PROGRESS REPORT

State: **NEW HAMPSHIRE** **Grant**: **F-61-R-21/F16AF00163**

Grant Title: **NEW HAMPSHIRE'S MARINE FISHERIES INVESTIGATIONS**

Project III: **MULTI-SPECIES EVALUATION**

Job 3: **ESTUARINE SURVEY OF JUVENILE FINFISH**

Objective: To monitor the relative abundance of juvenile finfish utilizing New Hampshire estuaries for nursery habitat.

Period Covered: January 4, 2016 – March 31, 2017

ABSTRACT

The monitoring of finfish is necessary for the management of riverine, estuarine, and marine environments. The objective of the beach seine survey as described in this report is to monitor relative abundance of juvenile finfish that use New Hampshire estuaries for nursery habitat.

A total of 27 finfish species were captured during the 2016 seine survey. Atlantic Silverside *Menidia menidia*, Striped Killifish *Fundulus majalis*, Mummichog *Fundulus heteroclitus*, Blueback Herring *Alosa aestivalis*, and Winter Flounder *Pseudopleuronectes americanus* accounted for 97.54% of the total catch. Similarly, green crab *Carcinus maenas* accounted for 98.34% of the invertebrate species of special interest caught. Since the inception of the survey in 1997, Atlantic Silverside and green crab have remained the most abundant finfish and invertebrate species captured, respectively. Rainbow Smelt *Osmerus mordax* abundance declined to its third lowest value in the time series, while American Shad *Alosa sapidissima* was captured for the first time since 2002. Above average mean temperatures and salinities were recorded at survey sampling stations, a likely result of the drought conditions New Hampshire experienced in 2016.

INTRODUCTION

Estuaries are highly productive ecosystems, known to provide diverse habitat utilized as nurseries and forage grounds by an array of estuarine species. Many of these estuarine species are commercially, recreationally, and culturally significant. Monitoring spawning success and recruitment of

finfish species is necessary for the effective management of riverine, estuarine, and marine environments.

Beach seining is an established sampling method for estuarine-based juvenile finfish surveys (NHFG 1981, 1982; Howell and Molnar 1993; MDDNR 1994; Young et al. 1994; NAI 1995). Juvenile finfish captured by beach seine allows for positive identification and the opportunity to collect important biological information (e.g., length, weight, and sex). With appropriate sampling procedures in place, an index of relative abundance can be calculated for each species. Evaluation of each index can provide an indication of spawning success and recruitment of important finfish species, such as Alewife *Alosa pseudoharengus*, Atlantic Herring *Clupea harengus*, Bluefish *Pomatomus saltatrix*, Striped Bass *Morone saxatilis*, and Winter Flounder *Pseudopleuronectes americanus*, which utilize estuaries on the East Coast as nursery habitat (MDDNR 1994; Young et al. 1994).

The estuarine survey of juvenile finfish was initiated in 1997. It was designed as a fixed station survey, as opposed to a stratified random survey, because strong tidal currents, rocky shorelines, and various anthropogenic shoreline structures limit the amount of suitable seining areas, particularly in Great Bay Estuary. Many fixed sampling locations chosen for this survey were sites used by beach seine surveys conducted in New Hampshire (NH) estuaries in the past (NAI 1979; NHFG 1981, 1982; Grout and Heckman 1996). This provides the opportunity to compare data from the current program with historical data from previous surveys.

The primary objective of this beach seine survey is to monitor relative abundance of juvenile finfish that utilize NH estuaries for nursery habitat each year. As designed it is intended to be a general-purpose survey, but some finfish species of special interest are: Alewife, Blueback Herring *Alosa aestivalis*, American Shad *Alosa sapidissima*, Rainbow Smelt *Osmerus mordax*, Atlantic Silverside *Menidia menidia*, and Winter Flounder.

PROCEDURES

A 30.5 m long by 1.8 m high, with 6.4 mm mesh, bag seine is the gear used to sample for juvenile finfish in NH tidal waters. A single seine haul is performed each month from June through November in NH estuaries at 15 fixed stations: four in the Hampton/Seabrook Estuary (HSE), three in Little Harbor (GBE1), three in the Piscataqua River (GBE2), and five in Little Bay/Great Bay (GBE3) (Table 3.3-1 and Figures 3.3-1 through 3.3-3).

Seine hauls are performed during daylight between 2 hours before and 2 hours after low tide. Seine hauls are set by boat 15-25 m from shoreline,

ideally in water depths less than 2 m in order to prevent the foot rope of the seine from lifting off of the bottom.

All captured finfish are identified to the lowest possible taxon, measured in total length to the nearest millimeter (with a maximum of 25 individual lengths recorded per species per seine haul), and then enumerated. Specific invertebrate species of special interest including the green crab *Carcinus maenas*, rock crab *Cancer irroratus*, Jonah crab *Cancer borealis*, Asian shore crab *Hemigrapsus sanguineus*, horseshoe crab *Limulus polyphemus*, and American lobster *Homarus americanus* are identified and enumerated although lengths are not obtained. All other captured invertebrate species are discarded. Water surface temperature (°C), salinity (ppt), and substrate type are recorded at each fixed station for each seine haul.

Catch distributions for many forage species or juveniles of some species can be heavily skewed due to a few large catches as a result of schooling behavior. In these instances one or two large catches can often inflate the value of an arithmetic mean by orders of magnitude resulting in a false characterization of the true relative abundance of a species. To compensate for this potential bias, a log transformation of the catch data was used to produce a normal (as opposed to skewed) catch distribution and the resulting mean of the log-transformed data can be transformed back to produce a geometric mean (Sokal and Rohlf 1969). In recent years the geometric mean has often replaced the arithmetic mean as a measure of relative abundance for juvenile finfish because it is a more statistically robust value (Howell and Molnar 1993; MDDNR 1994; Young et al. 1994; NAI 1995).

RESULTS

A total of 15 stations were surveyed once a month from June through November, resulting in a total of 90 seine hauls. Substrate type was observed and recorded during these sampling events to identify habitat type (Table 3.3-1). Six of the 15 stations sampled had substrate classified as “mud/sand”. The remaining stations were identified as “mud”, “sand”, “mud/shell”, or “mud/gravel”. One station (93) exhibited a variation in substrate type as compared to historical data; from mud/gravel to mud.

A total of 27 finfish and four invertebrate species of special interest were captured in 2016 (Table 3.3-2). The five most abundant finfish in 2016 were Atlantic Silverside, Striped Killifish *Fundulus majalis*, Mummichog *Fundulus heteroclitus*, Blueback Herring, and Winter Flounder accounting for 97.54% of the total finfish catch. Green crab was the most abundant

invertebrate of special interest, with a geometric mean CPUE of 3.79, representing 3.55% of the total catch and 98.35% of invertebrate species.

Overall relative abundance in 2016 was below average with the all-species geometric mean ranking eighth lowest in the 20 year time series (Table 3.3-3). White Hake *Urophycis tenuis* had a time series high relative abundance in 2016, while Ninespine Stickleback *Pungitius pungitius* had the lowest recorded levels for the second year in a row. Threespine Stickleback *Gasterosteus aculeatus* were not caught for the first time since 1997. Rainbow Smelt relative abundance declined sharply to the third lowest value of the time series. American Shad, a species of special interest, was captured for the first time since 2002. Two rarely encountered species, Bay Anchovy *Anchoa mitchilli* and squid (family Loliginidae), were captured in 2016.

Station 33 had the lowest overall geometric mean CPUE and lowest species diversity with only three species observed (Table 3.3-4). In contrast Station 54 had the highest abundance levels, while station 147 had the greatest species diversity with 21 different species captured. Atlantic Silverside dominated the catch composition at all stations except 5, 29, and 33. Striped Bass, American Shad, Cunner *Tautogolabrus adspersus*, Rock Gunnel *Pholis gunnellus*, squid, and Asian Shore Crab were found at only one of the 15 stations throughout the duration of the survey. September had the highest index value for all species combined in 2016, while June had the lowest (Table 3.3-5).

