FINAL REPORT

Project Title: 2009 Fishery Independent Scup Survey of hard bottom areas in Southern New England Waters (SNE)

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PROJECT SUMMARY

This is the 6th year continuation of the Research Set-Aside conducted by participating fishermen to provide an alternative but reliable index of abundance for scup using fixed gear and to provide an annual measure of fishing mortality on scup stock in Southern New England (SNE). The use of unvented scup pots was the mean in developing the index of abundance used in areas between Sakonnet Point, RI and Buzzard Bay, MA. Two fishing vessels, F/V *Drake* from Rhode Island and F/V *Evangeline* from Massachusetts, hauled a total of 1,500 baited pots from June to October 2009. The unvented scup pots were fished on twelve hard bottom areas divided in 2 strata; an Eastern and Western stratum. A total of 15,034 scup were captured in the unvented pots in the two selected areas in Massachusetts and Rhode Island. The CPUE (number of fish captured per pot hauled per set-over-time) varied without trends in both areas showing higher abundance in the Eastern strata. Mean lengths of scup were 21.95 cm and 23.50 cm (8.8”- 9.4”) in the Western and Eastern strata, respectively. Although the mean lengths and CPUE between East and West were different, the catch composition was not significantly different. Catch composition were compared to the National Marine Fisheries Service (NMFS) 2009 spring and fall trawl data and the Rhode Island Department of Environmental Management (RIDEM) 2009 trawl survey (spring and fall combined). The proportion of larger fish was significantly higher in the unvented pot survey than for the trawl surveys demonstrating, once again, that the trawl gear is not adequately sampling the older, larger scup and therefore not characterizing the size structure of the scup population as a whole. We estimated fishing mortality from our samples using catch curve analysis which revealed low fishing mortality between 0.1 and 0.14. The fishing mortality estimates seem consistent with the recent estimates provided by the 2008 Northeast “Data Poor Stocks” Working Group (DPWG).

INTRODUCTION

Scup, *Stenotomus chrysops*, is a temperate, demersal species that occurs primarily in the Mid-Atlantic Bight from Cape Cod, Massachusetts to Cape Hatteras, North Carolina, although it has been reported as far north as the Bay of Fundy and Sable Island Bank, Canada (Bigelow and Schroeder 1953; Fritz 1965; Scott and Scott 1988; Terceiro 2001) and as far south as Florida (Morse 1978; Manooch 1984). Scup use several benthic habitats from open water to structured areas to feed and possibly for shelter (Steimle et al. 1999). Seasonal migrations occur during spring and autumn. In summer, scup are common in inshore waters from Massachusetts to Virginia, while in winter, scup are found in offshore waters between Hudson Canyon and Cape Hatteras at depths ranging from 70 to 180 m (38 to 98 fathoms) (Terceiro 2001). During the summer, larger scup are found near the mouth of larger bays and in the ocean and are often found to inhabit rough bottom areas. Alternatively, smaller sized scup are generally found in the summer in shallow, smooth bottom areas of bays (Morse 1978).

The principal commercial fishing gears used to catch scup are bottom trawls, floating fish traps, and fish pots. In the New England area, the inshore fish pot fishery targets both scup and black sea bass and has a bycatch of lobster, summer flounder, tautog, and conger eel all of which are

sold. The New England fish pot fishery uses baited pots and is a mixed species fishery (Terceiro 2001). The population is managed by the Mid-Atlantic Fishery Management Council (MAFMC), Atlantic States Marine Fisheries Commission (ASMFC), and the NMFS. There is a long history of action by these agencies attempting to improve the quality of the scup assessment.

This project was designed to collect data on scup, which inhabit the hard bottom areas in SNE, and compare the length frequency distribution of the unvented fish pots to the catch in the NMFS Northeast Fisheries Science Center (NEFSC) trawl survey and the state (RIDEM) trawl survey. This project was initiated because of the major uncertainties noted in all scup stock assessments. Specifically, the recent scup assessment noted that the current level of sampling, and general lack of information on scup, impedes the development of an analytical assessment of the population. In particular, the lack of older animals in the NMFS survey is a major source of uncertainty in evaluating the status of the population and hinders the development of mortality estimates.

In 2008, the Northeast "Data Poor Stocks" Working Group (DPWG) was formed to perform stock assessments of species that are difficult to assess due to lack of critical data or severe modeling problems (DPWG 2009). Scup was one of the species they focused on. The data poor workshop convened in fall of 2008 to address data poor nature of the scup stock and proposed alternative assessment methods and Biological Reference Points (BRPs). The results of the new model (ASAP) lead to dramatically revised BRPs and the stock status changed from being severely overfished to no longer overfished.

However, the workshop also concluded that problems still persist in the assessment. The Review Panel Report (Miller et al. 2009) included advice about scientific uncertainties for consideration by the Scientific and Statistical Committee as well as research recommendations which were also included in the Northeast Data Poor Stocks Working Group Report (DPWG 2009):

- <u>2.4.3.3 Process Uncertainty</u> a) "Surveys indices used in the ASAP model are only available for fish of ages 0-2. Thus, the interpretation of the dynamics of older age groups relies on the catch information from the fishery and on assumptions regarding M. Thus, the results of the model with respect to fully recruited ages are driven by the fishery data" (Miller et al. 2009).

- <u>2.4.5 Research Recommendations: Longer term data and analyses needs</u> a) "Current research trawl surveys are likely adequate to index the abundance of scup at ages 0 to 2. However, the implementation of new standardized research surveys that focus on accurately indexing the abundance of older scup (ages 3 and older) would likely improve the accuracy of the stock assessment" (DPWG 2009; Miller et al. 2009).

Both of these sources of uncertainty are addressed directly by the ventless scup trap study. This project results in the collection of a wide range of scup sizes, including age 3+ fish, which

are underrepresented in the state and federal trawl surveys. In addition, this project has been collecting data by the same sampling format and methodology since 2006, providing an opportunity for scientists to determine if the survey methodology meets the long term data needs, i.e., "implementation of new standardized research surveys that focus on accurately indexing the abundance of older scup (ages 3 and older)" (Miller et al. 2009).

Since scup associate with bottom structure for a major part of the year, they are therefore unavailable to traditional bottom trawl gear, particularly during the early spring, summer, and fall months. Existing State and Federal research vessels, which rely on bottom trawls as their primary collection method, sample only fishable grounds and therefore do not survey hard bottom areas, which constitute the majority of summer inshore habitat of scup. The NEFSC survey in spring and autumn catch a large number of scup, however, based on comparisons of the age structure in the survey to the commercial catch indicates that the survey "does not provide a reliable index of stock abundance" (Miller et al. 2009). All of the sampling sites in this study are on rocky substrate and are located a considerable distance offshore, where there is little or no scup pot fishery and no active trawl fisheries. Due to the distance from coastal ports, in combination with low trip limits, these study areas are fished infrequently, if at all. In addition, the sampling locations are in close proximity to deep water, which may attract and hold larger scup. Since scup inhabit a narrow geographic range (New York to Southeastern Massachusetts) during the summer months, it may be possible to implement a fishery independent survey of hard bottom areas to better characterize the size composition of the population, or further supplement and complement the existing state and federal sampling program. The scientific benefits of this program will allow state and federal assessment scientists to assess the merit of deploying a more comprehensive hard bottom-sampling program in the future to supplement existing assessment sources. If this technique proves useful, it may substantially improve our current and future understanding of the scup resource. In addition, sampling in offshore areas may result in the collection of larger fish which are generally absent from all trawl surveys.

SAMPLING PROTOCOL

The Research Set-Aside project is similar in design to a fishery independent survey of rocky bottom areas in Southern New England conducted during 2004, 2005, 2006, 2007, 2008 and 2009. The scope of work is separated into a Western and Eastern strata. The F/V *Drake* sampled the Western sites and the F/V *Evangeline* sampled in the Eastern sites. At the beginning of the project, the research vessel(s) fished at each collection site in order to focus the sampling activity on areas with a high abundance of scup. The final stations were selected in 2006 with minor revisions and remained unchanged for 2007, 2008 and 2009, including all aspects of the sampling protocols. The sampling site locations are identified in Table 1.

Table 1. Sampling locations.

Number	Description	Loran
Western Stratum		
1	South of Sakonnet Point, RI (most likely inner Mayo Ledge or Elisha Ledge)	14330/43957
2	Western end of Buzzards Bay (most likely south of Old Cock rock or in the proximity of Buzzards Bay Tower)	14285/43953
3	Browns ledge (approximately ten miles southwest of Westport Harbor, MA in federal waters)	14315/43920
4	West or south of Nomans Island	14250/43850
5	South of Newport, RI (Elbow Ledge)	14368/43975
Eastern Stratum (all East of Oak Bluffs on the Vineyard)		
1	Horse Shoals	14025/43915
2	Cape Pogue	14075/43895
3	Hart Haven / East Chop	14105/43915
4	Mink Meadows / West Chop	14115/43930
5	Cedar Tree Neck / Norton Rock	14167/43917

Scup were collected from each site utilizing standard fish pots (2 x 2 x 2 foot) made with 1½ x 1½ inch coated wire mesh with double entry wire heads. Pots were unvented and therefore had the capability to retain all size classes of scup. The sampling protocol required the commercial vessels to take and set 30 pots to each sampling site once during each of the five sampling cycles. The sampling cycles were mid June, July, August, September, and the first week in October. Pots were baited with clams, which fish quickly and set overnight on the sampling sites. Each scup was measured for total length. The date, area, depth, and catch were recorded and all scup captured were measured. Sampling of the spawning sites was conducted beginning in Mid-June on the Western area and to late June on the Eastern side.

