FINAL REPORT
Northeast Fisheries Science Center

A. NOAA Grant Number: NA12NMF4540018

B. Grantee: Captain Charles Borden

C. Principal Investigators

Laura Skrobe
University of Rhode Island
Fisheries Center
East Farm – Building 83
Kingston, RI 02881

Captain Charles R. Borden
Cockeast Fisheries, Inc.
F/V *Drake*
38 D Mullin Hill Rd.
Little Compton, RI 02837

Dr. Stephen Cadrin
Department of Fisheries and Oceanography
School of Marine Science and Technology
200 Mill Rd, Suite 325
Fairhaven, MA 02719

Additional Fishing Industry Collaborators

Captain Eric S. Rodegast
F/V *Evangeline*
PO Box 2685
Oak Bluffs, MA 02557

Eric and Rob Burcaw
10 Crestview Drive
Seaville, NJ 02830

Captain Mark Hodges
2456 Bullock Trail
Virginia Beach, VA 23454

State Agency Collaborators

Rob O'Reilly
Deputy Chief of Fisheries
Virginia Marine Resources Commission
2600 Washington Avenue, 3rd Floor
Newport News, VA 23607

Dr. David Pierce
Deputy Director
MA Division of Marine Fisheries
251 Causeway Street
Boston, MA 02114

Brandon Muffley
Chief, Bureau of Marine Fisheries
NJ DEP Division of Fish and Wildlife
Nacote Creek Station
PO Box 418
Port Republic, NJ 08241

Mark Gibson
Deputy Chief, Division of Fish and Wildlife
RI Department of Environmental Management
Division of Fish and Wildlife
3 Ft. Wetherill Road
Jamestown, RI 02835

D. Project Title: Industry Based Survey on Black Sea Bass Utilizing Ventless Traps

E. Amount of Grant: $212,044.00

F. Award Start Date: 01/01/2012

G. Period Covered by Report: 01/01/2013 - 06/30/2013

PROJECT SUMMARY

This project is designed to be a fishery independent black sea bass survey of hard bottom sites in Southern New England (SNE) and Mid-Atlantic waters. Black sea bass were collected from four general zones along the coast utilizing black sea bass pots (43½" long, 23" wide, and 16" high) made with 1½ x 1½ inch coated wire mesh, single mesh entry head, and single mesh inverted parlor nozzle. Pots were unvented and therefore have the capability to retain all size classes of black sea bass. The four general zones will include one in Massachusetts, one south of Rhode Island, one south of New Jersey, and one south of Virginia (Figures 1-5). In each of these general zones, four individual sampling sites were selected, each of which is one square mile in size. For example, there were four sampling sites in Massachusetts waters, each of which was approximately 1 square mile in size. Each of the individual sampling sites was separated by at least four miles in order to provide adequate spatial coverage. This sampling design dispersed the sampling effort over a larger area, since it is not cost effective to sample along the entire coast at this time.

The sampling protocol required that a commercial vessel take 30 pots (3 ten pot trawls) to each of the randomly selected hard bottom sampling sites. This procedure continued each month during the sampling season for five months. Thus, 16 locations were sampled monthly. Pots were un-baited and allowed to remain in place for a minimum of four days. The date, area, depth, set over days, and catch was recorded and fish measured utilizing the standard NMFS sea sampling protocols. This same sampling format will be followed every four weeks for five complete cycles.

