STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-81-R-4

Study No.: 695 **Title:** Northern Lake Huron, coolwater fish community assessment.

Period Covered: October 1, 2002 to September 30, 2003

Study Objective: To collect relative abundance, growth rate, and other biological data with which to assess responses of the Les Cheneaux Islands region and the St. Marys River coolwater fish communities to exploitation, management initiatives, and changing environmental and biological conditions.

Summary: Analysis of the St. Marys River survey work (conducted in 2002) continues. Abundance indices for important species such as walleye, yellow perch, and smallmouth bass (see Table 1 for a complete listing of common and scientific name of all species mentioned in this report) remained stable compared to past surveys. Mean catch per unit of effort (CPUE) in the survey nets for lake herring and northern pike, however, indicated some decline. Comparison of the gillnet CPUE with past surveys which used a different mesh complement indicates that the decline in lake herring was not an artifact of mesh change. Total annual mortality rate rose for yellow perch but remained stable for all other notable species. Growth rate generally improved, especially for walleye, or remained similar to 1995 (the last year surveyed). Maturity of females of notable species was examined by length in an effort to assist with the evaluation of length limits in the river which are under review. Generally, length limits currently employed in the river by the various management agencies protect differing proportions of sexually mature females.

In the Les Cheneaux Islands, survey work was completed on schedule. Yellow perch abundance as indicated by gillnet mean CPUE was lower than 2001 but still within the range of past years. The yellow perch catch was nonexistent in Hessel Bay and low in Government Bay. Only Muskellunge Bay had an abundance of yellow perch. Species that exhibited an increase in 2002 included brown bullheads and white suckers. Total annual mortality rate of perch was 67% in 2002 and growth rate of yellow perch has increased substantially, consistent with the hypothesis that the overall population is depressed, as evidenced by declines in the sport fishery. Electrofishing was continued in 2002 to further develop an index of yellow perch recruitment (based on age-0 fish). As in 2001, the largest catch came from Moscoe Channel. Additional years of data will be necessary to bring perspective to this index. Comparison netting in August (for comparing to the traditional October timing) was performed and there was no overall significant difference in mean yellow perch CPUE, however, additional analysis for other species and an additional year of comparison netting will be necessary before a recommendation about future survey timing can be made.

Findings: Jobs 1 through 4 were scheduled for 2002-03, and progress is reported below.

Job 1. Title: Fish Community Survey of the St. Marys River.–As reported in 2002 gillnetting was performed in August of that year (Figure 1). Lab work, data entry, and analysis have been performed this past year. Analysis is continuing and a full research report on the St. Marys River survey findings is planned for 2004. Interpretation of the analysis and authorship of the report

will be shared by the members of the St. Marys River Fisheries Task Group. The following information presents some of the analysis to date.

The St. Marys River survey collected a total of 3,318 specimens from a total of 44 net sets. Catch per unit of effort, of three important species; yellow perch, walleye, and smallmouth bass were similar to the last survey of the river in 1995 (Table 2). Two other notable species, lake herring and northern pike, exhibited declines. August can be a difficult time to sample lake herring because of their coolwater distribution but the survey in past years has always indicated a sizeable population (Table 2). The sport harvest of lake herring has increased in recent years (Fielder et al. 2002).

The gillnet specifications used in the 2002 survey differed from past survey years in that additional meshes were added. Therefore the CPUEs summarized in Table 2 were standardized to only include the catch from those mesh sizes in common with past years to allow comparison. It remains possible that some of the available catch was spread over more mesh sizes whereby lowering the CPUE value of the traditional meshes. To explore this question, the CPUE of each species for the expanded mesh net (full complement of mesh sizes fished) was compared to just the CPUE of the traditional mesh sizes, yet both standardized to a total net length of 304.8 m (Table 3). From this it appears that the CPUE of lake herring was even lower when all mesh sizes were included than that indicated by the traditional mesh sizes alone. The same was true for northern pike, the other species that exhibited a decline in CPUE from past years. The CPUE from the expanded mesh catch was also slightly lower for walleye and smallmouth bass. The yellow perch catch was essentially the same. From this, it is concluded that the inclusion of the additional mesh sizes did not account for the observed declines in CPUE of the traditional mesh among years. On the whole, the expanded mesh nets are expected to yield a better representation of the overall size and age structure of the various fish populations and offer more validity in the analysis of various biological parameters.

The St. Marys River encompasses a large variety of habitats. Some indication of where changes in abundance have occurred can be derived by examining trends in CPUE by reach of river. Northern pike declined in CPUE from past years in all areas except Lake George and Potagannissing Bay (Table 4). Lake herring were absent from the catch in all areas except the upper river and Potagannissing Bay. Walleyes appeared to increase in Lake George and Raber Bay, but declined in Lake Nicolet and Potagannissing Bay. Smallmouth bass declined in all reaches except Lake George. Yellow perch remained largely unchanged except for indications of possible decline in the lower two reaches of the river (Table 4). The final research report will include the analysis of the statistical significance of these trends.

Trends in total annual mortality as determined by the Robson-Chapman method (Van Den Avyle and Hayward 1999) varied by species. Mortality was much greater in 2002 compared to the 1995 survey for yellow perch in all reaches of the river except Potagannissing Bay (Table 5). Mortality was lower for other notable species or largely unchanged from 1995. Lake herring mortality was somewhat greater in 2002 but low overall for that species. Lake herring total annual mortality appears to not support the idea that declines in CPUE are driven by harvest or predation.

Growth rate, as indicted by mean length at age, was generally near the state average (Schneider et al 2000) or slightly better for walleyes, yellow perch, and lake herring (Table 6). It was slightly less than the state average for northern pike and smallmouth bass. Growth rate increased substantially for walleye in 2002 compared to the 1995 means reported by Fielder and Waybrant (1998). Small increases were also noted for yellow perch and smallmouth bass. The overall growth rate was unchanged for northern pike and lake herring.

Maturity of females by length unit is an important parameter to evaluate the appropriateness of length limit harvest regulations. An effort is under way to review length limits in sport fisheries in the St. Marys River and to align regulations across jurisdictions (Ontario and Michigan). About 64% of female yellow perch were sexually mature at the 18 cm minimum length limit imposed by Michigan (Table 7). Female smallmouth bass are achieving 100% maturity by 25 cm, well in advance of the 36 cm Michigan minimum length limit. Maturity of female northern pike did not follow a consistent threshold (Table 7) and may have been a result of low sample size. The 61 cm Michigan minimum length limit appears to be within the range of maturity for pike. Ontario presently maintains no length limits in the St. Marys River except on walleye in the Lake George vicinity where a 46 cm maximum length limit is in place. Michigan maintains a 38 cm minimum length limit on the same species. It appears that female walleye in the St. Marys River consistently achieve 100% maturity around 51 cm. Length limits are not always intended to fully protect mature fish, however, these data may help in evaluating how best to align future harvest regulations.

