Notes on the taxonomy and distribution of species of the *Dryopteris dilatata* complex in the Caucasus, Siberia and the Far East

H. PIĘKOŚ-MIRKOWA

Nature Protection Research Centre, Polish Academy of Sciences, Cracow

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Abstract

The *Dryopteris dilatata* complex in the Caucasus, Siberia and the Far East was studied on the herbarium material from the Komarov Institute of Botany in Leningrad. The macromorphological characters of the sporophyte as well as the morphology and colour of spores were used. It has been found that *Dryopteris extremiorientalis* V. Vasil., regarded as an endemic taxon for the Far East, is conspecific with *Dryopteris assimilis* S. Walker, and *Dryopteris Alexeenkoana* Fom., regarded as a West Caucasian endemic species is identical with *Dryopteris dilatata* (Hoffm.) A. Gray, em. S. Walker. In the paper the distribution of *D. assimilis* in the Asiatic part of the USSR was given.

INTRODUCTION

Walker's cytotaxonomic papers (1955, 1961) on the *Dryopteris dilatata* complex have caused much interest in this complex of ferns among the scientists in Europe and North America. So far, however, there has been no modern elaboration of the complex under discussion from the areas of Asia. Fomin (1934) in "The flora of the USSR" listed from the Asiatic part three species of this complex: the widely distributed *Dryopteris spinulosa* (Müll.) O. Kuntze and *D. austriaca* (Jacq.) Woyнар (= *D. dilatata* A. Gray), and *D. Alexeenkoana* Fom. regarded as endemic species of the Western Caucasus. Vasilev (1957), furthermore, gave *D. extremiorientalis* V. Vasil., an endemic species for the Far East. Also the occurrence of *D. assimilis* S. Walker in the Caucasus (Simon, Vida 1966) and in Siberia and Kamchatka (Widén, Britton 1971) have recently been signaled.

During two trips to Leningrad in 1975 and 1976 I got a chance to study the species of the *Dryopteris dilatata* complex on the herbarium materials in the Komarov Institute of Botany. The aim of my studies was to elucidate the relation of the endemic taxa of *D. extremiorientalis* V. Vasil. and *D. Alexeenkoana* Fom., respectively, to the European taxa of the *Dryopteris dilatata* complex and to present distribution of *D. assimilis* in the Asiatic part of the USSR, a species hitherto not distinguished here from *D. dilatata* s. str.

MATERIAL AND METHODS

The herbarium materials of the Komarov Institute of Botany, Soviet Academy of Sciences, were the basis for the studies. Altogether, about 800 herbarium sheets were checked from the Caucasus, Western and Eastern Siberia, the Far East (Sakhalin, Kamchatka, the Kurile Islands, the Ochock region) and the European part of the USSR. The verification of herbarium specimens was based on vegetative characters of the sporophyte as well as on the colour and morphology of spores. Particular attention was paid to the following characters given in the literature for distinguishing between *D. assimilis* and *D. dilatata* (Walker, Jermy, 1964; Gätzi, 1966; Widén, Sarvela, Ahti, 1967; Crabbe, Jermy, Walker, 1970; Piękoś-Mirkowa, in press):

1. colour and sculpture of spores,
2. ratio of the length of the proximal basicopis pinnule on basal pinna to the total length of the pinna,
3. ratio of the length of the proximal basicopic pinnule on basal pinna to the length of the proximal acroscopic pinnule,
4. shape, colour and density of scales on the petiole,
5. colour of the lamina,
6. glandularity of the indusium and the lamina.

The sculpture of spores was estimated under a light microscope under 600× magnification.

The data obtained were compared to the results of analogous studies carried in the previous years on materials from Central Europe (Piękoś-Mirkowa, in press).

DISCUSSION AND CONCLUSIONS

1. *Dryopteris extremiorientalis* V. Vasil.

Dryopteris extremiorientalis V. Vasil. Fl. Ochotsk. pober., I (msc.) — *D. austriaca* var. *orientalis* Fom. Fl. USSR, I (1943) 41 — *Nephrodium spinulosum* Fedtsch. Fl. Command. (1906) 127.

