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Additions to the Pteridophyte Flora of Iowa—IV

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This report updates field collection records and summarizes nomenclatural changes of genera and binomials of species of Iowa pteridophytes based on the Flora of North America project. *Botrychium simplex var. compositum, Gymnocarpium jessoense* (Koidz.) Koidz. spp. *parvulum* Sarvela, *Gymnocarpium Xbrittonianum* (Sarvela) Pryer & Haufler, and *Gymnocarpium Xintermedium* Sarvela were recently added to the state flora. The flora now consists of 66 species, plus 7 hybrids, and 1 distinct form, for a total of 74 taxa. With the addition of 81 new county occurrence records, the Iowa pteridophyte flora now consists of 1754 county occurrence records. A data matrix of species/county occurrence records is provided.

INDEX DESCRIPTORS: Iowa vascular flora, pteridophytes, ferns and fern allies, state flora additions, county occurrence records.

Although the pteridophyte flora of Iowa has been the focus of numerous and extensive floristic investigations (Peck, 1976a, 1984), the last identification manual was that of Cooperrider (1959) which reported 54 species with 846 county occurrence records (COR). Peck (1976b) provided an annotated checklist with distribution maps of 57 species plus 3 hybrids, with 1254 county occurrence records. Subsequent publications by Peck (1980, 1983, 1989) added taxa and reported COR new to Iowa, resulting in a flora of 62 species plus 7 hybrids with 1672 county occurrence records. During the last seven years, additional field and herbarium work by the authors and several associates, the publication of a pteridophyte volume of the multivolume Flora of North America North of Mexico (FNA, 1993), and the publication of a modern checklist of the Iowa vascular plant flora (Eilers and Roosa, 1994), make another update necessary to summarize changes in nomenclature, report species new to the Iowa pteridophyte flora, add 80 additional county occurrence records, and provide a condensed method of summarizing Iowa pteridophyte floristic information. The Iowa pteridophyte flora now consists of 74 taxa, including 65 species plus 7 hybrids and 1 distinct form, supported by 1754 county occurrence records (Fig. 1).

NOMENCLATURAL CHANGES

With the publication of Flora North America Volume 2, Pteridophytes and Gymnosperms (FNA, 1993), a series of nomenclatural changes were recognized that affect the names used in the Iowa pteridophyte flora. Some corrective commments are also needed with regard to the representation of Iowa pteridophytes in that manual. The checklist of the vascular flora of Iowa (Eilers and Roosa, 1994) includes most names changed in FNA (1993) as synonyms. The extensive generic level changes in nomenclature in the Clubmoss Family, Lycopodiaceae, used in FNA (1993) were not available to Eilers and Roosa (1994) nor to Kartesz (1994) which also provide many synonyms or alternative classifications.

Traditionally, clubmosses have been treated as a single genus, *Lycopodium.* Evidence that this does not properly express phylogenetic relationships has accumulated from biosystematic studies over the past 40 years (Øllgaard, 1987, 1989; Wagner and Beitel, 1992). Wagner and Beitel (1993) placed the North American representatives into seven genera. Iowa taxa are classified into four genera: *Huperzia, Lycopodium, Diphasiastrum,* and *Lycopodiella.* In Iowa, the Gemma Firmoss Genus *Huperzia* contains two species and one hybrid. The Shining Firmoss *Lycopodium lucidulum* Michaux is now *Huperzia lucidula* (Michaux) Trevisian. The Rock Firmoss *Lycopodium porophilum* Lloyd & Underwood is now *Huperzia porophila* (Lloyd & Underwood) Holub. The hybrid *Lycopodium Xbartleyi* Cusick is now *Huperzia Xbartleyi* (Cusick) Kartesz & Gandhi. Two species in Iowa are retained in the Genus *Lycopodium* (*L. clavatum* L. and *L. dendroideum* Michx.) and have no name changes. FNA (1993) is in error by not listing *Lycopodium clavatum* in Iowa. The genus of Flatbranched Clubmosses, *Diphasiastrum* contains one species in Iowa, Southern Runningpine, *D. digitatum* (Dillenius ex Braun) Holub which was previously known as *Lycopodium digitatum* Dillenius. *Diphasiastrum complanatum* (L.) Holub was excluded from the Iowa flora (Peck, 1976b); it remains excluded. The Bog Clubmoss Genus *Lycopodiella* is represented in Iowa by one species, recently discovered in Iowa by J. C. Nekola (Peck et al., 1989). This species, the Northern Bog Clubmoss, *Lycopodium inundatum* L. is now recognized as *Lycopodiella inundata* (L.) Holub. The Iowa population of this species seems to have been adventive, being extant only three growing seasons, from 1987 through 1989. Hopefully, it will reappear at the original site in Buchanan Co. or appear at other locations in Iowa. FNA (1993) is in error by not listing this clubmoss in the Iowa flora.

