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Checklist of the Fishes Documented from the Zeke's Island and Masonboro Island Components of the North Carolina National Estuarine Research Reserve

Steve W. Ross and John Bichy

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ABOUT THIS DOCUMENT

The North Carolina National Estuarine Research Reserve is conducting basic biological inventories of the biota in and near the four reserve components. This checklist of fishes in two Reserve components represents the first major product in that area. We intend that this base line data will document the Reserve's ichthyofauna and will also serve as a benchmark to measure future changes.

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CONTACT INFORMATION FOR THE AUTHORS

Dr. Steve Ross, North Carolina National Estuarine Research Reserve, 5600 Marvin Moss Ln. Wilmington, NC 28409; rosss@uncwil.edu
John Bichy, Chesapeake Biological Laboratory, 1 Williams Street, Solomons, MD 20688, bichy@cbl.umces.edu

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The National Estuarine Research Reserves System (NERRS) is a network of protected areas promoting stewardship of the Nation's coasts through science and education. The reserve system's Technical Report Series is a means for disseminating data sets, curricula, research findings or other information that would be useful to coastal managers, educators, and researchers, yet are unlikely to be published in the primary literature. High quality of technical reports is ensured by a thorough peer-review and editorial process.

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Introduction

The National Estuarine Research Reserve System was established as a state/federal cooperative program by the Federal Coastal Zone Management Act of 1972. The purposes of the National Estuarine Research Reserves (NERR) are to: 1) provide opportunities for long-term estuarine research and monitoring, 2) provide opportunities for estuarine education and interpretation, 3) provide a basis for more informed coastal management decisions, and 4) promote public awareness, understanding and appreciation of estuarine ecosystems and their relationships to the environment. Currently there are 25 Reserves around the country.

Because North Carolina has an extensive and diverse estuarine system, including portions of two major biogeographic regions, a multi-component NERR (NCNERR) was established in this state (Figure 1). Four components have been designated: 1) Zeke's Island (Brunswick Co. and New Hanover Co.), 2) Masonboro Island (New Hanover Co.), 3) Rachel Carson (Carteret Co.), and 4) Currituck Banks (Currituck Co.). Masonboro Island was designated in 1991, while the other three components were designated in 1985.

The mission of the NCNERR is "to promote, through research, education and example, informed management and stewardship of the nation's estuarine and coastal habitats" (North Carolina National Estuarine Research Reserve and U.S. Dept. of Commerce 1998). The NCNERR research program goals are "to expand scientific knowledge of estuarine processes by addressing significant gaps in the understanding of dynamic change within estuarine ecosystems; and to improve the ability of resource managers to detect, quantify, and predict both short- and long-term changes in the health and viability of estuarine ecosystems" (North Carolina National Estuarine Research Reserve 1998). Increasing our scientific understanding obviously involves conducting a wide variety of basic and applied research. As part of that effort and in preparation for the site profile required by the NERR program, the NCNERR is conducting basic biological inventories of the biota in and near the four NERR components. This checklist of fishes in two Reserve components represents our first major product in that area. We intend that this base line data will document the Reserve's ichthyofauna and will also serve as a benchmark against which changes can be judged.

North Carolina hosts one of the most diverse marine/estuarine fish faunas in the United States. Over 730 marine species have been documented from the freshwater/estuarine interface offshore to the 200 m isobath (S.W. Ross, unpubl. data), which is more species than any other East or Gulf coast state, excluding Florida. Such diversity is explained by: 1) North Carolina's location at a moderate (temperate) latitude, 2) North Carolina straddles a major zoogeographic boundary (Cape Hatteras), 3) Gulf Stream influence facilitates an extensive tropical/sub-tropical marine community, 4) extensive habitat diversity that supports faunal diversity.

We report here on the fishes of Masonboro Island and Zeke's Island NCNERR components together because they are geographically close to one another, similar in habitat types, and they were the focus of our initial fish surveys. Although there are no published accounts of the overall fish faunas of these sites, this general area of North Carolina has been well studied for fishes (e.g., Weinstein 1979, Schwartz et al. 1982), and there have been a number of fish projects within these components (see references). The habitats (e.g., soft sediments, shallow creeks/bays, salt marsh systems, oyster beds) within both components are typical of those in other parts of coastal North Carolina and the South Atlantic Bight (Cape Hatteras to Cape Canaveral). These components are in

the lower estuary, near inlets, and usually display polyhaline to mesohaline salinities; therefore, the ichthyofauna is entirely marine, estuarine, or anadromous. Primary freshwater fishes are rare in these components. Herein we document the 155 and 103 fish species, representing 58 families, so far recorded from Masonboro Island and Zeke's Island NCNERR components, respectively.

Reserve Components

ZEKE'S ISLAND

The Zeke's Island component (Figure 2), approximately 6.4 km south of Kure Beach, is the southernmost of the NCNERR units and encompasses 472 hectares (1,165 acres) located in Brunswick and New Hanover counties. The component is bounded by the Fort Fisher State Recreation area to the north, the Atlantic Ocean to the east, Cape Fear River to the west, and the Smith Island complex to the south.

The Zeke's Island component receives salt water via New Inlet (when open), from the Cape Fear River inlet (flowing through Smith Island marsh complex and filtering through "the Rocks"), and from occasional storm overwash across the ocean beach. Although New Inlet, a major source of ocean water, was open during the period when fish data presented here were collected, it has been closed since late 1998. The effects of this inlet closing on fish populations within Zeke's Island are unknown, but we suspect that fish movement into or out of the system has been hampered. Fresh water enters the estuary from upland runoff, from groundwater, and from the adjacent Cape Fear River (via leakage through and over "the Rocks"). No detailed hydrologic studies are available for the Reserve area. Ranges of basic water quality data (daily means from three years) from the Zeke's Island monitoring station are presented (Figures 3-6). The semi-diurnal lunar tides normally fluctuate about one meter, while spring tides have a 1.4 m range.

The included estuary is shallow with the deepest tidal creeks measuring less than 1.8 m in depth. Tidal creeks are the primary channels for water interchange between "The Basin" and New Inlet (when open). Subtidal and intertidal soft bottoms are the dominant benthic habitat within the reserve (Figure 7), harboring numerous benthic organisms, and serve as feeding areas for fishes and crustaceans. Salt marshes consist of intertidal (low) marshes dominated by saltmarsh cordgrass (*Spartina alterniflora*), an important primary producer for the estuarine ecosystem, and supratidal (high) marshes with a variety of species. The ocean beach and surf zone provides a coarse sand, high energy, polyhaline habitat for numerous species. The dominant hard substrate is represented by "The Rocks", built during the late 1800s. Other hard substrate, complex habitats include rock groins called "the cribbings" and oyster reefs. These are available for attachment by algae and sessile organisms that, in turn, attract fishes, birds and other species for feeding and protection.

MASONBORO ISLAND

Masonboro Island contains about 2,063 hectares (5,097 acres) and is located in New Hanover County between the barrier island towns of Wrightsville Beach and Carolina Beach (Figure 8). It is bounded by Masonboro Inlet to the north, the Atlantic Ocean to the east, Carolina Beach Inlet to the south, and the Atlantic Intracoastal Waterway to the west.

Haline waters enter the Masonboro Island complex via inlets at the north and south ends of the island. Though Masonboro Island is not directly associated with a river, there is input of fresh water which enters the complex by direct precipitation, groundwater infiltration, and from the tidal creeks draining the adjacent mainland. Water from the Cape Fear River, traveling through Snow's Cut, enters the south end of the estuary under certain conditions. Ranges of basic water quality data from the Masonboro Island monitoring station are presented (Figures 9-12). Tides are semi-diurnal and usually fluctuate approximately 1.2 m, while spring tides average 1.4 m.

Component sound waters are < 1.8 m in depth. Tidal creeks are the primary channels for water interchange between the estuarine areas of the island and the waterway/inlets. Subtidal and intertidal soft bottoms are the dominant benthic habitat (Figure 13 a and b). Isolated eelgrass, *Zostera marina*, beds have been found in this Reserve, but they are not well established (at the southern limit of the plant's range). Salt marshes consist of intertidal (low) marshes dominated by saltmarsh cordgrass and supratidal (high) marshes. The extensive ocean beach and surf zone is a major high energy, polyhaline habitat in this component. The rock jetty on the north end of the island was made in the late 1970s and represents the largest concentration of hard bottom habitat in this Reserve component. Other hard bottom habitat is mostly composed of intertidal oyster beds.

Methods

The phylogenetic organization and general fish taxonomy in this list follow Nelson (1994), except where documented by other literature. We follow Robins et al. (1991) for standardized fish common names. Most species in the list were documented by collections with specimens deposited either in the NCNERR research collection or the University of North Carolina-Wilmington Biological Sciences collection.

All references to fishes in the two components were accessed from the NCNERR research bibliography (Lancaster et al. 1999), and fishes from those references were incorporated into the checklist. These fish references, as well as any found since production of the bibliography, are included in the references section. Most of these references are housed at the Reserve research office.

Some data sources used in the checklist have not been published. Data from these programs were computerized and both digital and analogue copies are housed at the NCNERR research office. Stations from major published and unpublished studies used for fish data are figured for each component (Figures 2 and 8). One of the major unpublished studies (the Miltner survey) lasted from January 1992 through September 1993, and nine stations in each of both Zeke's Island and Masonboro island were sampled twice per month. Each station was sampled with one min tows of a 3.2 m flat two seam otter trawl (6.4 mm mesh wings and 3.2 mm mesh cod end). We obtained the data from a second major unpublished survey by the NC Division of Marine Fisheries (NCDMF). Between 1970 and 1995 they irregularly sampled stations in both NCNERR components. The main gear used was the same small mesh trawl described above pulled from one to five minutes. A larger (6 m) net was used occasionaly in some deeper areas. Other miscellaneous samplings (unpublished) generally used the same small mesh trawl pulled for one to five minutes. Methods for the E-MAP E sites and the trawl comparison study sites (Figures 2 and 8) were described in Hyland et al. (1996,

1998) and Stokesbury et al. (1999), respectively. We did not plot stations from other studies and the original references (see bibliography) must be consulted for station locations and methods.

The NCNERR began long-term monitoring of basic water quality in the Zeke's Island component in 1994 and in the Masonboro Island component in 1995. Through 2001 there was one permanent station in each component (Figures 2 and 8) where a YSI 6000 or YSI 6600 was moored on the bottom. Water temperature, salinity (conductivity), pH, depth, dissolved oxygen, and turbidity were recorded at 30 min intervals at each station.

Data in the checklist on area, sampled habitats, and estuarine occurrence were derived from our own sampling, from the reserve literature, or unpublished data. Spawning data, basic habitat, and relative abundance were usually obtained from the scientific literature (when available) and were supplemented by our own sampling and experience. The surface sediment maps were generated using methods described in Ross and Epperly (1985). In many cases the fishes in the list may not spawn in or off North Carolina, but their larvae or juveniles are carried into the area; therefore, spawning seasons or areas may not be accurate for North Carolina.

Checklist of Fishes From the Masonboro Island and Zeke's Island Components of the North Carolina National Estuarine Research Reserve

Area: NCNERR component where species were captured and/or observed: Masonboro Island (MI), Zeke's Island (ZI).

Sampled Habitats: Area(s) of species collection and/or observation: surf zone (SZ), jetties and piers (JP) rocky ledges and crevices, oyster beds (OB), shallow bays and creeks (SBC), and deep channels (DC).

