

Perspectives in Pteridophytes

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THE FERN GENUS *PTERIDIUM* IN A TRANS EURO-SIBERIAN PERSPECTIVE – A MORPHOLOGICAL SYNTHESIS

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Abstract

The taxonomy and distribution of *Pteridium* Gled. ex Scop. is present across the broad west-east span of the Euro-Siberian region. It is concluded that at least two species of *Pteridium* – true *P. aquilinum* (L.) Kuhn and *P. pinetorum* C.N. Page & R.R. Mill. are widely present. Of these, *P. aquilinum* is restricted mainly to the western part of the Euro-Siberian region, *P. pinetorum* is dominant throughout much of Russia. In this territory, within *P. aquilinum* we recognize at least three morphological distinctive races of subspecific rank – *P. aquilinum* (L.) Kuhn subsp. *aquilinum* (= *P. aquilinum* (L.) Kuhn s. str.), *P. aquilinum* (L.) Kuhn subsp. *atlanticum* C.N. Page and *P. aquilinum* (L.) Kuhn subsp. *fulvum* C.N. Page, within *P. pinetorum* we recognise two slightly distinctive races – *P. pinetorum* C.N. Page & R.R. Mill subsp. *pinetorum* and *P. pinetorum* C.N. Page & R.R. Mill subsp. *sibiricum* Gureeva & C.N. Page. We also expect, that in the south of Eastern Europe (in Crimea and the Caucasus) there is at least one more race, which belongs to *P. aquilinum* – *P. aquilinum* (L.) Kuhn subsp. *tauricum* (C. Presl) Gureeva & C.N. Page *comb. nov.*

Key Words: *Pteridium*, taxonomy, morphological features, Europe, Russia, Siberia.

Introduction

The fern genus *Pteridium* Gled. ex Scop. (Hypolepidaceae) has become of increasing biological interest in recent years, partly because of its unusually widespread occurrence as a fern, and partly because of diverse growing awareness of the various economic problems associated with it. The latter includes concerns expressed about its role as a weed in agricultural pastures (grazing land) and the area that it may occupy, its potentially harmful effect on stock that may graze it (*e.g.* Evans 1976, Smith *et al.* 1999), and the occurrence within the plant (at least *P. aquilinum*) of potentially carcinogenetic agents (*e.g.* Evans & Osman 1974, Agnew & Lauren 1991). In many areas, it is also known as a weed, which can increase greatly as a result of forest fire. As a consequence of these many interests, there has become a growing need for better understanding of the variations within *Pteridium* present in different parts of the world, to which widely different variations of these and other different attributes probably apply.

Despite a great interest in this genus and a wealth of work dedicated to both the taxonomy and biology of the bracken, there is still a lack of clear idea of its polymorphism, status and taxonomic ranges. That very situation has, in our opinion, several reasons for. One of them is the fact that despite the typically high frequency of this fern in the field across its range and hence in the vegetation of so many floral regions, specimens of it are typically remarkably under-represented in virtually all herbaria. Partly this may be due to a reciprocity of relationship (characteristic of virtually all herbaria) between the frequency of a plant in the wild and the number of times which it is actually collected and preserved in herbaria, and partly it may be due to the relatively large fronds of many *Pteridium* specimens (which may be as much as 2 m+ long in

favourable situations), which makes their incorporation on to herbarium sheets a process with obvious practical difficulties.

As a result, a herbarium sheet ends up with either frond fragments (upper frond part, lower pinna or its fragment, middle pinna or pinnae), which are insufficient to give an idea of the shape of the whole frond, or small fronds having expanded from not quite mature croziers in the middle of vegetation period. That is why herbarium samples are insufficient to make any conclusion on both taxonomic affinity and expansion of one or other taxon.

The problems of the bracken taxonomy, not in the last turn, link to the problems of its typification. Tryon (1941) selected as a lectotype of *P. aquilinum* the illustration of «*Filix-femina* Fuchs, *Historiae Stirpium*: 596» (1542) cited by Carl Linnaeus in «*Species Plantarum*» (1753: 1075). As a result of further works dealing with the bracken typification, Thomson (2004) proposed as an epitype of *P. aquilinum* the herbarium specimen of Hortus Cliffortianus “473 *Pteris* 6?” also cited by Linnaeus (1753: 1075) (now numbered BM000647565, BM, London). In any case, Linnean epithet “*aquilinum*” has been keeping with the taxon widespread in the middle latitudes of Europe.

Background to the taxonomy of *Pteridium* with special focus on the Euro-Siberian region

The classic view on the taxonomy of *Pteridium* from early last century (*e.g.* Christensen, 1906), was to regard the genus as monotypic, the sole species *Pteridium aquilinum* (L.) Kuhn occurring throughout the range of the genus, which is nearly worldwide. In older herbarium material, specimens are thus accordingly typically almost universally so-annotated. In what were amongst the first subsequent major taxonomic advances on this situation, Tryon (1941) recognized the existence of multiple different regional forms on a world-wide basis, and classified these into a single species consisting of two subspecies with a total 12 varieties globally. These consisted of an essentially mainly northern hemisphere subspecies, *P. aquilinum* (L.) Kuhn subsp. *typicum*, and a mainly southern hemisphere subspecies, *P. aquilinum* (L.) Kuhn subsp. *caudatum* (L.) Bonap. The first of these contained 8 regional varieties, the second – 4 regional varieties. Using this system, Tryon defined morphological differences of each variety, recognized and defined their broad geographic ranges. *P. aquilinum* subsp. *typicum* var. *typicum* was ascribed by R.M. Tryon to most Europe (in Eastern Europe up to the Black Sea to the Caucasus), North Africa, Central America. The area of mainland northern Europe and Russia formed the eastern extremity of the range of the taxon attributed by Tryon to his *P. aquilinum* subsp. *typicum* var. *latiusculum* (Desv.) Underw. (Firstly, this taxon was described by Desvaux as a full species *Pteris latiuscula* Desv. from Newfoundland).