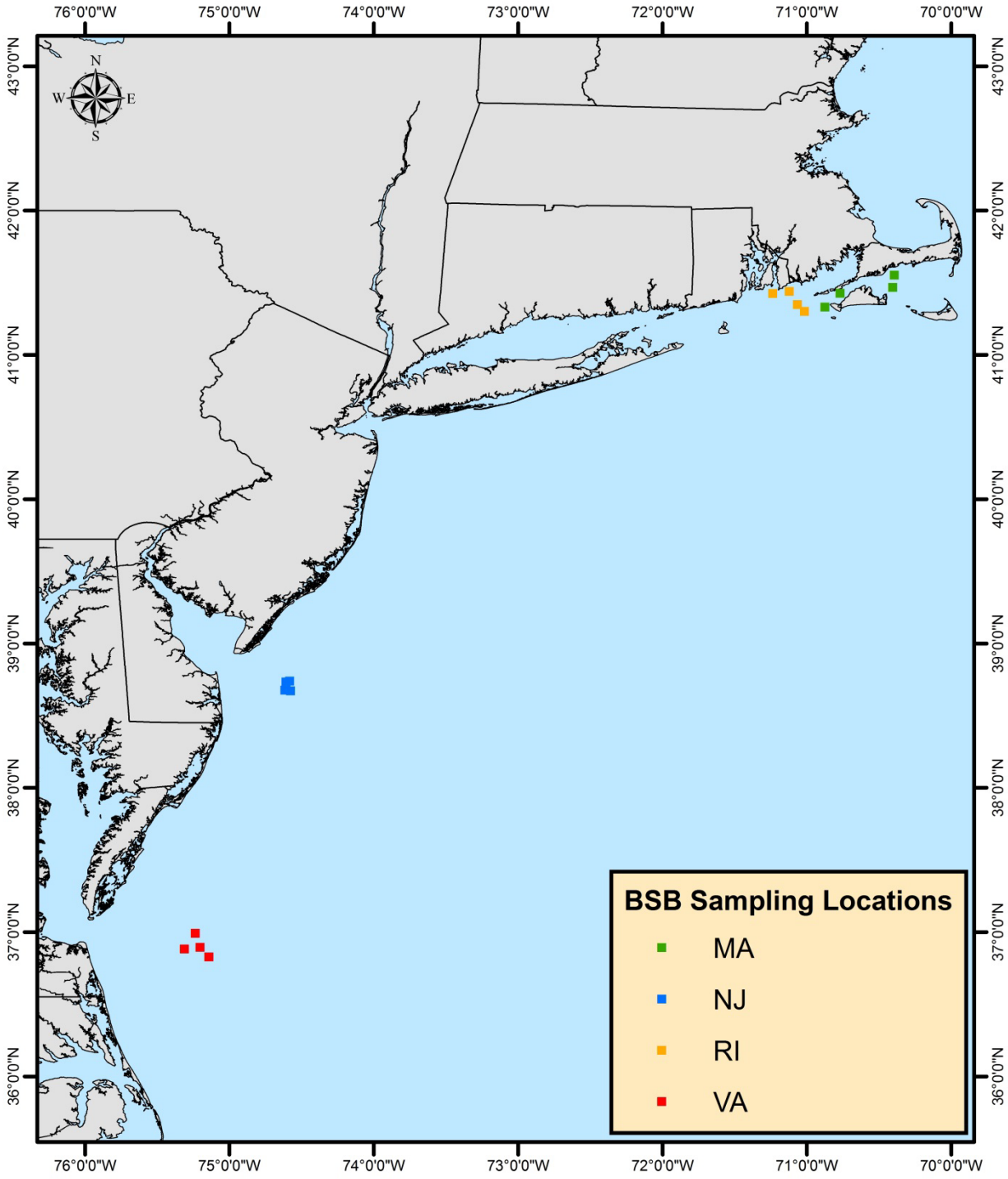

Figure 1. Map showing all 16 sampling sites, 4in each location: Virginia, New Jersey, Rhode Island, and Massachusetts.

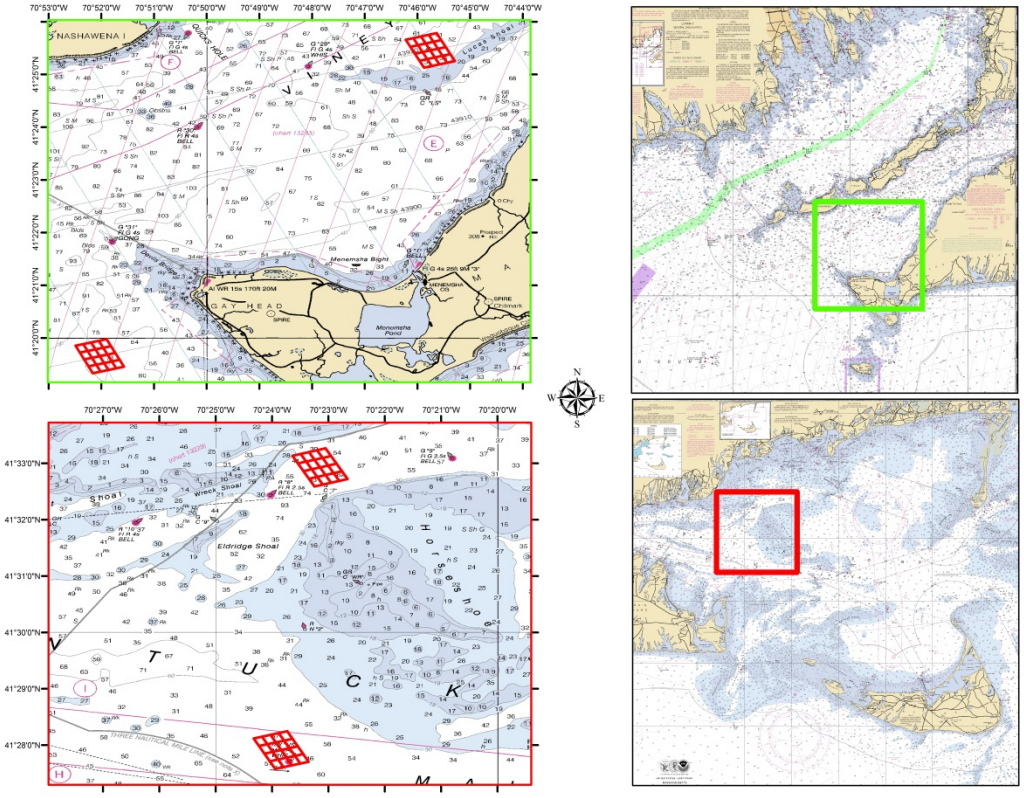

Figure 2. Four sampling sites in Massachusetts showing 16 sub-blocks in each site.

