DCMP: Attachment IV.B

THOUSAND ACRE MARSH BIOTIC COMPOSITION AND NATURAL COMMUNITY TYPES EVALUATION

Final Report

Submitted to:

Division of Soil and Water
Department of Natural Resources and Environmental Control

By:

Delaware Natural Heritage Inventory
Division of Parks and Recreation
Department of Natural Resources and Environmental Control

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INTRODUCTION

A biological inventory of 1000 Acre Marsh, New Castle County, Delaware was conducted during the 1993 growing season by the Delaware Natural Heritage Inventory (DNHI). The survey was requested and funded by the Division of Soil and Water Conservation, Department of Natural Resources and Environmental Control to address the biological components of this marsh and any impacts from proposed long term wetland management plans.

The 1000 Acre Marsh (Fig. 1) is located north of the town of Port Penn and is bounded on the north by the Dutch Neck Road and the C. & D. Canal, and on the east by Delaware Rte 9. The southern and western boundaries are located on private and state owned property bounded by Thowrnton Road, St. Georges-Port Penn Road, and Dutch Neck Road. The Marsh proper includes approximately 1288 acres.

Thousand Acre Marsh " ... may best be described as a large, fresh to slightly brackish (salinity 0 to 6 ppt), highly productive, low level wetland impoundment which has been experiencing a general decline in habitat quality for approximately two decades. The initial high wildlife value which resulted from stabilization of water levels and reduction of salinity has been gradually yielding to the longer term detrimental consequences of impounding and restriction of tidal flow, Similar to nearly all of Delaware's wetland impoundments constructed in the 1950s and 1960s, the marsh area is evolving toward a shallow, sediment-laden, open water area, devoid of vegetation important for waterfowl, waterbirds, muskrats, and most other wildlife species" (Carter unpublished report).

Survey Objectives:

(1) to determine and map the gross biotic composition of the marsh, in terms of dominant vegetative cover, using field data and recent color infrared photographs.

(2) to undertake a detailed biotic inventory for rare and endangered plants. Specific locations will be mapped.

(3) to undertake a general biotic inventory of the marsh for rare and endangered animals.

(4) to evaluate the impact of various management actions (such as tidal flushing, *Phragmites* spraying, marsh channelization, etc.) on listed threatened or endangered species, and State species of special concern that may be found to occur in the marsh.

METHODS

During the months of July through October 1993, several field surveys were undertaken at 1000 Acre Marsh. It was expected that much of the survey work could be done by small boat along the shoreline, however water levels were generally too low until very late in the season for boats to be used. The initial survey was conducted partially by canoe, but it was impossible to find

deep enough water in most of the marsh for this survey method to be practical. The remaining surveys were conducted on foot; access to the marsh was gained from the adjacent upland of private landowners.

Thirteen individual sites, numbered 1-13, were surveyed (Fig. 2). Natural community types, described below, were determined for each survey site. In addition, each survey site is described on a data sheet, or set of sheets (available upon request).

At each survey site, notes were taken on plant species observed and their relative abundancies. Dominant and sub-dominant species in each community were also noted. Plants that could not be identified to the species level were collected and, if possible, were identified later. Uncertain species identification are indicated on the data sheets (and on the species list) by an sp. after the genus name.

Upon completion of field surveys, the dominant vegetation types were determined and mapped (Figs. 3-4) from the survey data and by utilizing 1992 color infrared aerial photography of the 1000 Acre Marsh as an aid. In addition, a location map for plant species of special concern is included (Fig. 5). Faunal surveys were incomplete, and preliminary, as staff time was limited. Fish data were collected from four individual seining locations (Fig. 6). Due to their mobility, and the cursory nature of the data, locational maps for animals are not included in this report (contact DNHI staff for additional information).

RESULTS AND DISCUSSION

The vegetation in the eastern section of the marsh was dominated by dense *Phragmites australis* communities that were virtually monospecific. From the start of the survey in July until approximately early October, the water level was relatively low, water temperature was high, and algal blooms were common. In portions of the eastern section of the marsh there is a narrow fringe of emergent vegetation, that includes *Peltandra virginica, Pontederia cordata, Echinochloa walteri*, and other common brackish-to-fresh water emergents.

In spite of the low plant species diversity in this area, it was heavily used by wading birds, shore birds, raptors, waterfowl, etc. over the entire season; see animal species list (Appendix II). On the whole, animal surveys were incomplete, but do include observational data from studies undertaken by Manomet Bird Observatory staff. A map showing approximate localities of animals observed is available from the DNHI upon request.

In general, the vegetation in the western portion of the marsh is more diverse than elsewhere. In much of this area *Phragmites* is only a minor component of the vegetative communities. More rare species are found in the western section, the water quality appears to improve, and the plant communities are richer in species. This is especially true in the coves that are somewhat separated from the marsh's open water. Some of the areas that may have the most potential for rare species and high quality could not be surveyed due to lack of land owner consent, or lack of time. For a species list of plants observed at 1000 Acre Marsh see Appendix I.

There were four basic vegetative community types found on the marsh (see Figs. 3-4 for locations); several of these consisted of two or more community associations:

1. Mixed Herbaceous Emergent Wetlands

- *Schoenoplectus tabernaemontani-Typha* spp. Wetland Association
- *Schoenoplectus pungens-Cyperus odoratus* Wetland Association
- *Typha* spp.-*Schoenoplectus tabernaemontani-Leersis oryzoides* Wetland Association
- *Peltandra virginica-Leersia oryzoides* Wetland Association
- *Peltandra virginica-Schoenoplectus tabernaemontani* Wetland
- *Nuphar lutea-Peltandra virginica* Wetland Association
- *Decodon verticillatus-Peltandra virginica-Zizania aquatica* Wetland Association
- *Typha* spp. Wetland Association
- *Polygonum arifolium-Impatiens capensis* Wetland Association
- *Panicum dichotomiflorum* Wetland Association

2. *Hibiscus moscheutos* Wetland Association

3. Scrub-Shrub Wetlands

- *Cephalanthus occidentalis* Scrub-Shrub Wetland
- *Alnus serrulata-Cephalanthus occidentalis* Scrub-Shrub Wetland
- Mixed Shrubs/Mixed Herbaceous Scrub-Shrub Wetland

4. *Phragmites australis*-dominated Wetland

The *Phragmites*-dominated wetlands identified from field surveys are very consistent with those *Phragmites* colonies identified from aerial photography by L. Pomatto (Wetlands and Aquatic Protection Branch, Division of Water Resources).

SURVEY SITE DESCRIPTIONS

The following contains brief descriptions and locations of all the survey sites (Fig. 2). The descriptions includes data on species compositions, dominant and sub-dominant species, an application of a natural community name (if possible), and any additional notes.

SITE 1 (Shingle Landing North)

This site includes the northern shoreline of a point identified as Shingle Landing (Fig. 2), and is accessed via automobile. Travel north on Rte 9 from Port Penn. Just before reaching bridge, take road to the canal and Dutch Neck Road (RD 417), continue west on Dutch Neck RD to first dirt road on left. Take this road to Shingle Landing (access is required from land owner or State of Delaware personnel). Survey took place along the northeast shore of Landing. Water levels were low on survey date.

A narrow fringe of emergent vegetation is found along this shoreline. The natural community may be characterized as a ***Schoenoplectus tabernaemontanii-Typha* spp. Emergent Wetland [softstem bulrush-cattail wetland]**. The cattails that were observed here include *T. angustifolia, T. latifolia,* and *T. x glauca.* In addition to the above dominant species, other common species (which in some places may be quite abundant) include *Leersia oryzoides, Echinochloa walteri, Cyperus esculentus,* and *C. strigosus.* Less common species observed here included *Impatiens capensis, Ludwigia palustris, Lemna minor, Pontederia cordata, Peltandra virginica, Lythrum salicaria, Rumex crispus, Eleocharis parvula, Hypericum* sp., *Phragmites australis, Hibiscus moscheutos, Pluchea* cf. *odorata, Sagittaria calycina, Cephalanthus occidentalis, Juncus* sp., and *Lycopus* sp.

This narrow, but diverse, emergent marsh fringe occurs in a saturated to inundated mucky subtrate and occurs immediately adjacent to a tree and shrub upland. The overall habitat quality could be described as fair to good.

Species of Special Concern:

Only one Species of Special Concern was observed at this site: an arrowhead, *Sagittaria calycina* (S2). A total of eight individuals were observed; all were found to be growing in fairly exposed substrate along the shoreline.

