The Lycophytes, Monilophytes, and Gymnosperms of the Delmarva Peninsula, an Annotated Checklist

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Huperzia lucidula, shining clumoss

Dryopteris cristata, crested wood-fern

Pinus virginiana, Virginia pine

The Lycophytes, Monilophytes, and Gymnosperms of the Delmarva Peninsula, an Annotated Checklist

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Abstract.—Distinctive and usually well known components of the flora of most regions include the spore-bearing vascular plants [lycophytes (clubmosses, spikemosses, and quillworts) and monilophytes (true ferns)], and the cone-bearing plants [gymnosperms (hemlock, pine, cypress, cedar)]. The Delmarva Peninsula of the Atlantic Coastal Plain supports a rich flora, which includes a diverse collection of lycophytes, monilophytes, and gymnosperms. Fifty-eight (58) species and varieties of native and non-native lycophytes and monilophytes, and 12 species and varieties of native and non-native gymnosperms are reported here. This paper presents all taxa known to occur from these three groups on the Delmarva Peninsula in the form of an annotated checklist. These data provide the most accurate and up-to-date information on the distribution and status for all taxa listed, and adds to the overall knowledge of the Atlantic Coastal Plain flora.

INTRODUCTION

Unique and distinctive components of the flora of most regions include the spore-bearing vascular plants [lycophytes (clubmosses, spikemosses, and quillworts) and monilophytes (true ferns)], and the cone-bearing plants [gymnosperms (hemlock, pine, cypress, cedar)]. Members of these three groups are easily recognized and usually can be identified even by the inexperienced; they are frequently found in a variety of habitat types, and often form the basis for classifying plant communities. The Delmarva Peninsula, a unique geographic area of the Atlantic Coastal Plain province of the eastern U.S., supports a rich and diverse flora of over 2,400 species and varieties of native and naturalized vascular plants (McAvoy 2000). Important elements of this flora are the lycophytes, monilophytes, and gymnosperms, for which 58 species and varieties of native and non-native lycophytes and monilophytes are known, and 12 species and varieties of native and non-native gymnosperms. The purpose of this paper is to present all taxa known to occur from these three groups on the Delmarva Peninsula in the form of an annotated checklist. When research for this checklist began, the intent was to base each species occurrence, as much as possible, on modern day (less then 20 years old) collections in order to provide the most accurate and up-to-date distribution and status for each taxon listed. Researchers will now have at their disposal a document that should aid in their studies, as well as add to the overall knowledge of the Atlantic Coastal Plain flora and help to outline the phytogeography of the province.

Traditionally, botanists referred to two groups of spore-bearing plants as the “ferns” and “fern-allies,” and in most classifications, they were formally placed within the Division

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Pteridophyta and were collectively referred to as Pteridophytes. But new research (Hasebe et al. 1995, Manhart 1995, Pryer et al. 1995, Wolf et al. 1998, Pryer et al. 2001, Pryer et al. 2004) focusing on phylogenetic relationships has resulted in changes to the classification system of the ferns and their relatives. The current classification is based on new evidence derived from molecular and morphological studies and from the fossil record. It is now commonly agreed that it is more appropriate to refer to the fern and fern-related Divisions as Lycopodiophyta (clubmosses, spikemosses, and quillworts) and Monilophyta (true ferns and horsetails). The lycophytes comprise three main orders (Pryer et al. 2004): Lycopodiales (clubmosses), Selaginellales (spikemosses), and Isoetales (quillworts). The monilophytes comprise five main orders (Pryer et al. 2004): Psilotales (whisk ferns), Ophioglossales (ophioglossoid ferns), Equisetales (horsetails), Marattiales (marattioid ferns), and Polypodiales (leptosporangiate ferns). The lycophytes are quite distinct from the monilophytes and appear to have diverged early (early-mid Devonian, ca. 400 million years ago; Pryer 2004) and are thus not as closely related to the true ferns as botanists once thought. Furthermore, the horsetails (Equisetales) are now thought to be much more closely related to the true ferns than to any of the "fern-allies" (Pryer et al. 2001). Although the monilophytes and lycophytes are not as closely related as once believed, they do share a common trait in that both groups reproduce by spores.

The Study Area

The Delmarva Peninsula (Fig. 1) is an area lying entirely within the Atlantic Coastal Plain physiographic province of the eastern United States. The Peninsula lies south of the fall line (a term applied to the boundary between the Appalachian Piedmont province and the Atlantic Coastal Plain) in New Castle County, Delaware and Cecil County, Maryland, and is bordered on the east by the Delaware River, Delaware Bay and the Atlantic Ocean, and on the west by the Elk River and Chesapeake Bay. It includes the Coastal Plain province of Delaware (New Castle, Kent, and Sussex Counties), the Eastern Shore of Maryland (Cecil, Kent, Queen Anne's, Caroline, Talbot, Dorchester, Wicomico, Somerset, and Worcester Counties), and the Eastern Shore of Virginia (Accomack and Northampton Counties). Its length north to south is about 200 miles (320 km), its greatest width is about 70 miles (110 km), its narrowest width is about 10 miles (16 km), and the total land area is about 5,800 square miles (15,000 square kilometers). The climate of the Peninsula is moderated by the Delaware Bay, Chesapeake Bay, and the Atlantic Ocean and is characterized by moderately cold winters and warm humid summers. The landscape of the Delmarva is mostly agriculture, on flat to gentle sloping sandy plains with slow-flowing rivers and streams that are bordered by extensive swamp forests and tidal marshes. In the coastal areas, barrier islands, salt marshes, tidal flats and inland bays are well developed. The Delmarva's Coastal Plain soils of sands, silts, clays and gravel support forests primarily composed of mixed evergreen tree species, such as: loblolly pine, Virginia pine, and American holly and deciduous tree species, such as: oaks, hickory, beech, gums, maple, and tulip poplar. The Delmarva Peninsula lies within the Chesapeake Bay Lowlands Ecoregion as defined by The Nature Conservancy (2002), and within the Outer Coastal Plain Mixed Forest Province as mapped by Bailey (1995).

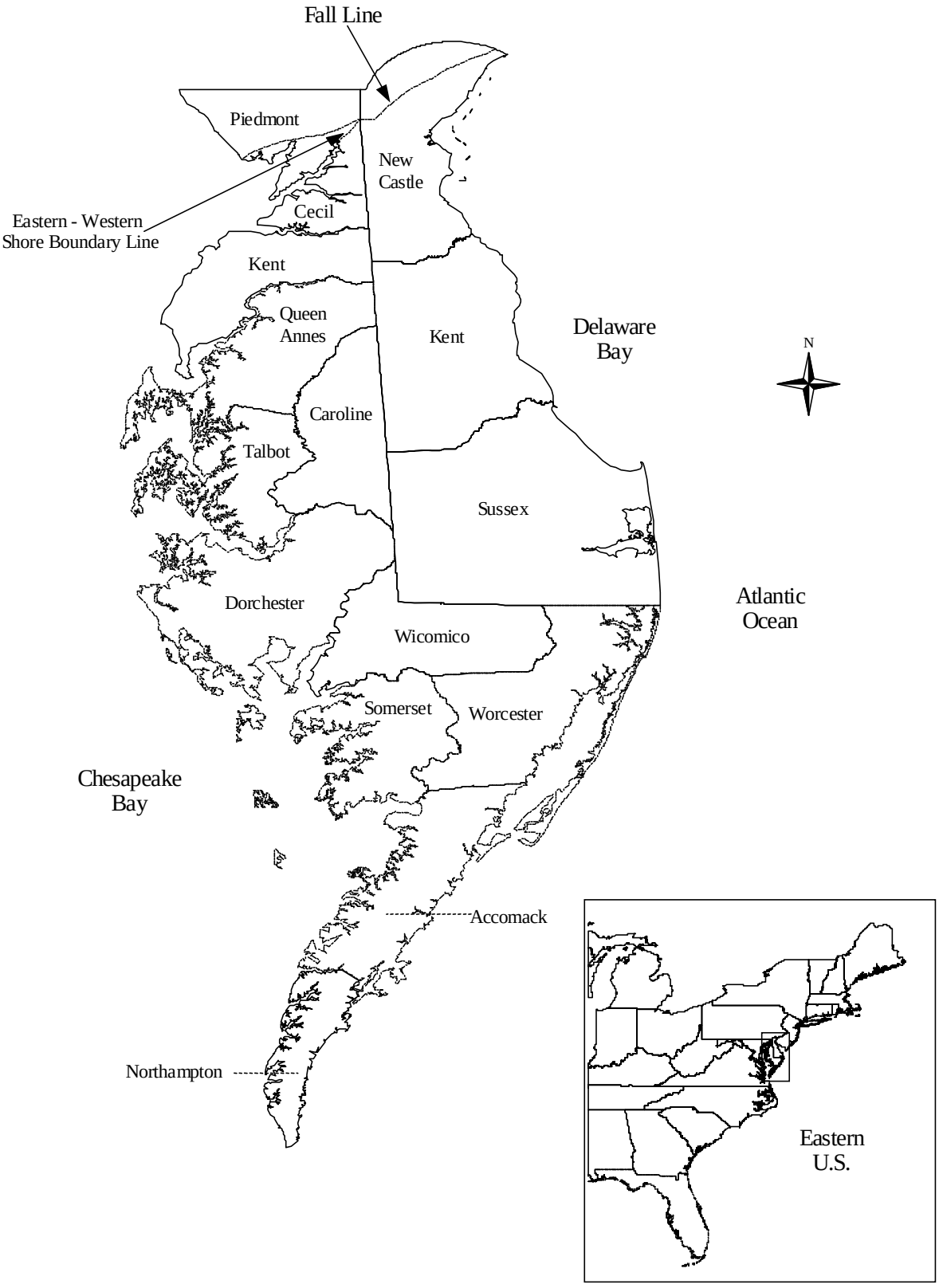

Figure 1. Location map, Delmarva Peninsula.

METHODS

The goal of this study was to base each species occurrence, as much as possible, on modern day (less then 20 years old) collections in order to provide the most accurate and up-to-date distribution and status for all taxa listed. Therefore, this checklist is based primarily on field work and voucher specimens made by the author between 1992 and 2007. All voucher specimens made by the author have been deposited at DOV (herbarium acronyms follow Holmgren et al. 1990). Data were also gathered from the literature and from herbaria searches. Herbaria searched included: BALT, DOV, DUKE, FARM, GH, GMUF, MARY, MO, NY, ODU, PH, REED (now at MO), US, VPI, and WILLI. Additional data were kindly shared by other botanists who are currently doing field work on the Delmarva, or have done field work in the recent past (Allen Belden, Pete Bowman, Janet Ebert, Gary Fleming, Chris Frye, Jason Harrison, Frank Hirst, Jack Holt, Wes Knapp, Rob Naczi, Matt Sarver, Pete Stango, Johnny Townsend, Ron Wilson, and Tom Wieboldt). Much field time was spent trying to relocate historical (greater then 20 years) locations for collections of uncommon taxa, as well searching counties for literature reports not supported by voucher specimens. When a taxon reported from a particular county on the Delmarva could not be relocated in the field by the author, other collections were utilized as vouchers, either modern day or historical. The oldest modern day collection of a lycophyte or monilophyte utilized as a county voucher is from 1988 of *Selaginella apoda* (Dorchester County, Maryland; *S. Hill 19511*, MARY). The oldest modern day collection of a gymnosperm utilized as a county voucher is from 1992 of *Taxodium distichum* (Sussex Co., Del., *W. McAvoy 932*, DOV). The oldest historical collection of a lycophyte or monilophyte utilized as a county voucher is from 1874 of *Pleopeltis polypodioides* subsp. *michauxiana* (Sussex County, Delaware, *A. Commons s.n.*, PH). The oldest historical collection of a gymnosperm utilized as a county voucher is from 1867 of *Chamaecyparis thyoides* (New Castle County, Delaware, *A. Commons s.n.*, PH). Often, unvouchered literature reports of certain taxa from particular counties could not be found in the field. In these cases, special notation is used in the text.

SUMMATION OF THE FLORA

Lycophytes and Monilophytes

The lycophytes and monilophytes are not as closely related as once thought, but they both share a common trait in that they reproduce by spores and thus form a distinctive component of the vascular flora of the Delmarva Peninsula. Therefore, the following results usually combine data for both the lycophytes and monilophytes, with some exceptions.

The results of this study (Table 1) show a total of 58 species and varieties (48 species, 10 varieties) of both native (56 taxa) and non-native (2 taxa) lycophytes and monilophytes (does not include hybrids), that have been vouchered with modern day (less then 20 years) and historical (greater then 20 years) collections. Overall, 17 families are represented, composed of 35 genera. A total of 6 hybrids have been documented from both groups. Thirty-three taxa, or 57% of the native lycophytes (7 taxa) and monilophytes (26 taxa) are considered by the author to be either rare, or infrequent on the Delmarva Peninsula. Thirty-four percent (19 taxa) of the native lycophytes (6 taxa) and monilophytes (13 taxa) of the Delmarva have a more northern overall distribution, and 14% (8 taxa) of the native lycophytes (1 taxon) and monilophytes (7 taxa) have a more southern overall distribution. The largest families of lycophytes and monilophytes

represented on the Delmarva are: Division Lycopodiophyta - Lycopodiaceae (7 taxa); Division Monilophyta - Dryopteridaceae (15 taxa), Ophioglossaceae (6 taxa), Osmundaceae (4 taxa), and Thelypteridaceae (4 taxa). The largest genera of lycophytes and monilophytes are: Lycopodiophyta - *Isoetes* (3 taxa); Monilophyta - *Dryopteris* (7 taxa), *Osmunda* (4 taxa), *Equisetum* (3 taxa), and *Sceptridium* (3 taxa). Table 2 shows the diversity of lycophytes and monilophytes (native and non-hybrid; 56 taxa) on the Delmarva by county, with New Castle and Sussex having the greatest number of taxa, 45 (80% of the flora), and Somerset having the lowest number, 28 (50% of the flora). Twenty taxa, or 36% of the native, non-hybrid lycophytes and monilophytes of the Delmarva have been documented from all counties on the Peninsula (Table 3).

Table 1. Summary of the lycophytes and monilophytes of the Delmarva Peninsula, including some data as a percentage (%) of the overall lycophyte and monilophyte flora.

