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The Marshes of Back Bay, Virginia

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Abstract: An inventory was undertaken to determine the type and extent of the emergent tidal wetlands in Back Bay, which, historically, has ranged from a lunar tidal brackish estuary to a wind tidal freshwater system. The inventory was conducted primarily by boat with visual observations made for each marsh. The configuration and areal extent of each marsh was determined from USGS topographic maps and confirmed with aerial photography where necessary. Approximately 9925 acres of wetlands as defined by the Commonwealth of Virginia were identified within the watershed. These wetlands supported a very diverse flora consisting of over 109 species.

The five dominant species accounted for almost 75% of the wetland acreage. They included: cattails, *Typha* spp., (4004 acres), needlerush, *Juncus roemerianus*, (2371 acres), big cordgrass, *Spartina cynosuroides*, (605 acres), saltmeadow hay, *Spartina patens*, (449 acres) and switchgrass *Panicum virgatum*, (427 acres). The remainder of the species represented a diverse mixture of brackish plants with a significant component of freshwater species.

The emergent tidal wetlands are dominated by plants typically indicative of brackish conditions even though the system now tends toward freshwater conditions under normal circumstances. These brackish species are probably relicts from when Back Bay was directly influenced by the salinity and tides afforded by inlets to the ocean. The brackish communities because of their continued dominance appear to be more adaptable to the periods of freshwater than the freshwater species are to periods of brackish conditions. These historical oscillations between brackish and fresh conditions are probably responsible for much of the plant diversity found. These plant communities are not static either, as evidenced by changes in the coverage of common reed, *Phragmites australis*, which has increased substantially between this inventory done in 1977 and recent (1990) observations.

Introduction

Back Bay has long been a significant aquatic resource in southeastern Virginia. Its vast expanses of emergent wetlands, beds of submerged aquatic vegetation and open water have provided excellent habitat for finfish, shellfish, waterfowl and furbearers. Despite their contribution to the resource value of Back Bay, the emergent tidal wetlands have received comparatively little scientific attention. Among the early works are a number of papers on the phytogeograghy of the plants of the region, including wetland species, which are summarized in Fernald (1940). He found the Back Bay region to be unique in that it represents the northern range limit for many southern plants and the southern limit for a number of northern species.

During the Back Bay-Currituck Sound Cooperative Study (Sincock et al., 1965), a generalized cover map of the Back Bay wetlands was prepared from aerial reconnaissance and photograph interpretation. The dominant species reported included: needlerush, *Juncus roemerianus*, big cordgrass, *Spartina cynosuroides*, cattails, *Typha* spp., wax myrtle, *Myrica* spp., saltgrass, *Distichlis spicata* and a heterogeneous marsh of mixed cattail, *Typha* spp., three-squares, *Scirpus* spp., spikerushes, *Eleocharis* spp., marsh hibiscus, *Hibiscus moscheutos* and smartweeds, *Polygonum* spp.

Sincock et al. (1965) also noted a community succession following disturbance by fire or grazing by geese. Initial dominants were *Cyperus* spp., spikerush, *Eleocharis palustris* and smartweeds, *Polygonum* spp. and were followed by three-squares, *Scirpus olneyi, S. americanus, S. robustus* and *S. validus*. The climax dominants were reported to be cattails, *Typha* spp. and marsh hibiscus, *Hibiscus moscheutos*.

A review of the wetland vegetation in Back Bay and Currituck Sound by Silberhorn (1977) indicated similar community compositions. He also noted as important aspects of plant community succession, the role of oceanic overwashes, changes in salinity and the effects of man.

According to Roy Mann Associates (1984) approximately 22% of the Back Bay watershed was wetlands. Emergent wetland vegetation comprised 11,351 acres or 17% of the watershed. Lowland forest with 2,357 acres and scrub/shrub wetlands with 749 acres made up 4% and

1%, respectively, of the watershed. Much of the emergent vegetation was characterized by relatively homogeneous stands of cattails, *Typha* spp., and needlerush, *Juncus roemerianus*.

The purpose of this inventory was to document the type and areal extent of the tidal wetlands found in Back Bay as defined by the Virginia Wetlands Act. The vegetated wetlands of Back Bay and its tributaries are defined by the Code of Virginia (Chapter 2.1, Section 62.1-13.2(f)) to include:

> "...all marshes subject to flooding by tides including wind tides, provided this shall not include hurricane or tropical storm tides, and upon which one or more of the following vegetation species are growing..." (25 species are listed in the Wetlands Act).

Physical Setting

Back Bay is a barrier spit lagoon isolated from the Atlantic Ocean by Sandbridge and False Cape (Fig. 1). Geologically, the bay and its watershed are part of the sand-ridge and mud-flat complex that consists of a number of roughly parallel sand ridges with intervening areas that were low lying mud flats (Oaks and Coch, 1973). The ridges from west to east include: Pungo Ridge, Dawley Corners Ridge, Charity Neck Ridge and Knotts Island Ridge (Fig. 2). Portions of the Knotts Island Ridge appear as the upland portions of Little Cedar, Cedar, Ragged and Long islands. Much of the emergent wetlands surveyed in this inventory have apparently developed on the lower elevation lagoonal deposits in between these old beach ridges.

The closest direct link of Back Bay to the Atlantic Ocean is now Oregon Inlet, NC, aproximately 60 miles to the south. Historically, though, there have been several inlets along the barrier spit that provided more direct access to the ocean and lunar tides (Fig. 1). Remnants of the flood tide deltas formed by these old inlets are evident in a number of locations along the barrier spit, particularly the Big Bull Island, Horse Island, Deal Creek complex along the North Carolina line. This was the location of the Old Currituck Inlet, which opened around 1650 and closed around 1729 (Hennigar, 1977). Back Bay also received periodic influxes of seawater during washovers prior to the stablization and enhancement of the sand dunes along the barrier spit during the 1930s. Since then overwashes have become more infrequent. The last major overwash occurred in 1962 during the Ash Wednesday storm.

The only other major source of salinity in Back Bay was the Albemarle and Chesapeake Canal that connected the Elizabeth River to the North Landing River. Locks were originally installed on the canal but were left open from 1918 to 1932. During this time the average salinity in lower Back Bay ranged from 2.2 to 2.7 parts per thousand (ppt) (Bourn, 1929).

Seawater began to be pumped from the ocean into Back Bay in 1965 in an effort to improve water quality by helping precipitate suspended silts and clays. It continued until 1974; during which time the salinity was generally less than 3.5 ppt (Norman and Southwick, 1978). Pumping was resumed in 1979 and was formally discontinued in 1986. Salinity during this period was generally greater than 3.5 ppt (Norman and Southwick, 1987). During the hiatus between pumpings from 1974-1979 the salinity in Back Bay was generally less than 1 ppt (Norman and Southwick, 1987). This inventory was conducted in 1977 during the period of freshwater conditions. Since the cessation of pumping the salinity of Back Bay has returned to approximately 1 ppt (Southwick, personal communication).

The existing situation, with the closest oceanic inlet being very remote, virtually eliminates any influence of astronomical tides on water levels in Back Bay (Roy Mann Assoc., 1984). Water level fluctuations are primarily attributable to wind tides. High water levels with a low average tide range usually occur during summer months with the predominantly south and southwest winds. During winter, water levels are generally low with a high average range because of the dominant northerly winds (Roy Mann Associates, 1984). The average water level at the Back Bay National Wildlife Refuge is 1.0 feet above mean sea level (MSL) with a maximum range in tides from -2.0 feet to 3.0 feet MSL during the period 1977 to 1983 (Roy Mann Associates, 1984).

Methods

Wetland locations and wetland boundaries were obtained by consulting USGS topographic maps and aerial photographs. The configuration and areal extent of each marsh was confirmed by observations by boat, on foot or by low level overflights. Individual plant species percentages are quantitative estimates of coverage based on visual inspections of every marsh. The field work was performed during the months of August, September and October, 1977.

In the inventory (Priest and Dewing, 1989), the outline of each marsh as depicted on the topographic map was planimetered to determine its acreage. Marshes 0.25 acres or larger are designated by number. The acreage, plant species percentage and respective acreage, marsh type and other observations are recorded in tabular form for each of these marshes. These tables are not being included in this report; so therefore these marsh numbers have been deleted from the

maps in this report for the sake of clarity. Marshes less than 0.25 acres (usually narrow fringing marshes and very small pocket marshes) are indicated by the same shaded symbol as the numbered marshes but are not included in the tabulations for the total acreage.

Areas surveyed included all emergent herbaceous vegetation including adjacent scrub, shrub communities where appropriate. This inventory generally does not include areas of swamp forest because of the difficulty in determining whether these areas met the requirement for periodic inundation contained within the Wetlands Act. This determination is made when necessary on a case-by-case basis when jurisdiction is in question on a particular project. Given the appropriate elevation and vegetation, which are present in many instances, many of these swamp forests would be covered under the Wetlands Act, greatly increasing the acreage of tidal wetlands in Back Bay.

Results

The 1977 inventory identified 9925 acres of emergent tidal wetlands as defined by the State of Virginia. These wetlands supported over 109 species of wetlands plants (Table 1). The dominant species were cattails with 4004 acres (40.3%) and needlerush with 2371 acres (23.9%). The balance of the tidal wetlands was vegetated by a variety of other species (Table 2). The marshes inventoried were divided into five sections along institutional boundaries where possible (Fig. 3).

The wetlands in Section I are contained within False Cape State Park and The Barbours Hill Wildlife Management Area (WMA) (Figs. 4 and 5). They were dominated by black needlerush (492 acres) and cattails (324 acres) with a total area of 1188 acres.

The majority of the wetlands in this section are large marshes that have developed on the landward side of the barrier spit. The marshes in the southern portion of this section have developed on the relicts of the flood tide delta of the Old Currituck Inlet. The remainder have developed as broad fringing marshes on old overwash and inlet features.

Included within this section are 129 acres of impoundments on Barbours Hill WMA, which are managed for moist soil emergent vegetation during spring and summer and flooded during fall and winter for migratory waterfowl.

Section II includes those wetlands included within the boundaries of the Back Bay National Wildlife Refuge (Figs. 6, 7, 8 and 9). They include approximately 3000 acres of marsh that extends from the barrier spit below Sandbridge across Back Bay to the mainland. These wetlands are dominated by cattails, 988 acres; and black needlerush, 699 acres; with large areas of big cordgrass (213 acres) and saltmeadow grasses (241 acres).

Along the barrier spit are approximately 512 acres of moist soil impoundments that have been developed on the old overwash flats. They are drained in spring to encourage emergent vegetation and flooded in fall to provide enhanced wintering habitat for migratory waterfowl. Along the shoreline adjacent to the impoundments are a number of broad fringing marshes that have developed around the extremities of these old overwashes.

The majority of the rest of the marshes in this section, the Long Island and Ragged Island complexes, have developed on a geological formation known as the Sandridge-mudflat complex. It is composed of a series of relict beach ridges interspaced with lower lagoonal or mudflat deposits that formed during recent oscillations in sea level. The upland portion of Long Island as well as Cedar and Little Cedar Islands in Section I are part of the Knotts Island Ridge that once extended up to the vicinity of Sandbridge. In many instances these lagoonal deposits were comparatively low in elevation and supported very diverse wetland floras.

