Administrative Report No. 41

WORKSHOP ON ALEWIVES AND TRAWLING
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Wisconsin Department of Natural Resources
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Executive Summary

Early in 1997 a workshop was convened by the Wisconsin DNR to address a request made by Governor Tommy Thompson. The Governor had asked that the Department form a group, including the Department of Development (now the Department of Commerce), the University of Wisconsin, the United States Fish and Wildlife Service, the University of Wisconsin Sea Grant Institute, and commercial and sport fishing representatives, to further study the dynamics of the alewife population and the effect of commercial trawling on the salmon sport fishery.

The purpose of the workshop was not to review or debate current commercial fishing regulations, although it was changes in those regulations that had given rise to the Governor's request. The management of alewives from Lake Michigan, including the development of trawling regulations, has been the subject of study and debate for over 30 years. During that time management policy in Wisconsin has moved from the goal of control through commercial exploitation, to the present policy of protecting alewives from incidental harvest in order to reserve them for use as food for salmon and trout. Commercial trawling is now directed to the harvest of smelt, and measures to protect alewives take the form of regulations limiting the gear, seasons, areas, and times of day when trawls may be used to harvest smelt. Those regulations have effectively limited the harvest of alewives to a fraction of earlier numbers.

Prior to the inception of large-scale stocking of salmon and trout in the 1960's, alewives were so abundant as to be considered a nuisance. They were blamed for declines in native species, including yellow perch, and spring die-offs of alewives fouled public beaches. But alewives also provided the opportunity for the creation of an enormously successful sport fishery. Since the mid 1960's, the abundance of alewives in Lake Michigan has been effectively controlled by predation by stocked salmon and trout. Today, approximately 15,000,000 salmon and trout are stocked annually by the four states on Lake Michigan, and natural reproduction adds substantially to the number of predators in the lake.

By the mid 1980's alewives had declined to the point where growth and survival of Pacific salmon was affected. Concerns were raised about the future of the sport fishery. It was at that time that regulations were enacted to sharply limit the ability of the commercial trawl fishery to harvest alewives. In Wisconsin, stocking of chinook salmon was also reduced. In 1993 a panel of experts convened under the auspices of the Great Lakes Fishery Commission concluded that, "The declining trend in alewife is consistent with a predator-prey imbalance, and, given that there seems to be little possibility to reverse the decline, an objective of increasing alewife biomass does not appear realistic or desirable."

Although many sport and commercial fishers believe that alewife abundance has increased somewhat in recent years, lakewide surveys using bottom trawls do not reflect a marked trend towards more alewives. The estimated lakewide biomass of alewives in 1996 was approximately 30,000 metric tons, which is close to the average for the last 10 years. Recent lakewide surveys utilizing hydroacoustic techniques show that an enormous year class of alewives was produced in 1995, but that a very small year class was produced in 1996.

Summary comments by participants in the 1997 workshop reflected differing perspectives on the issues at hand. No panelist argued that current alewife harvests by commercial trawlers are affecting sport fishing for salmon and trout, but some felt that increased harvests of alewives might have an effect on sport fishing. Differences in opinion among panelists reflected differences in perspective about the value of sport and commercial fisheries, but also reflected key remaining uncertainties about a) trends in lakewide alewife abundance, b) effects of fluctuations in alewife abundance on yellow perch and other native species, c) the health of the smelt population in Lake Michigan, d) local effects of possible increases in alewife harvests, and e) the stability of recent improvements in survival of stocked Pacific salmon.

Introduction

The management of alewives in Lake Michigan has been the subject of study and debate for over 30 years. During that time management policy in Wisconsin has moved from the goal of control through exploitation, to the present policy of protecting alewives from incidental harvest in order to reserve them for use as food for salmon and trout. Protection measures have taken the form of regulations limiting the gear, seasons, areas, and times of day when trawls may be used to harvest smelt. Those regulations have effectively limited the harvest of alewives to a fraction of earlier numbers.

In 1991, Governor Thompson asked (Appendix A) that the Department of Natural Resources form a group, including the Department of Development (now the Department of Commerce), the University of Wisconsin, the United States Fish and Wildlife Service, the University of Wisconsin Sea Grant Institute, and commercial and sport fishing representatives, to further study the dynamics of the alewife population and the effect of commercial trawling on the salmon sport fishery.

In 1993 this charge was addressed at a Lake Michigan Round Table convened under the auspices of the Board of Technical Experts of the Great Lakes Fishery Commission (Appendix D). The Round Table used the SIMPLE model to attempt to develop a common understanding of the problems confronting management of the fishery resources of Lake Michigan. The group addressed the problem of reversing the declining trend of alewife in Lake Michigan, and reached the conclusion that the future of alewife in Lake Michigan was doubtful. Its report stated,

> *The declining trend in alewife is consistent with a predator-prey imbalance, and, given that there seems to be little possibility to reverse the decline, an objective of increasing alewife biomass does not appear realistic or desirable.*

But Lake Michigan has continued to change, and today some reports suggest that the alewife population may be increasing to levels exceeding those thought possible in 1993. In January, 1997, a panel (Appendix B) was formed as recommended by the Governor. The panel met in a workshop format to review the situation and again addressed the topics raised by the Governor, the dynamics of the alewife population and the effect of commercial trawling on the salmon sport fishery. The purpose of the workshop was <u>not</u> to review or debate current regulations.

At the workshop invited presentations were made on the following topics: 1) An overview of the trawl fishery. 2) Alewife consumption by salmon and trout. 3) A review of the SIMPLE model. 4) Trends in lakewide abundance of alewives, smelt, and bloater chubs. 5) Lessons from Lake Ontario.

Following those invited presentations, contributed presentations were made on 1) The economic impact of the trout and salmon sport fishery and 2) The perspective of commercial trawlers.

Presentations were followed by an open-ended discussion focusing on the two issues raised by the Governor: the dynamics of the alewife population and the effect of commercial trawling on the salmon sport fishery.

This report summarizes the presentations and the concluding opinions of the participants. Although the purpose of the workshop was not to review trawling regulations, it is clear that this report will be considered in future discussions of those regulations. As background information about the issues surrounding current regulations, the briefing memo presented to the Natural Resources Board by George Meyer in October, 1993, is attached as Appendix C.

Summary of invited presentations

Invited presentations are summarized here, with some supplemental information and discussion added to tie them together.

Overview of the trawl fishery[1] - presented by Paul Peeters

Trawling as a technique for commercially harvesting fish in Wisconsin began in the late 1950's. Initially brought to Wisconsin to harvest overabundant slow-growing chubs, the use of the trawl was quickly adapted to harvest the exploding alewife population. The Wisconsin Department of Natural Resources (WDNR) actively monitored the commercial trawl industry for over nine years.

Two separate techniques were used in the evaluation of the commercial trawl fishery. The first technique used is the tracking of the commercial trawl catch reports. By law the commercial fisherman are required to file catch reports of their commercial fishing activities.

The reported catch of forage fish, primarily alewives, began about 1960. Expanding rapidly, the commercial catch of alewives peaked in 1977 when 44 million pounds of alewives were reported caught (Figure 1). Commercially caught alewives were primarily used in fish meal production for the animal feed market. Alewife harvest fell sharply during the next three years as a result of the discovery of PCB's in alewives and the fish meal made from them. The PCB's made the fish meal unsuitable as an animal feed additive. After 1980 the primary market for alewives was the pet food market. Harvest data do not accurately reflect fish abundance; they are strongly influenced by marketability of the fish products. Initially, both pound nets and trawls were used to harvest alewives. However, after the market crash in 1977 pound nets, unable to compete with the trawls, became an insignificant component of the fishery.

As alewife harvest declined in recent years, targeted smelt harvest for use as a human food increased. Reported smelt harvest rose from zero in 1949 to approximately 1.5 million pounds in the early 1990's (Figure 2). What began as a pound net and gill net harvest in the late 1940's became primarily a trawl fishery in the 1980's.

The other technique used to assess the commercial trawl fishery is the active monitoring of the commercial vessels engaged in fishing activities. During the years 1983 through 1991, 413 separate trawl outings were monitored and WDNR biologists personally witnessed the catch of over 8.5 million pounds of fish.

The Wisconsin trawl fishery can be divided into three distinct fisheries: the Lake Michigan

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[1] Additional information can be found in an internal WDNR report entitled, "Description of the commercial trawl fishery - November, 1992", prepared by Paul Peeters, Wisconsin Department of Natural Resources, Sturgeon Bay, Wisconsin.

forage fishery, the Lake Michigan winter smelt fishery, and the Green Bay summer smelt fishery. These fisheries are not only distinguished by the intended target and the location of the fishery but also by season, composition of the catch, and incidental species caught. Figures 3-5 compare the yearly composition of the various trawl fisheries.

In the Lake Michigan forage fishery (Figure 3) alewives represented the majority of the catch. During the shallow water forage fishing in 1983 through 1985 alewives made up 99 percent of the catch. During deep water forage trawling 1983 through 1990, alewives, smelt, and chubs made up 99 percent of the catch. From 1983 to 1990 there was an increase in the percentage of chubs caught in deep water trawling. This trend was also observed in forage fish surveys conducted by the US Fish and Wildlife Service.

Compared to the high percentage of alewives caught during the Lake Michigan forage fishery, the percentage of alewives caught during the Lake Michigan winter smelt fishery was very small (Figure 4). Smelt and chubs typically made up 99 percent of the catch. Chubs only made up 11 percent of the catch in 1983 but later became a major non-target species during this targeted smelt fishery.

During the Green Bay summer smelt fishery, smelt and alewives made up the majority of the catch during daytime fishing. However when fishing during the hours of darkness, alewives all but disappear from the catch (Figure 5).

During the years 1986 through 1991 there were three sets of regulation changes affecting trawl fishing activities (Figure 6). These changes reflected a concern for a declining abundance of alewives during the 1980's (Figure 17). The first set of rule changes in 1986 was put in place to prevent the expansion of the trawl industry and lessen the impact of the trawl industry on alewives while the status of the fishery was assessed. The second set of rule changes in 1988 was developed to prevent the expansion of the Green Bay summer smelt fishery until that aspect of the fishery could be evaluated. The third set of rule changes was an attempt to restructure the Wisconsin commercial trawl fishery from that of a high-volume low-value animal food fishery to that of a lower volume but higher value human food fish.

Prior to the rule changes, trawls targeting alewives fished throughout Lake Michigan. Today, trawling in Wisconsin is limited to an eight grid area near Manitowoc and the areas of southern Green Bay deeper than 65 feet (Figure 7).

Trawl regulation changes affected the annual reported catches of all species in all three components of the trawl fishery - the Lake Michigan forage fishery, the Lake Michigan winter smelt fishery, and the Green Bay summer smelt fishery. Total forage withdrawal by trawls dropped from 26.4 million pounds in 1983 to 2.2 million pounds in 1991 (Figure 8). That portion of the catch consisting of alewives dropped from 21.7 million pounds in 1983 to less than 0.1 million pounds in 1991.

Smelt harvests by trawling increased in Lake Michigan and Green Bay from 1983 to the early

1990's, but have declined since then (Figure 9). Catch rates (expressed as catch per trawl hour) have declined in recent years, suggesting a decline in smelt abundance. In the summer Green Bay smelt fishery (broken line in Figure 9) catch rates were fairly stable from 1991 through 1995 but dropped in 1996. In the Lake Michigan winter smelt fishery (solid line in Figure 9) catch rates have have declined since 1991.

Alewife consumption by salmon and trout - presented by Bill Horns

The rule changes described above had the desired effect of minimizing the commercial harvest of alewives, and thereby reserving alewives for use as food by trout and salmon. The rules were developed at a time when the alewife population was in decline and stocked salmon were exhibiting reduced growth rates and high mortality from bacterial kidney disease (BKD). Fish health experts advised that the increased prevalence of BKD reflected stress caused by limited food availability.

In order to understand the importance to sport fishing of protecting alewives from commercial harvest, we need to first consider what we know about the numbers of alewives consumed by stocked salmon and trout. Scientific modelling has given us some insight into this.

Stewart and Ibarra[2] used a bioenergetics modelling approach to estimate the total annual consumption of alewives by salmon and trout during certain years in the 1970's and 1980's. They provide estimates of gross conversion efficiency, the ratio of cumulative gross production to total consumption (Figure 10). Gross conversion efficiency for chinook salmon ranged from near 25% in the late 1970's to around 20% in the late 1980's. This means that a chinook salmon that is caught weighing 30 pounds has, in its entire lifetime, consumed 120 to 150 pounds of food, most of which would have been juvenile or adult alewives.

Stewart and Ibarra also developed estimates of the total consumption by stocked cohorts of 1,000,000 chinook salmon, coho salmon, and lake trout (Figure 11). Assumptions about mortality rates of the stocked fish were included in their calculations. They estimated that if one could measure the total weight of all alewives consumed by each stocked chinook salmon throughout its entire life, and then average those values (including chinook that died as fingerlings as well as those that lived to spawn), the average consumption would have been approximately 12 pounds for a fish stocked in the late 1970's and approximately 7.5 pounds for a fish stocked in the late 1980's.

In a sustained stocking program, several cohorts of chinook salmon are present in the lake simultaneously. Recognizing that, one can restate the estimates of Stewart and Ibarra in a different way: under a sustained program of stocking chinook salmon, the weight of alewives eaten each year (expressed in pounds) will be roughly ten times the number of chinook salmon stocked annually. Stewart and Ibarra extrapolated their results to estimate that total annual food

[2] Stewart, D.J. and M. Ibarra. 1991. Predation and production by salmonine fishes in Lake Michigan, 1978-1988. Can. J. Fish. Aquat. Sci. 48:909-922.

consumption by stocked salmon and trout was 71,000 metric tons (156,000,000 pounds) in 1983 and 76,000 metric tons (167,000,000 pounds) in 1987. Most of that food was alewives.

It is beyond the scope of this review to estimate how predation by stocked salmon has changed since 1987, but although Wisconsin, Illinois, and Indiana cut stocking levels for chinook salmon, Michigan did not, and total lakewide stocking levels have not changed greatly[3] (Figure 12). Today, approximately 15,000,000 trout and salmon are stocked annually by the four states on Lake Michigan.

By the late 1980's the alewife population in Lake Michigan was in a state of decline, chinook salmon growth rates were low, sport harvests of pacific salmon had declined (Figure 13), and mortality attributable to BKD was high. In 1990 the Great Lakes Fishery Commission's Board of Technical Experts, aware of these problems in Lake Michigan and concerned about the possibility of similar problems in Lake Ontario, formed the SIMPLE Task Group to study the sustainability of the salmon and trout sport fisheries. The acronym, SIMPLE, stands for Sustainability of Intensively Managed Populations in Lake Ecosystems.

The SIMPLE model - presented by Mark Holey

The SIMPLE Task Group[4] was formed with the following overall purpose:

> *To develop a framework for evaluating the risks of hatchery dependent fisheries and, thereby, help managers move Great Lakes fisheries, where possible, to more sustainable configurations.*

Additional background information about the SIMPLE Task Group is found in Appendix D.

To accomplish its purpose, the Task Group developed a mathematical model, referred to as the SIMPLE Model, to help understand Great Lakes ecosystems and to provide a tool for discussing and evaluating management options. The SIMPLE model incorporated both bioenergetics modelling, as used by Stewart and Ibarra and reviewed above, and population modelling, to develop simulations of likely future trends in abundance of alewives and other forage species under various possible levels of salmon and trout stocking.

In January, 1993, the SIMPLE Lake Michigan Round Table was convened in Racine, Wisconsin, to review the model as applied to Lake Michigan. Participants in the Round Table (listed in Appendix D) represented diverse management, scientific, and public interests. The

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[3] Holey, M.E. 1996. Summary of Trout and Salmon Stocking in Lake Michigan 1976-1995. Report to Lake Michigan Committee.

[4] Koonce, J.F. and Jones, M.L. 1994. Sustainability of the Intensively Managed Fisheries of Lake Michigan and Lake Ontario. Final report of the SIMPLE Task Group, Board of Technical Experts, Great Lakes Fishery Commission.

SIMPLE Round Table reached consensus on three points, the first of which is directly relevant to the present workshop:

> *First, the future of alewife in Lake Michigan is doubtful. The declining trend in alewife is consistent with predator-prey imbalance, and, given that there seems to be little reasonable possibility to reverse the decline, an objective of increasing alewife biomass does not appear realistic or desirable.*

That conclusion reflects the simulations depicted in Figure 14. There, the expected future trend in adult alewife abundance is shown for two possible stocking strategies. According to the model, continuation of stocking at 1992 levels would lead to a continuing downward trend in alewife abundance, while a 75% reduction in stocking would lead to a leveling off of alewife abundance.

Since the 1992 SIMPLE Lake Michigan Round Table, the alewife population has stabilized, and, by some accounts, increased. The best objective lakewide estimates of long-term trends in abundance of the primary forage species, alewives, bloater chubs, and smelt, are developed by the Great Lake Science Center of the National Geological Survey (formerly part of the US Fish and Wildlife Service).

Trends in forage species abundance - presented by Chuck Madenjian

Current data on forage species abundance are summarized in Appendix E, "Status of Prey Fish Populations in Lake Michigan, 1996", prepared by the Great Lakes Science Center of the U.S. Geological Survey.

Lakewide forage abundance estimates have been developed by two methods, trawling and hydroacoustics. Trawl surveys have been conducted annually during the fall since 1973, using seven transects (Figure 15). Trawls are made parallel to shore at several depths along each of the seven transects, and the catch rates are extrapolated based on the area swept by the trawl to develop a lakewide index of abundance for each of the forage species. The trawl surveys only reflect fish that are accessible to the trawls, and therefore tend to underestimate the abundance of young-of-year and yearling alewives. Alewife biomass, as estimated by trawl surveys, was approximately 30,000 metric tons in 1996 (Figure 16), which is near the average estimated biomass for the last 10 years (Figure 17). The trawl surveys indicate an increase in biomass of bloater chubs, which continue to constitute the preponderance of the forage biomass in the lake (Figures 16 and 17.

In recent years, estimates of lakewide forage abundance have been developed using an integrated approach involving both hydroacoustic methods and midwater trawling. The hydroacoustic survey conducted in the fall of 1995 indicated a very large year class of alewives, with a total biomass of young-of-year alewives of approximately 151,000 metric tons (332,200,000 pounds). The hydroacoustic survey conducted in the fall of 1996 indicated that the biomass of that year class of alewives in 1996 (as yearlings) was still large, but had dropped to 31,767 metric tons.

The 1996 survey also showed a small year class of alewives (3,501 metric tons) and a low abundance of alewives two-years old and older (8,735 metric tons).

Lessons from Lake Ontario - presented by Mike Hansen

Following the decline of alewives in Lake Michigan, and the subsequent drop in salmon sport fishing, fisheries managers on Lake Ontario sharply reduced stocking levels of chinook salmon and lake trout. Their objective was to reduce the predatory demand on alewives, and avoid a repetition of the experience of Lake Michigan.

A panel similar to this one was convened in early 1996 to review the status of Lakes Ontario's pelagic fish community[5]. That panel reached three conclusions for Lake Ontario:

1) The increase in alewife biomass in 1995 despite relatively high stocking rates and a low alewife population in 1994 indicates that the alewife population is more resilient than previously suggested.

2) Returning to higher stocking levels will increase the risk for prey limitation and decreased salmonine growth rates, and therefore increase the risk for disease outbreaks, especially for chinook salmon.

3) Returning to higher stocking rates should improve chances for increases in native fish species by keeping the alewife population low.

The Lake Ontario ecosystem differs from Lake Michigan in two important respects that are relevant to this workshop. First, reductions in nutrient inputs to Lake Ontario have limited primary production to the point where the alewife population is susceptible to being limited by food availability. That is not the case for Lake Michigan. Second, the ratio of predators stocked to biomass of alewives available is much smaller in Lake Ontario than in Lake Michigan. That is, the relative abundance of alewives is much higher in Lake Ontario than in Lake Michigan. Taken together, these facts mean that the experience of Lake Ontario may not be a useful guide for managing Lake Michigan.

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[5] Rudstam, L. (ed). 1996. A review of the current status of Lake Ontario's pelagic fish community. Report of the 1996 Lake Ontario Technical Panel. Great Lakes Research Review, 2:4-10.

Contributed presentations

In addition to the invited presentations, two additional presentations were contributed by panelists Mike Rusch and Pete LeClair. Those presentations are summarized below.

The economic impact of the trout and salmon fishery - presented by Mike Rusch

In 1993 the Coalition for the Advancement of Sportfishing and Tourism (COAST) estimated the economic impact of the declining salmon and trout sport fishery. Figures 18-24 summarize recent trends in license and stamp sales and other related information. Sales of Great Lakes Salmon and Trout Stamps have been reduced by over 50% (Figure 18). The number of licensed charter fishing boats dropped from 524 in 1988 to 257 in 1996 (Figure 21). The decline in participation by non-residents has been particularly sharp (Figure 22). Those data and others were used by COAST to estimate for the years 1988-93 the actual sport fishing expenditures, as well the possible sport fishing expenditures if the salmon and trout fishery had not declined (Figures 25-26). From those figures it was estimated that the decline in salmon and trout fishing resulted in a decline of over $400,000,000, statewide, in expenditures related to sport fishing (Figure 25).

The salmon and trout fishery, which declined sharply after 1987, is beginning to recover (Figures 27-28), but the chinook salmon fishery has not recovered in the Manitowoc-Two Rivers area, as much as in other areas (Figure 27).

The perspective of commercial trawlers - presented by Pete LeClair and Clyde Neuman

The trawl harvest of forage species (alewives, smelt, and bloater chubs) is compared in Figure 29 with the estimated lakewide biomass of forage species and the estimated consumption of forage species by trout and salmon. Current rules control the commercial harvest only; consumption by trout and salmon is left to chance. Forage fish consumption can vary greatly, and depends on the number of predator fish stocked, disease rates among the stocked fish, and fishing pressure. Those factors are very hard to control under present conditions, and may never be controlled. If survival of stocked chinook salmon doubled, the entire forage base could be consumed in one year.

Catch rates from charter fishing boats are illustrated in Figure 30. In 1983, when nearshore trawling was heavy in the Two Rivers/Manitowoc area, catch rates there exceeded those in all other ports. All ports showed an increase in catch rates after new trawling regulations were implemented in 1986, but the increase in the Two Rivers/Manitowoc area was no better than in other areas, despite the fact that the new trawling regulations affected that area most directly. Similarly, the Two Rivers/Manitowoc area did not show an improvement relative to other ports after additional regulations were enacted in 1991. Total harvests by charter boats are illustrated in Figure 31. Here, as in Figure 30, there is no sign the Two Rivers/Manitowoc area was especially helped by trawling regulations imposed in 1986 or 1991.

In 1988 the total lakewide biomass of forage species was 52,000 tons, while the commercial harvest was only 3,300 tons (Figure 32). The commercial harvest cannot have affected the lakewide biomass.

Trends in sale of Great Lakes Trout and Stamps and Two-day Great Lakes fishing licenses (Figures 33-35) do not indicate that changes in the trawling regulations in 1986 and 1991 helped sport fishing.

The incidental harvest of chubs during commercial trawling for smelt declined sharply between the 1993-94 commercial fishing year and the 1995-96 commercial fishing year (Figure 36).

The 1995 lakewide forage survey revealed extremely high concentrations of alewives (Figure 37). Alewives made up approximately 43.5% of the forage fish biomass, while smelt made up approximately 5.6%. Trawlers do not believe that a small increase in the harvest of alewives would hurt the trout and salmon fishery.

Concluding comments by panelists

Following the presentations summarized above, each panelist was asked to make concluding comments, and to specifically address the question of whether commercial trawling affects the salmon and trout sport fishery. Oral comments are summarized below. Written comments are attached as Appendices F through L.

Tom Gorenflo - Chippewa/Ottawa Treat Fisheries Management Authority

[See Appendix F for additional written comments]

It does not appear that the 1991 alewife harvest (the first full year under current regulations) could have an impact on the whole lake.

The Fish-Community Objectives for Lake Michigan[6] recognize the central and mixed role of alewives on the Lake Michigan fish community. We should bear that in mind in discussions of alewife management, recognizing that alewives may have harmful as well as beneficial roles to play.

COTFMA favors controlling alewives at a low level.

Mike Rusch - Coalition of the Advancement of Sportfishing and Tourism

[See Appendix G for additional written comments.]

I am concerned about the economic importance of the salmon and trout fishery.

I do not believe that present trawling affects lakewide salmon and trout populations significantly, but trawling has the potential to impact salmon and trout fishing locally in the Two Rivers/Manitowoc area.

I also have a concern for the effects of current trawling on the smelt population.

Finally, I see a need to improve our knowledge of forage fish populations.

Jim Butterbrodt - Great Lakes Study Committee and Wisconsin Federation of Great Lakes Sport Fishing Clubs

[See Appendix H for additional written comments.]

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[6] Eshenroder, R.L., M.E. Holey, T.K. Gorenflo, and R.D. Clark, Jr. 1995. Fish-Community Objective for Lake Michigan. Great Lakes Fish. Comm. Spec. Pub. 95-3. 56 p.

Pete LeClair was not being singled out for restrictions when trawling regulations were adopted. Trawling was removing over 5% of the lakewide alewife biomass and nearshore trawling was physically disruptive. The regulations on alewife trawling, along with cuts in stocking levels, were part of a strategy designed to reduce pressure on the forage fish population, especially alewives. The abundant chubs are not suitable forage for salmon.

I have a major concern for the health of the smelt population.

I am concerned about the incidental kill of bloater chubs in the trawl fishery.

The economic importance of alewives for the salmon and trout fishery is a major concern.

I do not believe we know the current effect of trawling on the salmon and trout fishery, there are too many confounding factors. The future of the sport fishery is promising.

Mark Holey - U.S. Fish and Wildlife Service

Commercial trawling today probably has a minuscule impact on the sport fishery.

In considering management options for alewives, we should remember that management options are limited, and should try to structure fish communities that do not require intensive management.

Chinook salmon are subject to population fluctuations, so focusing on that species as a management tool could be dangerous.

Paul Peeters - Wisconsin Department of Natural Resources

I do not believe that trawlers have a significant measurable direct effect on the salmon and trout fishery.

This is a resource allocation issue; current regulations reserve the limited alewife population for use as food by salmon and trout, rather than allowing it to be harvested for use as pet food. We have created a low-volume, high-value trawl fishery in place of a high-volume, low-value trawl fishery.

In discussing the need for additional data, remember that trawl monitoring is not forage assessment; if funding were available we could resume trawl monitoring, but that would not answer the questions we have about lakewide forage trends.

Terry Grossenheider - Wisconsin Department of Commerce

[See Appendix I for additional written comments]

I do not feel it is my role to comment on the impact of trawling on the salmon and trout fishery. There is clearly a need for further study. All interested parties need to work together, including the other states, especially Michigan, who were not present at this workshop.

Mike Hansen - University of Wisconsin - Stevens Point

[See Appendix J for additional written comments.

Lakewide studies in 1987 indicated that the trawl fishery at that time was harvesting a small percentage of the alewife biomass, probably not enough to significantly effect the salmon and trout fishery. But those studies also showed that alewives are not uniformly distributed around the lake, so we should be cautious about reaching conclusions regarding the possible effects of a trawl fishery that is focused on an area where alewives are concentrated. We lack sufficient information to predict the future; trawling now does not affect sport fishing, but we do not know how much additional trawling would be acceptable.

Charlie Henriksen - Wisconsin Commercial Fisheries

[See Appendix K for additional written comments.]

My interest is in the chub fishery. I do not believe that trawling today effects chub abundance, but it might in the future.

We need to also consider views of the general public, especially regarding spring die-offs of alewives.

Fish populations in Lake Michigan are not as easily managed as was once thought.

Future decisions about trawling rules must consider whose business we want to support.

Pete LeClair - Susie Q Fish Company, Inc.

[See Appendix L for additional written comments.]

I do not believe that the smelt population has declined. Physical displacement of smelt by alewives and other factors are affecting the trawlers' ability to catch smelt.

Because of the use of diverters, trawlers do not kill large numbers of sport fish anymore.

Current data from Green Bay is needed. We have no data on alewives in Green Bay since 1987. More monitoring of trawling is needed to provide current data.

More salmon should be stocked to reduce the alewife population.

Alewives, smelt, and chubs swim in the same water, so trawlers need to be allowed an incidental catch of alewives. I recommend an incidental catch quota for alewives.

Chuck Madenjian - Great Lakes Science Center, U.S. Geological Survey

Keeping alewives at a level where they provide sufficient food for salmon and trout, but do not have adverse effects, might be difficult. Modelling efforts such as the SIMPLE model will help us better understand the role of alewives in the Lake Michigan Ecosystem.

Bill Horns - Wisconsin Department of Natural Resources

Today, the commercial trawling fishery is strictly regulated, and therefore has a very limited effect on the alewife population. It probably does not affect salmon and trout fishing. The salmon and trout fishery, however, depends on alewives, and we do not know what amount of commercial alewife harvest could be sustained without affecting the sport fishery.

Corrected estimates by the National Geological Survey of forage fish abundance in the fall of 1996 now cast some doubt on earlier reports that alewife were increasing in abundance. With the reduced prevalence of bacterial kidney disease, chinook salmon are living longer. Also, the numbers of naturally reproduced salmon may be rising. Both of those trends will lead to increased predation pressure on alewives, so we should watch the alewife population carefully for signs of a decline. If a decline occurs, the salmon and trout populations could again suffer as they did in the late 1980's. In that case an increase in the harvest of alewives would exacerbate the problem. On the other hand, if the alewife population expands, despite the increased predation pressure, some additional alewife harvest could be sustained without harming sport fishing.

Alewives, at high levels of abundance, limit yellow perch, bloater chubs, and other native species. We would like to know what level of alewife abundance is detrimental to those species. If the current alewife population is adversely affecting native species, we face uncertainties and difficult choices regarding salmon and trout stocking policies. But, in any case, it is unlikely that commercial trawling could be an effective tool in controlling the lakewide alewife population, and certainly not without hurting sport fishing for trout and salmon.

List of Figures

16. Bottom trawl-based estimates of smelt, alewife, and bloater chub biomass in Lake Michigan during 1973-1996. (Great Lakes Science Center, USGS)

17. Bottom trawl-based estimates of smelt, alewife, and bloater chubs in Lake Michigan in 1996. (Great Lakes Science Center, USGS)

18. Total sales of Great Lakes Salmon and Trout Stamps during 1986-1995. (Coalition for the Advancement of Sportfishing and Tourism)

19. Combined daily licenses sales in lakeshore counties during 1988-1995. (Coalition for the Advancement of Sportfishing and Tourism)

20. Great Lakes Salmon and Trout Stamp sales in lakeshore counties during 1988-1995. (Coalition for the Advancement of Sportfishing and Tourism)

21. Numbers of licensed charter boats on Lake Michigan during 1984-1996. (Coalition for the Advancement of Sportfishing and Tourism)

22. Numbers of resident and non-resident anglers on Lake Michigan charter boats during 1987-1996. (Coalition for the Advancement of Sportfishing and Tourism)

23. Hours of fishing by anglers on Lake Michigan charter boats during 1988-1996. (Coalition for the Advancement of Sportfishing and Tourism)

24. Catch rates on Lake Michigan charter boats during 1988-1996. (Coalition for the Advancement of Sportfishing and Tourism)

25. Sportfishing expenditures in Wisconsin during 1988-1993. (Coalition for the Advancement of Sportfishing and Tourism)

26. Sportfishing expenditures in Wisconsin during 1988-1993.
(Coalition for the Advancement of Sportfishing and Tourism)

27. Annual trout and salmon catches from Lake Michigan during 1976-1996. (Coalition for the Advancement of Sportfishing and Tourism)

28. Annual chinook salmon catch by port during 1987-1996. (Coalition for the Advancement of Sportfishing and Tourism)

29. Tonnage of forage in Lake Michigan in 1991 compared with the commercial harvest and the amount consumed by predators. (Pete LeClair and Clyde Neuman)

30. Charter boat catch rates from several ports during 1976-1996. (Pete LeClair and Clyde Neuman)

31. Sport fish harvests from charter boats during 1976-1996. (Pete LeClair and Clyde Neuman)

32. Lake Michigan forage abundance and commercial harvest in 1988. (Pete LeClair and Clyde Neuman)

33. Great Lakes Salmon and Trout Stamp sales during 1983-1995. (Pete LeClair and Clyde Neuman)

34. Two-day sport fishing license sales in Wisconsin during 1987-1995. (Pete LeClair and Clyde Neuman)

35. Salmon stamp sales during 1990-1995. (Pete LeClair and Clyde Neuman)

36. Smelt harvests and trawling effort during 1993-1996. (Pete LeClair and Clyde Neuman)

37. 1995 forage survey data. (Pete LeClair and Clyde Neuman)

List of Appendices

A. Governor's veto message for 1991 Wisc. Act 39.

B. Alewife workshop participants.

C. Issue brief regarding commercial trawling presented to the Natural Resources Board in October 1993.

D. A report of the Lake Michigan Round Table of the SIMPLE Task Group. J.F. Koonce and M.L. Jones, Board of Technical Experts, Great Lakes Fishery Commission.

