrient-rich river alluvia, lacustrine banks and heavily nutrient loaded anthropogenic habitats of Eurasia

BID. *Bidentetea tripartitae* Tüxen et al. ex von Rochow 1951

This vegetation consists of tall, highly competitive, annual wetland herbs. Most stands are monodominant and species-poor. It occurs in both natural and man-made wet and nutrient-rich habitats such as river banks, muddy alluvial sediments, drying oxbows, bottoms of summer-dried fishponds, wet ditches, wet forest clearings, wet arable fields, edges of dung heaps and areas of agricultural run-off. This class is widespread in the northern hemisphere, particularly in the temperate zone. The class includes one order – *Bidentetalia tripartiti*.

BID-A. *Bidentetalia tripartitae* Br.-Bl. et R.Tx. ex Klika et Hadač 1944

BID-AA. *Chenopodion rubri* (Tüxen 1960) Hilbig et Jage 1972

This alliance includes vegetation dominated by annual species of *Atriplex* and *Chenopodium*, which develops on subsaline and ammonium-rich soils around dung hills and in places where agricultural waste water input, often near barns. They also occur on sediment accumulations along large rivers and on exposed bottoms of nutrient-rich fish ponds. These substrates tend to be rich in calcium and magnesium. The *Chenopodion rubri* alliance occurs in Europe and Central Asia. In Tajikistan, this vegetation occurs sporadically on alluvial deposits in the shore zone of lakes and ponds.

Fig. 531. *Symphyotrichum graminifolium*, a diagnostic species for the *Symphyotricho graminifolii-Chenopodietum rubri* vegetation in subsaline habitat of dried-up paddy fields near Khujand, Tajikistan (ca. 330 m a.s.l.). Photo: A. Nowak.

Fig. 532. Community of *Juncus nastanthus* in the shore zone of the Nofin Lake in Haft-kul Valley, Fann Mts, Tajikistan (ca. 1,780 m a.s.l.). Photo: A. Nowak.

BID-AA-01. *Symphyotricho graminifolii -Chenopodietum rubri* Nowak, S. Nowak et Nobis 2013 (weed vegetation of damp habitats of paddy fields in western Tajikistan) (Fig. 531)

Diagnostic species: *Symphyotrichum graminifolium.*
Constant species: *Symphyotrichum graminifolium, Bidens frondosa.*
Geographical range: The community occurs rarely in the rice fields of Tajikistan. It was found within the range of the diagnostic species (*Symphyotrichum graminifolium*) in the valley of the Syr-darya River near Khudzhand and Proletarska at an elevation of about 320 m a.s.l. (Nowak S. et al. 2013a).
Habitat characteristics: The association develops on the muddy, alkaline river alluvium (pH 7.2–7.8). Most stands were found in very shallow water or on completely dry out sites. Such habitat requirements of *Symphyotricho graminifolii-Chenopodietum rubri* make it similar to *Heleochloetum schoenoidis*. The same applies to soil salinity for both associations, which is relatively high (Nowak S. et al. 2013a).

BID-AB. *Bidention tripartitae* Nordhagen ex Klika et Hadač 1944

This vegetation includes stands of annual wetland species, mainly of the genera *Bidens*, *Persicaria*, *Ranunculus*, *Rumex* and *Xanthium*. These species are medium to tall (up to 150 cm) and produce large amounts of biomass. They develop on moist, loamy to clayey, nutrient-rich substrates. This vegetation is the first to colonise exposed bare wet substrates, especially if they are very nutrient-rich or dry out quickly.

BID-AB-c01. Community of *Bidens frondosa* (anthropogenic vegetation of ditches, rice

fields and artificial ponds, mainly in western Tajikistan)

Diagnostic species: *Bidens frondosa.*
Constant species: *Bidens frondosa.*
Geographical range: The community of *Bidens frondosa* is relatively rare in Tajikistan and occurs mainly in the south-western part of the country near Dushanbe and Hissar. The diagnostic species is an alien taxon in the flora of the country. It has been recently found in man-made habitats such as roadsides and irrigation ditches, mainly around Dushanbe (Nobis, Nowak 2011). The community of *Bidens frondosa* has been found east of the village of Akuyli on the rice fields terraces outside the flooding zone of the river (Nowak et al. 2013a).

Habitat characteristics: The community develops in areas with shallow water, on muddy soils with high clay content (Nowak S. et al. 2013a).

BID-AB-c02. Community of *Juncus nastanthus* (vegetation of summer therophytes on mud deposits in lake shorelands in western Tajikistan) (Fig. 532)

Diagnostic species: *Juncus nastanthus.*
Constant species: *Juncus nastanthus.*
Geographical range: The community is rare throughout western Tajikistan. It has been found from colline to alpine belts at an elevation of about 800–2,600 m a.s.l.
Habitat characteristics: The community inhabits muddy river alluvium. It has also been recorded on muddy lake shores.

Glossary of geobotanical terms

Rocky landscape in the vicinity of Tavildara, Darvaz Mts (ca. 3,200 m a.s.l.). Photo: A. Nowak.

A

arborescent – tree-like in growth or general appearance.
archaeophyte – a non-native plant that has been introduced to an area before 1500 year.
acidophilous – limited to or preferring acidic substrates.
alpine – vegetation belt below the permanent snow line and above the treeline of mountain ranges. It is covered by natural grasslands and low scrub vegetation.
anthropogenic vegetation – plant communities occupying man-made habitats. It includes e.g. ruderal, segetal, weed vegetation of disturbed habitats.
azonal vegetation – vegetation types that occur across several zonal habitats (e.g. altitudinal vegetation belts) and are primarily determined by soil and hydrological conditions (flooding, salinity, heavy metal content, rocky outcrops) rather than macroclimate.

B

basiphilous – limited to or favouring base-rich substrates (usually calcareous).
bog – permanent wetland with low levels of calcium and nutrients available to plants. Bog vegetation or habitat is fed by mineral-poor, acidic groundwater or precipitation.
boreal – bioclimatic zone bordering the arctic zone in the North and the temperate zone in the South. In Middle Asia it covers the northernmost part of Kazakhstan and is characterised by boreal coniferous forests (taiga).

C

calcicole – preferring calcareous habitats.
calcifuge – avoiding calcareous habitats.
carr – type of forest or woodland characteristic of waterlogged organic soils that are base-rich and moderately nutrient-rich.
chernozem – very fertile soil type, characterised by a deep humus horizon, developed in the post-glacial steppe zone.
chamaephytic – dominated by chamaephytes, i.e. perennial plants, especially dwarf shrubs, with over-wintering buds up to about 25 cm above the soil surface – hence typically protected by snow during winter.
chasmophytic – growing in rocky crevices, cliffs and rock ledges.
community (of plants) – an ecological assemblage of plants that characteristically occur together.
chionophilous – thriving in habitats with prolonged snow cover, which protects plants and vegetation from the destructive effects of wind and extremely low temperatures in winter.
chionophobous – in habitats without snow cover or with reduced periods of snow cover (e.g. steep slopes or wind-exposed ridges).
chomophytic – growing as cushions and mats rooted in shallow soils with a hard bedrock surface beneath.
colline – an altitudinal belt between the planar and montane belts, usually associated with hilly landscapes and the piedmont of mountain ranges. In Middle Asia it is characterised by a warm, sub-humid climate, mild winters, and supports open pistachio open woodlands and pseudosteppe vegetation.
colluvial – pertaining to colluvium – accumulation of debris in the form of cones and aprons at the foot of mountain slopes.

corresponding name (abbreviation: corresp.) – those names listed in the synonymy that cannot be considered true synonyms since their rank does not correspond to the rank of the correct name.

cryophytic – found on and in permanent snow and glacier zone.

cryoxerophytic – preferring habitats characterised by extremely dry climates in cold regions of the highlands, such as the Pamirian Plateau.

C4 (plant) – plants that use the C4 photosynthetic strategy to assimilate carbon dioxide. They are adapted to hot, tropical or subtropical climates and occur in Middle Asia mainly in the south.

D

deciduous – shed or fall seasonally, such as bark, leaves or petals.

E

endemic – having a natural distribution restricted to a particular geographical region.

epilithic – growing on the rock surface.

epiphytic – growing on other plants, e.g. on branches or trunks of trees and shrubs.

eremean – pertaining to desert environments. The name *Eremurus* is derived from this word.

F

fen – a type of permanent wetland, usually poor in nutrients but often rich in calcium. Fens are fed by neutral to basic groundwater.

fen meadow – meadow growing on a fen substrate.

flora – all the plant species that grow in a certain region or country.

forb – any non-woody flowering plant that is not a grass, sedge or rush.

forest – vegetation dominated by trees with their crowns touching and characterised by a more or less closed canopy.

forest-steppe – transitional zone between temperate (nemoral) or boreal forest and steppe, consisting of a patchy mosaic of forests and steppe grasslands. In Middle Asia it occurs mainly in northern Kazakhstan and Mongolia. In the southern forest margin the vegetation similar to forest-steppe is called "redkolese" from Russian "sparse woods".

G

geophyte – a Raunkiaer life-form category; perennial plant that survives unsuitable periods of the year such as summer drought or winter frost in underground organs.

graminoid – a grass-like plant characterised by tufted narrow leaves, inconspicuous flowers and often forming tussocks. The term includes members of *Poaceae*, *Cyperaceae*, *Juncaceae* and the like (e.g. *Isoëtaceae*, *Juncaginaceae*).

grassland – formation dominated by grasses (or graminoids), usually with a single-layered structure and sometimes (in the case of wooded savannas or savannoid vegetation) with an open, woody plant cover.

H

halo-nitrophilous – restricted to or preferring habitats with high levels of nitrates and soluble salts.

halophilous – limited to or preferring saline habitats characterised by high content of soluble salts in water or soil.

halophyte – a plant adapted to highly saline habitats.
halo-tolerant – tolerating increased content of soluble salts in water or soil.
heliophilous – a species or vegetation preffering sunny habitats.
hemicryptophytic – plant communities dominated by hemicryptophytes, i.e. perennial plant species with overwintering buds at the soil surface.
herbaceous – non-woody plant, usually green, soft, with no persistent stem.
herbarium – a collection of preserved, usually pressed and dried, plant material used for identification and comparison. Also a building in which such collections are stored.
herbland – structural vegetation type dominated by herbs.
hypersaline – referring to habitats and soils characterised by extremely high content of soluble salts (e.g. NaCl, MgSO4), making the environment toxic to most plants.
hygrophilous – restricted to or favouring water-saturated habitats.

I

IAVS – International Association for Vegetation Science (www.iavs.org).
intrazonal – type of vegetation that develops under azonal habitat conditions and is associated with a particular zonal macrohabitat (e.g. altitudinal belt).
ICPN – International Code of Phytosociological Nomenclature. The latest, 4th version of Theurillat et al. (2021).

K

kastanozem – in the low rainfall areas of the steppe zone, humus-rich and calcareous brown zonal soils developed under short grass steppe vegetation.
krummholz – gnarled, stunted and ascending or prostrate scrub vegetation typically found between the upper limit of forest (timberline) and the extreme upper limit of tree growth (treeline) in the mountains.

L

lithosol – substrate characterised by a very shallow and skeletal humus-rich horizon, with the parent bedrock often protruding to the surface.
littoral – the part of a water body or sea close to the shore. Littoral vegetation includes all plant communities that thrive in the shore zone of water bodies (lakes, ponds and ephemeral marshes).
loess – poorly stabilised sediment formed by the accumulation of wind-born particles (mainly siliceous, with admixture of calcium carbonate). In Middle Asia a vast areas of steppe and particularly pseudosteppe grasslands are associated with loess habitats.

M

mantle – scrub made of heliophilous shrub species that prefer the forest edge.
meadow – plant formation dominated by grasses (or other graminoids) and herbs, usually found in humid to mesic habitats and dependent on regular management such as mowing.
mediterranean – vegetation typical of the Mediterranean Region. It is dominated by natural sclerophyllous scrubland, tall evergreen thickets and woodlands, etc.
Mediterranean – phytogeographical unit (floristic region) around the Mediterranean Sea, characterised by warm, dry summers and wet, cool to mild winters.

mesophilous – preferring mesic habitats, hence those located around the middle of an environmental moisture gradient.

meso-xerophilous – preferring mesic and dry habitats, hence those located around the middle and at the dry end of an environmental moisture gradient.

mesophytic – dominated by mesophilous plants, hence those preferring habitats located in the middle of the environmental moisture gradient.

meso-xerophytic – dominated by mesic and xerophilous plants, hence plants that prefer habitats around the middle or at the dry end of the environmental moisture gradient.

mire – type of permanent wetland, usually poor to moderately rich in nutrients and often characterised by peat accumulation. Mires are usually divided into transitional mires, bogs and fens.

montane – an altitudinal belt in the mountains at mid-elevations, located above the colline belt and below the subalpine belt.

N

nemoral – the mid-latitude zone of Eurasia dominated by deciduous broadleaf forests.

neophyte – alien plant species that arrived in a particular area after 1492 (the year of the 'discovery' of America by Christopher Columbus).

nitrophilous – favouring habitats rich in nitrogen.

nival – vegetation, altitudinal belt influenced by permanent snow cover, and obviously the highest natural altitudinal belt of the nemoral and boreal mountain ranges. The landscapes of the nival belt typically combine snowfields and glaciers with cliffs and talus slopes.

nomen conservandum – conserved name, usually a name which has become so much better known than the correct name that a substitution has been made.

nomen correctum – a syntaxon name that is incorrect due to misidentification of the name-giving taxon (taxa) (i.e. an error of identification according to the taxonomic reference that has been used) occurred in the original diagnosis or at least in the type relevé. The name of the correcting author and the year of the effective publication of the correction are placed after the original author citation and preceded by the abbreviation corr. (in full: correxit).

nomen corrigendum – a syntaxon name that is incorrect according to ICPN, when no correct taxon name of the same taxonomic rank and circumscription is available. The syntaxon name should be used in its original form followed by the abbreviation nom. corrigend., i.e. "name to be corrected".

nomen inversum (abbreviated form: nom. invers.) – a proposal to inverse a syntaxon name, i.e. to change the order of the two name-giving taxa as they were used in the original publication of the name in order to follow the rule that if one is dominant or belongs to the highest stratum, then it appears at the second place (ICPN arts. 10b & 42 and Recommendation 42A).

nomen ineditum – an ineffectively published name of the syntaxon according to Art. 1 of ICPN (abbreviated form: nom. ined.).

nomen mutatum propositum (abbreviation: nom. mut. propos.) – a proposal to change a syntaxon name in order to update it according to the contemporary taxonomic nomenclature. The change remains provisional until its approval by the Nomenclatural Commission (ICPN art. 45 and Recommendation 45A).

nomen nudum – a name of syntaxon not published in accordance with the ICPN (e.g. due to the absence of a sufficient original diagnosis – Art. 2b of ICPN or published merely as a synonym – Art. 3a of ICPN. It should be validated later by another author and ascribed to the first author. In such cases the validating author is the correct author for the author citation.

nomen provisorium (abbreviated form: nom. prov.) – the syntaxon name that is suggested by the author(s) as a provisional name because there is no clear adoption of the name according to the rules of ICPN (lack of sufficient sampling, restricted area of the survey etc.).

O

oligotrophic – nutrient-poor.

oligo-mesotrophic – relatively nutrient-poor (compared to mesotrophic and eutrophic habitats).

ombrophilous – tolerant to and generally preferring habitats with much rain.

oro – referring to the mountains.

oro-Irano-Turanian – bioclimatic belt in the mountain ranges of Middle and Central Asia, embedded in the Irano-Turanian Region. This belt occurs below the tree line and is characterised by juniper woodlands.

oromediterranean – bioclimatic belt in the mountain ranges embedded in the Mediterranean Region. The oromediterranean belt occurs below the tree line and is characterised by coniferous heaths and juniper and pine forests.

P

pasture – open plant formation (mainly grassland) consisting of grasses (or other graminoids) and herbs on dry to wet soils. Similar to meadow, it is mainly of anthropogenic origin and depends on regular grazing, mainly by livestock (in Middle Asia sheep, goats, cows, horses, yaks and camels).

peat – accumulation of organic sediment derived from the dead biomass of *Sphagnum* mosses and vascular plants, especially sedges. Peat is a typical substrate of mires.

permafrost – permanently frozen subsoil layer where temperatures have been below freezing for at least two consecutive winters and the intervening summer.

psammophilous – limited to or favouring sandy substrates.

pseudosteppe – steppe-like grasslands outside the steppe zone, usually controlled by local edaphic conditions or considered relics of past climates similar to current steppe climatic patterns, or secondary grasslands replacing various Irano-Turanian open woodlands and scrublands.

R

refugial – a type of vegetation (e.g. some deciduous forests in Middle Asia) that survives in glacial refugia, i.e. regions not directly affected by glaciation or associated climate change.

riparian – pertaining to habitats and vegetation associated with rivers (both flowing and intermittent).

ruderal – preferring or limited to man-made or highly disturbed habitats such as ruins, roadsides, trampled places.

rupicolous – plants and vegetation growing on or between rocks, including cliffs, taluses, aprons and cones, or rock walls. The organisms are adapted to particular environmental

conditions, such as extreme changes in temperature and humidity, a limited nutrient pool and space to grow.

rush – a plant of the *Juncaceae* family or, more loosely, a variety of monocotyledons.

S

saline – soils or water with high levels of soluble salts (e.g. NaCl, $MgSO_4$), making the environment toxic to the most non-specialised species.

saxicolous – growing on solid rock or stone, like some lichens.

sclerophyllous – plant communities characterised by the dominance of species with small, leathery, evergreen leaves that allow them to tolerate summer drought stress.

sciophilous – restricted to or preferring shady habitats.

segetal – preferring or restricted to arable fields with cereals or tuber crops, vineyards, young fallows, etc.; many of the segetal species and communities have a specific relationship with particular cropping techniques.

seral vegetation – referring to an intermediate stage in a successional series.

silicicolous – restricted to or favouring siliceous bedrocks.

snow beds – depressions or sheltered slopes characterised by prolonged snow cover and supporting predominantly hygrophilous plant communities.

synonym – an outdated or 'alternative' name for the same taxon or syntaxon.

solonchak – type of saline soil with the highest content of soluble salts in the surface horizon. Solonchak usually develops in continental climate and habitats exposed to flooding or waterlogging for part of the year. Intensive evaporation during the dry season transports salts from the saline parent rock to the soil surface.

solonetz – a type of saline soil with a high content of soluble salts in the subsurface sodium horizon. It develops in continental, semi-arid or arid climates on relatively dry habitats where the movement of salts from the parent bedrock to the soil surface is limited. Typically, these saline soils support saline steppes.

steppe – a zonal plant formation dominated by perennial grasses in a continental climate.

steppic – grasslands that physiognomically resemble true steppe, but are found in zones outside of steppe – usually under specific edaphic conditions that limit water availability (e.g. rocky steppic grasslands, sandy steppic vegetation).

subalpine – an altitudinal belt located directly above the tree line in the mountain ranges. In Eurasia, this term is mostly used for the elevation belt dominated by dwarf shrub or krummholz vegetation with *Juniperus* spp., *Rhododendron* spp., *Pierris* spp., *Pinus mugo*, *Betula* spp., *Salix coesia*, *S. fedtschenkoi*, *S. karelinii*.

sublittoral – part of the littoral that is flooded throughout the year. Its upper limit is marked by the lowest water level in summer.

submediterranean – bioclimatic region which, although belonging to the temperate zone, has some climatic features typical of the Mediterranean zone.

submontane – an altitudinal belt located directly between the montane and colline belts, typically supporting mesophilous mixed deciduous woodlands.

subsaline – preferring slightly saline habitats, but often growing on other mineral-rich habitats.

subnival – an altitudinal belt usually developed in the highest zone where vegetation is typically found. It is determined by frequent frosts that restrict extensive plant colonisation. It is covered by patchy, often cushion or tragacanth vegetation typical of the Arctic or high alpine zones.

synusia (pl. 'synusiae') – any type of abstract partial community, including taxocoena, microcoena, stratocoena, chronocoena or any combination of these. In the narrow sense, this term is used for abstract partial biotic communities that share the same microhabitat, stratum, periodicity, or life form.

