

JOB 8: ESTUARINE SEINE SURVEY

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TABLE OF CONTENTS

	Page
GOAL.....	4
OBJECTIVES	4
METHODS	4
RESULTS	5
Relative Abundance of Juvenile Winter Flounder and Tautog.....	5
Presence of Other Important Recreational Finfish.....	6
Relative Abundance of Forage Species	6
Relative Abundance of Invertebrate Species	7
MODIFICATIONS	7

LIST OF TABLES

Table 8.1: Geometric mean catch of finfish species commonly captured in seine samples, 1988-2020.....	9-10
Table 8.2: Frequency of occurrence of finfish species commonly captured in seine samples, 1988-2020	11-12
Table 8.3: Mean catch of young-of-year winter flounder at eight sites sampled by seine, 1988-2020.....	13
Table 8.4: Total catch of finfish species commonly captured in seine samples, 1988-2020	14-15
Table 8.5: Total catch of finfish species infrequently captured in seine samples, 1988-2020.....	16
Table 8.6: Total catch of invertebrate species captured in seine samples, 2004-2020	17
Table 8.7: Mean catch of forage fish, 1988-2020.....	21

LIST OF FIGURES

Figure 8.1: Sampling locations of the estuarine seine survey along the coast of Connecticut	18
Figure 8.2: Mean catch of all finfish captured in seine samples, 1988-2020	18
Figure 8.3: Mean catch of young-of-year winter flounder, 1988-2020	19
Figure 8.4: Mean catch of young-of-year tautog, 1988-2020.....	19
Figure 8.5: Mean catch of young-of year black sea bass, 1988-2020.....	20
Figure 8.6: Mean catch of young-of year scup, 1988-2020.....	20
Figure 8.7: Mean catch of forage fish captured in seine samples, 1988-2020.....	21

LIST OF APPENDICES

Appendix 8.1: Finfish species captured in the Estuarine Seine Survey, 1988-2020. ... 22-23
Appendix 8.2: Invertebrate species captured in the Estuarine Seine Survey, 2020.....23



Beach seining with 25' bag seine.

JOB 8: ESTUARINE SEINE SURVEY

GOAL

To monitor the abundance and size composition of near-shore young-of-year and forage fish resources, with physical habitat parameters, in order to evaluate the effects of fishing and environmental conditions on the distribution and abundance of marine resources in Long Island Sound.

OBJECTIVES

- 1) *Indices of abundance for juvenile sportfish (age-0 and 1+).*
- 2) *An annual index of forage species abundance.*

METHODS

Eight sites (Figure 8.1) are sampled during September using an eight-meter (25 ft.) bag seine with 6.4mm (0.25 in.) bar mesh. Area swept is standardized to 4.6 m (15 ft.), width by means of a taut spreader rope and a 30m (98 ft.), measured distance, parallel to, or at a 45° angle to the shoreline, against the current or tide if present. At each site, six seine hauls are taken within two hours before and after low slack tide during daylight hours. All sites have been sampled since 1988 except Milford which was added in 1990.

Finfish, crabs, and other invertebrates taken in each sample are identified to species or lowest practical taxon (full listing given in Appendix 8.1, 8.2) and counted. One exception is inland silverside, which are not separated from Atlantic silverside because they are rare and difficult to identify. Qualitative counts were used for menhaden when abundant ($n > 1000$) to minimize discard mortality. Winter flounder are measured to total length (mm), and classified as young-of-year (YOY) if less than 12 cm and age 1+ if 12cm or larger. The age of flounder near this size was verified in 1990-1992 by examination of the sagittal otolith. Physical data recorded at each seine location included water temperature and salinity at one-meter depth. The geometric (retransformed natural log) mean catch per standard haul is calculated for total finfish catch and individually for the 22 most abundant species, with separate indices for young-of-year (YOY) and winter flounder age 1 and older. Winter flounder YOY catch is also reported for each site. Confidence intervals (95%) for each geometric mean are retransformations of the corresponding log intervals. Frequency of occurrence is given as a percentage of all samples taken each year.

Diversity in the catch, or species richness, was computed for finfish species captured in the Survey over the time series. Species were divided into three groups based on their temperature preferences and seasonal spawning habits as documented in the literature. Criteria used to assign species into a cold temperate group, warm temperate group, or subtropical group are listed in Job 5.

RESULTS

A total of 48 seine hauls were taken in 2020 at eight sites, yielding a total catch of 12,110 fish of 23 species and 6,240 invertebrates of 13 species. Geometric mean catch of all finfish (fish/haul) in 2020 was 260 fish/haul, above the 30-year time series median of 162 fish/haul (Figure 8.2). Although total catch varies considerably from year to year, the increasing trend is significant ($df=31$, $r^2=0.34$, $p<0.001$). Dominant species contributing to this increase include young-of-year (YOY) black sea bass, tautog, scup (porgy), northern kingfish, menhaden and a resurgence of five forage species. Catch slightly decreased from 2019 to 2020, however, species that contributed to high total catch in 2020 compared to 2019 were Black Sea Bass (13%), Cunner (18%), Fourspine Stickleback (200%), Rainwater Killifish (200%), Scup (29%), Smallmouth Flounder (171%), Tautog (8%), and Winter Flounder 1+ (40%).

Geometric means were calculated for 30 species commonly captured since the survey began in 1988 (Table 8.1). The most frequently caught species was Atlantic silverside, which occurred in all samples, followed by striped killifish, northern pipefish, black sea bass, tautog, scup, northern puffer, mummichog, sheepshead minnow and winter flounder (YOY) (Table 8.2). This rank order has changed from previous years, with a notable increase in recreationally important species in 2020 such as black sea bass, scup and cunner along with forage fish species such as sheepshead minnow, four spine stickleback and sheepshead minnow (Table 8.2).

Scup, black sea bass and northern kingfish occurrence and abundance increased well above the 30-year time series average in 2016 and 2017 (Tables 8.1 and 8.2). Occurrence of tautog, cunner and sheepshead minnow also ranked high in the time series. Windowpane flounder was again absent in 2020 after re-occurring at low abundance in 2011 and 2014, but absent in 2009-10, 2012-13, and 2015-20 (Table 8.1).

Relative Abundance of Juvenile Winter Flounder and Tautog

The 2020 index of YOY winter flounder (0.421 fish/haul) decreased 39% from the 2019 index. A modest increase from the lowest abundance recorded in 2013 occurred from 2014-2020 (Table 8.3, Figure 8.3). Total catch in 2020 decreased 43% from 2019 (Table 8.4). The time series has a significant negative trend ($df=31$, $r^2=0.38$, $p<0.001$), and indicates that a relatively strong year class has not been produced since 1996 (Table 8.1, Figure 8.3). As in previous years, highest abundance was seen at eastern sites (Waterford, Groton,) and Milford, New Haven and Bridgeport had no catch (Table 8.3) and the frequency of occurrence of this species has decreased over the time series (Figure 8.3) indicating that juvenile production has contracted in several areas of the Sound. Mean length of YOY winter flounder captured at all sites in 2020 was 67mm and shows no trend over the 30-year time series, ranging from 47.3 to 71.1mm.

The 2020 index of YOY tautog (2.2 fish/haul) was above the series average of 1.1 tautog fish/haul, increasing from 2017 (1.3 fish/haul) and decreasing from 2015 (4.8 fish/haul) which was the highest abundance in the time series (Table 8.1, Figure 8.4). Overall, the

time series has a significant increasing trend ($df=31$, $r^2=0.34$, $p<0.001$). Relatively abundant year classes have been produced in 1998-99, 2002-04, 2007-08, 2012 and 2014-15, 2017-2020. The frequency of occurrence of this species has also increased over the time series (Figure 8.4) indicating that juvenile production and survival is improving in several areas of the Sound.

Presence of Other Important Recreational Finfish

YOY scup and black sea bass are recent additions to the seine survey (Table 8.1, Figures 8.5 and 8.6). Scup occurred in 1999 but the highest relative abundance has been in the last five years of the time series. Record numbers for YOY scup occurred in 2015 (9.4 fish/haul), with a time series high occurring in 2018 (10.6 fish/haul), which is above the time series mean (1.36 fish/haul). The 2020 index for scup was 7.0 fish/haul, which is the third highest in the time series.

YOY black sea bass first appeared in Survey catches in 1991 and every year since 1998, reaching their record highest abundance in 2015 (16.3 fish/haul). The 2016 index (5.8 fish/haul) is third highest behind 2014 and 2015. The 2020 index was 5.1 fish/haul, the fifth highest in the times series and slightly lower than 2012 index of abundance. Total catch in 2019 increased 67% from 2018 and increased again in 2020 by 13% from 2019 (Table 8.4).