R. Tryon was not the only author to begin to recognize regional differences in *Pteridium*, for somewhat earlier, Ching (1940) had independently considered *Pteridium* to consist of 5 or 6 species worldwide, and Copeland, in his overall survey of fern genera, further endorsed also as a multiple-species view of *Pteridium*, had considered the genus to be “better treated as six or more species, even though they blend in some places” (Copeland, 1947: 59-60).

In 1976, one of the current authors (Page, 1976) first showed that not only did the morphology but also the ecology of *Pteridium* differ substantially between different global regions, and that these differences fitted substantially with the views of multiple taxa within *Pteridium* made independently by three authors – Ching, Tryon and Copeland (at whatever level the segregate taxa were to become recognised). Because of its completeness, Tryon’s available global monographic classification was, however, used as practical working framework from which to begin for this overall phytogeographic and ecological survey, for it provided the only single comparative nomenclatural treatment then available, and answered many of the problems of nomenclature, if not necessarily rank, of taxa that could be globally recognized. However, Page considered

that Ching and Copeland were each in particularly authoritative positions to best apply levels of equivalence of species concept on a morphological basis between genera of ferns, and wrote “evidence was already coming to the fore that the monotypic view of *Pteridium* may eventually have to be modified” (Page, 1976: 6). Along with *P. aquilinum* subsp. *aquilinum*, Page attributed two more subspecies – *P. aquilinum* – subsp. *atlanticum* Page (1989: 431) and subsp. *fulvum* Page (Page & Mill, 1995a: 139) – described by him to the Britain and Ireland territory. At first, the bracken populations which he had discovered in Scotland were assigned to *P. aquilinum* subsp. *latiusculum* (Desv.) Page, but a field investigation he had conducted over different bracken habitats in North America revealed that American plants which Tryon had attributed to var. *latiusculum* were not identical to those of Scotland. That is why the Scotland populations were afterwards described as independent species – *P. pinetorum* Page & Mill (1995a: 140). Moreover, subsp. *osmundaceum* (Christ) Page described firstly as the variety of *P. aquilinum* var. *osmundaceum* Christ (Page & Mill 1995a, b) was, along with the typical subsp. *pinetorum*, also attributed to this species.

In several past decades the problem of brackens has been repeatedly speculated by Thomson (1990, 2000, 2004), who, along with morphologic characters, used data of molecular investigations. In 2000 he had preferred to interpret some varieties established by R. Tryon, including var. *aquilinum* and var. *latiusculum*, as independent species (Thomson 2000), but in the later work, however, he did not believe it possible to place these taxa at species rank (Thomson 2004). He considered the bracken taxa whenever recognized in Europe and Asia to belong to a single species – *P. aquilinum* (L.) Kuhn, have a subspecific rank and form two morphologically and genetically distinct groups related to two morphotypes – ‘aquilinum’ and ‘latiusculum’. With thorough examination of the morphotype ‘latiusculum’ in the work cited above (including data of isozyme analysis, comparative study of chloroplast DNA, etc.) he accepted 3 subspecies for Northern Holarctic, for one of which he gave a new combination: *P. aquilinum* subsp. *pinetorum* (Page & Mill) J.A. Thomson widespread in North, Central and Eastern Europe up to the north of Ukraine to Siberia; *P. aquilinum* subsp. *japonicum* (Nakai) Á. Löve & D. Löve widespread in Japan, Korea, China, in the Far East of Russia (Kamchatka, the Amur river, Sakhalin); *P. aquilinum* subsp. *latiusculum* (Desv.) Hulten inherent only to the North American region (Canada, north and east regions of the USA, Mexico).

Subsequent molecular work (e.g. Thomson *et al.* 1995, 1999; Thomson, 1999; Speer, 1999) has independently endorsed the distinctiveness of *P. pinetorum* (*P. aquilinum* subsp. *pinetorum sensu* Thomson) from both *P. aquilinum s. str.* and *P. latiusculum s. str.* (*P. aquilinum* subsp. *latiusculum sensu* Thomson, 2004), while also showing it to occupy an intermediate position between these two taxa – a view which agrees exactly with its morphology. Such intermediacy further endorses the validity of the recognition of *P. pinetorum* as an independent species in its own right, rather than as an infra-specific taxon of either. [Indeed the molecular data of Speer, who included multiple-country sourced material of *P. pinetorum* noted “the greater phylogenetic relatedness amongst the sampled Scottish, Swedish and Russian populations” [of *P. pinetorum* – I.G. & C.P.] than amongst it “geographically close US populations” [of *P. latiusculum s. str.* – I.G. & C.P.] (Speer, 1999: 41).