šibljak – a distinct scrub formation dominated by heliophilous (mainly deciduous) shrubs of the genera *Corylus*, *Crataegus*, *Juniperus*, *Paliurus*, *Rhamnus*, *Prunus*, etc. It is the result of the degradation of the original temperate deciduous oak and oak-hornbeam forests, and rarely as primary shrublands in edaphically extreme habitats. This term was used for the shrubland vegetation of the Balkans and we don't recommend using it for Middle Asian vegetation.

T

taiga – the predominantly coniferous forest of the boreal zone of the Northern Hemisphere.

taxon – a category in a system of biological classification.

temperate – bioclimatic zone extending over most of Eurasia between the boreal zone in the north and the Mediterranean-Irano-Turanian-Eastern Asiatic zones in the south. It is characterised by the predominance of broad-leaved deciduous forests as potential natural vegetation.

terrestrial – the habitat on land as opposed to in water (aquatic), on rocks (lithophytic), or on other plants (epiphytic).

therophyte – usually an annual plant species that survives unsuitable conditions (e.g. low winter temperatures, summer drought or disturbance such as ploughing) as seeds in the soil.

tragacanthic – scrub formation dominated by hemispherical (cushion-forming) shrubs in the alpine belt of Eurasia. The term comes from the *Astragalus* section *Tragacantha*, which is commonly found in this type of vegetation.

tussock – a dense tuft of vegetation, usually well separated from neighbouring tussocks, for example in some grasses.

U

umbel – a racemose inflorescence in which all the individual flower stalks arise in a cluster at the top of the peduncle and are of about equal length; in a simple umbel each stalk is unbranched and bears only one flower. This morphological feature was used to name a plant formation with dominant representatives of the Apiaceae family, the *umbeliferniki*.

umbeliferniki – orig. in Russian – forb vegetation dominated by *Apiaceae* species.

undershrub – a low shrub, often with flowering branches that die off in winter.

understory – plant life growing beneath the forest canopy.

V

vascular – referring to the conducting tissues (xylem and phloem) of vascular plants.

W

woodland – open-canopy forest, usually with well developed grassy undergrowth.

X

xeric – dry.

xerophilous – preferring habitats characterised by (at least temporarily or locally) dry meso- and microclimates.

xero-thermophilous – preferring habitats characterised by (at least temporarily or locally) dry soils and warm meso- and microclimates.

xerophytic – dominated by xerophilous plants, hence preferring habitats at the dry end of the environmental water gradient.

Z

zonal vegetation – vegetation that occupies habitats, primarily controlled by macroclimate over long time scales. Large-scale natural disturbances such as heavy grazing and recurrent fire are also important drivers of such vegetation physiognomy.

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Appendix 1.
Conspectus of the syntaxa of the Middle Asian vegetation dominated by vascular plants

Appendix 1. Conspectus of the syntaxa of Middle Asian vegetation dominated by vascular plants

Holarctic coniferous forests on oligotrophic and leached soils in the boreal zone and at high altitudes of mountains in the nemoral zone of Eurasia

VAC Cl. *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939
O. et All. Unknown
VAC-XX-c01 Community of *Picea schrenkiana* subsp. *tianshanica*
VAC-XX-c02 Community of *Abies sibirica* subsp. *semenovii*
Monsoon-influenced group of communities
VAC-XX-c03 Community of *Pinus gerardiana*
Upper montane pine forest in monsoon-influenced areas
VAC-XX-c04 Community of *Cedrus deodara*
Upper montane pine forest in monsoon-influenced areas
VAC-XX-c05 Community of *Picea smithiana* and *Abies webbiana*
Upper montane spruce and fir forest in monsoon-influenced areas

Zonal, mesophilous, broad-leaved forests

FAG Cl. *Carpino-Fagetea sylvaticae* Jakucs ex Passarge 1968
FAG-A O. *Aceretalia turkestanici* Nowak, Świerszcz, S. Nowak, Nobis, M. Nobis 2023
Mesic broad-leaved forests of Middle Asia
FAG-AA All. *Acero turkestanici-Juglandion regiae* A. Nowak, M. Nobis, S. Nowak 2017 in A. Nowak, M. Nobis, S. Nowak, M. Gębala, A. Nobis 2017
Mesophilous deciduous forests of Irano-Turanian Region
FAG-AA-01 Ass. *Juglandetum regiae* A. Nowak, M. Nobis, S. Nowak 2017 in A. Nowak, M. Nobis, S. Nowak, M. Gębala, A. Nobis 2017
Mesophilous walnut woods of the montane belt in Irano-Turanian Region
FAG-AA-02 Ass. *Aceretum turkestanici* A. Nowak, M. Nobis, S. Nowak 2017 in A. Nowak, M. Nobis, S. Nowak, M. Gębala, A. Nobis 2017
Mesophilous turkestan maple woods of western Middle Asia and the Kopet-Dagh Mts
FAG-AA-03 Ass. *Violo suavis-Populetum albae* A. Nowak, M. Nobis, S. Nowak 2017 in A. Nowak, M. Nobis, S. Nowak, M. Gębala, A. Nobis 2017
Mesophilous deciduous poplar forests on we and fertile soils of the central Pamir-Alai Mts (mainly Darvaz Mts)
FAG-AA-04 Ass. *Swido darvasicae-Platanetum orientalis* A. Nowak, M. Nobis, S. Nowak 2017 in A. Nowak, M. Nobis, S. Nowak, M. Gębala, A. Nobis 2017
Mesophilous oriental plane forests of the montane belt on fertile habitats in river valleys

Oak, mixed deciduous and conifer open forests of warm regions in the cool-temperate nemoral zone of the montane belt of Hindu Kush Mts (Pakistan)

PUB Cl. *Quercetea pubescentis* Doing-Kraft ex Scamoni et Passarge 1959
O. et All. Unknown
PUB-XX-c01 Community of *Quercus baloot*
PUB-XX-c02 Community of *Quercus dilatata*

Xeric shrublands of the Irano-Turanian Region

PRU Cl. *Crataego-Prunetea* Tx. 1962
Scrub and mantle vegetation seral or marginal to broad-leaved forests in the nemoral zone of the Irano-Turanian Region
PRU-A O. *Crataegetalia ponticae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska, M. Nobis 2024
Scrub vegetation of xeric and nutrient-poor habitats (so called Rozaria)
PRU-AA All. *Rosion kokanicae* nom. prov
Xeric scrub on nutrient-poor soils on screes and slopes in Middle Asia (so called Rozaria)
PRU-AA-c01 Community of *Rosa kokanica*
PRU-AA-c02 Community of *Caragana alaica*
PRU-AA-c03 Community of *Prunus verrucosa*

Scrub vegetation of subhumid and nutrient-rich habitats
PRU-AB All. *Ranunculo tenuilobi-Cotoneastrion hissarici* A. Nowak, M. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, S. Świerszcz 2022 nom. corr.
PRU-AB-01 Ass. *Aveno ludovicianae-Rhoetum coriariae* A. Nowak, M. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, S. Świerszcz 2022 nom. corr.
PRU-AB-02 Ass. *Calophacetum grandiflorae* A. Nowak, M. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, S. Świerszcz 2022
PRU-AB-03 Ass. *Fraxinetum raibocarpae* S. Świerszcz, M. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, A. Nowak 2022
PRU-AB-04 Ass. *Pruno sogdianae-Crataegetum turkestanicae* S. Świerszcz, M. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, A. Nowak 2022
PRU-AB-05 Ass. *Aflatunio ulmifoliae-Caraganetum turkestanicae* S. Świerszcz, M. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, A. Nowak 2022

Variant with *Ferula clematidifolia*
Variant with *Malus sieversii*
PRU-AB-c01 Community of *Rosa ecae*
PRU-AB-c02 Community of *Cotoneaster nummularioides* (shrubland of the montane belt in river valleys of the Irano-Turanian mountains)
PRU-AB-c03 Community of *Exochorda korolkowii* (mesic shrublands of the upper montane and subalpine belts of the western Pamir-Alai)
PRU-AB-c04 Community of *Sorbus persica* (short shrubland of the upper montane and subalpine belt of the Irano-Turanian mountains)
PRU-AB-c05 Community of *Amygdalus communis* and *A. kuramica* (scrublands of the montane and subalpine belts of Hindu Kush Mts in Afghanistan)

Irano-Turanian open woodlands in warm, subtropical, semi-arid to sub-humid climate
PIV Cl. *Pistacietea verae* A. Nowak, S, Świerszcz, A. Naqinezhad, S. Nowak, M. Nobis 2023
PIV-A O. *Pistacietalia verae* A. Nowak, S, Świerszcz, A. Naqinezhad, S. Nowak, M. Nobis 2023
Thermophilous open woodlands of the Pamir-Alai, Hindu Kush and Kopet-Dagh Mts in Middle Asia
PIV-AA All. *Pistacion verae* A. Nowak, M. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, S. Świerszcz 2022
Thermophilous open woodlands of southern Middle Asia
PIV-AA-01 Ass. *Pistacietum verae* A. Nowak, M. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, S. Świerszcz 2022
Pistacia vera thermophilous open woodlands in south-western Tajikistan
PIV-AA-01a Subass. *Pistacietum verae typicum* A. Nowak, M. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, S. Świerszcz 2022
PIV-AA-01b Subass. *Pistacietum verae cercidetosum griffithii* A. Nowak, M. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, S. Świerszcz 2023
PIV-AA-02 Ass. *Pistacietum khinjuk* A. Nowak, S, Świerszcz, A. Naqinezhad, S. Nowak, M. Nobis 2023
Thermophilous pistachio open woods of the Hindu Kush and Zagros Mts
PIV-AA-c01 Community of *Zygophyllum darvasicum*
Thermophilous scrub of the southern Darvaz in Tajikistan
PIV-AA-c02 Community of *Punica granatum*
Thermophilous scrub of the southern Pamir-Alai Mts
PIV-AA-c03 Community of *Pistacia atlantica*
Thermophilous open woodlands of the southern and western Hindu Kush Mts
PIV-AA-c04 Community of *Ziziphus jujuba* and *Acacia modesta*
Thermophilous, open woodlands of the southern Hindu Kush Mts in Afghanistan and the Peshawar Mts in Pakistan

Thermophilous Zeravshan juniper stands in the lower montane belt of Middle Asia
PIJ Cl. *Junipero-Pinetea sylvestris* Rivas-Mart. 1965
PIJ-A O. *Juniperetalia seravschanicae* A. Nowak, M. Nobis, S. Nowak, M. Kotowski, S. Świerszcz 2024
Thermophilous Zeravshan juniper open woods in the colline and montane belts of Turkestanian province
PIJ-AA All. *Juniperion seravschanicae* A. Nowak, M. Nobis, S. Nowak, M. Kotowski, S. Świerszcz 2022
Thermophilous Zeravshan juniper open woods in the colline and montane belts of the western Pamir-Alai and Tian Shan Mts
PIJ-AA-01 Ass. *Juniperetum seravschanicae* A. Nowak, M. Nobis, S. Nowak, M. Kotowski, S. Świerszcz 2022
Thermophilous Zeravshan juniper stands in the Zeravshan, Darvaz, Hazratishokh and Aktau Mts
Variant with *Hedysarum denticulatum* and *Oxytropis glabra*
Variant with *Primula lactiflora* and *Brachythecium collinum*

Cryophilous juniper stands in the upper montane belt of Middle and Central Asia
JUP Cl. *Junipereteа pseudosabinae* B. Mirkin, N. Manibazar, V. Muchametsina, L. Alimbekova et L. Onishchenko 1986
JUP-A O. *Juniperetalia pseudosabinae* B. Mirkin, N. Manibazar, V. Muchametsina, L. Alimbekova et L. Onishchenko 1986
JUP-AA All. *Juniperion pseudosabinae* B. Mirkin, N. Manibazar, V. Muchametsina, L. Alimbekova et L. Onishchenko 1986
Cryophilous juniper open woods in the upper montane belt of Middle and Central Asia
JUP-AA-01 Ass. *Carici turkestanicae-Juniperetum pseudosabinae* A. Nowak, M. Nobis, S. Nowak, M. Kotowski, S. Świerszcz 2022
Cryophilous juniper open woods in the montane belt of western Middle Asia
JUP-AA-02 Ass. *Androsaco baltistanicae-Juniperetum pseudosabinae* Eberhardt 2004 nom. invers.
Juniper scrub of the subalpine belt of the Karakoram and Kunlun Mts
JUP-AA-c01 Community of *Juniperus sabina*
Subalpine scrub of the western Tian Shan Mts
JUP-AA-c02 Community of *Juniperus sibirica*
Cryophilous shrub vegetation of the central Tajikistan
JUP-AB All. *Juniperion semiglobosae* Eberhardt 2004

Cryophilous juniper scrublands and open woods in subalpine belt of the Karakoram, Kunlun, Hindu Kush Mts and the western Himalayas

JUP-AB-01 Ass. *Ephedro regelianae-Loniceretum microphyllae* Eberhardt 2004
Short scrub in the river valley sides in the subalpine belt of the Karakoram Mts

JUP-AB-02 Ass. *Comaro salesovianae-Juniperetum semiglobosae* Eberhardt 2004

JUP-AB-03 Ass. *Eritrichio fruticulosae-Juniperetum semiglobosae* Eberhardt 2004

JUP-AB-04 Ass. Androsacae thomsonii-Juniperetum semiglobosae Eberhardt 2004

JUP-AB-c01 Community of *Scrophularia dentata* and *Juniperus semiglobosa*

All three above mentioned associations represents Juniperus semiglobosa stands in various microhabitats in the subalpine belt (3,600-4,000 m a.s.l.) of the Karakoram Mts

Krummholz vegetation in the subalpine belt of Central Asia and the Himalayas

Cl. et O. Unknown

XXX-XA All. *Salicion karelinii* Eberhardt 2004
Krummholz vegetation in the subalpine belt of the Hindu Kush, Karakoram and the Himalayas

XXX-XA-01 Ass. *Carici nivalis-Salicetum karelinii* Eberhardt 2004
Subalpine Krummholz vegetation on damp, gravelly slopes of the Hindu Kush and Karakoram Mts

XXX-XA-02 Ass. *Hylotelephio ewersii-Salicetum karelinii* Eberhardt 2004
Subalpine Krummholz vegetation of the eastern Hindu Kush and Karakoram Mts

XXX-XA-03 Ass. *Vicatio wolffianae-Salicetum karelinii* Eberhardt 2004
Subalpine forb krummholz vegetation of the eastern Hindu Kush and eastern Karakoram Mts

XXX-XA-c01 Community of *Juniperus squamata*
Subalpine juniper krummholz vegetation of the eastern Hindu Kush, Karakoram, and the Himalayas

XXX-XB All. unknown

XXX-XB-c01 Community of *Salix fedtschenkoi*
Subalpine and alpine silicicolous chionophilous dwarf heats hof the Central Asia

Irano-Turanian subalpine forb steppes

NEP Cl. *Eremogono griffithii-Nepetetea podostachyos* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska, M. Nobis 2024

NEP-A O. *Nepetetalia podostachyos* A. Nowak, S. Świerszcz, M. Nobis, G. Swacha, S. Nowak in Świerszcz et al. 2023
Subalpine forb steppe of the eastern Irano-Turanian origin in subalpine belt of the Pamir-Alai Mts

NEP-AA All. *Ligulario thomsonii-Geranion regelii* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Forb rich mesophilous grasslands of the Pamir-Alai and Tian Shan Mts

NEP-AA-01 Ass. *Morinetum coulterianae* A. Nowak, S. Świerszcz, M. Nobis, G. Swacha, S. Nowak in Świerszcz et al. 2023
Intensively grazed alpine grassland of Middle Asia on slightly rupicolous habitats

NEP-AA-02 Ass. *Smelowskio calycinae-Dracocephaletum scrobiculati* A. Nowak, S. Swierszcz, M. Nobis, G. Swacha, S. Nowak in Swierszcz et al. 2023
Rupicolous alpine sward of Middle Asia

NEP-AA-03 Ass. *Phlomoidetum sarawschanicae* A. Nowak, S. Świerszcz, M. Nobis, G. Swacha, S. Nowak in Świerszcz et al. 2023 nom. mut. propos. (according to art. 45 ICPN)
Alpine rupicolous grassland of the Zeravshan range in western Pamir-Alai Mts

NEP-AA-03a Subass. *Phlomoidetum sarawschanicae typicum* A. Nowak, S. Świerszcz, M. Nobis, G. Swacha, S. Nowak in Świerszcz et al. 2023

NEP-AA-03b Subass. *Phlomoidetum sarawschanicae scorzoneretosum acanthocladae* A. Nowak, S. Świerszcz, M. Nobis, G. Swacha, S. Nowak in Świerszcz et al. 2023
Intensively grazed alpine rupicolous grassland of the Zeravshan Mts

NEP-AA-04 Ass. *Alopecuro himalaici-Veronicetum gorbunovii* A. Nowak, S. Świerszcz, M. Nobis, G. Swacha, S. Nowak in Świerszcz et al. 2023
Moderately grazed subalpine and alpine grasslands of the Hissar and Zeravshan Mts

NEP-AA-c01 Community of *Cousinia outichaschensis-Lepechiniella sarawschanica*
Alpine to subnival low forb steppe of the western Pamir-Alai Mts

NEP-AA-c02 Community of *Cousinia fedtschenkoana*
Subalpine forb steppes of central Tajikistan (Zeravshan, Hissar and Hazratishokh Mts)

NEP-AA-c03 Community of *Cousinia splendida*
Subalpine, intensively grazed forb steppes of the Zeravshan, Hissar and Hazratishokh Mts

NEP-AA-c04 Community of *Cousinia stephanophora*
Upper montane to alpine, grazed forb steppes of the Zeravshan, Hissar, Peter the First and Hazratishokh Mts in central Tajikistan

NEP-AA-c05 Community of *Cousinia semilacera*
Tragacanth forb steppe of semi-arid habitats in the Pamir Mts (Badakshan)

NEP-AA-c06 Community of *Senecio saposhnikovii*

Forb steppe of the northern Pamir-Alai Mts (Kyrgyzstan)
NEP-AA-c07 Community of *Cousinia batalinii* and *Euphorbia pamirica*
Subalpine to alpine forb steppe in the Hissar and Darvaz Mts
NEP-AA-c08 Community of *Lophanthus elegans*
Subalpine to alpine forb steppe of the eastern Pamir-Alai Mts
NEP-AA-c09 Community of *Oxytropis glabra*
Forb grasslands of the valley bottoms in the subalpine to alpine belts of the Pamir-Alai Mts
NEP-AA-c10 Community of *Semenovia dasycarpa*
Herb-rich grasslands of the subalpine and alpine belt in the northern Pamir-Alai and western Tian Shan Mts

