

**Zeitschrift:** Botanica Helvetica  
**Herausgeber:** Schweizerische Botanische Gesellschaft  
**Band:** 97 (1987)  
**Heft:** 2

**Artikel:** The Dryopteris dilatata complex in the Soviet Far East  
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**DOI:** <https://doi.org/10.5169/seals-67863>

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## The *Dryopteris dilatata* complex in the Soviet Far East

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Manuscript accepted July 1, 1987

### Abstract

Piękoś-Mirkowa, H. 1987. The *Dryopteris dilatata* complex in the Soviet Far East. Bot. Helv. 97: 167–177.

The *Dryopteris dilatata* complex is represented in the Soviet Far East by two species: *D. amurensis* Christ and *D. expansa* (C. Presl) Fraser-Jenkins et Jermy (= *D. assimilis* S. Walker). The former species is endemic to the Far East, whereas the second has a wide circumboreal range.

On the basis of verified herbarium material for the first time a detailed distribution map of *D. expansa* in the Soviet Far East is given. Comparative studies on morphological variability of *D. expansa* in eastern Asia and in Europe have shown that small differences in their gross morphology could be found, although there is a great number of essential similarities between Asiatic and European plants.

*Key-words:* *Dryopteris amurensis*, *D. expansa*, Far East, Europe, distribution, variability.

### Introduction

The *Dryopteris dilatata* complex is known in the literature as *D. spinulosa*, *D. carthusiana* or *D. austriaca* complex. This group of ferns has aroused the keen interest of pteridologists for the last 30 years. There have appeared many papers concerning the morphology, cytology, cytogenetics and chemotaxonomy of members of this complex.

Particularly intensive studies have been conducted in Great Britain, in Scandinavia, in the Iberian peninsula, in Macaronesia, and in North America (Walker 1955, 1961, Walker and Jermy 1964, Simon and Vida 1966, Gätzi 1966, Tryon and Britton 1969, Widén et al. 1967, Sorsa and Widén 1968, Widén and Britton 1969, Widén and Sorsa 1969, Crabbe et al. 1970, Widén et al. 1970, Nardi 1976, Gibby et al. 1977, Gibby and Walker 1977, Gibby et al. 1978, Gibby 1979, Fraser-Jenkins 1982, Gibby 1983, 1985).

Owing to the investigations of Walker and Gibby and others, the relationships between European and American taxa are now well-known, whereas we have as yet little information about the Asiatic forms (Widén and Britton 1971, Widén et al. 1975,

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Dedicated to Prof. T. Reichstein on the occasion of his 90<sup>th</sup> birthday

