STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-81-R-6

Study No.: 230495 **Title:** Assessment of lake trout populations in Michigan waters of Lake Superior

Period Covered: October 1, 2004 to September 30, 2005

Study Objectives: (1) To determine relative abundance, length and age composition, sex, 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 demographic variables (age, growth, etc.) of lake trout forms, 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: Lake trout surveys were conducted during the fall spawning period of 2004, and during the spring and summer of 2005. Spawner relative abundance has declined over the past few years on two of three reefs sampled in the Marquette area. Most of the spawning lake trout sampled were wild origin. Spring survey relative abundance of lean lake trout increased during the past 5 years in all management units except MI-3. Relative abundance of siscowet in the spring has generally been lower than leans in the last 10 years. The average percentage of hatchery leans in the spring survey was 2% in 2005. In the 2005 summer pre-recruit survey, lean relative abundance increased in half of the management units and declined in the other half of the units. Over the past five years, summer lean abundance has increased in MI-2, MI-5, MI-6, MI-7 and declined in MI-3 and MI-4. Siscowet relative abundance has declined since 2001 in MI-2, MI-3, MI-4, and MI-6 and was about equal to 2001 estimates in MI-5 and MI-7 during 2005. Siscowet relative abundance was equal to or higher than lean abundance in MI-2, MI-3, and MI-7. Based on statistical catch-at-age models for wild leans, the 2002 to 2004 average instantaneous total mortality rates (Z) for ages 6 through 11 lake trout were: 0.29 $year^{-1}$ in MI-5, 0.31 $year^{-1}$ in MI-6, and 0.39 $year^{-1}$ in MI-7. Sea lamprey predation was the dominant mortality source in all three populations. Sport fishing was the dominant fishing mortality source in MI-5 and MI-6, and commercial fishing was the principal fishing mortality source in MI-7.

Findings: Jobs 1, 2, and 4 through 9 were scheduled for 2004-05, and progress is reported below.

Job 1. Title: Conduct spring lean lake trout survey.–Lean lake trout were sampled in the spring starting on 26 April and ending 25 May 2005. A contracted commercial fisher (Newago Fisheries) under permit from GLIFWC fished six stations in management unit MI-3 (Figure 1). Personnel aboard the R/V Judy sampled 4 stations in MI-3, 9 stations in MI-4, 7 stations in MI-5, and 12 stations in MI-6. Chippewa Ottawa Resource Authority personnel sampled eight stations in MI-7. Over 2,200 fish were collected in the survey with about 1,600 lake trout.

All spring data collected during this performance period were entered into a computer database and proofed for errors by MFRS personnel. Stratified-random subsamples of the total fish catch from each management unit from the spring survey will be assessed for age using scales and/or otoliths collected from each fish.

Job 2. Title: Conduct pre-recruit lean lake trout survey.–Pre-recruit lake trout were sampled in the summer of 2005 starting on 03 August and ending 09 September 2005. 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 (Figure 1). There were about 5,100 fish collected with approximately 2,300 lake trout. All data have been entered into a computer database and were proofed for errors. Fish ages will be assessed during the winter months using scales and/or otoliths collected during sampling.

Job 4. Title: Conduct lean lake trout spawning survey and tag lean lake trout.–Spawning lean lake trout were sampled in the Marquette area during the fall of 2004 starting on 08 October and ending 10 November. Personnel aboard R/V Judy sampled three spawning areas: Presque Isle Harbor, Partridge Island Reef, and Garlic Island Reef (Figure 1). There were 36 net-sets totaling 13.2 km of net. There were 17 additional nets sets (6.3 km) to collect wild lake trout for the Marquette State Fish Hatchery for their broodstock replacement program. As part of the collection for the hatchery, 160 female wild leans were collected for eggs and sacrificed for disease profiles. In the entire fall survey, more than 2,500 fish were caught with 2,300 lake trout.

Job 5. Title: Analyze Survey Data.–

Spawner survey 2004–In 2004, 1,159 lake trout were marked with serialized anchor tags on three spawning areas sampled in the Marquette area (MI-5). There were 82 lake trout recaptured including 11 within year recaptures. Hatchery fish composed 3.1% of all lake trout caught. Spawner relative abundance declined at the Marquette and Garlic Island Reef spawning sites, and increased slightly at Partridge Island Reef (Figure 2).

