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New York District

NEW YORK AND NEW JERSEY HARBOR DEEPENING PROJECT

Aquatic Biological Survey Report




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NEW YORK AND NEW JERSEY HARBOR DEEPENING PROJECT

AQUATIC BIOLOGICAL SURVEY REPORT

2009

FINAL Report

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1.0 INTRODUCTION

1.1 BACKGROUND

The 2009 Aquatic Biological Survey (ABS) was conducted as part of the New York and New Jersey Harbor Deepening Project (HDP). The HDP is a United States Army Corps of Engineers – New York District (USACE-NYD) and Port Authority of New York and New Jersey (PANYNJ) sponsored project to deepen navigation channels to 50 feet to accommodate larger commercial vessels. A primary goal of the ABS is to collect data on finfish, shellfish, macroinvertebrates, and water quality, with a focus on fish community structure, distribution and seasonal patterns of habitat use in New York/New Jersey Harbor (Harbor). The information collected is used in determining the potential project related impacts of deepening existing Harbor navigation channels, anchorages, and berthing areas.

The 2009 ABS supplements data provided in previous reports: 1998-1999 New York and New Jersey Harbor Navigation Study ("1999 Survey"), 2000-2001 Supplemental Sampling Program ("2001 Survey"), 2001-2002 Aquatic Biological Sampling Program ("2002 Survey"), the 2002-2003 Biological Sampling Program ("2003 Survey"), the 2004 Aquatic Biological Survey Report, the 2005 Aquatic Biological Survey Report, 2006 Aquatic Biological Survey Report, 2007 Aquatic Biological Survey Report and the 2008 Aquatic Biological Survey Report.

The finfish assemblage (species occurrence and relative abundance) within the Harbor is a dynamic community consisting of a variety of resident and migratory fish species typical of coastal estuaries and inshore waterways along the Middle Atlantic Bight. The Harbor estuary serves as a spawning ground, migratory pathway, nursery and foraging area for many species of finfish. Multi-year sampling programs are essential to establishing the use of channel and non-channel areas within the Harbor from year to year. Program sampling conducted from 1999-2009 can be used to describe annual variability in seasonal movement patterns, in usage and relative abundance, and to expand the temporal coverage of the program database particularly with respect to winter flounder. This sampling has provided a valuable long-term data set whereby fish responses to changing conditions and anthropogenic alterations in the Harbor may be assessed. Since 2002, when program sampling began in the Lower Bay, the study objectives, survey areas, and sampling gear have remained relatively consistent among sampling years to allow for inter-annual comparisons.

The focus of the 2009 ABS conducted from 15 December 2008 through 17 June 2009 was to collect spatial and temporal distribution data in the Harbor for adults, juveniles, and early life stage eggs and larvae of winter flounder as well as other finfish including Essential Fish Habitat (EFH) designated species. These data were used to document finfish distribution, habitat use (spawning and nursery habitat utilization), and trends in relative abundance. The results of the 2009 ABS are provided and discussed in this report.

1.2 STUDY OBJECTIVES

During the 2009 ABS, data were collected on adult and early life stages of finfish in the Harbor with an emphasis on winter flounder. Sampling was conducted from December to June when winter flounder spawning and early life stages typically occur in the Harbor. The specific objectives were to determine the utilization and relative abundance of selected Harbor areas for adult and early life stage winter flounder and other EFH designated species.

To meet the program objectives, two sampling methodologies were employed. A bottom trawl was used to sample adult and juvenile finfish, and a plankton net mounted on an epibenthic sled was used to sample primarily demersal eggs and larvae.

1.3 REPORT ORGANIZATION

For this report all finfish species are classified into one of three groups: Essential Fish Habitat (EFH) designated species, important non-EFH species (those identified by the resource agencies as forage, commercial and/or recreationally important species of special concern), and other species. For the 2009 report, eleven (11) species were categorized as important non-EFH species: Alewife, American eel, American lobster, American shad, Atlantic menhaden, Atlantic sturgeon (none collected in 2009), blue crab, blueback herring, rainbow smelt, shortnose sturgeon and striped bass. This organization has been used since the 2006 report to broaden the study's focus from primarily winter flounder to other important species in the Harbor's finfish community that have become an increasing focus of interest for local and regional resource managers. Table 1-1 presents a summary of the EFH designated species by life stage occurring in the Harbor as determined by the National Marine Fisheries Service.

2.0 METHODS

2.1 SAMPLING LOCATIONS

Throughout the ABS program, a standard set of sampling locations has been used, but some adjustments have been made from year to year. Most of the sampling locations have been surveyed in each year with a few additions or deletions in some years. In 2009, 24 stations were sampled using both the bottom trawl and the epibenthic sled, including seven of the eight stations added to the Lower Bay in 2008 and one new station added in the channel of Newark Bay. Two additional Kill Van Kull ichthyoplankton stations were added beginning in March 2008 but were not surveyed in 2009 because of ongoing dredging in the immediate area. Table 2-1 provides a description of all the ABS stations sampled since 2002 when program sampling began in the Lower Bay. Stations surveyed during 2009 are highlighted in bold.

Of the 24 stations surveyed during 2009 using both the bottom trawl and the epibenthic sled, 14 were located in non-channel areas (typically less than 25 feet in depth) and 10 were located within channels (typically 40 feet and deeper). As in previous years, to better document the spatial dynamics of the various finfish populations, the Harbor was divided into three geographic regions: Arthur Kill/Newark Bay, Upper New York Bay, and Lower New York Bay (Figure 2-1). Sampling stations were distributed as follows among the three regions:

- **Arthur Kill and Newark Bay**
  During the 2009 ABS program, five stations were sampled in this region including two channel stations (AK-2 and AK-3) in the Arthur Kill, and one new channel (NB-8) and two non-channel stations (NB-4 and NB-7) in Newark Bay. Both of the Newark Bay channel stations (NB-5 and NB-6), as well as the non-channel Newark Bay station (NB-3), were not sampled in 2008 and 2009 because of ongoing dredging operations in the area. Channel station NB-8 was added in 2009 to provide a similar channel area/station to that found in NB-5 and NB-6. The non-channel AK-1 station has not been sampled since 2004 because the

shallow water contour has been removed by dredging. Both of the non-channel stations AK-4 and AK-7 have not been sampled since 2005 and 2006, respectively, because of underwater obstructions that have made those areas unsafe to trawl.

- **Upper New York Bay ("Upper Bay")**

  During the 2009 ABS program, six stations were sampled in this region including four stations in South Brooklyn (SB) and two in Port Jersey (PJ). The two Kill Van Kull channel stations (KVK-1 and KVK- 2), which were sampled using an epibenthic sled only during part of the 2008 ABS program, were generally not sampled in 2009 (except for one sample at KVK-1) because of ongoing dredging in the area. Of the four stations surveyed in South Brooklyn, three were located in channels including Bay Ridge Channel (SB-4) and Anchorage Channel (SB-5 and SB-6), and one was located in the Bay Ridge Flats (SB-3). Of the two stations surveyed in Port Jersey, both were located in non-channel areas including Port Jersey Flats (PJ-1) and Caven Point Flats (PJ-2). The two non-channel stations located within the inter-pier area of Gowanus Bay (SB-1 and SB-2) were not sampled since 2007 and have been dropped from the program. PJ-5 (Port Jersey Channel east) was not sampled in 2008 and 2009 and the channel station (PJ-4) was not sampled in 2009 because of ongoing dredge operations in the area.

- **Lower New York Bay ("Lower Bay")**

  During the 2009 ABS program, 13 stations were sampled in the Lower Bay (LB) including seven of the eight new station locations added in 2008 to provide better spatial coverage of the non-channel areas of the Lower Bay (LB-7 through LB-13) and the Ambrose Channel North (LB-14). LB-11 was dropped from the ABS Program due to safety reasons in April 2008. Of the six Lower Bay stations historically sampled in the Lower Bay, three are located in channels including Ambrose Channel (LB-2), Chapel Hill South Channel (LB-4) and Raritan Bay East Reach (LB-6), and three are located in non-channel areas including East Bank (LB-1), Swash Channel Range (LB-3) and Old Orchard Shoals (LB-5). In

2008, the 10 non-channel stations in the Lower Bay were further classified into two groupings based on water depth: non-channel deep stations (≥ 25 feet: LB-7, LB-9, LB-10 and LB-12) and non-channel shallow stations (< 25 feet: LB-1, LB-3, LB-5, LB-8, LB-11 and LB-13).

2.2 BOTTOM TRAWL

Bottom trawl sampling for adult and juvenile finfish was scheduled to bracket the period when adult winter flounder are historically present in the Harbor to spawn. For the 2009 ABS, bottom trawl surveys were conducted once in December 2008 and May 2009, and twice each month from January to April 2009 at the 24 bottom trawl stations described above. A total of 240 bottom trawls were collected in 2009: 100 at channel stations and 140 at non-channel stations (Table 2-2).

Bottom trawls were conducted using a 30-ft (9.1-m) otter trawl with the same specifications as used during previous years of ABS sampling (Table 2-3). Bottom trawls were conducted during daylight[1] hours from one hour after sunrise to one hour before sunset against the prevailing current at a bottom speed of approximately 5.0 ft/sec (150 cm/sec). Boat speed was measured using a General Oceanics (GO) Model 2031 electronic flow meter coupled to a GO Model 2135 deck readout. GPS coordinates were recorded at the beginning and end of each tow. Target tow duration was ten minutes, although tow times were occasionally adjusted as needed to account for obstructions, limited transect distance, commercial traffic, and other safety considerations in the field. A minimum ratio of 5:1 tow cable length to maximum station water depth was maintained to ensure that the trawl was in contact with the bottom throughout each tow.

Upon retrieval of the net, all of the contents were placed in a collection tub filled with ambient water and the net was inspected. If it was determined that the net was damaged while actively trawling and that some of the sample could have been lost or that the net did not fish properly, then the trawl was deemed invalid and repeated. If the trawl sample

[1] Bottom trawls were conducted during the night from the 1999 through 2004 sampling programs. In 2005, sampling was changed to daylight hours due to safety considerations.

was determined to be valid then all fish were identified and enumerated on the research vessel immediately following collection. For all winter flounder collected, the total length (TL) was recorded to the nearest millimeter (mm). For all other species, a random subsample of up to 25 specimens of each species was selected for length determination.

When available, a total of up to five winter flounder (≥ 250 mm TL) per trawl were used for gender determination. If gender could not be determined in the field, specimens were preserved on ice and returned to the laboratory for further analysis. Spawning condition (ripe, partially spent, and spent) was also recorded in the laboratory to provide additional information on spawning period. Since winter flounder typically exhibit adult gonad development at 250 mm TL and reach sexual maturity between 280 mm and 300 mm TL (Witherell 1993), a 250-mm TL requirement was established to limit the number of immature fish kept for analysis.

Except for winter flounder preserved for laboratory analysis, all fish collected were released into the water after on-board examination.

2.3 EPIBENTHIC SLED

Epibenthic sled tow sampling for ichthyoplankton was scheduled to bracket the period when winter flounder eggs and larvae are historically present in the Harbor. For the 2009 ABS, ichthyoplankton surveys were conducted twice each month (approximately every other week) from January to June 2009 at the 24 stations described above. A total of 289 epibenthic sled tows were collected in 2009: 121 at channel stations and 168 at non-channel stations (Table 2-2).

Ichthyoplankton samples were collected using 0.5-m² diameter plankton net with 0.5-mm mesh mounted on an aluminum epibenthic sled (Table 2-4). The plankton net was fitted with a GO Model 2030R flow meter to measure sample volume. All samples were collected during daylight hours from one hour after sunrise to one hour before sunset. Tows were conducted against the prevailing current at a bottom speed of approximately 3.0 to 3.6 ft/sec (90 to 110 cm/sec). Boat speed was measured using a GO Model 2031 electronic flow meter coupled to a GO Model 2135 deck readout. GPS coordinates were recorded at the beginning and end of each tow to ensure proper station maintenance. Target tow duration was ten minutes, although tow times were occasionally adjusted as needed to account for obstructions, limited transect distance, commercial traffic, and other safety considerations in the field. A minimum ratio of 3:1 tow cable length to maximum station water depth was maintained to ensure that the sled was in contact with the bottom throughout each tow.

Upon retrieval of the epibenthic sled, the flow meter reading was checked to ensure that enough water volume had been sampled and that the net had not been ripped or filled with mud/debris. If it was determined to be a valid sample, then the net was washed down from the outside concentrating the sample in the cod-end bucket. Each ichthyoplankton sample was then transferred to an appropriately sized container(s) and the remaining volume filled with 10% buffered Formalin containing the vital stain Rose Bengal. Samples were then returned to the laboratory for sorting and identification.

2.3.1 Laboratory Methodology for Ichthyoplankton Sort and Identification

All specimens were identified to the lowest taxonomic level practicable, assigned a life stage based on morphometric characteristics (i.e., egg, yolk-sac larvae, post yolk-sac larvae, or juvenile) and except for winter flounder, only viable eggs were enumerated. For some larvae, it was not possible to discern between yolk-sac and post yolk-sac life stages because the specimens were damaged by natural causes and/or during sample collection. These were classified as unidentified larval stage. Quality control procedures consisted of a continuous sampling plan to assure an average outgoing quality limit (AOQL) of <0.10 (≥90% accuracy) during sample sorting, enumeration, life stage designation, and identification.

To further identify and describe the embryonic development of viable[2] winter flounder eggs collected during the ichthyoplankton survey, the following sequential staging methodology was developed based upon the winter flounder egg development described by Martin and Drewry (1978). This methodology was employed by Schultz *et al*. (2007) and is consistent with other authors who have described similar staging systems for other species (Gorodilov 1996; Gadomski and Caddell 1996). In particular, Allen *et al.* (2005) describes a staging system for the developmental progression of lake trout, *Salvelinus namaycush*, which closely follows this study's five-stage methodology for winter flounder growth from fertilization to hatching as further described below. Staging of the eggs enables one to distinguish between eggs that were recently deposited from those that are more developed and may have moved from the site of their deposition (Schultz *et al.* 2007).

After sorting and species identification, all of the viable winter flounder eggs were further identified (beginning in 2008) into one of the following five stages using observed embryonic characteristics (see also Appendix D):

Egg Stages:

Stage 1 or Early Cleavage Stage: 1-64 cells, age equals < 24 hours.

Stage 2 or Blastula Stage: Final product of cleavage, formation of blastocoel, age equals approximately 24-48 hours.

Stage 3 or Gastrula Stage: Between formation of blastocoel and formation of embryonic axis, age equals approximately 2-3 days.

Stage 4 or Early Embryo Stage: Formation of embryonic axis, age equals approximately 4-15 days.

Stage 5 or Late Embryo Stage: After formation of embryonic near hatching, age equals approximately >15 days.

[2] Viable eggs were fertilized eggs showing various stages of development at the time of preservation. Non-viable eggs include those that were unfertilized as well as those fertilized but obviously dead: an egg that has become opaque or murky in nature or has the presence of fungus and/or other types of deterioration.

In 2008 and 2009, all non-viable winter flounder eggs were counted during the staging process but only viable eggs were applied to the density calculations (see Section 2.5.2) to allow for direct comparisons between previous years of sampling in which non-viable eggs were not counted. Consistent with previous years, non-viable eggs for other species were not counted.

In addition, all winter flounder yolk-sac and post yolk-sac larvae were further classified (beginning in 2007) into the following developmental stages (see also Appendix D):

Larval Stages:

Stage 1: Yolk-sac present or eyes not pigmented.

Stage 2: Eyes pigmented, no loop or coil formed in the gut, no flexion of the notochord, and no yolk-sac present or minimal traces of yolk may remain.

Stage 3: Loop or coil formed in gut and/or flexion of the notochord has begun, but left eye has not migrated past the midline.

Stage 4: Left eye has migrated past the midline, but juvenile characteristics not present.

Up to 25 winter flounder of each larval stage were then randomly selected and measured from each sample. Total lengths of larvae were measured to the nearest 0.1 mm using microscopic imaging and measuring software further described below (see also Appendix D). Juveniles that did not fit in the microscope view for image capturing measurement were measured to the nearest 1.0 mm using a calibrated measuring board. Larvae that exhibited prior damage/decomposition and/or sampling damage that could result in inaccurate lengths were not measured.

The measurement of winter flounder yolk-sac and post yolk-sac larvae was accomplished using a Motic DM143 Digital Microscope, a Canon Powershot S31S Digital Camera, and University of Texas Health Science Center at San Antonio (UTHSCSA) ImageTool software. The procedure involved first capturing a microscopic digital image of the larvae using Canon's CameraWindow software and saving it to a computer database. The images were then accessed and the larvae measured using the UTHSCSA image analysis software. Prior to each measurement session, a three-fold Daily Certification Process was employed to verify the user's precision and accuracy with the image analysis tool by first testing the user's hand motion when measuring 1-mm marks, then calibrating the tool to the user's hand and eyes, and lastly verifying the calibration by testing the user when making 10-mm measurements.

2.4 WATER QUALITY MEASUREMENTS

Dissolved oxygen (DO), temperature, conductivity, and salinity were measured during each survey at each station location using a calibrated YSI Model 85 Handheld Oxygen, Conductivity, Salinity and Temperature System meter with a known degree of accuracy (Table 2-5). Measurements were recorded from the bottom strata of the water column at approximately one foot (0.3 m) above the substrate. Field instruments were calibrated each day both prior to and after sampling. At least once per sampling day, the accuracy of the YSI Model 85 instrument was verified using an ASTM certified thermometer, a laboratory conductivity/salinity meter, and at least three water samples collected in the field and analyzed for DO using the Winkler titration method.

2.5 DATA ANALYSIS

All finfish were identified to the lowest practical taxonomic level in both trawl and ichthyoplankton sampling. Species were grouped into one of three categories: EFH designated species, important non-EFH species, and other species. Except where noted and appropriate, most data analyses for this report focused on the program years 2002 to 2009 when sampling included the Lower Bay stations.

2.5.1 Bottom Trawl

Catch per unit effort (CPUE), defined as the number of fish collected per 10 minutes of trawling, was determined for each bottom trawl sample and was standardized to 10 minutes using the following formula:

$$CPUE = \left(\frac{N}{T}\right) \times 10$$

Where:
N equals the number of fish collected during the trawl and
T equals the actual tow time expressed in minutes.

2.5.2 Epibenthic Sled

Ichthyoplankton densities expressed as total number per 1,000 cubic meters (m^3) were computed for each epibenthic sled tow based on the volume of water sampled and using the following formula:

$$Density = \left(\frac{N}{[A \times D]}\right) \times 1{,}000$$

Where:
N equals the total number of organisms collected,
A equals the area of the net mouth (m^2) and
D equals the distance traveled (m) calculated as the total flow meter count multiplied by the flow meter constant (0.026873).

3.0 RESULTS

Adult finfish and ichthyoplankton results are described for both channel and non-channel stations in three Harbor regions (Arthur Kill/Newark Bay, Upper Bay, and Lower Bay). Species composition, relative abundance, density (per unit volume for ichthyoplankton samples), and catch per unit effort (CPUE) for bottom trawl samples are described in the sections below. Detailed station data for adult and juvenile finfish, ichthyoplankton, and water quality are provided in Appendices A through C, respectively.

3.1 ALL SPECIES

3.1.1 Bottom Trawl

A total of 19,713 finfish (47 species) and two shellfish species American lobster (n=1) and blue crab (n=37) were collected during the 2009 bottom trawl survey (Tables 3-1 and 3-2). Alewife (4,108 collected, 20.8% of the total catch) and Atlantic herring (3,761, 19.1%) were the most commonly collected species in the Harbor during the 2009 sampling program, each contributing about one fifth of the total bottom trawl catch. They were followed in number collected by white perch (3,508, 17.8%), bay anchovy (3,148, 16.0%), blueback herring (2,772, 14.1%), striped bass (684, 3.5%), winter flounder (430, 2.2%), Atlantic silverside (318, 1.6%), American sandlance (270, 1.4%), and spotted hake (239, 1.2%). The remaining 39 species were each represented by less than 60 individuals, and of these, 31 were represented by 20 or fewer individuals (Table 3-2).

Approximately 39% (7,681 collected) of the total bottom trawl catch consisted of those fish grouped as other species; EFH and important non-EFH species represented about 22% (4,364) and 39% (7,668) of the total bottom trawl catch, respectively. Two EFH species: Atlantic herring (3,761 collected, 19.1% of the total catch) and winter flounder (430, 2.2%), and three important non-EFH species: alewife (4,108, 20.8%), blueback herring (2,772, 14.1%) and striped bass (684, 3.5%) each contributed over two percent of the total catch in the Harbor (Table 3-2). The remaining EFH and important non-EFH species each represented less than 0.3% of the total catch.

When defined by station type, a total of 10,571 finfish from 38 species, one American lobster, and 12 blue crabs were collected from the 100 samples obtained at 10 channel stations during 2009, and a total of 9,104 finfish from 41 species and 25 blue crabs were collected from the 140 samples obtained at 14 non-channel stations (Table 3-2). Alewife (3,708 collected, 35.0% of the total channel catch), white perch (3,477, 32.9%), blueback herring (1,773, 16.8%), striped bass (592, 5.6%), winter flounder (381, 3.6%), and spotted hake (164, 1.5%), were the six most common species collected at channel stations. Atlantic herring (3,702 collected, 40.6% of the total non-channel catch), bay anchovy (3,114, 34.1%), blueback herring (999, 10.9%), alewife (400, 4.4%), American sandlance (267, 2.9%), and Atlantic silverside (207, 2.3%), were the six most common species collected at non-channel stations. Finfish, American lobster and blue crab abundances at channel stations/non-channel stations totaled 4,316/4,399 in the Arthur Kill/Newark Bay; 4,595/2,709 in the Lower Bay; and 1,673/2,021 in the Upper Bay (Table 3-2).

During the 2009 ABS, average weekly bottom trawl CPUE for all fish combined varied temporally and spatially with channel stations having generally higher CPUE rates from January through April in all regions (Figure 3-1). CPUE rates at non-channel stations were higher in December and considerably higher during May. These seasonal variations in CPUE at channel and non-channel stations were largely a reflection of the species collected. Alewife (average peak monthly CPUEs of 90.6 in January and 49.3 in February), white perch (68.8 in January and 63.8 in March) and blueback herring (41.7 in January and 31.2 in February) being the most commonly collected species in channel stations (Table 3-3). By contrast, later in the sampling season the highest monthly average bottom trawl CPUEs were found at non-channel stations and consisted of Atlantic herring (264.7 in May) and bay anchovy (210.1 in May).

Winter flounder was the most common EFH species collected from channel stations while Atlantic herring was the most common EFH species collected in non-channel areas (Table 3-3). Other EFH species were uncommon in bottom trawl collections: Atlantic cod, black sea bass, butterfish, clearnose skate, pollock, summer flounder, and winter skate had the lower monthly mean CPUE rates, while the mean CPUEs for little skate, red hake, and windowpane were slightly higher. The highest monthly average bottom trawl CPUEs for important non-EFH species occurred at channel stations and included alewife in January (90.6), February (49.3) and March (28.7) as well as blueback herring in January (41.7) and February (31.2) and striped bass in January (14.1). Blueback herring were also common in non-channel collections during December (20.7) and January (15.4). Of note, one shortnose sturgeon (an important non EFH species that is federally listed as an endangered species) was collected at a non-channel station in the Upper Bay in May (Tables 3-2 and 3-3). This specimen was measured and released alive at the collection site.

As a group, the 27 other species collected in the bottom trawls consisted of a diverse assemblage of finfish species with a range of abundances (rare to abundant) distributed spatially and temporally. The most common of these species were white perch, bay anchovy, Atlantic silverside, American sandlance and spotted hake (Table 3-2). Bay anchovy were collected primarily in May in non-channel stations (average monthly CPUE of 210.1); only a few were collected from channel areas (Table 3-3). White perch were collected primarily in channels from January through March while spotted hake were more common in channel stations during April and May. American sandlance were found primarily in non-channel stations during December and Atlantic silverside were collected at both channel and non-channel stations during January (Table 3-3).

3.1.1.1 Arthur Kill/Newark Bay

A total of 8,691 fish (consisting of 27 species) and 24 blue crab were collected from 50 bottom trawl samples in the Arthur Kill/Newark Bay during 2009 (Table 3-2). Atlantic herring (3,360 collected, 38.6% of the total Arthur Kill/Newark Bay catch) and white perch (3,287, 37.7%) were the dominant species collected in the region; followed by bay anchovy (824, 9.5%), alewife, (399, 4.6%), striped bass (305, 3.5%), winter flounder (197, 2.3%), and blueback herring (165, 1.9%).

EFH and important non-EFH species comprised 51.5% (n=4,490) of the total bottom trawl collections in the Arthur Kill/Newark Bay during 2009 (Figure 3-2). Blueback herring and winter flounder were the most common species of this group collected in December while striped bass and winter flounder were the most common in January. Alewife became increasingly more common in February through April collections while Atlantic herring was dominant in May (Figure 3-2).

In grouping by channel or non-channel stations, 24 fish species plus blue crab were collected from the channel stations and 16 fish species plus blue crab were collected from the non-channel stations in the Arthur Kill/Newark Bay (Tables 3-4a and 3-4b). Of the most common species collected in the Arthur Kill/Newark Bay, white perch, striped bass, winter flounder, alewife, blueback herring, and spotted hake were collected primarily from channel stations; Atlantic herring and bay anchovy were primarily collected from non-channel stations. Trends in CPUE within the Arthur Kill/Newark Bay were primarily influenced by large collections of white perch in channel stations during the winter months (January to March) and large collections of Atlantic herring and bay anchovy in non-channel areas during May (Tables 3-4a and 3-4b).

3.1.1.2 Upper Bay

A total of 3,688 fish (consisting of 33 species) and 6 blue crab were collected from 60 bottom trawls samples in the Upper Bay during 2009 (Table 3-2). Bay anchovy (1,408 collected, 38.1% of the total Upper Bay catch) was the dominant species collected; followed by alewife (802, 21.7%), Atlantic herring (379, 10.3%), striped bass (372, 10.1%), white perch (221, 6.0%), winter flounder (181, 4.9%), blueback herring (130, 3.5%), and spotted hake (67, 1.8%).

EFH and important non-EFH species comprised 52.2% (n=1,927) of the total bottom trawl collections in the Upper Bay during 2009 (Figure 3-2). Striped bass, blueback herring and winter flounder were the most commonly collected of this group in the Upper Bay in December. Striped bass and alewife dominated the collections in January while alewife was dominant in February. Winter flounder, striped bass and alewife shared dominance in March and April while Atlantic herring dominated in May (Figure 3-2).

In grouping by channel or non-channel stations, 28 fish species plus blue crab were sampled from channel stations and 24 fish species plus blue crab were collected from non-channel stations in the Upper Bay (Tables 3-4a and 3-4b). Of the dominant species collected in the Upper Bay, alewife, white perch, winter flounder, and spotted hake were collected primarily from channel stations; Atlantic herring and bay anchovy were primarily from non-channel stations; and blueback herring and striped bass were collected from both areas. Trends in CPUE within the Upper Bay were influenced by higher CPUEs of striped bass in channel stations primarily during January, large collections of alewife in channel stations during February and high CPUEs of Atlantic herring and bay anchovy in non-channel stations during May (Tables 3-4a and 3-4b).

3.1.1.3 Lower Bay

A total of 7,296 fish (consisting of 35 species), one American lobster and 7 blue crab were collected from 130 bottom trawl samples in the Lower Bay during 2009 (Table 3-2). Alewife (2,907 collected, 39.8% of the total Lower Bay catch) was the dominant species collected; followed by blueback herring (2,477, 33.9%), bay anchovy (916 collected, 12.5%), Atlantic silverside (285, 3.9%), American sandlance (266, 3.6%), and spotted hake (116, 1.6%).

EFH and important non-EFH species comprised 76.9% (n=5,615) of the total bottom trawl collections in the Lower Bay during 2009 (Figure 3-2). Alewife and blueback herring were the co-dominant species from this grouping in December through April collections in the Lower Bay while several species shared dominance in May including butterfish, windowpane and alewife (Figure 3-2).

In grouping by channel or non-channel stations, 25 species of fish plus American lobster and blue crab were sampled from channel stations and 33 species of fish plus blue crab were collected from non-channel stations in the Lower Bay (Tables 3-4a and 3-4b). Of the dominant species collected in the Lower Bay, alewife and blueback herring were collected primarily from channel stations; bay anchovy and American sandlance were primarily from non-channel areas; and Atlantic silverside and spotted hake were collected from both areas. Trends in CPUE within the Lower Bay were influenced primarily by large collections of alewife and blueback herring at channel stations from January to March, and high collections of bay anchovy at non-channel stations during May (Tables 3-4a and 3-4b).

3.1.2 Epibenthic Sled

Finfish eggs, larvae, and juveniles were collected from channel and non-channel stations in all three regions of the Harbor during ABS epibenthic sled sampling in 2009. A total of 186,658 early life stage eggs and larvae, and juveniles were collected in 2009 (Table 3-5). A majority of the ichthyoplankton collected were eggs (174,368; 93.4%); 6.0% were post yolk-sac larvae (n=11,291), and 0.4% were yolk-sac larvae (n=781). Most were collected in the Lower Bay (150,788; 80.8%; 156 samples) followed by the Upper Bay (20,241; 10.8%; 73 samples) and the Arthur Kill/Newark Bay (15,629; 8.4%; 60 samples).

During the 2009 survey, a total of 28 taxa were identified in the ichthyoplankton samples with the Lower Bay having the highest taxa richness (24 taxa) compared to 22 taxa in both the Upper Bay and Arthur Kill/Newark Bay (Table 3-5). Four EFH designated species (Atlantic cod, summer flounder, windowpane, and winter flounder) and one important non-EFH species (Atlantic menhaden) were collected in 2009 ichthyoplankton samples (Table 3-5). The Lower Bay also had the highest number of EFH and important non-EFH species (5), compared to four in both the Upper Bay and Arthur Kill/Newark Bay regions.

Of these EFH and important non-EFH species, four (summer flounder, windowpane, winter flounder, and Atlantic menhaden) were collected from all three regions. Egg, yolk-sac larvae, and post yolk-sac larvae life stages of windowpane, winter flounder, and Atlantic menhaden were collected from all three regions except for no windowpane yolk-sac larvae collected in the Upper Bay. Summer flounder post yolk-sac larvae life stages were collected from all three regions and Atlantic cod egg and juvenile life stages were collected only in the Lower Bay (Table 3-5).

3.1.2.1 Eggs

A total of 174,368 viable eggs from 11 taxa of finfish were collected in the Harbor during ABS ichthyoplankton sampling in 2009 (Table 3-5). The majority of eggs collected were bay anchovy (142,500 collected, 81.7% of the total egg catch), followed by wrasses (Labridae family) (16,176, 9.3%), windowpane (8,687, 5.0%), Atlantic menhaden (3,323, 1.9%), and searobin species (*Prionotus* sp.) (1,790, 1.0%), with the remaining taxa each representing less than one percent of the total catch (Table 3-5).

Average weekly egg densities were generally higher in the Lower Bay compared to both the Upper Bay and Arthur Kill/Newark Bay (Figure 3-3). In the Lower Bay, peak egg densities were found at non-channel stations during the week of 15 June 2008 (53,682 eggs/1,000m^3) and at channel stations during the week of 1 June (27,172 eggs/1,000m^3). In the Arthur Kill/Newark Bay and the Upper Bay, egg densities were similar in scale and generally higher in the channels with peak average weekly densities occurring in both regions in channels during the week of 15 June at 17,840 eggs/1,000m^3 in the Upper Bay and 16,155 eggs/1,000m^3 in Arthur Kill/Newark Bay (Figure 3-3). The peak egg collections in June were generally the result of high collections of bay anchovy in both channel and non-channel areas with maximum monthly average catches of 33,624 and 20,437 eggs/1,000m^3 occurring in Lower Bay non-channel and channel stations, respectively (Table 3-6a). In addition, relatively large collections of wrasse eggs were made in all three Harbor regions in both channel and non-channel areas of the Lower Bay and channel stations of the Upper Bay and the Arthur Kill/Newark Bay. A maximum collection of 3,736 eggs/1,000 m^3 occurred at channel stations in the Arthur Kill/Newark Bay during June (Table 3-6a).

EFH and important non-EFH species comprised 7.0% (n=12,224) of the total egg collection during the 2009 ichthyoplankton sampling program (Figure 3-4). The collection of EFH and important non-EFH species eggs was dominated in February and March by winter flounder in all regions while April and May were dominated by windowpane. During June, Atlantic menhaden dominated the collections in the Arthur Kill/Newark Bay and Upper Bay while windowpane continued to dominate in the Lower Bay (Figure 3-4).

Of the EFH and important non-EFH species, the mean monthly collection of winter flounder eggs peaked at 44 eggs/1,000m^3 at non-channel stations of the Upper Bay in February (Table 3-6a). Windowpane eggs were collected from April through June at both channel and non-channel stations with peak mean monthly egg densities occurring in the Lower Bay in June at channel stations (1,424 eggs/1,000m^3) and during May at non-channel stations (801 eggs/1,000m^3). Monthly mean egg densities for windowpane were generally lower in the Upper Bay than the Lower Bay with the two highest densities of 679 and 660 eggs/1,000m^3 occurring at channel stations during May and June, respectively. Only a few windowpane eggs were collected in the Arthur Kill/Newark Bay during April and May (Table 3-6a). By comparison, Atlantic menhaden eggs were collected primarily in June with a peak mean monthly density of 1,659 eggs/1,000m^3 occurring at channel stations during June in the Upper Bay (Table 3-6a).

3.1.2.2 Yolk-sac Larvae

A total of 781 yolk-sac larvae from 11 taxa of finfish were collected in the Harbor during ABS ichthyoplankton sampling in 2009 (Table 3-5). The majority of yolk-sac larvae collected were winter flounder (417 collected, 53.4% of the catch), followed by bay anchovy (272, 34.8%), and grubby (68, 8.7%) with the remaining taxa each representing less than one percent of the total collection (Table 3-5).

Except for the week of 15 June 2009, when large numbers of bay anchovy were collected at non-channel areas in the Arthur Kill/Newark Bay (741 yolk-sac larvae/1,000m^3), average weekly densities of yolk-sac larvae were generally higher in the Lower and Upper Bays compared to the Arthur Kill/Newark Bay (Figure 3-5). In the Lower and Upper Bays, peak yolk-sac densities were found during the week of 16 March at both channel and non-channel stations and were largely the result of the collection of winter flounder yolk-sac larvae at both station types (Table 3-6b).

EFH and important non-EFH species comprised 55.1% (n=430) of the total yolk-sac larvae collection during the 2009 ichthyoplankton sampling program (Figure 3-6). The collection of EFH and important non-EFH species yolk-sac larvae were dominated by winter flounder from February through April in all three regions while windowpane and Atlantic menhaden dominated in May and June, respectively (Figure 3-6).

Of the EFH and important non-EFH species, winter flounder occurred at a peak mean monthly density of 97 yolk-sac larvae/1,000 m^3 at Lower Bay channel stations during March (Table 3-6b). Windowpane yolk-sac larvae were collected in non-channel areas of the Lower Bay during May and June and in channels of the Arthur Kill/Newark Bay in May at low densities of less than one yolk-sac larvae/1,000m^3. By comparison, Atlantic menhaden yolk-sac larvae were collected only in June at channel stations in all three regions with a peak mean monthly density of 3 yolk-sac larvae/1,000m^3 occurring in both the Upper Bay and the Arthur Kill/Newark Bay (Table 3-6b).

3.1.2.3 Post Yolk-sac Larvae

A total of 11,291 post yolk-sac larvae from 21 taxa of finfish were collected in the Harbor during ABS ichthyoplankton sampling in 2009 (Table 3-5). The majority of post yolk-sac larvae collected were winter flounder (6,710 collected, 59.4% of the catch), followed by grubby (1,692, 15.0%), bay anchovy (1,540, 13.6%), windowpane (454, 4.0%), gobies (338, 3.0%), rock gunnel (168, 1.5%), and northern pipefish (167, 1.5%)

with the remaining taxa each representing less than one percent of the total collection (Table 3-5).

Peak average weekly densities of post yolk-sac larvae across all stations occurred at non-channel stations in the Lower Bay during the week of 6 April (1,251 post yolk-sac larvae/1,000m³) and at non-channel stations in the Arthur Kill/Newark Bay (1,094 post yolk-sac larvae/1,000m³) during the week of 15 June (Figure 3-7). The peak post yolk-sac larvae collections in June were generally the result of high catches of bay anchovy in both channel and non-channel areas in the Lower Bay and Arthur Kill/Newark Bay (Table 3-6c). Maximum monthly average catches of 347 post yolk-sac larvae/1,000m³ were collected in Lower Bay channel stations and 254 post yolk-sac larvae/1,000m³ were collected at both Arthur Kill/Newark Bay channel stations and Lower Bay non-channel stations (Table 3-6c). In the Arthur Kill/Newark Bay, peak densities in June were also the result of gobies at non-channel stations with an average monthly collection of 327 post yolk-sac larvae/1,000 m³. The peak collections in April and May were primarily from winter flounder post yolk-sac larvae collected at both channel and non-channel stations in all three regions with a maximum collection of 799 post yolk-sac larvae/1,000m³ occurring in the Lower Bay during April (Table 3-6c).

EFH and important non-EFH species comprised 64.2% (n=7,249) of the total post yolk-sac larvae collection during the 2009 ichthyoplankton sampling program (Figure 3-8). EFH and important non-EFH species collected at this life stage included summer flounder, windowpane, winter flounder and Atlantic menhaden. The collection of EFH and important non-EFH species post yolk-sac larvae was dominated in March, April, and May by winter flounder in all three regions (Figure 3-8). In June, windowpane were collected in all three regions, but they were only dominant in the Lower Bay. Atlantic menhaden was the dominant species collected in the Arthur Kill/Newark Bay. Early channel collections in January and February were dominated by summer flounder when they were collected from all three regions, but in February they were only dominant in the Upper Bay (Table 3-6c). Winter flounder were collected from all three regions in

February, but were only dominant in the Lower Bay and Arthur Kill/Newark Bay during February (Figure 3-8).

Of the EFH and important non-EFH species, the mean monthly collection of winter flounder post yolk-sac larvae peaked in the Lower Bay during April at 799 post yolk-sac larvae/1,000m^3 at non-channel stations and at channel stations in April and May at 476 and 486 post yolk-sac larvae/1,000m^3, respectively (Table 3-6c). Windowpane post yolk-sac larvae were collected from May into June with peak mean monthly post yolk-sac larvae densities occurring in May in the Lower Bay at both non-channel (74 post yolk-sac larvae/1,000m^3) and channel stations (38 post yolk-sac larvae/1,000m^3). Monthly mean post yolk-sac larvae densities for windowpane were generally lower in the Upper Bay and Arthur Kill/Newark Bay compared to the Lower Bay with the highest densities for those two regions occurring in Upper Bay channel stations during May (26 post yolk-sac larvae/1,000m^3) and June (13 post yolk-sac larvae/1,000m^3). By comparison, Atlantic menhaden post yolk-sac larvae were collected each month from January to June with peak occurrence in June at channel stations of the Arthur Kill/Newark Bay (21 post yolk-sac larvae/1,000m^3) and the Upper Bay (8 post yolk-sac larvae/1,000m^3) (Table 3-6c).

3.1.2.4 Juveniles

A total of 29 juveniles from six taxa of finfish were collected in the Harbor during ABS ichthyoplankton sampling in 2009 (Table 3-5). The majority of juveniles collected were bay anchovy (17 collected, 58.6% of the catch), followed by Atlantic croaker, grubby, and northern pipefish (3 of each collected, with each representing 10.3% of the collection), Atlantic cod (2, 6.9%), and Atlantic tomcod (1, 3.4%) (Table 3-5).

Peak average weekly densities for juveniles occurred during the week of 5 January 2009 at channel stations in the Arthur Kill/Newark Bay region (35 juveniles/1,000m^3) and were the result of catches of bay anchovy and Atlantic croaker (Figure 3-9 and Table 3-6d).

EFH and important non-EFH species comprised 6.9% (n=2) of the total juvenile collection during the 2009 ichthyoplankton sampling program (Figure 3-10). Of the EFH and important non-EFH species, only Atlantic cod juveniles were collected. All Atlantic cod juveniles were collected in non-channel areas of the Lower Bay during April (Table 3-6d).

3.2 WINTER FLOUNDER

3.2.1 Bottom Trawl

A total of 430 adult and juvenile winter flounder were collected during the bottom trawl sampling of the 2009 ABS (Table 3-2). The majority were collected in the Arthur Kill/Newark Bay (197 collected, 45.8%) and the Upper Bay (181, 42.1%); followed by the Lower Bay (52, 12.1%). Winter flounder were collected at both channel and non-channel stations. However, the majority (88.6%) were collected from channel stations (Table 3-2). They were collected during each month of the bottom trawl sampling program from December to May with the highest monthly average catches (all regions combined) occurring at channel stations from December through March (Table 3-3).

3.2.1.1 Winter Flounder Catch Per Unit Effort (CPUE)

Average weekly bottom trawl collections of adult and juvenile winter flounder peaked (CPUE = 16.0) during the first week of the sampling season (15 December 2008) in the Upper Bay and then again during the week of 16 March 2009 (14.3) in the same region (Figure 3-11). Winter flounder were also common in channel station collections of the Arthur Kill/Newark Bay from December through March with a peak of 11.3 during the week of 19 January. Few winter flounder were collected in the bottom trawl after the 16 March sampling week through the end of the program in early May (Figure 3-11).

When compiled monthly by region (Tables 3-4a and 3-4b), mean CPUEs for winter flounder were highest at channel stations in the Upper Bay during December (monthly average CPUE = 16.0) and in the Arthur Kill/Newark Bay during January (10.4) and March (10.3). Monthly average CPUEs for winter flounder at non-channel stations were generally less than 1.0 with a maximum CPUE of 4.3 occurring in the Upper Bay during December (Table 3-4b). Of note, no winter flounder were collected at non-channel stations in the Arthur Kill/Newark Bay during March and April or in the Upper Bay during March (Table 3-4b).

In 2008, eight new bottom trawl sampling locations were added in the Lower Bay to better define the spatial distribution of winter flounder across a range of water depths. Figure 3-12a presents average weekly bottom trawl CPUE of winter flounder in the Lower Bay during 2009 by the three depth categories: channel (typically > 40 feet), non-channel deep (25-40 feet), and non-channel shallow (typically < 25 feet). In the Lower Bay, adult and juvenile winter flounder were collected primarily from the channels during January, February, and April. Only in December, on 16 March and in May were deep non-channel CPUEs slightly higher than channel CPUEs. Only a few winter flounder were collected in non-channel shallow areas of the Lower Bay (Figure 3-12a). Of note, CPUEs in the non-channel stations of the Upper Bay and Arthur Kill/Newark Bay were higher than observed in the Lower Bay at combined deep and shallow non-channel stations (Table 3-4b). Station depth preference data from 2009 for adult and juvenile winter flounder was consistent with the first year's data gathered in 2008, although the CPUEs were generally lower in 2009 at the Lower Bay channel stations especially in April and May (Figure 3-12b).

3.2.1.2 Winter Flounder Size Distribution

During the 2009 bottom trawl survey a total of 429 winter flounder were measured, ranging between 62 and 379 mm TL (Figure 3-13). The majority of the winter flounder collected (95%) were juveniles (TL ≤ 250 mm). Most of these measured between 80 and 140 mm TL. Just over 14% of the winter flounder collected in non-channel areas measured greater than 250 mm TL (considered sexually mature) compared to just under 4% in channel stations (Figure 3-13). The mean total length of winter flounder collected at channel and non-channels stations was 146 mm (standard deviation ± 50 mm) and 148 mm (± 73 mm), respectively. The modal length class was 120-129 mm TL at channel stations and 110-119 mm TL at non-channel stations (Figure 3-13).

Spatial patterns in size distribution indicate that 4.6% of winter flounder collected in the Arthur Kill/Newark Bay were ≥ 200 mm TL compared to 13.5% in the Lower Bay and 19.9% for the Upper Bay (Figures 3-14a through 3-14c). These larger sub-adult (200-249 mm TL) and adult-sized (≥ 250 mm TL) winter flounder were especially common in the Upper Bay during December and then again in April and May after the primary spawning period (Figure 3-14b). Except for the Upper Bay in December, when the average total length of winter flounder was above 150 mm, the most commonly measured winter flounder in each region were in the 80 to 150 mm TL range. Bottom trawl sampling ended in early May and there was no evidence that young of the year winter flounder had attained a length range of approximately 40 to 60 mm TL which, based on the bottom trawl mesh size, is the approximate length that juvenile winter flounder begin to be recruited into the trawl collections (Figures 3-14a through 3-14c).

3.2.1.3 Winter Flounder Gender Ratio

During the 2009 bottom trawl survey, a total of 21 adult winter flounder ≥ 250 mm TL and one 240 mm TL had their gender determined in either the field or in the laboratory (Table 3-7)[3]. One additional adult winter flounder specimen was returned to the lab damaged and its gender could not be determined. Of the 22 fish that were gender determined, a majority (59%) were collected in the Upper Bay and half were females (Figure 3-15). Females averaged 311 mm TL and weighed 340.7 g compared to males which averaged 281 mm TL and weighed 255.8 g. The average TL for females was highest in the Lower Bay (343 mm TL) and Arthur Kill/Newark Bay (339 mm TL) compared to the average TL for males which was highest in the Arthur Kill/Newark Bay at 299 mm TL (Table 3-7). The largest female measured 379 mm TL and weighed 564.4

[3] Note that spawning condition (i.e. ripe versus spent) could not always be determined in the field and weight was only measured on those specimens returned to the lab.

g. It was collected on the Port Jersey flats near Caven Point in May and was spent. The largest male measured 333 mm TL, was ripe and was collected in the Lower Bay during February.

Half of the winter flounder that had their gender determined were collected from mid December to mid March, before and during spawning, and all from this period (excluding the two specimens for which spawning condition was not determined in the field) were found to be ripe (n=6) or partially spent (n=3). The remaining half of winter flounder that had their gender determined were collected in April and May after the spawning period was over and all from this period were spent. All but one of the spent winter flounder were collected in the Upper Bay while the ripe winter flounder were collected primarily in the Lower Bay and Arthur Kill/Newark Bay regions. This contrasts to the 2008 data in which 82% of the spent winter flounder were collected in the Lower Bay (USACE 2009).

3.2.1.4 Winter Flounder Bottom Trawl Inter-Annual Variation

Figure 3-16a presents the average monthly bottom trawl CPUE of winter flounder for each of the three regions from 2002 through 2004 when bottom trawl sampling was conducted at night. Except for 2008, when winter flounder CPUEs within the Arthur Kill/Newark Bay were the highest mean monthly catches of the entire program (CPUE = 20.5 in February and CPUE = 19.8 in March), the results of the 2009 bottom trawl survey were relatively consistent with the most recent years of the program when bottom trawl sampling was conducted at night (Figure 3-16b). In 2009, the Arthur Kill/Newark Bay continued to have above average CPUEs of approximately 8 to 10 in January and March, and slightly below average CPUEs in the remaining months. Peak CPUE in December, based on only this year’s data, was found in the Upper Bay while the Lower Bay consistently had the lowest average monthly CPUE of any region in 2009. This is consistent with the day sampling data (2005-2009) in which the Lower Bay only had the highest average monthly CPUE in January and this was based largely on a very high CPUE of nearly 18 in January 2005 (Figure 3-16b).

Over the course of the ABS program, juvenile and adult winter flounder have been collected throughout the Harbor during bottom trawl sampling. Geographic Information Systems (GIS) software and analysis in ArcGIS 9.2 was employed to better define the spatial distribution of winter flounder from 2002 through 2009 (Figure 3-17). Based on average station CPUE, the highest collections of juvenile and adult winter flounder in the bottom trawl (average station CPUE of > 5.00) occur at channel stations adjacent to Port Jersey and in the Arthur Kill. A majority (55%) of the remaining channel stations had an average CPUE of between 2.01 and 5.00. By comparison, non-channel stations in the Lower Bay were generally less than 1.00 and just three non-channel stations (one each near Port Jersey, South Brooklyn and in Newark Bay) had an average CPUE of between 2.01 and 5.00 (Figure 3-17).

Monthly trends for length frequency distribution by region are presented for both night (Figure 3-18a) and day sampling (Figure 3-18b). December bottom trawl sampling during 2002-2004 showed a higher frequency of larger sub-adult and adult fish greater than 200 mm TL (Figure 3-18a) compared to January through March samples from 2005 to 2009 which were comprised predominantly of yearling juveniles that measured between 80 and 150 mm TL (Figures 3-18a and 3-18b). The widest range of winter flounder length classes were generally present in April for most years from 2002 through 2009 when more adult sized fish greater than 250 mm TL were collected in the Upper and Lower Bays (Figures 3 -18a and 3-18b).

During 2002-2004 night sampling, the two highest monthly average CPUEs of winter flounder occurred during June 2002 at Arthur Kill/Newark Bay (11.6) and during January 2004 at Upper Bay stations (13.7) (Figure 3-16a). The June 2002 peak corresponded to a high recruitment of age-0 winter flounder (< 80 mm TL) in the bottom trawl (Figure 3-18a). The late spring recruitment of age-0 winter flounder, primarily in the Arthur Kill/Newark Bay and in the Upper Bay, observed during the 2005 to 2008 sampling is usually observed in May and June. Although, it is somewhat less apparent in June and also involves some May recruitment in the Lower Bay (Figure 3-18b). This was not seen in the 2009 sampling program which ended in early May.

Regardless of whether the bottom trawl sampling was conducted during the night (2002-2004) or during the day (2005-2009), the winter flounder assemblage in each region was dominated by sexually immature individuals (TL <250 mm TL). From 2002 to 2004, only 10.1% of the winter flounder collected at channel stations and 12.8% collected at non-channel stations measured greater than 250 mm TL (Figure 3-19a). By comparison, from 2005 through 2009, a similar percentage of adult aged winter flounder were collected at channel stations (9.8%) and a higher percentage were collected at non-channel stations (16.1%) (Figure 3-19b). In addition, the mean total length of all winter flounder measured has increased from 154 and 139 mm TL at channel and non-channel stations, respectively, during night sampling to 170 and 160 mm TL at channel and non-channel stations, respectively, during day sampling (Figures 3-19a and 3-19b).

3.2.2 Epibenthic Sled

Winter flounder eggs, yolk-sac and post-yolk sac larvae were collected throughout the Harbor at both channel and non-channel stations during the 2009 ABS ichthyoplankton survey (Table 3-5). A total of 7,504 early life stage winter flounder were collected, consisting of 211 viable eggs, 417 yolk-sac larvae, 6,710 post yolk-sac larvae, and 168 unidentified larval stage (Table 3-5).

3.2.2.1 Winter Flounder Eggs

A total of 211 viable winter flounder eggs were collected during 2009 ichthyoplankton sampling in the Harbor; the majority of which were collected in the Lower Bay (64.9%), followed by the Upper Bay (32.2%) and the Arthur Kill/Newark Bay (2.8%) (Table 3-5). Within each area, they were collected primarily at non-channel stations (Table 3-6a). Winter flounder eggs were collected predominately in non-channel stations of the Upper Bay during February (monthly average density = 44 eggs/1,000 m^3) and in non-channel areas of the Lower Bay in March (38 eggs/1,000 m^3). Lower monthly average densities were collected at channel stations in the Upper Bay during March and April (7 eggs/1,000 m^3) and at channel stations in the Lower Bay during March and April (4 eggs/1,000 m^3). No viable eggs were collected in the channels of Arthur Kill/Newark Bay in 2009 (Table 3-6a).

Viable winter flounder eggs were first collected during the week of 16 February at non-channel stations of the Upper Bay and nearly 75% of the total density was Stage 1 (Figures 3-20a and 3-20b). The first collection of winter flounder eggs at channel stations occurred in the same region during the week of 23 February but at a much lower total density of approximately of 8 eggs/1,000 m^3 compared to 130 eggs/1,000 m^3 collected one week earlier at non-channel stations. Also, the channel stations collections were evenly divided between older Stage 4 and Stage 5 eggs. Of note, no Stage 1 or 2 eggs were collected at channel stations during the entire 2009 sampling season (Figure 3-20a). A second collection peak of winter flounder eggs occurred during the week of 16 March at non-channel stations in the Lower Bay (Figure 3-20b). Although all five eggs stages were represented in this collection, more than half were Stage 4 and 5 eggs. No viable winter flounder eggs were collected after the week of 6 April, a week in which most of the eggs were collected in channel areas of the Upper and Lower Bays and most were Stage 4 eggs (Figure 3-20a).

Figure 3-21 provides a percent composition of the total winter flounder egg collection by stages including the percentages of non-viable[4] eggs for the two years, 2008-2009, that staging data is available for channel and non-channel stations. Approximately 75% of the eggs collected at non-channel stations in the Upper Bay during February and at channel stations in the Upper Bay during March were non-viable (Figure 3-21). All of the eggs collected at channel stations in the Lower Bay during February were non-viable (n=4) and between 35-50% of those collected in the Lower Bay during March were non-viable. Approximately 25% of the eggs collected in the Upper Bay during February and about 30% of the eggs collected in the Arthur Kill/Newark Bay during March were Stage 1

[4] The definition of non-viable is described earlier in 2.3.1 of the laboratory procedures. Note that non-viable winter flounder eggs were only counted during the egg staging process but were NOT applied to the density calculations so as to remain consistent with previous years of the program.

eggs, while the majority of the eggs collected in the Upper and Lower Bays during April were older Stage 4 eggs (Figure 3-21).

3.2.2.2 Winter Flounder Yolk-sac Larvae

A total of 417 winter flounder yolk-sac larvae were collected during 2009 ichthyoplankton sampling in the Harbor; the majority of which were collected in the Lower Bay (60.2%) followed by the Upper Bay (31.2%), and the Arthur Kill/Newark Bay (8.6%) (Table 3-5). Winter flounder yolk-sac larvae were collected from February through April with peak occurrences in March at both channel and non-channel areas of the Upper Bay (average monthly density of 40 and 61 yolk-sac larvae/1,000 m³, respectively) and Lower Bay (97 and 49 yolk-sac larvae/1,000 m³, respectively) (Table 3-6b). Yolk-sac larvae densities were less than ten organisms per 1,000 m³ at both types of stations in the Upper and Lower Bays during February and April. Peak average monthly density in the Arthur Kill/Newark Bay occurred in March at non-channel stations (15 yolk-sac larvae/1,000 m³) and in April at channel stations (9 yolk-sac larvae/1,000 m³) (Table 3-6b).

Winter flounder yolk-sac larvae (Larval Stage 1) were first collected in very low density during the week of 2 February 2009 in non-channel areas of the Lower Bay (Figure 3-22a and 3-22b). Peak collections of yolk-sac larvae occurred during the week of 16 March at channel stations of the Lower Bay and at non-channel stations of the Upper Bay. No winter flounder yolk-sac larvae were collected at either station type after the sampling week of 20 April 2009 (Figure 3-22a and 3-22b).

Figure 3-23 provides the percent composition of winter flounder larval life stages for the three years (2007-2009) that larval staging data is available. Yolk-sac larvae (Stage 1) comprised a majority of the winter flounder larvae collected in February and March in all three regions with Stage 2 (post yolk-sac larvae) becoming increasingly more prevalent in March and into April (Figure 3-23).

3.2.2.3 Winter Flounder Post Yolk-sac Larvae

A total of 6,710 winter flounder post yolk-sac larvae were collected during 2009 ichthyoplankton sampling in the Harbor; the majority of which were collected in the Lower Bay (78.9%), followed by the Upper Bay (14.6%) and the Arthur Kill/Newark Bay (6.5%) (Table 3-5). Winter flounder post yolk-sac larvae were collected primarily from March through May with peak densities occurring in April and into May (Table 3-6c). The highest densities were recorded in April in the Lower Bay at non-channel stations (799 post yolk-sac larvae/1,000 m^3) and during April and May at channel stations (476 and 486 post yolk-sac larvae/1,000 m^3, respectively). Relatively high densities were also recorded at both station types in April in the Upper Bay (280 and 324 post yolk-sac larvae/1,000 m^3 in the non-channel and channel areas, respectively), at non-channel stations in the Lower Bay during May (232 post yolk-sac larvae/1,000 m^3) and at non-channel stations in the Arthur Kill/Newark Bay during April (219 post yolk-sac larvae/1,000 m^3).

Winter flounder post yolk-sac larvae (Larval Stage 2 through 4) were first collected in low density during the week of 2 February 2009 in channel areas of both the Upper and Lower Bays (Figures 3-22a and 3-22b). A majority of the post yolk-sac larvae collected in all three areas after March were Stage 3 larvae in both channel and non-channel areas. No winter flounder post yolk-sac larvae were collected after the sampling week of 18 May 2009 (Figures 3-22a and 3-22b).

Figure 3-23 provides the percent composition of winter flounder post-yolk sac larvae by stage for each of the three sampling regions from 2007 to 2009. Post yolk-sac Stage 2 larvae comprise an increasing percentage of the collections beginning in March, especially in the Arthur Kill/Newark Bay (approximately 70%), and during April in the Upper and Lower Bays. By May, however, a vast majority of the post yolk-sac larvae collected in all three regions were Stage 3 (Figure 3-23).

3.2.2.4 Winter Flounder Ichthyoplankton Inter-Annual Variation (Eggs)

Winter flounder eggs and larvae have been collected throughout New York/New Jersey Harbor over the course of the ABS program and provide an opportunity to observe trends in ichthyoplankton density and habitat use. Winter flounder eggs have been collected in all sampled regions of the Harbor but primarily in the Upper and Lower Bays (Figure 3-24a). Peak winter flounder egg collections occur in February and March, although eggs have been collected in April (typically less than 10 eggs/1,000 m^3 as a monthly average) during most of the sampling years from 2002 to 2009 (Figure 3-24a). Average monthly winter flounder egg densities in 2009 were generally lower than the eight year average since 2002 except for in the Upper Bay during February and in the Arthur Kill/Newark Bay and Lower Bay during March. By comparison, 2003, 2007 and 2008 have represented the peak years for egg collection since 2002 (Figure 3-24a).

The spatial distribution of winter flounder eggs from 2002 through 2009 was mapped using ArcGIS 9.2 (Figure 3-25). Based on the average egg density collected at each sampling location, three non-channel stations (one in the Upper Bay and two in the Lower Bay) each represented densities greater than 20 eggs/1,000 m^3 (Figure 3-25). Two more sampling locations in the Upper Bay (one channel and one non-channel) and one channel station in the Lower Bay (Chapel Hill Channel) had average densities of between 10.1 and 20 eggs/1,000 m^3 while a majority of the sampling locations in the Arthur Kill/Newark Bay and in the upper portion of the Lower Bay had average station densities of less than 1.0 (Figure 3-25).

Over the years, the results of program sampling have indicated that the timing and magnitude of winter flounder spawning in the Harbor varies annually. However, cumulative probability graphs were developed to better define temporal patterns and predict the probability of when (by date of year) a given percentage of eggs and larvae could be expected to occur (Figure 3-26a). Excluding the first 10% and last 10% collected in a given year, for example, 80% of winter flounder eggs spawned in the Harbor can be expected to be found during a six-week period between 19 February and 4

April (Figure 3-26a). Figure 3-26b plots the yearly variations during the ABS sampling program 1999 to 2009 with a fairly consistent pattern of egg collection except for 2008 when the bulk of the eggs were collected during the 21 February sampling week. By comparison, 2002 and 2003 generally represented earlier in the season collections (approximately 21 February to 15 March for 80% collection) compared to 2004 when eggs were generally collected later (12 March to 10 April) (Figure 3-26b). Figure 3-26c plots the cumulative probability occurrence of each winter flounder life stage by channel versus non-channel stations. After the collection of the first 25% of the eggs, collections in the channels tended to occur between five (50% occurrence) and 18 days (90% occurrence) later than in non-channel stations (Figure 3-26c).

The majority of winter flounder eggs collected in 2009 were collected in non-channel areas of the Upper Bay during February and March and the Lower Bay during March with only a few eggs collected in channel areas of the Upper Bay and Lower Bay during March and April (Table 3-6a). This is comparable to the 2007 and 2008 ABS collections, where the majority of the eggs were also collected in non-channel areas (USACE 2008 and USACE 2009). In 2008, additional sampling locations were added in the Lower Bay to further define the spatial distribution of winter flounder ichthyoplankton across a range of water depths. During 2008, and especially in 2009, the vast majority of eggs collected in the Lower Bay were collected at non-channel shallow stations of less than 25 feet (Figure 3-27a).

3.2.2.5 Winter Flounder Ichthyoplankton Inter-Annual Variation (Larvae)

Winter flounder larvae (yolk-sac and post-yolk sac combined) have been collected in all sampled regions of the Harbor, but peak abundances typically occur in the Lower Bay (Figure 3-24b). Peak winter flounder larvae collections occur in April, although larvae are also collected in relatively high densities in March and May as well. Generally, very low collections of larvae have been made in each region during February and June, and only during 2005 in the Upper Bay and during 2007 in the Arthur Kill/Newark Bay were larvae collected in January and then at very low density (Figure 3-24b). Average monthly winter flounder larval densities in 2009 were generally lower than the eight year average in all months and in all regions. By comparison, 2003, 2004 and 2007 have represented the peak years for winter flounder larvae collection since 2002 (Figure 3-24b).

The spatial distribution of winter flounder yolk-sac (Figure 3-28) and post yolk-sac larvae (Figure 3-29) from 2002 through 2009 was mapped using ArcGIS 9.2. For yolk-sac larvae, the vast majority of higher density collections were found at sampling locations in the Lower Bay including three non-channel and one channel station in the Lower Bay each with average densities greater than 40 yolk-sac larvae/1,000 m^3 (Figure 3-28). Three additional non-channel stations in the Lower Bay had average densities between 15.1 and 40 yolk-sac larvae/1,000 m^3 compared to just one non-channel station in both the Arthur Kill/Newark Bay and Upper Bay within this secondary range (Figure 3-28).

The collection of post yolk-sac larvae between 2002 and 2009 was also highly concentrated in the Lower Bay and included three non-channel and one channel station with average densities greater than 200 post yolk-sac larvae/1,000 m^3 (Figure 3-29). Five additional non-channel and two channel stations in the Lower Bay had average densities between 100.1 and 200 post yolk-sac larvae/1,000 m^3 compared to just one channel station in the Upper Bay and none in the Arthur Kill/Newark Bay within this secondary range (Figure 3-29).

Based on the cumulative probability graphs shown in Figure 3-26a, 80% of yolk-sac larvae collected in the Harbor would be expected to occur during an approximately one month period between 15 March and 14 April compared to post yolk-sac larvae which would be expected to occur during an approximate six week period between 29 March and 13 May. The earliest in season collections of yolk-sac larvae occurred during 1999 and 2002 compared to 2004 when they were collected later in the season while post yolk-sac larvae were collected earliest in 2002 and later in 2001 (Figure 3-26b). As with the collection of eggs, the collection of post yolk-sac larvae tended to occur later in channels than in the non-channel stations while yolk-sac larvae tended to occur at around the same time (Figure 3-26c).

During 2009, winter flounder yolk-sac larvae were collected primarily in the Upper and Lower Bays at both channel and non-channel stations during March (Table 3-6b). Post yolk-sac larvae were collected primarily from March to May in the Upper and Lower Bays with peak occurrences in the Lower Bay during April and May at channel stations, and during April at non-channel stations (Table 3-6c). Figure 3-27b presents the average monthly density of winter flounder larvae (yolk-sac and post yolk-sac combined) in the Lower Bay by station type. Unlike eggs, which have been collected almost entirely at non-channel shallow stations since 2008 (Figure 3-27a), winter flounder larvae have been collected at all three station types with the highest densities at non-channel shallow stations of less than 25 feet, followed closely by non-channel deep stations between 25 and 50 feet and channel stations typically 50 feet or more (Figure 3-27b). Of note, the highest collections of larvae later in the season (May) tended to be collected in the channels in both 2008 and 2009 (Figure 3-27b).

Figure 3-30a presents the length frequency distribution of all the winter flounder larvae measured in 2009. In the Lower Bay, the most frequently collected larvae length was 5-6 mm TL (n=334) and most of those (71%) were collected in non-channel areas. By contrast, in the Upper Bay, the most frequently collected larvae lengths were slightly larger 6-7 mm TL (n=125) and most of those (54%) were collected at channel stations (Figure 3-30a). Figure 3-30b compiles the length frequency distribution data for winter flounder larvae from 2003 through 2009. In both the Arthur Kill/Newark Bay and the Upper Bay, the most frequently collected length class was 5-6 mm TL as opposed to the Lower Bay where the most frequently measured length was slightly smaller at 4-5 mm TL. The all years data shows a peak of smaller larvae collected in the non-channel stations of the Lower Bay as opposed to the Upper Bay and to a lesser extent the Arthur Kill/Newark Bay where larval length appears more uniformly distributed between channel and non-channel areas (Figure 3-30b).

3.3 WATER QUALITY DATA

Mean monthly bottom water temperature from January to June 2009 ranged from approximately 4 to 19° C during the 2009 ABS sampling program (Figure 3-31). The bottom water temperature was slightly lower in the Arthur Kill/Newark Bay from January to March and slightly higher from April to June than in the other regions of the Harbor. The Upper Bay was generally intermediate in monthly mean temperature except during February and March when Upper Bay temperatures were slightly higher than the other two regions. The mean temperatures in the Lower Bay were slightly higher than the other regions in January, nearly equal to the other regions in February and March, and consistently lower than the other two regions from April through June. During January and February, mean bottom water temperatures throughout the Harbor ranged between 3 and 5° C and peaked to a high of approximately 19^{o} C in Arthur Kill/Newark Bay during June (Figure 3-31).

Mean monthly bottom water salinity recorded in parts per thousand (ppt) during the 2009 ABS program ranged from approximately 18 to 27 ppt (Figure 3-31). Salinities were consistently lowest in the Arthur Kill/Newark Bay and highest in the Lower Bay throughout the 2009 sampling season. In all three regions, salinities generally decreased monthly through the ABS sampling season with the highest salinities in the Lower Bay (27 ppt) recorded in January and the lowest salinities (18 ppt) in the Arthur Kill/Newark Bay during June (Figure 3-31).

Trends in bottom water dissolved oxygen levels were similar across the three Harbor regions from January to June 2009, generally increasing from January to a high in March and then decreasing from April to June as water temperatures increased (Figure 3-31). Mean monthly dissolved oxygen in all three regions remained between approximately 10 and 13 mg/L from January through March and then decreased in from approximately 10 mg/L in all three regions during April to a low of 6 mg/L in the Arthur Kill/Newark Bay during June (Figure 3-31).

All water quality sampling data are presented in Appendix C.

3.3.1 Water Quality Data Inter-Annual Variation

Previous reports have documented the inter-annual variations in bottom water temperatures in the Harbor. Water temperatures during January and February were generally warmer in 2002, 2005, 2006 and 2007 in all regions compared to other sampling years (USACE 2008). However, 2006 and 2007 tended to be among the coolest years in June and July for all three regions based on average monthly bottom water temperature. By comparison, 2002 had the warmest temperatures in both March and April for all three regions and 2006 had the warmest May (USACE 2008). Figure 3-32a presents the average monthly bottom water temperature by region from 2002-2009. The Arthur Kill/Newark Bay region shows the greatest monthly variations in bottom water temperature with an average monthly range from 3.4° C in February to 22.4° C in July. By comparison, the Lower Bay has the most steady bottom water temperatures with a range from 3.9° C in February to 19.0° C in July (Figure 3-32a). The average monthly bottom water temperatures in 2008 tended to be between 1 to 2° C higher than the all-year averages for all sampled months and in all regions with the greatest variations occurring in June and July while average monthly bottom water temperatures in 2009 were similar to the yearly average monthly temperatures (Figures 3-31 and 3-32a).

