STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-53-R-15

Study No.: 495 **Title:** Assessment of lake trout populations in Michigan waters of Lake Superior

Period Covered: April 1, 1998 to September 30, 1999

Cooperators: Bay Mills Indian Community (BMIC), Brimley, Michigan; Charlevoix Fisheries Station, Michigan Department of Natural Resources (MIDNR), Charlevoix, Michigan; Chippewa/Ottawa Treaty Fisheries Management Authority (COTFMA), Sault Ste. Marie, Michigan; Department of Fisheries and Wildlife, Michigan State University (MSU); Great Lakes Indian Fish and Wildlife Commission (GLIFWC), Odanah, Wisconsin; Green Bay Fishery Resources Office (GBFRO), U.S. Fish and Wildlife Service, Green Bay, Wisconsin; Isle Royale National Park (IRNP), National Park Service (NPS); Keweenaw Bay Indian Community (KBIC), Baraga, Michigan; Siverton Fisheries, Duluth, Minnesota; Red Cliff Band of Lake Superior Chippewas (RCBLSC), Bayfield, Wisconsin; Thill Fisheries, Marquette, Michigan; Vanlandschoot Fisheries, Munising, Michigan; and U. S. Geological Survey, Biological Research Division (USGS-BRD), Ashland, Wisconsin.

Study Objectives: (1) To annually (or semi-annually) determine relative abundance, length and age composition, sex and maturity, sea lamprey wounding, growth, and mortality for lean and siscowet lake trout in Michigan's Lake Superior lake trout management areas. (2) To periodically determine relative abundance, diet, and biological variables (age, growth, etc.) of lake trout varieties, other predator fish, and forage fish at various depth strata in Lake Superior. (3) To calculate total allowable catch (TAC) for lake trout in Michigan's Lake Superior management areas.

Summary: In the 1998 spring commercial-sized lake trout survey, the geometric mean number of lean lake trout per 305 m of 11.4 cm gill net per three nights fished (CPUE) declined by an average of 48% from 1997. However, relative abundance of commercial-sized lake trout in the spring 1999 survey increased to approximately the mean values for the period 1995-1997. The low spring survey CPUEs observed in 1998 may have been related to above-average warming trends in Lake Superior. Mean surface water temperature during the 1998 spring survey was 8.3 ^{O}C and in 1999 the mean was 4.4 ^{O}C. In the last two years, relative abundance of commercial-sized lean lake trout in all management units except MI-3 were approximately at the mean CPUE for 1995-1997. In MI-3, 1998-99 spring CPUEs were 35% of the 1995-97 mean values. Greater than 87.1% of commercial-sized lean lake trout sampled in 1998 were unclipped in all management areas. In the 1999 spring survey, more hatchery lake trout were caught, with the proportion wild ranging from 80.7% in MI-5 to 91.2% in MI-7. Sea lamprey wounding rates on 534-635 mm (TL) lake trout collected in the spring of 1998 and 1999 have been less than 5 wounds per 100 fish (W/100F) in all areas except MI-3. Wounding rates in MI-3 have increased from 2.2 W/100F in 1997 to an average of 11.0 W/100F in the recent two years. Overall, sea lamprey wounding rates are relatively low east of the Keweenaw peninsula to Grand Marais. In general, siscowet CPUE in the spring survey has increased in the last five years in all

management units except MI-3. In the 1998 spring survey, the percentages of commercial-sized lake trout captured that were siscowet were 36.9 in MI-3, 31.6 in MI-4, 21.8 in MI-5, 16.5 in MI-6, and 69.9 in MI-7. In 1999, the siscowet percentages were 47.3 in MI-3, 31.3 in MI-4, 7.8 in MI-5, 8.2 in MI-6, and 51.6 in MI-7. In the last two years, the relative abundance of commercial-sized siscowets in MI-7 has equaled or exceeded lean lake trout CPUE. In 1998, spring commercial-sized lean lake trout diet was dominated by rainbow smelt and *Mysis relicta*. In MI-5, *Diaporeia* was the most abundant invertebrate in lean lake trout stomachs. Spring, commercial-sized siscowet lake trout stomach contents were analyzed only for MI-3 and MI-4 in 1998. Sculpins and unidentified fishes were the most abundant prey fishes in commercial-sized siscowets in MI-3, while terrestrial insects were the most numerous invertebrate prey. In MI-4 siscowet stomachs collected in the spring survey, rainbow smelt was the most frequent prey fish observed. Both *Mysis relicta* and *Diaporeia* were abundant invertebrate prey observed in commercial-sized siscowets in MI-4.

In the pre-recruit lake trout survey conducted in summer 1998, relative abundance of pre-recruit lean lake trout increased in all management units in comparison to 1996. The pre-recruit survey was not conducted in 1997. The greatest increase was in MI-6 where CPUE increased from 0.88 in 1996 to 2.26 in 1998. The percentage of unclipped pre-recruit lake trout was lowest in MI-4 at 77.7% (n=265) and greatest in MI-7 at 100% (n=23). For all areas combined, 85.5% of all lake trout captured were unclipped. In the 1998 pre-recruit survey, siscowets were captured in all management units. Compared to 1996, relative abundance of pre-recruit siscowets increased in MI-6 and MI-7 and declined in MI-2, MI-3, MI-4, and MI-5 (Figure 3B). On average, the relative abundance of pre-recruit siscowet lake trout (TL<432 mm) in MI-3 and MI-7 has been greater than pre-recruit lean lake trout. An increasing trend in pre-recruit siscowet CPUE from 1990-1998 was observed in MI-4, MI-5, MI-6 and MI-7. Results of the 1999 pre-recruit survey were not available at the time of this report.

Statistical catch-at-age models for wild lake trout are under development for 1836 treaty waters of Lake Superior. A prototype model has been constructed for MI-6 and is currently being debugged of programming errors. Once model parameterizations are complete with the MI-6 model, this model will be adapted to the other management areas. Once all of the models are parameterized, total allowable catch (TAC) will be estimated for each management area and progress towards lake trout community objectives will be assessed.

