ASSESSMENT OF RECREATIONALLY IMPORTANT FINFISH STOCKS IN RHODE ISLAND WATERS

COASTAL FISHERY RESOURCE ASSESSMENT
TRAWL SURVEY
2012

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

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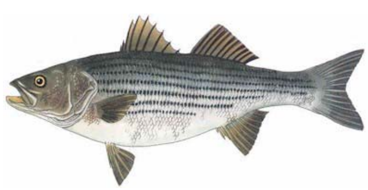
Division of Fish and Wildlife
Marine Fisheries

March 2013



Annual Performance Report

STATE: Rhode Island PROJECT NUMBER: F-61-R
SEGMENT NUMBER: 20

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, 2012 – December 31, 2012.

PROJECT SUMMARY: Job 1, summary accomplished:
A: 147, twenty minute bottom trawl were successfully completed.
B: Data on weight, length, sex and numbers were gathered on 70 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 2012

SCHEDULE OF PROGRESS: On schedule.

SIGNIFICANT DEVIATIONS: None
.
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) 2012

PROJECT SUMMARY: Job 2, summary accomplished:
A: 44, twenty minute tows were successfully completed during the Spring 2012 survey (26 NB. – 6 RIS – 12 BIS).
B: 44, twenty minute tow were successfully completed during the Fall 2012 survey (26 NB. – 6 RIS – 12 BIS)

TARGET DATE: DECEMBER 2012.

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 2013, 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 during 2012 survey year.

RESULTS AND DISCUSSION: 147 tows were completed during 2012 Job 1 (Monthly survey). 70 species accounted for a combined weight of 6,551.7 kgs. and 233,244 length measurements being added to the existing Narragansett Bay monthly trawl data set

By contrast, 88 tows were completed during 2012 Job 2 (Seasonal survey) 61 species accounted for a combined weight of 6,729.2 kgs. and 254,873 length measurements added to the existing seasonal data set.

With the completion of the 2012 surveys, combined survey(s) Jobs (1&2) data now reflects the completion of 5,546 tows with data collected on 132 species.

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PREPARED BY: ______________________ ______________________

Scott D. Olszewski Date
Principal Marine Fisheries Biologist
Principal Investigator

APPROVED BY: ______________________ ______________________

Mark Gibson Date
Deputy Chief
RIDFW – Marine Fisheries

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), 5,546 tows have been conducted within Rhode Island territorial waters with data collected on 132 species. This performance report reflects the efforts of the 2012 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 44 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, (14 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.

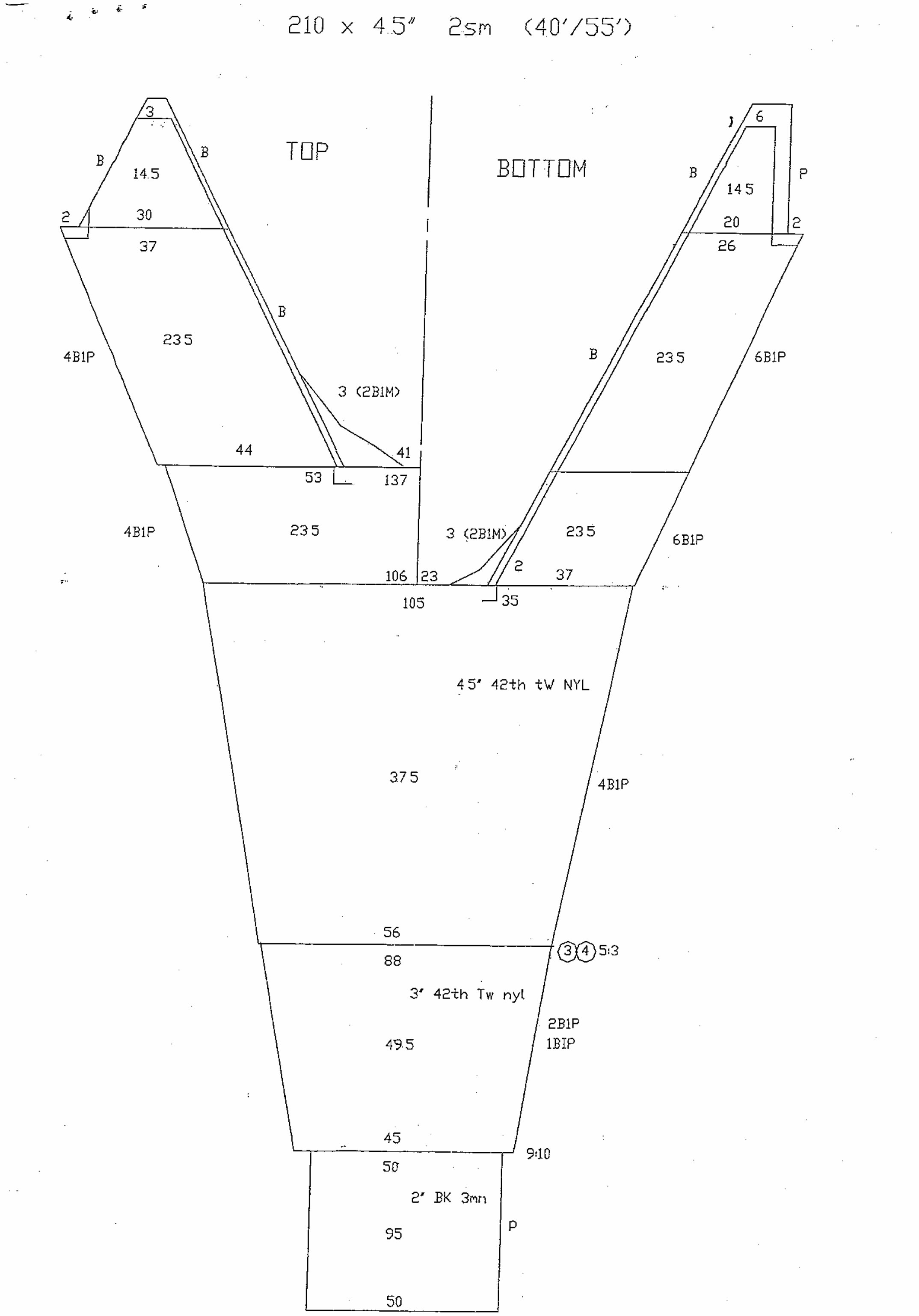
Survey changes- Beginning January 2012 the Rhode Island Coastal Trawl Survey began using an updated set of trawl doors. Throughout 2012, a comparative gear calibration study was completed to determine if a significant change to the survey catch data is exists. The analysis of this calibration study will be completed in 2013.

RIDEM R/V John H. Chafee

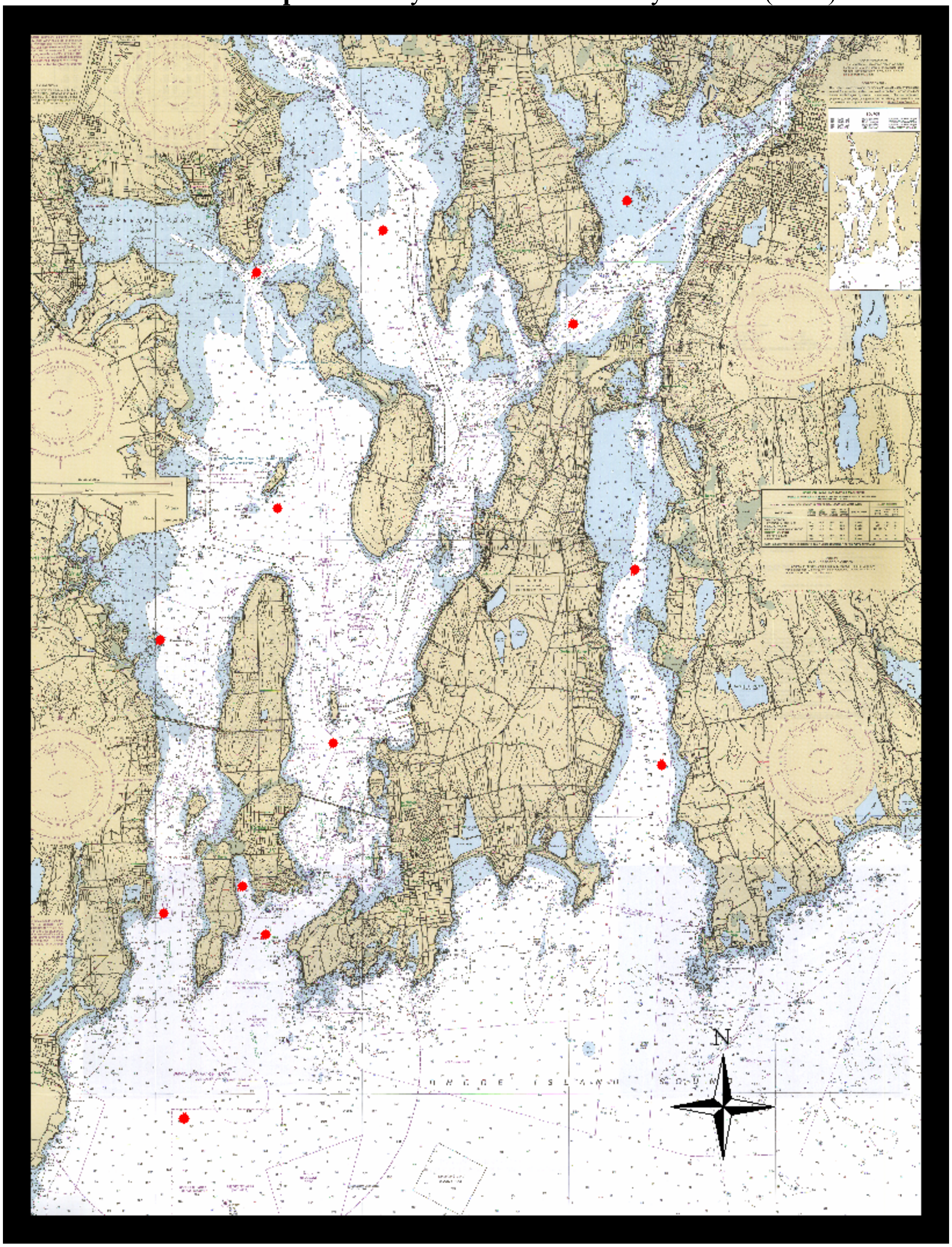
Acknowledgements:

Special thanks are again extended to Captain Richard Mello, Assistant Captain, Patrick Brown, Principal Biologist Eric Schneider, Timothy R. Lynch Principal Biologist (Ret.) 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
4B1P
23.5
3 (2B1M)
44
41
53
137
4B1P
23.5
106
23
105
6
B
P
14.5
20
2
26
B
23.5
6B1P
3 (2B1M)
23.5
6B1P
2
37
35
4.5' 42th tW NYL
37.5
4B1P
56
88
5:3
3' 42th Tw nyl
49.5
2B1P
1B1P
45
9:10
50
2' BK 3mn
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 70 species were observed and recorded during the 2012 Narragansett Bay Monthly Trawl Survey totaling 233,244 individuals or 1586.7 fish per tow. In weight, the catch accounted for 6,551.7 kg. or 44.6 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
Scup	STENOTOMUS CHRYSOPS	61555
Longfin Squid	LOLIGO PEALEI	48288
Bay Anchovy	ANCHOA MITCHILLI	41959
Atlantic Herring	CLUPEA HARENGUS	23788
Butterfish	PEPRILUS TRIACANTHUS	22848
Alewife	ALOSA PSEUDOHARENGUS	10311
Atlantic Silverside	MENIDIA MENIDIA	7536
Weakfish	CYNOSCION REGALIS	5921
Atlantic Moonfish	SELENE SETAPINNIS	3397
Little Skate	RAJA ERINACEA	1271
Black Sea Bass	CENTROPRISTIS STRIATA	639
Bluefish	POMATOMUS SALTATRIX	617
Silver Hake	MERLUCCIUS BILINEARIS	527
Rough Scad	TRACHURUS LATHAMI	493
Atlantic Menhaden	BREVOORTIA TYRANNUS	452
Spot	LEIOSTOMUS XANTHURUS	433
Winter Flounder	PLEURONECTES AMERICANUS	429
Blueback Herring	ALOSA AESTIVALIS	384
American Shad	ALOSA SAPIDISSIMA	299
American Lobster	HOMARUS AMERICANUS	292
Spiny Dogfish	SQUALUS ACANTHIAS	212
Summer Flounder	PARALICHTHYS DENTATUS	184
Spotted Hake	UROPHYCIS REGIA	181
Red Hake	UROPHYCIS CHUSS	148
Striped Searobin	PRIONOTUS EVOLANS	134
Fourspot Flounder	PARALICHTHYS OBLONGUS	131
Northern Kingfish	MENTICIRRHUS SAXATILIS	123
Northern Searobin	PRIONOTUS CAROLINUS	73
Windowpane Flounder	SCOPHTHALMUS AQUOSUS	67
Winter Skate	RAJA OCELLATA	65
Tautog	TAUTOGA ONITIS	62
Smooth Dogfish	MUSTELUS CANIS	58
Blue Crab	CALLINECTES SAPIDUS	57
Channeled Whelk	BUSYCOTYPUS CANALICULATUS	45
Longhorn Sculpin	MYOXOCEPHALUS OCTODECEMSPINOS	30
Smallmouth Flounder	ETROPUS MICROSTOMUS	28
Knobbed Whelk	BUSYCON CARICA	24

Horseshoe Crab	LIMULUS POLYPHEMUS	22
Hogchoker	TRINECTES MACULATUS	21
Silver Perch	BAIRDIELLA CHRYSOURA	15
Clearnose Skate	RAJA EGLANTERIA	13
Mantis Shrimp	SQUILLA EMPUSA	13
Northern Puffer	SPHOEROIDES MACULATUS	12
Striped Bass	MORONE SAXATILIS	12
Cunner	TAUTOGOLABRUS ADSPERSUS	9
Goosefish	LOPHIUS AMERICANUS	5
Rainbow Smelt	OSMERUS MORDAX	4
Hickory Shad	ALOSA MEDIOCRIS	4
Atlantic Mackerel	SCOMBER SCOMBRUS	4
Northern Pipefish	SYNGNATHUS FUSCUS	3
Striped Anchovy	ANCHOA HEPSETUS	3
Crevalle Jack	CARANX HIPPOS	2
Grubby	MYOXOCEPHALUS AENAEUS	2
Northern Sennet	SPHYRAENA BOREALIS	2
Gobies	GOBIIDAE	2
Rock Gunnel	PHOLIS GUNNELLUS	1
Bigeye Scad	SELAR CRUMENOPHTHALMUS	1
Atlantc Cutlassfish	TRICHIURUS LEPTURUS	1
Atlantic Torpedo Ray	TORPEDO NOBILIANA	1
Atlantic Black Sea Hare	APLYSIS MORIO	1
Ocean Pout	MACROZOARCES AMERICANUS	1
Sea Raven	HEMITRIPTERUS AMERICANUS	1
American Sand Lance	AMMODYTES AMERICANUS	1
Pollock	POLLACHIUS VIRENS	1
Sea Lamprey	PETROMYZON MARINUS	1
Pinfish	LAGODON RHOMBOIDES	1
Yellowtail Flounder	PLEURONECTES FERRUGINEUS	1
American Eel	ANGUILLA ROSTRATA	1
Atlantic Cod	GADUS MORHUA	1
Oyster Toadfish	OPSANUS TAU	1

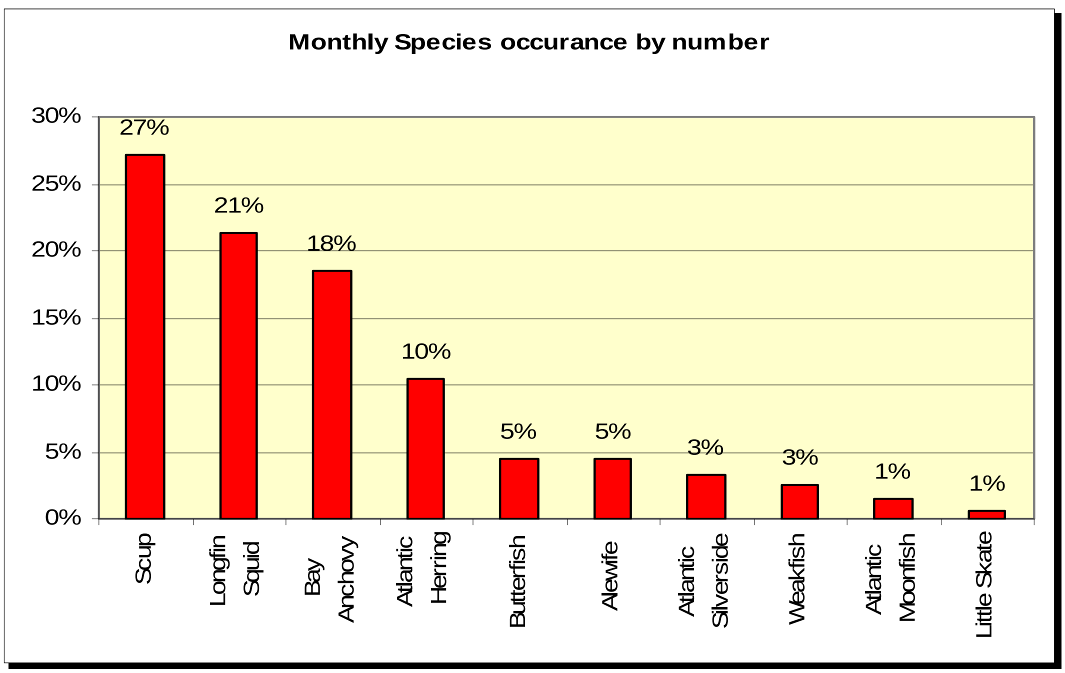
Figure 3 (Total Catch in Kilograms)

Fish Name	Scientific Name	Total kg
Scup	STENOTOMUS CHRYSOPS	1959.150001
Butterfish	PEPRILUS TRIACANTHUS	803.9859982
Little Skate	RAJA ERINACEA	761.2049969
Atlantic Herring	CLUPEA HARENGUS	717.9460054
Longfin Squid	LOLIGO PEALEI	516.6502507
Alewife	ALOSA PSEUDOHARENGUS	278.6479975
Weakfish	CYNOSCION REGALIS	153.1150003
Summer Flounder	PARALICHTHYS DENTATUS	148.7390002
Tautog	TAUTOGA ONITIS	106.1350006
American Lobster	HOMARUS AMERICANUS	99.76500083
Spiny Dogfish	SQUALUS ACANTHIAS	96.28000173
Winter Flounder	PLEURONECTES AMERICANUS	82.48299991
Bluefish	POMATOMUS SALTATRIX	80.99500064
Winter Skate	RAJA OCELLATA	78.76500207
Bay Anchovy	ANCHOA MITCHILLI	76.56799927
Smooth Dogfish	MUSTELUS CANIS	69.4899992
Black Sea Bass	CENTROPRISTIS STRIATA	60.31100048
Spot	LEIOSTOMUS XANTHURUS	57.18999923
Horseshoe Crab	LIMULUS POLYPHEMUS	47.22000009
Striped Searobin	PRIONOTUS EVOLANS	44.50999966
Atlantic Silverside	MENIDIA MENIDIA	34.74999998
Silver Hake	MERLUCCIUS BILINEARIS	32.01499978
Striped Bass	MORONE SAXATILIS	29.59500021
Fourspot Flounder	PARALICHTHYS OBLONGUS	25.35000006
Atlantic Moonfish	SELENE SETAPINNIS	20.26000077
Spotted Hake	UROPHYCIS REGIA	20.20100011
Clearnose Skate	RAJA EGLANTERIA	18.5049997
American Shad	ALOSA SAPIDISSIMA	17.75500012
Blue Crab	CALLINECTES SAPIDUS	11.75999984
Northern Kingfish	MENTICIRRHUS SAXATILIS	11.37500013
Windowpane Flounder	SCOPHTHALMUS AQUOSUS	10.43499984
Red Hake	UROPHYCIS CHUSS	10.18499977
Longhorn Sculpin	MYOXOCEPHALUS OCTODECEMSPINOS	10.0649997
Channeled Whelk	BUSYCOTYPUS CANALICULATUS	9.000000112
Rough Scad	TRACHURUS LATHAMI	8.464999802
Atlantic Menhaden	BREVOORTIA TYRANNUS	8.088000068
Blueback Herring	ALOSA AESTIVALIS	5.78499994
Northern Searobin	PRIONOTUS CAROLINUS	4.75799989
Knobbed Whelk	BUSYCON CARICA	4.599999994
Atlantic Cod	GADUS MORHUA	3.900000095
Atlantic Black Sea Hare	APLYSIS MORIO	3.50999999
Goosefish	LOPHIUS AMERICANUS	2.210000038
Hickory Shad	ALOSA MEDIOCRIS	2.050000042

Hogchoker	TRINECTES MACULATUS	1.869999975
Sea Raven	HEMITRIPTERUS AMERICANUS	0.930000007
Cunner	TAUTOGOLABRUS ADSPERSUS	0.880000014
Silver Perch	BAIRDIELLA CHRYSOURA	0.644999988
Ocean Pout	MACROZOARCES AMERICANUS	0.620000005
Mantis Shrimp	SQUILLA EMPUSA	0.559999995
Northern Puffer	SPHOEROIDES MACULATUS	0.540000007
American Eel	ANGUILLA ROSTRATA	0.405000001
Atlantic Mackerel	SCOMBER SCOMBRUS	0.324999995
Smallmouth Flounder	ETROPUS MICROSTOMUS	0.306999994
Yellowtail Flounder	PLEURONECTES FERRUGINEUS	0.219999999
Oyster Toadfish	OPSANUS TAU	0.155000001
Crevalle Jack	CARANX HIPPOS	0.149999999
Rainbow Smelt	OSMERUS MORDAX	0.112999998
Bigeye Scad	SELAR CRUMENOPHTHALMUS	0.064999998
Grubby	MYOXOCEPHALUS AENAEUS	0.054999999
Pinfish	LAGODON RHOMBOIDES	0.039999999
Northern Sennet	SPHYRAENA BOREALIS	0.025
Striped Anchovy	ANCHOA HEPSETUS	0.02
Pollock	POLLACHIUS VIRENS	0.02
Atlantc Cutlassfish	TRICHIURUS LEPTURUS	0.015
Rock Gunnel	PHOLIS GUNNELLUS	0.01
American Sand Lance	AMMODYTES AMERICANUS	0.01
Sea Lamprey	PETROMYZON MARINUS	0.01
Northern Pipefish	SYNGNATHUS FUSCUS	0.008
Gobies	GOBIIDAE	0.003
Atlantic Torpedo Ray	TORPEDO NOBILIANA	0

Figure 4 Monthly Survey Top Ten Species Catch in Number

Fish Name	Scientific Name	%
Scup	STENOTOMUS CHRYSOPS	27%
Longfin Squid	LOLIGO PEALEI	21%
Bay Anchovy	ANCHOA MITCHILLI	18%
Atlantic Herring	CLUPEA HARENGUS	10%
Butterfish	PEPRILUS TRIACANTHUS	5%
Alewife	ALOSA PSEUDOHARENGUS	5%
Atlantic Silverside	MENIDIA MENIDIA	3%
Weakfish	CYNOSCION REGALIS	3%
Atlantic Moonfish	SELENE SETAPINNIS	1%
Little Skate	RAJA ERINACEA	1%



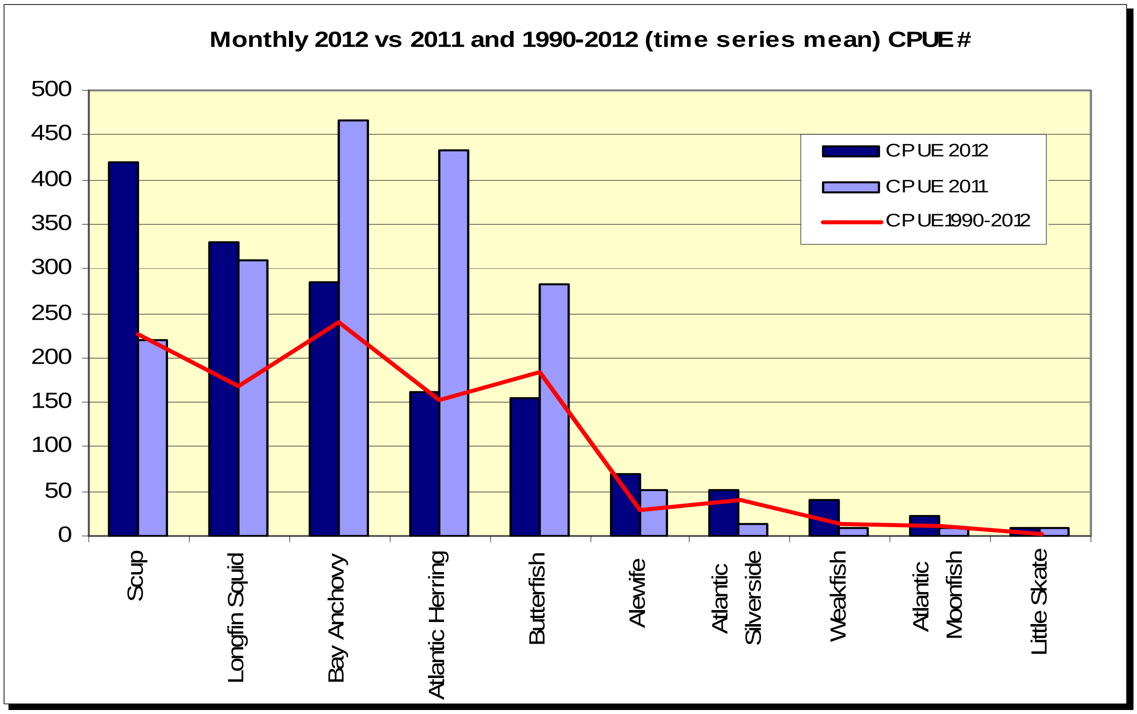
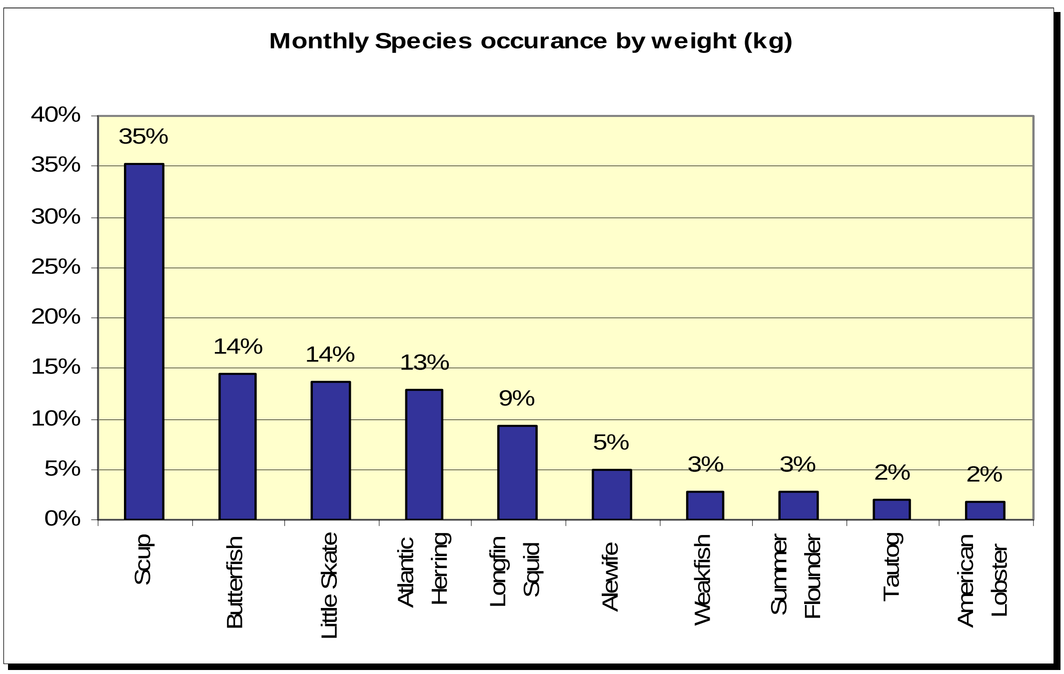
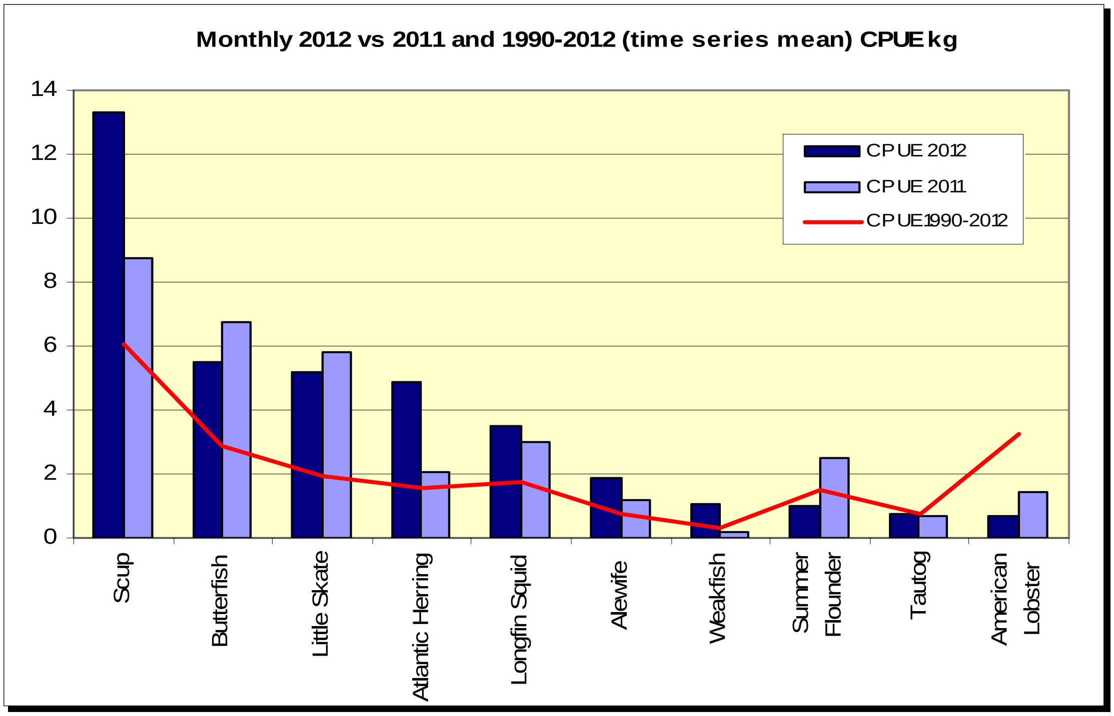

Monthly 2012 vs 2011 and 1990-2012 (time series mean) CPUE #
500
450
400
350
300
250
200
150
100
50
0
CPUE 2012
CPUE 2011
CPUE 1990-2012
Scup
Longfin Squid
Bay Anchovy
Atlantic Herring
Butterfish
Alewife
Atlantic Silverside
Weakfish
Atlantic Moonfish
Little Skate

Figure 5 Top Ten Species Catch in Kilograms

Fish Name	Scientific Name	%
Scup	STENOTOMUS CHRYSOPS	35%
Butterfish	PEPRILUS TRIACANTHUS	14%
Little Skate	RAJA ERINACEA	14%
Atlantic Herring	CLUPEA HARENGUS	13%
Longfin Squid	LOLIGO PEALEI	9%
Alewife	ALOSA PSEUDOHARENGUS	5%
Weakfish	CYNOSCION REGALIS	3%
Summer Flounder	PARALICHTHYS DENTATUS	3%
Tautog	TAUTOGA ONITIS	2%
American Lobster	HOMARUS AMERICANUS	2%



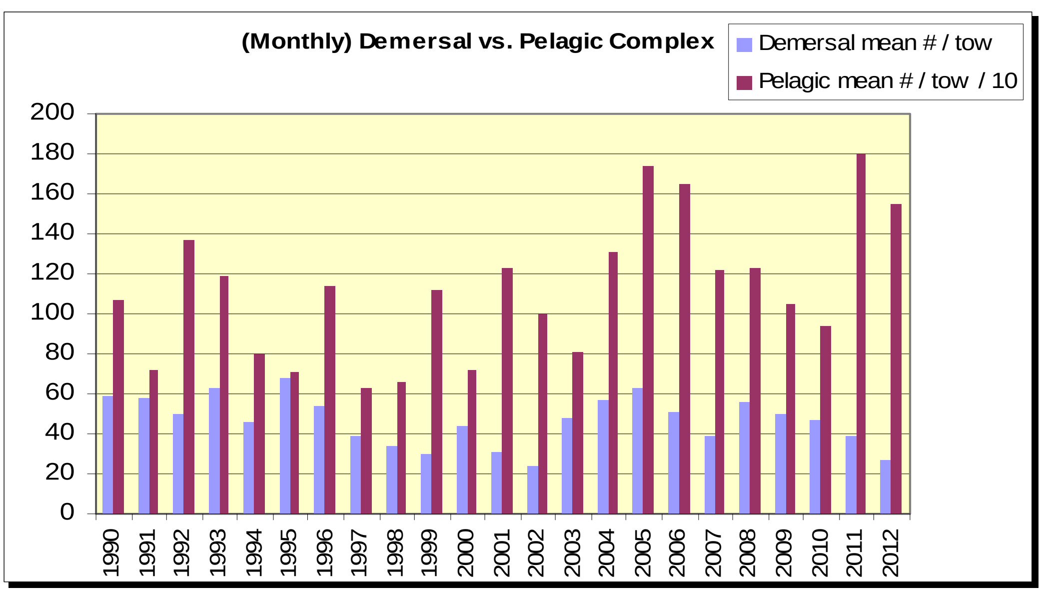

Monthly 2012 vs 2011 and 1990-2012 (time series mean) CPUE kg
14
12
10
8
6
4
2
0
CPUE 2012
CPUE 2011
CPUE 1990-2012
Scup
Butterfish
Little Skate
Atlantic Herring
Longfin Squid
Alewife
Weakfish
Summer Flounder
Tautog
American Lobster

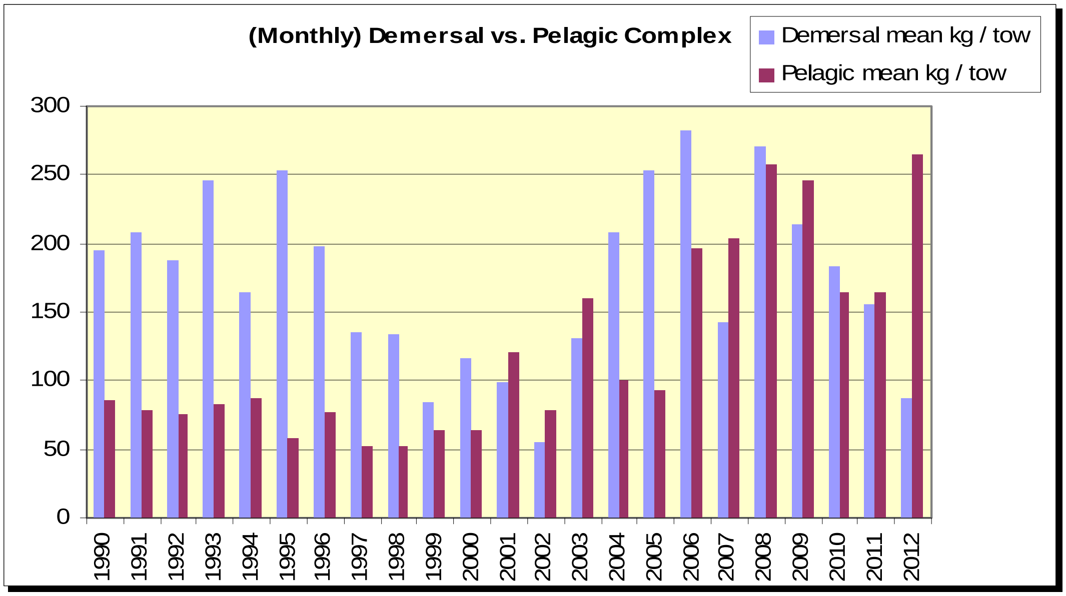
Demersal vs. Pelagic Species Complex

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

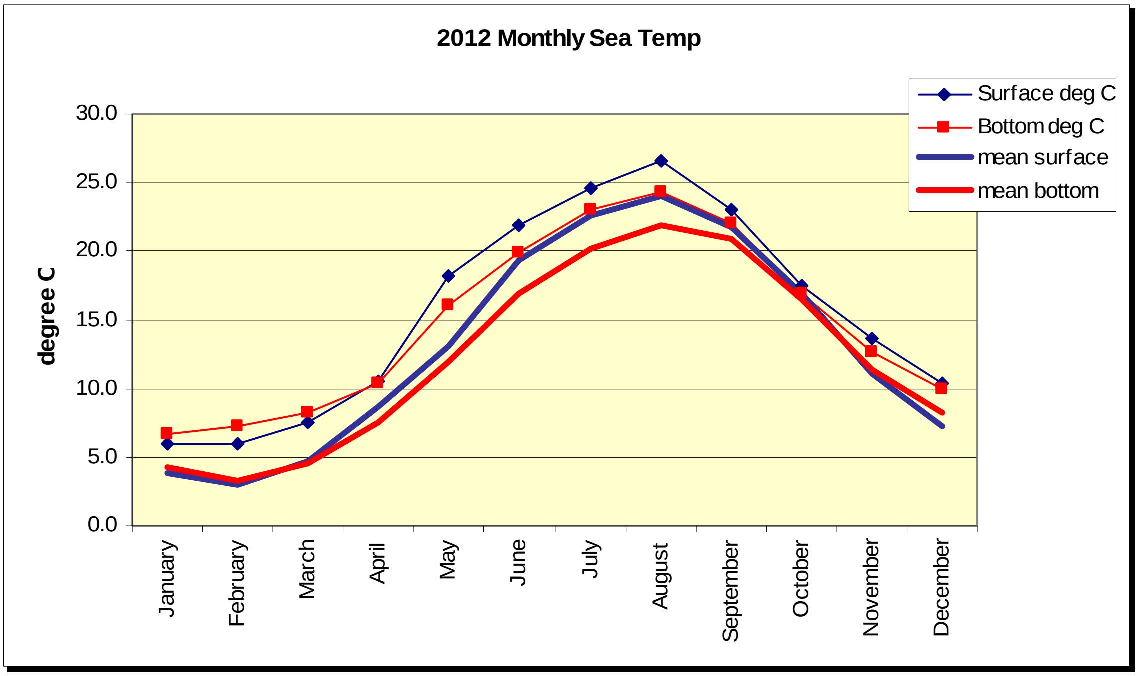
Figure 6 and 7

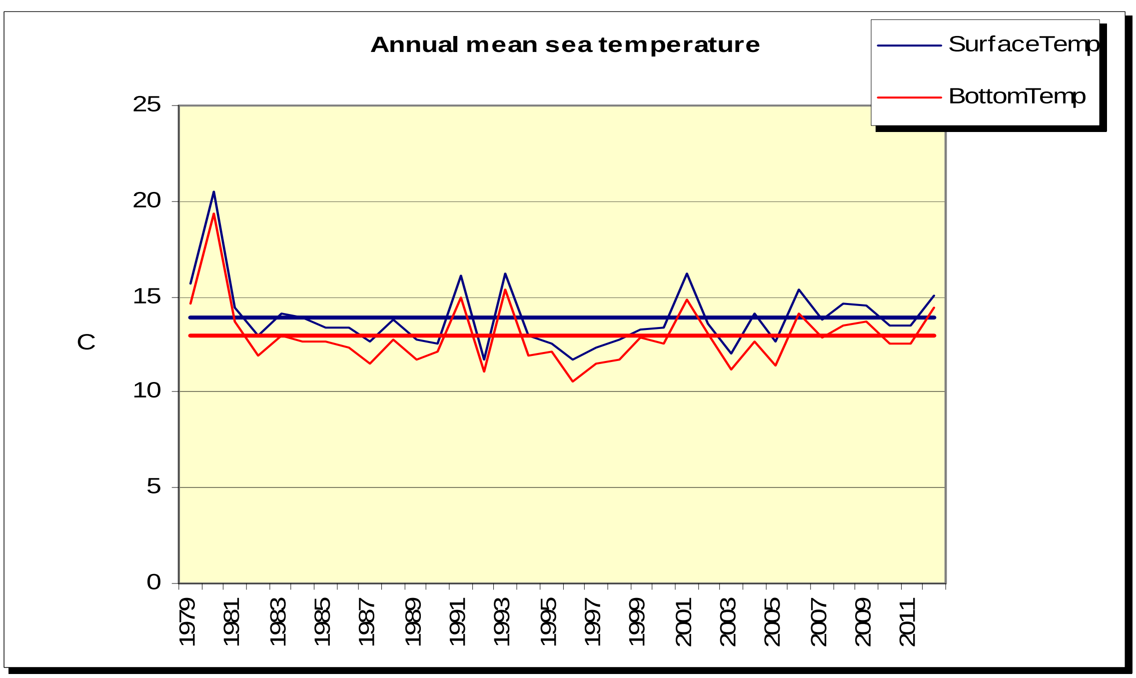



(Monthly) Demersal vs. Pelagic Complex
Demersal mean kg / tow
Pelagic mean kg / tow
300
250
200
150
100
50
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

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, 12 fixed stations in Block Island Sound.
60 species were observed and recorded during the 2012 Rhode Island Seasonal Trawl Survey, totaling 254873 individuals or 2896.3 fish per tow. In weight, the catch accounted for 6729.2 kg. or 76.5 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
Scup	STENOTOMUS CHRYSOPS	111172
Bay Anchovy	ANCHOA MITCHILLI	56317
Longfin Squid	LOLIGO PEALEI	32975
Butterfish	PEPRILUS TRIACANTHUS	26124
Atlantic Herring	CLUPEA HARENGUS	8676
Weakfish	CYNOSCION REGALIS	5382
Atlantic Moonfish	SELENE SETAPINNIS	2810
Little Skate	RAJA ERINACEA	2434
Alewife	ALOSA PSEUDOHARENGUS	2202
Spot	LEIOSTOMUS XANTHURUS	933
Bluefish	POMATOMUS SALTATRIX	840
Winter Flounder	PLEURONECTES AMERICANUS	689
Silver Hake	MERLUCCIUS BILINEARIS	655
Black Sea Bass	CENTROPRISTIS STRIATA	574
Winter Skate	RAJA OCELLATA	559
Round Scad	DECAPTERUS PUNCTATUS	439
Summer Flounder	PARALICHTHYS DENTATUS	267
Northern Kingfish	MENTICIRRHUS SAXATILIS	247
American Shad	ALOSA SAPIDISSIMA	185
Red Hake	UROPHYCIS CHUSS	162
Northern Searobin	PRIONOTUS CAROLINUS	136
Striped Searobin	PRIONOTUS EVOLANS	121
Longhorn Sculpin	MYOXOCEPHALUS OCTODECEMSPINOS	102
Spotted Hake	UROPHYCIS REGIA	89
Rough Scad	TRACHURUS LATHAMI	87
Atlantic Silverside	MENIDIA MENIDIA	86
Windowpane Flounder	SCOPHTHALMUS AQUOSUS	81
Fourspot Flounder	PARALICHTHYS OBLONGUS	76
American Lobster	HOMARUS AMERICANUS	58
Smooth Dogfish	MUSTELUS CANIS	49
Clearnose Skate	RAJA EGLANTERIA	30
Yellowtail Flounder	PLEURONECTES FERRUGINEUS	28
Channeled Whelk	BUSYCOTYPUS CANALICULATUS	28
Ocean Pout	MACROZOARCES AMERICANUS	27
Northern Puffer	SPHOEROIDES MACULATUS	25

Horseshoe Crab	LIMULUS POLYPHEMUS	24
Blueback Herring	ALOSA AESTIVALIS	24
Blue Crab	CALLINECTES SAPIDUS	20
Tautog	TAUTOGA ONITIS	18
American Sand Lance	AMMODYTES AMERICANUS	18
Atlantic Menhaden	BREVOORTIA TYRANNUS	16
Smallmouth Flounder	ETROPUS MICROSTOMUS	14
Knobbed Whelk	BUSYCON CARICA	13
Goosefish	LOPHIUS AMERICANUS	10
Hogchoker	TRINECTES MACULATUS	7
Cunner	TAUTOGOLABRUS ADSPERSUS	6
Sea Scallop	PLACOPECTEN MAGELLANICUS	6
Sea Raven	HEMITRIPTERUS AMERICANUS	6
Round Herring	ETRUMEUS TERES	4
Striped Anchovy	ANCHOA HEPSETUS	4
Northern Sennet	SPHYRAENA BOREALIS	4
Mantis Shrimp	SQUILLA EMPUSA	3
Rainbow Smelt	OSMERUS MORDAX	2
Striped Bass	MORONE SAXATILIS	2
Spiny Dogfish	SQUALUS ACANTHIAS	2
Oyster Toadfish	OPSANUS TAU	1
Crevalle Jack	CARANX HIPPOS	1
Atlantc Cutlassfish	TRICHIURUS LEPTURUS	1
Atlantic Torpedo Ray	TORPEDO NOBILIANA	1
Rock Gunnel	PHOLIS GUNNELLUS	1

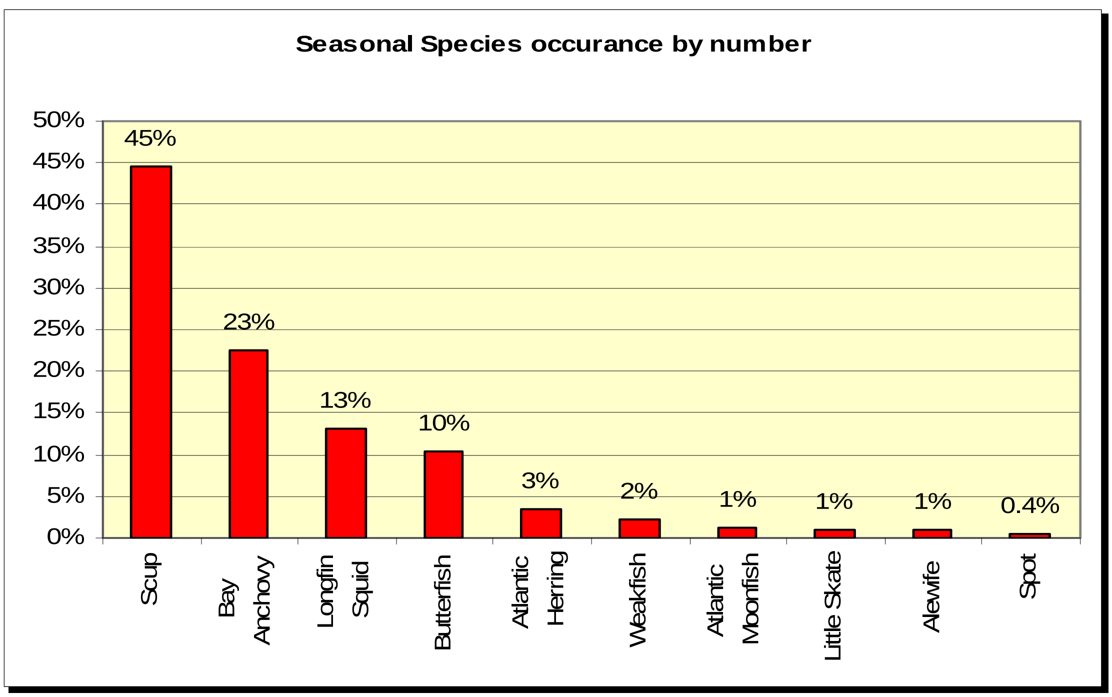
Figure 9 (Total Catch in Kilograms)

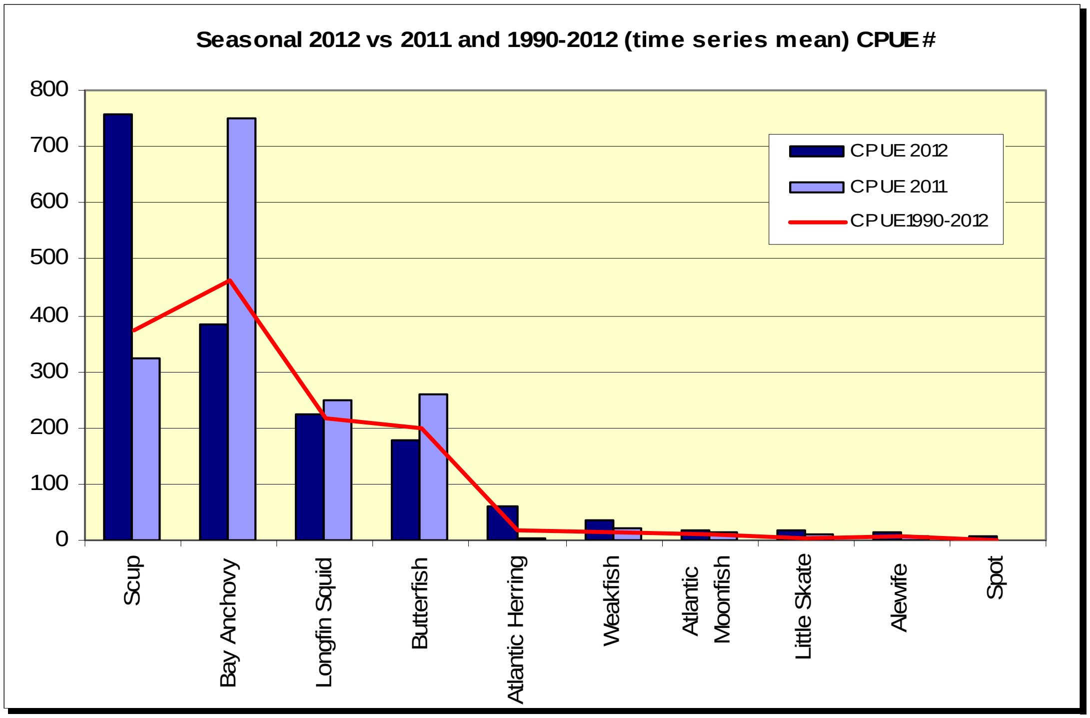
Fish Name	Scientific Name	Total kg
Scup	STENOTOMUS CHRYSOPS	1887.799996
Little Skate	RAJA ERINACEA	1397.494994
Butterfish	PEPRILUS TRIACANTHUS	826.7900016
Longfin Squid	LOLIGO PEALEI	604.4512461
Winter Skate	RAJA OCELLATA	374.199999
Winter Flounder	PLEURONECTES AMERICANUS	229.4950016
Summer Flounder	PARALICHTHYS DENTATUS	196.8500009
Weakfish	CYNOSCION REGALIS	185.1499999
Spot	LEIOSTOMUS XANTHURUS	151.1550021
Bluefish	POMATOMUS SALTATRIX	82.75500073
Smooth Dogfish	MUSTELUS CANIS	77.76000106
Alewife	ALOSA PSEUDOHARENGUS	65.34000066
Horseshoe Crab	LIMULUS POLYPHEMUS	56.30000031
Black Sea Bass	CENTROPRISTIS STRIATA	55.3850001
Bay Anchovy	ANCHOA MITCHILLI	51.35599944
Clearnose Skate	RAJA EGLANTERIA	47.42999923
Striped Searobin	PRIONOTUS EVOLANS	42.88499978
Silver Hake	MERLUCCIUS BILINEARIS	42.14500044
Longhorn Sculpin	MYOXOCEPHALUS OCTODECEMSPINOS	35.98000032
Atlantic Herring	CLUPEA HARENGUS	35.09699962
Ocean Pout	MACROZOARCES AMERICANUS	32.81999946
Red Hake	UROPHYCIS CHUSS	27.03999941
Windowpane Flounder	SCOPHTHALMUS AQUOSUS	20.10499985
American Lobster	HOMARUS AMERICANUS	19.93499999
Northern Kingfish	MENTICIRRHUS SAXATILIS	18.94999992
Northern Searobin	PRIONOTUS CAROLINUS	18.76000032
Atlantic Moonfish	SELENE SETAPINNIS	18.43500076
Yellowtail Flounder	PLEURONECTES FERRUGINEUS	16.31500018
Fourspot Flounder	PARALICHTHYS OBLONGUS	15.29000002
Atlantic Torpedo Ray	TORPEDO NOBILIANA	15.19999981
Spotted Hake	UROPHYCIS REGIA	13.43300011
Tautog	TAUTOGA ONITIS	13.12000018
Round Scad	DECAPTERUS PUNCTATUS	7.609999937
American Shad	ALOSA SAPIDISSIMA	7.175000194
Spiny Dogfish	SQUALUS ACANTHIAS	7.160000086
Goosefish	LOPHIUS AMERICANUS	6.620000035
Channeled Whelk	BUSYCOTYPUS CANALICULATUS	4.730000034
Blue Crab	CALLINECTES SAPIDUS	4.204999968
Rough Scad	TRACHURUS LATHAMI	3.470000017
Sea Raven	HEMITRIPTERUS AMERICANUS	2.899999939
Knobbed Whelk	BUSYCON CARICA	2.784999982
Cunner	TAUTOGOLABRUS ADSPERSUS	1.906000025
Striped Bass	MORONE SAXATILIS	1.210000038
Northern Puffer	SPHOEROIDES MACULATUS	1.090000013
Atlantic Silverside	MENIDIA MENIDIA	0.625000004
Hogchoker	TRINECTES MACULATUS	0.475000001