Figure 3-32b presents the average monthly bottom water salinities by region from 2002-2009. Average monthly salinities are lowest in the Arthur Kill/Newark Bay and highest in the Lower Bay with all three regions following a similar trend of higher salinities during the winter January into March followed by a decrease in salinity during April due to annual increased freshwater flow, and then an increase from May to June and into July as freshwater flows decrease (Figure 3-32b). In 2009, average monthly bottom water salinities in February and March were lower than the all-year averages for each of the three regions, although salinities for the remaining months of 2008 were generally higher than all-year averages (Figures 3-31 and 3-32b).

Figure 3-32c presents the average monthly bottom water dissolved oxygen by region from 2002-2009. Average monthly dissolved oxygen levels are generally the same across all three regions of the Harbor and correlate with bottom water temperatures. Dissolved oxygen increased from December into January, February and then March with a peak of around 11 mg/L, and then decreased progressively into April and through June and July to lows around 6 mg/L (Figure 3-32c). For the most part, average monthly dissolved oxygen readings in 2009 where slightly higher than the all-year averages (Figures 3-31 and 3-32c).

4.0 DISCUSSION

The data set of the Aquatic Biological Survey offers a unique and invaluable source of finfish abundance and distribution data in New York and New Jersey Harbor. While the systematic sampling program and the consistent sampling locations allow for comparisons between years; the adaptive nature of the program has also allowed the program to evolve to provide pertinent data for evaluation by local and regional resource managers. In 2008, for example, new sampling locations were added in the Lower Bay to better define the spatial distribution of winter flounder across a range of water depths. Similarly, in 2008, a new winter flounder egg staging protocol was developed to better distinguish between eggs that were recently deposited from those that are in later stages of development in order to better determine the location of spawning areas of the Harbor. In 2009, ArcGIS 9.2 was used to aid in the interpretation and understanding of the spatial distribution of all winter flounder life stages within the Harbor.

Water quality and habitat characteristics throughout the Harbor affect the spatial and temporal occurrence of finfish. The three Harbor regions defined in this study exhibit different water quality, currents, depth distributions and sediment conditions. Water temperatures are similar in the three regions during the winter months but the warmest water temperatures over the study period occur in the Arthur Kill/Newark Bay region during the spring and into early summer (April to July). The Arthur Kill/Newark Bay region has the lowest salinities while the Lower Bay has the highest and least variable salinities. Arthur Kill/Newark Bay and Upper Bay salinities are influenced by freshwater runoff from the Raritan, Passaic, Hackensack and Hudson Rivers. Dissolved oxygen concentrations are similar throughout the regions over the sampling period.

The bottom substrate in the Arthur Kill/Newark Bay region is dominated by fine grain sediments (silt and clay) while the Lower Bay is comprised primarily of sand and coarse grained sands. The Upper Bay consists of a mixture of finer clay and silt, and sand sediments. The Arthur Kill/Newark Bay and Upper Bay regions are comprised of a larger percentage of maintained deep channels and berthing areas compared to the Lower Bay which is dominated by shallows/shoals with a smaller percentage of maintained channel areas.

4.1 ALL SPECIES

The finfish composition of anadromous, semi-anadromous and shallow water residents collected during the 2009 Aquatic Biological Survey is typical of estuaries within the Middle Atlantic Bight (Able and Fahay 1998). The Harbor is dominated by migratory and seasonally transient fish species. Many species spawn in the Harbor seasonally, while others spawn offshore on the continental shelf or upstream in the Harbor tributaries. This seasonality and preference for different spawning habitat influences the occurrence and density of species collected during the sampling program. Species that spawn in the Harbor, such as bay anchovy, were present in high densities during their seasonal spawning period (April through July) while other species, such as American shad, were less abundant because they migrate through the Harbor to primary spawning habitats in the Hudson River.

Species abundance and richness has varied annually throughout the sampling program, although this variation in the number of species collected and total abundance is likely within the natural variation of populations within a dynamic system. For example, the highest total abundance of all species combined in bottom trawl catches over the sampling program occurred recently in 2008 with 24,531 finfish from 42 species and 84 blue crabs collected. This was followed in abundance by the 2006 collection with 23,874 fish compared to 2007 when only 7,032 fish were collected. During 2009, a total of 19,675 finfish (48 species) and two shell fish species: American lobster (n= 1) and blue crab (n= 37) were collected during the bottom trawl survey (Tables 3-1 and 3-2).

Figure 4-1 shows the percentage of species caught in each region at channel versus non-channel areas for the bottom trawl collections 2002 through 2009. Bay anchovy has dominated the non-channel collections in all three regions, especially in the Upper and Lower Bays (60% and 66% of the total catch, respectively), with alewife (36%), spotted hake (29%) and white perch (56%) dominating the channel collections at the Lower Bay, Upper Bay and Arthur Kill/Newark Bay, respectively (Figure 4-1).

During 2009 bottom trawl sampling, alewife (21% of the total catch) and Atlantic herring (19%) were the most commonly collected species in the Harbor (Table 3-2). Alewife were collected primarily from Lower Bay channel stations during January and February while Atlantic herring were primarily collected from non-channel stations in the Arthur Kill/Newark Bay during May (Table 3-3). White perch (18% of the total catch) and bay anchovy (16%) also contributed to the 2009 bottom trawl collections with white perch primarily collected from channel stations in Arthur Kill/Newark Bay during January to March and bay anchovy collected in non-channel stations in all three regions during May (Tables 3-2 and 3-3). Temporal and spatial trends in the sampling program continued to be generally evident across the Harbor regions. Specifically, there was a transition from higher CPUEs at channel stations during winter and early spring months to higher CPUEs at non-channel stations during the late spring (Figure 3-1).

Early life stage densities have also tended to vary spatially and temporally. More than 186,400 eggs, larvae and juveniles from 28 identified taxa were collected during ichthyoplankton sampling in 2009 (Table 3-5). This falls between the 143,000 early life stage organisms from 34 taxa collected in 2007 (USACE 2008) and the 270,000 early life stage organisms from 33 taxa collected in 2008 (USACE 2009). In 2009, bay anchovy eggs comprised more than 76% of the total ichthyoplankton collection and were collected predominantly in Lower Bay channel and non-channel stations during June (Tables 3-5 and 3-6a).

4.1.1 Essential Fish Habitat Species

Over the years of the bottom trawl sampling program, the spatial and temporal preferences of some EFH designated species has become evident while the preferences of other species remain less apparent. Bottom trawl catches of several EFH species (red hake, windowpane, winter flounder, and little skate) have generally occurred in deeper water (channel) habitats, and to a lesser extent in shallow water (non-channel) habitats. Atlantic herring, bluefish, butterfish, scup, and summer flounder are generally collected in non-channel stations. For the most part, these trends continued in 2009, although only a few EFH species (notably Atlantic herring and to a lesser extent winter flounder) were collected in substantial numbers.

The following sections discuss the results of a few of the more commonly collected EFH species in NY/NJ Harbor. Trends in the collection of winter flounder are discussed in more detail in Section 4.2.

4.1.1.1 Atlantic Herring (Clupea harengus)

Noted for its characteristic north-south migrations, Atlantic herring is a pelagic, schooling species that ranges from Labrador to Cape Hatteras (Able and Fahey 1998). Within the Harbor estuary, EFH is designated for Atlantic herring larvae, juveniles and adults (Table 1-1). Spawning typically occurs offshore and the eggs, which are demersal and adhesive, are not commonly collected (Stevenson and Scott 2005). Atlantic herring eggs have not been collected during ABS ichthyoplankton sampling. Since 2006 just a few post yolk-sac larvae have been collected primarily in channel stations of the Upper Bay between February and April. No Atlantic herring larvae were collected in 2009 (Table 3-5).

During ABS bottom trawl sampling for adults and juveniles, Atlantic herring was the second most commonly collected species at non-channel stations in both the Upper Bay and Arthur Kill/Newark Bay, accounting for 13% and 29% of the total non-channel catch in each of those regions, respectively (Figure 4-1). During 2009, they were the most commonly collected EFH species in both the Arthur Kill/Newark Bay and the Upper Bay (Table 3-2). They were collected overwhelmingly at non-channel stations in May (Table 3-3), which is consistent with previous collections in 2006 (USACE 2007) and 2008 (USACE 2009). Much fewer Atlantic herring were collected in 2007 (USACE 2008).

4.1.1.2 Red Hake (Urophycis chuss)

Within the Harbor estuary, EFH is designated for the larval, juvenile and adult stages of red hake (Table 1-1). Red hake make seasonal migrations in response to changing water temperatures, inhabiting shallow water habitat in the spring before moving to deeper water in the summer (Able and Fahay 1998). Spawning occurs offshore from the late spring through the summer and both eggs and larvae are pelagic (Steimle *et al*. 1999). No red hake eggs or larvae have been collected during the ABS ichthyoplankton program sampling in the Harbor.

During ABS bottom trawl sampling for adults and juveniles, red hake has historically been one of the more commonly collected species at channel stations of the Upper Bay, accounting for 7% of the total channel catch in that region (Figure 4-1). However, in 2009, fewer red hake (n=41) were collected, but the ones found continued a trend of being located primarily in deep water channel stations (Table 3-2). Red hake have tended to be collected in most months of the sampling season and this trend continued in 2009 (Table 3-3). During 2009, they were collected primarily in the Arthur Kill/Newark Bay (Table 3-2) compared to 2008 when they were collected almost exclusively in the Upper and Lower Bays (USACE 2009). Since the 2004 sampling season, the highest collections of red hake have occurred in 2006 and 2007 (USACE 2007 and USACE 2008).

4.1.1.3 Windowpane Flounder (Scophthalmus aquosus)

Windowpane is a left-eye flounder that commonly inhabits near shore estuaries and the continental shelf from Georges Bank to the Chesapeake (Chang *et al.* 1999). Spawning typically occurs in the New York Bight from February to May and then again in the fall (Able and Fahay 1998). Within the Harbor estuary, EFH is designated for all life stages of windowpane flounder (Table 1-1). During ABS ichthyoplankton sampling in 2009, windowpane was the most commonly collected EFH species (Table 3-5). Both eggs and larvae were collected at channel and non-channel locations with peak collections in the

Lower Bay and to a lesser extent in the Upper Bay, which is consistent with previous years. Peak collections of windowpane ichthyoplankton have typically occurred in May and June as was observed during 2009 (Tables 3-4a, 3-4b and 3-4c).

As was generally the case in previous years, adult and juvenile windowpane were collected in relatively low abundances during most months of the bottom trawl sampling season (Table 3-3). Although less apparent in 2009, adult and juvenile windowpane are typically collected in the bottom trawl at higher abundances at channel locations.

4.1.1.4 Other EFH Species

Of the remaining species with EFH designations, Atlantic cod, black sea bass, butterfish, clearnose skate, little skate, pollock, summer flounder and winter skate were collected in relatively low abundances within the Harbor estuary during 2009 ABS sampling. Of note, another EFH species, scup, was not collected in 2009, despite having been collected during more recent bottom trawl sampling in 2007 (n=121) and 2008 (n=111). Previous collections of scup were focused in the Lower and Upper Bays within non-channel stations in June during 2007 (USACE 2008) and within channel stations in May during 2008 (USACE 2009).

A few pollock (n=11) were collected at non-channel stations of the Lower Bay between March and May (Tables 3-2 and 3-3). Pollock were not collected during 2008 ABS sampling (USACE 2009) although a few were collected in bottom trawls during 2007 (n=2). A few Atlantic cod including one egg were collected in non-channel areas of the Lower Bay during 2009 (Tables 3-3 and 3-6a). Atlantic cod are fairly uncommon to the ABS program and had not been collected since 2005 when a few post yolk-sac larvae were collected in the Upper and Lower Bays (USACE 2006). Three skate species were collected in bottom trawls during 2009 with little skate being the most common as in previous years. They were collected primarily in the Lower Bay at both channel and non-channel locations throughout the sampling season (Table 3-3).

Because spawning typically occurs on the continental shelf from September through January (Able and Fahay 1998), summer flounder are usually uncommon to ABS collections in the winter and spring, although between 18 (2007 and 2008) and 42 (2009) post yolk-sac larvae and juveniles have been collected during ichthyoplankton sampling within the Harbor in each of the last three years (Table 3-5, USACE 2007 and USACE 2008). During 2009 bottom trawl sampling, just a few (n=10) adult and juvenile summer flounder were collected primarily in the Lower Bay at both channel and non-channel locations (Tables 3-2 and 3-3) compared to 2007 when 24 were collected (USACE 2008) and 2008 when 44 were collected (USACE 2009).

4.1.2 Important Non-EFH Species

Based upon their relative importance to both local and regional managers, eleven species have been grouped in this report for the ABS program as important non-EFH species: alewife, American eel, American lobster, American shad, Atlantic menhaden, Atlantic sturgeon, blue crab, blueback herring, rainbow smelt, shortnose sturgeon and striped bass. Of these eleven species, only alewife, Atlantic menhaden, blueback herring and striped bass have historically comprised a large part of the ABS bottom trawl and/or ichthyoplankton collections.

4.1.2.1 River Herring (Alewife and Blueback Herring)

More commonly referred to as river herring, alewife and blueback herring are often combined in management assessments because of their similar morphology, ecological role and environmental requirements (Bozeman and Van Den Avyle 1989). Both species enter the Harbor estuary during annual spawning runs in the spring although spawning typically occurs upstream in more brackish and freshwater portions of the estuary (Able and Fahay 1998). For this report, they are categorized as important non-EFH species because of the current fishery, which includes both commercial and recreational harvesting for bait, and because a general trend in decreasing abundance within the estuary has been observed and can be broadly attributed to the loss of spawning and nursery habitat in the upper half of the tidal Hudson. Water pollution, entrainment and impingement losses, and more recently increased predation from striped bass have also contributed to their decrease in numbers (Hattala *et al.* 2009).

Alewife was the fourth and first most commonly collected species during ABS bottom trawl sampling in 2008 and 2009, respectively, while blueback herring was tenth overall in 2008 and fifth in 2009 (Table 3-1 and USACE 2009). In 2007, much fewer of both species were collected (USACE 2008). Historically, alewife has been the most commonly collected species at channel stations in the Lower Bay comprising 36% of the total catch in those areas while blueback herring has been common to both station types in both the Upper and Lower Bays (Figure 4-1). Both alewife and blueback herring were collected throughout most of the 2009 sampling season with peak collections during January and February (Table 3-3) which is consistent with previous years of the program. No river herring eggs or larvae have been collected during the ABS ichthyoplankton sampling program.

4.1.2.2 Atlantic Menhaden (Brevoortia tyrannus)

Similar to river herring, Atlantic menhaden represent an important prey species for many other species of fish and have historically constituted one of the largest commercial fisheries by weight in the United States (Rogers and Van Den Avyle 1989). Seasonal migrations during the spring and fall reportedly coincide with changes in water temperature with most spawning occurring over the inner continental shelf across most months (Able and Fahay 1998). During ABS sampling, Atlantic menhaden has been only moderately abundant in bottom trawl collections in recent years (330 collected in 2008 and 15 collected in 2009) although they have comprised a common component of ichthyoplankton samples since 2003.

In 2009, Atlantic menhaden eggs were collected at both channel and non-channel stations in all three regions of the Harbor, but collections were primarily focused in the Upper and Lower Bays in May and June (Table 3-6a). Yolk-sac larvae were collected exclusively at channel stations in June and were found primarily in the Upper Bay and Arthur

Kill/Newark Bay while post yolk-sac larvae were collected at both station types and in all three regions during the sampling program, except for none found in non-channel stations in the Arthur Kill/Newark Bay, and scattered from January through June (Tables 3-6b and 3-6c).

4.1.2.3 Striped Bass (Morone saxatilis)

Striped bass is a recreationally important game fish that was harvested commercially in the Hudson River until the 1970s. Being an anadromous species, striped bass typically move into the estuary in April through mid-June to spawn in fresh water near the salt front (Smith 1985). Although they are migratory species that ranges along the Atlantic Coast, recent studies using otolith analysis have suggested that a year-round resident population may inhabit New York Harbor (Levinton and Waldman 2006).

Historically, striped bass have comprised an important component of the Arthur Kill/Newark Bay and Upper Bay bottom trawl collections, accounting for 16% and 8% of the channel and non-channel catches, respectively, in the Arthur Kill/Newark Bay as well as 10% of the channel catch in the Upper Bay (Figure 4-1). Striped bass was a dominant or very common species in collections during the early program years when bottom trawl surveys were conducted at night. Since changing to daytime trawling in 2005, however, striped bass catches have generally been lower.

During 2009 bottom trawl sampling, striped bass was the sixth most commonly collected species with a total of 684 striped bass found primarily at channel stations in the Arthur Kill/Newark Bay and Upper Bay from January through March (Tables 3-2 and 3-3). These results are relatively consistent with the more recent years of the ABS program when 522 striped bass were collected in 2007 (USACE 2008) and 1,420 were collected in 2008 (USACE 2009). Since 2001, just a few striped bass yolk-sac and post yolk-sac larvae have been collected during ABS ichthyoplankton sampling and none have been collected since 2007 (USACE 2008, Tables 3-6b and 3-6c).

4.1.2.4 Other Important Non-EFH Species

Shortnose sturgeon is a federally listed endangered species known to inhabit estuaries and large coastal rivers along the Atlantic Coast but is uncommon or no longer present in many of the river systems in its middle and southern range (Bain *et al.* 1998). One shortnose sturgeon was collected during bottom trawl sampling in 2009 and that occurred at a non-channel station in the Upper Bay in May (Tables 3-2 and 3-3). Sturgeon species are uncommon to the ABS collections. Since 2002, only six shortnose sturgeon and one Atlantic sturgeon have been collected and all of them were found in non-channel areas of the Upper Bay in either May or June. All of the shortnose sturgeon collected during the ABS program were promptly measured and released alive.

American shad is an important commercial fishery harvested for both its flesh and roe. Adult shad spend most of their lives in the Atlantic Ocean before migrating into the estuary in the spring to spawn when water temperatures reach between 12 and 21°C (Levinton and Waldman 2006). Spawning typically occurs in freshwater and in shallow water habitats north of Croton in the Hudson River (Smith 1985). Since 2007, the bottom trawl collections of American shad have remained remarkably consistent with between 47 and 65 fish collected each year and most of the collections have tended to be focused in channel areas of the Upper and Lower Bays throughout the sampling season (USACE 2008, USACE 2009, Tables 3-2 and 3-3). Just a few American shad eggs, yolk-sac and post yolk-sac larvae have been collected during the ABS ichthyoplankton sampling program including most recently in 2008 when 16 eggs were identified in non-channel stations of the Lower Bay in May (USACE 2009).

During initial program sampling, blue crabs were recorded as a bycatch in bottom trawls but beginning in 2006 they were enumerated and measured because of their importance as a commercial fishery. In 2007, 305 blue crabs were collected (USACE 2008) compared to just 84 in 2008 (USACE 2009) and 37 in 2009 (Table 3-2). Some of this decrease, however, is likely attributable to a shift in program sampling to more trawls being conducted in the Lower Bay because historically blue crab collections have been focused in the Arthur Kill/Newark Bay and Upper Bay with generally higher collections occurring in non-channel areas as occurred in 2009.

Of the remaining important non-EFH species, just one or two were collected of American eel, American lobster and rainbow smelt during 2009 bottom trawl sampling (Table 3-2).

4.2 WINTER FLOUNDER

As a valuable commercial and recreational species, winter flounder has remained a species of importance to local and regional resource managers. Winter flounder is traditionally managed as three separate stocks: The Gulf of Maine, Southern New England/Mid-Atlantic, and Georges Bank, which was once considered a separate species (Able and Fahay 1998). Recent assessments of the Southern New England/Mid-Atlantic stock have noted declines in commercial landings and recreational catches since the mid 1980s (ASMFC 1998 and Vonderweidt *et al*. 2006). Other studies in the region, such as the Niantic River Estuary winter flounder surveys, have also shown steady declines in winter flounder abundances since the 1970s (MEL 2008). As an ongoing, systematic sampling program, the USACE-NYD Aquatic Biological Survey offers the most comprehensive data source on the population structure and yearly habitat use of the near shore population of winter flounder in the Harbor.

4.2.1 Winter Flounder Occurrence in NY/NJ Harbor

4.2.1.1 Juveniles and Adults

Yearly indices of juvenile and adult winter flounder bottom trawl abundances (CPUE) by region are available from 2002 through 2009 when program sampling included the Lower Bay (Table 4-1). Overall, yearly average CPUE has varied from a low of 1.35 in 2006 to a high of 4.01 in 2008 when relatively large catches of juvenile sized (100 to 150 mm TL) winter flounder occurred in the Arthur Kill/Newark Bay (area annual CPUE of 13.37). Except for 2008, winter flounder abundance in bottom trawls has generally decreased since 2005 when program sampling switched to daytime trawling. Fewer adult and juvenile winter flounder were collected in 2009 (annual CPUE of 1.81). However, this fluctuation is within the expected deviation of sampling a dynamic fish population. Slightly lower CPUEs in most of the recent years may also reflect the program sampling shift to more Lower Bay stations as the proportion of zero catches has historically been slightly higher in the Lower Bay compared to the other two regions and abundances have typically been lower in the Lower Bay (Table 4-1).

Based on average station CPUE, the highest collections of juvenile and adult winter flounder in the bottom trawl (average station CPUE of > 5.00) occur at channel stations adjacent to Port Jersey and in the Arthur Kill (Figure 3-17). A majority (55%) of the remaining channel stations had an average CPUE of between 2.01 and 5.00. By comparison, non-channel stations in the Lower Bay were generally less than 1.00 and just three non-channel stations (one each near Port Jersey, South Brooklyn and in Newark Bay) had an average CPUE of between 2.01 and 5.00 (Figure 3-17).

Previous ABS reports have documented adult winter flounder use of channels as they move into the Harbor from offshore locations. During most years of the ABS sampling season (2005 to 2007 and in 2009), more sexually mature winter flounder (those ≥ 250 mm) were collected from the Upper Bay while in 2008 most were found in the Lower Bay (USACE 2009). However, collections of these adult (sexually mature) winter flounder have often peaked before spawning, as in January 2007, or after spawning as in April 2005, 2006 and 2007. In both 2008 and 2009 (Figure 3-14b), most sexually mature winter flounder were collected after spawning in April and May. The laboratory analysis of those winter flounder ≥ 250mm collected in April and May of 2008 showed that all but one of them were spent (USACE 2009), further suggesting that most of the sexually mature adults collected in 2008 were not collected during the ripe spawning period. This was also evident in 2009, when all 12 of the winter flounder ≥ 250mm collected in April and May were spent.

The comparatively low abundance of ripe spawners collected in ABS bottom trawls during the peak of winter flounder spawning, typically late February through March in NY/NJ Harbor, suggests that some winter flounder spawning may be occurring in habitats outside of the HDP. Wuenschel *et al.* 2009 collected mature winter flounder on the inner continental shelf of the New York Bight that were near spawning condition in January, contradicting the previous presumption that all adults move into estuaries in the fall for spawning in the winter. They speculated that some portion of the adult population may be spawning offshore, or alternatively, that some adults may spawn in multiple locations (estuarine and coastal waters) and multiple times during the seasonal migration.

4.2.1.2 Eggs and Larvae

Yearly indices of winter flounder egg (Table 4-2) and larvae (Table 4-3) densities are also available since 2002 and have generally shown a higher degree of yearly variation than bottom trawl CPUE, which is not unexpected given the natural variability of egg and larvae life stages and the variable nature of sampling with an epibenthic sled in a large harbor estuary. Other factors, such as water temperature and salinity, may also influence these annual variations, but nevertheless, the continued yearly data collection provides some insight into patterns of abundance and habitat use by all life stages of winter flounder.

Since 2002, the overall abundance of viable winter flounder eggs has varied from lows of 0.72 to 1.15 eggs/1,000 m^3 in 2004 and 2005, respectively, to highs of 11.40 to 16.52 eggs/1,000 m^3 in 2003 and 2007, respectively (Table 4-2). In all years, peak collections of eggs have occurred in either the Upper or Lower Bays and the proportion of zero catches in the Arthur Kill/Newark Bay has been 96% or greater in each year (Table 4-2). The collection of winter flounder larvae (both yolk-sac and post yolk-sac) has shown similar variability with low densities of 35.35 and 47.41 larvae/1,000 m^3 recorded in 2005 and 2006, respectively, compared to the highest density of 370.57 larvae/1,000 m^3 in 2007 (Table 4-3). An average of 131.75 larvae/1,000 m^3 were collected during 2009 which fell within a fairly consistent range of between approximately 90 and 185 larvae/1,000 m³ collected on average in most years of the sampling program. Similarly, the proportion of zero catches of larvae has remained fairly steady at between approximately 50 and 65% in each region in most years (Table 4-3).

Because winter flounder produce demersal eggs which adhere to the substrate (Crawford and Carey 1985), the occurrence of eggs and the subsequent collections of yolk-sac and post yolk larvae have been used as indicators to identify potential spawning areas in the Harbor. A vast majority of the viable winter flounder eggs collected in 2007 (97%) and 2008 (99%) were collected in non-channel areas of the Harbor and this trend continued in 2009 with approximately 80% of viable winter flounder eggs collected from non-channel stations. The highest average monthly densities of eggs during 2009 occurred at non-channel stations of the Upper Bay in February (43.83 eggs/1,000 m³) and at non-channel stations of the Lower Bay in March (37.79 eggs/1,000 m³) compared to a high of 7.09 and 4.42 eggs/1,000 m³ in the Upper Bay and Lower Bay, respectively, during April (Table 3-6a). Overall, the egg densities in 2002, 2005 and 2006 were also greater at non-channel stations compared to channel stations primarily in the Upper Bay where most eggs were collected in these years (USACE 2003a, USACE 2006 and USACE 2007). In 2003, eggs were collected at a slightly higher density at channel stations compared to non-channel stations in the Lower Bay and at relatively high densities at channel stations in the Upper Bay (USACE 2003b). In 2004, few winter flounder eggs (n=36) were collected (USACE 2005).

Figures 3-25 (eggs), 3-28 (yolk-sac larvae) and 3-29 (post yolk-sac larvae) show the spatial distribution of early life stage winter flounder within the Harbor and highlight the relative importance of the Lower Bay and portions of the Upper Bay (primarily in the area of Port Jersey) as determined by the ABS sampling to spawning. Based on the average egg density collected at each sampling location between 2002 and 2009, three non-channel stations (one in the Upper Bay and two in the Lower Bay) each represented densities greater than 20 eggs/1,000 m³ (Figure 3-25). Of note, a majority of the sampling locations in the Arthur Kill/Newark Bay and in the upper portion of the Lower Bay had average station densities of less than 1.0 eggs/1,000 m³. This is not unexpected given the generally lower salinities and lack of shallow water areas within the Arthur Kill and portions of Newark Bay and the generally deep water channels and lack of shallows within the Narrows of the Lower Bay.

For yolk-sac and post yolk-sac larvae, the vast majority of higher density collections were found at sampling locations in the Lower Bay and primarily at non-channel stations in the area of East Bank south of Coney Island and within the extensive shallows west of Chapel Hill Channel (Figures 3-28 and 3-29). In general, post yolk-sac larvae appear to be more highly concentrated in the Lower Bay than the other early life stages and they tend to be more evenly distributed among sampling locations. This is not unexpected given that winter flounder larvae are initially planktonic (NMFS 1999) and post yolk-sac larvae could have had more time to drift away from initial spawning areas.

Over the years, the results of program sampling have indicated that the timing and magnitude of winter flounder spawning in the Harbor varies annually. However, cumulative probability graphs were developed to better define temporal patterns and predict the probability of when (by date of year) a given percentage of eggs and larvae could be expected to occur (Figure 3-26a). Excluding the first 10% and last 10% collected in a given year, for example, 80% of winter flounder eggs spawned in the Harbor can be expected to be found during a six-week period between 19 February and 4 April (Figure 3-26a). Figure 3-26c plots the cumulative probability occurrence of each winter flounder life stage by channel versus non-channel stations. After the collection of the first 25% of the eggs, collections in the channels tended to occur between five (50% occurrence) and 18 days (90% occurrence) later than in non-channel stations (Figure 3-26c). This may suggest that eggs, given the typical 2 to 3 week period before hatching (NMFS 1999), are initially deposited in non-channel areas and that the hydrodynamic conditions within Harbor may relocate them into channels several weeks later.

The winter flounder egg staging protocols USACE-NYD instituted in 2008 were designed to aid in this type of temporal interpretation. Figure 3-21 provides a percent composition of the total winter flounder egg collection by stages including the percentages of non-viable collected for the two years, 2008-2009, that staging data is available. Approximately 25% of the eggs collected in the Upper Bay during February and about 30% of the eggs collected in the Arthur Kill/Newark Bay during March were classified as the earliest Stage 1 eggs, while the majority of the eggs collected in the Upper and Lower Bays during April were older Stage 4 eggs (Figure 3-21).

A large percentage of the winter flounder eggs collected in these two years, approximately 70%, were non-viable including a majority of the eggs collected during February in the Upper and Lower Bays, and in the Upper Bay during March (Figure 3-21). Overall, 1,674 winter flounder eggs were collected from the Upper Bay of which 75% were non-viable compared to 39% and 9% of non-viable eggs collected from the Lower Bay and Arthur Kill/Newark Bay, respectively. The lower viability of eggs collected within the Upper Bay may in part be a reflection of the region's habitat structure and hydrodynamic factors which may result in eggs being displaced from the shallow areas where they were spawned. The displacement of eggs into adjacent channels may not only account for decreased viability, but it would also transport eggs into sampling areas where they would be more likely collected. This may partially explain why lower densities of eggs are collected in the Lower Bay while larval densities are considerably higher in the Lower Bay compared to the Upper Bay during ABS sampling.

4.2.2 Winter Flounder Habitat Utilization

The ABS program results have been used to document winter flounder spawning over broad regional areas of the Harbor and found substantial inter-annual variability in the relative abundance and distribution of adults during spawning and early life stages. However, it is not clear if spawning occurs over large areas that meet broad tolerances for physical habitat and water quality, or if recruitment relies on relatively small areas with a narrow range of conditions which maximize survival of early life stages. Schultz *et al.* 2007 found there to be substantial data on the broad-scale movements of winter flounder adults during the breeding season, but not much specific information on where flounder deposit their eggs. This seems to describe, at least in part, the situation observed in the NY/NJ Harbor.

Except for the Georges Bank population, which may spawn at depths up to 45 meters, adult winter flounder migrate inshore in the fall and early winter throughout most of its range, typically spawning in very shallow water less than five meters (NMFS 1999 and Brown *et al*. 2000). Coastal near shore winter flounder populations are believed to spawn in shallow waters where conditions favor limited movements of their eggs, which are demersal and adhesive, due to tidal currents. Schultz *et al.* 2007 found that water depth (they sampled no deeper than six meters) and sediment type were not necessarily determining factors for winter flounder egg deposition. They found that early stage eggs were concentrated in low current areas. These areas in combination with the adhesive nature of the eggs would tend to maintain them where they were spawned. The yolk-sac larvae would then begin development in low current areas which would be beneficial for a life stage with limited mobility.

In general, the Lower Bay contains a larger amount of potential winter flounder spawning and nursery habitat compared to the Upper Bay and Arthur Kill/Newark Bay due to the combination of large amounts of uninterrupted shallow water habitat and extensive areas of potentially suitable substrate of sand and/or silt (NMFS 1999). In habitat with a suitable substrate to retain the eggs and low-current velocities as described by Shultz *et al.* 2007, a higher percentage of the winter flounder eggs spawned are likely to remain on the bottom and fewer would break loose and drift with the current. In the Upper Bay, by contrast, the shallow water habitats are much less extensive and their suitability for winter flounder spawning and early life stages is reduced due to proximity to channels. The fragmented shallow/shoal habitat of the Upper Bay would result in a higher percentage of adults spawning near channels compared to the Lower Bay and the propeller wash from tugs, ships, and other commercial traffic in the channels as well as tidal currents would be more likely to displace eggs and larvae from the shallow areas where they were spawned.

5.0 REFERENCES

Able, K.W. and M.P. Fahay. 1998. The First Year in the Life of Estuarine Fishes in the Middle Atlantic Bight. Rutgers University Press. 342p.

Allen, J.D., G.K. Walker, J.V. Adams, S.J. Nichols and C.C. Edsall. 2005. Embryonic development progression in lake trout (*Salvelinus namaycush*) (Walbaum, 1792) and its relation to lake temperature. Journal of Great Lakes Research 31:187-209.

Atlantic States Marine Fisheries Commission (ASMFC). 1998. Assessment of the Southern New England/Mid-Atlantic and Gulf of Maine Winter Flounder Stocks. A report by the ASMFC's Winter Flounder Technical Committee.

Bain, M.B., D.L. Peterson and K.K. Arend. 1998. Population Status of Shortnose Sturgeon in the Hudson River. Final Report for National Marine Fisheries Service in association with the Hudson River Fishery Unit of the NYSDEC.

Brown, S.K., K.R. Buja, S.H. Jury, M.E. Monaco and A. Banner. 2000. Habitat suitability index models for eight fish and invertebrate species in Casco and Sheepscot Bays, Maine. North American Journal of Fisheries Management 20:408-435.

Bozeman, E.L. and M.J. Van Den Avyle. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic) – alewife and blueback herring. U.S. Fish & Wildlife Service Biological Report 82 (11.111) and U.S. Army Corps of Engineers, TR EL-82-4.

Chang, S., P.L. Berrien, D.L. Johnson, and W.W. Morse. 1999. Essential Fish Habitat Source Document: Windowpane, *Scophthalmus aquosus*, Life History and Habitat Characteristics. NOAA TM NMFS-NE-137.

Crawford, R.E. and C.C. Carey. 1985. Retention of winter flounder larvae within a Rhode Island salt pond. Estuaries 8 (2B):217-227.

Gadomski, D.M. and S.M. Caddell. 1996. Effects of temperature on the development and survival of eggs of four coastal California fishes. Fishery Bulletin. 94(1):41-48.

Gorodilov, Y.N. 1996. Description of the early ontogeny of the Atlantic salmon, *Salmo salar*, with a novel system of interval (state) identification. Environmental Biology of Fishes 47:109-127.

Hattala, K., M. DuFour, R. Adams and A. Kahnle. 2009. Status of New York River Herring Stocks. Hudson River Fisheries Unit, Bureau of Marine Resources, New York Department of Environmental Conservation.

Levinton, J.S. and J.R. Waldman. 2006. The Hudson River Estuary. Cambridge University Press.

Martin, F.D. and G.E. Drury. 1978. Development of Fishes of the Mid-Atlantic Bight: An Atlas of Egg, Larval and Juvenile Stages, Vol. 6. Stromateidae through Ogocephalidae. U.S. Fish Wildlife Service, Biological Services Program. FWS/OBS-78/12. pp. 196-200.

National Marine Fisheries Service (NMFS). 1999. Essential Fish Habitat Source Document: Winter flounder, *Pseudopleuronectes americanus*, life history and habitat characteristics. NOAA Technical Memorandum NMFS-NE-138.

National Marine Fisheries Service (NMFS). 2007. Guide to Essential Fish Habitat Designations in the Northeastern United States. Posted on the internet at http://www.nero.noaa.gov/hcd/webintro.html.

Nelson, J.S., E.J. Crossman, H. Espinosa-Perez, L.T. Findley, C.R. Gilbert, R.N. Lea, and J.D. Williams. 2004. Common and Scientific Names of Fishes from the United States, Canada and Mexico. 6th edition. American Fisheries Society, Special Publication 29, Bethesda, Maryland.

Millstone Environmental Laboratory (MEL). 2008. Annual Report 2007: Monitoring the Marine Environment of Long Island Sound at Millstone Power Station. Millstone Environmental Laboratory, Millstone Power Station, Dominion Resources Services, Inc. April 2008.

Rogers, S.G. and M.J. Van Den Avyle. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic) – Atlantic menhaden. U.S. Fish & Wildlife Service Biological Report 82 (11.108) and U.S. Army Corps of Engineers, TR EL-82-4.

Schultz, E., J.J. Pereira and P.J. Auster. 2007. Determining winter flounder spawning sites in two Connecticut estuaries. Connecticut Department of Environmental Protection.

Smith, C.L. 1985. The Inland Fishes of New York State. New York State Department of Environmental Conservation.

Steimle, F.W., W.W. Morse, P.L. Berrien, and D.L. Johnson. 1999. Essential Fish Habitat Source Document: Red Hake, *Urophycis chuss*, Life History and Habitat Characteristics. NOAA TM NMFS-NE-133.

Stevenson, D.K. and M.L. Scott. 2005. Essential Fish Habitat Source Document: Atlantic Herring, *Clupea harengus*, Life History and Habitat Characteristics. Second Edition. NOAA TM NMFS-NE-192.

U.S. Army Corps of Engineers – New York District (USACE-NYD). 1999. New York Jersey Harbor Navigation Study. Biological Monitoring Program December 1999.

U.S. Army Corps of Engineers – New York District (USACE-NYD). 2002. New York and New Jersey Harbor Navigation Program. Supplemental Sampling Program 2000–2001.

U.S. Army Corps of Engineers – New York District (USACE-NYD). 2003a. New York and New Jersey Harbor Navigation Program. Aquatic Biological Sampling Program Survey Report 2001–2002.

U.S. Army Corps of Engineers – New York District (USACE-NYD). 2003b. New York and New Jersey Harbor Navigation Program. Aquatic Biological Sampling Program Survey Report 2002–2003.

U.S. Army Corps of Engineers – New York District (USACE-NYD). 2005. New York and New Jersey Harbor Deepening Project. Aquatic Biological Survey Report 2004.

U.S. Army Corps of Engineers – New York District (USACE-NYD). 2006. New York and New Jersey Harbor Deepening Project. Aquatic Biological Survey Report 2005.

U.S. Army Corps of Engineers – New York District (USACE-NYD). 2007. New York and New Jersey Harbor Deepening Project. Aquatic Biological Survey Report 2006.

U.S. Army Corps of Engineers – New York District (USACE-NYD). 2008. New York and New Jersey Harbor Deepening Project. Aquatic Biological Survey Report 2007.

U.S. Army Corps of Engineers – New York District (USACE-NYD). 2009. New York and New Jersey Harbor Deepening Project. Aquatic Biological Survey Report 2008.

Vonderweidt, C., A. Weber, and S. Sherman. 2006. Review of the Atlantic States Marine Fisheries Commission's Interstate Fishery Management Plan for Winter Flounder. Atlantic States Marine Fisheries Commission.

Witherell, D. 1993. Growth and maturation of winter flounder, *Pleuronectes americanus,* in Massachusetts. Fishery Bulletin 91:816-820.

Wuenschel, M.J., K.W. Able and D. Byrne. 2009. Seasonal patterns of winter flounder *Pseudopleuronectes americanus* abundance and reproductive condition on the New York Bight continental shelf. Journal of Fish Biology 74:1508-1524.

Table 1-1. Summary of federally designated EFH species in NY/NJ Harbor.

SPECIES	EGGS	LARVAE	NEONATE/ EARLY JUVENILES	JUVENILES	ADULTS	SPAWNING ADULTS
Atlantic herring (*Clupea harengus*)		M,S		M,S	M,S	
Atlantic mackerel (*Scomber scombrus*)				S	S	
Black sea bass (*Centropristus striata*)				M,S	M,S	
Bluefish (*Pomatomus saltatrix*)				M,S	M,S	
Butterfish (*Peprilus triacanthus*)		M		M,S	M,S	
Red hake (*Urophycis chuss*)		M,S		M,S	M,S	
Scup (*Stenotomus chrysops*)	S	S		S	S	
Summer flounder (*Paralicthys dentatus*)		F,M,S		M,S	M,S	
Windowpane flounder (*Scopthalmus aquosus*)	M,S	M,S		M,S	M,S	M,S
Winter flounder (*Pseudopleuronectes americanus*)	M,S	M,S		M,S	M,S	M,S
Clearnose skate (*Raja eglanteria*)				X	X	
Little skate (*Leucoraja erinacea*)				X	X	
Winter skate (*Leucoraja ocellata*)				X	X	
Cobia (*Rachycentron canadum*)	X	X		X	X	
King mackerel (*Scomberomorus cavalla*)	X	X		X	X	
Spanish mackerel (*Scomberomorus maculatus*)	X	X		X	X	
Dusky shark (*Carcharhinus obscurus*)			X	X		
Sand tiger shark (*Odontaspis taurus*)			X			
Sandbar shark (*Carcharinus plumbeus*)			X		X	

Source: National Marine Fisheries Service (2007): Guide to Essential Fish Habitat Designation in the Northeastern United States – the Hudson River/Raritan/Sandy Hook Bays, New York/ New Jersey Harbor Estuary.

Legend: S = Includes the seawater salinity zone (salinity ≥ 25.0%)

M = Includes mixing water / brackish salinity zone (0.5‰ < salinity < 25.0‰)

F = Includes tidal freshwater salinity zone (0.0‰ < salinity < 0.5%)

X = Designated EFH but no salinity zone specified

Table 2-1. Description of stations sampled during the 2002 to 2009 Aquatic Biological Survey and the number of valid samples collected during the 2009 sampling program.

Area	Station Name	Type	Station Location	Depth (ft)	Valid Samples Collected	
					Trawl	Ichthyo.
South Brooklyn (4 Transects in 2009)	SB–1	Non-channel	Gowanus Bay Interpier South	27	NS	NS
	SB–2	Non-channel	Gowanus Bay Interpier	30	NS	NS
	SB–3	**Non-channel**	**Bay Ridge Flats**	**18**	**10**	**12**
	SB–4	**Channel**	**Bay Ridge Channel**	**40**	**10**	**12**
	SB–5	**Channel**	**Anchorage Channel Middle**	**47**	**10**	**12**
	SB–6	**Channel**	**Anchorage Channel South**	**48**	**10**	**12**
Port Jersey (2 Transects in 2009)	**PJ–1**	**Non-channel**	**Jersey Flats**	**19**	**10**	**12**
	PJ–2	**Non-channel**	**Caven Point**	**10**	**10**	**12**
	PJ–3	Non-channel	Constable Hook	10	NS	NS
	PJ–4	Channel	Port Jersey Channel	51	NS	NS
	PJ–5	Channel	Port Jersey Channel East	42	NS	NS
Newark Bay (3 Transects in 2009)	NB–3	Non-channel	Newark Bay Flats Middle	10	NS	NS
	NB–4	**Non-channel**	**Newark Bay Flats South**	**12**	**10**	**12**
	NB–5	Channel	Newark Bay Middle Reach	42	NS	NS
	NB–6	Channel	Newark Bay South Reach	46	NS	NS
	NB–7	**Non-channel**	**Elizabeth Flats North**	**11**	**10**	**12**
	NB–8	**Channel**	**Newark Bay North Reach Channel**	**43**	**10**	**12**
Lower Bay (13 Transects in 2009)	**LB–1**	**Non-channel**	**East Bank**	**17**	**10**	**12**
	LB–2	**Channel**	**North End Ambrose Channel**	**54**	**10**	**12**
	LB–3	**Non-channel**	**Swash Channel Range**	**20**	**10**	**12**
	LB–4	**Channel**	**Chapel Hill South Channel**	**37**	**10**	**12**
	LB–5	**Non-channel**	**Old Orchard Shoals**	**21**	**10**	**12**
	LB–6	**Channel**	**Raritan Bay East Reach**	**46**	**10**	**12**
	LB-7	**Non-channel**	**South of West Bank**	**31**	**10**	**12**
	LB-8	**Non-channel**	**West Bank Flat**	**20**	**10**	**12**
	LB-9	**Non-channel**	**West of Channel**	**30**	**10**	**12**
	LB-10	**Non-channel**	**Anchorage west of Gravesend Bay**	**30**	**10**	**12**
	LB-11	Non-channel	Gravesend Bay Flats	22	NS	NS
	LB-12	**Non-channel**	**West of Chapel Hill South Channel**	**25**	**10**	**12**
	LB-13	**Non-channel**	**East of Chapel Hill South Channel**	**19**	**10**	**12**
	LB-14	**Channel**	**Just north of Ambrose Channel**	**52**	**10**	**12**
Arthur Kill (2 Transects in 2009)	AK-1	Non-channel	Elizabeth Flats South	19	NS	NS
	AK-2	**Channel**	**North of Shooter's Island Reach**	**52**	**10**	**12**
	AK-3	**Channel**	**Elizabeth Reach**	**50**	**10**	**12**
	AK-4	Non-channel	Prall's Island	20	NS	NS
	AK-7	Non-channel	Island of Meadows	15	NS	NS
Kill Van Kull (1 Transect in 2009)	**KVK-1**	**Channel**	**Entrance to KVK Channel (Sand)**	**52**	**NS**	**1**
	KVK-2	Channel	Entrance to KVK Channel (Silt)	55	NS	NS

Stations in BOLD represent those sampled during 2009 Sampling Program.
NS = Not Sampled

Table 2-2. Number of valid samples collected by gear and by month during the Aquatic Biological Survey 2002-2009.

Sampling Year	Bottom Trawl							Ichthyoplankton						
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jan	Feb	Mar	Apr	May	Jun	Jul
2002	21	53	52	52	26	26	26	26	52	52	63	41	52	26
2003	26	52	52	54	28	28	27	26	52	58	71	45	58	29
2004		28	55	53	27	27	27	28	56	84	54	28	55	28
2005		40	48	48	24	24	24	42	51	52	52	63	41	26
2006		47	45	51	24	23	23	25	43	52	48	64	28	23
2007		43	43	60	24	24	24	18	46	57	48	48	48	24
2008			53	52	41	58			52	62	61	61	52	26
2009	24	48	48	48	48	24		49	48	48	48	48	48	

Note: Shaded field indicates sampling was conducted.
Numbers in fields indicate number of valid samples for that month.

Table 2-3. Specifications of the bottom trawl used during the Aquatic Biological Survey.

Part	Specification
Headrope	25.9 ft. (7.9 m)
Footrope	27.9 ft (8.5 m)
Wing height	3.6 ft. (1.1 m)
Total length	35.1 ft (10.7 m)
Wing mesh (square)	1.0-in. (2.54 cm)
Body mesh (square)	1.0-in. (2.54 cm)
Cod end mesh (square)	0.75-in. (1.9 cm)
Cod end liner mesh (square)	0.25-in. (0.6 cm)
Trawl doors	32.0 x 17.0 x 1.0-in (81.3 x 43.2 x 2.5 cm)
Tow line length	5 times maximum station water depth

Table 2-4. Specifications of the epibenthic sled and plankton net used during the Aquatic Biological Survey.

Part	Specification
Mouth height x width	0.5 x 0.5 m
Overall length	3.0 m
Mesh size	0.5 mm
Cod-end diameter	10.1 cm
Cod-end mesh	0.5 mm (PVC cod-end bucket)
Distance from sled base	Bottom of net is 17.8 cm above the bottom of the sled runners
Epibenthic sled	Constructed of welded aluminum.

Table 2-5. Water quality parameters measured during the Aquatic Biological Survey.

Water Quality Parameter	Units and Accuracy	Sample Depths
Temperature	+/- 0.2˚C	Bottom
Dissolved oxygen	+/- 0.5 mg/L	Bottom
Conductivity	+/- 100 µS/cm	Bottom
Salinity	+/- 0.1 ppt	Bottom

Table 3-1. Taxa identified in bottom trawl and epibenthic sled (ichthyoplankton) samples collected during the 2009 Aquatic Biological Survey with ranking based on total number collected.

Group	Common Name	Scientific Name	Trawl	Sled
Essential Fish Habitat Species	Atlantic cod	*Gadus morhua*	x	x
	Atlantic herring	*Clupea harengus*	2	
	Black sea bass	*Centropristis striata*	x	
	Butterfish	*Peprilus triacanthus*	x	
	Clearnose skate	*Raja eglanteria*	x	
	Little skate	*Raja erinacea*	x	
	Pollock	*Pollachius virens*	x	
	Red hake	*Urophycis chuss*	x	
	Summer flounder	*Paralichthys dentatus*	x	x
	Windowpane	*Scopthalmus aquosus*	x	4
	Winter flounder	*Pseudopleuronectes americanus*	7	5
	Winter skate	*Raja ocellata*	x	
Important Non-EFH Species	Alewife	*Alosa pseudoharengus*	1	
	American eel	*Anguilla rostrata*	x	
	American lobster	*Homarus americanus*	x	
	American shad	*Alosa sapidissima*	x	
	Atlantic menhaden	*Brevoortia tyrannus*	x	6
	Blue crab	*Callinectes sapidus*	x	
	Blueback herring	*Alosa aestivalis*	5	
	Rainbow smelt	*Osmerus mordax mordax*	x	
	Shortnose sturgeon	*Acipenser brevirostrum*	x	
	Striped bass	*Morone saxatilis*	6	
Other Species	American sandlance	*Ammodytes americanus*	8	x
	Atlantic croaker	*Micropogonias undulates*	x	x
	Atlantic silverside	*Menidia menidia*	9	x
	Atlantic tomcod	*Microgadus tomcod*	x	x
	Bay anchovy	*Anchoa mitchilli*	4	2
	Clupeid unidentified			x
	Cods and Haddocks	Gadidae		9
	Conger eel	*Conger oceanicus*	x	x
	Cunner	*Tautogolabrus adspersus*	x	x
	Feather blenny	*Hypsoblennius hentzi*	x	x
	Fourbeard rockling	*Enchelyopus cimbrius*		x
	Fourspot flounder	*Hippoglossina oblonga*	x	
	Gizzard shad	*Dorosoma cepedianum*	x	
	Gobies	Gobiidae	x	x
	Goosefish	*Lophius americanus*		x

Group	Common Name	Scientific Name	Trawl	Sled
Other Species	Grubby	*Myoxocephalus aenaeus*	x	8
	Lined seahorse	*Hippocampus erectus*	x	
	Naked goby	*Gobiosoma bosci*	x	
	Northern pipefish	*Syngnathus fuscus*	x	x
	Northern puffer	*Sphoeroides maculatus*		x
	Northern searobin	*Prionotus carolinus*	x	
	Radiated shanny	*Ulvaria subbifurcata*		x
	Rock gunnel	*Pholis gunnellus*	x	x
	Sea raven	*Hemitripterus americanus*		x
	Seaboard goby	*Gobiosoma ginsburgi*	x	
	Searobin species	*Prionotus* sp.		7
	Sheepshead	*Archosargus probatocephalus*	x	
	Silver hake	*Merluccius bilinearis*	x	
	Smallmouth flounder	*Etropus microstomus*	x	
	Spotted hake	*Urophycis regia*	10	
	Striped killifish	*Fundulus majalis*	x	
	Striped searobin	*Prionotus evolans*	x	
	Tautog	*Tautoga onitis*	x	x
	Threespine stickleback	*Gasterosteus aculeatus*	x	
	Unidentified			1
	Weakfish	*Cynoscion regalis*		10
	White mullet	*Mugil curema*	x	
	White perch	*Morone americana*	3	
	Wrasses	Labridae		3
		Total Taxa	49	27

Notes:
*1-10 = Rank of ten most abundant species based on total collected. X = Species was collected.
**Family level classifications were not included in the total taxa count if species from within that family were collected and identified to a lower taxonomic level (e.g., Gobidae were not counted in trawls total taxa due to the collection of *Gobiosoma bosci* and *Gobiosoma ginsburgi*).

Table 3-2. Total number collected by species at channel and non-channel stations during bottom trawl sampling for the 2009 Aquatic Biological Survey.

Species	Station Type	Region			Total
		AKNB	LB	UB	
Essential Fish Habitat Species					
Atlantic cod	Channel	0	0	0	0
	Non-Channel	0	1	0	1
	Combined	0	1	0	1
Atlantic herring	Channel	18	16	25	59
	Non-Channel	3,342	6	354	3,702
	Combined	3,360	22	379	3,761
Black sea bass	Channel	1	0	1	2
	Non-Channel	0	0	0	0
	Combined	1	0	1	2
Butterfish	Channel	0	6	0	6
	Non-Channel	0	3	0	3
	Combined	0	9	0	9
Clearnose skate	Channel	0	0	2	2
	Non-Channel	0	0	0	0
	Combined	0	0	2	2
Little skate	Channel	0	15	4	19
	Non-Channel	0	21	1	22
	Combined	0	36	5	41
Pollock	Channel	0	0	0	0
	Non-Channel	0	11	0	11
	Combined	0	11	0	11
Red hake	Channel	22	8	8	38
	Non-Channel	0	3	0	3
	Combined	22	11	8	41
Summer flounder	Channel	3	1	1	5
	Non-Channel	0	5	0	5
	Combined	3	6	1	10
Windowpane	Channel	6	13	11	30
	Non-Channel	1	20	3	24
	Combined	7	33	14	54
Winter flounder	Channel	189	39	153	381
	Non-Channel	8	13	28	49
	Combined	197	52	181	430

Species	Station Type	Region			Total
		AKNB	LB	UB	
Winter skate	Channel	0	1	0	1
	Non-Channel	0	1	0	1
	Combined	0	2	0	2
Sub-Total Channel		***239***	***99***	***205***	***543***
Sub-Total Non-Channel		***3,351***	***84***	***386***	***3,821***
Sub-Total Essential Fish Habitat Species		***3,590***	***183***	***591***	***4,364***
Important Non-EFH Species					
Alewife	Channel	374	2,549	785	3,708
	Non-Channel	25	358	17	400
	Combined	399	2,907	802	4,108
American eel	Channel	0	0	0	0
	Non-Channel	0	0	1	1
	Combined	0	0	1	1
American lobster	Channel	0	1	0	1
	Non-Channel	0	0	0	0
	Combined	0	1	0	1
American shad	Channel	6	11	19	36
	Non-Channel	0	8	3	11
	Combined	6	19	22	47
Atlantic menhaden	Channel	0	9	2	11
	Non-Channel	0	4	0	4
	Combined	0	13	2	15
Blue crab	Channel	2	5	5	12
	Non-Channel	22	2	1	25
	Combined	24	7	6	37
Blueback herring	Channel	16	1,686	71	1,773
	Non-Channel	149	791	59	999
	Combined	165	2,477	130	2,772
Rainbow smelt	Channel	0	0	0	0
	Non-Channel	1	1	0	2
	Combined	1	1	0	2
Shortnose sturgeon	Channel	0	0	0	0
	Non-Channel	0	0	1	1
	Combined	0	0	1	1
Striped bass	Channel	301	1	290	592
	Non-Channel	4	6	82	92
	Combined	305	7	372	684

Species	Station Type	Region			Total
		AKNB	LB	UB	
Sub-Total Channel		***699***	***4,262***	***1,172***	***6,133***
Sub-Total Non-Channel		***201***	***1,170***	***164***	***1,535***
Sub-Total Important Non-EFH Species		***900***	***5,432***	***1,336***	***7,668***
Other Species					
American sandlance	Channel	0	0	3	3
	Non-Channel	0	266	1	267
	Combined	0	266	4	270
Atlantic croaker	Channel	1	0	0	1
	Non-Channel	0	0	0	0
	Combined	1	0	0	1
Atlantic silverside	Channel	1	100	10	111
	Non-Channel	12	185	10	207
	Combined	13	285	20	318
Atlantic tomcod	Channel	1	0	1	2
	Non-Channel	0	0	8	8
	Combined	1	0	9	10
Bay anchovy	Channel	7	24	3	34
	Non-Channel	817	892	1,405	3,114
	Combined	824	916	1,408	3,148
Conger eel	Channel	0	1	1	2
	Non-Channel	0	0	0	0
	Combined	0	1	1	2
Cunner	Channel	4	0	0	4
	Non-Channel	1	0	3	4
	Combined	5	0	3	8
Feather blenny	Channel	0	0	0	0
	Non-Channel	0	1	0	1
	Combined	0	1	0	1
Fourspot flounder	Channel	0	1	0	1
	Non-Channel	0	0	0	0
	Combined	0	1	0	1
Gizzard shad	Channel	10	0	2	12
	Non-Channel	2	3	0	5
	Combined	12	3	2	17
Gobies	Channel	0	0	1	1
	Non-Channel	0	0	0	0
	Combined	0	0	1	1

Species	Station Type	Region			Total
		AKNB	LB	UB	
Grubby	Channel	4	3	0	7
	Non-Channel	0	8	5	13
	Combined	4	11	5	20
Lined seahorse	Channel	0	0	1	1
	Non-Channel	0	1	2	3
	Combined	0	1	3	4
Naked goby	Channel	0	2	0	2
	Non-Channel	0	1	0	1
	Combined	0	3	0	3
Northern pipefish	Channel	4	2	6	12
	Non-Channel	2	4	3	9
	Combined	6	6	9	21
Northern searobin	Channel	0	0	1	1
	Non-Channel	0	1	0	1
	Combined	0	1	1	2
Rock gunnel	Channel	1	1	0	2
	Non-Channel	0	1	0	1
	Combined	1	2	0	3
Seaboard goby	Channel	0	0	0	0
	Non-Channel	0	1	0	1
	Combined	0	1	0	1
Sheepshead	Channel	0	0	0	0
	Non-Channel	0	2	1	3
	Combined	0	2	1	3
Silver hake	Channel	1	45	1	47
	Non-Channel	0	12	0	12
	Combined	1	57	1	59
Smallmouth flounder	Channel	4	6	4	14
	Non-Channel	2	8	2	12
	Combined	6	14	6	26
Spotted hake	Channel	54	48	62	164
	Non-Channel	2	68	5	75
	Combined	56	116	67	239
Striped killifish	Channel	1	0	0	1
	Non-Channel	0	0	0	0
	Combined	1	0	0	1

Species	Station Type	Region			Total
		AKNB	LB	UB	
Striped searobin	Channel	0	1	0	1
	Non-Channel	0	1	0	1
	Combined	0	2	0	2
Tautog	Channel	6	0	2	8
	Non-Channel	0	0	2	2
	Combined	6	0	4	10
Threespine stickleback	Channel	0	0	0	0
	Non-Channel	1	0	0	1
	Combined	1	0	0	1
White mullet	Channel	0	0	0	0
	Non-Channel	0	0	1	1
	Combined	0	0	1	1
White perch	Channel	3,279	0	198	3,477
	Non-Channel	8	0	23	31
	Combined	3,287	0	221	3,508
Sub-Total Channel Total		***3,378***	***234***	***296***	***3,908***
Sub-Total Non-Channel Total		***847***	***1,455***	***1,471***	***3,773***
Sub-Total Other Species		***4,225***	***1,689***	***1,767***	***7,681***
Total All - Channel		**4,316**	**4,595**	**1,673**	**10,584**
Total All- Non-Channel		**4,399**	**2,709**	**2,021**	**9,129**
Total All - Combined		**8,715**	**7,304**	**3,694**	**19,713**

Table 3-3. Monthly average bottom trawl CPUE by species for all channel and non-channel stations during the 2009 Aquatic Biological Survey.

Species	Station Type	Dec	Jan	Feb	Mar	Apr	May	Average
Essential Fish Habitat Species								
Atlantic cod	Channel							
	Non-channel						0.07	0.01
Atlantic herring	Channel		0.50	1.35	0.20	0.10	1.60	0.59
	Non-channel		0.07		0.04	0.29	264.66	26.54
Black sea bass	Channel					0.05	0.10	0.02
	Non-channel							
Butterfish	Channel						0.60	0.06
	Non-channel						0.21	0.02
Clearnose skate	Channel	0.10					0.10	0.02
	Non-channel							
Little skate	Channel	0.70	0.20	0.10	0.05	0.25		0.19
	Non-channel		0.07	0.04	0.07	0.39	0.43	0.16
Pollock	Channel							
	Non-channel				0.04	0.18	0.36	0.08
Red hake	Channel	0.91	0.83		0.05	0.35	0.50	0.39
	Non-channel					0.04	0.14	0.02
Summer flounder	Channel			0.05		0.05	0.30	0.05
	Non-channel		0.04			0.04	0.21	0.04
Windowpane	Channel	0.20		0.25	0.40	0.50	0.50	0.30
	Non-channel	0.07		0.07	0.11	0.39	0.50	0.17
Winter flounder	Channel	6.41	4.23	4.45	5.55	1.55	0.40	3.84
	Non-channel	1.25	0.27	0.20	0.04	0.29	0.80	0.36
Winter skate	Channel						0.10	0.01
	Non-channel		0.04					0.01
Important Non-EFH Species								
Alewife	Channel	10.81	90.60	49.30	28.65	11.15	0.60	37.08
	Non-channel	7.14	3.65	5.04	0.68	0.36	2.36	2.89
American eel	Channel							
	Non-channel					0.04		0.01
American lobster	Channel				0.05			0.01
	Non-channel							
American shad	Channel		0.20	0.95	0.45	0.20		0.36
	Non-channel		0.29	0.04		0.04	0.07	0.08
Atlantic menhaden	Channel	0.10	0.15			0.25	0.20	0.11
	Non-channel	0.07				0.11		0.03

Species	Station Type	Dec	Jan	Feb	Mar	Apr	May	Average
Blue crab	Channel	0.61		0.10	0.05	0.05	0.20	0.12
	Non-channel	0.21		0.15	0.23	0.23	0.43	0.19
Blueback herring	Channel	0.10	41.70	31.15	9.30	6.45		17.73
	Non-channel	20.70	15.36	6.04	0.11	0.25	9.41	7.36
Rainbow smelt	Channel							
	Non-channel		0.08					0.02
Shortnose sturgeon	Channel							
	Non-channel						0.07	0.01
Striped bass	Channel	0.30	14.06	5.80	7.35	2.40		5.95
	Non-channel	5.73	0.04			0.33	0.14	0.66
Other Species								
American sandlance	Channel	0.10	0.05	0.05				0.03
	Non-channel	10.21	2.29	1.32	0.82			1.91
Atlantic croaker	Channel		0.06					0.01
	Non-channel							
Atlantic silverside	Channel	0.10	5.00	0.30	0.20			1.11
	Non-channel	0.36	6.58	0.46	0.11	0.08		1.48
Atlantic tomcod	Channel	0.10					0.10	0.02
	Non-channel						0.57	0.06
Bay anchovy	Channel	2.51	0.16			0.15	0.30	0.34
	Non-channel	10.86	0.29			1.89	210.09	22.53
Conger eel	Channel			0.05			0.10	0.02
	Non-channel							
Cunner	Channel		0.05			0.10	0.10	0.04
	Non-channel	0.09				0.11		0.03
Feather blenny	Channel							
	Non-channel		0.04					0.01
Fourspot flounder	Channel	0.10						0.01
	Non-channel							
Gizzard shad	Channel	0.41	0.27	0.05	0.10			0.12
	Non-channel	0.36						0.04
Gobies	Channel				0.05			0.01
	Non-channel							
Grubby	Channel		0.05	0.20	0.10			0.07
	Non-channel	0.07	0.11	0.11	0.07	0.14		0.09
Lined seahorse	Channel						0.10	0.01
	Non-channel					0.07	0.07	0.02
Naked goby	Channel					0.10		0.02
	Non-channel			0.04				0.01

Species	Station Type	Dec	Jan	Feb	Mar	Apr	May	Average
Northern pipefish	Channel	0.10	0.15		0.25	0.15		0.12
	Non-channel	0.07	0.04		0.07	0.15	0.07	0.07
Northern searobin	Channel						0.10	0.01
	Non-channel					0.04		0.01
Rock gunnel	Channel					0.05	0.10	0.02
	Non-channel			0.04				0.01
Seaboard goby	Channel							
	Non-channel			0.04				0.01
Sheepshead	Channel						1.30	0.13
	Non-channel						0.21	0.02
Silver hake	Channel	0.80	1.65			0.30		0.47
	Non-channel					0.11	0.64	0.09
Smallmouth flounder	Channel			0.05	0.20	0.45		0.14
	Non-channel	0.09	0.07	0.04	0.04	0.18	0.14	0.09
Spotted hake	Channel	0.80	0.25		0.10	3.80	6.00	1.51
	Non-channel	0.07	0.04		0.07	1.36	2.39	0.54
Striped killifish	Channel			0.05				0.01
	Non-channel							
Striped searobin	Channel						0.10	0.01
	Non-channel						0.07	0.01
Tautog	Channel	0.20	0.11	0.05	0.10	0.05		0.08
	Non-channel					0.07		0.01
Threespine stickleback	Channel							
	Non-channel				0.04			0.01
White mullet	Channel							
	Non-channel	0.07						0.01
White perch	Channel	18.24	68.83	33.70	63.80	1.85	0.10	35.47
	Non-channel	2.27						0.23

Table 3-4 a. Monthly average bottom trawl CPUE by species for all channel stations in the Arthur Kill/Newark Bay (AKNB), Upper Bay (UB), and Lower Bay (LB) during the 2009 Aquatic Biological Survey.

Species	Region	Dec	Jan	Feb	Mar	Apr	May	Average
Essential Fish Habitat Species								
	AKNB							
Atlantic cod	UB							
	LB							
	AKNB			0.17	0.17		5.33	0.60
Atlantic herring	UB		1.00	2.67	0.50			0.83
	LB		0.50	1.25		0.25		0.40
	AKNB						0.33	0.03
Black sea bass	UB					0.17		0.03
	LB							
	AKNB							
Butterfish	UB							
	LB						1.50	0.15
	AKNB							
Clearnose skate	UB	0.33					0.33	0.07
	LB							
	AKNB							
Little skate	UB	0.33		0.17		0.33		0.13
	LB	1.50	0.50	0.13	0.13	0.38		0.38
	AKNB							
Pollock	UB							
	LB							
	AKNB	1.04	1.93		0.17	0.83	0.67	0.76
Red hake	UB	1.67	0.33				0.33	0.27
	LB	0.25	0.38			0.25	0.50	0.20
	AKNB			0.17			0.67	0.10
Summer flounder	UB					0.17		0.03
	LB						0.25	0.03
	AKNB			0.17	0.33	0.33	0.33	0.20
Windowpane	UB	0.67		0.50	0.33	0.17	1.00	0.37
	LB			0.13	0.50	0.88	0.25	0.33
	AKNB	5.04	10.44	6.17	10.33	2.50		6.39
Winter flounder	UB	16.00	2.33	5.67	7.67	1.33	1.00	5.10
	LB	0.25	1.00	2.25	0.38	1.00	0.25	0.98

Species	Region	Dec	Jan	Feb	Mar	Apr	May	Average
Winter skate	AKNB							
	UB							
	LB						0.25	0.03
Important Non-EFH Species								
Alewife	AKNB	0.37	1.33	6.67	32.00	21.33	1.67	12.47
	UB	1.33	31.33	90.50	5.83	2.50		26.17
	LB	25.75	202.00	50.38	43.25	10.00	0.25	63.73
American eel	AKNB							
	UB							
	LB							
American lobster	AKNB							
	UB							
	LB				0.13			0.03
American shad	AKNB			0.67	0.33			0.20
	UB		0.17	2.00	0.50	0.50		0.63
	LB		0.38	0.38	0.50	0.13		0.28
Atlantic menhaden	AKNB							
	UB		0.33					0.07
	LB	0.25	0.13			0.63	0.50	0.23
Blue crab	AKNB	0.37			0.17			0.07
	UB	1.67						0.17
	LB			0.25		0.13	0.50	0.13
Blueback herring	AKNB			0.33	2.17	0.17		0.53
	UB			8.33	2.50	1.00		2.37
	LB	0.25	104.25	71.38	19.75	15.25		42.15
Rainbow smelt	AKNB							
	UB							
	LB							
Shortnose sturgeon	AKNB							
	UB							
	LB							
Striped bass	AKNB	0.67	12.37	11.67	18.83	7.50		10.14
	UB		34.50	7.67	5.67	0.50		9.67
	LB	0.25						0.03
Other Species								
American sandlance	AKNB							
	UB	0.33	0.17	0.17				0.10
	LB							

Species	Region	Dec	Jan	Feb	Mar	Apr	May	Average
Atlantic croaker	AKNB		0.19					0.04
	UB							
	LB							
Atlantic silverside	AKNB			0.17				0.03
	UB	0.33	1.17	0.17	0.17			0.33
	LB		11.63	0.50	0.38			2.50
Atlantic tomcod	AKNB	0.33						0.03
	UB						0.33	0.03
	LB							
Bay anchovy	AKNB	2.04	0.19					0.24
	UB	0.33	0.33					0.10
	LB	4.50				0.38	0.75	0.60
Conger eel	AKNB							
	UB			0.17				0.03
	LB						0.25	0.03
Cunner	AKNB		0.17			0.33	0.33	0.13
	UB							
	LB							
Feather blenny	AKNB							
	UB							
	LB							
Fourspot flounder	AKNB							
	UB							
	LB	0.25						0.03
Gizzard shad	AKNB	1.37	0.72		0.33			0.35
	UB		0.17	0.17				0.07
	LB							
Gobies	AKNB							
	UB				0.17			0.03
	LB							
Grubby	AKNB			0.33	0.33			0.13
	UB							
	LB		0.13	0.25				0.08
Lined seahorse	AKNB							
	UB						0.33	0.03
	LB							
Naked goby	AKNB							
	UB							
	LB					0.25		0.05

Species	Region	Dec	Jan	Feb	Mar	Apr	May	Average
	AKNB	0.33	0.17			0.33		0.13
Northern pipefish	UB		0.17		0.83			0.20
	LB		0.13			0.13		0.05
	AKNB							
Northern searobin	UB						0.33	0.03
	LB							
	AKNB					0.17		0.03
Rock gunnel	UB							
	LB						0.25	0.03
	AKNB							
Seaboard goby	UB							
	LB							
	AKNB							
Sheepshead	UB						4.33	0.43
	LB							
	AKNB	0.33						0.03
Silver hake	UB		0.17					0.03
	LB	1.75	4.00			0.75		1.13
	AKNB			0.17	0.33	0.17		0.13
Smallmouth flounder	UB				0.33	0.33		0.13
	LB					0.75		0.15
	AKNB					4.50	9.00	1.80
Spotted hake	UB	1.00	0.17			4.83	5.33	1.63
	LB	1.25	0.50		0.25	2.50	4.25	1.20
	AKNB			0.17				0.03
Striped killifish	UB							
	LB							
	AKNB							
Striped searobin	UB							
	LB						0.25	0.03
	AKNB	0.33	0.35		0.33	0.17		0.20
Tautog	UB	0.33		0.17				0.07
	LB							
	AKNB							
Threespine stickleback	UB							
	LB							
	AKNB							
White mullet	UB							
	LB							

Species	Region	Dec	Jan	Feb	Mar	Apr	May	Average
	AKNB	38.81	226.59	112.00	197.67	2.33	0.33	111.63
White perch	UB	22.00	2.83	0.33	15.00	3.83		6.60
	LB							

Table 3-4 b. Monthly average bottom trawl CPUE by species for all non-channel stations in the Arthur Kill/Newark Bay (AKNB), Lower Bay (LB), and Upper Bay (UB) during the 2009 Aquatic Biological Survey.