Populations of *Lilaeopsis carolinensis*, a plant species ranked as extremely rare in the state and recommended for threatened status, were observed in several marshes in this section (Virginia Natural Heritage Program, 1990).

Section III extends from the Back Bay National Wildlife Refuge north to roughly the head of the Back Bay watershed (Figs. 10, 11 and 12). It includes the marshes along the developed portion of the barrier spit, the large embayed marshes of North Bay and the more isolated wetlands of the headwaters. There are almost 1500 acres of marsh in this section that are, again, dominated by cattails, 545 acres, and black needlerush, 249 acres. Smartweeds (119 acres), spikerush (97 acres) and big cordgrass (90 acres) also contribute significant areas to the acreage.

The wetlands along the bayside of Sandbridge have been severely impacted and diminished by extensive dredging and filling for the canal developments. North and west of Sandbridge are several somewhat isolated wetlands and water bodies including Black Gut, Lake Tecumseh, Redwing Lake and Lovetts Marsh. They are relicts of the Sandridge-mudflat complex and are hydrologically connected to Back Bay through a complex system of drainage ditches and the channelized Hell Point Creek.

The western shore marshes of Section IV are composed of the extensive marshes of the western bayshore as well as those of the major tributary streams, Asheville Bridge/Muddy Creek, Beggars Bridge Creek and Nawney Creek (Figs. 13, 14, 15 and 16). There are approximately

2848 acres of marsh in this section dominated by cattails, 1420 acres, and black needlerush, 793 acres, with substantial areas of big cordgrass (148 acres) and Olney threesquare (106 acres). Many of these marshes are floristically complex, supporting as many as 28 different species in a relatively small area of habitat.

The marshes of the Trojan Waterfowl Management Area maintained by the Virginia Department of Game and Inland Fisheries are included in this section.

The final section, Section V, includes marshes from several different areas (Figs. 17 and 18). The first part contains the last 166 acres of the western bayshore marshes; portions of which have been impacted by dredging and filling in the past. Typically, these marshes are dominated by cattails, black needlerush and big cordgrass.

Offshore is the Pocahontas Waterfowl Area, which is managed as a public waterfowl hunting area by the Virginia Department of Game and Inland Fisheries. It consists of a number of marsh islands totalling over 500 acres. The vegetation is dominated by cattails and switchgrass.

Immediately adjacent to the Pocahontas Waterfowl Area is the Virginia portion of the Mackay Island National Wildlife Refuge. The majority of the Refuge is located across the border in North Carolina. The Virginia portion consists of a number of marsh islands, some supporting stands of trees, and a large section of marsh west of Knotts Island. The area encompassed 724 acres of predominately cattail and black needlerush with a large number of associated species.

The total marsh area for this section is approximately 1442 acres. Cattails, 727 acres, and switchgrass, 345 acres, dominated the cover with sizeable complements of black needlerush (137 acres) and big cordgrass (85 acres).

Discussion

Since no methodology was provided by Roy Mann Associates (1984), a comparison of the 11,351 acres of emergent wetlands found by that study and the 9925 acres for this inventory is not possible. The difference, however, is probably attributable to differences in wetlands definitions and interpretations. This may be particularly true with respect to some transitional areas between the scrub/shrub and swamp communities, which were not included because of the difficulty in determining whether the periodic inundation criterion of the Wetlands Act was being met. In those instances where both the vegetation requirement and inundation periodicity were met these areas would be wetlands and increase the area of tidal wetlands present in Back Bay. In general, the inventory represents a reasonably conservative interpretation of wetlands, identifying only those clearly meeting the definition in the Wetlands Act.

The USGS topograghic maps used as the base maps for this inventory were prepared in the early 1950s and photo revised in 1970 and 1971. As a consequence, there are a number of physiograghic and cultural changes that have occurred, e. g. considerable shoreline erosion has occurred in many places reducing the existing areas of wetlands including several small marsh islands that have completely eroded away. Additionally, several areas have been filled by dredge and fill operations, further reducing existing wetland acreage.

Species percent cover estimates can be subject to a seasonal bias depending on what time of year the estimates are made. In brackish water marshes if the observations are made in spring many of the late developing annuals, e.g. water hemp, saltmarsh aster, marsh fleabane and orach, are not visible among the earlier developing grasses. In freshwater marshes, spring and early summer dominants, arrow arum, pickerelweed and cattails are often replaced by other dominants like beggars ticks and rice cutgrass during late summer and early fall. Back Bay was particularly well suited to the late summer and early fall time of this inventory because there was a relatively small amount of the early developing freshwater species and there was a sufficient amount of the early grasses remaining to obtain accurate estimates of their cover. There was also a large number of late developing species that were included in this inventory that would have been missed if it had been done during spring and early summer.

The dominant species in the emergent wetlands of Back Bay, cattail, *Typha angustifolia*, needlerush, *Juncus roemerianus*, and big cordgrass, *Spartina cynosuroides* are typically found in brackish marshes (Beal, 1977). These species are probably relicts from when Back Bay was directly influenced by the salinity and tides afforded by inlets to the ocean. The clear dominance of plants typically adapted to brackish conditions appears to indicate they are more suited to the varying salinity regimes of Back Bay than those more typical strictly freshwater systems. An example of this is the disappearance of the American lotus, *Nelumbo lutea*, from the Asheville Bridge Creek/ Muddy Creek complex soon after the resumption of seawater pumping.

Another major change in the vegetation of the wetlands of Back Bay is a continuing one involving the dramatic spread of the common reed, *Phragmites australis*. During the period of the inventory the estimated percent cover of this species was 0.9 percent. Observations made during low level overflights in 1990 would indicate a rough estimate of average percent cover

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Another major change in the vegetation of the wetlands of Back Bay is a continuing one involving the dramatic spread of the common reed, *Phragmites australis*. During the period of the inventory the estimated percent cover of this species was 0.9 percent. Observations made during low level overflights in 1990 would indicate a rough estimate of average percent cover

at up to 10 percent. The reasons for this spread are not clear. One plausible explanation would be that the large scale dredging and filling projects that occurred during the 1960s and early 1970s provided a sufficient disturbance of the natural flora that common reed had the opportunity to become firmly established. It has since been able to continue spreading by virtue of its aggressive growth habits that allow it to outcompete the native flora.

Summary

An inventory of the tidal wetlands of Back Bay in Virginia Beach, Virginia found a total of 9925 acres that support over 109 species of wetlands vegetation.

The inventory was influenced by two factors that affected the acreage estimates. Some areas were probably underestimated because of the uncertainty of whether the inundation criteria required by the state was being met. Other areas were overestimated because the topographic maps used as the base maps did not accurately reflect changes in marsh areas resulting from shoreline erosion.

The dominant species were typically representative of brackish water conditions. However, there were a large number of freshwater species that were present in smaller numbers.

The inventory was conducted during a period of freshwater dominance in the system that was sandwiched between two periods of brackish conditions occasioned by the pumping of seawater from the Atlantic Ocean.

The common reed, on recent observations appears to be spreading dramatically, increasing its cover from approximately 1 percent to 5-10 percent.

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Table 1. Marsh Plants (common names and scientific names as found in the data tables of this report).

American Lotus	*Nelumbo lutea* (Willd.) Persoon
Ammannia	*Ammannia teres* Raf.
Arrow Arum	*Peltandra virginica* (L.) Kunth
Arrow Grass	*Triglochin striata* R.& P.
Arrowhead	*Sagittaria latifolia* Willd.
Bald Cypress	*Taxodium distichum* (L.) Rich
Beak-Rush	*Rhynchospora* spp.
Bedstraw	*Galium tinctorium* L.
Beggar's Ticks*	*Bidens coronata* (L.) Britten
Big Cordgrass*	*Spartina cynosuroides* (L.) Roth
Black Willow	*Salix nigra* Marshall
Blue Flag	*Iris virginica* L.
Boneset	*Eupatorium perfoliatum* L.
	Eupatorium serotinum Michaux
Bur-Head	*Echinodorus cordifolius* L. Grisebach
Buttercup	*Ranunculus* Spp.
Button Bush	*Cephalanthus occidentalis* L.
Cane	*Arundinaria gigantea* (Walter) Muhl
Cardinal Flower	*Lobelia cardinalis* L.
Cattails*	*Typha angustifolia* L.
	Typha latifolia L.
Climbing Hempweed	*Mikania scandens* (L.) Willd.
Common Reed	*Phragmites australis* (Cav.) Trin. ex Steud.
Common Threesquare*	*Scirpus americanus* Pers.
Dayflower	*Commelina virginica* L.
Dodder	*Cuscuta* sp.
Duckweed	*Lemna* sp.
Dune Bean	*Strophyostyles helvola* (L.) Ell.
Eclipta	*Eclipta alba* (L.) Hasskarl
Eryngo	*Eryngium aquaticum* L.
False Loosestrife	*Ludwigia decurrens* Walter
False Nettle	*Boehmeria cylindrica* (L.) Swartz
Fireweed	*Erechtites hieracifolia* (L.) Raf.
Foxtail Grass	*Setaria magna* Grisebach
	Setaria glauca (L.) Beauvois
	Setaria geniculata (Lam.) Beauvois
Frogfruit	*Lippia lanceolata* Michx.
Germander	*Teucrium canadense* L.
Groundsel Tree*	*Baccharis halimifolia* L.
Jewelweed	*Impatiens capensis* Meerb
Lilaeopsis	*Lilaeopsis carolinensis* C.&.R.
	Lilaeopsis chinensis (L.) Knutze
Live Oak	*Quercus virginiana* Miller
Lizard's-tail	*Saururus cernuus* L.
Lobelia	*Lobelia elongata* Small
Marsh Elder*	*Iva frutescens* L.
Marsh Fern	*Thelypteris palustris* Schott
Marsh Fimbristylis	*Fimbristylis spadicea* (L.) Vahl
Marsh Fleabane	*Pluchea purpurascens* (Swartz) DC
Marsh Hibiscus*	*Hibiscus moscheutos* L.
Marsh Mallow	*Kosteletskya virginica* Presl.
Marsh Pink	*Sabatia stellaris* Pursh
Meadow-Beauty	*Rhexia virginica* L.
Mermaid-Weed	*Proserpinaca palustris* L.
Mock Bishop's-Weed	*Ptilimnium capillaceum* (Michaux) Raf.
Mud Plantain	*Heteranthera reniformis* R.&P.
Needle Rush*	*Juncus roemerianus* Scheele
Nodding Ladies' Tresses	*Spiranthes cernua* (L.) Richard
Nut Sedge	*Cyperus* spp.
Olney Threesquare*	*Scirpus olneyi* Gray
Panic Grass	*Panicum dichotomiflorum* Michaux
Partridge Pea	*Cassia fasciculata* Michaux
Pennywort	*Hydrocotyle umbellata* L.
	Hydrocotyle verticillata Thunberg

