SUMMARY REPORT:
RAFT CHANNEL AREA, POOL 8 ISLANDS, PHASE III, STAGE 2 POST-PROJECT FISHERIES EVALUATION, 2011

Wisconsin Department of Natural Resources,
Mississippi River Fisheries Team, La Crosse, WI

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BACKGROUND

Many of the natural islands in Navigation Pool 8 of the upper Mississippi River have eroded or disappeared since 1939 when the land beneath what is now Pool 8 was flooded after the construction of Lock and Dam 8, located near Genoa, Wisconsin. As part of the U.S. Army Corps of Engineers Environmental Management Program, island construction, restoration and dredging began in 1989 with Phase I. Phase III construction was initiated in 2008 and had various stages. Stage 2 has a total of 12 planned islands. Construction of four West Islands and three of the North Islands began in spring 2008. Construction of four seed islands and one North Island began in July 2007 and was completed in summer 2008. In the fall of 2008, all islands were in place, but additions to these islands were done in 2009. By the fall of 2009, construction of all islands in Stage 2 was completed. Adjacent to stage 2, a total of eight islands were constructed for Stage 3, which was completed in the fall of 2011.

PURPOSE

The purpose of this work is to describe the fisheries community changes as they occur after completion of the Pool 8 Islands, Phase III, Stage 2 habitat rehabilitation and enhance project Navigation Pool 8 of the Mississippi River. Identical annual fall sampling was also done during 2007, 2008, 2009 and 2010 (see Wisconsin Department of Natural Resources, Mississippi River Fisheries Team, 2009, 2010, 2011).

METHODS

The location of Pool 8 Islands, Phase III, Stage 2 Habitat Rehabilitation and Enhancement Project fisheries study area is given in Figure 1. The study area is located in the downstream one-third of the pool formed by Lock and Dam 8 and had a total water surface area of 19,676 acres as of the year 2002.

An 18 foot-long welded aluminum flat-bottomed maxi-boom electro shocking boat equipped with a Wisconsin Box was used on approximately 10 minute day-time runs. Two booms extended 8 feet from the bow and the box controls were adjusted to produce 16 amps. Two types of electro shocking runs where done: random and spatially fixed. Random runs were chosen from available locations that were between 0.4 and 2.0m deep. These runs were selected using an ArcView GIS 3.3® software random point generating script and the Long Term Resource Monitoring Program (LTRMP) (http://www.umesc.usgs.gov/data_library.html) 1998 bathymetric data (Rogala, 1997). Randomly selected runs that were too shallow, too deep, inaccessible or otherwise adverse to electro shocking, were not done and replaced with another randomly selected run. In 2011, a total of 43 random runs were done during 7.197 hours of electro shocking (Figure 2, Table 1).

A total of nine spatially fixed runs were sampled in 2011 (Figure 2, Table 1). These were sited in locations of special interest, including five runs in potential and known centrarchid over-wintering areas, which probably would not have a random run. In general, these potential over-wintering areas are located in moderately deep water with reduced current velocities. These runs were done along a fixed polyline, and were not done for a set time. Three of these fixed runs were sampled annually since 2007 with an additional four to six done from 2008 through 2011.

All 2011 electro shocking was done on October 21st, and the 24th through the 26th. All fish shocked were collected, counted and measured for total length to the nearest mm.

We calculated Proportional Size Structures for selected quality (PSS_Q) and preferred (PSS_P) game fishes (Guy, et al., 2006) using values from (Gabelhouse, 1984) (Table 10) as well as catch per effort for these size categories.

Statistical tests were done using SAS® (2002-2003) software for Windows version 9.13's General linear models (ANOVA) and were done at the alpha=0.05 level. In order to normalize catch per effort data, tests were calculated among means derived from natural logarithm transformed data.

FINDINGS

The mean daily ambient water temperatures during 2011 sampling was 10.7°C and varied by as much as 1.8°C over the sampling period (Table 2). Mean water temperature during 2011 was significantly higher than 2009 (8.2°C) and was the same as 2007, 2008, and 2010 (11.5, 10.3 and 10.1°C, respectively). Water surface elevation measured at the Brownsville, Minnesota, gage was relatively stable and changing as much as 0.21 feet. The mean daily discharge in cubic feet per second was 21,290 and fluctuated as much as 1,600 cubic feet per second. Mean 2011 discharge was less than 2007 and 2010 (about 66,800) and about the same as 2008 and 2009 (about 23,000).

Catch per Effort, Electro Shocking – Random Runs

During 2011 random electro-shocking, 25 fish taxa were recorded among 1121 individuals. The most common fish recorded was largemouth bass (52.9% of the total numerical catch) followed by bluegill (20.5%), yellow perch (8.8%), and spotted sucker (3.9%) (Table 3). Mean catch per hour for all species combined was 155.8 (standard deviation = 159.6, n = 43) during 7.197 total hours of fishing and varied from a minimum of 0.0 to a maximum of 670.7. Catch rates for individual species are given in Table 3.

The greatest change in relative abundance among years was gizzard shad. It dropped from 73.3% of the catch in 2007 to about 0.9% during the later years. Also, 2007 gizzard shad mean catch rate (490.6 per hour) was significantly different ($p<0.001$) from catch rates from either 2008 (0.9), 2009 (0.9), 2010 (6.2) and 2011 (0.1).

Random electro-shocking catch rates for all species combined from 2011 was significantly different from 2007 (591.9) but not from 2008 (88.1), 2009 (110.9) and 2010 (135.8) (Table 4). Besides comparing catch rates among years for random samples, we also looked at trends in catch per effort for the seven most abundant species and all species combined through time. For the years 2007 through 2011, bluegill, emerald shiner and rock bass each had no trend. The slopes of these linear regressions were not statistically different from zero. Gizzard shad, shorthead redhorse and all species combined had statistically significant negative slopes. Both largemouth bass and yellow perch had statistically positive slopes (Figures 3 – 10).

Since gizzard shad abundance dropped drastically from 2007 to later years and because gizzard shad abundances are known to fluctuate wildly, we tested random electro shocking catch rates among all years for all species combined excluding gizzard shad. Electro shocking without this fish, catch rates between 2007 (164.9), 2008 (87.0), 2009 (109.8), 2010 (134.1), and 2011 (155.6) were not significantly different (Table 5). This suggests that, the difference in total fish catch rates between 2007 and other years (about 43.2 fish/hour) was significantly influenced by a decline in gizzard shad abundance and without this fish included, combined species catch rates among years were the same.

When gizzard shad are eliminated from trend analysis in all species through time, there was no significant trend. ($p=0.7452$). This suggests that without gizzard shad, all other species combined had no statistical trend in abundance and that the trend seen for all species combined, including gizzard shad, was strongly influenced by the very high abundance of this fish in 2007. This suggests there were no change in bluegill, emerald shiner and rock bass during the years 2007 through 2011, and gizzard shad and shorthead redhorse declined, while largemouth bass and yellow perch increased.

Since 2007 seemed to be an anomalous year with high catch rates, we did the same regression analysis, without gizzard shad for all species combined, for the years 2008 through 2011, dropping the year 2007. In this analysis (Figures 11-18) there were two significant relationships rather than five from the previous analysis. The two significant relationships were largemouth bass and all species combined. Both of these had positive slopes,

suggesting increases. In fact, the increase in largemouth bass significantly influenced the combined species increase. When largemouth bass were removed from the combined species regression, the slope was not statistically different from zero (p= 0.2504**).**

Catch per Effort, Electro Shocking – Spatially Fixed Runs

During 2011 fixed electro-shocking, 22 fish taxa were recorded among 1000 individuals. The most common fish recorded was bluegill (43.5% of the total numerical catch) followed by largemouth bass (41.9%), yellow perch (4.5%), and spottail shiner (2.3%) (Table 6). Mean catch per hour for all species combined was 337.5 (standard deviation = 332.6, n = 43) during 2.134 total hours of fishing and varied from a minimum of 87.4 to a maximum of 1158.0 per hour. Catch rates for individual species are given in Table 6.

As with random sampling, the greatest change in relative abundance among years was gizzard shad. It dropped from 78.5% of the catch in 2007 to about 1.7% during the later years. Also, 2007 gizzard shad mean catch rate (1358.6 per hour) was significantly different ($p<0.001$) from catch rates from either 2008 (0), 2009 (0), 2010 (6.9) and 2011 (0).

Fixed electro-shocking catch rates for all species combined from 2011 was not significantly different from 2008 (190.9), 2009 (193.3), and 2010 (383.9) (Table 7). The year 2007 was not tested since there were only three fixed runs completed.

Besides comparing catch rates among years for fixed samples, we also looked at trends in catch per effort for the seven most abundant species and all species combined through time. For the years 2008 through 2011, none of the seven species and all species combined had a significant trend. The slopes of these linear regressions were not statistically different from zero (Figures 19-26). This suggests there were no change at fixed electro shocking runs in bluegill, emerald shiner, gizzard shad, largemouth bass, rock bass, shorthead redhorse, yellow perch and all species combined during the years 2008 through 2011**.**

Catch per Effort, Electro Shocking – Comparison between Random and Fixed Runs

We compared catch per effort between random and fixed runs for 2007 through 2011. For all species combined, bluegill and largemouth bass, the catch rates were greater at fixed runs than random runs ($p < 0.021$). For emerald shiner, gizzard shad, rock bass, shorthead redhorse, and yellow perch, catch rates were the same ($p > 0.098$). This suggests a generally greater abundance of fish at spatially fixed runs, than at random ones.

Length Distributions

For electro shocked 2011 fish species at randomly selected locations where there were sufficient numbers, we generated total length distributions and mean total lengths (Figures 27 - 30). Of the seven fish species tested for differences in mean total length among years (black crappie, bluegill, largemouth bass, northern pike, pumpkinseed, rock bass and yellow perch) three (black crappie, pumpkinseed and rock bass) were the same as all other years (Table 8). Bluegill and largemouth bass in 2011 were smaller than almost all other years. Northern pike in 2011 were the same size as two other years and larger than 2008 and 2009. Yellow perch in 2011 was the same mean size as two other years but larger than 2009 and 2010.

Trends in PSS were discernable for only two species: bluegill, which had an increasing trend, and yellow perch, which decreased. The trend in bluegill was due to the decreased abundance of fish between stock size and quality size (three to six inches) ($p=0.0053$) not in an increase in quality size and larger ($p=0.6635$). The trend in yellow perch was due to an increase in fish between stock size and quality size (five to eight inches) ($p<0.0001$), not a decrease in fish quality size and larger ($p=0.3577$).

Smaller mean bluegill and largemouth bass sizes in 2011 may be due to a high abundance of young-of-the-year for these two species. Catch per effort for bluegill less than three inches in length was significantly different from 2008 through 2010, but not 2007 ($p<0.001$). This test result was similar to those for mean lengths. Similar test results were found for largemouth bass catch rates for fish less than five inches in length, where 2011 had a significantly higher catch rate than all other years except 2009.

For electro shocked 2011 fish species at spatially fixed locations where there were sufficient numbers, we generated total length distributions and mean total lengths (Figures 31 - 33). Of the six fish species tested for differences in mean total length among years (black crappie, bluegill, largemouth bass, northern pike,

pumpkinseed, and yellow perch) pumpkinseed was the same as all other years (Table 9). As with random sampling, bluegill and largemouth bass in 2011 were smaller than all other years**.** Northern pike in 2011 were the same size as one other year and larger than 2008 - 2010. Yellow perch in 2011 was the same mean size as three other years but larger than 2008.

Although there were mixed results in tests among years, bluegill and largemouth bass, the two most abundant species, which comprised about 80 percent of the total catch, were smaller than almost all previous years. This smaller mean size was due to a relatively higher abundance of young-of-the-year fish.

