NOAA Technical Memorandum NMFS-NE-174

Essential Fish Habitat Source Document:

Clearnose Skate, *Raja eglanteria*, Life History and Habitat Characteristics

U. S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region
Northeast Fisheries Science Center
Woods Hole, Massachusetts

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Clearnose Skate, *Raja eglanteria*, Life History and Habitat Characteristics

David B. Packer, Christine A. Zetlin, and Joseph J. Vitaliano

National Marine Fisheries Serv., James J. Howard Marine Sciences Lab., 74 Magruder Rd., Highlands, NJ 07732

U. S. DEPARTMENT OF COMMERCE
Donald L. Evans, Secretary
National Oceanic and Atmospheric Administration
Vice Admiral Conrad C. Lautenbacher, Jr., USN (ret.), Administrator
National Marine Fisheries Service
William T. Hogarth, Assistant Administrator for Fisheries
Northeast Region
Northeast Fisheries Science Center
Woods Hole, Massachusetts

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Editorial Notes on Issues 122-152, 163, and 173-179 in the *NOAA Technical Memorandum NMFS-NE* Series

Editorial Production

For Issues 122-152, 163, and 173-179, staff of the Northeast Fisheries Science Center's (NEFSC's) Ecosystems Processes Division have largely assumed the role of staff of the NEFSC's Editorial Office for technical and copy editing, type composition, and page layout. Other than the four covers (inside and outside, front and back) and first two preliminary pages, all preprinting editorial production has been performed by, and all credit for such production rightfully belongs to, the staff of the Ecosystems Processes Division.

Internet Availability

Issues 122-152, 163, and 173-179 have been copublished, *i.e.*, both as paper copies and as Web postings. All Web postings are available at: *www.nefsc.noaa.gov/nefsc/habitat/efh*. Also, all Web postings are in "PDF" format.

Information Updating

By federal regulation, all information specific to Issues 122-152, 163, and 173-179 must be updated at least every five years. All official updates will appear in the Web postings. Paper copies will be reissued only when and if new information associated with Issues 122-152, 163, and 173-179 is significant enough to warrant a reprinting of a given issue. All updated and/or reprinted issues will retain the original issue number, but bear a "Revised (Month Year)" label.

Species Names

The NMFS Northeast Region's policy on the use of species names in all technical communications is generally to follow the American Fisheries Society's lists of scientific and common names for fishes (*i.e.*, Robins *et al.* 1991[a]), mollusks (*i.e.*, Turgeon *et al.* 1998[b]), and decapod crustaceans (*i.e.*, Williams *et al.* 1989[c]), and to follow the Society for Marine Mammalogy's guidance on scientific and common names for marine mammals (*i.e.*, Rice 1998[d]). Exceptions to this policy occur when there are subsequent compelling revisions in the classifications of species, resulting in changes in the names of species (*e.g.*, Cooper and Chapleau 1998[e]; McEachran and Dunn 1998[f]).

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[a]Robins, C.R. (chair); Bailey, R.M.; Bond, C.E.; Brooker, J.R.; Lachner, E.A.; Lea, R.N.; Scott, W.B. 1991. Common and scientific names of fishes from the United States and Canada. 5th ed. *Amer. Fish. Soc. Spec. Publ.* 20; 183 p.

[b]Turgeon, D.D. (chair); Quinn, J.F., Jr.; Bogan, A.E.; Coan, E.V.; Hochberg, F.G.; Lyons, W.G.; Mikkelsen, P.M.; Neves, R.J.; Roper, C.F.E.; Rosenberg, G.; Roth, B.; Scheltema, A.; Thompson, F.G.; Vecchione, M.; Williams, J.D. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: mollusks. 2nd ed. *Amer. Fish. Soc. Spec. Publ.* 26; 526 p.

[c]Williams, A.B. (chair); Abele, L.G.; Felder, D.L.; Hobbs, H.H., Jr.; Manning, R.B.; McLaughlin, P.A.; Pérez Farfante, I. 1989. Common and scientific names of aquatic invertebrates from the United States and Canada: decapod crustaceans. *Amer. Fish. Soc. Spec. Publ.* 17; 77 p.

[d]Rice, D.W. 1998. Marine mammals of the world: systematics and distribution. *Soc. Mar. Mammal. Spec. Publ.* 4; 231 p.

[e]Cooper, J.A.; Chapleau, F. 1998. Monophyly and interrelationships of the family Pleuronectidae (Pleuronectiformes), with a revised classification. *Fish. Bull. (U.S.)* 96:686-726.

[f]McEachran, J.D.; Dunn, K.A. 1998. Phylogenetic analysis of skates, a morphologically conservative clade of elasmobranchs (Chondrichthyes: Rajidae). *Copeia* 1998(2):271-290.

FOREWORD

One of the greatest long-term threats to the viability of commercial and recreational fisheries is the continuing loss of marine, estuarine, and other aquatic habitats.

Magnuson-Stevens Fishery Conservation and Management Act (October 11, 1996)

The long-term viability of living marine resources depends on protection of their habitat.

NMFS Strategic Plan for Fisheries Research (February 1998)

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), which was reauthorized and amended by the Sustainable Fisheries Act (1996), requires the eight regional fishery management councils to describe and identify essential fish habitat (EFH) in their respective regions, to specify actions to conserve and enhance that EFH, and to minimize the adverse effects of fishing on EFH. Congress defined EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." The MSFCMA requires NMFS to assist the regional fishery management councils in the implementation of EFH in their respective fishery management plans.

NMFS has taken a broad view of habitat as the area used by fish throughout their life cycle. Fish use habitat for spawning, feeding, nursery, migration, and shelter, but most habitats provide only a subset of these functions. Fish may change habitats with changes in life history stage, seasonal and geographic distributions, abundance, and interactions with other species. The type of habitat, as well as its attributes and functions, are important for sustaining the production of managed species.

The Northeast Fisheries Science Center compiled the available information on the distribution, abundance, and habitat requirements for each of the species managed by the New England and Mid-Atlantic Fishery Management Councils. That information is presented in this series of 38 EFH species reports (plus one consolidated methods report). The EFH species reports are a survey of the important literature as well as original analyses of fishery-independent data sets from NMFS and several coastal states. The species reports are also the source for the current EFH designations by the New England and Mid-Atlantic Fishery Management Councils, and understandably have begun to be referred to as the "EFH source documents."

NMFS provided guidance to the regional fishery management councils for identifying and describing EFH of their managed species. Consistent with this guidance, the species reports present information on current and historic stock sizes, geographic range, and the period and location of major life history stages. The habitats of managed species are described by the physical, chemical, and biological components of the ecosystem where the species occur. Information on the habitat requirements is provided for each life history stage, and it includes, where available, habitat and environmental variables that control or limit distribution, abundance, growth, reproduction, mortality, and productivity.

Identifying and describing EFH are the first steps in the process of protecting, conserving, and enhancing essential habitats of the managed species. Ultimately, NMFS, the regional fishery management councils, fishing participants, Federal and state agencies, and other organizations will have to cooperate to achieve the habitat goals established by the MSFCMA.

A historical note: the EFH species reports effectively recommence a series of reports published by the NMFS Sandy Hook (New Jersey) Laboratory (now formally known as the James J. Howard Marine Sciences Laboratory) from 1977 to 1982. These reports, which were formally labeled as *Sandy Hook Laboratory Technical Series Reports*, but informally known as "Sandy Hook Bluebooks," summarized biological and fisheries data for 18 economically important species. The fact that the bluebooks continue to be used two decades after their publication persuaded us to make their successors – the 38 EFH source documents – available to the public through publication in the *NOAA Technical Memorandum NMFS-NE* series.

JAMES J. HOWARD MARINE SCIENCES LABORATORY
HIGHLANDS, NEW JERSEY
SEPTEMBER 1999

JEFFREY N. CROSS, (FORMER) CHIEF
ECOSYSTEMS PROCESSES DIVISION
NORTHEAST FISHERIES SCIENCE CENTER

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INTRODUCTION

The clearnose skate (*Raja eglanteria* Bosc 1802; Figure 1) occurs along the eastern United States coast from the Nova Scotian Shelf to northeastern Florida as well as in the northern Gulf of Mexico from northwestern Florida to Texas (Bigelow and Schroeder 1953a; Robinson 1969; McEachran and Musick 1975; Stehmann and McEachran 1978; see also Northeast Fisheries Science Center [NEFSC] trawl surveys, below). It is a southern species that is considered rare in the northern part of its range (Bigelow and Schroeder 1953a).

McEachran (2002) distinguishes clearnose skates from other skates in the Gulf of Maine by a combination of the following characters: snout acute, three rows of equally-sized thorns on dorsal and lateral surfaces of the tail, and the dorsal surface of the disc is marked with a series of dark spots and bars.

LIFE HISTORY

The single fertilized egg is encapsulated in an amber to light brown egg case (Figure 2). The egg cases have been described from Sandy Hook Bay, New York/New Jersey (Breder and Nichols 1937; Breder and Atz 1938), Delaware Bay (Fitz and Daiber 1963), and the Gulf of Mexico (Luer and Gilbert 1985). The cases are rectangular in shape, with a relatively short, medially-curved horn at each corner, and range in size from 60-80 mm long and 37-51 mm wide (Fitz and Daiber 1963; Luer and Gilbert 1985; McEachran 2002). The horns are shorter than the remainder of the capsule and the anterior horns are longer than the posterior horns. The egg cases are smooth but are marked with fine longitudinal striations (McEachran 2002). North of Cape Hatteras the egg cases are deposited in the spring and summer; in Delaware Bay, Fitz and Daiber (1963) reported spawning to occur only in the spring. Off the central west coast of Florida, egg deposition occurs from December through mid-May (Luer and Gilbert 1985). Luer and Gilbert (1985), studying clearnose skate from Florida, found that they lay an average of 30 pairs of eggs in a season, ranging from 23-35 pairs/individual. The average interval between laying of successive pairs of eggs is around 4.5 days, with most of the intervals falling in the range of 2-6 days.

Incubation time has been reported as about three months for skate eggs in Delaware Bay [Fitz and Daiber (1963); this time period also agrees with Breder and Nichols (1937)] and 63 days for eggs from a specimen off the Atlantic coast of Florida (Libby and Gilbert 1960). Fitz and Daiber (1963) reported that newly hatched clearnose skates appeared in Delaware Bay in July, and based on newly hatched juveniles collected along the east coast, they suggest a northward progresson in hatching times. In the laboratory, Luer and Gilbert (1985) allowed eggs laid by Gulf of Mexico skate to incubate at a constant temperature and photoperiod. The mean incubation period was around 82 days. Eggs laid initially in the season hatched in about 88-94 days, while those laid late in the season required about 77-80 days. The incubation periods showed a gradual decrease in duration from 91-77 days, correlating directly with the order of egg pair deposition. [For a description of hatching and egg deposition and development, as well as the mating behavior of clearnose skate, see Luer and Gilbert (1985).]

Age and growth of clearnose skate have been estimated from length frequency plots and by counting rings on vertebral centra (Daiber 1960; Fitz and Daiber 1963). However, vertebrae are difficult to read (Schwartz 1996). In Delaware Bay, Fitz and Daiber (1963) reported newly hatched young to be 15 cm long. They calculated that skates approximately 33 cm long were one year old, 41 cm long two years old, 49 cm long three years old, and > 58 cm long five years old or older. Schwartz (1996) used disk width (DW) age designations from Fitz and Daiber (1963) to age fish from North Carolina. Based on these techniques, clearnose skate was about 21.0 cm DW at age I, 28.0 cm DW at age II, 34.0 cm DW at age III, 40.0 cm DW at age IV, 42.0 cm DW at age V, and 46.0 cm DW at age VI.

Maximum size and size at maturity varies with latitude, the largest individuals occur at highest latitudes (McEachran 2002). The maximum size of clearnose skate has been previously listed as 94-95 cm TL (Bigelow and Schroeder 1953a; Schaefer 1967). Bigelow and Schroeder (1953a) report that they ordinarily grow to a length of 76.2 cm TL. Based on the predictive equations from Frisk *et al*. (2001) and the Northeast Fisheries Science Center (NEFSC) survey maximum observed length of 78 cm TL, L_{mat} is estimated at 61 cm TL and A_{mat} is estimated at 5-6 years (Northeast Fisheries Science Center 2000b).

There are linear regressions defining male and female total length (TL)-weight relationships in North Carolina (Schwartz 1996):

log weight males = -4.9320 + 2.8808 log TL;

log weight females = -5.7680 + 3.1869 log TL.

Clearnose skate feed on polychaetes, amphipods, mysid shrimps (e.g. *Neomysis americana*), the shrimp *Crangon septemspinosa*, mantis shrimps, crabs including *Cancer*, mud, hermit, and spider crabs, *Ovalipes ocellatus*, bivalves (e.g. *Ensis directus*), squids, and small fishes such as soles, weakfish, butterfish, and scup (Bigelow and Schroeder 1953b; Fitz and Daiber 1963; Stehmann and McEachran 1978; Schwartz 1996; Bowman *et al*. 2000; Figure 3). In North Carolina, fish prey included striped anchovy, croaker, spot, and blackcheek tonguefish (Schwartz 1996).

Sharks, such as the sand tiger (*Odontaspis taurus*) regularly prey on the clearnose skate (McEachran 2002), and one has been found in the stomach of a greater amberjack (*Seriola dumerili*) (Rountree 2001). Boring snails may prey on the eggs of clearnose skate (Cox and Koob 1993).

GEOGRAPHICAL DISTRIBUTION

Although clearnose skate occurs along the east coast from the Gulf of Maine south, it is rare in the Gulf of Maine and off Massachusetts (see NEFSC and Massachusetts trawl surveys, below). In the past it has been reported from Gloucester, Provincetown, and on Nantucket shoals (Bigelow and Schroeder 1953a). McEachran and Musick (1975) caught none off Massachusetts or in the Gulf of Maine during 1967-1970 surveys from Nova Scotia to Cape Hatteras.

North of Cape Hatteras, it moves inshore and northward along the continental shelf during the spring and early summer, and offshore and southward during autumn and early winter when water temperatures cool to 13-16°C (Bigelow and Schroeder 1953b, McEachran 1973; McEachran and Musick 1975; see also NEFSC surveys, below). Bigelow and Schroeder (1953b) reported that it appears inshore between Chesapeake Bay and Delaware Bay in April, occurs off New Jersey and New York from late April-May to October-November, and is found off southern Massachusetts from July until September. Schaefer (1967) collected clearnose skate in the surf zone of Long Island from May to November while Gottschall *et al*. (2000), based on surveys from 1984-1994 (see below), found them in Long Island Sound mostly in September and October. Jivoff and Able (2001) found it in the deep channels of Little Egg Harbor in New Jersey in April and May. Fitz and Daiber (1963) found that it appeared in Delaware Bay during April-November. Clearnose skate has been found in Chesapeake Bay from April to December (Massman 1962; Geer 2002, see also Figure 12) and in Chinocoteague, Virginia, and Sinepuxent Bays, Maryland from May to November (Schwartz 1961). In Georgia estuaries, Dahlberg and Odum (1970) reported that it was a year-round resident.

JUVENILES

NEFSC bottom trawl surveys [see Reid *et al*. (1999) for details] captured juvenile (≤ 60 cm TL) clearnose skate year-round and show some of the seasonal onshore/offshore movements mentioned above. (Note that winter and summer distributions are presented as presence/absence data, precluding a discussion of abundances.) In winter, the densest concentrations of juveniles occurred on the Continental Shelf from the Delmarva Peninsula to Cape Hatteras out to the 200 m depth contour. Scattered individuals were also found near the Hudson Canyon (Figure 4). In spring they were concentrated inshore from the Delmarva Peninsula to south of Cape Hatteras, with scattered numbers farther out on the continental shelf (Figure 5). In summer they occurred inshore from the New Jersey coast to around Cape Hatteras, with a very limited presence off Cape Cod (Figure 6). In the fall heavy concentrations were found along the coast from Sandy Hook, New Jersey to south of Cape Hatteras (Figure 7).

The spring and fall 1978-2002 Massachusetts inshore trawl surveys [see Reid *et al*. (1999) for details] show a few scattered juveniles around Cape Cod, in Massachusetts Bay, and around Cape Ann (Figure 8).

The distributions and abundances of both juvenile and adult clearnose skate in Long Island Sound from April to November 1984-1994, based on the Connecticut Fisheries Division bottom trawl surveys, are shown in Figure 9. The following description of their distributions is taken verbatim from Gottschall *et al*. (2000).

Clearnose skate is a relatively rare species in the Sound (only 29 observed), were most often taken during September and October (Figure 9). They were distributed primarily on the sand and transitional bottom of the Mattituck Sill and Eastern Basin. Only five clearnose skate were observed west of the Sill, four of with were in depths > 18 m on mud bottom (Gottschall *et al*. 2000).

Occurrence of juveniles in the Hudson-Raritan estuary [based on Hudson-Raritan trawl surveys; see Reid *et al*. (1999) for details] appears to have the same seasonal pattern noted above; i.e., generally there are fewer in the estuary during the cooler months. Only one juvenile was found in the estuary during the winter (Figure 10). In spring small numbers were scattered throughout the estuary. The largest numbers were captured in the summer, particularly in or near the two channels and south of Coney Island. In the fall, small numbers of juveniles were again found throughout the Hudson-Raritan estuary (Figure 10).

The 1966-1999 Delaware Bay trawl surveys (adults and juveniles combined; Figure 11) also confirm the seasonal trends noted previously for clearnose skate. The greatest abundances occurred in the summer and fall, and they were almost completely absent in the winter. In the spring they were mostly found in the lower Bay, more toward the Delaware side (Figure 11). In summer, increased numbers were found in the center of the lower Bay and particularly near Cape Henlopen. In the fall, the greatest numbers were caught in the center of lower Delaware Bay, at the mouth and near Cape Henlopen (Figure 11).

The 1988-1999 Virginia Institute of Marine Science (VIMS) trawl surveys of Chesapeake Bay show that most juvenile and adult clearnose skate appear in catches between April and December with peak catch per unit effort between May and August (Figure 12; Geer [2002]). They were most abundant near the Bay mouth during spring and summer, but appeared throughout the Bay during all four seasons, and rarely appeared in the tributaries (Figure 13; Geer [2002]). A few were caught by seine in the 1990s along the seaside of the Eastern Shore of Virginia (Geer 2002).

ADULTS

NEFSC bottom trawl surveys captured adult clearnose skate (≥ 61 cm TL) during all seasons, and again showed some of the seasonal onshore/offshore movements mentioned above. (Again, winter and summer distributions are presented as presence/absence data, precluding a discussion of abundances.) In winter, adults were concentrated offshore on the Continental Shelf out to the 200 m depth contour from the near the Hudson Canyon to Cape Hatteras, with the heaviest concentrations from Delaware Bay to the Cape (Figure 14). In spring small numbers were concentrated inshore and out to the 200 m contour from Delaware to south of Cape Hatteras (Figure 15). In summer small concentrations were found mostly inshore from Cape May to Cape Hatteras (Figure 16). Small numbers of adult clearnose skate were concentrated inshore from Long Island to Cape Hatteras in the fall (Figure 17).

Only one adult was caught during the fall Massachusetts inshore trawl surveys (not shown).

The distribution and abundance of both adults and juveniles in Long Island Sound were discussed previously (Figure 9; Gottschall *et al*. [2000]).

As with the juveniles, adult clearnose skate in the Hudson-Raritan estuary were most abundant during the summer months, particularly near the channels (Figure 18).

The seasonal distribution and abundance of both adults and juveniles in Delaware and Chesapeake Bays were discussed previously (Figures 11, 12 and 13).

HABITAT CHARACTERISTICS

Information on the habitat requirements and preferences of clearnose skate (based on both the pertinent literature and the most recent NEFSC and state surveys) are presented here and summarized in Tables 1 and 2.

The clearnose skate is found on soft bottoms along the continental shelf, but also occurs on rocky or gravelly bottoms (Bullis and Thompson 1965; Struhsaker 1969). It has been captured from shore in the northern part of its range to 329 m (McEachran and Musick 1975). Bigelow and Schroeder (1953b) stated it was abundant from the sublittoral zone to around 55 m. Edwards *et al*. (1962) captured it at 280 m and 329 m off of Cape May, New Jersey in the winter. Schwartz (1996), in 1993-1994, captured it at depths of 20 m off Shackleford Banks, North Carolina. However, overall it is most abundant at depths < 111 m (McEachran and Musick 1975). McEachran and Musick (1975) report that during surveys of the Chesapeake Bight, clearnose skate was more abundant in shallow water during spring and summer than during autumn and winter and was more abundant in the Bight during the summer and autumn than in the winter and spring. The spring and fall 1963-2002 NEFSC trawl surveys from the Gulf of Maine to Cape Hatteras (see below) indicated that both juveniles and adults were found over a depth range during spring of between 1-300 m, and during the fall between about 1-80 m for the juveniles or 1-50 m for the adults. Most, however, were found at shallow depths of around 1-30 m during both seasons (Figures 19 and 23). The 1992-1997 Hudson-Raritan estuary trawl surveys (see below) showed that most juveniles were found at around 5-7 m (Figure 20); most adults were captured at 5-8 m (Figure 24). The 1966-1999 Delaware Bay trawl surveys (see below; Figure 21) showed that both juveniles and adults were found over a range of approximately 5-24 m. The 1988-1999 VIMS Chesapeake Bay trawl surveys caught both juveniles and adults over a depth range of 1-33 m, with most between about 7-15 m (see below, Figure 22).

Clearnose skate occurs over a temperature range of 9-30°C, but is most abundant between 9-20°C in the northern part of its range (McEachran and Musick 1975) and 19-30°C in North Carolina (Schwartz 1996). Fitz and Daiber (1963) found that it appeared in Delaware Bay at temperatures above 9°C (about April-November); the Delaware Bay trawl surveys (see below) show that this is generally true. The VIMS trawl surveys caught them in Chesapeake Bay at temperatures between 8-24°C (see below). It has been captured between 5-26°C in the Chesapeake Bight and 9-27°C south of Cape Hatteras (McEachran and Musick 1975). As state previously, north of Cape Hatteras, it moves inshore and northward along the continental shelf during the spring and early summer, and offshore and southward during autumn and early winter when water temperatures cool to 13-16°C (Bigelow and Schroeder 1953b, Schwartz 1961; Massman 1962; Fitz and Daiber 1963; Schaefer 1967; McEachran 1973; McEachran and Musick 1975). The spring and fall 1963-2002 NEFSC trawl surveys from the Gulf of Maine to Cape Hatteras (see below and Figure 19) collected juvenile little skate over a temperatures range of 4-27°C, with most fish found at cooler temperatures in the spring (around 7-16°C), as opposed to the fall (around 18-22°C). Adults were found over a temperature range of 4-25°C, and like the juveniles, most fish were found at cooler temperatures in the spring than in the fall (Figure 23). The 1992-1997 Hudson-Raritan estuary trawl surveys (see below) showed that the juveniles were found between 13-24°C (Figure 20) and adults between 9-24°C (Figure 24). Breder (1924) had reported that clearnose skate was not found in Sandy Hook Bay below a temperature of 14.4°C. The 1966-1999 Delaware Bay trawl surveys (see below; Figure 21) showed that both juveniles and adults were found over a range of approximately 6-27°C.

Fitz and Daiber (1963) reported clearnose skate in areas of Delaware Bay where the salinity was as low as 20 ppt, the Delaware Bay trawl surveys found a few of them at even lower salinities (see below). In Chesapeake

Bay, Geer (2002) reported that most clearnose skate were caught during the VIMS trawl surveys at salinities ≥ 22 ppt (see below). Schwartz (1996) captured them off Shackleford Banks, North Carolina at salinities of 32-34 ppt.. The spring and fall 1963-2002 NEFSC trawl surveys from the Gulf of Maine to Cape Hatteras (see below and Figures 19 and 23) collected juveniles and adults between salinities of about 26-36 ppt, with most found between 32-35 ppt in the spring and 31-32 ppt in the fall.

EGGS

As noted previously, in the laboratory, Luer and Gilbert (1985) allowed eggs laid by Gulf of Mexico skate to incubate at a constant temperature of 20-22°C and photoperiod of 12 hours light/12 hours dark. Eggs laid initially in the season hatched in about 88-94 days, while those laid late in the season required about 77-80 days. The incubation periods showed a gradual decrease in duration from 91-77 days, correlating directly with the order of egg pair deposition. The mean incubation period obtained at constant temperature and photoperiod was 82.2±3.6 days.

