Report of the
Coldwater Task Group
To the
Standing Technical Committee
Of the
Lake Erie Committee

28 March 2002

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Background

The Cold Water Task Group (CWTG) is one of several technical groups under the Lake Erie Committee (LEC) structure that addresses specific charges related to the coldwater fish community. Originally, the CWTG's primary function was the coordination, collation, analyses, and reporting of annual lake trout assessments among its five member agencies and assessing the results toward rehabilitation status. Restoration of lake trout into its native eastern basin Lake Erie habitat began in 1978 when 236,000 surplus yearlings were obtained from a scheduled stocking in Lake Ontario. Similar numbers of yearlings were also available for Lake Erie in 1979. In 1982, the Pennsylvania Fish and Boat Commission (PFBC), the U.S. Fish and Wildlife Service (USFWS), and the New York Department of Environmental Conservation (NYSDEC) formed a cooperative partnership for lake trout rehabilitation in Lake Erie. From 1982-1994 an average of approximately 200,000 yearlings were stocked. A formal rehabilitation plan was developed in 1985 and still serves as the working document guiding current assessment efforts.

In more recent years, interest in the expanding burbot and lake whitefish populations, as well as predator/prey relationships involving salmonines and rainbow smelt interactions have prompted additional charges from the LEC. Rainbow/steelhead trout dynamics have recently entered into the task group's list of charges. A new charge concerning lake herring was added in 1999.

This report is specifically designed to address each charge presented to the CWTG at the LEC's, annual meeting, held 27-28 March 2002. Data have been supplied by each member agency, when available, and combined for this report if the data conform to standard protocol. Individual agencies may still choose to report their own assessment activities, under separate agency letterhead.

Charge 1: Coordinate standardized lake trout assessments among all eastern basin agencies, and prepare a report of the status of lake trout rehabilitation.

Methods:

A stratified, random design, deepwater gill net assessment protocol for lake trout has been in place since 1986. NYSDEC modified the protocol in 1996 by using nets made of monofilament mesh, instead of the standard multifilament nylon mesh. This modification was made following two years of comparative data that detected no significant difference in the total catch between the two net types (Culligan et al. 1996). In 1998 and 1999, all CWTG agencies except PFBC, which still uses nets made of multifilament nylon mesh, switched to standard monofilament assessment nets to sample eastern basin lake trout. Some question still exists about the compatibility of PFBC's gear to standardization due to their use of nylon mesh graded by 6.4 mm increments, rather than the standard 12.7 mm increment.

Net panels, each 15.2 m long, are randomly tied together to form 152.4 m gangs. Each panel consists of 38 to 152 mm, by 12.7 mm increments, material. Gangs are set overnight, on bottom, along the contour and perpendicular to a randomly selected north/south-oriented transect during the month of August, or possibly into early September prior to fall turnover.

Sampling design divides the eastern basin of Lake Erie into eight equal areas using north/south-oriented 58000 series Loran C Lines of Position (LOP) bounded on the west by LOP 58435 and on the east by LOP 58955 (Figure 1.01). Each area contains 13 equidistant north/south-oriented LOPs that serve as transects. Three transects are randomly selected in each area and sampled first. Once completed, the whole process is repeated, including random selection. A full compliment of standard eastern basin effort should be 60 standard lifts each for New York and Pennsylvania waters (2 areas each) and 120 lifts from Ontario waters (4 areas total). This amount of effort has never been achieved, to date.

Sampling protocol calls for the first net gang to be set along the contour, where the 8° to 10°C isotherm intersects with the bottom (top of net needs to be in this stratum). The next three gangs are set at increments of 1.5 m greater depth or 0.8 km distance from the previous (shallower) gang, whichever occurs first along the transect toward deeper/colder water. The fifth and deepest net gang is set 15 m deeper than the shallowest net (number 1) or 1.6 km distance from net number 4, whichever occurs first.

NYSDEC and PFBC have been responsible for completing standard assessments in their jurisdictional waters since 1986 and 1991, respectively. The Sandusky office of the U.S. Geological Survey (USGS) has assumed responsibility for standard assessments in Canadian waters since 1992. The Ontario Ministry of Natural Resources (OMNR) began coordinating with USGS in 1998 to complete standard assessments in Canadian waters. In 2001, NYSDEC made 60 unbiased lifts, PFBC made 30 lifts, and USGS/OMNR made 20 unbiased lifts. Total effort for 2001 was 110 unbiased standard lake trout assessment lifts in the eastern basin of Lake Erie.

All lake trout are routinely examined for total length, weight, sex, maturity, fin clips, and sea lamprey wounding classification. Snouts from each lake trout are retained, and coded-wire tags (CWT) are extracted in the laboratory to accurately determine age and genetic strain. Scale samples and otoliths are also retained from most fish for aging when CWTs are not retrievable at the laboratory. Stomach data are usually collected as on-site enumeration or as preserved samples.

Results and Discussion:

Abundance

Sampling was conducted in seven of the eight standard areas in 2001, collecting a total of 291 lake trout (Figure 1.01). The age structure of the population continues to expand with 16 year-classes present from age 1 to 17 (Table 1.1). Young fish (age 2, 3, and 4) were the most abundant cohorts, representing 55% of the total catch (Fig. 1.02). Older fish (age-10-and-older) were also well represented (24%) in the population. The largest lake trout sampled measured 953 mm and weighed 10.36 kg (37.5 inches, 22.6 lbs). This was the largest specimen yet recorded from the Lake Erie lake trout gill net survey.

Overall lake trout catches by standard assessment area in 2001 indicate that the majority of the lake trout were in New York waters, similar to results in 1998 and 1999 (Fig. 1.01). Lake trout

Catch per lift (i.e., catch per unit effort, or CPE) decreased along northerly and westerly gradients. Areas A1-A3 continued to produce the most consistent catches from year to year, coinciding with the areas where stocking of yearling lake trout occurs. Effort in areas A5 – A8 was only half the normal effort (i.e., 20 sets instead of the normal 40) due to personnel shortage, possibly affecting overall catch rates in those areas.

The overall relative abundance of lake trout in 2001 was 2.07 individuals per standard lift (Figure 1.03). This represented an increase over the 1998 – 2000 indices (average = 1.46 lake trout/lift), which are the low point of the time series thus far. However, the 2001 index is still lower than the 1992 – 1997 indices (average = 2.63 lake trout/lift). The 2001 results may indicate the beginning of an upswing in the lake trout population towards a more abundant, stable population in Lake Erie.

Expansion of the adult (age-5-and-older) lake trout population, in response to initial sea lamprey treatments in 1986, has been monitored annually from standard assessments (Figure 1.04). A significant ($P<.05$) drop in abundance was observed in 1998, following a 6-year (1992-1997) period of steady growth. The relative index of abundance for age-5-and-older lake trout rebounded slightly in 2001, but was still low compared to indices of the early and mid-1990's. The 2001 index of 1.18 fish/lift was the second lowest index recorded (lowest in 2000) since the rapid build-up of the adult population due to improved survival following initial sea lamprey treatments in 1986-1987.

Recruitment

An increase in the age 1-3 juvenile abundance index occurred again in 2001, marking the second consecutive year that an increase has occurred (Figure 1.05). The juvenile abundance index of 1.06 fish/lift was at its highest level since 1992. Yearlings (age 1), although less abundant than the previous two years, were again present in gill net catches for the third consecutive year. Prior to this, yearlings were virtually absent from our samples since 1993. Catches of age 2 and age 3 lake trout were also at their highest levels since 1994 and 1992, respectively. Overall juvenile abundance, although not a complete index due to their lack of full vulnerability to sampling gear, still suggests that they, as a group, are less abundant today than they were in the mid to late 1980's in Lake Erie.

An age 2 recruitment index was developed to show patterns in yearly recruitment. The age 2 recruitment index was calculated by dividing age 2 CPE from NYSDEC standardized gill nets by the number of fish in that year class stocked, thus provided a stocking corrected age 2 CPE. The recruitment index shows a significant decline ($P<0.001$, $r^2 = 0.80$) in recruitment to age 2 from 1986 through 1999 (Figs. 1.05, 1.06). Increases were seen in 2000 and 2001, however, possibly due to new offshore stocking techniques or to suppressed levels of adult lake trout abundance.

Survival

Estimates of annual survival from standard eastern basin assessment gill net catches will not be reported by the CWTG until further analysis can be completed. Previous estimates of annual survival were calculated from age-based catch curves. The CWTG was not confident that survival estimates based upon age-based catch curves were accurately estimating the survival of lake trout in Lake Erie. The lake trout rehabilitation plan calls for survival of 60 percent or better (Lake Trout Task Group 1985).

As stated in the 2001 Coldwater Task Group Report (Murray 2001), lake trout survival estimates by catch curve analysis is a misleading representation of the lake trout rehabilitation progress. Low abundances of age 5 through age 9 lake trout, which experienced poor to almost non-existent juvenile recruitment (Fig. 1.04: 1993 – 1997) combined with higher abundances of older (ages 10+) lake trout (higher juvenile recruitment) were sampled that flattened out the catch curve to provide the survival estimate. So, while recruitment and survival of the older age classes was exceptional, recruitment and survival to the middle ages appears poor. Recent meetings of the CWT have discussed the problem with survival estimates based upon catch curves, and an effort is currently underway to develop revised estimates of survival using cohort analysis or stocking-corrected catch curve analysis.

Growth

Mean lengths-at-age and mean weights-at-age of all sampled eastern basin lake trout did not significantly deviate from long-term averages (Figures 1.07 and 1.08). Long-term averages from three time periods (1986 - 1990, 1991 - 1995, 1996 - 2000) indicate that lake trout growth has been consistent to slightly increasing since sampling began in 1985 with the majority of growth in length occurring by age 10 with fish reaching around 800 mm TL and weighing 6,000 g. Overall growth of lake trout in Lake Erie continues to be some of the best in the Great Lakes basin.

Maturity

Thirty-two mature females ranging from age 3 through 17 were sampled in standard assessment gill nets in 2001, generating a mean age of maturity of 8.4 years (Figure 1.09). This marks the fourth consecutive year that mature female lake trout have met or exceeded the target mean age established in the Strategic Plan of 7.5 years (Lake Trout Task Group 1985). The plan objective assumes that adult females would need at least two spawning years to contribute to the production of detectable, natural reproduction. Female lake trout in Lake Erie reach 100% maturation by age 5 (Culligan et al. 2002).

Natural Reproduction

Despite over 20 years of stocking, a naturally reproduced lake trout has yet to be documented in Lake Erie. Six potentially wild fish were sampled in the NYSDEC coldwater gill net survey in 2001, making 12 fish over the past two years. Unfortunately, a positive means of determining a fry stocked fish from a wild fish have not been found at this time. Samples of lake trout otoliths were sent to Dr. Pat Sullivan at the Natural Resources Department at Cornell University to determine if hatchery temperature marks and structural differences can be identified between hatchery released yearlings and hatchery released fry lake trout.

An overnight gill net set for spawning lake trout was completed in early November by the NYSDEC. Gill nets of 127, 140, 152, 178, and 203 mm were fished at two offshore sites near Brocton Shoals and two nearshore sites at Van Buren Reef. Brocton Shoal was known to be a traditional spawning location of native Lake Erie lake trout and contains optimal deepwater spawning habitat. Nearshore areas, although suitable in substrate, tend to be less suitable for egg survival due to wind and wave action.

Results of the survey revealed that the majority of lake trout were still residing in the nearshore spawning areas compared to the offshore areas. A total of 16 lake trout were caught nearshore and only one offshore. Interestingly, all nearshore fish were hatchery positive while the lone offshore fish was wild or from a past fry planting. These same two locations were fished in 1992 with similar results.

Diet

Analysis of the stomach contents of lake trout in the eastern basin of Lake Erie revealed a diet of 89% fish, 10% dreissenids, and 1% *Bythotrephes cederstroemi* (B.C) (Figure 1.10). Of the fish species consumed by lake trout, 99% were smelt (Figure 1.11). Round gobies were absent in lake trout stomachs, but were a significant portion of the diet for burbot (22%).

Stocking Strain

A preliminary analysis was conducted to assess the performance of the lake trout strains currently stocked into Lake Erie and is included in Appendix A. The analysis looked at longevity, CWT returns, paired stocking comparisons, sea lamprey wounding rates, and 2001 NYSDEC survey results between the three current stocking strains (Superior, Finger Lakes, and Lewis Lake). The results of the analysis favor the Finger Lakes (FL) stocking strain in all aspects when compared to the other two strains. Recommendations are to minimally stock 80,000 FL strain lake trout each year and eliminate stocking of the Lewis Lake strain.

Additionally, the CWTG will pursue the addition of the banker (humper) lake trout strain to stock into Lake Erie. This strain originates from the Klondike Reef in Lake Superior. Unlike lake trout strains currently stocked in Lake Erie, bankers are a deepwater spawning strain that have evolved for feeding and spawning over deepwater reef areas, such as Brocton Shoal. More importantly, bankers have been shown to be the most genetically diverse strain of all the Federal Hatchery fish, which is important in the development of a naturally reproducing population in Lake Erie. The addition of this strain to the Lake Erie lake trout stocking program will potentially replace both the Superior and Lewis Lake strains. Progress of this new strain will be reported in following CWTG reports.

Stocking

The current lake trout goal of 120,000 yearlings stocked was met for the third straight year (Figure 1.12). The Allegany National Fish Hatchery (ANFH) supplied all of the lake trout with 80,000 Superior strain fish delivered to New York and 40,000 Seneca (Finger Lakes) strain stocked in Pennsylvania waters of Lake Erie. Due to repair problems with the NYSDEC boat

ARGO, New York fish were shore stocked (compared to offshore) at Barcelona Harbor from 30 May to 4 June, 2001 while Pennsylvania lake trout were planted inshore at Safe Harbor Marina on 24 May 2001. All stocked lake trout were implanted with coded-wire tags (CWT) and adipose fin-clipped prior to release.

Lake trout sac fry from ANFH were stocked on cobble material on Brocton Shoal by NYSDEC personnel using SCUBA on 9 May 2001. The 130,200 lake trout fry was well below the stocking goal of 500,000 fry. All lake trout fry were otolith marked, by exposure to temperature change, prior to release for future identification.

A paired planting of yearling lake trout to compare survival and growth rates of large versus small stocking size was continued in 2001. This comparison started in 2000. Yearling lake trout averaging 11.5 and 7 fish/pound were stocked by ANFH on 30 May to 4 June 2001 in Barcelona Harbor. Each of the size groups consisted of 40,000 fish and had different CWT numbers. Initial results are favoring the larger stocked fish with 25 of the 34 returns being the larger-sized planting (2.8:1 return ratio) and an average of 33 mm larger in length at age 2. Returns of age 1 fish, which were few (3), also favor the larger sized stocking. Future assessments will continue to evaluate the size and frequency of these size groups to determine if the size of the yearlings stocked affects recruitment to adult sizes.

Sea Lamprey Activity

Despite continued effort, lake trout wounding rates by sea lamprey remained well above target levels established by the Lake Trout Task Group (1985b) and above high lamprey control period levels found in 1988 – 1996. Observed fresh (A1-A3) wounding rates on lake trout greater than 532 mm total length increased for the third straight year (Figure 1.13). The rate of 20.3 wounds per 100 fish in 2001 was the second highest rate since sea lamprey treatments took effect in 1987, and exceeded the target rate of 5 wounds per 100 fish for the sixth consecutive year. Most (78.6%) of the fresh lake trout wounds occurred in fish greater than 734 mm. Only two lake trout between 533 and 633 mm had sea lamprey wounds.

A4 wounds, which indicate the past year's cumulative attacks, were higher than 2000 rates, but were still lower than the rates observed in 1997 - 1999 (Figure 1.14). The observed 2001 attack rate was 18.8 wounds per 100 fish for lake trout greater than 532 mm. No A4 wounds were found on lake trout less than 634 mm.

Charge 2: Continue to assess the whitefish and burbot population age structure, growth, diet, seasonal distribution and other population parameters

Whitefish

Commercial Harvest

The total harvest of Lake Erie whitefish in 2001 was approximately 1.2 million pounds, representing a decline of 11% from 1999. Ontario accounted for 96% of the total harvest in 2000, most of which was from gill nets (99.3%). Approximately three percent (5%) of the Lake

Erie whitefish harvest was from Ohio, while the harvest from Pennsylvania trap nets was zero (Figure 2.1). The whitefish fishery in Ohio was conducted with trap nets set around islands in the western basin (O1) in November and December.

Relative harvests from gill nets in Ontario waters were 52%, 42%, 5%, 0.5%, and 0.2% for statistical districts (OE) 1 to 5, respectively. The majority of the Ontario harvest from the western basin (93.6%) was caught from October to December with the peak occurring during November. In the central basin, most of the harvest (93.1%) was taken from March to June. Whitefish catches in Ontario statistical districts 4 and 5 were negligible.

The age composition of whitefish caught during Ontario's fall fishery in statistical district 1 included fish ages 3 to 10, with 5 year-olds (1996 year class) representing 39% of the catch (Figure 2.2). Whitefish ages 3 to 13 comprised Ohio's harvest, with age 6 (1995 year class) representing the largest component (19%). The mean age of whitefish harvested from Ohio waters (6.7) was higher than the previous year (5.4) and higher than the mean age of Ontario's fall harvest in the western basin (5.6) (Figure 2.3).

Ontario's 2001 fall commercial gill net CPUE (33.6 kg / km) decreased 20% from 2000 (41.2 kg / km) (Figure 2.3). There was more targeting of whitefish by fishermen and targeted fishing produced a much higher CPUE. This has potential to bias the CPUE, so the contribution of targeted CPUE to the average CPUE was limited to the ratio observed in 1999, for data years 2000 and 2001. There was no apparent change in total mortality rate from the previous year's assessment, based on catch curve analysis using fall CPUE at age data from OE 1, 1997-2000 (Figure 2.4).

Index Fishing

With good representation in the 2001 harvest, the 1996 year class appears strong, confirming early indications of YOY and yearling abundance in Ohio August and October trawl indices within Districts 2 and 3. There is no evidence of strong year classes following the 1996 cohort. The 1998 year class may be moderate and was above the median value for index trawl catches (1990-2001, Ohio central basin. Young-of-the-year whitefish were caught in 2001, unlike the zero catch of 2000 in Ohio trawls. The distribution of young whitefish may be changing or expanding based on small numbers of 2001 year class whitefish caught in Pennsylvania, New York and Ontario in 2001-02. This is a significant change because index trawling conducted by the Pennsylvania Fish and Boat Commission has not produced juvenile whitefish since 1992, despite frequent catches of young fish during the previous decade**.** The catches from New York and Ontario occurred in areas that have not ever been noted as having young whitefish present.