SITE 2 (Shingle Landing South)

This site includes the shorelines south and west of Shingle Landing (Fig. 2). The vegetation of this site occurs in three fairly distinct zones (**Zones 1-3**) along the length of the shoreline: **Zone 1** consists of woody vegetation or ***Phragmites australis*-dominated wetlands** that are generally found along the upland edge; **Zone 2** is a narrow or broad emergent marsh; and **Zone 3** consists of low diversity exposed substrate extending into the open water.

This zonal pattern is a common feature of 1000 Acre Marsh, where the upland is divided from the broad open water by a relatively narrow shoreline. However, some of the area surveyed in this portion of 1000 Acre Marsh, were along edges that graded from woody upland to broad herbaceous marshes. Zonation was not a distinct characteristic of these areas, except possibly on a scale not detected in our survey. The eastern portion of Site 2 is a somewhat disturbed area that appears to be used mainly for recreational purposes, with a small camp with mowed grass leading to the shoreline.

Zone 1 is comprised of areas of abundant *Phragmites australis* pockets that give way to woody thickets of *Salix nigra, Acer rubrum, A. negundo,* and *Viburnum dentatum,* among woody taxa. Other species present here include *Boehmeria cylindrica, Juncus effusus, Scutellaria* sp., *Onoclea sensibilis, Thelypteris palustris, Eupatorium maculatum, Solidago rugosa,* and *Panicum* cf. *boscii.* The firm substrate was composed of rock/gravel extending out into the open water. Moisture conditons in Zone 1 varied from moist to saturated.

Zone 2 may be described as an ***Hibiscus moscheutos* Wetland Association [rose mallow wetland]**. This zone may be sparsely vegatated in some areas, and is typically dominated by *Hibiscus* throughout. Other species present include *Salix nigra, Bidens laevis, Cephalanthus occidentalis, Cyperus odoratus* (abundant), *Erechtites hieracifolia, Impatiens capensis, Phragmites australis, Boehmeria cylindrica, Panicum scoparia, Polygonum pensylvanica, Parthenocissus quinquefolius*, and *Cornus amomum*. The exotics *Lythrum salicaria* and *Polygonum persicaria* were also noted here. This zone had a firm, saturated substrate.

Zone 3 is a community dominated by ***Schoenoplectus pungens-Cyperus odoratus* Wetland Association [three square-umbrella sedge marsh]**. This zone is exceptionally diverse, more so than Zones 2 and 3, and include such additional species as *Bidens laevis, Cyperus strigosus, Impatiens capensis, Lemna minor, Leersia oryzoides, Leptochloa fascicularis, Ludwigia peploides, Lycopus americanus, Lythrum salicaria, Panicum dichotomiflorum, Peltandra virginica, Pluchea odorata, Polygonum arifolium, P. persicaria, P. pensylvanica, Pontederia cordata, Rumex verticillatus, Sagittaria latifolia, S. calycina, Schoenoplectus robustus, S. tabernaemontani, Typha angustifolia*, and *T. latifolia*. This zone was inundated with 2 to 5 cm of water on survey date.

Habitat Quality: Fair to good

Species of Special Concern: *Sagittaria calycina* (S2), and *Leptochloa fascicularis* (S1) were observed in **Zone 3** at this site.

SITE 3

This site, located along a narrow tributary west of Site 2 (Fig. 2), consists of a high quality, diverse scrub-shrub wetland with small, herbaceous openings. The community can be characterized as a ***Cephalanthus occidentalis* Scrub-Shrub Wetland**. The buttonbush is dominant throughout the site. Other sub-dominant species include *Carex stricta, C. stipata, C. comosa, C. crinita, Leersia oryzoides, Eleocharis palustris, Boehmeria cylindrica*, and *Hibiscus moscheutos*, while less abundant species include *Apios americana, Bidens frondosa, Asclepias incarnata, Cicuta maculata, Decodon verticillatus, Impatiens capensis, Iris versicolor, Juncus canadensis, J. effusus, Ludwigia peploides, L. palustris, Lycopus americanus, Lythrum salicaria, Nuphar lutea, Peltandra virginica, Pontederia cordata, Rosa palustris, Rumex verticillatus, Schoenoplectus tabernaemontani*, and *Sium suave*, to mention a few.

Along the margins of this scrub-shrub wetland is found a narrow forested wetland consisting of a typical ***Acer rubrum* Swamp Forest**. This is a second growth forest dominated by red maple with an understory comprised of *Lindera benzoin, Viburnum nudum, Woodwardia areolata, Impatiens capensis, Ilex verticillata*, and *Symplocarpus foetidus*. This habitat was only briefly surveyed.

Habitat Quality:

Overall, the scrub-shrub marshes of this site are of very high quality.

Species of Special Concern:

No rare species were observed at this site, but additional surveys should be undertaken.

SITE 4

This site consists of several highly diverse vegetation communities. On the north side of the narrow peninsula that juts out into the open water of 1000 Acre Marsh (see Fig. 2, labelled A) occurs an emergent marsh described as a ***Typha spp.-Schoenoplectus tabernaemontani-Leersia oryzoides*** **Wetland Association [cattail-softstem bulrush-rice cutgrass marsh]**. The cattails include *T. angustiflia, T. latifolia*, and possibly *T.* x *glauca*. The above species may form dense monospecific colonies, or occur in a more dispersed condition. Less common species include the following: *Bidens tripartita, B. coronata, Asclepias incarnata, Apios americana, Acer rubrum, Cephalanthus occidentalis, Cornus amomum, Echinochloa walteri, Eleocharis obtusa, E.* sp., *Cyperus odoratus, C. erythrorhizos, Decodon verticillatus, Impatiens capensis, Hibiscus moscheutos, Lemna minor, Panicum dichotomiflorum, Peltandra virginica, Pontederia cordata, Polygonum hydropiperoides, P. arifolium, P. pensylvanicum, Rumex verticillatus, Phragmites australis, Lythrum salicaria, Sagittaria latifolia, Boehmeria cylindrica*, and *Polygonum densiflorum.*

On the south side of the peninsula (Fig. 2, labelled B) occurs a **Mixed Shrubs/Mixed Herbaceous Scrub-Shrub Wetland**. There does not appear to be any true dominants. Common shrubs include *Cephalanthus occidentalis, Alnus serrulata, Clethra alnifolia, Ilex verticillata, Myrica cerifera, Acer rubrum*, and *Nyssa sylvatica*. Herbaceous species include *Asclepias incarnata, Bidens* spp. (*coronata, tripartita*), *Cyperus erythrorhizos, C. strigosus, Decodon verticillatus, Echinchloa walteri, Eleocharis* sp., *Hibiscus moscheutos, Impatiens capensis, Iris pseudacorus, Leersia oryzoides, Lemna minor, Limnobium spongia, Ludwigia palustris, Lythrum salicaria, Peltandra virginica, Phragmites australis, Pontederia cordata, Polygonum densiflorum, Rumex verticillatus, Sagittaria latifolia, Schoenoplectus tabernaemontani, Spirodela polyrhiza, Typha angustifolia, T. latifolia*, and *Wolffia brasiliensis*, among others. Further towards the west occurs additional species such as *Lobelia cardinalis, Nuphar lutea, Sparganium* sp., *Thelypteris palustris, Onoclea sensibilis, Galium* sp., *Dulichium arundinaceum*, and *Hypericum virginicum.*

Habitat Quality:

Moderately high quality, diverse wetlands.

Species of Special Concern:

The rare species identified from this site include tick-seed sunflower, *Bidens coronata* (S2), American frog-bit, *Limnobium spongia* (S1), and dense-flowered smartweed, *Polygonum*

densiflorum (**S1**).

SITE 5

This site (Fig. 2) consists of two basic vegetation community types, described in some detail below:

(1) ***Alnus serrulata-Cephalanthus occidentalis*** **Scrub-Shrub Wetland** dominated by the alder and buttonbush but with scattered *Acer rubrum, Rosa palustris, Viburnum recognitum, Cornus* sp., and *Salix nigra*. The scrub-shrub is a very diverse community which includes additional species such as *Asclepias incarnata, Aster vimineus, Bidens coronata, B. laevis, Carex crinita, Decodon verticillatus, Hibiscus moscheutos, Impatiens capensis, Leersia oryzoides, Nuphar lutea, Peltandra virginica, Polygonum punctatum, Limnobium spongia, Sium suave, Typha angustifolia, Hydrocotyle ranunculoides*, and *Zizania aquatica*, to name just a few. This community is rather narrow, varying from 15-50 feet in width.