Mesophilous steppic pastures of the upper montane to subalpine belts in the Pamir-Alai Mts
NEP-AB All. *Artemision dracunculi* A. Nowak, S. Świerszcz, M. Nobis, G. Swacha, S. Nowak 2023 in Świerszcz et al. 2023
NEP-AB-01 Ass. *Erigeronto seravschanici-Eremuretum hissarici* A. Nowak, S. Świerszcz, M. Nobis, G. Swacha, S. Nowak in Świerszcz et al. 2023
Mesic steppic forbs of the subalpine belt of the Zeravshan and Hissar Mts used as intensive pastures
NEP-AB-02 Ass. *Onobrychido arenariae-Stachyetum betoniciformae* G. Swacha, S. Świerszcz, S. Nowak, M. Nobis, A. Nowak 2023 nom. corr.
Mesic steppic meadows of the western Tian Shan and northern Pamir-Alai Mts
NEP-AB-c01 Community of *Dracocephalum formosum*
Upper montane low forb steppe of the western Pamir-Alai Mts
NEP-AB-c02 Community of *Allium giganteum*
Allium giganteum stands on humid and fertile habitats in Middle Asia
NEP-AB-c03 Community of *Adonis turkestanicus*
Intensively grazed pastures of the subalpine belt in Middle Asia
NEP-AB-c04 Community of *Chorispora sibirica*
Intensively grazed nitrophilous pastures of the subalpine belt in Middle Asia
NEP-AB-c05 Community of *Crocus korokowii*
Intensively grazed, spring grasslands of the subalpine and upper montane belts of Middle Asia
NEP-AB-c06 Community of *Eremurus regelii*
Intensively grazed subalpine vegetation in the northern Pamir-Alai and western Tian Shan Mts
NEP-AB-c07 Community of *Allium hymenorhizum*
Fen vegetation on peaty substrates in the alpine belt of the northern Pamir-Alai Mts and Central Asia
NEP-AB-c08 Community of *Phlomoides pratensis*
Montane to subalpine forb steppe vegetation of the central Tian Shan Mts

Riverside group
NEP-AB-03 Ass. *Heracleetum lehmannianii* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Riverside alpine fringe vegetation of Middle Asia
NEP-AB-c08 Community of *Ligularia heterophylla*
Subalpine ro alpine intensively grazed grassland of river valley's bottoms in Middle Asia

Mountain steppes of semi-arid to subhumid areas of Central Asia
CLE Cl. *Cleistogenetea squarrosae* Mirkin et al. ex K. Korotkov, O. Morozova, E. Belonovskaja 1991
CLE-A O. *Stipetalia krylovii* Kononov, Gogoleva, Mironova 1985 nom. inval. (Art. 2, ICPN)
Montane to subalpine steppes of subhumid to semi-arid zones of Central Asia
CLE-AA All. *Stipion krylovii* Kononov, Gogoleva, Mironova 1985 nom. inval. (Art. 2, ICPN)
Montane to subalpine steppes of the subhumid zone in Central Asia
CLE-AA-01 Ass. *Astragalo lithophili-Stipetum zalesskii* A. Nowak, A. Nobis, S. Nowak, M. Nobis 2018
Mesic, species-rich, cryophilous steppe of the western Tian Shan Mts
CLE-AA-02 Ass. *Littledaleo alaicae-Stipetum trichoidis* A. Nowak, A. Nobis, S. Nowak, M. Nobis 2018
Mesic cryophilous steppe of the subhumid zone in the northern Pamir-Alai Mts
CLE-AA-03 Ass. *Helictotricho fedtschenkoi-Stipetum kirghisori* A. Nowak, A. Nobis, S. Nowak, M. Nobis 2018
Mesic steppe of the subhumid zone in the western Tian Shan Mts
CLE-AA-04 Ass. *Stipetum kazachstanicae* M. Nobis, E. Klichowska, A. Nowak et al. 2024
Mesic steppe of the colline to montane belts of the central and eastern Tian Shan Mts
CLE-AA-c01 Community of *Stipa sereptana*

Continental steppe grasslands of the lowlands and colline belt of the northern Middle and Central Asia and southern Siberia.

CLE-AA-c02 Community of *Stipa lessingiana*
Continental steppe grasslands of the lowlands and colline belt of the north-western Irano-Turanian Region.

CLE-AA-c03 Community of *Stipa capillata*
Lowlands and colline belts' steppe of the northern Middle Asia, Central Asia and southern Siberia

Semi-arid group

CLE-AA-05 Ass. *Stipetum bungeanae* A. Nowak, A. Nobis, S. Nowak, M. Nobis 2018
Steppe grasslands of the semi-arid zone in the montane belt of the western Tian Shan Mts

CLE-AA-c04 Community of *Astracantha pterocephala-Dracocephalum bipinnatum*
Xerophytic steppe grasslands in the western Tian Shan Mts

CLE-AA-c05 Community of *Stipa krylovii-Stipa breviflora*
Xerophytic steppes in lowland to colline belts of the Central and Eastern Asia

Dry, thermophilous steppes of the montane and subalpine belts of Middle Asia

AST Cl. *Artemisio persicae-Stipetea drobovii* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, M. Nobis in A. Nowak et al. 2024

AST-A O. *Carici stenophylloidis-Stipetalia drobovii* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, M. Nobis 2024
Thermophilous steppes of the montane and subalpine belts of western Middle Asia

AST-AA All. *Poo bulbosae-Artemision persicae* A. Nowak, S. Nowak, A. Nobis, M. Nobis 2016
Thermophilous steppes on rupicolous habitats of the montane and subalpine belts of western Pamir-Alai Mts

AST-AA-01 Ass. *Stipetum drobovii* A. Nowak, S. Nowak, A. Nobis, M. Nobis 2016
Subalpine steppe on the gravely slopes of the western Pamir-Alai

AST-AA-02 Ass. *Stipetum lipskyi* A. Nowak, S. Nowak, A. Nobis, M. Nobis 2016
Thermophilous, species rich montane steppe of the western Pamir-Alai and Tian Shan Mts

AST-AA-03 Ass. *Stipetum jagnobicae* A. Nowak, S. Nowak, A. Nobis, M. Nobis 2016
Upper montane to subalpine thermophilous steppe of the Zeravshan Mts

AST-AA-04 Ass. *Convolvuletum spiniferi* A. Nowak, A. Nobis, S. Nowak, M. Nobis 2018
Semi-arid, thermophilous steppes of the colline and lower montane belts of the northern Pamir-Alai and western Tian Shan Mts

AST-AA-05 Ass. *Stipo magnificae-Otostegietum olgae* A. Nowak, A. Nobis, S. Nowak, M. Nobis 2018
Semi-arid, thermophilous steppes of the colline and lower montane belts of the western Tian Shan Mts

AST-AA-06 Ass. *Stipetum margelanicae* A. Nowak, S. Nowak, A. Nobis, M. Nobis 2016 nom. corr.
Thermophilous montane steppe of the northern Pamir-Alai Mts

AST-AA-07 Ass. *Helianthemetum songarici* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Thermophilous fine debris scree-like vegetation of the montane to subalpine belts in the western Pamir-Alai Mts

AST-AA-c01 Community of *Bromus tectorum-Stipa arabica*
Thermophilous steppes of the montane belt of Irano-Turanian Region

AST-AA-c02 Community of *Elytrigia trichophora-Linum corymbulosum*
Thermophilous forb steppes of the montane belt Irano-Turanian Region

AST-AA-c03 Community of *Artemisia baldshuanica*
Thermophilous mugwort steppe of the colline and montane belts of the south-western Pamir-Alai Mts (Khatlon district)

AST-AA-c04 Community of *Artemisia tenuisecta*
Thermophilous mugwort steppe of the montane and subalpine belts of the western Pamir-Alai Mts

AST-AA-c05 Community of *Stipa richteriana*
Continental steppes of lowlands to montane belt of north-eastern Irano-Turanian Region (mainly Kazakhstan, north-western China)

AST-AB All. *Bassio prostratae-Artemision ferganensis* nom. prov.
Lowland and colline desert steppes and semi-deserts of the eastern Irano-Turanian Region

AST-AB-c01 Community of *Artemisia namanganica-Artemisia mogoltavica*
Thermophilous mugwort steppe of the colline and montane belts of the northern Pamir-Alai and western Tian Shan Mts

AST-AB-c02 Community of *Artemisia ferganensis*
Thermophilous mugwort steppe of the colline and lower montane belts of the western Pamir-Alai and western Tian Shan Mts

AST-AB-c03 Community of *Otostegia fedtschenkoana*
Thermophilous steppe of the colline and lower montane belts of the south-western Pamir-Alai Mts

AST-AB-c04 Community of *Artemisia glanduligera*

Thermophilous mugwort steppe of the colline and montane belts of the western Pamir-Alai and western Tian Shan Mts

AST-AB-c05 Community of *Artemisia prolixa*
Thermophilous mugwort steppe of the colline and lower montane belts of the western Pamir-Alai and western Tian Shan Mts

AST-AB-c06 Community of *Artemisia turanica*
Thermophilous mugwort steppe of lowlands and colline belt on semi-arid habitats in the south-western Pamir-Alai Mts

AST-AB-c07 Community of *Astragalus vvedenskyi*
Thermophilous desert steppe of lowlands of the south-western Pamir-Alai Mts

AST-AB-c08 Community of *Stipa aktauensis*
Chasmophytic semi-desert vegetation of the colline belt of the Aktau Mts in Uzbekistan

High altitude desert steppes and cold semi-deserts of Central Asia

AJA Cl. *Ajanio-Cleistogenetea songoricae* (Mirkin B. in Kashapov R. et al. 1987) Mirkin B., Alimbekova L., Kashapov R., Onishchenko L. 1988

AJA-A O. *Krascheninnikovio ceratoidis-Stipetalia orientalis* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2023
High altitude cryophilous steppes and desert steppes of Central Asia

AJA-AA All. *Artemision rhodantho-skorniakovii* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2023 nom. corr.
High altitude desert steppes and semi-deserts of the eastern Pamir Mts

AJA-AA-01 Ass. *Cousinio pannosae-Artemisietum skorniakovii* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Desert steppe of the alpine belt in the eastern Pamir Mts

AJA-AA-02 Ass. *Artemisio glaucinae-Salsoletum paulseni A.* Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Semi-desert vegetation of alpine belt of the eastern Pamir and Hindu Kush Mts (Vakhan Corridor)

AJA-AA-03 Ass. *Acantholimetum pamirici* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2023 nom. corr.
Semi-desert, tragacanthic steppe of the alpine belt of the eastern Pamir Mts

AJA-AA-04 Ass. *Astragalo chomutowii-Stipetum subsesilliflorae* A. Nowak, A. Nobis, S. Nowak, M. Nobis 2018
Desert steppe, cryophylous vegetation of the alpine to subnival belts of Central Asia

AJA-AA-05 Ass. *Atriplici pamiricae-Lepidietum cordatae* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2023
Semi-desert, halophytic vegetation of alpine belt of the eastern Pamir Mts and Kashgaria

AJA-AA-06 Ass. *Astragalo pamirensis-Leymetum secalini* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2023 corr. (according to art. 43 ICPN)
Semi-desert steppe of the alpine and subnival belt in the eastern Pamir Mts and adjacent areas on sandy and gravelly substrates

AJA-AA-07 Ass. *Leymetum lanati* (A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021) A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2023
Semi-desert vegetation on coarse-grained substrates in high alpine and subnival belts of the eastern Pamir Mts

AJA-AA-08 Ass. *Brayo pamiricae-Stipetum glareosae* S. Świerszcz, M. Nobis, G. Swacha, Z. Kącki, I. Dembicz, K. Waindzoch, S. Nowak, A. Nowak 2020
Desert steppe of alpine belt of the eastern Pamir Mts

AJA-AA-09 Ass. *Artemisio skorniakovii-Acantholimetum diapensioides* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2023 nom. corr.
Semi-desert - tragacanthic vegetation of the high Pamir Mts in Central Asia

AJA-AA-c01 Community of *Limonium suffruticosum-Brachanthemum kirghisorum*
Semi-desert vegetation of the Issik-kul basin in the montane to subalpine belts on gravelly bedrock

AJA-AA-c02 Community of *Acantholimon velutinum*
Desert steppe vegetation in alpine belt of the Pamir-Alai Mts

AJA-AA-c03 Community of *Artemisia korsinskyi*
Alpine mugwort steppe of the Pamir-Alai Mts

AJA-AA-c04 Community of *Dracocephalum heterophyllum*
Semi-desert vegetation of alpine and subnival belts on sandy or gravelly substrates of Central Asia

AJA-AA-c05 Community of *Limbarda salsoloides*
Halophytic semi-desert on sandy habitats of the Central Asian river valleys

AJA-AA-c06 Community of *Salsola gemmascens*
Irano-Turanian semi-desert vegetation on sandy or gravelly substrates

AJA-AA-c07 Community of *Artemisia korovinii*
Desert mugwort steppe of the subalpine to alpine belts of semi-arid habitats in the eastern Pamir-Alai Mts

AJA-AA-c08 Community of *Stipa splendens*
Intensively grazed grassland of the subalpine to alpine belts of semi-arid habitats in Central Asia

AJA-AB All. *Piptathero gracilis-Artemision brevifoliae* Eberhardt 2004
Semi-desert vegetation of the Pamir, Hindu Kush and Karakoram Mts in Central Asia

AJA-AB-01 Ass. *Artemisio salsoloides-Ephedretum regelianae* Eberhardt 2004

AJA-AB-02 Ass. *Stipo orientalis-Krascheninnikovietum pungentis* Eberhardt 2004
AJA-AB-03 Ass. *Krascheninnikovia ceratoides-Artemisietum brevifoliae* Eberhardt 2004
AJA-AB-04 Ass. *Androsaco thomsonii-Stipetum himalaicae* Eberhardt 2004
AJA-AB-05 Ass. *Stachyo tibeticae-Stipetum himalaicae* Eberhardt 2004
AJA-AB-06 Ass. *Oxytropido humifusae-Artemisietum brevifoliae* Eberhardt 2004
AJA-AB-07 Ass. *Artemisietum salsoloides* Eberhardt 2004
AJA-AB-08 Ass. *Polygono rupestris-Artemisietum brevifoliae* Eberhardt 2004
AJA-AB-09 Ass. *Leontopodio brachyactis-Oxytropidetum humifusae* Eberhardt 2004
AJA-AB-10 Ass. *Calamagrostio stoliczkae-Hedysaretum falconeri* Eberhardt 2004
AJA-AB-11 Ass. *Semenovio lasiocarpae-Hedysaretum falconeri* Eberhardt 2004
AJA-AB-12 Ass. *Drabo cachemiricae-Bistortetum affinis* Eberhardt 2004
AJA-AB-13 Ass. *Oxytropido humifusae-Dianthetum anatolici* Eberhardt 2004
AJA-AB-14 Ass. *Oxytropido microphyllae-Artemisietum santolinifoliae* Eberhardt 2004
AJA-AB-15 Ass. *Poo suruanae-Festucetum kashmirianae* Eberhardt 2004
AJA-AB-16 Ass. *Epilobio angustifolii-Bistortetum affinis* Eberhardt 2004

We do not have detailed data from our own survey regarding the habitat conditions of above mentioned vegetation types. They are described in Eberhardt (2004), to which we refer the reader. The ranges of many of the diagnostic species pass into the territory of the eastern Pamir Mts, or extend into the Wakhan Corridor, so we decided to include them in the list of plant communities.

AJA-AB-c01 Community of *Salsola maracandica*
Semi-desert vegetation of the alpine belt of the Hindu Kush Mts in Afghanistan

Thermophilous secondary perennial grasslands on deep calcareous soils of the colline and montane belts in mediterranean-like climates (including Irano-Turanian) with long dry summer period

TRA Cl. *Stipo capensis-Trachynietea distachyae* S. Brullo in S. Brullo et al. 2001
TRA-A O. *Ptilostemono stellati-Vulpietalia ciliatae* Mucina ined.
Thermophilous secondary perennial pseudosteppes on deep soils of the colline and montane belts in Mediterranean and Irano-Turanian Regions.
TRA-AA All. *Vulpio persicae-Caricion pachystylidis* S. Świerszcz, M. Nobis, G. Swacha, Z. Kącki, I. Dembicz, K. Waindzoch, S. Nowak, A. Nowak 2020
Thermophilous secondary perennial pseudosteppes on deep soils of the colline and montane belts in Irano-Turanian Region
TRA-AA-01 Ass. *Eremuretum bucharici* S. Świerszcz, M. Nobis, G. Swacha, Z. Kącki, I. Dembicz, K. Waindzoch, S. Nowak, A. Nowak 2020
Intensively grazed mesic pseudosteppe of colline belt in the south-western Pamir-Alai Mts
TRA-AA-02 Ass. *Hordeo bulbosi-Astragaletum retamocarpi* S. Świerszcz, M. Nobis, G. Swacha, Z. Kącki, I. Dembicz, K. Waindzoch, S. Nowak, A. Nowak 2020
Moderately grazed mesic grassland of the colline and montane belts of the south-western Pamir-Alai Mts
TRA-AA-03 Ass. *Potentillo orientalis-Eremuretum fusci* S. Świerszcz, M. Nobis, G. Swacha, Z. Kącki, I. Dembicz, K. Waindzoch, S. Nowak, A. Nowak 2020
Intensively grazed mesic pseudosteppe of the montane and subalpine belts of the western Pamir-Alai and western Tian-Shan Mts
TRA-AA-04 Ass. *Achnathero caraganae-Delphinietum semibarbati* S. Świerszcz, M. Nobis, G. Swacha, Z. Kącki, I. Dembicz, K. Waindzoch, S. Nowak, A. Nowak 2020
Moderately grazed montane pseudosteppe in the north-west Pamir-Alai Mts and Fergana Valley surroundings
TRA-AA-05 Ass. *Eremuro tianschanici-Delphinietum biternati* S. Świerszcz, M. Nobis, G. Swacha, Z. Kącki, I. Dembicz, K. Waindzoch, S. Nowak, A. Nowak 2020
Moderately grazed mesic pseudosteppe of the central and western Tian-Shan Mts
TRA-AA-c01 Community of *Cousinia sclerophylla*
Intensively grazed sclerophyllous vegetation in warm zone of the colline belt of the south-western Tajikistan
TRA-AA-c02 Community of *Phlomis bucharica*
Ephemeral, intensively grazed grasslands on deep, loessic soils in the southern Pamir-Alai Mts
TRA-AA-c03 Community of *Meristotropis bucharica*
Intensively grazed secondary grasslands in the southern Pamir-Alai Mts
TRA-AA-c04 Community of *Inula macrophylla*
Dense forb vegetation on mesic habitats in the montane belt of Middle Asia

TRA-AB All. *Diantho humilis-Velezion rigidae* Korzhenevskii et Klyukin ex Didukh et Mucina 2014
Circum-Mediterranean and Irano-Turanian calciphilous annual and ephemeroid grasslands
TRA-AB-01 Ass. *Cryptosporo falcatae-Brachypodietum distachyi* S. Świerszcz, M. Nobis, G. Swacha, Z. Kącki, I. Dembicz, K. Waindzoch, S. Nowak, A. Nowak 2020
Ephemeral grasslands in the colline and lower montane belts in the south-western Pamir-Alai Mts
TRA-AB-c01 Community of *Epilasia mirabilis*
Ephemeral grasslands on deep, loessic soils in the Aktau and Babatag Mts in south-western Tajikistan
TRA-AB-c02 Community of *Eremurus ambigens*

High altitude arid halophytic graminoid vegetation

PUC Cl. *Festuco-Puccinellietea* Soó ex Vícherek 1973

PUC-A O. *Artemisietalia pauciflorae* Golub et Karpov in Golub et al. 2005
Saline steppes and desert grasslands in continental regions of Asia

PUC-AA All. *Taraxacion murgabici* S. Świerszcz, M. Nobis, A. Wróbel, E. Klichowska, S. Nowak et A. Nowak 2021
Halophytic, xerophytic grasslands on solonchak soils in the eastern Pamir Mts