Sea Scallop	PLACOPECTEN MAGELLANICUS	0.384999999
Blueback Herring	ALOSA AESTIVALIS	0.289999996
Smallmouth Flounder	ETROPUS MICROSTOMUS	0.234999997
Atlantic Menhaden	BREVOORTIA TYRANNUS	0.229999999
Northern Sennet	SPHYRAENA BOREALIS	0.199999997
Mantis Shrimp	SQUILLA EMPUSA	0.169999998
Oyster Toadfish	OPSANUS TAU	0.155000001
American Sand Lance	AMMODYTES AMERICANUS	0.144999995
Crevalle Jack	CARANX HIPPOS	0.059999999
Rainbow Smelt	OSMERUS MORDAX	0.044999999
Round Herring	ETRUMEUS TERES	0.035
Striped Anchovy	ANCHOA HEPSETUS	0.034999999
Atlantc Cutlassfish	TRICHIURUS LEPTURUS	0.015
Rock Gunnel	PHOLIS GUNNELLUS	0.005

Figure 10 Top Ten Species Catch in Number

Fish Name	Scientific Name	%
Scup	STENOTOMUS CHRYSOPS	45%
Bay Anchovy	ANCHOA MITCHILLI	23%
Longfin Squid	LOLIGO PEALEI	13%
Butterfish	PEPRILUS TRIACANTHUS	10%
Atlantic Herring	CLUPEA HARENGUS	3%
Weakfish	CYNOSCION REGALIS	2%
Atlantic Moonfish	SELENE SETAPINNIS	1%
Little Skate	RAJA ERINACEA	1%
Alewife	ALOSA PSEUDOHARENGUS	1%
Spot	LEIOSTOMUS XANTHURUS	0.4%

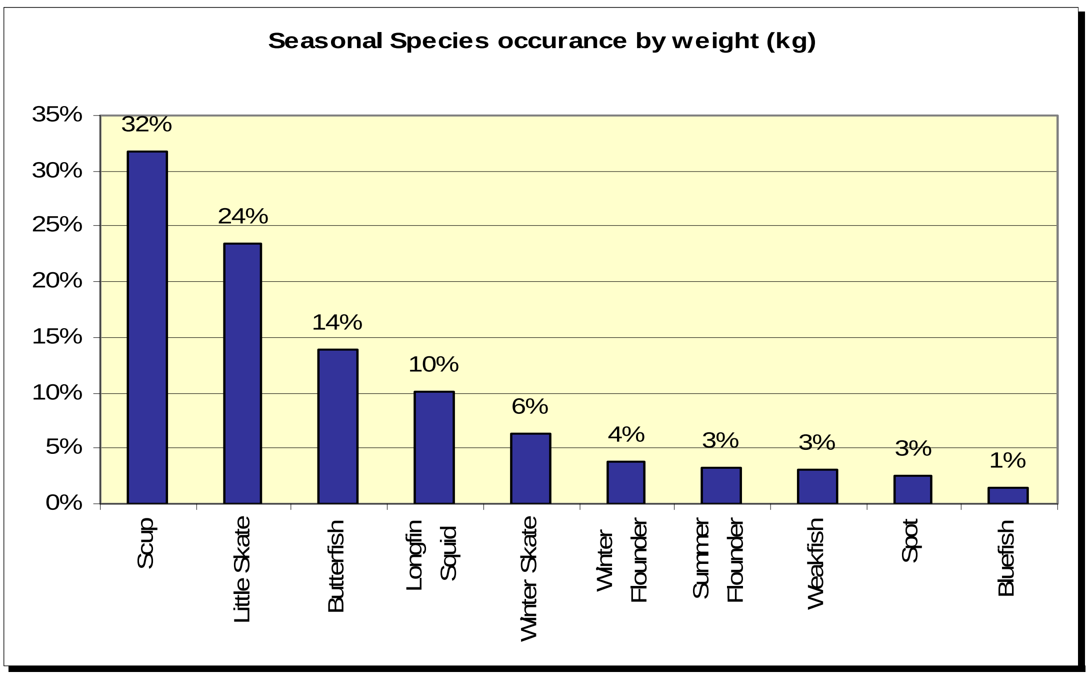


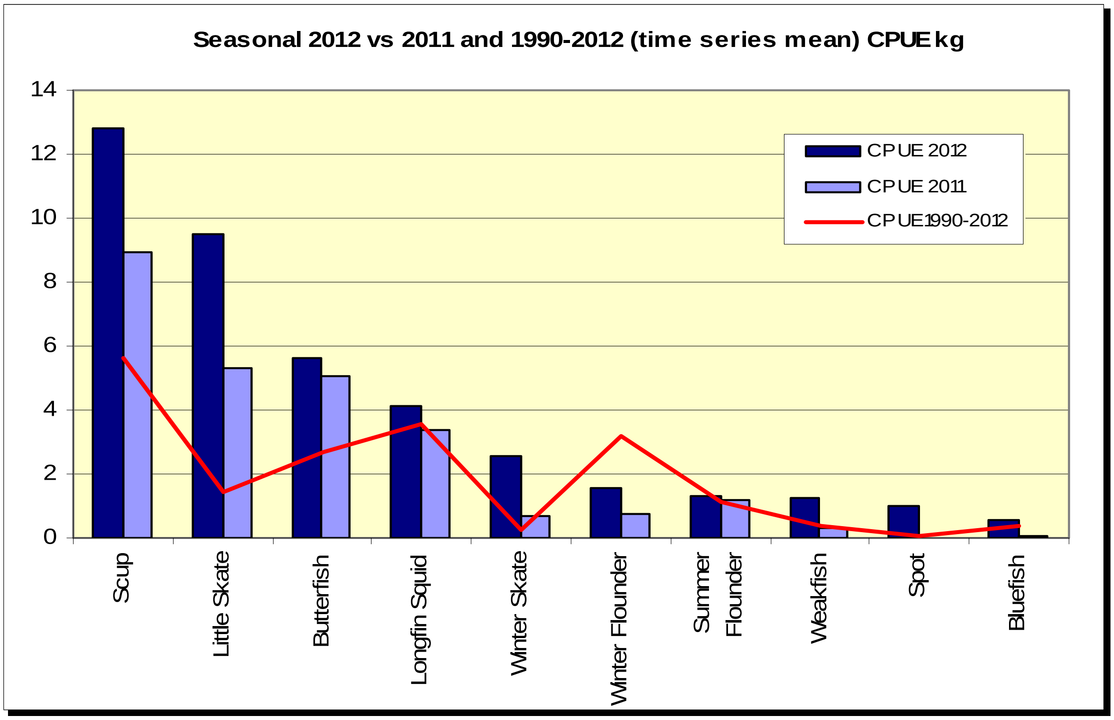


Seasonal 2012 vs 2011 and 1990-2012 (time series mean) CPUE #
800
700
600
500
400
300
200
100
0
CPUE 2012
CPUE 2011
CPUE 1990-2012
Scup
Bay Anchovy
Longfin Squid
Butterfish
Atlantic Herring
Weakfish
Atlantic Moonfish
Little Skate
Alewife
Spot

Figure 11 Top Ten Species Catch in Kilograms

Fish Name	Scientific Name	%
Scup	STENOTOMUS CHRYSOPS	32%
Little Skate	RAJA ERINACEA	24%
Butterfish	PEPRILUS TRIACANTHUS	14%
Longfin Squid	LOLIGO PEALEI	10%
Winter Skate	RAJA OCELLATA	6%
Winter Flounder	PLEURONECTES AMERICANUS	4%
Summer Flounder	PARALICHTHYS DENTATUS	3%
Weakfish	CYNOSCION REGALIS	3%
Spot	LEIOSTOMUS XANTHURUS	3%
Bluefish	POMATOMUS SALTATRIX	1%





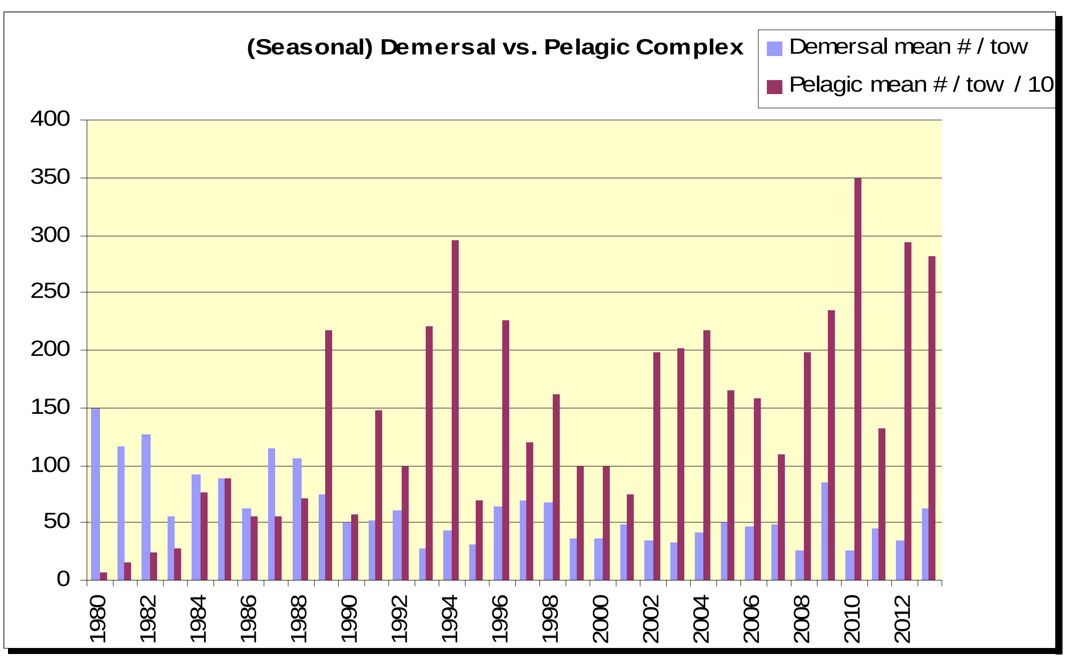
Seasonal 2012 vs 2011 and 1990-2012 (time series mean) CPUE kg
14
12
10
8
6
4
2
0
CPUE 2012
CPUE 2011
CPUE1990-2012
Scup
Little Skate
Butterfish
Longfin Squid
Winter Skate
Winter Flounder
Summer Flounder
Weakfish
Spot
Bluefish

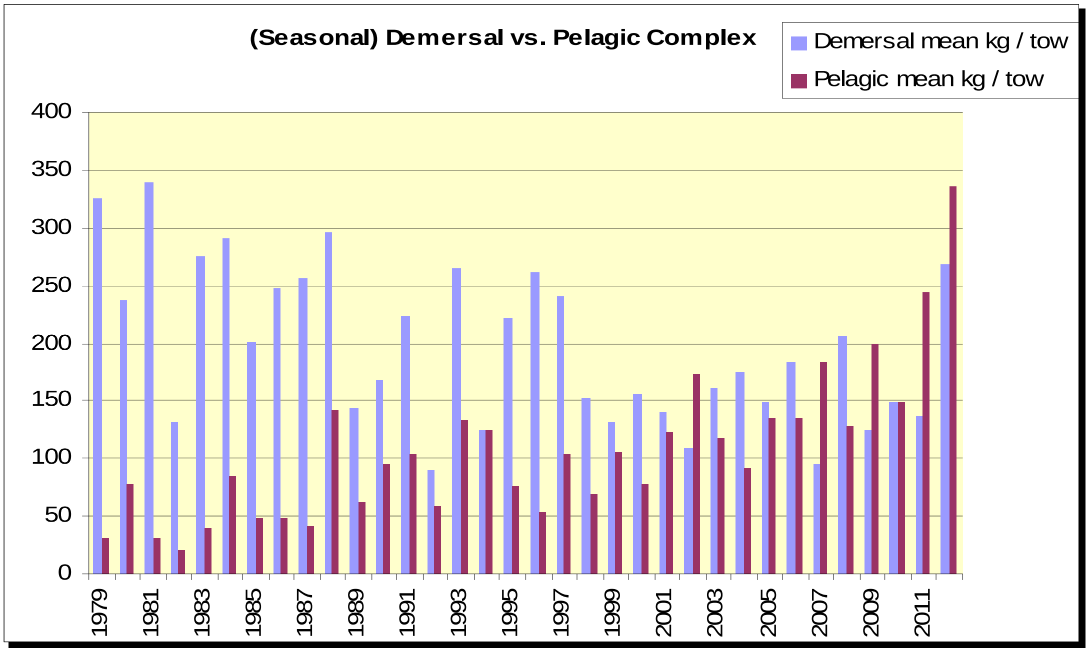
Demersal vs. Pelagic Species Complex

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

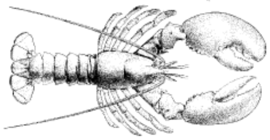
Pelagic/Multi-Habitat Species
Atlantic Herring
Alewife
Blueback Herring
Shad
Menhaden
Bay Anchovy
Rainbow Smelt
Silverside
Butterfish
Atlantic Moonfish
Bluefish
Striped Bass
Black Sea Bass
Scup
Weakfish
Longfin Squid

Figure 12 and 13



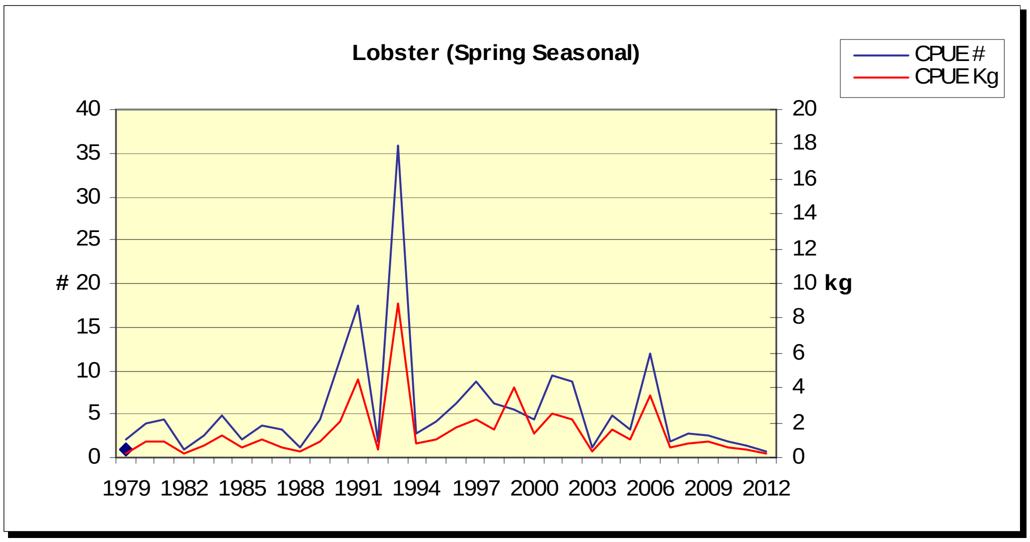

(Seasonal) Demersal vs. Pelagic Complex
Demersal mean kg / tow
Pelagic mean kg / tow
400
350
300
250
200
150
100
50
0
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011

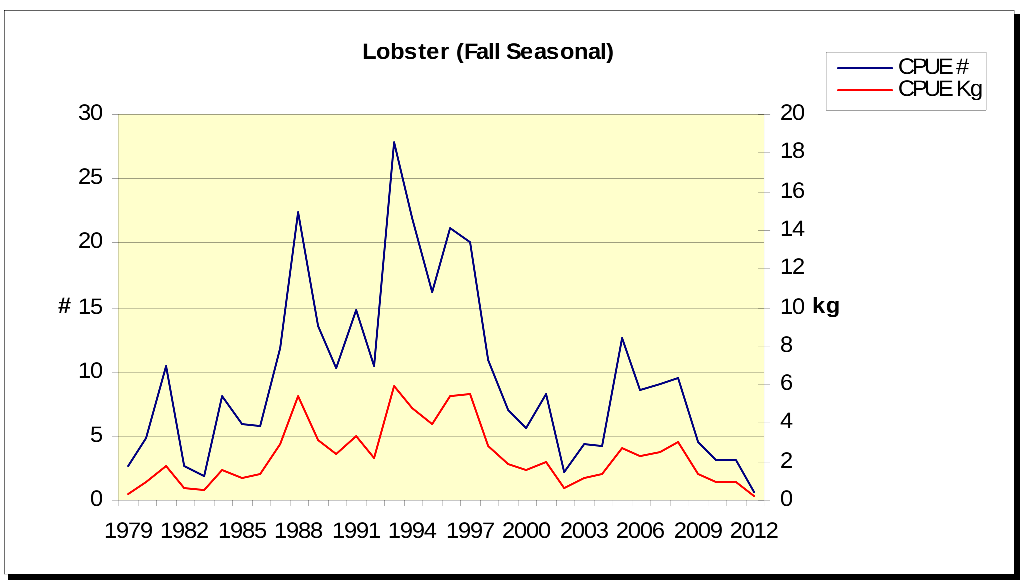
The following species represented are of high importance and are currently managed under fishery management plans through the Atlantic States Marine Fisheries Commission, New England Fishery Management Council, or the National Marine Fisheries Service. The seasonal portion of the Rhode Island Coastal 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***

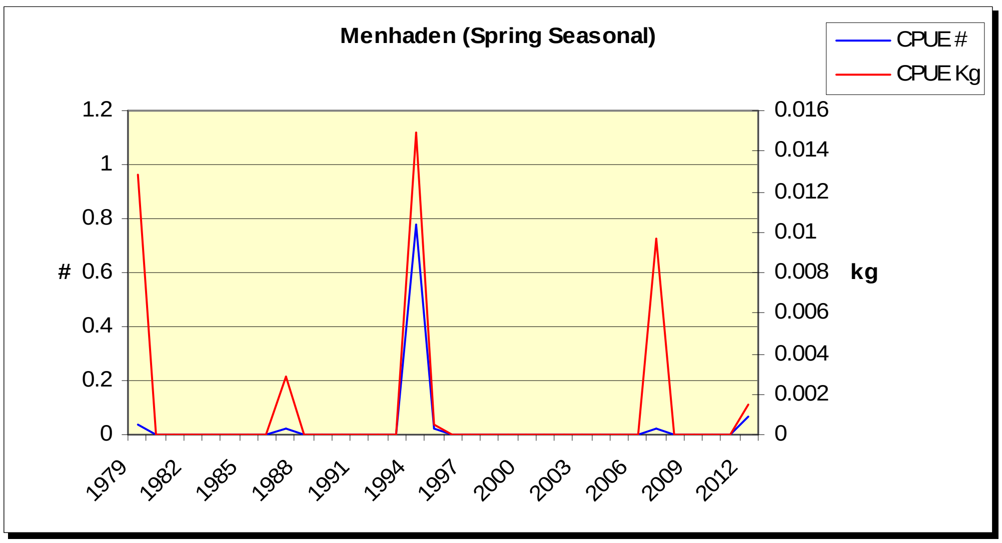
Stock Status: Southern New England Stock: overfished. Depleted Poor condition.
Management: ASMFC Amendment III, Addendum XX

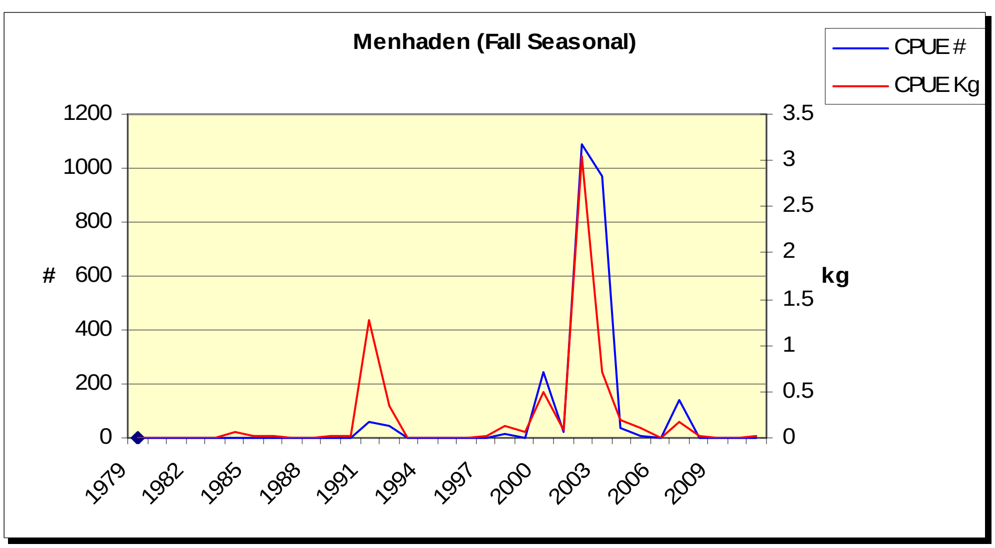




Atlantic Menhaden ***Brevoortia tyrannus***

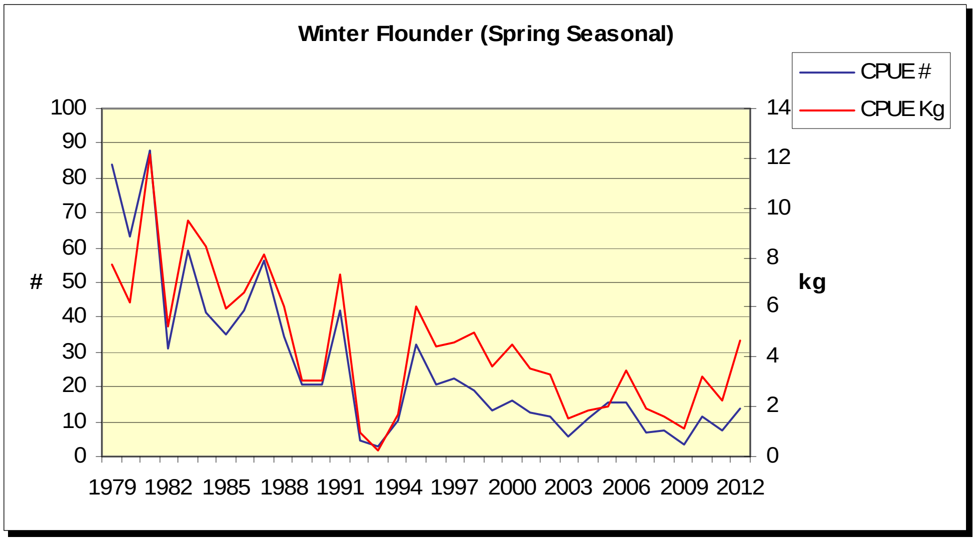
Stock Status: Not Overfished but overfishing is occurring.
Management: ASMFC Amendment II

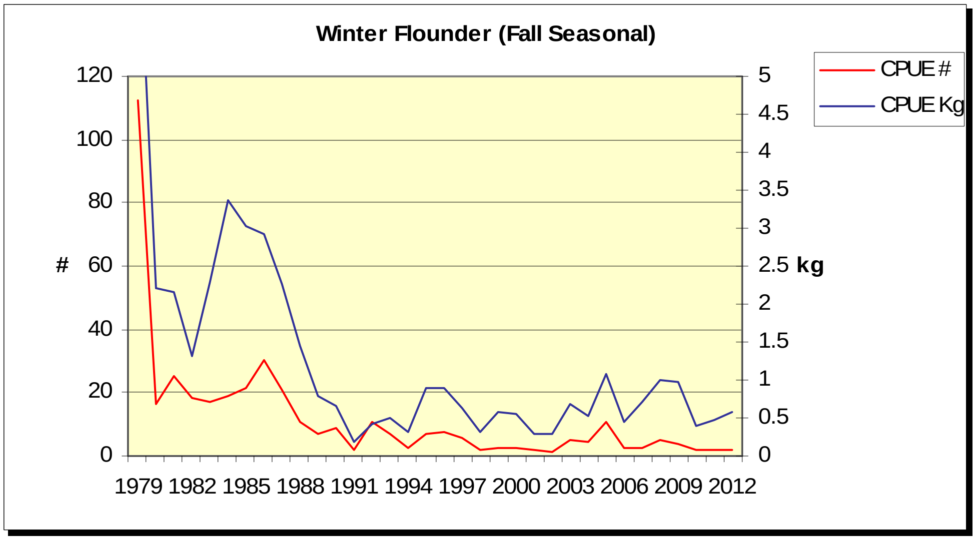




Winter Flounder ***Pleuronectes americanus***

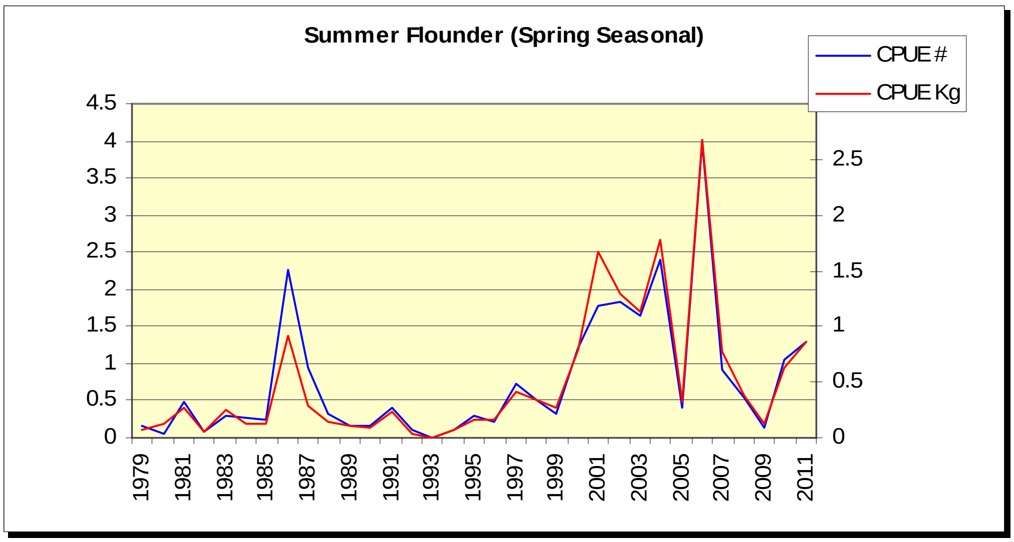
Stock Status: Overfished but overfishing is not occurring.
Management: ASMFC Amendment I, Addendum II

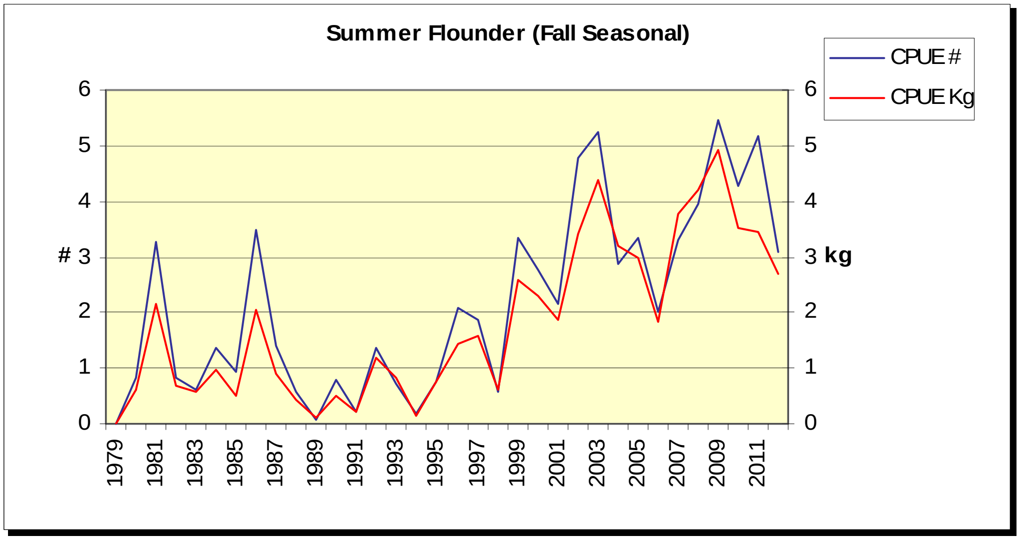




Summer Flounder ***Paralichthys dentatus***

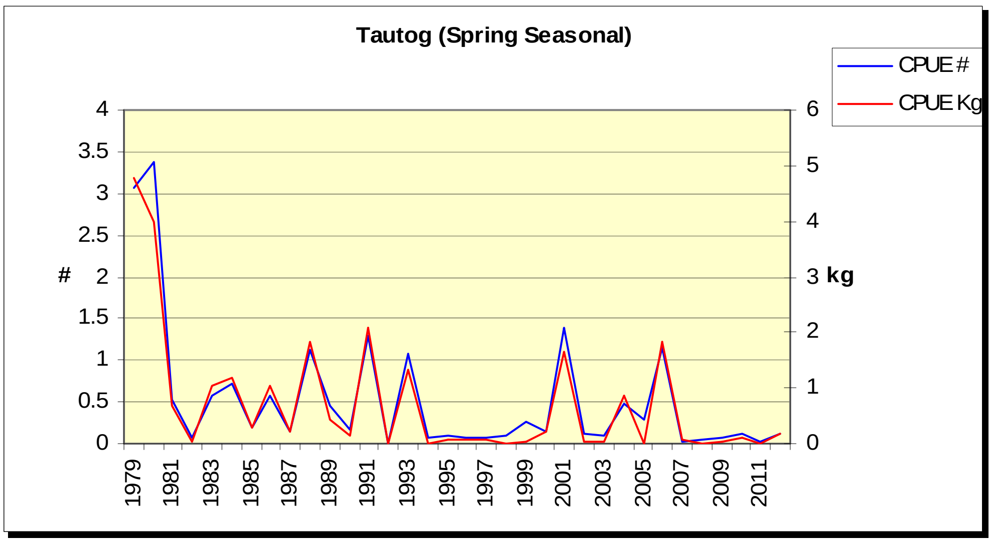
Stock Status: Not overfished and overfishing is not occurring.
Management: ASMFC Amendment XV Addendum XXIII

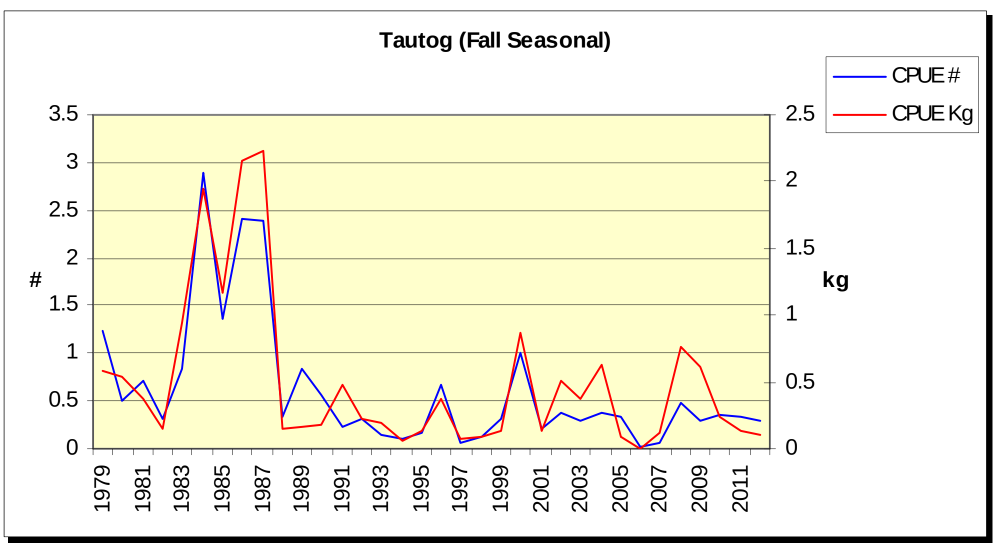


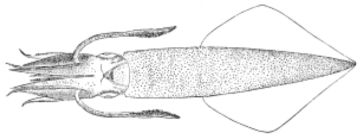


Tautog ***Tautoga onitis***

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

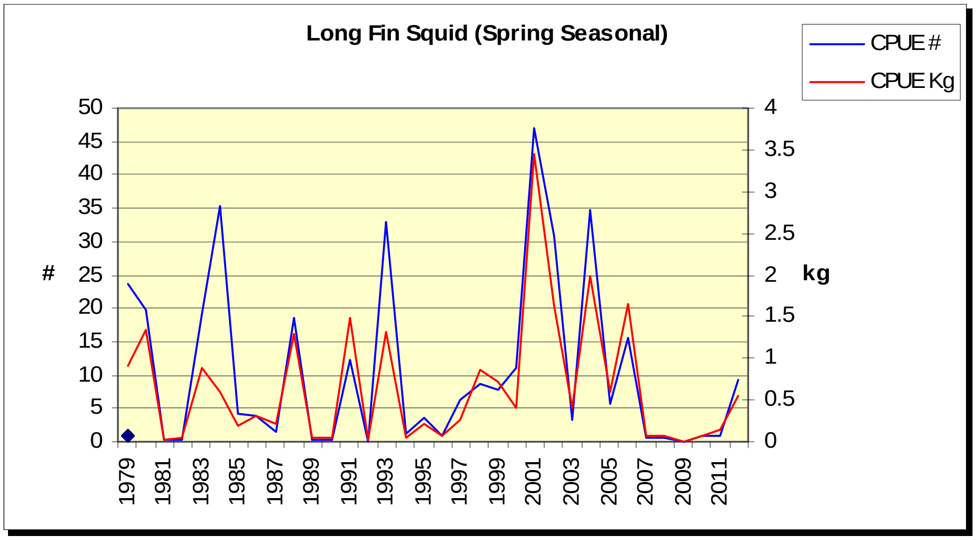


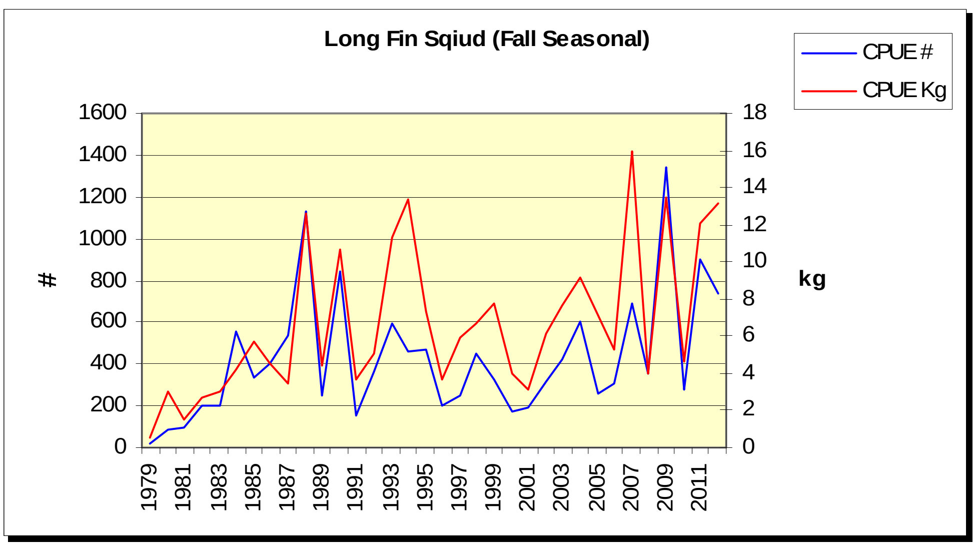


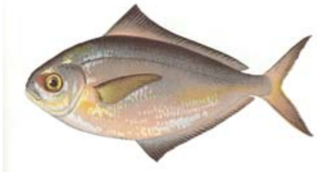


Longfin Squid ***Loligo pealei***

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

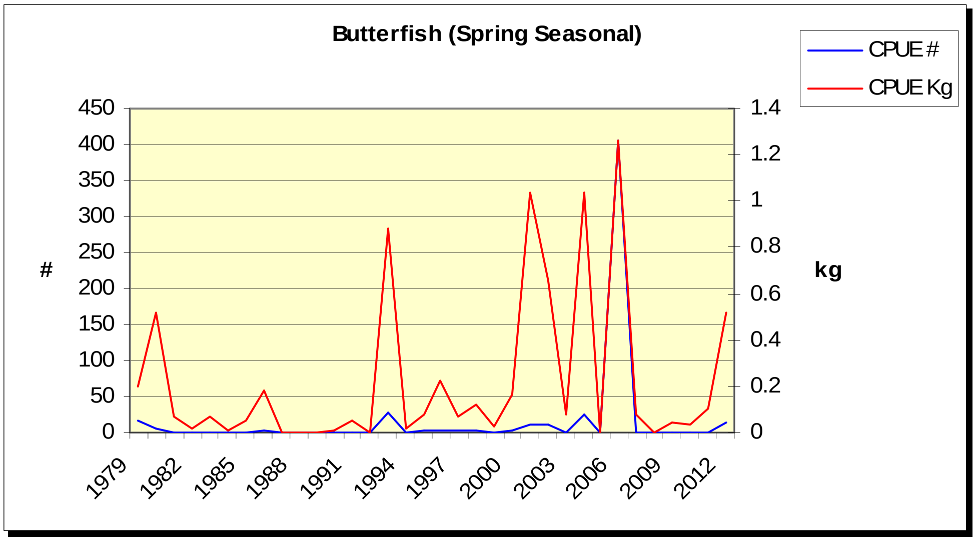


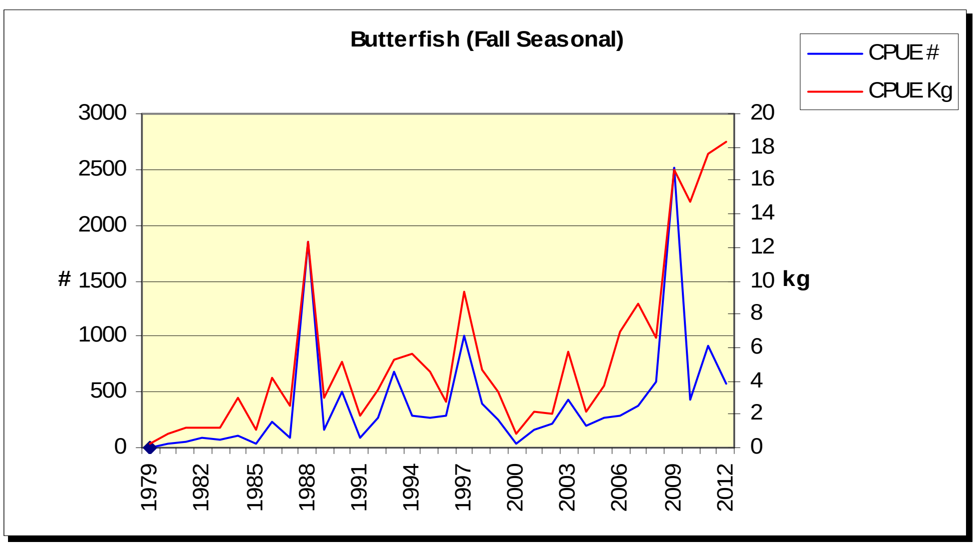




Butterfish ***Peprlilus triacanthus***

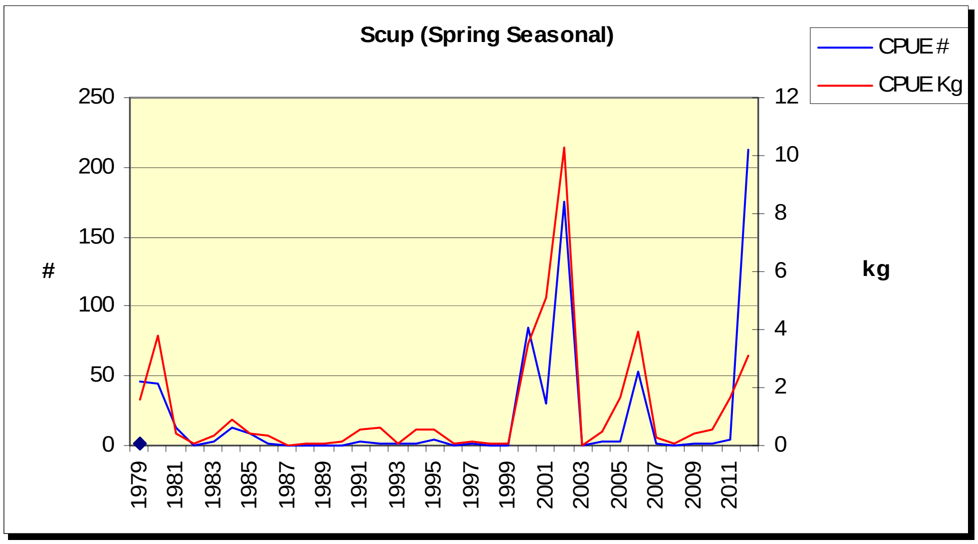
Stock Status: Variable / Uncertain
Management: Mid Atlantic Fishery Management Council, Atlantic Mackerel, Squid Butterfish FMP, ACL

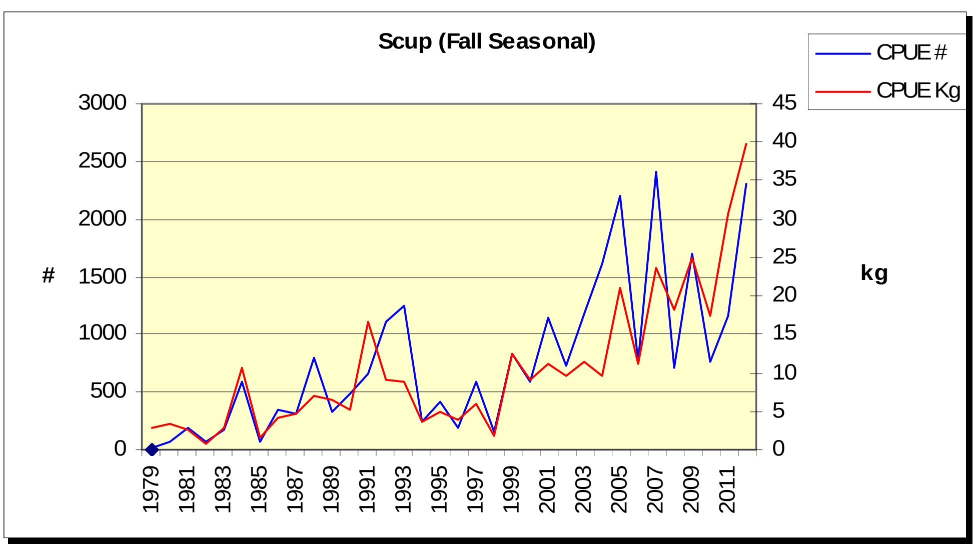




Scup ***Stenotomus chrysops***

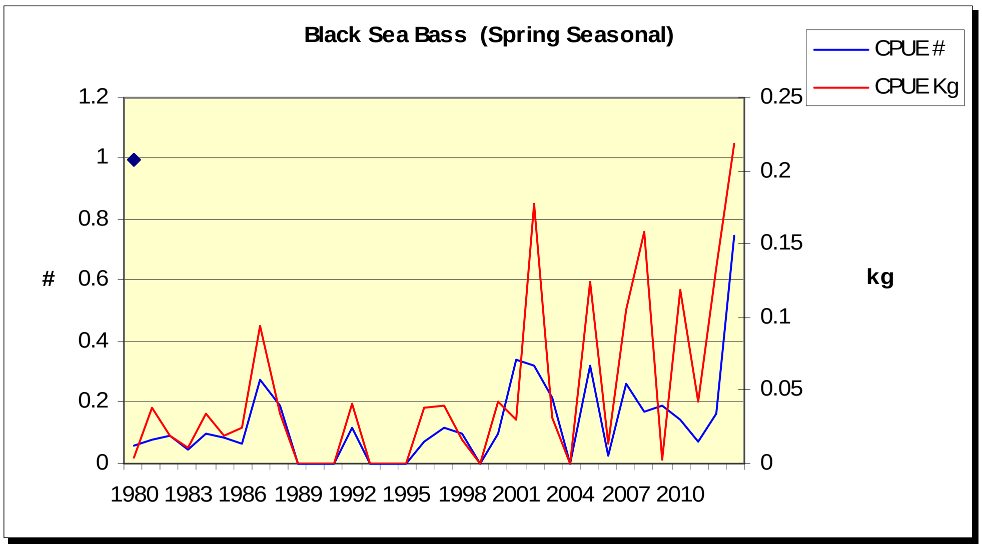
Stock Status: Rebuilt, overfishing is not occurring
Management: ASMFC Amendment XIIV, Addendum XXII, Summer Flounder, Scup Black Sea Bass FMP

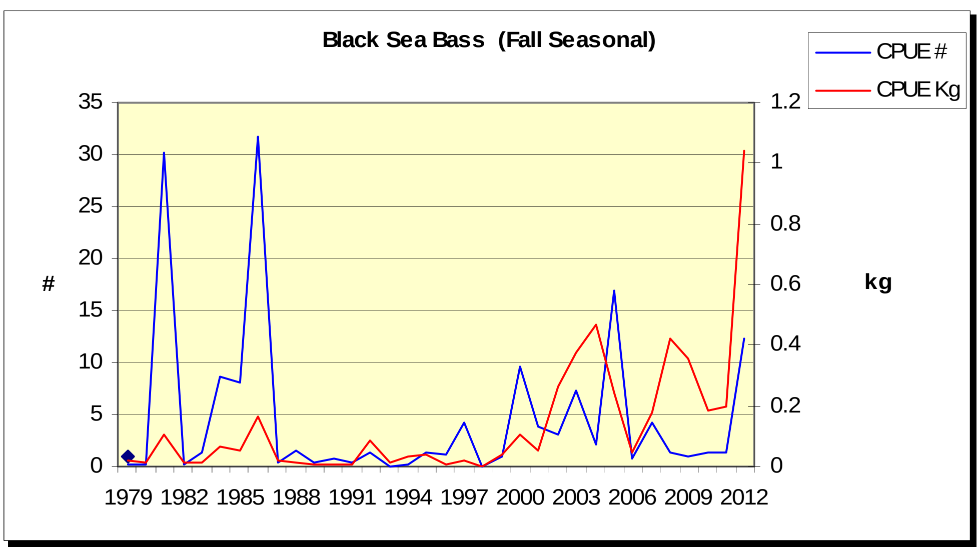




Black Sea Bass ***Centropristis striata***

Stock Status: Rebuilt, overfishing is not occurring
Management: ASMFC Amendment XIIV, Addendum XXIII





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Lynch, Timothy R. 2007. Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters, Coastal Fishery Resource Assessment, Performance Report.

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
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Principal Biologist (Marine Fisheries)
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Division of Fish and Wildlife
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Federal Aid in Sportfish Restoration
F-61-R

Performance Report – Job#3 March 2012

Performance Report

State: Rhode Island

Project Number: F-61-R
Segment Number: 20

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

Period Covered: January 1, 2012 – December 31, 2012

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 2012, Investigators caught 49 species of finfish representing 32 families. This number is similar to the 47 species from 30 families that were collected during 2011. Additionally, the numbers of individuals landed in 2012 increased slightly from the 2011 survey; 20225 collected in 2012 and 20003 collected in 2011.

Target Date: 2013

Status of Project: On Schedule

Significant Deviations: There were no significant deviations in 2012.

Recommendations: Continue into the next segment with the project as currently designed; continue at each of the 24 sample stations. The new stations added 2011 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 2012, 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 stations added during 2011 are displayed in figures 1-3. 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 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 head rope. 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.

Results and Discussion:

Winter Flounder (*Pseudopleuronectes americanus*)

Juvenile winter flounder were collected at 23 out of 24 stations over the course of the season. Winter flounder ranked fourth in overall species abundance (n=1776) in 2012, with the highest mean abundance, fish/seine haul, occurring in June (Table 1). This is a departure from the usual expected pattern of highest index values occurring in July. Several of the ponds had their highest values in May and June including Winnipaug, Point Judith, Potter, Green Hill, and the Pawcatuck river. Quonochontaug, Charlestown, and Narrow river had their greatest mean abundance in July. It should be noted that the index for Quonochontaug was high in May and June as well. The greatest numbers of winter flounder in one haul were captured in June at Winnipaug pond station number 1 where 171 individuals were captured.

During 2012, 1,776 winter flounder were collected, up from the 2,021 collected in 2011. The juvenile winter flounder abundance index (YOY WFL index) for the survey measured using the mean fish/seine haul decreased from 18.04 fish/seine haul in 2011 to 16.32 fish/seine haul in 2012. 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 2012 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.

Winnipaug , Quonochontaug, and Point Judith Ponds trended upward in 2012. While Charlestown pond and Narrow river trended downward. Narrow river experienced its lowest index value since the inception of the survey which is notable as it is usually one of the more heavily populated YOY winter flounder water bodies. The mixed signals from the individual ponds all shared one characteristic in 2012. After the month of July YOY winter flounder numbers in each of the ponds drastically declined and never returned for the rest of the sampling season (figure 5b). These results indicate that 2012 recruitment from the coastal ponds will not be strong. 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 downward YOY trend in 2012 is mirrored in the Narragansett Bay Seine Survey. The crash in YOY WFL numbers was also observed in Narragansett Bay V(McNamee Pers Comm). The spring Trawl Survey WFL index continued to rise, 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 then went back down in 2012 to 5.27, the second lowest value recorded in the time series. 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 but rebounded again in 2012 to 13.86 WFL per tow.

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 and 2012 , the over all YOY WFL index in Point Judith pond has increased increased to 5.96 WFL per haul in 2012. This increase in abundance might reflect the recent no possession rule in the pond as well as the coast wide closure. Again it is important to note that the YOY WFL population in Point Judith Pond crashed in August and did not recover. 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 2012, juvenile winter flounder ranged in size from 2 to 36 cm, representing age groups 0-3+. Only two adult flounder (age 3+) were caught during the 2012 survey. The size range of animals collected is similar to those caught from 2004 through 2011 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, 2 to 18, and 2 - 35 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 2012, 99.16% 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 in years past have displayed two peaks in average size for YOY WFL suggesting two cohorts or a protracted spawning event. This result was not clearly observed in the Coastal Pond Survey and is best observed in 2012 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 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 July . In 2012 Potter pond had WFL caught in August – October while Green Hill pond had no WFL caught after June. 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 (5 cm verses 4 cm respectively) suggesting 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 slightly higher average temperatures and is located in an area with low tidal flushing. The dissolved oxygen recorded in August (5.39 mg/L) at Potter's Pond station 1 was the lowest recorded on the survey in 2012. 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 added 2010, still 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)*
Fifty five bluefish were collected in June, July, August, and September and occurred in Narrow River, Point Judith, Potter, Pawcatuck River, Charlestown, Green Hill and Quonochontaug Ponds. This is a decrease from the 176 fish caught in 2011 and higher than the 17 individuals captured during 2010. The abundance index for 2012 was 0.30 fish/seine similar to the 2011 value of 0.29 fish/seine and higher than the value of 0.13

fish/seine haul observed in 2010. Table 4 contains the abundance indices for the survey by month and pond. Bluefish ranged in size from 6 cm to 21 cm. No adult bluefish were caught in 2012. Figure 18 displays the annual abundance index of bluefish for all stations combined.

Tautog (*Tautoga onitis*)

One hundred fifteen tautog were collected between May and October in each of the ponds except Quonochontaug, Green Hill and Potter's ponds. It is unusual to not catch YOY tautog in Quonochontaug pond for an entire sampling season. This is a increase from the 2011 catch of 76 individuals. The total survey 2012 abundance index was 0.90 fish/seine haul up slightly from the 2011 abundance index of 0.74 fish/seine haul. Table 5 contains the abundance indices for the survey by month and pond. The highest abundances in 2012 occurred in Charlestown Pond. Tautog caught in 2012 ranged in size from 1 cm to 13 cm. Figure 19 displays the annual abundance index of tautog for all stations combined.

Black Sea Bass (*Centropristis striata*)

A total of 398 juvenile black sea bass were collected during May, August, September, and October from each of the ponds except Green Hill and Potter's Pond in 2012. This is much more than the 97 fish that were caught in 2011 and much higher than the 7 fish collected in 2010. The highest abundances were found in Charlestown Pond. The total survey 2012 abundance index was 4.14 fish/seine haul up considerably from the 2011 abundance index of 0.85 fish/seine haul and well above the 2010 value of 0.07 fish/ seine haul. Although the population in the ponds has been trending upwards, the high BSB index value of 2012 represents the highest value on record for coastal pond survey. BSB abundance throughout state waters was historically high (McNamee, pers comm.). Table 5 contains the abundance indices for the survey by month and pond. Black sea bass caught in 2012 ranged in size from 1 cm to 14 cm. Figure 20 displays the annual abundance index of black sea bass for all stations combined.

Scup *(Stenotomus chrysops)*

One hundred and six scup were collected during the 2012 in June, July, August, and September in Charlestown, Quonochontaug, Winnipaug, Pawcatuck River and Point Judith Ponds much higher than to the 3 caught in 2011. The total survey abundance index was 0.97 fish per haul. Table 7 contains the abundance indices for the survey by month and pond. Scup caught in 2012 ranged in size from 3 cm to 10 cm. Figure 21 displays the annual abundance index of scup for all stations combined.

Clupeids:

In 2012 four species of clupeids were caught in the coastal pond survey, Atlantic menhaden (*Brevoortia tyrannus*), Atlantic herring (*Clupea harengus*), Blueback herring (*Alosa Aestivalis*) and Alewife (*Alosa pseudoharengus*). Two hundred and seventy seven alewives were captured in Narrow River, Charlestown, Point Judith, Potter, Pawcatuck River, and Winnipaug Ponds between May and September. The total survey abundance was 1.92 fish / seine haul. One thousand five hundred fifty three Atlantic menhaden were caught in all of the ponds sampled between August and

September during 2012. The total survey abundance was 10.78 fish /seine haul. There were several schools of YOY menhaden captured in 2012. One Atlantic herring was collected in Point Judith Pond during June. The total survey abundance was 0.01 fish / seine haul. One thousand seven hundred eighty eight blueback herring were caught in Point Judith pond and Pawcatuck river during July. The index of abundance for 2012 was 12.42 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 on a separate axis for scale issues.