(2) the ***Peltandra virginica-Leersia oryzoides*** **Wetland Association**, though dominated by arrow-arum and rice cutgrass also is quite diverse and contains many of the same species as in the scrub-shrub community. Additional species not listed above include *Cyperus odoratus, Lemna minor, Phragmites australis, Polygonum arifolium, Schoenoplectus tabernaemontani, Sium suave*, and *Typha latifolia*. This is also a relatively narrow community that extends along the shoreline in a southwest direction (further west up the gut the emergent marsh expands and broadens out (it also becomes more scrubby in physiognomy).

Habitat Quality:

Excellent quality emergent marsh and scrub-shrub wetland. High diversity.

Species of Special Concern:

Several species of special concern have been identified from this site, including tick-seed sunflower, *Bidens coronota* (**S2**); and American frog-bit, *Limnobium spongia* (**S1**).

SITE 6

This site consists of an extensive emergent marsh of relatively high diversity (though less so than previously described communities). Common reed, *Phragmites australis* becomes dominant further from the shore. Landward a narrow wooded thicket comprised of *Acer rubrum* and *Salix* sp. borders the marsh.

The area labelled A (Fig. 2) consists of a **Mixed Herbaceous Wetland Association** that is quite diverse and not easily classified. Dominant and sub-dominant species include *Decodon verticillatus, Leersia oryzoides, Nuphar lutea, Peltandra virginica*, and *Typha latifolia*. Less abundant species include *Cicuta maculata, Hibiscus moscheutos* (though may be locally

abundant), *Iris pseudacorus, Lemna minor, Lythrum salicaria, Pontederia cordata, Rumex verticillatus, Sagittaria latifolia, Schoenoplectus tabernaemontani*, and *Zizania aquatica*. Shrubs such as *Cephalanthus occidentalis, Ilex verticillatus*, and *Alnus serrulata* are scattered throughout this community.

Further west (labelled B, Fig. 2) occurs similar emergent marsh habitat but with a different suite of dominant species. This marsh may be characterized as a ***Decodon verticillatus-Peltandra virginica-Zizania aquatica*** **Wetland Association**. Extensive stands of wild rice, amid arrow arum and water willow are present. In some areas *Typha latifolia* forms extensive colonies. The upland edge is composed of the typical woody thicket of *Acer rubrum, Salix nigra*, and *Viburnum recognitum*, among others. Other species found in the marsh include *Asclepias incarnata, Bidens* sp., *Hibiscus moscheutos, Juncus effusus, Lemna minor, Nuphar lutea, Pontederia cordata, Limnobium spongia*, and *Boehmeria cylindrica*, to name a few.

Habitat Quality:

Good to excellent.

Species of Special Concern:

The only species of special concern observed at this site was the American frog-bit, *Limnobium spongia* (S1).

SITE 7

The marsh at this site (see Fig. 2) consists of two more or less different natural community types. One consists of a **Mixed Scrub-Shrub Wetland Association**, while the other may be characterized as a ***Hibiscus moscheutos-Leersia oryzoides-Typha latifolia*** **Wetland Association**. The scrub-shrub grades into the mixed herb wetland.

The **Mixed Scrub-Shrub** community is comprised of abundant *Cephalanthus occidentalis*. Other species include *Boehmeria cylindrica, Echinochloa walteri, Hibiscus moscheutos, Impatiens capensis, Juncus effusus, Leersia oryzoides, Lythrum salicaria, Nuphar lutea, Peltandra virginica*, and *Typha latifolia*.

The ***Hibiscus moscheutos-Leersia oryzoides-Typha latifolia*** **Wetland** is dominanted by these three species, but also has an assemblage of species that includes those found in the **Mixed Scrub-shrub**. Small stands of *Phragmites australis* are present along the shore.

Habitat Quality:

Good to excellent quality.

Species of Special Concern:

None observed at this site.

SITE 8

This site consists of several habitat types that vary considerably; these will be described in some detail. Along the eastern tip of the peninsula (area labelled A, Fig. 2) occurs a rip-rapped steep-sloped shoreline that abruptly changes to open water. A narrow zone of wetland vegetation, dominated by *Phragmites australis*, is found growing through the rip-rap. Additional species occurring here, though not as abundant as the reed grass, include *Rhus copallina, Viburnum dentatum, Echinochloa walteri, Hibiscus moscheutos, Pluchea odorata*, and *Polygonum punctatum*. Further west (labelled B, Fig. 2), where there are several small coves, occurs a ***Peltandra virginica-Schoenoplectus tabernaemontani* Wetland Association.** Because farming occurs right to the edge of the emergent wetland, the water is eutrophic as evidenced by its dense algal bloom. *Phragmites* and purple loosestrife, *Lythrum salicaria* occur in abundance in some areas along the shore. This area consists of a diversity of species including *Bidens tripartita, Boehmeria cylindrica, Cyperus erythrorhizos, C. strigosus, Echinochloa walteri, Hibiscus moscheutos, Juncus* spp., *Leersia oryzoides, Lemna minor, Limnobium spongia, Panicum dichotomiflorum, Pontederia cordata, Sagittaria calycina, Scirpus americanus, Typha angustifolia*, and *T. latifolia*.

The deep cove-like area surveyed on the south side of the peninsula (labelled C, Fig. 2) consists predominately of a ***Typha angustifolia-T. latifolia* Wetland Association.** Other less abundant, but nevertheless common, species include *Schoenoplectus tabernaemontani, Echinochloa walteri, Erechtites hieracifolia, Impatiens capensis*, and *Panicum dichotomiflorum*. *Phragmites* may be found in abundance, especially near upland edges.

To the extreme western portion of this site (labelled D, Fig. 2) occurs an ***Hibiscus moscheutos-Leersia oryzoides* Wetland Association.** In this area of the site vegetation cover and species diversity varies considerably, towards the south end there are relatively few species present, while in the north end there is a diversity of species and many small "pools" of *Nuphar lutea* and *Peltandra virginica*. Additional species present in this portion of the marsh include *Boehmeria cylindrica, Carex* sp., *Cephalanthus occidentalis, Cyperus* spp., *Dulichium arundinaceum, Impatiens capensis, Lemna minor, Panicum dichotomiflorum, Rumex verticillatus, Sagittaria latifolia*, and *Typha latifolia*. *Phragmites* occurs here rather sparingly.

Habitat Quality:

Good to excellent.

Species of Special Concern:

Several rare species were observed at this site, including American frog-bit, *Limnobium spongia* (S1), and arrowhead, *Sagittaria calycina* (S2).

SITE 9:

In the southeastern quadrant of the 1000 Acre Marsh occurs a diverse **Mixed Herbaceous Wetland Association** (Fig. 2) where there appears to be no true dominants. Those species that are abundant include *Hibiscus moscheutos, Impatiens capensis, Leersia oryzoides, Lemna minor, Ludwigia peploides, Panicum dichotomiflorum, Peltandra virginica, Polygonum arifolium, P. punctatum, Rumex verticillatus, Sagittaria latifolia, Schoenoplectus tabernaemontani*, and *Typha* spp. Other, less abundant species include *Carex lurida, Decodon verticillatus, Erechtites hieracifolia, Eclipta prostrata, Eupatorium dubium, Iris versicolor, Mikania scandens, Panicum virgatum*, and *Pluchea odorata*. The edges of the open water are dominated by *Phragmites* and *Typha* spp.; *Phragmites* is also abundant across the nearby channel.

Habitat Quality:

Moderately good quality.

Species of Special Concern:

No rare species were observed at this site.

SITE 10

A combination of what may be described as low and high marsh is present at this site (Fig. 2). The northern side of this site consists of sparse vegetation comprised primarily of *Polygonum arifolium* and *Impatiens capensis*. Several plant associations were identified from this area, including the above ***Polygonum arifolium-Impatiens capensis* Wetland Association**; a ***Nuphar lutea-Peltandra virginica* Wetland Association**. Several areas are dominated by *Hibiscus moscheutos* and *Phragmites australis*.

This diverse site also contains such species as *Asclepias incarnata, Cornus amomum, Cicuta maculata, Decodon verticillatus, Echinochloa walteri, Eleocharis* spp., *Erechtites hieracifolia, Iris pseudacorus, Juncus canadensis, J. effusus, Leersia oryzoides, Lemna minor, Ludwigia alternifolia, Polygonum hydropiperoides, P. scandens, Pontederia cordata, Sagittaria latifolia, Setaria magna, Solidago rugosa, Typha angustifolia, T. latifolia*, and *Wolffia brasiliensis*.

Zones of *Phragmites* are common, especially along the upland edge. In addition, this site contains a number of large coves in the southwest end.