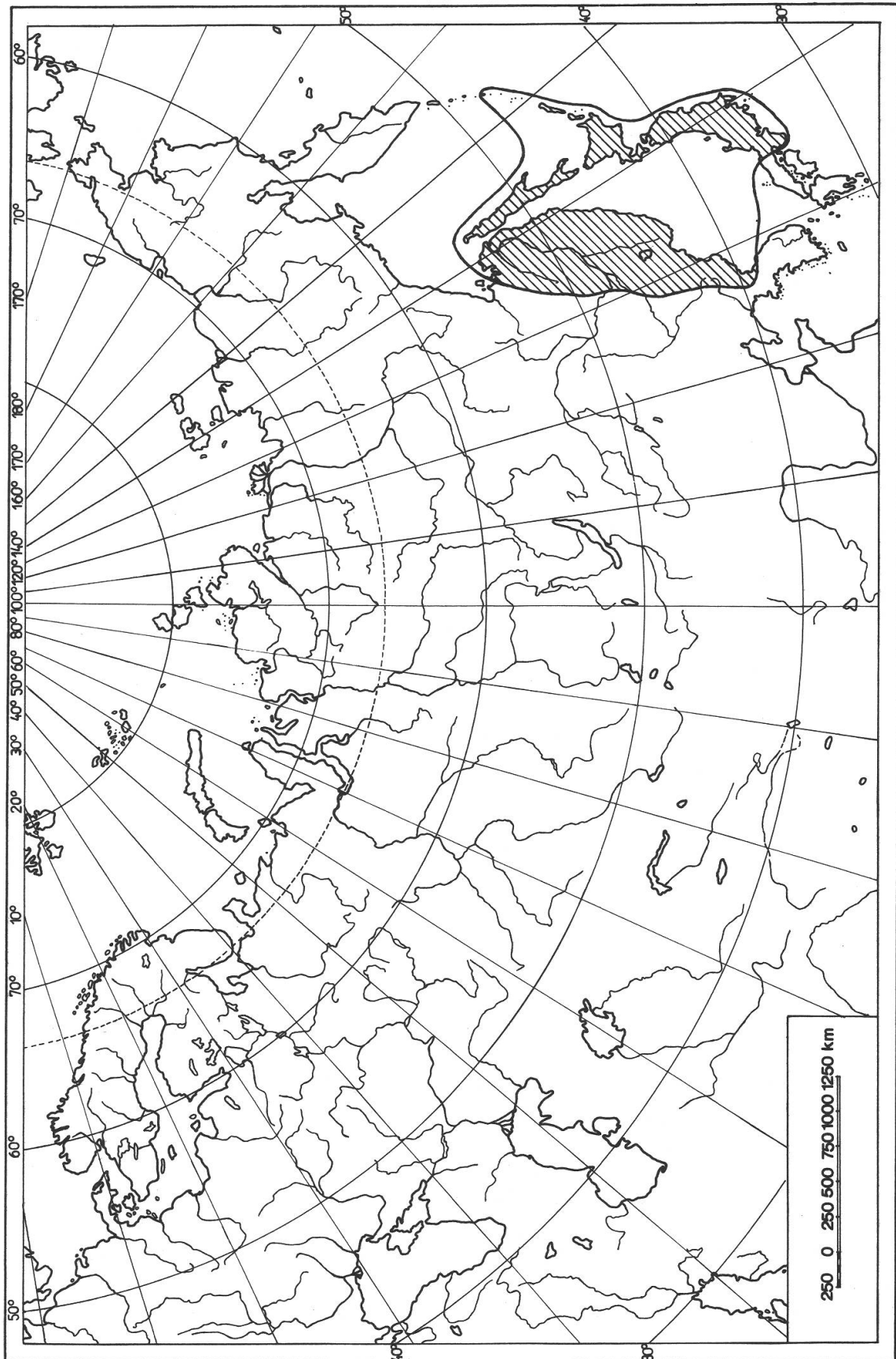


Fig. 1. Distribution of *Dryopteris amurensis* Christ.

Piękoś-Mirkowa 1977, Widén, Widén and Gibby 1978). Examination of the Asiatic taxa is necessary for the full understanding of the origin, the evolution and the interrelationships as well as the distribution patterns of the particular members of the complex.

### Material and methods

Taxonomic studies of the *D. dilatata* complex in the Soviet Far East were carried out on the basis of Soviet herbarium material. The maps of distribution (Figs. 1 and 3) have been prepared from verified materials seen in the following herbaria:

KW – Herbarium of Institute of Botany, Ukrainian Academy of Sciences, Kiev

LE – Herbarium of Komarov Institute of Botany, USSR Academy of Sciences, Leningrad

MHA – Herbarium of Botanical Garden, USSR Academy of Sciences, Moscow

MW – Herbarium of Moscow State University, Moscow

VLA – Herbarium of Institute of Biology and Pedology, USSR Academy of Sciences, Vladivostok.

Spores obtained from herbarium specimens were coated with carbon and gold and examined with a scanning electron microscope (Cambridge Stereoscan S4-10 at the University of Mining and Metallurgy in Cracow and Cambridge Stereoscan 2A in the Institute of Geology in Bern).

Morphological variability of *D. expansa* (= *D. assimilis*) was examined with respect to nine characters. They are presented in Table 1. The variability of the investigated specimens was analysed by using the sum of estimates and Anderson's Hybrid Index (Anderson 1949) as well as cyclograms (Davidson 1947, Staszkievicz, Tyszkiewicz 1969).

### Results and discussion

Among the more widely distributed members of the complex discussed and its relatives, neither *D. cristata* (L.) A. Gray nor *D. dilatata* (Hoffm.) A. Gray [= *D. austriaca* (Jacq.) Woyнар] occur in the Far East. The former species reaches Western Siberia, while *D. dilatata* is a European species. The eastern border of the latter runs through the western Soviet republics, the Eastern Carpathians and the Caucasus. Therefore, all reports in Russian and Soviet Floras on the wide distribution of *D. austriaca* or *D. dilatata* in the Asiatic part of the USSR should be referred to *D. expansa* (C. Presl) Fraser-Jenkins et Jermy (formerly known as *D. assimilis* S. Walker, see Fraser-Jenkins and Jermy 1977).

Presumably also *D. carthusiana* (Vill.) H. P. Fuchs does not occur in the Far East. This species was reported from two localities: in the Chukotka Peninsula (Yurtsev et al. 1973) and on Verchoturov Island (Krivochizhin and Siplivinsky 1974). These localities are remotely situated in relation to the main range of the species and need confirmation. Perhaps *D. expansa* should be taken into account here. I have seen herbarium material of *D. expansa* from higher geographical latitudes resembling *D. carthusiana* in habit as well as in colour of scales on the petiole.

