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The Pteridophyte Flora of Iowa

James H. Peck¹

Peck, James H. (Department of Botany and Plant Pathology, Iowa State University, Ames, Iowa 50011). The pteridophyte flora of Iowa. Proc. Iowa Acad. Sci. 83(4):143-160. 1976.

A floristic study of Iowa pteridophytes is presented based upon extensive herbarium and field work. Historical notes are included on the principal collectors, along with a summary of the accumulation of floristic records. Taxonomic notes are presented on seven taxa new to the state and on six excluded taxa. A flora of 57 species and 3 hybrids is recognized. Floristic notes are presented on

the status of the state flora and county floras. The addition of 402 new county records increases the total of county occurrences by 47%. Statements of habitat and distribution are presented with dot maps for the entire flora. Records requiring new collections are identified, along with counties needing further field study and species that require special attention.

INDEX DESCRIPTORS; Iowa pteridophyte flora, pteridophytes, ferns, horse-tails, scouring-rushes, *Equisetum*, clubmosses, *Lycopodium*, quillworts, *Isoetes*, spikemosses, *Selaginella*, Iowa vascular flora.

Iowa pteridophytes have received considerable attention from botanists over the last 130 years, including 12 state treatments. However, a comprehensive compilation of Iowa pteridophyte literature (Peck, 1976) revealed that many new state and county records might be added to the last treatment (Cooperrider, 1959). After conducting preliminary herbarium and field study, it became evident that a complete restudy of the flora was needed. Because accurate taxonomic and floristic data on Iowa pteridophytes is essential to my current research on pteridophyte reproductive biology, a comprehensive study of the state's pteridophyte flora was undertaken. This report summarizes present floristic information and identifies aspects that require further study.

PROCEDURE

The study was conducted through herbarium and field work. Approximately 5000 specimens in 19 Iowa herbaria were inspected and annotated. In order to resolve specific problems, selected specimens were also examined from four herbaria located outside the state. Published observations were not included unless vouchers could be located. Label and annotation data were recorded from each specimen. Space restrictions preclude citation of specimens in this report, but specific citations are available from the author.

Field study was conducted in each of the 99 Iowa counties, except Fremont Co. Special field efforts were directed at counties with depauperate floras, at species whose Iowa distribution is poorly documented, at species rare in Iowa, at making new collections of old records, and at stations which might warrant some protective status to preserve the flora.

ACKNOWLEDGEMENTS

I thank the following collectors for permission to include their unreported county records: Kathryn A. Carvey, Donald R. Farrar, Thomas G. Lammers, David A. Niemann, Margaret E. Plouffe, Dean M. Roosa, Delmar Vander Zee, and James P. Vogler.

The curators of the following Iowa herbaria are thanked for allowing inspection of pteridophyte specimens: Central College (Pella), Coe College (Cedar Rapids), Dordt College (Sioux Center), Drake University (Des Moines), Grinnell College (Grinnell), Iowa Lakeside Laboratory (Milford), Iowa State University (Ames), Luther College (Decorah), Maharishi International University (Fairfield), Marshalltown Community College (Marshalltown), Northwestern College (Orange City), Putnam Museum (Davenport), Simpson College (Indianola), St. Ambrose College (Davenport), University of Dubuque (Dubuque), University of Iowa (Iowa City), University of Northern

Iowa (Cedar Falls), Upper Iowa University (Fayette), and Wartburg College (Waverly). The curators of the following non-Iowa herbaria are also thanked for their assistance: Missouri Botanical Garden, Philadelphia Academy of Natural Sciences, United States National Museum, and the University of Minnesota (St. Paul).

I am grateful for the assistance of the following pteridophyte specialists who determined or verified difficult specimens: Joe Beitel, University of Michigan; Richard L. Hauke, University of Rhode Island; and Warren H. Wagner, Jr., University of Michigan. Dr. Wagner was especially helpful by clarifying the systematics of *Equisetum* and *Cystopteris* and by discussing the status of pteridophyte floristics in north-central United States.

Three workers were especially helpful and encouraging. Lawrence J. Eilers, University of Northern Iowa, discussed Iowa floristics and reviewed the manuscript. Donald R. Farrar, Iowa State University, advised the author throughout the study and reviewed the manuscript. Dean M. Roosa, Board Ecologist, Iowa State Preserves Advisory Board, collected many new records, established new stations for rare species, relocated old stations, and discussed Iowa collectors and Iowa floristics with the author. The assistance of these workers is gratefully acknowledged.

While many people have contributed and aided in the study, the responsibility for the identifications and the distributional data must rest solely with the author.

Readers aware of additional records or specimens that are in need of verification are encouraged to bring them to the attention of D.R. Farrar or me.

HISTORICAL NOTES

During the last 130 years, 50 principle collectors have contributed to the Iowa pteridophyte flora. These collectors, the duration of their pteridophyte collecting, and the regions of the state in which they made their studies are presented in Table 1. This floristic activity falls into four periods. While a few collectors were active in two periods, the majority of them can be readily assigned to one period.

The first period (ca. 1847-1899) was exploratory, with intensive collecting by a few workers in limited areas of the state. Collectors from this period include C.E. Bessey, G.W. Carver, R.I. Cratty, B. Fink, M.F.L. Fitzpatrick, T.J. Fitzpatrick, A.S. Hitchcock, T.H. Macbride, C.C. Parry, and F. Reppert. Their activities and collections resulted in six state floras (Arthur, 1886; Fitzpatrick, 1896; Fitzpatrick and Fitzpatrick, 1903; Greene, 1907; Pammel and King, 1902; Shimek, 1901). During this 53 year period, 47 species and two hybrids were collected, supported by 290 county records.

The second period (ca. 1900-1939) was part of the first attempt to systematically collect the entire vascular flora and describe the vegetation throughout the state, an effort which also greatly enhanced the knowledge of Iowa pteridophytes. Collectors from this period include C. Gilly, E.W. Graves, U. A. Hauber, A. Hayden, C.M. King, M.

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Table 1. Principal collectors of Iowa pteridophytes through 1976

Collector	Duration	Region of Emphasis
Anderson, J. P.	1897-1905	Decatur, Fremont Co.
Augustine, D. W.	1938-1939	Mahaska Co.
Bessey, C. E.	1871-1876	Boone, Jones Co.
Brown, R. G.	1937-1948	Jones, Muscatine Co.
Carter, J. L.	1956-1959	Northwestern Iowa
Conard, H. S.	1907-1966	Central Iowa
Cooperrider, T. S.	1955-1957	Eastern Iowa
Cratty, R. I.	1882-1931	Emmet Co.
Davidson, R. A.	1953-1955	Southeastern Iowa
Drexler, R. V.	1950-1975	Iowa, Lynn Co.
Easterly, N. W.	1949-1950	Iowa Co.
Eilers, L. J.	1962-1963	Northeastern Iowa
Farrar, D. R.	1971-1976	Entire State
Fay, M. J.	1950-1952	Southwestern Iowa
Fitzpatrick, M. F. L.	1893-1904	Entire State
Fitzpatrick, T. J.	1893-1904	Entire State
Frazier, C. B.	1896	Hardin Co.
Fultz, J.	1931-1935	Eastern Iowa
Grant, M. L.	1949-1963	Entire State
Graves, E. W.	1926-1933	Van Buren Co.
Guldner, L. F.	1938-1958	Muscatine, Scott Co.
Hartley, T. G.	1958-1960	Northeastern Iowa
Hauber, U. A.	1915-1932	Eastern Iowa
Hayden, A.	1907-1940	Entire State
Hitchcock, A. S.	1887-1889	Story Co.
Holway, E. W. D.	1880-1882	Winneshiek Co.
King, C. M.	1901-1921	Allamakee Co.
Lammers, T. G.	1975-1976	Eastern Iowa
Macbride, T. H.	1880-1895	Eastern Iowa
McDonald, M.	1933-1935	Jefferson Co.
Melhus, I. E.	1918-1933	Entire State
Murley, M.	1939-1940	Delaware Co.
Niemann, D. A.	1970-1974	Entire State
Oleson, O. M.	1904-1907	Webster Co.
Orr, E.	1875-1905	Allamakee Co.
Pammel, L. H.	1891-1930	Entire State
Peck, J. H.	1973-1976	Entire State
Plouffe, M. C.	1974-1976	Hardin Co.
Reppert, F.	1878-1898	Muscatine Co.
Rickey, M. D.	1962-1963	Delaware Co.
Roosa, D. M.	1973-1976	Entire State
Russell, N. H.	1952-1956	Central Iowa
Shimek, B.	1881-1932	Entire State
Somes, M. P.	1905-1906	Webster Co.
Spiker, W. D.	1925-1926	Chickasaw Co.
Thorne, R. F.	1950-1961	Entire State
Tolstead, W. L.	1933-1934	Allamakee Co.
Van Bruggen, T.	1956-1959	Southcentral Iowa
Wagenknecht, B. L.	1952-1953	Washington Co.
Wolden, B. O.	1918-1953	Emmet Co.

McDonald, I.E. Melhus, L.H. Pammel, B. Shimek, and B.O. Wolden. Their activities resulted in four state floras (Cratty, 1933; Lyness, 1933; 1937-1938; Melhus, 1936). During this period of 40 years, an additional five species and one hybrid were collected, supported by 485 additional county records. This formed a pteridophyte flora of 52 species and three hybrids with 775 county records.

Special mention of L.H. Pammel and B. Shimek is warranted. They must be regarded as the most important contributors to the Iowa pteridophyte flora. They both made extensive collections and published prolifically on Iowa pteridophytes. Pammel lobbied successfully for the preservation of natural areas rich in pteridophytes, many of which are today parks or preserves. Shimek is best known in pteridology for his pteridophyte flora of Nicaragua (Shimek, 1897), but in Iowa he should be known as the single most important collector. His specimens account for 60% of the county records known up to 1940.

The third period (ca. 1940-1969), part of a second effort to study the

entire vascular flora of Iowa, has been well summarized (Eilers, 1970; 1975; Thorne, 1954). Important collectors during this period include J.L. Carter, T.S. Cooperrider, R.A. Davidson, R.V. Drexler, L.J. Eilers, M.J. Fay, M.L. Grant, T.G. Hartley, M.D. Rickey, R.F. Thorne, T. Van Bruggen, and B.L. Wagenknecht. The first 20 years are treated by Cooperrider (1955b; 1959). During this period, five new state records and 277 new county records expanded the flora to 57 species and three hybrids, based upon 1052 county records.

The fourth period (since 1970) was initiated by D.R. Farrar, Iowa State University, who through his own collecting, research and formal instruction, has stimulated interest in the Iowa pteridophyte flora. Collectors during this period include K.A. Carvey, D.R. Farrar, T.G. Lammers, D.A. Niemann, M.C. Plouffe, D.M. Roosa, D. Vander Zee and the author. During these seven years 202 new county records were collected, resulting in the present flora of 57 species and three hybrids with 1254 county records.

TAXONOMIC NOTES

This section reports seven taxa new to the state, excludes six taxa from the flora, excludes five county records of rare and disjunct species, reports two important re-collections of rare species, and provides a checklist with synonyms commonly used in current Iowa floristic reports. Nomenclature follows Crabbe, Jermy, and Mickel (1975), Mickel (1975), and Wherry (1961).

New State Records

Four species plus three hybrids are added to the flora: *Cystopteris protrusa* (Weath.) Blasdel, *Cystopteris* × *tennesseensis* Shaver, *Dryopteris intermedia* (L.) Gray, *Equisetum* × *ferrissii* Clute, *Equisetum scirpoides* Michx., *Lycopodium lucidulum* × *Lycopodium porophyllum*, and *Lycopodium porophyllum* Lloyd and Underw.

Three varieties of *Cystopteris fragilis* (L.) Bernh., var. *fragilis*, var. *mackayi* Laws., and var. *protrusa*, were recognized by Cooperrider (1959), but the varieties were not plotted separately. The varieties were not determined on Iowa specimens. W. H. Wagner, Jr. annotated the Iowa *Cystopteris* specimens at the University of Iowa and selected specimens of Iowa State University in 1975-1976. Wagner followed Blasdel (1963), noting that var. *protrusa* has specific rank as *C. protrusa* (Weath.) Blasdel, and that var. *mackayi* was present. A hybrid taxa, *C. × tennesseensis* Shaver (*C. bulbifera* × *C. protrusa*) was also noted. The type variety was not seen in Iowa material.

Dryopteris intermedia (L.) Gray is reported here as new to Iowa. It was collected in 1903 by M. P. Somes from Woodman Hollow, Webster Co., and in 1959 by T. G. Hartley from Dubuque Co. These redetermined collections, previously identified as *Dryopteris spinulosa* (O. F. Muell.) Watt in Iowa literature, were verified by Wagner. I have extensively studied the Webster Co. station without finding the species. This site was a local source of ferns in the early 1900's for horticultural use in nearby towns. A collection of *D. intermedia* from a greenhouse in Ft. Dodge, the county seat, suggests that the wild population may have been eliminated by removal to various greenhouses, a common activity at that time.

Hauke (1960) reported *Equisetum* × *ferrissii* Clute (*E. hyemale* × *E. laevigatum*) from specimens deposited in herbaria outside Iowa. While visiting Iowa Lakeside Laboratory in northwestern Iowa in 1975, Wagner confirmed the occurrence of this hybrid in Iowa. Subsequent investigation has determined that it occurs throughout the state. It had been previously identified as one of its parents, usually *E. laevigatum*. It should be noted that in northwestern Iowa the hybrid seems to occur in greater frequency and abundance than its parents.

Equisetum scirpoides Michx. was first collected in Iowa by T. G. Hartley in 1959 from Allamakee, Clayton, and Winneshiek counties (Hartley, 1962; 1966). The voucher for Hartley's Winneshiek Co. station is missing, but I re-collected it there in 1976. Since then, D. M.

Roosa visited all of Hartley's stations and has located three additional stations of *E. scirpoides* in Clayton Co.

J. Beitel verified that Iowa specimens previously identified as *Lycopodium selago* are actually *Lycopodium porophilum* Lloyd and Underw. Beitel also noted that a 1921 collection by Shimek from Clayton Co. was actually the hybrid *Lycopodium lucidulum* × *L. porophilum*. This is the first report of a hybrid club moss in Iowa.

Excluded Taxa

Cooperrider (1959; 1968) excluded six species previously included in the Iowa flora: *Adiantum capillus-veneris* L., *Dryopteris filis-mas* (L.) Schott, *Equisetum palustre* L., *Thelypteris noveboracensis* (L.) Nieuw., *Woodsia scopulina* D. C. Eaton, and *Dennstaedtia punctilobula* Moore. These species remain excluded. I exclude another six taxa: *Cystopteris fragilis* (L.) Bernh. var. *fragilis*, *Dryopteris* × *uliginosa* Druce, *Equisetum* × *litorale* Kuhl., *Lycopodium complanatum* L., *Lycopodium selago* L. and *Polystichum munitum* (Kaulf.) Presl.