In 2016, 3,147 individual finfish were measured (Table 3.3-6). Length frequencies were weighted by catch and plotted for the species of special interest (Figure 3.3-4).

Mean surface water temperature was above average in 2016 at 17.4°C, equal to the second highest of the time series, with a low of 8.6°C at Station 39 in November and a high of 30.6°C at Station 54 in July (Tables 3.3-7 and 3.3-8). The annual area mean of Hampton/Seabrook Estuary exhibited cooler surface temperatures than other sampled areas; while the Little Bay and Great Bay area exhibited warmer temperatures.

Historical annual mean salinity ranges from 23.0 ppt in 2006 to the time series high of 29.2 ppt measured in 2016 (Table 3.3-7). Salinity in 2016 ranged from 11.7 ppt at Station 39 in November to 32.3 ppt at Station 23 in November (Table 3.3-9). The range in recorded salinities was greatest at Station 39, ranging from 11.7 ppt to 27.2 ppt, in contrast to Station 29 which experienced a minor difference in salinity.

DISCUSSION

The objective of this project is to annually monitor the relative abundance of juvenile finfish utilizing NH's estuaries for nursery habitat. As has been the case since the inception of the survey in 1997, only a few species account for the vast majority of those captured (Grout and Smith 1998). A total of four special interest invertebrate species and 27 finfish species were captured during the 2016 survey season. Five finfish species comprised 97.54% of the total catch: Atlantic Silverside, Striped Killifish, Mummichog, Blueback Herring, and Winter Flounder (Table 3.3-2). This diversity in annual catch is reflective of the general purpose design of the survey, but primary species of interest are Alewife, Blueback Herring, Winter Flounder, Rainbow Smelt, American Shad, and Atlantic Silverside. With the exception of American Shad, which were captured for the first time since 2002, all of these species of interest have been caught every year of the survey (Table 3.3-3). Although inter-annual variation is inherent in natural systems due to fluctuations in both biotic and abiotic factors, this survey's ability to monitor trends in relative abundance for species of interest over time is informative.

Environmental conditions, both abiotic and biotic, can influence the distribution of fish, especially in an estuary where these changes can be abrupt. Overall relative abundance levels in the 2016 sampling year increased slightly from the prior year, although relative levels of abundance were the eighth lowest of the last 20 years of the seine survey (Table 3.3-3). White Hake and Striped Killifish both had an above average abundance year. The relative abundances compared to the time series geometric means, nearly doubled and quadrupled for Striped Killifish and White Hake, respectively. Other commonly encountered species such as Atlantic Menhaden, Atlantic Herring, and Rainbow Smelt had a below average abundance year. It is important to understand there exists, to some extent, internal-annual variation with these time series data, while some species exhibit peaks one year and potential lows in other years, general trends are the important outcomes by design of this survey.

River herring (collectively Alewife and Blueback Herring) have been showing a declining trend since the inception of the survey and are currently listed as a "Species of Concern" by the National Oceanic and Atmospheric Administration's Fisheries Service and the NH Fish and Game Department. Relative abundance of Alewives in 2016 decreased 51.6% from 2015. In contrast, Blueback Herring increased to its highest abundance level since 2007 (Table 3.3-3). While no single factor has been determined for the cause of the general decline, certain factors such as habitat loss and degradation, impediments to spawning areas, fishing, and recovering predator stocks (e.g.,

Striped Bass) may all play a role in the general decline of coast-wide river herring populations (ASMFC 2012).

Rainbow Smelt have exhibited a declining trend since 2000, continuing that trend this year with the third lowest level recorded in the last 19 years (Table 3.3-3). In addition two surveys that target Rainbow Smelt illustrate a similar declining trend (See Project I-2 and II-1). In response to the observed decline in adult Rainbow Smelt populations the NH Fish and Game Department implemented a catch reduction for recreational harvest from 10 liquid quarts to 4 liquid quarts in 2015. Rainbow Smelt is also designated as a "Species of Concern" for the National Oceanic and Atmospheric Administration's Fisheries Service and NH Fish and Game Department. It is believed that populations of Rainbow Smelt throughout the northwest Atlantic have declined over the past few decades due to overfishing, pollution, unfavorable changes in ocean conditions (e.g., temperature), poor water quality, physical obstructions (e.g., poorly designed culverts, dams), and degradation and loss of spawning habitat (Enterline et al. 2012). In addition Rainbow Smelt spawning and migratory patterns are poorly understood.

Atlantic Silverside accounted for 79.94% of the total catch in 2016 (Table 3.3-2), and is persistently the most numerous species caught in the survey (Table 3.3-3). Furthermore, it was the only fish species to be captured at all 15 stations (Table 3.3-4) and was the most abundant finfish species in most months (Table 3.3-5). Atlantic Silversides are an important forage fish, and documented food source for Bluefish and Striped Bass.

Relative abundance of juvenile Atlantic Menhaden *Brevoortia tyrannus* peaked in 2000 and has shown a declining trend since 2007 (Table 3.3-3). The species was captured at three stations (23, 35, and 72) exclusively in the month of November (Tables 3.3-4 and 3.3-5). A temperate species that embarks on far-reaching north-south migrations, the Gulf of Maine is considered the extent of the commercially viable northern range of this species. Presence of Atlantic Menhaden is known to be sporadic and unpredictable in Canadian waters (Collette and Klein-MacPhee 2002).

Despite a decline in Winter Flounder abundance since 2000, geometric mean CPUE increased by 131.3% from 2015 and is above the time series geometric mean (Table 3.3-3). It is important to note, however, that this increase was within the standard deviation for that species. Winter Flounder was captured each month (Table 3.3-5), and was encountered at all but one station (Table 3.3-4); which suggests the species occupies a widespread area of the estuary. While a large portion of Winter Flounder populations are harvested in federal waters, the majority of the stock is composed of smaller localized populations that return inshore each year to spawn (ASMFC 2007).

This decline in the spawning success and recruitment to the localized populations in NH is likely the result of overfishing, pollution, habitat loss and degradation, and power plant entrainment and impingement (ASMFC 2012).

Shoreline types transform over time as a result of environmental conditions or natural events such as rain and flooding, and ultimately the process may result in the shifting of sand bars. Sediment type remained consistent with prior year classification, except station 93, which appears to fluctuate from year to year. Station 93 has reverted back to a mud substrate from its mud/gravel substrate characterized in 2015. Site substrate change occurs in some sites, while others it is less often experienced, but ultimately the process appears to be slow. The change in substrate within a given site may result in a transformation or shift in species diversity at a site over time as it may provide a more desirable nursery, forage, or shelter habitat for certain species.

Water temperature is thought to play an important role in species abundance and movement (Roessig et al. 2004). Within NH estuaries, finfish species abundance tended to be greater in the late summer and fall months. Overall abundance peaked in September, after which water temperatures decreased notably at all 15 stations (Tables 3.3-5 and 3.3-8). However, it should be noted that the two species with the highest geometric mean CPUE, Atlantic Silversides and Striped Killifish, are primarily driving this abundance level in September. The peak months for the majority of the other species encountered was June and July. In 2016, the annual mean salinity of 29.2 ppt and annual mean temperature of 17.4^{o}C, were both among the highest on record. These data are most likely driven by the drought conditions experienced in 2016 (Table 3.3-7).

In summary, of the 27 finfish captured in the 2016 seine survey, the five most abundant species were Atlantic Silverside, Striped Killifish, Mummichog, Blueback Herring, and Winter Flounder, representing 97.54% of the total finfish catch. Green crab was the most abundant invertebrate species encountered making up only 3.55% of the total catch, but 98.35% of the invertebrate catch. Overall, relative species abundance increased in 2016 from 2015, but is the eighth lowest estimate in the past 19 years. Atlantic Silverside continues to represent the highest relative abundance numbers annually. All species of interest, notably Rainbow Smelt remain relatively low. American Shad was captured in 2016 for the first time since 2002. White Hake and Striped Killifish exhibited an increase in relative abundance, while Rainbow Smelt continued to show a declining trend. Both mean water surface temperature and mean salinity were relatively high in 2016, likely as

a result of drought conditions. Station 93 was the only site that changed sediment type from the preceding year.

