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A Synopsis of the Ferns and Fern Allies of Nebraska, with Maps of Their Distribution

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A SYNOPSIS OF THE FERNS AND FERN ALLIES OF NEBRASKA, WITH MAPS OF THEIR DISTRIBUTION

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ABSTRACT

An annotated list and county-by-county distribution maps are presented for the 32 species of ferns and fern allies native to Nebraska, based upon field and herbarium studies and critical evaluation of the literature. Native to the state are *Isoetes melanopoda*, *Selaginella rupestris*, five species of *Equisetum*, and 25 species in 18 genera of ferns. Three native species are here verified for the first time, based upon recent collections: *Matteuccia struthiopteris* var. *pennsylvanica*, *Ophioglossum engelmannii*, and *Pellaea glabella* ssp. *glabella*. *Isoetes melanopoda* was rediscovered in 2000, the first record since 1941. Rejected are published reports of *Lycopodium annotinum*, *Selaginella densa*, *Equisetum* × *litorale*, *E. palustre*, *E. pratense*, *E. variegatum*, *Asplenium trichomanes*, *Azolla caroliniana*, *Botrychium dissectum*, *B. matricariifolium*, *B. multifidum*, *B. neglectum*, *Cryptogramma acrostichoides*, *Ophioglossum vulgatum*, *Osmunda cinnamomea*, *O. claytoniana*, *O. regalis*, and *Woodsia scopulina*. Some erroneous reports have been published repeatedly for more than a century, but others are recent.

RESUMEN

Se presentan un lista anotada y mapas de distribución por condados, de las 32 especies de helechos y otras pteridófitas nativas del estado de Nebraska (EE.UU.), basados en estudios de campo, examen de herbarios, y evaluación crítica de la literatura. Como nativas para este estado se cuentan *Isoetes melanopoda*, *Selaginella rupestris*, cinco especies de *Equisetum*, y 25 especies de helechos distribuidas en 18 géneros. Se citan tres especies como nativas por primera vez, basándose en recolecciones recientes: *Matteuccia struthiopteris* var. *pennsylvanica*, *Ophioglossum engelmannii*, y *Pellaea glabella*. *Isoetes melanopoda* fue redescubierta en el año 2000, siendo el primer registro de esta especie desde 1941. Se rechazan como erróneas las citas publicadas de la presencia de *Lycopodium annotinum*, *Selaginella densa*, *Equisetum* × *litorale*, *E. palustre*, *E. pratense*, *E. variegatum*, *Asplenium trichomanes*, *Azolla caroliniana*, *Botrychium dissectum*, *B. matricariifolium*, *B. multifidum*, *B. neglectum*, *Cryptogramma acrostichoides*, *Ophioglossum vulgatum*, *Osmunda cinnamomea*, *O. claytoniana*, *O. regalis*, y *Woodsia scopulina*. Algunas de estas citas erróneas han sido publicadas en repetidas ocasiones desde hace más de un siglo, mientras que otras son recientes.

INTRODUCTION

While preparing our *New Century Flora of Nebraska* (Kaul, Sutherland, & Rolfsmeier, in prep.), we reinterpreted and corrected many dubious or erroneous reports of the state's flora, among which those of the ferns and their allies were especially confused and contradictory.

The earliest credible report of Nebraska's complete vascular flora was the list by H.J. Webber (1890), but the first definitive account of Nebraska's ferns was that of Thomas J. Fitzpatrick (1920), which was based upon holdings in the Charles E. Bessey Herbarium (NEB) of the University of Nebraska-Lincoln. The only floristic manuals solely devoted to the state's flora (Petersen 1923; Winter 1936) were also based upon that herbarium's collection, which greatly expanded under Bessey's direction from the 1880s until his death in 1915. Regional and more extensive books that include Nebraska were based upon that and many other collections in and outside Nebraska: Britton & Brown (1896, 1913, but not Gleason (1952)); Rydberg (1932), Fernald (1950), Petrik-Ott (1979), Lellinger (1985), GPFA-Great Plains Flora Association (1977, 1986), FNA-Flora of North America Editorial Committee (1993), and various journal papers. With each succeeding publication, old distributional errors were perpetuated and new ones were introduced.