Cystopteris fragilis (L.) Bernh. var. *fragilis* was reported by Cooperrider (1959). A re-examination of Iowa *Cystopteris* specimens did not uncover specimens of this variety, and it is excluded.

Dryopteris × *uliginosa* Druce (*D. cristata* × *D. spinulosa*) was reported by Cooperrider (1959). The specimen was actually an immature plant of *D. spinulosa*. This identification was verified by Wagner. The hybrid is excluded.

Equisetum × *litorale* Kuhl. (*E. arvense* × *E. fluviatile*) was reported by Hartley (1966). The specimens were actually *E. fluviatile*. This identification was verified by R. L. Hauke.

Lycopodium complanatum L. was reported from the state by Cooperrider (1959); all specimens were assigned to var. *flabelliforme* Fern. Wilce (1965) recognized that variety as *L. flabelliforme* (Fern.) Blanch. All Iowa material is now referred to that name, except a collection of the typical variety that was collected by G. H. Berry from Linn Co. in 1907. Other records of rare plants and animals typical of more northern distributions have been reported by Berry from Linn Co., but they are considered to be erroneously attributed to Iowa, or at least, to Linn Co. (DuMont, 1933, p. 63; Hartley, 1962, p. 559). As no other collector found *L. complanatum* L. in Iowa, I exclude this species from the flora.

Lycopodium selago L. was reported by Cooperrider (1959), Eilers (1971), and Hartley (1966). All Iowa specimens previously identified as *L. selago* are actually *L. porophilum* or *L. lucidulum* × *L. porophilum*. *L. selago* was misapplied to Iowa material and is excluded.

Polystichum munitum (Kaulf.) Presl was reported by Pammel and King (1902). That identification was verified by C. A. Weatherby in 1933. The specimen, however, bears only the vague locality data of being from "along the Des Moines River." The label appears to have been written by A. S. Hitchcock, and the specimen was originally identified as *Polypodium vulgare* L. It is unlikely that Hitchcock made that incorrect identification; it is more likely that a label became misplaced. *P. munitum* is far-western in its distribution, with the closest known locality a recently reported (Brooks, 1968) station in the Black Hills, South Dakota, 500 miles from central Iowa. As the South Dakota station is a 550 mile disjunct from the species in Montana, the Iowa specimen would be a 1000 mile disjunct. To accept such an important record on such tenuous evidence seems unwarranted. The specimen and the species is excluded.

Based upon a consideration of the floras of neighboring states, populations of some taxa not yet known from the state might yet be found: *Asplenium trichomanes* L., *Asplenium* × *ebenoides* R. Schott (*A. platyneuron* × *Camptosorus rhizophyllum*), *Cystopteris fragilis* (L.) Bernh. var. *fragilis*, various hybrids of *Dryopteris*, *Equisetum* × *litorale* Kuhl. (*E. arvense* × *E. fluviatile*), *Equisetum variegatum* Schlechter, and *Gymnocarpium* × *heterosporum* Wagner (*G.*

dryopteris × *G. robertianum*).

Checklist

A checklist to the Iowa pteridophyte flora is presented in Table 2. The checklist presents the nomenclature now in use by pteridologists and follows Crabbe, Jermy, and Mickel (1975), Mickel (1975), and Wherry (1961). A flora of 60 taxa, 57 species plus 3 hybrids, is presented, distributed in 13 families and 27 genera. Synonyms are given to clarify recent Iowa usage; additional synonyms are given in Wherry (1961) and Cooperrider (1959).

Table 2. Checklist of Iowa pteridophytes

ADIANTACEAE

Adiantum pedatum L.
Cheilanthes feei Moore
Cryptogramma stelleri (Gmel.) Prantl
Pellaea atropurpurea (L.) Link
Pellaea glabella Mett. ex Kuhn

ASPLENIACEAE

Asplenium platyneuron Oakes ex D. C. Eat.
Athyrium angustum (Willd.) Presl
[*A. filix-femina* (L.) Roth.]
Athyrium pycnocarpon (Spreng.) Tidestr.
Athyrium thelypteroides (Michx.) Desv.
Camptosorus rhizophyllum (L.) Link
[*Asplenium rhizophyllum* L.]
Cystopteris bulbifera (L.) Bernh.
Cystopteris fragilis (L.) Bernh. var. *mackayi* Laws.
Cystopteris protrusa (Weath.) Blasdel
[*C. fragilis* (L.) Bernh. var. *protrusa* Weath.]
Cystopteris × *tennesseensis* Shaver
[*C. bulbifera* × *C. protrusa*]
Dryopteris cristata (L.) Gray
Dryopteris goldiana (Hook.) Gray
Dryopteris intermedia (Muhl.) Gray
[*D. spinulosa* (O. F. Muell.) Watt var. *intermedia* Underw.]
Dryopteris marginalis (L.) Gray
Dryopteris spinulosa (O. F. Muell.) Watt
Gymnocarpium dryopteris (L.) Newm.
Gymnocarpium robertianum (Hoff.) Newm.
Matteuccia struthiopteris (L.) Tod.
Onoclea sensibilis L.
Polystichum acrostichoides (Michx.) Schott
Woodsia ilvensis (L.) R. Br.
Woodsia obtusa (Spreng.) Torr.
Woodsia oregana D. C. Eat.

AZOLLACEAE

Azolla mexicana Presl

DENNSTAEDTIACEAE

Pteridium aquilinum (L.) Kuhn

EQUISETACEAE

Equisetum arvense L.
Equisetum fluviatile L.
Equisetum hyemale L.
Equisetum laevigatum A. Br.
Equisetum pratense Ehrh.
Equisetum scirpoides Michx.
Equisetum sylvaticum L.
Equisetum × *ferrissii* Clute
[*E. hyemale* × *E. laevigatum*]

ISOETACEAE

Isoetes melanopoda Gay and Dur.

LYCOPODIACEAE

- Lycopodium clavatum* L.
Lycopodium dendroideum Michx.
 [L. *obscurum* L. var. *dendroideum* D. C. Eat.]
Lycopodium flabelliforme (Fern.) Blanch.
 [L. *complanatum* L. var. *flabelliforme* Fern.]
Lycopodium lucidulum Michx.
Lycopodium porophyllum Lloyd and Underw.
Lycopodium lucidulum × *L. porophyllum*

MARSILEACEAE

- Marsilea quadrifolia* L.
Marsilea vestita Hook. and Grev.
 [M. *mucronata* A. Br.]

OPHIOGLOSSACEAE

- Botrychium dissectum* Spreng. var. *dissectum*
Botrychium dissectum Spreng. var. *obliquum* (Muhl.) Clute
Botrychium multifidum (Gmel.) Rupr.
Botrychium simplex E. Hitchc.
Botrychium virginianum (L.) Sw.
Ophioglossum pseudopodium (Blake) Far.
 [O. *vulgatum* L. var. *pseudopodium* Far.]

OSMUNDACEAE

- Osmunda cinnamomea* L.
Osmunda claytoniana L.
Osmunda regalis L.

POLYPODIACEAE

- Polypodium virginianum* L.
 [P. *vulgare* L. var. *virginianum* A. Eat.]

SELAGINELLACEAE

- Selaginella apoda* (L.) Spring
Selaginella rupestris (L.) Spring

THELYPTERIDACEAE

- Phegopteris connectilis* (Michx.) Watt
 [Thelypteris *phegopteris* (L.) Slosson]
Phegopteris hexagonoptera (Michx.) Watt
 [Thelypteris *hexagonoptera* (Michx.) Fee]
Thelypteris palustris Schott

Excluded County Records

County records were excluded if vouchers could not be found or the record was based upon mis-identified, mis-reported, or suspicious specimens. Five county records are excluded that documented disjunct stations of rare species. These exclusions warranted an explanation.

Athyrium thelypteroides (Michx.) Desv. was reported by Cooperrider (1959) from Story Co., based on a specimen collected by A. S. Hitchcock in 1889. The specimen is actually a sterile, aberrant frond of *Matteuccia struthiopteris* (L.) Tod. that has a morphology intermediate between the typical sterile and fertile fronds. This identification, confirmed by Wagner, was suggested by stipe indument and stelar pattern.

Lycopodium flabelliforme (Fern.) Blanch. was reported by Wilce (1965) from Warren Co., based on a specimen attributed to B. Shimek and collected from Cummington, Iowa. As the specimen label bears a University of Texas letterhead, as there is no town in Iowa named Cummington, and as Warren Co. lacks a suitable station for this species, the label data is considered erroneous. Cooperrider (1968) excluded two species from the Iowa flora that had similar label data. I concur with Cooperrider that these specimens were probably collected by someone other than Shimek at Cummington, Massachusetts and were subsequently mislabeled at the University of Texas before being deposited at the United States National Herbarium. Any other specimens so labeled and attributed

to Iowa must be considered erroneous and excluded unless confirmed by other collections.

Lycopodium selago L. was reported by Eilers (1964; 1971) from Chickasaw Co. Label data was mis-recorded from a mixed sheet of *L. porophyllum* (then known as *L. selago* in Iowa) from Delaware Co. and *L. lucidulum* from Chickasaw Co. The Chickasaw Co. data was reported for the wrong specimen.

Osmunda cinnamomea L. was reported by Cooperrider (1959) from Jasper Co. based on a specimen collected by E. W. Graves in 1933. Cooperrider (1955a) considered his identification "doubtful," but did not have the specimen verified. Wagner identified the specimen as *Thelypteris palustris* Schott. The very robust, sterile frond was easily identified by stipe indument and stelar pattern. The large size of the frond led to the erroneous report.

Woodsia oregana D. C. Eaton was reported by Hartley (1962) from Clayton Co. based upon a specimen with immature fronds. The specimen was actually *Cystopteris fragilis* var. *mackayi*. Wagner also verified this identification. The genera *Cystopteris* and *Woodsia* have been problem genera for many Iowa workers, but they may be readily distinguished by the characters in Blasdell (1963) and Brown (1964).

Important Re-collections

Two species, each known from but a single station in Iowa, were thought to have been extirpated. Recent collections of these species indicate that the populations have persisted.

Marsilea vestita Hook. and Grev. was originally collected by Shimek in 1899 from Lyon Co. In 1963 M. L. Grant, University of Northern Iowa, re-collected the species, but did not formally report this find. The species might be periodic in its appearance in Iowa, particularly as frequent droughts occur in northwestern Iowa. Unfortunately, this species may again be "probably extirpated," as the station is now used as a hog-lot. Additional field work is warranted.

Selaginella apoda (L.) Spring was collected initially by R. F. Thorne and R. L. Hulbary in 1958 from a sandy seepage area along the Cedar River in Muscatine Co. The station was drained, ditched, and planted in corn. In 1976 I found that the population still persists. It is of interest that while the population was not fertile in 1958, it is now quite fertile, perhaps as a result of the disturbance.

FLORISTIC NOTES

Considering the extensive literature and the many herbarium specimens that have accumulated for only 60 taxa in the last 130 years, the Iowa pteridophytes are better known than any other vascular plant group in the state. An ever increasing number of extirpated populations of rare species indicates the extent of human impact in Iowa which has gone unabated since settlement. Parks and preserves include many pteridophyte species, but not all are so protected. If the living flora is to be preserved, future floristic efforts must be directed toward distinguishing between the cumulative historical flora and the remaining living populations. Toward that end, the present status of the state flora and the county floras are discussed. The evaluation is not completed and remains an important task for further study.

Status of the State Flora

Most Iowa pteridophyte species are known from relatively few of the 99 counties; most counties have few pteridophyte species. This pattern of generally depauperate occurrence to some extent reflects the distribution of forest vegetation in pre-settlement Iowa. The flat upland landscape dominates 80-90% of Iowa, leaving only 10-20% of the state with varied terrain. The upland vegetation was prairie and wetlands. Gallery forests occurred along river valleys, but forests on the upland were only found in extreme northeastern and southeastern Iowa. As most Iowa species of pteridophytes are found in forested habitats, it is not surprising that two-thirds of the Iowa pteridophytes are known from

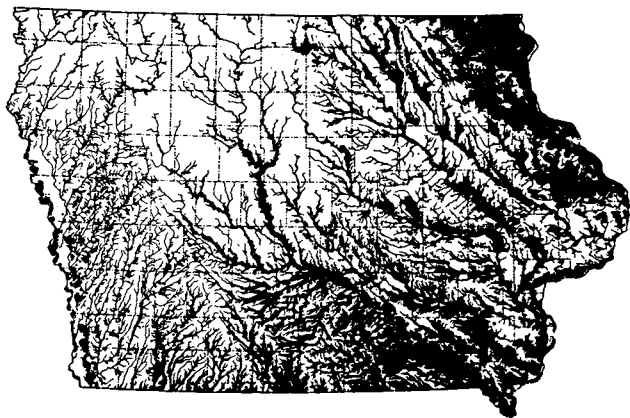


Fig. 1 Presettlement forest in Iowa reconstructed from original land survey conducted from 1832-1859, as presented in Shimek, B. 1948; p. 12, *The plant geography of Iowa*. Univ. Iowa Stud. Nat. Hist. 18(4): 1-178.

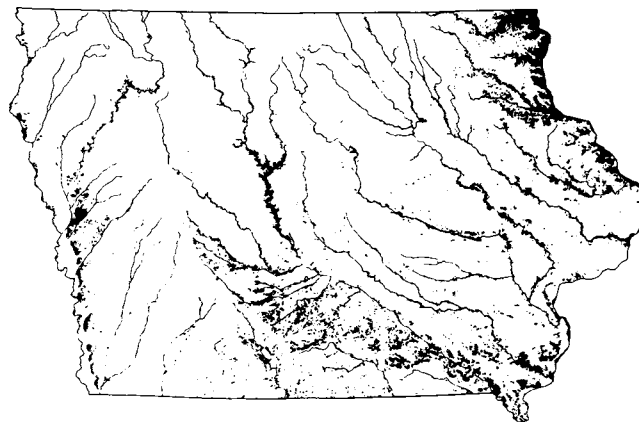


Fig. 2 Present forest in Iowa redrawn from remote-sensing, satellite photography gathered data as presented in *Land-Use in Iowa, Miscellaneous Map Series 5*, Iowa Geological Survey, 1976.

15 or fewer counties.

The lack of suitable habitats on the upland has been further emphasized by the plowing of virtually all prairies and the draining of most wetlands. Since settlement much of the gallery forest along major river systems has been cut, cleared, or grazed, leaving only remnants. A comparison of forest in Iowa at the time of settlement (Fig. 1) and at present (Fig. 2) illustrates the reduction in acreage. Continued demand on Iowa forests will further reduce the availability of suitable sites for pteridophyte populations. Because of the drastic reduction in suitable sites, many herbarium vouchers may no longer reflect extant populations.