Spawning: Primary location of spawn: estuary (E), ocean (O), and river (R); Spawning season(s): Spring (SP), Summer (S), Fall (F), and Winter (W). U = undetermined.

Estuarine Dependency: Life stage and seasonal occurrence within NCNERR estuarine waters: larva (L), juvenile (J), and adult (A).

Basic Habitat: Major adult habitat utilization: soft substrates (SS), hard substrates (HS), and pelagic (P).

Abundance: Relative species abundance in NC : rare (R), uncommon (U), common (C), abundant (A).

		Sampled Habitats					Spawning		Estuarine Occurrence		Basic	Relative
	Area	SZ	JP	OB	SBC	DC	Location	Season	Life Stage	Season	Habitat	Abund.
Class Chondrichthyes												
Order Lamniformes												
Family Carcharhinidae (Requiem sharks)												
Rhizoprionodon terraenovae (Atlantic sharpnose shark)	Both	X			X	X	E/O	SP	J, A	SP	P	C
Family Triakidae (Smoothhounds)												
Mustelus canis (smooth dogfish)	MI		X				O	SP, S	J, A	W, SP	P	C
Order Squaliformes												
Family Squalidae (Dogfish sharks)												
Squalus acanthias (spiny dogfish)	MI		X				O	W	A	W	P	C
Order Rajiformes												
Family Rajidae (Skates)												
Raja eglanteria (clearnose skate)	MI		X				O	SP	J, A	SP, S, F	SS	C
Family Dasyatidae (Stingrays)												
Dasyatis americana (southern stingray)	Both				X		O	U	J, A	S, F	SS	C
Dasyatis sabina (Atlantic stingray)	Both				X	X	E/O	SP, S, F	J, A	SP, S, F	SS	C

Dasyatis sayi (bluntnose stingray)	MI	X			X		E/O	S	J, A	SP, S, F	SS	C
Gymnura micrura (smooth butterfly ray)	Both				X	X	O	S	J, A	SP, S, F	SS	C
Family Myliobatidae (Eagle rays)												
Rhinoptera bonasus (cownose ray)	MI					X	O	SP, S	J, A	SP	SS	C
Class Osteichthyes												
Order Elopiformes												
Family Elopidae (Tarpons)												
Elops saurus (ladyfish)	Both				X		O	F	J, A	SP, S, F	P	C
Order Anguilliformes												
Family Anguillidae (Freshwater eels)												
Anguilla rostrata (American eel)	Both				X	X	O	W, SP	J, A	W, SP, S, F	SS	C
Family Ophichthidae (Snake eels)												
Myrophis punctatus (speckled worm eel)	Both				X	X	O	W, SP	J, A	W, SP, S, F	SS	C
Ophichthus ocellatus (planespotted eel)	Both				X		O	F, W, SP	J, A	W, SP, S, F	SS	R
Ophichthus gomesi (shrimp eel)	MI			X	X		O	SP, S	J, A	W, SP, S, F	SS	C
Family Congridae (Conger eels)										W, SP, S, F		
Conger oceanicus (conger eel)	Both				X	X	O	F, W	J, A	W, SP, S, F	SS	C
Paraconger caudilimbatus (margintail conger)	MI				X		O	U	J, A	W, SP, S, F	SS	R
Order Clupeiformes												
Family Clupeidae (Herrings)												
Alosa aestivalis (blueback herring)	Both		X		X		R	SP	J	F	P	R
Alosa mediocris (hickory shad)	ZI				X		R	SP	J	F	P	R
Alosa sapidissima (American Shad)	MI				X		R	SP	J	F	P	C
Brevoortia tyrannus (Atlantic menhaden)	Both	X	X	X	X	X	O	W	J, A	W, SP, S, F	P	A
Dorosoma cepedianum (gizzard shad)	MI				X		R	SP, S	J, A	W, SP, S, F	P	C
Dorosoma petenense (threadfin shad)	Both	X	X				R	SP, F	J, A	W, SP, S, F	P	C
Opisthonema oglinum (Atlantic thread herring)	Both		X		X	X	O	SP	J, A	SP, S, F	P	C
Famliy Engraulidae (Anchovies)												
Anchoa hepsetus (striped anchovy)	Both	X	X	X	X	X	E/O	SP	J, A	W, SP, S, F	P	C
Anchoa mitchilli (bay anchovy)	Both	X	X	X	X	X	E/O	S	J, A	W, SP, S, F	P	A
Order Siluriformes												

Family Ariidae (Sea catfishes)												
Arius felis (hardhead catfish)	ZI		X		X		E	S	J, A	SP, S, F	SS	R
Order Aulopiformes												
Family Synodontidae (Lizardfishes)												
Synodus foetens (inshore lizardfish)	Both			X	X	X	O	SP, S	J, A	W, SP, S, F	SS	A
Order Gadiformes												
Family Bregmacerotidae (Codlets)												
Bregmaceros atlanticus (antenna codlet)	MI				X		U	U	J	W	P	R
Family Gadidae (Cods)												
Urophycis earlli (Carolina hake)	MI				X		O	W?	J	W, SP	SS	C
Urophycis floridana (southern hake)	Both				X		O	U	J	W, SP	SS	C
Urophycis regia (spotted hake)	Both				X	X	O	F, W	J, A	W, SP	SS	C
Family Ophidiidae (Cusk-eels)												
Ophidion holbrooki (bank cusk-eel)	MI				X		U	U	J, A	SP, S, F	SS	C
Order Batrachoidiformes												
Family Batrachoididae (Toadfishes)												
Opsanus tau (oyster toadfish)	Both		X		X	X	E/O	S	J, A	SP, S, F	HS	C
Porichthys plectrodon (Atlantic midshipman)	MI				X		O	SP, S	J, A	SP, S	SS	R
Order Gobiesociformes												
Family Gobiesocidae (Clingfishes)												
Gobiesox strumosus (skilletfish)	Both	X		X			E	SP	J, A	W, SP, S, F	HS	C
Order Atheriniformes												
Family Exocoetidae (Flyingfishes)												
Hyporhamphus meeki (silverstripe halfbeak)	MI	X	X				E/O	S	J, A	S, F	P	C
Family Blenonidae (Needlefishes)												
Strongylura marina (Atlantic needlefish)	MI		X		X	X	E/R	SP, S	J, A	SP, S, F, W	P	C
Family Cyprinodontidae (Killifishes)												
Cyprinodon variegatus (sheepshead minnow)	Both			X	X		E	SP, S	J, A	W, SP, S, F	SS	A
Fundulus heteroclitus (mummichog)	Both	X		X	X		E	S	J, A	W, SP, S, F	SS	A
Fundulus majalis (striped killifish)	Both	X		X	X		E	S	J, A	W, SP, S, F	SS	A
Lucania parva (rainwater killifish)	Both				X		E	SP	J, A	W, SP, S, F	SS	C

Family Poeciliidae (Livebearers)												
Gambusia holbrooki (eastern mosquitofish)	MI			X	X		R	S	J, A	W, SP, S, F	SS	C
Family Atherinidae (Silversides)												
Membras martinica (rough silverside)	MI	X	X		X		E	SP, S	J, A	W, SP, S, F	P	C
Menidia beryllina (inland silverside)	MI				X		E	SP, S	J, A	W, SP, S, F	P	C
Menidia menidia (Atlantic siverside)	Both			X	X	X	E	SP, S	J, A	W, SP, S, F	P	A
Order Gasterosteiformes												
Family Syngnathidae (Pipefishes)												
Hippocampus erectus (lined seahorse)	Both				X	X	E	SP, S	J, A	SP, S, F, W	SS	C
Syngnathus floridae (dusky pipefish)	Both				X	X	E	SP, S	J, A	SP, S, F	SS	C
Syngnathus fuscus (northern pipefish)	Both	X			X	X	E	SP, S	J, A	SP, S, F, W	SS	C
Syngnathus louisianae (chain pipefish)	Both	X			X		E	SP, S	J, A	SP, S, F	SS	C
Order Dactylopteriformes												
Family Dactylopteridae (Flying gurnards)												
Dactylopterus volitans (flying gurnard)	MI				X		U	U	J, A	S	SS	R
Order Scorpaeniformes												
Family Scorpaenidae (Scorpionfishes)												
Scorpaena brasiliensis (barbfish)	MI				X		U	U	J	SP, S	HS	R
Scorpaena plumieri (spotted scorpionfish)	MI		X				U	U	U	S	HS	R
Family Triglidae (Searobins)												
Prionotus carolinus (northern searobin)	Both	X			X		E/O	SP, S	J, A	W, SP, S, F	SS	C
Prionotus evolans (striped searobin)	Both				X	X	E/O	SP, S	J, A	W, SP, S, F	SS	C
Prionotus scitulus (leopard searobin)	Both	X			X	X	E/O	SP, S	J, A	W, SP, S, F	SS	C
Prionotus tribulus (bighead searobin)	Both	X			X	X	E/O	SP, S	J, A	W, SP, S, F	SS	C
Order Perciformes												
Family Serranidae (Sea basses)												
Centropristis philadelphica (rock seabass)	Both				X	X	O	SP	J, A	W, SP, S, F	HS	C
Centropristis striata (black seabass)	Both		X		X	X	O	SP, S, F	J, A	W, SP, S, F	HS	C
Diplectrum formosum (sand perch)	MI				X		O	SP	J	SP, S	SS	R
Epinephelus niveatus (snowy grouper)	ZI				X		O	U	J	S	HS	R
Mycteroperca bonaci (black grouper)	ZI				X		O	SP	J	SP, S	HS	R

Mycteroperca microlepis (gag)	Both		X		X	X	O	W	J	SP, S	HS	C
Serranus subligarius (belted sandfish)	MI		X				O	U	J, A	S, F	HS	R
Family Centrarchidae (Sunfishes)												
Lepomis macrochirus (bluegill)	ZI				X		R	S	J	F	SS/HS	R
Family Pomatomidae (Bluefishes)												
Pomatomus saltatrix (bluefish)	Both	X	X		X	X	O	SP, S	J	W, SP, S, F	P	A
Family Echeneidae (Remoras)												
Echeneis naucrates (sharksucker)	Both	X					O	U	U	SP, S, F	P	R
Family Carangidae (Jacks)												
Caranx bartholomaei (yellow jack)	Both				X	X	O	W, SP, S	J	S, F	P	R
Caranx crysos (blue runner)	MI				X		O	W, SP, S	A	S, F	P	R
Caranx hippos (crevalle jack)	Both	X	X	X	X	X	O	W, SP, S	J	S, F	P	C
Caranx latus (horse-eyed jack)	Both				X		O	W, SP, S	J	S, F	P	R
Chloroscombrus chrysurus (Atlantic bumper)	Both				X	X	O	SP, S	J, A	S, F	P	C
Decapterus punctatus (round scad)	MI		X				O	W, SP, S	A	S, F	P	R
Selene vomer (lookdown)	Both	X	X	X	X		O	S, F	J	SP, S, F	P	C
Seriola dumerilli (greater amberjack)	Both		X		X		O	SP, S	J	S, F	P	R
Seriola zonata (banded rudderfish)	MI		X				O	W, SP, S, F	J	S	P	R
Trachinotus carolinus (Florida pompano)	MI	X					O	SP, S	J	SP, S, F	P	A
Trachinotus falcatus (permit)	Both	X					O	SP, S	J	SP, S, F	P	C
Trachinotus goodei (palometa)	Both	X					O	SP, S, F	J	S, F	P	R
Family Lutjanidae (Snappers)												
Lutjanus analis (mutton snapper)	MI				X		O	S	J	S, F, W	HS	R
Lutjanus apodus (schoolmaster)	Both	X			X		O	S	J	S, F, W	HS	R
Lutjanus campechanus (red snapper)	Both				X		O	S, F	J	S, F, W	HS	R
Lutjanus griseus (gray snapper)	Both		X		X	X	O	S	J	S, F, W	HS	C
Lutjanus jocu (dog snapper)	ZI				X		O	S	J	S, F, W	HS	R
Lutjanus synagris (lane snapper)	Both				X	X	O	SP, S	J	S, F, W	HS	C
Family Lobotidae (Tripletails)												
Lobotes surinamensis (tripletail)	MI				X		O	SP, S	J	S, F	P	R