Pickerelweed*	*Pontederia cordata* L.
Plumegrass	*Erianthus giganteus* (Walter) Muhl.
Red Maple	*Acer rubrum* L.
Rice Cutgrass*	*Leersia oryzoides* (L.) Sw.
Royal Fern*	*Osmunda regalis* L.
Rushes	*Juncus acuminatus* Michaux
	Juncus effusus L.
	Juncus scirpoides Lmn.
	Juncus spp.
Sacciolepis	*Sacciolepis striata* (L.) Nash
Saltmarsh Aster	*Aster subulatus* Michaux
	Aster tenuifolius L.
Saltmarsh Bulrush	*Scirpus robustus* Pursh
Saltmarsh Cordgrass*	*Spartina alterniflora* Loisel.
Saltmarsh Loosestrife	*Lythrum lineare* L.
Salt Meadow Hay*	*Spartina patens* (Aiton) Muhl.
Saltwort	*Salicornia* sp.
Seaside Goldenrod	*Solidago sempervirens* L.
Sedge	*Carex* spp.
Smartweed*	*Polygonum punctatum* Ell.
Soft Stem Bulrush	*Scirpus validus* Vahl.
Spikerush*	*Eleocharis fallax* Weatherby
	Eleocharis parvula (R.+S.) Link
Sprangletop	*Leptochloa fasicularis* (Lam.) Gray
Swamp Loosestrife	*Decodon verticillatus* (L.) Ell.
Swamp Milkweed	*Asclepias incarnata* L.
Swamp Rose	*Rosa palustris* Marshall
Sweet Flag	*Acorus calamus* L.
Sweet Gum	*Liquidambar styraciflua* L.
Switch Grass*	*Panicum virgatum* L.
Tearthumb	*Polygonom arifoliuim* L.
	Polygonum sagittatum L.
Water Dock*	*Rumex verticillatus* L.
Water Fern	*Azolla caroliniana* Wind.
Water Hemlock	*Cicuta maculata* L.
Water Hemp*	*Amaranthus cannabinus* (L.) J.D. Sauer
Water Horehound	*Lycopus virginicus* L.
Water Hyssop	*Bacopa caroliniana* (Walt.) Robins
Water Lily	*Nymphaea odorata* Alton
Water Parsnip	*Sium suave* Walter
Wax Myrtle*	*Myrica cerifera* L.
Wild Millet	*Echinochloa walteri* (Pursh) Nash
Wild Rice*	*Zizania aquatica* L.
Wild Rye Grass	*Elymus virginicus* L.
Woolgrass	*Scirpus cyperinus* (L.) Kunth

**Species included in the Wetlands Act of 1972.*

Table 2. Acreage of the dominant wetland plant species in Back Bay, Va.

	Plant Species	Acreage	Percent
1.	Cattail	4004	40.3
2.	Needlerush	2371	23.9
3.	Big cordgrass	605	6.1
4.	Saltmeadow hay	449	4.5
5.	Switchgrass	427	4.3
6.	Olney threesquare	261	2.6
7.	Spikerush	229	2.3
8.	Wild millet	188	1.9
9.	Smartweeds	181	1.8
10.	Marsh hibiscus	139	1.4
11.	Saltmarsh cordgrass	133	1.3
12.	Saltmarsh bulrush	133	1.3
13.	Marsh mallow	102	1.0
14.	Common threesquare	100	1.0
15.	Common reed	85	0.9
16.	Water hemp	79	0.8
17.	Tearthumb	71	0.7
20.	Rice cutgrass	29	0.3
21.	Aster	27	0.3
22.	Nutsedge	23	0.2
23.	Marsh fimbristylis	21	0.2
24.	Soft-stem bulrush	19	0.2
25.	Beggars ticks	19	0.2
26.	Plumegrass	16	0.2
27.	Woolgrass	16	0.2
28.	All other species	198	2.1
	Total	**9925**	**100**

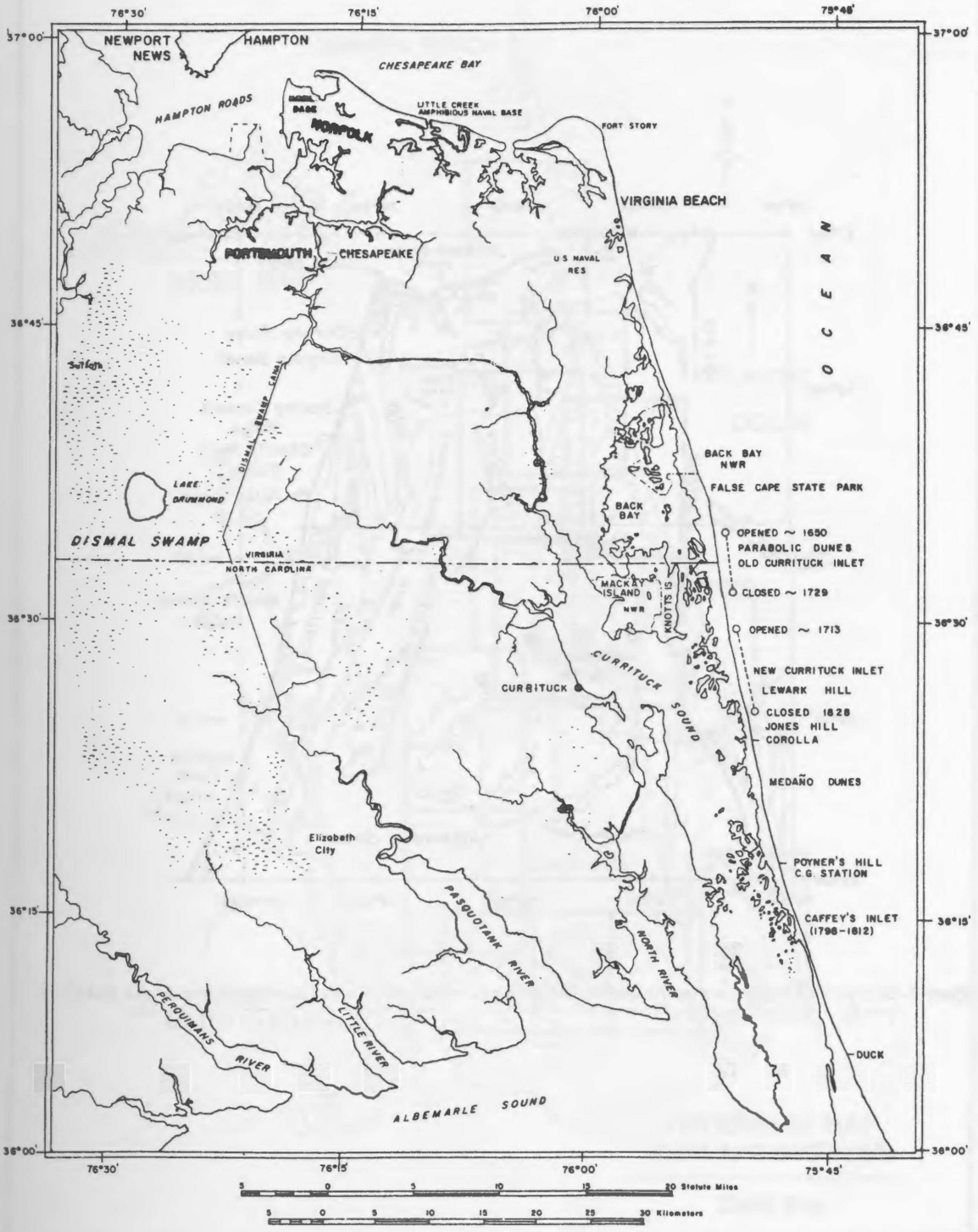

Figure 1. Vicinity map and locations of historical inlets along Currituck Spit (from Goldsmith, 1977).

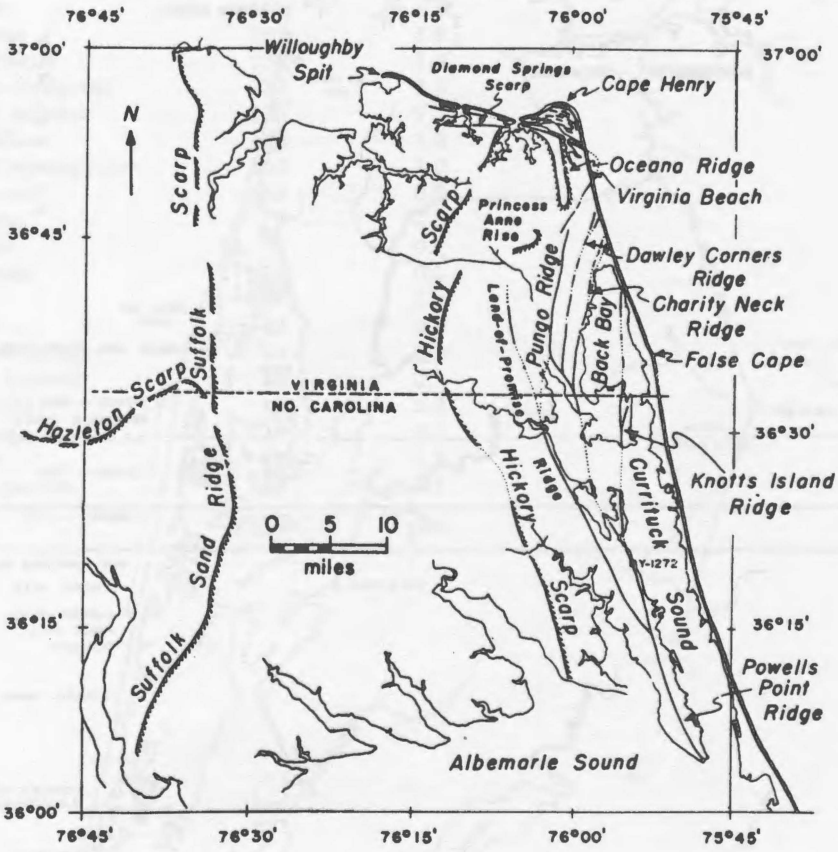

Figure 2. Scarps and ridges in southeastern Virginia and adjacent North Carolina (from Oaks and Coch, 1973).

