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# PTERIDOPHYTES OF SOUTHEAST ALABAMA: DICHOTOMOUS KEYS, ILLUSTRATIONS AND DISTRIBUTION MAPS

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## ABSTRACT

This treatment includes all species of pteridophytes known to occur naturally and those that have become naturalized in southeast Alabama. A total of seventeen families, twenty-nine genera, fifty-nine species, two varieties, and four hybrid taxa are known to occur in the study area. Dichotomous keys are provided for all families, genera, species, and three of the hybrids. A description is provided for the remaining two varieties and one hybrid. County level distribution maps and illustrations are provided for all species. The area delineated as southeast Alabama includes Barbour, Butler, Coffee, Conecuh, Covington, Crenshaw, Dale, Escambia, Geneva, Henry, Houston, and Pike counties. Distribution records are based upon specimens deposited in the Troy University Herbarium (TROY), J. D. Freeman Herbarium (AUA), The University of Alabama Herbarium (UNA), and University of West Florida Herbarium (UWFP).

## INTRODUCTION

Diamond and Woods (2007) discussed the history of the literature dealing with pteridophytes of Alabama, and also provided a description, including geology, topography, watersheds, and climate of the twelve counties in the southeastern section of the state that comprise the study area (Barbour, Butler, Coffee, Conecuh, Covington, Crenshaw, Dale, Escambia, Geneva, Henry, Houston, and Pike Counties). They provided a dichotomous key to the seventeen families and a checklist of the fifty-nine species, and three hybrid taxa known to occur in the study area.

The objectives of this treatment were to expand on the earlier publication and to develop dichotomous keys, not only for the families but for all species of pteridophytes known to occur naturally, and those that have become naturalized in southeast Alabama. Also provided in this treatment are descriptions for each genus, and illustrations, county level distribution maps, and habitats for each species.

## MATERIALS AND METHODS

The dichotomous keys and descriptions are based upon material deposited in the herbarium of Troy University (TROY) and descriptions provided by Snyder and Bruce (1986).

Distribution records are based upon specimens deposited in the Troy University Herbarium (TROY), J. D. Freeman Herbarium (AUA), The University of Alabama Herbarium (UNA), and University of West Florida Herbarium (UWFP). Additional distribution data were obtained from Jack Short (pers. com.). With the exception of Isoetaceae and Lycopodiaceae, the nomenclature follows *Flora of North America* (Flora of North America Editorial Committee, 1993).

## RESULTS AND DISCUSSION

Pteridophytes of southeast Alabama are represented by seventeen families, twenty-nine genera, fifty-nine species, two varieties, and four hybrid taxa. Dryopteridaceae, the largest family, is represented by seven genera, nine species and one hybrid; Thelypteridaceae by three genera and seven species; Pteridaceae by three genera, six species and one variety; Ophioglossaceae by two genera and eight species; Lycopodiaceae by two genera, six species and three hybrids. Isoetaceae is represented by one genus and seven species. The families Aspleniaceae, Blechnaceae, Osmundaceae, and Selaginellaceae are represented by one genus and two species each. Dennstaedtiaceae is represented by one genus and one variety. The families Azollaceae, Equisetaceae, Lygodiaceae, Marsileaceae, Polypodiaceae, and Salviniaceae are represented by a single species each. Thirteen species, or 22.4% of the taxa, are non-native.

The collection of *Polystichum braunii* (Spenner) Fée from Dale County represents the first collection of this species in the southern one-half of the United States (Woods and Diamond, 2006). This taxon is native to northeastern and coastal northwestern North America where it typically grows in cool, moist, shaded places in boreal forests and northern deciduous woods. Although the Dale County population is likely an escape from cultivation, no homes occur in the immediate vicinity of the collection site.

*Lycopodium digitatum* Dillenius *ex* A. Braun is known from two counties in the study area, Barbour and Escambia. The Barbour County population represents an extension of the natural range of this taxon by approximately 120 km south. However, the Escambia County population is possibly introduced. The site where it was collected is an area of a cemetery where flora arrangements have been discarded for many years. In addition, this site is approximately 300 km southwest from the nearest population.

Since Diamond and Woods (2007), one additional taxon has been found to occur in the study area. *Botrychium jenmanii* L. Underwood (Alabama grape fern) has been reported from Escambia County. The collection was made by James Burkhalter (#18178) on January 5, 2002 and is deposited in the herbarium at the University of West Florida (UWFP). In addition, one taxon, *Asplenium trichomanes* Linnaeus, reported by Woods and Diamond (2007) based on a single collection made from the study area was recently annotated by Jack Short to *A. resiliens* Kunze and, therefore, removed from this treatment.

## KEY TO PTERIDOPHYTE FAMILIES

1. Aerial stems hollow, jointed……..……..……..1. Equisetaceae
1. Aerial stems absent or solid, not jointed……...……...……...……2
   2. Leaves linear; stems a corm……..……...…….……2. Isoetaceae
   2. Leaves broad or reduced scale-like structures; stems a rhizome or stolon….……3
3. Plants aquatic, free floating or rooted in mud……4
3. Plants terrestrial……...……..6

4. Photosynthetic leaves 4-parted and clover-like, petioles widely spaced on long creeping stems at least partly rooted in substrate……...……3. Marsileaceae
4. Photosynthetic leaves round or oval, not clover-like, petioles closely spaced on short free floating stems..……..……...5
5. Leaves glabrous adaxially……..…….……...…4. Azollaceae
5. Leaves pubescent adaxially……...…...……..……5. Salviniaceae
6. Plants moss-like in appearance; leaves <1 cm long……...…...……...……7
6. Plants not moss-like; leaves >1 cm long……...……...8
7. Plants slender; sterile leaves dimorphic, ligulate; heterosporous……...…6. Selaginellaceae
7. Plants coarse; sterile leaves monomorphic, aligulate; homosporous…...…...7. Lycopodiaceae
8. Leaves with rachis twining, climbing, vine-like……....…….……8. Lygodiaceae
8. Leaves erect, without a rachis or a short rachis, not twining, not vine-like……...…9
9. Sporangia 0.5-1.0 mm in diameter; roots tuber-like, thick, fleshy……...9. Ophioglossaceae
9. Sporangia 0.08-0.1 mm in diameter; roots wiry……...……...……....10
10. Stems short, erect, stout; roots matted, wiry……..…10. Osmundaceae
10. Stems elongated rhizomes, creeping; roots scattered……11
11. Sori marginal, under revolute margins of blade; indusia absent……....……...12
11. Sori medial or submarginal but not under revolute margins of blade; indusia present or absent……..13
12. Rachis winged; pinnules opposite, >2.5 cm long……11. Dennstaedtiaceae
12. Rachis not winged; pinnules alternate, <2.5 cm long……12. Pteridaceae
13. Sori naked……...……14
13. Sori with indusia……..15
14. Fronds >25 cm long, glands and/or stipitate hairs present, peltate scales absent abaxially; sori <0.5 mm in diameter……..……...13. Thelypteridaceae
14. Fronds <25 cm long, glands and stipitate hairs present, peltate scales present abaxially; sori >1.0 mm in diameter…...…….....……...14. Polypodiaceae
15. Sori elongate, in 1 row on each side and immediately adjacent to costae or costules……..……15. Blechnaceae
15. Sori elongate to round, many per pinna, if elongate and parallel to costae then not immediately adjacent to them……..16
16. Petioles with 1 x-shaped or 2 back to back c-shaped vascular bundles; sori on one side of a vein……..……..…..……...…16. Aspleniaceae
16. Petioles with 2 u-shaped or 2-many circular vascular bundles arranged in an arch; sori at least partially on two sides of a vein…….……...……..17
17. Adaxial surface of leaves pubescent, trichomes transparent; blade scales absent; petioles with 2 u-shaped vascular bundles……..…….……...…13. Thelypteridaceae
17. Adaxial surface of leaves glabrous; blade scales present or absent; petioles with 2-many circular vascular bundles arranged in an arch……..……..…..…17. Dryopteridaceae

## 1. EQUISETACEAE Michaux *ex* DeCandolle
## EQUISETUM Linnaeus
## Horsetail or Scouring Rush

Rhizomes with nodal buds; aerial stems green with whorls of reduced, nonfunctional leaves; internodes hollow; strobili terminal.

1. *E. hyemale* Linnaeus - SMOOTH SCOURING RUSH. Figure 1a, 1b. Banks of rivers and streams, seeps. Often associated with limestone.

## 2. ISOETACEAE Reichenbach
## ISOETES Linnaeus
## Quillworts

Plants arising from the ground in tufts; stems a corm; leaves quill-like, 1-3 dm long and 1-3 mm wide; heterosporous with sporangia on the adaxial leaf bases.

1. Sporangia solid white or hyaline……2
1. Sporangia white or hyaline with brown streaks or spots……...3
   2. Velamen covering 100% of sporangia……...1. *I. flaccida*
   2. Velamen covering <100% of sprorangia……..2. *I. valida*
3. Microspores white to pale tan, tuberculate……..……..3. *I. appalachiana*
3. Microspores light gray to brown, papillose to spinulose……..……4
   4. Plants terrestrial or in seasonal pools or streams……..…….4. *I. melanopoda*
   4. Plants submerged or emergent aquatics……...5
5. Megaspores brown……...5. *I. louisianensis*
5. Megaspores white……..6
   6. Microspores with prominent broad based spines…….6. *I. hyemalis*
   6. Microspores papillose……..7. *I. boomii*

1. *I. flaccida* A. Braun - Our species is represented by var. *chapmanii* Engelmann. FLORIDA QUILLWORT. Figure 1c, 1d. Emergent or in shallow water of sand bottomed creeks or ponds.
2. *I. valida* (Engelman) Clute - ENGELMANN'S QUILLWORT. Figure 1e, 1f. Shallow, sand bottomed creeks.
3. *I. appalachiana* D. F. Brunton & D. M. Britton - APPALACHIAN QUILLWORT. Figure 2a, 2b. Submerged to emergent along creek banks, woodland pools and lakes in sand, clay, or gravel substrates.
4. *I. melanopoda* Gay & Durieu – BLACK-FOOTED QUILLWORT. Figure 2c, 2d. Terrestrial or seasonally dry pools and streams.
5. *I. louisianensis* Thieret - LOUISIANA QUILLWORT. Figure 2e, 2f. Emergent along creeks and swamps with clay or sand substrates.
6. *I. hyemalis* D. F. Brunton - EVERGREEN QUILLWORT. Figure 3a, 3b. Shallow, running water in creeks and along river banks.
7. *I. boomii* Luebke – BOOM'S QUILLWORT. Figure 3c, 3d. Flowing water in low woods.

## 3. MARSILEACEAE Mirbel
## MARSILEA Linnaeus
## Water-clover

Aquatic or amphibious, stems creeping with adventitious roots from nodes and internodes; leaves heteromorphic (photosynthetic and fertile), petioles filiform, blades palmately divided into 4 pinnae; sporocarps horizontal to strongly ascending near base of petioles.

1. *M. minuta* Linnaeus – DWARF WATER-CLOVER. Figure 3e, 3f. Shoreline and shallow water along margin of beaver pond. Introduced.

## 4. AZOLLACEAE Wettstein
## AZOLLA Lamarck
## Mosquito fern

Aquatic; roots threadlike, up to 5 cm long; stems dichotomously branched forming rotund to oblong plants about 1-3 cm in diameter; fronds minute, bilobed, pubescent, green to reddish-green.

1. *A. caroliniana* Willdenow - MOSQUITO FERN. Figure 4a, 4b. Swamps, ponds and streams.

## 5. SALVINACEAE Reichenbach
## SALVINIA Séguier
## Floating fern

Floating aquatic, roots absent; leaves 3, dimorphic, 2 green, sessile, entire, floating and 1 finely dissected, petiolate, rootlike, submerged; sporocarps chainlike on submerged leaf.

1. *S. minima* Baker – FLOATING FERN. Figure 4c, 4d. Still or stagnant waters of slow streams or ponds. Introduced.

## 6. SELAGINELLACEAE Willkomm
## SELAGINELLA Beauvois
## Spike-moss

Stems creeping close to the ground to erect, sometimes forming large dense mats, often occurring as individual stems on clay banks; leaves in 4 rows, margins finely toothed; heterosporous with terminal strobili 1-2 cm long, 4-angled.

1. Plants erect or creeping, not mat forming; microphylls with 1-2 rows of transparent marginal cells……...1. *S. apoda*
1. Plants creeping, mat forming; microphylls with 3-5 rows of transparent marginal cells……...2. *S. ludoviciana*

1. *S. apoda* (Linnaeus) Spring - MEADOW SPIKE-MOSS. Figure 4e, 4f. Moist shady areas, grassy margins of streams, clay banks.
2. *S. ludoviciana* (A. Braun) A. Braun - GULF SPIKE-MOSS. Figure 5a, 5b. Swamps, stream banks, roadside ditches, moist ravines of calcareous ledges.

## 7. LYCOPODIACEAE Mirbel

Plants terrestrial, on rocks or epiphytic; rhizomes normally present, erect stems simple or branched; leaves appressed to ascending or spreading; sporangia in strobili.

In *Flora of North America* (Flora of North America Editorial Committee, 1993), the taxa covered in this family from Alabama are placed in the genera *Diphasiastrum*, *Lycopodiella*, *Palhindaea* and *Psuedolycopodiella*. The authors believe the taxonomy followed in this treatment is a better representation of the Lycopodiaceae in Alabama.

