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DEVELOPMENT OF FISHERY AND BOATING PROGRAMS FOR THE LAKE ERIE COASTAL ZONE

Conducted as part of the implementation of the

PENNSYLVANIA COASTAL ZONE MANAGEMENT PROGRAM

December 31, 1983

PREPARED FOR:

The Department of Environmental Resources,
Division of Coastal Zone Management

and

The Pennsylvania Fish Commission

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EXECUTIVE SUMMARY

The long-term goal of the Pennsylvania Fish Commission (PFC) is the maintenance and improvement of fishing and boating opportunities throughout the commonwealth. To achieve this goal in a system as complex as the Lake Erie coastal zone, the Fish Commission believes a comprehensive planning and program implementation format must be followed. Such a program was outlined in a Coastal Zone Management study completed by Rickalon Hoopes in 1980. Hoopes included five major subject areas in his outline. The present study focuses on three of these areas in detail, namely: fishery assessment, fishery implementation, and communication. To better accommodate discussion, these three areas have been addressed under an amended format. The amended format consists of five subject headings: 1. Fisheries Management; 2. Water Quality Management; 3. Fishing and Boating Access Areas; 4. Communication; and 5. Boating. Using data and information collected from the literature, numerous agencies and institutions, and sportsmens clubs, the status and problem areas for each of these subjects were defined. A brief summary of major issues, for each subject area, follows.

Fisheries Management

Fisheries management in Pennsylvania's Lake Erie waters can be segregated into three major areas; the commercial fishery program, the sport fishery program, and the anadromous program. The responsibility for each of these programs rests with seperate sections within the PFC. This organizational framework has resulted in certain aspects of the fishery being neglected. The biology of important species such as smallmouth bass, steelhead, coho and chinook salmon, and white bass, is poorly understood, and little effort, outside the anadromous program, is being directed to the main lake sport fishery. Other assessment needs in the coastal zone include stock definition studies for species such as yellow perch; continuing sport fishing use and harvest evaluations; increased computer data processing capabilities; and improved commercial harvest reporting procedures.

Stocking programs in the coastal zone include the anadromous effort in Presque Isle Bay and the main lake; the catchable trout program on tributary streams; walleye, northern pike, and muskellunge plants in the bay; and an interagency lake trout program in the main lake. Problem areas for these programs include a lack of clear rationale for stocking allocations in the anadromous effort, and the potential for high mortalities under present rearing and stocking methodologies.

Regulation programs on Lake Erie are complicated because of the diversity of the system. Nevertheless, efforts are needed to simplify these programs. The current regulations on tributary

streams appear to be restricting the most effective utilization of the resource and other regulations should be reevaluated to verify if they are accomplishing their stated objectives.

Water Quality Management

Good water quality is dependent on the control of two major factors; 1. Accelerated eutrophication from cultural nutrient loading, and 2. contamination from toxic and hazardous wastes. Eutrophication has resulted in seasonal oxygen depletions in the central basin of Lake Erie as well as in Presque Isle Bay. Toxic and hazardous wastes, including PCB's, heavy metals, and pesticides have been found in various media in Pennsylvania's jurisdiction and a number of substances have approached U.S. Food and Drug Administration action levels in fish flesh. Although conditions have improved somewhat in recent years, additional monitoring efforts are needed. The Erie County Health Department has taken the lead role in water quality monitoring for the coastal zone, but programs are also being implemented by several other agencies and institutiions on the federal, state, and local level. Major problem areas include insufficient nutrient and dissolved oxygen monitoring in Presque Isle Bay, and a lack of coordination of programs to analyze contaminants in fish flesh. The Fish Commission should take an active role in improving these programs, since their implementation is critical to both human health, and the health of the resource.

Access Areas

As Pennsylvania's only access to the Great Lakes, the Lake Erie coastal zone receives high levels of recreational angling and boating use. However, access to the lake is limited by private riparian ownership and a shoreline dominated by steep bluffs ranging from 10 to 170 feet in height. Inadequate access has resulted in user-landowner conflicts in the past, with major problems during the fall salmon run. Problems are particularly acute east of the city of Erie where only three public access areas exist. These sites can only be used by boat anglers during times of minimal wave action since they are unprotected from the lake. Harbors of refuge are essential for safe boating access to Lake Erie. The high cost of constructing these facilities, as well as high property values and high facility maintenance costs, limit future access development along the Lake Erie coastline. Still, a concerted effort is needed to improve both shore and boat access to the lake. The greatest potential for development in the near future appears to be the PFC's North East Access Area and the west bank of Elk Creek.

Communication

Poor communication between the Fish Commission and the angling and boating public has been a major problem in the Lake Erie region.

This has caused the Commission to take a defensive posture on several issues, resulting in what has appeared to be a "crisis management" approach. Major emphasis on promotion of the anadromous program has created the impression that the management of native species was being neglected. Although public relations have improved somewhat in the recent past as the result of a concerted effort by PFC staff, measures must be taken to prevent a reoccurrence of similar problems in the future, Communication problems are also evident on the intraagency level. Improvements in this area are needed to help PFC employees, such as hatchery personnel and biologists, better execute their public information related duties, as well as increase the efficiency of operations within the agency.

Boating

Although the PFC maintains active programs in boating education and boating safety, there appears to be lack of public recognition that the Commission is involved in boating. More emphasis on communication is needed. Other problems include special safety considerations unique to the Lake Erie region, as well as more universal problems such as boat operation while under the influence of alcohol. Greater emphasis on enforcement and a reevaluation of current regulations are warranted.

Specific recommendations were formulated to address problems defined under each of the five subject headings. Incorporation of all the recommendations listed would represent a significant expansion of the current Lake Erie Program. However, such expansion would require the identification of additional sources of funding and manpower. In the interim, it is recommended that priority be given to those recommendations (there are many) which can be implemented under the current funding and manpower constraints.

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INTRODUCTION

This study is essentially a first attempt at developing a strategic management plan for fishing and boating on Pennsylvania's Lake Erie waters. These waters include a 790 mi^2 portion of the main lake, thirteen major tributary streams, and Presque Isle Bay, a unique 3200 acre area formed within a recurving sand spit (Figure 1). The Pennsylvania Fish Commission believes that its long-term goal of maintaining and improving fishing and boating opportunities on this diverse system can best be achieved through a comprehensive planning and program implementation format. Such a program was outlined in a Coastal Zone Management Study completed by Hoopes (1980) (Appendix 1). The present study addresses three segments of that report in detail, namely; fishery assessment, fishery implementation, and communication.

Hoopes (1980) concluded that the Lake Erie plan could best be implemented through the instatement of a Lake Erie coordinator. Unfortunately, funding constraints prohibit the Commission from making such a commitment at the present time. Therefore, this report attempts to address management of Lake Erie under the confines of the current organizational framework. Furthermore, in this report, the three subject areas have been addressed under an amended format to better accommodate discussion. The amended format consists of five subject headings: 1. Fisheries Management; 2. Water Quality Management; 3. Fishing and Boating Access Areas; 4. Communication; and 5. Boating.

Data and information for this report were acquired from the literature, Fish Commission files, PFC staff, and numerous other individuals representing various agencies and institutions (Appendix II). In addition, a fishing and boating questionnaire was mailed to sportsmen's groups in western Pennsylvania counties known to contribute substantially to Lake Erie angling and boating use. Eleven of the 52 clubs contacted mailed replies (Appendix III). Nine of these clubs were from Erie County. These varied information sources were utilized to define the status and problem areas under each subject heading, and to formulate recommendations to upgrade Pennsylvania's Lake Erie program. Attempts have been made to develop the plan in a manner consistent with the strategic plan of the Great Lakes Fishery Commission (GLFC), on which Pennsylvania has representation. The stated goal of the Great Lakes Fishery Commission's strategic plan is:

> "To secure fish communities, based on foundations of stable self-sustaining stocks, supplemented by judicious plantings of hatchery reared fish, and provide from these communities an optimum contribution of fish, fishing opportunities, and associated benefits to meet needs identified by society for: wholesome food, recreation, employment and income, and a healthy human environment." (Great Lakes Fishery Commission 1980.)

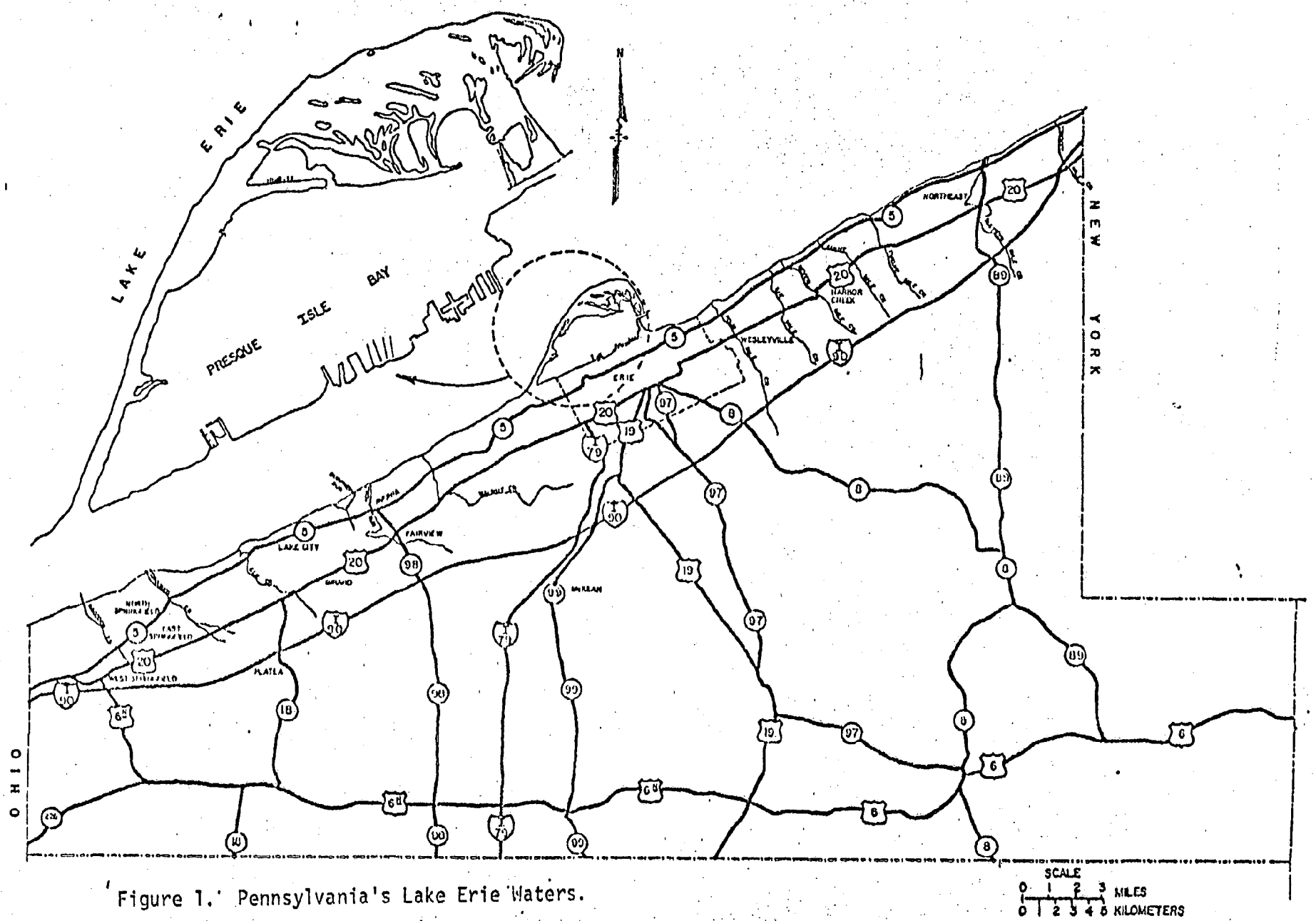


Figure 1. Pennsylvania's Lake Erie Waters.

SECTION I: FISHERIES MANAGEMENT

Fish population assessment and management on Pennsylvania's Lake Erie waters involves many parameters and considerations unique to this area of the Commonwealth. First, unlike other areas of the state, the commercial fishery is a major contributor to fishing mortality, and as such must be closely monitored. Secondly, fish sampling and management on the main lake, in contrast to that on inland waters, requires the use of large, sea-worthy research vessels and techniques similar to those used for marine fisheries. Thirdly, the fish community inhabiting the main lake, Presque Isle Bay and tributary streams is diverse and unlike that found in any other area of Pennsylvania. Finally, fisheries management of the Lake Erie coastal zone, while primarily the responsibility of the PFC, must also be coordinated with fisheries management on the other jurisdictions of the lake, and ultimately with management of the entire Great Lakes system, since actions taken in any one area of the system may, to varying degrees, impact the entire system. This coordination is accomplished through the forum of the GLFC, established in 1955. Separate committees have been formed within the GLFC to address the needs of each of the lakes in the Great Lakes basin, with Pennsylvania's major efforts directed toward the Lake Erie Committee (LEC).

Pennsylvania's fisheries management efforts in the Lake Erie coastal zone can be segregated into three major categories: the commercial fishery program, the sport fishery program, and the anadromous salmonid program. The history and status of each of these programs will be discussed in the following analysis. Fisheries assessment efforts implemented on Pennsylvania's waters by concerns outside the PFC will also be discussed. The status of the major fish species as defined by these studies and affected by various management programs will then be presented. Finally, perceived problems in these programs and recommended actions to correct these problems are given.

Commercial Fisheries Management Program - Status

Commercial Fisheries Assessment

Prior to the 1950's commercial fishery assessment on Pennsylvania's Lake Erie waters was largely restricted to the collection of commercial catch statistics. These records were sporadic prior to 1914 and their accuracy is suspect. Since that time, however, harvest has been recorded on an annual basis. Currently, commercial fishermen are required to submit monthly reports of catch by species, area fished (grid), type of gear used, and amount of gear fished, to the PFC's Linesville Fish Culture Station. Annual reports summarizing these statistics have been prepared by the Fish Commission since 1963.

Biological monitoring of the commercial fishery by the PFC began in the 1950's. These efforts were loosely structured through the mid-1960's, consisting of some age and growth analyses of fish sampled at commercial fish houses. Unfortunately most of the biological data accumulated during this era has been lost, and is unavailable for comparison with current statistics.

The federal Commercial Fisheries Research and Development Act allowed the Commission to greatly expand its commercial fishery efforts. Four projects have been funded under this program since its inception in 1967. Responsibility for these projects has been delegated to the Fisheries Research Section. The Lake Erie Research Unit consists of one biologist, one technician, and a boat captain.

Sampling efforts were limited to near shore studies of fish species composition and distribution prior to 1969. With the acquisition of the 42 foot patrol boat, the Perca, by the Division of Fisheries in 1967 and its subsequent lengthening to 49 feet and modification into a research vessel, offshore monitoring capabilities were vastly improved. Research efforts through 1970 included attempts to locate populations of blue pike, investigations of the incidence of the microsporidian parasite *Glugea hertwigi* on rainbow smelt, analysis of the availability of smelt to the commercial harvest by trawling, comparisons of the selectivities of varying gill net mesh sizes on yellow perch, and gill net and trawl net sampling to define the bathymetric distribution and species composition of the fish community.

A lapse in federal funding occurred from 1971-1972 but the Commission maintained and expanded its commercial fish sampling efforts. Index sampling of the major commercial and forage species commenced at this time. These efforts involved sampling selected index stations with gill nets and trawls under a standardized sampling regime. Abundance indices were then developed and biological data were collected from the samples. High sampling

variability was noted in the early efforts and the sources of variability were investigated using analysis of variance statistical procedures. Yellow perch, walleye, smelt, and whitefish growth rates were monitored in these years. Mortality rates were estimated for yellow perch using catch curves, and maturity schedules were developed. Gill net mesh size selectivity studies continued for perch.

Under project 3-167-R, conducted from 1973 to 1977, trawl and gill net index sampling methods were further refined with effort focused on yellow perch, smelt and forage species. The biology of the forage base was investigated more thoroughly in these years, including their utilization by predators such as walleye, perch, white bass, and freshwater drum. Walleye migration patterns were studied by tagging fish collected east of Presque Isle Bay and subsequently recording the site of their recapture by sport and commercial fishermen. Also, during these years, the effect of the commercial fishery on yellow perch was investigated, first using the method of Thompson (1950) and later using Patriarche's (1977) modification of the Ricker dynamic pool model (Ricker 1958). Thompson's method compares commercial catch per unit effort, to effort over a long period of time, to identify possible trends of overharvest. The Ricker model is more quantitative in nature than the Thompson model, and allows an evaluation of the effects of varying fishing mortality rates and ages of entry to the fishery (recruitment) on the yield. The combination of these factors which gives the maximum yield allowable without depleting the population below a level at which it can sustain itself can then be calculated. This method, termed the equilibrium yield approach, has been the basis for the Commission's yellow perch management program. Another statistical procedure initiated for yellow perch in these years was Fry's (1949) Virtual Population Analysis. This procedure is used to estimate biomass and biostatistical rates of exploitation.

The third commercial project, 3-284-R, was conducted from 1977-1980. Index sampling for commercial and forage species continued in these years. Attempts were made to increase the precision of recruitment estimates by using tow nets to sample fry, but these estimates proved to be no better than those derived using trawls. Growth of yellow perch was investigated using von Bertalanffy growth functions as described by Ricker (1975) and attempts to apply an equilibrium yield approach to perch management continued using both Ricker and Beverton-Holt (1957) models. The Beverton-Holt model was considered to be more useful since it allowed easier estimation of the effects of fractional ages of entry on the yield than did the Ricker model. Curves of yield/1000 recruits against fishing mortality (F) for different ages of entry provided a quick visual aid in determining the possible effects of various regulatory alternatives. Another study initiated during this project was an evaluation of the effects of climatic variables (warming rate and wind events) on the success of yellow perch year class production. Studies of this type are needed to aid in understanding stock-recruitment relationships, since in many instances it appears

that environmental effects have a much larger impact on year class strength than does the size of the adult stock (Busch et al. 1975, Clady 1976, Eschenroder 1977).

Project 3-339-R, initiated in 1980, continues to the present. Many of the efforts pursued during the preceding project have continued over this period, and several new projects have commenced. The Beverton-Holt model has been used to develop, for the first time, a catch quota for yellow perch in Pennsylvania's waters. The quota, or total allowable catch (TAC), is computed by determining the total yield per recruit allowable at equilibrium and multiplying this value by recruitment as estimated from young-of-the-year trawl index values and virtual population estimates. Other projects have included an investigation of the relative efficiency of mono- and multifilament gill nets for both target and non-target commercial species, and a second walleye tagging study. In both 1980 and 1981 walleye were collected on their spawning grounds west of Presque Isle Bay, marked with monel tags, and released. Tag returns, as supplied by commercial and sport fishermen, are being used to document walleye movements and stock discreteness. This effort supplements the tagging study conducted in 1975 in the waters east of Presque Isle Bay.