Thus, only two species of the *D. dilatata* complex have been recognized so far in the Soviet Far East, i.e., *D. amurensis* and *D. expansa*.

*D. amurensis* Christ is one of the most abundant fern species in the coniferous and broad-leaved forests in the Far East. It occurs in Japan, China, Korea, and in the USSR and is endemic to the Far East. The map (fig. 1) shows the distribution of *D. amurensis*. It undoubtedly belongs to the *D. dilatata* complex, as is evident from its leaf morphology and its type of spores (fig. 2). As can be seen in fig. 2, the perispore sculpture of *D.*

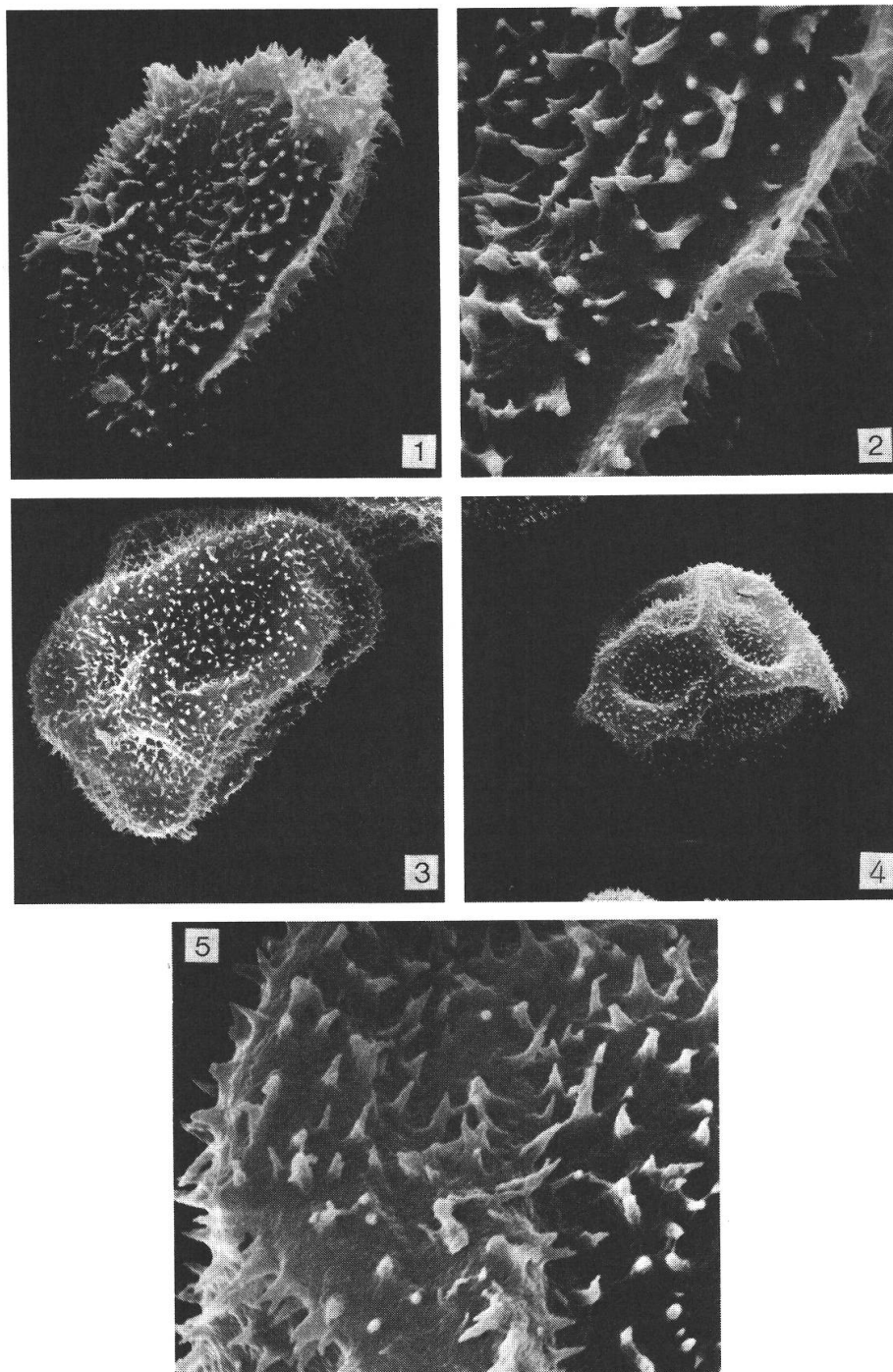


Fig. 2. Spores of *Dryopteris amurensis* and *D. expansa* as observed by SEM. 1, 2 – *D. amurensis*: Sakhalin (450 $\times$ , 2115 $\times$ ); 3, 5 – *D. expansa*: Far East (270 $\times$ , 1935 $\times$ ); 4 – *D. expansa*: Europe (270 $\times$ ).