YOY bluefish show a pattern similar to black seabass, first appearing in the catch in 1991 and almost consistently since 1998. Their abundance increased dramatically in 2014 and 2015, returning to abundance near the time series mean (0.29 fish/haul) in 2016 (Table 8.1). No juvenile bluefish (snappers) were captured in 2017, making it the eighth time in the 30-year time series that no snappers were seen. In 2018, juvenile bluefish reappeared with an abundance of 0.44 fish/haul and increased in 2019 with an abundance of 0.62 fish/haul then decreased to 0.18 fish/haul in 2020.

Relative Abundance of Forage Species

Seine survey catches are numerically dominated by forage species, defined here as short-lived, highly fecund species that spend the majority of their life cycle inshore where they are common food items for piscivorous fish. An index of forage fish abundance was generated using the catch of four of the most common forage species caught: Atlantic silverside, striped killifish, mummichog, and sheepshead minnow (Figure 8.7). The 2020 index (162 fish/haul) was above the series average (104 fish/haul), the fourth highest in the time series and slightly higher than the 2019 index of abundance.

Although numerically driven by the abundance of silverside, all four forage fish species increased in abundance and occurrence in 2015-2017 and were at or above their time series mean of 104. The time series high occurred in 2003, with a mean catch of 206 forage fish (Table 8.7). Although the forage index varies considerably from year to year, common for short-lived forage species, the increasing trend is significant (r^2 0.19, $p=0.01$, Figure 8.7).

Relative Abundance of Invertebrate Species

A total of 6,240 invertebrates of 13 species or taxon groups were captured in 2020 (Table 8.6, Appendix 8.2), a total similar to 2009 (5,931). Seven crab species were present in the seine hauls, along with two shrimp species. Mud snail, hermit crab, sand shrimp, shore shrimp, green crab, and comb jellyfish were the most abundant and at greater than 50% occurrence (Table 8.6).

Eighty-one blue crabs were captured in 2020. Blue crabs were captured at Groton, Old Lyme, Clinton, New Haven, Bridgeport, Greenwich, and Milford sites but continued at relatively low abundances in 2017, 2018 (n=11 and 19 crabs) down from a time series high in 2009 (n=333 crabs). The 2020 index (n=81 blue crabs) is third highest behind 2006 and 2009. The Japanese shore crab re-appeared in 2015 and 2016, with only one captured at the Old Lyme site. No Japanese shore crabs were captured in 2017 or 2018, but one was captured in 2019 and 2020. The shore shrimp returned to moderate abundance in 2016, 2017, after increasing substantially in 2014-15, then decreasing in 2018-2020 (Table 8.6). Sand shrimp decreased significantly from 2015 until 2016, then increased significantly in 2017 until 2020 (Table 8.6). Spider crab abundance has also increased nearly ten-fold from 2011 until 2017 compared to earlier years, with the highest catch in 2017, and decreased significantly in 2018-2020 (Table 8.6).

MODIFICATIONS

None.

Beach seining with 25' bag seine at the Old Lyme site.



Table 8.1: Geometric mean catch of finfish species commonly captured in seine samples, 1988-2020.

See Appendix 8.1 for complete taxonomic names.

Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
alewife	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
American sand lance	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American shad	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Atlantic menhaden	0.1	0.0	0.0	0.0	0.5	0.0	0.1	0.0	0.0	0.1	0.4	0.4	0.4	0.0	1.0	8.2
Atlantic silverside	68.2	31.6	45.0	88.5	51.2	42.7	37.7	27.0	17.7	23.1	74.3	102.5	99.7	36.1	80.1	113.6
Atlantic tomcod	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
black sea bass	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.1	0.0	0.0	0.1	0.1	0.0	1.0	0.4	0.2
blueback herring	0.0	0.1	0.0	0.5	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1
bluefish	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.9	0.0	0.1	0.0	0.2
cunner	0.2	0.3	0.0	0.1	0.2	0.0	0.3	0.2	0.3	0.0	0.3	0.5	0.3	0.2	0.3	0.2
fourspine stickleback	0.3	0.4	0.0	0.7	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.0
grubby	0.8	0.1	0.0	0.1	0.5	0.1	0.4	0.3	0.2	0.3	0.2	0.5	0.1	0.2	0.3	0.5
inshore lizardfish	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.4	0.1	0.2	0.2	1.2	0.0	0.0
mummichog	2.8	1.6	1.1	1.9	1.6	3.7	3.3	0.7	1.2	0.5	2.0	0.8	3.2	1.4	3.4	2.9
naked goby	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
northern kingfish	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.2	0.1	0.2
northern pipefish	0.7	0.3	0.4	1.0	0.9	0.9	1.1	0.5	1.0	0.4	2.1	1.0	1.0	1.4	0.5	0.3
northern puffer	0.1	0.3	0.1	0.4	0.1	0.4	0.2	0.5	0.2	0.1	0.1	0.2	0.6	0.2	0.7	0.7
rainbow smelt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
scup	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.6
sheepshead minnow	0.8	1.0	0.1	0.6	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.4	0.2	0.6	0.7
smallmouth flounder	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.0
striped bass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
striped killifish	11.9	7.9	5.9	4.2	3.1	4.9	5.1	3.9	2.0	1.5	7.2	4.5	8.6	7.5	14.5	14.9
striped searobin	0.2	0.2	0.1	0.2	0.1	0.9	0.1	0.0	0.1	0.4	1.9	0.6	0.1	0.4	0.3	0.7
summer flounder	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
tautog	0.3	0.1	0.3	0.7	0.4	0.2	0.8	0.7	0.3	0.2	0.9	1.3	0.5	0.6	1.5	1.1
weakfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
windowpane flounder	0.6	0.1	0.2	0.2	0.3	0.3	0.1	0.2	0.7	0.4	0.1	0.1	0.1	0.0	0.0	0.1
winter flounder-age 1+	0.2	0.1	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.0
winter flounder YOY	15.4	1.7	2.9	5.2	11.9	5.7	14.2	10.1	19.2	7.5	9.2	8.7	4.3	1.3	3.1	8.1

Table 8.1 continued: Geometric mean catch of finfish species commonly captured in seine samples, 1988-2020.

See Appendix 8.1 for complete taxonomic names.

Species	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
alewife	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American sand lance	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American shad	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.0
Atlantic menhaden	0.4	0.2	0.4	0.6	0.1	0.3	0.0	0.1	0.0	0.1	1.2	9.9	0.4	0.5	1.6	1.4	0.8
Atlantic silverside	85.1	81.3	37.7	74.9	57.5	66.8	96.9	66.5	45.0	35.0	64.8	114.5	73.0	75.9	117.4	111.3	116.9
Atlantic tomcod	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
black sea bass	0.4	0.1	0.5	0.6	0.3	1.1	0.4	3.2	5.2	3.7	10.8	16.3	5.8	3.2	4.6	2.8	5.1
blueback herring	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.8	0.0	0.3
bluefish	0.2	0.1	0.2	0.0	0.0	0.3	0.0	0.2	0.4	0.1	0.8	3.4	0.3	0.0	0.4	0.6	0.2
cunner	0.5	0.3	0.1	0.5	0.1	0.2	0.1	0.0	0.4	0.0	0.5	0.1	0.0	0.2	0.2	0.2	0.2
fourspine stickleback	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.3
grubby	1.3	0.8	0.3	0.3	0.2	0.5	0.3	0.7	0.2	0.2	0.2	0.2	0.0	0.3	0.1	0.6	0.1
inshore lizardfish	0.0	0.0	1.9	0.2	0.3	0.2	0.1	0.2	0.2	0.1	1.6	0.4	0.0	0.4	0.3	0.6	0.0
mummichog	2.3	1.5	2.5	7.3	2.9	3.8	1.7	3.1	1.6	0.9	5.0	5.3	2.2	3.3	4.5	5.6	4.1
naked goby	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0
northern kingfish	0.3	0.1	0.0	0.0	0.2	0.3	0.5	0.2	0.5	0.7	1.1	1.0	0.1	0.8	0.3	2.0	1.0
northern pipefish	0.7	0.5	0.6	0.8	0.7	1.9	0.6	1.1	1.4	1.7	2.6	2.0	0.5	0.8	2.2	1.4	1.9
northern puffer	0.7	0.5	0.4	1.2	0.2	0.3	0.4	0.4	0.9	1.1	1.1	1.4	0.2	0.2	0.6	1.5	1.2
rainbow smelt	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
scup	0.2	0.9	0.1	1.0	0.1	1.9	0.1	0.2	2.1	0.1	2.6	9.4	1.3	2.5	10.6	2.7	7.0
sheepshead minnow	0.5	0.2	0.2	3.3	1.2	0.5	0.3	0.5	0.8	0.2	0.6	0.3	0.5	0.5	1.8	1.0	2.0
smallmouth flounder	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.9	0.4	0.5	0.1	0.2	0.1	0.0	0.1	0.0	0.1
striped bass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
striped killifish	12.9	19.4	7.1	21.2	21.7	12.3	15.9	28.7	5.3	3.8	14.5	17.1	10.2	10.4	23.7	20.2	18.3
striped searobin	0.5	0.2	0.1	0.3	0.3	0.8	0.2	0.1	0.1	0.2	1.1	0.7	0.0	0.0	0.0	0.4	0.1
summer flounder	0.0	0.0	0.2	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
tautog	1.4	0.7	0.4	2.4	1.0	0.4	0.4	0.3	1.3	0.6	3.5	4.8	1.1	1.3	3.7	1.5	2.2
weakfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
windowpane flounder	0.2	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
winter flounder	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
winter flounder YOY	11.0	5.6	0.9	4.7	2.0	0.8	1.0	1.1	0.3	0.3	0.5	0.6	0.6	1.0	0.4	0.7	0.4