Interagency programs, in which the PFC has been involved, are coordinated through the GLFC. They have included efforts to develop a management plan for central basin yellow perch, and initial efforts to monitor lake trout abundance, growth, mortality, and possible recruitment as a result of stocking efforts to rehabilitate this species in the eastern basin. The effect of lamprey on these stocks is being monitored by noting the scarring incidence on adult lake trout collected in the fall. Additional support to the lake trout effort was provided by a lamprey study conducted in 1983 on Pennsylvania's tributary streams. This work was done by two student interns working under the supervision of the Lake Erie research biologist. Each major tributary was analyzed for the presence of ammocoetes using electrofishing gear designed specifically for the collection of lamprey by the U.S. Fish and Wildlife Service (USFWS). Visual assessments were made for adult migrants and the lamprey scarring incidence was recorded for salmonids during the fall spawning run.

Trawl and gill net index sampling will continue in the Fish Commission's future commercial fish management efforts. The walleye tagging program, discontinued in 1982, will be replaced with a tagging study for yellow perch, since the stock discreteness of this species is not well understood. Equilibrium yield management using the TAC approach will continue for yellow perch, as will efforts to establish an interagency perch management plan. Lake trout assessment will continue according to guidelines established in the "Draft Strategic Management Plan for the U.S. Waters of the Eastern Basin of Lake Erie" (LEC 1982). Finally, age and growth studies are proposed for white perch and white bass, two species which have had rapidly expanding populations in recent years.

Commercial Fisheries Stocking Program

Stocking of commercial species was a common management practice on Pennsylvania's Lake Erie waters up until the 1950's. During this time the PFC operated a fish hatchery at the foot of Chestnut Street in the Erie harbor. Eggs from commercially harvested whitefish, walleye, perch, blue pike and Lake Erie cisco were incubated and hatched, and the resulting progeny stocked as fry (Table 1). Efforts to document the success of this program were never made but stocks declined in spite of it. In 1955 the program was terminated as a result of both funding cuts and evidence throughout the Great Lakes that stocking native species to maintain stock levels was a futile effort. Commercial species have not been stocked in Pennsylvania's main lake waters since 1955, despite local political efforts (e.g., formal public hearings) to reinstitute a hatchery in both 1973 and 1980. The Erie hatchery was transferred to the city of Erie in 1962 and it is now used as the city water works facility.

Commercial Fishing Regulations

The imposition of regulations has been the primary technique chosen to manage the Lake Erie commercial fishery. Major regulatory changes have taken place since 1981 as efforts have been made to rehabilitate and protect populations of yellow perch and walleye, the two most valuable commercial species. The specific goals of the regulatory changes as discussed by Kenyon (1982a, 1983) and Hoopes and Kenyon (1982) were as follows:

> For perch - reduce commercial harvest by 30-35%, increase age at recruitment from 2.7 to 3.5 years, and protect populations from exploitation during the spring spawning period. These changes were deemed necessary to allow for moderate rehabilitation within 3-5 years.
>
> and for walleye - maintain the currently stable condition of the population by preventing increases in harvest and assuring protection during the spawning period.

The following outline summarizes the development of the program now in effect.

Regulations Prior to 1982:

1. Year round commercial fishing permitted for all commercial species.
2. Minimum gill net mesh size of 2-1/2"; mesh sizes between 3-1/6" and 4-1/2" prohibited.
3. Only gill nets not more than 36 meshes deep permitted.
4. From June 1 - September 30, gill nets restricted from waters within 4 miles of the entrance of the Erie harbor

and 1-1/2 miles of the Lake Erie Shoreline; From October 1 - May 31, nets restricted from waters within 3 miles of harbor entrance and 3/4 miles of shoreline.

5. Lifting of nets required at least once during each 5 day period from May 15 - September 30.

6. No restrictions on number of gill net licenses issued.

7. No restriction on amount of gear fished.

8. Sale permitted of all yellow perch and incidental catches of walleye and cisco caught in permitted year.

9. Whitefish greater than 1-3/4 pound may be sold with additional sale of 10% of those harvested which are less than 1-3/4 pound.

10. No possession of salmon, trout, lake trout, sauger, largemouth bass, smallmouth bass, muskellunge, northern pike or longjaw cisco.

Changes Instituted in 1982:

1. Quota or Total Allowable Catch (TAC) insituted for yellow perch. Quota set at 218,400 pounds with season to end after this fleetwide quota is reached. TAC to be established by March 1 of each year by order of the Executive Director.

2. Walleye TAC established not to exceed 1981 harvest of 24,633 pounds.

3. Commercial walleye season established from September 20 - December 31. All walleye taken incidentally prior to September 20 must be returned.

4. From June 1 - September 30, gill nets restricted from waters within 4 miles of Erie harbor entrance and 1-1/2 miles of shoreline; January 1 - May 31, nets restricted from waters within 4 miles of shoreline anywhere west of Presque Isle and 2 miles of shoreline east of Presque Isle.

5. Fishing allowed only during Monday, Tuesday, and Wednesday of each week from January 1 to May 31.

6. Number of commercial licenses issued limited to number issued in 1981.

7. Amount of gear fished on any one day limited to amount used on any one day in April, May or June 1981 as reported to Commission.

Changes in 1983:

1. Minimum mesh size raised from 2-1/2 inches to 2-3/4 inches; only gill nets 2-3/4 inches, 2-7/8 inches, and 4-1/2 inches permitted.

2. Maximum net depth - 24 meshes for 2-3/4, 2-7/8 inch mest; 36 meshes for 4-1/2 inch mesh.

3. Year round - gill nets restricted from waters within 1-1/2 miles of shoreline; in addition, from January 1 to May 31, no nets in following areas:

   a. From a point on the Ohio/Pa. border 42°02.5'N, 80°31.2'W;
   b. thence 064°T to 42°12.6'N, 80°.05'W;
   c. thence 090°T to 42°12.6'N, 80°00'W;
   d. thence 060°T to the New York/Pa. border, 42°18'N, 79°45'W.

4. Regulation limiting fishing to Monday, Tuesday and Wednesday prior to June 1, 1983 rescinded.

5. Amount of gear allowed to be fished at any one time restricted to 15,000 gill net feet for boats less than 26 feet in length, 24,000 feet for boats greater than or equal to 26 feet but less than 40 feet, and 36,000 feet for boats 40 feet or more.

Changes to be instituted in 1984

1. Incidental catch of walleye prior to September 20 permitted as long as yearly quota is not exceeded.

Sport Fisheries Assessment

Responsibilities for sport fisheries management on Pennsylvania's Lake Erie waters, excluding the anadromous program, are currently shared by the Area 2 Fisheries Manager stationed in Tionesta and the Lake Erie Research Biologist. The Area 2 Manager's responsibilities have historically included the tributary streams and since January 1982, Presque Isle Bay. The Lake Erie Research Biologist is responsible for sport fisheries management on the main lake.

Tributary sampling in the past has generally been limited to those streams included in the catchable trout program, namely: Twenty Mile Creek, Elk Creek, Crooked Creek, and Conneaut Creek. Twenty Mile Creek was sampled in 1957, 1975 and 1981; Elk Creek in 1931, 1975, and 1981; Crooked Creek in 1957 and 1981; and Conneaut Creek in 1931, 1972 and 1982. The most recent samples have been conducted under the Commission's new FUTURE management program and are the most thorough. In this program, various chemical, physical, social, and biological parameters are monitored and each water is catalogued in a statewide stream classification system with the goal of managing similar streams in a similar manner. Fish are sampled by electrofishing. Relative species composition is recorded and biomass estimates are made for salmonids. Natural reproduction of salmonids is also noted.

Monitoring efforts in Presque Isle Bay by the PFC prior to 1981 were limited to some haul seine sampling conducted in 1951 to determine general species composition. From the early 1970's until 1981 the bay was considered the responsibility of the Lake Erie Research Unit. Because that unit's efforts focused on the commercial fishery, which is excluded from the bay, almost no monitoring efforts were conducted in the bay. Management responsibility was transferred to the Area 2 Fisheries Manager in 1982 and sampling efforts commenced in the spring of that year. Fish stocks were assessed using trapnets and electrofishing. Sampling gear capture rates were recorded for each species. Age and growth analyses were conducted on yellow perch, black crappie, smallmouth bass, largemouth bass, bluegill, pumpkinseed, rock bass and northern pike. In addition, catch curves were constructed to estimate total mortality rates for yellow perch, black crappie, pumpkinseed and bluegill.

Sport fisheries assessment on the main lake has been negligible as a result of the Lake Erie Research Unit's primary commitment to the commercial fishery. With the exception of the previously mentioned lake trout effort, only those sport fish species which are of major commercial importance are being studied by the research unit. However, additional support to the sport fishery monitoring effort was provided by a creel survey conducted from June 1981 - May 1982 under the supervision of the Administrative Officer of the

Bureau of Fisheries and Engineering (Young and Lahr 1982). This survey was funded in part by a Coastal Zone Management grant administered by the Pennsylvania Department of Environmental Resources. A project leader and five man field crew were hired for the duration of this project. Daily counts of shore, boat and ice anglers, and angler interviews were conducted at 32 access sites located on the main lake and Presque Isle Bay. During each interview, angler sex, age, license number, zip code, sportsmens club membership status, and species preference were recorded, as were counts and length measurements of each species in the catch. Additional biological information such as lamprey scar and fin clip incidence on harvested salmonids was also recorded. This information was used to produce use and harvest estimates and angler characterizations.

Following the creel survey in 1982, log books were supplied to charter boat operators by the Chief, Fisheries Management Section, to solicit records of their offshore salmonid catch. Low levels of angler cooperation were realized in this effort and an accurate quantification of this component of the fishery was not accomplished.

Due to manpower limitations, future sport fishery monitoring efforts in the coastal zone will be limited to the sampling of Presque Isle Bay and the major tributaries on a rotating 4 or 5 year basis. The Area 2 manager, who is presently responsible for sampling the bay and tributaries, must also monitor approximately 33 other lakes, 156 stocked trout streams and several other large streams and rivers, including 150 miles of the Allegheny River. The Lake Erie Research Unit, which is responsible for sampling on the main lake, will continue to direct most of its monitoring efforts to the commercial fishery. Two sport fishing studies which have been proposed for 1987 in Presque Isle Bay are a repeat assessment using standard fish sampling gear, and a creel survey.

Sport Fisheries Stocking Programs

Prior to 1955 millions of sport fish such as walleye, perch, and blue pike, which were also commercial species, were propagated at the PFC's Chestnut Street hatchery and stocked as fry into both Lake Erie and Presque Isle Bay (Table 1). In addition, warmwater species such as largemouth bass, smallmouth bass, muskellunge, sunfish and catfish, spawned and reared at other state hatcheries, were transported to the lake and stocked in these years. These large scale stocking efforts were curtailed with the closing of the Erie hatchery, and the stocking of native warmwater species has been limited to the waters of Presque Isle Bay since then (Table 1). Largemouth bass have been stocked periodically in response to fish kills. Northern pike and muskellunge have been stocked in the bay to provide a trophy sport fishery and northern pike from these waters have become the Fish Commission's primary source of brood stock for the statewide northern pike and tiger muskellunge stocking programs. Since 1971, northerns have been stocked in 7 of 12 years at rates of

1,200 to 245,000 fry or fingerlings per year. Muskellunge have been stocked in all but two years since 1971 at rates of 1,200 to 5,700 fingerlings per year. Walleye fry, reared from eggs supplied by the Fish Commission, were stocked in the bay by sportsmen's cooperative nurseries each year from 1973 to 1977 at rates of 235,000 to 250,000 fish/year (Table 2). The walleye program was essentially a public relations effort to appease area sportsmen and no attempt to document its success was ever made, although local anglers claimed the program had made a substantial impact on the fishery. Following the PFC's management survey in the bay in 1982, an administrative decision was made to again stock walleye fry, this time at much higher stocking rates. Seven million fry were stocked in 1983 and 7,000,000 more are to be stocked in 1984. The decision to stock fry was prompted by the finding that the bay's walleye population was depressed, despite the existence of a healthy population in the main lake. The current effort is being done on an experimental basis with a reevaluation of the fishery via the aforementioned inventory sampling and a creel survey scheduled for 1987.

Coldwater species have received considerably more emphasis in the Commission's sport fish stocking program. Initiated in 1968 with the acquisition of funds provided through the federal Anadromous Fish Act, the program has resulted in the release of millions of coho salmon, chinook salmon, and steelhead trout by the Fish Commission (Table 1). Additional help has been provided by sportsmen's cooperative nurseries (Table 2). Each of these species is stocked into tributary streams to be imprinted before entering the lake. In addition, coho salmon have been stocked since 1975 into Presque Isle Bay. Steelhead will also be stocked in the bay, beginning in 1984. Details of the anadromous program are considered in a later section of this report.

An aspect which complicates the anadromous program is the maintenance of a catchable trout program on many of the same waters stocked with Pacific salmon and steelhead. Four of the Lake Erie tributaries, Crooked Creek, Elk Creek, Twenty Mile Creek and an upstream portion of Conneaut Creek are classified as approved trout waters. Catchable size brown trout, rainbow trout, palomino rainbow trout and brook trout, reared at the Oswayo Fish Culture Station, are stocked into these waters by the Fish Commission (Table 3). Stocking formulas for each tributary stream are devised using a method developed as part of the statewide FUTURE program.

Finally, an attempt to rehabilitate the lake trout fishery is currently underway through an interagency stocking effort. Pennsylvania made some early efforts to rehabilitate this fishery by stocking at rates of 15,500 to 34,000 yearlings/year intermittently from 1969-1976 (Table 4). These early plants had rather poor results, probably because of the low numbers used (Kenyon 1981). The lake trout rehabilitation program intensified in 1978 with a cooperative effort among the Fish Commission, New York Department of Environmental Conservation (NYDEC) and the USFWS. Lake trout are reared at the USFWS's Allegheny and Jordan River National Fish

Hatcheries, and transport and stocking are shared between New York and Pennsylvania. Since the initiation of this program, 38,000 to 500,000 fingerlings and 40,000 to 236,000 yearlings have been stocked annually (Table 4). In 1982 a Strategic Lake Trout Management Plan was drafted by the Lake Trout Task Group of the LEC. The goal of this plan, which still awaits final approval, is to develop, by 2010, a lake trout population in the eastern basin that will support a controlled fishery and consist of at least 50 percent naturally spawned individuals; the ultimate goal will be revised to 100 percent natural reproduction as soon as it appears practical (LEC 1982). By 1984, four hundred thousand yearlings are to be stocked annually under this cooperative agreement.

Sport Fishing Regulations

Until recent years, sport fishing regulations for Pennsylvania's Lake Erie waters differed from those on inland waters, being for the most part more liberal. Changes since 1982 have made Lake Erie and inland regulations the same for warmwater game fish and panfish. These changes were made in an attempt to reduce the yellow perch sport harvest, together with the commercial harvest, by 30-35% (Hoopes and Kenyon 1982, Kenyon 1983), and to maintain the stable walleye population at a desirable level (Kenyon 1982a).

Regulations for trout and salmon differ from those on inland waters. Recent changes in these regulations have been made to encourage the harvest of salmon and prevent the overharvest of lake trout.

Regulations for tributary streams are confusing. Regulations change four times through the year on some tributaries and rules vary between streams.

The following outline summarizes the development of the sport fishery regulation program since 1981.

1981 Regulations:

1. Muskellunge - Season closed March 14 - May 8; 30 inch size limit; 2 fish creel limit.

2. Northern Pike - Season closed March 14 - May 8; 24 inch size limit; 2 fish creel limit.

3. Walleye - Open year around; no size limit; no creel limit.

4. Bass (largemouth and smallmouth)

   a. Lake and bay - open year around; 12 inch size limit; 6 fish creel limit.
   b. Tributary streams - open year around; 10 inch size limit; 6 fish creel limit.

5. Trout and Salmon

   a. Lake and bay - open year around; 9 inch size limit; 6 fish creel limit.
   b. Tributary streams - April 18 to Labor Day-6 inch size limit; 6 fish creel limit; fishing allowed on all tributaries except nursery waters (Trout Run, Godfrey Run, one section of Crooked Creek). September 8 to February 28-6 inch size limit; 3 fish creel limit; fishing allowed on approved trout waters only (Elk Creek, Crooked Creek, Twenty Mile Creek), except September 1 - November 30 when fishing is also permitted on Four Mile Creek, Twelve Mile Creek, Sixteen Mile Creek, and Walnut Creek. March 1 to April 17 - Fishing closed on all tributaries except sucker fishing with worms on Walnut Creek and Twenty Mile Creek north of Route 5 and Elk Creek north of Route 20.

6. Smelt - season open April 1 to May 31; no size limit; no creel limit.

7. Panfish (yellow perch, sunfish, crappies, catfish, rock bass, suckers, eels, carp, white bass) - open year around; no size limit; no creel limit.

8. Sport anglers permitted to sell their catch.

Changes Instituted in Spring 1982:

1. Walleye - 15 inch size limit; 6 fish creel limit.

2. Panfish - 50 fish creel limit.

3. Sale of catch prohibited.

Changes Instituted in 1983:

1. Trout and Salmon -

   a. Tributary streams - size limit changed to 7 inches year around; September 6 - November 30 - fishing permitted in Raccoon Creek, Turkey Creek, and Conneaut Creek as well as all those in which fishing was permitted previously.

Changes to be Instituted in 1984:

1. Trout and Salmon -

   a. Lake and bay - 8 fish creel limit with no more than 2 being lake trout.
   b. Tributary streams - April 14 to Labor Day - 8 fish creel limit.

Anadromous Program - Status

One of the major efforts pursued in recent years by the PFC has been the Lake Erie anadromous program. In the mid-1960's the Fish Commission considered several exotic predator species which could be used to create a high quality sport fishery and fill an empty niche which had been created with the decimation of native lake trout and blue pike stocks. Among those considered were striped bass and several of the Pacific salmonids. Because excellent success had already been realized in the upper lakes for Pacific salmon, this group was chosen for the initial stocking effort. Partial funding was provided for the project by the Anadromous Fish Act in 1968, and federal monies have borne approximately 50 percent of the cost of the program since that time. Three species have been stocked by the PFC (Table 1). Coho salmon, first stocked in 1968, continue to be the mainstay of the program at the present time. Chinook salmon were first stocked in 1971 but relatively poor angler returns resulted in termination of that program in 1982. Steelhead trout were first stocked in 1970, but annual stocking did not begin until 1974. Good returns have prompted the Commission to steadily increase its steelhead commitment since then. Pennsylvania's present goal is to stock 1,000,000 coho salmon and 500,000 steelhead trout annually.