The number of whitefish caught per standard gill net lift (6.23) in 2001 was a major increase from the 2000 CPUE (2.43 fish/lift) and much larger than the average (2.58 for the deep water gillnet assessment conducted by New York in eastern Lake Erie (Figure 2.5). Mean age of the catch was 6.52 in 1997. The 2000 and 2001 values of 6.9, and 7.3 are further increases, which extend the trend begun in 1991. Although the 2001 CPUE increased considerably, it is represents capture of older fish which were presumably available for capture in 2000 or earlier. The Ontario partnership gill net index failed to catch any whitefish in the east basin during 2000 or 2001. The

Pennsylvania Ridge catch increased slightly in 2001, while central basin catches dropped.

Growth and Diet

Diet studies from Ohio waters of the Central basin in 2001(C. Knight, unpubl. data) indicated that age 0 whitefish (n=22) focussed on chironomids (44%; 28% larvae, 16% pupa), *Daphnia spp.* (22%) and Sphaeridae (15%). Older whitefish (age 1,2; n=29) continued to feed on chironomids (24%), but included larger fractions of gastropods (27%), *Dreissena spp.* (19%) and Sphaeridae (16%) in the diet.

Lake Whitefish Surveys

Lake whitefish are difficult to assess in Lake Erie, due to their low population size and their migratory and schooling behavior. The coldwater task group has been assembling the whitefish data in order to support a stock assessment review. A synthesis of this material was produced for a workshop in February 2002. We hope to complete this work in 2002.

Burbot

Commercial Harvest

Burbot has been increasing in the commercial harvest since the late 1980's (Table 2.1). This increase coincided with the increase in abundance of lake whitefish. Most commercial harvest of burbot occurs in the eastern end of the lake. Harvest decreased in Pennsylvania waters after 1995, with a shift from gill net to trap-net commercial fishery, which in turn resulted in a substantial decrease of commercial fishing effort (CWTG 1997). Harvest of burbot in New York is from one commercial fisherman. In 1999, a market was developed for burbot in Ontario, leading the commercial fishing industry to actively target them for the first time. As a result, the Ontario commercial harvest increased dramatically (Table 2.1). However, this market did not continue and resulted in a much lower harvests in 2000 and 2001. The majority of the harvest in 2001 was in statistical district OE5 (44%), followed by OE4 (38%) and OE2 (16%).

Assessment Programs

The deepwater gill net assessment for lake trout in the month of August by the NYSDEC, PAFBC, USGS-BRD and OMNR also collects burbot. The catch has been steadily increasing from 1993 through 2000 in all jurisdictions (Fig. 2.6). In 2001, the catch declined in both Pennsylvania and Ontario waters, but increased slightly in New York waters.

The Ontario Ministry of Natural Resources (OMNR) Partnership gill net assessment conducted in Canadian waters of Lake Erie during the months of September and October (1989-1999) includes burbot. Burbot catches increased in the eastern basin and Pennsylvania Ridge from 1992 to 1998, with a 4-fold increase in catch occurring between 1995 and 1998 (Fig.2.7). There was no sampling in the eastern basin in 1996 and 1997. Burbot catch continues to be very low in the central basin, with lowest catches in the west central basin. Catch declined in the Pennsylvanian Ridge basins from 1999 through 2000, but increased to an all time high in 2001. The catch continues to decline in the east basin from a high in 1998. The decline in catch in the east basin in 2001 was also observed in the lake trout assessment program (Fig. 2.6).

Age Structure & Growth

Although age information has been reported in past reports, there is some concern about the accuracy of the age data. Until there is some verification of age data, length and weight distributions will be reported. Length and weight information is from burbot collected in the lake trout assessment by NYSDEC, PAFBC, and USGS-BRD/OMNR. A total of 462 burbot were collected in 2000. Lengths ranged from 146 to 908 mm, with 94% of the catch between 450 and 750 mm (Fig. 2.8). Weight ranged from 0.03 to 5.24 kg, with 80% of the catch between 0.75 and 2.5 kg (Fig. 2.9).

Diet

Stomach contents were identified in burbot collected June through October 2000 by the Ohio DNR, PFBC and NYSDEC (Table 2.2). Rainbow smelt and round goby were present in the diet for all months except May. Round goby increased in the diet in all areas from 2000. In 2000, goby was not found in burbot diet in Pennsylvania waters, but occurred in 26.6% of the burbot in 2001. In New York waters, goby occurred in 4% of the burbot collected in 2000, but was found in almost 20% of the burbot collected in 2001. There appears to be a concurrent decrease in the importance of smelt in their diet, with a decline from almost 80% in 2000 to 50% in 2001. Round goby increased in the diet of burbot in Ohio waters, but the sample size was only 3 fish.

Seasonal Distribution

There is no information on seasonal distribution.

Charge 3: Continue to participate in the IMSL process on Lake Erie to outline and prescribe the needs of the Lake Erie sea lamprey management program

The Great Lakes Fishery Commission and its control agents (the U.S. Fish and Wildlife Service and Department of Fisheries and Oceans, Canada) continue to implement IMSL on Lake Erie including quantitative selection of streams for treatment and implementation of alternative control methods. The Lake Erie Cold Water Task Group has provided the forum for the discussion concerns about wounding and mortality of lake trout.

2001 Actions

Following the increased stream treatment efforts of 1999 and 2000, the Commission and its agents instituted a program of extensive larval assessments to monitor status and to focus new control efforts. During 2001, assessments were conducted in 5 streams (4 U.S., 1 Canada) to rank them for lampricide treatments, and in another 19 streams (9 U.S., 10 Canada) to determine presence or absence of sea lamprey larvae (Tables 3.1, 3.2). The populations considered for treatment were either re-established (Canadaway, Crooked, Big) or residual to treatment (Cattaraugus, Conneaut). Sea lamprey larvae were not detected in any of the other 19 tributaries that were surveyed to determine presence or absence. This finding reduced concerns that the expanding sea lamprey populations observed during the late 1990s had led to expanded infestation in new or rarely treated streams.

The lampricide treatment campaign begun during 1999 to deal with the observed increases in sea lamprey abundance continued during 2001. Successful lampricide treatments were performed on Cattaraugus, Raccoon, Big Otter and Young's creeks. Cattaraugus Creek was treated during 2001 to control a large residual larval population that survived treatment in 1999. Lampricide was applied at the Springville dam, the upper limit of larval sea lamprey distribution, adding 30km of stream to previous treatments from Gowanda. Assistance was provided to the USFWS lampricide application crew by DFO, in the form of personnel and equipment. Post-treatment assessments indicate that almost complete mortality of sea lamprey larvae was achieved.

The estimated numbers of spawning-phase sea lamprey in Lake Erie during 2001 declined by nearly 50% from those observed during the previous year. A total of 1214 spawning phase sea lampreys were trapped in 4 tributaries (Cattaraugus, Grand (OH), Big and Young's). The 2001 spawning population in Lake Erie was estimated at 8,092 (Schleen and Klar, 2002), down from 15,570 in 2000 (Klar and Schleen 2001). While more years of observation will be required to establish whether this is a downward trend, this result is consistent with the increase in treatment effort during 1999. The spawning-phase sea lampreys observed during the 2001 migration were residual to the extensive treatments carried out during 1999 including the treatment of the Grand River (OH) and the Cattaraugus River. The full round of treatment was completed with the Conneaut River during 2000 and, so, the Commission’s expectation is that this downward trend will continue.

Several sea lamprey barrier projects are proceeding in tributaries to Lake Erie. The inflatable barrier in Big Creek appeared to successfully block the spawning run in 2001, based on the absence of young-of the-year larvae in August and September assessments. During the previous year, barrier efficacy was high, although not 100%, and ammocoetes of the 2000 cohort are rarely encountered. The majority of sea lamprey larvae now present in Big Creek belongs to the 1999 year class.

Further multi-agency studies were continued to determine the feasibility of constructing a barrier on Conneaut Creek, one of Lake Erie's largest producers of sea lampreys. Existing dams on the Grand Rivers, located at Harpersfield, Ohio and Caledonia, Ontario, respectively, are being examined for possible modification or removal to improve the passage of non-jumping fish. Both have vast upstream areas and numerous tributaries with habitat suitable for sea lamprey reproduction, and future actions that impair the capacity of these structures to block sea lampreys would pose a significant environmental and economic risk.

2002 Plans

Sea lamprey management plans for Lake Erie in 2002 (Tables 3.1, 3.2) include the lampricide treatment of Crooked Creek, based on a comparison of cost-per-transformer estimates for all Great Lakes streams that were quantitatively assessed in 2001. Larval assessments are planned on 27 streams (16 U. S., 11 Canada), 4 of which (Cattaraugus, Canadaway, Conneaut and Big) will be considered for potential lampricide treatment in 2003. Trapping of adult lampreys will continue on the 4 tributaries previously noted.

Charge 4: Maintain an annual interagency electronic database of Lake Erie salmonid stocking and current projections for the STC, GLFC and Lake Erie agency data depositories

In 2001, 2.26 million yearling trout and salmon were stocked in Lake Erie, including rainbow trout, coho salmon, lake trout and brown trout (Figure 4.1). Total salmonine stocking decreased 0.4% from 2000 and decreased 4.6% from the long-term average (1989-2001). Annual summaries for each species stocked within individual state and provincial areas are summarized in Table 4.1.

All riparian agencies stocked rainbow trout in 2001. A total of 1,994,718 yearling rainbow trout were stocked in 2001, representing a slight (0.6%) increase from 2000. Rainbow trout stocking in 2001 had increased over 15% from the long-term average, primarily a result of surplus production. Stocking in 2002 is expected to remain at about 2 million yearlings in 2002.

The Pennsylvania Fish and Boat Commission (PFBC) remains the only agency that stocks coho salmon in Lake Erie. A total of 127,641 yearling coho salmon were stocked in 2001, representing a 7% decrease from 2000, and a 60% decrease from the 1989-2001 annual average. The Pennsylvania stocking effort will remain at a target level of 120,000 coho yearlings for 2002.

Lake trout stocked in Lake Erie are produced at the USFWS hatchery in Warren, Pennsylvania, and released in the eastern basin waters of Lake Erie in selected areas of New York and Pennsylvania. Total lake trout stocking in Lake Erie in 2001 was 120,000 yearling plants, the target baseline level. This represented a 9.2% decrease from 2000, and a 29% decrease from the long-term average. Strain composition and stocking strategy are discussed in greater detail under Charge 1. Yearling lake trout stocking is expected to increase about 25% in the near future. In the interest of establishing a naturally reproducing population of lake trout in Lake Erie, the CWTG is seeking to introduce a strain that is more suitable to the spawning conditions in the relatively shallow waters of Lake Erie.

Brown trout stocking in Lake Erie totaled 17,100 yearlings in 2001. This represents a slight decrease (0.4%) from 2000, and a large decrease (80%) from the long-term average. A Pennsylvania sportsman's group (3-C-U) stocked the majority of the brown trout in 2001. Additionally, Ontario stocked 1,000 fingerlings (100 yearling equivalents). No increases in brown trout stocking are anticipated for 2002.

Charge 5: Assist FTG with bioenergetics analysis of prey fish consumption by Coldwater predators.

The latest charge to the bioenergetics subgroup of the FTG was to update past bioenergetics modeling efforts to estimate the consumption of smelt and other prey fish by the main lake predators (i.e., walleye, lake trout, burbot, and steelhead). Until recently, population estimates of walleyes, the main lake predator, have been in question and have hindered completion of this charge. However, recent changes to the walleye population model have provided better estimates of walleye abundance and allowed the completion of updated walleye forage consumption estimates. With walleye model completed, the focus of the bioenergetics charge has now shifted to the three coldwater predators, which are each updated as follows.

Lake Trout

The CWTG has assisted the FTG in the past by providing a Lake Trout Population Model (LTPM) to estimate the lake trout population in Lake Erie. The LTPM is a simple spreadsheet model using stocked numbers of lake trout and annual mortality to generate an estimated population. It was initially created to predict the number of adult lake trout in the population to gauge the Lake Erie rehabilitation efforts. The model starts with a known number of yearling equivalents for each cohort and then annually applies an appropriate survival rate to that cohort as it passes through the fishery up to age 20 (CWTG 2001). Applied mortality rates were derived mostly from past standard assessment data. Several adjustments to be model were made through the years to account for poor juvenile survival and increased mortality due to sea lampreys. Initial versions of the model matched observations seen in annual coldwater gill nets surveys conducted by the NYSDEC with an increasing lake trout population with high survival. However, more recent runs of the model depict a departure between the model and annual surveys with the model showing a high, increasing lake trout population while surveys indicate a dropping population. Concerns over the LTPM to predict lake trout numbers were evident in the initial 1991 version of the bioenergetics model (Einhouse et al. 1999).

The Lake Erie CWTG is currently in the progress of revising and updating the LTPM. The most recent working version of the LTPM (Figure 5.1) incorporates some changes in sea lamprey mortality, fishing mortality, and stocking strain survival. Estimates of the adult population (age 5 and older) using the new model are around 20,000 fish, about half the estimate of the previous model. The Strategic Plan for Lake Trout Restoration (1985) suggested that successful Lake Erie rehabilitation required an adult population of 75,000 lake trout.

The biggest need identified during initial efforts reviewing the model was updated estimates of annual mortality. In order to facilitate this, a lake-wide lake trout database is being created with annual coldwater survey data from the NYSDEC, PFBC, and the USGS/OMNR. Once the database if finished, the annual assessment surveys will be used to obtain revised estimates of mortality using cohort analysis, effects of sea lampreys wounding rates, and survival at various life stages and by stocking strain. Once completed, the revised LTPM should more closely mimic the perceived lake trout population of Lake Erie and provide a better estimate of current lake trout numbers.

Burbot
Burbot were not included in the initial bioenergetics modeling effort by Einhouse et al. (1999). While burbot were an abundant inhabitant of the Lake Erie coldwater community prior to 1950, their numbers declined markedly thereafter (Trautman 1981). Burbot were not considered a major predator species in Lake Erie until their recent revitalization in the early 1990's. Burbot are now the most common species caught in all Lake Erie coldwater assessment programs.

The impact of the increasing burbot population on the Lake Erie forage community is not known. Stomach analysis results by the NYSDEC in August 2001 showed that fish consisted of 90% of the burbot diet with smelt and round gobies making up 70 and 22% of the fish consumed, respectively. Yellow perch, *Morone* species, sheepshead and unknown fish species made up the remainder of the fish component. Their increasing numbers combined with their diet preference make them a potential major consumer on the Lake Erie forage fish community.

Since little is known about the population parameters (recruitment, age structure, growth, survival, mortality, fecundity) of burbot in Lake Erie, it is difficult to estimate population size. In order to estimate their forage consumption in Lake Erie, however, some estimate of abundance must be made. The best indications of the numbers of burbot might be made from the Lake Trout Population Model (LTPM) and annual coldwater surveys. Since burbot and lake trout are both caught in the same gill net sets, the ratio of lake trout to burbot could be applied to the LTPM to estimate the burbot population. This approach assumes that lake trout and burbot populations experience similar catchability and selectivity rates in experimental gill nets, which are big assumptions. However, it may be the only available method at the present time to determine the potential impact of burbot on the Lake Erie forage community.

Steelhead
Aside from lake trout, the salmonine community stocked into Lake Erie has changed considerably since the 1991 bioenergetics modeling effort. Chinook salmon are no longer stocked and coho salmon are only stocked by Pennsylvania. Conversely, stockings of rainbow trout, mostly of the steelhead trout subspecies, have been expanded to almost 2 million fish per year and are now the most abundant salmonine in Lake Erie. Despite the vast expansion and popularity of this species in Lake Erie over the last few years, little additional data on steelhead trout diet, growth, abundance, and mortality exists from the initial bioenergetics modeling effort (Einhouse 1991). An additional unknown is the contribution of natural reproduction, which was formerly believed to be insignificant. Recent studies (Culligan 2002, Roth 2001, Goehle 1999) have shown that natural reproduction is a contributing factor to the steelhead population, but the overall significance remains unknown.

The Lake Erie CWTG recently discussed the lack of critical population information on steelhead. Unfortunately, major obstacles prohibit any assessment surveys in the near future to address these issues. However, current surveys might be able obtain some preliminary information. While the majority of the angler effort directed at this species is still conducted in the Lake Erie tributaries during the fall and spring, summertime offshore steelhead fisheries are just expanding and future creel census may provide an avenue for determining information on growth and summertime diet. Fin-clip studies on pen-reared steelhead released in Dunkirk Harbor, NY may also provide data on growth and longevity. Recommendations are that current bioenergetics modeling will have to use population information from the scarce Lake Erie studies and the literature. In the near future, the Lake Erie CWTG will need to address this lack of information on steelhead trout and determine effective ways of obtaining current population attributes of the Lake Erie steelhead population.

Charge 6: Report on the status of rainbow trout in Lake Erie, including stocking numbers, strains being stocked, academic and resource agency research interests, and related population parameters, including growth, diet and exploitation

Stocking

All jurisdictions stocked rainbow trout in 2001. Nearly all (99%) rainbow trout stocked in Lake Erie originated from naturalized Great Lakes strains. A naturalized Lake Erie strain comprises approximately 59% of the strain composition, followed by a Lake Michigan strain (25%), and a Lake Ontario strain (15%) stocked in Lake Erie. Approximately 1% of the stocked rainbow trout were of domestic origin.

Assessment of Natural Reproduction

Efforts to assess wild rainbow trout production by the NYSDEC continued in 2001 with estimates of juvenile abundance carried out in Spooner Creek, a tributary to Cattaraugus Creek. Population estimates of 14,852 young-of-year (yoy) fish and densities of 8,019 yoy/ha were the highest estimates of wild trout production since sampling on this tributary began in 1995. Significant numbers of age 1 and older trout were also found, indicating that Spooner Creek's habitat is suitable for supporting holdover steelhead and a resident trout population. Roth (2002) estimated that 1,702 wild steelhead emigrated from Spooner Creek in Spring 2001.

Spot sampling was also conducted on Chautauqua and Little Chautauqua Creeks by the NYS DEC to begin assessing the potential of other Lake Erie tributaries for wild steelhead production. Low numbers of yoy steelhead were found during sampling on Chautauqua Creek on 4 October 2001. Overall recruitment and spawning habitat was gauged to be low. However, the fact that any trout were found following the drought conditions present during the summer months was promising. Little Chautauqua Creek was also sampled on 4 October 2001 with a surprisingly high number of both yoy and age 1+ trout found. The habitat was considered excellent for steelhead spawning and recruitment. Unfortunately, a natural barrier approximately 0.75km prevents further passage upstream and limits the potential for significant reproduction.

Exploitation

All agencies provide estimates of open lake summer harvest. The total estimated harvest from the summer fishery in 2001 was 53,000 rainbow trout, a 28% decrease from 2000 estimates. Harvest estimates by basin showed that most (81%) of the harvest was in central basin waters, followed by the eastern basin waters (19%). Less than 1% of the rainbow trout harvest was in western basin waters of Lake Erie. Relative harvest estimates follow the seasonal distribution of rainbow trout as well as relative fishing intensity in each basin.