Family Gerreidae (Mojarras)												
Diapterus auratus (Irish pompano)	Both				X		U	SP?	J, A	SP, S, F	SS	C
Eucinostomus argenteus (spotfin mojarra)	Both		X	X	X	X	O	SP, S	J, A	SP, S, F	SS	A
Eucinostomus gula (silver jenny)	Both				X		O	W, SP	J, A	SP, S, F	SS	C
Family Haemulidae (Grunts)												
Haemulon aurolineatum (tomtate)	MI		X				O	SP	J	S, F	HS	C
Haemulon plumieri (white grunt)	MI		X				O	S	A	S, F	HS	R
Orthopristis chrysoptera (pigfish)	Both		X	X	X	X	O	SP, S	J, A	SP, S, F	SS	A
Family Sparidae (Porgies)												
Archosargus probatocephalus (sheepshead)	Both		X		X	X	O	SP	J, A	W, SP, S, F	HS	C
Calamus leucosteus (whitebone porgy)	MI		X				O	SP, S	J, A	SP, S, F	HS	R
Diplodus holbrooki (spottail pinfish)	MI		X		X		O	W, SP	J, A	SP, S, F	HS	C
Lagodon rhomboides (pinfish)	Both	X	X	X	X	X	O	F, W	J, A	W, SP, S, F	HS	A
Stenotomus caprinus (longspine porgy)	MI		X		X	X	O	U	J, A	SP, S, F	HS	C
Stenotomus chrysops (scup)	MI		X				O	SP, S	J, A	SP, S	HS	R
Family Sciaenidae (Drums)												
Bairdiella chrysoura (silver perch)	Both		X		X	X	E	SP	J, A	SP, S, F	SS	A
Cynoscion nebulosus (spotted seatrout)	Both				X	X	E/O	SP, S	J, A	W, SP, S, F	SS	C
Cynoscion nothus (silver seatrout)	Both				X	X	O	SP, S	J, A	SP, S, F	SS	C
Cynoscion regalis (weakfish)	Both				X	X	E	SP, S	J, A	SP, S, F	SS	C
Larimus fasciatus (banded drum)	MI	X					O	SP, S	J	S	SS	R
Leiostomus xanthurus (spot)	Both	X	X	X	X	X	O	F, W	J, A	W, SP, S, F	SS	A
Menticirrhus americanus (southern kingfish)	MI	X					O	SP, S	J, A	SP, S, F	SS	C
Menticirrhus littoralis (gulf kingfish)	MI	X					O	SP, S	J, A	SP, S, F	SS	C
Menticirrhus saxatillis (northern kingfish)	MI	X					O	SP	J, A	W, SP, S, F	SS	C
Micropogonias undulatus (Atlantic croaker)	Both	X	X		X	X	O	F, W	J, A	SP, S, F	SS	A
Pogonias cromis (black drum)	MI				X	X	O	SP	J, A	SP, S, F	SS	C
Sciaenops ocellatus (red drum)	Both		X		X	X	O	S, F	J, A	W, SP, S, F	SS	C
Stellifer lanceolatus (star drum)	Both		X		X	X	E/O	S	J, A	W, SP, S, F	SS	C
Family Ephippidae (Spadefishes)												
Chaetodipterus faber (Atlantic spadefish)	Both		X		X	X	O	S	J, A	S, F	HS	C

Family Chaetodontidae (Butterflyfishes)												
Chaetodon ocellatus (spotted butterflyfish)	MI		X				O	SP, S	J, A	S, F	HS	R
Family Pomacentridae (Damselfishes)												
Abudefduf saxatilis (sergeant major)	MI		X				O	U	J	S, F	HS	R
Stegastes dorsopunicans (dusky damselfish)	MI		X				O	U	J	S, F	HS	R
Stegastes variabilis (cocoa damselfish)	MI		X				O	U	J	S, F	HS	R
Famliy Mugilidae (Mullets)												
Mugil cephalus (striped mullet)	Both	X	X		X	X	O	F	J, A	W, SP, S, F	P	A
Mugil curema (white mullet)	Both	X		X	X		O	SP	J	SP, S, F	P	A
Famliy Sphyraenidae (Barracudas)												
Sphyraena barracuda (great barracuda)	Both		X		X		O	SP, S, F	J	S	P	R
Sphyraena borealis (northern sennet)	Both				X	X	O	W	J, A	SP, S, F	P	C
Sphyraena guachancho (guaguanche)	MI				X		U	U	J, A	SP, S, F	P	C
Family Labridae (Wrasses)												
Halichoeres bivittatus (slippery dick)	MI		X				O	U	J, A	S, F	HS	C
Tautoga onitis (tautog)	Both		X		X		O	SP, S	J, A	W, SP, S, F	HS	C
Family Uranoscopidae (Stargazers)												
Astroscopus y-graecum (southern stargazer)	MI				X		U	U	J, A	S, F	SS	C
Family Blenniidae (Combtooth blennies)												
Chasmodes bosquianus (striped blenny)	Both				X		E	SP, S	J, A	W, SP, S, F	HS	C
Hypleurochilus geminatus (crested blenny)	Both		X		X		E	SP, S	J, A	W, SP, S, F	HS	R
Hypsoblennius hentzi (feather blenny)	Both		X		X		E	SP, S	J, A	W, SP, S, F	HS	C
Parablennius marmoreus (seaweed blenny)	MI		X		X		E	SP, S	J, A	W, SP, S, F	HS	R
Family Eleotrididae (Sleepers)												
Erotelis smaragdus (emerald sleeper)	MI				X		E	SP?	A	SP	SS	R
Family Gobiidae (Gobies)												
Bathygobius soporator (frillfin goby)	MI				X		E	U	J, A	SP,S,F	SS	R
Evorthodus lyricus (lyre goby)	MI				X		E	U	J, A	W, SP, S, F	SS	R
Gobionellus boleosoma (darter goby)	Both				X		E	SP, S	J, A	W, SP, S, F	SS	R
Gobionellus oceanicus (highfin goby)	Both				X		E	U	J, A	W, SP, S, F	HS,SS	R
Gobionellus shufeldti (freshwater goby)	Both				X		E	U	J, A	W, SP, S, F	HS,SS	R

Gobiosoma bosc (naked goby)	Both			X		E	SP, S, F	J, A	W, SP, S, F	HS, SS	C
Microgobius thalassinus (green goby)	MI			X		E	U	J, A	W, SP, S, F	SS	R
Family Acanthuridae (Surgeonfishes)											
Acanthurus coeruleus (blue tang)	MI		X			O?	U	J	S, F	HS	R
Acanthurus chirurgus (doctorfish)	MI		X			O?	U	J	S, F	HS	R
Family Trichiuridae (Snake makerels)											
Trichiurus lepturus (Atlantic cutlassfish)	Both			X		O	SP	J, A	SP, S, F	P	C
Family Scombridae (Mackerels)											
Sarda sarda (Atlantic bonito)	MI		X			O	SP, S	A	SP, S, F	P	C
Scomberomorus cavalla (king mackerel)	ZI			X		O	SP, S, F	J, A	SP, S, F	P	C
Scomberomorus maculatus (Spanish mackerel)	Both			X	X	O	SP, S	J, A	SP, S, F	P	C
Family Stromateidae (Butterfishes)											
Peprilus alepidotus (harvestfish)	Both			X	X	O	SP, S	J, A	SP, S, F	SS	C
Peprilus triacanthus (butterfish)	Both			X	X	O	SP, S	J, A	SP, S, F	SS	C
Order Pleuronectiformes											
Family Bothidae (Lefteye flounders)											
Ancylopsetta quadrocellata (ocellated flounder)	Both				X	X	U	U	J, A	SP, S, F	SS	C
Citharichthys macrops (spotted whiff)	MI				X		U	U	J, A	SP, S, F	SS	C
Citharichthys spilopterus (bay whiff)	Both				X	X	U	U	J, A	SP, S, F	SS	C
Etropus crossotus (fringed flounder)	Both			X	X	X	E?	SP	J, A	SP, S, F	SS	C
Paralichthys albigutta (gulf flounder)	Both				X	X	O	F, W	J, A	W, SP, S, F	SS	C
Paralichthys dentatus (summer flounder)	Both	X		X	X	X	O	S, F, W	J, A	W, SP, S, F	SS	C
Paralichthys lethostigma (southern flounder)	Both	X	X	X	X	X	O	F, W	J, A	W, SP, S, F	SS	A
Paralichthys squamilentus (broad flounder)	MI	X					O	U	J	S, F	SS	R
Scophthalmus aquosus (windowpane)	Both				X		E	SP, S	J, A	W, SP, S, F	SS	C
Family Soleidae (Soles)											
Symphurus civitatium (offshore toungefish)	Both				X		O	W	J	W, SP, S, F	SS	R
Symphurus plagiusa (blackcheek toungefish)	Both	X	X		X	X	E	SP, S	J, A	W, SP, S, F	SS	A
Trinectes maculatus (hogchoker)	Both				X	X	E	SP, S	J, A	W, SP, S, F	SS	C
Order Tetraodotiformes											
Family Balistidae (Leatherjackets)											

Aluterus schoepfi (orange filefish)	Both			X		O	U	J	SP, S, F	P	R
Aluterus scriptus (scrawled filefish)	MI	X				O	U	J	SP, S, F	P	R
Monacanthus ciliatus (fringed filefish)	MI			X		O	U	J	SP, S, F	P	R
Monacanthus hispidus (planehead filefish)	Both	X	X	X	X	O	U	J, A	SP, S, F	P	C
Family Ostraciidae (Boxfishes)											
Acanthostracion quadricornis (scrawled cowfish)	ZI			X		O	U	J	S, F	P	R
Family Tetraodontidae (Puffers)											
Chilomycterus schoepfi (striped burrfish)	Both	X	X	X	X	U	U	J, A	SP, S, F	SS	C
Lagocephalus laevigatus (smooth puffer)	MI			X	X	O	U	J, A	SP, S, F	SS	R
Sphoeroides maculatus (northern puffer)	Both	X	X	X	X	O	SP, S, F	J, A	SP, S, F	SS	C

TOTAL MASONBORO ISLAND SPECIES 155
TOTAL ZEKE'S ISLAND SPECIES 103

The combined data bases and literature yielded a rich species diversity (163 total fish species) for these two southern North Carolina NCNERR components. The only comparative checklist for this area reported 249 marine and freshwater fishes from the Cape Fear River estuary, resulting from seven years of intensive sampling (Schwartz et al. 1982). Forty two of the fishes reported by Schwartz et al. (1982) were largely freshwater species that are unlikely to occur in the Reserve components. Thus, our listing encompasses 79% of the 207 marine fishes listed in this area. Most of the techniques used to sample fishes for the Reserve checklist were targeted toward shallow waters and small, juvenile life stages. Therefore, most of the larger species (e.g., sharks, rays) that probably occur in the Reserves were not adequately sampled.