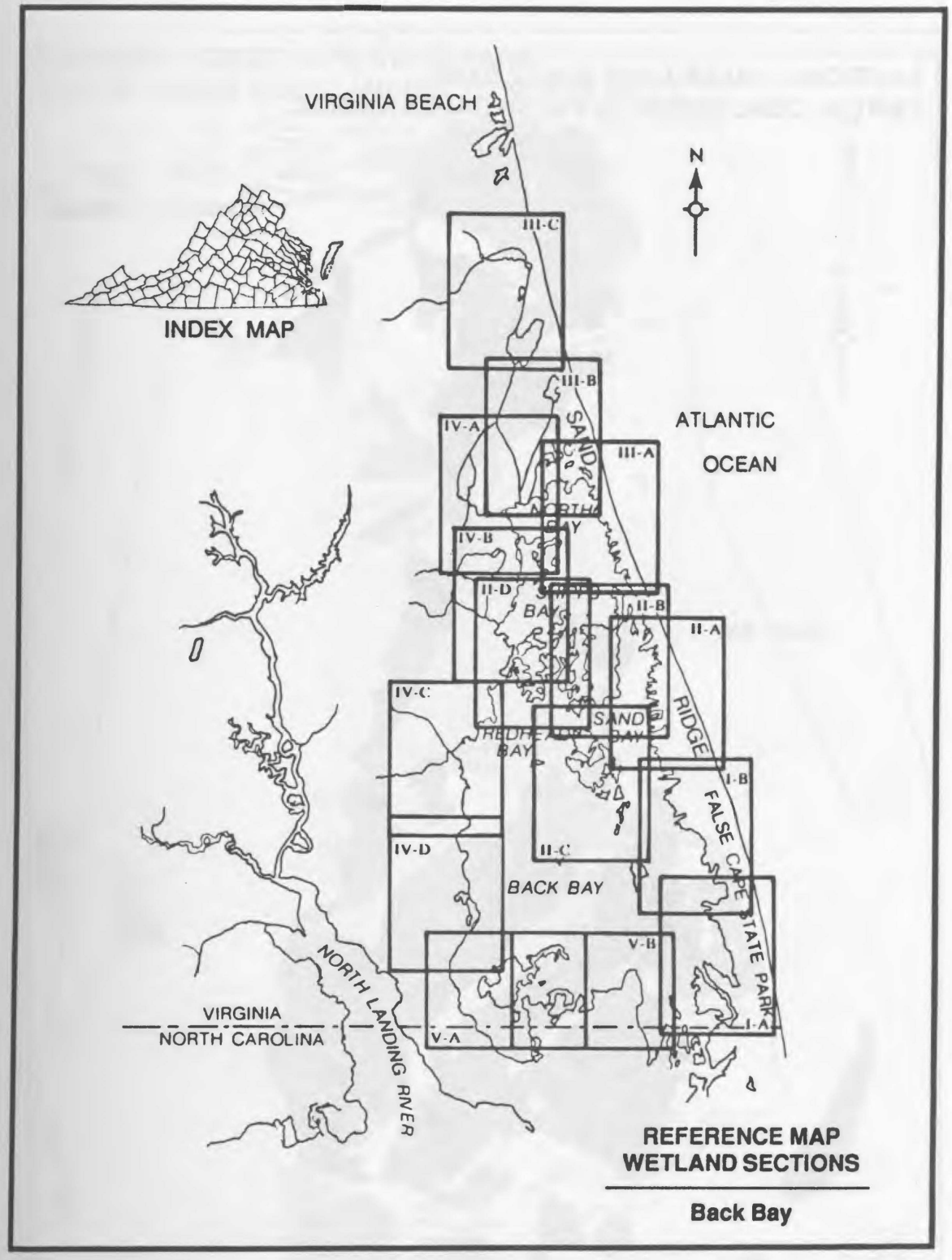

Figure 3. Location of inventory section maps (from Priest and Dewing 1989).

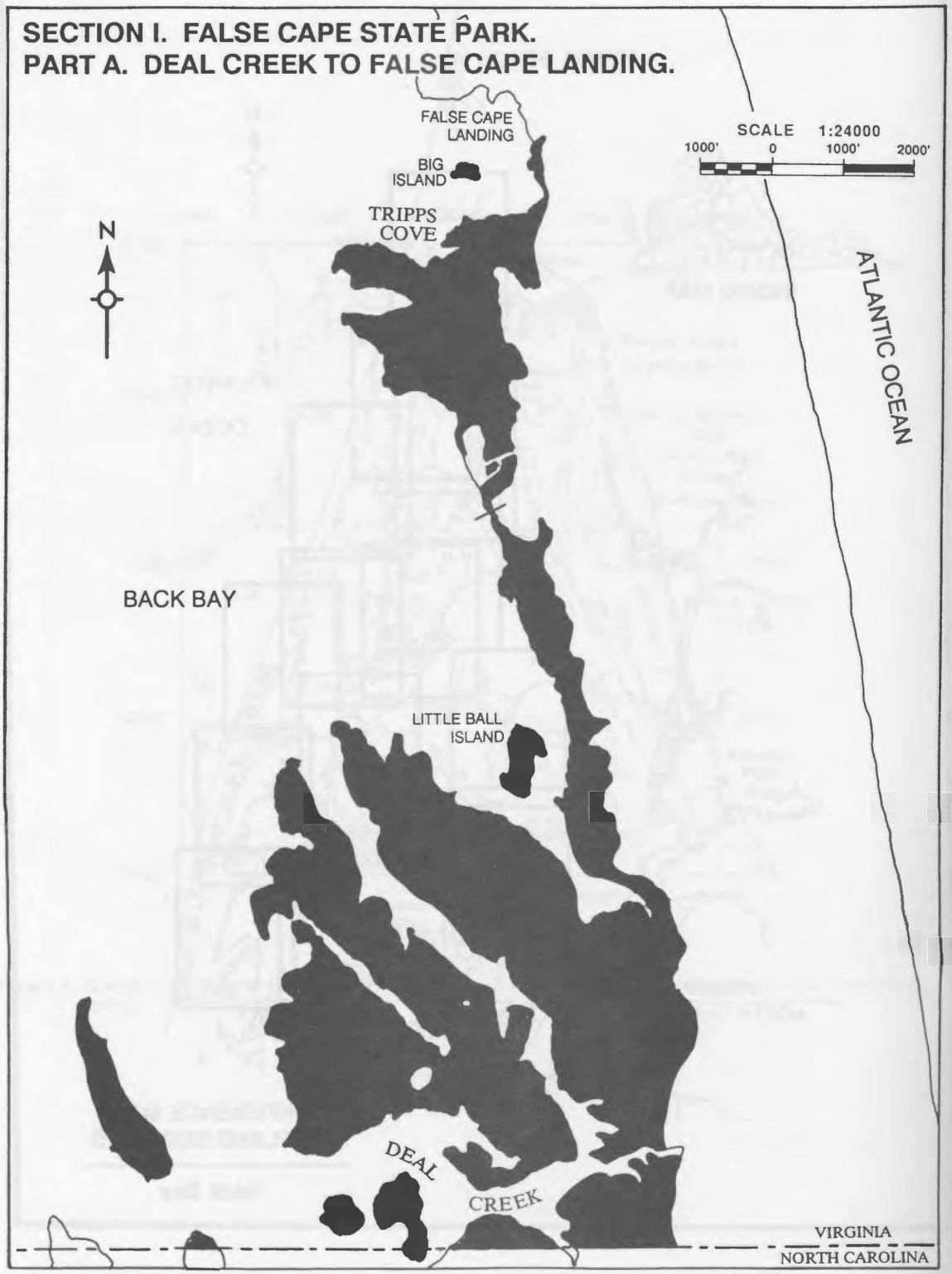

Figure 4. Section I. False Cape State Park. Part A. Deal Creek to False Cape Landing.

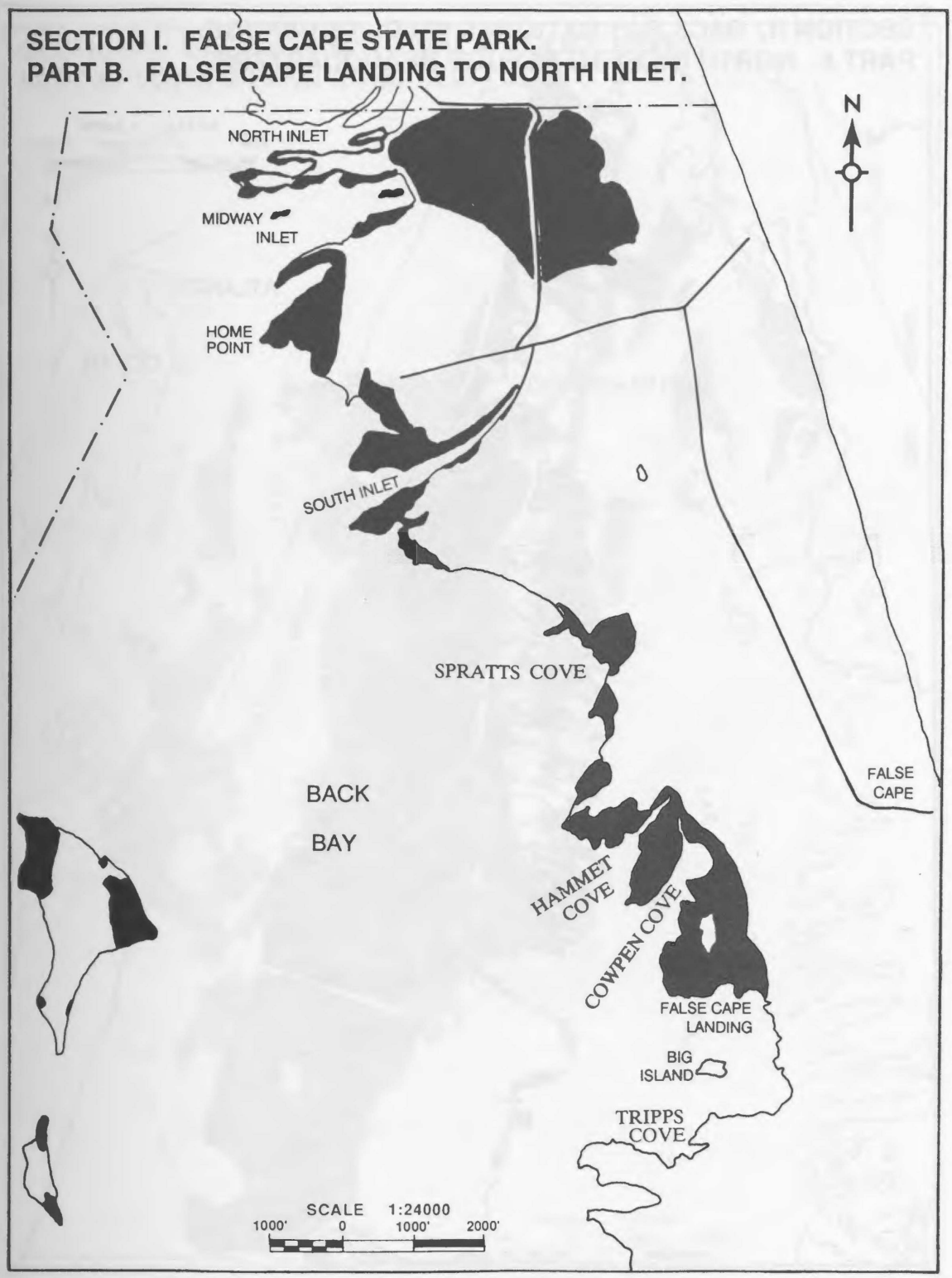

Figure 5. Section I. False Cape State Park. Part B. False Cape Landing to North Inlet.