E. Status of Prey Fish Populations in Lake Michigan, 1996. C.P.Madenjian, R.M.Stedman, T.J.DeSorcie, D.P.Passino-Reader, R.L.Argyle, G.W.Fleischer, G.C.Curtis, and R.Stickel, Great Lakes Science Center, U.S. Geological Survey.

F. Comments on draft report by Tom Gorenflo.

G. Comments on draft report by Mike Rusch.

H. Comments on draft report by Jim Butterbrodt.

I. Comments on draft report by Terry W. Grosenheider.

J. Comments on draft report by Michael J. Hansen.

K. Comments on draft report by Charles W. Henriksen

L. Comments on draft report by Pete LeClair.

M. Letters from invited panelists unable to attend the workshop.

FIGURES

Figure 1

FORAGE HARVEST, ALL GEAR 1960-1991 WISCONSIN WATERS, LAKE MICHIGAN

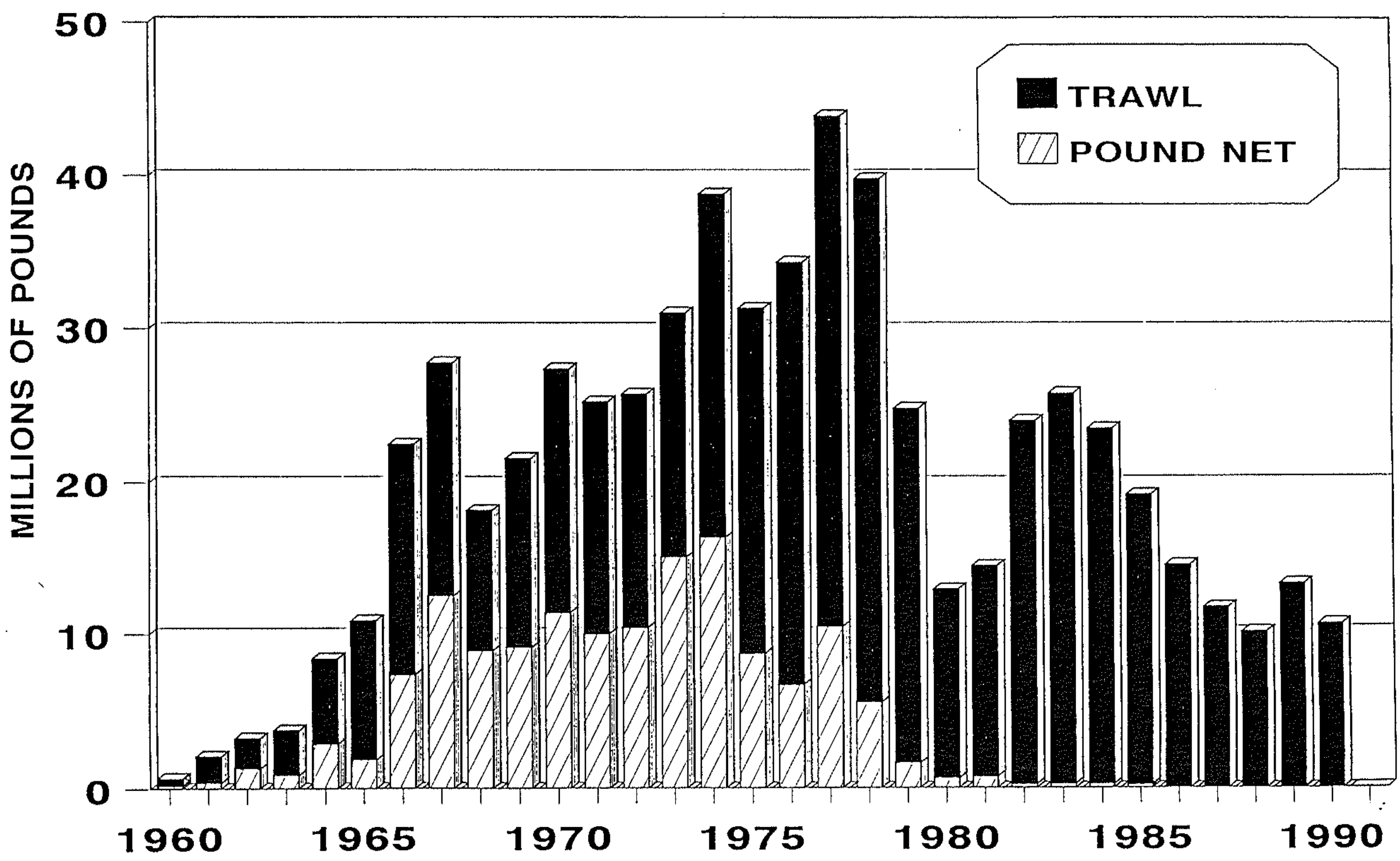


Figure 2

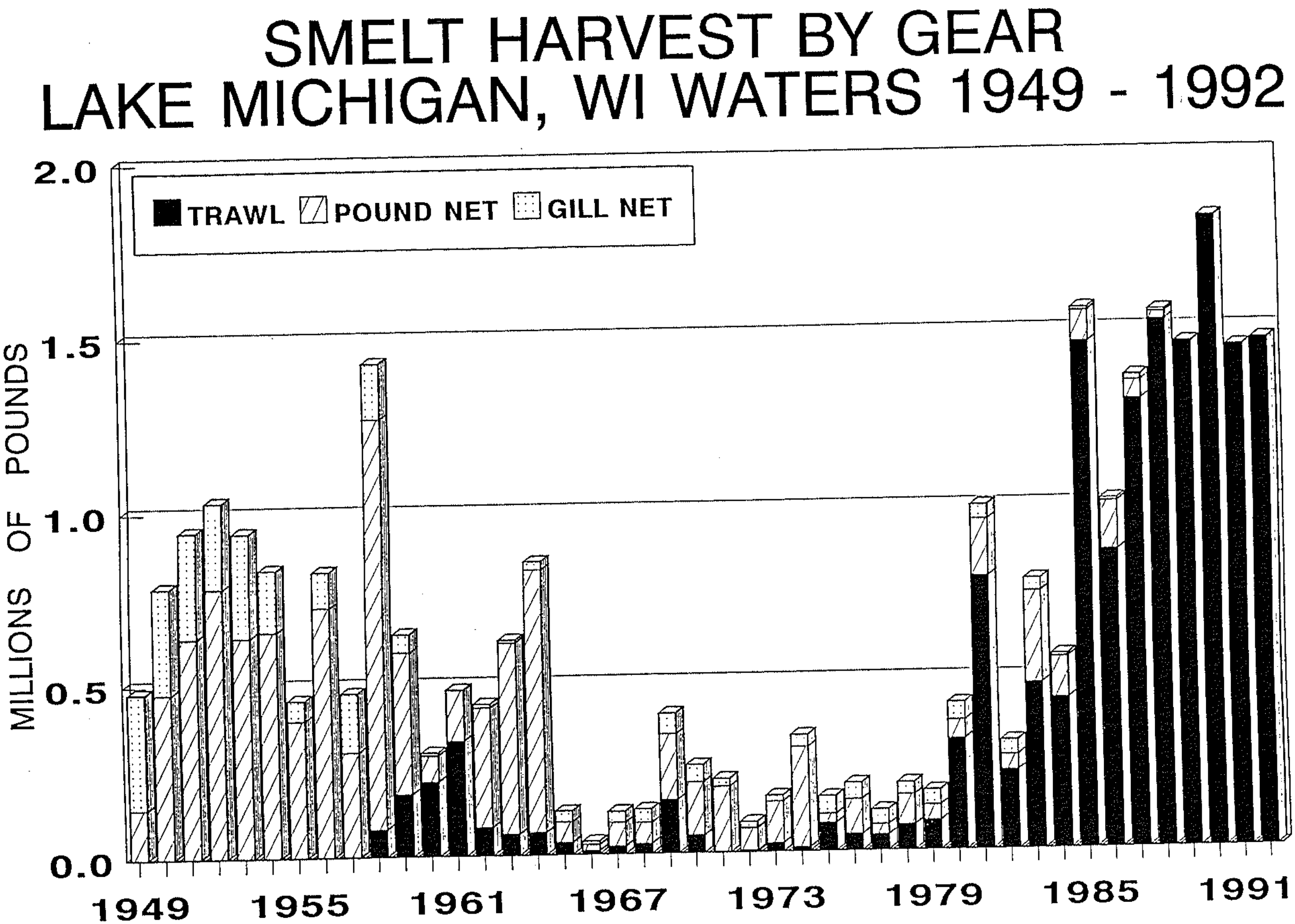
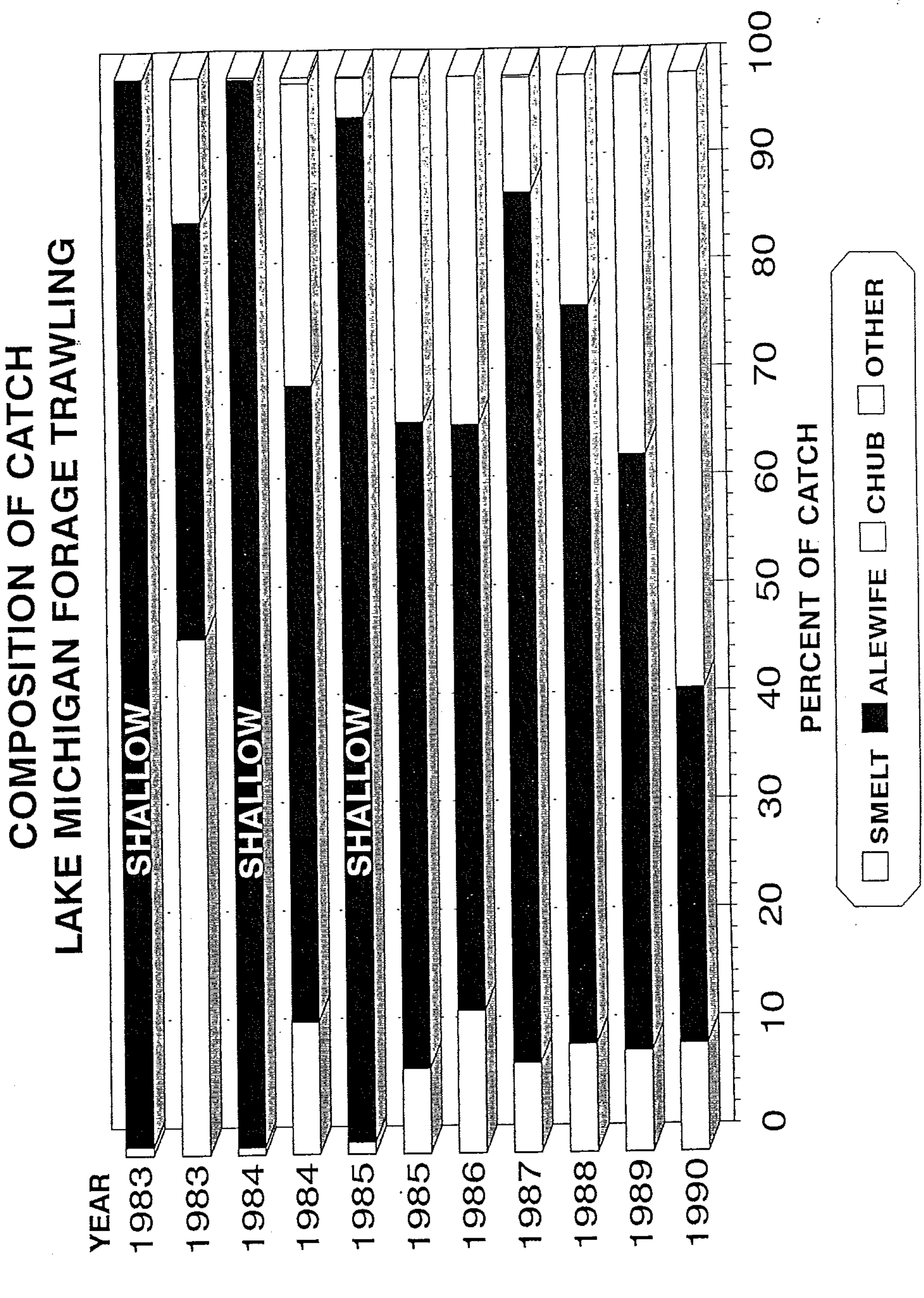

SMELT HARVEST BY GEAR
LAKE MICHIGAN, WI WATERS 1949 - 1992
TRAWL
POUND NET
GILL NET
MILLIONS OF POUNDS
0.0
0.5
1.0
1.5
2.0
1949
1955
1961
1967
1973
1979
1985
1991

Figure 3



COMPOSITION OF CATCH
LAKE MICHIGAN FORAGE TRAWLING
YEAR
1983
1983
1984
1984
1985
1985
1986
1987
1988
1989
1990
SHALLOW
SHALLOW
SHALLOW
0
10
20
30
40
50
60
70
80
90
100
PERCENT OF CATCH
SMELT
ALEWIFE
CHUB
OTHER

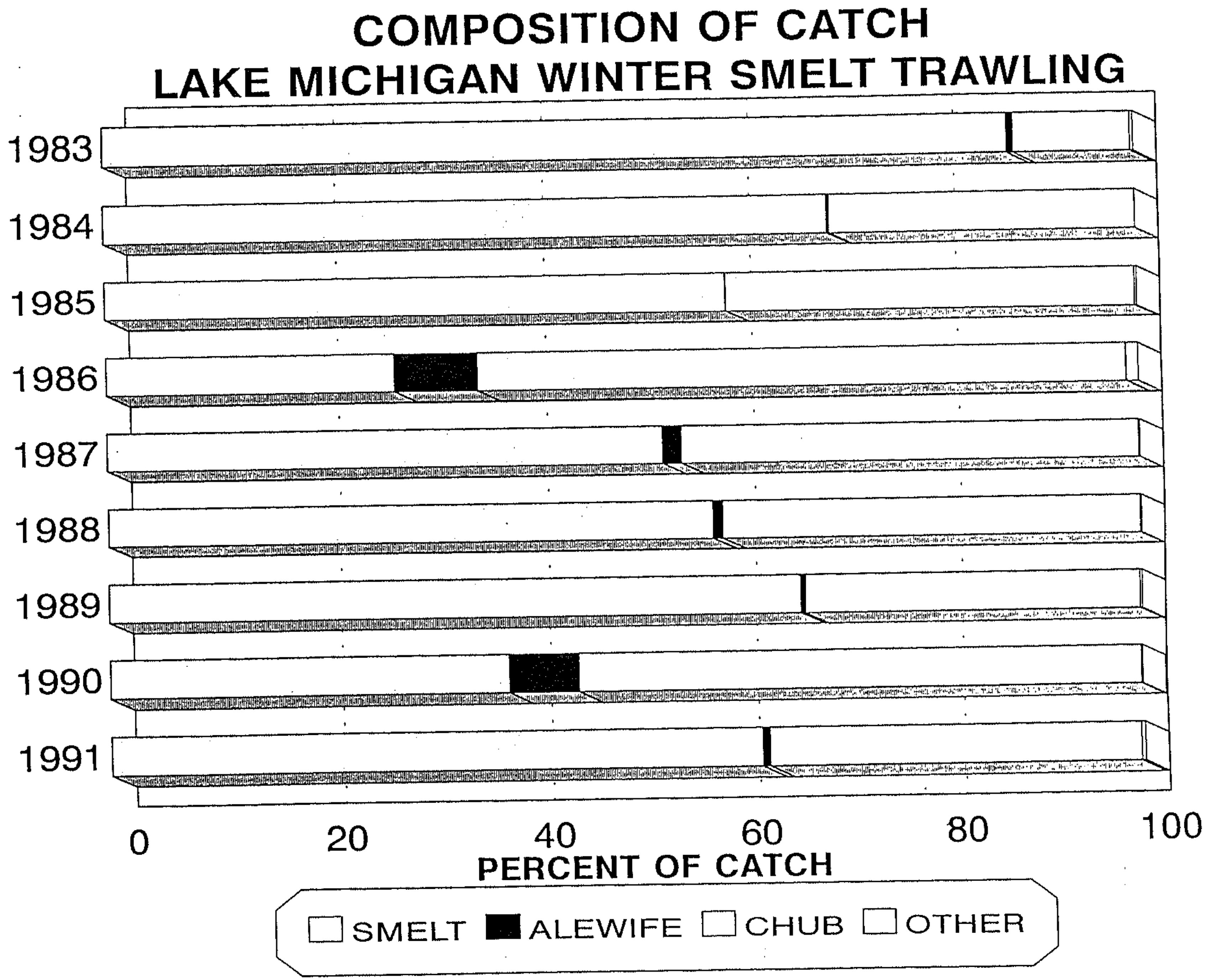
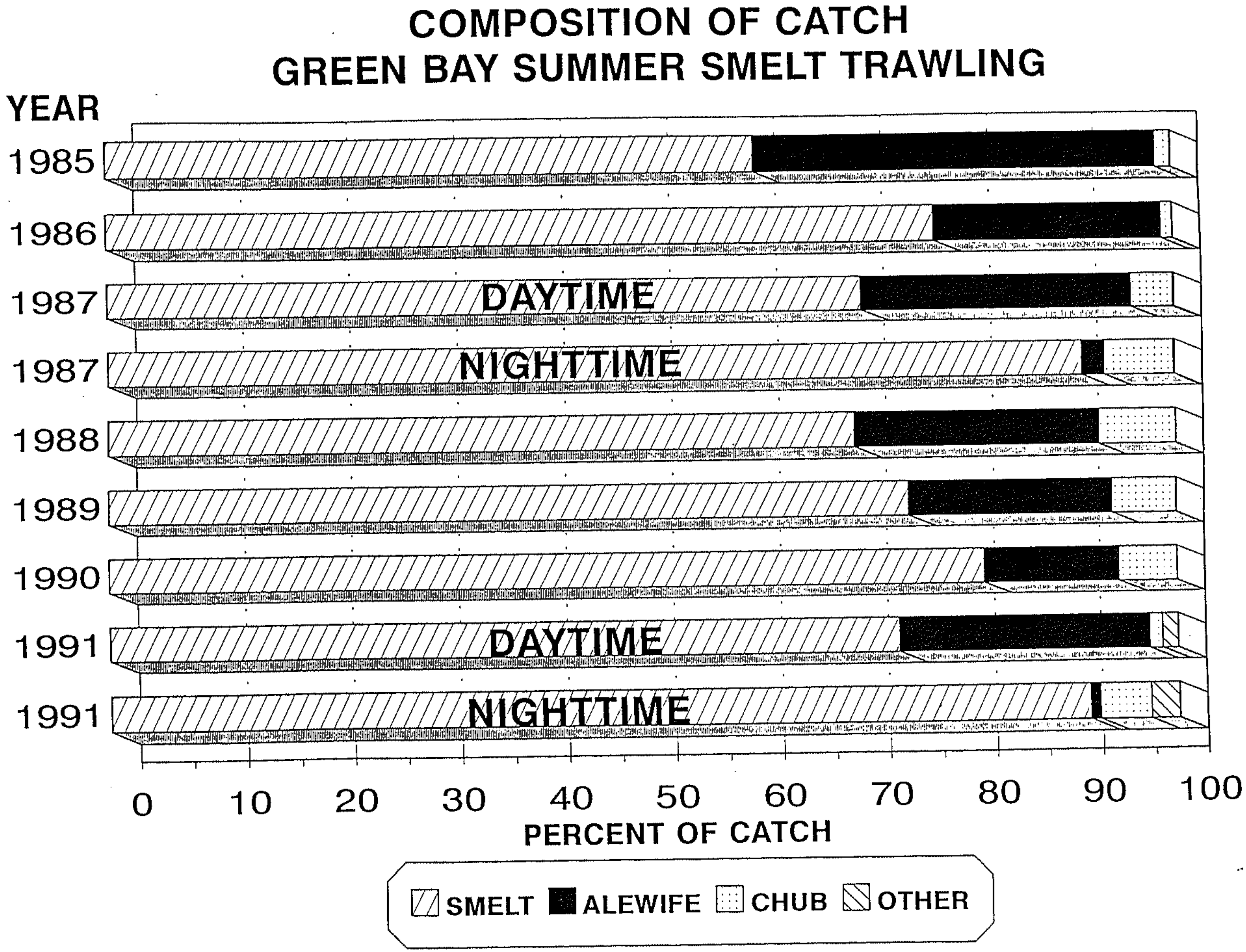

COMPOSITION OF CATCH
LAKE MICHIGAN WINTER SMELT TRAWLING
1983
1984
1985
1986
1987
1988
1989
1990
1991
0
20
40
60
80
100
PERCENT OF CATCH
SMELT
ALEWIFE
CHUB
OTHER

Figure 4

Figure 5


COMPOSITION OF CATCH
GREEN BAY SUMMER SMELT TRAWLING
YEAR
1985
1986
1987
DAYTIME
1987
NIGHTTIME
1988
1989
1990
1991
DAYTIME
1991
NIGHTTIME
0
10
20
30
40
50
60
70
80
90
100
PERCENT OF CATCH
SMELT
ALEWIFE
CHUB
OTHER

CHANGES IN TRAWL REGULATIONS SINCE 1983

1986

REGULATIONS WERE PUT IN PLACE TO PREVENT EXPANSION OF THE TRAWLER INDUSTRY WHILE THE STATUS OF THE FISHERY WAS ASSESSED.

1988

REGULATIONS WERE DEVELOPED TO PREVENT EXPANSION OF THE GREEN BAY SMELT FISHERY.

1991

THE TARGETED HARVEST OF FORAGE FISH WAS ELIMINATED, WHILE STILL PERMITTING A HARVEST OF SMELT FOR HUMAN FOOD. NEW RULES AND SEASONS WERE ESTABLISHED TO LIMIT CATCH OF NONTARGET SPECIES.

WISCONSIN WATERS OPEN TO COMMERCIAL TRAWLING

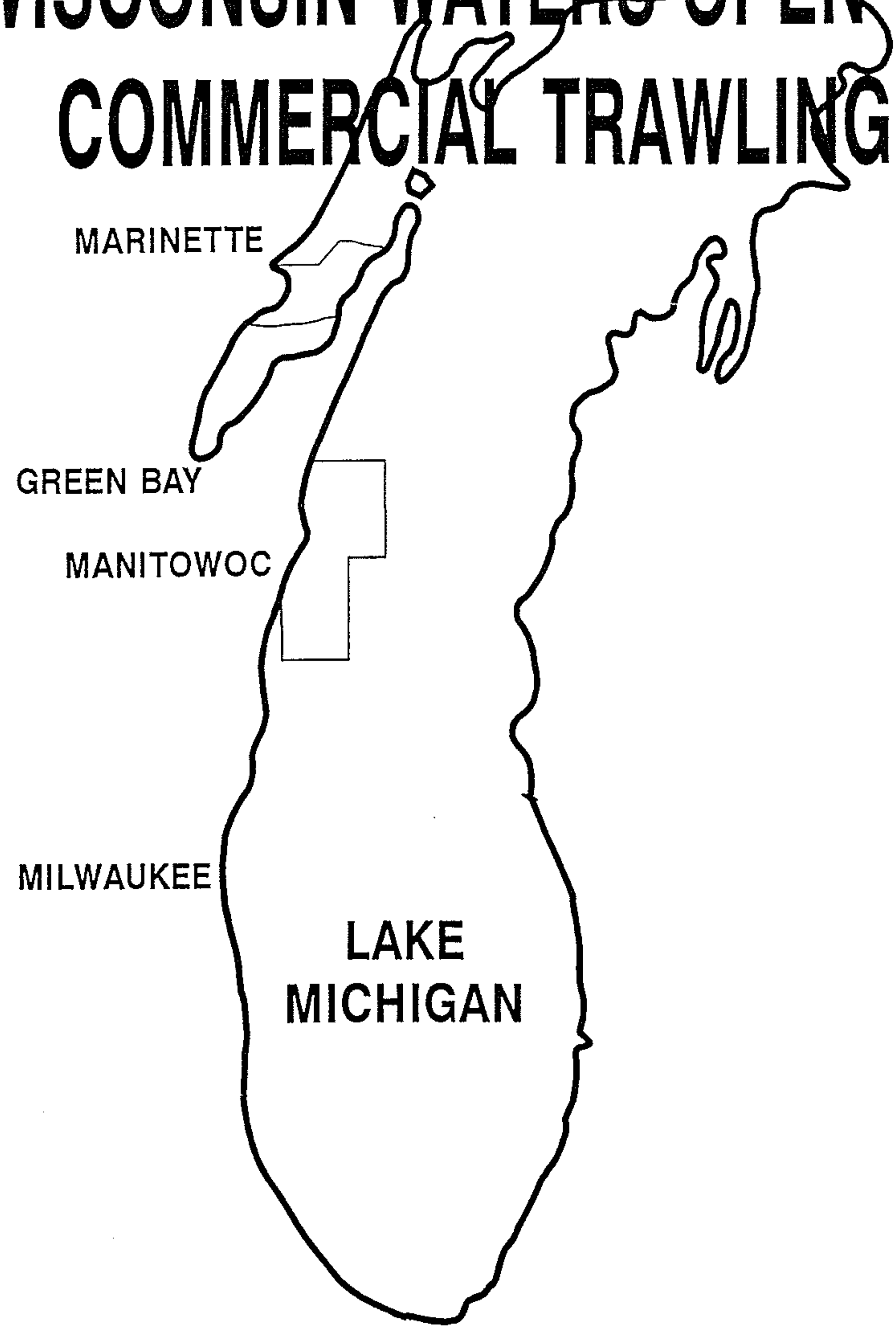


Figure 8

TOTAL FORAGE WITHDRAWL BY TRAWL
ALL WISCONSIN WATERS 1983 - 1992

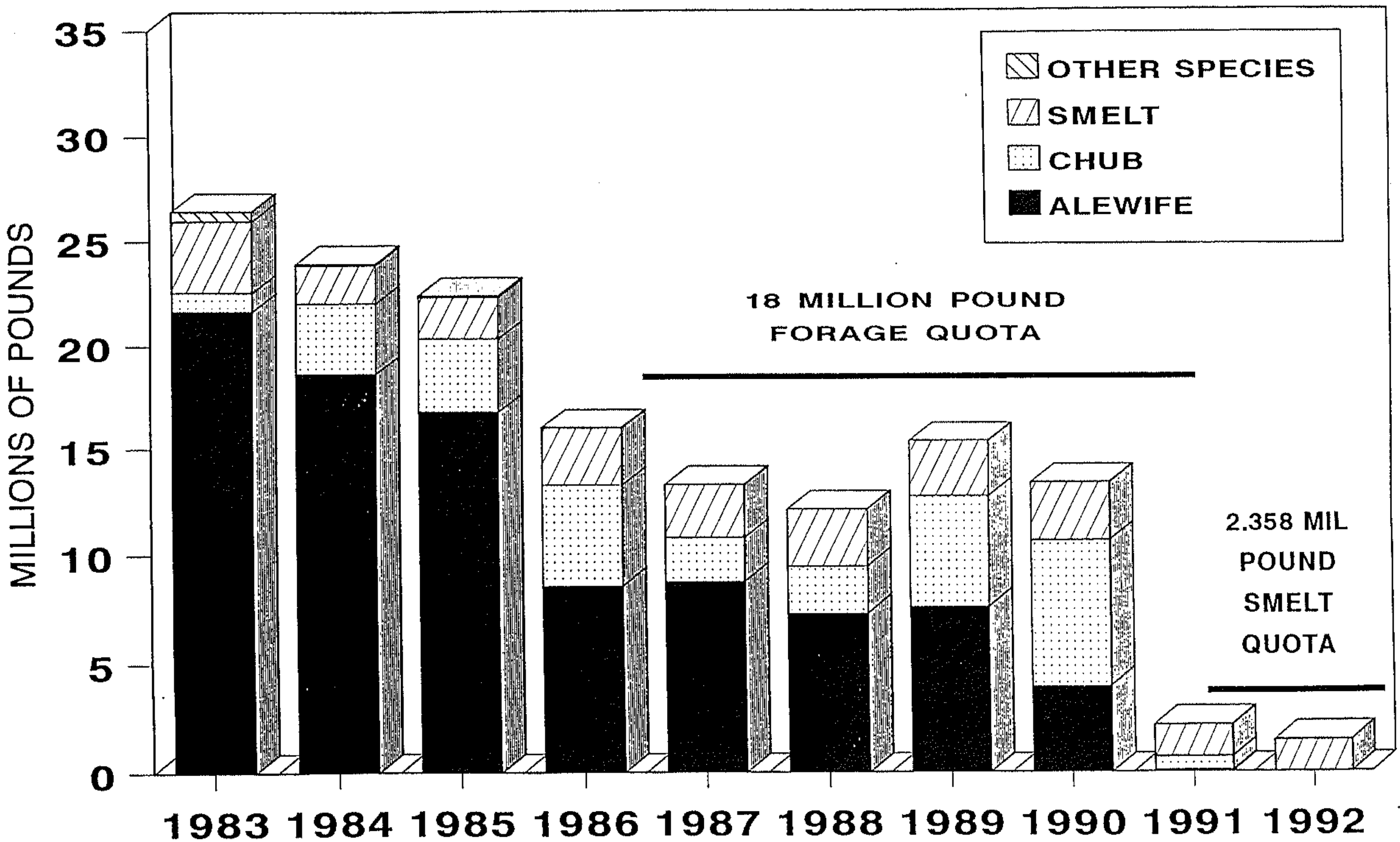


Figure 9

SMELT HARVEST AND CPE BY TRAWL 1983-1996
WISCONSIN WATERS OF LAKE MICHIGAN AND GREEN BAY

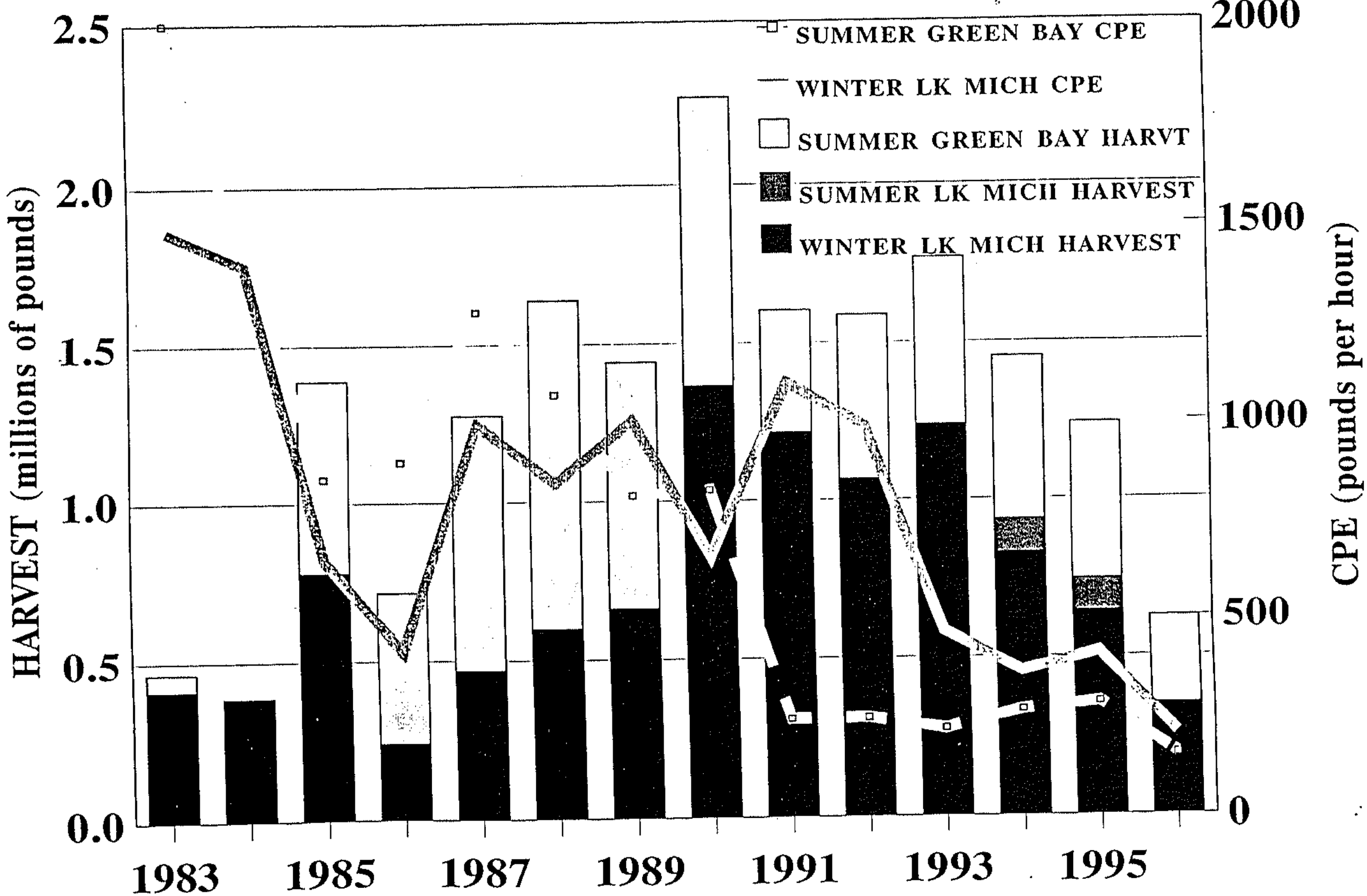


Figure 10

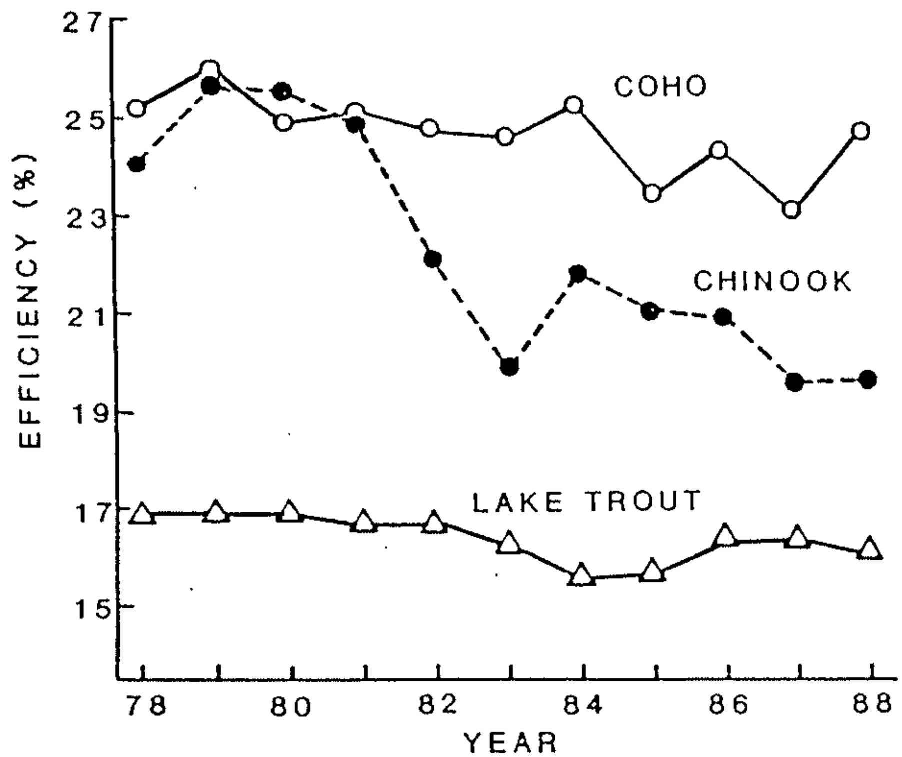


FIG. 7. Gross conversion efficiency of wet weight biomass (i.e. cumulative gross production divided by total consumption) for lake trout, coho salmon, and chinook salmon populations in Lake Michigan based on modeling simulations for 1978–88.