JUVENILES

The spring and fall distributions of juvenile clearnose skate relative to bottom water temperature, depth, and salinity based on 1963-2002 NEFSC bottom trawl surveys from the Gulf of Maine to Cape Hatteras are shown in Figure 19. In spring, they were found in waters between 4-21°C, the majority were spread between about 7-16°C. Their depth range during that season was between about 1-300 m, with most between 1-30 m. Their salinity range extended from 26-36 ppt, with the majority found between 32-35 ppt. During the fall, juvenile clearnose skate were found over a temperature range of about 7-27°C, with most spread between about 18-22°C and with peaks at 20-21°C. They were found over a depth range of about 1-80 m, with around 60% found between 11-20 m. They were found in salinities of between 27-36 ppt, with the majority found at 31-32 ppt.

Too few juveniles were found in the spring and fall Massachusetts inshore trawl surveys to plot their distributions relative to habitat parameters.

The seasonal distributions of juveniles in the Hudson-Raritan estuary relative to bottom water temperature, depth, salinity, and dissolved oxygen based on 1992-1997 Hudson-Raritan trawl surveys are shown in Figure 20. The surveys show that during the spring juveniles were found mostly between 13-18°C, with the majority at 16°C. Their depth range during that season was between 5 m to around 14 m, with most found at 5-7 m. Their salinities ranged between 22-30 ppt, with peaks at 25 ppt and 27 ppt. They were found over a range of dissolved oxygen levels of between 8-10 ppm with around 50% at 8 ppm. In summer, clearnose skate were found over a temperature range of between 17-24°C, with most between 20-22°C. Their depth range was between 4 m to about 26 m, with most found between 5-8 m. Their salinities ranged between 23-31 ppt. They were found over a range of dissolved oxygen levels of between 3-9 ppm with most between 6-7 ppm. In the fall, their temperature distribution was between 13-18°C, with about 50% at 16°C. They were found between 5-14 m deep, with most between 5-7 m. Their salinities ranged between 20-31 ppt, with a peak at 21 ppt. They were found over a range of dissolved oxygen levels of between 5-8 ppm with most between 7-8 ppm.

The seasonal distributions of both juveniles and adults in Delaware Bay relative to bottom water temperature, depth, salinity, and dissolved oxygen based on 1966-1999 Delaware Division of Fish and Wildlife bottom trawl surveys are shown in Figure 21. Very few were found in winter; their temperature range was between 7-8°C, and they were found at depths of 8 m, 13 m, and especially 18 m. They were found at salinities of 24 ppt, 28-29 ppt, and at 34 ppt. They were found over a range of dissolved oxygen levels of between 9-10 ppm. In spring, they were found over a wider temperature range of between 6-20°C, most occurred or were caught between 9-18°C. Their depth range was between 7-22 m, with a few at 4 m and 28 m, and peaks at 8-9 m and 13 m. Their salinities ranged between 17-33 ppt, with peaks at 26-27 ppt and 30 ppt. They were found over a range of dissolved oxygen levels of between 6-15 ppm, most were found between 8-10 ppm. In summer, clearnose skate were found over a higher temperatures range of between 14-27°C. They generally occurred or were caught with increasing frequency from 16°C to about 22-23°C. They had a roughly bimodal depth distribution of approximately 5-23 m, the peaks were at about 7-8 m and 13-14 m. Their salinities ranged between about 19-32 ppt, with a few at 12-13 ppt, and a peak at 30 ppt. They were found over a range of dissolved oxygen levels of between 5-10 ppm; the majority were between 6-7 ppm. During fall they were found between 8-24°C, with most found between about 16-21°C. Their depth range during that season was between 6-21 m with a few at 24 m, most were found between about 8-14 m. There was a peak (about 20%) at 8 m. Their salinities were spread between approximately 15-32 ppt, with the majority between 28-30 ppt. They were found over a range of dissolved oxygen levels of between 6-11 ppm, with the majority at 6-8 ppm.

The hydrographic preferences of both juvenile and adult clearnose skate in Chesapeake Bay from the 1988-1999 VIMS trawl surveys are shown in Figure 22 (all years and months combined). Geer (2002) suggests that since they are present in the Bay for all but the coldest months, there appears to be little relationship with catch and temperature, with catches common between 8-24°C (Figure 22). However, Geer (2002) does suggest that there is a clear relationship with salinity, with > 85% of the catch at ≥ 22 ppt. Their depth range was from 1-33 m, with most between about 7-15 m.

ADULTS

The spring and fall distributions of adult clearnose skate relative to bottom water temperature, depth, and salinity based on 1963-2002 NEFSC bottom trawl surveys from the Gulf of Maine to Cape Hatteras are shown in Figure 23. In spring, they were found at temperatures between 4-22°C, with most spread between about 6-15°C. During that period they were found at a depth range of about 1-300 m, with the majority at 11-30 m. They were found over a salinity range of between 26-36 ppt, with the majority between 32-35 ppt. During the fall, they were distributed over a temperature range of 10-25°C, with most found between 18-22°C. They were found over a depth range of 1-50 m with approximately 60% between 11-20 m. Their salinity range during that season was between 27-35 ppt, with the majority at 31-32 ppt.

The seasonal distributions of adults in the Hudson-Raritan estuary relative to bottom water temperature, depth, salinity, and dissolved oxygen are shown in Figure 24. During the spring adults were found over a temperature range of about 9-21°C, with most between 15-17°C and about 45% at 16°C. Their depth range during that season was between 5-16 m, with most found between 5-8 m. Their salinities during that period ranged between 23-30 ppt, with peaks at 25 and 27 ppt. They were found over a range of dissolved oxygen levels of between 6-11 ppm, with the majority between 7-9 ppm. In summer, adult clearnose skate were found over a temperature range of between 17-24°C, with a peak at 22°C. Their depth range was between 4 m to about 26 m, with most found between 5-8 m. Their salinities during that period ranged between 23-31 ppt, with peaks at 27 and 29 ppt. They were found over a range of dissolved oxygen levels of between 3-10 ppm, with the majority between 6-7 ppm. In the fall, their temperature distribution was between about 12-18°C (a few were at 9°C), with most at 16-17°C. They were found between 4 m to about 17 m deep, with most between 5-8 m. Their salinities during that period ranged between 20-32 ppt, with most between 26-30 ppt. They were found over a range of dissolved oxygen levels of between 5-10 ppm, with the majority between 6-8 ppm.

The seasonal distributions of both juveniles and adults in Delaware Bay relative to bottom water temperature, depth, salinity, and dissolved oxygen based on Delaware Division of Fish and Wildlife bottom trawl surveys were discussed previously (Figure 21).

The hydrographic preferences of both juvenile and adult clearnose skate in Chesapeake Bay from the 1988-1999 VIMS trawl surveys were discussed previously (Figure 22).

STATUS OF THE STOCKS

The following section is based on Northeast Fisheries Science Center (2000a, b).

The principal commercial fishing method used to catch all seven species of skates [clearnose, little (*Leucoraja erinacea*), barndoor (*Dipturus laevis*), winter (*Leucoraja ocellata*), thorny, (*Raja eglanteria*), rosette (*Leucoraja garmani*), smooth (*Malacoraja senta*)] is otter trawling. Skates are frequently taken as bycatch during groundfish trawling and scallop dredge operations and discarded recreational and foreign landings are currently insignificant, at < 1% of the total fishery landings.

Skates have been reported in New England fishery landings since the late 1800s. However, commercial fishery landings, primarily from off Rhode Island, never exceeded several hundred metric tons until the advent of distant-water fleets during the 1960s. Landings are not reported by species, with over 99% of the landings reported as "unclassified skates." Skate landings reached 9,500 mt in 1969, but declined quickly during the 1970s, falling to 800 mt in 1981 (Figure 25). Landings have since increased substantially, partially in response to increased demand for lobster bait, and more significantly, to the increased export market for skate wings. Wings are taken from winter and thorny skates, the two species currently used for human consumption. Bait landings are presumed to be primarily from little skate, based on areas fished and known species distribution patterns. Landings for all skates increased to 12,900 mt in 1993 and then declined somewhat to 7,200 mt in 1995. Landings have increased again since 1995, and the 1998 reported commercial landings of 17,000 mt were the highest on record (Figure 25). In terms of total recreational landings for clearnose skate, they varied between 2000 and 145,000 fish, equivalent to 2 to 232 mt, during 1981-1998.

The biomass for the seven skate species is at a medium level of abundance. For the aggregate complex, the NEFSC spring survey index of biomass was relatively constant from 1968-1980, then increased significantly to peak levels in the mid- to late 1980s. The index of skate complex biomass then declined steadily until 1994, but has recently increased again. The large increase in skate biomass in the mid- to late 1980s was dominated by little and winter skate. The abundance of clearnose skate has been increasing since the mid-1980s (Figure 25), although the recent increase in aggregate skate biomass has been due to an increase in all the small sized skates (< 100 cm max. length: clearnose, little, rosette, and smooth), primarily little skate. Clearnose skate is not considered to be overfished (Northeast Fisheries Science Center 2000a, b).

RESEARCH NEEDS

Imprecise reporting of fishery statistics where several skate species are lumped together under one category (e.g., "unclassified skates" or "skates spp.") can mask basic changes in community structure and profound reduction in populations of larger, slower growing species (Dulvy *et al*. 2000; Musick *et al*. 2000). Thus, it is important to have fishery-independent data on skates where the individual species are reported.

Northeast Fisheries Science Center (2000b) also suggests the following research needs:

- More life history studies (including age, growth, maturity, and fecundity studies) are necessary.
- Studies of stock structure are needed to identify unit stocks.
- Explore possible stock-recruit relationships by examination of NEFSC survey data.
- Investigate trophic interactions between skate species in the complex, and between skates and other groundfish.
- Investigate the influence of annual changes in water temperature or other environmental factors on shifts in the range and distribution of the species in the skate complex, and establish the bathymetric distribution of the species in the complex in the northwest Atlantic.
- Investigate historical NEFSC survey data from the R/V Albatross III during 1948-1962 when they become available, as they may provide valuable historical context for long-term trends in skate biomass.

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Table 1. Summary of habitat parameters for clearnose skate, based on the pertinent literature[1].

Depth	Temperature	Substrate/Salinity	Predators	Prey
Captured from shore in the northern part of its range to 329 m. Most abundant at depths < 111 m. Captured at 280 m and 329 m off of Cape May, New Jersey in the winter. In the Chesapeake Bight, it was more abundant in shallow water during spring and summer than during autumn and winter and was more abundant in the Bight during summer and autumn than in winter and spring. Captured at depths of 20 m off Shackleford Banks, North Carolina in 1993-1994.	Occurs over a temperature range of 9-30°C, but is most abundant between 9-20°C in northern part of range and 19-30°C in North Carolina. Appeared in Delaware Bay at temperatures above 9°C (about April-November). Has been captured between 5-26°C in the Chesapeake Bight and 9-27°C south of Cape Hatteras. North of Cape Hatteras, it moves inshore and northward along the continental shelf during spring and early summer, and offshore and southward during autumn and early winter when water temperatures cool to 13-16°C. In the lab, eggs from Gulf of Mexico skate hatched after a mean time of 82.2±3.6 days when incubated at a constant temperature of 20-22°C and photoperiod of 12 hours light/12 hours dark. Eggs laid initially in the season hatched in about 88-94 days, those laid later required about 77-80 days. Incubation periods showed a gradual decrease in duration from 91-77 days, correlating directly with order of egg pair deposition.	Found on soft bottoms along the continental shelf, but also occurs on rocky or gravelly bottoms. In Long Island Sound during 1984-1994, they were distributed primarily on the sand and transitional bottom of the Mattituck Sill and Eastern Basin. Only five skate observed west of the Sill, four of with were in depths > 18 m on mud bottom. Reported in areas of Delaware Bay where the salinity was as low as 20 ppt, the Delaware Bay trawl surveys found a few of them at even lower salinities (see below). Captured off Shackleford Banks, North Carolina at salinities of 32-34 ppt.	Sharks, such as the sand tiger (*Odontaspis taurus*). One found in the stomach of a greater amberjack (*Seriola dumerili*). Boring snails may prey on the eggs.	Polychaetes, amphipods, mysid shrimps (e.g. *Neomysis americana*), the shrimp *Crangon septemspinosa*, crabs including *Cancer*, mud, hermit, and spider crabs, *Ovalipes ocellatus*, bivalves (e.g. *Ensis directus*), squids, and small fishes such as soles, weakfish, butterfish, and scup. In North Carolina, fish prey included striped anchovy, croaker, spot, blackcheek tonguefish.

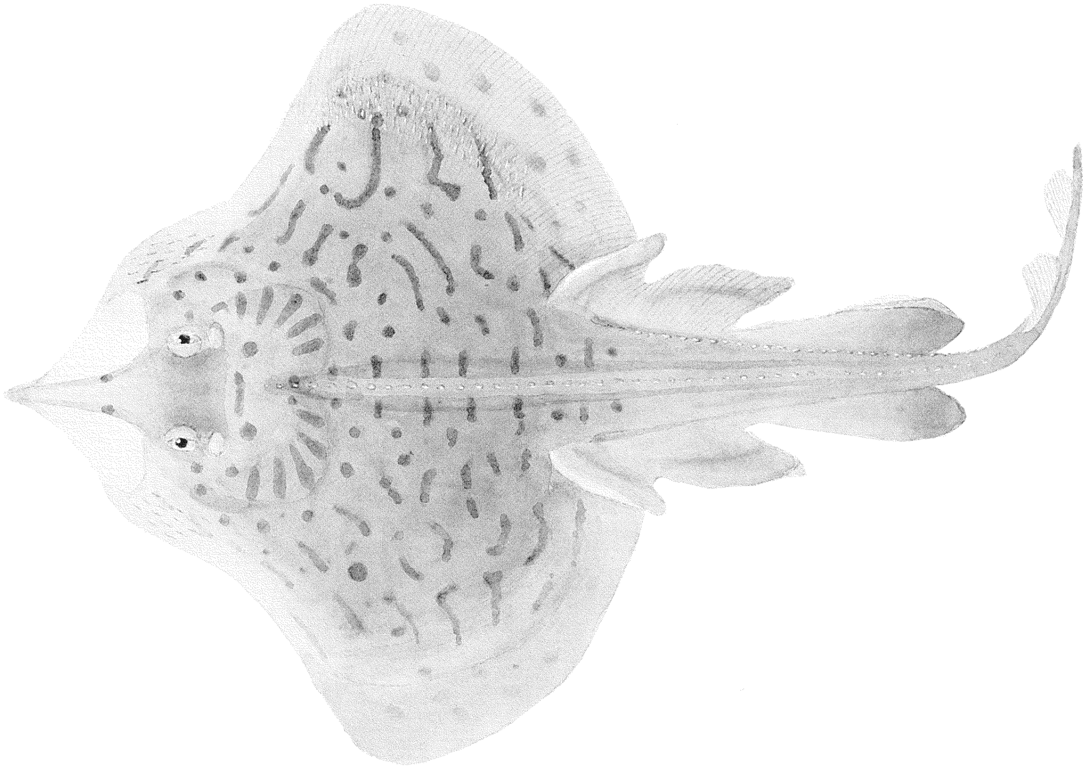
[1]Bigelow and Schroeder (1953b); Edwards *et al*. (1962); Massman (1962); Fitz and Daiber (1963); Bullis and Thompson (1965); Schaefer (1967); Struhsaker (1969); McEachran (1973); McEachran and Musick (1975); Stehmann and McEachran (1978); Schwartz (1961, 1996); Luer and Gilbert (1985); Cox and Koob (1993); Bowman *et al*. (2000); Gottschall *et al*. (2000); Rountree (2001); McEachran (2002).

Table 2. Summary of habitat parameters for clearnose skate, based on the most recent NEFSC and state surveys mentioned in the text.

Life Stage	Survey	Depth	Temperature	Salinity/DO
Juveniles	1963-2002 NEFSC trawl surveys from Gulf of Maine to Cape Hatteras.	*Spring*: range of about 1-300 m, most between 1-30 m. *Fall*: range of about 1-80 m, around 60% found between 11-20 m.	*Spring*: range of 4-21°C, majority spread between about 7-16°C. *Fall*: range of about 7-27°C, most spread between about 18-22°C, peaks at 20-21°C.	*Spring*: range of 26-36 ppt, majority between 32-35 ppt. *Fall*: range of 27-36 ppt, majority at 31-32 ppt.
	1992-1997 NEFSC trawl surveys of the Hudson-Raritan estuary.	*Spring:* range of 5 to around 14 m, most at 5-7 m. *Summer:* range of 4 m to about 26 m, most between 5-8 m. *Fall*: range of 5-14 m, most between 5-7 m.	*Spring*: range of 13-18°C, majority at 16°C. *Summer*: range of 17-24°C, most between 20-22°C. *Fall:* range of 13-18°C, about 50% at 16°C.	*Spring*: range of 22-30 ppt, peaks at 25 ppt and 27 ppt / range of 8-10 ppm, around 50% at 8 ppm. *Summer*: range of 23-31 ppt / range of 3-9 ppm, most between 6-7 ppm. *Fall*: range of 20-31 ppt, peak at 21 ppt / range of 5-8 ppm, most between 7-8 ppm.
	1966-1999 Delaware Division of Fish and Wildlife bottom trawl surveys of Delaware Bay (juveniles and adults combined).	*Winter*: very few found, at 8 m, 13 m, and especially 18 m. *Spring:* range of 7-22 m, a few at 4 m and 28 m, peaks at 8-9 m and 13 m. *Summer:* roughly bimodal distribution of approximately 5-23 m, peaks at about 7-8 m and 13-14 m. *Fall*: range of 6-21 m, a few at 24 m, most between about 8-14 m; peak (about 20%) at 8 m.	*Winter*: very few found, range of 7-8°C. *Spring*: range of 6-20°C, most between 9-18°C. *Summer:* range of 14-27°C, generally occurred or were caught with increasing frequency from 16°C to about 22-23°C. *Fall:* range of 8-24°C, most between about 16-21°C.	*Winter*: very few found, at 24 ppt, 28-29 ppt, and at 34 ppt / range of 9-10 ppm. *Spring*: range of 17-33 ppt, peaks at 26-27 ppt and 30 ppt / range of 6-15 ppm, most between 8-10 ppm. *Summer:* range of about 19-32 ppt, a few at 12-13 ppt, a peak at 30 ppt / range of 5-10 ppm, majority between 6-7 ppm. *Fall:* range of approximately 15-32 ppt, majority between 28-30 ppt / range of 6-11 ppm, majority at 6-8 ppm.
	1988-1999 Virginia Institute of Marine Science (VIMS) trawl surveys of Chesapeake Bay (juveniles and adults combined).	Range from 1-33 m, most between about 7-15 m.	Catches common between 8-24°C.	> 85% of the catch at ≥ 22 ppt.

Table 2. cont'd.

Life Stage	Survey	Depth	Temperature	Salinity/DO
Adults	1963-2002 NEFSC trawl surveys from Gulf of Maine to Cape Hatteras.	*Spring*: range of about 1-300 m, majority at 11-30 m. *Fall*: range of about 1-50 m, with approximately 60% between 11-20 m.	*Spring*: range of 4-22°C, most spread between about 6-15°C. *Fall*: range of 10-25°C, most between 18-22°C.	*Spring*: range of 26-36 ppt, majority between 32-35 ppt. *Fall:* range between 27-35 ppt, majority at 31-32 ppt.
	1992-1997 NEFSC trawl surveys of the Hudson-Raritan estuary.	*Spring*: range of 5-16 m, most between 5-8 m. *Summer*: range of 4 m to about 26 m, most found between 5-8 m. *Fall*: range of 4 m to about 17 m, most between 5-8 m.	*Spring*: range of about 9-21°C, most between 15-17°C, about 45% at 16°C. *Summer*: range of 17-24°C, peak at 22°C. *Fall*: range of about 12-18°C (a few at 9°C), most at 16-17°C.	*Spring*: range of 23-30 ppt, peaks at 25 and 27 ppt / range of 6-11 ppm, majority between 7-9 ppm. *Summer*: range of 23-31 ppt, peaks at 27 and 29 ppt / range of 3-10 ppm, majority between 6-7 ppm. *Fall*: range of 20-32 ppt, most between 26-30 ppt / range of 5-10 ppm, majority between 6-8 ppm.
	1966-1999 Delaware Division of Fish and Wildlife bottom trawl surveys of Delaware Bay (juveniles and adults combined).	*See juveniles.*	*See juveniles.*	*See juveniles.*
	1988-1999 Virginia Institute of Marine Science (VIMS) trawl surveys of Chesapeake Bay (juveniles and adults combined).	*See juveniles.*	*See juveniles.*	*See juveniles.*



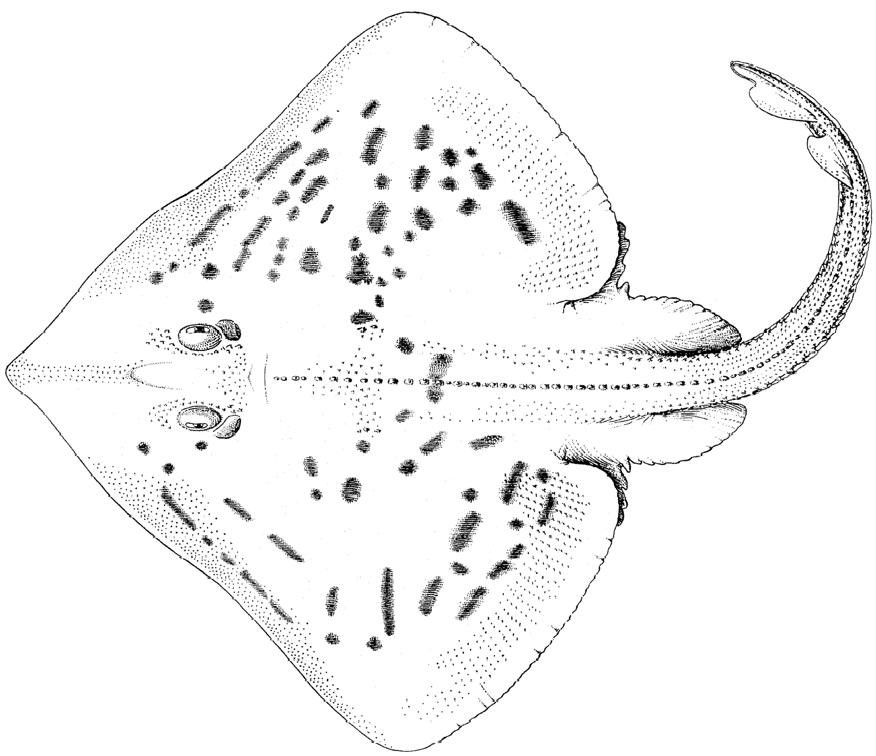


Figure 1. The clearnose skate, *Raja eglanteria* Bosc 1802. Top: male, from Murdy *et al*. (1997). Bottom: female, from Bigelow and Schroeder (1953b).

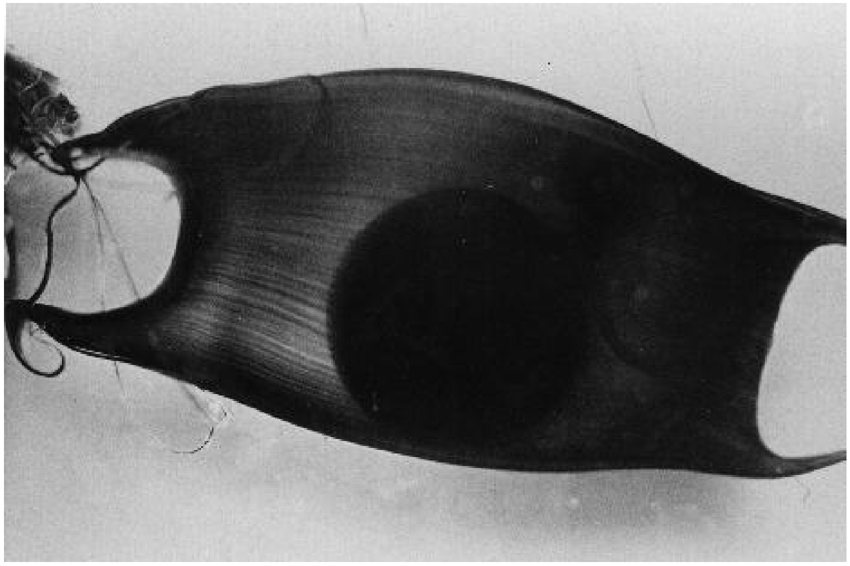
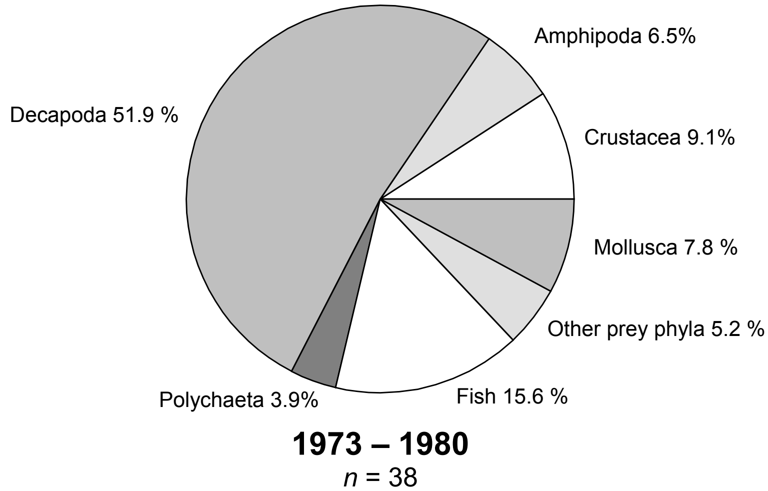


Figure 2. Egg case of clearnose skate, from Luer (1999).