Species	Region	Dec	Jan	Feb	Mar	Apr	May	Average
Essential Fish Habitat Species								
	AKNB							
Atlantic cod	UB							
	LB						0.11	0.01
	AKNB						1678.13	167.81
Atlantic herring	UB				0.17	0.67	116.33	11.80
	LB		0.11			0.22		0.07
	AKNB							
Black sea bass	UB							
	LB							
	AKNB							
Butterfish	UB							
	LB						0.33	0.03
	AKNB							
Clearnose skate	UB							
	LB							
	AKNB							
Little skate	UB						0.33	0.03
	LB		0.11	0.06	0.11	0.61	0.56	0.23
	AKNB							
Pollock	UB							
	LB				0.06	0.28	0.56	0.12
	AKNB							
Red hake	UB							
	LB					0.06	0.22	0.03
	AKNB							
Summer flounder	UB							
	LB		0.06			0.06	0.33	0.06
	AKNB	0.50						0.05
Windowpane	UB			0.17		0.17	0.33	0.10
	LB			0.06	0.17	0.56	0.67	0.22
	AKNB	1.25	0.63	0.63			1.13	0.49
Winter flounder	UB	4.33	0.67	0.17		0.67	2.00	0.93
	LB	0.22	0.06	0.11	0.06	0.22	0.33	0.14

Species	Region	Dec	Jan	Feb	Mar	Apr	May	Average
	AKNB							
Winter skate	UB							
	LB		0.06					0.01
Important Non-EFH Species								
	AKNB	2.00	0.25				12.50	1.50
Alewife	UB	2.00	1.35			0.17	0.67	0.57
	LB	10.00	5.17	7.83	1.06	0.50	0.67	3.98
	AKNB							
American eel	UB					0.17		0.03
	LB							
	AKNB							
American lobster	UB							
	LB							
	AKNB							
American shad	UB		0.17			0.17	0.33	0.10
	LB		0.39	0.06				0.09
	AKNB							
Atlantic menhaden	UB							
	LB	0.11				0.17		0.04
	AKNB			1.03	1.61	1.64	3.00	1.16
Blue crab	UB	0.33						0.03
	LB	0.22						0.02
	AKNB	22.88	1.25				64.88	9.03
Blueback herring	UB	19.00					0.67	1.97
	LB	20.78	23.61	9.39	0.17	0.39		8.79
	AKNB		0.31					0.06
Rainbow smelt	UB							
	LB		0.06					0.01
	AKNB							
Shortnose sturgeon	UB						0.33	0.03
	LB							
	AKNB	0.63				0.81		0.22
Striped bass	UB	24.67	0.17			1.00	0.33	2.73
	LB	0.56					0.11	0.07
Other Species								
	AKNB							
American sandlance	UB		0.19					0.04
	LB	15.89	3.50	2.06	1.28			2.96

Species	Region	Dec	Jan	Feb	Mar	Apr	May	Average
Atlantic croaker	AKNB							
	UB							
	LB							
Atlantic silverside	AKNB	1.00	1.06	1.00		0.56		0.62
	UB		1.17		0.50			0.33
	LB	0.33	9.61	0.50				2.06
Atlantic tomcod	AKNB							
	UB						2.67	0.27
	LB							
Bay anchovy	AKNB	33.00	0.56				394.63	42.88
	UB	4.00	1.00			0.50	461.33	46.83
	LB	8.22				2.78	85.33	9.91
Conger eel	AKNB							
	UB							
	LB							
Cunner	AKNB	0.63						0.06
	UB					0.50		0.10
	LB							
Feather blenny	AKNB							
	UB							
	LB		0.06					0.01
Fourspot flounder	AKNB							
	UB							
	LB							
Gizzard shad	AKNB	1.00						0.10
	UB							
	LB	0.33						0.03
Gobies	AKNB							
	UB							
	LB							
Grubby	AKNB							
	UB	0.33		0.33		0.33		0.17
	LB		0.17	0.06	0.11	0.11		0.09
Lined seahorse	AKNB							
	UB					0.17	0.33	0.07
	LB					0.06		0.01
Naked goby	AKNB							
	UB							
	LB			0.06				0.01

Species	Region	Dec	Jan	Feb	Mar	Apr	May	Average
	AKNB					0.53		0.11
Northern pipefish	UB		0.17			0.17	0.33	0.10
	LB	0.11			0.11	0.06		0.04
	AKNB							
Northern searobin	UB							
	LB					0.06		0.01
	AKNB							
Rock gunnel	UB							
	LB			0.06				0.01
	AKNB							
Seaboard goby	UB							
	LB			0.06				0.01
	AKNB							
Sheepshead	UB						0.33	0.03
	LB						0.22	0.02
	AKNB							
Silver hake	UB							
	LB					0.17	1.00	0.13
	AKNB	0.63				0.28		0.12
Smallmouth flounder	UB					0.17	0.33	0.07
	LB		0.11	0.06	0.06	0.17	0.11	0.09
	AKNB						1.25	0.13
Spotted hake	UB					0.17	1.33	0.17
	LB	0.11	0.06		0.11	2.06	3.00	0.76
	AKNB							
Striped killifish	UB							
	LB							
	AKNB							
Striped searobin	UB							
	LB						0.11	0.01
	AKNB							
Tautog	UB					0.33		0.07
	LB							
	AKNB				0.28			0.06
Threespine stickleback	UB							
	LB							
	AKNB							
White mullet	UB	0.33						0.03
	LB							

Species	Region	Dec	Jan	Feb	Mar	Apr	May	Average
	AKNB	4.38						0.44
White perch	UB	7.67						0.77
	LB							

Table 3-5. Total number of viable eggs, yolk-sac, post yolk-sac, juveniles and unidentified larval stage collected by region at all stations during ichthyoplankton sampling for the 2009 Aquatic Biological Survey.

Common Name	Life Stage	Region			Grand Total
		AKNB	UB	LB	
Essential Fish Habitat Species					
Atlantic cod	Egg			1	1
	Yolk-sac				
	Post yolk-sac				
	Unidentified larvae				
	Juvenile			2	2
	Total			3	3
Summer flounder	Egg				
	Yolk-sac				
	Post yolk-sac	10	19	13	42
	Unidentified larvae				
	Juvenile				
	Total	10	19	13	42
Windowpane	Egg	151	1,557	6,979	8,687
	Yolk-sac	1		5	6
	Post yolk-sac	6	47	401	454
	Unidentified larvae				
	Juvenile				
	Total	158	1,604	7,385	9,147
Winter flounder	Egg	6	68	137	211
	Yolk-sac	36	130	251	417
	Post yolk-sac	436	982	5,292	6,710
	Unidentified larvae	5	32	131	168
	Juvenile				
	Total	483	1,212	5,809	7,504
Sub Total Essential Fish Habitat Species Total		651	2,835	13,211	16,697
Important Non-EFH Species					
Atlantic menhaden	Egg	273	1,796	1,254	3,323
	Yolk-sac	3	3	1	7
	Post yolk-sac	23	20	4	47
	Unidentified larvae				
	Juvenile				
	Total	299	1,819	1,259	3,377
Sub Total Important Non-EFH Species		299	1,819	1,259	3,377

Common Name	Life Stage	Region			Grand Total
		AKNB	UB	LB	
Other Species					
American sandlance	Egg				
	Yolk-sac			4	4
	Post yolk-sac	5	10	34	49
	Unidentified larvae				
	Juvenile				
	Total	5	10	38	53
Atlantic croaker	Egg				
	Yolk-sac				
	Post yolk-sac	17	3		20
	Unidentified larvae				
	Juvenile	3			3
	Total	20	3		23
Atlantic silverside	Egg				
	Yolk-sac				
	Post yolk-sac	2		1	3
	Unidentified larvae				
	Juvenile				
	Total	2		1	3
Atlantic tomcod	Egg				
	Yolk-sac				
	Post yolk-sac	6			6
	Unidentified larvae				
	Juvenile		1		1
	Total	6	1		7
Bay anchovy	Egg	9,220	10,804	122,477	142,500
	Yolk-sac	272			272
	Post yolk-sac	342	51	1,147	1,540
	Unidentified larvae				
	Juvenile	15	2		17
	Total	9,849	10,857	123,624	144,329
Clupeid unidentified	Egg				
	Yolk-sac				
	Post yolk-sac				
	Unidentified larvae	16	1		17
	Juvenile				
	Total	16	1		17

Common Name	Life Stage	Region			Grand Total
		AKNB	UB	LB	
Cods and Haddocks	Egg	20	127	976	1,124
	Yolk-sac				
	Post yolk-sac				
	Unidentified larvae				
	Juvenile				
	Total	20	127	976	1,124
Conger eel	Egg				
	Yolk-sac				
	Post yolk-sac			2	2
	Unidentified larvae				
	Juvenile				
	Total			2	2
Cunner	Egg				
	Yolk-sac	1			1
	Post yolk-sac			2	2
	Unidentified larvae	1			1
	Juvenile				
	Total	2		2	4
Feather blenny	Egg				
	Yolk-sac		1	1	2
	Post yolk-sac	1		1	2
	Unidentified larvae				
	Juvenile				
	Total	1	1	2	4
Fourbeard rockling	Egg	5	25	9	39
	Yolk-sac				
	Post yolk-sac			1	1
	Unidentified larvae				
	Juvenile				
	Total	5	25	10	40
Gobies	Egg				
	Yolk-sac			2	2
	Post yolk-sac	286	5	47	338
	Unidentified larvae				
	Juvenile				
	Total	286	5	49	340
Goosefish	Egg		8	2	10
	Yolk-sac				
	Post yolk-sac				

Common Name	Life Stage	Region			Grand Total
		AKNB	UB	LB	
Goosefish	Unidentified larvae				
	Juvenile				
	Total		8	2	10
Grubby	Egg				
	Yolk-sac	29	16	23	68
	Post yolk-sac	463	359	870	1,692
	Unidentified larvae				
	Juvenile			3	3
	Total	492	375	896	1,763
Northern pipefish	Egg				
	Yolk-sac				
	Post yolk-sac	55	38	74	167
	Unidentified larvae				
	Juvenile		3		3
	Total	55	41	74	170
Northern puffer	Egg				
	Yolk-sac				
	Post yolk-sac			1	1
	Unidentified larvae				
	Juvenile				
	Total			1	1
Radiated shanny	Egg				
	Yolk-sac				
	Post yolk-sac		1		1
	Unidentified larvae				
	Juvenile				
	Total		1		1
Rock gunnel	Egg				
	Yolk-sac			1	1
	Post yolk-sac	18	33	117	168
	Unidentified larvae				
	Juvenile				
	Total	18	33	118	169
Sea raven	Egg				
	Yolk-sac			1	1
	Post yolk-sac				
	Unidentified larvae				
	Juvenile				
	Total			1	1

Common Name	Life Stage	Region			Grand Total
		AKNB	UB	LB	
Searobin species	Egg	1	124	1,666	1,790
	Yolk-sac				
	Post yolk-sac				
	Unidentified larvae				
	Juvenile				
	Total	1	124	1,666	1,790
Tautog	Egg				
	Yolk-sac				
	Post yolk-sac	30	2	7	39
	Unidentified larvae	3		1	4
	Juvenile				
	Total	33	2	8	43
Weakfish	Egg	15		491	506
	Yolk-sac				
	Post yolk-sac	5	1		6
	Unidentified larvae				
	Juvenile				
	Total	20	1	491	512
Wrasses	Egg	3,848	3,970	8,357	16,176
	Yolk-sac				
	Post yolk-sac				
	Unidentified larvae		1		1
	Juvenile				
	Total	3,848	3,971	8,357	16,177
Sub Total Other Species		14,679	15,586	136,319	166,584
Egg Total		13,539	18,480	142,349	174,368
Yolk-sac Total		342	150	289	781
Post Yolk sac Total		1,705	1,571	8,015	11,291
Unidentified Larval Stage Total		25	34	132	191
Juvenile Total		18	6	5	29
Grand Total		**15,629**	**20,241**	**150,788**	**186,658**

Table 3-6 a. Monthly average egg density (number/1,000m^3) by species for channel stations and non-channel stations in Arthur Kill/Newark Bay (AKNB), Upper Bay (UB), and Lower Bay (LB) during ichthyoplankton sampling for the 2009 Aquatic Biological Survey.

				Channel Stations				
Species	**Region**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Average**
Essential Fish Habitat Species								
Atlantic cod	AKNB							
	UB							
	LB							
Windowpane	AKNB				11.16	98.14		18.22
	UB				18.94	679.31	660.45	220.33
	LB				110.57	850.55	1,423.90	397.50
Winter flounder	AKNB							
	UB		1.31	7.00	7.09			2.50
	LB			3.93	4.42			1.39
Important Non-EFH Species								
Atlantic menhaden	AKNB					0.88	233.37	39.04
	UB					3.15	1,659.13	269.56
	LB					39.25	313.67	58.82
Other Species								
Bay anchovy	AKNB						7,087.75	1,181.29
	UB					6.49	8,123.97	1,318.45
	LB					51.72	20,437.04	3,414.79
Cods and Haddocks	AKNB				1.12	13.56		2.45
	UB		0.91	3.09			140.75	23.47
	LB		1.82	1.82	7.38	20.27	258.46	48.29
Fourbeard rockling	AKNB				5.58			0.93
	UB				17.00			2.76
	LB				1.49			0.25
Goosefish	AKNB							
	UB					5.53		0.90
	LB					1.72		0.29
Searobin species	AKNB						1.20	0.20
	UB					20.25	137.79	25.63
	LB					185.59	304.26	81.64
Weakfish	AKNB						17.97	2.99
	UB							
	LB						489.37	81.56

Channel Stations								
Species	**Region**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Average**
Wrasses	AKNB					196.09	3,736.02	655.35
	UB					297.85	3,425.21	603.74
	LB					655.87	1,783.35	406.54

Non-Channel Stations								
Species	**Region**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Average**
Essential Fish Habitat Species								
Atlantic cod	AKNB							
	UB							
	LB			0.48				0.08
Windowpane	AKNB					3.61		0.60
	UB				4.40	52.60	34.46	15.24
	LB				27.34	800.62	489.55	219.58
Winter flounder	AKNB			7.17				1.20
	UB		43.83	8.72	0.71			8.88
	LB		0.36	37.79	2.28			6.74
Important Non-EFH Species								
Atlantic menhaden	AKNB						47.87	7.98
	UB					1.89	167.91	28.30
	LB					68.54	178.11	41.11
Other Species								
Bay anchovy	AKNB					1.28	2,779.18	463.41
	UB						3,850.17	641.69
	LB					82.14	33,623.71	5,617.64
Cods and Haddocks	AKNB					2.41		0.40
	UB			1.87	1.43			0.55
	LB				7.38	9.20	211.91	38.08
Fourbeard rockling	AKNB							
	UB				9.65			1.61
	LB				0.79	1.48		0.38
Goosefish	AKNB							
	UB							
	LB							
Searobin species	AKNB							
	UB							
	LB					65.80	339.73	67.59
Weakfish	AKNB							
	UB							
	LB							

Non-Channel Stations								
Species	**Region**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Average**
Wrasses	AKNB					48.73	567.55	102.71
	UB					194.28	724.21	153.08
	LB					277.75	1,626.60	317.39

Table 3-6 b. Monthly average yolk-sac larval density (number/1,000m^3) by species for channel stations and non-channel stations in Arthur Kill/Newark Bay (AKNB), Upper Bay (UB), and Lower Bay (LB) during ichthyoplankton sampling for the 2009 Aquatic Biological Survey.

Channel Stations								
Species	**Region**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Average**
Essential Fish Habitat Species								
Windowpane	AKNB					0.84		0.14
	UB							
	LB							
Winter flounder	AKNB		5.60	5.16	8.54			3.22
	UB			40.33	0.60			6.64
	LB		5.06	97.23				17.05
Important Non-EFH Species								
Atlantic menhaden	AKNB						2.98	0.50
	UB						3.05	0.49
	LB						0.57	0.09
Other Species								
American sandlance	AKNB							
	UB							
	LB		1.85					0.31
Bay anchovy	AKNB						2.42	0.40
	UB							
	LB							
Cunner	AKNB						0.97	0.16
	UB							
	LB							
Feather blenny	AKNB							
	UB							
	LB							
Gobies	AKNB							
	UB							
	LB							
Grubby	AKNB		3.16	2.85	13.85			3.31
	UB			1.95	2.04			0.65
	LB				2.61			0.44
Rock gunnel	AKNB							
	UB							
	LB							

Channel Stations								
Species	**Region**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Average**
Sea raven	AKNB							
	UB							
	LB							

Non-Channel Stations								
Species	**Region**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Average**
Essential Fish Habitat Species								
Windowpane	AKNB							
	UB							
	LB					0.93	0.65	0.26
Winter flounder	AKNB		5.83	14.97	1.66			3.74
	UB			60.65	6.01			11.11
	LB		6.48	49.07	0.93			9.41
Important Non-EFH Species								
Atlantic menhaden	AKNB							
	UB							
	LB							
Other Species								
American sandlance	AKNB							
	UB							
	LB		0.36					0.06
Bay anchovy	AKNB						370.53	61.75
	UB							
	LB							
Cunner	AKNB							
	UB							
	LB							
Feather blenny	AKNB							
	UB					0.94		0.16
	LB					0.36		0.06
Gobies	AKNB							
	UB							
	LB				0.56			0.09
Grubby	AKNB		1.28	3.83	1.38			1.08
	UB			5.52	4.82			1.72
	LB			2.14	4.13			1.05
Rock gunnel	AKNB							
	UB							
	LB	0.34						0.06

Non-Channel Stations								
Species	**Region**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Average**
	AKNB							
Sea raven	UB							
	LB		0.28					0.05

Table 3-6 c. Monthly average post-yolk sac larval density (number/1,000m^3) by species for channel stations and non-channel stations in Arthur Kill/Newark Bay (AKNB), Upper Bay (UB), and Lower Bay (LB) during ichthyoplankton sampling for the 2009 Aquatic Biological Survey.

Channel Stations								
Species	**Region**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Average**
Essential Fish Habitat Species								
	AKNB	5.12	0.83	1.65		0.88		1.41
Summer flounder	UB	6.94	7.30					2.50
	LB	2.50	1.69	2.56	1.49			1.37
	AKNB					1.32	0.82	0.36
Windowpane	UB					26.22	12.89	6.34
	LB					37.64	19.06	9.45
	AKNB		3.19		140.86	103.58		41.27
Winter flounder	UB		1.03	16.80	323.92	68.70		66.56
	LB		0.73	57.67	475.90	486.29		170.10
Important Non-EFH Species								
	AKNB					1.32	20.60	3.65
Atlantic menhaden	UB	0.64			1.02		8.15	1.61
	LB	0.82						0.14
Other Species								
	AKNB	0.69	0.75	0.94				0.40
American sandlance	UB			3.91				0.63
	LB	1.65	2.36	3.95	2.20			1.70
	AKNB	16.46						2.74
Atlantic croaker	UB	1.13						0.21
	LB							
	AKNB					0.87	0.99	0.31
Atlantic silverside	UB							
	LB							
	AKNB			5.36				0.89
Atlantic tomcod	UB							
	LB							
	AKNB						254.18	42.36
Bay anchovy	UB						21.43	3.48
	LB						346.96	57.83
	AKNB							
Conger eel	UB							
	LB				0.90	0.72		0.27

				Channel Stations				
Species	**Region**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Average**
Cunner	AKNB							
	UB							
	LB							
Feather blenny	AKNB							
	UB							
	LB							
Fourbeard rockling	AKNB							
	UB							
	LB					0.74		0.12
Gobies	AKNB						54.01	9.00
	UB							
	LB						1.83	0.31
Grubby	AKNB		21.20	81.19	214.80	15.48		55.44
	UB		9.02	54.56	124.97	2.36		30.96
	LB		4.04	61.62	111.39	25.12		33.69
Northern pipefish	AKNB						15.68	2.61
	UB						17.28	2.80
	LB						17.97	3.00
Northern puffer	AKNB							
	UB							
	LB							
Radiated shanny	AKNB							
	UB					0.62		0.10
	LB							
Rock gunnel	AKNB		7.37	1.81	0.99			1.70
	UB		9.96	7.86	2.38			3.28
	LB	1.51	4.63	15.18	3.05			4.06
Tautog	AKNB						32.95	5.49
	UB						1.28	0.21
	LB						0.60	0.10
Weakfish	AKNB						5.59	0.93
	UB						1.42	0.23
	LB							

Non-Channel Stations								
Species	**Region**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Average**
Essential Fish Habitat Species								
Summer flounder	AKNB			1.35				0.22
	UB	1.72						0.29
	LB		0.30	2.07				0.40
Windowpane	AKNB					1.58	3.18	0.79
	UB						3.50	0.58
	LB					74.05	31.38	17.57
Winter flounder	AKNB		2.92	17.66	219.15	2.78		40.42
	UB			16.34	279.87	26.84		53.84
	LB		4.07	48.18	798.96	232.36		180.59
Important Non-EFH Species								
Atlantic menhaden	AKNB							
	UB		1.87	0.56	0.71	1.70	2.57	1.23
	LB		0.36				0.56	0.15
Other Species								
American sandlance	AKNB	1.03		1.60				0.44
	UB		1.28	2.18				0.58
	LB	0.40	3.95	1.96	1.48			1.30
Atlantic croaker	AKNB	1.03						0.17
	UB	0.63						0.11
	LB							
Atlantic silverside	AKNB							
	UB							
	LB						0.33	0.06
Atlantic tomcod	AKNB							
	UB							
	LB							
Bay anchovy	AKNB						186.69	31.11
	UB	0.63					26.40	4.50
	LB						254.21	42.37
Conger eel	AKNB							
	UB							
	LB							
Cunner	AKNB							
	UB							
	LB						0.77	0.13

Non-Channel Stations								
Species	**Region**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Average**
	AKNB				1.66			0.28
Feather blenny	UB							
	LB					0.32		0.05
	AKNB							
Fourbeard rockling	UB							
	LB							
	AKNB						326.61	54.43
Gobies	UB						4.67	0.78
	LB			15.36	2.54		1.12	3.17
	AKNB		4.13	55.10	40.74			16.66
Grubby	UB	1.05	2.78	61.66	67.99			22.25
	LB		3.48	73.96	103.98	20.80		33.70
	AKNB						53.95	8.99
Northern pipefish	UB						24.20	4.03
	LB						16.64	2.77
	AKNB							
Northern puffer	UB							
	LB						0.26	0.04
	AKNB							
Radiated shanny	UB							
	LB							
	AKNB		6.63	1.12				1.29
Rock gunnel	UB		7.07	1.71	1.43			1.70
	LB	2.92	14.84	16.43	2.23			6.07
	AKNB						3.38	0.56
Tautog	UB						0.91	0.15
	LB						2.18	0.36
	AKNB							
Weakfish	UB							
	LB							

Table 3-6 d. Monthly average juvenile density (number/1,000m^3) by species for channel stations and non-channel stations in Arthur Kill/Newark Bay (AKNB), Upper Bay (UB), and Lower Bay (LB) during ichthyoplankton sampling for the 2009 Aquatic Biological Survey.

Channel Stations

Species	Region	Jan	Feb	Mar	Apr	May	June	Average
Essential Fish Habitat Species								
Atlantic cod	AKNB							
	UB							
	LB							
Other Species								
Atlantic croaker	AKNB	2.94						0.49
	UB							
	LB							
Atlantic tomcod	AKNB							
	UB							
	LB							
Bay anchovy	AKNB	14.42						2.40
	UB	0.99						0.19
	LB							
Grubby	AKNB							
	UB							
	LB				1.34			0.22
Northern pipefish	AKNB							
	UB		0.91					0.15
	LB							

Non-Channel Stations

Species	Region	Jan	Feb	Mar	Apr	May	June	Average
Essential Fish Habitat Species								
Atlantic cod	AKNB							
	UB							
	LB				0.72			0.12
Other Species								
Atlantic croaker	AKNB							
	UB							
	LB							
Atlantic tomcod	AKNB							
	UB					0.85		0.14
	LB							

Non-Channel Stations								
Species	**Region**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Average**
Bay anchovy	AKNB							
	UB	0.86						0.14
	LB							
Grubby	AKNB							
	UB							
	LB				0.43			0.07
Northern pipefish	AKNB							
	UB						2.01	0.34
	LB							

Table 3-7. Winter flounder gender determination analysis for the 2009 Aquatic Biological Survey.

#	Sample Date	Station	Station Type	TL (mm)	Weight (g)	Sex	Comments
1	12/16/2008	AK-2	Channel	299	310.7	M	Brought Back; Ripe
2	12/16/2008	PJ-1	Non-channel	296	331.9	F	Brought Back; Partially spent
3	1/7/2009	AK-3	Channel	281		M	Thrown Back; Ripe
4	1/21/2009	SB-6	Channel	272	239.4	F	Brought Back; Partially spent
5	2/5/2009	AK-2	Channel	318		M	Thrown Back
6	2/5/2009	NB-8	Channel	339		F	Thrown Back
7	2/17/2009	LB-4	Channel	333		M	Thrown Back; Ripe
8	2/17/2009	LB-4	Channel	240		M	Thrown Back; Ripe
9	2/17/2009	LB-12	Non-channel	250		M	Thrown Back; Ripe
10	2/17/2009	LB-12	Non-channel	262		M	Thrown Back; Ripe
11	3/16/2009	SB-5	Channel	260	155.8	F	Brought Back; Partially spent
12	4/9/2009	PJ-1	Non-channel	253	182.5	F	Brought Back; Spent
13	4/10/2009	SB-5	Channel	370	517.8	F	Brought Back; Spent
14	4/10/2009	SB-5	Channel	315	347.4	F	Brought Back; Spent
15	4/10/2009	SB-5	Channel	296	277.9	F	Brought Back; Spent
16	4/10/2009	SB-5	Channel	250	165.3	M	Brought Back; Spent
17	4/10/2009	SB-5	Channel	257	177.4	M	Brought Back; Spent
18	4/21/2009	LB-13	Non-channel	343	446.7	F	Brought Back; Spent
19	4/23/2009	PJ-1	Non-channel	321	383.2	M	Brought Back; Spent
20	5/7/2009	PJ-2	Non-channel	379	564.4	F	Brought Back; Spent
21	5/7/2009	SB-5	Channel	333	424.1	UND	Brought Back; Spent (Undetermined sex due to visceral decomposition)
22	5/7/2009	SB-6	Channel	279	242.2	M	Brought Back; Spent
23	5/7/2009	SB-6	Channel	295	343.4	F	Brought Back; Spent

Averages			
Upper Bay Average	Male	277	242.0
	Female	304	328.9
Lower Bay Average	Male	271	--
	Female	343	446.7
Arthur Kill / Newark Bay	Male	299	310.7
	Female	339	--
Overall Average	Male	281	255.8
	Female	311	340.7

Table 4-1. Winter Flounder annual bottom trawl abundance (CPUE).

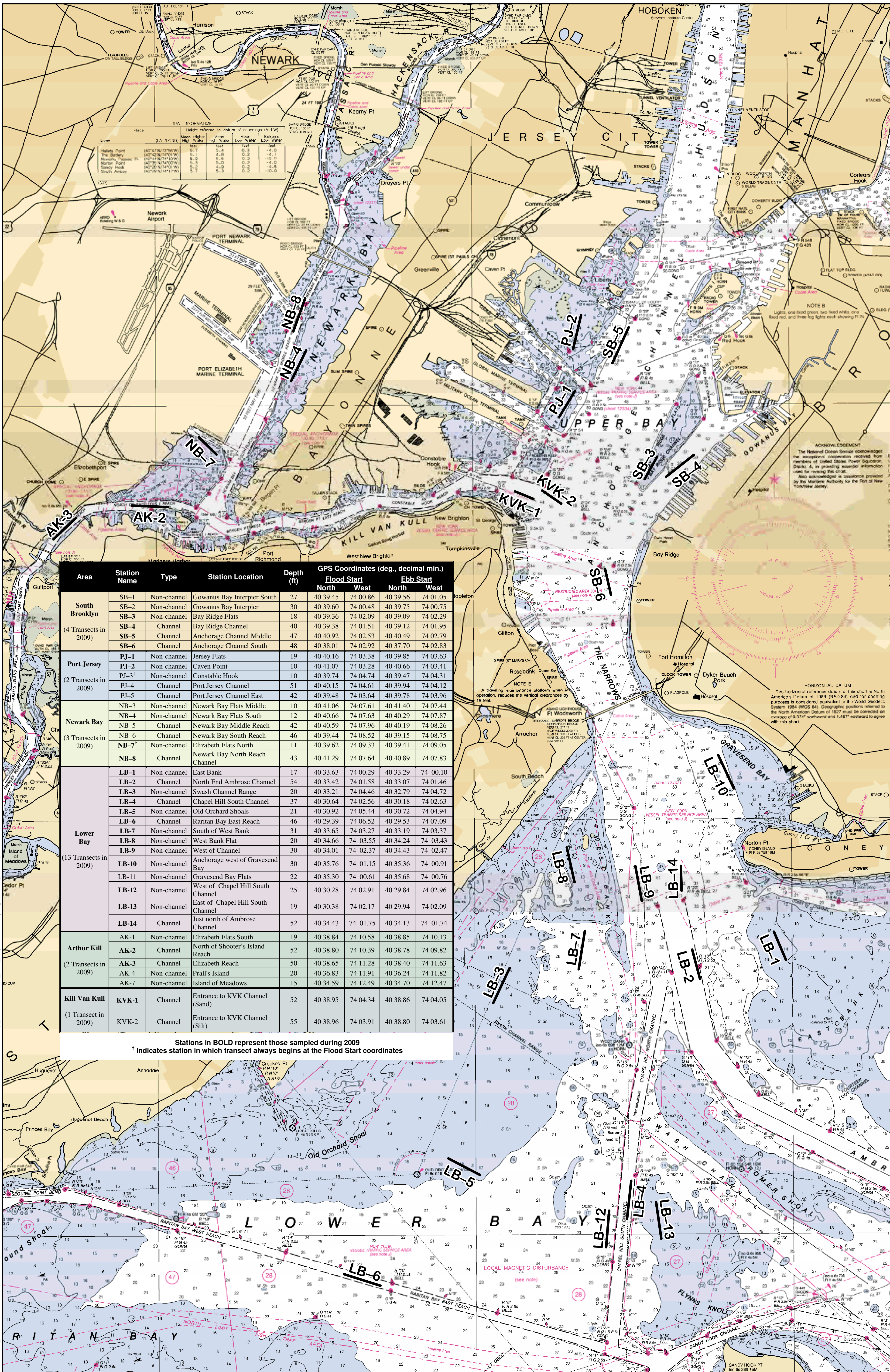
Year	Region	Number of Tows	Average CPUE	Standard Deviation	Proportion of Zeros	Coefficient of Variance	95% Confidence Interval
2002	AKNB	89	3.49	8.13	0.45	2.331	± 1.713
2002	LB	56	3.79	7.22	0.46	1.904	± 1.932
2002	UB	110	3.43	6.88	0.43	2.003	± 1.300
Total 2002		**255**	**3.53**	**7.38**	**0.44**	**2.091**	**± 0.910**
2003	AKNB	89	2.02	4.02	0.44	1.994	± 0.847
2003	HR	8	20.42	53.82	0.75	2.636	± 44.995
2003	LB	60	1.13	2.68	0.68	2.362	± 0.692
2003	UB	109	2.71	5.34	0.53	1.970	± 1.014
Total 2003		**266**	**2.66**	**10.26**	**0.54**	**3.865**	**± 1.239**
2004	AKNB	64	3.59	5.68	0.39	1.579	± 1.418
2004	HR	16	0.93	3.45	0.88	3.709	± 1.841
2004	LB	47	1.93	3.99	0.51	2.065	± 1.171
2004	UB	82	3.91	10.21	0.59	2.611	± 2.243
Total 2004		**209**	**3.14**	**7.47**	**0.53**	**2.377**	**± 1.018**
2005	AKNB	64	0.76	1.62	0.67	2.130	± 0.403
2005	LB	54	4.74	22.99	0.76	4.849	± 6.275
2005	UB	90	1.70	7.79	0.79	4.587	± 1.632
Total 2005		**208**	**2.20**	**12.83**	**0.75**	**5.835**	**± 1.754**
2006	AKNB	61	0.82	2.06	0.72	2.516	± 0.528
2006	LB	54	0.61	1.86	0.81	3.039	± 0.507
2006	UB	98	2.08	3.99	0.56	1.914	± 0.800
Total 2006		**213**	**1.35**	**3.13**	**0.67**	**2.323**	**± 0.423**
2007	AKNB	63	1.13	2.37	0.65	2.096	± 0.596
2007	LB	54	0.87	3.05	0.78	3.508	± 0.833
2007	UB	95	3.39	7.53	0.49	2.222	± 1.534
Total 2007		**212**	**2.08**	**5.54**	**0.61**	**2.668**	**± 0.750**
2008	AKNB	32	13.37	25.74	0.47	1.925	± 9.280
2008	LB	109	1.51	4.85	0.64	3.206	± 0.921
2008	UB	62	3.57	6.98	0.45	1.957	± 1.773
Total 2008		**203**	**4.01**	**12.10**	**0.56**	**3.016**	**± 1.674**
2009	AKNB	50	4.03	7.95	0.46	1.973	± 2.260
2009	LB	130	0.40	1.10	0.81	2.742	± 0.190
2009	UB	60	3.02	8.03	0.63	2.663	± 2.076
Total 2009		**240**	**1.81**	**5.66**	**0.69**	**3.126**	**± 0.720**

Table 4-2. Winter Flounder annual egg density (number/1,000m³).

Year	Life Stage	Region	Number of Tows	Average Density	Standard Deviation	Proportion of Zeros	Coefficient of Variance	95% Confidence Interval
2002	Egg	AKNB	107	0.27	2.67	0.98	9.978	± 0.458
2002	Egg	LB	72	5.34	25.08	0.83	4.696	± 4.784
2002	Egg	UB	132	1.16	9.73	0.95	8.361	± 1.378
Total 2002		**Egg**	**311**	**1.93**	**14.26**	**0.93**	**7.401**	**± 1.344**
2003	Egg	AKNB	108	0.22	1.40	0.97	6.236	± 0.267
2003	Egg	LB	72	30.93	159.28	0.78	5.150	± 37.429
2003	Egg	UB	159	10.15	84.33	0.91	8.308	± 13.209
Total 2003		**Egg**	**339**	**11.40**	**93.68**	**0.90**	**8.217**	**± 10.008**
2004	Egg	HR	12	2.00	6.94	0.92	3.464	± 4.407
2004	Egg	AKNB	107	0.18	1.06	0.97	5.961	± 0.204
2004	Egg	LB	72	2.54	6.87	0.82	2.710	± 1.615
2004	Egg	UB	136	0.11	1.28	0.99	11.916	± 0.213
Total 2004		**Egg**	**327**	**0.72**	**3.71**	**0.95**	**5.130**	**± 0.400**
2005	Egg	AKNB	108	0.28	2.32	0.98	8.191	± 0.442
2005	Egg	LB	78	0.55	3.13	0.96	5.712	± 0.705
2005	Egg	UB	140	2.15	15.51	0.91	7.217	± 2.582
Total 2005		**Egg**	**326**	**1.15**	**10.40**	**0.95**	**9.037**	**± 1.131**
2006	Egg	AKNB	78	0.12	1.09	0.99	8.888	± 0.244
2006	Egg	LB	72	0.18	1.50	0.99	8.485	± 0.353
2006	Egg	UB	132	3.27	20.50	0.93	6.269	± 3.529
Total 2006		**Egg**	**282**	**1.60**	**14.09**	**0.96**	**8.782**	**± 1.649**
2007	Egg	AKNB	84	0.41	3.19	0.98	7.739	± 0.688
2007	Egg	LB	72	20.68	134.17	0.90	6.488	± 31.528
2007	Egg	UB	130	24.63	120.23	0.89	4.882	± 20.702
Total 2007		**Egg**	**286**	**16.52**	**105.49**	**0.92**	**6.385**	**± 12.213**
2008	Egg	AKNB	48	2.86	18.80	0.96	6.580	± 5.458
2008	Egg	LB	160	0.14	1.06	0.98	7.506	± 0.165
2008	Egg	UB	106	16.32	147.77	0.94	9.056	± 28.458
Total 2008		**Egg**	**314**	**6.02**	**86.22**	**0.96**	**14.330**	**± 9.573**
2009	Egg	AKNB	60	0.48	2.98	0.97	6.236	± 0.770
2009	Egg	LB	156	5.14	41.12	0.90	7.998	± 6.503
2009	Egg	UB	73	5.64	31.69	0.89	5.614	± 7.393
Total 2009		**Egg**	**289**	**4.30**	**34.16**	**0.91**	**7.943**	**± 3.955**

Table 4-3. Winter Flounder annual larvae density (number/1,000m³).

Year	Life Stage	Region	Number of Tows	Average Density	Standard Deviation	Proportion of Zeros	Coefficient of Variance	95% Confidence Interval
2002	Larvae	AKNB	107	30.72	48.31	0.45	1.573	± 8.286
2002	Larvae	LB	72	199.51	397.06	0.39	1.990	± 75.741
2002	Larvae	UB	132	68.22	128.88	0.36	1.889	± 18.250
Total 2002		**Larvae**	**311**	**89.35**	**226.36**	**0.40**	**2.533**	**± 21.331**
2003	Larvae	AKNB	108	76.00	221.36	0.60	2.913	± 42.226
2003	Larvae	LB	72	379.97	1058.92	0.61	2.787	± 248.834
2003	Larvae	UB	159	123.83	330.49	0.56	2.669	± 51.767
Total 2003		**Larvae**	**339**	**162.99**	**561.50**	**0.58**	**3.445**	**± 59.987**
2004	Larvae	HR	12	60.62	139.96	0.75	2.309	± 88.925
2004	Larvae	AKNB	107	88.76	310.87	0.62	3.502	± 59.582
2004	Larvae	LB	72	463.45	1262.09	0.67	2.723	± 296.577
2004	Larvae	UB	136	126.87	318.10	0.66	2.507	± 52.774
Total 2004		**Larvae**	**327**	**185.01**	**661.01**	**0.65**	**3.573**	**± 71.255**
2005	Larvae	AKNB	108	17.47	56.21	0.68	3.217	± 10.722
2005	Larvae	LB	78	59.55	194.93	0.63	3.273	± 43.950
2005	Larvae	UB	140	35.64	95.60	0.65	2.682	± 15.917
Total 2005		**Larvae**	**326**	**35.35**	**119.09**	**0.65**	**3.369**	**± 12.956**
2006	Larvae	AKNB	78	10.29	23.69	0.66	2.301	± 5.306
2006	Larvae	LB	72	111.28	334.45	0.54	3.006	± 78.593
2006	Larvae	UB	132	34.78	96.94	0.61	2.787	± 16.692
Total 2006		**Larvae**	**282**	**47.41**	**184.90**	**0.60**	**3.900**	**± 21.635**
2007	Larvae	AKNB	84	90.75	258.13	0.51	2.845	± 55.678
2007	Larvae	LB	72	1077.41	5408.74	0.35	5.020	± 1270.992
2007	Larvae	UB	130	165.22	456.46	0.46	2.763	± 78.596
Total 2007		**Larvae**	**286**	**370.57**	**2737.44**	**0.45**	**7.387**	**± 316.937**
2008	Larvae	AKNB	48	19.48	51.22	0.58	2.630	± 14.873
2008	Larvae	LB	160	180.52	425.01	0.48	2.354	± 66.359
2008	Larvae	UB	106	57.89	189.76	0.58	3.278	± 36.546
Total 2008		**Larvae**	**314**	**114.51**	**330.05**	**0.53**	**2.882**	**± 36.647**
2009	Larvae	AKNB	60	44.83	104.70	0.55	2.336	± 27.047
2009	Larvae	LB	156	193.69	516.53	0.49	2.667	± 81.694
2009	Larvae	UB	73	70.83	134.07	0.56	1.893	± 31.280
Total 2009		**Larvae**	**289**	**131.75**	**393.61**	**0.52**	**2.988**	**± 45.571**



Area	Station Name	Type	Station Location	Depth (ft)	GPS Coordinates (deg., decimal min.)			
					Flood Start		Ebb Start	
					North	West	North	West
South Brooklyn (4 Transects in 2009)	SB–1	Non-channel	Gowanus Bay Interpier South	27	40 39.45	74 00.86	40 39.56	74 01.05
	SB–2	Non-channel	Gowanus Bay Interpier	30	40 39.60	74 00.48	40 39.75	74 00.75
	SB–3	Non-channel	Bay Ridge Flats	18	40 39.36	74 02.09	40 39.09	74 02.29
	SB–4	Channel	Bay Ridge Channel	40	40 39.38	74 01.51	40 39.12	74 01.95
	SB–5	Channel	Anchorage Channel Middle	47	40 40.92	74 02.53	40 40.49	74 02.79
	SB–6	Channel	Anchorage Channel South	48	40 38.01	74 02.92	40 37.70	74 02.83
Port Jersey (2 Transects in 2009)	**PJ–1**	Non-channel	Jersey Flats	19	40 40.16	74 03.38	40 39.85	74 03.63
	PJ–2	Non-channel	Caven Point	10	40 41.07	74 03.28	40 40.66	74 03.41
	PJ–3†	Non-channel	Constable Hook	10	40 39.74	74 04.74	40 39.47	74 04.31
	PJ–4	Channel	Port Jersey Channel	51	40 40.15	74 04.61	40 39.94	74 04.12
	PJ–5	Channel	Port Jersey Channel East	42	40 39.48	74 03.64	40 39.78	74 03.96
Newark Bay (3 Transects in 2009)	NB–3	Non-channel	Newark Bay Flats Middle	10	40 41.06	74:07.61	40 41.40	74 07.44
	NB–4	Non-channel	Newark Bay Flats South	12	40 40.66	74 07.63	40 40.29	74 07.87
	NB–5	Channel	Newark Bay Middle Reach	42	40 40.59	74 07.96	40 40.19	74 08.26
	NB–6	Channel	Newark Bay South Reach	46	40 39.44	74 08.52	40 39.15	74 08.75
	NB–7†	Non-channel	Elizabeth Flats North	11	40 39.62	74 09.33	40 39.41	74 09.05
	NB–8	Channel	Newark Bay North Reach Channel	43	40 41.29	74 07.64	40 40.89	74 07.83
Lower Bay (13 Transects in 2009)	**LB–1**	Non-channel	East Bank	17	40 33.63	74 00.29	40 33.29	74 00.10
	LB–2	Channel	North End Ambrose Channel	54	40 33.42	74 01.58	40 33.07	74 01.46
	LB–3	Non-channel	Swash Channel Range	20	40 33.21	74 04.46	40 32.79	74 04.72
	LB–4	Channel	Chapel Hill South Channel	37	40 30.64	74 02.56	40 30.18	74 02.63
	LB–5	Non-channel	Old Orchard Shoals	21	40 30.92	74 05.44	40 30.72	74 04.94
	LB–6	Channel	Raritan Bay East Reach	46	40 29.39	74 06.52	40 29.53	74 07.09
	LB-7	Non-channel	South of West Bank	31	40 33.65	74 03.27	40 33.19	74 03.37
	LB-8	Non-channel	West Bank Flat	20	40 34.66	74 03.55	40 34.24	74 03.43
	LB-9	Non-channel	West of Channel	30	40 34.01	74 02.37	40 34.43	74 02.47
	LB-10	Non-channel	Anchorage west of Gravesend Bay	30	40 35.76	74 01.15	40 35.36	74 00.91
	LB-11	Non-channel	Gravesend Bay Flats	22	40 35.30	74 00.61	40 35.68	74 00.76
	LB-12	Non-channel	West of Chapel Hill South Channel	25	40 30.28	74 02.91	40 29.84	74 02.96
	LB-13	Non-channel	East of Chapel Hill South Channel	19	40 30.38	74 02.17	40 29.94	74 02.09
	LB-14	Channel	Just north of Ambrose Channel	52	40 34.43	74 01.75	40 34.13	74 01.74
Arthur Kill (2 Transects in 2009)	AK-1	Non-channel	Elizabeth Flats South	19	40 38.84	74 10.58	40 38.85	74 10.13
	AK-2	Channel	North of Shooter's Island Reach	52	40 38.80	74 10.39	40 38.78	74 09.82
	AK-3	Channel	Elizabeth Reach	50	40 38.65	74 11.28	40 38.40	74 11.63
	AK-4	Non-channel	Prall's Island	20	40 36.83	74 11.91	40 36.24	74 11.82
	AK-7	Non-channel	Island of Meadows	15	40 34.59	74 12.49	40 34.70	74 12.47
Kill Van Kull (1 Transect in 2009)	**KVK-1**	Channel	Entrance to KVK Channel (Sand)	52	40 38.95	74 04.34	40 38.86	74 04.05
	KVK-2	Channel	Entrance to KVK Channel (Silt)	55	40 38.96	74 03.91	40 38.80	74 03.61

Stations in BOLD represent those sampled during 2009
† Indicates station in which transect always begins at the Flood Start coordinates

Figure 2-1. USACE Aquatic Biological Survey
2009 Transects

0 2,500 5,000 Meters

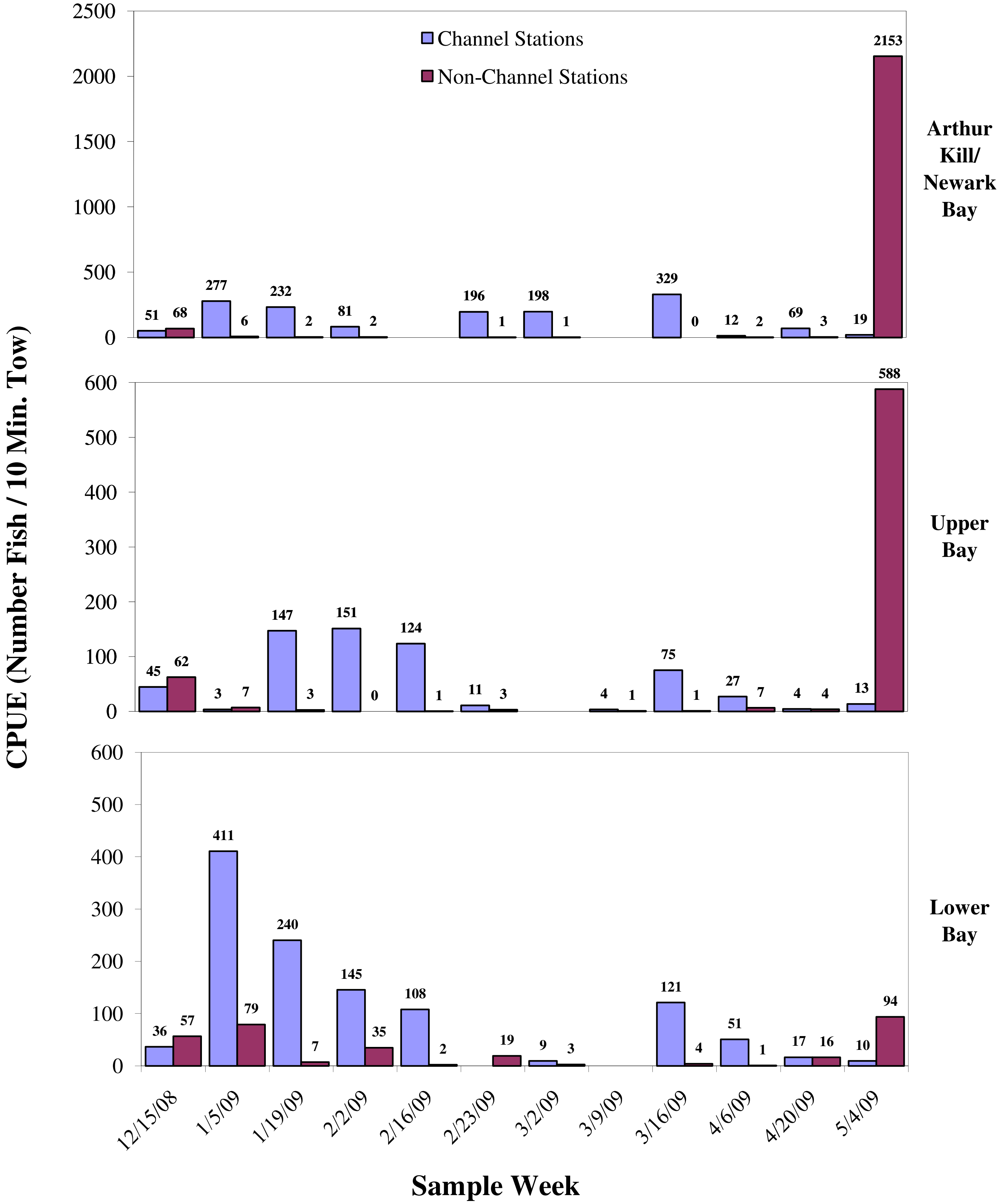


Figure 3-1 **Average weekly bottom trawl CPUE for all fish combined at channel and non-channel stations in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay, 2009 Aquatic Biological Survey.**

Note(s): Dates listed indicate Monday of each sample week.
CPUE does not include blue crab or American lobster

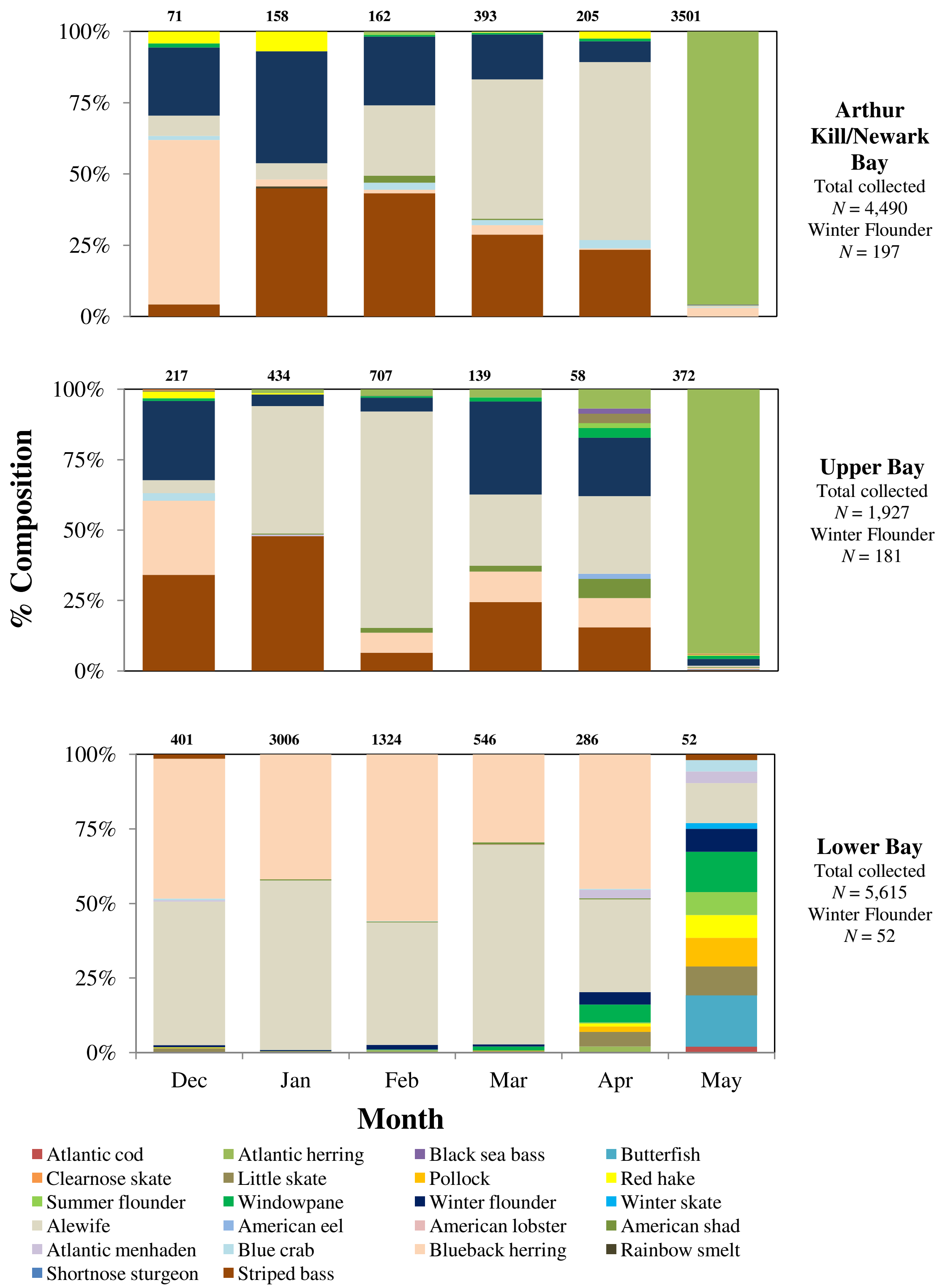


Figure 3-2 **EFH and Important Non-EFH species composition of bottom trawl catches from Arthur Kill/Newark Bay, Upper Bay,and Lower Bay stations during the 2009 Aquatic Biological Survey.**

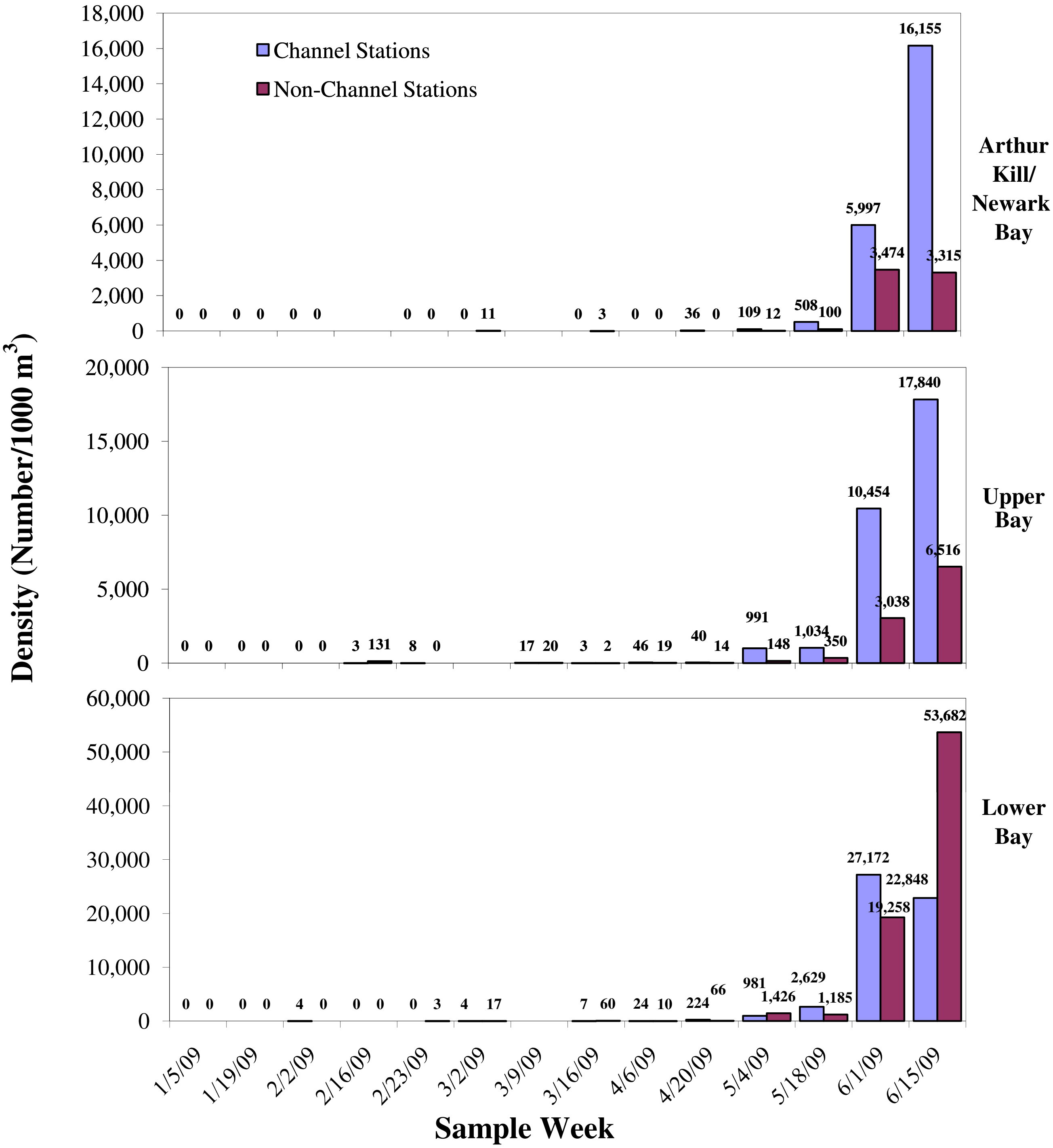


Figure 3-3 **Average weekly viable egg density of all species combined at channel and non-channel stations in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay, 2009 Aquatic Biological Survey.**

Note: Scale change for Lower Bay.
Weeks begin on Monday. Those weeks that are blank were not sampled.

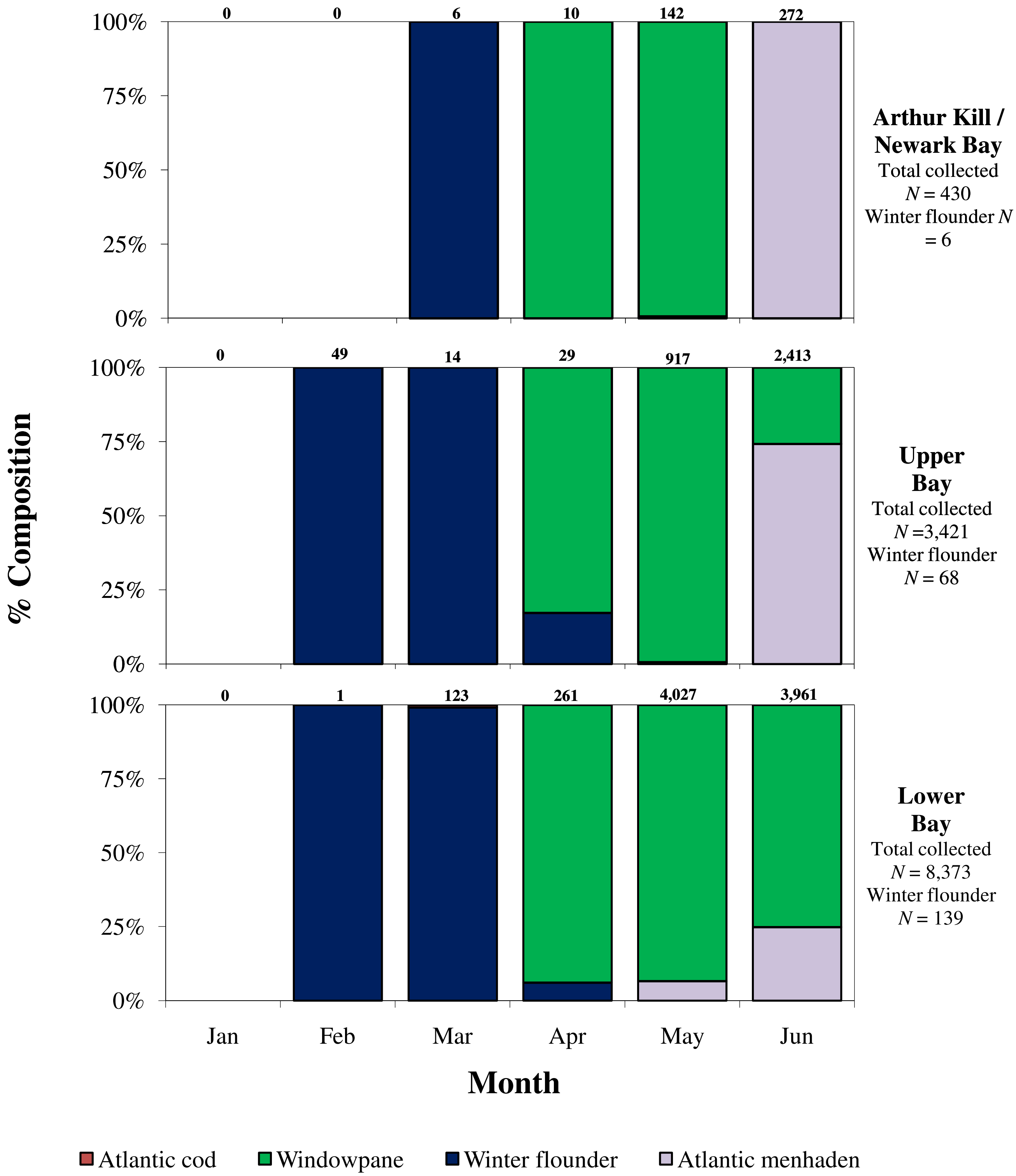


Figure 3-4 **EFH and important Non-EFH species compostion of viable eggs collected at all stations during the 2009 Aquatic Biological Survey.**

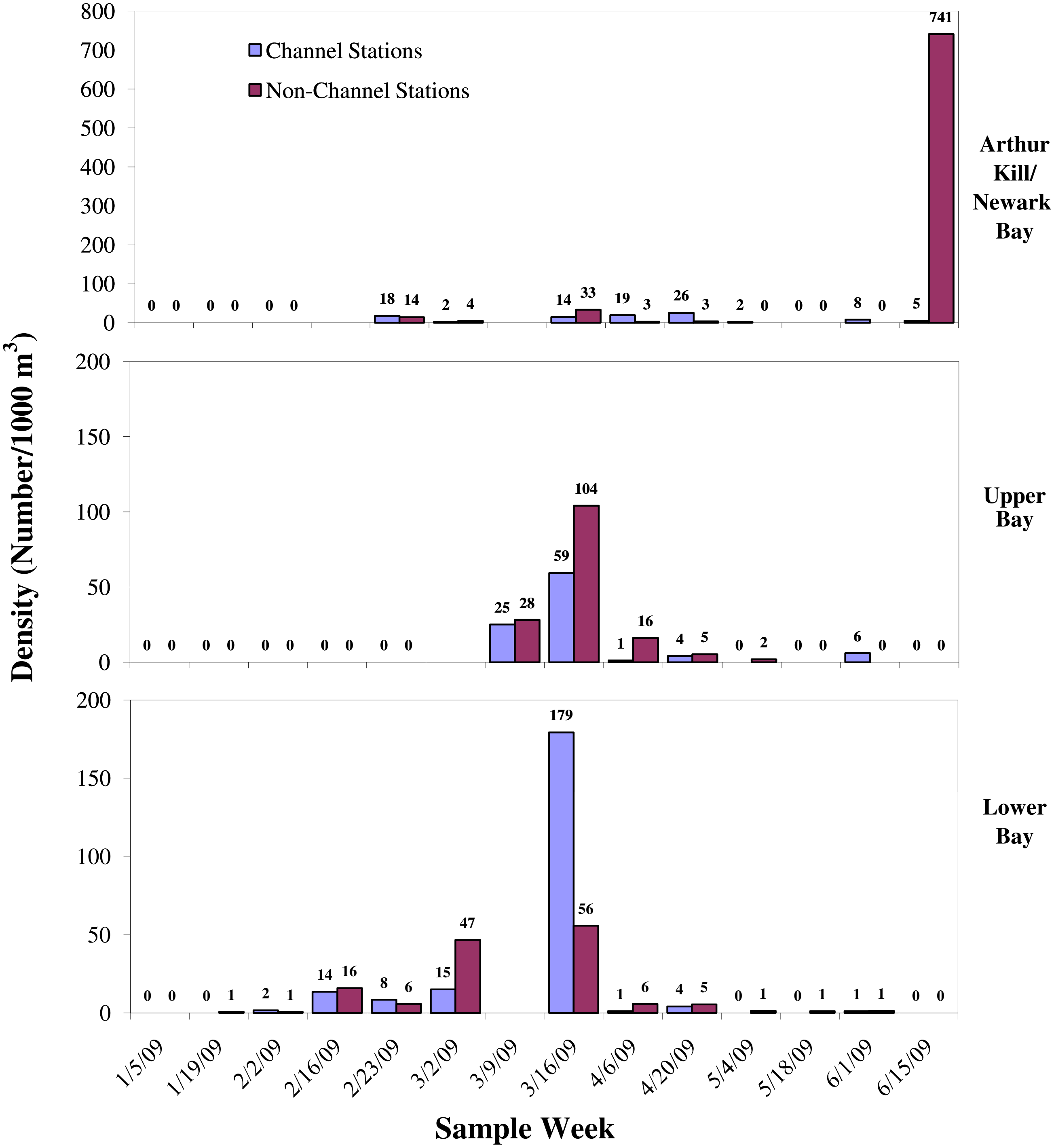


Figure 3-5 **Average weekly yolk-sac larvae density of all species combined at channel and non-channel stations in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay, 2009 Aquatic Biological Survey.**

Note: Scale change for Arthur Kill/Newark Bay.
Weeks begin on Monday. Those weeks that are blank were not sampled.