The only county-by-county maps of all the state's ferns and fern allies were those of *Atlas of the Flora of the Great Plains* (GPFA 1977), to which we contributed, and of *The Pteridophytes of Kansas, Nebraska, South Dakota and North Dakota* (Petrik-Ott 1979). The state-outline maps of *Flora of North America* (FNA 1993) are more generalized. There are mapping errors in all those publications that we seek to correct in this paper, and our extensive field and herbarium work has added many distributional records.

A continuing source of errors is the E.M. Hussong collection at NEB, supposedly from Franklin County in the 1890s, according to the labels. The collection includes ferns and many angiosperms that are far out of range for Nebraska. For example, *Osmunda regalis* has been attributed to Nebraska for more than a century, based upon those specimens, but it is yet unknown anywhere in the state, and Franklin and nearby counties lack suitable habitat. The handwriting on the labels is not Hussong's, and we reject the records as representing Nebraska plants.

The massive cattle-ranching and agricultural development of the past 150 years has greatly reduced the state's natural vegetation, especially that of the prairies, but suitable habitats remain and most species can be found today, if only in remote or widely scattered sites. Most pteridophytes in Nebraska are at the edge of their range and, as such, many have always been scarce, and a few have not been seen for decades. Relatively pristine are the Sandhills, 23,000 square miles of prairie-vegetated, uncultivated dunes and sandplains, the high

water-table producing thousands of lakes, ponds, marshes, and fens; and the valley of the Niobrara River, its bluffs and sheltered tributaries lined for much of its length with forests of ponderosa pine and hardwoods. Some species in Niobrara Valley forests and Sandhills fens are apparently relicts from cooler, wetter, early post-Pleistocene times, such as the now-disjunct *Ophioglossum pusillum*, *Dryopteris cristata*, *D. carthusiana*, *Athyrium filix-femina*, and many angiosperms and animals (Kaul et al. 1988; Kaul & Rolfsmeier 1993). The ponderosa pine forests of the Pine Ridge, Wildcat Hills, and Niobrara River valley still have much native flora, as do some of the oak-hickory forests of the Missouri River valley and its tributaries. With ranching and agrarian settlement came suppression of prairie fires, leading to major expansion of deciduous forests in the eastern, wettest third of the state, but their pteridophyte flora has not correspondingly expanded and is yet confined to the region of the original forests there.

MATERIALS AND METHODS

We have collected most species in the field during our combined 86 years of field work from 1964 through 2001. In addition, we examined all specimens at these herbaria in Nebraska: Charles E. Bessey Herbarium (NEB) at the University of Nebraska-Lincoln; University of Nebraska at Omaha (OMA); University of Nebraska at Kearney; Chadron (CSCN), Peru, and Wayne state colleges; Cedar Point Biological Station; Doane College; and Nebraska Wesleyan University. We also examined all Nebraska-collected specimens at the University of Kansas (KANU), Kansas State University (KSC), Fort Hays State University, University of South Dakota (SDU), South Dakota State University (SDC), and University of Wyoming (RM), and we saw some Nebraska specimens at the Missouri Botanical Garden (MO) and the New York Botanical Garden (NY).

Our nomenclature follows *Flora of North America* (FNA 1993), with synonyms as used in our cited references that specifically attributed the plants to Nebraska by text, map, or both. Species marked with a black diamond (◆) are here verified for the first time as native to Nebraska and were discovered in the late 1990s and 2000. Year of first collection is given for the rarer species, some of which have not been found again. Counties and some physiographic features are named in Figure 1, and all species are mapped by county in Figure 2.