Table 8.2: Frequency of occurrence of finfish species commonly captured in seine samples, 1988-2020.

See Appendix 8.1 for complete taxonomic names.

Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
alewife	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.02
American sand lance	0.00	0.00	0.00	0.00	0.02	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden	0.06	0.05	0.04	0.04	0.19	0.06	0.10	0.04	0.00	0.06	0.06	0.15	0.10	0.02	0.27	0.58
Atlantic silverside	0.97	0.93	0.96	1.00	1.00	0.96	1.00	0.96	0.94	0.92	0.98	0.94	1.00	0.92	1.00	0.96
Atlantic tomcod	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
black sea bass	0.00	0.00	0.00	0.04	0.00	0.00	0.15	0.04	0.00	0.00	0.06	0.08	0.02	0.25	0.17	0.13
blueback herring	0.00	0.05	0.04	0.13	0.04	0.00	0.06	0.02	0.00	0.00	0.02	0.08	0.02	0.00	0.04	0.06
bluefish	0.00	0.00	0.00	0.10	0.02	0.00	0.02	0.00	0.00	0.02	0.13	0.46	0.04	0.13	0.02	0.10
cunner	0.17	0.19	0.04	0.10	0.15	0.00	0.23	0.15	0.13	0.02	0.21	0.23	0.19	0.15	0.13	0.17
fourspine stickleback	0.17	0.19	0.00	0.23	0.15	0.04	0.02	0.00	0.04	0.00	0.13	0.04	0.02	0.06	0.00	0.00
grubby	0.33	0.07	0.04	0.10	0.31	0.06	0.33	0.25	0.19	0.29	0.17	0.27	0.10	0.17	0.21	0.29
inshore lizardfish	0.06	0.00	0.04	0.00	0.00	0.06	0.10	0.00	0.00	0.29	0.06	0.17	0.19	0.56	0.04	0.00
mummichog	0.47	0.48	0.35	0.40	0.38	0.50	0.42	0.35	0.42	0.15	0.42	0.29	0.44	0.42	0.54	0.44
naked goby	0.00	0.00	0.02	0.06	0.00	0.00	0.00	0.02	0.00	0.00	0.02	0.02	0.00	0.08	0.02	0.02
northern kingfish	0.00	0.00	0.00	0.06	0.08	0.10	0.04	0.15	0.04	0.13	0.10	0.08	0.04	0.13	0.04	0.15
northern pipefish	0.42	0.31	0.37	0.63	0.35	0.50	0.58	0.33	0.44	0.33	0.73	0.48	0.54	0.48	0.19	0.25
northern puffer	0.08	0.24	0.09	0.27	0.08	0.31	0.17	0.40	0.15	0.06	0.10	0.19	0.35	0.17	0.35	0.31
rainbow smelt	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
scup	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.23	0.35	0.25
sheepshead minnow	0.31	0.31	0.09	0.21	0.04	0.02	0.02	0.04	0.00	0.04	0.04	0.06	0.17	0.10	0.15	0.19
smallmouth flounder	0.03	0.00	0.00	0.02	0.00	0.13	0.10	0.06	0.04	0.04	0.00	0.21	0.06	0.13	0.00	0.00
striped bass	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.06
striped killifish	0.78	0.67	0.65	0.73	0.58	0.65	0.58	0.69	0.54	0.40	0.75	0.67	0.63	0.71	0.85	0.81
striped searobin	0.11	0.12	0.11	0.10	0.08	0.48	0.10	0.02	0.10	0.35	0.60	0.38	0.10	0.29	0.25	0.40
summer flounder	0.00	0.00	0.00	0.00	0.00	0.04	0.10	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00
tautog	0.22	0.05	0.22	0.42	0.31	0.19	0.33	0.33	0.13	0.17	0.38	0.46	0.23	0.40	0.54	0.50
weakfish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
windowpane flounder	0.31	0.10	0.13	0.23	0.23	0.19	0.17	0.19	0.35	0.23	0.13	0.13	0.06	0.00	0.02	0.10
winter flounder –age 1+	0.25	0.12	0.00	0.15	0.08	0.23	0.17	0.19	0.10	0.15	0.10	0.06	0.15	0.04	0.02	0.00
winter flounder YOY	0.97	0.71	0.74	0.92	0.98	0.88	0.98	0.94	1.00	0.94	0.92	0.88	0.77	0.58	0.79	0.85

Table 8.2 cont.: Frequency of occurrence of finfish species commonly captured in seine samples, 1988-2020. See Appendix 8.1 for complete taxonomic names.

Species	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
alewife	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0
American sand lance	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
American shad	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.04	0.00	0.13	0.1	0.00	0.02
Atlantic menhaden	0.08	0.06	0.13	0.17	0.02	0.15	0.02	0.02	0.04	0.04	0.23	0.54	0.1	100	0.29	0.23	0.13
Atlantic silverside	1	1	1	1	1	1	1	1	0.98	1	4	1	1	0.00	1	1	1
Atlantic tomcod	0.02	0.02	0.00	0.00	0.02	0.00	0	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0
black sea bass	0.25	0.08	0.23	0.23	0.15	0.27	0.13	0.58	0.75	0.58	0.77	0.9	0.88	0.77	0.94	0.50	0.83
blueback herring	0.00	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.11
bluefish	0.15	0.04	0.08	0.00	0.02	0.15	0.02	0.1	0.21	0.08	0.23	0.77	0.21	0.00	0.27	0.35	0.11
cunner	0.29	0.21	0.13	0.25	0.1	0.17	0.08	0.04	0.23	0.02	0.31	0.1	0.00	0.13	0.13	0.15	0.21
fourspine stickleback	0.02	0.00	0.02	0.00	0.00	0.02	0	0.04	0.00	0.00	0.15	0.00	0.04	0.06	0.08	0.00	0.15
grubby	0.5	0.46	0.27	0.15	0.19	0.27	0.21	0.42	0.23	0.2	0.19	0.15	0.02	0.19	0.08	0.40	0.13
inshore lizardfish	0.06	0.00	0.6	0.13	0.19	0.15	0.13	0.1	0.15	0.13	0.6	0.25	0.00	0.29	0.29	0.31	0
mummichog	0.35	0.27	0.48	0.65	0.48	0.5	0.4	0.42	0.35	0.27	0.54	0.65	0.4	0.5	0.54	0.65	0.51
naked goby	0.04	0.00	0.08	0.00	0.02	0.00	0	0.02	0.08	0.06	0.08	0.02	0.02	0.04	0.04	0.00	0.02
northern kingfish	0.17	0.1	0.02	0.02	0.19	0.17	0.23	0.13	0.29	0.35	0.4	0.38	0.1	0.4	0.21	0.56	0.40
northern pipefish	0.48	0.25	0.29	0.42	0.23	0.52	0.4	0.44	0.6	0.6	0.69	0.75	0.31	0.5	0.83	0.58	0.85
northern puffer	0.4	0.31	0.29	0.44	0.23	0.23	0.21	0.31	0.42	0.38	0.48	0.31	0.21	0.23	0.38	0.54	0.55
rainbow smelt	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
scup	0.13	0.29	0.04	0.29	0.02	0.38	0.04	0.06	0.42	0.08	0.48	0.71	0.38	0.71	0.96	0.54	0.74
sheepshead minnow	0.15	0.15	0.06	0.4	0.27	0.13	0.1	0.13	0.25	0.07	0.17	0.13	0.13	0.15	0.4	0.23	0.45
smallmouth flounder	0.00	0.00	0.02	0.00	0.13	0.15	0.06	0.4	0.17	0.29	0.06	0.15	0.13	0.02	0.1	0.02	0.11
striped bass	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
striped killifish	0.73	0.96	0.65	0.88	0.94	0.75	0.9	0.98	0.65	0.58	0.88	0.88	0.79	0.85	1	0.94	0.91
striped searobin	0.38	0.13	0.13	0.27	0.19	0.4	0.17	0.06	0.08	0.15	0.49	0.29	0.02	0.04	0.04	0.21	0.06
summer flounder	0.00	0.00	0.19	0.06	0.15	0.02	0.04	0.00	0.08	0.12	0.06	0.13	0.02	0.02	0.04	0.04	0.02
tautog	0.54	0.42	0.17	0.54	0.42	0.35	0.31	0.23	0.6	0.33	0.63	0.83	0.67	0.5	0.85	0.65	0.81
weakfish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.08	0.00	0.02
windowpane flounder	0.21	0.15	0.06	0.04	0.1	0.00	0.04	0.02	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0
winter flounder –age 1+	0.17	0.21	0.15	0.08	0.15	0.04	0.04	0.04	0.05	0.00	0.06	0.04	0.02	0.06	0.02	0.04	0.06
winter flounder YOY	0.98	0.94	0.46	0.92	0.71	0.52	0.6	0.63	0.27	0.23	0.33	0.46	0.35	0.48	0.4	0.46	0.40