Job 1. Title: <u>Assess commercial-size lake trout.</u>

Findings: Assessment in MI-3, MI-4, MI-5, MI-6, and MI-7 is based on a fixed station sampling design, where specific stations are sampled every year (Figure 1). The standard gear used in this survey was 11.4 cm mesh (stretch measure), nylon, multifilament (210/2) gill nets. The basic unit of gear deployed was defined as one net gang that was 457.2 m long and 1.83 deep consisting of five net panels each 91.4 m long. At each sampling station, usually two net gangs were deployed on the bottom as one continuous net across depth contours. The target depth range was 36 to 73.2 m. The nets were fished for approximately 72 hours. This survey is conducted in the spring months of April, May, and June. In MI-1, the assessment is conducted in cooperation with IRNP, NPS, and Sivertson Fisheries. The Isle Royale National Park sample stations are near Rock Harbor at the northeast end of the island, while Sivertson Fisheries samples the southwestern tip of the island. The sampling design in MI-1 differs from the other management units, in that the standard gear used in this survey included both 11.4 and 14.0 cm meshes that were either mono- or multifilament. The length of net used by both cooperators is variable and ranges from 30.5 to 914.4 m. The net width used by Sivertson Fisheries was 2.4 m while IRNP's was 1.8 m. These nets were usually set overnight. The MI-1 assessment was conducted by IRNP in the summer months of June-September, and by Sivertsons in the months of September and October. Due to staff shortages, data from MI-1 have not been completely processed and analyzed, and will not be reported at this time. Assessment of commercial-sized lake trout in MI-2 was conducted by RCBLSC and in MI-8 by BMIC. Results of those assessments are available in their agency reports.

The 1998 spring lake trout survey began on 30 April with ten stations in MI-5 being fished by Thill Fisheries and six stations in MI-6 fished by VanLandschoot and Sons, Inc. (Figure 1). Marquette Fisheries Station (MFS) personnel were aboard the commercial vessels to collect data. Marquette Fisheries Station's R/V Judy sampled five stations in MI-3 and nine stations in MI-4, while COTFMA personnel sampled eight stations in MI-7. Total catches of lean lake trout >431 mm (TL) were 140 in MI-3, 232 in MI-4, 873 in MI-5, 389 in MI-6, and 150 in MI-7. All required biotic and abiotic data were collected. Relative abundance was expressed as the geometric mean of catch per unit effort (CPUE) which equals the number of fish caught per 305 m of gill net per three night set.

In 1999, sampling began on 26 April and ended on 10 June. Contracted commercial fishers (Thills and VanLandschoots) began fishing for MFS on 26 April and finished on 13 May. The Research Vessel Judy started fishing on 04 May and returned to Marquette Harbor on the evening of 10 June. MI-7 was sampled by COTFMA. All data have been entered and are undergoing data validation. Total catch of lean lake trout >431 mm (TL) was 99 in MI-3, 729 in MI-4, 1047 in MI-5, 495 in MI-6, and 285 in MI-7.

Job 2. Title: <u>Assess pre-recruit lake trout.</u>

Findings: The pre-recruit assessment is only conducted in management units MI-2, MI-3, MI-4, MI-5, MI-6, and MI-7 (Figure 1). This survey is based on a fixed station sampling design, where specific stations are sampled every year. The standard gear used in this survey were graded mesh (stretch measure), nylon, multifilament gill nets with the following mesh sizes: 5.1, 5.7, 6.4, 7.0, 7.6, and 8.9 cm. The basic unit of gear deployed was defined as one net gang that was 548.6 m long and 1.83 deep, consisting of six net panels each 91.4 m long. At each sampling station, one or two net gangs were deployed on the bottom as one continuous net across depth contours. The target depth range was 27.4 to 91.4 m. The nets were fished for approximately 24 hours. This survey is conducted during the summer months of July and August.

The 1998 pre-recruit survey began on 28 July in MI-7 and ended 28 August in MI-5. Marquette Fisheries Station personnel aboard R/V Judy sampled five stations in MI-2, seven stations in MI-3, eight stations in MI-4, four stations in MI-5, four stations in MI-6, and two stations in MI-7. Total catches of pre-recruit lean lake trout (<432 mm, TL) were 61 in MI-2, 107 in MI-3, 265 in MI-4, 159 in MI-5, 41 in MI-6, and 23 in MI-7. The most abundant non-target fish caught was lake herring in MI-2, MI-4, and MI-7; lake whitefish in MI-3; round whitefish in MI-5; and longnose sucker in MI-6. All required biotic and abiotic data were collected. Relative abundance was expressed as the geometric mean of catch per unit effort (CPUE) which equals the number of fish caught per 305 m of gill net per one night set. All results reported are based on data collected from fish caught in all of the meshes.

The 1999 survey followed the usual sequence with MI-7 being sampled first starting 26 July and ended in MI-5 on 27 August. Due to the shortage of staff, the pre-recruit data have not been completely entered in to the database and no summaries are available at this time.

Job 3. Title: Assess lake trout variety composition.

Findings: A siscowet-specific survey was not conducted in 1998 by MFS. However, in the 1998 spring lean lake trout survey, siscowets were captured in all management units. Total catches of siscowet lake trout >431 mm (TL) were 82 in MI-3, 107 in MI-4, 244 in MI-5, 77 in MI-6, and 349 in MI-7. The percentages of lake trout captured that were siscowet were 36.9 in MI-3, 31.6 in MI-4, 21.8 in MI-5, 16.5 in MI-6, and 69.9 in MI-7. Compared to 1997, relative abundance of siscowet (expressed the same as lean CPUE) increased in MI-5 and MI-7; and decreased in MI-3, MI-4, and MI-6 (Figure 2B). The CPUE of siscowet in MI-7 was more than two times higher than the CPUE of lean lake trout. In all other areas, CPUE of siscowets were lower than lean lake trout.

In the pre-recruit survey, siscowets were captured in all management units. Compared to 1996, relative abundance of siscowets increased in MI-6 and MI-7, and declined in MI-2, MI-3, MI-4, and MI-5 (Figure 3B). On average, the relative abundance of siscowet lake trout <432 mm in MI-3 and MI-7 has been greater than that of pre-recruit lean lake trout. An increasing trend in siscowet CPUE from 1990-1998 was observed in MI-4, MI-5, MI-6 and MI-7.

From the spring 1999 survey, total catches of siscowet lake trout >431 mm were 89 in MI-3, 329 in MI-4, 88 in MI-5, 44 in MI-6, and 304 in MI-7. Percentages of lake trout caught that were siscowets were 47.3 in MI-3, 31.3 in MI-4, 7.8 in MI-5, 8.2 in MI-6, and 51.6 in MI-7. Siscowet CPUE was less than lean lake trout CPUE in all management areas except MI-7 where relative abundance was nearly equal for the two subspecies. Data from the pre-recruit survey were not available at the time of this report.

Job 4. Title: Analyze assessment data.