Human impact may have favored some species. The weedy taxa of *Equisetum* (*E. arvense*, *E. × ferrissii*, *E. hyemale*, and *E. laevigatum*) have certainly increased in abundance and possibly expanded their distribution by road and railroad construction, ditch maintenance, plowing of fields, and grading of secondary roads. *Asplenium platyneuron* and *Botrychium dissectum* are found on coal-mine spoils in central Iowa, but have not been found in habitats that are not man-made. Human impact may also have favored these two ferns.

On the other hand, some species were formerly known from more stations than the few that exist today. *Osmunda cinnamomea* and *O. regalis* were recently reported from Delaware Co. (Rickey, 1964), but the locality for *O. cinnamomea* was destroyed by cattle, while that of *O. regalis* was destroyed by road construction. *Osmunda cinnamomea*, known from three counties, persists only in Muscatine Co. *Osmunda regalis*, known from five counties, persists only in Cedar Co. *Dryopteris marginalis*, known from three counties, persists only in Hardin Co. *Ophioglossum pseudopodium*, known from three counties, might soon be represented only in Chickasaw Co. because the Linn Co. station has suffered from road building and dredging in 1975 and 1976, while the Bremer Co. station consisted of one plant with two leaves in 1976. *Lycopodium flabelliforme*, known from eight counties, has recently been observed in only three counties, and one of these stations has been declining. *Equisetum fluviatile*, known from 18 counties, may persist in only eight counties.

Some species occur in eastern Iowa and have disjunct, or "outlier" populations reported from central Iowa. Many of these outlier populations have not been observed in the last 40 years. Loss of peripheral stations may have occurred in such species as *Dryopteris intermedia*, *D. spinulosa*, *Equisetum pratense*, *E. sylvaticum*, *Gymnocarpium dryopteris*, *Lycopodium lucidulum*, *Pellaea glabella*, *Phegopteris hexagonoptera*, *Polypodium virginianum*, *Pteridium aquilinum*, and *Thelypteris palustris*.

Further discussion of the persistence of the Iowa pteridophyte flora must await additional field work.

Status of the County Floras

The pteridophyte floras of the 99 counties of Iowa are presented in Fig. 3. Twenty-three counties, having five or fewer taxa, are considered depauperate. Twenty counties, having 20 or more taxa, are considered rich floristically. Counties with depauperate floras tend to have little habitat diversity, slight topographic relief, and many are in the Great Plains floristic region. These counties are also less well collected than counties in eastern Iowa. The rich county floras in eastern Iowa have considerable habitat diversity, extreme topographic relief, and large tracts of forest. These counties are also near the species-rich Great Lakes floristic region to the northeast and to the richer Interior Highlands floristic region of Illinois and Missouri to the east and southeast.

The rich floras of Marion and Webster Co., isolated from the eastern counties, may be attributed to the many diverse micro-habitats afforded by the deep, river valley and tributaries of the Des Moines River system. Here the exposed sandstone bed rock and steep, north-facing slopes provide a relative constancy of moisture and temperature not encountered in other interior counties. The richness of the Hardin Co. flora, also an interior county, is even more astounding. Little forest existed in Hardin Co., and what does persist is located in the "Greenbelt" along the Iowa River. All 30 taxa are located in that zone. Topographic relief is less than that along the Des Moines River. An explanation might well involve an understanding of effects of Wisconsin glaciation on the vegetation. It is noteworthy that M. E. Plouffe (1977) observed 27 of the 30 taxa in a recent study of the Greenbelt vegetation. No other rich county flora is as well supported with recent observations of its pteridophyte flora.

THE FLORA

As a result of this study, so many changes in nomenclature and distribution have been added to the previous state pteridophyte flora (Cooperrider, 1959) that a restatement is warranted rather than a set of corrective notes. New dot maps were plotted to add 408 new county records to 846 records reported by Cooperrider (1959) and verified in this study, contributing to a 47% increase in total county collection records. New records were plotted with stars, while verified records in Cooperrider (1959) were plotted with dots.

The occurrence of the species is presented based upon the following

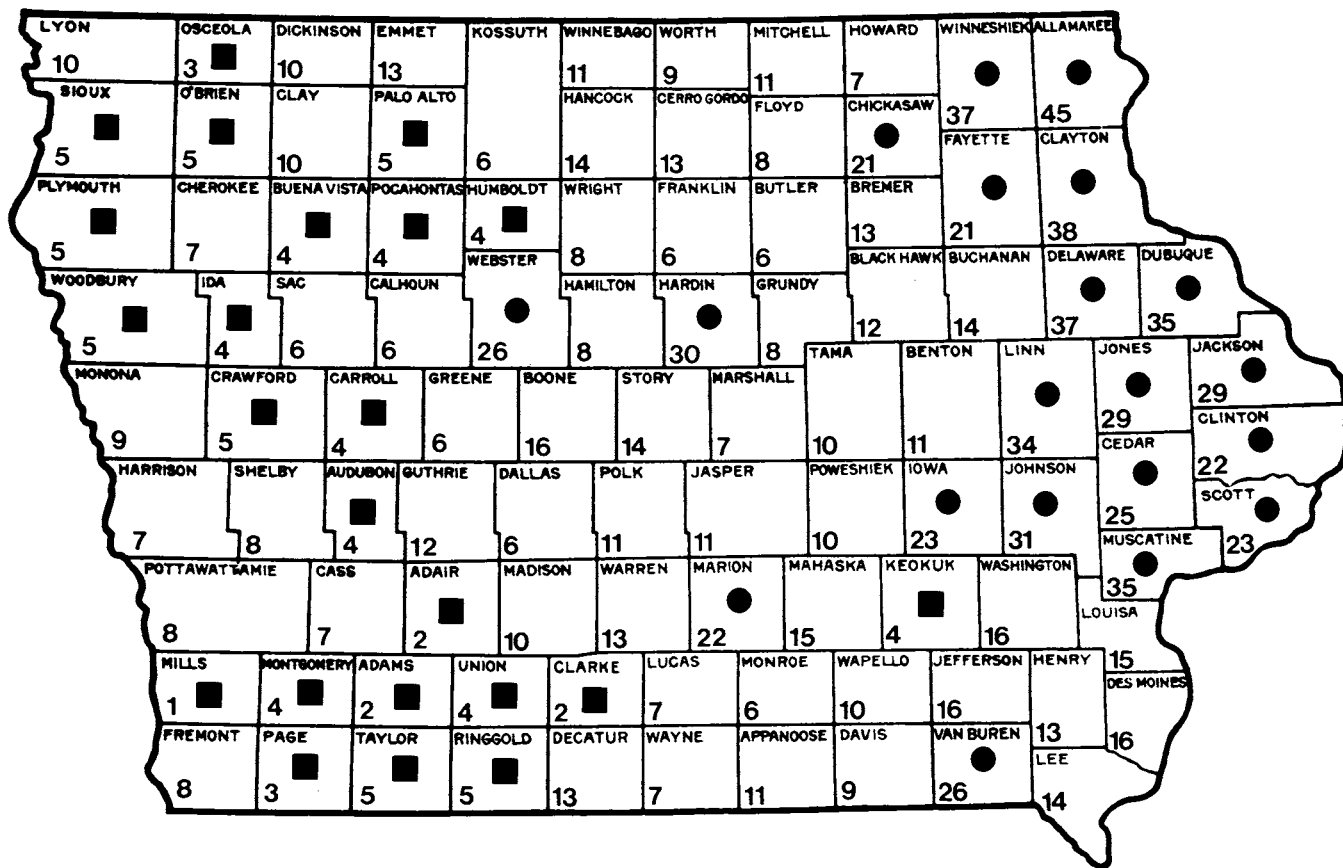


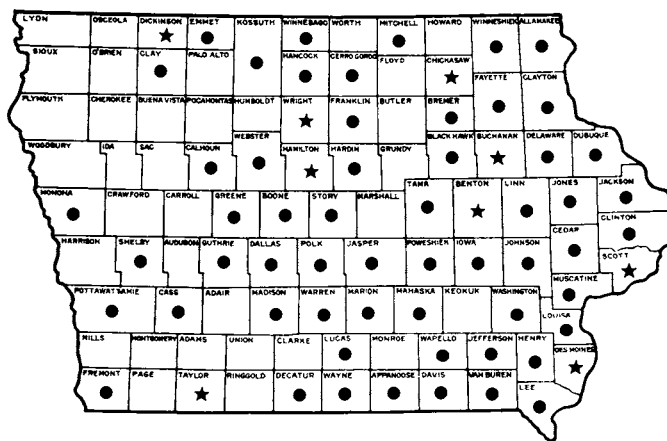
Fig. 3 Summary of county floras (species plus hybrids)

Depauperate ■

Rich ●

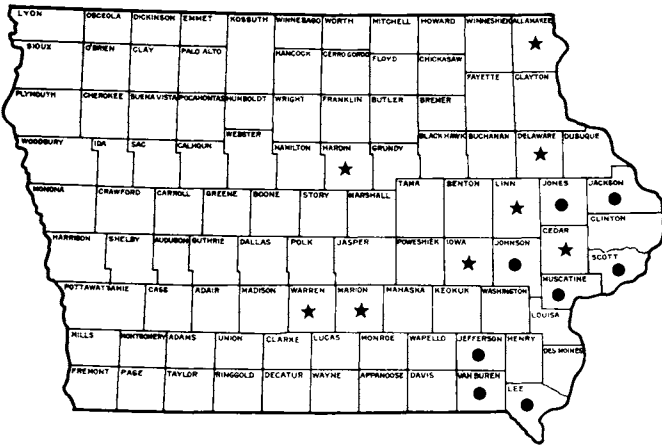
criteria: *common* = known from 46 or more counties, *frequent* = 31-45 counties, *infrequent* = 16-30 counties, and *rare* = 1-15 counties. Species in the flora which lack living populations are considered *possibly extirpated*. The occurrence of a species is presented with the number of counties in parentheses. Accordingly, eight species and one hybrid are designated as common, four species as frequent, ten species as infrequent, 32 species and two hybrids as rare. Three species are considered possibly extirpated. Nearly two-thirds of the Iowa pteridophytes are rare in Iowa, occurring in 15 or fewer counties. To clarify the abundance of species in populations across the state, the occurrence is restated in terms of regions of the state. Regional assessments are based upon my field experience supplemented with label data of other collectors.

Remarks are presented on habitat preferences as noted on label data and from my field experience.

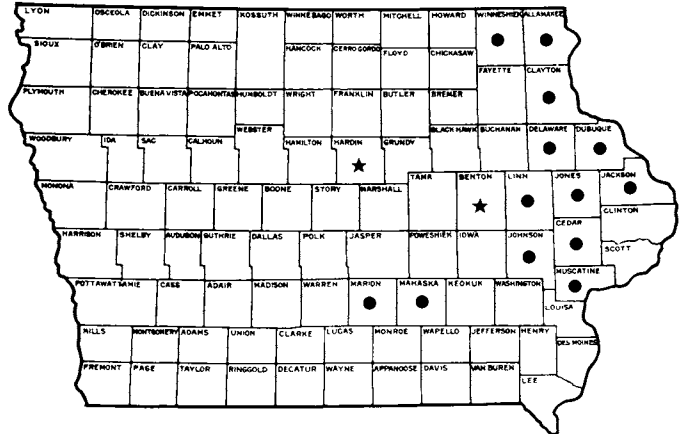


Adiantum pedatum L. Northern maidenhair fern
 Common (65): rare western third; frequent to common elsewhere
 Moist woods and ravines; rocky slopes

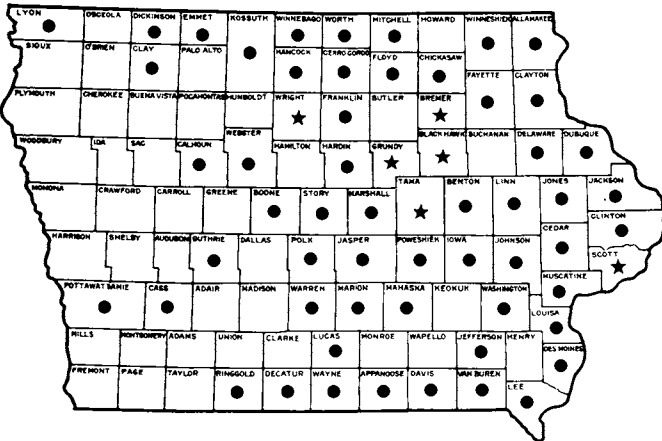
PTERIDOPHYTE FLORA



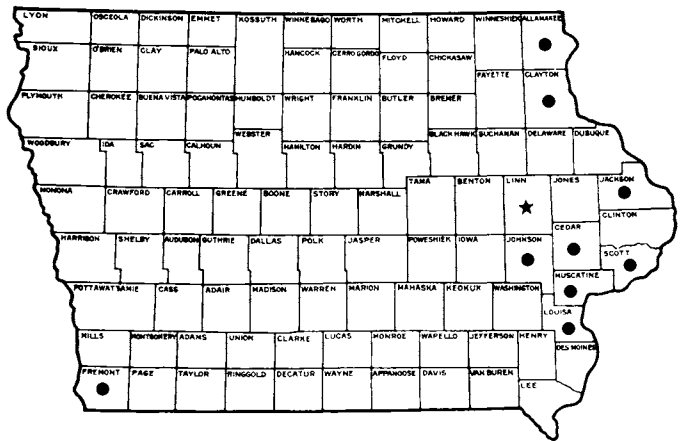
Asplenium platyneuron Oakes ex D. C. Eaton Ebony spleenwort
 Infrequent (16): rare central, southcentral, and northeast;
 infrequent southeast
 Shaded, sandstone out-crops and talus slopes; moist, wooded,
 sandy slopes; shaded ravines on coal-mine spoils



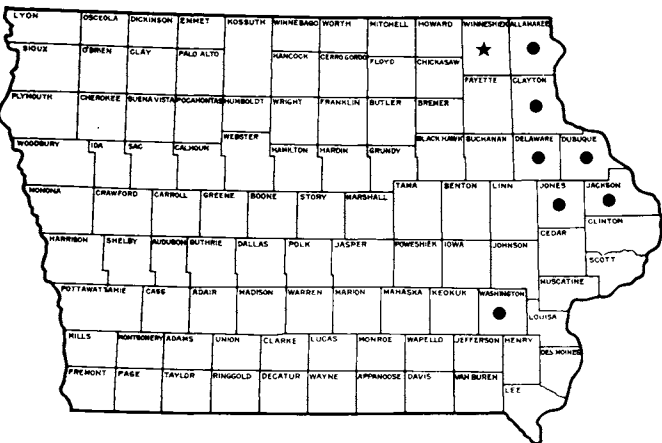
Athyrium thelypteroides (Michx.) Desv. Silvery glade fern
 Rare (15): rare central; infrequent eastern third
 Moist upland woods, ravines, and slopes; north-facing bluffs
 and talus; sandstone out-crops