1. Strobili sessile or pedunculate; peduncles, if present, bearing remote, reduced leaves; leafy stems primarily erect; leaves rigid, evergreen, dark green……..……1. *Lycopodium*
1. Strobili erect on leafy peduncules (non-leafy peduncles in *L. caroliniana*) or nodding or pendent on lateral shoots; peduncle, if present, bearing closely spaced, unreduced leaves; leafy stems prostrate or erect; leaves soft, deciduous, pale green; leafy stems prostrate or erect……..…….2. *Lycopodiella*

## 1. LYCOPODIUM Linnaeus

Rhizomes or stems prostrate, with erect, regularly branching stems; leaves of prostrate stems appressed to ascending, linear to narrowly lanceolate, 1.8-4.6 mm long, leaves of erect stems appressed with decurrent bases, subulate, 1.8-3.5 mm long; strobili 2-4 per upright shoot, 1.4-4.0 cm long.

1. *L. digitatum* Dillenius *ex* A. Braun – SOUTHERN RUNNING-PINE. Figure 5c, 5d. Synonym is *Diphasiastrum digitatum* Dillenius *ex* A. Braun in Flora of North America (1993). Hardwood forests or open fields. The Escambia County population is possibly introduced.

## 2. LYCOPODIELLA Holub

Rhizomes or stems prostrate, creeping, some with erect stems unbranched or branched; leaves needlelike to narrow, some 3-6 mm long; fertile shoot erect; strobili 0.5-8.0 cm long, pendulous or erect.

1. Upright stems branched; strobili pendulous from tips of lateral branches……..1. *L. cernua*
1. Upright stems not branched; strobili erect from tips of upright shoots…….2
   2. Sporophylls broader than sterile, linear microphylls…….…2. *L. caroliniana*
   2. Sporophylls and sterile microphylls similar in shape, narrow lance-linear…….3
3. Sporophylls and microphylls appressed; strobili <10 mm thick……4
3. Sporophylls and microphylls spreading; strobili >10 mm thick……5
   4. Strobili 3.0-4.9 mm wide; rhizomes <6 mm thick……..……3. *L. appressa*
   4. Strobili 5-9 mm wide; rhizome >6 mm thick……...4. *L.* x *brucei*
5. Stolons flat on ground……...5. *L. prostrata*
5. Stolons arching……...6
   6. Peduncles <4 mm wide; sporophylls wide spreading…….6. *L. alopecuroides*
   6. Peduncles >4 mm wide; sporophylls ascending to spreading…….…7

7. Microphylls of erect stems spreading at 45 degrees; strobili 4-12 mm wide.....*L.* x *copelandi*
7. Microphylls of erect stems ascending at 30 degrees; strobili 10-20 mm wide……
……..……..……..*L. alopecuroides* x *prostrata*

1. *L. cernua* (Linnaeus) Pichi Sermolli - NODDING CLUBMOSS. Figure 5e, 5f. Synonym is *Palhinhaea cernua* (Linnaeus) Vasconcellos & Franco in Flora of North America (1993). Roadside ditches and old borrow pits. Introduced.
2. *L. caroliniana* (Linnaeus) Pichi Sermolli - CAROLINA CLUBMOSS. Synonym is *Pseudolycopodiella caroliniana* (Linnaeus) Holub in Flora of North America (1993). Figure 6a, 6b. Moist, sandy soils and wet clay banks along roadsides.
3. *L. appressa* (Chapman) Cranfill - SOUTHERN CLUBMOSS. Synonym is *Lycopodiella appressa* (Chapman) Cranfill in Flora of North America (1993). Figure 6c, 6d. Wet, sandy roadsides or clay roadside ditches, shorelines.
4. *L.* x *brucei* Cranfill. – BRUCE'S CLUBMOSS. Figure 6e, 6f. Roadside ditches, shorelines, bogs. A hybrid between *L. appressa* and *L. prostrata*.
5. *L. prostrata* (R. M. Harper) Cranfill - PROSTRATE CLUBMOSS. Figure 7a, 7b. Synonym is *Lycopodiella prostrate* (R. M. Harper) Cranfill in Flora of North America (1993). Wet, sandy roadside or clay roadside ditches, shorelines.
6. *L. alopecuroides* (Linnaeus) Cranfill - FOXTAIL CLUBMOSS. Synonym is *Lycopodiella alopecuroides* (Linnaeus) Cranfill in Flora of North America (1993). Figure 7c, 7d. Wet, sandy field depressions, roadsides and clay roadside ditches.
7. *L.* x *copelandii* (Eiger) Cranfill – COPELAND'S CLUBMOSS. Figure 7e, 7f. Bogs, marshes, roadside ditches. A hybrid between *L. appressa* and *L. alopecuroides*.
8. *L. alopecuroides* (Linnaeus) Cranfill x *prostata* (R. M. Harper) Cranfill – HYBRID CLUBMOSS. Figure 8a, 8b. Acidic sandy soils, wet ditches, wet pine woodlands.

## 8. LYGODIACEAE C. Presl
## LYGODIUM Swartz
## Climbing Fern

Trailing or climbing by a twining rachis; fronds 1 to several meters long, pinnately divided; sporangia marginal on fingerlike projections developing from the pinnae margins.

1. *L. japonicum* (Thunberg *ex* Murray) Swartz - JAPANESE CLIMBING FERN. Figure 8c, 8d. Disturbed areas along roadsides, streams and in open woods. Introduced.

## 9. OPHIOGLOSSACEAE C. Agardh

The most primitive family of extant ferns is characterized by macroscopic sporangia whose walls are many cell layers thick. Fronds with sterile and fertile portions, the fertile developing on a stipe that arises below the sterile blade.

1. Blades entire, reticulately veined, margins entire; fertile spike unbranched, sporangia embedded in compact linear spike……..……1. *Ophioglossum*
1. Blades pinnately divided or lobed, veins free, margins entire to dentate; sporangia sessile or terminating short stalks…….……2. *Botrychium*

## 1. OPHIOGLOSSUM Linnaeus
Adder's-tongue

Sterile portion of fronds entire, ovate to lanceolate, venation reticulate; fertile portions of fronds simple with sporangia in two rows.

1. Stems globose; frond ≤1 cm long, blade deltoid……..……..1. *O. crotalophoroides*
1. Stem elongate; frond >1 cm long, blade ovate to lanceolate…….2
   2. Sporangial cluster 0.5-1.5 cm long with 5-12 sporangia pairs…….….2. *O. nudicaule*
   2. Sporangial cluster 2-4 cm long with 12-40 sporangia pairs…….…....3
3. Sterile leaves with veins forming small areoles within larger areoles…....3. *O. engelmannii*
3. Sterile leaves with veins only branched or nonbranched within large aeroles, but not forming smaller aeroles…….…….……..…4. *O. petiolatum*

1. *O. crotalophoroides* Walter - BULBOUS ADDER'S TONGUE FERN. Figure 8e, 8f. Grassy areas including lawns, roadside clearings and cemeteries.
2. *O. nudicaule* Linnaeus - DWARF ADDER'S TONGUE FERN. Figure 9a, 9b. Sandy, moist habitats such as grassy areas and cemeteries.
3. *O. engelmannii* Prantl - LIMESTONE ADDER'S TONGUE FERN. Figure 9c, 9d. Limestone derived soils of the Black Belt and limestone outcrops.
4. *O. petiolatum* Hooker – STALKED ADDER'S TONGUE. Figure 9e, 9f. Grassy areas including lawns. Introduced.

## 2. BOTRYCHIUM Swartz
Grapefern

Roots fleshy; blades 2.5-40.0 cm long, broadly triangular, bipinnate to tripinnate; fertile stalk arising from base of blade or base of petiole; sporangia on branching segments at upper end of fertile stalk.

1. Vegetative leaves with open sheaths; fertile stalks arising from the base of the blades of vegetative leaves……..……1. *B. virginianum*
1. Vegetative leaves with closed sheaths; fertile stalks arising near ground level from basal portion of petioles of vegetative leaves……2
   2. Vegetative leaves prostrate, blades two per plant; roots yellowish…..…..2. *B. lunarioides*
   2. Vegetative leaves erect or ascending, blades one per plant; roots black…….3
3. Basal pinnae alternate……3. *B. jenmanii*
3. Basal pinnae opposite to subopposite……4
   4. Pinnules sharply serrate, lateral lobes oblong and somewhat rounded; blades remaining green in winter……4. *B. biternatum*
   4. Pinnules entire or lobed, lateral lobes lanceolate; blades turning bronze in winter……..……..…….5. *B. dissectum*

1. *B. virginianum* (Linnaeus) Swartz - RATTLESNAKE FERN. Figure 10c, 10d. Moist deciduous woodlands in well drained soils.

2. *B. lunarioides* (Michaux) Swartz - WINTER GRAPEFERN. Figure 10a, 10b. Cemeteries; rare on sandy roadsides or pastures.
3. *B. jenmanii* L. Underwood - ALABAMA GRAPEFERN. Figure 10e, 10f. Both xeric woodlands and mesic wooded ravines.
4. *B. biternatum* (Savigny) L. Underwood - SOUTHERN GRAPEFERN. Figure 11a, 11b. Moist woodlands along stream banks and old fields.
5. *B. dissectum* Sprengel - DISSECTED GRAPEFERN. Figure 11c, 11d. Moist mesic woodlands along streambanks and mesic open areas

## 10. OSMUNDACEAE Berchtold & J. Presl
## OSMUNDA Linnaeus
## Royal Fern

Roots black, wiry; fronds pinnate-pinnatifid to bipinnate; rachis grooved; pinnae monomorphic or dimorphic; sori absent; sporangia on modified fertile segments of blades or separate fronds.

1. Fertile and sterile leaves on separate petioles, sterile leaves pinnate-pinnatifid; tufts of hairs persistent on abaxial surface of pinnae near base……..1. *O. cinnamomea*
1. Fertile and sterile leaves on same petiole, sterile leaves bipinnate; tufts of hairs absent on abaxial surface of pinnae near base…….2. *O. regalis*

1. *O. cinnamomea* Linnaeus - CINNAMON FERN. Figure 11e, 11f. In swamps, wet woods and along stream banks.
2. *O. regalis* Linnaeus - Ours is represented by *O. regalis* var. *spectabilis* (Willdenow) A. Gray - ROYAL FERN. Figure 12a, 12b. In swamps, wet woods and along stream banks.

## 11. DENNSTAEDTIACEAE Chling
## PTERIDIUM Gleditsch *ex* Scopoli,
## Bracken Fern

Rhizomes long, creeping; fronds 45-90 cm long; blades broadly triangular, bipinnate-pinnatifid to tripinnate; sori linear, marginal, covered by reflexed margin of blade.

1. *P. aquilinum* (Linnaeus) Kuhn – Figure 12c, 12d. Two varieties of *P. aquilinum* grow in South Alabama. *Pteridium aquilinum* var. *latiusculum* (Desvaux) L. Underwood *ex* A. Heller - EASTERN BRACKEN. Terminal segment of pinnules <4x as long as wide; pinnae pubescent beneath. Wooded slopes and dry open areas, in full to partial sun. *Pteridium aquilinum* var. *pseudocaudatum* (Clute) A. Heller - TAILED BRACKEN. Terminal segement of pinnules >4x as long as wide; pinnae glabrous beneath. Wooded slopes and dry open areas, in full to partial sun.

## 12. PTERIDACEAE Reichenbach

Rhizomes creeping, branched; petiole with 1-3 adaxial grooves; terminal segment of blade sessile to short-stalked; sori under reflexed margins of pinnules.

1. Sori separate along pinnae margins; leaves bright green, delicate……..…1. *Adiantum*
1. Sori continuous along pinnae margins or concentrated on small apical and lateral lobes; leaves dark-green, tough……..2
   2. Petiole rounded adaxially; sori concentrated on small apical or lateral lobes……..…….2. *Cheilanthes*
   2. Petiole with 2-3 grooves adaxially; sori continuous along pinnae margins…….3. *Pteris*

## 1. ADIANTUM Linnaeus
Maidenhair Fern

Rhizomes creeping; fronds 25-65 cm long; petioles shiny, dark brown to black; blades 15-35 cm long, fan-shaped to lanceolate; sori oblong under reflexed margins of pinnules.

1. Blades fan-shaped; pinnules oblong, 3x longer than wide……..……..1. *A. pedatum*
1. Blades lanceolate; pinnules rhomboid, cuneate, as long as wide……..2. *A. capillus-veneris*

1. *A. pedatum* Linnaeus - NORTHERN MAIDENHAIR FERN. Figure 12e, 12f. Rich mesic hardwood slopes.
2. *A. capillus-veneris* Linnaeus - SOUTHERN MAIDENHAIR FERN. Figure 13a, 13b. Wet crevices of limestone on riverbanks.

## 2. CHEILANTHES Swartz
Lip Fern

Rhizomes compact to short-creeping, ascending to horizontal; fronds 7-70 cm long; petiole dark brown; blades 1.5-5.0 cm wide, linear-oblong to lanceolate; sori concentrated on small apical and lateral lobes.

1. *C. lanosa* (Michaux) D.C. Eaton – HAIRY LIP FERN. Figure 13c, 13d. Rocky slopes and ledges.

## 3. PTERIS Linnaeus
Brake Fern

Rhizomes short, creeping; fronds 25-60 cm long; petioles 10-20 cm long, smooth; blades 15-40 cm long, oblong triangular, pinnate; rachis winged; sori submarginal under reflexed margins of blade.