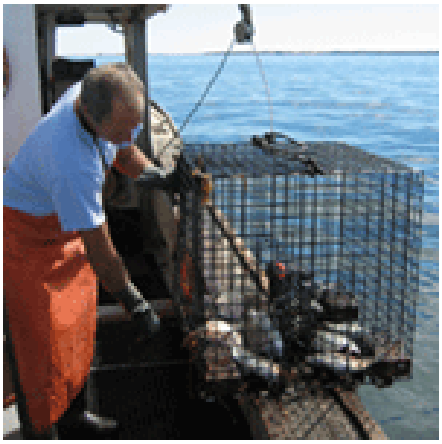
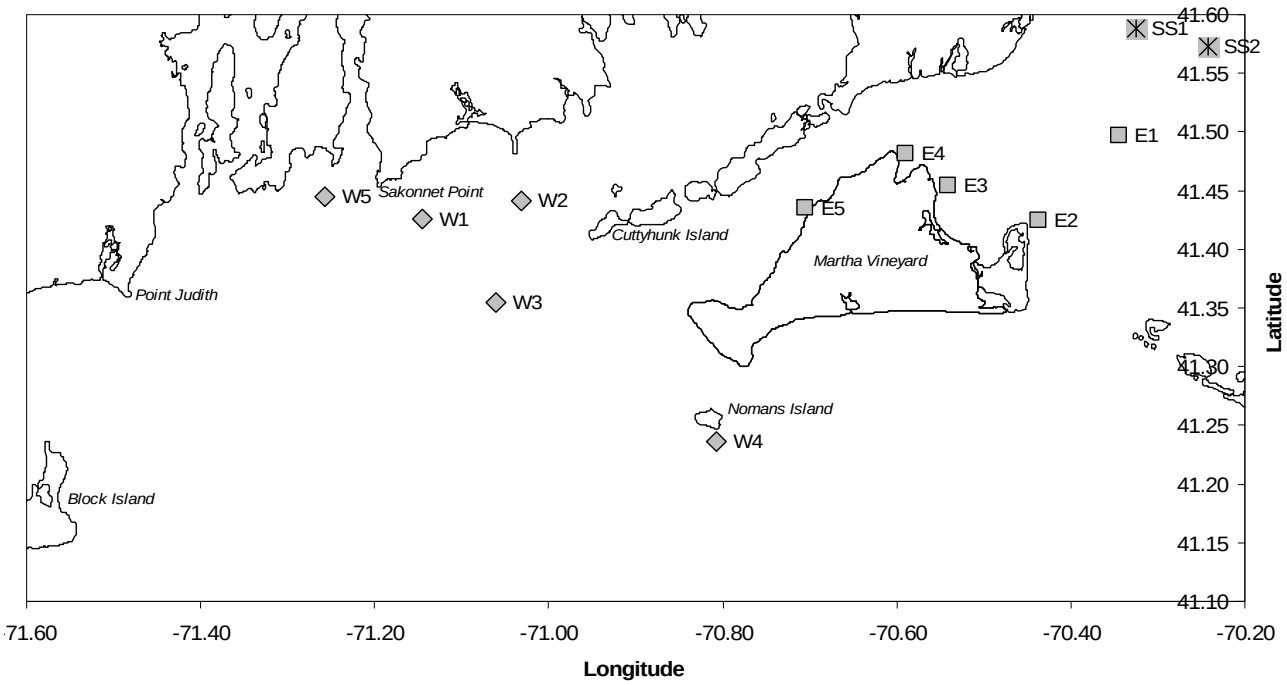


Figure 1. Map of sampling locations.



The sampling strategy is based on fixed sampling stations, all located on hard bottom, which are widely distributed throughout a major portion of the area inhabited by scup during the summer period. Fishermen sample scup on the survey sites but retain the latitude to move a site if the original site becomes unproductive. The two study areas were subdivided into an Eastern and Western strata (Figure 1). Fish sampling gear was then deployed at each station and set overnight. The average size of the catch of a scup within a certain stratum is considered independent random variable for estimating the mean number of scup in the stratum. Estimates per stratum are then averaged to provide an estimate of abundance of scup by study area. We recognize the useful properties of stratified sampling which increases the precision over simple random sampling due to increased homogeneity in catches within a stratum vs. between strata. In this project, we compared catch rates and catch frequencies between stations and between areas. Further comparisons were made between catch composition of the unvented survey and trawl surveys. The data are recorded on board vessels by participating fishermen using standard forms. Upon return from the survey, the data are entered into computer files using excel spreadsheets. The data are screened for errors in recording and data input. A new computer program based on MS Access is being developed to enter all the data (2004-2009) and future surveys for future analysis.

RESULTS

A total of 15,034 scup were captured in 1,500 baited pot hauled between June and October 2009 in SNE between Sakonnet Point, RI and Buzzards Bay, MA (Figure 1). Lengths ranged between 12 cm and 39 cm (4.8" – 15.60") in all areas with slightly higher abundance in the Eastern stratum. For each station we computed the mean CPUE as the mean-catch-per-trap-per-standard (1hr) set-over-time by replicate. Means and respective standard errors are presented in tables 2 to 13. In addition, we plotted the CPUEs by replicate samples for comparison in Figures 2 to 13. In general CPUEs increased gradually from June to the end of July, decreased in August, then increased again in early October. There seems to be very little difference between the replicate samples (Haul 1 and Haul 2) in most stations. Catches were very low in Station E4 (Mink meadows/West Chop) due mainly to availability. This figure seems to be consistent from past years sampling.

The overall length frequency distributions were compared using the Kolmogorov-Smirnov test within sampling areas and among areas. Results showed no difference between the size distribution sampled in all 5 stations in the Western areas. Similarly, there was no statistical difference in the size distribution sampled in the Eastern area, with the exception of station 1, due mainly to low sample size for lack of fish availability in this station throughout the sampling season. In addition, there was no significant catch composition between Eastern and Western catches (Figure 3). The statistical difference in length frequencies seems to be attributed to random error from catch variability among stations but in general, catch frequencies seem to be similar throughout the sampling area and seasons.

Length frequencies by station for the duration of the study are plotted in Figure 4. The lengths vary between 12 cm and 38 cm, representing all ages from 0 to 9. The mean length by site, were computed and were 21.95 cm and 23.50 cm in Western and Eastern stations respectively. Although the mean in the Eastern Stations was high, there was no statistical difference in mean lengths of scup caught in the unvented traps between all areas.

As a result of no statistical difference between the size distribution in the sampling sites, and the considerations of the remarkable representation of older fish in the unvented pots, we used the size structure of unweighted pooled samples as representation of all sampling efforts in 2009. A comparison was computed between the index of abundance at age between the unvented scup pots and the fall and spring trawl surveys of the NMFS. A significant difference was clear with high degree of distinction between the two sampling gears. Trawl survey samples were dominated by young of the year and age 1 and 2, while the unvented pots samples were composed largely of older fish with a wide range of sizes between 4 and 5 (Figure 5). The unvented pots selectivity for smaller fish is the result of the 1½ x 1½ inch coated wire mesh of the pots. This analysis strongly implies that traditional trawl gear is not adequately sampling the older, larger scup and therefore not characterizing the size structure of the population as a whole. The study seems to suggest that a composite index made of trawl and unvented pot survey will be most adequate to track and characterize the abundance of scup populations.

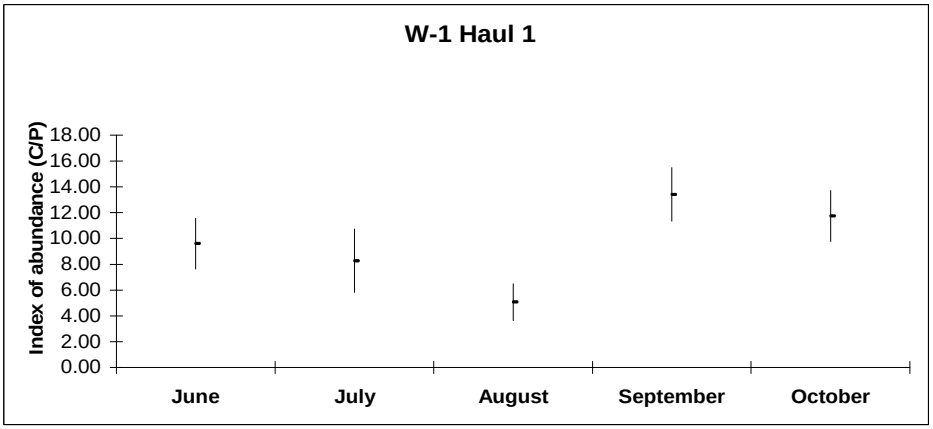
The catch matrix was standardized in catch per unit of effort for the period of the study from June to October 2009, where natural mortality was assumed *M*=0.15. The CPUEi at length were converted into CPUEi at age using the 2009 Age-length-Key developed by the NMFS trawl survey and the RIDEM fish traps. A linear regression was calculated for the descending limb of the curve for ages 3 to 8. Fish at age 3 seem to be fully recruited to the gear, and are thus not included in any estimates of mortality. Results of the catch curve analysis showed a moderate fishing mortality varying from 0.10 to 0.44 depending on the selection of the age group. The average fishing mortality was estimated at *F*=0.18 which is slightly higher than that estimated in 2008 at *F*=0.14. In addition, the descending limb of curve was robust with a high degree of correlation suggesting consistent year class strength over the age groups considered. In general, the assumptions that are usually violated with catch curve methods (constant recruitment, uniform survival rate, and constant effort) don't seem to be affecting greatly the mortality estimates in this case.