Classification	Lycophytes	Monilophytes	Totals
Taxa	11	47	**58**
Species	11	37	**48**
Varieties	0	10	**10**
Native taxa	11	45	**56**
Non-native taxa	0	2	**2**
Families	3	14	**17**
Genera	7	28	**35**
Hybrids	1	5	**6**
Rare or Infrequent	7	26	**33 (57%)**
Northern Native Taxa	6	13	**19 (33%)**
Southern Native Taxa	1	7	**8 (14%)**

Table 2. Total number of native and non-hybrid lycophytes and monilophytes combined, by county on the Delmarva Peninsula (from lowest to highest) and as a percentage (%) of the overall native, non-hybrid flora (56 taxa).

County	Total Taxa	Percentage %
Somerset	28	50
Northampton	32	57
Accomack	34	61
Cecil	35	63
Talbot	35	63
Wicomico	35	63
Queen Anne's	36	64
Kent, Md.	36	64
Kent, Del.	37	66
Dorchester	37	66
Worcester	38	68
Caroline	41	73
Sussex	45	80
New Castle	45	80

Table 3. The lycophytes and monilophytes documented (modern and historical collections) from all counties on the Delmarva Peninsula.

Lycophytes
Dendrolycopodium obscurum
Diphasiastrum digitatum
Monilophytes
Asplenium platyneuron
Athyrium filix-femina var. *angustum*
Athyrium filix-femina var. *asplenioides*
Botrypus virginianus
Dennstaedtia punctilobula
Dryopteris carthusiana
Equisetum arvense
Onoclea sensibilis
Osmunda cinnamomea var. *cinnamomea*
Osmunda regalis var. *spectabilis*
Polystichum acrostichoides
Pteridium aquilinum var. *latiusculum*
Sceptridium biternatum
Sceptridium dissectum
Thelypteris noveboracensis
Thelypteris palustris var. *pubescens*
Woodwardia areolata
Woodwardia virginica

Gymnosperms

The gymnosperm flora of the Delmarva consists of a total of 12 taxa (11 species and 1 variety), both native (9 taxa) and non-native (3 taxa) that have been vouchered with modern day and historical collections (Table 4). Two families are represented (Pinaceae and Cupressaceae), composed collectively of 5 genera (*Tsuga*, *Pinus*, *Taxodium*, *Chamaecyparis*, and *Juniperus*). Thirty-six percent of the native gymnosperm flora (5 taxa) is considered by the author to be either rare or infrequent on the Delmarva Peninsula. Fifty-six percent (5 taxa) of the native gymnosperm flora of the Delmarva has a more southern overall distribution, and 22% (2 taxa) of the native gymnosperm flora has a more northern overall distribution. The largest gymnosperm families containing native and non-native taxa represented on the Delmarva are: Pinaceae (9 taxa), and Cupressaceae (3 taxa). The largest gymnosperm genus is *Pinus* with 8 taxa, five being native and three being non-native. The highest diversity of native gymnosperms (9 taxa) on the Delmarva by county (Table 5), are found in Wicomico and Worcester, both with 8 taxa (89% of the gymnosperm flora). Cecil County has the lowest number of native gymnosperms with 3 (33% of the gymnosperm flora). Two taxa (*Juniperus virginiana* and *Pinus virginiana*), or 22% of the native gymnosperm flora of the Delmarva have been documented from all counties on the Peninsula.

Table 4. Summary of the gymnosperms of the Delmarva Peninsula, including some data as a percentage (%) of the overall gymnosperm flora.

Classification	Total Taxa
Taxa (native & non-native)	12
Species	11
Varieties	1
Native taxa	9
Non-native taxa	3
Families	2
Genera	5
Rare or infrequent taxa	5 (36%)
Southern native taxa	5 (56%)
Northern native taxa	2 (22%)

Table 5. The total native gymnosperm flora, by county on the Delmarva Peninsula (lowest to the highest), and as a percentage of the overall native flora (9 taxa).

County	Total Taxa	Percentage %
Cecil	3	33
Kent, Maryland	4	44
Northampton	4	44
Queen Anne's	4	44
Somerset	4	44
Talbot	4	44
Kent, Del.	5	56
Dorchester	5	56
New Castle	6	67
Accomack	7	78
Caroline	7	78
Sussex	7	78
Wicomico	8	89
Worcester	8	89

DISCUSSION

Prior to this study, the most extensive research on the lycophytes and monilophytes of the Delmarva Peninsula, were conducted by Tatnall (1946; covering all the Delmarva Counties), Reed (1953; covering the Delaware and Maryland Counties), Reed (1960; covering the Virginia Counties and Maryland Counties of Worcester and Somerset), Redman (1991; covering the Maryland Counties), Harvill et al. (1992; covering the Virginia Counties), and McAvoy & Bennett (2001; covering the Delaware Counties). Studies of the gymnosperms of the Delmarva were made by Tatnall (1946; covering all the Delmarva Counties), Taber (1960; covering the Delaware Counties), Harvill et al. (1992; covering the Virginia Counties), and McAvoy & Bennett (2001; covering the Delaware Counties). Of these authors, Tatnall (1946) was the only one to develop a floristic checklist, which included lycophytes, monilophytes, and gymnosperms

for the whole of the Delmarva. Though Tatnall was the only author to study the flora of the Delmarva overall, all of the former efforts mentioned have contributed to our floristic knowledge of the lycophytes, monilophytes, and gymnosperms of the Delmarva and provide an historical foundation for this study. In addition, these earlier works allow for comparisons to be made between the later day and present day flora.

It should be noted that Tatnall (1946) included the Piedmont physiographic province of New Castle County, Delaware and Cecil County, Maryland within his definition of the Delmarva Peninsula. This paper defines the Delmarva as being strictly Coastal Plain. Geologically, a peninsula is defined as a body of land surrounded by water and narrowly connected to a mainland (Hamblin 1985), the mainland in this case being the Piedmont of New Castle and Cecil Counties. Major differences in soils, hydrology and floristics are unquestionable between the Piedmont and Coastal Plain provinces; thus, the Delmarva Peninsula is defined here as one distinct geographic, geologic, and ecologic entity. While comparing Tatnall's (1946) checklist with this study, care was taken to exclude all Piedmont records from the analysis.

Table 6 shows the number of native and non-native lycophytes and monilophytes (excluding hybrids and forms) reported by Tatnall (1946), Reed (1953, 1960), Redman (1991), Harvill et al. (1992), and McAvoy & Bennett (2001), compared to the number of native and non-native lycophytes and monilophytes (excluding hybrids and forms) reported from this study. It should be noted that the taxonomic concepts employed by these earlier authors, updated to contemporary standards, often result in a reduction in the number of species they listed. For example, Tatnall (1946) listed 51 species and varieties of "ferns" and "fern-allies" (excluding hybrids and forms), but following the nomenclature used in this study, 6 would be "lumped" with other species.

In general, this study provides the most extensive list of the lycophyte and monilophyte flora of the Delmarva to date. Reed (1953) focused only on the Delaware and Maryland counties of the Delmarva and reported 45 taxa from Delaware counties and 43 taxa from Maryland counties. This study lists 54 taxa from Delaware counties and 50 from Maryland counties (Table 6; one taxon Reed listed in 1953 is now placed in synonymy in this checklist). In 1960, Reed turned his attention to the Virginia counties of the Delmarva and reported 30 taxa; here 37 taxa are listed from Virginia Counties (Table 6; one taxon Reed listed is now placed in synonymy in this checklist). Redman (1991) listed the known lycophytes and monilophytes in Maryland and reported 46 taxa from Maryland's Eastern Shore counties of the Delmarva, compared to 50 listed in this study (Table 6). In Harvill's (1992) checklist of the flora of Virginia, he reported 30 taxa from the state's Eastern Shore counties of the Delmarva (Table 6), here 37 taxa are listed from the same counties (Table 6). Finally, McAvoy & Bennett (2001) listed 53 taxa from the Delaware counties of the Delmarva, while this study lists 54 taxa (Table 6).

Table 6. Comparison of the number of native and non-native taxa (excluding hybrids and forms) listed from previous studies on the lycophyte and monilophyte flora of the Delmarva, with the number of taxa listed in this study. A question mark (?) indicates that these data could not be accurately determined due to the author's format of describing distribution data.

Authors	Delmarva	Delaware Counties	Maryland Counties	Virginia Counties
McAvoy (this study)	58	54	51	37
McAvoy & Bennett (2001)		53		
Tatnall (1946)	51	?	?	?
Reed (1953)		45	43	
Reed (1960)				30
Redman (1991)			46	
Harvill (1992)				30

Table 7 lists 13 species of native and non-native lycophytes and monilophytes that are listed in this checklist, but were not reported by Tatnall in his 1946 publication (excludes hybrids and forms). Of these 13 species, 7 are reported here as new additions to the flora of the Delmarva Peninsula (*Azolla caroliniana, Cystopteris protrusa, Diplazium pycnocarpon, Dryopteris clintoniana, D. goldiana, Isoetes echinospora,* and *Marsilea quadrifolia*). These new reports are based on Reed (1953, 1960), Redman (1991), Harvill et al. (1992) and McAvoy & Bennett (2001). *Sceptridium oneidense* (Dorchester Co.) and *Botrychium matricariifolium* (Accomack Co.) were first reported by Reed (1953) and Reed (1956), respectively. Redman (1991) also listed *S. oneidense* based on Reed's collection, and Harvill et al. (1992) listed *B. matricariifolium*, also based on Reed's collection.

Table 7. Native and non-native lycophytes and monilophytes (excluding hybrids and forms) listed in this study, but not reported by Tatnall (1946), with comments.

Species	Comments
Azolla caroliniana	Non-native, new report
Asplenium rhizophyllum	First reported by Hadaway (1992)
Botrychium matricariifolium	First reported by Reed (1956)
Cystopteris protrusa	New report
Diplazium pycnocarpon	New report
Dryopteris clintoniana	New report
Dryopteris goldiana	New report
Isoetes echinospora	New report
Marsilea quadrifolia	Non-native, new report
Osmunda cinnamomea var. *glandulosa*	First reported by Reed (1953)
Pellaea atropurpurea	First reported by Hadaway (1992)
Sceptridium oneidense	First reported by Reed (1953)
Schizaea pusilla	First reported by Hirst (1990)

The gymnosperms of the Delmarva were studied by Tatnall (1946), Taber (1960), Harvill et al. (1992), and McAvoy & Bennett (2001). Table 8 shows the number of gymnosperms

reported by these authors, compared to the number of gymnosperms listed in this study. This study lists 12 gymnosperms compared to Tatnall (1946), who reported 10. Taber (1960), who only studied the gymnosperms of Delaware, also reported 10 taxa, and Harvill et al. (1992), who was only concerned with the Virginia counties of the Delmarva, reported five. The two species reported here that were not listed by Tatnall (1946), Taber (1960) and Harvill et al. (1992) are: *Pinus thunbergiana* and *Pinus palustris*, both of which are not native to the Delmarva. Harvill et al. (1992) did not list *Chamaecyparis thyoides* from the Virginia counties of the Delmarva, and McAvoy & Bennett (2001) did not list *P. palustris* from the Delaware counties.

Table 8. Numbers of native and non-native gymnosperms listed from previous Delmarva Peninsula studies [Tatnall (1946); Taber (1960); Harvill et al. (1992); and McAvoy & Bennett (2001)], with the number of gymnosperms listed in this study. A question mark (?) indicates that these data could not be accurately determined due to the author's format of describing distribution data.

Authors	Delmarva	Delaware Counties	Maryland Counties	Virginia Counties
McAvoy (this study)	12	12	12	6
McAvoy & Bennett (2001)		11		
Tatnall (1946)	10	?	?	?
Taber (1960)		10		
Harvill (1992)				5

Comparing the species diversity of the native lycophyte and monilophyte flora (excluding hybrids and forms) of the Delmarva with other Atlantic Coastal Plain States [New Jersey (Montgomery & Fairbrothers 1992); Maryland (Redman 1991); Virginia, North Carolina, South Carolina, and Georgia (Weakley 2006)] and regions [Cape Cod, Massachusetts (Sorrie & Somers 1999), and Long Island, New York (Weldy & Werier 2005)], we find that Long Island supports the highest number of native taxa with 58, followed by New Jersey with 56, then Virginia and the Delmarva Peninsula, both with 56 taxa (Table 9).

Table 9 compares the percentage of the overall native lycophyte and monilophyte floras (excluding hybrids and forms) of Atlantic Coastal Plain States and regions (Atlantic Coastal Plain boundaries follow USGS 2004) that are primarily either southern or northern in distribution [defined as species that have the core of their distribution either in the southern or northern states or provinces based on the Flora of North America Editorial Committee (FNA 1993)]. The native lycophyte and monilophyte flora of the Delmarva is primarily northern in its biogeographic affinity, with 34% of the flora having a more northern distribution, compared to 14% of the flora that is more southern in distribution. As one travels north to south on the Atlantic Coastal Plain, the native lycophyte and monilophyte flora becomes much more southern in origin. Only 5% and 10% of the flora of Long Island and Cape Cod, respectively, have a more southern distribution. In contrast, the floras of South Carolina and Georgia includes only 4% and 0% northern element, respectively. The native lycophyte and monilophyte flora of Virginia appears to be transitional, with 24% of its flora being southern, and 22% being northern. South of Virginia, the northern lycophyte and monilophyte flora drops by 12%. North of Virginia, the southern monilophyte and lycophyte flora drops by 10%.

Table 9. Comparison of the native lycophyte and monilophyte floras (excluding hybrids and forms) and the percentage that is southern and northern (based on FNA 1993) of Atlantic Coastal Plain States (New Jersey, Maryland, Virginia, North Carolina, South Carolina, and Georgia) and regions (Cape Cod, MA and Long Island, NY) to the Delmarva Peninsula. Data from the state of Delaware is not included here because the state's Coastal Plain province is included within the Delmarva Peninsula in its entirety. State and regional flora data are based on: Cape Cod, MA (Sorrie & Somers 1999); Long Island, NY (Weldy & Werier 2005); New Jersey (Montgomery & Fairbrothers 1992); Maryland (Redman 1991); Virginia, North Carolina, South Carolina, and Georgia (Weakley 2006).