ACCEPTED SPECIES

Division LYCOPODIOPHYTA

ISOËTACEAE

Isoetes melanopoda Gay & Durieu ex Durieu.—Collected from the Rainwater Basins several times, 1880s–1941, but not again until 2000. Most habitat long since drained and plowed for agriculture. Mapped for the entire eastern half of

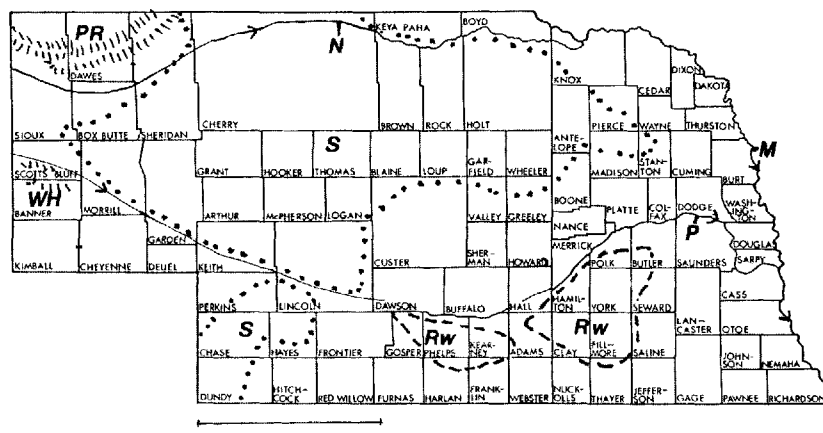


FIG. 1. Map of Nebraska with counties, major rivers, and some physiographic areas identified. *M*: Missouri, *N*: Niobrara, and *P*: Platte rivers. *PR*: Pine Ridge, and *WH*: Wildcat Hills, both forested with ponderosa pine. *Dotted line (S)*: Sandhills—prairie-vegetated dunes and sandplains, with thousands of ponds, lakes, marshes, and fens; *dashed line (RW)*: Rainwater Basins—level plains once having hundreds of shallow ponds, these now mostly drained and plowed for agriculture. Scale bar = 100 mi/160 km.

the state by FNA-Taylor et al. (1993), but known only from five south-central counties.

SELAGINELLACEAE

Selaginella rupestris (L.) Spring.—Locally abundant in parts of the Niobrara and Little Blue river drainages, scattered elsewhere.

Division Equisetophyta

EQUISETACEAE

Equisetum arvense L.—Common state-wide, except absent from the southwest.

Equisetum ×ferrisii Clute [= *Equisetum intermedium* (A. A. Eaton) Rydb.—Rydberg (1932)].—Occasional in the eastern half of the state; many reports in GPFA (1977) were based upon depauperate specimens of *E. hyemale*.

Equisetum fluviatile L. [= *Equisetum limosum* L.—Bessey (1892)].—Known only by collections from the eastern Sandhills in 1892, 1909, and 2000, and from one site near the Missouri River, 1941–1952, 1987, 2001. Mapped for the entire northern half of the state by FNA-Hauke (1993).

Equisetum hyemale L. ssp. *affine* (Engelm.) Calder & Roy L. Taylor [= *Equisetum affine* Engelm.—Rydberg (1932); *Equisetum hyemale* L.—Bessey (1892), Britton & Brown (1896, 1913), GPFA (1977); *Equisetum hyemale* L. var. *affine* (Engelm.) A.A. Eaton—GPFA (1986); *Equisetum robustum* A. Braun—Webber (1890), Fitzpatrick (1920), Rydberg (1932)].—Common over most of the state, except the southwest.

Equisetum laevigatum A. Braun [= *Equisetum kansanum* J.H. Schaffn.-Rydberg (1932)].—Common statewide.

Division POLYPODIOPHYTA

ASPLENIACEAE

Asplenium platyneuron (L.) Britton, Sterns, & Poggenb.—First collected in 1986, by J. Locklear in Jefferson County (Rolfsmeyer et al. 1988), where locally abundant; a single plant discovered and photographed in Washington County in 1988 (Garabrandt 1988), the photograph at OMA. It remains to be seen whether this plant will increase its range in Nebraska as it has elsewhere (Wagner & Johnson 1981).

AZOLLACEAE

Azolla mexicana C. Presl.—Sporadically abundant, sometimes massively so.