PUC-AA-01 Ass. *Knorringietum sibiricae* S. Świerszcz, M. Nobis, A. Wróbel, E. Klichowska, S. Nowak et A. Nowak 2021
Halophytic, xerophytic vegetation on gravelly substrates along rivers in the eastern Pamir Mts

PUC-AA-02 Ass. *Puccinellietum pamiricae* S. Świerszcz, M. Nobis, A. Wróbel, E. Klichowska, S. Nowak et A. Nowak 2021
Halophytic desert vegetation on solonchak soils and muddy sediments of the Pamir Mts

PUC-AA-c01 Community of *Hordetum turkestanicum*
Halophytic grassy vegetation around alpine lakes in the Pamir Mts

PUC-AA-c02 Community of *Halerpestes sarmentosa*
Halophytic matts along water courses, alpine lakes and salt pans in Middle Asia

PUC-AA-c03 Community of *Paracolpodium leucolepis*
Halophytic sparse grasslands on gravelly substrates in alpine and subnival belts of the Pamir and Tian Shan Mts

Tragacanthic, wind-swept vegetation of the alpine and subnival belts of the Irano-Turanian Region

ONO Cl. *Onobrychidetea cornuto-echidnae* A. Nowak, N. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, S. Świerszcz 2025

ONO-A O. *Onobrychidetalia cornuto-echidnae* A. Nowak, N. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, S. Świerszcz 2025

ONO-AA All. *Onobrychidion echidnae* A. Nowak, N. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, S. Świerszcz 2025

ONO-AA-01 Ass. *Onobrychidetum echidnae* A. Nowak, S. Świerszcz, G. Swacha, S. Nowak, M. Nobis 2024
Cushion-tragacanthic alpine grasslands of the Pamir-Alai Mts

ONO-AA-02 Ass. *Acantholimetum diapensioidis* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024 nom. corr.
Low cushion-tragacanthic alpine to subnival sparse grasslands of the high Pamir Mts

ONO-AA-c01 Community of *Acantholimon hilariae*
Tragacanthic vegetation of semi-arid zone in alpine belt of the eastern Pamir Mts

ONO-AA-c02 Community of *Acantholimon alatavicum*
Tragacanthic vegetation of semi-arid zone in the montane and subalpine belts of the western Tian Shan Mts

Mesic grasslands of the alpine belt of the Middle and Central Asia

FEA Cl. *Festucetea alaico-krylovianae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, M. Nobis 2024

FEA-A O. *Geranio saxatilis-Festucetalia alaicae* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024
Mesic, continental grasslands of the alpine belt of the Middle and Central Asia

FEA-AA All. *Poo alpinae-Bistortion ellipticae* S. Świerszcz, M. Nobis, G. Swacha, S. Nowak, A. Nowak 2023
Alpine swards and grasslands of the Middle and western Central Asia

FEA-AA-01 Ass. *Poo alpinae-Swertietum gracilliflorae* S. Świerszcz, M. Nobis, G. Swacha, S. Nowak, A. Nowak 2023
Alpine sward on moist habitats in the Hissar Mts

FEA-AA-02 Ass. *Astragalo alpini-Linetum olgae* S. Świerszcz, M. Nobis, G. Swacha, S. Nowak, A. Nowak 2023
Subalpine mesic forb grassland of relatively dry habitats in western and central Pamir-Alai Mts

FEA-AA-03 Ass. *Ligulario alpigenae-Solenanthetum karategini* S. Świerszcz, M. Nobis, G. Swacha, S. Nowak, A. Nowak 2023
Subalpine mesic to moist grassland in western and central Pamir-Alai Mts

FEA-AA-04 Ass. *Papavero crocei-Ranunculetum popovii* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024
Sparse alpine grasslands of Central Asia

FEA-AA-05 Ass. *Poo attenuatae-Callianthemetum alatavici* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024
Alpine snowbed vegetation of Tian Shan Mts

FEA-AA-06 Ass. *Drabo alajicae-Omalothecetum supinae* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024
Alpine short grassland of the eastern Pamir-Alai Mts (Peter the First range).

FEA-AA-07 Ass. *Bistorto ellipticae-Pedicularietum korolkowii* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024
Species rich, dense subalpine to alpine grasslands of western and central Tian Shan Mts

FEA-AA-08 Ass. *Poo bucharicae-Oxytropidetum savellanicae* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024
Alpine, sparse grassland of the Pamirian badlands

FEA-AA-c01 Community of *Trollius komarovii-Erigeron heterochaeta*
Alpine grassland on damp habitats in the Pamir-Alai and western Tian Shan Mts
FEA-AA-c02 Community of *Phlomoides oreophila*
Subalpine and alpine grasslands of central and western Tian Shan Mts
FEA-AA-c03 Community of *Carum carvi-Hordetum turkestanicum*
Alpine grassland on damp habitats in the Pamir-Alai Mts
FEA-AA-c04 Community of *Oxytropis incanescens*
Subnival to alpine swards of the Eastern Pamir Mts
FEA-AA-c05 Community of *Oxytropis lehmannii*
Subnival to alpine swards of the western Pamir-Alai Mts
FEA-AA-c06 Community of *Oxytropis michelsonii*
Subnival to alpine swards of the Zeravshan Mts
FEA-AA-c07 Community of *Lloydia serotina*
Subnival to alpine swards of the snow-beds in Middle and Central Asia

FEA-AB All. *Aconito rotundifolii-Potentillion pamiroalaicae* A. Nowak, G. Swacha, S. Świerszcz, S. Nowak, M. Nobis 2023 in Swacha et al. 2023
Mesic alpine and subalpine grasslands of Irano-Turanian Region, mainly northern and eastern Middle Asia
FEA-AB-01 Ass. *Potentillo pamiroalaicae-Pedicularidetum allorramphae* G. Swacha, S. Świerszcz, S. Nowak, M. Nobis, A. Nowak 2023
Short alpine swards of the central Tian Shan Mts in Kyrgyzstan
FEA-AB-02 Ass. *Scutellario oligodontae-Hedysaretum narynense* G. Swacha, S. Świerszcz, S. Nowak, M. Nobis, A. Nowak 2023
Species rich alpine swards of warmer habitats in central Tian Shan Mts
FEA-AB-03 Ass. *Aulacospermo tianschanici-Pulsatilletum campanulae* Swacha, S. Świerszcz, S. Nowak, M. Nobis, A. Nowak 2023
Species-rich subalpine to alpine grassland of Tian Shan and northern Pamir-Alai Mts
FEA-AB-04 Ass. *Seselio tallasici-Caricetum alajicae* G. Swacha, S. Świerszcz, S. Nowak, M. Nobis, A. Nowak 2023 nom. corr.
Mesic alpine and subalpine grasslands mainly on northern slopes of western and Central Tian Shan Mts
FEA-AB-05 Ass. *Poo alpinae-Eritrichietum villosae* G. Swacha, S. Świerszcz, S. Nowak, M. Nobis, A. Nowak 2023
Species rich, moderately dense subalpine to alpine sward of western Tian Shan (mainly Kyrgyz and Talas Mts)
FEA-AB-06 Ass. *Kobresio capillifoliae-Hedysaretum kirghisori* G. Swacha, S. Świerszcz, S. Nowak, M. Nobis, A. Nowak 2023
Forb matt vegetation of alpine belt of central and western Tian Shan Mts
FEA-AB-07 Ass. *Seselio valentinae-Oxytropidetum atbaschi* G. Swacha, S. Świerszcz, S. Nowak, M. Nobis, A. Nowak 2023 nom. corr.
Species poor, intensively grazed alpine grassland of southern Tian Shan Mts
FEA-AB-c01 Community of *Oxytropis globifera* and *Leontopodium ochroleucum*
Short and moderately dense swards on gravelly habitats of alpine to subnival belts of western and central Tian Shan Mts

Group of shrubby subalpine chionophilous heaths of Middle Asia
FEA-AB-08 Ass. *Caraganetum jubatae* G. Swacha, S. Świerszcz, S. Nowak, M. Nobis, A. Nowak 2023
Chionophilous shrubland of wet habitats of northern Pamir-Alai and Tian Shan Mts
FEA-AB-09 Ass. *Caraganetum aurantiacae* G. Swacha, S. Świerszcz, S. Nowak, M. Nobis, A. Nowak 2023
Chionophilous shrubland of wet habitats of western Tian Shan Mts (mainly Suusamyr Valley)

Chionophilous summit graminoid and dwarf-scrub mountain tundra in the alpine and subnival belts
KOB Cl. *Carici rupestris-Kobresietea bellardii* Ohba 1974
KOB-A O. *Kobresietalia capilliformis* Tsepkova 1987
Chionophilous graminoid and dwarf-scrub tundra in the alpine and subnival belts
KOB-AA All. *Stipo regelianae-Ptilagrostion malyschevii* A. Nowak, G. Swacha, S. Świerszcz, S. Nowak, M. Nobis 2023 in Swacha et al. 2023
Matt grasslands of alpine and subnival belts of the eastern Irano-Turanian Region
KOB-AA-01 Ass. *Potentillo moorcroftii-Stipetum tremulae* G. Swacha, S. Świerszcz, S. Nowak, M. Nobis, A. Nowak 2023
Graminoid swards of the alpine and subnival belts of central and eastern Tian Shan Mts
KOB-AA-02 Ass. *Ptilagrostio malyschevii-Trisetetum altaici* G. Swacha, S. Świerszcz, S. Nowak, M. Nobis, A. Nowak 2023
Graminoid swards of the alpine belt of central Tian Shan
KOB-AA-03 Ass. *Violo thianschanicae-Stipetum regelianae* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024
Graminoid short swards of the alpine and subnival belt on damp habitats of central Tian Shan and the Pamir Mts
KOB-AA-c01 Community of *Festuca tianschanica*
Graminoid swards of the alpine belt of Central Asia - mainly Hindu Kush, Karakoram and Tian Shan Mts

KOB-AA-c02 Community of *Festuca olgae*
Intensively grazed swards of the alpine belt of Central Asia - mainly Hindu Kush, Karakoram and Tian Shan Mts

Irano-Turanian thermophilous, mesic tall-forb vegetation
PRA Cl. *Prangetea ulopterae* Klein 1987
PRA-A O. *Prangeto pabulariae-Feruletalia kuhistanicae* A. Nowak, M. Nobis., S. Nowak., M. Kotowski, E. Klichowska, A. Nobis, S. Świerszcz 2025
Thermophilous, mesic tall-forb vegetation of the eastern Irano-Turanian subregion
PRA-AA All. *Rheion maximowiczii* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Tall-forb vegetation on rupicolus slopes in the eastern Irano-Turanian Region
PRA-AA-01 Ass. *Phlomoidetum kaufmannianae* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Tall-forb vegetation of screes and aprones of the Zeravshan and Turkestan Mts
PRA-AA-02 Ass. *Eremuretum stenophyllo-comosi* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021 nom. corr.
Montane to subalpine mesic forb vegetation of intensively grazed pastures in Pamir-Alai (mainly Hissar and Darvaz Mts)
PRA-AA-03 Ass. *Lathyretum mulkaki* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Forb vegetation on screes in subalpine and alpine belts of western Pamir-Alai Mts
PRA-AA-04 Ass. *Feruletum sumbuli* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Forb grassland on rocky coarse debris and blocks in western Pamir-Alai Mts
PRA-AA-05 Ass. *Feruletum tenuisectae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Rupicolous, forb vegetation of the western Tian Shan Mts

Tall-forb communities of the upper montane to alpine belts of the eastern Irano-Turanian Region
PRA-AB All. *Scabioso songaricae-Phlomoidion lehmannianae* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Tall-forb communities of the upper montane to alpine belts of the central Tajikistan
PRA-AB-01 Ass. *Eremuretum robusti* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Tall-forb vegetation of humid slopes of the Hissar, Darvaz, Hazratishokh and Peter the First Mts
PRA-AB-02 Ass. *Phlomoido lehmannianae-Onobrychidetum grandis* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Tall-forb vegetation of mesic slopes of the Pamir-Alai Mts in Middle Asia
PRA-AB-03 Ass. *Eremuretum kaufmannii* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Tall-forb vegetation of alpine belt of western Pamir-Alai (mainly Zeravshan and Hissar Mts)
PRA-AB-04 Ass. *Anthriscetum glacialis* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021 nom. corr.
Intensively grazed tall-forb vegetation of subalpine and alpine belts of western and central Pamir-Alai (mainly Hissar and Peter the First Mts)
PRA-AB-05 Ass. *Feruletum kuhistanicae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Mesic tall-forbs of the subalpine to alpine belts of the Pamir-Alai Mts
PRA-AB-c01 Community of *Rumex paulsenianus*
Subalpine intensively grazed forb grassland on wet or mesic slopes in western Middle Asia
PRA-AB-c02 Community of *Cousinia umbrosa*
Forb vegetation on wet habitats in the montane and subalpine belts of Middle Asia

Hot semi-deserts; Irano-Turanian semi-desertic hyperarid and continental habitats
PEG Cl. *Pegano harmalae-Salsoletea vermiculatae* Br.-Bl. et O. de Bolos 1958
PEG-XX O. et All. Unknown
PEG-XX-c01 Community of *Peganum harmala*
Irano-Turanian hot semideserts often as nitrophilous badland
PEG-XX-c02 Community of *Anabasis truncata*
Continental semi-desert of lowlands, the colline and montane belts of northern Pamir-Alai Mts and Central Asia

Semi-desert shrublands of the Irano-Turanian Region
HAL Cl. *Haloxyletea ammodendri* Asri 2003
HAL-A O. *Haloxyletalia ammodendri* Asri 2003
Semi-desert shrublands of the Irano-Turanian Region
HAL-AA All. *Carici physodes-Haloxylion persici* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2024
Hot semi-desert of south-western Pamir-Alai Mts (Kachakum, Kurdzhalak, Ravonkul)
HAL-AA-01 Ass. *Eminio lehmannii-Haloxyletum persici* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2024
Hot semi-desert of the eastern Karakum, Kachakum and Kurdzhalak

HAL-AA-02 Ass. *Leptaleo filifolii-Calligonetum grisei* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2024
Warm semi-desert of the colline belt of south-west Pamir-Alai Mts
HAL-AA-c01 Community of *Halocharis hispida-Microcephala lamellata*
Ephemeral vegetation of semi-deserts of Karakum, Kyzylkum and other sandy habitats in lowlands and colline belt of the Irano-Turanian Region
HAL-AA-c02 Community of *Halothamnus subaphyllus*
Continental, subhalophytic semi-desert of Middle Asia and Iran
HAL-AA-c03 Community of *Calligonum elegans-Calligonum leucocladum*
Continental, subhalophytic semi-desert of southern Middle Asia and Afghanistan
HAL-AA-c04 Community of *Salsola laricifolia*
Subhalophytic semi-desert vegetation of the colline belt of Middle Asian mountains
HAL-AA-c05 Community of *Salsola orientalis*
Subhalophytic semi-desert vegetation on loamy or gravelly soils in the colline to alpine belts of Middle Asian mountains
HAL-AA-c06 Community of *Zygophyllum oxianum*
Subhalophytic semi-desert in river valley sediments of Middle Asia
HAL-AA-c07 Community of *Salsola montana-Halogeton glomeratus*
Subhalophytic, montane to subalpine scrub vegetation of arid habitats of western Pamir-Alai Mts
HAL-AA-c08 Community of *Salsola arbuscula*
Subhalophytic, colline to montane scrub vegetation of arid habitats of Central Asia
HAL-AA-c09 Community of *Astragalus vilosissimus* and *Ferula assa-foetida*
Semi-desert vegetation of Kyzylkum in lowlands and colline belt of Uzbekistan

Halophytic thermophilous scrub vegetation on dry solonetz and solonchak soils inthe arid zones of southern Middle Asia
SAT Cl. *Haloxylo-Salsoletea tomentosae* Akhani 2004
SAT-XX O. et All. Unknown
SAT-XX-01 Ass. *Carici physodis-Zygophylletum gontscharovii* S. Świerszcz, M. Nobis, A. Wróbel, E. Klichowska, S. Nowak et A. Nowak 2021
Halophytic shrublands on solonetz soils in the colline belt of western Pamir-Alai Mts (Fergana Valley, Khatlon)
SAT-XX-02 Ass. *Zygophylletum ferganensis* S. Świerszcz, M. Nobis, A. Wróbel, E. Klichowska, S. Nowak et A. Nowak 2021
Hiperhalophytic shrublands on solonetz,, gravelly or sandy soils in the colline belt around Fergana Valley
SAT-XX-c01 Community of *Limonium otolepis*
Halophytic grasslands on sandy solonetz soils in large river valley of northern Pamir-Alai fothills
SAT-XX-c02 Community of *Atriplex ornata-Heliotropium ellipticum*
Sparse halophytic grasslands on sandy substrates in large river valley of the Pamir-Alai Mts
SAT-XX-c03 Community of *Phlomis betonicifolia*
Subhalophytic grassland on arid solonetz soils in south-west Pamir-Alai
SAT-XX-c04 Community of *Zygophyllum bucharicum*
Halophytic shrublands in colline belt of Aruk-Tau Mts in south-western Pamir-Alai Mts
SAT-XX-c05 Community of *Cephalorhizum popovii*
Halophytic sparsy vegetation of gypsum and salt outcrops in south-western Pamir-Alai Mts in colline belt of Aruk-Tau Mts in south-western Pamir-Alai
SAT-XX-c06 Community of *Seidlitzia rosmarinus* and *Salsola gemmascens*
Semi-desert vegetation of southern Hindu Kush Mts in Afghanistan
SAT-XX-c07 Community of *Salsola subaphylla* and *Salvia santoliniifolia*
Semi-desert vegetation of the Hindu Kush foothills
SAT-XX-c08 Community of *Cousinia arida*
Semi-desert vegetation of the colline belt of the southern and western Hindu Kush Mts in Afghanistan and Iran
SAT-XX-c09 Community of *Reaumuria stocksii*
Semi-desert subhalophytic scrubland vegetation of the colline and lower montane belts of the south-western Hindu Kush Mts in Afghanistan
SAT-XX-c10 Community of *Ferula asa-foetida*
Semi-desert vegetation of lowlands to lower montane belt of the Irano-Turanian Region
SAT-XX-c11 Community of *Amygdalus eburnea* and *A. erioclada*
Scrublands of the semi-desert, subhumid belt of the southern Middle Asia
SAT-XX-c12 Community of *Amygdalus brahuica*
Semi-desert scrublands of the arid zone of the eastern Afghanistan and northern Pakistan
SAT-XX-c13 Community of *Ziziphus nummularia*
Thermophilous open scrublands of the Hindu Kush Mts in Afghanistan and other southern semi-deserts of the Irano-Turanian Region

Sclerophyllous and thermophilous scrub vegetation of arid habitats on large rock ledges, screes and badlands of Middle Asia

EPH Cl. *Ephedretea intermedio-equisetinae* A. Nowak, M. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, S. Świerszcz 2025

EPH-A O. *Ephedretalia intermediae* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2024
Montane and subalpine shrubby chasmophytic vegetation on arid habitats of the Pamir-Alai and western Tian Shan Mts

EPH-AA All. *Ephedro glaucae-Spiraeion baldschuanicae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Montane and subalpine shrubby chasmophytic vegetation on arid habitats of the Pamir-Alai and western Tian Shan Mts

EPH-AA-01 Ass. *Spiraeetum baldschuanicae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Montane dwarf shrub vegetation on rock ledges of the western Pamir-Alai Mts