Baitfish Species:

Atlantic Silversides *(Menidia sp.)*

Silversides had the highest abundance of all species with 7917 caught during the 2012 survey, down compared to the 9453 silversides collected in 2011. Silversides were collected in each of the ponds throughout the time period of the survey (May – October). The highest abundances were observed in Pawcatuck river. The total survey abundance index was 54.98 fish / seine haul. Table 9 contains the abundance indices for the survey by month and pond. Atlantic silversides caught in 2012 ranged in size from 2 cm to 13 cm.

Striped Killifish *(Fundulus majalis)*

Striped killifish ranked fifth in species abundance with 1696 fish caught during 2012. This the higher than the 1765 fish caught during 2011. They occurred in each of the ponds and were caught each month during the survey. Point Judith Pond had the highest abundance of striped killifish. The total survey abundance index was 11.78 fish / seine haul. Table 10 contains the abundance indices for the survey by month and pond. Striped killifish caught in 2012 ranged in size from 2 cm to 13 cm.

Common Mummichog *(Fundulus heteroclitus)*

The mummichog was second in overall abundance in 2012 with 1,929 individuals collected. This value is an dencrease from 3,070 mummichogs collected in 2011. 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 13.40 fish / seine haul. Table 11 contains the abundance indices for the survey by month and pond. Mummichogs caught in 2012 ranged in size from 2 cm to 11 cm.

Sheepshead Minnow *(Cyprinodon variegatus)*

The Sheepshead minnow ranked seventh in overall abundance with 636 individuals collected. This is a increase from the 446 fish caught in 2011. Sheepshead minnow occurred in each of the ponds and were caught each month during the survey. Point Judith Pond had the highest abundances of Sheepshead minnows. The total survey abundance index was 4.42 fish / seine haul. Table 12 contains the abundance indices for the survey by month and pond. Sheepshead minnow caught in 2012 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 2012 Coastal Pond Survey is summarized in tables 13 – 15. Water temperature in 2012 averaged 20.9 ºC, with a range of 13.7ºC in May to 28.4 ºC in August. Salinity ranged from 0.5 ppt to 29.56 ppt, and averaged 25.3 ppt. Dissolved oxygen ranged from 15.08 mg/l to 4.5 mg/l, with an average of 8.41 mg/l.

New Station Preliminary Data
This year was the second year of sampling the three additional ponds. On a whole te samples were consistent with 2011. A brief description of each pond follows.
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 during 2011, 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. 2012 was similar except that fewer winter flounder were caught and they did not return after leaving in June. Other species frequently present in the pond are the baitfish species, naked goby, and blue crabs.
Potter Pond: Potter 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 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 have been caught at both stations but only PP – 1 with high frequency. Similarly to the Green Hill during both 2011 and 2012, 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. Interestingly, both 2011 and 2012 had small catches of 1 year old flounder at station PP-1 during the late summer and early fall. 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 2011, 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. The station was sampled in all 6 months during 2012. 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, alewife, 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. 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 two years 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 2012, Investigators caught 49 species of finfish representing 32 families. This number is similar to the 47 species from 30 families that were collected during 2011. Additionally, the numbers of individuals landed in 2012 increased slightly from the 2011 survey; 20225 collected in 2012 and 20003 collected in 2011. 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: 2012 Coastal Pond Survey Winter Flounder Frequency by station and month

Station	May	Jun	Jul	Aug	Sep	Oct	Totals	Mean	STD
CP1	6	5	77	14	8	10	**120**	**20.00**	**28.11**
CP2	21	38	9	5	0	0	**73**	**18.25**	**14.82**
CP3	7	11	34	7	2	1	**62**	**10.33**	**12.16**
CP4	0	0	0	0	1	0	**1**	**1.00**	
GH1	1	1	0	0	0	0	**2**	**1.00**	**0.00**
GH2	2	0	0	0	0	0	**2**	**2.00**	
NR1	4	4	1	1	0	0	**10**	**2.50**	**1.73**
NR2	1	35	74	23	4	3	**140**	**23.33**	**28.25**
NR3	6	6	36	2	0	0	**50**	**12.50**	**15.78**
PJ1	1	9	2	0	0	0	**12**	**4.00**	**4.36**
PJ2	15	20	5	2	1	0	**43**	**8.60**	**8.44**
PJ3	1	0	3	1	0	0	**5**	**1.67**	**1.15**
PJ4	70	12	1	0	0	0	**83**	**27.67**	**37.07**
PP1	16	6	0	5	1	4	**32**	**6.40**	**5.68**
PR1	23	13	33	3	2	4	**78**	**13.00**	**12.66**
PR2	1	4	0	0	1	1	**7**	**1.75**	**1.50**
PR3	0	0	0	1	1	3	**5**	**1.67**	**1.15**
QP1	67	32	32	3	0	2	**136**	**27.20**	**26.70**
QP2	1	73	92	3	0	2	**171**	**34.20**	**44.61**
QP3	103	68	63	0	0	1	**235**	**58.75**	**42.41**
WP1	15	171	37	21	20	2	**266**	**44.33**	**63.07**
WP2	82	29	26	1	3	0	**141**	**28.20**	**32.69**
WP3	0	91	5	2	4	0	**102**	**25.50**	**43.68**
Totals	**443**	**628**	**530**	**94**	**48**	**33**			
Mean	**22.15**	**33.05**	**31.18**	**5.88**	**4.00**	**3.00**			
STD	**31.40**	**42.36**	**29.65**	**7.10**	**5.44**	**2.57**			

Table 2: 2012 Coastal Pond Survey winter flounder abundance indices (fish/seine haul) by pond and month

Pond	May	Jun	Jul	Aug	Sep	Oct
Charlestown Pond	8.5	13.5	30.0	6.5	2.8	2.8
Green Hill Pond	1.5	0.5	0.0	0.0	0.0	0.0
Narrow River	3.7	15.0	37.0	8.7	1.3	1.0
Point Judith Pond	21.8	10.3	2.8	0.8	0.3	0.0
Potter's Pond	8.0	3.0	0.0	2.5	0.5	2.0
Pawcatuck River	12.0	5.7	11.0	1.3	1.3	2.7
Quonochontaug Pond	57.0	57.7	62.3	2.0	0.0	1.7
Winnipaug Pond	32.3	97.0	22.7	8.0	9.0	0.7
Total	**18.5**	**26.2**	**22.1**	**3.9**	**2.0**	**1.4**

Table 3: 2012 Coastal Pond Survey average lengths of juvenile winter flounder by pond and month.

Pond	May	Jun	Jul	Aug	Sep	Oct
Charlestown Pond	6.1	6.1	6.2	7.4	7.9	8.0
Green Hill Pond	5.0	4.6				
Narrow River	4.0	4.8	4.9	5.3	5.7	8.4
Point Judith Pond	4.3	5.8	7.0	6.2	5.5	
Potter's Pond	6.2	8.5		11.3	10.0	17.5
Pawcatuck River	4.3	5.6	5.7	7.0	6.2	11.5
Quonochontaug Pond	4.3	4.7	5.4	6.6		10.1
Winnipaug Pond	3.4	5.2	5.8	5.6	6.3	5.4

Table 4: 2012 Coastal Pond Survey bluefish abundance indices (fish/seine haul) by pond and month.

Pond	May	Jun	Jul	Aug	Sep	Oct
Charlestown Pond	0	0	0	0	0.25	0
Green Hill Pond	0	1.5	0	0	0.5	0
Narrow River	0	0	1	2.67	0	0
Point Judith Pond	0	1.25	0	0.25	1.75	0
Potter's Pond	0	0	0.5	0	0	0
Pawcatuck River	0	1	2	2.67	0.67	0
Quonochontaug Pond	0	0	0.33	1	0	0
Winnipaug Pond	0	0	0	0	0	0
Total pond index	**0**	**0.46**	**0.54**	**1.12**	**0.46**	**0**

Table 5: 2012 Coastal Pond Survey tautog abundance indices (fish/seine haul) by pond and month

Pond	May	Jun	Jul	Aug	Sep	Oct
Charlestown Pond	0.5	0.5	4	9.25	0.5	0
Green Hill Pond	0	0	0	0	0	0
Narrow River	0	0	0	1	0.67	0
Point Judith Pond	1.75	0.25	1.25	0.25	0.5	0
Potter's Pond	0	0	0	0	0	0
Pawcatuck River	0	0.33	4	3	2	0.33
Quonochontaug Pond	0	0	0	0	0	0
Winnipaug Pond	0	0	2	0	0	0
Total pond index	**0.38**	**0.17**	**1.63**	**2.08**	**0.5**	**0.04**

Table 6: 2012 Coastal Pond Survey black sea bass abundance indices (fish/seine haul) by pond and month

Pond	May	Jun	Jul	Aug	Sep	Oct
Charlestown Pond	0.5	0	3.5	27.75	13.75	1.5
Green Hill Pond	0	0	0	0	0	0
Narrow River	0	0	0.33	13.67	2.67	0.33
Point Judith Pond	0.5	0.25	0.75	2.5	2.25	0
Potter's Pond	0	0	0	0	0	0
Pawcatuck River	0	0	0	1.67	0	0
Quonochontaug Pond	0	0	0	23.33	7.33	0.67
Winnipaug Pond	0	0	0	0.67	12.67	0
Total pond index	**0.17**	**0.04**	**0.75**	**9.96**	**5.5**	**0.38**

Table 7: 2012 Coastal Pond Survey Scup abundance indices (fish/seine haul) by pond and month

Pond	May	Jun	Jul	Aug	Sep	Oct
Charlestown Pond	0	0	0	8	0.25	0
Green Hill Pond	0	0	0	0	0	0
Narrow River	0	0	0	0	0	0
Point Judith Pond	0	0.25	0	2	0.5	0
Potter's Pond	0	0	0	0	0	0
Pawcatuck River	0	0	1.67	1.67	1	0
Quonochontaug Pond	0	0	5.33	10	0	0
Winnipaug Pond	0	0	0.33	0.67	0	0
Total pond index	**0**	**0.04**	**0.92**	**3.21**	**0.25**	**0**

Table 8: 2012 Coastal Pond Survey Clupeid abundance indices (fish/seine haul) by month

Species	May	Jun	Jul	Aug	Sep	Oct
Alewife	0.04	3.29	5.42	0.04	2.75	0
Atlantic Menhaden	0	0	0	62.92	1.79	0
Atlantic Herring	0	0.04	0	0	0	0
Blueback Herring	0	0	74.5	0	0	0

Table 9: 2012 Coastal Pond Survey Atlantic Silverside abundance indices (fish/seine haul) by pond and month

Pond	May	Jun	Jul	Aug	Sep	Oct
Charlestown Pond	2	48.75	14	25.75	211.25	91
Green Hill Pond	35.5	2	18.5	12.5	40	10
Narrow River	84.67	2.33	7	299	72.33	10.67
Point Judith Pond	34.5	12	169.5	94.5	50.75	14.5
Potter's Pond	17.5	23	2.5	4.5	7	14.5
Pawcatuck River	33.33	9.33	36.67	344.33	12.33	3.67
Quonochontaug Pond	142	139	71.33	66.67	44.67	0.67
Winnipaug Pond	32.67	6.33	28	18.33	14.33	9.67
Total pond index	**47.08**	**31.83**	**50.21**	**112.5**	**65.54**	**22.71**

Table 10: 2012 Coastal Pond Survey Striped Killifish abundance indices (fish/seine haul) by pond and month

Pond	May	Jun	Jul	Aug	Sep	Oct
Charlestown Pond	0.5	3	6	58.5	19.75	33
Green Hill Pond	5.5	0	0	3.5	0	9
Narrow River	0	0	0	0	5.67	0.33
Point Judith Pond	5.75	6.25	134.75	0.75	32.5	7.25
Potter's Pond	2	4.5	1	0	0	0
Pawcatuck River	3	0	0.67	26.67	0.67	7.33
Quonochontaug Pond	0	3	6	35	3.67	21.33
Winnipaug Pond	0.67	0	3.67	2.33	17.67	0
Total pond index	**2.12**	**2.29**	**24.83**	**18.17**	**12.17**	**11.08**

Table 11: 2012 Coastal Pond Survey Mumichog abundance indices (fish/seine haul) by pond and month

Pond	May	Jun	Jul	Aug	Sep	Oct
Charlestown Pond	6.5	9.75	15.25	7.75	0.5	2.25
Green Hill Pond	13.5	0	3.5	2	0	0
Narrow River	153.33	21	3.33	0	5.33	2
Point Judith Pond	10	19.5	9.25	1	3	1
Potter's Pond	111.5	8	36.5	18	0	1
Pawcatuck River	0.33	0	0	10.33	0	0.67
Quonochontaug Pond	14.67	17.67	7.33	47	0	0.33
Winnipaug Pond	37.33	47.33	19	1	11.33	0
Total pond index	**38.88**	**16.29**	**11.12**	**10.42**	**2.67**	**1**

Table 12: 2012 Coastal Pond Survey Sheepshead Minnow abundance indices (fish/seine haul) by pond and month

Pond	May	Jun	Jul	Aug	Sep	Oct
Charlestown Pond	6	1.25	2.25	2.75	2.75	1.5
Green Hill Pond	0.5	0	0	0	0	0.5
Narrow River	2.33	1.33	0	0	8	6
Point Judith Pond	0.25	0.25	0	0	113.75	0
Potter's Pond	1	0	0	0	0	0
Pawcatuck River	0	0	0	0	0	0.33
Quonochontaug Pond	0	0	0	13.33	0	0.67
Winnipaug Pond	0	0	1	0.67	2.67	0
Total pond index	**1.46**	**0.42**	**0.05**	**2.21**	**20.75**	**1.17**

Table 13: 2012 Coastal Pond Survey average water temperature (degrees Celcius) by pond and month

Station	May	June	July	August	September	October
Charlestown Pond	17.80	21.75	25.65	24.85	20.18	14.75
Green Hill Pond	24.10	24.80	27.60	27.95	18.50	16.50
Narrow River	17.00	21.10	24.67	23.57	22.17	16.37
Point Judith Pond	20.43	22.30	24.13	23.43	20.90	15.23
Potter's Pond	19.20	21.60	26.00	23.95	20.55	14.05
Pawcatuck River	17.57	24.20	22.63	25.17	18.70	14.60
Quonochontaug Pond	16.83	21.17	23.30	24.60	20.33	15.57
Winnipaug Pond	17.80	19.50	25.00	22.40	21.90	16.17
Average	18.84	22.05	24.87	24.49	20.40	15.40

Table 14: 2012 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	25.78	27.11	28.31	27.32	28.06	28.46
Green Hill Pond	16.33	20.29	24.01	22.36	24.10	25.06
Narrow River	17.98	18.38		24.42	25.93	28.00
Point Judith Pond	20.44	26.34		28.23	28.80	28.95
Potter's Pond	11.96	25.45		27.07	26.52	26.96
Pawcatuck River	22.47	18.39	25.53	26.16	27.42	18.10
Quonochontaug Pond	22.40	28.72	28.77	28.75	28.99	29.16
Winnipaug Pond	17.14	27.59		28.26	28.16	28.62
Average	19.31	24.03	26.65	26.57	27.25	26.66

Table 15: 2012 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	9.05	9.75	7.67	8.03	7.02	8.77
Green Hill Pond	8.04	8.33	7.35	8.31	7.21	8.69
Narrow River	8.90	9.56		7.88	7.43	7.57
Point Judith Pond	10.20	9.15		7.20	7.25	8.03
Potter's Pond	10.38	9.67		5.39	6.87	8.22
Pawcatuck River	11.44	9.50	7.53	8.27	10.27	9.45
Quonochontaug Pond	8.49	8.28	7.39	7.17	7.68	8.04
Winnipaug Pond	11.07	8.36		7.74	8.01	8.12
Average	9.70	9.07	7.48	7.50	7.72	8.36

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

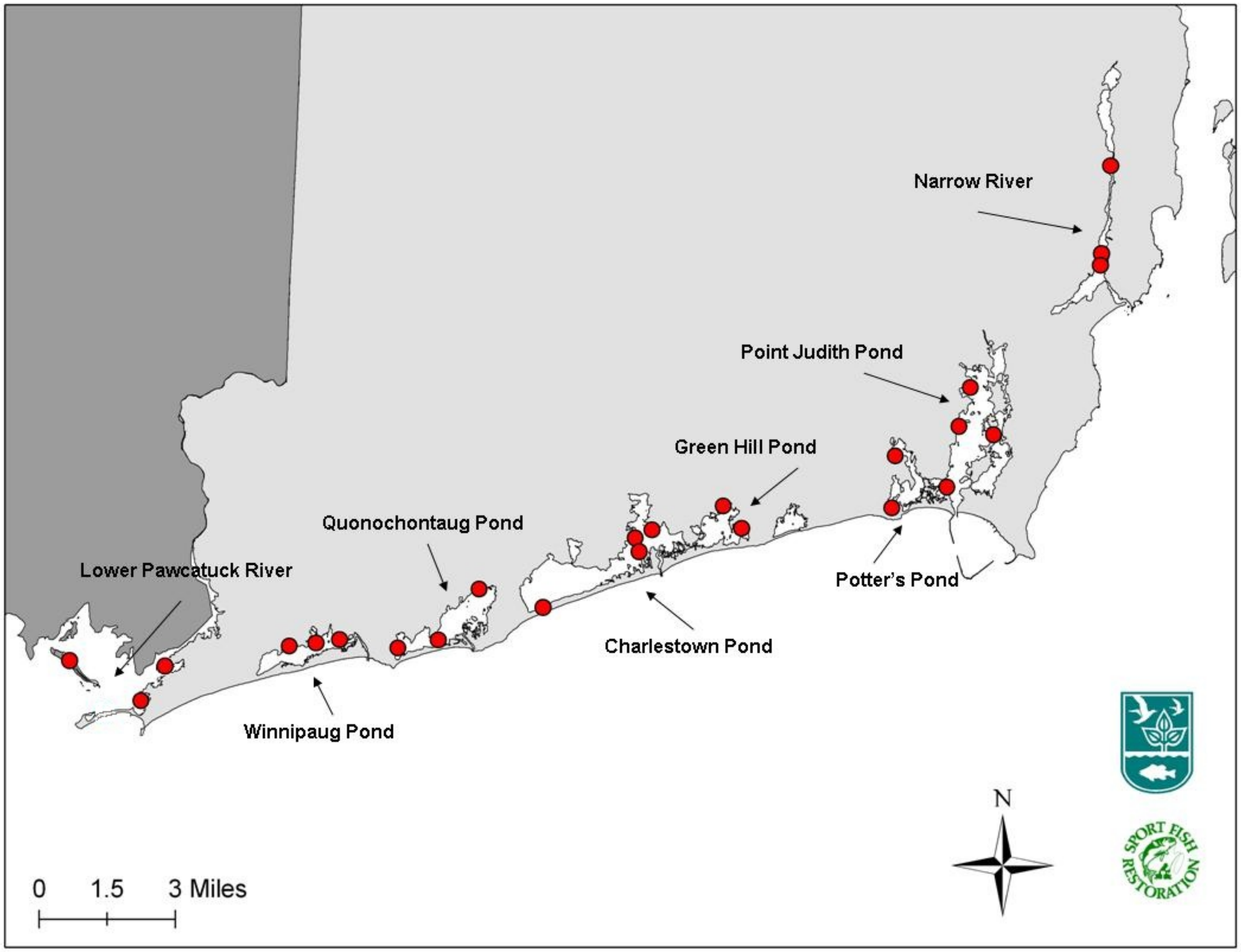


Figure 2: Coastal Pond Juvenile Finfish Survey station locations (western ponds).

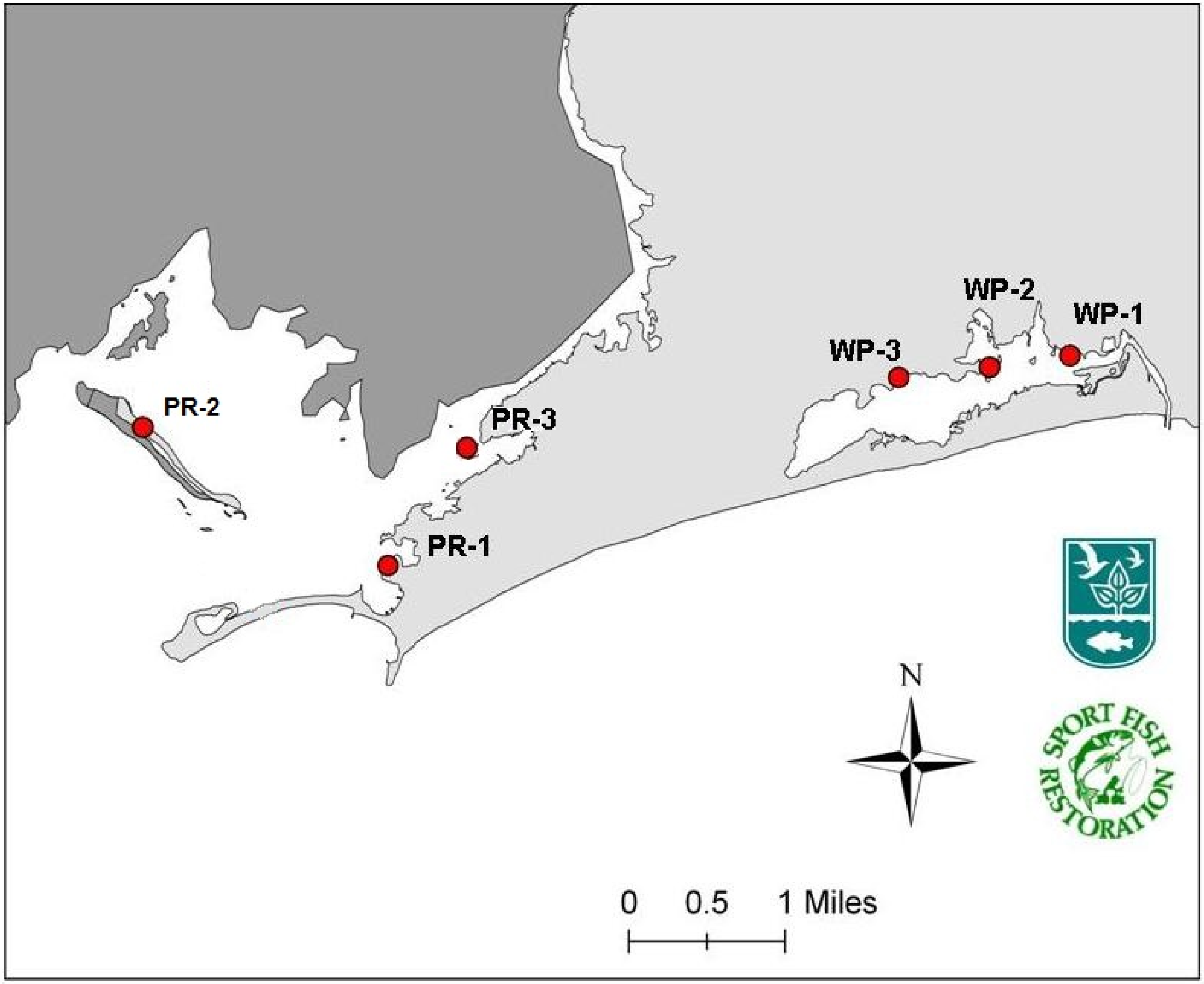


Figure 2 (cont): Coastal Pond Juvenile Finfish Survey station locations (western ponds).

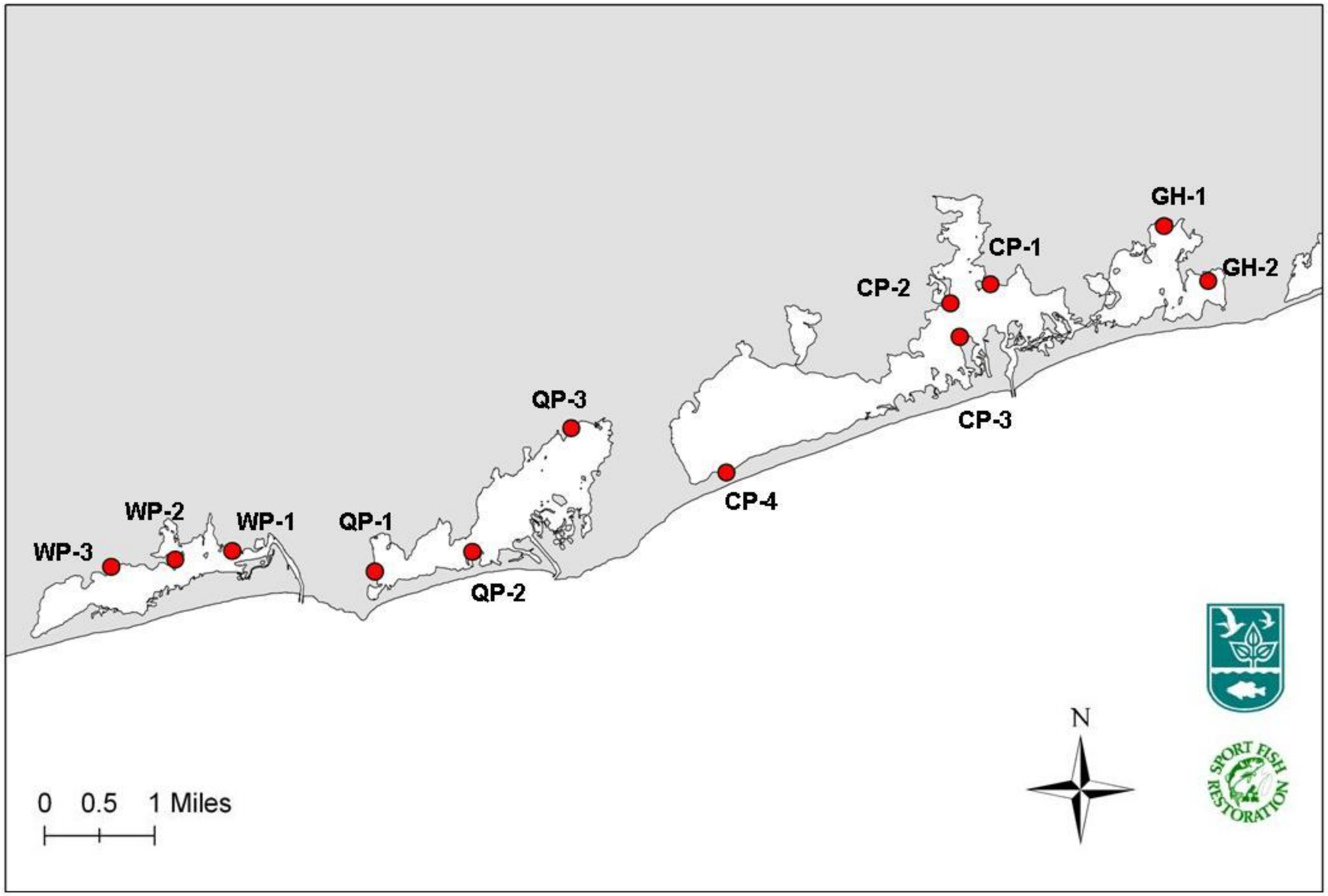


Figure 3: Coastal Pond Juvenile Finfish Survey station locations (eastern ponds).

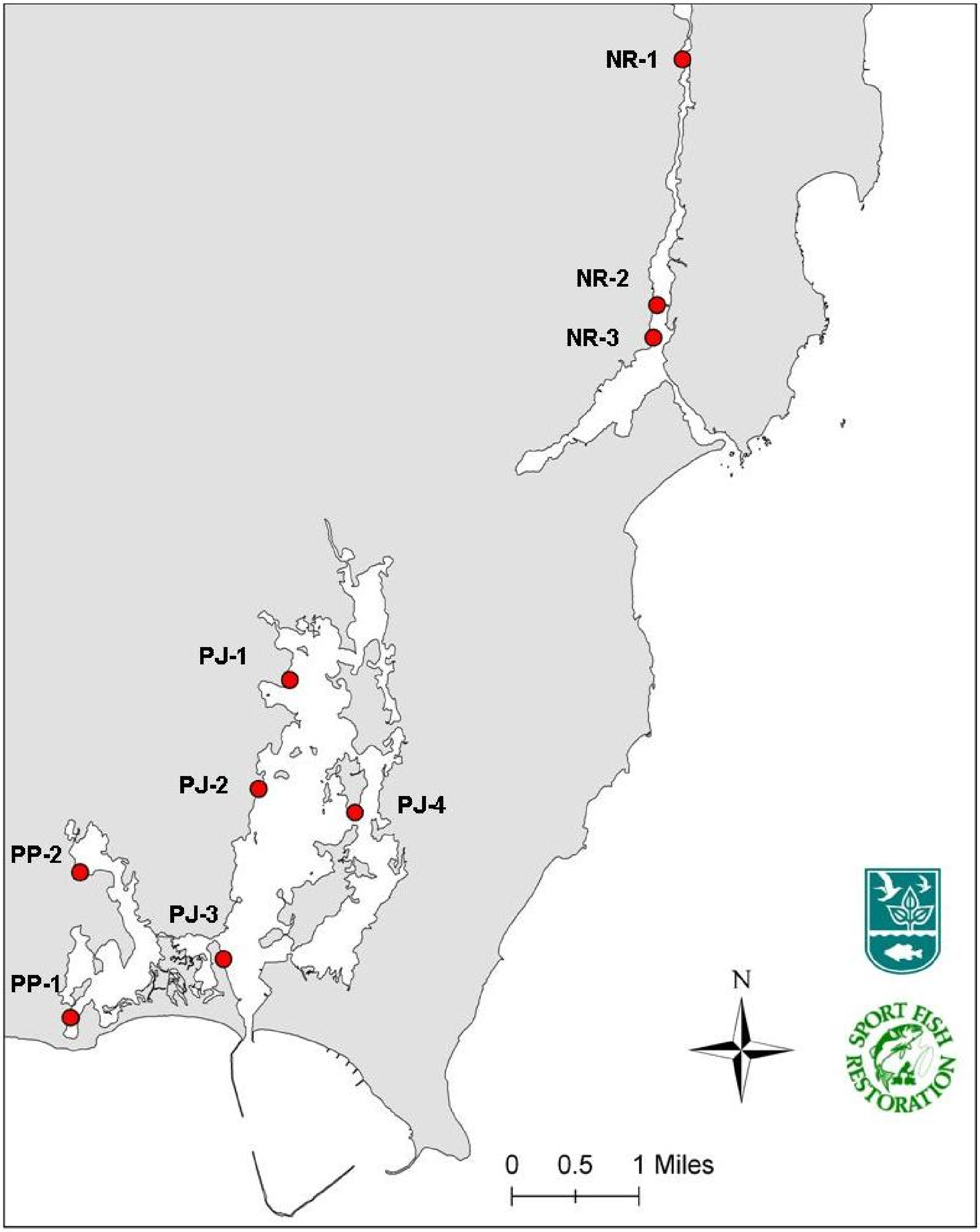


Figure 4
Coastal Pond Juvenile Finfish Survey

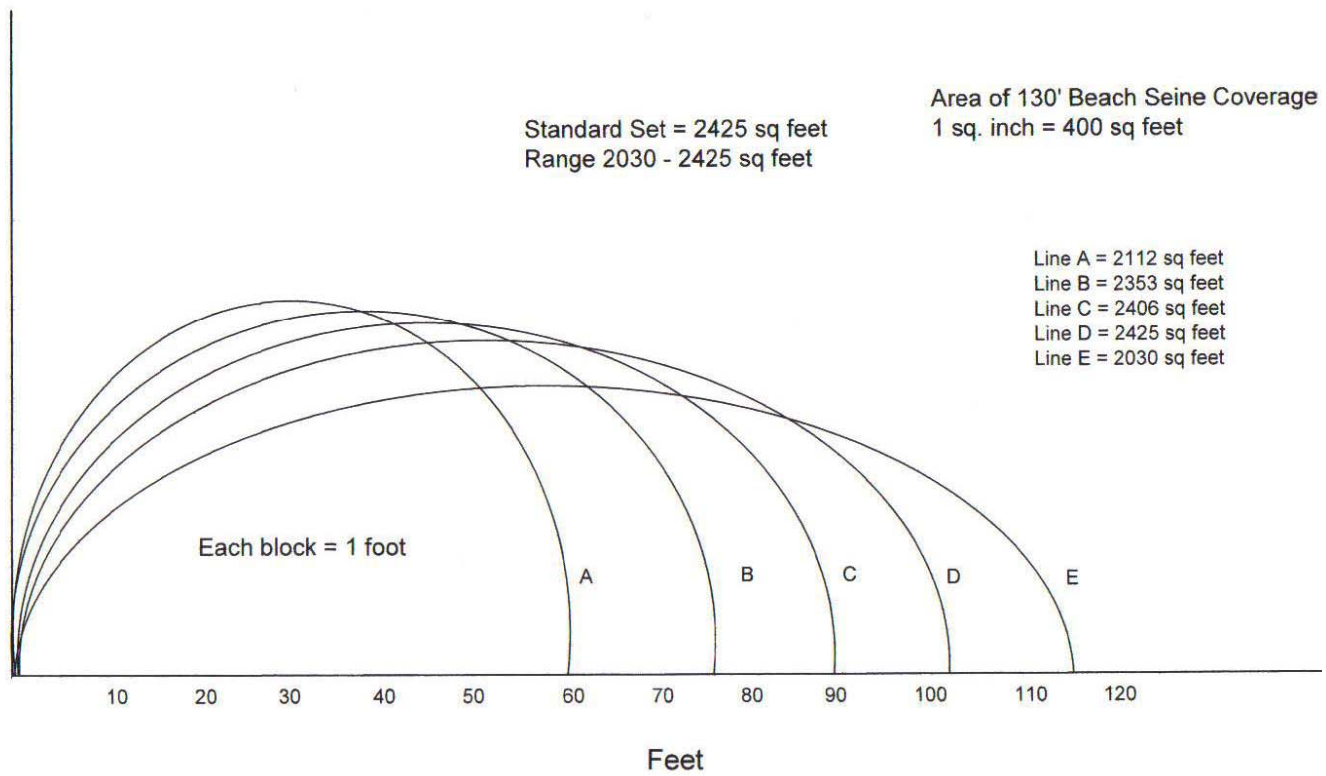


Figure 5a: Time series of abundance indices (fish/seine haul) for winter flounder YOY from each Coastal Pond in the survey.

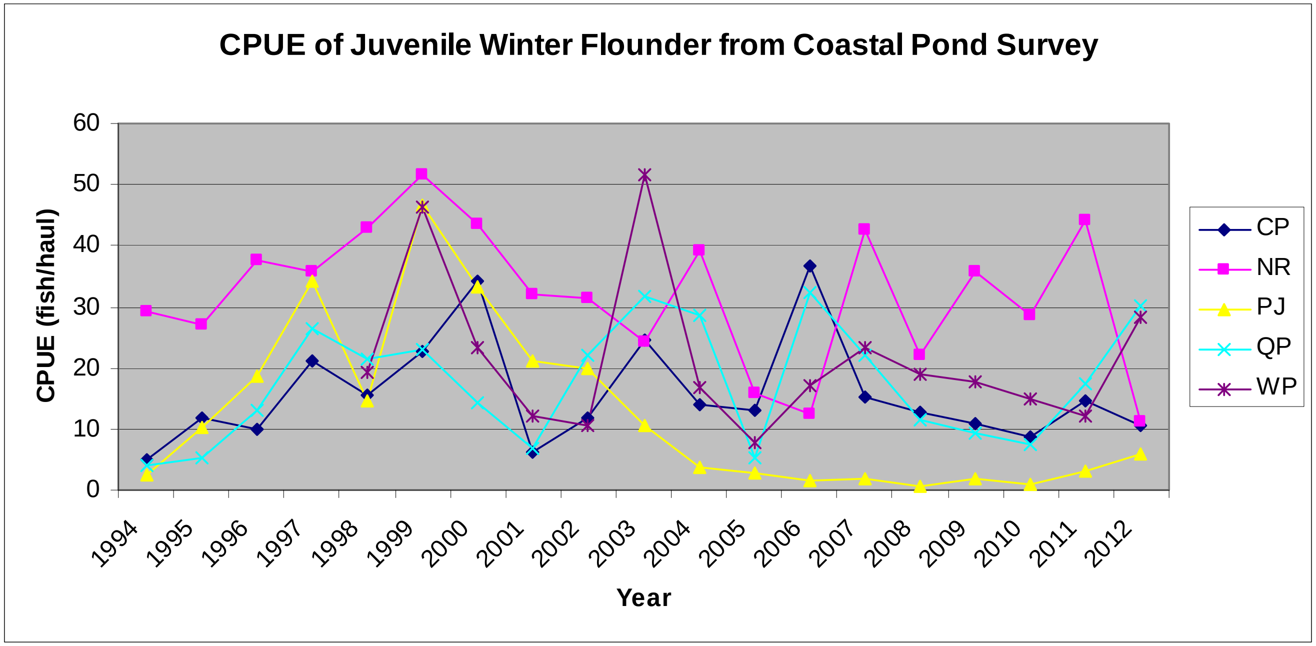


Figure 5b: 2012 time series of abundance indices (fish/seine haul) by month for winter flounder YOY for each Coastal Pond in the survey.

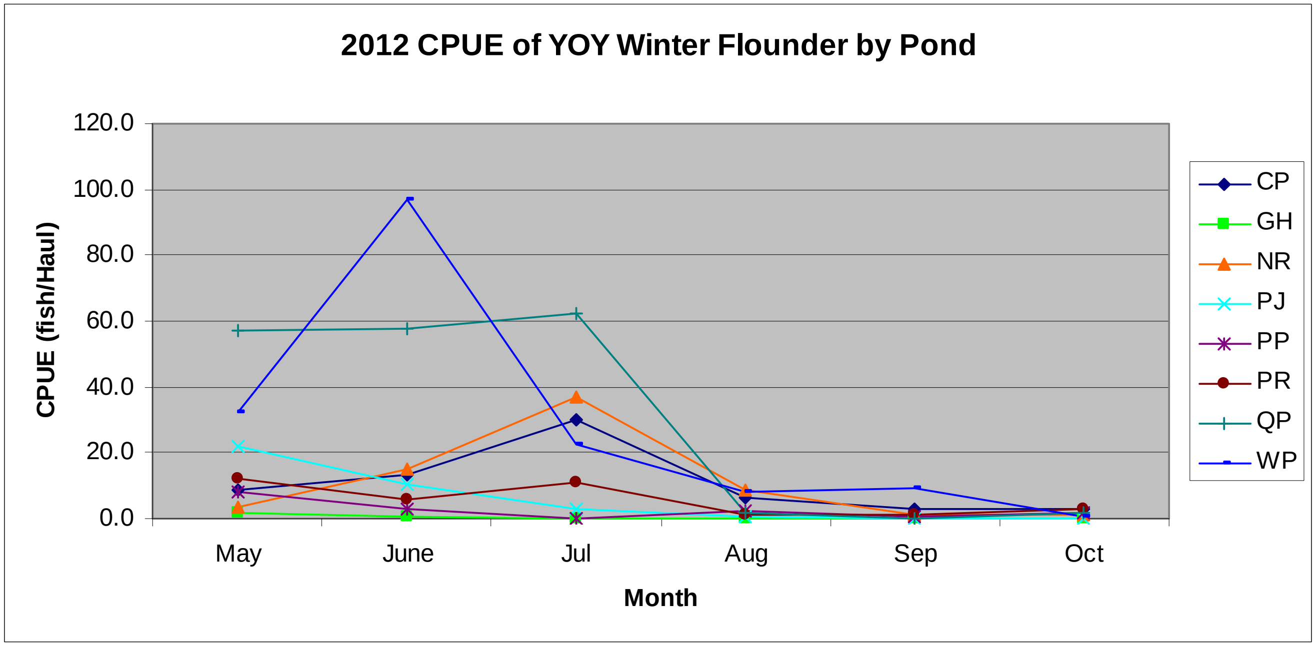


Figure 6: Length frequency of all winter flounder caught in Coastal Pond Survey during 2012.

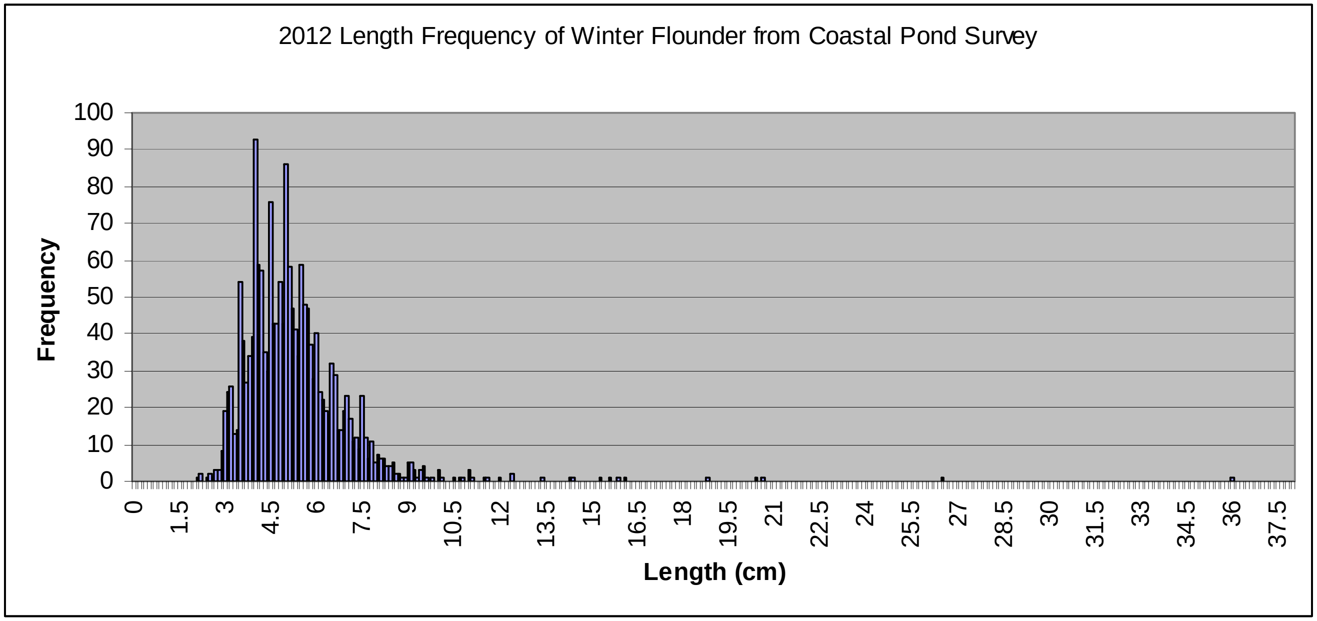


Figure 7: Monthly length frequency of winter flounder from Charlestown Pond, 2012.

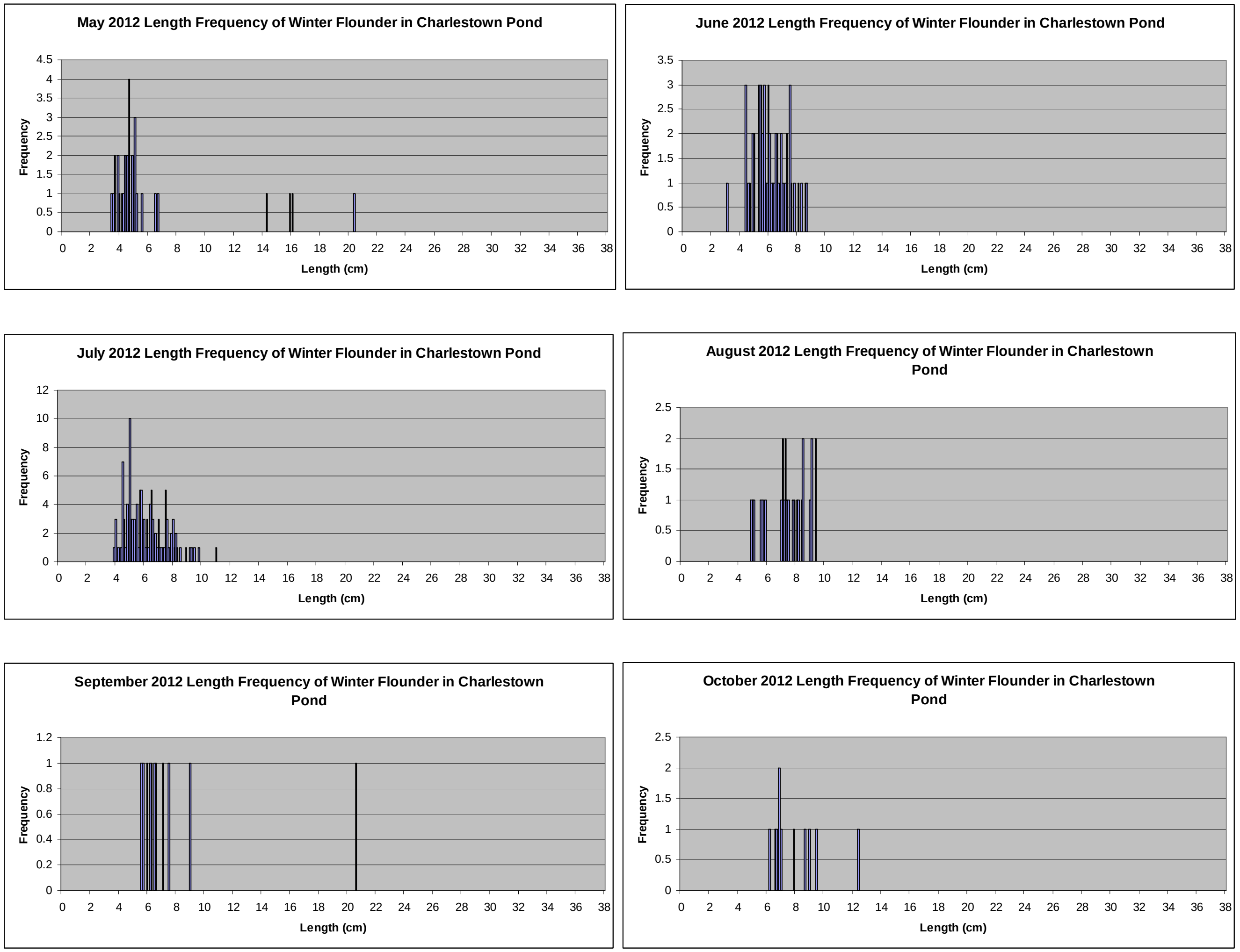


Figure 8: Monthly length frequency of winter flounder from Green Hill Pond, 2012.

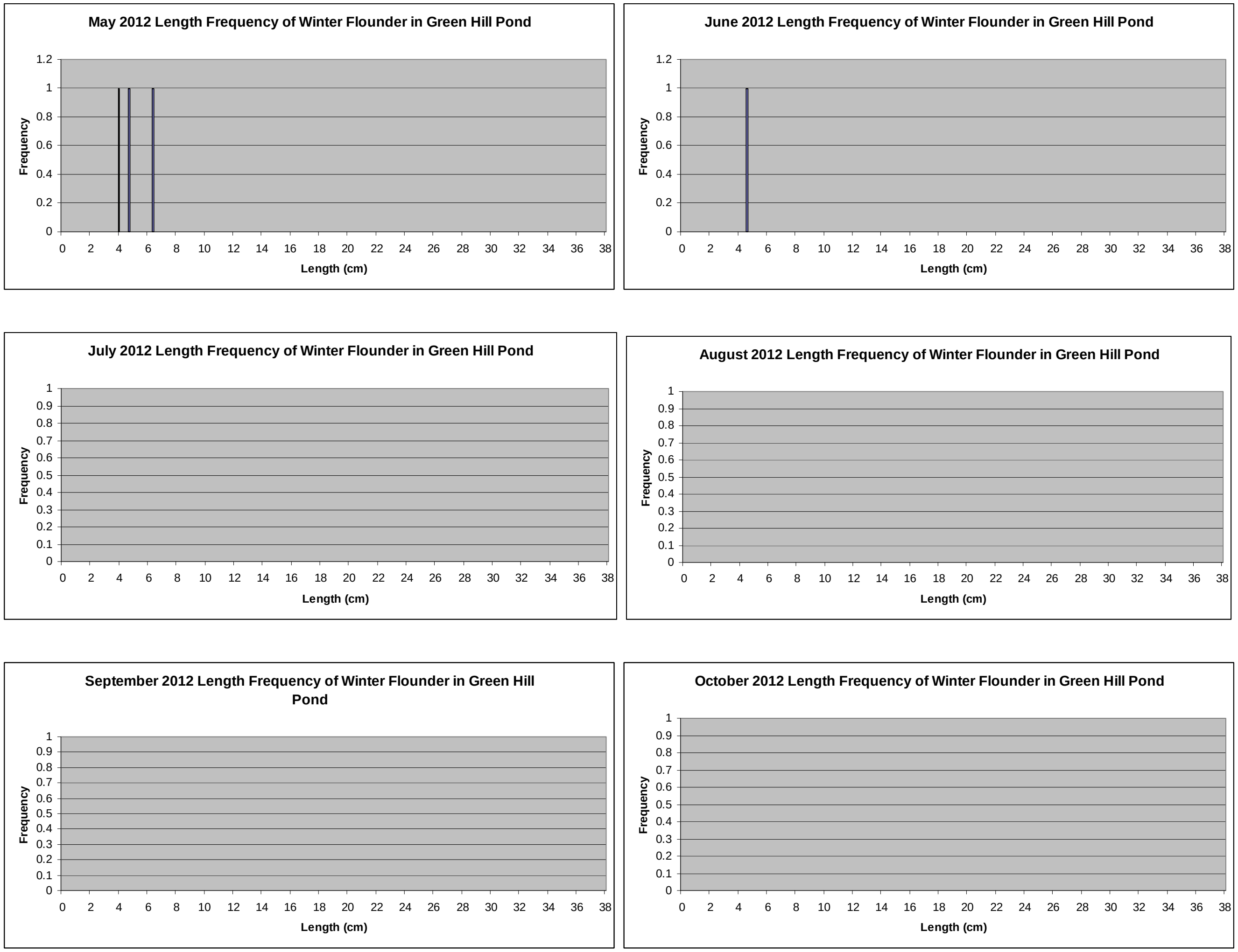


Figure 9: Monthly length frequency of winter flounder from Narrow River, 2012.

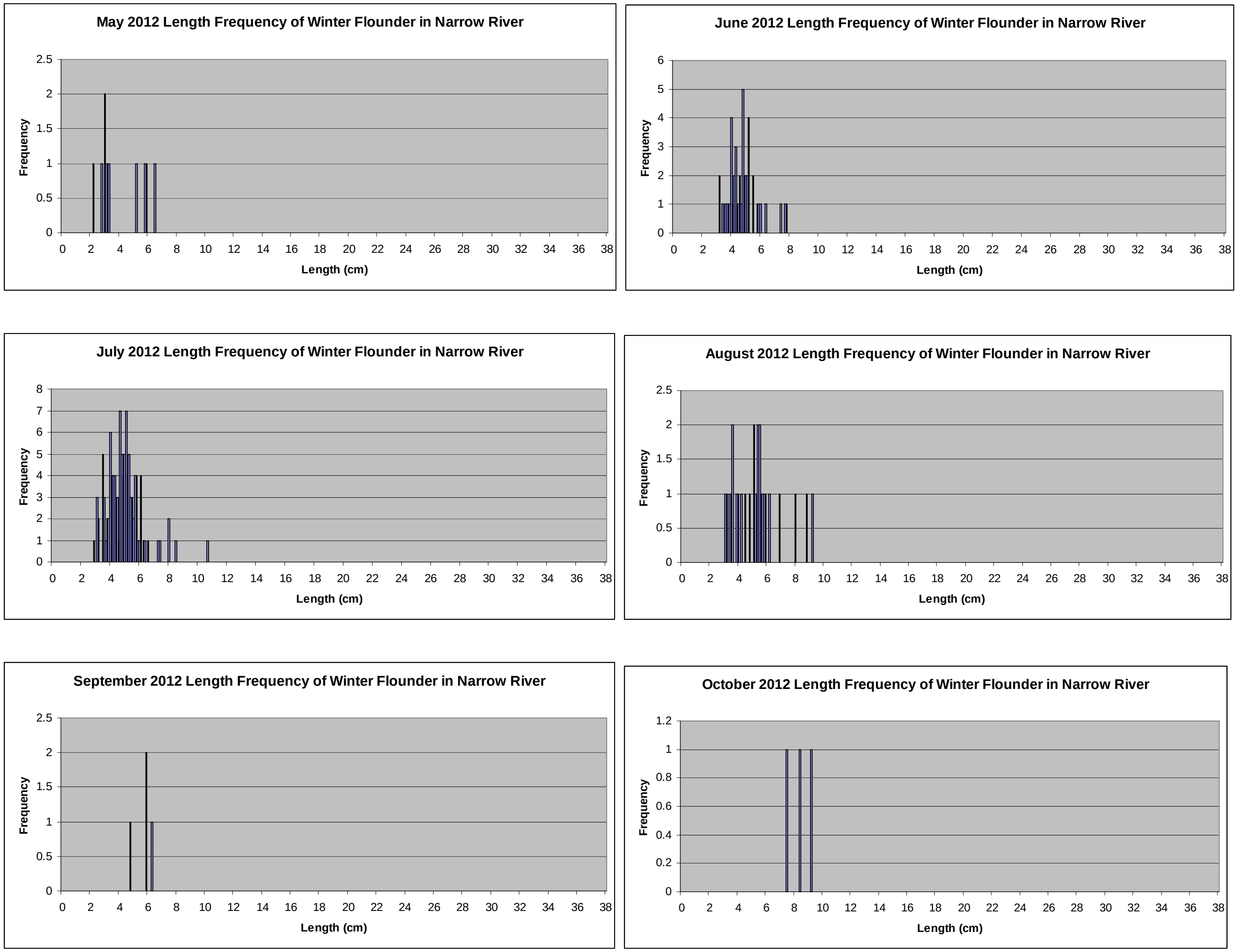


Figure 10: Monthly length frequency of winter flounder from Point Judith Pond, 2012.