Spring survey 2005–During 2005, relative abundance of lean lake trout was higher than in 2004 for all management units except MI-4 (Figure 3a). Overall, lean lake trout relative abundance has been increasing in the last 5 years except in MI-3, where it has been declining (Figure 3a). Generally, siscowet relative abundance was lower than lean abundance in all areas in the last 10 years (Figure 3b). Since 2001, siscowet relative abundance has generally been declining in MI-3, MI-5, and MI-7. Across all management units, the average proportion of lean lake trout that were of wild origin in 2005 was 0.98 (Figure 4). The lowest proportion of wild fish was in MI-4 due to continued stocking of hatchery fish in this management unit.

Pre-recruit survey 2005– Since 2001, relative abundance of pre-recruit lean lake trout increased in MI-2, MI-5, MI-6, MI-7 and declined in MI-3 and MI-4 (Figure 5a). Siscowet relative abundance has declined since 2001 in MI-2, MI-3, MI-4, and MI-6 (Figure 5b). In MI-5 and MI-7, siscowet relative abundance in 2005 was about equal to 2001 estimates. In the last five years, many of the management units, siscowet relative abundance was nearly equivalent to lean values.

Job 6. Title: Analyze diet data.–As of the date of this report, spring 2005 diet samples were still being processed. No stomach samples were collected during the summer 2005 pre-recruit lake trout survey.

Job 7. Title: Model lean lake trout populations.–As mandated by the 2000 Consent Decree of the 1836 Great Lakes Fishing Treaty between the State of Michigan and Native American Tribes, statistical catch-at-age models were updated for wild lake trout populations in MI-5, MI-6, and MI-7 during 2004 (Figure 1). These models were used to develop the 2005 harvest quotas (also termed Total Allowable Catch or TAC) for lake trout.

The average instantaneous total mortality rates (Z) for ages 6 through 11 lake trout during 2002 to 2004 were: 0.29 $year^{-1}$ in MI-5, 0.31 $year^{-1}$ in MI-6, and 0.39 $year^{-1}$ in MI-7. These rates were

below the target maximum rate of 0.59 $year^{-1}$ (A=45%). With the exception of background natural mortality (M), sea lamprey predation was the dominant mortality source in all three populations. The dominant fishing mortality source was sport fishing in MI-5 and MI-6, and commercial fishing in MI-7. Spawning stock biomass produced per recruit (SSBR) has been used to assess overall population health status, and is defined as the cumulative mature biomass produced per female recruit through its life given a set mortality schedule. The current SSBR was based on the average mortality rates, female maturity schedule, and weight at age estimates during 2002 through 2004. In all three models, current SSBRs were above target SSBRs indicating that the populations have mortality rates that are not likely inhibiting population growth and reproductive potential (Figure 6).

Job 8. Title: Assess lake trout morphotypes.– During 2005, lean and siscowet lake trout samples were collected to study maturation, gonad development, and reproductive physiology in collaboration with University of Wisconsin-Milwaukee researchers. Samples were collected in early spring and summer. Another collection of samples is scheduled in the fall. On each sampling day, various tissues were collected from 10 male-female pairs of mature siscowet and leans for analysis in the lab. Standard external metrics were recorded and otoliths were collected for age assessment. Standardized digital photographs were also taken for each sampled fish. Preliminary findings have been presented at a scientific conference.

Job 9. Title: Write reports.– A manuscript titled "Growth and maturity of hatchery and wild lean lake trout during population recovery in Michigan waters of Lake Superior" was submitted to the Transactions of the American Fisheries Society. The manuscript was accepted for publication and is currently under revision. Stock assessment reports for 2004 Lake Superior lake trout total allowable catch limits for 1836 Treaty waters were written and currently under review.