1. Fronds 1-pinnate, pinnae entire to divided; petioles shorter than rachis, scales present……...1. *P. vittata*
1. Fronds partly bi-pinnate, some pinnae lobed or divided; petioles longer than rachis, scales absent……...2
   2. Fronds divided into 4-6 pinnule pairs; rachis winged…….……2. *P. multifida*
   2. Fronds divided into 1-3 pinnule pairs; rachis not winged…….…….3. *P. cretica*

1. *P. vittata* Linnaeus – LADDER FERN. Figure 13e, 13f. Roadsides and various habitats. Introduced.
2. *P. multifida* Poiret – SPIDER BRAKE. Figure 14a, 14b. Damp soil and rocks. Oftentimes found growing on old rock and brick walls in shady areas. Introduced.
3. *P. cretica* Linnaeus – Figure 14c, 14d. Two varieties of *P. cretica* grow in South Alabama. *P. cretica* var. *cretica* – CRETAN BRAKE. Pinnae green throughout. On rocks, woods slopes, river banks. *Pteris cretica* var. albolineata Hooker - WHITE-LINED CRETAN BRAKE. Pinnae with white, central stripe. On rocks, woods slopes, river banks. Both are introduced.

## 13. THELYPTERIDACEAE Ching *ex* Pichi-Sermolli

Rhizome long, creeping; fronds pinnate-pinnatifid to bipinnate; blades oblong to triangular; sori round to oblong, medial to submarginal; indusia kidney-shaped or absent.

1. Leaves 1-pinnate; indusia diameter >0.3 mm.……1. *Thelypteris*
1. Leaves pinnate-pinnatifid; indusia absent or diameter <0.3 mm……..……2
   2. Indusium absent; stem diameter 1-4 mm; rachis winged throughout……...2. *Phegopteris*
   2. Indusium present; stem diameter 8-10 mm; rachis not winged or winged at apical portion of blades only..……..…....……...…3. *Macrothelypteris*

### 1. THELYPTERIS Schmidel
### Marsh Fern

Rhizome long, creeping; fronds 40-110 cm long; blade 20-75 cm long, lanceolate to ovate-lanceolate, pinnate-pinnatifid; sori round, medial to submarginal.

1. Petioles green with dark bases; stems diameter <4mm.……1. *T. palustris*
1. Petioles brown to purple; stems diameter >4.1 mm……..…….. 2
   2. Some basal veins of pinnules united below sinuses; petioles purplish brown..2. *T. dentata*
   2. Some basal veins of pinnules free or extending to sinuses; petioles straw colored…….3
3. Midrib on adaxial leaf surface glabrous or with few trichomes <0.2mm long; plants growing on limestone……..…….…….....3. *T. ovata*
3. Midrib on adaxial leaf surface pubescent; plants growing in various soils…….....…….4
   4. Sori medial; basal 1-2 pairs of pinnae not reduced; adaxial secondary veins of pinnae glabrous or with few trichomes……...4. *T. kunthii*
   4. Sori submarginal; basal 1-2 pairs of pinnae reduced; adaxial secondary veins of pinnae pubescent…….……5. *T. hispidula*

1. *T. palustris* Schott - MARSH FERN. Figure 14e, 14f. Wet swampy woods and open areas.
2. *T. dentata* (Forsskål) E. P. St. John - DOWNY MAIDEN FERN. Figure 15a, 15b. Mesic woods, pastures and roadsides. Introduced.
3. *T. ovata* R. P. St. John - OVATE MAIDEN FERN. Figure 15c, 15d. Limestone banks of rivers.
4. *T. kunthii* (Desvaux) C. V. Morton - SOUTHERN SHIELD FERN. Figure 15e, 15f. Wet soil in swampy woods, stream banks and rock crevices.

5. *T. hispidula* (Descaisne) C. F. Reed - Ours is represented by *T. hispidula* var. *versicolor* (R. P. St. John) Lellinger - VARIABLE MAIDEN FERN. Figure 16a, 16b. Shady areas in moist woods, stream banks and limestone sinks.

2. PHEGOPTERIS (C. Presl) Fée
Beech Fern

Rhizomes long, creeping; fronds 35-70 cm long; blades 15-30 cm long, broadly triangular, long pointed apex, pinnate-pinnatifid; sori round, marginal; indusium lacking.

1. *P. hexagonoptera* (Michaux) Fée - BROAD BEECH FERN. Figure 16c, 16d. Mesic woodlands and rich ravines.

3. MACROTHELYPTERIS (H. Itô) Ching

Rhizomes long, creeping; fronds 60-125 cm long; blades 35-70 cm long, broadly triangular, bipinnate-pinnatifid; rachis winged toward apex; sori round, sub-medial; indusium short-lived.

1. *M. torresiana* (Gaudichaud-Beaupré) Ching - MARIANA MAIDEN FERN. Figure 16e, 16f. Along stream banks and other wet areas. Introduced.

14. POLYPODIACEAE Berchtold & J. Presl
PLEOPELTIS Humboldt & Bonpland *ex* Willdenow
Golden Polypodies

Rhizomes long, creeping, slender; fronds 5-18 cm long, deeply pinnatifid; blades oblong, 3-10 cm long, abaxial surface silvery brown with scales; sori round, marginal, naked.

1. *P. polypodioides* (Linnaeus) E. G. Andrews & Windham – Ours is represented by *P. polypodioides* var. *michauxiana* (Weatherby) E. G. Andrews & Windham - RESURRECTION FERN. Figure 17a, 17b. Epiphytic on trunks and branches of trees with a rough periderm, can form dense mats on clay soil of road cuts.

15. BLECHNACEAE C. Presl
WOODWARDIA Smith
Chain Fern

Rhizomes long, creeping; fronds 30-130 cm long, monomorphic or dimorphic; blades pinnatifid to pinnate-pinnatifid, ovate-deltoid to ovate-triangular; sori oblong in chain-like rows.

1. Leaves monomorphic; sterile blades once-pinnate……..1. *W. virginica*
1. Leaves dimorphic; sterile blades pinnatifid…….2. *W. areolata*

1. *W. virginica* (Linnaeus) Smith - VIRGINIA CHAIN FERN. Figure 17c, 17d. Swampy woods and roadside ditches.

2. *W. areolata* (Linnaeus) T. Moore - NETTED CHAIN FERN. Figure 17e, 17f. Swamps and stream banks.

## 16. ASPLENIACEAE Newman
## ASPLENIUM Linnaeus
## Spleenwort

Rhizomes short, thick; fronds 5-40 cm long, monomorphic; rachis brown to black; blades pinnate, oblong; sori elongate, medial to sub-marginal; indusia laterally attached.

1. Pinnae 1.5-2.5 mm long, alternate, sessile; auricle of pinnae overlapping rachis; rachis black……..……2. *A. platyneuron*
1. Pinnae 0.5-1.4 mm long, opposite, short petiolules; auricle of pinnae not overlapping rachis; rachis dark brown……..……3. *A. resiliens*

1. *A. platyneuron* (Linnaeus) Britton, Sterns, & Poggenburg - EBONY SPLEENWORT. Figure 18a, 18b. Mesic woods, xeric woods and old fields.
2. *A. resiliens* Kunze - BLACK-STEMMED SPLEENWORT. Figure 18c, 18d. Crevices of limestone rocks in deep shaded areas.

## 17. DRYOPTERIDACEAE Herter

Rhizomes long, creeping; fronds monomorphic or dimorphic; blades pinnatifid to bipinnate; sori mostly abaxial, medial to marginal; sproangia stalked; spores oblong or reniform.

1. Sporangia on separate stalks from vegetative leaves……...…….1. *Onoclea*
1. Sporangia on abaxial surface of vegetative leaves……...2
   2. Indusia completely surrounding receptacle; petiole with 2 vascular bundles.….2. *Woodsia*
   2. Indusium not completely surrounding receptacle; petiole with 2 or more vascular bundles……...3
3. Fronds pinnate……4
3. Fronds pinnate-pinnatifid……...5
   4. Fronds with <13 pairs of pinnae, pinnae serrate with well developed basal auricle; sori completely covering abaxial surface of pinnae……..……3. *Polystichum*
   4. Fronds with >13 pairs of pinnae, pinnae undulate or dentate without a basal auricle; sori not completely covering abaxial surface of pinnae……..4. *Cyrtomium*
5. Sori elongated; petioles with 2 vascular bundles……...……6
5. Sori round; petioles with >3 vascular bundles……..……7
   6. Petioles yellowish green to reddish, glabrous or with a few scattered, chaffy scales; multicellular hairs absent on costa……...……...5. *Athyrium*
   6. Petioles light brown with long brown scales; multicellular hairs borne along costae…….……...6. *Deparia*
7. Indusia absent; petioles with scattered scales at base……..……..7. *Dryopteris*
7. Indusia present; petioles densely scaly throughout……....…….3. *Polystichum*

## 1. ONOCLEA Linnaeus
Sensitive fern

Rhizomes long, slender, creeping, green; fronds dimorphic, sterile 30-80 cm long, fertile 20-40 cm long; blades 15-40 cm long, pinnatifid into 12 pairs of oblong segments; sori in segmented segments at end of fertile stalks.

1. *O. sensibilis* Linnaeus - SENSITIVE FERN. Figure 18e, 18f. Swampy woodlands, roadside ditches.

## 2. WOODSIA R. Brown
Cliff fern

Rhizomes short, creeping; fronds 20-55 cm long; blades oblong, 10-30 cm long, pinnate-pinnatifid; sori round, marginal; indusia splitting along several sutures.

1. *W. obtusa* (Sprengel) Torrey - BLUNT-LOBED CLIFF FERN. Figure 19a, 19b. Xeric, often sunny roadside banks.

## 3. POLYSTICHUM Roth
Christmas fern

Rhizomes long, creeping; fronds 25-75 cm long, evergreen; petioles with tan scales; blades oblong-lanceolate, 20-55 cm long, pinnate; pinnae auriculate; fertile pinnae upper one-half of frond; sori round, submedial; indusia peltate.

1. Fronds 1 pinnate, fertile and sterile pinnae dimorphic…...……..1. *P. acrostichoides*
1. Fronds bipinnate, fertile pinnae and sterile pinnae isomorphic……..……2. *P. braunii*

1. *P. acrostichoides* (Michaux) Schott - CHRISTMAS FERN. Figure 19c, 19d. Shaded, mesic woods, ravines and creek banks.
2. *P. braunii* (Spenner) Fée – BRAUN'S HOLLY FERN. Figure 19e, 19f. Moist soils in mixed pines and hardwoods. Introduced.

## 4. CYRTOMIUM C. Presl
Holly fern

Rhizomes short, covered with brown scales; fronds 25-50 cm long; blades pinnate, 15-40 cm long, oblong-ovate; pinnae 4-10 pairs, alternate; sori round, scattered; indusia peltate.

1. *C. falcatum* (Linnaeus f.) C. Presl - ASIATIC HOLLY FERN. Figure 20a, 20b. Mesic ravines. Introduced.

## 5. ATHYRIUM Roth
Lady fern

Rhizomes short, creeping; fronds 25-130 cm long; rachis green or reddish; blades ovate or oblanceolate, 20-100 cm long, bipinnate or tripinnate; sori elongated, straight or curved, sub-marginal; indusia marginally ciliate.

1. *A. filix-femina* (Linnaeus) Roth *ex* Mertens. Ours is resented by *A. filix-femina* var. *asplenioides* (Michaux) Farwell - SOUTHERN LADY FERN. Figure 20c, 20d. Swampy woods, creek banks and roadside ditches.

## 6. DEPARIA Hooker & Greville

Rhizomes short, creeping; fronds 30-60 cm long; blades oblong-triangular, 15-35 cm long, pinnate-pinnatifid; pinnae oblong with long, tapering apices; sori elongated; indusia laterally attached.

1. *D. petersenii* (Kunze) M. Kato - PETERSONS TWIN-SORUS FERN. Figure 20e, 20f. Moist soils in disturbed areas and along stream banks. Introduced.

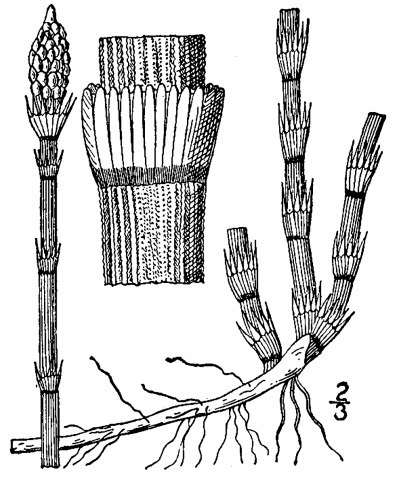
## 7. DRYOPTERIS Adanson
Shield fern

Rhizomes creeping, covered with tan scales; fronds 60-130 cm long; blades pinnate-pinnifid, 45-90 cm long, elliptic-lanceolate; sori round, medial; indusia peltate.

1. Fertile pinnae narrower than sterile, more widely spaced, restricted to the distal one-half of blade; scales at petiole base tan; fronds evergreen……..…..1. *D. ludoviciana*
1. Fertile pinnae and sterile same size, equally spaced, occupying distal one-half of blade to entire blade; scales at petiole base brown; fronds deciduous……....2. *D. celsa*

1. *D. ludoviciana* (Kunze) Small - SOUTHERN SHIELD FERN. Figure 21a, 21b. Mesic woods and swamps. Often associated with limestone.
2. *D. celsa* (W. Palmer) Knowlton – LOG FERN. Figure 21c, 21d. Swamps, wet woods and drainage ditches.
3. *D.* x *australis* (Wherry) Small - HYBRID SHIELD FERN. This is a sterile hybrid of *D. ludoviciana* (Kunze) Small and *D. celsa* (W. Palmer) Knowlton. Swamps. Known in southeast Alabama from a single collection in Conecuh County. This hybrid typically grows large like *D. ludoviciana*. Sporangia have few spores which are of various sizes.

a.