These fishes were typical of the warm temperate estuaries of the South Atlantic Bight (Ross and Epperly 1985, Weinstein 1985). This ichthyofauna was marine derived with one exception, a single bluegill collected at Zeke's Island. This fish was collected in Sep 1996 following large freshwater flows from the Cape Fear River after Hurricane Fran (Figure 5). Other noteworthy species included *Bregmaceros atlanticus* (antenna codlet), *Paraconger caudilimbatus* (margintail conger), *Lutjanus apodus* (schoolmaster), and *Erotelis smaragdus* (emerald sleeper). While the antenna codlet and margintail conger have been collected in offshore North Carolina waters, these represent the first estuarine records from this area. The margintail conger record, however, resulted from a species list in Innes (1992) where the specimen was not saved, and thus it is somewhat doubtful. Schoolmaster are generally not listed in literature for North Carolina, but juveniles have been collected in polyhaline estuaries between Cape Lookout and Cape Fear. Our record of emerald sleeper represents a new species for North Carolina, and it is being described in detail in a forthcoming review of gobioids from the region (Ross and Rohde, ms in review).

The ichthyofauna in these two Reserve components was dominated by relatively few families and species. Species of the families Clupeidae, Engraulidae, Cyprinodontidae, Sciaenidae, and Bothidae were ubiquitously present in large numbers which is typical of southeastern United States estuaries. The dominant life history trait exhibited by fishes in these estuaries is one where adults spawn offshore during late fall through early spring, larvae migrate into estuaries and as juveniles settle into shallow bays and creeks where they reside through the spring and summer, leaving for deeper waters in the fall.

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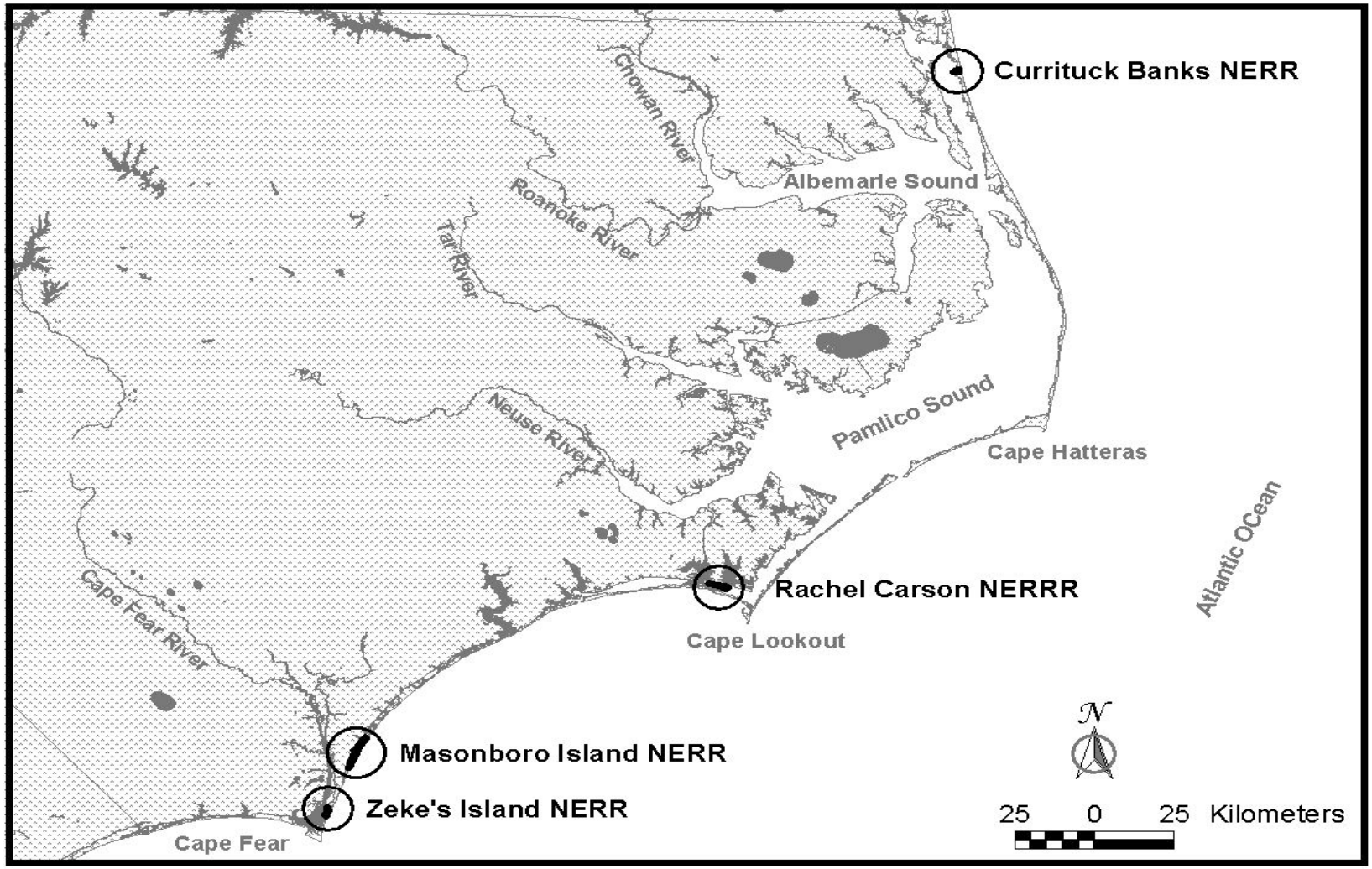

Figure 1. Components of the North Carolina Estuarine Research Reserve

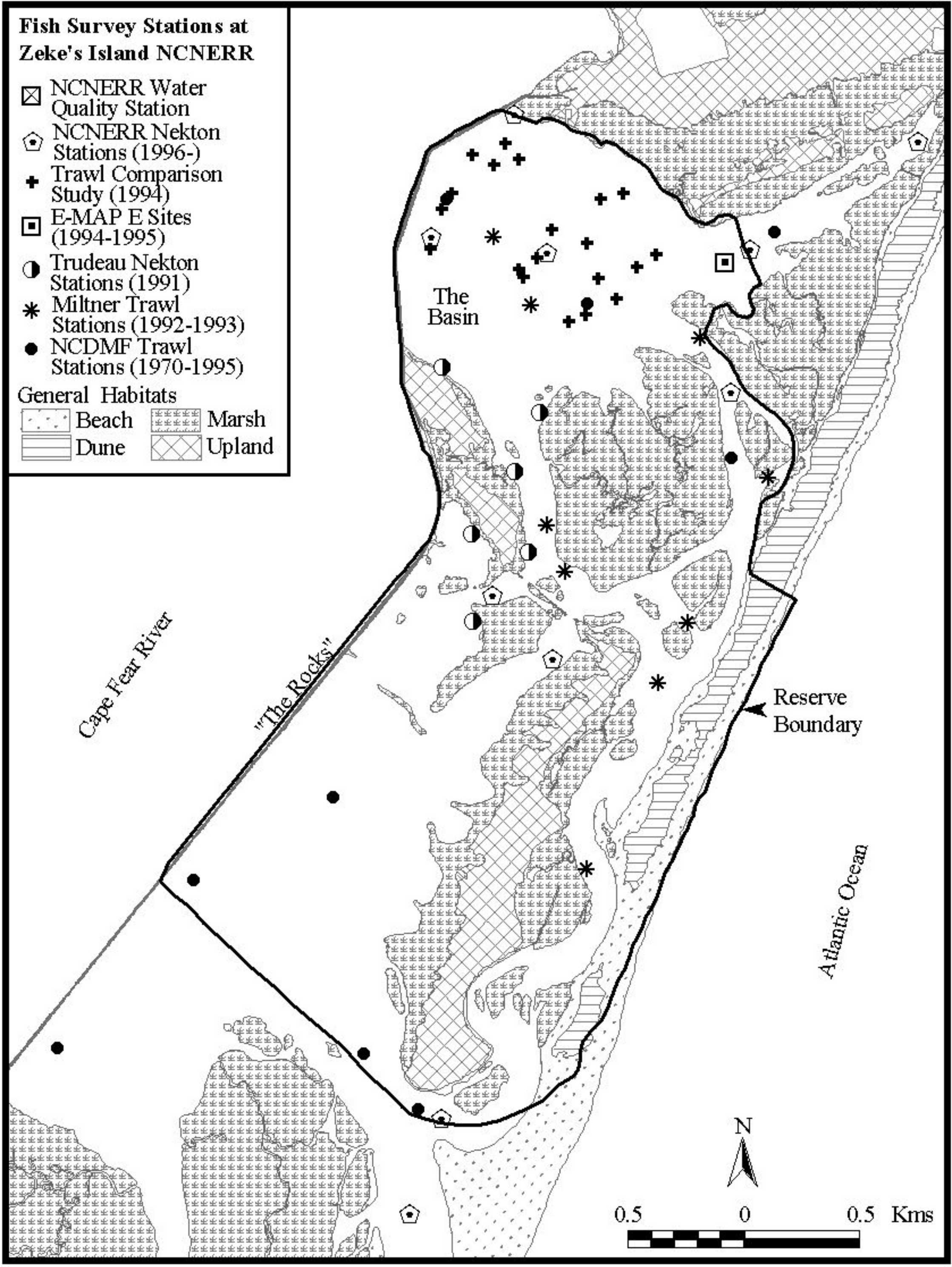

Figure 2. Nekton Sampling stations in and around the Zeke's Island NCNERR.