Habitat Quality:

Moderately good quality; zones of *Phragmites* lower habitat quality.

Species of Special Concern:

None observed at this site.

SITE 11

This site (Fig. 2) was surveyed by canoe. The vegetated habitat was only viewed from the boat, due to the soft, mucky substrate, and monospecific community, comprised of a ***Phragmites australis*** **dominated wetland** (occurring throughout this region of the impoundment). On survey date (3 Jul 1993) the water was extremely shallow (between 4-20"), making canoing very difficult.

Habitat Quality:

Extremely poor quality; *Phragmites* infested; eutrophic waters with an abundance of phytoplankton.

Species of Special Concern:

None observed at this site.

SITE 12

This site is located in the northeastern portion of 1000 Acre Marsh (Fig. 2). In the southern region of the site (labelled A, Fig. 2) occurs several small to medium-sized pools that are typically fringed by an abundance of ***Phragmites*-dominated wetland.** Other species observed here include *Cephalanthus occidentalis, Cyperus odoratus, Echinochloa walteri, Erechtites hieracifolia, Hibiscus moscheutos* (common in areas), *Juncus effusus, Leersia oryzoides, Lycopus* sp., *Lythrum salicaria, Panicum dichotomiflorum, P. scoparium, Pluchea odorata, Polygonum arifolium, P. punctatum, Rumex verticillatus*, and *Typha latifolia*. In some areas one finds scattered individuals of *Diospyros virginiana, Sassafras albidum, Sambucus canadensis, Baccharis halamifolia, Rhus copallina*, and *R. typhina*.

On the north side of this site near the intersection of Dutch Neck Rd and Canal RD occurs somewhat disturbed but diverse habitat; many dead *Phragmites* canes were observed indicating that this area may have been treated with herbicides. Towards the west (labelled B, Fig. 2) the marsh is composed of a ***Hibiscus moscheutos*** **Wetland Association** dominated by *Hibiscus moscheutos, Impatiens capensis*, and *Phragmites*. Less common species include *Aster subulatus, Erechtites hieracifolia, Leersia oryzoides* (locally abundant), *Lythrum salicaria, Peltandra virginica, Pluchea odorata, Polygonum arifolium, Rumex verticillatus*, and *Typha* spp., to name a few.

The area to the east (labelled C, Fig. 2) is a ***Panicum dichotomiflorum*** **Wetland Association** that grades, towards the road, to a shrub-thicket. This area (including Area B above) consists of relatively diverse shoreline. In addition to the panic grass, other species include *Bidens tripartita, Cyperus odoratus, Echinochloa walteri, Erechtites hieracifolia, Hibiscus moscheutos,*

Impatiens capensis, Juncus effusus, Lemna minor, Lycopus americanum, Pluchea odorata, Rumex maritima, R. verticillatus, Schoenoplectus tabernaemontani, Typha angustifolia, and *T. latifolia.*

Habitat Quality:

Relatively diverse, but apparently disturbed; *Phragmites* abundant in areas.

Species of Special Concern:

None observed at this site.

SITE 13

This area of the marsh (Fig. 2) consists of a diverse **Mixed Herbaceous Wetland.** Species in abundance at this site include *Amaranthus cannabinus, Bidens laevis, Cyperus* cf. *odoratus, Erechtites hieracifolia, Hibiscus moscheutos, Impatiens capensis, Lythrum salicaria, Panicum dichotomiflorum, Leptochloa fascicularis, Phragmites australis, Pluchea odorata, Rumex verticillatus*, and *Typha latifolia.* Less common species here include *Amorpha frutescens, Apios americana, Boehmeria cylindrica, Calystegia sepium, Euthamia tenuifolia, Onoclea sensibilis, Polygonum punctatum, Schoenoplectus tabernaemontani, Verbena hastata*, and *Zizania aquatica.*

Habitat Quality:

Moderately good quality.

Species of Special Concern:

There was only one rare species observed in this area of the marsh: *Leptochloa fascicularis* var. *maritima* (S1)

RARE PLANT SPECIES DISCOVERED AT 1000 ACRE MARSH

Only a brief discussion regarding the occurrence of each of the following rare species at 1000 Acre Marsh will be given. Likewise, only brief mention is made of the ecology/biology of the species.

Bidens coronata (L.) Britton, tick-seed sunflower, **S2**

B. coronata, a member of the Asteraceae (aster family) is an annual species of fresh to brackish tidal and non-tidal swamps, marshes, and river shores. The native, geographical range of *B. coronata* is from Massachusetts, southern Ontario, northern Wisconsin, eastern Minnesota, south to North Carolina, Kentucky and Nebraska. In Delaware, this species is found from the fall-line, south to Sussex County. *B. coronata* flowers in Delaware from August to October.

Within the 1000 Acre Marsh, *B. coronata* was infrequently observed at Site 4 and Site 5 (Fig. 5).

Leptochloa fascicularis (Lam.) Gray, sprangle-top, S1

L. fascicularis, a member of the Poaceae (grass family) is a tufted annual, that grows near the coast, from Massachusetts, south to Florida, in fresh, brackish or alkaline conditions. Habitat for *L. fascicularis* varies: wet to well drained soils, ponds, lake-beds, marshes, alluvial sands, peaty mucky shores, shallow water and cultivated and disturbed places. *L. fascicularis* is rather widespread throughout its native range, but here in Delaware, at this time, it appears to be rare to uncommon. Within the 1000 Acre Marsh, it is found growing abundantly at Site 2 and Site 13 (Fig. 5).

Limnobium spongia (Bosc.) Steudel., American frog-bit, S1

L. spongia, a member of the Hydrocharitaceae (frog-bit family) is a monotypic species, which is near the northern extent of its range in Delaware. Its overall distribution is from Florida, north to southern New Jersey. Habitat is described as shallow, freshwaters and marshy borders. Prior to *L. spongia's* 1993 rediscovery in the nearby Dragon Run Marsh, it had not been collected in Delaware since 1939. The Dragon Run Marsh and the 1000 Acre Marsh are the only known sites for *L. spongia* in Delaware today. This aquatic perennial is found rooted in the mud and has floating, emergent leaves; reproduction is sexual and asexual. In the 1000 Acre Marsh *L. spongia* is abundant at Site 4, infrequent at Site 5, frequent at Site 6, and frequent at Site 8 (Fig. 5).

Polygonum densiflorum Meissner, dense-flowered smartweed, S1

P. densiflorum, a member of the Polygonaceae (smartweed family) is a rhizomatous perennial of freshwater swamps, marshes and shallow water of the coastal plain, from New Jersey to Florida and Texas. In the 1000 Acre Marsh, *P. densiflorum* was found to be common at Site 4 (Fig. 5).

Sagittaria calycina Engelm. Mississippi arrow-head S2

S. calycina, a member of the Alismataceae (water plantain family) is an annual species, naturally distributed in the drainage of the Mississippi River, to Michigan and east to Delaware. *S. calycina* is found growing in fresh to brackish tidal marshes. In the 1000 Acre Marsh, *S. calycina* occurs at Site 1 (where a total of 8 plants were observed), and was found to be infrequent at Site 2 (Fig. 5).

ZOOLOGICAL INVENTORY

Limited zoological inventory work was undertaken at 1000 Acre Marsh during 1993 (from middle to late summer). Due to the brief and restricted nature of this inventory, it is difficult

to speculate to what extent this system provides crucial feeding or breeding habitat for many of the animal species present. Future zoological inventories should be aimed at determining the significance of 1000 Acre Marsh to breeding birds, migratory birds, invertebrates (dragonflies, *Lepidopteran* species, etc.) and fish. A list of animal species observed during this brief survey period can be found in Appendix II.

The most notable zoological occurrences at 1000 Acre Marsh were continuous use by wading waterbirds (herons, egrets). While none of these species were thought to have nested in this system, 1000 Acre Marsh does, apparently, provide important feeding areas for these species. Pea Patch Island, which lies approximately 2.5 miles northeast of 1000 Acre Marsh, is the largest multi-species heronry on the Atlantic coast north of Florida. Preliminary results from a study undertaken on Pea Patch Island in 1993 (Manomet Bird Observatory) to determine critical foraging areas for these species, indicates that 1000 Acre Marsh is providing important feeding habitat for this colony. In particular, 1000 Acre Marsh seems to experience high use by Snowy Egrets (*Egretta thula*) during the breeding season (generally April to July). In addition, Great Egrets (*Casmerodius albus*) and Great Blue Herons (*Ardea herodeas*) also use 1000 Acre Marsh on a regular basis. Higher numbers of Great Blue Herons were seen at 1000 Acre Marsh in August than in any other month. It is possible that Great Blue Herons increase their use of 1000 Acre Marsh during the post-nesting period as adults and juveniles disperse from Pea Patch Island and other regional heronries.

