

STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-3

Study No.: 495

Title: Assessment of lake trout populations in Michigan waters of Lake Superior

Period Covered: October 1, 2001 to September 30, 2002

Cooperators: Bay Mills Indian Community, Brimley, Michigan; Biology Department, Northern Michigan University; Chippewa Ottawa Resource, Sault Ste. Marie, Michigan; Department of Fisheries and Wildlife, Michigan State University; Great Lakes Indian Fish and Wildlife Commission, Odanah, Wisconsin; Isle Royale National Park, National Park Service; Peterson Fisheries, Hancock, MI; Keweenaw Bay Indian Community, Baraga, Michigan; Sivertson Fisheries, Duluth, Minnesota; Red Cliff Band of Lake Superior Chippewas, Bayfield, Wisconsin; and U. S. Geological Survey, Biological Research Division, 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 units. (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 units.

Summary: Compared to 2001, spring survey relative abundance of lean lake trout in 2002 increased in MI-3, MI-4, and MI-7, and declined in MI-4 and MI-5. Siscowet relative abundance as indexed in spring surveys remained relatively constant in all areas and was less than lean lake trout relative abundance. Pre-recruit lean lake trout relative abundance increased in MI-2, MI-3, MI-5, and MI-6 during 2002. Relative abundance of pre-recruit siscowets in 2002 increased in MI-2, MI-4, MI-5, and MI-6, and declined in MI-3 and MI-7. Wild lake trout statistical catch-at-age models for MI-5, MI-6, and MI-7 were used to estimate lake trout harvest quotas for state and tribal fisheries for 2002 in support of the 2000 Consent Decree of the 1836 Great Lakes Fishing Treaty. Average total annual mortality rates (1999-2001) for ages 6 to 11 were 28% in MI-5, 37% in MI-6, and 32% in MI-7. Spawning stock biomass per recruit values in MI-5, MI-6, and MI-7 were above the reference values indicating mortality rates were below target maximum rates.

Findings: Jobs 1, 2, 3, 4, 5, 6, and 7 were scheduled for 2001-02, and progress is reported below.

Job 1. Title: Assess commercial-sized lake trout.—During the fall of 2001, Marquette Fisheries Research Station (MFRS) personnel conducted a lean lake trout (*Salvelinus namaycush namaycush*) spawning survey in Presque Isle Harbor, Marquette, MI (MI-5). This was part of an ongoing cooperative study with the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) to index spawner relative abundance. Furthermore, this survey has an objective to tag lake trout to study movement patterns in support of the lake trout stock assessment models. The total number of lake trout caught was 836 with 84.4% of wild origin. There were 664 lake trout tagged with anchor tags and 59 recaptures from previous years. Otoliths were archived and

weights were recorded for the dead lake trout. Thermal/bathymetric archival data loggers were surgically implanted in 50 lake trout provided to GLIFWC personnel by MFRS.

Commercial-sized lean lake trout were sampled in the spring starting on 25 April and ending 21 June 2002. A contracted commercial fisher (Peterson Fisheries) under permit from GLIFWC fished seven stations in Management Unit MI-3 (Figure 1). Personnel aboard the R/V Judy sampled 10 stations in MI-4, 6 stations in MI-5, and 11 stations in MI-6. Chippewa Ottawa Resource Authority personnel sampled 8 stations in MI-7. The total number of fish sampled in the spring survey was 3,716 with 2,987 lake trout.

All spring and fall 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 for each management unit from the spring survey will be assessed for age using scales and/or otoliths collected from each fish.

During this performance period, commercial-sized lean lake trout were also sampled in MI-1 (Isle Royale) by Sivertson Fisheries (September-October 2001) and the National Park Service (June-August 2002). These data have not been processed due to limited staff hours available at MFRS.

Job 2. Title: Assess pre-recruit lake trout.—Pre-recruit lake trout were sampled in the summer starting on 23 July and ending 28 August 2002. Personnel aboard R/V Judy sampled 5 stations in MI-2, 7 stations in MI-3, 8 stations in MI-4, 4 stations in MI-5, 4 stations in MI-6, and 2 stations in MI-7 (Figure 1). The total number of fish sampled was 4,413 with 2,523 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 3. Title: Assess lake trout variety composition.—No work was done for this job during this performance period.