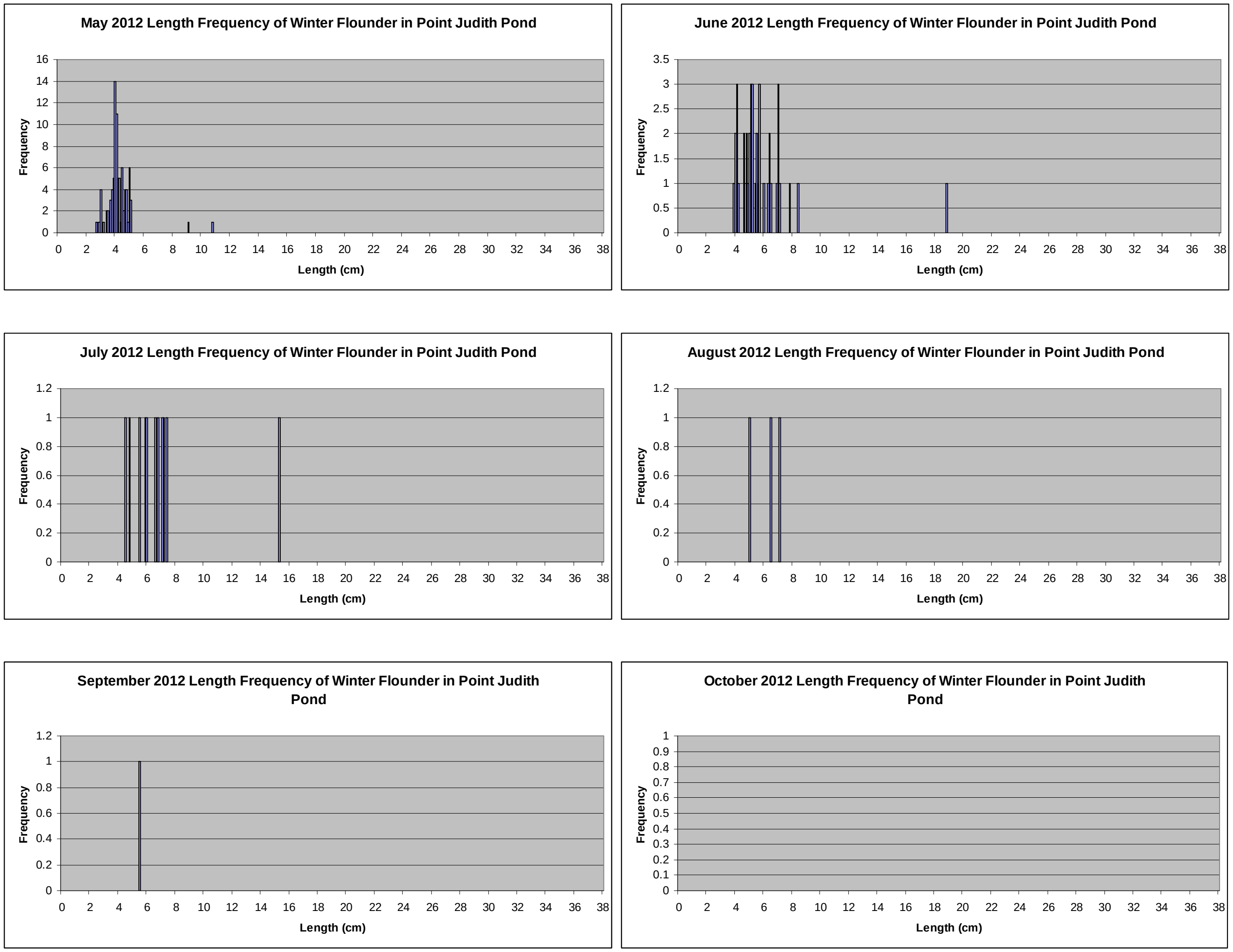


Figure 11: Monthly length frequency of winter flounder from Potter Pond, 2012.

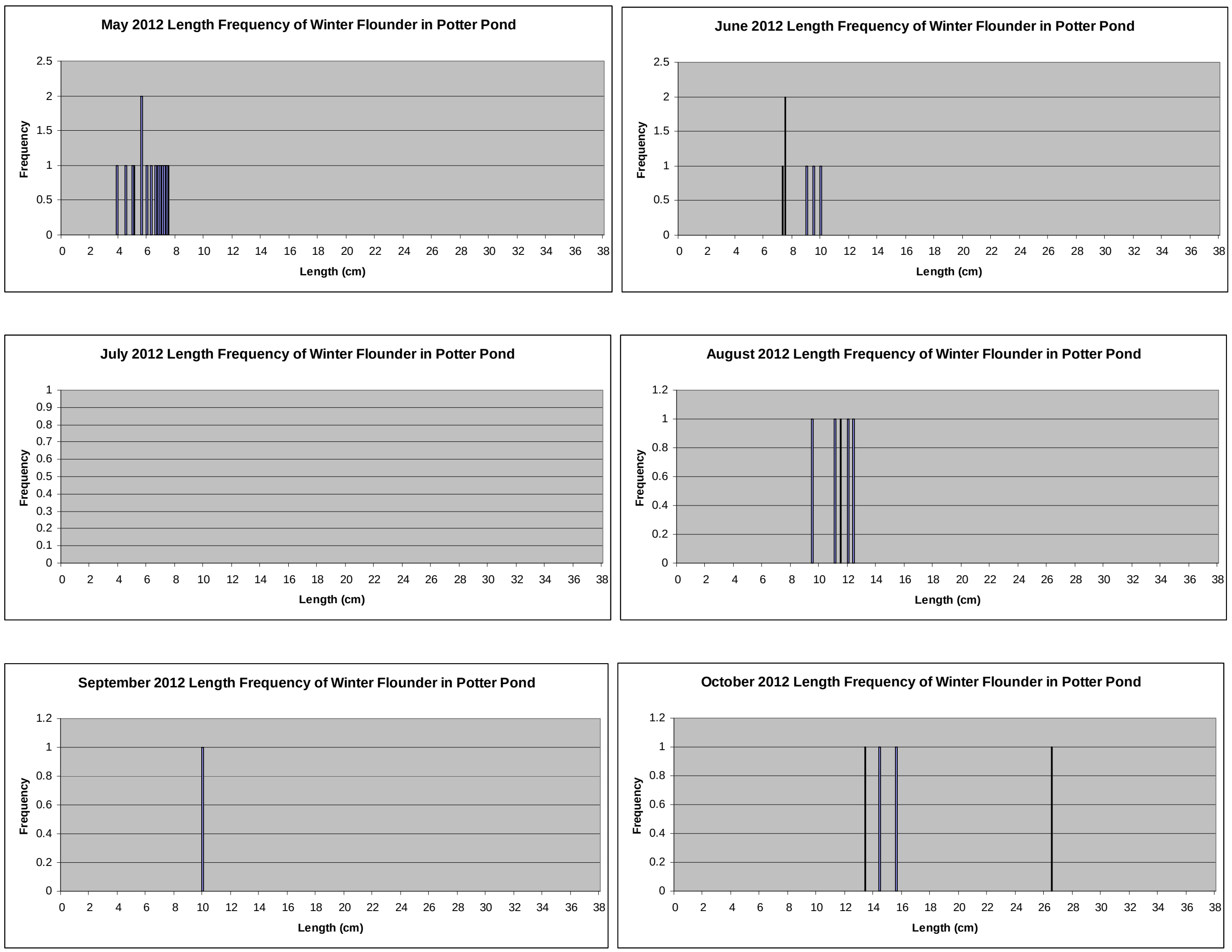


Figure 12: Monthly length frequency of winter flounder from Pawcatuck River, 2012.

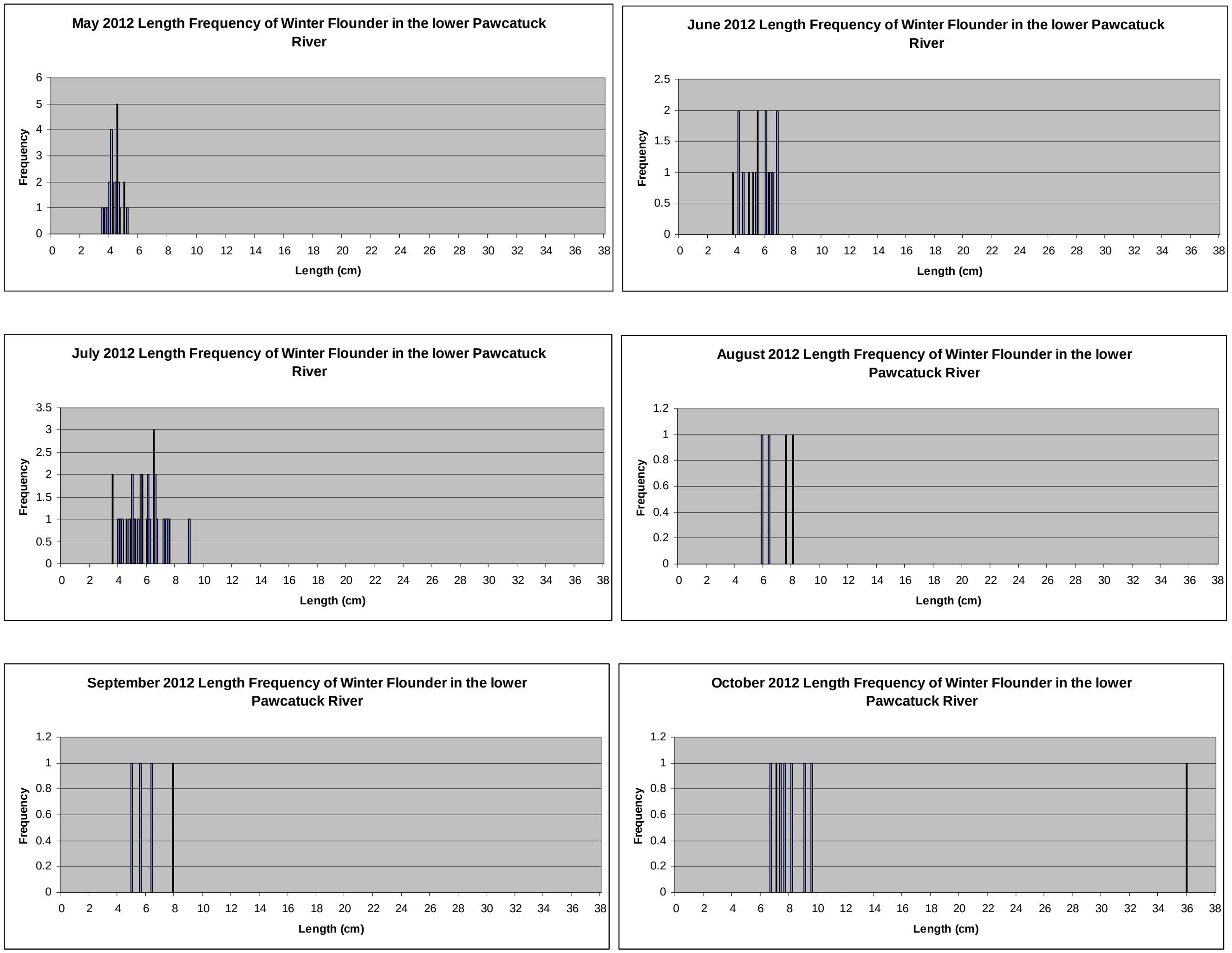


Figure 13: Monthly length frequency of winter flounder from Quonochontaug Pond, 2012.

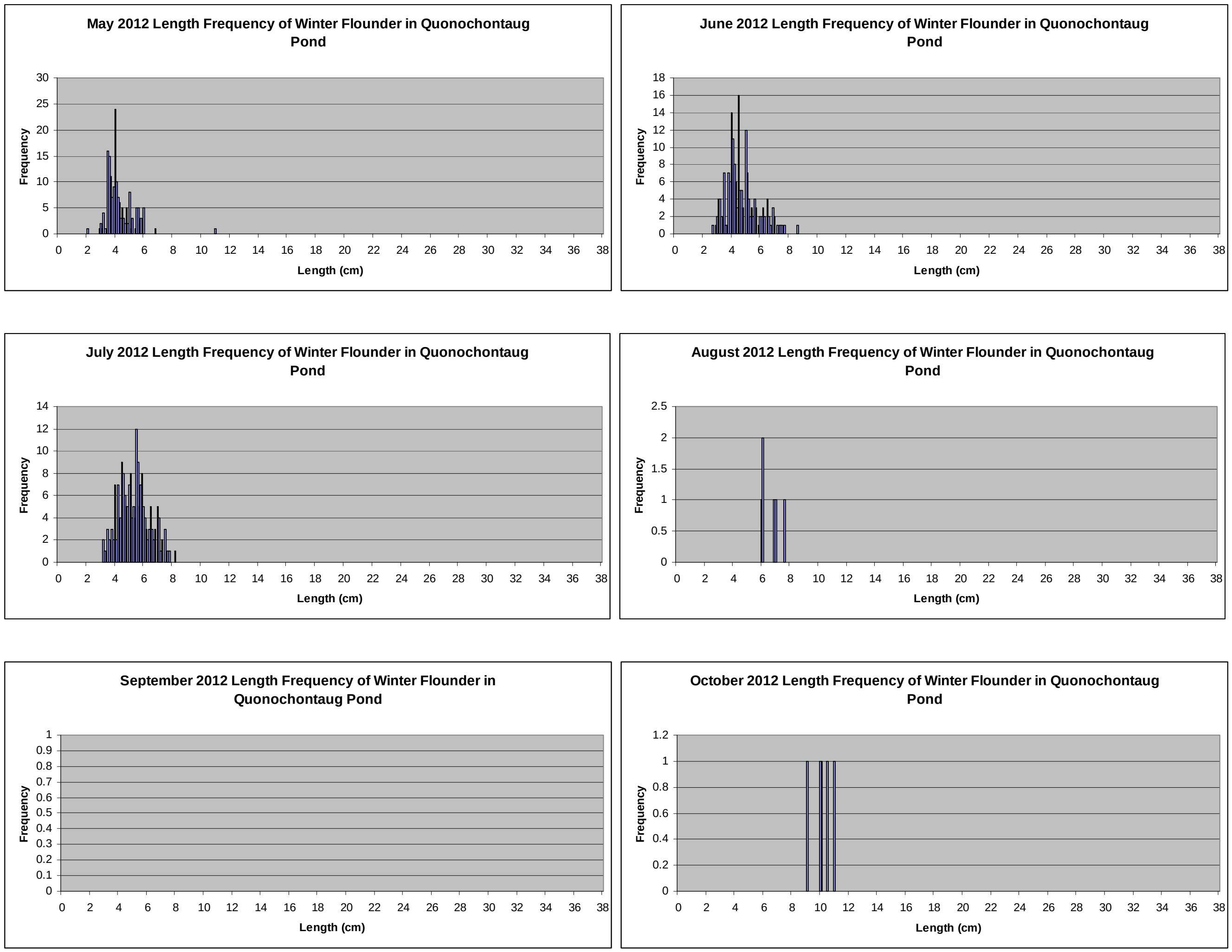


Figure 14: Monthly length frequency of winter flounder from Winnipaug Pond, 2012.

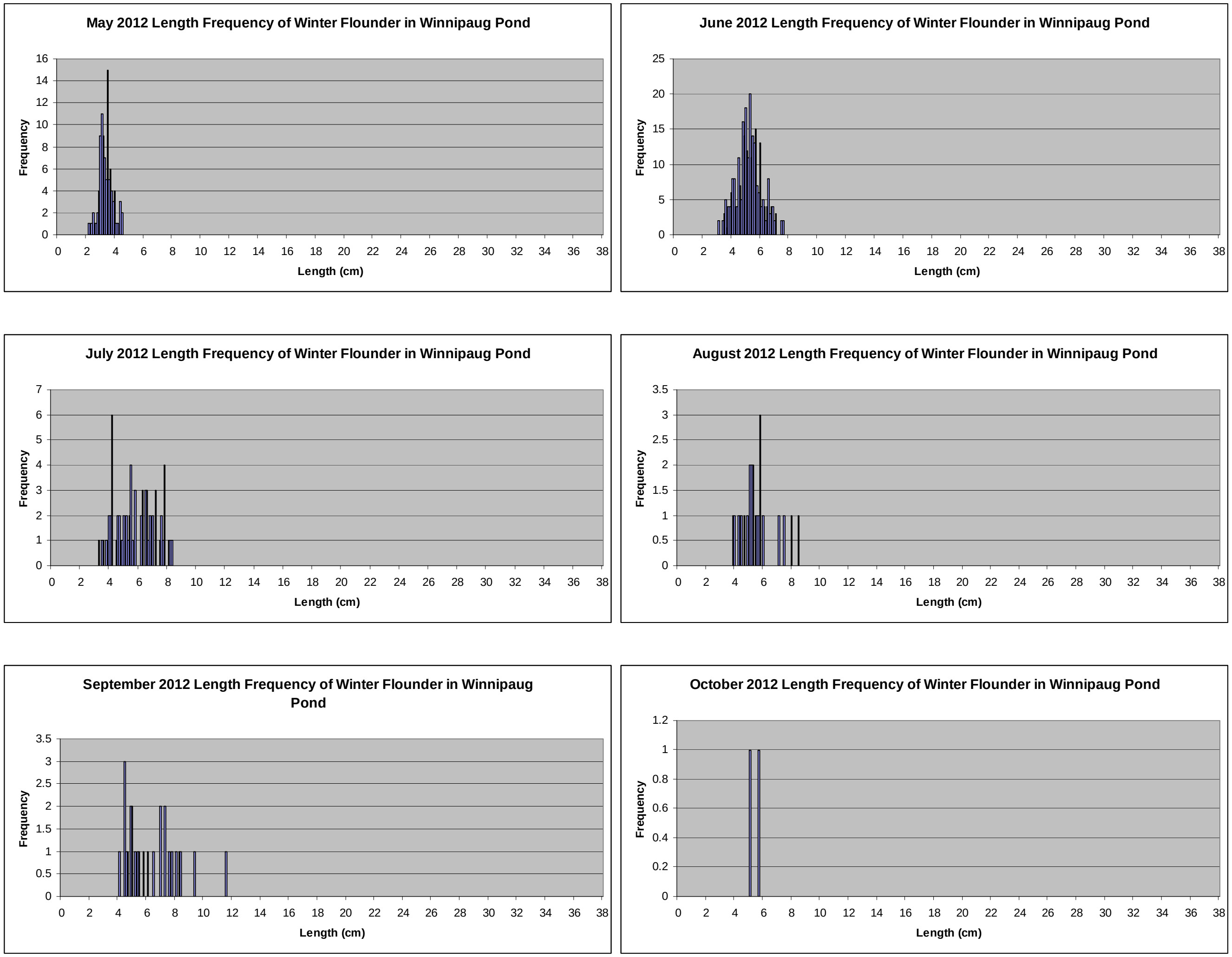


Figure 15: Time series of annual abundance indices for winter flounder YOY from the coastal pond survey.

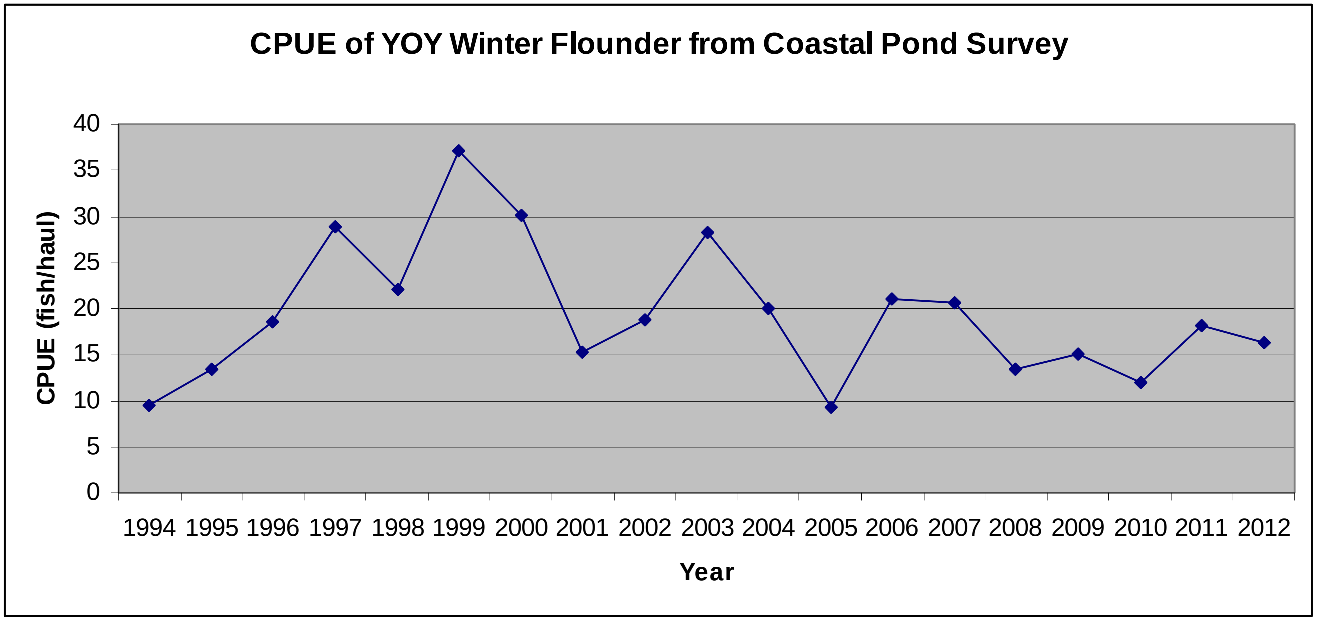


Figure 16: Abundance indices (fish/haul) from the Coastal Pond Survey, Narragansett Bay Seine Survey, and RIDFW Trawl Survey for winter flounder.

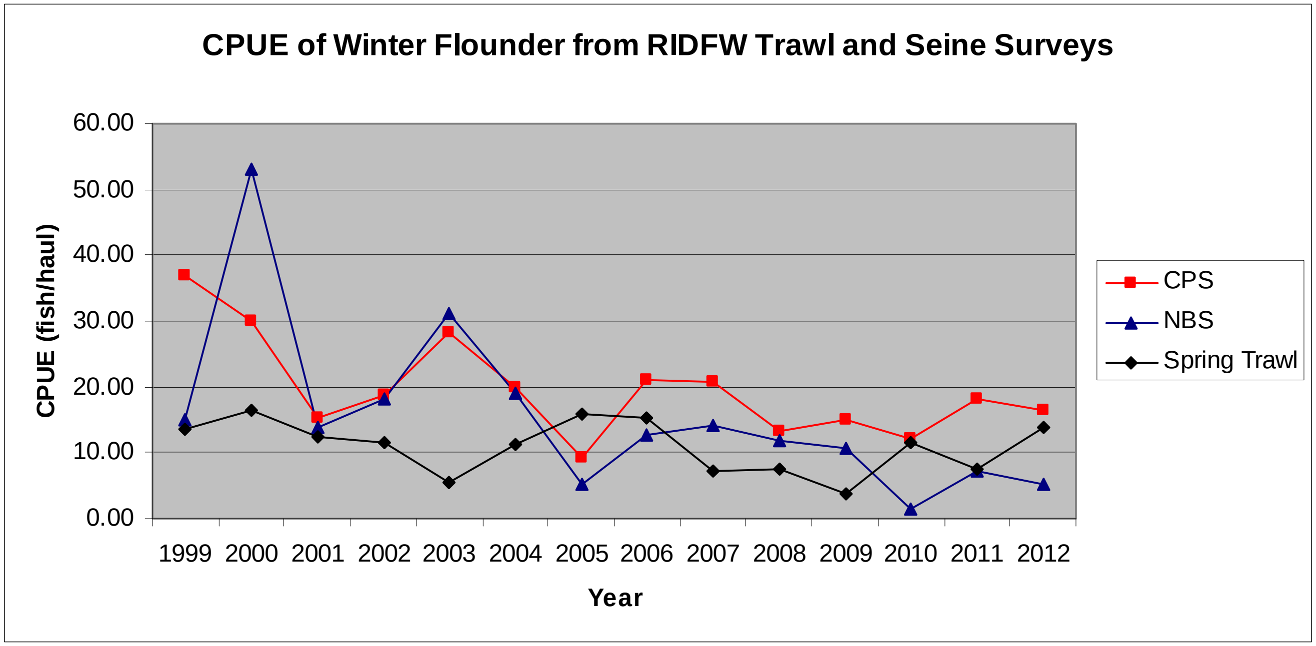


Figure 17: Abundance indices (fish/haul) from the Coastal Pond Survey and the Adult Winter Flounder Tagging Survey for winter flounder.

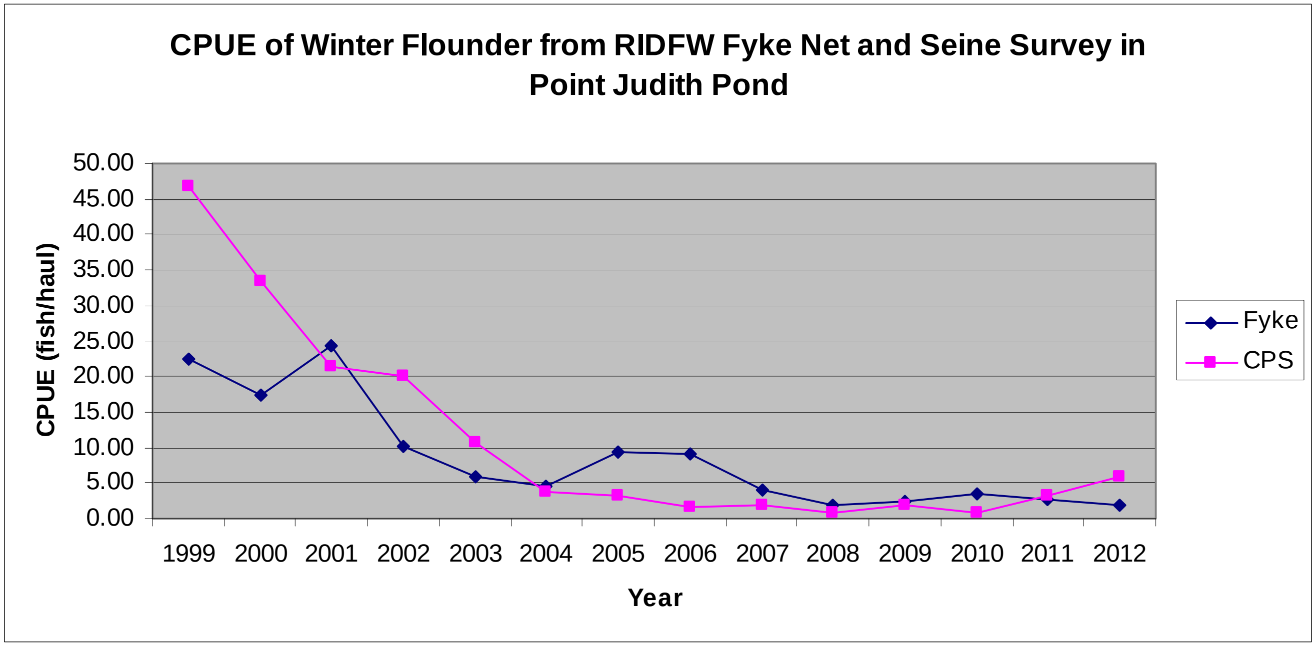


Figure 18. Time series of annual abundance indices for bluefish from the coastal pond survey.

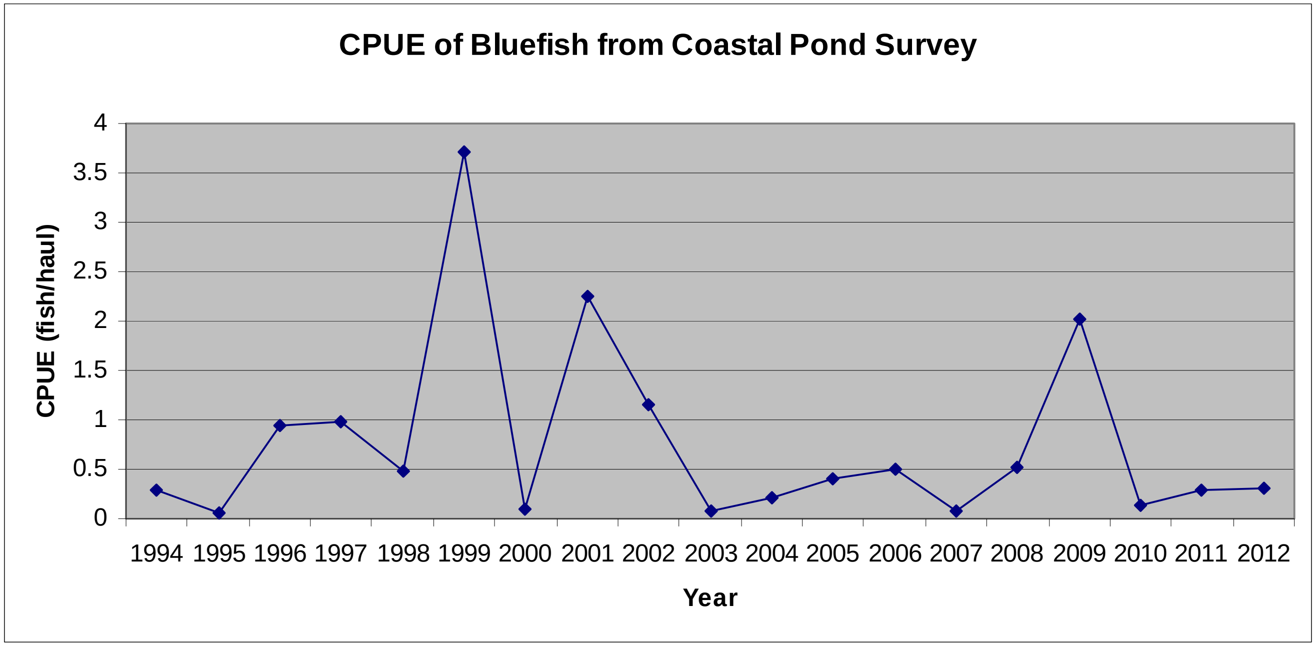


Figure 19. Time series of annual abundance indices for Tautog from the coastal pond survey.

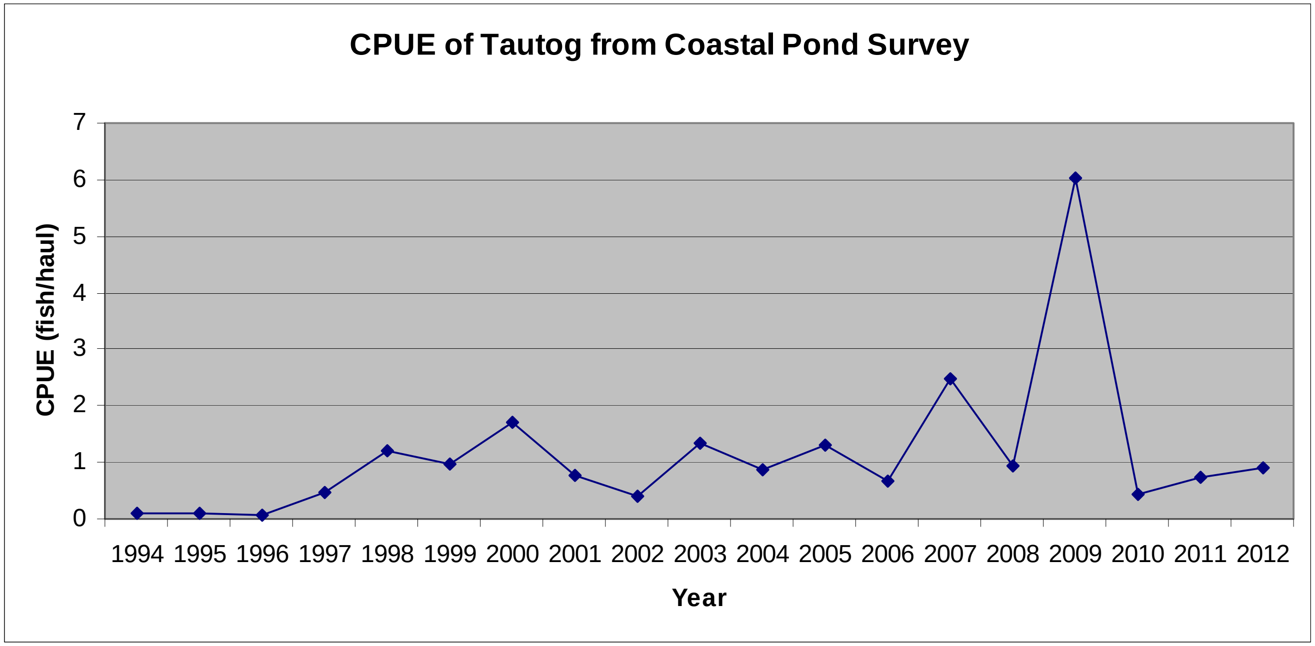


Figure 20. Time series of annual abundance indices for Black Sea Bass from the coastal pond survey.

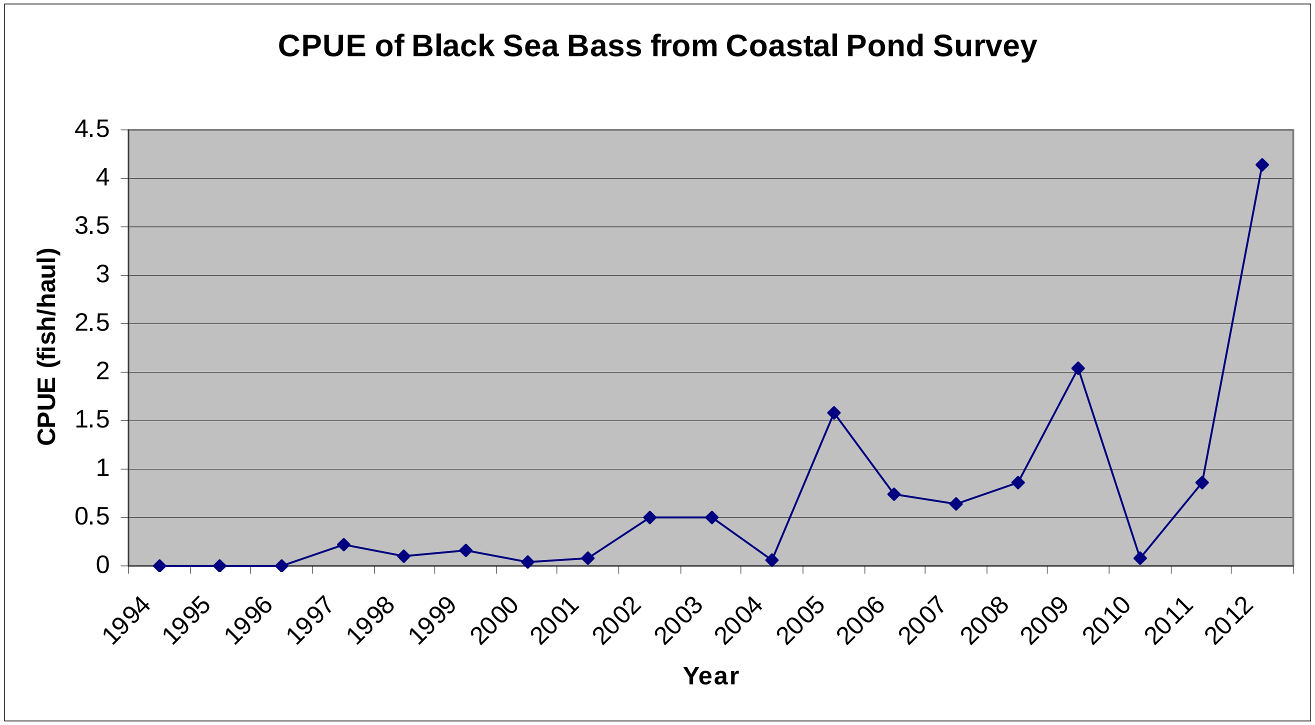


Figure 21. Time series of annual abundance indices for Scup from the coastal pond survey.

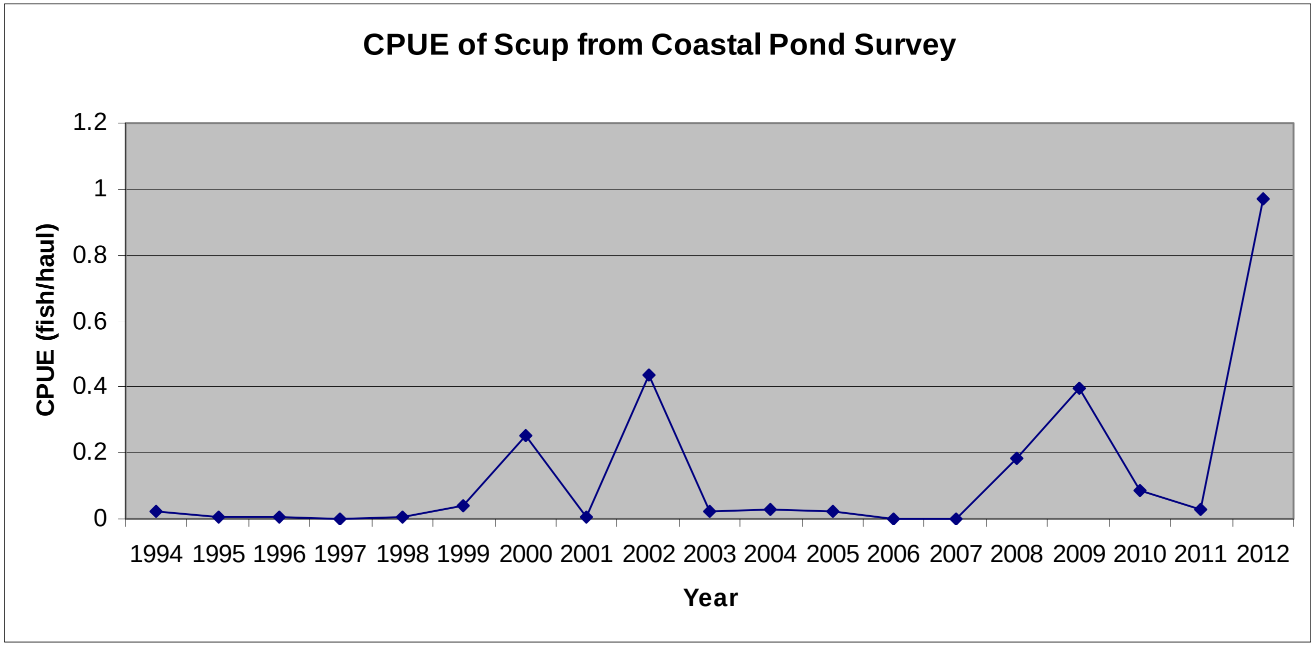


Figure 22. Time series of annual abundance indices for Clupeids from the coastal pond survey (menhaden on right y-axis)

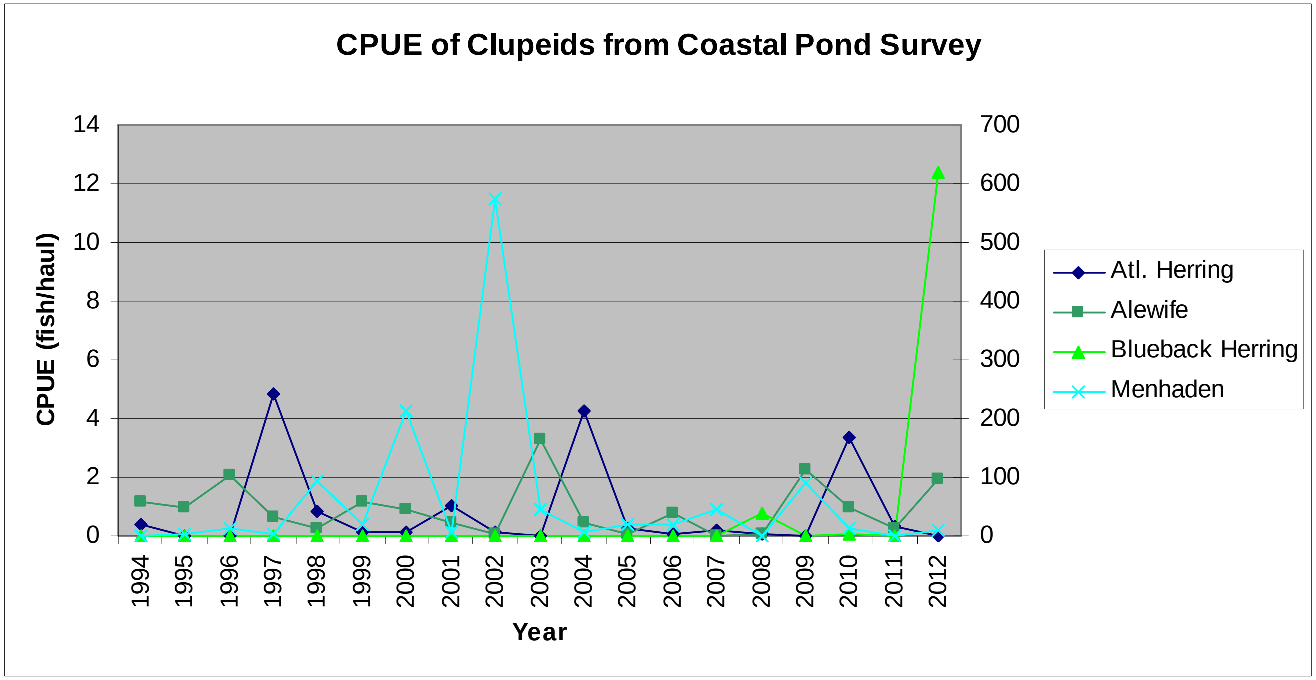
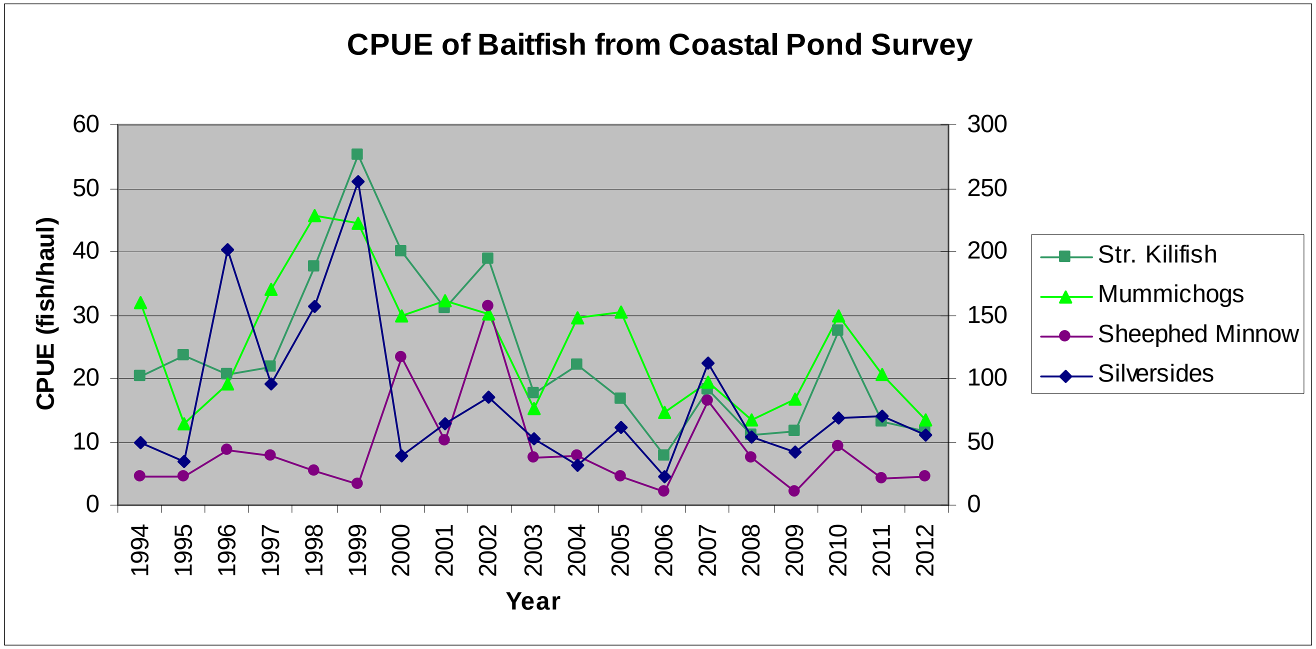


Figure 23. Time series of annual abundance indices for Baitfish from the coastal pond survey (silversides on right y- axis).



Appendix 1a: Catch frequency of all species by station for 2012 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)					1					1	1					66	
ANCHOVY BAY (ANCHOA MITCHILLI)				5	11			77			2		1				2
BASS STRIPED (MORONE SAXATILIS)			1				1				1				1	2	
BLUE CRAB (CALINECTES SAPIDIUS)	17	9	10	27	46	36	6	36	12		39	3	6				11
BLUEFISH (POMATOMUS SALTATRIX)			1		3	8		2	11		2	1	2	1			
CUNNER (TAUTOGOLABRUS ADSPERSUS)		2	2						6				4				
EEL AMERICAN (ANGUILLA ROSTRATA)	3	2	2			2											
FLOUNDER SMALLMOUTH (ETROPUS MICROSTOMUS)	1				2	4	2		1					5			
FLOUNDER SUMMER (PARALICHTHYS DENTATUS)		3							1		4		1	1	2	1	2
FLOUNDER WINTER (PLEURONECTES AMERICANUS)	120	73	62	1	10	140	50	12	43	5	83	136	171	235	266	141	102

GOBY NAKED (GOBIOSOMA BOSC)	1	1	1	3	1	1		6	2		12	1				1	2
GRUBBY (MYOXOCEPHALUS AENAEUS)			2						2				1		8	1	
GUNNEL ROCK (PHOLIS GUNNELLUS)																	
HAKE SPOTTED (UROPHYCIS REGIA)							4		1								
HERRING ATLANTIC (CLUPEA HARENGUS)											1						
HERRING BLUEBACK (ALOSA AESTIVALIS)											642						
HOGCHOKER (TRINECTES MACULATUS)					2												
HORSESHOE CRAB (LIMULUS POLYPHEMUS)											1		1	4			2
JACK CREVALLE (CARANX HIPPOS)	2				1							1	1	1			
KILLIFISH STRIPED (FUNDULUS MAJALIS)	145	79	144	115		18		6		711	32	95	89	23	44	1	28
KINGFISH NORTHERN (MENTICIRRHUS SAXATILIS)				1		38	4						1				1

LIZARDFISH INSHORE (SYNODUS FOETENS)									2		1	1	1				
MENHADEN ATLANTIC (BREVOORTIA TYRANNUS)				5	21	###				3	2			150			4
MINNOW SHEEPSHEAD (CYPRINODON VARIEGATUS)	28	29	5	4	2	50	1			457		1	37	4	7	2	4
MOJARRA SPOTFIN (EUCINOSTOMUS ARGENTEUS)	67	9			2	6					6			2			
MULLET WHITE (MUGIL CUREMA)				2	48	9	2						1	20			11
MUMMICHOG (FUNDULUS HETEROCLITUS)	27	67	62	12	79	473	3	73	11	47	44	209	12	40	195	5	148
NEEDLEFISH ATLANTIC (STRONGYLURA MARINA)				2									1	1	5		
PERCH WHITE (MORONE AMERICANA)																	
PERMIT (TRACHINOTUS FALCATUS)																	1
PIPEFISH NORTHERN (SYNGNATHUS FUSCUS)	12	3	17	2	2			5	13			3	1	2		1	1

PUFFER NORTHERN (SPHOEROIDES MACULATUS)	2			8	2		4					4	4	7			6
RAINWATER KILLIFISH (LUCANIA PARVA)	17	13	30	4		1	1					1			4		15
RUNNER BLUE (CARANX CRYSOS)											1						
SCUP (STENOTOMUS CHRYSOPS)	1	6	22	4				1	9		1	14	27	5		1	2
SEA BASS BLACK (CENTROPRISTIS STRIATA)	64	38	86		2	19	30	4	12		9	16	63	15	2	15	23
SEAHORSE LINED (HIPPOCAMPUS ERECTUS)			1										1				
SEAROBIN NORTHERN (PRIONOTUS CAROLINUS)							1								1		
SEAROBIN STRIPED (PRIONOTUS EVOLANS)	4				3	7	4		1			2	3	7		14	6
SENNET NORTHERN (SPHYRAENA BOREALIS)		3				1											
SILVERSIDE ATLANTIC (MENIDIA MENIDIA)	29	87	412	###	254	###	115	145	86	925	347	296	789	308	128	47	153
SPOT (LEIOSTOMUS XANTHURUS)	18			1	11						24					1	5

SQUID LONGFIN (LOLIGO PEALEI)												2				1	
STICKLEBACK FOURSPINE (APELTES QUADRACUS)	93	9	29	1	1	7	5					4	2				13
STICKLEBACK THREESPINE (GASTEROSTEUS ACULEATUS)	10	5	11			1									1		
TAUTOG (TAUTOGA ONITIS)	5	19	35			5		4	10		2					2	4
TOADFISH OYSTER (OPSANUS TAU)	1		1					5				1					
TOMCOD ATLANTIC (MICROGADUS TOMCOD)			1										3				

Appendix 1b: Catch frequency of all species by station for 2012 Coastal Pond Survey (new ponds).

Species	GH1	GH2	PP1	PP2	PR1	PR2	PR3
ALEWIFE (ALOSA PSEUDOHARENGUS)		1	1			28	178
ANCHOVY BAY (ANCHOA MITCHILLI)		6	17	235	2		1
BASS STRIPED (MORONE SAXATILIS)							
BLUE CRAB (CALINECTES SAPIDIUS)	38	28	106	16	11	2	4
BLUEFISH (POMATOMUS SALTATRIX)		4	1		6	8	5
CUNNER (TAUTOGOLABRUS ADSPERSUS)					5	3	23
EEL AMERICAN (ANGUILLA ROSTRATA)			2	2			1
FLOUNDER SMALLMOUTH (ETROPUS MICROSTOMUS)					3		
FLOUNDER SUMMER (PARALICHTHYS DENTATUS)	2	2	2	1			

FLOUNDER WINTER (PLEURONECTES AMERICANUS)	2	2	32		78	7	5
GOBY NAKED (GOBIOSOMA BOSC)	26	11	18	1			
GRUBBY (MYOXOCEPHALUS AENAEUS)							
GUNNEL ROCK (PHOLIS GUNNELLUS)							1
HAKE SPOTTED (UROPHYCIS REGIA)							
HERRING ATLANTIC (CLUPEA HARENGUS)							
HERRING BLUEBACK (ALOSA AESTIVALIS)						###	
HOGCHOKER (TRINECTES MACULATUS)							
HORSESHOE CRAB (LIMULUS POLYPHEMUS)					1		
JACK CREVALLE (CARANX HIPPOS)				1			

KILLIFISH STRIPED (FUNDULUS MAJALIS)		36	12	3	98	16	1
KINGFISH NORTHERN (MENTICIRRHUS SAXATILIS)				1			
LIZARDFISH INSHORE (SYNODUS FOETENS)					1		
MENHADEN ATLANTIC (BREVOORTIA TYRANNUS)	6	21	3			1	
MINNOW SHEEPSHEAD (CYPRINODON VARIEGATUS)	1	1		2	1		
MOJARRA SPOTFIN (EUCINOSTOMUS ARGENTEUS)							
MULLET WHITE (MUGIL CUREMA)	1		5	13	4		
MUMMICHOG (FUNDULUS HETEROCLITUS)	18	20	56	294			34
NEEDLEFISH ATLANTIC (STRONGYLURA MARINA)							

PERCH WHITE (MORONE AMERICANA)							1
PERMIT (TRACHINOTUS FALCATUS)							
PIPEFISH NORTHERN (SYNGNATHUS FUSCUS)			1	3	5		1
PUFFER NORTHERN (SPHOEROIDES MACULATUS)				1	2		1
RAINWATER KILLIFISH (LUCANIA PARVA)			1	19			
RUNNER BLUE (CARANX CRYSOS)							
SCUP (STENOTOMUS CHRYSOPS)					9	3	1
SEA BASS BLACK (CENTROPRISTIS STRIATA)						5	
SEAHORSE LINED (HIPPOCAMPUS ERECTUS)					1		
SEAROBIN NORTHERN (PRIONOTUS CAROLINUS)							

SEAROBIN STRIPED (PRIONOTUS EVOLANS)	1		2	1	6		
SENNET NORTHERN (SPHYRAENA BOREALIS)							
SILVERSIDE ATLANTIC (MENIDIA MENIDIA)	73	164	68	70	934	123	262
SPOT (LEIOSTOMUS XANTHURUS)		2	20				
SQUID LONGFIN (LOLIGO PEALEI)				1			
STICKLEBACK FOURSPINE (APELTES QUADRACUS)		4		16	1		13
STICKLEBACK THREESPINE (GASTEROSTEUS ACULEATUS)							
TAUTOG (TAUTOGA ONITIS)					2	13	14
TOADFISH OYSTER (OPSANUS TAU)			2	17			

TOMCOD ATLANTIC (MICROGADUS TOMCOD)					1		15

ASSESSMENT OF RECREATIONALLY IMPORTANT FINFISH STOCKS IN RHODE ISLAND WATERS

NARRAGANSETT BAY JUVENILE FINFISH SURVEY

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2012

PERFORMANCE REPORT

STATE: Rhode Island

PROJECT NUMBER: F-61-R
SEGMENT NUMBER: 20

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

PERIOD COVERED: 1 January 2012 - 31 December 2012

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 2012 with the standard 61 x 3.05 m beach seine. Adults and juveniles of approximately sixty-eight species were collected during the 2012 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 – 2012), 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 2012

SIGNIFICANT DEVIATIONS: There were no significant deviations to methodology in 2012.