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Table 3.3-1. Station number and its area code, location, coordinates, and substrate type, as well as historical seining data for each station, from a juvenile finfish seine survey conducted in New Hampshire estuaries, 2016.

Station #	Area	Station location	Latitude/longitude	Substrate	Historical data
5	GBE1	Fort Stark (Little Harbor)	43°03’28.0”N 070°42’51.7”W	sand	Grout & Heckman (1996)
7	GBE1	Wentworth (Little Harbor)	43°03’25.6”N 070°43’25.7”W	mud/sand	Grout & Heckman (1996)
9	GBE1	Odiorne Beach (Little Harbor)	43°03’07.9”N 070°43’22.9”W	sand	Grout & Heckman (1996)
30	GBE2	Schiller Plant (Piscataqua)	43°05’59.3”N 070°47’15.5”W	mud/gravel	NAI (1979)
35	GBE2	General Sullivan Bridge Cove (Piscataqua)	43°07’00.1”N 070°49’23.6”W	mud	NHFG (1981,1982)
39	GBE2	Upper Piscataqua (Power Lines)	43°10’16.2”N 070°49’43.9”W	mud/sand	None
54	GBE3	Broad Cove (Little Bay)	43°07’07.9”N 070°50’51.8”W	mud/sand	NHFG (1981)
72	GBE3	Fox Point (Little Bay)	43°07’15.0”N 070°51’33.2”W	mud/sand	NHFG (1981,1982)
93	GBE3	Herods Cove (Great Bay)	43°04’16.6”N 070°51’27.2”W	mud	NHFG (1981,1982)
107	GBE3	Moody Point (Lamprey/Squamscott)	43°04’07.0”N 070°54’12.5”W	mud	NHFG (1981)
147	GBE3	Oyster River	43°07’19.3”N 070°52’23.4”W	mud/shell	None
23	HSE	Smith & Gilmore (Hampton)	42°54’03.4”N 070°49’10.0”W	mud/shell	Grout & Heckman (1996)
25	HSE	Yankee Coop (Seabrook)	42°53’33.0”N 070°49’11.1”W	mud/sand	Grout & Heckman (1996)
29	HSE	Blackwater River	42°53’42.9”N 070°49’29.8”W	sand	Grout & Heckman (1996)
33	HSE	Brown’s River	42°53’56.3”N 070°49’33.4”W	mud/sand	Grout & Heckman (1996)

Area codes	Area names
HSE	Hampton/Seabrook Estuary
GBE1	Little Harbor
GBE2	Piscataqua River
GBE3	Little Bay/Great Bay

Table 3.3-2. Geometric and arithmetic mean catch per seine haul, as well as standard deviation of those values, for all species captured, from a juvenile finfish seine survey conducted in New Hampshire estuaries, 2016.

Species	Scientific name	Geometric		Arithmetic		Total catch	Percentage of total
		Mean	SD	Mean	SD	#	catch
Alewife	*Alosa pseudoharengus*	0.15	0.96	1.73	12.40	156	0.67
Bass, Striped	*Morone saxatalis*	0.01	0.08	0.01	0.11	1	0.00
Bay Anchovy	*Anchoa mitchilli*	0.03	0.20	0.06	0.43	5	0.02
Bluefish	*Pomatomus saltatrix*	0.02	0.13	0.03	0.18	3	0.01
crab, asian shore	*Hemigrapsus sanguineus*	0.01	0.08	0.01	0.11	1	0.00
crab, green	*Carcinus maenas*	3.79	2.45	9.24	13.94	832	3.55
crab, horseshoe	*Limulus polyphemus*	0.05	0.22	0.08	0.34	7	0.03
crab, rock	*Cancer irroratus*	0.03	0.20	0.06	0.43	5	0.02
Cunner	*Tautogolabrus adspersus*	0.01	0.08	0.01	0.11	1	0.00
Eel, American	*Anguilla rostrata*	0.02	0.15	0.03	0.23	3	0.01
Flounder, Smooth	*Pleuronectes putnami*	0.21	0.68	0.50	1.57	45	0.19
Flounder, Windowpane	*Scophthalmus aquosus*	0.02	0.11	0.02	0.15	2	0.01
Flounder, Winter	*Pseudopleuronectes americanus*	1.48	1.71	3.44	6.12	310	1.32
Grubby	*Myoxocephalus aenaeus*	0.20	0.61	0.50	2.22	45	0.19
Gunnel, Rock	*Pholis gunnellus*	0.01	0.12	0.02	0.21	2	0.01
Hake, Red	*Urophycis chuss*	0.04	0.21	0.07	0.36	6	0.03
Hake, White	*Urophycis tenuis*	0.08	0.31	0.13	0.50	12	0.05
Herring, Atlantic	*Clupea harengus*	0.04	0.26	0.09	0.65	8	0.03
Herring, Blueback	*Alosa aestivalis*	0.21	1.20	3.59	28.03	323	1.38
Killifish, Striped	*Fundulus majalis*	2.67	4.44	18.84	53.18	1696	7.23
Lance, American Sand	*Ammodytes americanus*	0.06	0.35	0.17	1.18	15	0.06
Mendaden, Atlantic	*Brevoortia tyrannus*	0.04	0.28	0.10	0.67	9	0.04
Mummichog	*Fundulus heteroclitus*	1.23	3.01	10.81	48.91	973	4.15
Perch, White	*Morone americana*	0.02	0.15	0.03	0.23	3	0.01
Pipefish, Northern	*Sygnathus fuscus*	0.19	0.49	0.32	0.90	29	0.12
Shad, American	*Alosa sapidissima*	0.02	0.16	0.03	0.32	3	0.01
Silverside, Atlantic	*Menidia menidia*	21.78	10.15	208.23	532.52	18741	79.94
Smelt, Rainbow	*Osmerus mordax*	0.15	0.85	1.16	7.98	104	0.44
squid	*Loliginidae*	0.01	0.08	0.01	0.11	1	0.00
Stickleback, Fourspine	*Apeltes quadracus*	0.14	0.52	0.32	1.23	29	0.12
Stickleback, Ninespine	*Pungitius pungitius*	0.04	0.21	0.07	0.33	6	0.03
Tomcod, Atlantic	*Microgadus tomcod*	0.19	0.79	0.77	3.97	69	0.29
	All species	57.40	260.34	552.38	6.48	23,445	100.00

Table 3.3-3. Geometric mean catch per seine haul, as well as standard deviation of those values, for all species caught in juvenile finfish seine survey conducted in New Hampshire estuaries, 1997–2016.

