ASSESSMENT OF RECREATIONALLY IMPORTANT FINFISH STOCKS IN RHODE ISLAND WATERS

COASTAL FISHERY RESOURCE ASSESSMENT
TRAWL SURVEY
2011

PERFORMANCE REPORT
F-61-R SEGMENT __
JOBS 1 AND 2

Scott D. Olszewski
Principle Marine Fisheries Biologist

Rhode Island Department of Environmental Management
Division of Fish and Wildlife
Marine Fisheries

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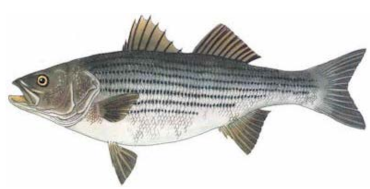

Annual Performance Report

STATE: Rhode Island PROJECT NUMBER: F-61-R
SEGMENT NUMBER: 19

PROJECT TITLE: Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters

JOB NUMBER: 1
TITLE: Narragansett Bay Monthly Fishery Resource Assessment

JOB OBJECTIVE: To collect, summarize and analyze bottom trawl data for biological and fisheries management purposes.

PERIOD COVERED: January 1, 2011 – December 31, 2011.

PROJECT SUMMARY: Job 1, summary accomplished:
A: 155, twenty minute bottom trawl were successfully completed.
B: Data on weight, length, sex and numbers were gathered on 82 species. Hydrographic data were gathered as well. Additionally, anecdotal notations were made on other plant and animal species. Although not previously discussed, these notations are in keeping with past practice.

TARGET DATE: December 2011

SCHEDULE OF PROGRESS: On schedule.

SIGNIFICANT DEVIATIONS: None

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JOB NUMBER: 2
TITLE: Seasonal Fishery Resource Assessment of Narragansett Bay, Rhode Island Sound and Block Island Sound

JOB OBJECTIVE: To collect, summarize and analyze bottom trawl data for biological and fisheries management purposes.

PERIOD COVERED: Spring(April – May)/ Fall (September – October) 2011

PROJECT SUMMARY: Job 2, summary accomplished:
A: 43, twenty minute tows were successfully completed during the Spring 2011 survey (26 NB. – 6 RIS – 11 BIS).
B: 43, twenty minute tow were successfully completed during the Fall 2011 survey (26 NB. – 6 RIS – 11 BIS)

TARGET DATE: DECEMBER 2011.

SCHEDULE OF PROGRESS: On schedule.

SIGNIFICANT DEVIATIONS: Addition of one fixed station in the vicinity of Block Island.

JOBS 1 & 2

RECOMMENDATIONS: Continuation of both the Monthly and Seasonal Trawl surveys into 2012, Data provided by these surveys is used extensively in the Atlantic States Marine Fisheries Commission Fishery Management process and Fishery Management Plans. Update survey trawl doors and complete calibration tows to measure possible effects of survey gear changes starting January 2012.

RESULTS AND DISCUSSION: 155 tows were completed during 2011 Job 1 (Monthly survey). 82 species accounted for a combined weight of 6,422.3 kgs. and 286,006length measurements being added to the existing Narragansett Bay monthly trawl data set
By contrast, 86 tows were completed during 2011 Job 2 (Seasonal survey) 68 species accounted for a combined weight of 4,608.1 kgs. and 259,756 length measurements added to the existing seasonal data set.

With the completion of the 2011 surveys, combined survey(s) Jobs (1&2) data now reflects the completion of 5,339 tows with data collected on 132 species.

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Coastal Fishery Resource Assessment – Trawl Survey

Introduction:

The Rhode Island Division of Fish and Wildlife - Marine Fisheries Section, began monitoring finfish populations in Narragansett Bay in 1968, continuing through 1977. These data provided monthly identification of finfish and crustacean assemblages. As management strategies changed and focus turned to the near inshore waters, outside of Narragansett Bay, a comprehensive fishery resource assessment program was instituted in 1979. (Lynch T. R. Coastal Fishery Resource Assessment, 2007)

Since the inception of the Rhode Island Seasonal Trawl Survey (April 1979) and the Narragansett Bay Monthly Trawl Survey (January 1990), 5,339 tows have been conducted within Rhode Island territorial waters with data collected on 132 species. This performance report reflects the efforts of the 2011 survey year as it relates to the past 30 years. (Lynch T. R. Coastal Fishery Resource Assessment, 2007)

Methods:
The methodology used in the allocation of sampling stations employs both random and fixed station allocation. Fixed station allocation began in 1988 in Rhode Island Sound and Block Island Sound. This was based on the frequency of replicate stations selected by depth stratum since 1979. With the addition of the Narragansett Bay monthly portion of the survey in 1990, an allocation system of fixed and randomly selected stations has been employed depending on the segment (Monthly vs. Seasonal) of the annual surveys.

Sampling stations were established by dividing Narragansett Bay into a grid of cells. The seasonal trawl survey is conducted in the spring and fall of each year. Usually 43 stations are sampled each season; however this number has ranged from 26 to 72 over the survey time series due to mechanical and weather conditions. The stations sampled in Narragansett Bay are a combination of fixed and random sites. 13 fixed during the monthly portion and 26, (13 of which are randomly selected) during the seasonal portion. The random sites are randomly selected from a predefined grid. All stations sampled in Rhode Island and Block Island Sounds are fixed.

Depth Stratum Identification

Area	**Stratum**	**Area nm2**	**Depth Range (m)**
Narragansett Bay	1	15.50	<=6.09
	2	51.00	>=6.09
Rhode Island Sound	3	0.25	<=9.14
	4	2.25	9.14 – 18.28
	5	13.5	18.28 – 27.43
	6	9.75	>=27.43
Block Island Sound	7	3.50	<=9.14
	8	10.50	9.14 – 18.28
	9	11.50	18.28 – 27.43
	10	12.25	27.43 – 36.57
	11	4.00	>=36.57

At each station, an otter trawl equipped with a ¼ mesh inch liner is towed for twenty minutes. The Coastal Trawl survey net is 210 x 4.5”, 2 seam (40’ / 55’), the mesh size is 4.5” and the sweep is 5/16” chain, hung 12” spacing, 13 links per space. Figure 1 depicts the RI Coastal Trawl survey net plan.
The research vessel used in the Coastal Trawl Survey is the R/V John H. Chafee. Built in 2002, the Research Vessel is a 50’ Wesmac hull, powered by a 3406 Caterpillar engine generating 700 hp.

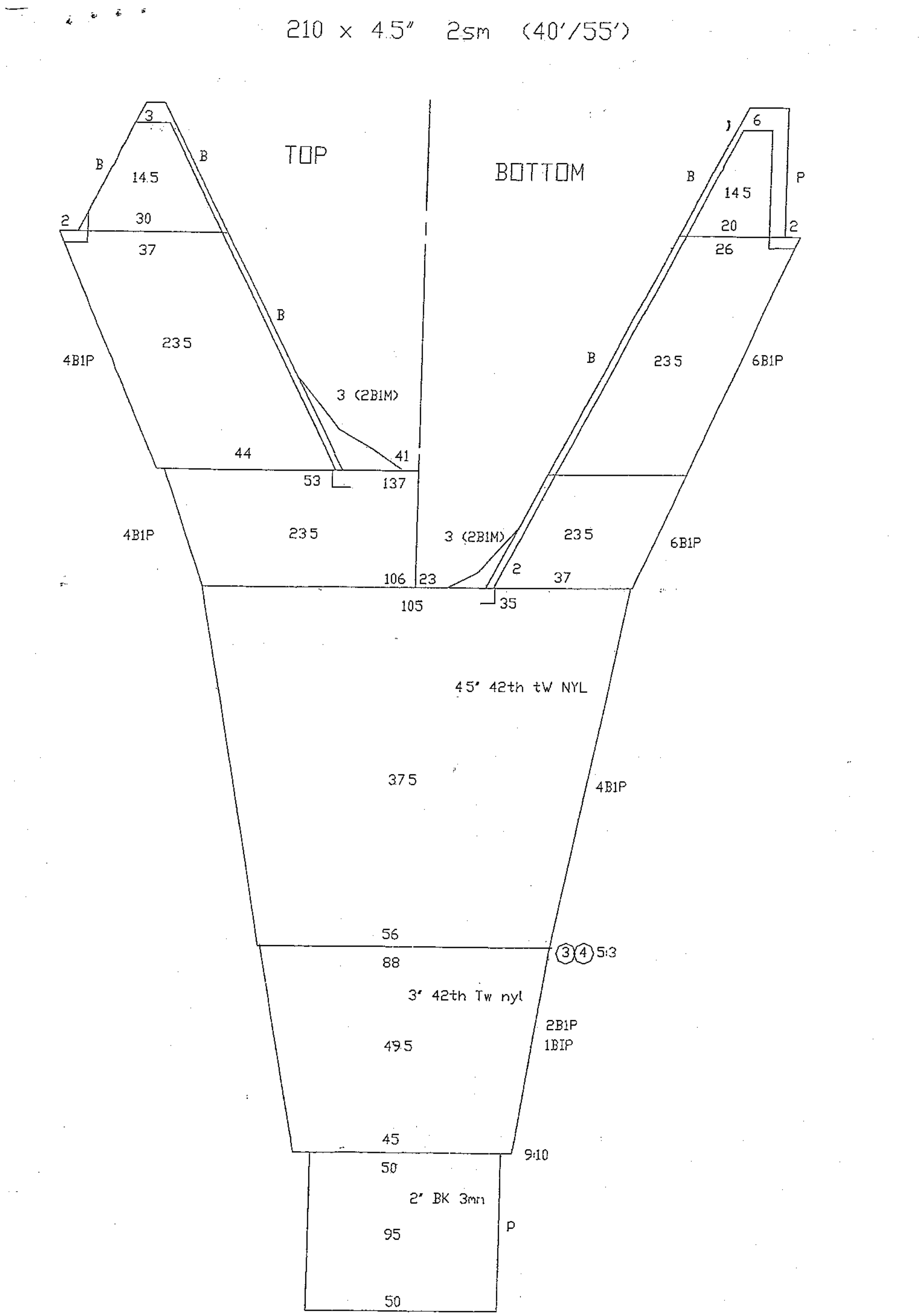
Data on wind direction and speed, sea condition, air temperature and cloud cover as well as surface and bottom water temperatures, are recorded at each station. Catch is sorted by species. Length (cm/mm) is recorded for all finfish, skates, squid, scallops, Whelk lobster, blue crabs and horseshoe crabs. Similarly, weights (gm/kg) and number are recorded as well. Anecdotal information is also recorded for incidental plant and animal species.

Survey changes- Beginning January 2012 the Rhode Island Coastal Trawl Survey began using an updated set of trawl doors. Throughout 2012, a comparative gear calibration study will be ongoing to determine if a significant change to the survey catch data is exists.

RI Department of Environmental Management
Marine Fisheries Section Research Vessel,
R/V John H. Chafee

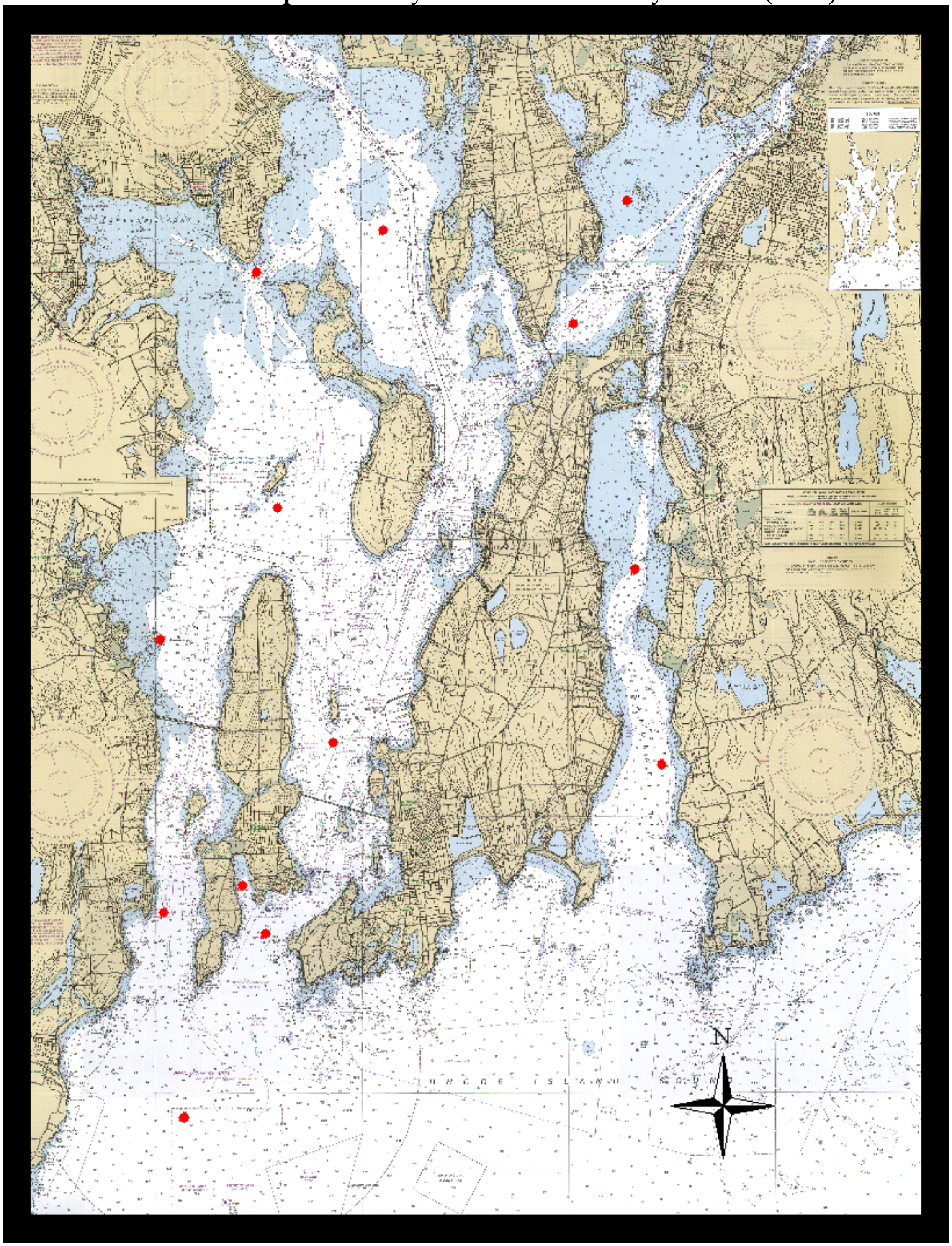
Acknowledgements:
Special thanks are again extended to Captain Richard Mello, Assistant Captain, Ken Benson (Ret.), Marine Fisheries Specialist Daniel Costa, Eric Schneider, Principal Biologist, (Ret.) Timothy R. Lynch Principal Biologist and the entire seasonal staff and volunteers. The support given over the years has been greatly appreciated.

Figure 1



210 x 4.5" 2sm (40'/55')
TOP
BOTTOM
3
B
B
14.5
2
30
37
B
235
4B1P
3 (2B1M)
44
41
53
137
4B1P
235
106
23
6
B
P
145
20
2
26
B
235
6B1P
3 (2B1M)
235
6B1P
2
37
105
35
45' 42th tW NYL
375
4B1P
56
88
3' 42th Tw nyl
2B1P
1B1P
495
45
9:10
50
2' BK 3mm
95
P
50

Map 1 Monthly Coastal Trawl Survey Stations (fixed)



Results: Job 1. Monthly Coastal Trawl Survey; 12 fixed stations in Narragansett Bay and 1 in Rhode Island Sound.

A total of 81 species were observed and recorded during the 2011 Narragansett Bay Monthly Trawl Survey totaling 286,006 individuals or 1845.2 fish per tow. In weight, the catch accounted for 6422.3 kg. or 41.4 kg. per tow. (Figures 2 and 3) The top ten species by number and catch are represented in figures 4 and 5. The change between demersal and pelagic species is represented in figures 6 and 7.

Figure 2 (Total Catch in Number)

Fish Name	Scientific Name	Total Number
Bay Anchovy	ANCHOA MITCHILLI	72356
Atlantic Herring	CLUPEA HARENGUS	67107
Longfin Squid	LOLIGO PEALEI	47886
Butterfish	PEPRILUS TRIACANTHUS	43689
Scup	STENOTOMUS CHRYSOPS	34104
Alewife	ALOSA PSEUDOHARENGUS	7873
Atlantic Silverside	MENIDIA MENIDIA	2056
Little Skate	RAJA ERINACEA	1524
Weakfish	CYNOSCION REGALIS	1504
Atlantic Moonfish	SELENE SETAPINNIS	1241
Silver Hake	MERLUCCIUS BILINEARIS	914
American Lobster	HOMARUS AMERICANUS	621
Winter Flounder	PLEURONECTES AMERICANUS	576
Summer Flounder	PARALICHTHYS DENTATUS	569
Fourspot Flounder	PARALICHTHYS OBLONGUS	460
Striped Anchovy	ANCHOA HEPSETUS	447
Spotted Hake	UROPHYCIS REGIA	353
Blue Crab	CALLINECTES SAPIDUS	246
Red Hake	UROPHYCIS CHUSS	231
Blueback Herring	ALOSA AESTIVALIS	204
Winter Skate	RAJA OCELLATA	196
Black Sea Bass	CENTROPRISTIS STRIATA	190
Striped Searobin	PRIONOTUS EVOLANS	150
Windowpane Flounder	SCOPHTHALMUS AQUOSUS	143
American Shad	ALOSA SAPIDISSIMA	142
Atlantic Cod	GADUS MORHUA	130
Channeled Whelk	BUSYCOTYPUS CANALICULATUS	93
Spiny Dogfish	SQUALUS ACANTHIAS	83
Tautog	TAUTOGA ONITIS	82
Northern Kingfish	MENTICIRRHUS SAXATILIS	80
Pollock	POLLACHIUS VIRENS	63
Rough Scad	TRACHURUS LATHAMI	58
Atlantic Menhaden	BREVOORTIA TYRANNUS	55
Smallmouth Flounder	ETROPUS MICROSTOMUS	50
Horseshoe Crab	LIMULUS POLYPHEMUS	50
Grubby	MYOXOCEPHALUS AENAEUS	49
Knobbed Whelk	BUSYCON CARICA	47
Northern Pipefish	SYNGNATHUS FUSCUS	43

Smooth Dogfish	MUSTELUS CANIS	38
Mantis Shrimp	SQUILLA EMPUSA	36
Bluefish	POMATOMUS SALTATRIX	32
Longhorn Sculpin	MYOXOCEPHALUS OCTODECEMSPINOS	29
Northern Searobin	PRIONOTUS CAROLINUS	22
Round Herring	ETRUMEUS TERES	20
Rainbow Smelt	OSMERUS MORDAX	15
Atlantic Mackerel	SCOMBER SCOMBRUS	15
Gobies	GOBIIDAE	14
Crevalle Jack	CARANX HIPPOS	11
Cunner	TAUTOGOLABRUS ADSPERSUS	10
Atlantic Tomcod	MICROGADUS TOMCOD	9
Atlantic Torpedo Ray	TORPEDO NOBILIANA	8
Clearnose Skate	RAJA EGLANTERIA	8
Hogchoker	TRINECTES MACULATUS	8
Rock Gunnel	PHOLIS GUNNELLUS	7
Silver Perch	BAIRDIELLA CHRYSOURA	7
Ocean Pout	MACROZOARCES AMERICANUS	5
Bigeye	PRIACANTHUS ARENATUS	4
Northern Puffer	SPHOEROIDES MACULATUS	4
Sea Raven	HEMITRIPTERUS AMERICANUS	4
Oyster Toadfish	OPSANUS TAU	3
Inshore Lizardfish	SYNODUS FOETENS	3
Hickory Shad	ALOSA MEDIOCRIS	3
Threespine Stickleback	GASTEROSTEUS ACULEATUS	3
Shortfin Squid	ILLEX ILLECEBROSUS	2
Fourbeard Rockling	ENCHELYOPUS CIMBRIUS	2
Striped Bass	MORONE SAXATILIS	2
Fawn Cusk-eel	LEPOPHIDIUM PROFUNDORUM	2
Lumpfish	CYCLOPTERUS LUMPUS	2
Striped Seasnail	LIPARIS LIPARIS	1
Bluntnose Stingray	DASYATIS SAY	1
Atlantic Seasnail	LIPARIS ATLANTICUS	1
Gulfstream Flounder	CITHARICHTHYS ARCTIFRONS	1
American Sand Lance	AMMODYTES AMERICANUS	1
Haddock	MELANOGRAMMUS AEGLEFINUS	1
Daubed Shanny	LUMPENUS MACULATUS	1
Conger Eel	CONGER OCEANICUS	1
Bay Scallop	ARRGOPECTIN IRRADANS	1
Sea Scallop	PLACOPECTEN MAGELLANICUS	1
American Eel	ANGUILLA ROSTRATA	1
Round Scad	DECAPTERUS PUNCTATUS	1
Planehead Filefish	MONACANTHUS HISPIDUS	1

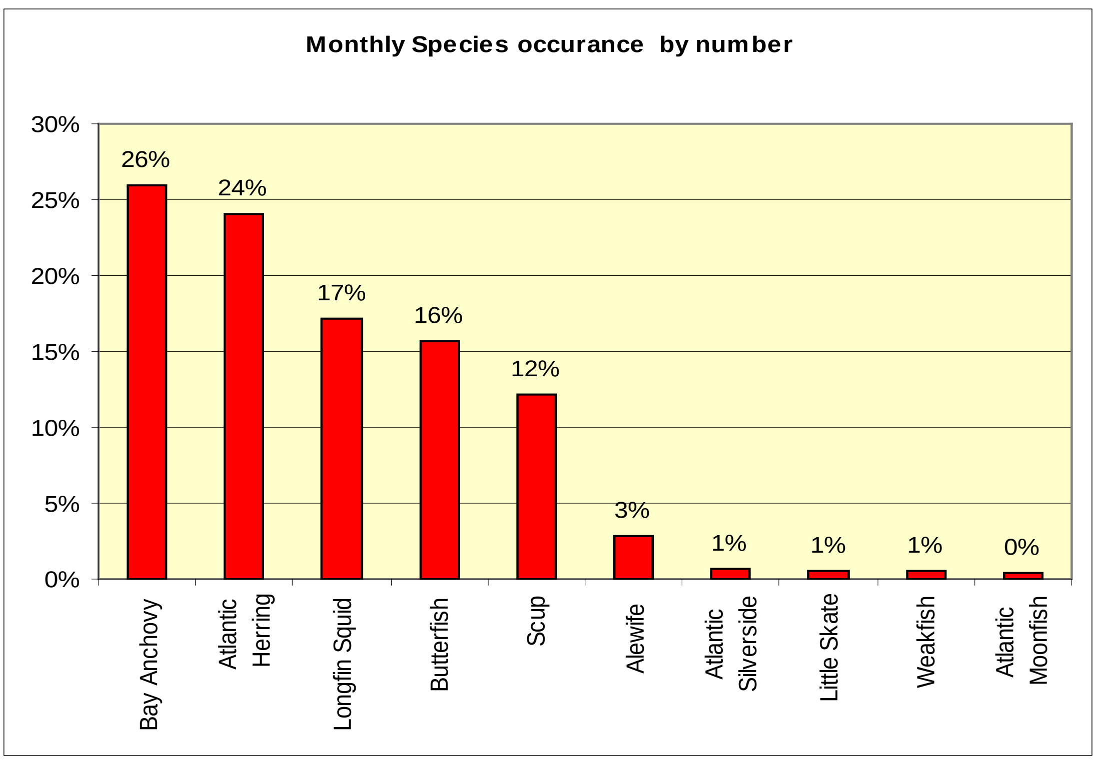
Figure 3 (Total Catch in Kilograms)

Fish Name	Scientific Name	SumOfnTotWeight
Scup	STENOTOMUS CHRYSOPS	1358.106999
Butterfish	PEPRILUS TRIACANTHUS	1045.279496
Little Skate	RAJA ERINACEA	897.0179942
Longfin Squid	LOLIGO PEALEI	464.2480009
Summer Flounder	PARALICHTHYS DENTATUS	390.0099997
Atlantic Herring	CLUPEA HARENGUS	316.3090031
American Lobster	HOMARUS AMERICANUS	218.2549963
Spiny Dogfish	SQUALUS ACANTHIAS	211.2850015
Alewife	ALOSA PSEUDOHARENGUS	181.4970001
Winter Skate	RAJA OCELLATA	167.6949977
Winter Flounder	PLEURONECTES AMERICANUS	147.1200009
Atlantic Torpedo Ray	TORPEDO NOBILIANA	117.9800005
Bay Anchovy	ANCHOA MITCHILLI	112.2430006
Tautog	TAUTOGA ONITIS	104.5599995
Horseshoe Crab	LIMULUS POLYPHEMUS	103.0849996
Fourspot Flounder	PARALICHTHYS OBLONGUS	88.44499885
Black Sea Bass	CENTROPRISTIS STRIATA	67.90399967
Silver Hake	MERLUCCIUS BILINEARIS	53.87000023
Striped Searobin	PRIONOTUS EVOLANS	48.31000008
Blue Crab	CALLINECTES SAPIDUS	46.8999998
Smooth Dogfish	MUSTELUS CANIS	38.97999969
Spotted Hake	UROPHYCIS REGIA	36.65549998
Weakfish	CYNOSCION REGALIS	32.31600015
Windowpane Flounder	SCOPHTHALMUS AQUOSUS	26.11000004
Red Hake	UROPHYCIS CHUSS	19.68000022
Bluefish	POMATOMUS SALTATRIX	18.09500016
Channeled Whelk	BUSYCOTYPUS CANALICULATUS	14.76499983
Clearnose Skate	RAJA EGLANTERIA	11.25
Knobbed Whelk	BUSYCON CARICA	8.789999887
Atlantic Moonfish	SELENE SETAPINNIS	8.729999743
Longhorn Sculpin	MYOXOCEPHALUS OCTODECEMSPINOS	7.694999918
Atlantic Silverside	MENIDIA MENIDIA	7.386000039
Northern Kingfish	MENTICIRRHUS SAXATILIS	6.67500003
American Shad	ALOSA SAPIDISSIMA	4.81499996
Striped Bass	MORONE SAXATILIS	4.579999894
Atlantic Menhaden	BREVOORTIA TYRANNUS	4.528999893
Atlantic Cod	GADUS MORHUA	4.181249933
Ocean Pout	MACROZOARCES AMERICANUS	3.25499995
Cunner	TAUTOGOLABRUS ADSPERSUS	2.581999972
Sea Raven	HEMITRIPTERUS AMERICANUS	2.390000015
Northern Searobin	PRIONOTUS CAROLINUS	2.306999994
Blueback Herring	ALOSA AESTIVALIS	2.294999974
Rough Scad	TRACHURUS LATHAMI	1.950000013
Atlantic Mackerel	SCOMBER SCOMBRUS	1.834999993
Mantis Shrimp	SQUILLA EMPUSA	1.200000006

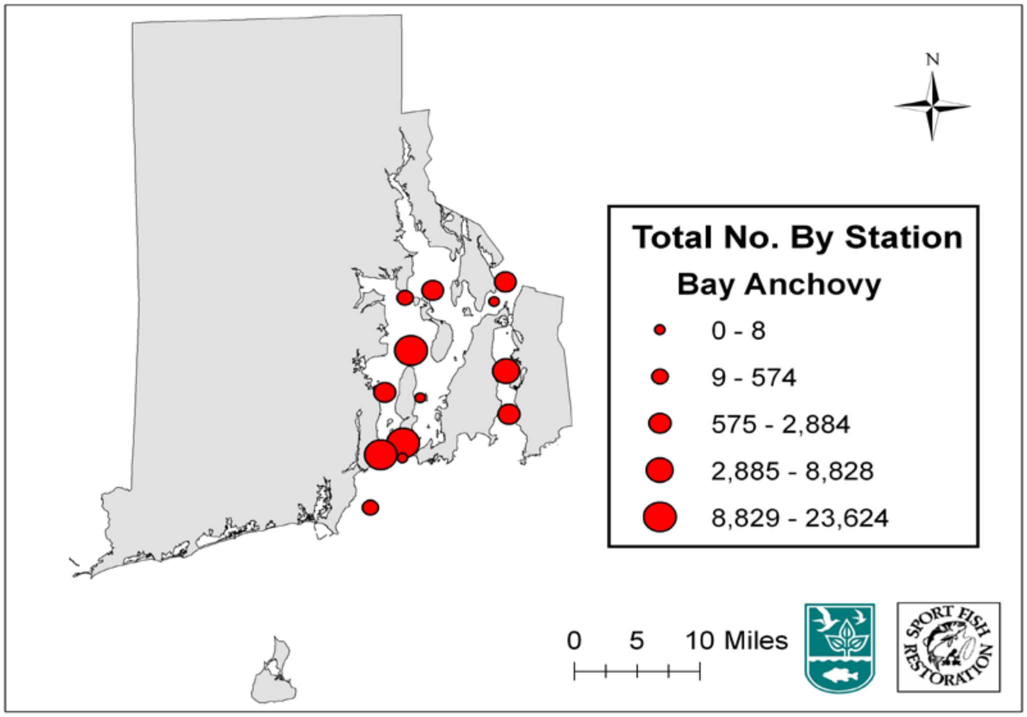
Hickory Shad	ALOSA MEDIOCRIS	0.990000017
Crevalle Jack	CARANX HIPPOS	0.970000006
Conger Eel	CONGER OCEANICUS	0.870000005
Striped Anchovy	ANCHOA HEPSETUS	0.679999989
Inshore Lizardfish	SYNODUS FOETENS	0.579999983
Hogchoker	TRINECTES MACULATUS	0.574999996
Bluntnose Stingray	DASYATIS SAY	0.574999988
American Eel	ANGUILLA ROSTRATA	0.514999986
Rainbow Smelt	OSMERUS MORDAX	0.484999996
Oyster Toadfish	OPSANUS TAU	0.474999988
Smallmouth Flounder	ETROPUS MICROSTOMUS	0.409999994
Grubby	MYOXOCEPHALUS AENAEUS	0.388000002
Round Herring	ETRUMEUS TERES	0.335000001
Silver Perch	BAIRDIELLA CHRYSOURA	0.309999995
Bigeye	PRIACANTHUS ARENATUS	0.154999997
Atlantic Tomcod	MICROGADUS TOMCOD	0.142000003
Lumpfish	CYCLOPTERUS LUMPUS	0.090000004
Fourbeard Rockling	ENCHELYOPUS CIMBRIUS	0.075000001
Northern Pipefish	SYNGNATHUS FUSCUS	0.068
Rock Gunnel	PHOLIS GUNNELLUS	0.064999999
Northern Puffer	SPHOEROIDES MACULATUS	0.059999999
Pollock	POLLACHIUS VIRENS	0.058999999
Fawn Cusk-eel	LEPOPHIDIUM PROFUNDORUM	0.055
Haddock	MELANOGRAMMUS AEGLEFINUS	0.050000001
Planehead Filefish	MONACANTHUS HISPIDUS	0.035
Shortfin Squid	ILLEX ILLECEBROSUS	0.02
Bay Scallop	ARRGOPECTIN IRRADANS	0.015
Sea Scallop	PLACOPECTEN MAGELLANICUS	0.015
Gobies	GOBIIDAE	0.0105
Gulfstream Flounder	CITHARICHTHYS ARCTIFRONS	0.01
Round Scad	DECAPTERUS PUNCTATUS	0.01
American Sand Lance	AMMODYTES AMERICANUS	0.008
Striped Seasnail	LIPARIS LIPARIS	0.005
Threespine Stickleback	GASTEROSTEUS ACULEATUS	0.0035
Atlantic Seasnail	LIPARIS ATLANTICUS	0.003
Daubed Shanny	LUMPENUS MACULATUS	0.002

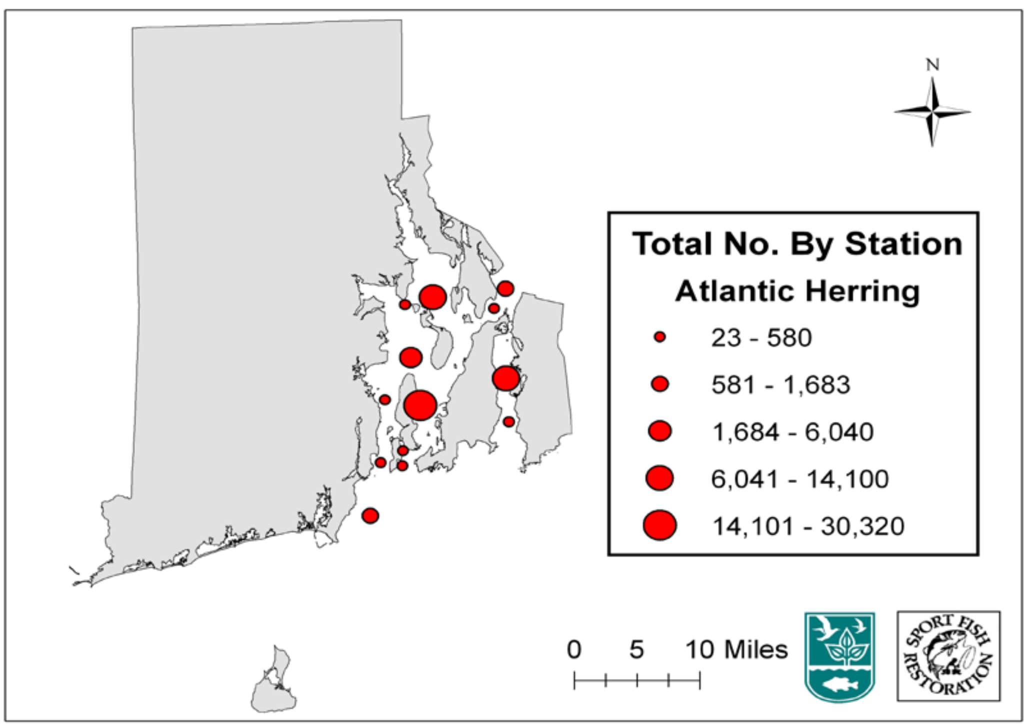
Figure 4 Monthly Survey Top Ten Species Catch in Number

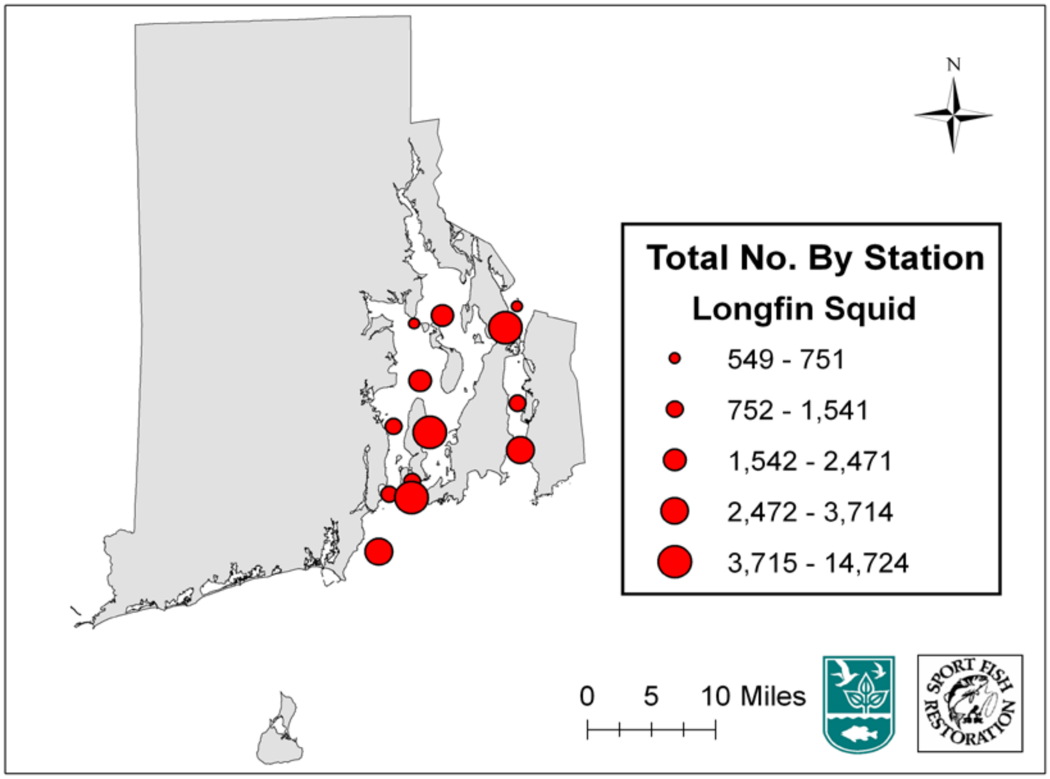
Fish Name	Scientific Name	%
Bay Anchovy	ANCHOA MITCHILLI	26%
Atlantic Herring	CLUPEA HARENGUS	24%
Longfin Squid	LOLIGO PEALEI	17%
Butterfish	PEPRILUS TRIACANTHUS	16%
Scup	STENOTOMUS CHRYSOPS	12%
Alewife	ALOSA PSEUDOHARENGUS	3%
Atlantic Silverside	MENIDIA MENIDIA	1%
Little Skate	RAJA ERINACEA	1%
Weakfish	CYNOSCION REGALIS	1%
Atlantic Moonfish	SELENE SETAPINNIS	0%



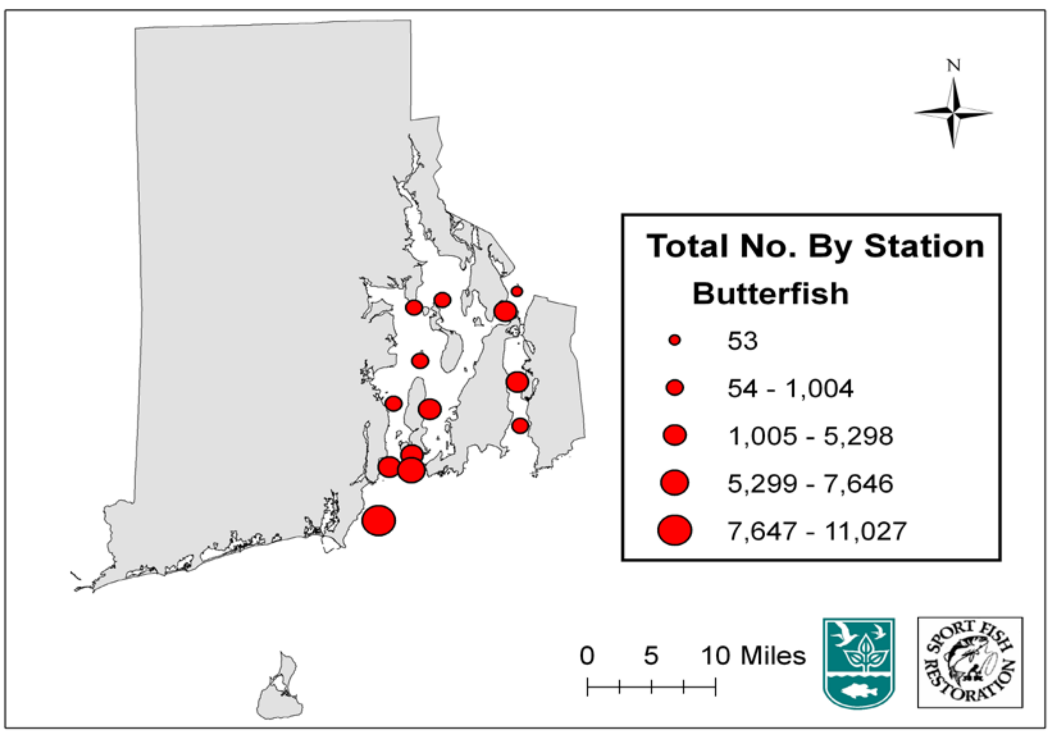
Maps 2 – 11 Top 10 species catch by station in the Narragansett Bay Monthly Coastal Trawl Survey



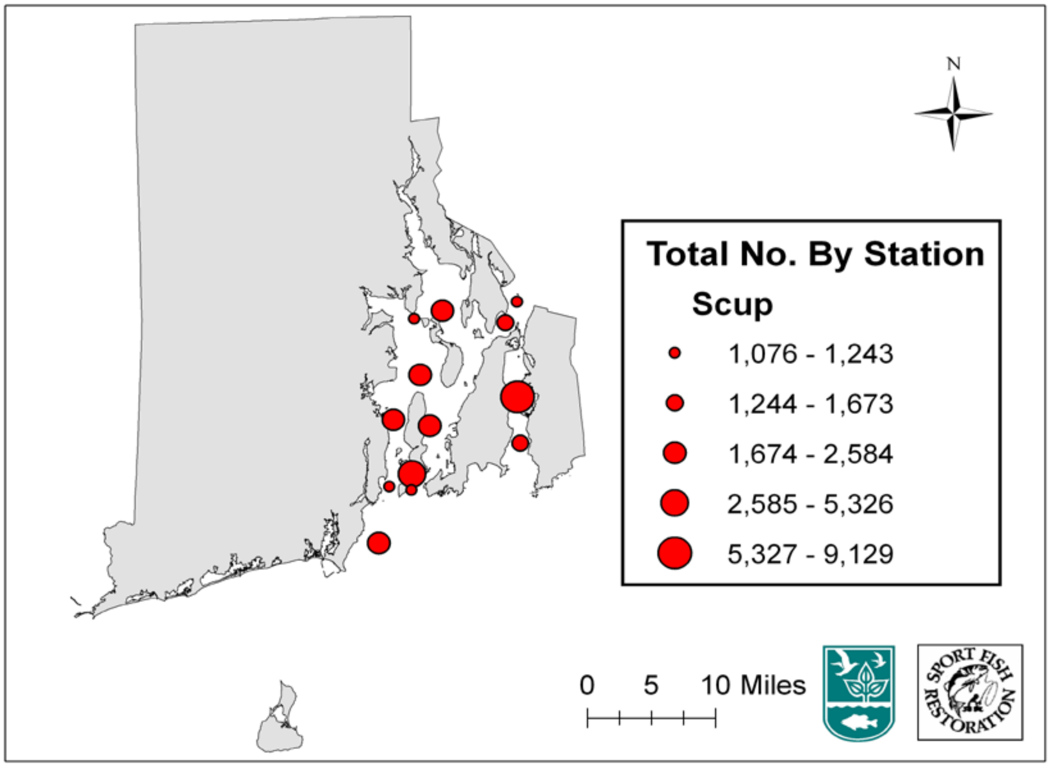


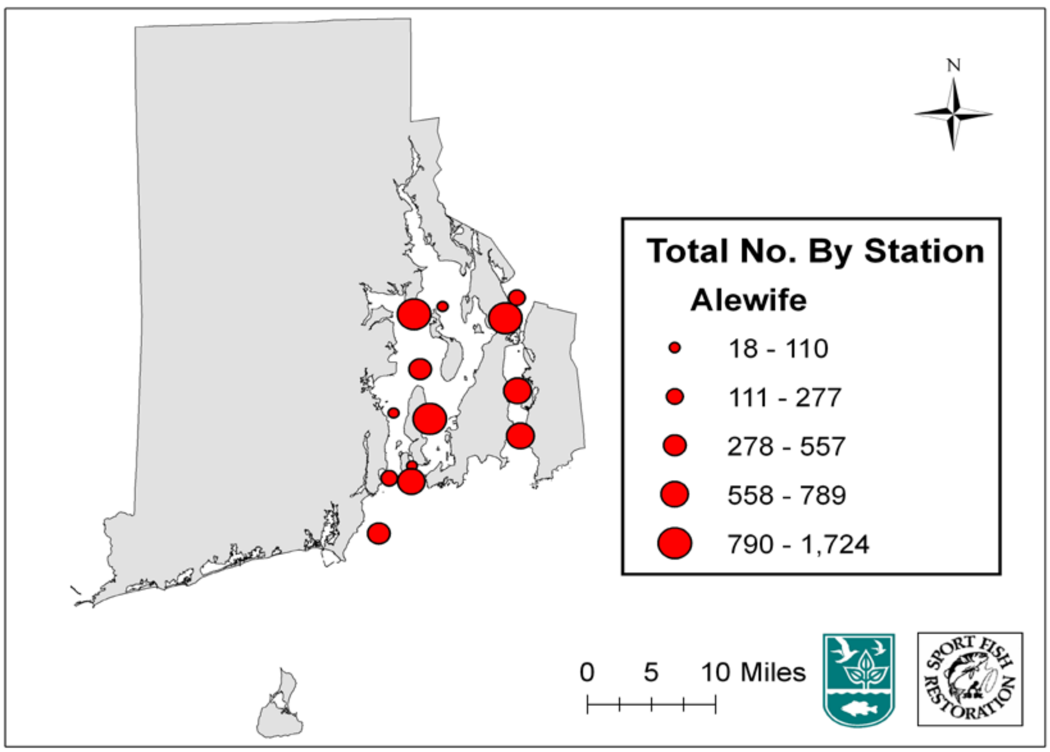


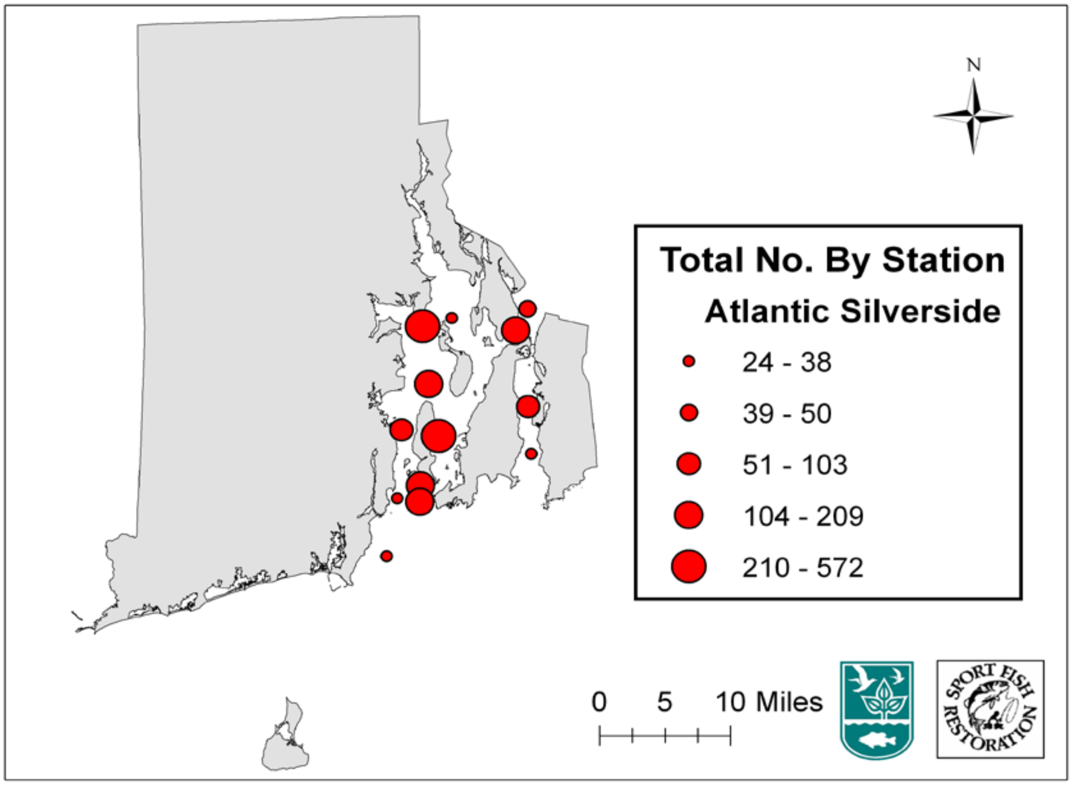
N
Total No. By Station
Longfin Squid
549 - 751
752 - 1,541
1,542 - 2,471
2,472 - 3,714
3,715 - 14,724
0 5 10 Miles

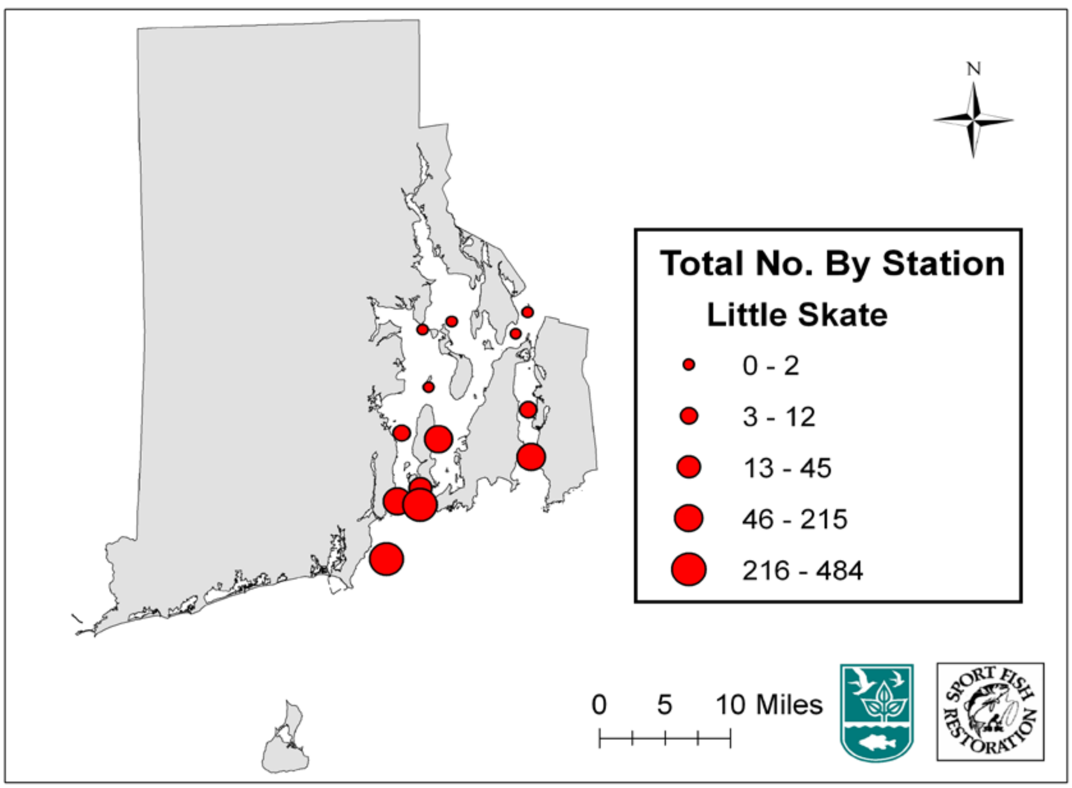


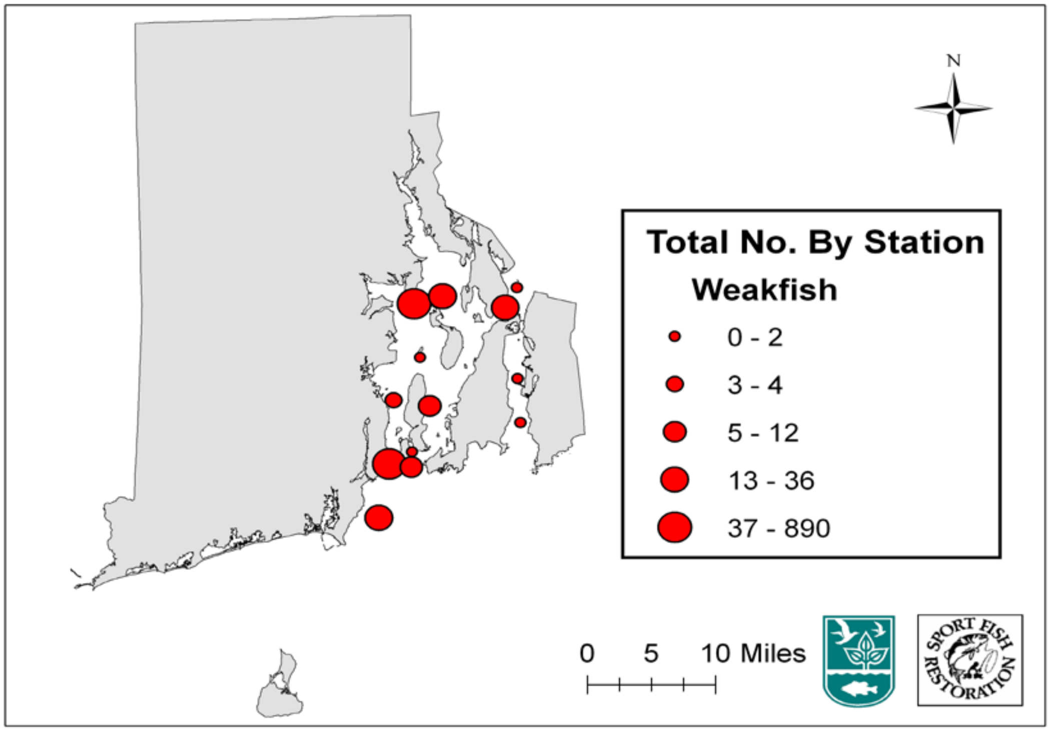
N
Total No. By Station
Butterfish
53
54 - 1,004
1,005 - 5,298
5,299 - 7,646
7,647 - 11,027
0 5 10 Miles

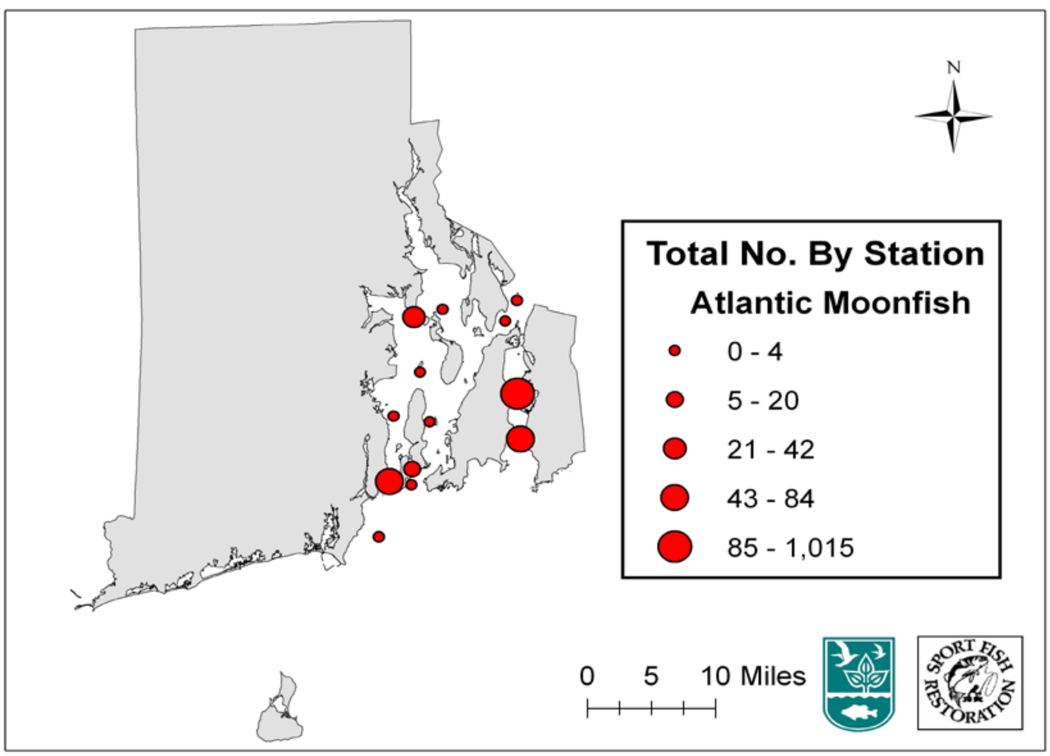

N
Total No. By Station
Scup
1,076 - 1,243
1,244 - 1,673
1,674 - 2,584
2,585 - 5,326
5,327 - 9,129
0 5 10 Miles
SPORT FISH RESTORATION


N
Total No. By Station
Alewife
18 - 110
111 - 277
278 - 557
558 - 789
790 - 1,724
0 5 10 Miles
SPORT FISH RESTORATION


N
Total No. By Station
Atlantic Silverside
24 - 38
39 - 50
51 - 103
104 - 209
210 - 572
0 5 10 Miles
SPORT FISH RESTORATION


N
Total No. By Station
Little Skate
0 - 2
3 - 12
13 - 45
46 - 215
216 - 484
0 5 10 Miles
SPORT FISH RESTORATION


Total No. By Station
Weakfish
0 - 2
3 - 4
5 - 12
13 - 36
37 - 890
N
0 5 10 Miles
SPORT FISH RESTORATION


Total No. By Station
Atlantic Moonfish
0 - 4
5 - 20
21 - 42
43 - 84
85 - 1,015
N
0 5 10 Miles
SPORT FISH RESTORATION

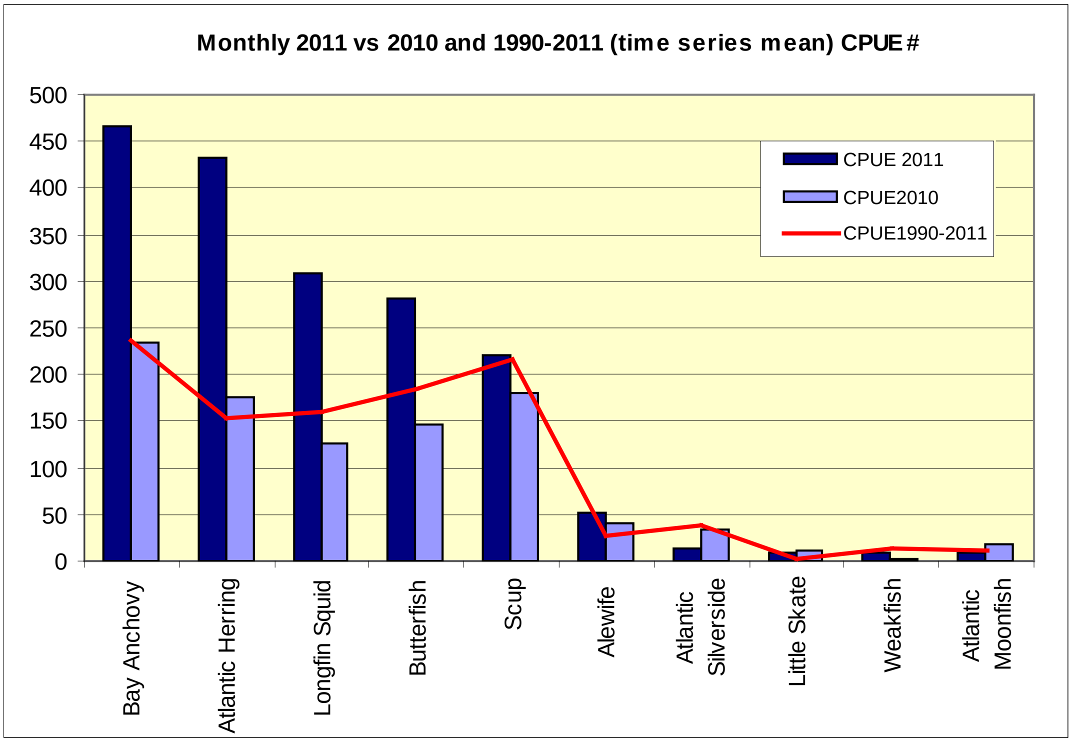
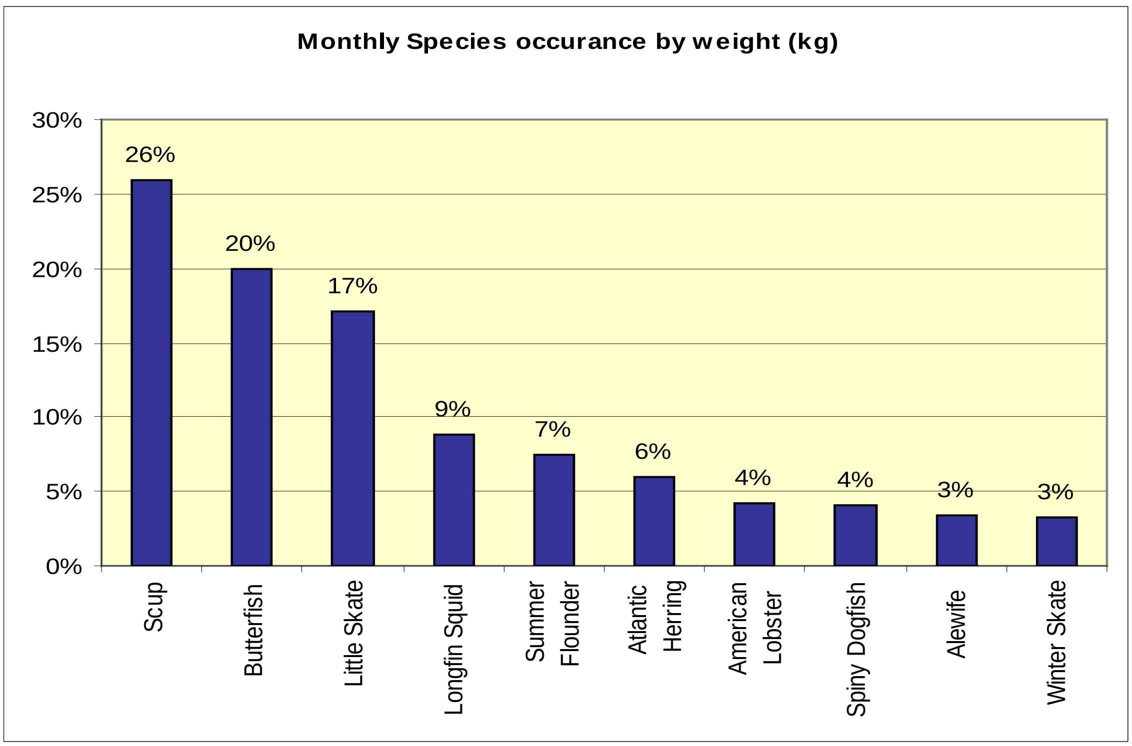
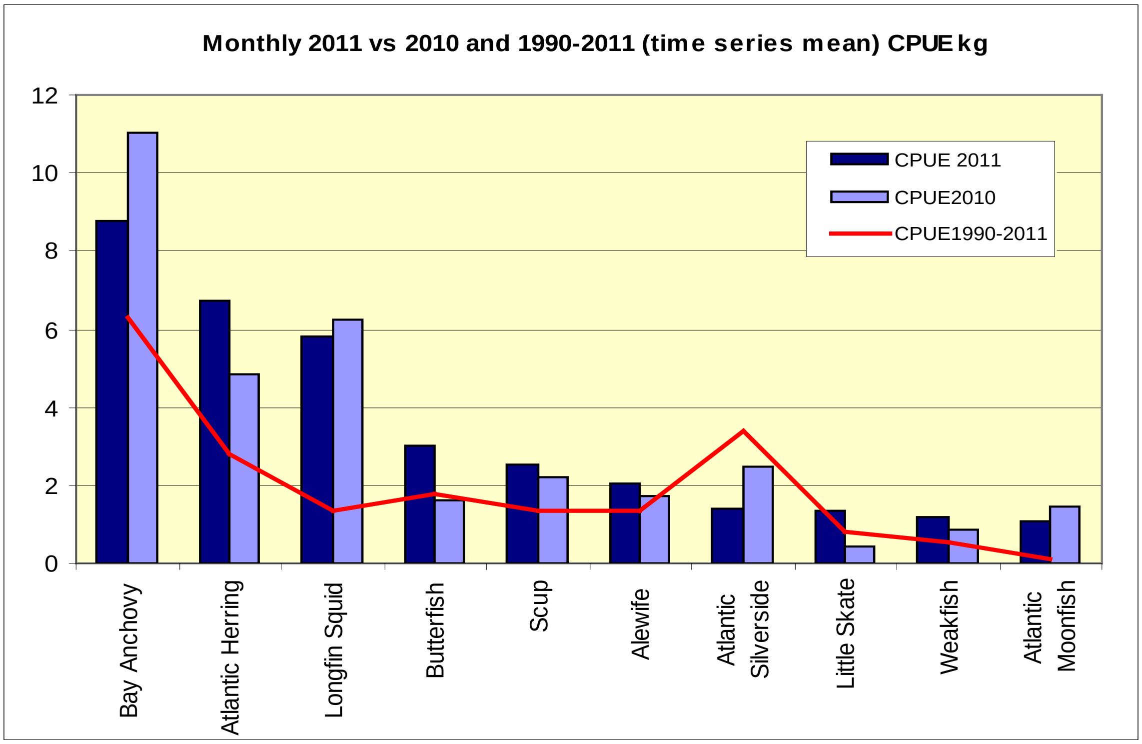