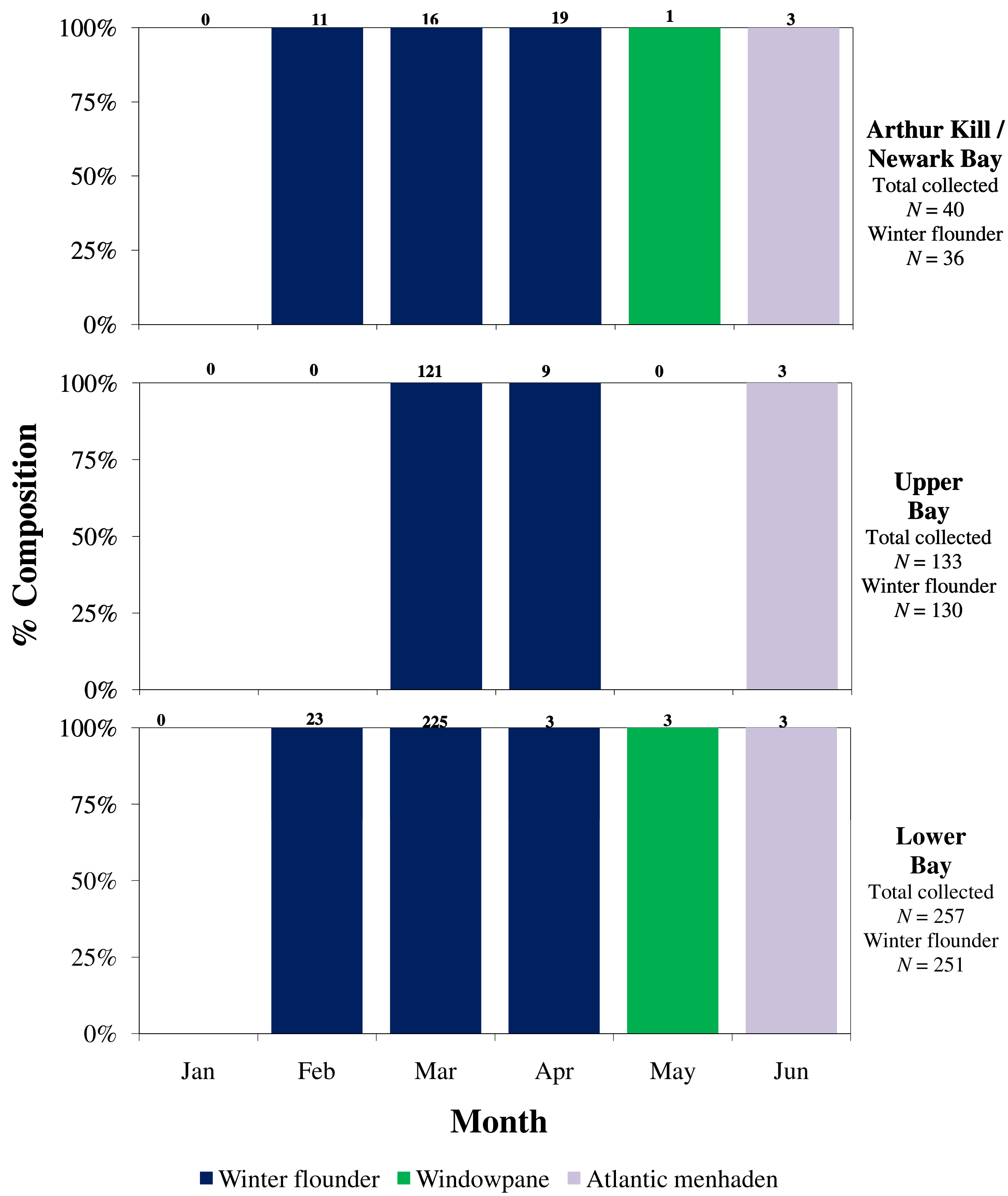


Figure 3-6 **EFH and important Non-EFH species compostion of yolk-sac larvae collected at all stations during the 2009 Aquatic Biological Survey.**

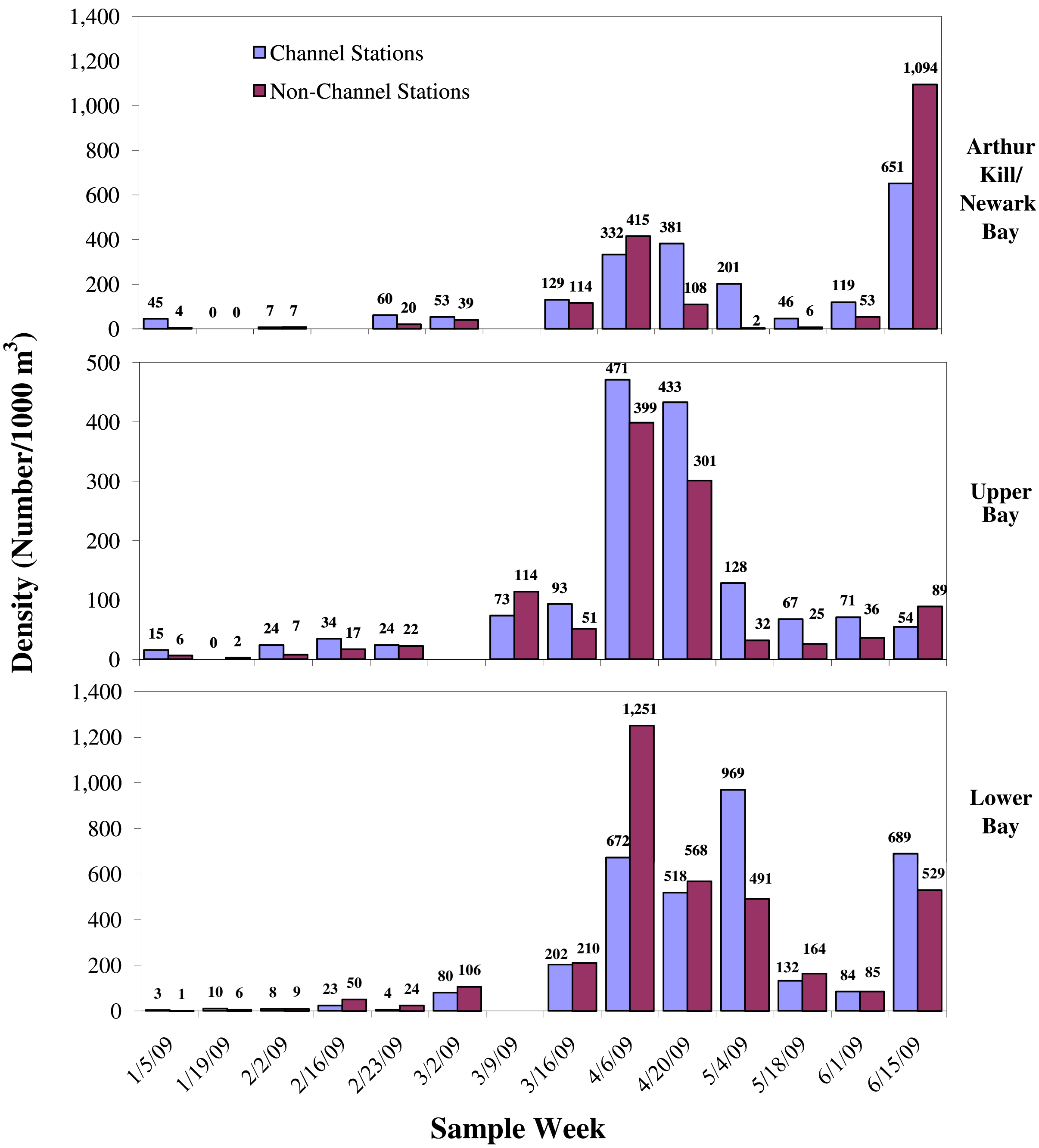


Figure 3-7 **Average weekly post-yolk sac larvae density of all species combined at channel and non-channel stations in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay, 2009 Aquatic Biological Survey.**

Note: Scale change for Upper Bay.
Weeks begin on Monday. Those weeks that are blank were not sampled.

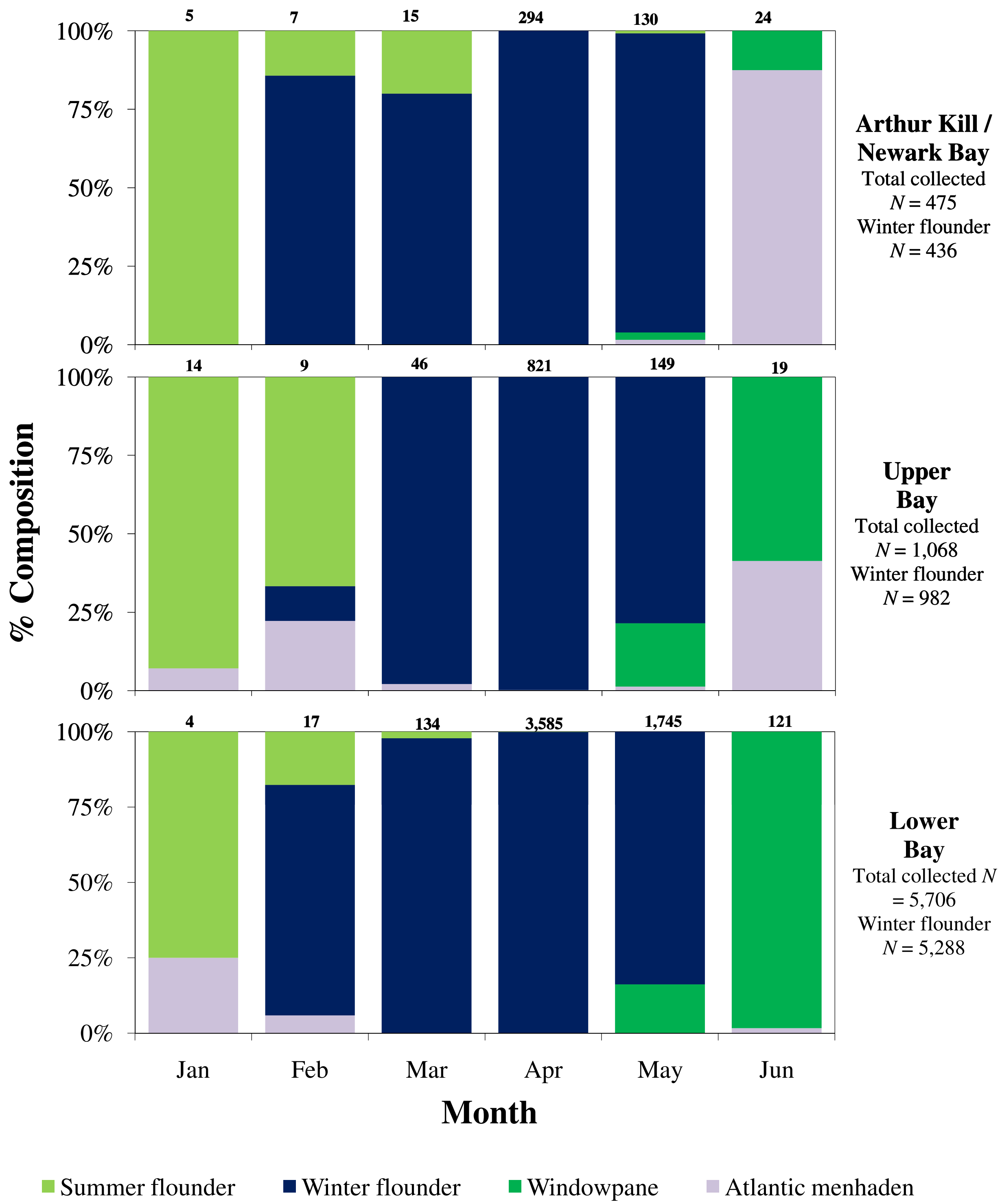


Figure 3-8 **EFH and important Non-EFH species compostion of post yolk-sac larvae collected at all stations during the 2009 Aquatic Biological Survey.**

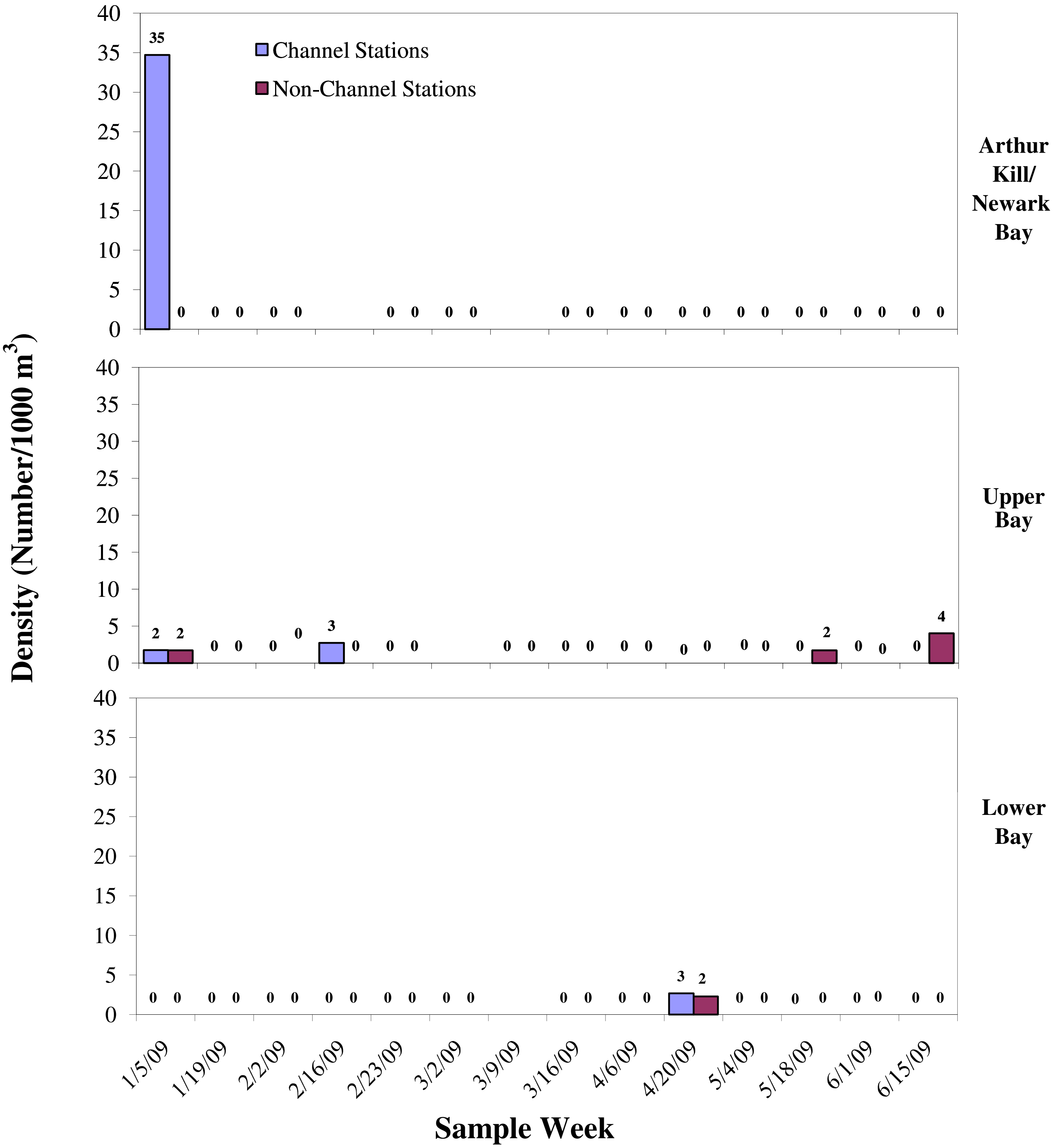


Figure 3-9 **Average weekly juvenile density of all species combined at channel and non-channel stations in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay, 2009 Aquatic Biological Survey.**

Note: Weeks begin on Monday. Those weeks that are blank were not sampled.

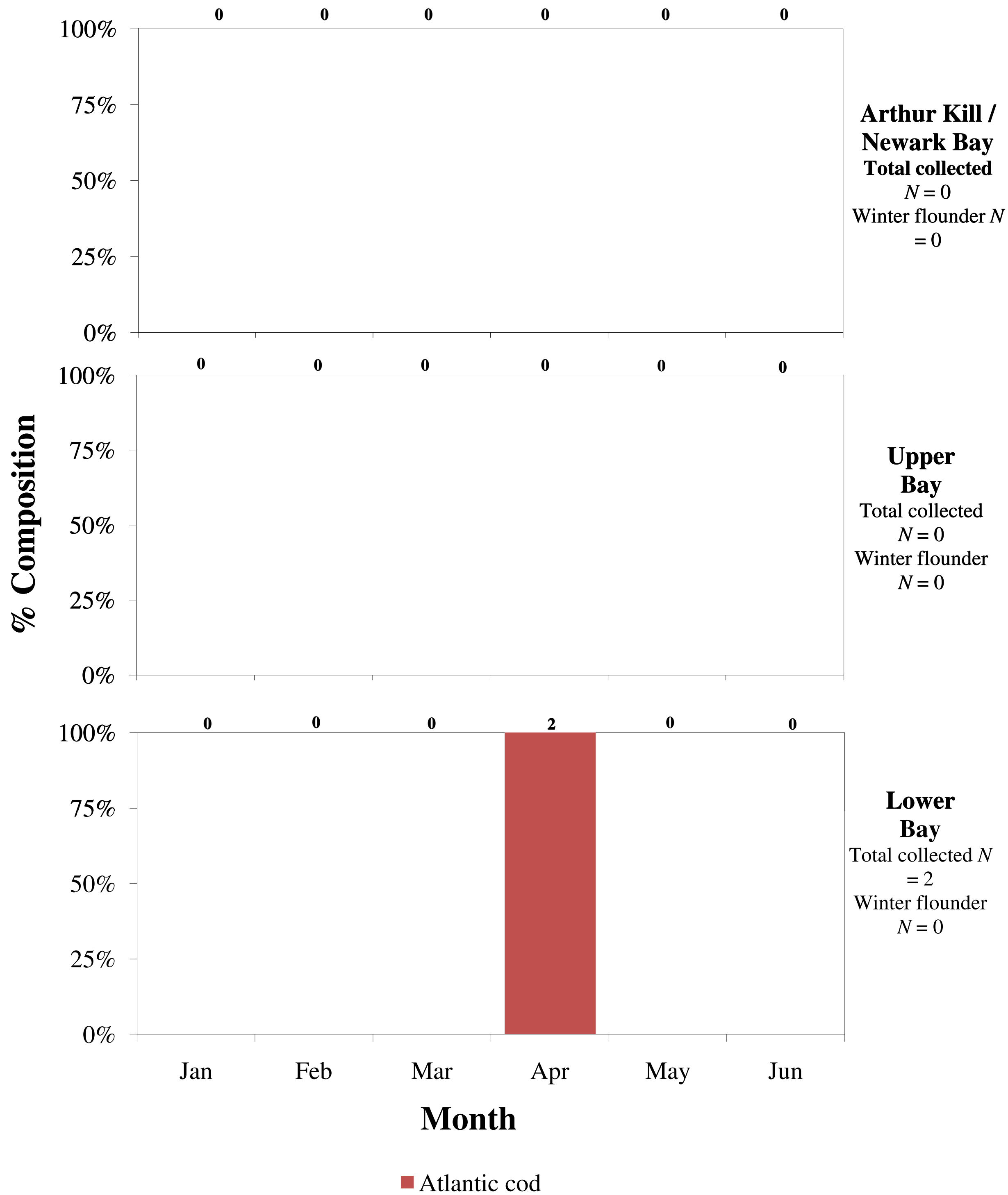


Figure 3-10 **EFH and important Non-EFH species compostion of juveniles collected at all stations during the 2009 Aquatic Biological Survey.**

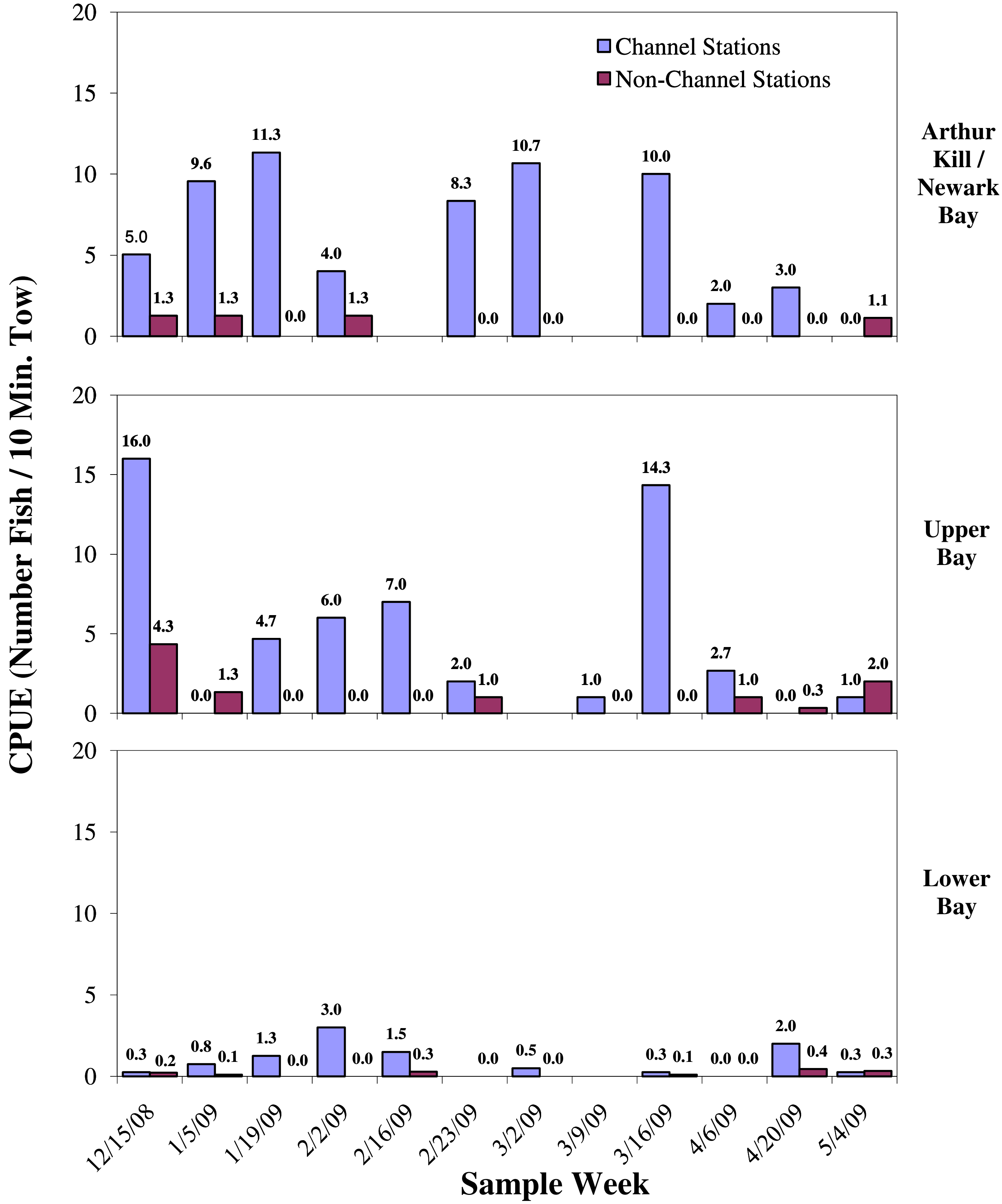


Figure 3-11 **Average weekly winter flounder bottom trawl CPUE at channel and non-channel stations in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay during the 2009 Aquatic Biological Survey.**

Note: Dates listed indicate the Monday of each sampling week.

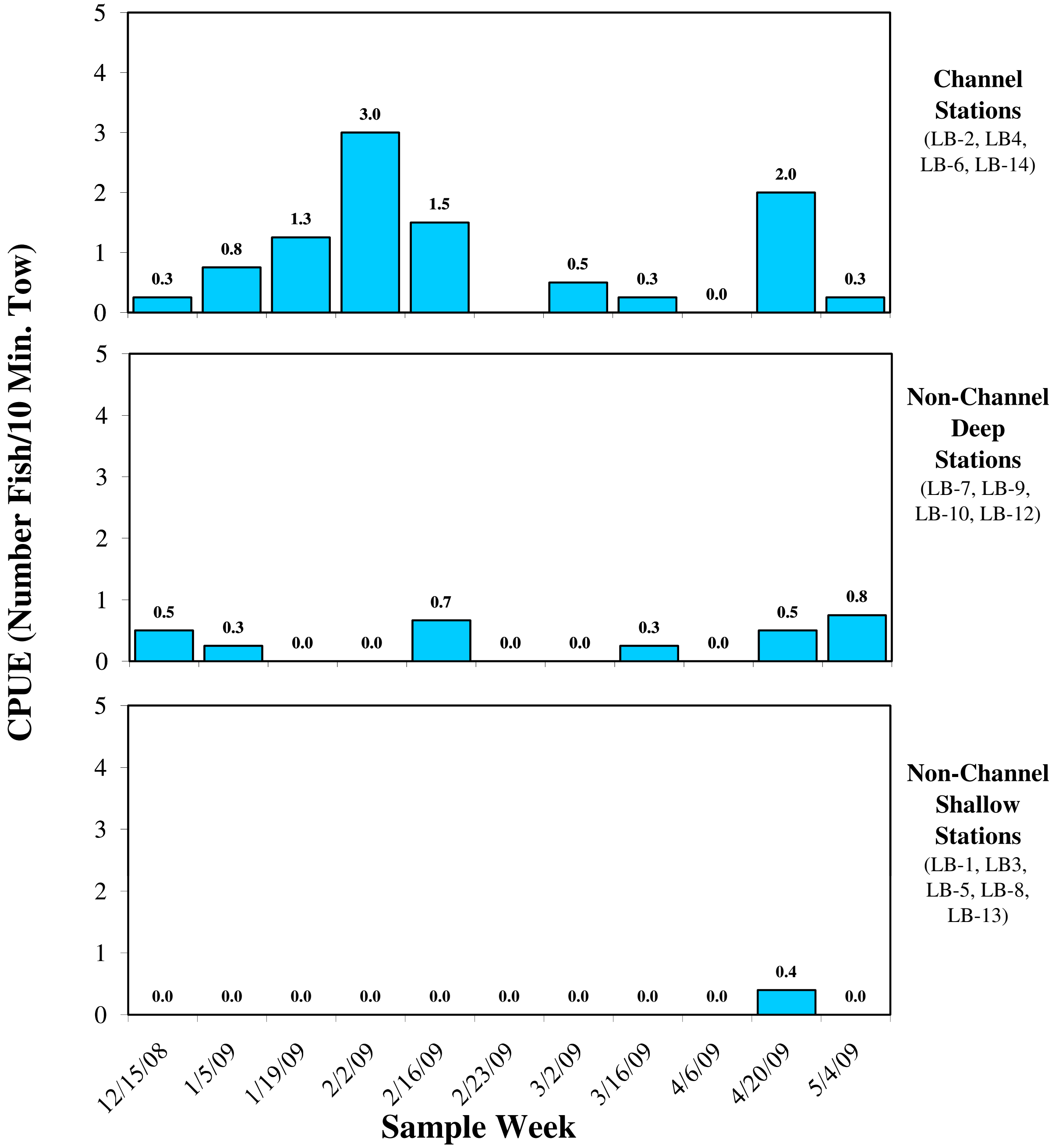


Figure 3-12 a **Average weekly bottom trawl CPUE of winter flounder in the Lower Bay by station depth during the 2009 Aquatic Biological Survey.**
Note: Dates listed indicate the Monday of each sampling week.

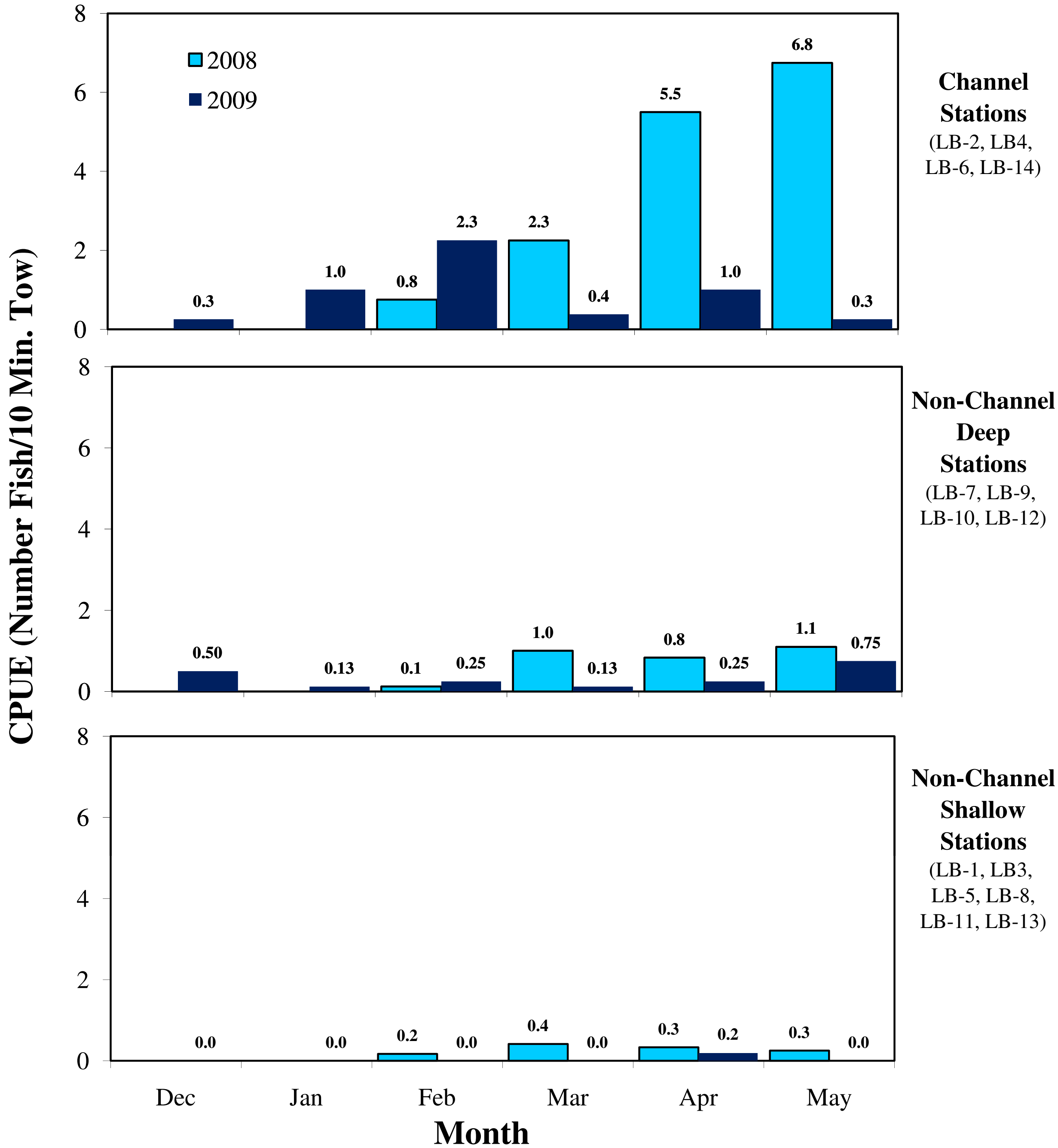


Figure 3-12 b Average monthly bottom trawl CPUE of winter flounder in the Lower Bay by station depth during the 2008 and 2009 Aquatic Biological Surveys.

Note: Months February through May were sampled during the 2008 Survey.
Station LB-11 was not sampled during the 2009 Survey.

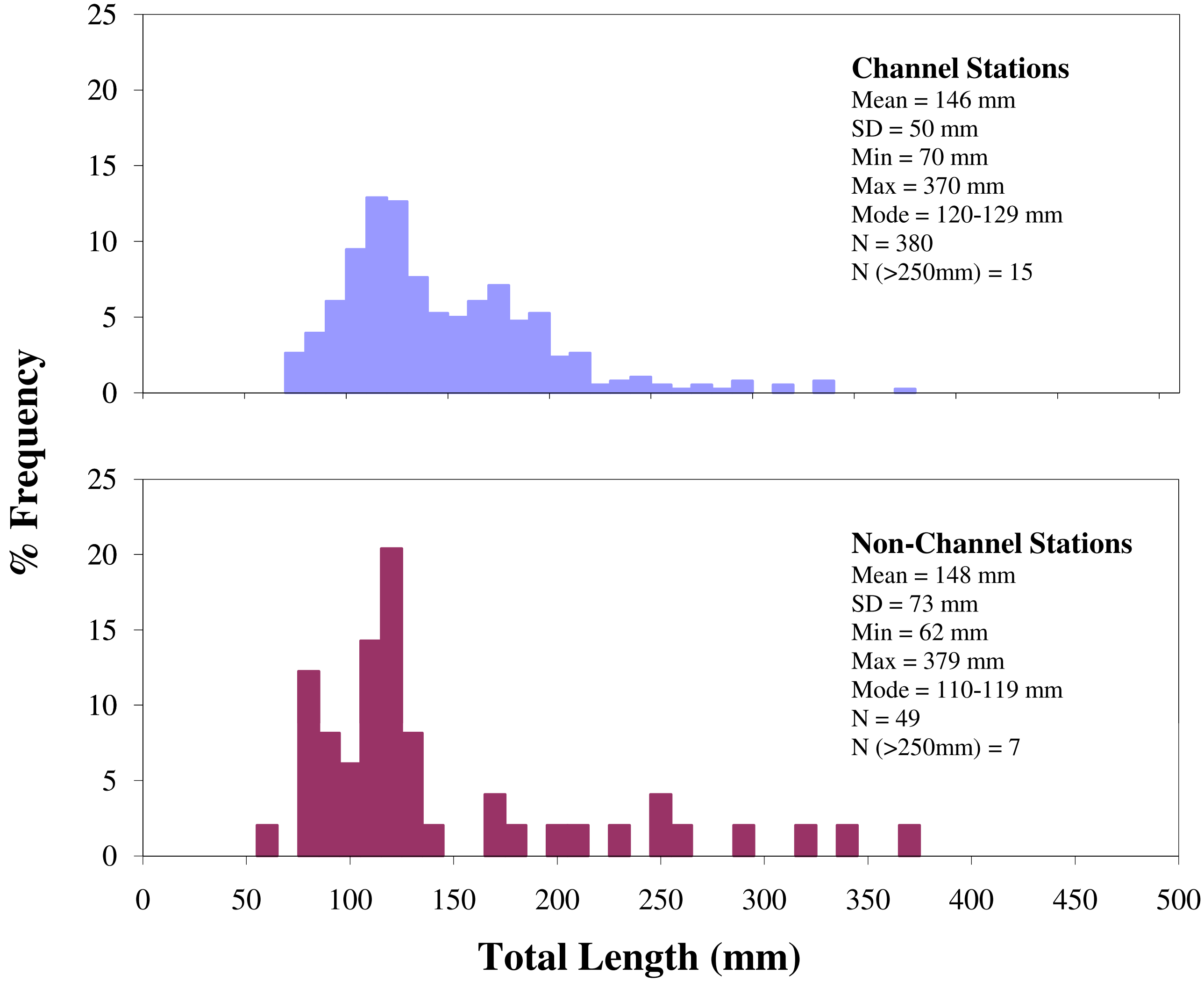


Figure 3-13 **Length frequency distribution (10-mm intervals) of all winter flounder measured during bottom trawl sampling for the 2009 Aquatic Biological Survey.**

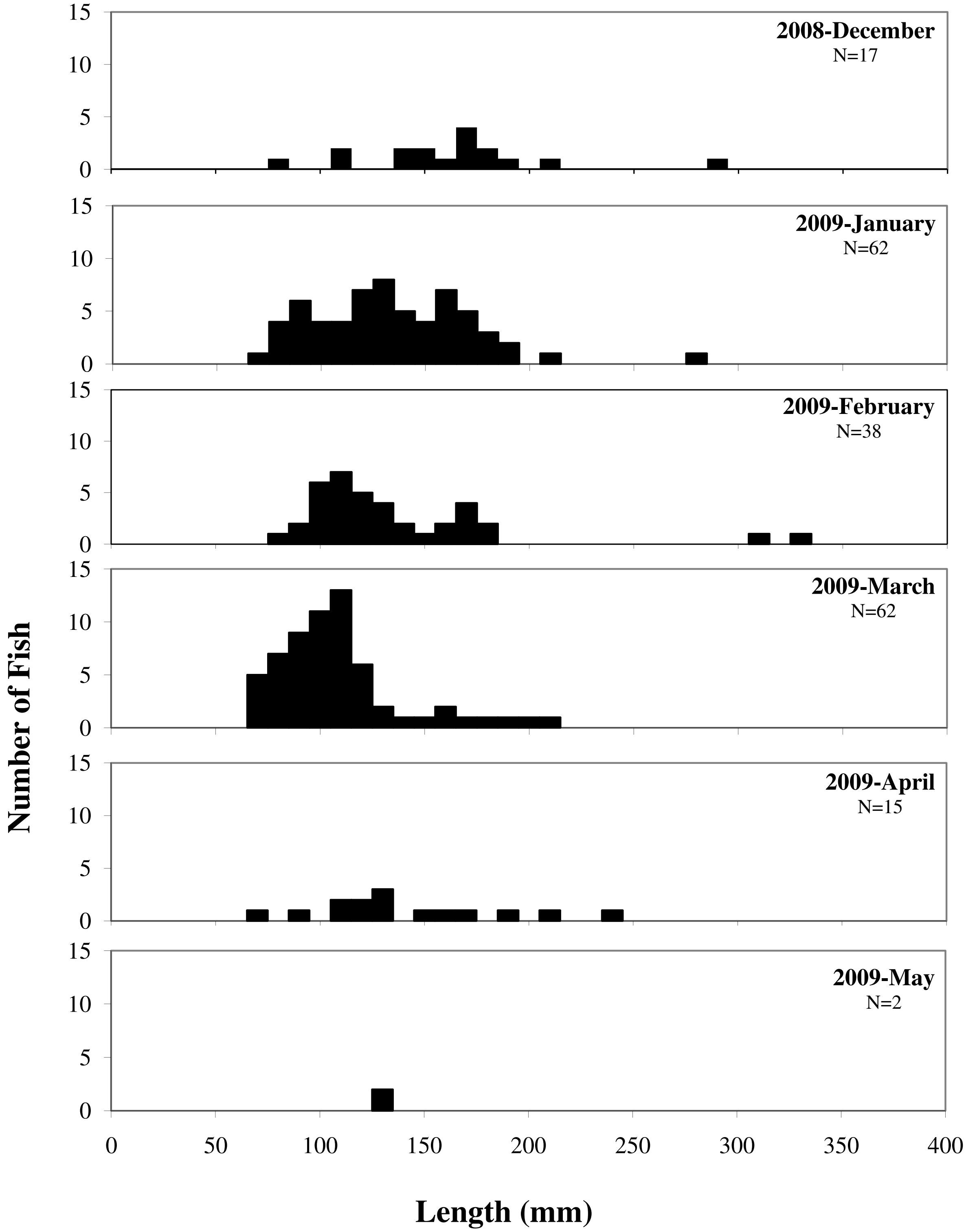


Figure 3-14 a **Length frequency distribution of winter flounder collected during bottom trawl sampling at Arthur Kill/Newark Bay stations, 2009 Aquatic Biological Survey.**

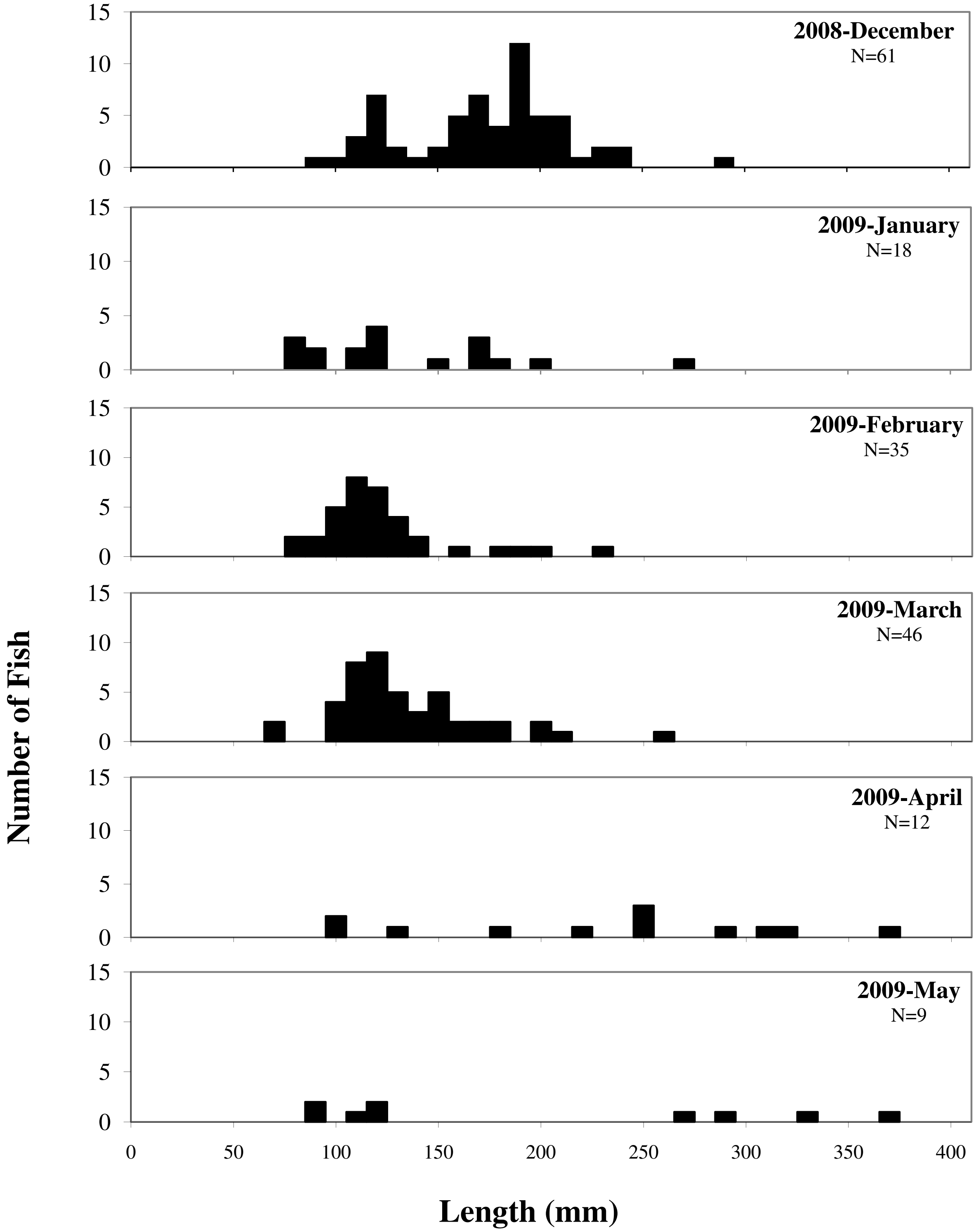


Figure 3-14 b **Length frequency distribution of winter flounder collected during bottom trawl sampling at Upper Bay stations, 2009 Aquatic Biological Survey.**

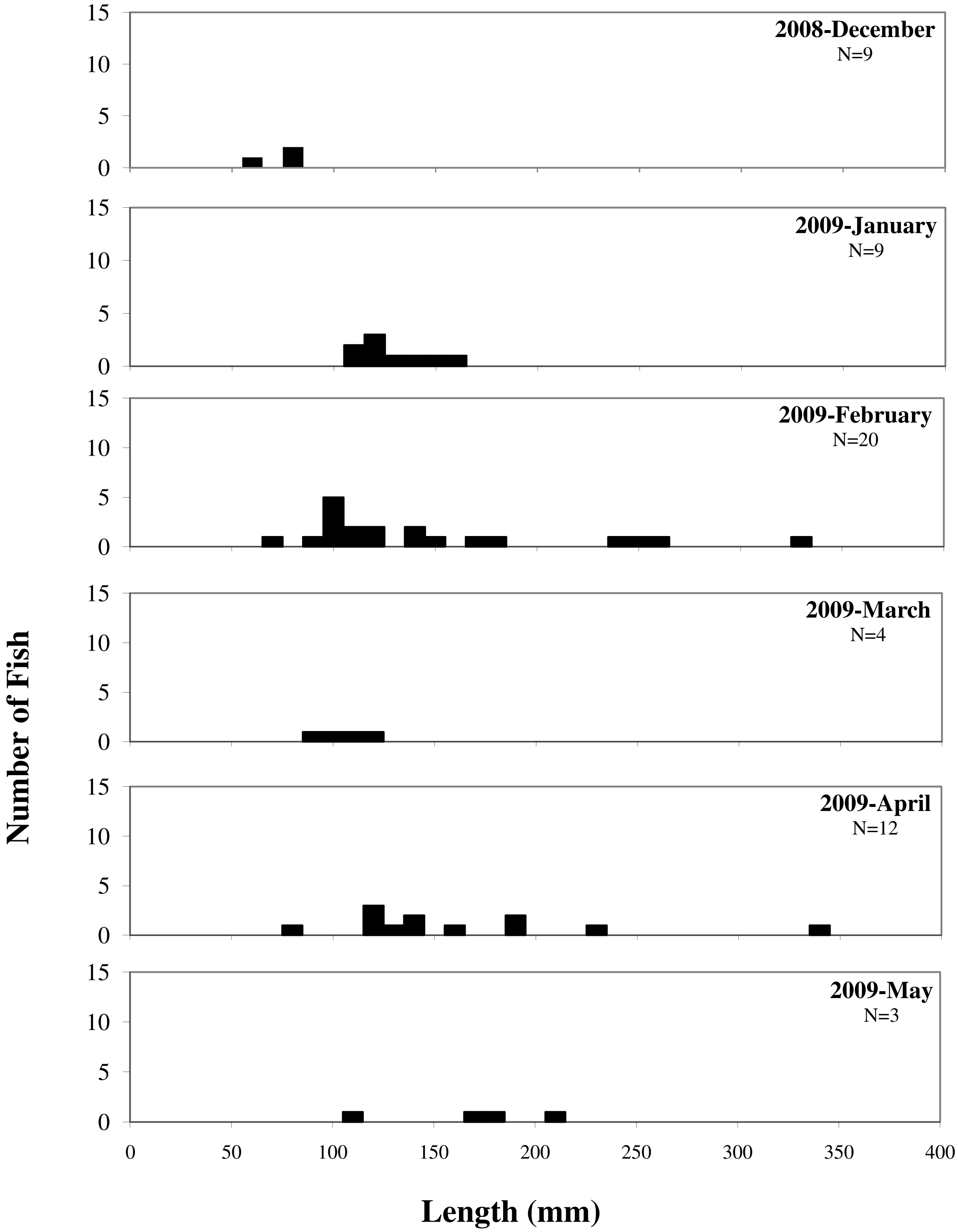


Figure 3-14 c **Length frequency distribution of winter flounder collected during bottom trawl sampling at Lower Bay stations, 2009 Aquatic Biological Survey.**

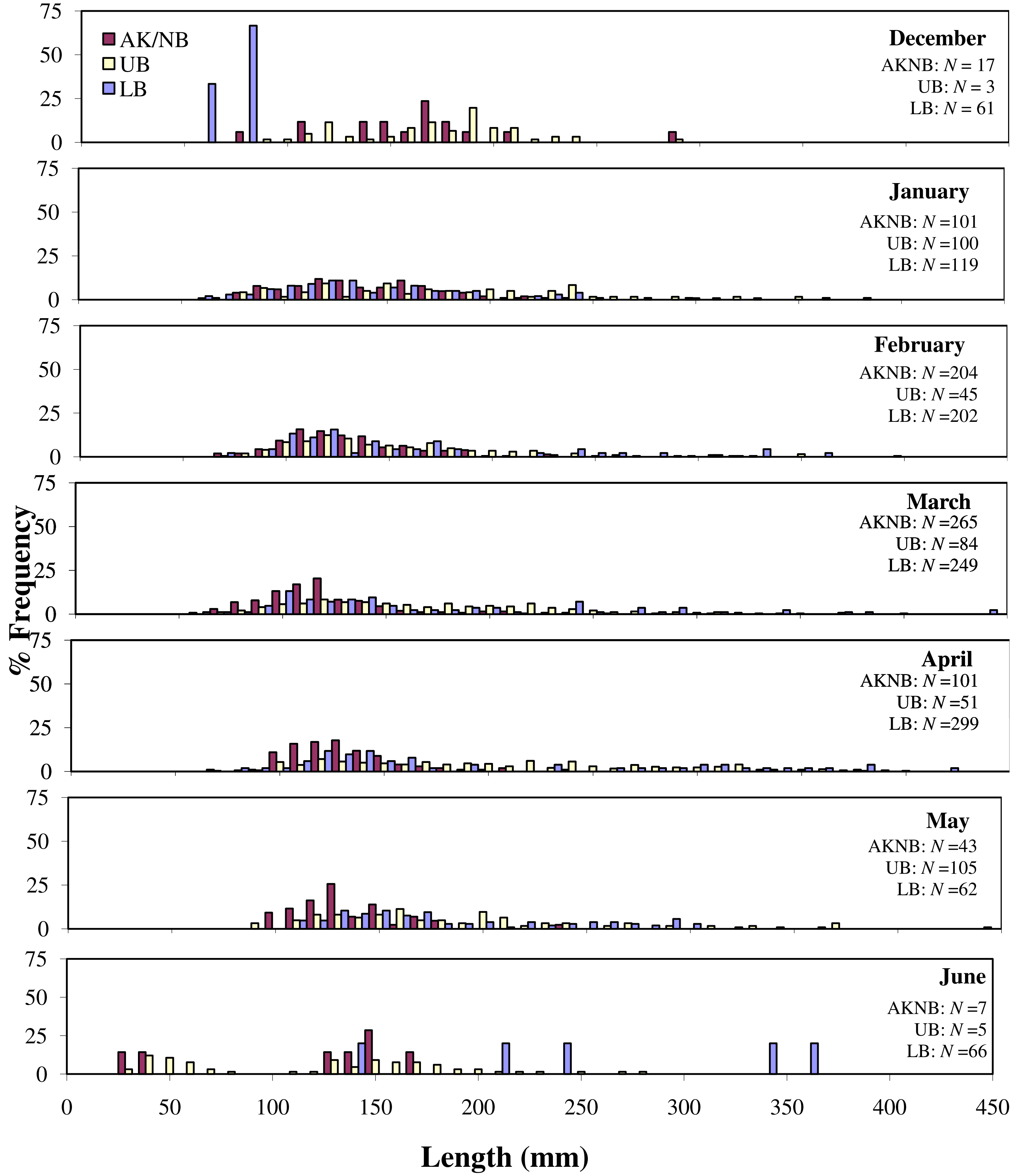


Figure 3-18 b **Length frequency distribution of winter flounder collected during bottom trawl sampling at Arthur Kill/Newark Bay, Upper Bay, and Lower Bay stations from the 2005 through 2009 Aquatic Biological Surveys.**

Note: No sampling was conducted in January or June during the 2008 Survey.
Sampling was conducted during December 2008 for the 2009 Survey.

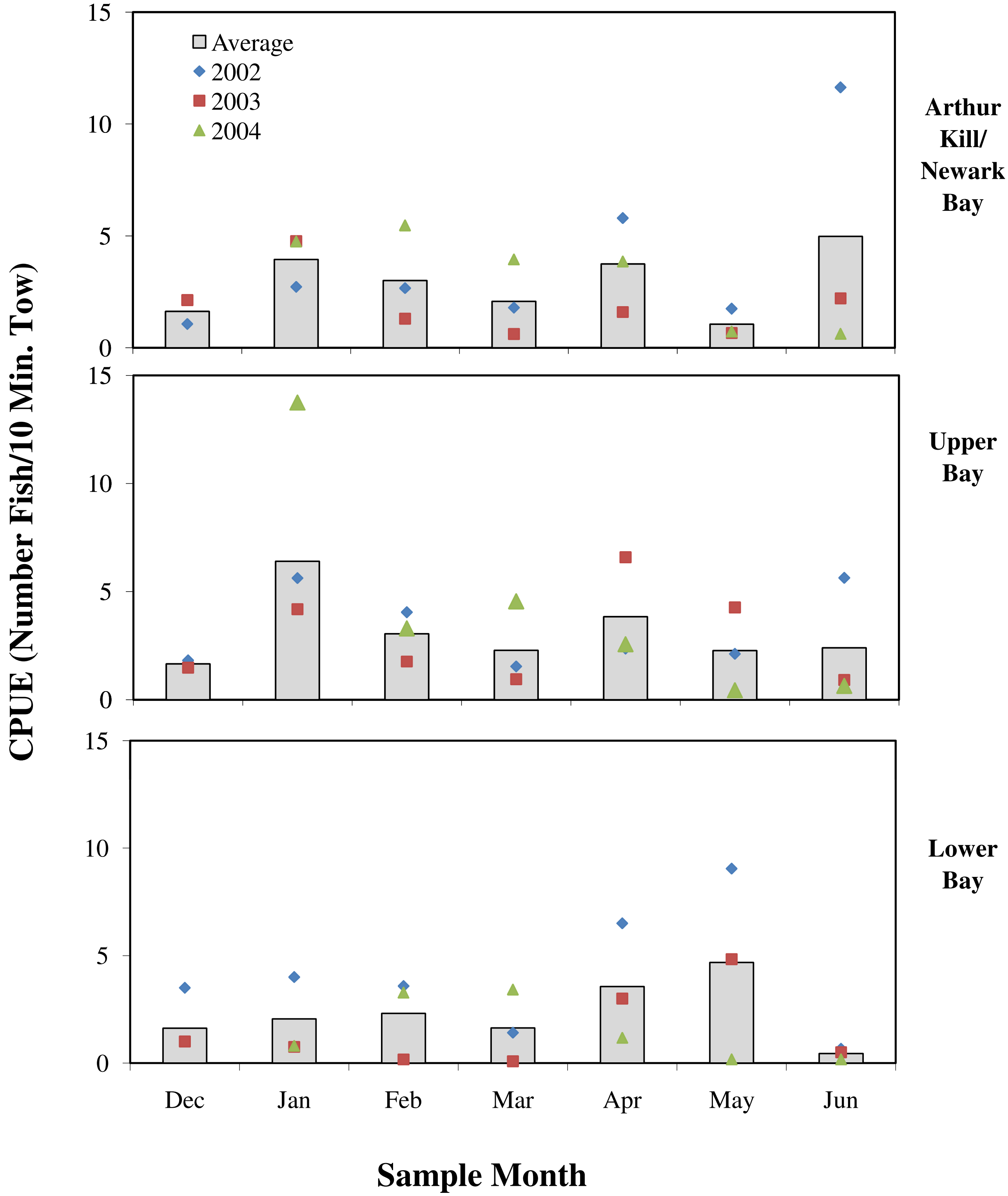


Figure 3-16 a **Average monthly bottom trawl CPUE of winter flounder during the 2002, 2003 and 2004 night surveys in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay stations**

Note: December was not sampled during 2004.

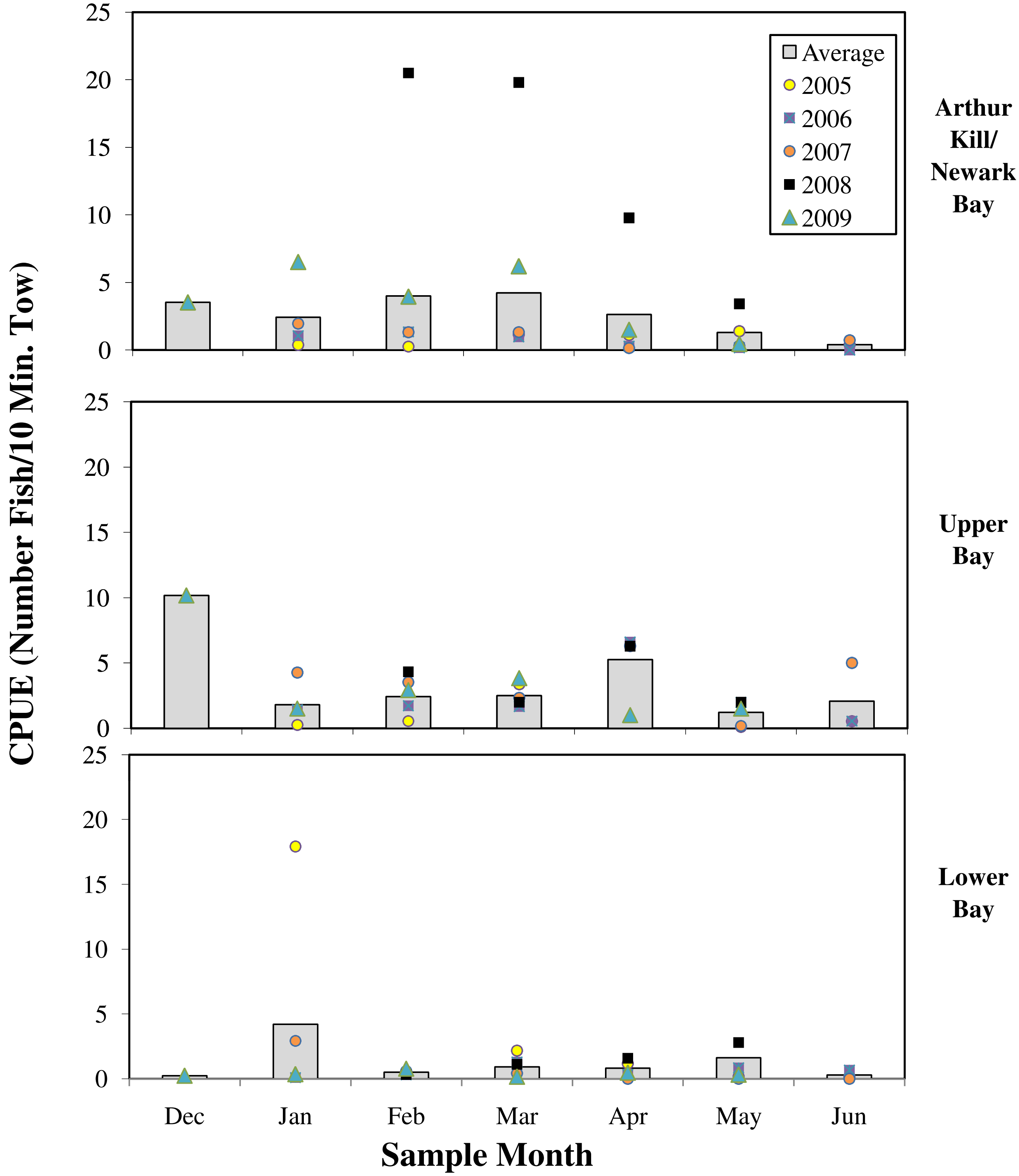


Figure 3-16 b **Average monthly bottom trawl CPUE of winter flounder during the 2005 through 2009 daytime surveys in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay stations**

Note: December was not sampled from 2005-2008.
January and June were not sampled in 2008
June was not sampled in 2009.

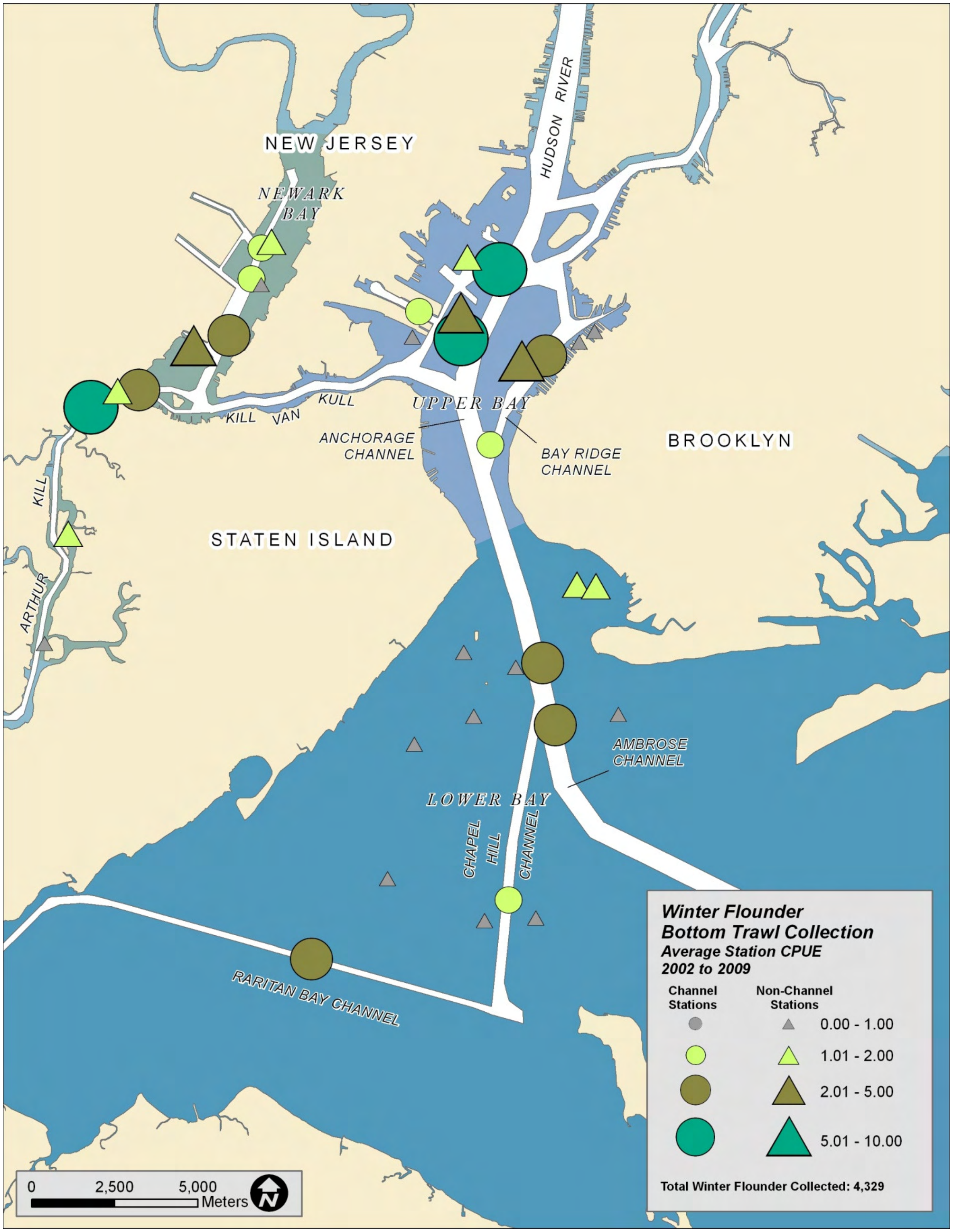


Figure 3-17 Average station CPUE of winter flounder bottom trawl collection 2002-2009 Aquatic Biological Survey.

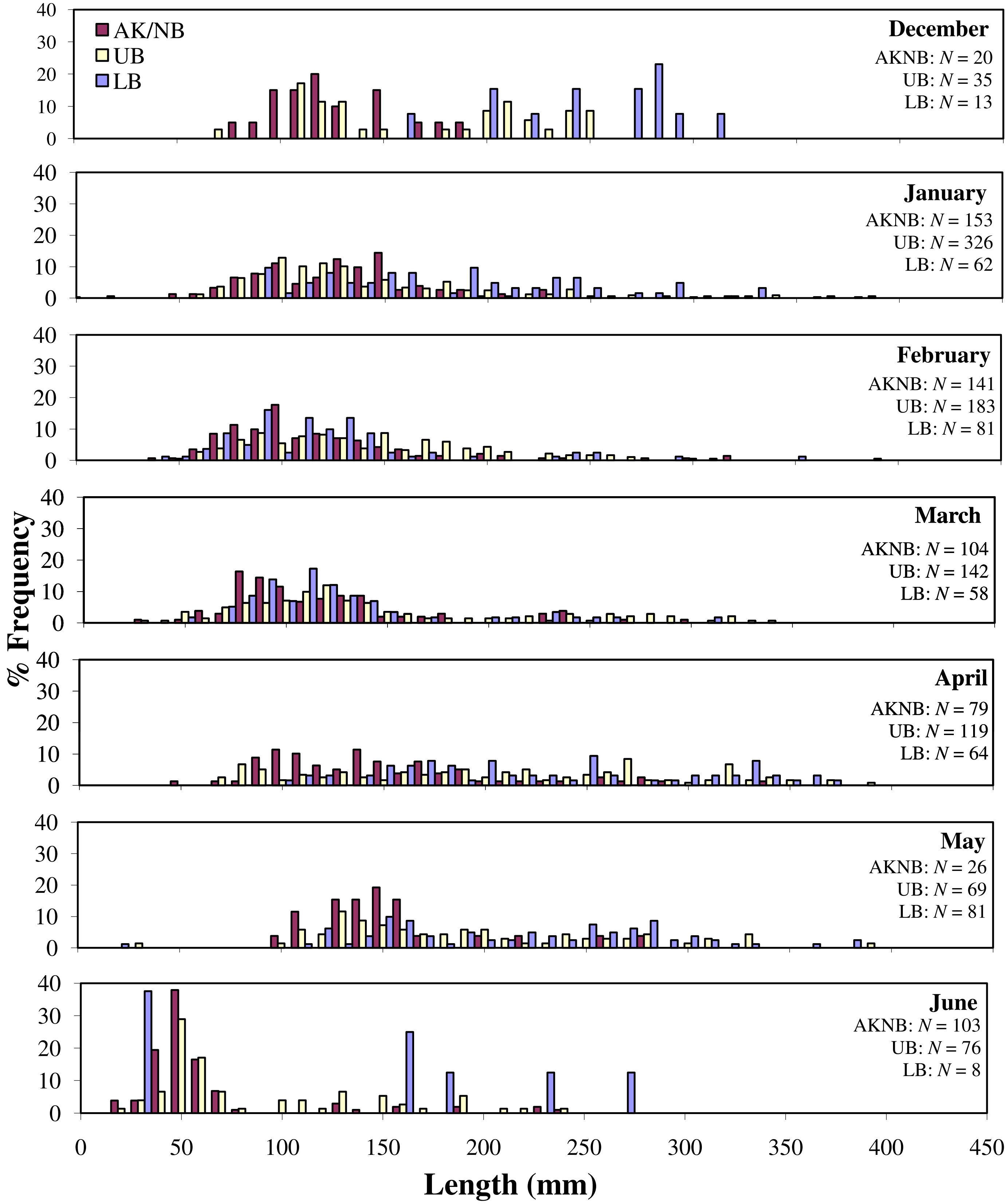


Figure 3-18 a **Length frequency distribution of winter flounder collected during bottom trawl sampling at Arthur Kill/Newark Bay, Upper Bay, and Lower Bay stations during the 2002, 2003, and 2004 Aquatic Biological Surveys.**

Note: Sampling was conducted at night in 2002, 2003 and 2004

No sampling was conducted in December 2004.