Most of the angling effort directed at rainbow trout is concentrated in the tributaries. No agencies are presently estimating total harvest at these locations. Ontario and Pennsylvania coordinate an angler diary program that provides some measure of the quality (catch rate) of the rainbow trout fishery in the streams on an annual basis. Results from the Pennsylvania Cooperative Angler Log have shown steady increases in catch rates since 1998. An estimated catch rate of just over one rainbow trout per line hour in Pennsylvania tributaries to Lake Erie in 2001 is the highest catch rate on record for the program (Figure 6.2). Catch rate estimates from the Ontario Sport Fish Diary Program dropped significantly from 2000 in both central basin waters (Figure 6.3) and eastern basin waters (Figure 6.4), but were still above the long-term-average of 0.083 rainbow trout per line hour.

Charge 7: Monitor the current status of Lake Herring. Review ecology and history of this species and assess potential for recovery

Lake herring is indigenous to the Great Lakes and historically supported one of the most productive fisheries in Lake Erie (Scott and Crossman 1973, Trautman 1981). Lake herring is considered extirpated in Lake Erie, although commercial fishermen report it periodically from the area of the Pennsylvania Ridge and the shoals of the western basin (Ryan et al. 1999). Their demise was mainly through over-fishing, although habitat degradation and competition likely contributed to recruitment failure (Greeley 1929, Hartman 1973, Scott and Crossman 1973). Siltation of spawning shoals, low dissolved oxygen, and chemical pollution are a few factors contributing to habitat degradation (Hartman 1973). Although lake herring collapsed prior to the expansion of introduced rainbow smelt (*Osmerus mordax*) and alewife (*Alosa psuedoharengus*) in the 1950s, these exotic species may have prevented any recovery of herring through competition and predation. Selgeby et al. (1978) documented consumption of lake herring eggs by rainbow smelt. Evans and Loftus (1987) summarized 2 studies in which smelt consumed large numbers of lake herring in the larval stage.

With the recent recovery of other native coldwater species (i.e. lake whitefish and burbot), and the decline in abundance of rainbow smelt, there may be an opportunity for lake herring to recover in Lake Erie. Commercial fisherman occasionally reported lake herring in the 1990s. Two large specimens (467+mm, 367mm) were collected from the eastern part of the central basin in 1995 and 1996 respectively. Herring were also recorded in the catch from an experimental gear study in 1997, south of Long Point, but their significance was not recognized and the fish were not examined. Small numbers of lake herring have been caught in the western basin commercial fishery during November and December 1998 (J. Omstead, Omstead Foods, Wheatley, Ont. pers. com.)

Frequency of lake herring reports increased in 1999, when commercial fishermen reported seven small herring (140-211 mm). Capture locations indicated there were herring present south of Long Point and southwest of Port Stanley. Fish were primarily captured in deep-water trawls targeting smelt. All specimens collected in the 1990s were examined at the Royal Ontario Museum (Erling Holm, unpubl. data). Counts of gill rakers placed them into the range for

Coregonus artedii (Koeltz 1929, Scott and Smith 1962). The herring from 1995 and 1996 were aged as 9 and 7 + respectively. Five of the herring caught in 1999 were aged as 1+ (1998 year class), and one was aged as 2+ (1997 year class).

Two more specimens were recorded from the central basin in 2000; one from Ohio (K. Kayle, ODNR, Fairport, OH, pers.com.) and one from Ontario (L.Witzel, OMNR, Port Dover, Ont., pers. com.). Two additional specimens were recorded at Port Stanley in 2001.

Numerous investigators have shown that alewife and smelt have negative effects on coregonid populations in the north-temperate lakes (see review in Ryan et al. 1999). The recent warm winters have promoted over-winter survival of alewife in eastern Lake Erie, while smelt numbers have continued to decline (L.D. Witzel, OMNR Port Dover, Ont. unpubl. data). A major die-off of alewife was documented in winter of 2001. When alewife and smelt stocks are depressed, it creates an opportunity for coregonids and other species to have stronger year classes. There is some evidence accumulating to indicate that this has occurred for whitefish in eastern Lake Erie in 2001. Lake herring would also be favored by these conditions.

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Table 1.1: Number, sex, mean length and weight, by age class, of lake trout collected in gill nets (all gear types) from eastern basin Lake Erie, August, 2001.

AGE	SEX	NUMBER	MEAN LENGTH (mm)	MEAN WEIGHT (g)
I	Combined	3	242	100
II	Combined	44	433	1065
III	Male Female	32 10	554 549	2089 1865
IV	Male Female	20 8	629 639	2969 3297
V	Male Female	9 7	686 693	4198 4088
VI	Male Female	8 3	710 740	4168 4620
VII	Male Female	5 10	738 744	4624 5320
VIII	Male Female	6 3	791 818	6507 7100
IX	Male Female	2 2	794 749	6511 4950
X	Male Female	8 8	813 789	6745 5771
XI	Male Female	13 9	812 795	6524 5928
XII	Male Female	7 2	831 798	6931 7264
XIII	Male Female	6 4	827 814	6752 6745
XIV	Male Female	1 2	834 814	7700 6940
XV	Male Female	6 1	815 908	6400 9580
XVI	Male Female	7 2	867 814	7720 5843
XVII	Male Female	1 2	953 849	10360 7280

Table 2.1: Total burbot commercial harvest (thousands of pounds) in Lake Erie by jurisdiction, 1980-2001.

Year	New York	Pennsylvania	Ohio	Ontario
80	0	2.00	0	0
81	0	2.00	0	0
82	0	0	0	0
83	0	2.00	0	6.00
84	0	1.00	0	1.00
85	0	1.00	0	1.00
86	0	3.00	0	2.00
87	0	0	0	4.00
88	0	1.00	0	0.00
89	0	4.00	0	0.80
90	0	15.50	0	1.70
91	0	33.40	0	1.20
92	0.70	22.20	0	5.90
93	2.60	4.20	0	3.10
94	3.00	12.10	0	6.80
95	1.90	30.90	1.20	8.90
96	3.40	2.30	1.20	8.60
97	2.90	8.90	1.70	7.40
98	0.20	9.00	1.50	9.90
99	0.97	7.94	1.15	394.78
2000	0.09	2.28	0.08	30.13
2001	0.39	4.36	0.05	6.45

Table 2.2: Prey of burbot collected in Ohio and New York waters of Lake Erie in 2001 by month. Unit of measure: (A) mean % dry weight in grams or (B) % Occurrence, or (C) Mean % volume. Burbot with empty stomachs were not included.

Month	May	June	June-Oct	August
Area of Lake Erie	OH	OH	PA	NY
Unit of Measure	(A)	(A)	(B)	(B)
Sample size	1	3	64	133
Rainbow Smelt		25	21.9	50.3
Goby		75	26.6	19.8
Yellow Perch			3.1	5.1
White Perch	100			1.1
Morone sp.				1.7
Freshwater Drum			1.6	0.6
Unidentifiable fish			35.9	11.9
Dreissena			34.4	8.5
Gastropods				0.6
Decopods (crayfish)				0.6
Amphipods			1.6	
Hexagenia sp.			1.6	
Bythotrephes cederstroemi			1.6	

Table 3.1. Summary of 2001larval sea lamprey assessments and 2002 plans for U.S. Lake Erie streams.

Stream	History	Surveyed In 2001	Survey Type	Results	Plans for 2002
Crooked Creek	Positive	**Yes**	*Quantitative*	Positive	**Lampricide treatment**
Canadaway Creek	Positive	**Yes**	*Quantitative*	Positive	Quantitative survey
Conneaut Creek	Positive	**Yes**	*Quantitative*[3]	Positive	Quantitative survey
Buffalo River					
Cayuga Creek	Positive	**Yes**	Evaluation	Negative	Evaluation survey
Cattaraugus Creek	Positive	**Yes**	*Quantitative*[3]	Positive	Evaluation survey
Grand River	Positive	**Yes**	Evaluation	Negative	Evaluation survey
Big Sister Creek	Negative	**Yes**	Detection	Negative	
Muddy Creek	Negative	**Yes**	Detection	Negative	
Halfway Brook	Positive	**Yes**	Evaluation	Negative	
Silver Creek	Negative	**Yes**	Detection	Negative	
Walker Creek	Negative	**Yes**	Detection	Negative	
Huron River	Negative	**Yes**	Detection	Negative	
Delaware Creek	Positive	No	-	-	Evaluation survey
Little Sister Creek	Negative	No	-	-	Detection survey
Walnut Creek	Negative	No	-	-	Detection survey
Chagrin River	Negative	No	-	-	Detection survey
Black River	Negative	No	-	-	Detection survey
Vermilion River	Negative	No	-	-	Detection survey
Sandusky River	Negative	No	-	-	Detection survey
Portage River	Negative	No	-	-	Detection survey
Maumee River	Negative	No	-	-	Detection survey
Clinton River	Negative	No	-	-	Detection survey
Belle River	Negative	No	-	-	Detection survey
Chautaqua Creek	Negative	No	-	-	
Elk Creek	Negative	No	-	-	
Raccoon Creek	Positive	No	-	-	
Ashtabula Creek	Negative	No	-	-	
Indian Creek	Negative	No	-	-	
Cowle's Creek	Negative	No	-	-	
Wheeler Creek	Positive	No	-	-	
Arcola Creek	Negative	No	-	-	
Cuyahoga River	Negative	No	-	-	
Raisin River	Negative	No	-	-	
Huron River	Negative	No	-	-	

Table 3.2. Summary of 2001larval sea lamprey assessments and 2002 plans for Canadian Lake Erie streams.

Stream	**History**	**Surveyed In 2001**	**Survey Type**	**Results**	**Plans for 2002**
Big Creek	Positive	**Yes**	*Quantitative*	Positive	Quantitative survey
South Otter Creek	Positive	**Yes**	Evaluation	Negative	
Clear Creek	Positive	**Yes**	Evaluation	Negative	
Dedrick’s Creek	Negative	**Yes**	Detection	Negative	
Forestville Creek	Positive	**Yes**	Evaluation	Negative	
Normandale Creek	Positive	**Yes**	Evaluation	Negative	
Fishers Creek	Positive	**Yes**	Evaluation	Negative	
Young's Creek	Positive	**Yes**	Treat. Eval	Negative	Evaluation survey
Lynn River	Negative	**Yes**	Detection	Negative	
Sandusk Creek	Negative	**Yes**	Detection	Negative	
Grand River	Negative	**Yes**	Detection	Negative	
Sixteenmile Creek	Negative	No	-	-	Detection survey
Kettle Creek	Negative	No	-	-	Detection survey
East Creek	Positive	No	-	-	Evaluation survey
Catfish Creek	Positive	No	-	-	Evaluation survey
Silver Creek	Positive	No	-	-	Evaluation survey
Big Otter Creek	Positive	No	-	-	Evaluation survey
Unnamed E-110	Negative	No	-	-	Detection survey
Unnamed E-116	Negative	No	-	-	Detection survey
Unnamed E-124	Negative	No	-	-	Detection survey
Detroit River	Negative	No	-	-	
Nanticoke Creek	Negative	No	-	-	
Frenchman’s Creek	Negative	No	-	-	
Black Creek	Negative	No	-	-	
Welland River	Negative	No	-	-	

Table 4.1: Summary of salmonid stocking in number of yearling equivalents, Lake Erie 1989 – 2001.

	Lake Trout	Coho	Chinook	Brown Trout	Rainbow Trout	Total
ONT.	--	--	--	--	14,370	14,370
NYS DEC	143,200	154,210	70,370	54,590	141,740	564,110
PFBC	80,000	1,166,480	--	62,450	720,920	2,029,850
ODNR	--	--	--	92,120	242,000	334,120
MDNR	--	400,190	--	50,350	69,560	520,100
1989 Total	**223,200**	**1,720,880**	**70,370**	**259,510**	**1,188,590**	**3,462,550**
ONT.	--	--	--	--	31,530	31,530
NYS DEC	113,730	5,730	65,170	48,320	160,500	393,450
PFBC	82,000	249,810	5,670	55,670	889,470	1,282,620
ODNR	--	--	--	--	485,310	485,310
MDNR	--	--	--	51,090	85,290	136,380
1990 Total	**195,730**	**255,540**	**70,840**	**155,080**	**1,652,100**	**2,329,290**
ONT.	--	--	--	--	98,200	98,200
NYS DEC	125,930	5,690	59,590	43,500	181,800	416,510
PFBC	84,000	984,000	40,970	124,500	641,390	1,874,860
ODNR	--	--	--	--	367,910	367,910
MDNR	--	--	--	52,500	58,980	111,480
1991 Total	**209,930**	**989,690**	**100,560**	**220,500**	**1,348,280**	**2,868,960**
ONT.	--	--	--	--	89,160	89,160
NYS DEC	108,900	4,670	56,750	46,600	149,050	365,970
PFBC	115,700	98,950	15,890	61,560	1,485,760	1,777,860
ODNR	--	--	--	--	561,600	561,600
MDNR	--	--	--	--	14,500	14,500
1992 Total	**224,600**	**103,620**	**72,640**	**108,160**	**2,300,070**	**2,809,090**
ONT.	--	--	--	650	16,680	17,330
NYS DEC	142,700	--	56,390	47,000	256,440	502,530
PFBC	74,200	271,700	--	36,010	973,300	1,355,210
ODNR	--	--	--	--	421,570	421,570
MDNR	--	--	--	--	22,200	22,200
1993 Total	**216,900**	**271,700**	**56,390**	**83,660**	**1,690,190**	**2,318,840**
ONT.	--	--	--	--	69,200	69,200
NYS DEC	120,000	--	56,750	--	251,660	428,410
PFBC	80,000	112,900	128,000	112,460	1,240,200	1,673,560
ODNR	--	--	--	--	165,520	165,520
MDNR	--	--	--	--	25,300	25,300
1994 Total	**200,000**	**112,900**	**184,750**	**112,460**	**1,751,880**	**2,361,990**
ONT.	--	--	--	--	56,000	56,000
NYS DEC	96,290	--	56,750	--	220,940	373,980
PFBC	80,000	119,000	40,000	30,350	1,223,450	1,492,800
ODNR	--	--	--	--	112,950	112,950
MDNR	--	--	--	--	50,460	50,460
1995 Total	**176,290**	**119,000**	**96,750**	**30,350**	**1,663,800**	**2,086,190**

Table 4.1 (Continued): Summary of salmonid stocking in number of yearling equivalents, Lake Erie 1989 – 2001.

	Lake Trout	Coho	Chinook	Brown Trout	Rainbow Trout	Total
ONT.	--	--	--	--	38,900	38,900
NYS DEC	46,900	--	56,750	--	318,900	422,550
PFBC	37,000	72,000	--	38,850	1,091,750	1,239,600
ODNR	--	--	--	--	205,350	205,350
MDNR	--	--	--	--	59,200	59,200
1996 Total	**83,900**	**72,000**	**56,750**	**38,850**	**1,714,100**	**1,965,600**
ONT.	--	--	--	1,763	51,000	52,763
NYS DEC	80,000	--	56,750	--	277,042	413,792
PFBC	40,000	68,061	--	31,845	1,153,606	1,293,512
ODNR	--	--	--	--	197,897	197,897
MDNR	--	--	--	--	71,317	71,317
1997 Total	**120,000**	**68,061**	**56,750**	**33,608**	**1,750,862**	**2,029,281**
ONT.	--	--	--	--	61,000	61,000
NYS DEC	106,900	--	--	--	299,610	406,510
PFBC	--	100,000	--	28,030	1,271,651	1,399,681
ODNR	--	--	--	--	266,383	266,383
MDNR	--	--	--	--	60,030	60,030
1998 Total	**106,900**	**100,000**	**0**	**28,030**	**1,958,674**	**2,193,604**
ONT.			--		85,235	85,235
NYS DEC	143,320		--		310,300	453,620
PFBC	40,000	100,000	--	20,780	835,931	996,711
ODNR			--		238,467	238,467
MDNR			--		69,234	69,234
1999 Total	**183,320**	**100,000**	**0**	**20,780**	**1,539,167**	**1,843,267**
ONT.	--	--	--	--	10,787	10,787
NYS DEC	92,200	--	--	--	298,330	390,530
PFBC	40,000	137,204	--	17,163	1,237,870	1,432,237
ODNR	--	--	--	--	375,022	375,022
MDNR	--	--	--	--	60,000	60,000
2000 Total	**132,200**	**137,204**	**0**	**17,163**	**1,982,009**	**2,268,576**
ONT.	--	--	--	100	40,860	40,960
NYS DEC	80,000	--	--	--	276,300	356,300
PFBC	40,000	127,641	--	17,000	1,185,239	1,369,880
ODNR	--	--	--	--	424,530	424,530
MDNR	--	--	--	--	67,789	67,789
2001 Total	**120,000**	**127,641**	**0**	**17,100**	**1,994,718**	**2,259,459**

Table 6.1: Rainbow trout/steelhead stocking by jurisdiction for 2001.