Monthly 2011 vs 2010 and 1990-2011 (time series mean) CPUE #
500
450
400
350
300
250
200
150
100
50
0
CPUE 2011
CPUE2010
CPUE1990-2011
Bay Anchovy
Atlantic Herring
Longfin Squid
Butterfish
Scup
Alewife
Atlantic Silverside
Little Skate
Weakfish
Atlantic Moonfish

Figure 5 Top Ten Species Catch in Kilograms

Fish Name	Scientific Name	%
Scup	STENOTOMUS CHRYSOPS	26%
Butterfish	PEPRILUS TRIACANTHUS	20%
Little Skate	RAJA ERINACEA	17%
Longfin Squid	LOLIGO PEALEI	9%
Summer Flounder	PARALICHTHYS DENTATUS	7%
Atlantic Herring	CLUPEA HARENGUS	6%
American Lobster	HOMARUS AMERICANUS	4%
Spiny Dogfish	SQUALUS ACANTHIAS	4%
Alewife	ALOSA PSEUDOHARENGUS	3%
Winter Skate	RAJA OCELLATA	3%





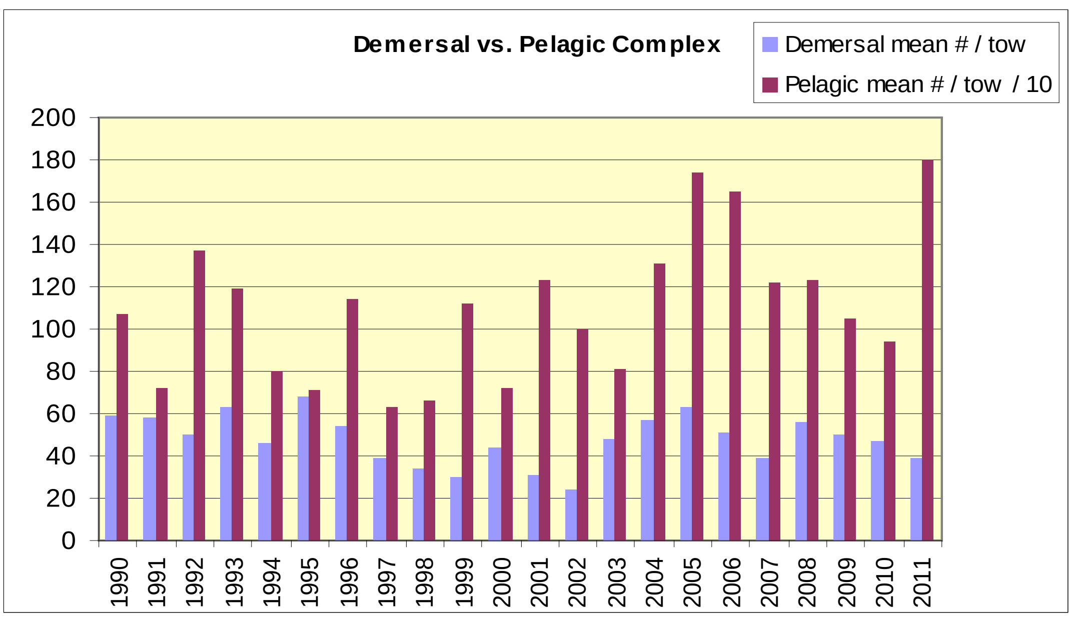
Monthly 2011 vs 2010 and 1990-2011 (time series mean) CPUE kg
12
10
8
6
4
2
0
CPUE 2011
CPUE2010
CPUE1990-2011
Bay Anchovy
Atlantic Herring
Longfin Squid
Butterfish
Scup
Alewife
Atlantic Silverside
Little Skate
Weakfish
Atlantic Moonfish

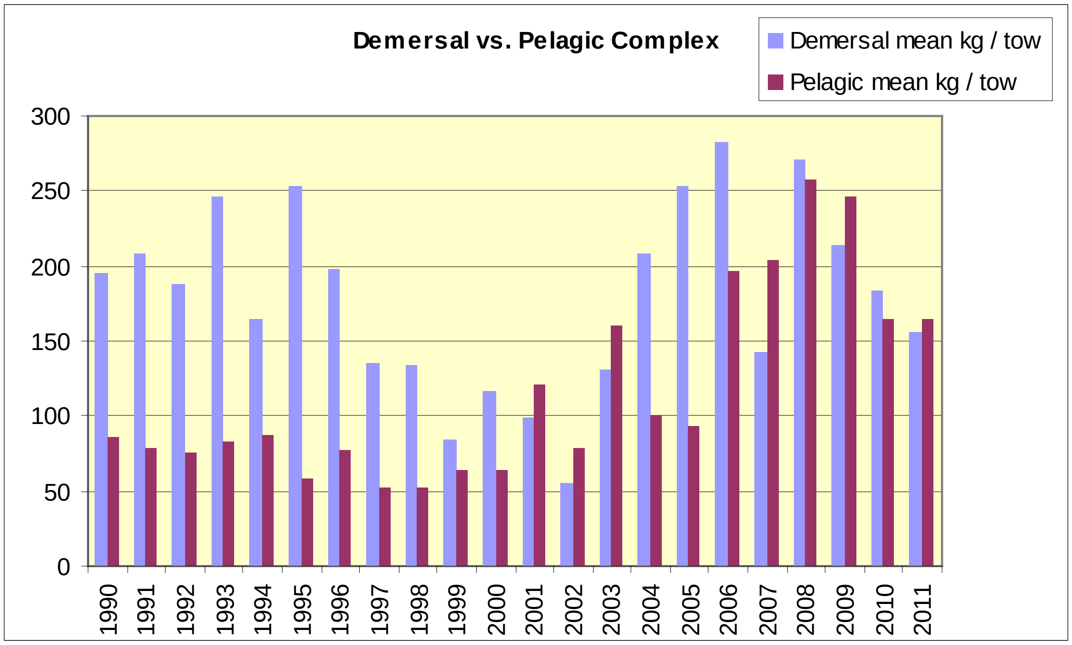
Demersal vs. Pelagic Species Complex

Demersal Species
Smooth Dogfish
Spiny Dogfish
Skates
Silver Hake
Red Hake
Spotted Hake
Summer Flounder
4 Spot Flounder
Winter Flounder
Windowpane Flounder
Hog Choker
Longhorn Sculpin
Sea Raven
Northern Searobin
Striped Searobin
Cunner
Tautog
Ocean Pout
Goosefish
Lobster

Pelagic/Multi-Habitat Species
Atlantic Herring
Alewife
Blueback Herring
Shad
Menhaden
Bay Anchovy
Rainbow Smelt
Silverside
Butterfish
Atlantic Moonfish
Bluefish
Striped Bass
Black Sea Bass
Scup
Weakfish
Longfin Squid

Figure 6 and 7

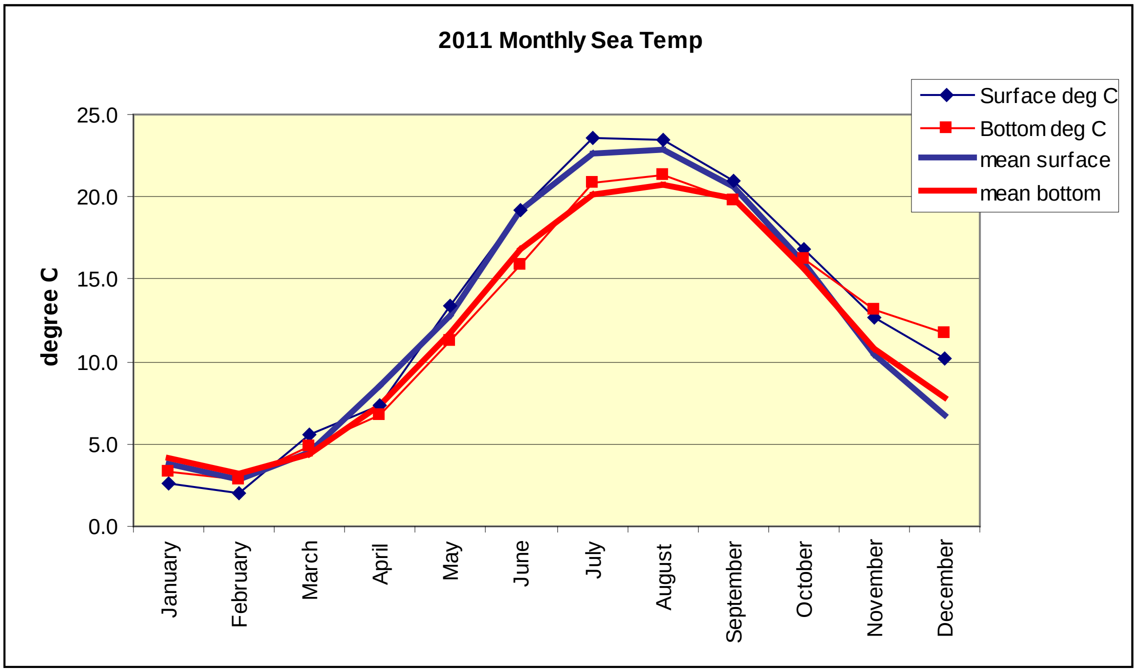


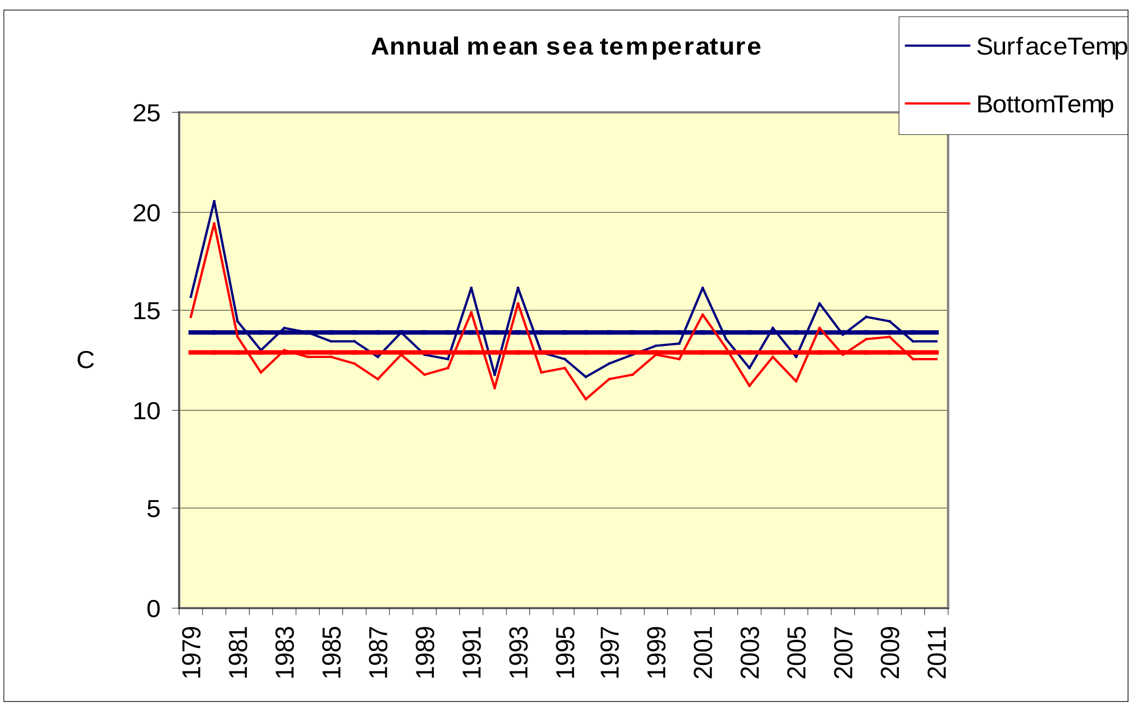


Demersal vs. Pelagic Complex
Demersal mean kg / tow
Pelagic mean kg / tow
300
250
200
150
100
50
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011

Survey Temperature Profile (Annual mean surface and bottom temperature)

Surface and bottom temperatures are collected at every station. The bottom temperature is collected by Niskin bottle at the average or maximum depth for each station.





Results: Job 2. The Seasonal Coastal Trawl Survey is defined by 12 fixed stations in Narragansett Bay, 14 random stations in Narragansett Bay, 6 fixed stations in Rhode Island Sound, 11 fixed stations in Block Island Sound.
68 species were observed and recorded during the 2011 Rhode Island Seasonal Trawl Survey, totaling 259756 individuals or 3020.4 fish per tow. In weight, the catch accounted for 4608.1 kg. or 53.6 kg. per tow. (Figures 8 and 9) The top ten species by number and catch are represented in figures 10 and 11. The change between demersal and pelagic species is represented in figures 12 and 13.

Figure 8 (Total Catch in Number)

Fish Name	Scientific Name	Total number
Bay Anchovy	ANCHOA MITCHILLI	116022
Scup	STENOTOMUS CHRYSOPS	50376
Butterfish	PEPRILUS TRIACANTHUS	40039
Longfin Squid	LOLIGO PEALEI	38827
Weakfish	CYNOSCION REGALIS	3037
Atlantic Moonfish	SELENE SETAPINNIS	2427
Rough Scad	TRACHURUS LATHAMI	1650
Little Skate	RAJA ERINACEA	1387
Alewife	ALOSA PSEUDOHARENGUS	1370
Atlantic Cod	GADUS MORHUA	858
Atlantic Herring	CLUPEA HARENGUS	570
Striped Anchovy	ANCHOA HEPSETUS	447
Winter Flounder	PLEURONECTES AMERICANUS	400
Atlantic Silverside	MENIDIA MENIDIA	355
Summer Flounder	PARALICHTHYS DENTATUS	278
American Lobster	HOMARUS AMERICANUS	194
Blueback Herring	ALOSA AESTIVALIS	149
Spotted Hake	UROPHYCIS REGIA	147
Pollock	POLLACHIUS VIRENS	102
Winter Skate	RAJA OCELLATA	98
Silver Hake	MERLUCCIUS BILINEARIS	93
Windowpane Flounder	SCOPHTHALMUS AQUOSUS	87
Red Hake	UROPHYCIS CHUSS	87
Blue Crab	CALLINECTES SAPIDUS	82
Bluefish	POMATOMUS SALTATRIX	73
Northern Kingfish	MENTICIRRHUS SAXATILIS	72
Black Sea Bass	CENTROPRISTIS STRIATA	64
American Shad	ALOSA SAPIDISSIMA	47
Longhorn Sculpin	MYOXOCEPHALUS OCTODECEMSPINOS	40
Clearnose Skate	RAJA EGLANTERIA	39
Striped Searobin	PRIONOTUS EVOLANS	36
Fourspot Flounder	PARALICHTHYS OBLONGUS	36
Horseshoe Crab	LIMULUS POLYPHEMUS	34
Ocean Pout	MACROZOARCES AMERICANUS	27
Northern Searobin	PRIONOTUS CAROLINUS	22

Northern Puffer	SPHOEROIDES MACULATUS	19
Sea Scallop	PLACOPECTEN MAGELLANICUS	18
Tautog	TAUTOGA ONITIS	15
Channeled Whelk	BUSYCOTYPUS CANALICULATUS	13
Smallmouth Flounder	ETROPUS MICROSTOMUS	13
Smooth Dogfish	MUSTELUS CANIS	12
Knobbed Whelk	BUSYCON CARICA	12
Inshore Lizardfish	SYNODUS FOETENS	11
Grubby	MYOXOCEPHALUS AENAEUS	10
Northern Pipefish	SYNGNATHUS FUSCUS	10
Sea Raven	HEMITRIPTERUS AMERICANUS	8
Mantis Shrimp	SQUILLA EMPUSA	5
Atlantic Menhaden	BREVOORTIA TYRANNUS	4
Yellowtail Flounder	PLEURONECTES FERRUGINEUS	3
Hogchoker	TRINECTES MACULATUS	3
Cunner	TAUTOGOLABRUS ADSPERSUS	3
Fawn Cusk-eel	LEPOPHIDIUM PROFUNDORUM	2
Crevalle Jack	CARANX HIPPOS	2
Round Scad	DECAPTERUS PUNCTATUS	2
Fourbeard Rockling	ENCHELYOPUS CIMBRIUS	2
American Sand Lance	AMMODYTES AMERICANUS	2
Rock Gunnel	PHOLIS GUNNELLUS	2
Bigeye	PRIACANTHUS ARENATUS	2
Atlantic Mackerel	SCOMBER SCOMBRUS	2
Striped Seasnail	LIPARIS LIPARIS	1
Conger Eel	CONGER OCEANICUS	1
Striped Bass	MORONE SAXATILIS	1
Snakefish	TRACHINOCEPHALUS MYOPS	1
Dwarf Goatfish	UPENEUS PARVUS	1
Northern Sennet	SPHYRAENA BOREALIS	1
Atlantic Torpedo Ray	TORPEDO NOBILIANA	1
Spiny Dogfish	SQUALUS ACANTHIAS	1
Daubed Shanny	LUMPENUS MACULATUS	1

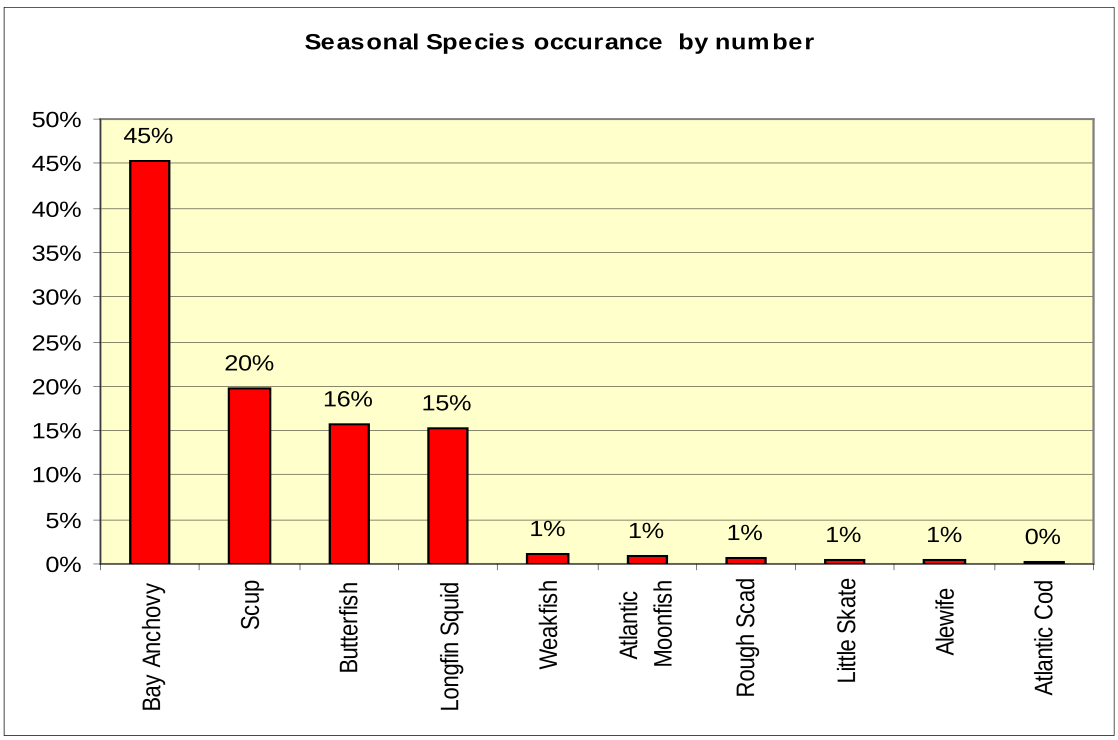
Figure 9 (Total Catch in Kilograms)

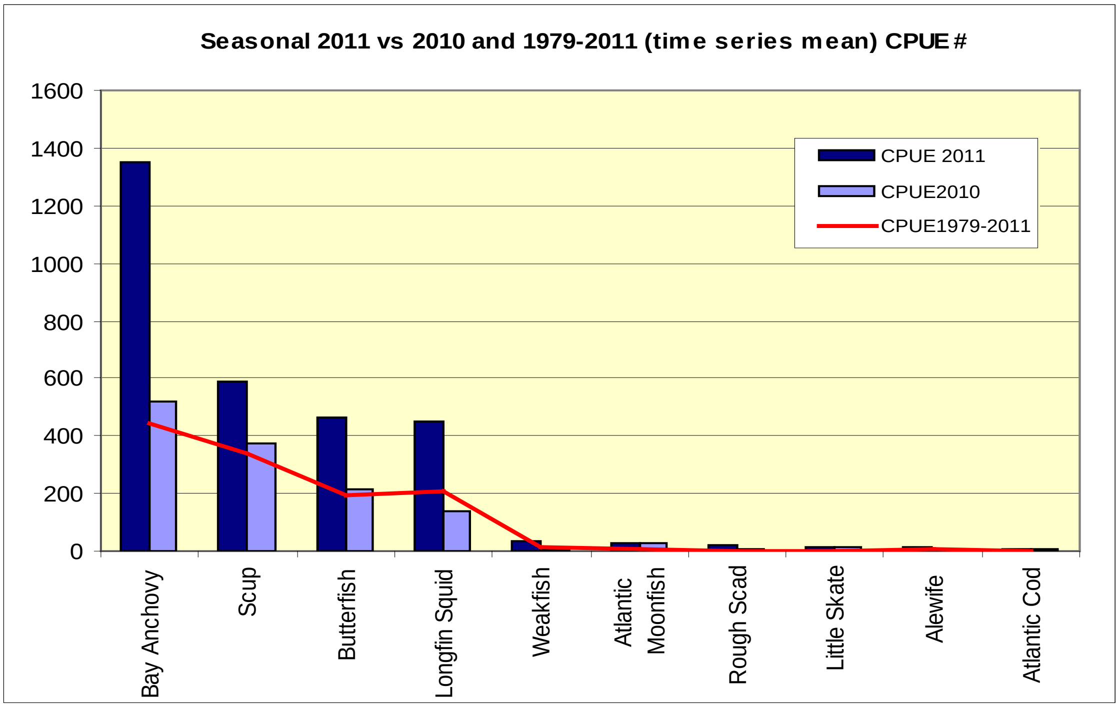
Fish Name	Scientific Name	Total weight
Scup	STENOTOMUS CHRYSOPS	1386.535009
Little Skate	RAJA ERINACEA	820.9299934
Butterfish	PEPRILUS TRIACANTHUS	779.9230001
Longfin Squid	LOLIGO PEALEI	527.055002
Summer Flounder	PARALICHTHYS DENTATUS	184.5999991
Winter Flounder	PLEURONECTES AMERICANUS	116.0749999
Winter Skate	RAJA OCELLATA	111.0750005
Bay Anchovy	ANCHOA MITCHILLI	96.03599916
Horseshoe Crab	LIMULUS POLYPHEMUS	69.0599997
Clearnose Skate	RAJA EGLANTERIA	65.97999954
American Lobster	HOMARUS AMERICANUS	59.89999919
Weakfish	CYNOSCION REGALIS	51.62000002
Rough Scad	TRACHURUS LATHAMI	50.35000015
Smooth Dogfish	MUSTELUS CANIS	33.14999998
Alewife	ALOSA PSEUDOHARENGUS	31.09599989
Ocean Pout	MACROZOARCES AMERICANUS	24.51000001
Windowpane Flounder	SCOPHTHALMUS AQUOSUS	20.98499994
Longhorn Sculpin	MYOXOCEPHALUS OCTODECEMSPINOS	17.28000009
Atlantic Moonfish	SELENE SETAPINNIS	16.74250007
Blue Crab	CALLINECTES SAPIDUS	16.14999989
Atlantic Torpedo Ray	TORPEDO NOBILIANA	14.60000038
Black Sea Bass	CENTROPRISTIS STRIATA	14.39499993
Spotted Hake	UROPHYCIS REGIA	13.21299992
Striped Searobin	PRIONOTUS EVOLANS	12.15500016
Atlantic Herring	CLUPEA HARENGUS	10.26224985
Bluefish	POMATOMUS SALTATRIX	9.954999944
Fourspot Flounder	PARALICHTHYS OBLONGUS	9.344999988
Red Hake	UROPHYCIS CHUSS	7.160000006
Tautog	TAUTOGA ONITIS	5.924999777
Silver Hake	MERLUCCIUS BILINEARIS	4.759000032
Northern Kingfish	MENTICIRRHUS SAXATILIS	4.499999947
Sea Raven	HEMITRIPTERUS AMERICANUS	3.629999965
Knobbed Whelk	BUSYCON CARICA	3.065000005
Channeled Whelk	BUSYCOTYPUS CANALICULATUS	1.705000009
Blueback Herring	ALOSA AESTIVALIS	1.686999989
Atlantic Cod	GADUS MORHUA	1.647250005
Inshore Lizardfish	SYNODUS FOETENS	1.269999981
Striped Bass	MORONE SAXATILIS	1.200000048
American Shad	ALOSA SAPIDISSIMA	1.109999987
Northern Searobin	PRIONOTUS CAROLINUS	1.080000021
Atlantic Menhaden	BREVOORTIA TYRANNUS	1.018999986
Atlantic Silverside	MENIDIA MENIDIA	0.945000007
Sea Scallop	PLACOPECTEN MAGELLANICUS	0.915000013
Conger Eel	CONGER OCEANICUS	0.870000005
Striped Anchovy	ANCHOA HEPSETUS	0.64499999

Hogchoker	TRINECTES MACULATUS	0.444999993
Northern Puffer	SPHOEROIDES MACULATUS	0.339999999
Mantis Shrimp	SQUILLA EMPUSA	0.260000004
Smallmouth Flounder	ETROPUS MICROSTOMUS	0.139999996
Bigeye	PRIACANTHUS ARENATUS	0.119999997
Yellowtail Flounder	PLEURONECTES FERRUGINEUS	0.08
Crevalle Jack	CARANX HIPPOS	0.08
Spiny Dogfish	SQUALUS ACANTHIAS	0.075000003
Atlantic Mackerel	SCOMBER SCOMBRUS	0.075000003
Fourbeard Rockling	ENCHELYOPUS CIMBRIUS	0.075000001
Grubby	MYOXOCEPHALUS AENAEUS	0.074999999
Round Scad	DECAPTERUS PUNCTATUS	0.039999999
Cunner	TAUTOGOLABRUS ADSPERSUS	0.039999999
Fawn Cusk-eel	LEPOPHIDIUM PROFUNDORUM	0.035
Northern Sennet	SPHYRAENA BOREALIS	0.035
Pollock	POLLACHIUS VIRENS	0.0305
Northern Pipefish	SYNGNATHUS FUSCUS	0.02
Rock Gunnel	PHOLIS GUNNELLUS	0.02
American Sand Lance	AMMODYTES AMERICANUS	0.018
Dwarf Goatfish	UPENEUS PARVUS	0.015
Snakefish	TRACHINOCEPHALUS MYOPS	0.01
Striped Seasnail	LIPARIS LIPARIS	0.005
Daubed Shanny	LUMPENUS MACULATUS	0.002

Figure 10 Top Ten Species Catch in Number

Fish Name	Scientific Name	%
Bay Anchovy	ANCHOA MITCHILLI	45%
Scup	STENOTOMUS CHRYSOPS	20%
Butterfish	PEPRILUS TRIACANTHUS	16%
Longfin Squid	LOLIGO PEALEI	15%
Weakfish	CYNOSCION REGALIS	1%
Atlantic Moonfish	SELENE SETAPINNIS	1%
Rough Scad	TRACHURUS LATHAMI	1%
Little Skate	RAJA ERINACEA	1%
Alewife	ALOSA PSEUDOHARENGUS	1%
Atlantic Cod	GADUS MORHUA	0%

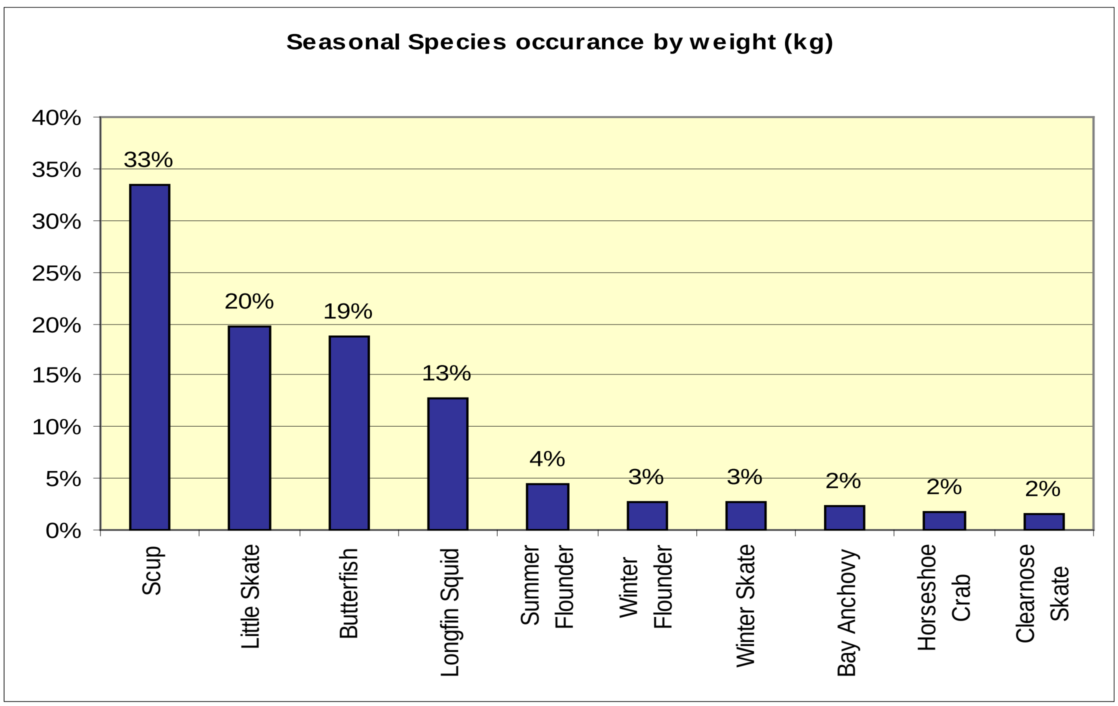


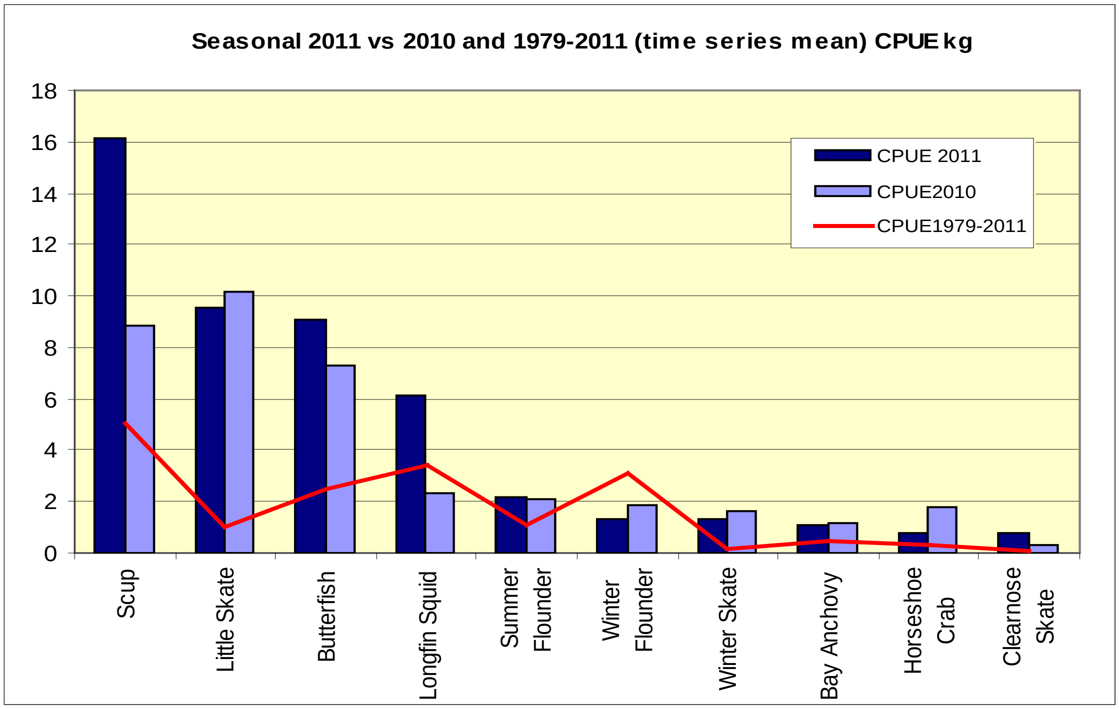


Seasonal 2011 vs 2010 and 1979-2011 (time series mean) CPUE#
1600
1400
1200
1000
800
600
400
200
0
CPUE 2011
CPUE2010
CPUE1979-2011
Bay Anchovy
Scup
Butterfish
Longfin Squid
Weakfish
Atlantic Moonfish
Rough Scad
Little Skate
Alewife
Atlantic Cod

Figure 11 Top Ten Species Catch in Kilograms

Fish Name	Scientific Name	%
Scup	STENOTOMUS CHRYSOPS	33%
Little Skate	RAJA ERINACEA	20%
Butterfish	PEPRILUS TRIACANTHUS	19%
Longfin Squid	LOLIGO PEALEI	13%
Summer Flounder	PARALICHTHYS DENTATUS	4%
Winter Flounder	PLEURONECTES AMERICANUS	3%
Winter Skate	RAJA OCELLATA	3%
Bay Anchovy	ANCHOA MITCHILLI	2%
Horseshoe Crab	LIMULUS POLYPHEMUS	2%
Clearnose Skate	RAJA EGLANTERIA	2%



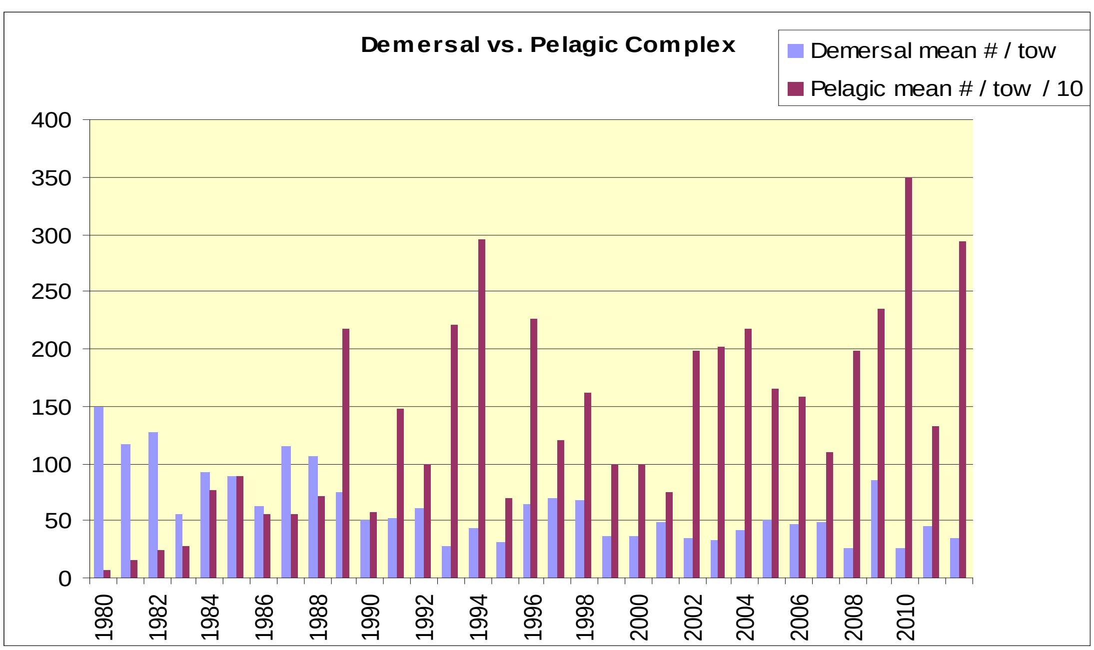

Seasonal 2011 vs 2010 and 1979-2011 (time series mean) CPUE kg
18
16
14
12
10
8
6
4
2
0
CPUE 2011
CPUE2010
CPUE1979-2011
Scup
Little Skate
Butterfish
Longfin Squid
Summer Flounder
Winter Flounder
Winter Skate
Bay Anchovy
Horseshoe Crab
Clearnose Skate

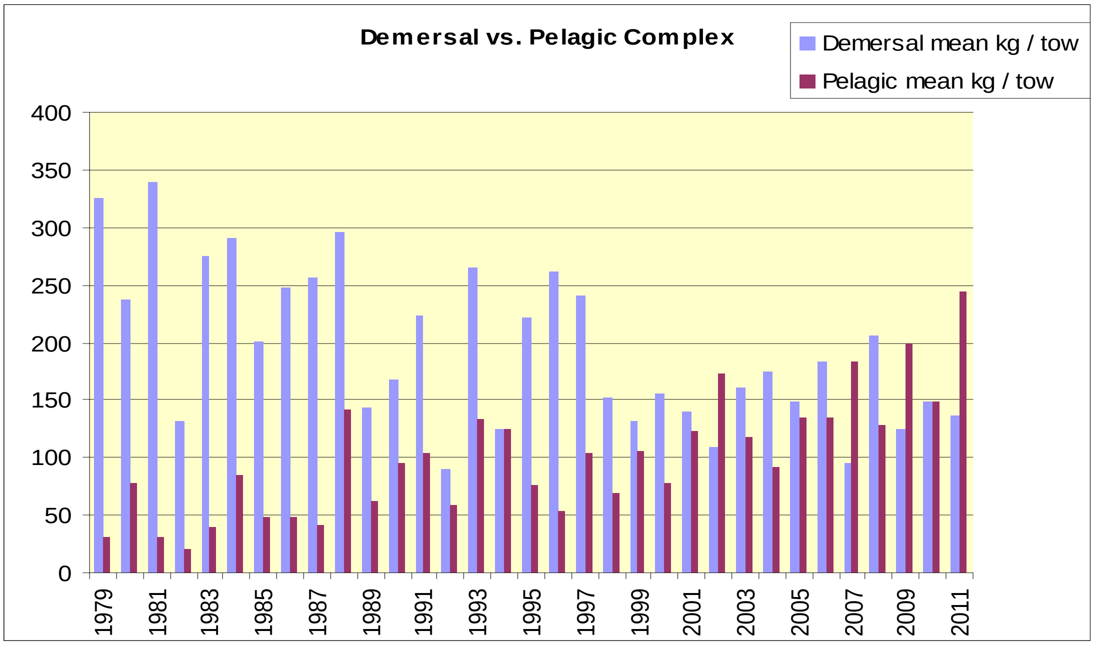
Demersal vs. Pelagic Species Complex

Demersal Species
Smooth Dogfish
Spiny Dogfish
Skates
Silver Hake
Red Hake
Spotted Hake
Summer Flounder
4 Spot Flounder
Winter Flounder
Windowpane Flounder
Hog Choker
Longhorn Sculpin
Sea Raven
Northern Searobin
Striped Searobin
Cunner
Tautog
Ocean Pout
Goosefish
Lobster

Pelagic/Multi-Habitat Species
Atlantic Herring
Alewife
Blueback Herring
Shad
Menhaden
Bay Anchovy
Rainbow Smelt
Silverside
Butterfish
Atlantic Moonfish
Bluefish
Striped Bass
Black Sea Bass
Scup
Weakfish
Longfin Squid

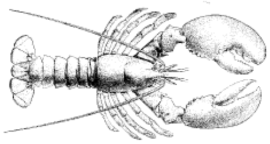
Figure 12 and 13





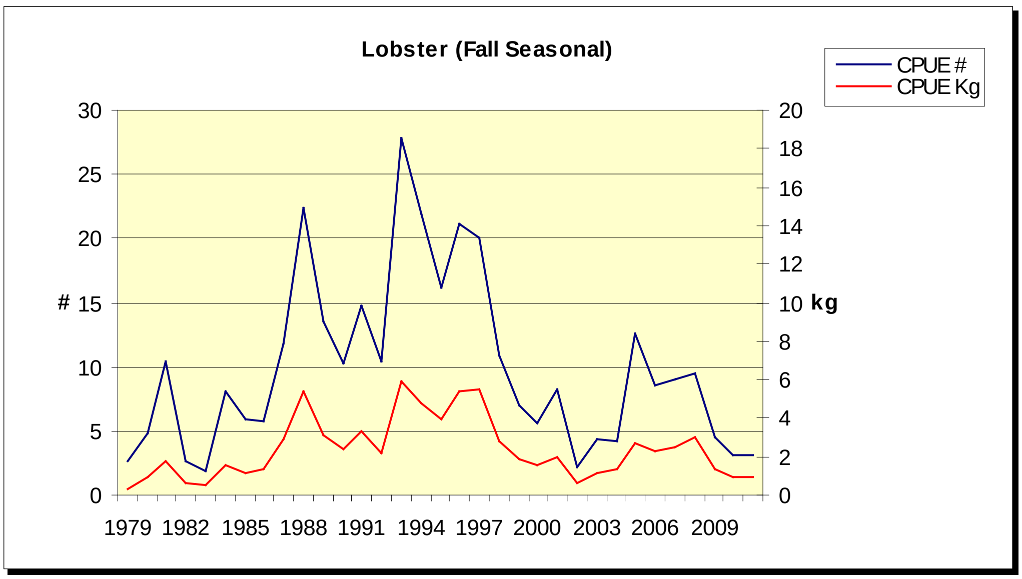
Demersal vs. Pelagic Complex
Demersal mean kg / tow
Pelagic mean kg / tow
400
350
300
250
200
150
100
50
0
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011

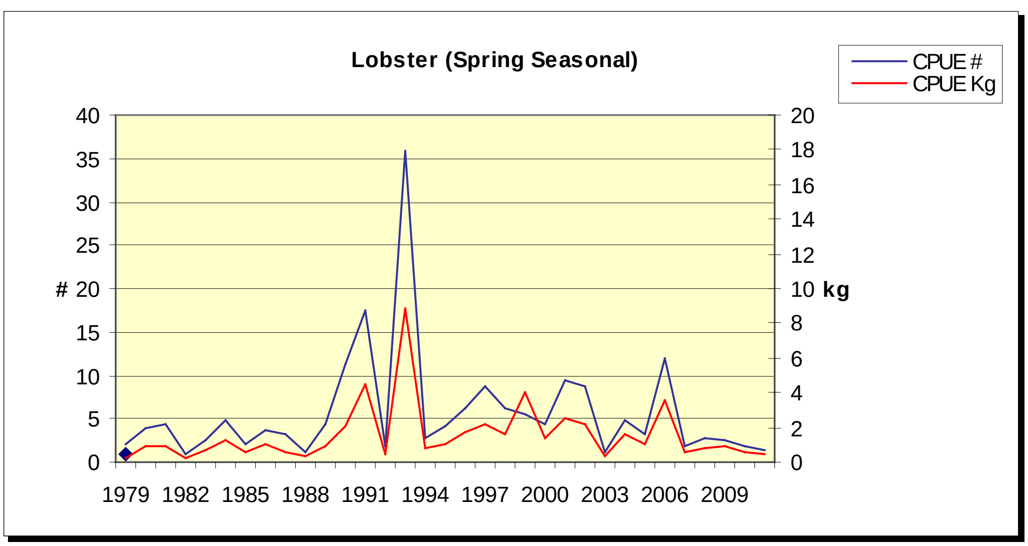
The following species represented are of high importance and are currently managed under fishery management plans through the Atlantic States Marine Fisheries Commission, New England Fishery Management Council, or the National Marine Fisheries Service. The seasonal portion of the Rhode Island Coastal Trawl Survey is an accurate indicator of relative abundance based on the biology and life history of a particular species. Values presented are expressed in either relative number or kilograms per tow. All data collected from both the Seasonal and Monthly Coastal Trawl Surveys are available upon request.

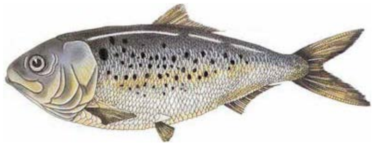


American Lobster ***Homarus americanus***

Stock Status: Southern New England Stock: overfished. Depleted Poor condition.
Management: ASMFC Amendment III, Addendum XVII

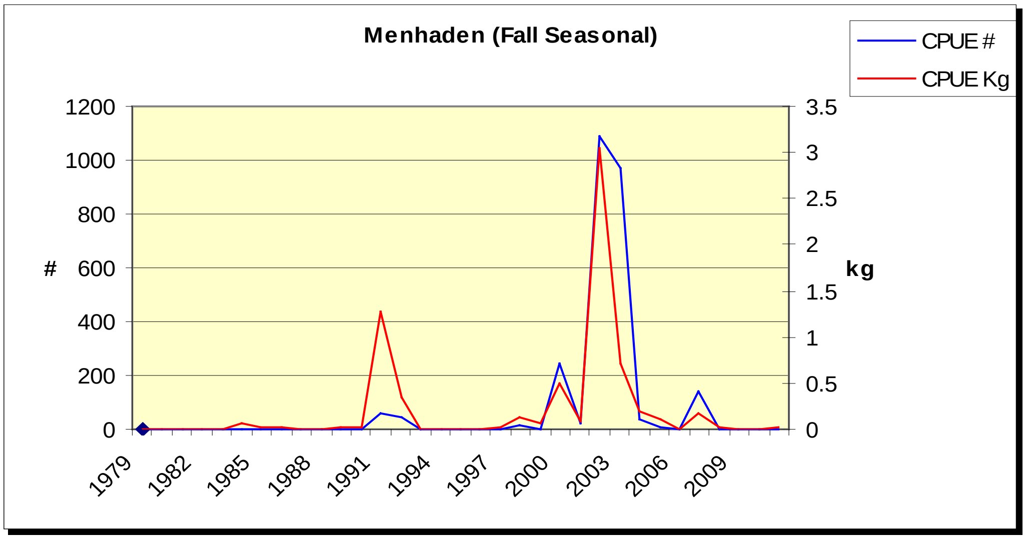


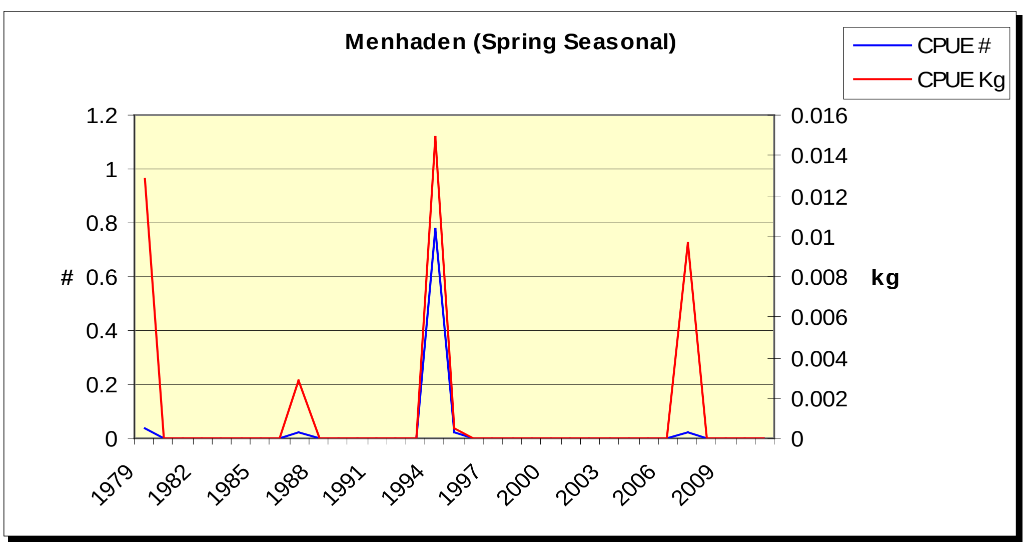




Atlantic Menhaden ***Brevoortia tyrannus***

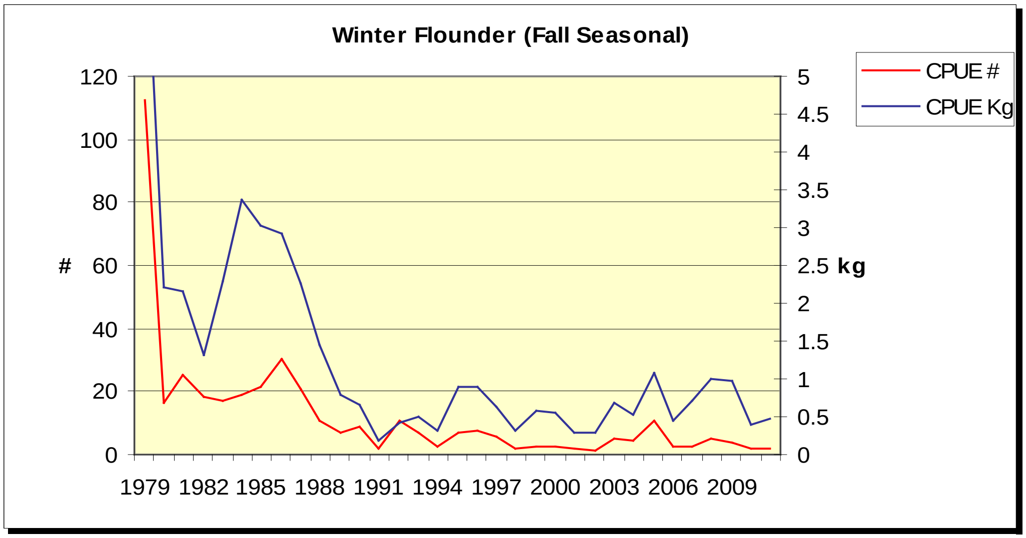
Stock Status: Not Overfished but overfishing is occurring.
Management: ASMFC Amendment II

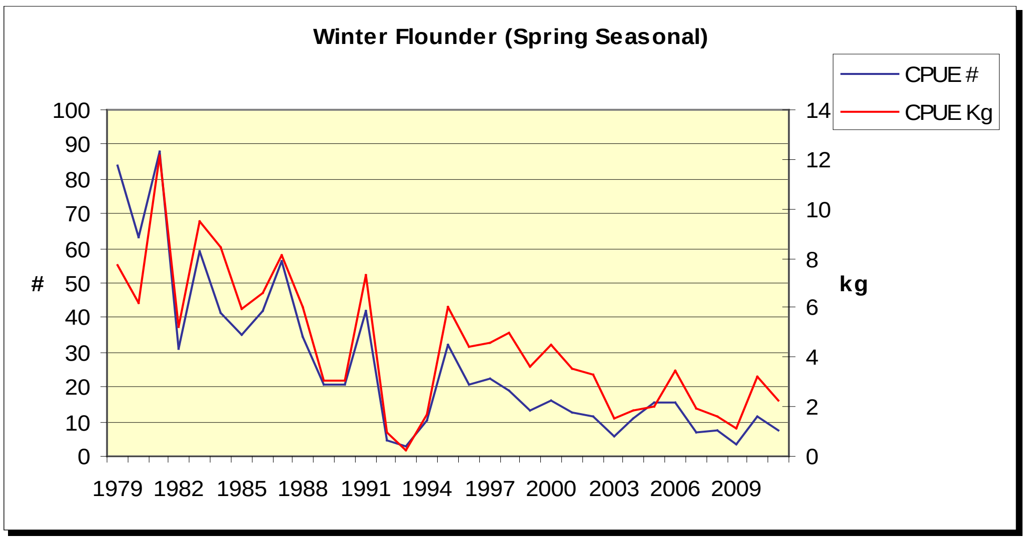




Winter Flounder ***Pleuronectes americanus***

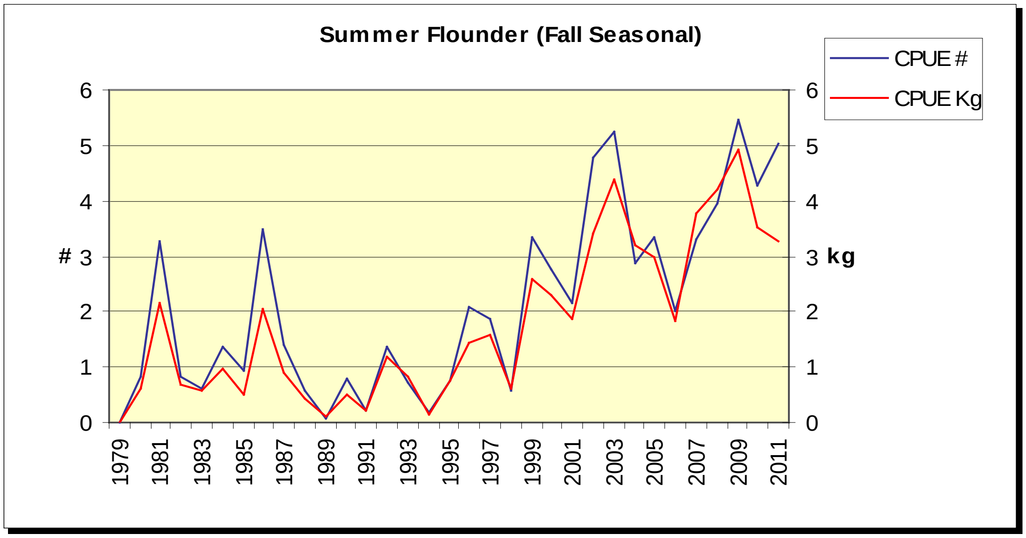
Stock Status: Not Overfished but overfishing is occurring.
Management: ASMFC Amendment I, Addendum III

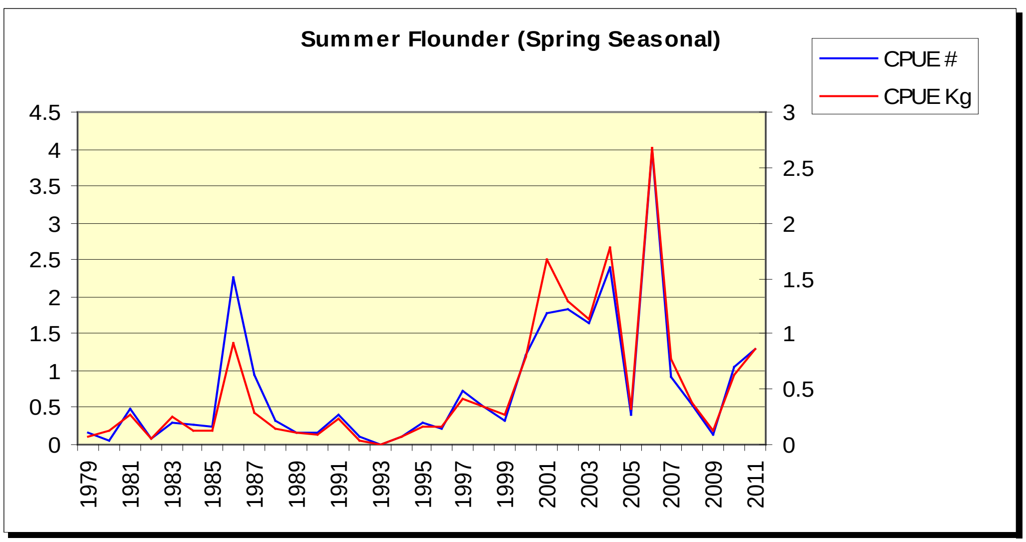




Summer Flounder ***Paralichthys dentatus***

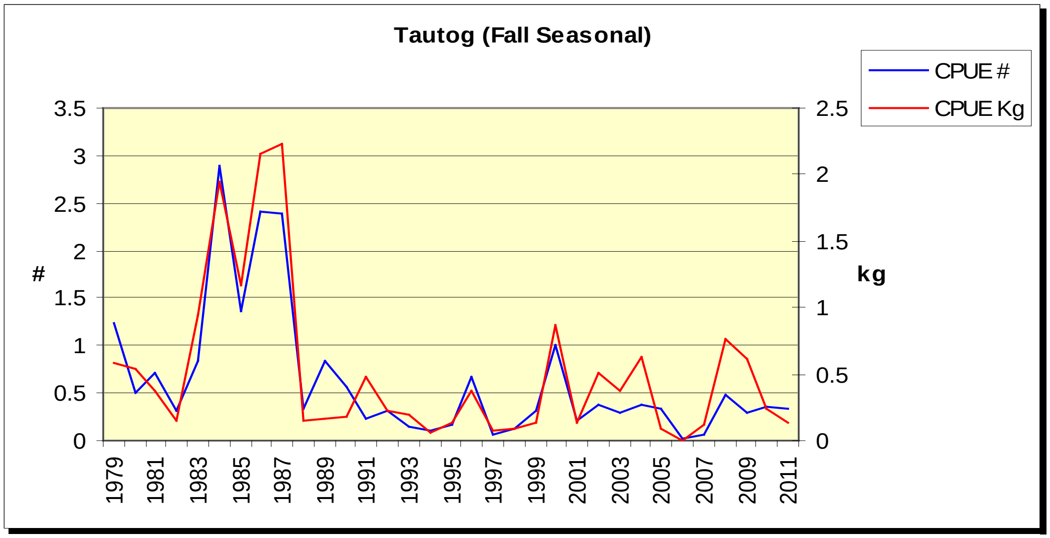
Stock Status: Not overfished and overfishing is not occurring.
Management: ASMFC Amendment XV Addendum XXII

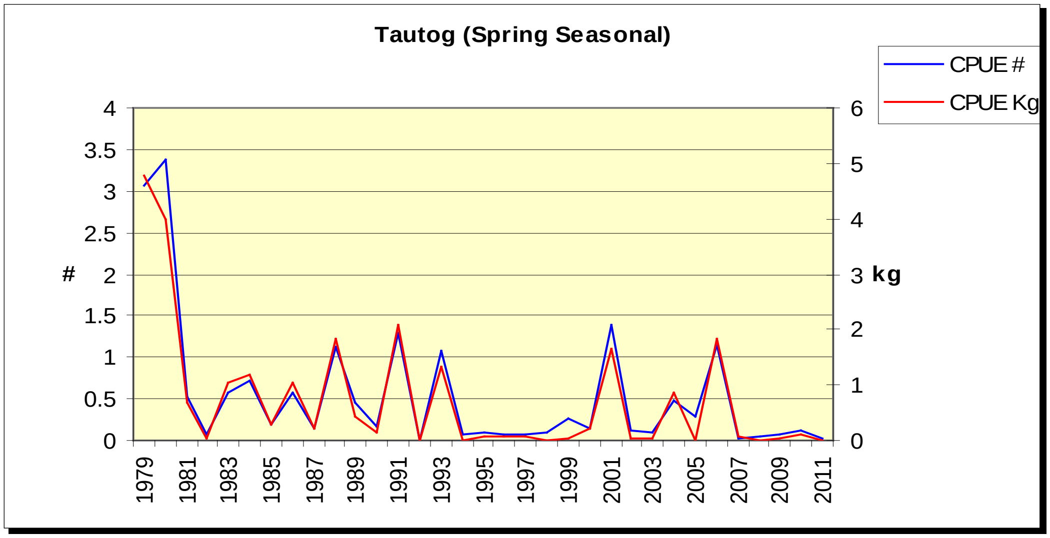


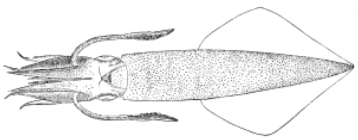


Tautog ***Tautoga onitis***

Stock Status: Overfished, Overfishing is not occurring based on Regional (Rhode Island and Massachusetts) Stock Assessment
Management: ASMFC Amendment I, Addendum V

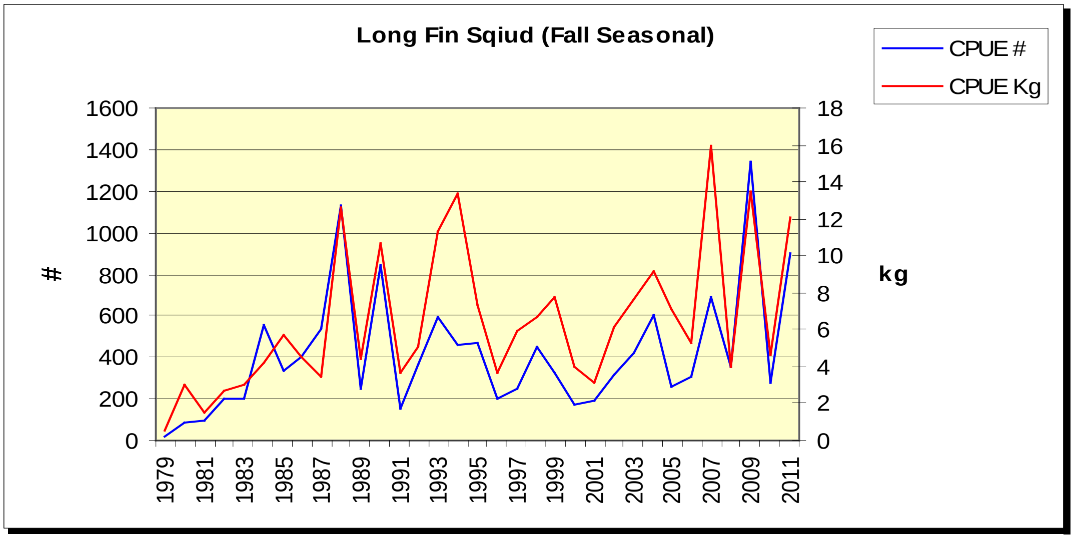


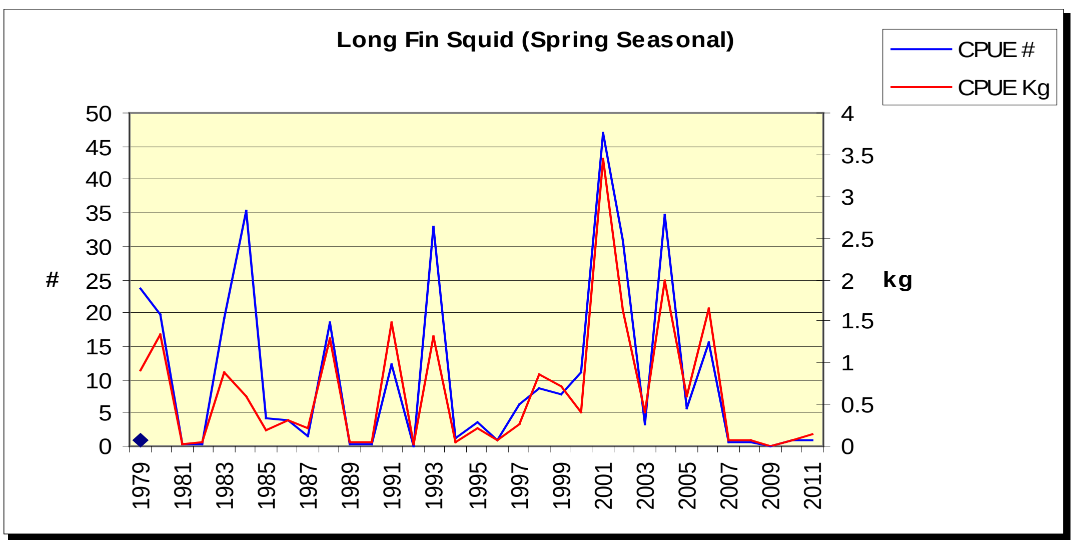




Longfin Squid ***Loligo pealei***

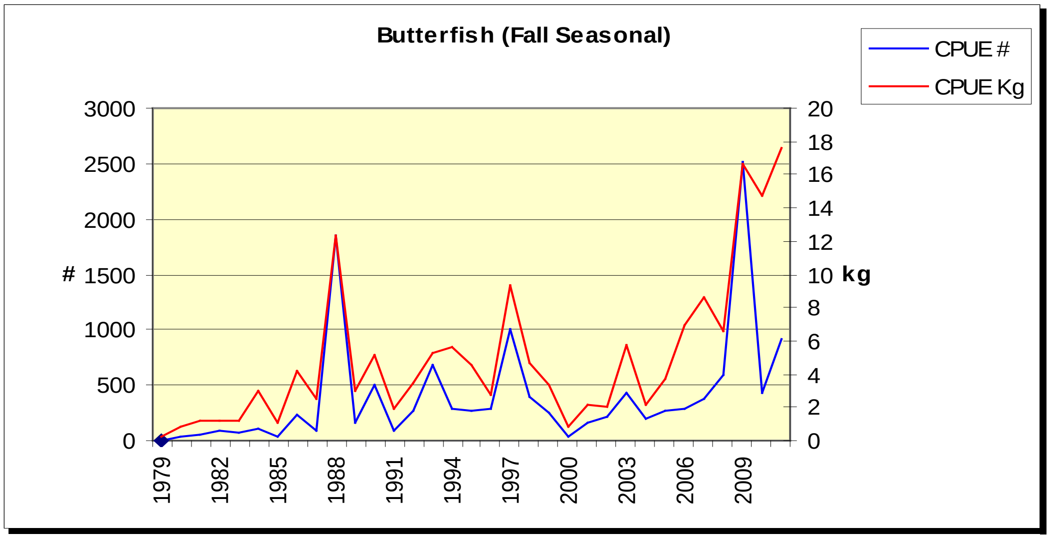
Stock Status: Undetermined, NMFS ACL exemption due to short life cycle.
Management: NMFS, MAFMC, Atlantic Mackerel, Squid Butterfish FMP

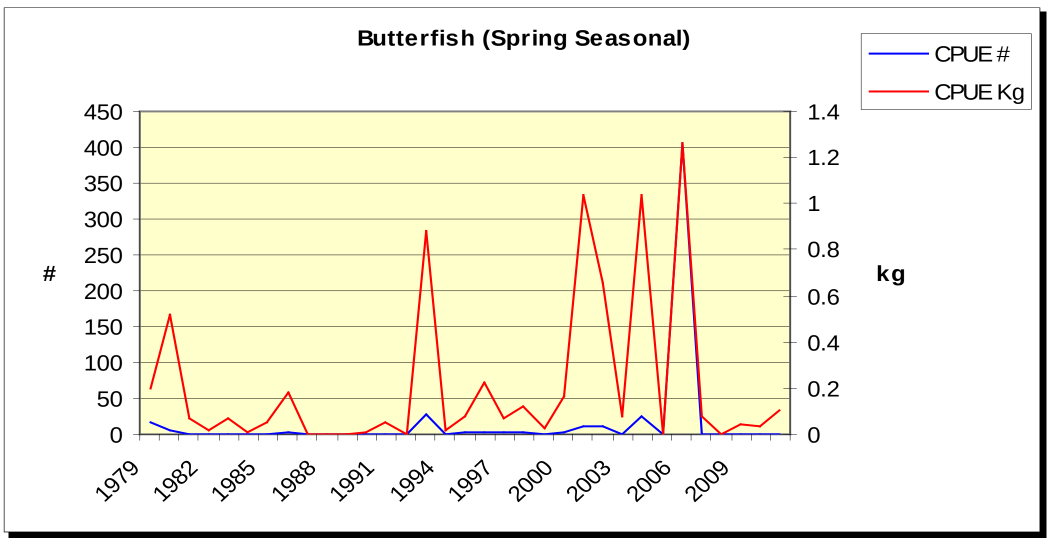




Butterfish ***Peprlilus triacanthus***

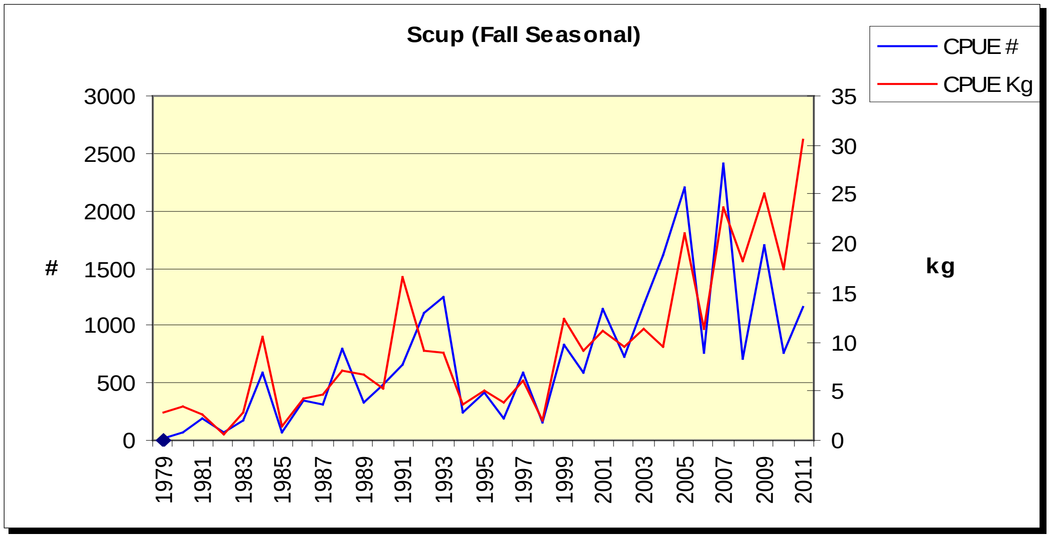
Stock Status: Variable / Uncertain
Management: Mid Atlantic Fishery Management Council, Atlantic Mackerel, Squid Butterfish FMP, ACL

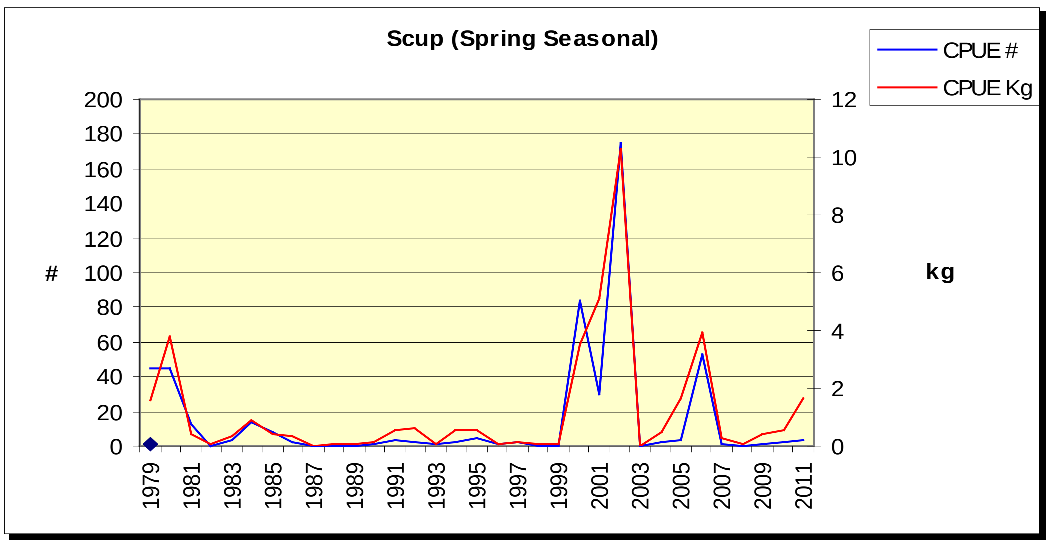




Scup ***Stenotomus chrysops***

Stock Status: Rebuilt, overfishing is not occurring
Management: ASMFC Amendment XIIV, Addendum XXII, Summer Flounder, Scup Black Sea Bass FMP





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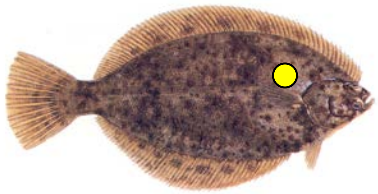


Assessment of Recreationally Important Finfish Stocks in Rhode Island Coastal Waters

<u>Winter Flounder Spawning Stock Biomass Survey in Pt. Judith Pond ,RI</u>

Scott D. Olszewski
Scott.Olszewski@dem.ri.gov
Rhode Island Division Fish and Wildlife
Marine Fisheries
Jamestown, Rhode Island

Rhode Island Department of Environmental Management
Federal Aid in Sportfish Restoration
F-61-18

Performance Report March, 2012

State: Rhode Island Project Number: F-61-R-19

Project Title: Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters

Period Covered: January 1, 2005 - May 30, 2011

Job Number and Title: Job III - Spawning Stock Biomass (SSB) in Rhode Island Coastal Ponds.