The PSS_Q and PSS_P and associated catch rates by species and year for electro shocked fish species at randomly selected locations are presented in Figures 34-38. The "acceptable" value of PSS_Q for bluegill, pumpkinseed and rock bass is 40 to 60 (Wisconsin Department of Natural Resources, 2010). All values of PSS_Q for these three fish species in 2011 fell below the state level for "acceptable". The "acceptable" value of PSS_P for bluegill and rock bass is 5. Only bluegill from 2010 (n stock = 33) and 2011 (n stock =8) met or exceeded this (6.06 and 12.50, respectively) and all other years and rock bass did not.

Only one of the five species size-specific catch rates at randomly selected locations showed any trend among years. Largemouth bass catch rates from random samples for larger fish appear to have steadily declined since 2008.

The PSS_Q and PSS_P and associated catch rates by species and year for electro shocked fish species at fixed locations are presented in Figures 39-41. All values of PSS_Q for bluegill and pumpkinseed in 2007 through 2011 fell below the state level for "acceptable". Also, bluegill and pumpkinseed from 2007 through 2011 did not meet the "acceptable" level for PSS_P. This suggests none of these two species' size structures were "acceptable" during the 2007 through 2011 sampling period at fixed locations.

Only one of the three species size-specific catch rates at fixed locations showed any trend among years. Yellow perch catch rates for larger fish appear to have increased slightly since 2008.

CONCLUSIONS

To date, there has been no clear significant changes in fish population metrics from 2007 – 2011 attributable to the Phase III Stage 2 habitat project. When gizzard shad are excluded from the current analysis, there was no difference in catch rates among years for all species combined.

Assuming the introduction of centrarchid over-winter habitat is an important population driver, interpretation of these results must take into consideration that it was not until the winter of 2009 – 2010 that features designed to provide this habitat were in place. Therefore, 2007 – 2009 data should be considered as "pre-project" data and 2010 represents the first year physical conditions would be met to provide improved over -wintering habitat in a portion of the study area. Fixed run sampling in the upper Mississippi River at Pool 8 Islands, Phase II, and Bertom McCartney, Pool 11 habitat projects provide evidence that detecting project induced changes in fish population metrics within over-wintering habitat is not significant until three to seven years post project. It is likely the random sampling design used in this study may require a longer interval of time to detect changes since it was designed to assess fish population metrics of the complex rather than just the over-wintering habitat.

Two species, largemouth bass and yellow perch had increasing trends in abundance since 2007, but these increases were also seen pool-wide as well as in the impounded strata of pool 8 since 2009 for largemouth bass and 2007 for yellow perch (LTRMP data; WDNR, 2012). Therefore, increases in these two species appear to be occurring pool-wide and may not be due to local effects of the habitat project, unless the project is affecting populations of these two species throughout the entire pool. Interestingly, no recent increasing trends were seen for either of these two species in LTRMP monitoring pools 4 and 13.

Mean total length of selected species changed over time. Of the fish species compared, bluegill and largemouth bass had the smallest sizes in 2011, which may be due to a large year class in 2011. It's possible these strong year classes could be a result of the habitat project. Of the 21 calculations made for 2007-2011 PSS_Q and PSS_P from electro shocking, only two met state standards for "acceptable": bluegill from 2010 and 2011. The 2011 value is questionable, since it was based on 8 stock-sized fish. This suggests that the quality and

larger sized fish within the study area are below state standards for most instances. It is not unusual for PSS's to be below "acceptable" values. During fall 2011 sampling in the Goose Island area of Pool 8 (WDNR, 2012), none of the four PSS calculations met state standards. Using LTRMP pool-wide electro shocking data, the state standard for PSS_Q was met only once in 20 years. Trends in PSS were seen for only two fish species through time. These trends were due to variable age class strengths. It's unclear if these variations are due to the habitat project.

It could be several years before changes are detected in fisheries populations affected by this habitat project. Due to the nature of fisheries population growth, it could take several years after project completion to see any changes that are detectable.

RECOMMENDATIONS

1. Continue to monitor the fisheries community in the Pool 8 Islands, Phase III, Stage 2 habitat rehabilitation and enhancement project in Navigation Pool 8 of the Mississippi River. Monitoring should continue for several years after the completion of this habitat project.

2. Monitoring results should be compared with ongoing WDNR Lake Assessment sampling results, and LTRMP sampling results which could serve as a reference conditions.

3. REFERENCES

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FIGURE 1. LOCATION OF PHASE III, STAGE 2 (RAFT CHANNEL AREA) STUDY FISHERIES AREA IN NAVIGATION POOL 8 OF THE UPPER MISSISSIPPI RIVER.

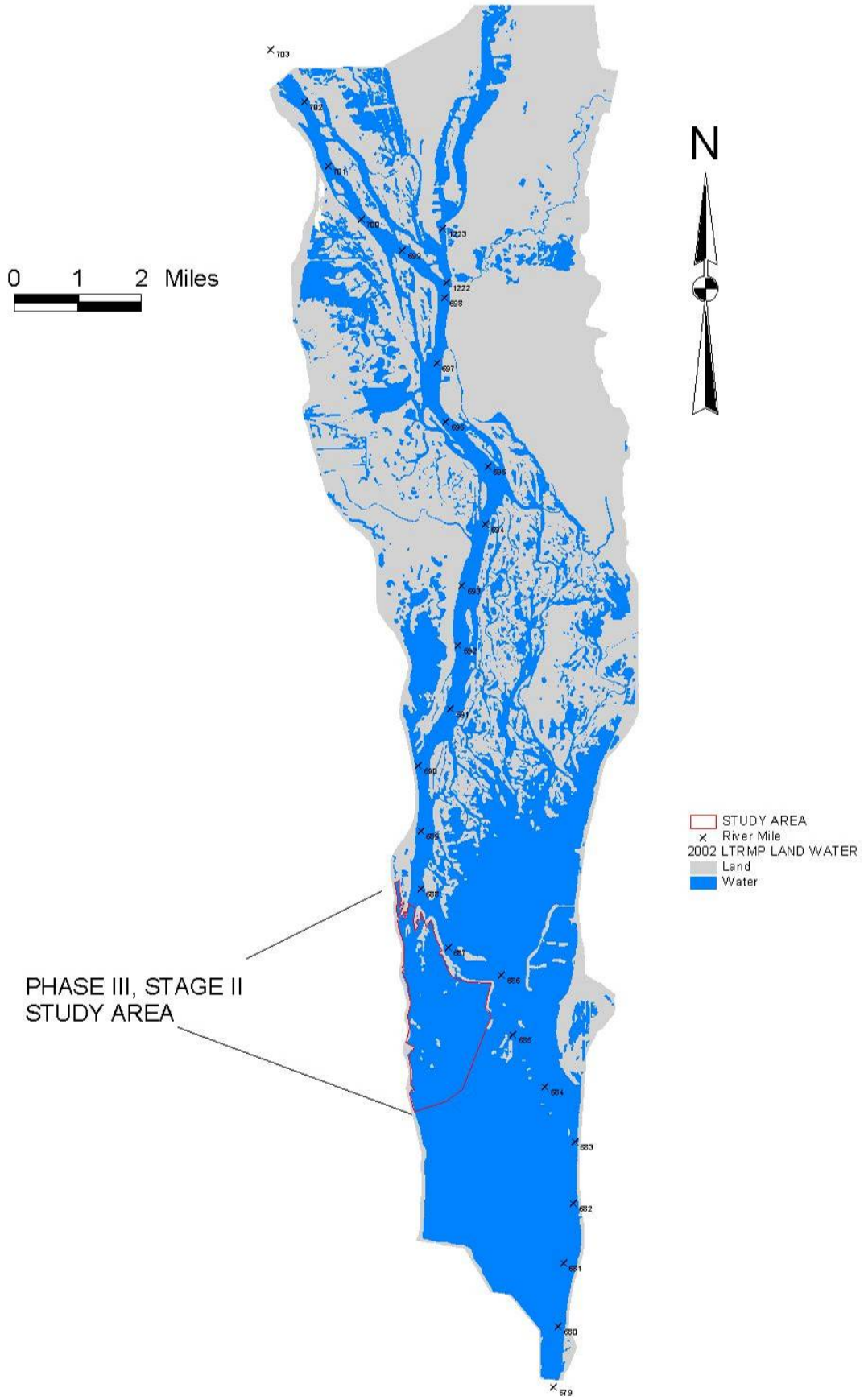


FIGURE 2. LOCATION OF 2011 PHASE III, STAGE 2 ELECTRO SHOCKING STATIONS. (2010 NAIP PHOTO).

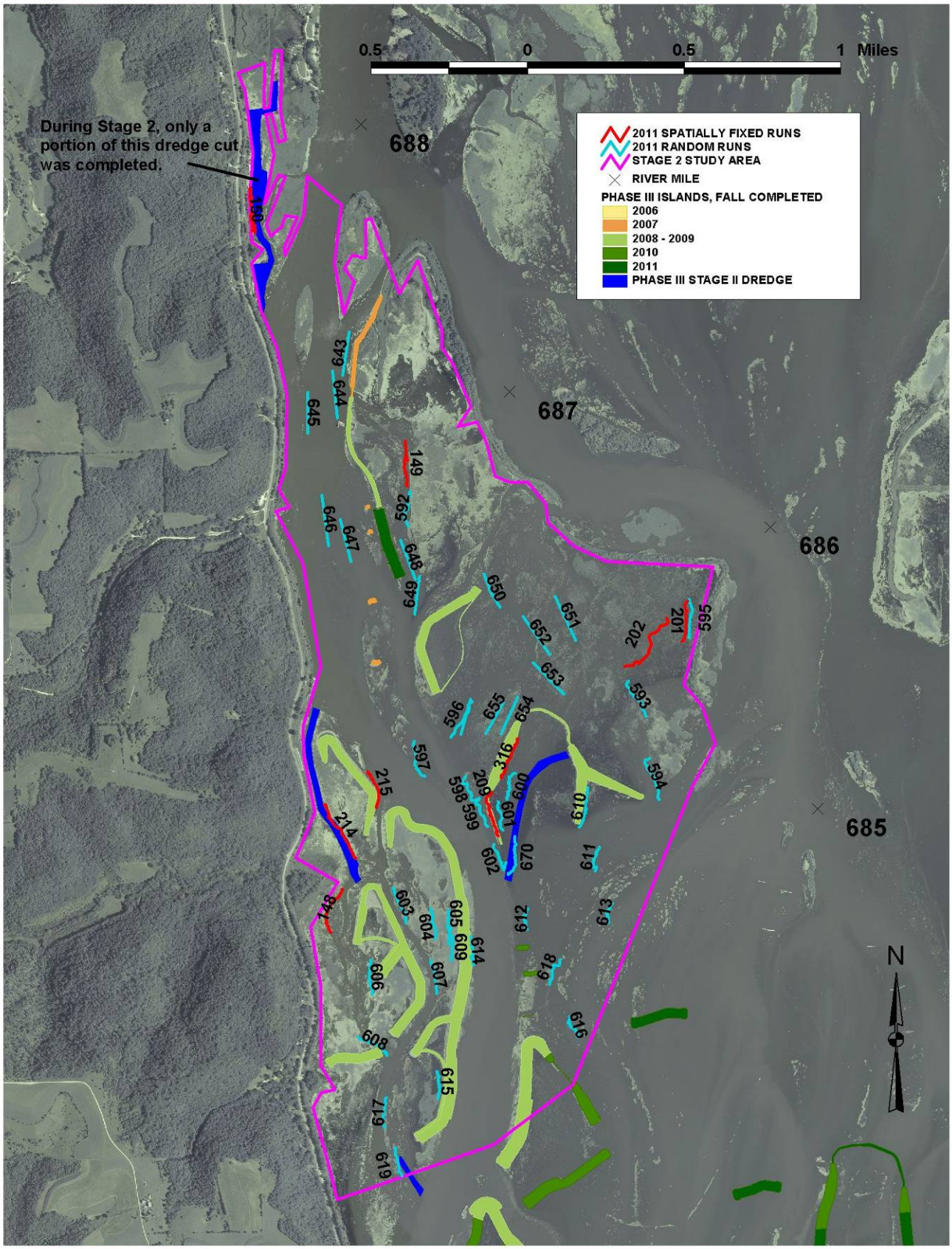


TABLE 1. ELECTRO SHOCKING STATION LENGTHS, STARTING AND ENDING COORDINATES (NAD 1983, ZONE 15N), 2011 PHASE III, STAGE 2 AREA.