Job 2. Title: <u>Fish community survey of the Les Cheneaux Islands region of Lake Huron.</u>–In 2002, gillnet surveys collected a total of 2,024 specimens; 1,217 during the August survey and another 807 during the October survey. Survey differences will be discussed more directly in Job 3 of this performance report. Unless otherwise noted, this discussion pertains to the traditional October survey findings. Catch per unit effort of yellow perch declined from 2001 but is still not as low as measured in some previous years (Table 8). An ongoing challenge is to account for the disparity between trends in the yellow perch recreational fishery which collapsed in 2000 and the survey CPUE which has not fully mirrored that trend. Lake herring CPUE remained largely unchanged although lake herring distribution can be patchy as the fall spawning season approaches making gillnet based assessment difficult. Smallmouth bass abundance similarly remained largely unchanged. Rock bass abundance did not change appreciably but it remained the third most common species. Northern pike CPUE increased, while white sucker and brown bullhead increased substantially (Table 8).

Closer inspection of the yellow perch survey catch indicated that much of the CPUE is supported by yellow perch catch from Muskellunge Bay (Figure 2). By contrast, yellow perch catch in Hessel Bay has become nearly nonexistent. Hessel Bay is more exposed to the influence of the main lake (Figure 3). Another difference is that Hessel Bay is in closer proximity to the two largest double-crested cormorant rookeries in the area (Goose Island and St. Martins Shoal). Double-crested cormorant habitation of the Les Cheneaux Islands region has greatly increased since the late 1980s and their predation on yellow perch has been postulated as one of the reasons the perch fishery has collapsed. Part of the explanation for the collapse of the perch fishery may include the near absence of perch from Hessel Bay which traditionally supported much of the fishing activity. Clearly, however, the entire Les Cheneaux Islands area is not without perch fishing opportunity as evidenced by Muskellunge Bay. Future analysis will include an examination of the trends in abundance of perch that are at or above the 178 mm minimum length limit that the sport fishery is subject to.

Age structure of the yellow perch population also gives insight as to what forces may be shaping the perch population and fishery. Another possible explanation for a decline in the perch fishery (aside from cormorant predation) is a decline in recruitment. To date, the gillnet CPUE of age-2 perch has been the best means with which to depict recruitment (Figure 4). There has been no obvious downward trend in age-2 yellow perch CPUE. In addition, the relative abundance of age-2 perch may have been diminished in this survey catch by predation from cormorants during ages 0 through 1, thus their true abundance aside from this mortality source may have been even greater. Mean age of the perch population has also steadily declined since 1997 (Table 9), the opposite trend of what would be expected in a population if there were a recruitment problem

occurring. From this, it appears that trends in recruitment are not a primary force accounting for the collapse in the fishery.

Most disconcerting in the age structure of the yellow perch population has been the fate of the record year class produced in 1998 (2000 age-2 catch). That year class was quickly depleted by age-4 in the 2002 survey (Table 9). Since the fishery remains depressed, this suggests that other forces are contributing to the mortality rate. This phenomenon is consistent with the cormorant predation explanation. Based on the age structure of the perch catch (Robson-Chapman method; Van Den Avyle and Hayward 1999), total annual mortality was estimated and compared to past survey values for indication of trends (Figure 5). Total annual mortality rate was unchanged from 2001 at the relatively high rate of 67%.

Growth rate of yellow perch in the Les Cheneaux Islands in 2002 has become fast as indicated by mean length at age (Table 10). The growth exhibited by yellow perch was greater for all measured age groups than the average for the state of Michigan. Growth rate has trended much faster since 2000 (Figure 6) compared to previous years. This inclination might be expected if in fact density of yellow perch is reduced.

Diet of yellow perch in 2002 was again dominated by crayfish (Table 11). Female yellow perch are achieving 100% maturity at about 200 mm in total length and males at 190 mm (Table 12). The minimum sport length limit of 178 mm leaves about 31% of females vulnerable to harvest before having an opportunity to spawn at least once.

Electrofishing to index yellow perch recruitment again took place in August of 2002 and 2003 (Table 13). It was previously determined that electrofishing was the optimal means with which to collect age-0 yellow perch in the Les Cheneaux Islands (versus the other gears evaluated in 2001). Only electrofishing is being employed in the remaining years of the study. Analysis of 2003 data will be reported in 2004. The unit of effort at each station was 30 minutes or 1,800 seconds of generator time (Table 13). Catch per unit effort in 2001 was standardized to 30 minute units for comparison to 2002 values. As in 2001, Moscoe Channel produced the greatest CPUE of age-0 yellow perch in 2002 (Table 14). The 2002 and 2001 CPUE values were similar suggesting that there was some recruitment those years. With only two years of index data, however, the relative strength of these values is not known. Also, it is not clear how significant it is that no age-0 yellow perch were collected in the other locations in 2002. Some locations also exhibited a low age-0 CPUE value in 2001 but there were fewer locations with no catch than in 2001 (Table 14). Additional years of electrofishing for age-0 yellow perch will be necessary to fully assess the meaning of this current data.

Job 3. Title: <u>Comparison netting of the Les Cheneaux Islands region and calculation of correction factors.</u>–Gillnetting was performed in August 2002 for comparing with the catch in gillnets during the traditional survey in October. Sampling was also performed in August 2003 but will be reported on in 2004. The intent is to determine if the survey could be conducted in August instead of October. To accomplish this, the August survey would have to (1) produce CPUE values of either no difference to the October survey or be correctable to maintain comparability to past October survey data (which dates back to 1969), (2) key species would have to be vulnerable to the survey gear in August, and (3) be acceptable to the public.

Statistical comparison of the survey catch between months has been limited to yellow perch to date. Analysis will be expanded to other species for the final report. There was no significant difference for mean yellow perch CPUE between months for either 2001 or 2002 as determined by Independent Samples T-tests performed at the significance level of $P<0.05$ (Table 15). Similarly, when examined within location, most CPUE differences were not significant except for

Government Bay in 2002 where the fall (October) mean CPUE was significantly greater than the summer (August) mean CPUE. On the whole, variance and confidence intervals were large for these samples and the sample size (especially within locations) was low. This, combined with inherent variability of catch with gillnets may have masked differences between sampling seasons. Closer inspection of the CPUE means indicates that fall CPUE was greater in both years for Government Bay. Muskellunge Bay yielded greater mean CPUE in the summer in both years (Table 15). The overall (locations combined) annual mean CPUE for yellow perch were similar for 2002. One more year (October 2003) of comparison netting is scheduled. A recommendation will be made in the final report as when to conduct the survey in the future.

Job 4. Title: **Write final reports.**–This annual Study Performance Report was prepared as scheduled.

Literature Cited:

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Van Den Avyle, M. V., and R. S. Hayward. 1999. Dynamics of exploited fish populations. Pages 127-166 *in* C. C. Kohler and W. A. Hubert, editors. Inland fisheries management in North America, 2nd edition. American Fisheries Society, Bethesda, Maryland.

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Date: September 30, 2003

Table 1.–Common and scientific names of fishes and other aquatic organisms mentioned in this report.