Findings: *Spring survey*–In 1998 relative abundance of lean lake trout >431 mm decreased in all management units from values for 1997 (Figure 2A). The greatest decrease in relative abundance was in MI-5 where CPUE declined from 33.4 in 1997 to 9.9 in 1998. The overall decline in CPUE observed in 1998 may be due to unusual limnological conditions in Lake Superior rather than decreased population size. Thermally, nearshore areas of Lake Superior appeared have been a month in advance of previous years. Mean surface water temperatures measured during the 1998 spring survey was 8.3^{o} C, while in 1999 the average was 4.4 ^{o} C. Commercial-sized lake trout may have been more pelagic and higher in the water column during this time period, thus making them less vulnerable to bottom-set gill nets. Greater than 87% percent of all lean lake trout caught were unclipped fish (Figure 4). Sea lamprey wounding rates (as indexed by the number of A1-A3 wounds (King and Edsall 1979) per 100 fish for 534-635 mm lake trout) were highest in MI-3 at 11.2 and lowest in MI-4 at 1.8 (Figure 5). The greatest increase in wounding rates compared to 1997 was in MI-3 where there was a five-fold increase. The modal ages of wild lake trout caught in the spring of 1998 were age 6 in MI-7, age 7 in MI-4 and MI-5, and age 8 in MI-3 and MI-6 (Table 1). Hatchery modal ages were age 6 in MI-4, MI-5, and MI-6; age 7 in MI-3; and age 8 in MI-7 (Table 2). The range of ages sampled was from 4 to 32. Spring lake trout age compositions were adjusted for disproportionate sampling. Since we age 20 fish per 25 mm length bin, younger and older fish were over-represented in the raw age composition. Therefore, age composition was calculated using the CPUE at age rather than catch-at-age.

Compared to 1998, lean lake trout CPUE in 1999 increased in all management areas except for MI-3 (Figure 2A). In general, 1999 CPUEs were approximately equal to mean values for 1995-

1997. This observation supports the hypothesis that 1998 was an anomalous year for indexing the relative abundance of adult lake trout. Lean lake trout CPUE in MI-3 has declined since 1994. Compared to 1998, the proportion of wild lean lake trout observed declined in all management areas except for MI-6 (Figure 4). Greater than 80% of all lean lake trout caught were unclipped (Figure 4). However, at Big Bay (MI-5) we caught an unusually high number of fin-clipped lake trout, with the percentage at one station being 55.8. Wild lean lake trout predominated (76.6%) at the other station in Big Bay, and overall, the percent wild for Big Bay was 66.7. The percent wild for the Marquette area was 87.7%, which is in the same management unit as Big Bay. Sea lamprey wounding rates on 534-635 mm lake trout were lower in MI-3, MI-5, and MI-7 than in 1998 (Figure 5). The highest wounding rates were in MI-3 (10.7 wounds per 100 fish), which was about five times the wounding rates in 1997 (2.19 wounds per 100 fish). None of the 1999 fish sampled have been aged at the time of this report.

Pre-recruit survey–Compared to 1996, relative abundance of pre-recruit lean lake trout increased in all management units in 1998 (Figure 3A). The pre-recruit survey was not conducted in 1997. The greatest increase was in MI-6 where CPUE increased from 0.88 fish per 305 m in 1996 to 2.26 fish per 305 m in 1998. No A1-A3 lamprey wounds were observed in any of the pre-recruit lean lake trout captured in 1998. Generally, sea lamprey wounding is very low for pre-recruit lean lake trout. Furthermore, the standard reporting of sea lamprey wounding is based on spring, adult lake trout survey data. The percentage of unclipped lake trout was lowest in MI-4 at 77.7% (n=265) and greatest in MI-7 at 100% (n=23). For all areas combined, 85.5% of all lake trout captured were unclipped (Figure 6). The modal age of wild lake trout caught was between age 4 and 6 across all management areas. The hatchery age compositions were more truncated than the wild fish and the modal age was age 5 in all management units except MI-5 where it was age 4 (Table 3). The range of ages for fish collected was 2 to 17.

Data for 1999 have not been entered into the database at the time of this report.

Job 5. Title: <u>Analyze diet data.</u>

Findings: *Spring Survey*–Stomach contents were measured and numerically quantified for lean and siscowet lake trout during the spring 1998 survey. The most numerically-abundant fish observed in lean lake trout stomachs was rainbow smelt in MI-3, MI-4, MI-5, and MI-6. Diet data from MI-7 were not available at the time of this report. *Mysis relicta* was the most abundant invertebrate prey item observed in lean lake trout stomachs in MI-3, MI-4, and MI-6. *Diaporeia* was the most abundant invertebrate prey item in MI-5. Siscowet lake trout stomach contents were analyzed only in MI-3 and MI-4. Sculpins and unidentified fishes were the most abundant food item in siscowets in MI-3. In MI-3, the number of terrestrial insects observed in siscowet stomachs was greater than all other invertebrates. Rainbow smelt was the most abundant prey fish observed in siscowets in MI-4. *Mysis relicta* and *Diaporeia* were the most abundant invertebrate prey observed in siscowet stomachs in MI-4. Very few terrestrial insects were observed in MI-4 siscowet stomachs.

Diet data from 1999 have not been completely entered or validated.

Pre-recruit survey–In 1998 whole stomachs from 100 lean and 100 siscowet lake trout were collected in both MI-2 and MI-5. Stomach contents have been analyzed, but data have not been entered or validated.

In 1999 stomach samples were collected from MI-4 and MI-7, but have not been analyzed. The stomach sampling protocol was changed this year from the preservation of stomachs in Notox to freezing whole stomachs. This was done for logistical reasons and to reduce bias in prey lengths and weights from desiccation caused by Notox.

Job 6. Title: Model lean lake trout populations.

Findings: This job is currently being accomplished in conjunction with the Modeling Technical Subcommittee of the Treaty Fisheries review Committee which is responsible for modeling fish stocks in 1836 treat waters for the upcoming tribal negotiations. We are also working with the Lake Superior Technical Committee of the Great Lakes Fishery Commission to expand this work to Minnesota, Wisconsin, and Ontario waters of Lake Superior.

The following phases will oocur in accomplishing this job: 1) assemble all lake trout assessment data into a relational database and correct all errors; 2) assemble all sport and commercial harvest data, including age compositions, into a single database and correct all errors; 3) assemble all stocking data and correct all errors; 4) define geographical boundaries for models and migration; 5) construct models and debug; 6) run catch-at-age analysis and estimate the optimum suite of parameters that best describes the population dynamics of lean lake trout; 7) run model simulations according to various management options to estimate future population dynamics; 8) update models as data become available and re-calibrate if necessary. Currently, we are at Phase 6 of this job. However, we have not completed every phase up to this point. There is still much work to do in all phases.