EPH-AA-02 Ass. *Rhamnetum coriaceae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Upper montane to subalpine dwarf shrub vegetation of rocky slopes of the western Pamir-Alai and western Tian Shan Mts

EPH-AA-03 Ass. *Pentaphylloidetum parvifoliae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Alpine dwarf shrub vegetation of rock faces and ledges on mainly northern expositions in the Pamir-Alai Mts

EPH-AA-04 Ass. *Spiraeetum pilosae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska, M. Nobis 2022
Montane chasmophytic dwarf scrub vegetation on rock ledges and clefts in the western and central Pamir-Alai and Tian Shan Mts

EPH-AA-05 Ass. *Clematido songoricae-Ephedretum intermediae* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2024 nom. corr.
Screes vegetation of the upper montane to alpine belts of the western Pamir-Alai Mts

EPH-AA-c01 Community of *Ephedra glauca*
Alpine scrub on rock shelves and rocky slopes in the western Pamir-Alai Mts

EPH-AA-c02 Community of *Sageretia thea*
Scree and rocky slopes scrub vegetation of the colline and montane belts of the south-western Pamir-Alai Mts

EPH-AB All. *Ephedrion regeliano-fedtschenkoi* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Chasmophytic dwarf shrub vegetation in semi-arid zone of the Pamir Mts

EPH-AB-01 Ass. *Pentaphylloidetum dryadanthoidis* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Chasmophytic dwarf shrub vegetation on limestone rocks in the alpine belt of the eastern Pamir Mts

EPH-AB-c01 Community of *Rhamnus minuta*
Chasmophytic dwarf shrub vegetation on limestone rocks in the alpine belt of the Pamir Mts

EPH-AB-c02 Community of *Erigeron vicarius* and *Ephedra regeliana*
Chasmopytic vegetation of alpine to subnival belts on rock ledges of the Trans-Alai Mts

EPH-AA-c03 Community of *Ribes villosum*
Scree and rocky slope scrub vegetation of high alpine desert zone of the Pamir Mts

Riparian forests of continental Central Asia with strong influences of temperate climate

POL Cl. *Populetea laurifolio-suaveolentis* Hilbig 2000
Riparian gallery forests of north-eastern outskirts of Irano-Turanian Region

POL-A O. *Populetalia laurifolio-suaveolentis* Mirkin et al. ex Hilbig 2000
Poplar riparian forests from upper reaches of Ob. River in the foothills of the Altai Mts

POL-AA All. *Populion laurifoliae* Mirkin et al. ex Hilbig 2000

POL-AA-01 Ass. *Artemisio dracunculi-Populetum laurifoliae* Mirkin et al. ex Hilbig 2000

POL-AA-02 Ass. *Populetum laurifolio-nigrae* Taran 1997

POL-AA-03 Ass. *Viburno opuli-Populetum laurifoliae* Taran 2017

POL-AA-04 Ass. *Brunnero sibiricae-Populetum laurifoliae* Taran 2016

POL-B O. *Betulo-Populetalia talassicae* A. Nowak, M. Nobis 2013
Riparian forests of the montane and subalpine river valleys of Middle Asia
Upper montane group

POL-BA All. *Populion talassicae* A. Nowak, M. Nobis 2013
Poplar, birch and ash forests of the montane and subalpine belts along rivers with high discharge or in the estuary areas of mountainous lakes in Middle Asia

POL-BA-01 Ass. *Populetum pamiricae* A. Nowak, M. Nobis in A. Nowak, M. Nobis, M. Gębala, P. Wasik 2015
Populus pamirica riverside woods of the Eastern Pamir

POL-BA-02 Ass. *Populetum talassicae* A. Nowak, M. Nobis 2013
Populus talassica riverside wood of the western Pamir-Alai and south-western Tian Shan Mts

POL-BA-02a Subass.: *Populetum talassicae caricetosum orbicularis* A. Nowak, M. Nobis 2013
Fen-related type of *Populus talassica* stands, mostly growing in a mountain lake shores

Lower montane group

POL-BB All. *Populion afghanicae* A. Nowak, M. Nobis, S. Nowak 2017 in A. Nowak, M. Nobis, S. Nowak, M. Gębala, A. Nobis 2017
Riparian forests of the montane stream and river valleys

POL-BB-01 Ass. *Fraxinetum sogdianae* A. Nowak, M. Nobis, S. Nowak 2017 in A. Nowak, M. Nobis, S. Nowak, M. Gębala, A. Nobis 2017
Stands of *Fraxinus sogdiana* in deep, narrow, montane river valleys of the Pamir-Alai and western Tian Shan Mts

POL-BB-02 Ass. *Betuletum turkestanico-tianschanicae* A. Nowak, M. Nobis, S. Nowak 2017 in A. Nowak, M. Nobis, S. Nowak, M. Gębala, A. Nobis 2017
Birch woods in the montane to subalpine belts in bottoms of V-shaped river valleys

POL-BB-c01 Community of *Ulmus pumila*

Riparian gallery forests and thickets of the Euro-Siberian, Mediterranean and Irano-Turanian Region

POA Cl. *Alno glutinosae-Populetea albae* P. Fukarek et Fabijanič 1968

POA-A O. *Salicetalia purpureae* Moor 1958
Riparian gallery forests of eastern Irano-Turanian Region under the influence of temperate climate

POA-AA All. *Rubio dolichophyllae-Populion albae* Taran 2005
White poplar riparian gallery forests of upper Irtysh watershed in Kazakhstan

POA-AB All. *Equiseto hyemalis-Populion nigrae* Taran 1997
Black poplar riparian gallery forests of upper Irtysh watershed in Kazakhstan

POA-AB-01 Ass. *Equiseto hyemalis-Populetum nigrae* Taran 2017

POA-AC All. *Salicion albae* Soó 1951
Willow alluvial woods on gravel bars of middle Irtysh in Kazakhstan

POA-B O. *Salici capusii-Hippophaeetalia rhamnoidis* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, M. Nobis 2024
Buckthorn and willow scrub vegetation on the submontane to subalpine river bars in the mountains of Middle Asia

POA-BA All. *Hippophaeion rhamnoidis* Eberhardt 2004
Buckthorn and willow scrub on the gravelly stream banks in the submontane to subalpine belts of the mountains of Middle Asia

POA-BA-01 Ass. *Salici pycnostachyae-Hippophaeetum rhamnoidis* Eberhardt 2004 nom. corr.
River-bar willow bushes of the Pamir-Alai, Kopet-Dagh and Tian Shan Mts

POA-BA-02 Ass. *Calamagrostio pseudophragmites-Hippophaeetum rhamnoidis* Eberhardt 2004 nom. corr.
Buckthorn thickets on river-bars of the alpine rivers in the Karakoram and Pamir Mts

POA-BA-03 Ass. *Salicetum turanico-pycnostachyae* A. Nowak, M. Nobis, S. Nowak 2017 in A. Nowak, M. Nobis, S. Nowak, M. Gębala, A. Nobis 2017
River-bar willow bushes of the Pamir-Alai, Kopet-Dagh and Tian Shan Mts

POA-BA-04 Ass. *Tussilagini farfarae-Calamagrostietum pseudophragmitae* Pawłowski et Walas 1949
Eurasian river-bar grassy vegetation dominated by *Calamagrostis pseudophragmites*

POA-BA-c01 Community of *Salix capusii*

POA-BA-c02 Community of *Chondrilla phaeocephala*

POA-BA-c03 Community of *Incarvillea olgae*

POA-BA-c04 Community of *Saccharum spontaneum*

POA-BA-c05 Community of *Saccharum ravennae*

POA-BA-c06 Community of *Pennisetum orientale*

POA-BA-c07 Community of *Berberis nummularia*

POA-BA-c08 Community of *Halimodendron halodendron*

POA-BA-c09 Community of *Glycyrrhiza glabra*

POA-BA-c10 Community of *Datisca cannabina*
Gravel aprons, humid gorge and ravine vegetation of Middle Asia

POA-BA-c11 Community of *Salix iliensis*
Subalpine vegetation of aprons, screes and river bars in Middle Asia
All above mentioned communities were found within the borders of Tajikistan, mainly in Surkhob, upper Vakhsh, Vanch, Pyandzh, Pamir and Zeravshan River Valleys. Some of them make the stands on the river bars secondarily, having the main habitats on neighbouring screes and aprons or small tributaries (e.g. *Incarvillea olgae*, *Chondrilla phaecocephala*).

POA-BB All. *Myricarion bracteato-squamosae* nom. prov.
Submontane to subalpine river bar scrub of Middle Asia

POA-BB-c01 Community of *Myricaria squamosa*

POA-BB-c02 Community of *Myricaria bracteata*
POA-BB-c03 Community of *Lonicera stenantha*

POA-BC All. *Chamaenerion latifolii* nom. prov.
Vegetation of the montane-subalpine river bars and gravel terraces of the Middle and Central Asia
POA-BC-c01 Community of *Clematis tangutica*
POA-BC-c02 Community of *Chamaenerion latifolium*

Riparian open wood vegetation of saline and subsaline alluvial habitats along mainly intermittent rivers and oases
POP Cl. *Populetea euphraticae* Zohary 1962 nom. inval.
POP-A O. *Populetalia pruinoso-euphraticae* Nowak, Świerszcz, S. Nowak, Nobis, Klichowska et M. Nobis 2024
Riparian galley open woods of alluvial habitats in Irano-Turanian and eastern Mediterranean Region
POP-AA All. *Elaeagno angustifoliae-Populion pruinosae* A. Nowak, M. Nobis, S. Nowak 2017 in A. Nowak, M. Nobis, S. Nowak, M. Gębala, A. Nobis 2017
Galley open forests and thickets of the large river floodlands in the lowland Middle Asia
POP-AA-01 Ass. *Populetum pruinosae* A. Nowak, M. Nobis, S. Nowak 2017 in A. Nowak, M. Nobis, S. Nowak, M. Gębala, A. Nobis 2017
Riparian open woods of large river valleys of Syr-daria, Amu-daria, Vakhsh, Pyandzh, Tarim
POP-AA-02 Ass. *Populetum euphraticae* Zohary 1951 nom. inval.
Riparian and oasis open woods of the Tarim river valley in semi-arid climate

Riparian scrub vegetation of saline and subsaline alluvial habitats along mainly lowland rivers
TAM Cl. *Tamaricetea arceuthoidis* Akhani et Mucina 2015
TAM-A O. *Elaeagno turcomanicae-Tamaricetalia ramossissimae* Akhani et Mucina 2015
Riparian subsaline river bar thickets of Irano-Turanian Region
TAM-AA All. *Agropyro fragilis-Tamaricion ramosissimae* Golub in Barmin 2001
Riparian subsaline bushes of Central Asia
TAM-AA-c01 Community of *Tamarix florida*
Halophytic shrublands along large rivers in the western Pamir-Alai and western Tian Shan Mts
TAM-AA-c02 Community of *Cynodon dactylon-Tamarix ramosissima*
Intensively grazed river-bar shrublands of Tajikistan
TAM-AA-c03 Community of *Tamarix hohenackeri*
Riparian subsaline bushes of western and central Tajikistan
TAM-AA-c04 Community of *Tamarix arceuthoides*
Riparian subsaline bushes of south-western Tajikistan
TAM-AA-c05 Community of *Trachomitum lancifolium*
Bushes and fringe vegetation on the river banks and flats in Tajikistan
TAM-AA-c06 Community of *Vitex agnus-castus*
Riparian patchy vegetation on river bars in western Tajikistan
TAM-AA-c07. Community of *Atraphaxis pyrifolia*
Scree-like vegetation on river bars in central Tajikistan

Hypersaline alluvial temporary flooded swards in the semi-desert and desert zones on solonchak soils in the Irano-Turanian Region
CLI Cl. *Climacoptereteа crassae* Akhani ex S. Świerszcz, M. Nobis, A. Wróbel, E. Klichowska, S. Nowak et A. Nowak 2021 nom. corrigend.
CLI-A O. *Psylliostachyetalia spicato-leptostachyae* S. Świerszcz, M. Nobis, A. Wróbel, E. Klichowska, S. Nowak et A. Nowak 2021
Hypersaline grasslands dominated by annuals on solonchak soils, often flooded areas in river valleys of Middle and Central Asia
CLI-AA All. *Climacopterion lanatae* Berdiev et Golub in Golub 1995
Hypersaline grasslands dominated by annuals on solonchak soils of Middle and Central Asia
CLI-AA-01 Ass. *Sphenopodo-Climacopteretum glaberrimae* Rukhlenko 2014
Halophytic vegetation of lowlands and colline belt of the western Pamir-Alai and western Tian Shan Mts
CLI-AA-c01 Community of *Aeluropus littoralis-Salsola leptoclada*
Halophytic matts of flooded river valleys and damp anthropogenic habitats of the western Pamir-Alai and western Tian Shan Mts
CLI-AA-c02 Community of *Halostachys belangeriana*
Halophytic vegetation of flooded river valleys and damp anthropogenic habitats of the western Pamir-Alai and western Tian Shan Mts

CLI-AA-c03 Community of *Salicornia europaea*
Halophytic vegetation of flooded river valleys of the western Pamir-Alai and western Tian Shan Mts

Pioneer ephemeral dwarf-grass vegetation in periodically flooded saline habitats of Eurasia

CRY Cl. *Crypsietea aculeatae* Vicherek 1973
CRY-A O. *Puccinellietalia limosae* (Soó 1968) Géhu et Rivas-Martinez 1982
CRY-AA All. *Cypero-Spergularion salinae* Slavnić 1948
CRY-AA-01 Ass. *Heleochloëtum schoenoidis* Ţopa 1939
Ephemeral vegetation of muddy sediments within rice fields in western Tajikistan

Shrubby vegetation on mobile screes and rock ledges in continental and temperate Central Asia

BER Cl. *Artemisio santolinifoliae-Berberidetea sibiricae* Ermakov et al. 2006
Subalpine chasmophytic vegetation of cold and arid habitats in Central Asia
BER-A O. *Artemisio santolinifoliae-Berberidetalia sibiricae* Ermakov et al. 2006
Subalpine and upper montane chasmophytic vegetation of warm and arid zone in northern Middle and Central Asia
BER-AX All. unknown
BER-AX-c01 Community of *Scutellaria oligodonta-Lonicera semenovii*
Scree vegetation of the alpine belt of the central Tian Shan Mts

Chasmophytic vegetation of Middle Asia

Relict chomophytic and chasmophytic vegetation in the shaded and water-splashed habitats of the Mediterranean, the Atlantic islands, North Africa, Middle East and Middle Asia

ADI Cl. *Adiantetea capilli-veneris* Br.-Bl. in Br.-Bl., Roussine, Nègre 1952
Chasmophytic thermophilous and water splashed vegetation of shaded rock walls of Middle Asia
ADI-A O. *Adiantetalia capilli-veneris* Br.-Bl. ex Horvatić 1934
ADI-AA All. *Adiantion capillis-veneris* Br.-Bl. ex Horvatić 1934
ADI-AA-01 Ass. *Soncho transcaspici-Adiantetum capilli-veneris* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Chasmophytic thermophilous and water-splashed vegetation of shaded rock walls of the Pamir-Alai Mts
ADI-AA-02 Ass. *Cryptogrammetum stelleri* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Chasmophytic, cosmopolitan, water splashed vegetation of shaded rock clefts of Middle Asia

Chasmophytic vegetation of the montane and alpine rock faces of Middle and Central Asia

ASO Cl. *Carici koshewnikowii-Asperuletea oppositifoliae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, M. Nobis 2024
ASO-A O. *Campanuletalia incanescentis* M. Nobis, A. Nowak et A. Nobis ex A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of the montane and alpine rock faces of Middle Asia
ASO-AA All. *Asperulo albiflorae-Campanulion lehmannianae* M. Nobis, A. Nowak et A. Nobis ex A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of the upper montane and alpine rock faces of Middle Asia
Western Pamir-Alai group
ASO-AAa Suball. *Campanulenion lehmannianae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
ASO-AA-01 Ass. *Sergietum regelii* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation on solid limestone walls of the upper montane belt in the Fann Mts (mainly Haf-kul valley)
ASO-AA-02 Ass. *Scutellarietum megalodontae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation on dolomite and conglomerate rocks in subalpine and alpine belts of the western Pamir-Alai Mts
ASO-AA-03 Ass. *Scutellarietum rubromaculatae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation on solid limestone walls of the alpine belt in western valleys of the Fann Mts
ASO-AA-04 Ass. *Scutellarietum orbicularis* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation on often overhanging limestone faces in the montane and subalpine belts of the central Zeravshan Mts (mainly Kshtut and Dukdon Valleys)
ASO-AA-05 Ass. *Campanuletum lehmannianae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of solid limestone faces of the western Hissar and Zeravshan Mts
ASO-AA-06 Ass. *Violetum majchurensis* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of solid limestone faces of the central Hissar and Zeravshan Mts (mainly Chore and Maichura Valleys)
ASO-AA-07 Ass. *Andrachnetum fedtschenkoi* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014

Chasmophytic vegetation of tiny limestone fissures on solid faces in the montane belt of Zeravshan and Turkestan Mts

ASO-AA-08 Ass. *Achoriphragmetum turkestanici* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of limestone clefts and ledges of the northern and western Pamir-Alai Mts

ASO-AA-09 Ass. *Minuartio litwinowii-Phaeonychietum surculosi* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of overhanging walls in alpine and subnival belts of the western Pamir-Alai Mts (mainly Zeravshan and Hissar Mts)

ASO-AA-10 Ass. *Silenetum samarcandensis* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation on limestone, marl and dolomite rocks in subalpine to alpine belts of the western Pamir-Alai Mts

ASO-AA-11 Ass. *Eritrichietum turkestanici* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of limestone solid faces in alpine belt of the Fann Mts

ASO-AA-c01 Community of *Andrachne pygmaea*
Chasmophytic vegetation of tiny fissures of limestone rock outcrops near Osh in the Fergana Valley

Eastern Pamir-Alai group

ASO-AA-12 Ass. *Achoriphragmetum darvazici* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of limestone faces and ledges of the eastern Pamir-Alai Mts (mainly Darvaz and Vanch Mts)

ASO-AA-13 Ass. *Asperuletum fedtschenkoi* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of limestone solid faces in the upper montane and alpine belts of the eastern Pamir-Alai Mts (mainly Darvaz and Vanch Mts)

ASO-AA-14 Ass. *Parryetum schugnanae* A. Nowak, S. Świerszcz, S. Nowak, V. Plášek, A. Nobis, E. Klichowska, M. Nobis 2022
Chasmophytic vegetation on limestone and schist rocks in the alpine to subnival belts of the eastern Pamir-Alai Mts (mainly Schugnan, Vanch and Rushan Mts)

ASO-AA-15 Ass. *Corydalido bucharicae-Hippolytietum schugnanicae* A. Nowak, S. Świerszcz, S. Nowak, V. Plášek, A. Nobis, E. Klichowska, M. Nobis 2022 nom. corr.
Chasmophytic vegetation on schist, granite and mudstone rocks in the alpine belt of the eastern Pamir-Alai Mts (mainly Schugnan, Vanch and Rushan Mts)

ASO-AA-16 Ass. *Drabetum darvasicae* A. Nowak, S. Świerszcz, S. Nowak, V. Plášek, A. Nobis, E. Klichowska, M. Nobis. 2022
Chasmophytic vegetation of limestone rock crevices and small ledges in the alpine belt of the Darvaz Mts

ASO-AA-17 Ass. *Paraquilegietum anemonoidis* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of solid rock faces in the alpine belt of the Pamir-Alai and Tian Shan Mts