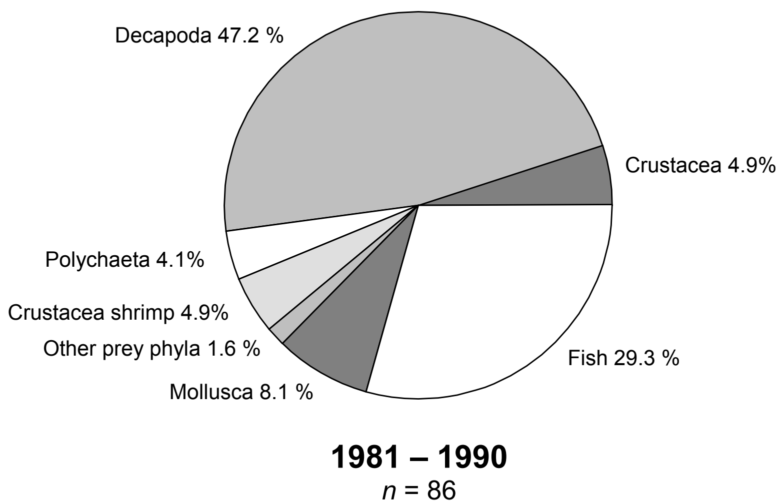


Figure 3. Abundance (% occurrence) of the major prey items of clearnose skate collected during NEFSC bottom trawl surveys from 1973-1980 and 1981-1990. Methods for sampling, processing, and analysis of samples differed between the time periods [see Reid *et al.* (1999) for details].

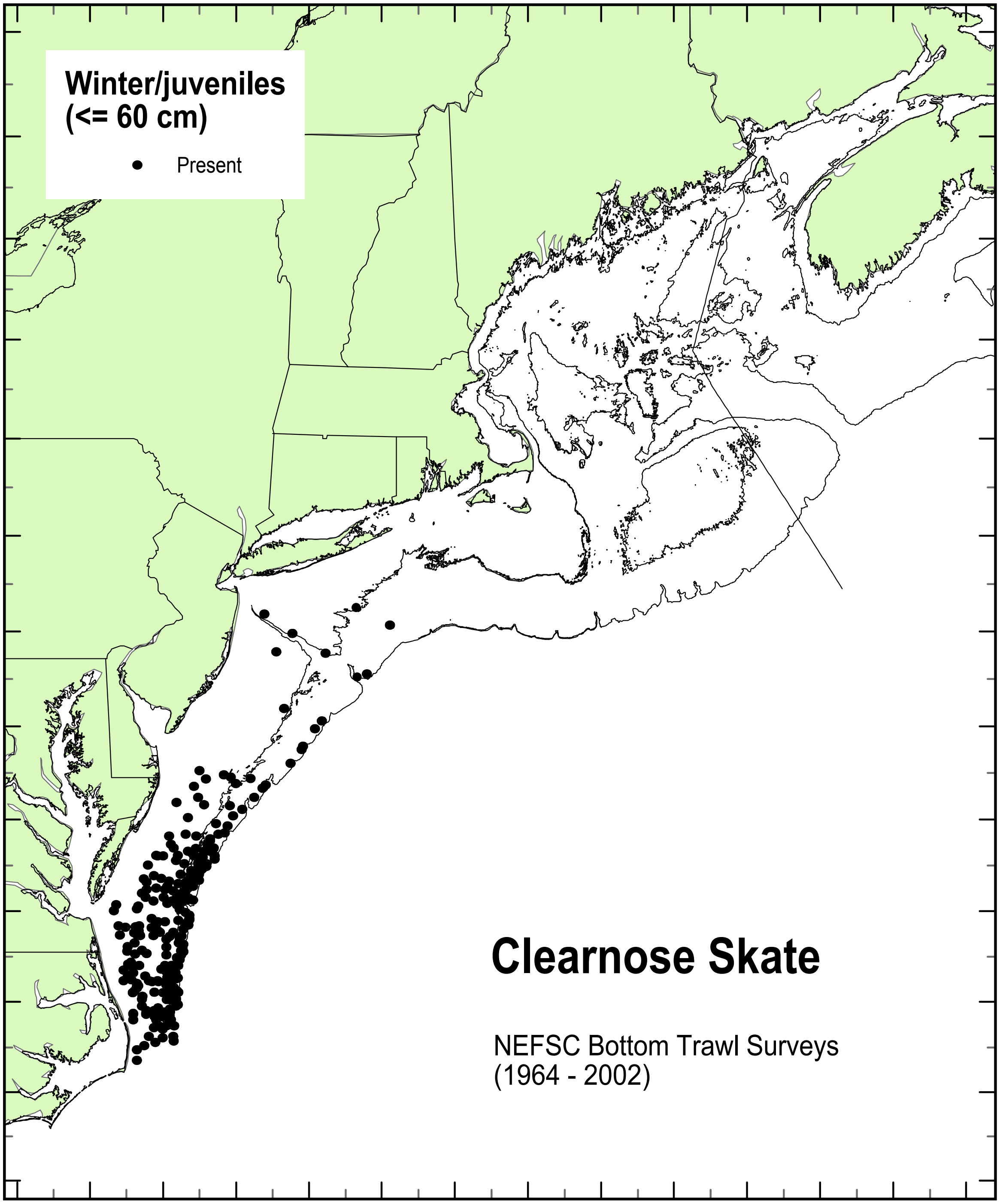


Figure 4. Distribution of juvenile clearnose skate collected during winter NEFSC bottom trawl surveys [1964-2002, all years combined; see Reid *et al.* (1999) for details]. Survey stations where juveniles were not found are not shown.

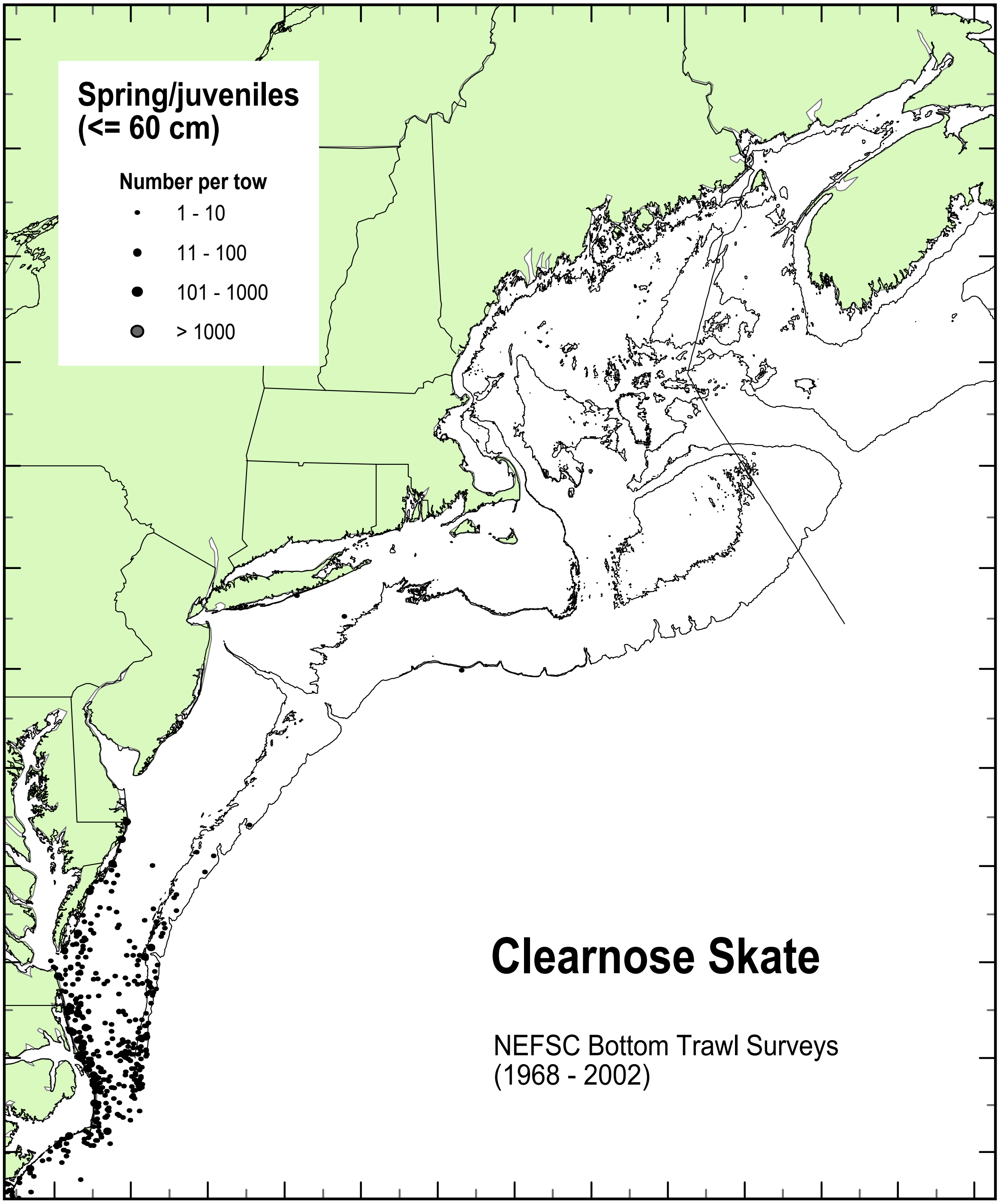


Figure 5. Distribution and abundance of juvenile clearnose skate collected during spring NEFSC bottom trawl surveys [1968-2002, all years combined; see Reid *et al.* (1999) for details].

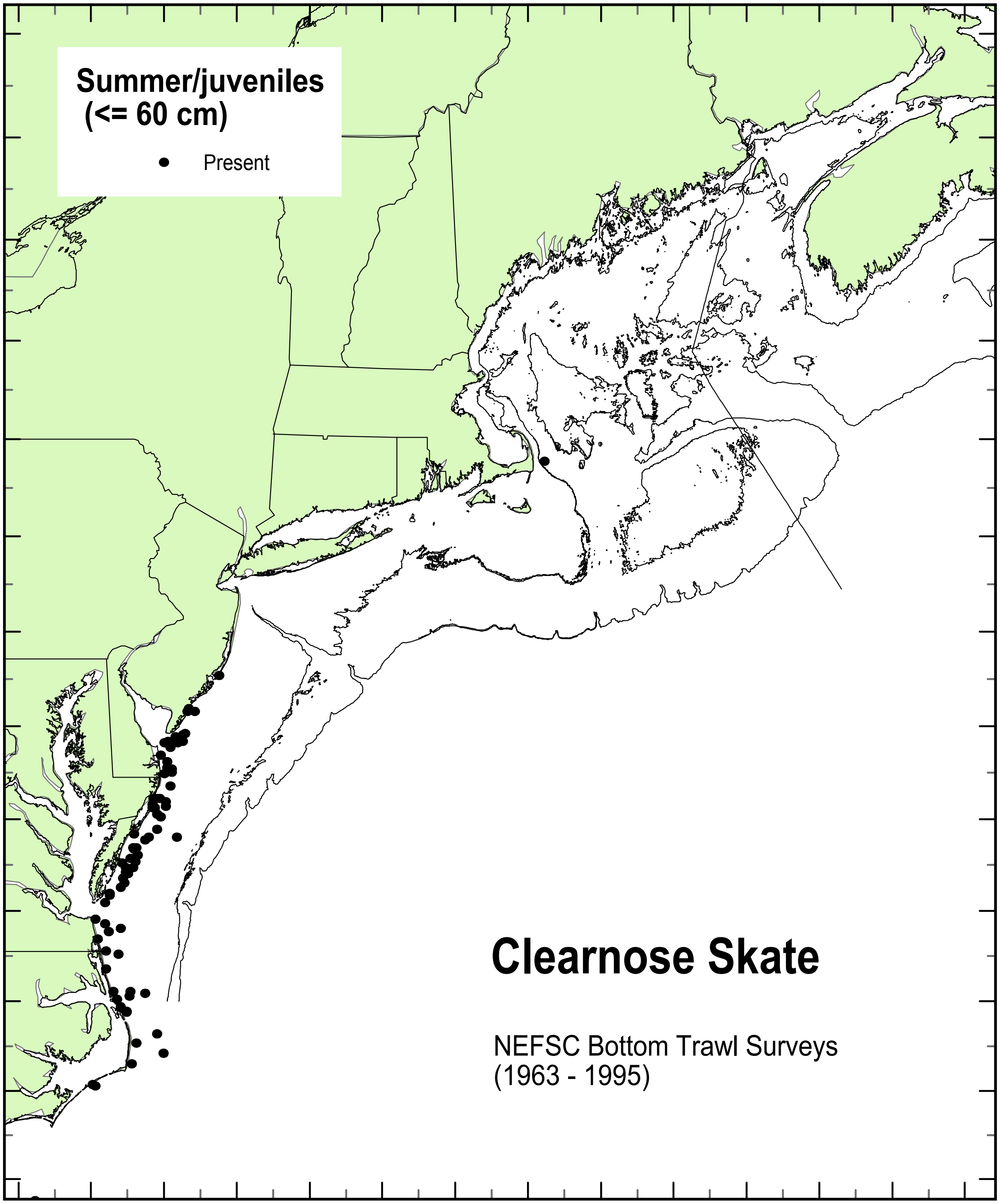


Figure 6. Distribution of juvenile clearnose skate collected during summer NEFSC bottom trawl surveys [1963-1995, all years combined; see Reid *et al.* (1999) for details]. Survey stations where juveniles were not found are not shown.

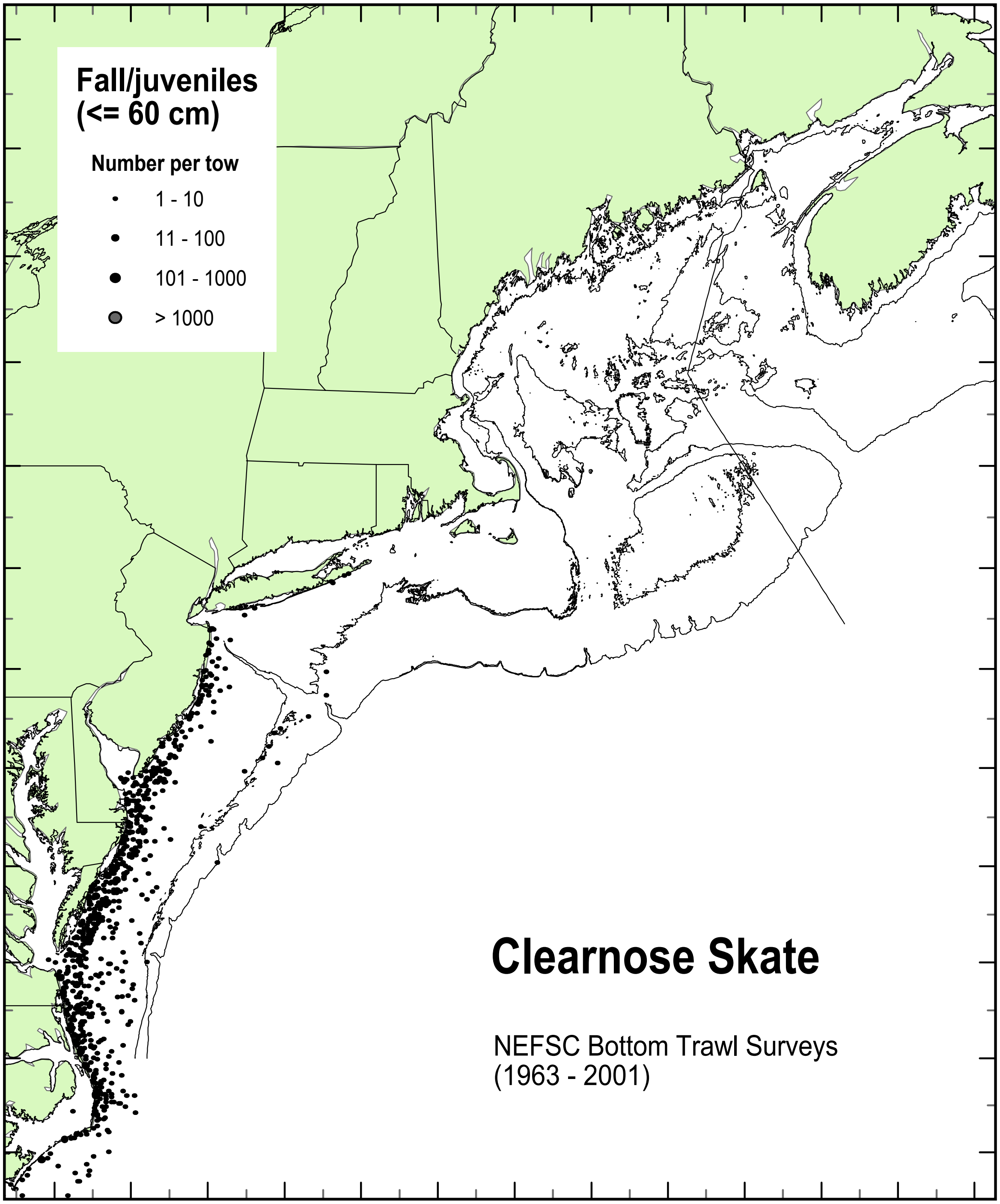


Figure 7. Distribution and abundance of juvenile clearnose skate collected during fall NEFSC bottom trawl surveys [1963-2001, all years combined; see Reid *et al.* (1999) for details].

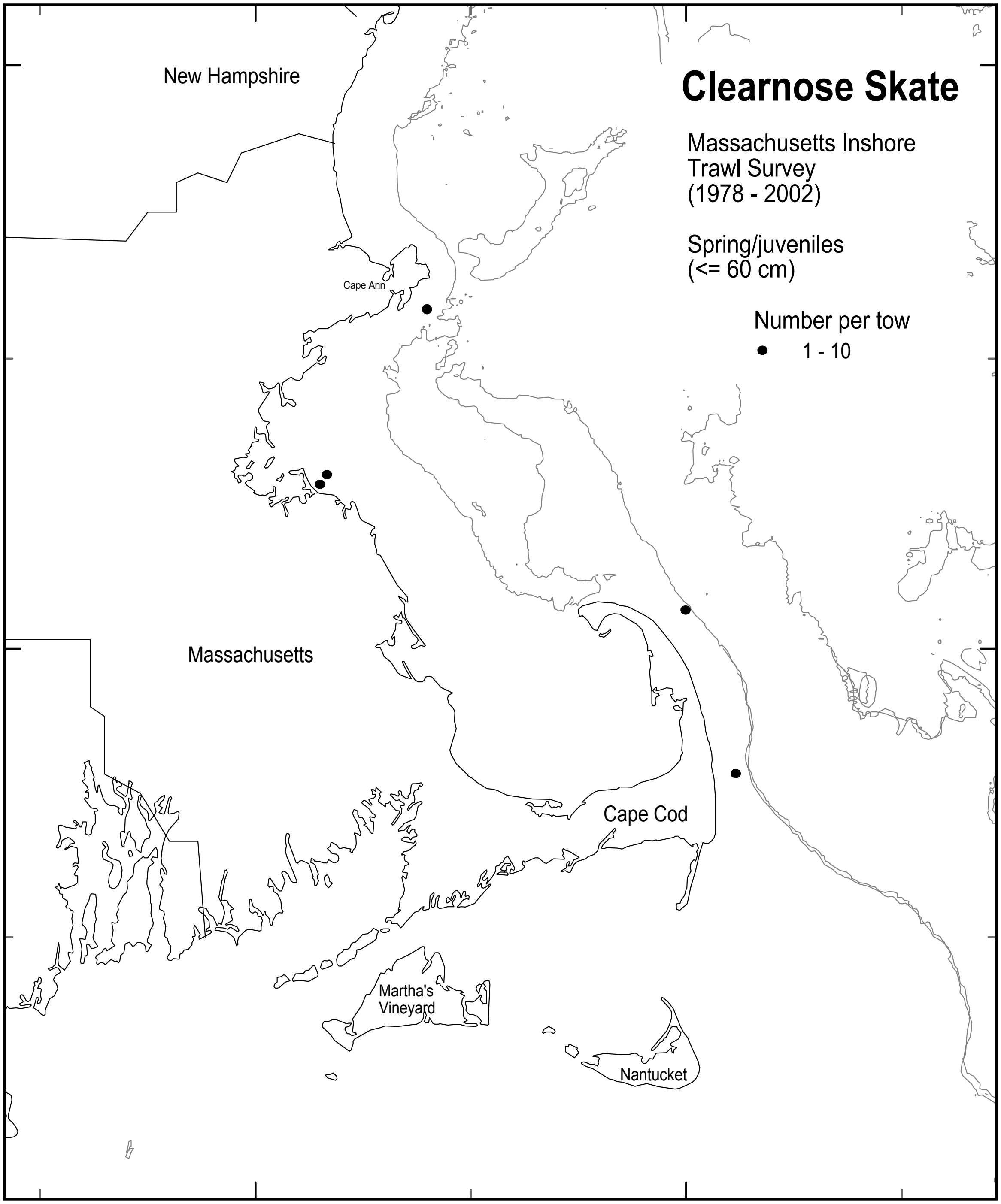


Figure 8. Distribution and abundance of juvenile clearnose skate in Massachusetts coastal waters collected during the spring and autumn Massachusetts inshore trawl surveys [1978-2002, all years combined; see Reid *et al.* (1999) for details].

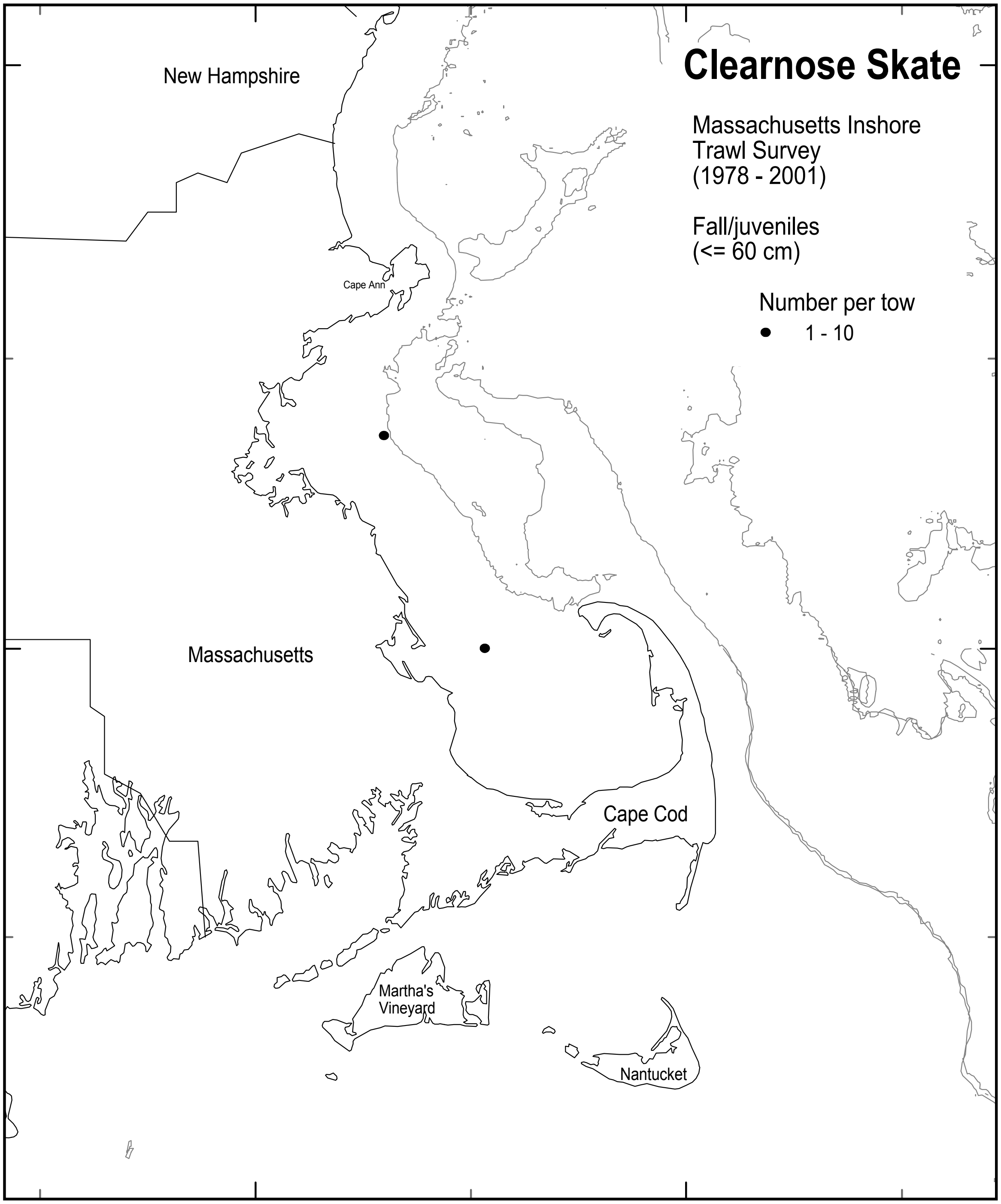


Figure 8. cont’d.