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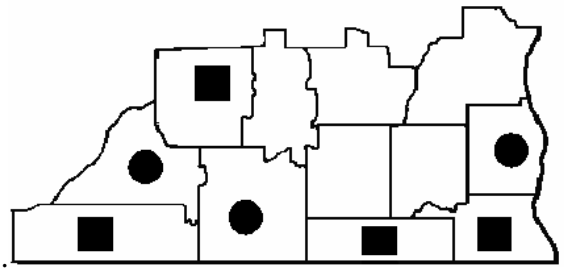

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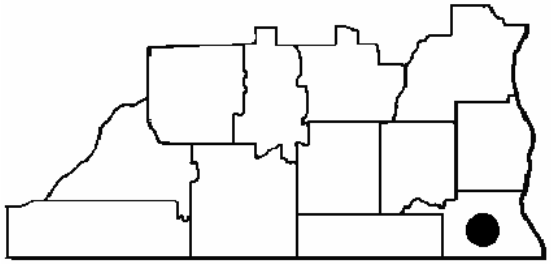

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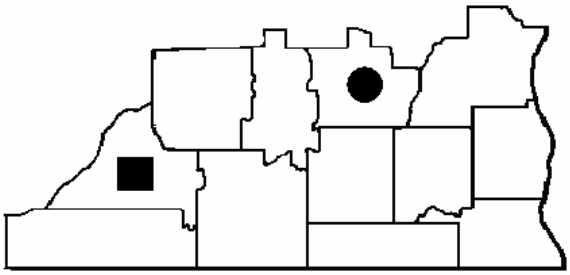
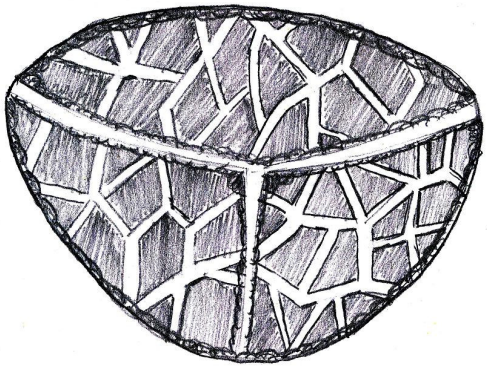


**Figure 1**. a) illustration of *Equisetum hyemale*, b) distribution of *E. hyemale*, c) illustration of *Isoetes flaccida* megaspore, d) distribution of *I. flaccida*, e) illustration of *I. valida* megaspore, f) distribution of. *I. valida*.
On the distribution maps, specimens deposited at TROY are represented by circles ● and specimens deposited at other institutions are represented by squares ■.



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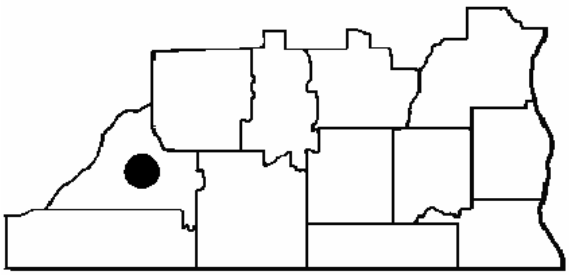

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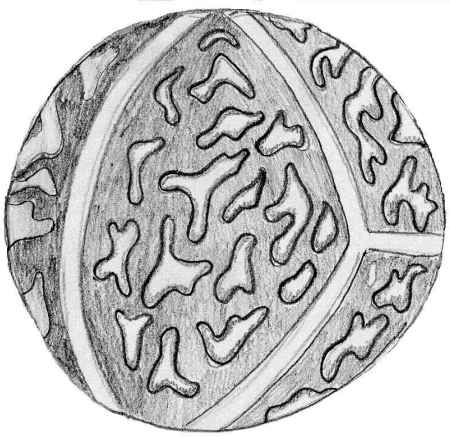

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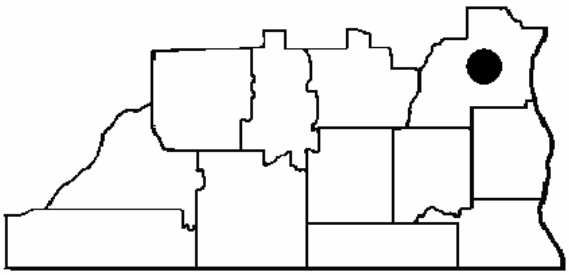

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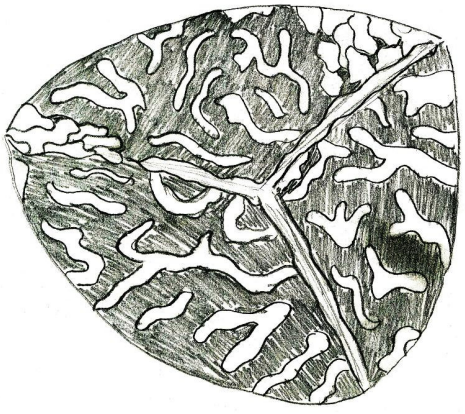

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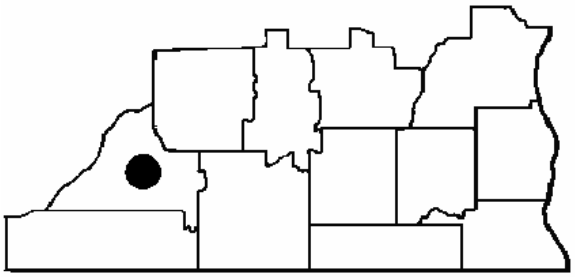
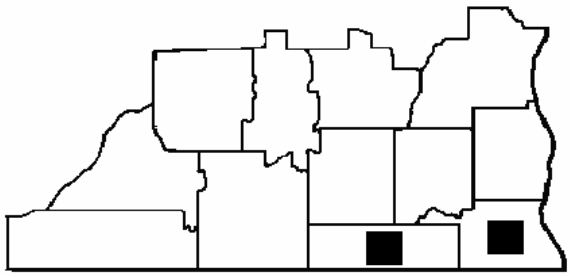


f.

**Figure 2**. a) illustration of *Isoetes appalachiana* megaspore, b) distribution of *I. appalachiana*, c) illustration of *I. melanpoda* megaspore, d) distribution of *I. melanpoda*, e) illustration of *I. louisianensis* megaspore, f) distribution of *I. louisianensis*.

a.



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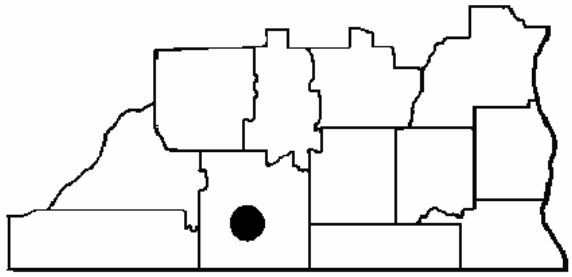

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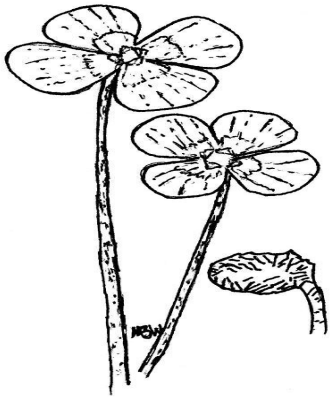

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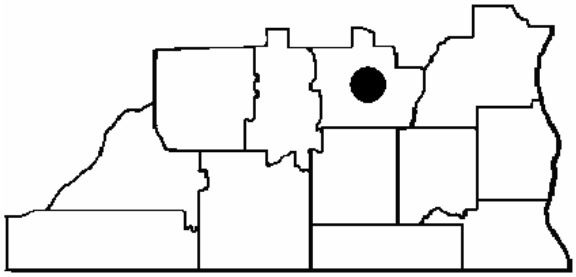

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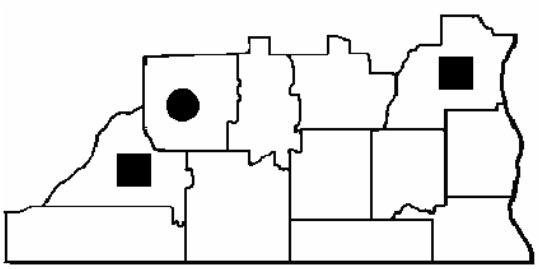
**Figure 3**. a) illustration of *Isoetes hyemalis* megaspore, b) distribution of *I. hyemalis*, c) illustration of *I. boomii* megaspore, d) distribution of *I. boomii*, e) illustration of *Marsilea minuta*, f) distribution of *M. minuta*.

a.



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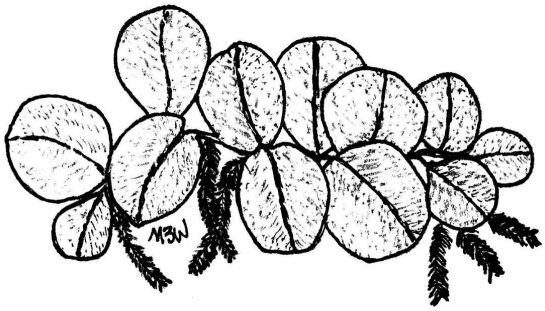

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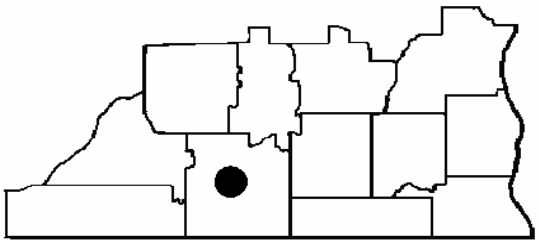

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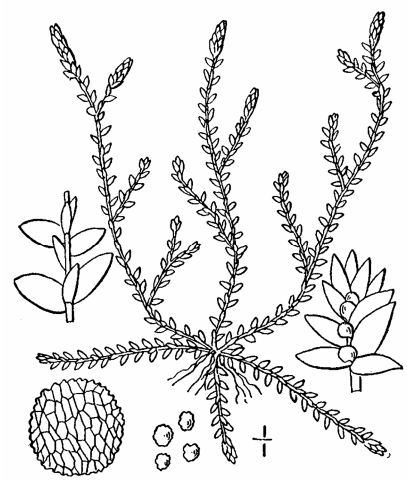

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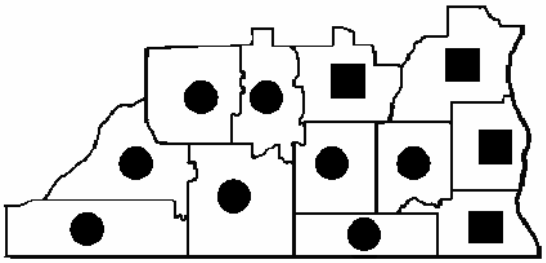
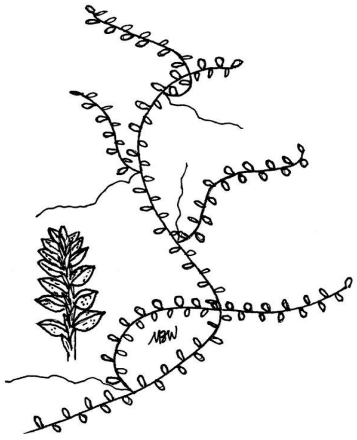


f.

**Figure 4**. a) illustration of *Azolla caroliniana*, b) distribution of *A. caroliniana*, c) illustration of *Salvinia minima*, d) distribution of *S. minima*, e) illustration of *Selaginella apoda*, f) distribution of *S. apoda*.



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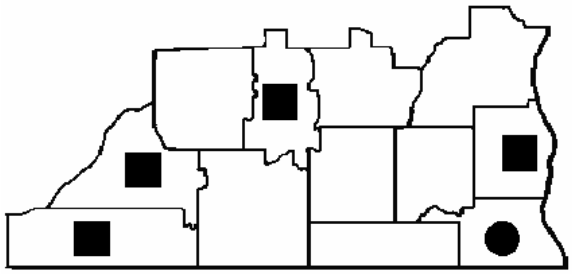

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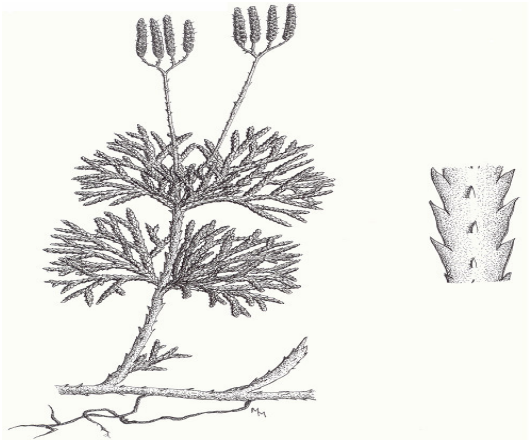

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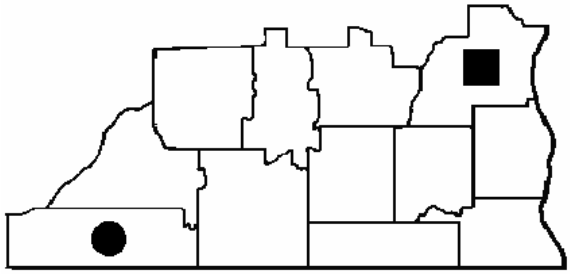

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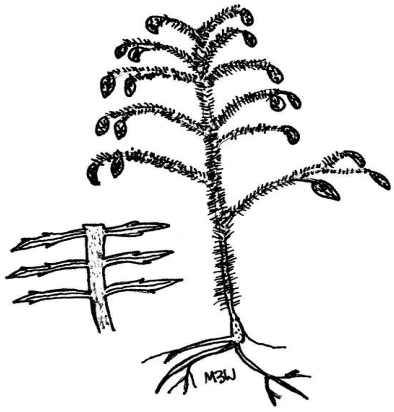

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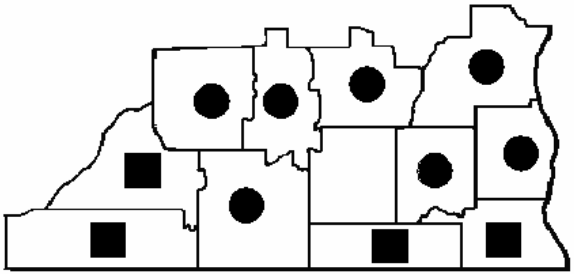
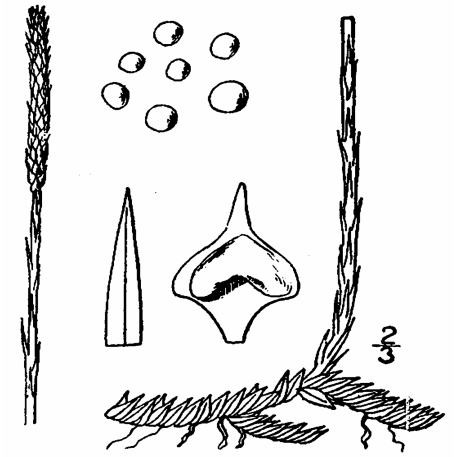


f.