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 of 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. Two iterations of this test were run on a sample of different species. The first was to analyze the entire dataset and then a second iteration of this non parametric trend analysis was done using a shortened time period of 10 years. While no species have any significant long term trend in abundance, winter flounder, tautog, and river herring 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.

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 2012.

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 (YOY). 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 2012 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 – 10 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. 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-six percent of the seine hauls for 2012. This is an increase from 2011 when they were present in fifty-two percent of the hauls. A total of 474 fish were collected in 2012 (all fish but two 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 2011. They were present at all but three stations (no presence at stations 10, 12, 14), and were collected in all months (Table 9).

The 2012 juvenile winter flounder standardized abundance index was 14.12 ± 3.05 S.E. fish/seine haul; this is higher than the 2011 index of 9.70 ± 2.17 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 does indicate a declining trend in the last 10 years (Table 1a, b).

July had the highest mean monthly abundance of 9.89 ± 2.26 S.E. Gaspee Pt (Sta. 1) and Pojac Pt (Sta. 4) had the highest mean station abundance of 14.0 ± 5.39 and 9.57 S.E. respectively, followed by Hog Island (Sta. 9) and Conimicut Pt (Sta. 2), with 12.4 ± 7.93 S.E. and 11.8 ± 5.89 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, but has happened over the past few survey years.

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 2012. 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 2012 survey indicate that all but two of the winter flounder collected were young-of-the-year (YOY). 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 2012 abundance index continues to be lower than most years since 2000, the survey high. The Division of Fish and Wildlife's trawl survey data (sampling both adults and juveniles) saw an increase in abundance from 2011 to 2012 during the spring seasonal survey, while the fall trawl survey was flat from 2011 to 2012. Over the course of the Narragansett Bay Juvenile Finfish Seine Survey the abundance index rose between 1995 and 2000, but then decreased with variability to 2012. While the Mann-Kendall trend analysis shows no trend in the abundance of juvenile winter flounder in Narragansett Bay over the entire time series, there is a declining trend indicated for the shortened 10 year time series. The dramatic abundance fluctuations over the past ten years shown in Figure 2 and the declining trend over the last decade continue to be a concern to resource managers.

Tautog

During the 2012 survey 350 juvenile tautog (*Tautoga onitis*) were collected. This is an increase over the 2011 survey when 104 juveniles were collected. The 2012 standardized abundance was one of the lower values in the survey time series, but was an increase from the previous year. The 2012 abundance index was 6.41 ± 1.81 S.E. fish/seine haul, an increase from the 2011 index of 2.48 ± 0.79 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. However, it may take some time for a slow growing species such as tautog to recoup its spawning stock biomass to levels that will have significant impacts; therefore we will continue to monitor this species closely in the coming years.

Juvenile tautog were collected in fifty-six percent of the seine hauls in 2012 (Table 10). This is an increase from 2011 when they were present in thirty-one percent of the seine hauls. In 2012 August had the highest mean monthly abundance of 7.61 ± 3.33 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. Conimicut Pt (Sta. 2) had the highest mean station abundance of 16.80 ± 9.49 S.E. followed by Patience Island (Sta. 5) with a mean station abundance of 15.00 ± 5.77 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 will be used as a young of the year index for the upcoming benchmarks in both the coastwide stock assessment by the Atlantic States Marine Fisheries Commission as well as the RI/MA regional tautog stock assessment.

Our Narragansett Bay spring trawl survey had a slight increase in the abundance of tautog in 2012, while the fall trawl survey saw a slight decrease. There would be a lag in time between when juveniles are caught in the seine survey and when the cohort shows up in the trawl survey, but the trends are worth monitoring.

Bluefish

During the 2012 survey 2,339 juvenile bluefish (*Pomatomus saltatrix*) were collected. This is significantly higher than the 738 juveniles collected in 2011. Juveniles were present in thirty-two percent of the seine hauls and were collected at sixteen of the eighteen stations (Table 11). They were present in all months with the exception of June. It should be noted that since this survey began only one hundred thirty-eight juvenile bluefish have been collected in October, in six different years (1990, 1997, 1999, 2005, 2011, and 2012), and only when water temperatures were 16 – 21° C.

The abundance index for 2012 was 3.81 ± 1.85 S.E. fish/seine haul. This is higher than the 2011 abundance index of 2.53 ± 1.22 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).

July had the highest mean monthly abundance of 61.44 ± 38.8 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 2012, Potters Cove (Sta. 8) had the highest mean station abundance of 138.60 ± 138.35 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 2012 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).

Striped Bass

During the 2012 survey 3 striped bass (*Morone saxatalis*) were collected. This is lower than the 6 fish collected in 2011. Striped bass were present in three percent of the seine hauls and were collected at three of the eighteen stations (Table 14). They were present in July and October.

The abundance index for 2012 was 0.06 ± 0.04 S.E. fish/seine haul. This is within the error level that occurred in 2011, which had an abundance index of 0.13 ± 0.07 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).

October had the highest mean monthly abundance 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 2012, Spar Island (Sta. 12), Spectacle Cove (Sta. 13), and Third Beach (Sta. 15) had the highest mean station abundances of 0.2 ± 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 2012 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 had an increasing trend during the late 90s to early 2000s, but now appears to be on a downward trajectory since 2008. 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. There do not appear to be any significant trends as indicated by the Mann-Kendall test.

Clupeidae

Four species of clupeids were collected during the 2012 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*) have also been collected during the surveys time series 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 sixteen percent of the seine hauls and were collected at eleven of the eighteen stations during 2012. River herring were present in all months except June in 2012. A total of 843 juveniles were collected in 2012, a significant decrease from the number collected in 2011 (2,795 fish).

The highest mean monthly abundance for 2012 occurred during July and was 44.94 ± 20.78 S.E. fish/seine haul. Dyer Island (Sta. 16) had the highest mean station abundance of 61.0 ± 61.0 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 standardized abundance index for 2012 was 3.86 ± 2.22 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, 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).

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 recent small increases in juvenile abundance 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

One-thousand three-hundred and fifty-two Atlantic menhaden (*Brevoortia tyrannus*) were collected during the 2012 survey, a large increase from 2011. They were present in twenty-eight percent of the seine hauls and were collected at fifteen of the eighteen stations (Table 12). By comparison eight thousand two hundred and fifty three juveniles were collected in 2007, which was much higher than in the past four years.

The highest mean monthly abundance for 2012 occurred during September and was 61.72 ± 61.25 S.E. fish/seine haul. Kickemuit River (Sta. 11) had the highest mean station abundance of 222.20 ± 220.20 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 standardized abundance index for 2012 was 14.37 ± 10.13 S.E. fish/seine haul. This was higher than the 2011 index of 1.55 ± 1.33 S.E (Figure 7). The standardized index indicates an increased abundance during the 2000s. In the most recent years a decreasing abundance is evident, though the 2012 estimate represents an increase. Our Narragansett Bay spring trawl survey had a slight increase in the abundance of menhaden in 2012, while the fall trawl survey was flat. The trawl survey catches juveniles as well as some age one fish. The Mann-Kendall test showed no long-term abundance trend for this species for both the long term and 10 year time period (Table 1a, b).

Similar to river herring, juvenile menhaden were also observed in very large schools around Narragansett Bay 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
One weakfish, *Cynocion regalis,* were collected during the 2012 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 weakfish that was caught was encountered at the Kickemuit River (Sta. 11) in 2012.

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 abundance index for 2012 was 0.01 ± 0.01 S.E. fish/seine haul. This was lower than the 2011 index of 0.02 ± 0.02 S.E (Figure 9). 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. A nominal index was developed, but due to the sparse nature of the data, the index generated should be viewed with caution.

Black Sea Bass
Three hundred and eight juvenile black sea bass (*Centropristis striata*) were collected in 2012 compared to ninety-nine collected during the 2007 survey, the last time a high recruitment event occurred in Narragansett Bay. The time series high was in 2001, with 105 juvenile black sea bass. The number of black sea bass has been highly variable from year to year during the time series of this survey, but the 2012 number stands out as unique. Black sea bass were caught in twenty-four percent of the seine hauls in 2012.

The highest mean monthly abundance for 2012 occurred during August and was 10.78 ± 5.39 S.E. fish/seine haul. Hog Island (Sta. 9) had the highest mean station abundance of 16.80 ± 16.80 S.E. (Table 13). Single large catches is the reason for the high standard error associated with the indices.

The abundance index for 2012 was 3.42 ± 1.33 S.E. fish/seine haul. This was higher than the 2011 index of 0.04 ± 0.03 S.E (Figure 10). Our Narragansett Bay spring and fall trawl survey had large increases in the abundance of black sea bass in 2012. This recruitment signal was seen not only in RI waters, but all along the Atlantic coast. The Mann-Kendall test showed no long-term abundance trend for this species for both the long term and 10 year time period (Table 1a, b).

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 2012 survey. These juveniles included scup (*Stenotomus chrysops*), Northern kingfish (*Menticirrhus saxatilis*), and windowpane flounder (*Scophthalmus aquosus*).

One-thousand four-hundred and four juvenile scup were collected in 2012 during June, August, September, and October. Eight hundred and sixteen Northern kingfish were collected in 2012 with the majority collected in August. Five windowpane flounder were collected in June and August. Four summer flounder were collected in 2012 in June, July, September, and October. One smallmouth flounder was caught in 2012. Relative to the sixty-eight smallmouth flounder that were caught in 2011, and the thirty-three that were caught in 2010, this is a decrease in abundance for 2012. 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. See Tables 3-8 for additional survey data on these species.

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 2012 survey ranged from a low of 15.7°C at Rose Island (Sta. 10) in June to a high of 28.3°C at Kickemuit River (Sta. 11) in August.

Salinities ranged from 22.7 *ppt* at Gaspee Pt. (Sta. 1) in June to 29 *ppt* at Third Beach (Sta. 15) in July.

There were no periods during 2012 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. There were two readings during 2012 that met the hypoxia definition; Gaspee Pt (Sta. 1) in September and Kickemuit River (Sta. 11) in August. DO ranged from 2.42 mg/l at Kickemuit River (Sta. 11) in August to 9.06 mg/l at Spar Island (Sta. 12) in June.

SUMMARY: In summary, data from the 2012 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, and river herring 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.

Sixty-eight species, both vertebrates and invertebrates, were collected in 2012. This is higher than, but fairly close to the survey mean for the past twenty-five 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 2012 nine 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

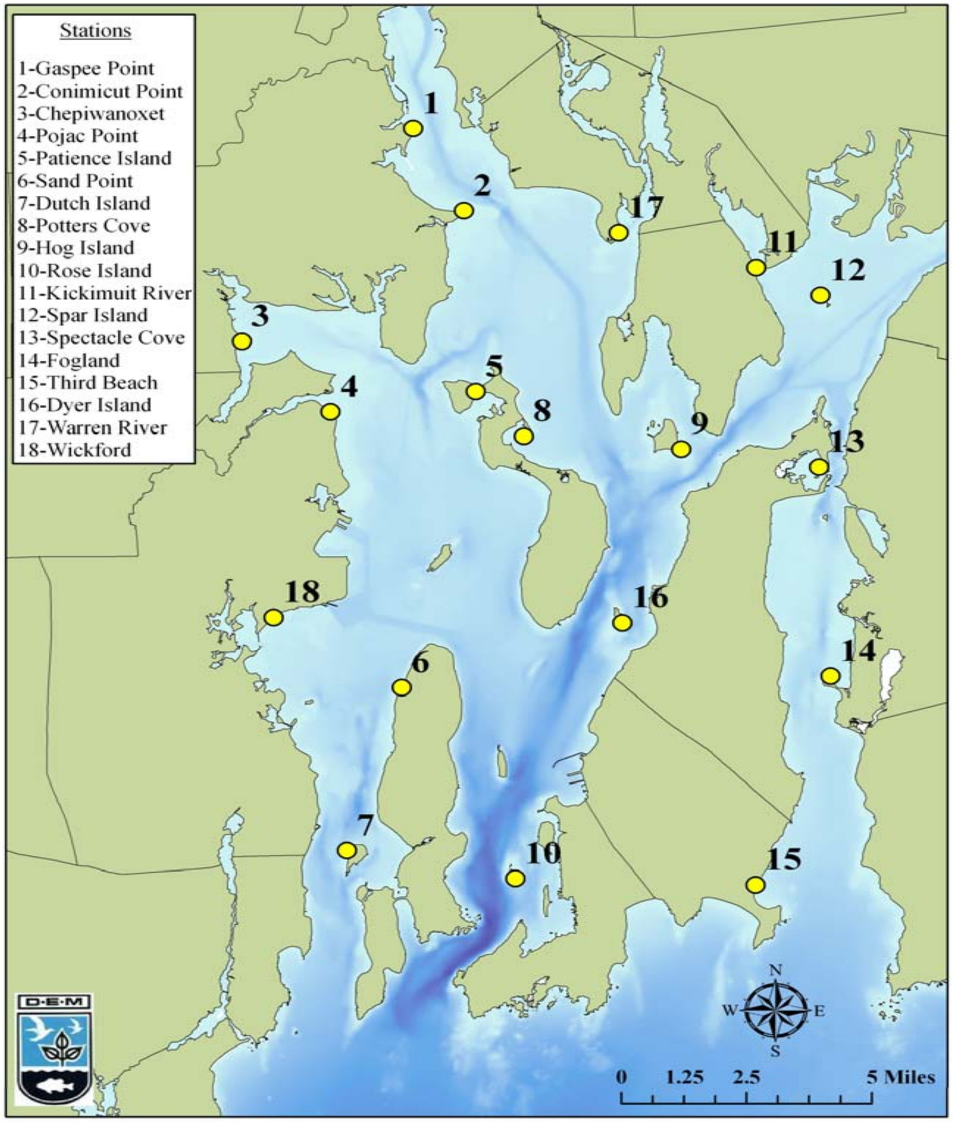


Figure 1. Survey station location map.

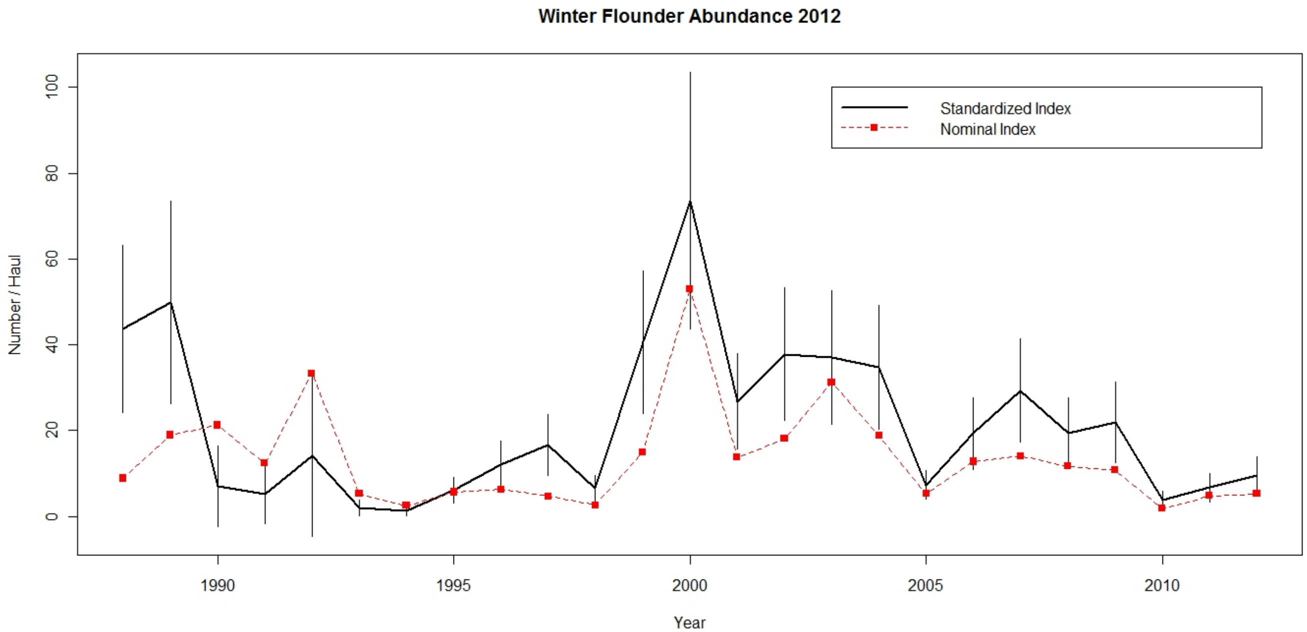


Figure 2. Juvenile winter flounder standardized abundance index 1988 – 2012 (see appendix A for standardization methodology).

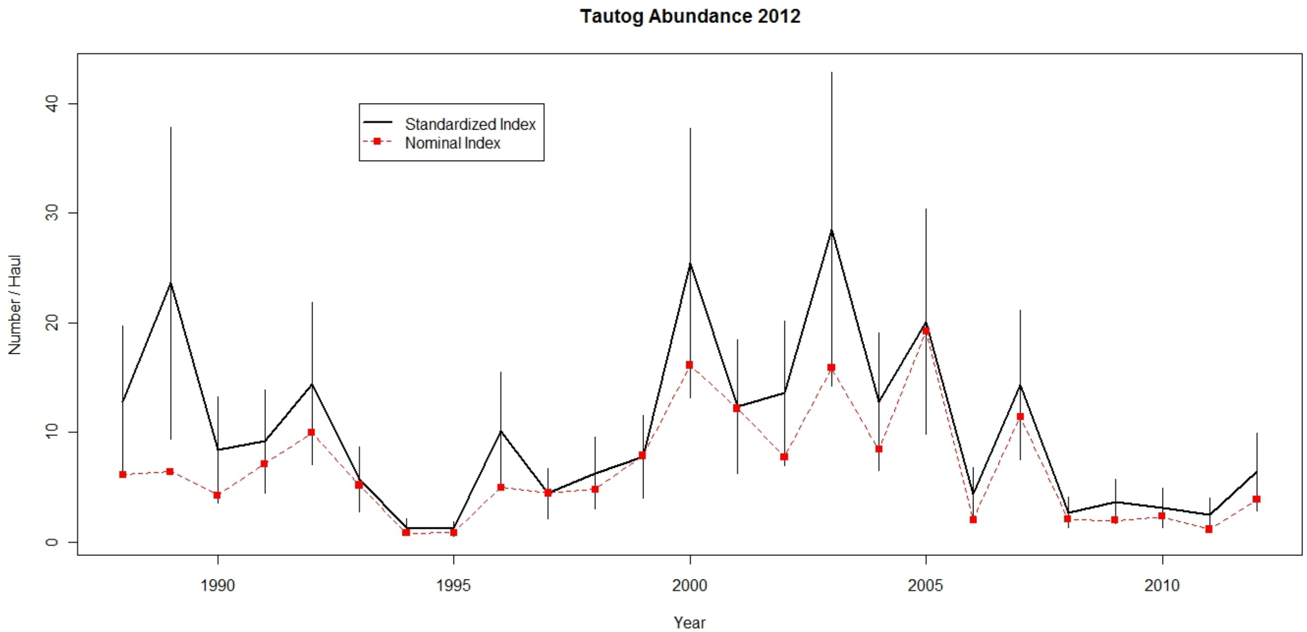


Figure 3. Juvenile tautog standardized annual abundance index 1988 – 2012 (see appendix A for standardization methodology).

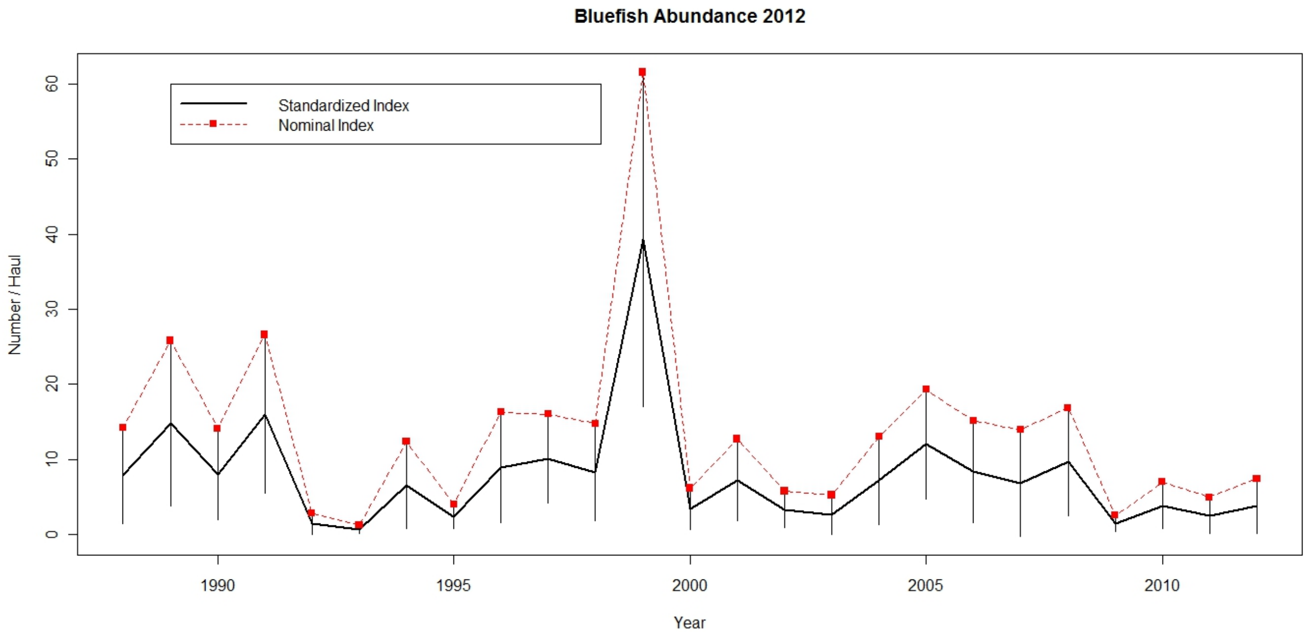


Figure 4. Juvenile bluefish standardized annual abundance index 1988 – 2012 (see appendix A for standardization methodology).

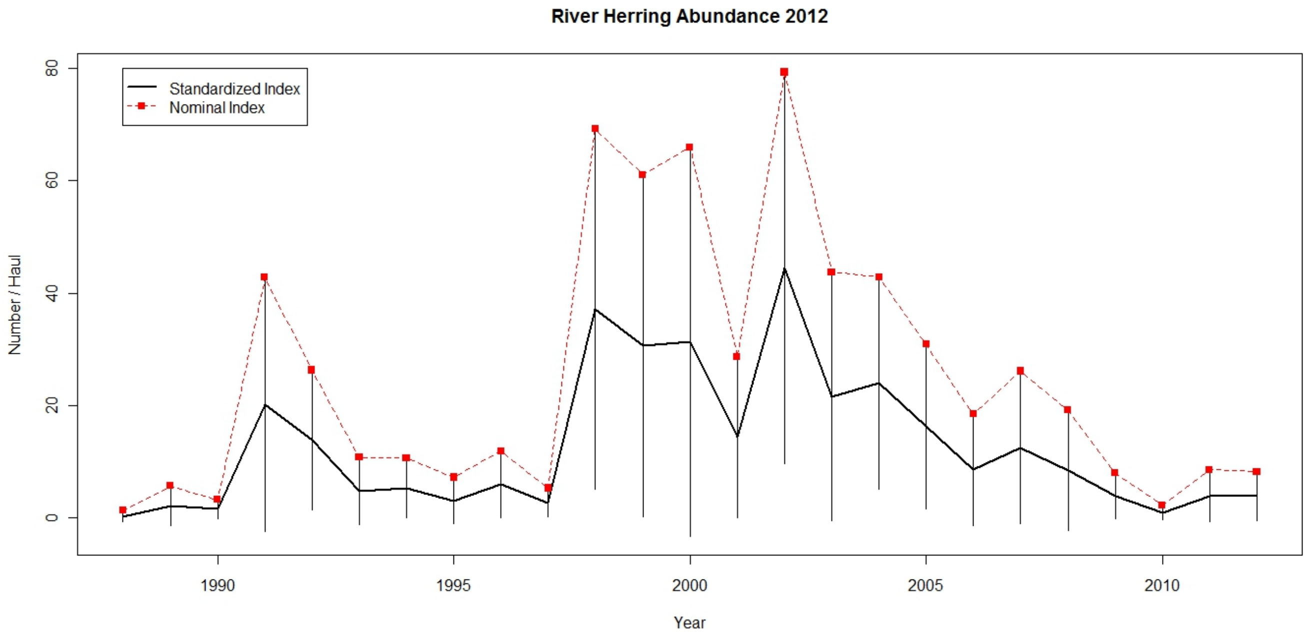
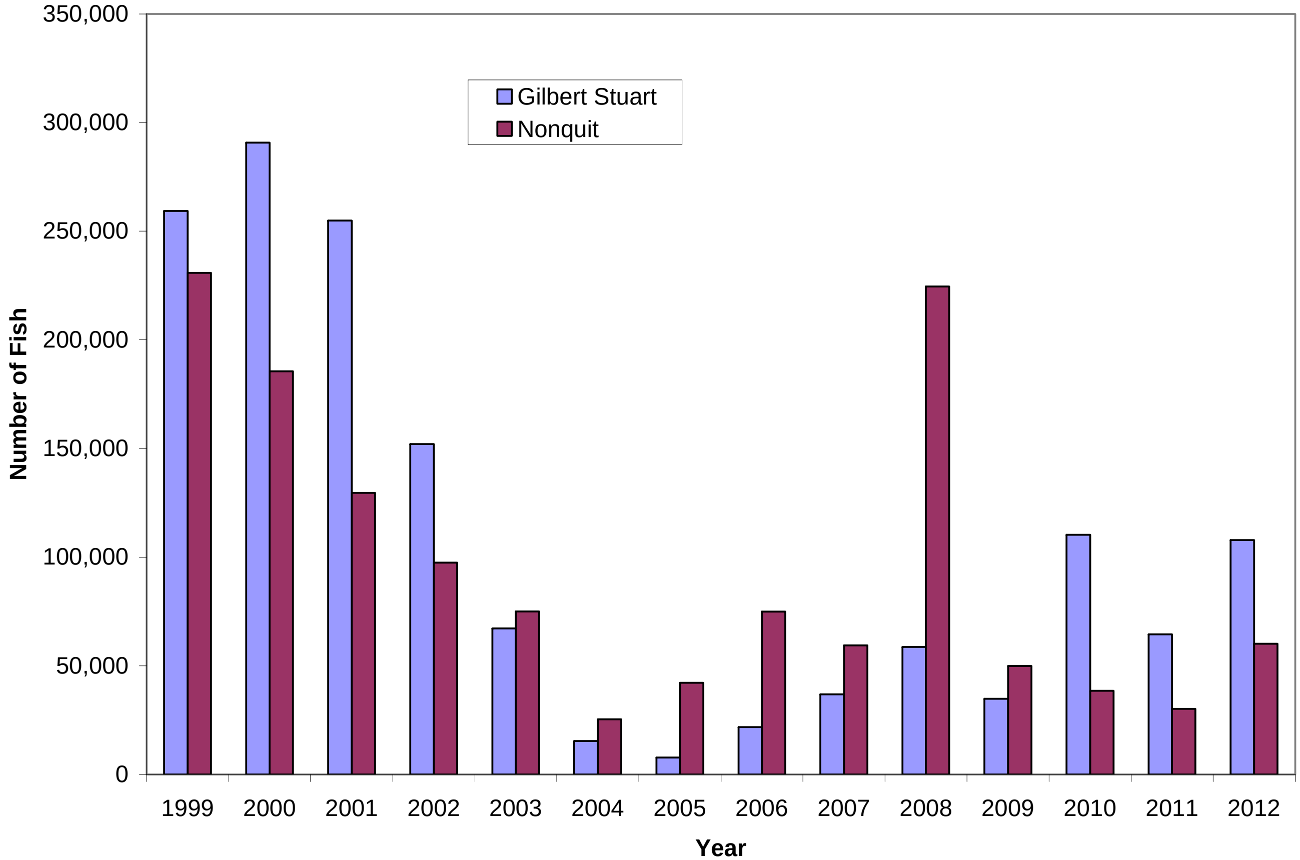


Figure 5. Juvenile river herring standardized annual abundance index 1988 – 2012 (see appendix A for standardization methodology).



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

Figure 6. River herring spawning stock size from monitoring at two locations 1999 – 2012.

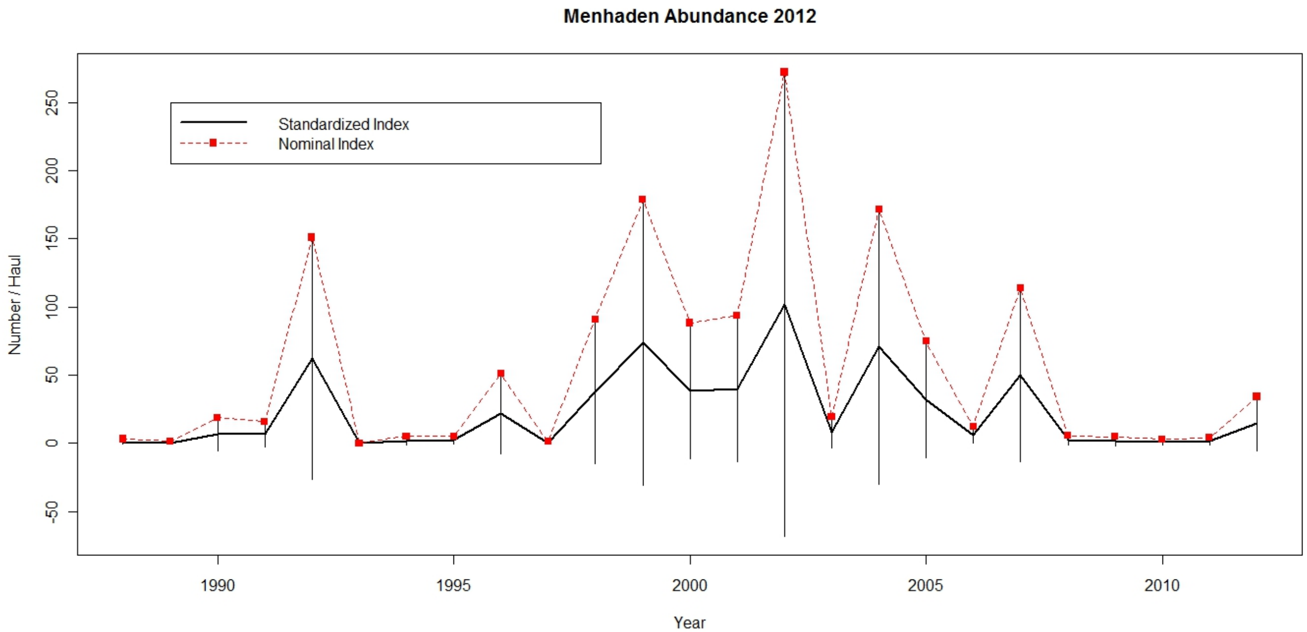


Figure 7. Juvenile menhaden standardized annual abundance index 1988 – 2012 (see appendix A for standardization methodology).

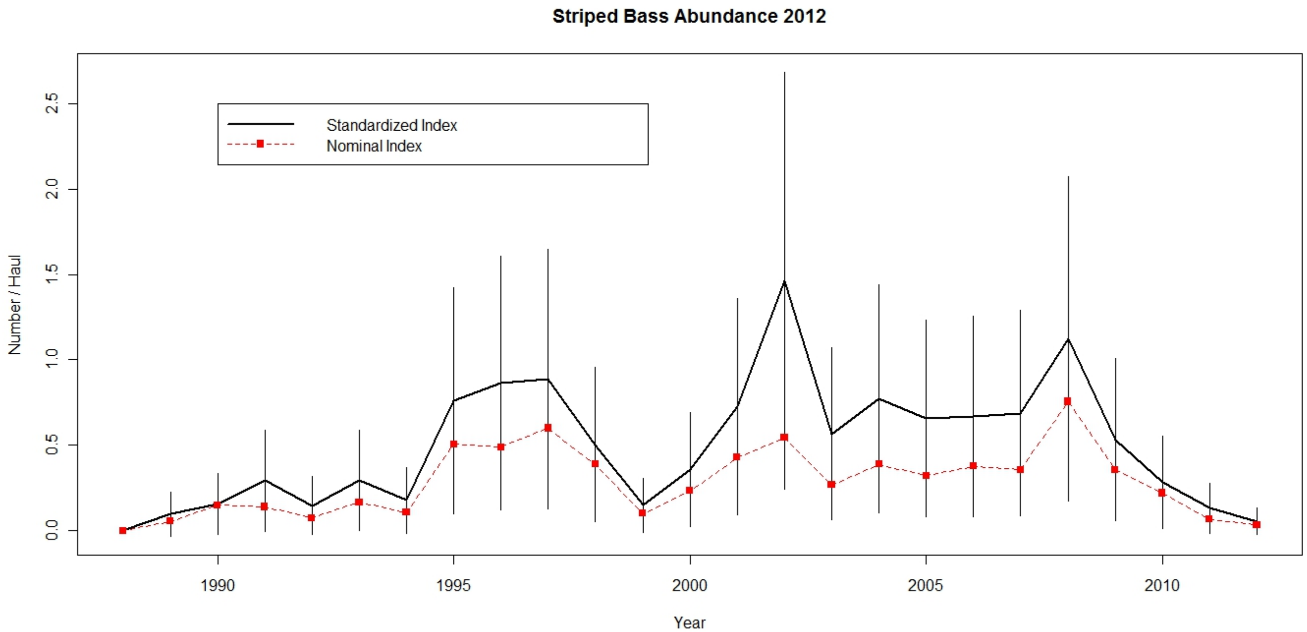


Figure 8. Striped bass standardized annual abundance index 1988 – 2012 (see appendix A for standardization methodology).

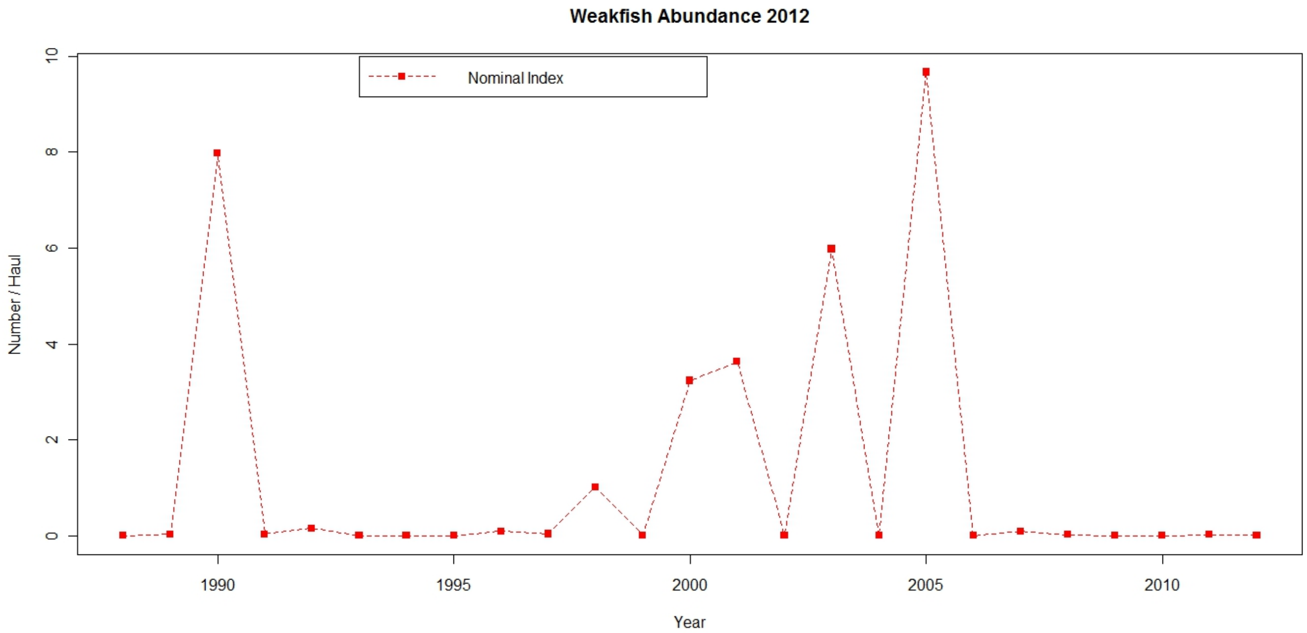


Figure 9. Weakfish annual abundance index 1988 – 2012.

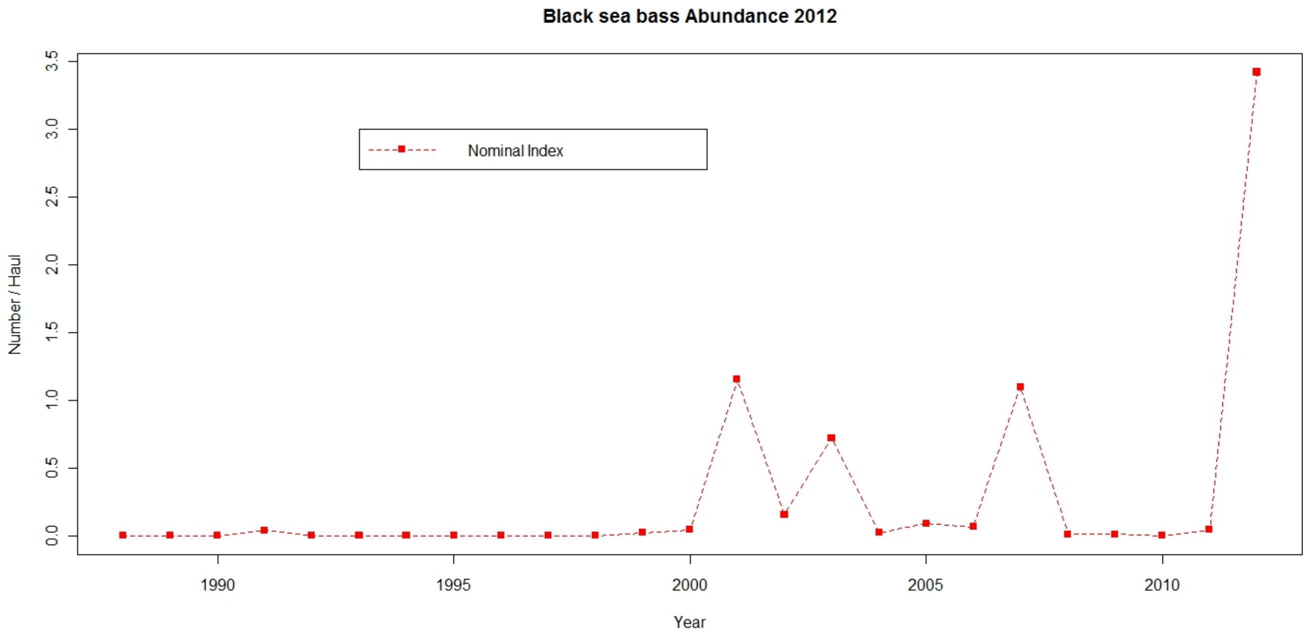


Figure 10. Black sea bass annual abundance index 1988 – 2012.

TABLES

Table 1a. Mann-Kendall test for target species abundance trend analysis (Full dataset; 1988 - 2012).

Mann-Kendall test	Winter Flounder	Tautog	Bluefish	River Herring	Menhaden	Striped Bass
S	10	-44	-42	14	26	60
n Observations	25	25	25	25	25	25
Variance	1833.3	1833.3	1833.3	1833.3	1833.3	1833.3
Tau	0.033	-0.147	-0.14	0.047	0.087	0.200
2-sided p value	0.834	0.315	0.338	0.761	0.559	0.168
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 (2003-2012).

Mann-Kendall test	Winter Flounder	Tautog	Bluefish	River Herring	Menhaden	Striped Bass
S	-23	-25	-13	-37	-21	-21
n Observations	10	10	10	10	10	10
Variance	125	125	125	125	125	125
Tau	-0.511	-0.556	-0.289	-0.822	-0.467	-0.467
2-sided p value	0.049	0.032	0.283	0.001	0.074	0.074
α	0.05	0.05	0.05	0.05	0.05	0.05
Significant Trend	Yes ↓	Yes ↓	No	Yes↓	No	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 presence by station for June 2012.

	Station																	
Scientific Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Anchoa mitchilli		1	1	1														1
Apeltes quadracus					1			1					1					
Calinectes sapidus		1	1	1				1					1					
Cancer irroratus																	1	
Carcinus maenus		1				1	1				1		1					
Crangon septemspinosa		1	1	1	1			1					1	1	1	1		1
Crepidula fornicata	1								1			1		1				
Ctenophora phylum										1								
Cyprinodon variegatus								1					1				1	
Emerita talpoida															1			
Fundulus heteroclitus	1	1	1	1	1	1					1		1	1	1		1	
Fundulus majalis	1	1	1		1	1					1		1	1				1
Gasterosteus aculeatus														1				
Geukensia demissa			1															
Gobiosoma bosc	1												1				1	1
Hemigrapsus sanguineus										1								
Isopoda order															1			
Libinia emarginata	1	1	1	1	1			1			1		1					
Limulus polyphemus		1			1			1										
Littorina littorea						1	1						1	1	1			1
Menidia menidia	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1
Mercenaria mercenaria			1	1														
Microgadus tomcod													1					
Mya arenaria	1																	
Myoxocephalus aenaeus													1					
Mytilus edulis									1									
Nassarius obsoletus		1	1	1							1	1						
Nassarius trivittatus																		1
Ovalipes ocellatus								1										
Pagurus spp	1	1	1	1	1		1	1	1		1			1	1	1	1	1
Palaemonetes vulgaris	1	1		1	1		1				1	1	1			1		
Panopeus spp	1		1	1	1	1		1			1		1			1	1	
Paralichthys dentatus		1																
Pseudopleuronectes americanus	1	1	1	1		1	1	1	1		1		1			1	1	1
Scophthalmus aquosus															1			
Stenotomus chrysops			1															
Syngnathus fuscus	1	1	1		1		1		1				1			1		1
Tautoga onitis		1			1							1				1		
Tautogolabrus adspersus							1											
Urophycis regia					1		1						1					1

Table 4. Species presence by station for July 2012.

Scientific Name	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Alosa aestivalis &/or pseudoharengus			1		1				1				1	1		1		1
Anchoa mitchilli				1			1										1	
Apeltes quadracus			1															
Brevoortia tyrannus			1															
Calinectes sapidus	1	1	1	1										1				
Carcinus maenus	1	1	1	1	1			1	1	1			1			1		
Centropristus striata					1													
Clupea harengus							1											
Crangon septemspinosa	1	1	1	1	1			1	1				1		1			
Crepidula fornicata									1			1	1	1	1			
Ctenophora phylum							1	1			1							
Fundulus heteroclitus	1		1	1	1	1		1	1		1		1	1	1	1	1	
Fundulus majalis	1	1	1	1		1			1		1		1	1		1	1	
Gasterosteus aculeatus										1								
Gobiosoma bosc									1					1				
Hemigrapsus sanguineus										1								
Libinia emarginata	1	1	1		1			1			1							
Littorina littorea		1	1			1							1		1	1	1	
Menidia menidia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1
Menticirrhus saxatilis		1	1	1											1		1	
Mercenaria mercenaria				1														
Microgadus tomcod									1							1		
Morone saxatilis													1					
Mugil curema											1							
Mya arenaria		1																
Myoxocephalus aenaeus					1				1	1	1		1			1		
Mytilus edulis		1														1		
Nassarius obsoletus			1	1				1	1				1					
Opsanus tau											1							
Ovalipes ocellatus			1												1			1
Pagurus spp		1	1	1	1		1	1	1	1	1				1	1	1	1
Palaemonetes vulgaris	1	1	1	1	1		1	1	1		1	1	1			1		
Panopeus spp	1	1	1	1	1			1	1		1	1		1		1		
Paralichthys dentatus															1			
Pomatomus saltatrix				1	1		1					1			1	1	1	1
Prionotus evolans				1														
Pseudopleuronectes americanus	1	1	1	1	1		1	1	1		1		1			1	1	1
Sphoeroides maculatus			1	1		1		1	1						1	1	1	1
Syngnathus fuscus			1	1				1		1	1		1					
Tautoga onitis	1	1	1		1	1					1	1	1			1		
Tautogolabrus adspersus												1						
Tunicata												1						

Table 5. Species presence by station for August 2012.

	Station																	
Scientific Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Alosa aestivalis &/or pseudoharengus							1			1	1							
Anchoa mitchilli												1						
Brevoortia tyrannus		1	1		1	1	1	1	1	1	1	1	1		1		1	1
Calinectes sapidus	1	1	1		1		1		1		1		1	1	1			1
Carcinus maenus		1			1	1		1	1	1						1		
Centropristus striata		1			1		1		1	1	1		1		1	1		1
Crangon septemspinosa			1			1					1	1						
Crepidula fornicata								1				1		1				
Ctenophora phylum					1	1				1	1	1		1	1			
Cynoscion regalis											1							
Fistularia tabacaria										1								
Fundulus heteroclitus	1	1	1			1		1	1		1		1	1		1	1	
Fundulus majalis	1	1	1	1		1		1	1	1	1		1	1	1	1	1	1
Gobiosoma bosc			1															
Hemigrapsus sanguineus						1										1		
Hippocampus genus														1				
Isopoda order														1				
Libinia emarginata	1	1			1						1					1	1	
Littorina littorea			1			1								1				
Menidia menidia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Menticirrhus saxatilis	1	1	1	1	1				1	1	1	1			1	1	1	1
Microgadus tomcod																1		
Mullidae family							1											
Myoxocephalus aenaeus							1									1		
Mytilus edulis	1									1						1		
Nassarius obsoletus			1		1						1		1				1	
Ovalipes ocellatus			1	1	1									1	1			
Pagurus spp						1	1	1	1		1				1	1		
Palaemonetes vulgaris	1	1	1						1	1	1	1	1	1			1	
Panopeus spp		1			1	1		1	1		1		1	1		1		
Pholis gunnellus																1		
Pomatomus saltatrix	1	1	1	1	1		1	1				1		1			1	1
Prionotus evolans	1	1	1					1	1		1			1	1			1
Pseudopleuronectes americanus	1	1	1				1		1		1		1		1		1	1
Scophthalmus aquosus															1			
Sphoeroides maculatus	1	1			1				1		1		1		1			1
Sphyraena borealis							1											
Stenotomus chrysops		1	1		1		1		1						1	1		1
Syngnathus fuscus					1						1				1			1
Synodus foetens															1			1
Tautoga onitis	1	1	1	1	1		1		1	1	1	1		1		1	1	1
Tautogolabrus adspersus					1		1		1	1						1		

Table 6. Species presence by station for September 2012.

Scientific Name	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Alosa aestivalis &/or pseudoharengus										1	1							
Anchoa mitchilli				1														
Apeltes quadracus	1																	
Arcopectin irradians	1																	
Brevoortia tyrannus		1		1				1		1	1	1					1	1
Calinectes sapidus	1	1	1	1	1								1				1	
Carcinus maenus	1	1			1		1	1	1							1	1	
Centropristus striata		1			1	1	1			1	1		1			1		
Crangon septemspinosa	1												1					
Crassostrea virginica				1									1					
Crepidula fornicata	1		1	1		1			1									
Ctenophora phylum						1	1		1	1						1		
Cyprinodon variegatus									1							1		
Emerita talpoida															1			
Eucinostomus argenteus							1											
Fundulus heteroclitus	1		1	1		1			1				1	1				
Fundulus majalis	1	1	1	1	1	1		1	1	1	1				1	1	1	1
Hemigrapsus sanguineus					1											1		
Hippocampus genus					1													
Isopoda order							1											
Libinia emarginata	1	1	1					1		1							1	
Littorina littorea						1		1						1	1			
Menidia menidia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Menticirrhus saxatilis	1	1		1				1	1		1	1			1	1		
Mercenaria mercenaria			1															
Microgadus tomcod										1								
Mugil curema						1		1					1					1
Myoxocephalus aenaeus									1	1								
Mytilus edulis		1			1													
Nassarius obsoletus	1		1	1									1					
Nassarius trivittatus					1	1	1											
Ovalipes ocellatus	1						1											1
Pagurus spp		1	1	1	1	1	1	1	1		1	1	1	1		1	1	1
Palaemonetes vulgaris	1	1	1	1	1								1	1				
Panopeus spp		1	1		1											1		
Paralichthys dentatus																		1
Pomatomus saltatrix	1			1			1	1	1		1	1	1				1	
Prionotus evolans				1			1											
Pseudopleuronectes americanus	1			1					1				1					
Seriola zonata															1			
Sphoeroides maculatus		1						1	1		1		1	1	1	1	1	
Stenotomus chrysops		1	1	1			1	1	1		1		1		1		1	
Strongylura marina	1											1					1	1
Syngnathus fuscus	1	1	1	1							1							
Synodus foetens				1														1
Tautoga onitis	1	1	1		1	1	1		1	1		1	1	1	1	1		
Tautogolabrus adspersus					1	1	1					1						

Table 7. Species presence by station for October 2012.

Scientific Name	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Chrysaora quinquecirrha						1				1								
Alosa aestivalis &/or pseudoharengus		1											1					
Arcopectin irradians			1															
Brevoortia tyrannus											1				1			
Busycon carica												1						
Calinectes sapidus			1										1					1
Carcinus maenus	1	1		1	1	1		1		1	1		1	1		1		
Centropristus striata					1		1			1								
Crangon septemspinosa	1		1															1
Crassostrea virginica								1										
Crepidula fornicata	1			1					1									
Ctenophora phylum							1						1	1	1	1		1
Cyprinodon variegatus			1								1					1		
Emerita talpoida					1													
Etropus microstomus															1			
Eucinostomus argenteus							1											
Fundulus heteroclitus	1		1	1		1			1		1		1	1				
Fundulus majalis	1	1	1	1		1		1	1	1	1		1	1	1	1	1	1
Geukensia demissa																	1	
Gobiosoma bosc	1																	
Libinia emarginata	1		1		1												1	
Littorina littorea					1	1	1	1			1			1			1	
Menidia menidia	1	1	1	1		1	1	1	1	1	1		1	1	1	1		1
Menticirrhus saxatilis		1		1							1		1		1	1		
Morone saxatilis												1			1			
Mugil curema		1													1			
Mytilus edulis					1											1		
Nassarius obsoletus			1	1				1				1	1		1		1	1
Ovalipes ocellatus									1									
Pagurus spp			1	1				1	1	1				1		1	1	1
Palaemonetes vulgaris	1	1	1			1			1		1		1			1	1	1
Panopeus spp	1	1			1						1	1					1	
Paralichthys dentatus							1											
Pomatomus saltatrix													1					
Pseudopleuronectes americanus	1	1	1	1	1	1	1		1				1					1
Sphoeroides maculatus							1											
Sphyraena borealis										1								
Stenotomus chrysops		1									1		1					
Strongylura marina	1																	
Syngnathus fuscus			1															
Tautoga onitis		1	1		1	1	1		1	1			1			1	1	
Tautogolabrus adspersus					1					1						1	1	
Trachinotus falcatus															1			

Table 8. Summary of species occurrence by station in 2012.