Prepared by: S.P. Sitar
Dated: October 5, 2005

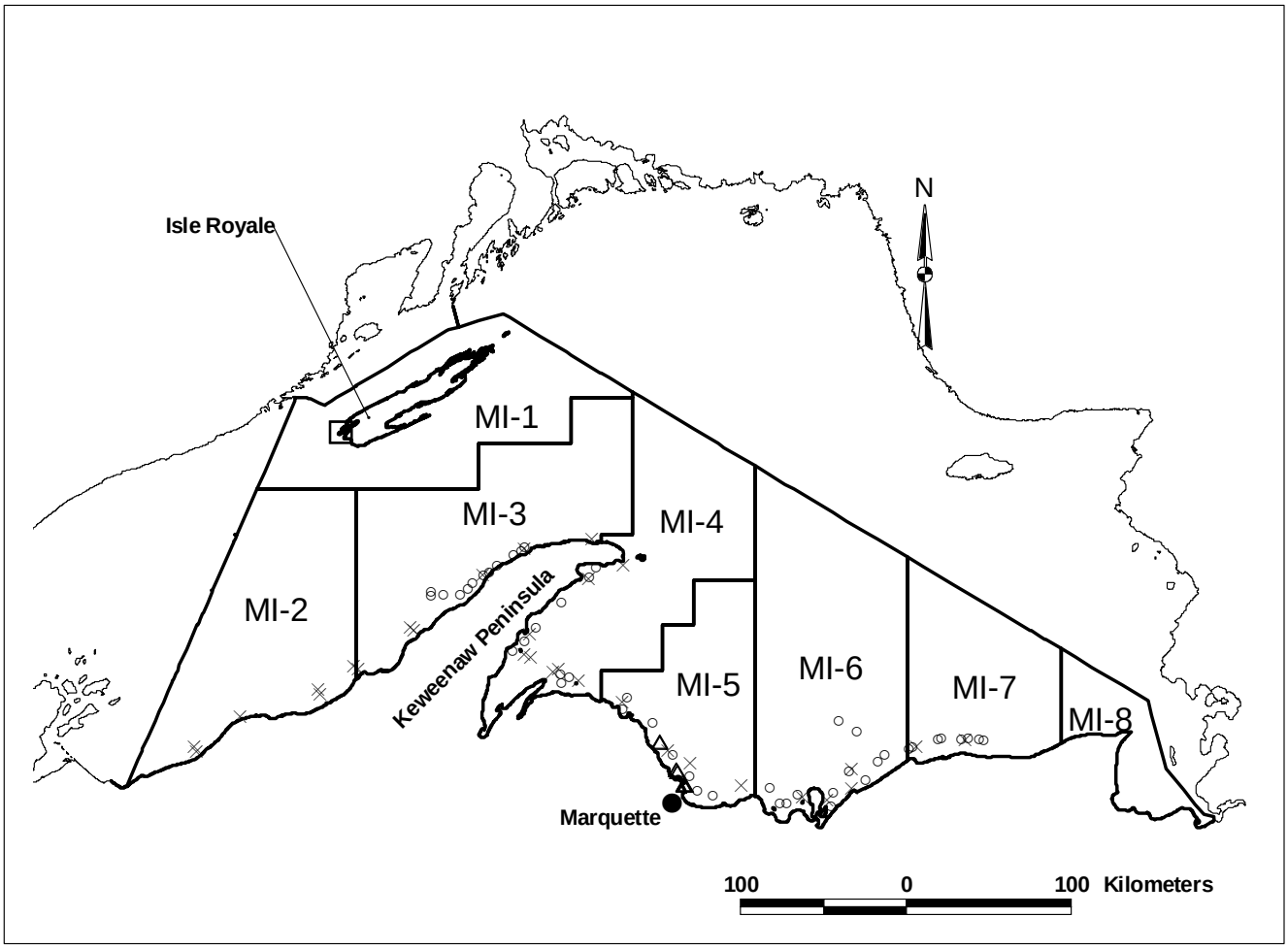

Figure 1.–Lake trout management units and lake trout survey sampling stations in Michigan waters of Lake Superior from October 2004 through September 2005. Open circles represent spring survey stations, Xs represent summer pre-recruit survey stations, and open triangles represent fall spawning survey stations.