An additional noteworthy occurrence, was the continuous presence of the Federally endangered Bald Eagle (*Haliaeetus leucocephalus*). An adult and juvenile were observed at 1000 Acre Marsh repeatedly during the nesting season, indicating the apparent importance of this marsh as a primary feeding site for these birds. It is unclear where the adult was nesting, or even if this was a nesting eagle.

Several additional State rare or uncommon species were seen at 1000 Acre Marsh (Appendix II). The importance of this marsh to these species is unclear. Nevertheless, their occurrence indicates that they are indeed using this system to some degree. Many nonbreeding species were found using 1000 Acre Marsh during the migratory months, indicating the importance of the marsh for these migratory species. Many bird species will show strong site fidelity to migratory stopover areas. Therefore, the future management of 1000 Acre Marsh may play an important role for these species in Delaware.

Four separate locations were seined (Fig. 6) to assist in determining fish species compositions at 1000 Acre Marsh. The locations were chosen on the basis of accessibility to different portions of the marsh, and were thought to be representative of different habitat conditions. Results of seining activities:

SITE A	Number of fish
Common carp (*Cyprinus carpio*)	5

Mosquito fish (*Gambusia affinis*)	6	
Banded killifish (*Fundulus diaphanus*)	1	
Inland silverside (*Menidia beryllina*)	1	

SITE B

White perch (*Morone americana*)	19	(several different age classes)
Inland silverside (*Menidia beryllina*)	3	

SITE C

White perch (*Morone americana*)	3
Common carp (*Cyprinus carpio*)	1

SITE D

Common carp (*Cyprinus carpio*)	1
Mosquitofish (*Gambusia affinis*)	1
Pumpkinseed (*Lepomis gibbosus*)	1

MANAGEMENT RECOMMENDATIONS AND COMMENTS

Zoological Impacts

The quality of wildlife habitat management will dictate the future significance of this system to all animal species which may potentially breed at 1000 Acre Marsh or may utilize this wetland while migrating to wintering grounds farther south. The location of 1000 Acre Marsh along the Delaware River provides prime habitat for a multitude of avian species of concern, on both a local and regional scale. In addition, 1000 Acre Marsh provides important feeding habitat for a variety of resident breeding birds and non-breeding birds which pass through Delaware in spring and fall. This wetland system also hosts an array of additional vertebrate and invertebrate species. The future of 1000 Acre Marsh as a naturally functioning system may depend largely on the quality of the water (determined by the degree of seepage from surrounding land use and other sources of contamination, as well as pH levels and oxygen levels).

The proposed disturbance of subaqueous bottoms and the creation of islands within 1000 Acre Marsh, will initially have negative impacts to water quality (disturbance of sediment will likely release contaminant build-up and increase turbidity), however, long term benefits will outweigh short term costs. Channelization and island creation will improve water quality and foraging habitat, respectfully.

Reintroduction of tidal flushing at 1000 Acre Marsh, will also improve water quality. This will have a direct positive impact on submerged aquatic vegetation, which, in turn will improve aquatic vertebrate and invertebrate diversity and abundance. Improving the quality and quantity

of this natural preybase, will improve the value of 1000 Acre Marsh for the species which rely on this wetland system as a primary feeding site. Promoting native marsh plant species will provide longterm positive effects by increasing species diversity and abundance, and enhancing nesting and feeding substrate for avian species of concern.

Habitat alteration should be conducted during the non-breeding season (late August to April) in order to minimize disturbance to species which are dependent on this system for feeding and/or nesting.

Botanical Impacts

There is little, if any, literature regarding affects of various water-level management techniques that would be specific to the rare plant species identified in this marsh. Therefore the comments presented below are more genenal in nature, and in some instances are purely speculative.

Reintroduction of Tidal Flushing

As long as salinity levels remain low, and the substrate is not exposed for any lengthy duration, it is believed that tidal-flushing will have no deleterious effects on the rare plants found in this marsh system, and as mentioned above should improve water quality dramatically. However, monitoring should be in-place to ensure that high salinity and exposed substrates are not encountered.

Phragmites Spraying

It can be stated, unequivocally, that severe negative impacts will result to any herbaceous plant species (including the rare species) if they are inadvertently sprayed with a non-selective herbicide used in the control of *Phragmites australis*. Application of herbicides to treat *Phragmites* should be undertaken either on the ground, or in such a manner that will minimize drift to non-*Phragmites* areas.

Channelization

Since all of the rare species are located in the upper reaches of 1000 Acre Marsh, it is unlikely that channelization activities will impact individual populations, or plants. Nevertheless, care should be employed when accessing the marsh with heavy equipment and the locations of the rare plants should be noted prior to channelization work, and those areas should be avoided.

Dredging and Island Creation

There should not be any negative impacts to the existing flora by dredging and island creation operations, as long as the spoil material is deposited on top of bare soil rather than onto vegetation. If dewatering of the marsh is required to undertake this activity, the DNHI is concerned that this may have negative impact to several rare species (particularly *Limnobium* and

Sagittaria). Island creation should be undertaken either late or early in the year, when plants have died back or prior to new growth in the Spring.

Another concern of the DNHI is to what extent may these newly created islands be susceptible to *Phragmites* invasion? And what precautions are being taken to avoid an invasion of this noxious plant?

SUMMARY

Surveys undertaken in 1993 revealed the majority of 1000 Acre Marsh to be rather degraded. The degraded portion of the marsh is primarily a shallow, open water impoundment devoid of vegetation, with generally very low water quality and an over-abundance of algae. However, many areas of surprisingly high quality were discovered in the western portion of the marsh. These high quality, and usually diverse, herbaceous and scrub-shrub wetlands occur along the small finger-like embayments that extend westward. While scattered colonies of *Phragmites australis* were found in these areas, this noxious species was most abundant in the eastern half of 1000 Acre Marsh.

On the whole, biotic surveys were incomplete (compare total area surveyed versus unsurveyed on Fig. 2), and much additional inventory work is needed to fully assess status of rare species in the marsh. Animal data presented in this report are primarily cursory.

As discussed above (in the **MANAGEMENT RECOMMENDATIONS AND COMMENTS** section), as long as certain precautions are undertaken, marsh restoration activities should have minimal impacts on the various vegetation communities and rare species found in the western portions of the marsh. The primary concerns are that salinity levels remain low, that the substrate not be exposed for lengthy periods, that heavy equipment remain off the emergent and scrub-shrub communities, that disturbance activities not be undertaken from May through August, and that islands be created on top of bare substrate.

In order to ensure success with marsh restoration, the lack of an adequate buffer to the marsh needs to be addressed and remedied; in some areas agricultural land lies immediately adjacent to the wetland. Whenever possible, buffer should be added, either by plantings of trees and/or shrubs, or by allowing natural succession to take place. Combined with the marsh restoration activities, adequate buffers should reduce the nutrient-loads in the marsh and help to ensure long-term marsh quality.