Scientific Name	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Chrysaora quinquecirrha						1				1								
Alosa aestivalis &/or pseudoharengus		1	1		1		1		1	2	2		2	1		1		1
Anchoa mitchilli		1	1	3			1					1					1	1
Apeltes quadracus	1		1		1			1					1					
Arcopectin irradians	1		1															
Brevoortia tyrannus		2	2	1	1	1	1	2	1	2	3	2	1		2		2	2
Busycon carica												1						
Calinectes sapidus	3	4	5	3	2		1	1	1		1		4	2	1		1	2
Cancer irroratus																	1	
Carcinus maenus	3	5	1	2	4	3	2	4	3	3	2		3	1		4	1	
Centropristus striata		2			4	1	3		1	3	2		2		1	2		1
Clupea harengus							1											
Crangon septemspinosa	3	2	4	2	2	1		2	1		1	1	3	1	2	1		2
Crassostrea virginica				1				1					1					
Crepidula fornicata	3		1	2		1		1	4			3	1	3	1			
Ctenophora phylum					1	2	3	1	1	3	2	1	1	2	2	2		1
Cynoscion regalis											1							
Cyprinodon variegatus			1					1	1		1		1			2	1	
Emerita talpoida					1										2			
Etropus microstomus															1			
Eucinostomus argenteus							2											
Fistularia tabacaria										1								
Fundulus heteroclitus	5	2	5	4	2	5		2	4		4		5	5	2	2	3	
Fundulus majalis	5	5	5	4	2	5		3	4	3	5		4	4	3	4	4	4
Gasterosteus aculeatus										1				1				
Geukensia demissa			1														1	
Gobiosoma bosc	2		1						1				1	1			1	1
Hemigrapsus sanguineus					1	1				2						2		
Hippocampus genus					1									1				
Isopoda order							1							1	1			
Libinia emarginata	5	4	4	1	4			3		1	3		1			1	3	
Limulus polyphemus		1			1			1										
Littorina littorea		1	2		1	5	2	2			1		2	4	3	1	2	1
Menidia menidia	5	5	5	5	4	5	5	5	5	4	5	4	5	5	5	4	4	5
Menticirrhus saxatilis	2	4	2	4	1			1	2	1	3	2	1		4	3	2	1
Mercenaria mercenaria			2	2														
Microgadus tomcod									1	1			1			2		
Morone saxatilis												1	1		1			
Mugil curema		1				1		1			1		1		1			1
Mullidae family							1											
Mya arenaria	1	1																
Myoxocephalus aenaeus					1		1		2	2	1		2			2		
Mytilus edulis	1	2			2				1	1						3		
Nassarius obsoletus	1	1	5	4	1			2	1		2	2	4		1		2	1
Nassarius trivittatus					1	1	1											1
Opsanus tau											1							
Ovalipes ocellatus	1		2	1	1		1	1	1					1	2			2
Pagurus spp	1	3	4	4	3	2	4	5	5	2	4	1	1	3	3	5	4	4
Palaemonetes vulgaris	5	5	4	3	3	1	2	1	3	1	4	3	5	2		3	2	1
Panopeus spp	3	4	3	2	5	2		3	2		4	2	2	2		4	2	
Paralichthys dentatus		1					1								1			1
Pholis gunnellus																1		
Pomatomus saltatrix	2	1	1	3	2		3	2	1		1	3	2	1	1	1	3	2
Prionotus evolans	1	1	1	2			1	1	1		1			1	1			1
Pseudopleuronectes americanus	5	4	4	4	2	2	4	2	5		3		5		1	2	3	4
Scophthalmus aquosus															2			
Seriola zonata															1			
Sphoeroides maculatus	1	2	1	1	1	1	1	2	3		2		2	1	3	2	2	2
Sphyraena borealis							1			1								
Stenotomus chrysops		3	3	1	1		2	1	2		2		2		2	1	1	1
Strongylura marina	2											1					1	1
Syngnathus fuscus	2	2	4	2	2		1	1	1	1	3		2		1	1		2
Synodus foetens				1											1			2
Tautoga onitis	3	5	4	1	5	3	3		3	3	2	4	3	2	1	5	2	1
Tautogolabrus adspersus					3	1	3		1	2		2				2	1	
Trachinotus falcatus															1			
Tunicata												1						
Urophycis regia					1		1						1					1

* 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 2012.

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	22	27	17	14	0	1	4	3	7	0	4	0	17	0	0	1	24	17	8.78	9.57	2.26
JUL	17	25	19	51	10	0	1	3	5	0	5	0	30	0	0	1	3	8	9.89	13.83	3.26
AUG	28	6	3	0	0	0	1	0	44	0	8	0	9	0	1	0	3	12	6.39	11.71	2.76
SEP	1	0	0	2	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0.39	0.85	0.20
OCT	2	1	1	3	1	1	1	0	3	0	0	0	1	0	0	0	0	2	0.89	1.02	0.24
Mean	14.00	11.80	8.00	14.00	2.20	0.40	1.40	1.20	12.40	0.00	3.40	0.00	11.60	0.00	0.20	0.40	6.00	7.80			
St Dev	12.06	13.18	9.22	21.39	4.38	0.55	1.52	1.64	17.74	0.00	3.44	0.00	12.24	0.00	0.45	0.55	10.17	7.01			
SE	5.39	5.89	4.12	9.57	1.96	0.24	0.68	0.73	7.93	0.00	1.54	0.00	5.47	0.00	0.20	0.24	4.55	3.14		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 2012.

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	14	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0.94	3.28	0.77
JUL	2	7	7	0	12	1	0	0	0	0	4	6	2	0	0	2	0	0	2.39	3.47	0.82
AUG	6	54	1	1	34	0	4	0	8	5	4	2	0	1	0	2	1	14	7.61	14.13	3.33
SEP	5	7	4	0	21	3	9	0	4	8	0	2	3	1	1	9	0	0	4.28	5.24	1.24
OCT	0	2	1	0	7	1	1	0	46	4	0	0	1	0	0	8	5	0	4.22	10.73	2.53
Mean	2.60	16.80	2.60	0.20	15.00	1.00	2.80	0.00	11.60	3.40	1.60	2.20	1.20	0.40	0.20	4.40	1.20	2.80			
St Dev	2.79	21.23	2.88	0.45	12.90	1.22	3.83	0.00	19.51	3.44	2.19	2.28	1.30	0.55	0.45	3.78	2.17	6.26			
SE	1.25	9.49	1.29	0.20	5.77	0.55	1.71	0.00	8.73	1.54	0.98	1.02	0.58	0.24	0.20	1.69	0.97	2.80		Total Fish	
Number	13	84	13	1	75	5	14	0	58	17	8	11	6	2	1	22	6	14		350	

Table 11. Numbers of juvenile bluefish per seine haul in 2012.

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
JUL	0	0	0	7	402	0	24	0	0	0	0	604	0	0	29	16	23	1	61.44	164.62	38.80
AUG	1	7	2	64	12	0	24	692	0	0	0	1	0	15	0	0	77	8	50.17	161.73	38.12
SEP	13	0	0	250	0	0	5	1	15	0	4	11	1	0	0	0	24	0	18.00	58.31	13.74
OCT	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0.33	1.41	0.33
Mean	2.80	1.40	0.40	64.20	82.80	0.00	10.60	138.60	3.00	0.00	0.80	123.20	1.40	3.00	5.80	3.20	24.80	1.80			
St Dev	5.72	3.13	0.89	107.28	178.51	0.00	12.40	309.36	6.71	0.00	1.79	268.82	2.61	6.71	12.97	7.16	31.46	3.49			
SE	2.56	1.40	0.40	47.98	79.83	0.00	5.55	138.35	3.00	0.00	0.80	120.22	1.17	3.00	5.80	3.20	14.07	1.56		Total Fish	
Number	14	7	2	321	414	0	53	693	15	0	4	616	7	15	29	16	124	9		2339	

Table 12. Numbers of juvenile menhaden per seine haul in 2012.

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
JUL	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.11	0.47	0.11
AUG	0	3	1	0	100	1	1	1	8	2	1	2	1	0	106	0	2	2	12.83	32.87	7.75
SEP	0	1	0	1	0	0	0	1	0	1	1103	1	0	0	0	0	2	1	61.72	259.87	61.25
OCT	0	0	0	0	0	0	0	0	0	0	7	0	0	0	1	0	0	0	0.44	1.65	0.39
Mean	0.00	0.80	0.60	0.20	20.00	0.20	0.20	0.40	1.60	0.60	222.20	0.60	0.20	0.00	21.40	0.00	0.80	0.60			
St Dev	0.00	1.30	0.89	0.45	44.72	0.45	0.45	0.55	3.58	0.89	492.39	0.89	0.45	0.00	47.29	0.00	1.10	0.89			
SE	0.00	0.58	0.40	0.20	20.00	0.20	0.20	0.24	1.60	0.40	220.20	0.40	0.20	0.00	21.15	0.00	0.49	0.40		Total Fish	
Number	0	4	3	1	100	1	1	2	8	3	1111	3	1	0	107	0	4	3		1352	

Table 13. Numbers of juvenile river herring per seine haul in 2012.

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
JUL	0	0	167	0	10	0	0	0	176	0	0	0	5	19	0	305	0	127	44.94	88.17	20.78
AUG	0	0	0	0	0	0	1	0	0	13	1	0	0	0	0	0	0	0	0.83	3.05	0.72
SEP	0	0	0	0	0	0	0	0	0	13	1	0	0	0	0	0	0	0	0.78	3.06	0.72
OCT	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0.28	0.83	0.19
Mean	0.00	0.40	33.40	0.00	2.00	0.00	0.20	0.00	35.20	5.20	0.40	0.00	1.60	3.80	0.00	61.00	0.00	25.40			
St Dev	0.00	0.89	74.68	0.00	4.47	0.00	0.45	0.00	78.71	7.12	0.55	0.00	2.30	8.50	0.00	136.40	0.00	56.80			
SE	0.00	0.40	33.40	0.00	2.00	0.00	0.20	0.00	35.20	3.18	0.24	0.00	1.03	3.80	0.00	61.00	0.00	25.40		Total Fish	
Number	0	2	167	0	10	0	1	0	176	26	2	0	8	19	0	305	0	127		843	

Table 14. Numbers of striped bass per seine haul in 2012.

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	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	1	0	0	0	0	0	0.06	0.24	0.06
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
OCT	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0.11	0.32	0.08
Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.00	0.20	0.00	0.00	0.00			
St Dev	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.45	0.00	0.45	0.00	0.00	0.00			
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.00	0.20	0.00	0.00	0.00		Total Fish	
Number	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0		3	

Table 15. Temperature, salinity, and dissolved oxygen by station and month – 2012 (NA indicates a day where batteries failed on
YSI

Station	Data	JUN	JUL	AUG	SEP	OCT
1	Average of Temp (C)	21	25.2	25.9	24	21
	Average of Salinity	22.7	25.2	24.8	23.2	24.2
	Average of DO	7.96	6.88	5.2	2.84	6.12
2	Average of Temp (C)	19.6	24.4	25.7	24.2	20.6
	Average of Salinity	24.7	26	25.5	24.1	24.5
	Average of DO	6.02	6.46	5.26	4.04	6.24
3	Average of Temp (C)	21	27.5	27.8	22.5	16.6
	Average of Salinity	25	27.4	27.3	25.8	26.1
	Average of DO	7.83	3.57	3.2	8.73	7.33
4	Average of Temp (C)	18.1	25	26.4	21.7	19.8
	Average of Salinity	26	25.8	27.1	25	26.2
	Average of DO	7.59	5.53	7.47	7.15	6.87
5	Average of Temp (C)	18.7	25.2	24.9	21.3	16.3
	Average of Salinity	26.1	27.9	27.7	26.7	27.2
	Average of DO	6.27	6.67	5.33	4.95	5.78
6	Average of Temp (C)	18.5	25.4	26	21.1	18.7
	Average of Salinity	27	28.5	28.4	27.6	27.8
	Average of DO	6.52	3.83	5.02	5.38	7.35
7	Average of Temp (C)	17.2	23.2	24.1	21.4	18.7
	Average of Salinity	27.5	28.5	28.9	28.2	28.5
	Average of DO	7.1	5.79	4.85	5.77	7.35
8	Average of Temp (C)	17	24.7	27.3	23.2	18.6
	Average of Salinity	25.8	27.4	27.7	27.5	26.6
	Average of DO	6.8	5.94	7.04	5	5.77
9	Average of Temp (C)	16.8	24.2	25.9	22.7	18.8
	Average of Salinity	27.1	27.3	28	27.8	26.7
	Average of DO	5.68	5.77	6.37	4.88	8.62
10	Average of Temp (C)	15.7	21.1	21.3	21.1	18.3
	Average of Salinity	28.6	28.6	28.9	28.4	28.8
	Average of DO	6.61	5.21	6.51	8.62	7.48
11	Average of Temp (C)	20.5	25.1	28.3	23.5	16.8
	Average of Salinity	24.5	26.3	26.6	24.5	25.8
	Average of DO	6.04	4.45	2.42	4.88	4.75
12	Average of Temp (C)	20.3	24.5	26	23.9	17.2
	Average of Salinity	29	26.5	27.2	24.4	26.1
	Average of DO	9.06	6.27	6.95	5.14	6.21
13	Average of Temp (C)	21	25.9	26.5	24.2	17.4
	Average of Salinity	27.1	27.9	28	27.3	27.7
	Average of DO	7.4	5.72	6.05	5.46	5.2
14	Average of Temp (C)	20.3	24.6	26.3	24.8	17.3
	Average of Salinity	27.9	28.5	28.4	28	27.7
	Average of DO	7.19	6.37	6.64	8.03	7.17
15	Average of Temp (C)	20	24.7	25	23.7	na
	Average of Salinity	28.1	29	28.6	28.5	na
	Average of DO	7.35	6.42	6.3	6.46	na
16	Average of Temp (C)	16.3	23.2	23.9	21.8	18.5
	Average of Salinity	27.6	27.7	28.4	28.2	28.1
	Average of DO	6.14	6.87	6.1	5.77	6.74
17	Average of Temp (C)	17.1	25	27.1	23.4	17
	Average of Salinity	26.2	26.8	27	26.7	26.3
	Average of DO	5.44	6.18	5.85	5.11	5.33
18	Average of Temp (C)	18.7	23.8	na	23	18.6
	Average of Salinity	26.8	28.3	na	27.3	27.2
	Average of DO	6.11	4.85	na	7.25	7.34

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	25	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 – Negative Binomial Generalized Linear Model

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	25	1988-2012
	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	25	1988-2012
	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	25	1988-2012
	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 negative binomial generalized linear model approach was used to develop standardized indices of abundance for the seine survey data. This method produces a generalized linear model (GLM) for the catch rates on all 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).

During the analysis of catch rates on hauls, a model assuming a 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 were:

Winter Flounder: Abundance = Year + Temperature + + Station + Station Periods
Tautog: Abundance = Year + Temperature + Station + Salinity
Striped Bass: Abundance = Year + Station

NO JOB 5

Assessment of Recreationally Important Finfish Stocks in RI Waters
2012 Annual Performance Report:
F-61-R, Segment 20, Job Number VI: Environmental Assessment Review

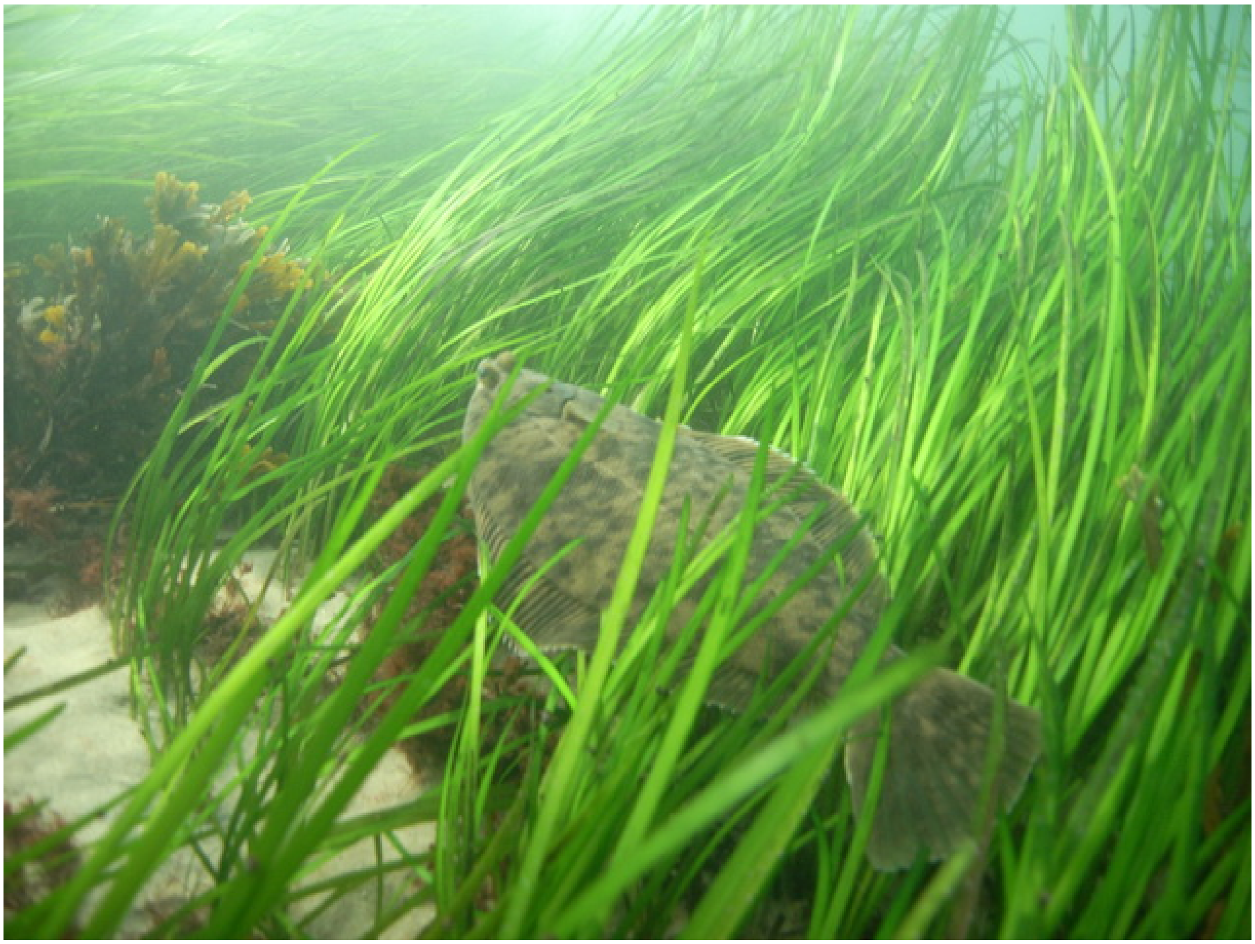


Photo Credit: NOAA Fisheries

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State: Rhode Island
Project No.: F-61-R
Segment No.: 20
Project title: Assessment of Recreationally Important Finfish Stocks in RI Waters
Job No. : VI - Environmental Assessment Review
Title: Environmental Assessment Review
Target Date: March 28, 2013
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, 2012. During this reporting period the DFW received 86 marine related permit applications (i.e. proposed projects); four more than in 2011 and 2010. The DFW provided either written (n = 36) or oral (n = 31) comments on all projects that posed potential impacts to fisheries or marine resources (Table 1). Of the 86 projects received, 67 (78%) posed potential impacts and warranted comment (Table 1), which is a 12% and 32% increase from 2011 and 2010, respectively.

During 2012, of the 86 projects received 43 (51%) were sited within an estuary, 26 (30%) in coastal ponds, 9 (10%) in coastal rivers, 6 (7%) in open ocean, and 2 (2%) in a coastal wetland (Figure 1A, Table 2). Not surprisingly projects within estuaries had the most activities and/or impacts 90 (47%), followed by 66 (34%) in coastal ponds, 13 (7%) in coastal rivers, 19 (10%) in open ocean, and 4 (2%) in a coastal wetland (Figure 1B, Table 2). The most numerous project type that was requested involved new or modifications to residential docks (15.1%), followed by maintenance dredging (6.8%), and new or modifications to commercial docks and piers (6.3%) (Table 2).

Since projects often involve multiple activities, the total number of activities and potential impacts (192) is greater than the number of projects received (86) (see Table 2). For example, a proposed marina expansion project could include reconfiguration of commercial docks and piers, rebuilding a bulkhead or riprap, and maintenance dredging. These activities could impact critical habitat such as shellfish beds (ASMFC 2007) and submerged aquatic vegetation (), temporally increase turbidity and reduce water quality potentially, and subsequently impact egg viability, juvenile survival, and foraging or spawning behavior of fish species (Klein-MacPhee et al. 2004; Newcombe and Jensen 1996; Wilber and Clark 2001).

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 (Newcombe and Jensen 1996; Wilber and Clark 2001) 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 cooperative study that was undertaken by the ACOE and DFW in response to a recognized lack of information regarding the spatial and temporal distribution of larval and juvenile finfish in both Old Harbor and Great Salt Pond on Block Island (Figure 2). Both agencies believed that a collaborative, site-specific approach was likely to result in a more accurate, defendable, and responsible permit that both parties could be satisfied with.

<u>Block Island Study - Background</u>

Early in 2011, the ACOE submitted applications for long-term permits to maintain both Old Harbor and Great Salt Pond federal navigation channels on Block Island. The DEM granted the ACOE 10-year dredge permits for both sites employing the 2010 permit conditions that were developed using the best available data and science. This was despite the ACOE request to move the work window earlier in the year at each site because there was limited information on which to base these restrictions. Similarly, these restrictions were causing major scheduling problems with the ACOE hydraulic-suction dredge vessel (Currituck) that was used for both projects, as well as many other federal navigation channels in the region. The DFW stated that it can not move the work window earlier in the year without new site-specific information 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 (Figure 2). The primary objective of the study was 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 2012 to include this specific cooperative study and therefore, is including a summery of this work in the annual compliance report.

> *Please note that a more detailed reporting of methods and results will be contained in an Appendix of the 2013 F-61R Compliance Report as part of a review of previous ichthyoplankton work. The Methods and Results below provide a brief overview of the project and is based, in part, on results presented at the 2012 Flatfish Conference by Klein-MacPhee et al. (2012).*

Block Island Study - Methods

Two field surveys, one targeting ichthyoplankton (i.e. larval life stages) and the other juvenile life stages were conducted from February to May and May to August, respectively, during 2012.

Ichthyoplankton Survey - Methods

Eight stations were sampled, 5 in the Great Salt Pond (Figure 3) and 3 in Old Harbor (Figure 4) approximately every two weeks beginning in late February through mid May. Samples were collected using a half-meter 335µ mesh plankton net, fitted with depressor and flowmeter, towed by a commercial fishing vessel contracted by the ACOE. Primarily, the F/V Linda and Laura conducted tows in Great Salt Pond and the F/V Lindsey E conducted tows in Old Harbor. At each station stratified-oblique tows were made at ~2.5 knots for 4-min (2-min per strata), except for Station No. 6 which was towed for 6-min to provide a mid-water measurement since the station was 45 – 50 feet deep. At the start and end of each tow water quality parameters including temperature, salinity, dissolved oxygen, turbidity, and pH was measured using a Quanta Hydrolab.

Samples were preserved in 6% formalin for 24-48 before being transferred to ethanol. Samples were archived in 70% ethanol. The entire sample was sorted for larvae, although eggs were sub-sampled. Larvae and eggs were identified, enumerated, and the results stored in an Excel file. The sorting and identification of samples was conducted by Grace Klein-MacPhee, who was contracted by the ACOE.

Juvenile Seine Survey - Methods

Thirteen stations were sampled, 8 stations in the Great Salt Pond (Figure 5) and 3 stations in Old Harbor (Figure 6) once every month from May until August 2012. Station locations were based on previous seine survey work in Great Salt Pond (Neumann 1992) and Old Harbor (Powell 1999; Powell et al. 2006). At each station a beach seine (39.6m x 1.5m) was set using a skiff. After the net was set, it was hauled by hand and all fish species were identified, enumerated, measured, and released as quickly as possible to reduce stress and potential mortality. At all stations in Great Salt Pond and at 3 representative locations in Old Harbor water quality parameters including temperature, salinity, dissolved oxygen, turbidity, and pH was measured using a Quanta Hydrolab.

Block Island Study - Results

Ichthyoplankton Survey – Results

Nine species represented 97% of all larvae collected during the ichthyoplankton survey work (Figure 7). Winter flounder, *Pseudopleuronectes americanus*, larvae were most abundant and constituted 66% of all larvae collected in Great Salt Pond and Old Harbor combined (Figure 7).

Great Salt Pond appeared to have greater abundance of winter flounder larvae overall (Figure 8); however the timing of peak abundance differed between the two systems. Abundance in Great Salt Pond peaked in late-February to mid-March, whereas abundance in Old Harbor peaked in mid- to late-April (Figure 8). When comparing spawning of winter flounder in Great Salt Pond and Old Harbor to previous work conducted by DFW in Narragansett Bay we find that on Block Island larvae peak in March with substantial larvae present both in February and April (Figure 9A), whereas in Narragansett Bay the timing of spawning appears more concentrated in March and April (Figure 9-B; Klein-MacPhee et al. 2012). Since this comparison is between one year of data collected from Block Island, in what was considered a very mild winter, and 8-years of data collected in Narragansett between 2002-2008 we can not test for a statistical difference in time of spawning between the two systems.

Juvenile Seine Survey - Results

More than 74% of fish collected in Great Salt Pond and Old Harbor (combined) were silver sides, *Menidia menidia*, followed by 6% juvenile spot, *Leiostomus xanthurus*, and 5% juvenile bluefish, *Pomatomus saltatrix* (Figure 10). Although winter flounder represented only 1% of all juvenile fish caught on Block Island (Figure 10), the number of juveniles was dramatically different between Great Salt Pond and Old Harbor (Figure 11). For example, winter flounder represented 6% of all fish caught in Old Harbor and only 0.3% of all fish caught in Great Salt Pond (Figure11). Interestingly, the two systems showed different composition of species. For example, 86% of species in Old Harbor were comprised of four species: Spot (33%), bluefish (28%), silver sides (15%), and black sea bass, *Centropristis striata*, (10%) (Figure 11A). In Great Salt Pond after accounting for that 87% of all fish collected were silversides, mummichog, *Fundulus heteroclitus*,(4%), striped killifish, *Fundulus majalis*, (4%), and sheepshead minnow (3%) comprised 98% of all fish caught (Figure 11B). As expected, we found a decline in the number of juvenile winter flounder as the summer progressed (Figure 12).

<u>Block Island Study – Discussion</u>

Although we expected to catch more winter flounder larvae in Great Salt Pond compared to Old Harbor, we were very surprised at the lack of juveniles caught in the seine survey in Great Salt Pond. The declining trend of juvenile winter flounder shown in Figure 12 is typical in nursery habitats and is likely influenced by natural mortality as well as movement of fish into deeper water as water quality declined during the summer. The locations we sampled for juvenile fish in Great Salt Pond were based on previous work by Neumann 1992 and although a visual inspection of bottom habitat type (e.g. cobble with algae, sand, sand with SAV, etc.) suggested that some stations did not appear to have ideal habitat for juvenile winter flounders (i.e. seine survey stations 2, 7, 6), habitat at other stations appeared suitable (i.e. seine survey stations 1, 4, 8) yet yield few fish. On the contrary, habitat in Old Harbor appeared suitable (sand with SAV) and relativity speaking yielded may juvenile winter flounder as well as other sport fish (Figure 11A, 12). It would be interesting to explore if the disparity between larvae and juvenile winter flounder detected in Great Salt Pond was due to poorly sited seine stations or whether there is very little settlement and subsequent recruitment coming out of that system.

<u>Block Island Study – Management Implications</u>

Although further analyses will be conducted during 2013, an initial review of this data by the ACOE suggests that a request to amend the dredge window conditions contained in the 10-year permit issued in 2010 was not appropriate. Furthermore both agencies agree that the cooperative study was a success. Staff from both agencies improved our knowledge and understanding of the fishery resources in both Block Island systems, as well as furthered our ability to work cooperatively and effectively on permitting requests.

Block Island Study – Acknowledgements
This project would not have been possible without support from the ACOE, specifically Valerie Cappola, Grace Bowles, Mike Walsh, and various interns. Also Rick Mello, Dennis Erkan, and John Lake of DFW provided essential assistance with gear preparation and survey implementation. We thank Grace Klein-MacPhee for sorting all of the ichthyoplankton samples. We also thank John Grant, captain of the F/V Linda and Laura and Mike Ernst, caption of F/V Lindsey E for their assistance with the ichthyoplankton work. Also, this work could not have been accomplished without Steven Land, Block Island Harbor Master and his staff, the Committee for Great Salt Pond and their president Sven Risom, and Wendle Corey all of who provided a vessel and assistance with the seining work. Similarly, Chris Littlefield and The Nature Conservancy provided critical assistance with logistics, travel, housing, as well as provided interns to assist with seining work. ACOE and US Fish and Wildlife Service Sportfish Restoration Funds supported this work.

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.

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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 2012 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 = 86). Note that the DFW provided either written or oral comments on all projects that posed a potential impact to fisheries or marine resources.

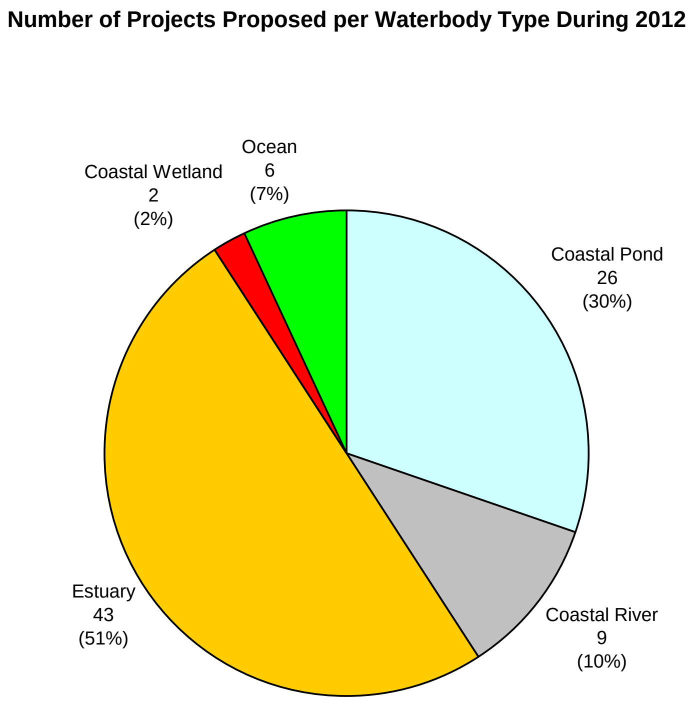
Proposed Activities and Potential Impacts	Comment Type			Total Number
	Written	Oral	None	
- Number of Projects Received -	36	31	19	86
- Percent of Projects Received -	42%	36%	22%	
Potential Eelgrass or Benthic Habitat Impacts	18	12	0	4
Eelgrass Restoration	2	0	0	1
Maintenance Dredging	13	0	0	13
New Dredging	2	0	0	1
New Marina	1	1	0	1
Marina Expansion or Reconfiguration	3	2	1	9
Restoration of Tidal Flow	3	1	0	3
Residential Docks (new)	1	8	11	28
Residential Docks (modification)	0	5	4	8
Commercial Piers or Docks	6	6	0	11
Salt Marsh or Coastal Wetland Impacts	5	6	0	9
Salt Marsh or Coastal Wetland Restoration	5	6	0	5
Terrestrial Project	0	5	0	2
Waterfront Bulkhead/Riprap	2	7	1	6
Waterfront Development	1	0	0	1
Aquaculture	11	1	0	10
Public Works or Utility	5	3	0	7
Fish Passage	3	1	0	2
Potential Shellfish Impacts	7	0	0	8
Channel Maintenance	8	0	0	7
Boat Ramp (New or Repair)	2	0	0	1
Oyster Restoration	1	0	0	0
Conflict with Recreational Use	9	1	0	0
Impacts from Discharge (RIPDES)	2	0	0	0

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* = 192) is greater than the number of projects received (*n* = 86). See text for an example and further discussion.

Proposed Activities and Potential Impacts	Great Salt Pond, BI	Ninigret Pond	Point Judith Pond	Potter Pond	Quonochontaug Pond	Weekapaug	Wesquage Pond	Barrington River	Kickemuit River	Quaket River	Seekonk River	Woonasquatucket River	Coastal Wetland	Mt. Hope Bay	Narragansett Bay	Pawcatuck River	Providence River	Sakonnet River	Ocean	Old Harbor, BI	Total Number	Percent (%) Total
Waterbody Type	CP	CP	CP	CP	CP	CP	CP	CR	CR	CR	CR	CR	CW	E	E	E	E	E	O	O		
Written Comments	4	3	2	2	2	1	-	1	-	-	-	2	-	-	11	-	1	3	2	2	36	41.9
Oral Comments	-	1	3	2	2	-	1	-	-	-	1	-	2	-	12	1	-	4	2	-	31	36.0
No Comments	-	2	1	-	-	-	-	2	2	1	-	-	-	2	5	-	1	3	-	-	19	22.1
Potential Eelgrass or Benthic Habitat Impacts	1	2	2	4	3	1	-	-	-	-	1	-	-	-	9	-	1	2	2	2	30	15.6
Eelgrass Restoration	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1.0
Maintenance Dredging	1	1	1	-	-	1	-	-	-	-	-	-	-	-	5	-	1	1	-	2	13	6.8
New Dredging	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	1.0
New Marina	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	1.0
Marina Expansion or Reconfiguration	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	1	-	1	6	3.1
Restoration of Tidal Flow	-	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-	4	2.1
Residential Docks (new)	-	2	2	2	2	-	-	2	1	1	-	-	-	2	3	-	-	3	-	-	20	10.4
Residential Docks (modification)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	1	-	-	-	-	9	4.7
Commercial Piers or Docks	-	-	2	-	-	-	-	-	-	-	1	-	-	-	7	-	1	-	-	1	12	6.3
Salt Marsh or Coastal Wetland Impacts	-	-	1	-	-	-	1	1	-	-	-	-	1	-	3	-	1	3	-	-	11	5.7
Salt Marsh or Coastal Wetland Restoration	-	-	1	-	-	-	1	1	-	-	-	-	1	-	2	-	1	3	1	-	11	5.7
Terrestrial Project	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	1	2	-	5	2.6
Waterfront Bulkhead/Riprap	-	-	1	-	-	-	-	-	-	-	-	-	-	-	5	-	1	1	2	-	10	5.2
Waterfront Development	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.5
Aquaculture	2	1	-	2	2	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	12	6.3
Public Works or Utility	1	-	-	-	-	-	1	1	-	-	1	1	-	-	-	-	-	1	2	-	8	4.2
Fish Passage	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1	-	4	2.1
Potential Shellfish Impacts	1	-	1	-	1	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	7	3.6
Channel Maintenance	1	1	2	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	1	8	4.2
Boat Ramp (New or Repair)	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	1.0
Oyster Restoration	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.5
Conflict with Recreational Use	-	3	-	2	2	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	10	5.2
Impacts from Discharge (RIPDES)	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	2	1.0
Total Number	7	13	16	10	10	6	4	5	1	1	3	3	4	2	62	1	6	19	12	7	192	
Percent (%) Total	3.6	6.8	8.3	5.2	5.2	3.1	2.1	2.6	0.5	0.5	1.6	1.6	2.1	1.0	32.3	0.5	3.1	9.9	6.3	3.6		

Figure 1. Number of projects [A] and activities and potential impacts from projects [B] proposed during 2012 per waterbody type. Table 2 details the composition of activities in [A] and [B].

[A]



[B]

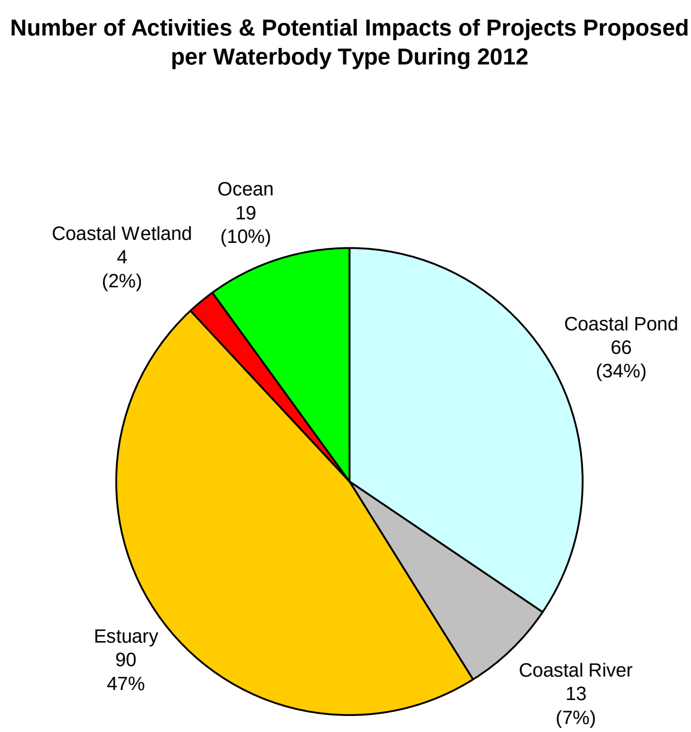


Figure 2. Locus map showing Block Island, Rhode Island. The approximate location of the federal navigation channels to Great Salt Pond and Old Harbor are noted with a blue star and red star, respectively.

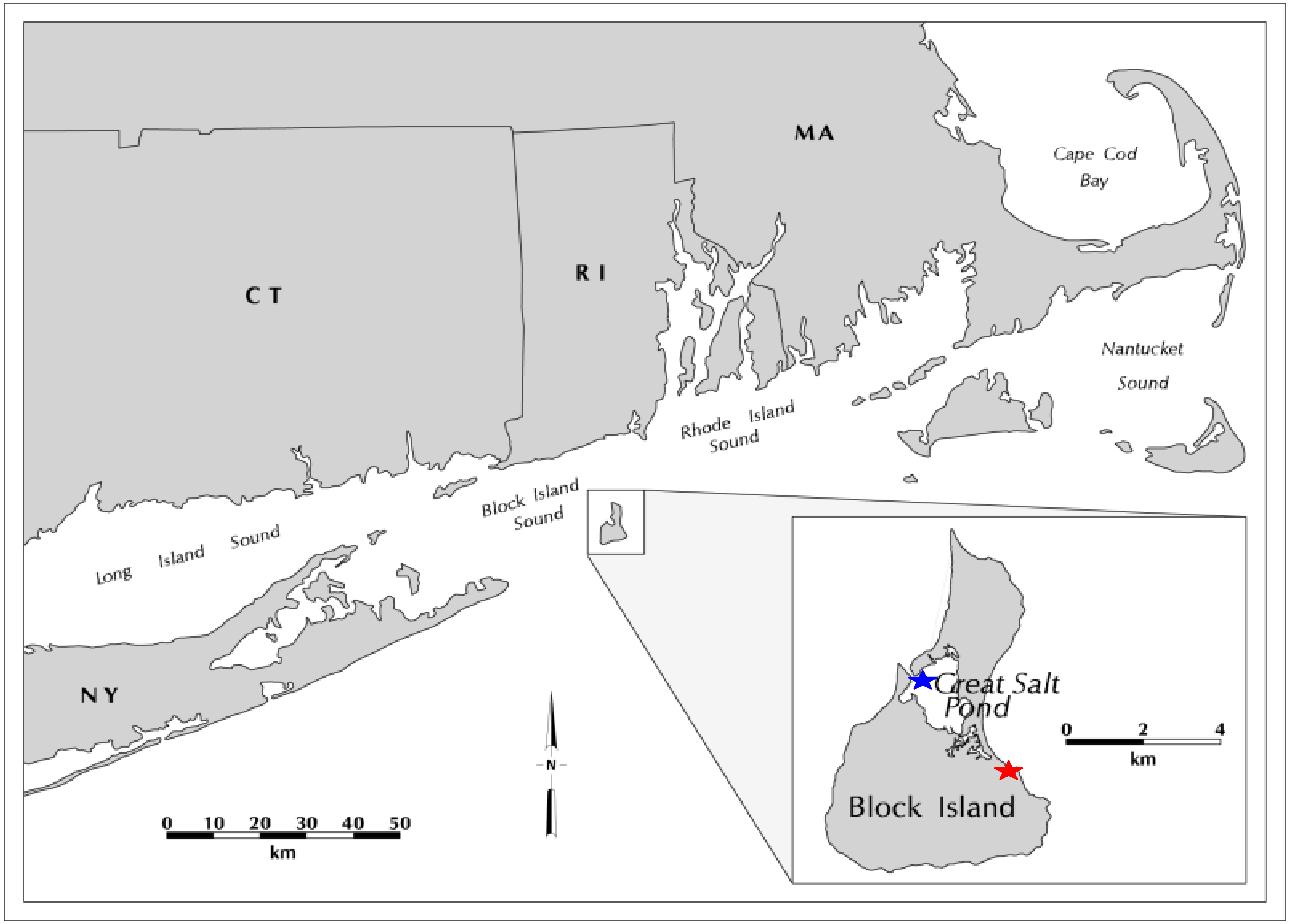


Figure 3. Ichthyoplankton survey transects (i.e. stations) in Great Salt Pond, Block Island. Station No. 2 is located within the federal navigation channel.

Figure 4. Ichthyoplankton survey transects (i.e. stations) in Old Harbor, Block Island. Station No. 8 is located within the federal navigation channel. Stations No. 1-5 are located in Great Salt Pond (see Figure 3).

Figure 5. Juvenile finfish survey stations sampled in Great Salt Pond, Block Island. Red triangles represent stations sampled by this project. Yellow circles represent the estimated center previous survey work by (Neuman 1992).

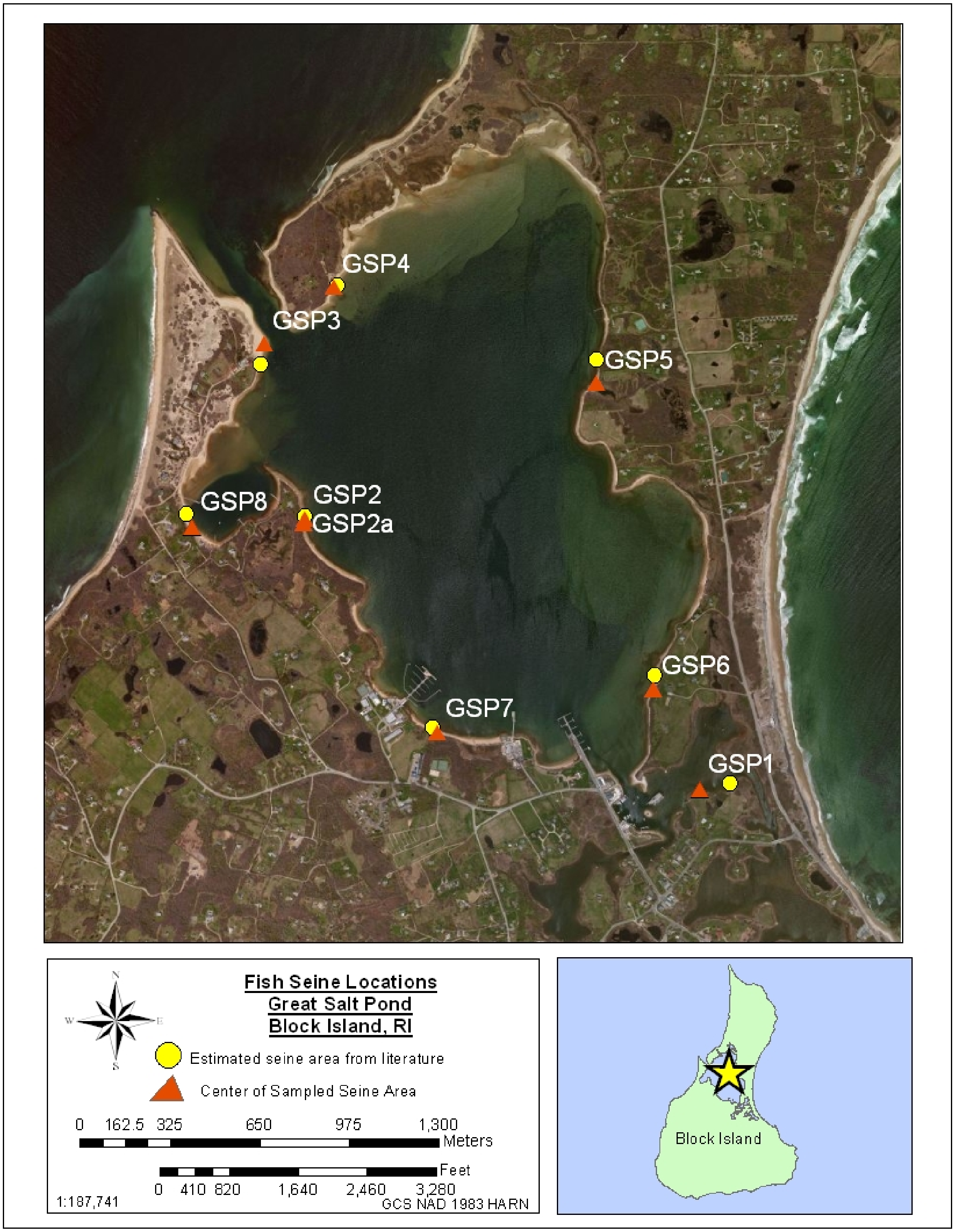


Figure 6. Juvenile finfish survey stations sampled in Old Harbor, Block Island. Red triangles represent stations sampled by this project. Yellow circles represent the estimated center previous survey work by (Powell 1997; Powell et al. 2007).

Figure 7. Percent of larvae by species that were collected during ichthyoplankton survey tows conducted in Great Salt Pond and Old Harbor, on Block Island (RI) from February to May 2012.

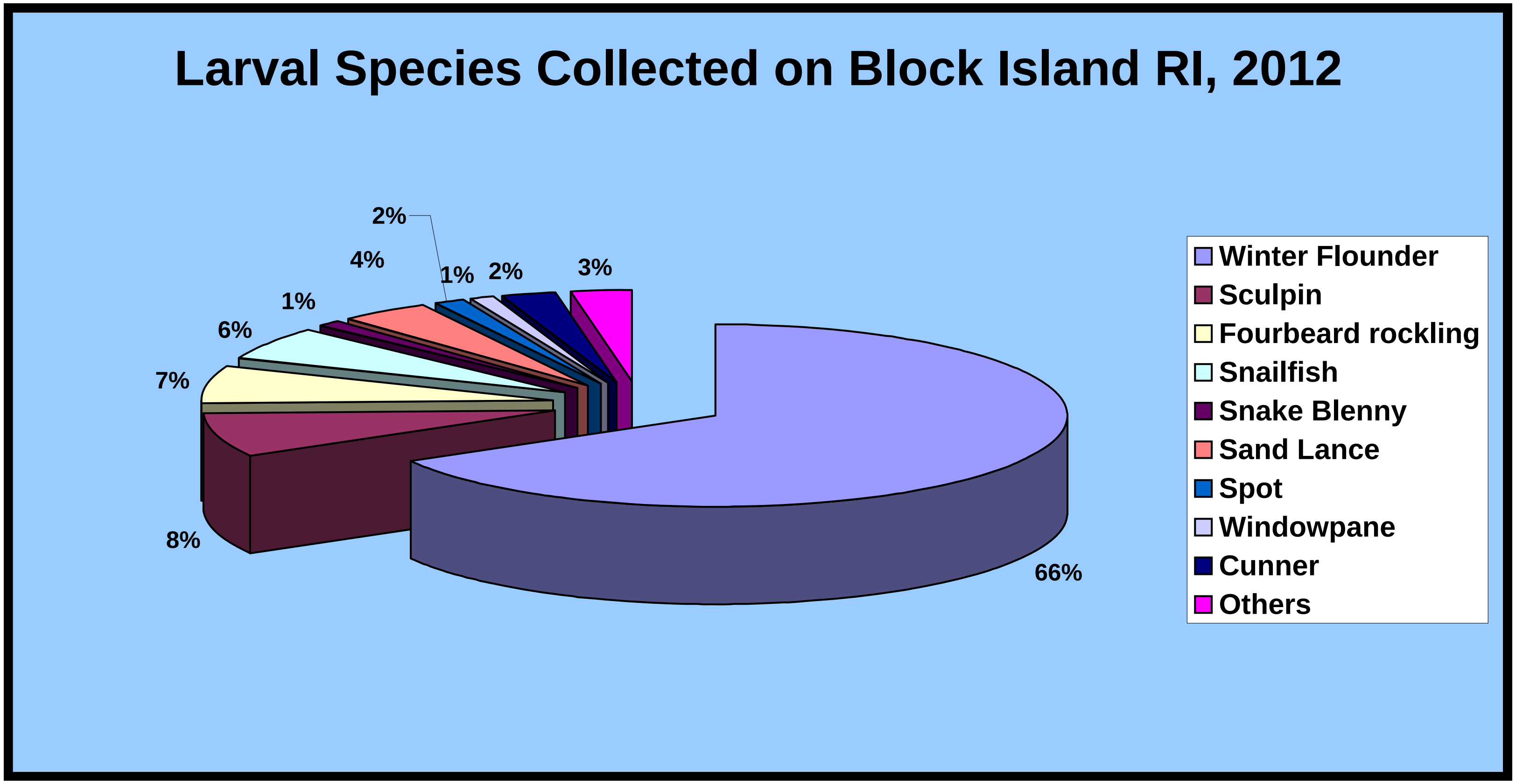


Figure 8. Total number of larval winter flounder (Number of larvae per $100m^3$) collected in Great Salt Pond and Old Harbor, Block Island (RI) by station for each ichthyoplankton survey tow between February and May 2012.

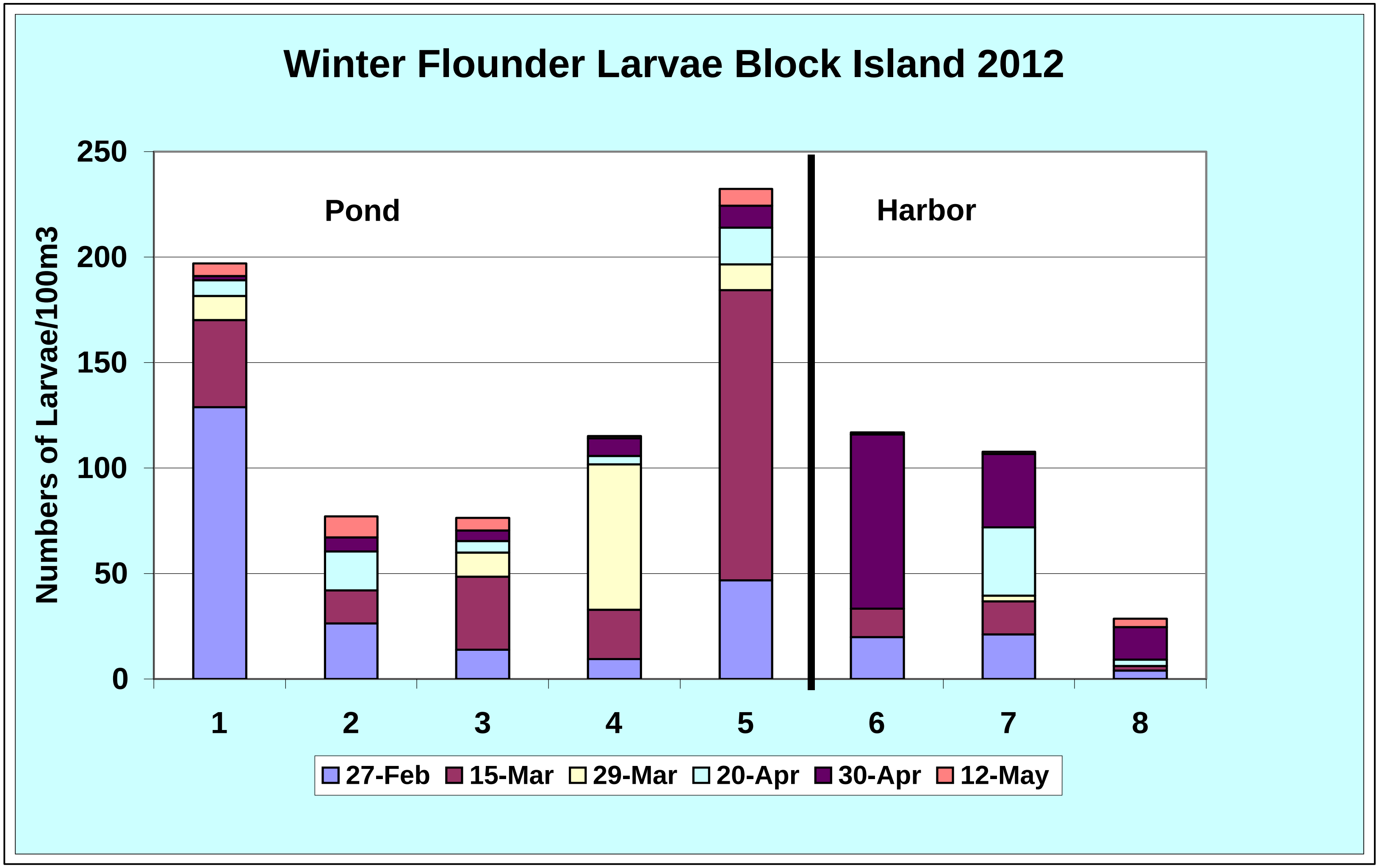


Figure 9. Seasonal distribution of larval winter flounder (Number of larvae per 100m^3) collected in [A] Great Salt Pond and Old Harbor, Block Island (RI) during 2012 (8 stations) and [B] Narragansett Bay from 2002-2008 (15 stations) from Klein-MacPhee et al. 2012.