State/Region	Total Native Taxa	% of Flora Southern	% of Flora Northern
Long Island, NY	58	5	52
Cape Cod, MA	44	10	48
New Jersey	56	13	45
Maryland	48	13	33
Delmarva Peninsula	**56**	**14**	**34**
Virginia	55	24	22
North Carolina	52	37	10
South Carolina	54	44	4
Georgia	53	70	0

Table 10 compares the species diversity of the native gymnosperm flora of the Delmarva with other Atlantic Coastal Plain States [New Jersey (Stone 1911); Maryland (Brown & Brown 1972); Virginia, North Carolina, South Carolina, and Georgia (Weakley 2006)] and regions [Cape Cod, MA (Sorrie & Somers 1999) and Long Island, NY (Weldy & Werier 2005)]. The Delmarva supports 9 taxa of native gymnosperms, while Cape Cod supports 6, the fewest within the Atlantic Coastal Plain province. South Carolina supports 14 taxa of native gymnosperms, the greatest number. Traveling north to south on the Atlantic Coastal Plain, the diversity of gymnosperms appears to increase. As mentioned, on Cape Cod 6 native gymnosperms occur, and in New Jersey 7 native gymnosperms are found. In contrast, Georgia and South Carolina support 13 and 14 native gymnosperms respectively.

Table 10. Comparison of the native gymnosperm flora of Atlantic Coastal Plain States (Massachusetts, New Jersey, Maryland, Virginia, North Carolina, South Carolina and Georgia) and regions (Cape Cod, MA and Long Island, NY) to the Delmarva Peninsula. Data from the state of Delaware is not included here because the state's Coastal Plain province is included within the Delmarva Peninsula in its entirety. State and regional flora comparisons of the Gymnosperms are based on: Cape Cod, MA (Sorrie & Somers 1999); Long Island, NY (Weldy & Werier 2005); New Jersey (Stone 1911); Maryland (Brown & Brown 1972); Virginia, North Carolina, South Carolina, and Georgia (Weakley 2006).

State/Region	Total Native Taxa
Cape Cod, MA	6
New Jersey	7
Long Island, NY	8
Delmarva Peninsula	**9**
Maryland	9
North Carolina	10
Virginia	11
Georgia	13
South Carolina	14

ANNOTATED CHECKLIST OF THE LYCOPHYTES, MONILOPHYTES, AND GYMNOSPERMS OF THE DELMARVA PENINSULA

Text Arrangement and Format

The Division Lycopodiophyta is listed first, followed by Division Monilophyta, and ending with the gymnosperms (Division Pinophyta). Division, order, families, genera and species are arranged phylogenetically. The phylogenetic order of arrangement for the Lycopodiophyta and Monilophyta follows both Pryer et al. (2004) and FNA (1993). The phylogenetic order of arrangement for the gymnosperms follows FNA (1993). For the most part, nomenclature for the Lycopodiophyta and Monilophyta follows FNA (1993). When names listed in FNA (1993) are not accepted, the following sources are recognized: Lycopodiaceae (Haines 2003); Ophioglossaceae (Kato 1987; Hauk 1996; Hauk, Parks, & Chase 2003). Nomenclature for the gymnosperms primarily follows FNA (1993), with the exception of the genus *Taxodium*, which follows Weakley (2006). Each taxon listed may or may not be followed by one or more synonyms, and names used by Reed (1953, 1960), Tatnall (1946) and FNA [1993 (when not recognized)] are also provided. For the most part, common names are based on McAvoy & Bennett (2001). Unless otherwise noted, the overall North American distribution (north of Mexico) is based on FNA (1993; state and provincial acronyms also follow FNA). If the core of a taxon's range is primarily northern or southern, then that is noted in the North American distribution field (e.g., **N.A. Distribution:** northern; Nfld. nw. to Alaska, s. to Oreg., e. to Del. and Md.). This indicates that the taxon is at or near the southern limits of its natural geographic distribution on the Delmarva Peninsula. The Delmarva Peninsula distribution of a taxon is listed first by state [Del. (Delaware), Md. (Maryland), and Va. (Virginia)], then by the counties within each state going from north to south (e.g., **Delmarva Distribution: Del.:** New Castle; Kent; Sussex. **Md.:** Cecil; Kent; Queen Anne's; Caroline; Talbot; Dorchester; Wicomico; Somerset;

Worcester. **Va.:** Accomack; Northampton). If a taxon is listed for a state and county, then it has been vouchered with a modern day (within the last 20 years) collection by the author, unless otherwise noted [e.g., *F. Hirst* (collector's last name), ## (collection number), 2003 (year of collection), DOV (herbarium where deposited)]. A county record has been vouchered by at least one collection, but in most cases several collections exist, both modern day and historical. Since the majority of county voucher specimens were collected by the author, collection data (year, number, herbarium) are not listed in order to save space (the author's collection data are available upon request). If a taxon has been reported from a county based on the literature (LIT.) and no voucher specimen has been seen by the author, then the literature citation is given (e.g., Reed 1953), followed by *nss*, (no specimen seen). For example, **Md.:** Cecil, LIT. (Reed 1953, *nss*). If a county of occurrence is historical (HIST.; not collected or reported for more than 20 years), or extirpated (EXT.; gone from a county or the Delmarva) then the name of the person to make the last collection, collection number, collection year, and herbarium where deposited is given [e.g., **Md.:** Cecil, HIST. or EXT. (*B. Long, 57072*, 1941, PH)]. If a taxon has been vouchered from all counties on the Delmarva with a modern day collection by the author, then the entry is: All Counties. The status of a taxon refers to its relative rarity on the Delmarva Peninsula and is based on the collection record, the literature, and the personal field experience of the author. The following terms are used to describe the status of a taxon on the Delmarva: Rare (known from only a few populations); Infrequent (occasionally encountered); Frequent (evenly distributed, but not plentiful); Common (plentiful throughout); Status Uncertain (field work and herbaria studies are needed to better understand the current distribution and abundance of the species). The duration of a taxon refers to its phenology, whether the foliage dies-back at the close of a growing season (deciduous) and reemerges the following season, or persists through the winter (evergreen) and develops new foliage the next season. The brief habitat description refers to the habitat preferences of a taxon on the Delmarva Peninsula, and is based on the collection record, the literature, and the personal field experience of the author. Comments are varied and are meant to provide useful information related to the taxon.

Division Lycopodiophyta – Clubmosses, Spikemosses, and Quillworts
Order Lycopodiales – Clubmosses
Family Lycopodiaceae

***Huperzia lucidula* (Michx.) Trevis.**
Synonym(s): *Lycopodium lucidulum* Michx.
Common Name: shining clubmoss
N.A. Distribution: northern; Nfld. nw. to se. Man., s. to the mountains of N.C., Tenn., Ga.,
Delmarva Distribution: All Counties, except Somerset and Northampton.
Delmarva Status, Duration, and Habitat: Frequent; evergreen; cool seepage slope wetlands and seepage swamps.
Comments: Species within the genus *Huperzia* have the ability to produce gemmae, which are miniature, 6-leaved plantlets that develop in a single whorl at the tip of the upright stem. Gemmae, which are spread by wind and water, potentially develop roots and grow into new plants. Gemmae usually mature by mid-to-late summer and are shed near the end of the growing season. The genus *Huperzia* is positioned near the base of the family tree within the Lycopodiaceae and contains characteristics distinct from other genera of the family, such as: there are no strobili (spore-bearing cones); sporophylls (spore-leaves) are borne in distinct

zones on the upright stem; an elongated, horizontal stem does not develop; and gemmae are produced at the tip of mature plants. Therefore, Haines (2003) has placed *Huperzia* within a separate family, Huperziaceae.

***Lycopodium clavatum* L.**
Common Name: staghorn clubmoss
N.A. Distribution: northern; Nfld. w. to Sask., se. to the mountains of W.Va., Va., N.C., Tenn., and also Alaska, s. to Calif.
Delmarva Distribution: Del.: New Castle; Kent; Sussex. **Md.:** Cecil; Caroline; Dorchester; Somerset; Worcester, HIST. [*F. Hirst s.n.*, 1979, DOV; (Hirst 1983)].
Delmarva Status, Duration, and Habitat: Infrequent to frequent; evergreen; open woods and thickets, successional habitats.
Comments: More frequently found in the northern counties (New Castle, Cecil), rare farther south.

***Dendrolycopodium obscurum* (L.) A. Haines**
Synonym(s): *Lycopodium obscurum* L.
Common Name: tree clubmoss
N.A. Distribution: northern; N.S., Wis., s. to the mountains of Tenn., the Carolina's and ne. Ala.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; evergreen; moist to poorly drained woods, edges of swamps.
Comments: This species is common and widespread on the Delmarva, but becomes very rare in Accomack and Northampton Counties. The genus *Dendrolycopodium*, which includes species formerly found within the *Lycopodium obscurum* complex (*L. dendroideum* Michx; *L. hickeyi* W. Wagner, Beitel & Moran; *L. juniperoideum* Spreng.; and *L. obscurum*), is now considered distinct (Haines 2003) from the type (*Lycopodium clavatum*) in several ways, but primarily by the upright, branched tree-like form and sessile, unstalked strobili. There are reports of *Dendrolycopodium hickeyi* (W.H. Wagner, Beitel, & Moran) A. Haines (*Lycopodium hickeyi*; *L. obscurum* var. *isophyllum* Hickey) from the Delmarva, as well as specimens labeled as such (Somerset Co., *Prenger 7*, 1979, BALT; New Castle Co., *D. Redman 9235*, 1998, BALT; Worcester Co., *Lauenstein 25*, 1970, BALT), but these specimens are not convincing enough to consider them as anything more than a growth or "sun" form of *D. obscurum* (these specimens have been annotated as *D. obscurum* by the author). I have seen populations of *D. obscurum* in the field that grade from shade to full-sun and assume an appearance of *D. hickeyi* (lateral shoots round in cross-section with all leaves the same length). The shade plants have the typical morphology of *D. obscurum* (lateral shoots flat in cross-section with leaves unequal in size), but as plants grow into the sun, branches become very erect (full-sun) and the lateral shoots appear round, but the leaves are all unequal in length.

***Diphasiastrum digitatum* (Dill. ex A. Braun) Holub**
Synonym(s): *Lycopodium complanatum* L. var. *flabelliforme* Fern.; *L. digitatum* Dill. ex A.Braun; *L. flabelliforme* Blanchard
Common Name: running-pine clubmoss
N.A. Distribution: Nfld. to s. Ont., Wis., s. to n. Ala.
Delmarva Distribution: All Counties, but Historical in Northampton (*Honick 249*, 1975, ODU).
Delmarva Status, Duration, and Habitat: Common; evergreen; woods and thickets, successional habitats.
Comments: Common and often abundant in the northern counties of the Delmarva, but becoming uncommon to rare farther south. This species is known from only one extant population in Accomack Co. and a single historical collection from Northampton County.

***Diphasiastrum tristachyum* (Pursh) Holub**
Synonym(s): *Lycopodium tristachyum* Pursh
Common Name: ground-cedar clubmoss
N.A. Distribution: northern; Nfld. to se. Man., se. in the mountains to n. Ga.
Delmarva Distribution: Del.: New Castle; Kent; Sussex. **Md.:** Cecil; Caroline; Dorchester; Somerset; Wicomico; Worcester.
Delmarva Status, Duration, and Habitat: Infrequent; evergreen; sandy woods and thickets, successional habitats.
Comments: Species is distinguished from *D. digitatum* by its deeply buried rhizomes and is often blue-green in color, but color will vary in sun or shade. In addition, this species can be distinguished from *D. digitatum* by the scale-like leaves on the underside of the branch, which are about the same length as the lateral branch leaves (underside branch leaves of *D. digitatum* are much shorter in length then the lateral branch leaves).

***Lycopodiella appressa* (Chapm.) Cranfill**
Synonym(s): *Lycopodium appressum* (Chapm.) Lloyd & Underw.; *L. chapmanii* Underw. ex Maxon; *L. inundatum* L. var. *appressum* Chapman; *L. inundatum* var. *bigelovii* Tuckerm.
Common Name: appressed bog clubmoss
N.A. Distribution: Mostly Coastal Plain, Nfld., s. to Fla., w. to Tex.
Delmarva Distribution: Del.: New Castle; Kent; Sussex. **Md.:** Kent, HIST. (*S. Brown s.n.*, 1907, PH); Caroline; Dorchester (*W. Longbottom 10377*, 2007, DOV); Wicomico; Somerset, HIST. (*C. Reed 31717*, 1953, MO); Worcester. **Va.:** Accomack; Northampton, HIST. (*R. Tatnall 3766*, 1938, DOV).
Delmarva Status, Duration, and Habitat: Infrequent; evergreen; interdunal swales, peat bogs, acidic sandy/peaty swales, powerline bogs, clear-cut swales.
Comments: Most frequently found in south-central Delmarva (Sussex, Wicomico, and Worcester Counties), infrequent to rare in other regions of the Peninsula. The horizontal stems of this species lie flat on the ground and upright shoots have appressed leaves with few to no teeth on the margins. Horizontal shoots are evergreen, but upright shoots senesce and die-back in winter. Redmond (1932) listed *Lycopodium carolinianum* L. [= *Pseudolycopodiella caroliniana* (L.) Holub] as occurring on the Delmarva from Worcester Co.: “in low places behind dunes, Fenwick Island” and “in low meadow east of Stockton.” Although this citation has persisted in the literature (Tatnall 1946, Reed 1952, Reed 1953,

Redman 1991), no specimen has been found. Only Tatnall (1946) points out that "no specimen has been seen." There are no other references, reports, or specimens of this species from the Delmarva. The area that Redmond describes as "in low places behind dunes, Fenwick Island," where he supposedly found *Pseudolycopodiella caroliniana*, must be an interdunal wetland (a unique non-tidal, freshwater depressional wetland); this habitat type occurs from the counties of Sussex to Accomack along the Peninsula's Atlantic coastal strand and barrier islands. A frequent inhabitant of this wetland type is *L. appressa*, so it is possible that Redmond confused *L. appressa* with *P. caroliniana*. The area that Redmond describes as "in low meadow east of Stockton" is outside of the distribution of the interdunal wetland type, but low meadows, or swales within the Stockton area could also support *L. appressa*. Redman did list *Lycopodium inundatum* [= *Lycopodiella inundata* (L.) Holub], apparently not based on his own personal observation, but based on Shreve's (1910) citation related to his publication on the "Plant Life of Maryland." Shreve obviously misapplied the name *L. inundatum* for *L. appressa* (*Lycopodiella inundata* is a more northern, circumboreal species that is found at higher elevations in the south). Without a voucher specimen, *P. caroliniana* is excluded from this checklist, however, it is not beyond the possibility that *P. caroliniana* could have occurred on the Delmarva in the past, or could possibly still be extant. FNA (1993) gives the Atlantic coastal range of *P. caroliniana* as being from Florida to Massachusetts. The species is rare in southeast Virginia and also on the western shore of Maryland's inner Coastal Plain, but is frequent in the pinelands of southern New Jersey. Perhaps the Delmarva gap in this species distribution will be filled by some fortunate field botanist in the future.