*amurensis* shows the presence of spines, which are characteristic of the other taxa of the *D. dilatata* complex. *D. amurensis* has been sometimes confused in the herbarium materials and identified as *D. dilatata* (= *D. austriaca*). However, it should be recognized as a good species. It differs very clearly from the remaining members of the *D. dilatata* complex in the shape of the lamina, the presence of the characteristic scales on the lower side of the lamina, as well as in its small sporangia.

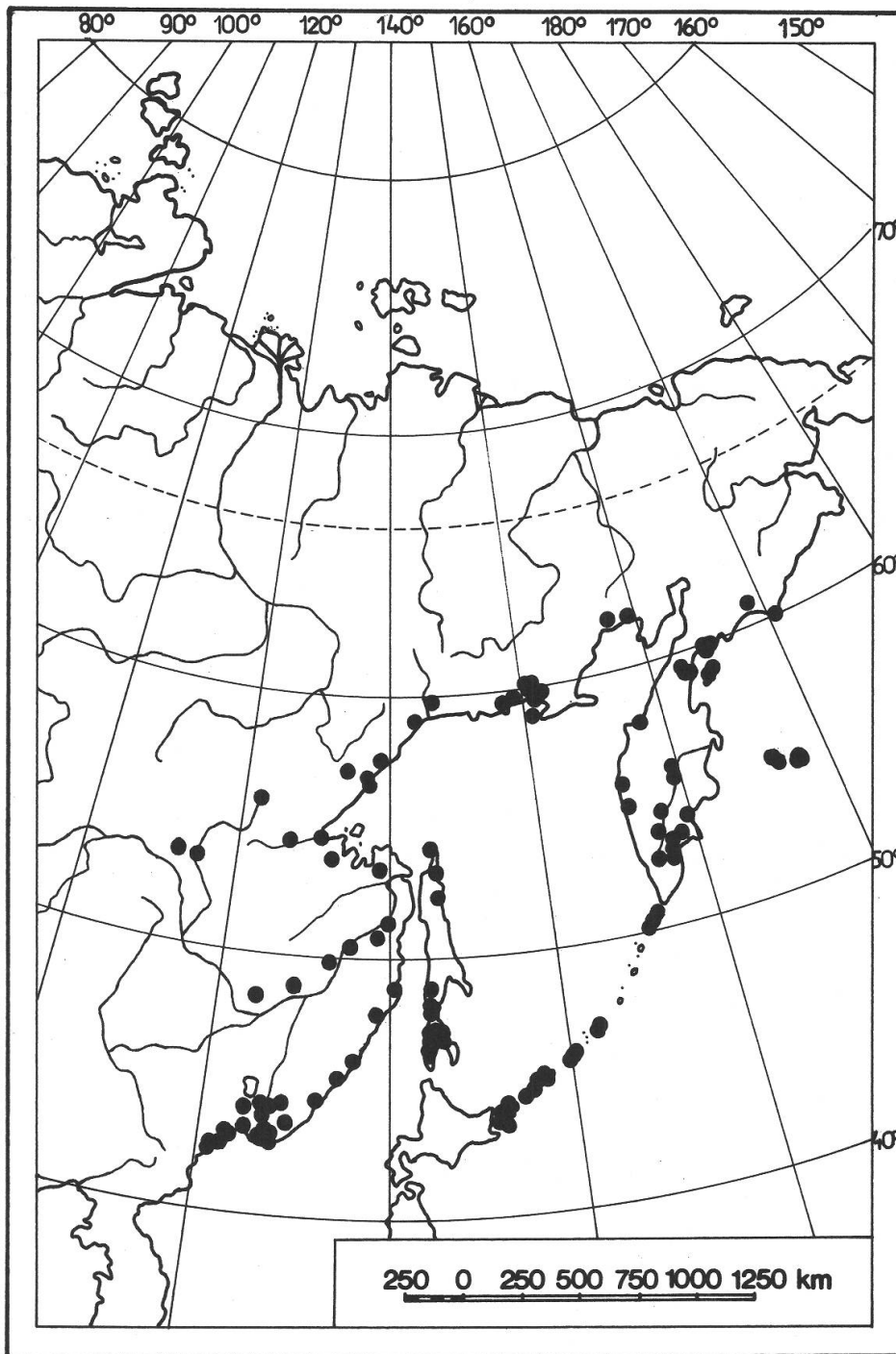


Fig. 3. Distribution of *Dryopteris expansa* (C. Presl) Fraser-Jenkins et Jermy in the Soviet Far East.