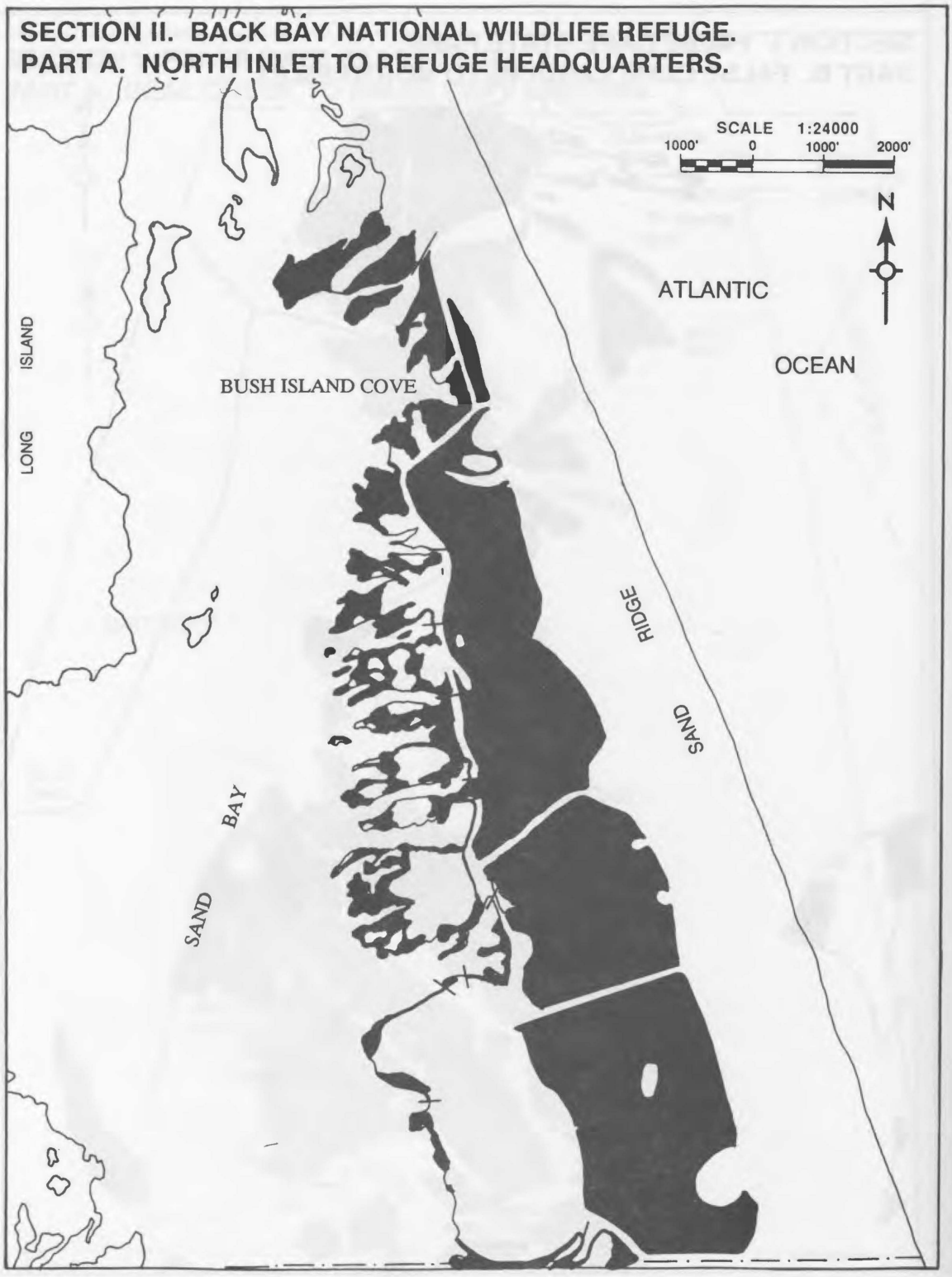

Figure 6. Section II. Back Bay National Wildlife Refuge. Part A. North Inlet to Refuge Headquarters.

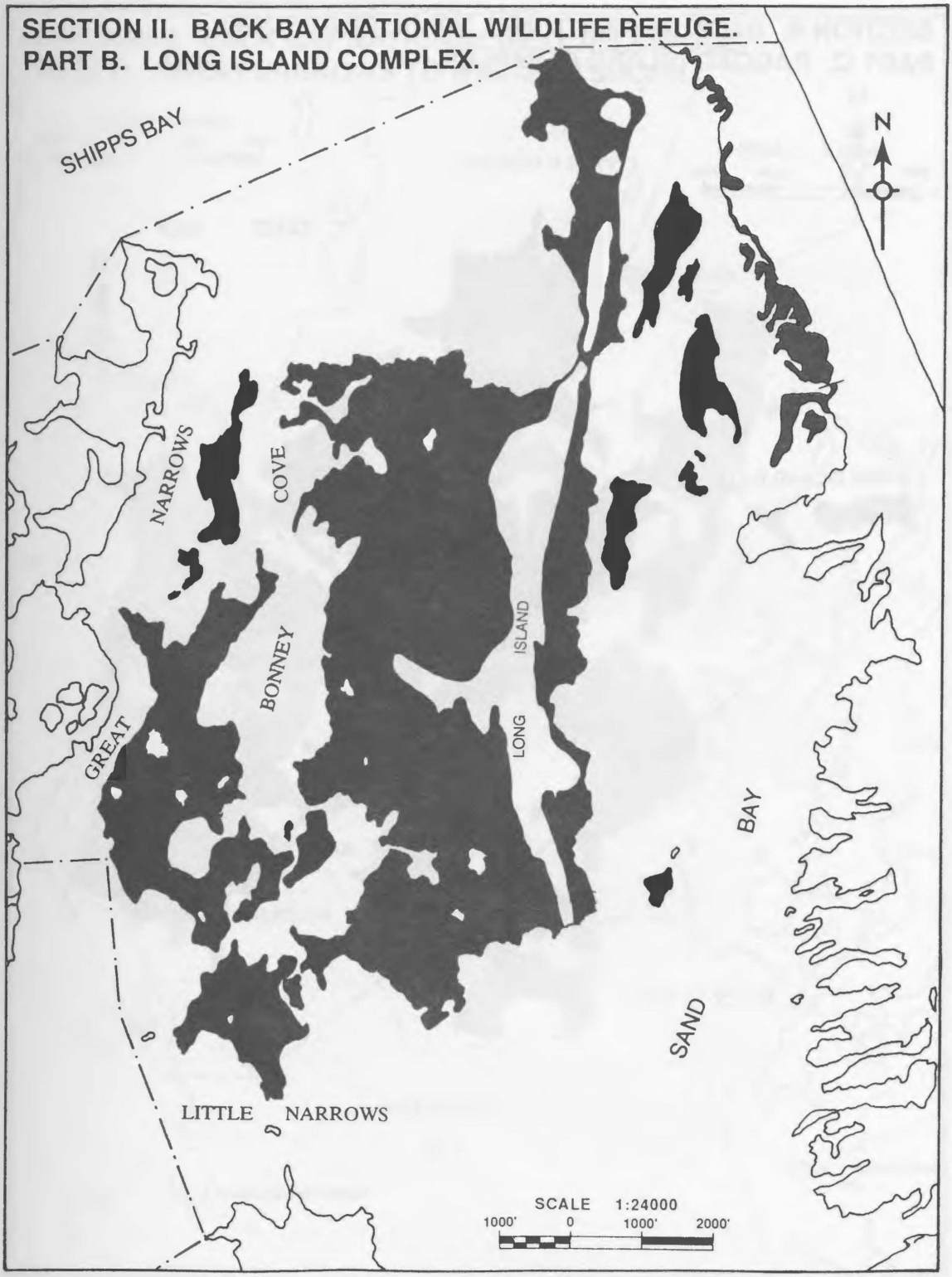

Figure 7. Section II. Back Bay National Wildlife Refuge. Part B. Long Island Complex.

Figure 8. Section II. Back Bay National Wildlife Refuge. Part C. Ragged Island Complex.

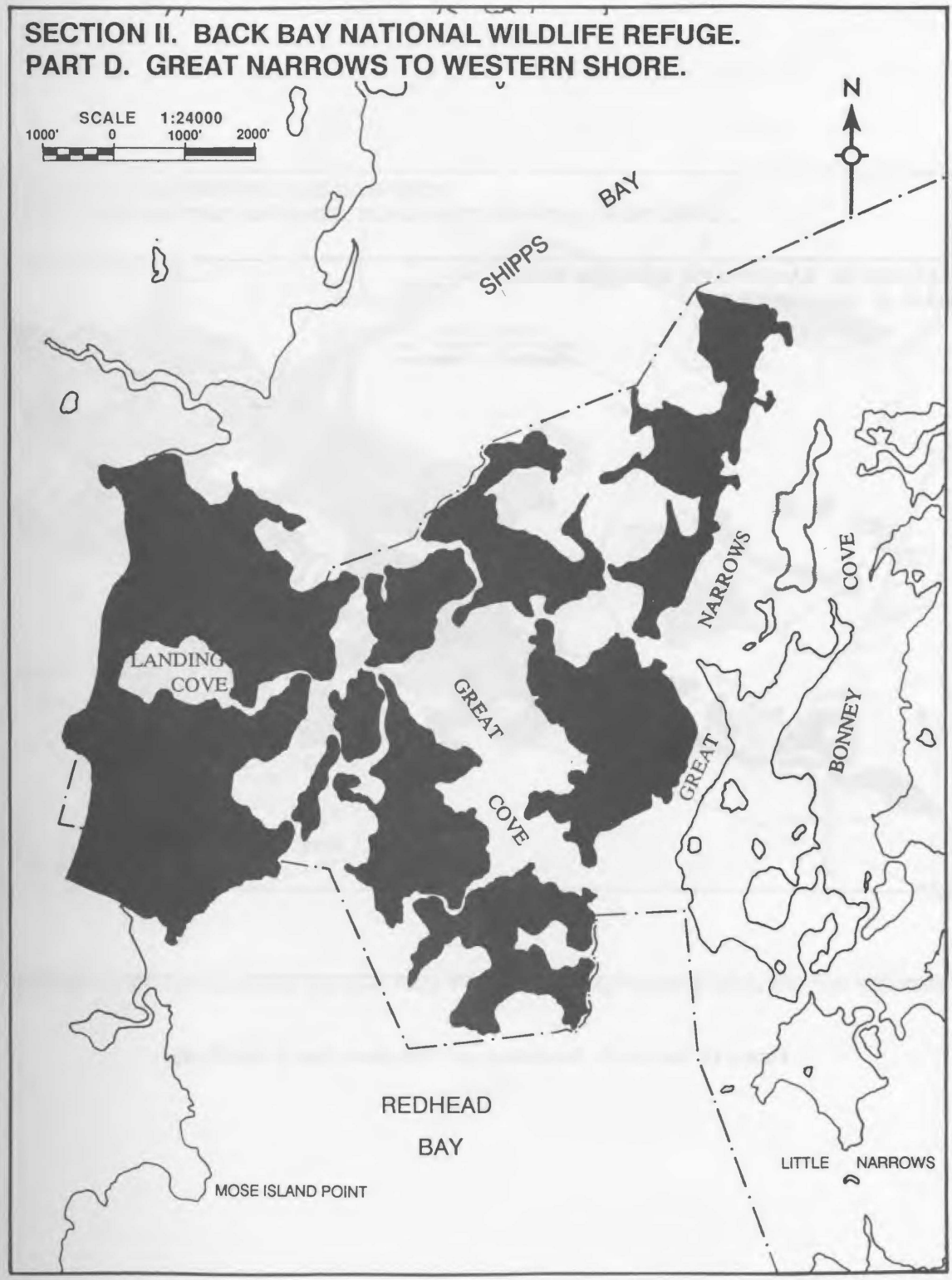

Figure 9. Section II. Back Bay National Wildlife Refuge. Part D. Great Narrows to Western Shore.