As a rule, in Soviet and Russian literature only one species – *P. aquilinum* (Krylov, 1927; Fomin, 1934; Ershova, 1971, 1990, 1999; Krasnoborov, 1988; Shmakov, 1999, 2001, 2005; Gureyeva, 2001) – has been accepted for the USSR and then Russian territory and regional floras. Some treatments of the genus in relation to regional floras bear mention on bracken forms, varieties and species. Thus, A.V. Fomin in the fern treatment for “Flora of Siberia and the Far East” (1930) attributed two forms to this region – f. *glabrum* Hook. and f. *lanuginosum* Hook., and two varieties – var. *osmundaceum* Christ and var. *caudatum* Hook., making a note that within Western Siberia European forms are met while var. *osmundaceum* and var. *caudatum* are present in the Far East. Grossgeim (1939) attributed not only *P. aquilinum* but also *P. tauricum* (C. Presl) V. Krecz. to the Caucasus.

Latest review on the bracken of Eastern Europe and North Asia was produced by Tzvelev (2005). He considers herein necessary to accept 2 species for this territory – *P. aquilinum* (L.) Kuhn (including *P. tauricum*) met in the Carpathians, Crimea and Odessa neighbourhood, the Caucasus and *P. latiusculum* (Desv.) Hieron. ex Fries more widespread in Northern and Eastern Europe, the Caucasus and North Asia, including the Far East.

Thus, we have taxa of different rank mentioned with the Euro-Siberian region which fit the conception of two morphotypes – ‘*aquilinum*’ and ‘*latiusculum*’. But a clear idea of taxa’s rank and their distribution over the territory is still absent which refers especially to Russia and Siberia in particular. That is why with the aim to put in order the idea of what the name “*Pteridium aquilinum*” means for this territory we undertook the research on bracken in natural populations and looked through all herbarium specimens in main herbaria.

A working hypothesis was as follows: the bracken in the Euro-Siberian region is presented by two species in their own right, each of them – by quite well distinguished races (subspecies); in the Siberian region (at least in Western Siberia) the bracken is presented by a single race close to that from Scotland. Bracken races are quite distinct in the wild and can be identified through a complex of characteristics, including behavioural ones; to identify herbarium specimens the characteristics of basal pinna can be used.

Material and Methods

The starting point of our investigations was, firstly, the idea of C.N. Page that in the Britain territory *Pteridium* is represented by two species: *P. aquilinum*, which includes 3 subspecies – subsp. *aquilinum*, subsp. *fulvum* Page, subsp. *atlanticum* Page, and *P. pinetorum* Page & Mill, which includes 2 subspecies – subsp. *pinetorum* and subsp. *osmundaceum* (Christ) Page, and, secondly, the idea of Gureyeva that the Siberian bracken is rather uniform in morphological and ecological properties over the vast territory from the Altai and Kuznetsky Alatau to Transbaikalia and is probably represented by one taxon which was traditionally designated as *P. aquilinum* but was described in 2005 as a subspecies within *P. pinetorum* – *P. pinetorum* Page & Mill subsp. *sibiricum* Gureeva & Page (2005).

Field observations were conducted in 2003–2006 in Cornwall and Scotland (Great Britain), Tomsk and Novosibirsk neighbourhood and the Republic Altai (Russia). Herbarium materials were looked through in 2003–2006, including the herbaria of Great Britain (BM, K, E), Austria (W, WU) and Russia (LE, MW, TK, ИА, ALTB). Long-term personal observations of both authors – C.N. Page in Britain and I.I. Gureyeva in Siberia were also used.

The observations were conducted among each taxon’s populations named there according to subspecific epithets: *aquilinum*, *atlanticum*, *fulvum*, *pinetorum*, and *sibiricum*. The first three populations were investigated in the Cornwall (UK); *pinetorum* – in *locus classicus* of *P. pinetorum*: near Loch an Eilein lake (Scotland, UK). From Siberia 5 populations were engaged being combined into 3 groups – the west-siberian (Novosibirsk and Tomsk neighbourhoods), Altaian (the Republic Altai) and sayanic (the Western Sayan). They were named, correspondingly, *sibiricum*1, *sibiricum*2 and *sibiricum*3. To formulate the morphological description measured, counted and computed characteristics were used. The measured characteristics were: 1 – stipe length (cm), 2 – frond lamina length (cm), 3 – the lowest (basal) pinna length (cm), 4 – the second lowest pinna length (cm), 5 – the third pinna length (cm), 6 – rachis length between basal and the second lowest pinna pairs (cm), 7-8 – length of basiscopic and acroscopic pinnules on the basal pinna (cm), 9-12 – length of the second and third basiscopic and acroscopic pinnules on the basal pinna (cm), 13 – ultimate segment (non-dissected part) length of the basal pinna (mm), 14 – ultimate segment (non-dissected part) length of the basal basiscopic pinnule on the basal pinna (mm). The counted ones were: 15-16 – number of pinnae pairs (total and of those more or less dissected), 17-18 – pinnule pairs number on the basal pinna (total and of those more or less dissected). The computed ones were: 19 – ratio between lamina length and stipe length, 20 – ratio between

frond lamina length and frond lamina broad, 21 – ratio between basal pinna length and the second pinna length, 22 – ratio between basal basiscopic pinnule length and basiscopic pinnule length in the middle of basal pinna, 23 – ratio between basal pinna length and basal basiscopic pinnule length of that very pinna.