The next species to be considered is *D. expansa* (C. Presl) Fraser-Jenkins et Jermy. As shown by verified herbarium material, it is the most widely distributed taxon of the *D. dilatata* complex in the USSR. The distribution of *D. expansa* in the Soviet Far East is shown in fig. 3. This fern species is common and abundant in the Far East, reaching its known northernmost limit at ca. 62° N. It has a wide ecological amplitude and grows in coniferous and broad-leaved forests as well as in the alder belt in the

Tab. 1. Estimates of characters of *Dryopteris expansa* (C. Presl) Fraser-Jenkins et Jermy

Character	Range of character	Range of estimates
1. Density of scales on petiole	sparse – dense	1–3
2. Shape of scales	broadly ovate – lanceolate	1–3
3. Colour pattern on scales	concolorous – bicolorous (with a dark median stripe)	1–4
4. Ratio of length of proximal basicopic pinule on basal pinna to total length of pinna	0.65–0.25	1–4
5. Ratio of length of proximal basicopic pinule to length of proximal acroscopic pinule on basal pinna	3.50–1.25	1–3
6. Glandularity of lamina	glabrous – densely glandular	1–4
7. Colour of spores	pale brown – dark brown	1–5
8. Colour of lamina	yellow-green-dark green	1–3
9. Ratio of length of proximal basicopic pinule on basal pinna to length of adjacent one	more than 1.0 – less than 1.0	1–3

mountains. In Kamchatka, an *Alnus-Calamagrostis-Dryopteris* community in the alder thickets was described by Hultén (1974); it is characterized by a dense undergrowth of *D. expansa*.

In 1957 Vasilev described *D. extremiorientalis*, an East-Asiatic species within the *D. dilatata* complex. It is based on *D. dilatata* var. *orientalis*, which had been distinguished by Fomin (1934). According to Fomin and Vasilev, this taxon – regarded as endemic to the Far East – differs from the European one in the concolorous pale brown scales on the petiole while the related European forms display bicolorous scales with a dark median stripe. My examination of the herbarium specimens has revealed that *D. extremiorientalis* and *D. expansa* from Central Europe show a similar type of frond dissection and an identical type of variation in the shape of lamina (Piękoś-Mirkowa 1977). Moreover, the concolorous scales on the petiole, regarded as characteristic of *D. extremiorientalis*, have been reported also for European specimens of *D. expansa* without much taxonomical importance being attached to them (Widén, Sarvela and Ahti 1967, Crabbe, Jermy and Walker 1970, Piękoś-Mirkowa 1979). In addition, the comparison of photographs (Fig. 2) indicates that the spores of *D. extremiorientalis* and those of *D. expansa* show essentially similar perispore sculpture. Thus, it was suggested (Piękoś-Mirkowa 1977) that the East-Asiatic taxon might be conspecific with the European *D. expansa*.

Despite the demonstrated close similarities, an analysis of morphological characters has revealed certain differences between the East-Asiatic and the European taxon. In this analysis the characters commonly considered in the literature to be taxonomically important have been used. Table 1 shows a set of characters with respect to the herbarium specimens analyzed. The ranges of these characters, and the ranges of point estimates ascribed to each character, are also given.