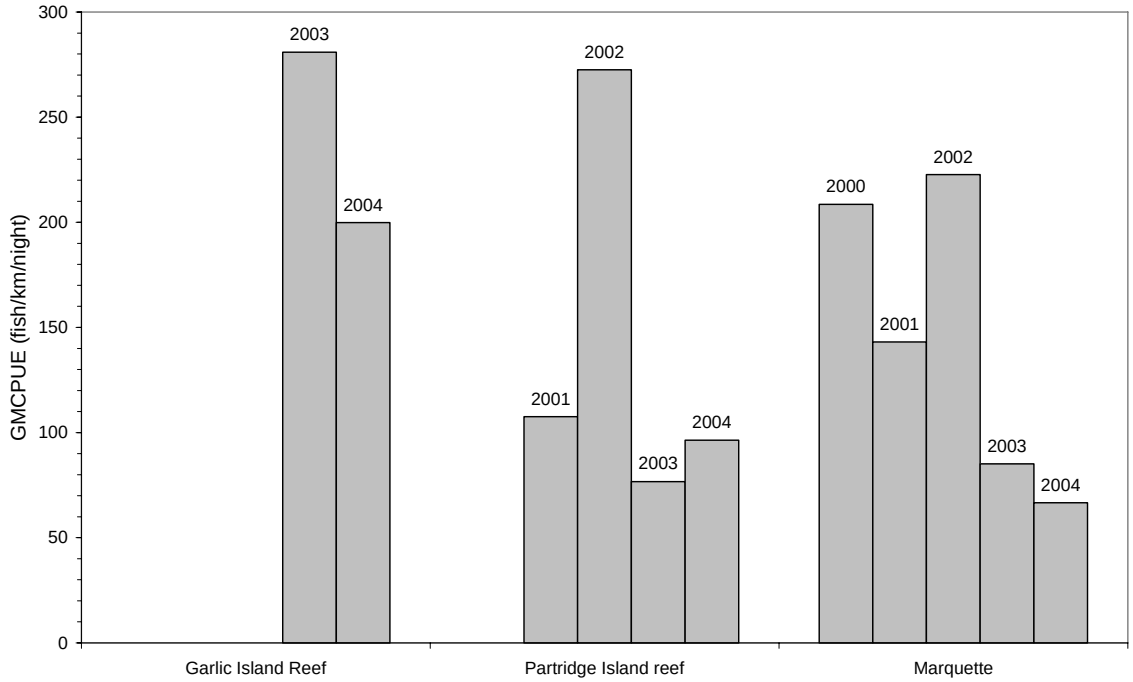

Figure 2.–Relative abundance of lean lake trout sampled during fall spawning surveys from 2000 to 2004 in the Marquette area (MI-5) of Michigan waters of Lake Superior. The graphs are presented with vertical bars in chronological order from left to right for each spawning area and the year indicated at the top of each bar. Relative abundance index based on the Geometric Mean Catch-Per-Unit-Effort (GMCPUE) expressed as the number of fish per km of net per night based on graded-mesh bottom gill nets (stretched mesh sizes: 11.4, 12.7, 13.0, 15.2 cm).