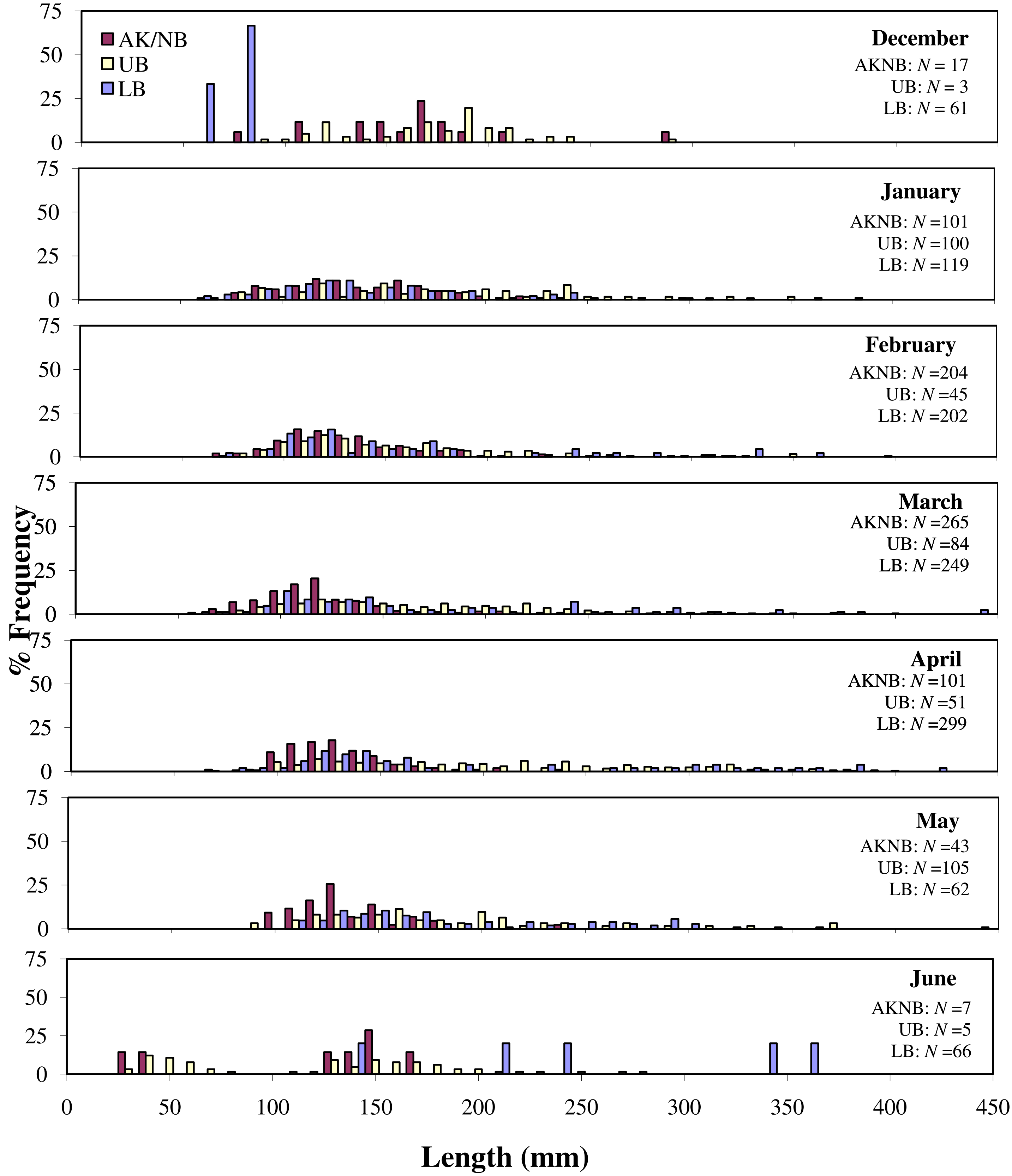


Figure 3-18 b **Length frequency distribution of winter flounder collected during bottom trawl sampling at Arthur Kill/Newark Bay, Upper Bay, and Lower Bay stations from the 2005 through 2009 Aquatic Biological Surveys.**

Note: No sampling was conducted in January or June during the 2008 Survey. Sampling was conducted during December 2008 for the 2009 Survey.

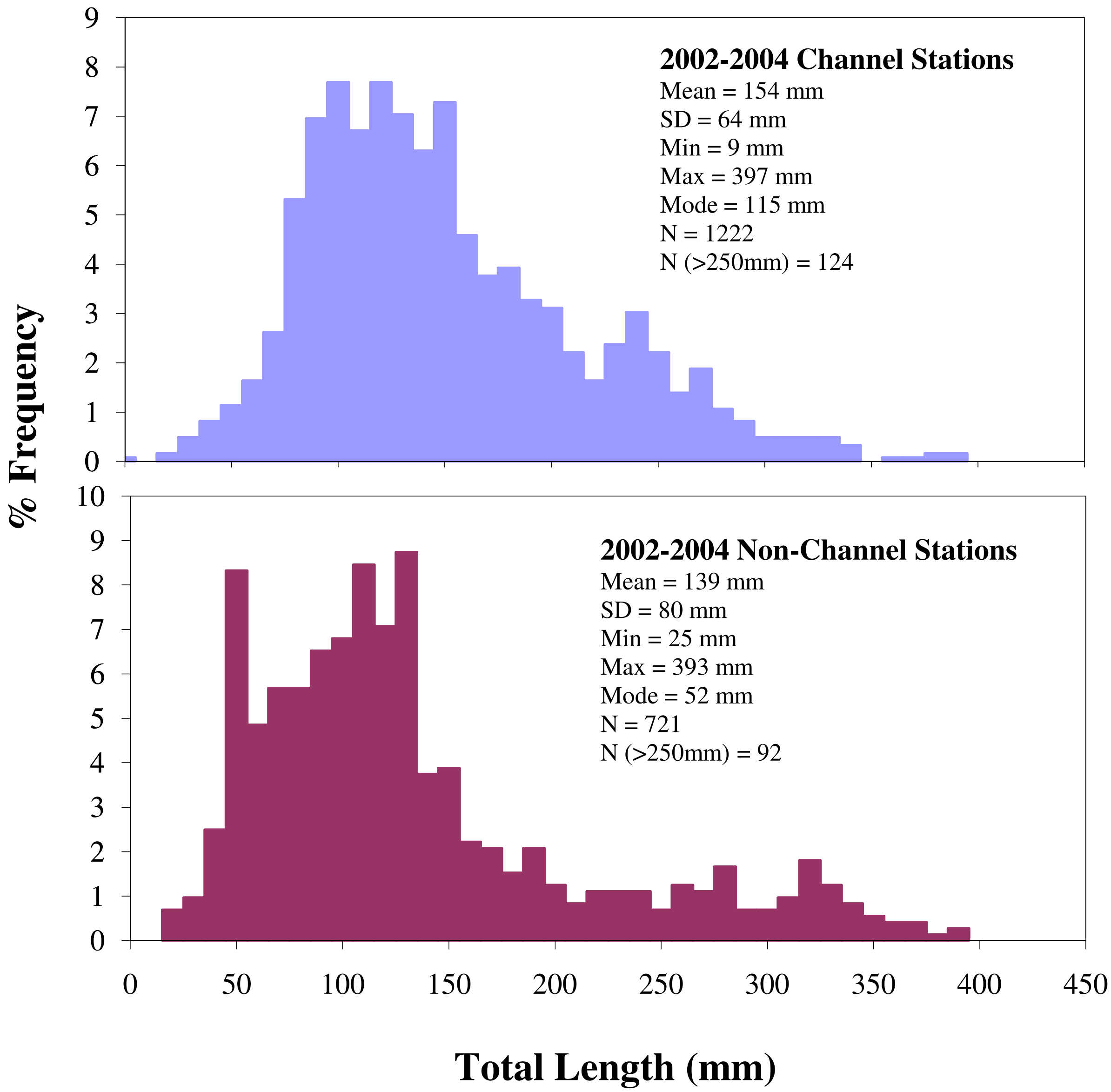


Figure 3-19 a **Length frequency distribution (10-mm intervals) of all winter flounder measured during bottom trawl sampling during the 2002-2004 Aquatic Biological Surveys.**

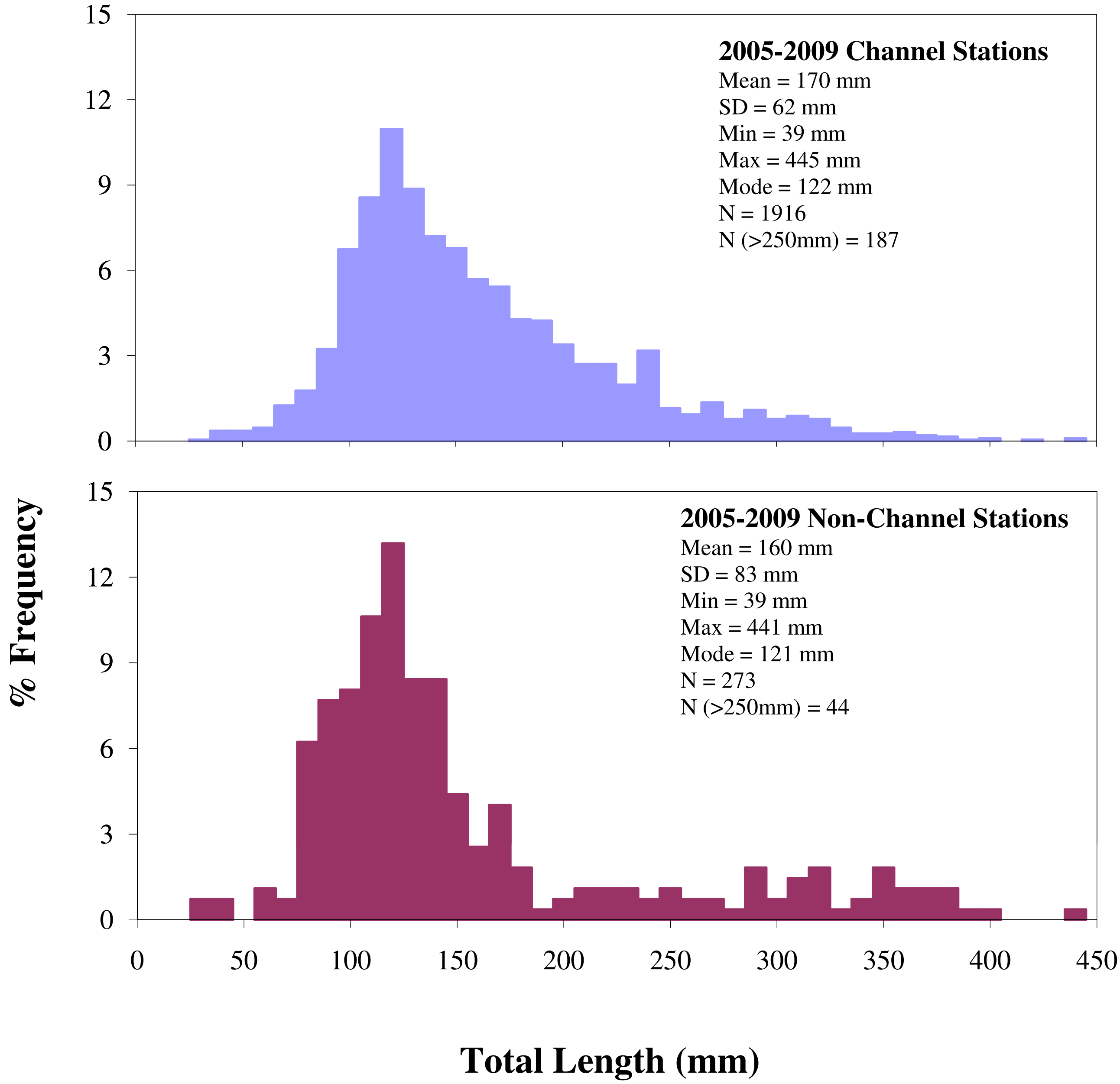


Figure 3-19 b **Length frequency distribution (10-mm intervals) of all winter flounder measured during bottom trawl sampling during the 2005-2009 Aquatic Biological Surveys.**

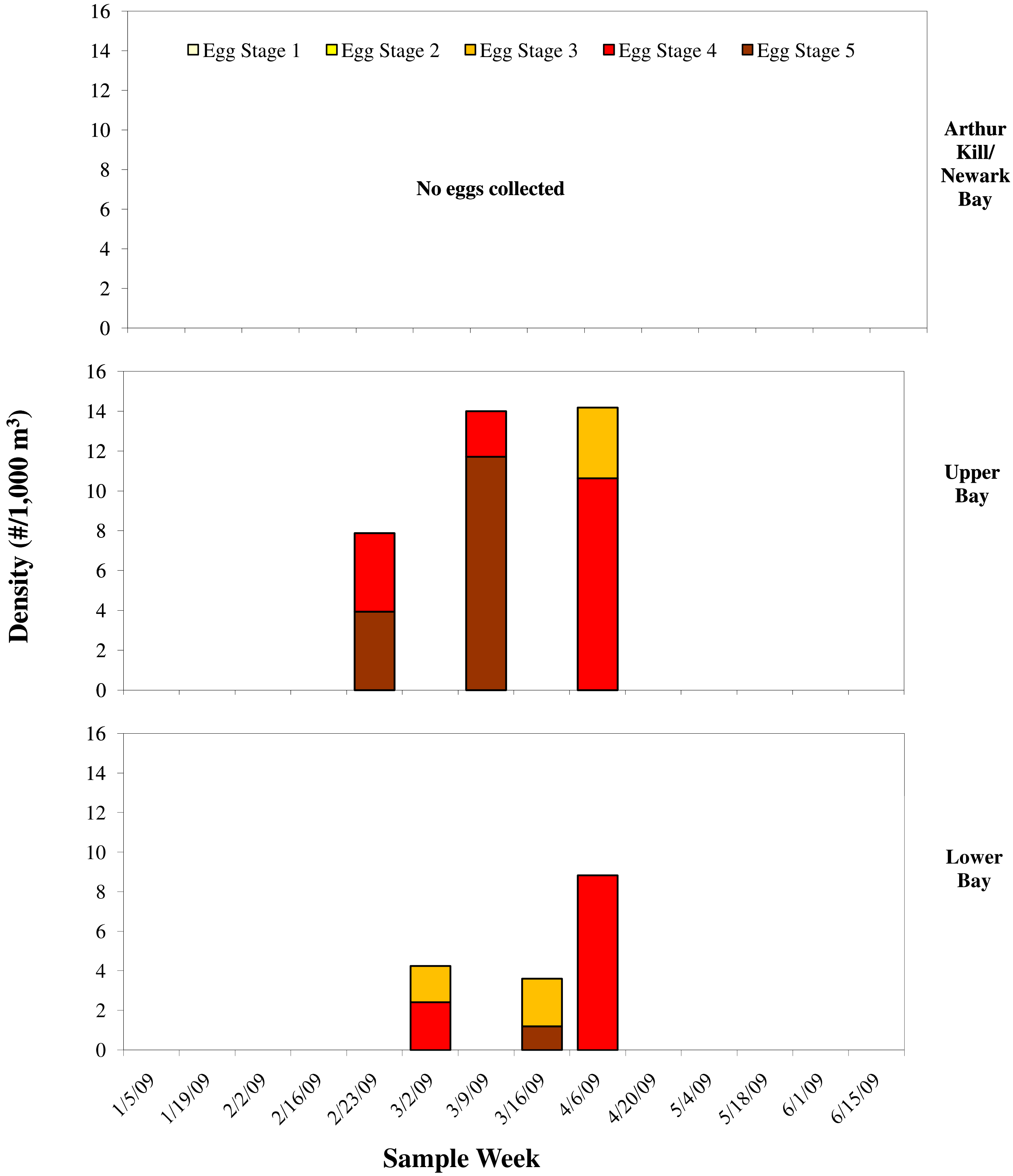


Figure 3-20 a **Average weekly winter flounder egg density at channel stations in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay, during the 2009 Aquatic Biological Survey**

Note: Dates listed indicate the Monday of each sample week.

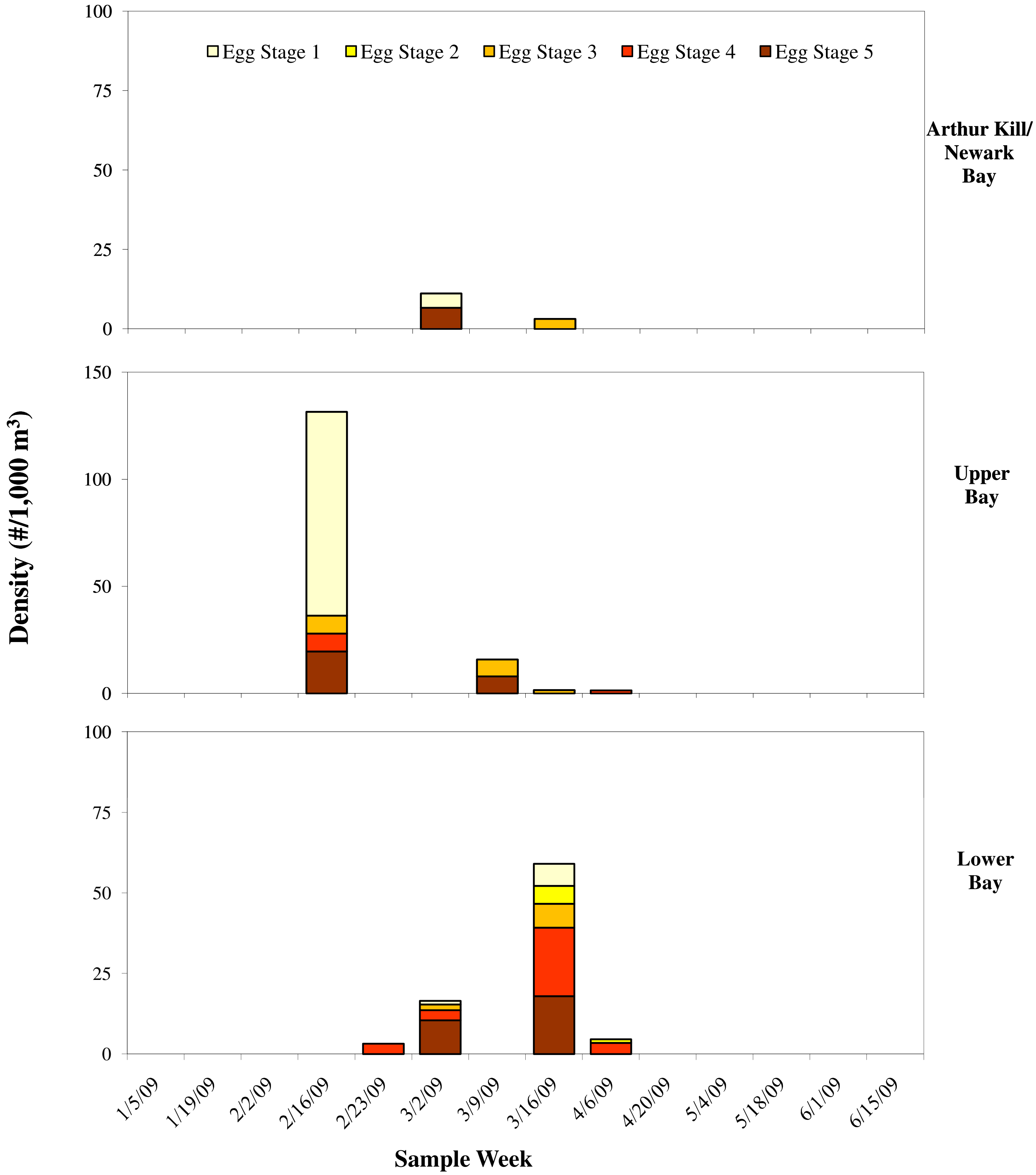


Figure 3-20 b **Average weekly winter flounder egg density at non-channel stations in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay, during the 2009 Aquatic Biological Survey**

Note: Dates listed indicate the Monday of each sample week.

Note scale change for Upper Bay

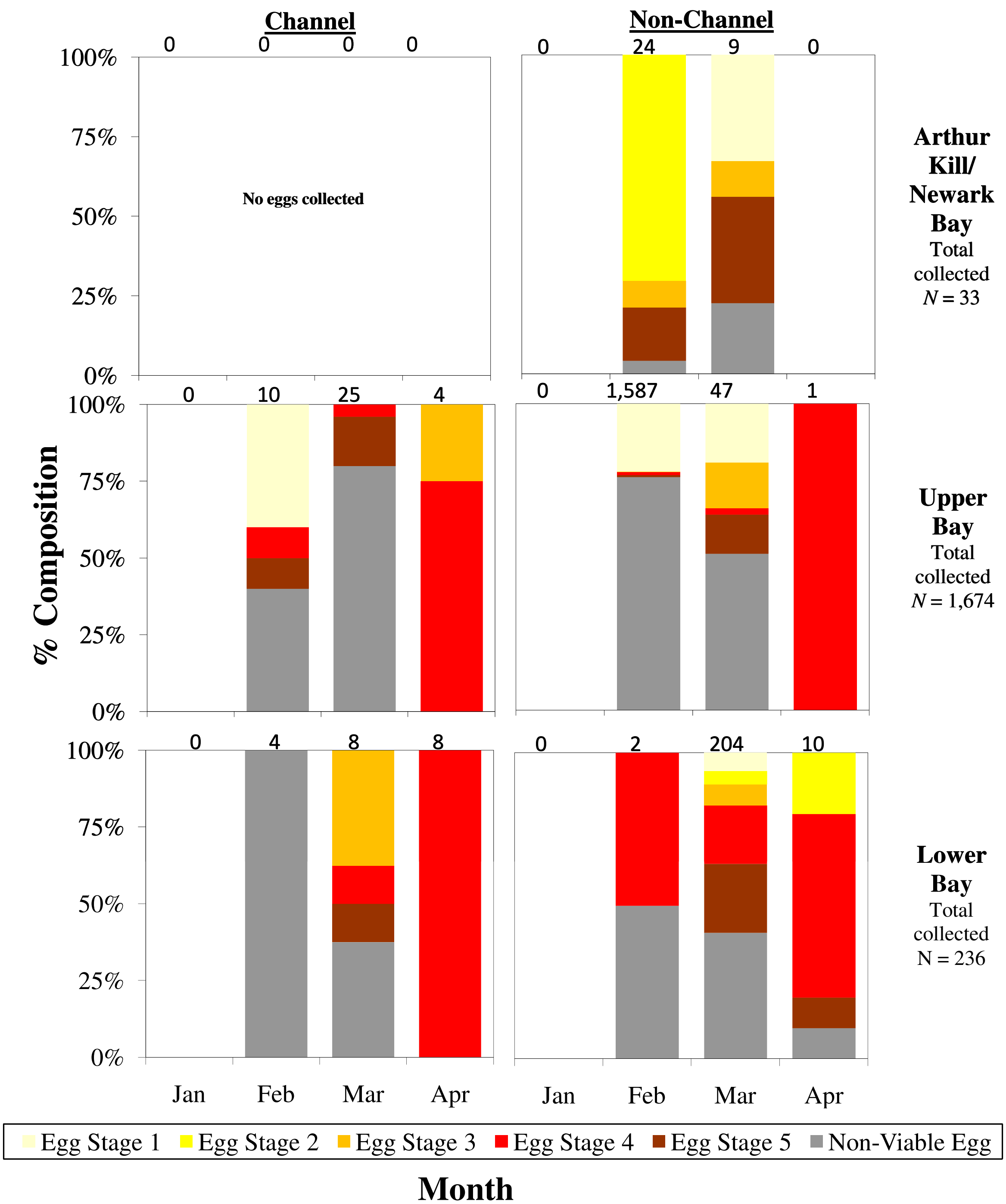


Figure 3-21 Percent composition of winter flounder egg lifestages, including non-viable eggs, collected at channel and non-channel stations in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay during the 2008 and 2009 Aquatic Biological Surveys.

Note: No sampling was conducted in January during the 2008 Survey.

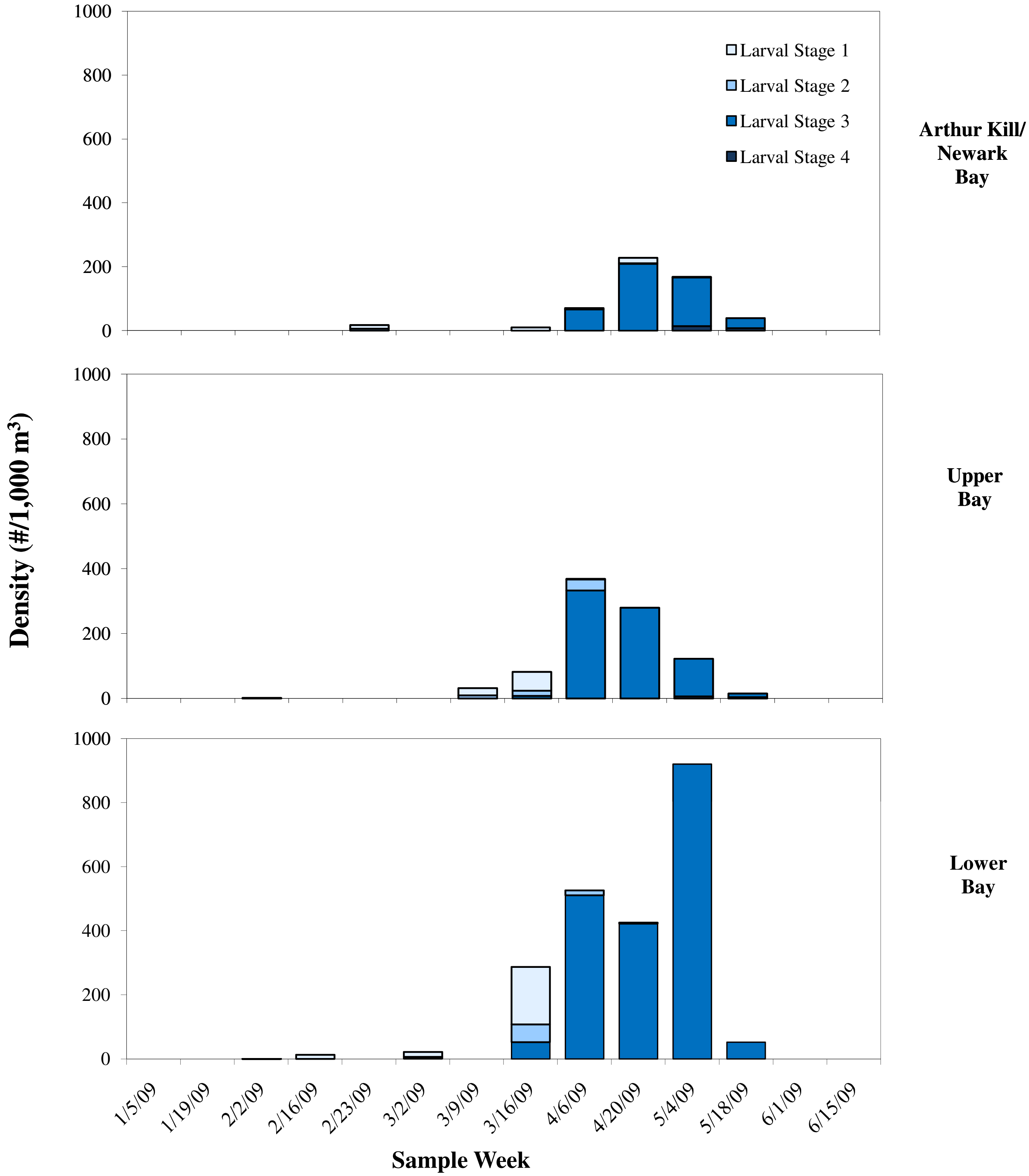


Figure 3-22 a **Average weekly winter flounder larval density at navigation channel stations in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay, during the 2009 Aquatic Biological Survey**

Note: Dates listed indicate the Monday of each sample week.

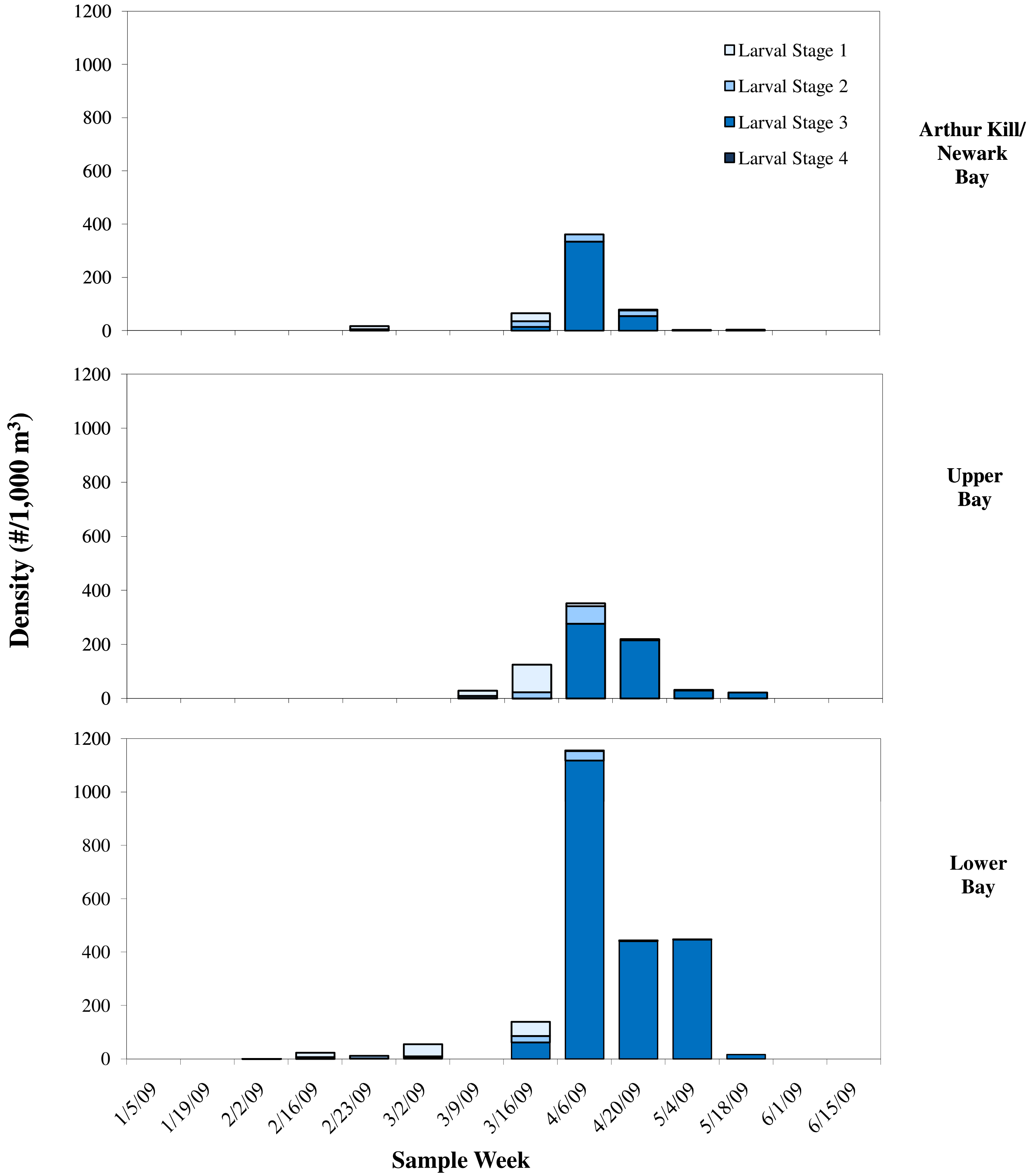


Figure 3-22 b **Average weekly winter flounder larval density at non-channel stations in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay, during the 2009 Aquatic Biological Survey**

Note: Dates listed indicate the Monday of each sample week.

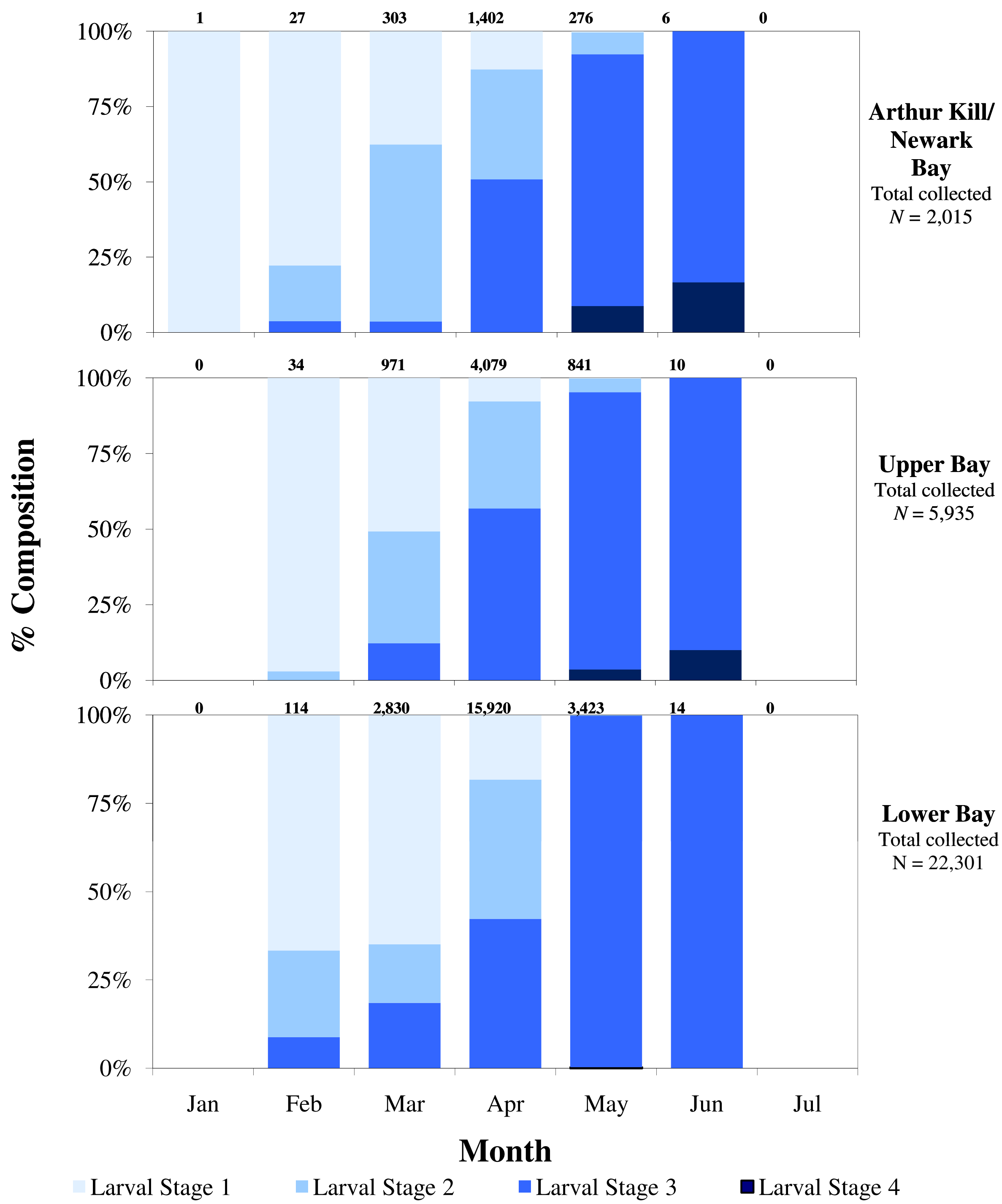


Figure 3-23 **Percent composition of winter flounder larval lifestages in the Arthur Kill/Newark Bay, Upper Bay, and Lower Bay stations during the 2007 through 2009 Aquatic Biological Surveys.**

Note: No sampling was conducted in January during the 2008 Survey.
No sampling was conducted in July during the 2009 Survey.

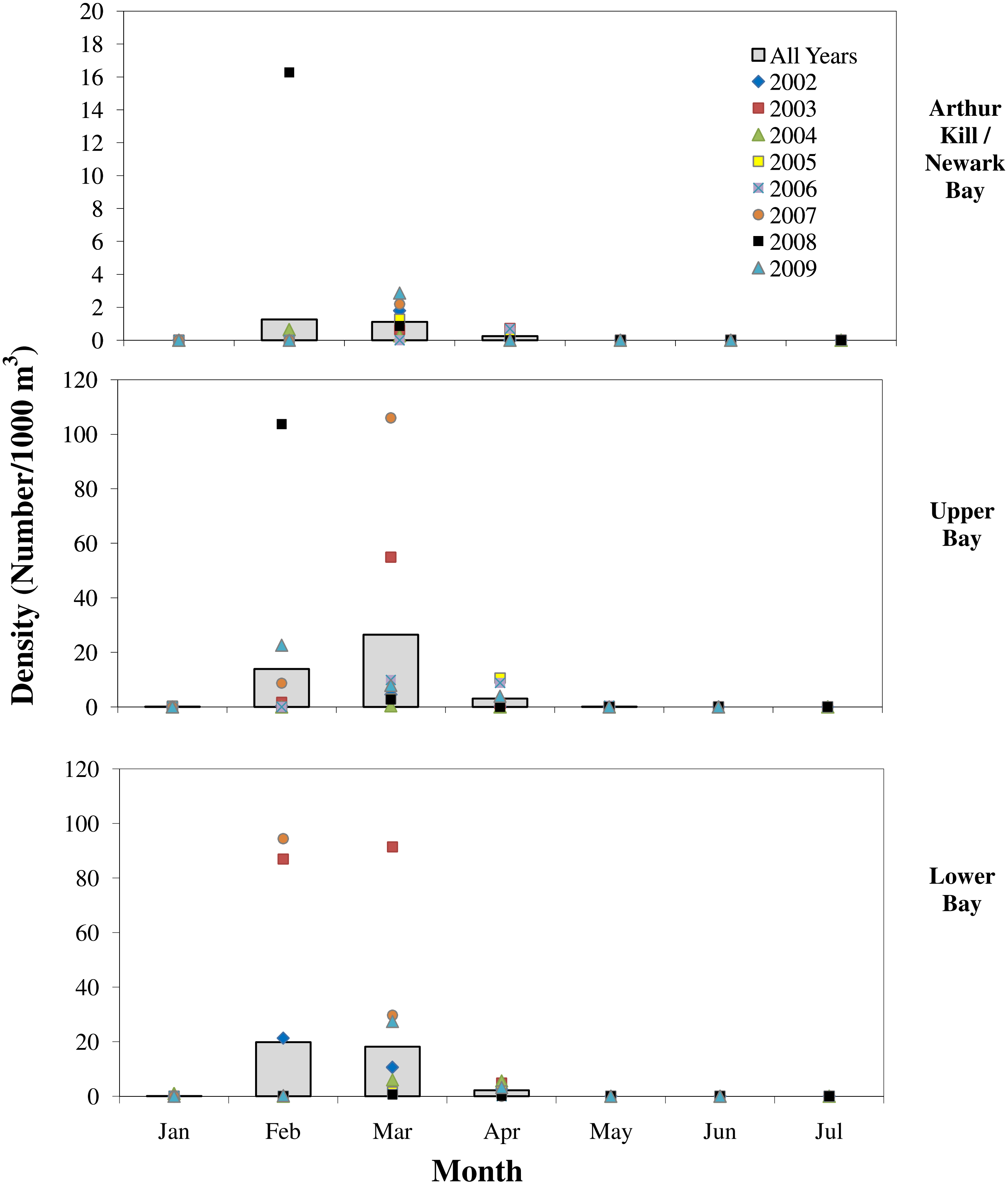


Figure 3-24 a Average monthly winter flounder egg density by region during the 2002 through 2009 Aquatic Biological Survey.

Note(s): Scale change for Arthur Kill/Newark Bay.
Densities only include viable eggs.
No sampling was conducted in January during the 2008 Survey.
No sampling was conducted in July during the 2009 Survey.

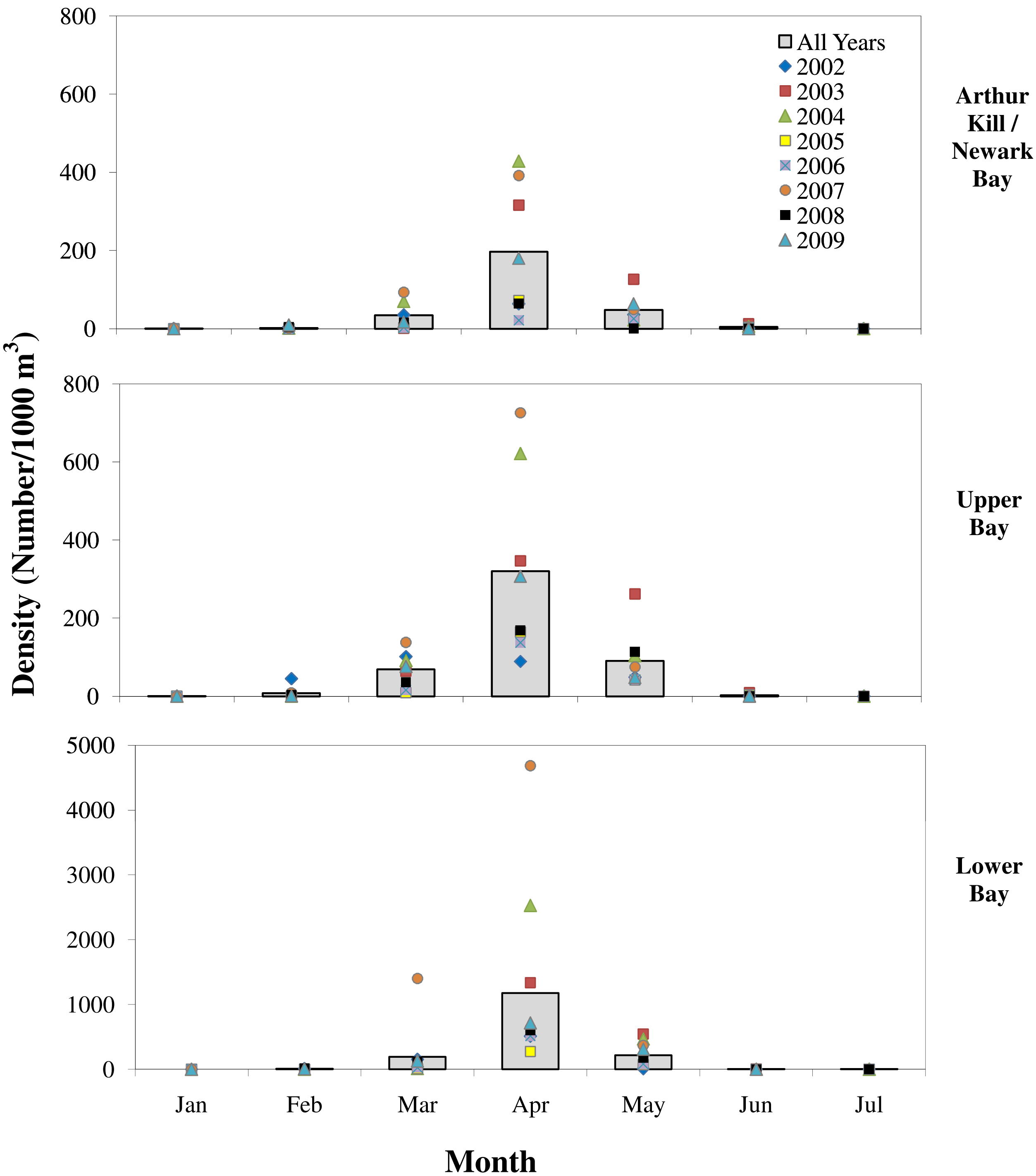


Figure 3-24 b **Average monthly winter flounder larval density by region during the 2002 through 2009 Aquatic Biological Survey.**

Note(s): Scale change for Arthur Kill/Newark Bay.
No sampling was conducted in January during the 2008 Survey.
No sampling was conducted in July during the 2009 Survey.

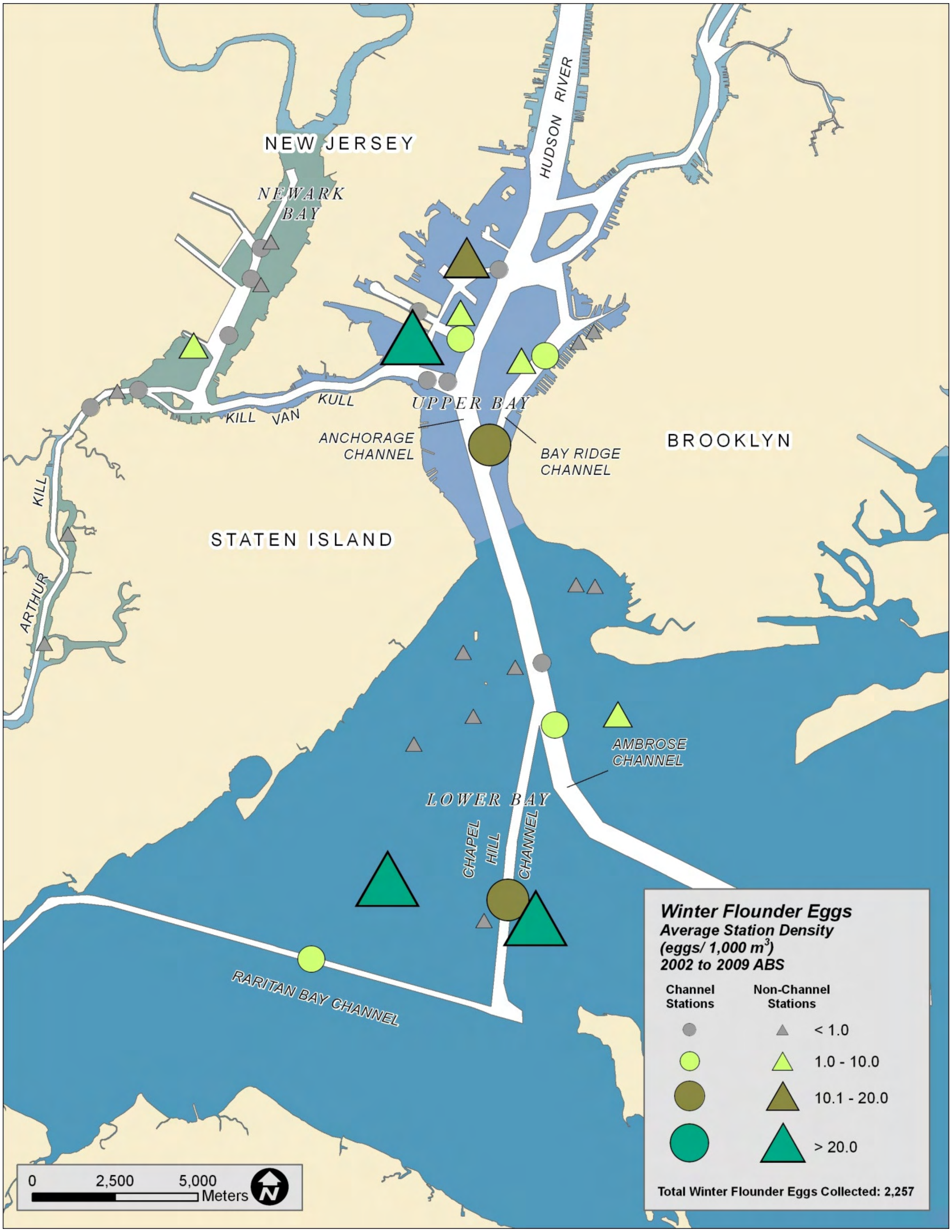


Figure 3-25 Average station density (eggs/1,000 m³) of winter flounder eggs 2002-2009 Aquatic Biological Survey.

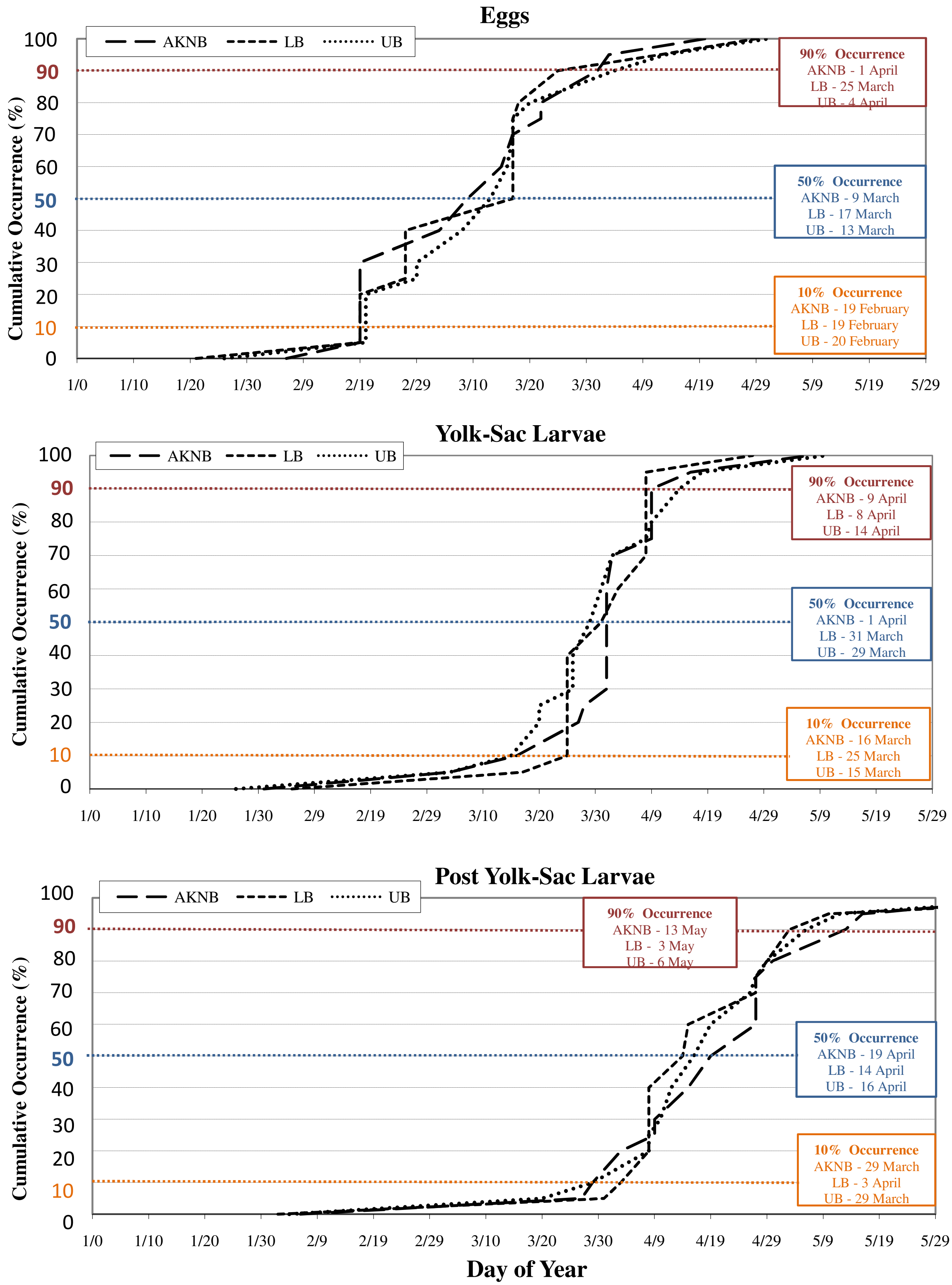


Figure 3-26 a Cumulative occurrence by area for winter flounder eggs, yolk-sac and post yolk-sac larvae for all years combined 1999 to 2009.

Note: No sampling was conducted in January during the 2008 Survey.
No sampling was conducted in July during the 2009 Survey.

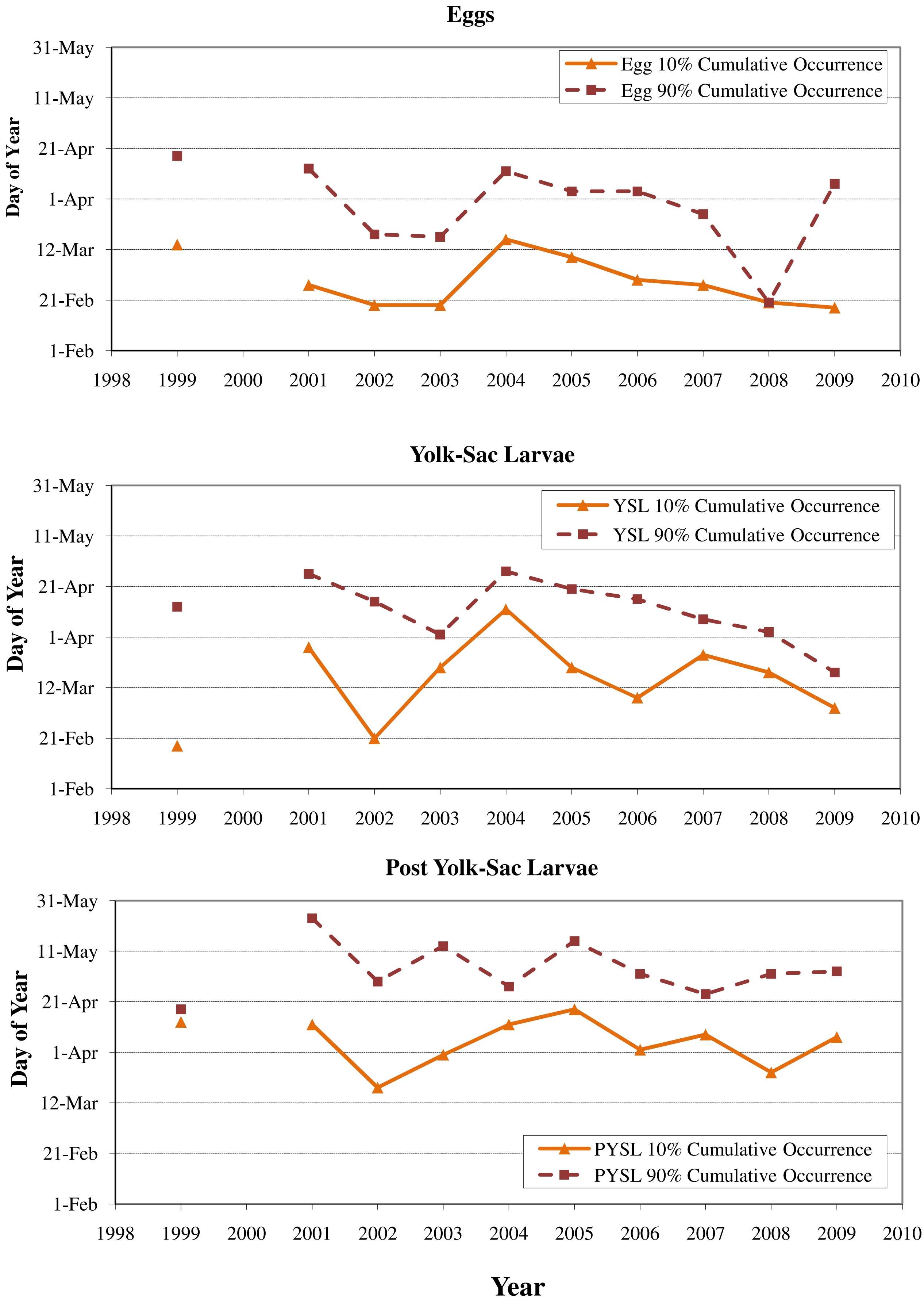


Figure 3-26 b 10% and 90% cumulative occurrence by year for winter flounder eggs, yolk-sac and post yolk-sac larvae, Aquatic Biological Survey 1999 to 2009.

Note: No ABS sampling was conducted in 2000

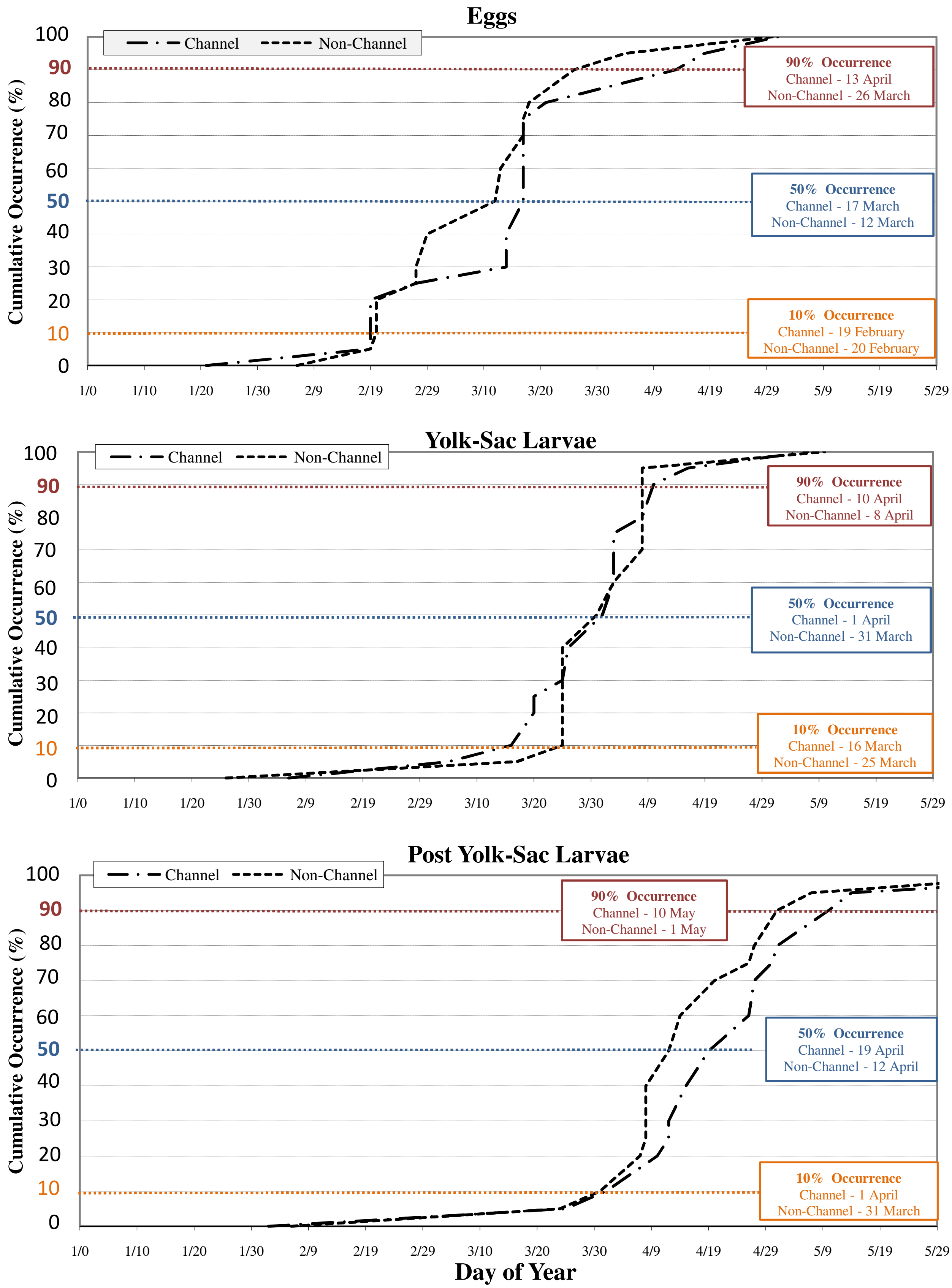


Figure 3-26 c Cumulative occurrence by channel versus non-channel for winter flounder eggs, yolk-sac and post yolk-sac larvae for all years combined 1999 to 2009.

Note: No sampling was conducted in January during the 2008 Survey.

No sampling was conducted in July during the 2009 Survey.

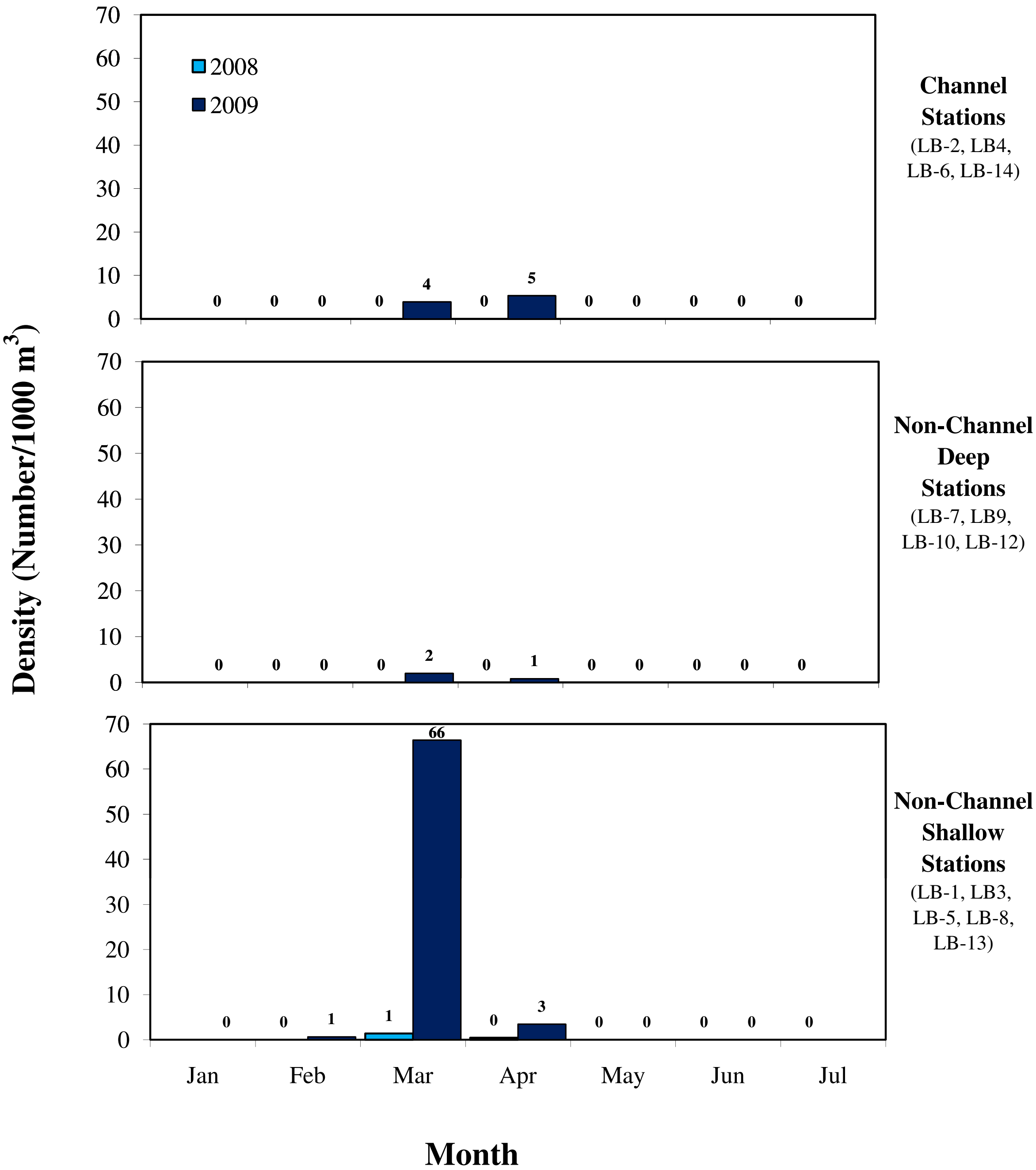


Figure 3-27 a **Average monthly winter flounder egg density in the Lower Bay by station depth during the 2008 and 2009 Aquatic Biological Survey.**

Note: Scale change in non-channel deep stations
Non-viable eggs are not included
No sampling was conducted in January during the 2008 Survey.
No sampling was conducted in July during the 2009 Survey.

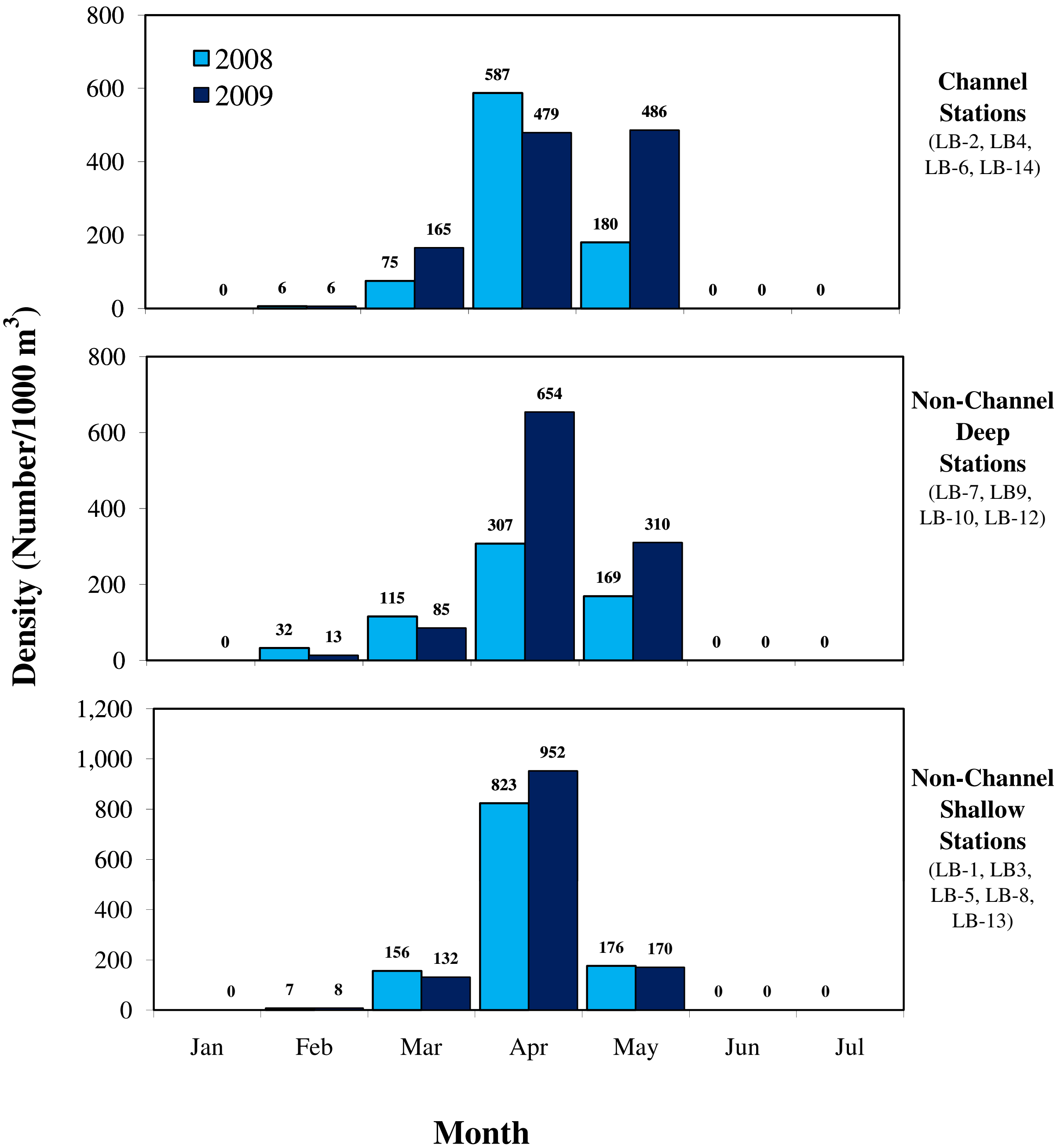


Figure 3-27 b Average monthly winter flounder larvae density in the Lower Bay by station depth during the 2008 and 2009 Aquatic Biological Survey.

Note: Scale change in non-channel shallow stations
No sampling was conducted in January during the 2008 Survey.
No sampling was conducted in July during the 2009 Survey.