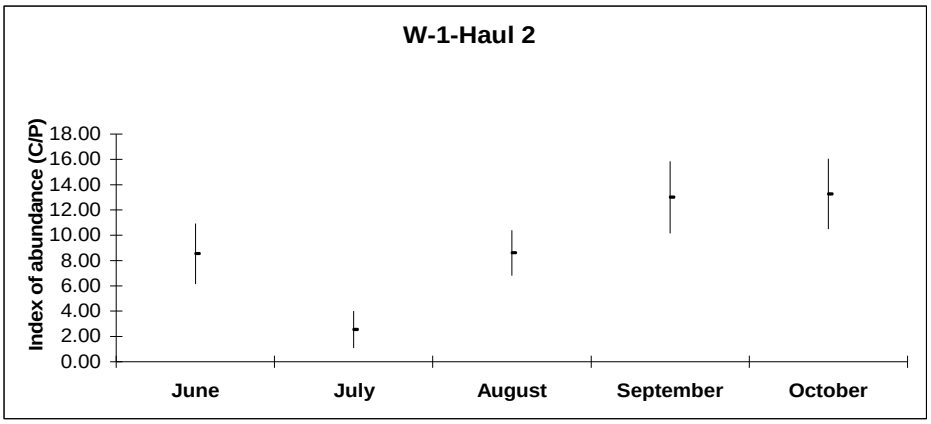
It is known that there is no completely appropriate statistical procedure for determining the fully recruited age groups and accounting for source of errors such as recruitment and natural mortality. A non-linear multiplicative model approach ($C=a * exp(b*age)+u$) and other semi-log models will be developed and considered for comparison. We will consider these models with sensitivity analysis when analyzing the 5 year-time series of the survey. If *M*=0.15, the fishing mortality estimates were *F*=0.14, according the results of the catch curve (Figure 5).

Future assessments of the population might be improved by developing a composite index based on the traditional trawl data in combination with data from an unvented pot survey. This study is ongoing and continued in 2010 and sampling began in June of 2010. We submitted the index at age developed from this survey to the NMFS in anticipation to be included as a tuning index in the updated assessment.

Table 1: Catch per pot per standard soak time (CPUE) of scup in the ventless pot survey
Western area June 2010

	Haul 1		Haul 2	
	Mean C/P	STDEV	Mean C/P	STDEV
June	9.60	3.89	8.53	4.73
July	8.27	4.86	2.53	2.90
August	5.07	2.81	8.60	3.56
September	13.40	4.10	13.00	5.62
October	11.73	3.90	13.27	5.51





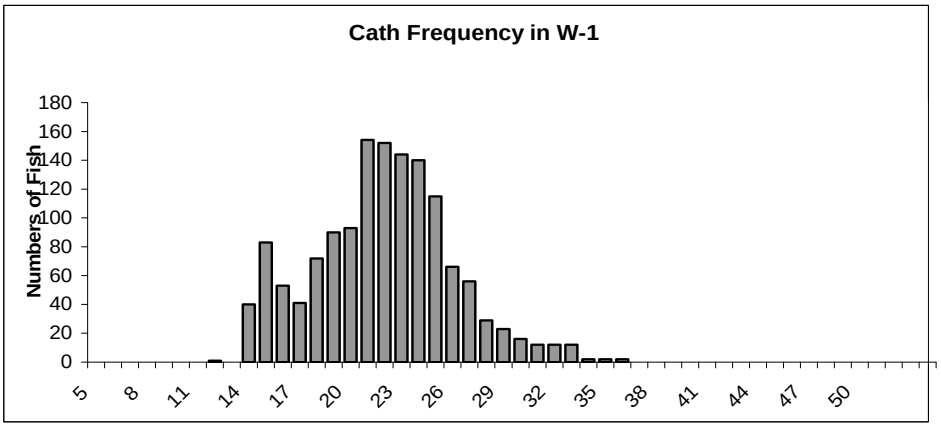
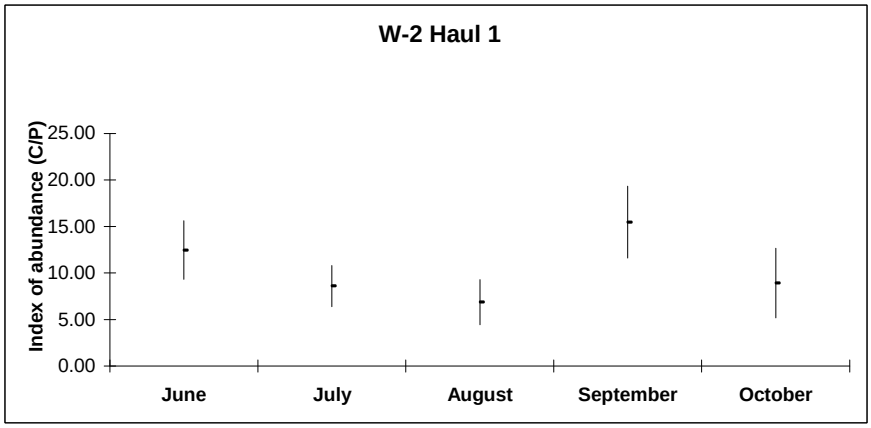
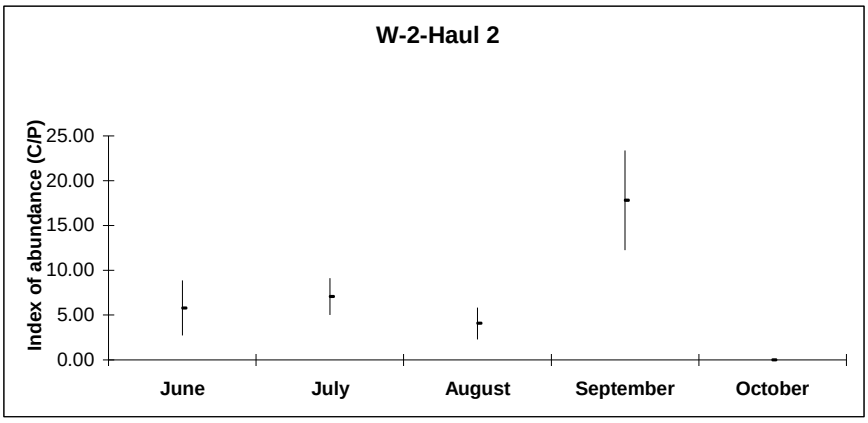


Table 2: Catch per pot per standard soak time (CPUE) of scup in the ventless pot survey
Western area June 2010

	Haul 1		Haul 2	
	Mean C/P	STDEV	Mean C/P	STDEV
June	12.47	6.20	5.80	6.05
July	8.60	4.37	7.07	4.08
August	6.87	4.79	4.07	3.51
September	15.47	7.63	17.80	10.97
October	8.93	7.40	0.00	0.00





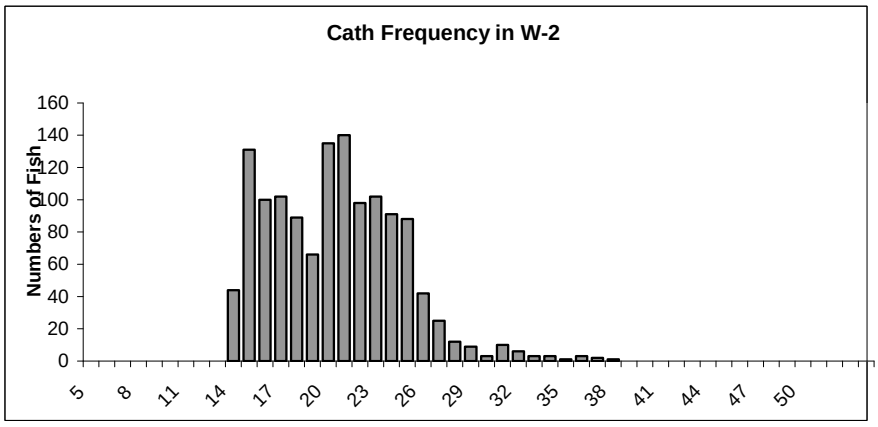
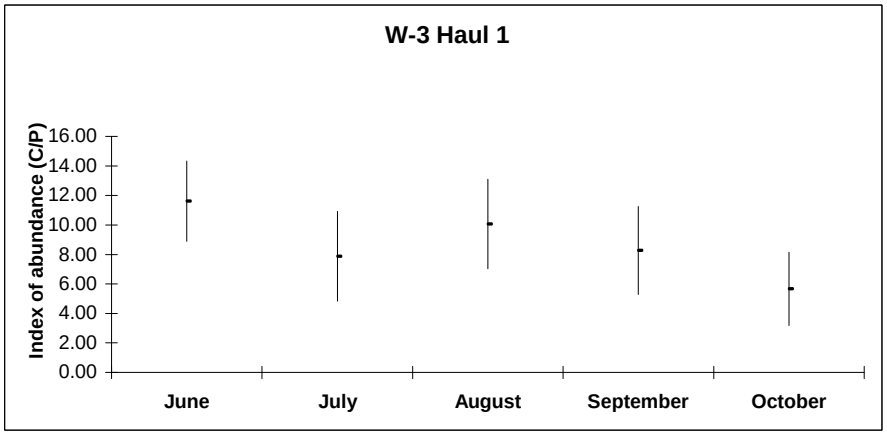
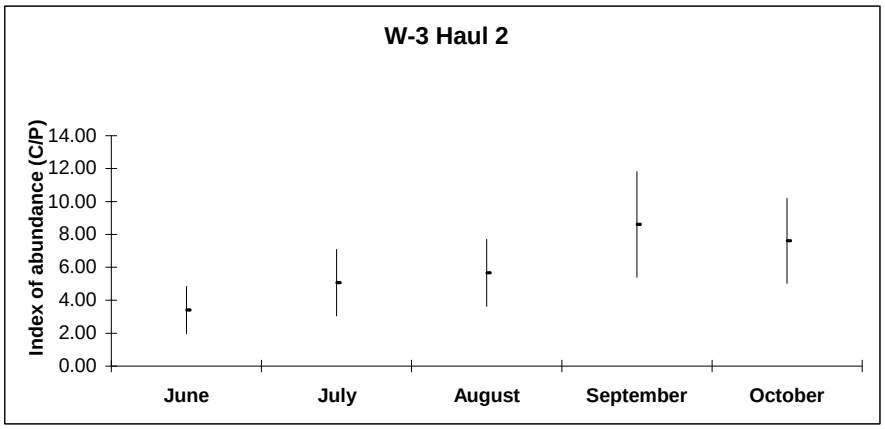