**Figure 5**. a) illustration of *Selaginella ludoviciana*, b) distribution of *S. ludoviciana*, c) *Lycopodium digitatum*, d) distribution of *L. digitatum*, e) illustration of *Lycopodiella cernua*, f) distribution of *L. cernua*.

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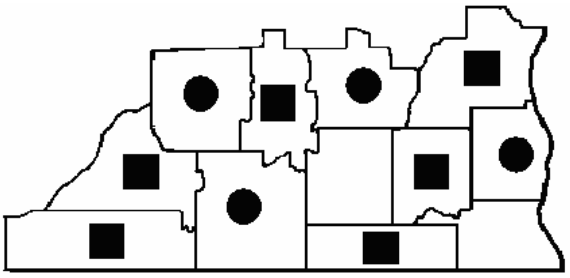

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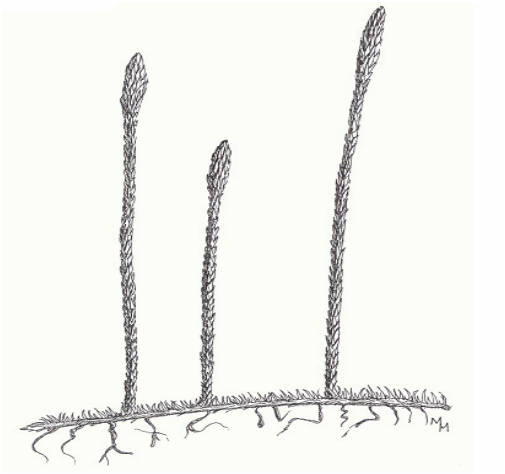

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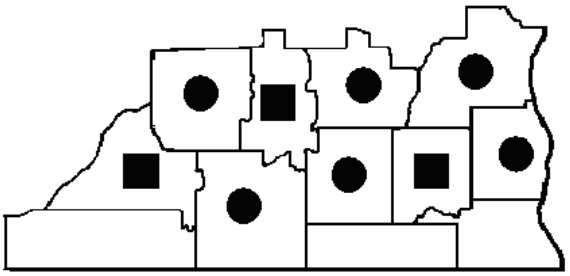

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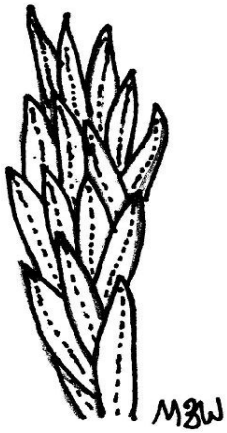

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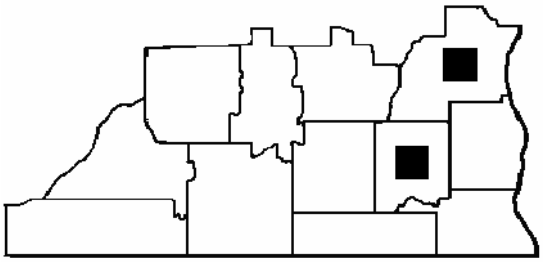
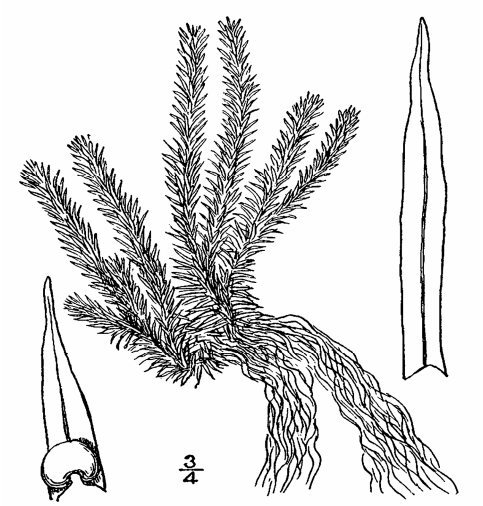
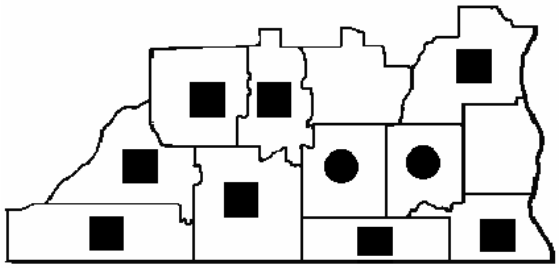


f.

**Figure 6**. a) illustration of *Lycopodiella caroliniana*, b) distribution of *L. caroliniana*, c) illustration of *L. appressa*, d) distribution of *L. appressa*, e) illustration of *L.* x *brucei* (shows angles of microphylly from erect stems), f) distribution of *L.* x *brucei*.




a.



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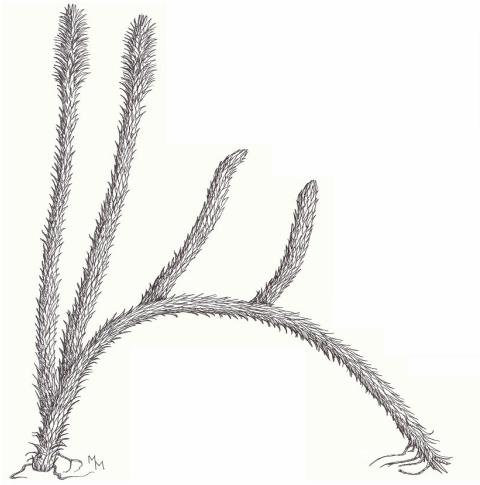

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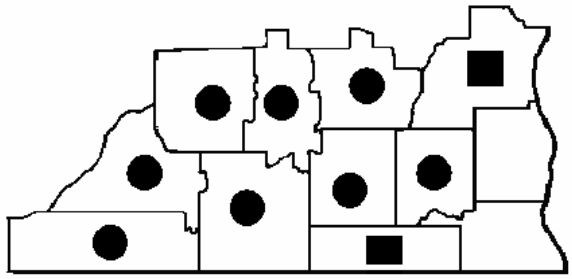

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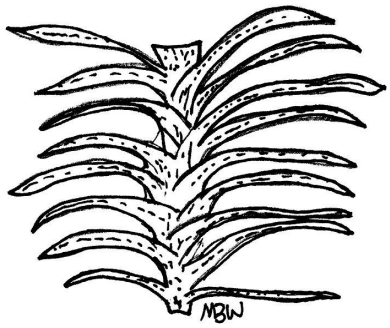


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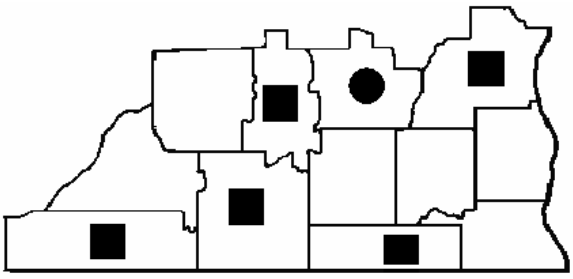
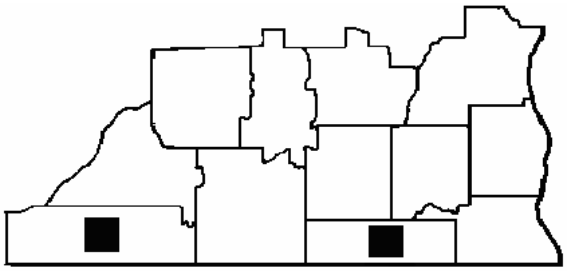


f.

**Figure 7**. a) illustration of *Lycopodiella prostrata*, b) distribution of *L. prostrata*, c) illustration of *L. alopecuroides*, d) distribution of *L. alopecuroides*, e) illustration of *L.* x *copelandii* (shows angles of microphylls from erect stems), f) distribution of *L.* x *copelandii*.

a.



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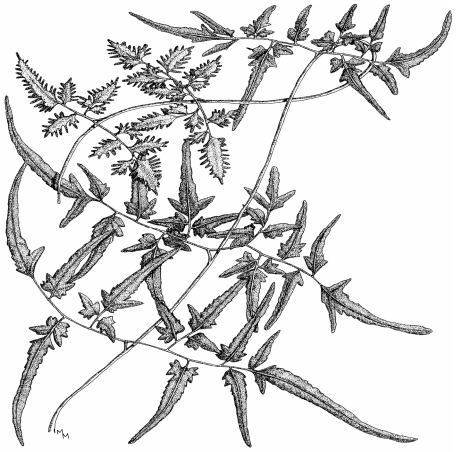

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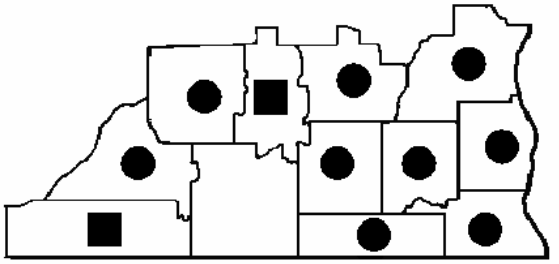

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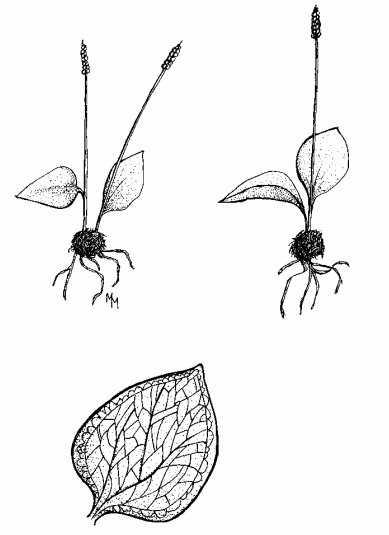

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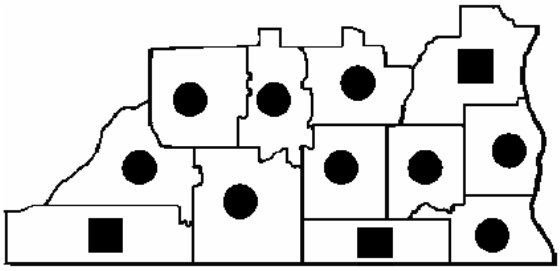
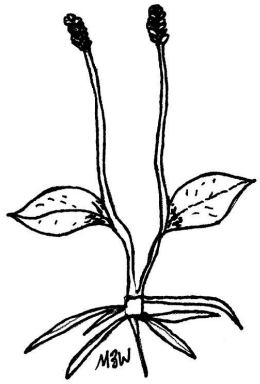


f.

**Figure 8**. a) illustration of *Lycopodiella alopecuroides* x *prostrata* (shows angles of microphylls from erect stems), b) distribution of *Lycopodiella alopecuroides* x *prostrata*, c) illustration of *Lygodium japonicum*, d) distribution of *L. japonicum*, e) illustration of *Ophioglossum crotalophoroides*, f) distribution of *O. crotalophoroides*.



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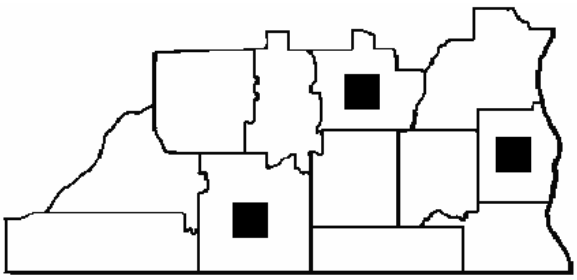

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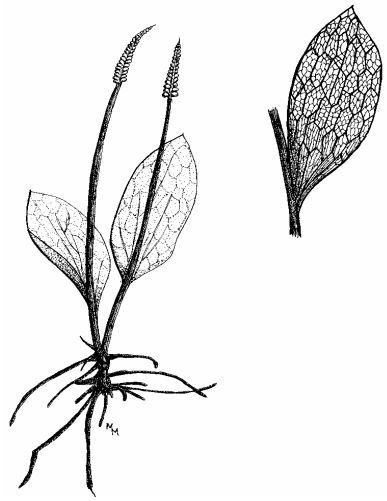

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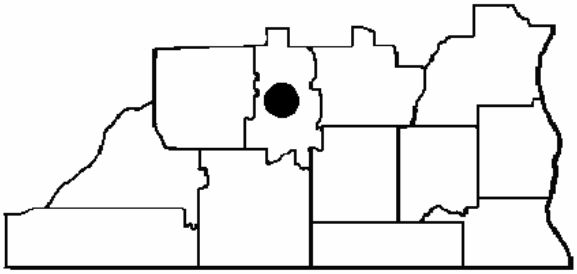
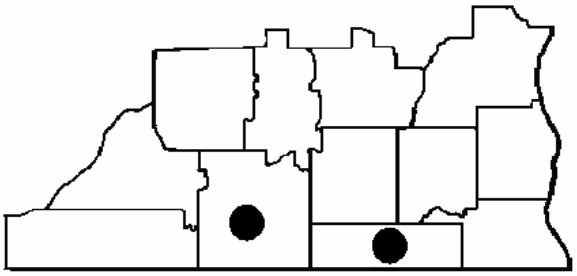


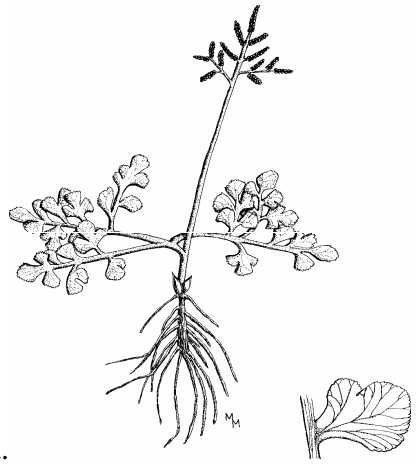
d.

e.