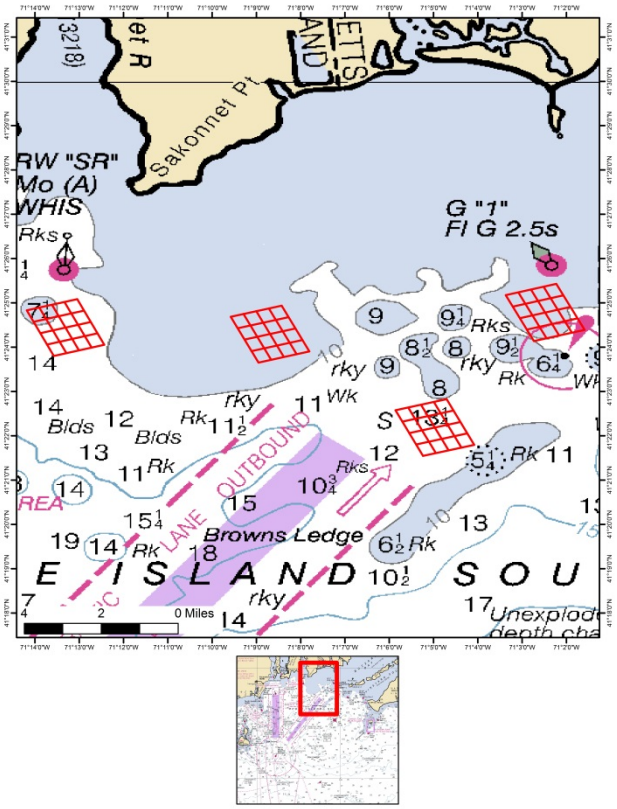

Figure 3. Four sampling sites in Rhode Island showing 16 sub-blocks in each site.

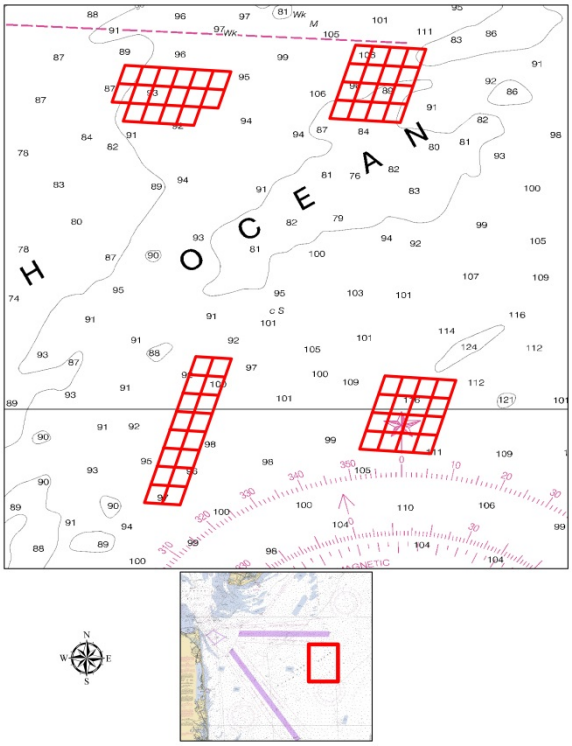

Figure 4. Four sampling sites in New Jersey showing 16 sub-blocks in each site.

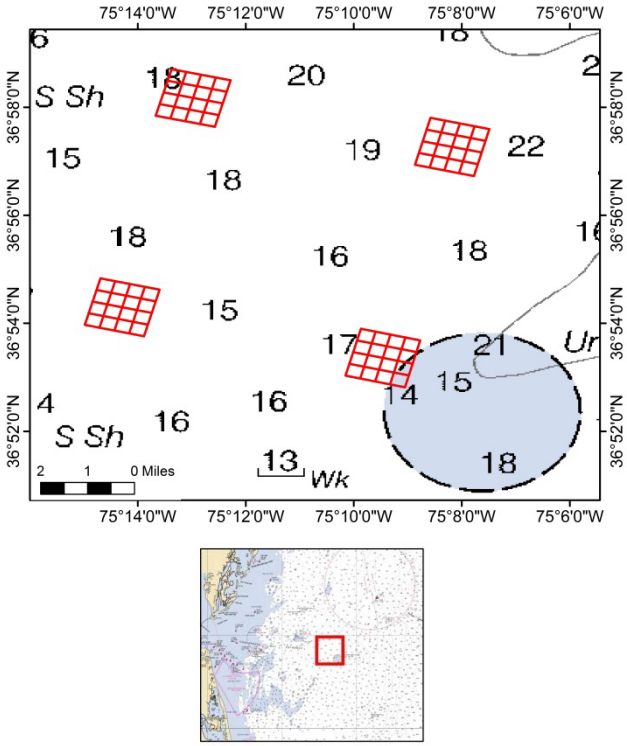

Figure 5. Four sampling sites in Virginia showing 16 sub-blocks in each site.