Job Objective: To support a seasonal Young of the Year Winter flounder survey by providing data on the dynamics and abundance of the spawning population of winter flounder in Rhode Island coastal ponds.

Significant Deviations: None

Summary: In 1999 the Rhode Island Coastal Ponds Project was expanded to support an adult winter flounder monitoring and tagging project. This winter phase of the seasonal coastal pond juvenile flounder work was an opportunity to collect data on the adult spawning populations of winter flounder in the south shore coastal ponds. An experimental winter flounder tagging study and monitoring project could be conducted with little additional funding or manpower. A commercial fishermen who had historically fished for winter flounder in the coastal ponds agreed to assist the RI Marine Fisheries staff and get the survey off the ground.

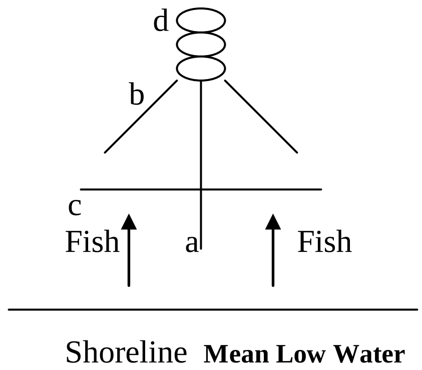
The research project runs from January - May annually. Fishing gear is deployed depending on ice cover in the ponds and the gear is generally hauled on three to four night sets. There are a total of eight stations where data exists, however only three to four have been used in the last four survey seasons, all found in Pt. Judith Pond. Former stations within the survey were located in an adjacent coastal pond (Potter Pond) with the same breach connecting to Block Island and Rhode Island Sounds.

Methods and Materials:

Fyke Nets are a passive fixed fishing gear, attached perpendicular to the shoreline at mean low water. A vertical section of net wall or leader directs fish toward the body of the net where the catch is funneled through a series of parlors, eventually being retained in the terminal parlor. The wings of the net accomplish further direction of the catch.

Net dimensions:
a. Leader - 100'
b. Wings - 25'
c. Spreader Bar - 15'
d. Net parlors – 2.5’
Mesh size - 2.5" throughout

Station water profile:
Depth / turbidity - feet
Dissolved oxygen - mg/l
Salinity - ppt
Temperature - degree C



Fieldwork:

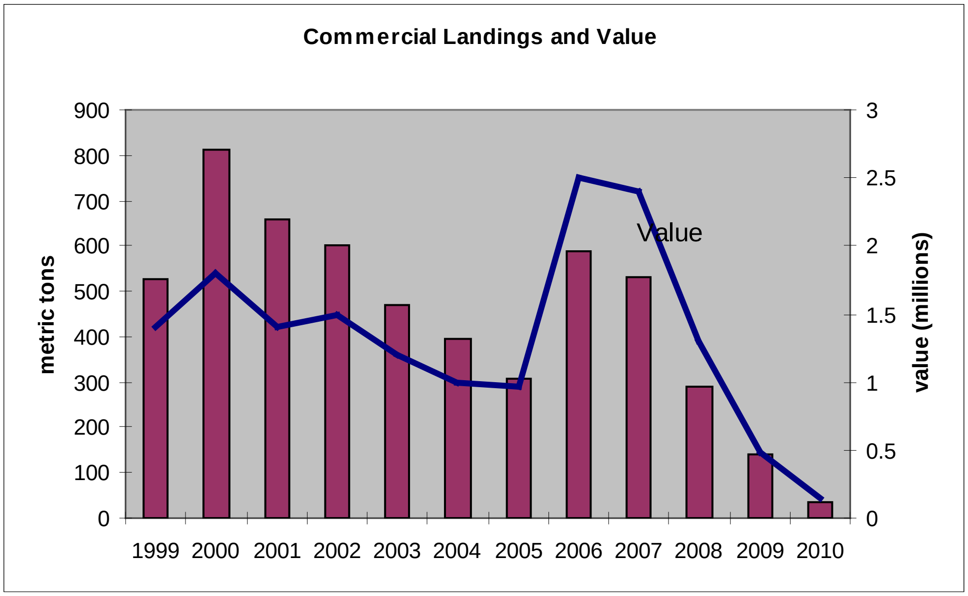
Three fyke nets were set at three fixed stations in Pt. Judith and Potter Ponds during January and April in 1999 - 2001 and two nets were set at four fixed stations from 2002 to present. The nets are fixed at mean low water and set perpendicular to the shoreline. Fyke nets are a passive fishing gear and allow the catch to be retained alive for a short period of time. Nets are tended from two to four days depending on the size of the catch and weather conditions. Higher catches increase density inside the net and attract predators such as cormorants, seals and otters thus increasing survey-induced mortality.

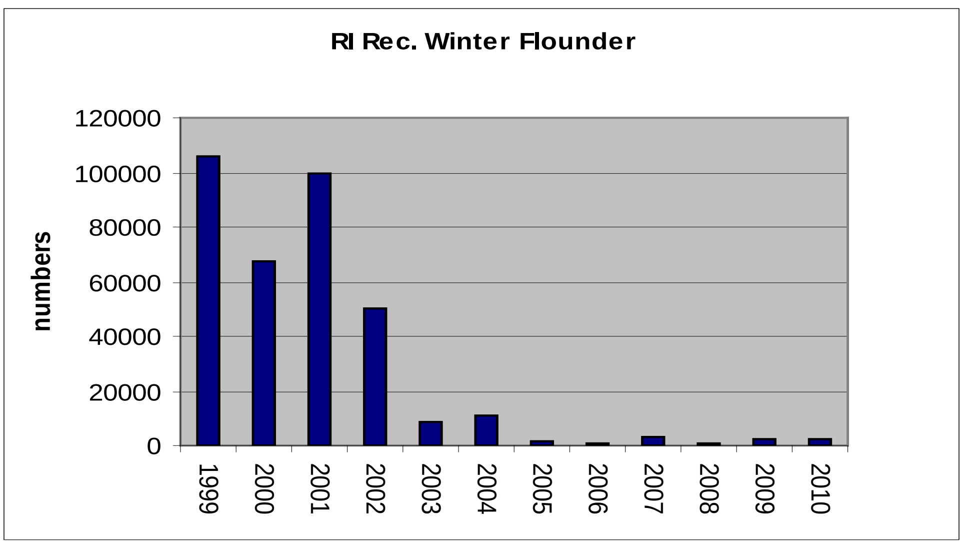
All fish captured are measured, sexed, enumerated and categorized to describe spawning stage. Spawning stage is defined as ripe (pre-spawn), ripe/running (active spawn), spent (post-spawn), resting (non-active spawn) and immature. These data illustrate how the spawning activity of flounder advances throughout the duration of the survey season. This is useful in determining the potential impacts of coastal zone activities such as harbor and breach way dredging and pier construction.

Fish of legal size, 30.48 cm or recruits to the fishery are tagged and released away from the capture area.

Fisheries:

Winter Flounder (***Pseudopleuronectes americanus***) are both a commercially and recreationally important species to the State of Rhode Island. From 1999 - 2010 commercial landings of winter flounder in Rhode Island averaged over 300 metric tons and an average value of one million dollars annually. Recreational landings have declined rapidly throughout the period to a time series low in 2006. (NMFS. 2010 Commercial landings query and MRFSS database)





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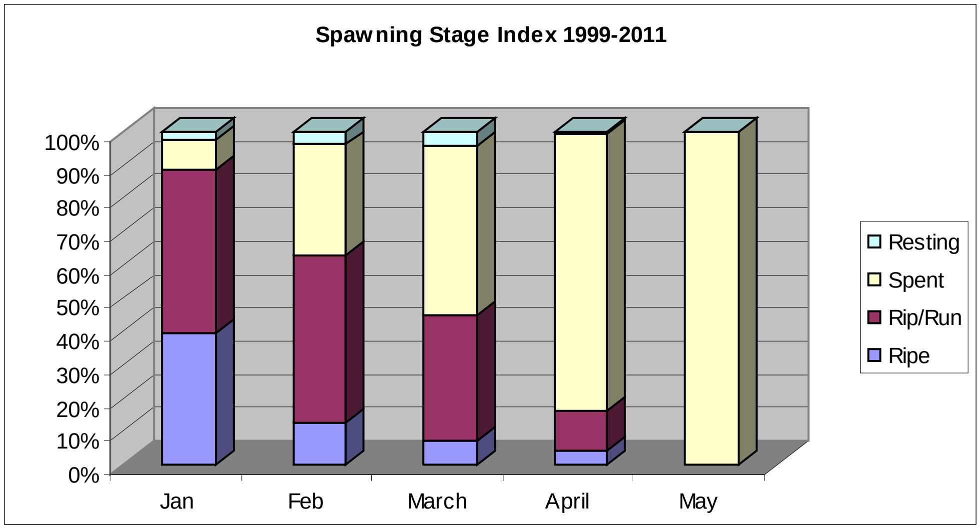
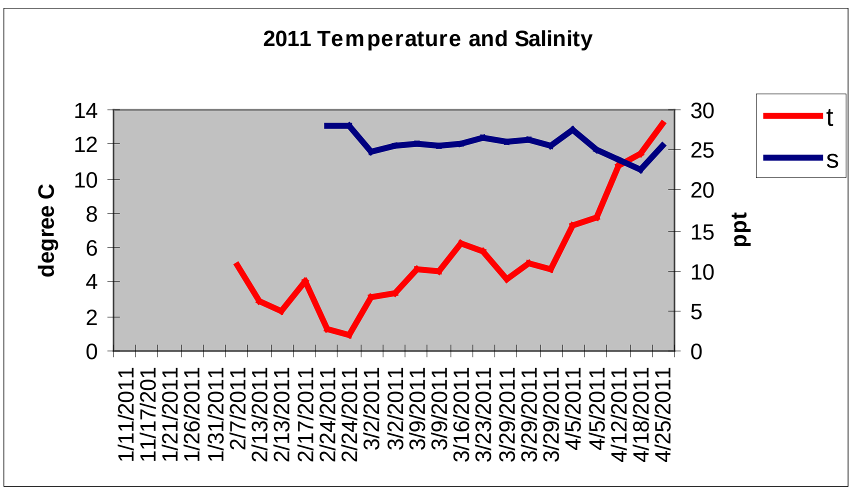
Spawning Behavior:

Winter Flounder enter the south shore coastal pond systems in Rhode Island to spawn in the early part of winter (November) and engage in spawning activity from January through May annually. Spawning and egg deposition takes place on sandy bottoms and algal accumulations. Winter Flounder eggs are non-buoyant and clump together on these substrates. Survey data indicate that peak-spawning activity takes place during the month of February, however this appears to vary annually in relation to average water temperatures.



Spawning occurs in inshore waters at close to seasonal minimal water temperatures of 0 - 1.7 degrees C and in estuarine salinities as low as 11.4 ppt. (Bigelow and Schroeder 2002) [1].



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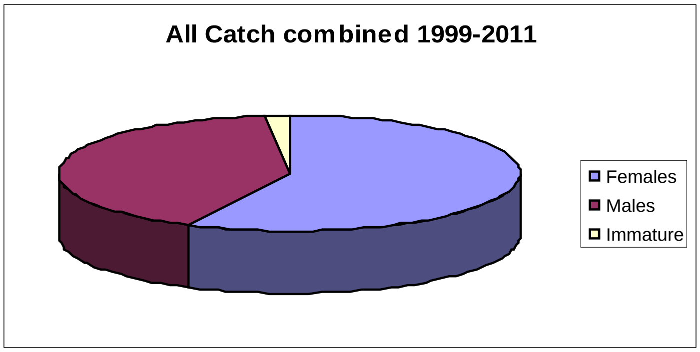
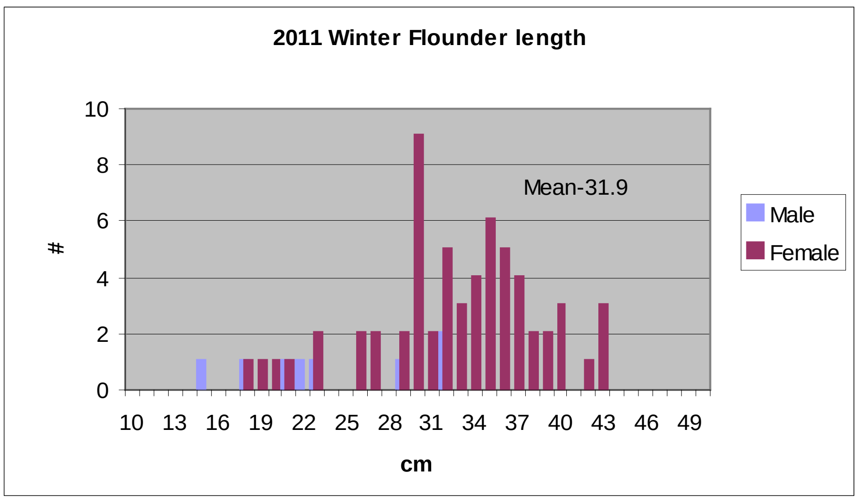
Sex ratios throughout the time series tend to favor females. Similar observations were made in Green Hill Pond, a neighboring coastal pond (Saila 1961), and in Narragansett Bay (Saila 1962).



Size Distribution:

The total number of winter flounder sampled during the 2011 survey was 68. This was a 20% decrease from the 2010 survey. Sizes ranged from 15cm to 43cm. The mean size sampled was 31.9cm.



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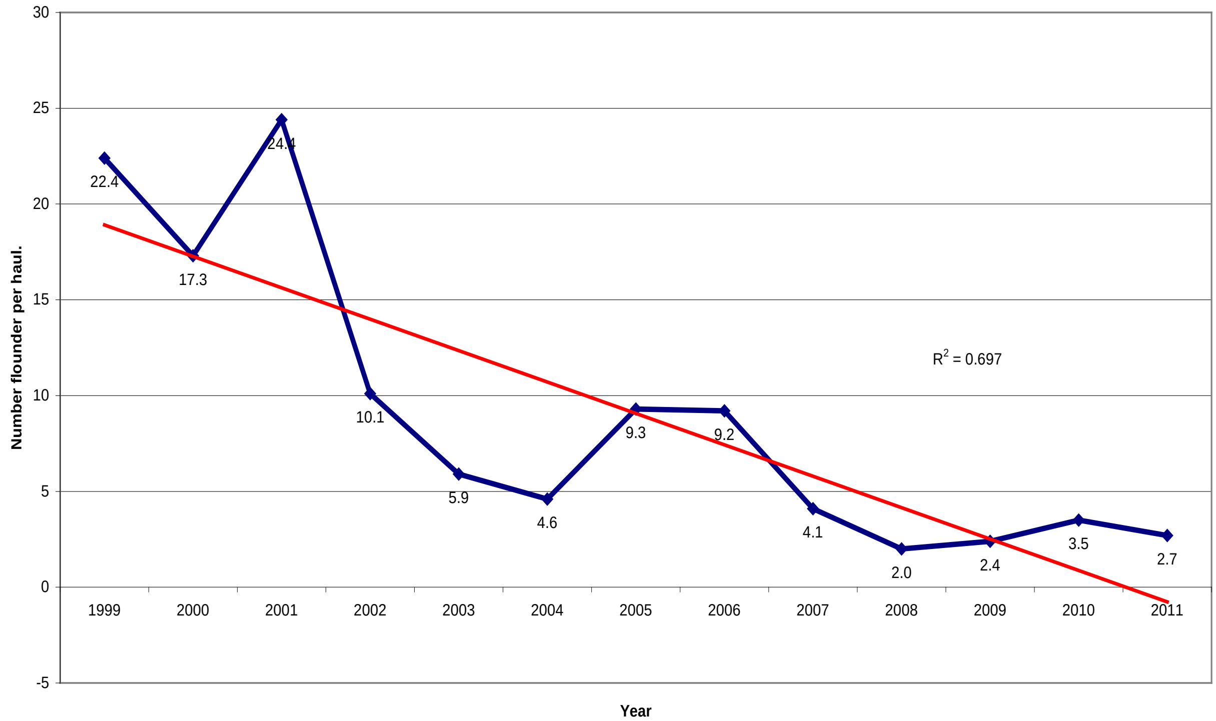
Results:

2011 Adult winter flounder CPUE decreased slightly to 2.7 fish per net haul or a 13% decrease from the 2010 value of 3.5 fish per net haul. This value is well below the time series high of 24.4 in 2001. The catch rates have showed a downward trend throughout the time series with the 2008 CPUE being the lowest point every recorded.



Other fishery independent monitoring:

The Rhode Island Division of Fish and Wildlife, Marine Fisheries Section conducts two beach seine surveys, in Narragansett Bay and in the south shore coastal ponds. The two surveys mirror each others findings but the connection between juvenile winter flounder abundance and the adult abundance is not clear.

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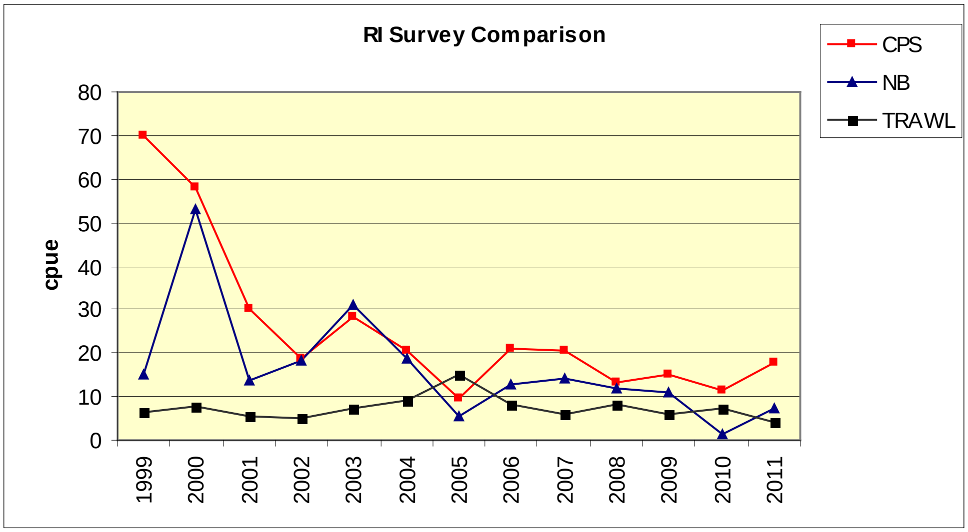

Discussion: Much lower catch rates are being observed in the later years of the adult coastal pond survey. For some time the data indicated that the problems found in nearby Narragansett Bay, were not as obvious in the south shore coastal ponds and that possibly, there were lower fishing mortality rates exhibited on the stocks that inhabit theses ponds and Block Island Sound.

Tag / Recapture data gives accurate estimations on population size and year class structure. These estimations depend on additional years and recapture data and therefore show the need for a more long-term approach to adult winter flounder assessments in Rhode Island south shore coastal ponds. Tag return rates for the survey time series are 13%. Almost the entire set of tag returns come from the recreational fishery which takes place in late April through early May in the coastal ponds, indicating the reluctance of the offshore commercial trawler fleet to supply information on flounder movements and mortality rates.

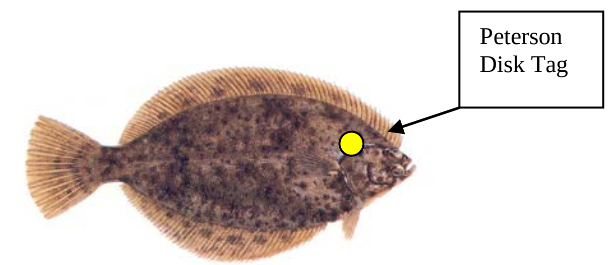

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Table 1 Mark / recapture data 1999 - 2011

Year	Number caught	Number tagged	Number recaptured
1999	1301	332	31

2000	417	208	31
2001	538	358	70
2002	265	182	18
2003	160	87	6
2004	102	64	14
2005	252	115	7
2006	416	91	9
2007	120	35	6
2008	42	14	2
2009	63	0	0
2010	85	19	0
2011	68	11	0
Total	3829	1516	194

Table 2 Mark recapture in subsequent years (Survey and Fishing Recaptures)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	% recap
1999	31	8	10	1	0	1	0	0	0	0	0	0	51	0.15361
2000		23	17	5	1	0	0	0	0	0	0	0	46	0.22115
2001			43	11	1	2	0	0	0	0	0	0	57	0.15922
2002				1	3	1	0	0	0	0	0	0	5	0.02747
2003					1	1	2	0	0	0	0	0	4	0.04598
2004						9	1	2	0	0	0	0	12	0.1875
2005							4	4	2	1	0	0	11	0.09565
2006								3	2	0	0	0	5	0.05495
2007									2	1	0	0	3	0.08571
2008										0	0	0	0	0
2009											0	0	0	0
2010												0	0	
2011												0	0	0
Total	31	31	70	18	6	14	7	9	6	2	0	0	194	0.12797

Table 3 Mark recapture in subsequent years (Fishing Recaptures Only)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	% recap
1999	26	6	6	0	0	1	0	0	0	0	0	0	39	0.11747
2000		18	9	0	1	0	0	0	0	0	0	0	28	0.13462
2001			39	2	1	2	0	0	0	0	0	0	44	0.12291
2002				1	3	1	0	0	0	0	0	0	5	0.02747
2003					1	1	2	0	0	0	0	0	4	0.04598
2004						9	1	2	0	0	0	0	12	0.1875
2005							1	3	2	1	0	0	7	0.06087
2006								1	1	0	0	0	2	0.02198
2007									2	1	0	0	3	0.08571
2008										0	0	0	0	0
2009											0	0	0	0
2010											0	0	0	0
2011												0	0	
Total	26	24	54	3	6	14	4	6	5	2	0	0	144	0.09499

Recommendations: Continuation of all adult winter flounder work statewide in order to make accurate connections between coastal pond, Narragansett Bay and Rhode Island/Block Island Sounds winter flounder stocks. Stress the importance of returning tag data from commercial trawl fleet in Rhode Island Sound and Block Island Sound as currently the majority of tag return data comes from recreational fishermen within the coastal pond.

Species captured:

Winter Flounder ***Pseudopleuronectes americanus***
Summer Flounder ***Paralicthes detatus***
Striped Bass ***Morone saxatilis***
White Perch ***Morone americana***
Atlantic Tomcod ***Microgadus tomcod***
Tautog ***Tautoga onitis***
Alewife ***Alosa pseudoharengus***
Atlantic Menhaden ***Brevortia tyrannus***
American Eel ***Anguilla rostrata***
Horseshoe Crab ***Limulus polyphemus***
American Lobster ***Homarus americanis***
Green Crab ***Carcinus maenas***
Atlantic Rock Crab ***Cancer irroratus***
Blue Crab ***Callinectes sapidus***
Longnose Spider Crab ***Libinia dubia***
Portly Spider Crab ***Libinia emarginata***

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Burnett M. 2005 Assessment of the Young of the Year Juveniles in Rhode Island Coastal Ponds.

Collette B. and Klein-MacPhee G. 2002 Bigelow and Schroeder's Fishes of the Gulf of Maine. 3rd edition

Powell C. J. 2006 Juvenile Finfish in Narragansett Bay Performance Report F-61-R-14

Saila, S. B. 1961. The contribution of estuaries to the offshore winter flounder fishery in Rhode Island . Proc. Gulf Carib. Fish. Inst.

Saila, S. B. 1962. Proposed hurricane barriers related to winter flounder movements in Narragansett Bay. Trans. American Fisheries Society

Assessment of Recreationally Important Finfish
Stocks in Rhode Island Coastal Ponds

Young of the Year Survey of Selected Rhode Island

Coastal Ponds and Embayments

by
John Lake
Principal Biologist (Marine Fisheries)
john.lake@dem.ri.gov

Rhode Island Department of Environmental Management
Division of Fish and Wildlife
Fort Wetherill Marine Fisheries Laboratory
3 Fort Wetherill Road
Jamestown, RI 02835

Federal Aid in Sportfish Restoration
F-61-R

Performance Report – Job4 March 2012

Performance Report

State: Rhode Island **Project Number**: F-61-R
Segment Number: 19

Project Title: Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters.

Period Covered: January 1, 2011 – December 31, 2011

Job Number & Title: Job 3 – Young of the Year Survey of Selected Rhode Island Coastal Ponds and Embayment's

Job Objectives: To collect, analyze, and summarize beach seine survey data from Rhode Island's coastal ponds and estuaries, for the purpose of forecasting recruitment in relation to the spawning stock biomass of winter flounder and other recreationally important species.

Summary: In 2011, Investigators caught 47 species of finfish representing 30 families. This number is similar to the 45 species from 29 families that were collected during 2010. Additionally, the numbers of individuals landed in 2011 decreased slightly from the 2010 survey; 20003 collected in 2011 and 20982 collected in 2010.

Target Date: 2012

Status of Project: On Schedule

Significant Deviations: During the 2011 sampling season three other Ponds were added to the survey (Green Hill, Potter's Pond, and the lower Pawcatuck River). The justification of the addition of these stations is found in appendix 2.

Recommendations: Continue into the next segment with the project as currently designed; continue at each of the 24 sample stations. The new stations in Green Hill Pond, Potter's Pond, and the lower Pawcatuck River should remain part of the survey moving forward. These stations provide additional information on population compositions in these ponds which previously were not being sampled.

Remarks:

During 2011, Investigators sampled twenty four traditional stations in four coastal ponds, Winnapaug Pond, Quonochontaug Pond, Charlestown Pond, Point Judith Pond, Green Hill Pond, Potter's Pond, Little Narragansett Bay and Narrow River. The additional station (PJ4) was also sampled all season long again and is now a permanent station. This station was added to better classify the fish populations in Point Judith Pond which has seen a significant decline in winter flounder abundance in the last 5 years. The station was selected due to its proximity to three fyke net sampling locations used in the Adult Winter Flounder Spawning Survey conducted during the winter months. (Figures 1-3) In addition to the new station in Point Judith Pond, Green Hill Pond, Potter's Pond and the lower Pawcatuck River were sampled all season long during 2011. The data from these ponds will provide information on population compositions in these ponds which have not been sampled in many years (early 1990s). The new stations for 2011 are displayed in figures 1-3. As mentioned above, please see Appendix 2 the proposal "Expanding the RIDFW Coastal Pond Juvenile Fish Survey to include Potter's Pond, Green Hill Pond, and Little Narragansett Bay" for justification and methodology for expanding the survey into these new ponds. For purposes of this report, the index value time series for young of the year (YOY) winter flounder will not include the data taken from the 8 new stations. For consistency, the time series species indices will only include the stations traditionally used in the past. The potential bias the new stations could introduce to the time series is unknown. This potential bias will be examined further when these samples have been sampled for a few more years. For the calculation of the annual catch per unit effort statistics for all species including winter flounder data from all stations will be used.

Materials and Methods:

As in previous years, investigators attempted to perform all seining on an incoming tide. To collect animals, investigators used a seine 130 ft. long (39.62m), 5.5 ft deep (1.67m) with ¼" mesh (6.4mm). The seine had a bag at its midpoint, a weighted footrope and floats on the headrope. Figure 4 describes the area covered by the seine net. The beach seine was set in a semi-circle, away from the shoreline and back again using an outboard powered 16' Lund aluminum boat. The net was then hauled toward the beach by hand and the bag was emptied into a large water-filled tote. All animals collected were identified to species, measured, enumerated, and sub-samples were taken when appropriate. Water quality parameters temperature, salinity and dissolved oxygen, were measured at each station. Figure 1 shows the location of the subject coastal ponds and the Narrow River, while figures 2 - 3 indicate the location of the sampling stations within each pond. The stations explored in Green Hill Pond, Potter's Pond, and the lower Pawcatuck River were all sampled using the same methodology.

Results and Discussion:

Winter Flounder (*Pseudopleuronectes americanus*)

Juvenile winter flounder were collected at all 24 stations over the course of the season. Winter flounder ranked third in overall species abundance (n=2021) in 2011, with the highest mean abundance, fish/seine haul, occurring in July (Table 1). Quonochontaug and Winnipaug Pond had their greatest mean abundance in August while Narrow River, Charlestown and Point Judith Ponds had their greatest mean abundance in July. Data from the new stations showed that both Potter's and Green Hill Ponds had peak abundances in May and that Pawcatuck River had its peak abundance in September. The greatest numbers of winter flounder were captured in July at Narrow River station number 2 where 171 individuals were captured. In 2011, winter flounder were caught at each of the stations in the survey including the new stations.

During 2011, 2,021 winter flounder were collected, up from the 1,164 collected in 2010. The juvenile winter flounder abundance index (YOY WFL index) for the survey measured using the mean fish/seine haul increased from 12.0 fish/seine haul in 2010 to 18.04 fish/seine haul in 2011. For the purposes of consistency, the YOY WFL index is only calculated using fish < 12 cm from the long term stations of the survey. Data collected from the new stations is not included in the index so as not to bias the results. A standardization methodology will be required to integrate this data into the overall YOY WFL index. Table 2 and figure 5b display the mean catch per seine haul (CPUE) of winter flounder for each month by pond during the 2011 survey. Figure 5a displays the abundance indices over the duration of the coastal pond survey. Figure 15 displays the annual abundance index for all stations combined.

With the exception of Winnipaug Pond, all of the other ponds in the survey trended upwards in 2011. Two other RIDFW surveys target juvenile and adult winter flounder, the Narragansett Bay Spring Seasonal Trawl Survey and the Narragansett Bay Juvenile Survey. A comparison of the Coastal Pond Survey to these other projects reveals that despite some slight differences, they display similar trends (Figure 16). The recent upward trend in 2011 is mirrored in the Narragansett Bay Seine Survey and Spring Trawl Survey WFL indices and is likely a result of regulations in place prohibiting possession in federal waters of Southern New England and only a 50 pound limit in State waters. The Narragansett Bay Seine Survey collects the most YOY WFL in June (McNamee Pers Comm). It should be noted that the Narragansett Bay Survey does not begin sampling until June and may miss those juvenile finfish which occur in May in the shallow coves etc. The 2010 Narragansett Bay Survey experienced its lowest abundance index value since its inception (cpue = 1.56), in 2011 the index value rebounded (cpue = 7.27) approaching a more average value for the time series but still on the low side. The Spring Trawl Survey collects the greatest number of Winter Flounder in April and May and is considered the best indicator for estimating local abundance especially for post spawn adults (Olszewski Pers Comm). The spring trawl index more than doubled from a low point of 3.67 WFL per tow in 2009 to 11.56

WFL per tow in 2010 then decreased to 7.53 WFL per tow in 2011. This small abundance peak in 2010 made up of mostly adults likely influenced the higher YOY abundances in the Seine surveys.

The time series of the survey shows that the ponds exhibit fluctuations of WFL abundance over time. One exception is Point Judith pond which has experienced a significant decline since 2000 and bottomed out at 0.89 fish/seine haul during 2010. In 2011, the over all YOY WFL index in Point Judith pond increased to 3.17 WFL per haul. This increase in abundance might reflect the recent no possession rule in the pond as well as the coast wide closure. Point Judith Pond is the only coastal pond where both a juvenile survey and an adult winter flounder survey occur annually. When relative abundance and number of WFL per seine haul of juvenile winter flounder are compared to the relative abundance and number of WFL per fyke net haul of the Adult Winter Flounder Tagging Survey, (Figure 17), a decline in relative abundance of winter flounder is observed in both surveys. The decline in adult spawner abundance and related decline in juvenile abundance does not support a fishery in the pond due to the lack of surplus production (Gibson, 2010). Given that winter flounder population shows an affinity for discrete spawning locations and the young of year tend to remain near the spawning location, the fish in this pond are in danger of depletion (Buckley et. al. 2008). A regulation was enacted 4/8/11 to close Point Judith Pond to both recreational and commercial fishing for winter flounder (RIMF Regulations Part 7 sec 8). Data from this survey and the Adult winter flounder spawning survey was the evidence used for justification of this regulation.

In 2011, juvenile winter flounder ranged in size from 1 to 35 cm, representing age groups 0-3+. Only two adult flounder (age 3+) were caught during the 2011 survey. The size range of animals collected is similar to those caught from 2004 through 2010 where the flounder ranged from 1 to 19 cm, 2 to 18 cm, 2 to 17 cm, 1 to 22, 1 to 19 cm, 2 to 19, and 2 to 18 respectively. Length frequency distributions indicate that the majority of individuals collected during sampling season were group 0 fish, less than 12 cm total length (Figure 6). During 2011, 99.36% of all winter flounder caught were <12 cm in length. The size ranges of these fish agree with ranges for young-of-the-year winter flounder in the literature (Able & Fahay 1998; Berry 1959; Berry et al. 1965). Mean monthly lengths for winter flounder are presented in Table 3. Length frequency distributions for coastal ponds by month are shown in Figures 7 -14. The WFL frequency histograms for each pond over time display two peaks in average size for YOY WFL during 2011 suggesting two cohorts or a protracted spawning event. This result is not uncommon to the Coastal Pond Survey and is best observed in 2011 in the Narrow River and Charlestown Pond (figures 7 and 9).

Winter Flounder YOY were caught in each of the new ponds and stations being sampled (Table 1). Green Hill pond and Potter's Pond station 1 display similar patterns of abundance of YOY WFL with the highest numbers of fish caught in May and decreasing to no fish found in August. Only one WFL was caught at Potter's pond station 1 during 2011. The WFL caught during May in Green Hill (Figure 8) and Potter's (Figure 9) Ponds are larger on average than WFL YOY caught in the other ponds (4 cm verses 2 cm respectively) suggested either an earlier spawning event or a higher growth rate. The water temperature in Green Hill was approximately 4 degrees Celsius higher than the average pond temperature for July and August (Table 13) and Potter's Pond station 1 had average temperatures but is located in an area with low tidal flushing. The dissolved oxygen recorded in July (5.84 mg/L) at Potter's Pond station 1 was the lowest on the survey. The abundance time series indicates that the YOY WFL in these two ponds are either experiencing mortality or are being displaced due to increasing water temperatures and/or decreasing dissolved oxygen. The Lower Pawcatuck River is a more open system than the other ponds sampled in the survey. Instead of an inlet breaching a barrier beach there is only a mostly sub tidal sandbar separating the water body from the ocean. With the exception of July the water temperatures are cooler than the average pond temperatures (Table 13). YOY WFL were caught at all three stations in the Lower Pawcatuck River with station 1 catching the most consistent numbers (Table 1). The new station in Point Judith Pond consistently catches high numbers of YOY

WFL than the other stations in the pond which is not surprising considering it was chosen due to its proximity to a known WFL spawning location.

Bluefish *(Pomatomus saltatrix)*

One hundred seventy six bluefish were collected in July, August, and September and occurred in Narrow River, Point Judith, Potter's, Pawcatuck River, and Quonochontaug Ponds. This is an increase from the 18 fish caught in 2010 and similar to the 158 individuals captured during 2009. The abundance index for 2011 was 1.23 fish/seine haul up considerably from the 2010 value of 0.15 fish/seine and similar to the value of 2.00 fish/seine haul observed in 2009. Table 4 contains the abundance indices for the survey by month and pond. Bluefish ranged in size from 5 cm to 19 cm. No adult bluefish were caught in 2011. It should be noted that the majority of bluefish, 146 fish, were caught at station PR -2 in August. Figure 18 displays the annual abundance index of bluefish for all stations combined.

Tautog (*Tautoga onitis*)

Seventy six tautog were collected between May and October in each of the ponds except Green Hill and Potter's ponds. This is a decrease from the 2010 catch of 48 individuals. The total survey 2011 abundance index was 0.53 fish/seine haul up slightly from the 2010 abundance index of 0.47 fish/seine haul. Table 5 contains the abundance indices for the survey by month and pond. The highest abundances in 2011 occurred in Charlestown Pond. Tautog caught in 2011 ranged in size from 2 cm to 18 cm. Figure 19 displays the annual abundance index of tautog for all stations combined.

Black Sea Bass (*Centropristis striata*)

A total of 97 juvenile black sea bass were collected during August, September, and October from each of the ponds except Green Hill and Potter's Pond in 2011. This is much more than the 7 fish that were caught in 2010 and similar to the 159 fish collected in 2009. The highest abundances were found in Charlestown Pond. The total survey 2011 abundance index was 0.69 fish/seine haul up considerably from the 2010 abundance index of 0.7 fish/seine haul and approaching the high 2009 value of 2.0 fish/seine haul. Table 5 contains the abundance indices for the survey by month and pond. Black sea bass caught in 2011 ranged in size from 3 cm to 8 cm. Figure 20 displays the annual abundance index of black sea bass for all stations combined.

Scup *(Stenotomus chrysops)*

Five juvenile scup were collected during the 2011 in July, August and October in Charlestown, and Point Judith Ponds similar to the 8 caught in 2010. The total survey abundance index was 0.03 fish per haul. Table 7 contains the abundance indices for the survey by month and pond. Scup caught in 2011 ranged in size from 5 cm to 9 cm. Figure 21 displays the annual abundance index of scup for all stations combined.

Clupeids:

In 2011 three species of clupeids were caught in the coastal pond survey, Atlantic menhaden (*Brevoortia tyrannus*), Atlantic herring (*Clupea harengus*), and Alewife (*Alosa pseudoharengus*).

Two hundred and thirteen alewives were captured in Narrow River, Charlestown, Point Judith, Potter's, and Winnipaug Ponds between June and July. The total survey abundance was 1.49 fish / seine haul. Twenty one Atlantic menhaden were caught in Quonochontaug, Potter's and Winnipaug Ponds as well as Narrow and Pawcatuck Rivers between August and October during 2011. The total survey abundance was 0.15 fish /seine haul. There were no big schools of YOY menhaden captured in 2011. Twenty nine Atlantic herring were collected in Narrow River, Point Judith and Charlestown Ponds during May and June. The total survey abundance was 0.20 fish / seine haul. Table 8 contains the abundance indices for culpeids by month pooled across all 5 ponds. Figures 22a and 22b display the annual abundance index of clupeids for all stations combined. Menhaden are plotted separately due to scale issues.

Baitfish Species:

Atlantic Silversides *(Menidia sp.)*

Silversides had the highest abundance of all species with 9453 caught during the 2011 survey, up compared to the 7937 silversides collected in 2010. Silversides were collected in each of the ponds throughout the time period of the survey (June – October). The highest abundances were observed in Charlestown Pond. The total survey abundance index was 66.10 fish / seine haul. Table 9 contains the abundance indices for the survey by month and pond. Atlantic silversides caught in 2011 ranged in size from 1 cm to 13 cm.

Striped Killifish *(Fundulus majalis)*

Striped killifish ranked fourth in species abundance with 1765 fish caught during 2011. This value is lower than the 2665 fish caught during 2010. They occurred in each of the ponds and were caught each month during the survey. Quonochontaug Pond had the highest abundance of striped killifish. The total survey abundance index was 12.34 fish / seine haul. Table 10 contains the abundance indices for the survey by month and pond. Striped killifish caught in 2011 ranged in size from 2 cm to 12 cm.

Common Mummichog *(Fundulus heteroclitus)*

The mummichog was second in overall abundance in 2011 with 3,070 individuals collected. This value is an increase from 2,831 mummichogs collected in 2010. Mummichogs occurred in each of the ponds and were caught each month during the survey. Point Judith Pond had the highest abundances of Mummichogs. The total survey abundance index was 21.47 fish / seine haul. Table 11 contains the abundance indices for the survey by month and pond. Mummichogs caught in 2010 ranged in size from 2 cm to 9 cm.

Sheepshead Minnow *(Cyprinodon variegatus)*

The Sheepshead minnow ranked sixth in overall abundance with 446 individuals collected. This is a decrease from the 897 fish caught in 2010. Sheepshead minnow occurred in each of the ponds and were caught each month during the survey. Charlestown Pond had the highest abundances of Sheepshead minnows. The total survey abundance index was 3.12 fish / seine haul. Table 12 contains the abundance indices for the survey by month and pond. Sheepshead minnow caught in 2010 ranged in size from 2 cm to 5 cm.

Figure 23 displays the annual abundance index of the baitfish species for all stations combined.

Physical and Chemical Data:

Physical and Chemical data for the 2011 Coastal Pond Survey is summarized in tables 13 – 15. Water temperature in 2011 averaged 20.9 ºC, with a range of 12.8ºC in May to 30.1 ºC in July. Salinity ranged from 7.33 ppt to 30.0 ppt, and averaged 24.9 ppt. Monthly average dissolved oxygen ranged from 7.7 mg/l in May to 9.1 mg/l in June, with an average of 8.22 mg/l.

New Station Preliminary Data

Appendix 2 outlines the justification for new stations to be added to the survey for 2011 (Figures 1-3). During 2011, each of the new stations was sampled or the entire survey with the exception of station PR-3 in the Pawcatuck river. Appendix 1b shows the species caught at each of the stations. The species assemblage at the new stations is similar to that of the traditional stations. I will give a description of each station by pond.

Green Hill Pond: Green Hill Pond is a small coastal pond located east of Charlestown Pond. It does not open directly to the ocean, instead its only inlet is via Charlestown Pond and is thus not well flushed. Green Hill pond has water quality issues including high summer temperatures, high nutrient load, and a permanent shellfish closure. GH – 1 is in the northeastern quadrant of the pond on a small island. The bottom substrate is mud with shell hash. GH – 2 is in the southeastern quadrant of the pond on a sand bar. The bottom substrate is muddy fine sand. WFL YOY were caught in relatively high abundance, 29.0 fish/ seine haul, in May suggesting spawning activity within the pond. The WFL YOY decreased in abundance at the stations in July and August when the water was warm and were not caught frequently after it had cooled in the fall. Other species frequently present in the pond are the baitfish species, naked goby, and blue crabs.

Potter's Pond: Potter's Pond is a small coastal pond located west of Point Judith Pond. Similarly to Green Hill Pond, it does not open directly to the ocean; instead its only inlet is via Point Judith Pond. The local geography is such that the tide flushes the pond more than in Green Hill. The inlet to Potter's Pond is closer to the inlet to Point Judith Pond and its inlet is shorter. PP – 1 is in the southwestern quadrant of the pond in a shallow cove. The bottom substrate is mud. PP – 2 is in the northwestern quadrant of the pond adjacent to a deep (~25') glacial kettle hole. The bottom substrate is fine sand with some cobble. WFL YOY were caught at both stations but only PP – 1 with high frequency. Similarly to the Green Hill stations WFL YOY were highest in May and decreased in abundance as the season progressed. The water temperature in Potter's Pond does not get as warm as Green Hill Pond but still may be a factor at station PP – 1. The geography of this station does not facilitate flushing and water quality may explain the lack of WFL YOY in mid summer. Water temperatures are higher than the pond proper and dissolved oxygen was lower in that section of the pond. The rest of the pond does not have the same water quality issues. Other species frequently caught in the pond include the baitfish species, American eel, oyster toad fish, naked goby, tautog, and blue crabs.

Lower Pawcatuck River: The lower Pawcatuck River or Little Narragansett Bay is the mouth of a coastal estuary formed by the Pawcatuck River. It is different form the other stations on the survey in that it does not have a traditional barrier beach pierced by an inlet; instead it is relatively open to Block Island Sound. PR – 1 is a small protected beach in a small cove surrounded by large boulders. The bottom substrate is fine sand. This station had the most consistent catch of WFL YOY which were present during all months of the survey. PR – 2 is located on a sand bar island in the middle of Little Narragansett Bay on the protected side. This sand bar is all that is left of a larger barrier beach which existed prior to the 1938 hurricane. The bottom substrate is coarse sand. This station caught WFL YOY but at lower frequencies that PR – 1, the highest catch number was observed in October. PR – 3 was originally located in the southern part of Little Narragansett Bay on the protected side of Napatree Beach. After it was initially sampled in May, the station was relocated because it was extremely shallow and a high wave energy area. PR – 3 is currently located in the northern section of Little Narragansett Bay at the mouth of the river near G. Willie Cove. The station is on a *Spartina spp*. covered bank at the head of G. Willie Cove. The bottom substrate is cobble. This station was selected to best characterize the species assemblage in the Lower Pawcatuck River as the majority of the shoreline consists of marsh grass covered banks. WFL YOY were not present in high frequencies at the station which is not unexpected due to the bottom substrate. Other species frequently caught in the river include the baitfish species, Tomcod, Menhaden, and Bluefish.

Point Judith Pond: The new station PJ – 4 is located in the eastern section of the pond on Ram Island. The bottom substrate is silty sand with some large cobble. The station was selected because of its proximity to three fyke net stations sampled during the Adult Winter Flounder Spawner Survey. As mentioned in Appendix 2, the station was added to better classify the species in the pond and to better document the decline of WFL YOY in the pond. The station had higher catch frequencies of WFL YOY than the other stations in the pond combined but still is low in comparison to the other ponds.

The first year of sampling the new stations successfully collected target species, notably WFL YOY. It is recommended that these stations be sampled into the future so as to continue to provide species assemblage information from these coastal ponds. The additional catch frequencies and distributions of WFL YOY will provide a better understanding of the population, notably in areas where the fish only occur in the spring / early summer. Further analysis will be required to integrate data from these new stations into the traditional abundance indices. Until then the data will be presented separately for the time series indices but not for the annual information.

Summary

In 2011, Investigators caught 47 species of finfish representing 30 families. This number is similar to the 45 species from 29 families that were collected during 2010. Additionally, the numbers of individuals landed in 2011 decreased from the 2010 survey, 20003 and 20982 individuals respectively. Appendix 1 displays the frequency of all species caught by station during the 2011 Coastal Pond Survey. Additional data is available by request.

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Table 1: 2011 Coastal Pond Survey Winter Flounder Frequency by station and month

Station	May	Jun	Jul	Aug	Sep	Oct	Totals	Mean	STD
CP1	11	34	82	96	8	3	**234**	**39.00**	**40.41**
CP2	10	24	12		3	3	**52**	**10.40**	**8.62**
CP3	1	22	27	11	2		**63**	**12.60**	**11.67**
CP4		2			1		**3**	**1.50**	**0.71**
GH1	33	9	1			1	**44**	**11.00**	**15.14**
GH2	25	1	1		1		**28**	**7.00**	**12.00**
NR1	43	34	45				**122**	**40.67**	**5.86**
NR2	9	133	171	29	38	40	**420**	**70.00**	**65.57**
NR3	11	11	145	21	49	14	**251**	**41.83**	**52.54**
PJ1		2	1	4	1		**8**	**2.00**	**1.41**
PJ2		2	22	1	1	2	**28**	**5.60**	**9.18**
PJ3		16			5		**21**	**10.50**	**7.78**
PJ4	1	2	49	12		1	**65**	**13.00**	**20.65**
PP1	29	10		1	1	4	**45**	**9.00**	**11.77**
PP2					1		**1**	**1.00**	
PR1	2	5	15	25	31	4	**82**	**13.67**	**12.13**
PR2		3	2	2		6	**13**	**3.25**	**1.89**
PR3			2	2			**4**	**2.00**	**0.00**
QP1	4	21	7	3	17	19	**71**	**11.83**	**8.06**
QP2	1	8	43	37	1	1	**91**	**15.17**	**19.52**
QP3	14	10	31	66	20	12	**153**	**25.50**	**21.24**
WP1		28	45	31	16	4	**124**	**24.80**	**15.55**
WP2		30	5	6	6	1	**48**	**9.60**	**11.59**
WP3		3	3	37	1	6	**50**	**10.00**	**15.20**
Totals	**194**	**410**	**709**	**384**	**203**	**121**	**2021**		
Mean	**13.86**	**18.64**	**35.45**	**22.59**	**10.68**	**7.56**	**84.21**		
STD	**13.47**	**27.88**	**47.46**	**26.03**	**14.39**	**10.11**	**97.72**		

Table 2: 2011 Coastal Pond Survey winter flounder abundance indices (fish/seine haul) by pond and month

Pond	May	June	July	August	September	October
Charlestown Pond	5.5	20.5	30.3	26.8	3.5	1.5
Green Hill Pond	29.0	5.0	1.0	0.0	0.5	0.5
Narrow River	21.0	59.3	120.3	16.7	29.0	18.0
Point Judith Pond	0.3	5.5	18.0	4.3	1.8	0.8
Potter's Pond	14.5	5.0	0.0	0.5	1.0	2.0
Pawcatuck River	1.0	2.7	6.3	9.7	10.3	3.3
Quonochontaug Pond	6.3	13.0	27.0	35.3	12.7	10.7
Winnipaug Pond	0.0	20.3	17.7	24.7	7.7	3.7
Total	**8.4**	**17.1**	**29.5**	**16.0**	**8.5**	**5.0**

Table 3: 2011 Coastal Pond Survey average lengths of juvenile winter flounder by pond and month.

Pond	May	June	July	August	Sepember	October

Charlestown Pond	3.3	5.2	5.3	5.5	6.9	6.8
Green Hill Pond	4.7	6.2	6.4		6.8	5.0
Narrow River	4.1	4.6	4.9	4.3	4.7	5.5
Point Judith Pond	3.2	5.3	5.4	6.4	6.6	6.1
Potter's Pond	4.3	9.1			9.5	
Pawcatuck River	10.2	4.3	4.8	5.3	7.0	7.0
Quonochontaug Pond	3.1	4.9	4.8	5.0	6.6	7.0
Winnipaug Pond		3.5	4.2	5.8	5.5	7.2

Table 4: 2011 Coastal Pond Survey bluefish abundance indices (fish/seine haul) by pond and month

Pond	**May**	**June**	**July**	**August**	**September**	**October**
Charlestown Pond	0.0	0.0	0.0	0.0	0.0	0.0
Green Hill Pond	0.0	0.0	0.0	0.0	0.0	0.0
Narrow River	0.0	0.0	2.3	0.3	0.3	0.0
Point Judith Pond	0.0	0.0	1.5	0.3	0.0	0.0
Potter's Pond	0.0	0.0	0.0	0.5	0.5	0.0
Pawcatuck River	0.0	0.0	0.3	48.3	0.0	0.0
Quonochontaug Pond	0.0	0.0	4.0	0.0	0.0	0.0
Winnipaug Pond	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**1.1**	**6.2**	**0.1**	**0.0**

Table 5: 2011 Coastal Pond Survey tautog abundance indices (fish/seine haul) by pond and month

Pond	**May**	**June**	**July**	**August**	**September**	**October**
Charlestown Pond	0.3	0.0	0.0	2.8	8.8	1.5
Green Hill Pond	0.0	0.0	0.0	0.0	0.0	0.0
Narrow River	0.0	0.0	0.0	0.0	0.3	0.0
Point Judith Pond	0.0	0.0	0.3	1.5	1.5	1.0
Potter's Pond	0.0	0.0	0.0	0.0	0.0	0.0
Pawcatuck River	0.0	0.0	0.0	0.3	0.3	0.0
Quonochontaug Pond	0.0	0.3	0.0	0.0	0.0	0.0
Winnipaug Pond	0.0	0.0	0.0	0.7	0.0	0.0
Total	**0.0**	**0.0**	**0.0**	**0.8**	**1.8**	**0.4**

Table 6: 2011 Coastal Pond Survey black sea bass abundance indices (fish/seine haul) by pond and month

Pond	May	June	July	August	September	October
Charlestown Pond	0.0	0.0	0.0	0.3	6.5	1.0
Green Hill Pond	0.0	0.0	0.0	0.0	0.0	0.0
Narrow River	0.0	0.0	0.0	0.0	7.0	0.7
Point Judith Pond	0.0	0.0	0.0	4.5	0.0	0.5
Potter's Pond	0.0	0.0	0.0	0.0	0.0	0.0
Pawcatuck River	0.0	0.0	0.0	0.0	4.7	0.0
Quonochontaug Pond	0.0	0.0	0.0	0.0	0.7	0.0
Winnipaug Pond	0.0	0.0	0.0	0.3	2.0	0.0
Total	**0.0**	**0.0**	**0.0**	**0.8**	**2.9**	**0.3**

Table 7: 2011 Coastal Pond Survey Scup abundance indices (fish/seine haul) by pond and month

Pond	May	June	July	August	September	October
Charlestown Pond	0.0	0.0	0.5	0.3	0.0	0.0
Green Hill Pond	0.0	0.0	0.0	0.0	0.0	0.0
Narrow River	0.0	0.0	0.0	0.0	0.0	0.0
Point Judith Pond	0.0	0.0	0.0	0.3	0.0	0.3
Potter's Pond	0.0	0.0	0.0	0.0	0.0	0.0
Pawcatuck River	0.0	0.0	0.0	0.0	0.0	0.0
Quonochontaug Pond	0.0	0.0	0.0	0.0	0.0	0.0
Winnipaug Pond	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**0.1**	**0.1**	**0.0**	**0.0**

Table 8: 2011 Coastal Pond Survey Clupeid abundance indices (fish/seine haul) by month

Species	May	June	July	August	September	October
Alewife	0.0	0.1	8.8	0.0	0.0	0.0
Atlantic Menhaden	0.0	0.0	0.0	0.6	0.2	0.1
Atlantic Herring	1.2	0.1	0.0	0.0	0.0	0.0
Blueback Herring	0.0	0.0	0.0	0.0	0.0	0.0

Table 9: 2011 Coastal Pond Survey Atlantic Silverside abundance indices (fish/seine haul) by pond and month

Pond	May	June	July	August	September	October
Charlestown Pond	32.5	43.5	208.0	161.0	53.8	20.8
Green Hill Pond	9.5	5.0	11.5	381.0	76.0	3.0
Narrow River	12.0	5.0	16.7	42.7	85.0	23.0
Point Judith Pond	9.0	269.3	20.8	130.5	50.8	31.5
Potter's Pond	14.5	21.5	2.5	24.0	14.5	26.0
Pawcatuck River	0.5	14.0	17.3	124.7	234.3	3.3
Quonochontaug Pond	13.0	241.7	40.0	172.7	31.3	4.7
Winnipaug Pond	148.0	3.7	13.0	56.7	56.3	24.0
Total	**31.9**	**87.4**	**50.2**	**131.9**	**75.8**	**18.0**

Table 10: 2011 Coastal Pond Survey Striped Kilifish abundance indices (fish/seine haul) by pond and month

Pond	May	June	July	August	September	October
Charlestown Pond	6.3	0.0	9.5	15.5	6.0	7.8
Green Hill Pond	30.0	5.0	15.5	0.0	4.0	4.5
Narrow River	0.0	7.3	0.0	0.0	0.7	0.0
Point Judith Pond	1.5	3.3	0.3	7.0	32.0	4.5
Potter's Pond	0.0	1.5	0.0	9.5	27.5	1.0
Pawcatuck River	0.0	0.0	0.0	75.7	1.3	17.7
Quonochontaug Pond	0.0	0.0	5.7	46.0	77.7	19.3
Winnipaug Pond	15.3	43.7	0.0	9.0	72.7	6.0
Total	**6.0**	**7.5**	**3.6**	**20.9**	**28.0**	**7.9**

Table 11: 2011 Coastal Pond Survey Mumichog abundance indices (fish/seine haul) by pond and month

Pond	May	June	July	August	September	October
Charlestown Pond	6.8	10.5	22.0	4.3	54.5	13.5
Green Hill Pond	9.0	52.5	88.0	8.0	20.0	10.5
Narrow River	3.0	61.3	44.0	0.3	0.0	0.0
Point Judith Pond	0.3	4.0	26.3	103.0	2.3	0.8
Potter's Pond	23.0	105.5	38.5	27.0	52.5	5.5
Pawcatuck River	0.0	0.0	9.3	0.0	31.0	0.0
Quonochontaug Pond	21.3	0.0	71.7	24.0	12.3	4.7
Winnipaug Pond	4.3	8.0	34.0	61.0	8.3	0.7
Total	**7.7**	**24.3**	**38.5**	**31.5**	**22.0**	**4.4**

Table 12: 2011 Coastal Pond Survey Sheepshead Minnow abundance indices (fish/seine haul) by pond and month

Pond	May	June	July	August	September	October

Charlestown Pond	0.3	0.0	1.8	0.5	29.8	16.3
Green Hill Pond	0.0	0.0	0.0	0.0	0.0	22.0
Narrow River	0.0	4.0	0.0	0.0	0.0	0.0
Point Judith Pond	0.0	0.3	0.3	0.3	0.5	0.3
Potter's Pond	0.0	0.0	0.0	0.5	2.5	0.0
Pawcatuck River	0.0	0.0	0.0	0.0	0.0	1.3
Quonochontaug Pond	0.0	0.0	0.7	0.0	11.7	31.7
Winnipaug Pond	0.0	0.0	0.0	0.3	15.7	0.0
Total	**0.0**	**0.5**	**0.4**	**0.2**	**8.7**	**8.7**

Table 13: 2011 Coastal Pond Survey average water temperature (degrees Celcius) by pond and month

Station	**May**	**June**	**July**	**August**	**September**	**October**
Charlestown Pond	16.23	23.88	24.08	26.23	23.18	16.18
Green Hill Pond	21.65	26.45	29.80	26.50	18.55	15.40
Narrow River	13.30	20.67	24.60	24.00	22.57	17.90
Point Judith Pond	15.95	22.90	24.28	25.63	19.20	18.85
Potter's Pond	16.70	23.10	25.05	25.95	18.25	18.70
Pawcatuck River	16.50	21.17	24.67	23.57	19.90	15.43
Quonochontaug Pond	17.43	19.57	24.80	23.10	18.10	15.20
Winnipaug Pond	14.43	19.00	25.97	25.10	19.60	17.57
Average	16.52	22.09	25.40	25.01	19.92	16.90

Table 14: 2011 Coastal Pond Survey average salinity (ppt) by pond and month
Note: No dissolved oxygen measurements were taken in Narrow River in June.