Sportsmen's cooperative nurseries have provided much support to the anadromous program (Table 2). Coho salmon and steelhead trout have been reared and stocked by these groups since the earliest years of the program. In addition, cooperative nurseries chose to initiate rearing chinook salmon in 1983 when the PFC deemphasized its own rearing efforts. Cooperative nurseries stocked over 20,000 coho, 24,000 chinook and 40,000 steelhead in 1983. Brown trout and palomino rainbow trout are also stocked by cooperative nurseries. The Fish Commission is instrumental in securing eggs for the co-op program and provides overall program guidance.

The responsibilities for the anadromous program are shared between the Fisheries Division Chief, the Warmwater Production Section Chief, the Superintendent of the Fairview Fish Culture Station, and the Research Section. The Division Chief decides on program goals, stocking allocations, and stocking strategies. Administration and supervision of the program are the responsibilities of the Section Chief. The Fairview Hatchery Superintendent is denoted the Anadromous Project Leader and is responsible for the supervision of all on-site activities. The Research Section's responsibilities include both steelhead brood stock selection and disease control.

Anadromous Program - Rearing.

Coho salmon eggs for the initial anadromous effort were obtained from the Underwood National Fish Hatchery, Underwood, Washington in the fall of 1966. The fish hatched from these eggs were reared for 8

months at the Corry Fish Culture Station and then transferred to PFC hatchery ponds on Grimshaw Run, Godfrey Run (Mission Site), and Trout Run (Raine Site), and to co-op nursery ponds on Trout Run, Elk Park Run, and an unnamed tributary. These fish were released as smolts at 18 months of age (Spring 1968) and allowed to migrate directly from the nursery waters into lake Erie. This original release consisted of 87,000 fish.

Many procedural changes have taken place since the initial rearing effort. In 1967, Pennsylvania began to secure coho eggs from the Michigan Department of Natural Resources (DNR). Pennsylvania's coho supplemented the egg supply beginning in 1969 with the state's first adult run. Coho were spawned at the Commission's Walnut Creek station each year through 1976, when the spawning operation was transferred to the new Fairview hatchery, which had been constructed at the Raine site. Artificial spawning has been done at Fairview since then.

Early in the coho program the hatching success of eggs taken from Pennsylvania fish averaged 40-50 percent and fry survival was high. By comparison, Michigan eggs showed a hatching percentage of only 30 percent and much lower fry survival rates. This situation reversed in the late 1970's with Pennsylvania's eggs showing a hatching rate as low as 10 percent compared to 75 percent for eggs from Michigan. The reasons for this phenomenon are unclear but because of it, Pennsylvania's current coho program is dependent upon Michigan supplied eggs with a token amount of eggs ($^{+}$100,000) taken from Pennsylvania's fish for comparative purposes.

The incubation, hatching, and rearing of coho salmon was initially done at the Walnut Creek, Corry, and Tionesta Fish Culture Stations. Since that time the Pleasant Mount and Linesville hatcheries have also been used in this capacity. Presently, Linesville, Corry, and Tionesta are the sites of the hatching and initial rearing efforts.

At the age of 3 months many of the coho fingerlings are transferred to the Erie drainage. Besides the original Mission, Raine (Fairview), and Grimshaw sites, the Fish Commission has operated rearing facilities at the Mason Site (located on Godfrey Run), Platz Site (located on Bear Creek, a tributary to Walnut Creek), and Hotchkiss site (located on Elk Creek). The Commission dropped the Grimshaw, Platz, and Mason sites in 1972, 1977 and 1981 respectively. This leaves Fairview, Mission and Hotchkiss as the current coho rearing facilities on the Erie drainage. It should be noted that the Fairview hatchery, the largest of these facilities, has had rearing problems resulting from low flow and high water temperatures since the time of its construction. Those fish which exceed the capacity of the Lake Erie sites are reared at Corry, Linesville, and Tionesta until the time of stocking.

The chinook program, like the coho program, has been dependent upon eggs acquired from the state of Michigan. Most of

Pennsylvania's chinook salmon have been incubated, hatched and reared at the Linesville and/or Tionesta hatcheries, with additional help from Oswayo and Pleasant Mount. Over the years, various rearing methods have been used in attempts to improve the return rates after stocking. Some fish have been transferred to facilities on the Erie drainage for long imprinting periods. Others have been stocked directly into tributary streams. Most chinook have been stocked during their first spring at the age of 4 months. However, since 1978 fish have also been held until their first fall (8 months) or second spring (16 months). None of these efforts have proven satisfactory and the Commission opted to deemphasize the chinook program in 1982. The only chinook rearing efforts since that time have been those of the 3-C-U Trout Club.

Eggs for Pennsylvania's steelhead program were supplied by the Michigan DNR in the early years. Eggs have also been obtained from the Washington Department of Game and the Oregon Department of Fish and Wildlife. However, in contrast to coho and chinook salmon, the viability of eggs from Pennsylvania's steelhead has been high and by 1982 Pennsylvania's fish had become the source of over 65 percent of the eggs used in the propagation effort.

Because Pennsylvania's steelhead have become a major source of eggs, brood stock selection is an important consideration. Only the largest fish are utilized for spawning and these fish must be healthy with no physical deformities. Approximately equal lots of eggs are taken from fall and spring run fish. Recent observations have suggested that late spring spawners (April) have faster growth rates than those which spawn earlier. It is hoped that these fish can be used to develop a superior strain. A second goal of the selection program is the development of a spring spawning domestic strain of rainbow trout for Pennsylvania's statewide catchable trout program. The rainbow trout currently used in Pennsylvania's hatchery system are late summer/early fall spawners.

Incubation, hatching, and rearing of steelhead for the Lake Erie program has been done primarily at the Tionesta hatchery. Steelhead are reared to the age of 12-15 months at which time they are stocked directly into the Lake Erie drainage. No steelhead are reared at the Fairview hatchery or its satellite facilities.

Anadromous Program - Stocking.

In the early years of the anadromous program coho salmon were stocked by simply allowing them to migrate to the lake from rearing facilities on Grimshaw Run, Godfrey Run, Trout Run, Walnut Creek, and Elk Creek. This method has continued to some extent over the years but fish have also been distributed to several additional waters. In 1975 stocking efforts were expanded to Presque Isle Bay and the bay has received approximately 25 percent of all coho since that time. Sixteen Mile Creek was stocked with coho for the first time in 1974 and in 1982 the stocking effort was expanded to include Crooked

Creek, Orchard Beach Run, Raccoon Creek, Twelve Mile Creek, and Twenty Mile Creek (Table 3). Most of the coho reared by cooperative nurseries have been stocked in Orchard Beach Run.

Chinook salmon have been stocked into many of the same tributaries as coho salmon. However, the bulk of the chinook have been stocked in Elk Creek and Walnut Creek (Table 3). Chinook have not been stocked in Presque Isle Bay.

Steelhead trout have been stocked into Elk Creek, Godfrey Run, Trout Run, Sixteen Mile Creek, and Twelve Mile Creek by the PFC, and Godfrey Run and Trout Run by cooperative nurseries (Table 3). Steelhead were first stocked in Presque Isle Bay in 1983 and 25 percent of all future stocking will be allocated to the Bay. It is hoped that this change will enhance the utilization of the resource, since the bay receives heavy fishing pressure during the fall, winter, and spring seasons when steelhead inhabit the nearshore region.

Anadromous Program - Disease Control.

Disease Control is a critical issue in the anadromous program. Because many of the stocked salmonids are introduced from out-of-basin sources, there is a perpetual risk of spreading exotic disease organisms to native Great Lakes stocks. Disease control efforts in the Great Lakes basin are coordinated through the Great Lakes Fish Disease Control Committee (GLFDCC) of the GLFC. The GLFDCC has developed a Model Fish Disease Control Program to guide these efforts. The basic obligation of the Great Lakes states, according to the plan, is to restrict the spread of certifiable fish diseases by containing them within their known geographic ranges and striving for their elimination. To this end, a system for inspection and certifying hatcheries has been developed. Source hatcheries must have a valid certificate for transport of fish to waters or other hatcheries in the basin.

Pennsylvania's involvement in the GLFDCC involves:

1. Screening for both certifiable and reportable fish diseases. Certifiable diseases are those diseases which are particularly dangerous for introduction to the population. They include viral hemorrhagic septicemia (VHS), infectious hemorrhagic necrosis (IHN), whirling disease (WD), *Ceratomyxa shasta* (CS), and enteric redmouth (ER). Reportable diseases are recognized to be more ubiquitous in nature. They include infectious pancreatic necrosis (IPN), furunculosis (BF), and bacterial kidney disease (BKD).

2. Preparation of reports to be submitted to the GLFDCC listing all diseases which have occurred at each Pennsylvania hatchery.

3. Attendance at semi-annual meetings.

The Fish Pathology Unit of the Fisheries Research Section has primary responsibilities for these duties.

The major emphasis of the GLFDCC at present is the prevention of the spread of IHN from the west coast to the Great Lakes Basin. The GLFDCC is on record as opposing the importation of west coast steelhead eggs to the Great Lakes to prevent the spread of this disease, an incurable virus which presently is not known to exist in the basin (Warren 1983).

Anadromous Program - Biological Monitoring.

The Fish Commission's biological monitoring efforts for the anadromous program have generally been only cursory in nature. The most intensive program pursued to date was a study to determine the amount of straying which occurred as fish returned or "homed" to natal streams. Hundreds of thousands of coho salmon, chinook salmon, and steelhead trout smolts were marked, prior to stocking, with fin clips assigned by the GLFC. Each fall, from 1968 to 1973, PFC personnel checked several thousand returning fish for the presence of these marks. As the program continued, marking proved to be too costly and time consuming and was determined to be submitting fish to undue stress. Because of this, the Fish Commission stopped marking coho salmon and steelhead in 1975 and chinook salmon in 1981. However, the cooperative nurseries, under the direction of the Fish Commission, continue to fin clip all three species at present. Future follow-up assessments of these efforts are to be the responsibility of hatchery personnel and waterways patrolmen. It is also hoped that information will be volunteered by the angling public.

Studies to follow the post-stocking migration of coho salmon were conducted in the early stages of the anadromous program using both the Perca and a specially equipped 18 foot boat. These efforts were largely unsuccessful and present knowledge of migration is based on studies done by the Ohio Department of Natural resources (DNR) (Baker & Scholl 1971) and information received from the deep water angling public, who, since 1977, have had much success in locating salmon and steelhead offshore.

Other PFC monitoring studies conducted under the anadromous program have been limited to general observations of returning adults by hatchery personnel, and angler use and harvest surveys. An abnormal swelling of the thyroid gland has been observed on large numbers of adult coho since early in the program. The percentage occurrence of this disorder has been recorded annually for fish observed during brood collection. The average size of returning jacks and adults, and the percentage of lamprey scars have also been recorded on an annual basis. Since 1982, lengths and weights of steelhead have been recorded in conjunction with the brood selection effort. Estimates of return to the creel, prior to the intensive use and harvest survey in 1981-82, were based on short term efforts conducted at a limited number of sites each year from 1969-1972. The

log book effort in 1982 targetted the charter boat fishery. Of these studies, only the 1981-82 survey produced even marginally reliable estimates of use and harvest.

Anadromous Program - Adult Trap and Transfer.

One unique aspect of the anadromous program has been the disposal of salmon which have been collected either for spawning purposes or simply to remove excess fish from trapping devices on nursery waters. Historically, excess fish have been sold to commercial fish companies, given to the Erie Zoo for bear food, and distributed to both the Soldiers and Sailors Home and the Erie Community Food Bank. In addition, adults and jacks were at one time stocked into various waters to encourage their harvest. Salmon have been stocked into Presque Isle Bay, the Waterworks Pond on Presque Isle Peninsula, Lake Pleasant, Union City Reservoir, and the Fairview Gravel Pit. At the present time, the trap and transfer effort has been discontinued but fish are still given to the Erie Community Food Bank and the Erie Zoo.

Other Assessment Efforts

A number of fisheries assessment efforts have been pursued on Pennsylvania's Lake Erie waters by outside concerns. In 1973 and 1974, Aquatic Ecology Associates, a consulting firm, produced species composition lists for both the near shore waters of Lake Erie adjacent to Lake City and Elk Creek near its mouth, as part of an impact study for a proposed power plant facility near Lake City (G.P.U. Service Corporation 1979). Gill net samples and ichthyoplankton tows were made offshore, while seines were used in the nearshore and stream habitats. This same consulting firm worked on an environmental impact study for U.S. Steel's proposed lake front mill on the Ohio-Pennsylvania line (U.S. Army Corps of Engineers, undated). From 1977 to 1978 tow samples for ichthyoplankters and fish eggs were made in the nearshore and offshore waters of Lake Erie near Raccoon Creek, and in the creek itself. Sampling for larval fish and adults was conducted in the near shore area using seines, and in Raccoon Creek by electrofishing. A third monitoring program in which Aquatic Ecology Associates was involved was the 316(b) impact study conducted in 1972 in Presque Isle Bay for the Pennsylvania Electric Company (Bardarik et al. 1973). Fish samples were collected using gill nets, trap nets, seines, and electrofishing in an attempt to describe the fish community and determine the effects of the power plant's cooling water intake and warm water discharge on it.

In 1975 Dr. Edwin Mastellar and his associates of Penn State University - Behrend, sampled Raccoon Creek, Crooked Creek, Elk Creek, Trout Run, Walnut Creek, Mill Creek, Four Mile Creek, Six Mile Creek, Seven Mile Creek, Eight Mile Creek, Twelve Mile Creek, and Sixteen Mile Creek, all tributaries to Lake Erie, with seines, and

described the fish species composition in each (Mastellar et al. 1976).

The U.S. Fish and Wildlife Service (USFWS) sampled with trawls and gill nets in the main lake waters off the City of Erie in May, July and September 1977 (Busch 1977). This work was part of that agencies effort to describe the species composition and distribution of fish in the central basin. A second study in which the USFWS was involved was a survey of 368 Lake Erie tributary streams, including several in Pennsylvania, to determine the spawning areas being occupied by the sea lamprey. This work was conducted between 1957 and 1978 (Pearce et al. 1980).

The Ohio DNR, USFWS, University of Guelph, McMaster University, and Pennsylvania State University have all conducted studies which have benefitted Pennsylvania's understanding of salmonid biology in Lake Erie. In the early stages of the anadromous program, Ohio studied coho salmon migration patterns, food habits of smolts and adults, and growth rates (Baker 1969, Baker and Scholl 1971). Also, in the early years of the program, the USFWS studied coho salmon to determine the cause of thyroid disorders. More recently, Dr. John Leatherland and Mr. Peter Morrison of the University of Guelph, Guelph, Ontario, and Dr. R. A. Sonstegard of McMaster University, Hamilton, Ontario, have been comparing coho salmon from Lakes Erie, Michigan, and Ontario to determine the etiologies of slower growth rates, higher incidences of thyroid hyperplasia, poorer egg viability, and lack of secondary sexual characteristics in Lake Erie's salmon. Also, in recent years, Dr. James Wright at the Pennsylvania State University, has been conducting chromosome studies on Lake Erie steelhead, with the goal of identifying different strains of fall and spring run fish.

Finally, an economic impact study of the sport and commercial fisheries was recently completed for the Erie Western Pennsylvania Port Authority by Hammer, Siler, George Assoc. (1983). The study was funded through Pennsylvania's Coastal Zone Management Program. The relative economic value of each of the major sport and commercial fish species was estimated as was the overall impact of sport and commercial fishing on the local economy. The study then identified strategies to envigorate the local economy through promotion and enhancement of the fishery.

Status of the Stocks

Yellow Perch

Prior to the 1930's, Lake Erie yellow perch were of low commercial value with respect to whitefish, lake herring, and blue pike. As whitefish stocks declined, attention began to shift to perch, and they became the target species of the commercial fishery with the decline of blue pike and lake herring in the 1950's. Commercial harvest in Pennsylvania's waters peaked at over 2 million pounds in 1962 but has declined steadily since then. The commercial harvest has averaged 309,000 pounds since 1972 (Figure 2). The 1982 harvest of 203,988 pounds was the lowest since 1953. This decline was primarily the result of new regulations imposed in that year. Over 99 percent of the harvest was taken by crews using gill nets. Yellow perch represented 35 percent of the total weight and 87 percent of the total economic value of the commercial harvest in 1982 (Table 5).

Perch are likewise the number one species sought by sport anglers in Pennsylvania's Lake Erie waters (Table 6). Thirty-two percent of all interviewed anglers sought perch during the 1981-82 use and harvest survey. Emphasis on perch was most noticeable in Presque Isle Bay, where over 50 percent of the interviewed anglers sought perch. Perch ranked first in the numerical harvest by sport anglers, representing 60 percent of the total (Table 7). Nearly 86 percent of the 498,100 perch harvested were taken from Presque Isle Bay. The total sport harvest, when converted to weight, approximated 44 percent of the commercial harvest during the same period (Table 8).

Using a formula in which the number of angler trips directed towards each species is multiplied by the estimated expense of each trip, Hammer, Siler, George Assoc. (1983) estimated that perch were responsible for 21.5 percent of the total economic impact of the sport fishery. This value was exceeded only by coho salmon at 23.8 percent (Table 9).

Pennsylvania's commercial fishery monitoring program has understandably placed more emphasis on the study of yellow perch than on any other species, and through this effort numerous signs of population stress have been noted. Although fishing effort has increased significantly in recent years, the total catch has not, and therefore catch per unit effort, has declined (Figure 3). Recruitment, as determined from young-of-the year indices, has been highly variable and very poor since the 1970's (Figure 4). Growth rates have increased dramatically since 1972 (Table 10) while age at maturity has declined (Table 11). These factors are all classical signs of overharvest (Spangler et al. 1977).

Equilibrium yield models have reinforced this contention. Harvest has been in excess of equilibrium since 1973 when the yield calculations were first made. Harvest rates have escalated most

dramatically since 1977 and have exceeded equilibrium levels by as much as 34 percent since that time. Mean age at entry to the fishery during this period was 2.7 years. Cropping the population at this young age exacerbated the stressful situation by limiting the spawning stock to only two age groups. Thus, poor recruitment in any one year was resulting in a precarious situation with potentially disastrous consequences.

Regulatory action to rehabilitate perch stocks was first taken in 1982 and additional changes were instituted in 1983. As noted earlier in this report, the primary goals of these regulations were to reduce harvest (both sport and commercial) by 30-35 percent, increase the age of recruitment from 2.7 to 3.5 years, and protect the population from exploitation during the spring spawning period. These efforts were deemed necessary to allow moderate rehabilitation within 3-5 years. The focal point of the regulations was the first time imposition of a catch quota or total allowable catch (TAC).