Status of Phases:

Phase 1–This phase is currently ongoing. Significant database restructuring and data validation has been underway. A relational database that integrates all data components has been designed for each lake trout survey. The new spring survey database contains data dating back to 1967, while the new pre-recruit database has data back to 1985. Previously, data have been organized and managed on an annual basis with at least five DBASE data files for each survey type for each year. Furthermore, the data fields and values in these files have been inconsistent. Numerous data errors have been found and have been corrected. However, partial data validation has only been done for spring survey data back to 1975. Spring survey data dating back to 1967, and pre-recruit data back to 1985 have not been reviewed thoroughly for errors.

Phase 2–Assembly of harvest data is currently underway in cooperation with BMIC; Charlevoix Fisheries Station, MIDNR; COTFMA; GLIFWC; MSU; and RCBLSC. State-licensed commercial fishery data are available through the MIDNR Fisheries Division intranet. Michigan recreational harvest data are still being assembled. Tribal harvest data have been provided by COTFMA and GLIFWC.

Phase 3–In cooperation with Green Bay FRO, GLIFWC, and MDNR Fisheries Division, lake trout stocking data have been assembled and corrected for data errors.

Phase 4–Due to insufficient quantitative information on lake trout movements in Michigan waters, the populations models are assumed to follow Lake Trout Management Unit boundaries. The spatial scale of the lake trout population models will be adjusted when more information is reported on migration rates between these management areas.

Phase 5–Statistical catch-at-age (SCAA) models are being developed in AD Model Builder software (Otter Research, Ltd.), which has been successfully applied in marine stock assessments (Quinn and Deriso 1999) and for lake trout in southern Lake Huron (Sitar et al. 1999). These models use fishery harvest and fishery age composition information, along with fishery-independent information on population structure to estimate parameters that determine mortality rates and abundance. The fishery-independent data include MIDNR survey CPUE and age composition. Other sources of information used in calibrating the models include prior information on natural mortality rates, estimates of sea lamprey-induced mortality rates, and uncertainty in data sources. These models are highly dependent of age data, therefore information on aging error has been incorporated. Due to changes in aging methodology and biases associated with readers, aging error matrices were incorporated into these models based on those used in SCAA models for MI-4 developed by Weeks (1997). Presently, a SCAA has been constructed for MI-6 wild lake trout, which will serve as a template for MI-5 and MI-7 wild lake trout populations. Models currently being developed for hatchery lake trout in Northern and Central Lake Huron will serve as templates for hatchery lake trout models in Lake Superior. Highest priority is given to the wild lake trout models in 1836 Treaty waters. The wild lake trout SCAA models for MI-5, MI-6, and MI-7 include sections that have parameters to estimate recreational and commercial fishing mortality and harvest.

Phase 6–We are currently debugging the SCAA model for wild lake trout in MI-6.

Phase 7–No progress has been made.

Phase 8–No progress has been made.

Job 7. Title: <u>Prepare reports.</u>

Findings: A summary report of this study's data was presented at the summer 1998 Lake Superior Technical Committee meeting. Summaries of both the spring and summer surveys from 1998 were presented at the 1999 Great Lakes Fishery Commission annual meeting. This annual progress report was prepared.

Literature cited:

King, E.L., Jr., and T.A. Edsall. 1979. Illustrated field guide for the classification of sea lamprey attack marks on Great Lakes lake trout. Great Lake Fishery Commission special Publication 79-1.

Quinn, T.J., II, and R.B. Deriso. 1999. Quantitative fish dynamics. Oxford University Press, New York.

Sitar, S.P., J.R. Bence, J.E. Johnson, M.P. Ebener, and W.W. Taylor. 1999. Lake trout mortality and abundance in southern Lake Huron. North American Journal of Fisheries Management 19: 881-900.

Weeks, C.T. 1997. Dynamics of lake trout (*Salvelinus namaycush*) size and age structure in Michigan waters of Lake Superior, 1971-1995. MS thesis. Michigan State University, East Lansing, MI.