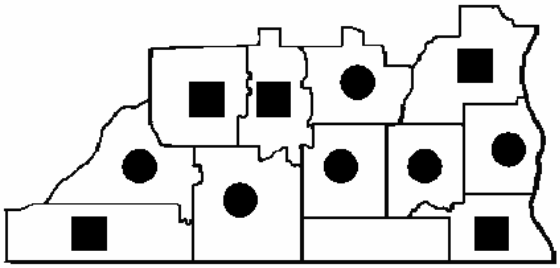


f.

**Figure 9**. a) illustration of *Ophioglossum nudicaule*, b) distribution of *O. nudicaule*, c) illustration of *O. engelmannii*, d) distribution of *O. engelmannii*, e) illustration of *O. petiolatum*, f) distribution of *O. petiolatum*.

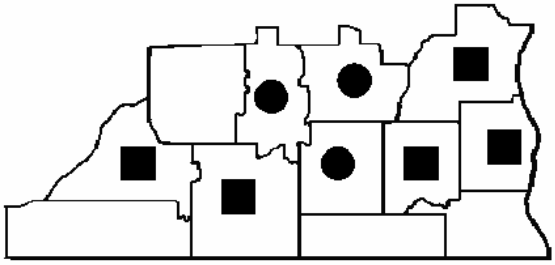


a.

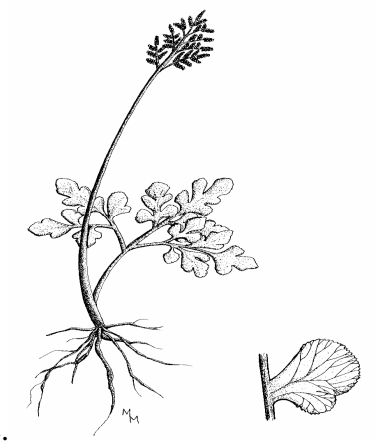


b.

c.



d.



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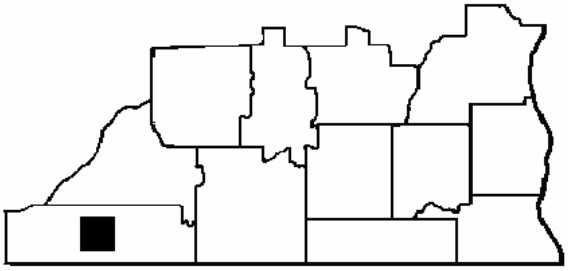
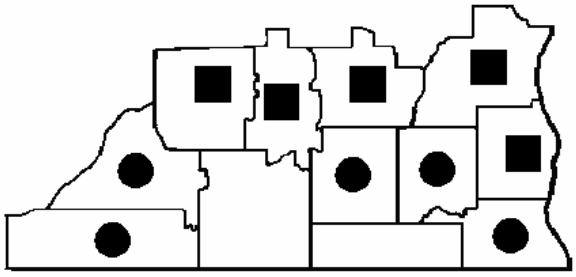


f.

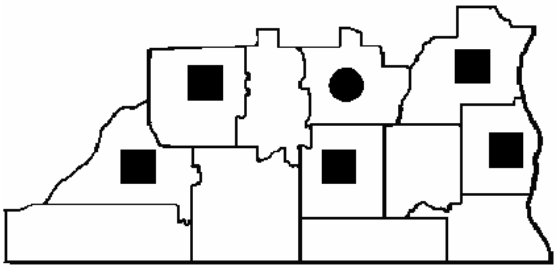
**Figure 10**. a) illustration of *Botrychium lunarioides*, b) distribution of *B. lunarioides*, c) illustration of *B. virginianum*, d) distribution of *B. virginianum*, e) illustration of *B. jenmanii*, f) distribution of *B. jenmanii*.

a.



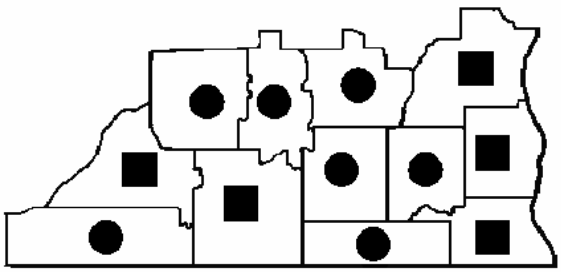
b.

c.



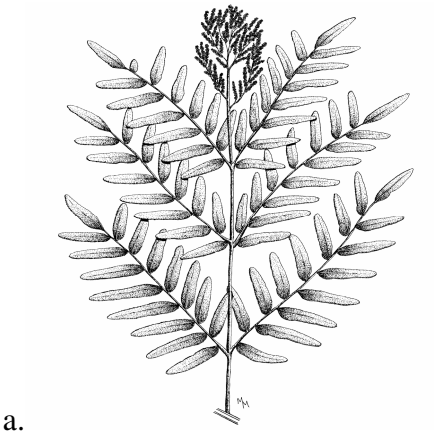
d.

e.

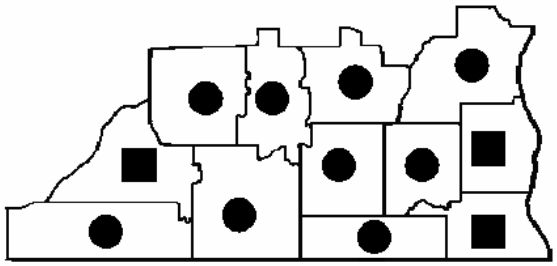


f.

**Figure 11**. a) illustration of *Botrychium biternatum*, b) distribution of *B. biternatum*, c) illustration of *B. dissectum*, d) distribution of *B. dissectum*, e) illustration of *Osmunda cinnamomea*, f) distribution of *O. cinnamomea*.



a.



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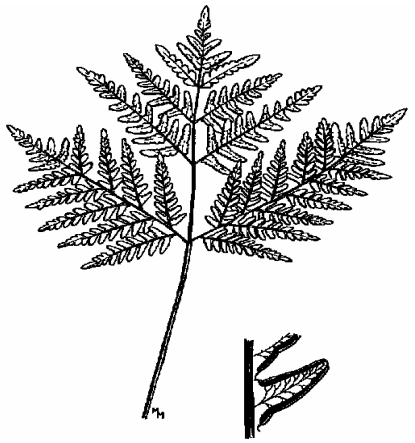

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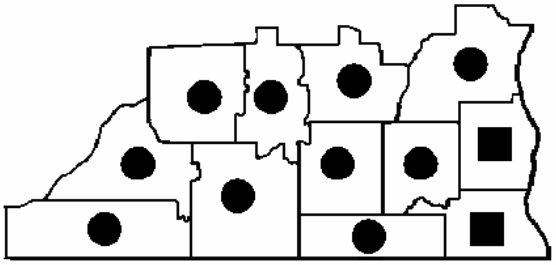

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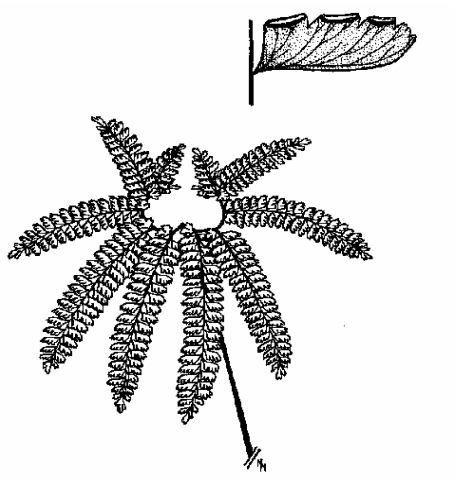

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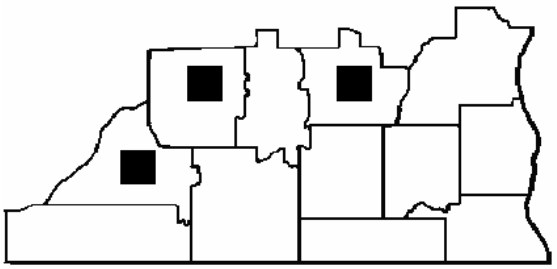
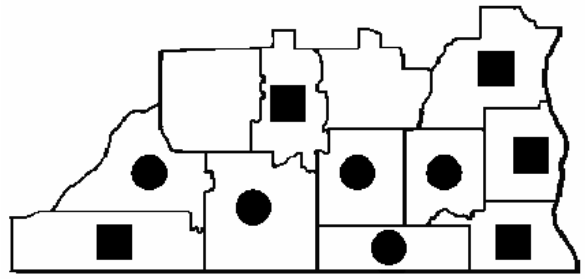


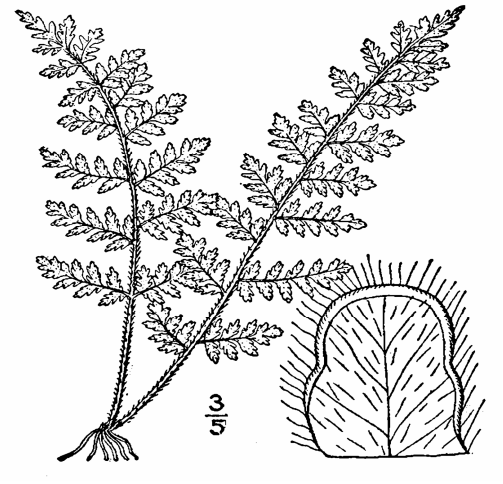
f.

**Figure 12**. a) illustration of *Osmunda regalis*, b) distribution of *O. regalis*, c) illustration of *Pteridium aquilinum*, d) distribution of *P. aquilinum*, e) illustration of *Adiantum pedatum*, f) distribution of *A. pedatum.*

a.



b.



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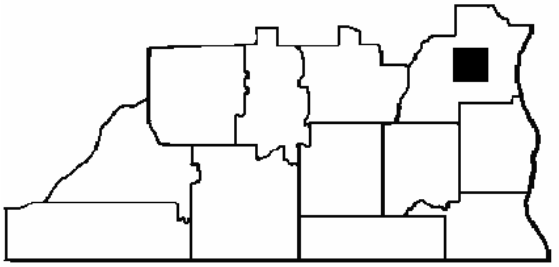

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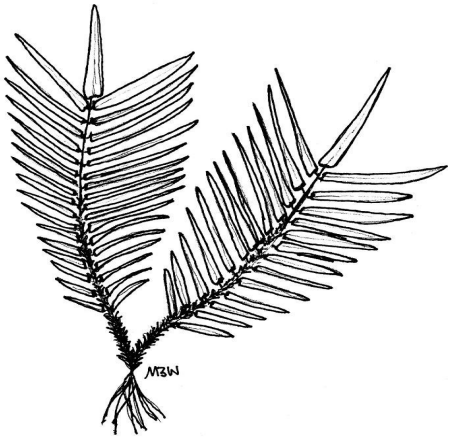

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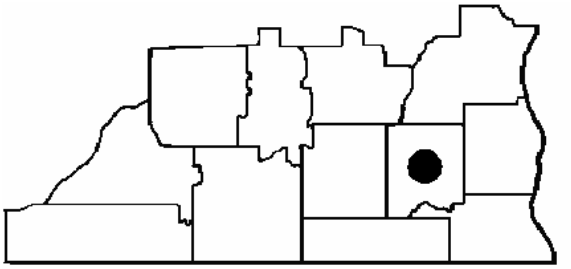


f.

**Figure 13**. a) illustration of *Adiantum capillus-veneris*, b) distribution of *A. capillus-veneris*, c) illustration of *Cheilanthes lanosa*, d) distribution of *C. lanosa*, e) illustration of *Pteris vittata*, f) distribution of *P. vittata*.