Table 3: Catch per pot per standard soak time (CPUE) of scup in the ventless pot survey
Western area June 2010

	Haul 1		Haul 2	
	Mean C/P	STDEV	Mean C/P	STDEV
June	11.60	5.38	3.40	2.87
July	7.87	6.01	5.07	4.04
August	10.07	6.01	5.67	4.05
September	8.27	5.90	8.60	6.37
October	5.67	4.89	7.60	5.14





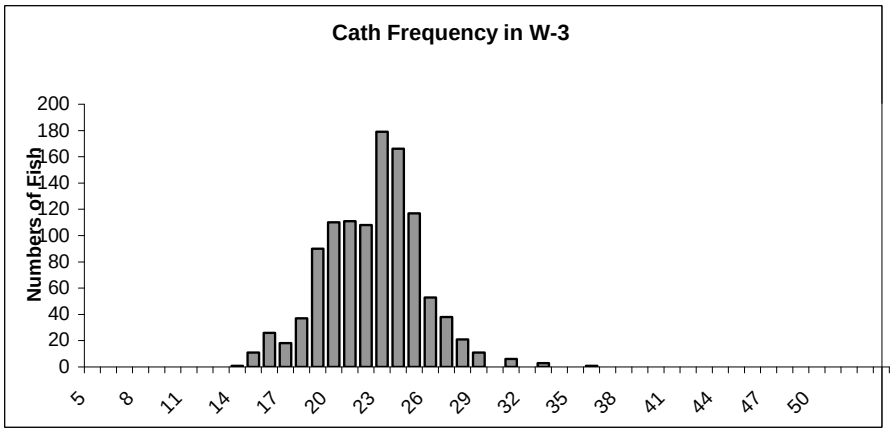
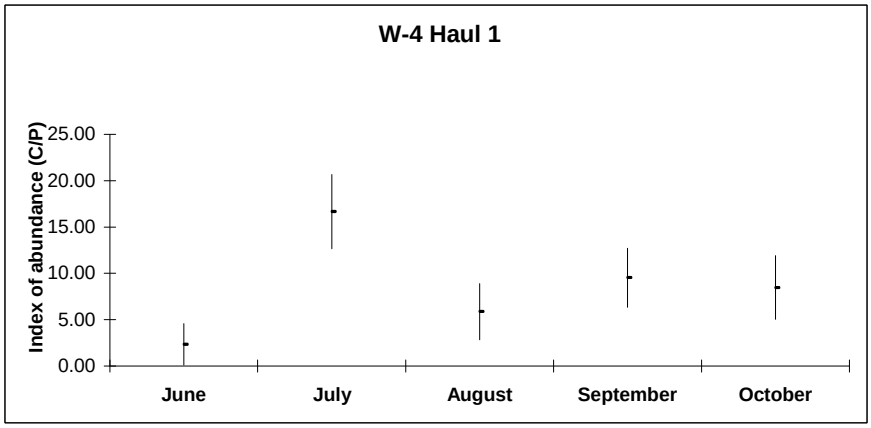
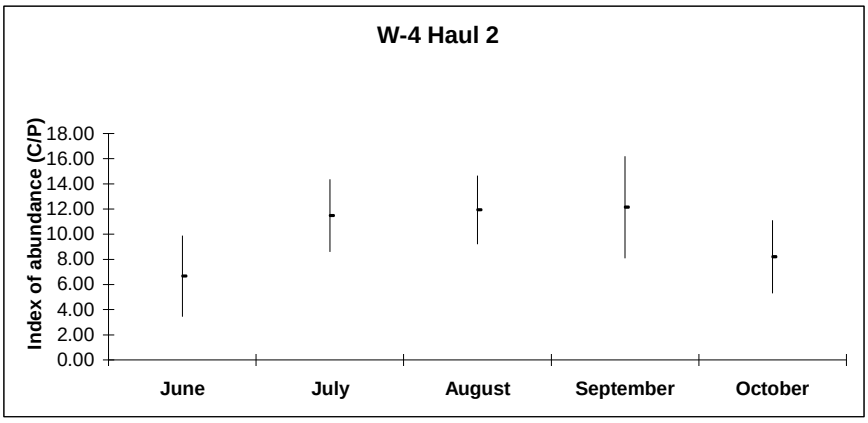


Table 4: Catch per pot per standard soak time (CPUE) of scup in the ventless pot survey
Western area June 2010

	Haul 1		Haul 2	
	Mean C/P	STDEV	Mean C/P	STDEV
June	0.00	0.00	0.00	0.00
July	0.00	0.00	0.00	0.00
August	0.00	0.00	0.00	0.00
September	0.00	0.00	0.00	0.00
October	0.00	0.00	0.00	0.00





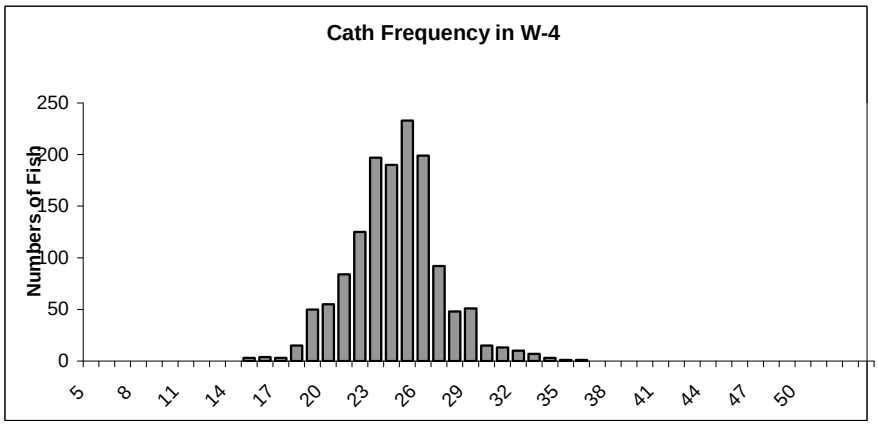
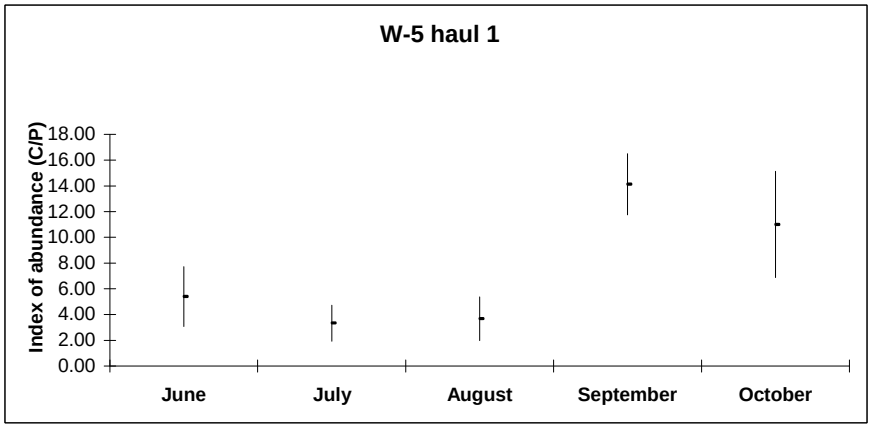
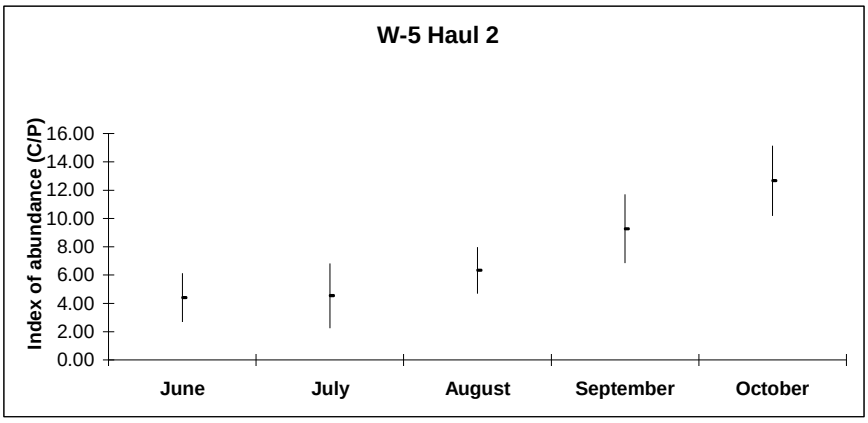


Table 5: Catch per pot per standard soak time (CPUE) of scup in the ventless pot survey
Western area June 2010

	Haul 1		Haul 2	
	Mean C/P	STDEV	Mean C/P	STDEV
June	5.40	4.60	4.40	3.40
July	3.33	2.77	4.53	4.52
August	3.67	3.37	6.33	3.24
September	14.13	4.69	9.27	4.80
October	11.00	8.16	12.67	4.91