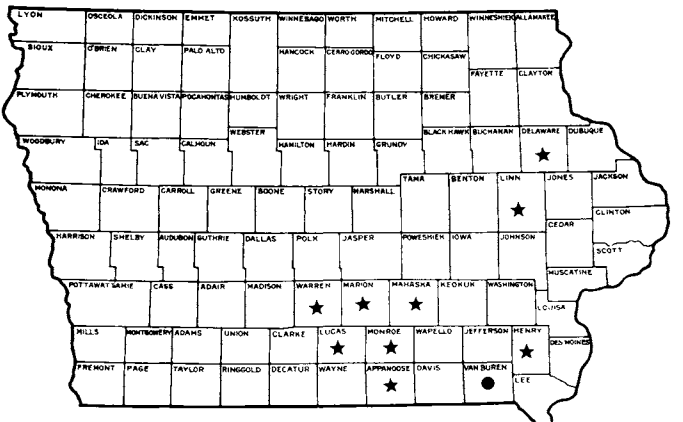
Athyrium angustum (Willd.) Prantl Northeastern lady fern
 Common (61): rare western third; frequent to common
 elsewhere
 Moist upland woods; wooded slopes and alluvium; margins and
 openings in woods



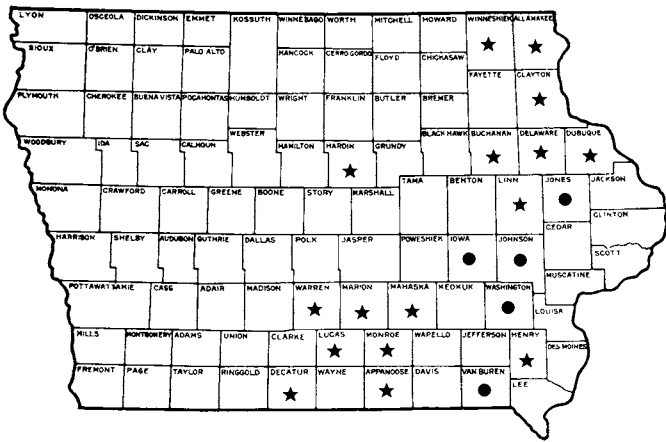
Azolla mexicana Presl Mosquito fern
 Rare (9): rare southwest and eastern third
 Shallows of ponds and backwaters; floating or stranded on mud
 or sand flats



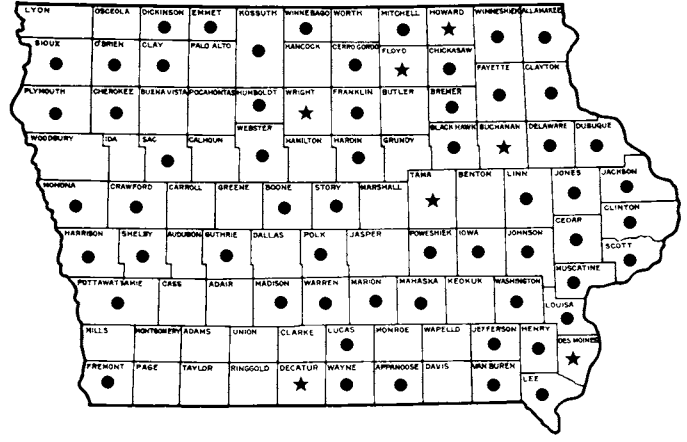
Athyrium pycnocarpon (Spreng.) Tidestr. Glade fern
 Rare (8): rare eastern third
 Moist alluvial woods; north-facing wooded slopes; shaded,
 sandy soil



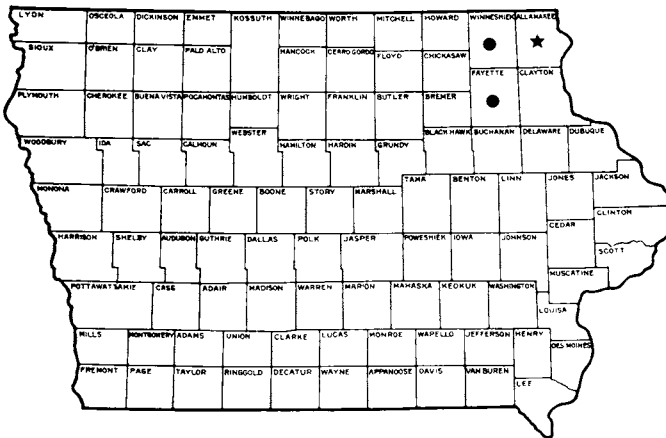
Botrychium dissectum Spreng. var. *dissectum* Dissected grape fern
 Rare (10): rare eastern half
 Dry, upland woods; rich wooded slopes; coal-mine spoils



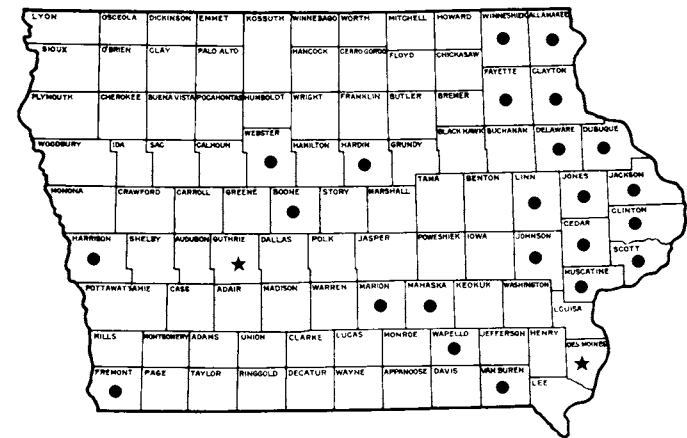
Botrychium dissectum Spreng. var. *obliquum* Clute
 Infrequent (21): rare eastern third; infrequent southcentral
 Dry, upland woods; rich wooded slopes; coal-mine spoils



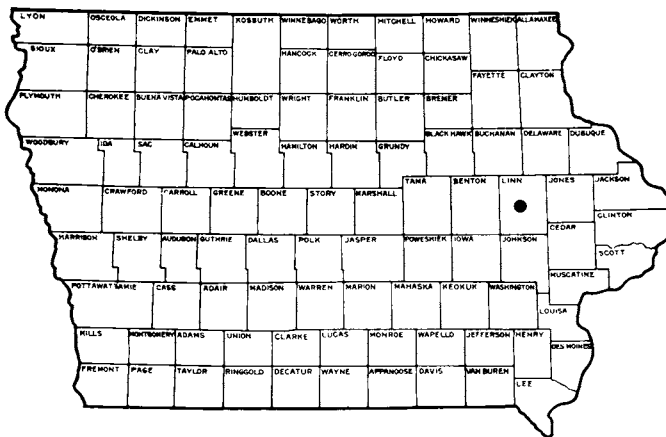
Botrychium virginianum (L.) Sw.
 Common (65): frequent western half; common eastern half
 Upland woods; moist wooded slopes and alluvium



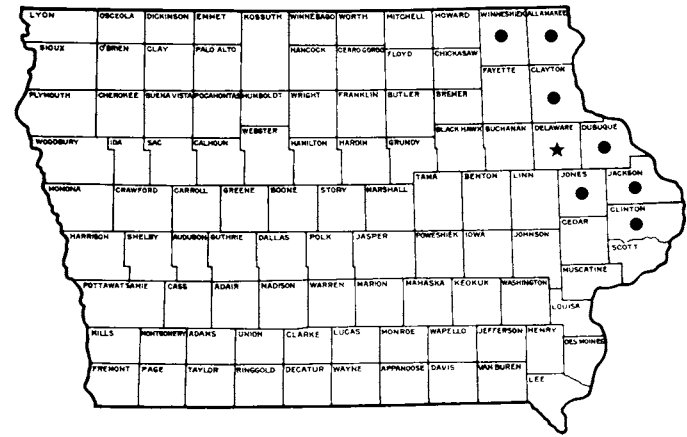
Botrychium multifidum (Gmel.) Rupr.
 Rare (3): rare northeast
 Sandy, dry, upland woods



Camptosorus rhizophyllus (L.) Link
 Infrequent (25): rare western half; infrequent southeast; frequent northeast
 Humus covered ledges and rocks in moist ravines

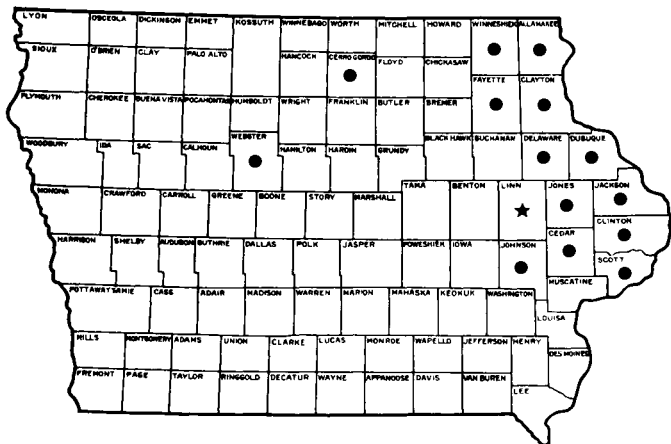


Botrychium simplex E. Hitchc.
 Rare (1): possibly extirpated from Linn Co.
 Sandy pasture near marsh

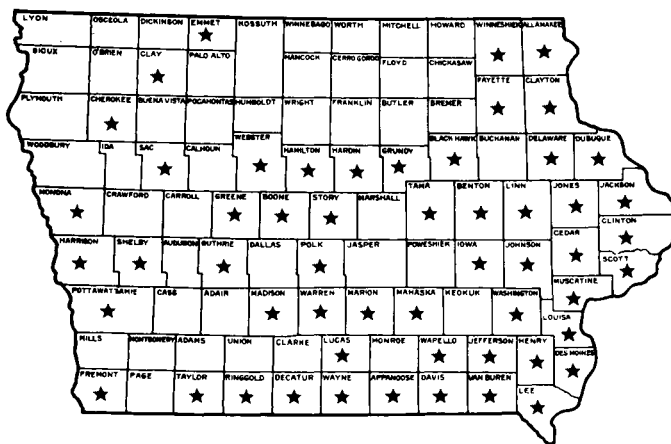


Cheilanthes feei Moore
 Rare (8): rare northeast
 Cracks and crevices of exposed, dry, dolomite cliffs

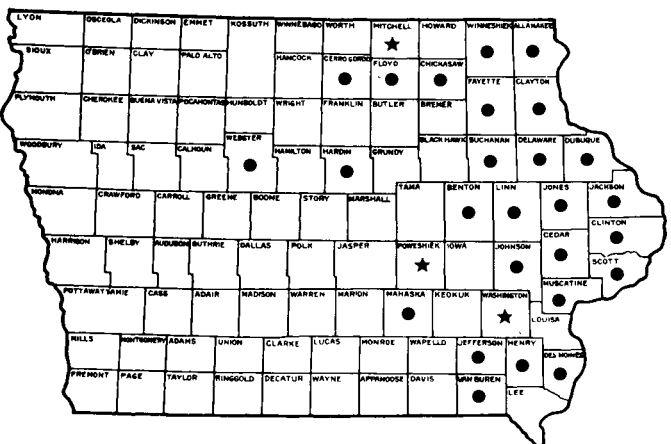
PTERIDOPHYTE FLORA



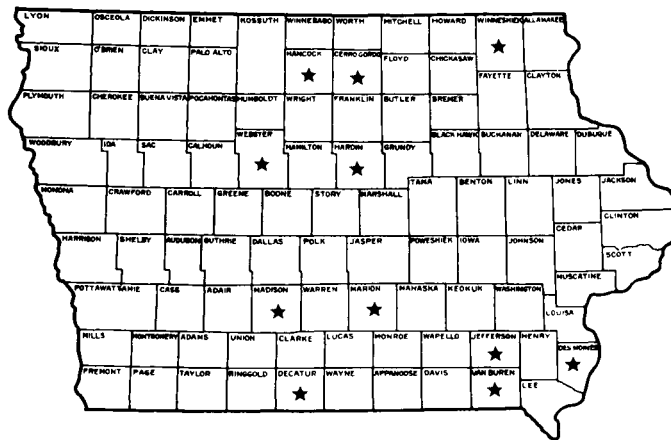
Cryptogramma stelleri (Gmel.) Prantl Slender cliff-brake
 Rare (15): rare central and eastcentral; infrequent northeast
 Moist, shaded cliffs, cool, rock talus slopes; sandstone and limestone



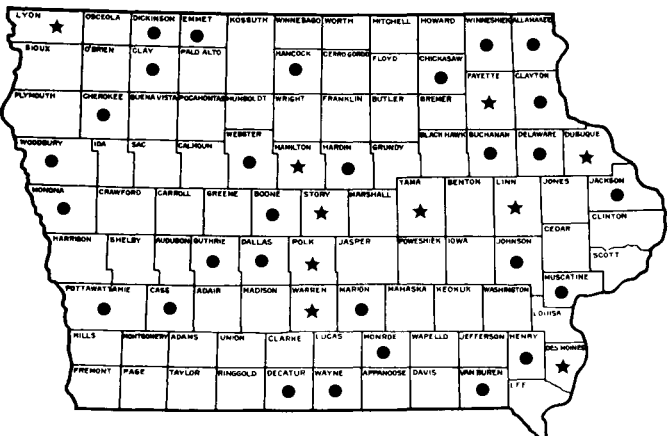
Cystopteris protrusa (Weath.) Blasdell Creeping fragile fern
 Common (54): infrequent western third; frequent central;
 common eastern third
 Moist wooded slopes and alluvium



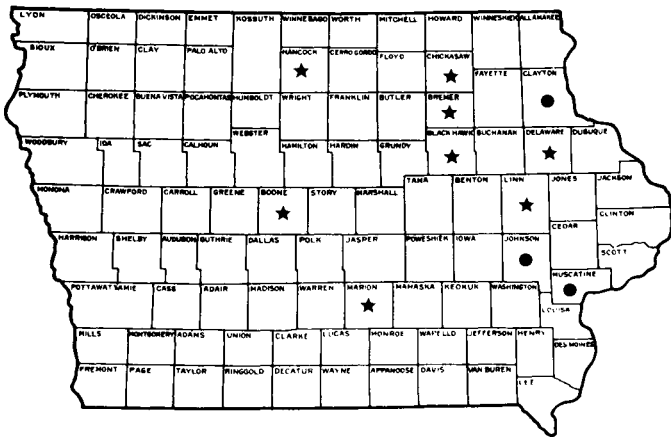
Cystopteris bulbifera (L.) Bernh. Bulblet fern
 Infrequent (19): rare central; infrequent southeast; frequent northeast
 Moist rocky slopes and ledges; exposed outcrops; sandstone and limestone