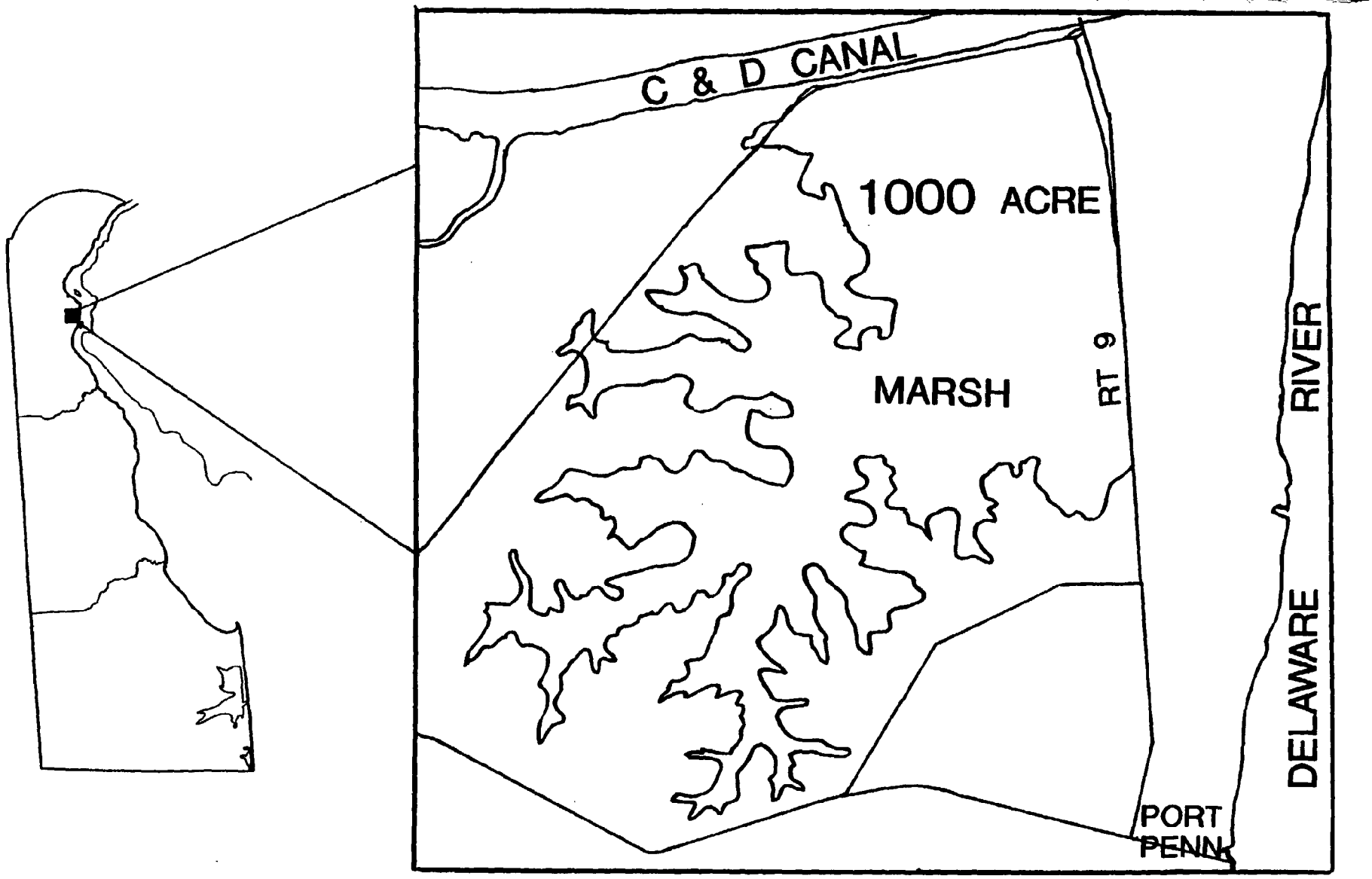

FIG. 1. LOCATION OF 1000 ACRE MARSH, NEW CASTLE COUNTY, DE.
Delaware City Quadrangle.

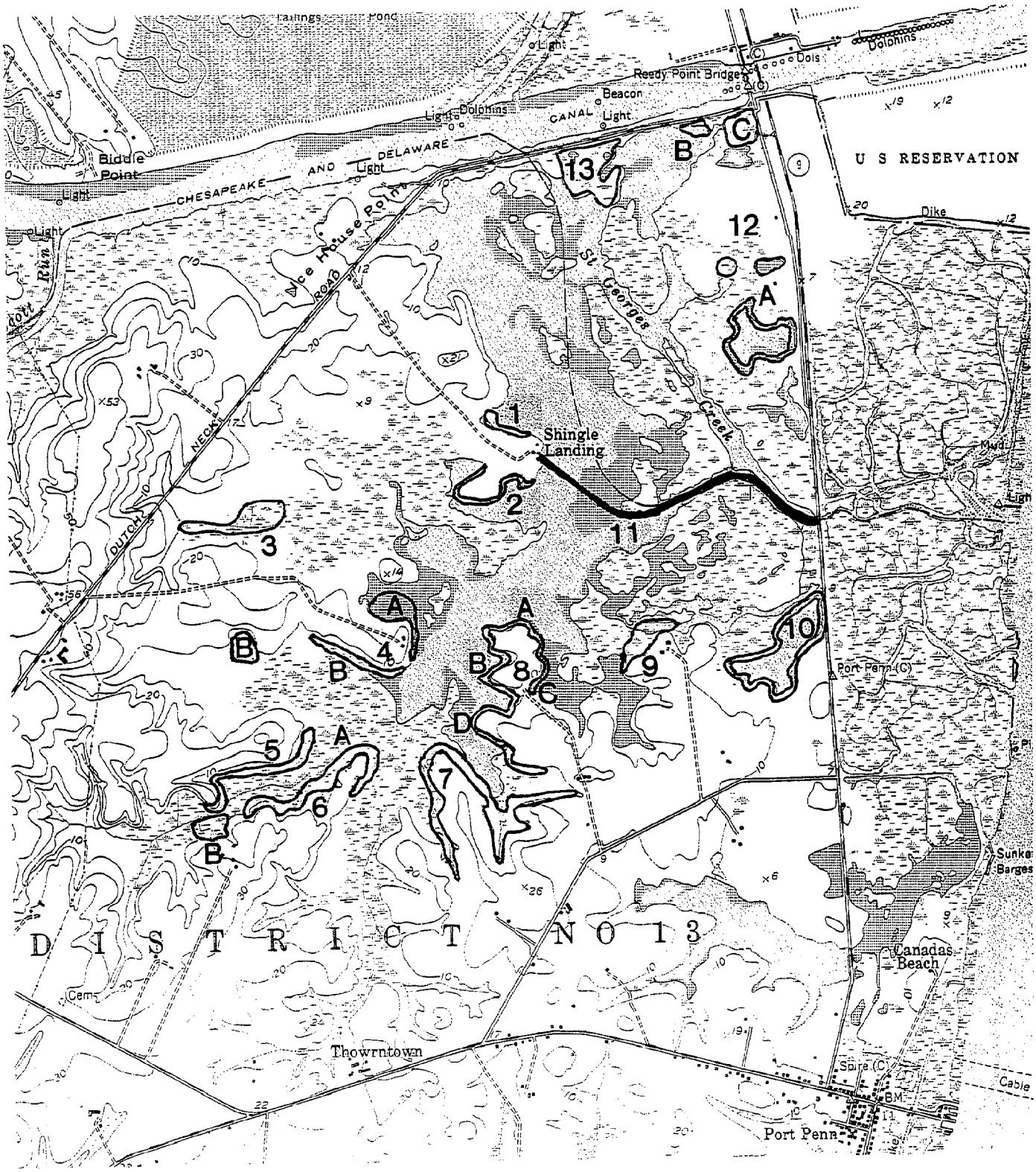

FIG. 2. 1000 ACRE MARSH SURVEY SITES (see text for details).

1000 Acre Marsh

LEGEND

- Mixed Herbaceous Wetland Associations
- Scrub-shrub Wetland Associations
- Hibiscus moscheutos Wetlands
- Phragmites australis-dominated Wetlands

N

This map is prepared primarily for internal DNREC resource management purposes. The information contained herein is preliminary and is subject to change or modification at any time. Use of this information by others is at their own risk and the DNREC in no way guarantees the accuracy of the information.