Table 8.3: Mean catch of young-of-year winter flounder at eight sites sampled by seine, 1988-2020.

BPT=Bridgeport, CLT=Clinton, GRT=Groton, GRW=Greenwich, MIL=Milford, OLM=Old Lyme, WTF=Waterford

Year	BPT	CLT	GRT	GRW	MIL	NHH	OLM	WTF	All Sites
1988	*18.72	2.73	11.39	9.63	-	38.66	58.19	29.57	15.4
1989	1.70	1.14	1.53	0.70	-	2.14	2.04	2.99	1.7
1990	3.97	0.19	2.21	0.51	1.62	5.69	16.83	2.64	2.9
1991	1.77	4.10	5.62	1.99	2.46	6.45	15.32	18.25	5.2
1992	3.34	5.53	6.25	9.42	4.29	40.15	47.99	32.52	11.9
1993	1.22	1.40	8.59	4.33	3.62	11.47	13.34	16.66	5.7
1994	4.46	8.11	38.36	4.26	4.62	35.34	61.65	21.03	14.2
1995	1.94	3.19	30.28	7.22	1.77	18.93	34.23	36.58	10.1
1996	7.67	11.81	15.67	*12.61	*6.58	*49.29	91.34	30.53	*19.2
1997	2.87	6.61	23.69	3.43	1.64	3.79	52.01	11.25	7.5
1998	1.24	4.03	17.63	8.12	0.91	22.37	57.19	21.89	9.2
1999	1.04	2.60	25.7	7.95	3.49	0.94	*137.07	36.12	8.7
2000	2.14	0.51	0.76	6.65	0.78	1.74	48.34	*41.56	4.3
2001	0.20	1.12	4.12	1.24	0.59	0	0.91	9.10	1.3
2002	0.91	2.66	3.06	5.08	0.26	1.08	15.55	8.98	3.1
2003	1.88	4.61	*45.78	5.88	0.89	1.70	51.13	32.30	8.1
2004	1.00	*18.36	33.84	11.27	3.36	33.06	11.13	13.04	11.0
2005	1.94	11.14	16.7	7.71	5.14	1.64	4.06	7.30	5.6
2006	0.12	1.38	5.53	0.12	0	0	3.30	1.29	0.9
2007	0.78	5.65	17.90	4.44	0.78	6.42	7.89	7.11	4.7
2008	0.51	2.45	10.84	0.51	0	1.57	2.62	5.94	2.0
2009	0.91	1.62	2.29	0.12	0.51	0.12	0.12	1.75	0.8
2010	0.41	1.11	1.71	1.33	0.12	0.41	1.88	1.57	1.0
2011	0.12	0.98	1.18	2.26	0.78	0.12	4.27	1.45	1.1
2012	0	0.26	0.70	0.76	0	0.12	0.26	0.44	0.3
2013	0	0	1.14	0.26	0	0	0.65	0.57	**0.28
2014	0.12	0.12	1.82	0.26	0.12	0.12	1.35	0.65	0.47
2015	0	0.59	1.96	0.70	0.12	0.12	0.51	2.40	0.64
2016	0.12	0	1.49	0.20	0	0	1.14	6.03	0.63
2017	0	0.12	13.53	0.91	0.26	0.26	0.12	4.19	1.03
2018	0	0.31	1.29	0.41	0	0	0.41	1.80	0.42
2019	0	0.65	2.56	0.44	0.26	0.12	0.41	2.91	0.68
2020	0	1.00	1.14	0.41	0	0	0.12	1.72	0.42

*record high for a site/year. **record low for time-series

Table 8.4: Total catch of finfish species commonly captured in seine samples, 1988-2020. See Appendix 8.1 for complete taxonomic names.

Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Atlantic Menhaden	3	2	2	4	1,074	3	9	2		11	2,003	377	1,236	1	1,284	5,098	1,117
Atlantic Silverside	4,750	3,316	5,356	6,383	5,468	5,263	6,311	2,352	1,942	3,249	6,345	10,120	8,738	4,417	5,730	13,278	5,122
Black Sea Bass				10			41	43			27	14	2	687	63	27	110
Bluefish			3	194	10		5	2			3	24	1		13	5	23
Cunner	15	27	2	5	19		42	24	63	1	23	142	26	15	110	15	54
Fourspine Stickleback	33	76		183	11	21	1		3		24	3	1	7			9
Grubby	111	3	2	7	61	6	38	19	21	28	17	55	15	73	33	95	143
Inshore Lizardfish	5		2			4	6			46	6	16	15	103	2		3
Mummichog	1,031	197	171	765	573	1,256	1,943	78	149	190	396	115	1,008	246	811	702	637
Naked Goby			1	4				1			1	1		4	2	2	2
Northern Kingfish				3	4	23	2	9	3	10	7	6	5	17	5	21	38
Northern Pipefish	65	23	33	106	120	82	117	52	241	38	295	141	96	189	87	25	72
Northern Puffer	4	22	13	34	4	37	15	40	25	5	5	13	63	14	79	101	75
Northern Searobin		2	1				1	1					3	40	24	5	4
Rainwater Killifish									3	4			2		6	35	53
Scup												1		58	172	131	50
Sheepshead Minnow	174	815	5	345	4	1	2	30		14	19	12	267	59	402	276	205
Smallmouth Flounder	1			1		8	14	7	2	5		40	3	12			
Striped Killifish	1,511	1,383	748	659	465	773	1,923	520	269	289	1,066	539	1,797	1,494	1,698	3,410	1,548
Striped Searobin	22	12	5	94	5	71	5	1	9	40	178	51	7	33	33	62	38
Summer Flounder						2	6		1		1						
Tautog	23	5	23	72	32	16	104	88	42	19	135	174	67	59	153	140	145
Windowpane Flounder	49	4	22	19	35	30	9	13	71	50	12	10	4		1	5	15
Winter Flounder 1+	12	6		7	6	14	13	12	21	282	9	4	7	2	3		9
Winter Flounder YOY	900	117	276	410	1,055	483	1,401	916	1,486	874	999	1,497	708	138	302	1,310	914

Table 8.4 cont.: Total catch of finfish species commonly captured in seine samples, 1988-2020. *See Appendix 8.1 for complete taxonomic names.*