All sampling was completed by August 2012 in the Mid-Atlantic sites and September 2012 in the New England sites. In the Mid-Atlantic a total of 10326 black sea bass were measured (3539 in Virginia waters and 6787 in New Jersey waters) (Figure 6). Mean size was 25.0 cm. A total of 7922 black sea bass were measured in the New England sites with 1644 measured in Rhode Island and 6278 in Massachusetts. Mean size in New England was larger than in the Mid-Atlantic at 30.9 cm.

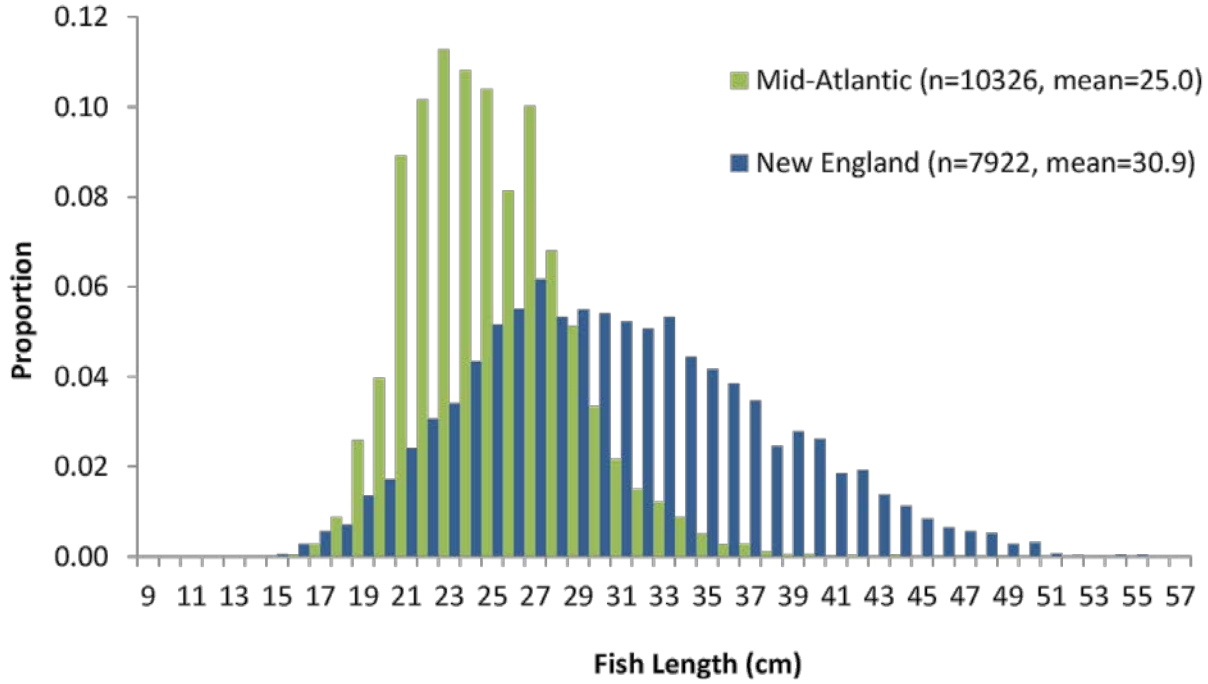

Figure 6. Length frequency distribution of black sea bass in the Mid-Atlantic and New England sites.

Data analysis was conducted by Greg DeCelles, Adam Barkley, and Dr. Steve Cadrin from the University of Massachusetts, School for Marine Science & Technology. Catch data and length frequency distribution were compared between areas as well as between other surveys. This final report is based almost entirely on their which is included below.

Mid-Atlantic Research Set-Aside (RSA) Report

Industry Based Survey on Black Sea Bass Utilizing Ventless Traps

Greg DeCelles, Adam Barkley, and Steve Cadrin

University of Massachusetts, Dartmouth

Department of Fisheries Oceanography

School for Marine Science & Technology

200 Mill Road, Suite 325

Fairhaven, MA 02719 U.S.A.