Species		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Time Series Mean
Alewife	Mean	0.07	0.04	0.27	0.26	0.14	0.34	0.32	0.14	0.11	0.32	0.21	0.15	0.10	0.08	0.08	0.02	0.22	0.05	0.31	0.15	0.17
	SD	0.38	0.33	1.56	0.87	0.74	1.21	1.98	0.58	0.53	1.92	1.08	0.64	0.53	0.34	0.44	0.23	1.49	0.25	1.09	0.96	0.96
Bass, Largemouth	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.03	0.01	0.00	†
	SD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.08	0.00	0.08	0.08	0.00	0.00	0.00	0.00	0.34	0.08	0.00	†
Bass, Striped	Mean	0.01	0.00	0.01	0.02	0.01	0.04	0.02	0.00	0.05	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01
	SD	0.08	0.00	0.08	0.13	0.08	0.21	0.11	0.00	0.25	0.00	0.08	0.00	0.12	0.00	0.00	0.00	0.08	0.00	0.08	0.08	0.08
Bay Anchovy	Mean	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.02	0.00	0.02	0.01	0.01	0.02	0.00	0.00	0.03	0.00	0.00	0.03	0.01
	SD	0.00	0.00	0.00	0.00	0.08	0.00	0.13	0.00	0.18	0.00	0.11	0.08	0.08	0.18	0.00	0.00	0.15	0.00	0.00	0.20	0.20
Bluefish	Mean	0.00	0.00	0.20	0.04	0.12	0.01	0.01	0.00	0.02	0.09	0.06	0.17	0.32	0.10	0.08	0.35	0.41	0.05	0.00	0.02	0.10
	SD	0.00	0.00	0.89	0.26	0.71	0.08	0.08	0.00	0.18	0.62	0.42	0.63	1.08	0.48	0.37	1.14	1.22	0.33	0.00	0.13	0.13
crab, asian shore	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
	SD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.08
crab, green	Mean	2.36	2.77	6.10	5.56	3.81	6.86	3.25	1.33	2.67	1.64	2.09	2.16	1.79	1.83	1.69	3.28	3.59	2.35	1.71	3.79	3.08
	SD	2.33	2.73	3.37	2.56	2.24	2.94	2.32	1.88	2.40	1.53	2.32	2.26	1.80	2.06	1.58	2.39	2.97	2.57	1.77	2.45	2.45
crab, horseshoe	Mean	0.07	0.01	0.00	0.06	0.02	0.00	0.05	0.01	0.08	0.07	0.11	0.02	0.04	0.03	0.05	0.02	0.02	0.00	0.02	0.05	0.04
	SD	0.31	0.08	0.00	0.31	0.13	0.00	0.28	0.12	0.41	0.38	0.41	0.11	0.21	0.15	0.22	0.11	0.15	0.00	0.13	0.22	0.22
crab, jonah	Mean	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.02	0.00	0.00	0.00	0.01	0.02	0.01	0.01	0.00	0.02	0.01	0.01	0.00	†
	SD	0.00	0.00	0.00	0.08	0.08	0.00	0.08	0.11	0.00	0.00	0.00	0.08	0.11	0.08	0.12	0.00	0.11	0.08	0.12	0.00	†
crab, rock	Mean	0.09	0.05	0.01	0.06	0.00	0.04	0.04	0.04	0.04	0.02	0.00	0.06	0.01	0.01	0.06	0.00	0.04	0.01	0.00	0.03	0.03
	SD	0.35	0.32	0.08	0.26	0.00	0.18	0.20	0.20	0.21	0.15	0.00	0.23	0.08	0.08	0.31	0.00	0.29	0.08	0.00	0.20	0.20
Cunner	Mean	0.05	0.02	0.02	0.04	0.00	0.02	0.04	0.05	0.05	0.01	0.00	0.02	0.00	0.00	0.02	0.09	0.03	0.02	0.00	0.01	0.02
	SD	0.29	0.11	0.13	0.18	0.00	0.13	0.18	0.22	0.28	0.08	0.00	0.11	0.00	0.00	0.11	0.36	0.17	0.11	0.00	0.08	0.08
Eel, American	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.02	0.02	0.01
	SD	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.12	0.08	0.00	0.00	0.08	0.08	0.00	0.12	0.00	0.08	0.11	0.15	0.15
Flounder, Smooth	Mean	0.18	0.14	0.47	0.34	0.31	0.39	0.56	0.17	0.73	0.12	0.22	0.04	0.59	0.27	0.87	0.33	0.08	0.58	0.38	0.21	0.36
	SD	0.49	0.61	1.28	0.98	0.82	0.88	1.30	0.47	1.49	0.43	0.66	0.23	1.44	0.74	1.63	0.79	0.31	1.28	1.15	0.68	0.68
Flounder, Windowpane	Mean	0.00	0.01	0.01	0.01	0.00	0.08	0.00	0.03	0.09	0.03	0.06	0.03	0.01	0.01	0.00	0.02	0.00	0.00	0.00	0.02	0.02
	SD	0.00	0.08	0.12	0.08	0.00	0.32	0.00	0.19	0.36	0.19	0.28	0.20	0.12	0.08	0.00	0.15	0.00	0.00	0.00	0.11	0.11
Flounder, Winter	Mean	0.94	1.63	0.80	3.44	1.68	3.14	2.42	1.31	1.99	0.94	1.33	1.10	0.35	0.17	0.20	0.57	0.38	0.32	0.64	1.48	1.28
	SD	1.35	1.95	1.12	2.85	1.44	3.33	2.13	1.68	2.09	1.80	1.93	1.36	0.63	0.53	0.44	0.86	0.79	0.66	0.93	1.71	1.71
Grubby	Mean	0.15	0.29	0.10	0.09	0.30	0.31	0.17	0.15	0.18	0.03	0.03	0.06	0.10	0.04	0.31	0.33	0.09	0.19	0.39	0.20	0.18
	SD	0.49	0.69	0.34	0.51	0.65	0.75	0.46	0.42	0.51	0.15	0.17	0.24	0.36	0.22	0.72	0.79	0.37	0.48	0.76	0.61	0.61
Gunnel, Rock	Mean	0.01	0.02	0.00	0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	SD	0.08	0.11	0.00	0.08	0.00	0.11	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12
Hake, Red	Mean	0.00	0.00	0.06	0.01	0.02	0.04	0.05	0.00	0.05	0.06	0.07	0.04	0.11	0.02	0.02	0.03	0.00	0.04	0.14	0.04	0.04
	SD	0.00	0.00	0.21	0.08	0.18	0.23	0.22	0.00	0.22	0.24	0.23	0.17	0.43	0.11	0.13	0.19	0.00	0.31	0.48	0.21	0.21
Hake, Silver	Mean	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	†
	SD	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	†
Hake, White	Mean	0.06	0.02	0.02	0.00	0.04	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.02	0.03	0.08	0.02
	SD	0.33	0.13	0.15	0.00	0.26	0.08	0.00	0.12	0.00	0.00	0.08	0.00	0.00	0.00	0.08	0.00	0.08	0.11	0.19	0.31	0.31

† value n calcula ed

Table 3.3-3 (cont.)