Species	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Atlantic Menhaden	75	117	144	21	54	3	43	2	14	3,404	3,948	150	703	614	1514	515	23,547
Atlantic Silverside	5,089	3,267	5,087	3,245	4,156	7,063	4,657	4,142	3,958	3,832	7,549	6,459	4,869	6,963	6,999	7377	182,852
Black Sea Bass	15	82	109	33	304	86	489	783	1,197	1,950	1,794	500	338	267	537	611	10,119
Bluefish	8	30		7	53	1	26	54	17	194	289	45		44	55	22	1,128
Cunner	35	18	58	8	28	15	2	42	1	73	7		28	23	15	18	954
Fourspine Stickleback		2			8		2			13		2	3	11			477
Grubby	76	31	32	16	51	25	55	18	19	18	16	1	35	4	50	9	1,183
Inshore Lizardfish		169	18	26	22	10	16	23	11	135	38		30	19	62		787
Mummichog	543	398	1,203	498	857	299	775	329	199	1,098	999	519	676	748	791	671	20,871
Naked Goby		13		2			2	4	4	6	5	1	7	2		1	65
Northern Kingfish	11	1	1	23	42	76	30	54	81	149	113	10	142	24	199	113	1,222
Northern Pipefish	92	82	75	156	307	49	248	152	204	413	142	48	63	147	126	118	4,204
Northern Puffer	93	34	241	19	41	51	28	98	202	97	448	18	17	56	163	96	2,251
Northern Searobin	13	2	10			1	9		6	35	105		45	41	143	47	538
Rainwater Killifish	19	3										4	55	6		7	197
Scup	154	6	170	14	413	21	30	375	18	485	1,573	198	212	646	532	715	5,974
Sheepshead Minnow	28	104	1,439	304	203	82	219	238	59	154	60	742	352	296	340	258	7,508
Smallmouth Flounder		1		14	21	5	114	63	49	15	13	7	1	10	1	13	420
Striped Killifish	1,470	1,063	1,994	1,874	1,508	1,300	1,964	720	493	1,158	1,531	1,482	961	1,412	1,358	1264	41,644
Striped Searobin	19	6	32	36	82	14	4	7	14	121	84	1	2	2	45	5	1,140
Summer Flounder		16	8	8	1	6		6	7	3	11	1	2	2	2	1	84
Tautog	64	93	321	131	25	33	27	123	73	467	446	75	140	255	141	153	3,864
Windowpane Flounder	15	3	2	17		2	4			2							394
Winter Flounder 1+	11	7	6	13	2	2	2	2		3	2	1	3	1	2	3	467
Winter Flounder YOY	470	110	365	190	72	71	86	22	24	48	48	74	140	29	51	29	15,615

Table 8.5: Total catch of finfish species infrequently captured in seine samples, 1988-2020. See Appendix 8.1 for complete taxonomic names

Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total		
Alewife							1								28	1																1	31			
American Eel	1	3					1				5														1		2	15			2	1		31		
American Sand Lance					1		10																	13									3	24		
American Shad		18	1								151																	42			50			265		
Anchovy, spp (YOY)																					15								3,051					3,066		
Atlantic Needlefish																2													1			1	4			
Atlantic Tomcod						3					1						1	3							8							2		19		
Banded Butterflyfish																															3			3		
Banded Gunnel											2	3					4	2	3	1		3			1									19		
Banded Rudderfish																																			1	
Bay Anchovy								4	69		27			1	11		1	12						1				520	24				39	709		
Black Spotted Stickleback																															2		3	5		
Blue Spotted Coronet Fish													1														2							3		
Blueback Herring		26																			9			3	1	1		11			165	50		266		
Burrfish, Striped				15	2		1			1	9	142	3	8	2	17									10							1		215		
Butterfish												1															21						6	28		
Crevalle Jack	6							1																1										8		
Feather Blenny																										36					7			3	46	
Flying Gurnard																				1															1	
Gizzard Shad																									4										4	
Grey Snapper			1																																1	
Hogchoker							2																1												3	
Lined Seahorse						4				1		2									2	7	2	1	2				1	4	7		3	36		
Little Skate										1					1																				2	
Moonfish																																16			16	
Northern Sennet																			1																1	
Northern Star Gazer		5																																	5	
Oyster Toadfish	5			1						1	1		1		1	2	1	1	1	1	1	2	1			6	2	4	2	4	3		2	41		
Pumpkin Seed				2												3																			5	
Rainbow Smelt						5	2									34																			41	
Rock Gunnel			1		1	1	1			3							1					1													9	
Smooth Dogfish			1																																1	
Spot																												6							6	
Striped Anchovy																							3												3	
Striped Bass												1			6							1											1	1	10	
Threespine Stickleback													11																						11	
Weakfish															15													4				10		3	32	
Web Burrfish																		1						1											2	
White Mullet	1	1	8		3										1				7	7	11		75	68		22			15	31	16		16	282		
White Perch																			3			11			6										20	
Yellow Jack																								1												1

Table 8.6: Total catch of invertebrate species captured in seine samples, 2004-2020.

See Appendix 8.2 for complete taxonomic names.

Species	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Blue crab	1	2	84	31	4	333	35	23	27	18	17	18	6	11	19	79	81
Boreal squid				1													
Brown shrimp			11										3				
Channeled whelk							1				3						
Common slipper shell			13														
Flat-claw hermit crab	761	532	703	153	244	539	558	441	283	367	562	308	2,878	829	658	1,157	838
Green crab	234	266	341	147	644	176	308	228	175	253	273	213	256	460	432	345	359
Horseshoe crab													1				
Japanese shore crab	1		1	1				6	1			1	1			1	1
Jonah crab						2											
Knobbed whelk																1	
Lady crab	298	119	66	195	92	42	19	24	18	13	41	102	12	20	2	52	17
Mantis shrimp									1								
Mole crab	1	5															
Moon jellyfish							319						461	16	200	200	
Mud crab	60	55	74	30	85	67	308	80	80	1,100	43	142	9	1	20	31	43
Mud snail	948	2,071	4,478	3,569	3,810	3,128	2,699	2,683	3,072	5,787	6,938	11,132	11,687	6,061	6,927	9,422	3417
Northern comb jelly						346	36			3,620	1,200		185	1,648	111	300	267
Northern moon snail														6		2	
Oyster drill			38												69		
Rock crab	2						1										
Sand shrimp	278	373	1,027	525	2,625	762	902	1,507	246	1,794	662	207	33	518	650	531	560
Scallop (bay)											3	3	1	2			3
Shore shrimp	990	404	1,149	707	1,390	535	619	762	402	511	1,011	4,795	478	1,517	921	526	621
Spider crab	4	5	6	1	3	1	7	33	13	20	14	45	53	161	21	8	31
Squid (longfin)												6					2
Starfish spp.							1										

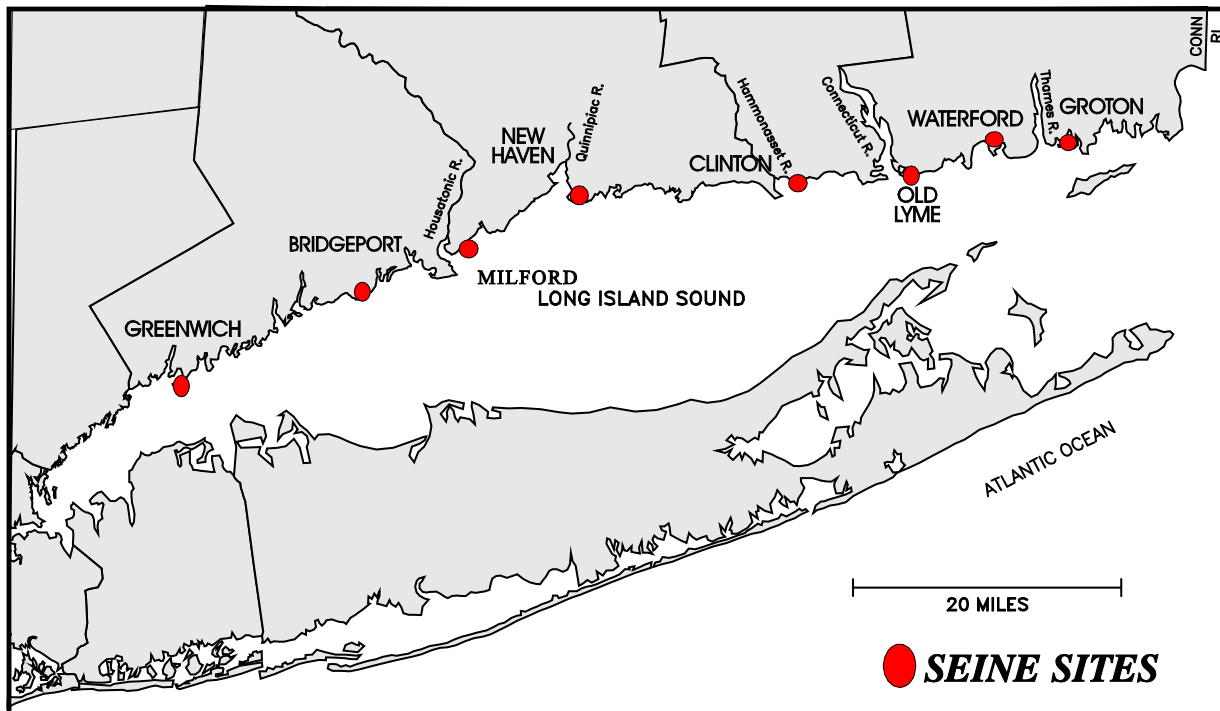


Figure 8.1: Sampling locations of the Estuarine Seine Survey.