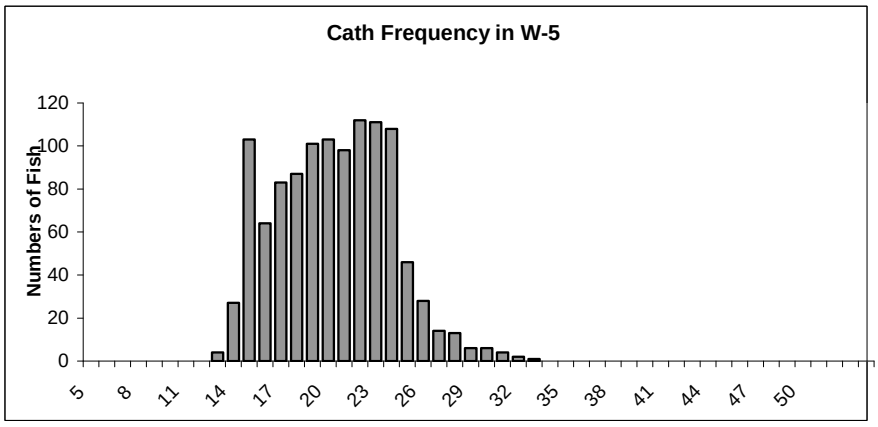
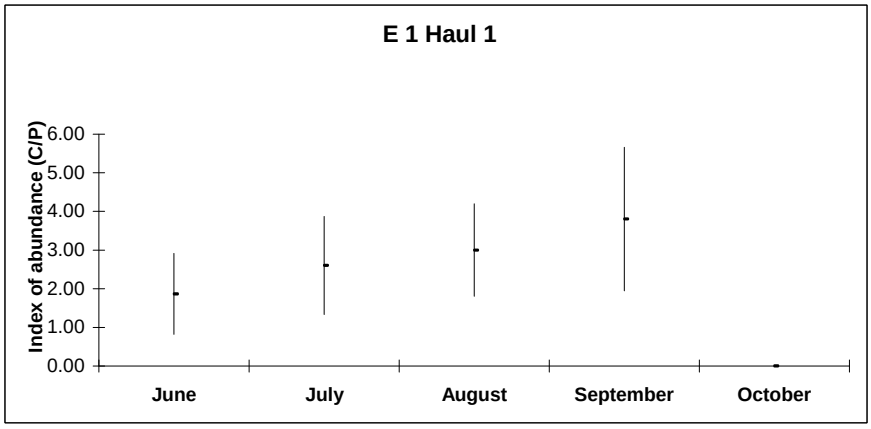
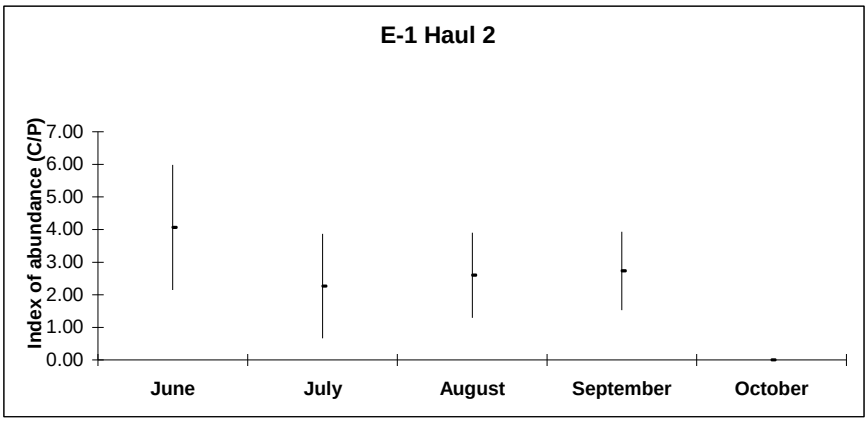


Table 6: Catch per pot per standard soak time (CPUE) of scup in the ventless pot survey
Eastern area June 2010

	Haul 1		Haul 2	
	Mean C/P	STDEV	Mean C/P	STDEV
June	1.87	2.07	4.07	3.79
July	2.60	2.50	2.27	3.17
August	3.00	2.36	2.60	2.59
September	3.80	3.67	2.73	2.37
October	0.00	0.00	0.00	0.00





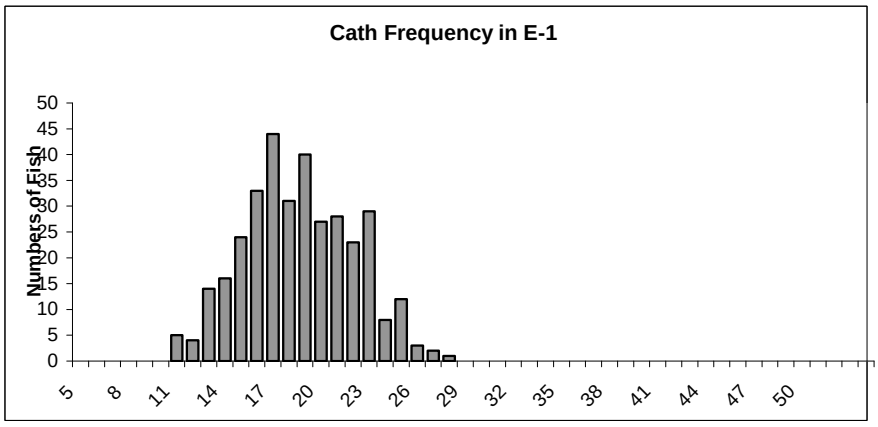
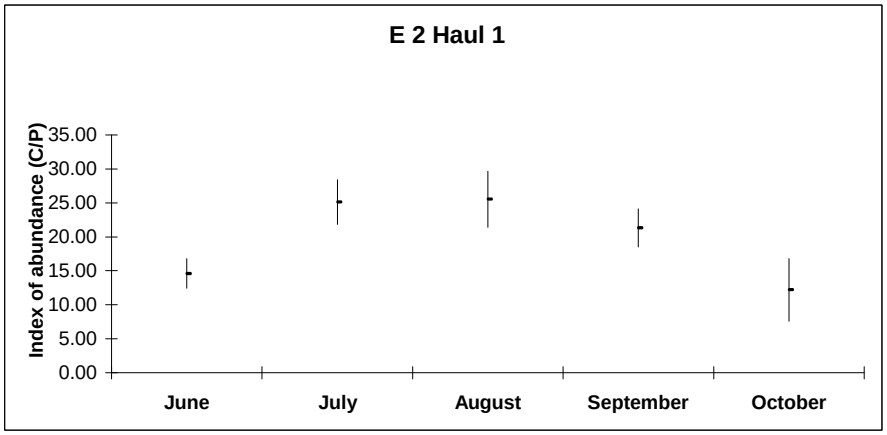
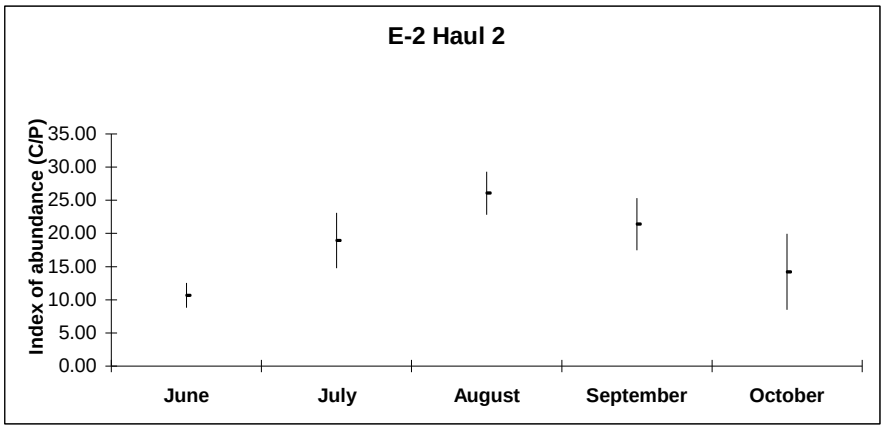


Table 7: Catch per pot per standard soak time (CPUE) of scup in the ventless pot survey
Eastern area June 2010

	Haul 1		Haul 2	
	Mean C/P	STDEV	Mean C/P	STDEV
June	14.60	4.31	10.67	3.72
July	25.13	6.48	18.93	8.22
August	25.53	8.11	26.07	6.42
September	21.33	5.54	21.40	7.77
October	12.20	9.10	14.20	11.29





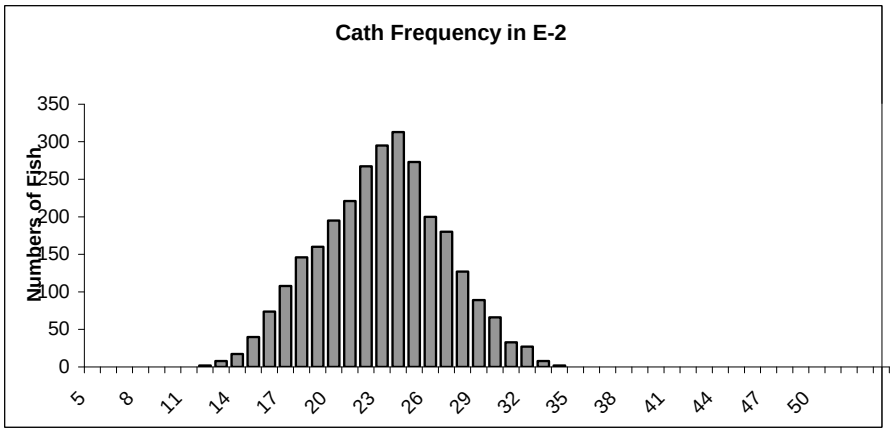
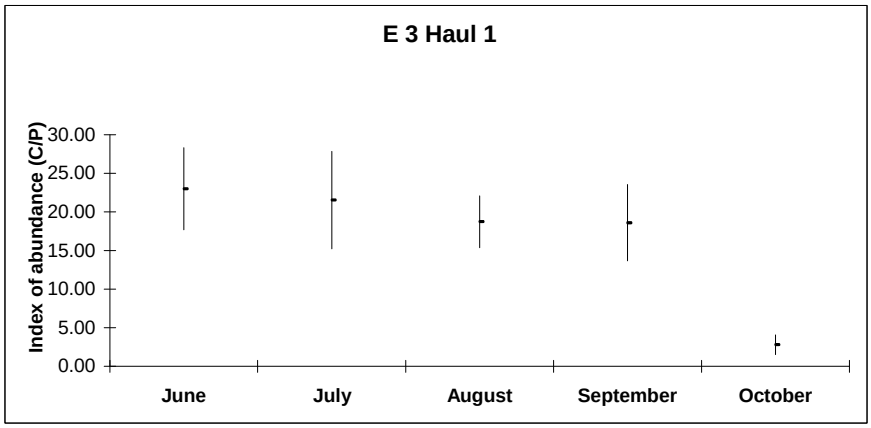
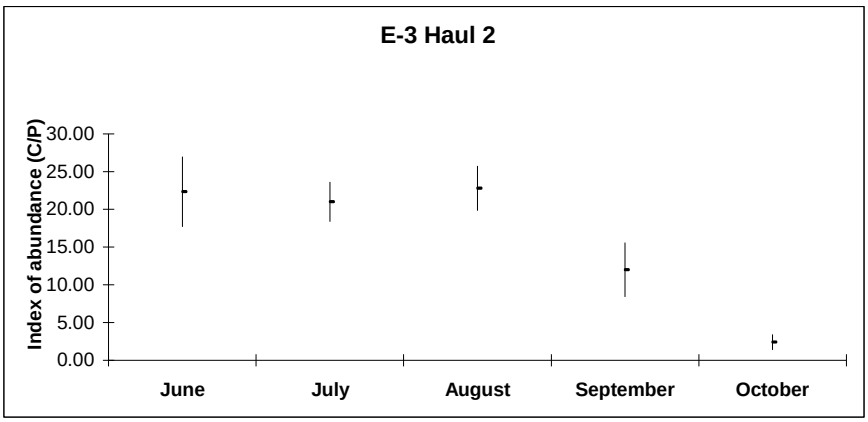