	Location	Strain	Fin Clips	Number	Life Stage	Yearling Equivalents	
Michigan	Flat Rock	Manistee River, L. Michigan	RP	60,162	Yearling	60,162	
		Manistee River, L. Michigan	None	216,058	Fall Fingerlings	7,627	
						67,789	**Sub-Total**
Ontario	Big Creek	Ganaraska River, L. Ontario	None	8,860	Yearling	8,860	
	Rondeau Bay	Ganaraska River, L. Ontario	None	10,000	Yearling	10,000	
	Port Stanley	Ganaraska River, L. Ontario	None	22,000	Yearling	22,000	
						40,860	**Sub-Total**
Pennsylvania	Raccoon Creek	Trout Run & Godfrey Run, L. Erie	None	42,558	Yearling	42,558	
	Raccoon Creek	Trout Run & Godfrey Run, L. Erie	None	26,663	Fall Fingerling	941	
	Crooked Creek	Trout Run & Godfrey Run, L. Erie	None	48,330	Yearling	48,330	
	Crooked Creek	Trout Run & Godfrey Run, L. Erie	None	30,373	Fall Fingerling	1,072	
	Elk Creek	Trout Run & Godfrey Run, L. Erie	None	280,500	Yearling	280,500	
	Godfrey Run	Trout Run & Godfrey Run, L. Erie	None	114,000	Yearling	114,000	
	Trout Run	Trout Run & Godfrey Run, L. Erie	None	228,025	Yearling	228,025	
	Walnut Creek	Trout Run & Godfrey Run, L. Erie	None	308,000	Yearling	308,000	
	Presque Isle Bay	Trout Run & Godfrey Run, L. Erie	None	28,825	Yearling	28,825	
	Fourmile Creek	Trout Run & Godfrey Run, L. Erie	None	15,000	Yearling	15,000	
	Sevenmile Creek	Trout Run & Godfrey Run, L. Erie	None	17,975	Yearling	17,975	
	Twelvemile Creek	Trout Run & Godfrey Run, L. Erie	None	36,013	Yearling	36,013	
	Orchard Beach Run	Trout Run & Godfrey Run, L. Erie	None	24,000	Yearling	24,000	
	Peck Run	Trout Run & Godfrey Run, L. Erie	None	5,000	Yearling	5,000	
	Twentymile Creek	Trout Run & Godfrey Run, L. Erie	None	35,000	Yearling	35,000	
						1,185,239	**Sub-Total**
Ohio	Conneaut Creek	Manistee River, L. Michigan	None	110,123	Yearling	110,123	
	Rocky River	Manistee River, L. Michigan	None	107,012	Yearling	107,012	
	Chagrin River	Manistee River, L. Michigan	None	111,498	Yearling	111,498	
	Grand River	Manistee River, L. Michigan	None	95,897	Yearling	95,897	
						424,530	**Sub-Total**
New York	Buffalo Creek	Chambers Creek, L. Ontario	None	20,000	Yearling	20,000	
	Buffalo Harbor	Domestic	None	1,750	Yearling	1,750	
	Canadaway Creek	Chambers Creek, L. Ontario	None	20,000	Yearling	20,000	
	Cattaraugus Creek	Chambers Creek, L. Ontario	None	72,000	Yearling	72,000	
	Cayuga Creek	Chambers Creek, L. Ontario	None	15,000	Yearling	15,000	
	Chautauqua Creek	Chambers Creek, L. Ontario	None	50,000	Yearling	50,000	
	Clear Creek	Chambers Creek, L. Ontario	None	18,000	Yearling	18,000	
	Dunkirk Harbor	Chambers Creek, L. Ontario	AD	10,000	Yearling	10,000	
	Eighteenmile Creek	Chambers Creek, L. Ontario	None	20,000	Yearling	20,000	
	S. BR. Eighteenmile Creek	Chambers Creek, L. Ontario	None	20,000	Yearling	20,000	
	Silver Creek	Chambers Creek, L. Ontario	None	5,000	Yearling	5,000	
	St. Colombans	Domestic	None	5,550	Yearling	5,550	
	Sturgeon Point	Domestic	None	14,000	Yearling	14,000	
	Walnut Creek	Chambers Creek, L. Ontario	None	5,000	Yearling	5,000	
						276,300	**Sub-Total**
						1,994,718	**Grand Total**

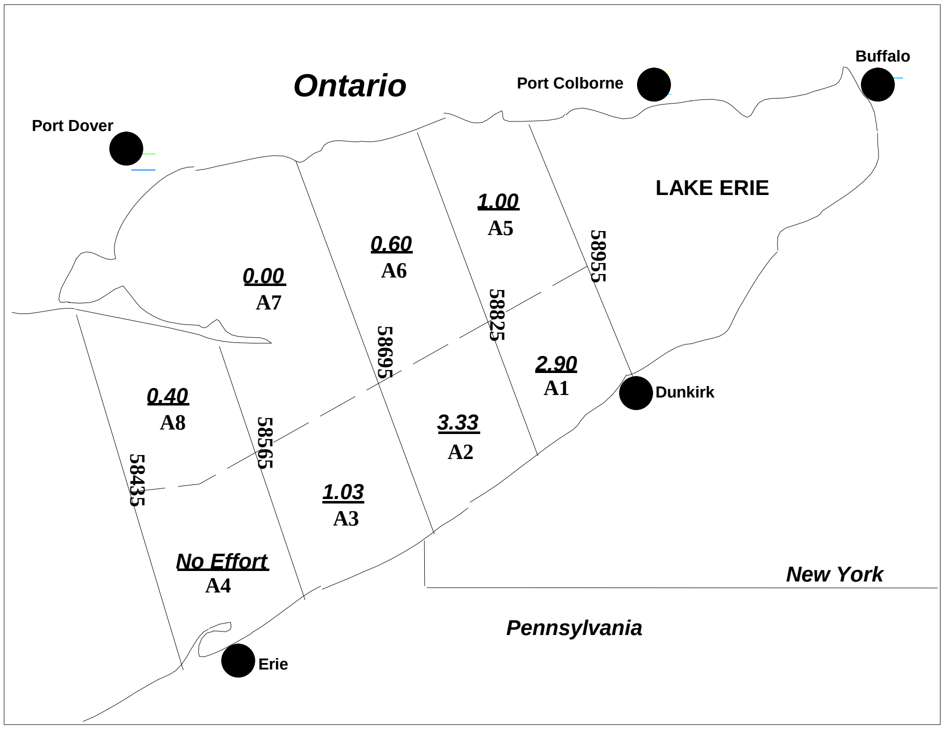

Figure 1.1: Standard sampling areas (A1 – A8) used for assessment of lake trout in the eastern basin of Lake Erie. The numbers in each area represent 2001 CPE (number/lift) for total lake trout catch within that area.

Figure 1.2: Relative abundance at age of lake trout collected from standard assessment gill nets fished in the eastern basin of Lake Erie, August 2001.

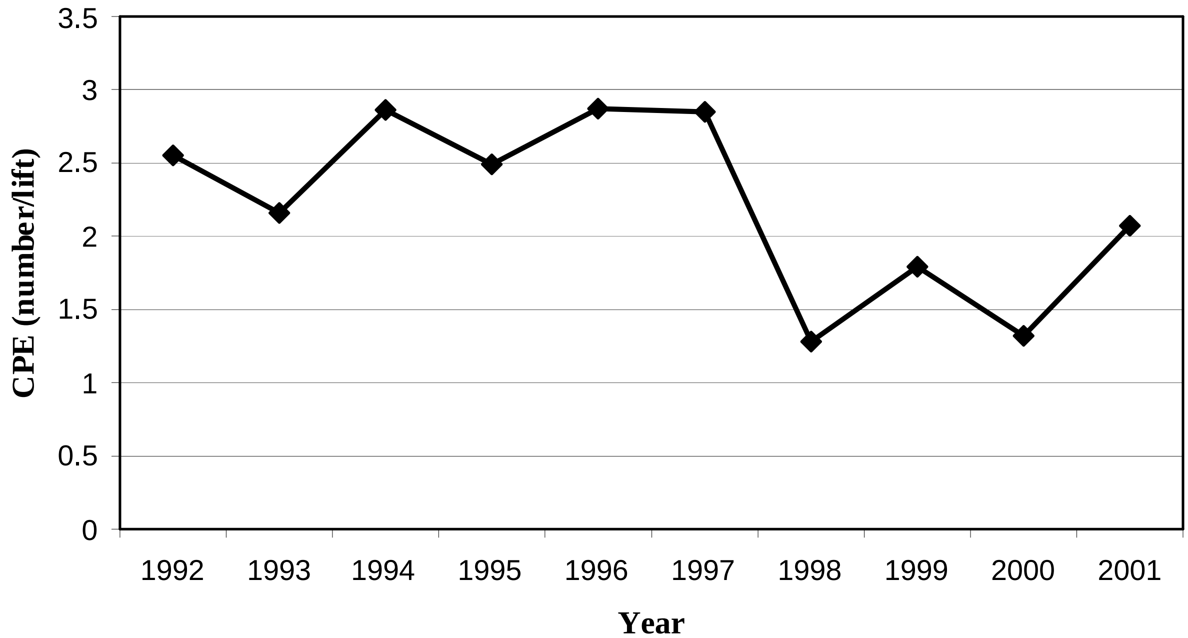

Figure 1.3: Relative abundance (number fish/lift) of all lake trout from a standard gill net assessment survey for Eastern Lake Erie, 1992 - 2001.

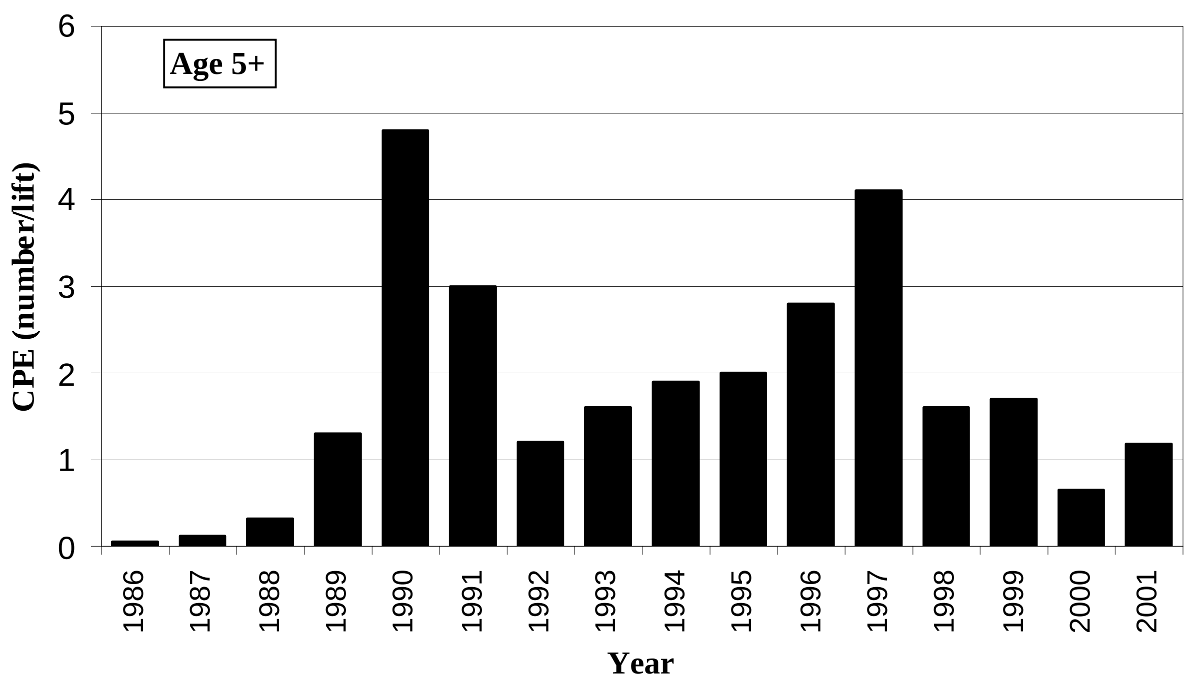

Figure 1.04: Relative abundance of age 5 and older lake trout sampled in gill nets from New York waters of Lake Erie, August, 1986 - 2001.

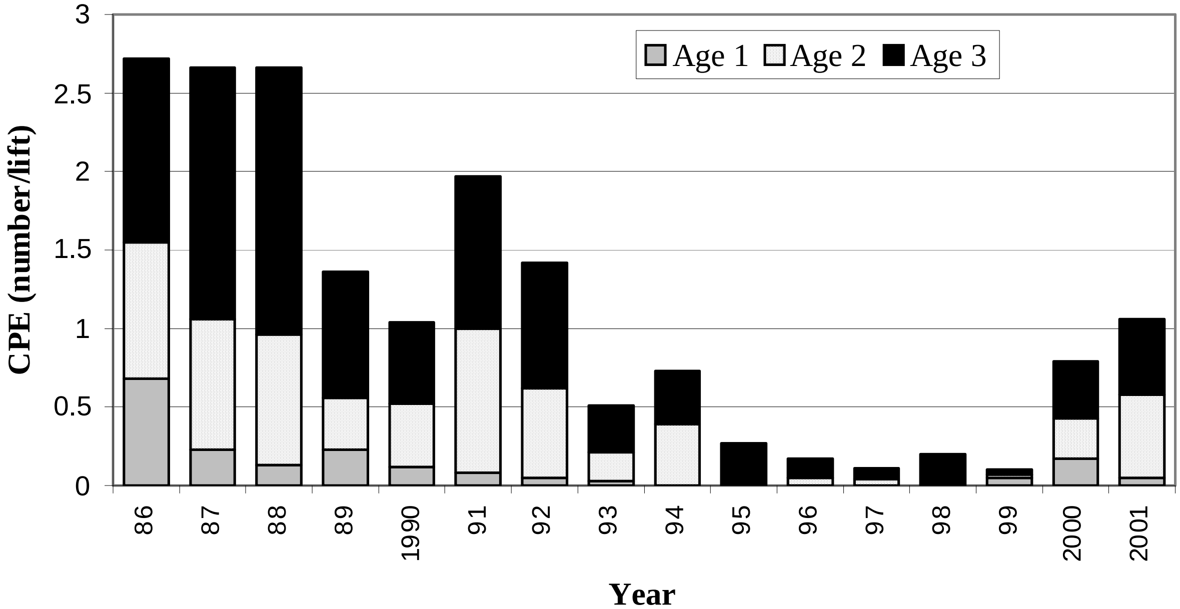

Figure 1.05: Relative abundance of juvenile (ages 1-3) lake trout collected from standard assessment gill nets fished in the New York waters of Lake Erie, August, 1986 - 2001.

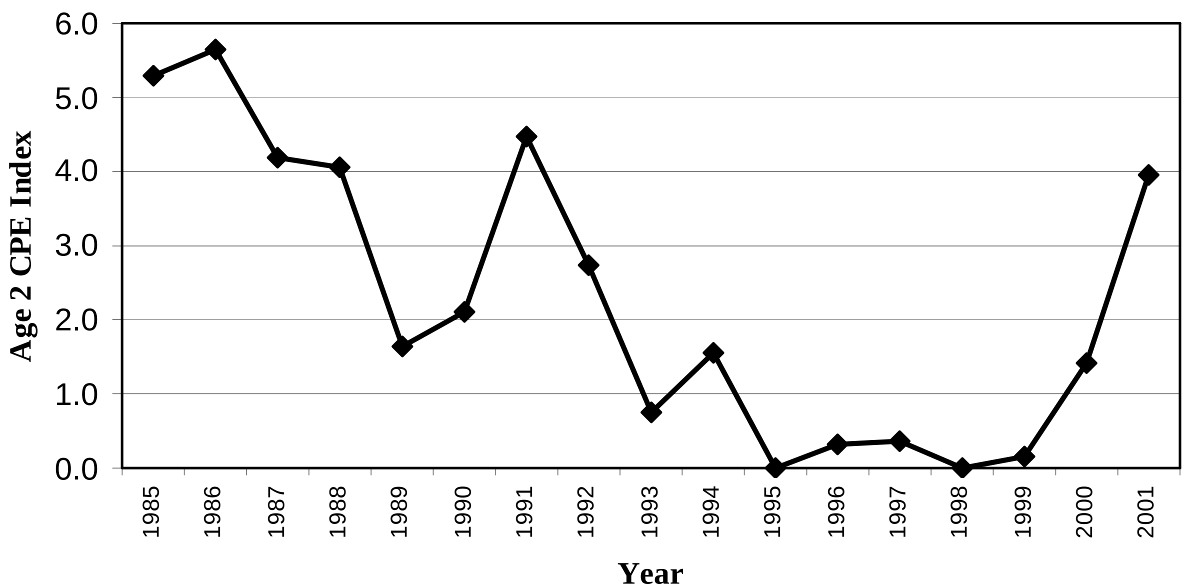

Figure 1.06: Index of age-2 recruitment of lake trout sampled in standard assessment gill nets from New York waters of Lake Erie, 1985 - 2001. The index is calculated by dividing the age 2 CPE by the stocking rate for each cohort.

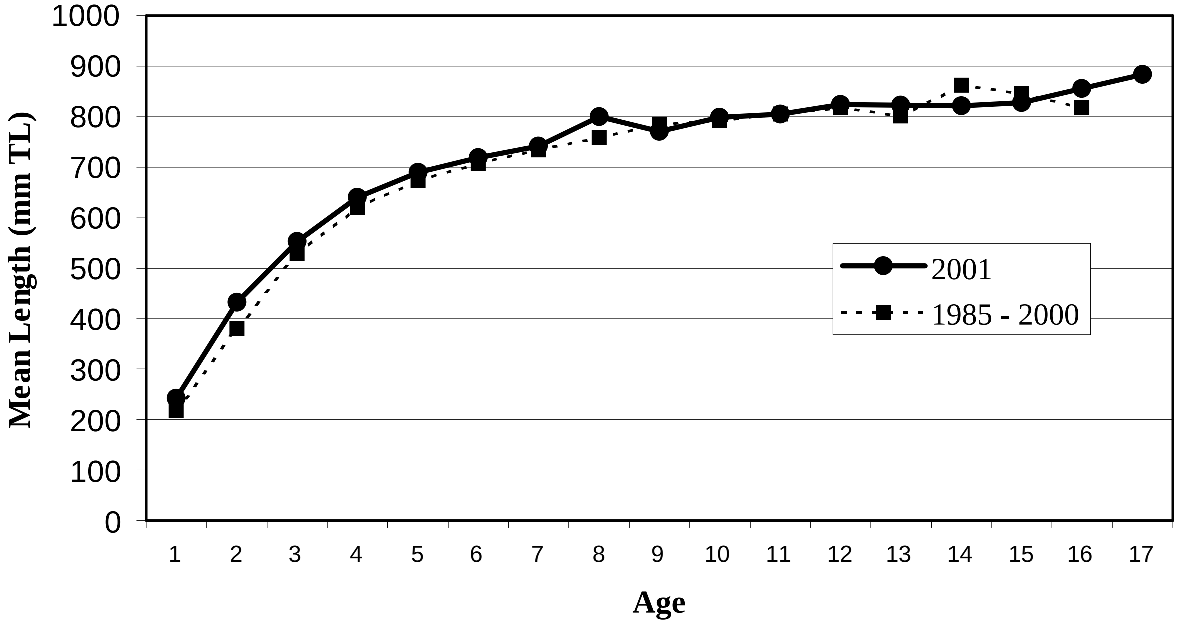

Figure 1.07: Mean length-at-age of lake trout collected in gill nets from the eastern basin of Lake Erie, August 2001. The long-term average from New York, 1985 - 2000, is also shown to compare current growth rates.