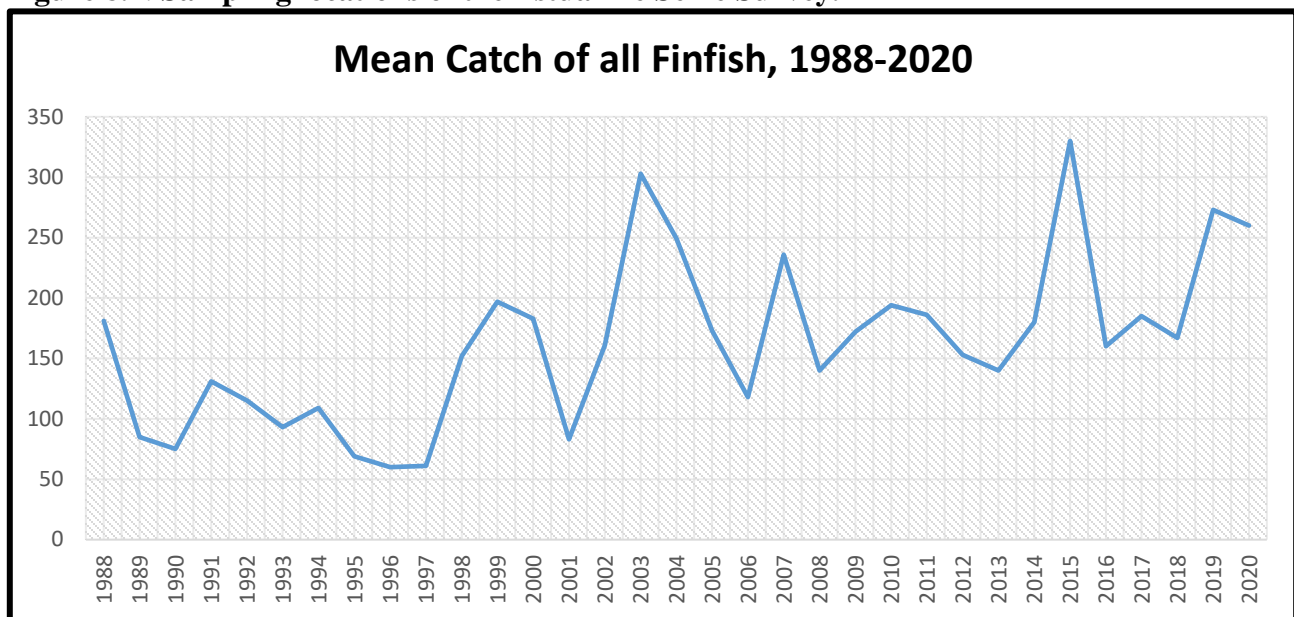


Figure 8.2: Mean catch of all finfish captured in seine samples, 1988-2020. Geometric mean catch (numbers) per haul includes samples at all sites. Note that sampling at the Milford site began in 1990.

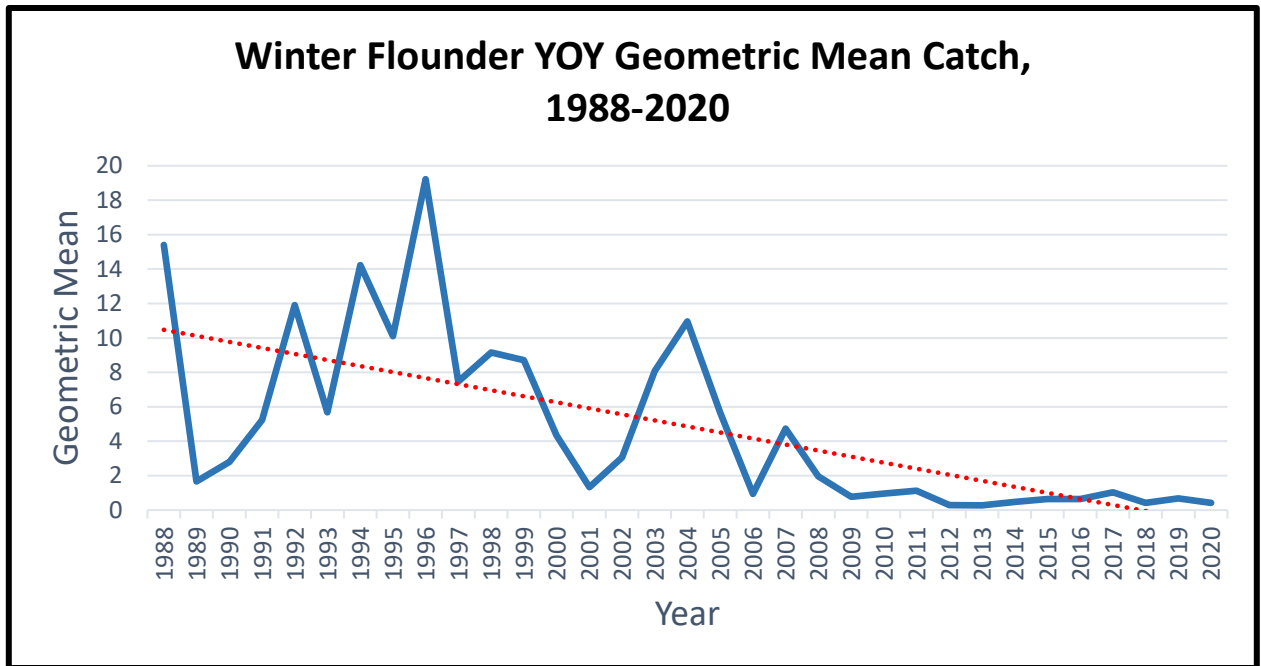


Figure 8.3: Mean catch and occurrence of young-of-year winter flounder, 1988-2020. *The negative trend (dashed line) is significant ($r^2 = 0.39$, $p < 0.001$, $df = 31$).*

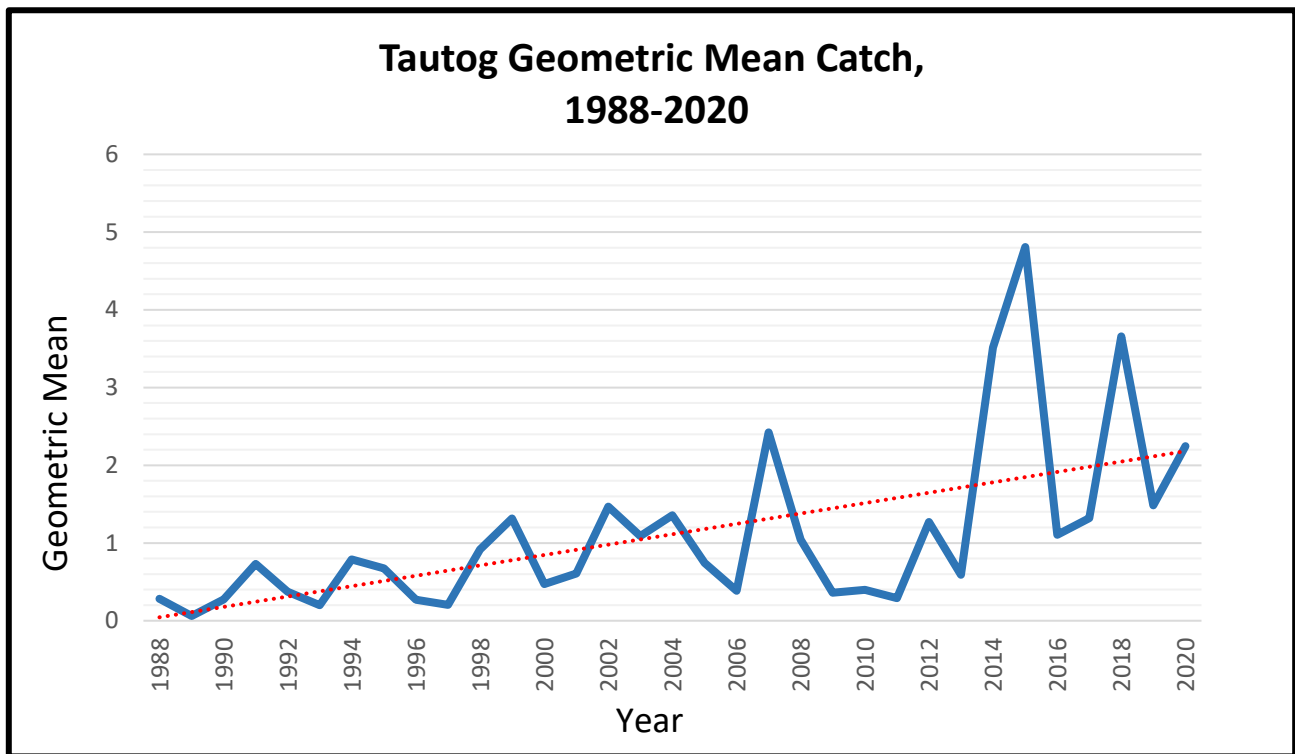


Figure 8.4: Mean catch and occurrence of young-of-year tautog, 1988-2020. *The positive trend (dashed line) is significant ($r^2 = 0.35$, $p < 0.001$, $df = 31$).*