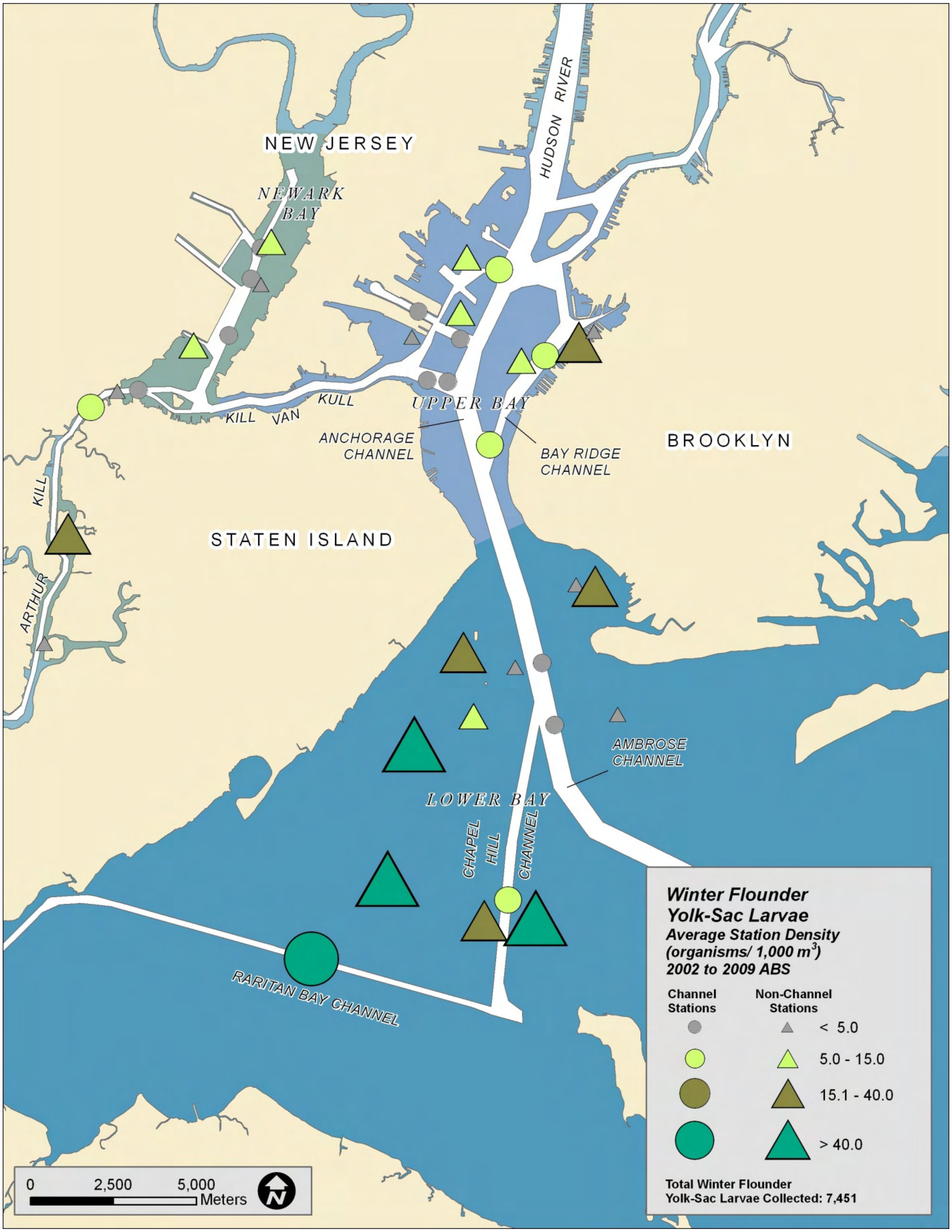


Figure 3-28 Average station density (organisms/1,000 m³) of winter flounder yolk-sac larvae 2002-2009 Aquatic Biological Survey.

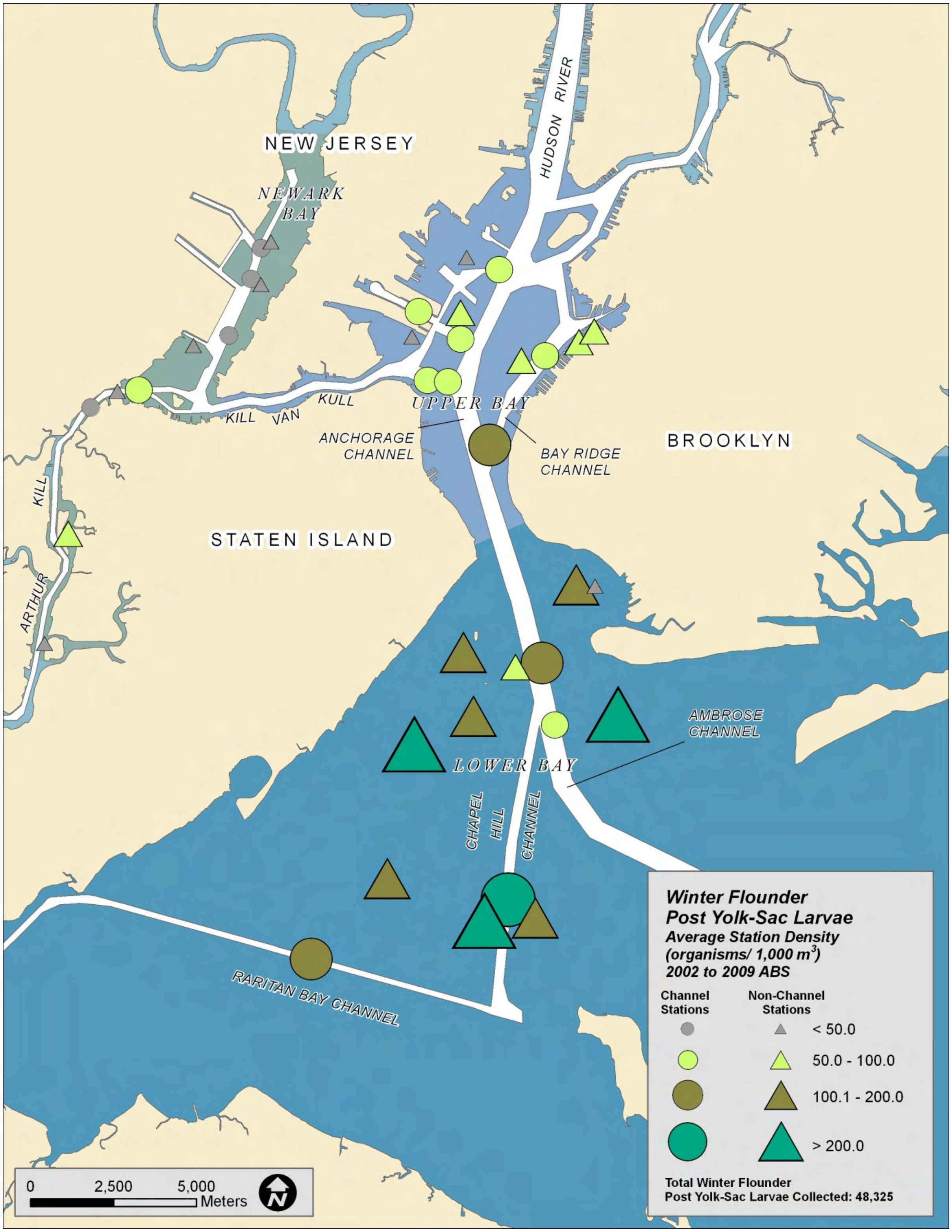


Figure 3-29 Average station density (organisms/1,000 m³) of winter flounder post yolk-sac larvae 2002-2009 Aquatic Biological Survey.

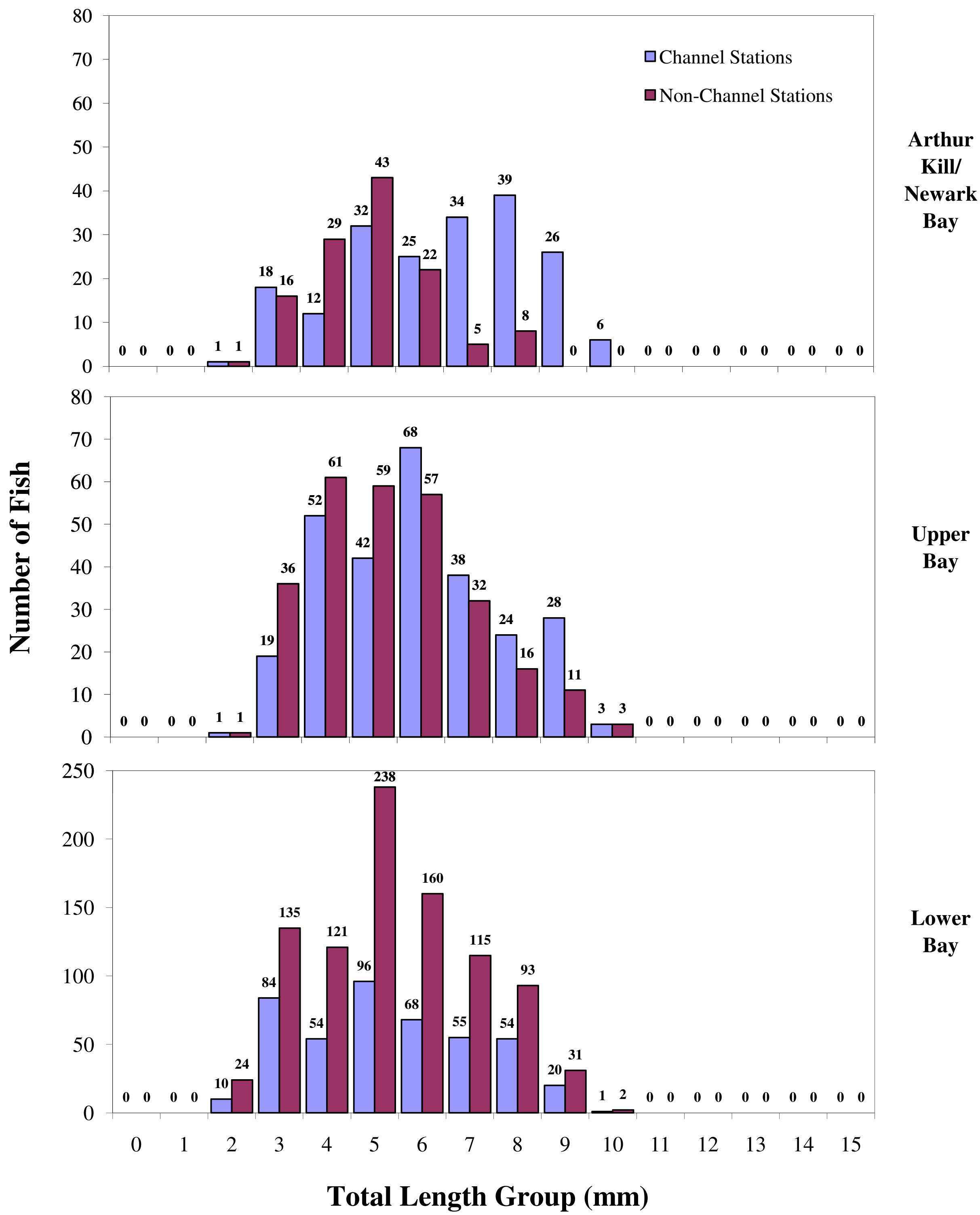


Figure 3-30 a **Length frequency distribution of winter flounder larvae collected during ichthyoplankton sampling at Arthur Kill/Newark Bay, Upper Bay, and Lower Bay stations, 2009 Aquatic Biological Survey.**

Note: Scale change in Lower Bay

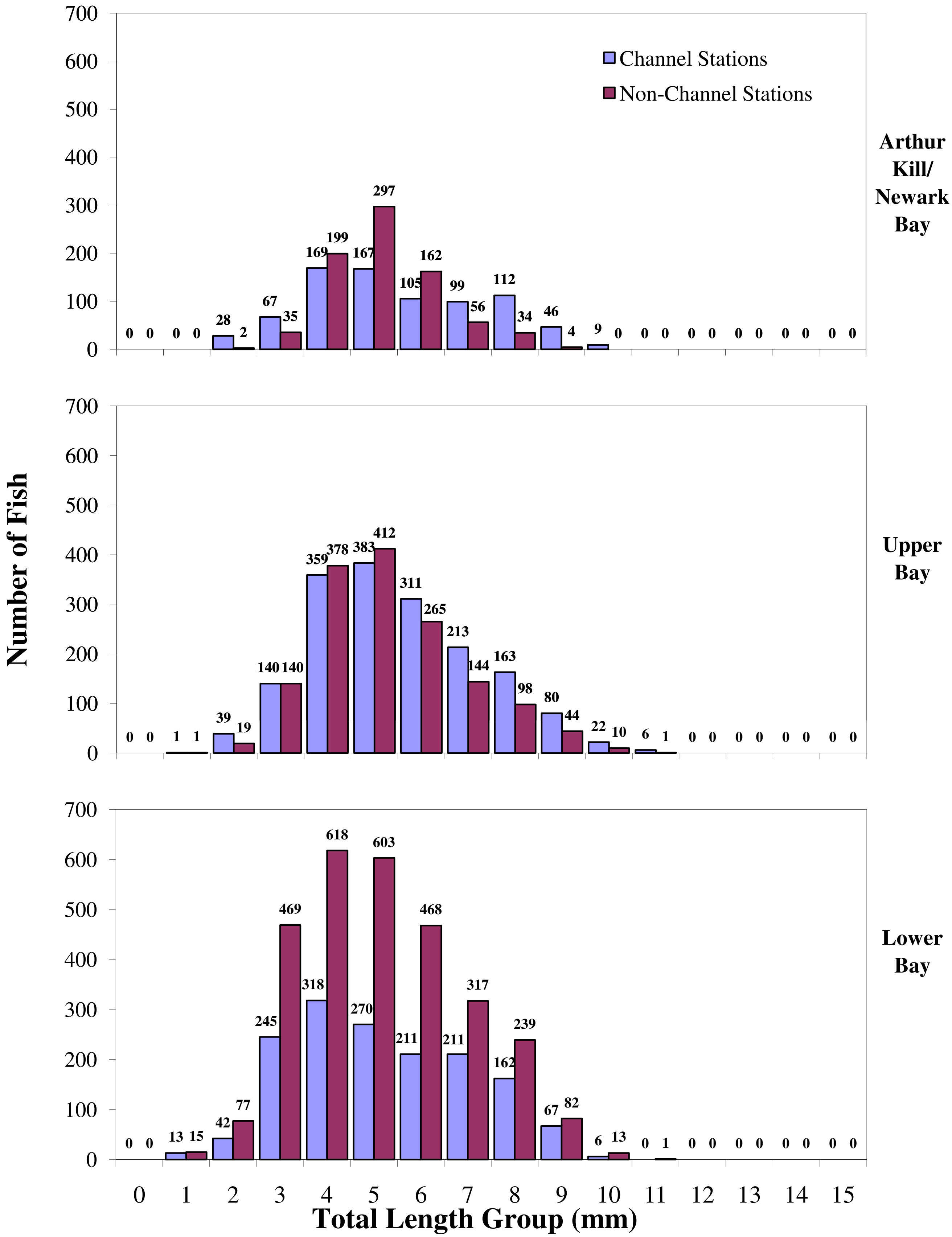


Figure 3-30 b Length frequency distribution of winter flounder larvae collected during ichthyoplankton sampling at Arthur Kill/Newark Bay, Upper Bay, and Lower Bay stations during the 2003-2009 Aquatic Biological Surveys.

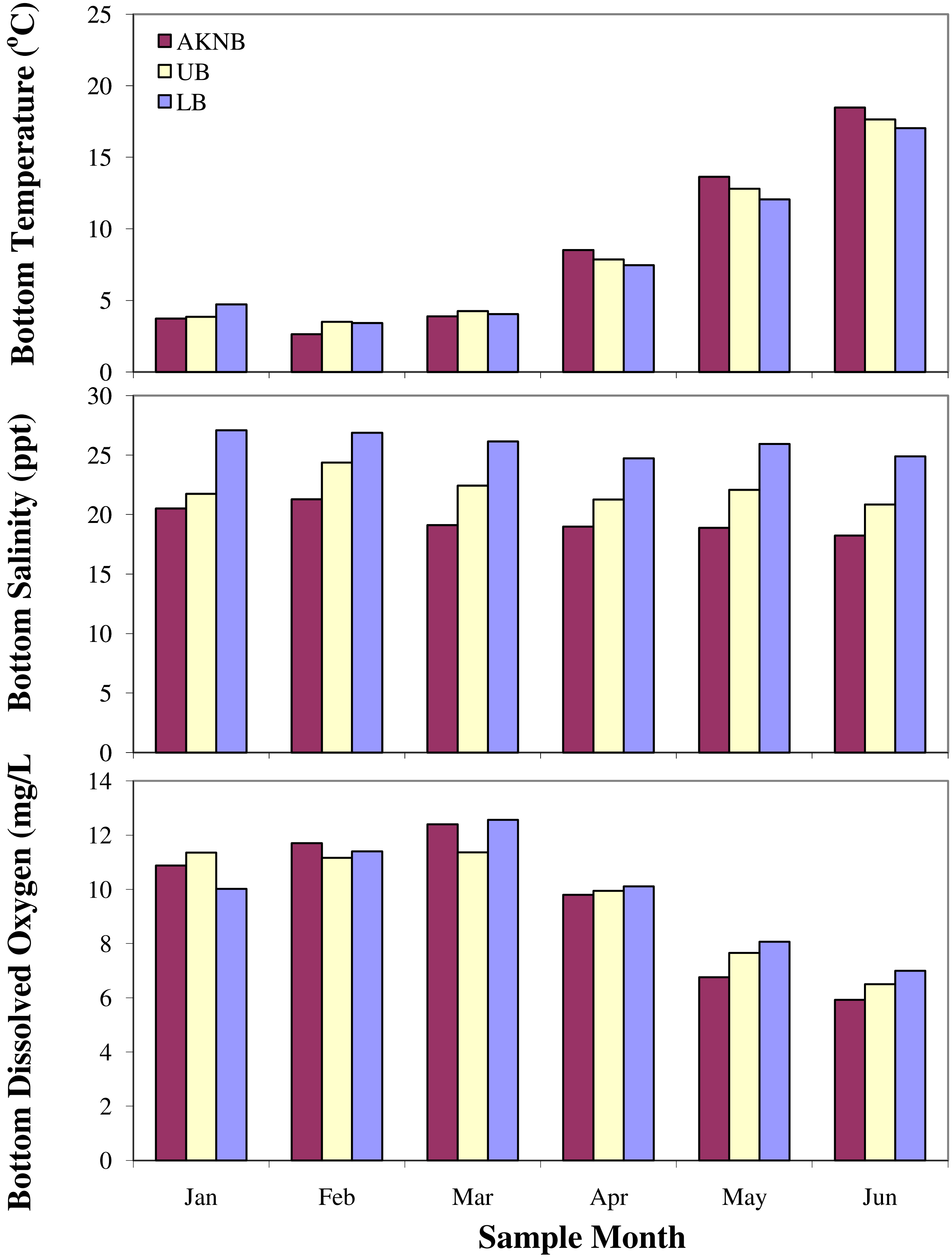


Figure 3-31 **Average monthly water quality data by region during the 2009 Aquatic Biological Survey.**

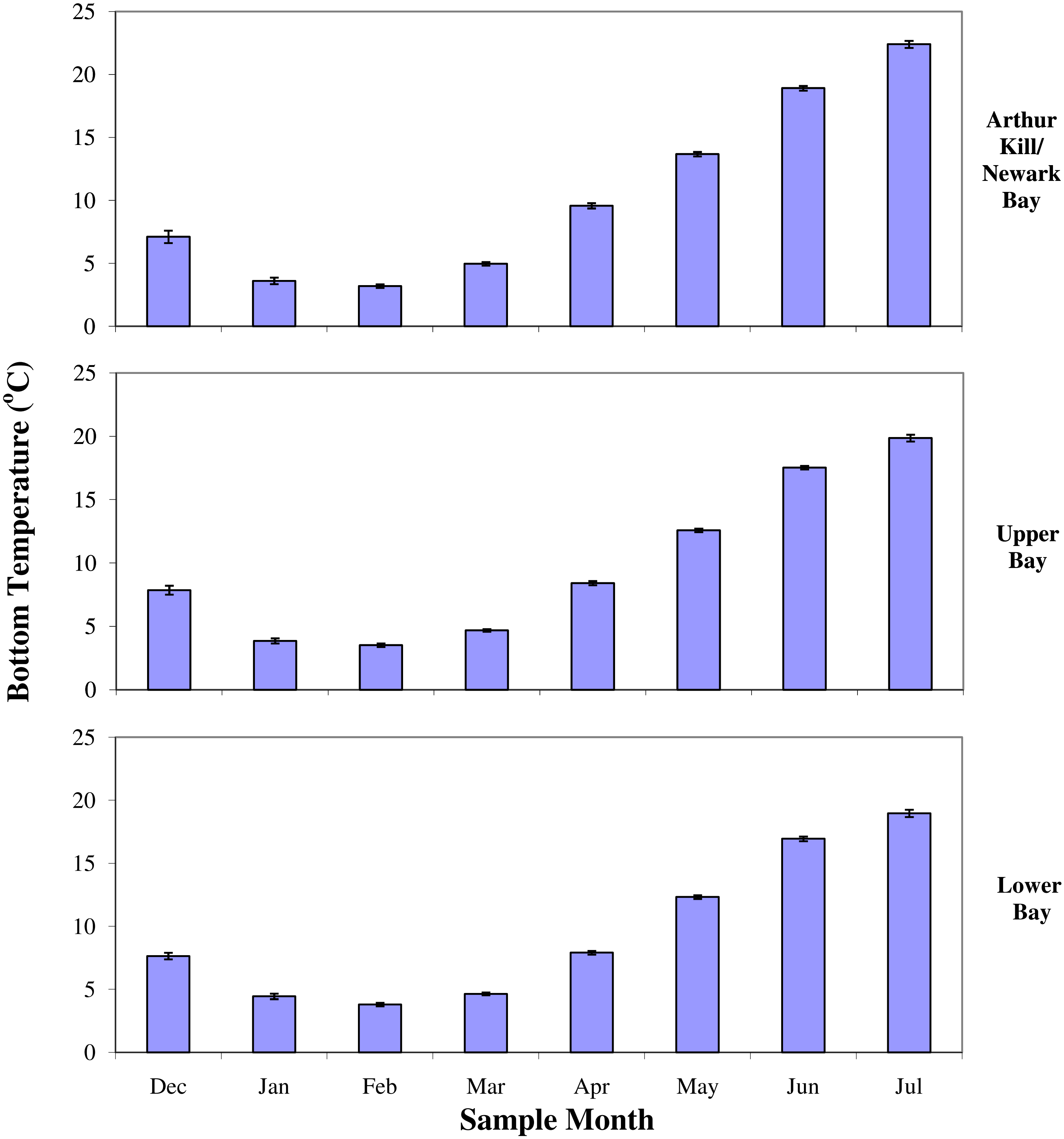


Figure 3-32 a **Average monthly bottom water temperature (± 1 standard error) by region during the 2002-2009 Aquatic Biological Surveys.**

Note: December sampling occurred during the 2002, 2003, and 2009 Program.
January sampling did not occurr during the 2008 Program.
July Sampling did not occur during the 2009 Program.

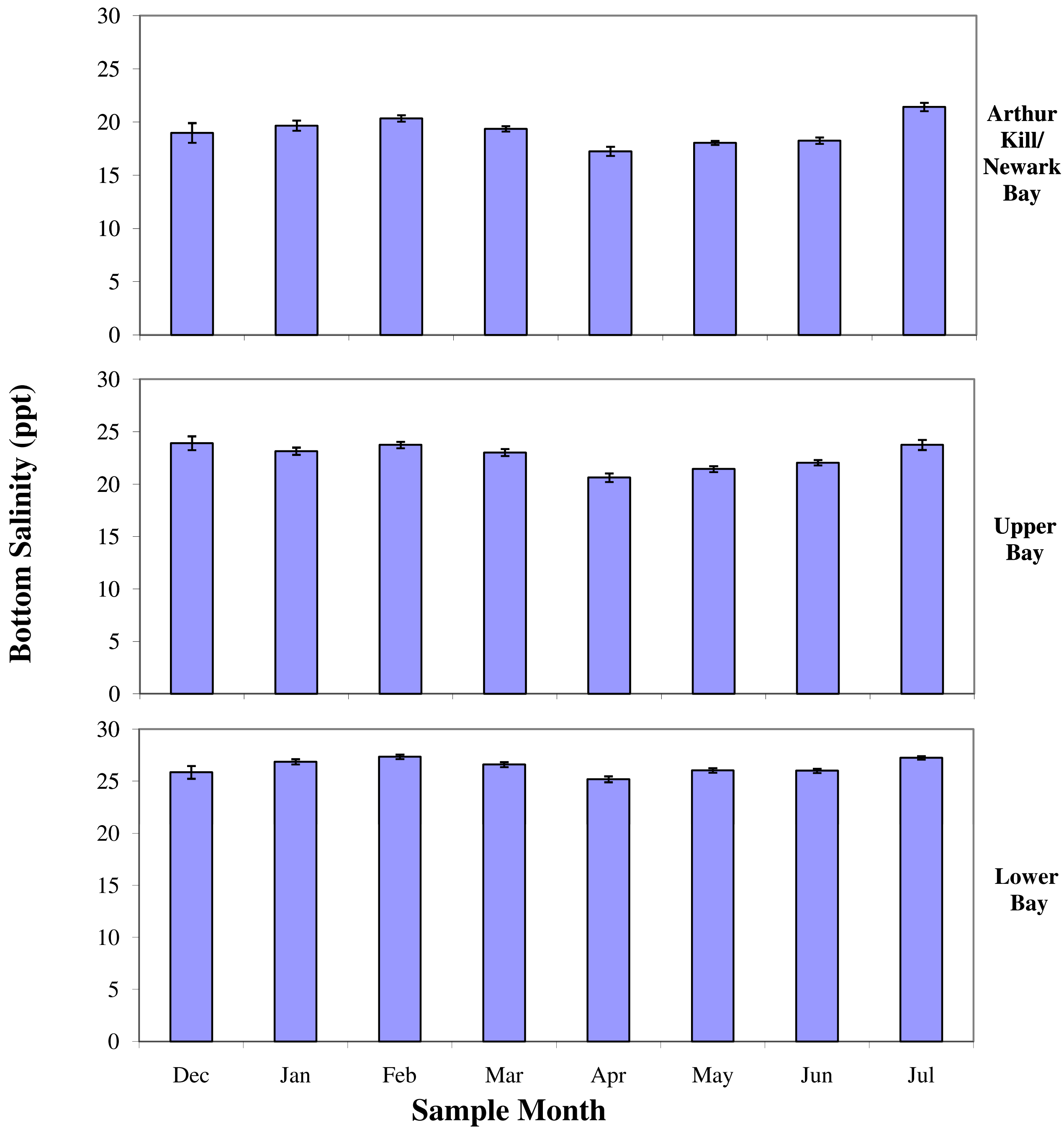


Figure 3-32 b **Average monthly bottom water salinity (± 1 standard error) by region during the 2002-2009 Aquatic Biological Surveys.**

Note: December sampling occurred during the 2002, 2003, and 2009 Program.
January sampling did not occurr during the 2008 Program.
July Sampling did not occur during the 2009 Program.

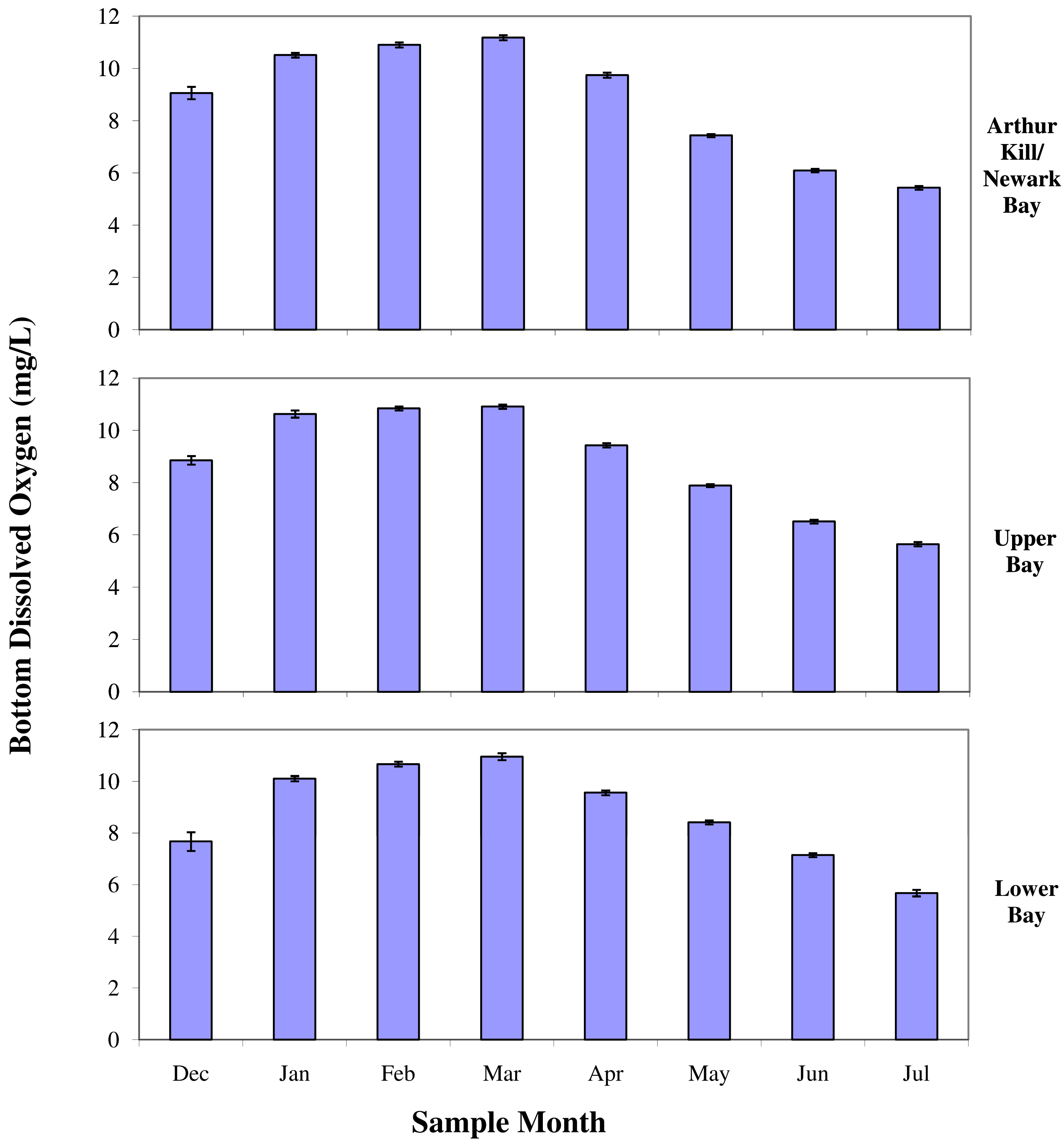


Figure 3-32 c **Average monthly bottom water dissolved oxygen (± 1 standard error) by region during the 2002-2009 Aquatic Biological Surveys.**

Note: December sampling occurred during the 2002, 2003, and 2009 Program.
January sampling did not occurr during the 2008 Program.
July Sampling did not occur during the 2009 Program.

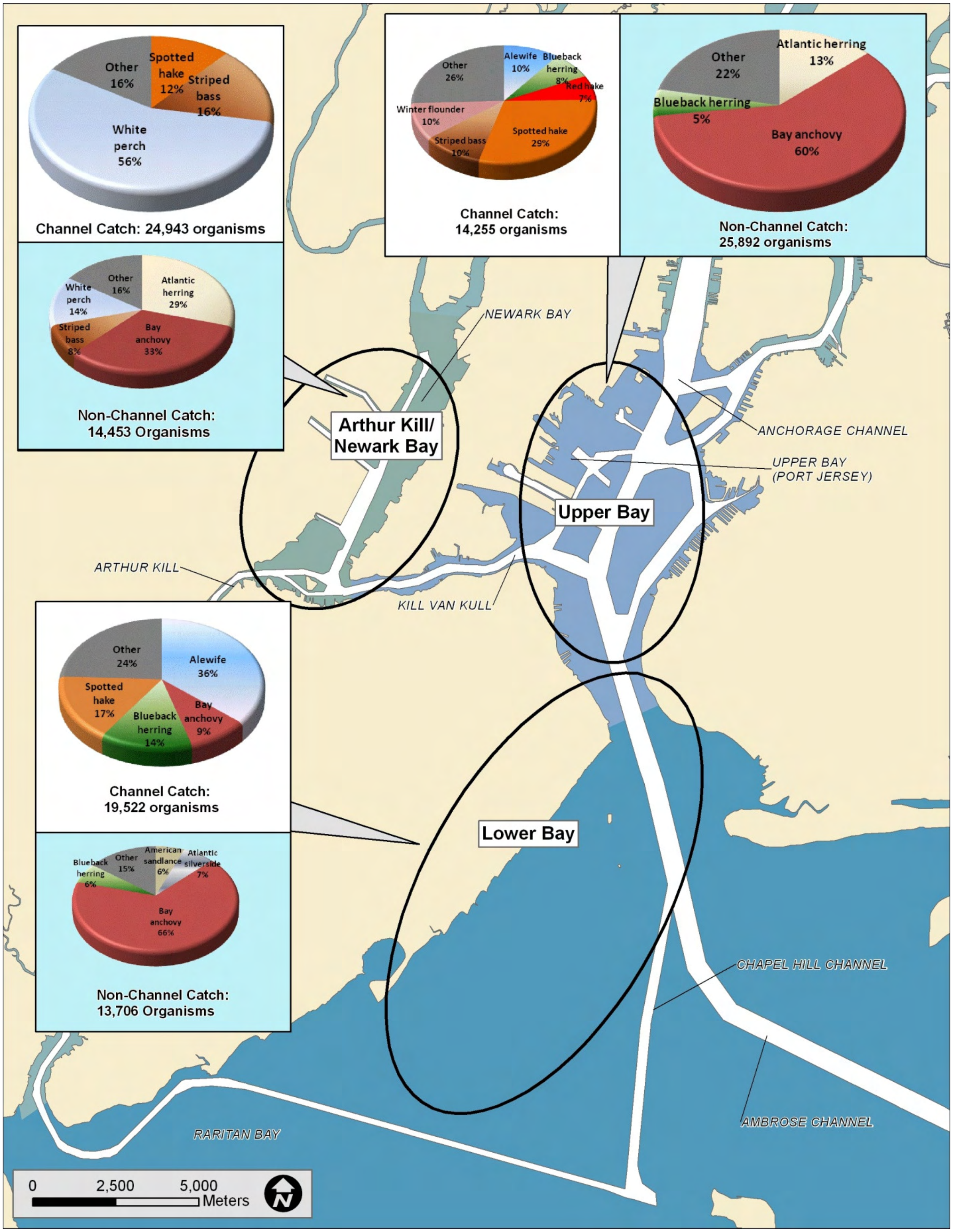


Figure 4-1 Total bottom trawl collection by region and station type (2002-2009).

Appendix A

Bottom Trawl CPUE (number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
12/15/2008	LB-10	Alewife	6.00
12/15/2008	LB-10	Bay anchovy	10.00
12/15/2008	LB-10	Blue crab	1.00
12/15/2008	LB-10	Gizzard shad	2.00
12/15/2008	LB-10	Striped bass	4.00
12/15/2008	LB-10	Winter flounder	1.00
12/15/2008	LB-13	Alewife	55.00
12/15/2008	LB-13	Bay anchovy	2.00
12/15/2008	LB-13	Blueback herring	8.00
12/15/2008	LB-14	Bay anchovy	4.00
12/15/2008	LB-14	Little skate	1.00
12/15/2008	LB-14	Red hake	1.00
12/15/2008	LB-14	Winter flounder	1.00
12/15/2008	LB-3	Alewife	19.00
12/15/2008	LB-3	American sandlance	2.00
12/15/2008	LB-3	Atlantic menhaden	1.00
12/15/2008	LB-3	Bay anchovy	52.00
12/15/2008	LB-3	Blueback herring	129.00
12/15/2008	LB-3	Gizzard shad	1.00
12/15/2008	LB-4	Alewife	1.00
12/15/2008	LB-4	Blueback herring	1.00
12/15/2008	LB-7	Winter flounder	1.00
12/15/2008	LB-8	Blueback herring	49.00
12/15/2008	LB-8	Spotted hake	1.00
12/15/2008	LB-8	Striped bass	1.00
12/15/2008	LB-9	Bay anchovy	1.00
12/16/2008	AK-2	Atlantic tomcod	1.00
12/16/2008	AK-2	Gizzard shad	2.00
12/16/2008	AK-2	Red hake	2.00
12/16/2008	AK-2	Silver hake	1.00
12/16/2008	AK-2	Striped bass	2.00
12/16/2008	AK-2	Tautog	1.00
12/16/2008	AK-2	White perch	106.00
12/16/2008	AK-2	Winter flounder	13.00
12/16/2008	AK-3	Alewife	1.11
12/16/2008	AK-3	Bay anchovy	1.11

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
12/16/2008	AK-3	Blue crab	1.11
12/16/2008	AK-3	Gizzard shad	1.11
12/16/2008	AK-3	Red hake	1.11
12/16/2008	AK-3	White perch	4.44
12/16/2008	AK-3	Winter flounder	1.11
12/16/2008	NB-4	Alewife	4.00
12/16/2008	NB-4	Atlantic silverside	2.00
12/16/2008	NB-4	Bay anchovy	46.00
12/16/2008	NB-4	Blueback herring	22.00
12/16/2008	NB-4	Gizzard shad	2.00
12/16/2008	NB-4	White perch	5.00
12/16/2008	NB-4	Windowpane	1.00
12/16/2008	NB-7	Bay anchovy	20.00
12/16/2008	NB-7	Blueback herring	23.75
12/16/2008	NB-7	Cunner	1.25
12/16/2008	NB-7	Smallmouth flounder	1.25
12/16/2008	NB-7	Striped bass	1.25
12/16/2008	NB-7	White perch	3.75
12/16/2008	NB-7	Winter flounder	2.50
12/16/2008	NB-8	Bay anchovy	5.00
12/16/2008	NB-8	Gizzard shad	1.00
12/16/2008	NB-8	Northern pipefish	1.00
12/16/2008	NB-8	White perch	6.00
12/16/2008	NB-8	Winter flounder	1.00
12/16/2008	PJ-1	Alewife	6.00
12/16/2008	PJ-1	Blue crab	1.00
12/16/2008	PJ-1	Blueback herring	1.00
12/16/2008	PJ-1	Grubby	1.00
12/16/2008	PJ-1	Striped bass	61.00
12/16/2008	PJ-1	White perch	19.00
12/16/2008	PJ-1	Winter flounder	8.00
12/16/2008	PJ-2	Bay anchovy	9.00
12/16/2008	PJ-2	Striped bass	11.00
12/16/2008	PJ-2	White mullet	1.00
12/16/2008	PJ-2	White perch	4.00
12/16/2008	PJ-2	Winter flounder	5.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
12/16/2008	SB-5	Alewife	2.00
12/16/2008	SB-5	Blue crab	5.00
12/16/2008	SB-5	Clearnose skate	1.00
12/16/2008	SB-5	Red hake	3.00
12/16/2008	SB-5	Spotted hake	2.00
12/16/2008	SB-5	Tautog	1.00
12/16/2008	SB-5	White perch	66.00
12/16/2008	SB-5	Winter flounder	47.00
12/18/2008	LB-1	American sandlance	141.00
12/18/2008	LB-1	Atlantic silverside	3.00
12/18/2008	LB-2	Silver hake	1.00
12/18/2008	LB-5	Alewife	10.00
12/18/2008	LB-5	Bay anchovy	9.00
12/18/2008	LB-5	Blue crab	1.00
12/18/2008	LB-5	Blueback herring	1.00
12/18/2008	LB-5	Northern pipefish	1.00
12/18/2008	LB-6	Alewife	102.00
12/18/2008	LB-6	Atlantic menhaden	1.00
12/18/2008	LB-6	Bay anchovy	14.00
12/18/2008	LB-6	Fourspot flounder	1.00
12/18/2008	LB-6	Little skate	5.00
12/18/2008	LB-6	Silver hake	6.00
12/18/2008	LB-6	Spotted hake	5.00
12/18/2008	LB-6	Striped bass	1.00
12/18/2008	SB-3	Bay anchovy	3.00
12/18/2008	SB-3	Blueback herring	56.00
12/18/2008	SB-3	Striped bass	2.00
12/18/2008	SB-4	Alewife	2.00
12/18/2008	SB-4	Bay anchovy	1.00
12/18/2008	SB-6	American sandlance	1.00
12/18/2008	SB-6	Atlantic silverside	1.00
12/18/2008	SB-6	Little skate	1.00
12/18/2008	SB-6	Red hake	2.00
12/18/2008	SB-6	Spotted hake	1.00
12/18/2008	SB-6	Windowpane	2.00
12/18/2008	SB-6	Winter flounder	1.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
1/5/2009	LB-12	American sandlance	4.00
1/5/2009	LB-12	Atlantic silverside	12.00
1/5/2009	LB-12	Smallmouth flounder	1.00
1/5/2009	LB-12	Winter flounder	1.00
1/5/2009	LB-13	Atlantic silverside	1.00
1/5/2009	LB-3	Blueback herring	2.00
1/5/2009	LB-4	Alewife	73.00
1/5/2009	LB-4	Blueback herring	400.00
1/5/2009	LB-6	Alewife	776.00
1/5/2009	LB-6	Atlantic menhaden	1.00
1/5/2009	LB-6	Atlantic silverside	68.00
1/5/2009	LB-6	Blueback herring	27.00
1/5/2009	LB-6	Red hake	1.00
1/5/2009	LB-6	Silver hake	2.00
1/5/2009	LB-6	Spotted hake	1.00
1/5/2009	LB-6	Winter flounder	2.00
1/6/2009	LB-1	American sandlance	52.00
1/6/2009	LB-1	Atlantic silverside	97.00
1/6/2009	LB-1	Spotted hake	1.00
1/6/2009	LB-10	Alewife	91.00
1/6/2009	LB-10	American shad	7.00
1/6/2009	LB-10	Atlantic herring	2.00
1/6/2009	LB-10	Blueback herring	414.00
1/6/2009	LB-14	American shad	3.00
1/6/2009	LB-14	Little skate	2.00
1/6/2009	LB-14	Silver hake	1.00
1/6/2009	LB-2	Alewife	208.00
1/6/2009	LB-2	Blueback herring	50.00
1/6/2009	LB-2	Red hake	2.00
1/6/2009	LB-2	Silver hake	23.00
1/6/2009	LB-2	Spotted hake	2.00
1/6/2009	LB-2	Winter flounder	1.00
1/6/2009	LB-7	Smallmouth flounder	1.00
1/6/2009	LB-8	Atlantic silverside	18.00
1/6/2009	LB-9	Atlantic silverside	2.00
1/6/2009	LB-9	Blueback herring	1.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
1/6/2009	LB-9	Grubby	3.00
1/6/2009	LB-9	Little skate	1.00
1/7/2009	AK-2	Alewife	2.00
1/7/2009	AK-2	Striped bass	8.00
1/7/2009	AK-2	White perch	17.00
1/7/2009	AK-3	Atlantic croaker	1.11
1/7/2009	AK-3	Bay anchovy	1.11
1/7/2009	AK-3	Gizzard shad	3.33
1/7/2009	AK-3	Red hake	5.56
1/7/2009	AK-3	Striped bass	32.22
1/7/2009	AK-3	Tautog	1.11
1/7/2009	AK-3	White perch	695.56
1/7/2009	AK-3	Winter flounder	26.67
1/7/2009	NB-4	Alewife	1.00
1/7/2009	NB-4	Bay anchovy	1.00
1/7/2009	NB-7	Bay anchovy	1.25
1/7/2009	NB-7	Blueback herring	5.00
1/7/2009	NB-7	Rainbow smelt	1.25
1/7/2009	NB-7	Winter flounder	2.50
1/7/2009	NB-8	Northern pipefish	1.00
1/7/2009	NB-8	Striped bass	2.00
1/7/2009	NB-8	White perch	33.00
1/7/2009	NB-8	Winter flounder	2.00
1/7/2009	PJ-1	Alewife	1.11
1/7/2009	PJ-1	American sandlance	1.11
1/8/2009	PJ-2	Alewife	6.00
1/8/2009	PJ-2	Atlantic silverside	1.00
1/8/2009	PJ-2	Bay anchovy	6.00
1/8/2009	PJ-2	Striped bass	1.00
1/8/2009	PJ-2	Winter flounder	4.00
1/8/2009	SB-3	American shad	1.00
1/8/2009	SB-4	Alewife	2.00
1/8/2009	SB-5	Alewife	4.00
1/8/2009	SB-5	American shad	1.00
1/8/2009	SB-5	Bay anchovy	2.00
1/8/2009	SB-6	Red hake	1.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
1/20/2009	LB-12	Alewife	2.00
1/20/2009	LB-12	Atlantic silverside	6.00
1/20/2009	LB-12	Blueback herring	8.00
1/20/2009	LB-12	Winter skate	1.00
1/20/2009	LB-13	American sandlance	7.00
1/20/2009	LB-13	Atlantic silverside	3.00
1/20/2009	LB-13	Feather blenny	1.00
1/20/2009	LB-13	Rainbow smelt	1.00
1/20/2009	LB-13	Summer flounder	1.00
1/20/2009	LB-4	Alewife	520.00
1/20/2009	LB-4	Atlantic herring	4.00
1/20/2009	LB-4	Atlantic silverside	5.00
1/20/2009	LB-4	Blueback herring	64.00
1/20/2009	LB-4	Northern pipefish	1.00
1/20/2009	LB-4	Silver hake	2.00
1/20/2009	LB-5	Atlantic silverside	1.00
1/20/2009	LB-6	Atlantic silverside	3.00
1/20/2009	LB-6	Winter flounder	1.00
1/21/2009	PJ-1	Alewife	1.00
1/21/2009	PJ-1	Northern pipefish	1.00
1/21/2009	PJ-2	Atlantic silverside	6.00
1/21/2009	SB-5	Alewife	19.00
1/21/2009	SB-5	Atlantic herring	6.00
1/21/2009	SB-5	Atlantic silverside	3.00
1/21/2009	SB-5	Gizzard shad	1.00
1/21/2009	SB-5	Northern pipefish	1.00
1/21/2009	SB-5	Red hake	1.00
1/21/2009	SB-5	Spotted hake	1.00
1/21/2009	SB-5	Striped bass	207.00
1/21/2009	SB-5	White perch	17.00
1/21/2009	SB-5	Winter flounder	12.00
1/21/2009	SB-6	Alewife	163.00
1/21/2009	SB-6	American sandlance	1.00
1/21/2009	SB-6	Atlantic menhaden	2.00
1/21/2009	SB-6	Atlantic silverside	4.00
1/21/2009	SB-6	Silver hake	1.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
1/21/2009	SB-6	Winter flounder	2.00
1/22/2009	AK-2	Striped bass	3.00
1/22/2009	AK-2	White perch	17.00
1/22/2009	AK-3	Alewife	6.00
1/22/2009	AK-3	Cunner	1.00
1/22/2009	AK-3	Red hake	4.00
1/22/2009	AK-3	Striped bass	21.00
1/22/2009	AK-3	Tautog	1.00
1/22/2009	AK-3	White perch	441.00
1/22/2009	AK-3	Winter flounder	34.00
1/22/2009	NB-4	Atlantic silverside	2.00
1/22/2009	NB-7	Atlantic silverside	2.22
1/22/2009	NB-8	Gizzard shad	1.00
1/22/2009	NB-8	Red hake	2.00
1/22/2009	NB-8	Striped bass	8.00
1/22/2009	NB-8	White perch	156.00
1/23/2009	LB-10	Atlantic silverside	31.00
1/23/2009	LB-14	Atlantic silverside	13.00
1/23/2009	LB-14	Grubby	1.00
1/23/2009	LB-14	Little skate	1.00
1/23/2009	LB-14	Silver hake	2.00
1/23/2009	LB-14	Winter flounder	3.00
1/23/2009	LB-2	Alewife	39.00
1/23/2009	LB-2	Atlantic silverside	4.00
1/23/2009	LB-2	Blueback herring	293.00
1/23/2009	LB-2	Little skate	1.00
1/23/2009	LB-2	Silver hake	2.00
1/23/2009	LB-2	Spotted hake	1.00
1/23/2009	LB-2	Winter flounder	1.00
1/23/2009	LB-9	Atlantic silverside	2.00
1/23/2009	LB-9	Little skate	1.00
2/2/2009	LB-4	Little skate	1.00
2/2/2009	LB-6	Atlantic silverside	1.00
2/2/2009	LB-7	Alewife	125.00
2/2/2009	LB-7	Blueback herring	145.00
2/4/2009	SB-4	Alewife	13.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
2/4/2009	SB-4	Blueback herring	1.00
2/4/2009	SB-4	Little skate	1.00
2/4/2009	SB-4	Striped bass	4.00
2/4/2009	SB-4	Winter flounder	6.00
2/4/2009	SB-5	Alewife	83.00
2/4/2009	SB-5	American shad	2.00
2/4/2009	SB-5	Atlantic herring	2.00
2/4/2009	SB-5	Blueback herring	1.00
2/4/2009	SB-5	Gizzard shad	1.00
2/4/2009	SB-5	Striped bass	31.00
2/4/2009	SB-5	White perch	1.00
2/4/2009	SB-5	Winter flounder	12.00
2/4/2009	SB-6	Alewife	281.00
2/4/2009	SB-6	American sandlance	1.00
2/4/2009	SB-6	Atlantic herring	9.00
2/4/2009	SB-6	Blueback herring	4.00
2/4/2009	SB-6	Conger eel	1.00
2/5/2009	AK-2	White perch	1.00
2/5/2009	AK-2	Winter flounder	1.00
2/5/2009	AK-3	Alewife	5.00
2/5/2009	AK-3	Blueback herring	2.00
2/5/2009	AK-3	Striped bass	4.00
2/5/2009	AK-3	Summer flounder	1.00
2/5/2009	AK-3	White perch	97.00
2/5/2009	AK-3	Windowpane	1.00
2/5/2009	AK-3	Winter flounder	9.00
2/5/2009	NB-4	Atlantic silverside	2.00
2/5/2009	NB-7	Winter flounder	2.50
2/5/2009	NB-8	Atlantic silverside	1.00
2/5/2009	NB-8	Striped bass	3.00
2/5/2009	NB-8	White perch	117.00
2/5/2009	NB-8	Winter flounder	2.00
2/6/2009	LB-1	Alewife	1.00
2/6/2009	LB-1	Atlantic silverside	2.00
2/6/2009	LB-1	Blueback herring	2.00
2/6/2009	LB-10	Alewife	9.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
2/6/2009	LB-10	Atlantic silverside	6.00
2/6/2009	LB-10	Blueback herring	20.00
2/6/2009	LB-14	Alewife	89.00
2/6/2009	LB-14	Atlantic silverside	1.00
2/6/2009	LB-14	Blueback herring	221.00
2/6/2009	LB-14	Grubby	2.00
2/6/2009	LB-14	Winter flounder	8.00
2/6/2009	LB-2	Alewife	163.00
2/6/2009	LB-2	American shad	2.00
2/6/2009	LB-2	Atlantic silverside	1.00
2/6/2009	LB-2	Blueback herring	88.00
2/6/2009	LB-2	Winter flounder	4.00
2/6/2009	LB-9	Atlantic silverside	1.00
2/6/2009	LB-9	Grubby	1.00
2/6/2009	LB-9	Seaboard goby	1.00
2/17/2009	LB-12	Blueback herring	1.00
2/17/2009	LB-12	Smallmouth flounder	1.00
2/17/2009	LB-12	Winter flounder	2.00
2/17/2009	LB-4	Alewife	144.00
2/17/2009	LB-4	American shad	1.00
2/17/2009	LB-4	Atlantic herring	10.00
2/17/2009	LB-4	Blueback herring	261.00
2/17/2009	LB-4	Winter flounder	2.00
2/17/2009	LB-5	Alewife	1.00
2/17/2009	LB-5	Windowpane	1.00
2/17/2009	LB-6	Alewife	5.00
2/17/2009	LB-6	Blueback herring	1.00
2/17/2009	LB-6	Windowpane	1.00
2/17/2009	LB-7	Alewife	5.00
2/17/2009	LB-7	American shad	1.00
2/17/2009	LB-7	Blueback herring	1.00
2/17/2009	LB-7	Little skate	1.00
2/17/2009	LB-8	Naked goby	1.00
2/18/2009	LB-2	Alewife	2.00
2/18/2009	LB-2	Atlantic silverside	1.00
2/18/2009	LB-2	Blue crab	2.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
2/18/2009	LB-2	Winter flounder	4.00
2/18/2009	SB-3	Grubby	1.00
2/18/2009	SB-4	Alewife	112.00
2/18/2009	SB-4	American shad	9.00
2/18/2009	SB-4	Atlantic herring	2.00
2/18/2009	SB-4	Atlantic silverside	1.00
2/18/2009	SB-4	Blueback herring	31.00
2/18/2009	SB-4	Striped bass	8.00
2/18/2009	SB-4	White perch	1.00
2/18/2009	SB-4	Winter flounder	14.00
2/18/2009	SB-6	Alewife	52.00
2/18/2009	SB-6	American shad	1.00
2/18/2009	SB-6	Atlantic herring	1.00
2/18/2009	SB-6	Blueback herring	11.00
2/18/2009	SB-6	Tautog	1.00
2/18/2009	SB-6	Windowpane	3.00
2/25/2009	LB-1	American sandlance	37.00
2/25/2009	LB-9	Rock gunnel	1.00
2/25/2009	PJ-1	Grubby	1.00
2/25/2009	PJ-1	Windowpane	1.00
2/25/2009	PJ-1	Winter flounder	1.00
2/25/2009	SB-5	Alewife	2.00
2/25/2009	SB-5	Atlantic herring	2.00
2/25/2009	SB-5	Blueback herring	2.00
2/25/2009	SB-5	Striped bass	3.00
2/25/2009	SB-5	Winter flounder	2.00
2/26/2009	AK-2	Alewife	18.00
2/26/2009	AK-2	American shad	1.00
2/26/2009	AK-2	Striped bass	5.00
2/26/2009	AK-2	White perch	35.00
2/26/2009	AK-2	Winter flounder	3.00
2/26/2009	AK-3	American shad	2.00
2/26/2009	AK-3	Atlantic herring	1.00
2/26/2009	AK-3	Grubby	1.00
2/26/2009	AK-3	Smallmouth flounder	1.00
2/26/2009	AK-3	Striped bass	58.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
2/26/2009	AK-3	Striped killifish	1.00
2/26/2009	AK-3	White perch	405.00
2/26/2009	AK-3	Winter flounder	21.00
2/26/2009	NB-4	Atlantic silverside	2.00
2/26/2009	NB-4	Blue crab	3.00
2/26/2009	NB-7	Blue crab	1.11
2/26/2009	NB-8	Alewife	17.00
2/26/2009	NB-8	American shad	1.00
2/26/2009	NB-8	Grubby	1.00
2/26/2009	NB-8	White perch	17.00
2/26/2009	NB-8	Winter flounder	1.00
3/4/2009	AK-2	Alewife	93.00
3/4/2009	AK-2	Atlantic herring	1.00
3/4/2009	AK-2	Blueback herring	8.00
3/4/2009	AK-2	Gizzard shad	2.00
3/4/2009	AK-2	Grubby	1.00
3/4/2009	AK-2	Striped bass	50.00
3/4/2009	AK-2	White perch	143.00
3/4/2009	AK-2	Windowpane	1.00
3/4/2009	AK-2	Winter flounder	9.00
3/4/2009	AK-3	Alewife	56.00
3/4/2009	AK-3	Blueback herring	3.00
3/4/2009	AK-3	Smallmouth flounder	2.00
3/4/2009	AK-3	Striped bass	20.00
3/4/2009	AK-3	White perch	157.00
3/4/2009	AK-3	Winter flounder	22.00
3/4/2009	NB-4	Blue crab	1.00
3/4/2009	NB-7	Blue crab	4.44
3/4/2009	NB-7	Threespine stickleback	1.11
3/4/2009	NB-8	Alewife	1.00
3/4/2009	NB-8	Blue crab	1.00
3/4/2009	NB-8	Red hake	1.00
3/4/2009	NB-8	Striped bass	7.00
3/4/2009	NB-8	White perch	15.00
3/4/2009	NB-8	Winter flounder	1.00
3/5/2009	LB-13	Alewife	1.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
3/5/2009	LB-13	American sandlance	23.00
3/5/2009	LB-6	Alewife	28.00
3/5/2009	LB-6	American shad	1.00
3/5/2009	LB-6	Atlantic silverside	3.00
3/5/2009	LB-6	Blueback herring	2.00
3/5/2009	LB-6	Windowpane	1.00
3/6/2009	LB-2	Winter flounder	2.00
3/9/2009	PJ-2	Atlantic herring	1.00
3/9/2009	SB-3	Atlantic silverside	1.00
3/9/2009	SB-4	Atlantic herring	1.00
3/9/2009	SB-5	Alewife	4.00
3/9/2009	SB-5	Blueback herring	1.00
3/9/2009	SB-5	Winter flounder	3.00
3/9/2009	SB-6	Smallmouth flounder	1.00
3/9/2009	SB-6	Windowpane	1.00
3/16/2009	PJ-1	Atlantic silverside	1.00
3/16/2009	SB-3	Atlantic silverside	1.00
3/16/2009	SB-4	Alewife	30.00
3/16/2009	SB-4	American shad	3.00
3/16/2009	SB-4	Atlantic herring	2.00
3/16/2009	SB-4	Atlantic silverside	1.00
3/16/2009	SB-4	Blueback herring	3.00
3/16/2009	SB-4	Gobies	1.00
3/16/2009	SB-4	Northern pipefish	3.00
3/16/2009	SB-4	Winter flounder	6.00
3/16/2009	SB-5	Alewife	1.00
3/16/2009	SB-5	Blueback herring	11.00
3/16/2009	SB-5	Northern pipefish	2.00
3/16/2009	SB-5	Smallmouth flounder	1.00
3/16/2009	SB-5	Striped bass	34.00
3/16/2009	SB-5	White perch	90.00
3/16/2009	SB-5	Windowpane	1.00
3/16/2009	SB-5	Winter flounder	37.00
3/17/2009	AK-2	Alewife	14.00
3/17/2009	AK-2	Blueback herring	1.00
3/17/2009	AK-2	Striped bass	1.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
3/17/2009	AK-2	White perch	11.00
3/17/2009	AK-2	Winter flounder	2.00
3/17/2009	AK-3	Alewife	2.00
3/17/2009	AK-3	Grubby	1.00
3/17/2009	AK-3	Striped bass	26.00
3/17/2009	AK-3	Tautog	1.00
3/17/2009	AK-3	White perch	627.00
3/17/2009	AK-3	Windowpane	1.00
3/17/2009	AK-3	Winter flounder	26.00
3/17/2009	NB-7	Blue crab	1.00
3/17/2009	NB-8	Alewife	26.00
3/17/2009	NB-8	American shad	2.00
3/17/2009	NB-8	Blueback herring	1.00
3/17/2009	NB-8	Striped bass	9.00
3/17/2009	NB-8	Tautog	1.00
3/17/2009	NB-8	White perch	233.00
3/17/2009	NB-8	Winter flounder	2.00
3/18/2009	LB-12	Alewife	14.00
3/18/2009	LB-12	Blueback herring	3.00
3/18/2009	LB-12	Northern pipefish	1.00
3/18/2009	LB-12	Spotted hake	2.00
3/18/2009	LB-3	Alewife	3.00
3/18/2009	LB-3	Little skate	1.00
3/18/2009	LB-3	Pollock	1.00
3/18/2009	LB-3	Windowpane	1.00
3/18/2009	LB-4	Alewife	94.00
3/18/2009	LB-4	American shad	1.00
3/18/2009	LB-4	Blueback herring	19.00
3/18/2009	LB-4	Little skate	1.00
3/18/2009	LB-4	Spotted hake	2.00
3/18/2009	LB-4	Windowpane	3.00
3/18/2009	LB-5	Windowpane	2.00
3/18/2009	LB-6	Alewife	184.00
3/18/2009	LB-6	American shad	2.00
3/18/2009	LB-6	Blueback herring	106.00
3/19/2009	LB-1	Alewife	1.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
3/19/2009	LB-1	Smallmouth flounder	1.00
3/19/2009	LB-10	Winter flounder	1.00
3/19/2009	LB-2	Alewife	40.00
3/19/2009	LB-2	American lobster	1.00
3/19/2009	LB-2	Blueback herring	31.00
3/19/2009	LB-2	Winter flounder	1.00
3/19/2009	LB-8	Grubby	1.00
3/19/2009	LB-9	Grubby	1.00
3/19/2009	LB-9	Little skate	1.00
3/19/2009	LB-9	Northern pipefish	1.00
4/6/2009	AK-2	Red hake	1.00
4/6/2009	AK-2	Spotted hake	13.00
4/6/2009	AK-2	Striped bass	1.00
4/6/2009	AK-2	White perch	1.00
4/6/2009	AK-2	Winter flounder	4.00
4/6/2009	AK-3	Alewife	1.00
4/6/2009	AK-3	Cunner	2.00
4/6/2009	AK-3	Northern pipefish	1.00
4/6/2009	AK-3	Striped bass	2.00
4/6/2009	AK-3	Tautog	1.00
4/6/2009	AK-3	White perch	2.00
4/6/2009	AK-3	Winter flounder	2.00
4/6/2009	NB-4	Striped bass	1.00
4/6/2009	NB-7	Blue crab	1.11
4/6/2009	NB-7	Northern pipefish	1.11
4/6/2009	NB-7	Striped bass	1.11
4/6/2009	NB-8	Red hake	1.00
4/6/2009	NB-8	Spotted hake	3.00
4/6/2009	NB-8	White perch	1.00
4/8/2009	LB-13	Atlantic menhaden	3.00
4/8/2009	LB-4	Alewife	4.00
4/8/2009	LB-4	Atlantic herring	2.00
4/8/2009	LB-4	Atlantic menhaden	4.00
4/8/2009	LB-4	Blueback herring	14.00
4/8/2009	LB-4	Little skate	1.00
4/8/2009	LB-6	Alewife	67.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
4/8/2009	LB-6	Bay anchovy	1.00
4/8/2009	LB-6	Blueback herring	108.00
4/8/2009	LB-6	Little skate	1.00
4/9/2009	LB-10	Atlantic herring	3.00
4/9/2009	PJ-1	Alewife	1.00
4/9/2009	PJ-1	American shad	1.00
4/9/2009	PJ-1	Atlantic herring	3.00
4/9/2009	PJ-1	Grubby	2.00
4/9/2009	PJ-1	Spotted hake	1.00
4/9/2009	PJ-1	Striped bass	6.00
4/9/2009	PJ-1	Winter flounder	3.00
4/10/2009	PJ-2	Atlantic herring	1.00
4/10/2009	PJ-2	Northern pipefish	1.00
4/10/2009	SB-3	Lined seahorse	1.00
4/10/2009	SB-5	Alewife	13.00
4/10/2009	SB-5	Blueback herring	6.00
4/10/2009	SB-5	Smallmouth flounder	2.00
4/10/2009	SB-5	Spotted hake	26.00
4/10/2009	SB-5	Striped bass	3.00
4/10/2009	SB-5	White perch	23.00
4/10/2009	SB-5	Winter flounder	8.00
4/20/2009	AK-2	Rock gunnel	1.00
4/20/2009	AK-2	Spotted hake	1.00
4/20/2009	AK-2	Striped bass	13.00
4/20/2009	AK-3	Alewife	11.00
4/20/2009	AK-3	Northern pipefish	1.00
4/20/2009	AK-3	Smallmouth flounder	1.00
4/20/2009	AK-3	Spotted hake	2.00
4/20/2009	AK-3	Striped bass	1.00
4/20/2009	AK-3	White perch	9.00
4/20/2009	AK-3	Windowpane	1.00
4/20/2009	AK-3	Winter flounder	4.00
4/20/2009	NB-4	Blue crab	1.00
4/20/2009	NB-4	Northern pipefish	1.00
4/20/2009	NB-7	Atlantic silverside	2.22
4/20/2009	NB-7	Blue crab	4.44

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
4/20/2009	NB-7	Smallmouth flounder	1.11
4/20/2009	NB-7	Striped bass	1.11
4/20/2009	NB-8	Alewife	116.00
4/20/2009	NB-8	Blueback herring	1.00
4/20/2009	NB-8	Red hake	3.00
4/20/2009	NB-8	Spotted hake	8.00
4/20/2009	NB-8	Striped bass	28.00
4/20/2009	NB-8	White perch	1.00
4/20/2009	NB-8	Windowpane	1.00
4/20/2009	NB-8	Winter flounder	5.00
4/21/2009	LB-1	Bay anchovy	11.00
4/21/2009	LB-1	Lined seahorse	1.00
4/21/2009	LB-12	Alewife	6.00
4/21/2009	LB-12	Bay anchovy	5.00
4/21/2009	LB-12	Grubby	1.00
4/21/2009	LB-12	Little skate	2.00
4/21/2009	LB-12	Pollock	1.00
4/21/2009	LB-12	Smallmouth flounder	3.00
4/21/2009	LB-12	Spotted hake	4.00
4/21/2009	LB-12	Summer flounder	1.00
4/21/2009	LB-12	Windowpane	2.00
4/21/2009	LB-12	Winter flounder	2.00
4/21/2009	LB-13	Bay anchovy	5.00
4/21/2009	LB-13	Blueback herring	4.00
4/21/2009	LB-13	Little skate	1.00
4/21/2009	LB-13	Winter flounder	1.00
4/21/2009	LB-14	Alewife	2.00
4/21/2009	LB-14	Atlantic menhaden	1.00
4/21/2009	LB-14	Northern pipefish	1.00
4/21/2009	LB-14	Spotted hake	5.00
4/21/2009	LB-14	Winter flounder	5.00
4/21/2009	LB-4	Blue crab	1.00
4/21/2009	LB-4	Naked goby	2.00
4/21/2009	LB-4	Red hake	2.00
4/21/2009	LB-4	Silver hake	4.00
4/21/2009	LB-4	Smallmouth flounder	6.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
4/21/2009	LB-4	Spotted hake	9.00
4/21/2009	LB-4	Windowpane	7.00
4/21/2009	LB-5	Grubby	1.00
4/21/2009	LB-5	Little skate	3.00
4/21/2009	LB-5	Spotted hake	4.00
4/21/2009	LB-5	Windowpane	4.00
4/21/2009	LB-6	Alewife	4.00
4/21/2009	LB-6	Bay anchovy	1.00
4/21/2009	LB-6	Little skate	1.00
4/21/2009	LB-6	Spotted hake	5.00
4/22/2009	LB-10	Alewife	1.00
4/22/2009	LB-10	Red hake	1.00
4/22/2009	LB-10	Spotted hake	4.00
4/22/2009	LB-2	Alewife	3.00
4/22/2009	LB-2	American shad	1.00
4/22/2009	LB-2	Bay anchovy	1.00
4/22/2009	LB-2	Silver hake	2.00
4/22/2009	LB-2	Spotted hake	1.00
4/22/2009	LB-2	Winter flounder	3.00
4/22/2009	LB-3	Alewife	1.00
4/22/2009	LB-3	Bay anchovy	6.00
4/22/2009	LB-3	Blueback herring	1.00
4/22/2009	LB-3	Little skate	3.00
4/22/2009	LB-3	Northern pipefish	1.00
4/22/2009	LB-3	Pollock	2.00
4/22/2009	LB-3	Spotted hake	9.00
4/22/2009	LB-3	Winter flounder	1.00
4/22/2009	LB-7	Alewife	1.00
4/22/2009	LB-7	Little skate	2.00
4/22/2009	LB-7	Northern searobin	1.00
4/22/2009	LB-7	Silver hake	3.00
4/22/2009	LB-7	Spotted hake	16.00
4/22/2009	LB-7	Windowpane	4.00
4/22/2009	LB-8	Pollock	2.00
4/22/2009	LB-9	Atlantic herring	1.00
4/22/2009	LB-9	Bay anchovy	23.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
4/22/2009	LB-9	Blueback herring	2.00
4/22/2009	SB-6	Alewife	2.00
4/22/2009	SB-6	American shad	3.00
4/22/2009	SB-6	Black sea bass	1.00
4/22/2009	SB-6	Little skate	1.00
4/22/2009	SB-6	Spotted hake	3.00
4/22/2009	SB-6	Windowpane	1.00
4/23/2009	PJ-1	American eel	1.00
4/23/2009	PJ-1	Cunner	3.00
4/23/2009	PJ-1	Tautog	2.00
4/23/2009	PJ-1	Windowpane	1.00
4/23/2009	PJ-1	Winter flounder	1.00
4/23/2009	PJ-2	Bay anchovy	3.00
4/23/2009	PJ-2	Smallmouth flounder	1.00
4/23/2009	SB-5	Little skate	1.00
4/23/2009	SB-5	Summer flounder	1.00
5/4/2009	LB-12	Bay anchovy	36.00
5/4/2009	LB-12	Butterfish	1.00
5/4/2009	LB-12	Little skate	1.00
5/4/2009	LB-12	Spotted hake	7.00
5/4/2009	LB-12	Winter flounder	1.00
5/4/2009	LB-13	Bay anchovy	1.00
5/4/2009	LB-3	Atlantic cod	1.00
5/4/2009	LB-3	Bay anchovy	419.00
5/4/2009	LB-3	Little skate	1.00
5/4/2009	LB-3	Spotted hake	2.00
5/4/2009	LB-4	Atlantic menhaden	2.00
5/4/2009	LB-4	Bay anchovy	3.00
5/4/2009	LB-4	Butterfish	3.00
5/4/2009	LB-4	Red hake	2.00
5/4/2009	LB-4	Rock gunnel	1.00
5/4/2009	LB-4	Spotted hake	14.00
5/4/2009	LB-4	Striped searobin	1.00
5/4/2009	LB-4	Windowpane	1.00
5/4/2009	LB-5	Bay anchovy	2.00
5/4/2009	LB-5	Spotted hake	2.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
5/4/2009	LB-5	Striped searobin	1.00
5/4/2009	LB-6	Alewife	1.00
5/4/2009	LB-6	Butterfish	3.00
5/4/2009	LB-6	Conger eel	1.00
5/4/2009	LB-6	Spotted hake	1.00
5/5/2009	AK-2	Alewife	5.00
5/5/2009	AK-2	Atlantic herring	16.00
5/5/2009	AK-2	Black sea bass	1.00
5/5/2009	AK-2	Cunner	1.00
5/5/2009	AK-2	Spotted hake	13.00
5/5/2009	AK-2	Summer flounder	2.00
5/5/2009	AK-2	White perch	1.00
5/5/2009	AK-3	Red hake	1.00
5/5/2009	AK-3	Spotted hake	1.00
5/5/2009	NB-4	Atlantic herring	3,285.00
5/5/2009	NB-4	Bay anchovy	608.00
5/5/2009	NB-4	Blue crab	6.00
5/5/2009	NB-4	Blueback herring	1.00
5/5/2009	NB-4	Winter flounder	1.00
5/5/2009	NB-7	Alewife	25.00
5/5/2009	NB-7	Atlantic herring	71.25
5/5/2009	NB-7	Bay anchovy	181.25
5/5/2009	NB-7	Blueback herring	128.75
5/5/2009	NB-7	Spotted hake	2.50
5/5/2009	NB-7	Winter flounder	1.25
5/5/2009	NB-8	Red hake	1.00
5/5/2009	NB-8	Spotted hake	13.00
5/5/2009	NB-8	Windowpane	1.00
5/5/2009	PJ-1	Alewife	2.00
5/5/2009	PJ-1	Atlantic herring	28.00
5/5/2009	PJ-1	Atlantic tomcod	2.00
5/5/2009	PJ-1	Bay anchovy	139.00
5/5/2009	PJ-1	Lined seahorse	1.00
5/5/2009	PJ-1	Smallmouth flounder	1.00
5/5/2009	PJ-1	Spotted hake	3.00
5/5/2009	PJ-1	Windowpane	1.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
5/5/2009	PJ-1	Winter flounder	3.00
5/6/2009	LB-1	Bay anchovy	28.00
5/6/2009	LB-1	Little skate	1.00
5/6/2009	LB-1	Pollock	1.00
5/6/2009	LB-10	Bay anchovy	155.00
5/6/2009	LB-10	Red hake	1.00
5/6/2009	LB-10	Silver hake	2.00
5/6/2009	LB-10	Smallmouth flounder	1.00
5/6/2009	LB-10	Spotted hake	13.00
5/6/2009	LB-10	Summer flounder	3.00
5/6/2009	LB-10	Winter flounder	2.00
5/6/2009	LB-14	Spotted hake	1.00
5/6/2009	LB-14	Winter skate	1.00
5/6/2009	LB-2	Blue crab	2.00
5/6/2009	LB-2	Spotted hake	1.00
5/6/2009	LB-2	Summer flounder	1.00
5/6/2009	LB-2	Winter flounder	1.00
5/6/2009	LB-7	Alewife	6.00
5/6/2009	LB-7	Bay anchovy	127.00
5/6/2009	LB-7	Butterfish	2.00
5/6/2009	LB-7	Little skate	1.00
5/6/2009	LB-7	Red hake	1.00
5/6/2009	LB-7	Silver hake	7.00
5/6/2009	LB-7	Spotted hake	3.00
5/6/2009	LB-7	Windowpane	5.00
5/6/2009	LB-8	Little skate	1.00
5/6/2009	LB-8	Pollock	4.00
5/6/2009	LB-8	Sheepshead	2.00
5/6/2009	LB-8	Striped bass	1.00
5/6/2009	LB-8	Windowpane	1.00
5/7/2009	PJ-2	American shad	1.00
5/7/2009	PJ-2	Atlantic herring	321.00
5/7/2009	PJ-2	Atlantic tomcod	6.00
5/7/2009	PJ-2	Bay anchovy	1,244.00
5/7/2009	PJ-2	Blueback herring	2.00
5/7/2009	PJ-2	Sheepshead	1.00

Appendix A. Bottom trawl CPUE (Number per 10 minute trawl) by date and station sampled during the 2009 Aquatic Biological Survey.