***Lycopodiella alopecuroides* (L.) Cranfill**
Synonym(s): *Lycopodium alopecuroides* L.
Common Name: foxtail bog clubmoss
N.A. Distribution: southern; mostly on the Coastal Plain, e. Mass, Conn., R.I., Pa., s. to Fla., w. to Tex.
Delmarva Distribution: Del.: New Castle; Kent; Sussex. **Md.:** Caroline; Dorchester; Wicomico (*W. Knapp 1568*, 2005, DOV); Worcester. **Va.:** Accomack; Northampton (*J. Townsend 2889*, 2002, WILLI).
Delmarva Status, Duration, and Habitat: Infrequent to frequent; evergreen; moist sandy/peaty swales in clear-cuts and power-lines;
Comments: Primarily of the southern counties on the Delmarva, rare farther north. Arching, horizontal stems and spreading leaves of upright shoots are diagnostic field characters. Horizontal shoots are evergreen, but upright shoots senesce and die-back in winter.

***Lycopodiella* x*copelandii* (Eig.) Cranfill** (*L. alopecuroides* x *appressa*)
Synonym(s): *Lycopodium alopecuroides* L. var. *elongatum* (Chapm.) Chapm.; *L. inundatum* L. var. *elongatum* Chapm.; *L. inundatum* var. *robustum* R.J. Eaton (*in* Reed 1953)
Common Name: hybrid bog clubmoss
N.A. Distribution: Coastal Plain, New England, s. to Fla., w. to Tex.
Delmarva Distribution: Del.: Sussex. **Md.:** Wicomico. **Va.:** Accomack.
Delmarva Status, Duration, and Habitat: Rare; evergreen; interdunal swales, peat bogs, acidic sandy/peaty swales on power-lines and clear-cuts.

Comments: Horizontal stems lie flat to somewhat arching on soil, with rooting at the ends and sometimes along the stem; leaves of upright shoots ascending to spreading with one or two pairs of teeth at the base. Perhaps not as rare as current data suggests; to be sought in counties where the two parents are known to occur.

Order Selaginellales – Spikemosses
Family Selaginellaceae

***Selaginella apoda* (L.) Spring**
Common Name: meadow spikemoss
N.A. Distribution: s. Maine, to ne. Ky., Ohio, s. to Fla., w. to e. Tex.,
Delmarva Distribution: Del.: New Castle; Sussex. **Md.:** Cecil, HIST. (*N. Seyfried s.n.*, 1982, DOV); Kent, LIT. (Redman 1991, *nss*); Queen Anne's, LIT. (Redman 1991, *nss*); Caroline, HIST. (*E. Wherry s.n.*, 1938, PH); Talbot, HIST. (*E. Earle 4307*, 1946, PH); Dorchester; Wicomico, HIST. (*E. Wherry 3677*, 1936, PH); Somerset, LIT. (Reed 1953, *nss*; Redman 1991, *nss*); Worcester. **Va.:** Accomack; Northampton.
Delmarva Status, Duration, and Habitat: Status uncertain; evergreen; acidic seepage bogs and swamps, wet meadows, moist edges.
Comments: The literature suggests that this species is widespread and common throughout its range; however, on the Delmarva this species has been difficult to find. Nearly all extant populations are found in relatively high quality, unique habitats, such as Atlantic white cedar swamps.

Order Isoetales - Quillworts
Family Isoetaceae

***Isoetes echinospora* Dur.**
Synonym(s): *I. echinospora* var. *braunii* (Dur.) Engelm.; *I. muricata* Dur.
Common Name: spiny-spored quillwort
N.A. Distribution: northern; Lab., s. to N.J., n. Pa., nw. to Alaska, s. to n. Calif.
Delmarva Distribution: Del.: Sussex (*L. Musselman 99196*, 1999, ODU).
Delmarva Status, Duration, and Habitat: Rare; evergreen; amphibious, muddy banks and high gravel shores of shallow, freshwater tidal streams.
Comments: This species was first discovered on the Delmarva in 1999 by Lytton Musselman and is currently known from a single, extant occurrence. This species may occur with *I. riparia* (discussed below), which it can easily be confused, but as the name indicates the mature spores of *I. echinospora* are ornamented with spines. *Isoetes echinospora* should be sought in areas where *I. riparia* is known to occur. Spores of all our *Isoetes* species may be found around the base of the plant during much of the year, but plants collected in late summer usually contain well-developed spores, making identification easier.

***Isoetes engelmannii* A. Braun**
Common Name: Engelmann's quillwort
N.A. Distribution: se. Ont., N.H., N.Y., s. to n. Fla., w. to Ala., se. Mo.
Delmarva Distribution: Del.: New Castle; Kent; Sussex. **Md.:** Cecil; Kent; Caroline; Talbot; Dorchester (*W. Knapp 1570*, 2005, DOV); Worcester, HIST. (*W. Sipple s.n.*, 1985, DOV). **Va.:** Northampton, HIST. (*M. Fernald 5228*, 1935, PH).
Delmarva Status, Duration, and Habitat: Infrequent; evergreen; amphibious; intermittent stream beds with gravel bottoms, floodplain swales and oxbow sloughs.
Comments: The Peninsula's most frequently occurring quillwort, but still uncommon. The species *I. valida* (Engelm.) Clute (syn. = *I. engelmannii* var. *valida* Engelm.), which is closely related to *I. engelmannii* has been reported from the Coastal Plain physiographic province of Delaware by Brunton and Britton (1996), however, several of the collections annotated by Brunton at PH are questionable for the Coastal Plain and may have actually been collected from the Piedmont province of New Castle Co., Delaware and not from the Coastal Plain province, or in other words, not from the Delmarva. Many of the specimens Brunton examined are clearly Piedmont, but several provide only vague label information that could place the collection in either the Piedmont, or on the northern edge of the Coastal Plain. For example, several collections give only "Wilmington," or "Stanton" as locales; Wilmington, as well as Stanton are situated near the fall-line of New Castle Co. and thus cover both the Piedmont and Coastal Plain physiographic provinces. The collection dates of the representative specimens of *I. valida* from Delaware that Brunton examined are historical and range from 1866 to 1895. *Isoetes valida* has not been reported from the state since 1895, therefore, until a modern day Coastal Plain collection of *I. valida* has been verified, *I. valida* is not considered to be part of the flora of the Delmarva Peninsula. In addition, Tatnall (1946) lists *I. engelmannii* var. *valida* Engelm. and cites the following voucher specimen, which is from the southwest portion of New Castle Co., on the Delmarva: "pondhole in field just west of Vandyke Station (NC), *Long*, 3 July 1909 (PH)." This specimen has been annotated as *I. engelmannii* by Brunton in 1995 (pers. comm., 7 Nov. 2000).

***Isoetes riparia* Engelm. ex A. Braun**
Synonym(s): *I. riparia* var. *palmeri* A.A. Eaton forma *saccharata* (Engelm.) Proctor (*in* Reed 1953); *I. saccharata* Engelm.
Common Name: riverbank quillwort
N.A. Distribution: northern; s. Que., sw. Maine, s. through New England, Pa., N.J., s. to ne. N.C., disjunct in S.C. and Fla.
Delmarva Distribution: Del.: New Castle, EXT. (*W. Canby s.n.*, 1896, DOV); Sussex. **Md.:** Cecil; Kent; Queen Anne's, HIST. (*R. Tatnall 4094*, 1938, DOV); Caroline; Dorchester; Wicomico (*F. Hirst 1226*, 1998, DOV); Worcester.
Delmarva Status, Duration, and Habitat: Rare; evergreen; amphibious; restricted to exposed intertidal shores of freshwater rivers and creeks; on gravel, sand and mud substrates.
Comments: Considerable variation in spore morphology can be found in *I. riparia* and as a result, the species has had a long taxonomic history with many segregates being described that range from form to species; *I. riparia* is treated here as a single polymorphic species. *Isoetes riparia* is threatened on the Delmarva from increased salinity levels, boat wake,

shoreline stabilization, non-native invasive plants [*Hydrilla verticillata* (L. f.) Royle], and algal blooms. Dense mats of *Hydrilla* and algae will cover shorelines like a carpet during low tides and smother plants of *I. riparia*. This species is historically known in New Castle Co. from the Delaware River (near the city of Wilmington), but is now thought to be extirpated due to habitat degradation, pollution, and salt water intrusion.

Division Monilophyta – True Ferns

Order Ophioglossales – Rattlesnake Ferns, Grapeferns, Moonworts and Adder's-tongue

Family Ophioglossaceae

To aid in separating the Ophioglossoid genera described below, the following characters should be helpful. In addition, taxa within the Ophioglossaceae do not arise in the spring as coiled fiddleheads, but emerge erect from the ground, or in a bent form.

a. The sporophore (fertile blade) and trophophore (sterile, leafy blade) are joined near, or below the soil surface; leaves evergreen ····· ***Sceptridium***
a. Sporophore is joined just below the trophophore, or well above the soil surface; leaves deciduous ····· *b.*
b. Plants usually less than 25 cm tall; trophophore fleshy in texture ····· ***Botrychium***
b. Plants 25 to 50 cm tall; trophophore herbaceous in texture ····· ***Botrypus***

Botrypus virginianus (L.) Holub
Synonym(s): *Botrychium virginianum* (L.) Sw.
Common Name: rattlesnake fern
N.A. Distribution: N.S., w. to s. Yukon, all States except California
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; deciduous; moist woods with rich organic soils.
Comments: This species is a good indicator of Coastal Plain rich wood habitat that supports a flora typical of the Piedmont physiographic province. As traditionally circumscribed, the genus *Botrychium* was composed of three subgenera: *Botrychium*, *Sceptridium*, and *Osmundopteris* (= *Botrypus*), but Kato (1987), Hauk (1996), and Hauk et al. (2003) show that these subgenera should be recognized at the generic level based on molecular and morphological evidence.

Sceptridium biternatum (Sav.) Lyon
Synonym(s): *Botrychium biternatum* (Sav.) Underw.; *B. dissectum* Spreng. var. *tenuifolium* (Underw.) Farw.; *B. tenuifolium* Underw.
Common Name: southern grapefern
N.A. Distribution: southern; se. Pa., s. to W.Va., se. Mo., s. to Fla., w. to se. Tex.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Frequent; evergreen; moist to low woods and thickets.
Comments: This species has a southern distribution and is near its northern limit on the Delmarva. *Sceptridium* is the only genus within Ophioglossaceae where the fronds emerge in mid-summer and remain green through the winter.

Sceptridium dissectum (Spreng.) Lyon
Synonym(s): *Botrychium dissectum* Spreng.; *B. dissectum* var. *obliquum* (Muhl.) Clute; *B. obliquum* Muhl. in Willd.
Common Name: cut-leaf grapefern
N.A. Distribution: N.S., se. Que., Wis., s. to Fla., w. to e. Tex.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; evergreen; moist woods, swamps, floodplains, and thickets.
Comments: Two forms of *S. dissectum* exist on the Delmarva: *S. dissectum* forma *obliquum* (Muhl.) Clute and *S. dissectum* forma *dissectum*. Forma *obliquum* is the most common, with trowel-shaped sub-leaflets, and forma *dissectum* is the extreme form with skeletonized leaflets cut into linear teeth. The two forms are often present within the same population.

Sceptridium oneidense (Gilbert) Holub
Synonym(s): *Botrychium dissectum* Spreng. var. *oneidense* (Gilbert) Farw.; *B. dissectum* forma *oneidense* (Gilbert) Clute; *B. multifidum* (S.G. Gmelin) Ruprecht. var. *oneidense* (Gilbert) Farw.; *B. oneidense* (Gilbert) House
Common Name: blunt-lobed grapefern
N.A. Distribution: northern; N.B., se. Que. and Ont., Mich., s. to the mountains of Va. and N.C.
Delmarva Distribution: Del.: Kent. **Md.:** Dorchester, HIST. (*C. Reed 3869*, 1945, MO). **Va.:** Northampton.
Delmarva Status, Duration, and Habitat: Rare; evergreen; swampy floodplain forests.
Comments: Due to its resemblance to *S. biternatum* and *S. dissectum*, this species is likely overlooked and may not be as rare as current data suggest.

Sceptridium biternatum, S. dissectum, and S. oneidense are all closely aligned and may grow together, so distinguishing between these taxa can be difficult. The following characters may be helpful when trying to separate them.

a. Leaflets elongate and nearly parallel-sided, margins finely denticulate, and little or not at all divided, apex short-acuminate, often contracted to a cuneate base……. ***S. biternatum***
b. Leaflets obliquely trowel-shaped or linear, margins denticulate to lacerate or coarsely cut, apex acute……. ***S. dissectum***
c. Leaflets not lobed or only scarcely so, broad and obliquely ovate, margins finely denticulate to rounded-serrate, apex rounded to acute…… ***S. oneidense***

***Botrychium matricariifolium* (A. Braun ex Dowell) A. Braun ex Koch**
Common Name: daisy-leaf moonwort
N.A. Distribution: northern; Nfld., Lab., N.S., Que., Ont., Minn., se. to w. N.C
Delmarva Distribution: Va.: Accomack, HIST. (*C. Reed 36617*, 1955, MO).
Delmarva Status, Duration, and Habitat: Rare; deciduous; moist rich tulip-poplar woods with a thin canopy.
Comments: A rare Coastal Plain occurrence (Reed 1956). The Accomack Co. population is the only known locale on the Peninsula for the species, which has repeatedly been searched by the author for years without success. The plant appears in spring and its small size makes it difficult to find.