Job 4. Title: Analyze assessment data.

Spawner survey—Average lean lake trout relative abundance (CPUE= catch per unit effort) during the spawning season was 178 fish/km/day. The percentage of the daily catch of wild lake trout that was female ranged from 0% to 45.3%.

Spring survey—During 2002, relative abundance (GMCPUE= Geometric Mean Catch Per Unit Effort) of lean lake trout was higher than 2001 in MI-3, MI-6, and MI-7 (Figure 2a). Lean lake trout GMCPUE declined in MI-4 and MI-5. Siscowet GMCPUE has remained relatively constant during the last two years (Figure 2b). Siscowet GMCPUE was highest in MI-4 and MI-7. Overall, wild lake trout composed 91.2% of all lean lake trout catch (not adjusted for sampling effort). Spring sea lamprey wounding rates for 534-635 mm lean lake trout increased from 2001 in all units except MI-3. Wounding rates were highest in MI-7 at 9.9 wounds (Type A1-A3) per 100 fish and averaged 7.2 wounds per 100 fish in all management units.

Pre-recruit survey—Pre-recruit lean lake trout GMCPUE in 2002 increased in MI-2, MI-3, MI-5, and MI-6 (Figure 3a). Pre-recruit siscowet GMCPUE increased from 2001 in MI-2, MI-4, MI-5, and MI-6. Pre-recruit siscowet relative abundance declined in MI-3 and MI-7 (Figure 3b).

Job 5. Title: Analyze diet data.—Diet samples from the spring survey were lost because the storage freezer was accidentally unplugged. Summer survey diet samples were not collected this year.

Job 6. Title: Model lean lake trout populations.—Statistical catch-at-age models were updated for wild lake trout populations in MI-5, MI-6, and MI-7 (Figure 1). These models have been used to develop harvest quotas (also termed Total Allowable Catch or TAC) for lake trout in accordance with the 2000 Consent Decree of the 1836 Great Lakes Fishing Treaty between the State of Michigan and Native American Tribes. Overall, model results indicated abundant wild lake trout populations in MI-5 and MI-7 with mortality rates below the target maximum rate ($A=40\%$) established by the Great Lakes Fishery Commission. The MI-6 model had to be modified in order to attain convergence. There is great uncertainty in parameter estimates for the MI-6 model, and the stock sizes estimated by the model are lower than expected and seem inconsistent with fishery catch per effort data. Further work is underway to evaluate MI-6 data and model code.

The status of the lake trout populations was indexed by comparing Spawning Stock Biomass produced per Recruit (SSBR) values with the target value. This index is a measure of the reproductive capacity of the population in the context of mortality rates. The SSBR for each population is the sum of the mature female biomass produced per recruit under recent mortality rates (mean of 1999-2001 rates). The target SSBR is the theoretical amount of SSBR produced if all fish older than age 7 suffer the target maximum total annual mortality rate of 40%. This method of indexing population health accounts for the age-specific differences in mortality rates from fishing and sea lamprey predation and incorporates the reproductive capacities of each population.

Recent total abundance (mean of 1997-2001) of ages 4 to 15 wild lake trout was estimated to be about 930,000 fish in MI-5; 108,000 fish in MI-6; and 491,000 fish in MI-7 (Figure 4). During the 1999 to 2001, total annual mortality has been below the target maximum rate for MI-5, MI-6, and MI-7 (Figure 5). Mean total annual mortality rates during 1999 to 2001 for ages 6 to 11 wild lake trout were 0.28 year^{-1} in MI-5, 0.37 year^{-1} in MI-6, and 0.32 year^{-1} in MI-7. Recreational fishing mortality was the dominant mortality source in MI-6 during 1999-2001. Sea lamprey mortality was the dominant mortality source in MI-5 and MI-7. The SSBR values were above the target in all management units modeled (Figure 6).

These modeling results were used to estimate lake trout harvest quotas for 2002. Currently, hatchery lake trout models have been partially developed for MI-5, MI-6, and MI-7. Data have been partially assembled for MI-2, MI-3, and MI-4 wild and hatchery lake trout models.