STATION	LENGTH (M)	UTM15STX	UTM15STY	UTM15EDX	UTM15EDY
148	270	639334	4834002	639276	4833780
149	284	639660	4836304	639666	4836073
150	489	638863	4837602	638887	4837371
201	224	641107	4835480	641080	4835274
202	406	641003	4835392	640785	4835146
209	274	640102	4834500	640135	4834273
214	340	639243	4834434	639403	4834160
215	208	639464	4834607	639509	4834421
316	240	640235	4834774	640152	4834572
592	222	639684	4836041	639675	4835865
593	224	640805	4835069	640895	4834889
594	251	640914	4834673	640961	4834464
595	204	641117	4835488	641116	4835292
596	185	639993	4834975	639944	4834797
596	233	640001	4834964	639893	4834781
597	212	639705	4834759	639758	4834581
598	229	639968	4834582	640025	4834435
599	190	640039	4834468	640081	4834322
600	178	640223	4834597	640181	4834464
601	175	640134	4834450	640159	4834305
602	195	640176	4834139	640113	4834231
603	200	639596	4834007	639662	4833828
604	198	639790	4833903	639810	4833745
605	184	639882	4833893	639883	4833718
606	184	639481	4833638	639489	4833460
607	178	639791	4833637	639820	4833468
608	211	639415	4833243	639564	4833148
609	182	639894	4833806	639895	4833638
610	216	640595	4834524	640553	4834320
611	155	640654	4834217	640635	4834097
612	135	640286	4833900	640283	4833797
613	118	640721	4833928	640702	4833829
614	197	639995	4833759	640009	4833611
615	152	639821	4833065	639825	4832927
616	151	640505	4833349	640541	4833242
617	166	639560	4832930	639552	4832777
618	166	640453	4833640	640398	4833514
619	159	639608	4832674	639641	4832529
643	225	639369	4836862	639338	4836639
644	243	639285	4836663	639309	4836421
645	211	639157	4836553	639157	4836342
646	262	639231	4836025	639264	4835765
647	223	639324	4835899	639380	4835683
648	215	639636	4835794	639712	4835593
649	198	639731	4835609	639709	4835412
650	190	640064	4835620	640144	4835449
651	249	640428	4835505	640534	4835280
652	238	640262	4835401	640400	4835207
653	224	640316	4835164	640474	4835005
654	205	640237	4834987	640152	4834800
655	183	640164	4834960	640073	4834801
670	221	640220	4834272	640187	4834076

TABLE 2. MEAN TEMPERATURE, WATER SURFACE ELEVATION AND FLOW DURING FALL 2011 PHASE III, STAGE 2 AREA.

DATE	MEAN DAILY TEMPERATURE ºC	WATER SURFACE ELEVATION (ft), BROWNSVILLE	FLOW (cfs) DAM 8
10/21/2011	10.2	630.96	21,300
10/24/2011	10.7	630.90	20,400
10/25/2011	11.6	631.11	21,600
10/26/2011	9.8	631.03	22,000
10/21/2011	10.2	630.96	21,300
MEAN	10.7	631.01	21,290

TABLE 3. FALL 2011 STAGE 2 RELATIVE ABUNDANCE (N AND PERCENT OF ALL TAXA), CATCH PER HOUR (MEAN, STANDARD DEVIATION, MINIMUM, MAXIMUM, NUMBER OF RUNS AND TOTAL HOURS), FOR RANDOM ELECTRO SHOCKING.

	SPECIES	N	PERCENT	MEAN	STANDARD DEV.	MIN.	MAX.	RUNS	TOTAL HOURS
1	black crappie	13	1.16	1.81	3.82	0	17.96	43	7.197
2	bluegill	230	20.52	32.02	38.88	0	173.65	43	7.197
3	brook silverside	2	0.18	0.28	1.83	0	11.98	43	7.197
4	channel catfish	4	0.36	0.56	1.76	0	5.99	43	7.197
5	common carp	5	0.45	0.70	1.94	0	5.99	43	7.197
6	emerald shiner	4	0.36	0.56	1.76	0	5.99	43	7.197
7	freshwater drum	3	0.27	0.42	1.54	0	5.99	43	7.197
8	gizzard shad	1	0.09	0.14	0.91	0	5.99	43	7.197
9	golden redhorse	2	0.18	0.27	1.22	0	5.99	43	7.197
10	golden shiner	11	0.98	1.53	4.73	0	23.95	43	7.197
11	johnny darter	1	0.09	0.14	0.91	0	5.99	43	7.197
12	largemouth bass	593	52.90	82.30	128.66	0	622.75	43	7.197
13	northern pike	13	1.16	1.81	3.07	0	11.98	43	7.197
14	pumpkinseed	17	1.52	2.37	4.16	0	17.96	43	7.197
15	quillback	2	0.18	0.28	1.83	0	11.98	43	7.197
16	rock bass	17	1.52	2.36	4.15	0	11.98	43	7.197
17	sauger	1	0.09	0.14	0.91	0	5.99	43	7.197
18	shorthead redhorse	18	1.61	2.49	4.56	0	17.96	43	7.197
19	silver redhorse	2	0.18	0.28	1.28	0	5.99	43	7.197
20	smallmouth bass	3	0.27	0.42	2.02	0	11.98	43	7.197
21	spottail shiner	29	2.59	4.04	9.84	0	41.92	43	7.197
22	spotted sucker	44	3.93	6.13	10.89	0	53.89	43	7.197
23	walleye	6	0.54	0.84	2.47	0	11.98	43	7.197
24	walleye x sauger	1	0.09	0.14	0.91	0	5.99	43	7.197
25	yellow perch	99	8.83	13.79	16.30	0	59.88	43	7.197
	ALL SPECIES	**1121**	**100.05**	**155.78**	**159.60**	**0**	**670.66**	**43**	**7.197**

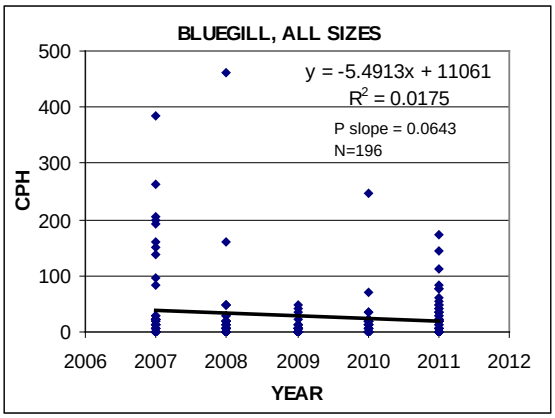
TABLE 4. COMPARISON OF MEAN PHASE III, STAGE 2 CATCH PER HOUR FOR 2007 THROUGH 2011 RANDOM ELECTRO SHOCKING RUNS FOR ALL SPECIES COMBINED.

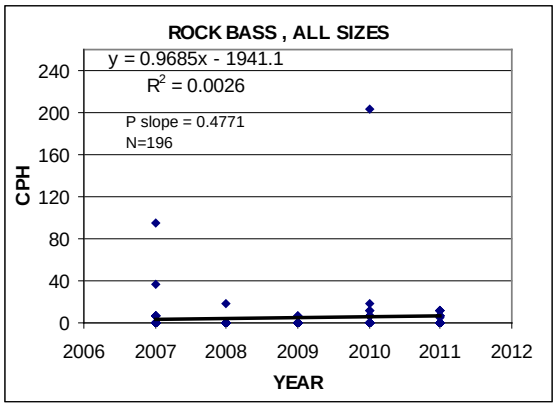
YEAR	MEAN	STD. DEV.	NUMBER OF RUNS	TOTAL HOURS	DIFFERENT (means with the same letter are not Sign. Different)
2007	591.9	1352.6	41	6.847	A
2011	155.8	159.6	43	7.197	B
2010	135.8	139.4	40	6.680	B
2009	110.9	121.2	38	6.346	B
2008	88.1	94.6	34	5.678	B
ALL YEARS	**222.5**	**652.5**	**196**	**32.748**	

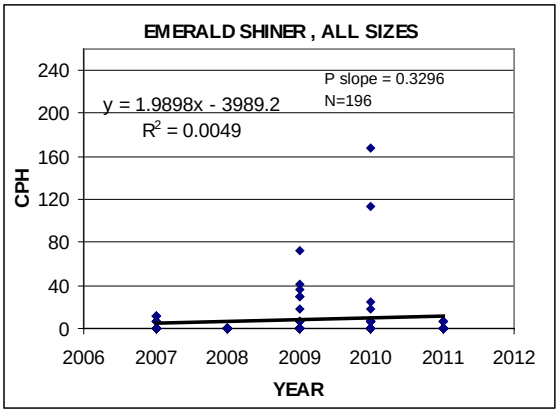
TABLE 5. COMPARISON OF MEAN PHASE III, STAGE 2 CATCH PER HOUR FOR 2007 THROUGH 2011 RANDOM ELECTRO SHOCKING RUNS FOR ALL SPECIES COMBINED EXCLUDING GIZZARD SHAD.

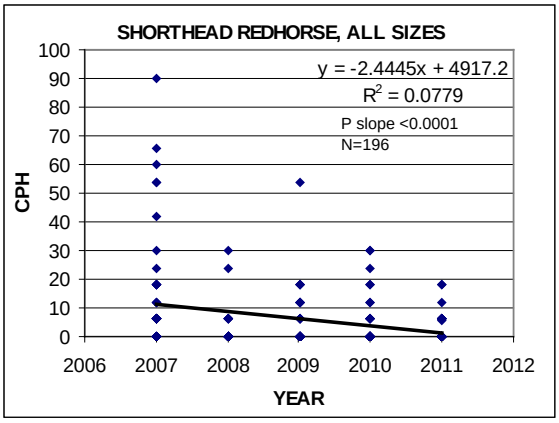
YEAR	MEAN	STD. DEV.	NUMBER OF RUNS	TOTAL HOURS	DIFFERENT (means with the same letter are not Sign. Different)
2007 WITHOUT GIZZARD SHAD	164.9	173.4	41	6.847	A
2011 WITHOUT GIZZARD SHAD	155.6	159.6	43	7.197	A
2010 WITHOUT GIZZARD SHAD	134.1	139.1	40	6.680	A
2009 WITHOUT GIZZARD SHAD	109.8	120.5	38	6.346	A
2008 WITHOUT GIZZARD SHAD	87.0	94.6	34	5.678	A
ALL YEARS WITHOUT GIZZARD SHAD	**132.4**	**143.5**	**196**	**32.748**	

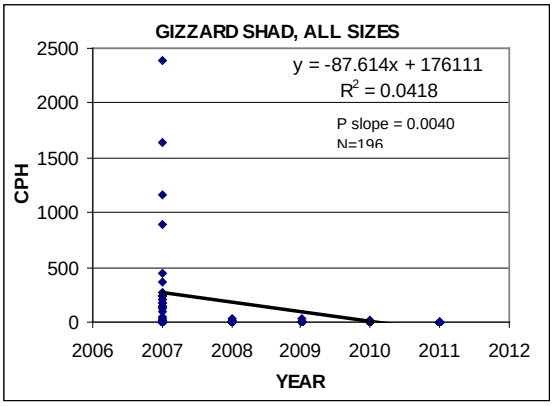
FIGURES 3-10. TRENDS IN CATCH PER HOUR PHASE III, STAGE 2 RANDOM ELECTRO SHOCKING STATIONS, 2007 - 2011.