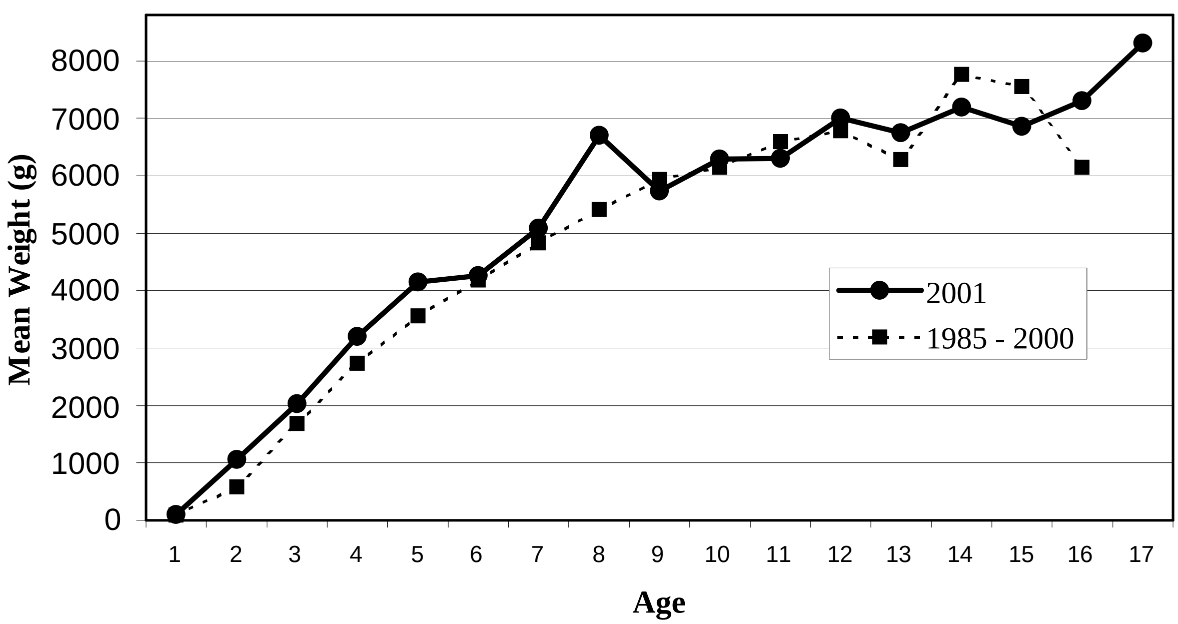

Figure 1.08: Mean weight-at-age of lake trout collected in gill nets from the eastern basin of Lake Erie, August 2001. The long-term average from New York, 1985 - 2000, is also shown to compare current growth rates.

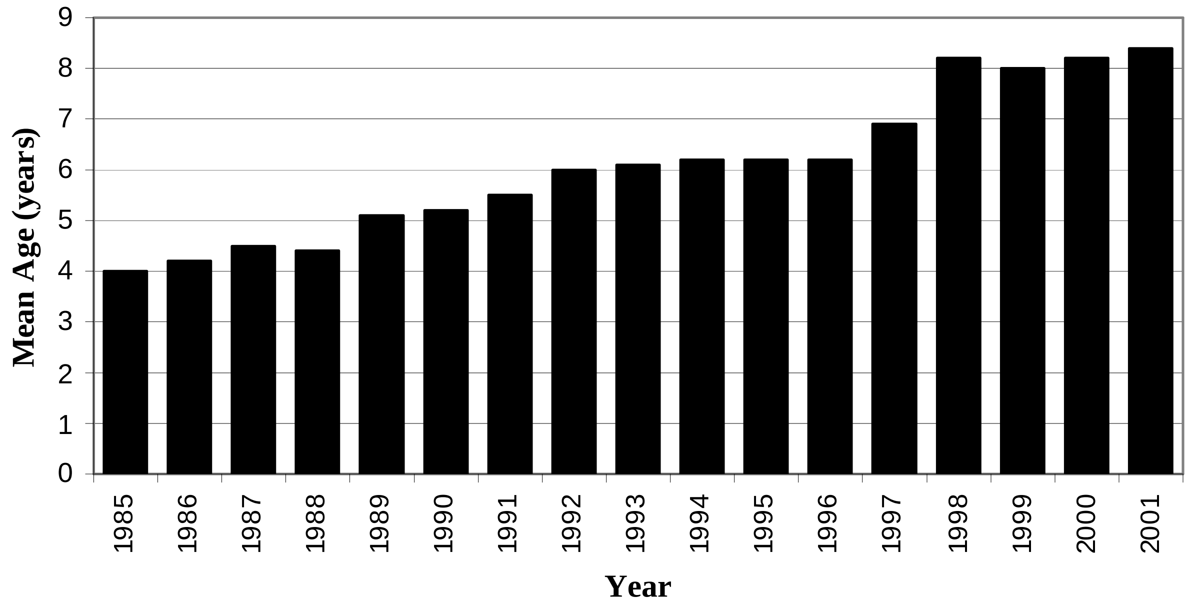

Figure 1.09: Mean age of mature female lake trout sampled in standard assessment gill nets from the eastern basin of Lake Erie, 1985 - 2001.

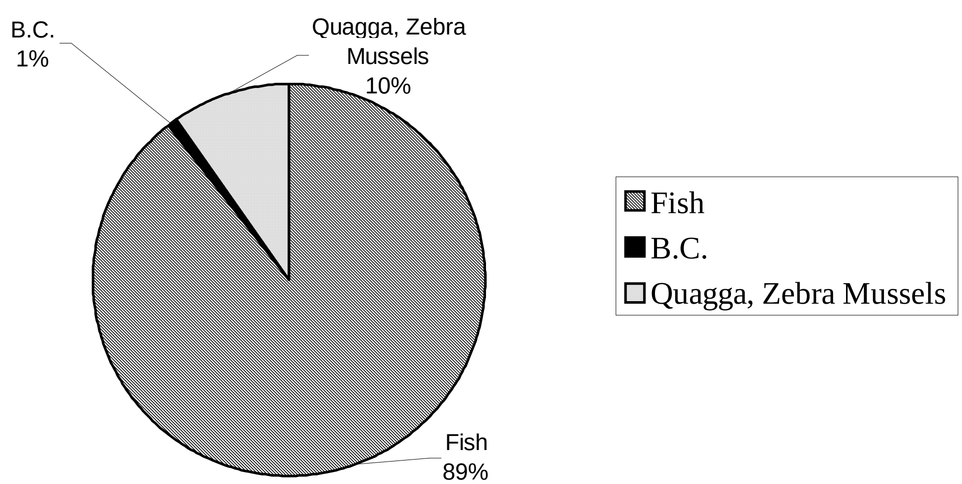

Figure 1.10: Diet composition of lake trout sampled in gill nets from the eastern basin of Lake Erie, August 2001.

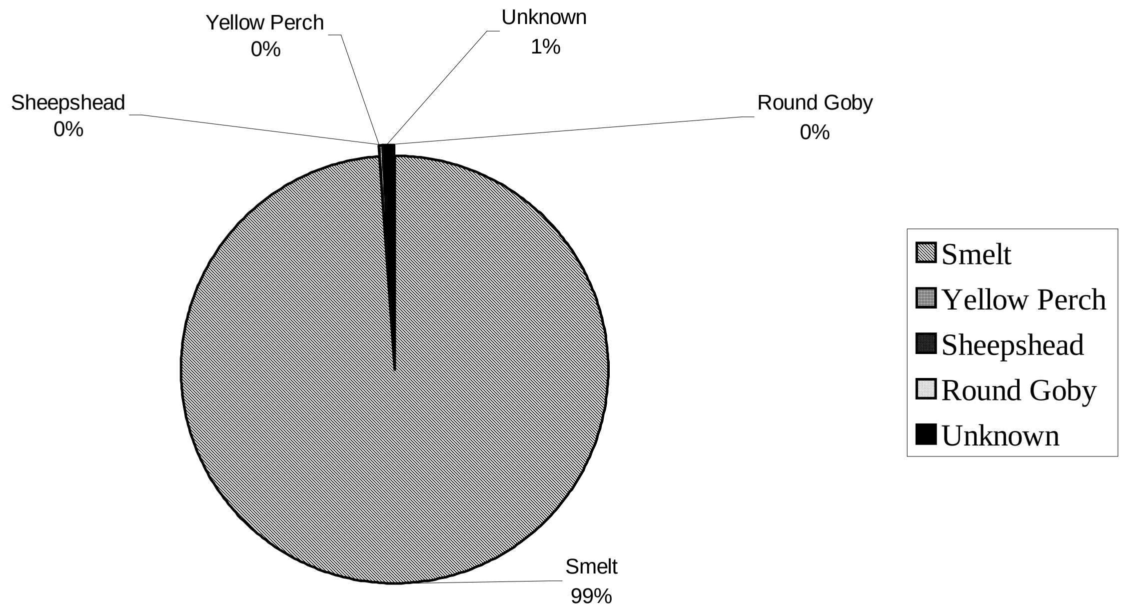

Figure 1.11: Fish component in the diet of lake trout sampled in gill nets from the eastern basin of Lake Erie, August 2001.

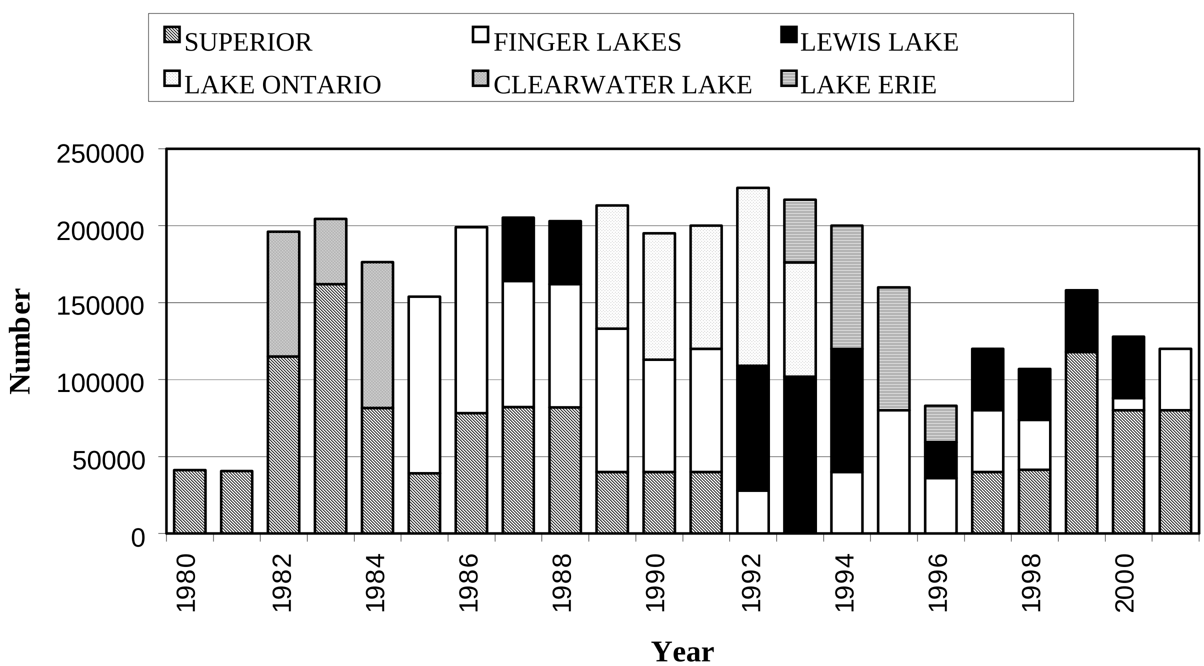

Figure 1.12: Yearling lake trout stocked in U.S. waters of the eastern basin of Lake Erie, 1980 - 2001, by strain. The current stocking goal is 120,000 yearlings per year.

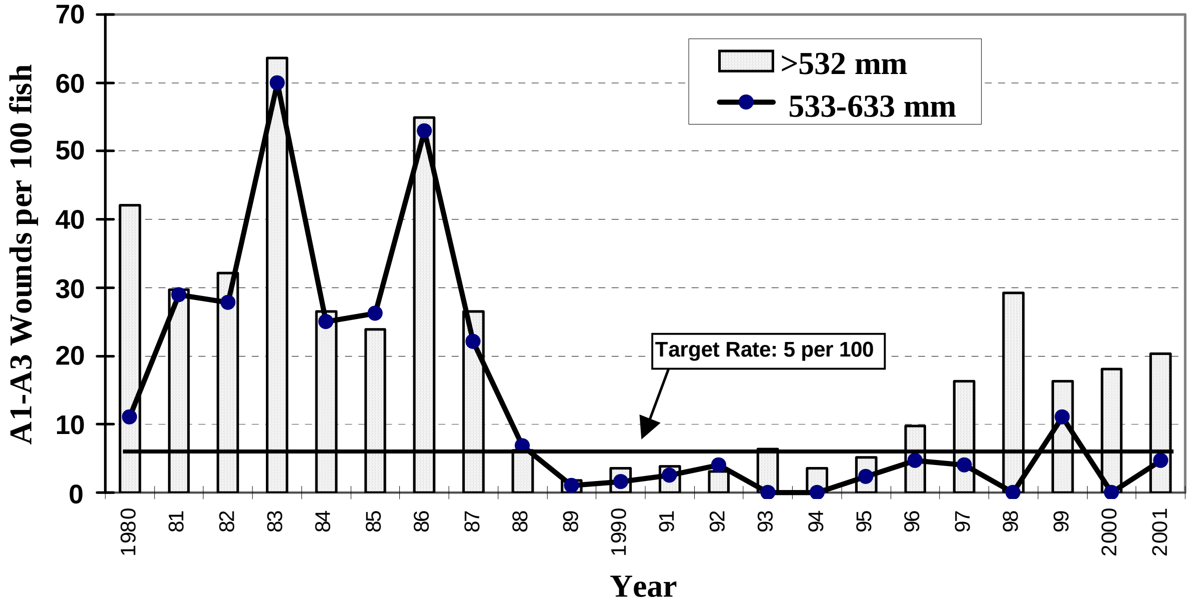

Figure 1.13: Number of fresh (A1-A3) sea lamprey wounds per 100 adult lake trout observed in standard assessment gill net surveys from New York waters of Lake Erie, August, 1980 - 2001. The Strategic Plan target rate is 5 wounds per 100 fish.

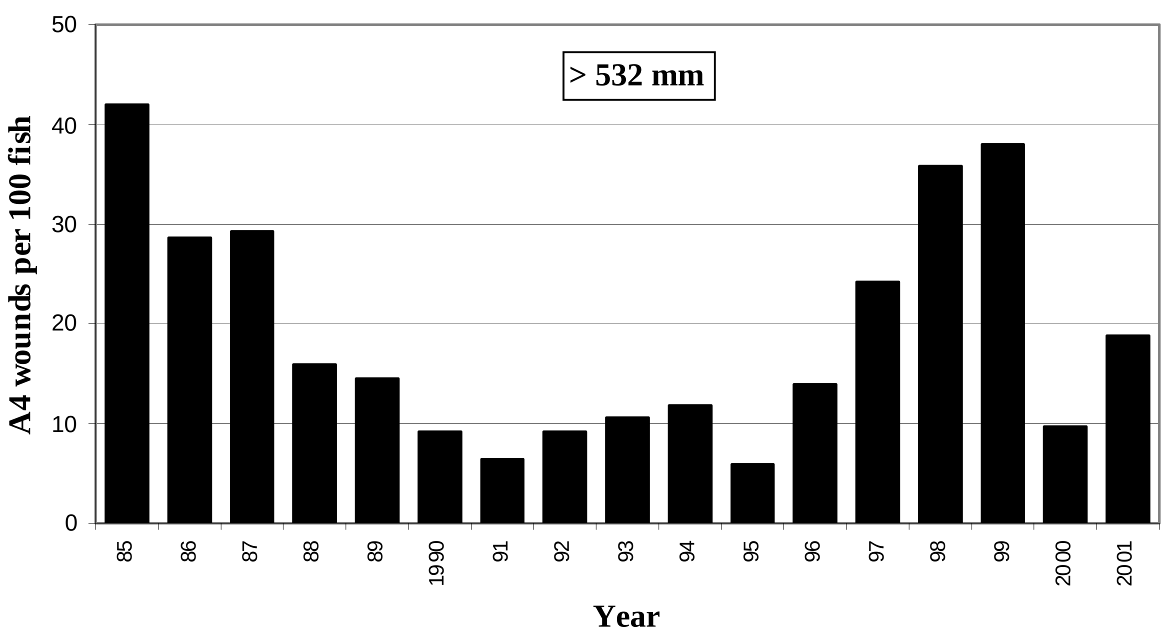

Figure 1.14: Number of A4 sea lamprey wounds per 100 lake trout (>532mm) sampled in standard assessment gill nets from New York waters of Lake Erie, August, 1985 - 2001.

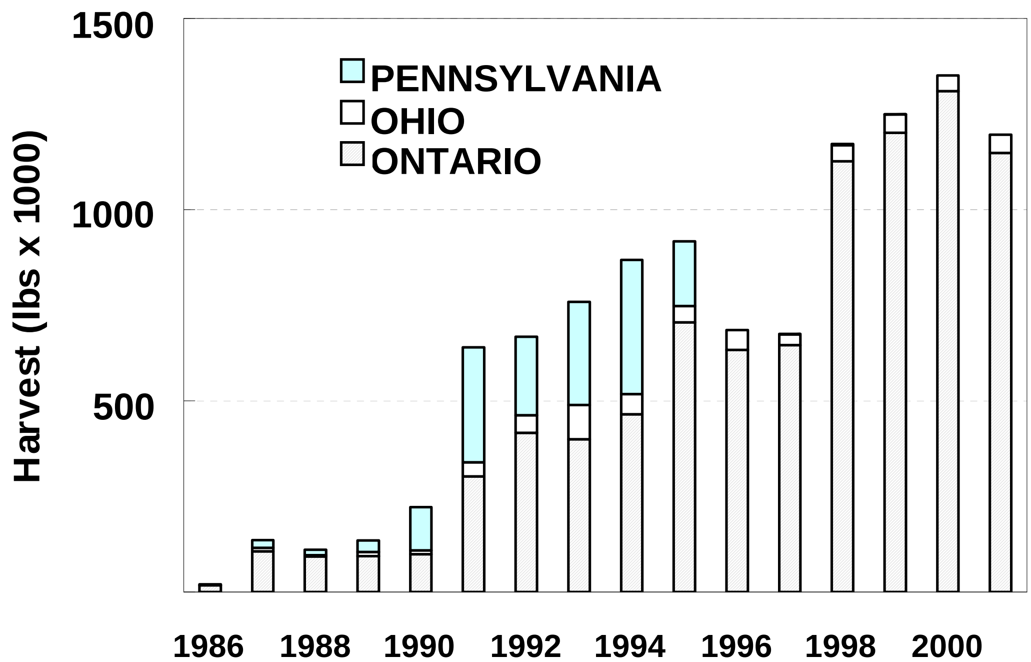

Fig. 2.1: Total Lake Erie commercial whitefish harvest, 1886-2001, by jurisdiction.