Common name	Scientific name
Alewife	*Alosa pseudoharengus*
Atlantic salmon	*Salmo salar*
Black crappie	*Pomoxis nigromaculatus*
Bloater	*Coregonus hoyi*
Bowfin	*Amia calva*
Brook trout	*Salvelinus fontinalis*
Brown bullhead	*Ictalurus nebulosus*
Brown trout	*Salmo trutta*
Burbot	*Lota lota*
Common carp	*Cyprinus carpio*
Channel catfish	*Ictalurus punctatus*
Chinook salmon	*Oncorhynchus tshawytscha*
Coho salmon	*Oncorhynchus kisutch*
Freshwater drum	*Aplodinotus grunniens*
Gizzard shad	*Dorosoma cepedianum*
Johnny darter	*Etheostoma nigrum*
Lake herring	*Coregonus artedii*
Lake trout	*Salvelinus namaycusn*
Lake whitefish	*Coregonus clupeaformis*
Lake Sturgeon	*Acipenser fulvescens*
Longnose dace	*Rhinichthys cataractae*
Longnose gar	*Lepisosteus osseus*
Longnose sucker	*Catostomus catostomus*
Menominee	*Prosopium cylindraceum*
Muskellunge	*Esox masquinongy*
Northern hogsucker	*Hypentelium nigricans*
Northern pike	*Esox lucius*
Pink salmon	*Oncorhynchus gorbuscha*
Rainbow smelt	*Osmerus mordax*
Pinook	*O. tshawytscha* x *O. gorbuscha*
Rainbow trout	*Oncorhyhus mykiss*
Redhorse spp.	*Moxostoma spp.*
Rock bass	*Ambloplites rupestris*
Sculpin	*Cottus bairdi*
Sea lamprey	*Petromyzon marinus*
Smallmouth bass	*Micropterus dolomievi*
Splake	*S. fontinalis* x *S. namaycusn*
Spottail shiner	*Notropis hudsonius*
Stickleback spp.	*Pungitius* or *Gasteropsteus spp.*
Sunfish spp.	*Lepomis spp.*
Trout-perch	*Percopsis omiscomaycus*
Walleye	*Sander vitreus* formerly *Stizostedion vitreum*
White bass	*Morone chrysops*
White perch	*Morone americana*
White sucker	*Catostomus commersoni*
Yellow perch	*Perca flavescens*

Table 2.–Mean Catch-Per-Unit-of-Effort (CPUE) of all species collected from the St. Marys River 1975 through 2002. Means are based on 304.8 m (1,000 ft) of gillnet with standard error in parentheses. Total nets set were 32 each in 1975 and 1979, 27 [b] in 1987, 51 in 1995, and 44 in 2002.

Species [a]	1975		1979		1987 [b]		1995 [c]		2002	
Alewife	1.64	(0.57)	0.23	(0.12)	0.19	(0.11)	15.11	(12.22)	3.92	(3.52)
Atlantic salmon	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.09	(0.07)	0.00	(0.00)
Black crappie	0.03	(0.03)	0.00	(0.00)	0.25	(0.22)	0.00	(0.00)	0.00	(0.00)
Bloater	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.06	(0.06)
Bowfin	0.03	(0.03)	0.03	(0.03)	0.40	(0.40)	0.00	(0.00)	0.00	(0.00)
Brook trout	0.03	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Brown bullhead	6.41	(3.16)	0.76	(0.50)	6.67	(3.51)	2.56	(1.36)	4.43	(2.28)
Brown trout	0.03	(0.03)	0.00	(0.00)	0.03	(0.03)	0.09	(0.07)	0.00	(0.00)
Burbot	0.05	(0.04)	0.00	(0.00)	0.00	(0.00)	0.05	(0.05)	0.57	(0.57)
Common carp	0.16	(0.08)	0.00	(0.00)	0.03	(0.03)	0.00	(0.00)	0.00	(0.00)
Channel catfish	0.00	(0.00)	0.00	(0.00)	0.09	(0.05)	0.00	(0.00)	0.06	(0.06)
Chinook salmon	0.00	(0.00)	0.03	(0.03)	0.46	(0.29)	0.08	(0.05)	0.28	(0.12)
Coho salmon	0.03	(0.03)	0.00	(0.00)	0.00	(0.00)	0.05	(0.05)	0.00	(0.00)
Freshwater drum	0.00	(0.00)	0.00	(0.00)	0.03	(0.03)	0.00	(0.00)	0.40	(0.18)
Gizzard shad	0.00	(0.00)	0.00	(0.00)	0.12	(0.12)	0.05	(0.05)	0.11	(0.11)
Lake herring	14.12	(5.13)	22.40	(11.28)	18.98	(8.34)	9.80	(3.40)	4.32	(2.52)
Lake sturgeon	0.99	(0.96)	0.03	(0.03)	0.09	(0.05)	0.00	(0.00)	0.00	(0.00)
Lake trout	0.00	(0.00)	0.31	(0.31)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Lake whitefish	1.15	(0.41)	0.55	(0.25)	2.10	(0.99)	0.73	(0.37)	0.85	(0.41)
Longnose gar	0.00	(0.00)	0.03	(0.03)	0.06	(0.04)	0.00	(0.00)	0.06	(0.06)
Longnose sucker	0.94	(0.51)	1.07	(0.49)	4.26	(2.46)	2.85	(1.33)	2.10	(1.01)
Menominee	0.83	(0.44)	0.52	(0.30)	0.00	(0.00)	1.49	(0.55)	0.85	(0.34)

Table 2.–Continued.

Species[a]	1975		1979		1987[b]		1995[c]		2002	
Muskellunge	0.00	(0.00)	0.68	(0.43)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Northern hogsucker	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.05	(0.05)	0.00	(0.00)
Northern pike	9.04	(1.77)	8.07	(1.31)	12.69	(2.11)	9.26	(1.64)	2.61	(0.61)
Pink salmon	0.00	(0.00)	0.00	(0.00)	2.78	(1.38)	0.55	(0.20)	0.28	(0.14)
Rainbow smelt	4.97	(2.45)	1.64	(0.69)	1.02	(0.47)	0.86	(0.50)	0.40	(0.21)
Rainbow trout	0.03	(0.03)	0.13	(0.07)	0.22	(0.22)	0.00	(0.00)	0.06	(0.06)
Redhorse spp.	0.65	(0.29)	0.55	(0.20)	0.62	(0.17)	1.69	(0.53)	0.40	(0.29)
Rock bass	6.20	(2.25)	2.29	(0.67)	11.67	(2.42)	5.57	(1.35)	11.42	(2.77)
Sculpin	0.05	(0.04)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Sea lamprey	0.00	(0.00)	0.03	(0.03)	0.00	(0.00)	0.12	(0.09)	0.00	(0.00)
Smallmouth bass	0.89	(0.45)	0.26	(0.14)	4.66	(2.23)	3.77	(0.95)	2.27	(0.59)
Splake	0.34	(0.19)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Sunfish spp.	0.13	(0.08)	0.13	(0.11)	1.54	(0.89)	0.65	(0.47)	0.97	(0.56)
Trout-perch	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.06	(0.06)
Walleye	4.27	(1.56)	4.14	(1.73)	7.47	(1.92)	3.92	(0.83)	3.58	(1.04)
White bass	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.85	(0.41)
White sucker	21.48	(3.94)	13.85	(2.20)	25.68	(5.46)	20.00	(2.47)	24.7	(3.93)
White perch	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.34	(0.17)
Yellow perch	23.02	(6.28)	25.68	(4.93)	49.48	(7.16)	29.97	(5.85)	25.3	(4.50)

[a] See Table 1 for a complete list of common and scientific names of fishes mentioned in this report.
[b] Mean CPUEs for 1987 are calculated from a restored data set that lacked five net sets compared to those summarized in Grimm 1987.
[c] Mean CPUEs for 1995 included the addition of nets from the St. Joseph Channel area of the St. Marys River. Mean CPUEs for 1995 also included the influence of 3.81 cm (1.5 inch) mesh net on some sets performed in the Raber and Potagannissing area of the river. This effort was incorporated in to the calculation of CPUE but may still have slightly inflated mean CPUE for certain species such as yellow perch and alewife.