Species		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Time Series Mean
Herring, Atlantic	Mean	0.28	0.16	0.82	0.32	0.12	0.24	0.29	0.11	0.00	0.03	0.04	0.65	0.36	0.33	0.05	0.01	0.16	0.17	0.15	0.04	0.21
	SD	2.63	1.14	5.59	1.89	0.89	1.38	2.38	0.68	0.00	0.23	0.37	3.69	1.69	1.70	0.33	0.12	0.95	0.68	0.82	0.26	0.26
Herring, Blueback	Mean	0.43	0.66	0.97	0.74	0.89	0.26	0.71	0.22	0.35	0.42	0.50	0.13	0.20	0.17	0.05	0.08	0.04	0.14	0.06	0.21	0.36
	SD	1.56	3.13	3.74	2.90	3.15	1.20	2.73	1.01	2.01	1.71	2.00	0.54	1.12	0.79	0.19	0.50	0.22	0.64	0.39	1.20	1.20
Killifish, Striped	Mean	0.23	0.05	1.46	0.82	1.21	1.24	1.97	1.38	2.07	1.55	1.03	1.31	0.76	1.65	3.19	1.49	1.02	1.39	2.05	2.67	1.42
	SD	1.06	0.36	3.70	2.32	2.25	3.27	3.33	2.97	3.65	3.53	2.37	2.76	2.10	4.03	5.08	3.05	2.67	3.15	3.77	4.44	4.44
Lance, American Sand	Mean	0.02	0.02	0.15	0.03	0.04	0.01	0.01	0.02	0.07	0.00	0.04	0.07	0.13	0.04	0.20	0.09	0.11	0.04	0.08	0.06	0.07
	SD	0.15	0.18	0.84	0.17	0.18	0.12	0.08	0.15	0.56	0.00	0.29	0.75	0.97	0.31	1.10	0.43	0.48	0.42	0.46	0.35	0.35
Lumpfish	Mean	0.07	0.03	0.01	0.02	0.06	0.04	0.06	0.02	0.04	0.04	0.00	0.02	0.02	0.01	0.00	0.00	0.01	0.00	0.02	0.00	†
	SD	0.40	0.17	0.08	0.13	0.23	0.18	0.28	0.11	0.47	0.18	0.00	0.13	0.13	0.08	0.00	0.00	0.08	0.00	0.11	0.00	†
Menhaden, Atlantic	Mean	0.06	0.00	0.57	2.15	0.30	1.37	1.23	0.19	1.79	1.16	0.93	0.09	0.08	0.00	0.02	0.26	0.00	0.06	0.03	0.04	0.43
	SD	0.47	0.00	3.14	8.45	1.85	7.31	4.86	0.97	8.58	4.58	4.87	0.65	0.42	0.00	0.15	1.90	0.00	0.42	0.23	0.28	0.28
Mummichog	Mean	1.35	0.45	1.51	0.96	0.55	0.68	0.77	0.67	0.56	0.75	0.36	0.49	0.63	0.78	0.66	1.09	0.44	0.53	0.86	1.23	0.80
	SD	3.30	1.80	3.51	2.35	1.40	2.31	1.72	1.90	1.59	2.26	0.95	1.54	1.66	2.25	1.76	2.47	1.27	1.77	2.19	3.01	3.01
Perch, White	Mean	0.13	0.02	0.02	0.12	0.00	0.16	0.09	0.10	0.24	0.27	0.17	0.04	0.00	0.13	0.02	0.02	0.03	0.35	0.01	0.02	0.10
	SD	0.57	0.15	0.13	0.56	0.00	0.69	0.57	0.45	0.98	1.04	0.53	0.18	0.00	0.56	0.13	0.15	0.19	1.26	0.08	0.15	0.15
Pipefish, Northern	Mean	0.05	0.12	0.07	0.14	0.09	0.11	0.08	0.05	0.19	0.05	0.06	0.07	0.07	0.06	0.11	0.21	0.22	0.09	0.10	0.19	0.11
	SD	0.23	0.42	0.27	0.43	0.36	0.34	0.33	0.19	0.50	0.22	0.23	0.24	0.27	0.30	0.42	0.48	0.56	0.34	0.31	0.49	0.49
Pollock	Mean	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	0.01	0.00	0.00	0.00	0.01	0.00	0.00	†
	SD	0.00	0.00	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.08	0.00	0.00	†
Raven, Sea	Mean	0.02	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.01	0.01	0.00	†
	SD	0.16	0.08	0.00	0.00	0.00	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.11	0.08	0.00	0.00	0.00	0.12	0.08	0.00	†
Shad, American	Mean	0.02	0.00	0.12	0.04	0.02	0.01	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	0.02	0.01
	SD	0.11	0.00	0.95	0.35	0.18	0.12	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	0.16	0.16
Silverside, Atlantic	Mean	18.57	7.93	56.21	30.16	23.03	22.95	21.28	19.18	23.05	15.24	20.30	14.35	8.24	27.73	26.38	18.67	11.20	24.77	18.87	21.78	24.98
	SD	10.06	8.65	17.62	15.56	10.77	14.05	13.69	9.11	9.35	9.72	11.80	9.17	7.39	10.20	12.98	9.57	9.42	12.19	11.81	10.15	10.15
Smelt, Rainbow	Mean	0.59	0.85	0.39	1.50	1.27	0.69	1.31	1.12	0.88	0.63	0.80	0.10	0.42	0.39	0.49	0.24	0.13	0.41	0.56	0.15	0.64
	SD	2.75	3.81	1.67	4.62	4.49	2.51	4.95	3.23	2.78	1.80	2.92	0.70	1.41	1.23	1.70	1.19	0.63	1.72	2.95	0.85	0.85
squid, Unc	Mean	0.00	0.00	0.00	0.01	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	0.01	0.00
	SD	0.00	0.00	0.00	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	0.08	0.08
Stickelback, Fourspine	Mean	0.34	0.13	0.18	0.16	0.31	0.09	0.12	0.09	0.20	0.16	0.02	0.13	0.14	0.43	0.85	0.40	0.37	0.36	0.28	0.14	0.25
	SD	1.43	0.49	0.61	0.48	0.92	0.36	0.48	0.33	0.68	0.57	0.11	0.46	0.58	1.22	2.06	0.94	1.13	1.49	0.79	0.52	0.52
Stickelback, Threespine	Mean	0.19	0.08	0.08	0.06	0.07	0.11	0.06	0.13	0.02	0.04	0.03	0.01	0.05	0.06	0.06	0.02	0.01	0.05	0.02	0.00	†
	SD	0.94	0.35	0.32	0.26	0.31	0.38	0.24	0.45	0.16	0.22	0.20	0.12	0.22	0.28	0.29	0.11	0.08	0.19	0.13	0.00	†
Stickleback, Ninespine	Mean	0.30	0.28	0.45	0.31	0.23	0.25	1.26	0.74	0.69	0.27	0.27	0.13	0.23	0.15	0.78	0.05	0.41	0.41	0.05	0.04	0.36
	SD	1.44	0.91	1.73	0.78	1.07	0.95	3.50	2.41	1.98	1.09	1.18	0.52	0.80	0.87	3.09	0.25	1.94	1.48	0.28	0.21	0.21
Tomcod, Atlantic	Mean	0.14	0.11	0.06	0.18	0.10	0.13	0.10	0.10	0.17	0.10	0.26	0.04	0.17	0.07	0.05	0.06	0.11	0.30	0.09	0.19	0.13
	SD	0.77	0.52	0.49	0.52	0.45	0.55	0.43	0.48	0.84	0.53	0.98	0.23	0.69	0.33	0.25	0.25	0.48	0.98	0.39	0.79	0.79
All species	Mean	64.25	34.70	222.31	146.34	87.50	118.31	111.31	57.44	95.60	47.44	66.90	52.94	29.22	62.10	80.15	46.59	36.34	64.47	53.31	57.40	†
	SD	5.64	6.04	7.32	5.61	4.67	5.36	7.06	4.93	5.74	7.39	7.21	5.43	5.20	6.32	6.51	6.58	6.45	7.00	6.77	6.48	†

† value n calcula ed

Table 3.3-4. Geometric mean catch per seine haul, by station and species, for all months combined, from a juvenile finfish seine survey conducted in New Hampshire estuaries, 2016.

	Station #														
	Little Harbor			Hampton/Seabrook Estuary				Piscataqua River			Little Bay/Great Bay				
Species	5	7	9	23	25	29	33	30	35	39	54	72	93	107	147
Alewife	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.00	0.00	0.00	0.00	1.65	0.88
Bass, Striped	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay Anchovy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.31	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26
crab, asian shore	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
crab, green	4.39	3.46	1.14	2.14	0.82	0.35	0.47	26.75	19.87	2.07	8.31	14.38	3.84	0.62	12.86
crab, horseshoe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.12	0.62	0.00	0.00
crab, rock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.31
Cunner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eel, American	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.20
Flounder, Smooth	0.12	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.12	0.12	0.00	0.35	1.24	1.96	0.12
Flounder, Windowpane	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00
Flounder, Winter	0.41	7.40	0.65	0.62	4.12	1.80	0.51	2.26	4.12	0.76	2.41	3.22	0.12	0.00	1.57
Grubby	0.00	0.00	0.00	0.26	0.00	0.00	0.00	1.40	0.00	0.12	0.12	0.82	0.00	0.00	1.35
Gunnel, Rock	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	0.20
Hake, Red	0.00	0.12	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
Hake, White	0.00	0.35	0.26	0.00	0.00	0.00	0.00	0.35	0.12	0.00	0.20	0.00	0.00	0.00	0.00
Herring, Atlantic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.38	0.00	0.00	0.12	0.00
Herring, Blueback	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.12	0.00	2.83	1.57
Killifish, Stiped	0.00	1.99	0.00	2.20	0.00	0.00	0.00	0.70	4.80	30.69	9.91	3.36	16.82	9.88	9.77
Lance, American Sand	0.12	0.00	0.00	0.00	0.82	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Menhaden, Atlantic	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.12	0.00	0.00	0.00
Mummichog	0.00	0.65	0.00	0.26	0.00	0.00	0.00	0.20	0.86	10.14	5.32	0.89	9.31	3.43	5.00
Perch, White	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	0.20	0.12
Pipefish, Northern	0.12	0.12	0.00	0.12	0.00	0.12	0.00	0.20	0.35	0.44	0.12	0.51	0.00	0.00	1.03
Shad, American	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.00	0.00	0.00
Silverside, Atlantic	3.06	11.69	6.76	26.49	12.68	1.43	0.12	39.81	170.61	67.32	350.98	92.47	19.93	19.39	82.72
Smelt, Rainbow	0.00	0.00	0.00	0.12	0.44	0.00	0.00	0.00	3.11	0.00	0.00	0.00	0.00	0.00	0.26
squid, Unc	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	0.12
Stickleback, Ninespine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.12	0.00	0.00	0.00	0.00	0.12	0.20
Sticlleback, Fourspine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.38	0.12	0.00	0.20	0.00	1.29
Tomcod, Atlantic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.49	1.04	0.00	0.12	1.64
All species	10.10	34.95	12.77	89.42	35.69	5.56	0.85	122.79	444.27	156.08	583.76	178.51	78.87	92.43	207.76