***Ophioglossum vulgatum* L.**
Synonym(s): *O. vulgatum* var. *pycnostichum* Fern.
Common Name: southern adder's-tongue
N.A. Distribution: southern; Pa., s. to w. Fla., e. to Tex.
Delmarva Distribution: Del.: New Castle; Kent; Sussex. **Md.:** Cecil, LIT. (Reed, 1953, *nss.*; Redman 1991, *nss*); Kent; Queen Anne's; Caroline; Talbot; Dorchester, HIST. (*C. Phillips 16*, 1977, DOV); Wicomico, LIT. (Redman, 1991, *nss*); Somerset (*M. Sarver s.n.*, 2004, DOV); Worcester. **Va.:** Accomack; Northampton.
Delmarva Status, Duration, and Habitat: Infrequent; deciduous; moist open woods often on rich soils, occasionally in low acidic swales.

Order Equisetales – Horsetails
Family Equisetaceae

***Equisetum fluviatile* L.**
Common Name: water horsetail
N.A. Distribution: northern; Nfld., nw. to Alaska, s. to Oreg., e. to Del. and Md.
Delmarva Distribution: Del.: New Castle. **Md.:** Kent (*P. Stango PS66SS*, 2003, DOV).
Delmarva Status, Duration, and Habitat: Rare; deciduous; seepage swamps and marshes on fresh tidal creeks.
Comments: Populations may contain stems that are both branched and unbranched. Stems late in the season, or following injury may produce regular whorls of branches that could cause confusion with *E. arvense*. The stem cavity of *E. fluviatile* is 9/10 the diameter of stem, vs. stem cavity 2/3 diameter of stem for *E. arvense*. *Equisetum fluviatile* also occurs on the Western Shore of Md. in Cecil County. The hybrid horsetail *Equisetum* x*litorale* Kuhlewein ex Ruprecht (*E. arvense* x *fluviatile*) is reported in FNA (1993) for Delaware, but no specimen can be found and no other reports from the Delmarva of this hybrid are known in the literature. As in the Ophioglossaceae, taxa within the Equisetaceae do not arise in the spring as coiled fiddleheads, but emerge erect from the ground.

***Equisetum arvense* L.**
Common Name: field horsetail
N.A. Distribution: Greenland, most of Canada, and all States except Fla., La, Miss., S.C.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Frequent; deciduous; speepage swamps, wet meadows, swales, ditches, roadsides.
Comments: This species is dimorphic (fronds or parts of fronds differentiated into fertile and sterile portions). The fertile, unbranched stems are yellow-brown in color and appear in early spring and wither by early summer. The vegetative stems are regularly branched, green in color and appear some time after the fertile stems.

***Equisetum hyemale* L. subsp. *affine* (Engelm.) Calder & Taylor**
Synonym(s): *E. prealtum* Raf.
Common Name: scouring-rush horsetail
N.A. Distribution: N.B., west to B.C., and all U.S. States.
Delmarva Distribution: Del.: New Castle; Sussex. **Md.:** Cecil, LIT. (Reed 1953, *nss*; Redman 1991, *nss*); Kent, LIT. (Reed 1953, *nss*; Redman 1991, *nss*); Queen Anne's; Caroline; Talbot. **Va.:** Accomack (*G. Fleming 10066*, 1994, WILLI); Northampton (*A. Belden 2110*, 2005, VPI).
Delmarva Status, Duration, and Habitat: Infrequent; evergreen; primarily on steep wooded slopes above tidal rivers, but occasionally in thickets, edges, and moist swales.
Comments: *Equisetum hyemale* subsp. *hyemale* is found in Europe and Asia. From Cecil Co., I have only seen specimens (PH) of this species from the Piedmont province and Western Shore.

Order Osmundales – Cinnamon, Interrupted, and Royal Ferns
Family Osmundaceae

Osmunda cinnamomea* L. var. *cinnamomea
Synonym(s): *O. cinnamomea* var. *frondosa* Gray
Common Name: cinnamon fern
N.A. Distribution: Lab., Nfld., e. Que., Minn., s. to Fla., w. to e. Tex.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; deciduous; swamps, floodplains, wet woods.
Comments: The genus *Osmunda* is known for having unusual growth forms and two such forms have been documented on the Delmarva: forma *frondosa* (Torr. & Gray) Britt. [New Castle Co. (*R. Tatnall 898*, 1930, DOV); Sussex Co. (*R. Tatnall 2183*, 1934, DOV)], and forma *incisa* (Huntington) Gilbert [Wicomico Co. (*C. Phillips s.n.*, 1974, DOV)]. Forma *frondosa*, which has the fertile portion at the apex of the leafy frond was treated at the level of variety by Tatnall (1946). Forma *incisa* can be distinguished by having acutely toothed or lobed segments. Taxa within the Osmundaceae, as well as all families and taxa that follow, emerge in the spring as coiled fiddleheads.

***Osmunda cinnamomea* L. var. *glandulosa* Waters**
Common Name: glandulose cinnamon fern
N.A. Distribution: R.I., Pa., N.J., Md., W.Va., Va., S.C., Ala., Miss., Ark. [distribution based on Nature Serve Explorer (2005) and Weakley (2006)].
Delmarva Distribution: Del.: Kent, HIST. (*C. Phillips s.n.*, 1974, DOV); Sussex. **Md.:** Queen Anne's; Dorchester.
Delmarva Status, Duration, and Habitat: Rare; deciduous; swamps, floodplains, wet woods.
Comments: This variety of the cinnamon fern has copious stalked glands on the rachis, and on both surfaces and margins of the leaf segments. These glands are intermingled with short, stiff silvery-white hairs. Reed (1953) also cites this taxon from Kent Co. (Del.), but no specimen can be found at MO where Reed's collection now resides (George Yatskievych, pers. comm., 2006).

***Osmunda claytoniana* L.**
Common Name: interrupted fern
N.A. Distribution: northern; Lab., Nfld., e. Que., s. Ont., Minn., s. to N.C. and Tenn.
Delmarva Distribution: Del.: New Castle; Kent; Sussex. **Md.:** Cecil; Kent; Queen Anne's, HIST. (*C. Reed 51355*, 1961, US); Caroline (*J. Ebert* & *R. Holt 99*, 1998, DOV); Worcester, HIST. (*J. Potryai 10*, 1970, BALT). **Va.:** Accomack, HIST. (*R Tatnall 4354*, 1939, PH).
Delmarva Status, Duration, and Habitat: Infrequent; deciduous; moist deciduous woods (both rich and acidic) and edges of swamps.
Comments: Most frequently encountered in the northern counties (New Castle, Cecil) of the Delmarva, rare farther south. Although the Worcester specimen is correctly identified, its label data is suspect, due to the fact that suitable habitat simply does not exist where it was reported to be collected, as well as for other reasons too complicated to detail. This species is often confused with cinnamon fern, but interrupted fern lacks the brown, woolly tufts of hair found on the cinnamon fern that appear at the junction of the leaflets and the rachis. The fertile leaflets of the interrupted fern develop in the middle of the blade, with sterile, vegetative leaflets above and below.

***Osmunda regalis* L. var. *spectabilis* (Willd.) Gray**
Common Name: royal fern
N.A. Distribution: Nfld., s. Que. and Ont., Minn., s. to Fla., w. to e. Tex.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; deciduous; swamps, marshes, floodplains, low woods, interdunal wetlands.
Comments: *Osmunda regalis* var. *regalis* is widely distributed in Europe and Asia.

Order Schizaeales – Climbing Fern and Curly Grass Fern
Family Lygodiaceae - Climbing Ferns

***Lygodium palmatum* (Bernh.) Sw.**
Common Name: climbing fern
N.A. Distribution: New England, s. to Ga., w. to Miss.
Delmarva Distribution: Del.: New Castle, EXT. (*R. Tatnall 5002*, 1942, DOV); Sussex. **Md.:** Kent, EXT. (*D. Redman 9585*, 1994, BALT); Wicomico, HIST. [*F. Hirst s.n.*, 1981, DOV; (Hirst 1983)]; Worcester.
Delmarva Status, Duration, and Habitat: Rare; evergreen; thickets, open swampy floodplains, clearings, edges.
Comments: The literature indicates that this species is rare and local throughout much of its range. The sites in New Castle and Kent (Md.) Counties have been destroyed and the species is thought to be extirpated from both of these counties. At the two remaining extant populations on the Delmarva (Sussex and Worcester Co.'s), the habitat for both are dirt-roadside thickets where the plants are climbing and twining over other vegetation.

Family Schizaeaceae - Curly Grass Ferns

***Schizaea pusilla* Pursh**
Common Name: curly-grass fern
N.A. Distribution: northern; Nfld., N.S., N.B., N.Y, N.J., Del.
Delmarva Distribution: Del.: Sussex.
Delmarva Status, Duration, and Habitat: Rare; evergreen; Atlantic white cedar swamp and bog.
Comments: Known from a single population on the Delmarva, where it was first discovered by Frank Hirst and Ron Wilson in 1990 (Hirst 1990). A remarkable disjunct population of curly-grass fern has been reported from Peru (Stolze 1987).

Order Salviniales - Water-clover Ferns and Mosquito Ferns
Family Marsileaceae - Water-clovers

***Marsilea quadrifolia* L.**
Common Name: water-clover
N.A. Distribution: se. Ont., Maine, s. to Md., w. to Mo.
Delmarva Distribution: Del.: Sussex (*C. Martin 10*, 2000, DOV).
Comments: *Marsilea quadrifolia* is native to Europe and was introduced to North America about 1860 (Johnson 1993). This species is a rare non-native occurrence on the Peninsula and is currently known only from Sussex Co., where it was collected from a storm water retention pond. This species is known to form dense colonies in artificial impoundments, ponds, and sandpits, so it has the potential to become invasive. Leaflets are arranged like a four-leaf clover. A potential new introduction to the Delmarva is *Marsilea mutica* Mett., which has been documented from southeast Virginia (Jacono & Johnson 2006) and is native to Australia and New Caledonia (Jacono & Johnson 2006). The leaflets of *M. mutica* are two-toned green, while the leaflets of *M. quadrifolia* are evenly green.

Family Azollaceae - Mosquito Ferns

***Azolla caroliniana* Willd.**
Common Name: eastern mosquito-fern
N.A. Distribution: southern; s. Ont., Minn., s. to Fla., w. to Tex.
Delmarva Distribution: Del.: New Castle; Kent; Sussex. **Md.:** Cecil; Dorchester (*J. Harrison*, 2006, photograph, MD Dept. of Nat. Res.); Wicomico; Worcester. **Va.:** Northampton.
Delmarva Status, Duration, and Habitat: Infrequent; evergreen; floating in farm ponds, impoundments, headwaters of slow-moving freshwater tidal rivers and streams, and wetland depressions.
Comments: Considered to be adventive on the Delmarva. This species is native to the southeast and was likely introduced initially on the Delmarva through commercial crayfish farming and then subsequently spread by waterfowl. The mosquito-fern was first reported from the Delmarva by Frank Hirst in 1978 from Worcester Co. (Hirst 1983). Populations appear to fluctuate in size from year to year and may disappear from a site altogether.

Order Polypodiales – Polypod Ferns
Family Dennstaedtiaceae - Bracken ferns

***Dennstaedtia punctilobula* (Michx.) T. Moore**
Common Name: hay-scented fern
N.A. Distribution: s. Nfld., Que., s. to se Va., sw. to Ala.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; deciduous; dry to moist woods and slopes; often forming extensive, dense colonies.

***Pteridium aquilinum* (L.) Kuhn var. *latiusculum* (Desv.) Underw. ex Heller**
Synonym(s): *P. latiusculum* (Desv.) Fries
Common Name: northern bracken fern
N.A. Distribution: Nfld., w. to se. Man., s. to Fla., w. to La.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; deciduous; dry soils, edges, open sandy woods.
Comments: The genus *Pteridium* worldwide is composed of a single highly variable species and is represented on the Delmarva by the northern variety *P. aquilinum* var. *latiusculum* and the southern variety *P. aquilinum* var. *pseudocaudatum*. The two tend to intergrade and distinction can sometimes be difficult. Northern variety: terminal sub-leaflets 2-4 times longer than wide, 3-6 mm wide. Southern variety: terminal sub-leaflets 6-15 times longer than wide, 2-5 mm wide.

***Pteridium aquilinum* (L.) Kuhn var. *pseudocaudatum* (Clute) Heller**
Common Name: southern bracken fern
N.A. Distribution: southern; se. Maine, sw. to Ill., Ind., Ohio, s. to Fla., w. to e. Tex.
Delmarva Distribution: Del.: New Castle, HIST. (*R. Tatnall s.n.*, 1922, DOV); Sussex. **Md.:** Caroline; Dorchester; Wicomico; Somerset; Worcester. **Va.:** Accomack; Northampton.
Delmarva Status, Duration, and Habitat: Frequent; deciduous; dry soils, edges, open sandy woods.
Comments: Most frequently found in the southern counties of the Delmarva, uncommon to rare farther north. Both varieties of the species are aggressive and can form extensive colonies in sun.

Family Pteridaceae – Maidenhair Ferns

***Adiantum pedatum* L.**
Common Name: maidenhair fern
N.A. Distribution: N.S., se. Que and Ont., Minn., s. to n. Ga., w. to Okla.
Delmarva Distribution: Del.: New Castle; Kent. **Md.:** Caroline; Talbot; Dorchester.
Delmarva Status, Duration, and Habitat: Rare; deciduous; wooded ravines and slopes with moist, rich organic soils.

***Pellaea atropurpurea* (L.) Link**
Common Name: purple-stem cliff-brake
N.A. Distribution: s. Que. and Ont., Mich., Vt., s. to w. Fla., w. to Utah
Delmarva Distribution: Md.: Kent; Worcester (*R. Wilson*, 2003, photograph, pers. coll.).
Delmarva Status, Duration, and Habitat: Rare; evergreen; calcareous marl boulders and soil on steep cliff.
Comments: This species is rare throughout its range on the Coastal Plain and prefers limestone rocks and soils. It was first discovered on the Delmarva by Eric Hadaway (Hadaway1992), where it grows with *Asplenium rhizophyllum* (discussed below). The Worcester Co. occurrence grows in the crevices of an old stone wall with limestone mortar (Ron Wilson, pers. comm., 2003) and is considered to be adventive in this county due to its presence on an artificial substrate.