Table 3.–Mean Catch-Per-Unit-of-Effort (CPUE) of all species collected from the St. Marys River in 2002 with all mesh sizes included (Expanded mesh) and from the traditional mesh. Means are based on 304.8 m (1000 ft) of gillnet with standard error in parentheses. There were 44 total nets set.

Species[a]	Expanded mesh		Traditional mesh	
Alewife	10.61	(7.84)	3.92	(3.52)
Atlantic salmon	0.00	(0.00)	0.00	(0.00)
Black crappie	0.00	(0.00)	0.00	(0.00)
Bloater	0.02	(0.02)	0.06	(0.06)
Bowfin	0.00	(0.00)	0.00	(0.00)
Brook trout	0.00	(0.00)	0.00	(0.00)
Brown bullhead	2.59	(1.21)	4.43	(2.28)
Brown trout	0.02	(0.02)	0.00	(0.00)
Burbot	0.09	(0.04)	0.57	(0.57)
Common carp	0.05	(0.03)	0.00	(0.00)
Channel catfish	0.02	(0.02)	0.06	(0.06)
Chinook salmon	0.64	(0.21)	0.28	(0.12)
Coho salmon	0.00	(0.00)	0.00	(0.00)
Freshwater drum	0.43	(0.18)	0.40	(0.18)
Gizzard shad	0.09	(0.09)	0.11	(0.11)
Lake herring	2.84	(1.35)	4.32	(2.52)
Lake sturgeon	0.02	(0.02)	0.00	(0.00)
Lake trout	0.00	(0.00)	0.00	(0.00)
Lake whitefish	0.77	(0.35)	0.85	(0.41)
Longnose gar	0.02	(0.02)	0.06	(0.06)
Longnose sucker	1.20	(0.56)	2.10	(1.01)
Menominee	0.36	(0.15)	0.85	(0.34)
Muskellunge	0.00	(0.00)	0.00	(0.00)
Northern hogsucker	0.00	(0.00)	0.00	(0.00)
Northern pike	1.55	(0.33)	2.61	(0.61)
Pink salmon	0.39	(0.22)	0.28	(0.14)
Rainbow smelt	0.25	(0.11)	0.40	(0.21)
Rainbow trout	0.00	(0.00)	0.06	(0.06)
Redhorse spp.	0.53	(0.27)	0.40	(0.29)
Rock bass	5.95	(1.45)	11.42	(2.77)
Sculpin	0.00	(0.00)	0.00	(0.00)
Sea lamprey	0.00	(0.00)	0.00	(0.00)
Smallmouth bass	1.48	(0.30)	2.27	(0.59)
Splake	0.00	(0.00)	0.00	(0.00)
Sunfish spp.	0.41	(0.23)	0.97	(0.56)
Trout-perch	0.05	(0.03)	0.06	(0.06)
Walleye	2.55	(0.65)	3.58	(1.04)
White bass	0.02	(0.02)	0.85	(0.41)
White crappie	0.02	(0.02)	0.00	(0.00)
White sucker	18.80	(2.09)	24.77	(3.93)
White perch	0.16	(0.09)	0.34	(0.17)
Yellow perch	23.43	(4.25)	25.34	(4.50)

Table 4.–Mean catch-per-unit-of-effort in 304.8 m (1000 ft.) collected from St. Marys River 1975 through 2002. Standard error of the mean is in parentheses.

Species	Year	Upper River		Lake Nicolet		Lake George		Lake Munuscong		St. Joseph Channel		Raber Bay		Potagannissing Bay	
Yellow perch	2002	26.5	(11.1)	20.7	(7.8)	42.5	(20.5)	17.0	(4.6)	54.5	(18.3)	17.9	(7.3)	11.8	(6.0)
	1995	39.0	(17.2)	21.6	(10.2)	42.3	(22.6)	20.3	(2.5)	–	–	27.0	(6.8) [a]	29.6	(11.5)
	1987	33.9	(15.9)	30.4	(27.1)	65.0	(19.0)	30.0	(4.9)	–	–	41.4	(4.8)	62.5	(16.3)
	1979	43.1	(9.0)	18.9	(9.5)	26.2	(11.0)	9.2	(2.1)	–	–	9.8	(5.0)	37.3	(11.7)
	1975	25.3	(16.6)	13.9	(10.0)	31.8	(10.0)	11.2	(6.0)	–	–	6.0	(3.6)	33.5	(16.4)
Northern pike	2002	1.0	(1.0)	2.1	(1.8)	5.8	(1.4)	3.5	(2.2)	5.0	(3.3)	2.1	(1.0)	0.5	(0.3)
	1995	2.5	(1.6)	8.1	(3.4)	16.3	(4.5)	18.4	(5.5)	–	–	12.8	(3.4)	1.6	(1.2)
	1987	6.9	(5.0)	2.9	(2.1)	27.0	(5.2)	15.6	(3.0)	–	–	11.7	(3.2)	8.0	(3.0)
	1979	1.9	(0.3)	4.7	(3.5)	14.3	(3.3)	11.8	(4.6)	–	–	6.0	(2.6)	6.5	(1.4)
	1975	4.4	(4.0)	11.7	(7.1)	17.3	(7.8)	9.3	(2.6)	–	–	5.0	(3.0)	7.1	(2.4)
Walleye	2002	2.5	(2.5)	1.1	(0.5)	8.8	(3.6)	1.0	(1.0)	3.0	(1.5)	7.9	(5.6)	1.8	(1.2)
	1995	2.5	(0.8)	5.6	(3.1)	2.0	(6.9)	2.8	(0.9)	–	–	3.6	(1.1)	5.4	(2.1)
	1987	1.1	(0.7)	0.8	(0.0)	8.0	(3.5)	3.1	(1.4)	–	–	21.9	(8.0)	6.3	(2.4)
	1979	0.0	(0.0)	1.1	(0.7)	4.0	(2.8)	2.9	(1.0)	–	–	5.6	(2.8)	6.3	(4.8)
	1975	0.0	(0.0)	4.7	(2.0)	5.0	(4.0)	2.9	(1.8)	–	–	2.1	(1.4)	6.5	(4.1)
Smallmouth bass	2002	0.0	(0.0)	1.1	(0.7)	4.2	(2.9)	4.5	(1.4)	4.5	(1.8)	2.5	(2.0)	0.8	(0.4)
	1995	0.0	(0.0)	3.1	(3.1)	3.5	(2.0)	8.1	(2.8)	–	–	5.9	(4.5)	2.5	(1.0)
	1987	0.6	(0.3)	2.1	(1.2)	15.5	(10.6)	7.9	(5.3)	–	–	2.3	(0.4)	0.2	(0.1)
	1979	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.3	(0.3)	–	–	0.0	(0.0)	0.6	(0.4)
	1975	0.0	(0.0)	0.0	(0.0)	0.3	(0.2)	1.8	(1.2)	–	–	0.0	(0.0)	1.4	(1.1)
Lake herring	2002	0.0	(0.0)	2.5	(2.1)	1.2	(0.6)	0.0	(0.0)	0.5	(0.5)	0.4	(0.4)	16.0	(10.5)
	1995	0.0	(0.0)	13.4	(5.9)	3.5	(3.2)	0.0	(0.0)	–	–	11.7	(9.3)	19.2	(9.8)
	1987	0.0	(0.0)	0.8	(0.8)	3.3	(2.9)	0.8	(0.6)	–	–	1.2	(1.0)	54.0	(21.1)
	1979	0.0	(0.0)	3.1	(3.1)	0.0	(0.0)	0.0	(0.0)	–	–	62.7	(62.4)	39.8	(23.8)
	1975	0.0	(0.0)	9.2	(8.3)	0.0	(0.0)	0.1	(0.1)	–	–	42.5	(17.8)	23.0	(11.7)

[a] Means from these areas included some efforts of 3.51 c, (1.5 in.) mesh. While compensated for in the calculation of CPUE, the influence of the smaller mesh may have slightly inflated the mean for certain species such as yellow perch.