Table 3.3-5. Geometric Mean (GM) and Arithmetic Mean (AM) catch per seine haul, by species and month, for all stations combined, from a juvenile finfish seine survey conducted in New Hampshire estuaries, 2016.

Species	June		July		August		September		October		November	
	GM	AM	GM	AM	GM	AM	GM	AM	GM	AM	GM	AM
Alewife	0.30	1.27	0.44	7.73	0.00	0.00	0.23	1.40	0.00	0.00	0.00	0.00
Bass, Striped	0.00	0.00	0.00	0.00	0.05	0.07	0.00	0.00	0.00	0.00	0.00	0.00
Bay Anchovy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.33	0.00	0.00
Bluefish	0.00	0.00	0.00	0.00	0.05	0.07	0.10	0.13	0.00	0.00	0.00	0.00
crab, asian shore	0.00	0.00	0.05	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
crab, green	4.51	11.93	7.43	16.40	4.35	7.73	3.64	6.67	3.04	9.33	1.59	3.40
crab, horseshoe	0.08	0.13	0.08	0.13	0.10	0.13	0.05	0.07	0.00	0.00	0.00	0.00
crab, rock	0.11	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.07
Cunner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.07	0.00	0.00
Eel, American	0.08	0.13	0.05	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flounder, Smooth	0.37	0.93	0.60	1.27	0.13	0.20	0.15	0.47	0.05	0.07	0.05	0.07
Flounder, Windowpane	0.00	0.00	0.00	0.00	0.05	0.07	0.00	0.00	0.05	0.07	0.00	0.00
Flounder, Winter	0.95	2.40	3.02	7.80	2.12	3.87	1.81	2.87	1.44	3.07	0.39	0.67
Grubby	0.34	1.47	0.18	0.27	0.08	0.13	0.20	0.33	0.24	0.47	0.20	0.33
Gunnel, Rock	0.08	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hake, Red	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.27	0.10	0.13
Hake, White	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.60	0.13	0.20
Herring, Atlantic	0.19	0.47	0.05	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Herring, Blueback	0.23	0.73	0.67	18.07	0.13	0.33	0.27	2.33	0.05	0.07	0.00	0.00
Killifish, Striped	1.24	4.93	1.80	27.33	3.42	32.87	5.15	27.87	6.56	16.40	0.90	3.67
Lance, American Sand	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.73	0.08	0.13	0.10	0.13
Menhaden, Atlantic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.60
Mummichog	1.16	5.33	1.86	33.73	1.84	12.80	3.37	11.73	0.54	1.20	0.05	0.07
Perch, White	0.05	0.07	0.08	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipefish, Northern	0.41	0.67	0.18	0.27	0.14	0.40	0.24	0.33	0.10	0.13	0.08	0.13
Shad, American	0.10	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Silverside, Atlantic	3.88	31.20	2.82	14.27	23.34	284.33	98.63	381.93	43.61	286.47	68.34	251.20
Smelt, Rainbow	0.00	0.00	0.00	0.00	0.00	0.00	0.69	5.67	0.26	1.07	0.10	0.20
squid, Unc	0.00	0.00	0.00	0.00	0.05	0.07	0.00	0.00	0.00	0.00	0.00	0.00
Stickleback, Fourspine	0.30	0.73	0.13	0.20	0.08	0.13	0.00	0.00	0.20	0.53	0.17	0.33
Stickleback, Ninespine	0.13	0.20	0.00	0.00	0.13	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Tomcod, Atlantic	0.96	3.80	0.14	0.40	0.15	0.27	0.00	0.00	0.05	0.07	0.05	0.07
All species	20.21	66.07	36.39	128.20	60.57	343.67	160.40	442.53	65.00	320.33	75.27	261.27

Table 3.3-6. Mean, minimum, and maximum total length (cm), as well as sample size (N), for all fish species measured, from a juvenile finfish seine survey conducted in New Hampshire estuaries, 2016.

	Total length (cm)			
Species	Mean	Minimum	Maximum	N
Alewife	8.89	4.30	14.50	66
Bass, Striped	58.40	58.40	58.40	1
Bay, Anchovy	6.94	5.80	7.60	5
Bluefish	9.87	7.10	11.40	3
Cunner	3.70	3.70	3.70	1
Eel, American	19.10	18.10	20.00	3
Flounder, Smooth	6.95	3.00	20.90	45
Flounder, Windowpane	5.00	4.70	5.30	2
Flounder, Winter	5.20	1.50	15.50	296
Grubby	6.10	3.30	8.60	45
Gunnel, Rock	10.30	10.00	10.60	2
Hake, Red	5.73	4.50	7.60	6
Hake, White	5.35	3.20	6.80	12
Herring, Atlantic	7.07	6.70	7.50	7
Herring, Blueback	8.99	4.00	15.30	73
Killifish, Striped	5.59	2.80	12.40	638
Lance, American Sand	10.48	9.40	12.70	14
Menhaden, Atlantic	6.27	4.50	7.80	9
Mummichog	5.88	3.70	9.10	368
Perch, White	14.73	12.30	19.40	3
Pipefish, Northern	17.26	9.40	24.00	27
Shad, American	13.33	13.00	13.60	3
Silverside, Atlantic	9.03	3.90	14.10	1,370
Smelt, Rainbow	7.11	5.10	13.20	55
Stickleback, Fourspine	4.19	3.40	5.10	28
Stickleback, Ninespine	4.62	3.80	5.60	6
Tomcod, Atlantic	7.51	5.70	13.40	59
			Total	3,147

Table 3.3-7. Mean minimum, and maximum water surface temperature and salinity, from a juvenile finfish seine survey conducted in New Hampshire estuaries, 1997 – 2016.

	Temperature (°C)			Salinity (ppt)		
Year	Mean	Min	Max	Mean	Min	Max
1997	16.5	3.0	25.0	26.8	4.0	31.0
1998	15.9	6.0	26.0	23.4	0.0	35.0
1999	17.4	4.0	28.0	*	*	*
2000	17.5	10.0	25.0	28.4	9.0	34.0
2001	15.6	6.0	26.0	28.6	9.0	33.0
2002	16.2	4.0	26.0	25.8	2.0	32.0
2003	16.7	4.0	28.0	25.8	4.0	31.0
2004	16.4	4.0	26.0	25.2	3.0	31.0
2005	16.9	1.0	29.0	24.2	0.0	31.0
2006	17.4	6.0	31.0	23.0	0.0	30.0
2007	16.5	7.4	28.0	25.6	0.1	31.8
2008	17.0	6.3	27.1	23.5	1.7	31.8
2009	15.9	6.9	23.8	24.1	2.3	31.5
2010	17.1	7.5	26.7	27.1	9.7	31.2
2011	17.2	5.7	28.2	23.7	1.6	30.2
2012	17.0	6.2	28.2	26.2	4.7	31.1
2013	16.2	3.5	27.9	25.1	2.3	32.1
2014	16.8	7.2	28.1	26.9	6.2	34.4
2015	16.8	10.8	26.2	27.8	9.2	31.9
2016	17.4	8.6	30.6	29.2	11.7	32.3
Mean	16.7			25.8		

* No data for 1999 due to instrument failure

Table 3.3-8. Water surface temperature (^{o}C) by month and station, from a juvenile finfish seine survey conducted in New Hampshire estuaries, 2016.