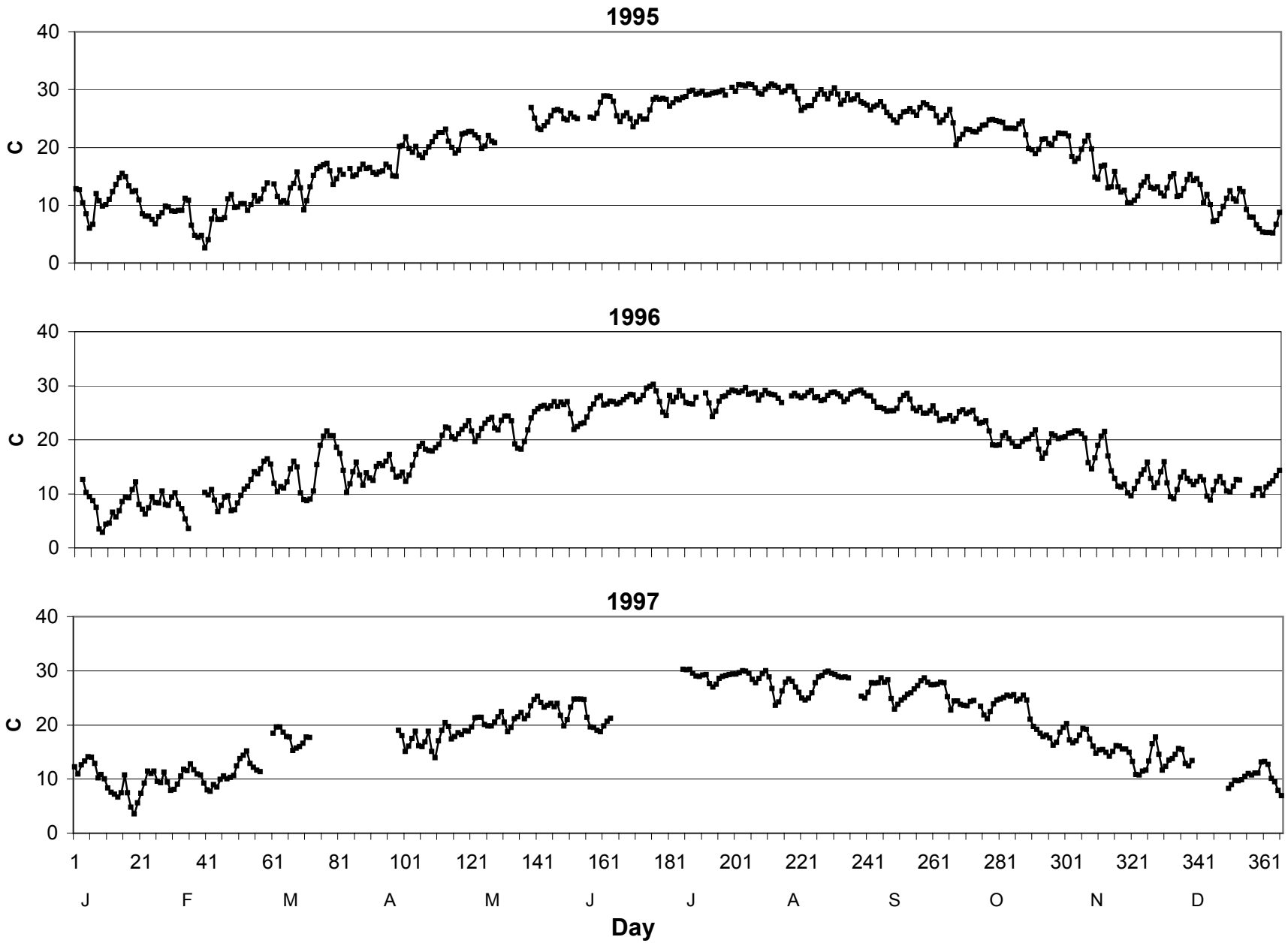

Figure 3. Daily mean bottom water temperature from the Zeke's Island NCNERR.

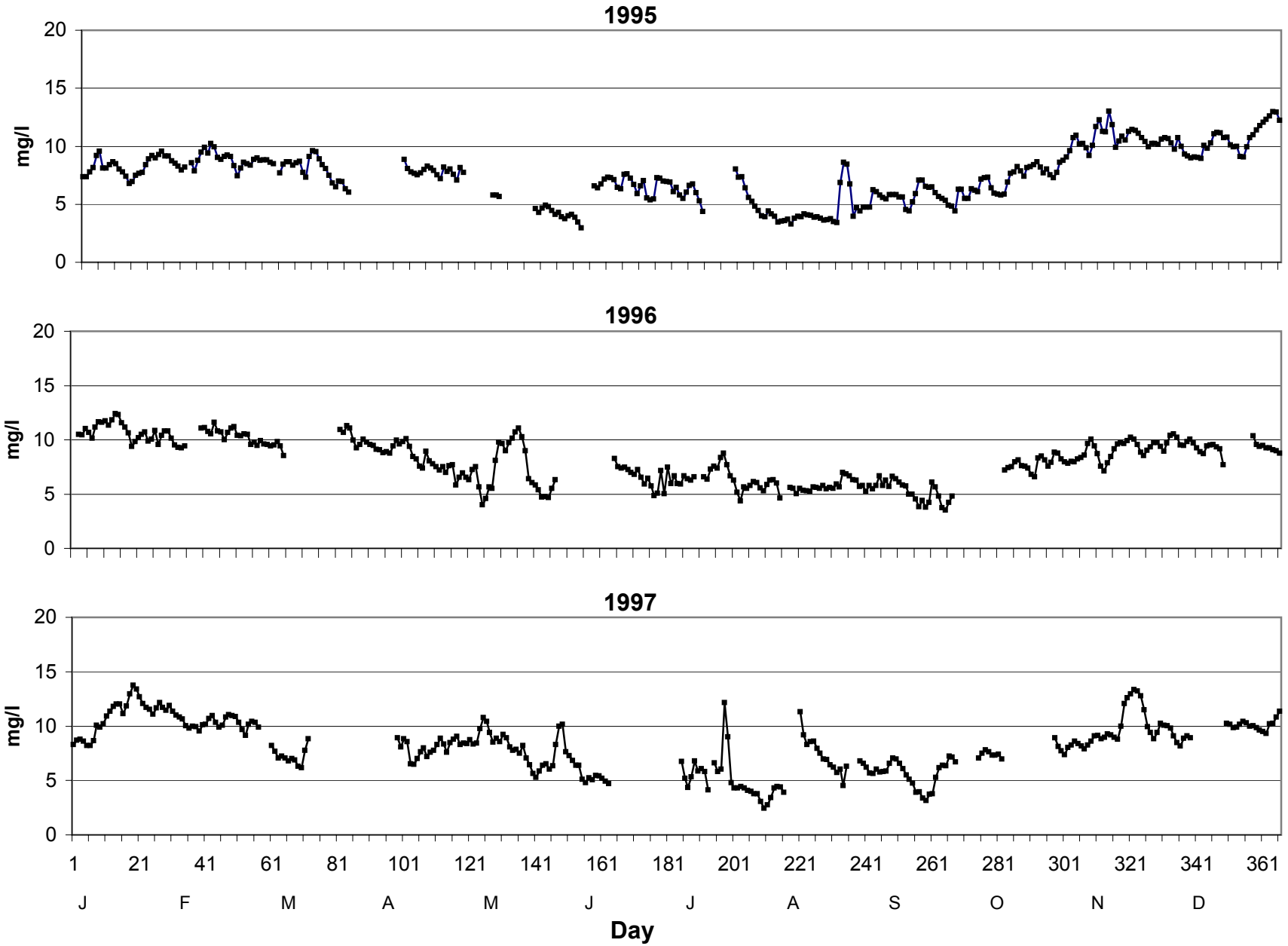

Figure 4. Daily mean bottom dissolved oxygen from the Zeke's Island NCNERR.

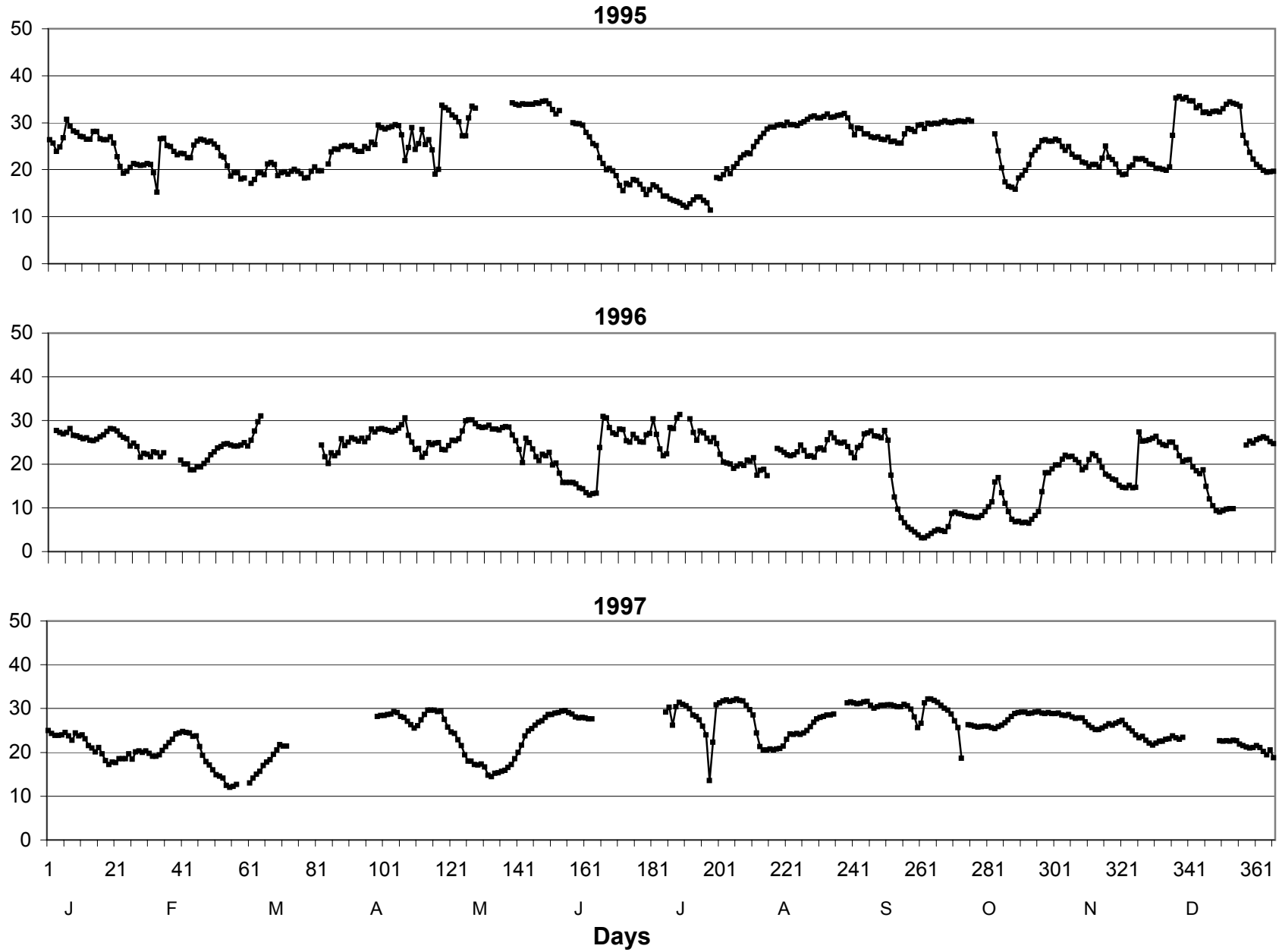

Figure 5. Daily mean bottom salinity from the Zeke's Island NCNERR.