Table 8: Catch per pot per standard soak time (CPUE) of scup in the ventless pot survey
Eastern area June 2010

	Haul 1		Haul 2	
	Mean C/P	STDEV	Mean C/P	STDEV
June	23.00	10.50	22.33	9.22
July	21.53	12.43	21.00	5.18
August	18.73	6.65	22.80	5.88
September	18.60	9.75	12.00	7.11
October	2.80	2.51	2.40	2.06





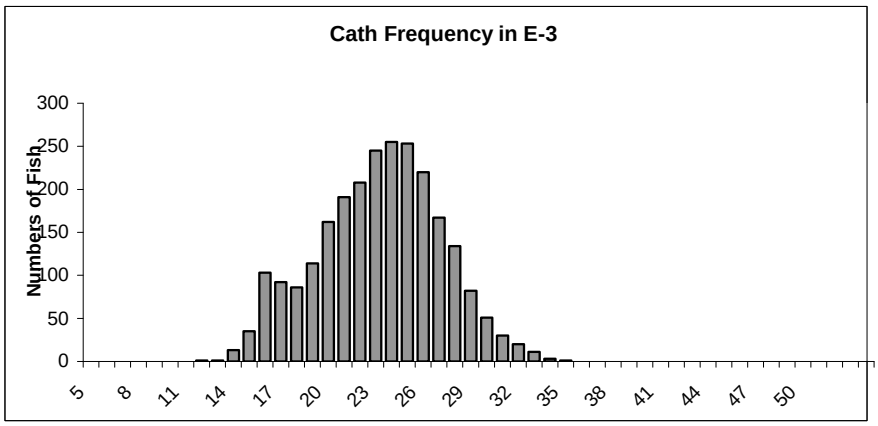
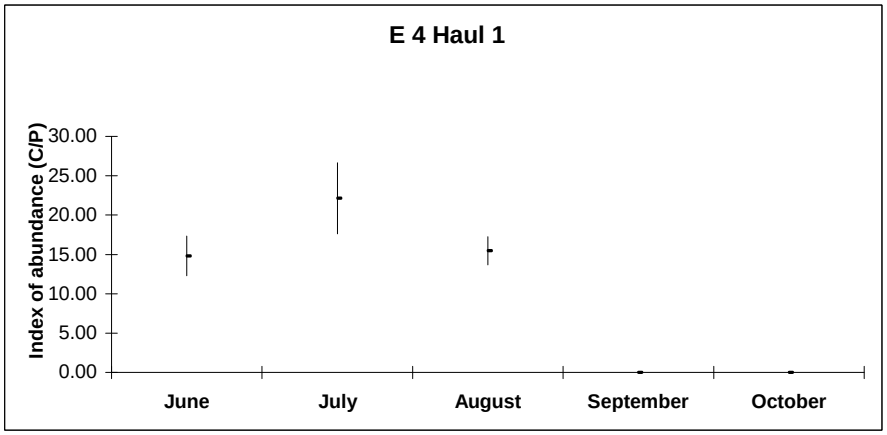
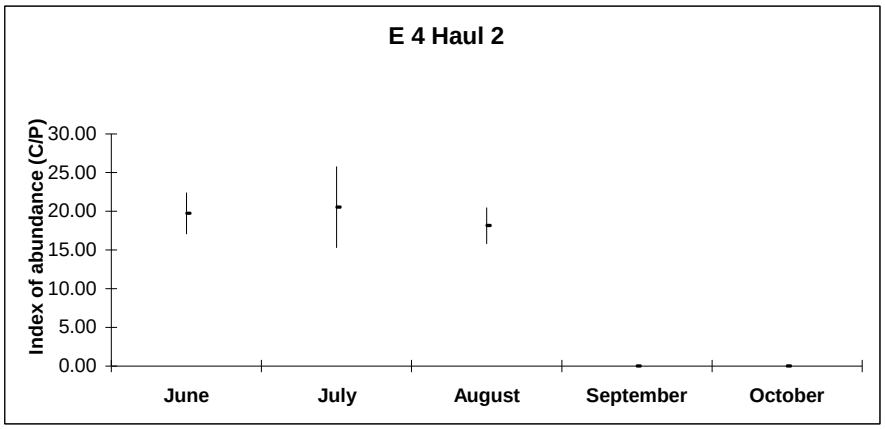


Table 9: Catch per pot per standard soak time (CPUE) of scup in the ventless pot survey
Eastern area June 2010

	Haul 1		Haul 2	
	Mean C/P	STDEV	Mean C/P	STDEV
June	14.80	4.97	19.73	5.30
July	22.13	8.92	20.53	10.41
August	15.47	3.52	18.13	4.64
September	0.00	0.00	0.00	0.00
October	0.00	0.00	0.00	0.00





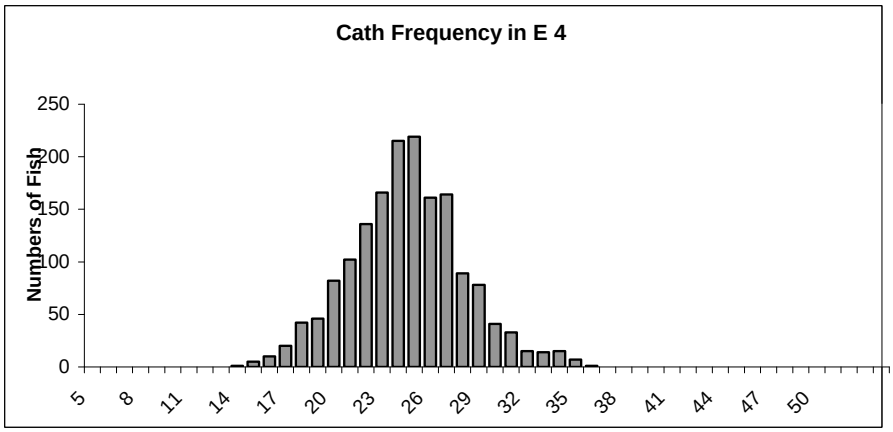
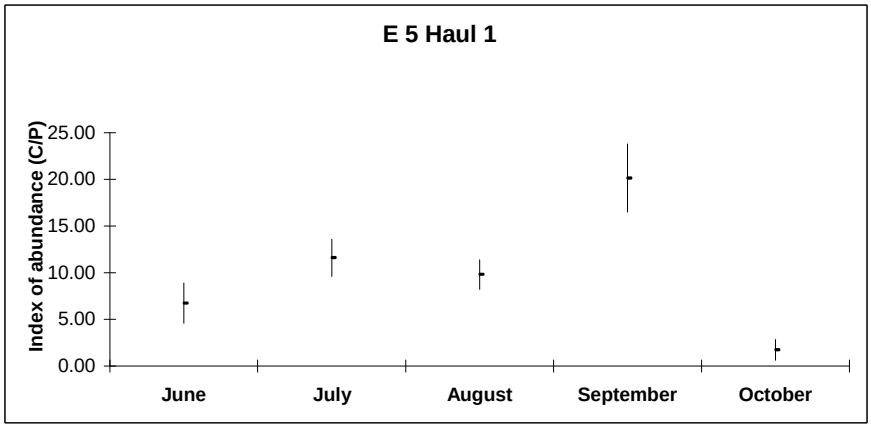
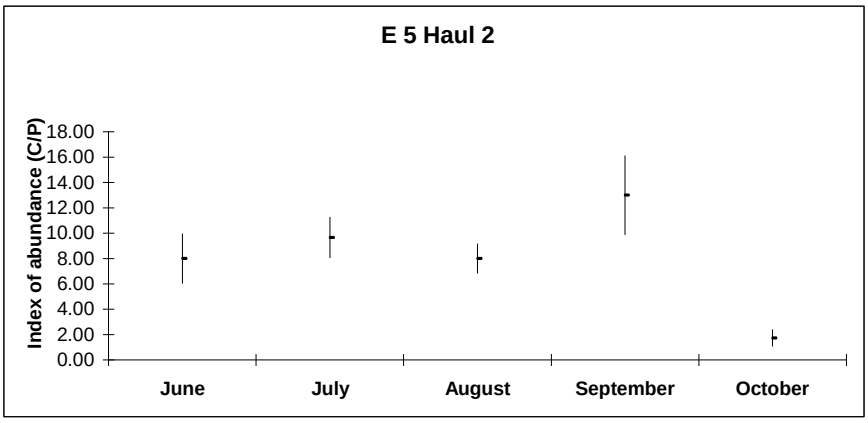