The measures were only taken in living plants. No less than 25 fronds were measured in each population. The data were processed by mathematical statistics methods with the support of discriminant analysis. The analysis was performed in all chosen characteristics (23) and in characteristics determinant for basal pinna (3, 7-14, 17-18, 21-23).

Results and Discussion

According to morphological characteristics the examined subspecies combine two groups which present two morphotypes: 'aquilinum' morphotype – subspecies of *Pteridium aquilinum* (subsp. *aquilinum*, *atlanticum* and *fulvum*) and 'latiusculum' morphotype – subspecies of *P. pinetorum* (subsp. *pinetorum* and *sibiricum*). The difference between morphotypes and hence species lies mainly in both frond and pinnae form and orientation, basal pinna structure, ultimate pinnae and pinnule size, frond lamina texture and pubescence, frond veneration period. A contrastive-morphological analysis in bracken fronds from different populations revealed that Siberian brackens essentially differ from those from Central and South Britain but are quite close to Scottish *P. pinetorum* from *locus classicus*.

The examined subspecies of *Pteridium aquilinum* have almost upright fronds, pinnae arranged in tiers one over another, pinnae of the second from the base pair are the largest and dissected, basal pinnae elongate-triangular to elongate-lanceolate (Fig. 1, 1–3). Pinnules are elongate or elongate-lanceolate, often sedentary or with very short stipes, fasten to pinna rachilla at almost right angles (80–90°). Pinna and pinnules are dissected nearly along their own full length. That is why their ultimate segments (non-dissected part) are short, with maximum length of 7–10(12) mm. Frond lamina is rigid, almost leathery, with upper surface often green and bright and lower surface more or less dim, densely pubescent mainly along the nerves. Typical for *P. aquilinum* subspecies is rather long frond veneration such as (in ascending order): subsp. *fulvum* – subsp. *aquilinum* – subsp. *atlanticum*. Of these, the two latter have fronds not fully expanding until the end of vegetation season – new pinnae constantly arise on the top that remains unexpanded until the season end whereas the basal pinnae become withered especially in dense colonies. Subsp. *fulvum* has fronds expanding rather long, but the frond top expands fully except upper pinnae remaining "under-expanded". This resulted in number of fully developed pinnae not increasing 5–9 pairs of 10–15.

P. pinetorum subspecies have rachis arcuate backwardly (it deviates consistently from the stipe growth direction at 35-45° in the junctions of the basal and second pinnae pairs). That is why pinnae lie not in tiers but in nearly the same plane, basal pinnae are the largest and dissected having triangular-ovate shape (Fig. 1, 4–5) generally copying the shape of frond. The size of the basal pinnae is nearly equal to the rest of frond. That is why it looks like tripartite. Pinnules are elongate-ovate on distinct stipites of up to 2.5 cm length, fasten to the pinna rachilla at 45–50°. Top pinnae and pinnules are non-dissected, therefore their ultimate segments are rather long - to 25-30 mm. A frond lamina is grassy although rather rigid and dim, the lower surface with scarce hairs along the rachillae and lateral nerves of last order segments or almost glabrous. Unlike fronds of *P. aquilinum* subspecies those of *P. pinetorum* subspecies expand rather rapidly - to 2-3 weeks.

A special character of the bracken is the lack of scales typical to most of leptosporangiate ferns. Pubescence consists of hairs (sometimes called trichoid scales). The hairs are of two types – long, usually curved or twisted consisting of a few (often 3–4) flat oblong cells arranged in a row; and short straight consisting of 2–3 cells of which the upper is acute. The long hairs are colourless (on the whole white), brown or reddish, the short hairs are white. The long hairs produce an especially dense cover on croziers (fronds in a non-expanded state) emerging in spring.