Job 7. Title: Prepare reports.—Draft reports on lake trout TAC recommendations for 2002 have been written for the 1836 Treaty Technical Fisheries Committee. This progress report was prepared on schedule.

Prepared by: S. P. Sitar

Dated: September 30, 2002

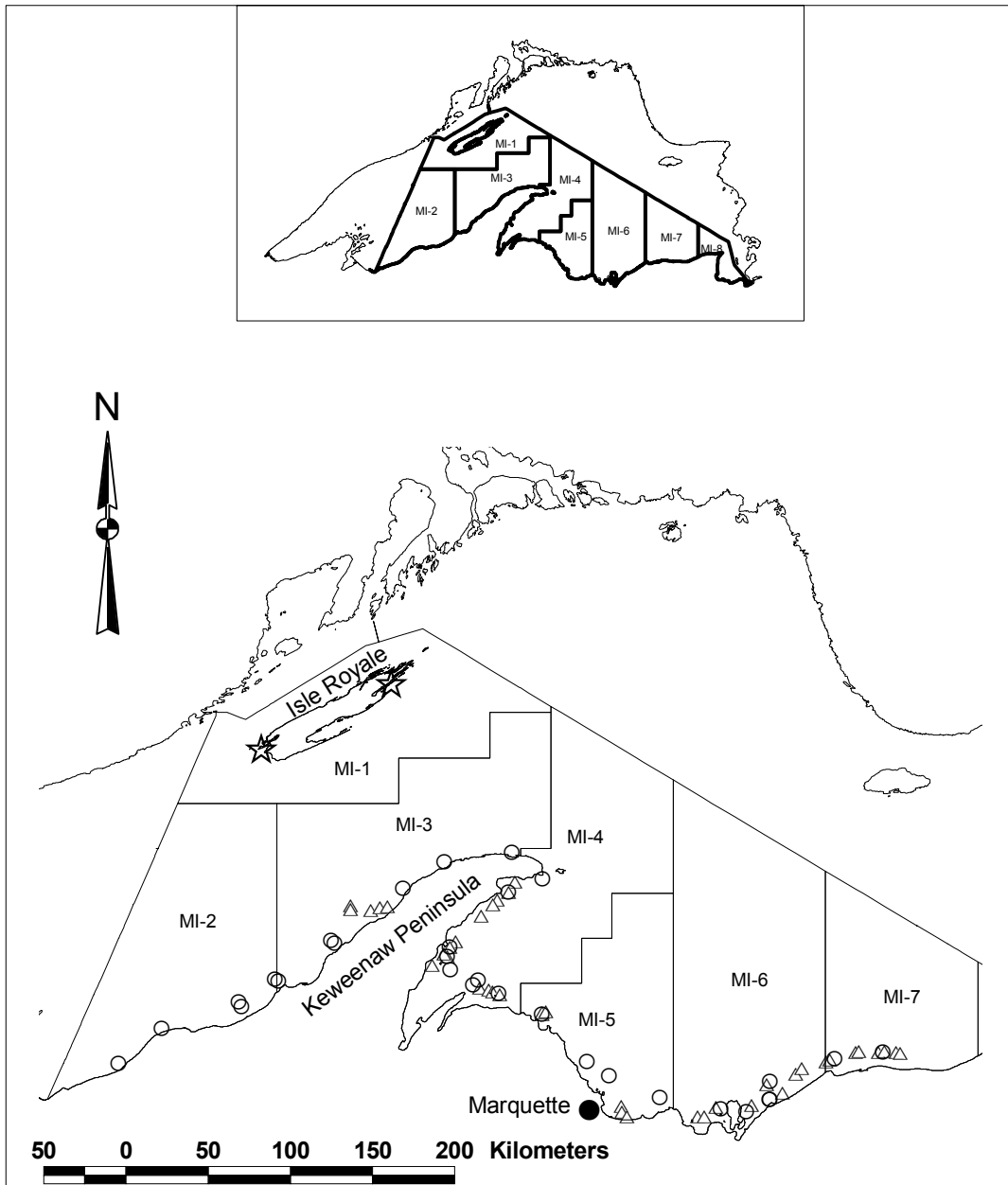


Figure 1.—Lake trout management units and lake trout survey sampling stations in Michigan waters of Lake Superior for 2002. Triangles represent spring survey stations, circles represent summer pre-recruit survey stations, and stars represent Isle Royale survey stations.