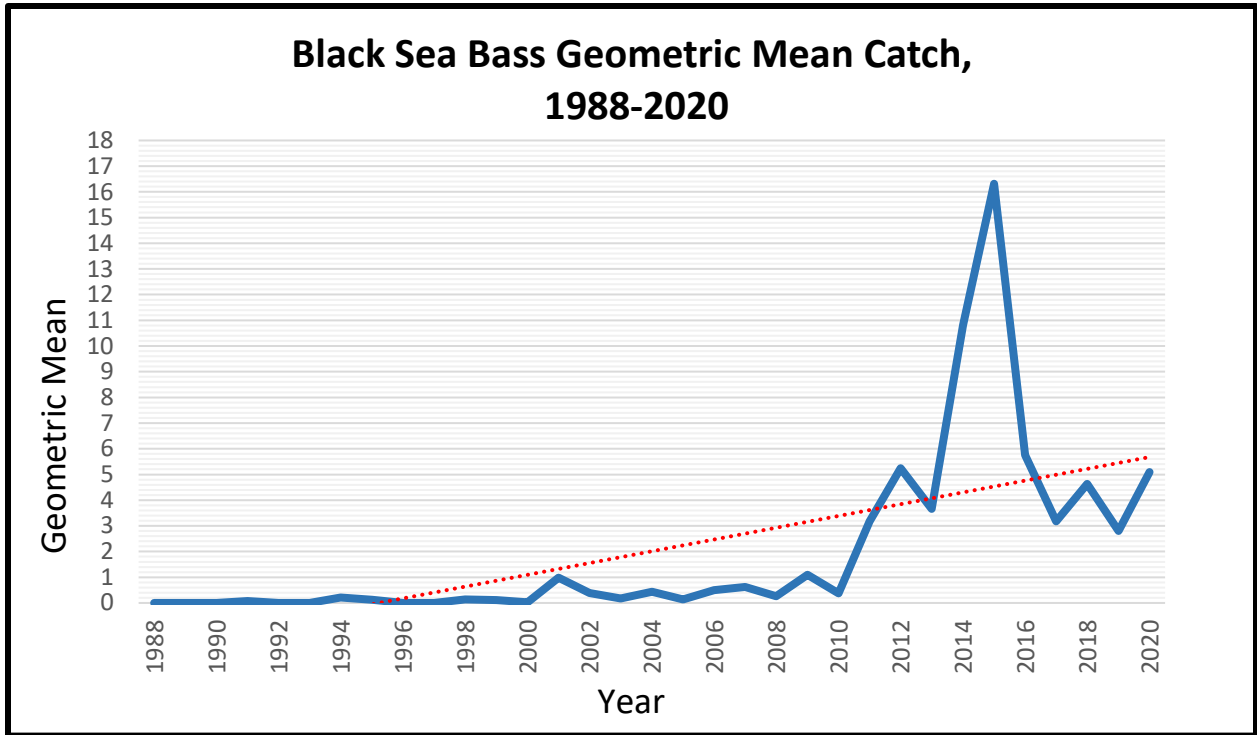


Figure 8.5: Mean catch of black seabass young-of-year, 1988-2020. The positive trend (dashed line) is significant ($r^2 = 0.39$, $p < 0.001$, $df = 31$).

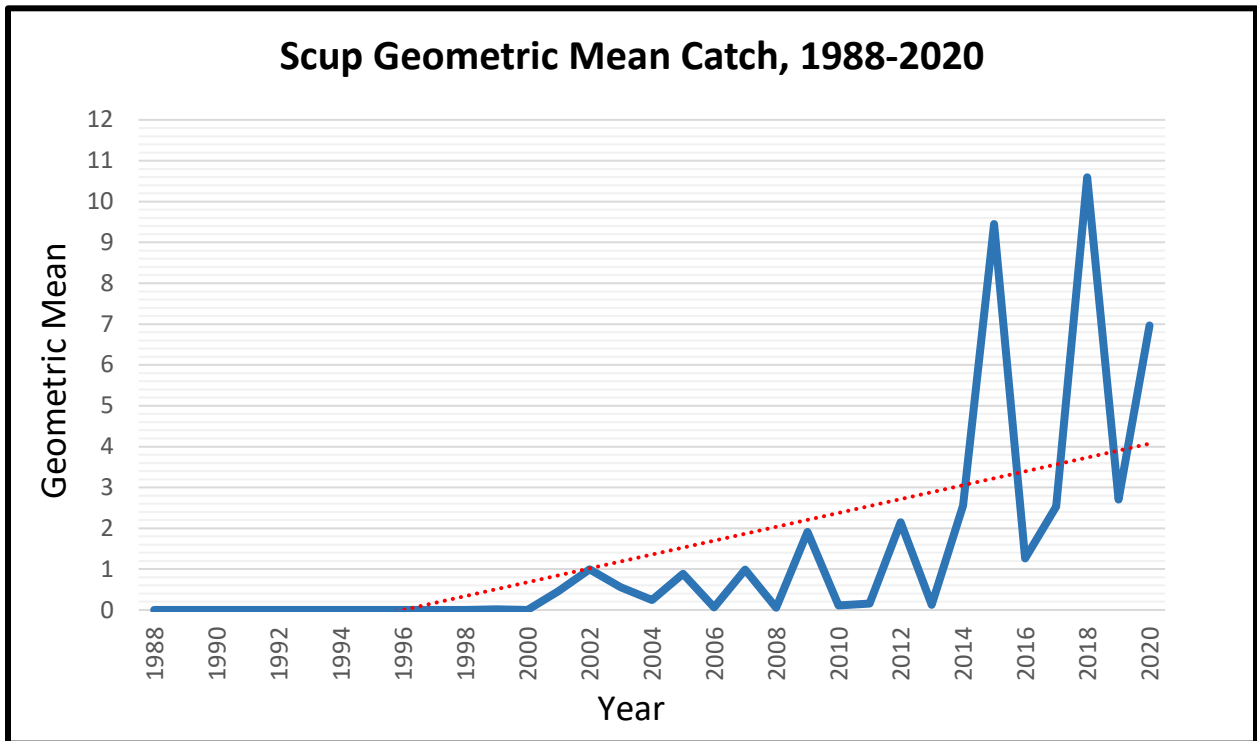


Figure 8.6: Mean catch of scup young-of-year, 1988-2020. Annual percent of hauls catching one or more scup are also shown. The positive trend (dashed line) is significant ($r^2 = 0.39$, $p < 0.0001$, $df = 31$).