Date	Station	Common Name	CPUE
5/7/2009	PJ-2	Shortnose sturgeon	1.00
5/7/2009	PJ-2	Striped bass	1.00
5/7/2009	PJ-2	Winter flounder	3.00
5/7/2009	SB-3	Bay anchovy	1.00
5/7/2009	SB-3	Little skate	1.00
5/7/2009	SB-3	Northern pipefish	1.00
5/7/2009	SB-3	Spotted hake	1.00
5/7/2009	SB-4	Atlantic tomcod	1.00
5/7/2009	SB-4	Clearnose skate	1.00
5/7/2009	SB-4	Lined seahorse	1.00
5/7/2009	SB-4	Northern searobin	1.00
5/7/2009	SB-4	Red hake	1.00
5/7/2009	SB-4	Spotted hake	16.00
5/7/2009	SB-5	Sheepshead	13.00
5/7/2009	SB-5	Winter flounder	1.00
5/7/2009	SB-6	Windowpane	3.00
5/7/2009	SB-6	Winter flounder	2.00

Appendix B

Ichthyoplankton (epibenthic sled) life stage densities by date and station collected during the 2009 Aquatic Biological Survey.

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
1/5/2009	LB-6	American sandlance	PYS	4.11
1/6/2009	LB-2	American sandlance	PYS	9.12
1/6/2009	LB-9	American sandlance	PYS	7.13
1/7/2009	NB-4	American sandlance	PYS	4.10
1/7/2009	NB-4	Atlantic croaker	PYS	4.10
1/7/2009	NB-8	Atlantic croaker	PYS	45.81
1/7/2009	NB-8	Summer flounder	PYS	13.09
1/7/2009	AK-2	American sandlance	PYS	4.15
1/7/2009	AK-2	Bay anchovy	JUV	4.15
1/7/2009	AK-3	Atlantic croaker	JUV	17.65
1/7/2009	AK-3	Atlantic croaker	PYS	52.94
1/7/2009	AK-3	Bay anchovy	JUV	82.34
1/7/2009	AK-3	Summer flounder	PYS	17.65
1/8/2009	PJ-2	Atlantic croaker	PYS	3.80
1/8/2009	PJ-2	Bay anchovy	PYS	3.80
1/8/2009	SB-3	Bay anchovy	JUV	5.17
1/8/2009	SB-3	Summer flounder	PYS	10.34
1/8/2009	SB-4	Atlantic croaker	PYS	3.42
1/8/2009	SB-4	Summer flounder	PYS	10.27
1/8/2009	SB-6	Bay anchovy	JUV	6.95
1/8/2009	SB-6	Summer flounder	PYS	6.95
1/8/2009	KVK-1	Atlantic croaker	PYS	4.48
1/8/2009	KVK-1	Atlantic menhaden	PYS	4.48
1/8/2009	KVK-1	Summer flounder	PYS	31.33
1/20/2009	LB-4	Summer flounder	PYS	20.01
1/20/2009	LB-5	Rock gunnel	PYS	10.12
1/21/2009	PJ-2	Grubby	PYS	6.28
1/23/2009	LB-14	Atlantic menhaden	PYS	6.60
1/23/2009	LB-2	Rock gunnel	PYS	12.12
1/23/2009	LB-9	Rock gunnel	PYS	14.36
1/23/2009	LB-7	Rock gunnel	PYS	18.30
1/23/2009	LB-7	Rock gunnel	YS	6.10
1/23/2009	LB-8	Rock gunnel	PYS	9.80
2/2/2009	LB-13	Rock gunnel	PYS	20.35
2/2/2009	LB-4	American sandlance	PYS	6.33

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
2/2/2009	LB-4	American sandlance	YS	6.33
2/2/2009	LB-4	Rock gunnel	PYS	12.67
2/2/2009	LB-6	Cods and Haddocks	Egg	5.82
2/2/2009	LB-6	Winter flounder	ST2	5.82
2/2/2009	LB-5	Rock gunnel	PYS	4.83
2/2/2009	LB-3	Rock gunnel	PYS	22.14
2/2/2009	LB-7	Rock gunnel	PYS	21.16
2/4/2009	SB-6	Rock gunnel	PYS	37.10
2/4/2009	SB-6	Winter flounder	ST2	6.18
2/4/2009	SB-3	Rock gunnel	PYS	6.88
2/4/2009	SB-5	Summer flounder	PYS	28.17
2/4/2009	PJ-1	American sandlance	PYS	7.66
2/4/2009	PJ-1	Rock gunnel	PYS	7.66
2/5/2009	AK-2	Rock gunnel	PYS	8.90
2/5/2009	AK-3	Grubby	PYS	5.61
2/5/2009	AK-3	Rock gunnel	PYS	5.61
2/5/2009	NB-4	Grubby	PYS	4.87
2/5/2009	NB-4	Rock gunnel	PYS	9.73
2/6/2009	LB-10	Grubby	PYS	5.42
2/6/2009	LB-10	Summer flounder	PYS	5.42
2/6/2009	LB-9	Rock gunnel	PYS	5.85
2/6/2009	LB-9	Winter flounder	ST1	5.85
2/6/2009	LB-2	Cods and Haddocks	Egg	8.72
2/6/2009	LB-2	Rock gunnel	PYS	8.72
2/6/2009	LB-14	Winter flounder	WFNVE	7.67
2/17/2009	LB-13	American sandlance	PYS	17.21
2/17/2009	LB-13	Grubby	PYS	8.60
2/17/2009	LB-13	Rock gunnel	PYS	25.81
2/17/2009	LB-13	Winter flounder	ST1	25.81
2/17/2009	LB-4	American sandlance	PYS	8.32
2/17/2009	LB-4	Grubby	PYS	24.96
2/17/2009	LB-4	Rock gunnel	PYS	8.32
2/17/2009	LB-4	Summer flounder	PYS	8.32
2/17/2009	LB-4	Winter flounder	ST1	24.96
2/17/2009	LB-12	American sandlance	PYS	17.70

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
2/17/2009	LB-12	Grubby	PYS	17.70
2/17/2009	LB-12	Rock gunnel	PYS	44.25
2/17/2009	LB-12	Winter flounder	ST1	8.85
2/17/2009	LB-6	Summer flounder	PYS	5.18
2/17/2009	LB-6	Winter flounder	ST1	15.55
2/17/2009	LB-5	Rock gunnel	PYS	13.03
2/17/2009	LB-5	Winter flounder	ST1	6.52
2/17/2009	LB-5	Winter flounder	ST2	6.52
2/17/2009	LB-3	Grubby	PYS	6.25
2/17/2009	LB-3	Rock gunnel	PYS	6.25
2/17/2009	LB-3	Winter flounder	ST1	6.25
2/17/2009	LB-7	American sandlance	PYS	19.03
2/17/2009	LB-7	Grubby	PYS	12.69
2/17/2009	LB-7	Rock gunnel	PYS	44.41
2/17/2009	LB-7	Winter flounder	ST1	57.09
2/17/2009	LB-7	Winter flounder	ST2	12.69
2/17/2009	LB-7	Winter flounder	ST3	6.34
2/17/2009	LB-8	Grubby	PYS	6.36
2/17/2009	LB-8	Rock gunnel	PYS	12.72
2/17/2009	LB-8	Winter flounder	ST1	6.36
2/17/2009	LB-8	Winter flounder	ST2	19.08
2/18/2009	LB-10	American sandlance	PYS	5.68
2/18/2009	LB-10	Grubby	PYS	5.68
2/18/2009	LB-10	Rock gunnel	PYS	39.79
2/18/2009	LB-10	Winter flounder	ST2	5.68
2/18/2009	LB-2	Grubby	PYS	7.34
2/18/2009	LB-2	Rock gunnel	PYS	7.34
2/18/2009	LB-2	Winter flounder	WFNVE	22.01
2/18/2009	SB-6	Cods and Haddocks	Egg	5.48
2/18/2009	SB-6	Grubby	PYS	21.90
2/18/2009	SB-6	Northern pipefish	JUV	5.48
2/18/2009	SB-6	Rock gunnel	PYS	16.43
2/18/2009	SB-6	Summer flounder	PYS	5.48
2/18/2009	SB-4	Grubby	PYS	12.47
2/18/2009	SB-4	Rock gunnel	PYS	6.23

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
2/18/2009	SB-4	Summer flounder	PYS	6.23
2/18/2009	SB-3	Grubby	PYS	11.09
2/18/2009	SB-3	Rock gunnel	PYS	16.64
2/18/2009	PJ-2	Atlantic menhaden	PYS	5.60
2/18/2009	PJ-2	Winter flounder	ES1	190.24
2/18/2009	PJ-2	Winter flounder	ES3	16.79
2/18/2009	PJ-2	Winter flounder	ES4	16.79
2/18/2009	PJ-2	Winter flounder	ES5	39.17
2/18/2009	PJ-2	Winter flounder	WFNVE	436.43
2/25/2009	LB-1	American sandlance	PYS	6.51
2/25/2009	LB-1	American sandlance	YS	6.51
2/25/2009	LB-1	Atlantic menhaden	PYS	6.51
2/25/2009	LB-1	Rock gunnel	PYS	6.51
2/25/2009	LB-1	Winter flounder	ES4	6.51
2/25/2009	LB-1	Winter flounder	ST2	13.02
2/25/2009	LB-14	American sandlance	PYS	4.23
2/25/2009	LB-14	American sandlance	YS	8.47
2/25/2009	LB-9	American sandlance	PYS	4.99
2/25/2009	LB-9	Sea raven	YS	4.99
2/25/2009	LB-9	Winter flounder	ST2	4.99
2/25/2009	LB-9	Winter flounder	ST3	4.99
2/25/2009	PJ-1	Atlantic menhaden	PYS	5.62
2/25/2009	PJ-1	Grubby	PYS	5.62
2/25/2009	PJ-1	Rock gunnel	PYS	11.23
2/25/2009	SB-5	Grubby	PYS	19.72
2/25/2009	SB-5	Summer flounder	PYS	3.94
2/25/2009	SB-5	Winter flounder	ES4	3.94
2/25/2009	SB-5	Winter flounder	ES5	3.94
2/26/2009	NB-7	Grubby	PYS	6.56
2/26/2009	NB-7	Rock gunnel	PYS	6.56
2/26/2009	NB-7	Winter flounder	ST1	13.12
2/26/2009	NB-7	Winter flounder	ST3	6.56
2/26/2009	NB-4	Grubby	PYS	5.11
2/26/2009	NB-4	Grubby	YS	5.11
2/26/2009	NB-4	Rock gunnel	PYS	10.22

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
2/26/2009	NB-4	Winter flounder	ST1	10.22
2/26/2009	NB-4	Winter flounder	ST2	5.11
2/26/2009	NB-4	Winter flounder	UID	5.11
2/26/2009	NB-8	Grubby	PYS	39.85
2/26/2009	NB-8	Grubby	YS	9.96
2/26/2009	NB-8	Rock gunnel	PYS	9.96
2/26/2009	NB-8	Summer flounder	PYS	4.98
2/26/2009	NB-8	Winter flounder	ST1	9.96
2/26/2009	AK-3	American sandlance	PYS	4.50
2/26/2009	AK-3	Grubby	PYS	36.02
2/26/2009	AK-3	Grubby	YS	9.00
2/26/2009	AK-3	Rock gunnel	PYS	4.50
2/26/2009	AK-3	Winter flounder	ST1	13.51
2/26/2009	AK-3	Winter flounder	ST2	9.00
2/26/2009	AK-2	Grubby	PYS	45.72
2/26/2009	AK-2	Rock gunnel	PYS	15.24
2/26/2009	AK-2	Winter flounder	ST1	10.16
2/26/2009	AK-2	Winter flounder	ST2	10.16
3/4/2009	AK-3	American sandlance	PYS	5.67
3/4/2009	AK-3	Grubby	PYS	68.03
3/4/2009	AK-3	Rock gunnel	PYS	5.67
3/4/2009	AK-2	Grubby	PYS	34.89
3/4/2009	AK-2	Grubby	YS	4.98
3/4/2009	AK-2	Summer flounder	PYS	4.98
3/4/2009	NB-8	Grubby	PYS	34.47
3/4/2009	NB-8	Summer flounder	PYS	4.92
3/4/2009	NB-4	Grubby	PYS	38.40
3/4/2009	NB-4	Winter flounder	UID	5.49
3/4/2009	NB-7	Grubby	PYS	35.70
3/4/2009	NB-7	Grubby	YS	8.92
3/4/2009	NB-7	Rock gunnel	PYS	4.46
3/4/2009	NB-7	Winter flounder	ES1	8.92
3/4/2009	NB-7	Winter flounder	ES5	13.39
3/4/2009	NB-7	Winter flounder	WFNVE	8.92
3/5/2009	LB-13	American sandlance	PYS	10.28

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
3/5/2009	LB-13	Grubby	PYS	10.28
3/5/2009	LB-13	Rock gunnel	PYS	123.42
3/5/2009	LB-13	Winter flounder	ES1	10.28
3/5/2009	LB-13	Winter flounder	ES3	10.28
3/5/2009	LB-13	Winter flounder	ES5	10.28
3/5/2009	LB-13	Winter flounder	ST1	82.28
3/5/2009	LB-13	Winter flounder	ST2	30.85
3/5/2009	LB-13	Winter flounder	ST3	10.28
3/5/2009	LB-13	Winter flounder	UID	10.28
3/5/2009	LB-13	Winter flounder	WFNVE	10.28
3/5/2009	LB-4	American sandlance	PYS	10.75
3/5/2009	LB-4	Grubby	PYS	21.50
3/5/2009	LB-4	Rock gunnel	PYS	21.50
3/5/2009	LB-4	Summer flounder	PYS	10.75
3/5/2009	LB-4	Winter flounder	ST1	21.50
3/5/2009	LB-4	Winter flounder	ST2	10.75
3/5/2009	LB-12	Grubby	PYS	86.80
3/5/2009	LB-12	Rock gunnel	PYS	37.20
3/5/2009	LB-12	Winter flounder	ST1	297.61
3/5/2009	LB-12	Winter flounder	ST2	24.80
3/5/2009	LB-6	American sandlance	PYS	9.70
3/5/2009	LB-6	Grubby	PYS	19.39
3/5/2009	LB-6	Rock gunnel	PYS	29.09
3/5/2009	LB-6	Summer flounder	PYS	9.70
3/5/2009	LB-6	Winter flounder	ES4	9.70
3/5/2009	LB-6	Winter flounder	ST1	38.78
3/5/2009	LB-6	Winter flounder	ST2	9.70
3/5/2009	LB-5	Grubby	PYS	105.15
3/5/2009	LB-5	Rock gunnel	PYS	35.05
3/5/2009	LB-5	Summer flounder	PYS	17.52
3/5/2009	LB-3	Grubby	PYS	91.24
3/5/2009	LB-3	Rock gunnel	PYS	11.40
3/5/2009	LB-3	Summer flounder	PYS	11.40
3/5/2009	LB-3	Winter flounder	ST1	11.40
3/5/2009	LB-7	Grubby	PYS	84.61

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Sample Date	Station	Common name	Life Stage	Density
3/5/2009	LB-7	Grubby	YS	7.69
3/5/2009	LB-7	Winter flounder	ST1	15.38
3/5/2009	LB-7	Winter flounder	ST3	7.69
3/6/2009	LB-8	Grubby	PYS	51.37
3/6/2009	LB-8	Winter flounder	WFNVE	70.63
3/6/2009	LB-9	Grubby	PYS	16.16
3/6/2009	LB-9	Winter flounder	ES5	16.16
3/6/2009	LB-2	Grubby	PYS	63.38
3/6/2009	LB-2	Rock gunnel	PYS	36.22
3/6/2009	LB-14	Grubby	PYS	51.27
3/6/2009	LB-14	Rock gunnel	PYS	7.32
3/6/2009	LB-14	Winter flounder	ES3	7.32
3/6/2009	LB-14	Winter flounder	ST3	7.32
3/6/2009	LB-14	Winter flounder	WFNVE	21.97
3/6/2009	LB-1	Grubby	PYS	33.91
3/6/2009	LB-1	Winter flounder	ES3	5.65
3/6/2009	LB-1	Winter flounder	ES4	28.25
3/6/2009	LB-1	Winter flounder	ES5	67.81
3/6/2009	LB-1	Winter flounder	ST3	5.65
3/6/2009	LB-1	Winter flounder	WFNVE	180.83
3/6/2009	LB-10	American sandlance	PYS	6.05
3/6/2009	LB-10	Grubby	PYS	102.77
3/6/2009	LB-10	Grubby	YS	6.05
3/6/2009	LB-10	Rock gunnel	PYS	24.18
3/6/2009	LB-10	Winter flounder	ST3	12.09
3/9/2009	PJ-2	Cods and Haddocks	Egg	5.24
3/9/2009	PJ-2	Grubby	PYS	125.78
3/9/2009	PJ-2	Grubby	YS	10.48
3/9/2009	PJ-2	Rock gunnel	PYS	5.24
3/9/2009	PJ-2	Winter flounder	ST1	15.72
3/9/2009	PJ-1	Grubby	PYS	145.40
3/9/2009	PJ-1	Grubby	YS	11.63
3/9/2009	PJ-1	Winter flounder	ST1	40.71
3/9/2009	PJ-1	Winter flounder	ST2	23.26
3/9/2009	PJ-1	Winter flounder	ST3	5.82

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Sample Date	Station	Common name	Life Stage	Density
3/9/2009	SB-5	Grubby	PYS	102.99
3/9/2009	SB-5	Grubby	YS	6.87
3/9/2009	SB-5	Rock gunnel	PYS	13.73
3/9/2009	SB-5	Winter flounder	ES4	6.87
3/9/2009	SB-5	Winter flounder	ST1	20.60
3/9/2009	SB-5	Winter flounder	ST2	6.87
3/9/2009	SB-6	American sandlance	PYS	12.25
3/9/2009	SB-6	Grubby	PYS	16.33
3/9/2009	SB-6	Rock gunnel	PYS	28.57
3/9/2009	SB-6	Winter flounder	ST1	4.08
3/9/2009	SB-6	Winter flounder	ST2	4.08
3/9/2009	SB-6	Winter flounder	WFNVE	4.08
3/9/2009	SB-4	Cods and Haddocks	Egg	8.79
3/9/2009	SB-4	Grubby	PYS	17.57
3/9/2009	SB-4	Winter flounder	ES5	35.14
3/9/2009	SB-4	Winter flounder	ST1	43.93
3/9/2009	SB-4	Winter flounder	ST2	17.57
3/9/2009	SB-4	Winter flounder	WFNVE	166.92
3/9/2009	SB-3	Cods and Haddocks	Egg	5.96
3/9/2009	SB-3	Grubby	PYS	35.74
3/9/2009	SB-3	Grubby	YS	5.96
3/9/2009	SB-3	Winter flounder	ES3	23.82
3/9/2009	SB-3	Winter flounder	ES5	23.82
3/9/2009	SB-3	Winter flounder	WFNVE	89.34
3/16/2009	SB-5	Grubby	PYS	81.99
3/16/2009	SB-3	American sandlance	PYS	3.34
3/16/2009	SB-3	Atlantic menhaden	PYS	3.34
3/16/2009	SB-3	Grubby	PYS	13.38
3/16/2009	SB-3	Winter flounder	ST1	6.69
3/16/2009	SB-3	Winter flounder	ST2	36.79
3/16/2009	SB-3	Winter flounder	ST3	3.34
3/16/2009	SB-3	Winter flounder	UID	46.83
3/16/2009	SB-4	American sandlance	PYS	4.86
3/16/2009	SB-4	Cods and Haddocks	Egg	9.73
3/16/2009	SB-4	Grubby	PYS	102.14

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Sample Date	Station	Common name	Life Stage	Density
3/16/2009	SB-4	Grubby	YS	4.86
3/16/2009	SB-4	Rock gunnel	PYS	4.86
3/16/2009	SB-4	Winter flounder	ST1	170.24
3/16/2009	SB-4	Winter flounder	ST2	29.18
3/16/2009	SB-4	Winter flounder	ST3	14.59
3/16/2009	SB-4	Winter flounder	UID	9.73
3/16/2009	SB-6	American sandlance	PYS	6.33
3/16/2009	SB-6	Grubby	PYS	6.33
3/16/2009	SB-6	Winter flounder	ST1	3.16
3/16/2009	SB-6	Winter flounder	ST2	18.99
3/16/2009	SB-6	Winter flounder	ST3	9.49
3/16/2009	SB-6	Winter flounder	UID	12.66
3/16/2009	PJ-2	American sandlance	PYS	4.69
3/16/2009	PJ-2	Grubby	PYS	9.39
3/16/2009	PJ-2	Winter flounder	ES3	4.69
3/16/2009	PJ-2	Winter flounder	ST1	295.75
3/16/2009	PJ-2	Winter flounder	ST2	18.78
3/16/2009	PJ-2	Winter flounder	UID	18.78
3/16/2009	PJ-1	American sandlance	PYS	5.03
3/16/2009	PJ-1	Grubby	PYS	40.26
3/16/2009	PJ-1	Grubby	YS	5.03
3/16/2009	PJ-1	Rock gunnel	PYS	5.03
3/16/2009	PJ-1	Winter flounder	ST1	5.03
3/16/2009	PJ-1	Winter flounder	ST2	10.07
3/16/2009	PJ-1	Winter flounder	UID	20.13
3/17/2009	AK-3	Atlantic tomcod	PYS	6.06
3/17/2009	AK-3	Grubby	PYS	90.83
3/17/2009	AK-3	Grubby	YS	12.11
3/17/2009	AK-2	Grubby	PYS	29.25
3/17/2009	AK-2	Winter flounder	ST1	4.87
3/17/2009	NB-8	Atlantic tomcod	PYS	26.10
3/17/2009	NB-8	Grubby	PYS	229.67
3/17/2009	NB-8	Rock gunnel	PYS	5.22
3/17/2009	NB-8	Winter flounder	ST1	26.10
3/17/2009	NB-4	Grubby	PYS	37.73

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Sample Date	Station	Common name	Life Stage	Density
3/17/2009	NB-4	Summer flounder	PYS	5.39
3/17/2009	NB-4	Winter flounder	ST1	21.56
3/17/2009	NB-4	Winter flounder	ST2	10.78
3/17/2009	NB-4	Winter flounder	ST3	21.56
3/17/2009	NB-7	American sandlance	PYS	6.39
3/17/2009	NB-7	Grubby	PYS	108.55
3/17/2009	NB-7	Grubby	YS	6.39
3/17/2009	NB-7	Winter flounder	ES3	6.39
3/17/2009	NB-7	Winter flounder	ST1	38.31
3/17/2009	NB-7	Winter flounder	ST2	31.93
3/17/2009	NB-7	Winter flounder	ST3	6.39
3/18/2009	LB-13	Grubby	PYS	27.90
3/18/2009	LB-13	Winter flounder	ES1	61.39
3/18/2009	LB-13	Winter flounder	ES2	50.23
3/18/2009	LB-13	Winter flounder	ES3	66.97
3/18/2009	LB-13	Winter flounder	ES4	161.84
3/18/2009	LB-13	Winter flounder	ES5	161.84
3/18/2009	LB-13	Winter flounder	ST1	61.39
3/18/2009	LB-13	Winter flounder	ST2	39.07
3/18/2009	LB-13	Winter flounder	ST3	106.04
3/18/2009	LB-13	Winter flounder	UID	78.13
3/18/2009	LB-13	Winter flounder	WFNVE	212.07
3/18/2009	LB-4	American sandlance	PYS	4.81
3/18/2009	LB-4	Cods and Haddocks	Egg	4.81
3/18/2009	LB-4	Grubby	PYS	105.76
3/18/2009	LB-4	Rock gunnel	PYS	4.81
3/18/2009	LB-4	Winter flounder	ES3	9.61
3/18/2009	LB-4	Winter flounder	ES5	4.81
3/18/2009	LB-4	Winter flounder	ST1	115.37
3/18/2009	LB-4	Winter flounder	ST2	48.07
3/18/2009	LB-4	Winter flounder	ST3	33.65
3/18/2009	LB-4	Winter flounder	UID	14.42
3/18/2009	LB-12	American sandlance	PYS	5.25
3/18/2009	LB-12	Grubby	PYS	10.50
3/18/2009	LB-12	Rock gunnel	PYS	5.25

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Sample Date	Station	Common name	Life Stage	Density
3/18/2009	LB-12	Winter flounder	ST1	20.99
3/18/2009	LB-12	Winter flounder	ST2	41.99
3/18/2009	LB-12	Winter flounder	ST3	78.72
3/18/2009	LB-6	Cods and Haddocks	Egg	6.58
3/18/2009	LB-6	Grubby	PYS	125.10
3/18/2009	LB-6	Rock gunnel	PYS	6.58
3/18/2009	LB-6	Winter flounder	ST1	592.59
3/18/2009	LB-6	Winter flounder	ST2	118.52
3/18/2009	LB-6	Winter flounder	ST3	19.75
3/18/2009	LB-6	Winter flounder	UID	26.34
3/18/2009	LB-5	American sandlance	PYS	7.62
3/18/2009	LB-5	Grubby	PYS	251.31
3/18/2009	LB-5	Grubby	YS	7.62
3/18/2009	LB-5	Rock gunnel	PYS	30.46
3/18/2009	LB-5	Winter flounder	ES4	7.62
3/18/2009	LB-5	Winter flounder	ST1	38.08
3/18/2009	LB-5	Winter flounder	ST2	38.08
3/18/2009	LB-5	Winter flounder	UID	7.62
3/18/2009	LB-3	Gobies	PYS	276.50
3/18/2009	LB-3	Rock gunnel	PYS	16.76
3/18/2009	LB-3	Summer flounder	PYS	8.38
3/18/2009	LB-3	Winter flounder	ST1	125.68
3/18/2009	LB-3	Winter flounder	ST2	25.14
3/18/2009	LB-3	Winter flounder	UID	8.38
3/18/2009	LB-7	American sandlance	PYS	6.02
3/18/2009	LB-7	Grubby	PYS	42.15
3/18/2009	LB-7	Rock gunnel	PYS	12.04
3/18/2009	LB-7	Winter flounder	ST2	12.04
3/18/2009	LB-7	Winter flounder	ST3	42.15
3/18/2009	LB-7	Winter flounder	UID	18.06
3/19/2009	LB-10	Atlantic cod	Egg	8.61
3/19/2009	LB-10	Grubby	PYS	111.93
3/19/2009	LB-10	Grubby	YS	17.22
3/19/2009	LB-10	Winter flounder	ST1	8.61
3/19/2009	LB-10	Winter flounder	ST3	60.27

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
3/19/2009	LB-1	Grubby	PYS	118.95
3/19/2009	LB-1	Winter flounder	ES4	21.63
3/19/2009	LB-1	Winter flounder	ST3	173.02
3/19/2009	LB-1	Winter flounder	UID	10.81
3/19/2009	LB-1	Winter flounder	WFNVE	10.81
3/19/2009	LB-2	Grubby	PYS	90.59
3/19/2009	LB-9	Grubby	PYS	171.92
3/19/2009	LB-9	Winter flounder	ST3	9.05
3/19/2009	LB-9	Winter flounder	UID	27.15
3/19/2009	LB-14	American sandlance	PYS	6.38
3/19/2009	LB-14	Cods and Haddocks	Egg	3.19
3/19/2009	LB-14	Grubby	PYS	15.94
3/19/2009	LB-14	Rock gunnel	PYS	15.94
3/19/2009	LB-14	Winter flounder	ST1	9.56
3/19/2009	LB-14	Winter flounder	ST2	57.38
3/19/2009	LB-14	Winter flounder	ST3	156.19
3/19/2009	LB-14	Winter flounder	UID	41.44
3/19/2009	LB-8	Grubby	PYS	14.31
3/19/2009	LB-8	Winter flounder	ST1	221.87
3/19/2009	LB-8	Winter flounder	ST2	64.41
3/19/2009	LB-8	Winter flounder	ST3	85.88
3/19/2009	LB-8	Winter flounder	UID	85.88
4/6/2009	NB-7	Grubby	PYS	66.39
4/6/2009	NB-7	Winter flounder	ST2	33.20
4/6/2009	NB-7	Winter flounder	ST3	404.99
4/6/2009	NB-4	Grubby	PYS	38.54
4/6/2009	NB-4	Grubby	YS	5.51
4/6/2009	NB-4	Winter flounder	ST2	22.02
4/6/2009	NB-4	Winter flounder	ST3	264.29
4/6/2009	NB-8	Grubby	PYS	58.31
4/6/2009	NB-8	Winter flounder	ST3	27.21
4/6/2009	AK-3	Grubby	PYS	618.57
4/6/2009	AK-3	Grubby	YS	57.85
4/6/2009	AK-3	Winter flounder	ST3	84.55
4/6/2009	AK-2	Grubby	PYS	109.18

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
4/6/2009	AK-2	Winter flounder	ST2	9.93
4/6/2009	AK-2	Winter flounder	ST3	89.33
4/8/2009	LB-13	Grubby	PYS	122.23
4/8/2009	LB-13	Winter flounder	ES4	24.45
4/8/2009	LB-13	Winter flounder	ST2	14.67
4/8/2009	LB-13	Winter flounder	ST3	669.80
4/8/2009	LB-13	Winter flounder	WFNVE	4.89
4/8/2009	LB-4	Cods and Haddocks	Egg	4.67
4/8/2009	LB-4	Grubby	PYS	261.32
4/8/2009	LB-4	Grubby	YS	4.67
4/8/2009	LB-4	Rock gunnel	PYS	9.33
4/8/2009	LB-4	Winter flounder	ES4	18.67
4/8/2009	LB-4	Winter flounder	ST2	14.00
4/8/2009	LB-4	Winter flounder	ST3	471.30
4/8/2009	LB-12	Fourbeard rockling	Egg	4.18
4/8/2009	LB-12	Grubby	PYS	146.13
4/8/2009	LB-12	Grubby	YS	4.18
4/8/2009	LB-12	Winter flounder	ST2	8.35
4/8/2009	LB-12	Winter flounder	ST3	1394.54
4/8/2009	LB-6	Cods and Haddocks	Egg	49.98
4/8/2009	LB-6	Grubby	PYS	49.98
4/8/2009	LB-6	Winter flounder	ES4	16.66
4/8/2009	LB-6	Winter flounder	ST3	491.43
4/8/2009	LB-5	Cods and Haddocks	Egg	4.66
4/8/2009	LB-5	Grubby	PYS	102.53
4/8/2009	LB-5	Grubby	YS	9.32
4/8/2009	LB-5	Winter flounder	ST2	9.32
4/8/2009	LB-5	Winter flounder	ST3	1281.61
4/8/2009	LB-5	Winter flounder	UID	23.30
4/8/2009	LB-3	Fourbeard rockling	Egg	5.03
4/8/2009	LB-3	Grubby	PYS	100.55
4/8/2009	LB-3	Winter flounder	ST2	80.44
4/8/2009	LB-3	Winter flounder	ST3	3800.72
4/8/2009	LB-3	Winter flounder	UID	201.10
4/8/2009	LB-7	Cods and Haddocks	Egg	11.14

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Sample Date	Station	Common name	Life Stage	Density
4/8/2009	LB-7	Grubby	PYS	122.50
4/8/2009	LB-7	Winter flounder	ST1	16.71
4/8/2009	LB-7	Winter flounder	ST2	122.50
4/8/2009	LB-7	Winter flounder	ST3	1603.68
4/8/2009	LB-7	Winter flounder	UID	22.27
4/8/2009	LB-8	Fourbeard rockling	Egg	5.07
4/8/2009	LB-8	Gobies	PYS	45.66
4/8/2009	LB-8	Gobies	YS	10.15
4/8/2009	LB-8	Winter flounder	ES2	10.15
4/8/2009	LB-8	Winter flounder	ST2	40.59
4/8/2009	LB-8	Winter flounder	ST3	563.16
4/8/2009	LB-8	Winter flounder	UID	15.22
4/9/2009	LB-10	Grubby	PYS	59.30
4/9/2009	LB-10	Winter flounder	ST3	197.66
4/9/2009	LB-10	Winter flounder	UID	14.82
4/9/2009	LB-1	American sandlance	PYS	5.72
4/9/2009	LB-1	Cods and Haddocks	Egg	11.43
4/9/2009	LB-1	Grubby	PYS	68.60
4/9/2009	LB-1	Grubby	YS	5.72
4/9/2009	LB-1	Winter flounder	ST2	34.30
4/9/2009	LB-1	Winter flounder	ST3	268.69
4/9/2009	LB-2	Cods and Haddocks	Egg	4.44
4/9/2009	LB-2	Grubby	PYS	204.07
4/9/2009	LB-2	Winter flounder	ST2	39.93
4/9/2009	LB-2	Winter flounder	ST3	554.53
4/9/2009	LB-2	Winter flounder	UID	4.44
4/9/2009	LB-14	American sandlance	PYS	7.36
4/9/2009	LB-14	Grubby	PYS	51.53
4/9/2009	LB-14	Winter flounder	ST2	7.36
4/9/2009	LB-14	Winter flounder	ST3	526.32
4/9/2009	LB-14	Winter flounder	UID	18.40
4/9/2009	LB-9	American sandlance	PYS	13.06
4/9/2009	LB-9	Cods and Haddocks	Egg	6.53
4/9/2009	LB-9	Grubby	PYS	84.91
4/9/2009	LB-9	Grubby	YS	6.53

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Sample Date	Station	Common name	Life Stage	Density
4/9/2009	LB-9	Winter flounder	ES4	6.53
4/9/2009	LB-9	Winter flounder	ST2	13.06
4/9/2009	LB-9	Winter flounder	ST3	280.85
4/9/2009	LB-9	Winter flounder	UID	78.38
4/9/2009	SB-6	Fourbeard rockling	Egg	3.61
4/9/2009	SB-6	Grubby	PYS	104.74
4/9/2009	SB-6	Rock gunnel	PYS	3.61
4/9/2009	SB-6	Winter flounder	ST2	57.79
4/9/2009	SB-6	Winter flounder	ST3	393.69
4/9/2009	PJ-1	Atlantic menhaden	PYS	4.28
4/9/2009	PJ-1	Cods and Haddocks	Egg	8.55
4/9/2009	PJ-1	Fourbeard rockling	Egg	38.49
4/9/2009	PJ-1	Grubby	PYS	98.35
4/9/2009	PJ-1	Grubby	YS	8.55
4/9/2009	PJ-1	Rock gunnel	PYS	8.55
4/9/2009	PJ-1	Winter flounder	ES4	4.28
4/9/2009	PJ-1	Winter flounder	ST1	21.38
4/9/2009	PJ-1	Winter flounder	ST2	94.08
4/9/2009	PJ-1	Winter flounder	ST3	333.55
4/9/2009	PJ-1	Winter flounder	UID	4.28
4/10/2009	SB-5	Fourbeard rockling	Egg	85.11
4/10/2009	SB-5	Grubby	PYS	127.67
4/10/2009	SB-5	Rock gunnel	PYS	10.64
4/10/2009	SB-5	Winter flounder	ES3	10.64
4/10/2009	SB-5	Winter flounder	ES4	31.92
4/10/2009	SB-5	Winter flounder	ST2	10.64
4/10/2009	SB-5	Winter flounder	ST3	170.22
4/10/2009	PJ-2	Grubby	PYS	46.71
4/10/2009	PJ-2	Grubby	YS	10.38
4/10/2009	PJ-2	Winter flounder	ST2	5.19
4/10/2009	PJ-2	Winter flounder	ST3	88.24
4/10/2009	SB-3	Fourbeard rockling	Egg	4.21
4/10/2009	SB-3	Grubby	PYS	12.62
4/10/2009	SB-3	Winter flounder	ST1	8.42
4/10/2009	SB-3	Winter flounder	ST2	96.79

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Sample Date	Station	Common name	Life Stage	Density
4/10/2009	SB-3	Winter flounder	ST3	408.19
4/10/2009	SB-3	Winter flounder	UID	4.21
4/10/2009	SB-4	Fourbeard rockling	Egg	7.18
4/10/2009	SB-4	Grubby	PYS	64.65
4/10/2009	SB-4	Winter flounder	ST1	3.59
4/10/2009	SB-4	Winter flounder	ST2	35.92
4/10/2009	SB-4	Winter flounder	ST3	434.59
4/10/2009	SB-4	Winter flounder	UID	7.18
4/20/2009	NB-7	Feather blenny	PYS	6.63
4/20/2009	NB-7	Grubby	PYS	53.00
4/20/2009	NB-7	Winter flounder	ST1	6.63
4/20/2009	NB-7	Winter flounder	ST2	26.50
4/20/2009	NB-7	Winter flounder	ST3	19.88
4/20/2009	NB-7	Winter flounder	UID	6.63
4/20/2009	NB-4	Grubby	PYS	5.03
4/20/2009	NB-4	Winter flounder	ST2	15.10
4/20/2009	NB-4	Winter flounder	ST3	90.62
4/20/2009	NB-4	Winter flounder	UID	5.03
4/20/2009	NB-8	Grubby	PYS	81.81
4/20/2009	NB-8	Winter flounder	ST3	56.24
4/20/2009	AK-3	Cods and Haddocks	Egg	6.69
4/20/2009	AK-3	Fourbeard rockling	Egg	33.47
4/20/2009	AK-3	Grubby	PYS	153.95
4/20/2009	AK-3	Grubby	YS	13.39
4/20/2009	AK-3	Windowpane	Egg	66.94
4/20/2009	AK-3	Winter flounder	ST1	33.47
4/20/2009	AK-3	Winter flounder	ST2	6.69
4/20/2009	AK-3	Winter flounder	ST3	327.99
4/20/2009	AK-2	Grubby	PYS	266.96
4/20/2009	AK-2	Grubby	YS	11.86
4/20/2009	AK-2	Rock gunnel	PYS	5.93
4/20/2009	AK-2	Winter flounder	ST1	17.80
4/20/2009	AK-2	Winter flounder	ST3	243.23
4/20/2009	AK-2	Winter flounder	UID	5.93
4/21/2009	LB-14	American sandlance	PYS	5.97

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Sample Date	Station	Common name	Life Stage	Density
4/21/2009	LB-14	Fourbeard rockling	Egg	11.95
4/21/2009	LB-14	Grubby	PYS	197.09
4/21/2009	LB-14	Grubby	YS	11.95
4/21/2009	LB-14	Summer flounder	PYS	11.95
4/21/2009	LB-14	Windowpane	Egg	11.95
4/21/2009	LB-14	Winter flounder	ST2	11.95
4/21/2009	LB-14	Winter flounder	ST3	674.90
4/21/2009	LB-14	Winter flounder	UID	11.95
4/21/2009	LB-1	Grubby	PYS	22.57
4/21/2009	LB-1	Grubby	YS	5.64
4/21/2009	LB-1	Windowpane	Egg	28.21
4/21/2009	LB-1	Winter flounder	ST3	163.62
4/21/2009	LB-13	Cods and Haddocks	Egg	5.70
4/21/2009	LB-13	Grubby	PYS	74.10
4/21/2009	LB-13	Grubby	YS	11.40
4/21/2009	LB-13	Winter flounder	ST3	433.18
4/21/2009	LB-4	Grubby	JUV	10.76
4/21/2009	LB-4	Grubby	PYS	32.27
4/21/2009	LB-4	Rock gunnel	PYS	10.76
4/21/2009	LB-4	Windowpane	Egg	731.53
4/21/2009	LB-4	Winter flounder	ST3	21.52
4/21/2009	LB-12	Grubby	PYS	244.51
4/21/2009	LB-12	Rock gunnel	PYS	5.82
4/21/2009	LB-12	Windowpane	Egg	29.11
4/21/2009	LB-12	Winter flounder	ST3	384.22
4/21/2009	LB-6	American sandlance	PYS	4.31
4/21/2009	LB-6	Grubby	PYS	51.67
4/21/2009	LB-6	Grubby	YS	4.31
4/21/2009	LB-6	Rock gunnel	PYS	4.31
4/21/2009	LB-6	Windowpane	Egg	4.31
4/21/2009	LB-6	Winter flounder	ST3	770.81
4/21/2009	LB-5	Grubby	PYS	150.98
4/21/2009	LB-5	Rock gunnel	PYS	6.29
4/21/2009	LB-5	Winter flounder	ST3	301.97
4/22/2009	LB-10	Grubby	PYS	89.09

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Sample Date	Station	Common name	Life Stage	Density
4/22/2009	LB-10	Rock gunnel	PYS	4.69
4/22/2009	LB-10	Windowpane	Egg	4.69
4/22/2009	LB-10	Winter flounder	ST2	28.13
4/22/2009	LB-10	Winter flounder	ST3	618.96
4/22/2009	LB-3	American sandlance	PYS	7.78
4/22/2009	LB-3	Atlantic cod	JUV	7.78
4/22/2009	LB-3	Cods and Haddocks	Egg	93.33
4/22/2009	LB-3	Grubby	JUV	7.78
4/22/2009	LB-3	Grubby	PYS	248.87
4/22/2009	LB-3	Grubby	YS	15.55
4/22/2009	LB-3	Rock gunnel	PYS	23.33
4/22/2009	LB-3	Windowpane	Egg	279.98
4/22/2009	LB-3	Winter flounder	ST3	1431.02
4/22/2009	LB-7	Grubby	PYS	101.08
4/22/2009	LB-7	Grubby	YS	15.96
4/22/2009	LB-7	Windowpane	Egg	31.92
4/22/2009	LB-7	Winter flounder	ST3	388.36
4/22/2009	LB-8	Atlantic cod	JUV	5.13
4/22/2009	LB-8	Grubby	PYS	41.06
4/22/2009	LB-8	Windowpane	Egg	71.86
4/22/2009	LB-8	Winter flounder	ST3	189.90
4/22/2009	LB-9	Grubby	PYS	92.66
4/22/2009	LB-9	Windowpane	Egg	46.33
4/22/2009	LB-9	Winter flounder	ST3	57.91
4/22/2009	LB-2	Conger eel	PYS	7.20
4/22/2009	LB-2	Grubby	PYS	43.19
4/22/2009	LB-2	Windowpane	Egg	136.76
4/22/2009	LB-2	Winter flounder	ST3	223.13
4/22/2009	SB-6	Atlantic menhaden	PYS	6.11
4/22/2009	SB-6	Fourbeard rockling	Egg	6.11
4/22/2009	SB-6	Grubby	PYS	372.89
4/22/2009	SB-6	Grubby	YS	12.23
4/22/2009	SB-6	Windowpane	Egg	110.03
4/22/2009	SB-6	Winter flounder	ST3	91.69
4/23/2009	PJ-2	Grubby	PYS	18.80

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Sample Date	Station	Common name	Life Stage	Density
4/23/2009	PJ-2	Windowpane	Egg	6.27
4/23/2009	PJ-2	Winter flounder	ST1	6.27
4/23/2009	PJ-2	Winter flounder	ST2	6.27
4/23/2009	PJ-2	Winter flounder	ST3	175.47
4/23/2009	SB-5	Grubby	PYS	21.52
4/23/2009	SB-5	Windowpane	Egg	3.59
4/23/2009	SB-5	Winter flounder	ST3	319.29
4/23/2009	SB-4	Grubby	PYS	58.35
4/23/2009	SB-4	Winter flounder	ST3	429.70
4/23/2009	SB-3	Fourbeard rockling	Egg	15.19
4/23/2009	SB-3	Grubby	PYS	131.63
4/23/2009	SB-3	Windowpane	Egg	10.13
4/23/2009	SB-3	Winter flounder	ST3	167.06
4/23/2009	PJ-1	Grubby	PYS	99.80
4/23/2009	PJ-1	Grubby	YS	9.98
4/23/2009	PJ-1	Windowpane	Egg	9.98
4/23/2009	PJ-1	Winter flounder	ST3	304.38
5/4/2009	LB-13	Cods and Haddocks	Egg	41.78
5/4/2009	LB-13	Grubby	PYS	5.22
5/4/2009	LB-13	Windowpane	Egg	219.34
5/4/2009	LB-13	Winter flounder	ST3	1211.62
5/4/2009	LB-4	Atlantic menhaden	Egg	14.11
5/4/2009	LB-4	Cods and Haddocks	Egg	28.23
5/4/2009	LB-4	Grubby	PYS	183.47
5/4/2009	LB-4	Windowpane	Egg	973.82
5/4/2009	LB-4	Winter flounder	ST3	3302.52
5/4/2009	LB-12	Grubby	PYS	323.14
5/4/2009	LB-12	Windowpane	Egg	2883.41
5/4/2009	LB-12	Winter flounder	ST3	1789.70
5/4/2009	LB-6	Atlantic menhaden	Egg	251.59
5/4/2009	LB-6	Grubby	PYS	4.84
5/4/2009	LB-6	Windowpane	Egg	232.24
5/4/2009	LB-6	Winter flounder	ST3	261.27
5/4/2009	LB-5	Atlantic menhaden	Egg	513.58
5/4/2009	LB-5	Cods and Haddocks	Egg	51.36

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Sample Date	Station	Common name	Life Stage	Density
5/4/2009	LB-5	Feather blenny	YS	6.42
5/4/2009	LB-5	Grubby	PYS	12.84
5/4/2009	LB-5	Windowpane	Egg	1181.24
5/4/2009	LB-5	Winter flounder	ST3	160.49
5/4/2009	LB-3	Atlantic menhaden	Egg	80.22
5/4/2009	LB-3	Cods and Haddocks	Egg	45.84
5/4/2009	LB-3	Feather blenny	PYS	5.73
5/4/2009	LB-3	Windowpane	Egg	653.21
5/4/2009	LB-3	Winter flounder	ST2	5.73
5/4/2009	LB-3	Winter flounder	ST3	22.92
5/5/2009	NB-4	Cods and Haddocks	Egg	9.63
5/5/2009	NB-4	Windowpane	Egg	14.45
5/5/2009	NB-4	Winter flounder	ST3	4.82
5/5/2009	NB-8	Cods and Haddocks	Egg	20.56
5/5/2009	NB-8	Grubby	PYS	4.11
5/5/2009	NB-8	Windowpane	Egg	24.67
5/5/2009	NB-8	Winter flounder	ST2	4.11
5/5/2009	NB-8	Winter flounder	ST3	4.11
5/5/2009	AK-3	Atlantic menhaden	Egg	5.28
5/5/2009	AK-3	Grubby	PYS	63.40
5/5/2009	AK-3	Summer flounder	PYS	5.28
5/5/2009	AK-3	Windowpane	Egg	52.84
5/5/2009	AK-3	Winter flounder	ST3	438.53
5/5/2009	AK-3	Winter flounder	ST4	42.27
5/5/2009	AK-3	Wrasses	Egg	142.65
5/5/2009	AK-2	Cods and Haddocks	Egg	60.83
5/5/2009	AK-2	Grubby	PYS	25.34
5/5/2009	AK-2	Windowpane	Egg	20.28
5/5/2009	AK-2	Windowpane	YS	5.07
5/5/2009	AK-2	Winter flounder	ST3	15.21
5/5/2009	PJ-1	Atlantic menhaden	Egg	11.33
5/5/2009	PJ-1	Feather blenny	YS	5.67
5/5/2009	PJ-1	Windowpane	Egg	79.32
5/5/2009	PJ-1	Winter flounder	ST2	5.67
5/5/2009	PJ-1	Winter flounder	ST3	56.66

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
5/6/2009	LB-10	Windowpane	Egg	1460.67
5/6/2009	LB-10	Winter flounder	ST3	66.39
5/6/2009	LB-10	Wrasses	Egg	442.63
5/6/2009	LB-1	Grubby	PYS	5.74
5/6/2009	LB-1	Windowpane	Egg	2364.01
5/6/2009	LB-1	Windowpane	YS	5.74
5/6/2009	LB-1	Winter flounder	ST3	235.25
5/6/2009	LB-1	Wrasses	Egg	229.52
5/6/2009	LB-2	Fourbeard rockling	PYS	5.94
5/6/2009	LB-2	Windowpane	Egg	760.35
5/6/2009	LB-2	Winter flounder	ST3	65.34
5/6/2009	LB-2	Wrasses	Egg	71.28
5/6/2009	LB-14	Atlantic menhaden	Egg	48.27
5/6/2009	LB-14	Windowpane	Egg	1383.88
5/6/2009	LB-14	Winter flounder	ST3	52.30
5/6/2009	LB-14	Wrasses	Egg	160.92
5/6/2009	LB-9	Grubby	PYS	16.20
5/6/2009	LB-9	Searobin species	Egg	43.20
5/6/2009	LB-9	Windowpane	Egg	907.22
5/6/2009	LB-9	Winter flounder	ST3	21.60
5/6/2009	LB-9	Wrasses	Egg	194.40
5/6/2009	LB-7	Atlantic menhaden	Egg	44.68
5/6/2009	LB-7	Grubby	PYS	11.17
5/6/2009	LB-7	Windowpane	Egg	569.67
5/6/2009	LB-7	Windowpane	PYS	5.59
5/6/2009	LB-7	Winter flounder	ST3	474.73
5/6/2009	LB-7	Wrasses	Egg	178.72
5/6/2009	LB-8	Atlantic menhaden	Egg	14.72
5/6/2009	LB-8	Windowpane	Egg	596.13
5/6/2009	LB-8	Winter flounder	ST3	44.16
5/6/2009	LB-8	Wrasses	Egg	117.75
5/7/2009	PJ-2	Windowpane	Egg	33.57
5/7/2009	PJ-2	Wrasses	Egg	22.38
5/7/2009	SB-5	Atlantic menhaden	Egg	18.89
5/7/2009	SB-5	Grubby	PYS	9.44

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
5/7/2009	SB-5	Windowpane	Egg	1492.07
5/7/2009	SB-5	Winter flounder	ST3	155.82
5/7/2009	SB-5	Wrasses	Egg	169.98
5/7/2009	SB-6	Radiated shanny	PYS	3.71
5/7/2009	SB-6	Windowpane	Egg	348.65
5/7/2009	SB-6	Winter flounder	ST3	7.42
5/7/2009	SB-6	Wrasses	Egg	51.93
5/7/2009	SB-4	Grubby	PYS	4.74
5/7/2009	SB-4	Searobin species	Egg	18.96
5/7/2009	SB-4	Windowpane	Egg	739.44
5/7/2009	SB-4	Winter flounder	ST3	184.86
5/7/2009	SB-4	Winter flounder	ST4	18.96
5/7/2009	SB-4	Wrasses	Egg	132.72
5/7/2009	SB-3	Windowpane	Egg	185.70
5/7/2009	SB-3	Winter flounder	ST3	32.50
5/7/2009	SB-3	Wrasses	Egg	111.42
5/18/2009	PJ-2	Atlantic menhaden	PYS	10.19
5/18/2009	PJ-2	Atlantic tomcod	JUV	5.09
5/18/2009	PJ-2	Winter flounder	ST3	66.22
5/18/2009	PJ-2	Wrasses	Egg	896.54
5/18/2009	SB-5	Searobin species	Egg	63.63
5/18/2009	SB-5	Windowpane	Egg	424.17
5/18/2009	SB-5	Windowpane	PYS	26.51
5/18/2009	SB-5	Winter flounder	ST3	10.60
5/18/2009	SB-5	Wrasses	Egg	699.88
5/18/2009	PJ-1	Wrasses	Egg	112.63
5/18/2009	AK-3	Atlantic silverside	PYS	5.21
5/18/2009	AK-3	Windowpane	Egg	41.70
5/18/2009	AK-3	Winter flounder	ST3	52.12
5/18/2009	AK-3	Wrasses	Egg	708.82
5/18/2009	AK-2	Atlantic menhaden	PYS	7.93
5/18/2009	AK-2	Windowpane	Egg	7.93
5/18/2009	AK-2	Windowpane	PYS	7.93
5/18/2009	AK-2	Wrasses	Egg	325.08
5/18/2009	NB-8	Windowpane	Egg	441.44

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
5/18/2009	NB-8	Winter flounder	ST3	40.71
5/18/2009	NB-8	Winter flounder	ST4	24.42
5/18/2009	NB-4	Bay anchovy	Egg	5.12
5/18/2009	NB-4	Wrasses	Egg	56.30
5/18/2009	NB-7	Windowpane	PYS	6.30
5/18/2009	NB-7	Winter flounder	ST3	6.30
5/18/2009	NB-7	Wrasses	Egg	138.62
5/19/2009	LB-13	Atlantic menhaden	Egg	580.57
5/19/2009	LB-13	Searobin species	Egg	193.52
5/19/2009	LB-13	Windowpane	Egg	387.04
5/19/2009	LB-13	Windowpane	PYS	96.76
5/19/2009	LB-13	Wrasses	Egg	387.04
5/19/2009	LB-4	Conger eel	PYS	5.74
5/19/2009	LB-4	Grubby	PYS	5.74
5/19/2009	LB-4	Searobin species	Egg	1470.08
5/19/2009	LB-4	Windowpane	Egg	2940.17
5/19/2009	LB-4	Windowpane	PYS	28.71
5/19/2009	LB-4	Winter flounder	ST3	189.50
5/19/2009	LB-4	Wrasses	Egg	4410.25
5/19/2009	LB-12	Bay anchovy	Egg	192.76
5/19/2009	LB-12	Searobin species	Egg	578.27
5/19/2009	LB-12	Windowpane	Egg	963.78
5/19/2009	LB-12	Windowpane	PYS	36.14
5/19/2009	LB-12	Winter flounder	ST3	120.47
5/19/2009	LB-12	Wrasses	Egg	771.03
5/19/2009	LB-6	Bay anchovy	Egg	386.21
5/19/2009	LB-6	Windowpane	Egg	128.74
5/19/2009	LB-6	Winter flounder	ST3	12.07
5/19/2009	LB-6	Wrasses	Egg	386.21
5/19/2009	LB-5	Bay anchovy	Egg	741.23
5/19/2009	LB-5	Windowpane	Egg	123.54
5/19/2009	LB-5	Windowpane	PYS	255.76
5/19/2009	LB-5	Winter flounder	ST3	9.65
5/19/2009	LB-5	Wrasses	Egg	123.54
5/19/2009	LB-3	Bay anchovy	Egg	38.63

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
5/19/2009	LB-3	Searobin species	Egg	5.52
5/19/2009	LB-3	Windowpane	Egg	11.04
5/19/2009	LB-3	Windowpane	PYS	38.63
5/19/2009	LB-3	Wrasses	Egg	44.14
5/19/2009	LB-7	Searobin species	Egg	80.72
5/19/2009	LB-7	Windowpane	Egg	430.53
5/19/2009	LB-7	Windowpane	PYS	116.04
5/19/2009	LB-7	Windowpane	YS	5.05
5/19/2009	LB-7	Wrasses	Egg	538.16
5/19/2009	LB-8	Bay anchovy	Egg	145.25
5/19/2009	LB-8	Windowpane	Egg	332.01
5/19/2009	LB-8	Windowpane	PYS	181.57
5/19/2009	LB-8	Wrasses	Egg	498.01
5/19/2009	SB-6	Bay anchovy	Egg	38.94
5/19/2009	SB-6	Searobin species	Egg	38.94
5/19/2009	SB-6	Windowpane	Egg	739.91
5/19/2009	SB-6	Windowpane	PYS	85.19
5/19/2009	SB-6	Winter flounder	ST3	18.25
5/19/2009	SB-6	Winter flounder	ST4	12.17
5/19/2009	SB-6	Wrasses	Egg	467.31
5/20/2009	LB-9	Searobin species	Egg	256.52
5/20/2009	LB-9	Windowpane	Egg	205.21
5/20/2009	LB-9	Windowpane	PYS	25.65
5/20/2009	LB-9	Winter flounder	ST3	6.41
5/20/2009	LB-9	Wrasses	Egg	564.33
5/20/2009	LB-2	Cods and Haddocks	Egg	51.37
5/20/2009	LB-2	Searobin species	Egg	14.68
5/20/2009	LB-2	Windowpane	Egg	110.07
5/20/2009	LB-2	Windowpane	PYS	66.04
5/20/2009	LB-2	Winter flounder	ST3	7.34
5/20/2009	LB-2	Wrasses	Egg	80.72
5/20/2009	LB-14	Bay anchovy	Egg	27.51
5/20/2009	LB-14	Cods and Haddocks	Egg	82.54
5/20/2009	LB-14	Goosefish	Egg	13.76
5/20/2009	LB-14	Grubby	PYS	6.88

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Sample Date	Station	Common name	Life Stage	Density
5/20/2009	LB-14	Windowpane	Egg	275.12
5/20/2009	LB-14	Windowpane	PYS	206.34
5/20/2009	LB-14	Wrasses	Egg	137.56
5/20/2009	LB-1	Bay anchovy	Egg	266.23
5/20/2009	LB-1	Cods and Haddocks	Egg	26.62
5/20/2009	LB-1	Fourbeard rockling	Egg	26.62
5/20/2009	LB-1	Searobin species	Egg	26.62
5/20/2009	LB-1	Windowpane	Egg	745.44
5/20/2009	LB-1	Windowpane	PYS	246.26
5/20/2009	LB-1	Winter flounder	ST3	13.31
5/20/2009	LB-1	Wrasses	Egg	532.45
5/20/2009	LB-10	Bay anchovy	Egg	94.44
5/20/2009	LB-10	Windowpane	Egg	377.75
5/20/2009	LB-10	Windowpane	PYS	330.53
5/20/2009	LB-10	Windowpane	YS	5.90
5/20/2009	LB-10	Wrasses	Egg	377.75
5/20/2009	SB-4	Goosefish	Egg	33.16
5/20/2009	SB-4	Windowpane	Egg	331.62
5/20/2009	SB-4	Windowpane	PYS	45.60
5/20/2009	SB-4	Winter flounder	ST3	4.15
5/20/2009	SB-4	Wrasses	Egg	265.30
5/20/2009	SB-3	Windowpane	Egg	17.02
5/20/2009	SB-3	Wrasses	Egg	22.69
6/1/2009	LB-13	Atlantic silverside	PYS	6.01
6/1/2009	LB-13	Bay anchovy	Egg	20777.40
6/1/2009	LB-13	Northern pipefish	PYS	6.01
6/1/2009	LB-13	Windowpane	PYS	42.07
6/1/2009	LB-4	Atlantic menhaden	Egg	1002.19
6/1/2009	LB-4	Bay anchovy	Egg	33072.38
6/1/2009	LB-4	Cods and Haddocks	Egg	334.06
6/1/2009	LB-4	Northern pipefish	PYS	10.44
6/1/2009	LB-4	Searobin species	Egg	334.06
6/1/2009	LB-4	Windowpane	Egg	334.06
6/1/2009	LB-4	Windowpane	PYS	26.10
6/1/2009	LB-4	Wrasses	Egg	2004.39

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Sample Date	Station	Common name	Life Stage	Density
6/1/2009	LB-12	Bay anchovy	Egg	44086.02
6/1/2009	LB-12	Bay anchovy	PYS	6.26
6/1/2009	LB-12	Cods and Haddocks	Egg	1603.13
6/1/2009	LB-12	Northern pipefish	PYS	25.05
6/1/2009	LB-12	Windowpane	Egg	801.56
6/1/2009	LB-12	Windowpane	PYS	225.44
6/1/2009	LB-12	Windowpane	YS	6.26
6/1/2009	LB-12	Wrasses	Egg	4007.82
6/1/2009	LB-6	Atlantic menhaden	YS	4.54
6/1/2009	LB-6	Bay anchovy	Egg	32546.95
6/1/2009	LB-6	Bay anchovy	PYS	177.08
6/1/2009	LB-6	Northern pipefish	PYS	4.54
6/1/2009	LB-6	Windowpane	PYS	4.54
6/1/2009	LB-5	Atlantic menhaden	Egg	1392.27
6/1/2009	LB-5	Atlantic menhaden	PYS	5.44
6/1/2009	LB-5	Bay anchovy	Egg	45944.89
6/1/2009	LB-5	Bay anchovy	PYS	10.88
6/1/2009	LB-5	Northern pipefish	PYS	16.32
6/1/2009	LB-5	Tautog	PYS	5.44
6/1/2009	LB-5	Windowpane	PYS	43.51
6/1/2009	LB-5	Windowpane	YS	5.44
6/1/2009	LB-3	Bay anchovy	Egg	1818.76
6/1/2009	LB-3	Northern pipefish	PYS	24.80
6/1/2009	LB-3	Tautog	PYS	12.40
6/1/2009	LB-3	Windowpane	PYS	18.60
6/1/2009	LB-3	Wrasses	Egg	33.07
6/1/2009	LB-7	Bay anchovy	Egg	917.34
6/1/2009	LB-7	Bay anchovy	PYS	5.46
6/1/2009	LB-7	Windowpane	Egg	21.84
6/1/2009	LB-7	Windowpane	PYS	5.46
6/1/2009	LB-7	Wrasses	Egg	10.92
6/1/2009	LB-8	Atlantic menhaden	Egg	28.42
6/1/2009	LB-8	Bay anchovy	Egg	994.74
6/1/2009	LB-8	Bay anchovy	PYS	10.66
6/1/2009	LB-8	Windowpane	PYS	37.30

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Sample Date	Station	Common name	Life Stage	Density
6/1/2009	LB-8	Wrasses	Egg	56.84
6/1/2009	PJ-1	Atlantic menhaden	Egg	544.42
6/1/2009	PJ-1	Atlantic menhaden	PYS	9.72
6/1/2009	PJ-1	Bay anchovy	Egg	3266.52
6/1/2009	PJ-1	Bay anchovy	PYS	14.58
6/1/2009	PJ-1	Wrasses	Egg	155.55
6/1/2009	PJ-1	Wrasses	UID	4.86
6/1/2009	PJ-2	Atlantic menhaden	Egg	90.82
6/1/2009	PJ-2	Atlantic menhaden	PYS	5.68
6/1/2009	PJ-2	Bay anchovy	Egg	3133.34
6/1/2009	PJ-2	Bay anchovy	PYS	45.41
6/1/2009	PJ-2	Northern pipefish	PYS	11.35
6/1/2009	PJ-2	Wrasses	Egg	227.05
6/2/2009	LB-9	Atlantic menhaden	Egg	98.27
6/2/2009	LB-9	Atlantic menhaden	PYS	4.61
6/2/2009	LB-9	Bay anchovy	Egg	4324.06
6/2/2009	LB-9	Northern puffer	PYS	4.61
6/2/2009	LB-9	Windowpane	PYS	41.46
6/2/2009	LB-9	Wrasses	Egg	98.27
6/2/2009	LB-14	Atlantic menhaden	Egg	895.65
6/2/2009	LB-14	Bay anchovy	Egg	13255.55
6/2/2009	LB-14	Northern pipefish	PYS	5.60
6/2/2009	LB-14	Windowpane	Egg	1970.42
6/2/2009	LB-14	Windowpane	PYS	44.78
6/2/2009	LB-14	Wrasses	Egg	2149.55
6/2/2009	LB-2	Atlantic menhaden	Egg	611.49
6/2/2009	LB-2	Bay anchovy	Egg	13045.05
6/2/2009	LB-2	Cods and Haddocks	Egg	1222.97
6/2/2009	LB-2	Searobin species	Egg	407.66
6/2/2009	LB-2	Windowpane	Egg	2038.29
6/2/2009	LB-2	Windowpane	PYS	63.70
6/2/2009	LB-2	Wrasses	Egg	3465.09
6/2/2009	LB-1	Atlantic menhaden	Egg	1219.95
6/2/2009	LB-1	Bay anchovy	Egg	19925.91
6/2/2009	LB-1	Bay anchovy	PYS	6.35