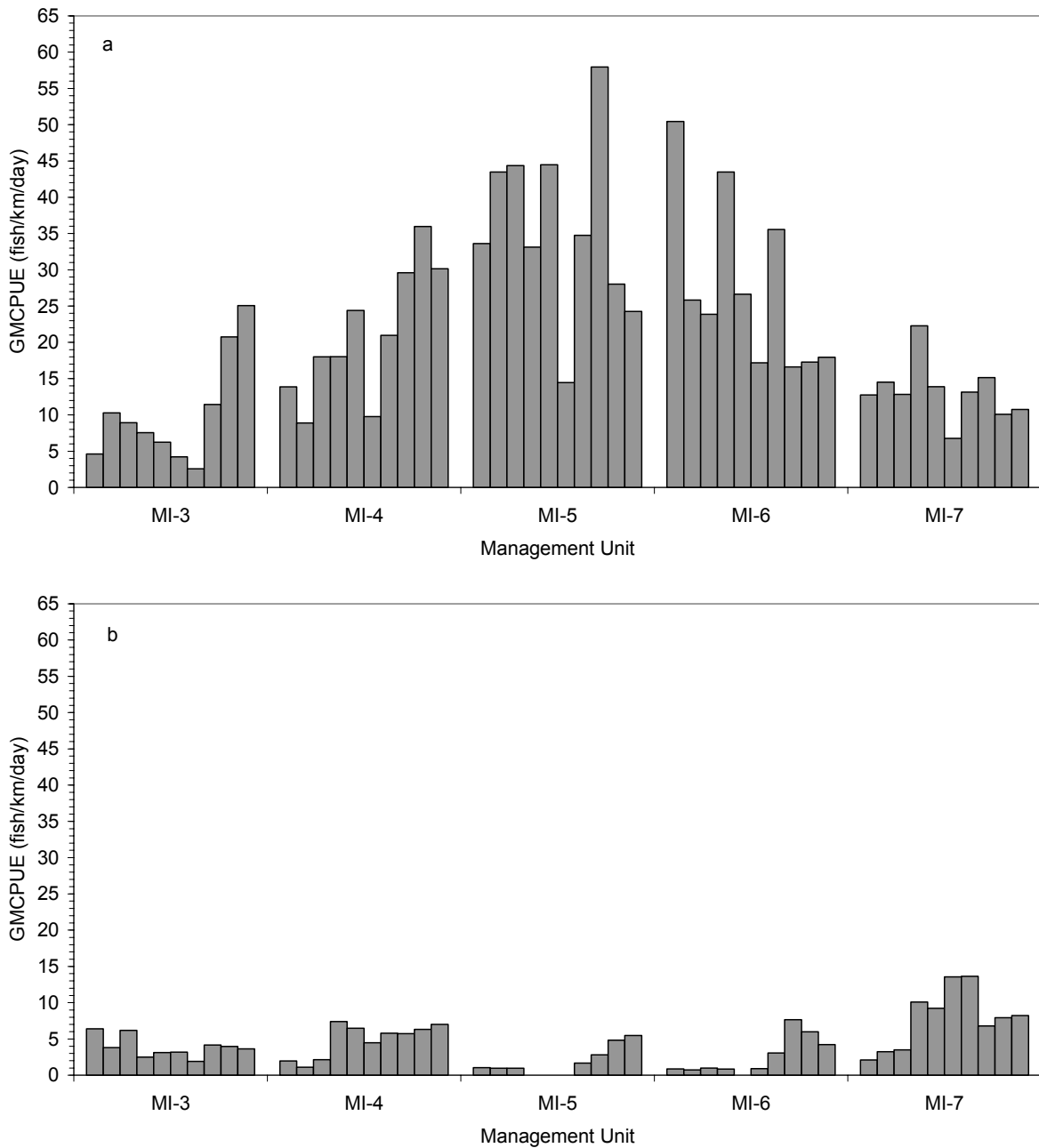


Figure 2.—Relative abundance of (a) lean and (b) siscowet lake trout during spring surveys from 1993 to 2002 in Michigan waters of Lake Superior. The graphs are presented with vertical bars in chronological order from left to right for each management unit. Data expressed as geometric mean catch per unit effort (GMCPUE) based on 11.4 cm stretched-mesh bottom gill nets.