	Station #															
	Little Harbor			Hampton/Seabrook Estuary				Piscataqua River			Little Bay/Great Bay					Monthly
Month	5	7	9	23	25	29	33	30	35	39	54	72	93	107	147	mean
June	13.9	14.3	15.2	16.6	14.0	16.4	18.1	14.1	15.0	17.9	17.8	18.4	20.5	20.9	19.6	16.8
July	19.9	19.9	20.7	12.5	20.1	21.3	22.2	20.1	19.3	24.2	30.6	19.4	22.0	25.2	25.0	21.5
August	18.6	19.0	19.6	18.2	18.0	18.7	19.6	18.3	19.1	24.9	22.4	22.2	25.4	26.6	24.3	21.0
September	19.5	19.3	19.7	20.7	19.5	20.5	20.8	19.8	19.1	21.5	20.7	21.5	23.3	21.2	23.5	20.7
October	16.2	15.5	15.8	10.7	10.7	10.2	9.8	15.6	15.3	15.5	15.5	15.6	15.8	15.8	15.5	14.2
November	11.1	10.4	10.3	10.7	10.5	9.9	9.8	10.9	10.0	8.6	10.6	10.5	9.4	9.3	9.6	10.1
Site mean	16.5	16.4	16.9	14.9	15.5	16.2	16.7	16.5	16.3	18.8	19.6	17.9	19.4	19.8	19.6	
Area mean	16.6			15.8				17.2			19.3					

Table 3.3-9. Salinity (ppt) by month and station, from a juvenile finfish seine survey conducted in New Hampshire estuaries, 2016.

	Station #															
	Little Harbor			Hampton/Seabrook Estuary				Piscataqua River			Little Bay/Great Bay					Monthly
Month	5	7	9	23	25	29	33	30	35	39	54	72	93	107	147	mean
June	31.1	28.5	30.6	30.6	31.3	31.1	31.2	29.2	28.9	17.2	28.3	28.3	26.9	13.9	27.6	27.6
July	31.2	31.0	30.8	30.6	30.8	31.2	31.2	29.2	30.7	20.2	20.8	29.8	29.9	22.2	29.5	28.6
August	31.2	21.7	31.8	31.3	31.4	31.7	31.9	31.0	30.8	25.5	30.7	30.1	31.0	28.2	31.0	30.0
September	31.4	31.4	31.6	31.4	31.5	31.5	31.6	30.6	30.8	27.2	31.2	31.2	30.5	28.6	31.0	30.8
October	32.1	31.4	30.2	31.2	31.7	31.5	31.0	32.1	32.1	24.4	31.3	31.1	27.5	28.7	30.6	30.5
November	31.9	31.2	31.0	32.3	31.9	32.0	32.0	29.5	28.0	11.7	27.5	27.5	25.0	17.5	25.9	27.7
Site mean	31.5	29.2	31.0	31.2	31.4	31.5	31.5	30.3	30.2	21.0	28.3	29.7	28.5	23.2	29.3	
Area mean	30.6			31.4				27.2			27.8					

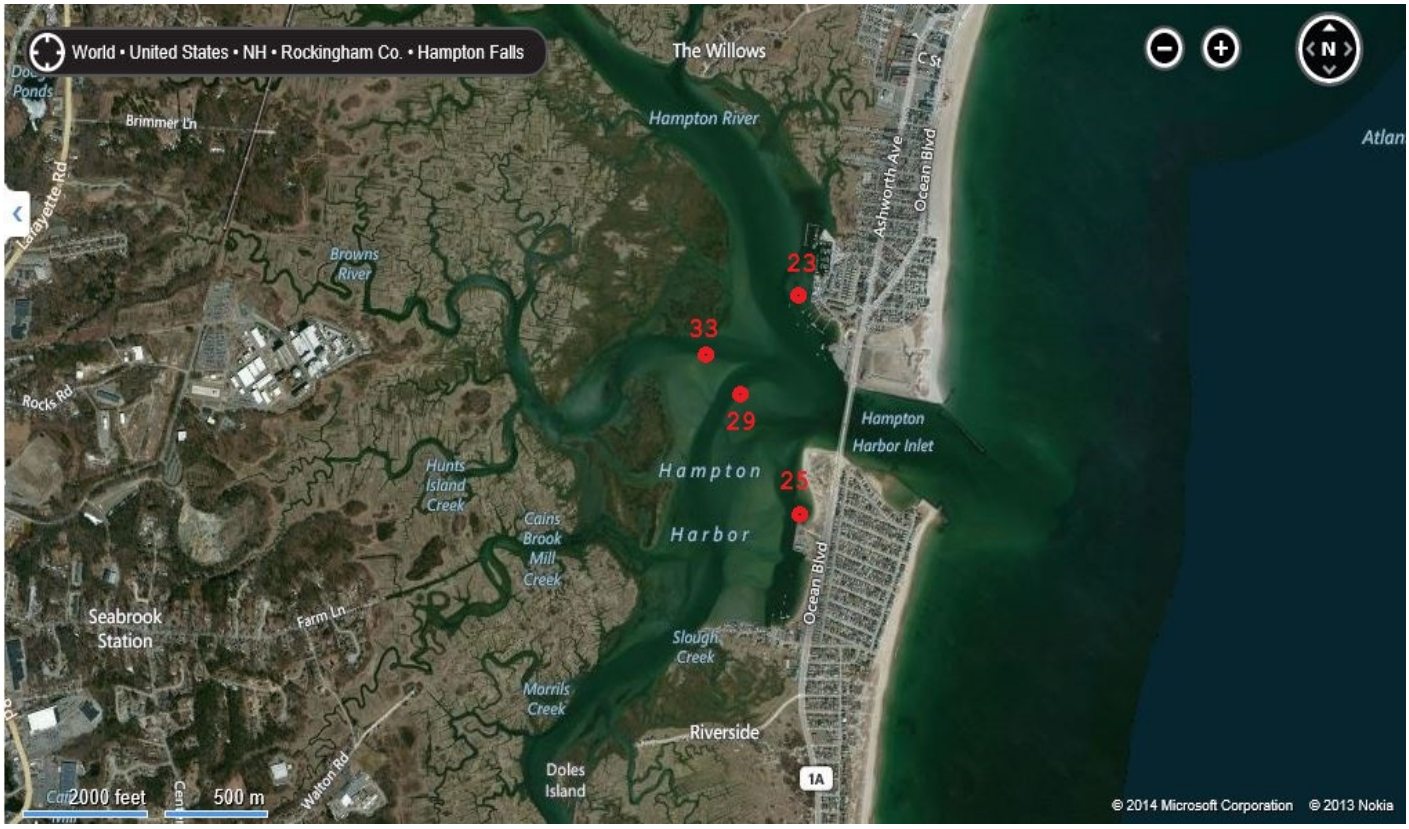

Figure 3.3-1. Sampling stations in Hampton/Seabrook Estuary, from a juvenile finfish seine survey conducted in New Hampshire estuaries, 2016.

Figure 3.3-2. Sampling stations in Little Harbor, from a juvenile finfish seine survey conducted in New Hampshire estuaries, 2016.