Prepared by: S.P. Sitar and J.W. Peck
Dated: September 30, 1999

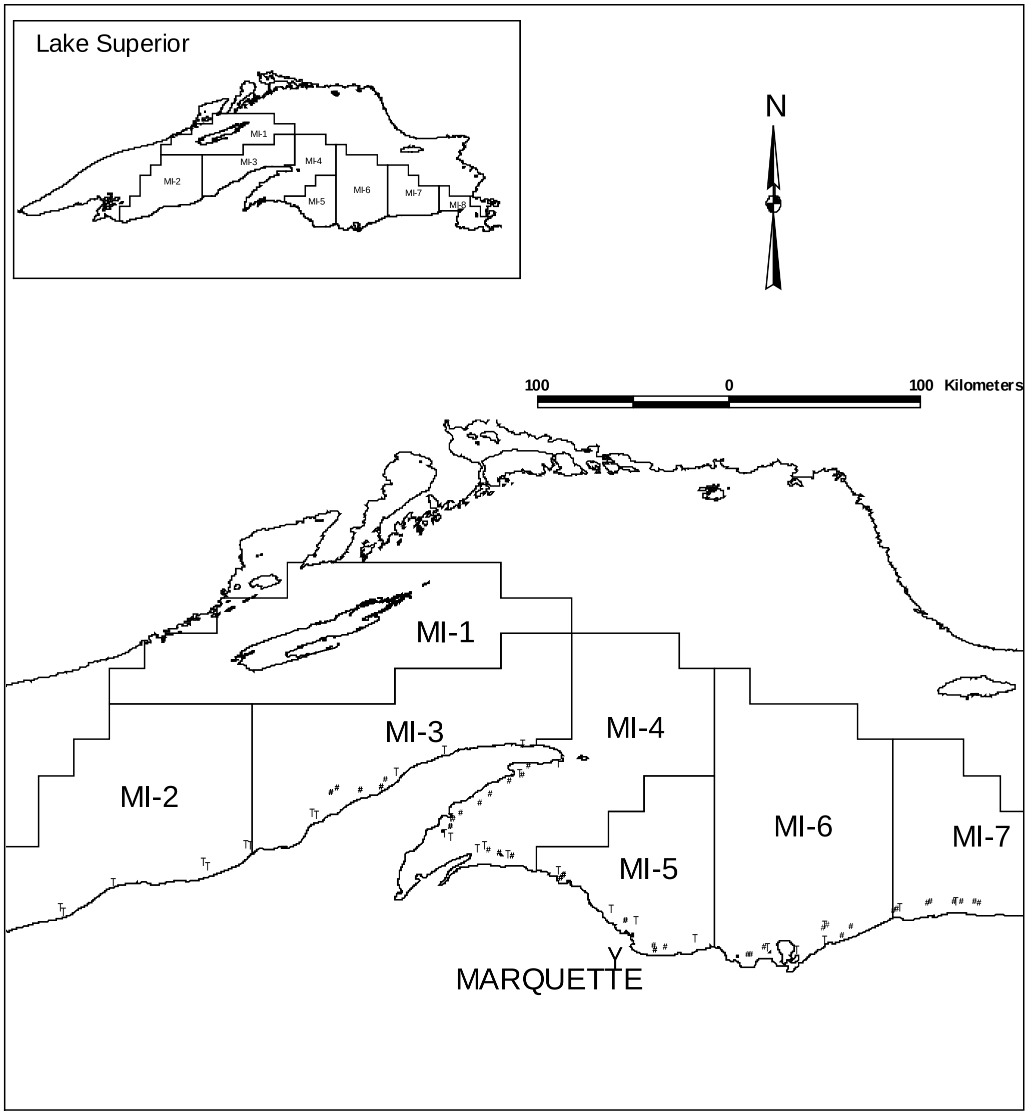

Figure 1.–Lake Superior lake trout management units and Michigan Department of Natural Resources lake trout survey sampling stations. The symbol "#" represents spring stations (commercial-sized lake trout) and the symbol "T" represents summer stations (pre-recruit lake trout).

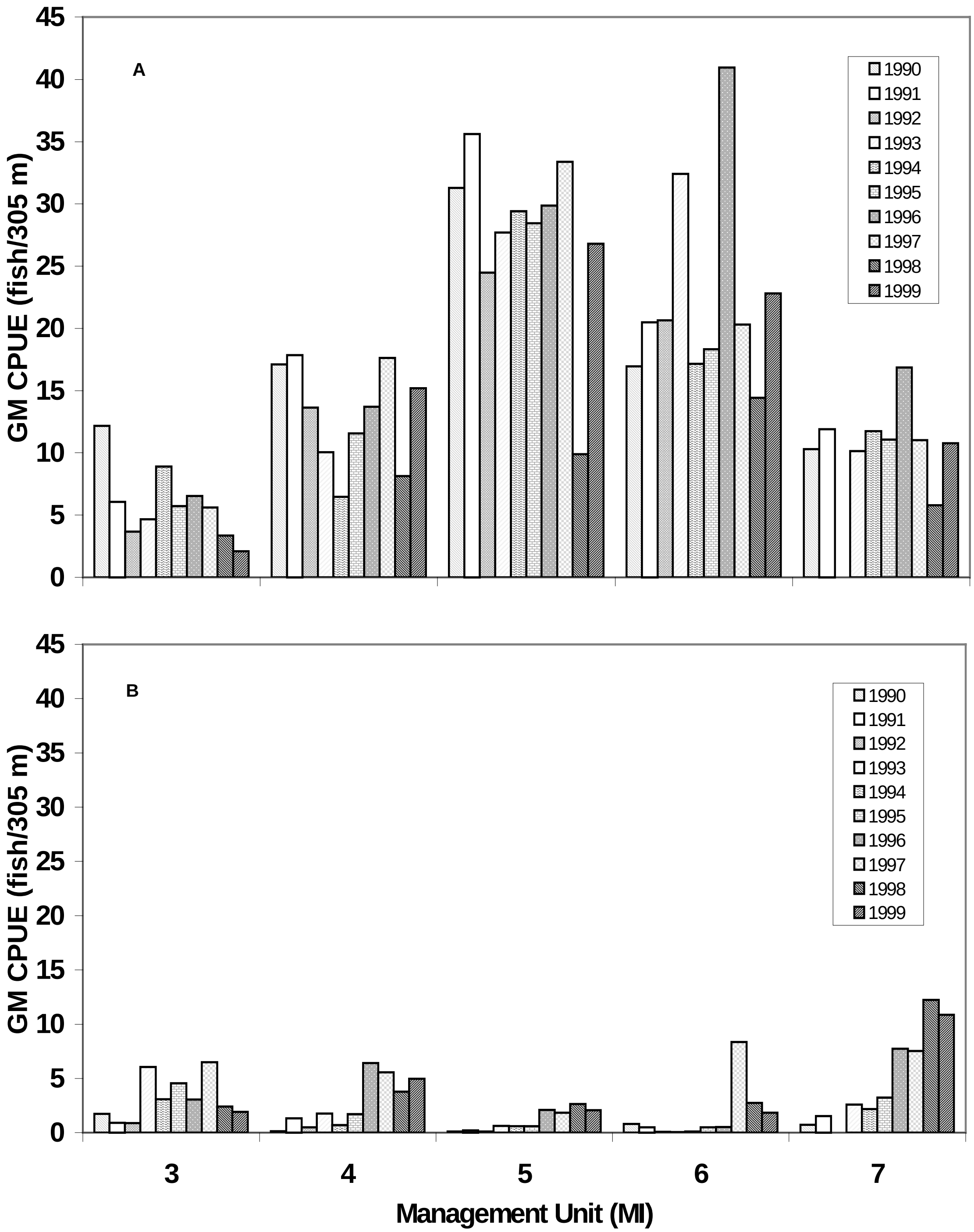

Figure 2.–Relative abundance of commercial-sized lake trout (>431 mm, TL) captured in spring surveys in Michigan management units of Lake Superior. A. Lean lake trout. B. Siscowet lake trout. Relative abundance expressed as the geometric mean catch per unit of effort (GM CPUE=number of fish per 305 m of 11.4 cm mesh gill net per three night set). No survey was conducted for MI-7 in 1992.