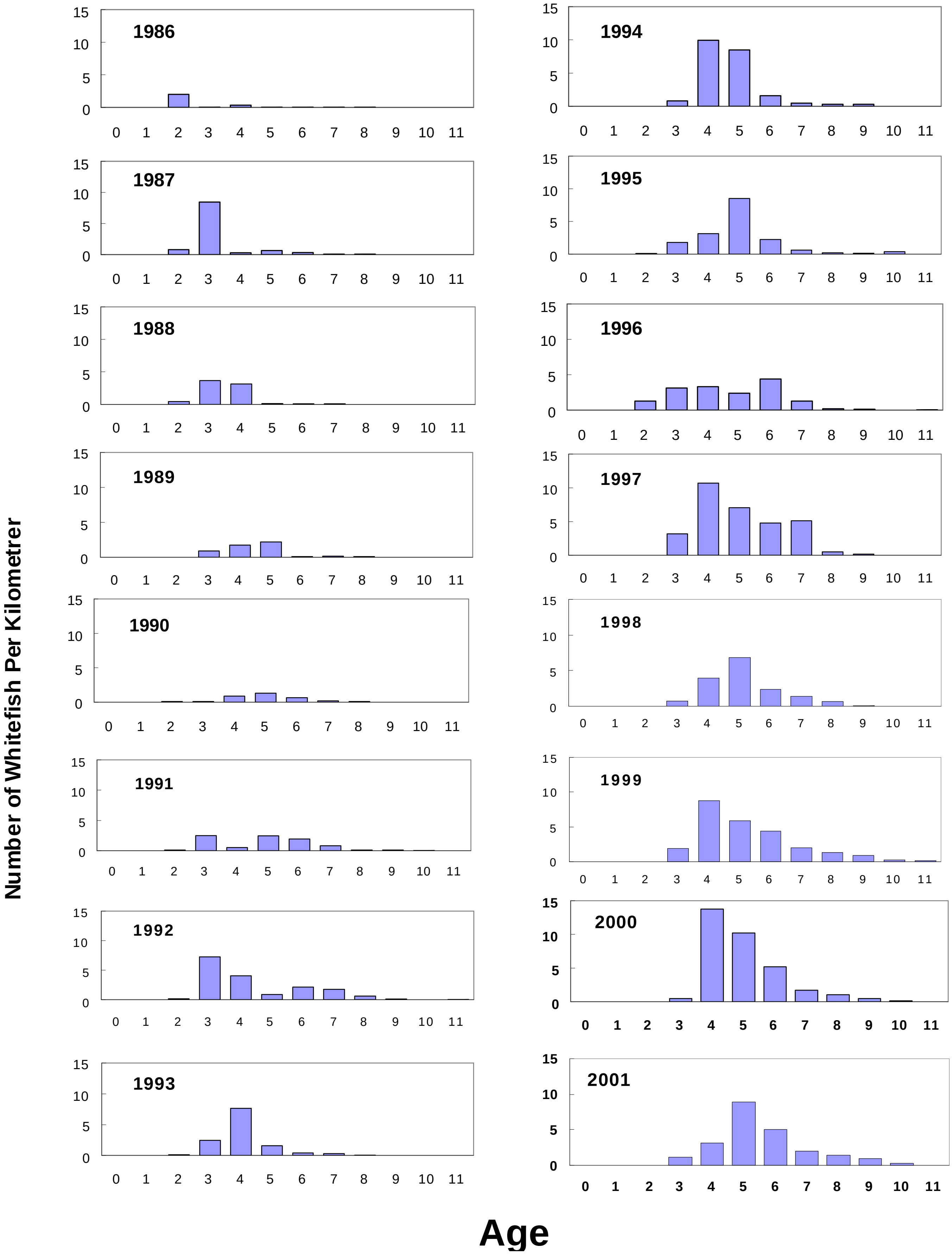

Figure 2.2. Ontario fall commercial whitefish CUE at age (# / km gill net) in statistical district 1, 1986-2001. (Effort with gill nets >= 3 inches, with whitefish in catch from October to December)

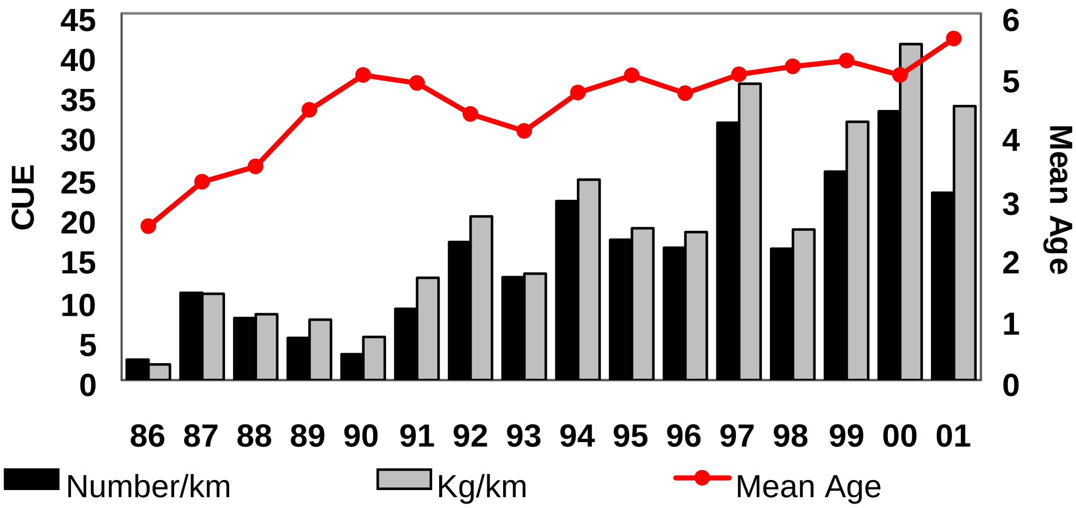

Fig. 2.3: Catch rate (number/km and kg/km) and mean age of lake whitefish harvested by the Ontario fall gillnet fishery, district OE1, 1986-2001 (fall=October to December).

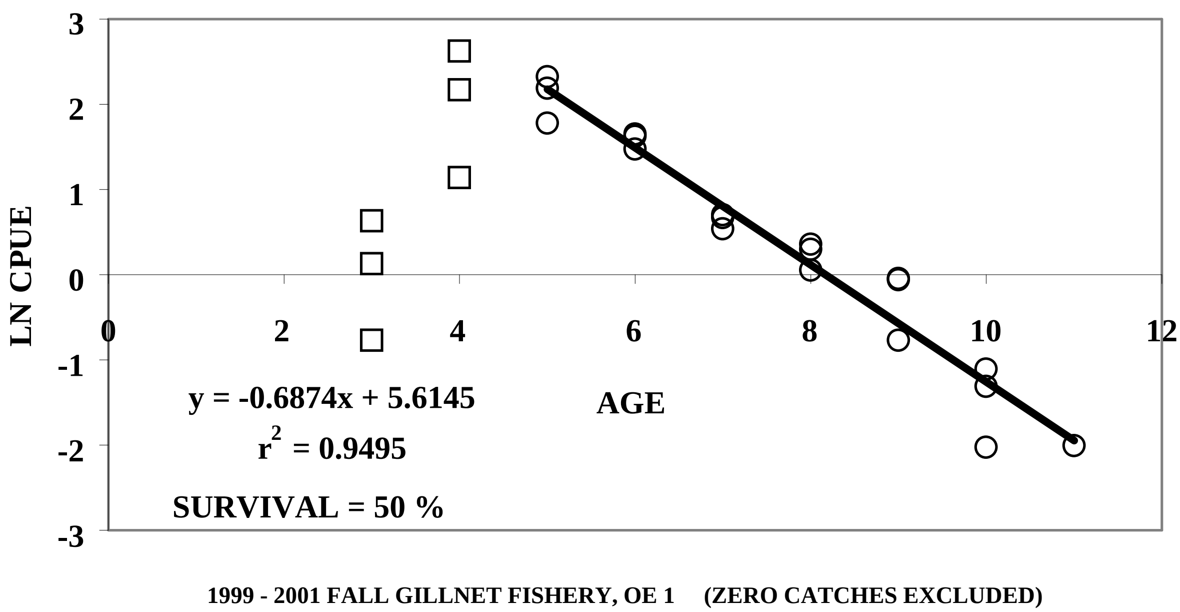

Fig. 2.4: Catch curve for lake whitefish using Ontario fall large mesh gillnet CPUE (number/km) from 1999-2001. Circles represent ages of whitefish (age 5 and older) fully recruited, used in the regression. Squares indicate ages (age 4 and younger) of partial recruitment to the gear.

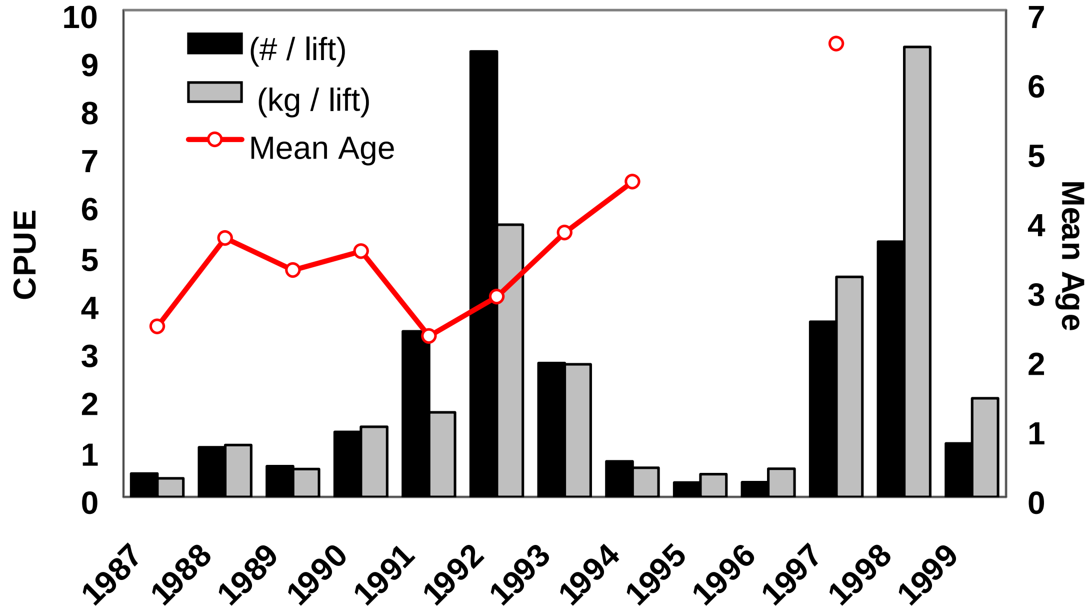

Fig. 2.5: Catch rate (number/lift and kg/lift) and mean age of lake whitefish from deepwater gill net assessment in eastern Lake Erie from 1987 to 1999. Age information was not collected in 195, 1996, 1998, and 1999.

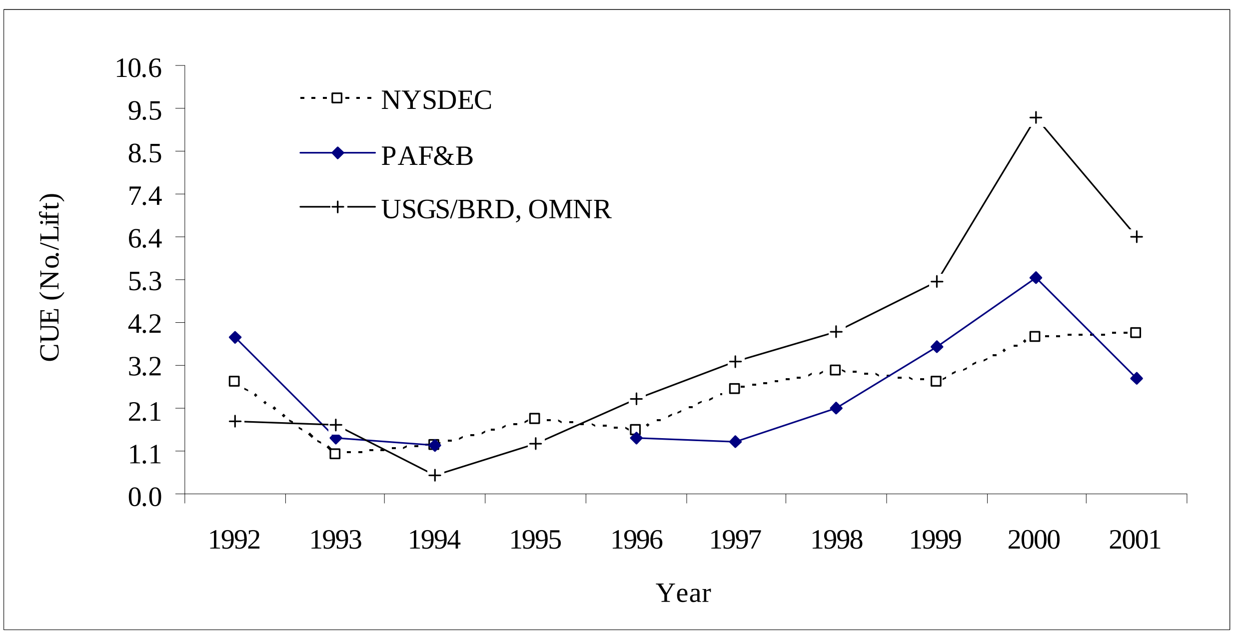

Fig. 2.6. Burbot catch rate (fish/lift) from August gillnet assessment by Agency, 1992-2001.

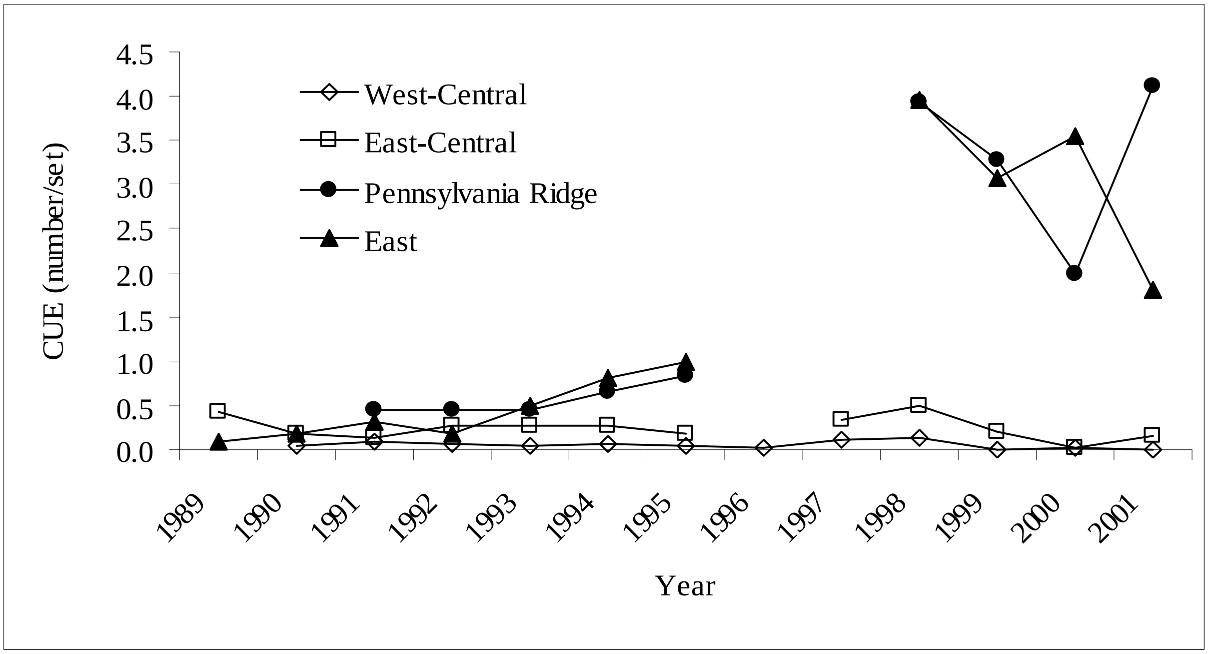

Fig. 2.7: Burbot CUE by basin from the OMNR Partnership Index Fishing Program, 1989 - 2001. (Includes canned and bottom nets, all mesh sizes, except thermocline sets.)

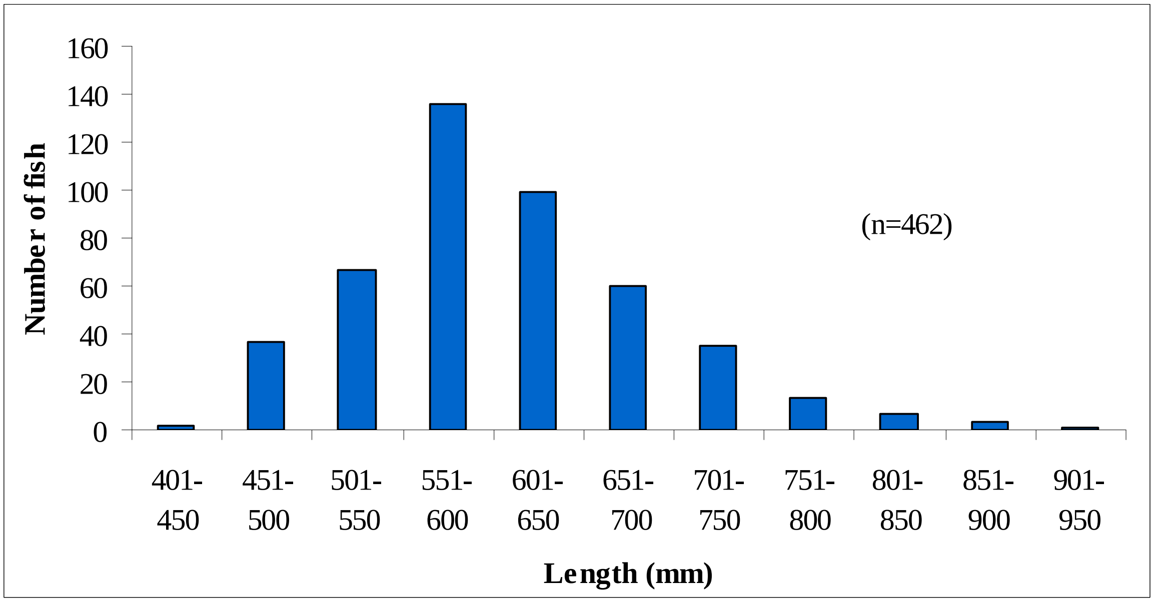

Figure 2.8: Size distribution of burbot collected in the Lake Trout Summer Assessment, 2001.