Date of draft report: August 29th, 2013

Background

The stock assessment model for black sea bass was developed by the Data Poor Working Group meeting in December 2008 (NEFSC 2009) and was updated in 2011 (NEFSC 2011). The assessment indicated that the sea bass stock was not overfished and that overfishing was not occurring. However, the assessment has substantial uncertainty and the peer review panel concluded that "a pot survey for black sea bass should be considered" (NEFSC 2011).

An industry-based, fishery independent survey of black sea bass was initiated to develop a new index of abundance, which could be used to improve the quality of the stock assessment for black sea bass. The survey was conducted between Virginia and Massachusetts, at the core of the species range. Unvented fish pots were sampled on hard-bottom substrates, which are not currently sampled by other fishery independent surveys. Unvented pots were sampled for five months; from June to October in New England waters, and from April through August in the Mid-Atlantic. Four commercial fishing vessels served as industry partners during the research.

Methods

Four sampling zones (MA, RI, NJ, and VA) were covered by the 2012 unvented pot survey. Sampling was conducted monthly between April and August, 2012 at the southern sites (NJ and VA), while monthly sampling took place between May and September at the northern sites (MA and RI). Four stations were sampled monthly within each zone. Within each station, 30 unbaited fish pots were deployed each month, and each pot was fished for a minimum of four days. Each black sea bass was measured to the nearest cm (excluding the tendril), and the total catch of black sea bass at each size class was recorded for each unvented pot. The data were aggregated by zone, station and month to allow for analysis.

Catch data from the 2012 black sea bass unvented pot survey was examined using a Nested Analysis of Variance (ANOVA). The Nested ANOVA was used for two tests. First, we tested for significant differences in catch rates (sea bass/trawl) between the four survey zones (MA, RI, NJ and VA). Secondly, we tested for significant differences in catch rates between the four stations within each survey zone. The catch data were grouped by study area, month, station and trawl to perform the Nested ANOVA analysis. GT2 tests (Sokal and Rohlf, 2001) were used to test for significant differences in the catch rates of black sea bass sampled between pairs of survey zones. A total of six GT2 tests were performed, which tested for differences between the six pairs of survey zones. The GT2 test is a slight modification of the Tukey's Honestly Significant Difference method, and the GT2 test allows for unequal sample sizes between treatment groups (Sokal and Rohlf, 2001).

A single factor ANOVA and Kolmogorov-Smirnov tests were used to test for significant differences in the length frequency distributions of black sea bass sampled at the four survey zones in the fixed gear survey (MA, RI, NJ and VA). GT2 tests were also used to test for significant differences in the mean length of black sea bass sampled between pairs of survey zones.

The length frequency distributions of black sea bass caught in the four areas sampled during the fixed gear survey were combined to form a single aggregated length frequency distribution. A Kolmogorov-Smirnov test was used to investigate whether the aggregated length frequency distribution of black sea bass sampled during the fixed gear survey differed significantly from the length frequency distributions observed in the three other available indices (Massachusetts Division of Marine Fisheries Spring Trawl Survey, the Northeast Fisheries Science Center Spring trawl survey and recreational fisheries samples from Massachusetts). A Kolmogorov-Smirnov test was also used to look for differences in the length frequency distribution of black sea bass caught on this survey, and those caught on the unvented pot survey for scup in southern New England waters.

Results

A total of 18,248 black sea bass were measured during the 2012 fixed gear survey. The catch rates of black sea bass at each of the four sampling zones is shown in Table 1. Overall, the highest catch rates were observed in NJ, while the lowest catch rates were seen in RI. The results of the nested ANOVA indicated that catch rates (number of sea bass/trawl) differed significantly between the four survey areas ($p<0.001$). The nested ANOVA also detected significant variation in catch rates between stations within each survey area ($p<0.001$).

GT2 tests were performed to investigate whether the catch rates of black sea bass differed significantly between pairs of survey zones. The GT2 tests results are shown in Table 2. NJ has the highest catch rates of black sea bass, and the catch rates in NJ were found to differ significantly from the three other survey zones (RI, MA and VA). A significant difference in catch rates was also noted between MA and RI. Catch rates did not differ significantly between MA and VA, and between VA and RI using the GT2 test.

The length frequency distribution of black sea bass caught in the four survey zones is shown in Figure 1 and Table 3 and is summarized in Table 4. Generally, larger fish are caught more often in the northernmost survey areas (MA and RI), while smaller black sea bass are sampled more frequently in the southern range of the survey (NJ and VA). Results of the ANOVA indicated that the length frequency distributions of black sea bass varied significantly between the four study sites ($p<0.001$).

The results of the GT2 tests for differences in length distribution among areas are shown in Table 5. The mean length of black sea bass was found to differ significantly in all six of the pairs of survey zones that were tested. The results of the K-S tests indicated that the length frequency distributions of black sea bass differed significantly between the four survey zones (Table 6; Figure 2).