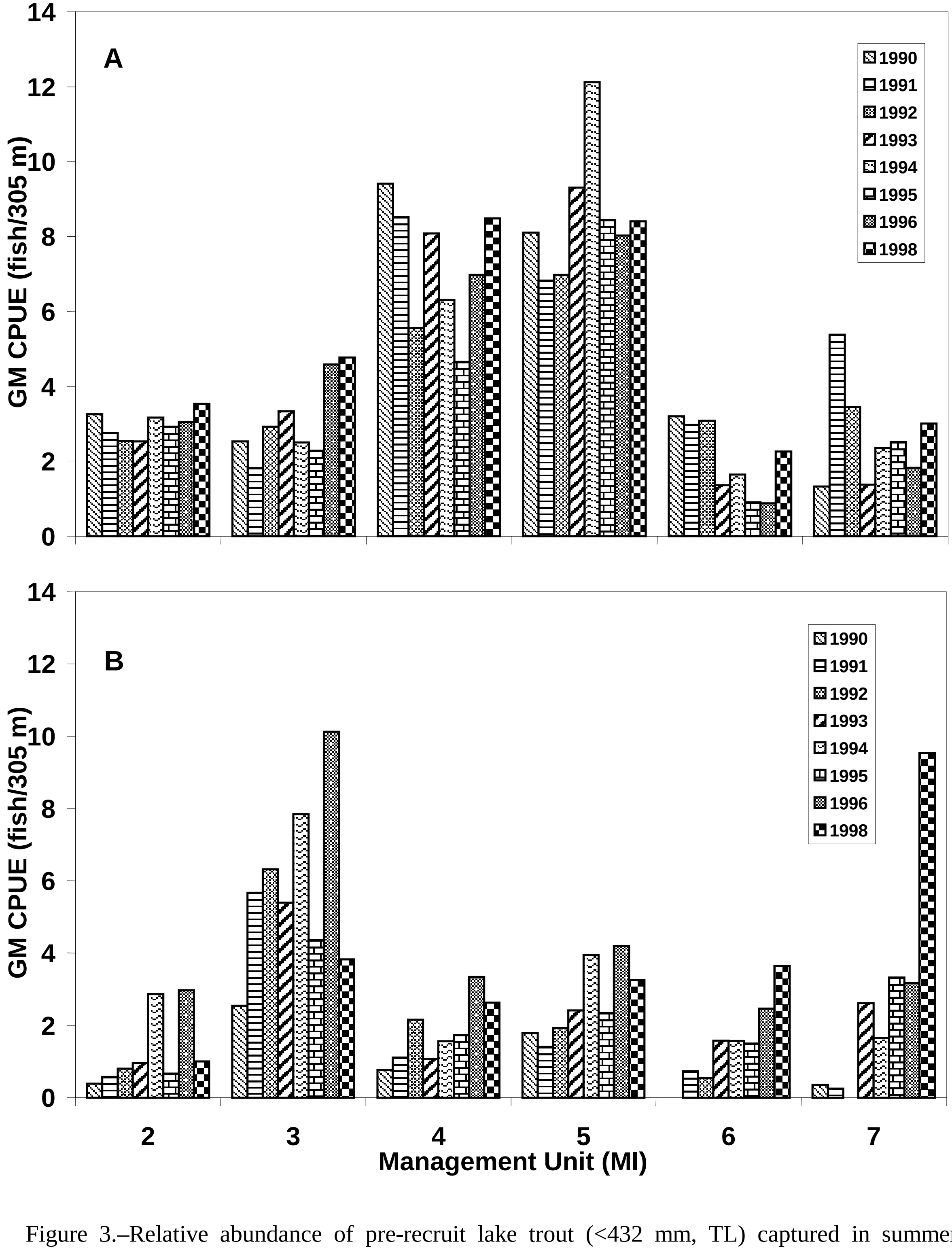

Figure 3.–Relative abundance of pre-recruit lake trout (<432 mm, TL) captured in summer surveys in Michigan management units of Lake Superior. A. Lean lake trout. B. Siscowet lake trout. Relative abundance expressed as the geometric mean catch per unit of effort (GM CPUE=number of fish per 305 m of graded mesh gill net per one night set). Mesh sizes (stretched) were 5.1, 5.7, 6.4, 7.0, 7.6, and 8.9 cm. No survey was conducted in 1997.

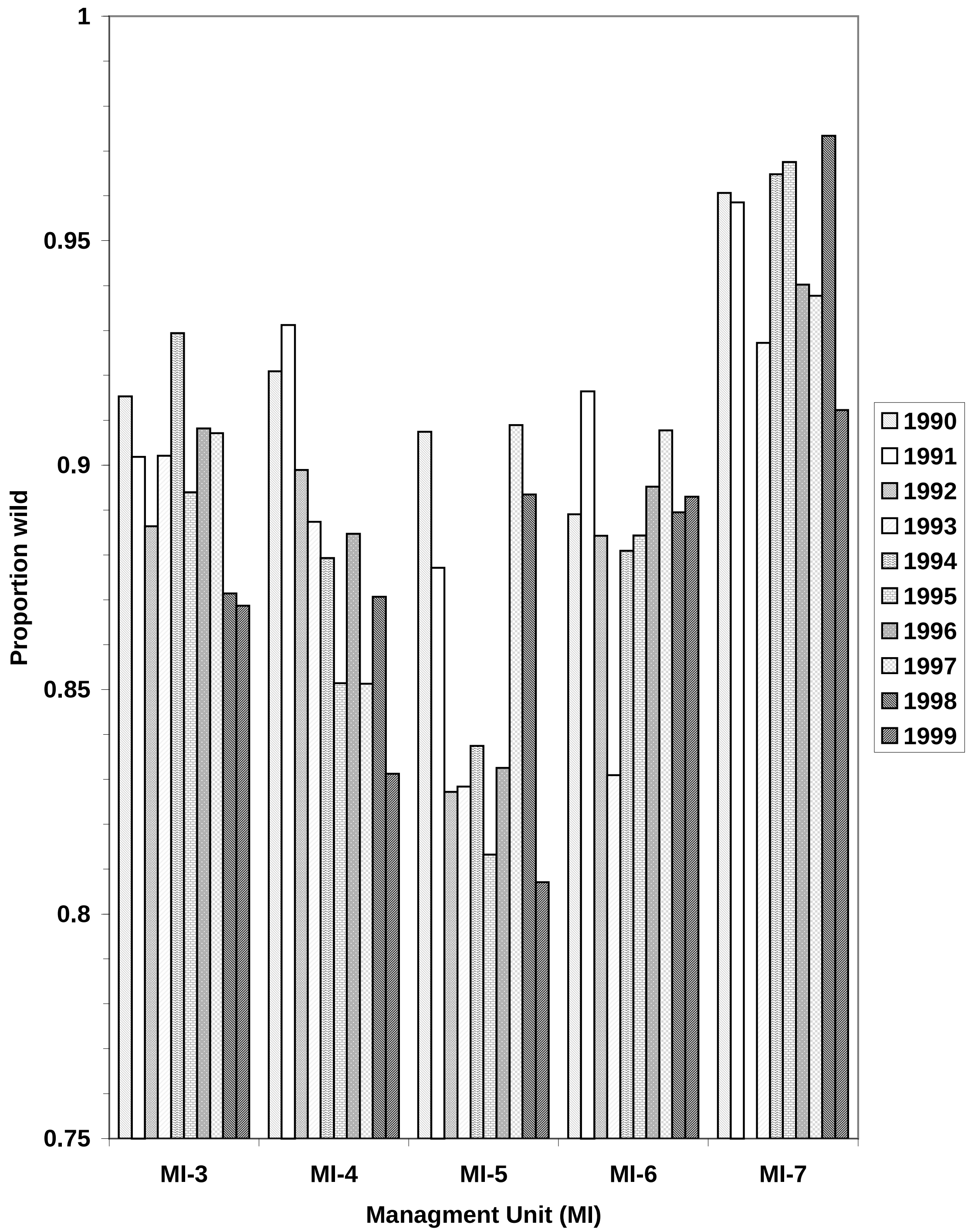

Figure 4.–Proportion of unclipped lean lake trout (>431mm, TL) collected in spring surveys in Michigan waters of Lake Superior from 1990-1999. No survey was conducted for MI-7 in 1992.