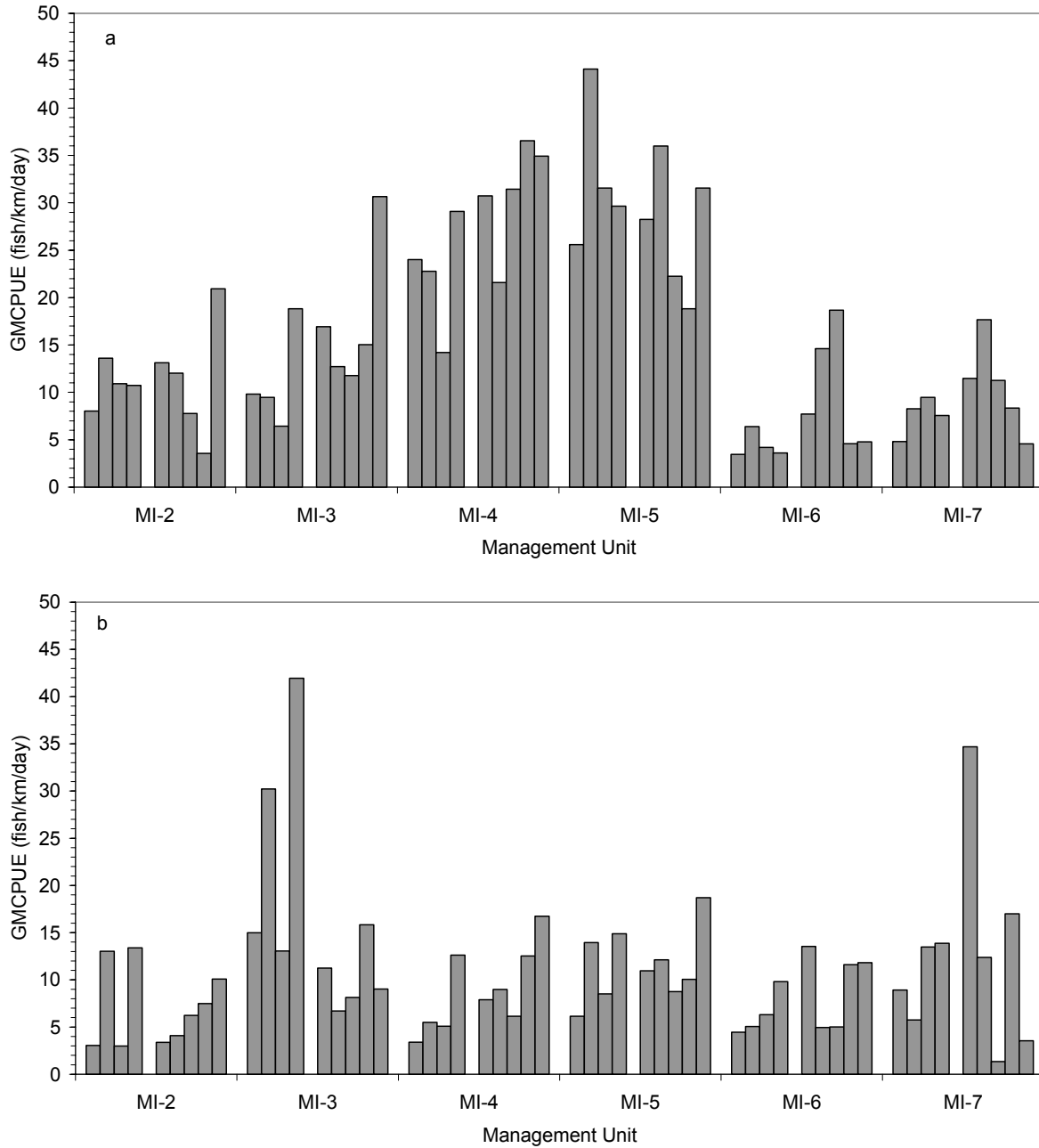


Figure 3.—Relative abundance of pre-recruit (< 432 mm total length) (a) lean and (b) siscowet lake trout during summer surveys from 1993 to 2002 in Michigan waters of Lake Superior. The graphs are presented with vertical bars in chronological order from left to right for each management unit. Data expressed as geometric mean catch per unit effort (GMCPUE) based on graded-mesh bottom gill nets (stretched mesh sizes=5.1, 5.7, 6.4, 7.0, 7.6, 8.9 cm). No pre-recruit survey was conducted in 1997.