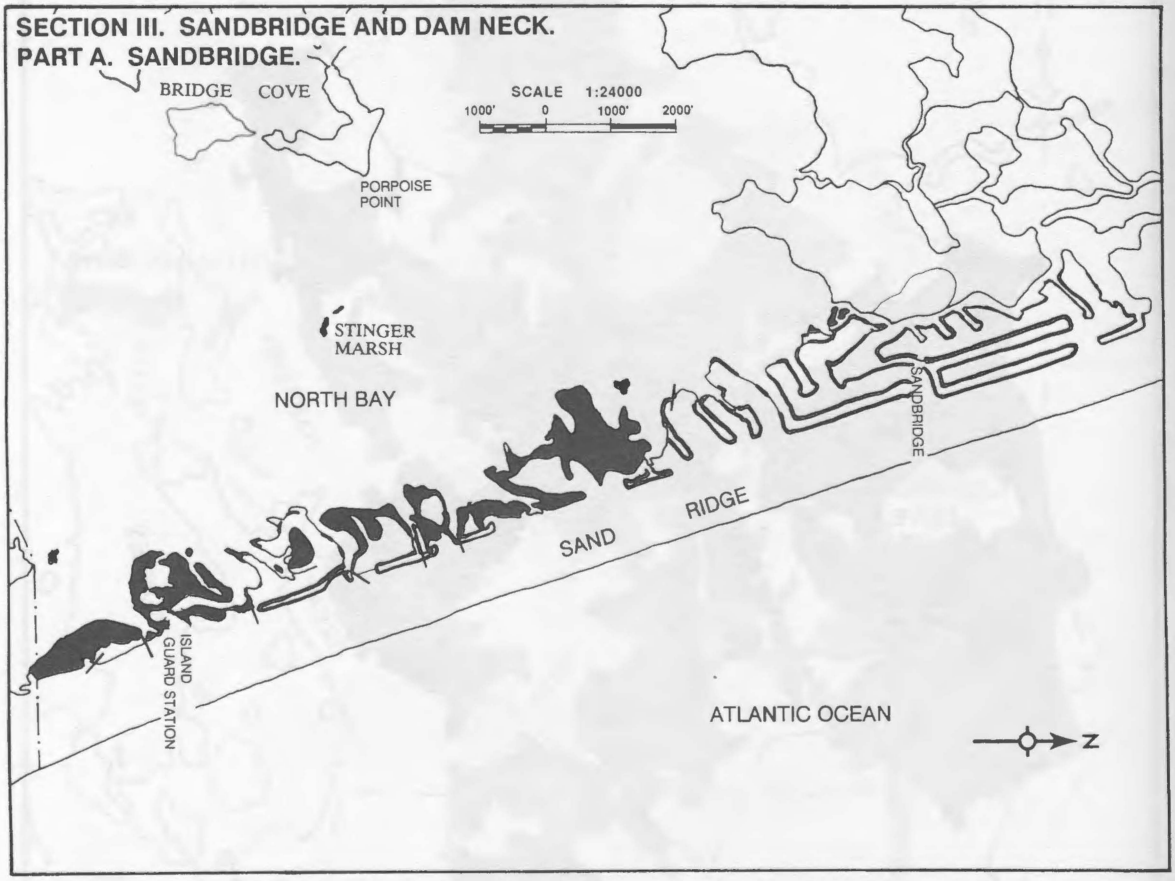

Figure 10. Section III. Sandbridge and Dam Neck. Part A. Sandbridge.

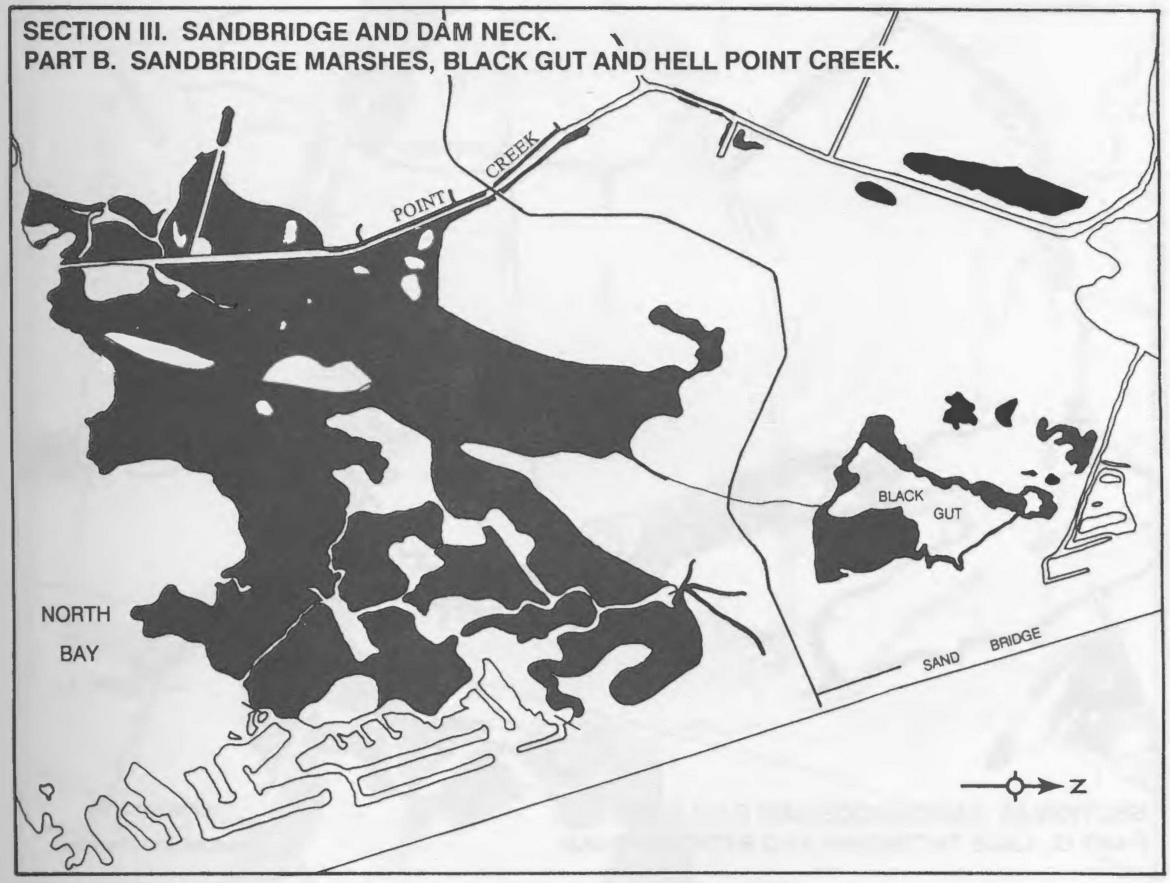

Figure 11. Section III. Sandbridge and Dam Neck. Part B. Sandbridge Marshes, Black Gut, and Hell Point Creek.

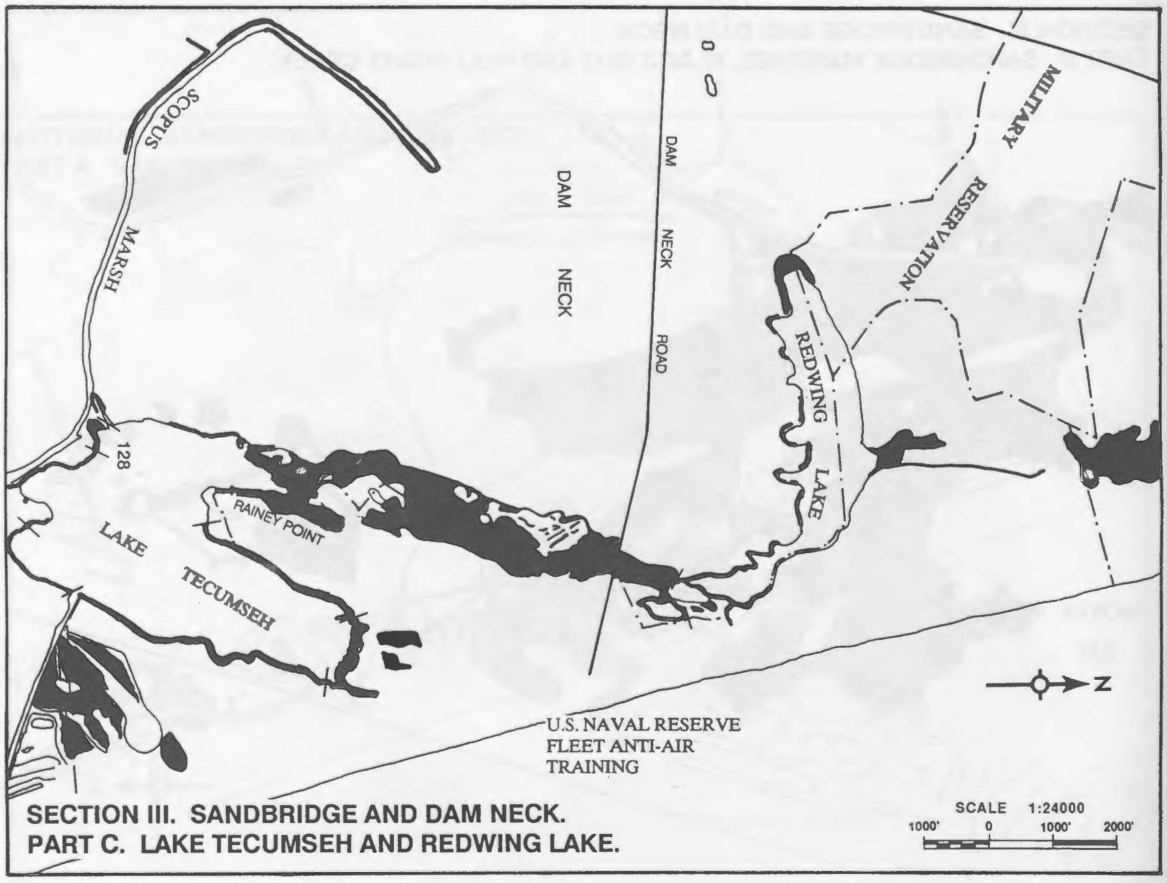

Figure 12. Section III. Sandbridge and Dam Neck. Part C. Lake Tecumseh and Redwing Lake.