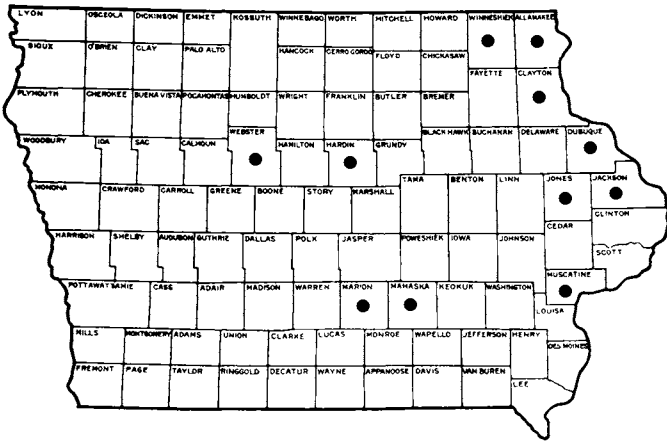
Cystopteris x tennesseensis Shaver Southern hybrid-bulblet fern
 Rare (11): rare eastern half
 Ledges in moist, wooded ravines; sandstone and limestone



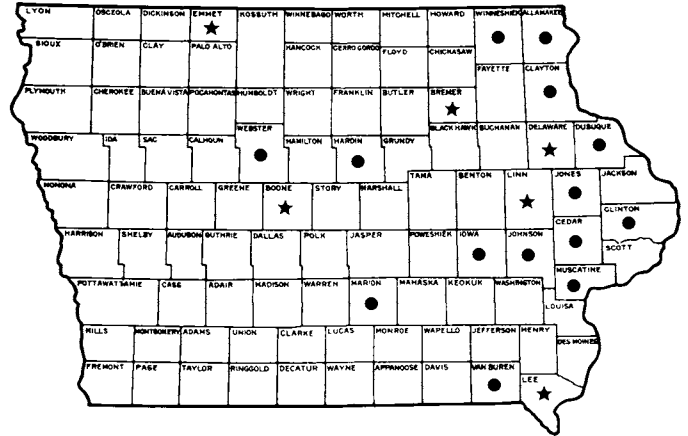
Cystopteris fragilis (L.) Bernh. var. *mackayi* Laws. Mackay's fragile fern
 Frequent (39): common northeast; rare southwest; frequent elsewhere
 Ledges and crevices; sandstone and limestone



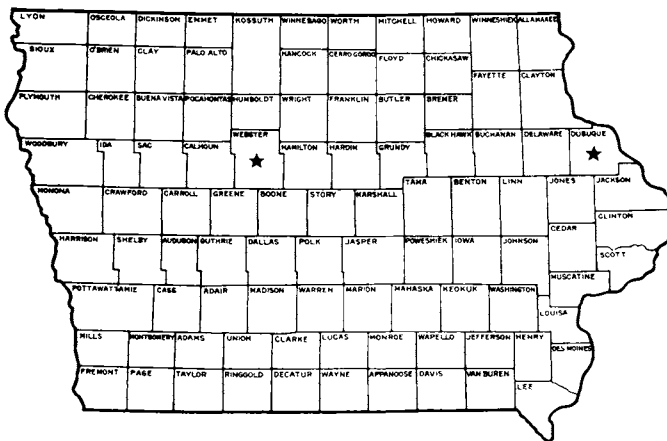
Dryopteris cristata (L.) Gray Crested wood fern
 Rare (11): rare in eastern half
 Sandy seeps and marshes; sphagnum bog; coal-mine spoils



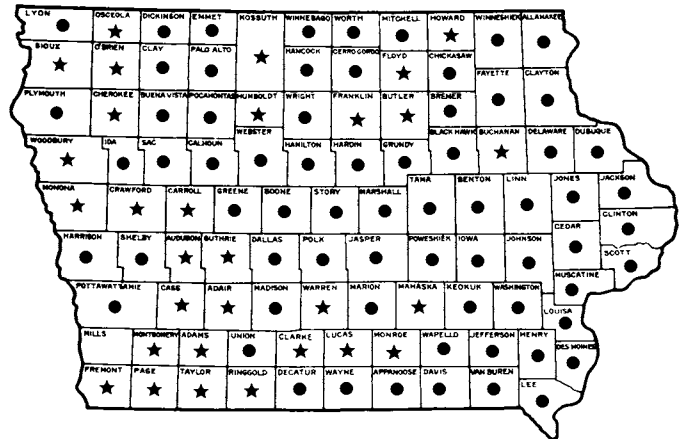
Dryopteris goldiana (Hook.) Gray Goldie's wood fern
Rare (11): rare eastern half
Moist humus at base of steep, north-facing slopes



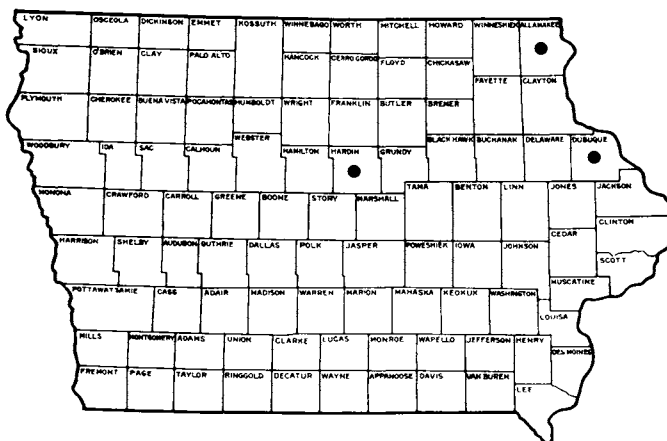
Dryopteris spinulosa (O. F. Muell.) Watt Spinulose wood fern
Infrequent (20): rare central and southeast; infrequent northeast
Moist humus of north-facing slopes; sandstone ledges



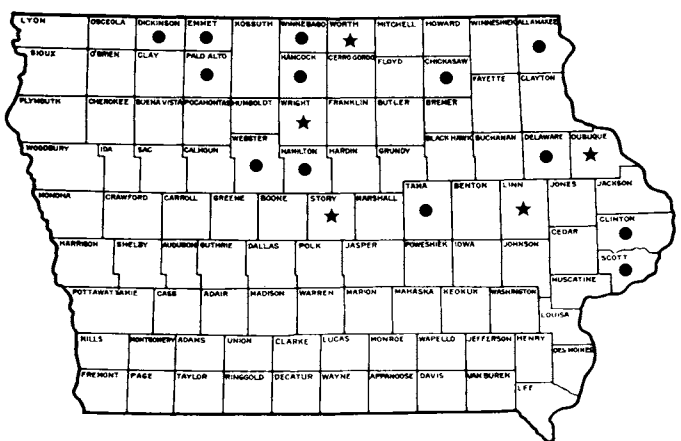
Dryopteris intermedia Gray Glandular wood fern
Rare (2): rare central and eastcentral
Moist humus at base of steep north-facing slopes



Equisetum arvense L. Field horsetail
Common (98): frequent to infrequent western half; common eastern half
Variety of disturbed habitats: roadsides, railroad ballast, alluvial prairies, sandy soil, ditches, and stream banks

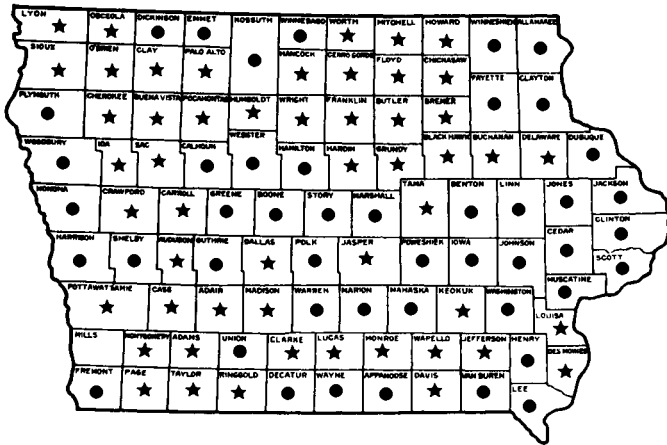


Dryopteris marginalis (L.) Gray Marginal shield fern
Rare (3): rare central and northeast
Moist humus to sandy soil on wooded, north-facing slopes; sandstone outcrops

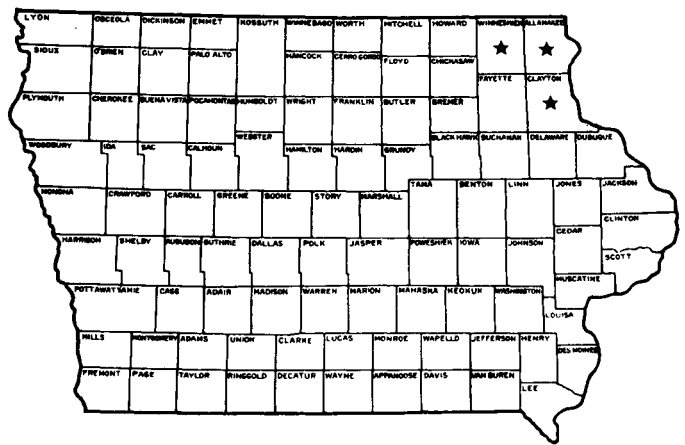


Equisetum fluviatile L. Water horsetail
Rare (18): rare northern half
Variety of wetland habitats: marshes, ponds, seeps, stream margins

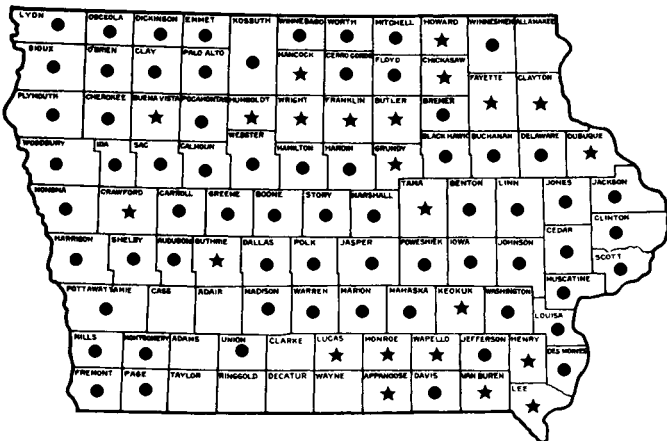
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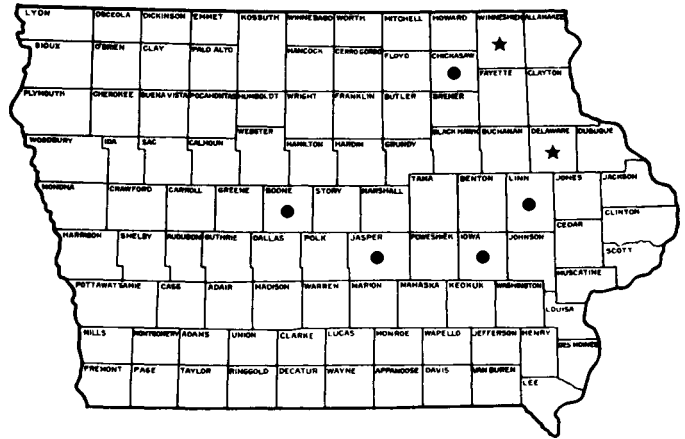
Equisetum hyemale L. Common scouring-rush
 Common (98): infrequent western third; frequent to common elsewhere
 Variety of disturbed habitats: roadsides, railroad ballast, moist prairies, shaded stream banks, along water courses



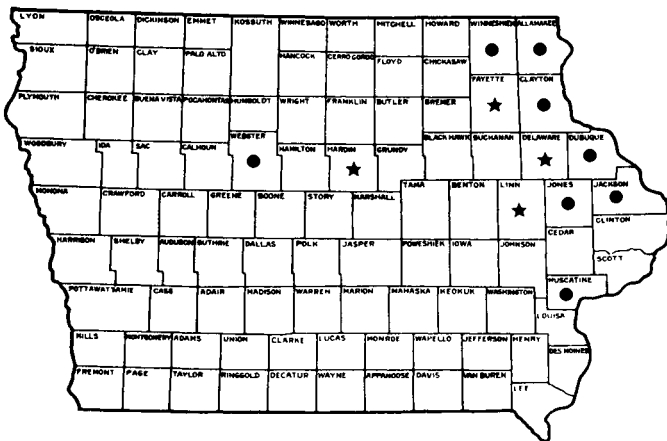
Equisetum scirpoides Michx. Dwarf scouring-rush
 Rare (3): rare extreme northeast
 Openings on wooded, north-facing slopes; moss covered talus at seeps



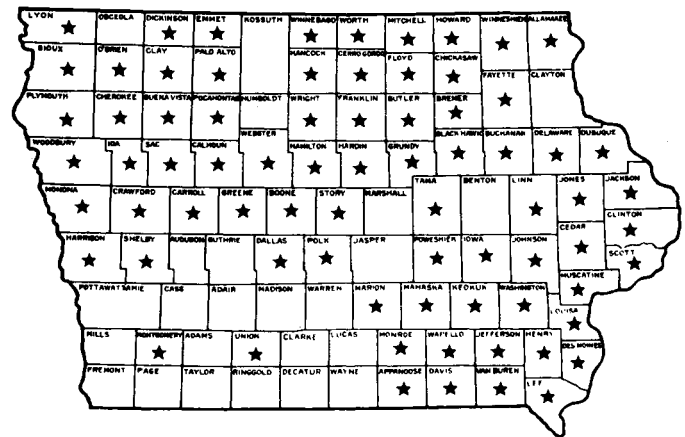
Equisetum laevigatum A. Br. Smooth scouring-rush
 Common (90): infrequent southern half; common northern half
 Dry prairies and variety of disturbed habitats: roadsides, railroad ballast; loess bluffs and sandy areas