Station	**May**	**June**	**July**	**August**	**September**	**October**
Charlestown Pond	26.07	26.31	26.58	27.05	25.91	26.81
Green Hill Pond	21.02	21.08	22.83	19.99	19.37	19.09
Narrow River	24.23		21.47	24.63	24.65	25.41
Point Judith Pond	25.97	26.05	27.07	27.16	26.95	26.82
Potter's Pond	23.35	24.90	25.77	26.30	22.99	24.47
Pawcatuck River	21.74	22.31	20.01	15.73	20.59	16.93
Quonochontaug Pond	27.76	28.40	27.92	27.33	27.79	23.94
Winnipaug Pond	26.52	27.64	26.21	27.39	27.24	27.89

Table 15: 2011 Coastal Pond Survey average dissolved oxygen (mg/l) by pond and month Note: No dissolved oxygen measurements were taken in Narrow River in June.

Station	**May**	**June**	**July**	**August**	**September**	**October**
Charlestown Pond	7.23	9.79	8.17	7.34	8.21	8.48
Green Hill Pond	7.34	7.17	6.06	8.69	8.40	9.07
Narrow River	8.07		6.68	6.97	7.50	8.03

Point Judith Pond	7.95	8.37	7.88	9.86	9.03	8.27
Potter's Pond	7.16	9.08	7.33	7.64	7.28	7.14
Pawcatuck River	8.37	9.24	9.14	7.58	10.09	8.54
Quonochontaug Pond	7.43	9.85	7.65	7.66	8.18	8.40
Winnipaug Pond	8.24	9.87	8.76	8.39	7.72	8.25

Figure 1: Location of coastal ponds sampled by the Coastal Pond Juvenile Finfish Survey in Southern Rhode Island.

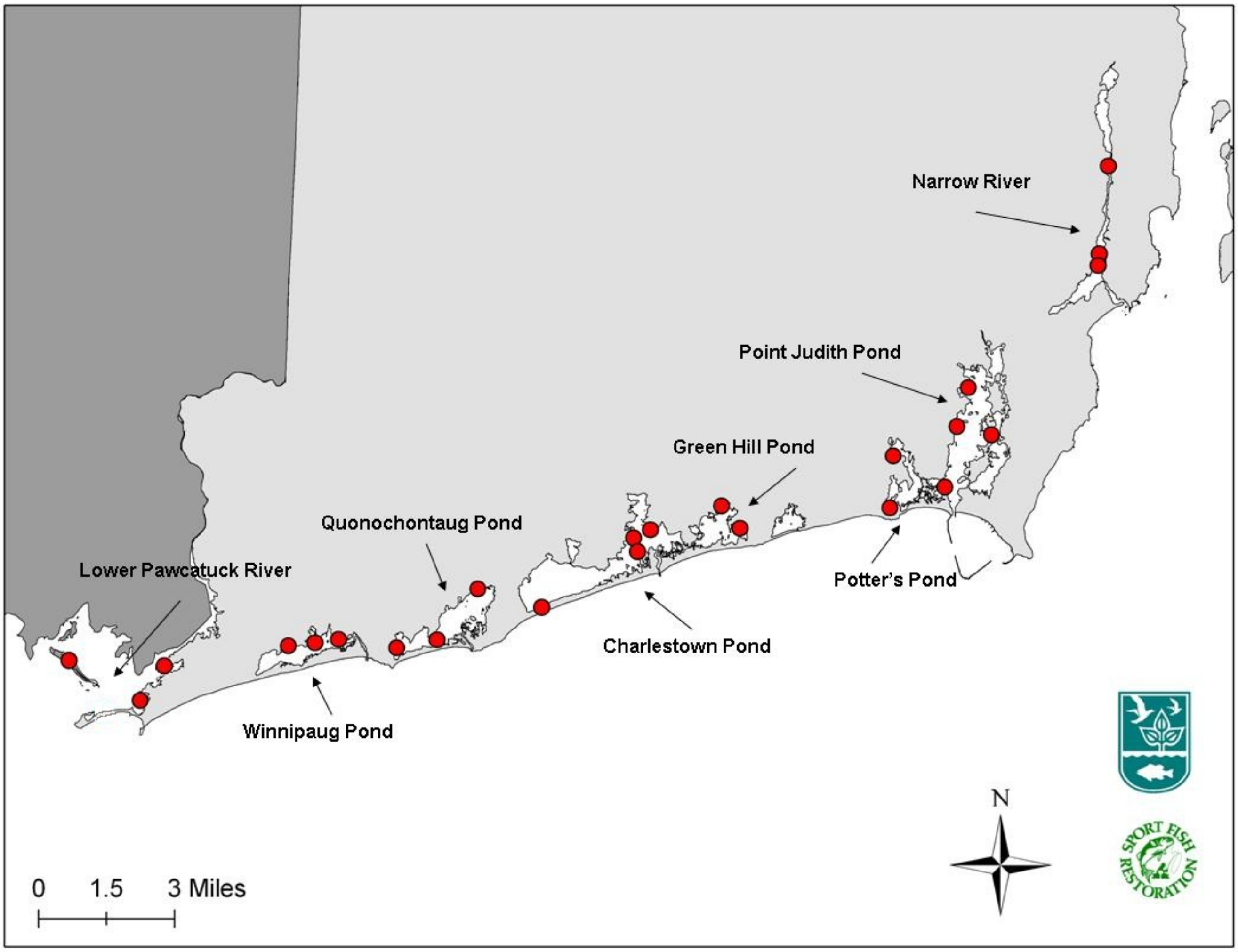


Figure 2: Coastal Pond Juvenile Finfish Survey station locations (western ponds).

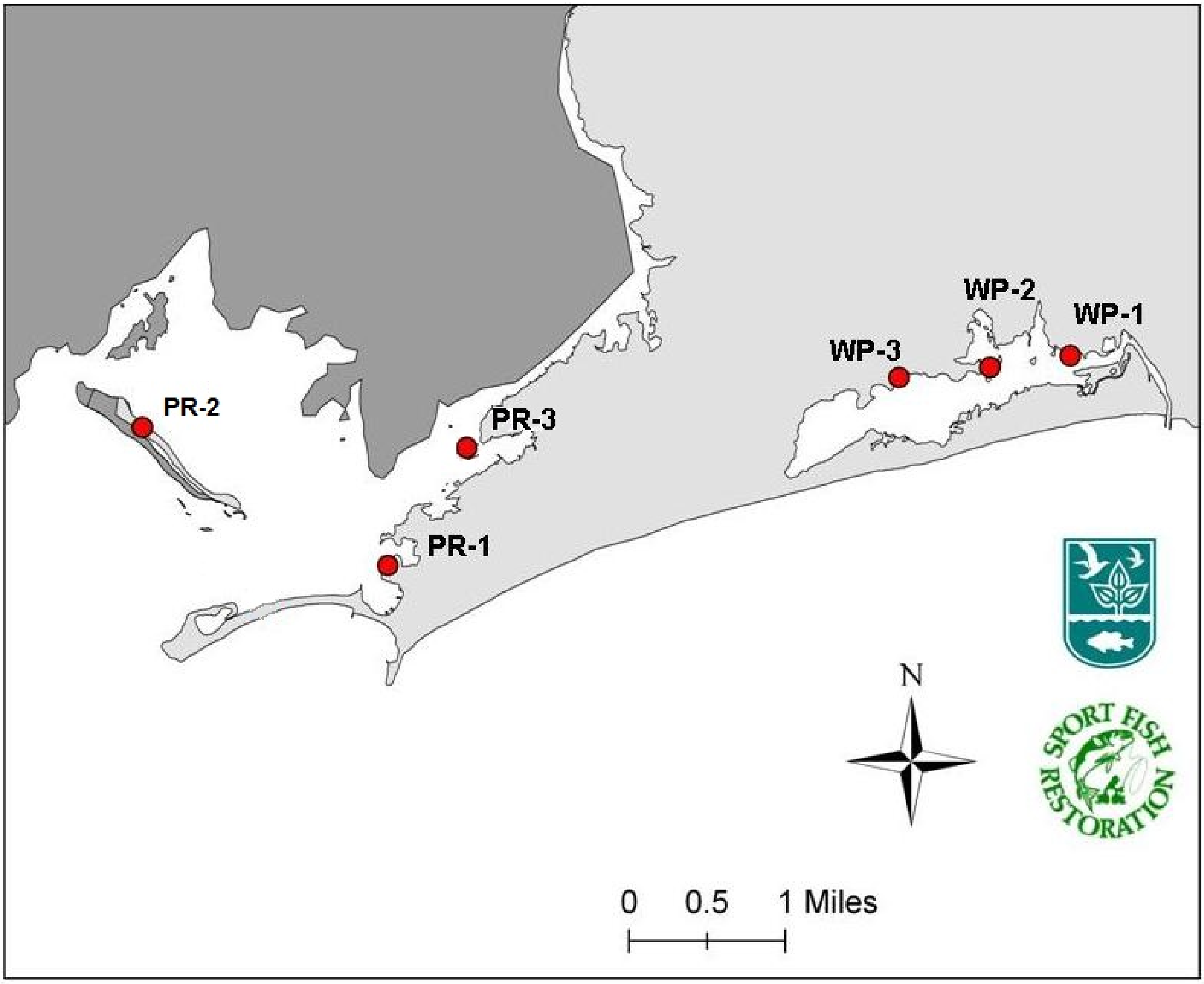


Figure 2 (cont): Coastal Pond Juvenile Finfish Survey station locations (western ponds).

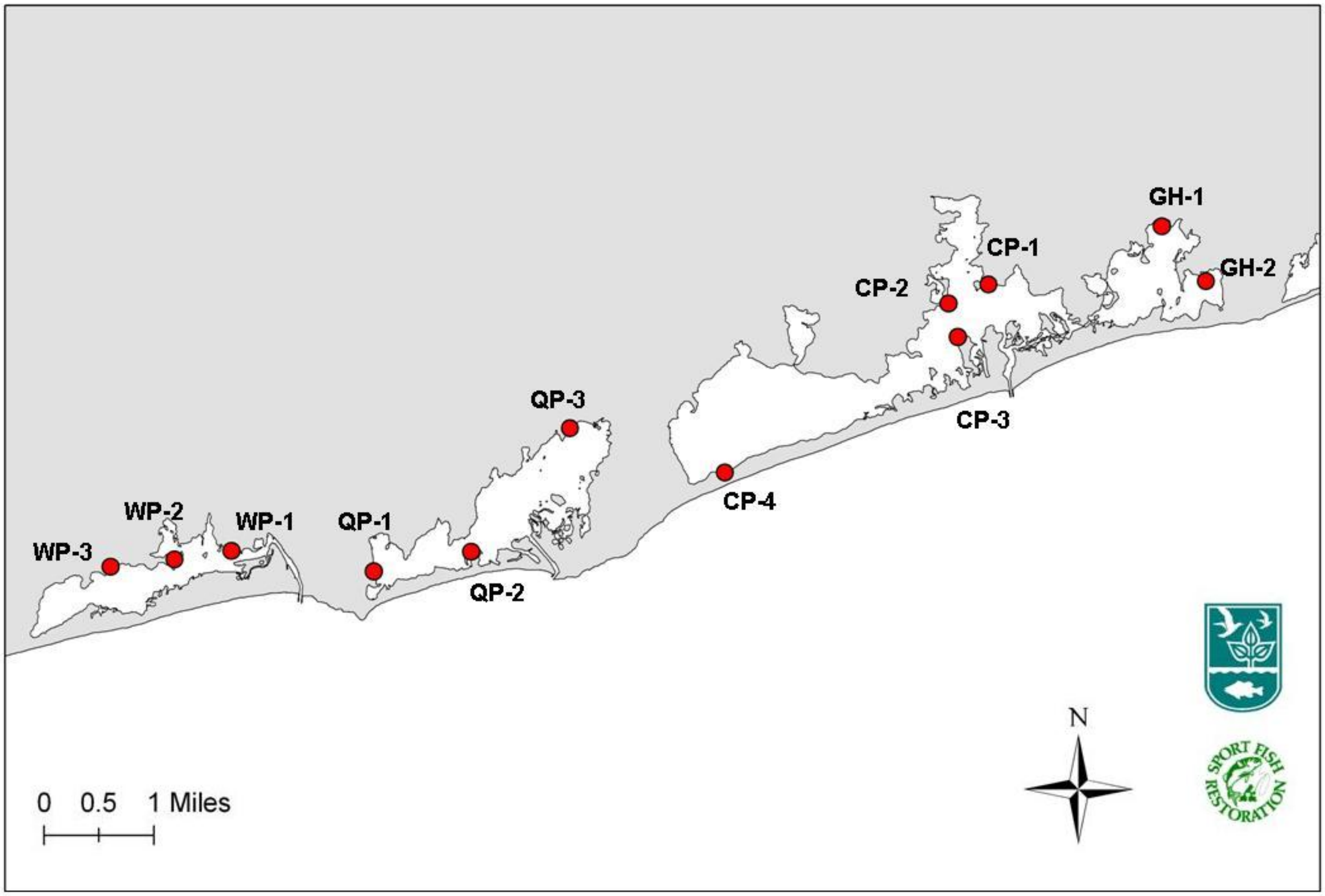


Figure 3: Coastal Pond Juvenile Finfish Survey station locations (eastern ponds).

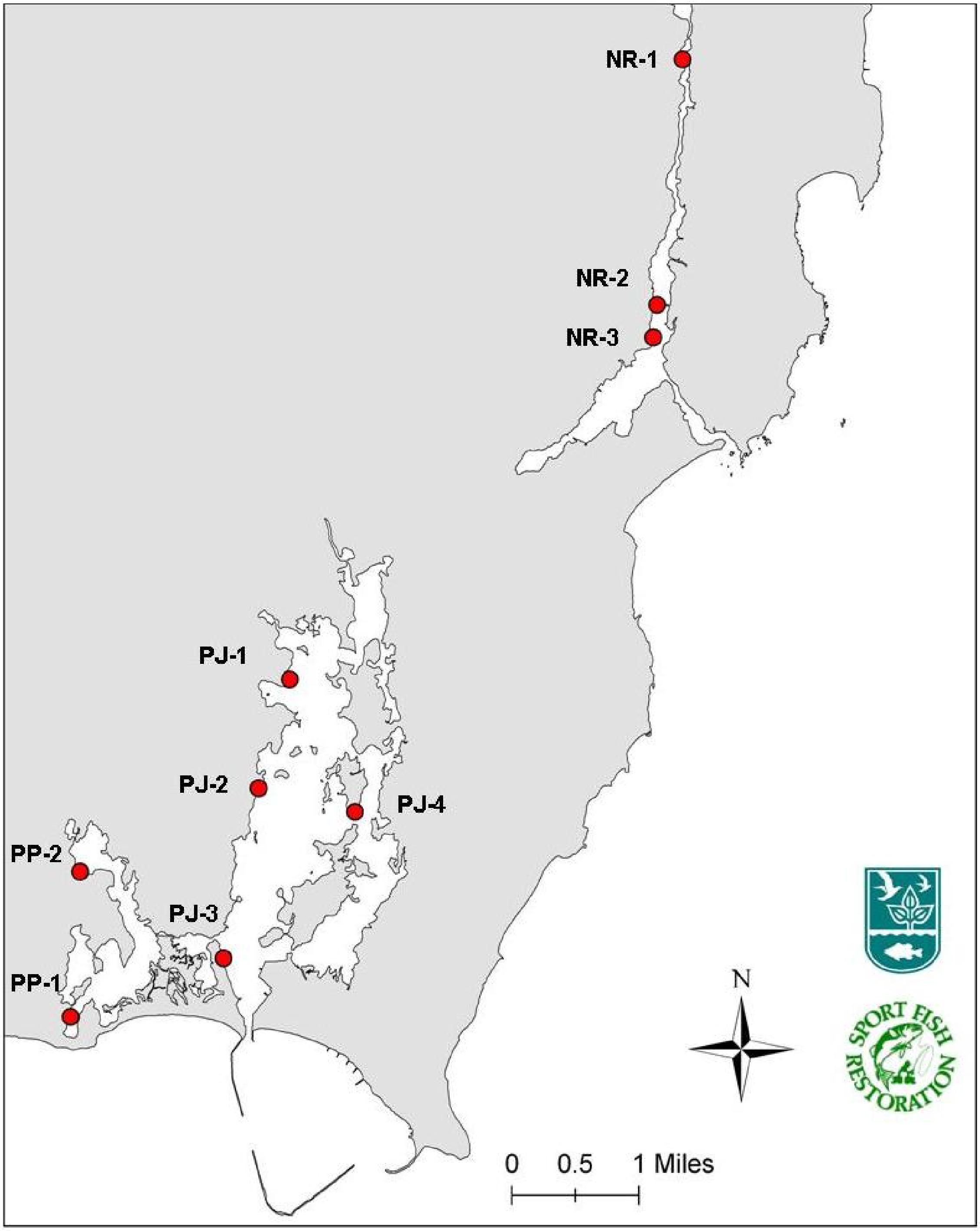

NR-1
NR-2
NR-3
PJ-1
PJ-2
PJ-4
PP-2
PJ-3
PP-1
N
SPORT FISH RESTORATION
0
0.5
1 Miles

Figure 4
Coastal Pond Juvenile Finfish Survey

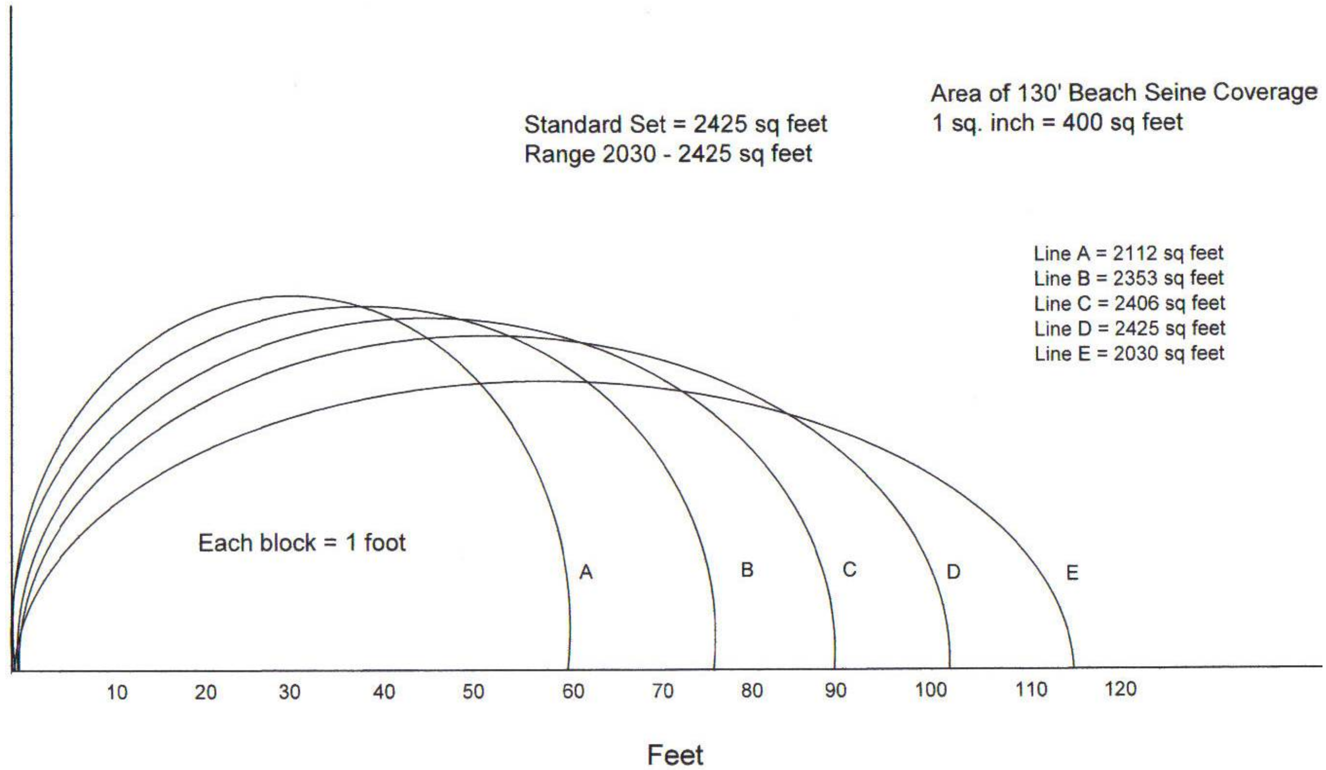


Figure 5a: Time series of abundance indices (fish/seine haul) for winter flounder YOY from each Coastal Pond in the survey.

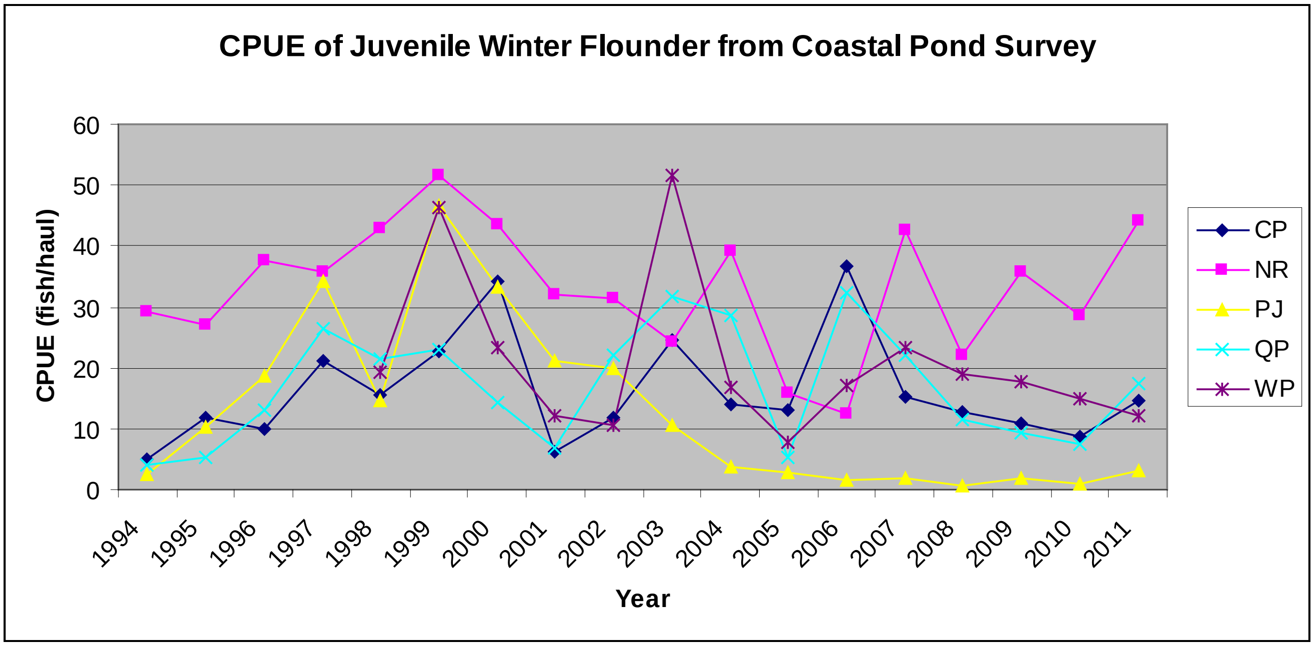


Figure 5b: 2011 time series of abundance indices (fish/seine haul) by month for winter flounder YOY for each Coastal Pond in the survey.

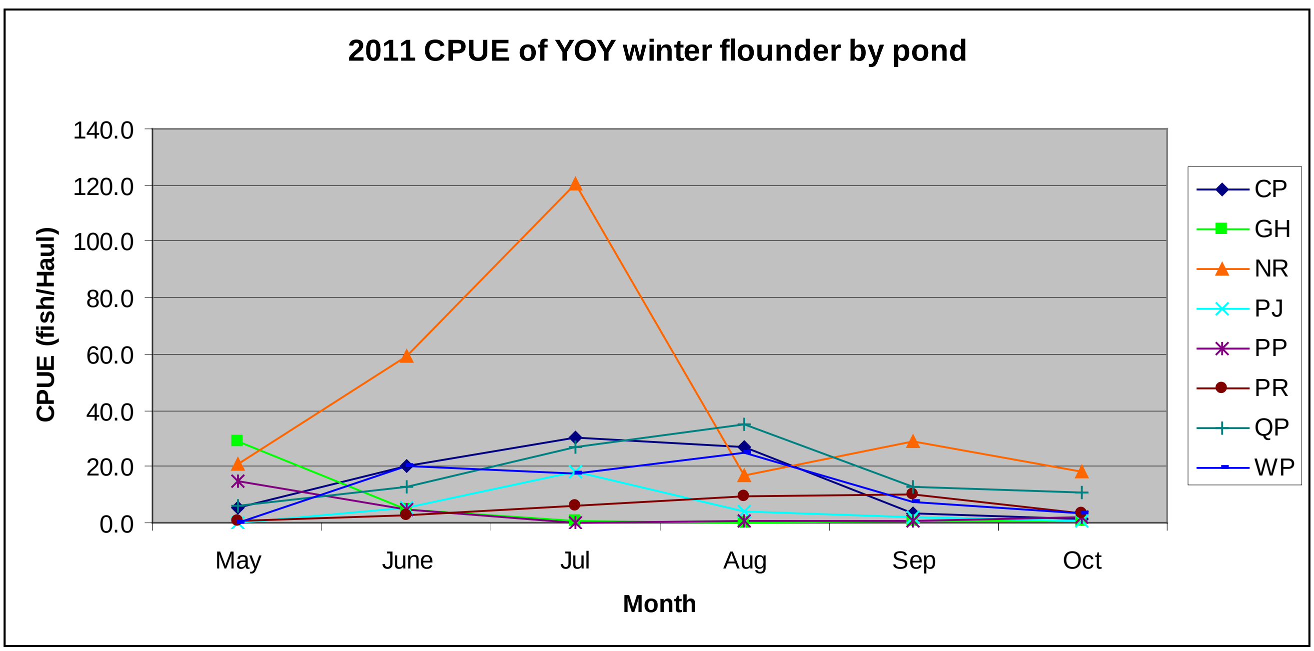


Figure 6: Length frequency of all juvenile winter flounder caught in Coastal Pond Survey during 2011.

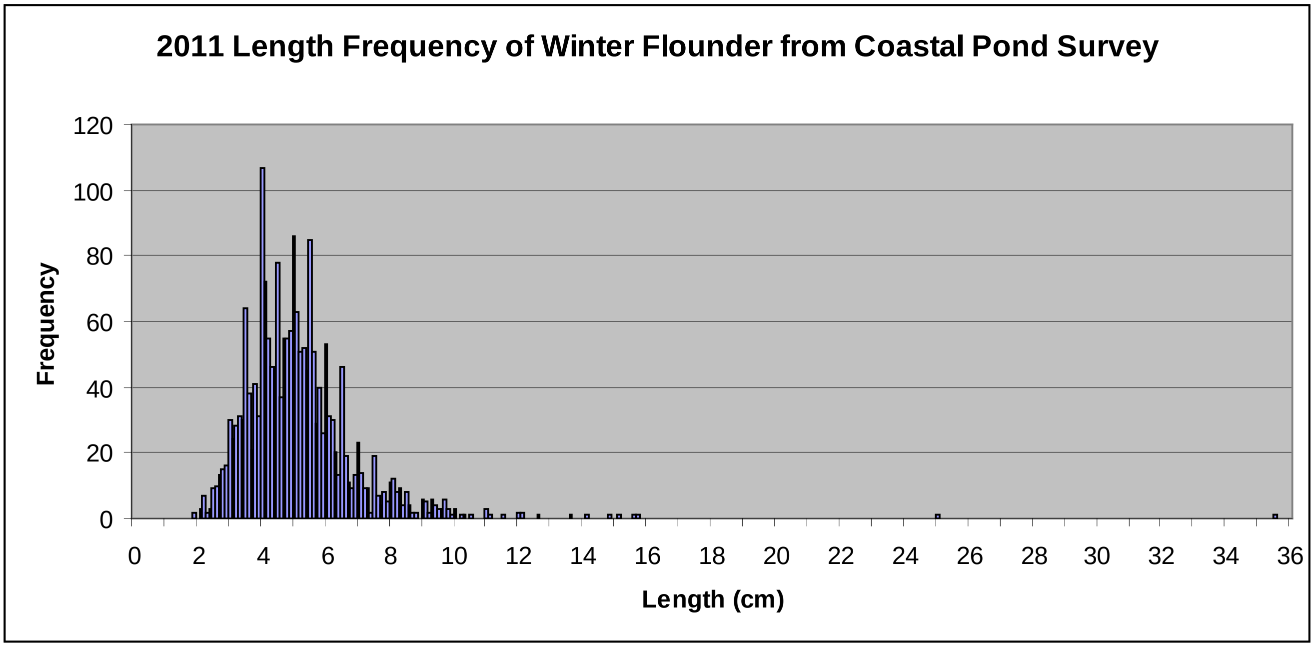
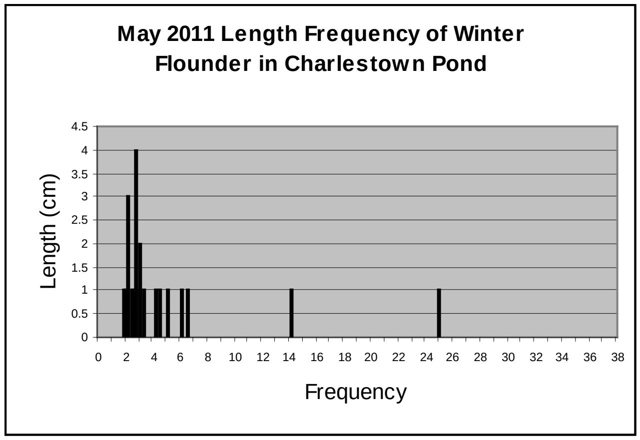
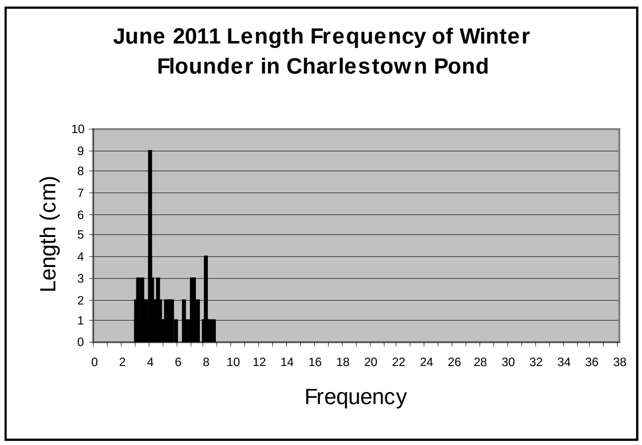
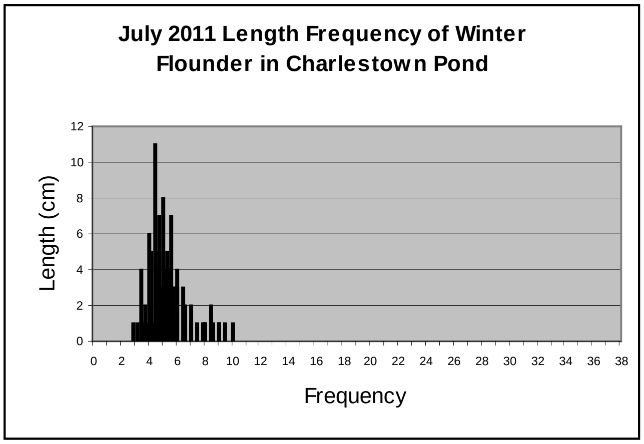
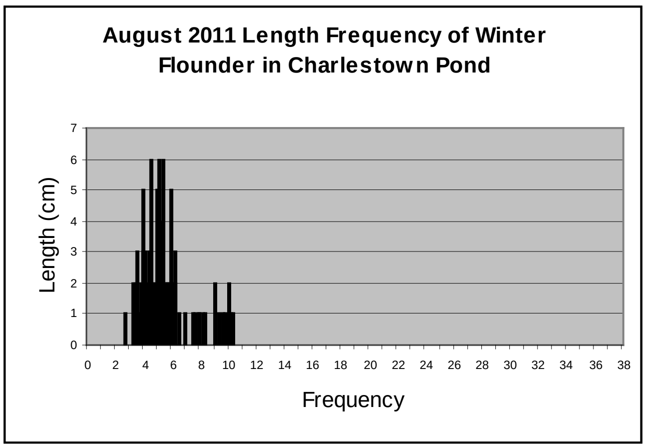


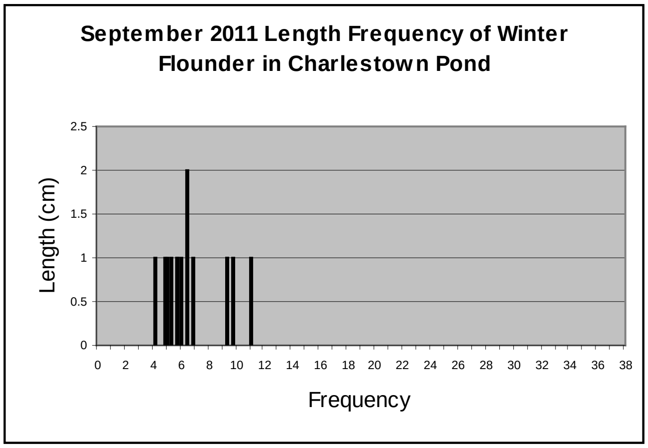
Figure 7: Monthly length frequency of winter flounder from Charlestown Pond, 2011.






July 2011 Length Frequency of Winter Flounder in Charlestown Pond
Length (cm)
0
2
4
6
8
10
12
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency


August 2011 Length Frequency of Winter Flounder in Charlestown Pond
Length (cm)
0
1
2
3
4
5
6
7
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency


September 2011 Length Frequency of Winter Flounder in Charlestown Pond
Length (cm)
Frequency
0
0.5
1
1.5
2
2.5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38

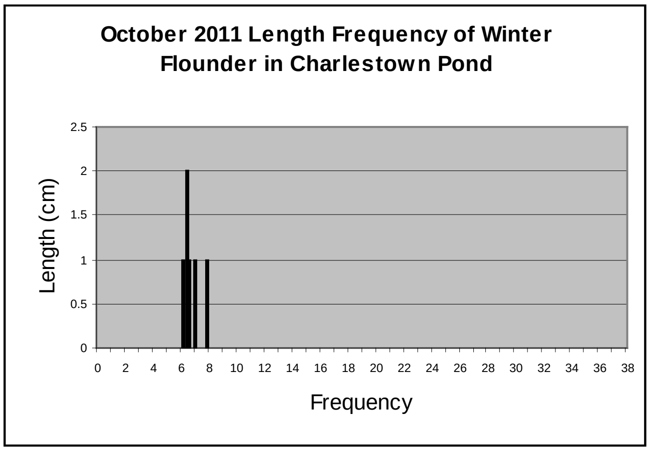
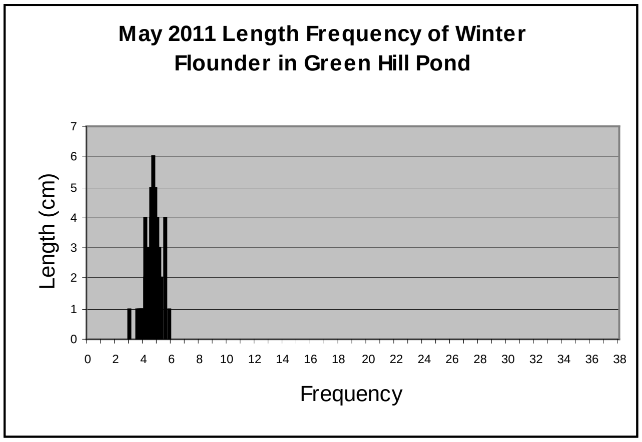
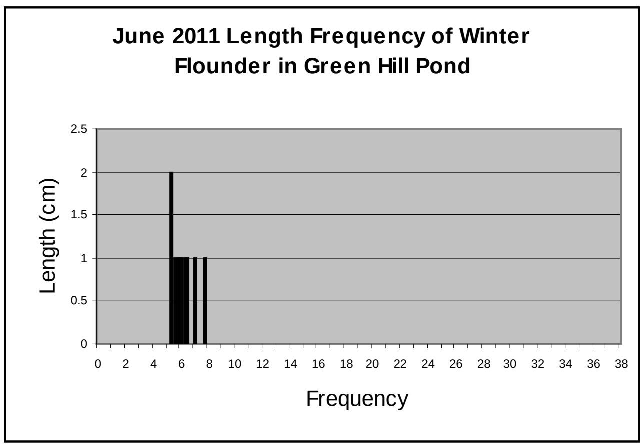
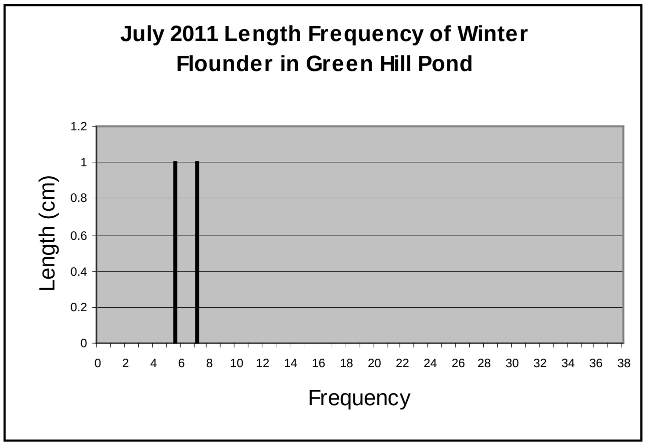
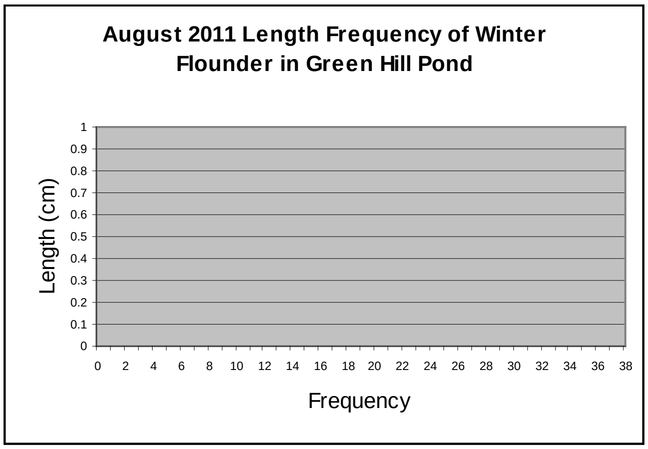

October 2011 Length Frequency of Winter Flounder in Charlestown Pond
Length (cm)
Frequency
0
0.5
1
1.5
2
2.5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38

Figure 8: Monthly length frequency of winter flounder from Green Hill Pond, 2011.

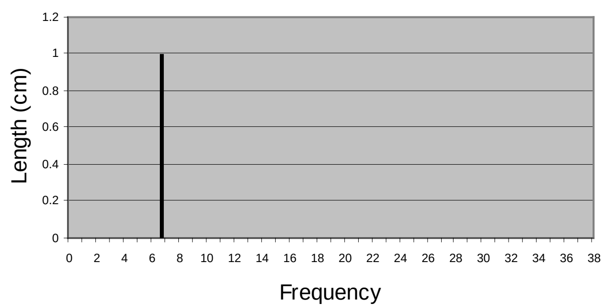





July 2011 Length Frequency of Winter Flounder in Green Hill Pond
1.2
1
0.8
0.6
0.4
0.2
0
Length (cm)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency


August 2011 Length Frequency of Winter Flounder in Green Hill Pond
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Length (cm)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency

September 2011 Length Frequency of Winter Flounder in Green Hill Pond



October 2011 Length Frequency of Winter Flounder in Green Hill Pond

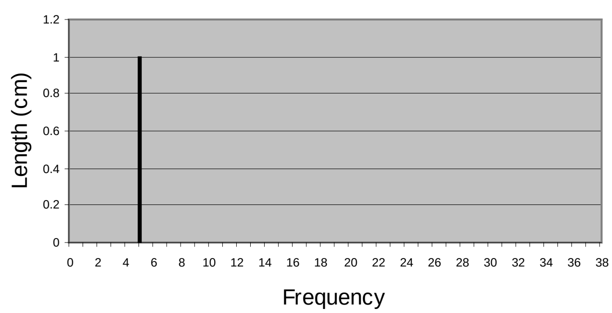
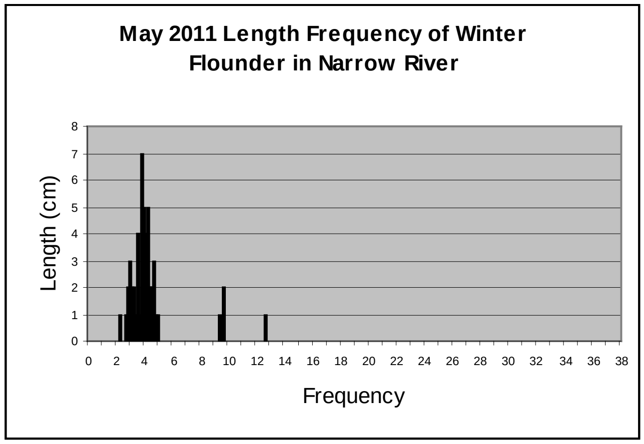
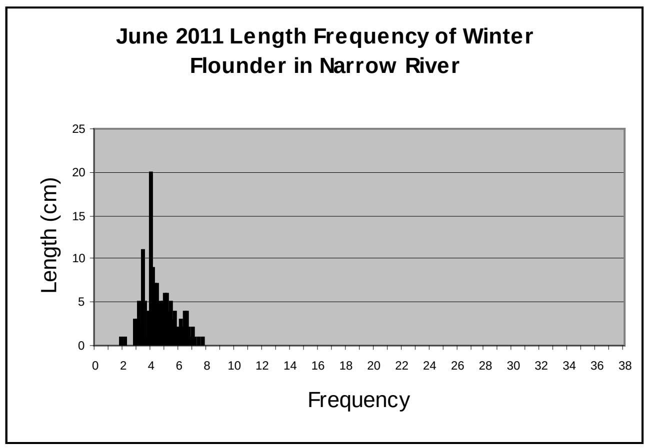
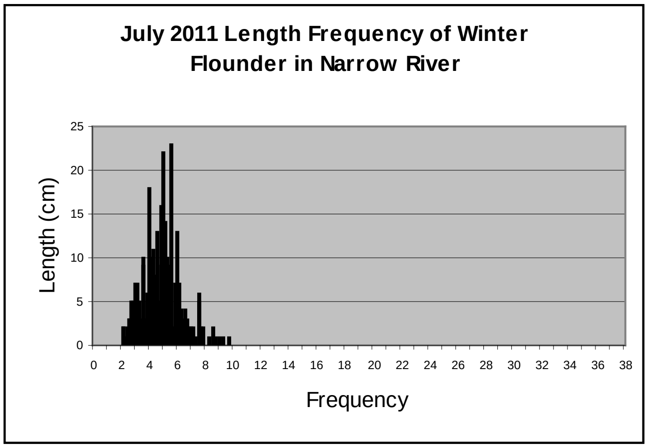
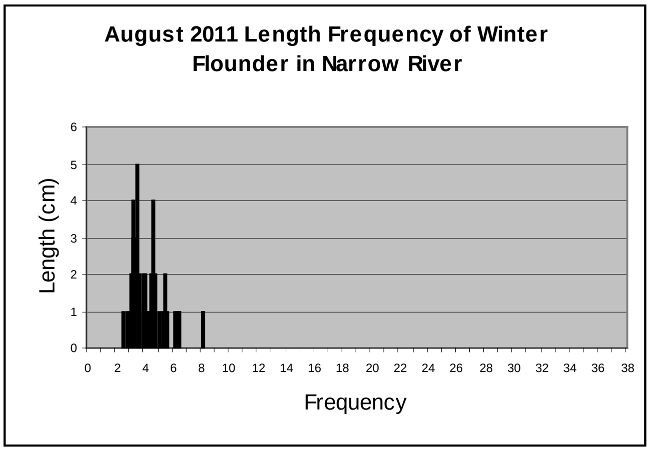


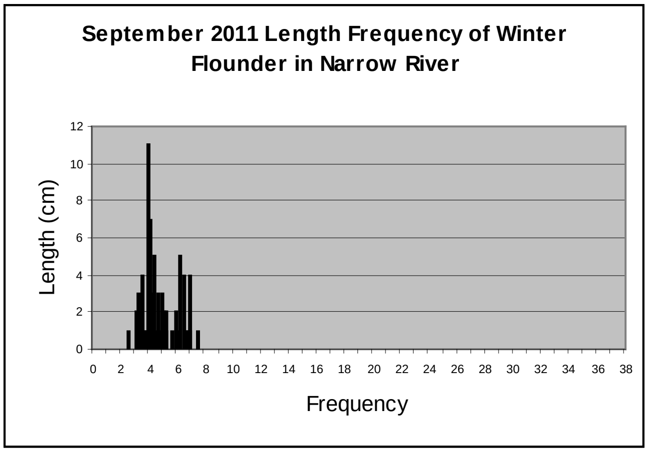
Figure 9: Monthly length frequency of winter flounder from Narrow River, 2011.






July 2011 Length Frequency of Winter Flounder in Narrow River
Length (cm)
Frequency
0
5
10
15
20
25
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38


August 2011 Length Frequency of Winter Flounder in Narrow River
Length (cm)
Frequency
0
1
2
3
4
5
6
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38


September 2011 Length Frequency of Winter Flounder in Narrow River
Length (cm)
Frequency
0
2
4
6
8
10
12
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38

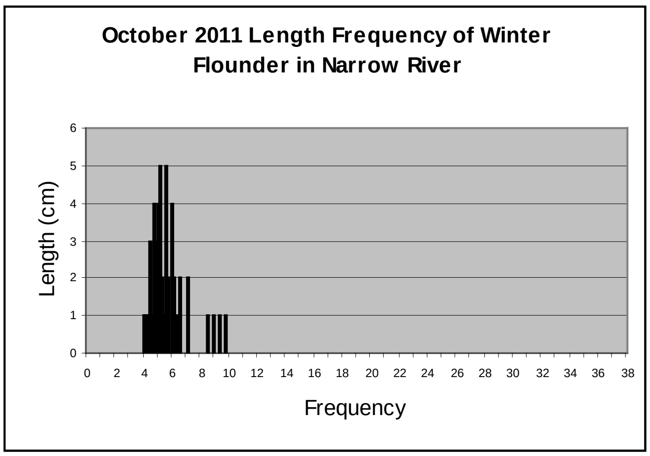
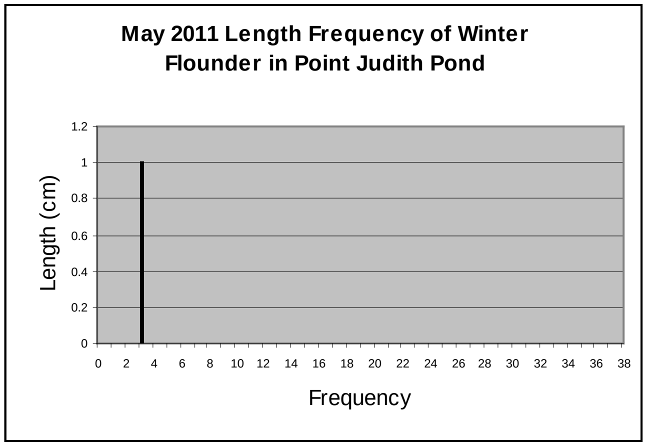
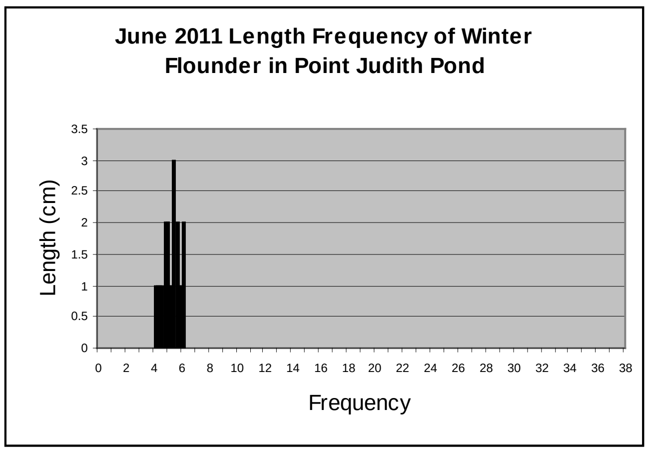
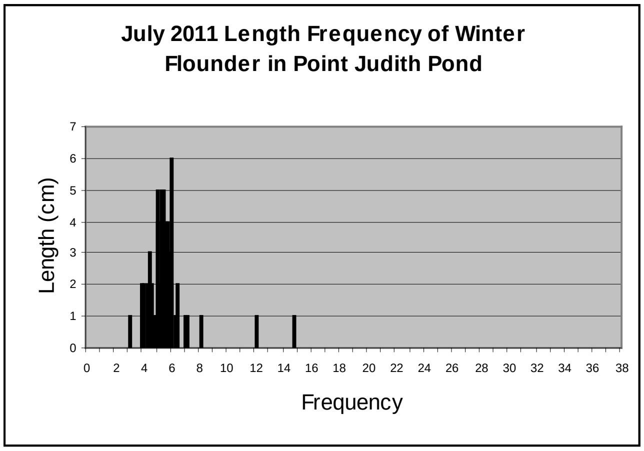
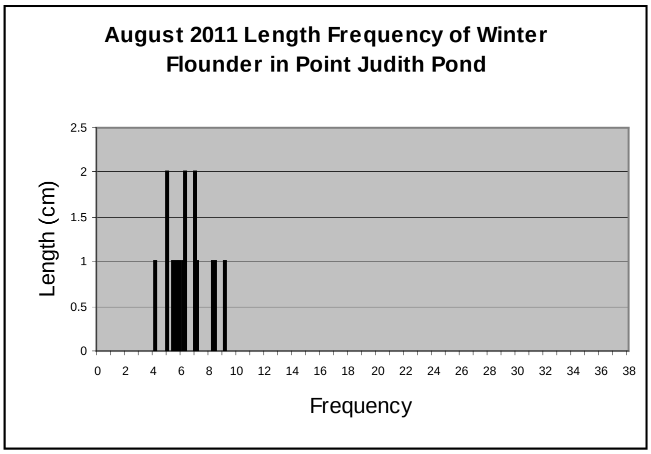

October 2011 Length Frequency of Winter Flounder in Narrow River
Length (cm)
Frequency
0
1
2
3
4
5
6
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38

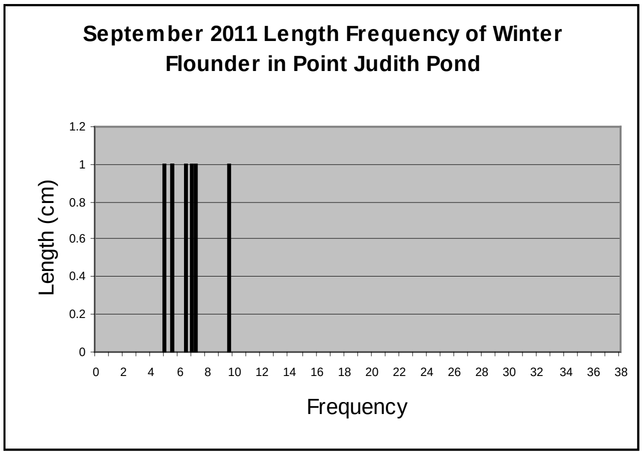
Figure 10: Monthly length frequency of winter flounder from Point Judith Pond, 2011.






July 2011 Length Frequency of Winter Flounder in Point Judith Pond
Length (cm)
Frequency
0
1
2
3
4
5
6
7
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38


August 2011 Length Frequency of Winter Flounder in Point Judith Pond
Length (cm)
Frequency
0
0.5
1
1.5
2
2.5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38


September 2011 Length Frequency of Winter Flounder in Point Judith Pond
Length (cm)
1.2
1
0.8
0.6
0.4
0.2
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency

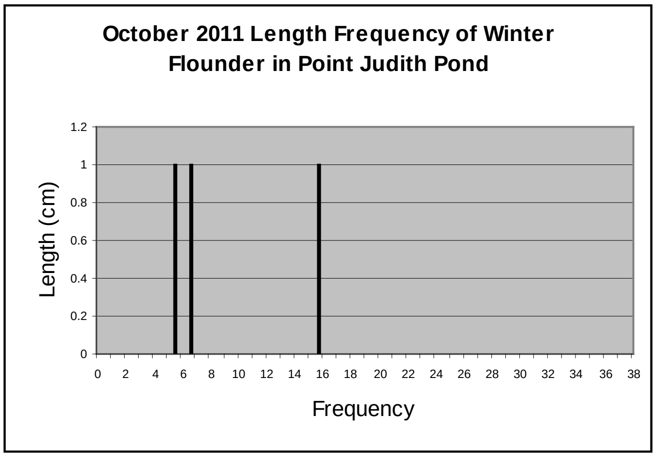
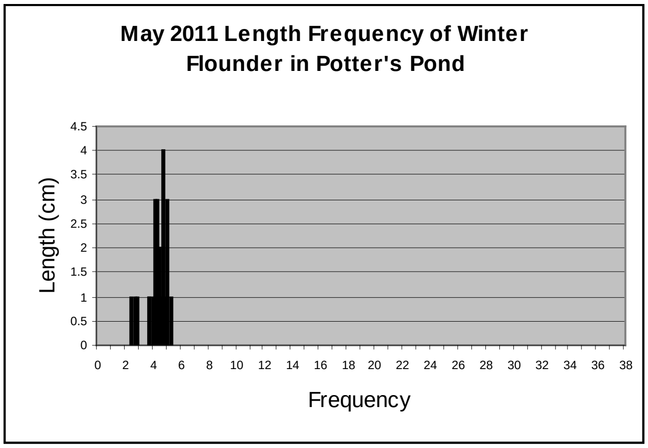
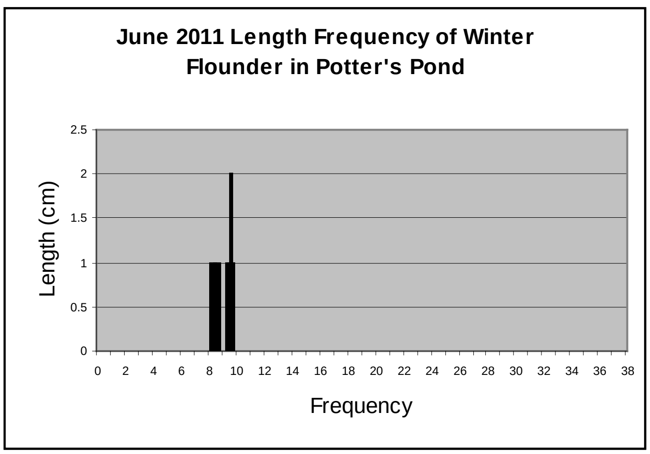
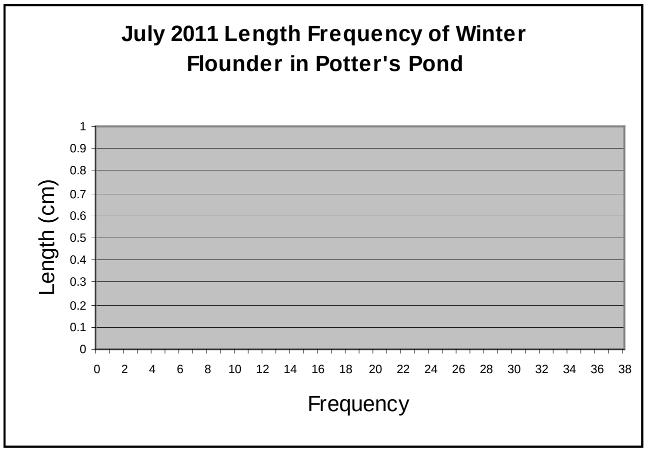
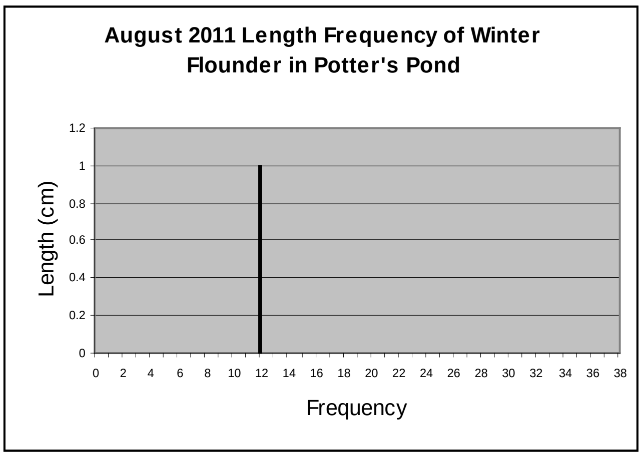

October 2011 Length Frequency of Winter Flounder in Point Judith Pond
Length (cm)
1.2
1
0.8
0.6
0.4
0.2
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency

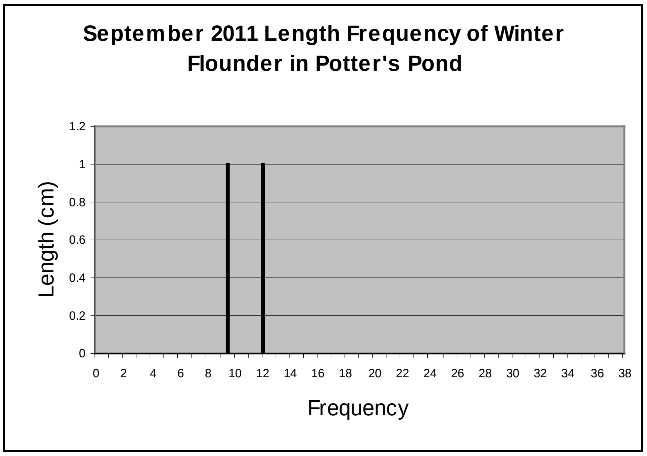
Figure 11: Monthly length frequency of winter flounder from Potter's Pond, 2011.






July 2011 Length Frequency of Winter Flounder in Potter's Pond
Length (cm)
Frequency
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38


August 2011 Length Frequency of Winter Flounder in Potter's Pond
Length (cm)
Frequency
1.2
1
0.8
0.6
0.4
0.2
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38


September 2011 Length Frequency of Winter Flounder in Potter's Pond
Length (cm)
1.2
1
0.8
0.6
0.4
0.2
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency

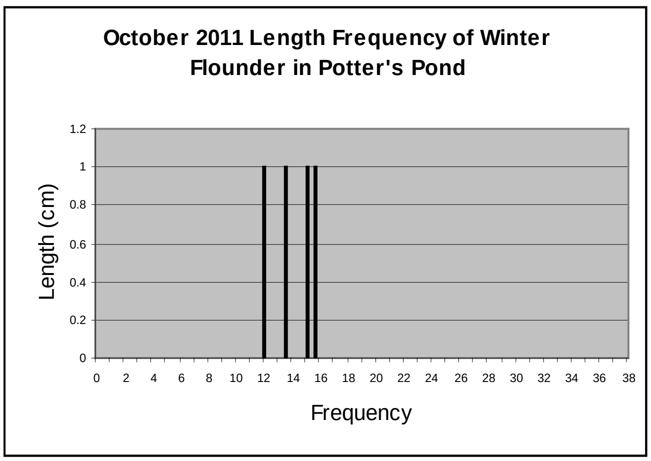
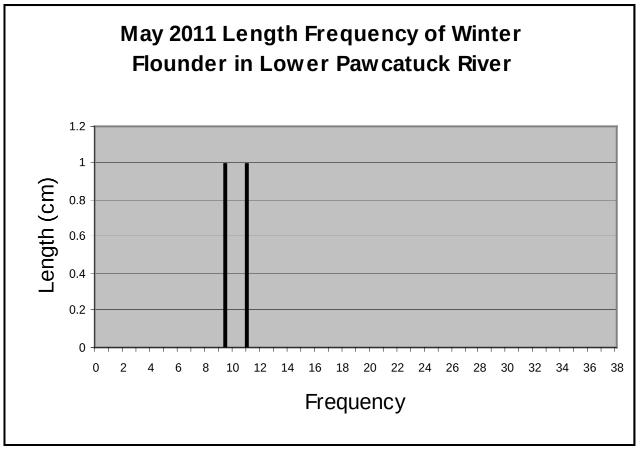
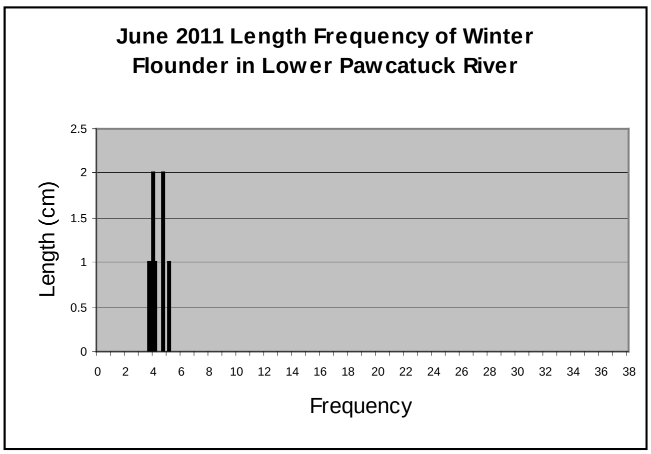
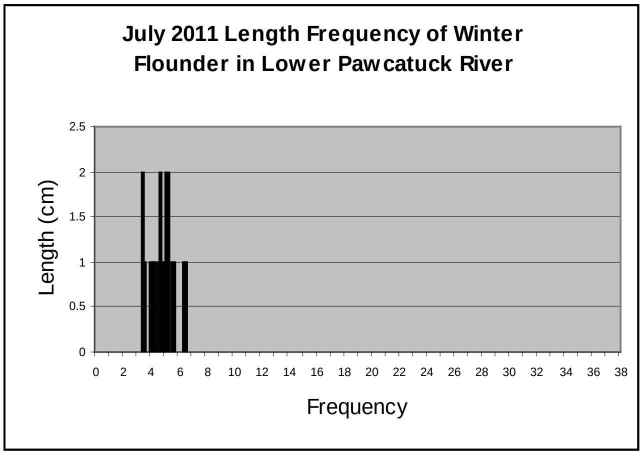
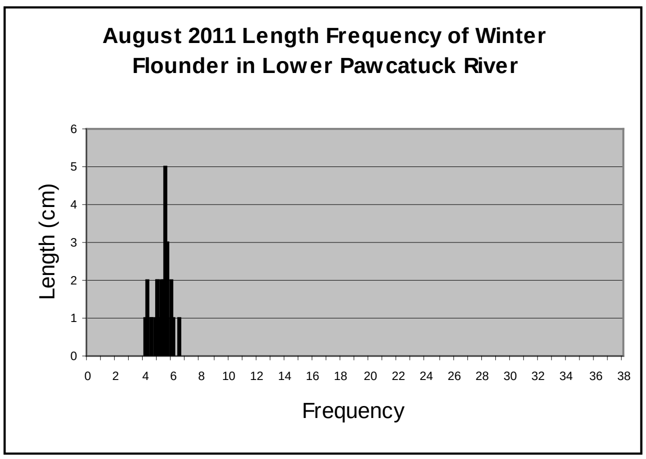

October 2011 Length Frequency of Winter Flounder in Potter's Pond
Length (cm)
1.2
1
0.8
0.6
0.4
0.2
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency

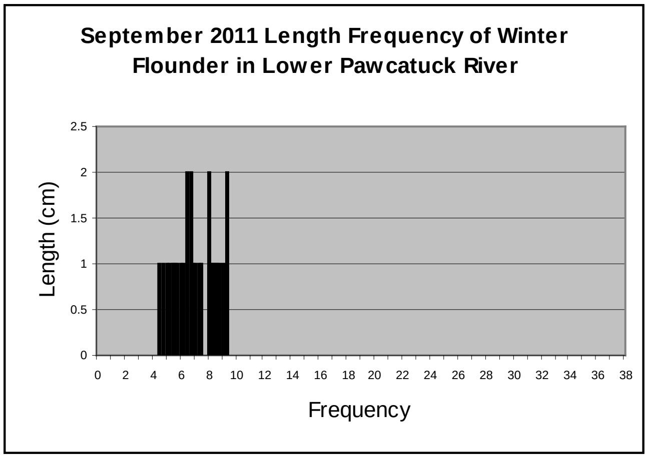
Figure 12: Monthly length frequency of winter flounder from Pawcatuck River, 2011.