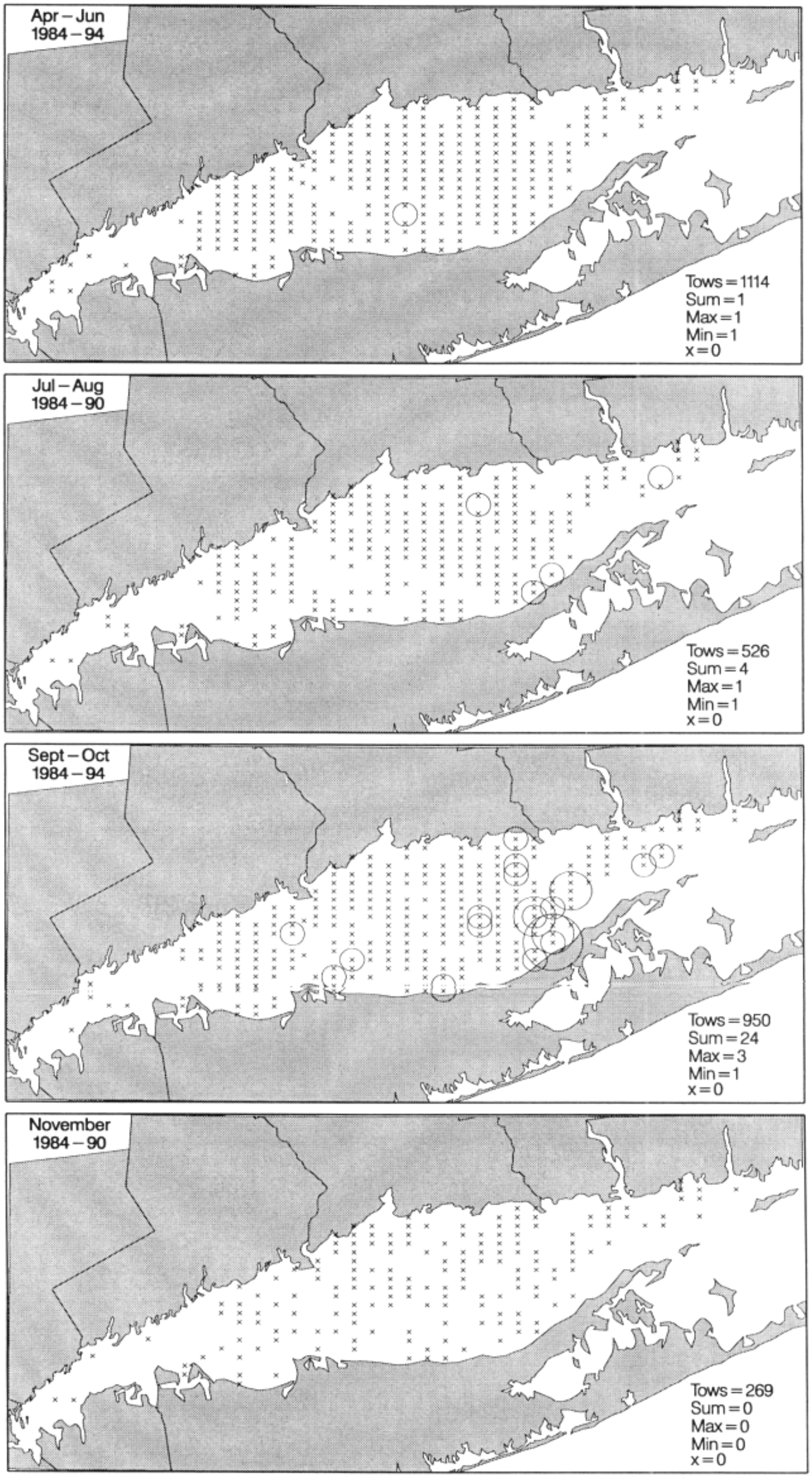


Figure 9. Distribution and abundance of juvenile and adult clearnose skate collected in Long Island Sound, based on the finfish surveys of the Connecticut Fisheries Division, 1984-1994 (from Gottschall *et al.* [2000]). Circle diameter is proportional to the number of fish caught, and is scaled to the maximum catch (indicated by “max =”). Collections were made with a 14 m otter trawl at about 40 stations chosen by stratified random design.

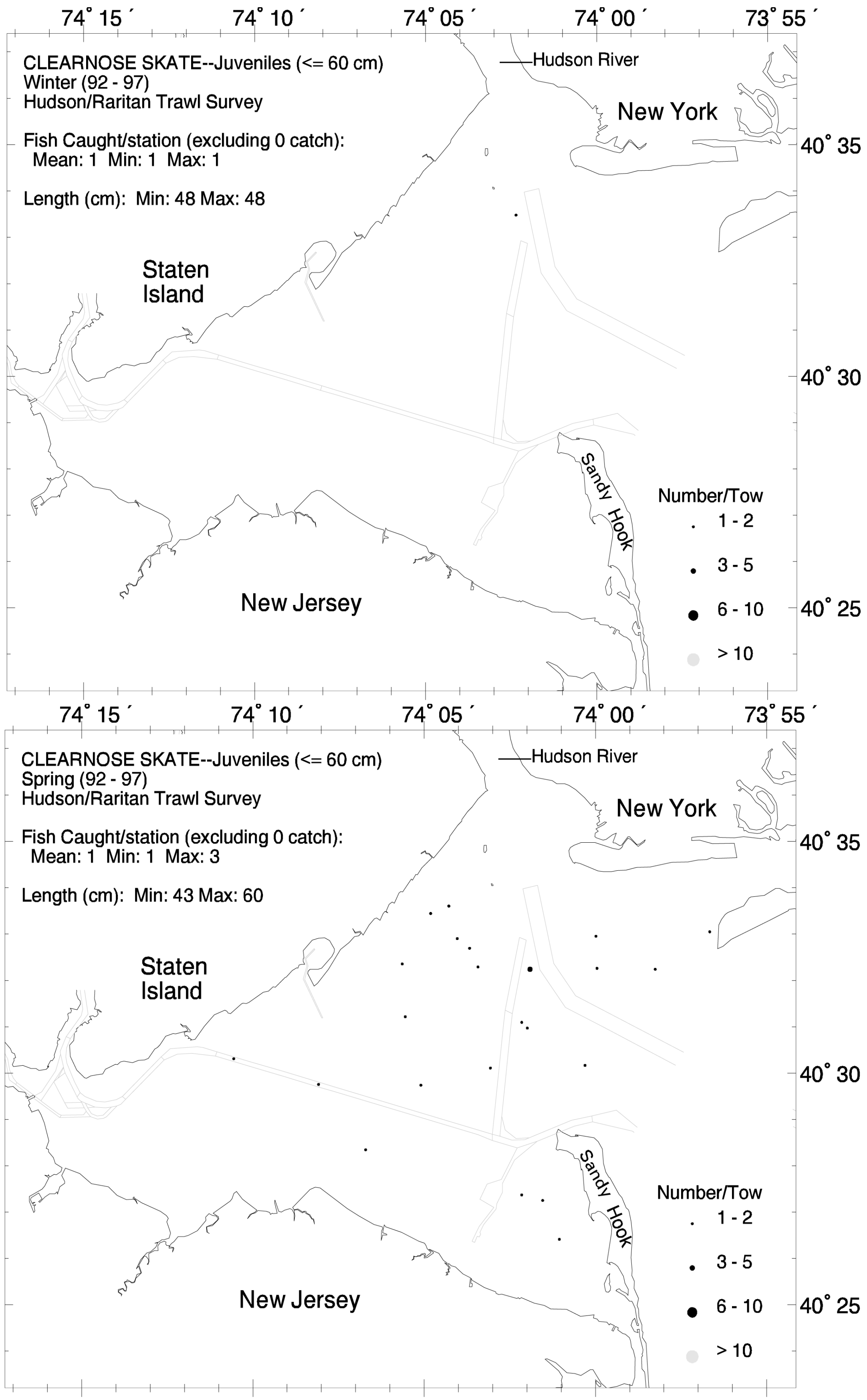
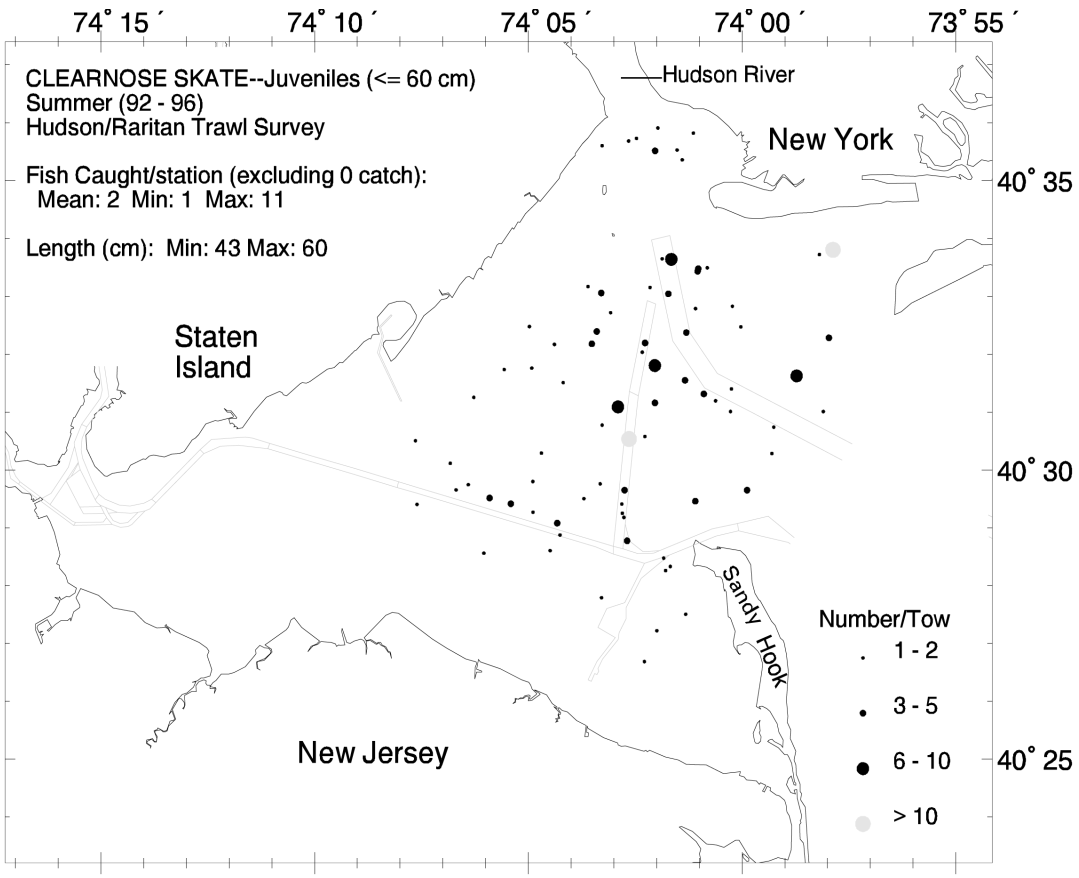


Figure 10. Seasonal distribution and abundance of juvenile clearnose skate in the Hudson-Raritan estuary, based on Hudson-Raritan trawl surveys, 1992-1997 [see Reid *et al.* (1999) for details].



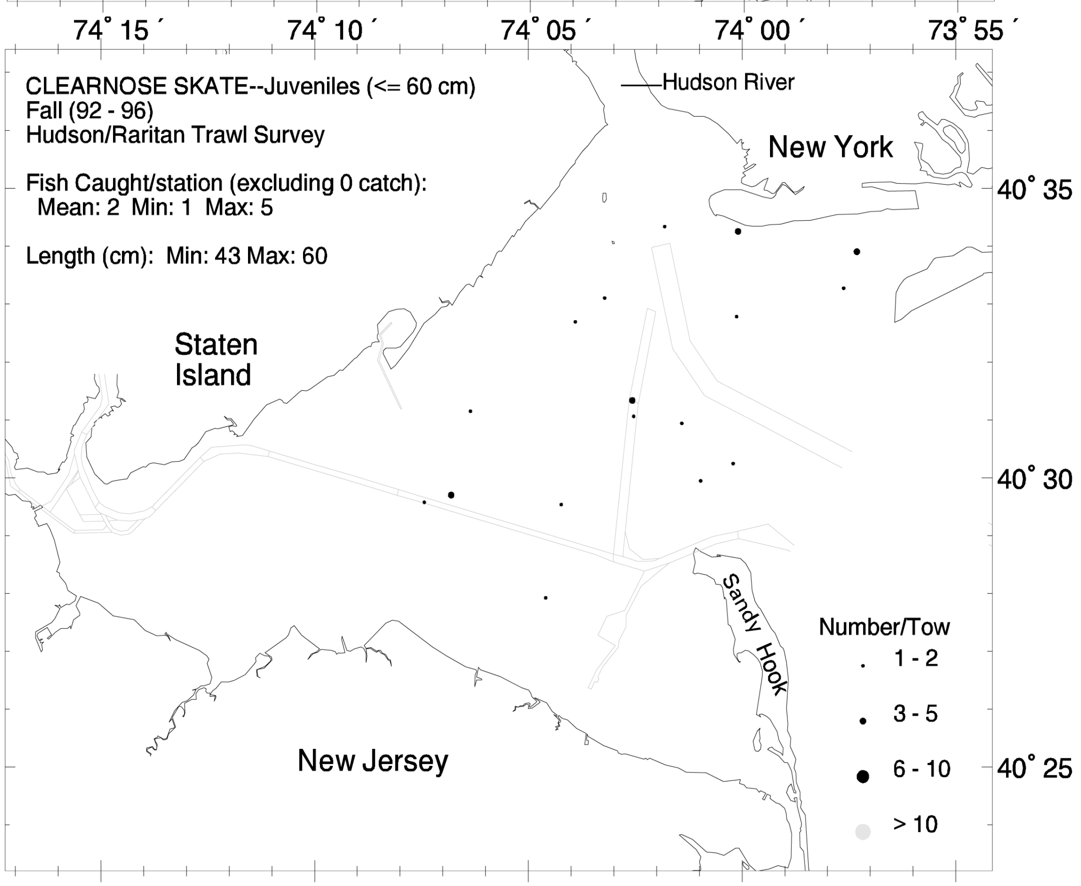


Figure 10. cont’d.

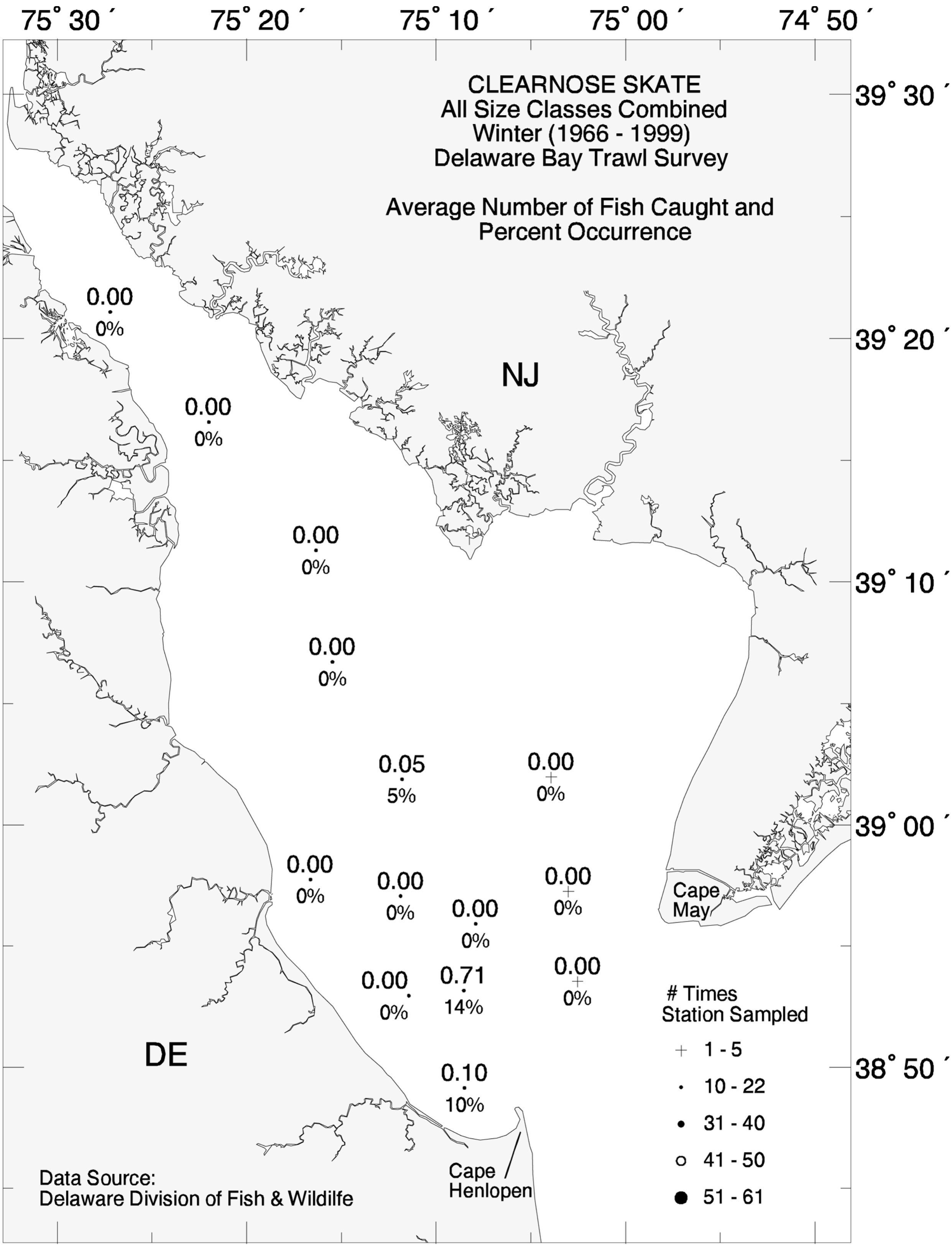


Figure 11. Seasonal distribution and abundance of juvenile and adult clearnose skate in Delaware Bay, based on Delaware Division of Fish and Wildlife bottom trawl surveys from 1966-1999 (all years combined). Surveys were conducted monthly at 9-14 fixed stations, using a 9.1 m otter trawl towed for 20-30 min (for methods see Michels and Greco 2000).

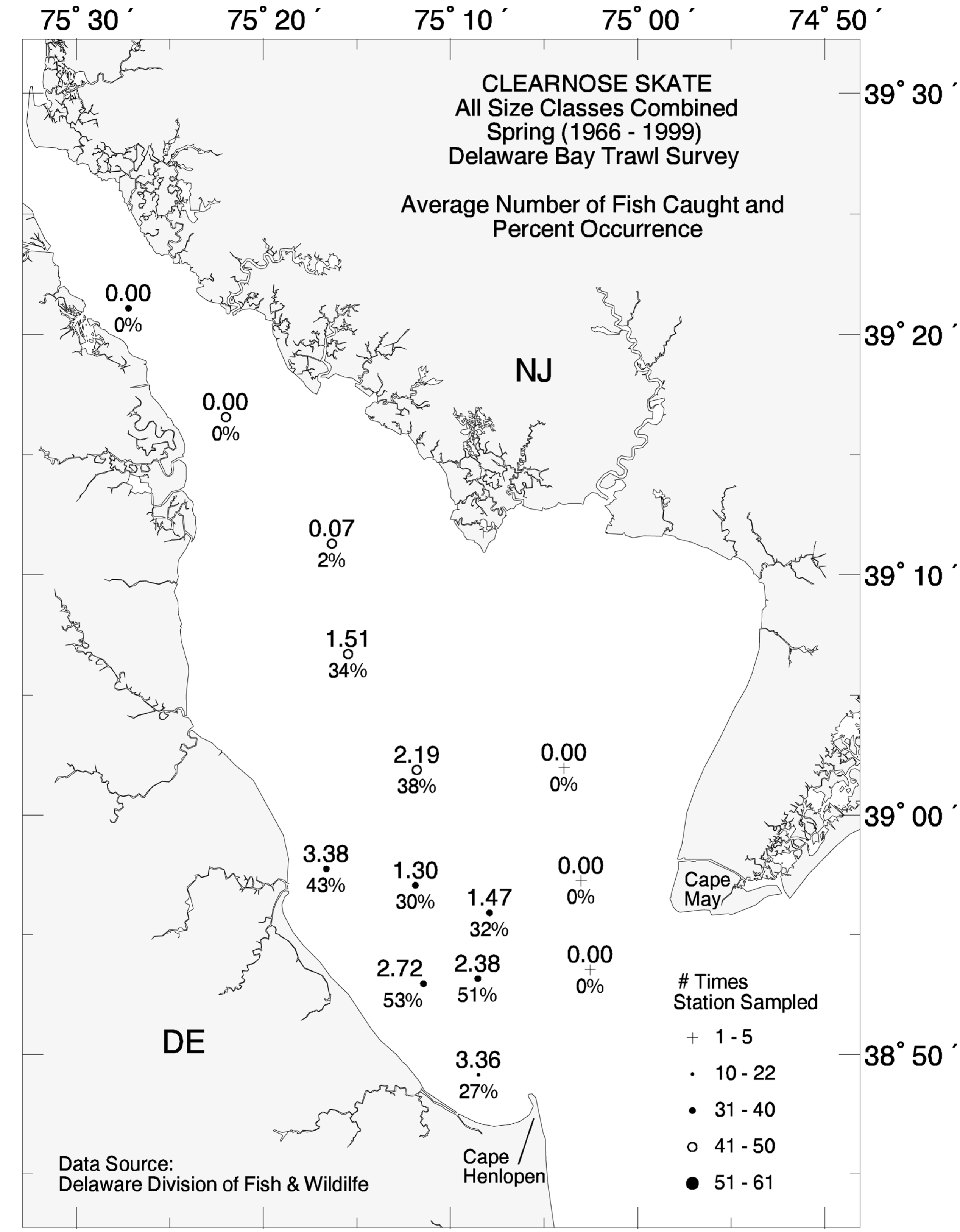


Figure 11. cont'd.