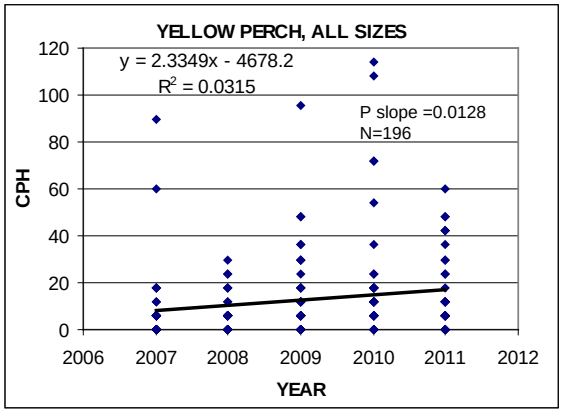


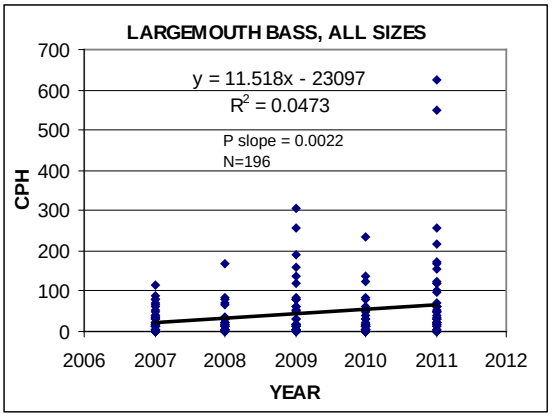


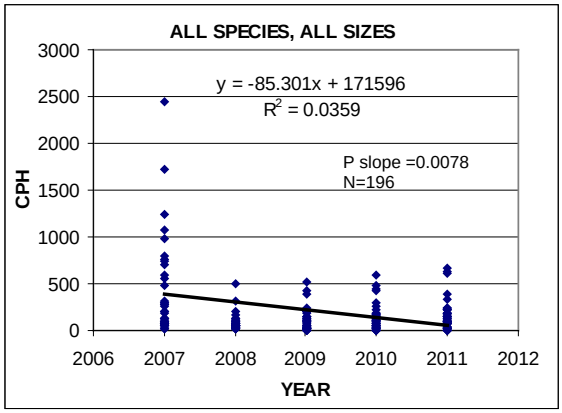




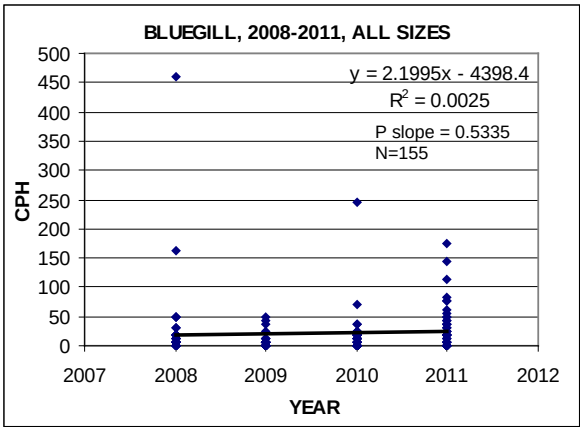


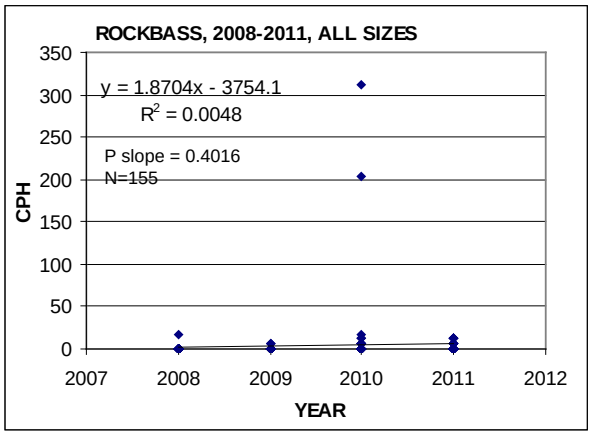


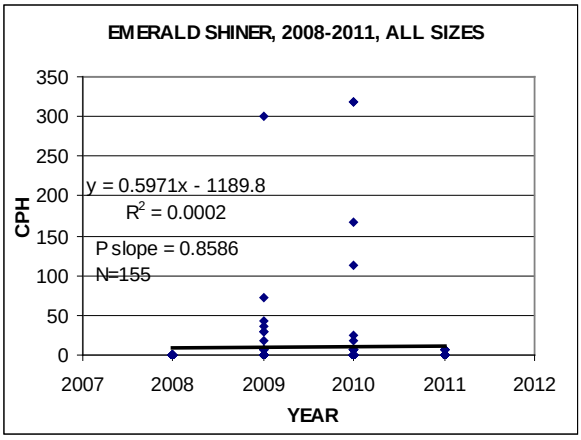


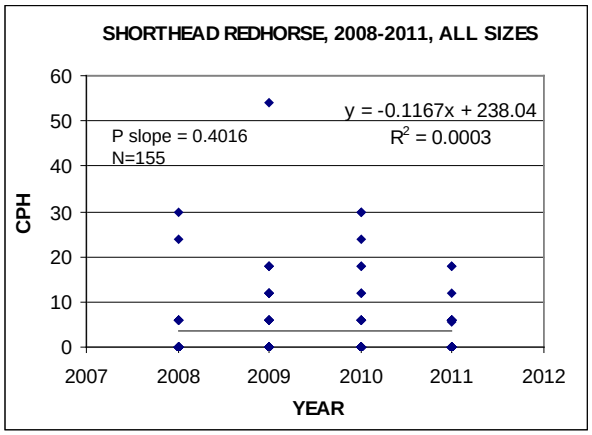


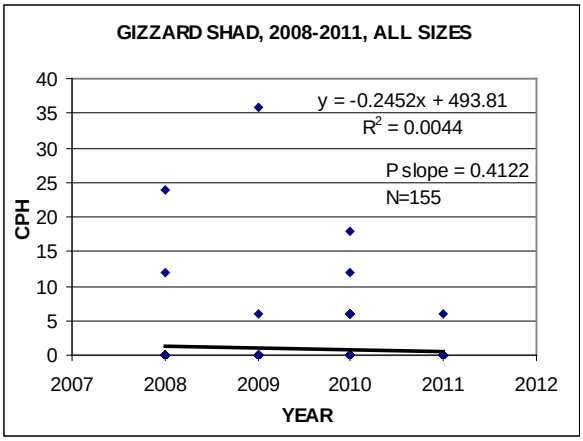
FIGURES 11-18. TRENDS IN CATCH PER HOUR PHASE III, STAGE 2 RANDOM ELECTRO SHOCKING STATIONS, 2008 - 2011.

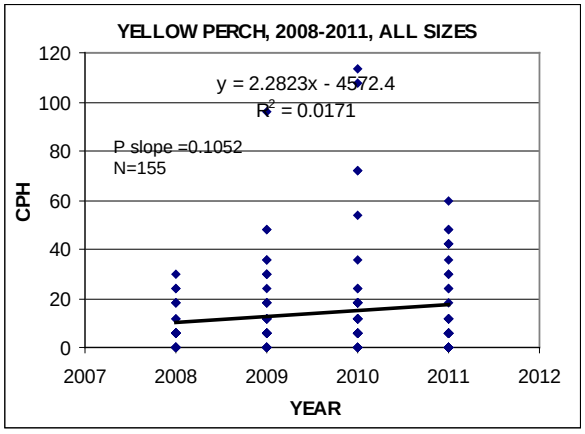


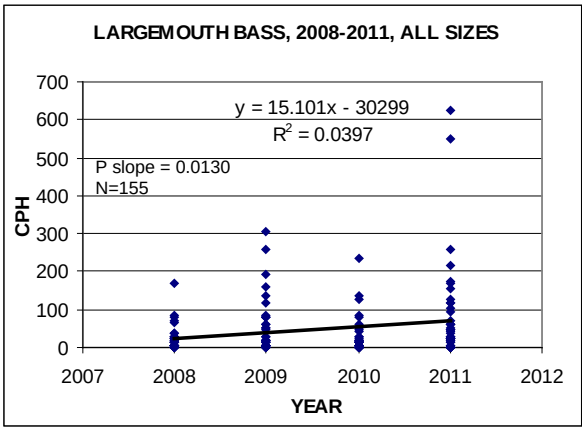












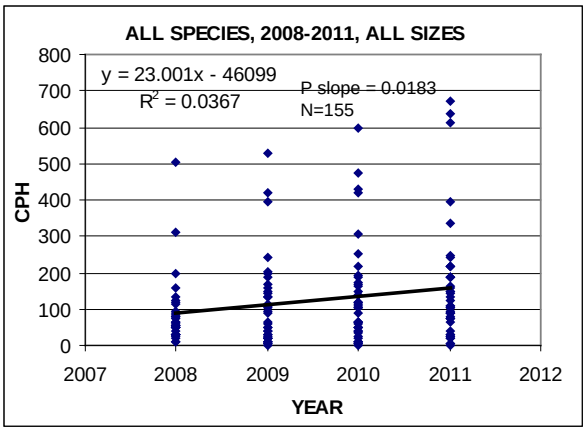


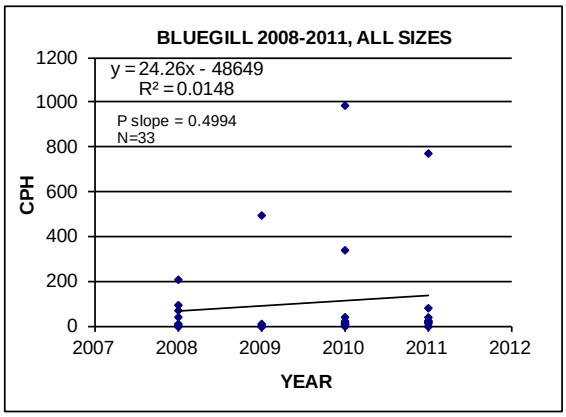
TABLE 6. FALL 2011 STAGE 2 RELATIVE ABUNDANCE (N AND PERCENT OF ALL TAXA), CATCH PER HOUR (MEAN, STANDARD DEVIATION, MINIMUM, MAXIMUM, NUMBER OF RUNS AND TOTAL HOURS), FOR FIXED ELECTRO SHOCKING.