Table 5.–Total annual mortality rates for select fish species in the St. Marys River, computed from fish collected in gillnets in 2002, with 1995 results for comparison.

Species	Area, if not total for the river	1995 total annual mortality	2002 total annual mortality
Yellow perch	Upper River	0.25	0.54
	Lake Nicolet	0.38	0.70
	Lake George	0.40	0.52
	St. Joseph Channel	Not sampled	0.64
	Lake Munuscong	0.41	0.61
	Raber Bay	0.44	0.63
	Potagannissing Bay	0.60	0.57
	River Total	0.38	0.68
Northern pike		0.58	0.52
Walleye		0.51	0.49
Lake herring		0.31	0.39
Smallmouth bass		0.36	0.37

Table 6.–Mean length (in mm) at age for five notable species from the St. Marys River, August, 2002 with state averages for comparison (from Schneider et al. 2000). Mean lengths limited to age groups with a minimum of five specimens.

	Walleye		Yellow perch		Northern pike		Smallmouth bass		Lake herring	
Age	St. Marys	State average	St. Marys	State average	St. Marys	State average	St. Marys	State average	St. Marys	State average
1	353	250	151	127	371	422	146	178	199	214
2	312	338	153	160	455	511		257	240	241
3	393	386	177	183	564	579	222	305	306	267
4	472	437	220	208	620	635	291	356	338	294
5	530	472	258	234		683	325	386	374	321
6		516	274	257		732	376	406	383	347
7		541	320	277		780		434		374
8		561		292				452		400
9		582		302				475		

Table 7.–Percent mature females of five notable species by length in the St. Marys River collected by gillnets in August 2002.

Length (cm)	Species				
	Walleye	Smallmouth bass	Northern pike	Yellow perch	Lake herring
13				33.3	
14		0		39.5	
15				53.8	
16				41.4	
17				54.5	
18				63.9	0
19		0		66.0	0
20				61.5	0
21				88.6	0
22		50		83.3	0
23		0		92.9	
24		0		80.0	
25		100		89.5	
26				94.1	
27		100		88.9	0
28		100		100	100
29		100		100	66.7
30		100	0	100	100
31		100		100	
32	100	100		100	85.7
33		100		66.7	100
34				100	100
35				100	100
36	0			100	100
37		100		100	100
38	0	100	100		100
39			50		100

Table 7.–Continued.

Length (cm)	Species				
	Walleye	Smallmouth bass	Northern pike	Yellow perch	Lake herring
40		100			100
41			0		50
42			0		50
43			0		
44					
45			100		
46		100			
47	50				
48	100		0		
49	66.7		0		
50	85.7				
51	100		100		
52					
53	100		0		
54	100		0		
55					
56	100		100		
57					
58			0		
59			100		
60	100		0		
61			100		
62					
63					
64					
65			100		
66			100		

Table 8.–Catch per unit of effort and total effort from traditional netting locations in the Les Cheneaux Islands, 1990 through 2002. All data are from October unless otherwise noted.

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Aug 2001	2001	Aug 2002	2002
Total effort (in ft. of net)	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
Net lifts	3	3	3	3	6	3	3	1	3	6	6	6	6	6	6
Alewife	0.0	0.2	0.2	0.7	1.3	0.0	1.7	0.0	1.2	0.2	1.2	0.83	0.5	14.5	12.0
Black bullhead	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Black crappie	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Bowfin	0.7	1.3	0.3	0.3	0.7	0.0	2.3	0.3	0.0	0.0	0.2	0.3	0.2	0.0	0.2
Brown bullhead	9.2	8.3	3.7	3.0	1.0	7.2	32.8	2.5	3.2	10.7	6.3	13.7	6.8	103.5	24.5
Brown trout	0.3	0.3	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Burbot	0.2	0.3	0.3	0.5	0.0	0.0	0.3	0.0	1.0	0.0	0.3	0.3	0.0	0.3	0.0
Common carp	0.2	0.7	2.0	0.5	1.2	0.0	1.3	0.2	1.0	0.3	0.0	0.0	0.2	0.2	0.2
Channel catfish	0.5	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chinook salmon	0.2	0.0	0.2	0.2	0.0	0.0	0.7	0.2	0.2	0.2	0.3	0.2	0.0	0.5	0.7
Coho salmon	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Freshwater drum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Gizzard shad	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.3
Lake herring	13.7	7.8	1.0	5.2	3.2	1.3	1.7	0.2	0.3	9.0	0.2	8.3	1.3	4.3	2.8
Lake trout	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Lake whitefish	0.3	1.0	0.0	0.0	0.0	0.0	0.3	0.8	1.0	2.8	1.0	0.0	0.0	0.0	0.0
Largemouth bass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.0	0.0

Table 8.–Continued.

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Aug 2001	2001	Aug 2002	2002
Longnose dace	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Longnose gar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Longnose sucker	0.0	0.2	0.0	0.0	0.2	0.0	0.3	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0
Menominee	0.0	0.2	0.2	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	0.8	0.5	1.2
Muskellunge	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northern pike	15.8	13.7	13.7	13.8	11.0	9.2	15.5	10.0	15.3	16.7	8.2	0.8	4.7	1.8	8.5
Pinook	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rainbow smelt	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.0
Rainbow trout	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Redhorse spp.	0.0	0.0	0.0	0.0	0.5	2.2	0.7	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rock bass	7.8	2.7	10.2	2.0	10.3	12.8	15.7	10.5	8.2	44.3	11.0	14.3	11.7	15.5	21.5
Sea lamprey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smallmouth bass	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.3	0.7	0.7	2.2	0.7	1.0	1.0
Splake	0.0	0.0	0.0	0.7	0.0	2.5	1.2	2.3	2.0	0.7	0.2	0.0	0.0	0.0	0.3
Spottail shiner	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Sunfish spp.	0.0	0.2	0.5	0.0	0.0	0.0	0.3	0.2	0.0	0.2	3.0	0.3	2.8	0.0	0.0
Walleye	1.0	0.3	0.2	0.2	0.3	0.2	1.0	0.7	1.7	0.5	0.7	0.0	0.2	0.2	0.0
White perch	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.3
White sucker	22.2	22.2	14.5	9.2	26.8	6.2	9.8	5.2	2.3	13.5	8.3	10.2	8.7	3.5	32.5
Yellow perch	23.7	18.0	17.8	15.7	26.3	41.8	20.2	15.3	36.2	21.2	73.5	52.5	45.8	28.2	28.5

Table 9.–Yellow perch catch per unit effort (CPUE) by age from the Les Cheneaux Islands 1998-2002 based on October gillnet catch.