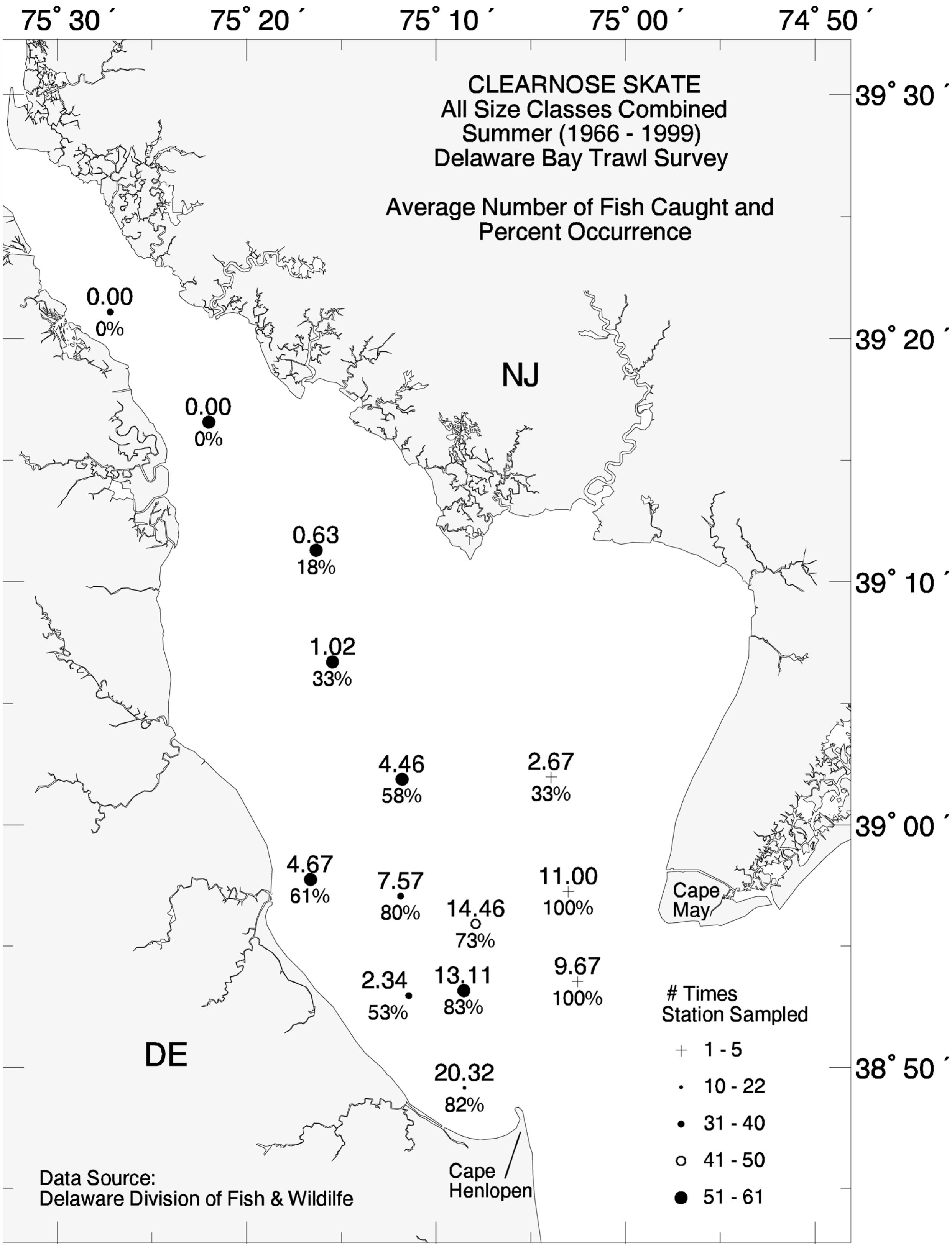


Figure 11. cont'd.

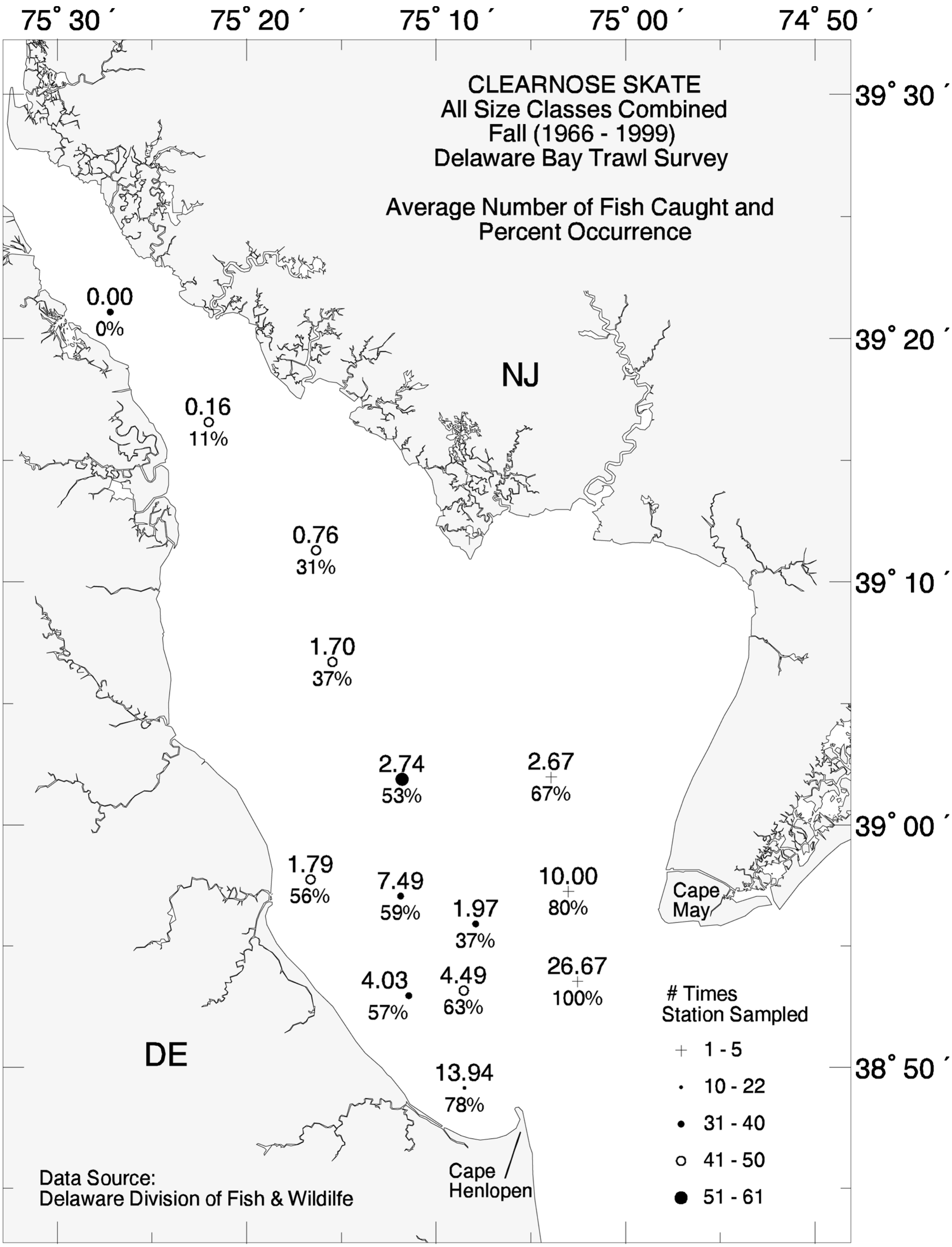


Figure 11. cont'd.

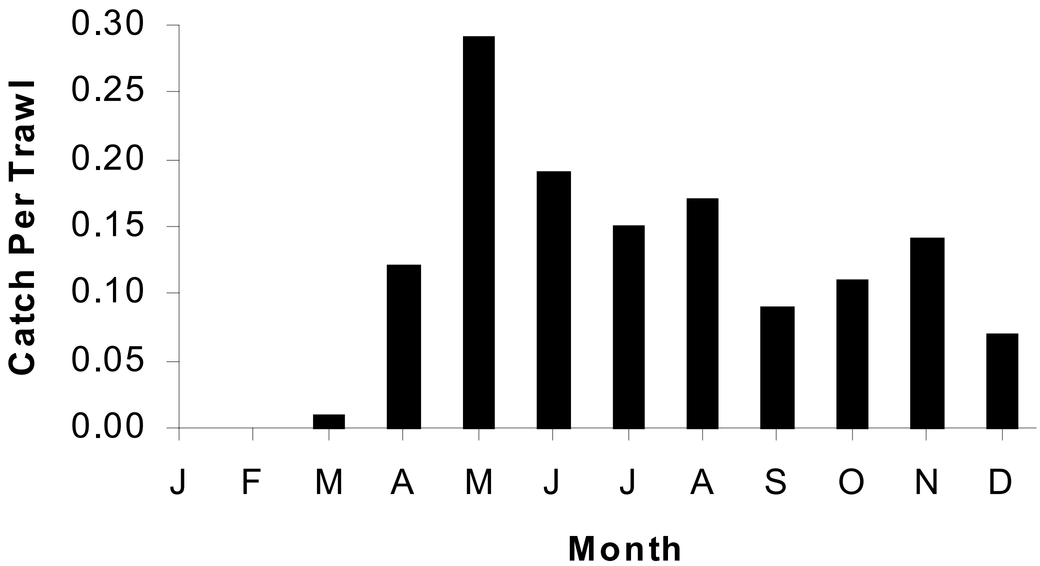


Figure 12. Catch per unit effort for total catch of juvenile and adult clearnose skate in Chesapeake Bay, from the Virginia Institute of Marine Science's (VIMS) trawl surveys, 1988-1999 (all years combined). Monthly surveys were conducted using a random stratified design of the main stem of the Bay using a 9.1 m semi-balloon otter trawl with 38 mm mesh and 6.4 mm cod end with a tow duration of five minutes. Adapted from Geer (2002).

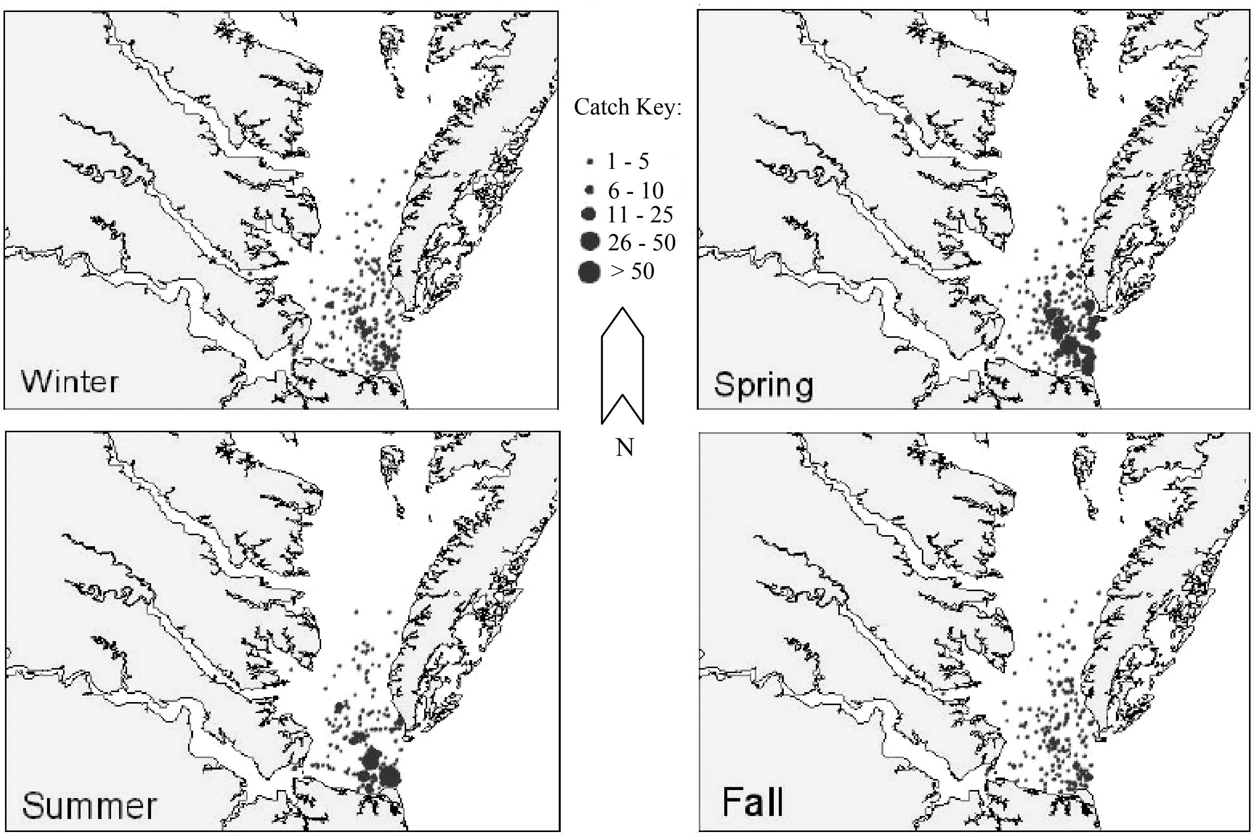


Figure 13. Seasonal distribution and abundance of juvenile and adult clearnose skate in Chesapeake Bay, from the VIMS trawl surveys, 1988-1999 (all years combined). Adapted from Geer (2002).

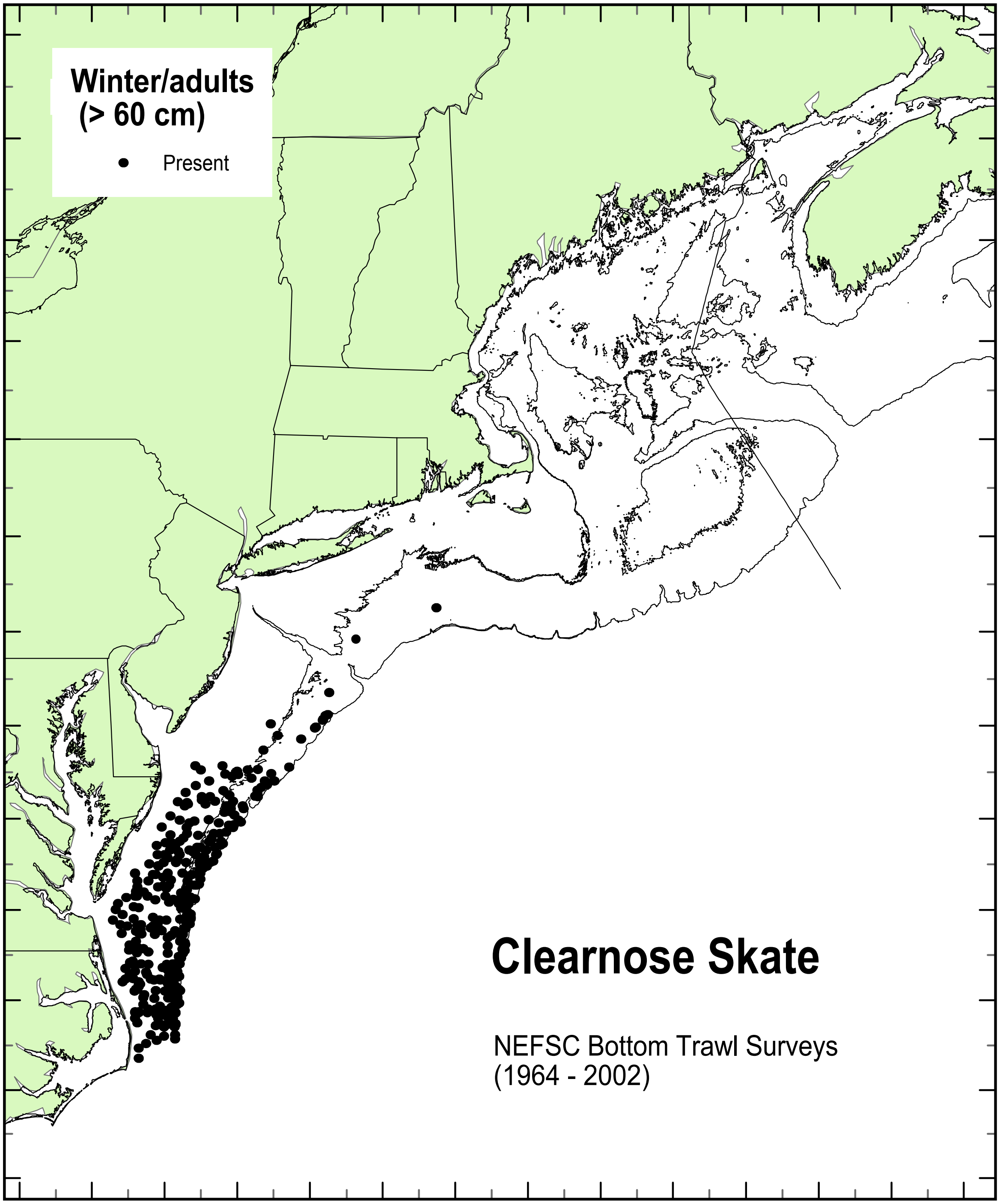


Figure 14. Distribution of adult clearnose skate collected during winter NEFSC bottom trawl surveys [1964-2002, all years combined; see Reid *et al.* (1999) for details]. Survey stations where adults were not found are not shown.

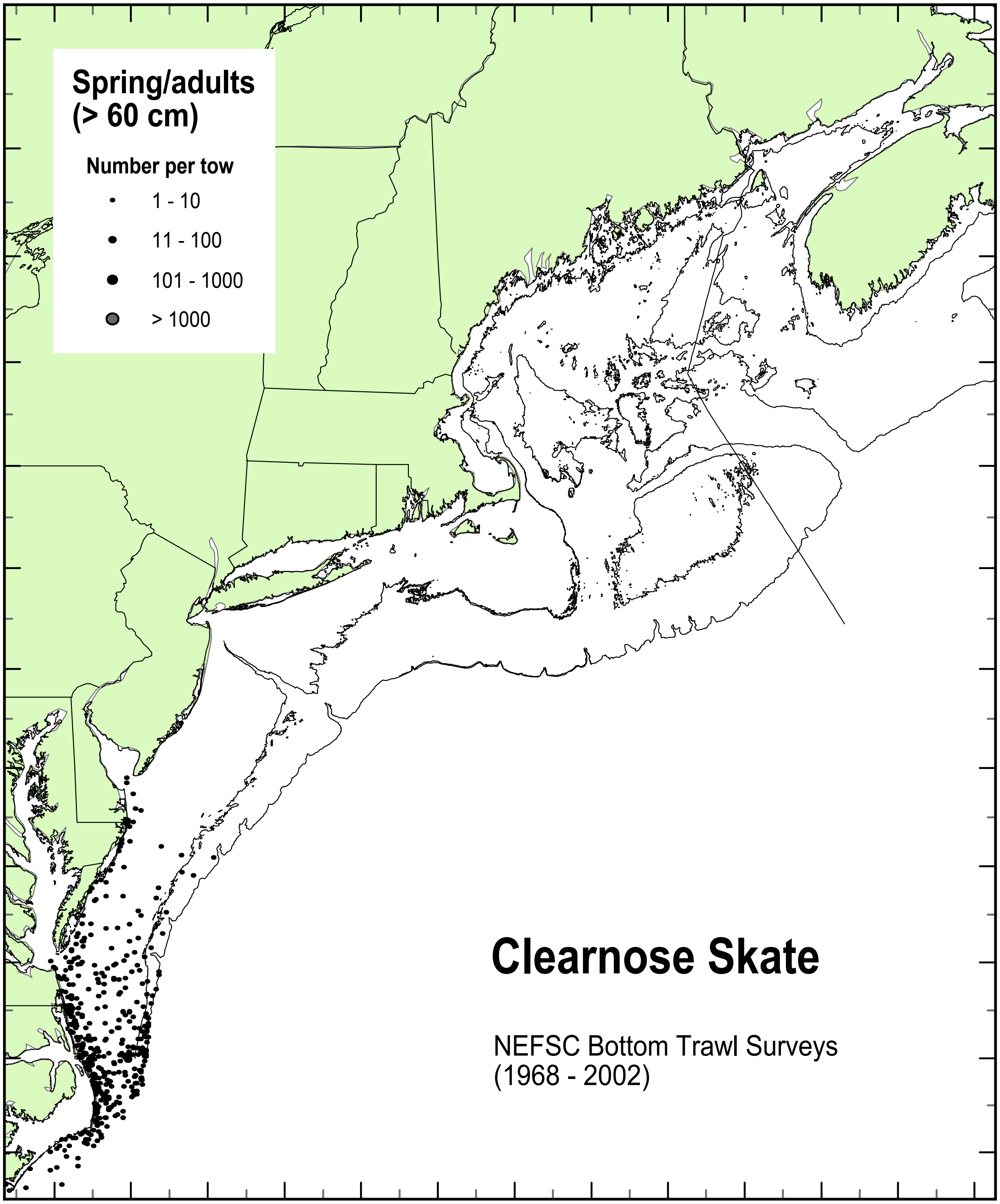


Figure 15. Distribution and abundance of adult clearnose skate collected during spring NEFSC bottom trawl surveys [1968-2002, all years combined; see Reid *et al.* (1999) for details].

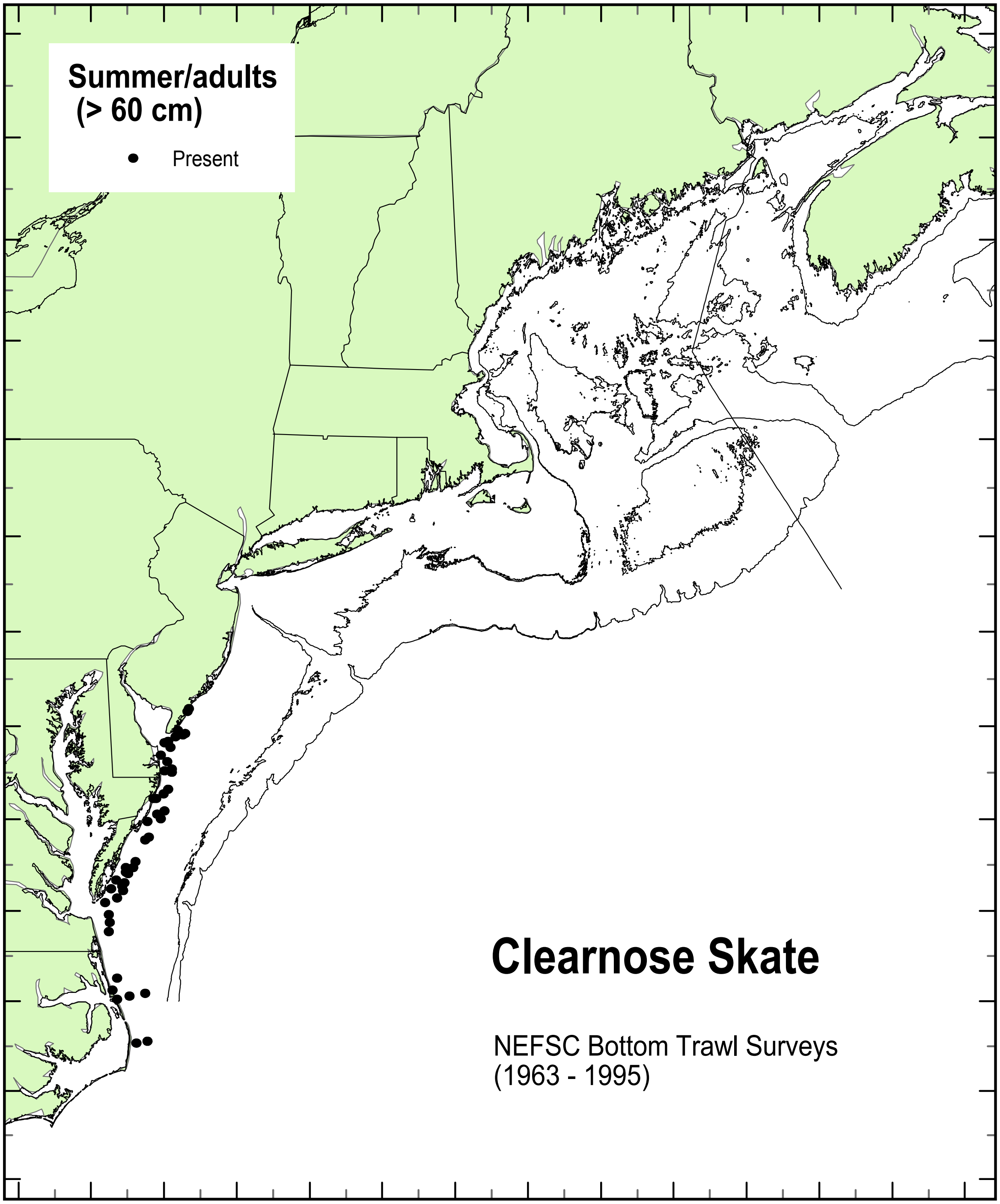


Figure 16. Distribution of adult clearnose skate collected during summer NEFSC bottom trawl surveys [1963-1995, all years combined; see Reid *et al.* (1999) for details]. Survey stations where adults were not found are not shown.