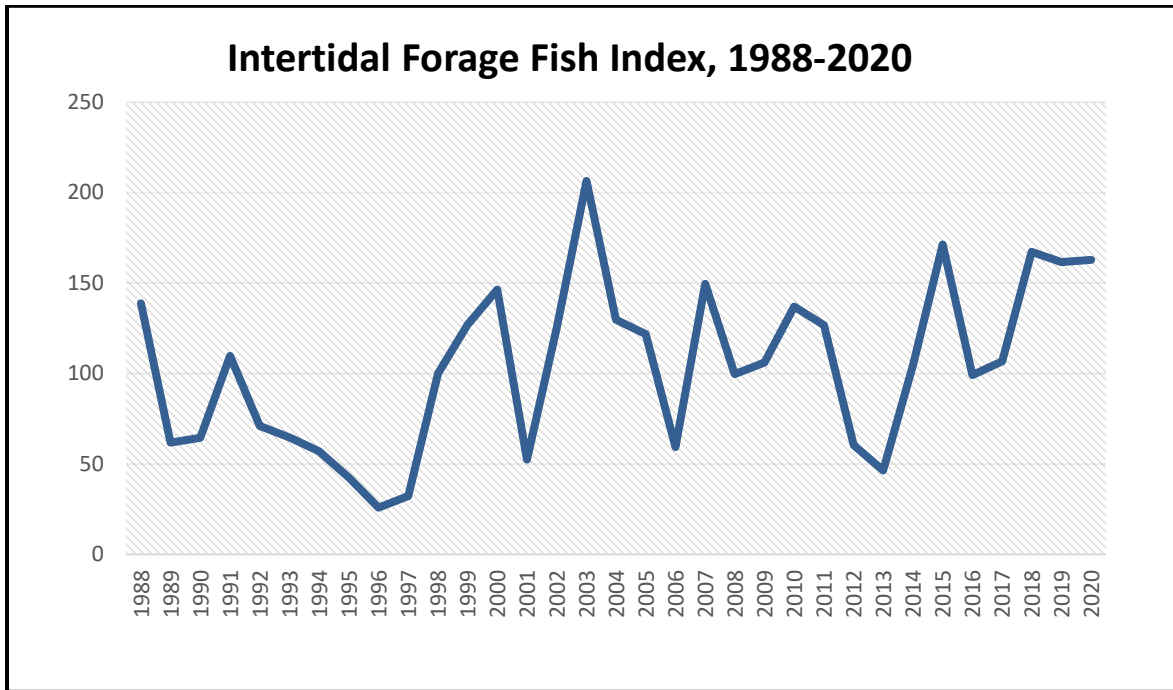


Figure 8.7: Mean catch of forage fish, 1988-2020. Forage species included in the index are Atlantic silversides, striped killifish, mummichog, and sheepshead minnow. See Appendix 8.1 for complete taxonomic names.

Table 8.7: Mean catch of forage fish, 1988-2020.

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
139	62	64	110	71	65	57	42	26	32	100	127
2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	
146	52	125	206	130	122	59	149	100	106	137	
2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
127	60	46	104	171	99	107	167	161	162		

Appendix 8.1: Finfish species captured in the Estuarine Seine Survey, 1988-2020.

<u>COMMON NAME</u>	<u>SPECIES CODE</u>	<u>SCIENTIFIC NAME</u>
Alewife	ALW	<i>Alosa pseudoharengus</i>
American eel	EEL	<i>Anguilla rostrata</i>
American shad	ASD	<i>Alosa sapidissima</i>
American sand lance	ASL	<i>Ammodytes americanus</i>
Atlantic needlefish	ANF	<i>Strongylura marina</i>
Atlantic silversides	ASS	<i>Menidia menidia</i>
Atlantic tomcod	TOM	<i>Microgadus tomcod</i>
Banded butterflyfish	BBF	<i>Chaetodon striatus</i>
Banded gunnel	BGN	<i>Pholis fasciata</i>
Banded rudderfish	RUD	<i>Seriola zonata</i>
Bay anchovy	ACH	<i>Anchoa mitchilli</i>
Black-spot stickleback	BSS	<i>Gasterosteus wheatlandi</i>
Black sea bass	BSB	<i>Centropristis striata</i>
Blueback herring	BBH	<i>Alosa aestivalis</i>
Bluefish	BLF	<i>Pomatomus saltatrix</i>
Blue spotted coronetfish	BSC	<i>Fistularia tabacaria</i>
Crevalle jack	CRJ	<i>Caranx hippos</i>
Cunner	CUN	<i>Tautoglabrus adspersus</i>
Feather Blenny	FBL	<i>Hypsoblennius hentzi</i>
Flying Gurnard	FGD	<i>Dactylopterus volitans</i>
Four-spine stickleback	FSS	<i>Apeltes quadracus</i>
Gizzard Shad	GIZ	<i>Dorosoma cepedianum</i>
Gray snapper	GRA	<i>Lutjanus griseus</i>
Grubby	GRB	<i>Myoxocephalus aeneus</i>
Hogchoker	HOG	<i>Trinectes maculatus</i>
Inshore lizardfish	LIZ	<i>Synodens foetens</i>
Little skate	LSK	<i>Raja erinacea</i>
Menhaden	MEN	<i>Brevoortia tyrannus</i>
Moonfish	MOO	<i>Mene maculata</i>
Mummichog	MUM	<i>Fundulus heteroclitus</i>
Naked goby	NKG	<i>Gobiosoma boscii</i>
Nine-spine stickleback	NSS	<i>Pungitius pungitius</i>
Northern kingfish	NKF	<i>Menticirrhus saxatilis</i>
Northern pipefish	PIP	<i>Syngnathus fuscus</i>
Northern puffer	PUF	<i>Sphaeroides maculatus</i>
Northern searobin	NSR	<i>Prionotus carolinus</i>
Northern stargazer	STR	<i>Astroscopus guttatus</i>
Pumpkinseed	PUM	<i>Lepomis gibbosus</i>
Rainbow smelt	RSM	<i>Osmerus mordax</i>
Rainwater killifish	RWK	<i>Lucania parva</i>
Rock gunnel	RGN	<i>Pholis gunnellus</i>
Northern seahorse	SEH	<i>Hippocampus erectus</i>
Northern sennet	NOS	<i>Sphyræna borealis</i>
Scup	PGY	<i>Stenotomus chrysops</i>
Sheepshead minnow	SHM	<i>Cyprinodon variegatus</i>
Shorthorn Sculpin	SHS	<i>Myoxocephalus scorpius</i>
Skilletfish	SKT	<i>Gobiesox strumosus</i>
Smallmouth flounder	SMF	<i>Etropus microstomus</i>
Smooth dogfish	SMD	<i>Mustelus canis</i>
Spotted hake	SPH	<i>Urophycis regius</i>
Striped anchovy	STA	<i>Anchoa hepsetus</i>
Striped bass	STB	<i>Morone saxatilis</i>
Striped burrfish	SBF	<i>Chilomycterus schoepfi</i>
Striped killifish	SKF	<i>Fundulus majalis</i>
Striped searobin	SSR	<i>Prionotus evolans</i>
Summer flounder	SFL	<i>Paralichthys dentatus</i>
Tautog	BKF	<i>Tautoga onitis</i>
Three-spine stickleback	TSS	<i>Gasterosteus aculeatus</i>

Appendix 8.1, continued:

Toadfish	TDF	<i>Opsanus tau</i>
Weakfish	WKF	<i>Cynoscion regalis</i>
Web Burrfish	WBF	<i>Chilomycterus antillarum</i>
White mullet	WML	<i>Mugil curema</i>
Windowpane flounder	WPF	<i>Scophthalmus aquosus</i>
Winter flounder (YOY)	WFO	<i>Pseudopleuronectes americanus</i>
Winter flounder (AGE 1+)	WFL	<i>Pseudopleuronectes americanus</i>
Yellow jack	YJK	<i>Caranx bartholomaei</i>

Appendix 8.2: Invertebrate species captured in the Estuarine Seine Survey, 1988-2020.

<u>COMMON NAME</u>	<u>SPECIES CODE</u>	<u>SCIENTIFIC NAME</u>
Bay Scallop	SCA	<i>Argopecten irradians</i>
Blue crab	BCR	<i>Callinectes sapidus</i>
Brown Shrimp	BNS	<i>Panaeus aztecus</i>
Channeled Whelk	CHW	<i>Busycotypus canaliculatus</i>
Common Slipper Shell	CSL	<i>Crepidula fornicata</i>
Northern Comb Jelly	COM	<i>Bolinopsis infundibulum</i>
Green crab	GCR	<i>Carcinus maenas</i>
Flat-claw hermit crab	HER	<i>Pagurus spp.</i>
Horseshoe crab	HSC	<i>Limulus polyphemus</i>
Japanese crab	JSC	<i>Hemigrapsus sanguineus</i>
Jonah crab	JCR	<i>Cancer borealis</i>
Knobbed whelk	KNW	<i>Busycon carica</i>
Lady crab	LCR	<i>Ovalipes ocellatus</i>
Long-finned squid	SQI	<i>Loligo pealeii</i>
Mantis shrimp	MAN	<i>Squilla empusa</i>
Moon Jelly	MOJ	<i>Aurelia aurita</i>
Mud crab	BMC	<i>Panopeus spp.</i>
Mole crab	MLR	<i>Emerita talpoida</i>
Mud snail	MSN	<i>Nassarius obsoletus</i>
Northern moon snail	NMS	<i>Lunatia heros</i>
Oyster drill	OYD	<i>Urosalpinx cinerea</i>
Rock crab	RCR	<i>Cancer irroratus</i>
Sand shrimp	CRG	<i>Crangon septemspinosa</i>
Sea Star	STF	<i>Asterias forbesi</i>
Shore shrimp	PAL	<i>Palaemonetes spp.</i>
Spider crab	SPI	<i>Libinia emarginata</i>