Table 10: Catch per pot per standard soak time (CPUE) of scup in the ventless pot survey
Eastern area June 2010

	Haul 1		haul 2	
	Mean C/P	STDEV	Mean C/P	STDEV
June	6.73	4.27	8.00	3.93
July	11.60	3.92	9.67	3.22
August	9.80	3.12	8.00	2.33
September	20.13	7.23	13.00	6.19
October	1.73	2.19	1.73	1.33





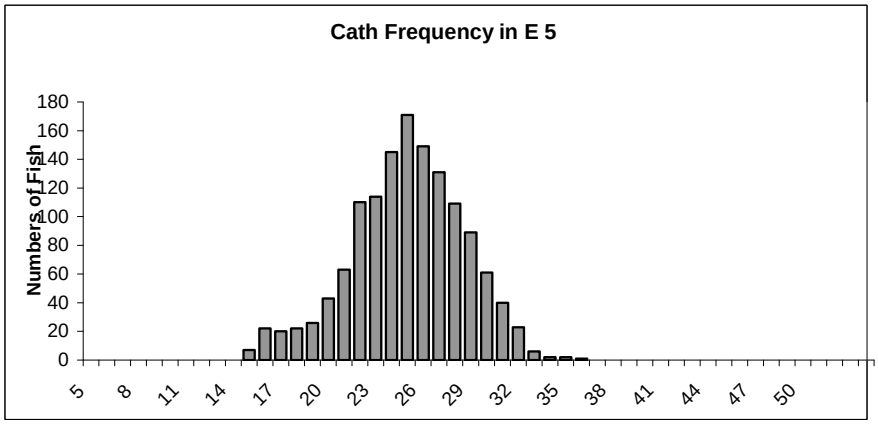


Table 11: Catch in number of fish and CPUE by area fished during the months June-October 2009 by the ventless scup pot survey

	W1	W2	W3	W4	W5	E1	E2	E3	E4	E5
fish caught (#)	1410	1306	1107	1399	1121	344	2851	2478	1662	1356
Mean CPUE	9.400	8.707	7.380	9.327	7.473	2.293	19.007	16.520	11.080	9.040
Stdev	4.189	5.501	5.066	6.264	4.446	2.252	7.095	7.130	3.777	3.773

	W-area	E-area
Fish caught (#)	6343	8691
Mean CPUE	8.457	11.588
Stdev	5.093	4.805

W=Western stations

E=Eastern stations

Figure 2: Size frequency comparison KS between the Eastern and Western Stations

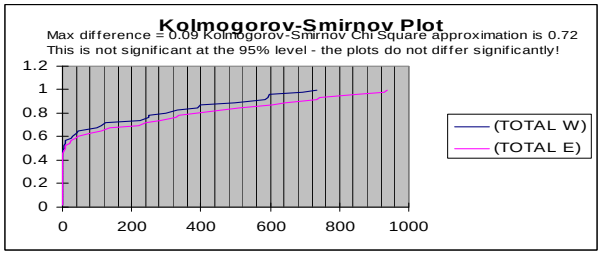
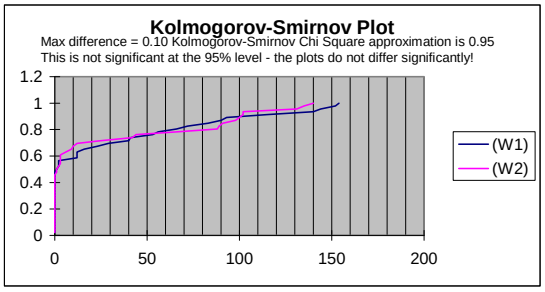
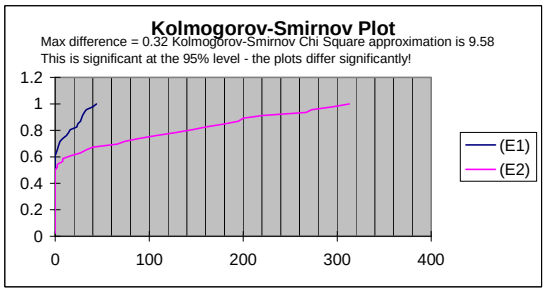
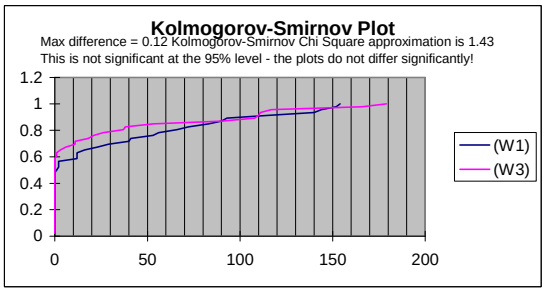
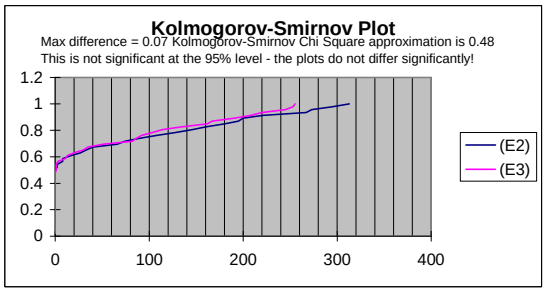


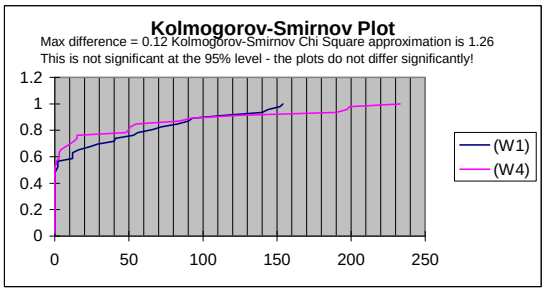
Figure 3: Multiple size frequency comparison of scup catches by the ventless pots in Eastern and Western sampling areas

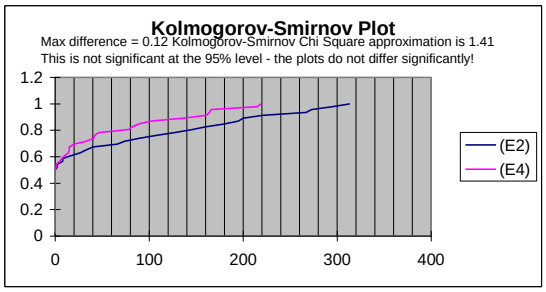


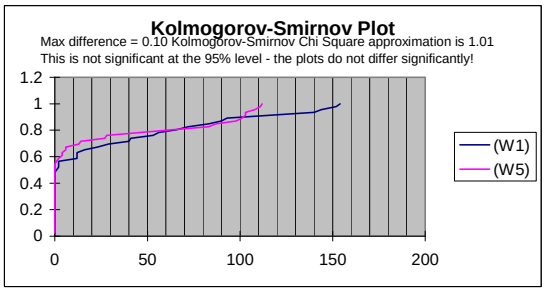


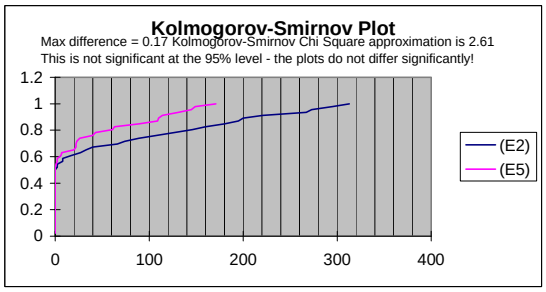












W= Western stations
E=Eastren Stations

Figure 4: Catch composition of scup in the ventless pot survey by station in the western and Eastern sampling areas (june - October)