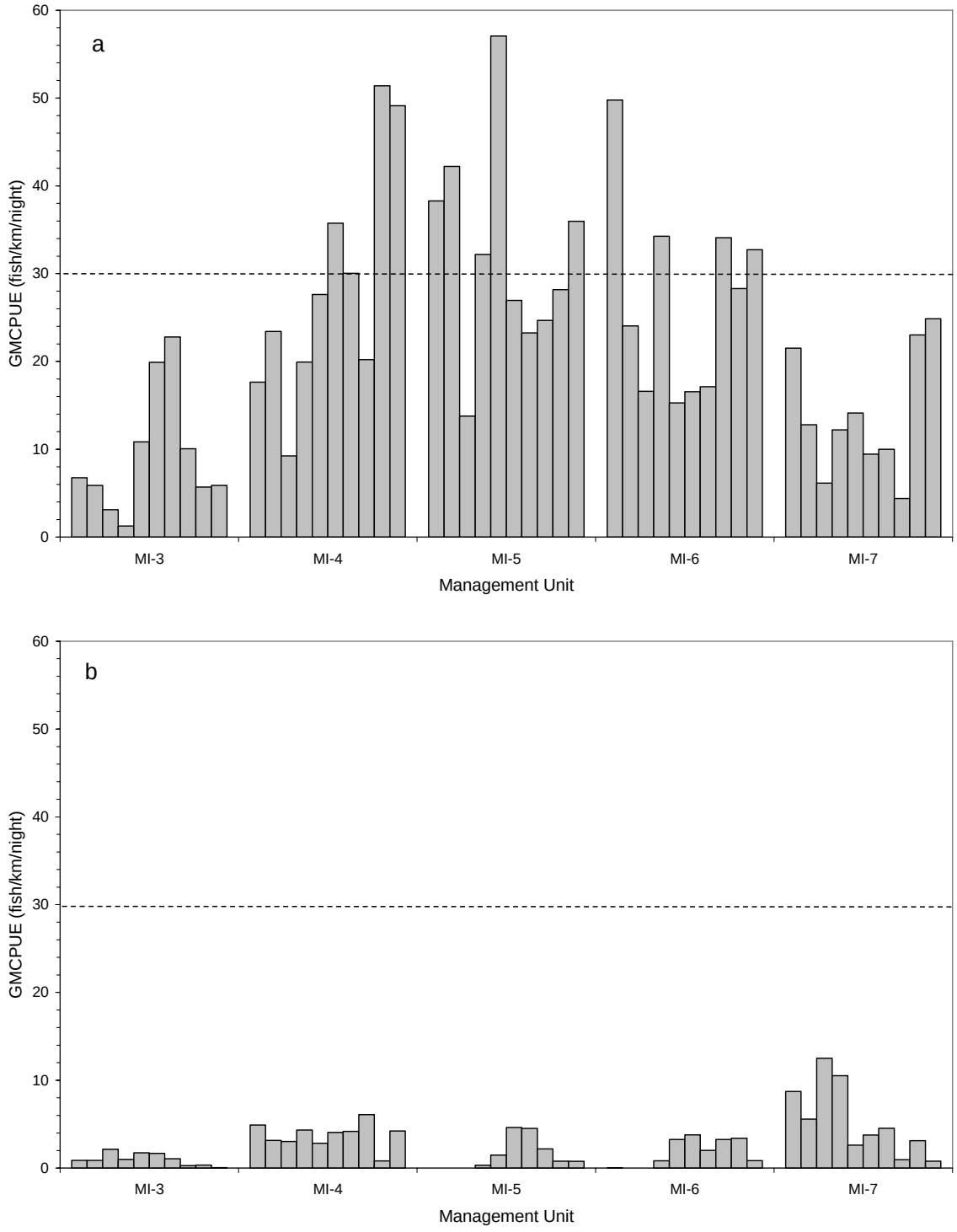

Figure 3.–Relative abundance of (a) lean and (b) siscowet lake trout sampled in spring surveys from 1996 to 2005 in Michigan waters of Lake Superior. The graphs are presented with vertical bars in chronological order from left to right for each management unit. The horizontal dashed line is a reference line (30 fish/km/night) for comparing the two graphs. Relative abundance index based on the Geometric Mean Catch-Per-Unit-Effort (GMCPUE) expressed as the number of fish per km of net per net night based on 11.4 cm stretched-mesh bottom gill nets.