ASO-AA-18 Ass. *Psychrogetonetum andryaloidis* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014 nom. corr.
Chasmophytic vegetation of limestone clefts and ledges of eastern Pamir-Alai Mts (Peter the First and Vanch Mts)

ASO-AA-19 Ass. *Asperulo oppositifoliae-Achnatheretum jacquemontii* M. Nobis, Klichowska, A. Nowak 2023
Chasmophytic vegetation of limestone rocks of the eastern Pamir-Alai Mts (mainly Alai and eastern Zeravshan Mts)

ASO-AA-c02 Community of *Potentilla malacotricha* and *Waldheimia glabra*
Chasmophytic vegetation of alpine to subnival belts of the Pamir Mts

ASO-AAb Suball. *Pentanemenion albertoregeliae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of rock ledges and clefts with organic substrates in the Pamir-Alai Mts

ASO-AA-20 Ass. *Pentanemetum albertoregeliae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of rock ledges and clefts of the montane belt in the western Pamir-Alai Mts

ASO-AA-21 Ass. *Saussureetum ovatae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014 nom. corr.
Chasmophytic vegetation of rock ledges and clefts of the alpine to subnival belts in the western Pamir-Alai Mts

ASO-AA-22 Ass. *Rhinactinidietum popovii* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of rock ledges of the alpine belt in the western Pamir-Alai Mts

ASO-AA-23 Ass. *Asperulo albiflorae-Stipetum zeravshanicae* M. Nobis, A. Nowak et A. Nobis 2013
Chasmophytic vegetation of small limestone rock ledges of the alpine belt in the Zeravshan and Alai Mts

ASO-AA-24 Ass. *Achoriphragmetum pinnatifidi* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of rock clefts and overhanging rocks on limestone and marl faces in the Pamir-Alai, Tian Shan and Altai Mts

ASO-AA-25 Ass. *Inuletum glaucae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation of rock clefts and overhanging rocks on limestone and marl faces in the upper montane to subalpine belts of the western Pamir-Alai Mts

Vegetation of rock crevices of the submontane and colline zones in the Pamir-Alai and Tian Shan Mts

ASO-AB All. *Caricion koshevnikovii* (A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014) A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Chasmophytic vegetation of the submontane and colline belts in the Pamir-Alai and Tian Shan Mts

ASO-AB-01 Ass. *Scutellarietum hissaricae* (A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014) A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Chasmophytic vegetation of granite rock ledges of the montane belt in the Hissar Mts

ASO-AB-02 Ass. *Scutellarietum zaprjagaevii* (A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014) A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Chasmophytic vegetation of montane belt on granite friable rocks of the montane belt in Hissar Mts

ASO-AB-03 Ass. *Scutellarietum baldshuanicae* (A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014) A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Chasmophytic vegetation of the colline and montane belts in the south-western Pamir-Alai Mts (mainly Sarsarak, Darvaz and Hazratishokh Mts)

ASO-AB-04 Ass. *Tylospermetum lignosae* (A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014) A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Chasmophytic vegetation of granite and gneiss rocks (often overhanging) of the montane belt in the Hissar Mts

ASO-AB-05 Ass. *Dionysietum involucratae* A. Nowak, M. Nobis, S. Nowak et A. Nobis 2014
Chasmophytic vegetation of granite rocks of the colline and montane belts in the central Hissar Mts

ASO-AB-06 Ass. *Nanorrhinetum ramosissimi* (A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014) A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Chasmophytic vegetation of limestone rocks of the colline and montane belts in the southern Darvaz and Hazratishokh Mts

ASO-AB-07 Ass. *Campanuletum albertii* (A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014) A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Chasmophytic vegetation of limestone rocks of the montane belts in the western Tian Shan Mts

ASO-AB-08 Ass. *Asperulo albiflorae-Kafirniganietum hissaricae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska, M. Nobis 2022
Chasmophytic vegetation of granite, crambly rocks in the montane belt of Sarday-Miyona Valley (Hissar Mts)

ASO-AB-09 Ass. *Scrophularietum glabellae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska, M. Nobis 2022
Chasmophytic vegetation of limestone and gypsum rock ledges in the colline and montane belts of the Aktau and Babatag Mts

ASO-AB-10 Ass. *Scutellarietum immaculatae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska, M. Nobis 2022
Chasmophytic vegetation on solid rock faces with tiny fissures and crevices in the montane and subalpine belts in the western Alai Mts

ASO-AB-11 Ass. *Campanuletum eugeniae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska, M. Nobis 2022
Chasmophytic vegetation of limestone rock faces and ledges in the montane and subalpine belts of the Kyrgyz, Talas and Fergana Mts

ASO-AB-11a Subass. *Campanuletum eugeniae fumarioletosum turkestanicae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska, M. Nobis 2022
Chasmophytic vegegatation of shadowed solid limestone faces (gorges, river rock narrowings) in the central Alai Mts

ASO-AB-12 Ass. *Silenetum kuschakewiczii* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska, M. Nobis 2022
Chasmophytic vegetation of the upper montane and subalpine belts of the western Pamirian and Darvazian Mts

ASO-AB-13 Ass. *Rosularietum platyphyllae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska, M. Nobis 2022
Chasmophytic vegetation on ledges and shelves in the montane belt of semi-arid zones of Fergana, Terskey and Kungey Ala Too Mts

ASO-AB-14 Ass. *Silenetum lithophilae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska, M. Nobis 2022
Chasmophytic vegetation of schist rock faces in the montane and subalpine belts of the Talas and Kyrgyz Mts

ASO-AB-15 Ass. *Rhinactinidietum limoniifoliae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska, M. Nobis 2022
Chasmophytic vegetation of limestone rock ledges in the montane and subalpine belts of the western Tian Shan Mts

ASO-AB-c01 Community of *Scutellaria comosa*
Chasmophytic, thermophilous vegetation of the the colline and lower montane belts of the Fergana Valley

ASO-AB-c02 Community of *Pterocephaus afghanicus*
Chasmophytic, thermophilous vegetation of the colline and lower montane belts of the western Pamir-Alai Mts

ASO-AB-c03 Community of *Rosularia glabra*
Rock ledges and boulders in the colline and lower montane belts of the western Pamir-Alai Mts in warm climatic zone

ASO-AB-c04 Community of *Rosularia lutea*
Rock ledges and boulders in the montane and alpine belts of the Pamir-Alai Mts

ASO-AB-c05 Community of *Dionysia hissarica*
Chasmophytic vegetation of sandstone rocks of the montane belt of the western Hissar Mts

ASO-AB-c06 Community of *Scutellaria chodshakasiani*
Chasmophytic vegetation of the colline and montane belts in the south-western Pamir-Alai Mts; mainly Khojaqoziyon, Tuyun-Efn, Koiki-Toy Mts

ASO-AC All. *Eritrichion pamirico-subjacquemontii* Nowak, Świerszcz, S. Nowak, Plášek, Nobis, Klichowska et M. Nobis 2024
Vegetation of rock ledges and clefts in highly elevated semiarid zone of the Pamir

ASO-AC-01 Ass. *Crepidifolio tenuifolii-Stipetum tianschanicae* A. Nowak, S. Świerszcz, S. Nowak, V. Plášek, A. Nobis, E. Klichowska, M. Nobis 2022
Vegetation of rock ledges and clefts in the alpine belt of the eastern Pamir Mts

ASO-AC-c01 Community of *Androsace villosa* var. *dasyphylla*
Vegetation of rock ledges, clefts and screes in the alpine and subnival belts of the eastern Pamir Mts

ASO-AD All. *Hippolytion darvasicae* A. Nowak, S. Świerszcz, S. Nowak, V. Plášek, A. Nobis, E. Klichowska, M. Nobis 2022
Rock vegetation of the eastern Pamir-Alai and Western Pamir Mts

ASO-AD-01 Ass. *Silenetum kuhistanicae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014
Chasmophytic vegetation on conglomerates and limestone rocks in the montane and subalpine belts of the Pamir-Alai Mts

ASO-AD-02 Ass. *Scutellarietum schugnanicae* (A. Nowak, S. Nowak, M. Nobis, A. Nobis 2014) A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Chasmophytic vegetation of upper montane to alpine belts in the Schugnan, Vanch and Rushan ranges (eastern Pamir-Alai Mts)

ASO-AD-03 Ass. *Acantholimetum alexeenkoani* A. Nowak, S. Świerszcz, S. Nowak, V. Plášek, A. Nobis, E. Klichowska, M. Nobis 2022 nom. corr.
Chasmophytic vegetation of limestone clefts and ledges in the montane to subalpine belts of Shakhdara, Wakhan and Ishkashim ranges (southern Pamir Mts)

ASO-AD-04 Ass. *Inuletum schmalhausenii* A. Nowak, S. Świerszcz, S. Nowak, V. Plášek, A. Nobis, E. Klichowska, M. Nobis 2022
Chasmophytic vegetation on solid granite faces (often overhanging) in the alpine belt of Rushan, Yazgulem, Gunt, Shakhdara, and Bartang valleys in the Pamir Mts

ASO-AD-c01 Community of *Rosularia alpestris*
Chasmophytic vegetation on boulders and rock ledges in the alpine belt of the Pamir Mts

ASO-AD-c02 Community of *Silene schugnanica*
Chasmophytic vegetation in the montane to subalpine belts in the eastern Pamir-Alai Mts (mainly Shugnan and Darvaz Mts)

ASO-AD-c03 Community of *Cephalopodum badachshanicum*
Chasmophytic vegetation of large crevices and ledges of the upper montane and alpine belts of the western Pamir Mts

ASO-B O. *Potentilletalia caulescentis* Br.-Bl. in Br.-Bl. et Jenny 1926

ASO-BA All. *Cystopteridion fragilis* Richard 1972
Chasmophytic vegetation of shadowed rocks and screes in Eurasia

ASO-BA-01 Ass. *Asplenio-Cystopteridetum fragilis* Oberdorfer 1938
Chasmophytic vegetation of shadowed rocks and screes in the Pamir-Alai and Tian Shan Mts
Variant with *Asplenium viride*
Variant with *Gymnocarpium robertianum*

ASO-BA-02 Ass. *Asplenietum trichomano-rutae-murariae* Tüxen 1937
Chasmophytic vegetation of shadowed, limestone rocks in Eurasia, including the Pamir-Alai and Tian Shan Mts

ASO-BA-c01 Community of *Asplenium septentrionale*
Vegetation on acidic rocks in shaded habitats of the alpine belt of Middle and Central Asia

High altitude subnival rupiculous and snow-bed vegetation

DRA Cl. *Didymophyso aucheri-Dracocephaletea aucheri* Noroozi et al. 2017

DRA-A O. *Drabo pamiricae-Androsacetalia akbaitalensis* A. Nowak, S. Nowak, S. Świerszcz, M. Nobis, G. Swacha 2024 in S. Nowak et al. 2024
Subnival and alpine vegetation of screes and snow-beds of Middle Asia

DRA-AA All. *Oxytropido savellanicae-Nepetion pamiricae* A. Nowak, S. Nowak, S. Świerszcz, M. Nobis, G. Swacha 2024 in S. Nowak et al. 2024
High-elevation grasslands in relatively dry habitats with often patchy structure in the eastern Pamir and western Tian Shan Mts

DRA-AA-01 Ass. *Saxifrago oppositifoliae-Potentilletum biflorae* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024
Rupicolous vegetation of gravelly damp screes, glacier moraines and rocks in the alpine to subnival belts of the eastern Pamir-Alai and the northern and central Tian Shan Mts

DRA-AA-02 Ass. *Carici stenocarpae-Androsacetum akbaitalensis* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024
Subnival rupicolous vegetation of rocky and gravelly slopes of the Pamir Mts

DRA-AA-03 Ass. *Dracocephaletum imberbe* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024
Subnival to alpine rupicolous vegetation on gravelly slopes and screes or rock ledges of the central Tian Shan Mts

DRA-AA-04 Ass. *Dracocephaletum nodulosi-Rosularietum borissovae* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024
Alpine rupicolous vegetation of gravelly slopes, rock ledges and moraines in the central and western Tian Shan Mts

DRA-AA-05 Ass. *Nepetetum longibracteatae* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024
Subnival vegetation of rupicolous habitats of Central Asia and the Himalayas

DRA-AA-06 Ass. *Nepeto pamirensis-Rhodioletum recticaulis* S. Nowak, S. Świerszcz, M. Nobis, G. Swacha, A. Nowak 2024
Alpine and subnival patchy swards of the Pamir and central Tian Shan Mts

DRA-AA-c01 Community of *Leiospora bellidifolia-Ajania trilobata*
Subnival rupicolous vegetation of the central Tian Shan Mts

DRA-AA-c02 Community of *Oxyria digyna*
Alpine to subnival rupicolus vegetation of damp habitats in the western Tian Shan Mts

DRA-AA-c03 Community of *Dracocephalum oblongifolium*
Alpine to subnival rupicolous vegetation of the Pamir-Alai, Tian Shan and Altai Mts

DRA-AA-c04 Community of *Dracocephalum scrobiculatum*
Alpine to subnival rupicolous vegetation of the Pamir-Alai and western Tian Shan Mts

DRA-AA-c05 Community of Dracocephalum stamineum
Alpine grasslands on screes and gravelly aprons of the central Tian Shan and Pamir Mts

DRA-AA-c06 Community of *Oxytropis tianschanica*
Alpine to subnival swards of the northern Pamir-Alai and Tian Shan Mts
DRA-AA-c07 Community of *Richteria leontopodium*
Alpine to subnival rupicolus vegetation of rock ledges and moraine in the central Tian Shan Mts
DRA-AA-c08 Community of *Calamagrostis anthoxanthoides*

Scree vegetation of the montane and subalpine belts of Irano-Turanian Region
PAC Cl. *Trichodesmo incani-Pachypterygietea brevipes* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, M. Nobis 2024
PAC-A O. *Sileno brahuicae-Lactucetalia orientalis* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Scree vegetation of alpine and subalpine belts of western Middle Asia
PAC-AA All. *Ferulo foetidissimae-Vicion kokanicae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Scree vegetation of the alpine belt of the Pamir-Alai and western Tian Shan Mts
PAC-AA-01 Ass. *Anaphallidetum zeravschanicae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Fine scree vegetation of alpine belt of the western Pamir-Alai Mts
PAC-AA-02 Ass. *Angelicetum ternatae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Scree vegetation on colluvial cones and slopes with coble or pebble material in the alpine belt of the Pamir-Alai Mts
PAC-AA-03 Ass. *Feruletum foetidissimae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Alpine vegetation on compacted rock debris in the Pamir-Alai Mts
PAC-AA-03a Subass. *Feruletum foetidissimae mediasietosum macrophyllae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Upper montane to alpine rupicolous vegetation with endemic *Mediasia macrophylla* in the western Pamir-Alai Mts
PAC-AA-03b Subass. *Feruletum foetidissimae typicum* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
PAC-AA-04 Ass. *Feruletum koso-poljanskyi* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Loose scree vegetation with deep gravel deposits in the upper montane and alpine belts of the Pamir-Alai Mts
PAC-AA-05 Ass. *Hedysaretum flavescentis* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Screes and mesic steep slope vegetation in the alpine belts of the western Pamir-Alai Mts (mainly Hissar and Zeravshan Mts)
PAC-AA-06 Ass. *Stellarietum turkestanicae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Fine scree vegetation on deep gravel deposits of the alpine belt of the western Pamir-Alai Mts
PAC-AA-07 Ass. *Tetrataenietum olgae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Scree vegetation on coarse debris in the alpine belt of the western Pamir-Alai Mts
PAC-AA-08 Ass. *Feruletum bucharicae* A. Nowak, S. Świerszcz, S. Nowak, A. Nobis, E. Klichowska, M. Nobis 2022
Chasmophytuc, thermophilous vegetation of eroded rocky slopes and screes of the south-western Pamir-Alai Mts
PAC-AA-09 Ass. *Perovskietum scrophulariifoliae* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Montane vegetation of aprons, talus cones and river bar gravel sediments of Middle Asia
PAC-AA-10 Ass. *Eremuretum turkestanicae* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Scree forb vegetation of alpine belt of the western Tian-Shan Mts
PAC-AA-c01 Community of *Ferula ovina*
Typical scree vegetation on deep gravel deposits in the western Pamir-Alai Mts
PAC-AA-c02 Community of *Astragalus macropterus*
Mesic steep slopes and scree vegetation of Middle and Central Asia
PAC-AA-c03 Community of *Atraphaxis zeravschanica*
Scree and steep slope rupicolous vegetation of the semi-arid zone in upper montane to alpine belt in the western Pamir-Alai Mts
PAC-AA-c04 Community of *Glaucium squamigerum*
Nitrophilous scree vegetation of the montane belt of the western Pamir-Alai Mts
PAC-AA-c05 Community of *Rheum fedtschenkoi*
Alpine rupicolous vegetation of the Pamir-Alai Mts
PAC-AA-c06 Community of *Alajja afghanica*
Alpine scree vegetation of the western and southern Pamir-Alai Mts
PAC-AA-c07 Community of *Euphorbia cyrtophylla*
Alpine vegetation on compact screes and talus cones of the western Pamir-Alai Mts
PAC-AA-c08 Community of *Euphorbia pamirica*
Alpine vegetation on screes, aprons and talus cones of the Pamir Mts
PAC-AA-c09 Community of *Melissitus pamiricus*
Alpine vegetation on screes, aprons and talus cones of the eastern Pamir Mts

PAC-AA-c10 Community of *Eremurus korshinskyi*
Scree forb vegetation of alpine belt of Middle Asia

PAC-AB All. *Ferulion grigoriewii* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Scree vegetation of alpine and subalpine belts of eastern Middle Asia
PAC-AB-01 Ass. *Crambo schugnanae-Feruletum grigoriewii* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Scree vegetation in semi-arid zone in alpine belt of the eastern Pamir Mts
PAC-AB-02 Ass. *Allietum galanthii* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Scree vegetation on deep gravel deposits of the montane belt in the central Tian-Shan Mts
PAC-AB-03 Ass. *Nepetetum floccosae* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Scree, rupicolous vegetation in semi-arid zone of the alpine belt in the Pamir Mts
PAC-AB-c01 Community of *Bunium badachschanicum*
Scree vegetation on deep rock gravel deposits in alpine belt of Badakshan region
PAC-AB-c02 Community of *Lagochilus seravschanicus*
Scree vegetation of alpine and subalpine belts of the Pamir-Alai Mts
PAC-AB-c03 Community of *Corydalis fimbrillifera*
Scree and escarpment vegetation of the semi-arid zone of the Pamir Mts
PAC-AB-c04 Community of *Stipa turkestanica*
Scree and apron's vegetation of the subalpine and alpine belts of the western Pamir Mts

PAC-AC All. *Alceion nudiflorae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Scree, mesic vegetation of the montane belt of subhumid zone of Middle Asia
Calcifuge group:
PAC-AC-01 Ass. *Cousinietum corymbosae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Scree, rupicolous vegetation on fine granite debris in the montane and subalpine belts of the Hissar Mts
PAC-AC-02 Ass. *Phlomoidetum tadshikistanicae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016 nom. corr.
Scree, rupicolous, thermophilous vegetation in the upper montane to subalpine belts of the western Pamir-Alai Mts
PAC-AC-03 Ass. *Cousinietum refractae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Rupicolous, thermophilous vegetation in the montane belt of the Hissar, Aktau and Karatau Mts
Calcicole group:
PAC-AC-04 Ass. *Caccinietum dubiae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Scree vegetation of schist and limestone debris in the montane to subalpine belts of the Kuraminian, Turkestan and Zeravshan Mts
PAC-AC-05 Ass. *Eremuretum sogdiani* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Rupicolous, thermophilous vegetation of the montane belt in the western Pamir-Alai and south-western Tian Shan Mts
PAC-AC-05a Subass. *Eremuretum sogdiani typicum* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
PAC-AC-05b Subass. *Eremuretum sogdiani delphinietosum ovczinnikovii* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016 corr. (according to art. 43 ICPN)
Rupicolus vegetation with domination of *Delphinium ovczinnikovii* in the western Zeravshan Mts
PAC-AC-c01 Community of *Ampelopsis vitiifolia*
Typical mantle scree vegetation on loose debris in the Pamir-Alai Mts
PAC-AC-c02 Community of *Comarum salesovianum*
Scree and rupicolus vegetation on limestone debris in alpine belt of the Pamir-Alai Mts
PAC-AC-c03 Community of *Scutellaria adenostegia*
Scree vegetation in the upper montane to subalpine belts of Middle Asia
PAC-AC-c04 Community of Patrinia intermedia and Salvia bucharica
Subalpine and montane scree vegetation of the Pamir-Alai and western Tian Shan Mts