Family Aspleniaceae – Spleenworts

***Asplenium rhizophyllum* L.**
Synonym(s): *Camptosorus rhizophyllus* (L.) Link
Common Name: walking fern
N.A. Distribution: s. Ont., Que., Minn., s. to N.C., sw. to Ala.
Delmarva Distribution: Md.: Kent.
Delmarva Status, Duration, and Habitat: Rare; evergreen; calcareous marl boulders and soil on steep cliff.
Comments: The walking fern is primarily a plant of the Piedmont and Mountains where it prefers limestone rocks and soils, and is a rare occurrence on the Coastal Plain. This species is extant in the Piedmont of Maryland and historical in the Piedmont of Delaware. On the

Delmarva, this species was first discovered by Eric Hadaway (Hadaway 1992), growing on a steep cliff with calcareous marl boulders and soil that have been eroded and exposed by natural forces. Marl is a crumbly mixture of clays, calcium and magnesium carbonates and remnants of shells (Hamblin 1985).

***Asplenium platyneuron* (L.) B.S.P.**
Common Name: ebony spleenwort
N.A. Distribution: s. Que., Ont., se. Wis., Maine, s. to Fla., w. to e. Tex., disjunct in Colo. and N. Mex.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; evergreen; moist woods, open thickets, edges and clearings.
Comments: The sterile fronds of *A. platyneuron* are evergreen, while the fertile fronds are deciduous. A form of *A. platyneuron* with the leaf margins of the pinnae serrate [forma incisum (Howe ex Peck) Blomq. & Correll], has been documented from Sussex and Queen Anne's Counties by the author. This form was recognized at the level of variety [*A. platyneuron* var. *incisum* (Howe) Robinson] by Reed (1953).

***Asplenium* x*ebenoides* R.R. Scott** (*A. platyneuron* x *rhizophyllum*)
Synonym(s): *Asplenosorus* x*ebenoides* (R.R. Scott) Wherry
Common Name: Scott's hybrid spleenwort
N.A. Distribution: Vt. to N.C., Ala. and Mo. (Montgomery & Fairbrothers 1992)
Delmarva Distribution: Md.: Kent.
Delmarva Status, Duration, and Habitat: Rare; evergreen; calcareous marl boulders and soil on steep cliff.
Comments: Rare at this single locale where both parents are found.

Family Thelypteridaceae - Marsh Ferns

***Thelypteris noveboracensis* (L.) Nieuwl.**
Synonym(s): *Dryopteris noveboracensis* (L.) Gray; *Parathelypteris noveboracensis* (L.) Ching
Common Name: New York fern
N.A. Distribution: Nfld., se. Que. and Ont., Mich., s. to e. La.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; deciduous; moist woods, swamps and floodplains.
Comments: Leaflets gradually become smaller towards the base, and the veins of each sub-leaflet are simple, or not forked. This species, as well as the next are included in subgenus, or section *Parathelypteris,* which is treated by some authors as a full genus [Holttum (1976); Smith & Cranfill (2002)].

***Thelypteris simulata* (Davenp.) Nieuwl.**
Synonym(s): *Dryopteris simulata* Davenp.; *Parathelypteris simulata* (Davenp.) Holttum
Common Name: bog fern
N.A. Distribution: northern; N.S., N.B., se. Que. and Ont., Maine through New England, N.Y., e. central Pa., s. in the mountains to N.C., along the coast from Cape Cod to se. Va., disjunct in Wis.
Delmarva Distribution: Del.: Sussex. **Md.:** Caroline; Talbot, HIST. (*R. Tatnall 3112*, 1936, DOV); Wicomico, HIST. (*R. Tatnall 3974*, 1938, DOV); Worcester. **Va.:** Accomack, LIT. (Harvill et al. 1992, *nss*); Northampton.
Delmarva Status, Duration, and Habitat: Rare; deciduous; acidic seepage swamps, Atlantic white cedar swamps.
Comments: From Maryland south, *T. simulata* is found at high elevations and is infrequent to rare on the Coastal Plain. The specific epithet, *simulata*, refers to its resemblance to *T. noveboracensis* and *Thelypteris palustris* var. *pubescens*. The lower leaflets of *T. simulata* are somewhat reduced, but not greatly so as in *T. noveboracensis*. The veins of each sub-leaflet of *T. simulata* are simple, whereas the veins of *Thelypteris palustris* var. *pubescens* are once forked. The literature report for Accomack Co. (Harvill et al. 1992) is likely based on Reed (1960). But the specimens cited in Reed (1960) from Accomack Co. [1955: *36611, 36814, 36857,* and *37071* (now at MO)] have forked veins and have been annotated as *Thelypteris palustris* var. *pubescens* (George Yatskievych, pers. comm., 2005).

***Thelypteris palustris* Schott var. *pubescens* (Lawson) Fern.**
Synonym(s): *Dryopteris thelypteris* (L.) Gray var. *pubescens* (Lawson) Weath.; *T. palustris* var. *haleana* Fern.
Common Name: marsh fern
N.A. Distribution: Lab., Nfld., se. Que., Ont., Man., N. Dak., s. to Fla., w. to e. Tex.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; deciduous; open floodplains, wet meadows, fresh and brackish tidal marshes.
Comments: The veins of each sub-leaflet are once forked. The typical variety *palustris* is European.

***Phegopteris hexagonoptera* (Michx.) Fee**
Synonym(s): *Dryopteris hexagonoptera* (Michx.) C. Christensen; *Thelypteris hexagonoptera* (Michx.) Weatherby
Common Name: broad beech fern
N.A. Distribution: se. Que. and Ont., Mich., s. to Fla., w. to e. Tex.
Delmarva Distribution: Del.: New Castle; Kent; Sussex. **Md.:** Cecil; Kent; Queen Anne's; Caroline; Talbot; Worcester. **Va.:** Accomack; Northampton.
Delmarva Status, Duration, and Habitat: Infrequent; deciduous; moist rich woods, ravines and slopes. Within the database of the Maryland Wildlife and Heritage Program (Maryland Dept. of Natural Resources), there exists a record for *Gymnocarpium dryopteris* (L.) Newman from Talbot Co. (Wes Knapp, pers. comm., 2002). This site has been searched by the author without success and the habitat does not appear to be suitable for the species (disturbed, early successional woodland on moist sandy-loam soils). *Gymnocarpium dryopteris* is a northern species, reaching its southern limit in Pennsylvania and northern

New Jersey. The record gives no indication that a collection was ever made and notes associated with this record state “all plants appeared in poor health.” This species was likely misidentified and was probably a diminutive form of *P. hexagonoptera*, the only species on the Delmarva that *G. dryopteris* could be confused with. Therefore, this record is not recognized and *G. dryopteris* is excluded from this checklist.

Family Blechnaceae - Chain Ferns

***Woodwardia areolata* (L.) T. Moore**
Synonym(s): *Lorinseria areolata* (L.) Presl
Common Name: netted chainfern
N.A. Distribution: southern; mostly on the Coastal Plain, se. N.S., se. Maine, se. N.H., s. to Fla., w. to Tex.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; deciduous; acidic wet woods and swamps.
Comments: Species is dimorphic and sterile plants can be confused with *Onoclea sensibilis*. The leaflets of *W. areolata* are alternate and the margins are serrate, whereas *Onoclea* has opposite leaflets and the margins are entire.

***Woodwardia virginica* (L.) Sm.**
Synonym(s): *Anchistea virginica* (L.) Presl
Common Name: Virginia chainfern
N.A. Distribution: Mostly Coastal Plain, N.S., w. to Mich., se. to Fla., w. to Tex.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Frequent; deciduous; acidic swamps, peaty swales, and depressional wetlands.
Comments: This species is monomorphic (fertile and sterile fronds are all alike). Species is most frequent in the southern counties of the Delmarva, becoming uncommon to rare farther north. The black stipe of this species is diagnostic.

Family Dryopteridaceae - Wood Ferns

***Onoclea sensibilis* L.**
Common Name: sensitive fern
N.A. Distribution: Nfld., s. Que. to se. Man., Maine, s. to Fla., w. to e. Tex.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; deciduous (sterile fronds); open swamps, floodplains, marshes, wet meadows, mesic woods, and ditches.
Comments: Species is dimorphic and the fertile fronds (produced late in the season) are persistent through the winter, while the vegetative (sterile) fronds are deciduous.

***Diplazium pycnocarpon* (Spreng.) Broun**
Synonym(s): *Athyrium pycnocarpon* (Spreng.) Broun
Common Name: glade fern
N.A. Distribution: s. Que. and Ont., se. Mich., N.H., Vt., s. to n. Fla., w. to Miss.
Delmarva Distribution: Md.: Cecil.
Delmarva Status, Duration, and Habitat: Rare; deciduous; moist, shady wooded ravine with rich organic soils.
Comments: This species, known from a single extant occurrence on the Delmarva, was a new addition to the flora when first discovered by botanists Jack Holt and Janet Ebert in 2002. This species is similar to Christmas fern (*Polystichum acrostichoides*), but is not evergreen and the leaflets lack auricles.

***Deparia acrostichoides* (Sw.) M. Kato**
Synonym(s): *Athyrium acrostichoides* (Sw.) Diels; *A. thelypterioides* (Michx.) Desv.
Common Name: silvery spleenwort
N.A. Distribution: northern; N.S., s. Que. and Ont., s. to w. S.C., n. Ga., n. Ala., ne. Ark.
Delmarva Distribution: Del.: New Castle; Sussex. **Md.:** Cecil; Kent; Queen Anne's; Talbot, HIST. (*E. Earle 2489*, 1940, PH). **Va.:** Accomack.
Delmarva Status, Duration, and Habitat: Rare; deciduous; rich woods and slopes with moist organic soils.
Comments: This species is rare for the Coastal Plain province. On the Delmarva, the majority of the extant occurrences are from the northern counties of the Peninsula. Both Reed (1953) and Redman (1991) cite Worcester as a county of occurrence for this species, likely based on Beaven & Oosting's (1939) listing of the species from the Pocomoke Swamp. A specimen at DUKE collected by Beaven from the Pocomoke Swamp in Worcester Co., was labeled *Athyrium acrostichoides*, but was misidentified and has been annotated as *Athyrium filix-femina* var. *asplenioides* (Robert Wilbur, pers. comm., 1999).

***Athyrium filix-femina* (L.) Mertens var. *angustum* (Willd.) Lawson**
Synonym(s): *A. angustum* (Willd.) Presl; *A. filix-femina* var. *michauxii* (Spreng.) Farw.
Common Name: northern lady fern
N.A. Distribution: northern; Nfld., w. to Sask., Maine s. to N.C., w. to Mo.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; deciduous; moist woods, floodplains, swamps.
Comments: Within populations of the northern lady fern, a red-stemmed form is often present, designated as forma *rubellum* (Gilbert) Farw. The type variety, *filix-femina* is native to Europe. FNA (1993) recognizes four North American taxa, the two listed here, which are eastern and two western varieties: *cyclosorum* Ruprecht and *californicum* Butters.

***Athyrium filix-femina* (L.) Mertens var. *asplenioides* (Michx.) Farw.**
Synonym(s): *A. asplenioides* (Michx.) Des.
Common Name: southern lady fern
N.A. Distribution: southern; Mass., R.I., Conn., s. to n. Fla., w. to e. Texas, e. Kans.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; deciduous; moist woods, floodplains, swamps.
Comments: On the Delmarva, both the northern and southern lady fern are frequent in all counties and tend to intergrade, thus making separation difficult at times. The fronds of var. *angustum* narrow to the base, with the longest leaflet near, or just below the middle. The blades of var. *asplenioides* are slightly narrowed to the base, with the lowest leaflet being the longest. Based on spore morphology and genetic differentiation, Kelloff et al. (2002) gives evidence to support distinction of the *Athyrium* taxa *angustum* and *asplenioides* at the rank of either subspecies or species.

***Cystopteris protrusa* (Weath.) Blasdell**
Synonym(s): *C. fragilis* (L.) Bernh. var. *protrusa* Weath.
Common Name: lowland fragile fern
N.A. Distribution: Conn., w. to Minn., s. through the mountains and Piedmont to n. N.J., sw. to n. La.
Delmarva Distribution: Del.: New Castle, HIST. (*J. Ebert & R. Holt*, 1993).
Delmarva Status, Duration, and Habitat: Rare; deciduous; rich alluvial floodplains.
Comments: This species is distributed primarily within the Mountain and Piedmont provinces of the eastern U.S. The species occurrence on the Coastal Plain of the Delmarva is quite rare, but unfortunately, the only known population in New Castle Co. may have been destroyed through construction activities. This population was reported, but not vouchered by two very credible botanists, Janet Ebert and Jack Holt in 1993. Their report included detailed location, habitat and population data. This population occurred on the inner Coastal Plain, about one mile (1.6 km) south of the fall-line. Habitat is a rich alluvial floodplain of a creek that originates in the Piedmont province of Delaware, where several populations of *C. protrusa* are known to exist.

Woodsia obtusa* (Spreng.) Torr. subsp. *obtusa
Common Name: blunt-lobe woodsia
N.A. Distribution: se. Que. and Ont., Wis., s. Maine, s. to w. Fla. (avoiding the outer Coastal Plain), w. to e. Tex., Okla., Nebr.
Delmarva Distribution: Del.: Kent. **Md.:** Queen Anne's; Talbot.
Delmarva Status, Duration, and Habitat: Rare; evergreen (sterile fronds); rich wooded slopes.
Comments: This species is a rare Coastal Plain occurrence throughout its range and is rarely terrestrial. It typically grows on rock substrates that are often calcareous. *Woodsia obtusa* subsp. *occidentalis* Windham occurs at the western edge of the species range.

***Dryopteris marginalis* (L.) Gray**
Common Name: marginal wood fern
N.A. Distribution: northern; Nfld., se. Que., Wis., s. to w. Va., n. Ga., n. Ala., w. to e. Okla.
Delmarva Distribution: Del.: New Castle; Kent; Sussex. **Md.:** Cecil; Kent; Queen Anne's; Caroline; Talbot; Dorchester; Wicomico, HIST. (*R. Tatnall 4567*, 1940, DOV); Somerset, LIT. (Reed 1953, *nss*); Worcester, LIT. (Reed 1953, *nss*).
Delmarva Status, Duration, and Habitat: Infrequent; evergreen; moist woods and steep slopes, usually with rich organic soils and often with *Polystichum acrostichoides*.
Comments: More frequent in the northern counties of the Delmarva on steep slopes, rare farther south. The sori of this species are positioned near the margins of the leaflets.