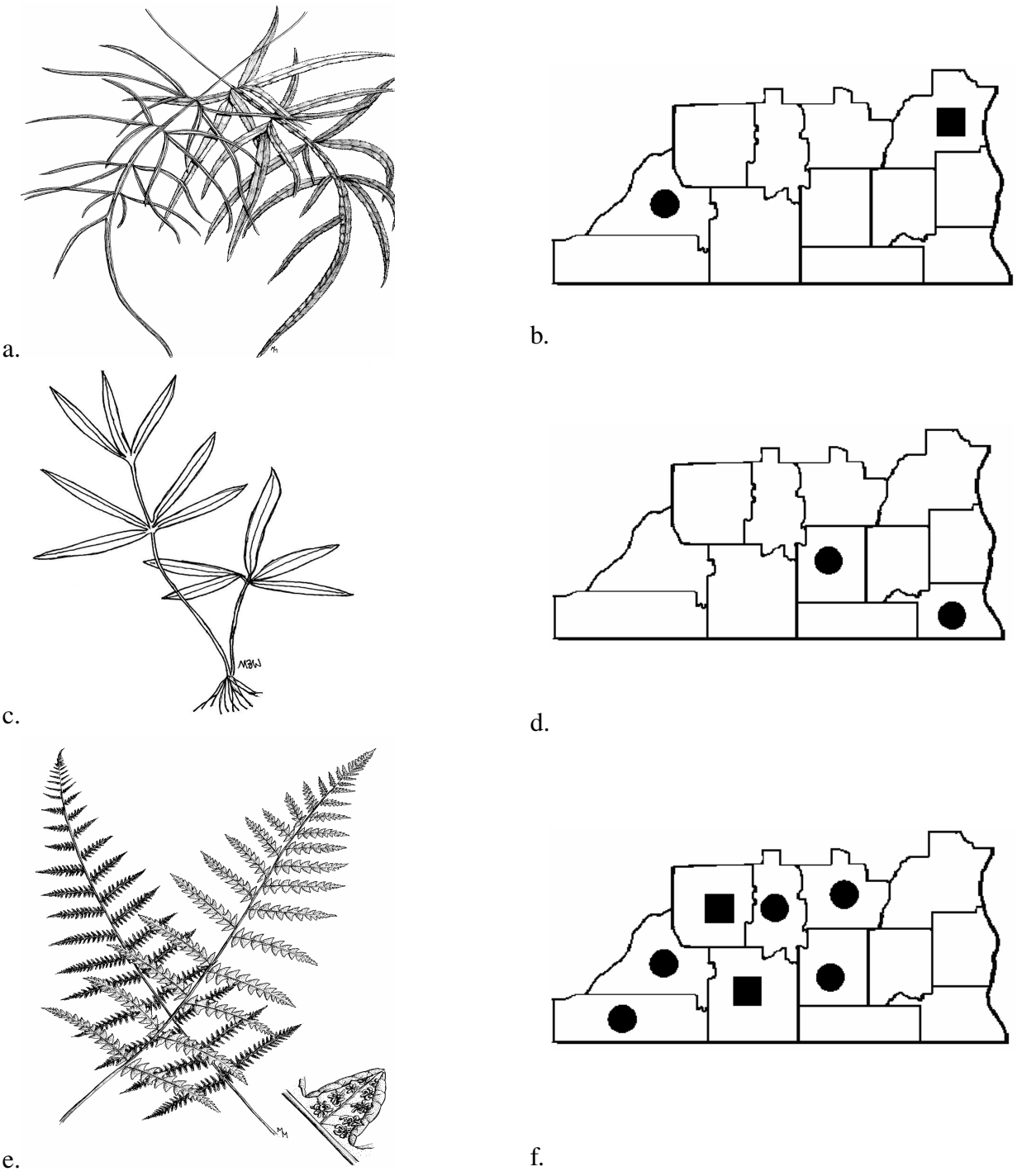
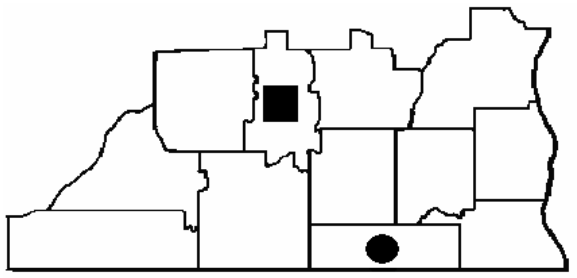


**Figure 14**. a) illustration of *Pteris multifida*, b) distribution of *P. multifida*, c) illustration of *P. cretica*, d) distribution of *P. cretica*, e) illustration of *Thelypteris palustris*, f) distribution of *T. palustris*.

a.



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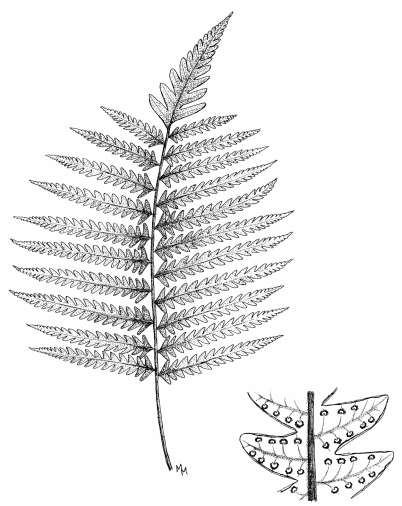

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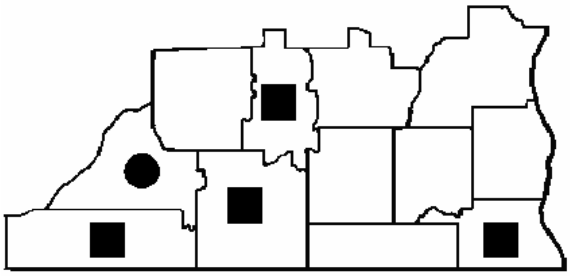

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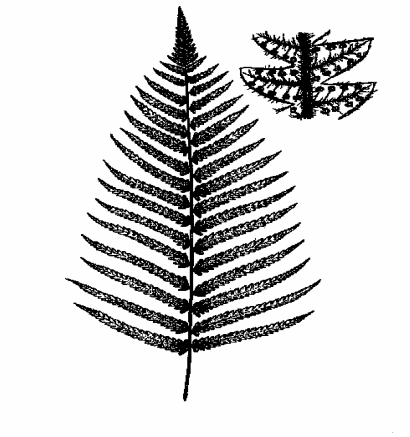

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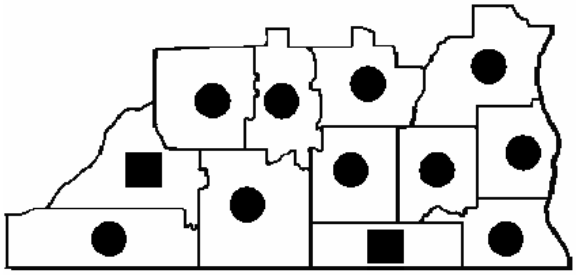
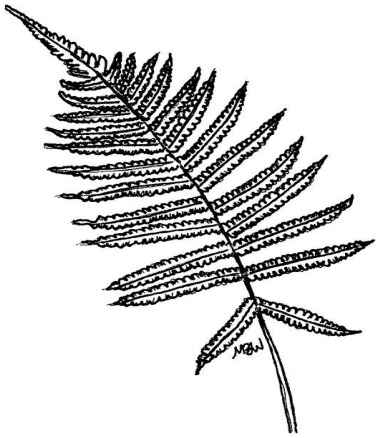
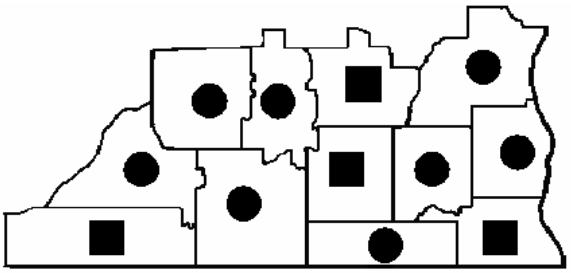


f.

**Figure 15**. a) illustration of *Thelypteris dendata*, b) distribution of *T. dendata*, c) illustration of *T. ovata*, d) distribution of *T. ovata*, e) illustration of *T. kunthii*, f) distribution of *T. kunthii*.



a.



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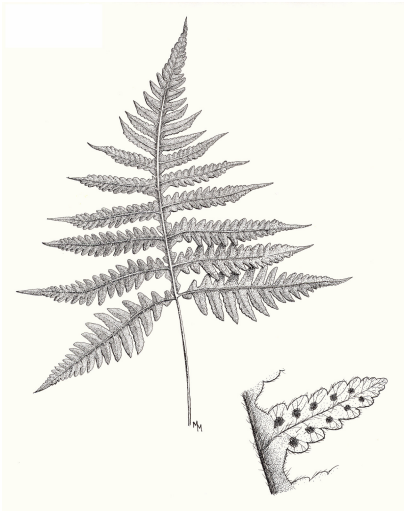

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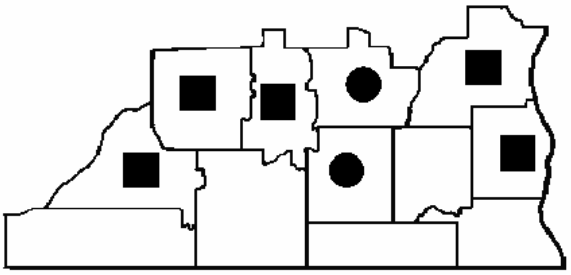

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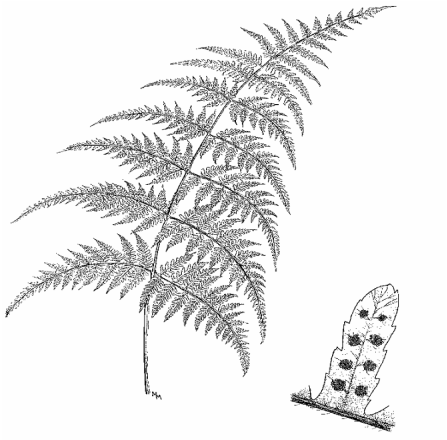

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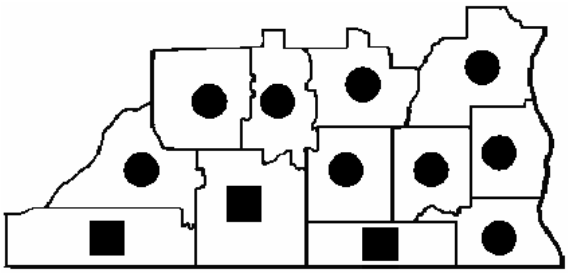


f.

**Figure 16**. a) illustration of *Thelypteris hispidula*, b) distribution of *T. hispidula*, c) illustration of *Phegopteris hexagonoptera*, d) distribution of *P. hexagonoptera*, e) illustration of *Macrothelypteris torresiana*, f) distribution of *M. torresiana*.

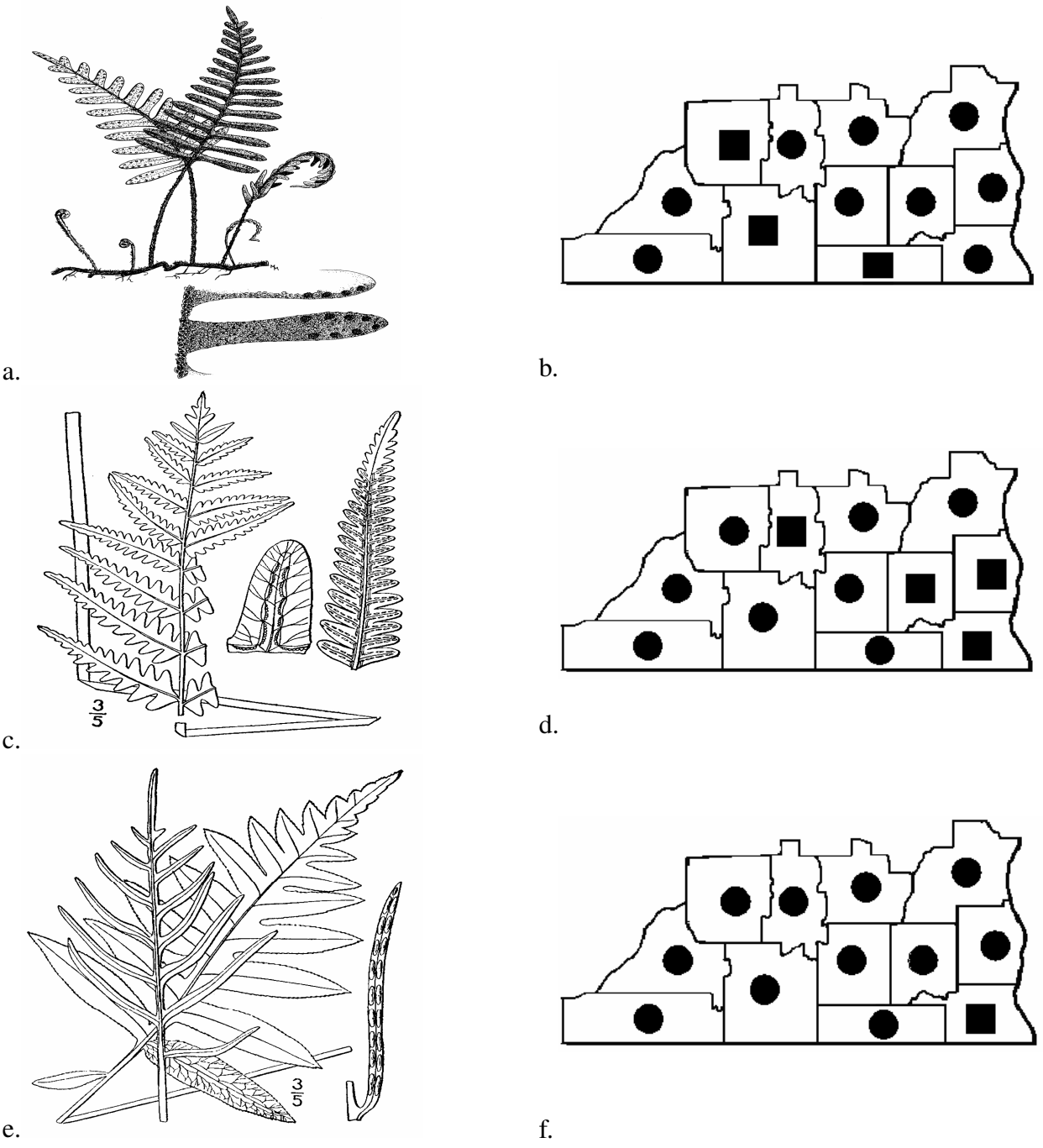
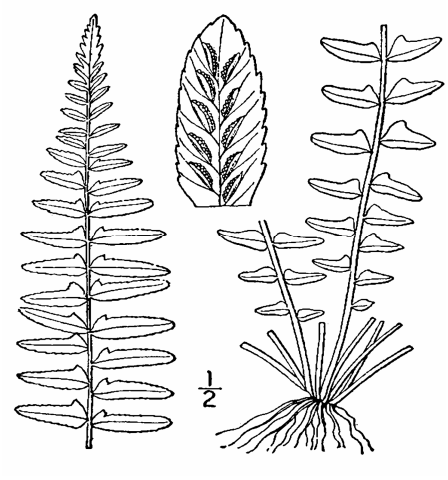



**Figure 17**. a) illustration of *Pleopeltis polypodioides*, b) distribution of *P. polypodioides*, c) illustration of *Woodwardia virginica*, d) distribution of *W. virginica*, e) illustration of *W. areolata*, f) distribution of *W. areolata*.