From: Stewart, D.J. and M. Ibarra. 1991. Predation and production by salmonine fishes in Lake Michigan, 1978-1988. Can. J. Fish. Aquat. Sci. 48:909-922.

Figure 11

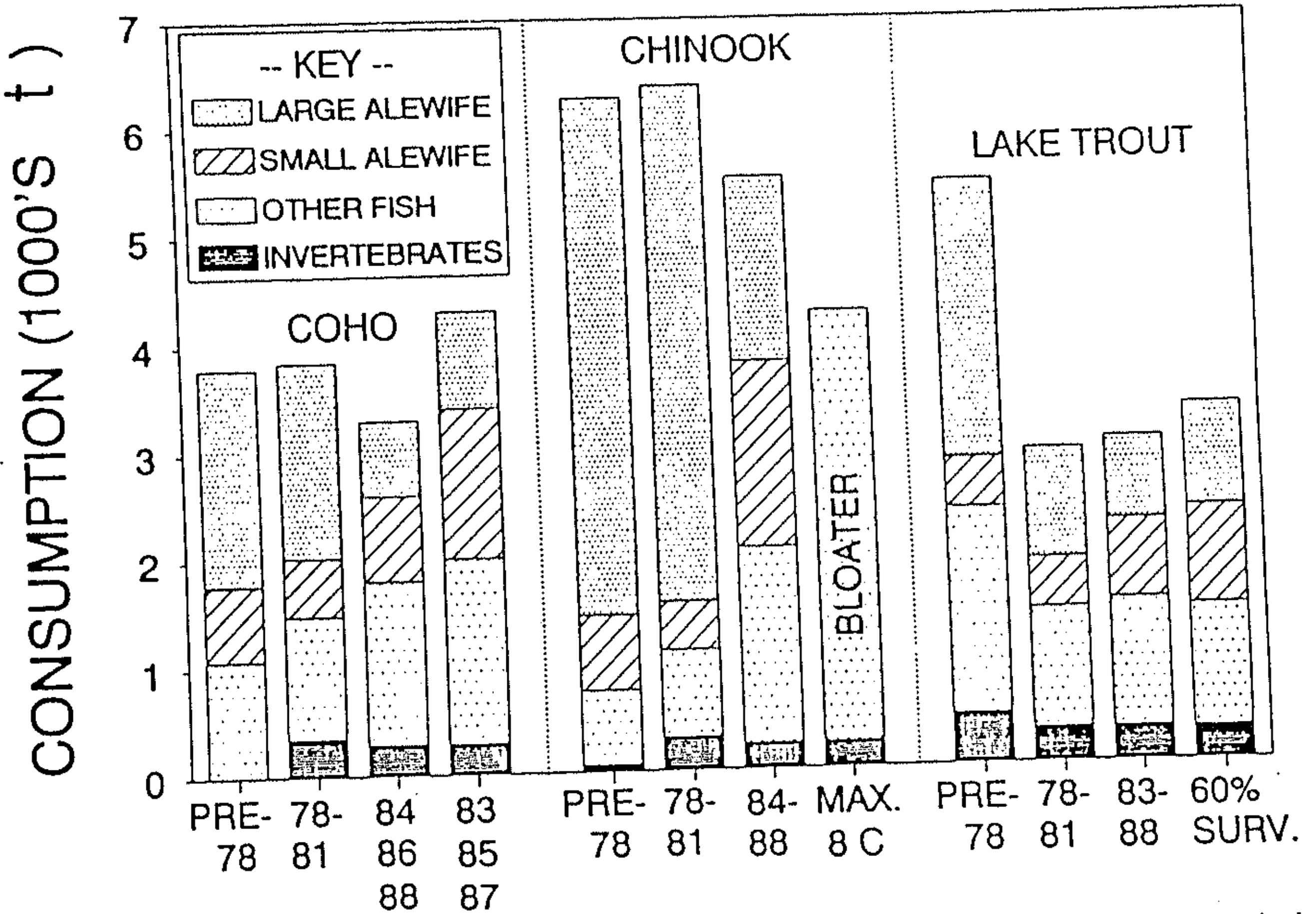


FIG. 5. Comparison of total consumption and breakdown by prey type for a standard 1 million stocked fish for each of coho salmon, chinook salmon, and lake trout in Lake Michigan. Results from Stewart et al. (1981) are presented as Pre-78, and those simulations were adjusted for 1978–81 by including results from Jude et al. (1987; cohort 1 diets for coho and chinook salmon), Eck and Brown (1985; lake trout growth and survival rates), and Eck and Wells (1986; lake trout winter diets). Results for the period after the main alewife decline (1983–88) are based on average growth and diets for the years indicated above each bar (see text). We also present results of two hypothetical scenarios involving chinook salmon eating bloater at 8°C and lake trout with 60% annual survival after age 4.

From: Stewart, D.J. and M. Ibarra. 1991. Predation and production by salmonine fishes in Lake Michigan, 1978-1988. Can. J. Fish. Aquat. Sci. 48:909-922.

Figure 12

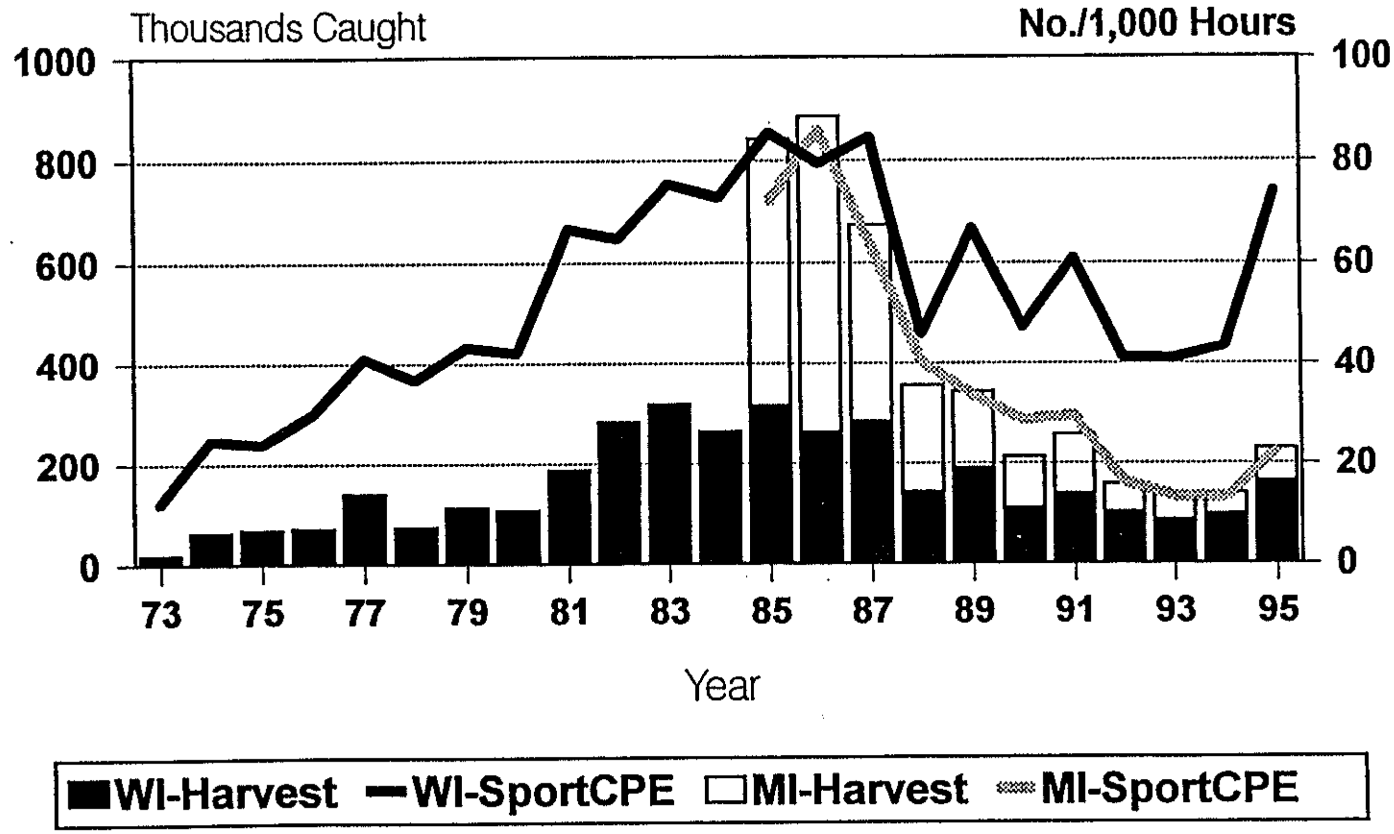
Table 1. Lake Michigan Trout and Salmon Stocking, 1976-1994, All Jurisdictions.

	SPECIES								
YEAR	LAKE	BROOK	BROWN	CHINOOK	COHO	RAINBOW +	ATLANTIC	SPLAKE	TOTAL
1976	2,548,000	80,000	881,000	3,264,000	2,937,000	1,831,000	43,000	0	11,584,000
1977	2,390,000	623,000	1,152,000	2,818,000	3,014,000	1,202,000	47,000	0	11,246,000
1978	2,501,000	243,000	1,535,000	5,365,000	2,630,000	1,937,000	46,000	0	14,257,000
1979	2,427,000	185,000	1,213,000	5,085,000	4,000,000	2,511,000	0	0	15,421,000
1980	2,604,000	188,000	1,307,000	6,106,000	2,943,000	2,661,000	0	0	15,809,000
1981	2,295,000	208,000	1,140,000	4,797,000	2,463,000	1,939,000	20,000	0	12,862,000
1982	2,264,000	245,000	2,159,000	6,035,000	2,180,000	2,442,000	45,000	0	15,370,000
1983	2,241,000	297,000	2,219,000	6,380,000	2,364,000	2,441,000	0	20,000	15,962,000
1984	1,245,000	233,000	1,853,000	7,710,000	3,028,000	3,192,000	0	34,000	17,295,000
1985	3,024,000	316,000	1,791,000	5,955,000	2,659,000	1,764,000	0	54,000	15,563,000
1986	2,917,000	197,000	1,431,000	5,693,000	2,291,000	2,022,000	0	115,000	14,666,000
1987	1,984,000	118,000	1,342,000	5,800,000	2,304,000	1,831,000	0	18,000	13,397,000
1988	2,180,000	497,000	1,545,000	5,417,000	3,210,000	1,443,000	0	104,000	14,396,000
1989	3,332,000	150,000	1,504,000	7,859,000	2,334,000	1,844,000	0	88,000	17,111,000
1990	1,317,000	360,000	1,675,000	7,125,000	2,380,000	1,710,000	0	50,000	14,617,000
1991	2,779,000	326,000	1,384,000	6,237,000	2,471,000	1,841,000	0	396,000	15,434,000
1992	3,027,000	272,000	1,644,000	5,795,000	2,744,000	1,823,000	0	55,000	15,360,000
1993	2,699,000	294,000	1,673,000	5,491,000	1,709,000	1,806,000	0	141,000	13,813,000
1994	3,062,000	269,000	2,166,000	5,894,000	1,471,000	2,100,000	0	127,000	15,089,000
1995	2,264,000	328,000	1,868,000	6,400,000	2,398,000	1,861,000	0	191,000	15,310,000
Ave.	2,455,000	271,450	1,574,100	5,761,300	2,576,500	2,010,050		107,154	14,728,100

Note: All numbers were rounded to the nearest 1,000 fish.
Tiger Trout were not included in this summary.

+ Rainbow category includes steelhead and domestic rainbow trout.

Chinook Harvest and Catch Rate for Sport Anglers in Wisconsin and Michigan 1973-1995.



Lake Michigan Simulation Results

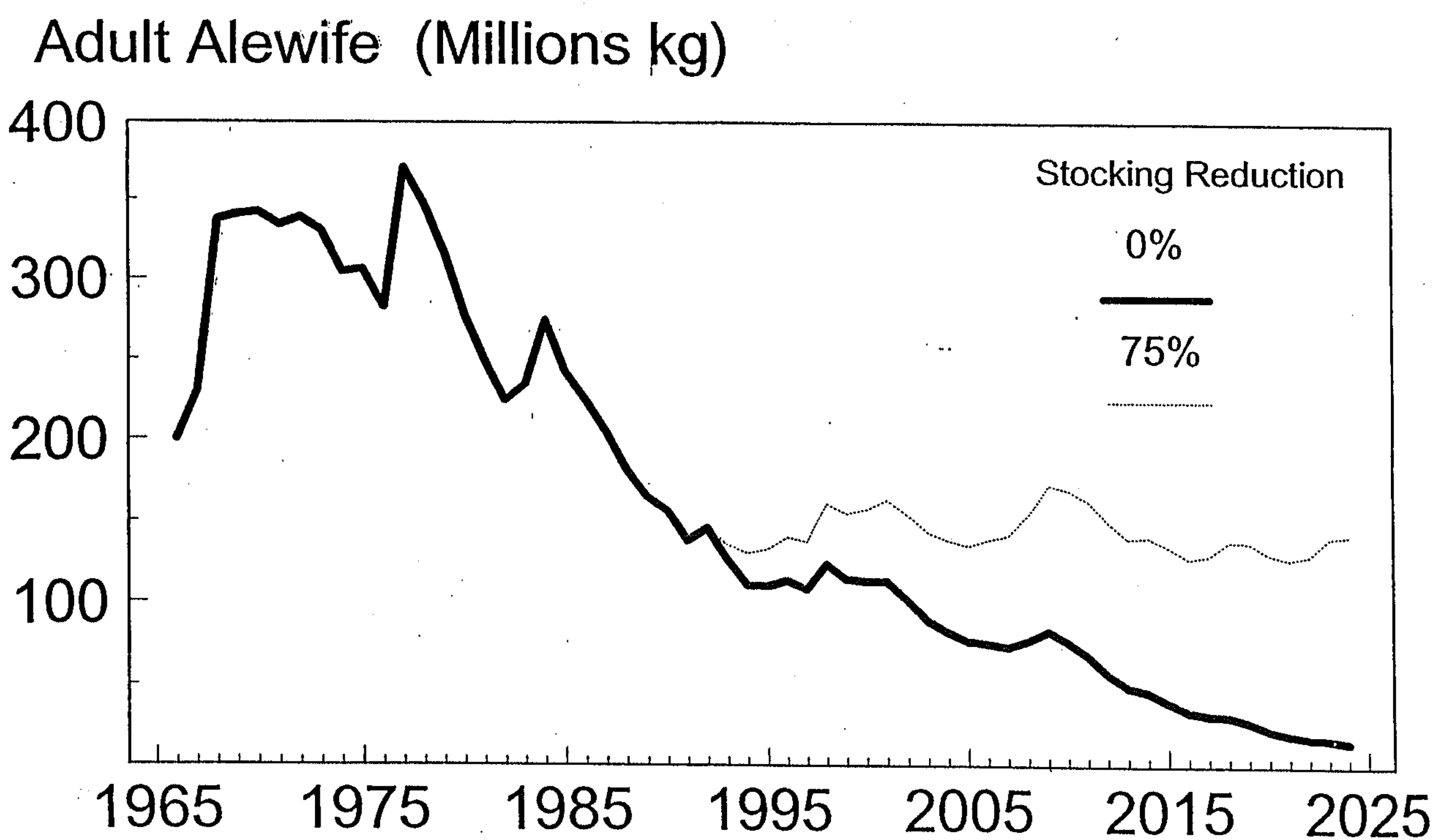
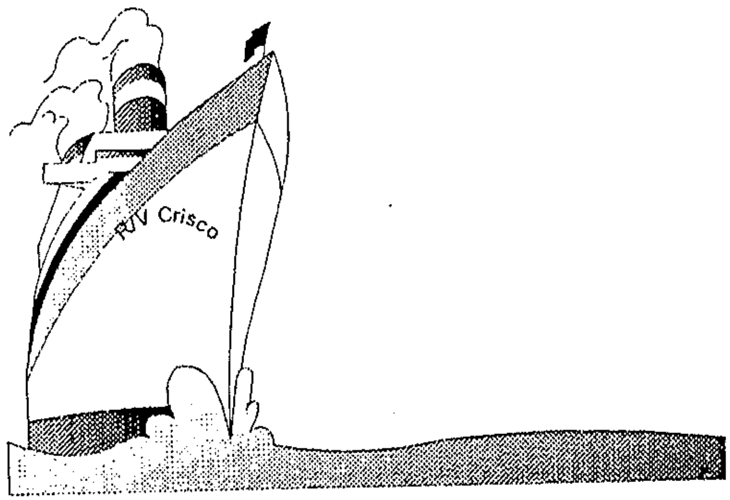
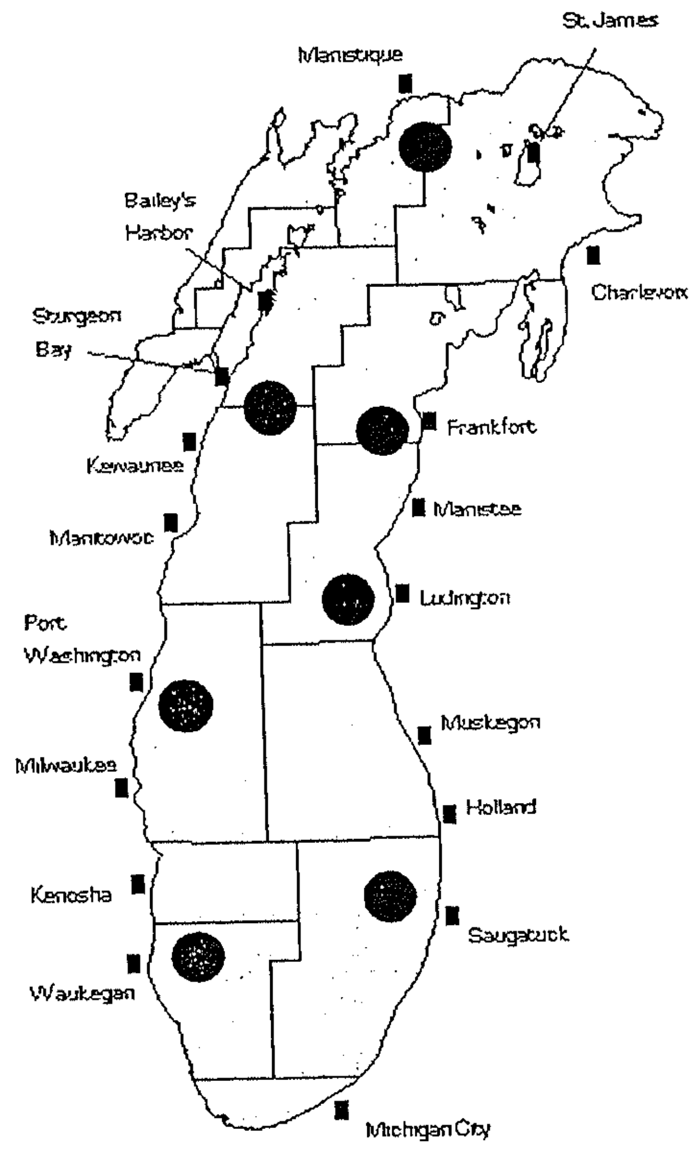


Figure 14

Figure 15.



Sample Locations on Lake Michigan



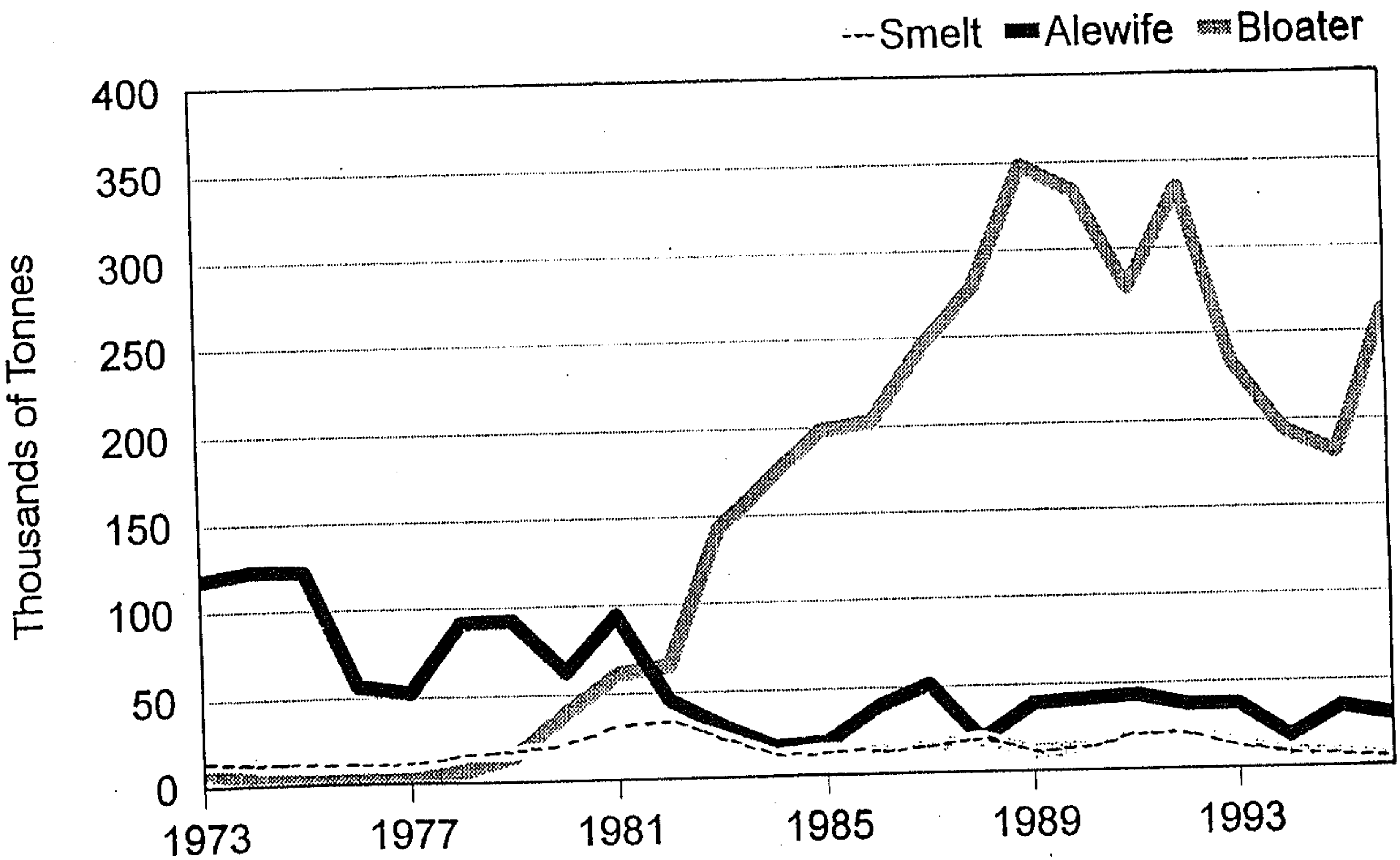
Bottom Trawl-based Biomass Estimates

Lake Michigan - 1996

	Age 0	Age 1 and Older
Alewife	9 t	29,856 t
Smelt	80 t	3,890 t
Bloater	12 t	262,311 t

Figure 17

Bottom Trawl-based Biomass Estimates
Lake Michigan - 1973-1996



Total Sales

Great Lakes Trout & Salmon Stamps

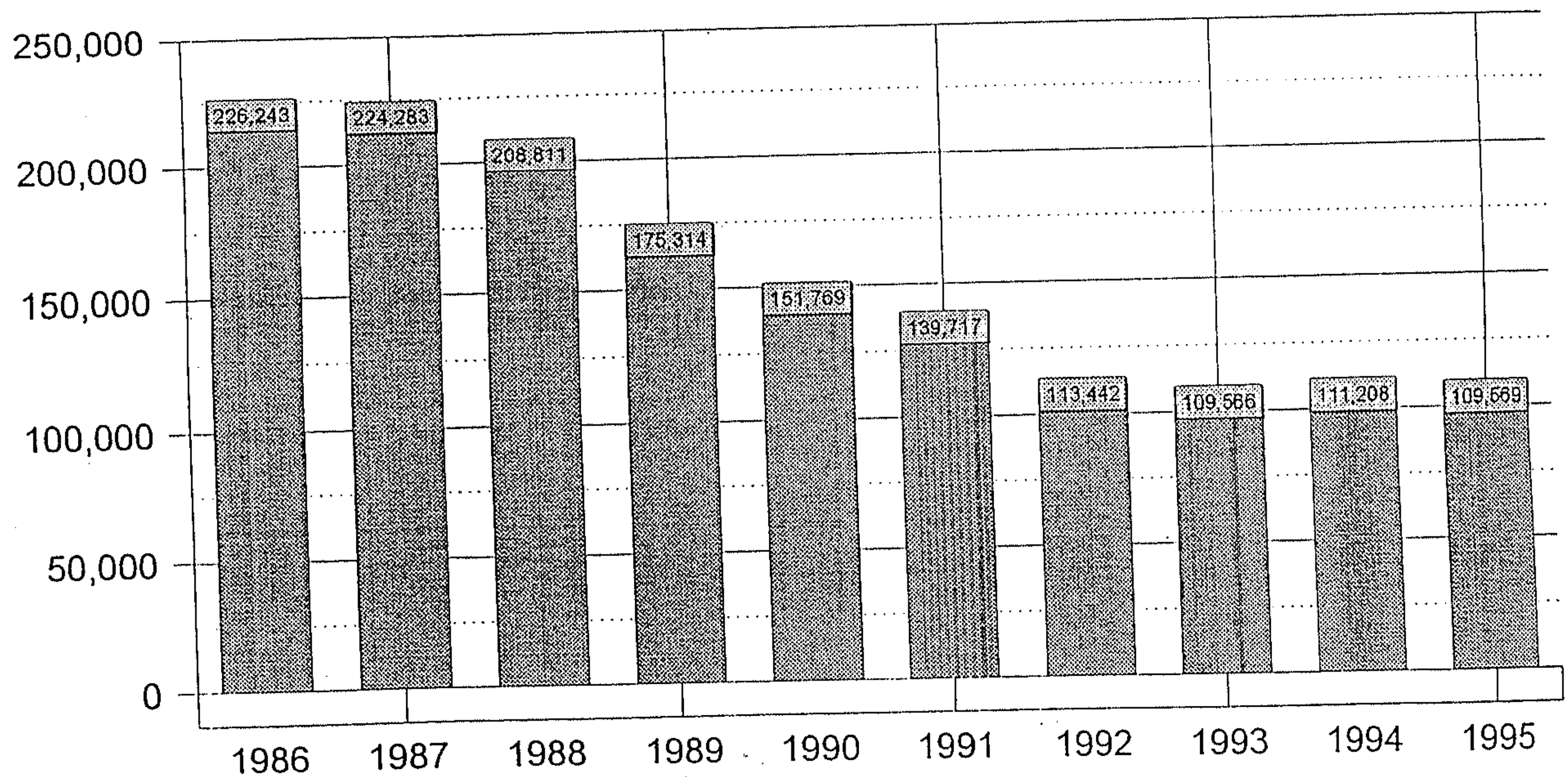


Figure 18

Combined Daily Licenses Sales

Lakeshore Counties

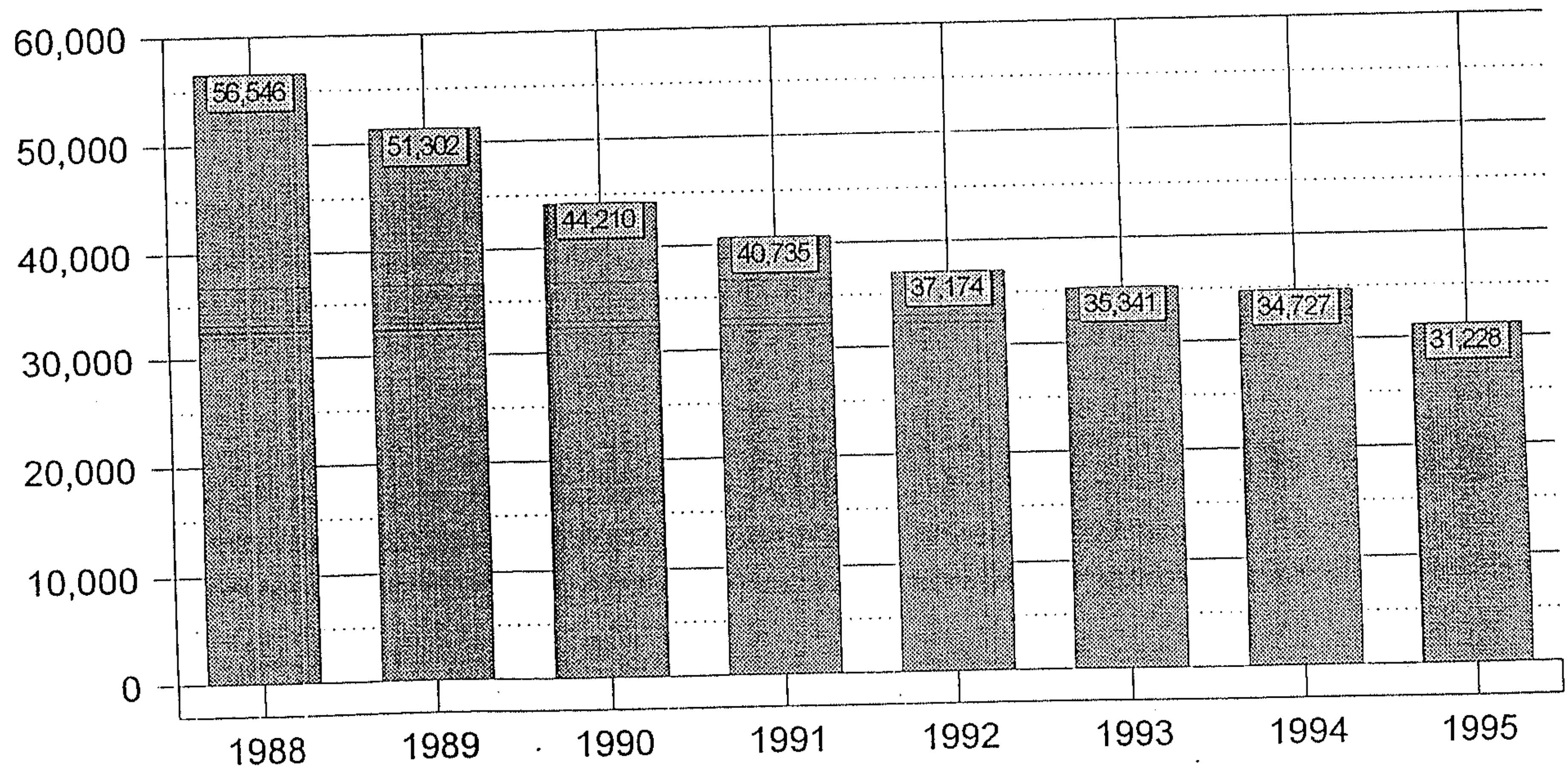
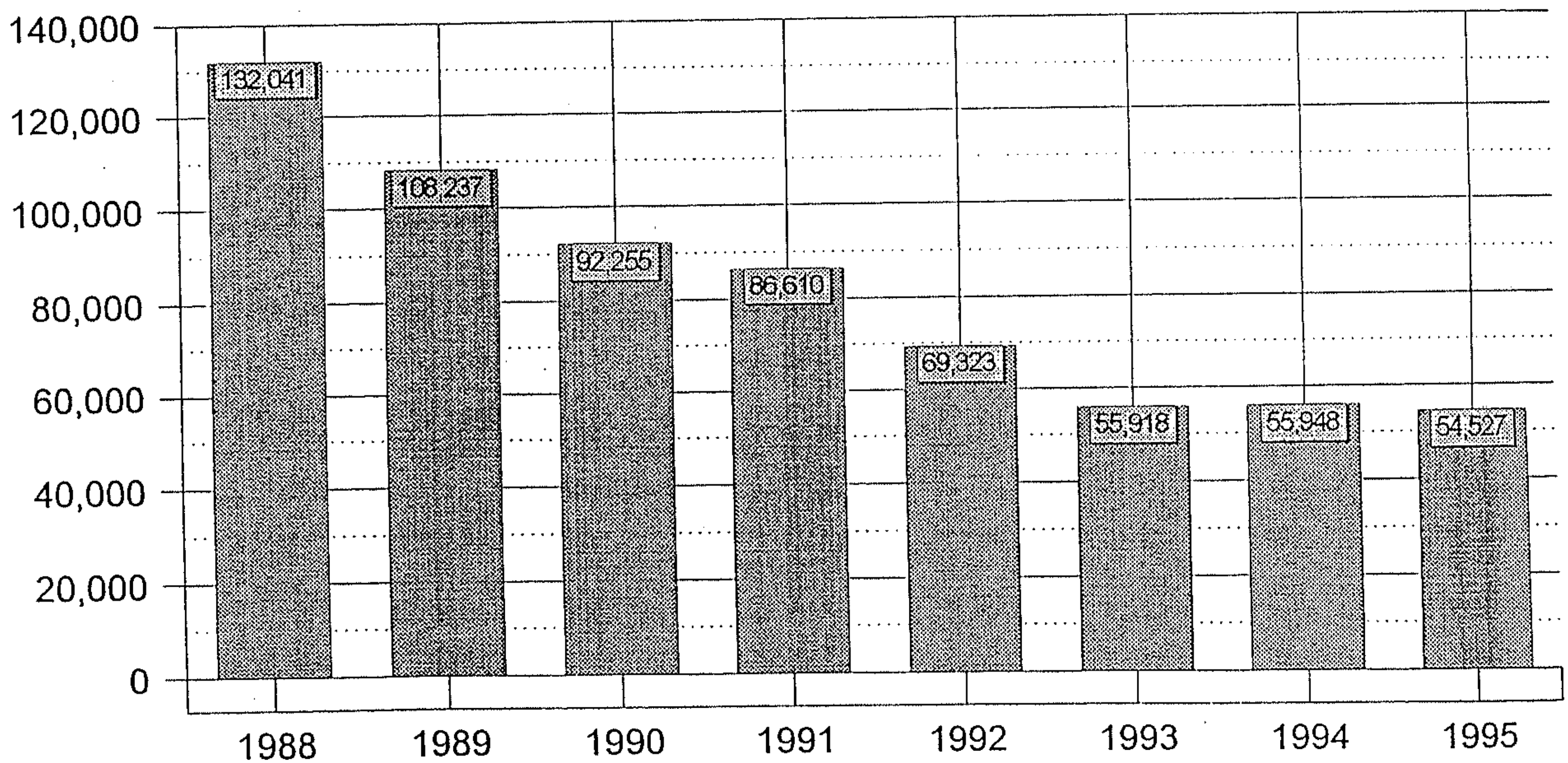