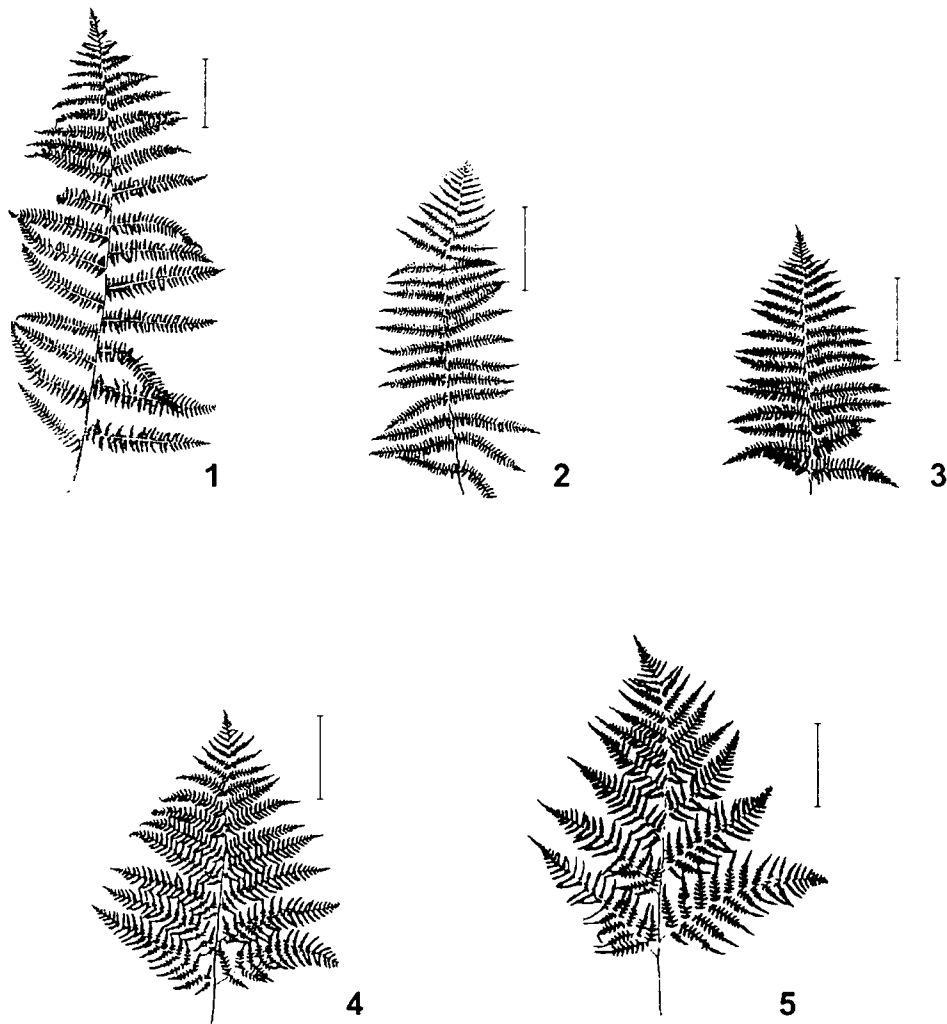


Figure 1: Shape and comparative dimensions of the basal pinna in the subspecies of *Pteridium aquilinum* (L.) Kuhn (1-3) and *P. pinetorum* C.N. Page et R.R. Mill (4-5): 1 subsp. *aquilinum*, 2 subsp. *atlanticum* C.N. Page, 3 subsp. *fulvum* C.N. Page, 4 subsp. *pinetorum* 5 subsp. *sibiricum* Gureeva et C.N. Page, The drawing scale 10 cm.

Most of the features described are available only in living plants. Herbarium specimens can often give only such characteristics as shape and dissection of basal pinna, lamina pubescence, pinna and pinnules ultimate segments length; in small specimens – frond shape and dissection of the whole frond. However, it must be noted that in a population small fronds have, as a rule, the dissection lesser in order of magnitude as compared with big ones. But these are precisely the fronds which are usually subjected to herbarisation. As a result, a false idea about the lesser dissection appears. Such fronds arise, as a rule, later than general body of fronds and the lesser dissection results from the development from immature croziers.

The discriminant analysis presented here revealed quite clear distinctions between 7 groups selected on the basis of the whole set of morphological characteristics (23) and that of basal pinna (3, 7-14, 17-18, 21-23). (For definitions of characteristics see “Material and Methods”).

The most essential features-discriminators for the examined samples are: the ratio between basal basicopic pinnule length and basicopic pinnule length in the middle of the basal pinna which displays the pinna shape; the ratio between frond lamina length and basal pinna length and the ratio between basal pinna length and the second pinna length. Most clearly the isolation of subspecies is demonstrated in

scatterplots of objects of the examined samples which correspond to subspecies (Fig. 2–3). As shown in the plots, all the samples form quite isolated clouds. The most clearly delineated clouds occur when all the characteristics are used but in the case of basal pinna characteristics the clouds are also quite distinct. As we expected, the objects from population samples of subsp. *sibiricum* from three regions of Siberia - the south of Western Siberian Lowland (*sibiricum1*), the Altai (*sibiricum2*) and the Western Sayan (*sibiricum3*) form a common cloud which witnesses for their belonging to the same taxon. The *P. aquilinum* subspecies are more isolated than those of *P. pinetorum* subsp. *fulvum* appears to be the closest to *P. pinetorum* among *P. aquilinum* subspecies probably because of similarity in the shape of both the frond and its parts (basal pinna in particular).