The original description of this species according to Vasilev (1957) is as follows:

PLATE I

Fig. 1. *Dryopteris extremiorientalis* V. Vasil. The Far East, the Ochock region, 20.VIII.1928, lg. G. D. Dylkejt (LE)

Fig. 2. *Dryopteris assimilis* S. Walker. Poland, the Tatra Mtns, 29.IX.1970, lg.
H. Piękoś (KRAM)

Fig. 3—7. Spores in the *Dryopteris dilatata* complex ($\times$ ca.390): 3 — *D. extremiorientalis* V. Vasil. (the Far East); 4 — *D. assimilis* S. Walker (Poland); 5 — *D. Alexeenkoana* Fom. (the Caucasus); 6 — *D. dilatata* (Hoffm.) A. Gray, em. S. Walker (Poland); 7 — *D. dilatata sensu* Fomin (the Caucasus).

"Perennial. Rhizome thick, oblique; petiole twice shorter than the lamina; leaves large, lamina broad, ovate-oblong, sharply pointed, 3- or 4-pinnate, smooth, with whitish glands on the surface, tertiary segments toothed, with thin spines on the teeth; sori large, their numerous indusia with glands on the margin. It differs from West Siberian and European typical forms of *D. austriaca* by concolorous scales on the petioles. In the mountain valleys and slopes. Eastern Siberia and Far East. East Siberian-Commander's distributional type".

The name *D. extremiorientalis* was published in Russian only, without the Latin diagnosis, which in the light of the International Code of Botanical Nomenclature (1961) is an invalid publication.

The above-quoted description of *D. extremiorientalis* suggests identity of this taxon with *D. assimilis*. It is also confirmed by examinations of herbarium materials. All specimens in the Leningrad herbarium, designated as *D. extremiorientalis*, differ from the European *D. assimilis* neither with respect to vegetative characters nor characters of spores. Thus, their laminae are light-green, the proximal basicopic pinnule on basal pinna is relatively long, equal to about 1/2 length of the whole pinna (Figs. 1, 2); the spores are light-brown with the sculpture of perispore typical of *D. assimilis* (Fig. 3). With respect to the glandularity of the lamina and petiole, the specimens from Eastern Siberia and the Far East show variability from the wholly bare forms (the most frequent) up to the strongly glandular. A similar type of variability has been found by me also in the European specimens of *D. assimilis* (Piękoś-Mirkowa, in press). The indusia of the specimens determined as *D. extremiorientalis* are always markedly glandular. The differentiation of the shape of the lamina became the basis for separating of two varieties within *D. extremiorientalis*, var. *oblonga* and var. *deltoidea* (Vasilev in herb.), which correspond to the analogous differentiation within *D. assimilis*. The scales of *D. assimilis* may be bicolorous (i.e. with a dark strip or band in the middle part or with a dark spot in the base part of the scale) or, more rarely, concolorous (redbrown). In the literature, the forms of *D. assimilis* with concolorous scales have been given without much taxonomic importance being attached to them (Widén, Sarvela, Ahti, 1967; Crabbe, Jermy, Walker, 1970; Piękoś-Mirkowa, in press). Such forms are found mostly in the North and at higher altitude in the mountains. The concolour of scales is thus not the character that could exclusively differ the forms from the Far East and be the basis for a separating of the endemic species *D. extremiorientalis*.

The chromosome number of *D. extremiorientalis* is not yet known. However, the gross morphology and characters of spores permit regarding this taxon as conspecific with *D. assimilis* S. Walker.

2. *Dryopteris Alexeenkoana* Fom. and *D. dilatata* (Hoffm.) A. Gray
sensu Fomin

Fomin (1911, 1913) in his comprehensive analysis of the genus *Dryopteris* and then Grossgeim (1949) gave from the Caucasus territory three species of the complex under discussion; the endemic West Caucasian *D. Alexeenkoana* Fom. and the widely distributed *D. eupinulosa* (Diels.) Fom. and *D. dilatata* (Hoffm.) A. Gray. However, as a result of cytotaxonomic studies, the hitherto broadly grasped species *D. dilatata* has recently been divided into the diploid *D. assimilis* and the tetraploid *D. dilatata* s. str. (Walker, 1955, 1961). To elucidate relations between the Caucasian taxa given by Fomin (l.c.) and the species *D. assimilis* and *D. dilatata* s. str. that are being presently distinguished in Europe, the below-presented original descriptions of *D. Alexeenkoana* and *D. dilatata* given by that author were analysed and the comparative studies of herbarium specimens were conducted.