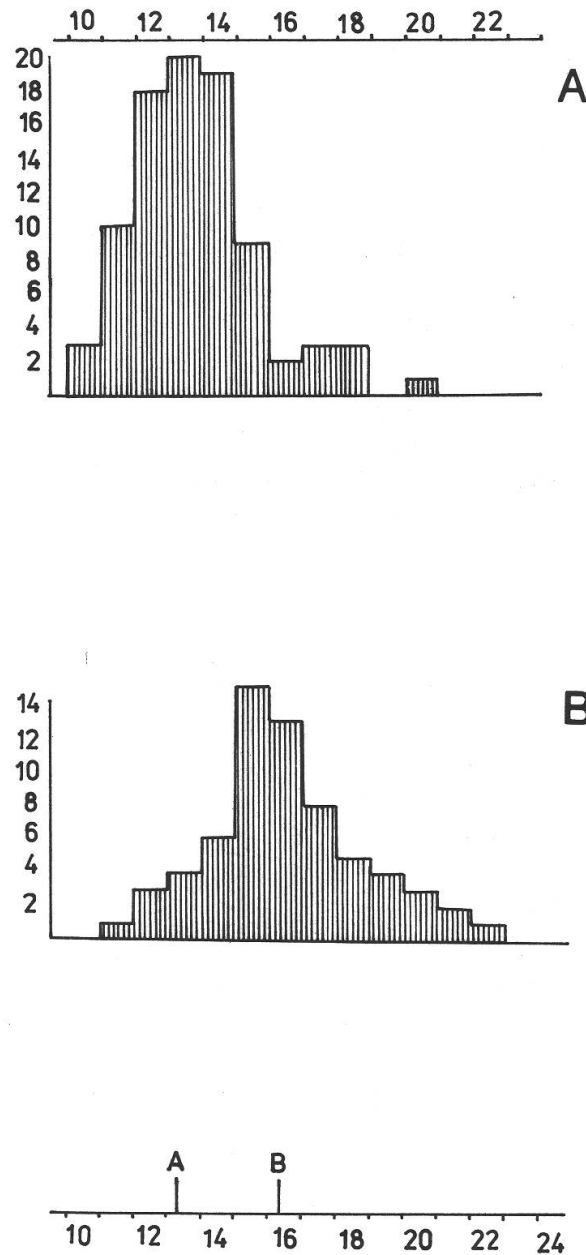
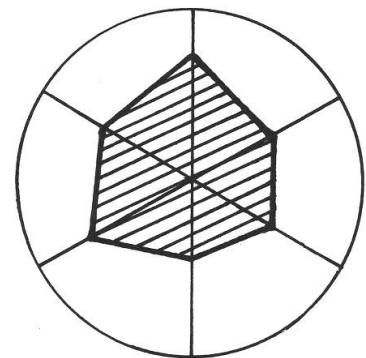
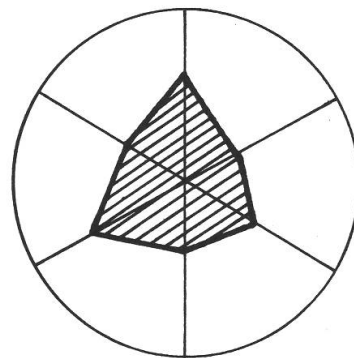