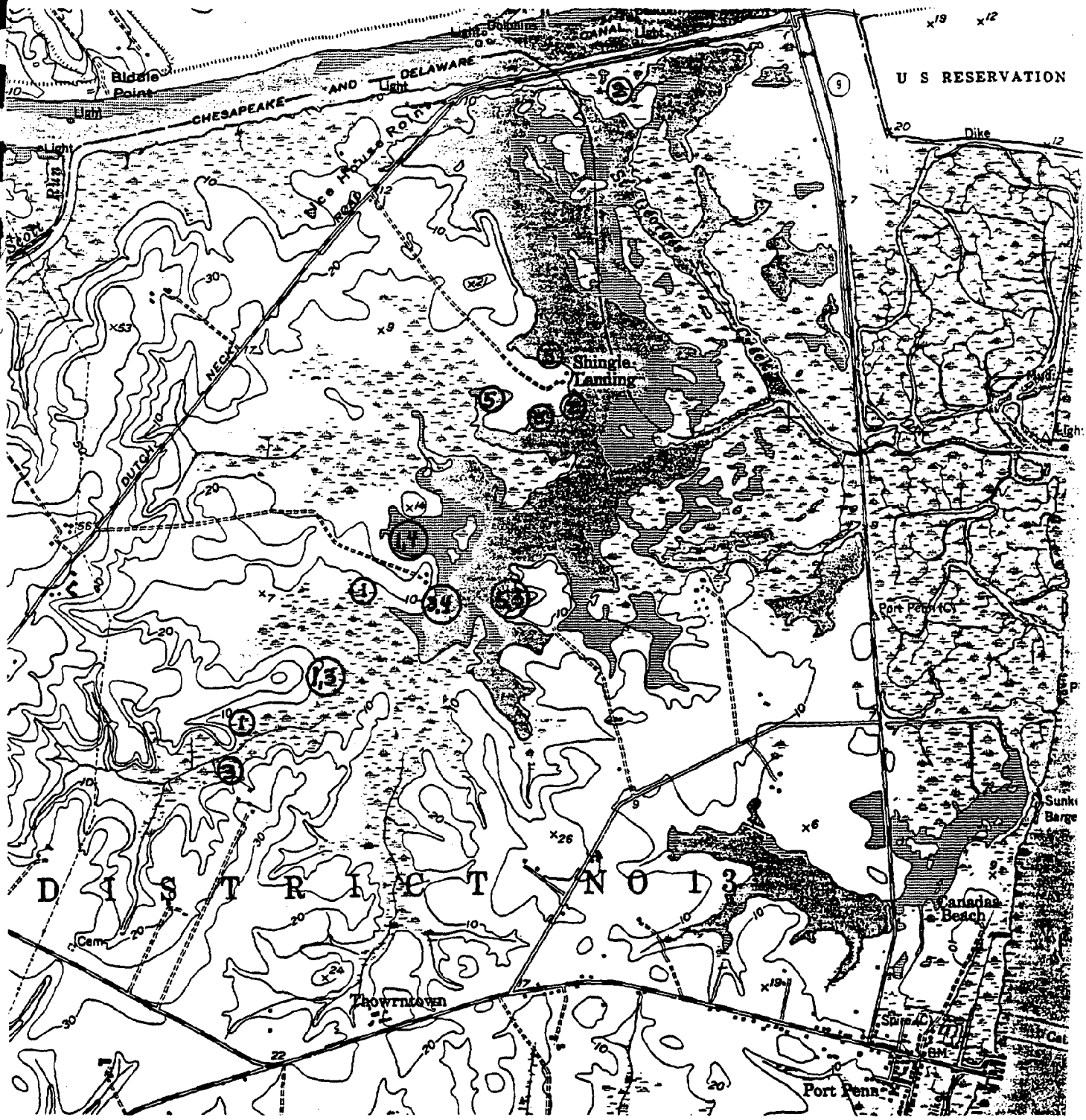

Fig. 5. Rare Plant locations at 1000 Acre Marsh (1, *Bidens coronata*; 2, *Leptochloa fascicularis*; 3, *Limnobium spongia*; 4, *Polygonum densiflorum*; 5, *Sagittaria calycina*).

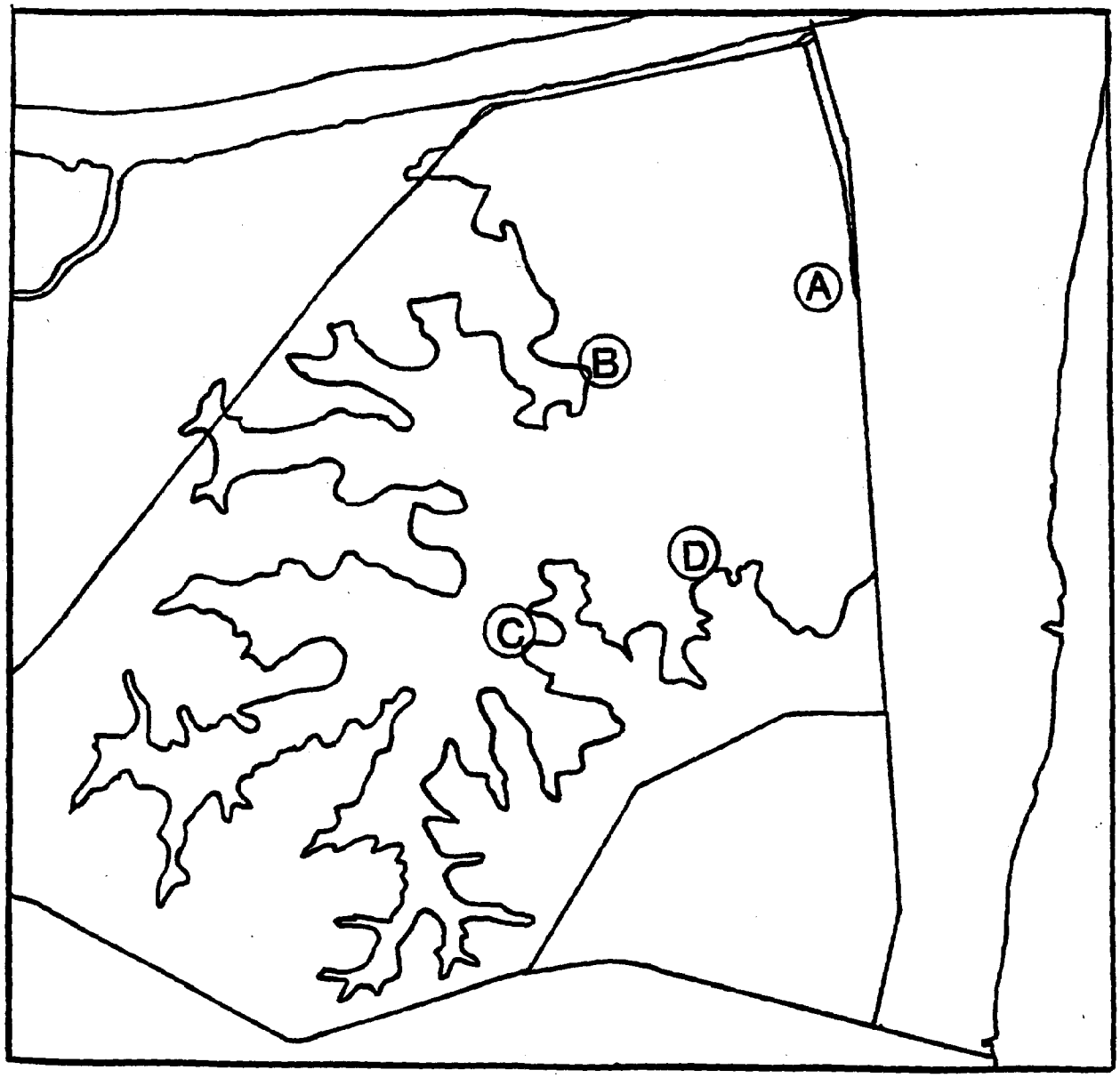

Fig. 6. Seining locations (A-D) at Thousand Acre Marsh.

APPENDIX I. A check list of vascular plant species observed at 1000 Acre Marsh during 1993 field surveys.

Acer rubrum		red maple
Acer negundo		box elder
Alnus serrulata		common alder
Amaranthus cannabinus		water hemp
Amorpha fruitcosa		false indigo (alien)
Apios americana		groundnut
Asclepias incarnata var. *pulchra*		swamp milkweed
Aster vimineus		small white aster
Aster sp.		aster
Atriplex patula		sea-orach
Baccharis halimifolia		groundsel bush
Bidens coronata	S2	crowned beggarticks
Bidens frondosa		beggarticks
Bidens laevis		smooth beggarticks
Boehmeria cylindrica		false nettle
Calystegia sepium		hedge bindweed (alien)
Carex alata		winged sedge
Carex crinita		perfect sedge
Carex comosa		bearded sedge
Carex lurida		yellow-green sedge
Carex scoparia		broom-like sedge
Carex stipata		crowded-head sedge
Carex stricta		tussock sedge
Cephalanthus occidentalis		buttonbush
Cicuta maculata		spotted cowbane
Clethra alnifolia		sweet-pepper bush
Commelina communis		Asiatic dayflower (alien)
Cornus amomum		red-willow dogwood
Cornus sp.		a dogwood
Cuscuta sp.		dodder
Cyperus erythrorhizos		red-root nut-sedge
Cyperus odoratus		fragrant nut-sedge
Cyperus strigosus		straw-colored nut-sedge
Decodon verticillatus		swamp willow
Diospyros virginiana		persimmon
Dulichium arundinaceum		three-way sedge
Echinochloa walteri		Walter's millet
Eclipta prostrata		Yerba-de-tajo (alien)