DRYOPTERIDACEAE

Athyrium filix-femina (L.) Mertens var. **cyclosorum** Rupr. [= *Asplenium filix-foemina* (L.) Bernh.—Botanical Survey of Nebraska (1893); *Athyrium angustum* (Willd.) C. Presl-Rydberg (1932)].—Known only as independent 1893 collections by J.M. Bates, F.C. Clements, and P.A. Rydberg, on different dates and at different sites in the Niobrara River valley, and perhaps yet present in pristine forests of Long Pine Canyon. The sites are disjunct from the main ranges of var. *cyclosorum* to our west and var. *angustum* (Willd.) G. Lawson to our east. FNA-Kato (1993) attributed only var. *angustum* to Nebraska, but the specimens from the wild, with their rounded sori and long-ciliate indusia, are var. *cyclosorum*. In 1979, R.E. Brooks annotated those specimens as ssp. *cyclosorum* (Rupr.) C. Christens., but in GPFA (1986) he did not attribute the species to Nebraska; the key to varieties there is incorrect. Petrik-Ott (1979) did not specify infraspecific taxa, and an Adams County specimen she cited but did not map was from a garden; several other specimens in herbaria are of cultivated plants.

Cystopteris bulbifera (L.) Bernh.—GPFA (1977, 1986).—First collected in 1972 (Anderson 1974), in Richardson County in the extreme southeastern corner of the state, and still abundant at that site, but unknown elsewhere in the state. Not attributed to Nebraska by FNA-Haufler et al. (1993).

Cystopteris fragilis (L.) Bernh. [= *Filix fragilis* (L.) Gilib.—Petersen (1923), Rydberg (1932)].—Common in the northern and eastern halves of the state.

Cystopteris protrusa (Weath.) Blasdell.—Common in the eastern one-fifth of the state, especially southeastward.

Cystopteris tenuis (Michx.) Desv. [= *Cystopteris fragilis* (L.) Bernh., in part—GPFA (1977, 1986)].—Locally abundant in the eastern one-fifth of the state. Moran (1983) and FNA-Haufler et al. (1993) mapped it for one station in the extreme west, but we cannot verify its presence there.

Dryopteris carthusiana (Vill.) H.P. Fuchs [= *Aspidium spinulosum* Sw.—Web-

ber (1890); *Dryopteris spinulosa* (O.F. Müll.) Kuntze-Fitzpatrick (1920), Petersen (1923), Rydberg (1932); *Dryopteris spinulosa* (O.F. Müll.) Watt-GPFA (1986)].—Collected infrequently between 1892 and 2001; locally common today at scattered sites in the paper-birch forests of the Niobrara River valley in Cherry County, and in oak-wooded ravines between bluffs of the Missouri River in Dakota and Thurston counties.

Dryopteris cristata (L.) A. Gray.—Collected by Rydberg in 1893 from shrub-filled fens of Hooker County, in the Sandhills, disjunct 150 mi/240 km west of the main range; not found since then, but potentially persisting in the many remaining fens. Erroneously attributed also to adjacent Thomas County by Petersen (1923) and GPFA (1977), based upon incorrect interpretation of the location as written on the labels.

♦ ***Matteuccia struthiopteris*** (L.) Tod. var. ***pennsylvanica*** (Willd.) C.V. Morton.—First collected from the wild in 2000, in native habitat in Thurston County, remote from past or present habitations. Commonly cultivated but not known to have naturalized in the state, although seemingly capable of doing so.

Onoclea sensibilis L.—Abundant today in Sandhills marshes and in the Elkhorn, Loup, and lower Little Blue river valleys, but rare and mostly extirpated elsewhere.

Woodsia obtusa (Spreng.) Torr.—Occasional to locally common in rocky woods in the eastern one-fifth of the state.

Woodsia oregana D.C. Eaton ssp. ***cathcartiana*** (B.L. Robins.) Windham.—Occasional in the western two-thirds of the state. Mapped for all but the extreme southeastern corner of the state by FNA-Windham (1993), but absent from a much greater area (Fig. 2).

MARSILEACEAE

Marsilea vestita Hook. & Grev.—Locally abundant, sometimes massively so, in the Platte River valley and Rainwater Basins, scarce elsewhere.