Age	1997	1998	1999	2000	2001	2002
0	–	–	–	–	0.33	0.17
1	–	0.67	1.50	1.5	20.50	17.00
2	1.50	7.67	28.00	28.00	3.83	4.83
3	1.83	13.50	29.67	29.67	11.67	5.50
4	5.67	5.33	8.83	2.17	6.67	0.67
5	2.50	2.67	3.67	0.17	2.17	0.17
6	2.50	2.17	0.83	–	0.17	–
7	1.33	1.33	0.17	–	–	–
8	0.17	1.33	0.17	–	–	–
9	0.17	0.5	0.17	–	–	–
10	–	0.33	–	–	–	–
11	–	0.17	–	–	–	–
Number aged	94	213	126	438	272	170
Total CPUE	15.67	35.5	21.00	73.00	45.33	28.30
Mean age	4.52	3.75	2.88	2.87	2.24	1.65

Table 10.–Mean length-at-age (in mm) for yellow perch from Les Cheneaux Islands, 2002 with the state average (Schneider et al. 2000) for comparison.

Age	Mean Length	Number	State average
0	–	–	–
1	172	226	133
2	217	65	165
3	249	38	191
4	289	6	216
5	–	–	240
6	–	–	262
7	–	–	282
8	–	–	295
9	–	–	307

Table 11.–Incidence of void stomachs and percent-abundance of food items found in stomachs of yellow perch in Les Cheneaux Islands region, 2002.

Parameter	% Abundance
Void	67
Nonvoid	33
Food item	
Amphipods	–
Crayfish	92.7
Dipterians	0.4
Alewives	0.4
Sculpins	–
Sticklebacks	4.5
Others	2.0
Total	100.0

Table 12.–Percentage of yellow perch that were scored as sexually mature in the Les Cheneaux Islands region, 2002 by length increment.

	Males		Females	
Length (cm)	Total No.	% Mature	Total No.	% Mature
13	1	0	1	0
14	3	67	1	0
15	8	50	6	0
16	21	29	13	0
17	38	45	10	40
18	41	89	16	69
19	9	100	18	89
20	6	100	20	100
21	5	100	8	100
22	5	100	13	93
23	3	100	8	100
24	2	100	12	100
25	2	100	12	100
26	–		11	100
27	–		3	100
28	–		3	100
29	–		2	100
30	–		2	100
31	1	100	2	100

Table 13.–Sample location and effort (in seconds of generator time) yellow perch electrofishing recruitment index in the Les Cheneaux Islands, August, 2001 - 2003.

Location	Effort		
	2001	2002	2003
Hessel Bay	1,018	1,800	1,800
Muskellunge Bay	1,800	1,800	1,800
Government Bay	1,800	1,800	1,800
Cedarville Bay	1,800	1,800	1,800
Moscoe Channel	1,000	1,800	1,800
Mackinac Bay	–	1,800	–

Table 14.–Catch per unit of effort of yellow perch by age from electrofishing in the Les Cheneaux Islands 2001 and 2002. One unit of effort equals 30 minutes of generator time.

Location	Year and age							
	2001				2002			
	Age-0	Age-1	Age-2	Age-3	Age-0	Age-1	Age-2	Age-3
Hessel	0.24	0.18	0.35	0.18	0.00	0.07	0.00	0.00
Muskellunge	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Government	0.50	0.37	0.13	0.00	0.00	0.00	0.00	0.00
Cedarville	0.50	0.57	0.20	0.03	0.00	0.10	0.00	0.00
Moscoe	2.47	0.47	0.13	0.00	2.63	0.33	0.00	0.00
Mackinac	–	–	–	–	0.00	0.03	0.00	0.00
Total	0.74	0.32	0.16	0.04	0.44	0.09	0.00	0.00

Table 15.–Comparison of mean catch per unit effort of yellow perch in gillnets in the Les Cheneaux Islands for 2001 and 2002. Comparisons are within year between fall (F) sets made in October and summer (S) sets made in August, comparisons by specific sampling location and locations combined. Tests were Independent-samples T-test. Significance was determined at $P<0.05$.

Location	Difference	P	Means
2001:			
Muskellunge Bay	Not significant	0.22	F=115.5, S=154.5
Hessel Bay	Not significant	0.62	F=1.0, S=3.0
Government Bay	Not significant	0.28	F=21.0, S=0.0
Locations combined	Not significant	0.87	F=45.8, S=52.5
2002:			
Muskellunge Bay	Not significant	0.76	F=68.0, S=84.5
Hessel Bay	Not significant	0.50	F=1.5, S=0.0
Government Bay	Significant	0.04	F=16.0, S=0.0
Locations combined	Not significant	0.99	F=28.5, S=28.2