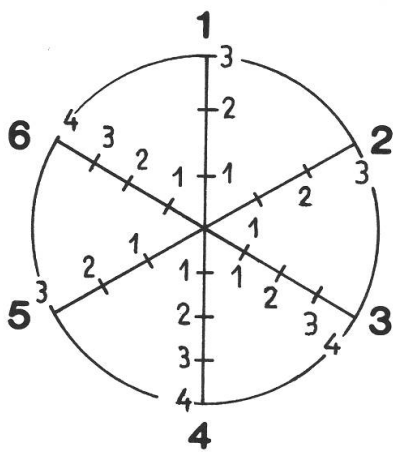
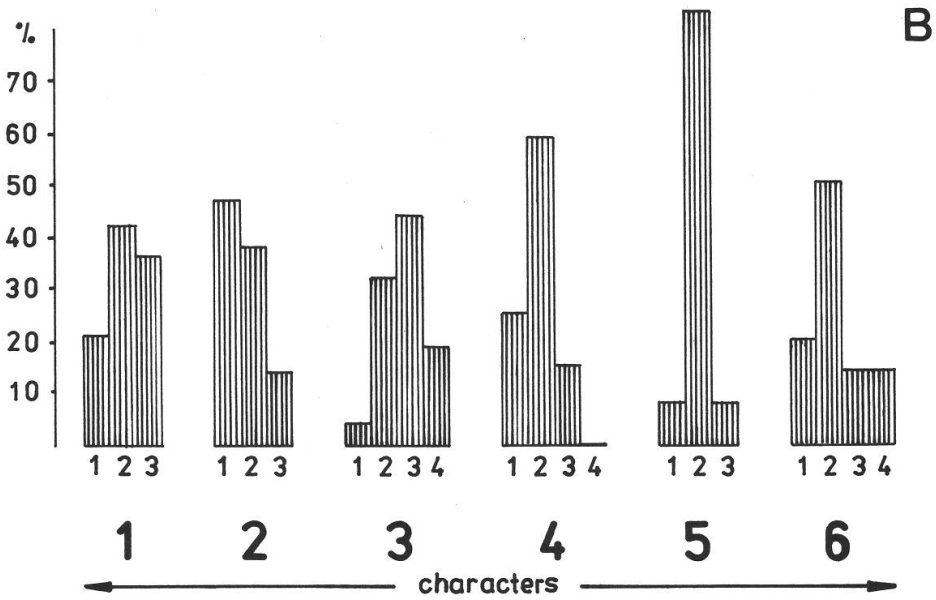
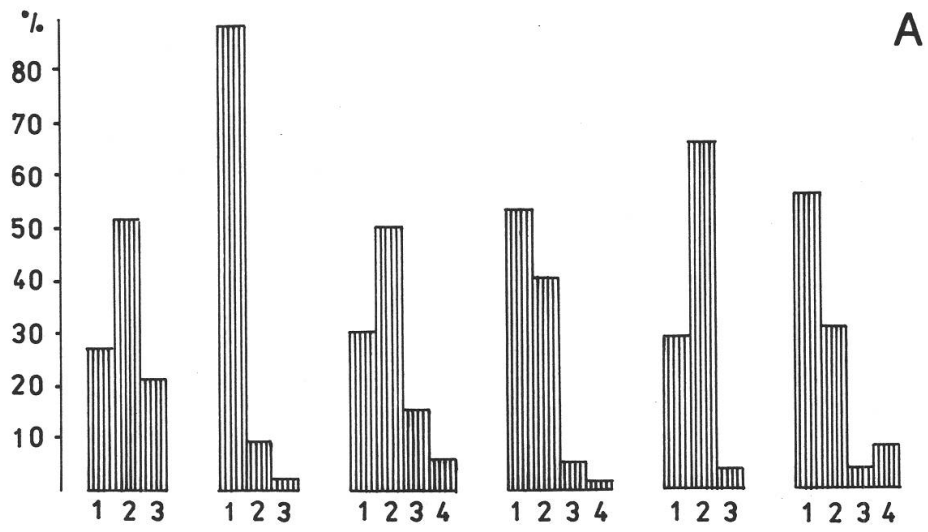