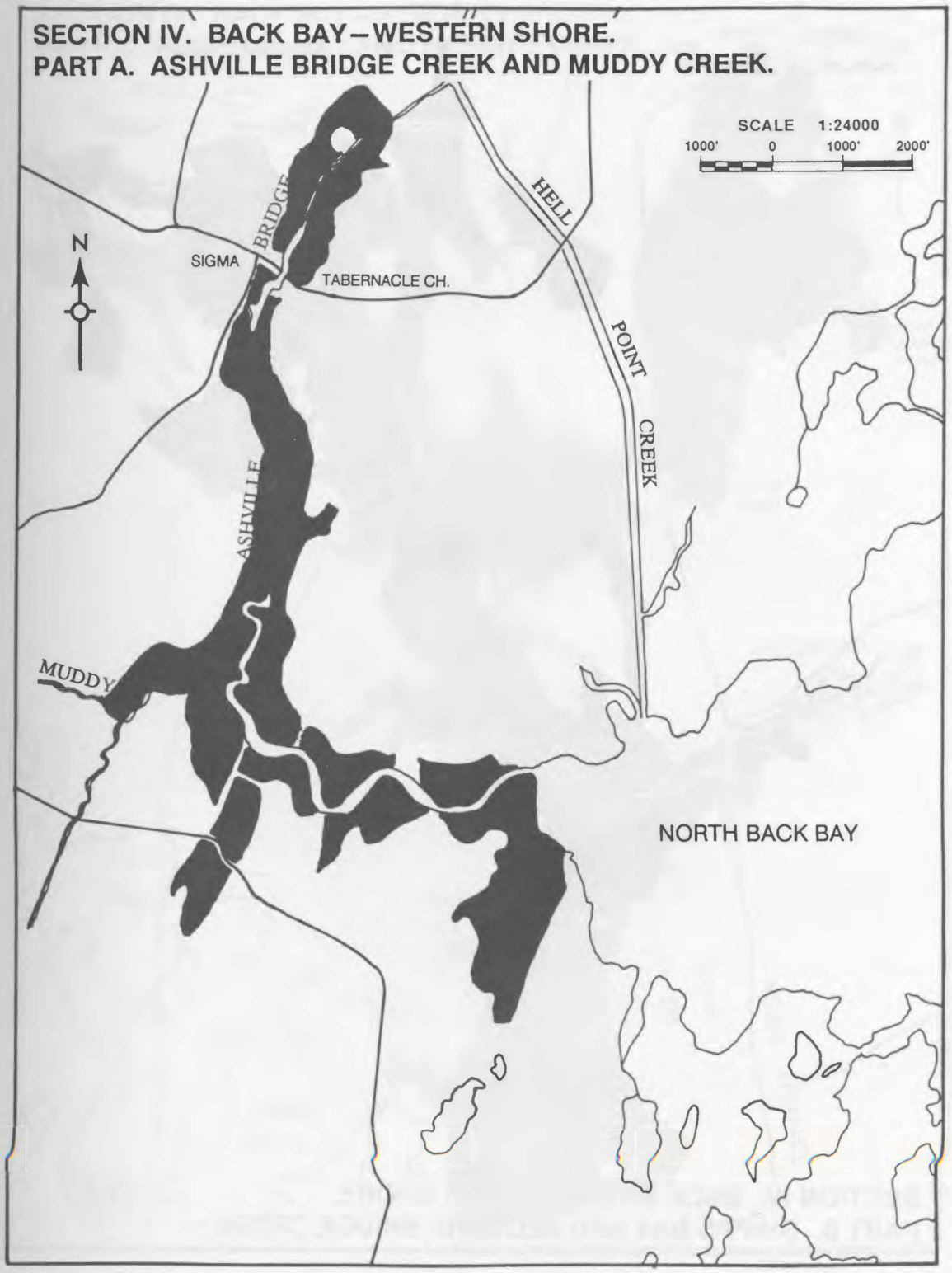

Figure 13. Section IV. Back Bay - Western Shore. Part A. Ashville Bridge Creek and Muddy Creek.

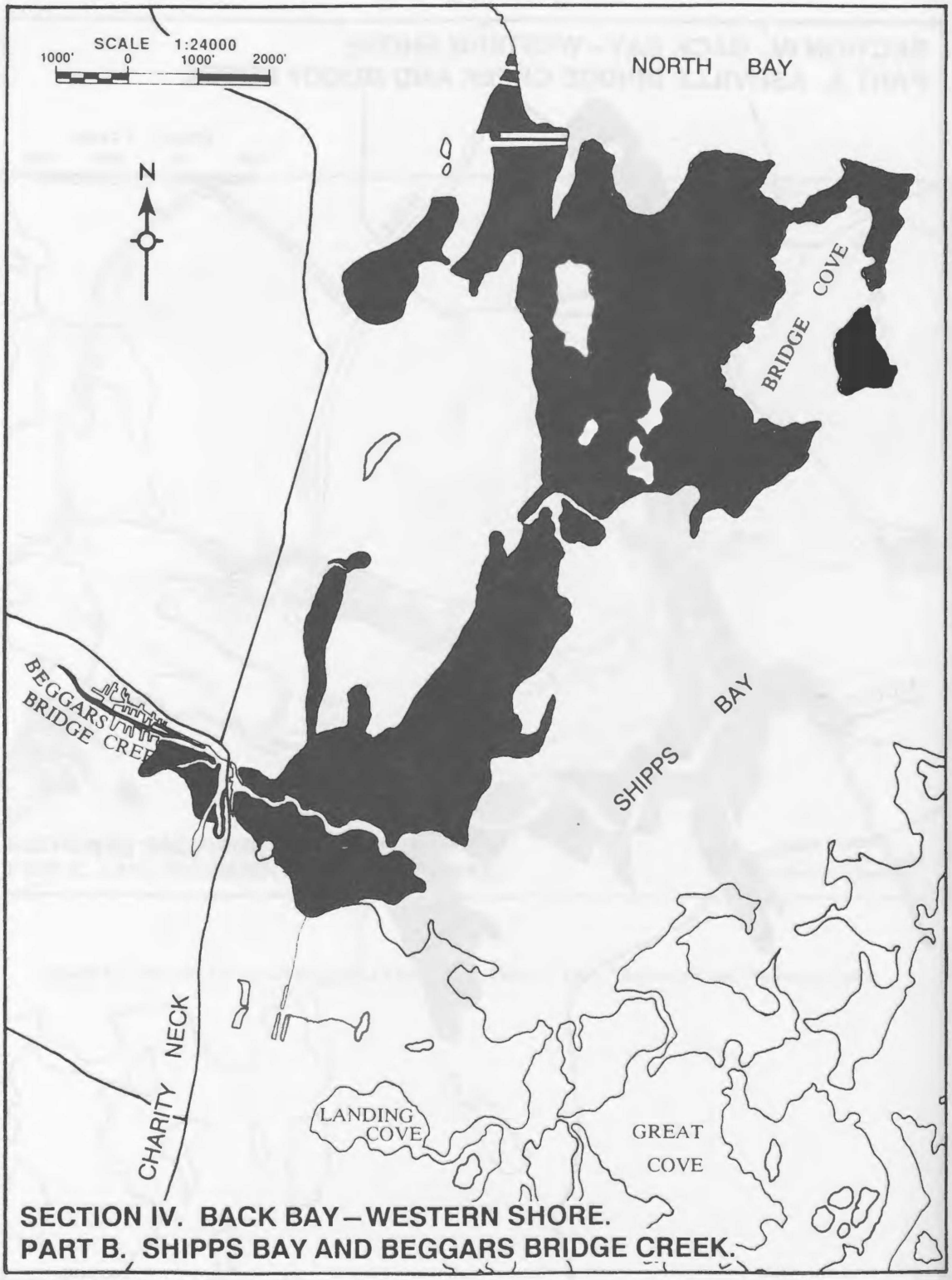

Figure 14. Section IV. Back Bay - Western Shore. Part B. Shipps Bay and Beggars Bridge Creek.

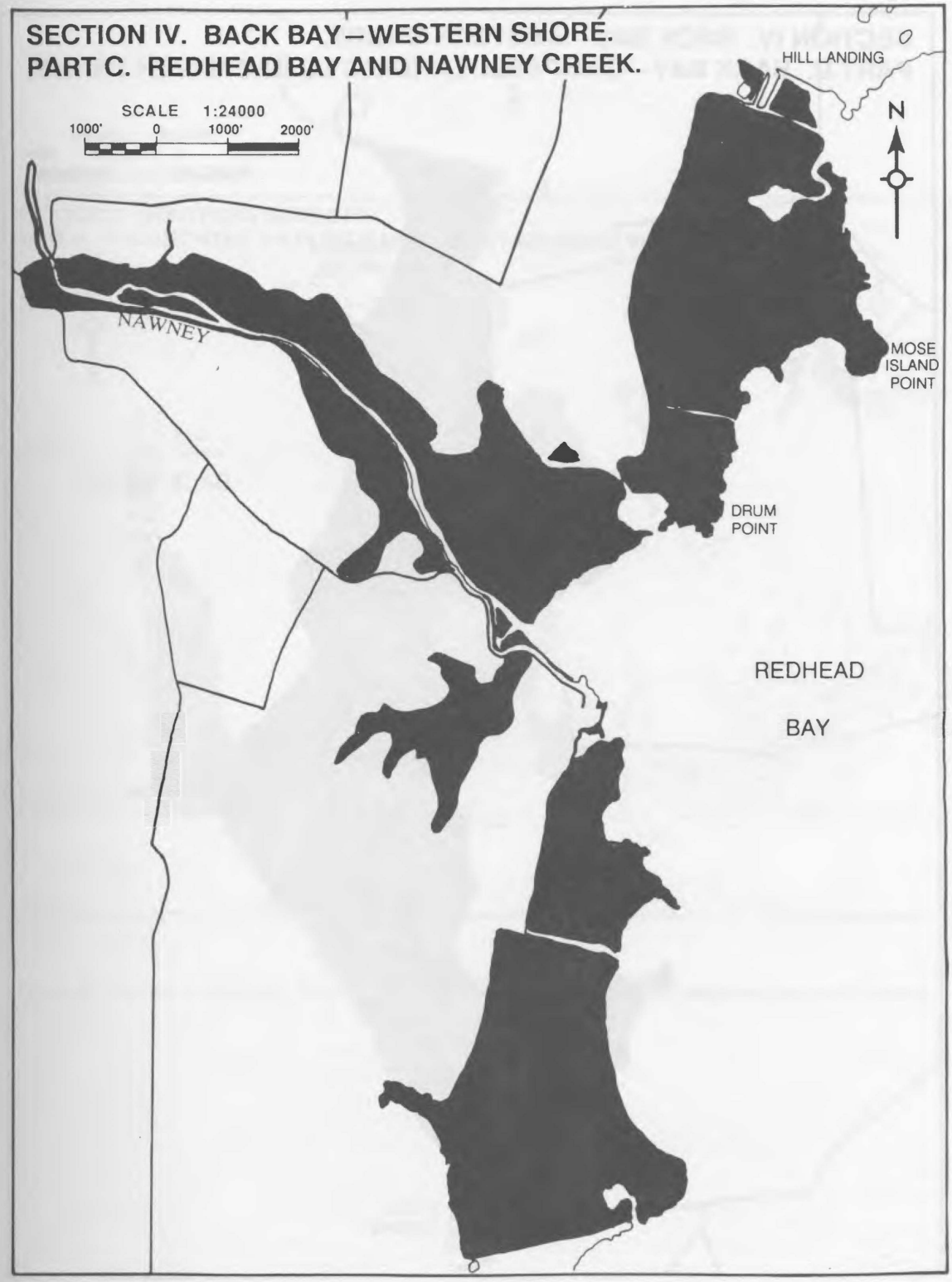

Figure 15. Section IV. Back Bay - Western Shore. Part C. Redhead Bay and Nawney Creek.