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Sample Date	Station	Common name	Life Stage	Density
6/2/2009	LB-1	Northern pipefish	PYS	38.12
6/2/2009	LB-1	Searobin species	Egg	406.65
6/2/2009	LB-1	Windowpane	Egg	2846.56
6/2/2009	LB-1	Windowpane	PYS	57.19
6/2/2009	LB-1	Wrasses	Egg	2439.91
6/2/2009	LB-10	Atlantic menhaden	Egg	467.12
6/2/2009	LB-10	Bay anchovy	Egg	15259.42
6/2/2009	LB-10	Cunner	PYS	7.30
6/2/2009	LB-10	Northern pipefish	PYS	21.90
6/2/2009	LB-10	Searobin species	Egg	155.71
6/2/2009	LB-10	Windowpane	Egg	1401.37
6/2/2009	LB-10	Windowpane	PYS	80.29
6/2/2009	LB-10	Wrasses	Egg	2179.92
6/2/2009	SB-6	Atlantic menhaden	Egg	817.51
6/2/2009	SB-6	Atlantic menhaden	PYS	24.56
6/2/2009	SB-6	Bay anchovy	Egg	3898.87
6/2/2009	SB-6	Bay anchovy	PYS	44.22
6/2/2009	SB-6	Clupeid unidentified	UID	4.91
6/2/2009	SB-6	Windowpane	Egg	62.89
6/2/2009	SB-6	Windowpane	PYS	24.56
6/2/2009	SB-6	Wrasses	Egg	251.54
6/2/2009	SB-4	Atlantic menhaden	Egg	7211.15
6/2/2009	SB-4	Atlantic menhaden	PYS	24.36
6/2/2009	SB-4	Atlantic menhaden	YS	18.27
6/2/2009	SB-4	Bay anchovy	Egg	9549.90
6/2/2009	SB-4	Bay anchovy	PYS	42.63
6/2/2009	SB-4	Windowpane	Egg	1169.38
6/2/2009	SB-4	Windowpane	PYS	36.54
6/2/2009	SB-4	Wrasses	Egg	389.79
6/2/2009	SB-3	Atlantic menhaden	Egg	372.20
6/2/2009	SB-3	Bay anchovy	Egg	992.54
6/2/2009	SB-3	Bay anchovy	PYS	5.17
6/2/2009	SB-3	Windowpane	Egg	206.78
6/2/2009	SB-3	Windowpane	PYS	15.51
6/2/2009	SB-3	Wrasses	Egg	124.07

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Sample Date	Station	Common name	Life Stage	Density
6/3/2009	NB-7	Atlantic menhaden	Egg	191.48
6/3/2009	NB-7	Bay anchovy	Egg	4531.73
6/3/2009	NB-7	Bay anchovy	PYS	5.98
6/3/2009	NB-7	Northern pipefish	PYS	17.95
6/3/2009	NB-7	Windowpane	PYS	5.98
6/3/2009	NB-7	Wrasses	Egg	127.65
6/3/2009	NB-4	Bay anchovy	Egg	2062.14
6/3/2009	NB-4	Bay anchovy	PYS	38.23
6/3/2009	NB-4	Northern pipefish	PYS	38.23
6/3/2009	NB-4	Wrasses	Egg	34.95
6/3/2009	NB-8	Atlantic menhaden	Egg	278.82
6/3/2009	NB-8	Atlantic menhaden	PYS	58.09
6/3/2009	NB-8	Bay anchovy	Egg	4089.30
6/3/2009	NB-8	Bay anchovy	PYS	40.66
6/3/2009	NB-8	Clupeid unidentified	UID	58.09
6/3/2009	NB-8	Cunner	YS	5.81
6/3/2009	NB-8	Tautog	UID	17.43
6/3/2009	NB-8	Wrasses	Egg	743.51
6/3/2009	AK-3	Atlantic menhaden	Egg	1016.14
6/3/2009	AK-3	Atlantic menhaden	PYS	65.49
6/3/2009	AK-3	Atlantic menhaden	YS	17.86
6/3/2009	AK-3	Atlantic silverside	PYS	5.95
6/3/2009	AK-3	Bay anchovy	Egg	4191.58
6/3/2009	AK-3	Bay anchovy	PYS	148.85
6/3/2009	AK-3	Clupeid unidentified	UID	35.72
6/3/2009	AK-3	Gobies	PYS	5.95
6/3/2009	AK-3	Tautog	PYS	11.91
6/3/2009	AK-3	Wrasses	Egg	1778.25
6/3/2009	AK-2	Atlantic menhaden	Egg	105.25
6/3/2009	AK-2	Bay anchovy	Egg	5262.59
6/3/2009	AK-2	Bay anchovy	PYS	9.87
6/3/2009	AK-2	Northern pipefish	PYS	4.93
6/3/2009	AK-2	Windowpane	PYS	4.93
6/3/2009	AK-2	Wrasses	Egg	526.26
6/3/2009	SB-5	Atlantic menhaden	Egg	1109.41

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
6/3/2009	SB-5	Bay anchovy	Egg	5916.84
6/3/2009	SB-5	Searobin species	Egg	123.27
6/3/2009	SB-5	Tautog	PYS	7.70
6/3/2009	SB-5	Windowpane	Egg	246.53
6/3/2009	SB-5	Windowpane	PYS	7.70
6/3/2009	SB-5	Wrasses	Egg	616.34
6/15/2009	LB-13	Bay anchovy	Egg	11081.48
6/15/2009	LB-13	Bay anchovy	PYS	364.85
6/15/2009	LB-13	Cods and Haddocks	Egg	395.77
6/15/2009	LB-13	Gobies	PYS	6.18
6/15/2009	LB-13	Northern pipefish	PYS	6.18
6/15/2009	LB-13	Windowpane	PYS	6.18
6/15/2009	LB-13	Wrasses	Egg	1978.84
6/15/2009	LB-4	Bay anchovy	Egg	14831.56
6/15/2009	LB-4	Bay anchovy	PYS	2005.47
6/15/2009	LB-4	Gobies	PYS	6.68
6/15/2009	LB-4	Northern pipefish	PYS	13.37
6/15/2009	LB-4	Searobin species	Egg	285.22
6/15/2009	LB-4	Windowpane	Egg	1140.89
6/15/2009	LB-4	Wrasses	Egg	1711.33
6/15/2009	LB-12	Bay anchovy	Egg	4648.09
6/15/2009	LB-12	Bay anchovy	PYS	495.18
6/15/2009	LB-12	Cods and Haddocks	Egg	105.64
6/15/2009	LB-12	Searobin species	Egg	105.64
6/15/2009	LB-12	Tautog	UID	6.60
6/15/2009	LB-12	Windowpane	Egg	105.64
6/15/2009	LB-12	Wrasses	Egg	1056.38
6/15/2009	LB-6	Bay anchovy	Egg	38701.45
6/15/2009	LB-6	Bay anchovy	PYS	487.30
6/15/2009	LB-6	Northern pipefish	PYS	101.32
6/15/2009	LB-6	Tautog	PYS	4.82
6/15/2009	LB-6	Windowpane	Egg	823.44
6/15/2009	LB-6	Windowpane	PYS	4.82
6/15/2009	LB-5	Bay anchovy	Egg	287152.41
6/15/2009	LB-5	Bay anchovy	PYS	14.20

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
6/15/2009	LB-5	Northern pipefish	PYS	28.40
6/15/2009	LB-5	Searobin species	Egg	3634.84
6/15/2009	LB-5	Windowpane	Egg	3634.84
6/15/2009	LB-5	Wrasses	Egg	3634.84
6/15/2009	LB-3	Bay anchovy	Egg	73633.24
6/15/2009	LB-3	Bay anchovy	PYS	947.87
6/15/2009	LB-3	Gobies	PYS	6.54
6/15/2009	LB-3	Northern pipefish	PYS	32.69
6/15/2009	LB-3	Wrasses	Egg	4183.71
6/15/2009	LB-7	Bay anchovy	Egg	4855.63
6/15/2009	LB-7	Bay anchovy	PYS	790.30
6/15/2009	LB-7	Cods and Haddocks	Egg	50.58
6/15/2009	LB-7	Northern pipefish	PYS	6.32
6/15/2009	LB-7	Wrasses	Egg	101.16
6/15/2009	LB-8	Bay anchovy	Egg	41306.98
6/15/2009	LB-8	Bay anchovy	PYS	239.05
6/15/2009	LB-8	Wrasses	Egg	382.47
6/15/2009	PJ-1	Bay anchovy	Egg	562.14
6/15/2009	PJ-1	Bay anchovy	PYS	60.39
6/15/2009	PJ-1	Gobies	PYS	21.96
6/15/2009	PJ-1	Northern pipefish	PYS	76.86
6/15/2009	PJ-1	Tautog	PYS	5.49
6/15/2009	PJ-1	Windowpane	PYS	5.49
6/15/2009	PJ-1	Wrasses	Egg	292.78
6/15/2009	PJ-2	Bay anchovy	Egg	11394.70
6/15/2009	PJ-2	Bay anchovy	PYS	24.14
6/15/2009	PJ-2	Gobies	PYS	6.04
6/15/2009	PJ-2	Northern pipefish	JUV	12.07
6/15/2009	PJ-2	Northern pipefish	PYS	48.28
6/15/2009	PJ-2	Wrasses	Egg	3476.35
6/16/2009	LB-10	Bay anchovy	Egg	9090.98
6/16/2009	LB-10	Bay anchovy	PYS	773.61
6/16/2009	LB-10	Cunner	PYS	6.56
6/16/2009	LB-10	Northern pipefish	PYS	72.12
6/16/2009	LB-10	Tautog	PYS	6.56

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
6/16/2009	LB-10	Wrasses	Egg	1118.89
6/16/2009	LB-1	Bay anchovy	Egg	10192.72
6/16/2009	LB-1	Bay anchovy	PYS	911.12
6/16/2009	LB-1	Cods and Haddocks	Egg	1659.28
6/16/2009	LB-1	Gobies	PYS	7.41
6/16/2009	LB-1	Northern pipefish	PYS	14.82
6/16/2009	LB-1	Searobin species	Egg	948.16
6/16/2009	LB-1	Tautog	PYS	14.82
6/16/2009	LB-1	Windowpane	PYS	7.41
6/16/2009	LB-1	Wrasses	Egg	1659.28
6/16/2009	LB-2	Bay anchovy	Egg	9872.59
6/16/2009	LB-2	Bay anchovy	PYS	71.81
6/16/2009	LB-2	Cods and Haddocks	Egg	510.65
6/16/2009	LB-2	Gobies	PYS	7.98
6/16/2009	LB-2	Searobin species	Egg	680.87
6/16/2009	LB-2	Weakfish	Egg	3914.99
6/16/2009	LB-2	Wrasses	Egg	2212.82
6/16/2009	LB-14	Bay anchovy	Egg	8170.82
6/16/2009	LB-14	Bay anchovy	PYS	34.05
6/16/2009	LB-14	Northern pipefish	PYS	8.51
6/16/2009	LB-14	Searobin species	Egg	726.30
6/16/2009	LB-14	Windowpane	Egg	5084.07
6/16/2009	LB-14	Windowpane	PYS	8.51
6/16/2009	LB-14	Wrasses	Egg	2723.61
6/16/2009	LB-9	Bay anchovy	Egg	9216.69
6/16/2009	LB-9	Northern pipefish	PYS	6.75
6/16/2009	LB-9	Searobin species	Egg	864.07
6/16/2009	LB-9	Wrasses	Egg	6336.48
6/16/2009	SB-6	Bay anchovy	Egg	7020.80
6/16/2009	SB-6	Bay anchovy	PYS	34.28
6/16/2009	SB-6	Cods and Haddocks	Egg	526.56
6/16/2009	SB-6	Northern pipefish	PYS	6.86
6/16/2009	SB-6	Windowpane	Egg	1053.12
6/16/2009	SB-6	Wrasses	Egg	3861.44
6/16/2009	SB-4	Bay anchovy	Egg	10651.22

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
6/16/2009	SB-4	Bay anchovy	PYS	7.45
6/16/2009	SB-4	Cods and Haddocks	Egg	317.95
6/16/2009	SB-4	Northern pipefish	PYS	37.26
6/16/2009	SB-4	Searobin species	Egg	158.97
6/16/2009	SB-4	Windowpane	Egg	1430.76
6/16/2009	SB-4	Wrasses	Egg	5087.15
6/16/2009	SB-3	Bay anchovy	Egg	3751.75
6/16/2009	SB-3	Bay anchovy	PYS	8.68
6/16/2009	SB-3	Northern pipefish	PYS	8.68
6/16/2009	SB-3	Wrasses	Egg	69.48
6/16/2009	SB-5	Atlantic menhaden	Egg	816.71
6/16/2009	SB-5	Bay anchovy	Egg	11706.18
6/16/2009	SB-5	Northern pipefish	PYS	59.55
6/16/2009	SB-5	Searobin species	Egg	544.47
6/16/2009	SB-5	Weakfish	PYS	8.51
6/16/2009	SB-5	Windowpane	PYS	8.51
6/16/2009	SB-5	Wrasses	Egg	10344.99
6/17/2009	NB-7	Bay anchovy	Egg	2107.59
6/17/2009	NB-7	Bay anchovy	PYS	702.53
6/17/2009	NB-7	Gobies	PYS	175.63
6/17/2009	NB-7	Northern pipefish	PYS	60.80
6/17/2009	NB-7	Tautog	PYS	13.51
6/17/2009	NB-7	Windowpane	PYS	6.76
6/17/2009	NB-7	Wrasses	Egg	2107.59
6/17/2009	NB-4	Bay anchovy	Egg	2415.29
6/17/2009	NB-4	Bay anchovy	YS	1482.11
6/17/2009	NB-4	Gobies	PYS	1130.79
6/17/2009	NB-4	Northern pipefish	PYS	98.81
6/17/2009	NB-8	Bay anchovy	Egg	15766.60
6/17/2009	NB-8	Bay anchovy	PYS	1115.83
6/17/2009	NB-8	Bay anchovy	YS	14.49
6/17/2009	NB-8	Gobies	PYS	137.67
6/17/2009	NB-8	Northern pipefish	PYS	21.74
6/17/2009	NB-8	Tautog	PYS	181.14
6/17/2009	NB-8	Weakfish	PYS	21.74

Appendix B. Ichthyoplankton (epibenthic sled) life stage densities (Number per 1,000 m^3) by date and station collected during the 2009 Aquatic Biological Survey. ES1 to ES5 are winter flounder egg stages 1-5, WFNVE are winter flounder non-viable eggs, ST1 to ST4 are winter flounder larval life stages 1-4, YS is yolk-sac larvae, PYS is post yolk-sac larvae, JUV is juveniles, and UID is unidentified larval lifestage.

Sample Date	Station	Common name	Life Stage	Density
6/17/2009	NB-8	Wrasses	Egg	18317.08
6/17/2009	AK-3	Bay anchovy	Egg	2249.44
6/17/2009	AK-3	Bay anchovy	PYS	43.12
6/17/2009	AK-3	Gobies	PYS	64.68
6/17/2009	AK-3	Northern pipefish	PYS	7.19
6/17/2009	AK-3	Searobin species	Egg	7.19
6/17/2009	AK-3	Weakfish	Egg	107.80
6/17/2009	AK-3	Weakfish	PYS	7.19
6/17/2009	AK-3	Wrasses	Egg	754.61
6/17/2009	AK-2	Bay anchovy	Egg	10966.98
6/17/2009	AK-2	Bay anchovy	PYS	166.73
6/17/2009	AK-2	Cunner	UID	4.63
6/17/2009	AK-2	Gobies	PYS	115.78
6/17/2009	AK-2	Northern pipefish	PYS	60.21
6/17/2009	AK-2	Tautog	PYS	4.63
6/17/2009	AK-2	Weakfish	PYS	4.63
6/17/2009	AK-2	Wrasses	Egg	296.40

Appendix C

Water quality data by date and station collected during the 2009 Aquatic Biological Survey

Appendix C. Water quality data by date and station collected during the 2009 Aquatic Biological Survey.

Date	Station	Temp (°C)	DO (mg/L)	Cond. (uS/cm)	Salinity (ppt)	Depth (ft)
05-Jan-09	LB-3	6.4	9.6	38980	24.6	15
05-Jan-09	LB-5	5.7	10.1	42530	26.9	20
05-Jan-09	LB-6	5.2	10.1	43010	27.1	45
05-Jan-09	LB-12	5.2	10.4	40930	25.7	25
05-Jan-09	LB-4	5.8	10.1	44040	27.5	38
05-Jan-09	LB-13	5.8	10.1	44460	28.2	21
06-Jan-09	LB-10	6.7	9.2	43420	27.6	30
06-Jan-09	LB-14	6.3	9.5	45370	28.9	50
06-Jan-09	LB-2	6.1	9.6	46930	28.4	52
06-Jan-09	LB-1	6.2	9.4	46930	29.8	22
06-Jan-09	LB-9	5.3	10	40010	25	33
06-Jan-09	LB-7	6.1	9.4	46310	29.3	29
06-Jan-09	LB-8	4.4	10.2	39600	24.5	15
07-Jan-09	NB-7	4.4	10.8	28740	17.5	8
07-Jan-09	NB-4	4.2	10.8	28160	16.9	8
07-Jan-09	NB-8	4.6	10.7	32470	19.7	42
07-Jan-09	AK-2	5	10.5	35150	21.7	48
07-Jan-09	AK-3	4.7	10.7	32720	20.1	50
07-Jan-09	PJ-1	4.2	11.3	29220	14.4	15
08-Jan-09	PJ-2	4.7	10.7	32150	19.9	11
08-Jan-09	SB-5	4.5	10.8	36650	22.2	45
08-Jan-09	SB-3	4.1	11.3	32450	19.7	16
08-Jan-09	SB-4	4.6	10.8	36520	22.6	37
08-Jan-09	SB-6	5.1	10.5	40210	25.1	45
08-Jan-09	KVK-1	4.3	19	34920	21.5	49
20-Jan-09	LB-13	2.6	9.82	42370	26.3	20
20-Jan-09	LB-4	4	9.4	45020	28.2	37
20-Jan-09	LB-12	3.6	9.4	42810	26.9	25
20-Jan-09	LB-6	3.4	9.4	45050	28.3	45
20-Jan-09	LB-5	2.5	10.8	41680	25.2	20
20-Jan-09	LB-3	2.1	10.3	40060	24.9	19
21-Jan-09	PJ-2	2.3	11.1	29160	17.6	10
21-Jan-09	PJ-1	2.4	11.2	35320	20.4	13
21-Jan-09	SB-3	3	10.3	37990	23.5	18
21-Jan-09	SB-4	3.6	10.1	41510	25.7	40
21-Jan-09	SB-6	4.1	10	41830	26.1	48
21-Jan-09	SB-5	3.2	10.5	39650	23.8	52
22-Jan-09	NB-7	3.2	11	33460	20.6	7
22-Jan-09	NB-4	0.8	12.2	28320	16.7	9
22-Jan-09	NB-8	3.2	10.6	37490	22.9	45
22-Jan-09	AK-3	3.4	10.9	39590	23.8	45

Appendix C. Water quality data by date and station collected during the 2009 Aquatic Biological Survey.

Date	Station	Temp (°C)	DO (mg/L)	Cond. (uS/cm)	Salinity (ppt)	Depth (ft)
22-Jan-09	AK-2	3.8	10.6	40420	25.2	47
23-Jan-09	LB-10	3.8	10.6	40500	25.5	32
23-Jan-09	LB-14	4.8	10.2	46400	29.5	52
23-Jan-09	LB-2	5.1	10.1	47250	30.1	52
23-Jan-09	LB-1	4.6	10.6	43180	27.2	17
23-Jan-09	LB-9	3.6	10.8	41790	26.1	28
23-Jan-09	LB-7	4.3	10.3	44480	28.1	29
23-Jan-09	LB-8	3	11.1	39650	24.6	10
02-Feb-09	LB-13	3.3	12.3	40420	25.2	19
02-Feb-09	LB-4	3.2	11.6	44640	28	40
02-Feb-09	LB-12	3	11.6	41370	26	28
02-Feb-09	LB-6	3.5	11.1	45530	28.7	49
02-Feb-09	LB-5	3	11.7	41830	25.6	24
02-Feb-09	LB-3	3	11.9	40720	25.8	20
02-Feb-09	LB-7	4.1	10.7	45400	28.5	18
04-Feb-09	SB-6	4.3	10.7	42900	27	48
04-Feb-09	SB-4	3.6	11	43550	27.5	40
04-Feb-09	SB-3	3.1	10.8	40510	25.2	18
04-Feb-09	SB-5	3	11.3	38880	24.8	52
04-Feb-09	PJ-1	2.8	11.9	37300	23.1	14
04-Feb-09	PJ-2	2.7	11.5	36570	22.5	11
05-Feb-09	AK-2	2.4	11.8	37050	22.7	46
05-Feb-09	AK-3	2.2	10.8	36400	22.3	46
05-Feb-09	NB-8	2.4	10.2	35560	21.5	41
05-Feb-09	NB-4	1.5	10.7	17180	18.8	8
05-Feb-09	NB-7	1.6	11.1	18140	19.8	8
06-Feb-09	LB-10	3.2	11.3	43990	27.7	30
06-Feb-09	LB-1	2	11.8	44080	27.4	16
06-Feb-09	LB-8	1.8	12.2	41230	25.5	10
06-Feb-09	LB-9	2.1	11.9	40980	25.4	28
06-Feb-09	LB-2	3.2	11.3	47010	29.8	51
06-Feb-09	LB-14	2.3	11.8	43970	27.1	52
17-Feb-09	LB-13	3.4	12.2	37410	23.2	19
17-Feb-09	LB-4	3.9	10.7	40570	24.9	39
17-Feb-09	LB-12	3.4	11.6	37540	23.2	26
17-Feb-09	LB-6	4.4	10	45790	29	48
17-Feb-09	LB-5	3.5	10.9	38680	24	22
17-Feb-09	LB-3	3.4	12.3	38610	23.7	19
17-Feb-09	LB-7	4.6	9.5	45070	28.8	19
17-Feb-09	LB-8	3.5	12.3	38680	23.8	12
18-Feb-09	LB-10	4.5	12.1	43270	26.5	30

Appendix C. Water quality data by date and station collected during the 2009 Aquatic Biological Survey.

Date	Station	Temp (°C)	DO (mg/L)	Cond. (uS/cm)	Salinity (ppt)	Depth (ft)
18-Feb-09	LB-2	4.8	10.7	49080	31.3	53
18-Feb-09	SB-6	4.7	10.6	47360	30.1	48
18-Feb-09	SB-4	4.2	10.8	41260	26.5	40
18-Feb-09	SB-3	3.8	11.5	30780	22.8	18
18-Feb-09	PJ-2	3	12.5	24110	14.2	10
25-Feb-09	LB-1	4.2	11.7	46680	29.7	20
25-Feb-09	LB-14	3.8	10.7	47720	30.1	51
25-Feb-09	LB-9	3.6	10.5	47230	29.9	30
25-Feb-09	PJ-1	3.4	10.8	39870	24.8	13
25-Feb-09	SB-5	3.4	10.6	38600	23.9	50
26-Feb-09	NB-7	3.4	12.8	33210	20.4	11
26-Feb-09	NB-4	3.1	13.2	34100	21	12
26-Feb-09	NB-8	3.2	12.2	35340	21.7	42
26-Feb-09	AK-3	3.3	12.1	37180	23	50
26-Feb-09	AK-2	3.3	12.1	35400	21.7	48
04-Mar-09	AK-3	2.6	12.2	33560	20.5	46
04-Mar-09	AK-2	2.4	11.5	34090	20.8	47
04-Mar-09	NB-8	2.6	11.4	33830	20.7	41
04-Mar-09	NB-4	2.5	11.7	31640	19.2	9
04-Mar-09	NB-7	2.5	12	32760	20	9
05-Mar-09	LB-13	2.7	13.5	41400	25.7	17
05-Mar-09	LB-4	2.8	11.9	44770	28.6	37
05-Mar-09	LB-12	2.6	12.9	41590	25.9	25
05-Mar-09	LB-6	2.5	12.9	43700	27.2	46
05-Mar-09	LB-5	2.5	14.2	40340	25.1	21
05-Mar-09	LB-3	2.5	14.3	39790	24.7	20
05-Mar-09	LB-7	3	11.6	43500	27.3	30
06-Mar-09	LB-8	3.2	14.6	39750	24.7	11
06-Mar-09	LB-9	3.1	13.2	41200	25.5	25
06-Mar-09	LB-2	3.5	12.1	45720	29.1	52
06-Mar-09	LB-14	3.2	12.3	42800	26.8	48
06-Mar-09	LB-1	3.4	13	43730	27.3	17
06-Mar-09	LB-10	3.2	12	41370	25.9	29
09-Mar-09	PJ-2	4.2	12.9	35880	22.2	12
09-Mar-09	PJ-1	4	11.1	42080	26.5	20
09-Mar-09	SB-5	4.1	10.8	41270	25.9	54
09-Mar-09	SB-6	4.2	10.6	43690	27.5	49
09-Mar-09	SB-4	4	10.7	40600	25.4	40
09-Mar-09	SB-3	4	10.8	38470	24	18
16-Mar-09	SB-5	4.4	11.6	30300	18.3	48
16-Mar-09	SB-3	4.6	11.5	35080	21.7	20

Appendix C. Water quality data by date and station collected during the 2009 Aquatic Biological Survey.

Date	Station	Temp (°C)	DO (mg/L)	Cond. (uS/cm)	Salinity (ppt)	Depth (ft)
16-Mar-09	SB-4	4.5	11.2	40770	25.7	40
16-Mar-09	SB-6	4.5	11.2	43700	28.4	52
16-Mar-09	PJ-2	4.4	12.1	18060	10.7	12
16-Mar-09	PJ-1	4	11.9	21550	12.8	13
17-Mar-09	AK-3	5.2	12.8	31060	19	48
17-Mar-09	AK-2	4.8	12.6	33270	20.3	48
17-Mar-09	NB-8	5.3	12.6	29240	17.9	48
17-Mar-09	NB-4	5.4	13.4	26720	16.2	10
17-Mar-09	NB-7	5.5	13.8	27280	16.4	11
18-Mar-09	LB-13	5	12.9	39240	26.2	20
18-Mar-09	LB-4	4.9	11.7	45250	28.8	38
18-Mar-09	LB-12	5	13.3	40800	24.4	27
18-Mar-09	LB-6	4.9	12	44410	28.1	47
18-Mar-09	LB-5	5.2	12.2	38470	24.1	21
18-Mar-09	LB-3	5.3	11.7	37670	23.8	20
18-Mar-09	LB-7	5.3	11.7	42910	27.3	30
19-Mar-09	LB-10	5.3	11.4	44500	28.3	30
19-Mar-09	LB-1	5.2	11.9	41350	26.1	17
19-Mar-09	LB-2	5.1	12.2	42000	26.5	52
19-Mar-09	LB-9	5	11.7	38020	23	26
19-Mar-09	LB-14	5.1	12.2	42130	27.4	43
19-Mar-09	LB-8	5.5	13.3	35030	22	12
06-Apr-09	NB-7	8	11	29250	17.9	10
06-Apr-09	NB-4	8.7	10.2	27620	16.9	10
06-Apr-09	NB-8	8	10.5	29830	18.4	45
06-Apr-09	AK-3	8.7	9.9	29510	18.2	45
06-Apr-09	AK-2	7.8	10	30070	18.5	46
08-Apr-09	LB-13	6.2	11.1	42870	27.2	21
08-Apr-09	LB-4	6.2	10.2	43480	27.5	38
08-Apr-09	LB-12	6.4	10.3	39910	25.2	25
08-Apr-09	LB-6	6.9	10.1	38000	23.8	43
08-Apr-09	LB-5	7.4	10.4	35420	22.1	18
08-Apr-09	LB-3	6.6	9.9	37420	23.5	15
08-Apr-09	LB-7	6.9	10.2	37500	23.5	27
08-Apr-09	LB-8	7	9.6	33350	20.7	12
09-Apr-09	LB-10	6.3	11	40810	25.7	30
09-Apr-09	LB-1	6	11	45460	29	18
09-Apr-09	LB-2	5.8	10.6	46160	29.4	53
09-Apr-09	LB-14	6	10.3	44490	28.3	50
09-Apr-09	LB-9	6.5	10.4	38940		24
09-Apr-09	SB-6	6.6	10.3	36970	23.1	50

Appendix C. Water quality data by date and station collected during the 2009 Aquatic Biological Survey.

Date	Station	Temp (°C)	DO (mg/L)	Cond. (uS/cm)	Salinity (ppt)	Depth (ft)
09-Apr-09	PJ-1	7.4	10.4	26050	15.2	10
10-Apr-09	SB-5	6.7	10.3	38090	23.9	52
10-Apr-09	PJ-2	7.3	9.9	28840	17.8	12
10-Apr-09	SB-3	7.1	9.7	31990	19.8	20
10-Apr-09	SB-4	6.8	9.6	37090	23.3	35
20-Apr-09	NB-7	9.4	10.4	28060	17.3	7
20-Apr-09	NB-4	9.5	9.3	28530	17.5	9
20-Apr-09	NB-8	8.1	8.96	35070	21.6	42
20-Apr-09	AK-3	8.9	8.9	33160	20.4	47
20-Apr-09	AK-2	8	8.8	37130	23.2	48
21-Apr-09	LB-14	8.6	10.3	39150	24.8	53
21-Apr-09	LB-1	8.5	10.2	37900	23.9	18
21-Apr-09	LB-13	8.4	10.2	36050	22.6	17
21-Apr-09	LB-4	8.1	9.4	39180	24.8	37
21-Apr-09	LB-12	8.2	9.6	38400	24.1	25
21-Apr-09	LB-6	8.1	9.4	38400	24.3	44
21-Apr-09	LB-5	8.8	10	33740	21.1	20
22-Apr-09	LB-10	8.9	10.3	36350	22.9	32
22-Apr-09	LB-3	8.4	9.1	38300	24.2	17
22-Apr-09	LB-7	8.3	9.5	41500	26.4	31
22-Apr-09	LB-8	8.8	10	35000	21.9	10
22-Apr-09	LB-9	8.6	9.7	36400	22.9	28
22-Apr-09	LB-2	7.9	10.1	44200	28.2	51
22-Apr-09	SB-6	8.4	9.48	37800	23.8	46
23-Apr-09	PJ-2	8.9	11.3	31360	19.3	11
23-Apr-09	SB-5	8.6	9.9	39520	24.8	47
23-Apr-09	SB-4	8.7	9.6	37080	23.2	40
23-Apr-09	SB-3	8.9	9.5	32150	20	19
23-Apr-09	PJ-1	8.9	9.4	33330	20.8	12
04-May-09	LB-13	11.6	9.4	39640	25.3	18
04-May-09	LB-4	10.2	9	43400	27.9	36
04-May-09	LB-12	10.4	8.7	43070	27.6	23
04-May-09	LB-6	10.7	8.8	42330	27.1	43
04-May-09	LB-5	12.1	8.1	38040	24.1	19
04-May-09	LB-3	11.8	8.7	38790	24.7	18
05-May-09	NB-7	13.1	7.2	30800	19.1	10
05-May-09	NB-4	13.3	6.6	29900	18.5	9
05-May-09	NB-8	13	6.7	31600	19.7	46
05-May-09	AK-3	12.9	6.8	31800	19.9	46
05-May-09	AK-2	12.9	6.9	31300	19.5	52
05-May-09	PJ-1	12.5	10.3	29000	17.9	11

Appendix C. Water quality data by date and station collected during the 2009 Aquatic Biological Survey.

Date	Station	Temp (°C)	DO (mg/L)	Cond. (uS/cm)	Salinity (ppt)	Depth (ft)
06-May-09	LB-10	11.5	7.9	41230	26.4	28
06-May-09	LB-1	11	8	43590	27.7	17
06-May-09	LB-2	11.1	8.3	44070	28.3	52
06-May-09	LB-14	11.2	7.7	42950	27.6	51
06-May-09	LB-9	11.5	7.5	38670	24.5	28
06-May-09	LB-7	11.4	7.3	39770	25.4	28
06-May-09	LB-8	12.3	7.4	35220	22.1	10
07-May-09	PJ-2	12.6	8	32180	20.1	12
07-May-09	SB-5	11.9	7.1	39200	24.8	50
07-May-09	SB-6	11.9	7	39170	25.1	50
07-May-09	SB-4	12.2	6.9	36480	23.1	40
07-May-09	SB-3	12.3	6.7	35120	21.8	18
18-May-09	PJ-2	14.5	7.8	23590	14.3	10
18-May-09	SB-5	12.7	7.5	41490	26.4	48
18-May-09	PJ-1	13.9	6.7	30320	18.3	11
18-May-09	AK-3	13.6	6	33880	21.3	45
18-May-09	AK-2	13.6	6.1	34000	21.2	45
18-May-09	NB-8	14.6	7.3	29070	17.9	40
18-May-09	NB-4	14.6	6.8	27300	16.8	8
18-May-09	NB-7	14.8	7.2	24560	14.9	7
19-May-09	LB-13	13.5	7.3	38690	24.6	17
19-May-09	LB-4	12.3	7.6	42470	27.3	36
19-May-09	LB-12	12.4	8	41770	26.9	24
19-May-09	LB-6	12.5	7.8	41830	26.9	42
19-May-09	LB-5	14	7.9	34770	21.9	18
19-May-09	LB-3	14.1	7.2	35440	22.1	15
19-May-09	LB-7	12.8	7.9	41190	26.4	29
19-May-09	LB-8	14	7.8	35400	22.5	12
19-May-09	SB-6	12.4	8.1	42070	27.1	49
20-May-09	LB-9	13.1	7.9	38830	24.8	25
20-May-09	LB-2	10.6	8.6	46140	29.8	50
20-May-09	LB-14	11.1	8.5	45450	29.4	50
20-May-09	LB-1	12.7	8.4	42540	27.4	16
20-May-09	LB-10	13.4	8.1	40280	25.8	29
20-May-09	SB-4	13	8	38920	24.8	37
20-May-09	SB-3	13.8	7.8	33580	21.1	16
01-Jun-09	LB-13	16.4	7.5	37780	24	17
01-Jun-09	LB-4	15.2	6.9	42810	27.6	35
01-Jun-09	LB-12	16	7.2	39420	25.1	24
01-Jun-09	LB-6	15.9	7	40870	26.2	42
01-Jun-09	LB-5	16.2	7.9	38160	24.3	18

Appendix C. Water quality data by date and station collected during the 2009 Aquatic Biological Survey.

Date	Station	Temp (°C)	DO (mg/L)	Cond. (uS/cm)	Salinity (ppt)	Depth (ft)
01-Jun-09	LB-3	16.6	8	38490	24.5	17
01-Jun-09	LB-7	15.6	6.9	41400	26.6	28
01-Jun-09	LB-8	16.1	7.7	38900	24.8	12
01-Jun-09	PJ-1	16.8	6.9	31700	19.8	18
01-Jun-09	PJ-2	16.9	7	28260	16.5	5
02-Jun-09	LB-9	16.5	7.5	38740	24.7	25
02-Jun-09	LB-14	15.2	7.8	43140	27.9	51
02-Jun-09	LB-2	14.8	8.3	44200	28.7	50
02-Jun-09	LB-1	16.3	7.4	38200	24.3	15
02-Jun-09	LB-10	16.1	7.2	40000	25.6	28
02-Jun-09	SB-6	16.1	7.3	38700	24.7	45
02-Jun-09	SB-4	16.7	6.9	35140	22.1	37
02-Jun-09	SB-3	17.3	6.5	32610	20.4	16
03-Jun-09	NB-7	18.1	6.2	30880	19.3	7
03-Jun-09	NB-4	18.3	6.3	29650	18.4	8
03-Jun-09	NB-8	17.8	6.4	31330	19.6	43
03-Jun-09	AK-3	17.7	6.4	32110	20.1	46
03-Jun-09	AK-2	17.7	6.5	32100	20.1	45
03-Jun-09	SB-5	16.6	7.1	38370	24.5	46
15-Jun-09	LB-13	18.1	6.2	37850	23.5	19
15-Jun-09	LB-4	18	6.1	38780	24.8	37
15-Jun-09	LB-12	18.3	6.6	36380	23.1	25
15-Jun-09	LB-6	17.5	6.5	41200	26	44
15-Jun-09	LB-5	18.4	5.9	34020	22.2	21
15-Jun-09	LB-3	19	6.5	34130	21.5	20
15-Jun-09	LB-7	18.1	6.2	39310	25.1	29
15-Jun-09	LB-8	19	7.7		21.4	14
15-Jun-09	PJ-1	19	6.3	28660	17.8	19
15-Jun-09	PJ-2	19	5.9	27500	16.9	12
16-Jun-09	LB-10	18.2	6.7	39460	25.1	29
16-Jun-09	LB-1	18	6.9	39520	25.4	17
16-Jun-09	LB-2	17.4	6.7	42680	27.4	51
16-Jun-09	LB-14	17.9	6.6	40000	25.5	44
16-Jun-09	LB-9	18.3	6	34940	22	26
16-Jun-09	SB-6	18.3	6.5	36580	22.8	47
16-Jun-09	SB-4	18	6.1	37590	23.9	40
16-Jun-09	SB-3	18.7	5.8	31830	19.7	18
16-Jun-09	SB-5	18.4	5.7	33800	21.1	49
17-Jun-09	NB-7	19.1	6.2	23640	14.3	7
17-Jun-09	NB-4	19.6	5.4	23100	13.4	8
17-Jun-09	NB-8	18.9	5.1	21470	18.3	43

Appendix C. Water quality data by date and station collected during the 2009 Aquatic Biological Survey.

Date	Station	Temp (°C)	DO (mg/L)	Cond. (uS/cm)	Salinity (ppt)	Depth (ft)
17-Jun-09	AK-3	18.9	5.2	30500	19	46
17-Jun-09	AK-2	18.7	5.5	31710	19.8	47

Appendix D

Laboratory microscope setup and winter flounder egg and larval staging photographs and illustrations

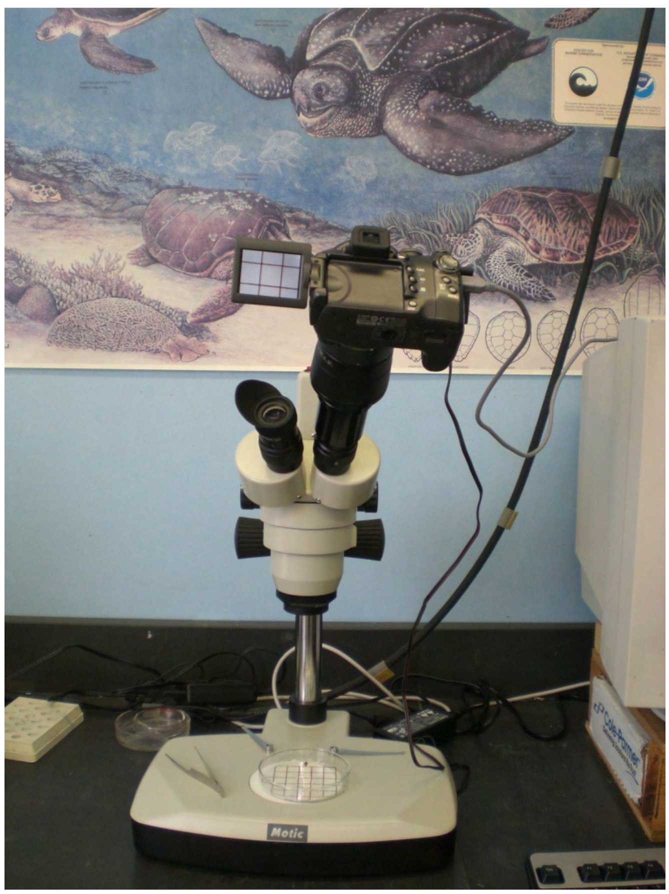


Figure D-1. Laboratory analysis set up showing the Motic DM143 Digital Microscope with Canon Powershot S31S Digital Camera.

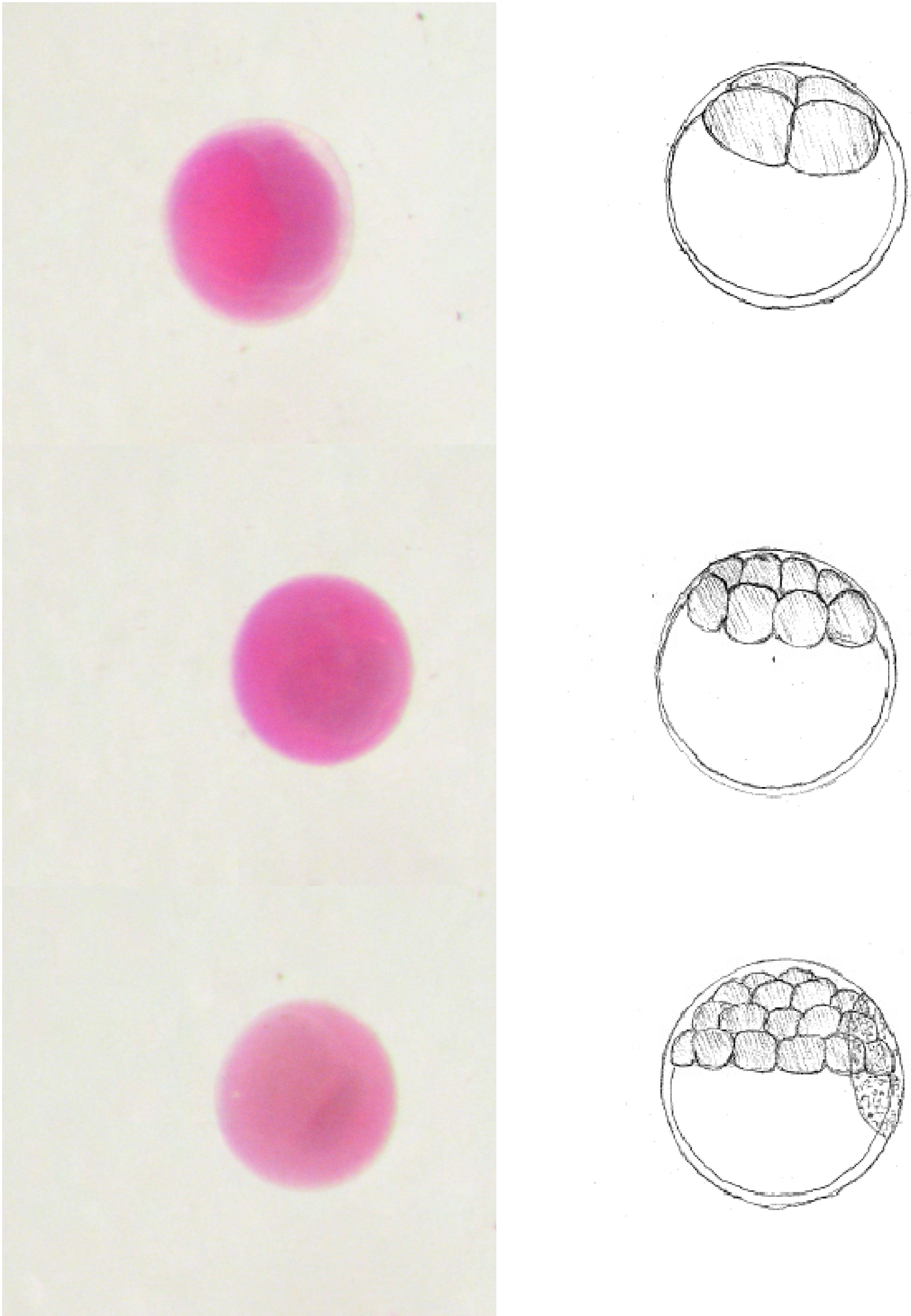


Figure D-2. Winter Flounder - Egg Stage 1 or Early Cleavage Stage.

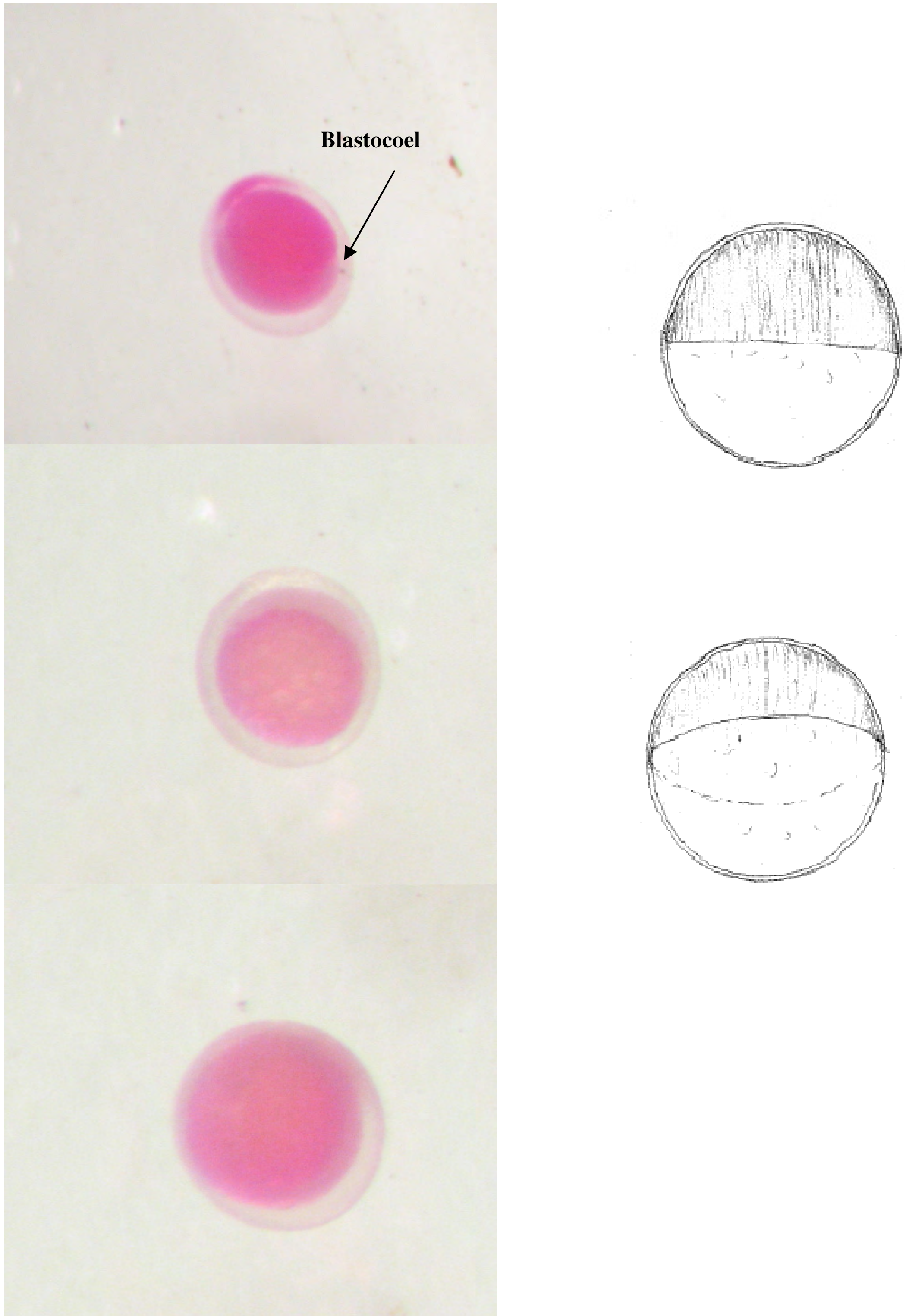


Figure D-3. Winter Flounder - Egg Stage 2 or Blastula Stage.

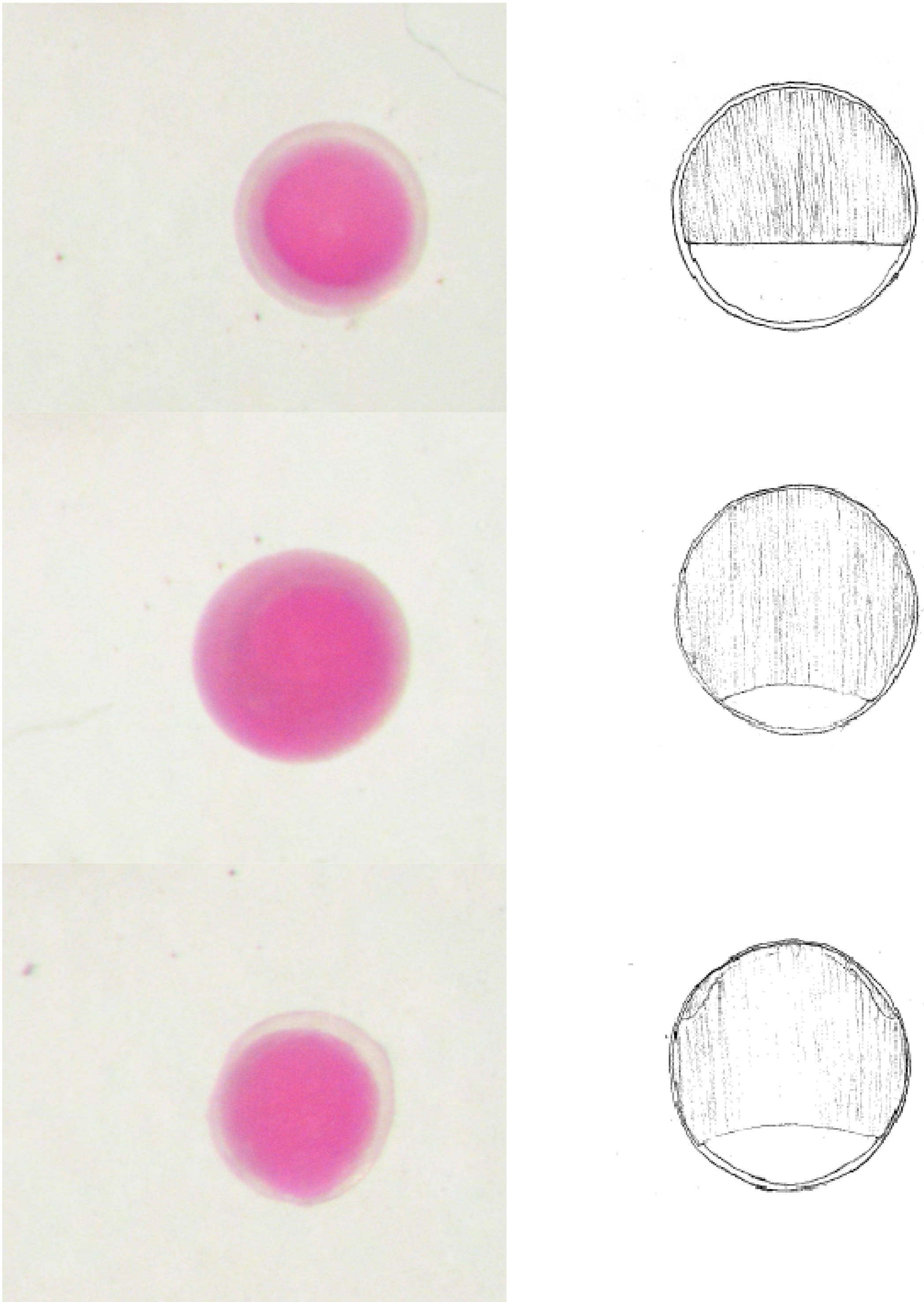


Figure D-4. Winter Flounder – Egg Stage 3 or Gastrula Stage.

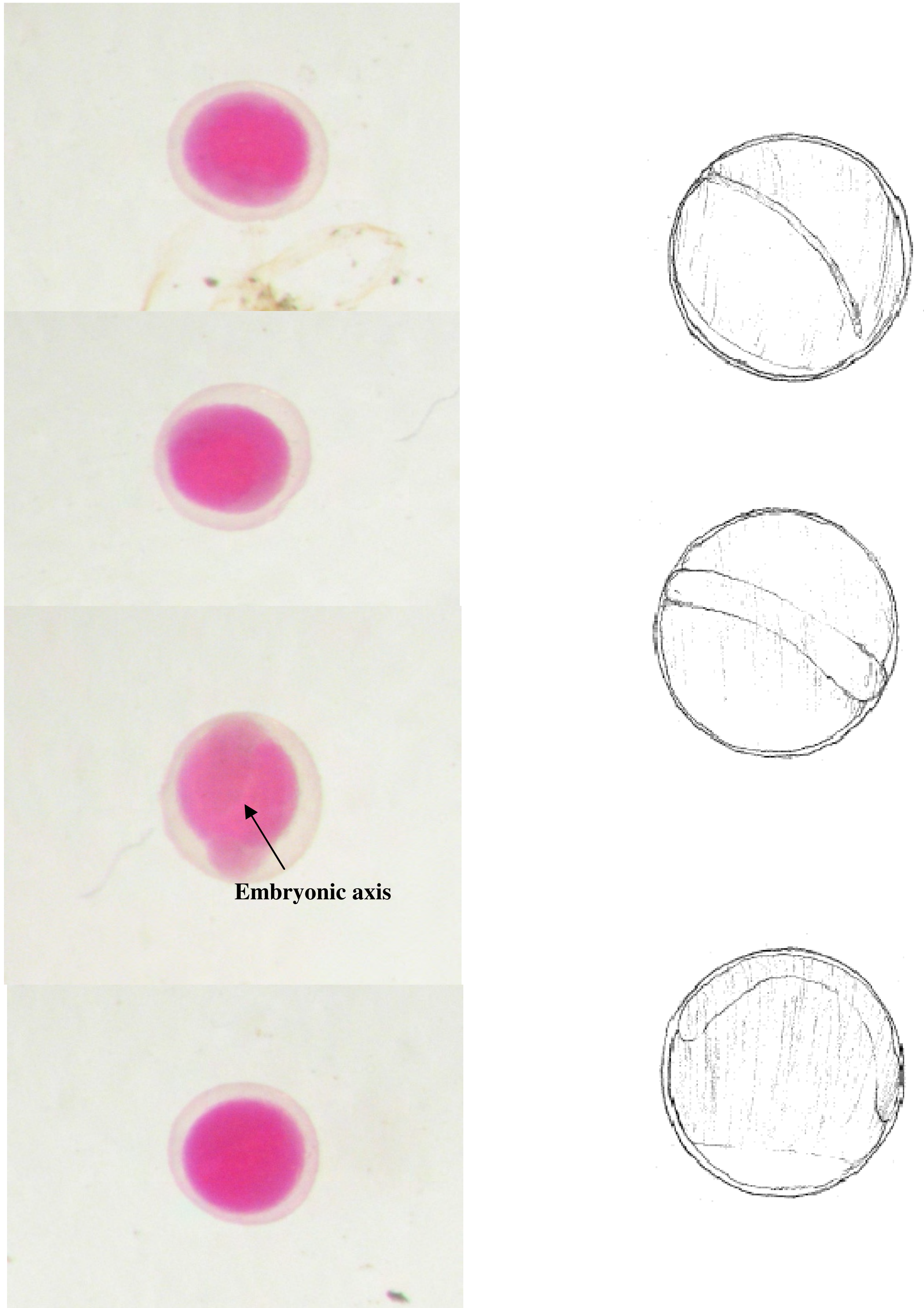


Figure D-5. Winter Flounder – Egg Stage 4 or Early Embryo Stage.

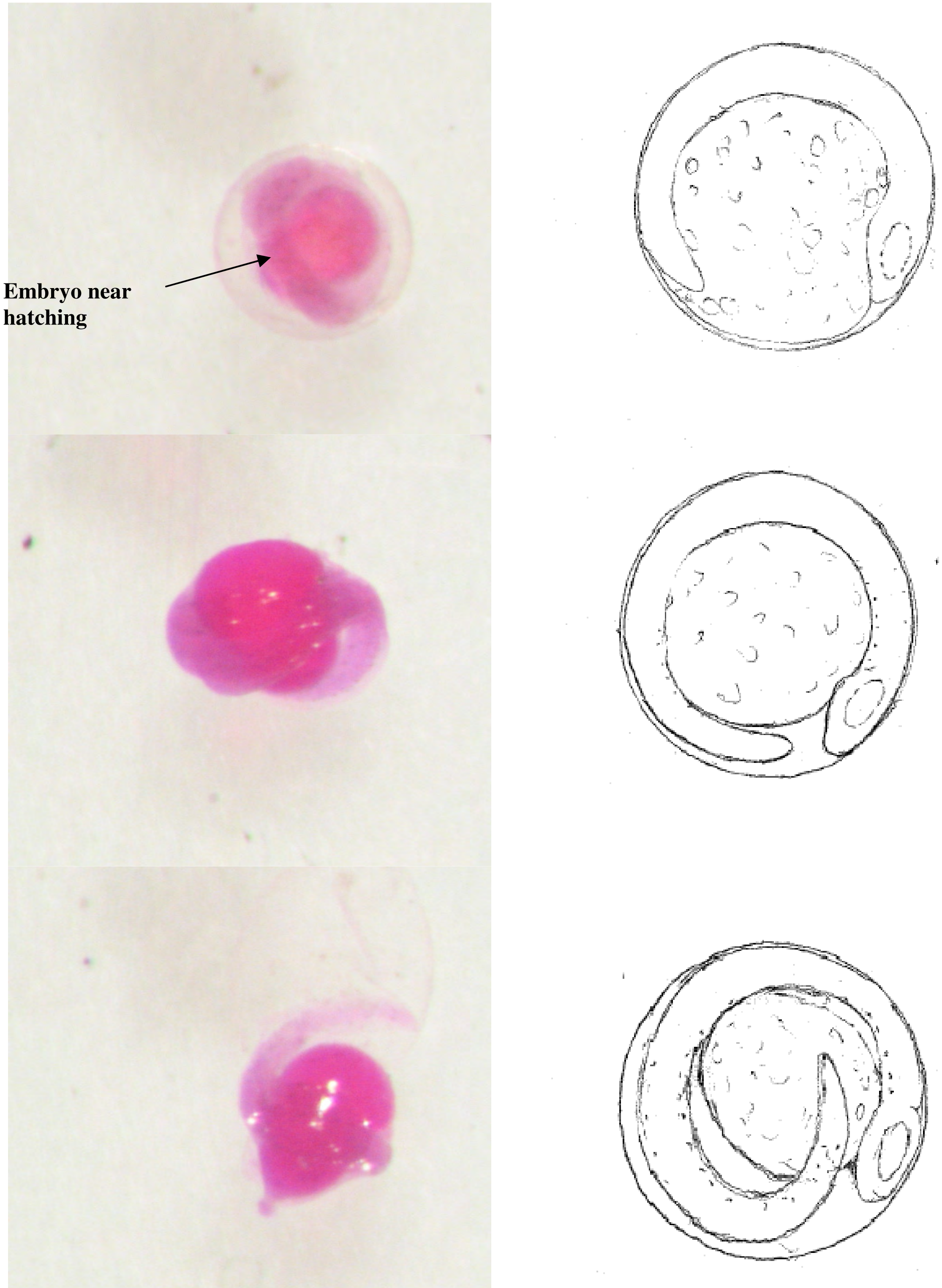
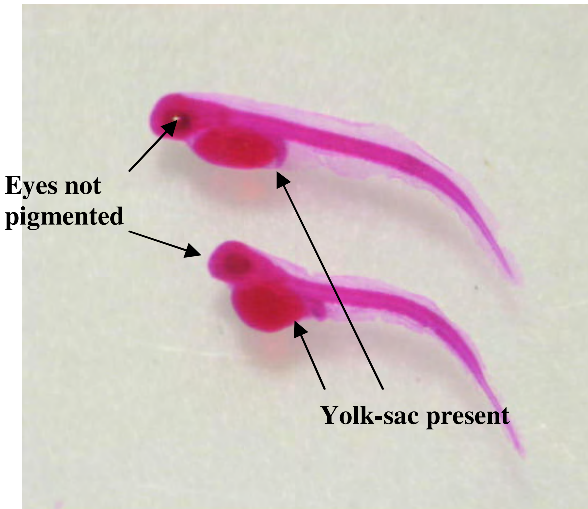


Figure D-6. Winter Flounder - Egg Stage 5 or Late Embryo Stage.



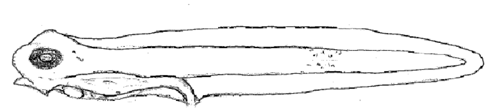


Figure D-7. Winter Flounder - Larval Stage 1.

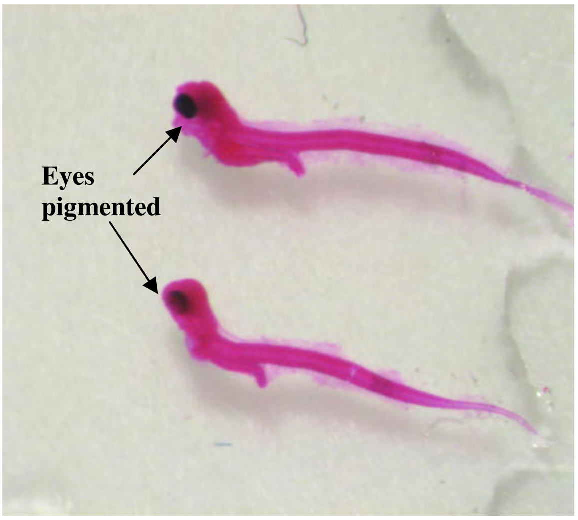


Figure D-8. Winter Flounder - Larval Stage 2.

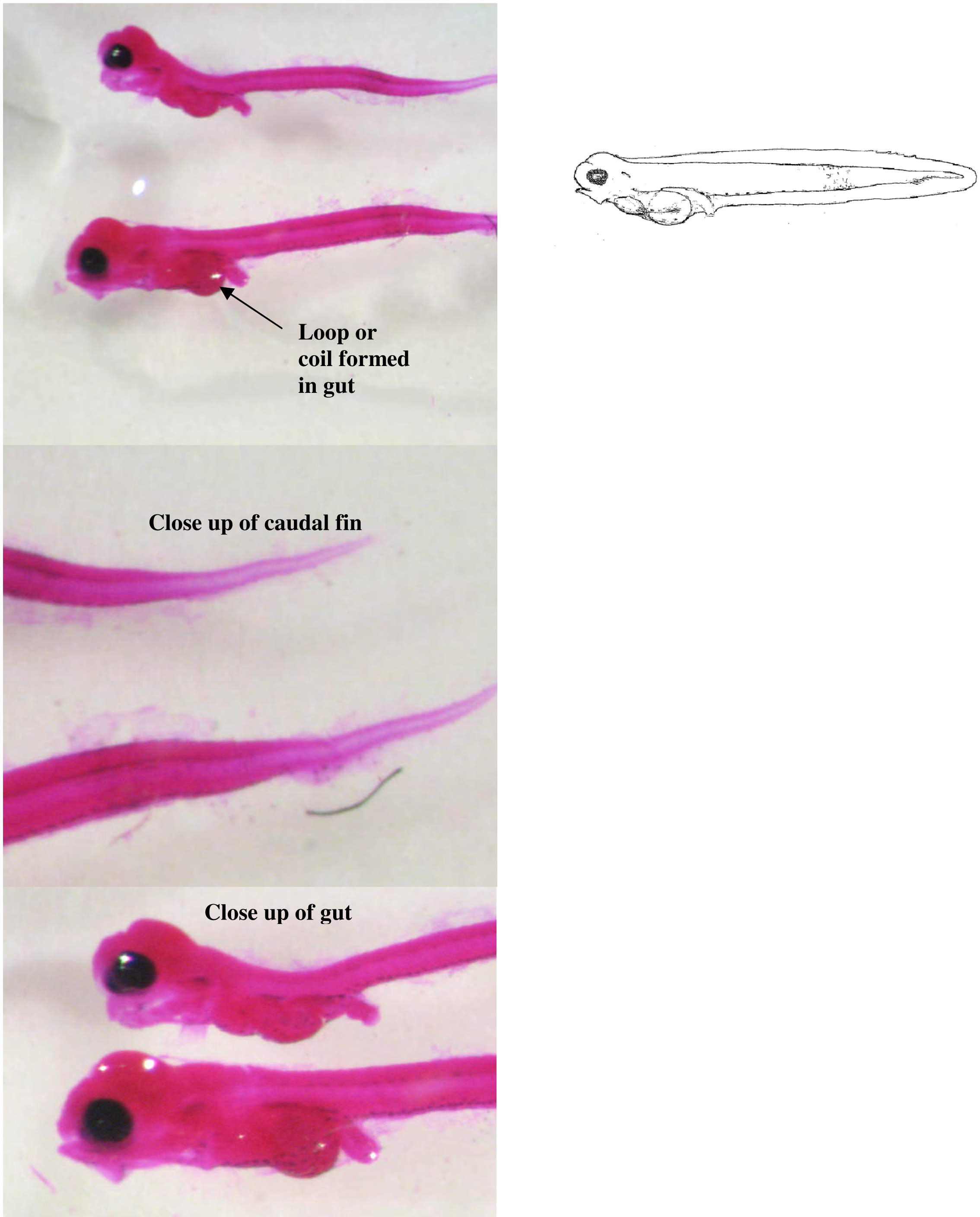
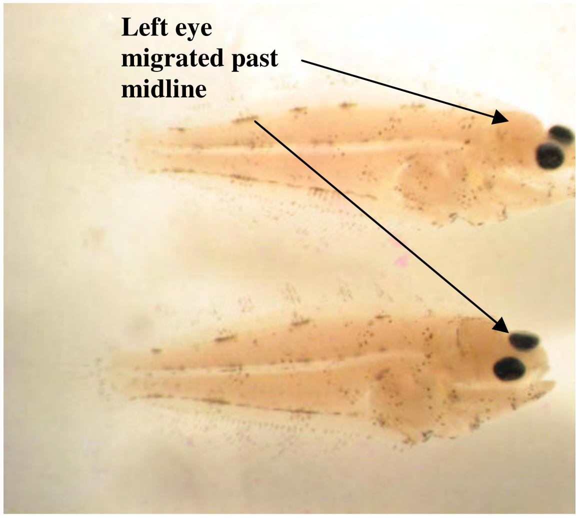


Figure D-9. Winter Flounder – Larval Stage 3.



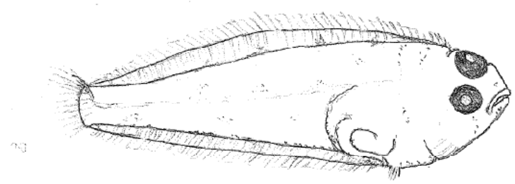


Figure D-10. Winter Flounder - Larval Stage 4.

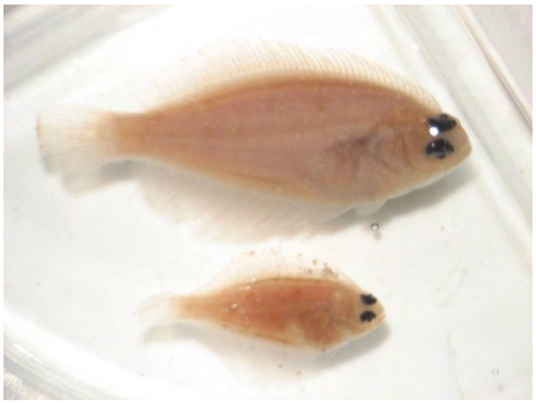


Figure D-11. Winter Flounder – Juvenile.