Fig. 4. Histograms of the sum of estimates of the examined specimens of *Dryopteris expansa* from the Far East (A) and Europe (B). Mean sums of estimates are shown below.

On the basis of characters 1–9 (Tab. 1) histograms of the sum of estimates of the examined specimens from the Far East and Europe are given in fig. 4. As can be seen, these histograms overlap. Thus, a close similarity between East-Asiatic and European plants is evident, but at the same time one can see that they differ fairly well by the mean sums of estimates. The plants from the Far East form a relatively compact group and show a smaller range of variability than do plants of *D. expansa* from Europe.

In fig. 5 histograms of six characters (1–6 in Tab. 1) are shown. Evidently, the plants from the Far East and Europe may differ with respect to some characters (2, 3, 4 and 6). Thus, the East-Asiatic plants often have broadly ovate, concolorous scales (characters Nos. 2 and 3) and usually a fairly long basal pinnule on the lowest pinna (character



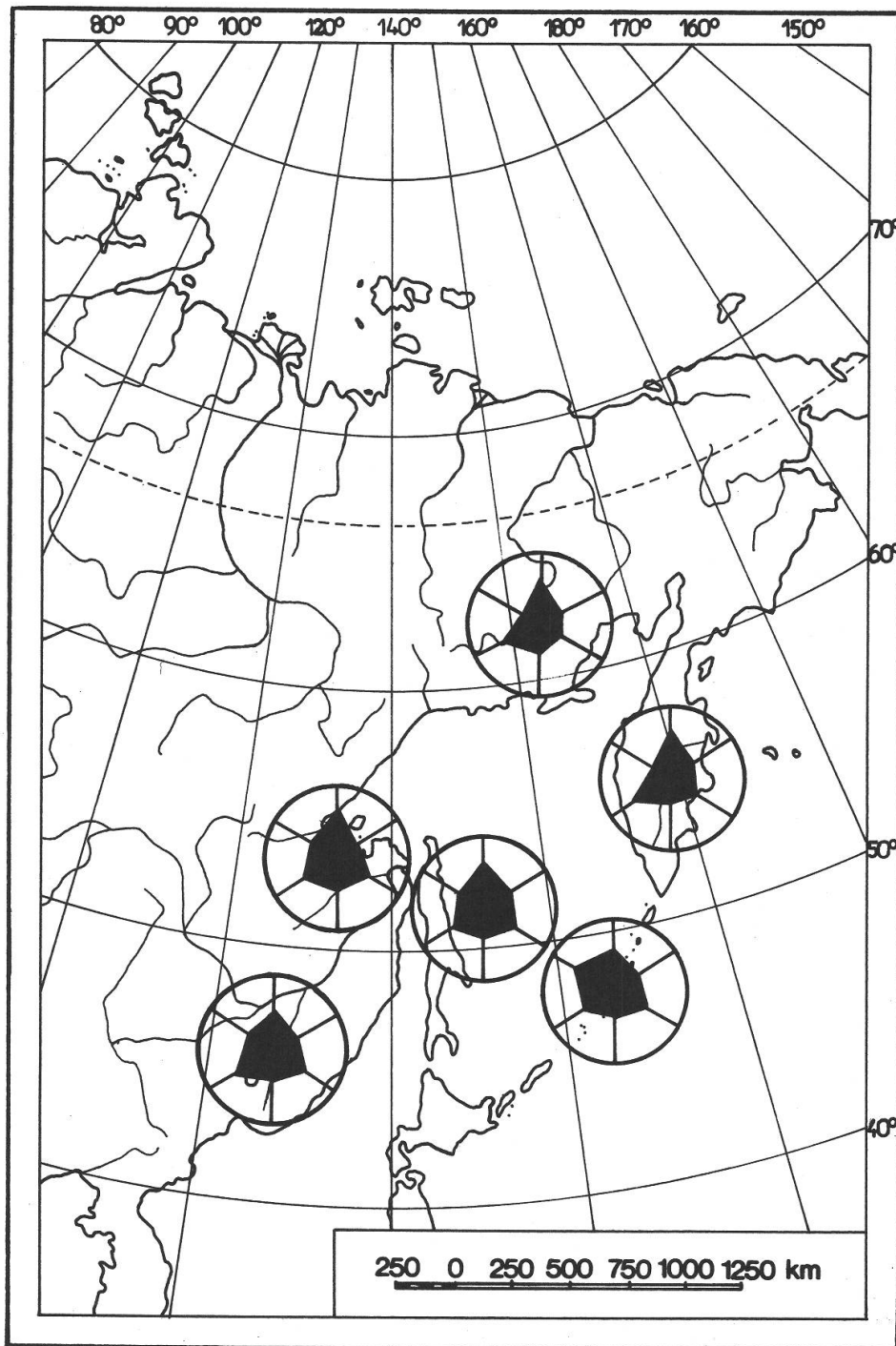


Fig. 7. Cyclograms of *Dryopteris expansa* made on the basis of mean estimates of the characters for groups of specimens from the various regions in the Far East.

Fig. 5. Numbers of specimens (in per cent) in the particular classes of point estimates for *Dryopteris expansa* from the Far East (A) and Europe (B). Characters 1–6 and classes of point estimates as in Table 1.

Fig. 6. Cyclograms of *Dryopteris expansa* from the Far East (A) and Europe (B) based on mean estimates of characters. Cyclograms: numerals on the circle denote characters as in Tab. 1, numerals on the radii denote estimates of these characters.

No. 4), while the European plants are more variable with respect to these characters. Moreover, non-glandular specimens dominate in the Far East while the European plants are characterized by more densely glandular fronds.

Based also on the point estimates of six characters (1–6), cyclograms for the investigated specimens were drawn. The cyclograms in fig. 6 present mean values of estimates calculated for all investigated specimens from the Far East and Europe. The cyclograms show also a close resemblance between these two groups of plants. On the other hand, in some characters slight differences can be seen.

The differentiation of the investigated taxon in the Far East is shown in fig. 7. The cyclograms have been drawn on the basis of mean values of estimates calculated for all specimens from a given area. A comparison of these cyclograms indicates that there are certain differences between the populations from the various areas in the Far East. The morphological types from the Kamchatka and the Okhock Region are very similar while the population from the Kurile Islands is distinct. The plants from the Kurile Islands are characterized by more densely glandular fronds while those from the remaining regions are glabrous.

As was demonstrated with histograms and cyclograms, the plants from the Far East differ morphologically to some extent from the European *D. expansa*. However, the East-Asiatic taxon is morphologically within the range of variation of *D. expansa*. In view of the great morphological and chemical variability of *D. expansa* as well as the lack of clear-cut borders between these two taxa, the differences observed cannot constitute a sufficient basis for the separation of the East-Asiatic taxon as a distinct species. Taking into account the morphological and chemical distinctness (Widén et al. 1975), the rank of subspecies seems to be more adequate.

I would like to express my gratitude to the Curators of the herbaria, especially to Prof. Dr. S. S. Kharkewich (Vladivostok), for the loan of material. I also wish to thank Dr. E. S. Brammer (Uppsala) for his revision of the English text, as well as Mr F. Zweili (Bern) and Mr J. Stępiński (Kraków) for their help in preparing the S.E.M. photographs of the spores.

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