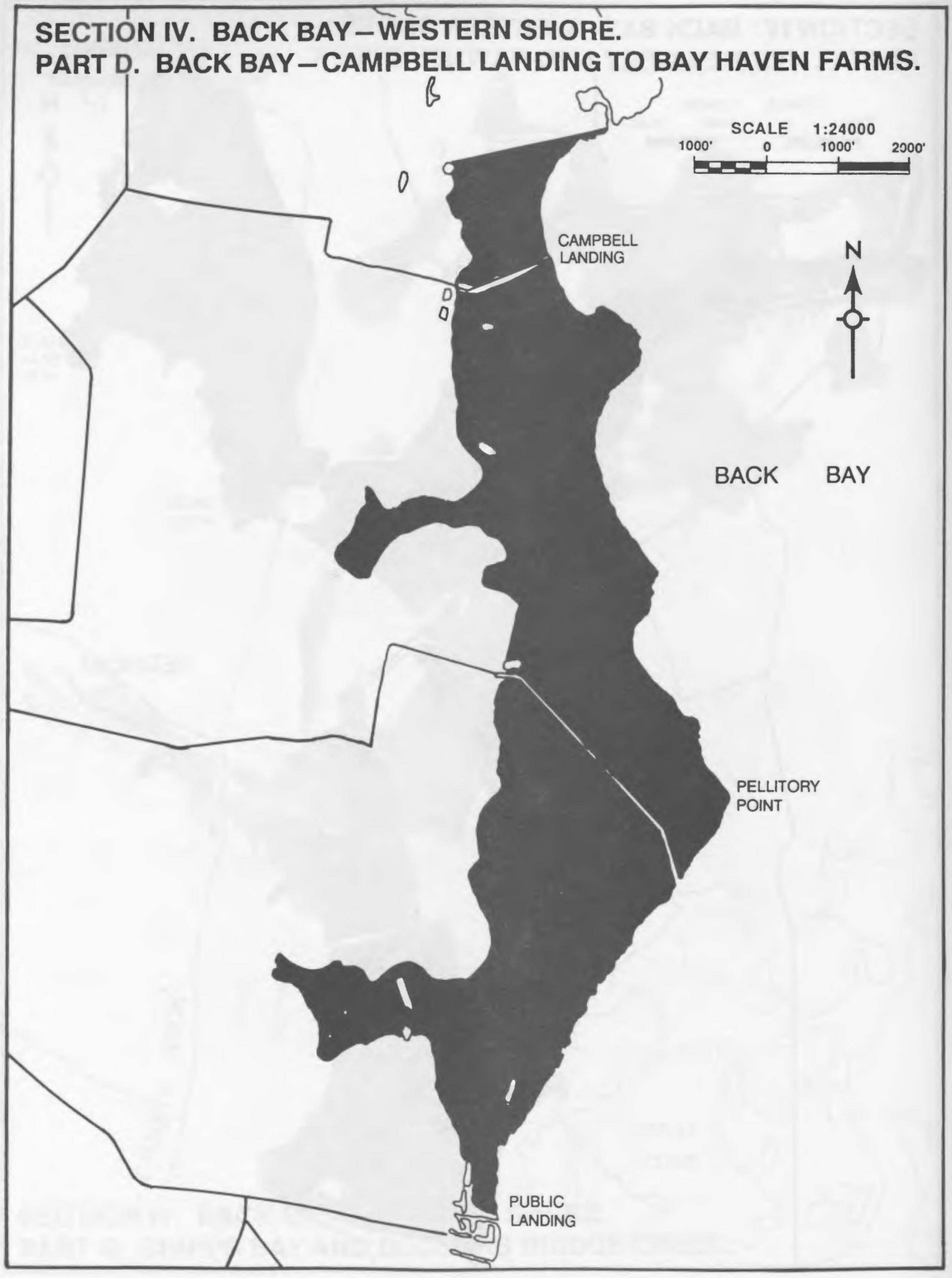

Figure 16. Section IV. Back Bay - Western Shore. Part D. Back Bay - Campbell Landing to Bay Haven Farms.

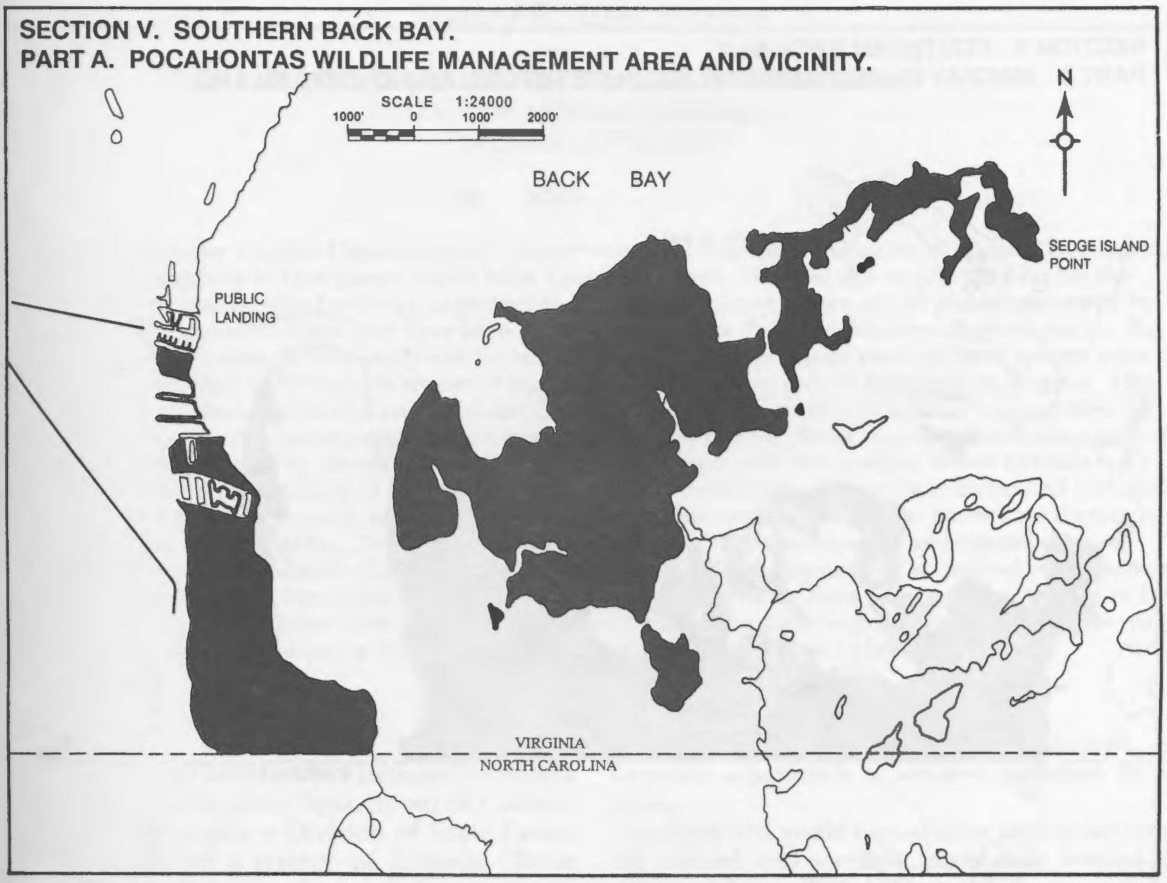

Figure 17. Section V. Southern Back Bay. Part A. Pocahontas Wildlife Management Area and Vicinity.

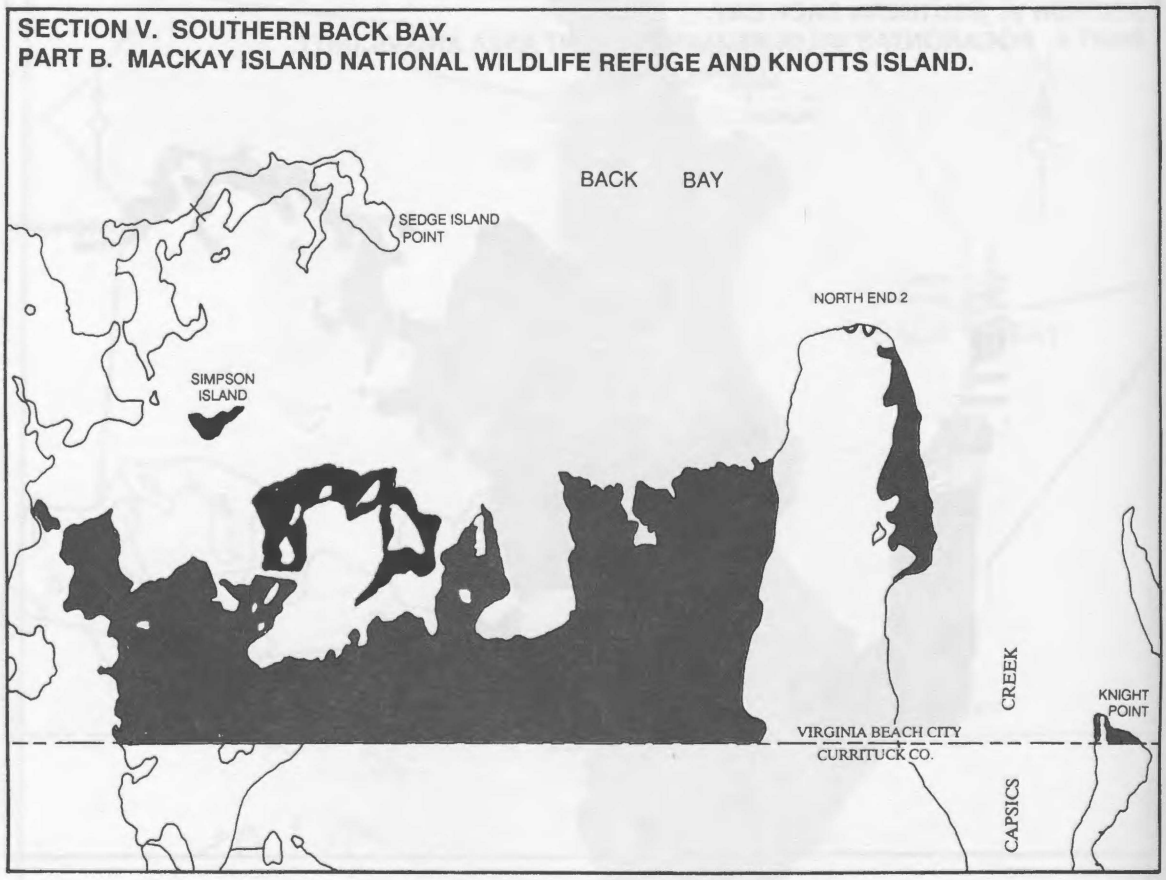

Figure 18. Section V. Southern Back Bay. Part B. Mackay Island National Wildlife Refuge and Knotts Island.