Dryopteris Alexeenkoana Fomin (1911) — *Nephrodium dilatatum* var. *pontica* Alexeenko, in herbariis — *N. spinulosum* β. *dilatatum* Albow, Prodr. Fl. Colch. p. 272 (partim).

"Frondibus graveolentibus amplis gracilibus oblongo-deltoideis acuminatis atroviridibus parce glanduligeris glandulis clavatis, petiolo lamina brevior e sicco nitente castaneo vel atro-castaneo e vivo fere nigro plus minus glanduligero paleis lanceolatis et anguste-lanceolatis valde acuminatis nigris margine atro-fuscis paleisque piliformibus nigris immixtis dense vestito, rachide costisque paleis atris piliformibus obsitis, pinnis e vivo convexis lanceolatis et triangulari-lanceolatis acuminatis, infimis saepe fertilibus ovato-deltoides inaequilateralibus, pinnulis e vivo convexis ovato-oblongis acutiusculis vel acutis in segmenta tertiaria lanceolato-linearia vel linearia apice subtruncata margine dentata pinnatisectis, dentibus late-ovatis apice abrupte in spinulam mollem longam productis, pinnula infima lateris superioris pinnae infimae proximam aequante, soris in segmentis tertii ordinis dispositis, nervis in segmentis tertiariis 1-furcatis e sicco pellucidis apice incrassatis, soris in apice vel sub apicem incrassatum rami fertilis abbreviati sitis, indusio membranaceo margine glandulis clavatis obsito, sporis fuscis ovato-reniformibus sine alis et cristis. In silvis umbrosis regionis inferioris Transcaucasiae occidentalis".

Type: *Dryopteris Alexeenkoana* — Abchazia, Tzebelda. Fauces Patzkir, in sylva umbroso, lg. G. Woronow, 25.IX.1920.

The type is in the Herbarium of the Komarov Institute of Botany, Soviet Academy of Sciences (abbr. LE).

Fomin (1913) in a note, written in Russian, stresses that *D. Alexeenkoana* is a species very close to *D. dilatata* from which it differs in the following characters: the dark-green lamina, and the dark, almost

black petiole, the black scales on the petiole and on the rhachis, a sharp, unpleasant odour which remains even after the drying of the plant. Furthermore, the pinnules are divided into lanceolate-linear or even linear, at the end as though truncate, the third order segments, the teeth on the margins of the pinnules ovate-circular, abruptly passing into very long, thin and sharp end. The sori are on the ends or somewhat below the thickened ends of the branches of nerves. Spores brown, on the margin without wings and without crista.

For comparison, it would be well to quote the whole of the description of *D. dilatata* given by Fomin (1913):

„Rhizomate obliquo robusto, frondibus flaccidis membranaceis 1—3' longis deltoideis, deltoideo-ovatis vel oblongo-ovatis acuminatis basi plerumque 3 — 4-pinnatisectis glabris vel saepius plus minus glandulosis plerumque saturate viridibus vel atro-viridibus et a basi fertilibus petiolo stramineo rarius fusco cum rachide dense paleis lanceolatis et oblongo-lanceolatis acuminatis fuscis medio atris obsito lamina brevior suffultis, pinnis approximatis omnibus in apicem longum angustum pinnatifidum abeuntibus, pinnulis praecipue a basi frondis plerumque pinnatisectis jugi infimi pinnarum pinnula infima lateris superioris proxima brevior, laciniis saepe convexis dentibus laciniarum longis in spinulam mollem longam productis saepius replicatis, indusio plerumque glanduloso, glandulis indusii et frondis cylindricis unicellularibus, nervis in segmentis III ordinis uni- vel bifurcatis, soris ad medium vel paulum supra medium rami fertilis furcae insidentibus, sporis reniformi-ovatis margine late alatis lateribus late cristatis, cristis et alis integris tota superficie aculeolatis”.