Traditionally, Lady Ferns have been treated as a single genus, *Athyrium.* Evidence that this is inadequate to properly express phylogenetic relationships has accumulated from biosystematic studies over the past 40 years, primarily from tropical and Asiatic studies (Kato, 1977; 1984; Kato and Darnaedi, 1988). The three species in Iowa are now segregated into three genera: *Athyrium, Diplazium,* and *Deparia.* The Narrowleaved Glade Fern *Athyrium pycnocarpon* (Sprengel) Tidestrom is now *Diplazium pycnocarpon* (Sprengel) Broun (Kato, 1993b). The Silvery Glade Fern *Athyrium thelypterioides* (Michx.) Desv. is now *Deparia acrostichoides* (Swartz) Kato (Kato, 1993c). Although the Northern Lady Fern remains in *Athyrium,* the biological relations among the infraspecific taxa of *Athyrium filix-femina* (L.)

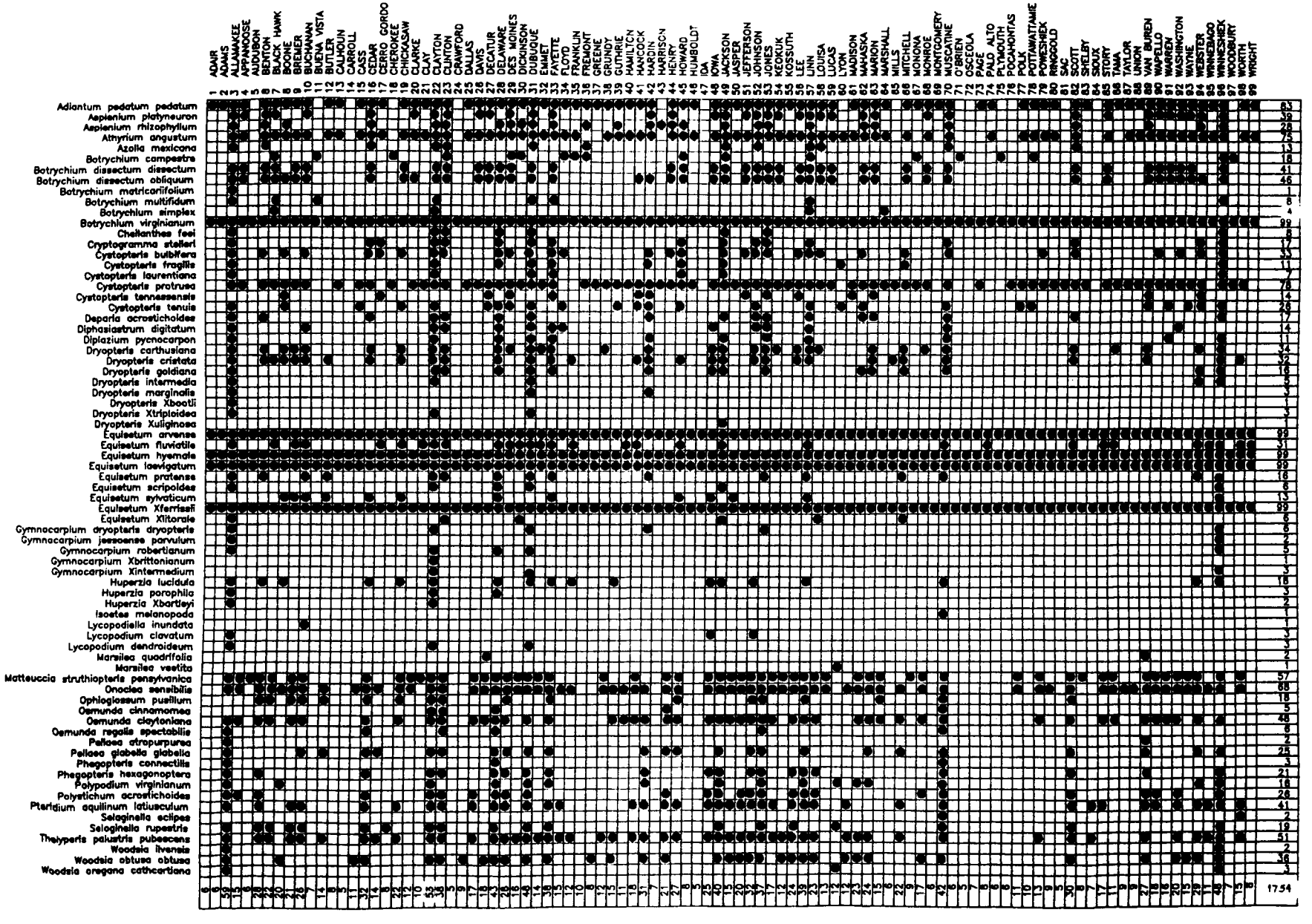

Fig. 1. A summary matrix displays 1754 county occurrence records for the Iowa pteridophyte flora. A dot indicates a voucher specimen was collected in that county and was deposited in an herbarium.

Roth ex Mertens remain in need of study; the four varieties of Lady Fern that occur north of Mexico (Kato, 1993a) are quite distinct morphologically and geographically. Iowa's variety, the Northeastern Lady Fern, when treated as one of four separate species, is *Athyrium angustum* (Willdenow) Presl; when treated as a variety, it is *A. filix-femina* (L.) Mertens var. *angustum* (Willdenow) Lawson.

While documenting the pteridophyte floras of Iowa (Peck, 1976b), the Driftless Area of the Upper Midwest (Peck, 1982), and Wisconsin (Peck and Taylor, 1980), numerous problematic specimens of *Cystopteris* were encountered in herbaria or collected from the field. Since then, other workers have conducted biosystematic studies that resolved some of the taxonomic confusion and constructed an appropriate nomenclature that reflects relationships in this genus. Peck (1989) reported clarifications