Figure 19

Figure 20

Lake Michigan Stamp Sales

Lakeshore Counties



Number Of Charter Boats

Lake Michigan Charter Fishing

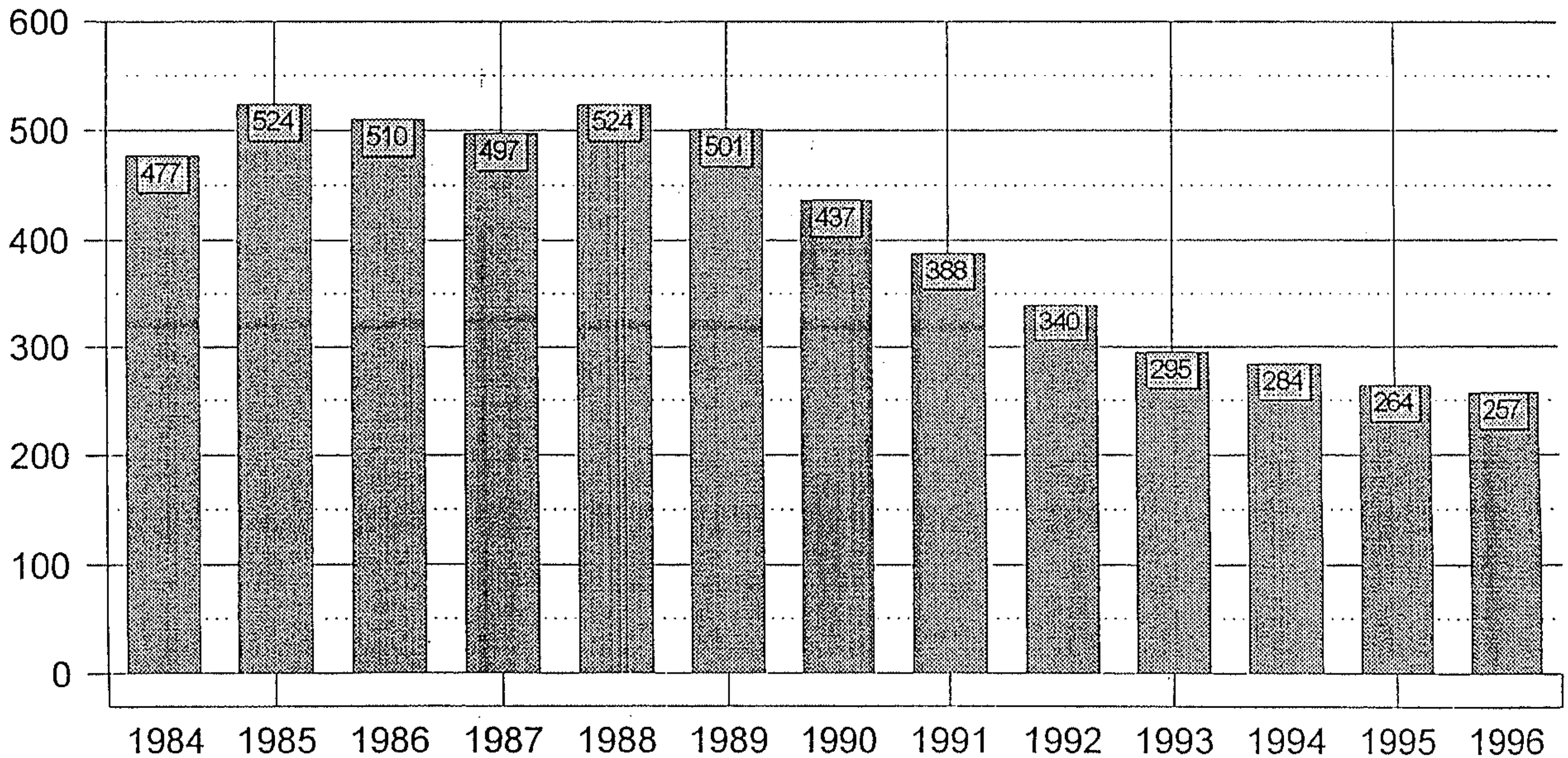


Figure 21

Figure 22

Resident vs. Non-Resident Anglers

Lake Michigan Charter Fishing

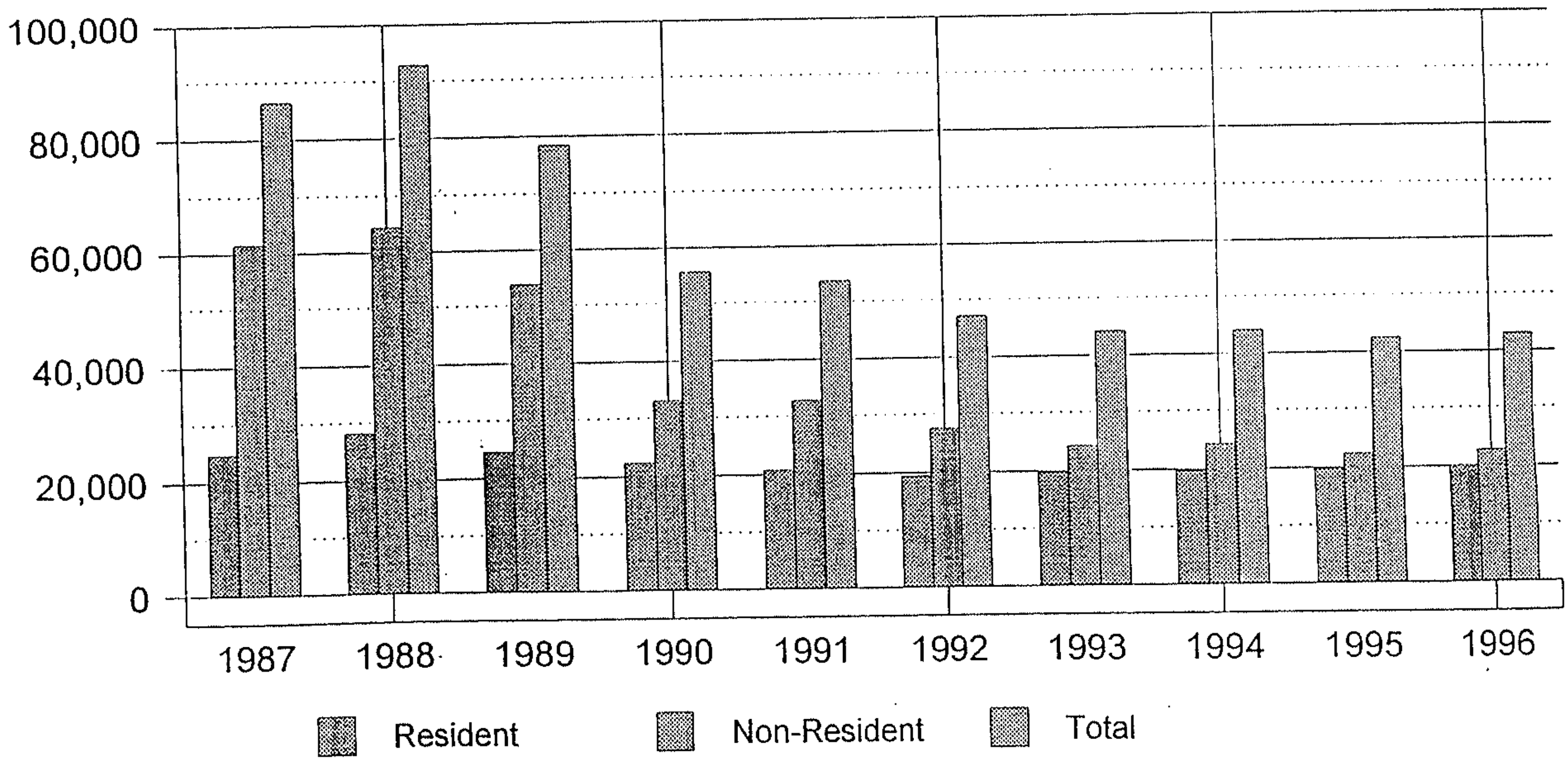


Figure 23

Angler Hours/Effort

Lake Michigan Charter Fishing

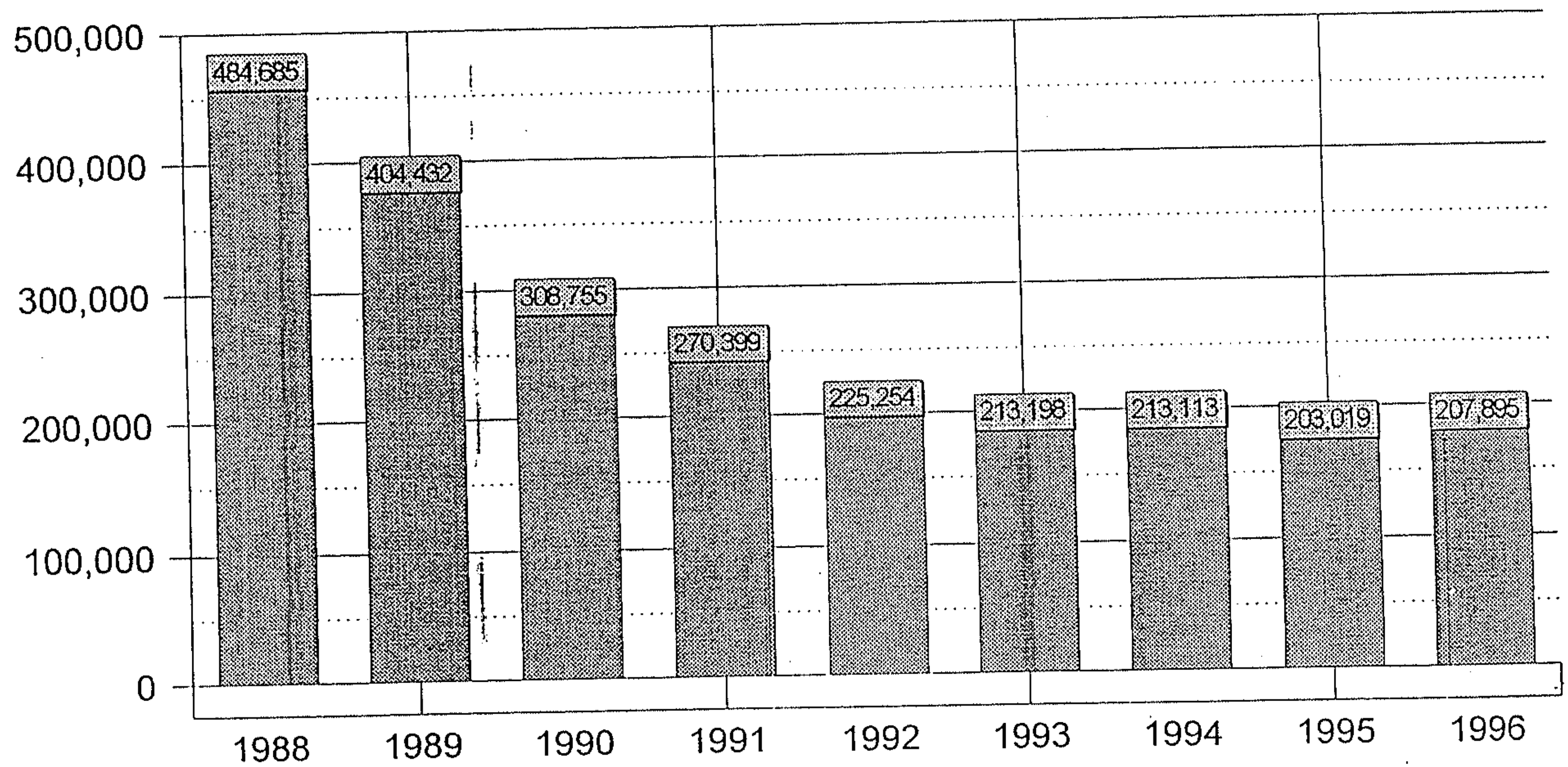


Figure 24

Fish/Angler Hours

Lake Michigan Charter Fishing

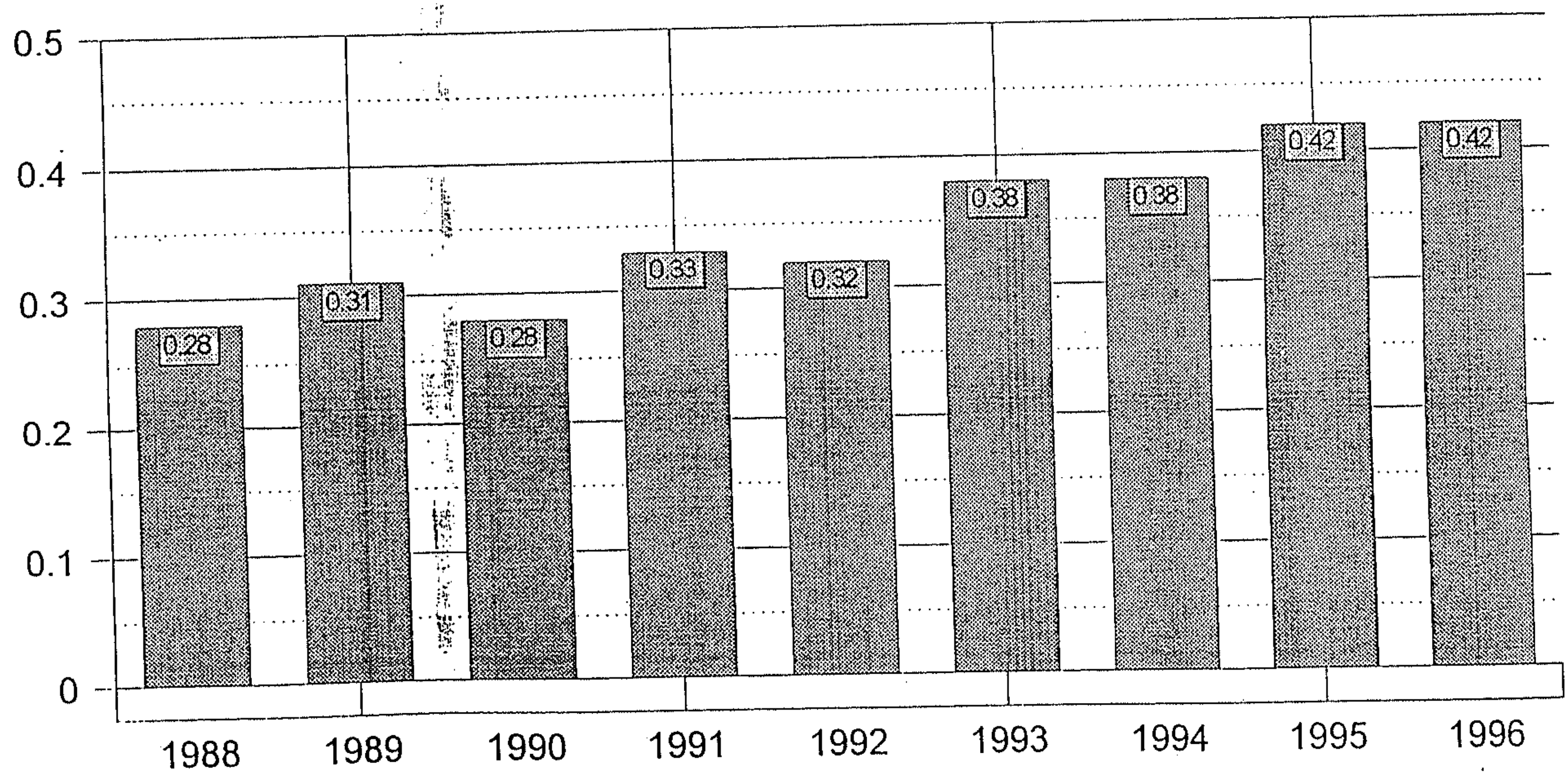


Figure 25

Sport Fishing Expenditures

State Of Wisconsin

	Possible	Actual	Difference
1988	$211,120,575	$211,120,575	0 %
1989	$221,275,475	$188,777,612	-14.69%
1990	$233,224,350	$173,105,294	-25.78%
1991	$243,019,773	$165,862,728	-31.75%
1992	$250,334,668	$142,236,951	-43.18%
1993	$256,392,767	$118,730,641	-53.69%

Actual Total Loss = $415,533,806

Sport Fishing Expenditures 1988- 1993

State of Wisconsin

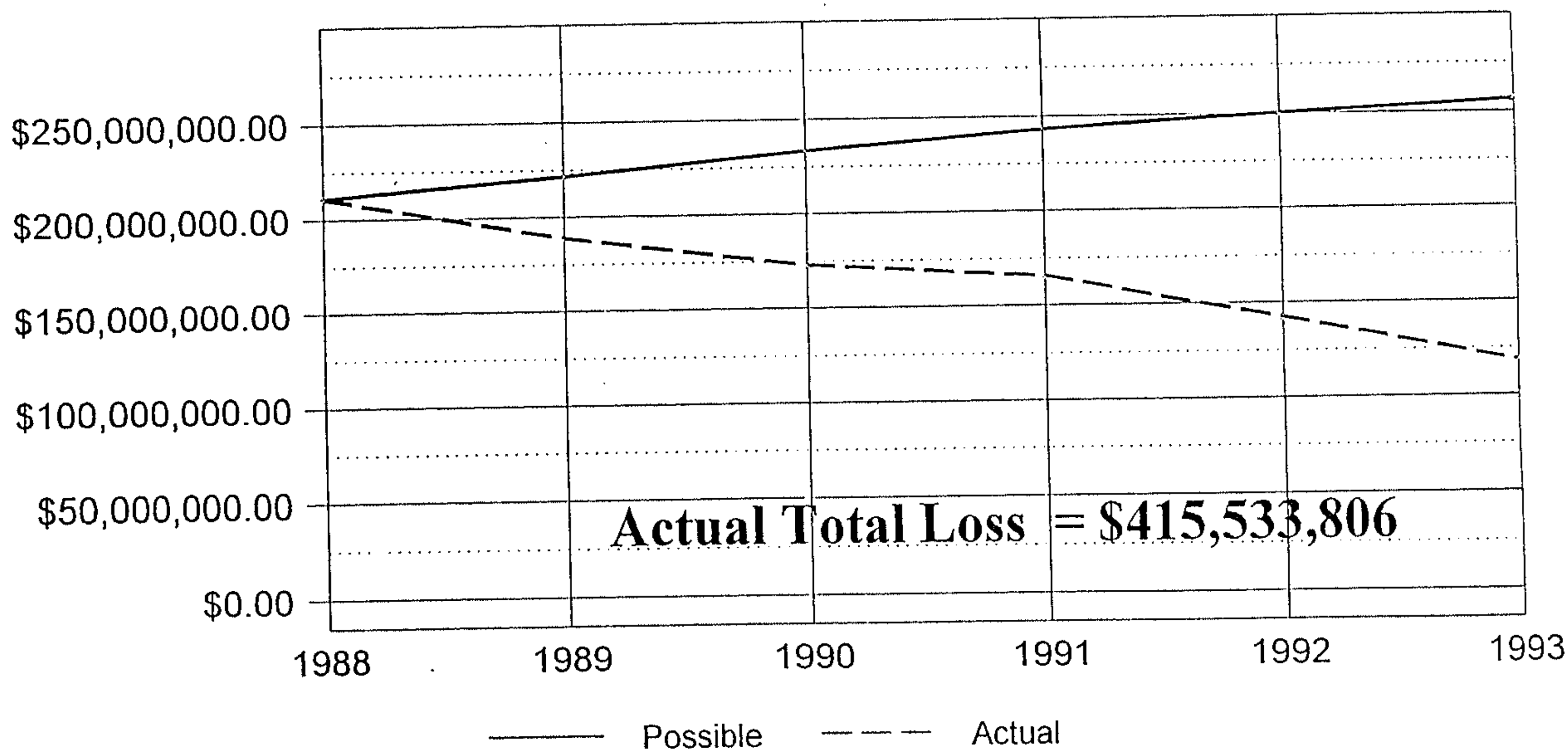


Figure 26

Lake Michigan Trout & Salmon Catch

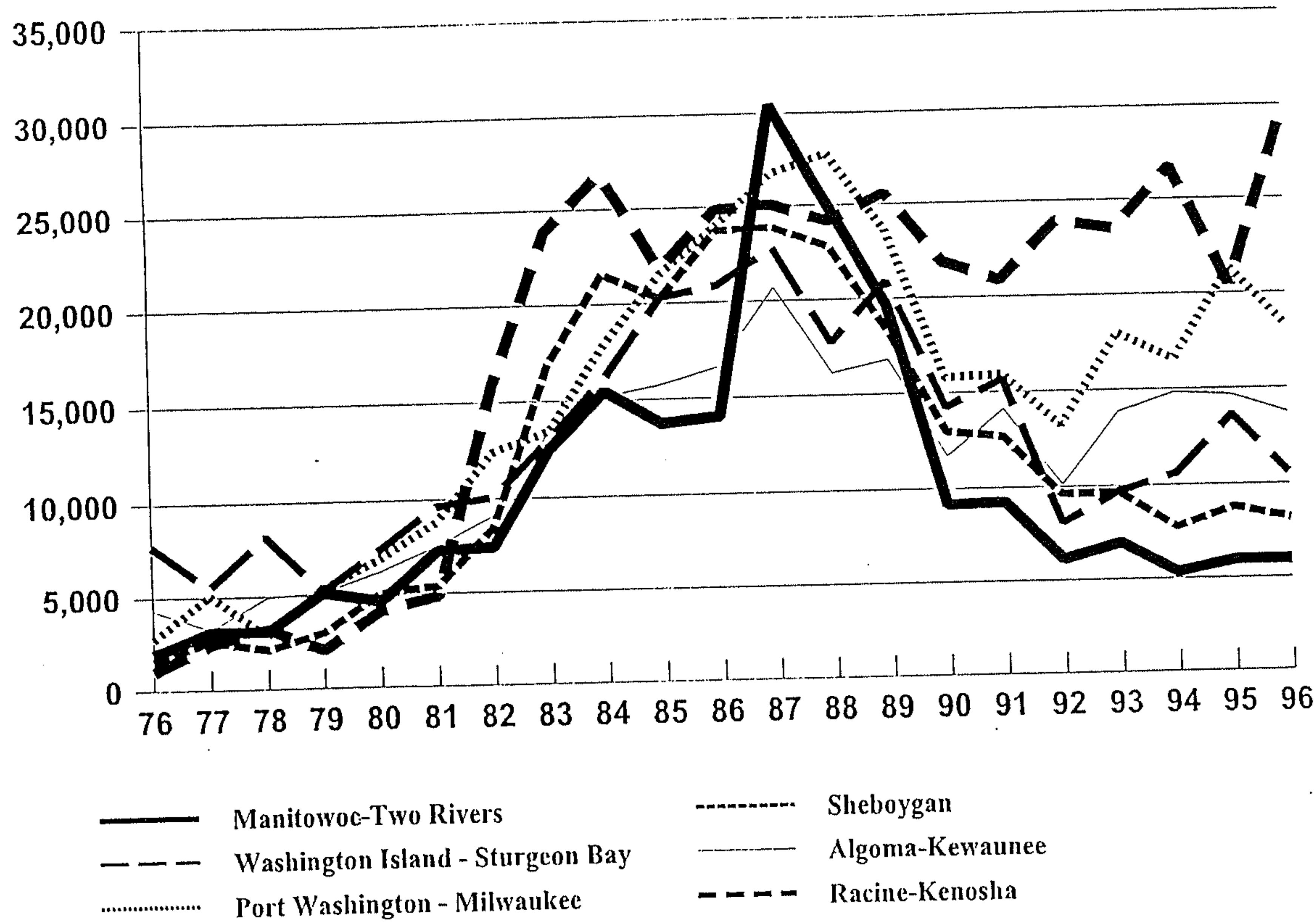


Figure 27

Figure 28

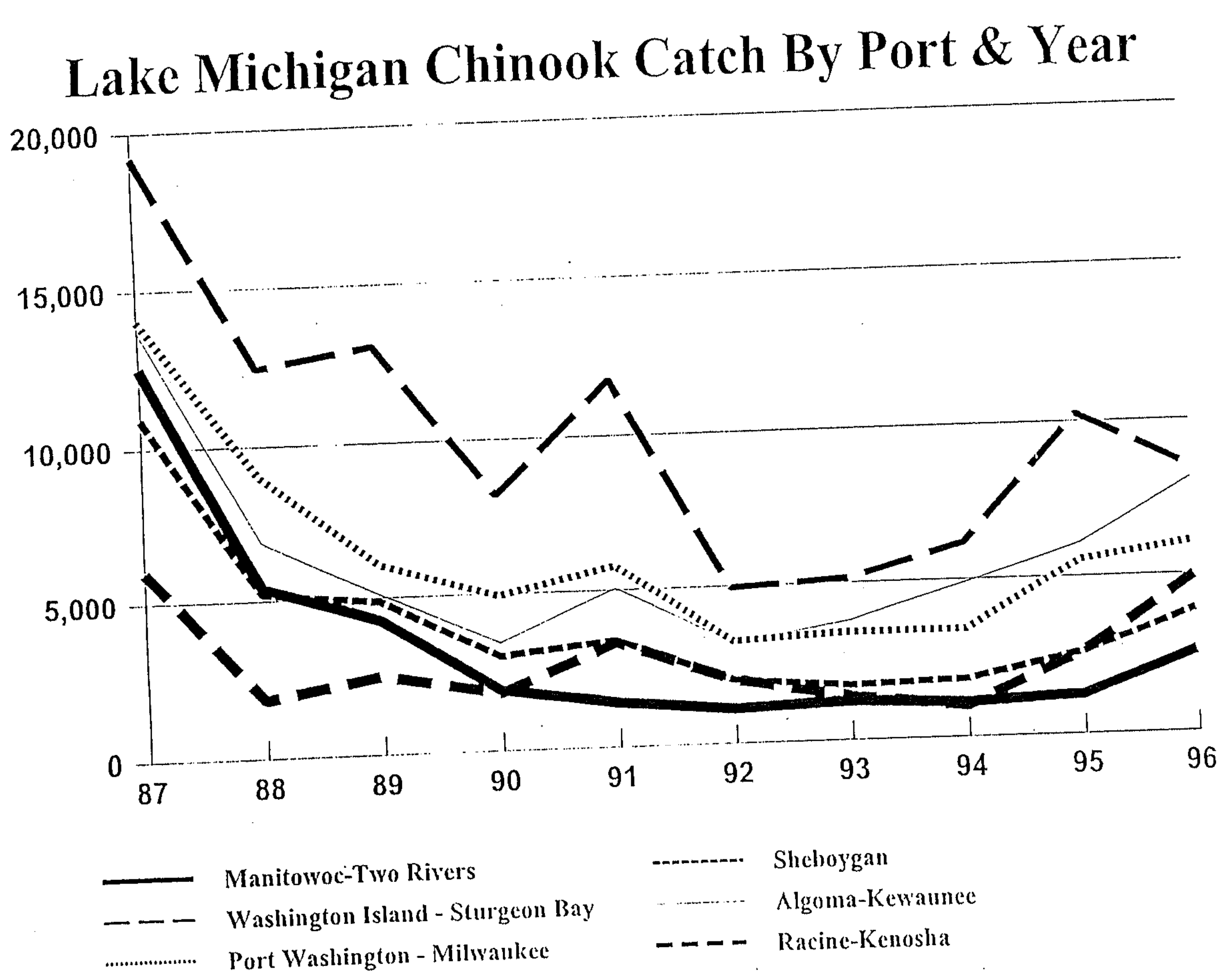
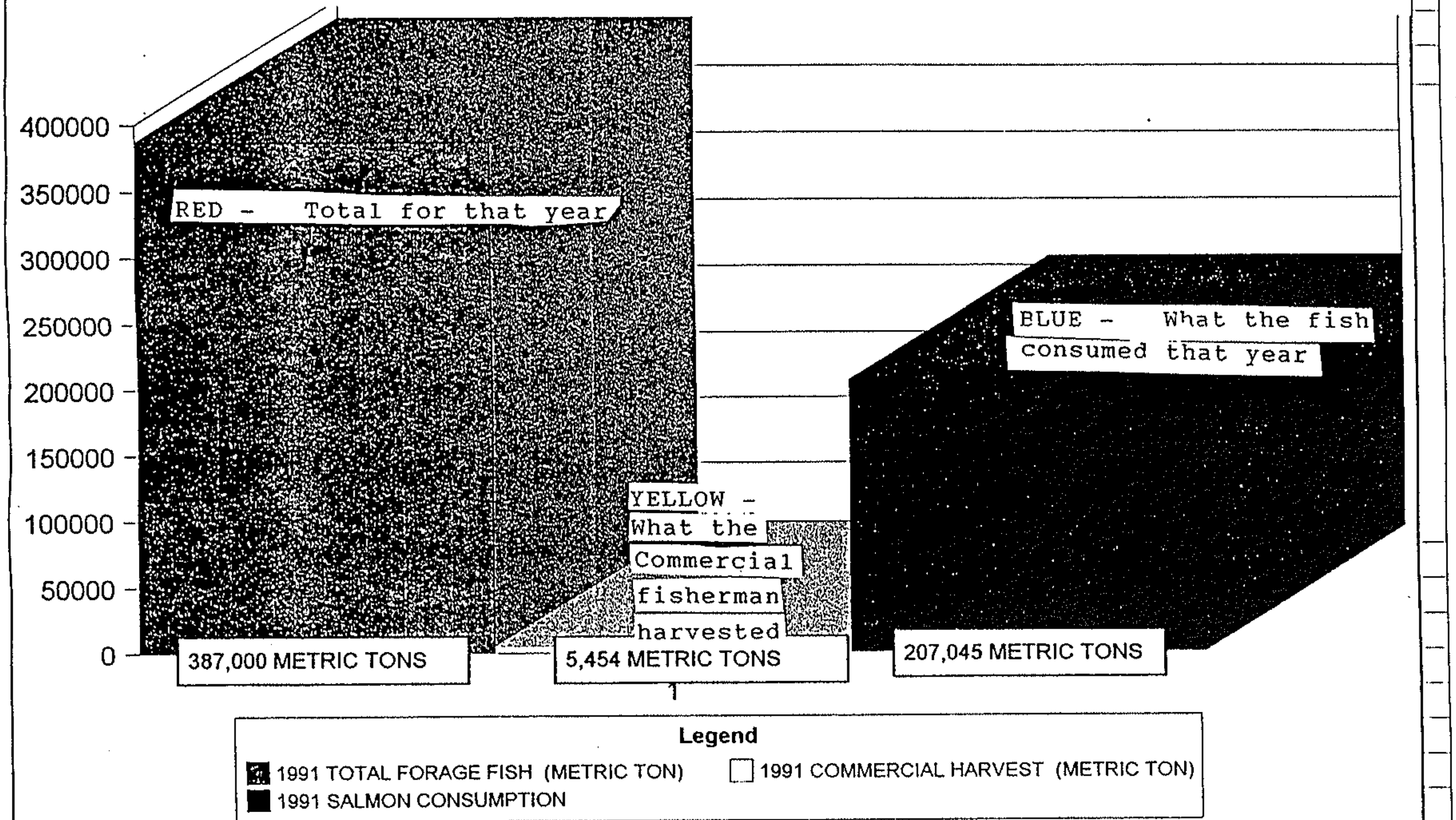

Lake Michigan Chinook Catch By Port & Year
20,000
15,000
10,000
5,000
0
87
88
89
90
91
92
93
94
95
96
Manitowoc-Two Rivers
Washington Island - Sturgeon Bay
Port Washington - Milwaukee
Sheboygan
Algoma-Kewaunee
Racine-Kenosha

Figure 29

This graph shows the comparison of the total forage in Lake Michigan.