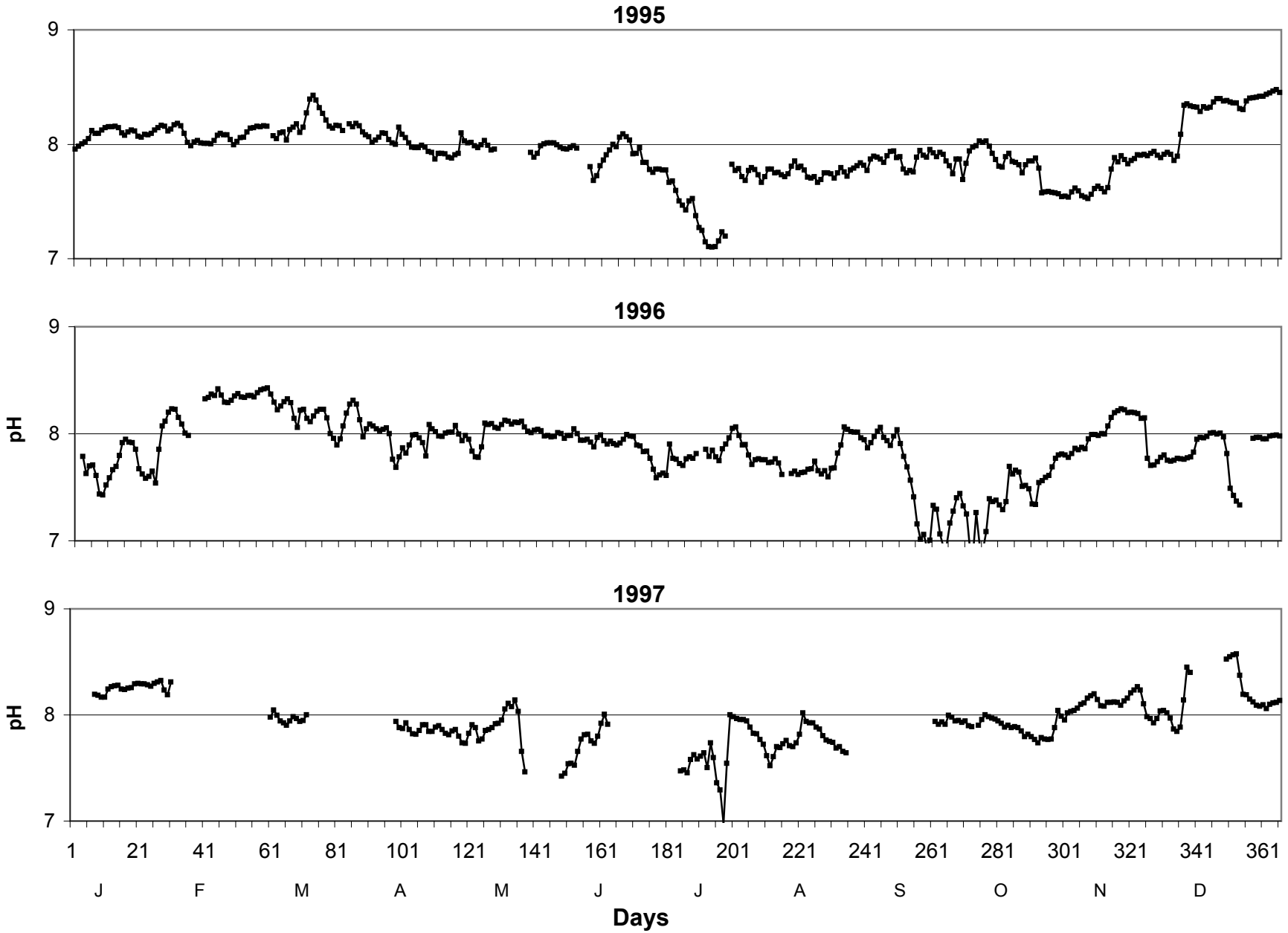

Figure 6. Daily mean bottom pH from the Zeke's Island NCNERR.

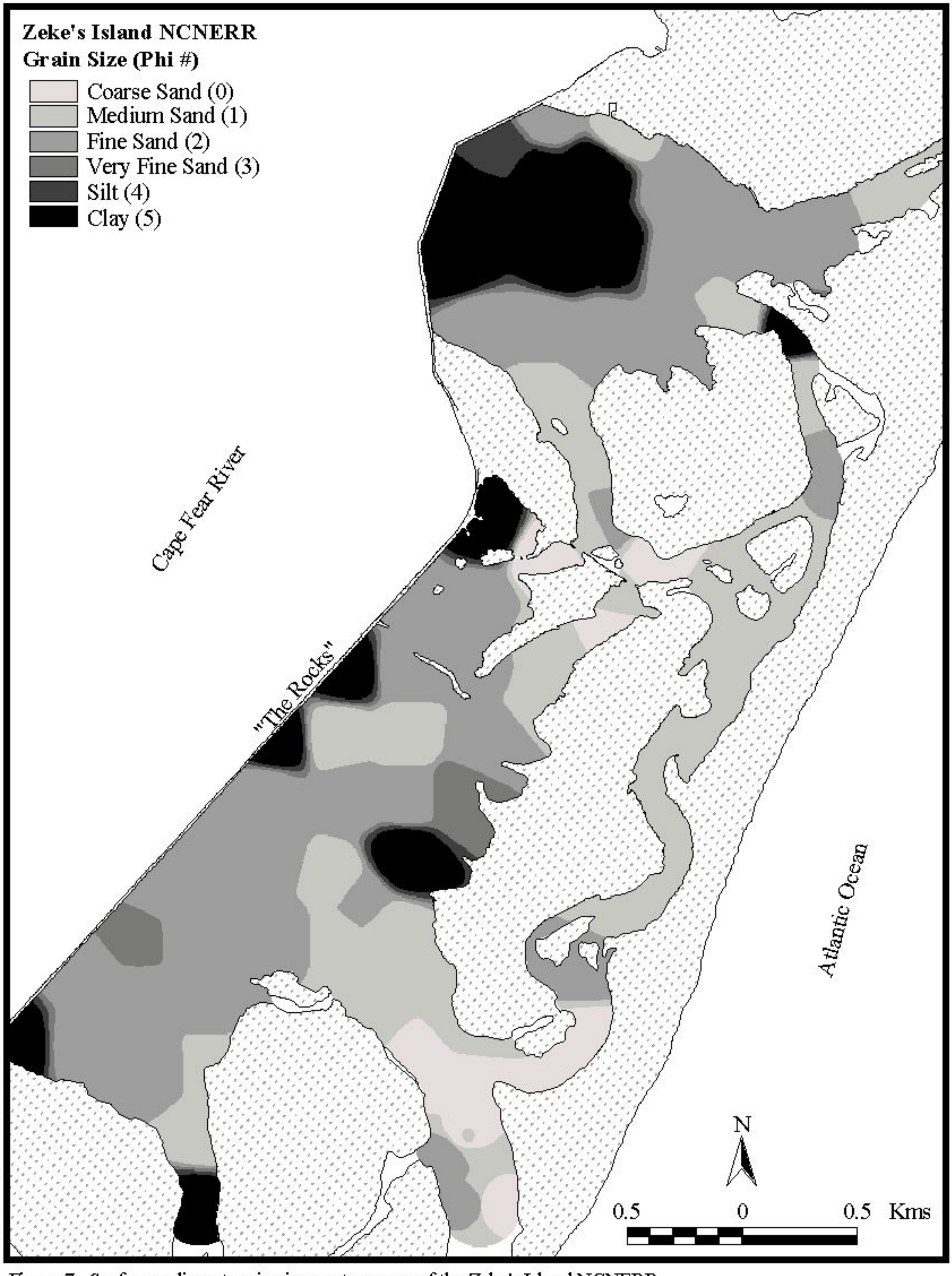

Figure 7. Surface sediment grain size contour map of the Zeke's Island NCNERR.

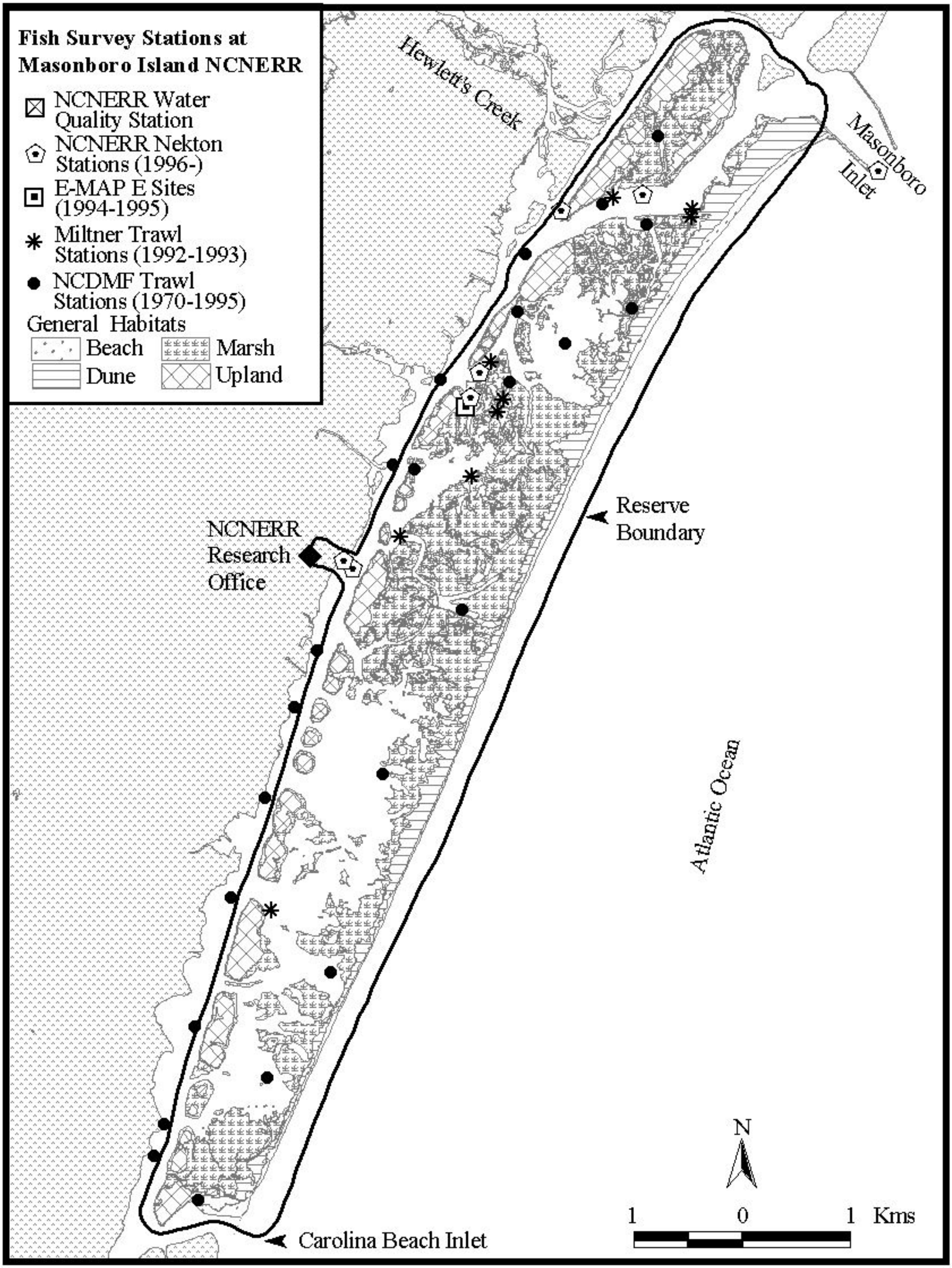

Figure 8. Nekton Sampling stations in the Masonboro Island NCNERR.