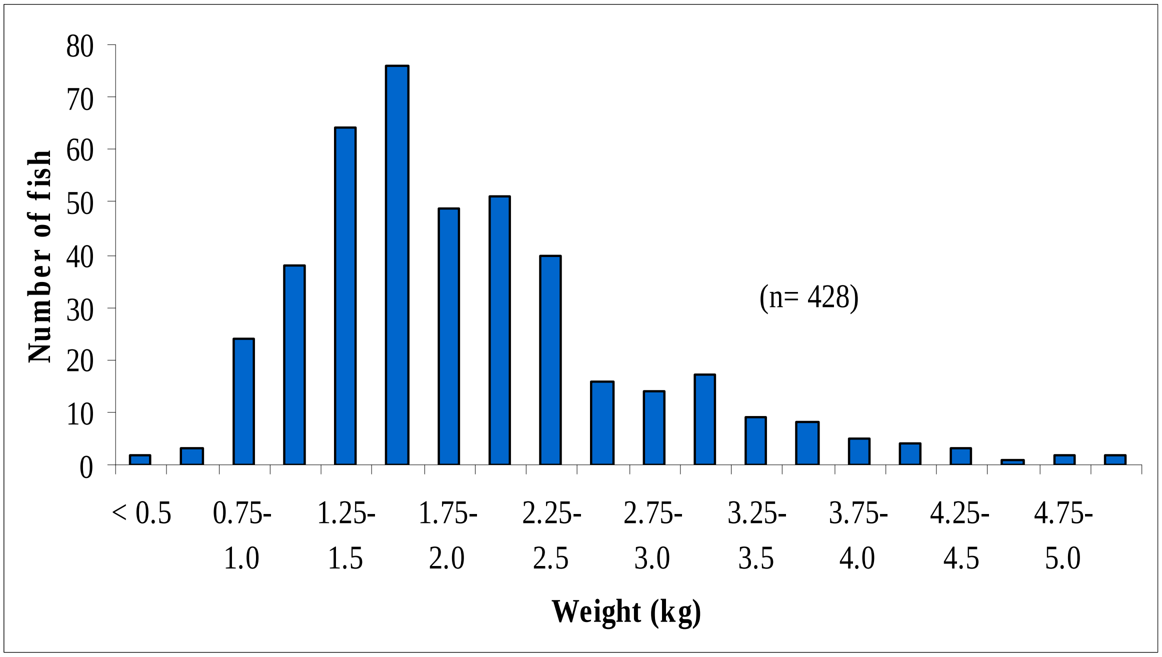

Figure 2.9: Weight distribution of burbot collected in the lake trout summer assessment, 2001.

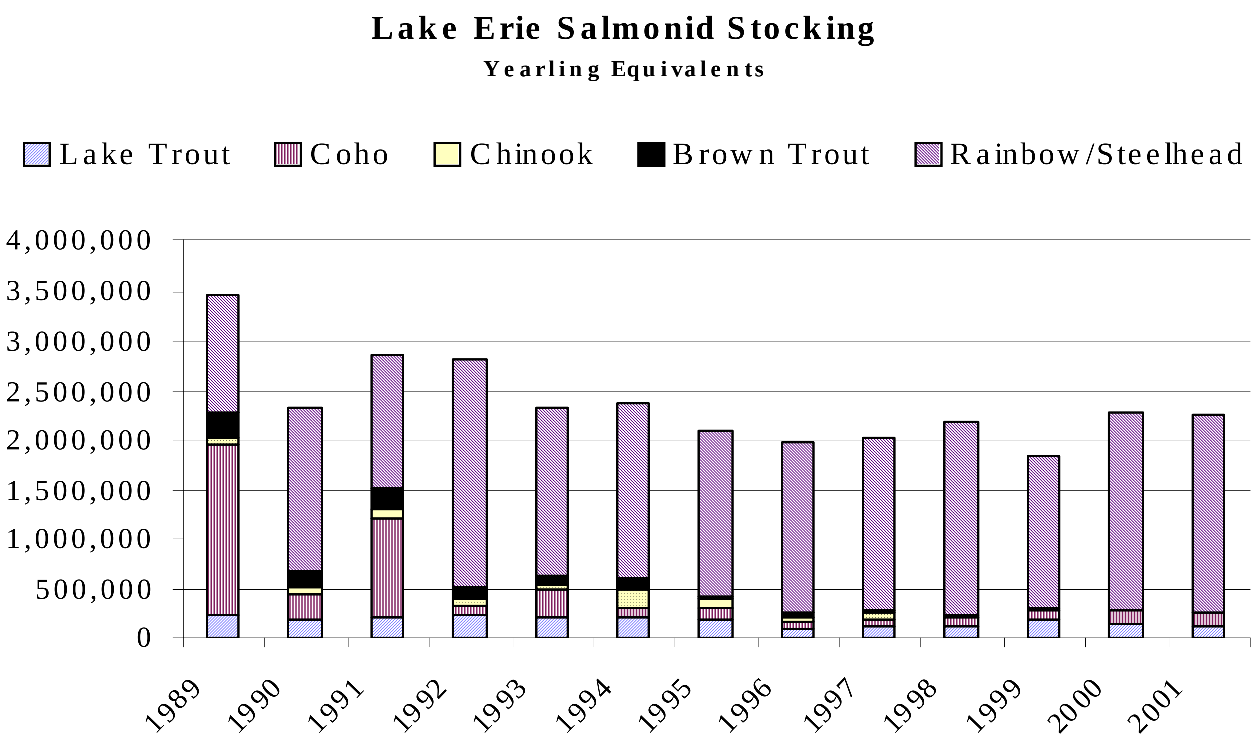

Figure 4.1: Annual stocking of all salmonid species in Lake Erie by all riparian agencies, 1989 – 2001. Numbers are in terms of yearling equivalents

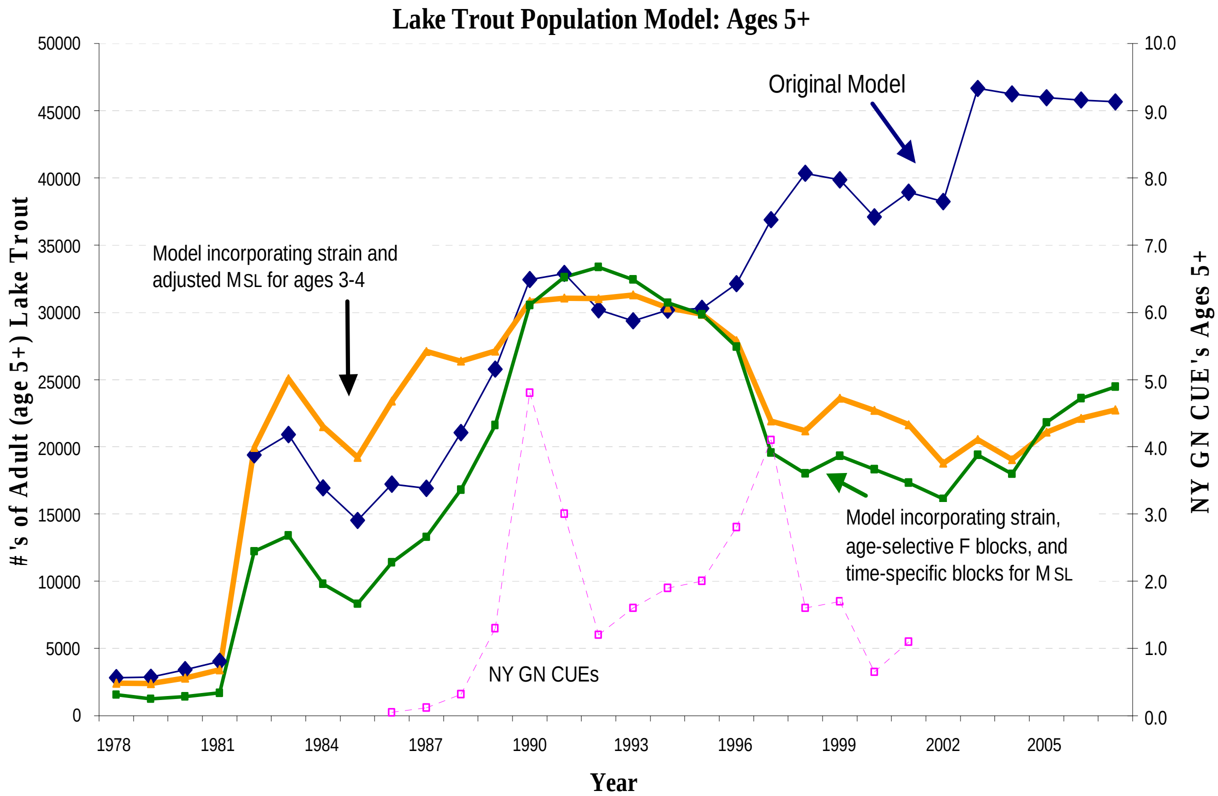

Fig. 5.1: Three simulations of the Lake Erie adult lake trout population model incorporating different estimates of mortality. The NYS DEC gill nets CUEs are also included to compare sampling trends in adult lake trout abundance.

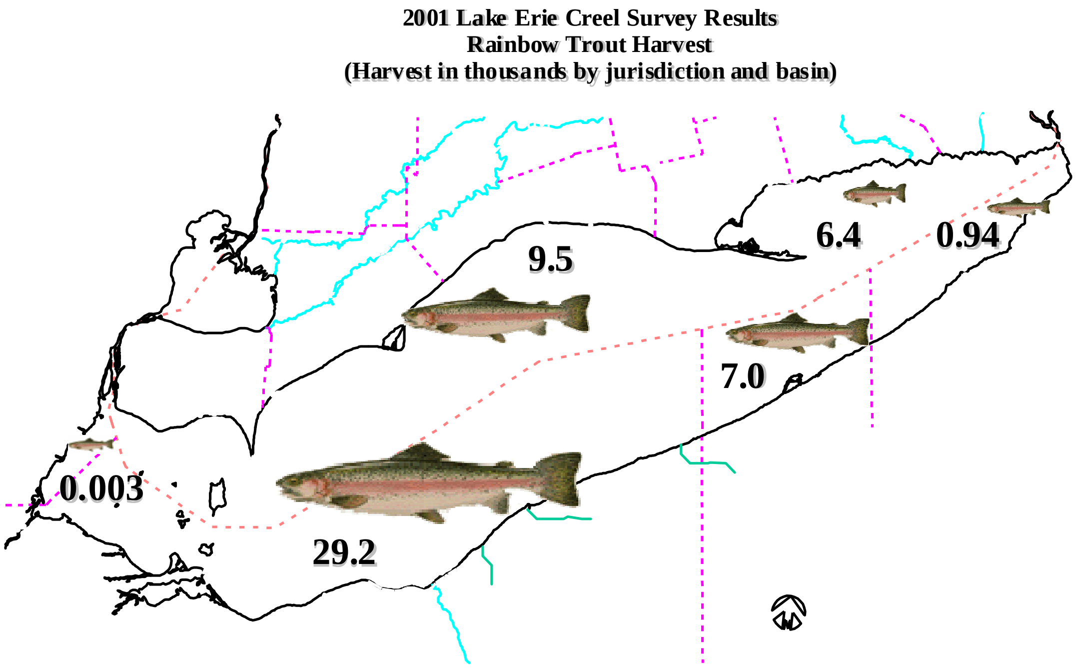

Figure 6.1: Estimated harvest of rainbow trout by open lake boat anglers by jurisdiction during 2001.

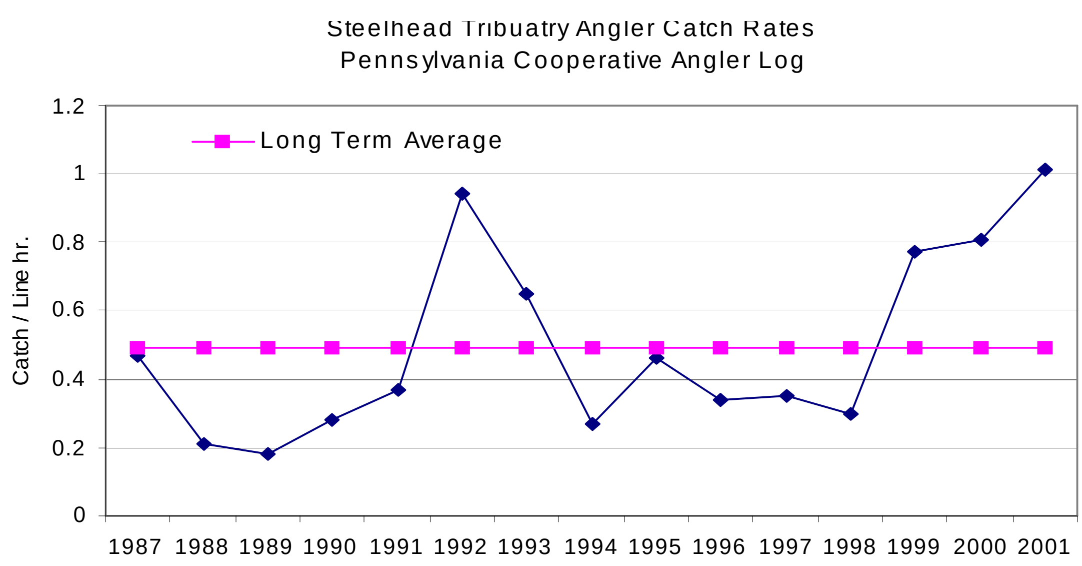

Figure 6.2: Rainbow trout catch per line hour as estimated from data supplied by anglers participating in the Pennsylvania Cooperative Angler Log.

APPENDIX

Strains of Lake Trout Stocked in Lake Erie: Evaluation and Recommendations

by
James L. Markham
NYS DEC - Lake Erie Fisheries Unit

Introduction

Lake trout have been stocked in Lake Erie since the late 1970's as part of an effort to restore lake trout populations in all the Great Lakes. Annual stocking hovered around 200,000 fish/year from 1982-1994, but dropped to 120,000 thereafter in the face of forage concerns (Fig. A.1). Six different strains of lake trout have been stocked in order to diversify the genetic stock and promote natural reproduction. Unlike all of the other Great Lakes, however, the lake trout population in Lake Erie has yet to produce any documented naturally spawned fish.

The relative performances of the strains of lake trout stocked in Lake Erie were evaluated in order to determine which strains have the best potential for establishing a naturally reproducing population in Lake Erie. Currently, three strains of lake trout are available for stocking: Superior (SUP), Lewis Lake (LL), and Finger Lakes (FL). The SUP and FL strains have the longest stocking records of any lake trout in Lake Erie, dating back to 1978 and 1985 respectively. Data used for this analysis included the annual coldwater assessment surveys from NYSDEC, the PFBC, and the USGS/OMNR. The relative performance of each strain was evaluated by analyzing these interagency data sets from 1985-2000 for longevity, coded-wire tag (CWT) returns, paired stocking comparisons, and sea lamprey wounding rates. Finally, the relative performance of each strain was evaluated from the 2001 NYSDEC survey results.

Results

Longevity – For each strain, maximum age recorded in annual lake trout surveys was compared to maximum potential age from stocking. FL strains performed the best with both a maximum age and a maximum potential age of 17 years. For the SUP strain, these ages were 15 years and 17+ years, respectively. Because survival of lake trout stocked prior to 1985 was poor due to high rates of lamprey attacks, additional SUP potential years were not considered. The LL strain had a maximum-recorded age of 10 years and a maximum potential age of 15 years.

Overall CWT Returns - Overall returns of known hatchery fish were compiled by strain, age and year stocked. Return potential for each of three strains was calculated as the cumulative number of CWT returns to minimally reach each age divided by the cumulative number stocked. Return potential was then expressed as returns per 10,000 fish stocked, and was plotted against age at return (Fig. A.2). The results revealed that the highest returns were for the SUP strain up to age 7. However, survival of the SUP strain for ages 10 and older was less than that for the FL strain. Further, the FL strain was the only strain for which there were returns of fish older than age 15. LL strain had the lowest returns in young age classes and had zero returns by age 10.

Paired Stocking Comparisons – The FL and SUP strains were compared for number of returns/10,000 stocked and maximum age at return for each year from 1985-1991 (Table A.1). In each year, the maximum age at return of the FL strain was greater than that for the SUP strain. Results for the return rates for these strains were mixed. Each strain had higher return rates in 3 of the 6 years compared. Both strains had highest returns in 1985, in which the return ratio favored the FL strain 2.6:1. Comparisons for all 3 strains were made for 1998. Initial results suggest generally poor returns on all strains from this stocking, with LL strain returns twice as high as both the FL and SUP strains.

Wounding Rates - Wounding rates of the strains of lake trout were examined in three time periods, based on historical sea lamprey abundance: 1985-1987 ("Pre-Lamprey Control"), 1988-1996 ("Lamprey Control - Low Abundance"), and 1997-2000 ("Lamprey Control - High Abundance") (Fig. A.3). For lake trout > 532 mm length, the FL strain clearly exhibited lower A1 and A1-A3 wounding rates than either the LL or SUP strain in all three time periods (Figs. A.4 and A.5). The A1 wounding rates of the SUP strain returns were between 2 and 4.7 times higher than those of FL strain fish in all three time periods. The LL strain had A1 wounding rates that were equal to the FL rates in the "Lamprey Control - Low Abundance" time period, but 3.4 times higher in the "Lamprey Control - High Abundance" period. Similar results occurred for the A1-A3 wounding rate.

2001 NYSDEC Survey Results - Overall CWT returns from the 2001 annual coldwater gill net assessment showed six different strains or strain hybrids of lake trout present in the Lake Erie population (Fig. A.6). The FL and SUP strains had the greatest rates of return, with modest returns from both LL and Lake Ontario (LO) stockings. With the exception of one age-15 fish, all of the SUP returns were from fish ages 1-5 (Fig. A.7). FL strain, on the other hand, was present from ages 4-17 and comprised the majority of CWT returns over age 11. LL returns were from ages 2 through 10. An additional one-night survey conducted on the spawning grounds in early November 2001 revealed that the FL strain was the most abundant (Fig. A.8). Despite low sample sizes, the absence of the SUP strain was also notable.

Conclusions - The results suggest that the performance of the FL stocking strain compares favorably with or exceeds those of the SUP and LL strains. Overall CWT returns suggest that FL live longer, with maximum ages to 17 years thus far. The FL strain's longer life span is most likely due to their lower susceptibility to sea lamprey predation. Wounding rates were clearly least in the FL strain, with wounding rates minimally half of those found in the SUP and LL strains. Return rates of paired stockings of FL and SUP had mixed results, but the maximum age of the FL strain was greater than that of the SUP strain in all years examined. The majority of the older fish caught during annual gill nets in recent 2001 NYSDEC surveys were FL strain.

Recommendations - Minimally stock 80,000 FL strain each year out of the 120,000 fish target. It might be beneficial to the long-term rehabilitation goals of Lake Erie to consider a different lake trout strain, such as the banker (humper) strain from Lake Superior, to replace the SUP and LL strains.

Table A.1: Overall tag returns and longevity for paired stockings of three lake trout strains in Lake Erie.