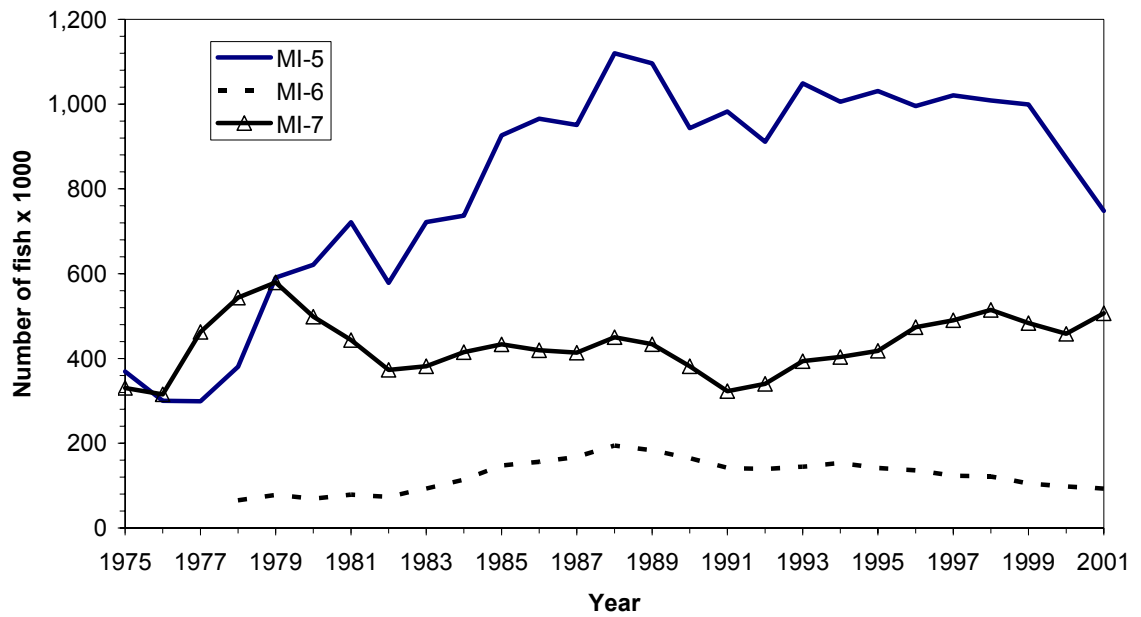


Figure 4.—Annual abundance of ages 4-15 wild lake trout in MI-5, MI-6, and MI-7 based on estimates from statistical catch-at-age models.