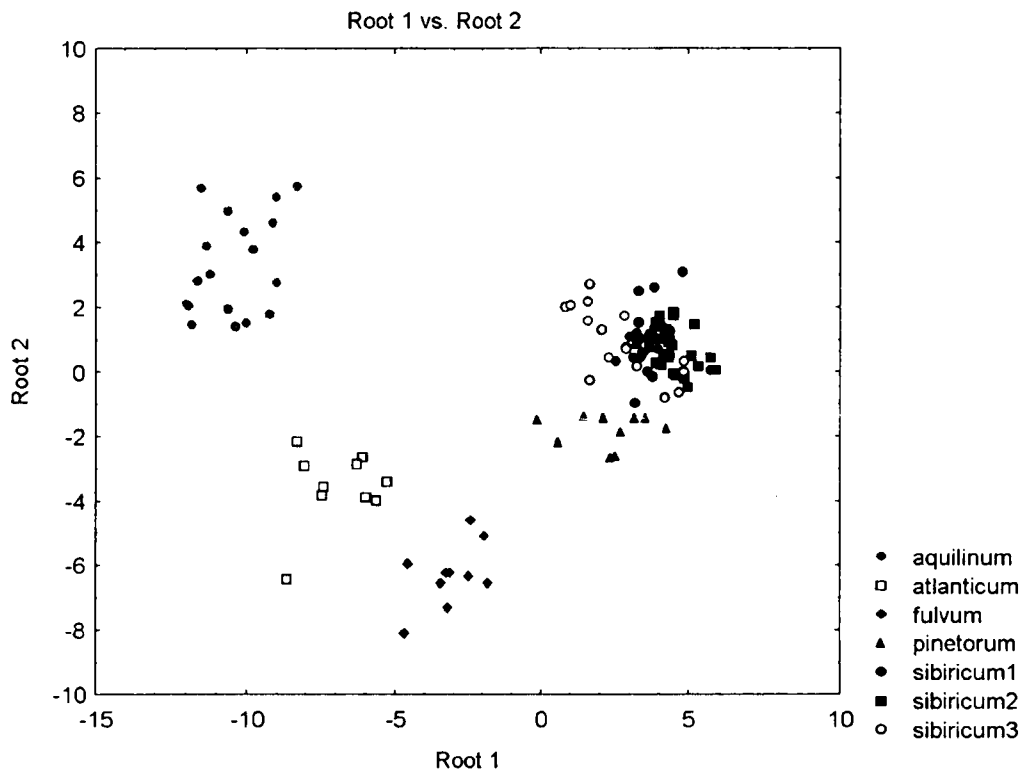


Figure 2: The scatterplot of canonical scores according to the result of discriminant analysis of *Pteridium aquilinum* (L.) Kuhn and *P. pinetorum* C.N. Page et R.R. Mill subspecies characteristics (1-23, please, see the list of characteristics in Material and Methods). Samples: "aquilinum" subsp. *aquilinum*, "atlanticum" subsp. *atlanticum* C.N. Page, "fulvum" subsp. *fulvum* C.N. Page (all from Cornwall) "pinetorum" subsp. *pinetorum* (Scotland), "sibiricum1" subsp. *sibiricum* Gureyeva et C.N. Page (from the Western Siberian Lowland), "sibiricum2" subsp. *sibiricum* Gureeva et C.N. Page (from the Altai mountains), "sibiricum2" subsp. *sibiricum* Gureeva et C.N. Page (from the Western Sayan mountains).

The main question of our research, that we were eager to obtain the answer to, was whether the Siberian bracken traditionally attributed to *P. aquilinum* differs from that from Europe and in case of positive answer which species the bracken from the Russian territory should be attributed to. The revision of herbarium material and field contrastive-morphological investigations led us to the same conclusions which Tzvelev (2005) and somewhat earlier Thomson (2004) had come to: there are 2 distinct taxa present in North Eurasia. As for the rank of taxa, we quite agree there with Tzvelev and accept them as well isolated species in their own right but regard the bracken met in the north of Western Europe (Scotland, Scandinavia), most part of European Russia and Siberia to belong not to *P. latiusculum* (Desv.) Kuhn but *P. pinetorum*. In our opinion, the grounds for making such a conclusion are following: field observations, comparison of *P. pinetorum* from *locus classicus* with herbarium specimens of brackens from European Russia and Siberia as well as living populations of Siberia – all these reveal their identity except for a few features that allow to depict the