July 2011 Length Frequency of Winter Flounder in Lower Pawcatuck River
Length (cm)
2.5
2
1.5
1
0.5
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency


August 2011 Length Frequency of Winter Flounder in Lower Pawcatuck River
Length (cm)
6
5
4
3
2
1
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency


September 2011 Length Frequency of Winter Flounder in Lower Pawcatuck River
Length (cm)
Frequency
0 0.5 1 1.5 2 2.5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38

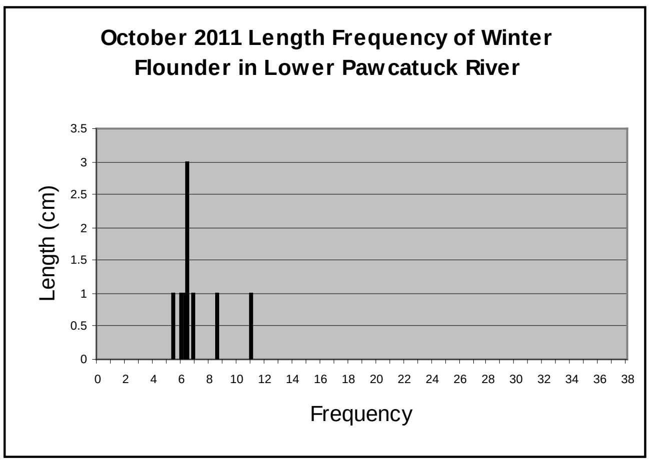
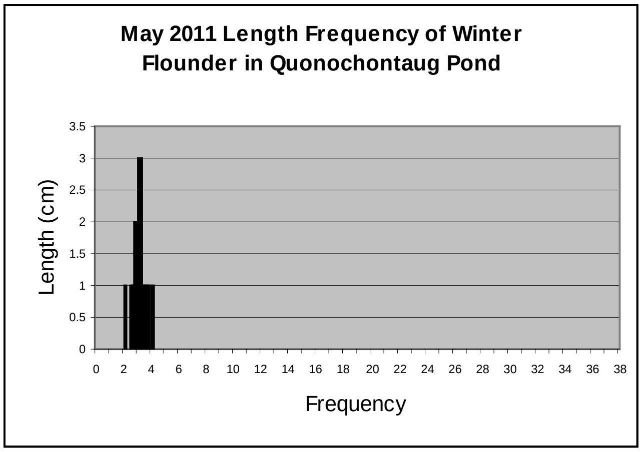
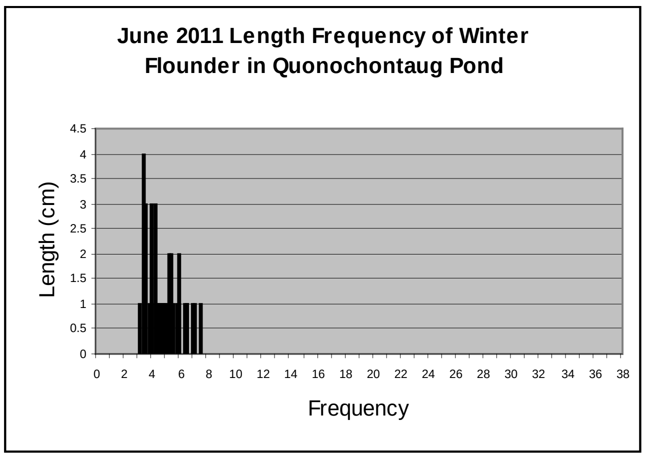
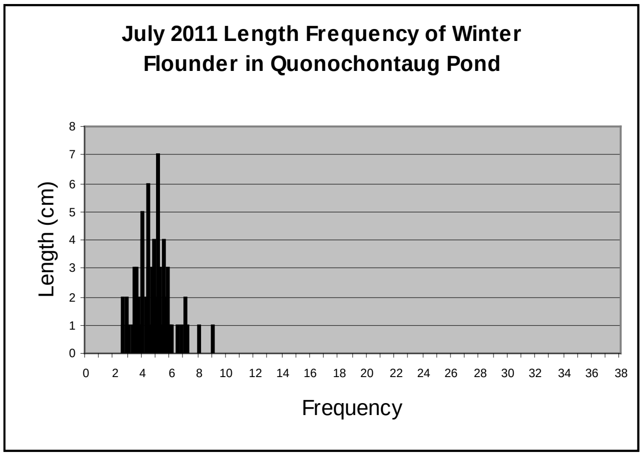

October 2011 Length Frequency of Winter Flounder in Lower Pawcatuck River
Length (cm)
Frequency
0 0.5 1 1.5 2 2.5 3 3.5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38

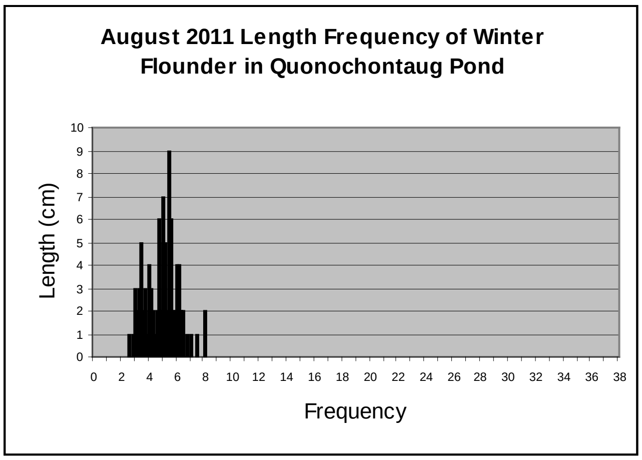
Figure 13: Monthly length frequency of winter flounder from Quonochontaug Pond, 2011.



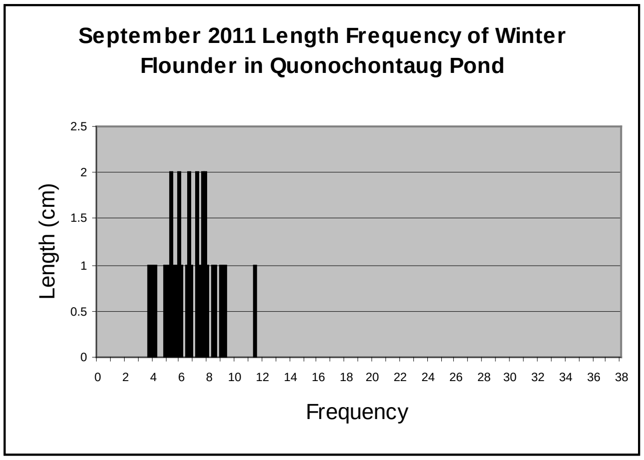




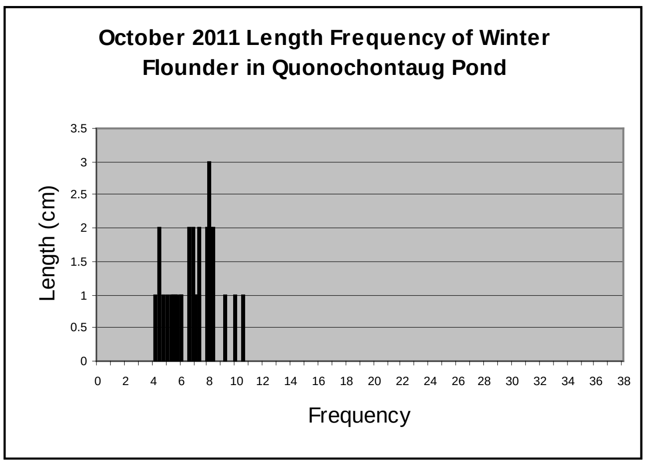
July 2011 Length Frequency of Winter Flounder in Quonochontaug Pond
Length (cm)
0
1
2
3
4
5
6
7
8
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency



August 2011 Length Frequency of Winter Flounder in Quonochontaug Pond
Length (cm)
0
1
2
3
4
5
6
7
8
9
10
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency

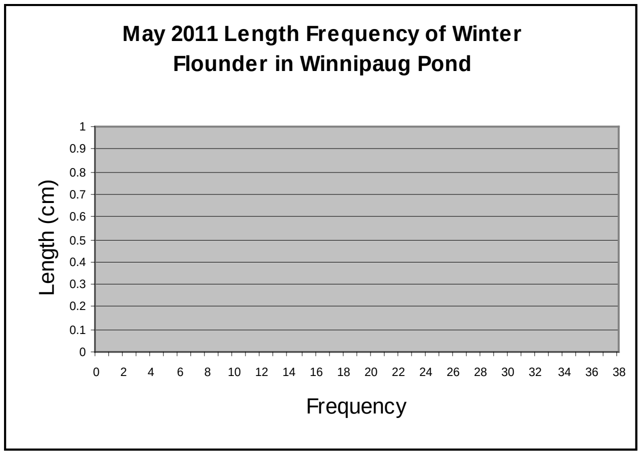


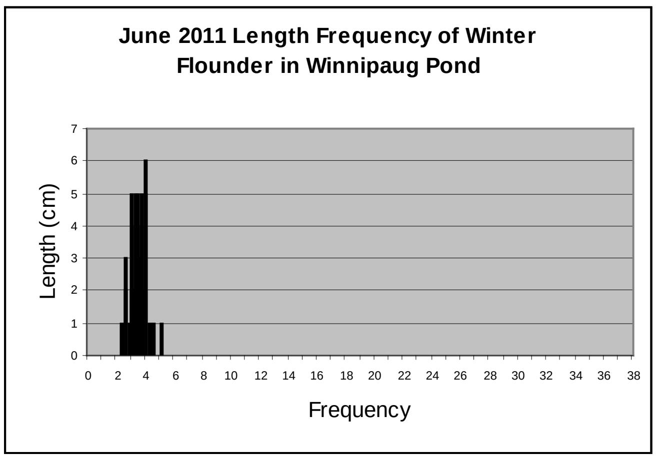
September 2011 Length Frequency of Winter Flounder in Quonochontaug Pond
Length (cm)
2.5
2
1.5
1
0.5
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency

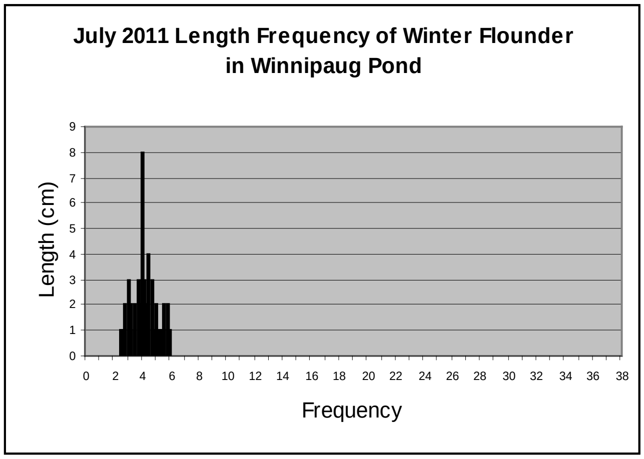


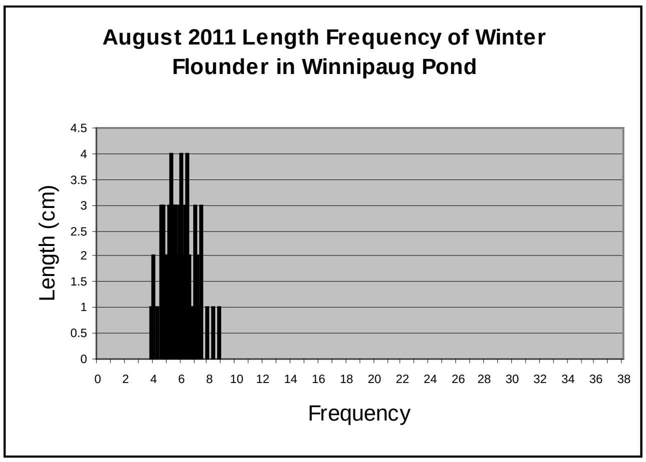
October 2011 Length Frequency of Winter Flounder in Quonochontaug Pond
Length (cm)
3.5
3
2.5
2
1.5
1
0.5
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency

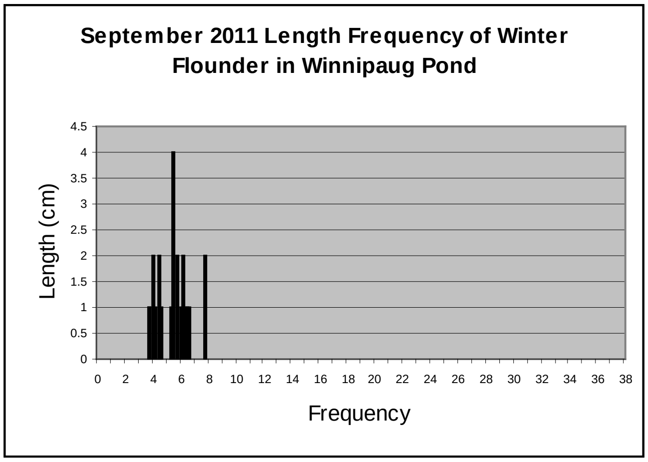
Figure 14: Monthly length frequency of winter flounder from Winnipaug Pond, 2011.






July 2011 Length Frequency of Winter Flounder in Winnipaug Pond
Length (cm)
Frequency
0
1
2
3
4
5
6
7
8
9
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38


August 2011 Length Frequency of Winter Flounder in Winnipaug Pond
Length (cm)
Frequency
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38


September 2011 Length Frequency of Winter Flounder in Winnipaug Pond
Length (cm)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency

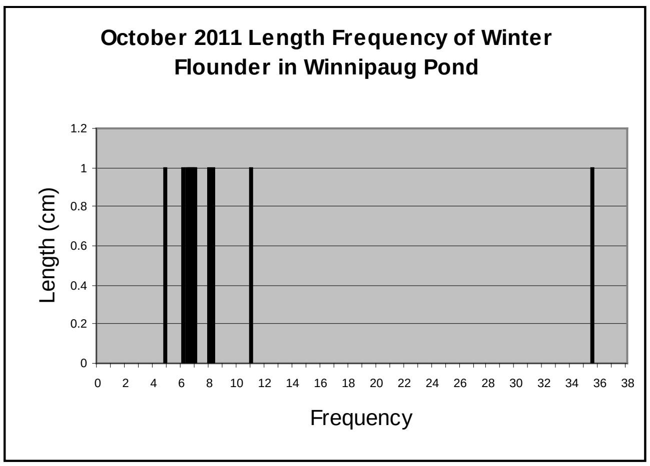

October 2011 Length Frequency of Winter Flounder in Winnipaug Pond
Length (cm)
1.2
1
0.8
0.6
0.4
0.2
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Frequency

Figure 15: Time series of annual abundance indices for winter flounder YOY from the coastal pond survey.

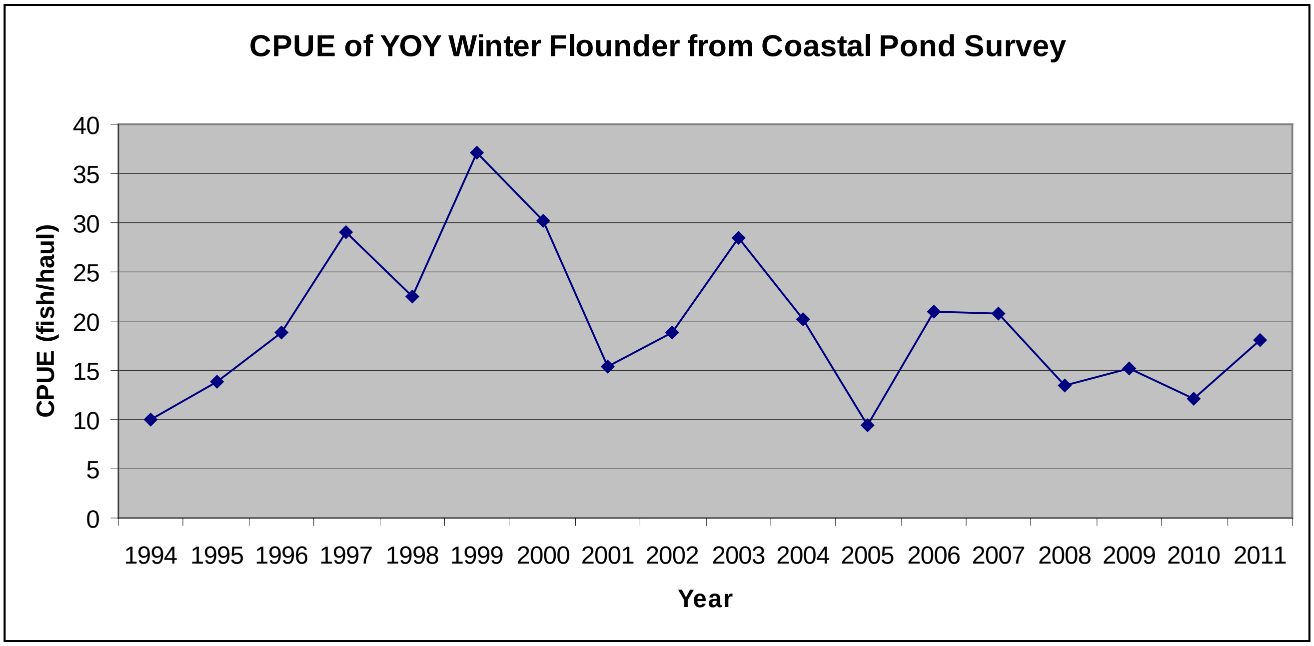


Figure 16: Abundance indices (fish/haul) from the Coastal Pond Survey, Narragansett Bay Seine Survey, and RIDFW Trawl Survey for winter flounder.

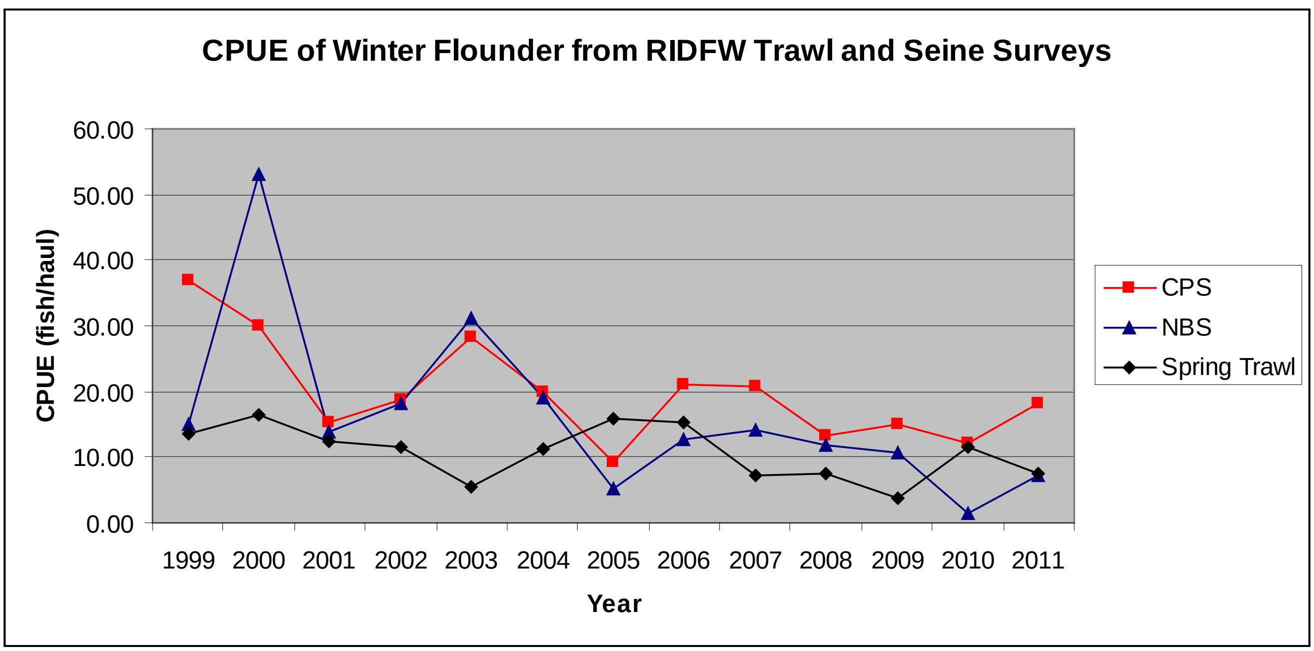


Figure 17: Abundance indices (fish/haul) from the Coastal Pond Survey and the Adult Winter Flounder Tagging Survey for winter flounder.

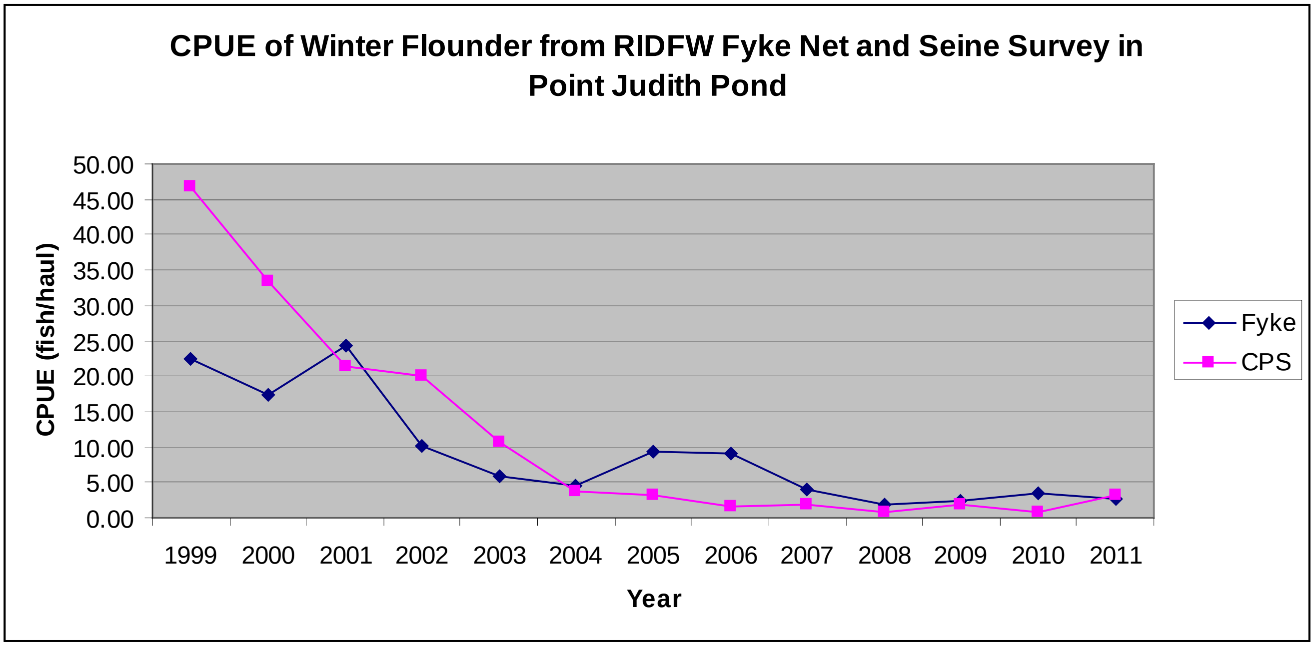


Figure 18. Time series of annual abundance indices for bluefish from the coastal pond survey.

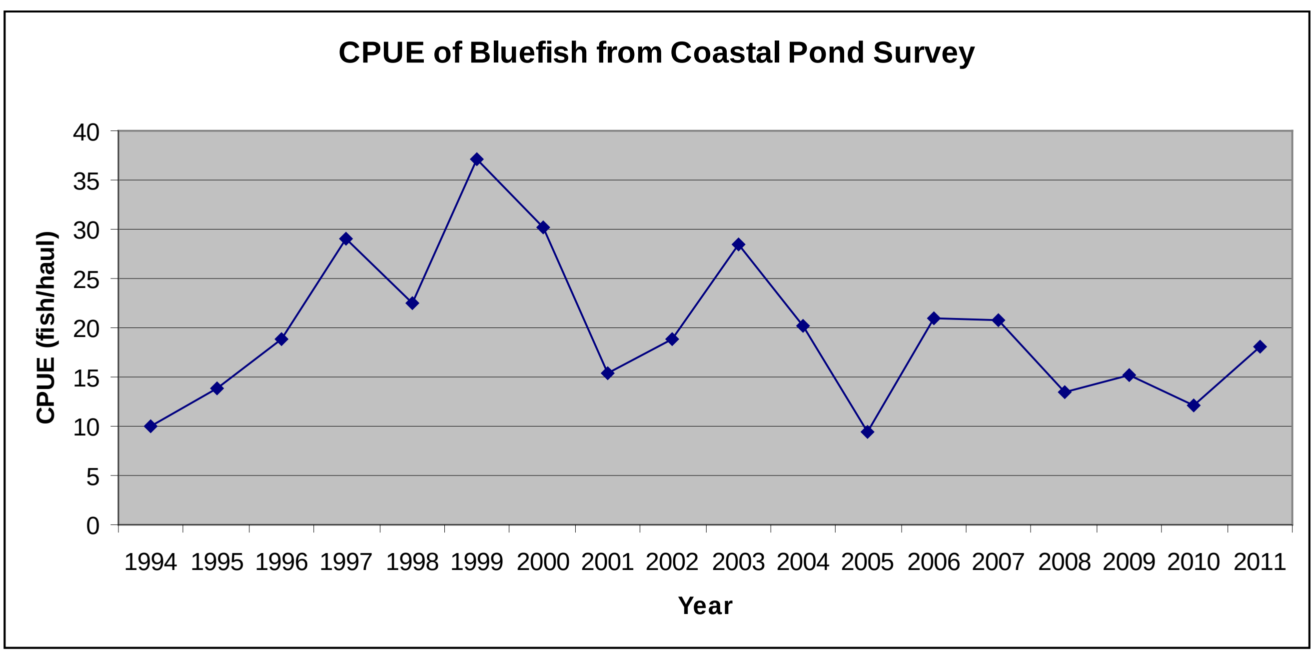


Figure 19. Time series of annual abundance indices for Tautog from the coastal pond survey.

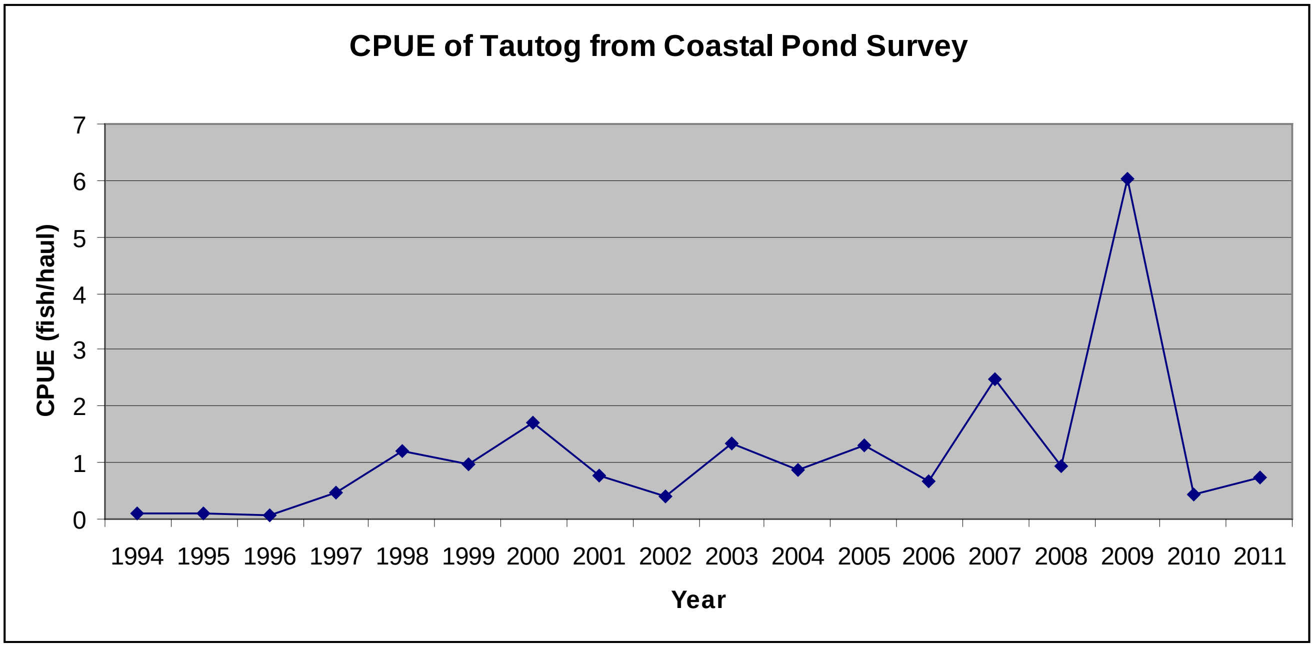


Figure 20. Time series of annual abundance indices for Black Sea Bass from the coastal pond survey.

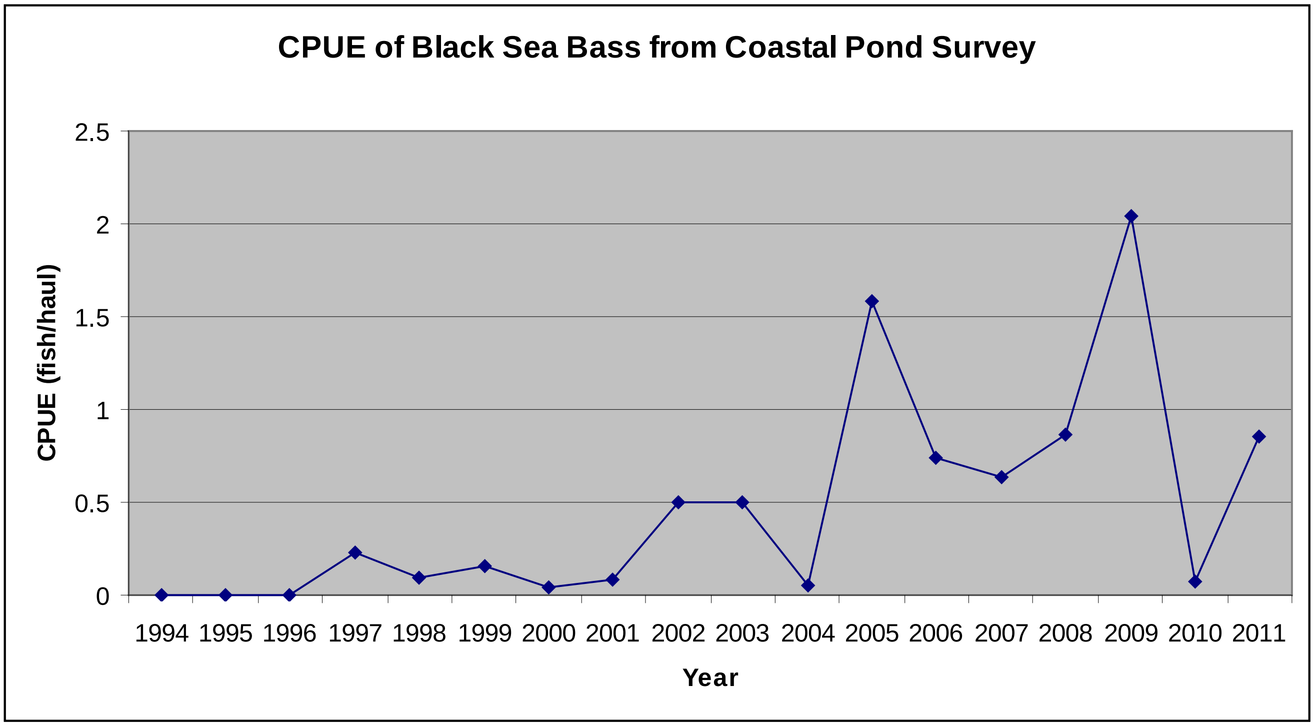


Figure 21. Time series of annual abundance indices for Scup from the coastal pond survey.

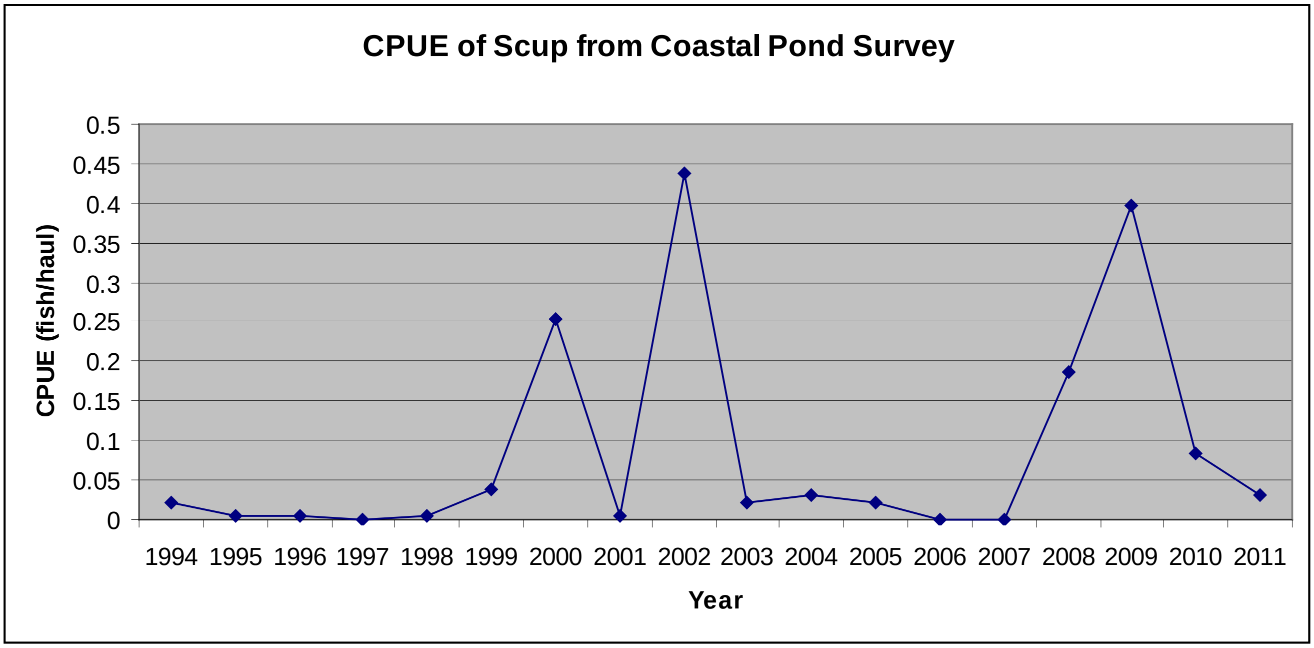


Figure 22a. Time series of annual abundance indices for Clupeids (w/o Menhaden) from the coastal pond survey.

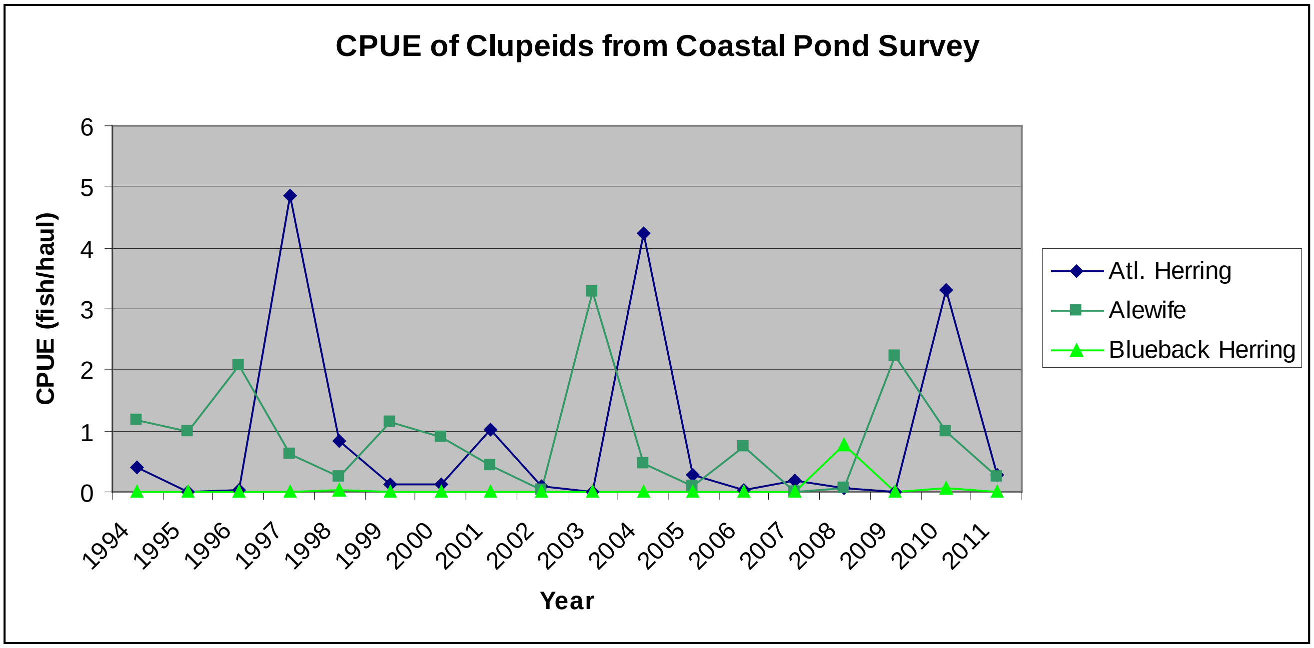


Figure 22b. Time series of annual abundance indices for Clupeids (Menhaden) from the coastal pond survey.

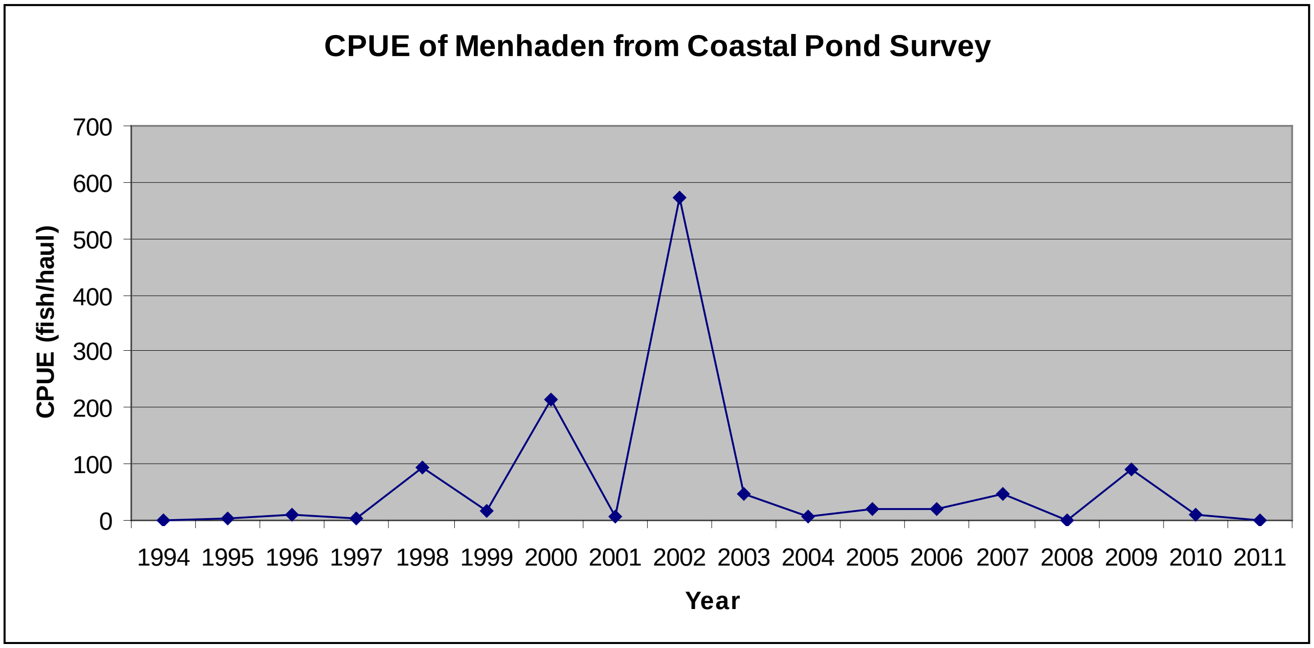
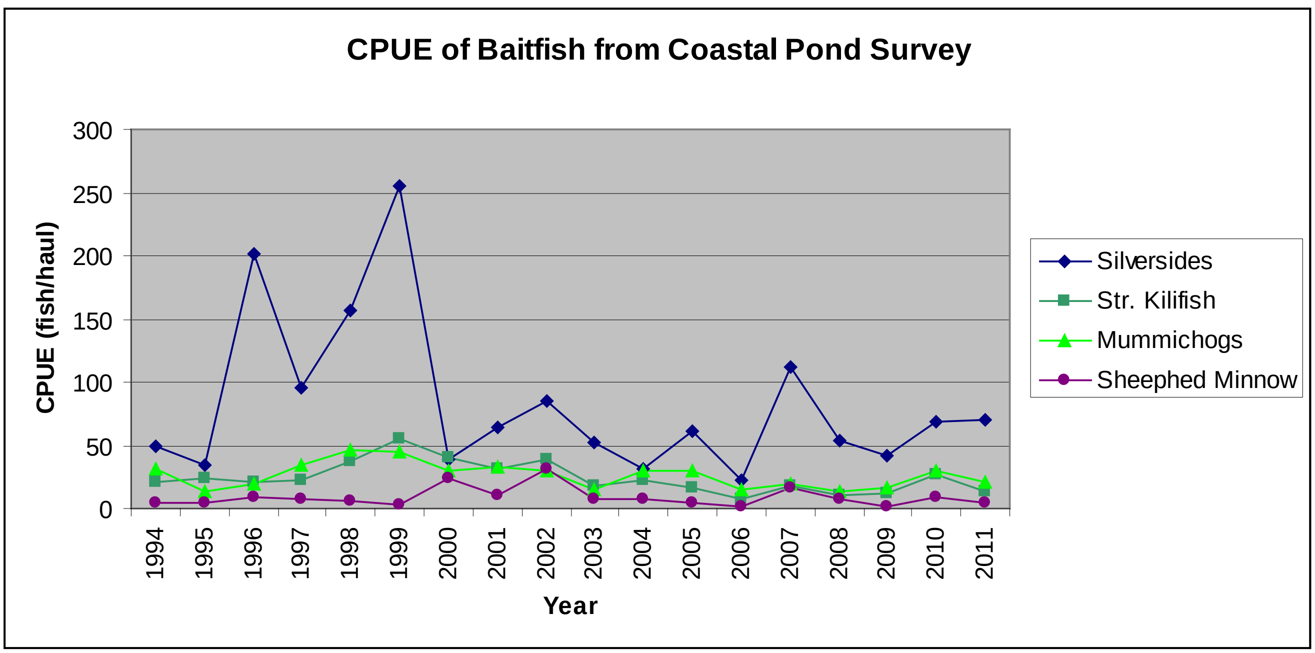


Figure 23. Time series of annual abundance indices for Baitfish from the coastal pond survey.



Appendix 1a: Catch frequency of all species by station for 2011 Coastal Pond Survey original ponds.

Species	CP1	CP2	CP3	CP4	NR1	NR2	NR3	PJ1	PJ2	PJ3	PJ4	QP1	QP2	QP3	WP1	WP2	WP3
ALEWIFE (ALOSA PSEUDOHARENGUS)					10		10			3	188						1
ANCHOVY BAY (ANCHOA MITCHILLI)					702	3											
BASS STRIPED (MORONE SAXATILIS)							6										
BLUE CRAB (CALINECTES SAPIDIUS)	19	9	6	19	70	10	8	22	4	4	15	6		6	2		17
BLUEFISH (POMATOMUS SALTATRIX)					1	2	6	7					12				
CUNNER (TAUTOGOLABRUS ADSPERSUS)		3	10						3		1		6				1
EEL AMERICAN (ANGUILLA ROSTRATA)	1	1	1														
FLOUNDER SMALLMOUTH (ETROPUS MICROSTOMUS)	10	1				6			1	1	3	2	2	6			2
FLOUNDER SUMMER (PARALICHTHYS DENTATUS)	1						1							1			
FLOUNDER WINTER (PLEURONECTES AMERICANUS)	234	52	63	3	122	420	251	8	28	21	65	71	91	153	124	48	50
GOBY NAKED (GOBIOSOMA BOSC)		4	1					1	1		4						4
GRUBBY (MYOXOCEPHALUS AENAEUS)	4	2	27	1		8	9		1			1	62	1	11	13	3
GUNNEL ROCK (PHOLIS GUNNELLUS)						1										1	
HAKE SPOTTED (UROPHYCIS REGIA)			1														
HERRING ATLANTIC (CLUPEA HARENGUS)		24	1		3						1						
JACK CREVALLE (CARANX HIPPOS)				1													
KILLIFISH STRIPED (FUNDULUS MAJALIS)	26	7	104	43	2	1	21	16	9	156	13	243	113	90	23		417
LIZARDFISH INSHORE (SYNODUS FOETENS)	1					1			6		11		1			1	
MENHADEN ATLANTIC (BREVOORTIA TYRANNUS)					2	3								3		1	
MINNOW SHEEPSHEAD (CYPRINODON VARIEGATUS)	25	148	16	5			12	1		4	1	72	26	34	1	43	4
MULLET WHITE (MUGIL CUREMA)				1	31	17						6		74			
MUMMICHOG (FUNDULUS HETEROCLITUS)	45	256	131	14	25	229	72	258	70	132	86	299	50	53	112	20	217
NEEDLEFISH ATLANTIC (STRONGYLURA MARINA)	2		1	4		2											
PERCH WHITE (MORONE AMERICANA)					89												
PERMIT (TRACHINOTUS FALCATUS)						2							1				
PIPEFISH NORTHERN (SYNGNATHUS FUSCUS)	5	16	9	2	2	4	5	5	7		8	1	9	3		7	6
POLLOCK (POLLACHIUS VIRENS)			2			23	1						1			4	
PUFFER NORTHERN (SPHOEROIDES MACULATUS)		1		1	1				1		2		1	2		1	

RAINWATER KILLIFISH (LUCANIA PARVA)	3	35	87	12		1		1			1	1	9		3		24
SCUP (STENOTOMUS CHRYSOPS)		3									2						
SEA BASS BLACK (CENTROPRISTIS STRIATA)	2	21	8			3	20		19		1		2			7	
SEAHORSE LINED (HIPPOCAMPUS ERECTUS)		1														1	
SEAROBIN NORTHERN (PRIONOTUS CAROLINUS)					1												
SEAROBIN STRIPED (PRIONOTUS EVOLANS)	1	1		2	3		1		2		3		1	2		1	
SENNET NORTHERN (SPHYRAENA BOREALIS)		1															
SILVERSIDE ATLANTIC (MENIDIA MENIDIA)	76	120	224	1658	277	127	149	73	1275	385	314	103	875	532	78	177	650
SPOT (LEIOSTOMUS XANTHURUS)														1			
SQUID LONGFIN (LOLIGO PEALEI)												1					
STICKLEBACK FOURSPINE (APELTES QUADRACUS)	1	121	60			42	9	3				3	27			2	49
STICKLEBACK THREESPINE (GASTEROSTEUS ACULEATUS)	1	11	12			10							2		4		
TAUTOG (TAUTOGA ONITIS)	2	10	41			1		9	5		3		1				2
TOADFISH OYSTER (OPSANUS TAU)							1	1			2						
TOMCOD ATLANTIC (MICROGADUS TOMCOD)		6	2			4			2		1		8				
WEAKFISH (CYNOSCION REGALIS)		2															
WINDOWPANE (SCOPHTHALMUS AQUOSUS)																	

Appendix 1b: Catch frequency of all species by station for 2011 Coastal Pond Survey (new ponds).

Species	GH1	GH2	PP1	PP2	PR1	PR2	PR3
ALEWIFE (ALOSA PSEUDOHARENGUS)			1				
ANCHOVY BAY (ANCHOA MITCHILLI)	7		46				1
BASS STRIPED (MORONE SAXATILIS)							11
BLUE CRAB (CALINECTES SAPIDIUS)	46	6	44	2	7		5
BLUEFISH (POMATOMUS SALTATRIX)				2		145	1
CUNNER (TAUTOGOLABRUS ADSPERSUS)							27
EEL AMERICAN (ANGUILLA ROSTRATA)	1						1
FLOUNDER SMALLMOUTH (ETROPUS MICROSTOMUS)					27	1	
FLOUNDER SUMMER (PARALICHTHYS DENTATUS)	2		1				
FLOUNDER WINTER (PLEURONECTES AMERICANUS)	44	28	45	1	82	13	4
GOBY NAKED (GOBIOSOMA BOSC)	25	17	29				
GRUBBY (MYOXOCEPHALUS AENAEUS)					50	5	5
GUNNEL ROCK (PHOLIS					1		

GUNNELLUS)							
HAKE SPOTTED (UROPHYCIS REGIA)							
HERRING ATLANTIC (CLUPEA HARENGUS)							
JACK CREVALLE (CARANX HIPPOS)				2			
KILLIFISH STRIPED (FUNDULUS MAJALIS)		118	51	28	5	279	
LIZARDFISH INSHORE (SYNODUS FOETENS)					4		
MENHADEN ATLANTIC (BREVOORTIA TYRANNUS)			2				10
MINNOW SHEEPSHEAD (CYPRINODON VARIEGATUS)	1	43	5	1	4		
MULLET WHITE (MUGIL CUREMA)		3	3		2		
MUMMICHOG (FUNDULUS HETEROCLITUS)	7	369	215	289	8	4	109
NEEDLEFISH ATLANTIC (STRONGYLURA MARINA)			1				
PERCH WHITE (MORONE AMERICANA)							
PERMIT (TRACHINOTUS FALCATUS)						1	
PIPEFISH NORTHERN (SYNGNATHUS FUSCUS)	1	1		1	2	3	4
POLLOCK (POLLACHIUS VIRENS)				1			
PUFFER NORTHERN (SPHOEROIDES MACULATUS)		1					
RAINWATER KILLIFISH (LUCANIA PARVA)		2		9			
SCUP (STENOTOMUS CHRYSOPS)							
SEA BASS BLACK (CENTROPRISTIS STRIATA)					14		
SEAHORSE LINED (HIPPOCAMPUS ERECTUS)							
SEAROBIN NORTHERN (PRIONOTUS CAROLINUS)							
SEAROBIN STRIPED (PRIONOTUS EVOLANS)					5		
SENNET NORTHERN (SPHYRAENA BOREALIS)							
SILVERSIDE ATLANTIC (MENIDIA MENIDIA)	37	935	148	58	346	57	779
SPOT (LEIOSTOMUS XANTHURUS)							
SQUID LONGFIN (LOLIGO PEALEI)				2			
STICKLEBACK FOURSPINE (APELTES QUADRACUS)	1			9	4	6	18
STICKLEBACK THREESPINE (GASTEROSTEUS ACULEATUS)							
TAUTOG (TAUTOGA ONITIS)							2
TOADFISH OYSTER (OPSANUS TAU)	1	12	5	11			
TOMCOD ATLANTIC (MICROGADUS TOMCOD)					6	2	16
WEAKFISH (CYNOSCION REGALIS)							2
WINDOWPANE (SCOPHTHALMUS AQUOSUS)					1		

Appendix 2: Proposal to expand the Coastal Pond Juvenile Finfish Survey into Potter's Pond, Green Hill Pond, and the Lower Pawcatuck River.

Title: Expanding the RIDFW Coastal Pond Juvenile Fish Survey to include Potter's Pond, Green Hill Pond, and Little Narragansett Bay.

Goals and Objectives

The primary objective of the Coastal Pond Survey is to collect, analyze, and summarize beach seine survey data from Rhode Island's coastal ponds and estuaries, for the purpose of forecasting recruitment in relation to the spawning stock biomass of winter flounder and other recreationally important species. The goal of this proposal is to expand the RIDFW Coastal Pond Survey by adding 7 stations to the annual survey in Green Hill Pond, Potters Pond, and Little Narragansett Bay (lower Pawcatuck River) (Figures 1-3).

Background

The RIDFW coastal pond survey is being carried out in Winnipaug Pond, Quonochontaug Pond, Ninigret Pond, Point Judith Pond and the Narrow River (Figures 4 and 5). The Survey has been conducted at these 16 sites since 1993 between the months of May and October annually. The survey has proven to be an effective method to track juvenile fish populations in the coastal ponds particularly the main target species, winter flounder. Juvenile fish abundance indices derived from the survey are provided to stock assessment biologists.

The population of target species, winter flounder, is currently assessed to be at historically low levels. According to the 2008 stock assessment the Southern New England winter flounder stock is overfished with overfishing occurring. Fishing mortality (F) in 2007 was estimated to be 0.649, over twice the FMSY proxy = F40% = 0.248. Spawning Stock Biomass (SSB) in 2007 was estimated to be 3,368 mt, about 9% of SSBMSY = 38,761 mt. (NEFSC 2008). These results have prompted a winter flounder fishing closure in SNE federal waters and a 50 lb possession limit in State waters for sampling purposes only.

Locally the effects of this decline in winter flounder can be seen in a population crash within Point Judith Pond, RI. In addition to the coastal pond survey an annual fyke net survey is conducted aimed at collection of adult spawning winter flounder. When relative abundance, number of fish/seine haul, of juvenile winter flounder are compared to the relative abundance, number of fish/fyke net haul, of the Adult Winter Flounder Tagging Survey, (Figure 6), the decline in relative abundance of winter flounder is observed in both surveys. The decline in adult (spawner) abundance and related decline in juvenile abundance does not support a fishery in the pond due to the lack of surplus production. Given that winter flounder population shows an affinity for discrete spawning locations and the young of year tend to remain near the spawning location, the fish in this pond are in danger of depletion (Buckley et. al. 2008). Action will be initiated to close the pond to both recreational and commercial fishing for winter flounder (Gibson, 2010).

The recovery of the SNE stock only starts with reducing fishing effort; anthropogenic and environmental facts can also have adverse effects on the population. Aside from overfishing, anthropogenic factors include nutrient loading, intertidal construction, and dredging. Environmental factors include warming water temperatures and potential species assemblage switches brought on by climate change.

The life history strategy of winter flounder makes local populations very susceptible to both large and small scale anthropogenic and environmental disturbances. Research on winter flounder life history in Narragansett Bay has revealed that winter flounder tend to show affinity to certain spawning locations resulting in smaller meta stocks throughout Narragansett Bay

(Buckley et. al. 2008). Winter flounder spawn and lay their eggs which attach to silty sand or algal mats on the bottom. This activity takes place between January and May usually coinciding with cold water temperatures (Bigelow and Schroder 1953). After hatching the juveniles spend a period of time in the water near where the eggs hatch and metamorphose and settle to the bottom at around 13 mm (Laroche 1981). Once settled, juveniles believed to be relatively stationary with affinity to sites near spawning locations. (Gray 1990) (Buckley et. al. 2008).

Nutrient loading, intertidal construction and dredging can have local effects on juvenile fish habitat, including that of winter flounder, which can result in potential adverse on eggs, larvae, and juveniles. Loss or disturbance of habitat due to low dissolved oxygen or sedimentation during early life stages when the fish are present in a generally small area could have a significant effect on survival rates especially at key times of the year.

Climate change effects most notable increased sea surface temperatures have potential adverse effects on the assemblages of the fish communities living in the coastal ponds and their biology. These effects are not limited to winter flounder but all fish populations living in the coastal ponds. Hsieh et. al. (2008), suggests that exploited populations are more sensitive to climate variations and more likely to display shifts in larval distributions, notably in species with more localized distributions. Studies on long term data set inside and out of Rhode Island have documented shifts in production and species assemblages correlated with warming ocean temperatures (Brander 2006). Long term trawl survey data collected between 1959 and 2005 in Narragansett Bay, RI documents a shift in species assemblages from benthic to pelagic species as well as from vertebrates to invertebrates. Species diversity also increased during this time period. Theses shifts in species composition are correlated strongly with increased surface water temperatures as well as North Atlantic Oscillation and chlorophyll concentration all associated with climate change (Collie et. al. 2008). Climate change may have indirect effects on juvenile fish populations in the coastal ponds by adversely impacting their some of their preferred habitats such as eelgrass. Warming sea surface temperature stressors on the plants physiology and physical environment has potential to shift eelgrass (*Zostra spp*) distribution. (Shorta and Neckles 1999). A lack of or reduced distributions of eelgrass in the pond would potentially increase predation on juvenile populations that use eel grass as a refuge.

Rising sea surface temperatures effect on the ecology, particularly predation on larval and juvenile winter flounder could potentially reduce population size or prevent a rebound in abundance in the ponds. Sand Shrimp (*Crangon septemspinosa*) predation on winter flounder eggs, larvae and juveniles is postulated to have a strong influence on year class strength (Taylor 2005). Young of the year winter flounder use shallow waters (< 1 m) as a refuge from predation particularly from piscovores (Manderson et. al. 2004). The sand shrimp migrate into the same shallow waters in the early spring based on water temperature. If this influx of sand shrimp into the shallow waters overlaps with the timing of winter flounder settlement high predation rates can occur on the YOY flounder (Taylor 2005). Warm winters result in sand shrimp migrating into the ponds earlier in the year and thus the probability that the shrimp and newly settled flounder overlap in the shallow water increases. Furthermore, it has been documented that sand shrimp predation rates increase with higher water temperatures (Taylor and Collie 2003) (Witting and Able 1995). It is suspected that other crustacean predators display a similar increase in predation rates such as green crabs (*Carcinus maenas*), rock crabs (*Cancer irroratus*), and lady crabs (*Ovalipes ocellatus*) (Witting and Able 1995). Depending on population levels and the temporal and spatial overlap in distribution of the crustacean predators, local populations of newly settled juveniles can be significantly impacted (Taylor 2005) (Taylor and Collie 2003).

Juveniles that have settled at larger sizes or grow rapidly after settlement have a better chance of survival (Witting and Able 1995, Chambers et. al. 1988) presumably because they grow out of the size most susceptible to predation. Elevated sea surface temperatures effect on the larval biology of winter flounder could exacerbate predation on YOY winter flounder. Chambers and Legget (1987) found that temperature had an effect on larval winter flounder growth rates and the timing of metamorphosis. Higher temperatures resulted in more rapid growth rates, shorter larval periods, and smaller size at settlement. Keller and MacPhee (2000) found that winter flounder egg survival, percent hatch, time to hatch and initial size decreases with increasing temperature and that increased predation and food assemblage shifts at higher temperature compounded the problem resulting in high mortality rates.

Historically all of the coastal ponds including Green Hill Pond, Potters Pond, and the Pawcatuck River have supported fisheries for winter flounder. Spawning locations have also been identified in the past in Green Hill and Potters Pond (Saila 1961) (Crawford 1990). RIDFW has not sampled for juvenile saltwater fish in these areas since the early 1990's Satchwill and Sisson 1990, Satchwill and Sisson 1991). It remains unclear as to why these water bodies were not continued when the annual Coastal Pond Survey began in 1993. During the 2010 survey, an additional station was added in Point Judith Pond to provide better geographic coverage as well as to further characterize the juvenile winter flounder population in that pond (figure 1). Preliminary results from the new station indicate higher abundances of juvenile wither flounder in the pond than would be calculated from just the three original pond stations. Preliminary results from this station increases the diversity of the species collected in the pond more so than would be observed from just the original three stations. These results validate our approach of adding stations to get better abundance and diversity data from all of the coastal ponds.

Need

The depressed state of the SNE winter flounder stock is of great concern to RIDFW as well as commercial and recreational fishing interests in Rhode Island. The significant change in management measures makes monitoring the winter flounder population essential to determine their effectiveness. RIDFW feels it would further the objective of the survey and complement the survey even further to evaluate the juvenile winter flounder population in additional coastal ponds in southwestern Rhode Island. By expanding the range of the survey into other water bodies, more potential changes in pond specific populations could be detected. There is uncertainty whether local winter flounder spawning aggregations can recover after they have not been detectable for long periods of time. It is unclear if as the stock recovers the fish will expand back into previously populated spawning and settlement grounds. Alternatively the distinct localized structure of the various meta populations may only return to their preferred locations and thus not repopulate areas used by other distinct spawning aggregations. In areas where winter flounder abundance is low, environmental factors directly (e.g. higher sea surface temperatures) or indirectly (e.g. increased predation rates) associated with climate change may be too severe for the local population to re-establish at previous abundances. By monitoring additional these water bodies the current distributions of winter flounder juveniles can be better determined as well as whether their numbers are increasing or declining into the future.

The benefit of more comprehensive geographic distribution of stations in the coastal ponds would benefit the juvenile abundance indices, for all the target species not just winter flounder. Expanding the scope of the survey has potential to reveal juvenile assemblages that would otherwise go undocumented. An expansion of scope in the survey would also allow for more innovative modeling for stock assessment. The data from this survey complements habitat mapping work in progress by the University of Rhode Island (MapCoast) and other researchers in the coastal ponds. The existing ponds as well as the additional ponds proposed to be sampled are being mapped by URI's MapCoast and fed into a geographic database which houses other data sources from the ponds such as water quality and sediment composition. The survey data in conjunction with this geographic database will allow for more robust modeling of population size and structure of all of the target species using ecosystem based approaches which take into account many factors in addition to single species abundance. Additionally, more comprehensive data can be gathered on species assemblages and their associated habitats in the southern Rhode Island coastal ponds and incorporated into the management decision process. Examples of the utility of this type of ecosystem approach ranges from better decision making information when evaluating proposed projects at specific locations on the ponds to providing more comprehensive data for the creation of a state wide climate change plan.

Approach

RIDFW proposes to add 7 additional stations to the annual Coastal Pond Juvenile Fish Survey to be sampled concurrently with the existing stations during the months of May – October. Theses stations will be added to Potters Pond (figure 1), Green Hill Pond (figure 2), and Little Narragansett Bay (figure 3). The current stations for the Coastal Pond Juvenile Fish Survey can be found in figures 4 and 5. Proposed station locations were selected when possible at locations where previous survey work had been done in the past for comparative purposes. There is an existing freshwater seine survey already in progress in the upper Pawcatuck River; this survey does not extend into Little Narragansett bay.

The current survey design requires 5 days of field sampling, one day for each pond. It is estimated that the addition of the new stations would only increase the workload by one sampling day as some of the new stations are in the vicinity of the existing stations that they could be sampled on the same day. Data entry and analysis tasks associated with the additional stations would be minimal.