Komogorov-Smirnov tests were used to test for differences in the length frequency distribution of black sea bass sampled during the fixed gear survey and those observed in other indices (2012 MA and NEFSC spring trawl surveys and 2012 MA recreational fisheries samples). The results of the K-S test indicate that the length frequency of black sea bass observed during the fixed gear survey differed significantly from the length frequency of sea bass observed in the other available indices (Table 6). Because the sample sizes differ substantially between the different indices, the proportional length frequency distributions were examined (Figure 2). Overall, the fixed gear survey tends to sample smaller black sea bass than both the recreational and commercial fisheries. The greatest proportion of sea bass sampled in the fixed gear survey is noted around 23cm, which is smaller than both the commercial and recreational catches (30 and 34 cm respectively). The largest sea bass are observed in the commercial fishery. Significant differences were also noted in the length frequency distributions of black sea bass in current survey, and those observed on the URI unvented pot survey for scup in southern New England waters ($p<0.001$; Figure 3). While the range of sizes of black sea bass sampled on both surveys was similar, the average size of black sea bass captured on the URI scup survey was larger than those sampled on the current survey.

Discussion

Results of the Nested ANOVA indicated that there was significant variability in the catch rates of black sea bass between the zones sampled in the fixed gear survey (MA, RI, NJ, VA). In addition, catch rates were found to vary significantly between stations within a survey zone. This result suggests that black sea bass are not homogenously distributed within a survey zone, and instead may exhibit a patchy distribution that is related to food availability or habitat preference. The GT2 test found that catch rates in New Jersey were significantly higher than those in VA, MA and RI. Catch rates in the MA survey were also significantly higher than those

in RI. These results suggest that the productivity and abundance of black sea bass varies spatially, and that these differences should be accounted for in survey design and resource monitoring.

The length frequency distribution of black sea bass was found to vary significantly between survey areas. The largest black sea bass were typically sampled in the northern range of the survey (MA and RI), while smaller sea bass were encountered more frequently in the southern portion of the survey area (NJ and VA). There were also significant differences in the length frequency distributions of black sea bass observed in the fixed gear survey and those sampled on the NEFSC spring trawl survey, the MADMF spring trawl survey and in the 2012 Massachusetts recreational catch. The fixed gear survey samples intermediate sized black sea bass effectively, but does not typically capture the smallest and largest sea bass. The preponderance of small sea bass (<10cm) captured during the NEFSC spring survey (Figure 2) suggests that this may be an appropriate fisheries independent index to monitor recruitment in the black sea bass stock. In addition, the relatively high proportion of large black sea bass in the recreational catch and MADMF spring survey suggests that these indices may be good candidates for monitoring the relative abundance of older year classes in the black sea bass population. These analyses demonstrate the importance of the fixed gear survey due to the differences in length distribution. We expect that the expansion of the time-series for this survey will increase the utility of this data set for future use in the stock assessment for black sea bass.

References

Northeast Fisheries Science Center (NEFSC) 2009. The Northeast Data Poor Stocks Working Group Report, December 8-12, 2008 Meeting. Part A. Skate species complex, Deep sea red crab, Atlantic wolfish, and Black sea bass. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 09-02; 496 p.

Northeast Fisheries Science Center (NEFSC) 2011. 53rd Northeast Regional Stock Assessment Workshop (53rd SAW) Assessment Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-05; 559 p.

Sokal, R.R., and Rohlf, F.J. 2001. Biometry. Third Edition. W.H. Freeman and Company, USA. 850 p.

Tables

Table 1. Summary of black sea bass survey catches (fish/trawl) at each of the four survey areas that were sampled during the fixed gear survey.

	VA	NJ	RI	MA
n trawls	45	27	60	60
Mean Catch/Trawl	78.6	251.4	26.9	103.2
Minimum Catch/Trawl	1	0	0	8
Maximum Catch/Trawl	439	705	160	294

Table 2. Results of the GT2 test that was used to investigate whether the catch rates of sea bass varied significantly between survey areas. The differences in mean catch rates (fish/trawl) between survey areas is shown, and significant results are denoted with an *.

	NJ	MA	VA	RI
NJ	-	-	-	-
MA	148.2*	-	-	-
VA	172.8*	24.6	-	-
RI	224.3*	76.2*	51.6	-

Table 3. Observed length frequency distribution of black sea bass caught in each of the four survey zones during the 2012 fixed gear survey.