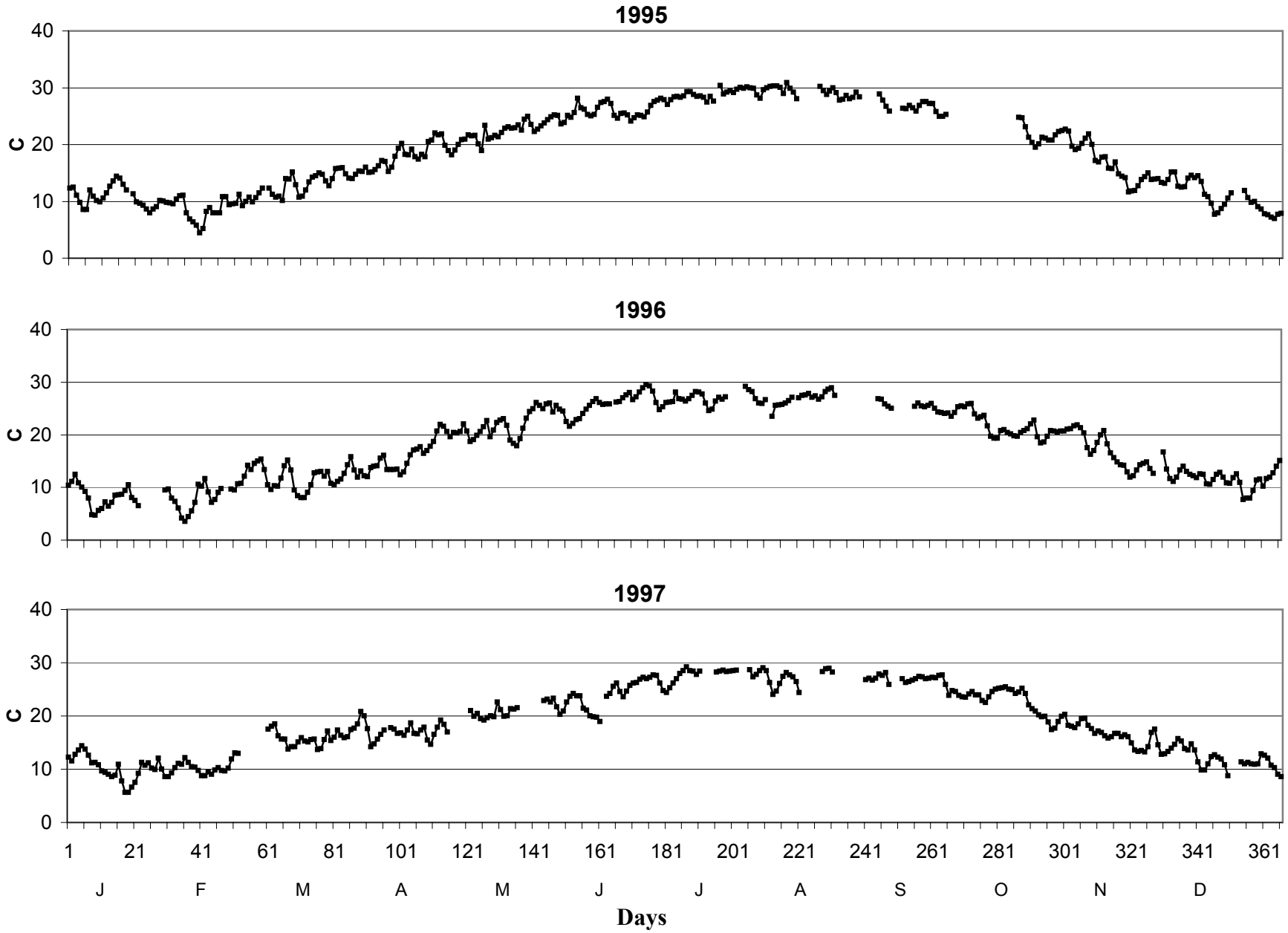

Figure 9. Daily mean bottom water temperature from the Masonboro Island NCNERR.

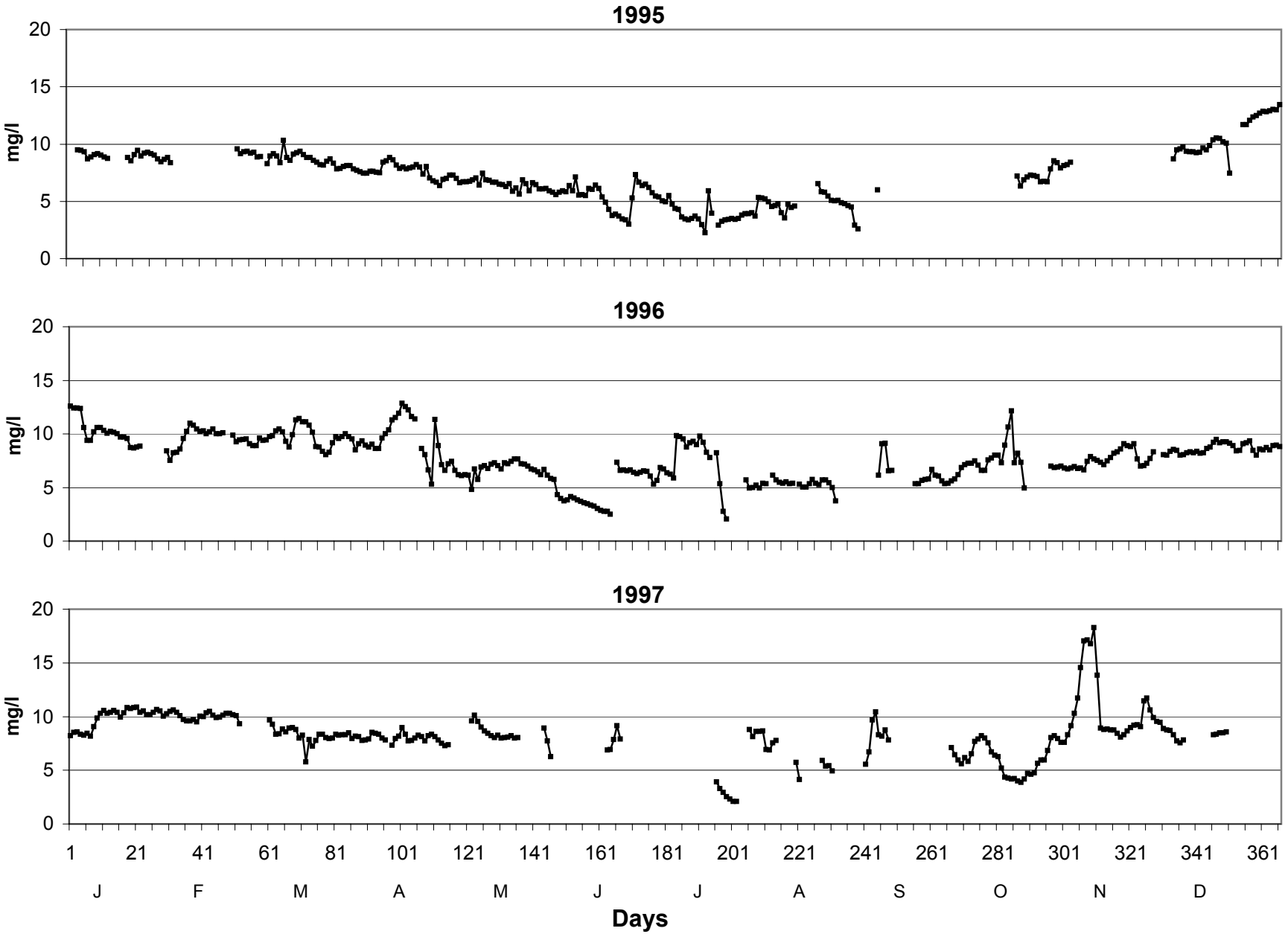

Figure 10. Daily mean bottom dissolved oxygen from the Masonboro Island NCNERR.

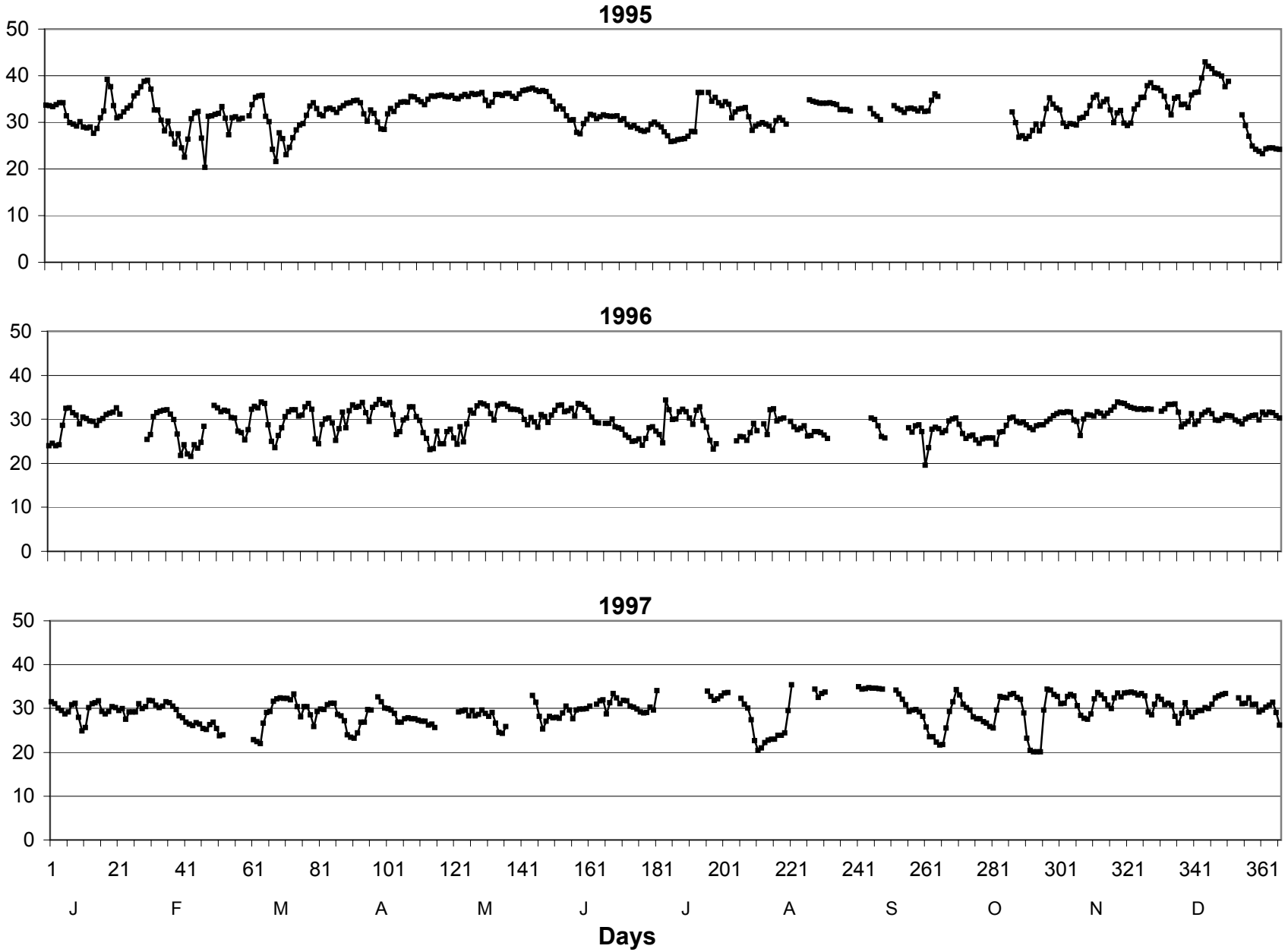

Figure 11. Daily mean bottom salinity from the Masonboro Island NCNERR.