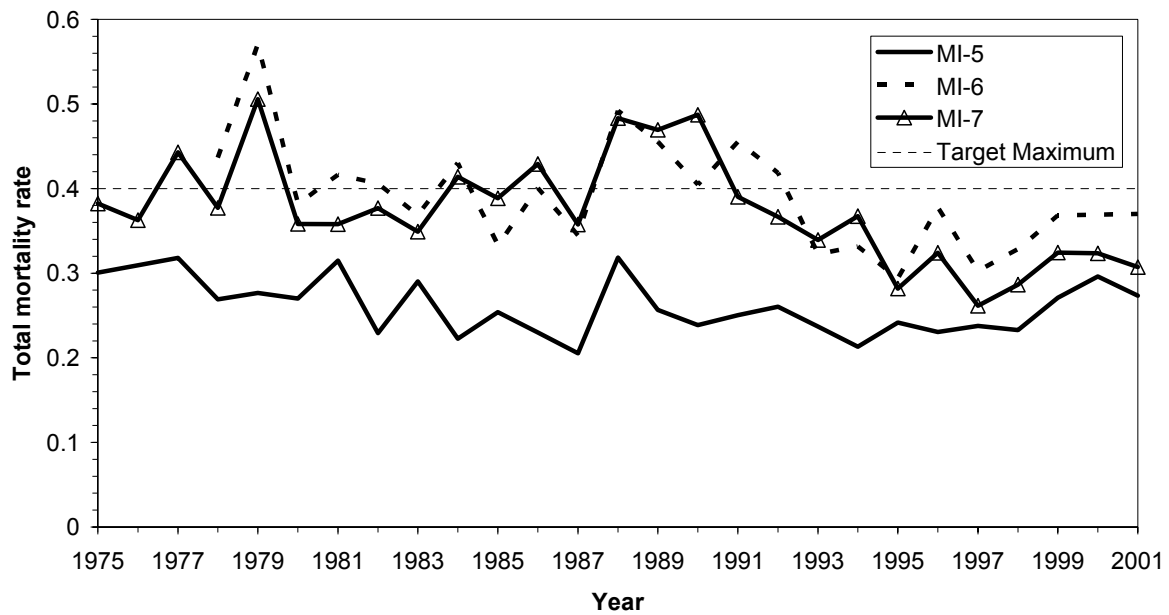


Figure 5.—Total annual mortality rates for wild lake trout (average of ages 6 to 11 fish) during 1975-2001 in MI-5, MI-6, and MI-7 based on statistical catch-at-age models. The thin dashed line indicates the Great Lakes Fishery Commission’s lake trout rehabilitation target maximum mortality rate of 0.4.

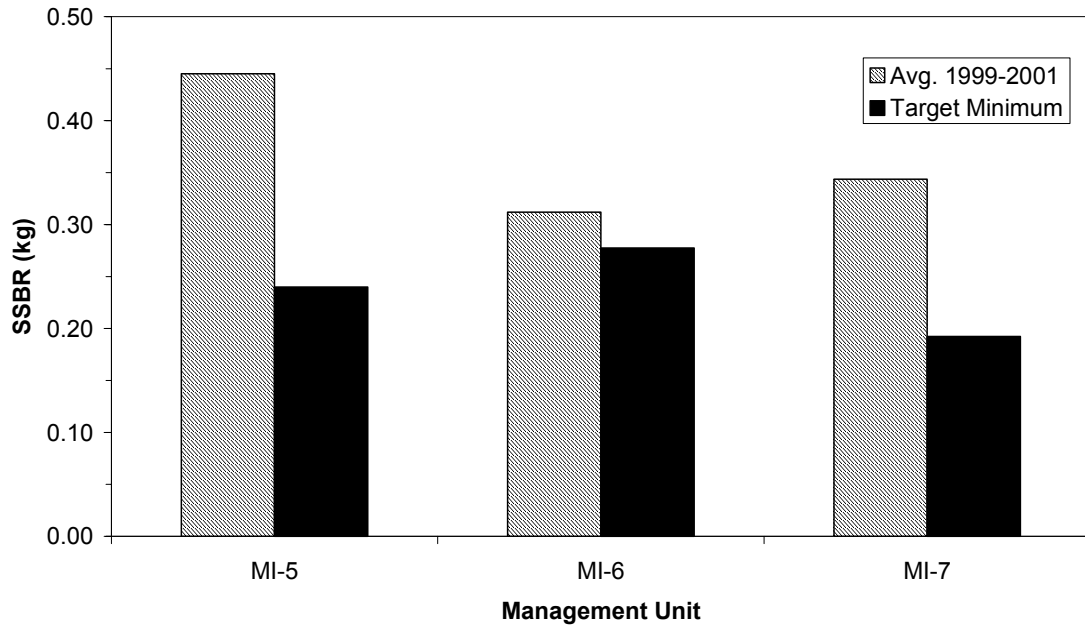


Figure 6.—Reproductive index of wild lake trout populations in MI-5, MI-6, and MI-7 based on results from statistical catch-at-age models. Reproductive index was measured using Spawning Stock Biomass produced per Recruit (SSBR) values. The target minimum SSBR value was based on the Great Lakes Fishery Commission target maximum total annual mortality rate of 40%.