Recent studies in Presque Isle Bay have shown that perch in these waters may also be stressed. An annual mortality rate of 84 percent was estimated for the bay by Lee et al. (1983) (compared to 78 percent in the main lake), and only 4 percent of the fish sampled with trap nets were 4 years of age or older. These findings concurred with the results of the 1981-82 creel survey which showed that only 2 percent of the bay's perch harvest exceeded 250 mm, which approximates the size of a 4 year old perch. Lee concluded that these findings were the result of a winter kill which occurred during the 1978-79 winter. However, excessive fishing mortality could produce the same effects. Overexploitation seems likely when one considers that 86 percent of the total sport harvest was taken in the bay (Table 7), while total sport harvest represented 44 percent of the commercial harvest in the main lake (Table 8).

The factors regulating recruitment need to be understood to effectively manage the resource. Several investigators have noted that year class strength in percids appears to be affected more by environmental conditions during the spring spawning period than by the size of the adult stock (Forney 1980, Clady 1976, Eschenroder 1977, Hokenson and Kleiner 1974). Pennsylvania's recent studies concur with these findings. For the period 1971-1978, yellow perch year class size was highly correlated with both climatological warming rate (R^2=.82) and wind events (R^2=.76), while essentially no relationship was found between year class size and stock size (R^2=.01) (Kenyon 1982b).

Tagging studies by Ohio and Ontario have revealed that perch seldom move outside the central basin, but there is considerable movement within the basin. This suggests that the central basin population may constitute a unit stock. Sub-populations within the basin may also exist. Perch in Pennsylvania's waters, which occupy the transition zone between the eastern and central basins, could therefore consist of at least two distinct stocks. Further clouding the issue in Pennsylvania is the factor of Presque Isle Bay. Length

frequency distributions of perch on the main lake appeared to be quite different from those in the bay during the 1981-82 use and harvest survey. This is preliminary evidence that bay and lake stocks may be distinct. Tagging studies proposed by Pennsylvania for 1984 should help us better understand this problem.

The bathymetric distribution and food habits of yellow perch have both been investigated by the Lake Erie Research Unit. Perch have usually been found in waters less than 60 feet deep but documentation of perch to 114 feet has been made. The food of small samples of young perch was found to consist of zooplankton and benthos. This invertebrate diet was supplemented with fish in older perch, particularly young-of-the-year gizzard shad, alewives, emerald shiners, spottail shiners, and smelt. These findings differ little from those reported for the species in general.

Walleye

Pennsylvania's commercial harvest of walleye has averaged 12,900 pounds since 1972 (Figure 2). Throughout this period, walleye have ranked second only to perch in terms of economic value of the commercial harvest. However, in 1982, white bass, which have become more important in recent years, also surpassed walleye in the economic value of the harvest (Table 5).

Walleye are an important component of Pennsylvania's Lake Erie sport fishery. They were surpassed only by perch, "anything that bites," and the three major salmonids in terms of species sought by all sport anglers in 1981-82 (Table 6). Walleye were the premier species sought by boat anglers.

Approximately 37,200 walleye with an estimated weight of 81,734 pounds were harvested by sport anglers in 1981-82. This value represents nearly four times the commercial harvest during the same period (Table 8). Over 96 percent of the sport harvest of walleye was taken from the main lake (Table 7).

Hammer, Siler, George Assoc. (1983) estimated that the walleye fishery represented 11.3 percent of the economic impact of the sport fishery, fourth in importance behind coho salmon, yellow perch, and panfish (Table 9).

Knowledge of the biology of Pennsylvania's Lake Erie walleye prior to 1972 is limited. Since that time, the Lake Erie Research Unit has studied bathymetric distribution, food habits, growth rates, abundance, migration, and mortality of the main lake population. The diet of small samples of walleye was found to consist primarily of smelt, supplemented by alewife and various shiners. Walleye have seldom been found in depths exceeding 48 feet. Tagging studies, conducted in 1975 east of Presque Isle Bay and again in 1980-81 west of the bay, have shown that Pennsylvania's walleye usually migrate in an easterly direction after spawning and seldom stray outside a 30

mile radius of the spawning grounds. This information, along with interbasin comparisons of growth, longevity, and abundance, has supported the findings of Wolfert (1963, 1969, 1977, 1981) and Wolfert and Van Meter (1978) that Lake Erie walleye consist of two distinct stocks, with little movement of fish between the eastern basin and those waters to the west.

Age and growth studies of Pennsylvania's Lake Erie walleye were first conducted in 1972, with subsequent efforts from 1980 to the present. Pennsylvania's walleye in the early 1970's were found to grow slower than walleye in the western basin at ages I-III with similar growth at older ages. Recent data has shown a reversed trend, with eastern basin growth rates up to age V greater than those in the western basin (Table 12). This is probably due to greatly expanded populations which have occurred recently in the western basin as a result of a moratorium on walleye harvest prompted by mercury contamination in the early 1970's and the subsequent inter-agency quota management of these stocks. Because of these efforts, the western basin is probably near its carrying capacity for the species and declining growth rates are likely the result of increased competition for food and a possible decline in the forage base (Muth et al. 1983).

Abundance estimates, based upon spring gill net indices of fish age II and older, have ranged from 8-12 fish/1000 gill net feet since 1980 in Pennsylvania's waters. This compares to Ohio assessment values of 3.5 to 50.4 fish/1000 gill net feet from 1977-81 in the western basin. The mean age of walleye in Pennsylvania's gill net samples has ranged from 5.6 to 4.6 years since 1980, compared to a mean age of 2.1 years in Ohio. This is probably due to much higher fishing mortality rates in the western basin. The annual fishing mortality rate to which walleye are subject under the present quota management regime in the western basin is 22 percent (Walleye Task Group 1983). Fishing mortality rates from Pennsylvania's waters probably do not exceed 11-16 percent (Kenyon 1982a). Lower mortality rates and the protracted age distribution of Pennsylvania's walleye suggest that although the population is not as dense in the eastern basin, it is near the upper limit of what the habitat will support. Higher abundance in Ohio is ascribed to greater productivity and superior spawning habitat in the shallow, eutrophic waters of the western basin.

The walleye population in Presque Isle Bay appears to be very low. The Fish Commission's 1982 management survey had an evaluation of this population as its primary goal in response to sustained pressure from local sportsmen's clubs to stock the species. Trap nets were set in the spring in what should have been the most suitable locations for walleye spawning and electrofishing was done in both early and late spring. Only five walleye were collected in these efforts. These results support the findings of the use and harvest survey of 1981-82 which indicated that the bay's walleye fishery was poor. Only 1600 of the total harvest of 37,200 walleye were attributed to anglers from the bay and this value is considered

to be a maximum, since boat catch was recorded for the departure site only and to some extent represented catches of fish taken in the main lake.

The previously mentioned stocking effort (7,000,000 fry in both 1983 and 1984) is an attempt to bolster the bay's walleye population.

Coho Salmon/Chinook Salmon

Pennsylvania's Lake Erie salmon fishery is solely the result of stocking efforts since 1968. Most of the fish planted have been reared by Pennsylvania, but Michigan, Ohio, and New York have also stocked both coho and chinook salmon in lake Erie (GLFC 1982).

Since salmon were introduced to provide a high quality sport fishery in Pennsylvania's waters, their commercial harvest is restricted. The only agency that allows the commercial harvest of salmon on Lake Erie is Ontario, where 33,000 pounds were taken in 1981. This factor has been a matter of contention for Pennsylvania's sport anglers.

Coho salmon were surpassed only by yellow perch in terms of species preference of Pennsylvania's Lake Erie sport anglers during 1981-82 (Table 6). They were the most highly preferred species of main lake anglers and were third in importance in the bay. While chinook salmon ranked lower in preference, it is believed that salmon anglers are, in general, not species specific when seeking salmon, and the preference values for both species could probably be combined.

Approximately 43,200 coho salmon were harvested by sport anglers in the project year, making them the fourth most abundant component of the total harvest (Table 7). Harvest in terms of weight was estimated at 199,776 pounds (Table 8). The chinook harvest was much lower at 7,900 fish. Insufficient length-weight data prevented an estimation of the weight of the chinook harvest.

Hammer, Siler, George Assoc. (1983) estimated that the coho salmon fishery represented 23.8 percent of the total economic impact of Pennsylvania's Lake Erie sport fishery, ranking first (Table 9). Chinook salmon represented 7.0 percent of the total economic impact and ranked sixth. Most of this impact was realized during the fall spawning run and the concurrent influx of non-local anglers. Seventy percent of the salmon fishermen in the 1981-82 season traveled to the lake from outside Erie county.

The post-stocking mortality rates of salmon in Pennsylvania's waters are presently unknown. However, crude estimates of a 10-15 percent return rate have been made for coho salmon. The survival of chinook salmon appears to be much lower than that for coho. This can be deduced from the fact that although chinook salmon have been stocked in comparable or even greater numbers than coho in recent

years (Table 1), their harvest during 1981-82 was less than 20 percent of the harvest of coho (Table 7). These data verified the results of spot checks of sport anglers in earlier years which had likewise suggested that chinook return rates were poor.

The possible causes for salmon mortality are numerous. Ontario's commercial fishery is certainly one factor, and salmon snared in Pennsylvania's commercial gill nets are another. Sport anglers inflict an unknown mortality by hooking recently stocked salmon during the trout season. Natural mortality is induced by piscivorous waterfowl soon after salmon are stocked. Two other factors which appear to affect mortality are lamprey predation and thyroid disorders. These final two factors have received the most study by both the PFC and other agencies and institutions.

Lamprey scars have been observed since the earliest years of Pennsylvania's salmon program. Scarring rates of 5 to 13 percent have been observed for adult coho, while jacks have shown lower rates, usually under 1 percent. Chinook salmon have shown rates of 11-13 percent. New York has also examined wounding rates on coho, and since 1978 from 4-10 percent of their fish have been scarred (NYDEC 1983).

Thyroid hyperplasia or goiters were observed on 10-20 percent of Pennsylvania's returning adult coho in the early 1970's. Since 1978 this value has increased steadily and in 1981 seventy percent of one lot of 100 fish had this condition. These rates are much higher than those observed in the other Great Lakes. The USFWS studied this problem in 1969. Results of their studies were inconclusive but they suggested the presence of high levels of detergents and heavy metals in Lake Erie were possible causes. Other workers at first believed the condition to simply be the result of an iodide deficiency (Black and Simpson 1974; Drankowski et al. 1975). However, further research suggested that environmental factors were a more likely cause (Sonstegard and Leatherland 1976; Moccia 1978; Moccia et al. 1977; Leatherland and Sonstegard 1980). Although the specific agent or agents causing the abnormality remains unidentified, bioaccumulated organochlorines, bacterial contamination, sulfonated hydrocarbons, minerals or heavy metals have been suggested as possibilities (Leatherland and Sonstegard 1981).

Growth of coho salmon in Lake Erie has been shown to be slower than that in Lake Ontario or the upper lakes. Jacks returning to Pennsylvania's shoreline average 12-16 inches and 3 year old adults average 23-26 inches. Adult coho generally range from 3.5-6 pounds in Lake Erie versus 11-13 pounds in Lake Ontario and the upper lakes (Dr. John Leatherland, personal communication). Accompanying this phenomenon is the observation that adult coho salmon in Lake Erie typically lack secondary sexual characteristics of color change and kype formation at the time of spawning. It is possible that each of these factors may be related to the thyroid problem (Leatherland et al. 1982).

Pennsylvania's chinook salmon have shown growth to 23, 28 and 35 inches at ages II, III and IV respectively. Pennsylvania's chinook grow more rapidly than Pennsylvania's coho, but slower than chinook in the other Great Lakes. Similar reasons to those cited for coho are possible.

Food habit studies done on small samples of Pennsylvania's Lake Erie coho have shown that smelt and emerald shiners are the major prey. Studies done by the Ohio DNR have shown that food habits of coho salmon in Ohio's waters are similar (Baker and Scholl 1971). Little has been done to diagnose the feeding biology of Pennsylvania's Lake Erie chinook.

Present knowledge of the migration routes of salmon stocked into tributaries of Lake Erie are based primarily on the work of Baker and Scholl (1971) in Ohio. Coho salmon appeared to move in a clockwise direction around the lake throughout the year. Fish released in Ohio's waters congregated over winter near the warmwater outfalls of power plants near Cleveland and Lorain. Fish then appeared along the north shore of Lake Erie in the deeper eastern basin waters through the summer. In the fall, fish returned to the sites of their release. Observations by the PFC reveal that coho prefer depths of 80 feet or more through the summer. Coho begin to return to the tributaries in mid-September in Pennsylvania and the spawning run often extends into December. The fin clipping efforts in the early years of the anadromous program (1968-1973) revealed that most coho returning to Pennsylvania's shores were fish which had also been stocked by Pennsylvania. Up to 6300 fish were checked each year in this effort, and fish bearing the Pennsylvania clip consistently made up 80-90 percent of the samples.

Fewer observations have been made on chinook salmon in lake Erie, but they probably follow a similar migration pattern. One difference, however, is that chinook salmon usually begin to run as early as late August in Pennsylvania and few fish are observed entering tributaries after November. The homing accuracy of chinook was only investigated during the 1972 run. Eighty-two percent of the 230 chinook salmon observed that year bore Pennsylvania clips.

Little is known of the extent of natural reproduction of chinook and coho salmon in Pennsylvania's Lake Erie tributaries. Some reproduction of coho salmon has been observed in both Crooked Creek and Twenty Mile Creek. However, the contribution of natural recruitment to the total population is assumed to be minimal.

Steelhead/Rainbow Trout

Rainbow trout were first introduced to Pennsylvania's Lake Erie tributaries in the late 1800's. They have been stocked periodically since that time. Prior to the late 1960's, most of these plants were limited to fish stocked in approved trout waters as part of the catchable trout program. The stocking program has escalated greatly

since the initiation of the anadromous program, particularly since the Fish Commission's recent change in emphasis from chinook salmon to steelhead. Over 400,000 steelhead are scheduled to be stocked in 1984. These stocked fish undoubtedly support the bulk of the fishery. However, some natural reproduction is known to occur in Bear Creek, Thomas Run (both tributaries to Walnut Creek), Trout Run, Godfrey Run, Crooked Creek, Twenty Mile Creek, and Elk Creek, and reproduction in several other streams is likely.

Steelhead trout are not a commercial species in Pennsylvania. They are an important component of the sport fishery. Steelhead were the fourth most frequently sought species during the 1981-82 use and harvest survey behind yellow perch, coho salmon and "anything that bites" (Table 6). They were second only to coho in terms of species sought on the West End and third behind coho and walleye on the East. They ranked ninth in Presque Isle Bay.

The sport harvest of steelhead was estimated to be 14,800 fish in 1981-82, making them the eighth most abundant component of the total (Table 7). Eighty-five percent of these fish were taken in waters to the west of Presque Isle Bay.

Hammer, Siler, George Assoc. (1983) estimated that Pennsylvania's steelhead fishery represented about 5 percent of the total economic impact of the sport fishery (Table 9).

Much of the life history and other biological information available for Great Lakes steelhead has been summarized by Biette et al. (1981) and MacCrimmon and Gots (1972). However, specific information for Pennsylvania's fish is scanty. Steelhead tend to home to a general area to spawn but straying studies have never been done in Pennsylvania. Steelhead run in Pennsylvania's streams from September through at least April and fall and spring run fish are believed to represent different strains; fall runners predominated by lake run domestic strain rainbow trout, and spring runners predominated by true west coast steelhead. Chromosome studies by Dr. James Wright at the Pennsylvania State University continue in an attempt to unravel this problem. Spawning populations in the Great Lakes typically consist of fish 2-6 years old and fish usually spawn 1-5 times per lifetime. It is unclear if Pennsylvania's Lake Erie fish also fit this description.

It appears that Pennsylvania's spring spawners are typically larger than fish which run in the fall. However, little data for fall spawners has been collected. Fish collected during the springs of 1982 and 1983 averaged approximately 25-26 inches in total length and 5 to 6 pounds in weight. Steelhead observed in the 1981-82 sport harvest averaged 20 inches in total length, but fish up to 31 inches were seen.

Like the other salmonids, steelhead are parasitized by sea lamprey. The only scarring data available to date for Pennsylvania's steelhead was collected during the 1981-82 use and harvest survey. Only 2 percent of 509 fish observed in that study were scarred.

food habit studies, estimates of natural recruitment, and identification of optimal spawning areas.

White Bass/White Perch

The white bass and white perch are two closely related species which have experienced increases in Pennsylvania's waters in recent years. While the white bass has been a low value component in the commercial catch for many years, the white perch is a recent invader. White perch were first recorded in Lake Erie in 1953 in the waters off Erie, Pennsylvania (Larsen 1954) and are believed to have entered the lake via the Welland Canal. There were no further reports of the species until the early 1970's (Busch et al. 1977). The first significant hatch occurred in 1977 (Ohio DNR 1983), and white perch began to appear in Pennsylvania's index samples in 1979.

Pennsylvania's commercial harvest of white bass averaged 6500 pounds from 1972-1980 but has increased greatly since then (Figure 2). Over 73,000 pounds were harvested in 1982 as white bass surpassed walleye for the first time in terms of the economic value of Pennsylvania's commercial yield (Table 5). This increase can be attributed to a redirection of commercial effort as a result of recent declines in yellow perch stocks and recruitment of a strong 1980 year class of white bass.

White perch were first recorded in Pennsylvania's commercial catch in 1981 and annual yield through 1982 averaged 1205 pounds. White perch are currently a low commercial value species.

White bass were sought by few sport anglers during the 1981-82 use and harvest survey (Table 6) but they were surprisingly the third most abundant component of the total sport harvest (Table 7). Conversely, white perch were an insignificant component of the total sport harvest. Over 70 percent of the 45,500 white bass harvested were taken from Presque Isle Bay by shore anglers.

White bass in Pennsylvania's waters have usually been found in waters less than 60 feet in depth, and most often in waters under 30 feet. Because of this, food habits appear to consist primarily of various shiners, which are more likely to be found in shallow habitats than rainbow smelt, another abundant forage species. Little is known of the feeding biology of Lake Erie white perch.

Young-of-the-year index values for white bass have been variable since 1972 but high values have been recorded consistently since 1980 (Figure 5). Adult gill net indices have increased since 1980 and the value for 1982 approached that for yellow perch. Interestingly, few white bass over age II have been observed in adult index samples. White perch young-of-the-year index values have increased each year since the species was first observed in 1979 (Figure 5). The reasons for the sudden appearance of white perch, and the recent increases in numbers of both white perch and white bass are presently unclear.

Whitefish

Whitefish were an important commercial species in Lake Erie in the late 1800's and early 1900's. However, deteriorating environmental conditions and overfishing have reduced numbers to a fraction of that once observed. Commercial harvest in Pennsylvania's waters has averaged only 1000 pounds/year since 1972 (Figure 2) and just 340 pounds were taken in 1982. Although whitefish are a valuable food fish, little commercial effort is expended on them in Pennsylvania because of their sparse distribution and cohabitation with rainbow smelt, which often foul deepwater gill nets.