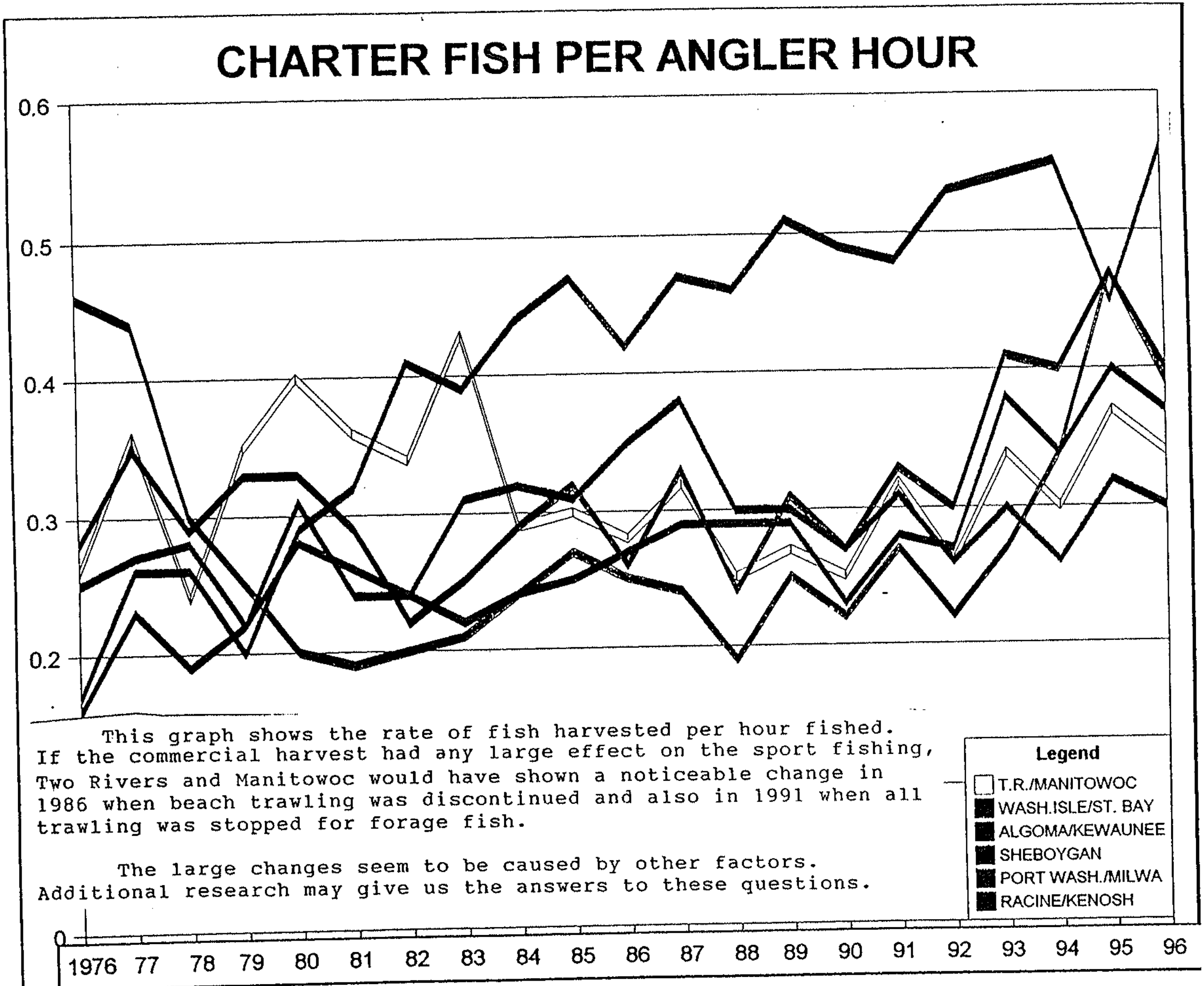


387,000 METRIC TONS OF FORAGE FISH (ALEWIVES SMELT, AND CHUBS).
STEVE HOLGERS STATEMENT ON TRAWLERS IMPACT:
ALEWIVE TRAWLERS TOOK 10-13 MILLION POUNDS OF THESE FISH. THAT LIKELY KEPT THE ALEVIVES IN THAT AREA IN CHECK BUT HAD LITTLE IMPACT ON THE LAKE AS A WHOLE

1991 - Total Forage Fish Metric Tons.
Red 387,000 Tons Forage alewive, smelt, chubs.
Salmon Consumption 207,045 Metric Tons
Commercial Harvest 5,454 Metric tons

DNR managed the 5,454 Metric Ton
Read Steve Hologers statement bottom pf page.

Figure 30

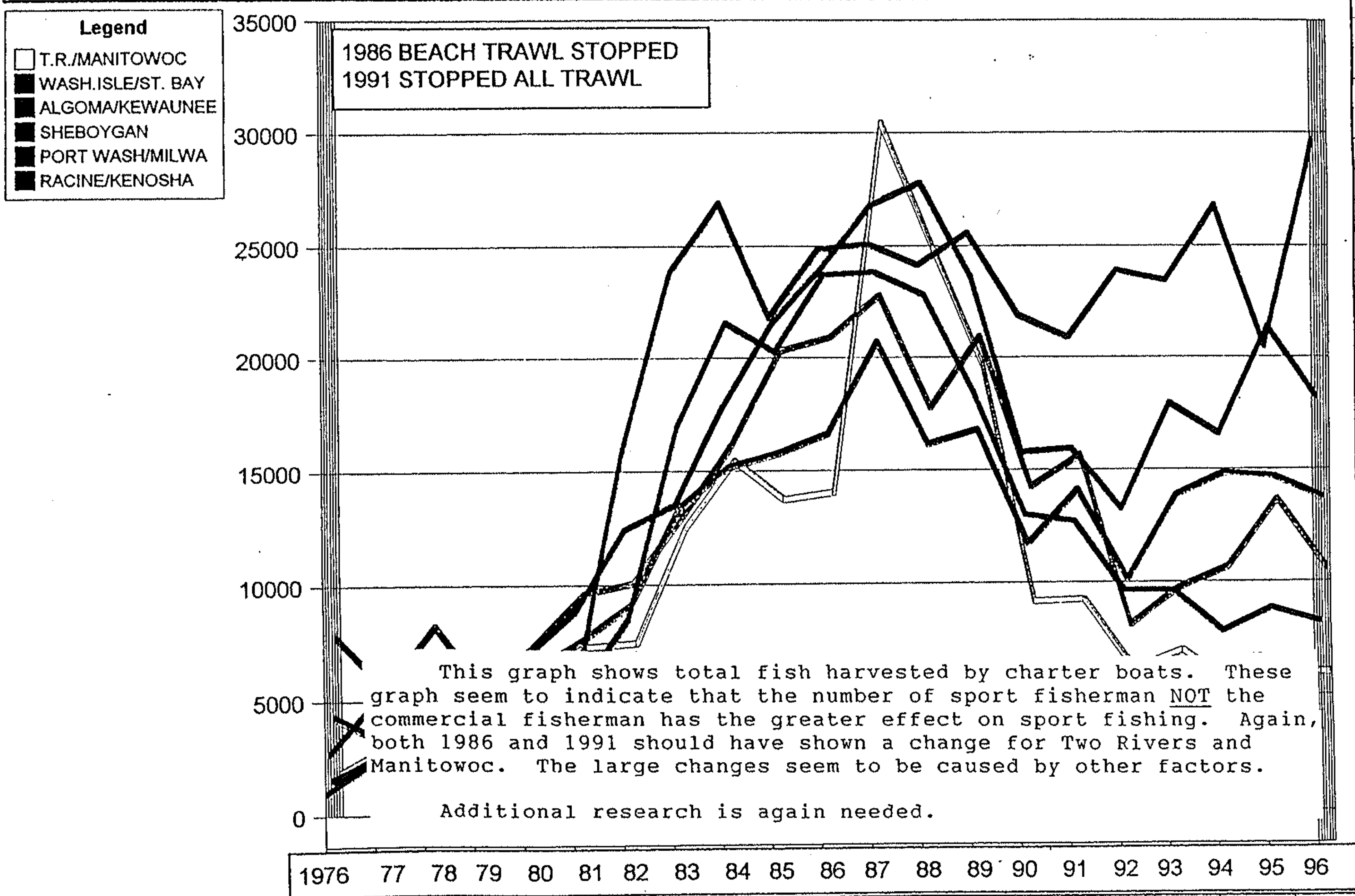


This graph shows the rate of fish harvested per hour fished. If the commercial harvest had any large effect on the sport fishing, Two Rivers and Manitowoc would have shown a noticeable change in 1986 when beach trawling was discontinued and also in 1991 when all trawling was stopped for forage fish.

The large changes seem to be caused by other factors. Additional research may give us the answers to these questions.

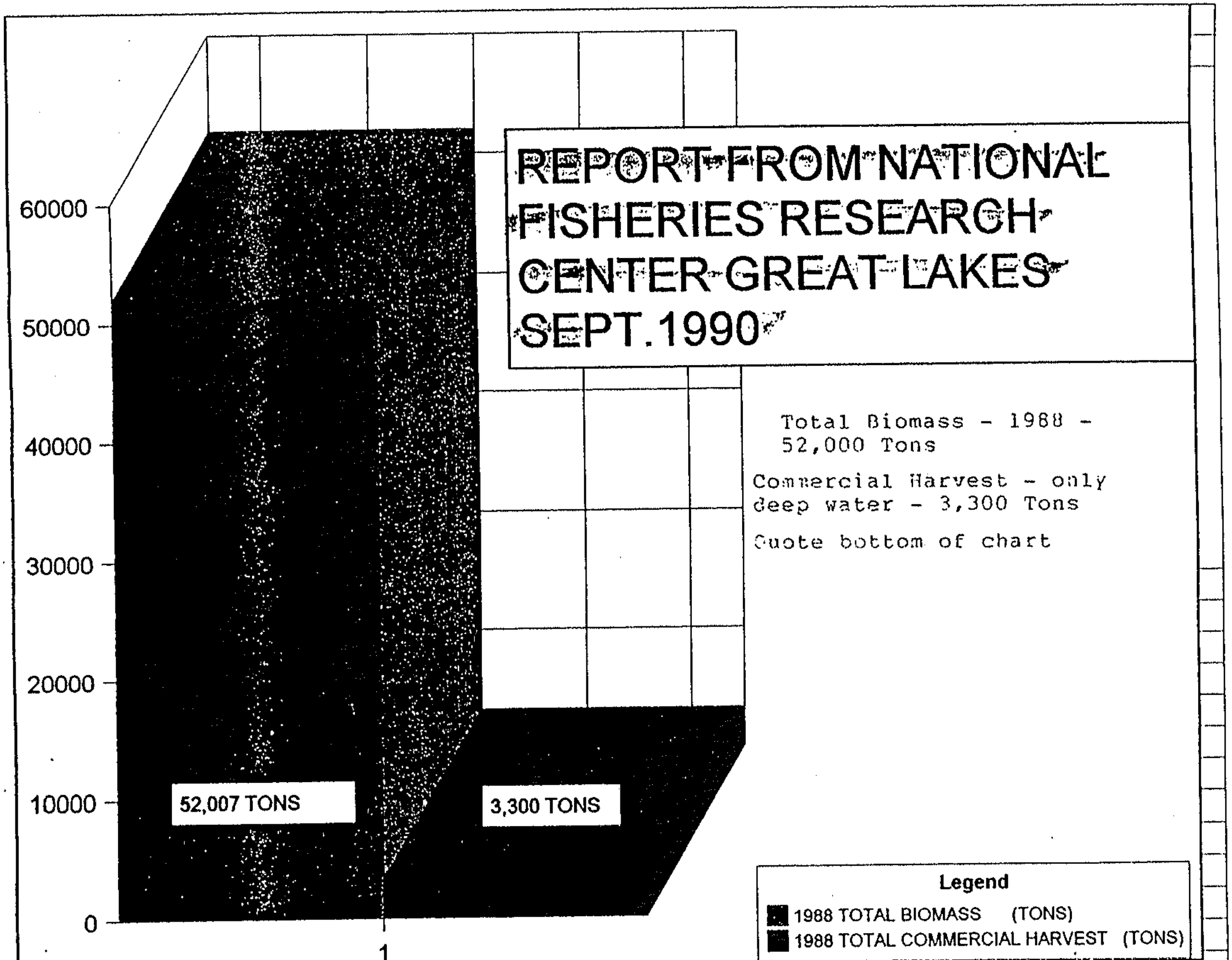
Figure 31

FISH HARVESTED/CHARTER BOATS



This graph shows total fish harvested by charter boats. These graph seem to indicate that the number of sport fisherman NOT the commercial fisherman has the greater effect on sport fishing. Again, both 1986 and 1991 should have shown a change for Two Rivers and Manitowoc. The large changes seem to be caused by other factors.

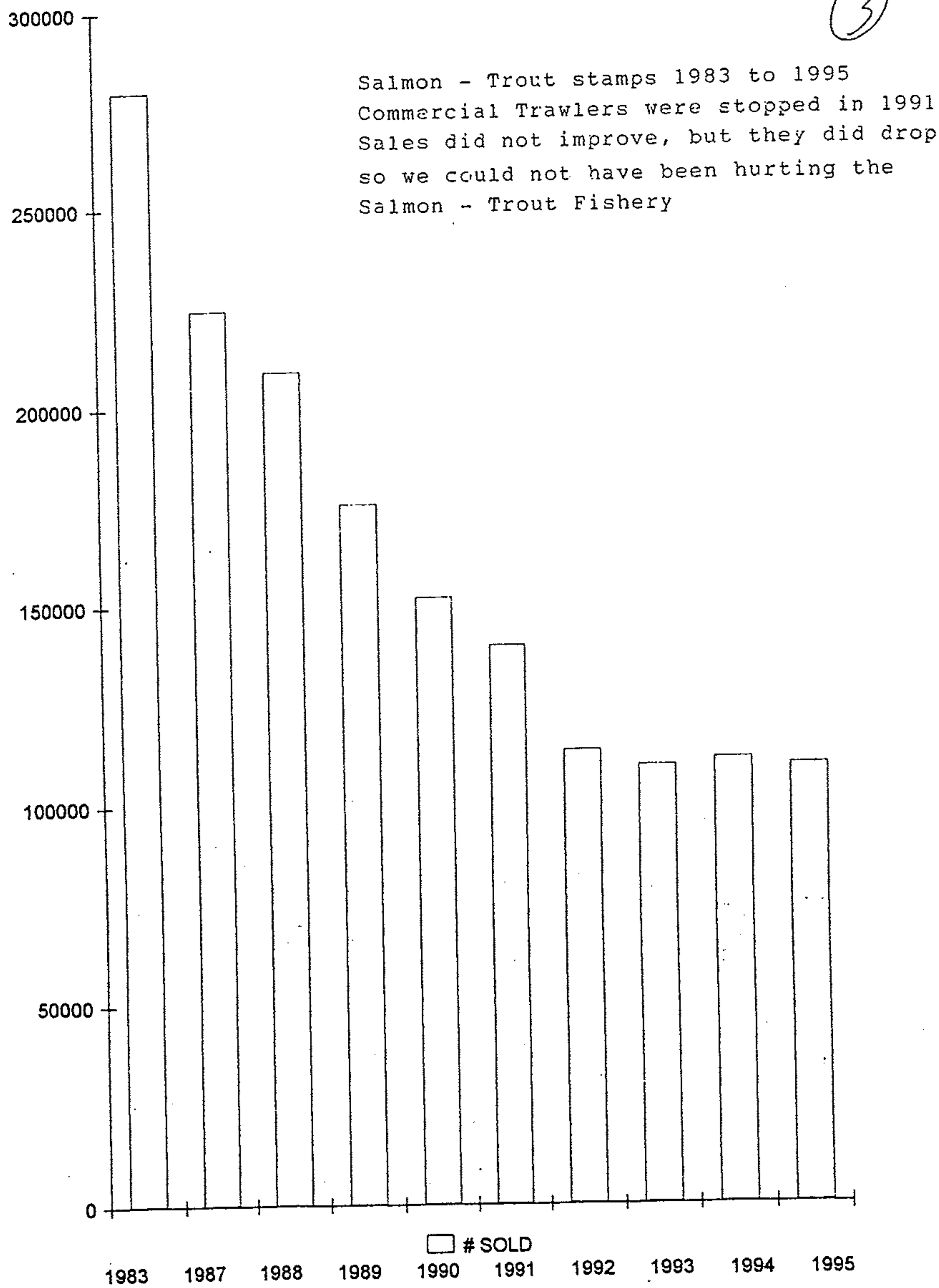
Additional research is again needed.

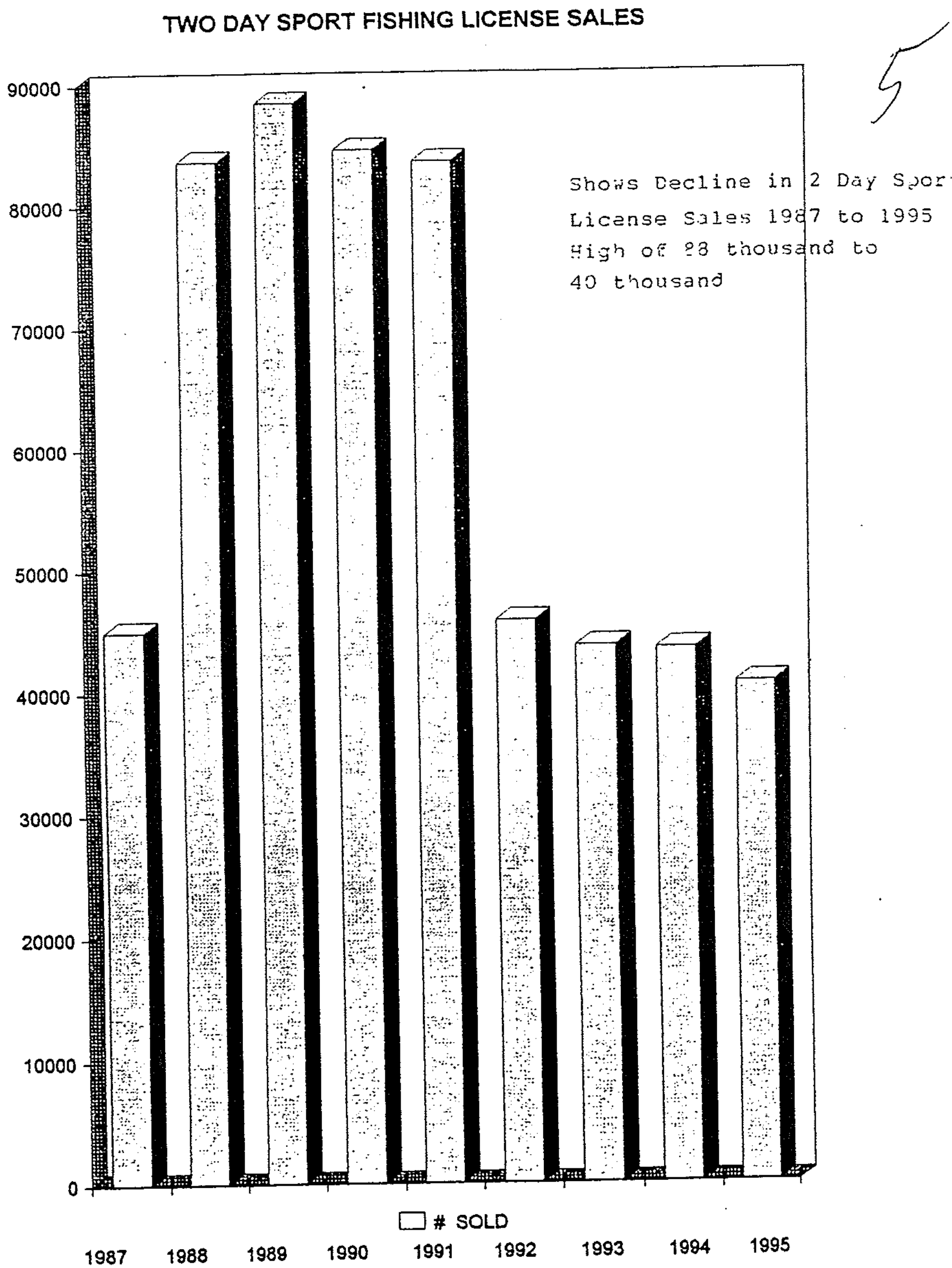


IN AND OF ITSELF, THIS HARVEST COULD HARDLY BE A FACTOR IN POPULATION CHANGES IN ALL REGIONS OF THE LAKE.

GREAT LAKES SALMON AND TROUT STAMPS SALES--1983 WAS THE HIGHEST YEAR

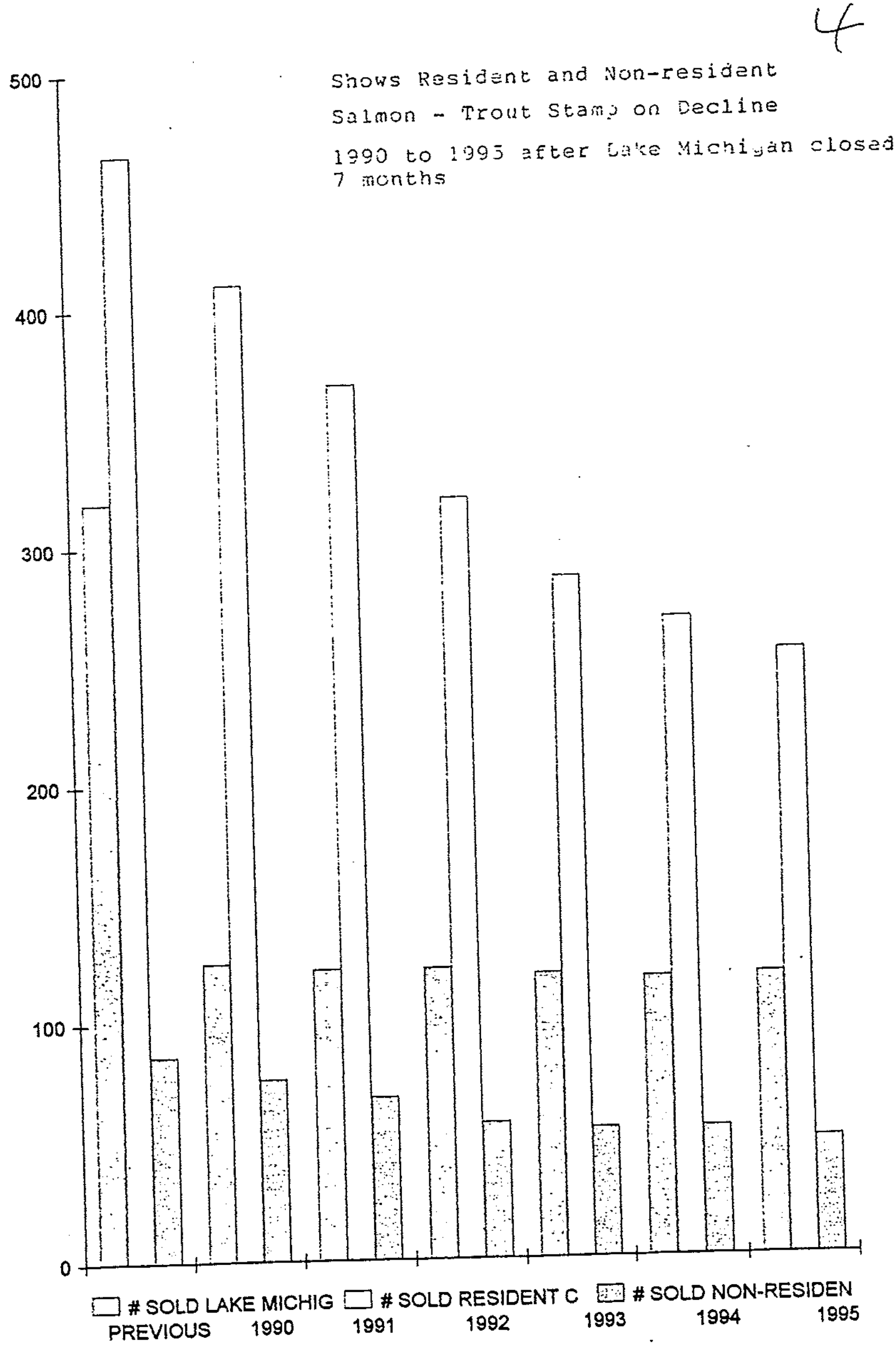
(3)




TWO DAY SPORT FISHING LICENSE SALES
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
Shows Decline in 2 Day Spor
License Sales 1987 to 1995
High of 88 thousand to
40 thousand
SOLD
1987
1988
1989
1990
1991
1992
1993
1994
1995

5

Figure 35


4
Shows Resident and Non-resident
Salmon - Trout Stamp on Decline
1990 to 1995 after Lake Michigan closed
7 months
500
400
300
200
100
0
SOLD LAKE MICHIG
SOLD RESIDENT C
SOLD NON-RESIDEN
PREVIOUS
1990
1991
1992
1993
1994
1995

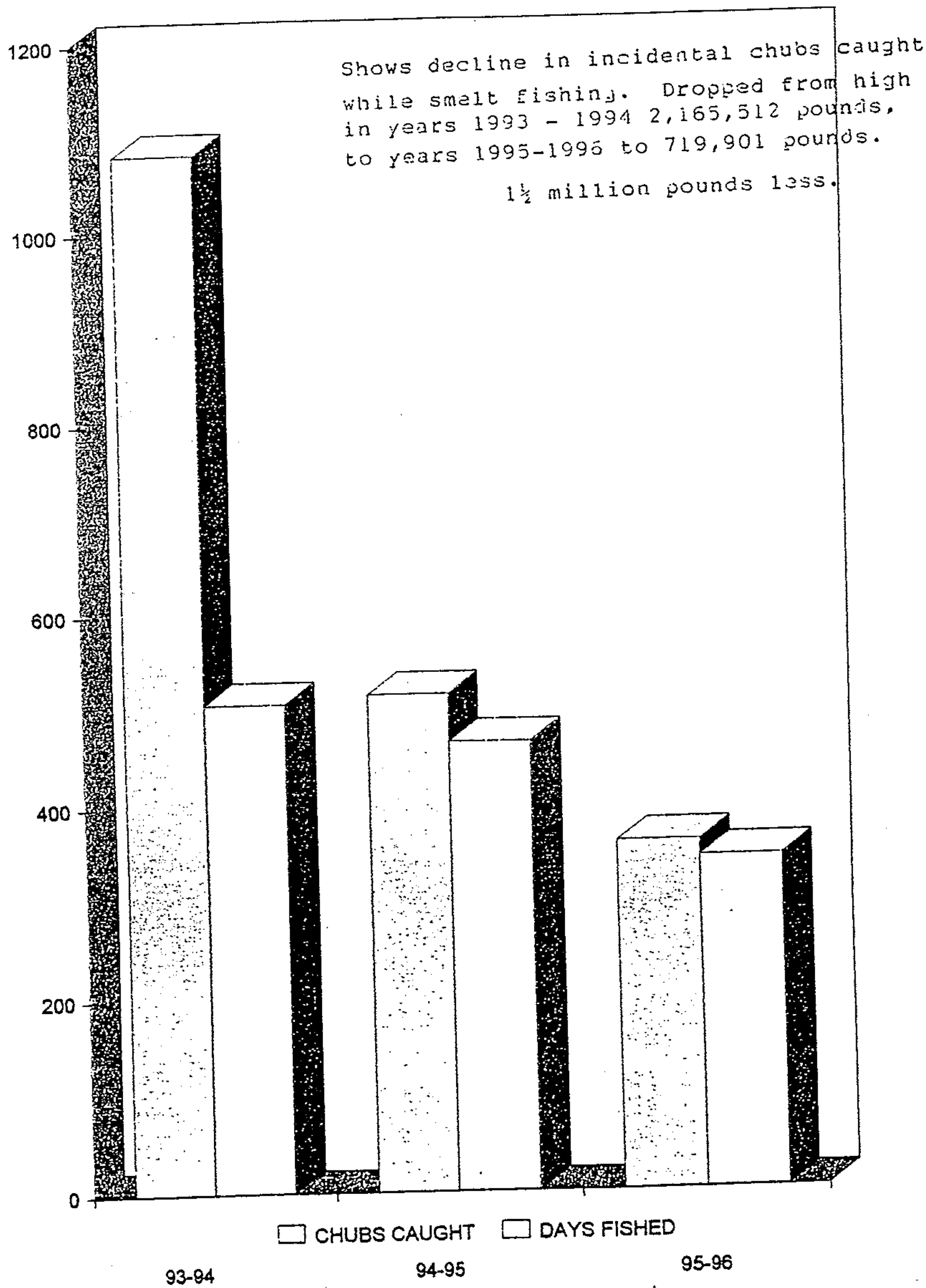
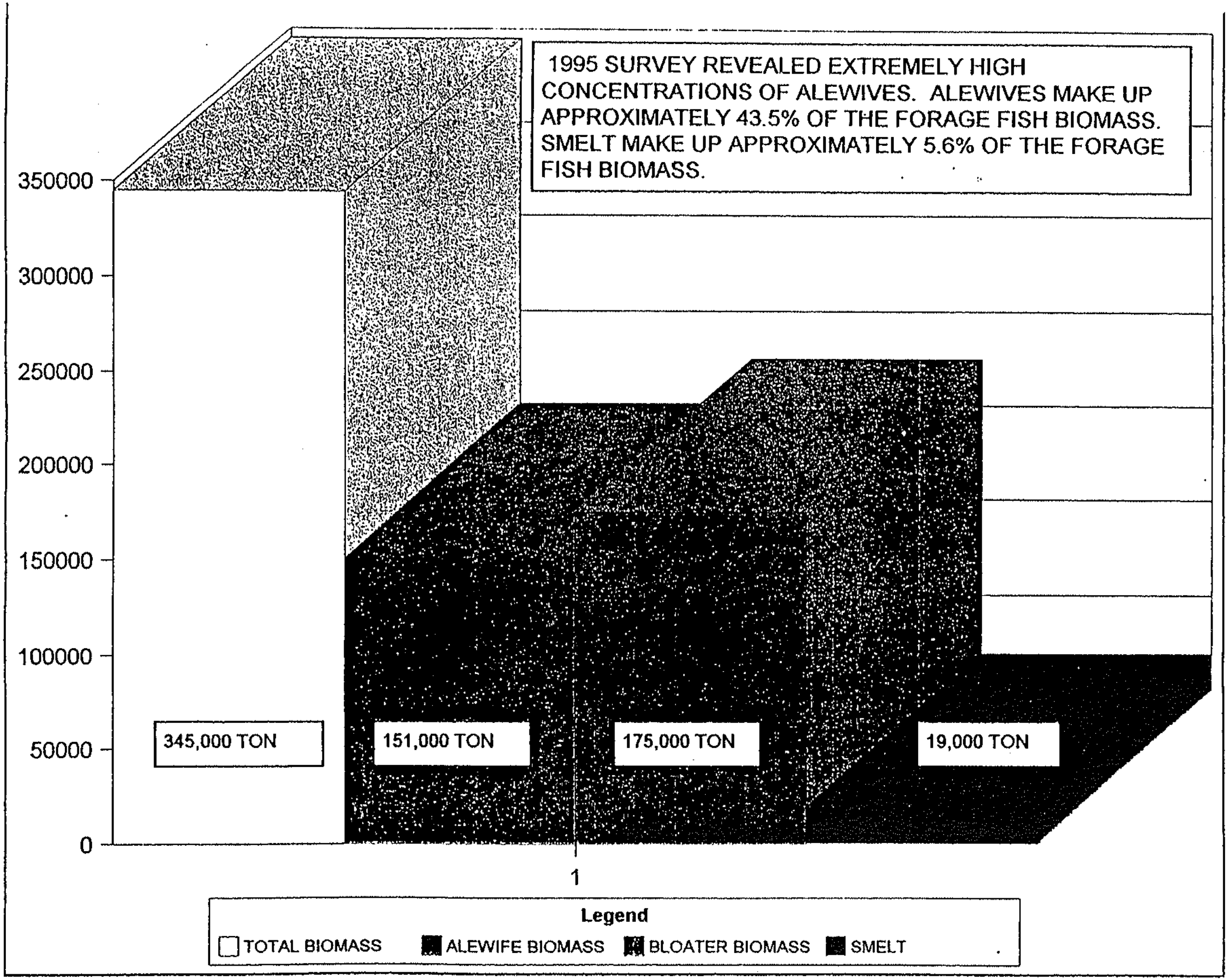

1200
1000
800
600
400
200
0
Shows decline in incidental chubs caught while smelt fishing. Dropped from high in years 1993 - 1994 2,165,512 pounds, to years 1995-1996 to 719,901 pounds.
1½ million pounds less.
CHUBS CAUGHT
DAYS FISHED
93-94
94-95
95-96

Figure 37



1995 Survey shows Total Forage 345,000 ton - 115,000 ton alewive, 175,000 ton chub & 19,000 ton Smelt. This makes up 5.6% of the forage biomass and Commercial Trawlers under quote harvest 2.3 million pounds and do not hurt the resource. We don't believe a small quota of the other species will hurt the Salmon and Trout fishery.