of problematic Iowa specimens of *Cystopteris* based on biosystematic studies of R. Moran and C. Haufler, summarized in FNA(1993) by Haufler, Moran, and Windham (1993). All Iowa *Cystopteris* taxa previously reported as hybrids are now considered to be species of hybrid origin with fertility restored through polyploidy. Thus, they do not warrant the hybrid sign (multiplication sign) in front of the specific epithet.

The family Thelypteridaceae contains approximately 900 species that have been variously sorted into one to thirty genera. Smith (1993) placed North American members in three genera: *Thelypteris, Phegopteris,* and *Macrothelypteris.* The three Iowa species are placed in the first two genera. Eilers and Roosa (1994) placed all three in genus *Thelypteris,* providing as synonyms the binomials used in FNA (1993) and in previous reports on Iowa pteridophytes (Peck, 1976b, 1980, 1983, and 1989).

TAXA NEW TO IOWA

Botrychium simplex E. Hitch. in the eastern United States has been recognized as including three varieties by some authors: var. *simplex,* var. *tenebrosum* (A. A. Eat.) Clausen, and var. *compositum* (Lasch) Milde (see Mickel, 1979). The morphological differences between these varieties are clear only in large plants, and some have questioned whether these differences are environmentally induced (Wagner and Wagner, 1983). Farrar and Wendel (1996) have shown by starch gel enzyme electrophoresis that the *B. simplex* varieties are highly distinct genetically, and that the plants growing in the prairie swale in Black Hawk County are variety *tenebrosum.* Because of similar morphology and habitat, plants in Marshall and Linn counties are probably also this variety. A plant collected by Tom Rosburg from a woodland slope in Pikes Peak State Park, Clayton Co., on 25 June 1996 is much larger and distinctly not var. *tenebrosum.* Its morphology is that of var. *compositum* and represents a new taxon for Iowa.