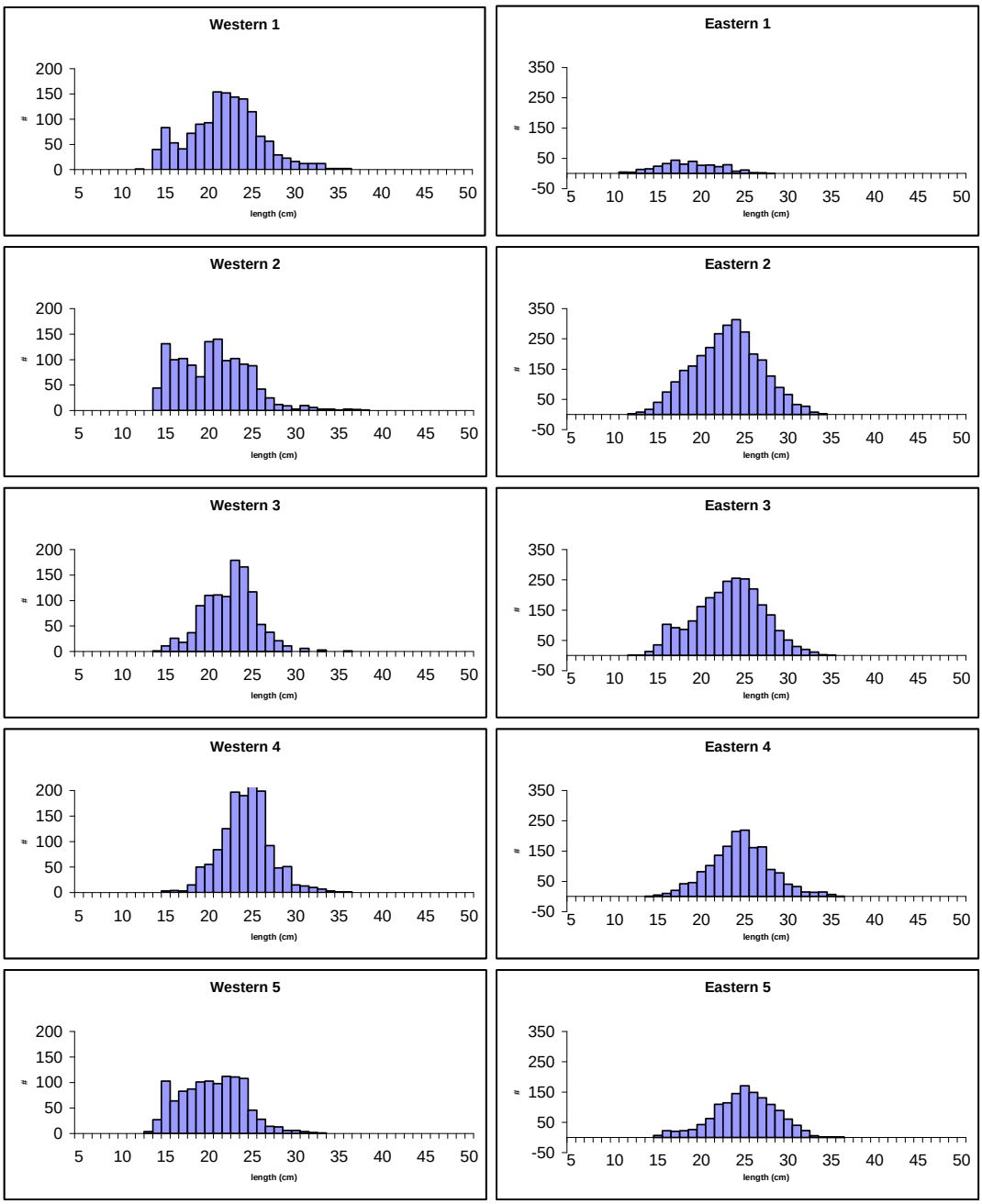


Figure 5: Comparison of NMFS Trawl index and the ventless pot survey index (2009)

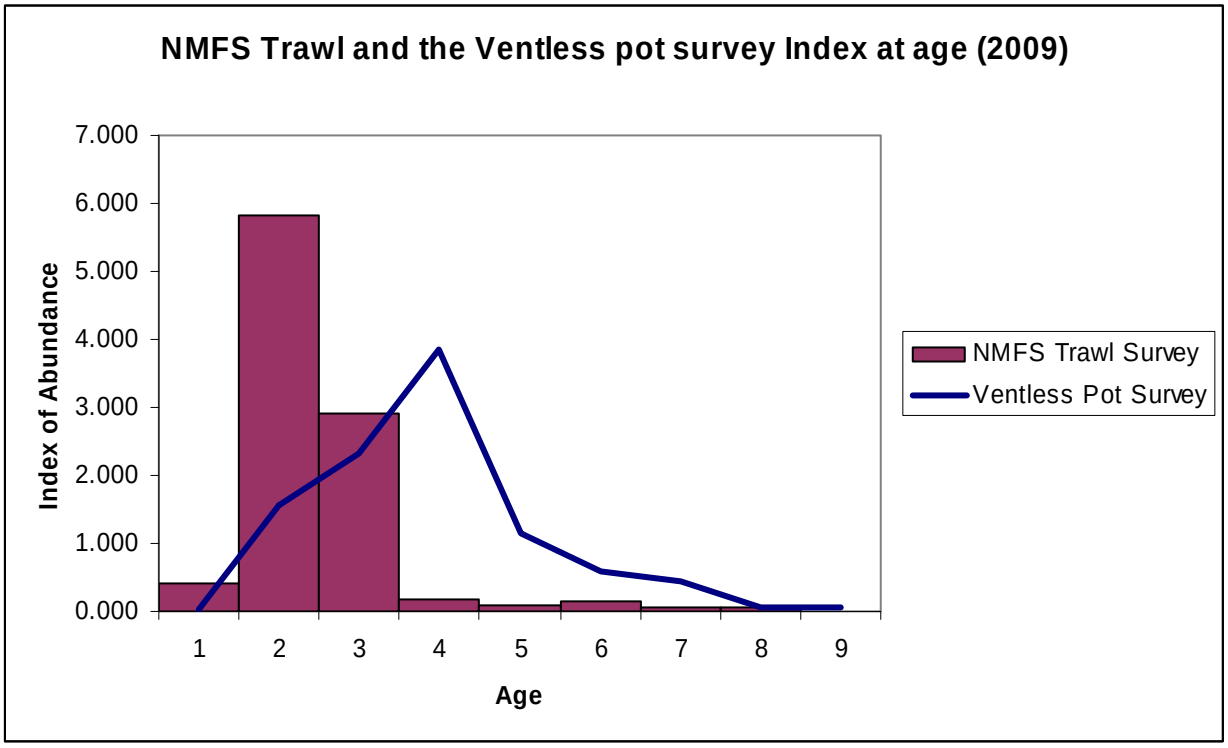


Figure 6: Catch Curve Analysis for the 2009 Scup Ventless Pot Survey (areas combined)

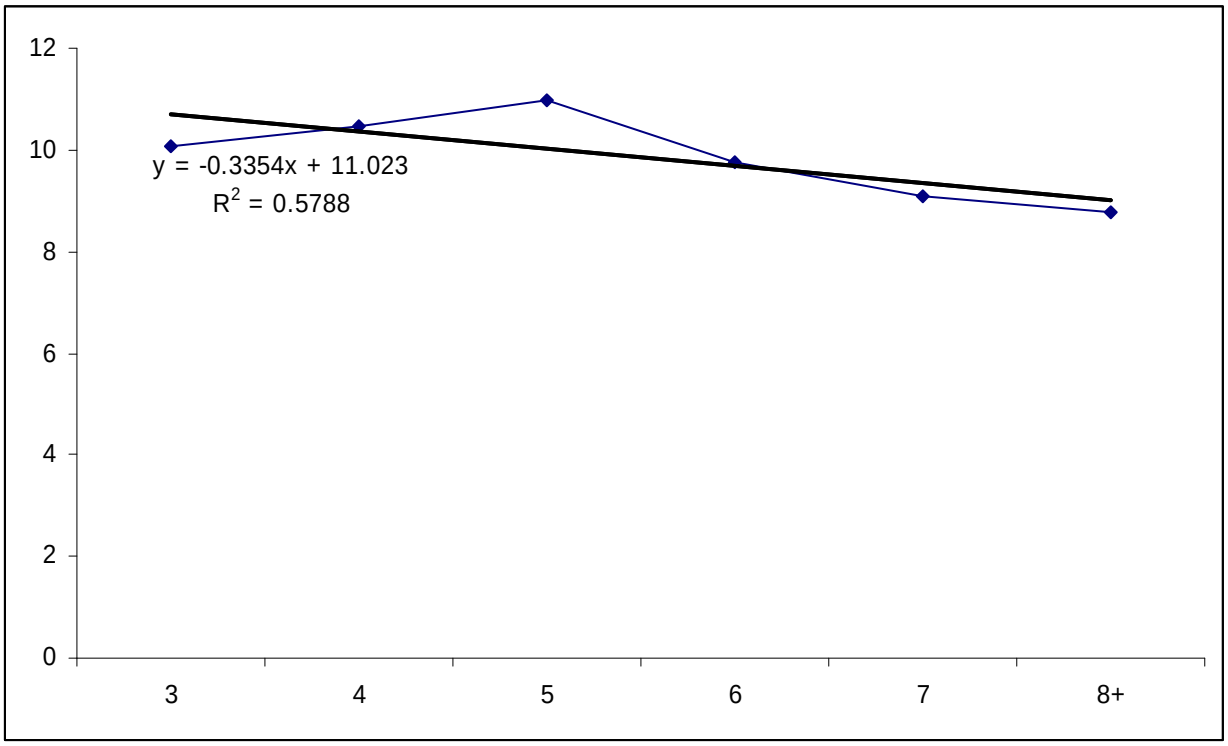


Table 12: Catch Composition of Scup in the Ventless Pot Survey in the Southern New England by Station and Area (June - October 2009)

Length (cm)	W1	W2	W3	W4	W5	E1	E2	E3	E4	E5	TOTAL W	TOTAL E	Grand Total
5	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	5	0	0	0	0	0	5	5
12	1	0	0	0	0	4	2	1	0	0	1	7	8
13	0	0	0	0	4	14	8	1	0	0	4	23	27
14	40	44	1	0	27	16	17	13	1	0	112	47	159
15	83	131	11	3	103	24	40	35	5	7	331	111	442
16	53	100	26	4	64	33	74	103	10	22	247	242	489
17	41	102	18	3	83	44	108	92	20	20	247	284	531
18	72	89	37	15	87	31	146	86	42	22	300	327	627
19	90	66	90	50	101	40	160	114	46	26	397	386	783
20	93	135	110	55	103	27	195	162	82	43	496	509	1005
21	154	140	111	84	98	28	221	191	102	63	587	605	1192
22	152	98	108	125	112	23	267	208	136	110	595	744	1339
23	144	102	179	197	111	29	295	245	166	114	733	849	1582
24	140	91	166	190	108	8	313	255	215	145	695	936	1631
25	115	88	117	233	46	12	273	253	219	171	599	928	1527
26	66	42	53	199	28	3	200	220	161	149	388	733	1121
27	56	25	38	92	14	2	180	167	164	131	225	644	869
28	29	12	21	48	13	1	127	134	89	109	123	460	583
29	23	9	11	51	6	0	89	82	78	89	100	338	438
30	16	3	0	15	6	0	66	51	41	61	40	219	259
31	12	10	6	13	4	0	33	30	33	40	45	136	181
32	12	6	0	10	2	0	27	20	15	23	30	85	115
33	12	3	3	7	1	0	8	11	14	6	26	39	65
34	2	3	0	3	0	0	2	3	15	2	8	22	30
35	2	1	0	1	0	0	0	1	7	2	4	10	14
36	2	3	1	1	0	0	0	0	1	1	7	2	9
37	0	2	0	0	0	0	0	0	0	0	2	0	2
38	0	1	0	0	0	0	0	0	0	0	1	0	1
39	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0