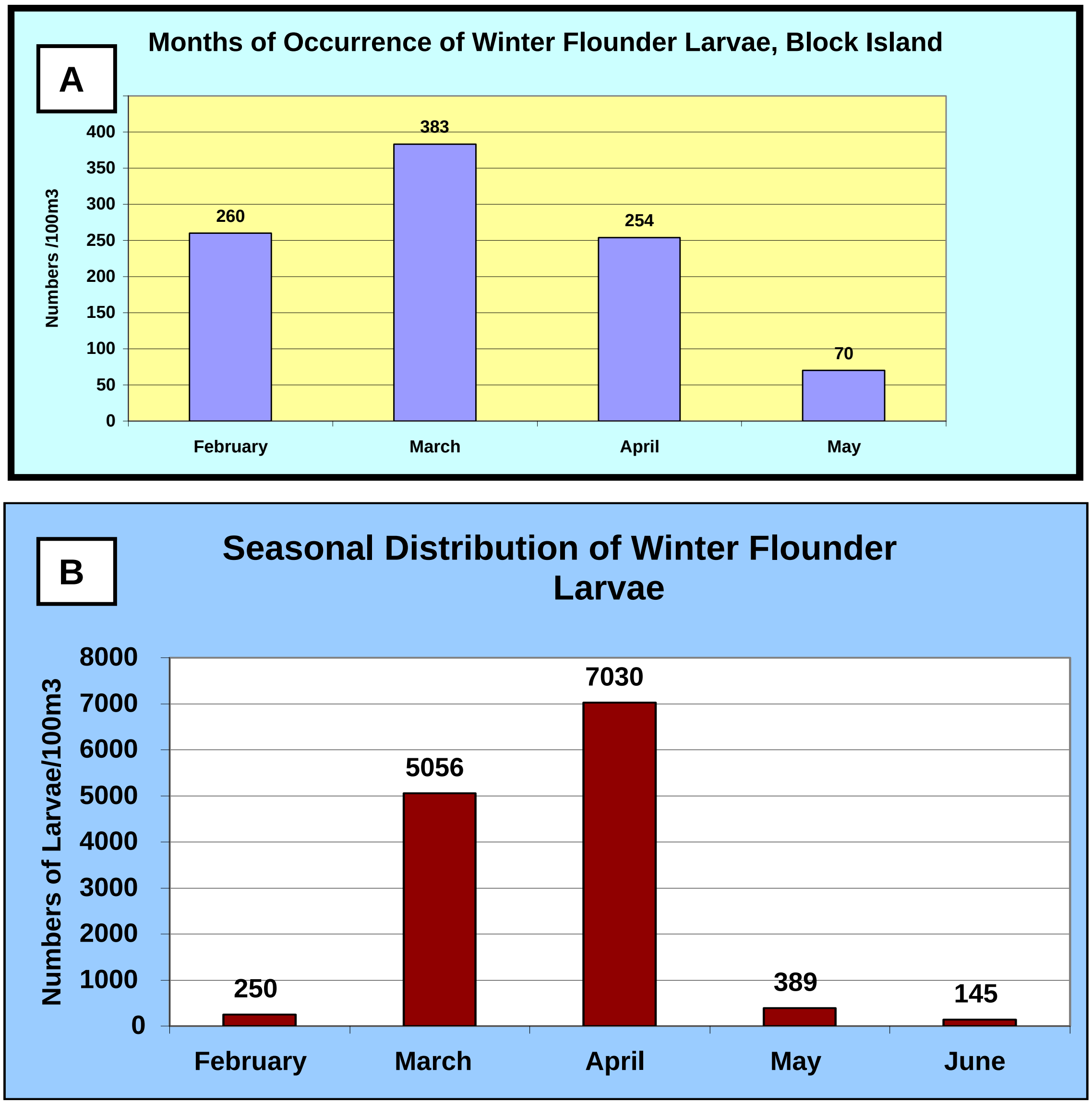


Figure 10. Top ten species collected in Great Salt Pond and Old Harbor, Block Island (RI) by monthly seine surveys conducted from May to August 2012.

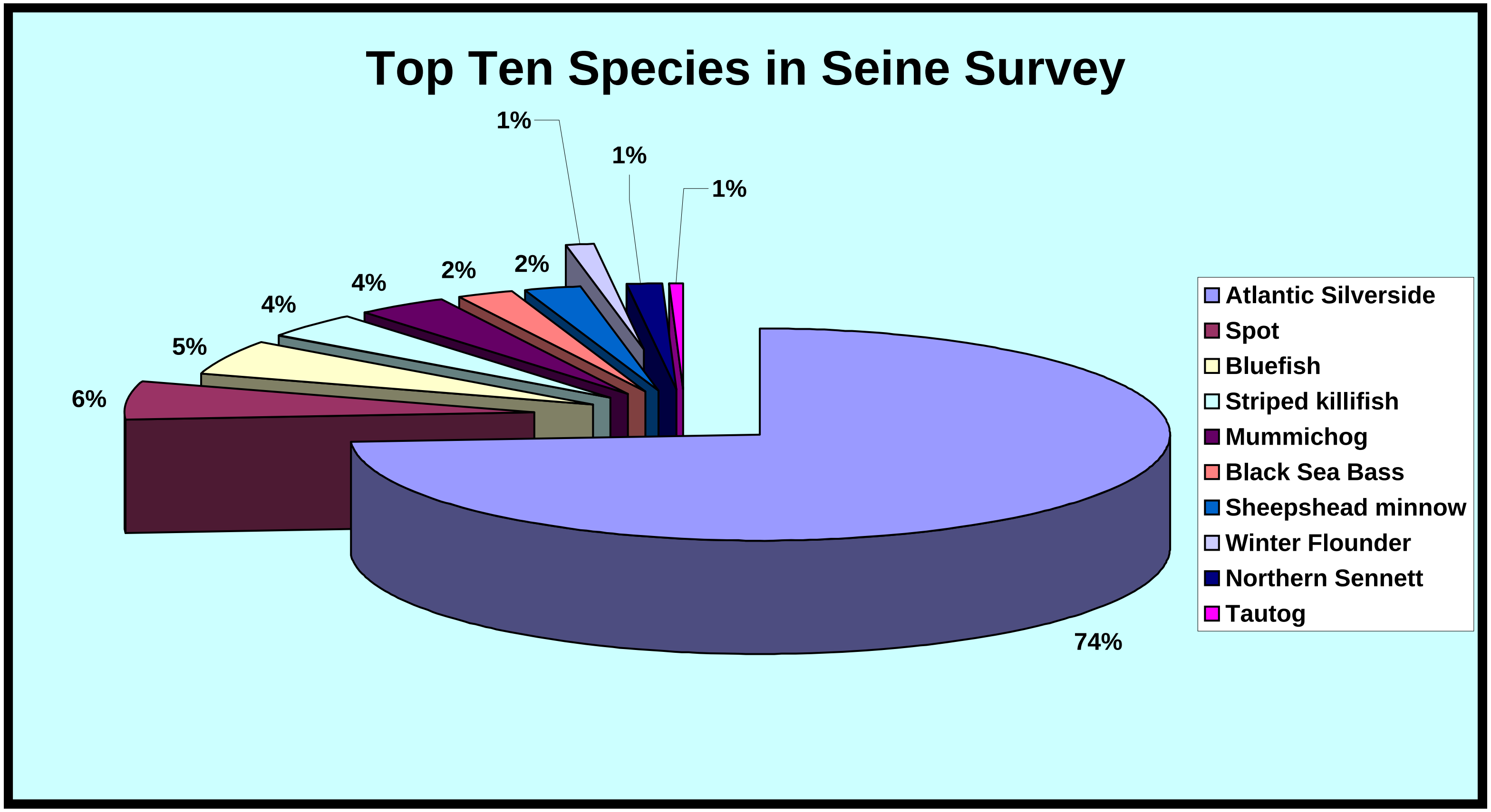


Figure 11. Percent composition of juvenile species in [A] Old Harbor and [B] Great Salt Pond, Block Island (RI) by monthly seine surveys conducted from May to August 2012.

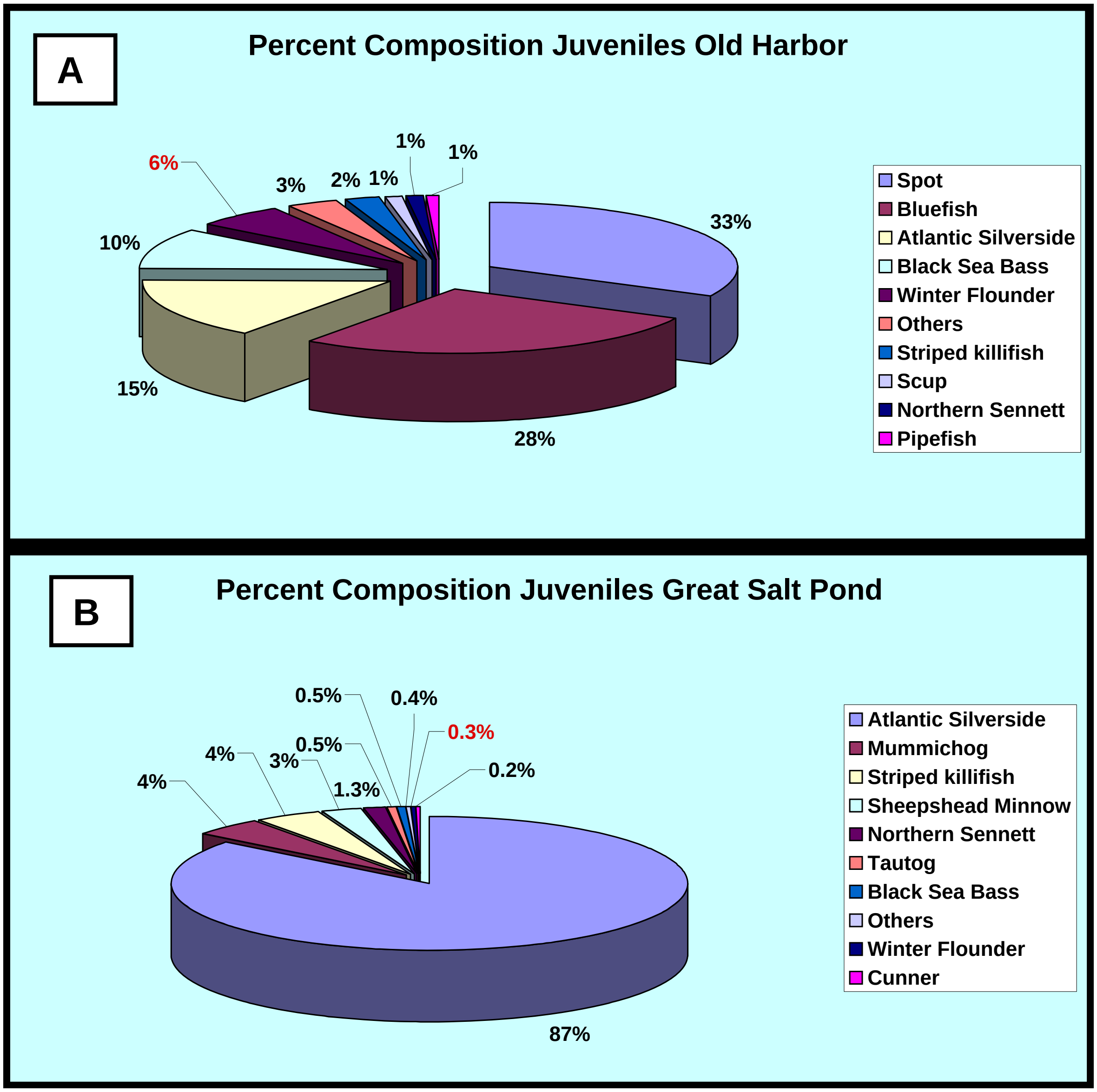
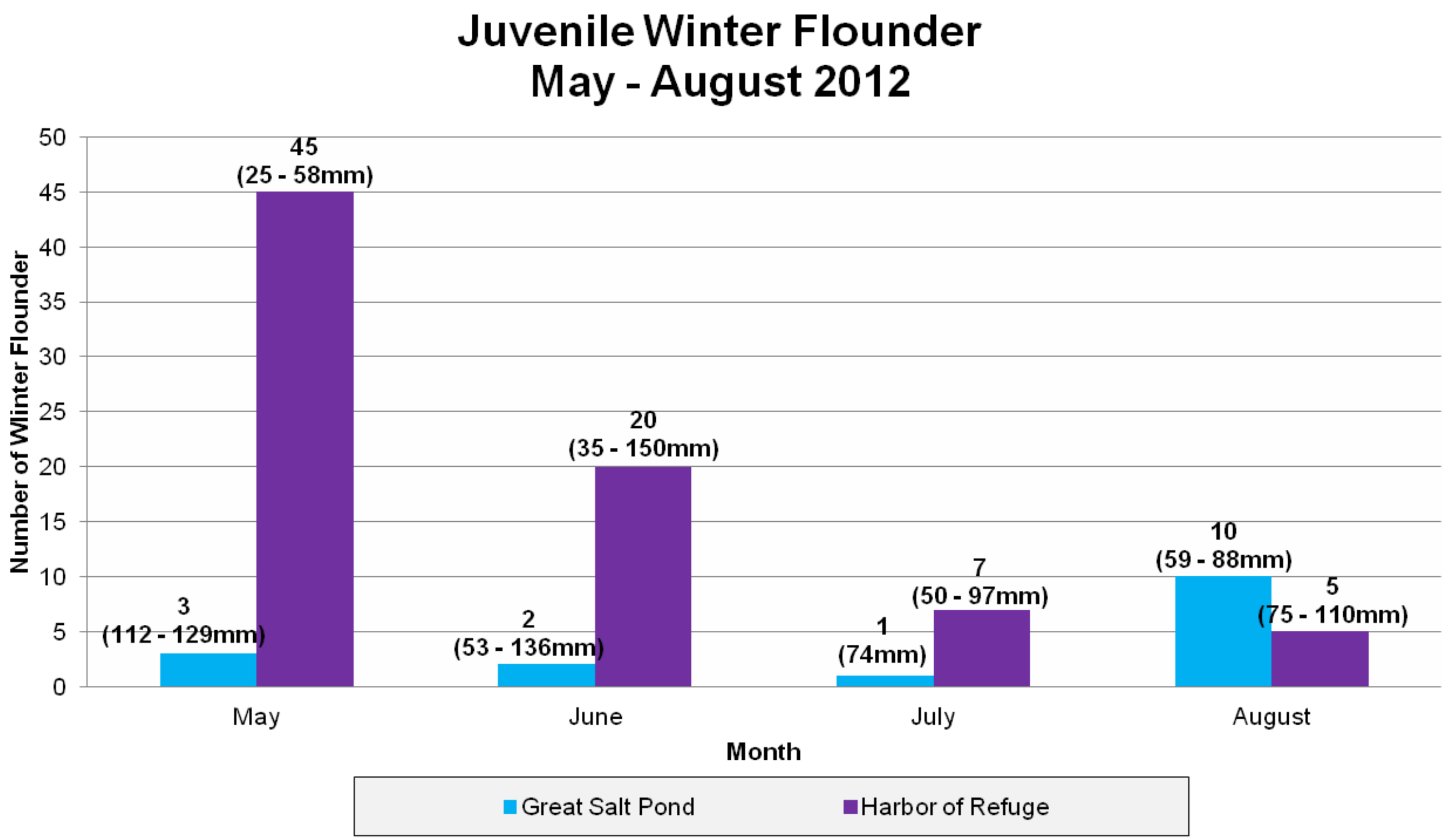


Figure 12. Total number of juvenile winter flounder and the estimated size range (in parenthesis) collected in Great Salt Pond and Old Harbor, Block Island (RI) by monthly seine survey from May to August 2012.



ASSESSMENT OF RECREATIONALLY IMPORTANT FINFISH STOCKS IN RHODE ISLAND WATERS

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

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March 2013

PERFORMANCE REPORT

STATE: Rhode Island **PROJECT NUMBER:** F-61-R
SEGMENT NUMBER: 20

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

PERIOD COVERED: January 1, 2012 – December 31, 2012

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

JOB OBJECTIVE: To perform compliance monitoring as necessary in order to continue 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 write an artificial reef plan for the state of Rhode Island as requested by the Coastal Resources Management Council. To continue to work with recreational anglers as necessary following the completion and acceptance of the artificial reef plan for the state of Rhode Island.

SUMMARY: In 2012, no compliance monitoring was necessary and efforts were focused on developing a draft of the RI Artificial Reef Plan. Investigators also began to work in cooperation with The Nature Conservancy on a five-year research reef project to be constructed in Narragansett Bay, RI.

TARGET DATE: 2013

STATUS OF PROJECT: On schedule

SIGNIFICANT DEVIATIONS: No significant deviations.

RECOMMENDATIONS: No recommendation as this is the final progress report for this job.

REMARKS: In 2012, the RI DEM in cooperation with The Nature Conservancy has received funding to start a five-year Artificial Reef research project in Narragansett Bay, RI. Upon completion of this research project, investigators plan on amending the artificial reef plan for the state of Rhode Island to reflect the findings of this research and make recommendations about the future of 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 engaged 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. A draft of the plan is currently available (Appendix A).

BACKGROUND

When the Old Jamestown Bridge was closed to traffic in 1992 following the opening of the Jamestown-Verrazano Bridge, the Rhode Island Department of Transportation in partnership with the Rhode Island Department of Environmental Management (RIDEM) created 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. 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 of the Rhode Island Artificial Reef Plan). The development of the Rhode Island Artificial Reef Plan (Appendix A) was the final task for this job.

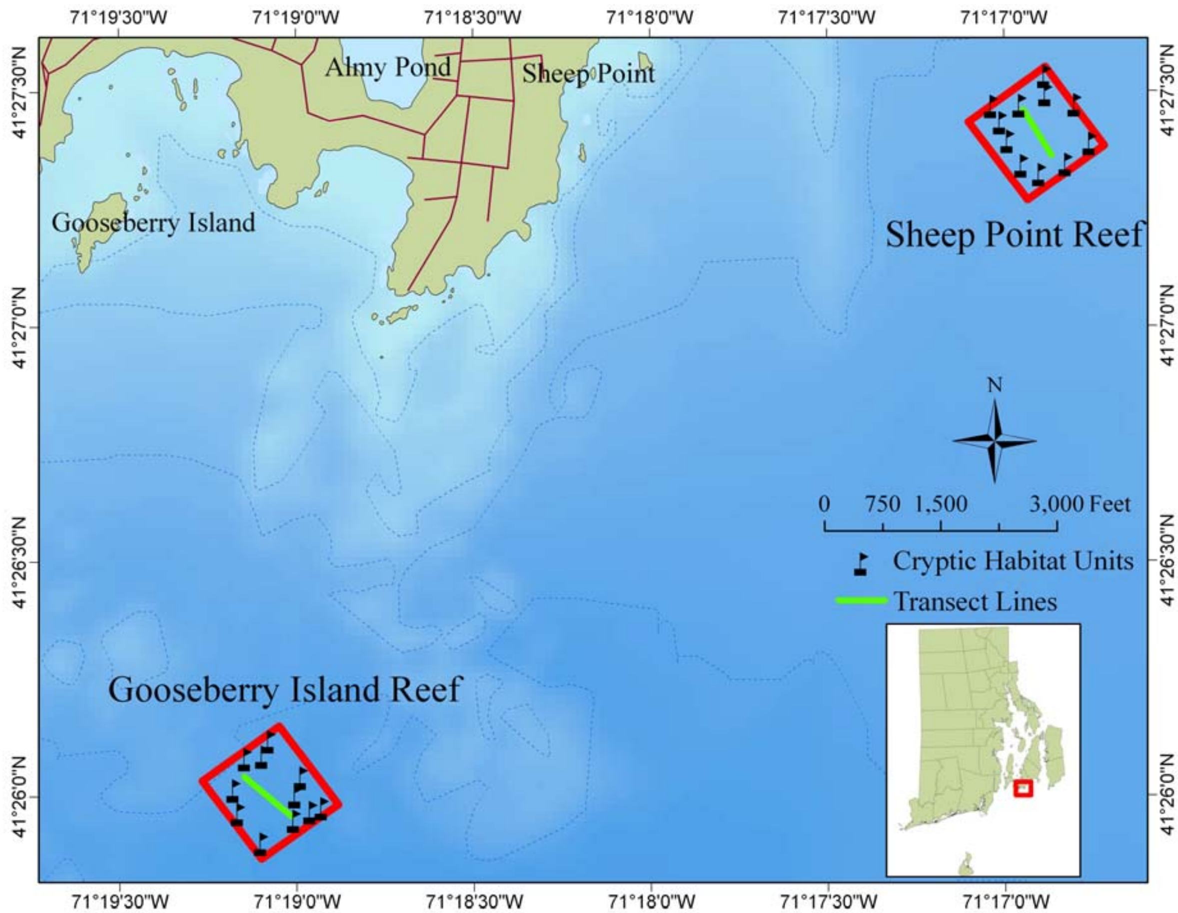

Figure 1. Map showing the location of Gooseberry Island reef and Sheep Point reef in RI waters.

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 received comments from RISAA and developed a draft plan based on the table of contents. RIDEM presented a draft of the plan at a RISAA Artificial Reefs Subcommittee meeting and received comments. Once internal review of the draft is complete, the draft will be circulated to RISAA.

RESULTS AND DISCUSSION

The RIDEM has successfully developed a draft of 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 future cooperation with RISAA on artificial reefs in RI. In 2012, the RI DEM in cooperation with The Nature Conservancy has received funding to start a five-year Artificial Reef research project in Narragansett Bay, RI. Upon completion of this research project, investigators plan on amending the Rhode Island Artificial Reef Plan to reflect the findings of this research and make recommendations about the future of artificial reefs in RI waters.

REFERENCES

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APPENDIX A

THE RHODE ISLAND

ARTIFICIAL REEF PLAN

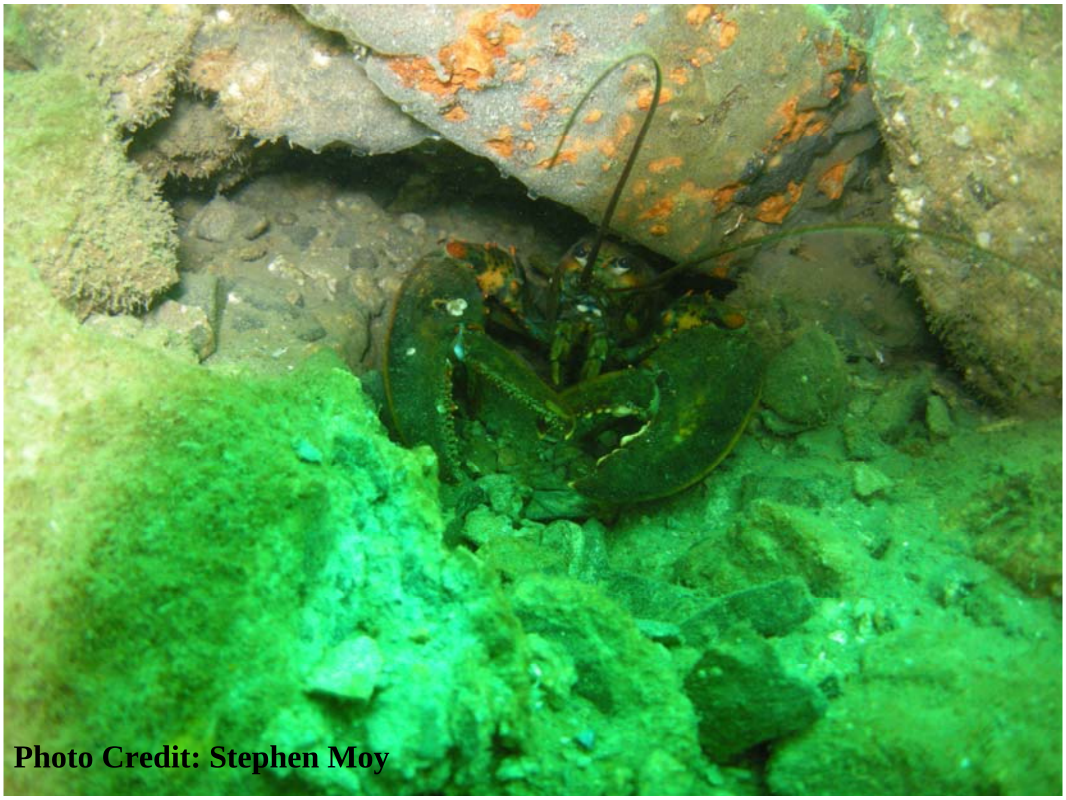

Photo Credit: Stephen Moy

RI Department of Environmental Management

Division of Fish & Wildlife

Marine Fisheries

3 Fort Wetherill Road

Jamestown, RI 02835

March, 2013

TABLE OF CONTENTS

1. OBEJCTIVE OF THE RI ARTIFICIAL REEF PLAN

The State of Rhode Island Artificial Reef Plan was developed as a reference document for organizations and state agencies to ensure proper citing, placement, and design of artificial reefs in Rhode Island waters. A large portion of the material used in this plan was adapted from the National Artificial Reef Plan (Stone, 1985) which should be referenced for additional information on any of the topics discussed below.

While artificial reefs are commonly used to enhance fisheries resources, it remains unclear as to whether the construction of artificial reefs results in new fish biomass or merely attracts and aggregates fish from other areas. As a result, the Department of Environmental Management, Division of Fish and Wildlife (DFW) in cooperation with The Nature Conservancy (TNC) are undertaking a 5-year artificial reef project to address these concerns. This project will be the initial step in developing a comprehensive artificial reef plan for the state of Rhode Island. The objective of this project is to answer the following questions:

1) do artificial reefs increase the abundance and biomass of important sportfish species?
2) do artificial reefs merely attract and aggregate existing fish leading to a higher exploitation rate?

The importance of answering these questions is that it will allow the DFW the ability to collect empirical evidence, which it can then use to weigh the costs and benefits of further developing an artificial reef program in the state. Further, this information will help the DFW determine whether artificial reef development is in fact in the states best interest or if state resources are better spent on other conservation strategies for sportfish.

To accomplish this, TNC will be contracted to construct 3 artificial reefs in middle Narragansett Bay covering a 0.25 acre area per reef location for a total project footprint of 0.75 acres. Pre and post construction monitoring, evaluation and analysis of data collected from these three research reefs will help scientists determine the true costs and/or benefits of creating artificial reefs in the waters of Narragansett Bay. At the completion of the project, the State of Rhode Island Artificial Reef Plan will be appropriately amended with the results of this research and recommendations for the creation of artificial reefs in RI waters in the future.

2. BACKGROUND

For centuries our oceans fish stocks have been subjected to increased fishing pressure, pollution, and loss of hard bottom habitat, which have all contributed to stock depletion for some stocks, which we are faced with today (Stone, 1985). Each year the fishing community is faced with decreased harvest limits, stricter possession limits and seasons for some important sportfish species in an attempt by managers to allow the stocks to rebuild. In recent years, in an effort to create additional fishing opportunities and replenish fish stocks, resource managers and industry have turned to constructing artificial reefs.

The Merriam Webster dictionary defines a reef as a ridge of sand or chain of rocks or coral at or near the surface of the water. An artificial reef is a man-made reef constructed from a variety of materials including but not limited to rock, concrete or concrete debris, and ships. These materials are placed on the seafloor to achieve some level of vertical relief for the purpose of fisheries and/or habitat enhancement.

Following the acceptance of the National Artificial Reef Plan in 1985, many coastal states have developed artificial reef plans with guidelines for developing artificial reefs specific to those states natural and economic resources. Artificial reef programs will differ in each state depending on that states need, ability to create artificial reefs, and the unique species and ecosystems endemic to that state's waters. Factors such as substrate type, availability of funding, and the availability of state resources all lead to unique characteristics for each state's artificial reef plan. For instance a successful ships-to-reefs program requires heavy involvement from the state (Hynes et al., 2004), however some states may not have the staff time or funding available to dedicate to such a program. The following is an attempt to begin to define these characteristics for the state of Rhode Island's artificial reef plan.

3. EFFECTS OF ARTIFICIAL REEFS

3.1 Benefits

Artificial reefs have many biological benefits associated with them. One of the main goals of an artificial reef is to take an area of the seafloor with little to no bottom relief and develop a structure that creates additional complex habitat for marine life to colonize. The added complexity and vertical relief of the structure will also help to maximize the amount of surface area available for colonization. The interstitial spaces of artificial reefs will provide refuge for reef fishes from predation, particularly juveniles that are highly susceptible to predation. The reef structure can also diffuse currents and decrease the amount of energy invested in swimming and increase the amount of energy invested in growth and development. All of these benefits often result in an artificial reef with a high biological diversity.

In addition to biological benefits, there are also many socio-economic benefits linked to artificial reefs. Increased opportunities for recreational and commercial fishermen as well as recreational scuba divers are among these. Re-directing fishing pressure from natural habitats towards artificial reefs can lead to decreased exploitation and crowding. The location of the artificial reef may also decrease travel time for anglers resulting in fuel savings and increased safety.

3.2 Risks

3.2.1 *Biological*

Artificial reefs can often attract nuisance and/or invasive species that are highly un-desirable. This occurs because the creation of the reef is in fact a disturbance, and this initial disturbance can create an opportunity for non native species to outcompete and colonize an area prior to the establishment of native species. Once the non native species establishes itself, the occurrence of that species may then increase, exacerbating the effects of the biological invasion in local waters.

It is currently unknown whether artificial reefs increase production or merely attract and aggregate fish from other areas. If the latter is true, artificial reefs may merely aggregate existing fish to a location where they are subjected to increased fishing pressure, which in turn may have a net negative impact on the population.

3.2.2 *Socio-economic*

One of the most poorly understood and under-estimated factors associated with the construction of artificial reefs are the financial considerations. While it may be easy to have materials donated at no cost, there is often a large cost associated with the handling and moving of these materials both on land and at sea (Dammann, 1974). In addition, there are future costs associated with reef construction that in most cases need to be accommodated by a state agency, such as monitoring maintenance, and management of the artificial reef after installation. These costs should be considered when a state contemplates creating artificial reefs.

User conflicts can often arise between commercial and recreational fishermen as they are competing for space and resources. With the creation of an artificial reef, these conflicts become focused into discrete areas. These conflicts also have a cost associated with them, as they often result in increased management, regulatory adjustments, and stakeholder meetings that seek to mitigate the conflicts.

3.2.3 *Physical*

The use of improper materials or the improper placement of materials can pose a danger to recreational divers. Additionally, artificial reefs can pose a threat to mariners who are unaware of the location, especially if the reef is not adequately marked on nautical charts. By the same token, storm events can shift artificial reefs into non optimal areas, creating even further hazard to recreational and commercial boating. There can also be unintended impacts to current and tidal flows which may not be accounted for in a given project because they are quite difficult to predict. Finally, given the variability and difficulty in ascertaining the nature of physical oceanographic components of an artificial reef construction area, the placement of the reef in an area with inappropriate oceanographic characteristics can render the reef ineffective.

4. ARTIFICIAL REEF PERMITTING GUIDELINES

The construction and maintenance of reefs in United States waters and waters overlaying the outer continental shelf are regulated by the U.S. Army Corps of Engineers (ACOE). Permits for any reef building activities must be obtained from the ACOE under section 10 of the Rivers and Harbors Act of 1899 and/or section 404 of the Clean Water Act ("Artificial Reefs", n.d.; Stone, 1985).

Other federal agencies such as the National Marine Fisheries Service (NMFS), National Ocean Survey (NOS), Environmental Protection Agency (EPA), and the U.S. Coast Guard (USCG) should be consulted during the planning process of an artificial reef. The USCG is responsible for maintaining safe navigation in U.S. waters and may require that aids to navigation such as buoys be installed and maintained at reef locations. Aids to navigation may add a substantial cost to an artificial reef project and therefore the USCG should be consulted early in project planning.

It is important to note that this permitting process can be lengthy and can have a significant cost, so these factors should be accounted for when developing an artificial reef project.

5. ARTIFICIAL REEF DESIGN

5.1 Site selection

5.1.1 *Substrate type*

One of the most important characteristics of a potential artificial reef site that will ultimately determine the stability and longevity of the reef is the dominant substrate type. The use of soft sediments such as fine sand, silt, or clay may not only result in sinking and/or shifting of reef materials over time, but can lead to substantial siltation and sand abrasion. Wave action and currents can lead to these soft sediments being re-suspended and deposited on reef materials and subsequently reef organisms, ultimately decreasing the effectiveness of the reef over time (Stone, 1985).

Reefs being constructed from heavy dense materials such as concrete should be situated on hard bottoms such as rock to prevent settling and scouring. Less dense materials such as those made out of fiberglass and PVC can be placed on firm bottoms such as compacted sand, shell, and gravel (Stone, 1985).

Preferable	Non-preferable
rock	loosely packed sand
compacted sand	clay
shell	silt
gravel	

While sediment maps and NOAA nautical charts are good resources for assessing what the dominant substrate type is in a potential artificial reef project area, it is strongly recommended that planners confirm the substrate through video or scuba diver surveys early in the planning process.

5.1.2 *Depth*

Depth is a critical factor to consider when selecting an artificial reef site. A site should be selected where the depth is great enough that the reef will not create a hazard to navigation, or dramatically alter the nature of existing surface or sub-surface current flows. Planners should consider the different types and sizes of vessels that will be navigating the area and ensure there is sufficient clearance for them to pass over the reef. Water depth can also largely determine the type of reef that develops over time as well as the user groups that will utilize the reef. Reefs constructed in shallow, warmer waters with more light attenuation will support a different reef community than that of a reef constructed in deeper, cooler, darker waters (Stone, 1985). In addition, information should be collected on current and flow structure in the area so that appropriate depths can be determined for the site. If no information on this exists for a given site, at a minimum, small scale research studies or modeling studies should be conducted to account for this aspect.

5.1.3 *Other environmental*

Currents, tides, and wave action are other important environmental factors to consider in site selection. Reefs placed in areas with strong currents, tides, and wave action can result in movement and/or deposition of reef materials. Conversely, reefs placed in areas with a lack of sufficient currents, tides, and wave action can result in stagnant water not conducive to promoting the colonization of marine life. Areas with poor water quality that would not be suitable to support a growing reef ecosystem should not be considered (Stone, 1985).

5.1.4 *Conflicts*

Any areas designated as having existing rights of way such as those with buried telecommunication cables, should be avoided as potential locations to site an artificial reef. Other areas that should be avoided to prevent user conflicts are those that are fished heavily with mobile fishing gear such as otter trawls or fixed gear such as gill nets. Artificial reefs are commonly placed in areas with sandy bottoms and little to no bottom relief which is also the ideal bottom type for trawlers.

When considering the construction of an artificial reef for the enhancement of recreational and commercial fishing, planners should take several things into consideration. Factors such as how many anglers are likely to use the reef, distance to the reef, target species, and proximity to existing fishing areas should all be taken into account. In some cases it may be ideal to place a reef in a more remote area to decrease user conflicts in other areas, in other instances it may be wise to choose a location in a more populated area so it can be easily accessed (Stone, 1985).

Recently there has been a large interest in states pursuing sources of renewable energy such as offshore wind power. Currently the state of Rhode Island has received an application to develop a 30-MW windfarm consisting of 5 turbines located approximately 3 miles off the southeast portion of Block Island. As the state continues to seek sources of renewable energy, it is possible that conflicts could arise between developers looking to construct renewable energy facilities and organizations looking to construct artificial reefs. These conflicts may be more likely to arise in the waters of Rhode Island Sound and Block Island Sound, and to a lesser extend in the waters of Narragansett Bay.

5.2 Materials

Artificial reefs can be constructed from a wide variety of materials, some more suitable than others. The materials discussed below include those that are preferred for artificial reef projects.

5.2.1 *Rock (manmade or natural)*

Concrete is a material that been used widely in the construction of artificial reefs due to it's compatibility with the marine environment, and it's strong and durable nature. Due to the readily available supply of concrete rubble from sidewalks, buildings, and bridges, constructing reefs out of concrete is typically a very cost-effective option. The variation in size and shape of the pieces or slabs of concrete rubble may create a more diverse artificial reef. Additionally, projects using bridge rubble as artificial reef material may be able to be financed directly by the state Department of Transportation. A low-cost alternative to concrete rubble is using pre-cast molds that are available to fabricate concrete structures, or reef balls, that can be used as artificial reefs. While there are many benefits associated with using concrete for artificial reefs, there are several drawbacks as well. The biggest downside with using concrete is the weight of the material. The extreme weight of concrete often requires the use of large equipment to handle it and can also result in subsidence of material into the underlying sediment after construction is completed. Another important consideration when using concrete rubble is what other materials may be mixed in (Lukens and Selberg, 2004). For example, the rubble from the demolition of the Old Jamestown Bridge used as the materials for the construction of the Gooseberry Island reef and Sheep Point reef had a large amount of re-bar mixed in with the concrete. As a result, these reefs can be dangerous for recreational scuba divers.

5.2.2 *Steel ships and barges*

Due to the high cost associated with the de-commissioning and disposal of US Navy and MARAD ships, many states are now requesting to have ships donated to them with the intent of sinking them as artificial reefs. Hynes et al. 2004 estimated that over 100,000 ships have been sunk by acts of nature or by man. Given the magnitude of ships available for reefing and the success of sunken ships serving as popular tourist attractions for recreational scuba divers, the use of steel hull ships as artificial reefs seems like a viable option. However, there are many drawbacks associated with the sinking of ships as reefs that must be carefully considered. While it is possible for a state to have a ship donated to them at no cost, there is a very large cost associated with preparing the ship for sinking, sinking the ship, and performing any pre or post monitoring (Hynes et al., 2004). Additionally materials of concern such as fuel, oil, or paint may be present on board the ship and must be dealt with appropriately prior to sinking ("Artificial Reefs", n.d.).

5.2.3 *Boxcars and subway cars*

One of the largest benefits to using boxcars and subway cars in artificial reef construction is that they are typically donated by other states so only cleanup, preparation and transportation costs are required. Additionally, they are available in large numbers and offer a great deal of surface area and bottom relief (Lukens and Selberg, 2004). While some states such as Delaware have reported great success in using subway cars as reef material (http://www.dnrec.delaware.gov/fw/Fisheries/Pages/ArtificialReefProgram.aspx) other states such as New Jersey have gone back and forth on whether subway cars is an appropriate material for reef construction. This stems from the fact that the vertical relief offered by steel walled boxcars and/or subway cars can be lost due to the collapse of the roof and one or more side walls. While subway cars are thought to be more durable than boxcars and have a projected lifespan of 25-30 years, loss of vertical relief over time is possible (Lukens and Selberg, 2004)

5.3 Configuration

Proper configuration of an artificial reef can be just as important as site selection and choosing what material to use. Designing a reef configuration to maximize the available surface area for colonization is a key design element. Additionally, materials should be placed so that an adequate flow of water is able to reach the interstitial spaces of the reef to prevent a stagnant anoxic environment from developing. The vertical relief or profile of the artificial reef should also be carefully considered as a low profile reef is most likely to attract demersal species whereas a high profile reef will attract more pelagic species (Stone, 1985).

5.4 Deployment

The success of artificial reef construction is ultimately determined by the proper planning for and on-site deployment of reef materials. While the desired configuration of materials should be planned well ahead of deployment, achieving that configuration during deployment should also be carefully considered as well. Planners should ensure that staging areas appropriate for their needs are available as well as any and all heavy equipment that may be needed to move and transport materials. Deployment of materials should be done when weather and sea conditions are not only safe but optimal to increase the success of achieving the desired configuration. Ensuring that all required personnel involved in the deployment are present, and are competent, reputable, licensed, and insured for working on this type of project may also increase the chances of a successful deployment (Stone, 1985).

5.5 Monitoring

Generally, there are two types of monitoring involved in the construction of artificial reefs, compliance and performance monitoring. Compliance monitoring is typically any monitoring that is required under any of the permits that were issued for the project or that is required by law or regulation. Currently, the state of Rhode Island does not have any law or regulation pertaining to compliance monitoring of artificial reefs and therefore any required monitoring will be under the permits issued for the project. Performance monitoring is carried out to address whether the specific goals of the project are being achieved and to make sure no potentially dangerous changes have occurred post construction.

Typical compliance monitoring that may be required under a permit issued by the Army Corp. of Engineers (ACOE) may include inspection of the reef material to ensure that there has been no sinking or movement of the materials. Additional monitoring may include inspection of the buoy, mooring chain or anchor marking the artificial reef location.

Performance monitoring of artificial reefs is not required and is conducted voluntarily to study the reef. Specific projects will have certain goals they are wishing to achieve such as increasing recreational fishing activity or increasing abundance and biomass of important species of finfish. As a result, performance monitoring will vary with each project. For RI, performance monitoring will be required as the DFW feels it will be of critical importance to make sure the goals and objectives of each project are meeting the proposed goals, and to make sure the reef continues to benefit the states best interests.

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7. APPENDIX A: The Jamestown Bridge Artificial Reef Final Report

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

September 2011

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.

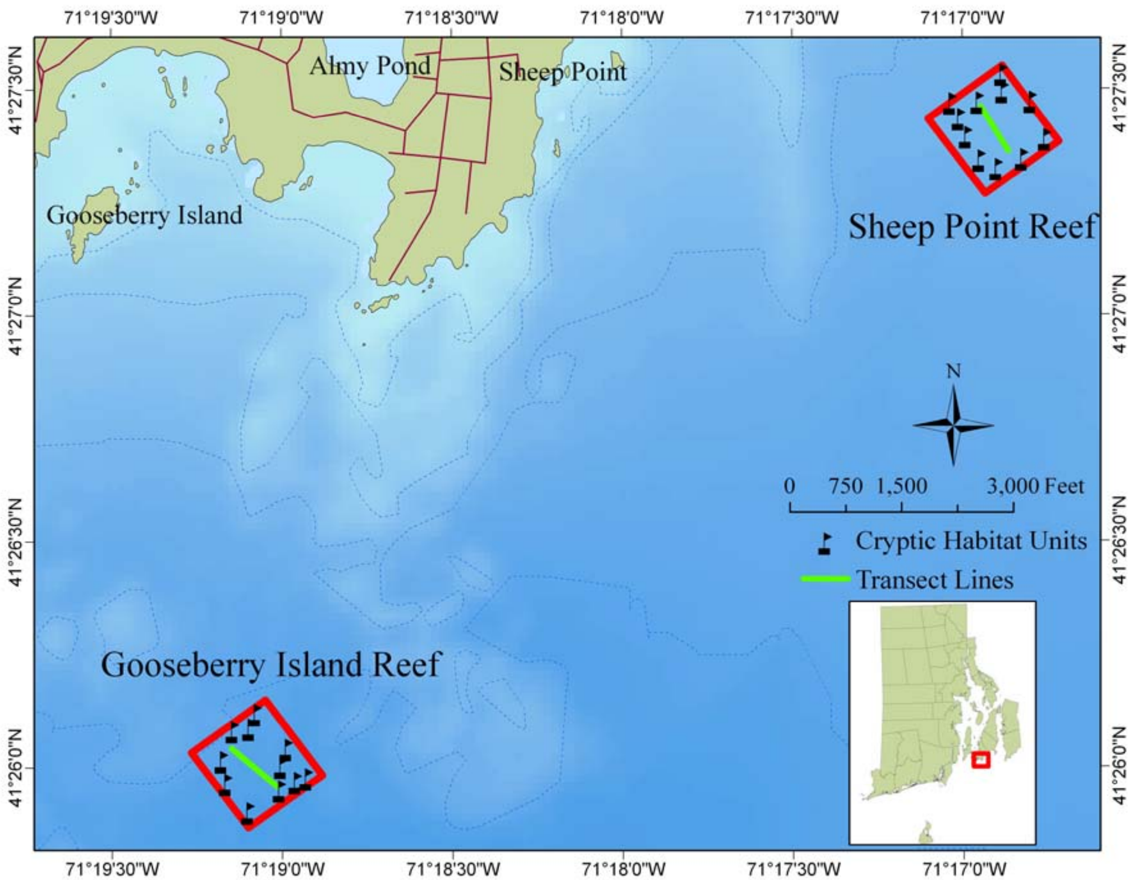


Figure 1. Map showing the locations of Gooseberry Island Reef and Sheep Point Reef.

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 Compliance monitoring

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.

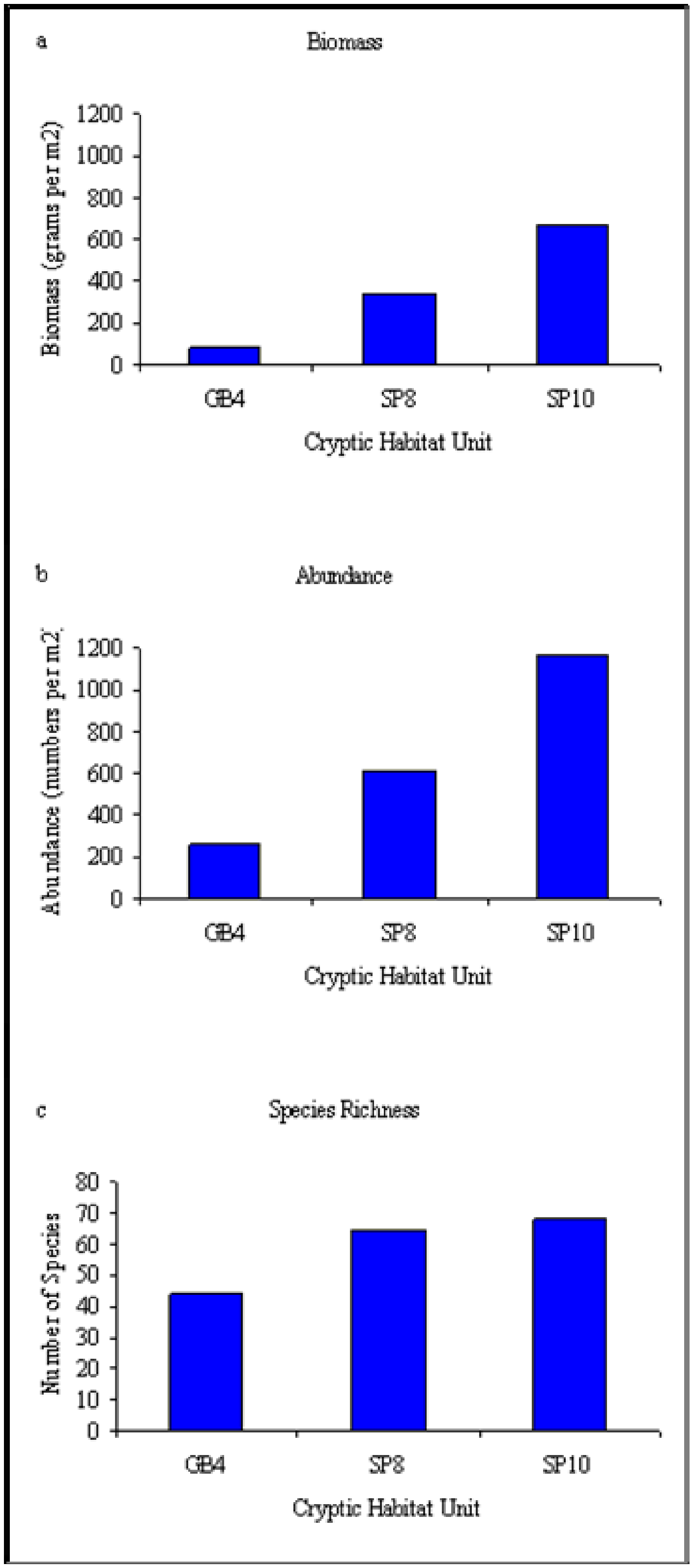


Figure 3. Biomass, abundance and species richness of marine invertebrates and fish found on Cryptic Habitat Units.

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.

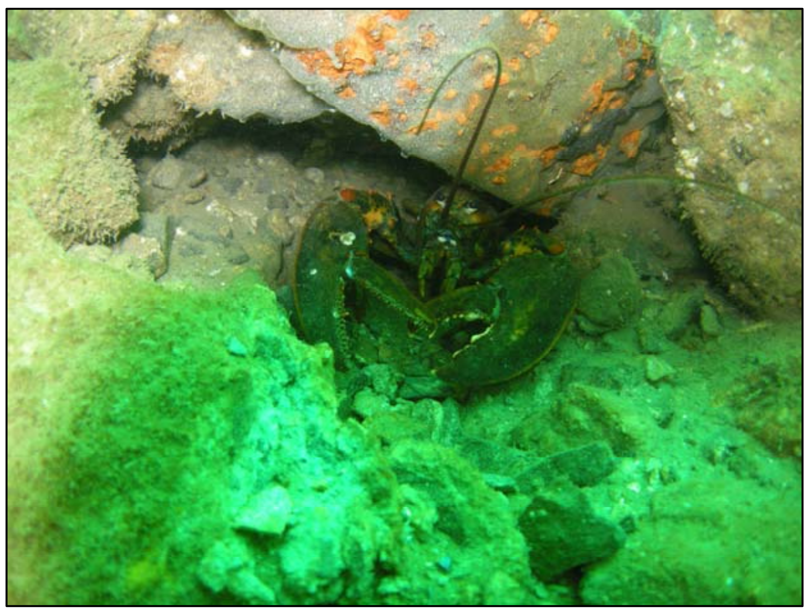
Date	Reef	Number of Species	Total Fish Count
6/20/2008	Sheep Point	4	442
7/20/2008	Sheep Point	3	289
8/23/2008	Gooseberry Island	3	44
9/13/2008	Sheep Point	6	483
7/26/2010	Gooseberry Island	3	38
7/26/2010	Sheep Point	1	18

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.

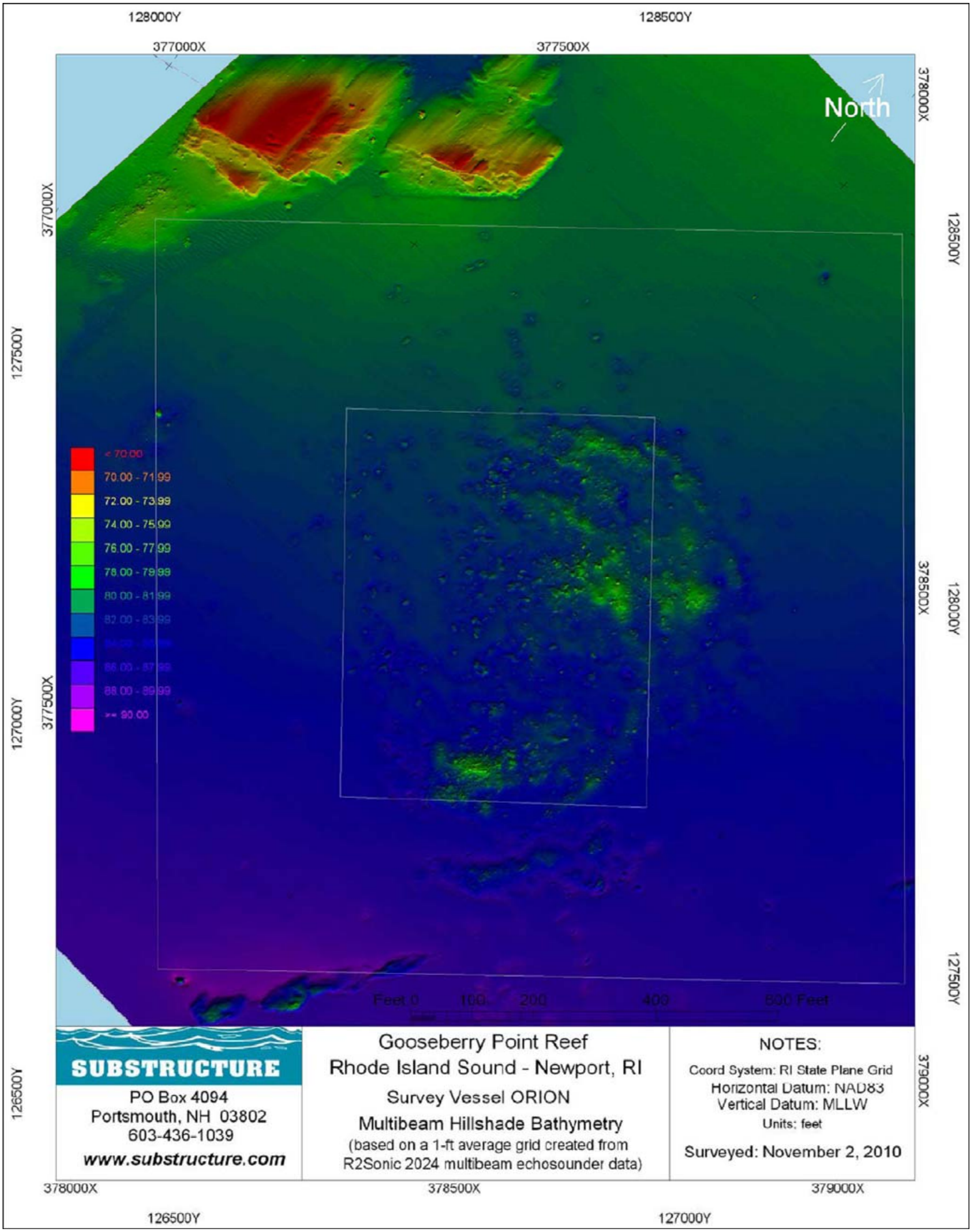


Figure 6. Multibeam Hillshade Bathymetry at Gooseberry Island Reef, November 2, 2010

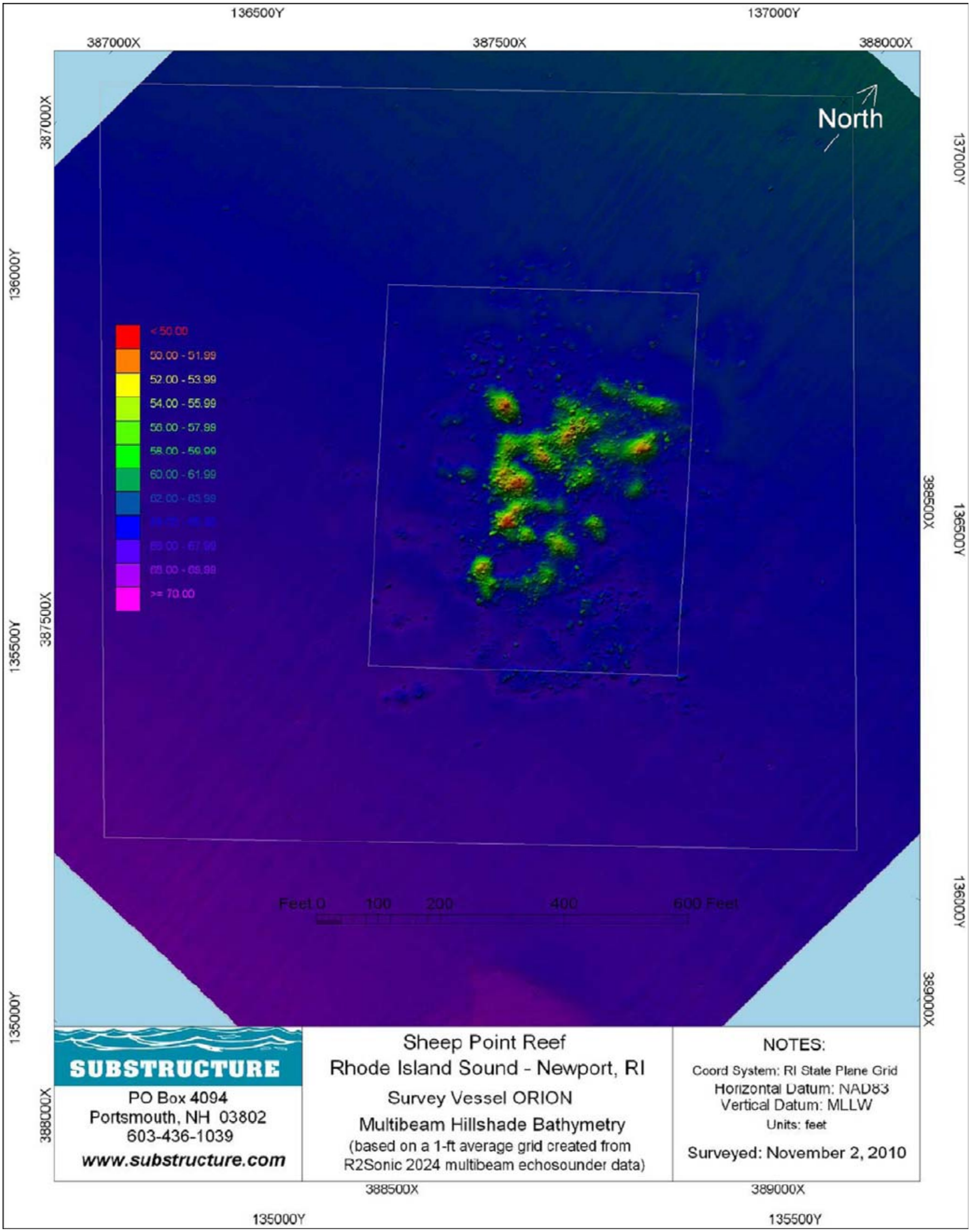


Figure 7. Multibeam Hillshade Bathymetry at Sheep Point Reef, November 2, 2010

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.