APPENDICES

WORKSHOP ON ALEWIVES AND TRAWLING
January 29, 1997

Governor's veto message for
1991 Wisc. Act 39

37. Lake Michigan Commercial Fishing

Section 962 bn [as it relates to trawling of smelt during daytime hours]

This provision creates s. 29.33 (4m), which enacts certain changes governing fishing in Lake Michigan and Green Bay.

I am partially vetoing the language in s. 29.33 (4m) (c) which allows trawling for smelt during daytime hours on the waters of Green Bay. However, I am preserving the provision which allows sorting or sale of fish caught incidentally, as it is currently illegal to dispose of rough fish into waters of the State. I am also requesting that the Department of Natural Resources (DNR) form a group, including the DNR, the Department of Development, the University of Wisconsin, the Unites States Fish and Wildlife Service, the University of Wisconsin-Sea Grant Institute, and commercial and sport fishing representatives, to further study the dynamics of the alewife population and the effect of commercial trawling on the salmon sport fishery.

As the alewife population declined during the 1980's, the health of the salmon population also declined. The DNR and the Great Lakes Fishery Commission have determined that alewives need protection to recover from precariously low population levels. At night, alewife move off the lake bottom and are much less vulnerable to trawling. The DNR estimates that limiting trawling to night-time hours will reduce the incidental alewife kill from greater than 300,000 pounds to an estimated 25,000 pounds. Therefore, because daytime trawling could harm alewife populations and the salmon fishery, I am partially vetoing this provision.

WORKSHOP ON ALEWIVES AND TRAWLING
January 29, 1997

Participants

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State of Wisconsin

CORRESPONDENCE/MEMORANDUM

FILE REF: 3600

DATE: October 6, 1993

TO: Natural Resources Board

FROM: George E. Meyer *George*

SUBJECT: Commercial Trawling in Lake Michigan

Issue

At the April meeting of the Natural Resources Board, commercial trawlers requested changes in regulations governing trawling for smelt in Lake Michigan and Green Bay. The trawlers requested specifically that the spring trawling season in Lake Michigan be extended and that daytime trawling be allowed in Green Bay. Since then, DNR staff, administrators, and/or Board members have met with trawlers and sport fishers on three occasions to discuss options, including those suggested by the trawlers, by which the trawlers could increase the harvested percentage of the total allowable commercial harvest of smelt.

The Natural Resources Board has directed the Department staff to recommend a course of action at the October Board meeting. This memo reviews the ideas brought forward at those meetings and recommends a course of action based on all of the information and opinions reviewed during the past six months.

Background

Trawling for smelt in Lake Michigan and Green Bay is conducted by six licensed trawlers. Their combined harvest is limited to 2,358,000 pounds, of which no more than 830,000 may be taken from Green Bay. In recent years the total commercial harvest has been approximately 1,700,000 pounds of smelt, with incidental harvests of approximately 100,000 pounds of alewives and 1,538,000 pounds of bloater chubs.

At issue here are regulations that limit trawling in Green Bay to hours of darkness, limit trawling in Green Bay to the period June 15 through September 30, limit trawling in Lake Michigan to the period November 15 through April 20, and require diverters to be used in all trawls.

Those regulations restrict the times, seasons, and methods of trawling in order to minimize the incidental harvest of alewives. Those regulations reflect the **scientific judgement** that alewives are in a state of decline, the **value judgement** that the reduced alewife population is best allocated to the sport fishery (as forage for salmon and trout), and the **technical judgement** that the regulations cannot be altered to allow increased efficiency of trawling for smelt without also increasing the incidental harvest of alewives.

The scientific judgement is sound. A great deal of attention has been given to this problem by the Great Lakes' scientific and fisheries management community. The best available empirical data and the projections of a modelling effort sponsored by the Great Lakes Fisheries Commission (the SIMPLE model) both support the conclusion that even the current reduced alewife population may not be sustainable under present levels of trout and salmon stocking.

The most recent meeting with the trawlers, held September 2, 1993, was directed at examining the technical judgement. That discussion brought forward only one rule change proposal that would allow increased smelt harvest without increasing the harvest of alewives: the removal or modification of the requirement that trawlers use diverters when trawling in Lake Michigan.

Although elimination or modification of diverters would allow increased smelt harvest without affecting alewives, I cannot support that technical solution to the trawlers' problems. The potential impact on the lake trout restoration program is not known, but several thousand lake trout might be killed. It is possible that our lake trout restoration program would not be hurt by some added lake trout mortality, but before any surplus lake trout are allocated to the trawlers, the Bureau of Fisheries Management must very carefully consider alternative allocations. Other commercial fishers have adjusted fishing practices in ways that have resulted in lower lake trout mortality, and have made strong requests for modifications in rules governing commercial fishing for chubs and whitefish, modifications that would also entail increased lake trout mortality.

All other rule changes proposed in September or at other times would result in some increased alewife harvest by trawlers. In other words, there are no acceptable technical solutions to this issue. This brings us to the value judgement referred to above and raises the allocation issue.

The two sources of controllable alewife mortality are predation by salmon and trout and harvest by humans. Current regulations are based on the value judgement that the alewives that would be harvested by trawlers under any possible regulation changes are better reserved for use as food by salmon and trout. The Board may wish to re-examine that value judgement, to re-allocate a portion of the alewife population away from the sport fishery for the benefit of the trawlers. If so we face two technical questions: 1) How many additional alewives will be lost under each of several possible rule changes? 2) What would be the impact of those alewife losses on the sport fishery?

In the following summary of the options, I have attempted to answer the first of those questions. Where possible I provide estimates of added alewife mortality that would result from each proposed rule change. As to the second question, we can take some guidance from bioenergetics modelling: the average annual alewife consumption of one stocked chinook salmon is approximately eight pounds. That relationship is based on a number of assumptions that deserve further study, but I believe it is sufficiently reliable to justify cutting the stocking of chinook salmon by one fish for approximately every eight pounds of additional alewife harvest brought about by relaxation of the rules governing trawling, and I would so direct the Bureau of Fisheries Management.

Alternatives

We have two primary alternatives:

1) Reaffirm the current position that alewives are best allocated for use as forage by salmon and trout.

2) Adopt changes that would result in some reallocation. If the second option is taken, there are two primary possibilities for specific rule changes:

a) Allow daytime trawling in Green Bay.
b) Extend the trawling season in Lake Michigan.

Analysis of alternatives

1. Reaffirm the present allocation

This alternative maximizes the food available to salmon and trout, but continues restrictions on commercial fishing. Trawlers have argued that the continued economic viability of their operations is threatened.

2. Reallocate some alewives to the commercial trawlers

Under this alternative the trawlers would benefit, but the Department would be obliged to cut chinook salmon stocking. The trawlers have asked for daytime trawling in Green Bay and for a longer season on Lake Michigan.

1. Allow daytime trawling in Green Bay. We have estimated that if the trawlers continue to fish as they have during hours of darkness and catch the balance of the Green Bay racehorse quota during the day, 305,000 pounds of smelt, 261,000 pounds of alewives and 5,000 pounds of chubs would be taken in additional to current catches. To compensate for that alewife harvest, I would direct the Bureau of Fisheries Management to cut chinook salmon stocking by at least 33,000 annually (1.9% of the number stocked annually under currrent guidelines). It is possible, as the trawlers argue, that by restricting daytime fishing to an hour or two after sunrise they could minimize the alewife catch, but our data show that alewives become vulnerable to trawls immediatly after daybreak and that any allowance for daytime trawling will result in substantially higher harvests of alewives.

2. Extend the trawling season in Lake Michigan. The most recent specific request by the trawlers is a ten-day extension, to April 30. The impact on alewives of a 10-day season extension would vary from year to year. Our best estimate is that it would result in an increased smelt harvest of 168,000 pounds, with an incidental harvest of 104,000 pounds of alewives and 75,000 pounds of chubs. To compensate for that alewife harvest, I would direct the Bureau of Fisheries Management to cut chinook salmon stocking by at least 13,000 annually (0.7% of the number stocked annually under current guidelines).

Trawlers have also asked that they be allocated a total allowable commercial harvest of alewives equal one or two percent of the lakewide alewife biomass. This implies an allocation of one to two million pounds, requiring stocking cuts of 125,000 to 250,000 chinook salmon annually. Such an allocation would exceed the expected alewife harvest that would result if both of the foregoing changes were made. It would require summer trawling during times when very large incidental catches of chubs would be likely.

Recommendations

I ask that the Board advise the Department on the primary allocation question: Should any additional alewives be reallocated to the commercial trawl fishery for smelt?

If the Board determines that some reallocation of alewives is desirable, I recommend that a rule extending the trawling season in Lake Michigan by 10 days (changing the ending date from April 20 to April 30) be taken to public hearing. As stated above, this should result in an increased smelt harvest of approximately 168,000 pounds, with an incidental alewife harvest of approximately 104,000 pounds. It would call for a cut in annual chinook salmon stocking of at least 13,000.

Trawlers continue to call for special studies to evaluate options. Recent requests are for a study of the effects of summer trawling for smelt in Lake Michigan for a study of the feasibility of authorizing a trawl fishery targetting adult bloater chubs. Studies are an important element of fisheries management, but I recommend no further special studies until the Bureau of Fisheries Management has completed development of the Lake Michigan Integrated Fisheries Management Plan and has reviewed research needs related to all sport and commercial fisheries. Our fisheries management resources are stretched thin, and special studies always require the diversion of those resources from other important areas of work.

SUSTAINABILITY OF THE INTENSIVELY MANAGED FISHERIES OF LAKE MICHIGAN AND LAKE ONTARIO

FINAL REPORT OF THE SIMPLE TASK GROUP

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and

Michael L. Jones
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February 1994

Board of Technical Experts
Great Lakes Fishery Commission
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INTRODUCTION

Sustainability of Intensively Managed Populations in Lake Ecosystems (SIMPLE) is a Task Group of the Board of Technical Experts of the Great Lakes Fishery Commission. By focusing on the intensively managed fisheries of Lakes Michigan and Ontario, the Task Group addressed issues arising from an ecosystem approach to fisheries management. The guiding purpose of the Task Group was to develop a framework for evaluating the risks of artificially maintained fisheries and, thereby, help managers move Great Lakes fisheries, where possible, to more sustainable configurations. The specific objectives were (1) to synthesize scientific understanding regarding ecological processes governing stability in Great Lakes fish communities; (2) to assess the influence of a range of management options on stability; (3) to evaluate the extent to which the social preferences and institutional concerns constrain options for Great Lakes fisheries management; (4) to promote communication across disciplinary lines usually separating water quality management from fisheries management; (5) to share the study's findings with those involved in making decisions about Great Lakes fisheries management; and (6) to develop recommendations for future management direction, priorities for research and monitoring, and a plan for continuing evaluation of management goals and options.

The SIMPLE Task Group grew of out a request by fish managers to the Board of Technical Experts to initiate a research program that would address the issue of long-term stability of fish communities and fisheries of the Great Lakes. This management concern was a response to the "roller-coaster ride" history of Great Lakes fisheries. Over the past 50 years, fish communities in the Great Lakes have shown great variation in structure and harvest. By 1950, a history of overexploitation, invasion of sea lamprey, smelt, and alewife, and eutrophication had combined to decimate native top predators and displace endemic planktivores. By 1960, lake trout were extirpated from Lake Michigan, Eastern Lake Erie, and Lake Ontario. Lake trout in Lake Huron were reduced to a few remnant stocks, and the diversity of lake trout stocks in Lake Superior had been greatly reduced. These losses coupled with the extirpation of blue pike from Lake Erie and Western Lake Ontario resulted in fish communities with a severe deficit of predators. Not surprisingly, populations of formerly subdominant species or new invading species exploded in their absence. Alewife in Lake Michigan, for example, became so abundant that spring mortality became an increasingly severe nuisance problem, culminating in a massive die-off in 1967.

Responding to the collapsing fisheries, management agencies and the federal governments initiated a series of rehabilitation measures. The federal governments formed the Great Lakes Fishery Commission, and it began to control sea lamprey in the Great Lakes by the late 1950's. In the mid-1960's, success of sea lamprey control allowed the start of a large stocking program to restore lake trout populations. Supplementing this program to reestablish native predators, large scale planting of other trout and exotic salmonids (rainbow trout, *Oncorhynchus mykiss*; Chinook salmon, *Oncorhynchus* *tshawytscha*; coho salmon, *Oncorhynchus kisutch*; and brown trout, *Salmo trutta*) began in Lake Michigan and spread to other lakes during the following decade. In 1980, all of the agencies with management authority on the Great Lakes committed themselves to a policy of obtaining "...fish communities, based on foundations of stable self-sustaining stocks..." as a long term goal (Great Lakes Fishery Commission 1980).

The 1980's witnessed a remarkable recovery of fisheries. By 1984, Dochoda (Great Lakes Fishery Commission, personal communication) estimated that more than 430 million salmon and trout had been stocked. Due to this stocking program, high valued recreational fisheries developed for salmon and trout in Lakes Michigan, Huron, and Ontario. Lake Superior experienced a resurgence of its lake trout stocks, and elimination of overfishing led to a dramatic recovery of walleye in Western Lake Erie. Public reaction to these increased fishing opportunities, however, has created an ever growing demand that threatens to undermine long term goals of fishery management. Re-establishment of self-sustaining stocks of native lake trout throughout the Great Lakes requires trade-offs in levels of exploitation and stocking that are beginning to conflict with emerging angler preference. Simply stated, the angling public, especially for Lakes Michigan and Ontario, is demanding levels of harvest of Chinook and Coho salmon that can only be maintained through extensive artificial propagation.

These trends of collapse, recovery, and spiraling increases of new demand are typical of unstable fisheries systems. The original goal of establishing self-sustaining stocks sought to improve the stability of Great Lakes fisheries, but success has wrought unexpected risks. Eshenroder (1989)[1] identified several stability related concerns: competition for forage between lake trout and stocked salmonids, vulnerability of stocked salmonids to hatchery diseases or loss of genetic fitness, future invasions of exotic, and angler intolerance for depressions in stocked trout and salmon. The latter risk, according to Eshenroder (1989), in fact, reduces the scope of possible management actions. The future of fisheries management in the Great Lakes involves balancing self-maintaining and artificially maintained components. The central problem confronting the task group, therefore, was the question: "Is the long-term stability of Great Lakes fisheries limited by our current management practices, and, if so, how great are the risks and what are the alternatives?"

To guide implementation of the evaluation framework, the Task Group began a series of workshops and technical working meetings to develop computer models with which to explore the consequences of fishery management options (Figure 1). The work of the Task Group was guided by a core team consisting of Michael Jones and Joseph Koonce, who served as co-chairs, and Richard Hess (Illinois Department of Conservation), John Williamson (Ontario Ministry of Natural Resources), and Randy Eshenroder (Great Lakes Fishery Commission), who represented the interests of fish managers. The first workshop in January, 1991, produced detailed conceptual models of Lake Michigan and Lake

[1] Eshenroder, R. L. 1989. A perspective on artificial fishery systems for the Great Lakes. Paper presented at Wild Trout IV, Yellowstone National Park, September 18-19, 1989. 8 pp.

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December 24, 1996

William H. Horns
WI Department of Natural Resources
Bureau of Fisheries Management
101 South Webster Street
Madison, WI 53707-7921

Dear Bill:

I am sorry, but I will be unable to attend the workshop in Madison on January 29, 1997. I will be in Seattle taking some digital acoustics training that I have had scheduled for several months. As you probably know, the GLSC has completed the reorganization and Chuck Madenjian is the new section leader for Lake Michigan. I request that he attend the meeting and participate in the workshop. He will have the fall bottom trawl index data ready for the meeting and we will provide him with the hydroacoustic assessment data.

Just to keep the loop closed, I am enclosing a copy of the letter and information I sent to Pete LeClair.

Sincerely,

Ray

Ray L. Argyle
Branch Chief,
Central Basin Ecosystem Branch

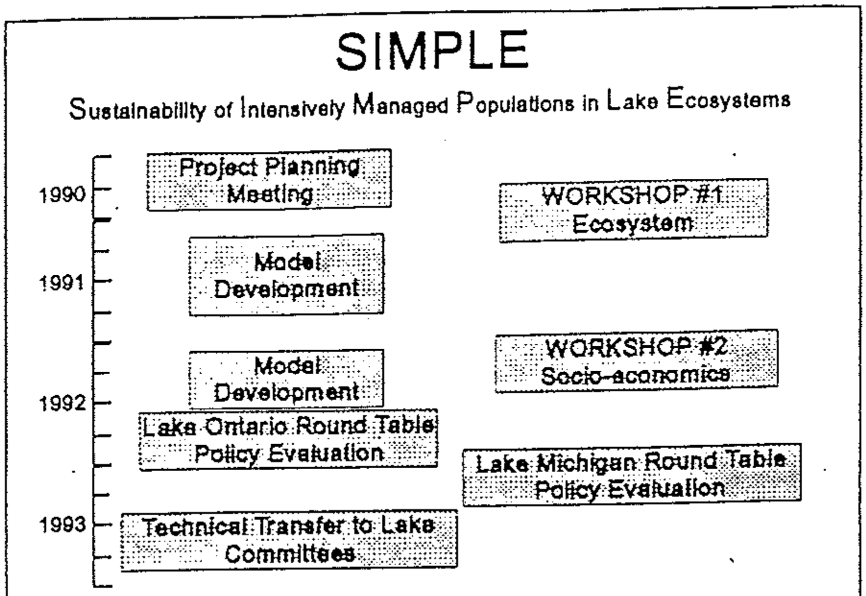

Figure 1. Summary of major activities of the SIMPLE Task Group.

Ontario that captured the ecological context of management options. During the following summer and fall, these conceptual models evolved into two simulation models of the fish communities of each lake through a series of technical working meetings. The second workshop (April 1992) focused on incorporation of social and economic factors into the simulation models and on the preparation for the realistic evaluation of management policies in their full ecological, social, economic, and political context. After more model development, the Task Group hosted two round tables for policy evaluation, one for Lake Ontario in October 1992 and the other in January 1993 for Lake Michigan. Reports of these two round tables are included in appendices II and III. Finally, the Task Group concluded its work with a Technology Transfer Workshop (December 1993) and distribution of models for Lake Michigan and Lake Ontario to representatives of the technical committees for each lake (January 1994).

PROJECT ACCOMPLISHMENTS AND FINDINGS

The SIMPLE Task Group achieved most of its objectives. The project succeeded in establishing a framework for the evaluation of the sustainability of fish management options for Lakes Michigan and Ontario and assisted managers in their deliberations over future stocking options. Table 1 lists the primary products of the Task Group. Progress on the specific objectives was also significant (Table 2). The approach adopted by the SIMPLE Task Group was the Adaptive Environmental Assessment and Management (AEAM) methodology[2] As expected, the most important product of this approach was the process itself. Participants in the workshops came from Provincial, State, and Tribal management authorities, Department of Fisheries and Oceans, U.S. Fish and Wildlife Service, academic institutions,

[2] Holling, C. S. [ed.] 1978. *Adaptive Environmental Assessment and Management*. John Wiley and Sons, New York. 377 pp..

Table 1. Products of SIMPLE Task Group

Reports

SIMPLE Task Group Final Report (May 18, 1991). Report of SIMPLE Workshop I to develop a conceptual model of the Lake Michigan and Lake Ontario fish communities. 14 pp.

Proceedings of SIMPLE Workshop II. A report of the socio-economic impacts workshop of the SIMPLE Task Group. June 1992. 13 pp.

Proceedings of the SIMPLE Lake Ontario Round Table. A report of the Lake Ontario Round Table of the SIMPLE Task Group, Alliston, Ontario October 21-23, 1992. 16 pp.

Proceedings of the SIMPLE Lake Michigan Round Table. A report of the Lake Michigan Round Table of the SIMPLE Task Group, Wingspread, Racine, Wisconsin, January 19-21, 1993. pp.

Publications

Jones, M. L., J. F. Koonce, and R. O'Gorman. in press. Sustainability of hatchery-dependent fisheries in Lake Ontario: the conflict between predator demand and prey supply. Trans. Amer. Fish. Soc. (accepted for publication).

Newsletters:

SIMPLE Newsletter Vol 1, No. 1
SIMPLE Newsletter Vol 2, No. 1

Software

Lake Ontario Model
Lake Michigan Model

organizations representing various fishery interests, and organizations representing broader interests in the future of the Great Lakes. Appendix I lists individuals participating in the initial workshops and round tables. Assembling this range of participants was vital to the development of credible models and open communication of alternate points-of-view, preferences for future management options, and possible consequences of these choices.

The Round Table format proved to be very successful. Non-governmental participants, in particular, found the format to be a productive way of communicating the context of management decisions and of understanding the constraints that fish managers must work around. Public participation is this format is not adversarial. Managers are not proposing regulations or management options for comment. Rather, the Round Table format seeks to provide a common meeting ground for the communication of concerns and ranges of solutions. Disagreements occur, but the primary emphasis is on finding areas of agreement and common understanding of the problems in developing a sustainable fishery. This emphasis appears to be a better way to build public consensus for management decisions. Open discussions before decisions are made provide more opportunities to explore and understand the consequences of the ultimate decisions. Models of the fish communities play an important role in this process. Because they are a product of a consensus building exercise, the models are objective statements of the current understanding of the regulation of fish community structure. Due to knowledge limitations, the models were probably wrong in some details. Nevertheless, the use of the models imposes a check on the internal consistency of arguments for various management options or beliefs about the state of the fish

A consensus emerged from the work of the Task Group that the recent initiatives of fish management agencies may not be sustainable. Clearly, the prey populations of Lake Michigan and Lake Ontario are vulnerable to sharp declines if stocking continues at recent levels. Figures 2 and 3 illustrate some of the model predictions for both lakes. The validity of these predictions depends upon some key assumptions and the influence of climatic factors, which are unpredictable. It appears, however, that rather large reductions in stocking will be needed to reverse alewife decline, if it is, in fact, reversible at all. Additional research will be required to obtain better understanding of the risks associated with various management options, but these findings add support to the urgency of the efforts of fish managers to develop more explicit, long-term objectives for the fish communities of Lake Michigan and Lake Ontario. Because models play such an important role in evaluating and communicating the consequences

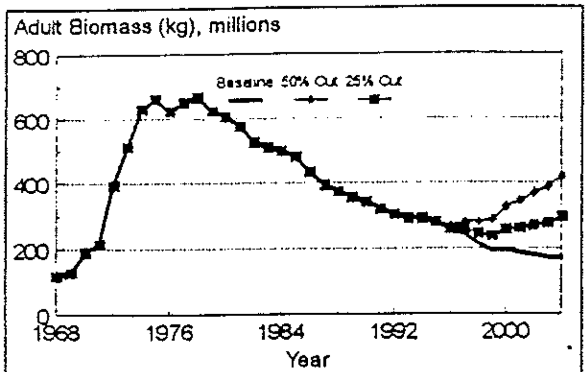

Figure 2. Predictions of effects of various stocking cuts on alewife abundance in Lake Michigan.

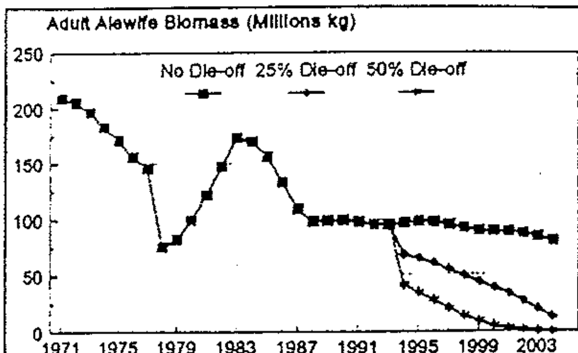

Figure 3. Predictions of Lake Ontario Model of. trends in alewife biomass at current salmonid stocking levels given severity of over-winter mortality.

of fish management policy options, it would appear that something like the SIMPLE models should be incorporated into the evolving fish community objectives for each of the Great Lakes.

Conclusions and Recommendations

In attempting to develop a framework for evaluating the risks associated with artificially maintained fisheries, the SIMPLE Task Group has uncovered substantial opportunities and challenges to implementing sustainable, fish management in the Great Lakes. Dealing with public expectations has clearly become as complex as understanding ecological relationships. One of the conclusions of the workshop on social and economic factors was that vague or generally stated long-term goals for fish communities do not provide sufficient guidance for managers nor do they make explicit the social and economic trade-offs that are required to achieve a biologically stable structure of fish communities. Public understanding and acceptance of these trade-offs is essential to establishing a new basis for public expectation and preferences based on stewardship principles. Participants in the Round Tables found this format productive at building common understanding of the problems confronting management of the fish communities of the Great Lakes. The Task Group, therefore, recommends that the GLFC and BOTE consider ways of incorporating this Round Table format into other policy venues in which public preference and science play joint roles in policy formation and screening of management options.

Another challenge is to improve the scientific basis for sustainable fish management. The Task Group only began a superficial consideration of sustainability issues. Much of the model analysis addressed a narrower issue of balance of predator and prey populations in Lake Michigan and Lake Ontario. Underlying this question, however, are needs for more fundamental research in three general areas: the influence of biodiversity on sustainable fisheries management, determinants of productive capacity of large lake ecosystems, and strategic approaches to establishing and pursuing sustainable production goals. The BOTE research priorities[3] addressed these points, but the Task Group recommends their reconsideration along the following lines:

- Recommendation on biodiversity research. In a restoration context, the influence of biodiversity on sustainable production becomes important with decisions on long-term goals for the structure of fish communities. This is a central problem confronting the drafters of Fish Community Objectives for each of the Great Lakes. An important scientific issue concerns the significance of species composition. Are there any adverse ecological consequences (e.g. ecosystem instability or diminished production) associated with preserving alewife dominance over indigenous planktivores? The tropho-dynamic approach taken in the SIMPLE models is insufficient to explore the effects of species composition on ecosystem structure. What is required is a more explicit analysis of the interaction of biodiversity (both species composition and stock structure) with ecosystem energetics through a combination of modeling studies, historical analysis, and emerging techniques for complementing diet studies with stable isotope ratios.
- Recommendation on productive capacity research. The SIMPLE have addressed the stability of predator-prey balance for various levels and combinations of salmonid stocking. With future improvements in tributary and near-shore habitat, natural reproduction will become a more important consideration in the decisions on stocking programs in Lake Michigan and Lake Ontario. However, there remain substantial gaps in knowledge of the relative contribution of habitat, biodiversity, and nutrient loading in determining the productive capacity of these ecosystems for top predators. A fundamental principle of sustainable fishery management is that maintenance of fish community structure should not require major stocking programs, i.e. there should be a major emphasis on self-sustaining populations. The

[3] Great Lakes Fishery Commission. 1993. Research Priorities for the 1990s. William Taylor [ed.]. Board of Technical Experts. Great Lakes Fish. Comm., Ann Arbor. 14 pp.

interaction of habitat and biodiversity seems to be emerging as an important linkage, which currently limits lake trout reproduction[4]. This research must go beyond a classification and inventory of habitat to a more fundamental exploration of the evolutionary ecology of the adaptation of fish populations to habitat constraints in the Great Lakes.

- Recommendation on sustainable production research. The experience of the SIMPLE Task Group reinforces the need for additional research on levels of fish harvest that are consistent with sustainable fisheries management. Requests by the Lake Michigan Technical Committee to assist the development of production expectations from the Lake Michigan Fish Community Objectives, however, have revealed a continuing difficulty in the specification of exploitation targets. The need for such targets as part of the delivery of fish community objectives will not be met unless there is a concerted effort to address this issue through an integrated study of the interaction of exploitation (including commercial and recreational harvests) with fish community structure.

The SIMPLE Task Group began as a research project. From a research point-of-view the theoretical components of the research (model building, policy gaming, and experimentation with techniques of adaptive management) have produced promising results, which now must be further prepared for communication. From a management point-of-view, these "scientific" findings offer some interesting possibilities, but technology transfer is far from complete. Computer simulation models are becoming increasingly more valuable to managers. However, there continue to be severe resource constraints (people and time) on agencies to accept full responsibility for the continuation of the SIMPLE initiative. The BOTE has invested substantial resources into the delivery of AEAM process and modeling to the Great Lakes fish management community. In order to maintain this investment, therefore, the Task Group recommends that BOTE consider reintegrating the SIMPLE and IMSL initiatives. The interface between fish management policy and Integrated Management of Sea Lamprey is clearly a priority of the Sea Lamprey Integration Committee. SLIC has arranged for joint meetings of the lake technical committees and control agents. If BOTE could assist the ongoing model development that will be required to make models operational for the lake committees, the joint activity would facilitate the fullest development of sustainable fisheries management in the Great Lakes.

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[4] Eshenroder, R. L., C. R. Bronte, and J. W. Peck. (In press). Comparison of lake trout-egg survival at inshore and offshore and shallow-water and deepwater sites in Lake Superior. Paper presented at BOTE Lake Trout Symposium in Ann Arbor, 1994.

APPENDIX I. LISTS OF PARTICIPANTS IN THE WORKSHOPS OF THE SIMPLE TASK GROUP

Participants in the first SIMPLE Workshop, January 8 to 10, 1991, and their institutional affiliation.

Name	Affiliation
Ray Argyle	U.S. Fish and Wildlife Service
Fred Binkowski	University of Wisconsin, Milwaukee
Dave Borgeson	Michigan Department of Natural Resources
Dan Brazo	Indiana Department of Natural Resources
Dieter Busch	U.S. Fish and Wildlife Service
Gavin Christie	Great Lakes Fishery Commission
Glenda Daniel	Lake Michigan Federation
Doug Dodge	Ontario Ministry of Natural Resources
Tom Edsall	U.S. Fish and Wildlife Service
Randy Eshenroder	Great Lakes Fishery Commission
Gary Fahnenstiel	NOAA/Great Lakes Environmental Research Laboratory
Tony Friend	University of Ottawa
John Gannon	U.S. Fish and Wildlife Service
David Gibson	Ontario Federation of Anglers and Hunters
Lorne Greig	Environmental and Social Science Analysts, Ltd.
Michael Hansen	U.S. Fish and Wildlife Service
Richard Hess	Illinois Department of Conservation
Mark Holey	Wisconsin Department of NaturalResources
Rodney Horner	Illinois Department of Conservation
Pat Hudson	U.S. Fish and Wildlife Service
Peter Ihssen	Ontario Ministry of Natural Resources
Michael Jones	Ontario Ministry of Natural Resources
David Jude	University of Michigan
Jim Kitchell	University of Wisconsin, Madison
Joseph Koonce	Case Western Reserve University
Greg Lang	NOAA/Great Lakes Environmental ResearchLaboratory
Robert Lange	New York Department of EnvironmentalConservation
Joe Leach	Ontario Ministry of Natural Resources
Chuck Madenjian	University of Wisconsin, Madison
Ed Mills	Cornell University
Bob O'Gorman	U.S. Fish and Wildlife Service
Brian Potter	Ontario Ministry of Natural Resources
Peter Rand	State University of New York, Syracuse
Tom Stewart	Ontario Ministry of Natural Resources
Bill Taylor	Michigan State University
Dan Thomas	Great Lakes Sport Fishing Council
John Williamson	Ontario Ministry of Natural Resources

Participants in the Second SIMPLE Workshop, April 27-29, 1992, and their institutional affiliation.