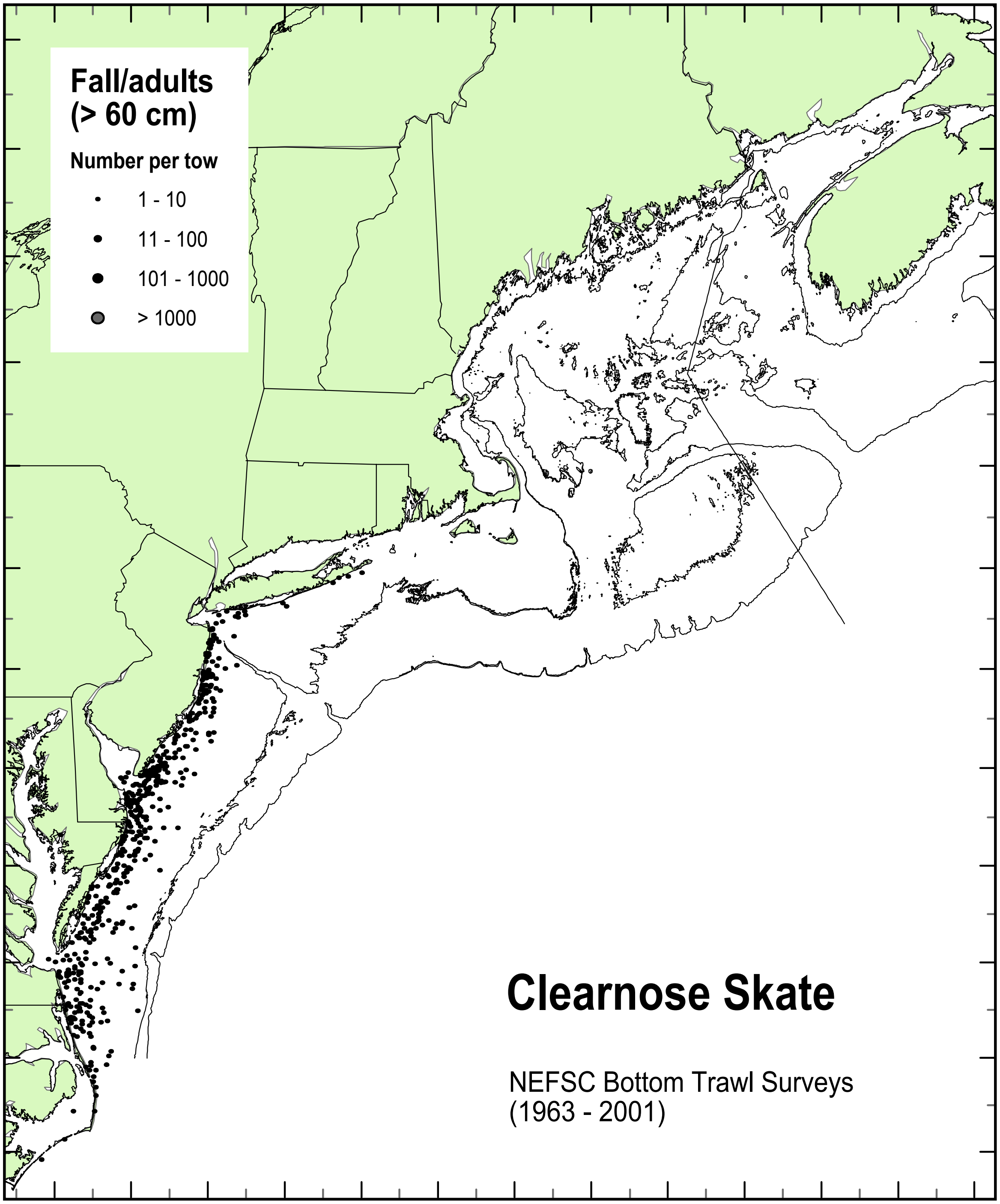


Figure 17. Distribution and abundance of adult clearnose skate collected during fall NEFSC bottom trawl surveys [1963-2001, all years combined; see Reid *et al.* (1999) for details].

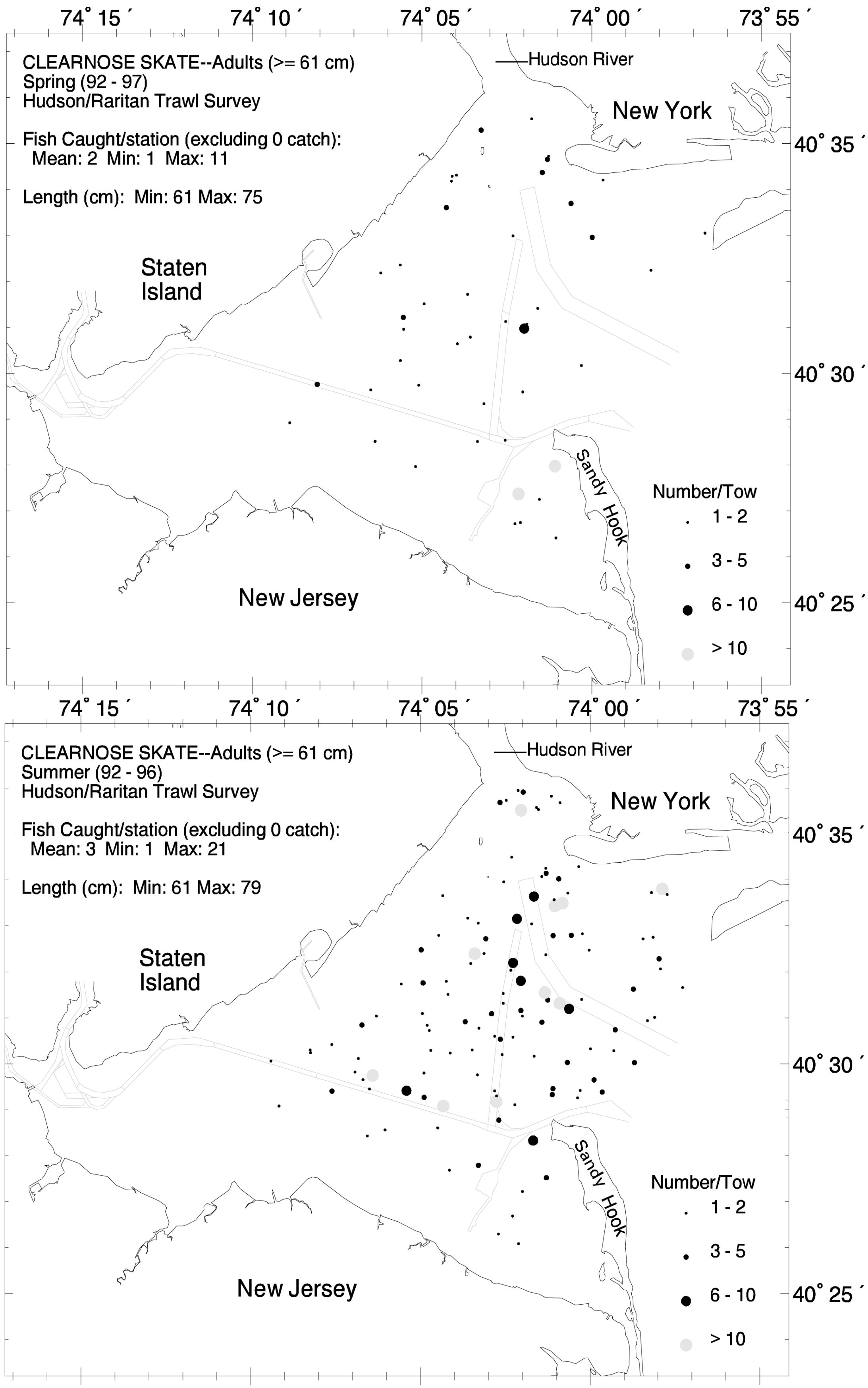


Figure 18. Seasonal distribution and abundance of adult clearnose skate in the Hudson-Raritan estuary, based on Hudson-Raritan trawl surveys, 1992-1997 [see Reid *et al.* (1999) for details].

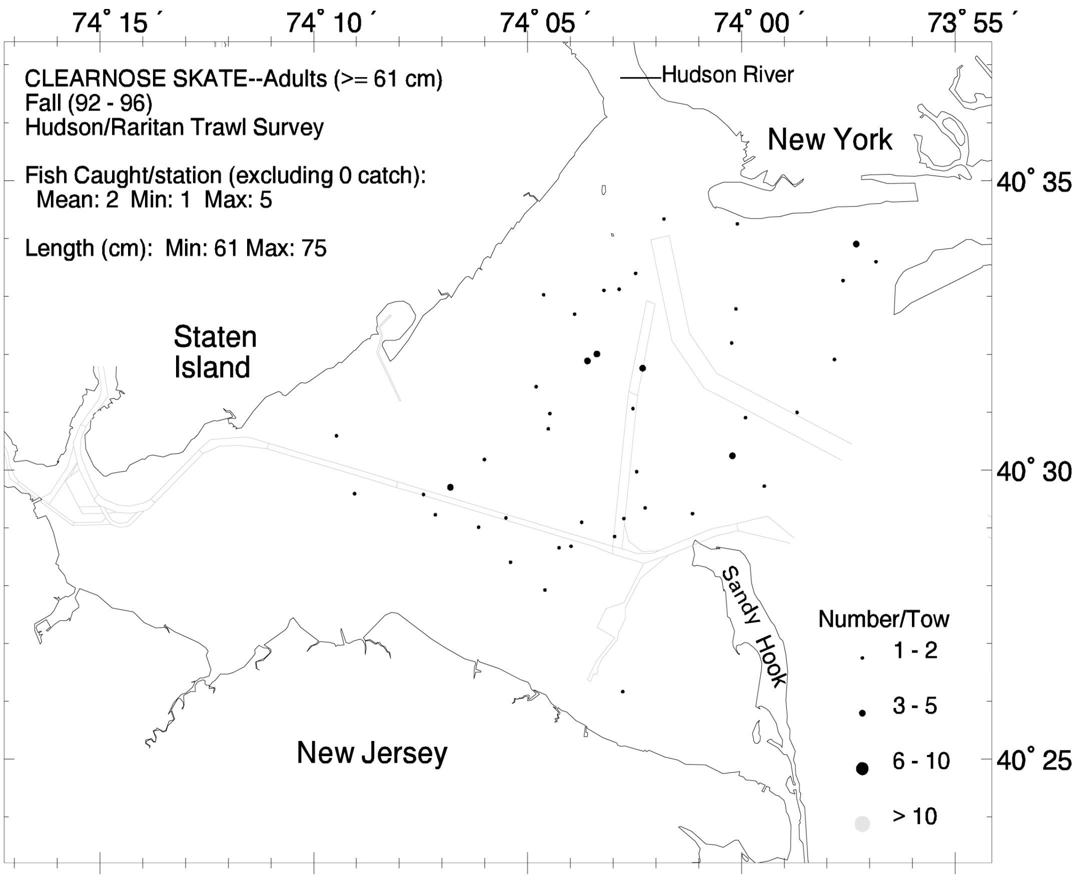


Figure 18. cont’d.

Clearnose Skate

NEFSC Bottom Trawl Survey
Spring/Juveniles

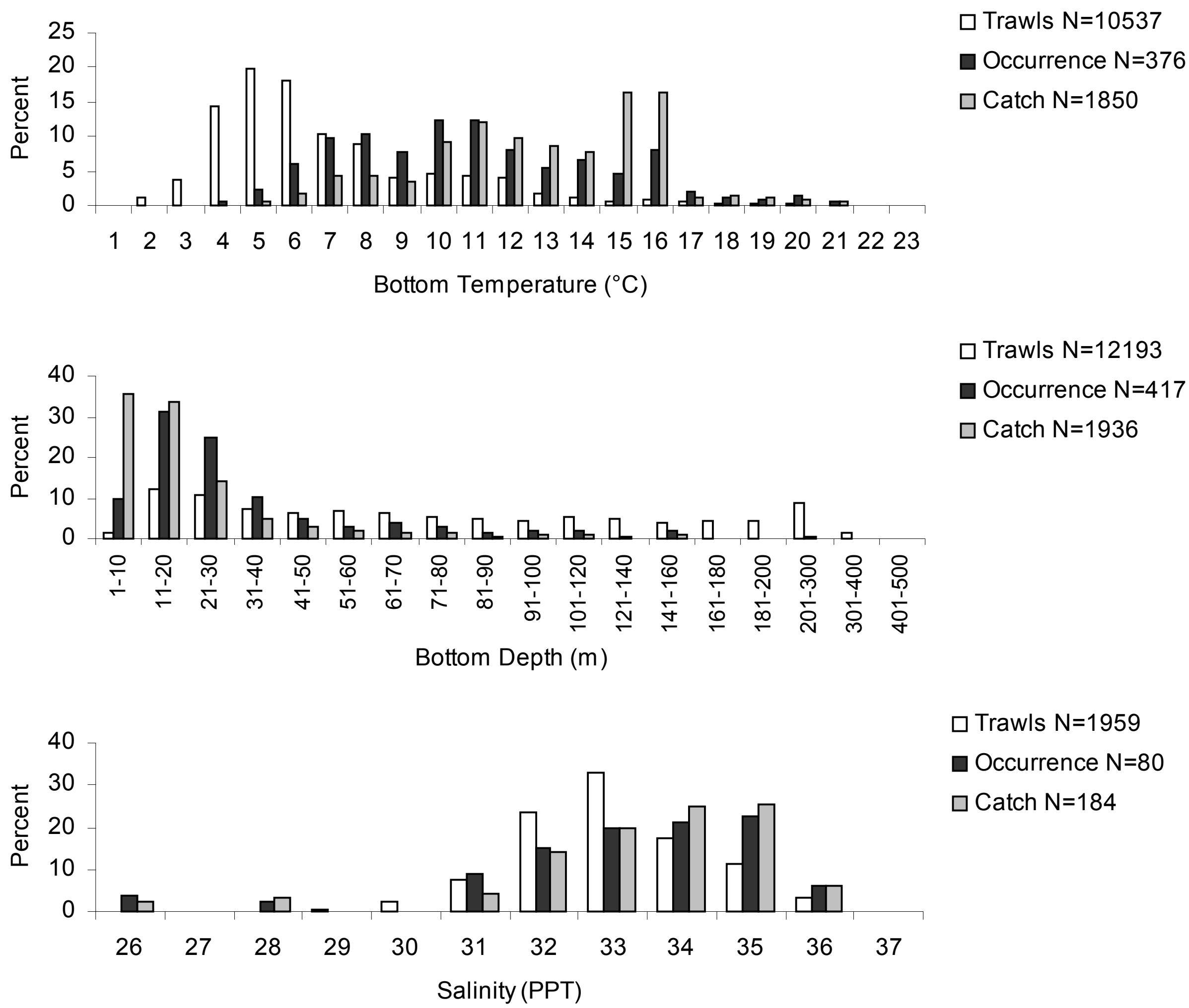


Figure 19. Spring and fall distributions of juvenile clearnose skate and trawls relative to bottom water temperature, depth, and salinity based on NEFSC bottom trawl surveys (1963-2002; all years combined). White bars give the distribution of all the trawls, black bars give the distribution of all trawls in which clearnose skate occurred, and gray bars represent, within each interval, the percentage of the total number of clearnose skate caught.

<u>Clearnose Skate</u>
NEFSC Bottom Trawl Survey
Fall/Juveniles

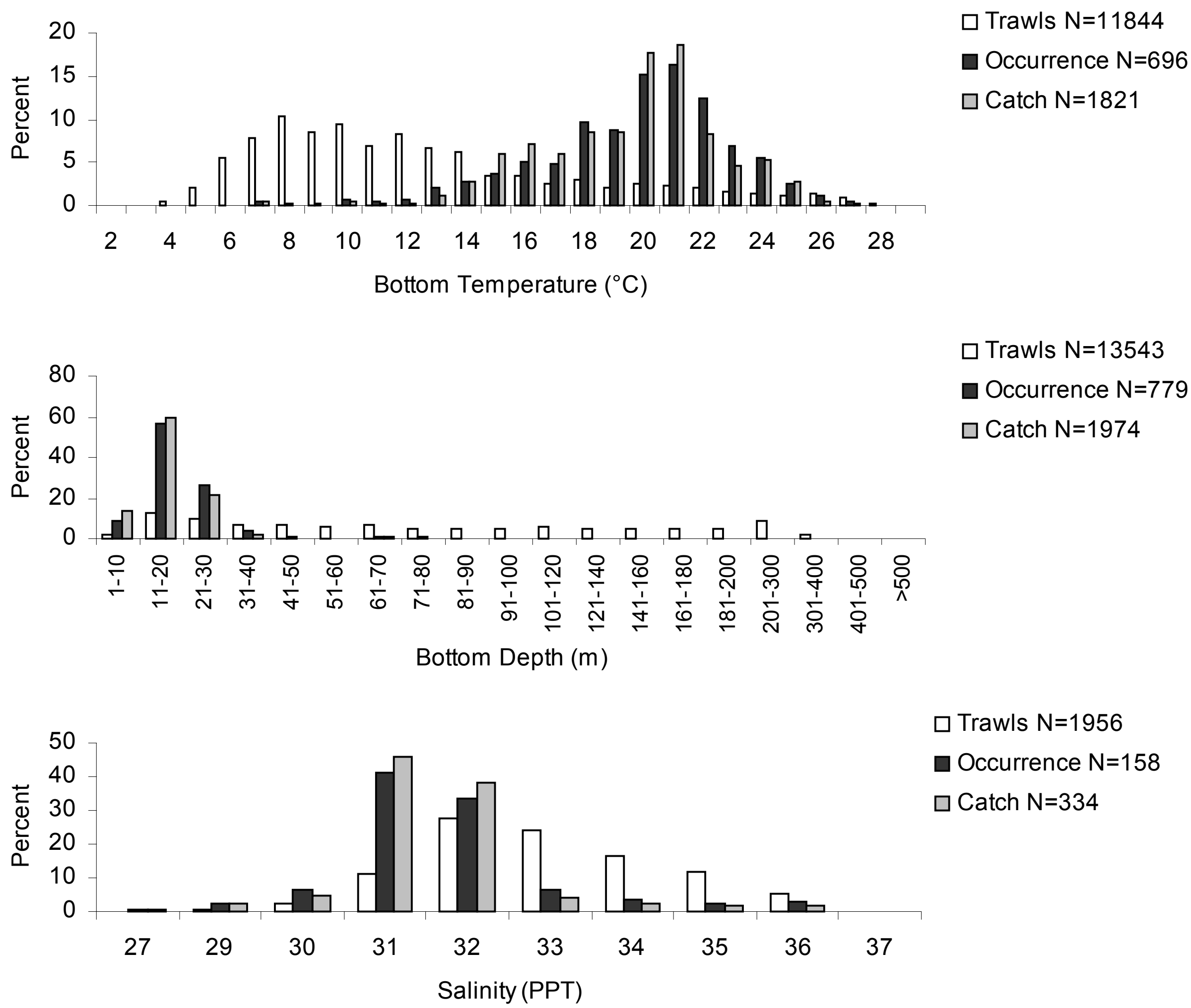


Figure 19. cont'd.

Spring

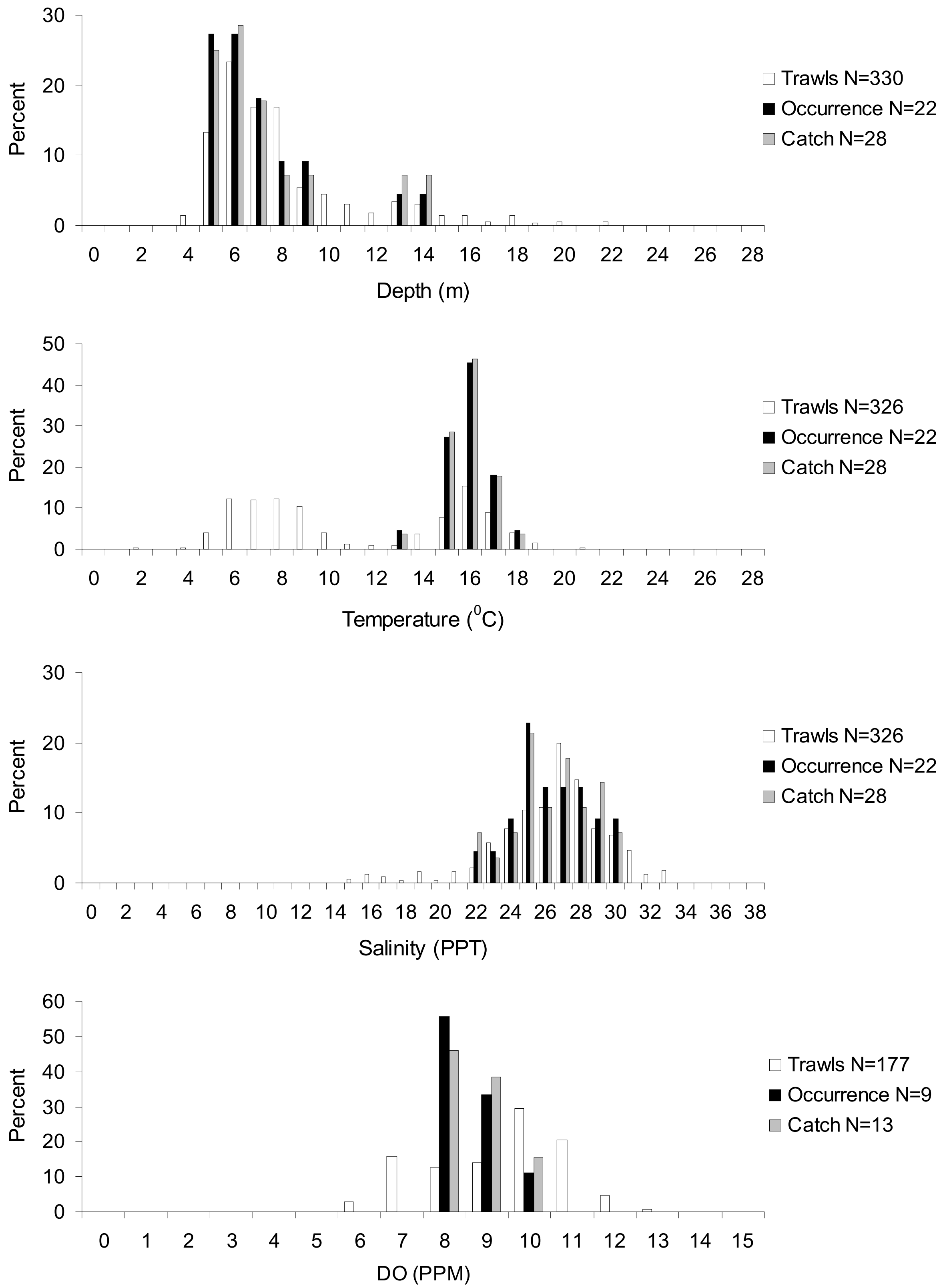


Figure 20. Seasonal distributions of juvenile clearnose skate and trawls relative to bottom water temperature, depth, salinity, and dissolved oxygen based on NEFSC Hudson-Raritan estuary trawl surveys (1992-1997; all years combined). White bars give the distribution of all the trawls, black bars give the distribution of all trawls in which clearnose skate occurred, and gray bars represent, within each interval, the percentage of the total number of clearnose skate caught.

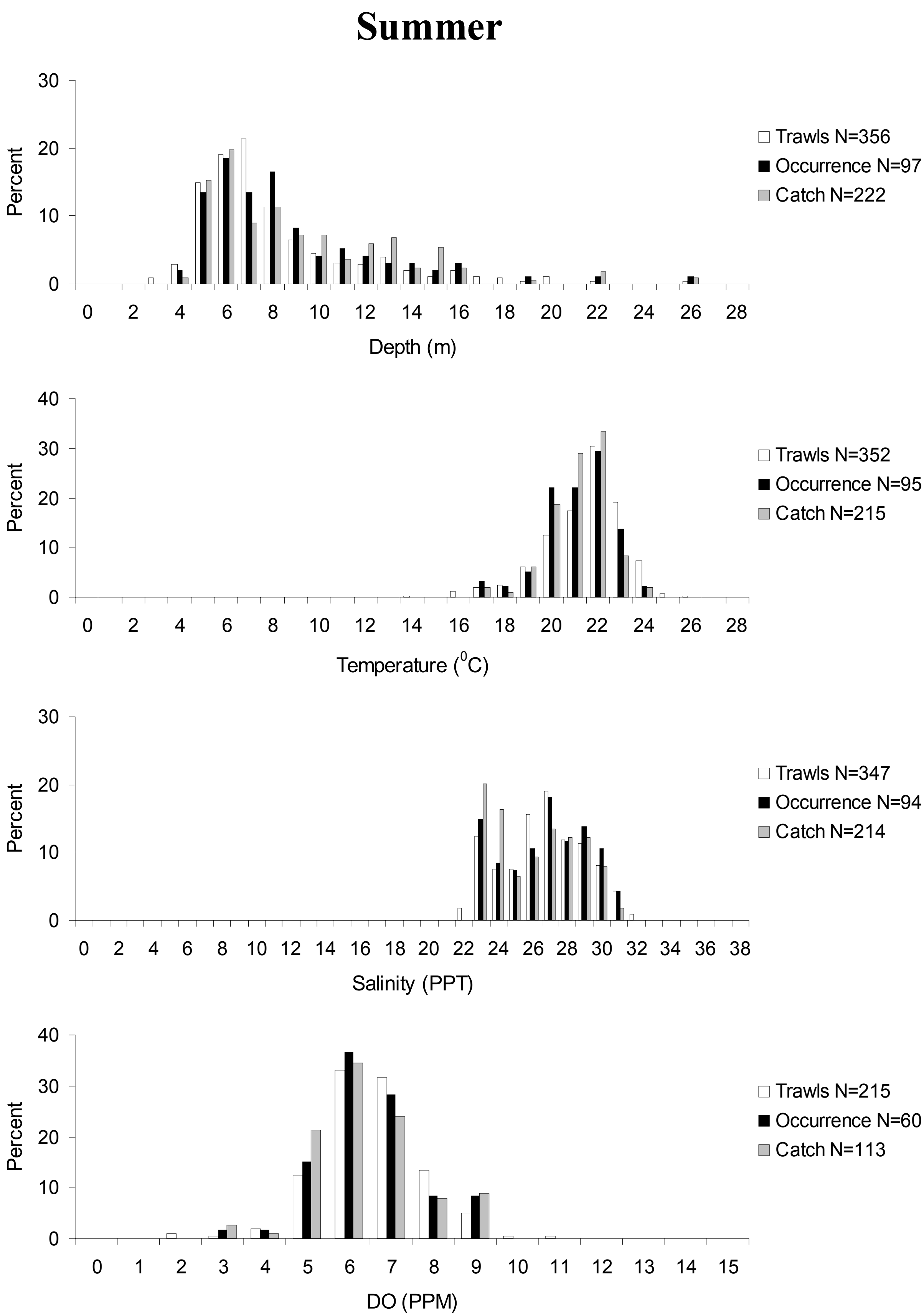


Figure 20. cont'd.