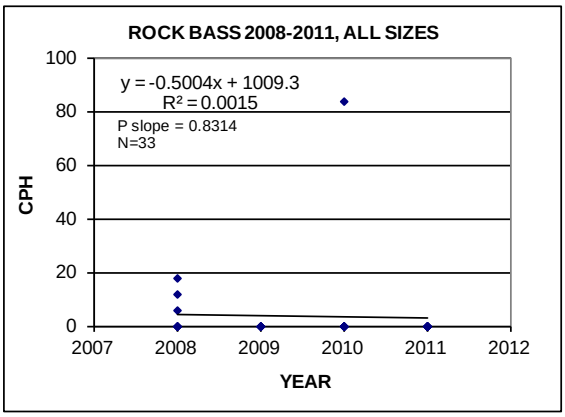
	SPECIES	N	PERCENT	MEAN	STANDARD DEV.	MIN.	MAX.	RUNS	TOTAL HOURS
1	black crappie	13	1.30	5.25	7.22	0.00	22.47	9	2.134
2	bluegill	435	43.50	108.71	250.73	0.00	774.00	9	2.134
3	brook silverside	9	0.90	2.52	5.52	0.00	16.00	9	2.134
4	common carp	2	0.20	1.21	3.64	0.00	10.93	9	2.134
5	emerald shiner	1	0.10	0.74	2.22	0.00	6.67	9	2.134
6	freshwater drum	4	0.40	2.14	4.74	0.00	13.83	9	2.134
7	golden redhorse	1	0.10	0.51	1.54	0.00	4.61	9	2.134
8	green sunfish	3	0.30	0.67	2.00	0.00	6.00	9	2.134
9	largemouth bass	419	41.90	159.72	138.73	21.86	419.48	9	2.134
10	logperch	1	0.10	0.22	0.67	0.00	2.00	9	2.134
11	northern pike	7	0.70	4.21	5.97	0.00	13.33	9	2.134
12	pumpkinseed	13	1.30	4.05	6.41	0.00	14.98	9	2.134
13	quillback	1	0.10	0.51	1.54	0.00	4.61	9	2.134
14	shorthead redhorse	4	0.40	2.60	4.58	0.00	13.33	9	2.134
15	silver redhorse	1	0.10	0.61	1.82	0.00	5.46	9	2.134
16	smallmouth bass	3	0.30	2.22	6.67	0.00	20.00	9	2.134
17	spotfin shiner	3	0.30	2.09	3.15	0.00	6.67	9	2.134
18	spottail shiner	23	2.30	13.70	25.85	0.00	64.52	9	2.134
19	spotted sucker	10	1.00	4.73	7.39	0.00	18.43	9	2.134
20	walleye	1	0.10	0.74	2.22	0.00	6.67	9	2.134
21	weed shiner	1	0.10	0.22	0.67	0.00	2.00	9	2.134
22	yellow perch	45	4.50	20.12	28.48	0.00	92.17	9	2.134
	ALL SPECIES	**1000**	**100.00**	**337.50**	**332.55**	**87.43**	**1158.00**	**9**	**2.134**

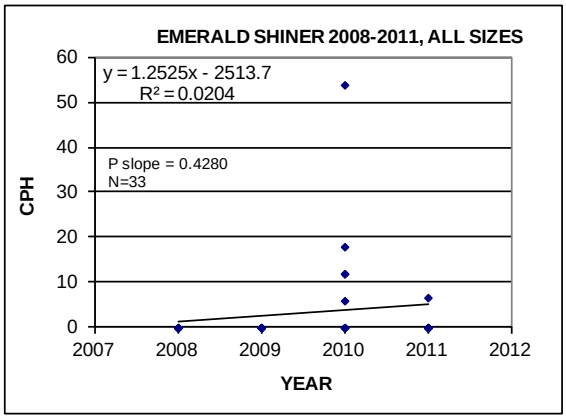
TABLE 7. COMPARISON OF MEAN PHASE III, STAGE 2 CATCH PER HOUR FOR 2008 THROUGH 2011 SPATIALLY FIXED ELECTRO SHOCKING RUNS FOR ALL SPECIES COMBINED.

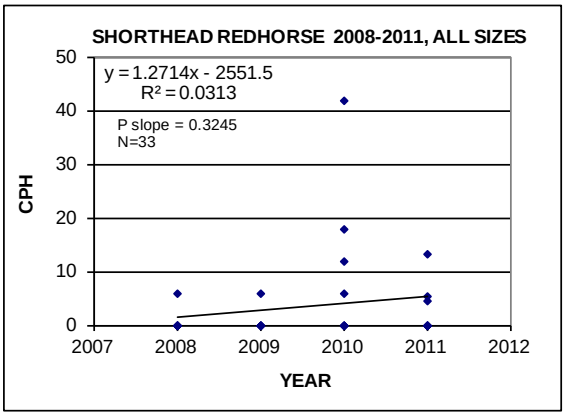
YEAR	MEAN	STD. DEV.	NUMBER OF RUNS	TOTAL HOURS	DIFFERENT (means with the same letter are not Sign. Different)
2010	383.9	481.3	9	1.503	A
2011	337.5	332.6	9	2.134	A
2009	193.3	226.8	7	1.169	A
2008	190. 9	148.3	8	1.336	A
ALL YEARS	284.0	328.0	33	6.142	

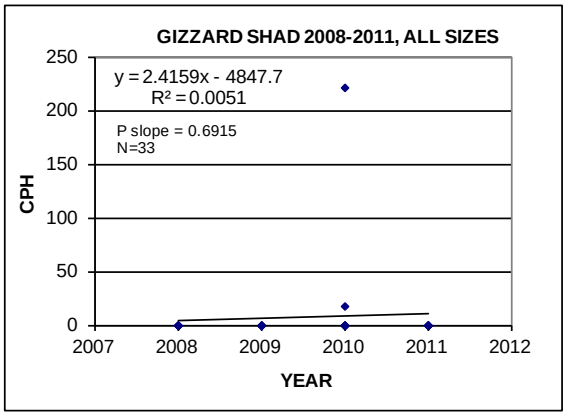
FIGURES 19-26. TRENDS IN CATCH PER HOUR PHASE III, STAGE 2 FIXED ELECTRO SHOCKING STATIONS, 2008-2011.

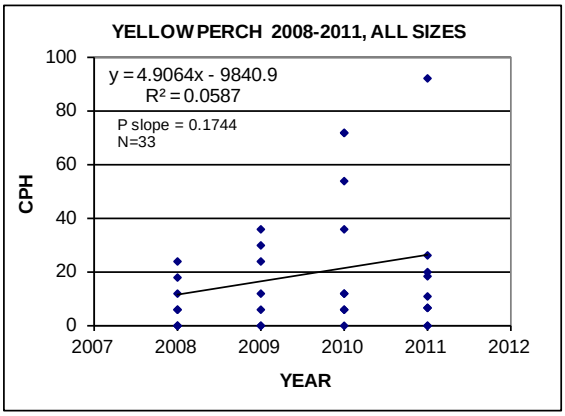


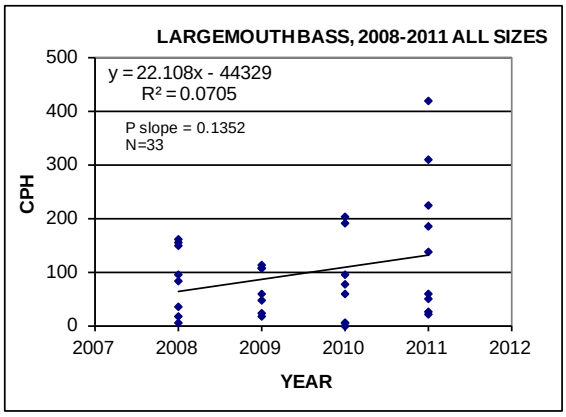












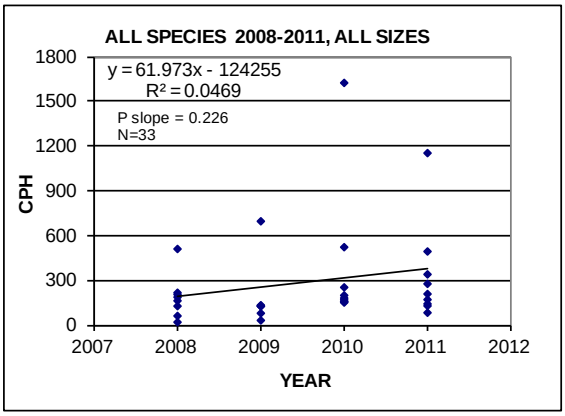


FIGURE 27. BLUEGILL LENGTH DISTRIBUTION, PHASE III, STAGE 2 AREA, POOL 8, RANDOM ELECTRO SHOCKING, 2011.