Scree vegetation of the colline and montane belts of arid and warm zones in Middle Asia
PAC-AC-06 Ass. *Zygophylletum atriplicoidis* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Scree, rupicolus, thermophilous scrub on coarse-gravel and pebble deposits with very scarse soil ingredient in Irano-Turanian Region
PAC-AC-c05 Community of *Echinops nanus*
Subhalophytic vegetation of semi-desert screes and badlands of Middle Asia
PAC-AC-c06 Community of *Glaucium elegans*
Scree vegetation of alpine belt of the western Pamir-Alai and Tian-Shan Mts

PAC-AC-c07 Community of *Chondrilla gibbirostris*
Scree vegetation of the montane belt of the Pamir-Alai Mts
PAC-AC-c08 Community of *Tetracme bucharica*
Thermophilous scree and steep slope vegetation of the south-western Pamir-Alai Mts
PAC-AC-c09 Community of *Olgaea chodshamuminensis*
Scree-like thermophilous vegetation of the colline and montane belts in south-western Tajikistan
PAC-AC-c10 Community of *Echinops chloroleucus*
Scree-like thermophilous vegetation of the colline and montane belts in south-western Tajikistan

Thermophilous chasmophytic vegetation of walls and road verges in subcontinental regions of temperate Europe, Middle East and North Africa
CYM Cl. *Cymbalario-Parietarietea diffusae* Oberdorfer 1969
CYM-A O. *Tortulo-Cymbalarietalia* Segal 1969
CYM-AA All. *Parietario judaicae-Hyoscyamion aurei* S. Brullo et Guarino 1999
CYM-AA-01 Ass. *Corydalidetum kashgaricae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2016
Rupicolous and scree vegetation of arid zone of Central Asia
CYM-AA-01a Subass. *Corydalidetum kashgaricae trigonelletosum gontscharovii* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2021
Rupicolous vegetation on screes or steep slopes of the eastern Pamir-Alai Mts (Darvaz Mts)
CYM-AB All. Cymbalario muralis-Asplenion Segal 1969
Chasmophytic vegetation of thermophilous, lowland to colline shaded habitats in Eurasia, including Middle Asia
CYM-AB-01 Ass. *Asplenio fontani-Ceterachetum officinarum* Gillet ex Ferrez 2009
Chasmophytic thermophilous vegetation of shaded clefts and crevices of Middle Asia
CYM-AB-02 Ass. *Cheilanthetum persicae* A. Nowak, S. Nowak, M. Nobis, A. Nobis 2015
Chasmophytic thermophilous vegetation of shaded clefts, crevices and anthropogenic habitats of Middle Asia

Vegetation of rooted floating or submerged macrophytes of stagnant mesotrophic, eutrophic and brackish freshwater bodies and slowly flowing shallow streams
POT Cl. *Potametea* Klika in Klika et Novák 1941
POT-A O. *Potametalia* Koch 1926
Vegetation of rooted floating-leaf macrophytes of sheltered nutrient-rich freshwaters
POT-AA *Nymphaeion* Oberdorfer 1957
Aaquatic vegetation of large macrophytes of mesotrophic to eutrophic waters
POT-AA-c01 Community of *Nymphaea odorata*
POT-AB All. *Potamion* Miljan 1933
POT-AB-01 Ass. *Potametum denso-nodosi* de Bolós 1957
Aquatic vegetation of shallow paddy fields and lakes in western Tajikistan
POT-AB-02 Ass. *Potametum lucentis* Hueck 1931
Aquatic vegetation of lakes and ponds in western Tajikistan
POT-AB-03 Ass. *Potametum natantis* Hild 1959
Aquatic vegetation of eutrophic ponds, artificial reservoirs and paddy fields in Middle Asia
POT-AB-04 Ass. *Potametum perfoliati* Miljan 1933
Aquatic vegetation of eutrophic ponds and artificial reservoirs in Middle Asia
POT-AB-05 Ass. *Stuckenio pectinati-Myriophylletum spicati* Rivas Goday 1964
Aquatic vegetation of alpine lakes and ponds in Tajikistan
POT-AB-06 Ass. *Myriophylletum verticillati* Gaudet ex Šumberová in Chytrý 2011
Aquatic vegetation of alpine lakes and ponds in Tajikistan
POT-AB-07 Ass. *Potametum crispi* von Soó 1927
Aquatic vegetation of eutrophic ponds and artificial reservoirs in Middle Asia
POT-AB-c01 Community of *Ludwigia peploides* subsp. *stipulacea*
Anthropogenic vegetation of rivers, ditches and eutrophic pools of Pamir-Alai foothills
POT-AB-c02 Community of *Myriophyllum sibiricum*

Vegetation of crosswort rooted macrophytes in shallow stagnant freshwaters
POT-AC All. *Ranunculion aquatilis* Passarge ex Theurillat in Theurillat et al. 2015

POT-AC-01 Ass. *Potametum graminei* Lang 1967
Vegetation of shallow alpine lakes in Pamir-Alai
POT-AC-02 Ass. *Potametum pusilli* von Soó 1927
Aquatic vegetation of eutrophic ponds, artificial reservoirs and paddy fields of Middle Asia
POT-AC-03 Ass. *Potametum berchtoldii* Krasovskaja 1959
Aquatic vegetation of eutrophic ponds, artificial reservoirs and paddy fields of Middle Asia
POT-AC-04 Ass. *Ranunculetum natantis* nom. prov.
Aquatic vegetation of alpine shallow lakes and pools in the Eastern Pamir
POT-AC-05 Ass. *Potametum filiformis* Koch 1926 (syn. *Charo-Potamogetonetum filiformis* Spence 1964)
Vegetation of shallow alpine lakes and pools in Middle Asia

Vegetation of crowfoot and milfoil rooted macrophytes in shallow moving freshwaters
POT-AD All. *Batrachion fluitantis* Neuhäusl 1959
POT-AD-01 Ass. *Stuckenietum amblyphyllae* A. Nowak, M. Nobis 2012
Vegetation of shallow alpine lakes and brooks in Pamir-Alai
POT-AD-02 Ass. *Stuckenietum pectinati* Carstensen ex Hilbig 1971
Aquatic vegetation of eutrophic ponds and artificial reservoirs in Middle Asia
POT-AD-c01 Community of *Stuckenia pamirica*
Vegetation of shallow alpine lakes and brooks in the eastern Pamir Mts

POT-B O. *Zannichellietalia pedicellatae* Schaminée, Lanjouw et Schipper ex Mucina et Theurillat ined.
Vegetation of rooted macrophytes in meso-eutrophic brackish waters
POT-BA All. *Zannichellion pedicellatae* Schaminée, Lanjouw et Schipper ex Passarge 1996
POT-BA-01 Ass. *Najadetum graminae* A. Nowak, S. Nowak, M. Nobis 2013
Vegetation of shallow paddy fields in western Tajikistan, mainly Syr-daria and Zeravshan River Valleys
POT-BA-02 Ass. *Parvo-Potamo-Zannichellietum pedicellatae* De Soó 1947
Vegetation of shallow paddy fields in western Tajikistan, mainly Syr-daria and Zeravshan River Valleys
POT-BA-03 Ass. *Ceratophyllo-Azolletum filiculoidis* Nedelcu 1967
Vegetation of shallow paddy fields in western Tajikistan

Spring and fen vegetation of the montane and alpine belts of Middle Asia
Spring vegetation of the Irano-Turanian Region
MON Cl: *Montio-Cardaminetea* Br.Bl. et Tüxen ex Klika et Hadač 1944
MON-A O. *Montio-Cardaminetalia* Pawłowski in Pawłowski et al. 1928
MON-AA All. *Cirsio hygrophili-Cortusion turkestanicae* A. Naqinezhad, A. Nowak, M. Nobis, S. Nowak, S. Świerszcz et M. Hájek 2021
Forb vegetation of water outflows in the upper montane and alpine belts of Irano-Turanian mountains
MON-AA-01 Ass. *Codonopsio clematidi-Cortusetum turkestanicae* A. Nowak, M. Nobis, S. Nowak, V. Plášek 2016 nom. corr.
Forb vegetation of water outflows in the Pamir-Alai Mts
MON-AA-02 Ass. *Epilobio tianschanici-Bryetum schleicheri* A. Nowak, M. Nobis, S. Nowak et V. Plášek 2016
Herbaceous vegetation of flat spring basins and headwaters with abundant bryophyte cover in the Pamir-Alai Mts
MON-AA-03 Ass. *Clementsietum semenovii* A. Nowak, M. Nobis, S. Nowak et V. Plášek 2016
Herbacious vegetation of flat flanks of the alpine rivulets in the Pamir-Alai and Tian Shan Mts
MON-AA-04 Ass. *Cirsio hygrophili-Myosotidetum rivularis* A. Naqinezhad, A. Nowak, M. Nobis, S. Nowak, S. Świerszcz et A. Kamrani 2021
Spring vegetation of base-poor and slightly acidic to neutral habitats in the montane and alpine belts of the Central Alborz range
MON-AA-04a Subass. *Cirsio hygrophili-Myosotidetum rivularis typicum* A. Naqinezhad, A. Nowak, M. Nobis, S. Nowak, S. Świerszcz et A. Kamrani 2021
MON-AA-04b Subass. *Cirsio hygrophili-Myosotidetum rivularis scrophularietosum umbrosae* A. Naqinezhad, A. Nowak, M. Nobis, S. Nowak, S. Świerszcz et A. Kamrani 2021
MON-AA-05 Ass. *Epilobio pontici-Barbaretum plantagineae* A. Naqinezhad, A. Nowak, M. Nobis, S. Nowak, S. Świerszcz et A. Kamrani 2021
Spring vegetation of the (sub)montane to subalpine rivulets and in spring heads with stagnant and running water in western Alborz Mts
MON-AA-06 Ass. *Ligularietum persicae* A. Naqinezhad, A. Nowak, M. Nobis, S. Nowak, S. Świerszcz et A. Kamrani 2021
Spring vegetation of stream flanks and small steep rivulets or fringes of alpine fens in the Alborz Mts
MON-AA-c01 Community of *Stellaria fontana* and *Catabrosa capusii*

Vegetation of free floating aquatic plants

LEM Cl. *Lemnetea* de Bolós et Masclans 1955

LEM-A O. *Lemnetalia minoris* (R. Tx. 1955) de Bolós et Masclans 1955

LEM-AA All. *Utricularion vulgaris* Passarge 1964
Vegetation of bladderworts in mesotrophic to eutrophic water bodies

LEM-AA-c01 Community of *Utricularia vulgaris*

LEM-AA-c02 Community of *Salvinia natans*

Reed swamp, sedge bed and herbland vegetation of freshwater or brackish water bodies and streams of Eurasia

PHR Cl. *Phragmito-Magnocaricetea* Klika in Klika et Novák 1941

PHR-A O. *Phragmitetalia australis* Koch 1926
Reed vegetation of pond and lake littoral zone in Tajikistan

PHR-AA All. *Phragmition austalis* Koch 1926
Reed vegetation of pond and lake littoral zone in Tajikistan

PHR-AA-01 Ass. *Typhetum angustifoliae* Pignatti 1953
Reed vegetation of alpine lakes in Tajikistan

PHR-AA-02 Ass. *Typhetum latifoliae* Nowiński 1930
Reed vegetation of eutrophic ponds, ditches and flooded areas in Tajikistan

PHR-AA-03 Ass. *Typhetum laxmannii* (Ubrizsy 1961) Nedelcu 1968
Vegetation of ditches, ponds and rice paddies with astatic water level in Tajikistan

PHR-AA-04 Ass. *Phragmitetum australis* Savič 1926
Reed vegetation of eutrophic ponds, ditches and flooded areas in Tajikistan

PHR-AA-05 Ass. *Scirpetum triqueteri* Zonneveld 1955
Vegetation of eutrophic ponds and ditches in Tajikistan

PHR-AA-06 Ass. *Scirpetum triquetriformis* A. Nowak, S. Nowak, M. Nobis 2013
Vegetation of rice paddy fields in south-western Tajikistan

PHR-AA-07 Ass. *Scirpetum hippolytii* A. Nowak, S. Nowak et M. Nobis 2013
Vegetation of rice paddy fields in western Tajikistan

PHR-AA-08 Ass. *Cyperetum longi* Micevski 1957
Vegetation of rice paddy fields in western Tajikistan

PHR-AA-09 Ass. *Cyperetum serotini* Krausch 1965 [Syn. Juncelletum serotini Krausch 1965]
Vegetation of rice paddy fields, ditches and other anthropogenic pools in western Tajikistan

PHR-AB All. *Arundion collinae* S. Brullo, Giusso, Guarinoet Sciandello in S. Brullo et al. 2010
Thermophilous reed vegetation of southern Tajikistan

PHR-AB-c01 Community of *Arundo donax*
Thermophilous vegetation of flooded areas in large river valleys, ditches and anthropogenic pools in south-western Tajikistan

PHR-AC All. *Eleocharito palustris-Sagittarion sagittifoliae* Passarge 1964.
Helophyte vegetation of shallow pools and ponds in Tajikistan

PHR-AC-01 Ass. *Eleocharitetum uniglumis* W. Braun 1968
Helophyte vegetation of shallow pools, ponds and wet grasslands in Tajikistan

PHR-AC-02 Ass. *Eleocharitetum mitracarpae* A. Nowak, S. Nowak et M. Nobis 2014
Helophyte vegetation of shallow pools, ponds and damp habitats in Tajikistan

PHR-AC-03 Ass. *Eleocharitetum argyrolepis* A. Nowak, S. Nowak et M. Nobis 2014
Helophyte vegetation of shallow pools, ponds and damp habitats in Tajikistan

PHR-AC-04 Ass. *Eleocharito palustris-Hippuridetum vulgaris* Passarge 1964
Emerging helophyte vegetation of lakes and ponds, mainly in the alpine belt of the Pamir Mts

PHR-AC-05 Ass. *Juncetum brachytepali* A. Nowak, S. Nowak et M. Nobis 2014
Helophyte vegetation of fens and swampy grasslands in western Tajikistan

PHR-AC-06 Ass. *Scirpetum tabernaemontani* De Soó 1947

Helophyte vegetation of shallow pools and ponds on deep muddy substrates in Tajikistan

PHR-AC-07 Ass. *Rorippo palustris-Alismatetum graminei* A. Nowak, S. Nowak et M. Nobis 2014
Helophyte grasslands in pools, ditches and paddies with unstable water in western Tajikistan

PHR-AC-08 Ass. *Bolboschoenetum glauci* Grechushkina, Sorokin et Golub 2011
Thermophilous, subhalophytic reed vegetation of shallow pools and ponds in Tajikistan

PHR-AC-09 Ass. *Bolboschoenetum affinis* A. Nowak, M. Nobis 2024
Thermophilous, subhalophytic reed vegetation of anthropogenic shallow pools in northern Middle and Central Asia

PHR-AC-10 Ass. *Caricetum pamirensis* A. Nowak, M. Nobis 2024
Littoral vegetation of shallow alpine lakes and ponds in the eastern Pamir Mts

PHR-AC-c01 Community of *Pycraeus flavidus*
Thermophilous vegetation on muddy habitats of pools and alluvial sediments

PHR-AD All. *Glycerio-Sparganion* Br.-Bl. et Sissingh in Boer 1942
Hygrophilous herblands of shallow pools and lakes

PHR-AD-01 Ass. *Leersietum oryzoidis* Eggler 1933
Hygrophilous reeds of shallow lakes and ditches with stable water

PHR-AD-02 Ass. *Helosciadietum nodiflori* Maire 1924
Herbland vegetation of the margins of river bars in western Tajikistan

PHR-AD-03 Ass. *Beruletum erectae* Roll 1938
Hygrophilous herblands of shallow pools and ditches in lowlands and colline belt of Tajikistan

PHR-AD-04 Ass. *Mentho asiaticae-Nasturtietum microphylli* A. Nowak, S. Nowak et M. Nobis 2014 nom. corr.
Hygrophilous herblands of shallow pools and ditches in lowlands and colline belt of Tajikistan

PHR-AD-05 Ass. *Sparganietum stoloniferi* A. Nowak, S. Nowak et M. Nobis 2014
Hygrophilous herblands of shallow pools and ditches in lowland Tajikistan

PHR-AD-06 Ass. *Sparganietum erecti* Roll 1938
Hygrophilous herblands of shallow pools and ditches in the lowland of Tajikistan

PHR-AD-07 Ass. *Glycerietum notatae* Kulczyński 1928
Hygrophilous herblands of shallow pools, anthropogenic ponds and ditches in the lowland of Tajikistan

PHR-AE All. *Phalaridion arundinaceae* Kopecký 1961
Reed vegetation of freshwater flowing and seasonally fluctuating of Eurasia

PHR-AE-01 Ass. *Calamagrostio pseudophragmitae–Typhetum minimae* Dihoru 1971
Hygrophilous reeds of the river bed margins or the surrounding of oxbow lakes in the montane belt of Tajikistan

PHR-AF All. *Magno-Caricion gracilis* Géhu 1961
Sedge-bed marsh vegetation on mesotrophicorganic sediments of Eurasia

PHR-AF-01 Ass. *Caricetum rip*a*riae* Máthé et Kovács 1959
Sedge-bed marsh vegetation in littoral zone of lakes and ponds in the montane and colline belts of Tajikistan

PHR-AF-c01 Community of *Carex melanostachya*
Sedge-bed marsh vegetation in littoral zone of lakes and ponds in western Tajikistan

PHR-AF-c02 Community of *Carex diluta*
Sedge-bed marsh vegetation on peaty substrates of lake littoral zone in western Tajikistan

Fen and mire vegetation of boreal and hemiboreal Eurasia

SCH Cl. *Scheuchzerio-Caricetea nigrae* Tüxen 1937

SCH-A O. *Caricetalia orbicularis* A. Naqinezhad, A. Nowak, M. Nobis, S. Nowak, S. Świerszcz et M. Hájek 2021
Fens of the alpine and upper montane belts of mountain ranges in the Irano-Turanian Region

SCH-AA All. *Dactylorhizo umbrosae-Caricion orbicularis* A. Nowak, M. Nobis, S. Nowak et V. Plášek 2016
Fen and mire vegetation of the Irano-Turanian Region

SCH-AA-01 Ass. *Allietum fedtschenkoani* A. Nowak, M. Nobis, S. Nowak et V. Plášek 2016
Fen vegetation of the alpine passes and flat valleys in the western Pamir-Alai, Hindu Kush and central Tian Shan Mts

SCH-AA-02 Ass. *Eleocharito quinqueflorae-Primuletum iljinskii* A. Nowak, M. Nobis, S. Nowak et V. Plášek 2016 nom. corr.
Fen vegetation on gentle slopes and valley bottoms in alpine belt of the western Pamir-Alai Mts