Pilularia americana A. Braun.—First and last collected in 1966, from a large, shallow Sandhills lake in Cherry County (McGregor 1967).

OPHIOGLOSSACEAE

Botrychium campestre W.H. Wagner & Farrar.—First collected in 1982, from a bur-oak and red-cedar forest on the floodplain of the Niobrara River, Brown County (Freeman & Churchill 1983, as *B. matricariifolium* A. Braun, but later formally described as *B. campestre* in Wagner & Wagner (1986)), and still thriving there; two nearby populations discovered in 2000.

Botrychium virginianum (L.) Sw.—Common in eastern and northern counties, less so westward. Mapped for the entire state by FNA-Wagner and Wagner (1993), but unknown to us in the entire southwestern half, which lacks suitable habitat.

♦ ***Ophioglossum engelmannii*** Prantl.—Known only by collections in 1999 from Pawnee County, the northern edge of its range.

Ophioglossum pusillum Raf. [= *Ophioglossum vulgatum* L. var. *pseudopodium* (S.F. Blake) Farw.-Fernald (1950), Brooks (1980), GPFA (1986)].—Locally abundant on peat mounds in northwestern Sandhills fens, and on shallow peat near springs in the Niobrara River valley. First collected in 1912, but not again until 1982 and subsequently at seven other sites. The habitats are not especially threatened, and a few are preserved.

PTERIDACEAE

Adiantum pedatum L.—Common in oak-hickory forests on bluffs near the Missouri River and nearby tributaries, and known from a single collection from Rock County, in the Niobrara River valley.

Argyrochosma dealbata (Pursh) Windham [= *Notholaena dealbata* Kunze-Webber (1890), Britton & Brown (1913), Fitzpatrick (1920), Petersen (1923), Rydberg (1932), Fernald (1950), GPFA (1977, 1986)].—First and last collected in 1888, from Weeping Water Valley, Cass County. The site, now severely disturbed by quarrying of limestone, is northernmost for the species.

Cheilanthes feei T. Moore [= *Cheilanthes lanuginosa* Nutt.-Webber (1890)].—Uncommon in western counties, absent elsewhere; mapped for the entire state by FNA-Windham & Rabe (1993).

Pellaea atropurpurea (L.) Link.—Mapped for the entire state by FNA-Windham (1993), but known to us only from one western county, where it is locally abundant in narrow, shady, cool canyons, and from seven eastern counties, where it is uncommon.

♦ **Pellaea glabella** Mett. ex Kuhn ssp. **glabella**.—The only specimen we have seen is our collection from Gage County, 1998, although the plant was earlier mapped for Nebraska by Gastony (1988), but without citation of specimens. It was then attributed to the state and mapped for Richardson County by FNA-Windham (1993), perhaps based upon Gastony's map.

THELYPTERIDACEAE

Thelypteris palustris Schott var. **pubescens** (G. Lawson) Fernald [= *Aspidium thelypteris* (L.) Sw.-Webber (1890); *Dryopteris thelypteris* (L.) A. Gray-Fitzpatrick (1920), Petersen (1923), Rydberg (1932); *Thelypteris palustris* Schott-GPFA (1977, 1986)].—Common now in Sandhills marshes and fens, sometimes massively so, and locally abundant in the Elkhorn and Loup river drainages and in Jefferson County; essentially extirpated elsewhere.

EXCLUDED SPECIES

Division LYCOPODIOPHYTA

LYCOPODIACEAE

Lycopodium annotinum L. was reported for Nebraska by Petrík-Ott (1975, 1979) and GPFA (1977), based upon an 1892 specimen supposedly from Cherry County and attributed to J.M. Bates. Bates included no label with the specimen, and all label data are in the handwriting of Thomas J. Fitzpatrick. Al-