Fall

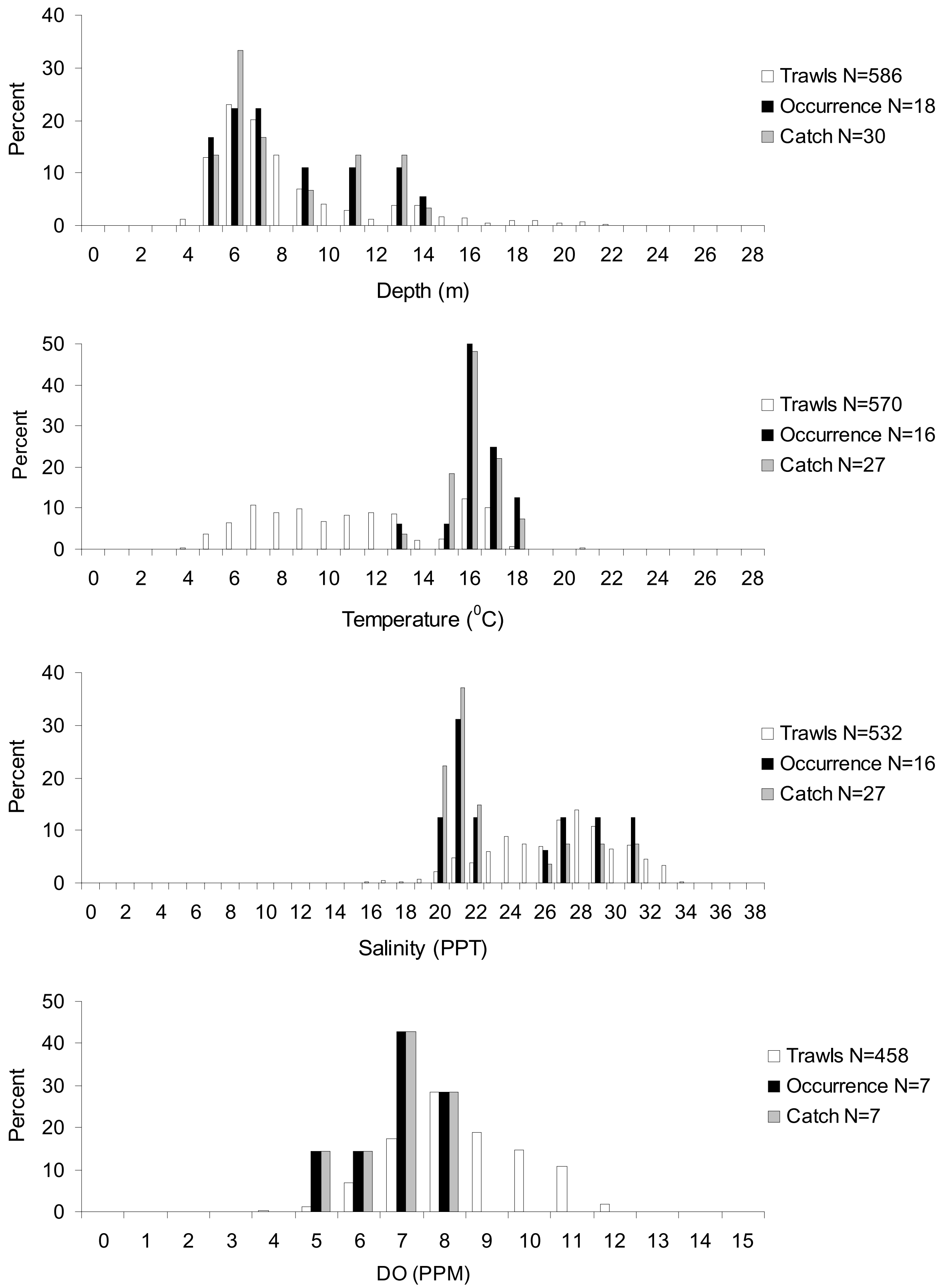


Figure 20. cont'd.

Winter

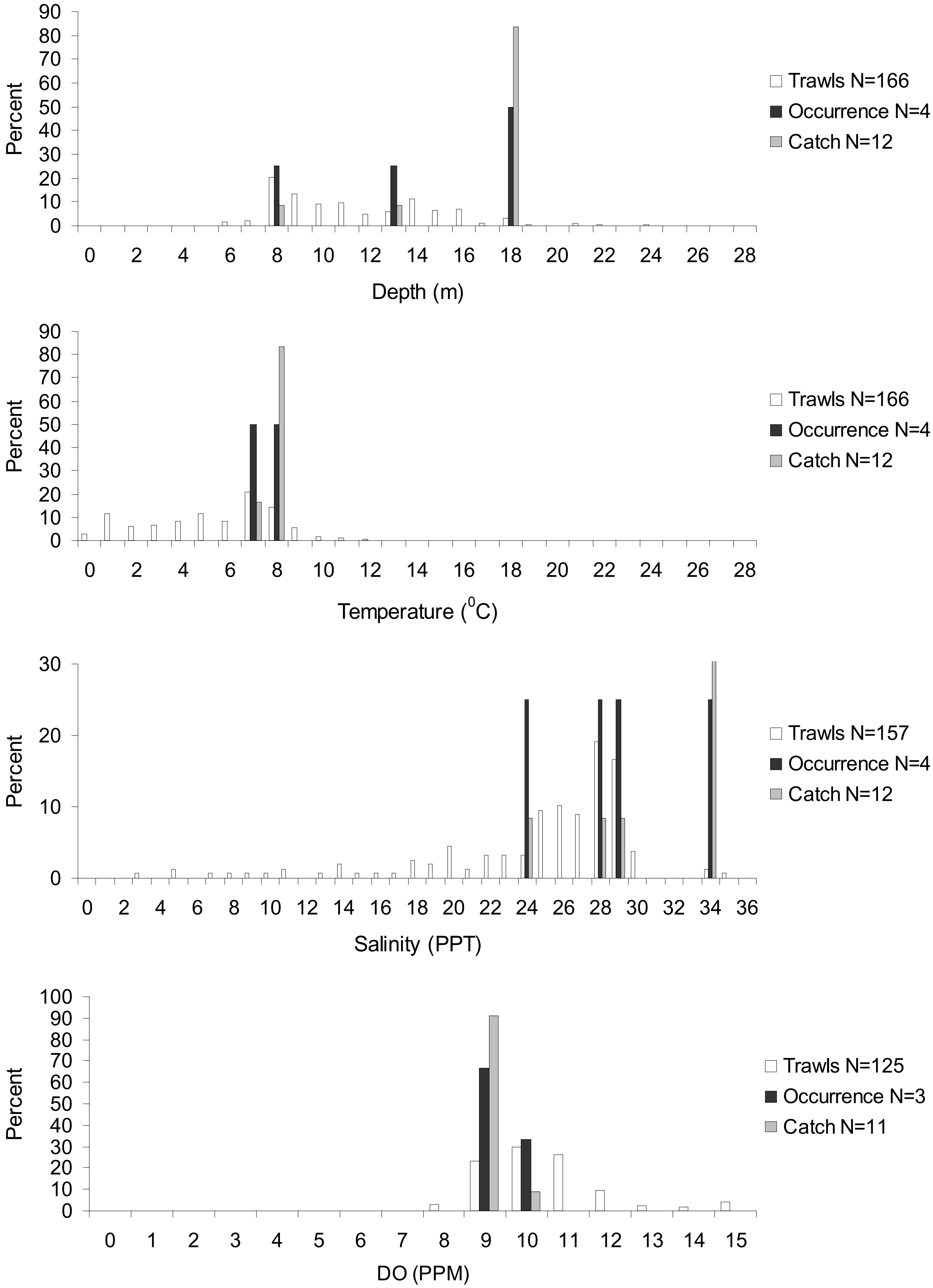


Figure 21. Seasonal distributions of juvenile and adult clearnose skate and trawls relative to bottom temperature, depth, salinity, and dissolved oxygen based on Delaware Division of Fish and Wildlife trawl surveys from 1966-1999 (all years combined). White bars give the distribution of all the trawls, black bars give the distribution of all trawls in which the skate occurred, and gray bars represent, within each interval, the percentage of the total number of skate caught.

Spring

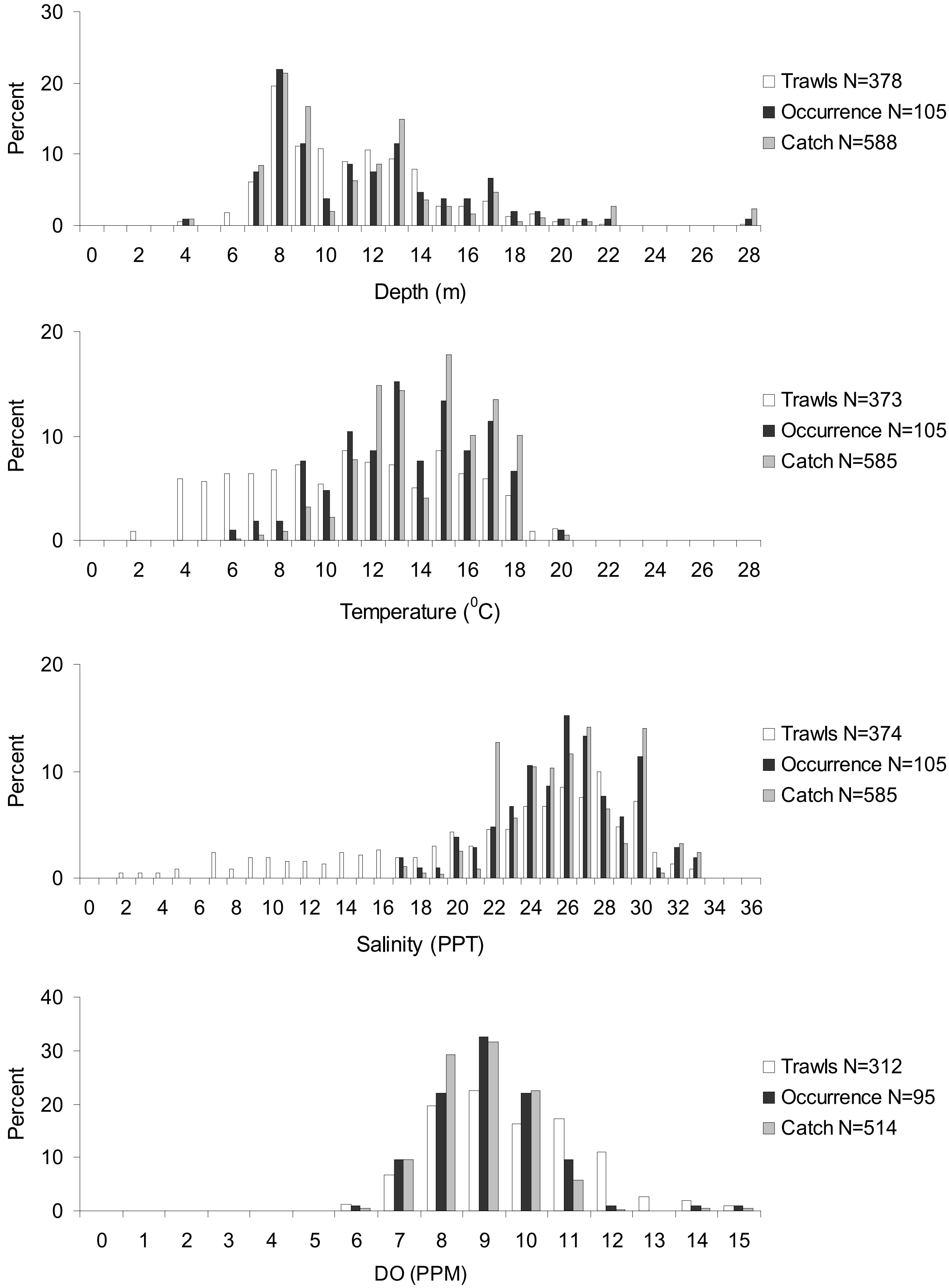


Figure 21. cont'd.

Summer

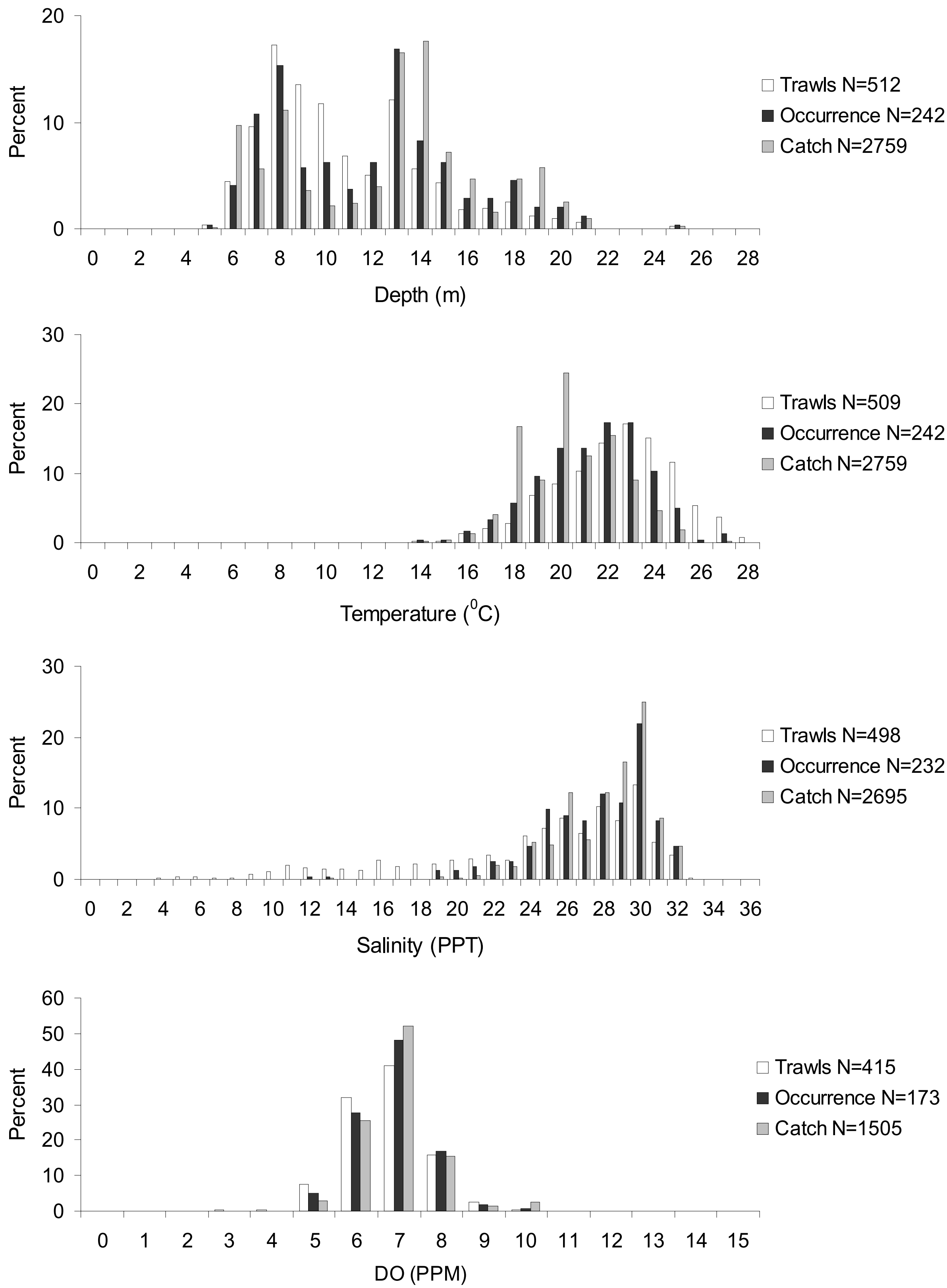
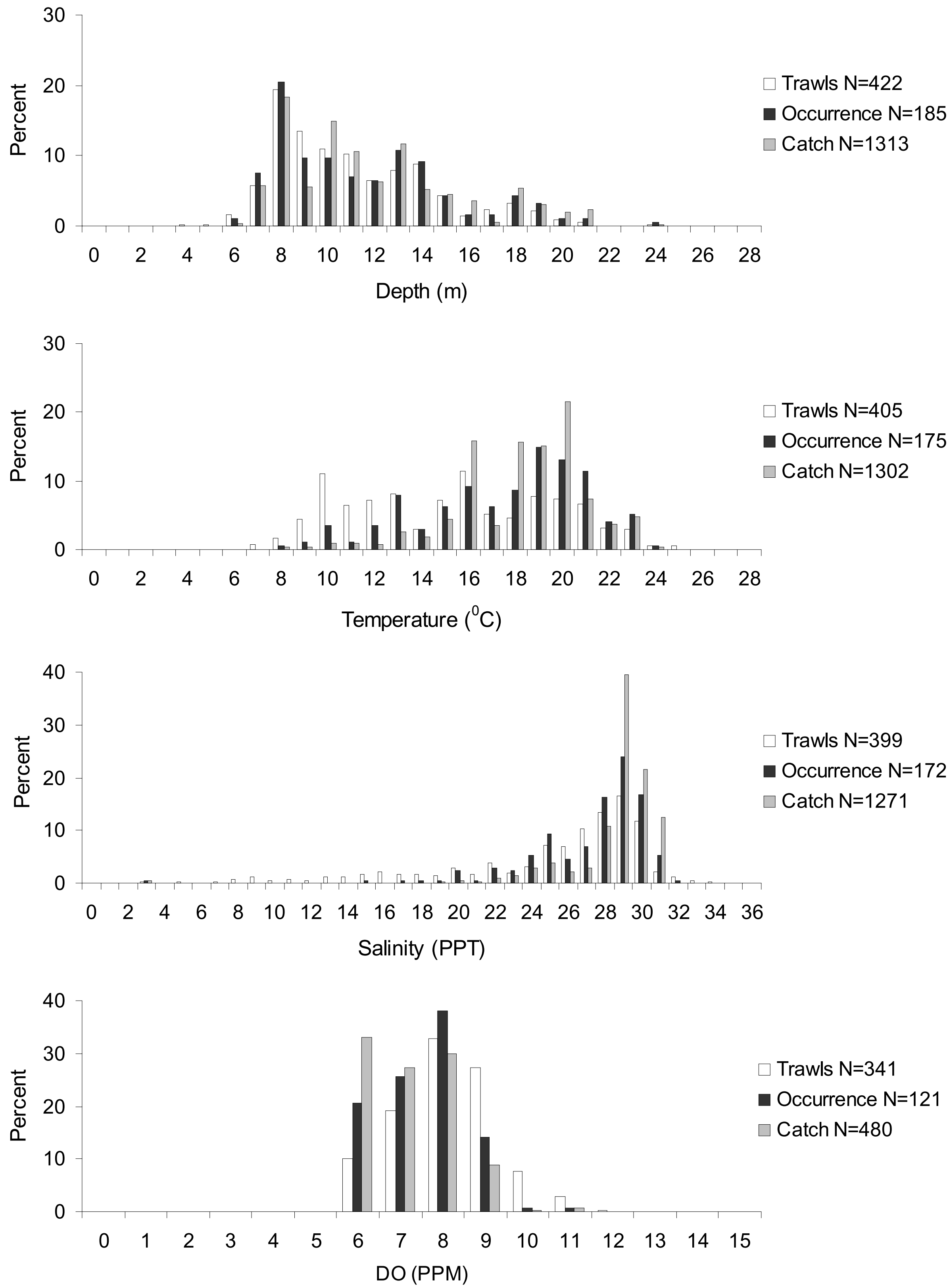


Figure 21. cont'd.

Fall



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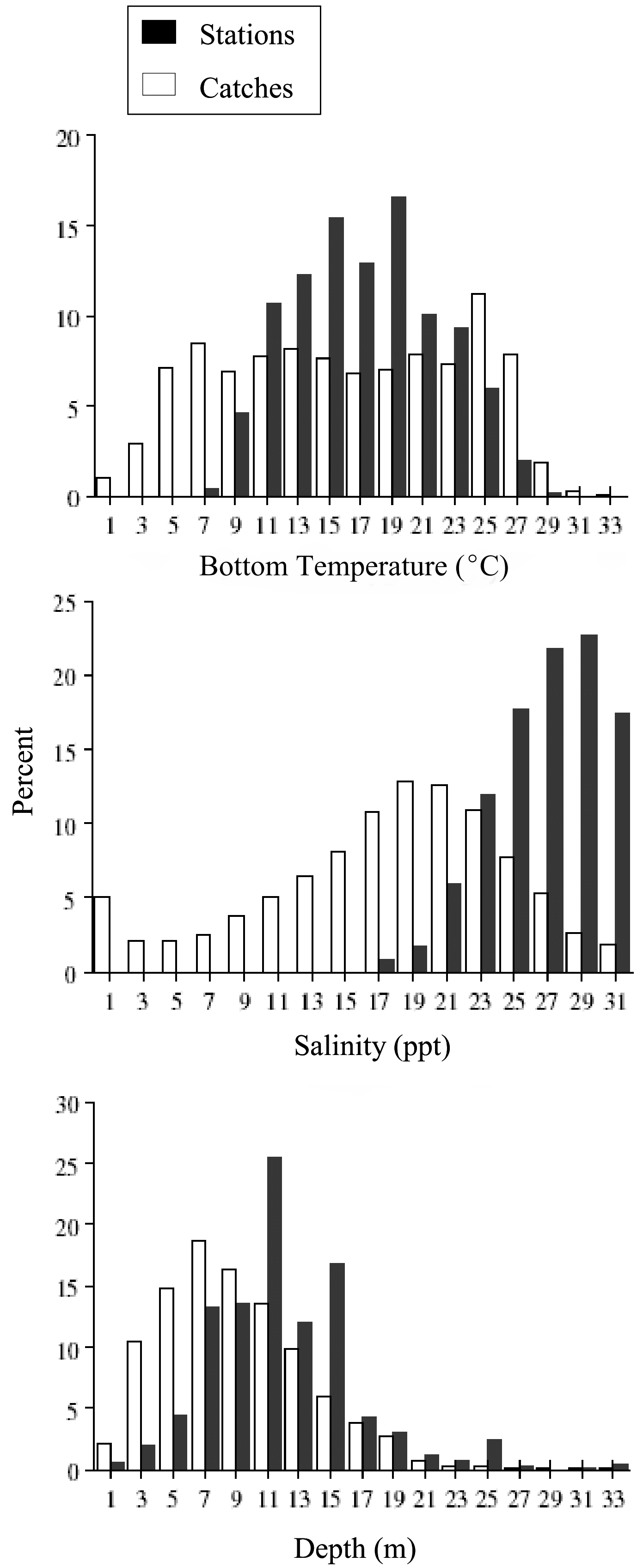


Figure 22. Hydrographic preferences for juvenile and adult clearnose skate in Chesapeake Bay, from the VIMS trawl surveys, 1988-1999 (all years combined). Adapted from Geer (2002).