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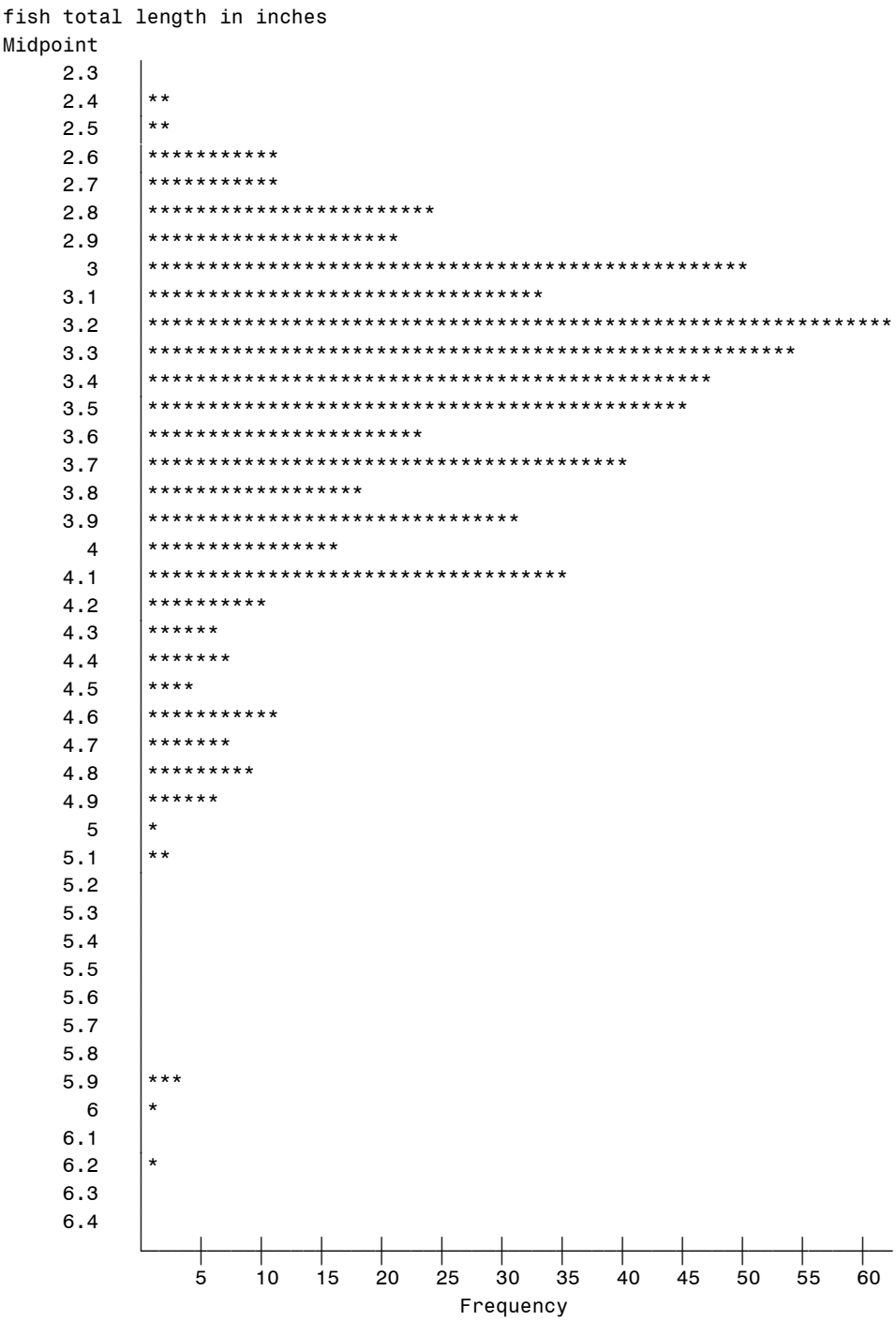
fish total length in inches                                                                  Cum.              Cum.
Midpoint                                                                              Freq  Freq  Percent  Percent
       1  |                                                                             0     0     0.00     0.00
     1.2  |*                                                                            1     1     0.43     0.43
     1.4  |*                                                                            1     2     0.43     0.87
     1.6  |********************                                                        20    22     8.70     9.57
     1.8  |*************************************************************              61    83    26.52    36.09
       2  |****************************************************                        52   135    22.61    58.70
     2.2  |***********************************************                            47   182    20.43    79.13
     2.4  |*******************                                                         19   201     8.26    87.39
     2.6  |****************                                                            16   217     6.96    94.35
     2.8  |****                                                                         4   221     1.74    96.09
       3  |**                                                                           2   223     0.87    96.96
     3.2  |                                                                             0   223     0.00    96.96
     3.4  |                                                                             0   223     0.00    96.96
     3.6  |                                                                             0   223     0.00    96.96
     3.8  |                                                                             0   223     0.00    96.96
       4  |                                                                             0   223     0.00    96.96
     4.2  |                                                                             0   223     0.00    96.96
     4.4  |                                                                             0   223     0.00    96.96
     4.6  |                                                                             0   223     0.00    96.96
     4.8  |                                                                             0   223     0.00    96.96
       5  |*                                                                            1   224     0.43    97.39
     5.2  |                                                                             0   224     0.00    97.39
     5.4  |*                                                                            1   225     0.43    97.83
     5.6  |***                                                                          3   228     1.30    99.13
     5.8  |                                                                             0   228     0.00    99.13
       6  |                                                                             0   228     0.00    99.13
     6.2  |                                                                             0   228     0.00    99.13
     6.4  |                                                                             0   228     0.00    99.13
     6.6  |                                                                             0   228     0.00    99.13
     6.8  |                                                                             0   228     0.00    99.13
       7  |                                                                             0   228     0.00    99.13
     7.2  |                                                                             0   228     0.00    99.13
     7.4  |                                                                             0   228     0.00    99.13
     7.6  |*                                                                            1   229     0.43    99.57
     7.8  |                                                                             0   229     0.00    99.57
       8  |                                                                             0   229     0.00    99.57
     8.2  |*                                                                            1   230     0.43   100.00
          |-----+----+----+----+----+----+----+----+----+----+----+----+
                5   10   15   20   25   30   35   40   45   50   55   60
                                   Frequency
```

N	Mean	Std Dev	Minimum	Maximum
230	2.1816348	0.7878286	1.2200000	8.1500000

FIGURE 28. LARGEMOUTH BASS LENGTH DISTRIBUTION, PHASE III, STAGE 2 AREA, POOL 8, RANDOM ELECTRO SHOCKING, 2011.



Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
2.3	0	0	0.00	0.00
2.4	2	2	0.34	0.34
2.5	2	4	0.34	0.67
2.6	11	15	1.85	2.53
2.7	11	26	1.85	4.38
2.8	24	50	4.05	8.43
2.9	21	71	3.54	11.97
3	50	121	8.43	20.40
3.1	33	154	5.56	25.97
3.2	62	216	10.46	36.42
3.3	54	270	9.11	45.53
3.4	47	317	7.93	53.46
3.5	45	362	7.59	61.05
3.6	23	385	3.88	64.92
3.7	40	425	6.75	71.67