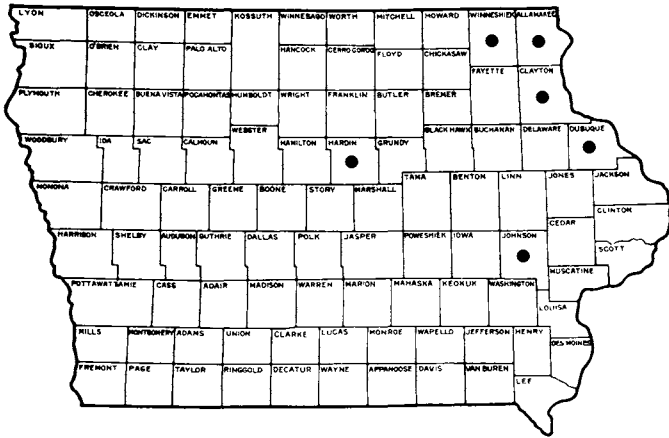
Equisetum sylvaticum L. Woodland horsetail
 Rare (7): rare central and northeast
 Sandy seeps on wooded, north-facing slopes; moist sandy areas



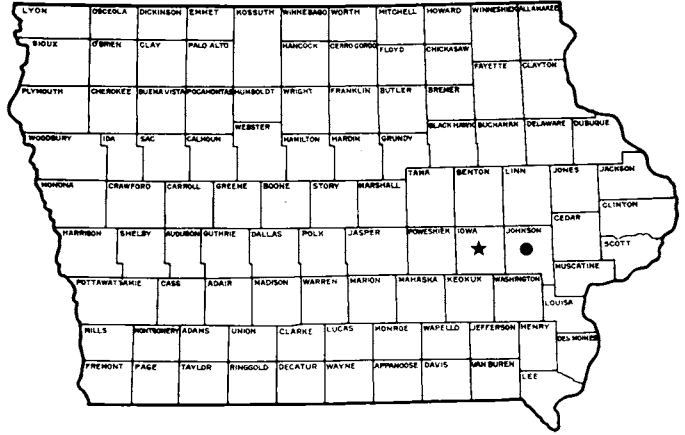
Equisetum pratense Ehrh. Meadow horsetail
 Rare (12): rare central and eastcentral; infrequent northeast
 Moist, wooded, north-facing slopes; sandy to rocky



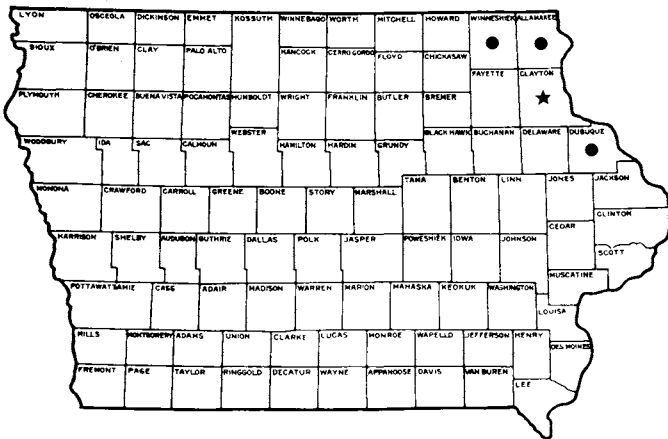
Equisetum × *ferrissii* Clute Ferriss' hybrid scouring-rush
 Common (75): common northwest and northcentral; frequent to infrequent elsewhere
 Dry to moist prairies; disturbed habitats: roadsides and railroads



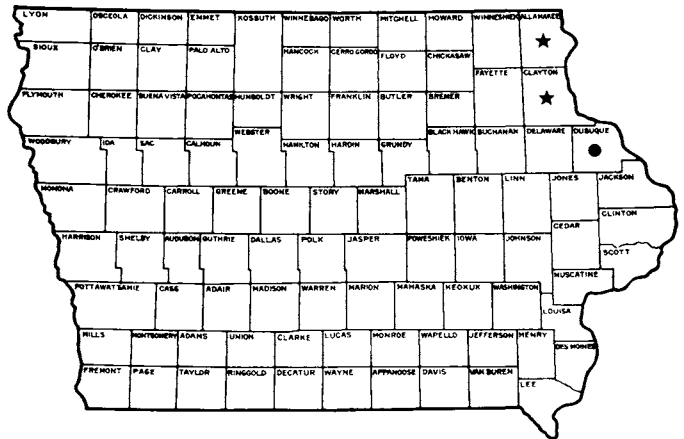
Gymnocarpium dryopteris (L.) Newm. Oak fern
 Rare (6): rare central; rare to infrequent northeast
 North-facing cliffs and rocky slopes; cool, moist, moss-covered talus slopes



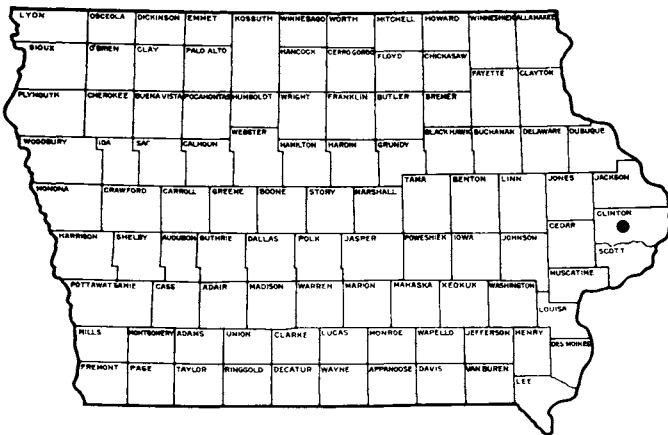
Lycopodium clavatum L. Running clubmoss
 Rare (2): rare eastcentral
 Disturbed, sandy, wooded slopes and embankments



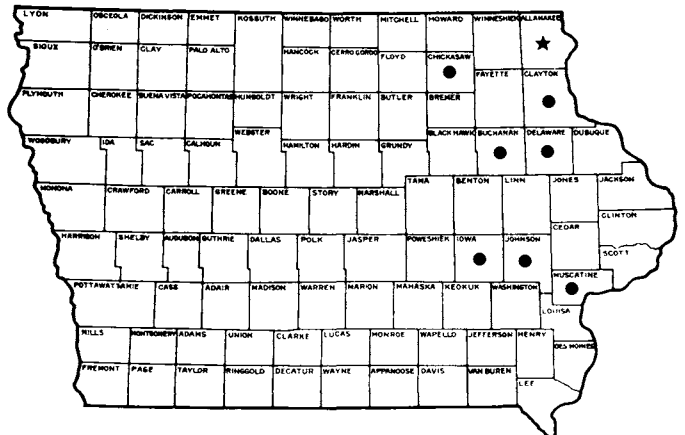
Gymnocarpium robertianum (Hoff.) Newm. Limestone Oak fern
 Rare (4): rare northeast
 North-facing cliffs and rocky slopes; cool, moist, moss-covered talus slopes



Lycopodium dendroideum Michx. Round-branched ground-pine
 Rare (3): rare northeast
 North-facing, wooded, sandstone bluffs; moist, cool, talus slopes

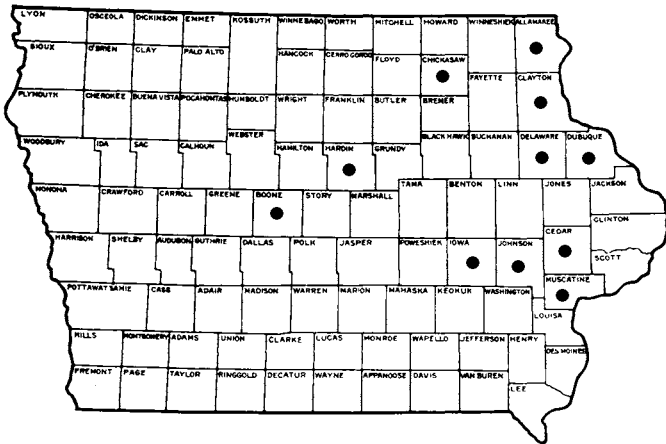


Isoetes melanopoda Gay and Dur. Midland quillwort
 Rare (1): possibly extirpated from Clinton Co.
 Prairies (no data on Iowa specimen)

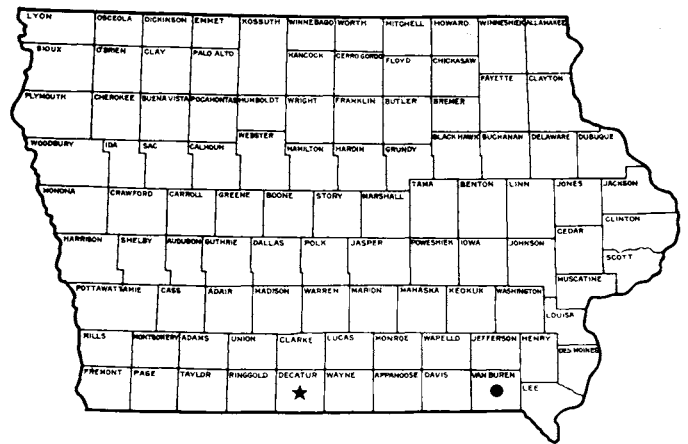


Lycopodium flabelliforme (Fern.) Blanch. Crowfoot clubmoss
 Rare (8): rare eastern third
 North-facing, sandy, wooded slopes; sandy embankments

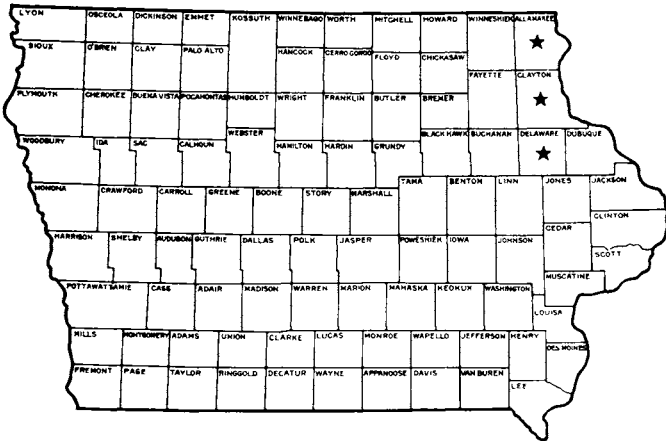
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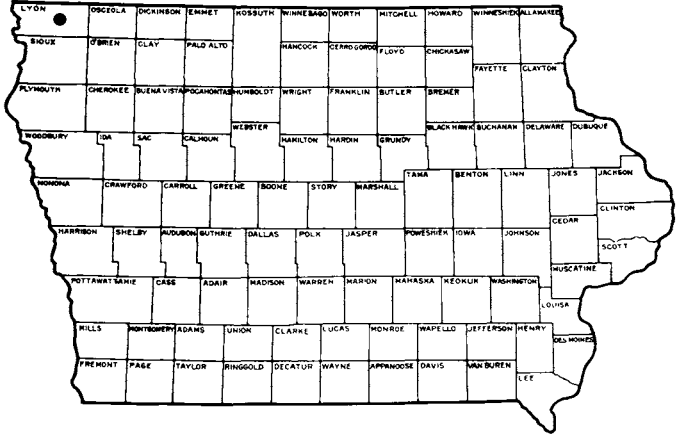
Lycopodium lucidulum Michx. Shining clubmoss
 Rare (11): rare eastern half
 Moist sandy soil and sandstone rocks at base of steep, north-facing slopes and bluffs



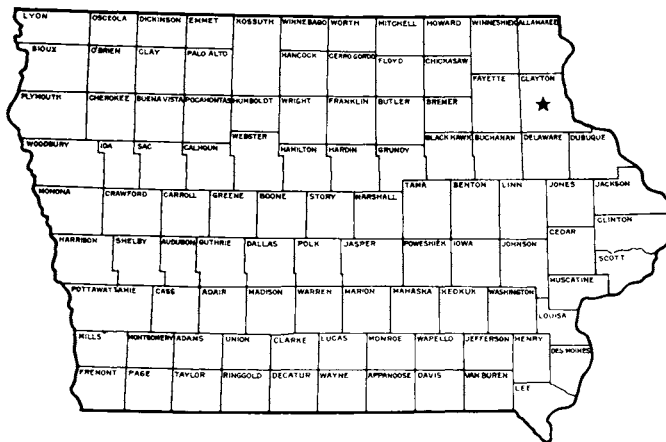
Marsilea quadrifolia L. European water-clover
 Rare (2): rare southcentral and southeast (Escape; now naturalized)
 Muddy shallows of sheltered or lake margins



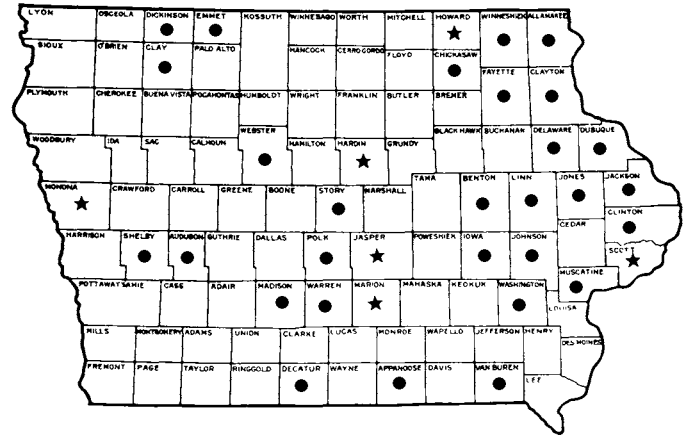
Lycopodium porophyllum Lloyd and Underw. Rock clubmoss
 Rare (3): rare northeast
 Moist, wooded, north-facing sandstone cliffs and bluffs



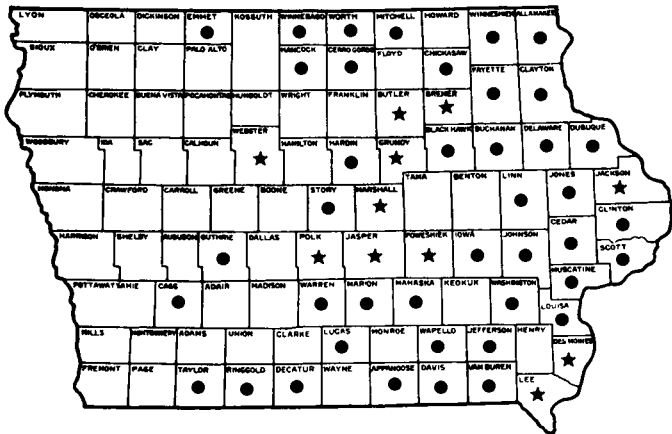
Marsilea vestita Hook. and Grev. Hairy water-clover
 Rare (1): rare and periodic (?) in northwest
 Muddy depressions in rocky prairies