With the realization that hybrid taxa occurred in the genus *Gymnocarpium* (Root, 1961), preliminary biosystematic examination of North American material resulted in the identification of two widespread tetraploid species and one regionalized diploid species (Wagner, 1966). A world-wide synopsis of the Oak Fern genus *Gymnocarpium* by Sarvela (1978) led to a re-examination of North American taxa (Sarvela, 1980; Sarvela et al., 1981) that uncovered previously unknown and complex relationships. The North American material has been studied biosystematically over the past decade by K. Pryer and associates (Pryer, 1981, 1990, 1992, 1993; Pryer & Britton, 1983; Pryer, Britton, & McNeil, 1983, 1984; Pryer and Haufler, 1993). Specimens from Iowa cited in these reports were identified as two taxa that were new to Iowa. Those reports indicated that additional field study in the Iowa Driftless Area (Paleozoic Plateau) might be rewarding. Examination by Pryer of an extensive series of *Gymnocarpium* plants collected from Iowa algific talus slopes collected by Nekola from 1984–1991 documented a third *Gymnocarpium* taxon new to Iowa. In 1993, Peck sent the holdings of Iowa *Gymnocarpium* specimens from four Iowa herbaria (ISC, IA, ISTC, and COE) to Pryer for inspection and annotation to provide uniform and expert identifications. As a result, five Oak Ferns are now known from Iowa.

Two tetraploid species, *Gymnocarpium dryopteris* (L.) Newm. and *Gymnocarpium robertianum* (Hoffm.) Newm., were previously reported as being present in Iowa (Peck, 1976a). The first species is widely distributed in eastern North America, Europe and Asia. The second occurs in eastern North America, Europe and Asia Minor. In addition to these taxa, three other taxa (one species and two hybrids) were recently reported as new to the Iowa pteridophyte flora (Nekola, 1997).

Sarvela (1978) split what had previously been called *Gymnocarpium robertianum* into two species: *G. robertianum s. s.,* occurring in eastern North America westward to the Great Lakes region and *G. jessoense* ssp. *parvulum,* occurring from the Great Lakes region westward to Alaska. *Gymnocarpium jessoense* (Koidz.) Koidz. ssp. *parvulum* Sarvela, the Nahanni Oak Fern, is a tetraploid that occurs in Asia, Scandanavia, and across western North America, from Alaska to the western Great Lakes region, with outliers in Quebec. Distinguishing features of these two species were elaborated by Sarvela et al. (1981), Pryer et al. (1983), and Pryer (1990). Most Iowa plants are *G. robertianum*; however, Pryer et al. (1984) reported *G. jessoense* ssp. *parvulum* as present in the Iowa flora based on two herbarium specimens: an 1882 collection by E. W. Holway from Decorah, Winneshiek Co. (*Holway s. n.,* G), and a 1958 collection by T. G. Hartley from "Old Stone House", 7 mi NE of Postville, Allamakee Co. (*Hartley 6254,* IA). The voucher of the Allamakee Co. record is no longer at IA, (pers. comm. from Dr. Diana Horton). Efforts by Nekola in 1990–1991 to relocate this species were unsuccessful (Nekola, 1997).

Gymnocarpium X*brittonianum* (Sarvela) Pryer & Haufler is a triploid, sterile hybrid originating from a cross between *Gymnocarpium dryopteris* which occurs in six counties in northeastern Iowa and *Gymnocarpium disjunctum* (Rupr.) Ching which occurs in the Pacific Northwest, but not in Iowa nor in the eastern United States. This hybrid produces large, "basketball" spores and small, irregular, abortive spores. The large, presumably unreduced (triploid) spores may allow for dispersal and apogamous production of sporophytes (Pryer and Britton, 1983). *G.* X*brittonianum* has two centers of concentration: northwestern North America and northeastern North America surrounding the Great Lakes and New England states. The first Iowa record was collected on algific talus slopes in Bixby State Preserve, Clayton Co. (sec. 23, Lodomillo Twp., 7 July 1990, *Nekola 8499* COE) and was subsequently identified by K. Pryer in 1991. An additional distinct population was located in the same valley on 16 June 1991 (*Nekola 9415,* COE). Another possible population of this hybrid was located on 22 May 1991 (*Nekola 9405, 9409, 9414* COE), but herbarium material lacked spores, precluding a definitive determination. These populations are 300 km disjunct from the nearest populations in northern Wisconsin. It must be considered one of our rarest Iowa pteridophytes. Extensive searches of approximately 100 algific talus slopes in Iowa have not located additional populations (Nekola, 1997).