Length (cm)	NJ	VA	MA	RI	Total
15	1	0	3	1	5
16	4	0	18	4	26
17	28	1	35	9	73
18	77	13	51	5	146
19	235	33	86	21	375
20	302	108	100	36	546
21	700	222	155	36	1113
22	708	342	195	48	1293
23	728	437	235	35	1435
24	689	428	297	47	1461
25	670	404	323	86	1483
26	436	405	359	77	1277
27	707	328	378	111	1524
28	473	231	341	82	1127
29	335	194	354	81	964
30	245	100	349	80	774
31	139	85	333	81	638
32	106	49	303	99	557
33	77	48	309	114	548
34	60	31	262	90	443
35	31	21	253	77	382
36	12	16	236	69	333
37	15	14	216	59	304
38	5	6	147	48	206
39	1	4	182	38	225
40	0	6	181	26	213
41	0	2	118	29	149
42	0	3	122	30	155
43	0	1	91	18	110
44	2	2	75	14	93
45	0	0	51	15	66
46	1	1	35	16	53
47	0	2	31	13	46
48	0	0	26	15	41
49	0	2	15	7	24
50	0	0	13	12	25
51	0	0	0	5	5
52	0	0	0	2	2
53	0	0	0	1	1
54	0	0	0	3	3
55	0	0	0	3	3
56	0	0	0	0	0
57	0	0	0	1	1
Total	6787	3539	6278	1644	18248

Table 4. Summary of the length frequency distribution of black sea bass caught in each of the four survey areas during the 2012 fixed gear survey.

	n	mean length (cm)	median length (cm)	min. length (cm)	max. length (cm)
MA	6278	30.7	30	15	50
RI	1644	31.6	31	15	57
NJ	6787	24.8	24	15	46
VA	3539	25.4	25	17	49

Table 5. Results of the GT2 test to examine whether significant differences exist in the mean length of black sea bass observed at pairs of locations that were sampled during the fixed gear survey. Differences in the mean length (cm) between pairs of survey areas are shown, and significant results are denoted with an *.

	RI	MA	VA	NJ
RI	-	-	-	-
MA	0.83*	-	-	-
VA	6.14*	5.31*	-	-
NJ	6.79*	5.96*	0.65*	-

Table 6. Kolmogorov-Smirnov test results. The factors MA, RI, NJ and VA are areas that were surveyed during the fixed gear survey. Fixed gear is the aggregate length frequency distribution of all black sea bass that were sampled in the fixed gear survey. NEFSC Spring is the 2012 Northeast Fisheries Science Center spring bottom trawl survey. MA Recreational is the 2012 recreational catch length data from Massachusetts recreational fisheries. MA Spring is the 2012 Massachusetts Division of Marine Fisheries Spring bottom trawl survey.

Factors	D	p-value
MA-RI	0.0644	<0.0001
MA-NJ	0.4381	<0.0001
MA-VA	0.4238	<0.0001
RI-NJ	0.4847	<0.0001
RI-VA	0.4759	<0.0001
NJ-VA	0.0996	<0.0001
Fixed gear-NEFSC Spring	0.4481	<0.0001
Fixed gear-MA Recreational	0.7596	<0.0001
Fixed gear- MA Spring	0.3507	<0.0001

Figures

Figure 1. Proportional length-frequency distribution of black sea bass sampled at the four survey zones during the fixed gear survey.