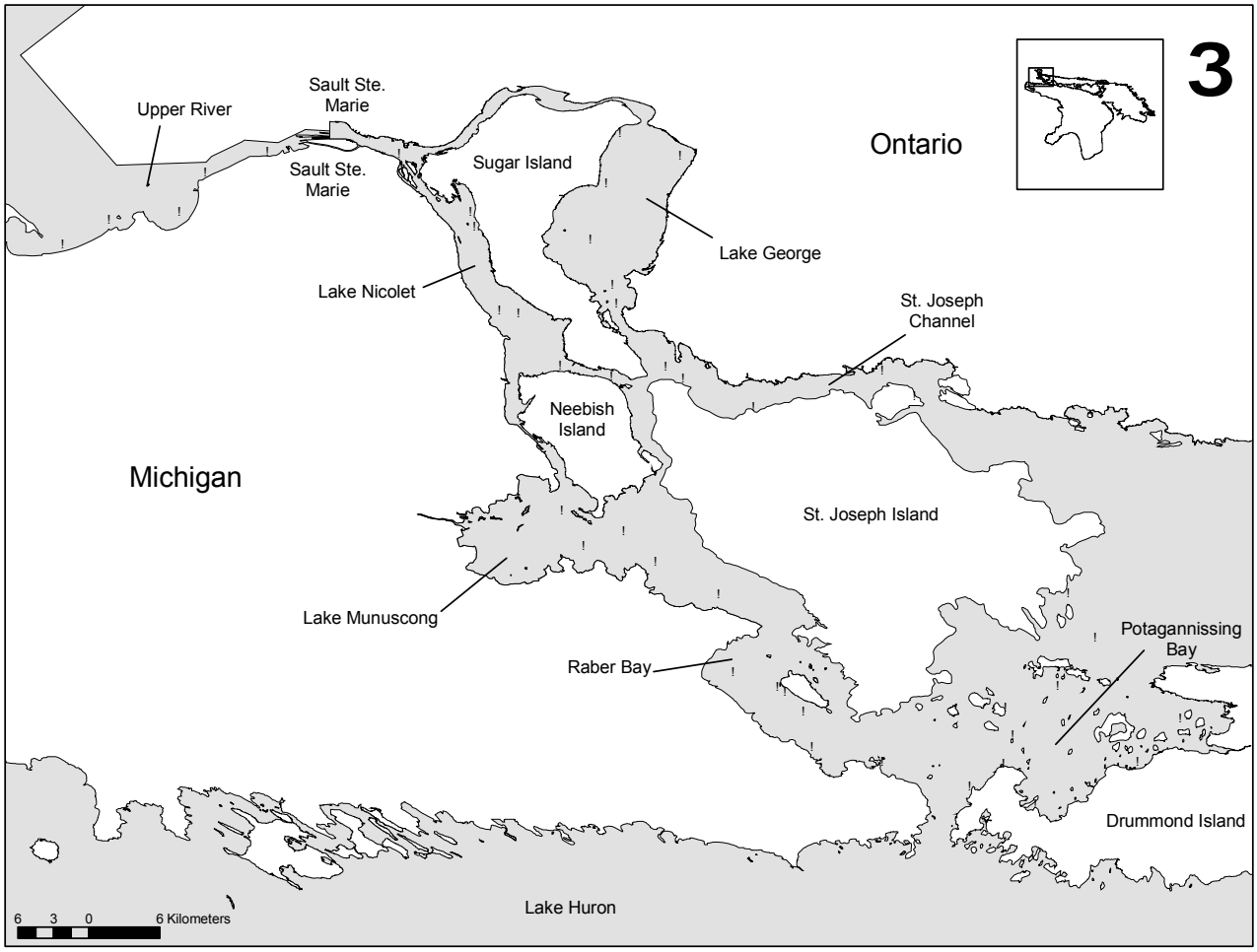

Figure 1.–Gillnet set locations in the St. Marys River, August 2002.

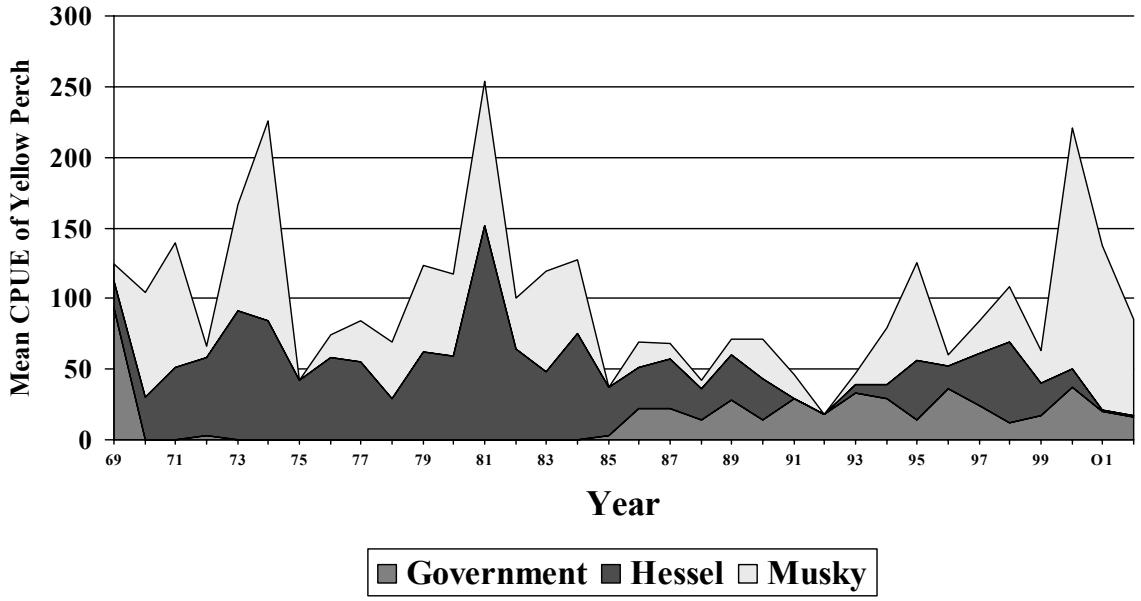

Figure 2.–Mean catch per unit of effort (CPUE) in gillnets of yellow perch in the Les Cheneaux Islands by sampling station 1969 – 2002.

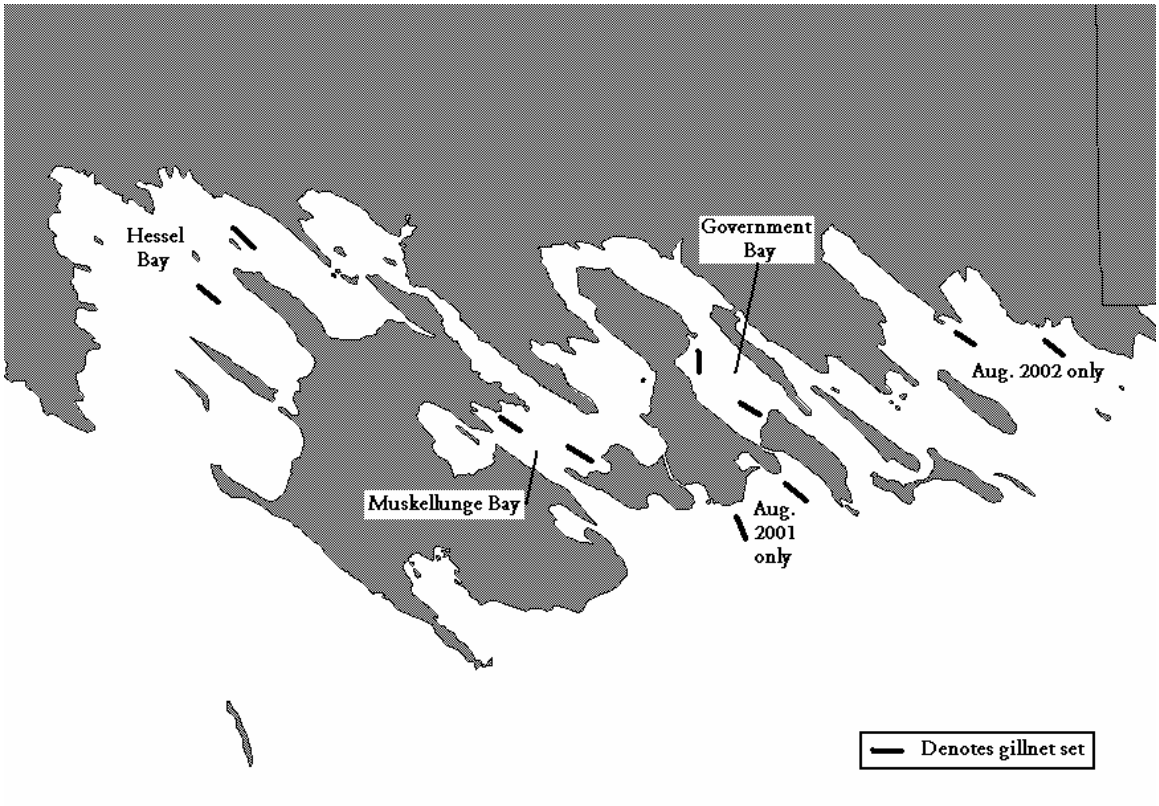

Figure 3.–Gillnet locations in the Les Cheneaux Islands region, set in 2001 and 2002.