Gymnocarpium X*intermedium* Sarvela, previously known as *G.* X*heterosporum* Wagner, but missapplied, is the sterile hybrid that results from a cross between *Gymnocarpium dryopteris* and *Gymnocarpium jessoense* subsp. *parvulum.* This hybrid occurs across North America from Alaska to Quebec, Canada; it is common in the Great Lakes region. Like the previous taxon, this hybrid produces large, "basketball" spores and smaller, irregular, abortive spores. The larger spores may allow the hybrid to disperse and apogamously produce additional sporophytes. In 1990, populations of this hybrid were discovered on algific talus slopes in two counties: Clayton Co.: Sec 26, Boardman Twp. on 14 September 1990 (*Nekola 9051* COE), and Dubuque Co.: Secs 4 & 5, Taylor Twp. on 23 June 1990 (*Nekola 8385* COE) and

on 3 July 1991 (*Nekola 9884* COE). Subsequently, in 1995, Pryer annotated as *G. Xintermedium* the collections by H. Goddard on 21 June 1899 from rock bluffs in Winneshiek Co. (*Goddard s. n.* IA; ISC). Thus, it is known from three counties in northeastern Iowa. Extensive searches for this taxon on approximately 100 algific talus slopes in Iowa have located no additional populations (Nekola, 1997).

COUNTY OCCURRENCE RECORDS NEW TO IOWA

Thirty-two taxa have additional county occurrence records (COR) that document their distribution within Iowa. Of particular importance is a series of COR for *Botrychium campestre* reported from cedar glade communities in northeastern Iowa (Nekola and Schlicht, 1996a,b). The 81 COR added with this report, when combined with those previously reported (Peck, 1976b, 1980, 1983, and 1989), result in a total of 1754 COR supporting the Iowa pteridophyte flora. This more than doubles the 846 COR reported by Cooperrider (1959) and adds 500 COR to the flora of Peck (1976b). A data matrix was prepared (Fig. 1) to succinctly display the Iowa pteridophyte flora and the COR for each taxon. New records are cited by species, collector, collection number and herbarium of deposit. The latter is cited by acronym code: University of Iowa (IA), Iowa State University (ISC), University of Northern Iowa (ISTC), and Coe College (COE).

Asplenium platyneuron Britton, Sterns & Poggenburg: Appanoose Co.: *Zehr 5219011* (ISTC), Benton Co.: *C. Peck s. n.* (ISTC), Buchanan Co.: *Peck 91001* (ISTC), Clarke Co.: *Peck 91101* (ISTC), Davis Co.: *Peck 91121* (ISTC), Keokuk Co.: *Peck 91143* (ISTC), Lucas Co.: *Peck 91163* (ISTC), Mahaska Co.: *Zehr s. n.* (ISTC), Monroe Co.: *Zehr s. n.* (ISTC), Story Co.: *Norris s. n.* (ISC), Wapello Co.: *Peck 91186* (ISTC), Wayne Co.: *Peck 91188* (ISTC).

Asplenium rhizophyllum L.: Benton Co.: *Nekola 6805.*(COE).

Botrychium campestre Wagner & Farrar: Black Hawk Co.: *Nekola 10738* (COE), Butler Co.: *Nekola 10739* (COE), Cherokee Co.: *Farrar s. n.* (ISTC), Clinton Co.: *Nekola 10875* (COE), Delaware Co.: *Nekola 10750* (COE), Floyd Co.: *Nekola 10741* (COE), Franklin Co.: *Nekola 10740* (COE), Howard Co.: *Nekola 10766* (COE), Jackson Co.: *Nekola s. n.* (COE), Linn Co.: *Nekola 10731* (COE), O'Brien Co.: *Farrar s. n.* (ISTC), Winneshiek Co.: *Nekola 10767* (COE).

Botrychium dissectum Spreng. f. *dissectum*: Mitchell Co.: *Nekola 10031* (COE).

Botrychium dissectum Spreng. f. *obliquum* Clute: Mitchell Co.: *Nekola 10047* (COE).

Botrychium multifidum (Gmel.) Rupr.: Black Hawk Co.: *Nekola 9375* (COE), Linn Co.: *Nekola 8074* (COE).

Botrychium simplex E. Hitch. var. *compositum* (Lasch) Milde: Clayton Co.: *Rosburg 1493* (ISC).