The sampling methodology in place for the current Coastal Pond Juvenile Fish Survey will be used at the proposed sampling locations. All seining will be attempted on incoming tides. To collect animals, investigators used a seine 130 ft. long (39.62m), 5.5 ft deep (1.67m) with ¼" mesh (6.4mm). The seine has a bag at its midpoint, a weighted footrope and floats on the head rope. The beach seine is set in a semi-circle, away from the shoreline and back again using an outboard powered 16' Aluminum boat. The net is then hauled toward the beach by hand and the bag emptied into a large water-filled tote. All animals collected are identified to species, measured, enumerated, and sub-samples are taken when appropriate. Water quality parameters, (temperature, salinity and dissolved oxygen) are measured at each station.

The abundance indices for the target species are a key end product of the coastal pond survey. The addition of more stations into the index could have potential effects on the integrity of the time series. It is unknown whether adding the data collected at the new stations will skew the results either positively or negatively if at all. In the interest of keeping the time series consistent, the abundance indices will be calculated with and without the additional stations. As the survey progresses and more data are gathered at the new stations, the differences in the indices can be modeled to create a new abundance index which includes the new stations in the entire time series. Ideally this index will be standardized such that it is comparable to other fisheries independent surveys being conducted in Rhode Island. One method likely to be used is being developed by Jason McNamee for the Narragansett Bay seine survey abundance indices (McNamee 2010). The abundance index under development is a zero adjusted negative binomial two part model. The model is designed to handle data sets which have many zero values by breaking out the data into two sets one only containing frequency of occurrence, the other containing the counts for each station (Zuur et. al. 2009). The advantage of using this technique is that the new stations can be incorporated into the time series and compared with abundance indices from other surveys which use the same model.

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Figure 1. Proposed station locations in and Potters Pond (1 and 2) and new station added in Point Judith Pond during 2010 (3).

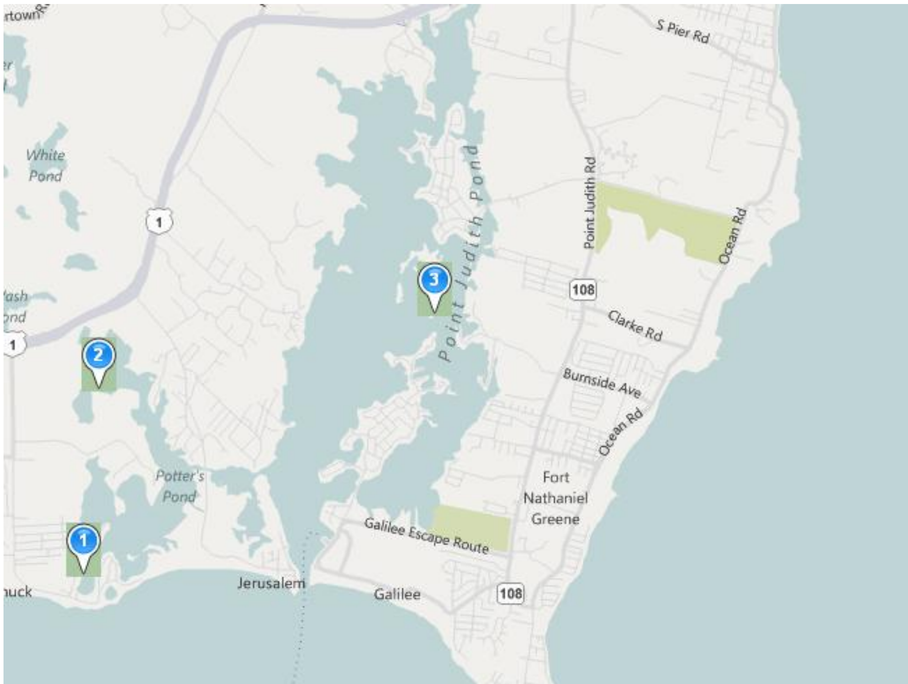


Figure 2. Proposed station locations in Green Hill Pond (4 and 5).

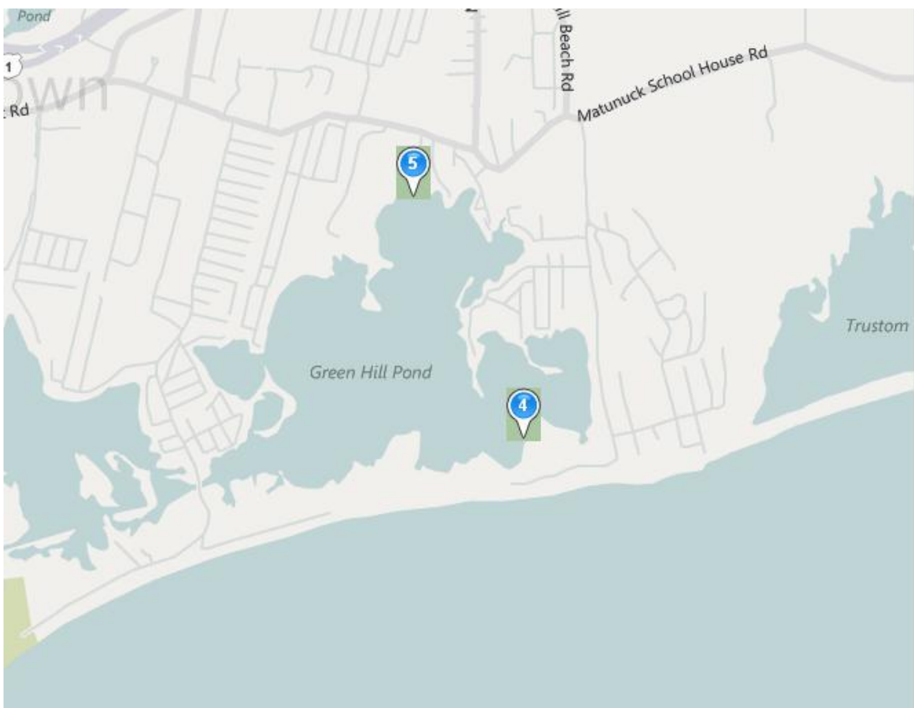


Figure 3. Proposed station locations in Little Narragansett Bay (6, 7, and 8).

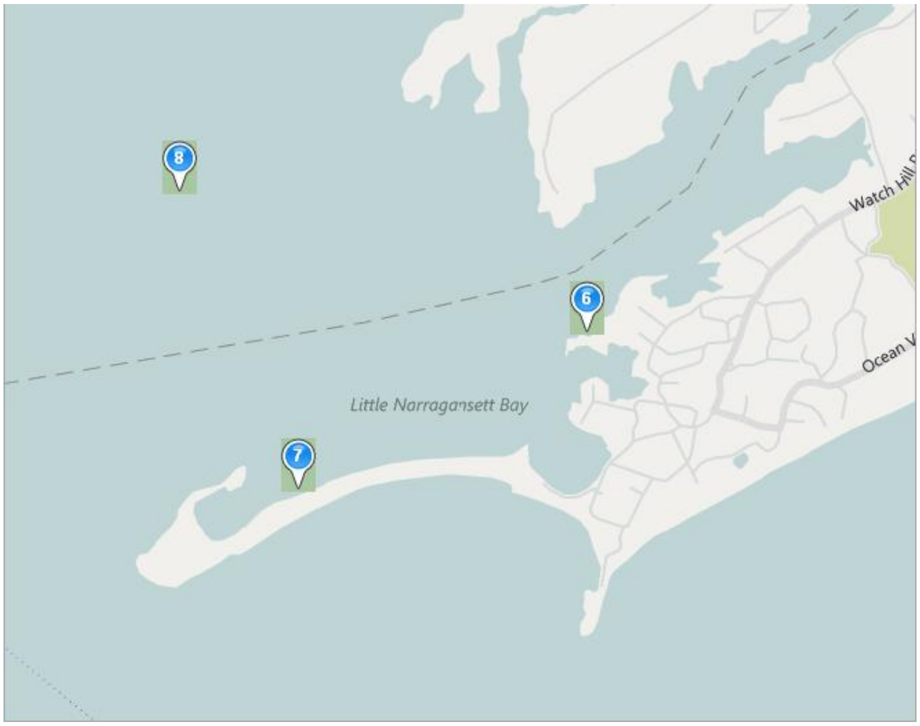


Figure 4. Existing stations in Point Judith Pond and the Narrow River.

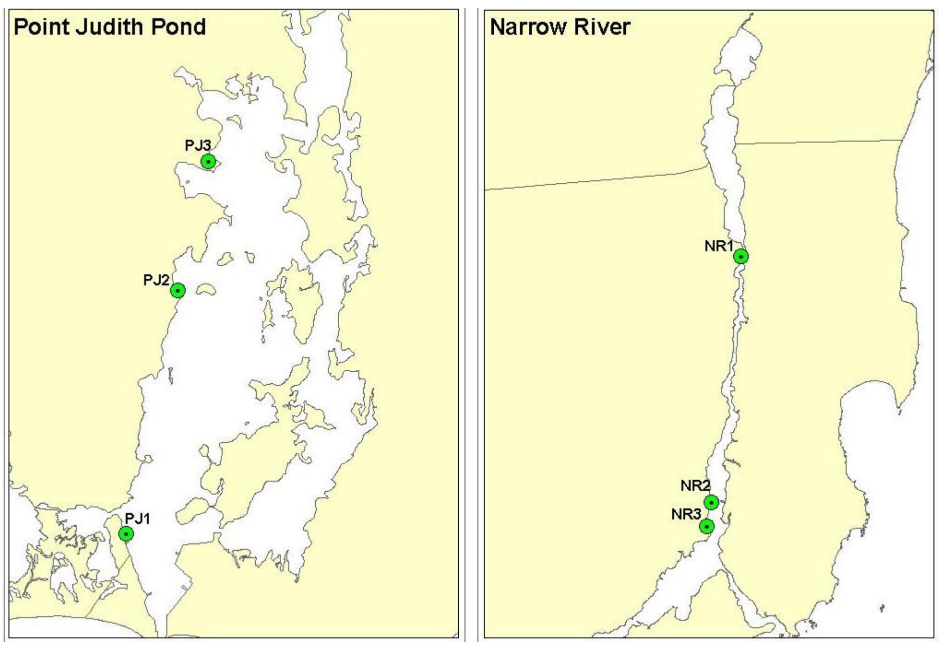


Figure 5. Existing Station Locations in Ninigret Pond, Quonochontaug Pond, and Winnipaug Pond.

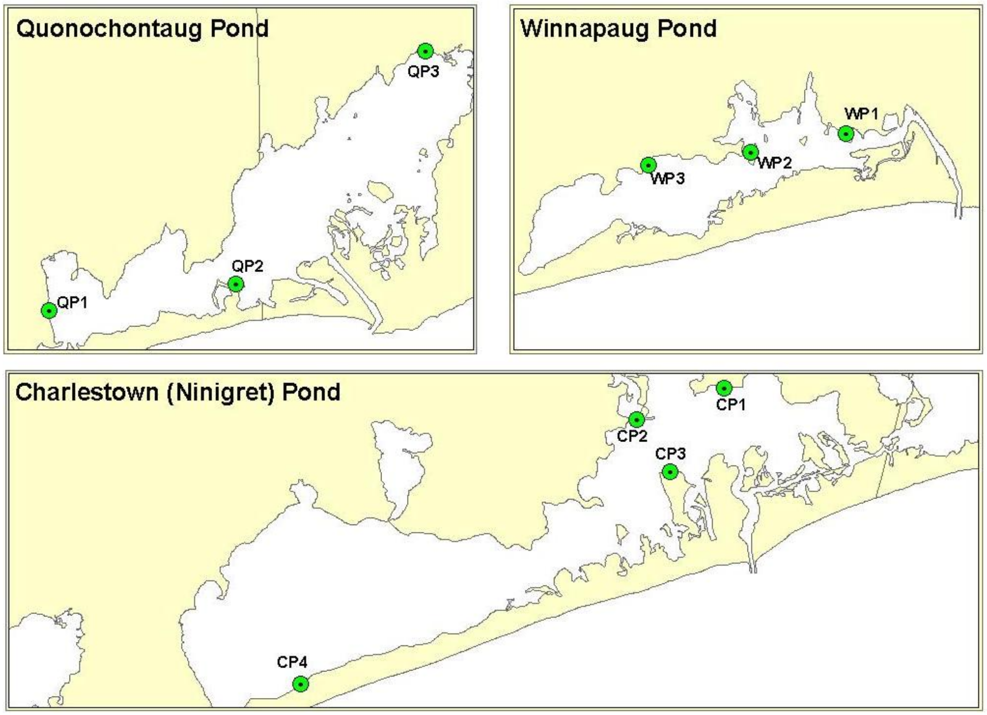
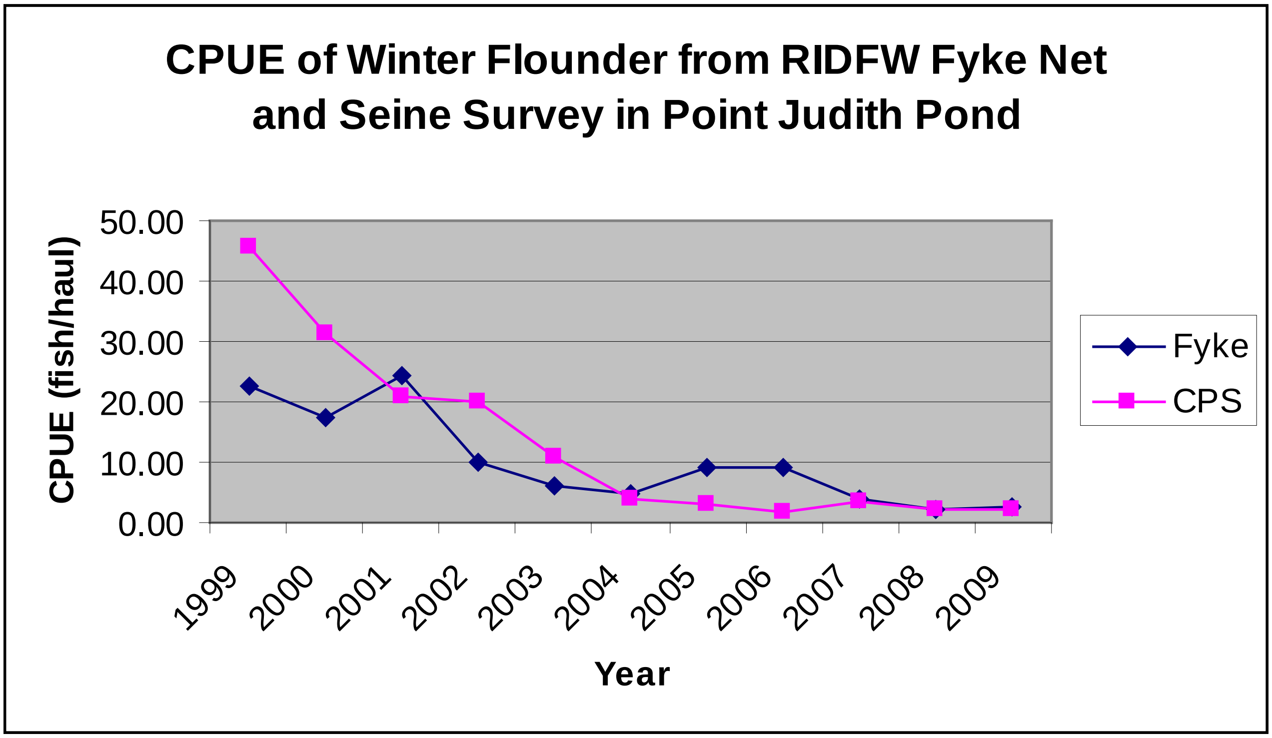


Figure 13: Abundance indices (fish/haul) from the Coastal Pond Survey and the Adult Winter Flounder Tagging Survey for winter flounder.



ASSESSMENT OF RECREATIONALLY IMPORTANT FINFISH STOCKS IN RHODE ISLAND WATERS

NARRAGANSETT BAY JUVENILE FINFISH SURVEY

Jason McNamee
Principal Marine Fisheries Biologist

R. I. Division of Fish & Wildlife
Marine Fisheries

Ft. Wetherill Marine Laboratory
3 Ft. Wetherill Road
Jamestown, Rhode Island 02835

2011

PERFORMANCE REPORT

STATE: Rhode Island

PROJECT NUMBER: F-61-R
SEGMENT NUMBER: 19

PROJECT TITLE: Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters.

PERIOD COVERED: 1 January 2011 - 31 December 2011

JOB NUMBER AND TITLE: IV - Juvenile Marine Finfish Survey

JOB OBJECTIVE: To monitor the relative abundance and distribution of the juvenile life history stage of winter flounder (*Pseudopleuronectes americanus*), tautog (*Tautoga onitis*), bluefish (*Pomatomus saltatrix*), scup (*Stenotomus crysops*), weakfish (*Cynocion regalis*), black sea bass (*Centropristis striata*), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), Atlantic menhaden (*Brevoortia tyrannus*), Atlantic herring (*Clupea harengus)*, striped bass (*Morone saxatilis*), and other selected species of commercial and recreational importance in Narragansett Bay. To use these data to evaluate short and long term annual changes in juvenile population dynamics, to provide data for stock assessments, and for the development of Fishery Management Plans. To collect fish community data that is used to continue to identify, characterize, and map essential juvenile finfish habitat in Narragansett Bay.

SUMMARY: Eighteen fixed stations (Figure 1) around Narragansett Bay were sampled once a month from June through October 2011 with the standard 61 x 3.05 m beach seine. Adults and juveniles of approximately seventy species were collected during the 2011 survey. For comparison seventy-four species were collected in 2008, the highest number of species and families collected since the survey began. For the entire survey time series (1988 – 2011), all individuals of the target species: winter flounder, tautog, bluefish, weakfish, black sea bass, scup, river herring, sea herring, and menhaden were enumerated and measured. With few exceptions (noted) all individuals of these species that were collected in the survey were juveniles. Adult and juveniles of other species collected were not differentiated for data analysis or descriptive purposes prior to 2009. Presence and relative abundance (few, many, abundant) of three forage species: Atlantic silversides (*Menidia menidia*), common mummichog (*Fundulus heteroclitus*) and striped killifish (*Fundulus majalis*) had been noted until 2009. Since 2009 all finfish species caught were enumerated and measured. Invertebrate species were noted and enumerated using the relative abundance scale as noted above. Data on weather, water temperature, salinity, and dissolved oxygen were recorded at each station.

TARGET DATE: December 2011

SIGNIFICANT DEVIATIONS: There were no significant deviations to methodology in 2011. One change that will occur is in the analysis of the data and is presented in detail below and in appendix A.

RECOMMENDATIONS: Continue standard seine survey at all eighteen stations. Continue to provide comments and recommendations to other resource management and regulatory agencies regarding potential anthropogenic impacts to fisheries resources and habitat. Continue to analyze and provide data for use in fisheries stock assessments. A reassessment and characterization of the habitat at each station should be undertaken to see if any major changes have occurred since the original evaluation. A power analysis of the data specifically for the target species should be undertaken to quantify the adequacy of the sampling protocol.

REMARKS: Abundance trends derived from adult data collected from the RIDFW seasonal trawl survey since 1979 indicate a declining abundance of demersal species and an increasing abundance for pelagic species in Rhode Island waters. It should be noted that the trawl survey samples both adult and juvenile fish and invertebrates. This trend has also been observed in other estuaries along the Atlantic coast. Reasons for these shifts are attributed to a number of factors but may not be limited to these factors. These include the effects of climate change, warming coastal waters, water quality, habitat degradation and loss, overexploitation of some species leading to niche replacement by other species, and trophic level changes and shifts associated with all these factors. Anthropogenic affects and the synergy between factors have no doubt led to changes in fish communities along the coast (Kennish, 1992).

A non parametric Mann-Kendall test for trend significance can be used to show annual abundance trends for species collected during this juvenile survey. While no species have any significant long term trend in abundance, winter flounder, tautog, river herring, and menhaden showed significant trends of decreasing abundance during the past 10 years. The other species such as juvenile bluefish and striped bass show no abundance trend for either the full dataset or the past ten years (Table 1a, b). The data in Table 1a all indicate trends or lack thereof for the entire survey data series going back to 1988. A second iteration of this non parametric trend analysis was done using a shortened time period of 10 years (Table 1b).

Reductions and annual fluctuations in abundance of many species may be attributed to a number of factors outlined above. Any one or more of these factors and/or the synergy between them may be responsible for inhibiting populations of some species from returning to historic or in some cases sustainable levels. Continued monitoring of juvenile fish populations is necessary to document the abundance and distribution of important species as well as the interactions between species. Further, this data can be analyzed to evaluate the effectiveness of management actions, an example being a spawning closure enacted for tautog in 2006 and then lengthened in 2010. This spawning closure was in part supported by the data derived from this survey. Trends in abundance and shifts in fish community composition can also be evaluated with these data.

While the primary purpose for conducting this survey is to provide data for making informed fisheries management decisions, these data are also used when evaluating the adverse impacts of dredging and water dependent development projects.

METHODS, RESULTS & DISCUSSION: A 61m x 3.05m beach seine, deployed from a 23' boat, was used to sample the juvenile life stage of selected fish species in Narragansett Bay. Monthly seine collections were completed at the eighteen standard survey stations (Figure 1) from June through October 2011.

Number of individuals and lengths were recorded for all finfish species. While both juveniles and adults were represented in the collections for many species, individuals collected for the target species were predominately young-of-the-year juveniles (YOYs). Species and number of individuals (both juveniles and adults) of invertebrate species collected were also recorded with the use of a relative index of abundance (abundant, many, few). Tables 3 - 7 show the species occurrence and number caught at each station for June through October. Table 8 is a summary table for all stations and species collected during the 2008 survey. Tables 9-13 provide the number of fish/seine haul for each station along with the station mean, monthly mean, and annual abundance index for each target species. Figures 2 – 8 show the annual abundance index trends for a number of important species for both the original and standardized indices. It should be noted when interpreting these data, that the survey began in 1986 with fifteen stations. The data represented in the graphs begins in 1988 as the period of time when the survey began using consistent methodology with the 15 stations, and then station 16 (Dyer Is.) was added in June 1990, station 17 (Warren R.) was added in July of 1993, and station 18 (Wickford) was added in July of 1995. The addition of the stations is standardized in the analysis, see appendix A.

Table 15 provides bottom temperature, salinity, and dissolved oxygen data for each station by month.

Winter flounder

Juvenile winter flounder (*Pseudopleuronectes americanus*) were present in fifty-two percent of the seine hauls for 2011. This is an increase from 2010 when they were present in thirty-seven percent of the hauls. A total of 428 fish were collected in 2011 (all fish would be considered young-of-the-year (YOY) according to Table 2 winter flounder maximum size by month). This was a decrease from the 969 individuals collected during the 2009 survey, but significantly higher than 2010. They were present at all but four stations (no presence at stations 10, 12, 14, 16), and were collected in all months (Table 9).

The 2011 juvenile winter flounder standardized abundance index was 7.27 ± 1.95 S.E. fish/seine haul; this is higher than the 2011 index of 4.3 ± 1.45 S.E. Figure 2 shows the standardized annual abundance indices since 1988. The Mann-Kendall test showed no significant abundance trend for this species for the full dataset, but did indicate a decreasing trend in the last 10 years (Table 1a, b).

July had the highest mean monthly abundance of 11.4 ± 4.1 S.E. Gaspee Pt (Sta. 1) had the highest mean station abundance of 21.1 ± 9.4 S.E. followed by Conimicut Pt. (Sta. 2) and Pojac Pt (Sta. 4), with 18.9 ± 8.5 S.E. and 10.2 ± 4.5 S.E. respectively. Gaspee Pt. typically has the highest abundance of juveniles in most survey years; the high mean abundance of juvenile winter flounder at Pojac Pt. (Sta. 4) is not typical for the entire time series.

Overall upper and mid bay stations continue to have higher abundances than lower bay stations. This is expected since the primary spawning area for this species is believed to be in the Providence River followed by a secondary spawning area in Greenwich Bay where Station 3 is located. Wickford (Sta. 18), located in the lower bay, also has high numbers of juveniles, though not in 2011. This station is located just outside Wickford Harbor, an area believed to be an important winter flounder spawning area.

Winter flounder length frequency data from the 2011 survey indicate that all of juveniles collected were young-of-the-year (YOY). No individuals were greater than the maximum length estimated for YOY during each month of the survey. The maximum lengths by month for YOY winter flounder used for this report are supported by growth rates in Rhode Island waters as reported in the literature (Delong et al, 2001; Meng et al, 2000; Meng et al, 2001; Meng et al, 2008). See Table 2 for maximum YOY lengths by month.

Figure 2 shows the 2011 abundance index continues to be lower than most years since 2000, the survey high. Our juvenile finfish coastal pond survey showed an increase in abundance from 2010 to 2011, but the survey abundance remains low relative to the entire time series. The Division of Fish and Wildlife's trawl survey data (sampling both adults and juveniles) saw a decrease in abundance from 2010 to 2011 during the spring seasonal survey. Over the course of the Narragansett Bay Juvenile Finfish Seine Survey the abundance index rose between 1995 and 2000, fluctuated between 2000 and 2005, had a slow increasing trend to 2007 and a decrease to

2011. While the Mann-Kendall trend analysis shows no trend in the abundance of juvenile winter flounder in Narragansett Bay over the entire time series, the shortened 10 years time series does indicate a decreasing trend, and the dramatic abundance fluctuations over the past ten years shown in Figure 2 continues to be a concern to resource managers.

Tautog

During the 2011 survey 104 juvenile tautog (*Tautoga onitis*) were collected. This is an decrease over the 2010 survey when 201 juveniles were collected. The 2011 standardized abundance was one of the lowest values since the beginning of the survey time series. The 2011 abundance index was 1.0 ± 0.43 S.E. fish/seine haul, a decrease from the 2010 index of 2.23 ± 0.62 S.E. (Figure 3). As indicated in the introduction, based on this survey data, it can be concluded that the spawning closure enacted in 2006 and then extended in 2010 does not appear to be having a significant impact on the number of juveniles produced during the spring to this point.

Juvenile tautog were collected in thirty-one percent of the seine hauls in 2011 (Table 10). This is a decrease from 2010 when they were present in thirty-three percent of the seine hauls. In 2011 August had the highest mean monthly abundance of 3.4 ± 1.0 fish per seine haul, which corresponds to the majority of the survey time series data which indicates August as being the month with the highest abundance. Rose Island (Sta. 10) had the highest mean station abundance of 4.4 ± 2.6 S.E. followed by Spectacle Cove (Sta. 13) with a mean station abundance of 3.4 ± 1.9 S.E. fish/seine haul. The Mann-Kendall test showed no long-term abundance trend for juvenile tautog but does indicate a decreasing trend in the past 10 years (Table 1a, b). It should be noted that this survey data is used as a young of the year index in both the coastwide stock assessment by the Atlantic States Marine Fisheries Commission as well as the RI/MA regional tautog stock assessment.

Our coastal pond juvenile seine survey had a slight increase in the abundance of juvenile tautog in 2011.

Bluefish

During the 2011 survey 738 juvenile bluefish (*Pomatomus saltatrix*) were collected. This is significantly lower than the 2,072 juveniles collected in 2010. Juveniles were present in thirty-four percent of the seine hauls and were collected at fourteen of the eighteen stations (Table 11). They were present in all months. It should be noted that since this survey began only one hundred thirty-two juvenile bluefish have been collected in October, in four different years (1990, 1997, 1999, 2005, and 2011), and only when water temperatures were 16 – 21° C.

The abundance index for 2011 was 1.9 ± 0.9 S.E. fish/seine haul. This is significantly higher than the 2010 abundance index of 3.2 ± 1.3 S.E fish/seine haul (Figure 4). The Mann-Kendall test showed no long-term or 10 year abundance trend for this species (Table 1a, b).

August had the highest mean monthly abundance of 23.8 ± 17.2 S.E. fish/seine haul (Table 11). July and August are typically the months of highest juvenile abundance for this species. The only exception to this was in 2005 when September had the highest mean monthly abundance. This was probably due to the higher than normal water temperatures during September 2005 and 2010.

In 2011 the Wickford station (Sta. 18) had the highest mean station abundance of 61.4 ± 61.2 S.E. fish/seine haul. This high abundance and high standard error are due to a single large catch during August (Table 11).

Length frequency data for 2011 indicates that all juveniles collected were young-of-the-year individuals.

The spatial distribution and abundance of juvenile bluefish in Narragansett Bay is highly variable and is dependent on a number of factors: natural mortality, fishing mortality, size of offshore spawning stocks, spawning success, number of cohorts, success of juvenile immigration into the estuaries, and the availability of appropriate size prey species like Atlantic silversides (*Menidia menidia*) when juveniles enter the bay. The annual abundance indices since 1988 show dramatic fluctuations supporting a synergy of these factors affecting recruitment of this species to Narragansett Bay (Figure 4). The most recent years increasing abundance is evident in the index. The RI coastal pond seine survey saw an increase in bluefish abundance in 2011.

Striped Bass

During the 2011 survey 6 striped bass (*Morone saxatalis*) were collected. This is lower than the 20 juveniles collected in 2010. Striped bass were present in seven percent of the seine hauls and were collected at four of the eighteen stations (Table 14). They were present in all months except October.

The abundance index for 2011 was 0.22 ± 0.1 S.E. fish/seine haul. This is within the error level that occurred in 2010, which had an abundance index of 0.22 ± 0.1 S.E fish/seine haul (Figure 8). The Mann-Kendall test showed no abundance trend for this species for the entire dataset or the truncated 10 year dataset (Table 1a, b).

September had the highest mean monthly abundances of 0.11 ± 0.08 S.E. fish/seine haul (Table 14). September and October are the months with the highest abundance consistently for the entire time series.

In 2011 the Rose Island (Sta. 10) and Third Beach had the highest mean station abundances of 0.6 ± 0.2 S.E. (Table 14). The station with the highest abundance each year is variable, though it does tend to be the lower bay stations in general for the entire time series.

Length frequency data for 2011 indicates that a mix of juveniles and adults were collected. This is normal for the seine survey. The spatial distribution and abundance of striped bass in Narragansett Bay is highly variable and is most likely highly dependent on the availability of appropriate size prey species like Atlantic silversides (*Menidia menidia*) and juvenile menhaden (*Brevoortia tyrannus*) when fish enter the bay. The annual abundance indices since 1988 show fluctuations in abundance from year to year (Figure 8), but generally appears to have an increasing trend since 1994. The standardized index, which accounts for some of these factors, follows a similar trend year to year as the straight catch per unit effort (CPUE) index. This long term trend is supported by the Mann-Kendall test.

Clupeidae

Four species of clupeids were collected during the 2011 survey. Alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), collectively referred to as river herring, and Atlantic menhaden (*Brevoortia tyrannus*) were most common. Atlantic herring (*Clupea harengus*) were also collected but in very small numbers.

River Herring

Due to the large numbers of anadromous herring collected, and the difficulty of separating juvenile alewives from juvenile blueback herring without sacrificing them, both species are combined under the single category of river herring. Data collected from this survey and the Division's Anadromous Fish Restoration Project show alewives to be the predominate river herring species collected, although both species are present and have been stocked as part of the Division's restoration efforts.

River herring were present in twenty-six percent of the seine hauls and were collected at twelve of the eighteen stations during 2011. River herring were present in all months except August in 2011. A total of 2,795 juveniles were collected in 2011, a significant increase from the number collected in 2010 (510 fish).

The highest mean monthly abundance for 2011 occurred during July and was 151.7 ± 94.6 S.E. fish/seine haul. Gaspee Pt (Sta. 1) had the highest mean station abundance of 313.4 ± 313.2 S.E. (Table 13). Single large catches of these species are due to their schooling behavior and is the reason for the high standard error associated with the indices.

The abundance index for 2011 was 3.9 ± 2.3 S.E. fish/seine haul (Figure 5). The annual abundance indices since 1988 show dramatic fluctuations as is a common occurrence with schooling clupeid species. The standardized index seems to indicate a decrease in abundance in recent years despite the increase in 2011, which is corroborated by the 10 year Mann-Kendall test (Table 1b), however the Mann-Kendall test showed no long-term abundance trend for river herring (Table 1a). The RI coastal pond seine survey saw a decrease in river herring abundance in 2011.

Figure 6 shows the estimated spawning stock size of river herring as monitored by our Anadromous Fish Restoration Program at two fishways in Rhode Island. There may be some correlation between increasing numbers of returning adult fish (Figure 6) and the abundance index generated by this survey (Figure 5) as the possible increasing trend in the data corresponds to an increase in returning adults, and vise versa. Due to an extended period of low abundance of river herring in Rhode Island the taking of either species of river herring is currently prohibited in all state waters.

Menhaden

Thirteen Atlantic menhaden (*Brevoortia tyrannus*) were collected during the 2011 survey. They were present in eight percent of the seine hauls and were collected at six of the eighteen stations

(Table 12). By comparison eight thousand two hundred and fifty three juveniles were collected in 2007, which was an order of magnitude higher than in the past three years.

The highest mean monthly abundance for 2011 occurred during September and was 0.4 ± 0.2 S.E. fish/seine haul. Gaspee Pt (Sta. 1), Chepiwanoxet (Sta. 3), and Rose Island (Sta. 10) had the highest mean station abundance of 0.4 ± 0.4 S.E. (Table 13). Single large catches of these species are due to their schooling behavior and is the reason for the high standard error associated with the indices.

The abundance index for 2011 was 1.9 ± 1.6 S.E. fish/seine haul. This was higher than the 2010 index of 1.2 ± 1.2 S.E (Figure 7). The standardized index indicates an increased abundance during the 2000s. In the most recent years a decreasing abundance is evident. The RI coastal pond seine survey saw a decrease in menhaden abundance in 2011. The Mann-Kendall test showed no long-term abundance trend for this species, but it did indicate a decreasing trend over the past 10 years (Table 1a, b).

Similar to river herring, juvenile menhaden were also observed in very large schools around Narragansett Bay (though not in 2011) and as discussed earlier, this behavior often results in single large catches resulting in a high abundance index and large standard error. This schooling behavior also contributes to the variability of their spatial and temporal abundance from year to year. Because of these characteristics it is difficult to develop an abundance index that will accurately reflect the number of juveniles actually observed in the field rather than the number represented in the samples. The standardization techniques used for analysis this year are an effort to take in to account this variability and high percentage of zero catches through the use of a delta lognormal model. It should be noted that our survey data is one of five fishery independent surveys along the Atlantic coast used in the coastwide stock assessment by the Atlantic States Marine Fisheries Commission.

Weakfish

Two weakfish, *Cynocion regalis,* were collected during the 2011 survey. Station 3 in Greenwich Bay and Station 4 at the mouth of the Potowomut River, immediately south of Greenwich Bay, are the stations where this species is collected most frequently, however, none were found at these stations since 2009. The two weakfish that were caught were encountered at Gaspee Pt. (Sta. 1) in 2011.

The abundance trend over the past several years indicate the juvenile population of this species in Narragansett Bay fluctuates dramatically, a trend also reflected in our trawl survey. The RI coastal pond seine survey did catch weakfish in 2011, but abundance has historically been very low in this survey. Possible reasons for this high variability in abundance, other than fishing pressure, may be environmental and anthropogenic factors that affect spawning and nursery habitat. Survival rate at each life history stage may also be influenced by these factors. The literature indicates this species spawns in calm coves within the estuary and juveniles move up the estuary to nursery areas of lower salinity. These are the same areas of the bay where anthropogenic impacts are high, often resulting in hypoxic and/or anoxic events that may increase mortality of the early life history stages of this species.

With the limited and sporadic juvenile data generated by this survey a juvenile population trend analysis is difficult.

<u>*Black Sea Bass*</u>
Four juvenile black sea bass (*Centropristis striata*) were collected in 2011 compared to ninety-nine collected during the 2007 survey. The 2007 recruitment event was an order of magnitude higher than 2008, 2009, 2010, and 2011. The number of black sea bass has been highly variable from year to year during the time series of this survey.

One hundred five juveniles were collected in 2001, the survey high, with eighty-three individuals collected in September at Chepiwanoxet (Sta. 3) in Greenwich Bay. The coastal pond seine survey indicated a significant increase in abundance from 2010 to 2011, as well. Both the trawl survey and the coastal pond survey seem to be better indicators for local abundances of black sea bass. The Narragansett Bay seine survey does not catch them in any consistent manner leading one to believe that they may be using deeper water and or the coastal ponds as their preferred nursery areas. There are no indications that there are any problems with the local abundance of black sea bass, information that is also corroborated by the coastwide stock assessment for black sea bass, which indicates no overfishing and a rebuilt stock.

Other important species
Juveniles of other commercial or recreationally important species were also collected during the 2011 survey. These juveniles included scup (*Stenotomus chrysops*), Northern kingfish (*Menticirrhus saxatilis*), and windowpane flounder (*Scophthalmus aquosus*).

Three juvenile scup were collected in 2011 during July, August, and September. Two-hundred and four Northern kingfish were collected in 2011 with the majority collected in August at Conimicut Pt (Sta. 2). Five windowpane flounder were collected in June and July at Third Beach (Sta. 15). No summer flounder were collected in 2011. See Tables 3-8 for additional survey data on these species. Sixty-eight smallmouth flounder were caught in 2011. Relative to the twelve smallmouth flounder that were caught in 2009, and the thirty-three that were caught in 2010, this is an increase in abundance. The overall trend appears to be increasing. This species will have to be monitored in future years to see if, due to changing habitat conditions or possible vacant niches, it is increasing its residency in the Bay.

Physical & Chemical Data
Previous to 2010 a YSI 85 was used to collect water temperature, salinity and dissolved oxygen data from the bottom water at all stations on each sampling date. This meter was upgraded in 2010 to a YSI Professional Plus Multiparameter instrument 6050000. The instrument collects the same suite of information as the YSI 85, but is an improved meter with better functionality. The water quality data collected are shown in Table 15.

Water temperatures during the 2011 survey ranged from a low of 15.6°C at Kickemuit (Sta. 11) in October to a high of 27.2°C at Chepiwanoxet (Sta. 3) in July.

Salinities ranged from 15.6 *ppt* at Conimicut Pt. (Sta. 2) in September to 28.4 *ppt* at Rose Island

(Sta. 10) in October.

There were no periods during 2011 where readings of <1 mg/l of dissolved oxygen (DO) were taken during the survey. Hypoxia is defined as a DO <3 mg/l: anoxia is a DO <0.1 mg/l, no readings during 2011 meet either of these criteria. DO ranged from 4.54 mg/l at Warren River (Sta. 17) in August to 11.87 mg/l at Gaspee Pt. (Sta. 1) in June.

SUMMARY: **In summary, data from the 2011 Juvenile Finfish Survey continue to show that a number of commercial and recreationally important species utilize Narragansett Bay as an important nursery area. Using the Mann Kendall test, winter flounder, tautog, river herring, menhaden, striped bass, and bluefish showed no long-term abundance trends. Winter flounder, tautog, river herring, and menhaden showed a decreasing abundance trend when analyzed over the past 10 years. For some species abundance trends from this survey agree with those from our coastal pond survey and/or trawl survey, in some instances they do not. Hopefully, juvenile survey abundance indices will be reflected later in the abundance of adults in the trawl survey, but this is not always the case.**

Seventy species, both vertebrates and invertebrates, were collected in 2011. This is higher than, but fairly close to the survey mean for the past twenty-one years of 60.2 species. An initial audit of the earlier time series and information contained on the field logs was undertaken to determine if some of the species diversity was missing from the earlier time series. Some issues were resolved from this analysis, however there are still some unresolved issues contained in the historical field logs. These final issues will be addressed over the coming year.

During 2011 five tropical and subtropical species were collected during the survey. While tropical and subtropical species are collected during this survey every year, the number of species and individuals is dependent upon the course of the Gulf Stream, the number of streamers and warm core rings it generates, and the proximity of these features to southern New England.

The survival and recruitment of juvenile finfish to the Rhode Island fishery is controlled by many factors: over-fishing of adult stocks, spawning and nursery habitat degradation and loss, water quality changes, and ecosystem changes that effect fish community structure. Any one of these factors, or a combination of them, may adversely impact juvenile survival and/or recruitment in any given year.

An ongoing effort to increase populations of important species must embrace a comprehensive approach that takes into account the above factors, their synergy and the changing fish community in the Bay. A continued effort to identify and protect essential fish habitat (EFH) and improve water quality is essential to this effort. The Division through our permit review program does represent the interests of fish and habitat preservation and protection. As well, properly informed management decisions are tantamount to preserving spawning stock biomass in order to create and maintain sustainable populations. This survey's dataset is used to inform the statistical catch at age models for both a regional tautog assessment as well as the coastwide menhaden assessment. In addition to the direct usage of the data in fisheries models, the other information collected by the survey helps to identify ancillary information such as abundances of forage species and habitat parameters, all important information for making good informed management decisions. These activities will all continue to be an important component of this project.

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FIGURES

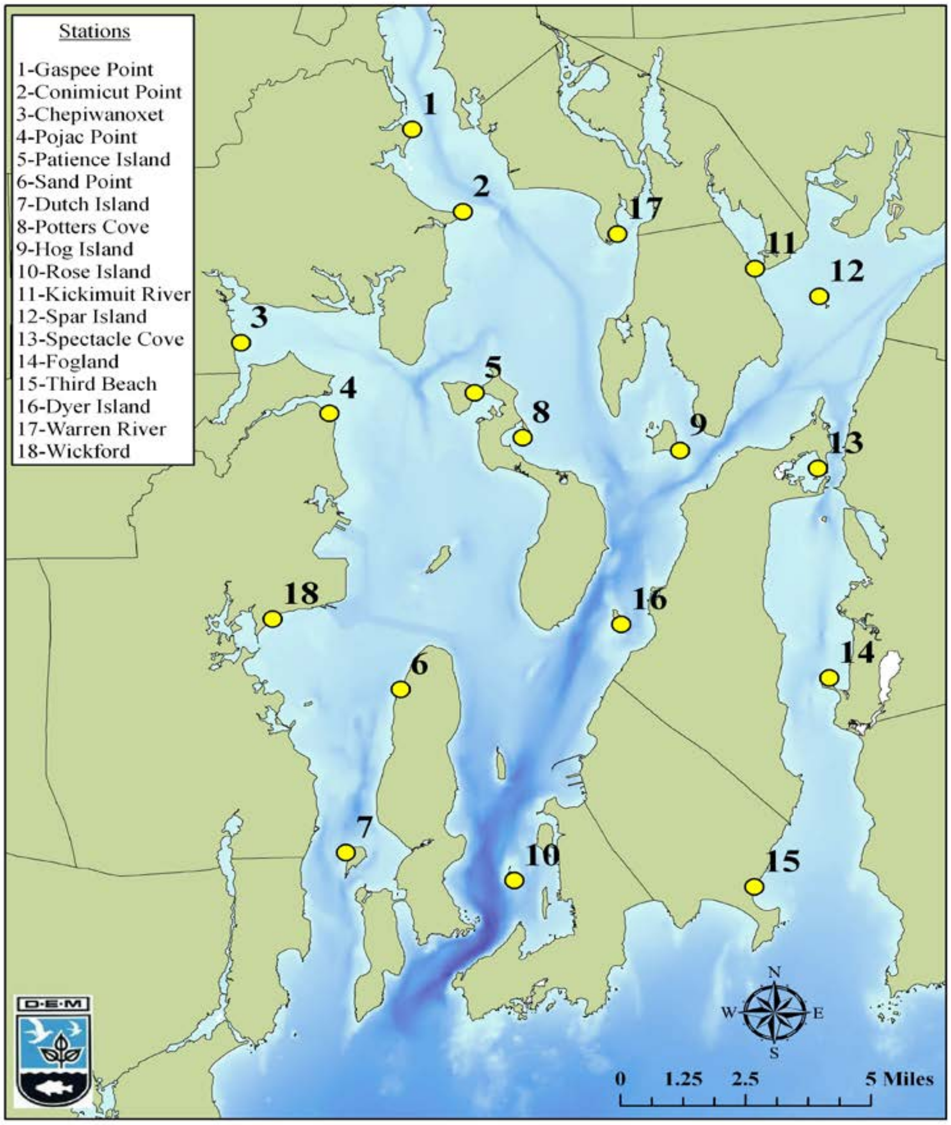


Figure 1. Survey station location map.

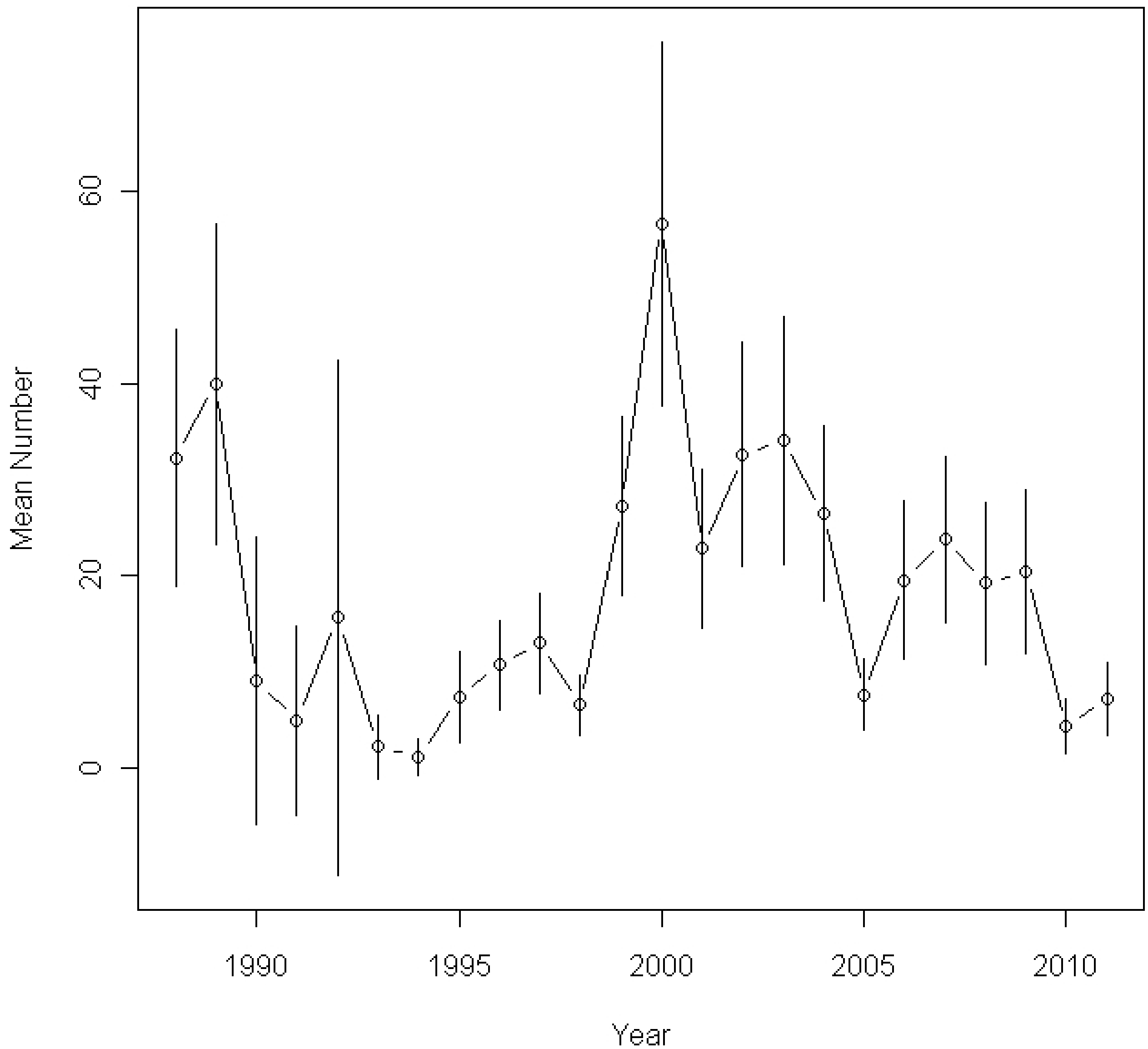


Figure 2. Juvenile winter flounder standardized abundance index 1988 – 2011 (see appendix A for standardization methodology).

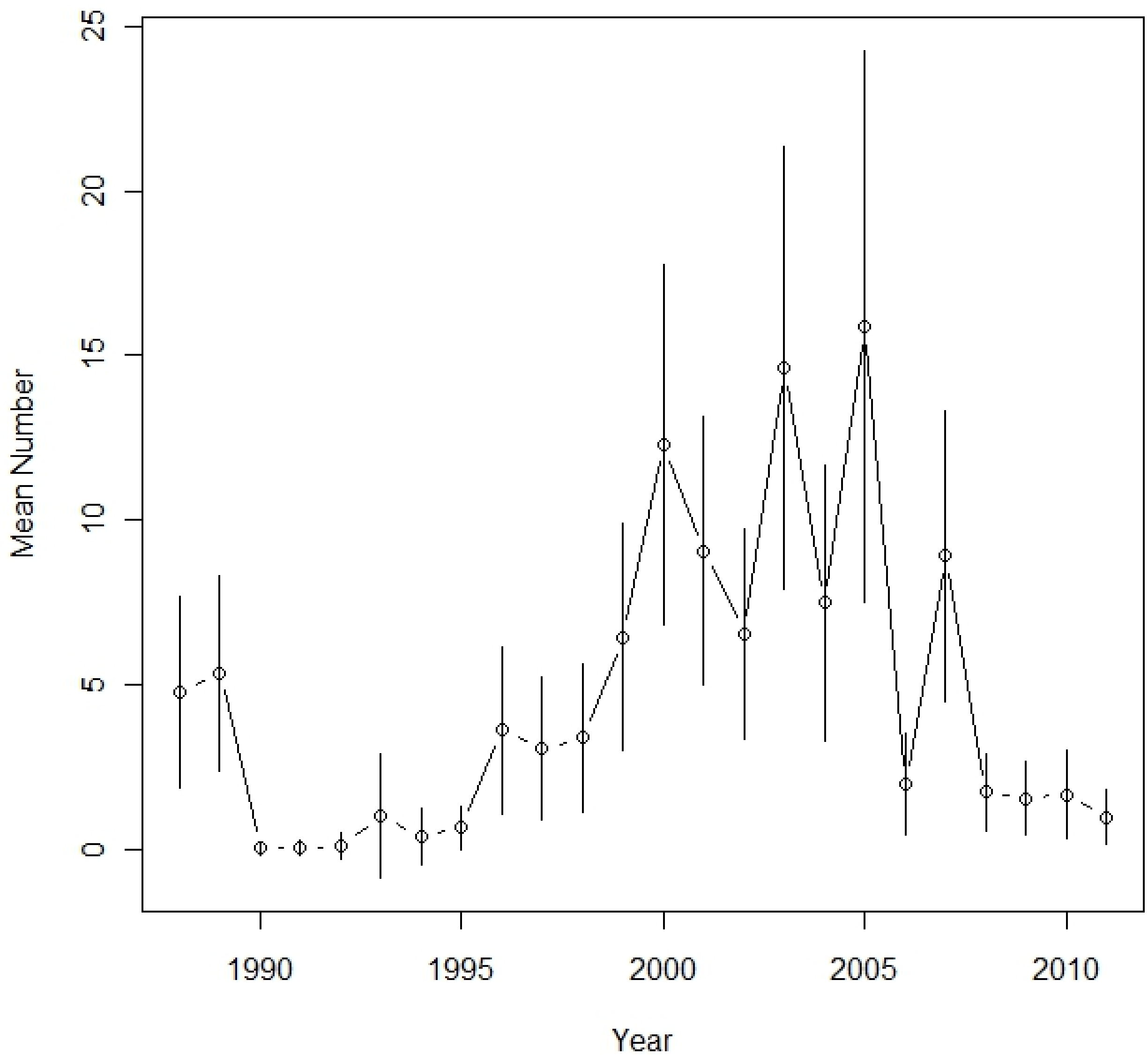


Figure 3. Juvenile tautog standardized annual abundance index 1988 – 2011 (see appendix A for standardization methodology).

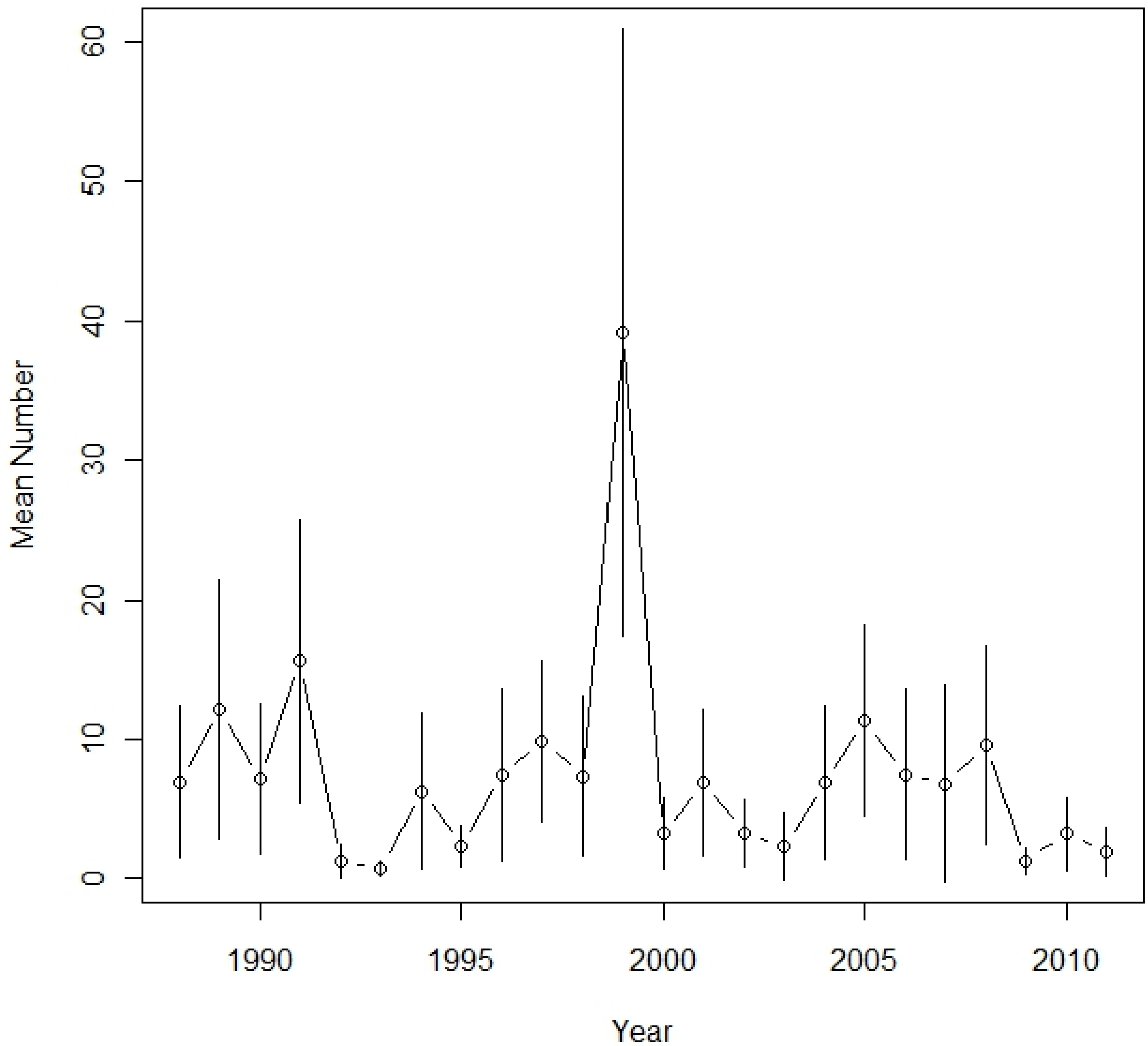


Figure 4. Juvenile bluefish standardized annual abundance index 1988 – 2011 (see appendix A for standardization methodology).

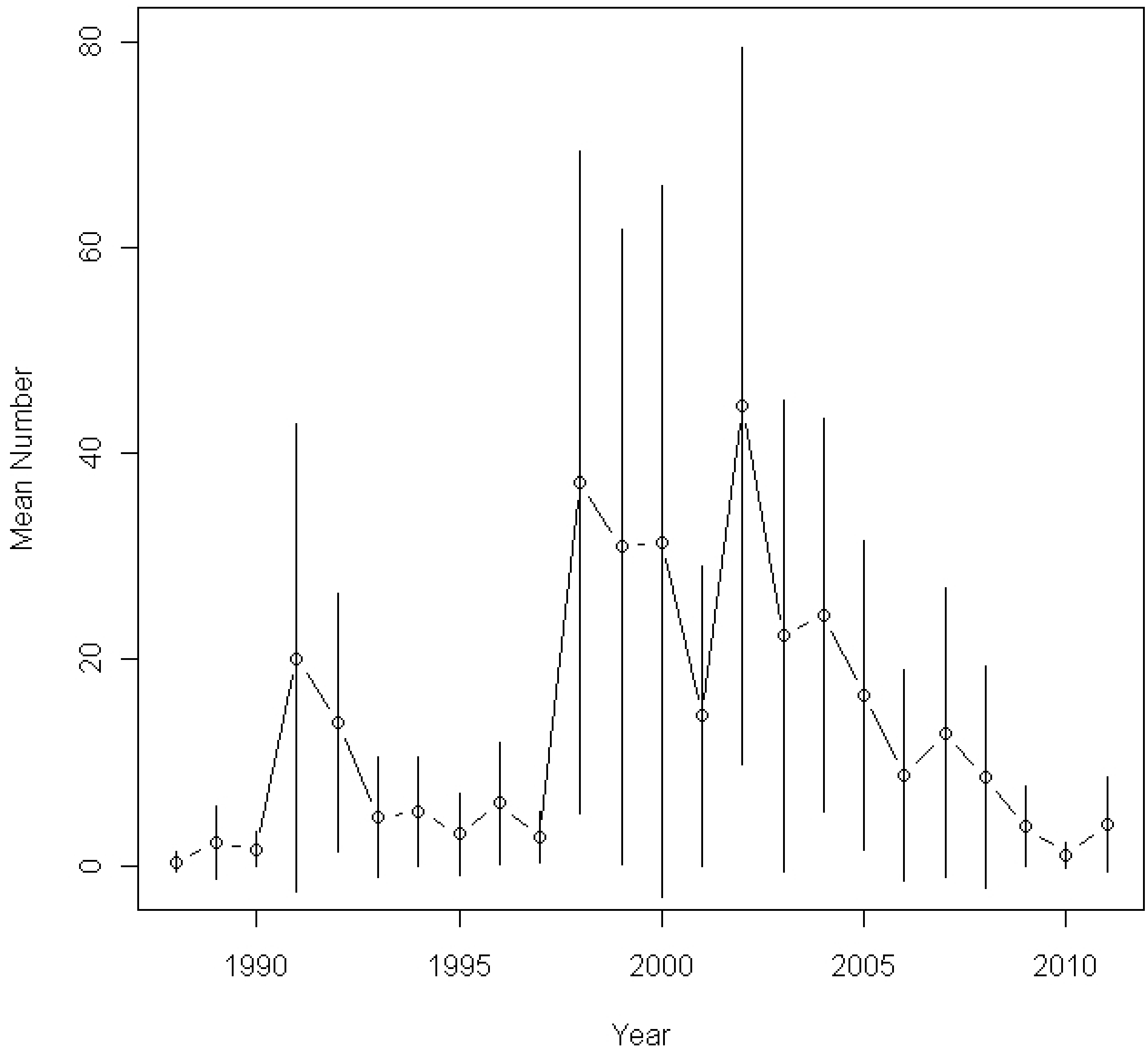
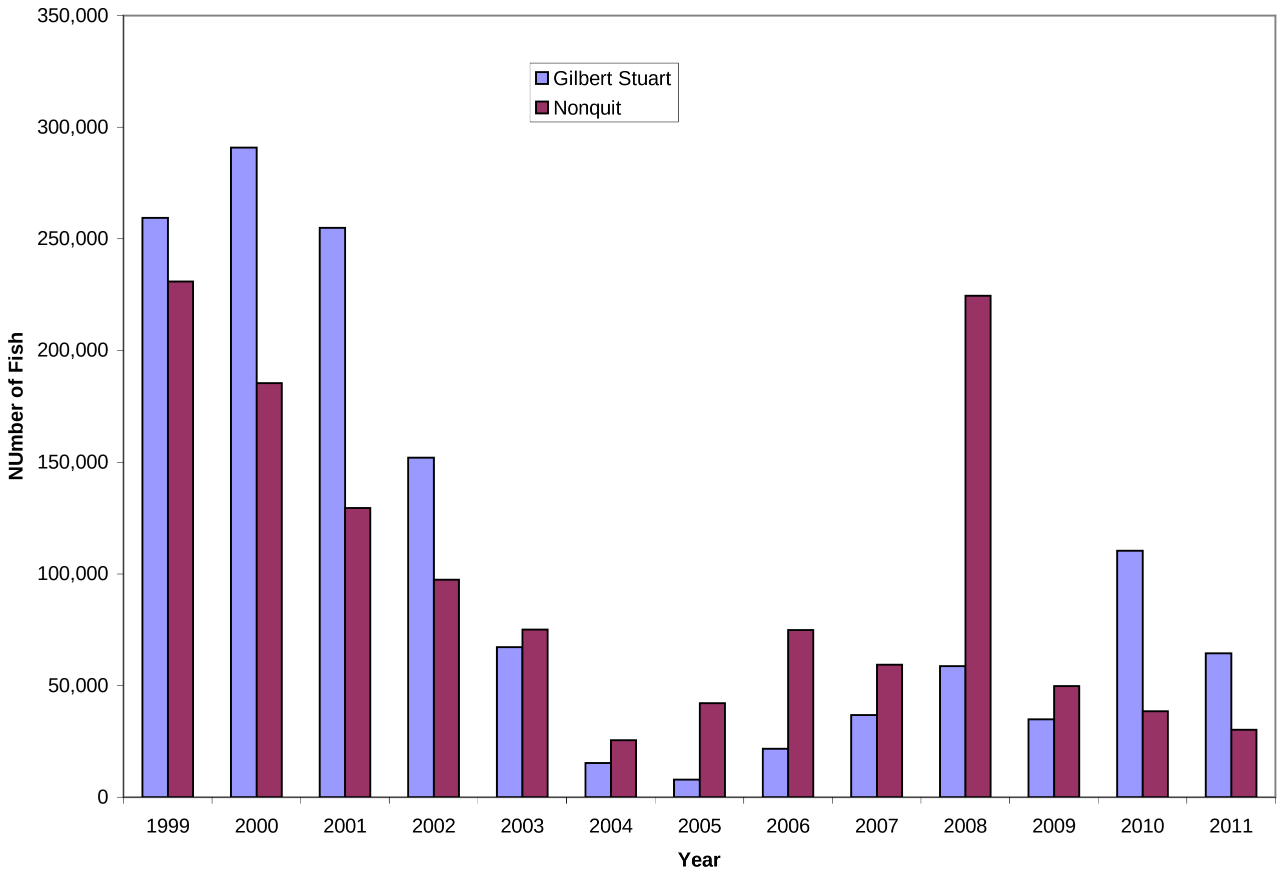


Figure 5. Juvenile river herring standardized annual abundance index 1988 – 2009 (see appendix A for standardization methodology).



Courtesy - Phil Edwards, RIF&W Anadromous Fish Restoration Program

Figure 6. River herring spawning stock size from monitoring at two locations 1999 – 2011.