Eleocharis obtusa		obtuse spike-rush
Eleocharis palustris		marsh spike-rush
Eleocharis parvula		salt marsh spike-rush
Epilobium coloratum		purple-leaf willowherb
Erechtites hieracifolia		fire-weed
Eupatorium dubium		joe-pye-weed
Eupatorium hyssopifolium		hyssop leaf joe-pye-weed
Eupatorium maculatum		spotted joe-pye-weed
Eupatorium serotinum		late flowering joe-pye-weed
Euthamia graminifolia		slender fragrant goldenrod
Galium tinctorum		common madder
Hibiscus moscheutos		marsh mallow
Hydrocotyle ranunculoides		water penny
Hypericum mutilum		St. Johnswort
Ilex verticillata		winterberry
Impatiens capensis		jewel weed
Iris pseudacorus		yellow iris (alien)
Iris versicolor		blue-flag iris
Juncus canadensis		Canadian rush
Juncus effusus		smooth rush
Leersia oryzoides		rice-cut grass
Lemna minor		duckweed
Leptochloa fascicularis	S1	sprangle-top
Limnobium spongia	S1	American frog-bit
Lindera benzoin		spicebush
Lobelia cardinalis		cardinal flower
Ludwigia alternifolia		seedbox
Ludwigia palustris		water purslane
Ludwigia peploides		water primrose (alien)
Lycopus americanus		water horehound
Lycopus europaeus		gypsy weed (alien)
Lysimachia terrestris		swamp candle
Lythrum salicaria		purple loosestrife (alien)
Mentha spicata		spearmint (alien)
Microstegium vimineum		alien grass (alien)
Mikania scandens		climbing hemp-weed
Myrica cerifera		bayberry
Nuphar lutea		spatterdock
Nyssa sylvatica		black gum
Onoclea sensibilis		sensitive fern
Osmunda cinnamomea		cinnamon fern
Osmunda regalis		royal fern
Panicun cf. *boscii*		a panic grass
Panicum dichotomiflorum		fall panic grass

Panicum scoparium		velvet panic grass
Panicum virgatum		switch grass
Parthenocissus quinquefolia		Virginia creeper
Peltandra virginica		arrow arum
Phragmites australis		reed grass
Pluchea odorata		marsh fleabane
Polygonum arifolium		tearthumb
Polygonum cespitosum		long-bristled smartweed (alien)
Polygonum densiflorum	S1	smartweed
Polygonum hydropiperoides		mild water pepper
Polygonum lapathifolium		pale smartweed (alien)
Polygonum pennsylvanicum		Pennsylvania smartweed
Polygonum persicaria		spotted ladysthumb (alien)
Polygonum punctatum		water smartweed
Polygonum sagittatum		arrowleaf tearthumb
Polygonum sp.		smartweed
Pontederia cordata		pickerelweed
Rhus copallina		winged sumac
Rhus typhina		staghorn sumac
Rosa palustris		swamp rose
Rosa multiflora		multiflora rose (alien)
Rumex crispus		curled dock (alien)
Rumex maritimus		golden dock (alien)
Rumex verticillatus		swamp dock
Sagittaria calycina	S2	brackish arrowhead
Sagittaria latifolia		broad-leaf arrowhead
Salix nigra		black willow
Sambucus canadensis		elderberry
Sassafras albidum		sassafras
Schoenoplectus pungens		three square
Schoenoplectus robustus		saltmarsh sedge
Schoenoplectus tabernaemontanii		bulrush (alien)
Scirpus cyperinus		woolgrass sedge
Scutellaria lateriflora		mad-dog skullcap
Setaria glauca		yellow fox-tail (alien)
Setaria magna		giant fox-tail
Setaria viridis		green fox-tail
Sium suave		water parsnip
Solidago rugosa		rugose goldenrod
Solidago sempervirens		sea-beach goldenrod
Sparganium sp.		burreed
Spirodela polyrhiza		duckweed
Symplocarpus foetidus		skunk cabbage
Thelypteris palustris		marsh fern

Toxicodendron radicans	poison-ivy
Triadenum virginicum	marsh St. Johnswort
Typha angustifolia	narrow-leaf cattail (alien)
Typha latifolia	broad-leaf cattail
Typha x *glauca*	hybrid cattail
Vernonia noveboracensis	New York ironweed
Verbena hastata	wild vervain
Viburnum dentatum var. *lucidum*	southern arrowood
Viburnum nudum	naked witherrod
Wolffia brasiliensis	duckweed
Woodwardia areolata	netted chain fern
Zizania aquatica	wild rice

138 species (including 2 varieties; 1 hybrid; 19 aliens)

APPENDIX II. Animal species observed at 1000 Acre Marsh during 1993 field surveys.

Birds

Little Blue Heron	**S2B**	*Egretta caerulea*
Great Blue Heron	**S2B**	*Ardea herodeas*
Black-crowned Night Heron	**S2B**	*Butorides striatus*)
Great Egret	**S2B**	*Casmerodius albus*
Snowy Egret	**S1B**	*Egretta thula*
Cattle Egret	**S2B**	*Bulbulcus ibis*
Glossy Ibis	**S2B**	*Plegadis falcinellas*
Canada Goose	**S3B, S5N**	*Branta canadensis*
Wood Duck	**S4B**	*Aix sponsa*
Green-winged Teal	**S4B**	*Anas crecca*
American Black Duck	**S4B**	*Anas rubripes*
Mallard	**S5B**	*Anas platyrhynchos*
Northern Pintail	**S4N**	*Anas acuta*
Gadwall	**S3N**	*Anas sterepera*
American Coot	**S2B, S3N**	*Fulica americana*
American Widgeon	**S3N**	*Anas americana*
Common Merganser	**S3N**	*Mergus merganser*
Laughing Gull	**S3B, S4N**	*Larus atricilla*
Great Black-backed Gull	**S1B, S5N**	*Larus marinus*
Lesser Yellowlegs	**S3N**	*Tringa flavipes*
Common Tern	**S1B, S3N**	*Sterna hirundo*
Black Tern	**S3N**	*Chlidonias niger*
Caspian Tern	**S3N**	*Sterna caspia*
Osprey	**S4B**	*Pandion haleatus*
Bald Eagle	**S1B**	*Haliaeetus leucocephalus*
Northern Harrier	**S1B, S3N**	*Circus cyaneus*
Sharp-shinned Hawk	**S3N**	*Accipiter striatus*
Red-tailed Hawk	**S5B**	*Buteo Jamaiccensis*
Red-bellied Woodpecker	**S5**	*Melanerpes carolinus*
Downy Woodpecker	**S5**	*Picoides pubescens*
Northern Flicker	**S5**	*Colaptes auratus*
Tree Swallow	**S4B**	*Tachycineta bicolor*
Eastern Kingbird	**S5B**	*Tyrannus tyrannus*
Blue Jay	**S5**	*Cyanocitta cristata*
American Crow	**S5**	*Corvus brachyrhynchos*
Marsh Wren	**S4B**	*Cistothorus palustris*
White-eyed vireo	**S5B**	*Vireo griseus*
Common Yellowthroat	**S5B**	*Geothlypis trichas*
Yellow-breasted Chat	**S5B**	*Icteria virens*

Northern Cardinal	S5	*Cardinalis cardinalis*
Blue Grosbeak	S5B	*Guiraca caerulea*
Indigo Bunting	S5B	*Passerina cyanea*
Eastern Meadowlark	S4	*Sturnella magna*
Common Grackle	S5	*Quiscalus quiscula*
American Goldfinch	S5	*Carduelis tristis*
Double-crested Cormorant	S4	*Phalacrocorax auritus*
Great-crested Flycatcher	S5B	*Myiarchus crinitus*
Belted Kingfisher	S4B, S3N	*Ceryle alcyon*
Fish		
Common carp	SE	*Cyprinus carpio*
Mosquitofish	S4	*Gambusia affinis*
Banded killifish	S4	*Fundulus diaphanus*
Inland silverside	S4	*Menidia beryllina*
White perch	S5	*Morone americana*
Pumpkinseed	S5	*Lepomis gibbosus*
Mummichog	S5	*Fundulus heteroclitus*
Channel catfish	S5	*Ictalurus punctatus*
Brown bullhead	S5	*Ictalurus nebulosus*
Reptiles and amphibians		
Green tree-frog	S3	*Hyla cinerea*
Spring Peeper	S5	*Hyla crucifer*
Bullfrog	S5	*Rana catesbeiana*
Southern leopard frog	S5	*Rana spenocephala*
Snapping turtle	S5	*Chelydra serpentina*
Redbelly turtle	S5	*Chrysemys rubriventris*
Mammals		
Virginia opposum	S5	*Didelphis virginiana*
Raccoon	S5	*Procyon lotor*
Eastern gray squirrel	S5	*Sciurus carolinensus*
White-tail deer	S5	*Odocoileus virginianus*
Dragonflies		
Erythrodiplax berenice	S5	
Pachydiplax longipennis	S5	