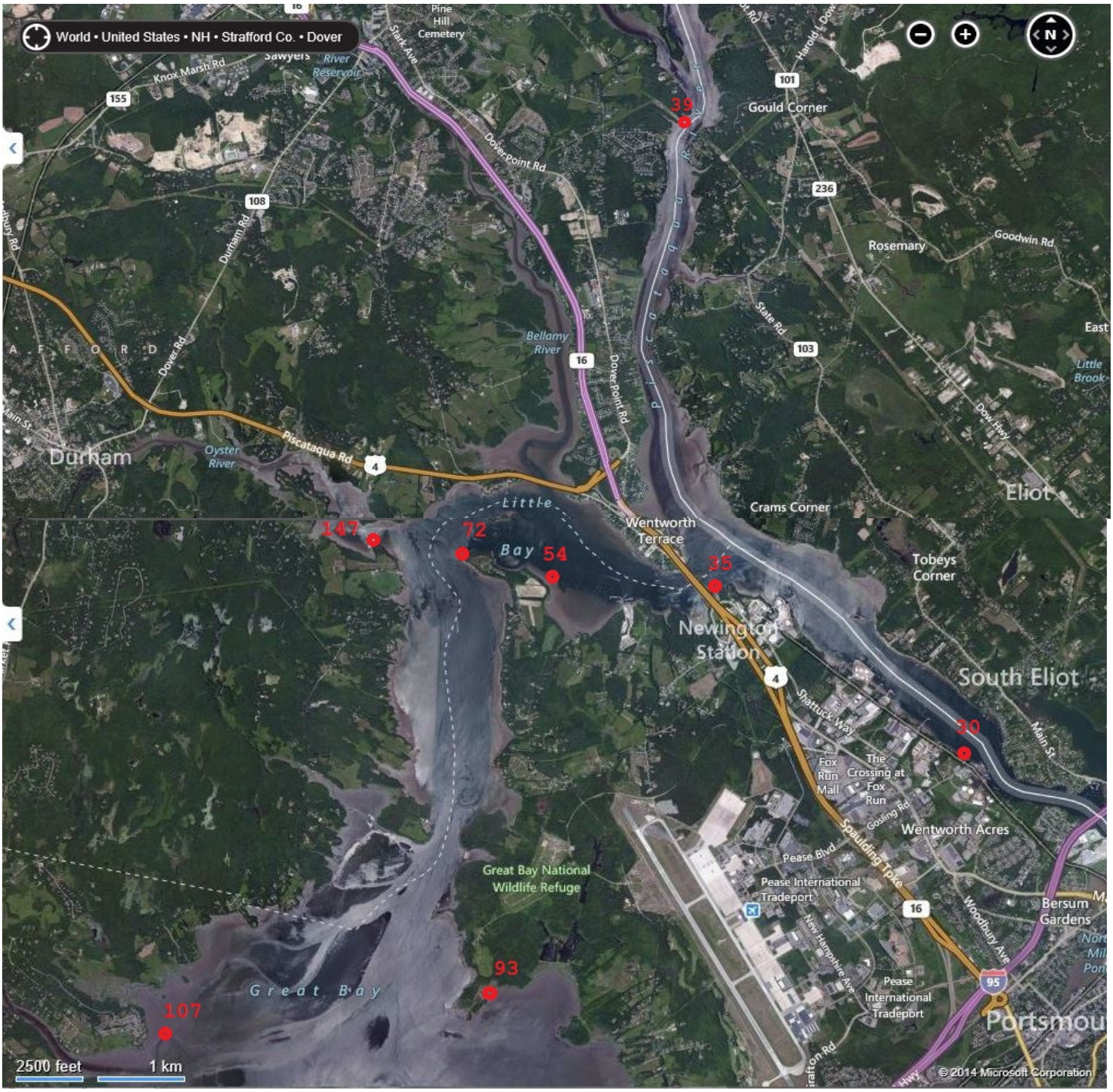

Figure 3.3-3. Sampling stations in the Piscataqua River and Little Bay/Great Bay area from a juvenile finfish seine survey conducted in New Hampshire estuaries, 2016.

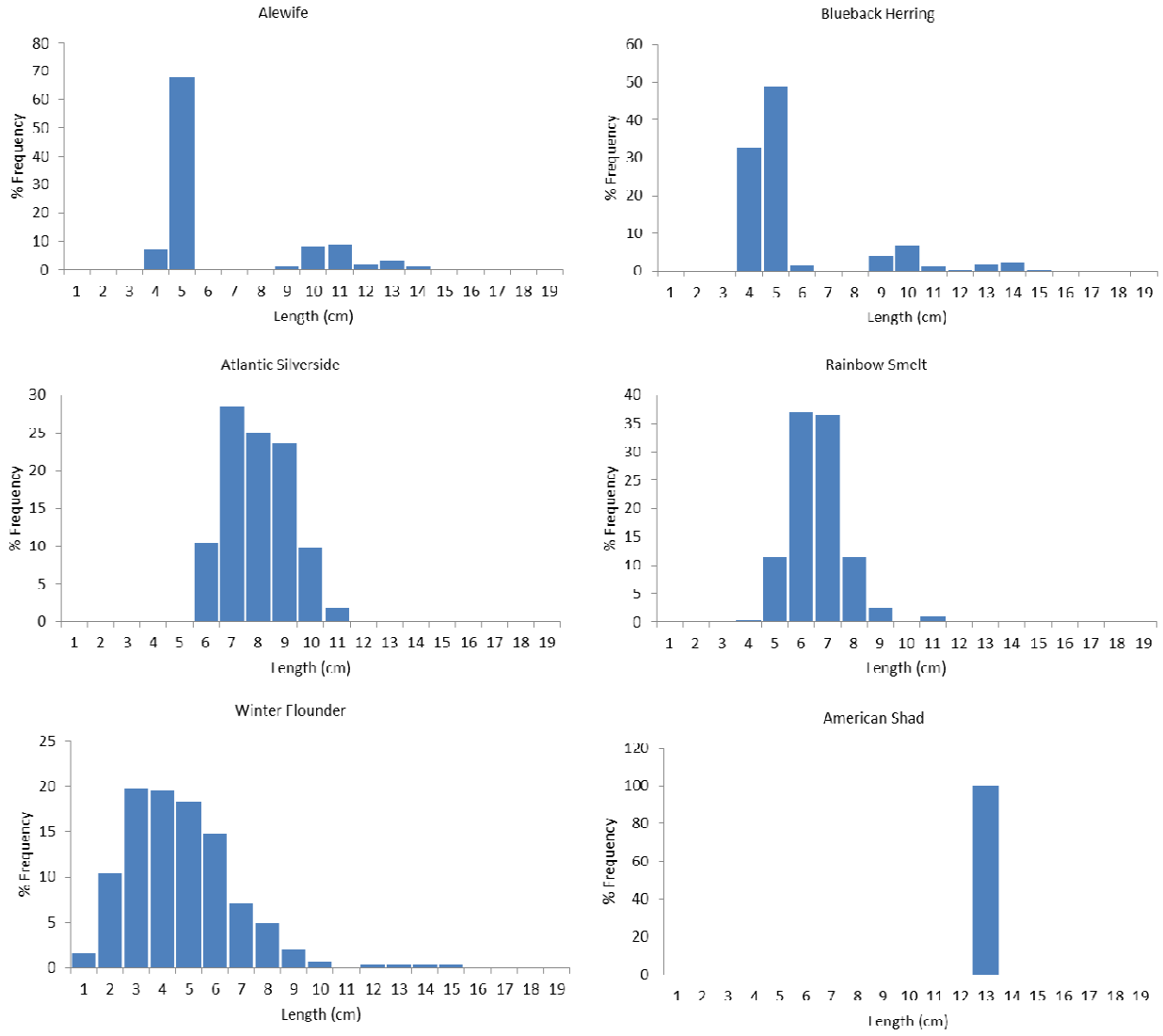

Figure 3.3-4. Weighted length frequencies of five finfish species of special interest captured from a juvenile finfish seine survey conducted in New Hampshire estuaries, 2016.