Whitefish in Pennsylvania's waters are confined in distribution, for much of the year, to the eastern basin waters east of Presque Isle Bay at depths of 60-85 feet or greater. Movement to shallower waters occurs at the time of spawning. Spawning in Pennsylvania waters is believed to occur on the sand bar transversing the lake north of Presque Isle Bay, as well as in near shore areas.

The PFC has documented whitefish abundance annually in its index samples. Young-of-the-year whitefish are seldom encountered in trawl samples and gill net indices must be viewed with caution because of low sample sizes and high variability in sample catches. Only the largest year classes can be distinguished with any certainty. Given these limitations, it appears that whitefish populations have remained fairly constant since index sampling began in 1972. Data from the most recent years has not yet been analyzed.

Growth rates of Lake Erie whitefish during the 1970's was compared to rates during the 1920's by Kenyon (1978). Although whitefish were much less abundant in the 1970's, a factor which should have decreased competition for food, growth rates declined. Kenyon attributed this to environmental stress imposed in recent years. Because whitefish are believed to be only marginally adapted to the Lake Erie environment, this stress has been particularly detrimental and has probably been a major factor preventing populations from recovering to earlier levels.

Freshwater Drum

Freshwater drum appear to be one species that has benefitted from changing environmental conditions in Lake Erie. Since drum lay pelagic eggs, degraded substrate conditions have little effect on reproduction. This factor, along with decreasing competition from other, once abundant species has allowed populations to expand since the 1950's (Hartman 1972).

Freshwater drum are currently a major component of Pennsylvania's Lake Erie fish community. The annual commercial harvest averaged 8900 pounds from 1972 to 1979 but increased dramatically thereafter (Figure 2). Over 241,000 pounds were taken in 1982, making drum the largest single component of the harvest (Table 5).

However, because of their low commercial value, many were discarded as scrap. As a result, the value of the harvest, as reported by commercial fishermen, was only $268.

Drum were seldom listed as a preferred species by sport anglers during the 1981-82 use and harvest survey. This low interest was reflected in the catch and harvest statistics. The total sport catch of drum during the 1981-82 season was 141,000 fish making them the second largest component of the total (Table 7). However, because an estimated 92 percent of this catch was returned to the lake, the resulting harvest ranked only tenth. Obviously, large numbers of drum are taken by sport anglers in search of other species.

Biological monitoring of Pennsylvania's Lake Erie drum population has generally been limited to studies of bathymetric distribution, food habits, and adult abundance. Adult drum have usually been found in depths less than 60 feet with younger fish inhabiting near shore areas which are difficult to sample. Their food consists of both invertebrates and fish to age III, when fish become the major component. Abundance indices showed declining populations from 1974 to 1979. However, abundance data since 1979, when commercial harvest has been highest, has not yet been analyzed.

Smallmouth Bass

Smallmouth bass were sought by approximately 6 percent of Pennsylvania's Lake Erie sport anglers during the 1981-82 season, making them the seventh most frequently preferred species (Table 6). An estimated 33,100 smallmouth bass were harvested by sport anglers and they likewise ranked seventh for this parameter. Harvest was highest in Presque Isle Bay but good numbers of smallmouth were taken at all three general sites (Table 7). It is interesting to note that smallmouth bass were surpassed only by yellow perch for harvest in the waters east of Presque Isle Bay. The NYDEC has found that the smallmouth bass harvest is also high in the state's eastern basin waters, and they view the fishery as exceptional (NYDEC 1983).

Hammer, Siler, George Assoc. (1983) estimated that the smallmouth bass fishery accounted for 8.3 percent of the total economic impact of the sport fishery, ranking them fifth behind coho salmon, perch, panfish and walleye (Table 9).

Smallmouth bass may not be harvested commercially in Pennsylvania's waters. Because the Lake Erie Research Unit concentrates on commercial species, no biological monitoring has been done by Pennsylvania for smallmouth bass in the main lake. However, studies in New York's waters by the NYDEC have shown that smallmouth demonstrate a stable age composition suggestive of low exploitation rates (NYDEC 1983). Growth rates in New York are rapid, with fish reaching the minimum legal size of 12 inches at age II+. Similar characteristics might be assumed for Pennsylvania's population, but it is unknown if the stocks are contiguous.

Only 33 smallmouth bass were collected from Presque Isle Bay by Lee in his 1982 management survey (Lee et al. 1983). A subsample of these fish was aged using scales. Eighty-seven percent of the sample was either three or four years of age. All fish had attained the legal size of 12 inches by age IV.

Little other biological information has been collected to define the status of smallmouth bass in Pennsylvania's Lake Erie waters. However, one additional noteworthy phenomenon, observed during the 1981-82 creel survey, was the migration of large members of bass into tributary streams during the spring spawning period.

Largemouth Bass

Largemouth bass, unlike smallmouth bass, are primarily confined to the eutrophic waters of Presque Isle Bay. They were sought by only 2 percent of the bay's sport anglers during the 1981-82 season and less than 2 percent of the anglers lakewide (Table 6). The total sport harvest of largemouth bass was only 3600 fish. Surprisingly, over 21 percent of the fish observed in the harvest were under the 12 inch minimum length limit. Over 91 percent of the harvest was taken in the bay where largemouth ranked eleventh in total harvest (Table 7). Hammer, Siler, George Assoc. (1983) estimated that the largemouth fishery represented only 2 percent of the economic impact of the total sport fishery, and ranked eighth in this category (Table 9).

Considerable effort was made in 1982 by the PFC to collect largemouth bass in Presque Isle Bay by electrofishing (Lee et al. 1983). The 165 fish sampled consisted of eight year classes and ranged from 3 to 20 inches in total length. Growth rates were similar to those for smallmouth bass with fish attaining the legal size of 12 inches at age IV. Fourteen percent of the sample was four years of age or older. Lee concluded that largemouth bass in Presque Isle Bay were stable and self-sustaining.

Northern Pike/Muskellunge

Both northern pike and muskellunge are stocked in Presque Isle Bay by the Fish Commission. However, neither species is an important component of the sport fishery either in terms of species sought (Table 6), number harvested (Table 7), or economic value (Table 9). This is an interesting phenomenon, since northern pike were found to be the most abundant species of game fish sampled during the 1982 trap netting effort in the bay (Lee et al. 1983). However, it should be noted that sampling was conducted during the peak of the northern pike spawning period, when this species is highly vulnerable to capture. Nineteen percent of the northern pike sampled exceeded the 24 inch minimum length limit. Analysis of empirical length at age revealed that northerns up to seven years of age were present with fish attaining the legal size limit by the age of V or VI.

Only three muskellunge were collected in the 1982 effort, thus age analysis of this species was not possible. It is unclear if the sample actually reflected the relative abundance of muskellunge since sampling activities were completed prior to the peak of the musky's spawning period when they would be expected to be much more vulnerable to capture.

Natural recruitment was not noted for either northern pike or muskellunge during the 1982 sampling effort.

Panfish

Panfish, for the purpose of this report, will include crappie, bluegill, pumpkinseed, rock bass, channel catfish and bullheads. Bullheads, channel catfish, and rock bass occur in both the main lake and Presque Isle Bay. However, the fishery for the remaining species is primarily limited to the bay. As a group, panfish are an important component of the sport fishery. Crappie ranked fourth in terms of species sought by sport anglers in the bay during the 1981-82 season, and the two sunfish species ranked ninth (Table 6). Black crappie, which are more abundant than white crappie in the bay, were the second most abundant component of the total sport harvest in those waters, while pumpkinseed were third, bluegill seventh, and rock bass eighth (Table 7). Panfish were estimated to account for over 20 percent of the economic impact of the sport fishery in Pennsylvania's waters (Hammer, Siler, George Assoc. 1983). However, this estimate is probably somewhat high since fishing directed towards "anything that bites" was included with panfish in the economic study.

Other than these harvest statistics, the Fish Commission's present knowledge of the panfish population is based on data collected by Lee et al. (1983). Relative abundance was recorded for each species, empirical length at age was estimated for bluegill, pumpkinseed, rock bass, and black crappie, and mortality rates were determined for bluegill, pumpkinseed and black crappie. The most interesting observations to note from these studies were that few panfish greater than age III were collected, and total annual mortality rates were very high, ranging from 65 percent for bluegill, to 77 percent for black crappie. Lee et al. concluded that these findings were the result of a large winter kill which had occurred in the bay during the 1978-79 winter. However, excessive fishing mortality could result in the same effects.

Forage Species

The forage base in Pennsylvania's Lake Erie waters has been found to consist primarily of five species: rainbow smelt, alewife, gizzard shad, emerald shiners, and spottail shiners. Abundance indices for each of these species in the main lake have reflected highly variable recruitment (Figures 6 and 7). However, because of

the high sampling variability, only large changes in year class strength can be detected with any reliability.

Smelt appear to be the most abundant component of the forage base in the main lake with thousands collected during standard ten minute trawl tows. Smelt young-of-the-year are more abundant near shore with adult smelt constituting the major forage of the deep waters of the eastern basin. Smelt appear to be the most long-lived species of the forage base with five year classes often represented.

Gizzard shad and alewife are extremely fast growing species, often exceeding the vulnerable size of most predators prior to the end of the first year. Mortality rates are very high in Lake Erie, particularly over winter, with few surviving past age I. Both species are usually found in shallower and more near shore areas than smelt.

Emerald shiners and spottail shiners, like gizzard shad, are most prevalent in shallower waters. They are also short-lived, and few fish exceeding age II are ever collected. Unlike the gizzard shad and alewife, they remain vulnerable throughout their lifespan to most predators.

Abundance indices have not been conducted in Presque Isle Bay. However, emerald shiners were the most abundant forage species collected in the Fish Commission's 1982 trapnetting effort. Gizzard shad are also known to be very abundant in the bay, particularly during the winter, when gizzard shad die-offs and the subsequent impingement of dead fish on cooling water intake screens have caused operational difficulties for the Pennsylvania Electric Company. Gizzard shad were found to constitute nearly 85 percent of the estimated total impingement during a 316(b) impact study conducted in 1978-79. Rainbow smelt, emerald shiners and spottail shiners were the next most abundant components of impingement mortality in the bay, representing 6.8 percent, 6.5 percent and 0.8 percent of the total respectively.

Growth and food habit studies have been conducted on each of the major forage species in the main lake. The reader is directed to Kenyon (1977) for a detailed account of this work.

The incidence of the microsporidian parasite *Glugea hertwigi* on rainbow smelt has been recorded by the Lake Erie Research Unit since the early years of the commercial program. This parasite is thought to be a significant factor affecting smelt growth, fecundity and mortality. Early studies in Pennsylvania showed infestation rates approaching 90 percent for smelt in fall samples. However, the incidence has declined over the years and fewer than 16 percent of the smelt collected during the fall of 1982 were parasitized by *Glugea*.

Gizzard shad, smelt and emerald shiners are all harvested commercially in Pennsylvania's waters (Table 5). Emerald shiners are harvested by seine as a baitfish and were surpassed only by perch in

1982 in total commercial value. Gizzard shad and smelt are of low commercial value in Pennsyvania due to a lack of processing and marketing capabilities. It is interesting to note that over 20 million pounds of smelt are harvested annually on a lakewide basis, but most are taken in Canada, where they are a valuable component of the fishery.

Smelt are the only forage species harvested by Pennsylvania's Lake Erie sport anglers. The availability of the species near shore has varied greatly over the years, and sport harvest during the 1981-82 season was very low (Table 7).

Other Species

At least 63 species, in addition to those already discussed, have been observed in various fisheries assessments on Pennsylvania's Lake Erie waters (Table 13). Most of these species are either rare or of relatively minor commercial or sport interest. Because of this, little biological information has been collected for them.

FISHERIES MANAGEMENT - PROBLEMS

Fisheries Assessment Programs - Problems

Under the current management regime, fisheries assessment on Pennsylvania's Lake Erie waters is the responsibility of several separate sections within the PFC: Commercial fisheries assessment is the responsibility of the Research Section; assessment of the sport fishery is the joint responsibility of the Fisheries Management Section and the Research Section; and the anadromous program, while implemented at the Fisheries Division level, is primarily the responsibility of the Warmwater Production Section (See Appendix IV for an organizational framework of the Fisheries Division). This organizational framework has resulted in certain aspects of the fishery being neglected. Contract commitments and manpower limitations have confined the Lake Erie Research Unit's efforts to commercial and forage species on the main lake. Yellow perch, walleye and smelt have received the major emphasis in this program and the biology and population dynamics of other important species such as white bass and white perch are poorly understood. Sport fisheries assessment targets Presque Isle Bay and certain tributary streams. As a result, little is being done with the sport fishery on the main lake and important species such as smallmouth bass remain unstudied. The Warmwater Production Section is not staffed to monitor the biology of the anadromous species after the time of stocking. As a result, the biology of Pennsylvania's coho and chinook salmon, and steelhead trout is, surprisingly, poorly understood. Studies to measure the impact of these fish on native stocks are needed, especially in Presque Isle Bay, where increased stocking allocations have been implemented.

The development of quotas is currently being used for the management of yellow perch. One factor which underlies and could ultimately limit the success of this approach is the issue of unit stocks. This concept is not well understood (Kutkuhn 1981), but one definition of unit stock, attempted by Booke (1981) was "a specific group or population of fish that sustains itself over time in a definable area." A definition provided earlier by Paulik and Greenough (1966) for stocks in the Great Lakes was" a group of fish that would be treated as a homogeneous unit in a management program." The need for stock definition in the Great Lakes has been voiced by Ney (1978), Isbell (1981), Kutkuhn (1981), and Selgeby (1982), among others. Selgeby (1982) explained the danger of not examining this factor. He contends that the decline of lake herring in Wisconsin's waters of Lake Superior resulted from the sequential overharvest of unit stocks by moving from one fishing ground to the next. By harvesting these stocks sequentially, declines in harvest were not apparent until the 1960's when the last two stocks failed. Factors such as depensatory mortality have inhibited the population from rebounding from low levels since then. A similar scenario can be envisioned for Lake Erie yellow perch if the issue of unit stocks is not soon resolved. Tagging studies will be used to study this phenomenon in the main lake. However, the population in Presque Isle

Bay should also be considered. If bay and lake stocks are distinct, as was implied in data from the 1981-82 use and harvest survey, the sport harvest, which represented approximately 44 percent of the commercial harvest during the survey period, has little impact on the main lake populations, since 86 percent of the sport harvest was taken from the bay. Conversely, if there is significant interaction between populations, the impact of sport fishing on Pennsylvania's perch must be considered great, and mortality studies and cohort analyses must take the sport harvest into account.

Migration studies are likewise needed for species other than perch. Near shore migrations for factors such as spawning and feeding account for a marked seasonal nature of the sport fishery. However, the magnitude of these migrations into Presque Isle Bay and tributary streams is unknown. A better understanding of this phenomenon could affect current management strategies for species such as smallmouth bass.

There are problems with the present quota approach to harvest regulations. This approach is based on the equilibrium yield methodology of Ricker (1975) and Beverton and Holt (1957). These models are founded on the assumption that a maximum yield can ultimately be obtained by limiting catch to that of the surplus stock. A major fault with this approach is that it focuses on a single species. Managing one species for maximum yield may have extremely detrimental effects on other species in the community, depending on how these species interact (Larkin 1977). Therefore, it is hoped that management using a community or multispecies approach can be implemented in the future. Initial attempts at the development of multispecies models using computer simulation techniques have been made by Koonce and Shuter (1983) for Lake Erie yellow perch and walleye, and by Koonce et al. (1983) for perch, walleye, white bass and forage species. These models are presently characterized by poor resolution and their refinement is hindered by the fact that little information has been collected concerning the dynamics of species interactions. Quantification of these relationships is needed.

A second problem with the equilibrium yield methodology is that these models were developed under the assumption of steady state conditions in fish populations (Beverton and Holt 1957). In reality, such conditions are rare (Gulland 1978). Yet, there are no models which have proven to operate more satisfactorily than those presently being used (Kutkuhn 1981). Nevertheless, attempts at the development of new methodologies should continue.

Natural mortality rates, which are essential elements of cohort analysis and equilbrium yield determinations, have not been developed for yellow perch in the eastern basin. Pennsylvania's attempts at estimating natural mortality have proven unsatisfactory and a value of 22.5 percent has been assumed by drawing upon the studies of Heyerdahl and Smith (1971) of perch in Red Lakes, Minnesota, and the values used by Hartman et al. (1980) and Isbell (1981) for perch in the western and central basins, respectively. This value could easily be in error and attempts to resolve this problem are needed.

Knowledge of the nature of stock-recruitment relationships is another factor essential to the development of optimum yield estimates. However, these relationships are poorly understood. Continued efforts are needed to define the relative influence of such factors as environmental conditions and stock size on recruitment.

The development of yield equations, estimates of back-calculated growth, virtual population analysis, and multiple regression analysis (used in examining stock-recruitment relationships) are all rigorous mathematical procedures. Most of these procedures are used very little by biologists in other Pennsylvania management areas, but are essential to management on Lake Erie. Because the Lake Erie research biologist currently lacks access to computer facilities, these procedures take up large amounts of time; time which could probably be better utilized in data collection or other areas. Lack of computer capabilities also limits the level of complexity at which the Lake Erie biologist can work. For example, multispecies and other simulation approaches are almost impossible without a computer. Fish management should be based on the best scientific means available. Lack of computer capability limits Pennsylvania's present ability to achieve this ideal.

The index sampling methods currently utilized in Pennsylvania's program are essential to the development of management strategies. However, these methods currently lack precision as sampling variability is large. Also, the level of accuracy, or the indice's ability to measure true abundance, is unknown. Such unknowns limit our ability to understand such things as stock-recruitment relationships. Little confidence can be placed in correlation estimates of these two parameters if the accuracy of the underlying measurements is suspect (Walters and Ludwig 1981). The precision of index samples has been examined by Pennsylvania in the past but more effort to increase precision, examine the accuracy of these methods, and possibly pursue other sampling procedures is needed.

Inaccurate and/or late commercial harvest reports are other current assessment problems. Inaccurate reports can have a substantial effect on total harvest estimates, while late reports make it difficult to determine when the commercial quota has been reached. An improved reporting system is critical to implementation of an effective management program.

Pennsylvania's knowledge of the sport harvest is limited to the results of the 1981-82 use and harvest survey. The significant harvest of species such as yellow perch and walleye suggests that sport fishing mortality should be considered in the development of harvest strategies. However, a one year survey is inadequate for a proper evaluation of such a dynamic factor. A case in point is the fact that during the creel survey, the winter harvest of perch was higher than that during any other season of the year. However, in the year following the survey, an unusually warm winter prevented ice from forming to a sufficient thickness to allow fishing, and the winter harvest was probably very low. Also to be considered is the

possibility that fishing pressure could increase in the near future in light of the city of Erie's current efforts to boost the local economy by attracting more anglers to the lake (Hammer, Siler, George Assoc. 1983). This factor, coupled with the possibility of declining numbers of commercial fishermen which could result if these individuals are unable to weather financial losses resulting from the recent regulatory changes, could result in sport fishing becoming a much larger component of total fishing mortality in the future. The impact of sport fishing on lake trout is another critical issue and must be measured to satisfy the conditions of the LEC's lake trout management plan. Ontario, Ohio, and New York have all recognized the importance of the sport fishery in their respective management jurisdictions and have instituted ongoing surveys. Similar efforts in Pennsylvania are warranted.