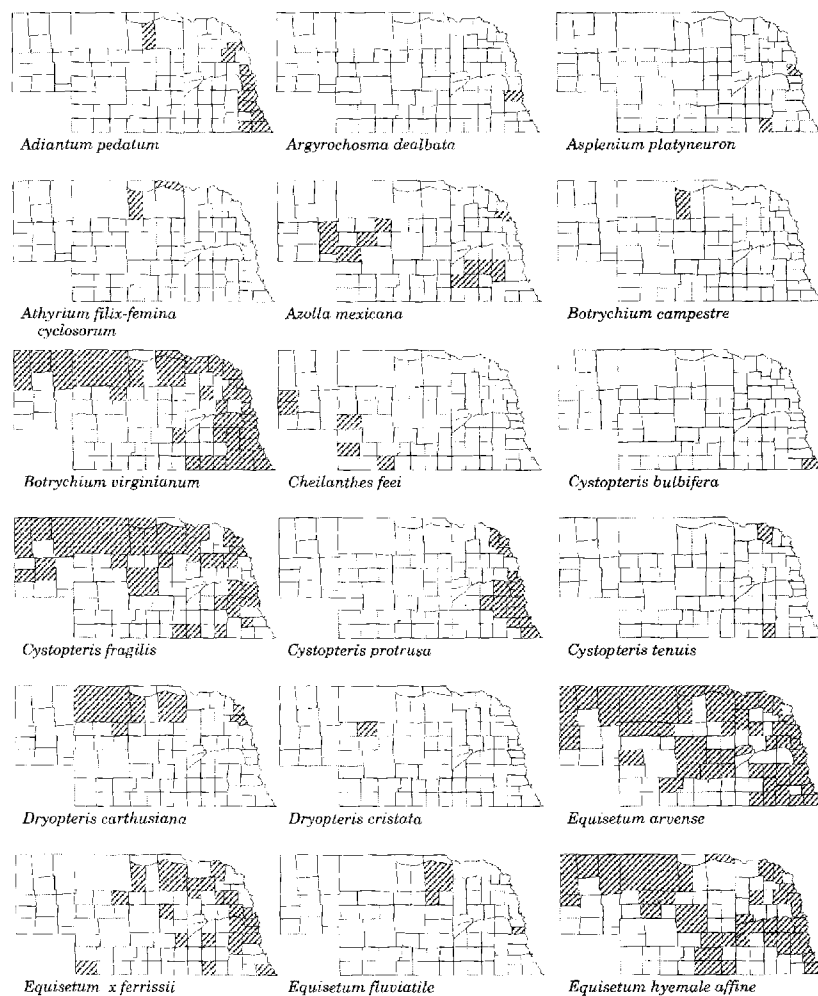


FIG. 2. Distribution maps of all Nebraska species of ferns and fern allies, as collected from 1873 through 2001. The records for each shaded county are supported by at least one voucher specimen deposited in an herbarium cited in this paper.

though correctly identified, the specimen was rejected by Brooks (1978) because the mosses with the specimen are not native to Nebraska, and Petrik-Ott (1979), in the addendum to her book, agreed. Neither this nor any other species of *Lycopodium*, *sensu lato*, is known in Nebraska.

SELAGINELLACEAE

Selaginella densa Rydb. was reported from Holt County by Petrik-Ott (1975, 1979) and GPFA (1977), but based upon a misidentified specimen of *S. rupestris*. It was attributed to Nebraska and mapped for the extreme northwestern corner of the state by FNA-Valdespino (1993), but we have not found it there, although it is nearby in Wyoming and South Dakota.



FIG. 2. (cont.)

Division EQUISETOPHYTA

EQUISETACEAE

Equisetum \times *litorale* K  hlew. ex Rupr. was mapped for the entire northern half of Nebraska by FNA-Hauke (1993), but we have neither collected it in the state nor have we seen voucher specimens in any herbarium.

Equisetum palustre L. was reported for Nebraska by Taylor (1970), but we have not seen specimens.

Equisetum pratense Ehrh. Bessey (1892) reported a specimen from Sowbelly Canyon, Sioux County, supposedly collected in August, 1890, but we have not found such a specimen.