Botrychium simplex E. Hitch. var. *tenebrosum* (A. A. Eat.) Clausen: Marshall Co.: *Peck 90001* (ISTC).

Botrychium virginianum (L.) Sw.: Osceola Co.: *Peck 87073* (ISTC), Worth Co.: *Peck 87007* (ISTC).

Cystopteris fragilis (L.) Bernh.: Dubuque Co.: *Nekola 8395* (COE), Mitchell Co.: *Nekola 6844* (COE).

Cystopteris protrusa (Weath.) Blasdell: Calhoun Co.: *Zehr s. n.* (ISTC), Keokuk Co.: *Peck 91144* (ISTC), Poweshiek Co.: *Peck 90307* (ISTC), Wapello Co.: *Peck 91187* (ISTC).

Cystopteris tennesseensis Shaver: Lee Co.: *Zehr s. n.* (ISTC).

Diphasiastrum digitatum (Dill. ex Broun) Holub: Fayette Co.: *Nekola 7307* (COE); Linn Co.: *Nekola 8030* (COE).

Dryopteris carthusiana (Vill.) Fuchs: Benton Co.: *C. Peck s. n.* (ISTC); Story Co.: *Friedrick s. n.* (ISC).

Dryopteris cristata (L.) Gray: Butler Co.: *Leoschke 516* (ISC), Floyd Co.: *Leoschke 888* (ISC), Van Buren Co.: *Peck 81376* (ISTC).

Dryopteris goldiana (Hook.) Gray: Fayette Co.: *Nekola 8519* (COE).

Equisetum fluviatile L.: Franklin Co.: *Leoschke 881* (ISC), Muscatine Co.: *Leoschke 491* (ISC).

Equisetum pratense Ehrh.: Benton Co.: *Leoschke 1067* (ISC), Buchanan Co.: *Klug 90186-3* (IA).

Equisetum scirpoides Michx.: Dubuque Co.: *Nekola 8384* (COE).

Equisetum sylvaticum L.: Bremer Co.: *Freeman 78114* (ISC), Cedar Co.: *Nekola 9152* (COE), Fayette Co.: *Nekola 7726* (ISTC).

Equisetum Xferrissii Clute: Osceola Co.: *Peck 7665* (ISC).

Gymnocarpium jessoensee (Koidz.) Koidz. ssp. *parvulum* Sarvela: Allamakee Co.: *Hartley 6254* (IA), Winneshiek Co.: *Holway s. n.* (GH).

Gymnocarpium robertianum (Hoffm.) Newm.: Delaware Co.: *Nekola 9662* (COE).

Gymnocarpium Xbrittonianum (Sarvela) Pryer & Haufler: Clayton Co.: *Nekola 8499* (COE).

Gymnocarpium Xintermedium Sarvela: Clayton Co.: *Nekola 9051* (COE), Dubuque Co.: *Nekola 8385* (COE), Winneshiek Co.: *Goddard s. n.* (IA).

Huperzia lucidula (Michx.) Trevs.: Webster Co.: *Farrar s. n.* (ISC) [voucher from population at Woodman Hollow State Preserve replaces photovoucher of extirpated population at Dolliver State Park].

Ophioglossum pusillum Raf.: Butler Co.: *Leoschke 1481* (ISC), Clinton Co.: *Peck 90018* (ISTC), Clayton Co.: *Nekola 10093* (COE), Des Moines Co.: *Peck 91204* (ISTC); Jones Co.: *Peck 90022* (ISTC).

Osmunda claytoniana L.: Des Moines Co.: *Peck 87512* (ISTC).

Osmunda regalis L.: Jones Co.: *Nekola 10018* (COE).

Pellaea glabella Mett. ex Kuhn: Butler Co.: *Nekola 8458* (COE).

Polystichum acrostichoides (Michx.) Schott: Appanoose Co.: *Wright s. n.* (ISC), Jones Co.: *Peck 87207* (ISTC), Monroe Co.: *Peck 91006* (ISTC).

Selaginella eclipes Buck: Worth Co.: *Nekola 8930* (COE).

Woodsia obtusa (Spreng.) Torr. subsp. *obtusa*: Des Moines Co.: *Peck 87286* (ISTC), Fayette Co.: *Peck 90007* (ISTC), Monroe Co.: *Peck 91006* (ISTC).

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