	FL		**SUP**		**LL**	
YEAR	Total Returns Per 10,000 Stocked	Maximum Age	Total Returns Per 10,000 Stocked	Maximum Age	Total Returns Per 10,000 Stocked	Maximum Age
1985	252	15	96	13		
1988	8	14	17	12		
1988	5	14	8	11		
1989	14	13	13	10		
1990	11	12	18	11		
1991	17	11	14	10		
1998	3	4	4	4	9	4

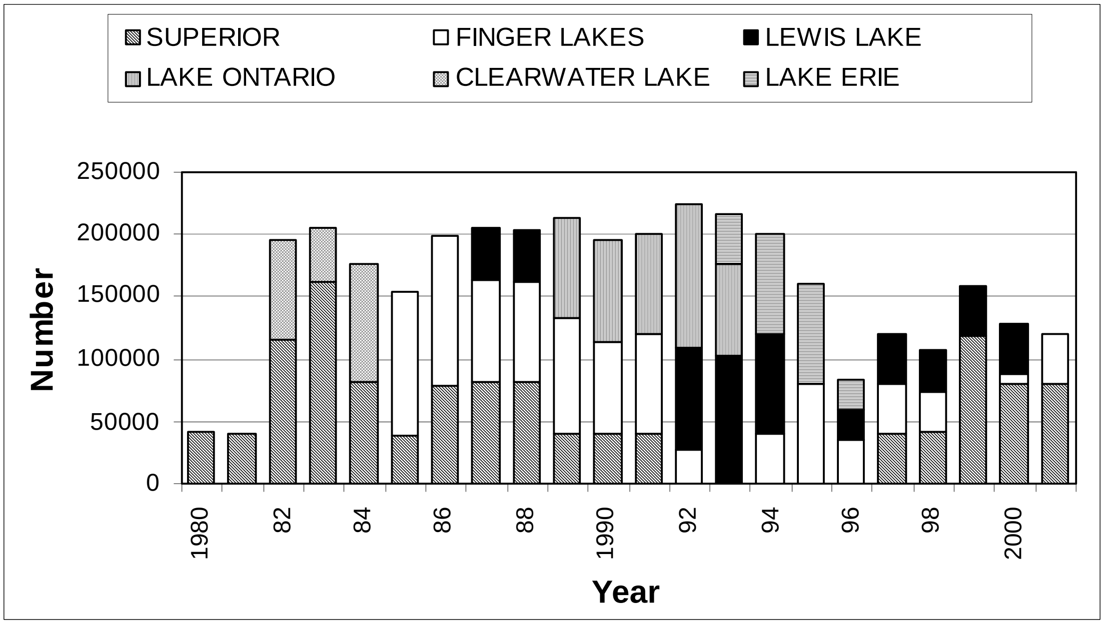

Fig. A.1: Yearling lake trout stocked in U.S waters of the eastern basin of Lake Erie, 1980 – 2001, by strain. The current stocking goal is 120,000 yearlings.

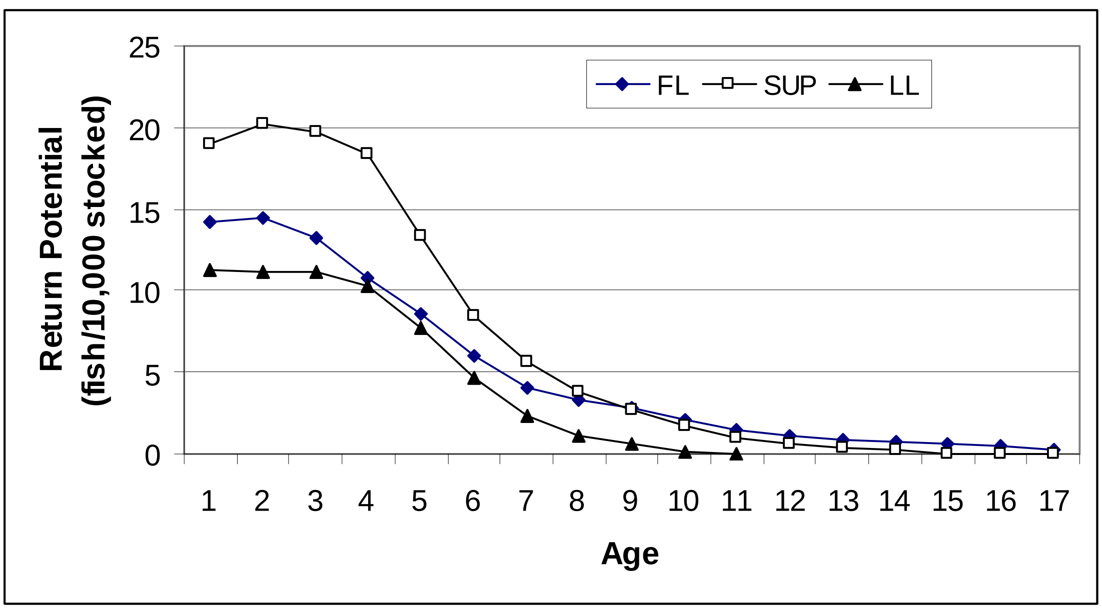

Fig. A.2: Return potential of three strains of lake trout collected in gill nets from New York waters of Lake Erie, 1985 – 2001.

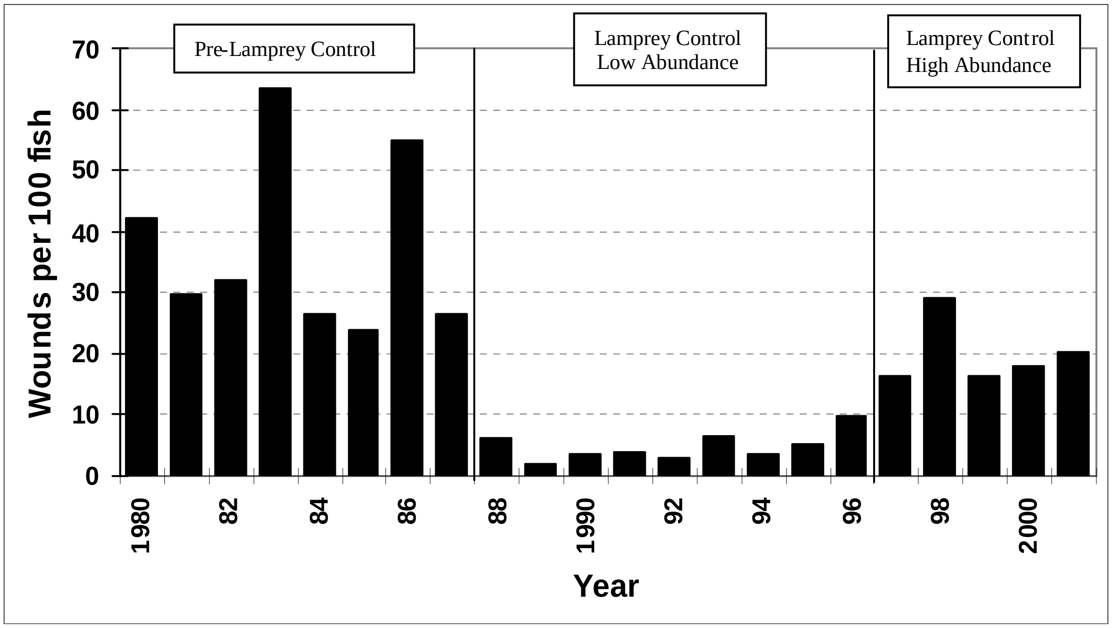

Fig. A.3: Number of fresh (A1-A3) sea lamprey wounds per 100 adult lake trout >532mm caught in standard assessment gill nets from New York waters of Lake Erie, 1980 – 2001, showing three periods of lamprey abundance.

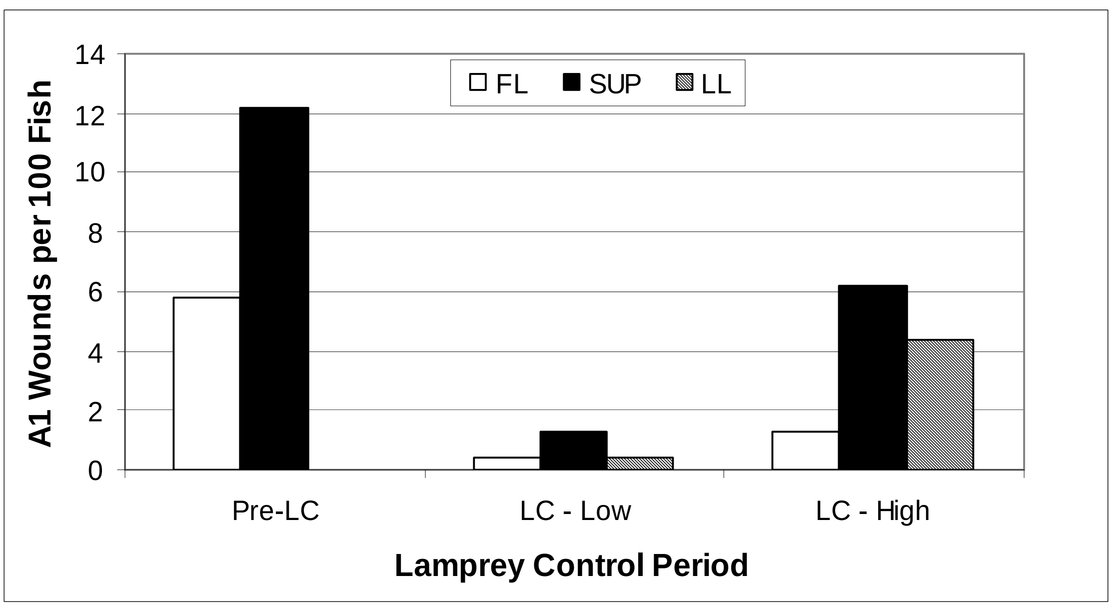

Fig. A.4: A1 wounding rate by lake trout stocking strain for three periods of sea lamprey abundance.

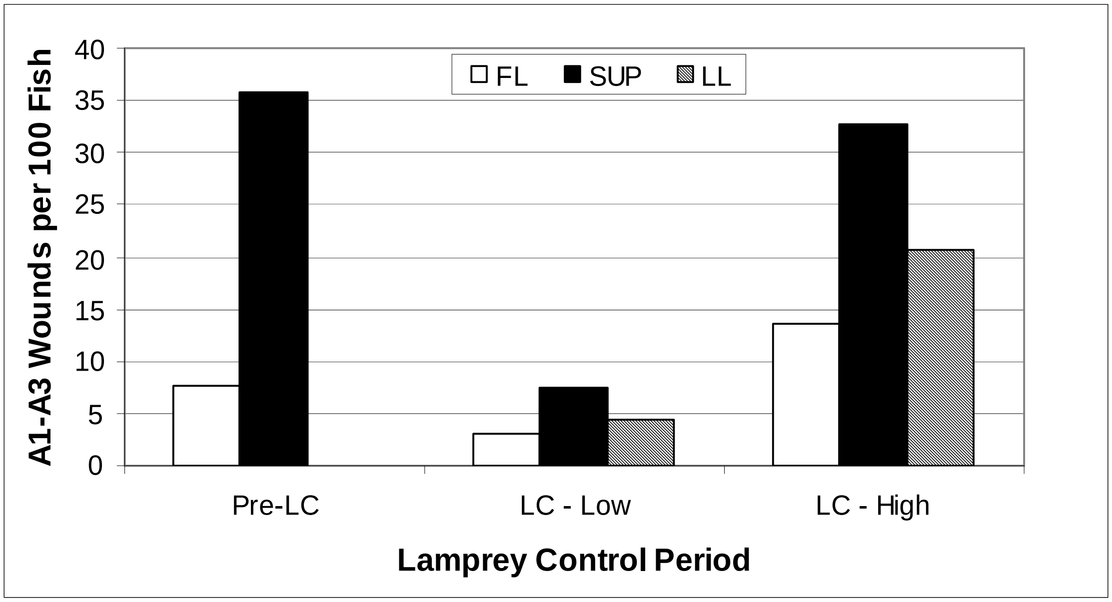

Fig. A.5: A1-A3 wounding rate by lake trout stocking strain for three periods of sea lamprey abundance. Abbreviations: LC=lamprey control, Low=low abundance of sea lampreys, High=high abundance of sea lampreys.

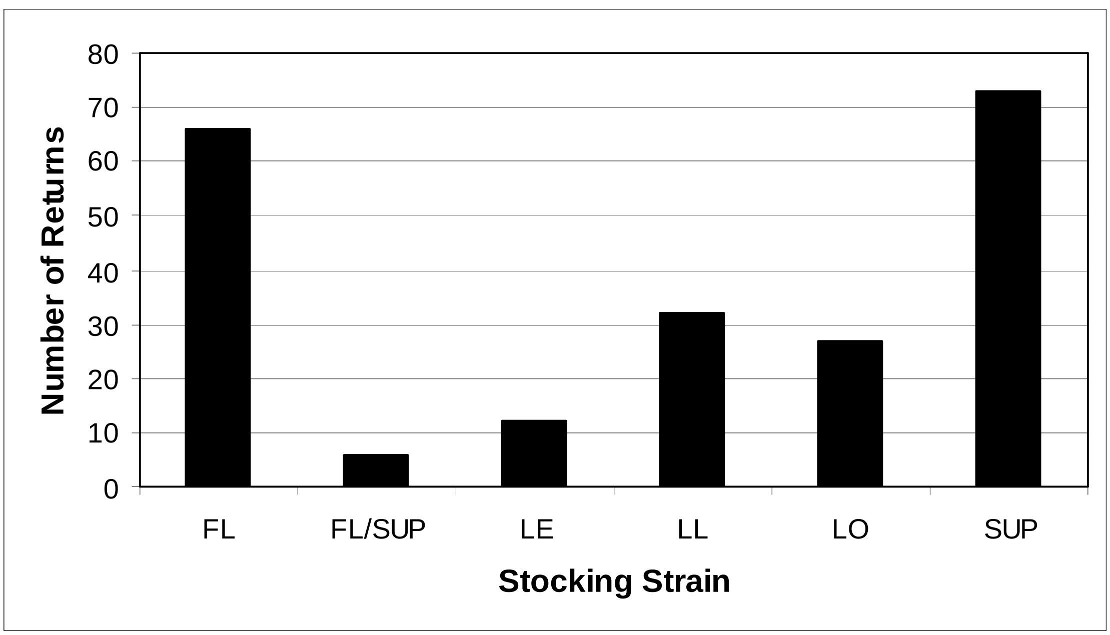

Fig. A.6: Number of lake trout collected by stocking strain in gill nets from New York waters of Lake Erie, August, 2001.

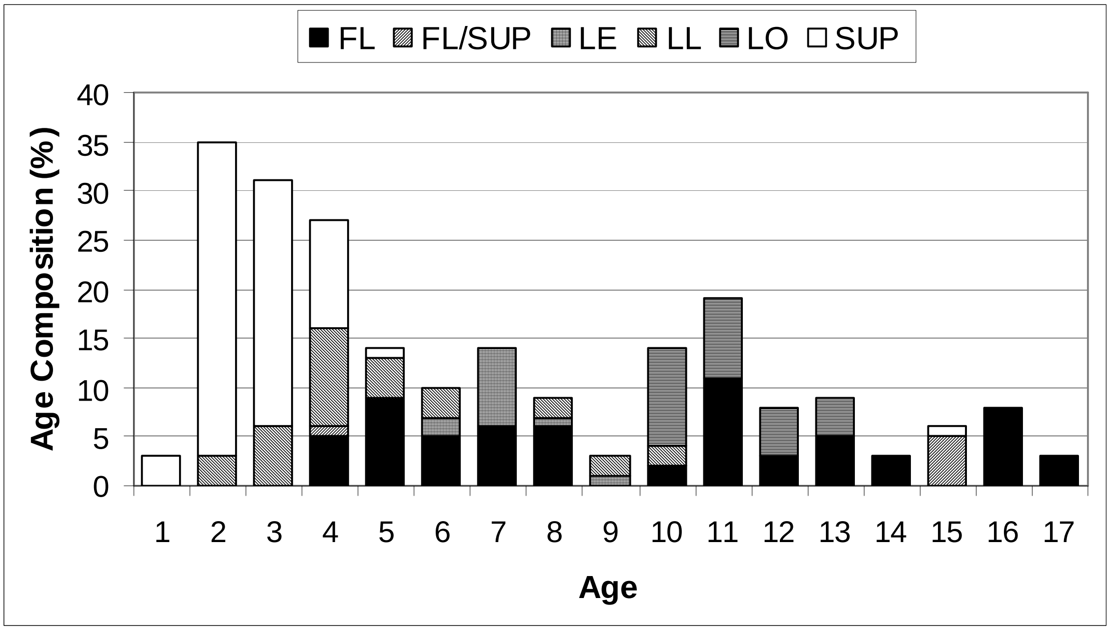

Fig. A.7: Number of lake trout collected by stocking strain and age in gill nets from New York waters of Lake Erie, August, 2001.

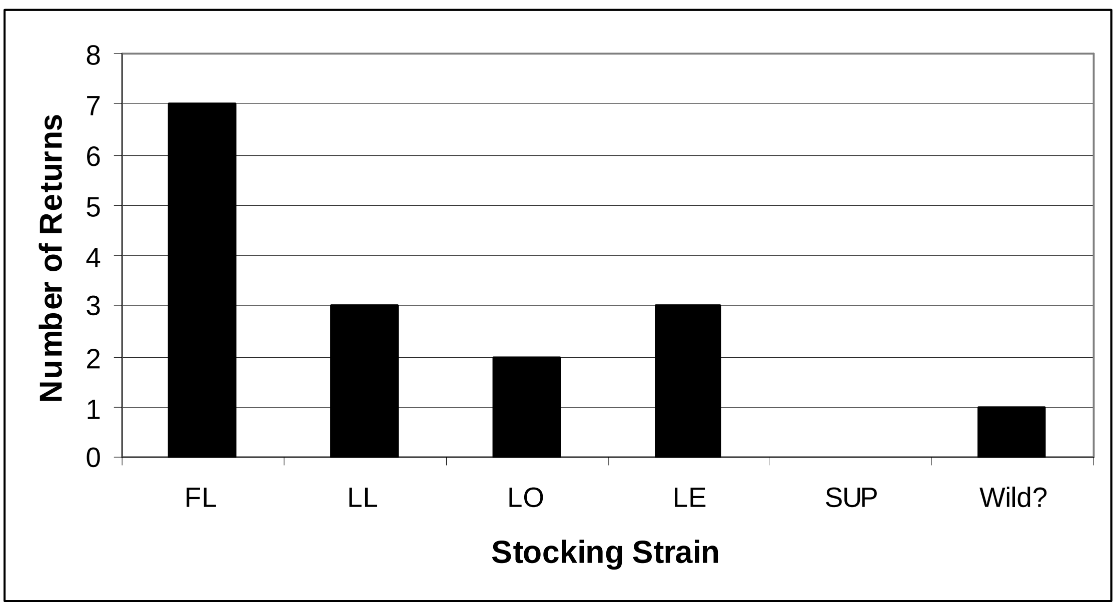

Fig. A.8: Number of lake trout collected by stocking strain in gill nets from a fall Spawning ground survey in New York waters of Lake Erie, November, 2001.