3.8	18	443	3.04	74.70
3.9	31	474	5.23	79.93
4	16	490	2.70	82.63
4.1	35	525	5.90	88.53
4.2	10	535	1.69	90.22
4.3	6	541	1.01	91.23
4.4	7	548	1.18	92.41
4.5	4	552	0.67	93.09
4.6	11	563	1.85	94.94
4.7	7	570	1.18	96.12
4.8	9	579	1.52	97.64
4.9	6	585	1.01	98.65
5	1	586	0.17	98.82
5.1	2	588	0.34	99.16
5.2	0	588	0.00	99.16
5.3	0	588	0.00	99.16
5.4	0	588	0.00	99.16
5.5	0	588	0.00	99.16
5.6	0	588	0.00	99.16
5.7	0	588	0.00	99.16
5.8	0	588	0.00	99.16
5.9	3	591	0.51	99.66
6	1	592	0.17	99.83
6.1	0	592	0.00	99.83
6.2	1	593	0.17	100.00
6.3	0	593	0.00	100.00
6.4	0	593	0.00	100.00

N	Mean	Std Dev	Minimum	Maximum
593	3.5173524	0.5798329	2.4020000	6.1810000

FIGURE 29. SPOTTED SUCKER LENGTH DISTRIBUTION, PHASE III, STAGE 2 AREA, POOL 8, RANDOM ELECTRO SHOCKING, 2011.

fish total length in inches

Midpoint		Freq	Cum. Freq	Percent	Cum. Percent
3.1	**********	2	2	4.65	4.65
3.4	**********	7	9	16.28	20.93
3.7	**********	7	16	16.28	37.21
4	**********	11	27	25.58	62.79
4.3	**********	6	33	13.95	76.74
4.6	**********	4	37	9.30	86.05
4.9		0	37	0.00	86.05
5.2		0	37	0.00	86.05
5.5		0	37	0.00	86.05
5.8		0	37	0.00	86.05
6.1		0	37	0.00	86.05
6.4		0	37	0.00	86.05
6.7		0	37	0.00	86.05
7		0	37	0.00	86.05
7.3		0	37	0.00	86.05
7.6		0	37	0.00	86.05
7.9		0	37	0.00	86.05
8.2		0	37	0.00	86.05
8.5		0	37	0.00	86.05
8.8		0	37	0.00	86.05
9.4		0	37	0.00	86.05
9.7		0	37	0.00	86.05
10		0	37	0.00	86.05
10.3		0	37	0.00	86.05
10.6		0	37	0.00	86.05
10.9		0	37	0.00	86.05
11.2		0	37	0.00	86.05
11.5		0	37	0.00	86.05
11.8		0	37	0.00	86.05
12.1		0	37	0.00	86.05
12.4		0	37	0.00	86.05
12.7		0	37	0.00	86.05
13		0	37	0.00	86.05
13.3		0	37	0.00	86.05
13.6	*****	1	38	2.33	88.37
13.9		0	38	0.00	88.37
14.2		0	38	0.00	88.37
14.5		0	38	0.00	88.37
14.8		0	38	0.00	88.37
15.1		0	38	0.00	88.37
15.4	*****	1	39	2.33	90.70
15.7		0	39	0.00	90.70
16	*****	1	40	2.33	93.02
16.3	*****	1	41	2.33	95.35
16.6	*****	1	42	2.33	97.67
16.9		0	42	0.00	97.67
17.2		0	42	0.00	97.67
17.5	*****	1	43	2.33	100.00
17.8		0	43	0.00	100.00

1 2 3 4 5 6 7 8 9 10 11

Frequency

N	Mean	Std Dev	Minimum	Maximum
43	5.5823023	4.2530447	2.9920000	17.5200000

FIGURE 30. YELLOW PERCH LENGTH DISTRIBUTION, PHASE III, STAGE 2 AREA, POOL 8, RANDOM ELECTRO SHOCKING, 2011.

fish total length to 0.1 inches

Midpoint		Freq	Cum. Freq	Percent	Cum. Percent
3.4		0	0	0.00	0.00
3.6	**********	2	2	2.02	2.02
3.8	**********	14	16	14.14	16.16
4	**********	10	26	10.10	26.26
4.2	**********	9	35	9.09	35.35
4.4	**********	4	39	4.04	39.39
4.6	**********	4	43	4.04	43.43
4.8		0	43	0.00	43.43
5		0	43	0.00	43.43
5.2		0	43	0.00	43.43
5.4	**********	2	45	2.02	45.45
5.6		0	45	0.00	45.45
5.8	*****	1	46	1.01	46.46
6	*****	1	47	1.01	47.47
6.2	**********	8	55	8.08	55.56
6.4	**********	4	59	4.04	59.60
6.6	**********	7	66	7.07	66.67
6.8	**********	6	72	6.06	72.73
7	**********	7	79	7.07	79.80
7.2		0	79	0.00	79.80
7.4	**********	2	81	2.02	81.82
7.6	**********	3	84	3.03	84.85
7.8	*****	1	85	1.01	85.86
8	**********	2	87	2.02	87.88
8.2		0	87	0.00	87.88
8.4	*****	1	88	1.01	88.89
8.6		0	88	0.00	88.89
8.8	*****	1	89	1.01	89.90
9	**********	4	93	4.04	93.94
9.2		0	93	0.00	93.94
9.4		0	93	0.00	93.94
9.6	**********	3	96	3.03	96.97
9.8	*****	1	97	1.01	97.98
10	**********	2	99	2.02	100.00
10.2		0	99	0.00	100.00
10.4		0	99	0.00	100.00

1 2 3 4 5 6 7 8 9 10 11 12 13 14

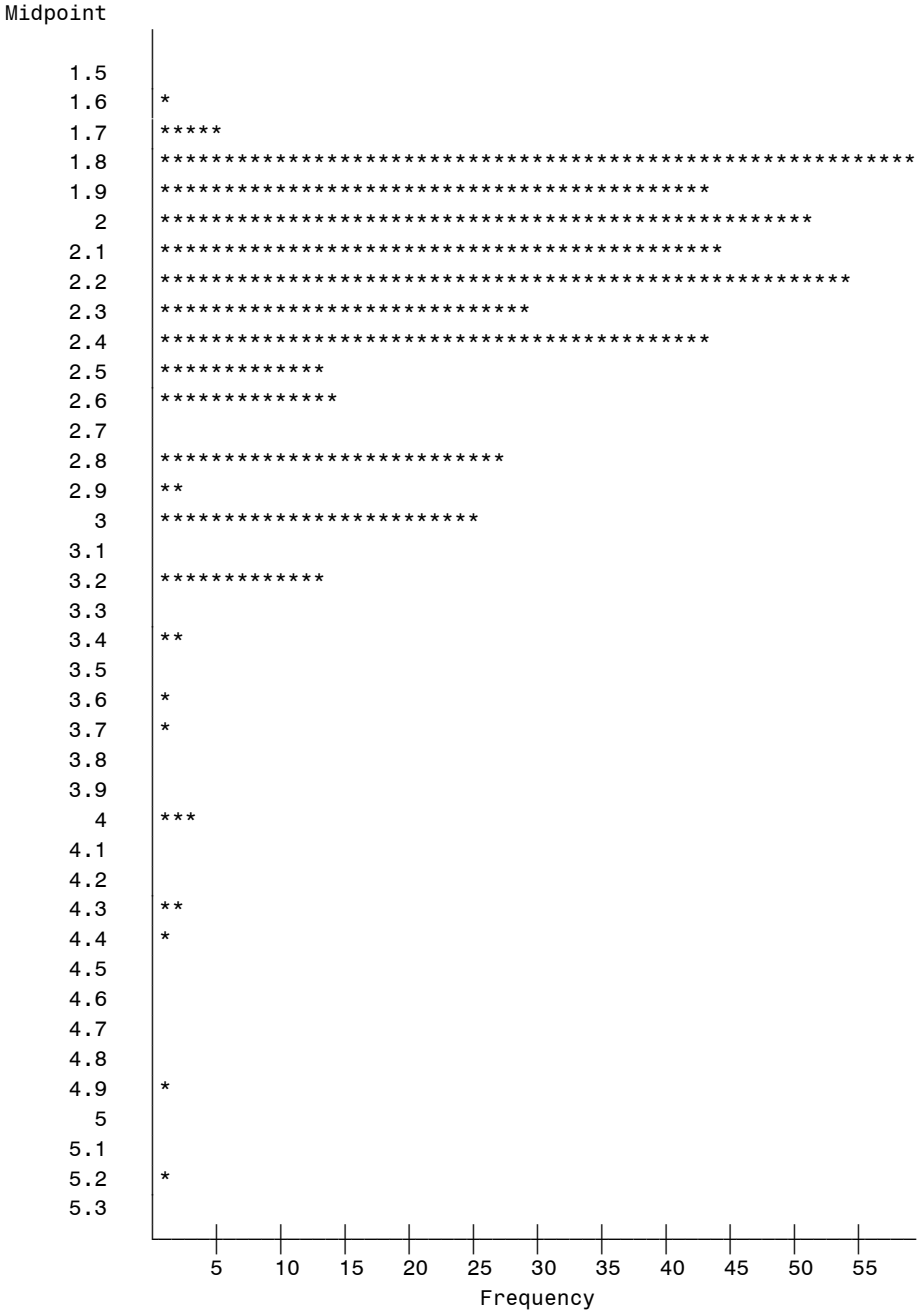
Frequency

N	Mean	Std Dev	Minimum	Maximum
99	5.8748889	1.8682474	3.5830000	10.0790000

TABLE 8. COMPARISON OF MEAN TOTAL LENGTH FOR SELECTED INDIVIDUAL SPECIES, AMONG YEARS, RANDOM SAMPLES, PHASE III, STAGE 2, ELECTRO SHOCKING, FALL 2007 - 2011.

SPECIES	MEAN	STD. DEV.	N	YEAR	DIFFERENT (means with the same letter are not Sign. Different)
BLACK CRAPPIE	4.30	1.68	7	2009	A
	3.43	0.98	8	2008	A
	3.34	0.79	75	2007	A
	3.23	0.16	13	2011	A
	3.10	0.14	2	2010	A
BLUEGILL	4.06	1.48	42	2009	A
	2.85	1.48	173	2008	B
	2.80	1.38	117	2010	B
	2.49	0.94	364	2007	BC
	2.18	0.79	230	2011	C
LARGEMOUTH BASS	4.46	2.6	142	2008	A
	4.35	1.69	156	2007	AB
	4.10	1.81	334	2009	AB
	3.99	1.57	187	2010	B
	3.52	0.58	593	2011	C
NORTHERN PIKE	20.55	7.60	6	2007	A
	16.86	6.37	13	2011	AB
	12.95	3.94	26	2010	BC
	11.49	4.36	38	2009	C
	9.54	3.88	35	2008	C
PUMPKINSEED	4.96	1.37	16	2011	A
	4.78	1.28	3	2008	A
	4.58	0.62	5	2009	A
	4.58	1.01	59	2010	A
	4.12	0.91	41	2007	A
ROCK BASS	5.26	1.4	28	2007	A
	4.88	0.78	2	2009	A
	4.54	1.15	3	2008	A
	4.4	1.88	17	2011	A
	4.14	1.04	99	2010	A
YELLOW PERCH	5.87	1.87	99	2011	A
	5.21	2.43	51	2007	AB
	5.05	2.11	40	2008	AB
	5.02	1.65	131	2010	B
	4.69	1.37	94	2009	B

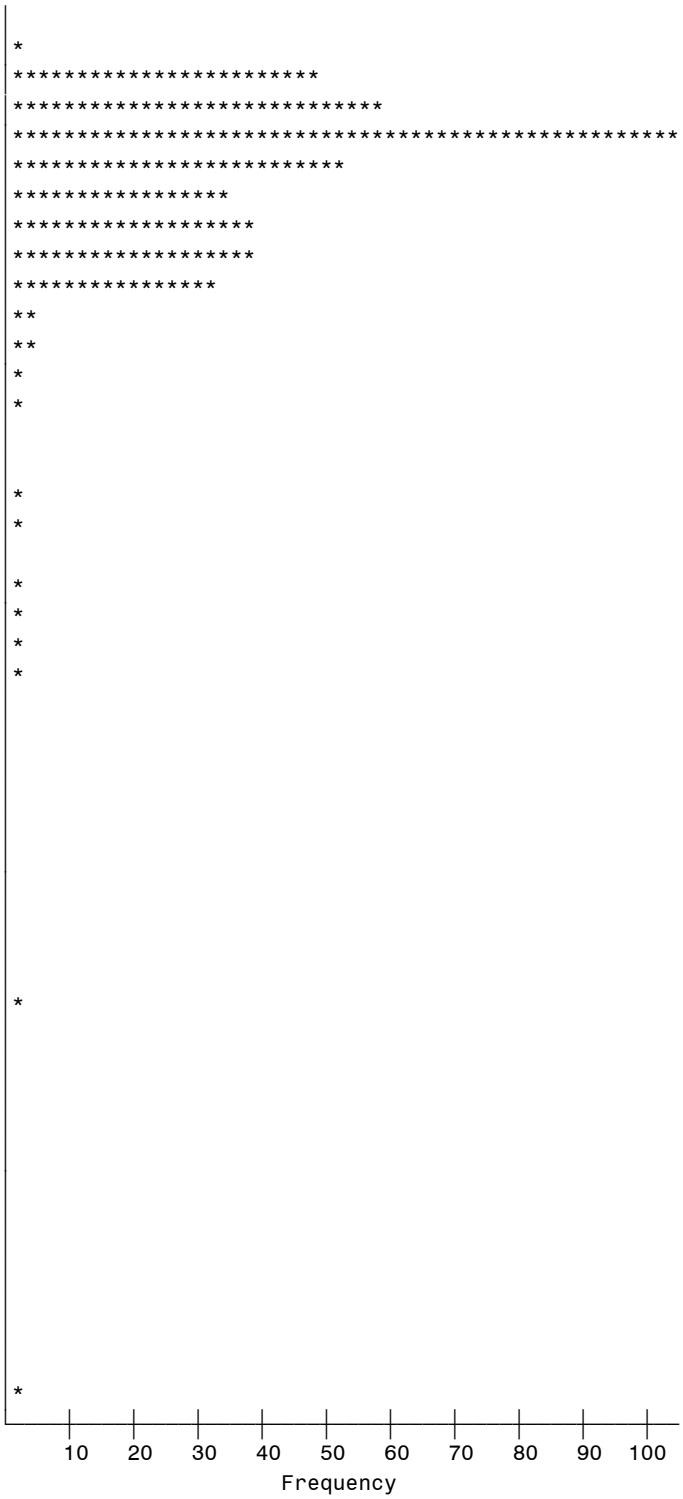
FIGURE 31. BLUEGILL LENGTH DISTRIBUTION, PHASE III, STAGE 2 AREA, POOL 8, SPATIALLY FIXED ELECTRO SHOCKING, 2011.



Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
1.5	0	0	0.00	0.00
1.6	1	1	0.23	0.23
1.7	5	6	1.15	1.38
1.8	59	65	13.56	14.94
1.9	43	108	9.89	24.83
2	51	159	11.72	36.55
2.1	44	203	10.11	46.67
2.2	54	257	12.41	59.08
2.3	29	286	6.67	65.75
2.4	43	329	9.89	75.63
2.5	13	342	2.99	78.62
2.6	14	356	3.22	81.84
2.7	0	356	0.00	81.84
2.8	27	383	6.21	88.05
2.9	2	385	0.46	88.51
3	25	410	5.75	94.25
3.1	0	410	0.00	94.25
3.2	13	423	2.99	97.24
3.3	0	423	0.00	97.24
3.4	2	425	0.46	97.70
3.5	0	425	0.00	97.70
3.6	1	426	0.23	97.93
3.7	1	427	0.23	98.16
3.8	0	427	0.00	98.16
3.9	0	427	0.00	98.16
4	3	430	0.69	98.85
4.1	0	430	0.00	98.85
4.2	0	430	0.00	98.85
4.3	2	432	0.46	99.31