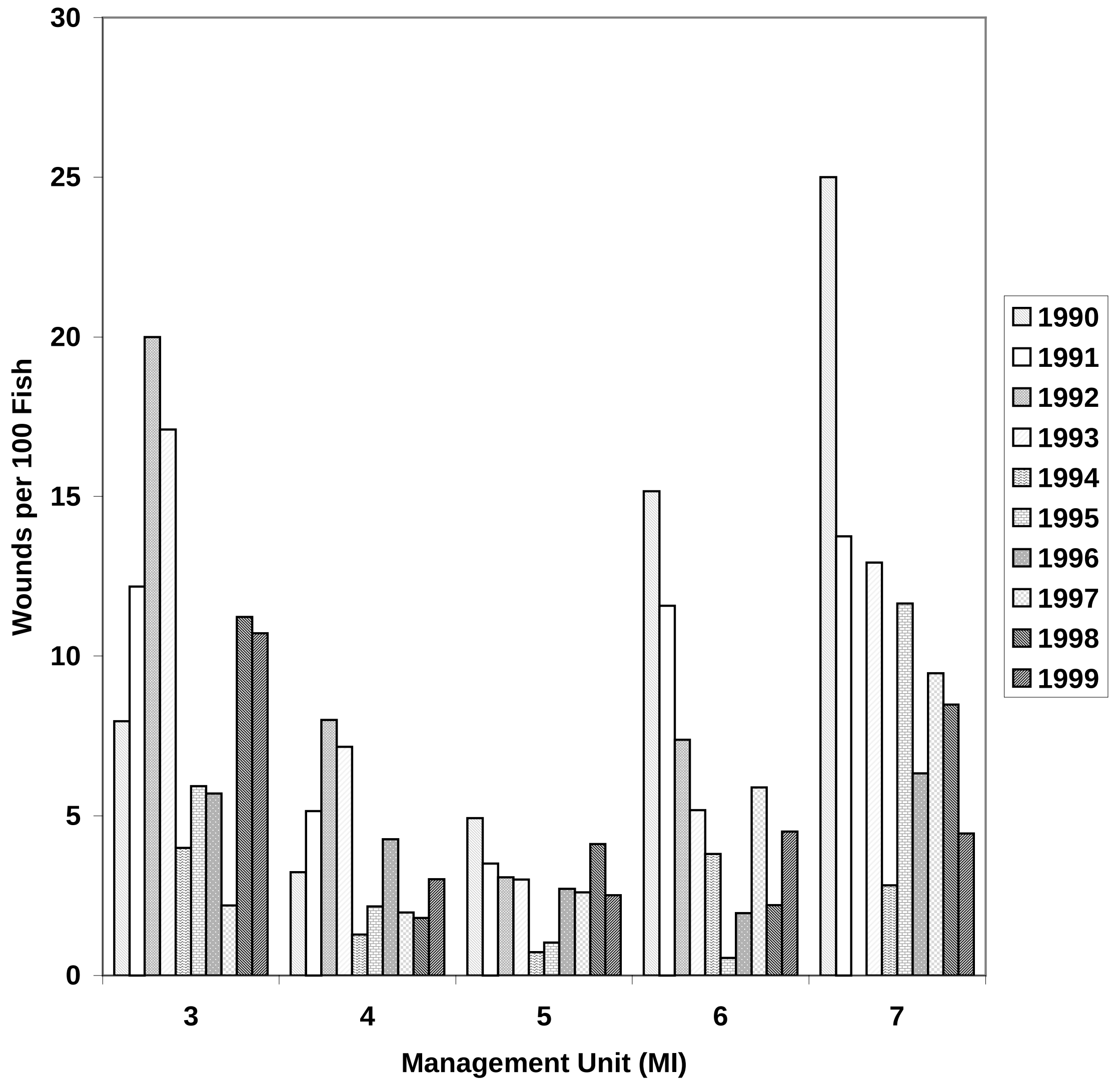

Figure 5.–Sea lamprey wounding rates for 534-635 mm (TL) lean lake trout sampled in spring gill net surveys in Michigan waters of Lake Superior. Wounding rates expressed as the total number of Type A, Stage 1 to 3 wounds per 100 lake trout. No survey was conducted for MI-7 in 1992.