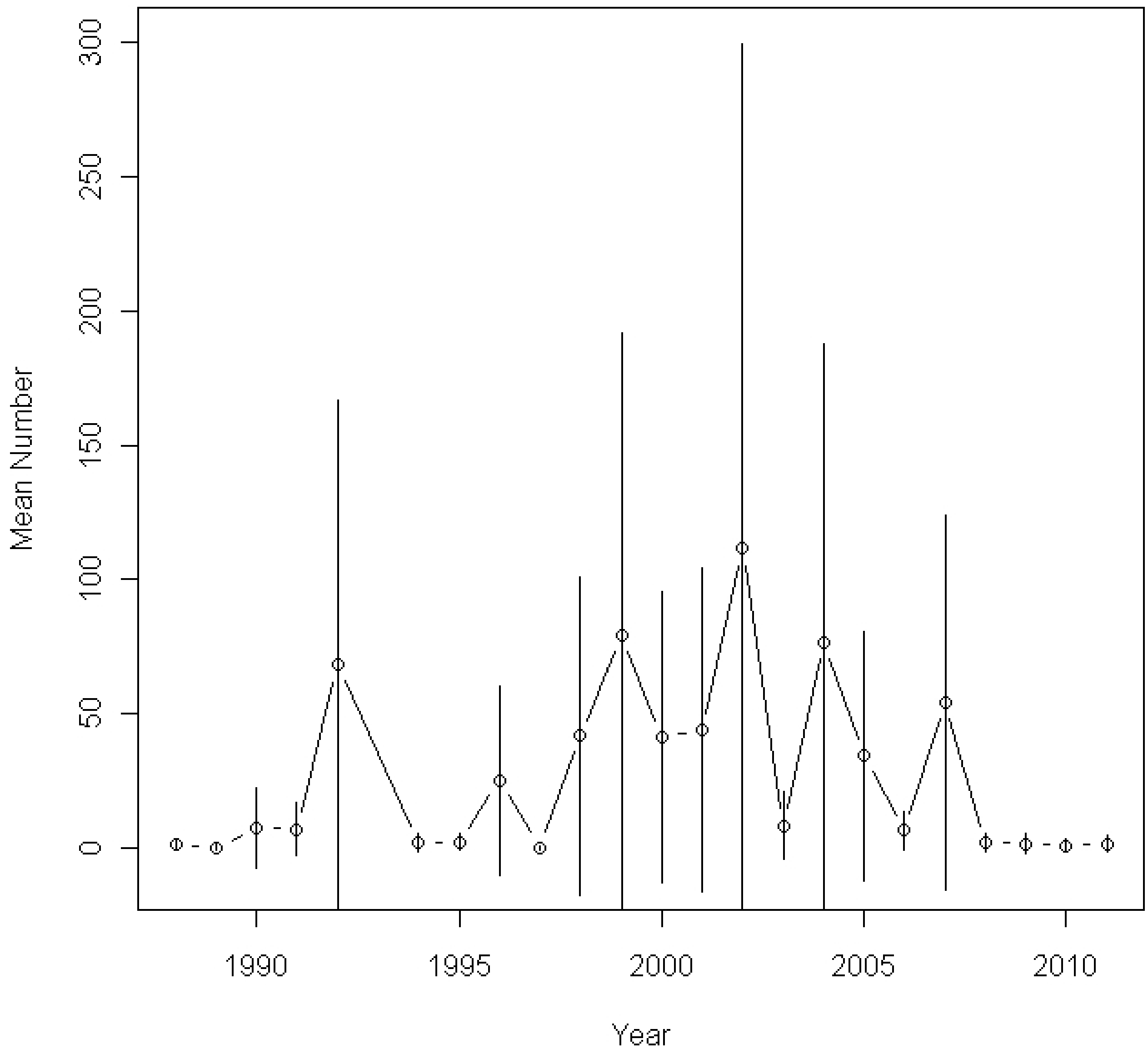


Figure 7. Juvenile menhaden standardized annual abundance index 1988 – 2011 (see appendix A for standardization methodology).

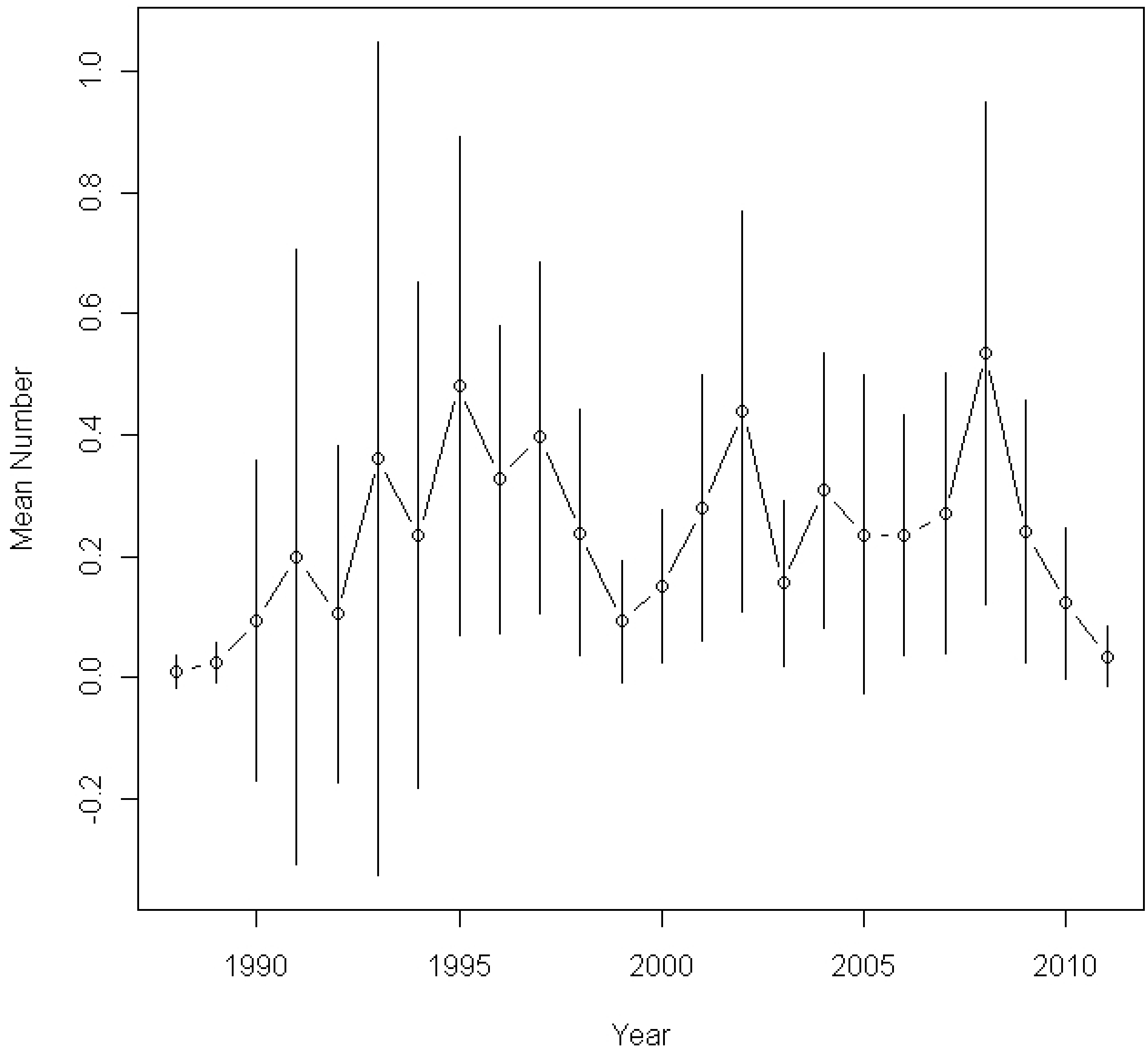


Figure 8. Striped bass standardized annual abundance index 1988 – 2011 (see appendix A for standardization methodology).

TABLES

Table 1a. Mann-Kendall test for target species abundance trend analysis (Full dataset; 1988 - 2011).

Mann-Kendall test	Winter Flounder	Tautog	Bluefish	River Herring	Menhaden	Striped Bass
S	6	64	-38	28	20	44
n Observations	24	24	24	24	24	24
Variance	1625.3	1625.3	1625.3	1625.3	1625.3	1625.3
Tau	0.0217	0.232	-0.138	0.101	0.073	0.159
2-sided p value	0.90	0.118	0.359	0.503	0.637	.286
α	0.05	0.05	0.05	0.05	0.05	0.05
Significant Trend	No	No	No	No	No	No

Table 1b. Mann-Kendall test for target species abundance trend analysis (2002-2011).

Mann-Kendall test	Winter Flounder	Tautog	Bluefish	River Herring	Menhaden	Striped Bass
S	-27	-27	-9	-37	-31	-15
n Observations	10	10	10	10	10	10
Variance	125	125	125	125	125	125
Tau	-0.6	-0.6	-0.2	-0.822	-0.689	-0.333
2-sided p value	0.020	0.02	0.474	0.001	0.007	0.210
α	0.05	0.05	0.05	0.05	0.05	.05
Significant Trend	Yes ↓	Yes ↓	No	Yes↓	Yes↓	No

Table 2. Young-of-the-Year (YOY) winter flounder - maximum total length for each month.*

Month	July	August	September	October
Max. YOY length (TL)	100 mm	107 mm	109 mm	115 mm

* data provided by L. Buckley, National Marine Fisheries Service, Narragansett Laboratory, Narragansett, R.I.

Table 3. Species abundance by station for June 2011.

Sum of SumOfAbundance	Station																		
Scientific Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Grand Total
Alosa aestivalis &/or pseudoharengus	1				1						20		2						24
Ammodytes americanus			1									6				1			8
Amphipoda order										0									0
Anchoa mitchilli			1	1															2
Anguilla rostrata													1						1
Asteroidea								0											0
Calinectes sapidus	2	3	2	7							1	2	2						19
Carcinus maenus	0					0			0		0		0						0
Clupea harengus												1	6				4	3	14
Crangon septemspinosa	0	0	0		0			0	0		0				0			0	0
Ctenophora phylum		0					0	0	0	0	0	0	0	0			0	0	0
Fundulus heteroclitus	1		121	12	2	16					38		17				5		212
Fundulus majalis	16		15		11						125		5	9			6		187
Gobiosoma bosc		1	1		1							1							4
Isopoda order							0												0
Libinia emarginata		0			0				0		0		0						0
Limulus polyphemus		2																	2
Littorina littorea						0				0	0			0	0	0			0
Menidia menidia	94	928	50	351	73	4		14	15		30	225	1493	207	12		28	169	3693
Microgadus tomcod	0	1		1	3				1		2	21	1			1	1		32
Morone saxatilis					1					1									2
Mya arenaria	0	0																	0
Myoxocephalus aenaeus		3			3				2		15	1	23						47
Nassarius obsoletus	0		0						0				0						0
Opsanus tau											1								1
Ovalipes ocellatus			0																0
Pagurus spp	0	0	0		0		0	0	0	0	0		0				0	0	0
Palaemonetes vulgaris	0		0		0	0		0	0	0	0	0	0						0
Panopeus spp	0				0				0		0								0
Pomatomus saltatrix	1	116	2												3		58		180
Pseudopleuronectes americanus	41	22	14	7		2		4	2				11		1		4	8	116
Scophthalmus aquosus															3				3
Syngnathus fuscus	1	1							1		4	3							10
Tautoga onitis												1	1						2
Tautogolabrus adspersus							1												1
Trachurus lathami				1	1														2
Grand Total	157	1077	207	380	96	22	1	18	21	1	236	261	1562	216	19	2	106	180	4562

* The 0 (zeroes) in the above table indicate species presence with only relative abundance (few, many, abundant) taken.

Table 4. Species abundance by station for July 2011.

Sum of SumOfAbundance	Station																		
Scientific Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Grand Total
Alosa aestivalis &/or pseudoharengus	1566	4		2	70			2	4		808	68	8	10				189	2731
Apeltes quadracus			2																2
Asteroidea	0	0												0					0
Calinectes sapidus	1	11	11	12	2		2	2					1						42
Carcinus maenus	0	0		0		0		0			0		0						0
Crangon septemspinosa	0	0	0	0	0		0		0						0				0
Crassostrea virginica						0													0
Crepidula fornicata				0	0						0								0
Ctenophora phylum		0	0	0	0		0			0				0		0	0		0
Cyprinodon variegatus																2			2
Emerita talpoida															0				0
Fundulus heteroclitus	23		9	37	33	22					38						3	14	179
Fundulus majalis	115	38	232	30	18	12			2		14		36	3		5	4	37	546
Gobiosoma bosc		9									1								10
Isopoda order							0		0	0					0				0
Libinia emarginata	0			0	0				0						0			0	0
Limulus polyphemus													1						1
Littorina littorea						0			0					0					0
Menidia menidia	293	79	18	12	100	31	15	23	39		33	54	6167	151	100	202	101	213	7631
Menticirrhus saxatilis			7															2	9
Mercenaria mercenaria											0								0
Microgadus tomcod	10	1								2				1					14
Mogula singularis		0	0																0
Morone saxatilis										1									1
Mugil curema						1													1
Myoxocephalus aenaeus		14			2			1	1		26		13	1					58
Mytilus edulis						0													0
Nassarius obsoletus	0		0										0						0
Ovalipes ocellatus			0	0	0		0								0			0	0
Pagurus spp		0	0	0	0		0	0	0	0	0	0		0	0	0	0		0
Palaemonetes vulgaris	0	0	0	0	0			0			0	0		0	0		0		0
Panopeus spp	0	0			0								0					0	0
Pomatomus saltatrix	8	18	9	2				16			2	2	1				17	1	76
Prionotus evolans		1																	1
Pseudopleuronectes americanus	55	51	16	28	13				1		6		28		6		1	1	206
Scophthalmus aquosus															2				2
Sphoeroides maculatus				2	1										1			6	10
Stenotomus chrysops																		1	1
Syngnathus fuscus		1	1	1															3
Synodus foetens																		3	3
Tautoga onitis												1	1					1	3
Tautogolabrus adspersus							1												1
Tunicata									0										0
Grand Total	2071	227	305	126	239	66	18	44	47	3	928	125	6256	166	109	209	126	468	11533

* The 0 (zeroes) in the above table indicate species presence with only relative abundance (few, many, abundant) taken.

Table 5. Species abundance by station for August 2011.

Sum of SumOfAbundance	Station																		
Scientific Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Grand Total
Amphipoda order										0									0
Anchoa mitchilli		2							1										3
Apeltes quadracus													3						3
Asteroidea	0																0		0
Calinectes sapidus	1		9	1	1			1					3	1				2	19
Carcinus maenus		0			0	0				0			0	0		0			0
Centropristus striata															1				1
Crangon septemspinosa															0				0
Crepidula fornicata				0								0							0
Ctenophora phylum							0					0	0				0		0
Cynoscion regalis	2																		2
Cyprinodon variegatus	1												2			1			4
Etropus microstomus		1					1								3				5
Fundulus heteroclitus	101	0	110	4	15	7		13	29				22	3		18	3		325
Fundulus majalis	132	126	263	30	2	1	1	18	50		84		62	4	95	66	84	49	1067
Gobiosoma bosc			1																1
Hemigrapsus sanguineus												0							0
Isopoda order										0								0	0
Libinia emarginata		0	0		0					0	0						0		0
Limulus polyphemus					1												0		1
Littorina littorea						0							0	0		0			0
Lucania parva													7						7
Menidia menidia	167	320	42	85	1112	122	261	556	230	7	223	181	477	85	392	178	261	170	4869
Menticirrhus saxatilis	31	53	4	4	8		1	13							11		2	44	171
Mercenaria mercenaria							0												0
Microgadus tomcod										3									3
Morone saxatilis	1																		1
Mugil curema				1														1	2
Mya arenaria	0																		0
Myoxocephalus aenaeus					4				1	5				2					12
Mytilus edulis	0																		0
Nassarius obsoletus		0	0	0					0							0			0
Neanthes succinea	0																		0
Opsanus tau			2								6			3					11
Ovalipes ocellatus		0	0	0	0		0	0	0						0	0		0	0
Pagurus spp					0	0	0	0	0		0			0	0	0	0		0
Palaemonetes vulgaris	0	0	0						0		0		0	0				0	0
Panopeus spp	0		0	0		0		0	0	0	0	0	0	0					0
Paralichthys dentatus		1																	1
Pomatomus saltatrix	1			77	18						3	3	18	1			2	306	429
Prionotus evolans	1		2	10				2							2			4	21
Pseudopleuronectes americanus	11	7	11	6	3	1			4				18		3				64
Sphoeroides maculatus		1		2		2	1		4						6	1		3	20
Stenotomus chrysops												1							1
Syngnathus fuscus	1		1	1						1	6		1						11
Synodus foetens															1			2	3
Tautoga onitis	5	3		10	5			1	2	14	2	1	11	6		1			61
Tautogolabrus adspersus									1	56				1		1			59
Grand Total	455	514	445	231	1169	133	265	604	322	86	324	186	624	106	514	266	352	581	7177

* The 0 (zeroes) in the above table indicate species presence with only relative abundance (few, many, abundant) taken.

Table 6. Species abundance by station for September 2011.

Sum of SumOfAbundance	Station																		
Scientific Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Grand Total
Alosa aestivalis &/or pseudoharengus		2							8		4	3		1					18
Ammodytes americanus										4									4
Anchoa mitchilli		3														23			26
Arcopectin irradians									0										0
Asteroidea																	0		0
Brevoortia tyrannus	2		2	1		1				2									8
Calinectes sapidus			1	1			2		2								1	24	31
Carcinus maenus						0			0		0		0			0			0
Centropristus striata																2			2
Crangon septemspinosa	0															0			0
Crepidula fornicata								0				0		0					0
Ctenophora phylum							0			0									0
Cyprinodon variegatus		1							2				12	1		3			19
Emerita talpoida															0				0
Etropus microstomus							1											25	26
Fundulus heteroclitus	1	2	115	18		144		44	57				441	46		2	6		876
Fundulus majalis	77	76	111	18	78	43	2	72	15	54	8	12	39	121	3	70	69	6	874
Gobiosoma bosc	1																		1
Isopoda order									0						0				0
Libinia emarginata		0		0	0		0		0		0		0						0
Limulus polyphemus																	1		1
Littorina littorea						0			0				0	0					0
Menidia menidia	22	497	244	379	232	203	50	141	642	831	3273	256	396	427	7	106	1180	11	8897
Menticirrhus saxatilis			1	1		1			2		6	1			1			2	15
Mercenaria mercenaria							0												0
Microgadus tomcod									1										1
Morone saxatilis										1							1		2
Myoxocephalus aenaeus		1							85				5	1					92
Mytilus edulis				0			0		0	0									0
Nassarius obsoletus		0						0	0										0
Opsanus tau									22										22
Ovalipes ocellatus				0	0		0	0							0			0	0
Pagurus spp	0	0			0		0	0	0	0			0			0	0	0	0
Palaemonetes vulgaris	0	0	0						0	0	0	0	0	0	0				0
Panopeus spp	0	0	0						0		0								0
Paralichthys dentatus												1						1	2
Pholis gunnellus									1										1
Pomatomus saltatrix		2			4				1		10						32		49
Prionotus evolans									1				1					3	5
Pseudopleuronectes americanus	6			1		2	1	1	15				2					4	32
Stenotomus chrysops																	1		1
Strongylura marina				11															11
Syngnathus fuscus									1	3									4
Synodus foetens																		2	2
Tautoga onitis	7								6	4	3		1						21
Tautogolabrus adspersus									1	24									25
Grand Total	116	584	474	430	314	394	56	258	862	923	3304	273	897	597	11	206	1291	78	11068

* The 0 (zeroes) in the above table indicate species presence with only relative abundance (few, many, abundant) taken.

Table 7. Species abundance by station for October 2011.

Sum of SumOfAbundance	Station																		
Scientific Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Grand Total
Alosa aestivalis &/or pseudoharengus			3	9				7											19
Anchoa mitchilli				588					1						1				590
Anguilla rostrata			1																1
Apeltes quadracus				1															1
Asteroidea	0	0	0														0		0
Aurelia aurita										0									0
Bairdiella chrysoura														1					1
Brevoortia tyrannus				4				1											5
Calinectes sapidus			1	6	1													3	11
Cancer irroratus																0			0
Carcinus maenus	0	0						0	0		0		0	0		0	0		0
Centropristus striata							1												1
Crangon septemspinosa	0	0		0	0		0								0			0	0
Crassostrea virginica												0							0
Crepidula fornicata					0						0	0		0					0
Ctenophora phylum										0									0
Cyprinodon variegatus									2		11								13
Emerita talpoida															0				0
Etropus microstomus		5					11							1	10			10	37
Fundulus heteroclitus	1	1	115	4		131					22		77			1			352
Fundulus majalis	21	2	7	7	10	3	1	3	7	2	6	1	48	6	5	5	29		163
Geukensia demissa							0												0
Gobiosoma bosc		1			1														2
Isopoda order															0				0
Libinia emarginata				0										0					0
Littorina littorea	0												0						0
Lutjanus aratus						1													1
Menidia menidia	101	17	45	91	138	93	750	429	398	15	68		80	114	52	22	1	48	2462
Menticirrhus saxatilis				7											2				9
Mercenaria mercenaria															0				0
Microgadus tomcod														1					1
Myoxocephalus aenaeus					1								3						4
Mytilus edulis																0			0
Nassarius obsoletus											0	0	0						0
Ovalipes ocellatus					0		0	0						0	0		0	0	0
Pagurus spp		0	0	0	0		0	0	0	0				0		0	0	0	0
Palaemonetes vulgaris	0	0	0	0	0						0	0	0	0					0
Panopeus spp	0	0	0	0			0					0	0	0				0	0
Pomatomus saltatrix			2	2															4
Pseudopleuronectes americanus	2	2			1		1		1				1		1			1	10
Sciaenops ocellatus			1																1
Selene setapinnis				31															31
Syngnathus fuscus				1						3									4
Tautoga onitis		1		6		1				4			3	2					17
Tautogolabrus adspersus				1	1					4				16					22
Trinectes maculatus	1																		1
Grand Total	126	29	175	758	153	229	764	440	409	28	107	1	212	141	71	28	30	62	3763

* The 0 (zeroes) in the above table indicate species presence with only relative abundance (few, many, abundant) taken.

Table 8. Summary of species occurrence by station in 2011.

Scientific Name	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Grand Total
Alosa aestivalis &/or pseudoharengus	1	1	1	1	1			1	1		1	1	1	1				1	12
Ammodytes americanus			1							1		1				1			4
Amphipoda order										1									1
Anchoa mitchilli		1	1	1					1						1	1			6
Anguilla rostrata			1										1						2
Apeltes quadracus			1	1									1						3
Arcopectin irradians									1										1
Asteroidea	1	1	1					1						1			1		6
Aurelia aurita										1									1
Bairdiella chrysoura														1					1
Brevoortia tyrannus	1		1	1		1		1		1									6
Calinectes sapidus	1	1	1	1	1		1	1	1		1	1	1	1			1	1	14
Cancer irroratus																1			1
Carcinus maenus	1	1		1	1	1		1	1	1	1		1	1		1	1		13
Centropristus striata							1								1	1			3
Clupea harengus												1	1				1	1	4
Crangon septemspinosa	1	1	1	1	1		1	1	1		1				1	1		1	12
Crassostrea virginica						1						1							2
Crepidula fornicata				1	1			1			1	1		1					6
Ctenophora phylum		1	1	1	1		1	1	1	1	1	1	1	1		1	1	1	15
Cynoscion regalis	1																		1
Cyprinodon variegatus	1	1							1		1		1	1		1			7
Emerita talpoida															1				1
Etropus microstomus		1					1							1	1			1	5
Fundulus heteroclitus	1	1	1	1	1	1		1	1		1		1	1		1	1	1	14
Fundulus majalis	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	18
Geukensia demissa							1												1
Gobiosoma bosc	1	1	1		1						1	1							6
Hemigrapsus sanguineus												1							1
Isopoda order							1		1	1					1			1	5
Libinia emarginata	1	1	1	1	1		1		1	1	1		1	1	1		1	1	14
Limulus polyphemus		1			1								1				1		4
Littorina littorea	1					1			1	1	1		1	1	1	1			9
Lucania parva													1						1
Lutjanus aratus						1													1
Menidia menidia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	18
Menticirrhus saxatilis	1	1	1	1	1	1	1	1	1		1	1			1		1	1	14
Mercenaria mercenaria							1				1				1				3
Microgadus tomcod	1	1		1	1				1	1	1	1	1	1		1	1		12
Mogula singularis		1	1																2
Morone saxatilis	1				1					1							1		4
Mugil curema				1		1												1	3
Mya arenaria	1	1																	2
Myoxocephalus aenaeus		1			1			1	1	1	1	1	1	1					9
Mytilus edulis	1			1		1	1		1	1						1			7
Nassarius obsoletus	1	1	1	1				1	1		1	1	1			1			10
Neanthes succinea	1																		1
Opsanus tau			1						1		1			1					4
Ovalipes ocellatus		1	1	1	1		1	1	1					1	1	1	1	1	12
Pagurus spp	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	18
Palaemonetes vulgaris	1	1	1	1	1	1		1	1	1	1	1	1	1	1		1	1	16
Panopeus spp	1	1	1	1	1	1	1	1	1	1	1	1	1	1				1	15
Paralichthys dentatus		1										1						1	3
Pholis gunnellus									1										1
Pomatomus saltatrix	1	1	1	1	1			1	1		1	1	1	1	1		1	1	14
Prionotus evolans	1	1	1	1				1	1				1		1			1	9
Pseudopleuronectes americanus	1	1	1	1	1	1	1	1	1		1		1		1		1	1	14
Sciaenops ocellatus			1																1
Scophthalmus aquosus															1				1
Selene setapinnis				1															1
Sphoeroides maculatus		1		1	1	1	1		1						1	1		1	9
Stenotomus chrysops												1					1	1	3
Strongylura marina				1															1
Syngnathus fuscus	1	1	1	1					1	1	1	1	1						9
Synodus foetens															1			1	2
Tautoga onitis	1	1		1	1	1		1	1	1	1	1	1	1		1		1	14
Tautogolabrus adspersus				1	1		1		1	1				1		1			7
Trachurus lathami				1	1														2
Trinectes maculatus	1																		1
Tunicata									1										1
Grand Total	30	32	28	32	26	17	19	22	33	21	26	23	26	24	21	20	19	25	444

* The units are number of times present at each station (maximum would be 18 times present for a species at all stations for the year).

Table 9. Numbers of juvenile winter flounder per seine haul in 2011.

	Station																				
Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Mean	St Dev	SE
JUN	41	22	14	7	0	2	0	4	2	0	0	0	11	0	1	0	4	8	6.44	10.54	2.48
JUL	55	51	16	28	13	0	0	0	1	0	6	0	28	0	6	0	1	1	11.44	17.72	4.18
AUG	11	7	11	6	3	1	0	0	4	0	0	0	18	0	3	0	0	0	3.56	5.19	1.22
SEP	6	0	0	1	0	2	1	1	15	0	0	0	2	0	0	0	0	4	1.78	3.69	0.87
OCT	2	2	0	0	1	0	1	0	1	0	0	0	1	0	1	0	0	1	0.56	0.70	0.17
Mean	23.00	16.40	8.20	8.40	3.40	1.00	0.40	1.00	4.60	0.00	1.20	0.00	12.00	0.00	2.20	0.00	1.00	2.80			
St Dev	23.57	21.17	7.69	11.37	5.50	1.00	0.55	1.73	5.94	0.00	2.68	0.00	11.34	0.00	2.39	0.00	1.73	3.27			
SE	10.54	9.47	3.44	5.09	2.46	0.45	0.24	0.77	2.66	0.00	1.20	0.00	5.07	0.00	1.07	0.00	0.77	1.46		Total Fish	
Number	115	82	41	42	17	5	2	5	23	0	6	0	60	0	11	0	5	14		428	

Table 10. Numbers of juvenile tautog per seine haul in 2011.

	Station																				
Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Mean	St Dev	SE
JUN	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0.11	0.32	0.08
JUL	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0.17	0.38	0.09
AUG	5	3	0	10	5	0	0	1	2	14	2	1	11	6	0	1	0	0	3.39	4.31	1.02
SEP	7	0	0	0	0	0	0	0	6	4	3	0	1	0	0	0	0	0	1.17	2.26	0.53
OCT	0	1	0	6	0	1	0	0	0	4	0	0	3	2	0	0	0	0	0.94	1.73	0.41
Mean	2.40	0.80	0.00	3.20	1.00	0.20	0.00	0.20	1.60	4.40	1.00	0.60	3.40	1.60	0.00	0.20	0.00	0.20			
St Dev	3.36	1.30	0.00	4.60	2.24	0.45	0.00	0.45	2.61	5.73	1.41	0.55	4.34	2.61	0.00	0.45	0.00	0.45			
SE	1.50	0.58	0.00	2.06	1.00	0.20	0.00	0.20	1.17	2.56	0.63	0.24	1.94	1.17	0.00	0.20	0.00	0.20		Total Fish	
Number	12	4	0	16	5	1	0	1	8	22	5	3	17	8	0	1	0	1		104	

Table 11. Numbers of juvenile bluefish per seine haul in 2011.

	Station																				
Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Mean	St Dev	SE
JUN	1	116	2	0	0	0	0	0	0	0	0	0	0	0	3	0	58	0	10.00	29.74	7.01
JUL	8	18	9	2	0	0	0	16	0	0	2	2	1	0	0	0	17	1	4.22	6.45	1.52
AUG	1	0	0	77	18	0	0	0	0	0	3	3	18	1	0	0	2	306	23.83	72.77	17.15
SEP	0	2	0	0	4	0	0	0	1	0	10	0	0	0	0	0	32	0	2.72	7.71	1.82
OCT	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.22	0.65	0.15
Mean	2.00	27.20	2.60	16.20	4.40	0.00	0.00	3.20	0.20	0.00	3.00	1.00	3.80	0.20	0.60	0.00	21.80	61.40			
St Dev	3.39	50.21	3.71	34.00	7.80	0.00	0.00	7.16	0.45	0.00	4.12	1.41	7.95	0.45	1.34	0.00	24.00	136.74			
SE	1.52	22.46	1.66	15.21	3.49	0.00	0.00	3.20	0.20	0.00	1.84	0.63	3.56	0.20	0.60	0.00	10.73	61.15		Total Fish	
Number	10	136	13	81	22	0	0	16	1	0	15	5	19	1	3	0	109	307		738	

Table 12. Numbers of juvenile menhaden per seine haul in 2011.

	Station																				
Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Mean	St Dev	SE
JUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
JUL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
AUG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
SEP	2	0	2	1	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0.44	0.78	0.18
OCT	0	0	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0.28	0.96	0.23
Mean	0.40	0.00	0.40	1.00	0.00	0.20	0.00	0.20	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
St Dev	0.89	0.00	0.89	1.73	0.00	0.45	0.00	0.45	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
SE	0.40	0.00	0.40	0.77	0.00	0.20	0.00	0.20	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		Total Fish	
Number	2	0	2	5	0	1	0	1	0	2	0	0	0	0	0	0	0	0		13	

Table 13. Numbers of juvenile river herring per seine haul in 2011.

Month	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Mean	St Dev	SE
JUN	1	0	0	0	1	0	0	0	0	0	20	0	2	0	0	0	0	0	1.33	4.69	1.11
JUL	1566	4	0	2	70	0	0	2	4	0	808	68	8	10	0	0	0	189	151.72	401.20	94.56
AUG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
SEP	0	2	0	0	0	0	0	0	8	0	4	3	0	1	0	0	0	0	1.00	2.11	0.50
OCT	0	0	3	9	0	0	0	7	0	0	0	0	0	0	0	0	0	0	1.06	2.65	0.62
Mean	313.40	1.20	0.60	2.20	14.20	0.00	0.00	1.80	2.40	0.00	166.40	14.20	2.00	2.20	0.00	0.00	0.00	37.80			
St Dev	700.22	1.79	1.34	3.90	31.20	0.00	0.00	3.03	3.58	0.00	358.76	30.10	3.46	4.38	0.00	0.00	0.00	84.52			
SE	313.15	0.80	0.60	1.74	13.95	0.00	0.00	1.36	1.60	0.00	160.44	13.46	1.55	1.96	0.00	0.00	0.00	37.80		Total Fish	
Number	1567	6	3	11	71	0	0	9	12	0	832	71	10	11	0	0	0	189		2792	

Table 14. Numbers of striped bass per seine haul in 2011.

Month	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Mean	St Dev	SE
JUN	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0.11	0.32	0.08
JUL	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.06	0.24	0.06
AUG	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.06	0.24	0.06
SEP	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0.11	0.32	0.08
OCT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Mean	0.20	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00			
St Dev	0.45	0.00	0.00	0.00	0.45	0.00	0.00	0.00	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.00			
SE	0.20	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00		Total Fish	
Number	1	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0	1	0		6	

Table 15. Temperature, salinity, and dissolved oxygen by station and month – 2010 (NA indicates a day where batteries failed on YSI).

Station		Month JUN	JUL	AUG	SEP	OCT
1	Average of Salinity	21.1	21.6	16.8	16.6	15.7
	Average of DO	11.87	9.3	8.68	6.28	7.46
	Average of Temp (C)	21.8	26.4	25.2	19.6	17.9
2	Average of Salinity	23	23.3	20.2	15.6	20.1
	Average of DO	9.45	8.97	8.17	8.46	6.46
	Average of Temp (C)	21.8	26.8	25.3	19.3	18.1
3	Average of Salinity	24.4	25.7	24.7	24.2	24.2
	Average of DO	8.07	7.05	9.31	5.04	5.8
	Average of Temp (C)	22.3	27.2	25.5	23.3	NA
4	Average of Salinity	25.3	25.1	26	24.7	23.6
	Average of DO	6.54	6.77	8.19	5.23	5.89
	Average of Temp (C)	20.3	26.5	24.5	21.5	18.2
5	Average of Salinity	26.1	26.6	25.5	23.9	26.3
	Average of DO	6.11	5.61	7.24	6.64	5.56
	Average of Temp (C)	18.7	25.2	24	21.1	18.6
6	Average of Salinity	25.9	26.8	27.3	25.7	26.6
	Average of DO	7.12	6.56	6.43	6.02	5.29
	Average of Temp (C)	19.3	26	23.4	20.9	17.9
7	Average of Salinity	27.1	27.2	27.6	26.8	27.2
	Average of DO	7.87	6.5	6.22	4.86	5.32
	Average of Temp (C)	18.8	24.2	22.3	20.7	18
8	Average of Salinity	25.4	25.3	24.8	NA	24.4
	Average of DO	6.14	5.5	7.75	NA	7.47
	Average of Temp (C)	18.8	23.7	23.4	NA	18
9	Average of Salinity	26.3	25.7	26	NA	24.8
	Average of DO	5.9	5.32	6.5	NA	5.04
	Average of Temp (C)	17.7	23.2	23	NA	18
10	Average of Salinity	28.1	27.4	27.9	NA	28.4
	Average of DO	7.53	7.7	9.82	NA	7.38
	Average of Temp (C)	15.9	23.2	22.9	NA	18.5
11	Average of Salinity	23.8	25	25.2	23.5	20.2
	Average of DO	4.94	5.52	5.51	7.32	5.25
	Average of Temp (C)	20.6	25.2	25.1	22.6	15.6
12	Average of Salinity	24.5	24.6	25.7	24	25.7
	Average of DO	7.06	6.93	7.99	7.45	6.08
	Average of Temp (C)	19.6	24.1	24.1	22.4	16.8
13	Average of Salinity	26.3	26.7	26.7	26.3	26.8
	Average of DO	6.32	7.72	7.21	6.39	7.46
	Average of Temp (C)	21.1	27	25.1	22.7	17.3
14	Average of Salinity	26.7	27.4	27.4	27.3	27.4
	Average of DO	7.93	6.03	5.45	6.08	7.08
	Average of Temp (C)	20.8	26	23.5	22.4	16.7
15	Average of Salinity	22.5	27.4	24.7	27.9	26.2
	Average of DO	6.72	6	6.39	6.64	5.91
	Average of Temp (C)	20.9	23.3	22.5	21.2	16.1
16	Average of Salinity	26.8	26.6	26	NA	27
	Average of DO	6.83	6.29	7.45	NA	5.61
	Average of Temp (C)	17.4	21.1	22.9	NA	17.8
17	Average of Salinity	24.5	25.9	25.4	NA	26.7
	Average of DO	5.38	5.23	4.54	NA	4.54
	Average of Temp (C)	21.8	25.1	23.3	NA	18.2
18	Average of Salinity	26.7	26.7	27.1	25.7	26
	Average of DO	6.08	8	6.42	5.82	6.35
	Average of Temp (C)	18.9	25.2	23.6	21	18.1

APPENDIX A

Standardized Index Development – Delta Lognormal

Menhaden, Bluefish, River Herring

The standardized indices for 2 of the main target species of the survey considered five factors as possible influences on the indices of abundance, which are summarized below:

Factor	**Levels**	**Value**
Year	24	1988-2011
Month	5	June - October
Temperature (°C)	Continuous	
Salinity (ppt)	Continuous	
Station	18	18 fixed stations throughout bay

The delta lognormal model approach (Lo et al., 1992) was used to develop standardized indices of abundance for the seine survey data. This method combines separate generalized linear model (GLM) analyses of the proportion of successful hauls (i.e. hauls that caught winter flounder) and the catch rates on successful hauls to construct a single standardized CPUE index. Parameterization of each model was accomplished using a GLM procedure in the R statistical software package (dglm function see: http://www.sefsc.noaa.gov/sedar/download/SEDAR17-RD16%20User%20Guide%20Delta-GLM%20function%20for%20R%20languageenvironment%20(Ver.%201.7.2,%2007-06-2006).pdf?id=DOCUMENT).

For each GLM procedure of proportion positive trips, a binomial error distribution was assumed, and the logit link was selected. The response variable was proportion successful trips. During the analysis of catch rates on successful trips, a model assuming lognormal error distribution was examined.

The final models for the analysis of catch rates on successful trips, in all cases were:

Ln(catch) = Year + Month + Station + Temperature + Salinity

The final models for the analysis of the proportion of successful hauls, in all cases including menhaden, were:

Success = Year + Month + Station + Temperature + Salinity

Standardized Index Development – Zero Inflated Negative Binomial

Winter Flounder, Tautog, Striped Bass

The standardized indices for 3 of the main target species of the survey considered up to six factors as possible influences on the indices of abundance, which are summarized below:

Species	Factor	Levels	Value
Winter Flounder	Year	24	1988-2011
	Station Periods	4	Stations were added to the survey on 3 separate occasions (station 16 added June 1990, station 17 added July 1993, station 18 added July 1995)
	Temperature (°C)	Continuous	
	Salinity (ppt)	Continuous	
	Station	18	18 fixed stations throughout bay
Tautog	Year	24	1988-2011
	Station Periods	4	Stations were added to the survey on 3 separate occasions (station 16 added June 1990, station 17 added July 1993, station 18 added July 1995)
	Station	18	18 fixed stations throughout bay
Striped Bass	Year	24	1988-2011
	Station Periods	4	Stations were added to the survey on 3 separate occasions (station 16 added June 1990, station 17 added July 1993, station 18 added July 1995)
	Temperature (°C)	Continuous	
	Salinity (ppt)	Continuous	
	Station	18	18 fixed stations throughout bay
	Month	5	June - October

The zero inflated negative binomial model approach (Zuur et al, 2009) was used to develop standardized indices of abundance for the seine survey data. This method combines separate generalized linear model (GLM) analyses of the proportion of successful hauls (i.e. hauls that caught winter flounder) and the catch rates on successful hauls to construct a single standardized CPUE index. Parameterization of each model was accomplished using a GLM procedure in the R statistical software package, the code of which was modified from Nelson and Coreia of the Northeast Fishery Science Center (personal communication).

For each GLM procedure of proportion positive trips, a binomial error distribution was assumed, and the logit link was selected. The response variable was proportion successful trips. During the analysis of catch rates on successful trips, a model assuming negative binomial error distribution was examined. The linking function selected was "log", and the response variable was abundance (count) for each individual haul where one of the three species was caught.

A stepwise approach was used to quantify the relative importance of the factors. First a GLM model was fit on year. These results reflect the distribution of the nominal data. Next, each potential factor was added to the null model sequentially and the resulting reduction in deviance per degree of freedom was examined. The factor that caused the greatest reduction in deviance per degree of freedom was added to the base model if the factor was significant based upon a Chi-Square test ($p<0.05$). This model then became the base model, and the process was repeated, adding factors individually until no factor met the criteria for incorporation into the final model.

The final models for the analysis of catch rates on successful trips were:

Winter Flounder: Abundance = Year + Temperature + Station Periods + Salinity + Station

Tautog: Abundance = Year + Station Periods + Station

Striped Bass: Abundance = Year + Station Periods + Station + Month + Salinity + Temperature

The final models for the analysis of the proportion of successful hauls were:

Winter Flounder: Success = Year + Temperature + Station Periods + Salinity + Station

Tautog: Success = Year + Station Periods + Station

Striped Bass: Success = Year + Station Periods + Station + Month + Salinity + Temperature

Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters 2011 Annual Performance Report: Part VI - Environmental Assessment Review

Eric Schneider

R. I. Division of Fish & Wildlife, Marine Fisheries
Ft. Wetherill Marine Laboratory, 3 Ft. Wetherill Road
Jamestown, Rhode Island 02835

A hydraulic cutter head suction dredge working at the Ninigret Pond sedimentation basin in Charlestown, RI (top center), and pipe laid along the beach used to pump sediment (bottom left) from the dredge vessel for disposal on Charlestown Town Beach (bottom right). (Pictures taken by Eric Schneider, DFW)

State: Rhode Island
Project No.: F-61-R
Segment No.: 19
Project title: Assessment of Recreationally Important Finfish Stocks in RI Waters
Job No. : VI - Environmental Assessment Review
Title: Environmental Assessment Review
Target Date: March 23, 2011

Staff: Eric Schneider, Principal Marine Fisheries Biologist

Introduction

Healthy marine ecosystems are dependent on the careful stewardship of the both the living marine resources and the habitats upon which they depend. Many marine fish and shellfish species are important to the quality of life of many Rhode Islanders and to the economics of the State. Recreational and commercial fishing plays a vital role in the economy of Rhode Island. Development, dredging, and dredge spoil disposal projects within Rhode Island (RI) state waters can adversely impact these resources and their habitat. The importance of fish habitat to the sustainability of healthy fisheries has been formally recognized with the advent of the Essential Fish Habitat component (EFH) of the Sustainable Fisheries Act (1996) and made a priority component of environmental reviews.

In order for marine resources to be properly assessed, evaluated, and protected from the adverse impacts of human activity RI Department of Environmental Management (DEM), Division of Fish & Wildlife (DFW) staff provides timely and comprehensive review all marine related development, habitat restoration, and dredging and dredge spoil disposal projects that occur in Rhode Island waters. Proper review by DFW has become an integral part of state and federal permitting processes. Other state and federal agencies actively seek the advice of DFW regarding potential impacts to marine resources and incorporate our comments and recommendations into their permits. Reviews and recommendations are aimed at avoiding, and when necessary minimizing and mitigating adverse impacts to marine resources.

Methods

The DFW reviews all RI Coastal Resource Management Council (CRMC) marine-related applications and DEM Water Quality Certification (WCQ) and dredging applications. The DEM Office of Technical and Customer Assistance (OCTA) usually coordinates the Department's reviews and responses for all environmental reviews; however, some requests are forwarded directly to DFW by CRMC, National Marine Fisheries Service (NMFS), and US Army Corps of Engineers (ACOE). The aforementioned agencies work cooperatively to address and resolve potential marine related impacts and permitting issues prior to rendering final decisions and permits.

The review process involves determining marine resources and the habitat present at or near the project site, as well as evaluating the potential direct and indirect adverse affects of the proposed project on fishery resources and marine habitat. More specifically, this process often requires reviewing scientific literature, fishery resource data, and marine habitat data that were collected at or near the project site or in similar habitat conditions. This often includes data collected by DFW finfish surveys funded by the USFWS Sport Fish Restoration Program (e.g. Narragansett Bay Monthly and Seasonal Fishery Resource Assessment, Winter Flounder Spawning Stock Biomass Survey, Young of the Year Survey of Selected RI Coastal Ponds and Embayments, and the Juvenile Marine Finfish Survey) and surveys related to finfish, shellfish, and ichthyoplankton conducted by either DFW pursuant to other funding sources or other originations and institutions (e.g. NEMAP, NEFSC, and URI GSO trawl surveys).

A review may involve visiting the project site to characterize the habitat and biological community. Depending upon site attributes and available data, it may be necessary to obtain new or updated habitat, substrate, or shellfish samples (data) via wading from shore, or sampling from a research vessel, or conducting a dive (snorkel or SCUBA). Underwater video and digital cameras may be used to document conditions before, during, and after the project is completed. Other sources of habitat data may include aerial photography, lidar, or GIS analysis of data depicting habitat (e.g. eelgrass, SAV, sediment, and benthic structure). In addition, other DFW staff are consulted for advice, recommendations, and potential impacts to resources.

DFW provides comments and recommendations to the appropriate agency(s). Usually comments are in presented in a departmental memo to OCTA where they are incorporated into the DEM's comments and permit conditions. However, depending on the project status and severity of the potential impacts, comments may be presented in an email or in person during ACOE Programmatic General Permit (PGP) or project specific meetings.

Results

This report summarizes all projects received by DFW between January 1 and December 31, 2011. Coincidently, during 2011 the DFW received 82 marine related permit applications (i.e. proposed projects), which was the same number as in 2010. The DFW provided either written (n = 23) or oral (n = 31) comments on all projects that posed potential impacts to fisheries or marine resources (Table 1). Of the 82 projects received, 54 (66%) posed potential impacts warranted comments (Table 1), which is a 20% increase from 2010 when 38 (46%) projects posed potential impacts.

During 2011, of the 82 projects received 47 (57%) were sited within an estuary, 20 (24%) in coastal ponds, 9 (11%) in coastal rivers, 3 (4%) in open ocean, 2 (2%) in a harbor, and 1 (1%) in a coastal wetland (Figure 1A, Table 2). Not surprisingly projects within an estuaries had the most activities 74 (54%), followed by 38 (28%) in coastal ponds, 15 (11%) in coastal rivers, 5 (4%) in open ocean, 4 (3%) in a harbor, and 1 (1%) in a coastal wetland (Figure 1B, Table 2). The majority of projects received were for new residential docks (20.4%), followed by Maintenance Dredging (9.5%), and Commercial Docks and Piers (8.0%) (Table 2).

Since projects often involve multiple activities, the total number of activities (137) is greater than the number of projects received (82) (see Table 2). For example, a proposed marina expansion project could include reconfiguration of commercial docks and piers, rebuilding or construction a bulkhead or riprap, and maintenance dredging, which could impact critical habitat such as shellfish beds (ASMFC 2007), and temporally increase turbidity and reduce water quality potentially impacting egg viability, juvenile survival, and foraging and spawning behavior of may marine species.

Discussion

The greatest challenge that Marine Fisheries faces in protecting fish and fish habitat from adverse anthropogenic impact is the Department's willingness to negotiate a compromise on resource protective conditions proposed for a given permit. The DEM is often asked to allow modifications to mitigation plans or deviate from environmental protective measures stipulated in original comments. Economic hardship, and in particular the sluggish economy, are often presented as rational for the applicants inability or resistance to meet the proposed measures.

Dredging projects present both the greatest potential for impacts to fisheries and marine habitat as well as the greatest resistance by applicants to restrictive permitting related to the timing of in-water work and required mitigation, which ultimately increases cost. Therefore, it's extremely important that the DFW provide concise, well written, science-based recommendations. The following sub-sections highlight a large dredge project in Ninigret Pond, the issuance of a long-term dredge permits for two projects that were annually becoming more contentious to permit, as well as some other general comments.

<u>Ninigret Pond Breachway Dredge Project</u>

Ninigret Pond, also known as Charlestown Pond, is a coastal pond on the south shore of RI connected to the Block Island Sound via an armored, permanent breachway constructed by the ACOE in the 1960's (Figure 2). Ninigret Pond provides critical habitat that supports several species of finfish with recreational importance to Rhode Island, notably winter flounder (*pseudopleuronectes americanus*), tautog (*tautoga onitis*), and black sea bass (*centropristis striata*), as well as multiple species of forage fish. The quality and function of such habitat can be degraded from poor quality, lack of tidal flushing, and direct loss due to sedimentation. Therefore, proper maintenance of the Ninigret Pond sedimentation basin and relief channel is critical to the long-term health and viability of these critical habitats and the estuarine system as a whole.

In response to dramatic shoaling and sedimentation that was impeding navigation and causing loss of eelgrass and marine habitat the CRMC and ACOE established the "Ninigret and Cross Mills Pond Habitat Restoration Project" in 2003. From 2006 to 2008 the project removed approximately 122,000 and 75,000 cubic yards of sediment from the flood tidal delta (shoal) and sedimentation basin, respectively, as well as restored 40 acres of eelgrass. Due to lack of maintenance (i.e. scheduled dredging), by 2010 sediment from the sedimentation basin and relief channel was spilling into the pond, resulting in sedimentation of recently restored eelgrass beds and making navigation dangerous.

Early in 2011 the Town of Charlestown submitted an application to remove approximately 30,000 cubic yard of sediment from the sedimentation basin and relief channel. Given the state of the tidal delta and rate of sedimentation into the pond, this project was made a top priority by CRMC, DEM, and RI's General Assembly. Because of the critical and equally sensitive marine habitats located just inside the tidal delta, using a typical bucket dredge and dewatering on a barge was not an option. It was determined that the only appropriate and acceptable permitting option would be to utilize a hydraulic cutter head suction dredge, which minimizes suspended sediment and turbidity, and pump the sediment via a pipeline out to the beach front where it could be placed in the inner-tidal for beneficial reuse (Figure 3).

To ensure that fisherman and hunters would not be deterred from using the Ninigret (i.e. Charlestown) Breachway parking lot and boat ramp, DEM conditioned that the project could not begin until after November 15th, which is a month after the start of the standard dredge window (Oct 15). Similarly, while the project was ongoing the ramp had to be clear to ensure that fisherman and hunters could use the parking lot and access the boat ramp and pond. Considering the delayed start, logistical challenges of pumping dredge spoils through a pipeline, and the amount of material to be removed it was expected that the project could not be completed during the standard dredge window and therefore needed an extended work window.

Noting a few exceptions, DFW has been steadfast with requiring all dredging to occur within the standard dredge window. However, DFW was comfortable with extending the work window for this project because it expected no direct impacts to eelgrass beds, critical marine habitats, or winter flounder spawning because the work is confined to the sedimentation basin and relief channel where there is no winter flounder spawning habitat and no eelgrass. It should also be noted that the dredging has to stop periodically to clear the dredge intake and dredge pipe, which should allow any migrating winter flounder the opportunity to pass through the work zone and enter the pond to spawn. The town of Charlestown was granted a dredge permit with a work window between November 15 and March 15. To date the project has gone well. The 2012 F-61 report will include an update on this project as well.

Cooperative Site-specific Studies to Improve Two Long-term Dredge Permits

Last years report highlighted the need for long-term agreements with the ACOE for two federal navigation channels on Block Island, one located in Old Harbor and the other in Great Salt Pond, that are typically dredged annually in order to maintain a safe and viable channels for navigation. The DFW and ACOE agreed that establishing long-term permits for these projects would improve project planning, protection of marine resources, as well as eliminate what was becoming an annual battle pinning resource protection against dredging scheduling needs.

Early in 2011, the ACOE submitted applications for long-term permits to maintain both Old Harbor and Great Salt Pond federal navigation channels. The DEM granted the ACOE 10-year dredge permits for both sites. Despite the ACOE request to move the work window earlier in the year for each site, the DFW suggested that each permit must be held to the 2010 permitting conditions that were developed using the best available data and science. The DFW stated that it can not move the work window earlier in the year without new site-specific studies to quantify potential impacts to winter flounder and other marine resources.

During the fall of 2011, the ACOE secured most of the funding necessary to conduct site-specific studies at both sites and began discussions with the DFW about conducting a cooperative study that would quantify the spatial and temporal distribution of larval and juvenile finfish in both Old Harbor and Great Salt Pond. The study would be designed so that data collected could be used to determine whether the work windows and other conditions in the current 10-year permits were sufficient and should or could be modified. The DFW modified this job (i.e. Job 6) for 2011to include this specific cooperative study and expects the results to be available for the 2012 F-61 report. Although the majority of data is yet to be collected, both the ACOE and DFW agree that this type of collaborative site-specific approach is likely to result in a more accurate, defendable, and responsible permit that both parties can be satisfied with.

General Comments

Over the previous two years the DFW didn't receive any applications for residential dock dredging. However, this year the DFW was asked to review a preliminary determination made by CRMC regarding a potential residential dock project. The DFW was asked if CRMC's determination was accurate and the DFW agreed it was. In short, the project would have required dredging a long, narrow, linear channel and removal of substantial shallow water habitat at the dock itself. It was CRMC's opinion that in this location the linear channel would not flush well and may become anoxic impairing the habitat not only within, but adjacent the dredge footprint. Similarly, considering the removal of shallow water habitat, which is important to spawning and juvenile fish, this activity would likely have faced a long and rigorous review by CRMC and DFW. Thus, CRMC staff advised the applicant to pursue an alternative approach that doesn't involve dredging. In recent years, it's been determined that residential dock dredging has presented greater impact to public resources (fishery and marine habitat) compared to benefits and have not been permitted.

Conclusion

While DFW continues to make strides towards fisheries and habitat protection in RI waters, resource management agencies like DEM and CRMC continue to come under political and economic pressures during the permitting process to accommodate the applicant. To counter these efforts DFW will continue to use the best available data and published scientific literature to develop and defend our position. Discussions and meetings within DEM indicate that our permitting suggestions and concerns are taken very seriously. Similarly, DFW continues to achieve more influential status in the permit review process both within the State and with Federal agencies. Through these efforts we are moving toward better protection of our marine fisheries and habitat.

Literature Cited

ASMFC. 2007. The Importance of Habitat Created by Molluscan Shellfish to Managed Species along the Atlantic Coast of the United States. Prepared by L. D. Coen and R. E. Grizzle, Edited by J. Thomas and J. Nygard. ASMFC Habitat Management Series No. 8, http://www.asmfc.org/publications/habitat/hms8ShellfishDocument.pdf

Table 1. Summery of the type of responses to permit applications (i.e. proposed projects) received by the Division of Fish and Wildlife (DFW) during 2011 and the proposed activities and potential impacts of proposed projects. Given that projects often involve multiple activities or potential impacts the total number of activities and potential impacts is greater than the number of projects received (n = 82). Note that the DFW provided either written or oral comments on all projects that posed a potential impact to fisheries or marine resources.

	Comment Type			
Proposed Activities and Potential Impacts	Written	Oral	None	Total Number
- Number of Projects Received -	23	31	28	82
- Percent of Projects Received -	28%	38%	34%	
Potential Eelgrass Impacts	1	3	0	4
Eelgrass Restoration	1	0	0	1
Maintenance Dredging	12	0	1 [A]	13
New Dredging	1	0	0	1
New Marina	0	1	0	1
Marina Expansion or Reconfiguration	2	4	3	9
Restoration of Tidal Flow to Coastal Pond	3	0	0	3
Residential Docks (new)	1	14	13	28
Residential Docks (modification)	0	2	6	8
Commercial Piers or Docks	2	5	4	11
Salt Marsh or Coastal Wetland Impacts	2	7	0	9
Salt Marsh or Coastal Wetland Restoration	3	2	0	5
Terrestrial Project - No Direct Marine Issues	0	1	1	2
Waterfront Bulkhead/Riprap	3	0	3	6
Waterfront Development	1	0	0	1
Aquaculture	3	7	0	10
Public Works or Utility	5	1	1	7
Fish Passage	2	0	0	2
Potential Shellfish Impacts	7	1	0	8
Channel Maintenance	7	0	0	7
Boat Ramp (New or Repair)	1	0	0	1

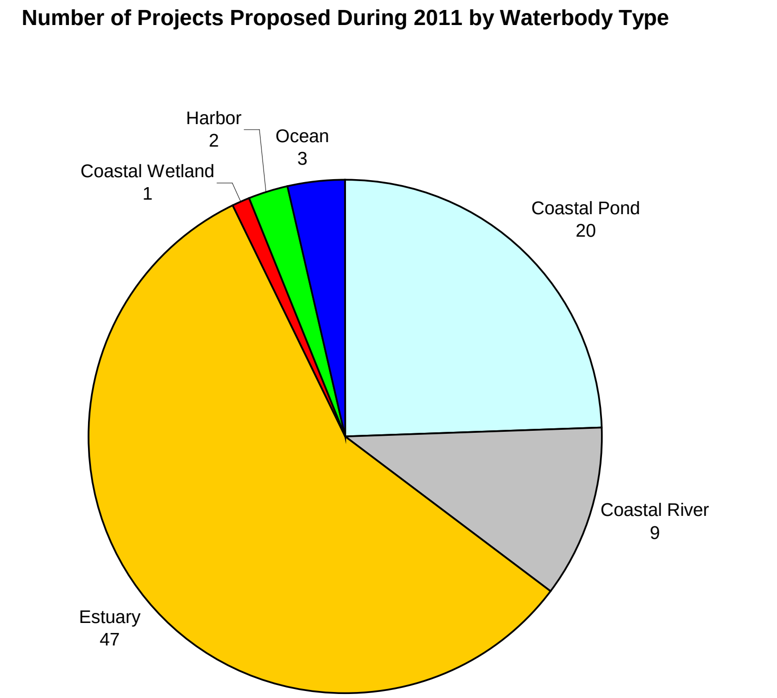
[A] This project was subject to state statute, which allowed for an automatic one-year extension to the original permit (i.e. permit tolling) and was not subject to review by DFW. The project was mistakenly issued a public notice by the RI Coastal Resource Management Council (CRMC).

Table 2. Summary of proposed activities and potential impacts from the proposed activity contained in permit applications (i.e. proposed projects) received by the Division of Fish and Wildlife (DFW) during 2011. Waterbody types are classified as: coastal pond (CP), coastal river (CR), coastal wetland (CW), estuary (E), harbor (H), and ocean (O). Given that projects often involve multiple activities or potential impacts the total number of activities and potential impacts (n = 137) is greater than the number of projects received (n = 82). See text for an example and further discussion.

Proposed Activities and Potential Impacts	Great Salt Pond, BI	Green Hill Pond	Mud Pond & Card Pond	Ninigret Pond	Point Judith Pond	Potters Pond	Quonochontaug Pond	Winnapaug Pond	Barrington River	Kickemuit River	Narrow River	Pawtuxet River	Seekonk River	Woonasquatucket River	Coastal Wetland	Greenwich Bay	Narragansett Bay	Pawcatuck River	Sakonnet River	Seekonk River	Wickford Cove	Old Harbor, BI	Ocean	Total Number	Percent (%) Total
Waterbody Type	CP	CP	CP	CP	CP	CP	CP	CP	CR	CR	CR	CR	CR	CR	CW	E	E	E	E	E	E	H	O		
Written Comments	2	-	1	2	2	-	1	-	1	-	-	-	-	1	-	-	8	-	1	-	-	2	2	23	28.0
Oral Comments	-	1	-	2	3	2	1	-	-	-	1	-	1	-	1	1	10	2	3	-	2	-	1	31	37.8
No Comments	-	1	-	1	-	-	-	1	1	3	-	1	-	-	-	2	11	1	4	2	-	-	-	28	34.2
Potential Eelgrass Impacts	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	4	2.9
Eelgrass Restoration	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.7
Maintenance Dredging	1	-	-	1	1	-	1	-	-	-	-	-	-	-	-	-	6	-	1	-	-	2	-	13	9.5
New Dredging	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.7
New Marina	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	0.7
Marina Expansion or Reconfiguration	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	4	-	1	1	1	-	-	9	6.6
Restoration of Tidal	-	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2.2
Residential Docks (new)	-	1	-	-	3	2	1	1	1	3	1	-	-	-	-	2	6	3	4	-	-	-	-	28	20.4
Residential Docks (modification)	-	1	-	2	-	-	-	-	-	-	-	1	-	-	-	-	3	-	1	-	-	-	-	8	5.8
Commercial Piers or Docks	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	5	-	1	1	2	-	-	11	8.0
Salt Marsh or Coastal Wetland Impacts	-	1	-	1	-	-	-	-	-	-	1	-	1	-	1	1	3	-	-	-	-	-	-	9	6.6
Salt Marsh or Coastal Wetland Restoration	-	-	-	1	-	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-	-	-	1	5	3.6
Terrestrial Project	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	2	1.5
Waterfront Bulkhead/Riprap	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	1	-	-	-	6	4.4
Waterfront Development	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.7
Aquaculture	1	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	4	-	1	-	1	-	1	10	7.3
Public Works or Utility	-	-	-	1	-	-	-	-	1	-	-	-	1	1	-	-	1	-	-	1	-	-	1	7	5.1
Fish Passage	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	1.5
Potential Shellfish Impacts	-	-	-	1	1	-	1	-	-	-	-	-	-	-	-	-	2	-	1	-	1	-	1	8	5.8
Channel Maintenance	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2	-	7	5.1
Boat Ramp (New or Repair)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.7
Total Number	3	3	1	11	8	3	8	1	4	3	2	1	3	2	1	5	44	3	12	4	6	4	5	137	
Percent (%) Total	2.2	2.2	0.7	8.0	5.8	2.2	5.8	0.7	2.9	2.2	1.5	0.7	2.2	1.5	0.7	3.6	32.1	2.2	8.8	2.9	4.4	2.9	3.6		

Figure 1. Number of projects [A] and activities and potential impacts from projects [B] proposed during 2011 by waterbody type. Table 2 details the composition of activities in [A] and [B].

[A]



[B]

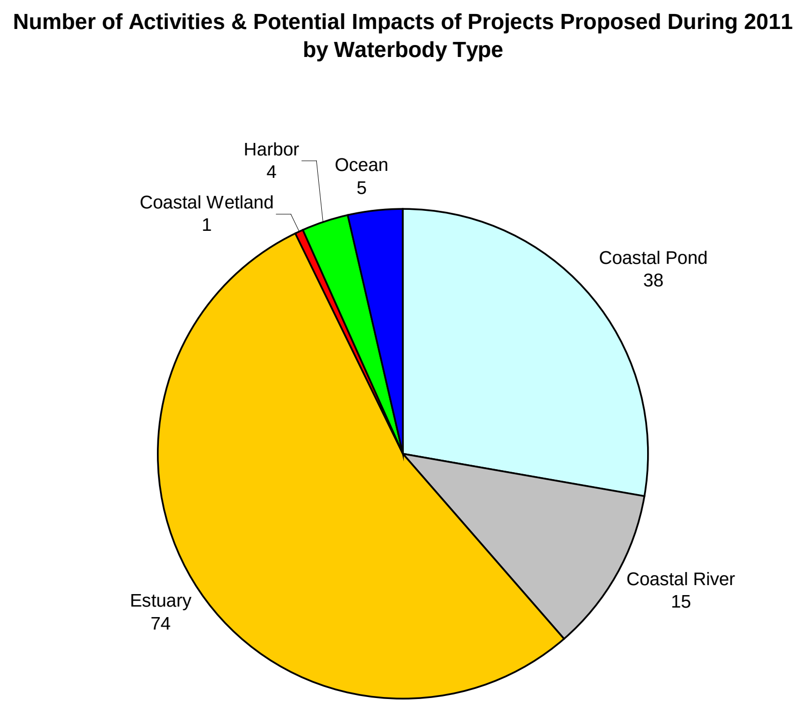


Figure 2. Map showing Ninigret Pond, Charlestown, RI.