While analysing the descriptions given by Fomin (1913) for *Dryopteris Alexeenkoana* and *D. dilatata* and comparing them with the contemporary descriptions of *D. assimilis* and *D. dilatata* s. str., a pronounced convergence may be observed. Thus the features given by Fomin (l.c.) for *D. dilatata* are characteristic of the present *D. assimilis*, e.g. a light-green colour of leaves, variable glandularity of the lamina from very bare to glandular, mostly (thus not always) glandular indusia, the shape of scales, asymmetry of the proximal basicopic pinnules on basal pinna. Instead, the majority of characters given by Fomin (1913) in the diagnosis of *D. Alexeenkoana* are now being ascribed to *D. dilatata* s. str., e.g. a dark-green colour of leaves, the scales narrower than those of the former species and more strongly elongate, the leaves always glandular, proximal — basicopic and acroscopic pinnules on basal pinna $\pm$ the same length.

Grossgeim (1949) mentions still one more character that differs both species, convex pinnules and tertiary leaf segments in *D. Alexeenkoana* and plane leaf segments in *D. dilatata* sensu Fomin. At the present time, the plane tertiary leaf segments are being ascribed to

D. assimilis while the convex ones are often characteristic of *D. dilatata* s. str.

In the descriptions of *D. Alexeenkoana* and *D. dilatata*, Fomin (1913) lays much emphasis on differences in the sculpture of spores. It is a modern approach. It should be stressed that Fomin was the first to pay attention to a great taxonomic significance of the characters of spores in the *D. dilatata* complex. As is demonstrated by contemporary studies, the sculpture of perispore is one of the most certain criterions in identification species in this complex (Crabbe, Jermy, Walker, 1970; Piękoś, 1975). According to Fomin (1913), the spores of *D. dilatata* have broad wings on both margins while those of *D. Alexeenkoana* are characterized by the lack of wings. The description of spores in *D. Alexeenkoana* points, as the already mentioned characters of the morphology of leaves do, to *D. dilatata* s. str. in the present grasp. On the other hand, the spores of *D. dilatata* sensu Fomin with "broad wings" would correspond to the present *D. assimilis*. The revision of the Caucasian herbarium materials and the examination of spores also proved that the specimen being a type of *D. Alexeenkoana* as well as other specimens determined by Fomin or other scientists as *D. Alexeenkoana* are identical with *D. dilatata* s. str. in its present grasp (Figs. 5 and 6). On the other hand, the Caucasian specimens of *D. dilatata* sensu Fomin and their spores proved to be identical with the European *D. assimilis* (Figs. 4 and 7). Fraser-Jenkins who in 1976 revised part of the Caucasian materials in Leningrad also arrived at a similar conclusion.

D. Alexeenkoana occurs in fir-beech forests at lower altitudes of the Western Caucasus. On the other hand, *D. dilatata* sensu Fomin is widely distributed over the Caucasus, reaching up to 2,950 m a.s.l. (the data from the labels). It grows in scrubs with *Rhododendron caucasicum*, in the subalpine birch scrubs, spruce and beech forests, the rocky subalpine meadows and on glacial moraines. Vertical distributions of *D. dilatata* s. str. and *D. assimilis* run similarly in the mountains of Central Europe. Thus *D. dilatata* s. str. occurs at lower altitudes and *D. assimilis* reaches high into the mountains growing still above the upper forest limit.

As is evident from the above examinations, the first who distinguished the taxa, now defined as *D. assimilis* and *D. dilatata* s. str., in the rank of separate species, was therefore Fomin. He based this identification among other features on the characters of spores which are now being given a great taxonomic importance. A common and widespread in the USSR taxon was called by him *D. dilatata*, and a much rarer one, which was found by him in the Caucasus only, was described by Fomin as *D. Alexeenkoana*. Judging from the exsiccata given by Fomin, he had not at his disposal greater, comparative herbarium ma-

terials from Central and Western Europe. In the listed literature, Fomin (l.c.) does not quote the paper by Moore (1857) who, on the basis of the morphology of leaves, described from Great Britain *Lastrea dilatata* Presl var. *alpina* Moore, known today as *D. assimilis*. Fomin could then not know about the existence in Europe of two races within *D. dilatata* s.l.