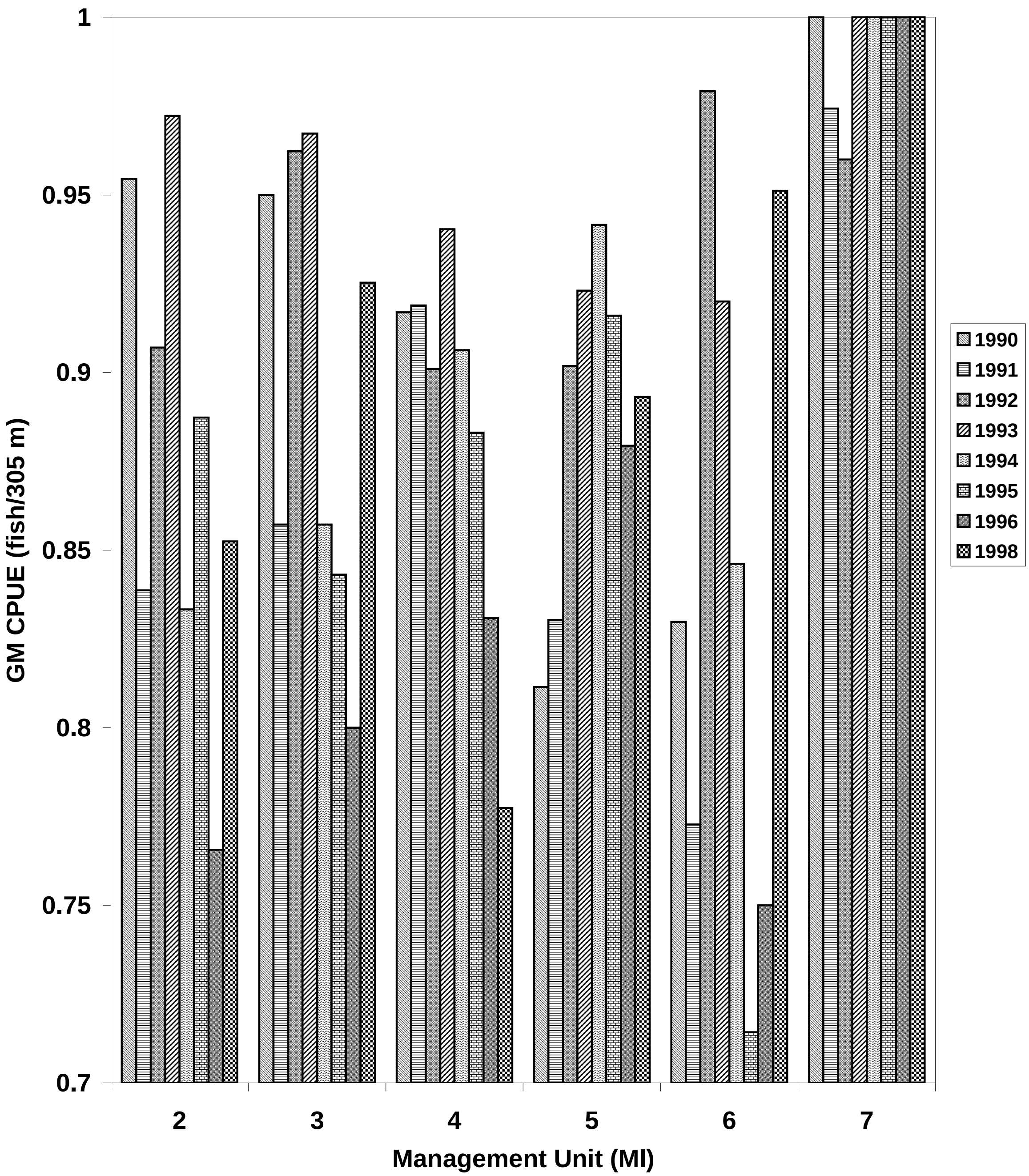

Figure 6.–Proportion of unclipped pre-recruit (<432 mm, TL) lean lake trout collected in summer surveys in Michigan waters of Lake Superior from 1990-1996, 1998. No survey was conducted in 1997.

Table 1.–Age composition of commercial-sized (>431 mm, TL) wild lake trout captured in spring surveys in Lake Superior in 1998. Age composition was adjusted for disproportionate subsampling and expressed as proportion. The proportion at age for each management unit was calculated by dividing the catch-per-unit-effort at age by total catch per unit effort. Data were based on lake trout caught in 11.4 cm (stretched measure) nylon, multifilament gill nets fished during April-June.

	Management Unit				
Age	MI-3	MI-4	MI-5	MI-6	MI-7
5	0.034	0.020	0.004	0.010	0.007
6	0.192	0.154	0.120	0.149	0.304
7	0.216	0.283	0.288	0.186	0.294
8	0.221	0.155	0.237	0.267	0.165
9	0.127	0.136	0.145	0.143	0.129
10	0.084	0.092	0.108	0.109	0.040
11	0.017	0.035	0.030	0.041	0.034
12	0.025	0.035	0.017	0.018	
13	0.017	0.025	0.030	0.019	0.014
14	0.033	0.015	0.008	0.020	0.007
15	0.008	0.020	0.007	0.013	0.006
16	0.025		0.004	0.009	
17		0.021	0.001	0.006	
18			0.001	0.003	
19				0.006	
20					
21					
22		0.005			
23					
24					
25					
26					
27		0.005			
28					
29					
30					
31					
32				0.003	

Table 2.–Age composition of commercial-sized (>431 mm, TL) hatchery lake trout captured in spring surveys in Lake Superior in 1998. Age composition was adjusted for disproportionate subsampling and expressed as proportion. The proportion at age for each management unit was calculated by dividing the catch-per-unit-effort at age by total catch per unit effort. Data were based on lake trout caught in 11.4 cm (stretched measure) nylon, multifilament gill nets fished during April-June.

	Management Unit				
Age	MI-3	MI-4	MI-5	MI-6	MI-7
4			0.098	0.162	
5	0.440	0.080	0.219	0.281	
6	0.168	0.418	0.297	0.325	0.198
7	0.279	0.066	0.111	0.023	0.270
8	0.059	0.206	0.077	0.046	0.532
9	0.054	0.033	0.078		
10		0.033	0.044	0.093	
11		0.100		0.047	
12				0.023	
13		0.032	0.022		
14			0.033		
15					
16					
17					
18					
19					
20					
21		0.0320			
22					
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24					
25					
26			0.021		

Table 3.–Age composition of pre-recruit lake trout (<432 mm, TL) captured in summer surveys in Lake Superior in 1998. The proportion at age for each management unit was calculated by dividing the catch at age by total catch. Data were based on lake trout caught in nylon, multifilament gill nets consisting of 5.1, 5.7, 6.4, 7.0, 7.6, and 8.9 cm meshes fished during July-August.

	Management Unit					
Age	MI-2	MI-3	MI-4	MI-5	MI-6	MI-7
Wild						
2		0.009		0.005		
3	0.025	0.043	0.028	0.032	0.055	0.025
4	0.188	0.296	0.121	0.252	0.236	0.100
5	0.238	0.313	0.298	0.252	0.218	0.175
6	0.263	0.174	0.305	0.230	0.236	0.325
7	0.150	0.061	0.138	0.104	0.164	0.175
8	0.075	0.009	0.038	0.041	0.036	0.025
9	0.025	0.044	0.021	0.050	0.036	0.075
10		0.009	0.014	0.018	0.018	0.075
11	0.013	0.035	0.014	0.009		0.025
12			0.004			
13	0.025		0.007	0.009		
14			0.004			
15		0.009	0.004			
16						
17			0.007			
Hatchery						
2		0.111				
3			0.205	0.050		
4	0.250	0.222	0.108	0.300	0.400	
5	0.563	0.444	0.265	0.275	0.600	
6		0.111	0.181	0.150		
7	0.188	0.111	0.229	0.150		
8						
9						
10			0.012	0.050		
11				0.025		