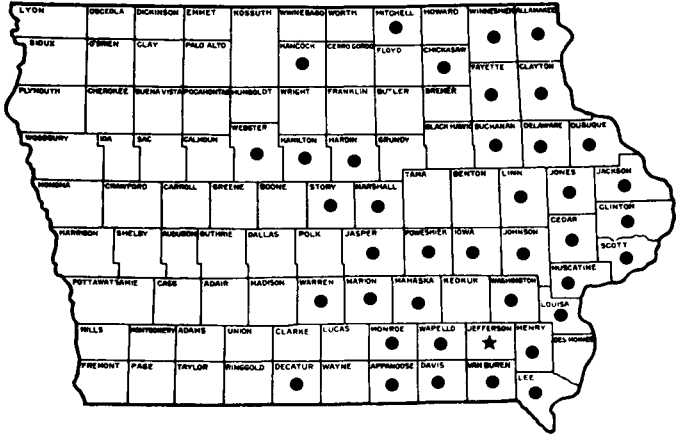
Lycopodium lucidulum x *L. porophyllum* (no common name)
 Rare (1): rare northeast
 Moist, wooded, north-facing sandstone cliffs and bluffs



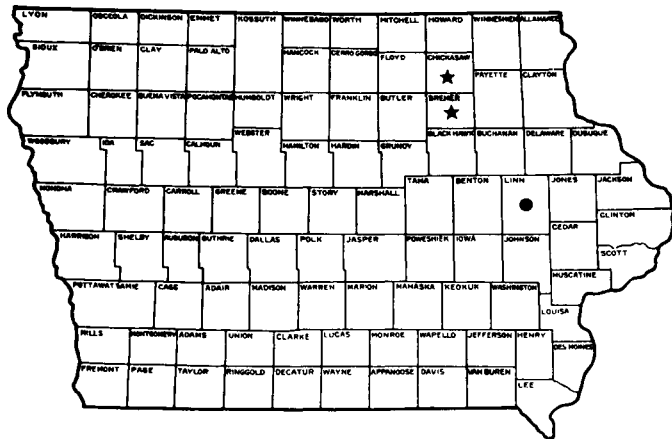
Matteuccia struthiopteris (L.) Tod. American ostrich fern
 Frequent (35): rare western half; frequent southeast; common northeast
 Moist, wooded, slopes and alluvium



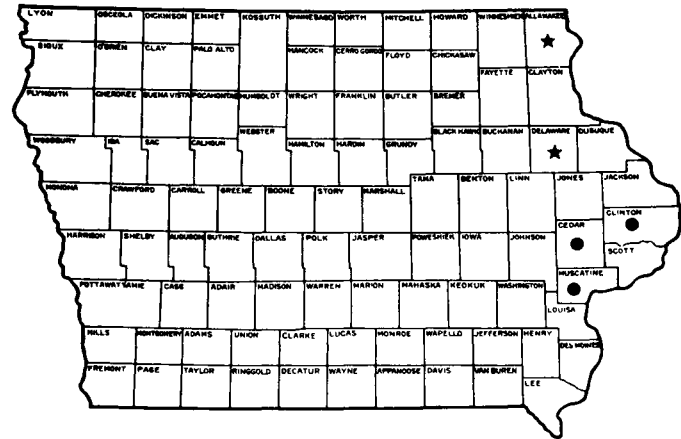
Onoclea sensibilis L. Sensitive fern
Common (52): infrequent southwest and northcentral; common eastern half
Moist, sandy, open areas: marshes, woods, alluvium



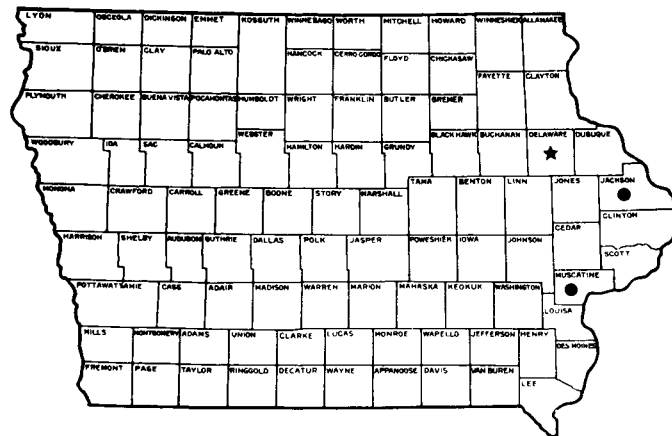
Osmunda claytoniana L. Interrupted fern
Frequent (40): infrequent central third; frequent eastern third
Moist, wooded, north-facing slopes and alluvium



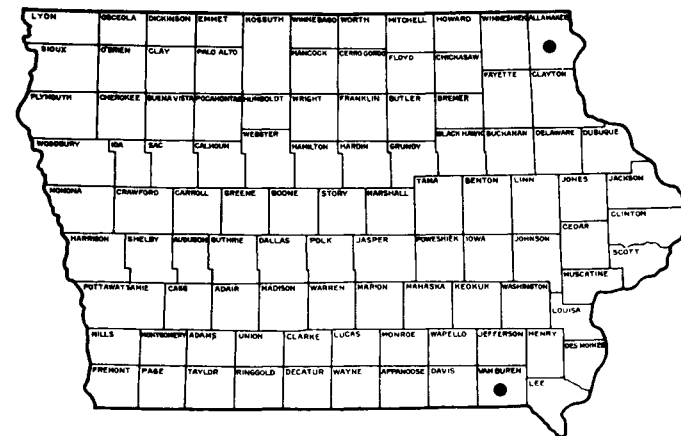
Ophioglossum pseudopodium (Blake) Far. Northern adder's-tongue fern
Rare (3): rare northeast
Moist sandy soil and sedge tussocks; margins of woods



Osmunda regalis L. American royal fern
Rare (5): rare eastern fourth
Moist, sandy openings; sandy hillside seeps

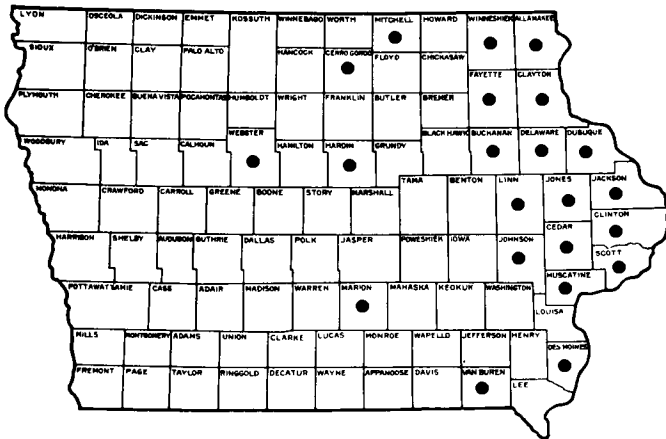


Osmunda cinnamomea L. Cinnamon fern
Rare (3): rare eastern fourth
Moist, sandy areas at base of wooded, north-facing slopes

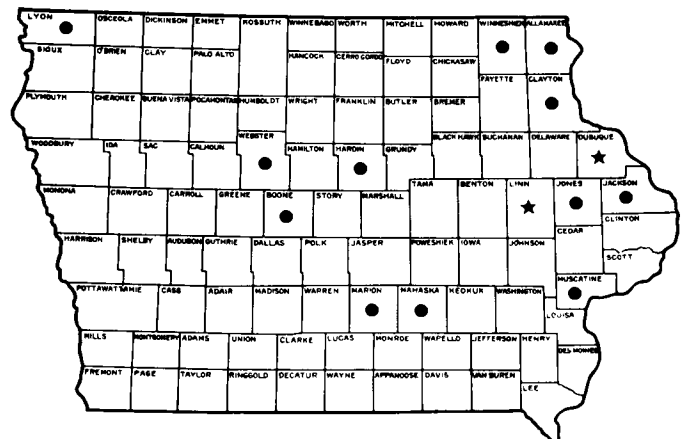


Pellaea atropurpurea (L.) Link Purple cliff-brake
Rare (2): rare extreme northeast and extreme southeast
Dry, exposed sandstone outcrops

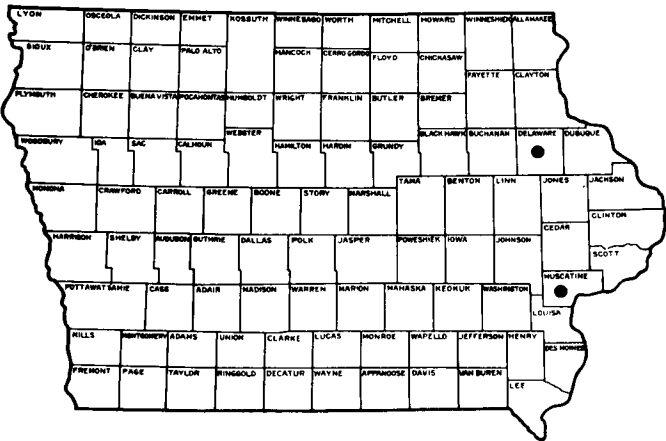
PTERIDOPHYTE FLORA



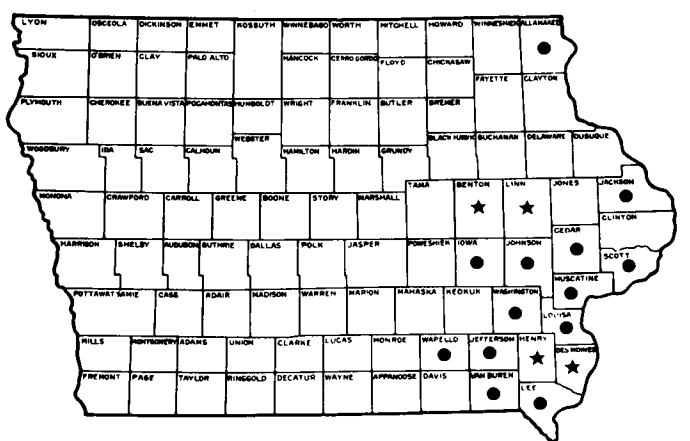
Pellaea glabella Mett. ex Kuhn Smooth cliff-brake
 Infrequent (22): rare central third, infrequent eastern third
 Crevices of exposed calcareous sandstone or limestone bluffs or ledges



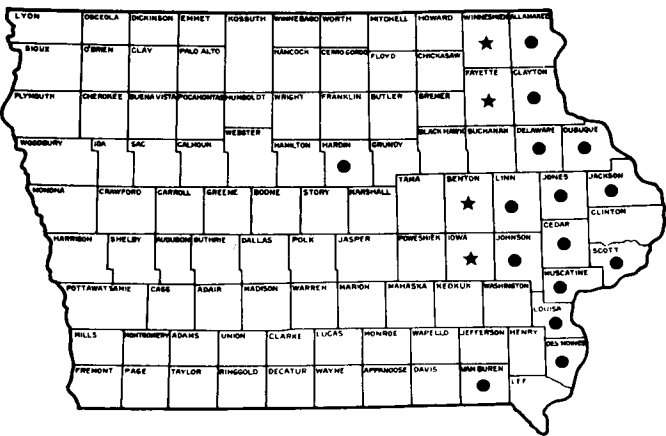
Polygodium virginianum L. Common polyopody
 Rare (14): infrequent extreme northeast; rare elsewhere
 Moist, wooded, north-facing sandy slopes and sandstone cliffs; climbing base of tree (Des Moines Co.)



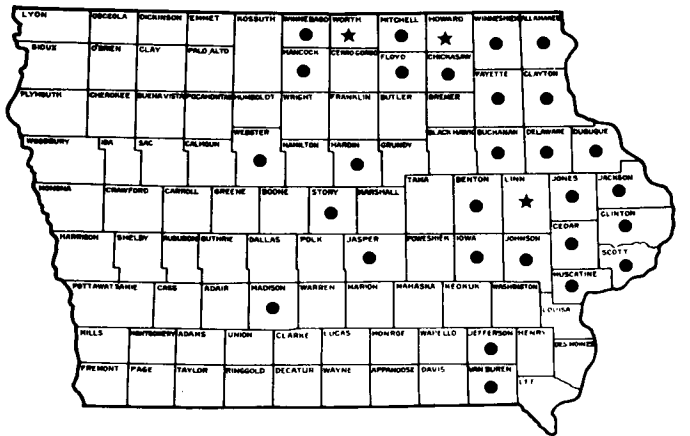
Phegopteris connectilis (Michx.) Watt Northern beech fern
 Rare (2): possibly extirpated from Delaware and Muscatine counties
 Moist wooded sandstone talus and bluffs



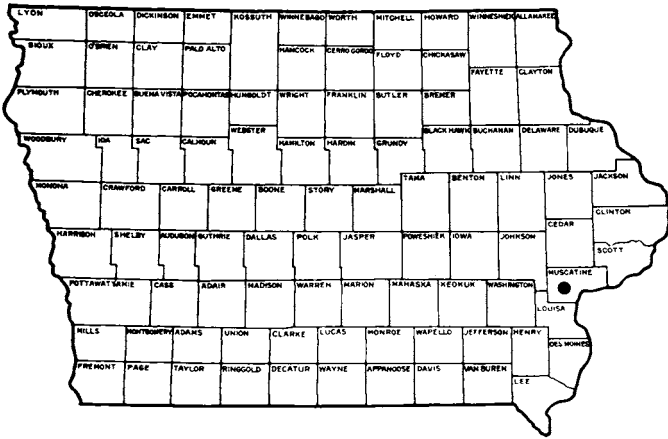
Polystichum acrostichoides (Michx.) Schott Christmas fern
 Infrequent (17): rare northeast; infrequent eastcentral; frequent southeast
 Moist, wooded, sandy north-facing slopes



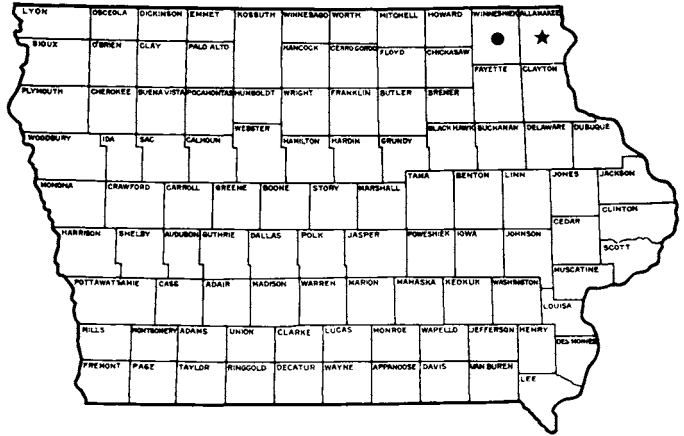
Phegopteris hexagonoptera (Michx.) Fee Southern beech fern
 Infrequent (18): rare central and southeast; infrequent northeast
 Moist humus at base of wooded, north-facing slopes