Clearnose Skate
NEFSC Bottom Trawl Survey
Spring/Adults

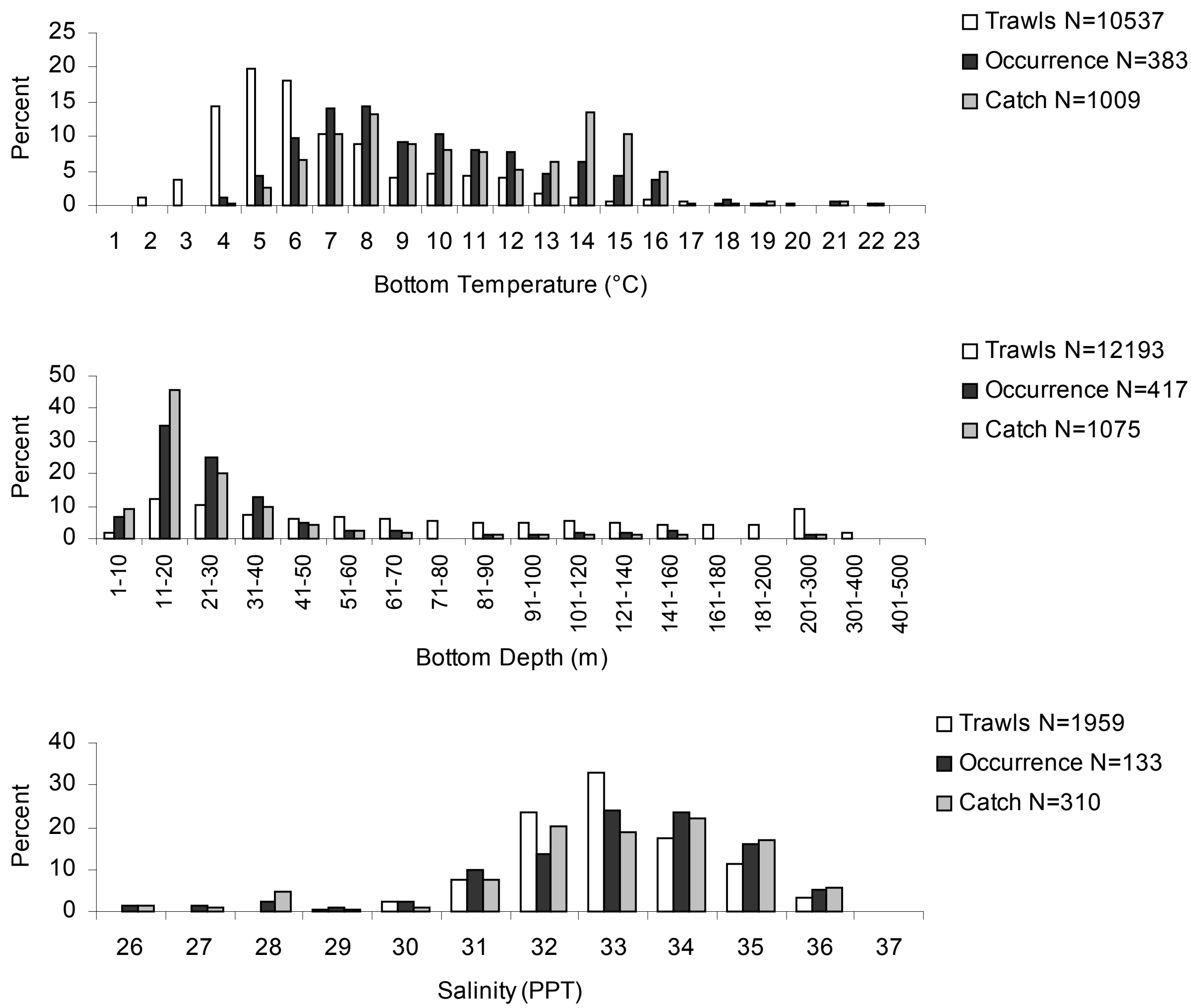


Figure 23. Spring and fall distributions of adult clearnose skate and trawls relative to bottom water temperature, depth, and salinity based on NEFSC bottom trawl surveys (1963-2002; all years combined). White bars give the distribution of all the trawls, black bars give the distribution of all trawls in which clearnose skate occurred, and gray bars represent, within each interval, the percentage of the total number of clearnose skate caught.

Clearnose Skate
NEFSC Bottom Trawl Survey
Fall/Adults

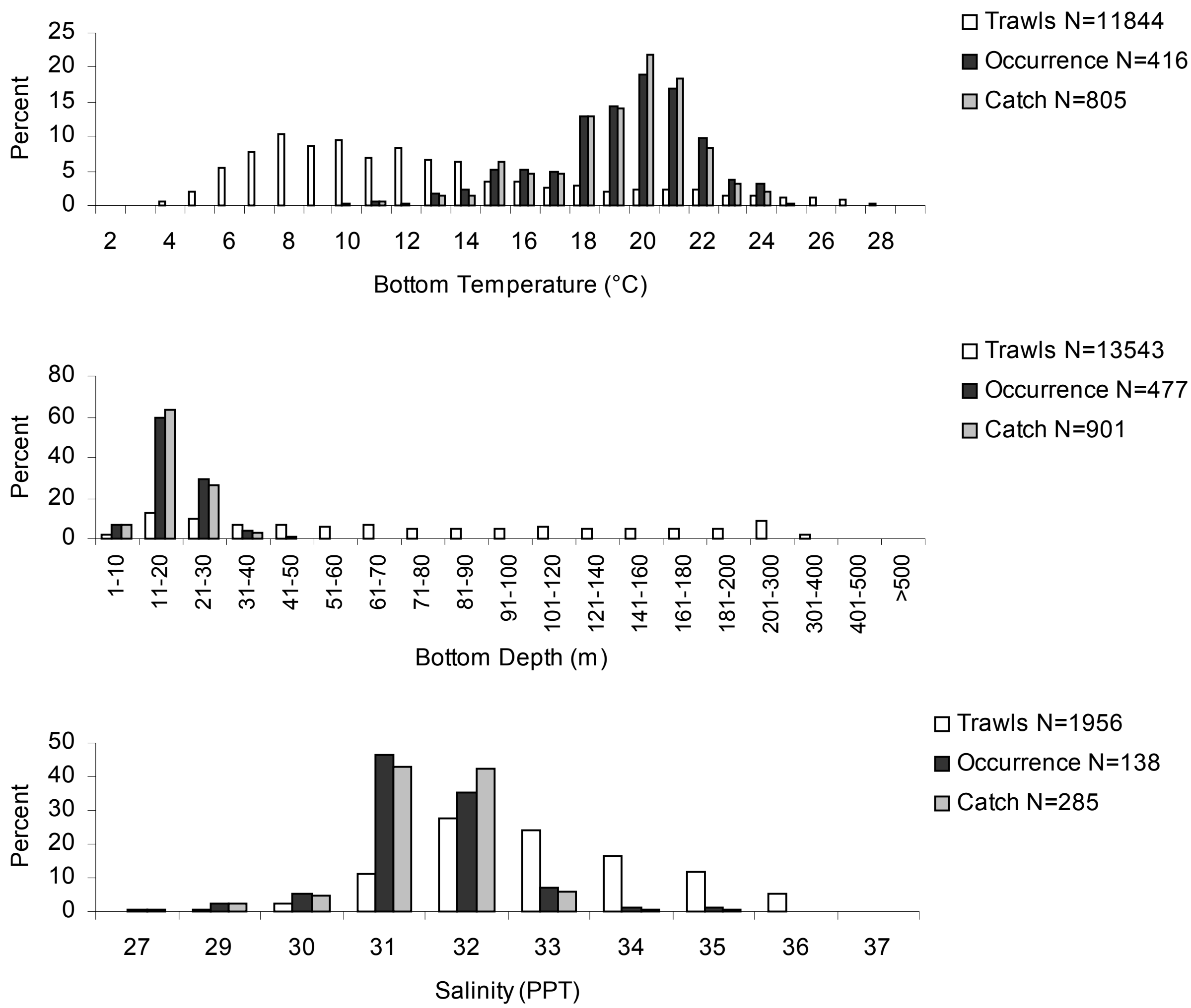


Figure 23. cont'd.

Spring

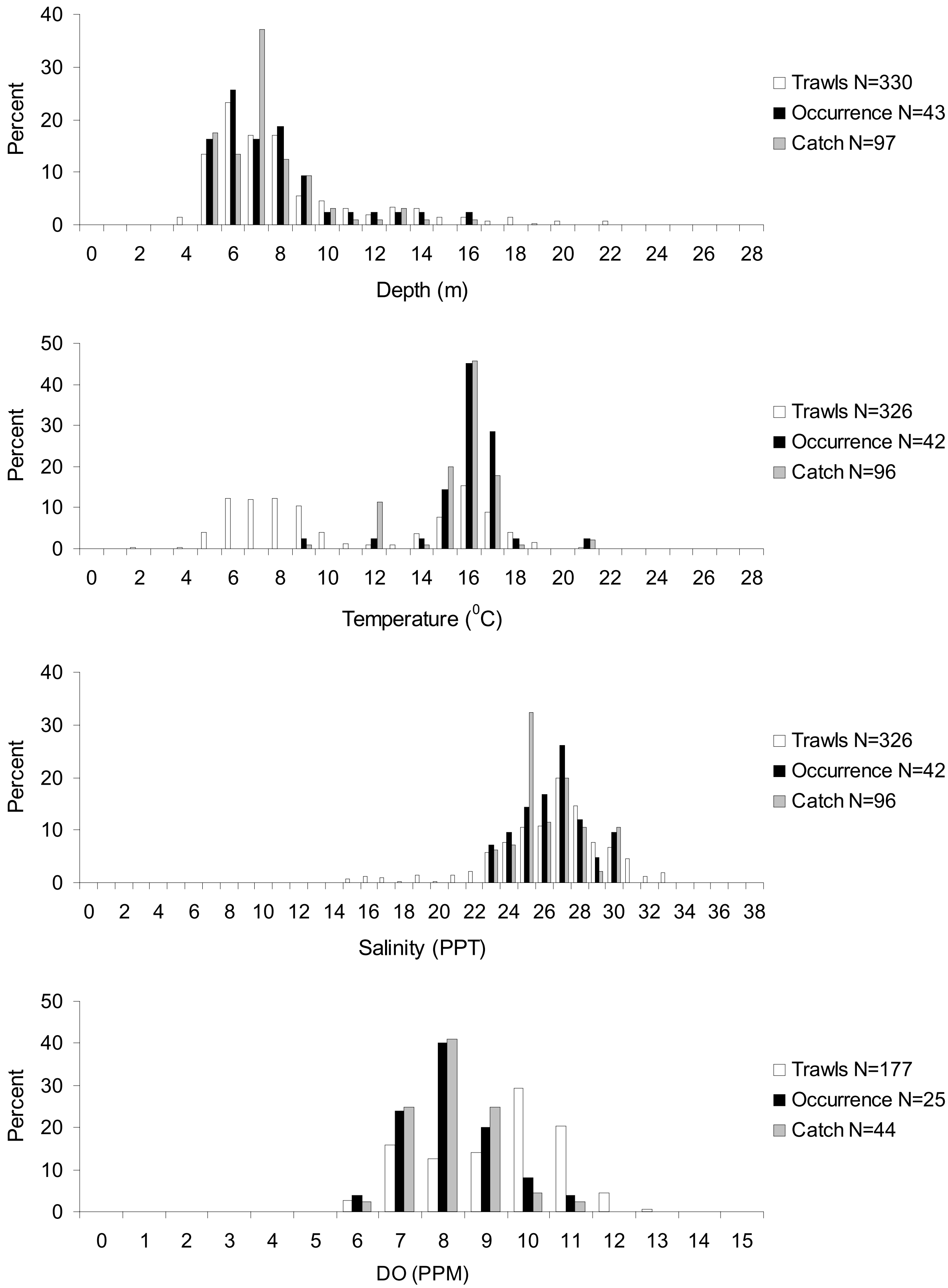


Figure 24. Seasonal distributions of adult clearnose skate and trawls relative to bottom water temperature, depth, salinity, and dissolved oxygen based on NEFSC Hudson-Raritan estuary trawl surveys (1992-1997; all years combined). White bars give the distribution of all the trawls, black bars give the distribution of all trawls in which clearnose skate occurred, and gray bars represent, within each interval, the percentage of the total number of clearnose skate caught.

Summer

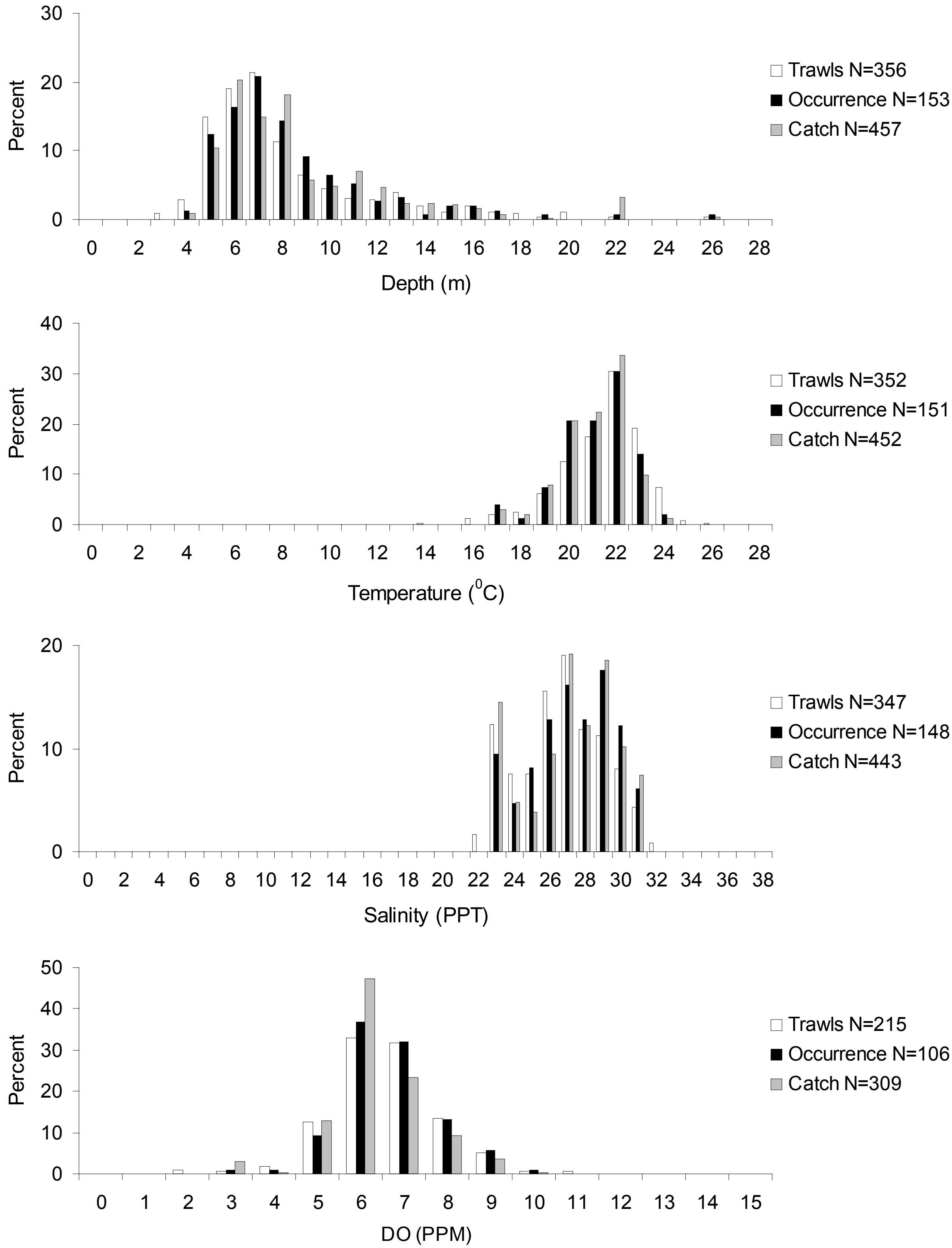
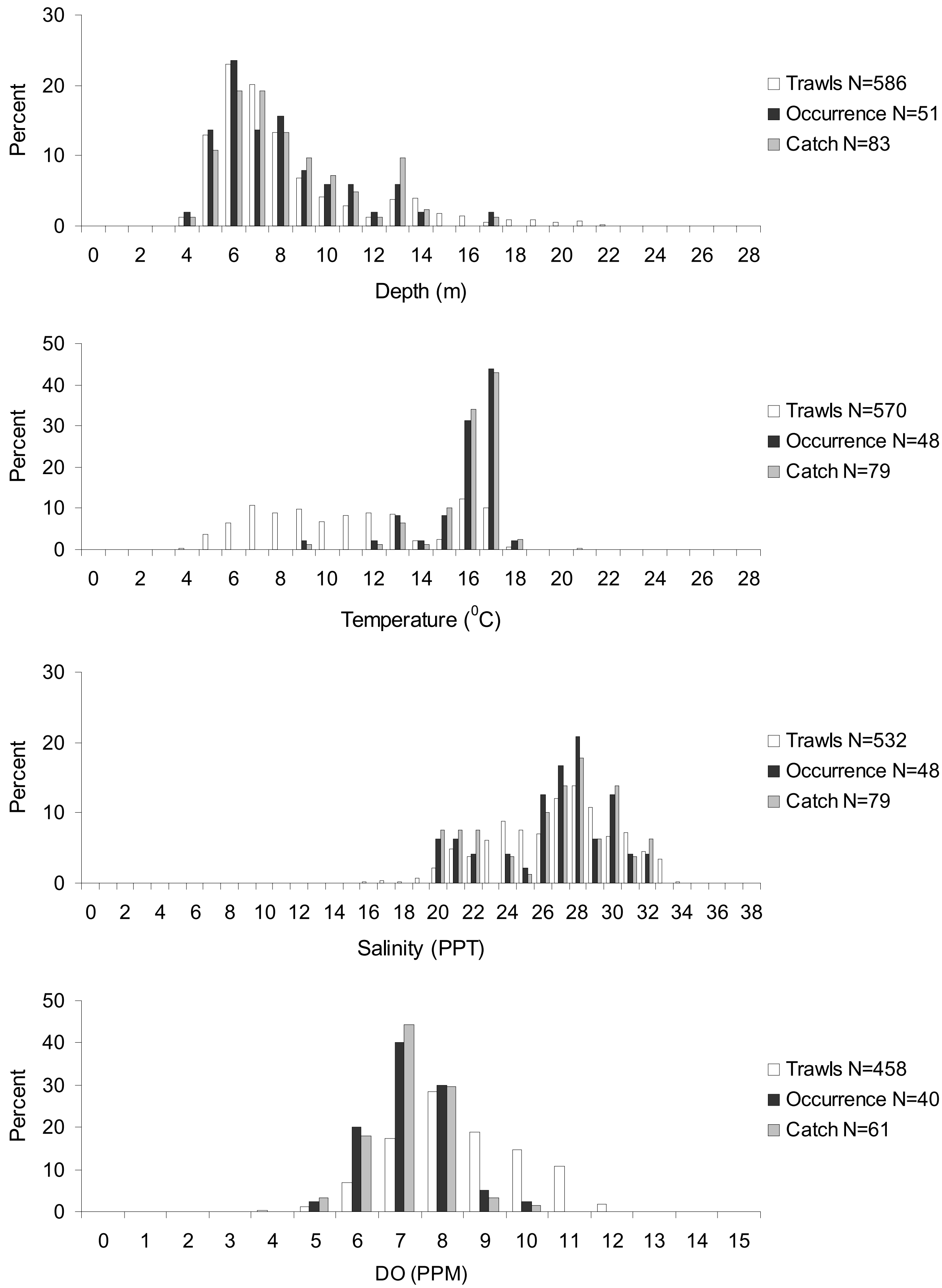


Figure 24. cont'd.

Fall



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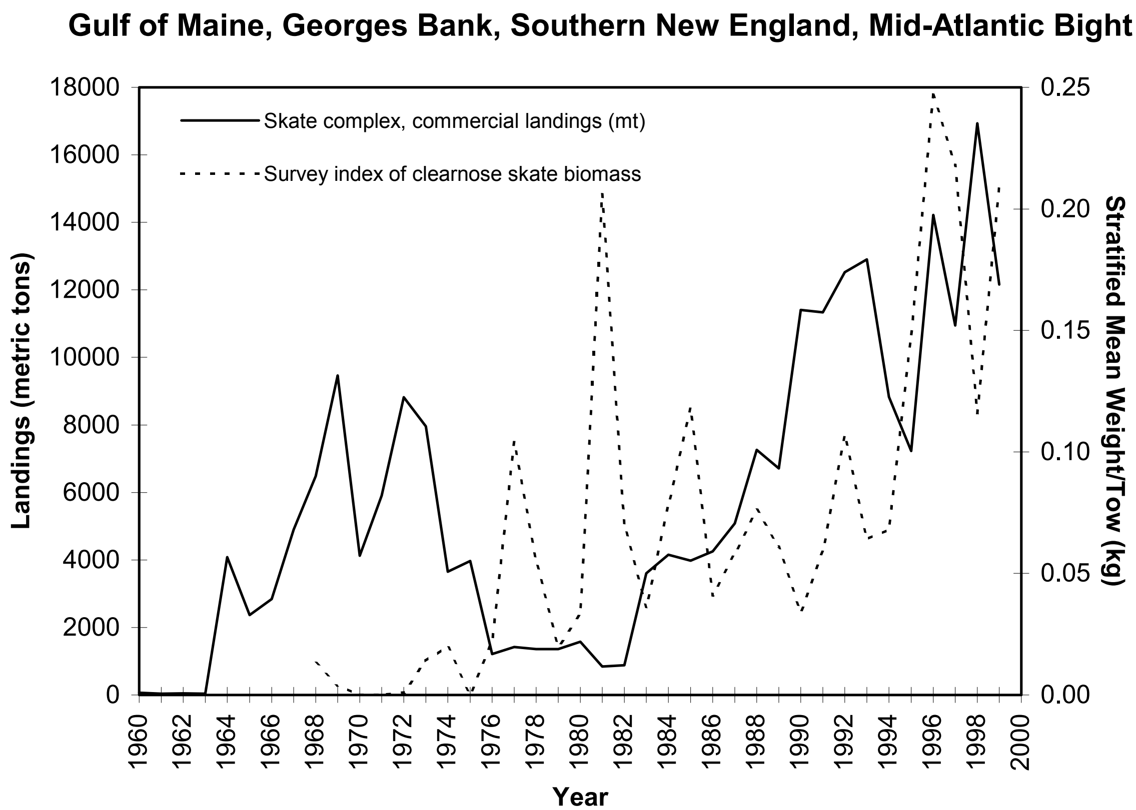

Figure 25. NEFSC spring survey index of clearnose skate biomass and commercial landings of the seven species skate complex from the Gulf of Maine to the Mid-Atlantic Bight.

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Publications and Reports of the Northeast Fisheries Science Center

The mission of NOAA's National Marine Fisheries Service (NMFS) is "stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Science Center (NEFSC) supports the NMFS mission by "planning, developing, and managing multidisciplinary programs of basic and applied research to: 1) better understand the living marine resources (including marine mammals) of the Northwest Atlantic, and the environmental quality essential for their existence and continued productivity; and 2) describe and provide to management, industry, and the public, options for the utilization and conservation of living marine resources and maintenance of environmental quality which are consistent with national and regional goals and needs, and with international commitments." Results of NEFSC research are largely reported in primary scientific media (*e.g.*, anonymously-peer-reviewed scientific journals). However, to assist itself in providing data, information, and advice to its constituents, the NEFSC occasionally releases its results in its own media. Those media are in four categories:

NOAA Technical Memorandum NMFS-NE -- This series is issued irregularly. The series typically includes: data reports of long-term or large-area studies; synthesis reports for major resources or habitats; analytical reports of environmental conditions or phenomena; annual reports of assessment or monitoring programs; manuals describing unprecedented field and lab techniques; literature surveys of major resource or habitat topics; proceedings and collected papers of scientific meetings; and indexed and/or annotated bibliographies. All issues receive internal scientific review and most issues receive technical and copy editing.

Northeast Fisheries Science Center Reference Document -- This series is issued irregularly. The series typically includes: data reports on field and lab observations or experiments; progress reports on continuing experiments, monitoring, and assessments; manuals describing routine surveying and sampling programs; background papers for, and summary reports of, scientific meetings; and simple bibliographies. Issues receive internal scientific review, but no technical or copy editing.

Fishermen's Report -- This information report is a quick-turnaround report on the distribution and relative abundance of commercial fisheries resources as derived from each of the NEFSC's periodic research vessel surveys of the Northeast's continental shelf. There is no scientific review, nor any technical or copy editing, of this report.

The Shark Tagger -- This newsletter is an annual summary of tagging and recapture data on large pelagic sharks as derived from the NMFS's Cooperative Shark Tagging Program; it also presents information on the biology (movement, growth, reproduction, etc.) of these sharks as subsequently derived from the tagging and recapture data. There is internal scientific review, but no technical or copy editing, of this newsletter.

OBTAINING A COPY: To obtain a copy of a *NOAA Technical Memorandum NMFS-NE* or a *Northeast Fisheries Science Center Reference Document*, or to subscribe to the *Fishermen's Report* or the *The Shark Tagger*, either contact the NEFSC Editorial Office (166 Water St., Woods Hole, MA 02543-1026; 508-495-2228) or consult the NEFSC webpage on "Reports and Publications" (*http://www.nefsc.noaa.gov/nefsc/publications/*).