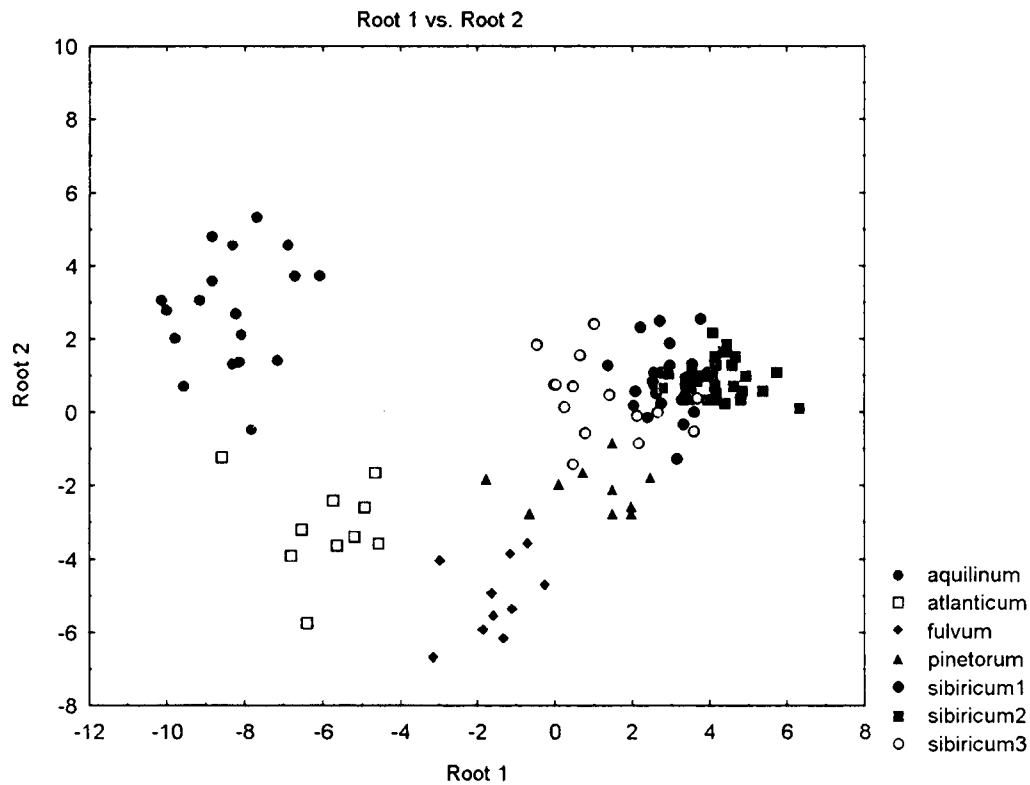


Figure 3: The scatterplot of canonical scores according to the result of discriminant analysis of *Pteridium aquilinum* (L.) Kuhn and *P. pinetorum* C.N. Page et R.R. Mill subspecies characteristics of the basal pinna (3, 7-14, 17-18, 21-23, see the list of characteristics in Material and Methods). Samples: "aquilinum" subsp. *aquilinum*, "atlanticum" subsp. *atlanticum* C.N. Page, "fulvum" subsp. *fulvum* C.N. Page (all from Cornwall), "pinetorum" subsp. *pinetorum* (Scotland), "sibiricum1" subsp. *sibiricum* Gureeva et C.N. Page (from the Western Siberian Lowland), "sibiricum2" subsp. *sibiricum* Gureeva et C.N. Page (from the Altai mountains), "sibiricum3" subsp. *sibiricum* Gureeva et C.N. Page (from the Western Sayan mountains).

Siberian bracken as a separate subspecies subsp. *sibiricum* (Gureyeva & Page, 2005). More over, recent molecular studies on brackens have revealed that Scottish, Scandinavian and Russian [*P. pinetorum* from the north of European Russia – I.G. & C.P.] populations happen to be closer to each other than to American "*latiusculum*" (Speer, 1999). The North-Asian bracken stands out for its unique haplotype never met in either European bracken belonging to 'aquilinum' morphotype or North-American "*latiusculum*" (Thomson, 2000, 2004). With evidence from isozyme analysis, it is impossible to interpret the European bracken of 'latiusculum' morphotype and North-American "*latiusculum*" as a single taxon (Rumsey *et al.* 1991).

As for the intraspecific taxonomy of two bracken species in the Euro-Siberian region, our investigations confirm the presence of quite isolated races which we acknowledge to be at the rank of subspecies of two species – *Pteridium aquilinum* (subsp. *aquilinum*, *atlanticum* and *fulvum*) and *P. pinetorum* (subsp. *pinetorum* and *sibiricum*). Investigations into herbarium specimens permitted to outline in general the ranges of the subspecies in the euro-Siberian region. Below is given a *Pteridium* system for the Euro-Siberian region, main synonyms and data on the subspecies ecology and ranges.

Genus *Pteridium* Gled. ex Scop.

1. *P. aquilinum* (L.) Kuhn in Decken, Reisen in Ost-Afrika 3(3): 11 (1879).

Basionim – *Pteris aquilina* L. 1753, Sp. Pl.: 1075.

Lectotype: Hort. Cliff. 473 *Pteris* 6 (Sheffield *et al.*, 1989: 385); epitype: "Hortus Cliffortianus 473 *Pteris* 6 (BM 000647565)" (Thomson, 2004). BM.

As a species it is widespread over the vast area of Europe – in Central and South Britain, Atlantic, Central and South Europe, in the south of Eastern Europe and in the Caucasus.

- 1.1. *P. aquilinum* (L.) Kuhn subsp. *aquilinum* in Fl. Europ., ed 2, 1: 16 (1993); Page & Mill in Bot. J. of Scotland, 47: 233 (1995b); Page in The Ferns of Britain and Ireland, ed. 2: 349 (1997). – *P. aquilinum* (L.) Kuhn var. *typicum*, Tryon in Rhodora, 43(505): 15 (1941) – *P. aquilinum* (L.) Kuhn, Fomin in Flore of the USSR, 1: 83 (1934), p.p.

Type: as for species.

P. aquilinum (L.) Kuhn subsp. *aquilinum* is present throughout the range of species in Europe. This is the most widespread and aggressive subspecies; it is common in most parts of Britain, Atlantic, Central and South Europe, in Eastern Europe – in Ukraine and Belorussia, it is mentioned for south-west of Finland; in Russia – mainly in the Caucasus. Plants are tolerant of a wide range of climatic conditions, including exposure to full daylight, occurring usually in ground with pH from 4.5 to 6.5. Subspecies also succeeds well in nutrient-poor soils.

- 1.2. *P. aquilinum* (L.) Kuhn subsp. *atlanticum* C.N. Page, Watsonia, 17: 431(1989).

Type: Scotland: north-east Arran, Clyde Isles (v.c. 100), between the Cock of Arran and Laggan, G.R. NR 937511, c. 15 m alt., on Carboniferous limestone, 4 June 1987, C.N. Page 29020 (holo: E, iso: ABD, GL, PTH).

According to available information and herbarium specimens this subspecies is a plant of limited occurrence which occurs in relatively "pure" form only in certain low-altitude habitats widely scattered from western Britain to probably Brittany and the western and southern Iberian Peninsula, southward to the western African coast (Page, 1997). The habitats of this subspecies are in slightly flushes in coastal or valley-bottom sites at low altitude chiefly on limestone and other basic soil, principally in mild, oceanic climates.