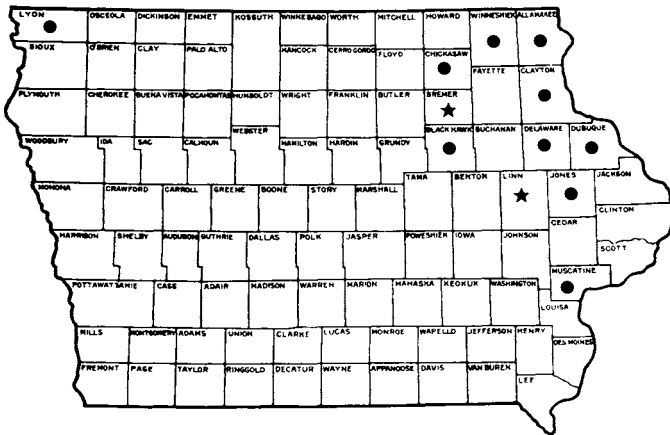
Pteridium aquilinum (L.) Kuhn. Bracken fern
 Frequent (31): rare central and southeast; infrequent east; frequent northeast
 Sandy soil; disturbed margins of woods; embankments



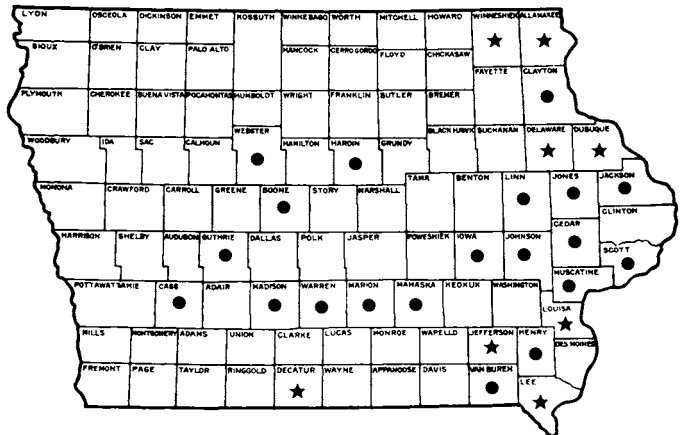
Selaginella apoda (L.) Spring Meadow spikemoss
Rare (1): known only from Muscatine Co.
Moist, sandy, open, pastured field



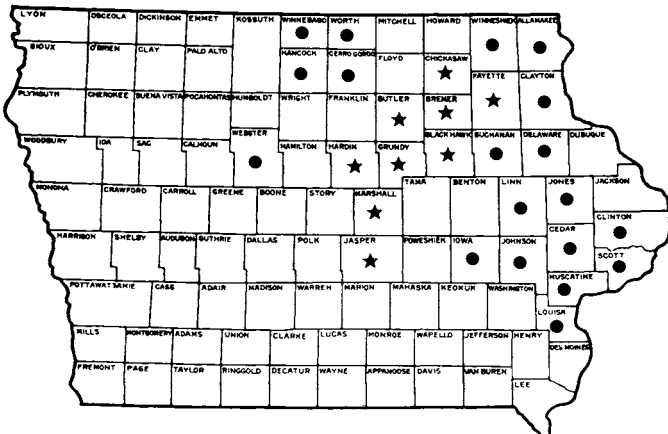
Woodsia ilvensis (L.) R. Br. Rusty cliff fern
Rare (2): rare extreme northeast
Dry, exposed cliffs and ledges; sandstone crevices



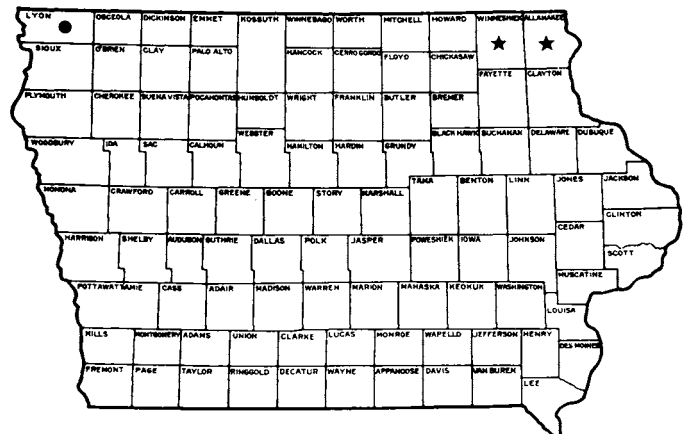
Selaginella rupestris (L.) Spring Rock spikemoss
Rare (12): rare northwest and rare eastern third
Dry, exposed quartzite rocks; dry, exposed limestone and sandstone; dry, exposed, sandy soils



Woodsia obtusa (Spreng.) Torr. Blunt-lobed cliff fern
Infrequent (28): rare central; infrequent southeast; frequent northeast
Dry, exposed sandstone and limestone cliffs and ledges



Thelypteris palustris Schott Marsh fern
Infrequent (29): infrequent central and southeast; frequent northeast
Moist open places: marshes, ditches, seeps, sandy slopes, sphagnum bog



Woodsia oregana D. C. Eaton Western cliff fern
Rare (3): rare extreme northwest and extreme northeast
Shaded crevices of sioux quartzite rocks in west; shaded, dry crevices in sandstone out-crops in east

FUTURE CHALLENGES

While this study is the 13th state-wide treatment, floristic study of Iowa pteridophyte is not completed. Two taxonomic problems exist which need in-depth study and additional collecting. Some county records require new vouchers as the existing vouchers are too old. Furthermore, to adequately know the living flora, some records of rare species need to be supported with new vouchers. Depauperate county floras warrant further collecting as they are probably under-collected. Efforts should be made to locate populations of the three species considered possibly extirpated. This section provides notes that would assist these improvements.

Taxonomic Problems

Efforts to rename Iowa material assignable to *Cystopteris fragilis* var. *mackayi* or to *C. protrusa* led to the conclusion that some specimens are inadequate for specific determinations. They often lacked a rhizome, which is useful in distinguishing between these species. New collections are needed. An ecological study is also needed to further clarify their distinctiveness in the field.

The genus *Equisetum* also presents some difficulty. *Equisetum hyemale* and *E. laevigatum* form a hybrid, *E. × ferrissii*. The species are readily distinguished from the hybrid if fertile material is at hand (Hauke, 1963; 1965). Vegetative characters are less distinct. The spores of the species are green, possess elaters, and are uniform in size and shape. Spores of the hybrid are clear, lack elaters, and are highly variable in size and shape. In 1976 I made extensive collections of these taxa. I noticed that damaged aerial stems of the parents form new stems that closely resemble typical hybrid stems, but viable spores are still produced. It is imperative to have fertile material of damaged stems for accurate identification. Furthermore, stems of *E. hyemale* resemble *E. laevigatum* when growing in the shade of forested stream banks. Thus physical damage and environmental conditions contribute to the difficulties of identifying scouring-rushes using vegetative characteristics. Further study of the variability of these species and their hybrid in Iowa is desirable.

Records Requiring New Vouchers

Three types of records require new vouchers: those missing vouchers, records known only from the 1800's, and records of rare plants not seen in the last 25 years. At the beginning of 1976, 32 records were identified as lacking their reported vouchers. During 1976, 18 records were substantiated with new collections. The remaining 14 records are excluded from the flora plotted on maps, but they might have occurred as named and reported. The records are presented to aid in either relocation of the specimen or to suggest a new collection. Five records noted by Cooperrider (1959) were thus excluded:

Equisetum fluviatile: Cerro Gordo Co. (Shimek, 1917, IA)

Osmunda claytoniana: Benton Co. (Knupp, 1910, IA)

Woodsia obtusa: Jasper Co. (citation not given); Dallas Co. (Van Bruggen #908, IA); Greene Co. (citation not given).

Nine additional records have been reported, but now lack their vouchers:

Cystopteris bulbifera: Howard Co. (Eilers #2120, 1962, IA)

Cystopteris fragilis: Howard Co. (Eilers #2121, 1962, IA); Floyd Co. (Eilers #3142, 1963, IA); Benton Co. (Eilers #2791, 1963)

Lycopodium flabelliforme: Washington Co. (Griffin, 1963, IA)

Onoclea sensibilis: Howard Co. (Eilers #3159, 1963, IA); Benton Co. (Eilers #2642, 1962, IA)

Pellaea glabella: Howard Co. (Eilers #2122, 1962, IA)

Thelypteris palustris: Benton Co. (Eilers #2669, 1962, IA).

Old Records

Records documented by vouchers collected only in the 1800's may now reflect extirpated stations. At the beginning of 1976, 94 old

records were identified. In 1976, 55 old records were re-collected, leaving 39 records still needing new vouchers:

Asplenium platyneuron: Muscatine Co. (1897)

Athyrium thelypteroides: Delaware Co. (1897)

Azolla mexicana: Louisa Co. (1897)

Botrychium multifidum: Fayette Co. (1893)

Camptosorus rhizophyllus: Harrison Co. (1892); Scott Co. (1888)

Cheilanthes feei: Dubuque Co. (1888)

Cryptogramma stelleri: Johnson Co. (1880)

Cystopteris bulbifera: Floyd Co. (1874); Powershiek Co. (1886)

Cystopteris fragilis: Dallas Co. (1897); Pottawattamie (1897)

Cystopteris protrusa: Emmet Co. (1882); Ringgold Co. (1890)

Cystopteris × tennesseensis: Cerro Gordo Co. (1899); Decatur Co. (1898)

Dryopteris goldiana: Jackson Co. (18—?)

Equisetum arvense: Pottawattamie Co. (1896)

Equisetum × ferrissii: Shelby Co. (1894); Union Co. (1892)

Equisetum fluviatile: Hamilton Co. (1882); Hancock Co. (1896); Story Co. (1889)

Equisetum laevigatum: Dallas Co. (1897); Lee Co. (1897)

Equisetum pratense: Webster Co. (1897)

Equisetum sylvaticum: Jasper Co. (1886); Winneshiek Co. (1880)

Gymnocarpium dryopteris: Johnson Co. (1892); Winneshiek Co. (1899)

Isoetes melanopoda: Clinton Co. (1863)

Lycopodium flabelliforme: Muscatine Co. (1894)

Phegopteris connectilis: Delaware Co. (1878); Muscatine Co. (1897)

Polystichum acrostichoides: Jackson Co. (18—?); Scott Co. (18—?)

Selaginella rupestris: Dubuque Co. (1885).

Records of Rare Plants

Some records of rare taxa have not been verified in the field during the last 25 years. In 1976, 71 records of rare plants were identified for field verification. Twenty-four records were verified, leaving the following 47 records still in need of new vouchers:

Asplenium platyneuron: Iowa Co. (1924); Jefferson Co. (1935); Scott Co. (1905)

Azolla mexicana: Allamakee Co. (1901); Clayton Co. (1934); Fremont Co. (1905)

Botrychium dissectum: Van Buren Co. (1932)

Cryptogramma stelleri: Cerro Gordo Co. (1917)

Cystopteris × tennesseensis: Hardin Co. (1949); Jefferson Co. (1933); Webster Co. (1920); Winneshiek Co. (1933)

Dryopteris cristata: Chickasaw Co. (1925); Clayton Co. (1921)

Dryopteris goldiana: Mahaska Co. (1938)

Dryopteris intermedia: Webster Co. (1903)

Dryopteris marginalis: Allamakee Co. (1905); Dubuque Co. (1922)

Equisetum fluviatile: Chickasaw Co. (1926); Dubuque Co. (1901); Emmet Co. (1922); Palo Alto Co. (1939); Tama Co. (1933); Webster Co. (1906)

Equisetum sylvaticum: Boone Co. (193-?); Chickasaw Co. (1926); Linn Co. (1928)

Lycopodium flabelliforme: Buchanan Co. (1917); Chickasaw Co. (1925); Clayton Co. (1923); Delaware Co. (1940)

Lycopodium lucidulum: Cedar Co. (1941); Boone Co. (1933); Chickasaw Co. (1926)

Lycopodium porophyllum: Delaware Co. (1930)

Lycopodium lucidulum × L. porophyllum: Clayton Co. (1921)

Osmunda cinnamomea: Jackson Co. (1905)

Osmunda regalis: Muscatine Co. (1932)

- Pellaea atropurpurea*: Van Buren Co. (1932)
Polypodium virginianum: Jones Co. (1948); Mahaska Co. (1921)
Polystichum acrostichoides: Allamakee Co. (1927)
Selaginella rupestris: Bremer Co. (1930); Blackhawk Co. (1937); Chickasaw Co. (1930); Muscatine Co. (1916).

County Floras

Further efforts to collect in the counties noted in Fig. 3 as depauperate are expected to be rewarding. At the beginning of the 1976 collecting season, 38 counties were rated as depauperate, having five or fewer taxa in their floras. With help, I was able to collect enough to remove 15 counties from the list. Of the 23 remaining counties, 18 also had records added to their floras. This indicates that to some degree the "depauperate" counties are "under-collected". All remaining 23 counties might yield new county records, and many might eventually be removed from the list of depauperate floras.

At the beginning of 1976, 18 counties were considered to have rich floras. By the end of 1976, two additional counties (Chickasaw and Floyd) were added (Fig. 3), while the floras of 13 of the original 18 were also increased. The counties with rich floras have been heavily collected, but they still continue to yield new records. Field work in eastern Iowa is expected to continue to provide additional records.

Possibly Extirpated Species

Special mention of three species possibly extirpated in Iowa may aid in their rediscovery. The location of these species anywhere in the state would be of considerable importance.

Botrychium simplex was collected by R. F. Thorne, R. L. Hulbary, and T. S. Cooperrider in 1954 from a sandy pasture near Coggen, Linn Co. The species has not been observed since. I have visited the station six times without relocating the species. The station was disturbed by road building in 1975 and was further disturbed by dredging in 1976. The plant is quite small and will require patient searching on hands-and-knees.

Isoetes melanopoda has not been observed in Iowa since its original collection by A. Vasey in 1863 from Clinton Co. The drastic changes in wetland habitats along the Mississippi River brought about by agriculture, industry, and construction of lock-and-dam systems may have lessened the likelihood of its persistence in Clinton Co. The species has also been collected in Rock Co., Minnesota, a few miles from Lyon Co., Iowa. As that collection was found near Sioux quartzite rocks in prairies, and as similar habitats occur in Lyon Co., the species might be located there. Its rediscovery is hampered in that *Isoetes melanopoda* has emergent leaves, 10-25 cm tall, which resemble a sedge tussock.

Phegopteris connectilis was collected once in Delaware Co. and once in Muscatine Co., in the 1800's. Dr. L. F. Guldner made many trips to the Muscatine Co. station, near the area of Wild Cat Den State Park, but was unsuccessful in relocating the species. No locality was given for the Delaware Co. specimen. The species resembles *P. hexagonoptera*.

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