***Dryopteris goldiana* (Hook. ex Goldie) Gray**
Common Name: Goldie's wood fern
N.A. Distribution: northern; N.B., se. Que., Minn., New England, south in the mountains to Ga.
Delmarva Distribution: Del.: New Castle.
Delmarva Status, Duration, and Habitat: Rare; deciduous; moist woods with rich organic soils.
Comments: This species just makes it onto the Coastal Plain of the Delmarva and is known from a single extant population about .5 miles (2.8 km.) south of the fall-line in New Castle County.

***Dryopteris celsa* (Wm. Palmer) Knowlt., Palmer & Pollard ex Small**
Synonym(s): *D. goldiana* (Hook. ex Goldie) A. Gray subsp. *celsa* W. Palmer; *D.* x*celsa* (Palmer) Small, *D. goldiana* x *clintoniana* (Tatnall 1946); *D.* x*clintoniana* Wherry forma *celsa* (Palmer) Wherry, *D. goldiana* x *cristata* (Reed 1953)
Common Name: log wood fern
N.A. Distribution: se. Pa., ne. N.J. south to S.C., west to Ark. and n. La., disjunct in N.Y. and Mich.
Delmarva Distribution: Del.: New Castle; Kent. **Md.:** Cecil, LIT. (Redman 1991, *nss*); Queen Anne's; Caroline; Talbot; Wicomico; Somerset; Worcester.
Delmarva Status, Duration, and Habitat: Infrequent; rich seepage swamps and floodplains.
Comments: The only report of this species from Cecil Co. is based on Redman (1991) who gives no indication if the report is from the Delmarva region of the county. I have seen specimens at PH of this species from the Piedmont and Western Shore of Cecil Co. and have collected it from Cecil Co.'s Western Shore (*McAvoy 2465*, 1997, DOV).

***Dryopteris clintoniana* (D.C. Eaton) Dowell**
Synonym(s): *D. cristata* (L.) A. Gray var. *clintoniana* (D.C. Eaton) L. Underw.; *D.* x*clintoniana* (D.C. Eaton) Wherry, *D. goldiana* x *cristata* (Reed 1953).
Common Name: Clinton's wood fern
N.A. Distribution: northern; N.B., se. Que., se. Ont., s. to central Pa. and n. N.J, w. to Mich., n. Ind.,
Delmarva Distribution: Del.: New Castle; Sussex. **Md.:** Queen Anne's; Caroline; Somerset.

Delmarva Status, Duration, and Habitat: Rare; evergreen; rich seepage swamps.
Comments: Based on the literature (Carlson & Wagner 1982; Montgomery & Fairbrothers 1992; Rhoads & Klein 1993), this species appears to be rare south of the Wisconsin glacial line, and the Delmarva populations apparently mark the southern extreme for the species (James Montgomery, pers. comm., 2005). First documented on the Delmarva from Sussex Co. (*McAvoy 1549*, 1996, DOV) and confirmed by James Montgomery, a noted *Dryopteris* specialist, and by Bill Olson a highly respected botanist from Pennsylvania. A specimen labeled *D. celsa* from Wicomico Co., Maryland (*Smith s.n.*, 1949, PH) has been examined by James Montgomery that "may possibly" be *D. clintoniana* (J. Montgomery, pers. comm., 2000), but the specimen is such that a definitive determination can not be made. In addition, E. Wherry (no date) annotated this specimen with the following notation: "locality subsequently destroyed." This species can be confused with *D. celsa*, but the lowest leaflets of *D. clintoniana* are triangular (broadest at the base), while the lowest leaflets of *D. celsa* are ovate (broadest above the base). In addition, the fertile fronds of *D. clintoniana* are lanceolate with parallel sides, while the fertile fronds of *D. celsa* are ovate-lanceolate and gradually narrowed to the tip.

***Dryopteris cristata* (L.) Gray**
Common Name: crested wood fern
N.A. Distribution: northern; Nfld., s. Man., se. B.C., s. to N.C.
Delmarva Distribution: Del.: New Castle; Kent; Sussex. **Md.:** Cecil; Kent; Queen Anne's; Caroline; Talbot; Dorchester; Wicomico; Worcester. **Va.:** Accomack; Northampton.
Delmarva Status, Duration, and Habitat: Frequent; evergreen; seepage swamps and floodplains.
Comments: The lower leaflets of the fertile fronds will twist horizontally.

***Dryopteris intermedia* (Muhl. ex Willd.) Gray**
Synonym(s): *D. spinulosa* (O.F. Muell.) Watt var. *intermedia* (Muhl. ex Willd.) Underw.
Common Name: evergreen wood fern
N.A. Distribution: northern; Nfld., w. to Ont., Minn., s. to se. Va., and s. in the mountains to n. Ga.
Delmarva Distribution: All Counties, except Northampton.
Delmarva Status, Duration, and Habitat: Frequent; evergreen; moist woods, swamps and floodplains.
Comments: Similar to *D. carthusiana*, but *D. intermedia* has hat pin-like glandular hairs on the indusia and rachis. Rare in Accomack County.

***Dryopteris carthusiana* (Vill.) H.P. Fuchs**
Synonym(s): *D. spinulosa* (O.F. Muell.) Watt
Common Name: spinulose wood fern
N.A. Distribution: N.S. w. to B.C., Nebr., Maine, s. to S.C.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Frequent; deciduous; moist woods, slopes, swamps, floodplains, stream banks.
Comments: *Dryopteris carthusiana* is often confused with *D. intermedia*, but *D. intermedia* is evergreen and has glandular hairs on the indusia and rachis.

Dryopteris celsa* x *cristata
Common Name: hybrid wood fern
Delmarva Distribution: Del.: New Castle; Kent. **Md.:** Talbot.
Delmarva Status, Duration, and Habitat: Rare; evergreen; seepage swamps and floodplains.
Comments: The genus *Dryopteris* is quite promiscuous with four hybrids reported from the Delmarva. Hybrids can be recognized by their intermediate morphology and if spores are produced, they are irregular in size, shape and color.

***Dryopteris* x*boottii* (Tuck.) Underw.**
Synonym(s): *D. cristata* x *intermedia*
Common Name: hybrid wood fern
N.A. Distribution: Nfld. to Wis., s. to Pa., N.J., W.Va., and Tenn.
Delmarva Distribution: Del.: Kent. **Md.:** Wicomico, HIST. (*Smith s.n.*, 1950, PH).
Delmarva Status, Duration, and Habitat: Rare; evergreen; floodplain swamps.

***Dryopteris* x*slossonae* Wherry**
Synonym(s): *D. cristata* x *marginalis*
Common Name: hybrid wood fern
N.A. Distribution: N.B., Wis., Maine, s. to Va.
Delmarva Distribution: Del.: Kent, HIST. (*D. Redman 2814*, 1974, BALT). **Md.:** Talbot, LIT. (Reed 1953, *nss*).
Delmarva Status, Duration, and Habitat: Rare; sub-evergreen; swampy floodlplains.

***Dryopteris* x*triploidea* Wherry**
Synonym(s): *D. carthusiana* x *intermedia*
Common Name: hybrid wood fern
N.A. Distribution: N.S., w. to Minn., s. to Ky. and N.C.
Delmarva Distribution: Del.: New Castle; Kent; Sussex. **Md.:** Queen Anne's.
Delmarva Status, Duration, and Habitat: Status uncertain; sub-evergreen; moist woods, swamps and floodplains.
Comments: This hybrid wood fern has the appearance of *D. carthusiana* and the glandular hairs of *D. intermedia*. This hybrid is likely more frequent than current data indicates.

***Polystichum acrostichoides* (Michx.) Schott**
Common Name: Christmas fern
N.A. Distribution: N.S., se. Que. and Ont., Wis., s. to Fla., w. to e. Tex.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Frequent; evergreen; deciduous and evergreen woodlands with moist soils (usually rich organic soils), eroding slopes of ravines and stream banks.
Comments: The fertile leaflets are in the upper portion of the blade and are much smaller then the vegetative leaflets below. Leaflets can be variable in shape and many forms have been described. This species is a good indicator of Coastal Plain rich wood habitat.

Family Polypodiaceae - Polypodys

***Polypodium virginianum* L.**
Synonym(s): *P. vulgare* var. *virginianum* (L.) D.C. Eaton
Common Name: common polypody
N.A. Distribution: Lab., Nfld., w. to ne. Alta., Minn., s. to w. S.C., Tenn., Ark.
Delmarva Distribution: Del.: New Castle; Sussex. **Md.:** Cecil; Kent; Queen Anne's, LIT. (Redman 1991, *nss*); Caroline; Talbot; Dorchester (*R. Wilson 0825992*, 1991, pers. coll.); Wicomico, HIST. (*E. Wherry s.n.*, 1936, PH).
Delmarva Status, Duration, and Habitat: Infrequent; evergreen; growing on bare soil and the bases of trees on steep slopes above rivers and creeks and rarely in flat woods, also at the bases of trees.
Comments: Most frequently encountered in the Maryland counties of Cecil, Kent, Caroline, and Talbot on steep slopes above tidal rivers; rare farther south.

***Pleopeltis polypodioides* (L.) Andrews & Windham subsp. *michauxiana* (Weath.) Andrews & Windham**
Synonym(s): *Polypodium polypodioides* (L.) Watt var. *michauxianum* Weath.
Common Name: resurrection fern
N.A. Distribution: southern; Del., Md., W. Va., s. to Fla., w. to e. Tex., n. to Okla.
Delmarva Distribution: Del.: Sussex, HIST. (*A. Commons s.n.*, 1874, PH). **Md.:** Wicomico; Worcester. **Va.:** Accomack, HIST. (*C. Reed 39650*, 1955, MO); Northampton, HIST. (*W. Palmer s.n.*, 1895, US; Palmer 1899).
Delmarva Status, Duration, and Habitat: Rare; evergreen; epiphytic on tree trunks and branches in swamps and floodplains.
Comments: The stronghold for this species on the Peninsula is within the Pocomoke River drainage of Wicomico and Worcester Counties (specifically on Nassawango Creek and along the Pocomoke River). It is within this region of the Delmarva where the only extant populations for the species are to be found. A literature report (Hadaway 1992) lists this species from Kent Co. (Md.), but this specimen was misidentified and has been annotated as *P. virginianum* (Eric Hadaway, pers. comm., 1998). Curiously, the historical population from Accomack Co. was actually last observed (not collected) in the late 1980's - early 1990's by Frank Hirst and Ron Wilson (F. Hirst & R. Wilson, pers. comm., 1995). They report that the limbs that the species were growing on (a giant *Liriodendron tulipifera*) were

"loaded" with plants, but annual visits to this site by the author (since 1995) have not found a single frond, it has simply vanished.

Gymnosperms

Division Pinophyta – Hemlock, Pine, Cypress, Cedar
Order Pinales
Family Pinaceae - Pines

***Tsuga canadensis* (L.) Carr.**
Synonym(s): *Pinus canadensis* L.
Common Name: eastern hemlock
N.A. Distribution: northern; N.S., N.B., se. Que. and Ont., e. Minn., Maine, in the mountains s. to n. Ga.
Delmarva Distribution: Del.: New Castle. **Md.:** Cecil; Kent; Queen Anne's; Caroline; Talbot.
Delmarva Status, Duration, and Habitat: Infrequent to rare; evergreen; steep north and east facing slopes above tidal rivers.
Comments: This species is rare on the Coastal Plain of the eastern U.S. and occurrences on the Delmarva Peninsula represent relict, disjunct populations (McAvoy & McAvoy 2003). The hemlock woolly adelgid, an exotic insect pest threatens the existence of this species on the Delmarva. Occasionally, this species is found planted around old home sites.

***Pinus echinata* P. Mill.**
Common Name: shortleaf pine
N.A. Distribution: southern; N.J., s. to n. Fla., w. to e. Tex., ne. to Mo.
Delmarva Distribution: Del.: Kent, LIT. (Taber 1960, *nss*); Sussex. **Md.:** Caroline; Wicomico; Worcester. **Va.:** Accomack; Northampton, LIT. (V.B.A. 2005, *nss*).
Delmarva Status, Duration, and Habitat: Infrequent; evergreen; dry sandy soils, ancient sand dunes or ridges.
Comments: Rarely dominates the canopy, usually found with other pines and as lone individuals. This species is locally abundant in the counties of Caroline, Wicomico and Worcester. Evident resin pockets on the bark plates are a diagnostic field character.

***Pinus rigida* Miller**
Synonym(s): *P. rigida* P. Mill. subsp. *rigida*
Common Name: pitch pine
N.A. Distribution: northern; se. Maine, s. to Ohio and Md., s. in the mountains to ne. Ga.
Delmarva Distribution: Del.: New Castle, HIST. (*B. Long 57757*, 1942, PH); Kent, LIT. (Taber 1960, *nss*); Sussex. **Md.:** Caroline; Wicomico; Worcester.
Delmarva Status, Duration, and Habitat: Infrequent; evergreen; dry to moist sandy soils and coastal dunes.
Comments: Significant, but local populations are known from Sussex Co. (Cape Henlopen), Caroline Co. (Idylwild Wildlife Management Area), and Worcester Co. (Pocomoke St. Forest). Outside of these areas, the species is found in small, scattered populations and as lone individuals.