Equisetum variegatum Schleich. ex F. Weber & D. Mohr was reported for various localities across the state by Webber (1890), Fitzpatrick (1920) and Petersen (1923), but those reports were based upon misidentified, depauperate specimens of *Equisetum laevigatum*. The records were rejected by Petr  k-Ott (1975, 1979) and Brooks (1986).

Division POLYPODIOPHYTA

ASPLENIACEAE

Asplenium trichomanes L. ssp. *trichomanes* was not reported for Nebraska by Moran (1982), but it was both mapped and cited for the state by FNA-Wagner et al. (1993). Moran (1995, *in litt.*) could not

account for the discrepancy. The nearest vouchered stations we know are in the Black Hills of South Dakota.

AZOLLACEAE

Azolla caroliniana Willd. Reports before 1950 were made by authors who did not distinguish this from *Azolla mexicana*. Both species were reported for Nebraska by FNA-Lumpkin (1993), but the distinction is difficult and requires mature megaspores, which are lacking in most of our specimens. We reject reports of *A. caroliniana*, as did Petrik-Ott (1979), until further evidence is available.

DRYOPTERIDACEAE

Woodsia scopulina D.C. Eaton was reported by Rydberg (1932), but we have not found vouchers specimens. It occurs in the Black Hills of South Dakota and perhaps is in the nearby Pine Ridge of Nebraska's northwestern corner.

OPHIOGLOSSACEAE

Botrychium dissectum Spreng. was reported (as *Botrychium obliquum* Muhl.) by Petersen (1923), who suggested that the latter name might be correct for the Hussong collection of *B. multifidum* (which see, below).

Botrychium matricariifolium A. Braun was reported as new to Nebraska by Freeman & Churchill (1983) and Brooks (1986), based upon specimens of *Botrychium campestre* (q.v. above), which was not described until 1986.

Botrychium multifidum (S.G. Gmel.) Rupr. A specimen (Hussong's n.) at NEB, supposedly from Franklin County, was so identified by Petrik-Ott (1975, 1979). The specimen is from a large collection of very doubtful provenance, and the record was excluded by GPFA (1977, 1986) and is rejected by us.

Botrychium neglectum A. Wood was reported by Britton and Brown (1913), Fitzpatrick (1920), and Petersen (1923), the latter two reports being based on the specimen later reported as *B. multifidum* by Petrik-Ott (1979). The placement of this name is in doubt, and Brooks (1986) included it as a synonym of *B. matricariifolium*.

Ophioglossum vulgatum L. was first reported for Nebraska by Bates (1912). All reports before 1980 were by authors who did not distinguish this species from *O. pusillum* Raf., of which there are old and recent records for the state.

OSMUNDACEAE

Osmunda cinnamomea L. was reported for Nebraska by Lellinger (1985) but not by GPFA (1977, 1986) or FNA-Whetstone & Atkinson (1993); we have not found vouchers specimens.

Osmunda claytoniana L. was reported by Fitzpatrick (1920), based upon a specimen at NEB "without definite locality and doubtfully referred to Nebraska." The report was later accepted by Rydberg (1932) and rejected by Petrik-Ott (1975, 1979).

Osmunda regalis L. var. *spectabilis* (Willd.) A. Gray was first reported for Nebraska in 1897 (*Fern Bull.*, p. 66), based upon specimens at NEB that were collected by E. M. Hussong, supposedly from Franklin County but of doubtful provenance. The report was reiterated by Britton & Brown (1913), Fitzpatrick (1920), Petersen (1923), Petrik-Ott (1975, 1979), and Lellinger (1985), but not by Fernald (1950), Gleason (1952), GPFA (1977, 1986), or FNA-Whetstone & Atkinson (1993). Franklin County lacks suitable habitat, and the plant has not been found anywhere in the state.

PTERIDACEAE

Cryptogramma acrostichoides R. Br. was reported by Fitzpatrick (1920) and Petersen (1923) on the basis of a single frond that was sent to C.E. Bessey for determination. The specimen is from a collection by E.M. Hussong and supposedly from Franklin County, but with doubtful locality data that is not written in Hussong's hand. Petrik-Ott (1975, 1979) considered the specimen not to be from Nebraska, and so do we.

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