Sea lamprey constitute a serious threat to both lake trout rehabilitiation and the success of the anadromous program. Continuing evaluations of this problem are needed, but it appears that control efforts may already be necessary.

Finally, two problems which loom on the horizon are expanded dredging operations and offshore gas drilling. The Erie Sand and Gravel Company recently made application to increase their permitted dredging area from 12 mi^2 to over 100 mi^2. Although the company withdrew this application in December 1983, future attempts to expand dredging operations are likely. Offshore gas drilling in Pennsylvania's waters is a possibility depending on future economic conditions. Each of these practices could pose serious impacts on important species such as walleye, yellow perch, lake trout, and whitefish. However, an evaluation of the importance for spawning of offshore areas which are likely to be impacted has never been done and future study is warranted.

Stocking Programs - Problems

Stocking walleye fry in the Great Lakes, where native populations already exist, has not been shown to have a measurable impact on the fishery (Hile 1936; Dymond 1956). However, where population levels are extremely low, as appears to be the case in Presque Isle Bay, it is conceivable that stocking might be beneficial. Still, when stocking fry, environmental effects are critical in determining survival. If conditions are not conducive to the establishment of high zooplankton populations concurrent to the walleye switch from endogenous to exogenous feeding, high mortality will result. This problem can be ameliorated by stocking walleye as fingerlings. In fact, fingerling plants in other areas of the Great Lakes have appeared to be quite successful (Kernen 1979, Lynchwick and Pellett 1982). Stocking walleye fingerlings should likewise be considered for Presque Isle Bay should future studies reflect low survival of the recently stocked fry.

Stocking Pacific salmon and steelhead in Lake Erie, unlike the stocking of native species, has proven to be a highly successful management technique. Still, this program has not been problem free. The egg viability of Pennsylvania's coho salmon is extremely low when compared to that of coho from the other Great Lakes. Because of this, Pennsylvania must rely on eggs supplied by Michigan to continue the anadromous program. Other problems with Pennsylvania's coho are slower growth rates, lower incidences of fully developed secondary sexual characteristics, and higher incidences of goiters compared to coho from the other lakes. These problems may have related etiologies. However, the specific cause, despite numerous studies at the University of Guelph and elsewhere, remains unknown.

The incubation and rearing techniques used by Pennsylvania in the anadromous program are consistent with the state-of-the-art. However, problems of low flow and high water temperatures have plagued the Fairview Hatchery since it began operation. These problems cause stress, resulting in a constant battle against various diseases and parasites and periodic high mortalities. High mortalities have also been caused by bird predation and an estimated 60,000 fish were lost to this factor alone during the 1981-82 project year. Continued efforts to control these mortality sources are needed.

Control of the introduction of exotic disease organisms to the Great Lakes Basin via interhatchery transfer of anadromous fish is being addressed by the Fish Pathology Unit with its participation in the GLFDCC. Because this unit is based at the Benner Spring Fish Research Station in central Pennsylvania, fish sample collections as related to this commitment take up inordinate amounts of time due to the travel time involved. Another problem concerning disease control has been poor intraagency communication on matters involving the GLFDCC and Lake Erie in general. For the PFC to attain maximal benefit from its participation in the GLFDCC, the Fish Pathology Unit must be kept well informed in these areas.

Fin-clipping of salmon and trout has been eliminated from the Fish Commission's stocking program. This effort had proven to be time consuming and an unnecessary source of stress, particularly since follow up assessment efforts were not being done. Still, cooperative nurseries continue to fin-clip their hatchery stock under the guidance of the Fish Commission. At present, only unstructured assessments involving information obtained from hatchery personnel, waterways patrolmen, and volunteer anglers have been planned to evaluate post-stock returns. Continuation of this program without a well designed and coordinated plan appears to be a futile effort since little useable information will be obtained.

The rationale for the stocking allocations of anadromous salmonids is another unclear issue. Currently, 25 percent of the production of salmon and steelhead is allocated to Presque Isle Bay. The remaining fish are distributed among various tributary streams. Efforts to develop a well defined allocation strategy, as is

currently being done under operation FUTURE for catchable trout, should be pursued.

It is possible that hooking mortality, bird predation, and thermal stress causes significant losses of salmonids soon after they are stocked. Night stocking has been attempted to reduce mortality from birds. However, none of these sources of mortality have been properly evaluated. Efforts to measure and minimize these sources should be considered in the overall management scheme.

Finally, federal aid commitments to the anadromous program have wavered in recent years, causing the PFC to assume increasing portions of the total cost. Efforts to secure additional monies must be considered if the program is to continue at its present level.

Regulations - Problems

The present sport fishing regulations for tributary streams are confusing. Changes have been frequent over the years, reflecting a lack of clear policy on how these streams should be managed. Most major tributaries, with the exception of nursery waters, are open through November 30 which is considered the end of the "salmon season." After this time, through February 28, only approved trout streams are open. Only Twenty Mile Creek, Elk Creek, Crooked Creek, and an upstream portion of Conneaut Creek bear this classification. This factor unnecessarily limits recreational opportunities, since good fall and winter runs of steelhead trout occur in many of the other tributaries. Another regulation limiting recreational opportunities is the closing of all tributary streams from March 1 to the opening day of trout season in April. It is during this period that many spring-running steelhead migrate, spawn, and return to the lake or die. Because spawning success is believed to be minimal in Pennsylvania's tributaries, there is no need to protect these fish and excellent angling opportunities are being lost. With Pennsylvania's escalating interest in the steelhead program, harvest of these trophy sized fish should be promoted, not restricted.

Another need for tributary regulations is a clear definition of where a tributary begins and the lake ends. Clarificiation of this issue could simplify current enforcement efforts.

Smallmouth bass length limits differ between tributaries and the main lake. However, considerable migration of bass into the tributaries is observed during the spring spawning period. The magnitude of this migration should be investigated and the regulations reviewed in light of the findings.

A second issue concerning smallmouth bass is the elimination of the closed season which occurred in 1980. This regulation change has been a hotly contested issue in the Erie area, as will be shown later in this report.

Commercial and sport fishing regulations on the main lake generally appear to be accomplishing their stated objectives. Commercial harvest of perch was reduced by 35 percent in the year following the regulatory changes in 1981, and the average age of recruitment was raised with the increase in gill net mesh size in 1983. Walleye harvest is being controlled through the recently imposed seasonal limits for the commercial fishery and size and creel limits for the sport fishery. However, one regulation which appears to be having little effect in reducing harvest is the 50 fish creel limit for panfish. The goal of this regulation was to reduce sport harvest of perch by 30-35 percent. This regulation was imposed during spring 1982 before any knowledge of the possible effects of such a measure was known. Results from the creel survey, which was completed later that year, showed that fewer than 2 percent of all anglers had harvests even approaching 50 fish. Additional analysis of this data is now being done, but it is clear that changes in this regulation are necessary if a substantial reduction in sport fishing harvest is truly needed.

One additional problem area with respect to sport fishing regulations is the apparent lack of compliance by anglers to largemouth bass length limits. Twenty-one percent of the largemouth bass observed during the 1981-82 creel survey were under the legal size of 12 inches.

Fisheries Management Problems as Perceived by Sportsmen's Clubs

Input from the angling public has been collected to be considered in the development of management recommendations. Erie County and other western Pennsylvania sportsmen's and boating clubs were contacted and asked to complete an angling and boating questionnaire. While club members represent special interest groups, and are therefore not necessarily representative of the "average" angler, input from these clubs should help to define the major problems as viewed by the angling public.

Commercial fishing groups were not contacted in the present effort. However, this contingent, as represented by the Pennsylvania Fish Producers Association (PFPA), is on record as opposing the recent commercial regulation changes. The PFPA contends that the Fish Commission's index samples are inaccurate and therefore inappropriate for use in establishing catch quotas. Commercial fishermen charge that they will be unable to withstand financial losses resulting from the new restrictions. The PFPA has recommended as an alternative to these regulations: 1. Greatly increased license fees to eliminate the casual fisherman, and 2. Increasing quotas for both yellow perch and walleye. Sportsmen's clubs, on the other hand, strongly support the new regulations and would probably support even more conservative measures.

A summary of the responses to the angling and boating questionnaire is presented in Appendix III. One question which was posed in order to gain a general feeling of angler's opinions concerning the

quality of the fishery was to rate the fisheries for each species as having declined, improved, or remained the same over the most recent 10 year period. In general, anglers believed the salmon, steelhead, white bass, and smallmouth bass fisheries had improved and the perch and walleye fisheries had declined. Anglers also were of the general opinion that the largemouth bass, northern pike, muskellunge, and various panfish fisheries in Presque Isle Bay had declined.

To gain an understanding of the public's attitude towards present fishery management programs on Lake Erie, anglers were asked to predict the trend in the same fisheries over the next 10 year period. Most groups believed the salmon and steelhead fisheries would continue to improve and that the perch and walleye fisheries would make a turnaround to improving quality in the future. Opinion was divided for northern pike, muskellunge, white bass and panfish, but in general, no change in the quality of these fisheries was anticipated. Only the largemouth bass and smallmouth bass fisheries were predicted to undergo declines in the future by the majority of the clubs which responded.

Sportsmen's clubs were asked to note what they felt were the greatest fishing and boating needs in Pennsylvania's Lake Erie coastal zone, along with any regulation changes they believed were warranted. The need for better access to the fishery was the most common response to the question of fishing and boating needs. However, needs relating directly to the fishery were also frequently voiced. The focal points of angler dissatisfaction were the management of bass and other native species and regulations on tributary streams.

Eight of the eleven clubs responding stated that changes in the regulation of the bass fishery were needed. Two clubs listed this aspect as the most urgent need. Five clubs called for the reinstatement of the bass season; two clubs called for increased length limits; and one club suggested that refuge areas were needed during the spawning period.

Six clubs stated that more effort was needed on native species in general. Four of these clubs called for increased stocking of native fish, one club suggested the development of "spawning refuges" during the spring, and several other clubs suggested "protection" of native fish during the spawning period.

Among the changes recommended for the management of tributary streams were: elimination of closed seasons (4 clubs); a 3 fish creel limit (3); single hooks only (3); no night fishing (2); no landing nets (2); elimination of put and take stocking (2); increasing minimum size limits for salmonids (2); and standardization of lake and tributary size limits (1) and creel limits (1).

Other recommended changes included increasing the stocking rate of salmonids (2 clubs), initiation of lamprey control (1), and stocking all trout south of Route 5 and all salmon north of Route 5 (1).

Fisheries Assessment Programs - Recommendations

1. Coordinate the assessment efforts of the Research, Fisheries Management and Warmwater Production Sections to develop a more efficient and comprehensive assessment program.

2. Continue index sampling to obtain abundance and recruitment data for yellow perch, walleye, lake trout, whitefish, white bass, white perch, and forage species. Expand the program to include smallmouth bass.

3. Expand efforts to measure and improve the precision and accuracy of index samples. Alternative sampling methods such as Miller high speed samplers (Forney 1980), acoustical techniques (Argyle 1982), midwater trawls, and canned gill nets might be considered.

4. Continue mortality and age and growth studies for yellow perch and walleye and expand to include all other commercial and sport species targetted in index samples, as well as salmon and steelhead.

5. Initiate studies to monitor the impact of anadromous salmonids on native stocks in Presque Isle Bay.

6. Include fish from Presque Isle Bay in future tagging studies for stock assessment of yellow perch

7. Investigate the magnitude of annual migrations of smallmouth bass into Presque Isle Bay and tributary streams to determine stock discreteness. Other species such as white bass could also be considered in these efforts.

8. If it is determined that bay and lake stocks are distinct, establish management programs separately for each. Then, since it is impractical to enforce regulations in the bay differently from those on the lake, manage the entire population as the stock which is determined to need the most conservative regulatory measures.

9. Identify the areas presently being utilized as spawning habitat by important sport and commercial species. Particular emphasis should be placed on those areas which would be most affected by future gas drilling and dredging activities.

10. Continue to cooperate with the GLFC in the development of multispecies modelling and harvest strategies.

11. Continue to cooperate with the Yellow Perch Task Group of the LEC in the development of interagency harvest strategies for yellow perch, while simultaneously continuing and refining a unilateral approach.

12. Continue to study stock-recruitment relationships for yellow perch using multiple regression analysis.

13. Develop a plan for the computerization of present analysis procedures. Two possible approaches are as follows:

    a. Centralization of computer analysis efforts at the Bellefonte office as is presently done for the Fisheries Management Section.
    b. Acquisition of a desk top computer for the Lake Erie Research Lab at Fairview.

14. Attempt to refine estimates of natural mortality for eastern basin yellow perch.

15. Conduct additional sport fishing use and harvest analyses on an alternating 2 or 3 year basis. These efforts are costly and alternative methods to those used previously should be considered. A scaled down monitoring system using a subsample of the sites studied in 1981-82 is one possibility. Another possibility is the dual frame approach developed by Human Science Research, Inc. for the National Marine Fisheries Service to evaluate marine sport fisheries (Hiett and Ghosh 1977). This method combines data collected from both direct contact and telephone interviews and may prove less costly than a survey consisting of direct contact interviews only. This approach has been suggested by Eck (1980) as a possible interagency Great Lakes approach.

16. Improve the commercial harvest reporting system. One suggestion offered by Hoopes and Kenyon (1982) is that receipts for sale of fish be required with harvest reports with a signed statement that these reports are accurate. Supplying harvest reports to waterways patrolmen might aid them in identifying possible violations. Steps must also be taken to assure timely reporting, since this factor is critical to quota management.

17. Continue to monitor lamprey scarring rates and participate in the initiation of interagency lamprey control efforts.

Stocking Programs - Recommendations

1. Consider stocking walleye fingerlings in Presque Isle Bay should fry stocking efforts fail.

2. Continue to cooperate with the University of Guelph to determine the etiology of goiters, slow growth, lack of secondary sexual characteristics and poor egg viability for coho salmon. Consider initiating additional studies of our own.

3. Initiate efforts to reduce high hatchery mortalities of coho salmon from bird predation and marginal water quality. Shielding the raceways has been suggested as one possible approach.

4. Include greater participation of Erie area staff in matters involving disease control (e.g. fish sampling) and improve intraagency communication related to the GLFDCC commitment.

5. Terminate all fin clipping of salmon and trout by both the PFC and sportsmen's cooperative nurseries unless this effort becomes part of a well designed study with well defined goals.

6. Develop a rationale for stocking allocations and stocking rates of Pacific salmon and steelhead.

7. Evaluate hooking mortality, bird mortality, and mortality from thermal stress in streams, of Pacific salmon and steelhead smolts and develop a methodology to minimize both.

8. Identify new sources of funding for the anadromous program.

Regulations - Recommendations

1. Expand the extended trout season to waters other than those classified as approved trout streams.

2. Open at least portions of these same tributaries to year around fishing.

3. Include with the current regulations a definition of where tributary streams begin and the main lake ends.

4. Review the rationale for differing length limits for smallmouth bass between Lake Erie and tributary streams.

5. Analyze the effectiveness of the 50 panfish creel limit and determine if more restrictive measures are warranted.

6. Intensify enforcement with respect to largemouth bass length limits (The instatement of a third Erie County waterways patrolman will help alleviate the current problem).

Table 1. Lake Erie Stocking Records, 1934-1982. Locations are: E = Lake Erie (location unspecified), P = Presque Isle Bay, T = Tributaries

Year	Species	Location	Size (inches)	Number
1934	Sunfish	E	2	4,000
	Catfish	E	4	1,500
	Frogs	E	3	10,000
1935	Blue pike	E	Fry	68,613,000
	Muskellunge	E	4-12	123
	Walleye	E	Fry	900,000
	Yellow perch	E	Fry	156,800,000
	Whitefish	E	Fry	18,500,000
	Cisco	E	Fry	3,240,000
1936	Blue pike	E	Fry	21,242,000
	Muskellunge	P	5-10	399
	Walleye	P	Fry	400,000
	Yellow perch	E	Fry	15,000,000
	Largemouth bass	E	2-3	1,000
	Smallmouth bass	E	2	2,000
	Smallmouth bass	P	10-12	122
	Catfish	P	10	750
	Whitefish	E	Fry	8,460,000
	Cisco	E	Fry	14,000,000
1937	Blue pike	E	Fry	61,769,000
	Muskellunge	E	6	58
	Walleye	E	Fry	1,980,000
	Walleye	P	Fry	300,000
	Largemouth bass	E	3-6	3,000
	Smallmouth bass	E	12	110
	Yellow perch	E	Fry	22,200,000
1938	Largemouth bass	E	3-6	4,590
	Smallmouth bass	E	12	52
	Bream	E	2	500
	Whitefish	E	Fry	2,000,000
	Cisco	E	Fry	1,530,000
1939	Blue pike	E	Fry	7,625,000
	Walleye	E	Fry	8,750,000
	Largemouth bass	E	3	3,000
	Yellow perch	E	Fry	38,000,000
	Cisco	E	Fry	13,600,000

Table 1. (Cont'd.)

Year	Species	Location	Size (inches)	Number
1940	Walleye	E	Fry	9,199,000
	Largemouth bass	E	2-6	5,850
	Smallmouth bass	E	5	275
	Yellow perch	E	Fry	144,000,000
	Cisco	E	Fry	12,000,000
1941	Walleye	E	Fry	4,625,000
	Largemouth bass	P	3-6	6,450
	Smallmouth bass	P	5-16	600
	Yellow perch	E	Fry	65,000,000
	Bream	E	2-3	9,723
	Catfish	E	6	3,000
	Cisco	E	Fry	16,650,000
1942	Walleye	E	Fry	31,000,000
	Walleye	P	Fry	4,000,000
	Largemouth bass	P	3.5-4	7,000
	Yellow perch	E	Fry	15,750,000
	Yellow perch	P	Fry	19,250,000
	Whitefish	E	Fry	31,185,000
	Cisco	E	Fry	4,545,000
1943	Walleye	E	Fry	18,375,000
	Largemouth bass	P	3	10,000
	Yellow perch	E	Fry	62,500,000
	Whitefish	E	Fry	18,928,000
1944	Blue pike	E	Fry	1,075,000
	Walleye	E	Fry	13,800,000
	Largemouth bass	P	3-4	10,000
	Yellow perch	E	Fry	71,150,000
	Whitefish	E	Fry	5,200,000
1945	Blue pike	E	Fry	870,000
	Walleye	E	Fry	525,000
	Largemouth bass	P	2.5-7	8,000
	Yellow perch	E	Fry	56,775,000
	Cisco	E	Fry	2,520,000
1946	Walleye	E	Fry	375,000
	Largemouth bass	P	2.5	10,000
	Yellow perch	E	Fry	153,150,000
	Cisco	E	Fry	9,500,000

Table 1. (Cont'd.)