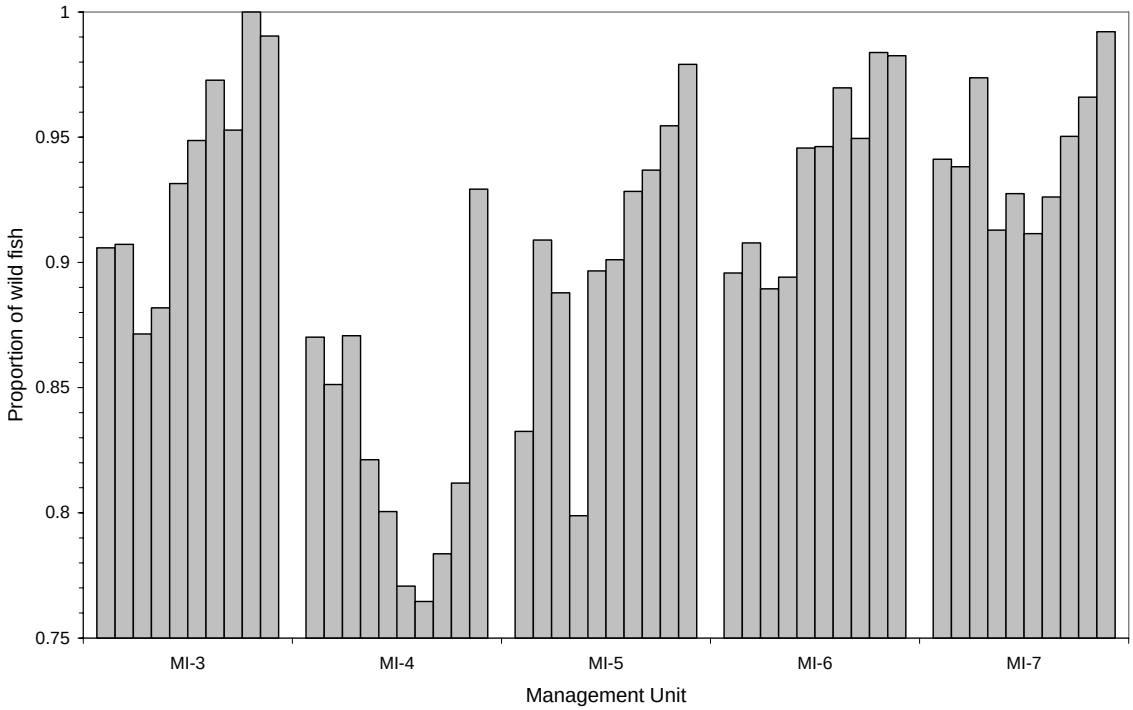

Figure 4.–Proportion of wild lean lake trout collected in annual spring lake trout surveys from 1996 to 2005 in Michigan waters of Lake Superior. The graph is presented with vertical bars in chronological order from left to right for each management unit.