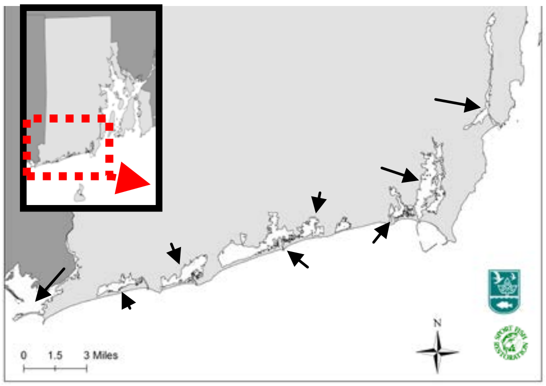
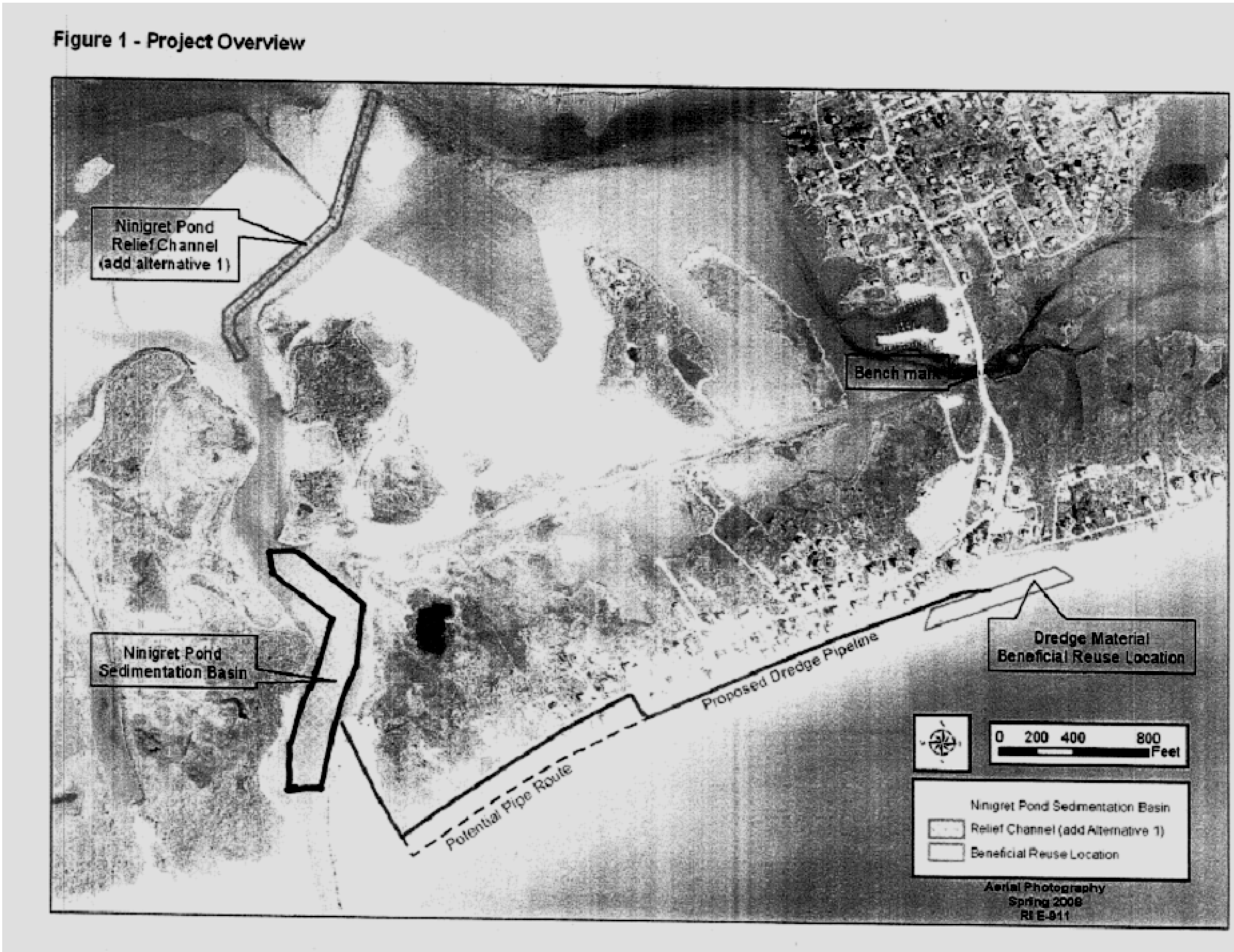


Figure 3. Overview of the Ninigret Pond Dredge Project, taken from the 2011 dredge permit application. Map depicts the sedimentation basin and relief channel to be dredged, the sediment pipeline, and beneficial reuse disposal area.



ASSESSMENT OF RECREATIONALLY IMPORTANT FINFISH STOCKS IN RHODE ISLAND WATERS

Evaluation, Monitoring, and Development of Artificial Reefs in Rhode Island Territorial Waters

Nicole Travisono
Principal Marine Fisheries Biologist

R. I. Division of Fish & Wildlife
Marine Fisheries

Ft. Wetherill Marine Laboratory
3 Ft. Wetherill Road
Jamestown, Rhode Island 02835

March 2012

PERFORMANCE REPORT

STATE: Rhode Island **PROJECT NUMBER:** F-61-R
SEGMENT NUMBER: 19

PROJECT TITLE: Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters

PERIOD COVERED: January 1, 2011 – December 31, 2011

JOB NUMBER AND TITLE: 7, Evaluation, Monitoring, and Development of Artificial Reefs in Rhode Island Territorial Waters

JOB OBJECTIVE: To manage two artificial reef sites in Rhode Island waters for the benefit of the recreational fishing public and to a lesser degree, commercial fisherman and scuba divers. To monitor the succession of biological organisms through

Performance Monitoring according to the “Post-Development Monitoring Plan for the Jamestown Bridge Artificial Reef Sites”. To perform compliance monitoring by completing the first multibeam bathymetric survey of the sites. To write an artificial reef plan for the state of Rhode Island as requested by the Coastal Resources Management Council. To continue to develop the two reef sites as necessary following the completion and acceptance of the artificial reef plan for the state of Rhode Island.

SUMMARY: Investigators continue to manage two inshore artificial reef sites in RI waters. Performance monitoring as well as compliance monitoring as described in the “Post-Development Monitoring Plan for the Jamestown Bridge Artificial Reef Sites”, was completed in 2011. A five year summary report detailing the project in full was prepared by the RI DEM Office of Marine Fisheries in 2011. Investigators began preparations to develop an artificial reef plan for the state of Rhode Island. During this preparation, extensive literature reviews and research were performed as well as outreach to recreational stakeholder groups. An outline for the RI Artificial Reef Plan was developed and distributed to the RI Saltwater Anglers Association (RISAA) for review and comment. Investigators will continue to work with stakeholders throughout 2012 while writing the RI Artificial Reef Plan.

TARGET DATE: 2012

STATUS OF PROJECT: On schedule

SIGNIFICANT DEVIATIONS: Investigators were unable to make he desired amount of progress on writing the RI Artificial Reef Plan, however the project is on track to be completed in 2012.

RECOMMENDATIONS: To continue into the next segment to complete the RI Artificial Reef Plan for the state of Rhode Island.

REMARKS: In the final year of the project, investigators plan on focusing solely on writing a the artificial reef plan for the state of Rhode Island as well as working with stakeholders o facilitate their efforts to create additional artificial reefs in RI waters.

INTRODUCTION

As stated in the “Post-Development Monitoring Plan for the Jamestown Bridge Artificial Reef Sites”, the state of RI is committed to developing a RI Artificial Reef Plan. The purpose of the plan is to identify the key elements to successful artificial reef development such as reef placement, proper materials, compliance and performance monitoring requirements, and the permitting process. The RIDEM has started to engage public stakeholders such as the RISAA, to ensure that the public is given the opportunity to contribute to and participate in the writing of the RI artificial reef plan.

BACKGROUND

When the Old Jamestown Bridge was closed to traffic in 1992 following the opening of the Jamestown-Verrazano Bridge, the fate of the Old Jamestown Bridge had not yet been decided. The state had several options to consider including sending the materials to the landfill for disposal, recycling the materials, or a combination of the two. In the end, the state chose the third option, recycling the majority of the material and sending the remaining material to the landfill. Once this was decided, the Rhode Island Department of Transportation in partnership with the Rhode Island Department of Environmental Management devised a plan to recycle the concrete slabs and rubble from the bridge to create two inshore artificial reef sites. Construction of Gooseberry Island reef and Sheep Point reef was completed in August, 2007.

The Gooseberry Island reef is located 1.5 miles south of Newport, RI while the Sheep Point reef is located 1.1 miles east of Newport, RI (Figure 1). Both reefs span an area of 0.03 km^2 with the Gooseberry Island reef being the deepest in approximately 80 feet of water and the Sheep Point reef slightly shallower in approximately 65 feet of water. Upon completion of the artificial reefs a single transect line composed of white sinking line was deployed at each reef site spanning 650 feet across in a northwest-southeast direction to serve as a guide for research divers. In March 2008, 22 cryptic habitat units were deployed at the two reef sites, 11 at each site. Each cryptic habitat unit stands approximately 5.5 feet tall and is composed of a concrete base, a concrete pedestal, and a plastic-coated wire mesh cage. The wire cage holds 150 surf clam shells which provide interstitial spaces for small organisms such as juvenile fish and lobster to hide. Since the completion of the two inshore artificial reefs, the RIDEM has completed five years of consecutive compliance and performance monitoring of the inshore reefs, the details of which are available in "The Jamestown Bridge Artificial Reef Project, Final Report" (Appendix A).

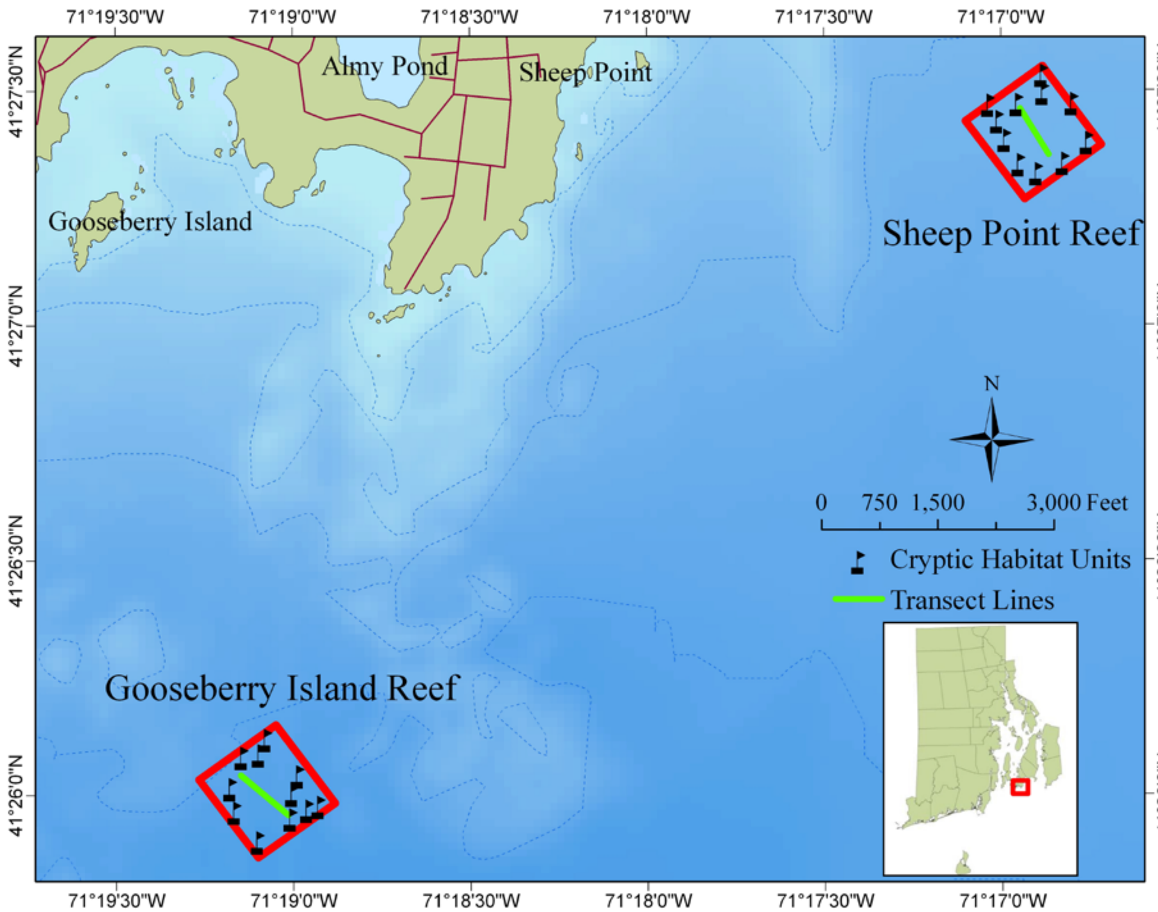


Figure 1. Map showing the location of Gooseberry Island reef and Sheep Point reef in RI waters.

MATERIALS AND METHODS

In preparation for writing the RI artificial reef plan, the RIDEM conducted an extensive literature review. Investigators began by reviewing the National Artificial Reef Plan as well as the state artificial reef plans developed by New Jersey and Massachusetts. Elements that were part of all three plans were considered to be very important and thus were chosen to be elements in the RI artificial reef plan. A table of contents was developed as the initial step in the writing of the artificial reef plan. The table of contents was presented to the RISAA for their review. The RIDEM is awaiting comments from RISAA on the table of contents. Once the comments are received the RIDEM will begin writing one section of the plan at a time and allow the RISAA to review and comment on each section as they see fit.

RESULTS AND DISCUSSION

The RIDEM has successfully started developing the RI artificial reef plan. Investigators have reached out to public stakeholders, primarily the RISAA, to encourage their participation in the development of the plan. Feedback received thus far has been positive and the RIDEM anticipates having several meetings and workshops throughout 2012 to successfully complete the RI artificial reef plan.

REFERENCES

Massachusetts Division of Marine Fisheries, Policy Report PR-1. *Massachusetts Artificial Reef Plan*. 2006.

State of New Jersey, Department of Environmental Protection, Division of Fish and Wildlife. *Artificial Reef Management Plan for New Jersey*. 2005.

United States Department of Commerce, National Oceanic and Atmospheric Administration. *National Artificial Reef Plan (as Amended): Guidelines for siting, construction, development, and assessment of artificial reefs.* 2007.

APPENDIX A

THE JAMESTOWN BRIDGE

ARTIFICIAL REEF PROJECT

FINAL REPORT

RI Department of Environmental Management

Division of Fish & Wildlife

Marine Fisheries

3 Fort Wetherill Road

Jamestown, RI 02835

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Importance of artificial reefs

In recent years, in an effort to continue to rebuild important recreational and commercial fish stocks, many states have adopted artificial reef programs designed to create areas of increased biodiversity to benefit recreational fisherman and scuba divers. By transforming flat, sandy substrate into structurally complex habitats, artificial reefs promote areas of increased biodiversity by attracting a variety of fish and invertebrate species. Additionally, artificial reefs offer refuge to vulnerable organisms such as juvenile lobsters and finfish by providing small crevices to hide from predators.

1.2 The Jamestown Bridge

One common obstacle in creating artificial reefs is that the planning, construction, and monitoring can be quite costly. As a result, many states have chosen to utilize materials that can be acquired with little to no expense to the state. The State of Rhode Island was presented with a unique opportunity when the Old Jamestown Bridge was closed to traffic in 1992 following the completion of the new Jamestown-Verrazano Bridge. Although a significant portion of the old bridge was destined to be demolished, an appropriate and cost-effective method for disposal had not yet been decided. Due to the costly nature of traditional landfill disposal, several alternatives were considered. The most appealing disposal option for the state was to recycle the bridge steel and use the bridge concrete to create two inshore artificial reef sites.

On April 18, 2006, spectators from all over the state gathered to view the demolition of the Old Jamestown Bridge. On April 3, 2007, an Agreement between the RI Dept. of Transportation (RIDOT), RI Dept. of Environmental Management (RIDEM), and the RI Coastal Resources Management Council (RI CRMC) was signed and put into effect (State of RI 2007). With funds that the RIDOT received from the Federal Highway Administration (FHWA), the construction of the Gooseberry Island and Sheep Point reefs began shortly after and was completed in August 2007.

1.3 Objectives of the study

The main objective of this study was to enhance the habitat at two inshore, sandy bottom sites in Rhode Island waters. In doing so, scientists expected to 1) see increased biomass, 2) provide spawning, nursery, refuge, and feeding areas for juveniles and vulnerable species, 3) provide improved recreational fishing and scuba diving opportunities, and 4) create research opportunities for scientists throughout the state (RIDEM 2006).

2.0 MATERIALS AND METHODS

2.1 Reef sites

Sheep Point Reef lies in approximately 65 feet of water and is located 1.1 miles east of Newport, RI (Figure 1, Table 1). Gooseberry Island Reef is slightly deeper in approximately 85 feet of water and is located 1.5 miles south of Newport, RI. These two locations were ideal for artificial reef development due to the flat, sandy nature of the substrate. Additionally, the depth at these two sites was great enough to provide adequate clearance above the reefs for vessels to pass over. A third site in Rhode Island Sound was permitted for the construction of an artificial reef from the bridge debris, however it was never utilized.

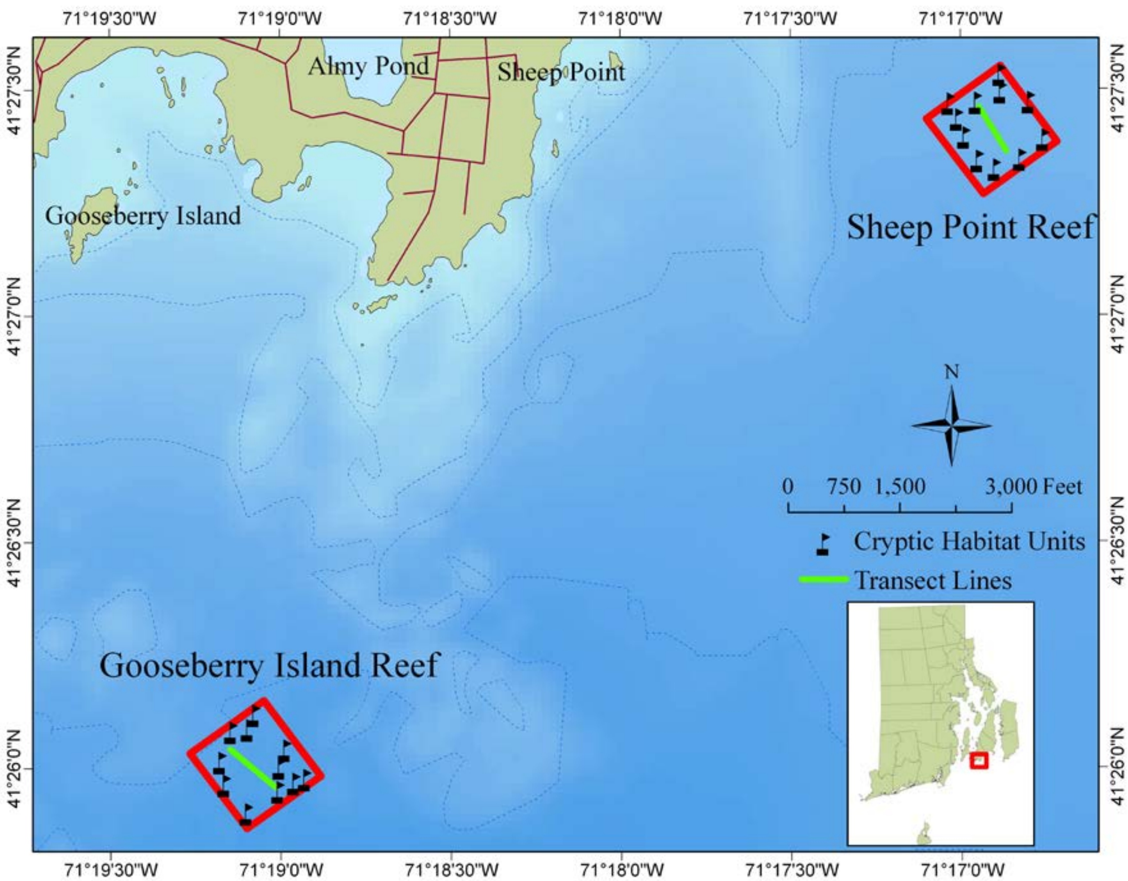


Figure 1. Map showing the locations of Gooseberry Island Reef and Sheep Point Reef.

Table 1. Reef coordinates.

Gooseberry Island Reef		
	Latitude	Longitude
NE Corner	41° 26.150'	-71° 19.050'
SE Corner	41° 25.983'	-71° 18.883'
SW Corner	41° 25.867'	-71° 19.100'
NW Corner	41° 26.033'	-71° 19.267'
Sheep Point Reef		
	Latitude	Longitude
NE Corner	41° 27.550'	-71° 16.883'
SE Corner	41° 27.383'	-71° 16.717'
SW Corner	41° 27.267'	-71° 16.933'
NW Corner	41° 27.433'	-71° 17.100'

2.2 Reef material and transects

The materials used for the construction of the Sheep Point and Gooseberry Island reefs included concrete slabs with re-bar and concrete rubble. In addition to these materials, a total of 22 cryptic habitat units were designed and constructed for deployment on the artificial reefs based on Figley (2003). When construction of the two artificial reefs was completed in August 2007, a single transect line was deployed at each reef site. Each transect was composed of white sinking line and spanned a length of 650 feet in a NW to SE direction. Red canvas labels were placed every 25 feet along the entire length of each transect. Each label noted the location along the transect from 0-650 feet. On August 31, 2007, a news release was issued on the RIDEM website to warn users of the area of any potential hazards they may encounter.

2.3 Cryptic habitat units

The cryptic habitat units were intended to provide a temporary substrate similar to that of the artificial reefs for marine invertebrates to colonize. The units could later be retrieved and analyzed at the DEM Marine Fisheries Laboratory to determine the abundance, biomass and number of species present on the units. This data could then be used as a proxy for what could be found on the artificial reefs.

Designed to sit firmly on the ocean floor and allow for stability, the bottom half of each unit was composed of a concrete base (length: 81 cm; width: 81 cm; height: 17.8 cm), and above that a concrete pedestal (height: 48.3 cm; diameter: 56 cm) (Figure 2). The number of each unit was engraved in the pedestal portion of each unit for easy identification. A plastic coated wire mesh (mesh: 2.5 cm x 2.5 cm) cage comprised the top half of each unit (height: 97 cm; width: 32 cm). The wire cage portion of the unit was filled with three different materials to allow for the colonization of a variety of marine organisms. The bottom of the cage was filled with 10 fiberglass plates followed by three layers of surf clam shells (50 shells per layer). Each layer of surf clam shells was separated by a 1 ½” PVC double tee intended to provide interstitial spaces for small organisms such as juvenile finfish and lobster to hide. In March of 2008, 11 cryptic habitat units were deployed on each artificial reef (Figure 1).

Figure 2. Cryptic habitat units prior to be deployed. Photo courtesy of Natasha Pinckard.

In May of 2009 one cryptic habitat unit was retrieved from Gooseberry Island reef. The R/V Beavertail was used to transport divers and researchers out to the reef where the unit was located with GPS coordinates. A buoy was dropped at the approximate location of the unit for the diver to use as a reference. Once the diver located the unit, a buoy was attached and the diver re-surfaced. A winch onboard the vessel was then used to haul the unit on board for processing.

The unit was placed in a fiberglass box to catch any falling organisms during processing. An electric utility knife was used to dis-assemble the wire-mesh cage on the top portion of the unit. Surf clam shells were removed from the unit and picked free of all living organisms. Water in the fiberglass catch box was put through a sieve to capture any organisms. All macrofauna and living epifauna were placed in jars and preserved in a 10% buffered formalin solution for later identification and enumeration. Shells, fiberglass plates and sections of the wire-mesh cage were photographed, bagged and frozen to be analyzed at the DEM laboratory.

In June of 2009, two additional cryptic habitat units were retrieved from the Sheep Point reef. The R/V Privateer was used to transport divers out to the reefs and locate the units. Once the units were located, a buoy was used to mark their position and the R/V Chafee was used to haul the units out of the water for processing. On board processing was performed as stated above. From June through August 2009, preserved specimens were sorted, identified to the lowest taxonomic level possible, enumerated, weighed and preserved in 70% ethanol. Frozen shells, fiberglass plates and sections of the wire mesh cage were analyzed for percent cover of encrusting bryozoans using a sheet of plastic with a 2.5cm x 2.5cm grid. All collected data was entered in MS Excel and/or MS Access.

In order to calculate the surface area of the entire unit, the surface area of individual surf clam shells had to be determined first. A total of thirty shells, representing 20% of the total number of shells in each unit, were measured for surface area. Each shell that was measured was wrapped in aluminum foil. The foil was removed from the shell, placed on a sheet of graph paper, and the outline of the shell traced on the graph paper. The surface area was determined by summing the number of whole squares counted as well as the percentages of partial squares counted and multiplying this number by the known surface area of one square. Once the surface area of the clam shells had been determined, this data along with the measurements of the unit itself could be used to calculate the surface area of the entire unit (Table 2).

Table 2. Surface area of cryptic habitat unit, referred to here as Experimental Reef Unit (ERU), taken from Pinckard (2010).

Component	**Surface Area (cm^2)**
Wire Cage[1]	28,800
10 Fiberglass Plates	22,200
150 Surf Clam Shells[2]	47,172
2 PVC Pipe Assemblies	3,714
Concrete Base	9,865
Concrete Pedestal	10,960
Sea Floor Footprint	6,561
Total ERU Habitat Surface Area	122,711
Increase in Surface Area	116,150

[1] The actual attachment surface of the wire cage was 1.6 mm diameter wire.
[2] The mean surface area calculated for 30 shells was multiplied by 150 shells for the total surface area of the shells encompassing one ERU.

2.4 Performance monitoring

In an effort to collect additional data about what species may be utilizing the reefs, researchers designed and implemented a photo quadrat survey and fish census survey to be conducted once a month, May through September. For each survey to be conducted a minimum of two professional scuba divers, one back-up diver, a biologist, a captain, and a vessel was required. Due to a lack of available funds, several dives were conducted on a volunteer basis. When funds were available to pay divers, only enough funds to cover the direct cost for supplies to the diver was available. As a result it was extremely difficult to schedule the surveys as the divers frequently had other jobs that paid a fair hourly wage as well as direct costs for supplies. In addition to the diver availability being an obstacle, the availability of a vessel and a captain in combination with inclement weather also became problematic. Because RIDEM vessels are used for various research surveys in the summer months, if a dive survey was scheduled but unable to be conducted due to inclement weather, it could not be easily re-scheduled. This resulted in many surveys being planned, but not able to be performed.

Monthly dive surveys of each reef were scheduled for May through September of 2008. On May 1st and May 2nd the first dive survey was conducted on Sheep Point reef and Gooseberry Island reef respectively. A square quadrat, of a known size, made out of PVC pipe was placed along each transect line and photos taken. Additionally, one data logger was installed at each reef.

The June survey was conducted from June 20th through June 21st. Divers intended to retrieve the data loggers that were installed in May, however they were only able to retrieve the Gooseberry Island unit, the Sheep Point unit was missing and the transect line had been cut. The transect line was repaired underwater and images were obtained at each transect. A fish census was also conducted at Sheep Point reef. For the fish census, the diver swam along the transect stopping every twenty-five feet to do a fish count. At each location the diver stopped, the diver would do a 360 degree fish count for three minutes. Divers recorded species of fish, average length, and abundance. Other factors such as visibility, depth, substrate type, etc were also recorded.

In the month of July only one survey took place at Sheep Point reef. Both a photo quadrat survey and fish census were conducted. Both surveys were conducted as stated above. For the month of August, only the Gooseberry Island reef was surveyed. Both a photo quadrat survey and fish census were conducted. Finally, in the month of September, only the Sheep Point reef was surveyed. Both a photo quadrat survey and fish census were conducted.

In 2009, no monthly surveys were conducted. In 2010, the Division of Fish and Wildlife tried to resume the May through September monthly fish census surveys. After several meetings it was decided that before a fish census could be completed, an exploratory dive at both reef sites was needed to investigate the condition of each transect line and to install a single mooring at each reef. On June 21st, 2010, the mooring installation was successfully completed. During installation the condition of the transects was noted as being in good condition with no further maintenance being required. While on the bottom, divers noted several species of finfish although a formal fish census was not conducted due to bottom time limitations.

On July 26, 2010, a fish census was conducted at Sheep Point reef and Gooseberry Island reef. The deeper of the two reefs, Gooseberry Island reef, was surveyed first. Using surface supply oxygen, the diver was lowered to the bottom and swam to the 250 foot marker to begin the survey. After arriving at the marker, the diver waited a brief period of time for conditions to settle before starting the fish census. Once the census began, the diver identified and enumerated all finfish observed in a 360 degree view for a period of three minutes. All observations were communicated to a biologist on the surface who recorded the data. The extent of the divers view was limited by the visibility conditions which varied from 2-4 feet at Gooseberry Island. At the end of the three minutes the diver was instructed to swim fifty feet to the 300 foot marker. This marker was missing from the transect, thus the diver swam to the next visible marker at

325 feet, where a three minute fish census was completed. At this point the diver only had sufficient time to swim twenty-five feet instead of the preferred fifty feet. The final fish count was performed at the 350 foot marker. Once the survey at Gooseberry Island reef was completed, the team then moved on to Sheep Point reef. A fish census was conducted at Sheep point reef following the same procedure as that stated for Gooseberry Island reef above. The only exception was that due to the shallow depth at Sheep Point, there was sufficient bottom time to perform four fish counts compared to only three at Gooseberry Island.

For the month of August, researchers planned on not only performing a fish census at both reefs, but also retrieving two cryptic habitat units from each reef. Five days were put aside the week of August 16th to complete this work. Heavy showers and winds occurred every day that week and researchers were unable to accomplish the work. Researchers had also hoped to make up the work in the September. However, due to staff and vessel availability, this was not possible.

The photographs collected as part of the photo quadrat survey were analyzed by a graduate student at the University Of Rhode Island Graduate School Of Oceanography as part of her Masters Thesis Research. For more details regarding the performance monitoring, please refer to Pinckard (2010).

2.5 <u>Compliance monitoring</u>

On November 2, 2010, a multibeam hydrographic survey of both reef sites was conducted by Substructure, Inc. The primary objective of this survey was to ensure that no significant sinking or shifting of reef material occurred since the last survey was conducted in 2008.

3.0 RESULTS

3.1 Cryptic habitat units

The cryptic habitat unit analysis revealed that Sheep Point unit #10 (SP10) had the highest species richness, abundance and biomass followed by Sheep Point unit #8 (SP8) and Gooseberry Island unit #4 (GB4) (Figure 3, Table 3). A total of 86 taxa were identified from the three cryptic habitat units analyzed. The unit from Gooseberry Island reef had 44 taxa, slightly less than the two Sheep Point units which had 65 and 68 taxa. Of the taxa present, the common Atlantic slippersnail, *Crepidula fornicata*, had the highest abundance (number/m^2) on both Sheep Point units while the smooth jingle shell, *Anomia simplex*, had the highest abundance on the Gooseberry Island unit. In looking at the species with the highest biomass on each unit, the blue mussel, *Mytilus edulis*, the sea vase tunicate, *Ciona intestinalis*, and the colonial hydroid, *Hydrozoa* unident., had the highest biomass on units SP10, SP8, and GB4 respectively.

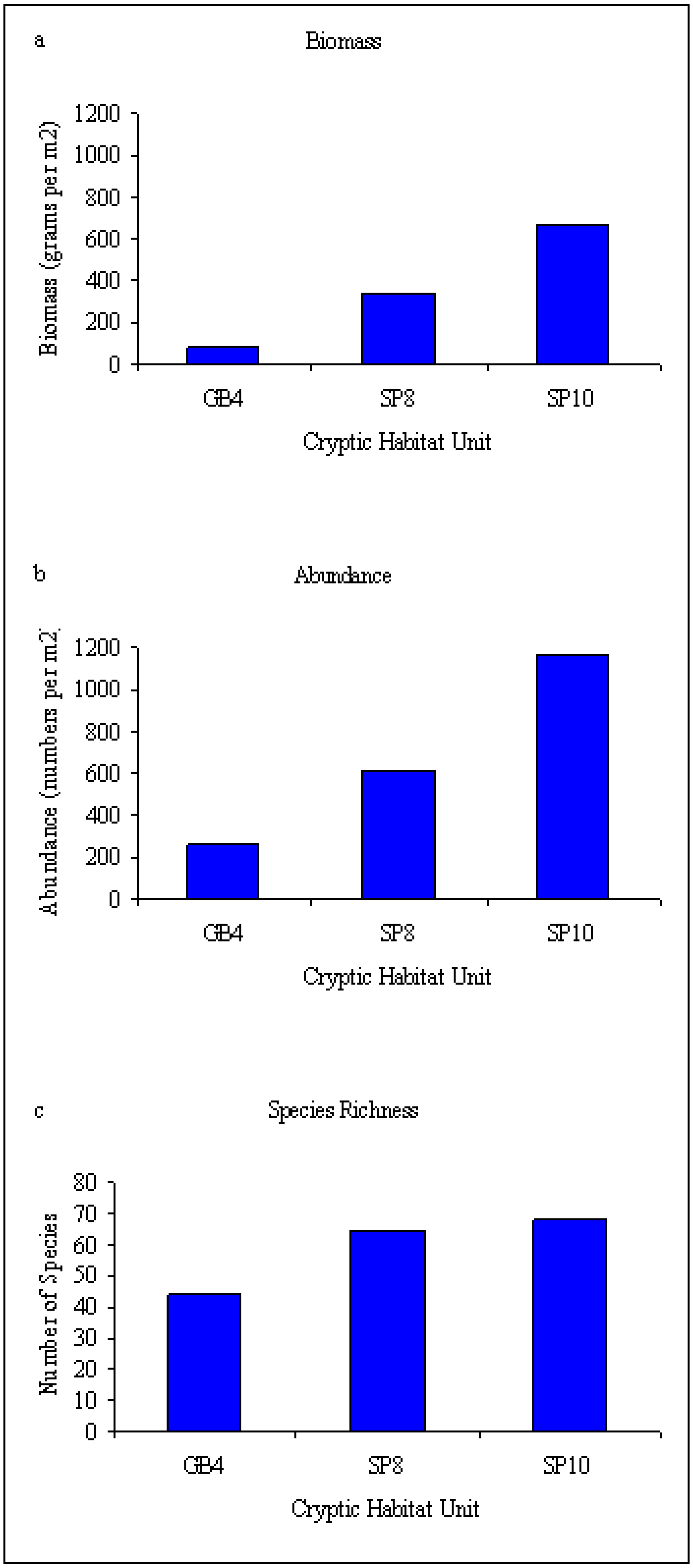


Figure 3. Biomass, abundance and species richness of marine invertebrates and fish found on Cryptic Habitat Units.

Table 3. List of species commonly found on the Gooseberry Island and Sheep Point reefs.

Table 1. List of species commonly found on the Gooseberry Island and Sheep Point Reefs

Species	Goosberry Island Reef	Sheep Point Reef	Notes
Fish			
Black Sea Bass *Centropristis striata*	X	√	Small schools of up to 25 individuals were observed during fish census surveys at Sheep Point Reef.
Cunner *Tautogolabrus adspersus*	√	√	Schools of up to 50 individuals were observed during fish census surveys. Small juveniles were found in all three cryptic habitat units retreived.
Scup *Stenotomus chrysops*	X	√	Large schools of up to 100 individuals were observed during fish census surveys at Sheep Point Reef.
Invertebrates			
Arthropods			
Barnacles *Chthamalus spp.* *Balanus crenatus*	√	√	These two species were abundantly attached to the concrete bases of the cryptic habiata units. A large number were also found attached to surf clam shells inside the units.
Say mud crab *Dyspanopeus sayi*	X	√	As the name implies, these crabs were found hiding in the mud on the underside of surf clam shells inside the cryptic habitat units.
Mollusks			
Blue mussel *Mytilus edulis*	√	√	A large number of very small juveniles were found at both reefs colonizing the interior and exterior of the cryptic habitat units.
Slippersnails *Crepidula fornicata* *Crepidula plana* *Crepidula spp.*	√	√	These mollusks are most commonly found attached to surf clam shells inside the cryptic habitat units. They are routinely found in a stacked fashion on top of each other on hard surfaces and wedged into small spaces such as the aperture of gastropods.
Greedy dovesnail *Anachis avara*	X	√	Found in abundance at Sheep Point Reef this small gastropod rarely exceeds 1/2" in height and is often found hiding among colonial epifauna.
Lunar dovesnail *Mitrella lunata*	√	√	Found at both reef sites, this gastropod is even smaller than the greedy dovesnail rarely exceeeding 1/5" in height.
Jingle shells *Anomia squamula* *Anomia simplex*	√	√	Found at both reef sites inside the cryptic habitat units, these two species closely ressemble each other with the only difference being the surface of one species (A. *squamula*) is prickly and the surface of the other species (A. *simplex*) is smooth.
Polychaetes			
Scale worm *Harmothoe* spp. *Lepidonatus squamatus*	X	√	Two species of scale worms that were most commonly found on the underside of surf clam shells inside the cryptic habitat units as well as other small crevices. They are also known for burrowing underneath layers of *Didemnum vexillum* .
Tunicates			
Colonial tunicate *Didemnum vexillum*	X	√	An invasive colonial ascidian found globally known for rapidly colonizing artificial and natural hard surface structures and outcompeting native fauna.
Sea vase tunicate *Ciona intestinalis*	√	√	An abundant solitary tunicate found at Sheep Point Reef attached to the exterior of the cryptic habitat units and on surf clam shells inside the unit.

3.2 Performance monitoring

Results from the fish census survey revealed that Sheep Point reef had a higher species diversity and abundance compared to Gooseberry Island reef (Table 4). A total of eight different species of finfish were observed with only one species, cunner, observed at both reef sites (Table 5).

Table 4. Number of species and total fish count observed during fish census surveys.

Date	Reef	Number of Species	Total Fish Count
6/20/2008	Sheep Point	4	442
7/20/2008	Sheep Point	3	289
8/23/2008	Gooseberry Island	3	44
9/13/2008	Sheep Point	6	483
7/26/2010	Gooseberry Island	3	38
7/26/2010	Sheep Point	1	18

Table 5. Species of finfish observed at Sheep Point Reef and Gooseberry Island Reef.

Common Name	Scientific Name	Sheep Point	Gooseberry Island
Atlantic Cod	*Gadus morhua*	X	√
Summer Flounder	*Paralichthys dentatus*	X	√
Black Sea Bass	*Centropristis striata*	√	X
Scup	*Stenotomus chrysops*	√	X
Northern Sea Robin	*Prionotus carolinus*	√	X
Striped Sea Robin	*Prionotus evolans*	√	X
Cunner	*Tautogolabrus adspersus*	√	√
Tautog	*Tautoga onitis*	√	X

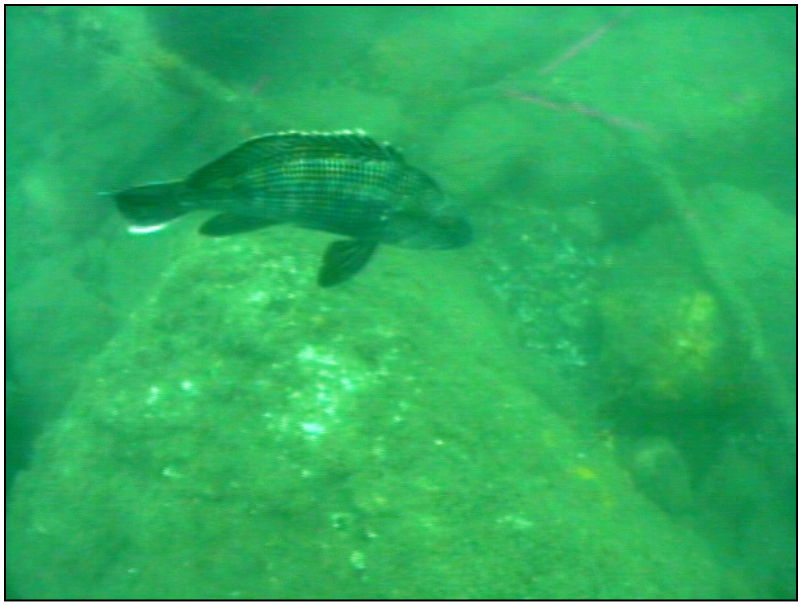


Figure 4.
Black Sea Bass, *Centropristis striata*, photographed during a fish census survey on Gooseberry Island Reef.

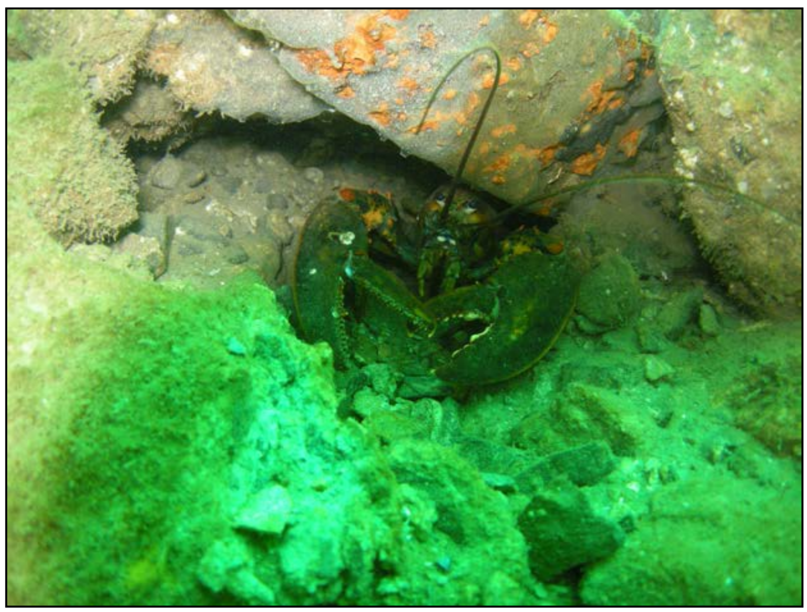


Figure 5.
American lobster, *Homarus americanus*, photographed during a fish census on Gooseberry Island Reef.

3.3 Compliance monitoring

Multibeam Hillside Bathymetery surveys conducted at Sheep Point reef and Gooseberry Island reef revealed no significant shifting or sinking of bottom material at either reef (Figures 6 & 7). Although the materials at Gooseberry Island reef appear to have shifted outside of the target area, this is how they were originally offloaded during the construction of the reef and not due to shifting materials.

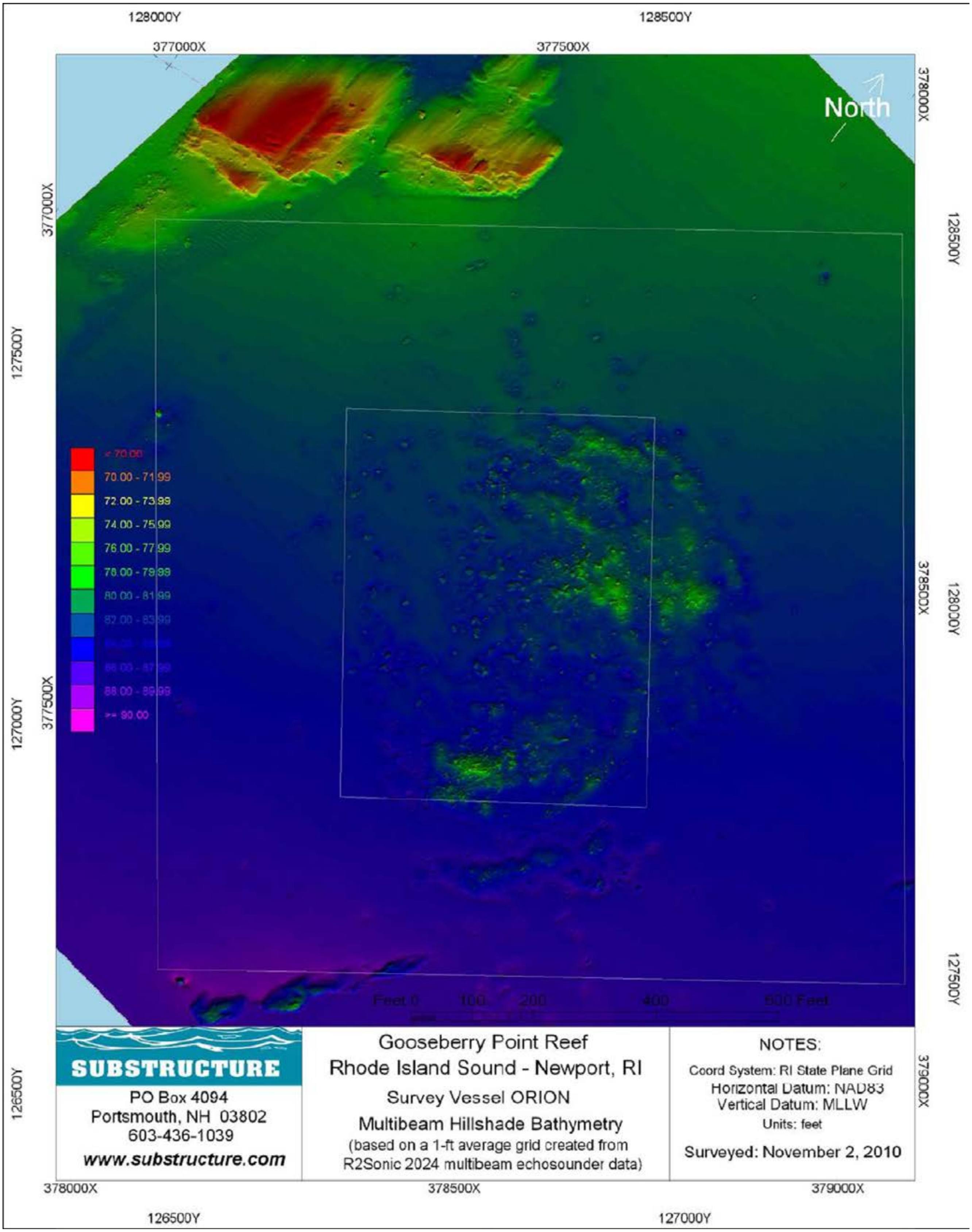


Figure 6. Multibeam Hillshade Bathymetry at Gooseberry Island Reef, November 2, 2010

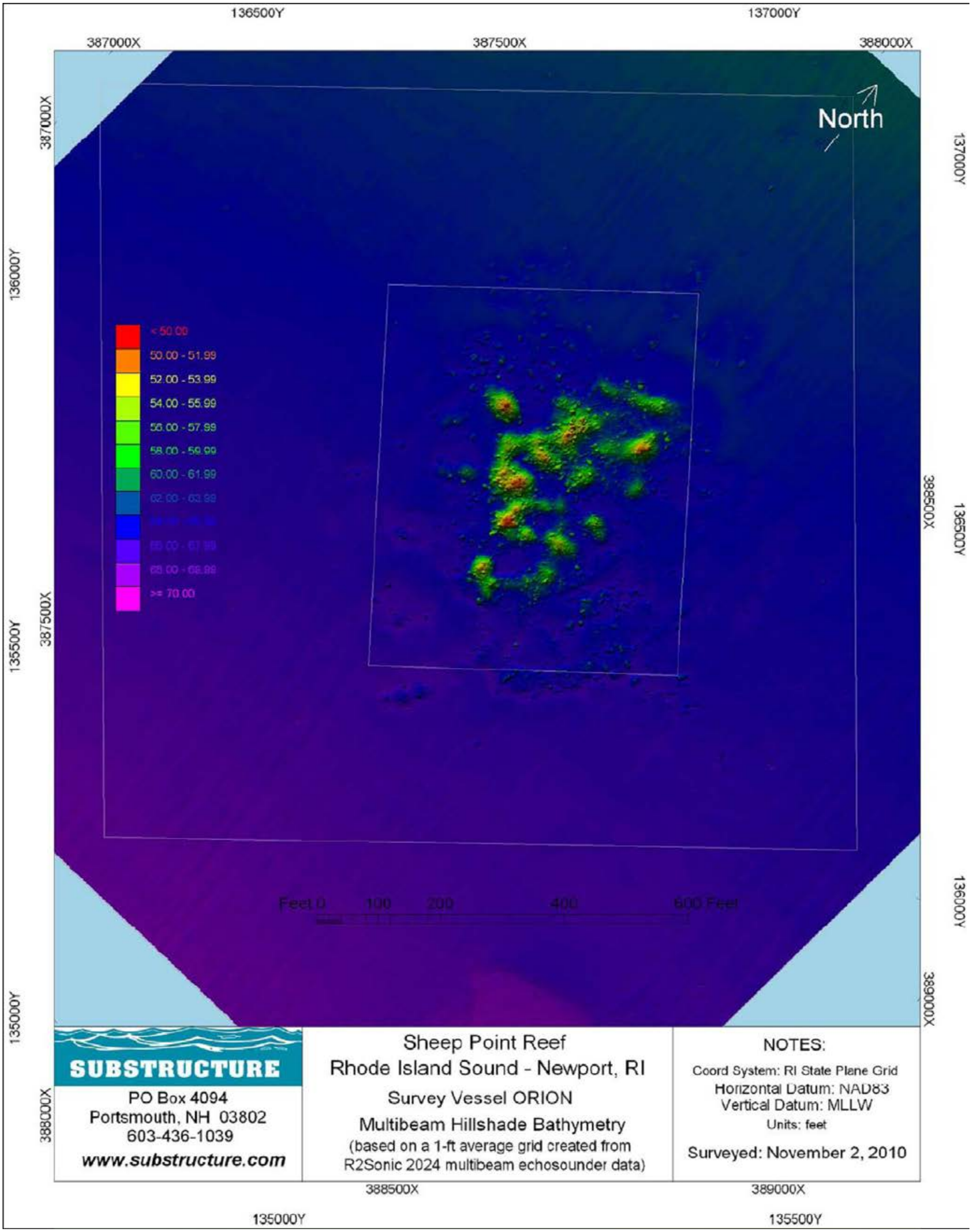


Figure 7. Multibeam Hillshade Bathymetry at Sheep Point Reef, November 2, 2010

4.0 DISCUSSION

The establishment of two inshore artificial reefs in the waters of Rhode Island Sound successfully created habitat for a variety of marine invertebrates and several commercially and recreationally important species of finfish. Although both reefs appear to be thriving, Sheep Point Reef appears to be the more successful reef with a higher abundance, biomass and species richness. This greater success could be due to the shallow depth at Sheep Point reef in comparison to Gooseberry Island reef. Additionally, the slightly closer proximity of Gooseberry Island reef to the mouth of the Bay could make it less favorable for colonization.

The establishment of Gooseberry Island reef and Sheep Point reef was a unique opportunity for the State to gain a perspective on the need and feasibility associated with creating additional artificial reefs in state waters. Artificial reefs are extremely complex in nature and a project should not be undertaken without the proper planning and consideration. Adequate approvals/permits, placement, materials, and funds are a few of the key components required to create a successful artificial reef. As such, it is recommended that an artificial reef plan for the State of Rhode Island be developed before considering any future projects. The artificial reef plan will, among other things, discuss in detail the key components mentioned above and can be used as planning tool for future artificial reef development in state waters.

5.0 ACKNOWLEDGEMENTS

We thank Richard Satchwill, RIDEM Principal Biologist for the design, planning, and implementation of this post-monitoring study. Natasha Pinckard, a Masters candidate at the University Of Rhode Island Graduate School Of Oceanography played a vital role throughout the project. Dive surveys could not be completed without the knowledge and expertise of divers Stephen Moy of CONUSUB and Michael Lombardi of Ocean Opportunity Inc. Additional diving and consulting services were provided by Tre Nebstedt, Michael Cole (SAIC), Joe Ascoila (GRA Engineering), Jeff Lee, Allison LeBalnc (RIDOT), Brian Borderi, Greg DeAscentis (Aquidneck Mooring Company), and Josh De Monbrun. Tom Waddington and Tom Reis of Substructure Inc. performed the Multibeam Hillside Bathymetery surveys. Special thanks to the various RIDEM employees who offered their assistance throughout the project.

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Sportfish Assessment and Management in Rhode Island Waters

Mark Gibson
Jason McNamee
John Lake
Eric Schneider

R. I. Division of Fish & Wildlife
Marine Fisheries
Ft. Wetherill Marine Laboratory
3 Ft. Wetherill Road
Jamestown, Rhode Island 02835

STATE: Rhode Island

PROJECT NUMBER: F-61-R

SEGMENT NUMBER: 19

PROJECT TITLE: Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters

PERIOD COVERED: January 1, 2011 – December 31, 2011

JOB NUMBER 8 TITLE: Sportfish Assessment and Management in Rhode Island Waters

During this segment, several fish stock assessments were completed that included a black sea bass coastwide stock assessment, a winter flounder stock assessment, a tautog coastwide and regional stock assessment, a summer flounder stock assessment update, a scup stock assessment update, and an Atlantic menhaden stock assessment correction. Scientific advice to fisheries managers emerged from these assessments, particularly during the deliberations of the state's licensing provisions for 2011 as well as in the process for setting the recreational management plans for 2011 and 2012. The project leaders participated at the Atlantic States Marine Fisheries Commission's meetings relative to the management of recreationally important coastal stocks. They also participated in the National Marine Fisheries Service (NMFS) stock assessment meetings for species under their jurisdiction. Other project staff participated at fish stock assessment trainings conducted through ASMFC and NOAA. The status of the most important recreationally caught species in Rhode Island were presented in the finfish sector management plan which was submitted for public review and input for establishing management strategies for 2012 (Finfish Sector Management Plan 2012, see: http://www.dem.ri.gov/pubs/regs/regs/fishwild/mpfinfsh.pdf). The following is a summary of the activities that took place in 2011.

1. SCUP

Beginning when the new statistical catch at age stock assessment (ASAP = age structured assessment program) was introduced and peer reviewed in 2008, an annual update has been performed for the coastwide stock for scup. These updates are less time consuming than full benchmark assessments, but still require some work to be able to perform the update. The main tasks are to gather both catch and fishery independent information from the previous year, and stratify that information by age based on aging information from the NMFS trawl survey as well as supplemental information from the RI floating fish trap sampling program. RI contributes its Division of Fish and Wildlife trawl survey data (see job number 2 from this grant) to the assessment. Staff collects the information and age stratifies it for the assessment. Staff also participates in several meetings where the assessment update information is released.

2. SUMMER FLOUNDER

Beginning when the new statistical catch at age stock assessment (ASAP = age structured assessment program) was introduced and peer reviewed in 2008, an annual update has been performed for the coastwide stock for summer flounder. These updates are less time consuming than full benchmark assessments, but still require some work to be able to perform the update. The main tasks are to gather both catch and fishery independent information from the previous year, and stratify that information by age based on aging information from the NMFS trawl survey. RI contributes its Division of Fish and Wildlife trawl survey data (see job number 2 from this grant) to the assessment. Staff collects the information and age stratifies it for the assessment. Staff also participates in several meetings where the assessment update information is released.

3. TAUTOG

The ASMFC Tautog Technical Committee completed the most recent coastwide assessment update for tautog in 2011 (ASMFC 2011). This stock assessment is a Virtual Population Analysis (VPA) which is an age structured modeling technique. One of the project leaders for this job participated on the stock assessment sub committee for this species where they were responsible for collecting, age stratifying, auditing, and reviewing the assessment. Report development is also part of the project leader’s responsibilities. RI contributes its Division of Fish and Wildlife trawl survey data (see job number 2 from this grant) as well as its Narragansett Bay seine survey (see job number 4) to the assessment. Staff collects the information and age stratifies it for the assessment. Staff also participates in several meetings where the assessment update information is released.

A regional approach to tautog management was also approved by the ASMFC in 2008, allowing MA and RI to assess the tautog stock in the two state’s waters region. It is the same modeling technique as the coastwide assessment (VPA), just performed on data from the two state region. All of the same data needs are required for this task, and the products and information from this model provide the information used as the management metrics in RI. Staff time is spent updating local users on impacts to the RI state waters fisheries, most notably the recreational community who comprise approximately 90% of the harvest on tautog.

4. BLACK SEA BASS

A new assessment was introduced and peer reviewed in 2008 that uses a forward projection modeling technique called SCALE (Statistical Catch at Length). In 2011 a benchmark was performed for this stock assessment as well as the intent to introduce an additional and preferred modeling technique, a statistical catch at age stock assessment (ASAP = age structured assessment program). The main tasks are to gather both catch and fishery independent information from the entire applicable time series, and stratify that information by age based on aging information from the NMFS trawl survey as well as some external research that had been performed on this species. RI contributed its Division of Fish and Wildlife trawl survey data (see job number 2 from this grant) to the assessment as well as its Narragansett Bay and Coastal Pond seine survey information (see jobs 3 and 4 from this grant). Staff collects the information and age stratifies it for the assessment. Staff also participates in several meetings where the assessment update information is released, which included the peer review meeting. Note: The benchmark assessment did not pass peer review therefore the assessment defaults to the 2008 approved SCALE model.

5. WINTER FLOUNDER

The most recent stock assessment for winter flounder took place in June, 2011 at the 52nd Northeast Stock Assessment Workshop. Fishing mortality (F) and spawning stock biomass (SSB) estimates were generated using the age structured assessment program statistical catch at age model (ASAP SCAA). Maximum sustainable yield for F and SSB were calculated using a stock recruitment model. The stock assessment workshop focused on all three stocks of winter flounder, Gulf of Maine (GOM), Georges Bank (GBK), and Southern New England (SNE). Rhode Island waters are part of the SNE stock unit. RIDFW staff provided fisheries independent and dependent data from state run (RI Coastal Pond Survey F-61 job 3; Narragansett Bay Seine Survey, F- 61 job 4; RI Trawl Survey F-61 job 2) as well as other regional (URI GSO trawl survey, Dominion Power Co. Trawl Survey) trawl and seine surveys to be considered for use in the assessment. This data was gathered and prepared by RIDFW staff for the assessment by running length frequencies through age at length keys and by preparing annual abundance indices. A staff member also attended each of the stock assessment meetings. The same staff member gave a summary presentation of the assessment to RIDFW staff and the Winter Flounder advisory panel of the RI Marine Fisheries Council.

In addition to the large scale population level stock assessments, local biomass dynamic model assessments are run to determine local stock status, as this species exhibits a strong spawning site fidelity so smaller scale spatial components are important to its biology. Division personnel spend time collecting and preparing data inputs as well as developing the actual model framework. This local stock status is used to inform local management strategies, such as for the recent protection of a RI coastal pond to conserve what appears to be a depleted indigenous population in the coastal pond.

6. MENHADEN

Stock Status: The ASMFC Atlantic Menhaden Stock Assessment Subcommittee last assessed the menhaden stock in 2010. The assessment was completed in 2010 however, due to a coding error found in the model, a corrected assessment was performed and reviewed during 2011. Staff participated in several meetings where the corrected assessment update information was reviewed and released.

ASSESSMENT OF RECREATIONALLY IMPORTANT FINFISH STOCKS IN RHODE ISLAND WATERS

Age and Growth Study

Nicole Travisono
Principal Marine Fisheries Biologist

R. I. Division of Fish & Wildlife
Marine Fisheries

Ft. Wetherill Marine Laboratory
3 Ft. Wetherill Road
Jamestown, Rhode Island 02835

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PERFORMANCE REPORT

STATE: Rhode Island **PROJECT NUMBER:** F-61-R
SEGMENT NUMBER: 19

PROJECT TITLE: Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters

PERIOD COVERED: January 1, 2011 – December 31, 2011

JOB NUMBER AND TITLE: 9, Age and Growth Study

JOB OBJECTIVE: To collect age and growth data on recreationally and ecologically important finfish in Narragansett Bay for management purposes. Data collected in this study will be used in state, regional and coast-wide fisheries management.

SUMMARY: Investigators collected lengths, weights, and age structures from seven species of recreationally important finfish. The type of age structure collected and the number of samples collected varied by species. Work to age the structures collected in 2011 has started and will continue to be underway throughout the spring of 2012. Ageing structures collected for tautog will not be aged until the completion of a tautog ageing workshop being held by the Atlantic States Marine Fisheries Commission (ASMFC) in May of 2012. The aim of this workshop is to determine what age structure is best suited for ageing tautog and what ageing methodology should be used for that structure. Additionally, investigators have reached out to recreational fishing groups for the 2012 fishing season to encourage their participation in donating fish racks. The donation of fish racks will decrease the amount of time that investigators need to be in the field collecting samples and allow more time for ageing the collected structures.

TARGET DATE: Ongoing

STATUS OF PROJECT: On schedule

SIGNIFICANT DEVIATIONS: Investigators were unable to make the desired amount of progress on ageing structures collected in 2011, however will continue into 2012.

RECOMMENDATIONS: To continue ageing structures collected in 2011 and move into the next project segment for 2012.

REMARKS: For the remainder of 2012 investigators will focus on ageing structures collected in 2011 and begin the 2012 field sampling season.

INTRODUCTION

Age and growth information is essential in estimating the age-structure of a fish population. Understanding the age-structure of a population allows scientists to make informed management decisions regarding acceptable harvest levels for a species.

This study is aimed to characterize the age-structure of stocks whose ranges extend into Narragansett Bay and will supplement data collected in the Northeast Fisheries Science Center (NEFSC) spring and fall surveys, which limit their sampling to the mouth of Narragansett Bay. Additionally, this study is designed to enhance the existing age and growth work conducted at the Ft. Wetherill Marine Laboratory. Past work has included collecting age and growth data from Scup, Striped Bass, Tautog, and Weakfish. This study includes the aforementioned species in addition to several new species including Black Sea Bass, Menhaden, and Summer Flounder.

MATERIALS AND METHODS

Seasonal port sampling of seven species of finfish considered to be extremely important to the recreational fishing community was conducted from May through October of 2011. Data collected included lengths, weights and the appropriate age structure for the specific species (i.e. scale, otolith, or operculum). The number of samples and age structures collected varied depending on the species (Table 1). Investigators focused on obtaining samples from various locations throughout the state from various finfish dealers, recreational anglers, and commercial floating fish trap companies (Table 2).

Table 1. Species, number of ageing structures, and number of fish to sampled in 2011.

Common name	**Ageing structure**	**Sampling Targets**	**Number of fish sampled**
Black sea bass	Scale	100	68
Menhaden	Scale	100	92
Scup	Scale	1000	1074
Striped bass	Scale	150 fish/gear type**	625
Summer Flounder	Scale	100	102
Tautog	Operculum/Otolith	200	267
Weakfish	Otolith	3 fish aged per metric ton landed*	10

*Per ASMFC FMP requirements
**Gear types include floating fish traps and rod & reel

Table 2. Gear type sampled for each species collected (FFT=Floating Fish trap).

Common name	**Gear Type**
Black sea bass	FFT, Otter Trawl
Menhaden	FFT
Scup	FFT, Otter Trawl
Striped bass	FFT, Hook and Line
Summer Flounder	Otter Trawl
Tautog	Hook and Line
Weakfish	FFT, Otter Trawl

RESULTS AND DISCUSSION

Port sampling efforts were very successful in 2011. Sampling targets for black sea bass, menhaden and weakfish were not satisfied although investigators came very close to the target numbers. Black sea bass was difficult to sample as it is a highly desired species and was typically the first species to be packaged and/or sold once offloaded from the fishing vessel. Menhaden samples are very limited to floating fish traps and the availability of samples varies from year to year. Weakfish samples are very difficult to acquire due the extremely diminished weakfish stock. The sampling requirement for weakfish in 2011 as mandated by the ASMFC, were based on 2010 landings which were 5,380 pounds (2.44 MT) landed commercially. Based on the requirement of 6 lengths measured per metric ton landed commercially and 3 fish aged per metric ton landed in total, the required number of samples was 15 lengths and 7 fish aged. In 2011, a total of 10 weakfish were sampled which satisfied the number of age samples required, but not the number of lengths required.

To date, ageing of striped bass scales is underway with the remaining species to follow (Table 3). Ageing structures collected for tautog will not be aged until the completion of a tautog ageing workshop being held by the Atlantic States Marine Fisheries Commission (ASMFC) in May of 2012. The aim of this workshop is to determine what age structure is best suited for ageing tautog and what ageing methodology should be used for that structure. As a result, investigators decided to postpone tautog ageing until the workshop has been completed.

Table 3. Age/length key for Striped Bass collected in 2011.

Length (cm)/Age	5	6	7	8	9	10	11
56	0	1	0	0	0	0	0
64	0	2	0	0	0	0	0
65	1	2	3	0	0	0	0
66	0	0	0	0	0	0	0
67	0	3	7	0	0	0	0
68	0	1	1	0	0	0	0
69	0	0	2	0	0	0	0
70	0	1	2	1	0	0	0
71	0	0	2	0	0	0	0
72	0	1	1	3	0	0	0
73	0	0	3	2	0	0	0

74	0	0	4	2	0	0	0
75	0	0	1	1	1	0	0
76	0	0	3	5	0	0	0
77	0	0	1	5	0	0	0
78	0	0	0	4	1	0	0
79	0	0	0	2	0	0	0
80	0	0	0	2	1	0	3
81	0	0	0	0	1	0	0
82	0	0	0	1	1	0	0
83	0	0	0	1	2	0	0
84	0	0	0	2	0	0	0
86	0	0	0	1	0	0	0
87	0	0	0	1	0	0	0
88	0	0	0	1	0	1	0
90	0	0	0	0	0	1	1
93	0	0	0	0	0	1	1