6.0 LITERATURE CITED

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Sportfish Assessment and Management in Rhode Island Waters

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STATE: Rhode Island

PROJECT NUMBER: F-61-R

SEGMENT NUMBER: 20

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

PERIOD COVERED: January 1, 2012 – December 31, 2012

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 update, a summer flounder stock assessment update, a scup stock assessment update, a bluefish stock assessment update, a river herring stock assessment, and an Atlantic menhaden stock assessment update. Scientific advice to fisheries managers emerged from these assessments, particularly during the deliberations of the state's licensing provisions for 2012 as well as in the process for setting the recreational management plans for 2012 and 2013. 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 2013 (Finfish Sector Management Plan 2013, see: http://www.dem.ri.gov/pubs/regs/regs/fishwild/mpfinfsh.pdf). The following is a summary of the activities that took place in 2012.

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. 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 defaulted to the 2008 approved SCALE model, which was updated during 2012.

4. ATLANTIC MENHADEN

The ASMFC performed an update assessment in 2012 for the coastwide stock for Atlantic menhaden. The Atlantic menhaden stock is assessed with a statistical catch at age model called BAM (Beaufort Assessment Model). 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 menhaden sampling program, which RI contributed locally caught samples to. RI contributes its Division of Fish and Wildlife seine survey data (see job number 4 from this grant) to the assessment. Staff collects the information and processes it for the assessment. Staff also participates in several meetings where the assessment update information is released.

5. BLUEFISH

Beginning when the new statistical catch at age stock assessment (ASAP = age structured assessment program) was introduced and peer reviewed in 2005, an annual update has been performed for the coastwide stock for bluefish. 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 bluefish aging program, which RI contributes to. A bluefish aging workshop was also conducted in 2012. Staff collects the aging structures and processes them for aging. Staff has also started to participate in the aging process. Staff also participates in several meetings where the assessment update information is released.

6. River Herring

River herring were newly assessed in 2012. The assessment process was long and very complicated due to the river specific populations, which were all assessed separately. The main tasks that RI contributed were its Division of Fish and Wildlife trawl, seine, and adult monitoring survey data (see job number 2 and 4 from this grant) to the assessment. Staff also participated in the creation of a sustainable fishery plan in 2012.

ASSESSMENT OF RECREATIONALLY IMPORTANT FINFISH STOCKS IN RHODE ISLAND WATERS

Age and Growth Study

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March 2013

PERFORMANCE REPORT

STATE: Rhode Island **PROJECT NUMBER:** F-61-R
SEGMENT NUMBER: 20

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

PERIOD COVERED: January 1, 2012 – December 31, 2012

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 target 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 2012 is nearly complete and will continue throughout the spring of 2013. Although the target number of samples for each species was not met in 2012, except for weakfish, investigators are confident that sampling targets will be met in 2013 due to the addition of an extra staff member to assist in port sampling and ageing as well as extra outreach to seafood dealers. Additionally, investigators have reached out to recreational fishing groups for the 2013 fishing season, specifically, the Rhode Island Party and Charter Boat Association (RIPCBA), 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: The sampling targets set for 2012 were not met for most species due to the availability of certain species from floating fish traps for sampling, weather and difficulty in scheduling port samples. An additional full-time employee has been added to this job for 2013 to ensure adequate sampling in 2013. Additional outreach to seafood dealers as well as commercial and recreational fishermen is being conducted to ensure adequate sampling.

RECOMMENDATIONS: Finish ageing structures collected in 2012 and move into the next project segment for 2013.

REMARKS: For the remainder of 2013 investigators will focus on ageing the remaining structures collected in 2012 and begin the 2013 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. Bluefish was added as a port sampling species for 2012 and 2013 per Addendum I to Amendment I to the Fishery Management Plan for the Bluefish Fishery set forth by the Atlantic States Marine Fisheries Commission (ASMFC).

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 November of 2012. 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 sampled in 2012.

Common name	Ageing structure	Sampling Targets	Number of fish sampled
Black sea bass	Scale	100	8
Bluefish***	Otolith	100	87
Menhaden	Scale	100	76
Scup	Scale	1000	0
Striped bass	Scale	150 fish/gear type**	252
Summer Flounder	Scale	100	0
Tautog	Operculum/Otolith	200	122
Weakfish	Otolith	3 fish aged per metric ton landed*	13

*Per ASMFC FMP requirements, 8 ages required for 2012
**Gear types include floating fish traps and rod & reel
***Required by ASMFC for 2012 and 2013

Table 2. Gear type sampled for each species collected in 2012 (FFT=Floating Fish trap).

Common name	Gear Type
Black sea bass	FFT
Bluefish	Hook and Line
Menhaden	FFT, Purse Seine
Striped bass	FFT, Hook and Line
Tautog	Hook and Line
Weakfish	FFT, Otter Trawl

RESULTS AND DISCUSSION

Port sampling efforts were successful in 2012 however the availability of fish as well as staff time prevented all of the sampling targets from being met. The only species for which the full sampling target was met was weakfish. Staff were sometimes engaged on other projects that were timely in nature and thus scheduling and conducting port samples was at times difficult. The addition of an extra staff member on this job for 2013 will alleviate scheduling conflicts in the future and help ensure that adequate sampling is achieved.

The early arrival and departure of scup from Narragansett Bay in 2012 resulted in extremely low landings of scup for the floating fish traps and subsequently, a transfer of 96% of the FFT scup quota to the general category fishery. General category scup brought to seafood dealers is typically packaged as soon as it is offloaded from fishing vessels making sampling scup directly at the dealer difficult. As a result, no scup samples were taken in 2012. If this issue should arise again in 2013, investigators will work with seafood dealers to obtain samples before packaging occurs. Sampling of black sea bass and summer flounder typically takes place on board the RI DEM Trawl Survey. Staff aboard the trawl survey was very limited in 2012 and therefore it was not possible to have an additional sampler on board to collect age samples. 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 off-loaded from the fishing vessels at the dock. Menhaden samples are very limited to floating fish traps and the availability of samples varies from year to year. Although weakfish samples are very difficult to acquire due the extremely diminished weakfish stock, investigators were able to fulfill their sampling target in 2012. The sampling target for weakfish in 2012, as mandated by the ASMFC, was based on 2011 landings which were 5,766 pounds (2.62 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 16 lengths and 8 fish aged.

To date, ageing of striped bass scales and tautog operculum is complete (Tables 3-4, Figure 1). Additionally, tautog ages for 2011 have been included in this report as they were not available when the 2011 progress report was submitted (Table 5, Figure 2). Ageing structures collected for bluefish will not be aged until the ASMFC bluefish technical committee is able to coordinate ageing efforts among the participating states. Menhaden scales were sent for ageing to the menhaden program laboratory in Beaufort, NC. Weakfish otoliths will be processed and aged in the coming months and age data will be included in the next progress report.

Table 3. Age/length key for Striped Bass collected in 2012.

TL (in) / Age	4	5	6	7	8	9	10	11	12	13	14	15	Total
26	2	0	1	0	0	0	0	0	0	0	0	0	3
27	0	3	5	0	0	0	0	0	0	0	0	0	8
28	1	1	3	3	0	0	0	0	0	0	0	0	8
29	0	0	3	2	1	0	0	0	0	0	0	0	6
30	0	0	7	12	0	0	0	0	0	0	0	0	19
31	0	0	6	4	0	0	1	0	0	0	0	0	11
32	0	0	1	7	3	0	0	0	0	0	0	0	11
33	0	0	0	5	6	0	0	0	0	0	0	0	11
34	0	0	0	1	2	2	0	0	0	0	0	0	5
35	0	0	0	1	4	3	0	0	0	0	0	0	8
36	0	0	0	2	6	1	3	0	0	0	0	0	12
37	0	0	0	0	3	3	0	0	0	0	0	0	6
38	0	0	0	0	0	4	2	1	0	0	0	0	7
39	0	0	0	0	0	1	2	0	0	0	0	0	3
40	0	0	0	0	0	3	1	1	0	0	0	0	5
41	0	0	0	0	0	0	2	0	1	0	0	0	3
42	0	0	0	0	0	0	2	0	0	0	0	0	2
43	0	0	0	0	0	0	1	0	0	0	0	0	1
44	0	0	0	0	0	0	1	1	2	1	0	0	5
45	0	0	0	0	0	0	0	0	1	2	2	1	6
46	0	0	0	0	0	0	1	0	0	0	0	0	1
47	0	0	0	0	0	0	0	0	1	0	0	0	1
48	0	0	0	0	0	0	0	0	0	1	1	0	2
Total	3	4	26	37	25	17	16	3	5	4	3	1	

Table 4. Age/length key for Tautog collected in 2012.

TL (in)/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
10	0	1	2	1	2	1	0	0	0	0	0	0	0	0	7
11	0	1	1	4	1	0	0	0	0	0	0	0	0	0	7
12	0	0	3	2	4	0	0	0	0	0	0	0	0	0	9
13	0	0	2	3	2	0	0	0	0	0	0	0	0	0	7
14	0	0	3	5	7	1	0	0	0	0	0	0	0	0	16
15	0	0	0	1	11	4	1	0	0	0	0	0	0	0	17
16	0	0	0	1	17	6	0	0	0	0	0	0	0	0	24
17	0	0	0	1	7	6	3	2	0	0	0	0	0	0	19
18	0	0	0	0	3	4	2	3	0	0	0	0	0	0	12
19	0	0	0	0	0	1	4	1	0	1	0	0	0	0	7
20	0	0	0	0	0	0	2	0	0	0	1	0	0	0	3
21	0	0	0	0	0	0	0	1	0	0	1	0	0	0	2
22	0	0	0	0	0	0	0	1	1	0	0	1	0	0	3
Total	0	3	11	18	54	23	12	8	1	1	2	1	0	0	

Table 5. Age/length key for Tautog collected in 2011.

TL (in)/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
7	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
8	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	4	2	0	0	0	0	0	0	0	0	0	0	0	6
11	0	1	3	2	1	0	0	0	0	0	0	0	0	0	7
12	0	0	3	5	0	0	1	0	0	0	0	0	0	0	9
13	0	0	2	8	6	2	3	0	0	0	0	0	0	0	21
14	0	0	1	25	8	3	1	1	0	0	0	0	0	0	39
15	0	0	0	13	6	2	2	2	0	0	0	0	0	0	25
16	0	0	0	15	15	15	4	3	0	1	0	0	0	0	53
17	0	0	0	4	9	11	5	2	2	0	0	0	0	0	33
18	0	0	0	1	2	9	11	3	3	0	0	0	0	0	29
19	0	0	0	0	1	5	6	4	1	0	0	0	0	0	17
20	0	0	0	0	0	2	2	4	2	0	0	1	1	0	12
21	0	0	0	0	0	1	0	4	0	0	0	0	0	0	5
22	0	0	0	0	0	1	0	0	1	1	0	0	0	0	3
23	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
Total	0	6	12	73	48	51	35	23	9	4	0	1	1	0	

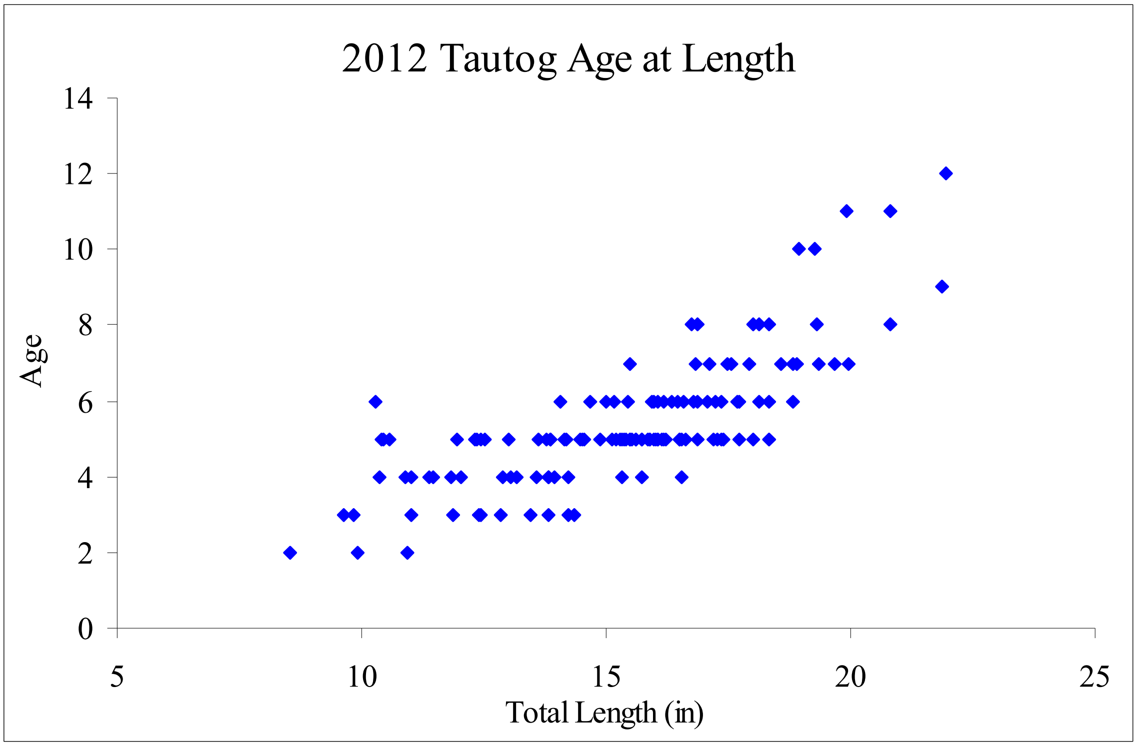


Figure 1. Tautog age at length for the 2012 RI recreational fishery.

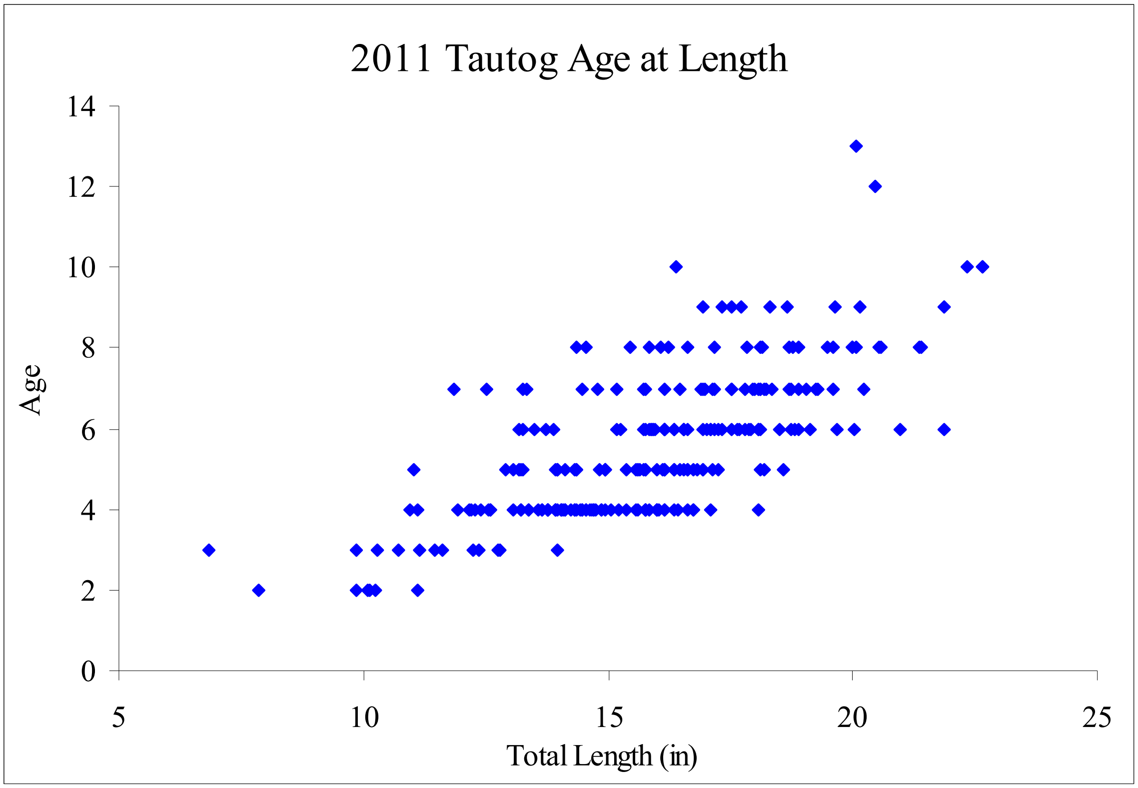
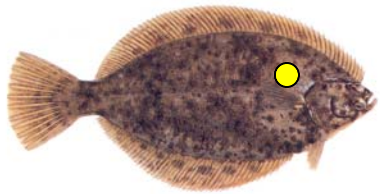


Figure 2. Tautog age at length for the 2011



Assessment of Recreationally Important Finfish Stocks in Rhode Island Coastal Waters

Winter Flounder Spawning Stock Biomass Survey in Pt. Judith Pond ,RI

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Rhode Island Department of Environmental Management
Federal Aid in Sportfish Restoration
F-61-20

Performance Report March, 2013

State: Rhode Island Project Number: F-61-R-20

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

Period Covered: January 1, 2005 - May 30, 2012

Job Number and Title: Job 10 - 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 seven night sets. There are a total of eight stations where data exists, all found in the Pt. Judith Pond system including Potters Pond. (NOAA Nautical Chart 13219) These two ponds use the same breach to connect to Block Island and Rhode Island Sounds.

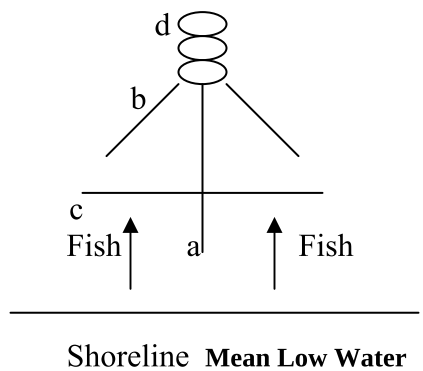
Additional Research : In 2012 an additional coastal pond system was added to the survey. As adult winter flounder abundance in the Point Judith system declined to all time lows, an adjacent pond, Charlestown Pond, also know as Ninigret Pond (NOAA Nautical Chart 13205) was surveyed during the same time period and is continuing during the 2013 sampling year. Rhode Island Coastal Trawl Survey data (Spring Survey) shows a sharp increase in relative abundance in the Block Island Sound area. This appears to be a similar trend in the Charlestown Pond system. If, through this continuation of the multiple sampling areas, Point Judith continues to experience low abundance and recruitment while other area surveys show a diverging trend then the assumption would be that the Point Judith system is having localized winter flounder depletion from sources other than fishing mortality. Commercial fishing activity in Block Island Sound is also returning valuable tag recapture information from the Charlestown Pond sampling, that which is now missing from the Point Judith Pond survey due to the inability to catch enough fish to tag.

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:

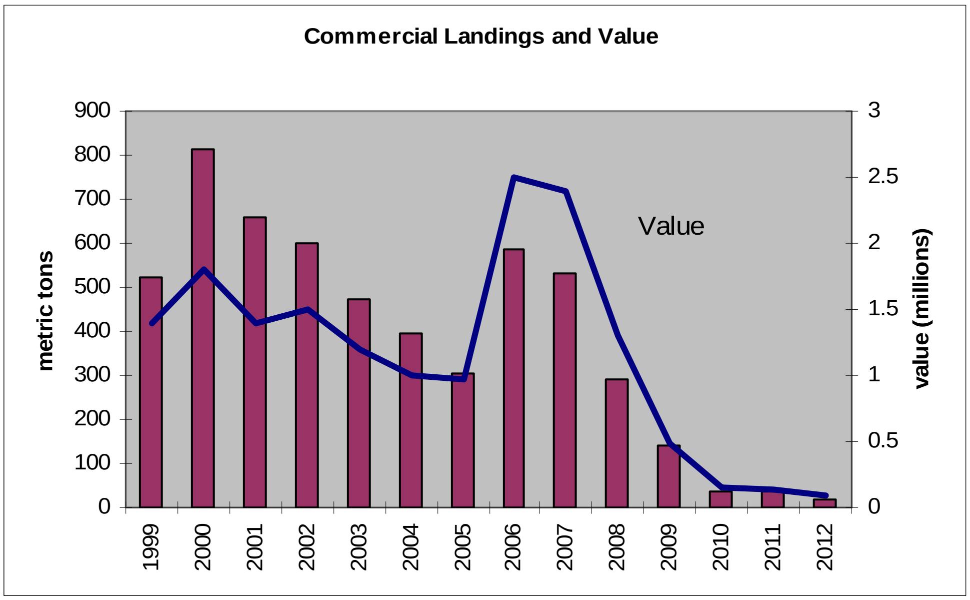
Three fyke nets were set at three fixed stations in Pt. Judith and Potter Ponds during January and April in 1999 - 2001 and two nets were set at four fixed stations from 2002 to present. The nets are fixed at mean low water and set perpendicular to the shoreline. Fyke nets are a passive fishing gear and allow the catch to be retained alive for a short period of time. Nets are tended from two to seven 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.

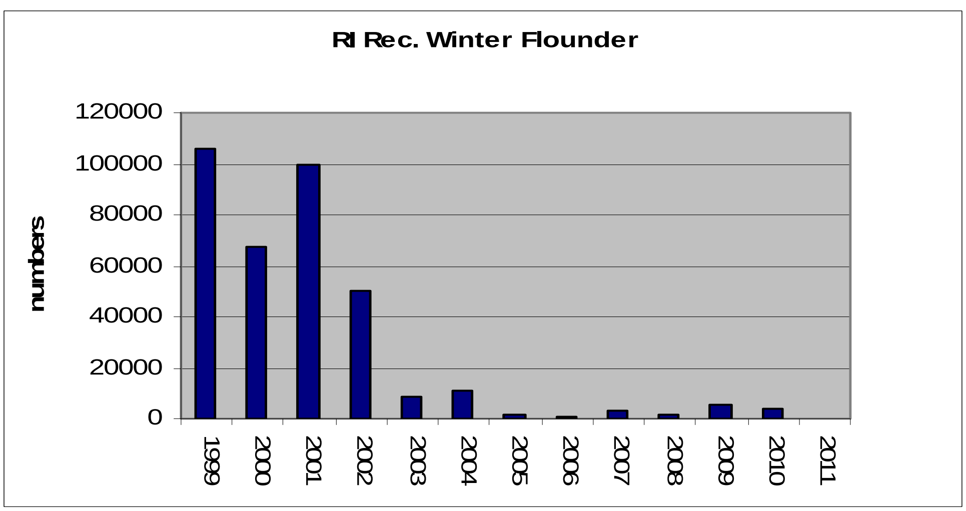
All fish captured are measured, sexed, enumerated and categorized to describe spawning stage. Spawning stage is defined as ripe (pre-spawn), ripe/running (active spawn), spent (post-spawn), resting (non-active spawn) and immature. These data illustrate how the spawning activity of flounder advances throughout 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:

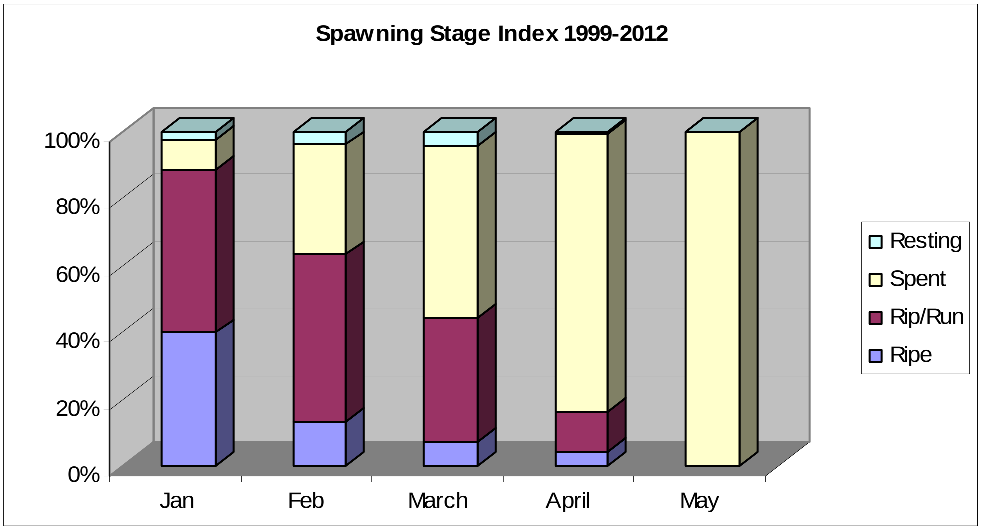
Winter Flounder (***Pseudopleuronectes americanus***) are both a commercially and recreationally important species to the State of Rhode Island. From 1999 - 2012 commercial landings of winter flounder in Rhode Island averaged over 300 metric tons and an average value of one million dollars annually. Recreational landings have declined rapidly throughout the period to a new time series low in 2011. (NMFS. 2013 Commercial landings query and MRFSS database)



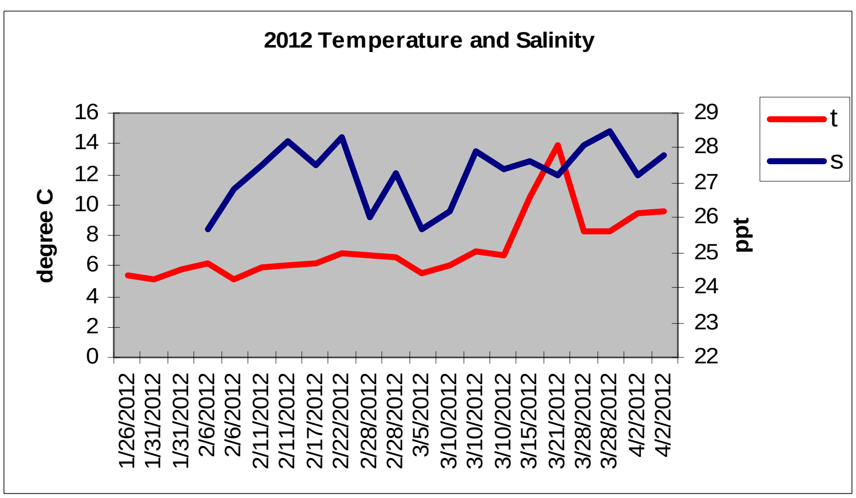


Spawning Behavior:

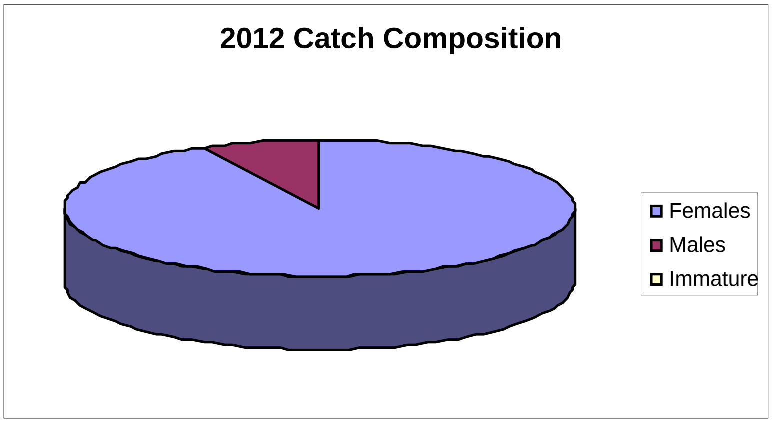
Winter Flounder enter the south shore coastal pond systems in Rhode Island to spawn in the early part of winter (November) and engage in spawning activity from January through May annually. Spawning and egg deposition takes place on sandy bottoms and algal accumulations. Winter Flounder eggs are non-buoyant 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.

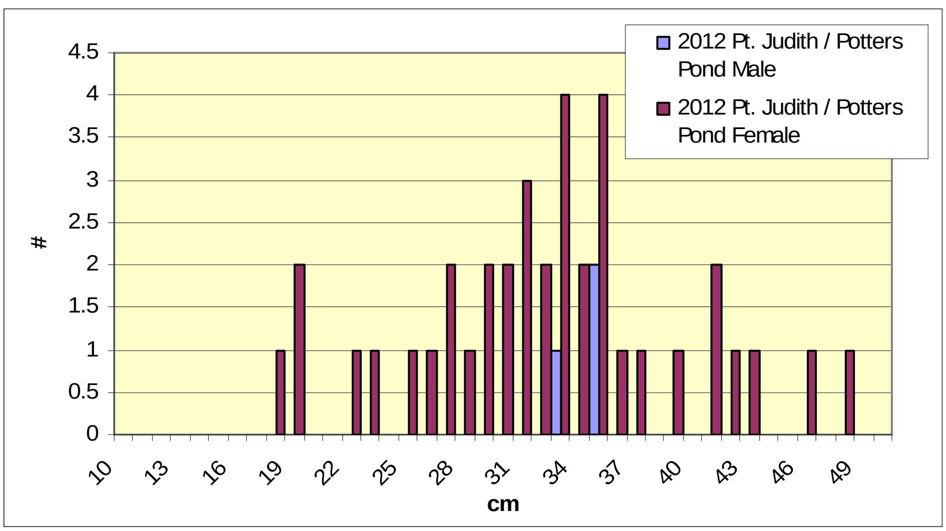


Sex ratios throughout the time series tend to favor females. Similar observations were made in Green Hill Pond, a neighboring coastal pond (Saila 1961), and in Narragansett Bay (Saila 1962).



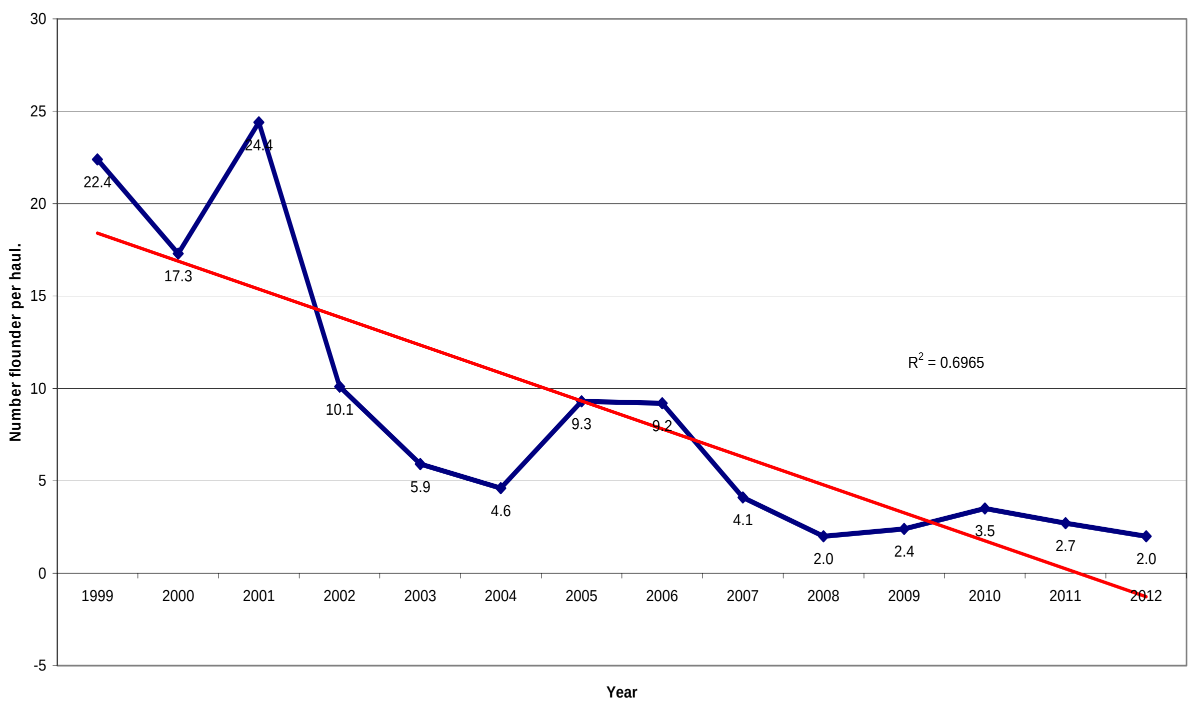
Size Distribution:

The total number of winter flounder sampled during the 2012 survey was 41. This was a 40% decrease from the 2011 survey. Sizes ranged from 18cm to 48cm. The mean size sampled was 32.3cm.



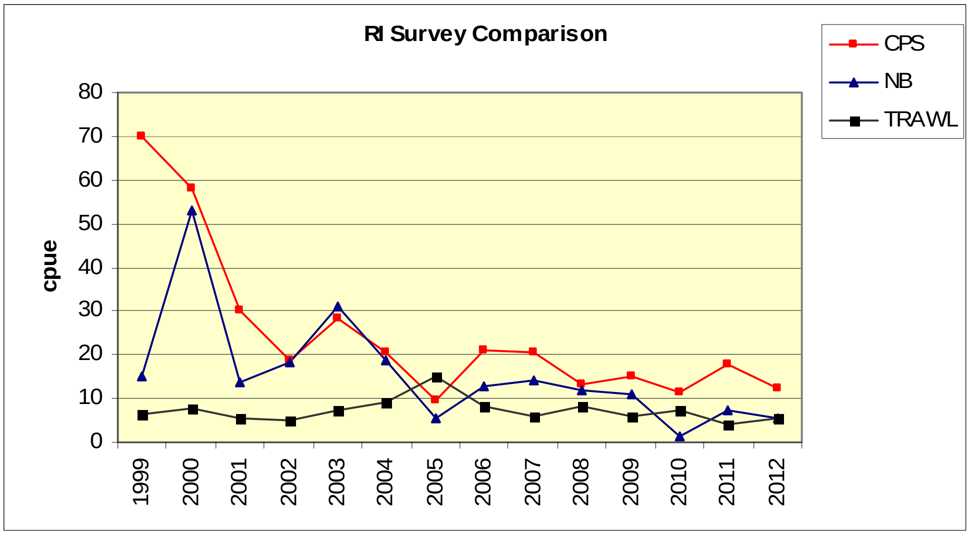
Results:

2012 Adult winter flounder CPUE decreased slightly to 2.0 fish per net haul or a 26% decrease from the 2012 value of 2.7 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 and 2012 CPUE being the lowest points 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.



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.

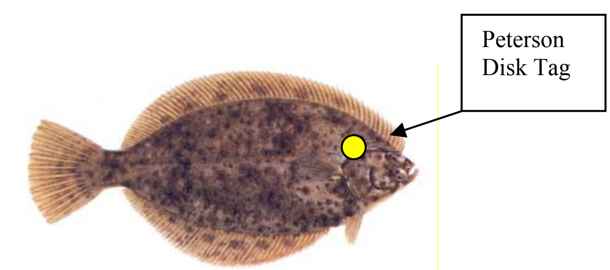


Table 1 Mark / recapture data 1999 - 2012 (Pt Judith system)

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
2012	41	15	0
Total	3870	1531	194

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

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total	% recap
1999	31	8	10	1	0	1	0	0	0	0	0	0	0	0	51	0.15361
2000		23	17	5	1	0	0	0	0	0	0	0	0	0	46	0.22115
2001			43	11	1	2	0	0	0	0	0	0	0	0	57	0.15922
2002				1	3	1	0	0	0	0	0	0	0	0	5	0.02747
2003					1	1	2	0	0	0	0	0	0	0	4	0.04598
2004						9	1	2	0	0	0	0	0	0	12	0.1875
2005							4	4	2	1	0	0	0	0	11	0.09565
2006								3	2	0	0	0	0	0	5	0.05495
2007									2	1	0	0	0	0	3	0.08571
2008										0	0	0	0	0	0	0
2009											0	0	0	0	0	0
2010												0	0	0	0	0
2011													0	0	0	0
2012														0	0	0
Total	31	31	70	18	6	14	7	9	6	2	0	0			194	0.12671

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

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total	% recap
1999	26	6	6	0	0	1	0	0	0	0	0	0	0	0	39	0.11747
2000		18	9	0	1	0	0	0	0	0	0	0	0	0	28	0.13462
2001			39	2	1	2	0	0	0	0	0	0	0	0	44	0.12291
2002				1	3	1	0	0	0	0	0	0	0	0	5	0.02747
2003					1	1	2	0	0	0	0	0	0	0	4	0.04598
2004						9	1	2	0	0	0	0	0	0	12	0.1875
2005							1	3	2	1	0	0	0	0	7	0.06087
2006								1	1	0	0	0	0	0	2	0.02198
2007									2	1	0	0	0	0	3	0.08571
2008										0	0	0	0	0	0	0
2009											0	0	0	0	0	0
2010												0	0	0	0	0
2011													0	0	0	0
2012														0	0	0
Total	26	24	54	3	6	14	4	6	5	2	0	0	0	0	144	0.09406

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. Continuation of the Charlestown Pond System to track local adult winter flounder abundance and use the catch as a source of tag able animals to gain information on population size, mortality and year class structure. 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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Prepared by:____________________	Approved by:___________________
Scott D. Olszewski Marine Fisheries Biologist	Mark Gibson Deputy Chief, Marine Fisheries

Narragansett Bay Atlantic Menhaden Monitoring Program

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STATE: Rhode Island

PROJECT NUMBER: F-61-R

SEGMENT NUMBER: 20

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

PERIOD COVERED: January 1, 2012 – December 31, 2012

JOB NUMBER 11 TITLE: Narragansett Bay Atlantic Menhaden Monitoring Program

JOB OBJECTIVE: Continue administering an Atlantic menhaden monitoring program in Narragansett Bay that will use sentinel fishery observations (information of landings from floating fish traps), abundance information from spotter flights (both with a trained spotter and independent flights), removal information by tracking fishery landings, and a mathematical model (Depletion Model for Open Systems; see Gibson, 2007) to monitor the abundance of menhaden in Narragansett Bay in close to real-time and adjust access to the fishery as necessary through a dynamic regulatory framework.

SUMMARY: Atlantic menhaden (menhaden) undergo large coastwide migrations each year. After aggregating in the offshore waters of the Mid Atlantic region during the winter, menhaden migrate west and north stratifying by size and age the further north they migrate (Arenholz, 1991). Menhaden arrive in RI coastal waters beginning in the early spring, and in some years enter Narragansett Bay in large numbers, where they can reside for varying amounts of time until they begin their southward migration in the fall. During the period when they reside in Narragansett Bay, a number of user groups compete for the resource. Commercial bait companies begin to fish on the schools of menhaden and provide bait for both recreational fishing interests and for the lobster fishery. As well, recreational fishermen access the schools of menhaden directly and use the resource as bait for catching larger sport fish such as striped bass and bluefish. Large numbers of sport fishermen can be seen in their boats surrounding large schools of menhaden throughout the spring and summer using various methods to harvest them (snagging lures, cast nets, dip nets). The migration of menhaden to the north is also one factor which brings these larger sport fish to northern areas, as they are an important food resource for these species (Arenholz, 1991; ASMFC, 2010). During the period when the menhaden resource is within Narragansett Bay and multiple user groups are accessing it, user group conflicts are an inevitable outcome.

To help assuage some of these conflicts, to allow for an amount of the menhaden resource to remain unharvested by commercial interests for use by the recreational community, and to allow a portion of the menhaden resource to remain in Narragansett Bay to provide ecological services, the RI Division of Fish and Wildlife (DFW) administered a menhaden monitoring program in Narragansett Bay. The program collectively uses sentinel fishery observations (floating fish trap data), spotter flight information both with a trained spotter pilot and from independent helicopter flights, fishery landings information, computer modeling, and biological sampling information to open, keep track of, and close the fisheries on menhaden as conditions dictate.

TARGET DATE: December 2012

SIGNIFICANT DEVIATIONS: There were no significant deviations to methodology in 2012, with the exception of entertaining an additional spotter pilot biomass estimate in the model.

RECOMMENDATIONS: Continue spotter flights and data collection to create the estimate of Narragansett Bay Atlantic menhaden biomass. Continue to analyze and provide data for use in the RI menhaden fishery management program. Continued development of the assessment model and continue to move from a Microsoft excel framework in to an ADMB framework. An effort to create a consistent protocol for the spotter flights will be created so that if additional estimates are to be submitted, all estimates will be from flights undergoing similar flight paths at similar times of the day.

REMARKS: Abundance estimates derived from the menhaden monitoring program have been used to open and close the Narragansett Bay menhaden fishery. The management is performed to accommodate the recreational sportfish fishery that depends on menhaden as a source of bait for striped bass, bluefish, and weakfish, popular sportfish species in Narragansett Bay. In addition, the maintenance of a standing stock of menhaden biomass in Narragansett Bay meets other ecological services that this species performs.

The structure of the management is to maintain a biomass threshold of 1.5 million pounds in the Bay, which provides forage for the predatory species of striped bass and bluefish. Prior to the commencement of commercial fishing, the biomass needs to reach 2 million pounds to provide a body of fish for the fishery to remove without dropping below the 1.5 million pound threshold. Once fishing is authorized, the commercial fishery is allowed to remove 50% of the biomass above the 1.5 million pound threshold, leaving the rest for ecological services and for use as bait by recreational fishermen. If the biomass estimates based on the spotter flights drop below the 1.5 million pound threshold, the fishery will close. In addition, if landings by the commercial fishery reach the 50% cap, the fishery closes.

METHODS, RESULTS & DISCUSSION: The program in 2012 consisted of three main elements: collection of fishery landing information through call in requirements, computer modeling work, and field work (spotter fights and biological sampling). DEM regulations require that purse seine vessels fishing for menhaden in Narragansett Bay report their catches to DFW staff. The commercial fishery interests also agree to carry a DFW observer on the fishing vessel upon request, or allow a port sample to occur while the catch is being offloaded. In 2012, port samples were undertaken where DFW observers sampled the catch and recorded the weight of catch offloaded. Catch sampling includes length frequencies and body weights. The DFW also contracted with a trained spotter pilot to make abundance estimates of menhaden in Narragansett Bay. When in the air, DFW observers recorded the pilot counts of the number of menhaden schools observed, the estimated weight within the schools, and the location of the schools. An additional series of flights were taken in a state helicopter independent of the contracted spotter pilot. During these flights, DFW staff recorded the number and location of schools, allowing for independent verification of the spotter pilot estimates of school number. Other commercial harvesters such as floating fish trap operators were required to file logbook reports monthly with the DFW that detailed daily fishing activities. These fishers were also contacted for information and biological sampling during periods of increased menhaden activity on a more frequent basis. These fixed gear fisheries are useful as sentinels, documenting the arrival and movements of menhaden in state waters. Other information on menhaden abundance and movements were obtained from scientific staff on DFW research cruises and a network of fishers working Narragansett Bay. Collectively, these sources of information were analyzed using the theory of depletion estimation as applied to open populations. All of the afore mentioned information was centrally collected and used in a computer modeling approach that allows the DFW to monitor the abundance of menhaden in Narragansett Bay. The existing regulatory framework governing state waters allows the DFW to use the output from the mathematical modeling approach to set a number of fishing activity parameters including a static amount of fish that need to be present to allow commercial fishing to commence, thus protecting recreational and ecological interests if only a small population enters the Bay, allows for only half of the standing population present in Narragansett Bay above the initial threshold amount to be harvested, thus maintaining an amount of unharvested fish even when commercial fishing has commenced, and subsequently allows the DFW to close the fishery when the standing population of menhaden in Narragansett Bay drops back below the threshold level of fish, again maintaining a portion of the population for recreational fishermen and ecological services.

<u>2012 Fishery Data</u>

In 2012, only one commercial menhaden fishing operation fulfilled requirements for fishing in Narragansett Bay. In previous years a second operation also participated in the fishery, but has not come back to RI for the past 2 years. After biomass levels were estimated and confirmed, commercial fishing was allowed to commence on May 15, 2012. Spotter flight estimates had commenced the week previous to the opening of fishing to make sure a number of biomass estimates were accomplished with which to initiate the model. The commercial bait fishery closed on June 6, 2012, as it was determined that the biomass levels dropped below the threshold 1.5 million lbs. The fishery reopened on June 12, 2013 due to the influx of menhaden biomass in to the Bay. Flights and biomass estimates were continued even while the fishery had closed. The commercial bait fishery closed again on June 20, 2012, and remained closed for the season.

A figure of the cumulative landings is shown in Figure 1. The landings are transformed to protect confidentiality. The landings cap is also represented in the figure. In 2012 the landings cap was exceeded, though it was only exceeded by less than one days possession limit. The precision of the model depends on the estimates that are being conveyed by the spotter pilot, and therefore overages of this nature are not unprecedented, and in this case the overage is equivalent to one day which is not too egregious when considering the magnitude of the fishery and biomass that is in the Bay.

There were 30 spotter flights accomplished in 2012. The flights were spread throughout the season to make sure there were estimates that occurred before, during, and after the fishery occurred. This was done to achieve an accurate sense of the migratory patterns of this important species in to RI waters. Over time, these estimates could be used to improve the predictive power of the model. In addition to the professional spotter pilot estimates, helicopter flights were also undertaken. Six helicopter flights were taken in

2012. The idea behind the helicopter flights is to add an additional independent observation in to the program. School counts are the metric used from the helicopter flights.

The model performed relatively well in 2012. A graph showing the spotter observations and the model estimated biomass trajectory are shown in Figure 2. A few of the late season estimates (not shown in figure 2) caused the model estimates to bias above the observed values in the earlier part of the season. It is hoped that this biasing can be avoided in the future with the use of historical biomass estimates from the program as well as using the helicopter school counts as a tuning index. In addition, moving the model in to a different software package (ADMB) will also help improve the model performance.

SUMMARY: The menhaden monitoring program in Narragansett Bay opened in May. There was one in season closure, which ended in June when a second pulse of biomass entered the Bay. The fishery closed for the season at the end of June. Biomass estimates were continued throughout the season and ended in September. In total 30 spotter flights were taken and 6 helicopter flights were taken, giving ample data to use in the depletion model. Upon review, it was found that the harvest cap was exceeded, but it was exceeded by less than 1 day, or less than one daily possession limit, therefore the program can be considered a success in 2012.

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Figures

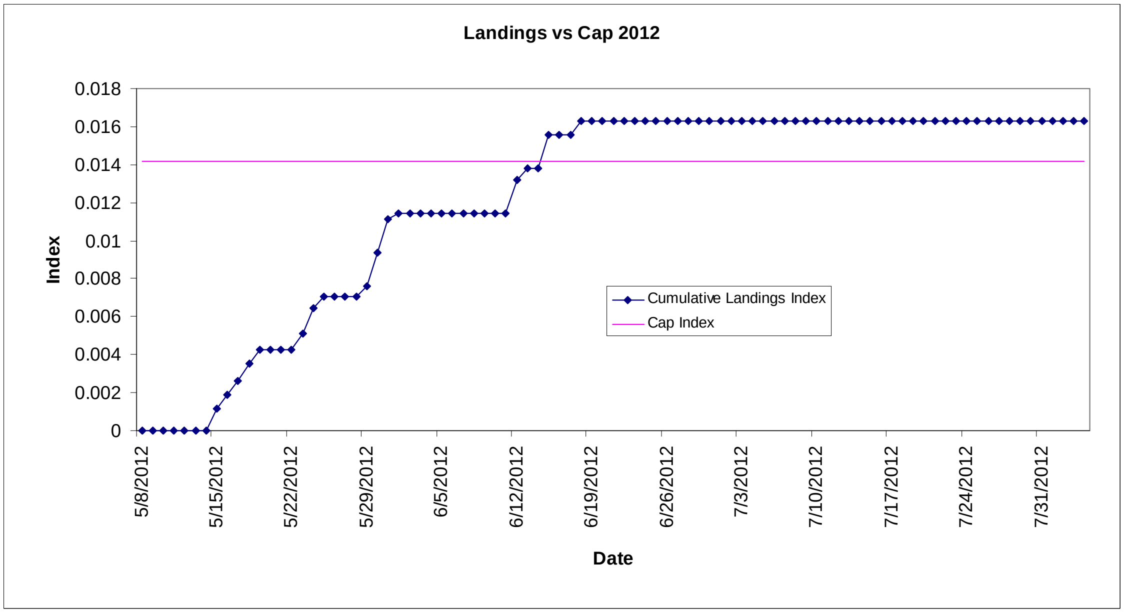

Figure 1 – Cumulative landing index for the RI commercial menhaden fishery versus the landings cap.

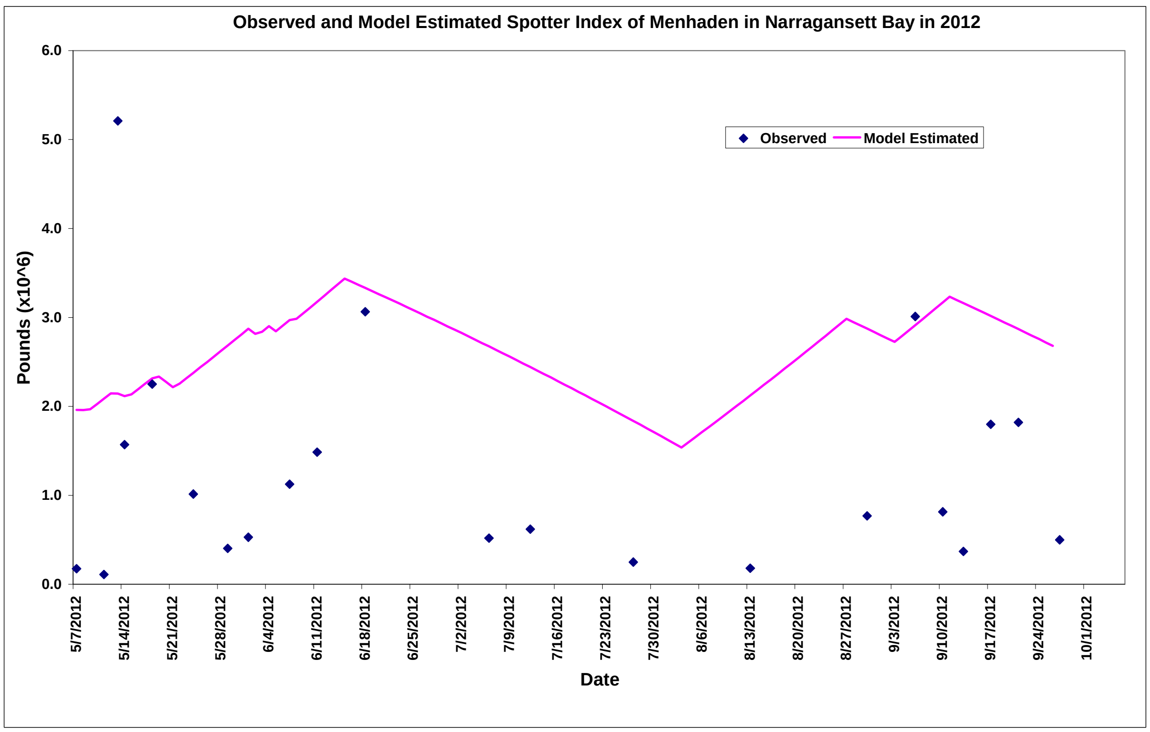

Figure 2 – Spotter pilot estimates of menhaden biomass and model derived prediction of biomass.