***Pinus serotina* Michx.**
Synonym(s): *P. rigida* Miller subsp. *serotina* (Michx.) Clausen; *P. rigida* var. *serotina* (Michx.) Hoopes
Common Name: pond pine
N.A. Distribution: southern; s. N.J., s. to n. Fla., w. to se. Ala.
Delmarva Distribution: Del.: Kent, LIT. (Taber 1960, *nss*); Sussex. **Md.:** Caroline; Dorchester; Wicomico; Worcester. **Va.:** Accomack, LIT. (Mazzeo 1972, *nss*); Northampton, LIT. (Mazzeo 1972, *nss*).
Delmarva Status, Duration, and Habitat: Infrequent to frequent; evergreen; swamps (often associated with Atlantic white cedar) and mesic soils on sandy slopes and flats.
Comments: *Pinus serotina* and *P. rigida* are closely related. *Pinus serotina* has been described as a distinct species, as well as a subspecies and variety of *P. rigida*. *Pinus serotina* is treated as distinct by Kral (FNA 1993), and he gives well defined geographic ranges for both *P. serotina* and *P. rigida*. *Pinus rigida* has a somewhat more northern distribution within the Mountain and Piedmont provinces, and *P. serotina* is more southern and chiefly Coastal Plain. Only on the Delmarva Peninsula and in southern New Jersey do the two meet; it is within this "contact zone," as described by Smuse and Saylor (1973), where the taxonomy of the two entities becomes complicated. On the Delmarva, the two can grow together and intermediates are often found containing the morphological characters of both. Hybrids between the two have been reported (Little et al. 1967; Smouse & Saylor 1973), and to further cloud the issue, *P. rigida* and *P. serotina* are also known to interbreed with *P. taeda* and *P. echinata* (Little et al. 1967; Smouse & Saylor 1973). In addition, the two taxa on the Delmarva appear to overlap in relation to edaphic conditions; both will inhabit moist sandy soils. To distinguish the two in the broad sense: the cones of *P. rigida* are ovoid acute (longer then broad) with a round bottom, an elevated triangular umbo with stout prickles, and the needles are shorter (6-12 cm.) compared to *P. serotina*; the cones of *P. serotina* are sub-globose rounded (broader then long) with a flat bottom, a poorly defined umbo with weak prickles, and the needles are longer (13 to 21 cm.) compared to *P. rigida*. But again, intermediates are often found.

***Pinus strobus* L.**
Common Name: Eastern white pine
N.A. Distribution: Nfld., s. Que. and Ont., Minn., Maine, in the mountains s. to n. Ga.
Comments: Not native to the Delmarva, but this species has been widely planted in the landscape throughout the Peninsula and the author has observed this species as a rare escape to woodlands. Taber (1960) in his trees of Delaware, which was first published in 1939, reports that, "there remains only one known natural stand situated west of Harrington, in Kent County [Delaware]." Tatnall (1946) reports a "fine stand of mature white pine 3 miles southwest of Harrington, Kent Co. [Delaware]," but points out that a resident of the area told him that "these trees had been planted by his grandfather." Taber's quote is curious, because Tatnall (1946) cites a collection [(*W.S. Taber*), *R.R. Tatnall*, 2849, 27 Oct. 1935, personal collection], which suggests that Taber was with Tatnall at the time of the collection, so why Taber would make such a statement is odd.

***Pinus palustris* Miller**
Common Name: longleaf pine
N.A. Distribution: se. Va., s. to Fla., w. to e. Tex.
Delmarva Distribution: Del.: Sussex. **Md.:** Caroline. **Va.:** Accomack, HIST. (*H. Moldenke 2780*, 1925, NY).
Comments: The nativity of longleaf pine on the Delmarva Peninsula has been debated. In addition to FNA (1993), Boyer (1990) gives the range of this species as reaching its northern extreme in southeast Virginia. *Pinus palustris* is extant on the Delmarva only from planted, non-native populations: the species has been intentionally planted in a natural area in Sussex Co. [Angola Neck (Pete Martin, pers. comm., 2005 and Rob Line, pers. comm., 2005) and a natural area in Caroline Co. [Idylwild Wildlife Mgmt. Area (Wes Knapp, pers. comm., 2005 and staff of the Le Compte Wildlife Mgmt. Area, pers. comm., 2005)]. The Caroline Co. population appears to be of mixed age and cones have been observed (Wes Knapp, pers. comm., 2005), so apparently, the species is reproducing on the Delmarva. Historical records of red-cockaded woodpecker (RCW), which prefers longleaf pine for cavity nests, have been published for the Delmarva (Robbins & Blom 1996). In the Blackwater region of Dorchester Co., RCW has been observed periodically from 1932 to 1976 (Robbins & Blom 1996), and a "young bird" was observed on Assateague Island, Worcester Co. (Robbins & Blom 1996) in 1939. Based on these records of RCW, some have argued that longleaf pine must have been present on the Delmarva, but longleaf pine has never been reported from these areas. In addition, RCW is known to utilize other species of pine for cavity nests (Jackson 1994), such as loblolly pine (*P. taeda*), shortleaf pine, Virginia pine (*P. virginiana*) and pitch pine (Jackson 1994). Also, Jackson (1994) pointed out that nineteenth century records beyond the current range of RCW include northern New Jersey and southeast Pennsylvania, and that longleaf pine has never been reported this far north. Another piece of evidence that has been used to justify the occurrence of longleaf pine on the Delmarva are place names, such as Girdletree (Worcester Co.) and Tar Bay (Accomack Co.), which suggests a pine tar industry once existed in the area. Longleaf pine is well known for its ability to produce high quantities of resin or tar, which was first exploited by early European settlers (Outcalt 2000) for a variety of uses, such as to seal cracks in sailing ships (Outcalt 2000). Loblolly pine, which is quite common and widespread in the southern portion of the Delmarva (see description below), was also used as a source for pine tar by the early settlers (Lee 2006) for many of the same purposes as longleaf pine tar. If a pine tar industry did exist in the southern Delmarva, and longleaf pine was the source of this tar, it then seems logical to assume that historical information about the specific use of longleaf pine in this industry should exist, yet the author is unaware of any. In the herbarium of the New York Botanical Garden (NY), a specimen labeled *P. palustris* exists that was collected by Harold Moldenke (1909-1996) in 1925 from Accomack Co. (Accomack Co., Va., "In sandy woods, Sinnickson, Longleaf pine," 8 Dec. 1935, *H. Moldenke 2780*, NY). This specimen consists of two leaves (two fascicles each containing three leaves) up to 29 cm. long. I was fortunate enough to obtain a copy of notes related to Moldenke's collection that were compiled by a noted ecologist from North Carolina (who will remain anonymous for this paper), who was studying longleaf pine. In these notes, the ecologist points out that he examined Moldenke's collection at NY, and that he interviewed Moldenke in 1979 regarding his collection. In his notes, the ecologist states that "it was his [Moldenke] belief that this was a natural stand." The ecologist goes on to say that he visited the site himself, "along the road from Silva [now

known as Signpost] to Sinnickson" in 1979, but could not relocate the population. The ecologist also points out in his notes that Moldenke collected a specimen of *P. palustris* from the same site in 1911 [specimen not at NY, (Thomas Zanoni, pers. comm., 2005)]. The ecologist examined this specimen and states that it had been annotated as "cultivated specimen," by "someone who apparently disbelieved that natural longleaf occurred that far north." These notes are curious because Moldenke was born in 1909 and he would have been two years old when making a collection in 1911. Perhaps the ecologist mistakenly typed 1911 for Moldenke's collection date when he should have typed 1925, but he typed 1911 twice in the same paragraph and also used 1911 again in subsequent pages of related notes. I'll also add that Moldenke was 16 years of age when he made the 1925 collection and he had already accumulated 2780 specimen numbers (Thomas Zanoni, pers. comm., 2005). I am familiar with, and have done field work in the area where Moldenke made his collection in Accomack Co., but have never found native or planted populations of this species. I would not expect to find native populations of longleaf pine in this area, but an obvious plantation of this species would not be a surprise. In addition, Clyde Reed and Frank Hirst, who are both cited many times in this paper, have also done field work in this area in the past (see Reed 1956 and 1960 for text specific to this area) and both have never reported finding this species. In a conversation with Virginia botanist Tom Wieboldt, Tom points out that *P. palustris* tends to "shun the outer Coastal Plain from central NC northward" (Tom Wieboldt, pers. comm., 2006). The southern portion of the Delmarva where native longleaf pine is alleged to have once existed falls within the outer Coastal Plain region. Finally, none of the local floras (Brown & Brown 1972; Weakley 2006), or checklists (Tatnall 1946; Mazzeo 1972; Harvill et al. 1992; V.B.A. 2005) of the region give any indication that *P. palustris* ever existed on the Delmarva Peninsula. Until further research proves otherwise, this study does not consider longleaf pine to be native in Accomack Co., nor on the Delmarva Peninsula.

***Pinus taeda* L.**
Common Name: loblolly pine
N.A. Distribution: southern; s. N.J., s. to n. Fla., w. to e. Tex.
Delmarva Distribution: All Counties, except Cecil.
Delmarva Status, Duration, and Habitat: Common; evergreen; poorly-drained to well-drained soils.
Comments: Most common from the central to the southern portions of the Delmarva. Often dominates the canopy, or appears as a co-dominant. Native populations in New Castle Co. are restricted to a narrow zone near the Delaware Bay. *Pinus taeda* is a commercially important species that forms the foundation for 1000's of acres of plantations on the Delmarva. Pre-settlement, this species was likely confined to the swamps of the southern regions of the Delmarva, but with colonization and land-clearing, it has now become widely and well established on a variety of soil types.

***Pinus thunbergiana* Franco**
Common Name: Japanese black pine
Delmarva Distribution: Del.: Sussex. **Md.:** Worcester.
Comments: Native of Japan and Asia. The species was planted to stabilize dunes along the Peninsula's Atlantic coast in Sussex (Tony Pratt, pers. comm.) and Worcester Counties

[Assateague State Park, (Angela Baldwin, pers. comm., 2005)]. This species is well established and widespread on dunes in Sussex Co. and is reproducing. This species is also reported from Mass., N.Y., N.J., Va. and N.C (Nature Serve Explorer 2005). Many dead and dying individuals of this species have been observed by the author along the Atlantic coast of Sussex County. The pinewood nematode (*Bursaphelenchus xylophilus*) has been identified as the species that is causing the trauma (Rob Line, pers. comm., 2006).

***Pinus virginiana* Miller**
Common Name: Virginia pine
N.A. Distribution: southern; L.I., N.Y., w. to Ohio, s. to n. Ga. and Miss.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; evergreen; well-drained soils, young woodlands, edges, old fields.
Comments: Early colonizer of disturbed sites and abandoned fields. Pre-settlement, this pine was likely most abundant in the Piedmont and at low elevations in the Mountains, but with colonization and land clearing, it is now well established and wide spread on the Coastal Plain in the northern part of its range.

Family Cupressaceae - Cypresses

***Taxodium distichum* (L.) L.C. Richard**
Synonym(s): *T. distichum* (L.) L.C. Richard var. *distichum*
Common Name: bald cypress
N.A. Distribution: southern; chiefly Coastal Plain, Del., s. to Fla., w. to e. Tex., ne. to s. Ill. and Ind.
Delmarva Distribution: Del.: Kent; Sussex. **Md.:** Wicomico; Somerset; Worcester. **Va.:** Accomack.
Delmarva Status, Duration, and Habitat: Infrequent to frequent; deciduous; typically associated with fresh water non-tidal and tidal creeks and rivers on swampy floodplains, and rarely in isolated stands away from water courses.
Comments: This species is at its extreme northern limit on the Delmarva (Kent Co., Del.). Populations in Indiana are slightly more southern then populations on the Peninsula (Michael Homoya, pers. comm., 2003). Most frequent in the Pocomoke and Nanticoke watersheds of Sussex, Wicomico, Somerset and Worcester Counties.

***Chamaecyparis thyoides* (L.) B.S.P.**
Common Name: Atlantic white cedar
N.A. Distribution: Mostly Coastal Plain, se. Maine, s. to n. Fla., w. to s. Miss.
Delmarva Distribution: Del.: New Castle, EXT. (*A. Commons s.n.*, 1867, PH); Kent; Sussex. **Md.:** Dorchester; Wicomico; Worcester. **Va.:** Accomack.
Delmarva Status, Duration, and Habitat: Infrequent to frequent; evergreen; fresh water non-tidal and tidal creeks and rivers on swampy floodplains; often in pure stands, rarely found as isolated stands in lowland swamps away from water courses.
Comments: Populations of this species are most frequently found in Sussex County, where they often occupy large areas of stream corridor. The only known New Castle Co. population of the species was destroyed when a storm in 1878 breached a barrier island that

protected a freshwater swamp where *C. thyoides* was known to occur (Fleming 1978). The barrier island kept saltwater from the Delaware Bay out of the freshwater swamp, but the breach allowed saltwater to intrude, which then led to the species demise in this county. Known from just a single occurrence in Kent Co. (Del.) where it is barely holding on due to salt water intrusion. Mazzeo (1972) lists this species from Northampton Co., but points out that it has been "reported but not documented." Therefore, *C. thyoides* is not recognized from this county on the Delmarva.

Juniperus virginiana* L. var. *virginiana
Common Name: red cedar
N.A. Distribution: se. Que. and Ont., se. N. Dak., Minn., s. Maine, s. to nw. Fla., w. to e. Tex.
Delmarva Distribution: All Counties.
Delmarva Status, Duration, and Habitat: Common; evergreen; old fields, edges, hedgerows, thickets, and early successional shrublands and woodlands.
Comments: The var. *silicicola* (Small) E. Murray is restricted to coastal foredunes from North Carolina to Florida.

The following taxa are excluded from the gymnosperm flora of the Delmarva Peninsula because they do not appear to be reproducing. They are reported here because they have been observed as intentional plantings in natural areas on private land and may appear native to future botanists in the field.

***Picea rubens* Sargent**
Family: Pinaceae
Common Name: red spruce
N.A. Distribution: northern; N.B., N.S., Ont., Que., s. through New England, N.Y., n. N.J., Pa., and s. at high elevations to N.C.
Comments: This species is primarily a northern Mountain species and is also found at high elevations in the south. This species is not native to the Coastal Plain of the Delmarva, but it has been observed by the author around old-home sites and as an intentional planting to natural areas on private lands.

***Taxodium ascendens* Brongniart**
Family: Cupressaceae
Synonym(s): *Cupressus disticha* L. var. *imbricaria* Nutt.; *T. distichum* (L.) L.C. Rich. var. *imbricarium* (Nutt.) Croom
Common Name: pond cypress
N.A. Distribution: southern; strictly Coastal Plain, N.C., s. to Fla., w. to se. La.
Comments: Pond cypress is not native to the Delmarva, but has been intentionally planted (Pete Martin, pers. comm.) in a natural area in south central Sussex County (Great Cypress Swamp Conservation Area).

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