Notice. It seems likely that this subspecies closely relates to the Crimea-Caucasus taxon once described as *Allosorus tauricus* C. Presl and cited later as *Pteridium tauricum* (Presl) V. Kreczetovicz (Grossgeim, 1939). Tzvelev (2005) does not recognize it as a species in its own right and reduces it to a synonym of *P. aquilinum* (L.) Kuhn. This bracken belongs undoubtedly to the "*aquilinum*" complex. With its characteristics and ecology, it differs from *P. aquilinum* subsp. *aquilinum* and approaches subsp. *atlanticum*. The latter closes in on it because of "tripinnate-pinnatifid leathery frond lamina covered beneath with dense reddish hairs" (Grossgeim, 1939) and ecological adaptation to lowlands and lower mountain zone of 400–500 m above sea level.

We believe that this taxon may be accepted as independent one in a rank of subspecies of *Pteridium aquilinum* (L.) Kuhn subsp. *tauricum* (C. Presl) Gureeva & C.N. Page *comb. nov.* Perhaps, this subspecies populations might be attributed to subsp. *atlanticum* provided a bigger amount of materials and field observations were available.

- 1.3. *P. aquilinum* (L.) Kuhn subsp. *fulvum* C.N. Page, 1995a, in Page & Mill, Bot. J. Scotl. 47, 1: 139.

Type: Scotland, Perthshire, steep east-facing banks of the River Tummel 3 km N of Pitlochry, overlooking Loch Fascally 500 m S of Clunie Power Station, on shallow rocky soil, G.R. NN 915592, 140 m, 17 August 1989, C.N. Page 27053 & H.M. McHaffie (holo: E).

This subspecies is known from the limited areas in Britain and may be considered as a Britain endemic. Its colonies grow in woodland margin sites scattered over shallow slopes in birch, birch-oak and mixed vegetation in central Scotland, in last time this taxon is found out in Cornwall. Colonies develop on relatively rich soil. More recently, this taxon has been found also in Cornwall. Colonies develop on relatively rich soils.

2. *P. pinetorum* C.N. Page & R.R. Mill, 1995a, Bot. J. Scotl., 47, 1: 140. – *P. aquilinum* (L.) Kuhn) subsp. *latiusculum* (Desv.) C.N. Page, 1989, in *Watsonia*, 17, 4: 429, p.p. excl. type.

Type: Scotland, E Inverness-shire, Rothiemurchus Forest near Loch an Eilein, G.R. NH 896092, 4 June 1983, C.N. Page 17049 (holo: E, iso: ABD, GL, PTH).

According to new data, based on the big herbarium material, the range of this species is restricted to the area from Scotland eastwards to Scandinavia, southwards to Poland and Germany to most part of European Russia (including north part), the Ural, Siberia below the latitude 60° North, to Mongolia (at least, North Mongolia), and, probably, North China.

Notice. The bracken occurring in the Far East of Russia, in Japan, Korea and East China belongs indeed to the 'latiusculum' morphotype. Thomson (2004) considers it as *P. aquilinum* (L.) Kuhn subsp. *japonicum* (Nakai) A. Löve & D. Löve. We have not enough material from this range of *Pteridium*, so that in this paper we do not comment on this taxon. In some time we can say, that this East-Asian taxon belongs to the 'latiusculum' morphotype and, according to our multiple-species view on the *Pteridium*, this subspecies belongs either to *P. pinetorum*, or to *P. latiusculum* (Desv.) Hieron. ex Fries.

- 2.1. *P. pinetorum* C.N. Page & R.R. Mill subsp. *pinetorum*, 1995b, Bot. J. Scotl., 47, 2: 243.

Type: as for species.

Plants of this subspecies occur in Scotland, Scandinavia, southwards to Poland and Germany. The plants of *P. pinetorum* subsp. *pinetorum* form open low-canopied stands over small areas on cool, generally moist soil sites of highly acidic character.

- 2.2. *P. pinetorum* C.N. Page & R.R. Mill subsp. *sibiricum* Gureyeva & C.N. Page in Taxonomical Notes on the Material of Krylov Herbarium, 95: 22 (2005). – *P. aquilinum* (L.) Kuhn var. *latiusculum* auct. non (Desv.) Underw.: Tryon in *Rhodora*, 43(505): 41 (1941), p.p. – *P. aquilinum* auct. non (L.) Kuhn: Fomin in *Flora of the USSR*, 1: 83 (1934); Krylov in *Flora of Western Siberia*, 1: 37 (1927); Krasnoborov in *Flora of Siberia*, 1:73 (1988); Shmakov, *Key of Fern of Russia*: 34 (1999), p.p.; Gureyeva, *Homosporous Ferns of South Siberia*: 17 (2001). – *P. latiusculum* auct. non (Desv.) Hieron. ex Fries: Tzvelev in *Bot. J.* 90(6): 895 (2005).

Type: Novosibirsk neighbourhood, the pine wood with bracken cover. 19. VIII. 2004. I.I. Gureyeva (holo., para: TK).

Common in Siberia, mainly southwards from the latitude 60° North except arid steppe districts of Middle and East Siberia, also reaches westwards to the north of European Russia and southwards to Mongolia and North China. The plants of *P. pinetorum* subsp. *sibiricum* grow in low-canopied pine, small-leaved and mixed forests, in open spaces – forest meadows, exposed slopes, burned-over areas on acid gray, dark-gray forest and sod-podzol soils.

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