Participant Name	Affiliation
Brazo, Dan	Indiana Department of Natural Resources
Christie, Gavin	Great Lakes Fishery Commission
Eshenroder, Randy	Great Lakes Fishery Commission
Friend, Tony	IREE, University of Ottawa
Beggs, Gail	Ontario Ministry of Natural Resources
Gibson, Dave	Ontario Federation of Anglers and Hunters
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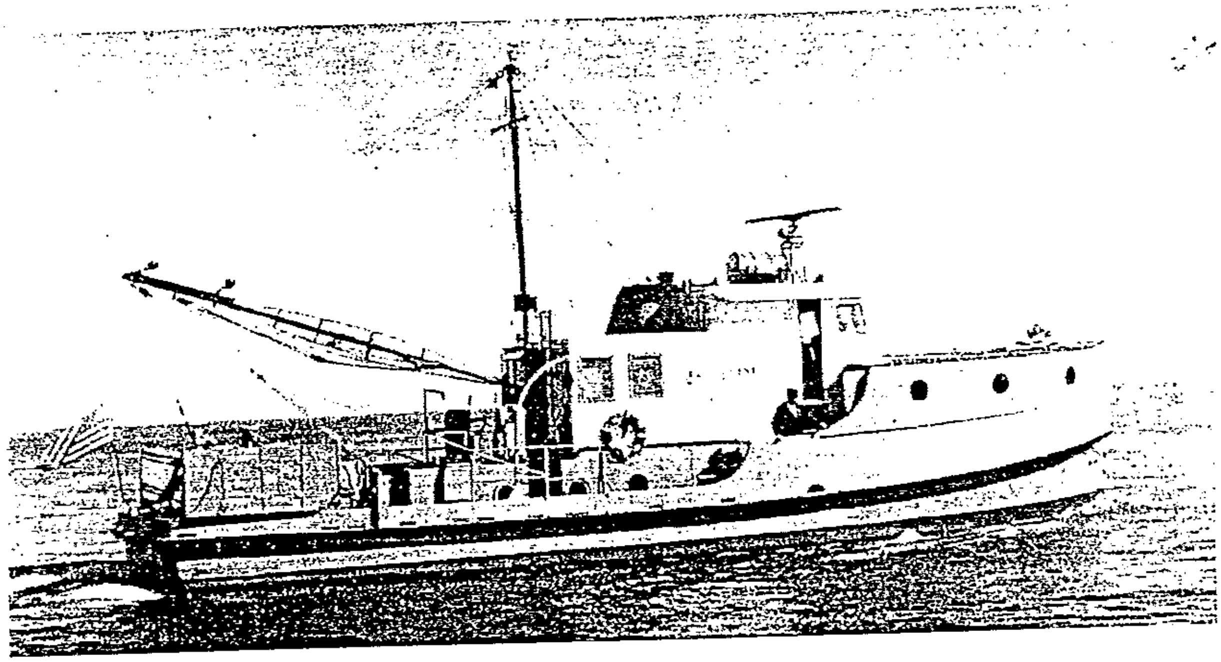
Status of Prey Fish Populations in Lake Michigan, 1996



Department of the Interior
U.S. Geological Survey
Biological Resources Division
Great Lakes Science Center
1997

Lake Michigan Committee
March 20, 1997
Agenda Item 4.b

Status of Prey Fish Populations in Lake Michigan, 1996[1]

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with an update of the acoustic assessment by
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Abstract

The Great Lakes Science Center (formerly known as the National Fisheries Research Center - Great Lakes of the U. S. Fish and Wildlife Service) has conducted lakewide surveys of the major prey fish populations in Lake Michigan each fall since 1973. These systematic surveys are performed using standard 12-m bottom trawls towed along the contour at depths of 9 to 110 m at each of seven to nine index transects. The resulting data on relative abundance, size structure within the population, and condition of individual fish are used to estimate various population parameters needed for managing the fish stocks, and are shared with state and tribal management agencies that have jurisdiction over the fishery resources. The biomass of age-1 and older alewife available to the bottom trawls in Lake Michigan during 1996 was 30,000 metric tons, which was similar to the 1995 biomass of 32,000 metric tons. Biomass of age-1 and older bloaters increased from 181,000 metric tons in 1995 to 262,000 metric tons in 1996; this marked the first increase in bloater biomass in Lake Michigan since 1992. Bloater recruitment remained low during 1996, as the catch per unit effort of age-0 bloater averaged only 0.3 fish per 10-min tow. Lakewide biomass of age-1 and older rainbow smelt was estimated at 3,900 metric tons. Thus, the rainbow smelt population biomass, as estimated using bottom trawls, has continued to decline since 1992. Yellow perch reproduction was low for the sixth consecutive year; only nine age-0 yellow perch were caught in our trawls. The lakewide biomass estimate for deepwater sculpin increased from 66,000 metric tons in 1995 to 124,000 metric tons in 1996. Abundance of slimy sculpin rose sharply from 36 fish per 10-min tow in 1995 to 93 fish per 10-min tow in 1996. Prior to 1996, slimy sculpin abundance in Lake Michigan had not exceeded 50 fish per 10-min tow since 1981.

The fall 1996 integrated acoustic and midwater trawl survey marked the last scheduled field work as part of the 6-year study. Bloaters were the most abundant midwater species to total about 211,000 metric tons lakewide, an increase over 1995. Estimated alewife biomass totaled about 44,000 metric tons, which was largely due to age-1 fish (32,000 metric tons). Adult alewives were not found in the water column and were poorly represented (9,000 metric tons) in the lakewide biomass estimate. Rainbow smelt biomass was estimated at about 34,000 metric tons, an increase from 1995, followed by stickelbacks at 13,000 metric tons. An in-depth analysis of the findings of the acoustic study will be detailed in a final report that will be completed in summer 1997, including recommended plans to integrate acoustics in future fish stock assessment.

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[1]Presented at: Great Lakes Fishery Commission
Lake Michigan Committee Meeting
Ann Arbor, Michigan
March 20, 1997

Provisional data, not to be cited without permission.

The Great Lakes Science Center (formerly known as the National Fisheries Research Center - Great Lakes) has conducted daytime bottom trawl surveys in Lake Michigan during the fall each year from 1973 to the present. From this survey, the relative abundance of the prey fish populations can be estimated, and estimates of lakewide biomass available to the bottom trawls can be generated (Hatch et al. 1981; Brown and Stedman 1995). Such estimates are critical to fisheries managers making decisions on stocking rates of salmonines and on allowable harvests of prey fish by commercial fishing operations.

The basic unit of sampling in our surveys was a 10-min tow using a bottom trawl (12-m headrope) dragged along the contour. At each of the index transects, nine depths were typically sampled. During 1973-1993, the shallowest tow was at the 18-m contour and the deepest tow was at 91-m contour, and tows were spaced in 9-m depth increments. During 1994-1996, tows were made at depths from 9 to 73 m, and at 91 and 110 m. Since 1992, seven index transects have been employed in the survey. These index transects were located off Manistique, Frankfort, Ludington, and Saugatuck, Michigan; Waukegan, Illinois; and Port Washington and Sturgeon Bay, Wisconsin.

To estimate lakewide biomass, each of the seven transects was assigned a proportionate area of Lake Michigan, based on the statistical district system for reporting commercial catch that was established in the 1950s (Hatch et al. 1981). Catch in weight, by prey species and life stage, for a particular tow was then expanded on the basis of the total area represented by a particular depth contour at that particular transect. These estimates are then summed for all of the depth-contour intervals and transects to yield estimates of lakewide biomass available to the bottom trawl. These estimates are of fish biomass in the lower 1.8 m of the water column, which is the height of the opening of our trawl. It should be noted that some fish occupying this area may be missed by the trawl. Large fish may avoid the trawl by swimming out of its path, whereas slimy sculpins may be situated so tightly to the bottom that the net passes over many of them.

For purposes of this report, we will refer to "adult" prey fish as those fish age 1 or older. Age was assigned based on length-frequency data; alewives > 90 mm, rainbow smelt > 60 mm, and bloaters > 100 mm in total length were classified as "adults". Unless otherwise stated, all length measurements refer to total length.

ABUNDANCE

Adult alewife - Adult alewife has remained the most important constituent of salmonine diet in Lake Michigan for the last 20 years (Jude et al. 1987; Stewart and Ibarra 1991; P. Peeters, Wisconsin Department of Natural Resources, Sturgeon Bay, WI, personal communication; R. Elliott, U. S. Fish and Wildlife Service, Green Bay, WI, personal communication). The commercial fishery for alewives, operated within Wisconsin waters of the lake, was closed in 1991, although the commercial trawlers are presently requesting the state of Wisconsin to reopen the fishery (W. Horns, Wisconsin Department of Natural Resources, Madison, WI, personal communication).

Relative abundance of adult alewives in Lake Michigan in 1996 was 109 fish per tow, which was close to the 1995 level of 104 fish per tow (Fig. 1). Since 1990, there has been no consistent upward or downward trend in adult alewife abundance in Lake Michigan. Rather, the abundance has

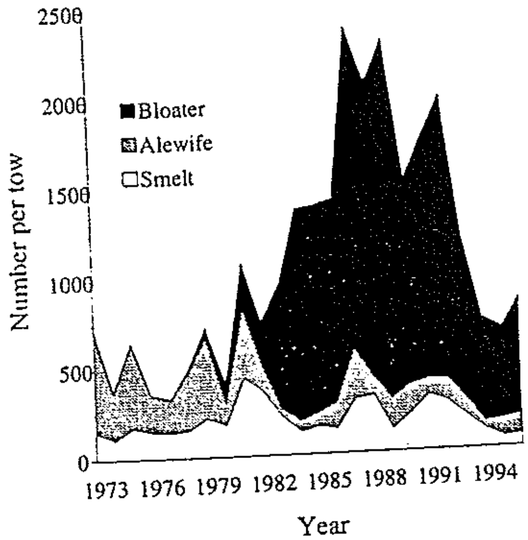

Fig. 1. Mean number fish per trawl tow of age-1 and older of bloater, alewife, and rainbow smelt in Lake Michigan, 1973-1996.

fluctuated about a mean level of approximately 80 fish per tow. The modal length for adult alewives in Lake Michigan has typically fallen at 175 or 185 mm during the last 25 years; the year 1996 was no exception as modal length of adult alewife in the bottom trawls was 185 mm (Fig. 2).

Adult bloater - Adult bloaters are eaten by salmonines in Lake Michigan, although not to the extent that adult alewives are consumed. Over 30% of the diet of large (≥600 mm) lake trout at Saugatuck and on the mid-lake reef was composed of adult bloaters during 1994-1995, although adult bloater was a minor component of lake trout

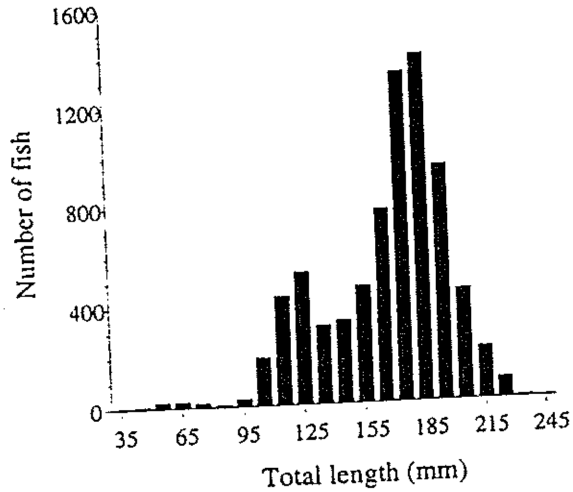

Fig. 2. Length-frequency distribution for alewives caught in bottom trawls in Lake Michigan, 1996

diet at Sturgeon Bay (Madenjian et al. 1996). Adult bloaters are also consumed by chinook salmon in Michigan waters (R. Elliott, personal communication). The bloater population in Lake Michigan also supports commercial fisheries (M. Ebener, Chippewa/Ottawa Treaty Fishery Management Authority, Sault Ste. Marie, MI, personal communication; P. Peeters, personal communication).

Adult bloaters increased in abundance from 504 fish per tow in 1995 to 649 fish per tow in 1996 (Fig. 1). This marked the first increase in adult bloater abundance since 1992. The modal length of adult bloaters caught in the bottom trawls continued to increase through 1996. Modal length increased from 175 mm in 1992 to 185 mm in 1993, and then to 195 mm in 1995 (Passino-Reader et al. 1996). In 1996, modal length of adult bloaters was 205 mm (Fig. 3).

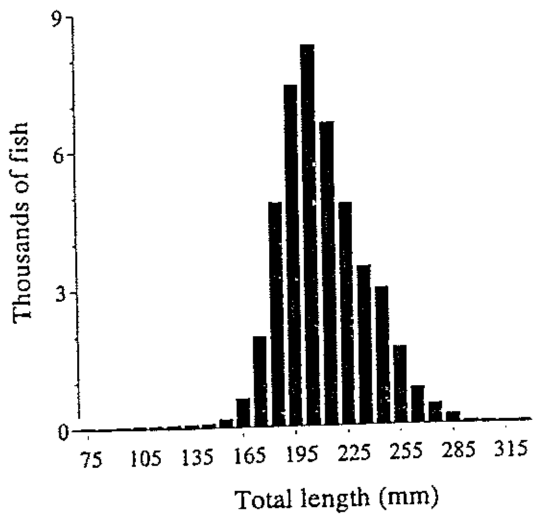

Fig. 3. Length-frequency distribution for bloaters caught in bottom trawls in Lake Michigan, 1996.

Adult rainbow smelt - Adult rainbow smelt is an important diet item for intermediate-size (between 400 and 600 mm total length) lake trout from the nearshore region of Lake Michigan (Stewart et al. 1983; Madenjian et al. 1996). The rainbow smelt population supports commercial fisheries operated in Wisconsin and Michigan waters (P. Peeters, personal communication; P. Schneeberger, Michigan Department of Natural Resources, Marquette, MI, personal communication). Adult rainbow smelt abundance in 1996 was 69 fish per tow, which was similar to the 55 fish per tow in 1995 (Fig. 1). Adult smelt abundance averaged 150 fish per tow between 1991 and 1996. Thus, adult smelt abundance remained low during 1996.

Young-of-the-year - Catches of young-of-the-year (YOY) alewives, bloaters, and rainbow smelt generally are not very strong indicators of future year-class strength for these populations, because their small size and position in the water column make them less vulnerable and available to bottom trawls. Nevertheless, during the bloater recovery in Lake Michigan that began in the late 1970s, our trawling survey did indicate that the lake contained unusually high abundances of age-0 bloaters, so there is some correspondence between our bottom trawl catches of YOY prey fish and their actual abundance in the lake. Abundance of YOY alewife was unusually low at only 1 fish per tow during 1996 (Fig. 4). Catch per unit effort (CPE) for age-0 alewife was 200

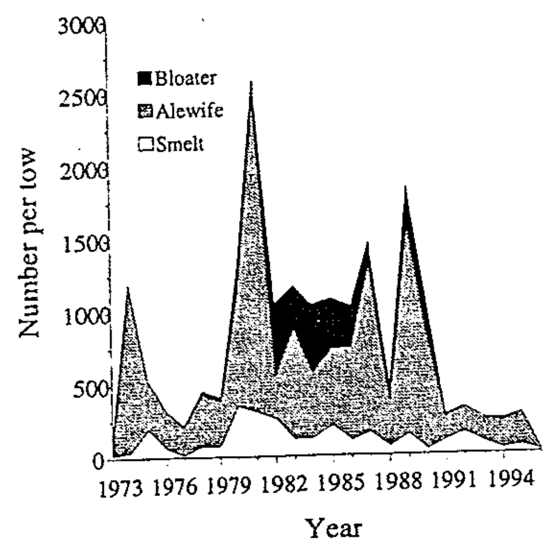

Fig. 4. Mean number of fish per trawl tow for YOY alewife, bloater, and rainbow smelt in Lake Michigan, 1973-1996.

fish per tow in 1994 and 203 fish per tow in 1995.

Abundance of age-0 bloater in 1996 was only 0.3 fish per tow (Fig. 4). Bottom trawl catches of YOY bloaters has remained very low during the 1990s; CPEs were 1.1, 1.0, 0.1, and zero in years 1992, 1993, 1994, and 1995. The length-frequency distributions of bloaters during this time period strongly suggested that bloater recruitment has been low during this time (Passino-Reader et al. 1996). Recruitment during 1996 appeared to follow this trend.

CPE of YOY rainbow smelt declined from 52 fish per tow in 1995 to 16 fish per tow in 1996 (Fig. 4).

Yellow perch - Overall, yellow perch are of relatively minor significance in the diet of Lake Michigan salmonines (Jude et al. 1987), however the yellow perch population in Lake Michigan has supported a valuable recreational fishery (Wells 1977). Although adult yellow perch are not highly vulnerable to bottom trawls towed during daylight hours, incidental catches of age-0 yellow perch in the fall prey fish surveys have generally been fair indicators of reproductive success and future stock size. Additional tows were performed at 5, 9, 13 and 22 m at Saugatuck, as well as the 18-m depth at Frankfort, in 1996 to target age-0 yellow perch. Inspection of the yellow perch length-frequency distribution for 1996 suggested that the cutoff length to distinguish YOY yellow perch from "adults" should be at 110 mm.

Our trawling survey indicated that 1996 was yet another year of poor yellow perch recruitment in Lake Michigan (Fig. 5). Only nine age-0 yellow perch were caught in 1996; all of these fish were trawled at Saugatuck at depths ranging from 5 to 64 m. Age-0 perch CPE was only 0.2 fish per tow in 1996, whereas YOY perch abundance was 2.0 fish per tow in 1995.

In addition to the nine age-0 perch, we caught 274 age-1 and older yellow perch at Saugatuck in 1996. These perch ranged in

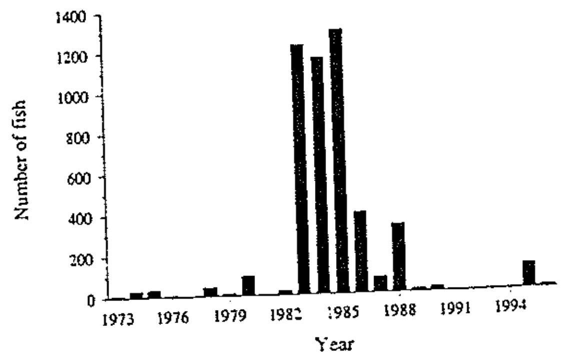

Fig. 5. Total catch of YOY yellow perch taken in bottom trawls in Lake Michigan, 1973-1996.

size from 120 to 330 mm. with the bulk of the catch between 190 and 240 mm (Fig. 6). More than 85% of these fish were caught at Saugatuck, with the rest from Frankfort, Ludington, and Waukegan. Almost certainly, some of the perch between 120 and 150 mm in length were yearlings, and therefore the bottom trawling data documented some survival of the 1995 year-class to the fall yearling stage. Our CPE for age-1 and older yellow perch in 1996 was

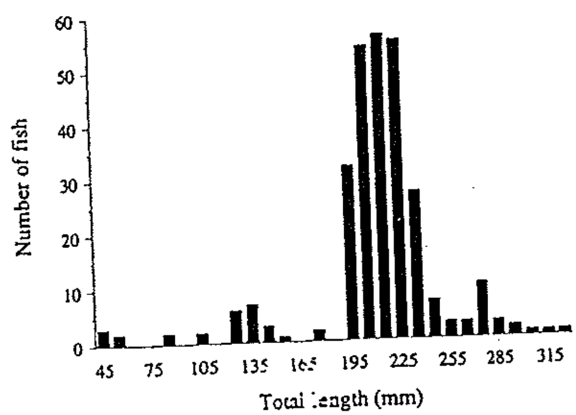

Fig. 6. Length-frequency distribution of yellow perch caught in bottom trawls in Lake Michigan, 1996.

4.0 fish per tow, which was somewhat lower than that in 1995, when 5.9 fish per tow was observed.

Sculpins - Most of the slimy sculpins that are caught in the bottom trawls are age-1 and older fish, because many YOY slimy sculpins are too small to be effectively sampled by the gear. (R. Owens, U. S. Geological Survey, Lake Ontario Biological Station, Oswego, NY, personal communication). It is possible that YOY deepwater sculpins may not be vulnerable to the gear due to their position in the water column; it is unknown whether the YOY deepwater sculpins remain pelagic in the fall (Wells 1968). Both slimy and deepwater sculpins are important diet constituents of juvenile lake trout in most nearshore regions of the lake (Stewart et al. 1983; Madenjian et al. 1996). As lake trout grow, the importance of sculpins in lake trout diet decreases substantially so that sculpins form only a minor portion of adult lake trout diet. Sculpins, especially deepwater sculpins, are also eaten by burbot in Lake Michigan (Brown and Stedman 1995).

Deepwater sculpin abundance in Lake Michigan increased substantially from 165 per tow in 1995 to 297 per tow in 1996 (Fig. 7). Year 1996 was the first time that deepwater sculpin abundance exceeded 200 fish per tow since 1988. The 24-year long-term average for deepwater sculpin abundance was 240 per tow.

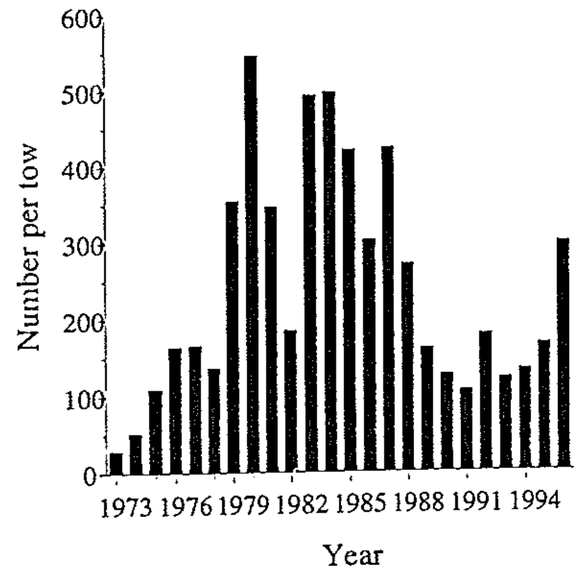

Fig. 7. Mean number of deepwater sculpins per trawl tow in Lake Michigan, 1973-1996.

Slimy sculpin abundance rose sharply between 1995 and 1996, with CPE increasing from 36 to 93 per tow (Fig. 8). It appeared that slimy sculpin abundance has been increasing since 1991. This increase

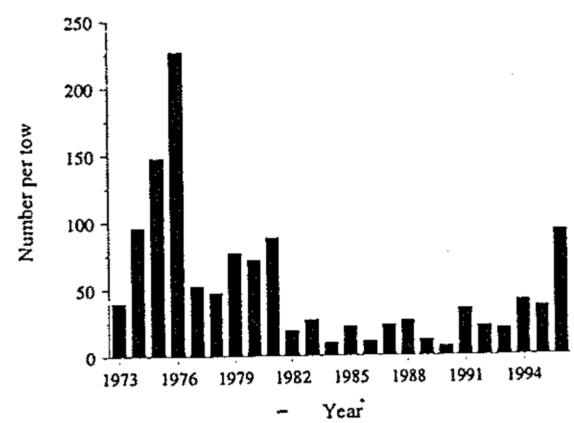

Fig. 8. Mean number of slimy sculpins per trawl tow in Lake Michigan, 1973-1996.

occurred following a decrease in the lake trout stocking rates in many of the nearshore areas of the lake that was imposed during the late 1980s and continued through the 1990s (see Holey et al. [1995]). Owens and Bergstedt (1994) documented a decrease in sculpin abundance in an area of Lake Ontario that was stocked with lake trout each spring over the course of 10 years. Perhaps the release of predatory pressure by reduced stocking of lake trout in many nearshore areas of Lake Michigan has caused the increase in lakewide abundance of slimy sculpin, as measured by our bottom trawling.

BIOMASS

We estimated a total lakewide biomass of prey fish available to the bottom trawl in 1996 of 425,000 metric tons (t) (Fig. 9), compared with 292,000 t in 1995. This total prey fish biomass was the sum of the population biomass estimates for alewife, bloater, smelt, deepwater sculpin, and slimy sculpin. Once again, bloaters dominated the prey fish biomass of Lake Michigan in 1996, and this has been a consistent feature of the lake=s prey fish biomass composition since 1983 (Fig. 10). Bloaters composed 61.8% (262,000 t), alewives 7.0% (30,000 t), rainbow smelt 0.9% (4,000 t), and sculpins 30.2% (slimy sculpins 4,200 t; deepwater sculpins 124,000 t) of the estimated total prey fish biomass. Almost all of the biomass available to the bottom trawls in 1996 was composed of adults rather than YOY: only 8 t of YOY alewives compared with 30,000 t of adult alewives, only 9 t of YOY bloaters compared with 262,000 t of adult bloaters, and 76 t of YOY rainbow smelt compared with 3,900 t of adult smelt.

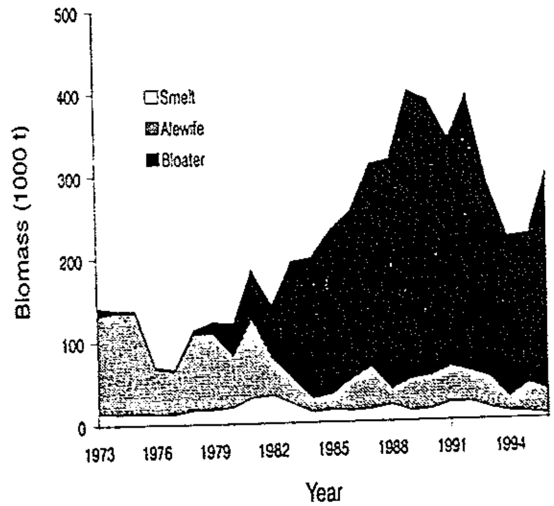

Fig. 10. Lakewide biomass, as estimated by bottom trawling, for alewife, bloater, and rainbow smelt populations in Lake Michigan, 1973-1996.

Bloater biomass increased substantially from 181,000 t in 1995 to 262,000 t in 1996 (Fig. 11). This increase was not only due to growth of individual adults, but was also probably due to some recruitment to the

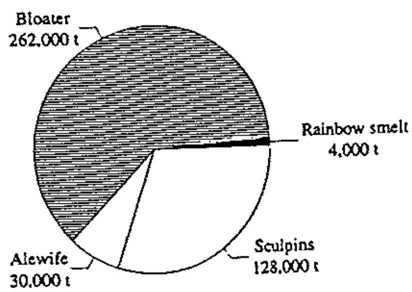

Fig. 9. Bottom trawl estimates of prey fish biomass in Lake Michigan, 1996. Total biomass for all five populations pooled was 425,000 t.

adult population, as indicated by the CPE data. Bloater biomass had been steadily decreasing since 1992, but this trend was reversed in 1996.

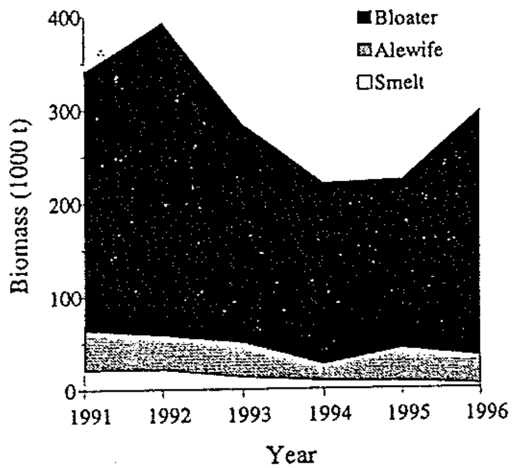

Fig. 11. Lakewide biomass, as estimated by bottom trawling, for alewife, bloater, and rainbow smelt populations in Lake Michigan, 1991-1996.

Biomass of adult alewife in 1996 (30,000 t) was very similar to that in 1995 (32,000 t). Overall, alewife biomass in Lake Michigan, as estimated by the bottom trawling survey, has not shown an upward or downward trend during the 1990s, rather the population biomass has fluctuated about a mean value of approximately 33,000 t (Fig. 11). A hydroacoustic survey of Lake Michigan indicated an unusually strong year-class of alewives in 1995 (G. Fleischer, Great Lakes Science Center, Ann Arbor, MI, personal communication). The 1996 hydroacoustic survey results showed that although this year-class suffered heavy mortality losses during 1996, its biomass in the fall of 1996 was estimated at 32,000 t. Most of these yearling alewives in the fall of 1996 were in the upper half of the water column and not vulnerable to the bottom trawls. We would expect this 1995 year-class to be recruited to the bottom trawls in 1997; although how much additional biomass this year-class will contribute to the bottom trawl estimate of adult alewives would depend on survival of the 1995 year-class, as well as survival of older alewives, during 1997.

Rainbow smelt biomass, as measured by bottom trawling, continued to decline in Lake Michigan in 1996, following a downward trend that began in 1992 (Fig. 11). The reasons for this downward trend remain unclear. Smelt recruitment, as indexed by trawl CPE of YOY smelt, did not appear to be impaired during the 1990s (Fig. 4).

Both deepwater and slimy sculpin biomass showed substantial increases in 1996. Deepwater sculpin biomass increased from 66,000 t in 1995 to 124,000 t in 1996, whereas slimy sculpin biomass increased from 1,300 t in 1995 to 4,200 t in 1996. These increases may be related to reduced predatory pressure by juvenile lake trout due to changes in lake trout stocking practices in the late 1980s. Furthermore, burbot relied on deepwater sculpins for a major portion of their diet in the mid-1980s, but may have switched their diet somewhat to include other prey fish since that time. Burbot CPE, based on the bottom trawls, remained relatively high in 1996 at 1.5 per tow. This abundance level was fairly similar to the 0.9 per tow recorded in 1995.

ACOUSTIC ASSESSMENT

The 1996 acoustic survey was conducted from September 12 through September 26 and October 5 through October 17. The survey was conducted with the *S/V Steelhead* and the *R/V Grayling*. We completed a total of 11 transects (Fig. 12), which was fewer than planned due to the combination of poor weather conditions and mechanical problems on the *R/V Grayling*. The areas not fully covered include those waters between Charlevoix and Frankfort (MM-3 and MM-5) and between Sturgeon Bay and Port Washington (WM-4 and northern WM-5). This coverage will allow calculation of lakewide biomass estimates, but limits our ability to develop comparative estimates on a regional basis.

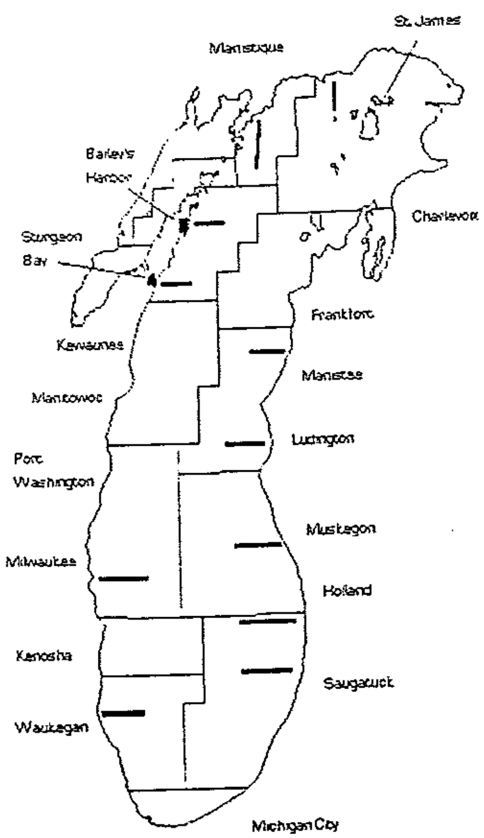

Figure 12. Fall 1996 acoustic sampling transects.

The midwater trawls revealed alewives to be the dominant species in the warmer near-surface areas (typical of most years), but overall densities of alewives were much lower than the extremely high concentrations of age-0 alewives observed in 1995. The greatest mean density of the three major pelagic fishes occurred in shallower waters and declined with depth (Fig. 13). In typical fashion, alewife and rainbow smelt densities on average were greatest in the shallower areas and declined with depth. Bloaters were the predominant midwater species, but they did not show their usual distribution pattern of increased abundance with depth,

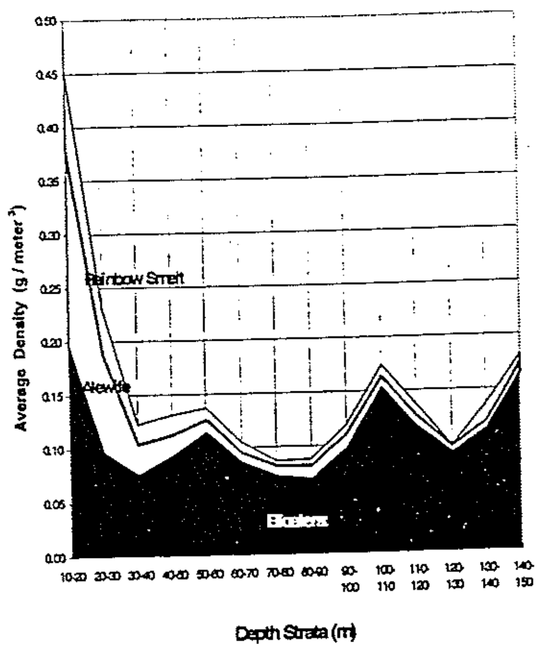

Figure 13. Mean biomass density (g/m^3) of alewives, rainbow smelt, and bloaters by depth for the lakewide acoustic survey in Lake Michigan, fall 1996.

rather they were found in roughly similar densities throughout all depths on average. This shift in distribution was probably the result of bloaters moving nearshore with the weather-induced cold-water upwellings observed along much of the eastern shore of Lake Michigan during the time of our surveys.