4.4	1	433	0.23	99.54
4.5	0	433	0.00	99.54
4.6	0	433	0.00	99.54
4.7	0	433	0.00	99.54
4.8	0	433	0.00	99.54
4.9	1	434	0.23	99.77
5	0	434	0.00	99.77
5.1	0	434	0.00	99.77
5.2	1	435	0.23	100.00
5.3	0	435	0.00	100.00

N	Mean	Std Dev	Minimum	Maximum
435	2.2900782	0.4861294	1.6140000	5.1570000

FIGURE 32. LARGEMOUTH BASS LENGTH DISTRIBUTION, PHASE III, STAGE 2 AREA, POOL 8, SPATIALLY FIXED ELECTRO SHOCKING, 2011.



fish total length in inches

Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
2.5	1	1	0.24	0.24
2.8	48	49	11.46	11.69
3.1	57	106	13.60	25.30
3.4	104	210	24.82	50.12
3.7	52	262	12.41	62.53
4	33	295	7.88	70.41
4.3	37	332	8.83	79.24
4.6	37	369	8.83	88.07
4.9	31	400	7.40	95.47
5.2	3	403	0.72	96.18
5.5	3	406	0.72	96.90
5.8	1	407	0.24	97.14
6.1	2	409	0.48	97.61
6.4	0	409	0.00	97.61
6.7	0	409	0.00	97.61
7	2	411	0.48	98.09
7.3	1	412	0.24	98.33
7.6	0	412	0.00	98.33
7.9	1	413	0.24	98.57
8.2	1	414	0.24	98.81
8.5	2	416	0.48	99.28
8.8	1	417	0.24	99.52
9.1	0	417	0.00	99.52
9.4	0	417	0.00	99.52
9.7	0	417	0.00	99.52
10	0	417	0.00	99.52
10.3	0	417	0.00	99.52
10.6	0	417	0.00	99.52
10.9	0	417	0.00	99.52
11.2	0	417	0.00	99.52
11.5	0	417	0.00	99.52
11.8	0	417	0.00	99.52
12.1	1	418	0.24	99.76
12.4	0	418	0.00	99.76
12.7	0	418	0.00	99.76
13	0	418	0.00	99.76
13.3	0	418	0.00	99.76
13.6	0	418	0.00	99.76
13.9	0	418	0.00	99.76
14.2	0	418	0.00	99.76
14.5	0	418	0.00	99.76
14.8	0	418	0.00	99.76
15.1	0	418	0.00	99.76
15.4	0	418	0.00	99.76
15.7	0	418	0.00	99.76
16	1	419	0.24	100.00

N	Mean	Std Dev	Minimum	Maximum
419	3.8502530	1.1425938	2.5590000	15.9450000

FIGURE 33. YELLOW PERCH LENGTH DISTRIBUTION, PHASE III, STAGE 2 AREA, POOL 8, SPATIALLY FIXED ELECTRO SHOCKING, 2011.

fish total length in inches

Midpoint		Freq	Cum. Freq	Percent	Cum. Percent
2.6		0	0	0.00	0.00
2.8	**********	1	1	2.22	2.22
3		0	1	0.00	2.22
3.2		0	1	0.00	2.22
3.4		0	1	0.00	2.22
3.6	**********	1	2	2.22	4.44
3.8	**********	3	5	6.67	11.11
4	**********	1	6	2.22	13.33
4.2		0	6	0.00	13.33
4.4	**********	1	7	2.22	15.56
4.6		0	7	0.00	15.56
4.8		0	7	0.00	15.56
5		0	7	0.00	15.56
5.2	**********	1	8	2.22	17.78
5.4	**********	1	9	2.22	20.00
5.6	**********	2	11	4.44	24.44
5.8	**********	1	12	2.22	26.67
6	**********	1	13	2.22	28.89
6.2	**********	3	16	6.67	35.56
6.4	**********	4	20	8.89	44.44
6.6	**********	4	24	8.89	53.33
6.8	**********	1	25	2.22	55.56
7	**********	4	29	8.89	64.44
7.2	**********	1	30	2.22	66.67
7.4	**********	2	32	4.44	71.11
7.6		0	32	0.00	71.11
7.8	**********	2	34	4.44	75.56
8	**********	2	36	4.44	80.00
8.2	**********	1	37	2.22	82.22
8.4	**********	1	38	2.22	84.44
8.6	**********	3	41	6.67	91.11
8.8		0	41	0.00	91.11
9	**********	1	42	2.22	93.33
9.2	**********	1	43	2.22	95.56
9.4		0	43	0.00	95.56
9.6		0	43	0.00	95.56
9.8	**********	1	44	2.22	97.78
10		0	44	0.00	97.78
10.2		0	44	0.00	97.78
10.4		0	44	0.00	97.78
10.6		0	44	0.00	97.78
10.8	**********	1	45	2.22	100.00
11		0	45	0.00	100.00

1 2 3 4

Frequency

N	Mean	Std Dev	Minimum	Maximum
45	6.6527333	1.7395111	2.7950000	10.7090000

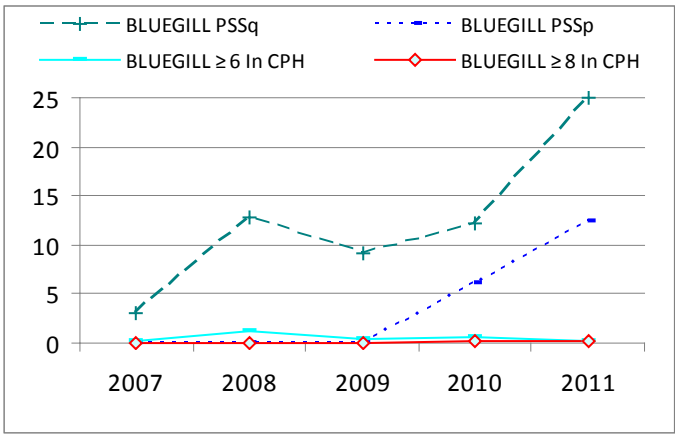
TABLE 9. COMPARISON OF MEAN TOTAL LENGTH FOR SELECTED INDIVIDUAL SPECIES, AMONG YEARS, SPATIALLY FIXED SAMPLES, PHASE III, STAGE 2, ELECTRO SHOCKING, FALL 2007 - 2010.

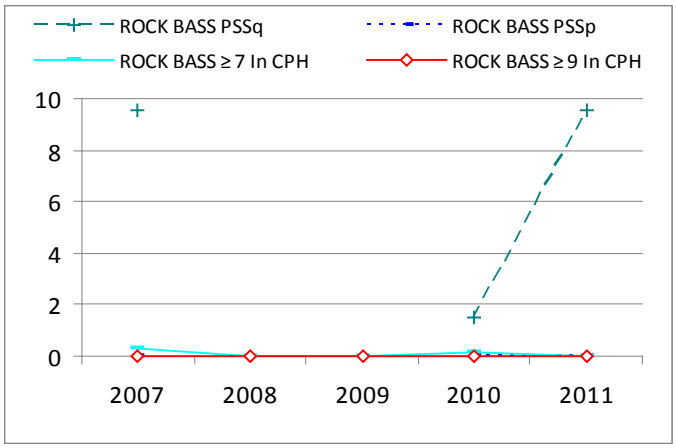
SPECIES	MEAN	STD. DEV.	N	YEAR	DIFFERENT (means with the same letter are not Sign. Different)
BLACK CRAPPIE	5.77	1.26	7	2009	A
	4.17	1.52	8	2008	B
	3.21	0.45	13	2011	B
	3.06	0.30	10	2010	B
	3.03	0.43	3	2007	B
BLUEGILL	4.11	1.65	73	2008	A
	3.63	1.22	64	2007	B
	3.33	0.63	86	2009	B
	2.61	0.83	241	2010	C
	2.29	0.49	435	2011	D
LARGEMOUTH BASS	4.78	1.08	71	2007	A
	4.33	1.06	80	2009	B
	4.12	0.88	118	2008	BC
	3.85	1.14	419	2011	C
	3.80	0.68	107	2010	C
NORTHERN PIKE	21.59	2.33	3	2007	A
	20.98	4.25	7	2011	A
	14.43	4.09	12	2010	B
	9.8	3.14	17	2009	BC
	8.5	4.65	19	2008	C
PUMPKINSEED	4.93	1.13	13	2011	A
	4.76	0.11	2	2007	A
	4.05	1.34	33	2010	A
	3.82	0.11	4	2008	A
	4.93	1.13	13	2011	A
YELLOW PERCH	6.65	1.74	45	2011	A
	5.48	1.68	18	2009	AB
	5.17	2.04	45	2010	AB
	5.05	1.17	5	2007	AB
	4.55	0.8	11	2008	B

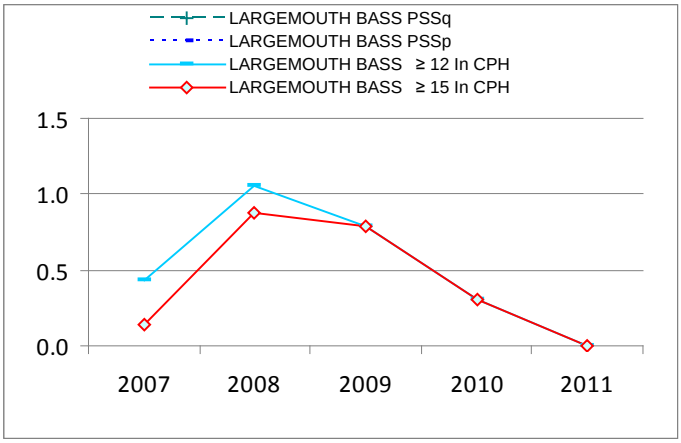
TABLE 10. LIST OF STOCK SIZE, QUALITY SIZE (PSS_Q) AND PREFERRED SIZE (PSS_P) IN INCHES FOR SELECTED FISH SPECIES.

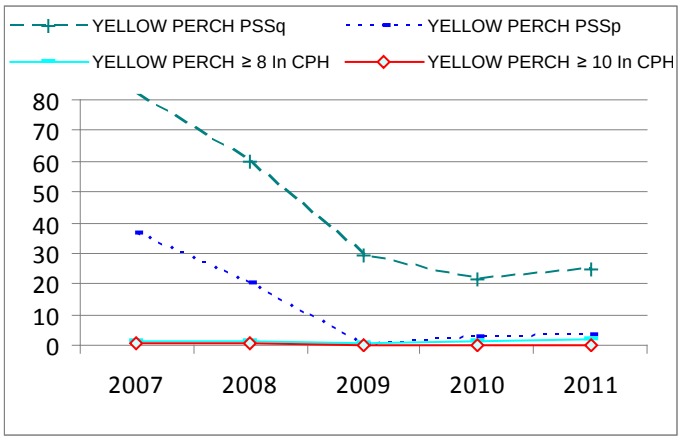
FISH SPECIES	PSS SOURCE	STOCK	QUALITY	PREFERRED
black crappie	Gabelhouse (1984)	5.0	8.0	10.0
bluegill	Gabelhouse (1984)	3.0	6.0	8.0
largemouth bass	Gabelhouse (1984)	8.0	12.0	15.0
northern pike	Gabelhouse (1984)	14.0	21.0	28.0
pumpkinseed	Gabelhouse (1984)	3.0	6.0	8.0
sauger	Gabelhouse (1984)	8.0	12.0	15.0
smallmouth bass	Gabelhouse (1984)	7.0	11.0	14.0
walleye	Gabelhouse (1984)	10.0	15.0	20.0
warmouth	Gabelhouse (1984)	3.0	6.0	8.0
white crappie	Gabelhouse (1984)	5.0	8.0	10.0
yellow perch	Gabelhouse (1984)	5.0	8.0	10.0

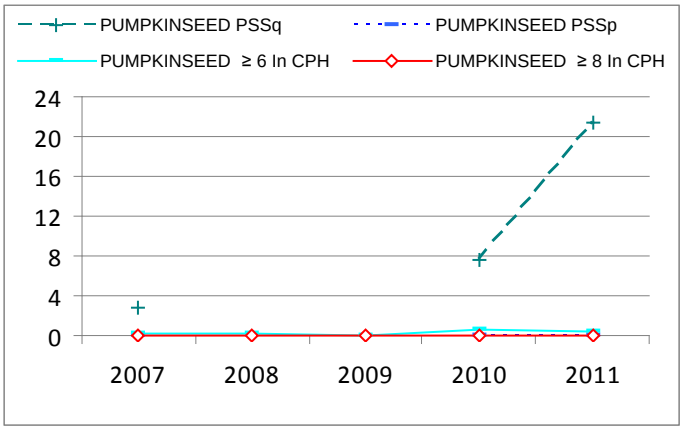
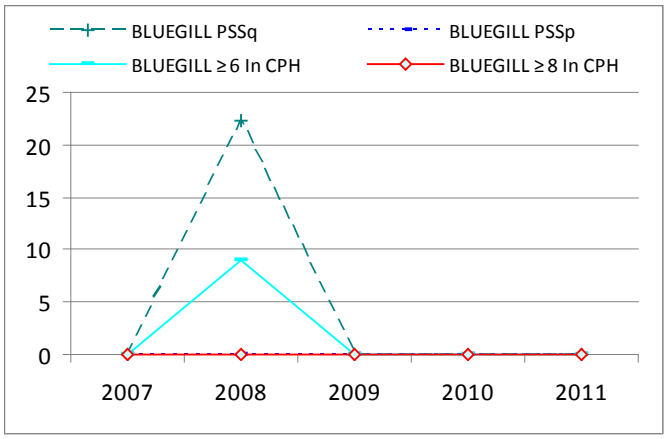
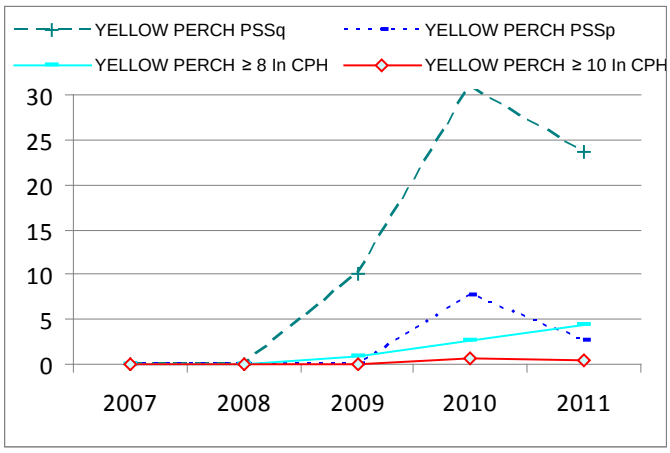
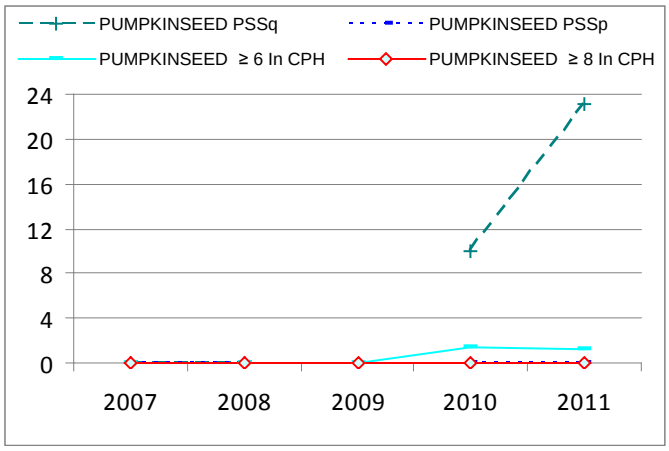
FIGURES 34-38. COMPARISON OF MEAN CATCH PER HOUR AND PSS (FOR STOCK > 20) FOR SELECTED SPECIES OF SELECTED SIZES IN PHASE III, STAGE 2, RANDOM ELECTRO SHOCKING, FALL 2007-2011.











FIGURES 39-41. COMPARISON OF MEAN CATCH PER HOUR AND PSS (FOR STOCK > 20) FOR SELECTED SPECIES OF SELECTED SIZES IN PHASE III, STAGE 2, FIXED ELECTRO SHOCKING, FALL 2007-2011.