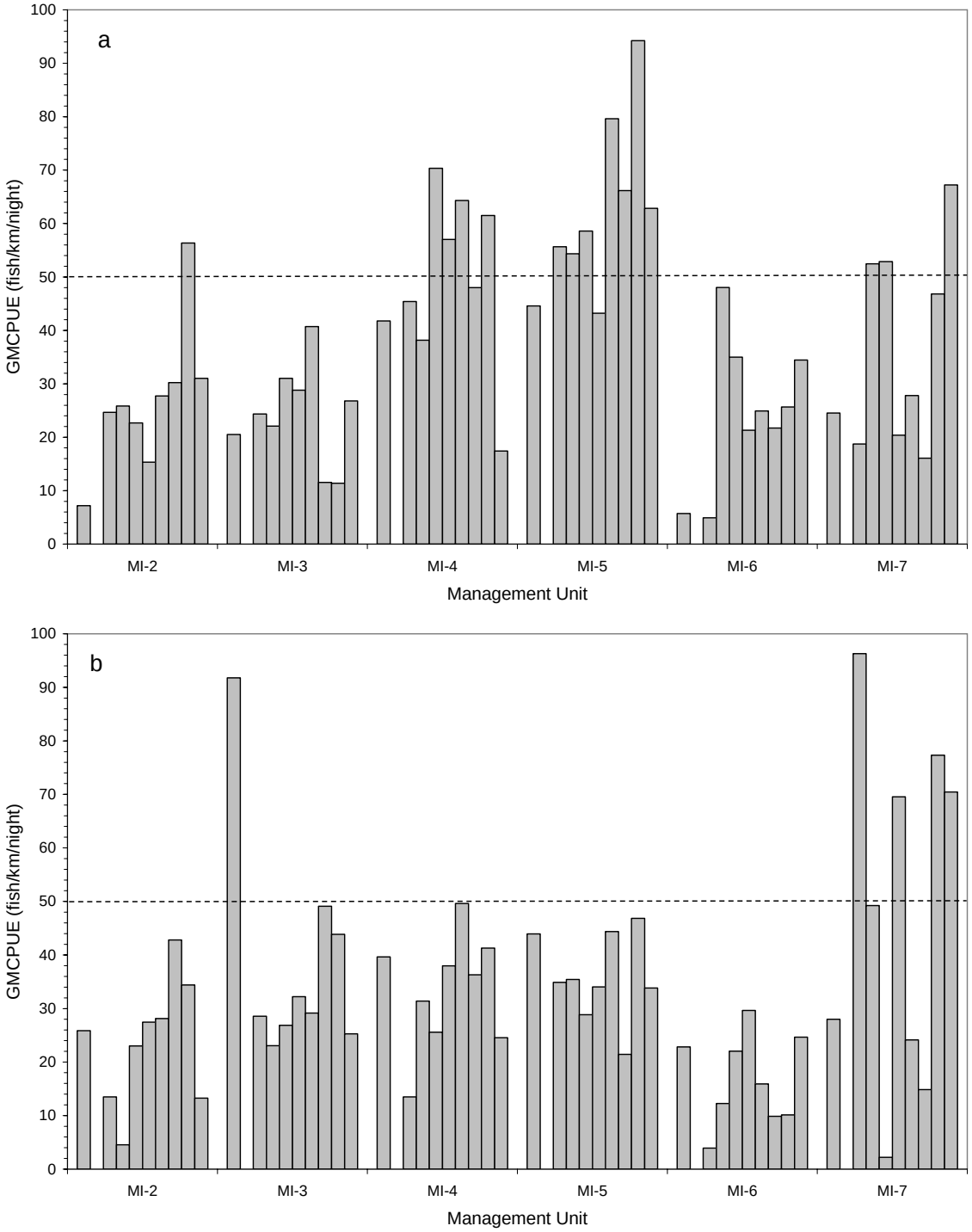

Figure 5.–Relative abundance of (a) lean and (b) siscowet lake trout sampled in summer pre-recruit surveys from 1996 to 2005 in Michigan waters of Lake Superior. The graphs are presented with vertical bars in chronological order from left to right for each management unit. No pre-recruit survey was conducted in 1997 as indicated by gaps for each management unit in the figure. Horizontal dashed line is a reference line (50 fish/km/night) for comparing the two graphs. Relative abundance index based on the Geometric Mean Catch-Per-Unit-Effort (GMCPUE) expressed as the number of fish per km of net per net night based on graded-mesh bottom gill nets (stretched mesh sizes: 5.1, 5.7, 6.4, 7.0, 7.6, 8.9 cm).

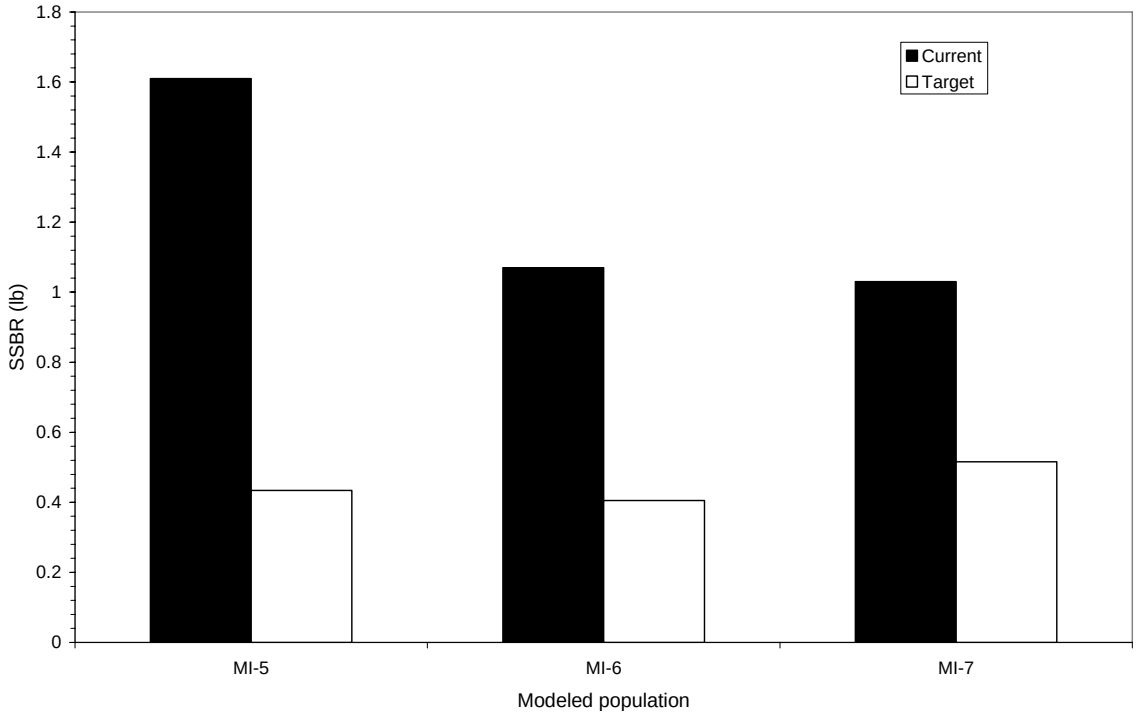

Figure 6.–Spawning Stock Biomass produced per Recruit (SSBR) values for wild lake populations in MI-5, MI-6, and MI-7 in 2004 based on results from statistical catch-at-age models. The target minimum SSBR value was based on the Great Lakes Fishery Commission target maximum total annual mortality rate of 45%.