Total lakewide biomass of alewives, rainbow smelt, and bloaters was estimated at 302,600 t in 1996. Lakewide biomass of alewives was estimated at about 44,000 t (Fig. 14). Age-1 alewives contributed 72 %, or about 32,000 t to the biomass estimate. This large 1995 alewife yearclass was well represented in this year's midwater trawl catches and we expect this

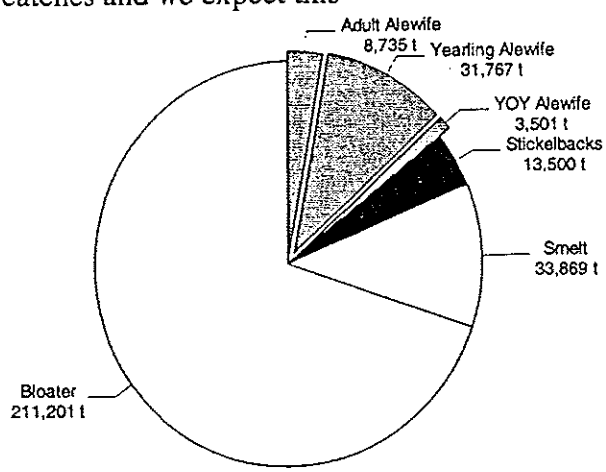

Figure 14. Acoustic lakewide biomass estimates (metric tons) by species for Lake Michigan, fall 1996.

cohort to begin to contribute to the bottom trawl catches next year. Adult alewife biomass totaled only about 9,000 t, an estimate that is much lower than reported previous years. This reduction was due to a noticeable absence of adult alewives in the water column along many transects that was probably related to the cold-water upwellings we encountered during the survey, combined with the incomplete coverage in northern and west-central areas of Lake Michigan where alewives have been more prevalent in past surveys.

Bloater biomass estimates totaled about 211,000 t followed by rainbow smelt at 34,000 t (Fig. 14). Sticklebacks accounted for over 13,000 t lakewide.

Fluctuations in acoustic-based estimates of lakewide biomass occurred for the different prey species between 1993 and 1996 (Fig. 15.).

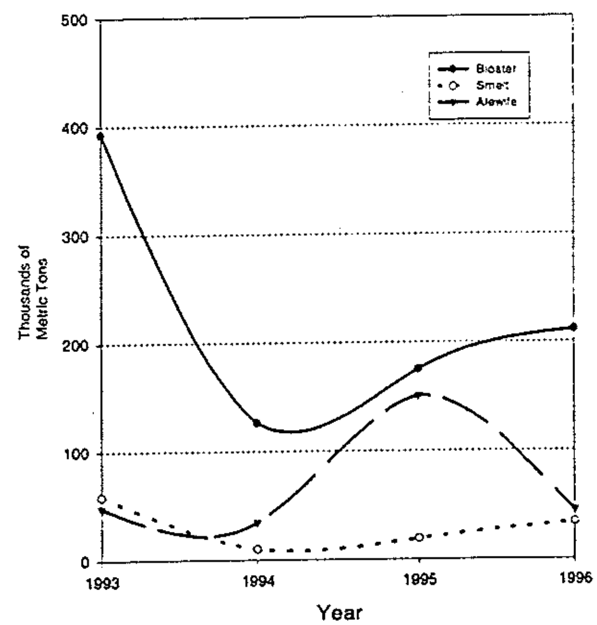

Figure 15. Comparison of annual lakewide total biomass estimates of alewives, rainbow smelt, and bloaters based on acoustic surveys in Lake Michigan.

Estimated bloater biomass was much greater in 1993 than in subsequent years. This decline in recent years, also seen in the bottom trawl catches, is expected due to consistently lower recruitment in bloaters. The large 1995 estimate of alewife biomass can be directly attributed to the large 1995 year class, while adult alewife biomass was consistent during 1993-1995, and probably is at a similar level for 1996 as indicated by the bottom trawl catches. Rainbow smelt biomass has been fairly consistent during 1993-1996. These fish constitute a greater proportion to the total biomass in the acoustic surveys compared to the bottom trawls, which indicates adult rainbow smelt are found to a large degree suspended in the water column.

Acoustic Study Update – The fall 1996 acoustic survey marked the last scheduled field work as part of the multi-agency sponsored acoustic and midwater trawl study. The results of this study will be detailed in a final report that will be completed in summer 1997. Our plans for the integration of acoustics in future fish stock assessment will be included in this final report.

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Appendix F

INTER-TRIBAL FISHERIES AND ASSESSMENT PROGRAM

SAULT STE. MARIE TRIBE OF CHIPPEWA INDIANS

Chippewa/ Ottawa Treaty Fishery Management Authority

Memorandum

TO: Bill Horns, WDNR

FROM: Tom Gorenflo, COTFMA

DATE: May 5, 1997

SUBJECT: Alewife Trawling Workshop

I apologize for the delay in responding to the workshop minutes, I hope I didn't delay the process. I would first like to say that I thought it was a very productive workshop. The many issues raised and discussed regarding alewife "management" were heard by some attendees probably for the first time, and given the cross-section of participants, perhaps this workshop will serve as a springboard for further discussions related to alewife.

I think you captured the gist of my comments in the "closing remarks" section just fine. However, I suspect others will elaborate some on their comments so...

The Fish Community Objectives for Lake Michigan recognize the pivotal role of alewife in the Lake Michigan Fish Community. Alewife serve a beneficial role as the primary forage item for the salmonide predators, particularly chinook salmon. Conversely, alewife act as predator or competitor with other valuable species, most notably yellow perch, chub, and perhaps lake trout. Further more, recent evidence suggests alewife may also be a factor in Early Mortality Syndrome (EMS) in some species (e.g. Atlantic salmon, lake trout), although additional research is needed.

For agencies striving to manage a fish community as well as a multi-user fishery, the dual role of alewife presents a significant paradox. Fishery managers will have to seek a balance between a constituency which desires salmonides, particularly chinook, and one which desires other species which are negatively impacted by alewife. Agencies such as COTFMA, and other organizations which favor native species, will prefer to see alewife at reduced levels of abundance. This can be accomplished by increasing the stocking of predators, at levels matched to prey availability and predator demand, and commercial harvest.

With regard to the commercial harvest of alewife, I see no evidence to suggest that the commercial harvest has impacted the lakewide salmon/trout fishery.

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Final Comments from Mike Rusch representing **COAST, Coalition On the Advancement of Sportfishing & Tourism.**

I must admit that before the workshop, I believed the Alewife population lake wide was rebounding and the Smelt population was stable in other areas of the lake except in the Manitowoc/Two Rivers grids where the extensive trawl operations for smelt takes place.

After all of the reports were given and discussed. I feel that at this time we need to address not only the alewife forage populations, but also take a long hard look at protecting the smelt population from over harvest. Smelt are a highly prized food fish for human consumption, therefore markets do exist to harvest the approximate 2.35 million pounds of the present quota if the population would be high enough to support that harvest.

With the trawlers CPE, (Catch Per Effort) continuing to drop on smelt and the surveys conducted by the National Geological Survey on forage fish abundance, referencing the bottom trawls in the fall of 1996 and the new Acoustic-based Estimates, both studies indicate population have not increased to any stable levels, in fact, the population appears to be dropping. We have no recourse but to protect the present smelt populations from over harvest.

I still believe that the trawlers, operating at their present levels, have little if any impact on the **Lakewide Trout and Salmon Population,** but restricting them to just a few grids in the Manitowoc/Two Rivers area of Lake Michigan definitely has the possibility of creating a negative effect on the local fish populations along with the image that is transferred to the **out-of area sportfishermen.**

If we look back just a few years, 1983-1995, at the **Reported Incidental Sport Catch** from the trawlers operating out of Two Rivers, please see chart labeled **Incidental Sport Catch Associated With The Smelt Trawls**, we can see that a few trawlers can and did have an impact on the sport fishery, especially the lake trout fishery. During this same time table, the sport fishery was asked to reduce it's Lake Trout catch from five fish per person to the present two fish per person.

The following table compares the catch of lake trout by the Manitowoc/Two Rivers Charter Captains, whose numbers fluctuated from about 80-100 captains per year and the few trawlers fishing for smelt. When a few trawlers fishing smelt can kill three times as many **Adult Lake Trout** than an entire fleet of charter boats, the possible negative affect this industry can have on the local area is real. The trawlers were forced to install diverters to lessen the kill of **Adult Lake Trout**, but the small lake trout still can go into the nets.

YEAR	TRAWLERS REPORTED INCIDENTAL HARVEST OF LAKE TROUT	LOCAL CHARTER CAPTAINS HARVEST OF LAKE TROUT
1985	14,202	5,957
1986	11,294	4,814
1987	13,249	9,331
1988	8,192	11,087
1989	11,847	9,193
1990	4,717	5,138
1991	2,919	5,553
1992	3,022	2,949

I have also included in my final report a table developed by the Department of Natural Resources after the data of the summer trawl was conducted in 1994 and 1995. The table is labeled as follows: **Predicted Impact Of A Summer Trawl On Other Species If Expanded To Previous Catch Numbers.** The summer trawl studies were conducted in the Manitowoc/Two Rivers area. If we make the assumption that the smelt are out there and more time just needs to be given in order to reach the present 2,350,000 pound quota, the table indicates that we will be looking at a tremendous incidental catch. At the present the trawlers are harvesting just under 1,000,000 pounds. For the trawlers to raise their smelt catch 1,000,000 pounds, they will have to catch an additional 3,116,569 pounds of fish. For every pound of smelt fit for human consumption, 2 additional pounds of dead fish would be discarded. This would include some 8,444 Lake Trout. These totals are unacceptable.

My recommendation is to not increase the trawl industry, but to reduce the smelt harvest to a point that the smelt population has an opportunity to recover. At this time we need to reduce the smelt quota and monitor the smelt base very closely

Sincerely,

Mike Rusch

INCIDENTAL SPORT CATCH ASSOCIATED WITH THE SMELT TRAWLS

The table below indicates the numbers of reported incidental catch of sport fish including perch from 1983–1995 along with the total catch of smelt from Lake Michigan and Green Bay. The smelt catch is in pounds, while the incidental catch are individual fish.

YEAR	SMELT QUOTA	TOTAL SMELT CATCH (includes scrap)	YELLOW PERCH	COHO	CHINOOK	LAKE TROUT
1983	UNLIMITED	2,551,203	564	230	1,018	1,866
1984	UNLIMITED	2,207,005	1,024	199	2,959	3,136
1985	UNLIMITED	1,987,207	470	72	1,109	14,202
1986	18,000,000	2,722,142	10,781	26	248	11,294
1987	18,000,000	2,502,580	423	35	420	13,249
1988	18,000,000	2,660,475	11,540	108	144	8,192
1989	18,000,000	2,187,920	8,287	35	147	11,847
1990	2,358,000	2,754,352	7,075	0	0	4,717
1991	2,358,000	1,444,883	199	0	22	2,919
1992	2,358,000	2,013,316	7,655	0	26	3,022
1993	2,358,000	1,569,870	0	0	0	2,649
1994*	2,358,000	1,343,492	0	0	0	0
1995*	2,358,000	1,035,710	0	0	0	0

Special Note:
* In 1994 and 1995, the regular smelt fishery was not monitored to the extent it was in the earlier years. The summer trawl was monitored and the two table on the following page from Steve Hogler to George Boronow indicate the impact this type of summer fishery could have on the sport fishery if it was permitted and then the effort expanded.. The above information has been supplied by the WISCONSIN DNR.

PREDICTED IMPACT OF A SUMMER TRAWL ON OTHER SPECIES IF EXPANDED TO PREVIOUS CATCH NUMBERS

Smelt Harvest	Total Catch	Smelt . scrap	Alewife	Chub	Lake Trout			Salmon spp.			Lake Whitefish	Yellow Perch	SMB
					Total	Alive	Dead	Total	Alive	Dead			
100,000	311,657	11,040	65,981	134,611	844	551	293	19	12	7	134	2	1
200,000	623,402	22,135	131,952	269,203	1,689	1,102	587	39	23	16	267	5	1
300,000	935,015	33,206	197,951	403,853	2,533	1,653	880	58	35	23	400	7	1
400,000	1,246,760	44,277	263,950	538,502	3,378	2,205	1,173	77	47	30	534	10	2
500,000	1,558,285	55,340	329,903	673,056	4,222	2,756	1,466	97	58	39	667	12	2
1,000,000	3,116,569	110,682	659,806	1,346,112	8,444	5,512	2,932	193	117	76	1,335	24	5
1,500,000	4,675,075	166,031	989,755	2,019,263	12,666	8,268	4,398	290	176	114	2,002	36	7
2,000,000	6,233,360	221,371	1,319,658	2,692,319	16,888	11,023	5,865	386	234	149	2,670	48	9

The affect of a given smelt harvest on other species of fish. The estimates were calculated from the average catches from the 1994, and 1995 Lake Michigan studies. The smelt, alewfie, chub, totals are in pounds, as is total catch. All other totals are individual fish.

* Information obtained from the Wisconsin Department of Natural Resources.

Appendix H

May 8, 1997

To: William Horns, Wisconsin Department of Natural Resources

From: Jim Butterbrodt, Wisconsin Federation of Great Lakes Sport Fishing Clubs

Re: Comments on the Draft Report of the January 29,1997 Workshop on Alewife Trawling/Harvest in Wisconsin waters.

1) The disregard for the fisheries management input from the states of Illinois, Indiana and Michigan on a shared stock of a forage species that is essential to the future of their stocking programs. The obvious lack of participants in the Workshop from these state's fisheries departments is cause for alarm as they have been historically opposed to the commercial harvest of forage fish in Lake Michigan. Such an obvious over-sight may be construed as intentional.

2) The absurd use of the 35,268 metric tons estimate of 2+ and older alewife number that the workshop participants used to base their opinions on was incorrect to the extreme. The correct estimate is approximately 9,000 metric tons. The use of the 35,268 metric ton number caused confusion in the workshop, as many of the workshop members (myself included) were under the correct impression that the stock of 2+ and older alewives had declined. My question is: would those present have had a different opinion on the commercial harvest of alewives had they not been shown a huge increase in alewife abundance when reality was that the population was already in decline? This use of the 35,268 metric ton number leads me to believe the workshop was a useless exercise.

3) The emphasis the workshop placed on the use of the Simple model. As I stated at the workshop, it is my opinion that the Simple model is garbage. The built-in assumptions that it uses do not

accurately reflect the lake's dynamics, and I have zero confidence in its use. Hopefully, in the future, it will be refined to the point of becoming a viable management tool.

4) The workshop's focus on the alewife population, and its not including the smelt population numbers as a total forage base is of great concern. Lake Michigan's forage base should be looked at as a whole, not species by species. The lack of interest in the decline of the smelt population in Lake Michigan by the workshop's participants also concerns the sportfishing community. The sportfishing community is adamant in their belief that there is currently an excessive amount of commercial harvest pressure being placed on the smelt population in Green Bay and Lake Michigan. This concern has been ignored by the Wisconsin Department of Natural Resources for many years.

5) Although this subject was not covered in the workshop, the sportfishing community is furious that a small group of potential alewife trawlers in the Manitowoc area can abuse the WDNR to the tune of thousands of dollars a year with their constant barrage of requests for meetings, workshops, and etc., when they presently do not generate enough license sale revenue to cover their fisheries management and law enforcement costs. These reactionary costs to the WDNR by the trawlers is born on the backs of the Lake Michigan sport-fishing community. We find the current system unacceptable and look to the Department for future changes to mitigate the reactionary system now in place.

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Wisconsin
Department of Commerce

Tommy G. Thompson, Governor
William J. McCoshen, Secretary

April 10, 1997

William Horns
Great Lakes Specialist, Bureau of Fisheries Management
Department of Natural Resources
101 S. Webster Street
Box 7921
Madison, WI 53707-7921

Dear Bill:

I want to acknowledge your fine preliminary efforts in summarizing the proceedings of the January 29th workshop on alewives and trawling. Thank you for the opportunity to provide a statement of my views for inclusion in the final report. At this time, I would like to add the following observations on behalf of the Wisconsin Department of Commerce.

I recognize that I do not have the training to comment as an environmental specialist, regarding the optimum way to manage the Lake Michigan resource. However, as an advocate for responsible business development, I have an obligation to point out the impact of current Lake Michigan regulation on segments of the Wisconsin business community, and to reiterate concerns related to the fishery rules, based on the testimony of those with scientific expertise. Finally, I would like to suggest a pathway for the Department of Natural Resources (DNR) that may better balance environmental, tourism, and broad business requirements.

Regulatory Impact

The Wisconsin commercial fishing industry has alerted the Department of Commerce (COMMERCE), by letter and through statements at the January workshop, that the rules enacted in 1991 now governing alewife fishing and the trawl fishery are having a severe negative impact on commercial fishermen. The 1991 rules reduced the number of days trawl fishing could occur, and did not allow for the incidental take of alewives during smelt fishing. These and other restrictions helped depress the profitability of commercial fishing, and have contributed to the exodus of fishermen from this profession.

In large part, the 1991 rules were enacted to protect the salmon and trout fisheries, and were expected to benefit the Wisconsin charter-boat and sport-fishing industries that depend on these fish. However, according to data included in this report, Lake Michigan charter and sport fishing have not rebounded appreciably in the six years since the rule change.

In 1991, experts believed the Lake Michigan alewife was in dangerous decline; hence, regulation was undertaken to stabilize the population. Now, alewives appear to be flourishing in excess of predation by trout and salmon. In fact, photographs taken in 1996 show alewives decaying on Wisconsin beaches. Dead, smelly fish are not attractive to tourists seeking enjoyment of our shoreline. If the alewife population continues to increase and die off, I fear a negative impact on Wisconsin's tourism industry, especially the hotel, retail, and restaurant communities that rely on residents and out-of-state visitors attracted by Lake Michigan beaches.

All this begs the question, is our fishery regulation really working?

Testimony

I would like to call your attention to the following points that emerged at the January 29th workshop. I believe they reinforce the need to re-examine Wisconsin's current regulation.

- ✓ Michigan is taking a different approach to managing the ecosystem comprised by alewives, smelt, salmon, and trout -- based on scientific data and models that its DNR believes are relevant. Whatever management approach Michigan adopts in Lake Michigan will affect both Wisconsin commercial and charter fishing industries. The Wisconsin DNR should make every effort to coordinate its fisheries regulation with Michigan and the other Lake Michigan states so that a consistent, lakewide management approach prevails.

- ✓ According to testimony, the model used to format the 1991 rule has not proved a good predictor of alewife population trends. The resource experts concurred that the Lake Michigan ecosystem is complex, and that its population dynamics are not adequately understood. Where regulatory boundaries are set for the fisheries can better be described as a trial-and-error process than as hard-and-fast science.

- ✓ Most participants believe that the current level of trawling has no detrimental effect on Lake Michigan salmon and trout. There was speculation that the alewife catch and trawling restrictions could be relaxed without harm to the sport-fish population. However, resource experts are apprehensive that going too far with rule relaxation could upset lake-system dynamics. It seems possible that an incremental approach to modifying the 1991 rule would satisfy both environmental concerns and the fishing industry.

- ✓ The commercial fishermen have offered to assist DNR research efforts, and to gather more comprehensive data on Lake Michigan fishery dynamics. The fishermen are interested in preserving the fishery, and are seeking a rule change that makes environmental as well as business sense.

Recommendations

In light of the preceding observations, I recommend that the Wisconsin DNR convene a panel in 1997 charged with modifying the rules that now govern commercial alewife fishing and trawling in Lake Michigan. This panel should include appropriate representatives from the sport-fishing, commercial fishing, and at-large tourism industries, as well as trained scientists from various agencies and DNR naturalists. The new rule should be targeted for adoption in 1998, if possible.

If it has not already done so, I encourage the Wisconsin DNR to adopt a policy of periodic and scheduled review of rules governing Wisconsin's fisheries, which are subject to changing environmental dynamics. As such, these rules require regular examination and updating to ensure their efficacy. A standing panel representing industry and environmental viewpoints, as described above, would be highly useful in this ongoing review process.

Respectfully submitted,

Terry W. Grosenheider

University of Wisconsin-Stevens Point
College of Natural Resources
Stevens Point, WI 54481-3897 (715) 346-2853
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March 19, 1997

William H. Horns
Wisconsin Department of Natural Resources
Bureau of Fisheries and Habitat Management
101 South Webster Street, P.O. Box 7921
Madison, Wisconsin 53707-7921

Dear Bill:

I have reviewed your draft report on the *Workshop on Alewives and Trawling*, which you prepared as a summary of our meeting in Madison on January 29, 1997. I found your rendition of my invited presentation and my closing comments to be a fair and accurate interpretation of my contributions to the meeting.

You note in your cover letter that your summary of the meeting was intended to provide a connected and logical presentation of the facts surrounding the status of the alewife population and of the effects of trawling on the salmon sport fishery in Lake Michigan. I believe you have accomplished that objective. However, the effects of the trawling fishery on the salmon sport fishery are poorly understood. Most of those invited to participate in the panel did not feel that the trawling fishery was having a measurable effect on the salmon sport fishery *at this time*. The question, therefore, is *How much could the trawl fishery harvest of alewife increase without affecting the salmon sport fishery in Lake Michigan?* No one at the workshop felt confident enough about our understanding of the dynamics of Lake Michigan to answer this question, which leads to a dilemma for managing the trawl fishery. I suggest that you recommend in the report that we conduct more research on this question. The participants of the workshop would all agree that this recommendation is sound.

My recommendation undoubtedly seems self-serving, since I, as a University researcher, could benefit from the recommendation. However, this does not change the fact that we know too little of the dynamics of alewife, effects of trawling, and predator-prey dynamics to predict the effects of increased trawling on the salmon sport fishery. Good luck!

Very Truly Yours,

Michael J. Hansen, Ph.D.
Assistant Professor of Fisheries

HENRIKSEN FISHERIES, INC.

1597 BIRCH RD.
BAILEYS HARBOR, WI 54202

[illegible]
[illegible]

Dr. William Horns
Wisconsin DNR
Great Lakes Specialist

Re: Workshop on Alewives and Trawling

Dear Bill,

The most significant idea that I heard at the workshop was the general opinion of many of the biologists that the complex interactions occurring in Lake Michigan are not controllable simply by management decisions. It was refreshing to hear this admitted and generally not disputed by this group.

The second significant idea is that managing the lake for high populations of alewive (and therefore chinooks) may be impossible and probably detrimental to almost everything but chinooks. It also seems that the general consensus is that the current levels of trawling do not significantly impact the salmon and trout sport fishery. Minor relaxation and positive fine-tuning of rules to make the trawlers more effective probably will not adversely affect the sport fishery either.

A related concern of some commercial fishers is that trawlers have the potential to negatively impact chub stocks. At the current huge levels of chub abundance this is obviously not a concern, but could become one in the future.

Finally, the original goal of eliminating alewife because of the spring die-off is largely disregarded by fish managers today. As someone who enjoys time by the water I wish it was possible to alleviate this problem.

Sincerely,

Charles W. Henriksen

SUSIE Q FISH COMPANY, INC. TWO RIVERS, WISCONSIN 54241

Dealers in INDUSTRIAL AND COMMERCIAL FISH
3138 Memorial Drive

MIKE LE CLAIR, President
Paul LE CLAIR, Vice President

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Dear Bill,

Thank You for the work you put in the rough draft. I believe it is to many pages and refers to a lot of information the Governor is not requesting. Remember I asked you if I couls submit my information on alewive biomass and chubs and as to what these forage fish year classes are and what our summer studies proved, but I was told we could only talk about what effect commercial Trawling has on Salmon and Trout Fishing. This what I did. The simple model from 1993 does not reflect to our problem 4 years later. Trends in forage species abundance. Lessons from Lake Ontario. These are not pertinent to the question the Governor asked for and I was not allowed to present my documented information like alewive eating perch larvae and etc. So in the final draft to the Governor we should just address the issue he asked for.

In your summary you stated Commercial Trawling has little effect on Salmon and Trout Fishing. Then your next sentence you state the salmon depend on alewive, which is true, but U.S.F.W.S., Mark Holey, Chuck Madenjian, Tom Gorenflo, Paul Peeters, Mike Rusch all stated that we don't have any effect on alewive biomass Lake wide, so that should answer the question. Later in your summary you have no facts, but you do have a lot of doubts and ifs and etc. We can't manage a fishery without actual data and that is what I wanted to present and I was told I could not do it.

In your last sentence it is hard to tell what you really are trying to say. From all the testimony I heard we would have very small impact on the Sport Fishery as Mark Holey stated. This is what the governor wants to hear and I think statements made by these people should be the only thing in your summary for the Governor.

I wrote to all the panelists and asked for their last comments, but again only on the issue the Governor asked for. If their are to be rule changes later, that is another issue that we can discuss as soon as possible if the Governor agrees we do not hurt the Sport Fishers. Again if we are not successful in getting help from the governor, I don't think we have to worry about the Trawlers because we will be out of business in short order. The last two winters we would have been better off not to even attempt to catch smelt. Wind, cold weather and etc. forced the smelt to deep water and when this happens they scatter all over and don't concentrate in schools which is needed for a trawl to be effective.

Bill, I hope we can work things out with you that we can continue fishing and have rules that both Sport and commercial Fishers can live together with. Your comments would be appreciated and I will have my final input as soon as I hear from other people on the panel.

I would appreciate your comments before I write my final draft.

Sincerely

Pete Le Clair

Pete Le Clair

P.S. I talked to many members of the panel and they would like there whole statement of the summary when you went around the table asking the question. Does commercial trawling effect the sport fishery. If you cannot do this could I have the last tape consisting of their comments. I will gladly pay for the tape. Thanks

Pete

SUSIE Q FISH COMPANY, INC. TWO RIVERS, WISCONSIN 54241

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please add these items to your final summary

April 4, 1997

Bill Horns
P.O. Box 7921
Madison, WI 53707-7921

Dear Bill, Just a last few comments on the summary to the Governor:

1) Put persons status and who they represent in their summary.
2) Please put in Fred copes letters and our local City Manager's. Their opinions should be heard.
3) Statement from Steve Holger, our local fish manager on alewive trawling and its impact. Quote "Alewive trawling only occured off Two Rivers and Fishermen took 10 to 13 million pounds of fish in 1991, their last year. That likely kept the alewives in that area in check, but had little impact on the Lake as a whole", he said.
4) Try and explain your last sentence in your summary. It can be taken two ways, so try and make it more clear. Do you believe we have an impact on Salmon and Trout fishing after you heard almost everyone state Commercial Fishing has very little impact on alewive biomass on Lake Michigan as a whole. Make this statement in your summary.
5) The simple Model should not be in the summary. The data is four years old and the Governor did not ask for this information. If that is allowed in, then more of my data should be allowed.
6) Also state that the U.S.F.W.S. estimate in bottom trawling is only the fish in the bottom 6 feet and does not include the fish that escape.
7) George Meyer's Letter dated October 6, 1993, should not be in this summary. His comments are on rule making, DNR Board actions and etc. If this is allowed then I want my letters that explain our side of the issue. The Governor again did not ask for this information.
8) You told me to only comment on the Governor's request. That is what I did and now all these other comments on rule making. Round Table discussions, graphs from 1978 - 1988 Salmon stocking and etc. The Governor only wants to know the answer to that one big question. I hope you can keep the summary short and to the point and get the Governor's question answered biologically, instead of politically and let him decide if he can help our fishery.

I am also sending charts showing what short seasons we have on Lake Michigan and Green Bay.Pete Flattery sent me the instructions the Legislature gave to the DNR and a chart showing how Commercial Trawlers impacted the Sport Fishery. Please put this all in your summary.

Thank You for your help and understanding!

Sincerely

Pete Le Clair

Pete Le Clair

SUSIE Q FISH COMPANY, INC. TWO RIVERS, WISCONSIN

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	new-Rules into effect
Trawls Harvested 20 to 25 million pounds of Forage Fish in 1986 & 1987	1991 - 1996 all Forage Fishing was stopped
Salmon Stamps sold 220,000	Salmon and Trout Stamps sold 139717 down 109669
Daily Licenses sold 50000	Daily licenses sold 40,735 to 31228
Lake Michigan Trout Stamps sold Lakeshore counties 132041	1991 - 1996 86610 to 54527
Lake Michigan Charter Boats 500	Lake Michigan Charter boats 340 down to 275
Lake Michigan Trout & Salmon catch 25,000 to 30,000 fish	1994 to 1996 9000 down to 6000 fish

Do these figures show that the rules imposed on the commercial Trawlers helped the Salmon and Trout Fishers? I don't think so.

The Salmon and Trout consumed 53% of the forage fish. Wisconsin Trawlers harvested 5%. Yet, the DNR controlled the 5% by stopping all forage fish harvest, but continued to plant 15 million predator fish every year. By stopping all forage fish harvest, Sport Fishing got worse and these rules are forcing the Commercial Trawlers out of business and all the data proves that the trawlers have no impact on the forage biomass or hurt the Salmon and Trout Fishery.

Lake Michigan a[...] population debat[...]

By **BARRY GINTER**
Thomson News Service

SHEBOYGAN — Fish biologists say salmon will spare Lake Michigan from the massive alewife die-offs that occurred in the 1960s. Wayne Schwarz isn't so sure.

Schwarz, who recalls the sight and smell of huge piles of dead alewives that washed up on the lake's beaches in the '60s, says the alewife population is on the upswing. He wonders what would happen to Sheboygan's marina if the 3-foot windrows of rotting fish return.

"The salmon aren't going to do it by themselves," said Schwarz, who holds a commercial fishing license. "Now the fishermen are having a hard time getting the fish to bite because there's so many alewives out there ... they've got so much to eat."

Biologists agree that there are probably more alewives in Lake Michigan than in recent years, but not as many as 30 years ago.

"Certainly, numbers in the lake now are far, far below what they were in the 1960s," said state Department of Natural Resources fisheries biologist Steven Hogler. In the 1960s, alewive[s] made up about 90 percent of th[e] biomass in the lake, he sai[d]. Today that has dropped to the 4[...] percent range.

The difference, according to DNR Gre[...] Horns, is [...] which prey upon alewives. They were stocked in the lake beginning in the 1970s.

"In the 1960s, before the salmon program started, there were essentially no predators in the lake for alewives," he said. "As far as I know it's the only tool if we wanted to reduce the alewife abundance."

The sensitive alewives die off each spring due to temperature changes in the lake. DNR biologists say the die-off was larger than normal this spring primarily due to strong east winds that forced the fish into shore.

Commercial fishermen were allowed to trawl for alewives until 1992 and sold the fish to pet food companies. The practice was banned because alewives were deemed more valuable as a forage base for trout and salmon than as pet food, Hogler said.

Schwarz said that without trawling to control alewives, the population could continue to rise. But Hogler said that alewife trawling only occurred off Two Rivers and fishermen took about 10 million to 13 million pounds of fish in 1991, their last year. That likely kept the alewives in that area in check, but had little impact on the lake as a whole, he said.

Editor's note: Ginter writes for The Sheboygan Press, Sheboygan, Wis.

Steve Holger
Lake Mich
manager

Steve Holge
alewive report

Total Biomass in
1997 was

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January 22, 1997

Bill Hornes
P.O. Box 7921
101 South Webster St.
Madison, Wi 53707

Dear Bill:

I wish to thank you for the invitation to participate in a workshop dealing with alewives in Lake Michigan. I will not be able to attend. I will be in Texas.

Sport, commercial, and forage fish production depend on a variety of abiotic and biotic factors. Some factors affecting fisheries are beyond the control of fish management agencies. It is not possible to predict exactly what the Lake Michigan ecosystem will do over a significant time period.

I believe alewives (and other exotics) have a deleterious effect on the native fish stocks of Lake Michigan. High populations of alewives may be hindering the recovery of native fish stocks of Lake Michigan. Therefore, the incidental catch of alewives by commercial fishermen may be beneficial to the native fish stocks.

Incidental catches of forage fish, by smelt trawlers, returned to the lake ecosystem are not lost from the energy transfer between tropic levels. The returned incidental catch is preyed upon by predators and scavengers with the balance decaying and returning nutrients back to the system.

I believe there should be both regulated sport and commercial fisheries in Lake Michigan. Lake Michigan fish are a common property resource and belong to all citizens.

I will participate in future fisheries related workshops if requested.

Sincerely,

Fred Copes

Fred Copes
Emeritus Professor of Biology and Fishery Science
FC:js

cc: Pete LeClair