Year	Species	Location	Size (inches)	Number
1947	Walleye	P	Fry	8,020,000
	Largemouth bass	P	2-4	17,000
	Yellow perch	E	Fry	146,912,500
	Whitefish	E	Fry	2,516,000
	Cisco	E	Fry	5,400,000
1948	Walleye	E	Fry	610,000
	Largemouth bass	P	1.5-4.5	15,204
	Yellow perch	E	Fry	233,466,000
	Whitefish	E	Fry	9,500,000
	Cisco	E	Fry	11,500,000
1949	Blue pike	E	Fry	22,375,000
	Walleye	E	Fry	1,875,000
	Largemouth bass	P	2.5-4.5	14,946
	Yellow perch	E	Fry	257,800,000
	Bream	E	.5	30,000
	Whitefish	E	Fry	36,600,000
	Cisco	E	Fry	5,000,000
1950	Blue pike	E	Fry	37,000,000
	Walleye	E	Fry	525,000
	Largemouth bass	P	1.5-3.5	12,598
	Yellow perch	E	Fry	350,734,000
	Sunfish	E	1-2	30,000
	Whitefish	E	Fry	9,000,000
	Cisco	E	Fry	1,500,000
1951	Blue pike	E	Fry	1,250,000
	Walleye	E	Fry	41,000,000
	Largemouth bass	P	2-5	15,321
	Yellow perch	E	Fry	308,250,000
	Cisco	E	Fry	1,500,000
1952	Walleye	E	Fry	31,000,000
	Largemouth bass	P	2.5-4	13,956
	Yellow perch	E	Fry	288,500,000
	Whitefish	E	Fry	6,000,000
1953	Blue pike	E	Fry	840,000
	Walleye	E	Fry	53,140,000
	Largemouth bass	P	Fry	50,000
	Largemouth bass	P	3-4	9,960
	Yellow perch	E	Fry	318,875,000

Table 1. (Cont'd.)

Year	Species	Location	Size (inches)	Number
1954	Blue pike	E	Fry	500,000
	Walleye	E	Fry	30,000,000
	Largemouth bass	P	3-4	30,626
	Yellow perch	E	Fry	477,150,000
	Yellow perch	E	8	176
	Cisco	E	Fry	100,000
1955	Blue pike	E	Fry	3,000,000
	Walleye	E	Fry	43,850,000
	Largemouth bass	P	3.5-4	7,642
	Yellow perch	E	Fry	456,500,000
	Yellow perch	E	7	100
1962	Northern pike	P	Fry	130,000
1964	Muskellunge	P	5.5-6.5	500
	Largemouth bass	P	3.5-4.5	2,500
1965	Muskellunge	P	3.5-4.5	1,000
	Largemouth bass	P	2.5-3.5	6,000
1967	Northern pike	P	Fry	25,000
1968	Coho salmon	E	7	20,000
	Coho salmon	T	7	45,000
	Brown trout	E	6-12	91
	Rainbow trout	E	6-8	3
1969	Coho salmon	T	4-7	129,473
	Lake trout	E	3-5	16,988
	Brook trout	E	6-8	6,000
1970	Coho salmon	E	4-6	185,135
	Steelhead trout	E	3-5	144
1971	Muskellunge	P	9-11	1,200
	Northern pike	P	11-13	1,200
	Chinook salmon	E	4-6	129,040
	Coho salmon	E	4-7	139,774
1972	Muskellunge	P	7-9	2,000
	Chinook salmon	E	2-3	150,000
	Coho salmon	E	5-8	115,627

Table 1. (Cont'd.)

Year	Species	Location	Size (inches)	Number
1973	Muskellunge	P	6-11	2,000
	Northern pike	P	Fry	245,000
	Chinook salmon	E	2-4	155,000
	Coho salmon	E	5-7	297,400
1974	Northern pike	P	Fry	245,000
	Channel catfish	P	2-4	150,000
	Chinook salmon	E	2-5	188,837
	Coho salmon	E	4-11	451,700
	Lake trout	E	6-9	16,050
	Steelhead trout	E	6-8	5,200
1975	Muskellunge	P	6-9	4,000
	Chinook salmon	E	2-4	483,000
	Coho salmon	P	4-6	90,000
	Coho salmon	T	5-10	273,381
	Lake trout	E	7-9	33,600
	Steelhead trout	E	5-6	9,750
1976	Muskellunge	P	6-8	3,500
	Walleye	P	14-23	26
	Yellow perch	P	13	1
	Black crappie	P	11-13	16
	Bluegill	P	8-10	15
	Sucker	P	18-19	2
	Carp	P	22	1
	Chinook salmon	T	2-3	769,000
	Coho salmon	P	4-8	70,640
	Coho salmon	T	4-8	177,000
	Coho salmon	E	14-22	27
	Lake trout	E	5-6	15,500
	Steelhead trout	E	14-18	3
	Steelhead trout	T	6-9	21,000
1977	Chinook salmon	T	2-3	1,497,850
	Coho salmon	P	4-5	140,000
	Coho salmon	T	5-8	495,955
	Steelhead trout	T	6-8	14,500
1978	Muskellunge	P	7-14	4,410
	Northern pike	P	Fry	250,000
	Chinook salmon	T	1-3	572,000
	Chinook salmon	T	4-7	95,865
	Coho salmon	P	4-9	1,190,528
	Coho salmon	T	5-7	540,960
	Steelhead trout	T	4-9	36,000

Table 1. (Cont'd.)

Year	Species	Location	Size (inches)	Number
1979	Muskellunge	P	5-9	5,700
	Northern pike	P	2-8	16,135
	Largemouth bass	P	2-4	11,500
	Chinook salmon	T	2-9	875,061
	Coho salmon	P	5-6	10,000
	Coho salmon	T	5-9	88,400
	Steelhead trout	T	4-9	170,700
1980	Muskellunge	P	5-7	5,700
	Northern pike	P	6-8	9,950
	Largemouth bass	P	2-4	11,500
	Chinook salmon	T	2-9	448,872
	Coho salmon	P	4-7	138,000
	Coho salmon	T	4-7	389,700
	Steelhead trout	T	3-6	398,000
1981	Northern pike	P	2-4	15,205
	Chinook salmon	T	2-9	448,800
	Coho salmon	P	4-6	84,000
	Coho salmon	T	4-6	369,700
	Steelhead trout	T	3-8	309,500
1982	Muskellunge	P		5,393
	Northern pike	P		10,287
	Coho	E		1,186,600
	Coho	P		188,500
	Steelhead	E		375,700

Table 2. Sportsmen's Cooperative Nursery Stocking Record for Lake Erie, 1972-1982. Locations are: P = Presque Isle Bay, T = Tributaries.

Year	Species	Location	Number
1972	Brook trout	T	1,800
	Brown trout	T	2,800
	Rainbow trout	T	35,993
	Steelhead trout	T	2,080
	Coho salmon	T	15,600
1973	Brook trout	T	790
	Brown trout	T	4,430
	Rainbow trout	T	21,294
	Palomino trout	T	17
	Steelhed trout	T	35,000
	Coho salmon	T	17,800
	Walleye	P	250,000
1974	Palomino trout	T	200
	Steelhead trout	T	52,700
	Walleye	P	240,000
1975	Brook trout	T	1,769
	Brown trout	T	2,850
	Rainbow trout	T	14,433
	Palomino trout	T	15,061
	Steelhead trout	T	47,200
	Coho salmon	T	3,102
	Walleye	P	240,000
1976	Brook trout	T	1,948
	Brown trout	T	8,802
	Rainbow trout	T	19,787
	Palomino trout	T	70
	Steelhead trout	T	48,000
	Walleye	P	235,000
1977	Brook trout	T	1,778
	Brown trout	T	41,396
	Rainbow trout	T	9,167
	Palomino trout	T	10,000
	Steelhead trout	T	25,000
	Walleye	P	250,000
1978	Brook trout	T	1,700
	Brown trout	T	35,790
	Rainbow trout	T	32,990
	Palomino trout	T	10,000
	Steelhead trout	T	9,000

Table 2. (Cont'd.)

Year	Species	Location	Number
1979	Brown trout	T	43,290
	Rainbow trout	T	12,920
	Palomino trout	T	8,190
	Steelhead trout	T	28,400
	Coho salmon	T	9,700
1980	Brook trout	T	3,462
	Brown trout	T	34,143
	Rainbow trout	T	6,913
	Palomino trout	T	2,010
	Steelhead trout	T	45,000
	Coho salmon	T	7,500
1981	Brown trout	T	38,876
	Rainbow trout	T	11,112
	Palomino trout	T	50
	Steelhead trout	T	40,400
	Coho salmon	T	14,000
1982	Brown trout	T	29,123
	Rainbow trout	T	14,605
	Steelhead trout	T	55,000
	Coho salmon	T	21,000

Table 3. Pennsylvania Fish Commission and Co-Operative Nurseries Lake Erie Salmonid Plantings, 1982.

Locations	Numbers	Remarks
		Chinook Salmon
Elk Creek	22,260	Brood Year 1980, Spring Fing., No Marking
Walnut Creek	24,400	Brood Year 1980, Spring Fing., No Marking
Sub-Total	46,660	
		Coho Salmon
Crooked Creek	100,000	Brood Year 1981, Spring Fing., No Marking
Crooked Creek	66,000	Brood Year 1980, Spring Fing., No Marking
Elk Creek	100,000	Brood Year 1980, Spring Fing., No Marking
Elk Creek (Hotchkiss Site)	35,600	
Godfrey Run (Mission Site)	41,000	
Orchard Beach Run	100,000	Brood Year 1981, Spring Fing., No Marking
Raccoon Creek	175,000	Brood Year 1981, Sprin- Fing., No Marking
Presque Isle Bay (Lake Erie)	188,500	Brood Year 1981, Spring Fing., No Marking
Sixteen Mile Creek	100,000	
Trout Run	94,000	
Twelve Mile Creek	75,000	
Twenty Mile Creek	100,000	
Walnut Creek	100,000	Brood Year 1981, Spring Fing., No Marking
Walnut Creek	100,000	Brood Year 1980, Spring Fing., No Marking
Orchard Beach Run (Coops)	21,000	
Sub-Total	1,396,100	
		Brook Trout
Elk Creek (Oswayo FCS)	3,000	In-Season
Walnut Creek (Coops)	500	In-Season
Elk Creek (Coops)	300	Pre-Season
Walnut Creek (Coops)	100	In-Season
Sub-Total	3,900	
		Brown Trout
Elk Creek (Oswayo FCS)	6,200	Pre-Season
Crooked Creek (Oswayo FCS)	1,650	Pre-Season
Twenty Mile Creek (Oswayo FCS)	3,650	In-Season
Lake Erie (Coops)	25,000	In-Season
Elk Creek (Coops)	400	Pre-Season
Walnut Creek (Coops)	400	Pre-Season
Albion Reservoir, Trib. to Temple Run (Coops)	1,162	In-Season
Conneaut Creek (Coops)	1,156	In-Season
Temple Run, Trib. to Conneaut Creek (Coops)	380	Pre-Season
Temple Run, Trib. to Conneaut Creek (Coops)	125	In-Season
Baldwin Pond, Trib. to Raccoon Creek	500	Pre-Season
Sub-Total	40,623	

Table 3. (Cont'd.)

Locations	Numbers	Remarks
		Palomino Rainbow Trout
Elk Creek (Oswayo FCS)	615	Pre-Season
Crooked Creek (Oswayo FCS)	100	Pre-Season
Sub-Total	715	
		Rainbow Trout
Elk Creek (Oswayo FCS)	10,185	Pre-Season
Crooked Creek (Oswayo FCS)	1,250	Pre-Season
Twenty Mile Creek (Oswayo FCS)	3,980	Pre-Season
Elk Creek (Coops)	1,500	In-Season
Walnut Creek (Coops)	3,300	In-Season
Crooked Creek (Coops)	400	In-Season
West Branch Conneaut Creek (Coops)	228	In-Season
Little Elk Creek, Trib. to Elk Creek (Coops)	410	Pre-Season
Taylor Run, Trib. to Temple Run (Coops)	480	Pre-Season
Temple Run, Trib. to Conneaut Creek (Coops)	7,310	Pre-Season
Temple Run, Trib. to Conneaut Creek (Coops)	977	Pre-Season
Sub-Total	30,020	
		Steelhead Trout
Elk Creek (Tionesta FCS)	50,000	
Godfrey Run (Tionesta FCS)	86,000	
Sixteen Mile Creek (Tionesta FCS)	50,000	
Trout Run (Tionesta FCS)	89,700	
Twelvemile Creek (Tionesta FCS)	50,000	
Walnut Creek (Tionesta FCS)	50,000	
Godfrey Run (Coops)	8,000	
Lake Erie (Coops)	47,000	
Sub-Total	430,700	
Grand Total	1,948,718	

Table 4. Lake Trout Stocking Records U.S. Waters of the Eastern Basin of Lake Erie, 1969-1982. Agency Responsible for Rearing in Parentheses.

Year	Fingerlings	Yearlings
1969		17,000 (PFC)
1974		26,050 (PFC)
1975	100,000 (NYDEC)	33,600 (PFC)
1976	186,000 (USFWS)	15,500 (PFC)
1977	125,000 (USFWS)	
1978		236,000 (USFWS)
1979	500,000 (USFWS)	200,000 (USFWS)
1980	445,000 (USFWS)	40,000 (USFWS)
1981	38,000 (USFWS)	40,500 (USFWS)
1982		196,040 (USFWS)

Table 5. Pennsylvania's Lake Erie Commercial Harvest, 1982.

Species	Pounds	Value	Incidental Catch (Pounds)
Yellow perch	203,988	$244,321	
Emerald shiner*	7,947	18,099	
White bass	73,626	11,153	
Walleye	6,338	5,583	3,389
Smelt	17,619	540	
Whitefish	340	304	
Drum	241,140	268	4,680
Burbot	347	33	9
Channel catfish	881	7	25
Bullheads	314		130
White sucker	7,198		
Redhorse	11,440		807
Carp	126		
Shad	7,979		
White perch	1,439		14
Lake trout			2,205
Salmon			2,583
Black bass			252
Sturgeon			29
Total	580,722	280,311	14,123

*Baitfish seining industry

Table 6. Species Sought by all Interviewed Anglers on Pennsylvania's Lake Erie Waters, June 1981 May 1982.

Species	West End		East End		Presque I. Bay		Total	
	Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank
Coho Salmon	47.4	1	39.9	1	8.7	3	23.8	2
Chinook Salmon	18.3	3	13.4	5	1.0	8	7.7	5
Steelhead Trout	27.5	2	16.4	3	0.8	9	10.9	4
Brown Trout	0.7	9	0.0		<0.1	14	0.2	13
Yellow Perch	4.3	6	9.1	7	50.9	1	32.4	1
Walleye	13.2	4	17.5	2	1.2	7	6.3	6
Smallmouth Bass	4.1	7	14.1	4	6.1	5	5.8	7
Largemouth Bass	0.2	12	2.4	8	2.3	6	1.6	9
Crappie	<0.1	14	0.7	9	6.3	4	3.8	8
Sunfish	0.0		0.0		0.8	9	0.5	11
Channel Catfish	1.1	8	0.3	20	0.2	13	0.6	10
Bullhead	0.4	11	0.3	10	0.7	10	0.6	10
White Bass	0.1	13	0.3	10	0.4	12	0.3	12
Northern Pike	0.0		0.0		0.6	11	0.3	12
Muskellunge	<0.1	14	0.0		0.2	13	0.1	14
White Sucker	0.6	10	0.0		0.0		0.2	13
Carp	0.0		0.0		0.4	12	0.3	12
Anything that bites	8.8	5	11.7	6	28.8	2	20.9	3

Table 7. Total Sport Fishing Catch and Harvest (100's of Fish) from Pennsylvania's Lake Erie Waters, June 1981 May 1982. (C = Catch, H = Harvest)

Species	West End		P.I. Bay		East End		Total	
	C	H	C	H	C	H	C	H
Coho salmon	284	273	106	101	59	58	449	432
Chinook salmon	65	64	4	4	12	11	81	79
Steelhead	156	127	11	10	12	11	181	148
Palomino trout	6	6	0	0	0	0	6	6
Brown trout	8	5	2	2	2	1	12	9
Brook trout	1	<1	0	0	0	0	1	<1
Lake trout	4	4	7	7	1	1	12	12
Yellow perch	430	359	5915	4266	467	357	6812	4981
Walleye	295	269	19	16	93	87	408	372
Smallmouth bass	148	58	475	158	283	116	906	331
Largemouth bass	4	2	238	33	3	<1	246	36
Black crappie	4	0	725	580	61	55	791	635
White crappie	0	0	28	14	1	1	29	14
Pumpkinseed	2	<1	820	356	19	6	840	363
Bluegill	7	<1	294	95	5	1	305	96
Rock bass	38	16	196	87	66	12	300	114
Warmouth	0	0	1	0	0	0	1	0
Channel catfish	17	8	14	6	11	8	42	23
Brown bullhead	11	1	91	44	5	<1	105	46
Black bullhead	0	0	9	7	4	4	13	10
Yellow bullhead	4	1	14	4	2	1	19	6
Stonecat	3	2	0	0	7	7	11	10
White bass	36	10	518	351	116	94	669	455
White perch	1	0	1	<1	0	0	2	<1
Northern pike	0	0	28	2	0	0	28	2
Muskellunge	0	0	6	1	0	0	6	1
Freshwater drum	763	50	296	40	352	17	1411	107
White sucker	7	5	1	<1	3	0	11	6
Redhorse	0	0	2	2	0	0	2	2
Common carp	6	<1	18	10	0	0	25	10
Rainbow smelt	17	17	13	6	0	0	30	23
Bowfin	0	0	2	1	0	0	2	1
Total	2317	1277	9854	6203	1584	848	12757	8330

Table 8. Comparison of Sport and Commercial Harvest from Pennsylvania's Lake Erie Waters, June 1981-May 1982.

Species	Sport Harvest		Commerical Harvest	
	Kilograms	Pounds	Kilograms	Pounds
Walleye	37,074	81,734	10,084	22,232
Rainbow smelt	63	139	7,660	16,888
Yellow perch	50,784	111,960	116,138	256,041
White sucker	764	1,684	2,562	5,649
Carp	1,440	3,175	104	229
Channel catfish	1,654	3,646	295	650
Freshwater drum	4,846	10,684	95,132	209,730
White bass	3,870	8,532	28,887	63,685
Coho salmon	90,617	199,776		
Lake trout	1,625	3,582		
Smallmouth bass	20,935	46,154		
Largemouth bass	1,250	2,756		
Black crappie	9,906	21,839		
Pumpkinseed	2,787	6,145		
Bluegill	701	1,545		
Northern pike	276	608		
Brown bullhead	1,431	3,155		

Table 9. Fishing-Oriented Expenditures Attributable to Species, Lake Erie, Pennsylvania, 1982 (Hammer, Siler, George Assoc. 1983).