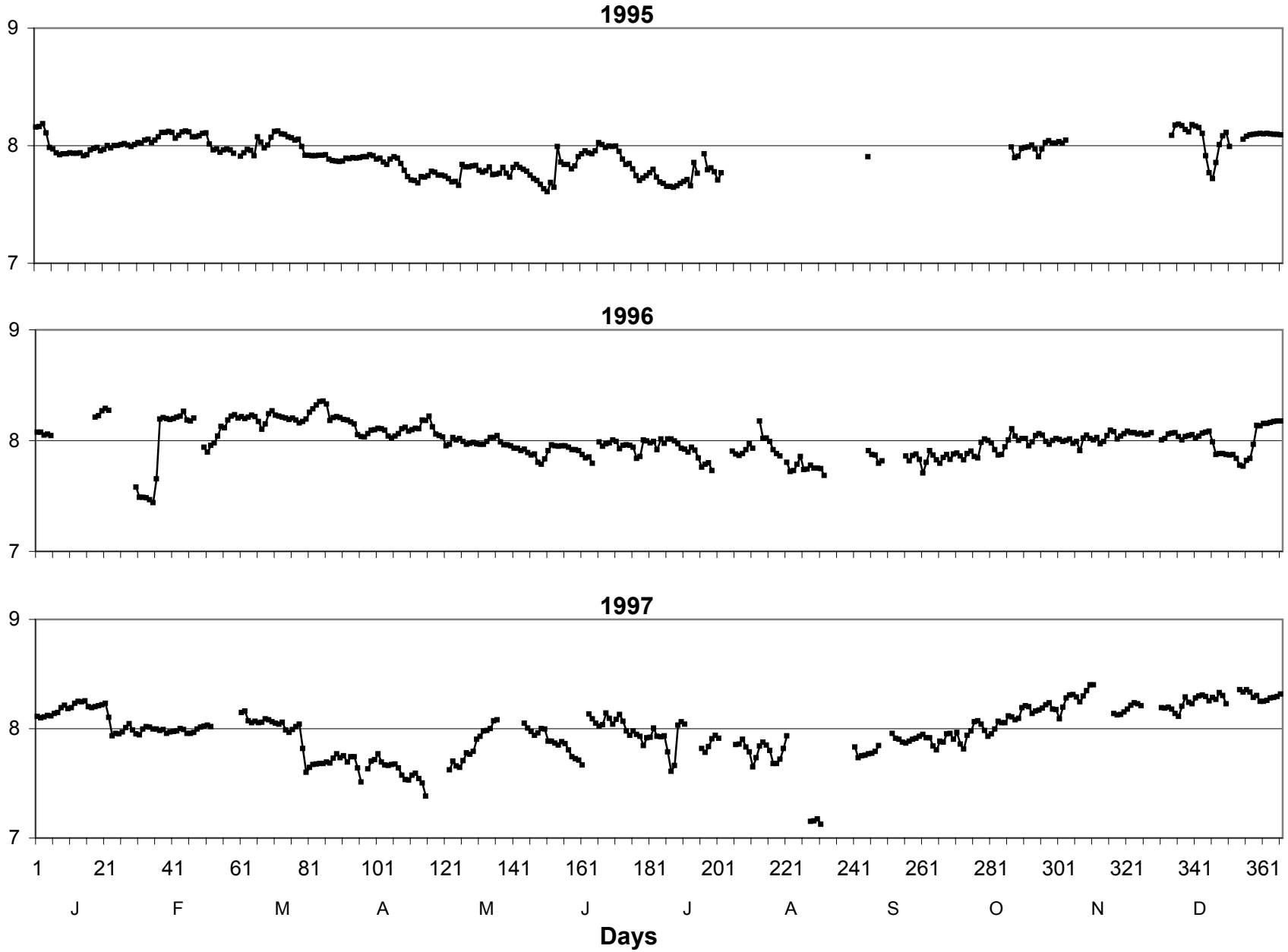

Figure 12. Daily mean bottom pH from the Masonboro Island NCNERR.

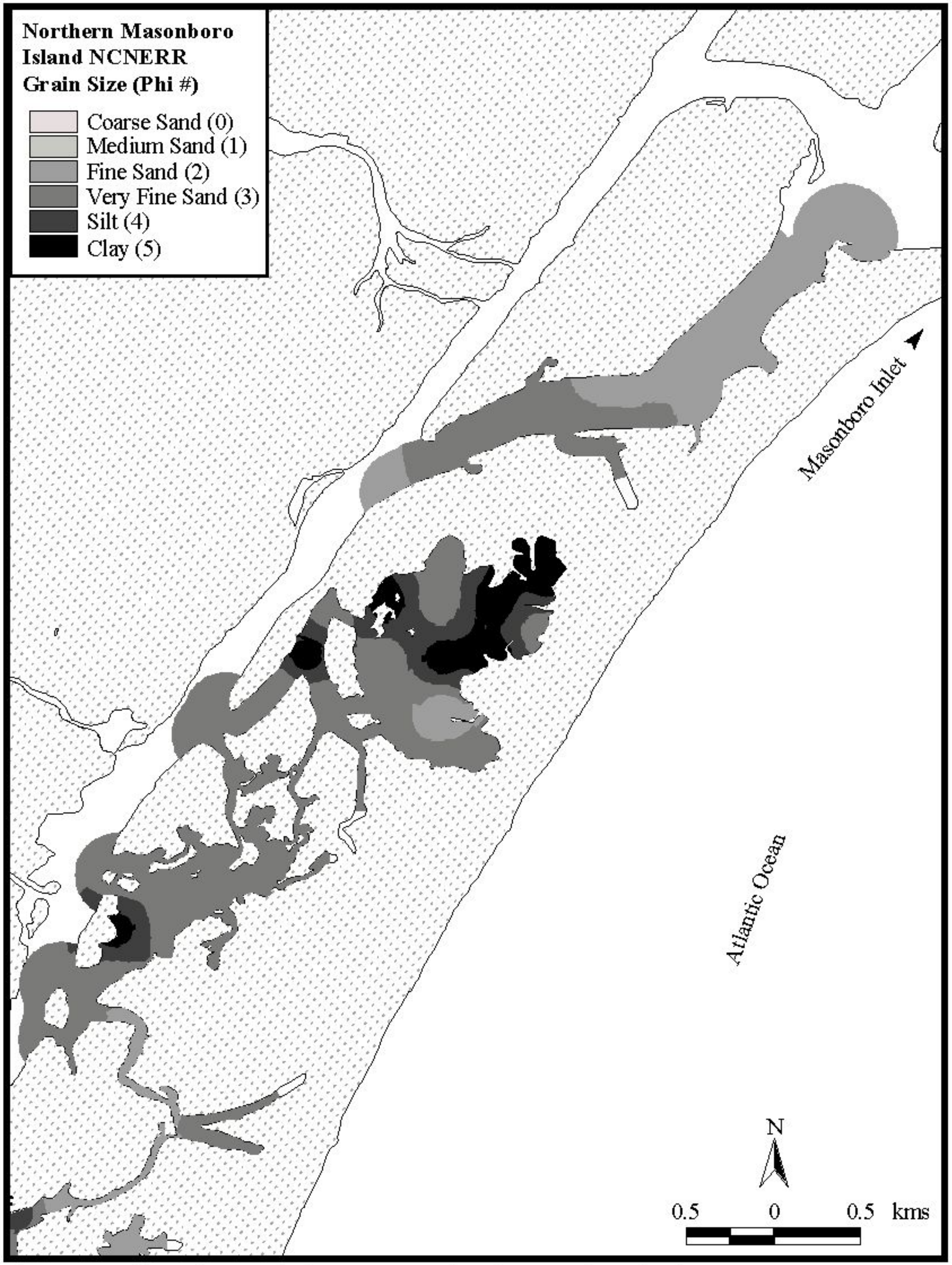

Figure 13a. Surface sediment grain size contour map of Northern Masonboro Island NCNERR.

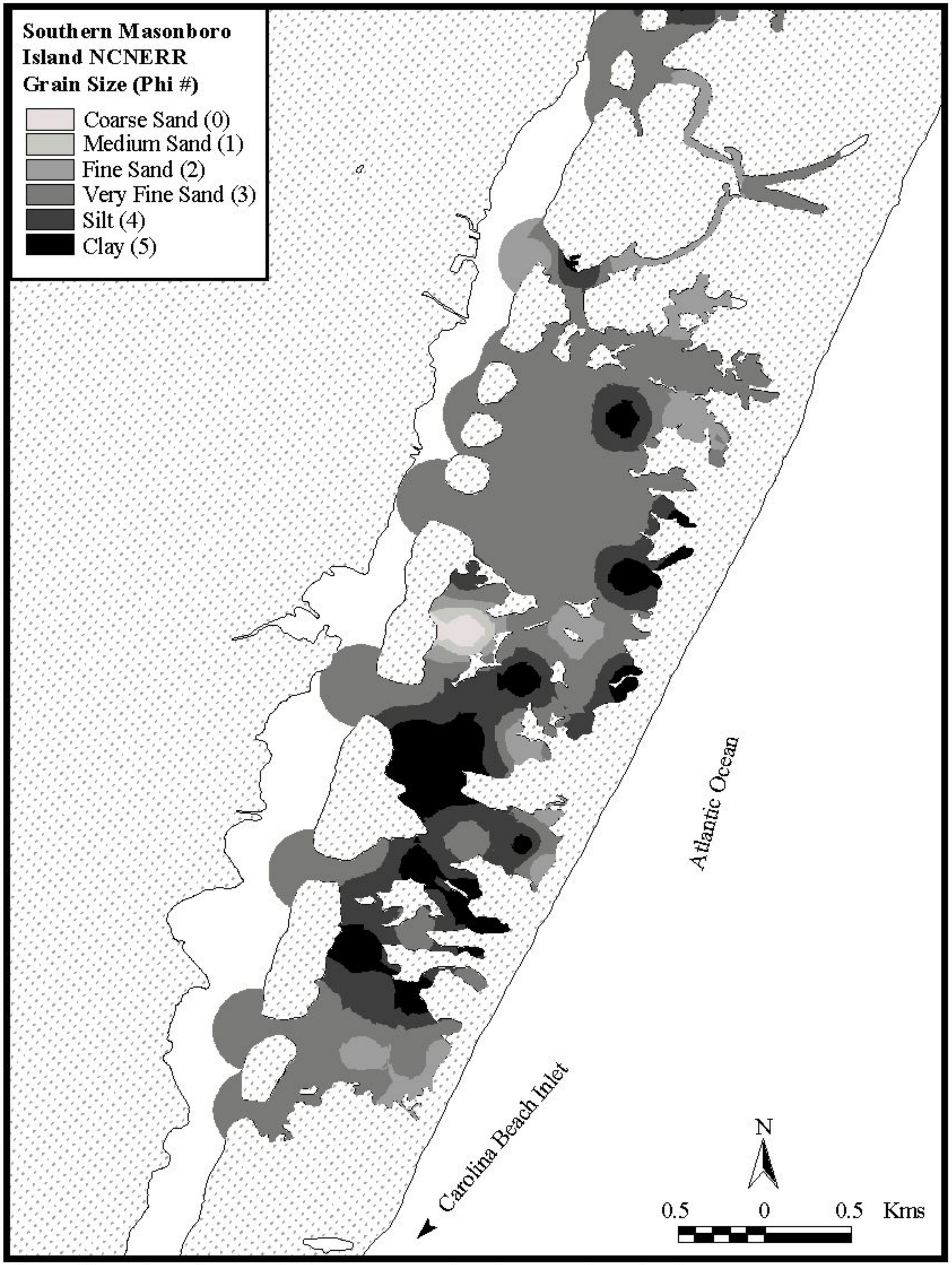

Figure 13b. Surface sediment grain size contour map of Southern Masonboro Island NCNERR.