It is evident then from the already said that the nomenclature in the *Dryopteris dilatata* complex needs a new examination in the light of the new data and in accordance with the requirements of the International Code of Botanical Nomenclature.

CONCLUSIONS

As a result of the revision of the herbarium materials from the Asiatic part of the USSR and the comparative studies of the species of the *Dryopteris dilatata* complex in Central Europe and the USSR, it has been found that:

1. the Eastern Siberian-Commander's taxon *Dryopteris extremi-orientalis* V. Vasil. (= *D. austriaca* var. *orientalis* Fom.), regarded as endemic, is conspecific with *Dryopteris assimilis* S. Walker.

2. *Dryopteris Alexeenkoana* Fom. (= *D. dilatata* var. *pontica* Alexeenko, regarded as a West Caucasian endemic species is identical with *D. dilatata* s. str. in the present grasp. On the other hand, *D. dilatata* sensu Fomin (1913) from the Caucasus is identical with *D. assimilis* S. Walker.

3. The past data on distribution of *D. dilatata* (= *D. austriaca*) in the Caucasus, Siberia and the Far East, included in "The flora of the USSR" and the regional "Floras", refer to *D. assimilis*.

4. *Dryopteris assimilis* is a species very common in both lowland and mountain forests in Siberia, the Far East and the Caucasus.

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Author's address:

Dr. H. Piękoś-Mirkowa
Nature Protection Research Centre
Polish Academy of Sciences,
Lubicz 46; 31-512 Kraków; Poland

Uwagi o systematyce i rozmieszczeniu gatunków z grupy Dryopteris dilatata na Kaukazie, Syberii i Dalekim Wschodzie

Streszczenie

W czasie pobytu w Instytucie Botaniki im. Komarowa AN ZSRR w Leningradzie przeprowadzono na materiałach zielnikowych tamtejszego zielnika studia nad gatunkami grupy *Dryopteris dilatata* z Kaukazu, Syberii i Dalekiego Wschodu. Celem badań było wyjaśnienie stosunku endemicznych taksonów *Dryopteris extremorientalis* V. Vasil. i *D. Alexeenkoana* Fom. do europejskich taksonów z grupy *Dryopteris dilatata* oraz przedstawienie rozmieszczenia w azjatyckiej części ZSSR *D. assimilis* S. Walker, gatunku nie odróżnianego tam dotąd od *D. dilatata* (Hoffm.) A. Gray s. str. Przy weryfikacji okazów zielnikowych oparto się zarówno na cechach makroskopowych sporofitu, jak i na barwie i morfologii zarodników.

Porównawcze studia nad gatunkami omawianej grupy z Europy Środkowej i ZSRR wykazały, że:

- uważany dotychczas za endemiczny wschodniosyberyjsko-komandorski takson *Dryopteris extremiorientalis* V. Vasil., jest konspecyficzny z *D. assimilis* S. Walker,
- *Dryopteris Alexeenkoana* Fom. uważana dotąd za endemit zachodniokaukaski, jest tożsama z *D. dilatata* (Hoffm.) A. Gray s. str. w dzisiejszym ujęciu. Natomiast *D. dilatata* sensu Fomin (1913) z Kaukazu jest tożsama z *D. assimilis* S. Walker,
- dotychczasowe dane o rozmieszczeniu *D. dilatata* (= *D. austriaca*) na Kaukazie, Syberii i Dalekim Wschodzie, zawarte we „Florze ZSRR” oraz „Florach” regionalnych, odnoszą się do *D. assimilis*,
- *Dryopteris assimilis* jest gatunkiem bardzo pospolitym w lasach zarówno nizinnych jak i górskich na Kaukazie, Syberii i Dalekim Wschodzie.