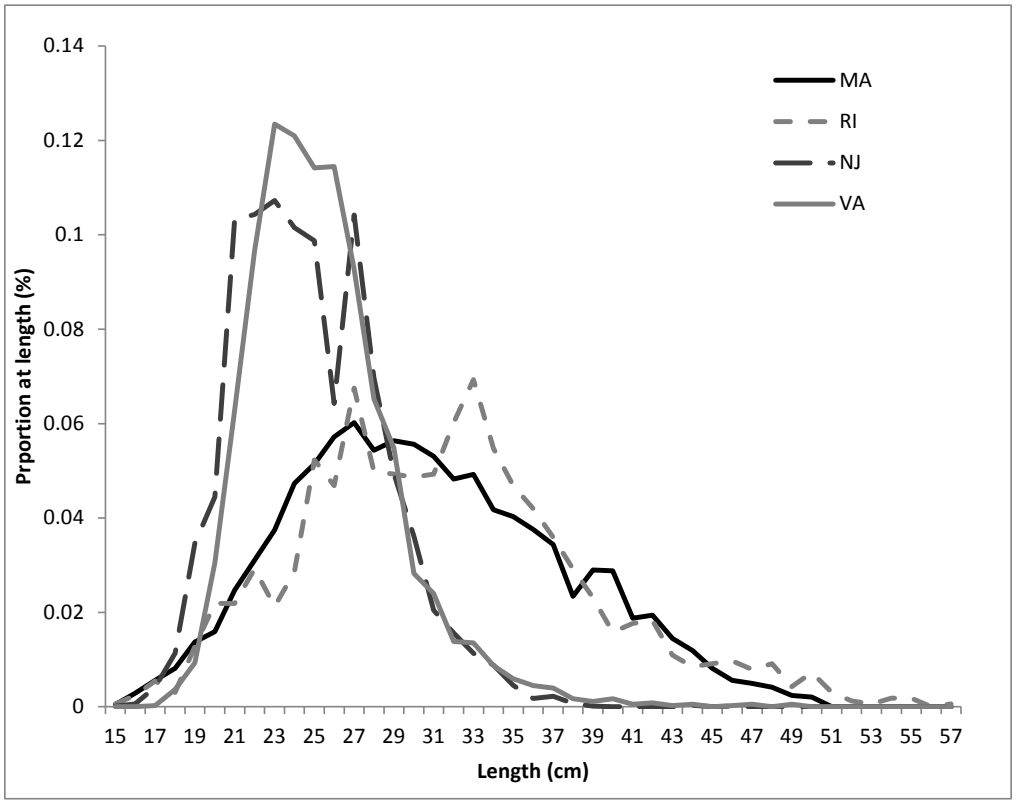

Figure 2. Proportional length-frequency plot of black bass sampled in the fixed gear survey, the NEFSC spring survey, the MA spring survey and MA recreational catch. This plot shows the proportion of black sea bass at length category for the four sampling programs.

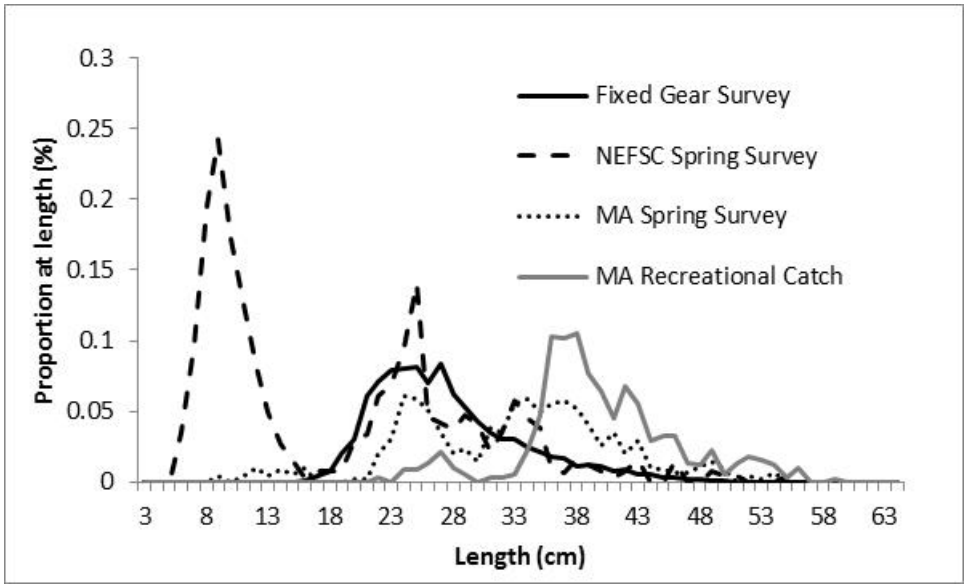
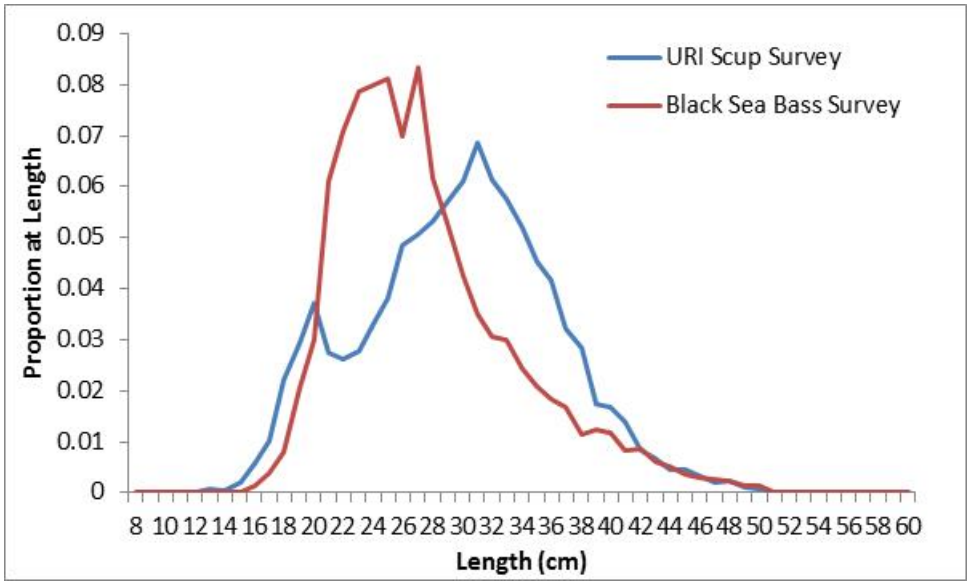
Figure 3. Proportional length-frequency plot of black bass sampled in the current survey and those sampled during the 2012 URI unvented pot survey for scup in the waters of southern New England.