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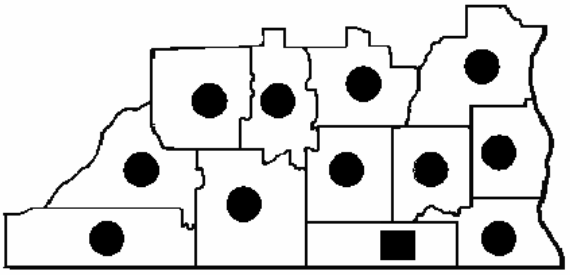
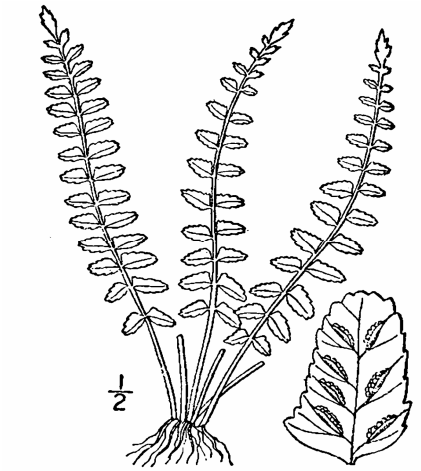
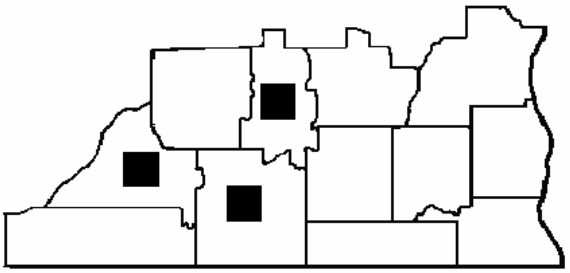


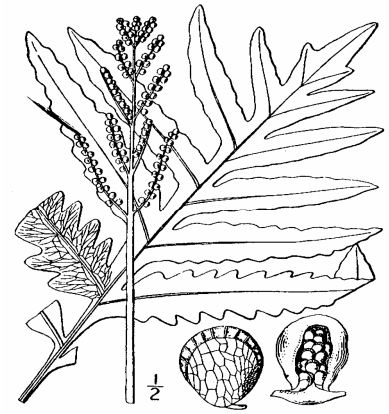
b.



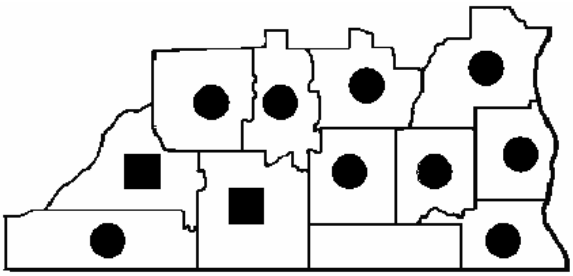

c.



d.



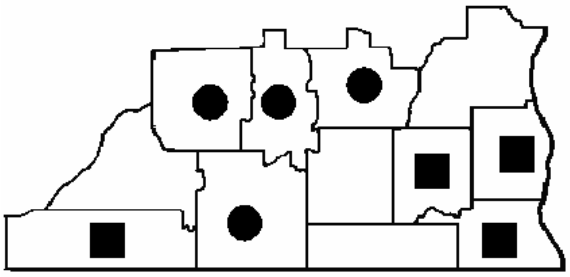

e.



f.

**Figure 18**. a) illustration of *Asplenium platyneuron*, b) distribution of *A. platyneuron*, c) illustration of *A. resiliens*, d) distribution of *A. resiliens*, e) illustration of *Onoclea sensibilis*, f) distribution of *O. sensibilis*.

a.



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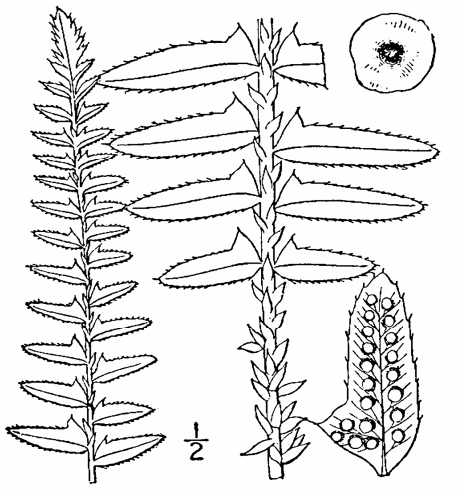


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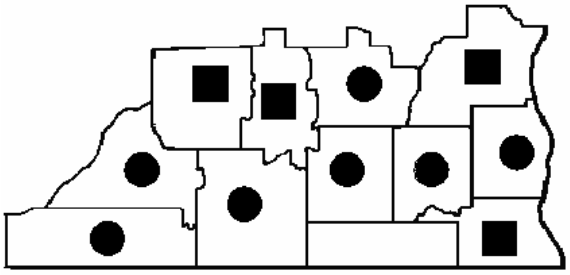

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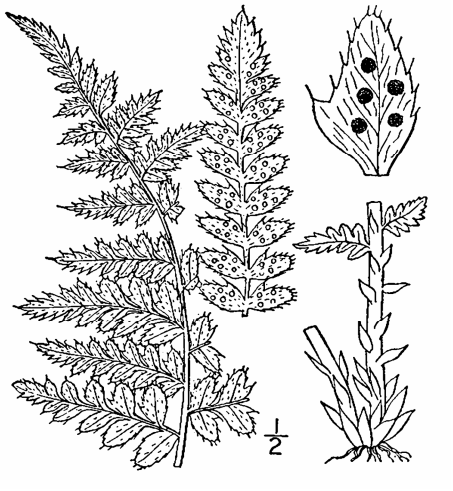


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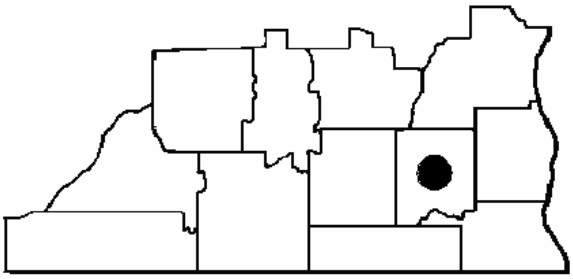
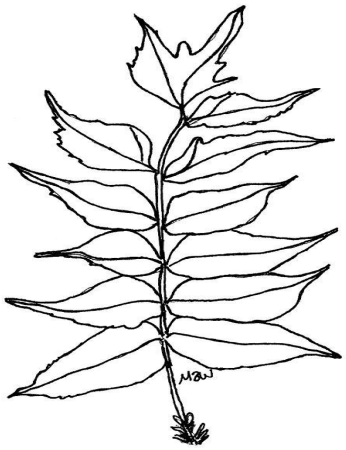
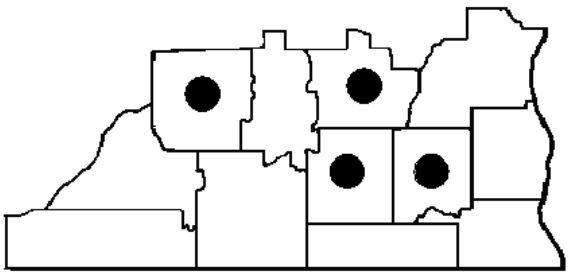


f.

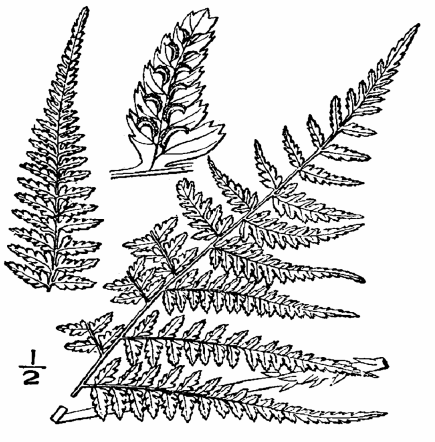
**Figure 19**. a) illustration of *Woodsia obtusa*, b) distribution of *W. obtusa*, c) illustration of *Polystichum acrostichoides*, d) distribution of *P. acrostichoides*, e) illustration of *P. braunii*, f) distribution of *P. braunii*.



a.



b.

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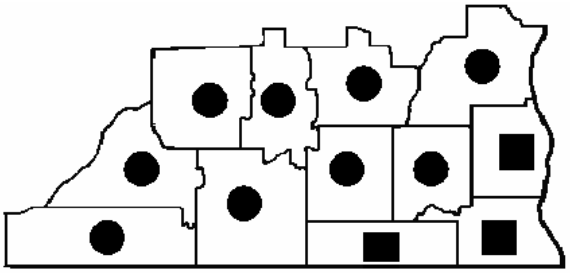

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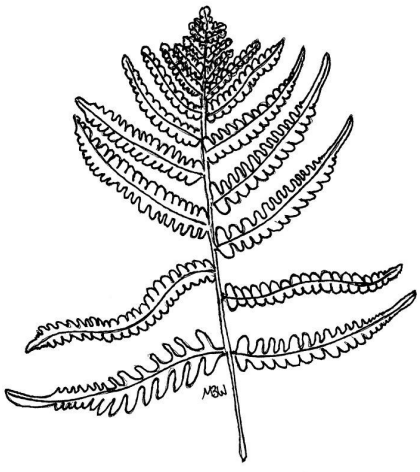

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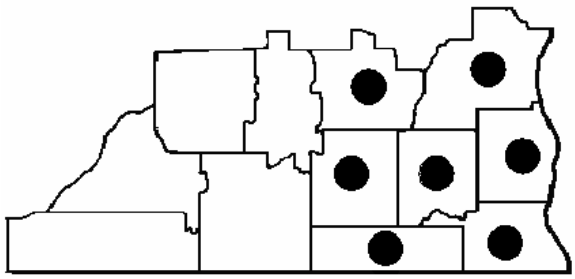
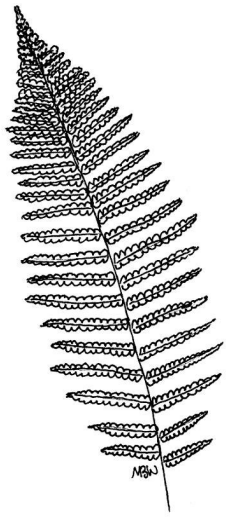
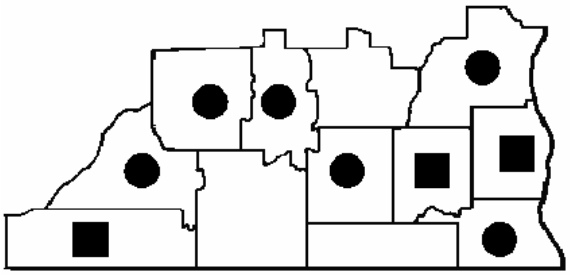


f.

**Figure 20**. a) illustration of *Cyrtomium falcatum*, b) distribution of *C. falcatum*, c) illustration of *Athyrium filix-femina*, d) distribution of *A. filix-femina*, e) illustration of *Deparia petersenii*, f) distribution of *D. petersenii*.



a.



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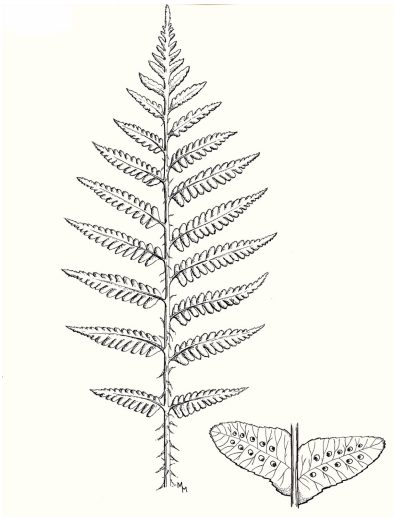

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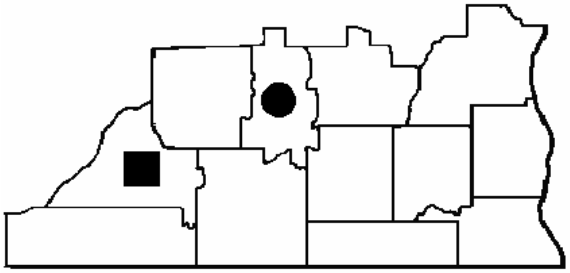

d.

**Figure 21**. a) illustration of *Dryopteris ludoviciana*, b) distribution of *D. ludoviciana*, c) illustration of *D. celsa*, d) distribution of *D. celsa*.

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