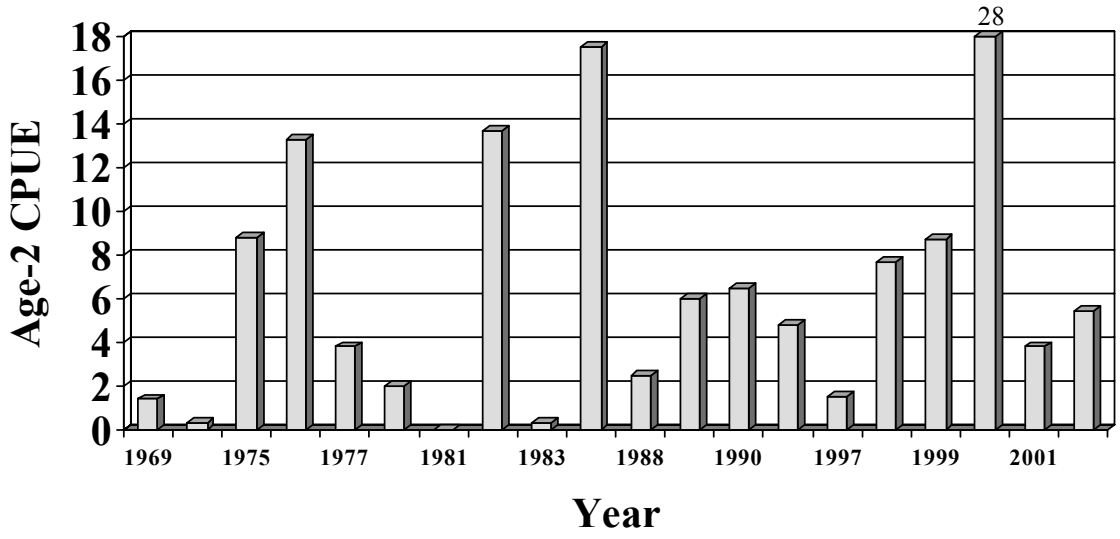

Figure 4.–Catch per unit effort (CPUE) of age-2 yellow perch in gillnets as an indicator of recruitment in the Les Cheneaux Islands 1969 through 2002.

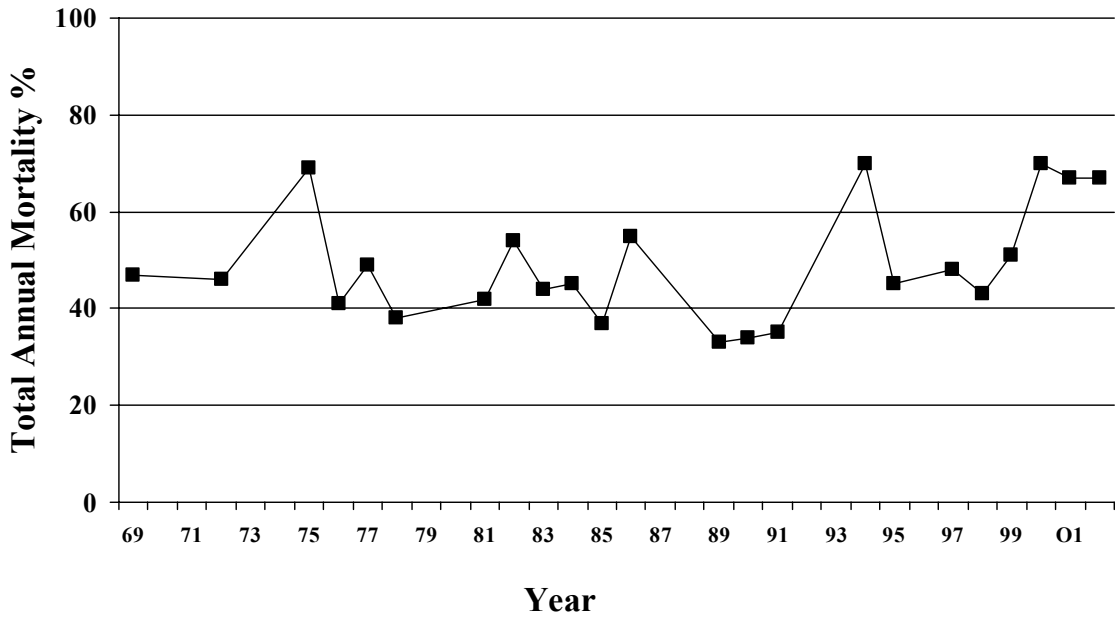

Figure 5.–Total annual mortality of yellow perch in the Les Cheneaux Islands from 1969 through 2002 gillnet catches. Calculated with Robson-Chapman Method.

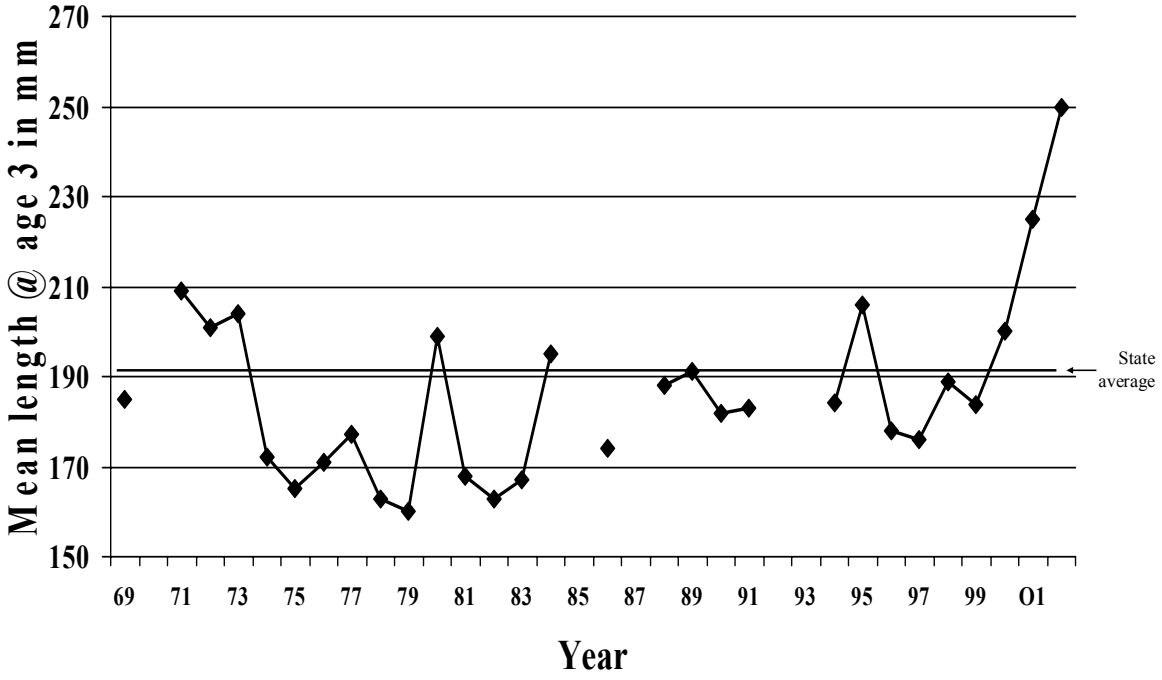

Figure 6.–Mean length at age-3 for yellow perch (sexes combined) for 1969 – 2002 from the Les Cheneaux Islands October gillnet catch. Michigan state average length at age-3 indicated for reference.