SCH-AA-03 Ass. *Primulo auriculatae-Caricetum kotschyanae* A. Naqinezhad, A. Nowak, M. Nobis, S. Nowak, S. Świerszcz et A. Kamrani 2021
Mire vegetation of the montane and alpine belts of the Alborz Mts

SCH-AA-04 Ass. *Primulo auriculatae-Pedicularietum rotundatae* A. Naqinezhad, A. Nowak, M. Nobis, S. Nowak, S. Świerszcz et A. Kamrani 2021
Dense fen swards in the alpine belt of the Alborz Mts

SCH-AA-05 Ass. *Primulo auriculatae-Trichophoretum pumili* A. Naqinezhad, A. Nowak, M. Nobis, S. Nowak, S. Świerszcz et A. Kamrani 2021
Sparse, grazed fen vegetation of the Alborz Mts

SCH-AA-06 Ass. *Pediculari sibthorpii-Ranunculetum amblyolobi* A. Naqinezhad, A. Nowak, M. Nobis, S. Nowak, S. Świerszcz et A. Kamrani 2021
Fen vegetation on the mineral and base-rich, sometimes subhalophytic alluvial flats of large mountain rivers and gentle slopes in the Alborz Mts

SCH-AA-07 Ass. *Swertio longifoliae-Caricetum iranicae* A. Naqinezhad, A. Nowak, M. Nobis, S. Nowak, S. Świerszcz et A. Kamrani 2021
Fens on base-rich substrates on wet alluvial fans, bottoms of U-shaped valleys or in less waterlogged sloping springs in the high montane or subalpine belts of the central Alborz Mts

SCH-AA-c01 Community of *Oxytropis riparia*
Forb fen vegetation of the montane to alpine belts of the western Pamir-Alai Mts

SCH-AA-c02 Community of *Inula rhizocephala*
Heavily grazed mires and fens in flats of U-shaped valleys in Middle Asia

SCH-AA-c03 Community of *Triglochin maritima* and *Blysmum compressus*
Initial fen vegetation on peaty substrates with water outflows of the Pamir-Alai Mts

SCH-AA-c04 Community of *Blysmus compressus* and *Philonotis fontana*
Initial fen vegetation on peaty substrates with water outflows of the Pamir-Alai Mts

SCH-AA-c05 Community of *Allium atrosanguineum*
Fen vegetation on peaty substrates with water outflow in the alpine belt of Middle and Central Asia

Shrubby group

SCH-AA-08 Ass. *Salicetum schugnanicae* A. Nowak et M. Nobis in Nowak et al. 2013
Alpine, groundwater-fed shrubby fen vegetation of the western Pamir-Alai Mts

SCH-AA-c07 Community of *Salix caesia*
Dwarf shrub alpine vegetation on rivulets banks and flats in the Tian Shan Mts

SCH-AB All. *Alopecurion mucronati* A. Nowak, A. Naqinezhad, M. Nobis, S. Nowak, S. Świerszcz et M. Hájek 2021 in Naqinezhad et al. 2021
Fens of continental, eastern Irano-Turanian subregion, including Pamir

SCH-AB-01 Ass. *Swertio marginatae-Caricetum regelianae* A. Nowak, A. Naqinezhad, M. Nobis, S. Nowak et S. Świerszcz 2021 in Naqinezhad et al. 2021
Alpine fens of flat bottoms of river valleys and post-glacial flattenings in eastern Tajikistan and the central and western Tian Shan Mts

SCH-AB-02 Ass. *Caricetum pseudofoetidae* A. Nowak, M. Nobis, S. Nowak et V. Plášek 2016
Alpine species-poor fens of neutral peaty soils in flat valley bottoms of the Pamir and the eastern Pamir-Alai Mts

SCH-AB-03 Ass. *Pediculari rhinanthoidis-Primuletum pamiricae* A. Nowak, A. Naqinezhad, M. Nobis, S. Nowak et S. Świerszcz 2021 in Naqinezhad et al. 2021
Alpine to subnival fens of the eastern Pamir

SCH-AB-c01 Community of *Oxytropis humifusa*
Initial fens of the rivulet flats of the alpine and subnival belt in the eastern Pamir and Tian Shan Mts

SCH-AB-c02 Community of *Trollius liliacinus*
Initial fens of the rivulet flats of the alpine belt in the central and eastern Tian Shan Mts

SCH-AB-c03 Community of *Ranunculus alaiensis*
Intensively grazed fens in alpine belt of the Pamir-Alai and western Tian Shan Mts

Annual weed segetal vegetation of arable crops, gardens and vineyards in the cool-temperate and boreal zones of Eurasia

PAR Cl. *Papaveretea rhoeadis* S. Brullo et al. 2001

PAR-A O. *Turgenio latifoliae-Roemerietalia refractae* S. Nowak, A. Nowak, M. Nobis, A. Nobis 2013
Annual weed segetal vegetation of arable crops, gardens and vineyards in Irano-Turanian Region

PAR-AA All. *Lathyrion sativi* S. Nowak, A. Nowak, M. Nobis, A. Nobis 2013
Weed vegetation of cereal crops on sandy soils in the Pamir Mts

PAR-AA-01 Ass. *Lathyretum sativi* S. Nowak, A. Nowak, M. Nobis, A. Nobis 2013
Weed vegetation of cereal crops on sandy soils in the southern Pamir Mts

PAR-AA-c01 Community of *Scleranthus annuus*

Weed vegetation of cereal crops on sandy, poorly developed soils

PAR-AB All. *Cirsion incani* A. Nowak, M. Nobis, S. Nowak, M. Kotowski, E. Klichowska, A. Nobis, S. Świerszcz 2025
Weed vegetation of cereal crops on poor, sandy or gravelly soils in Middle Asia

PAR-AB-01 Ass. *Asperugini procumbentis-Cannabietum ruderalis* S. Nowak, A. Nowak, M. Nobis, A. Nobis 2013 nom. corr.
Weed vegetation of cereal crops on poor, sandy or loessic soils

PAR-AC All. *Aveno trichophyllae-Euphorbion falcatae* S. Nowak, A. Nowak, M. Nobis, A. Nobis 2013
Weed, calcicole vegetation of crops in Middle Asia

PAR-AC-01 Ass. *Caucalido platycarpi-Vicietum michauxii* S. Nowak, A. Nowak, M. Nobis, A. Nobis 2014
Calcicole weed vegetation of cereal crops on gravelly soils in Middle Asia

PAR-AC-02 Ass. *Vicietum hyrcanico-peregrinae typicum* S. Nowak, A. Nowak, M. Nobis, A. Nobis 2013
Calcicole weed vegetation on brown, clayey soils in Middle Asia

PAR-AC-02a Subass. *Vicietum hyrcanico-peregrinae garhadioletosum angulosi* S. Nowak, A. Nowak, M. Nobis, A. Nobis 2013

PAR-AC-02b Subass. *Vicietum hyrcanico-peregrinae anchusetosum italicae* S. Nowak, A. Nowak, M. Nobis, A. Nobis 2013

PAR-AC-03 Ass. *Eremodauco lehmannii-Lagonychietum farcti* S. Nowak, A. Nowak, M. Nobis, A. Nobis 2013
Thermophilous weed vegetation of cereal crops and wastelands in southern Middle Asia

PAR-AC-c01 Community of *Chenopodium glaucum* and *Ch . rubrum*
Weed vegetation of cereal crops in flooded fields in the river valleys

PAR-AC-c02 Community of *Scandix pecten-veneris*
Weed vegetation of cereal crops on calcareous habitats

Weed vegetation of root crops and gardens in Irano-Turanian Region

PAR-AD All. *Spergulo arvensis-Erodion cicutariae* J. Tüxen in Passarge 1964
Weed vegetation of root crops on brown, moderately fertile soils in eastern and central Tajikistan

PAR-AD-01 Ass. *Convolvulo arvensis-Cyperetum rotundi* Carretero et Aguilella ex Ninot, X. Font, Masalles et Vigo 2011
Irrigated or flooded weed vegetation of maize, potato, tomato, cotton, leek and, rarely, in parsley plantations

PAR-AD-01a Subass. *Convolvulo arvensis-Cyperetum rotundi kochietosum scopariae* S. Nowak et A. Nowak 2013
Weed vegetation of root crops in irrigated fields on poor sandy soils in western Tajikistan

PAR-AD-02 Ass. *Daturo stramonii-Hibiscetum trioni* Bagrikova (1996) 1997
Weed vegetation on irrigated fields with mainly cotton plantations in Tajikistan

PAR-AD-03 Ass. *Setario pumilae-Sorghetum halepensi* Ştefan et Oprea 1997
Weed vegetation on irrigated fields with mainly potato or lentil plantations in Tajikistan

PAR-AD-04 Ass. *Equiseto arvensis-Xanthietum italici* Kolev 1976
Weed, thermophilous vegetation in maize, lentil, potato, sunflower, and tomato plantations in the south-western Pamir-Alai Mts

PAR-AD-c01 Community of *Chrysanthemum coronarium*
Weed, thermophilous vegetation of lentil, potato, sunflower, and tomato plantations in the eastern Irano-Turanian Region

PAR-AE All. *Oxalidion fontanae* Passarge 1978
Weed vegetation on mesic soils and wastelands of Middle Asia

PAR-AE-01 Ass. *Galinsogo-Setarietum* (R. Tx. et Beck. 1942) R. Tx. 1950
Weed vegetation of different crop types and ruderal habitats in western Tajikistan

PAR-AF All. *Veronico-Euphorbion* Sissingh ex Passarge 1964
Weed vegetation of different root crops in western Tajikistan

PAR-AF-01 Ass. *Brassico campestris-Lamietum amplexicauli* S. Nowak et A. Nowak 2013
Weed vegetation of root and cereal crops in central and eastern Tajikistan

Weed vegetation of the rice fields of Eurasia

ORY Cl. *Oryzetea sativae* Miyawaki 1960

ORY-A O. *Cypero-Echinochloetalia oryzoidis* O. Bolòs, Masclans 1955

ORY-AA All. *Oryzo sativae-Echinochloion oryzoidis* O. Bolòs, Masclans 1955 [Syn. *Oryzion sativae* Koch 1954]
Weed vegetation of eutrophic to hypertrophic waters of rice fields in Middle Asia

ORY-AA-01 Ass. *Oryzo sativae-Echinochloetum cruris-galli* Soó ex Ubrizsy 1948
Weed vegetation of eutrophic rice paddy fields in Tajikistan

ORY-AA-02 Ass. *Ammanietum auriculato-multiflorae* A. Nowak, S. Nowak, M. Nobis 2013

Thermophilous weed vegetation of shallow rice paddy fields in southern Tajikistan

ORY-AA-03 Ass. *Bolboschoenetum planiculmis* Miyawaki 1960
Weed vegetation of rice paddy fields and pools in Middle Asia

ORY-AA-04 Ass. *Typho angustifoliae-Scirpetum mucronati* Tallon 1950
Weed vegetation of eutrophic rice paddy fields in western Tajikistan

ORY-AA-05 Ass. *Sagittarietum trifoliae* A. Nowak, S. Nowak, M. Nobis 2013
Weed vegetation of eutrophic rice paddy fields in western Tajikistan

ORY-AA-c01 Community of *Paspalum distichum*

Subcosmopolitan therophyte-rich dwarf-herb vegetation of trampled habitats

POE Cl. *Polygono arenastri-Poëtea annuae* Rivas-Martínez 1975 corr. Rivas-Martínez et al. 1991

POE-A O. *Polygono arenastri-Poetalia annuae* Tx. in Géhu et al. 1972 corr. Rivas-Martínez et al. 1991

POE-AA All. *Saginion procumbentis* Tüxen et Ohba in Géhu et al. 1972
Widespread annual vegetation of wetter, trampled habitats with considerable share of bryophytes in Tajikistan

POE-AA-01 Ass. *Sagino procumbentis-Bryetum argentei* Diemont et al. 1940
Widespread therophyte vegetation of trampled habitats of Tajikistan

POE-AB All. *Polygono-Coronopodion* Sissingh 1969

POE-AB-01 Ass. *Coronopodo procumbentis-Sclerochloetum durae* Br.-Bl. in Br.-Bl., Gajewski, Wraber, Walas 1936
Vegetation of trampled road verges in Eurasia, including Middle Asia

POE-AC All. *Atriplicion* Passarge 1978

POE-AC-01 Ass. *Cynodonto dactyli-Atriplicetum tataricae* Morariu 1943
Nitrophilous, often irrigated vegetation of road verges in southern Tajikistan

Thermophilous grass-rich anthropogenic vegetation rich in summer-annual C4 species

DIG Cl. *Digitario sanguinalis-Eragrostietea minoris* Mucina, Lososová et Šilc in Mucina et al. 2016

DIG-A O. *Euphorbietalia prostratae* Vicedo et al. 1997

DIG-AA All. *Euphorbion prostratae* Rivas-Mart. 1976
Thermophilous vegetation of anthropogenic, often trampled habitats in Middle Asia

DIG-AA-01 Ass. *Amarantho blitoidis-Tribuletum terrestris* Dubyna, Dziuba et Vakarenko 2018
Thermophilous vegetation of pavements, road verges and crop fields in Tajikistan

DIG-AA-02 Ass. *Malvo neglectae-Chenopodietum vulvariae* Gutte 1972
Thermophilous and nitrophilous vegetation of ground roads and backyards in Tajikistan

DIG-AA-03 Ass. *Portulacetum oleraceae* Felföldy 1942
helo-thermophilous vegetation of pavements and road verges in Tajikistan

DIG-AA-04 Ass. *Cynodontetum dactyli* Gams 1927
Anthropogenic, often watered matts on road verges, city parks and irrigated fields

DIG-AA-c01 Community of *Alhagi kirghizorum-Chrozophora tinctoria*
Ruderal, nitrophilous vegetation of road verges and backyards in lowlands and colline belt of Tajikistan

DIG-AA-c02 Community of *Malva neglecta*
Nitrophilous ruderal vegetation of trampled habitats

DIG-AA-c03 Community of *Chenopodium murale*
Ruderal, nitrophilous vegetation of road verges and backyards in Tajikistan

DIG-AA-c04 Community of *Dysphania botrys*
Nitrophilous vegetation of gravelly habitats on road verges, escarpments and in backyards in Tajikistan

DIG-AA-c05 Community of *Eragrostis cilianensis*
Ruderal vegetation of road verges in northern Tajikistan and Central Asia

DIG-AA-c06 Community of *Duchesna indica*
Ruderal, often watered vegetation of lawns, flowerbeds and urban green areas

DIG-AA-c07 Community of *Geranium sibiricum*
Ruderal, anthropogenic vegetation of railways, road verges and urban green areas)

DIG-AA-c08 Community of *Xeranthemum longipapposum*
Ruderal, anthropogenic vegetation of railways, road verges and urban green areas

DIG-AA-c09 Community of *Acalypha australis*
Ruderal, anthropogenic vegetation of ditches, road verges and urban green areas
DIG-AA-c10 Community of *Ipomoena purpurea*
Ruderal, anthropogenic vegetation of railways, road verges and urban green areas

Perennial xerophytic ruderal vegetation
ART. Cl. *Artemisietea vulgaris* Lohmeyer et al. in Tx. ex von Rochow 1951
ART-A O. *Elytrigio repentis-Dittrichietalia viscosae* Mucina in Mucina et al. 2016
ART-AX All. unknown
ART-AX-01 Ass. *Artemisio annuae-Dittrichietum graveolens* A. Nowak, S. Świerszcz, S. Nowak, M. Nobis 2024
Xerophytic, ruderal vegetation of road verges in western Tajikistan
ART-AX-02 Ass. *Hyoscyamo nigri-Conietum maculati* Slavnić 1951
Ruderal, nitrophilous vegetation of backyards and dumping places
ART-AX-c01 Community of *Rubus praecox*
Ruderal hedgerows on road verges, along walls and fences
ART-AX-c02 Community of *Urtica cannabina*
Ruderal, nitrophilous vegetation of backyards and dumping places in Central Asia
ART-AX-c03 Community of *Onopordum acanthium*
Ruderal, helo-xerophytic vegetation of roadsides and other arid habitats in Tajikistan
ART-AX-c04 Community of *Onopordum leptolepis*
ruderal, helo-xerophytic vegetation of roadsides and other arid habitats in Tajikistan
ART-AX-c05 Community of *Silybum marianum*
Ruderal, nitrophilous vegetation of backyards and dumping places
ART-AX-c06 Community of *Crambe orientalis*
Ruderal vegetation of wastelands and fallow lands in Tajikistan
ART-AX-c07 Community of *Aster salignus*
Ruderal vegetation of roadsides and fallow lands in Tajikistan

Therophyte-rich zoogenic vegetation of mammal lairs under stoneoverhangs in the mountains of Europe, Middle East, Central Asia and southern Africa
SIS Cl. *Sisymbrietea* Gutte et Hilbig 1975
SIS-A O. *Hackelio deflexae-Blitetalia foliosi* Mucina 2016
SIS-AX All. unknown
SIS-AX-c01 Community of *Galium verticillatum* and *Asperugo procumbens*
Nitrophilous vegetation of sheep and goat lairs under the rock walls or along summer barns in Middle Asia

Summer-annual pioneer vegetation of seasonally flooded nutrient-rich river alluvia, lacustrine banks and heavily nutrient loaded anthropogenic habitats of Eurasia
BID Cl. *Bidentetea tripartitae* Tüxen et al. ex von Rochow 1951
BID-A O. *Bidentetalia tripartitae* Br.-Bl. et R.Tx. ex Klika et Hadač 1944
BID-AA All. *Chenopodion rubri* (Tüxen 1960) Hilbig et Jage 1972
BID-AA-01 Ass. *Symphyotricho graminifolii-Chenopodietum rubri* A. Nowak, S. Nowak, M. Nobis 2013
Weed vegetation of damp habitats of paddy fields in western Tajikistan
BID-AB All. *Bidention tripartitae* Nordhagen ex Klika et Hadač 1944
BID-AB-c01 Community of *Bidens frondosa*
Anthropogenic vegetation of ditches, rice fields and artificial ponds, mainly in western Tajikistan
BID-AB-c02 Community of *Juncus nastanthus*
Vegetation of summer therophytes on mud deposits in lake shorelands in western Tajikistan

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MIDDLE ASIA, encompassing countries such as Tajikistan, Kyrgyzstan, Uzbekistan, Kazakhstan, and Turkmenistan, is one of the world's richest floristic regions. The extraordinary interplay of climatic influences, phytogeographical divisions, and diverse geomorphology has shaped an exceptional diversity of plant life and vegetation. More than 10,000 species of vascular plants can be found in this region, which also boasts a remarkable variety of habitats and vegetation types. Despite its botanical richness, Middle Asia remained largely overlooked by geobotanists in the second half of the 20th century.

In 2006, a team of Polish researchers launched a long-term geobotanical exploration program in Tajikistan and its neighboring countries. Over the course of 56 expeditions, they collected approximately 6,000 vegetation records, covering nearly all major vegetation types. The results of this extensive research are now presented in the first comprehensive catalogue of plant communities for the region, organized within a hierarchical system. A total of 552 vegetation types were identified, including 297 associations, 16 sub-associations, and 239 communities, classified into 45 vegetation classes, 51 orders, and 87 alliances. Additionally, a schematic geobotanical map was developed, depicting 29 major zonal vegetation types for Tajikistan.

This work serves as a foundation for future research in vegetation ecology and syntaxonomy in Middle Asia and lays the groundwork for the conservation planning of the region's unique phytocoenotic diversity.

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