	Expenditures Generated	Share
Coho salmon	$1,606,000	23.8%
Chinook salmon	472,000	7.0
Steelhead trout	358,000	5.3
Yellow perch	1,450,000	21.5
Smallmouth bass	560,000	8.3
Walleye	762,000	11.3
Largemouth bass	121,000	1.8
Panfish	1,370,000	20.3
Other Game Fish	47,000	0.7
Total	$6,746,000	100.0%

Table 10. Comparison of Back-Calculated Mean Total Lengths of Yellow Perch Sampled in Pennsylvania Waters of Lake Erie. Data in mm.

1972 Period

Age Groups	1	2	3	4	5	6	7	8
Male	87	148	183	207	235	250	258	
Female	91	146	191	214	247	284	290	

1977-1981 Period

Age Groups	1	2	3	4	5	6	7	8
Male	102	156	195	216	234	249	258	277
Female	103	163	213	250	284	303	323	351

Table 11. Comparison of Female Yellow Perch Maturity Schedules, 1971-72 and 1979-81.

Year	Age:	I+	II+	III+	IV+
		Percent Mature			
1971		0	46	63	100
1972		0	39	80	100
					n = 330
1979		0	96	100	100
1980		0	84	100	100
1981		7	97	100	100
					n = 1048

Table 12. Age-Composition Structure of Eastern Basin and Western Basin Lake Erie Walleye.

Eastern Basin: PA waters, spring

	Age Group							
	2	3	4	5	6	7	8	9+
1982								
n	58	13	34	7	8	8	12	4
%	40.3	9.0	23.6	4.9	5.6	5.6	8.3	2.8
TL	353	454	502	543	573	602	590	622-741
	13.9	17.9	19.8	21.4	22.6	23.7	23.2	24.5-29.2
	(Mean Age - 4.6 yrs.)							
1981								
n	10	27	12	6	9	12	12	5
%	10.8	29.0	12.9	6.5	9.7	12.9	12.9	5.4
TL	351	451	493	542	546	575	630	622
	13.8	17.8	19.4	21.3	21.5	22.6	24.8	24.5
	(Mean Age - 4.9 yrs.)							
1980								
n	24	29	11	8	16	9	15	31
%	16.8	20.3	7.7	5.6	11.2	6.3	10.5	21.7
TL	358	458	487	528	557	557	569	504-779
	14.1	18.0	19.2	20.8	21.9	21.9	22.4	19.8-30.7
	(Mean Age - 5.6 yrs.)							

Western Basin: OHIO Waters, Fall

	Age Group						
	1+	2+	3+	4+	5+	6+	7+
1980							
n	120	89	85	8	9	2	1
%	38.2	28.3	27.1	2.5	2.9	0.6	0.3
TL	342	416	464	527	540	545	515
	13.5	16.4	18.3	20.7	21.3	21.5	20.3
	(Mean Age - 2.1 yrs.)						
1981							
n	64	28	25	17	3	2	1
%	45.7	20.0	17.9	12.1	2.1	114	0.7
TL	297	361	403	455	469	559	550
	11.7	14.2	15.9	17.9	18.5	22.0	21.6
	(Mean Age - 2.4 yrs.)						

Table 13. Checklist of Species Known to Occur in Pennsvlvania's Lake Erie Waters.

Lake sturgeon	Quillback
Spotted gar	Longnose sucker
Longnose gar	White sucker
Bowfin	Northern hog sucker
Alewife	Bigmouth buffalo
Gizzard shad	Silver redhorse
Mooneye	Black redhorse
Lake Erie cisco	Golden redhorse
Lake whitefish	Shorthead redhorse
Lake trout	Black bullhead
Rainbow trout	Yellow bullhead
Palomino rainbow trout	Brown bullhead
Brown trout	Channel catfish
Brook trout	Stone cat
Coho salmon	Tadpole madtom
Chinook salmon	Brindled madtom
Pink salmon	Troutperch
Rainbow smelt	Burbot
Grass pickeral	Banded killifish
Northern pike	Brook silverside
Muskellunge	White bass
Goldfish	White perch
Carp	Rock bass
Redside dace	Pumpkinseed
Longnose dace	Warmouth
Blacknose dace	Bluegill
Silverjaw Minnow	Green sunfish
Silver chub	Smallmouth bass
Bigeye chub	Largemouth bass
Hornyhead chub	White crappie
River chub	Black crappie
Creek chub	Blackside darter
Golden shiner	Rainbow darter
Emerald shiner	Johnny darter
Common shiner	Greenside darter
Striped shiner	Fantail darter
Pignose shiner	Varigate darter
Blackchin shiner	Channel darter
Blacknose shiner	Banded darter
Spottail shiner	Logperch
Rosyface shiner	Yellow perch
Spotfin shiner	Sauger
Sand shiner	Walleye
Silver shiner	Freshwater drum
Mimic shiner	Mottled sculpin
Fathead minnow	Sea lamprey
Bluntnose minnow	American brook lamprey
Stoneroller	Ohio lamprey

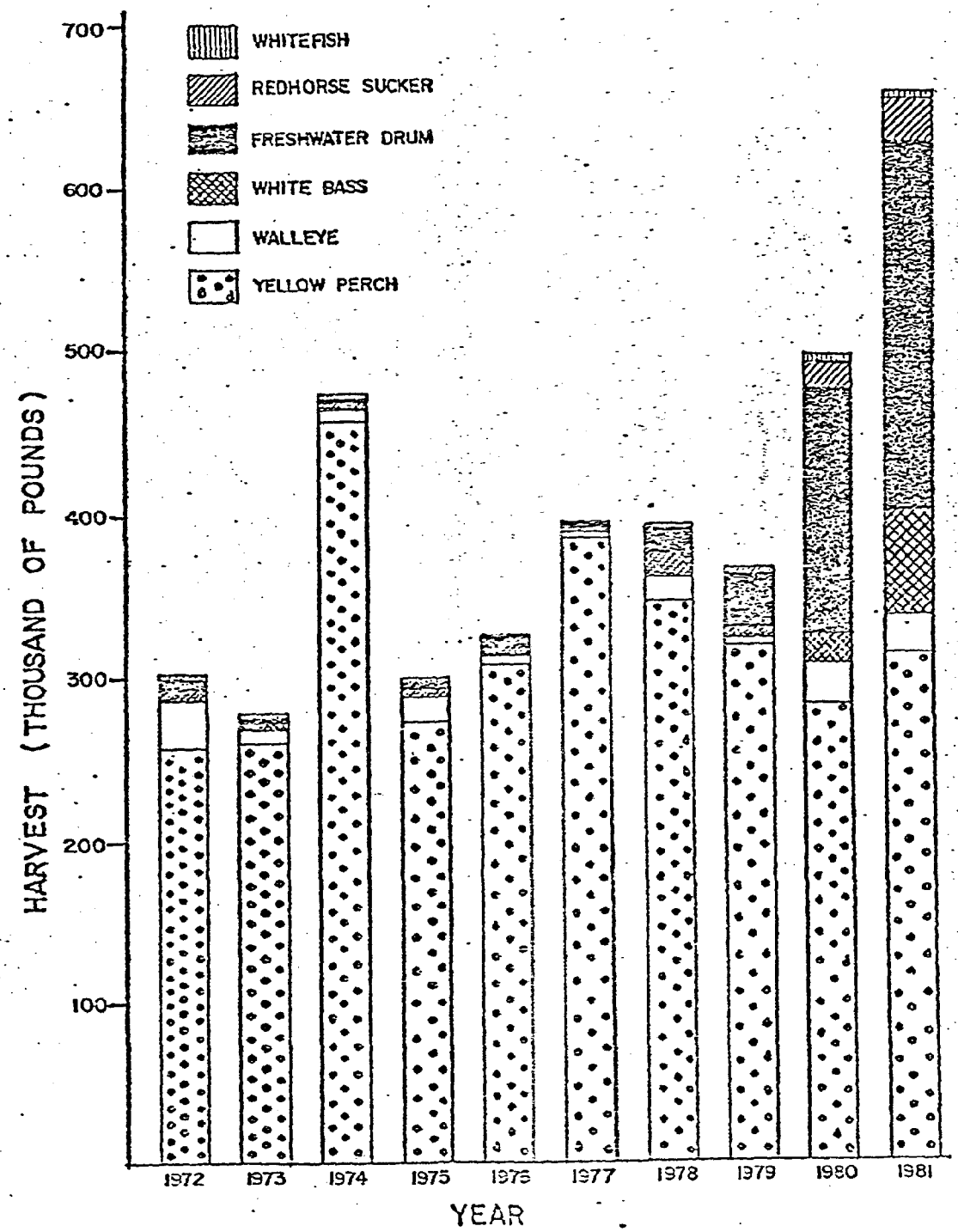


Figure 2. Annual Harvest by Pennsylvania's Lake Erie Commercial Fishery, 1972-1981.

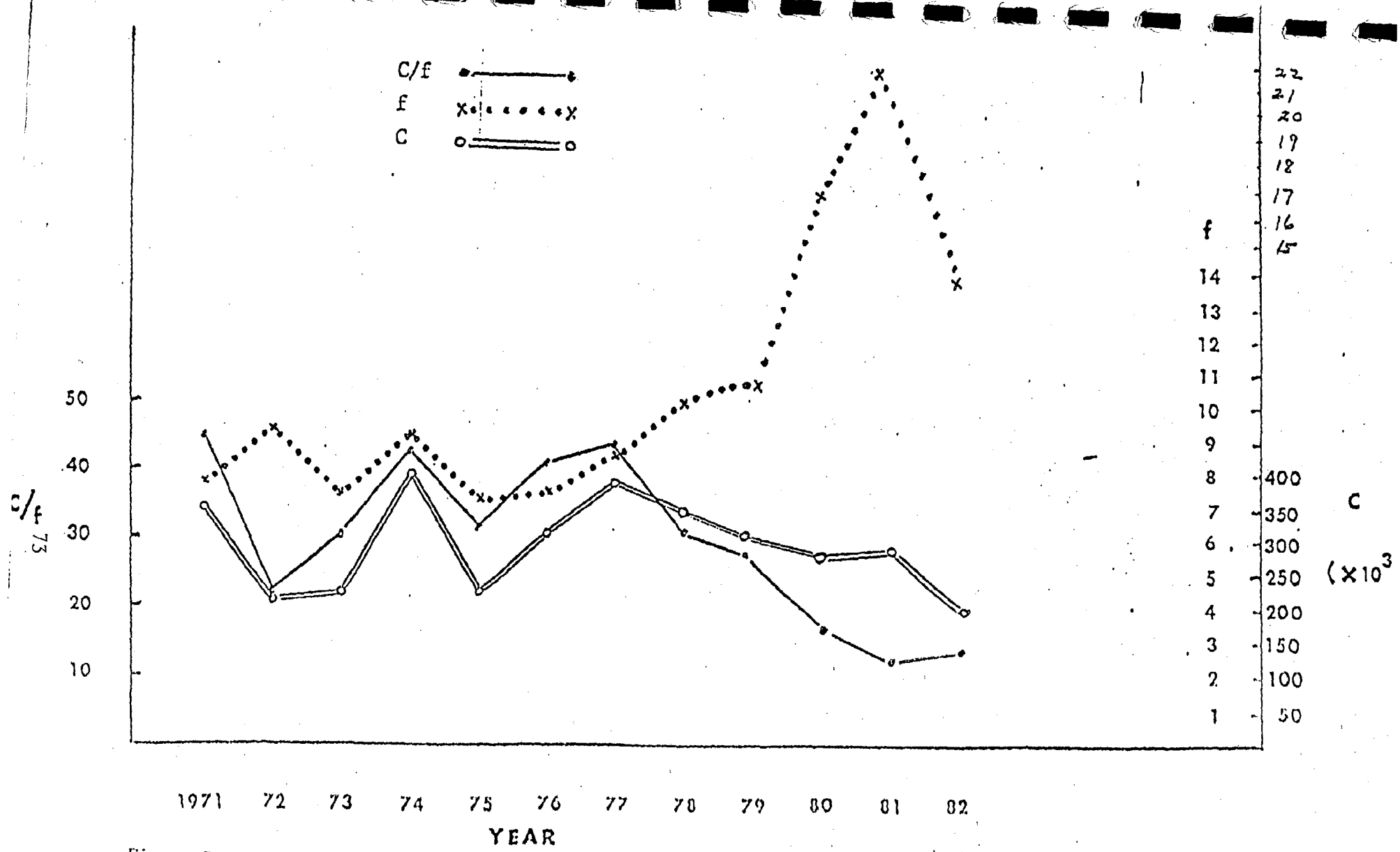


Figure 3. Commercial perch catch statistics; catch per effort (c/f in lbs/10^3 ft.), production (C in lbs. landed), and effort (f in millions of gill net feet annually.

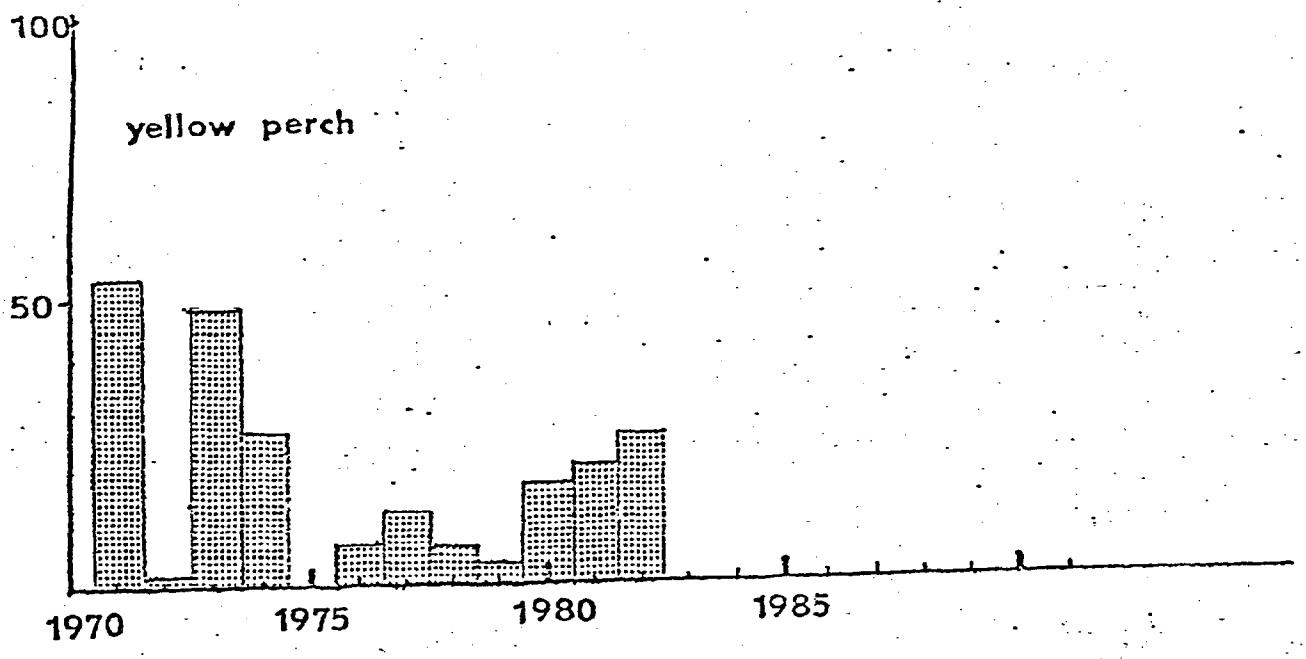


Figure 4. Young-of-year abundance indices of year classes of yellow perch. Values in number per 10 minute trawl tow.

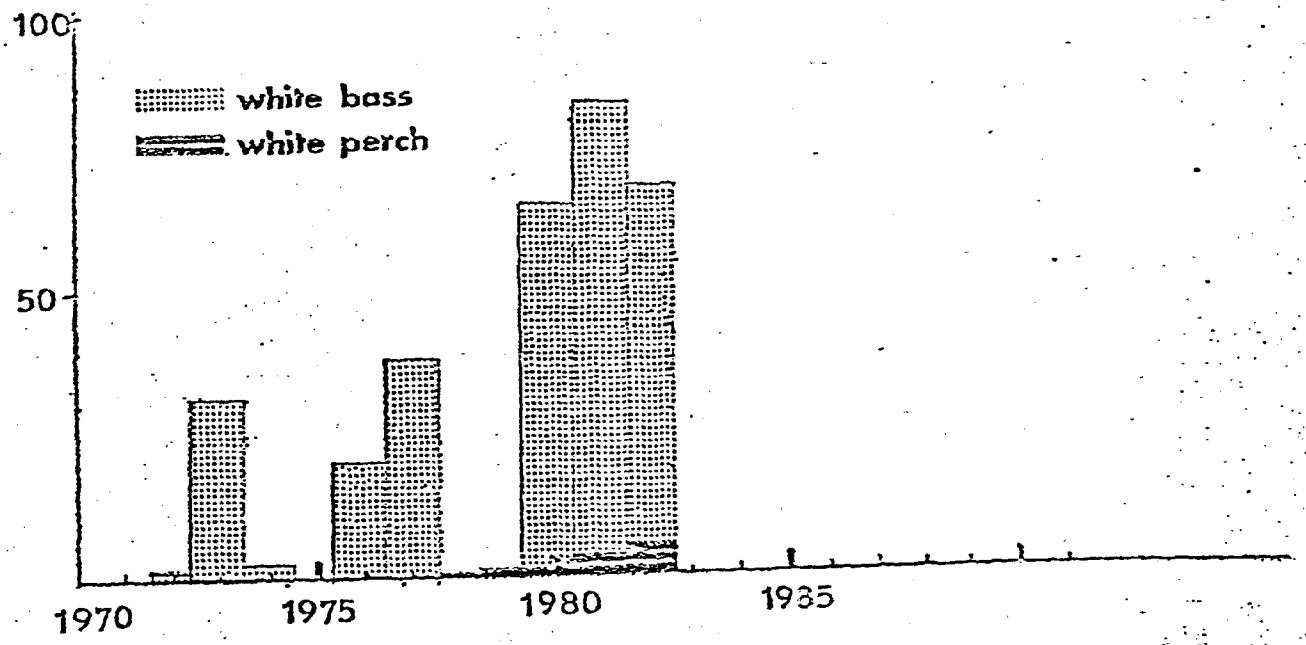
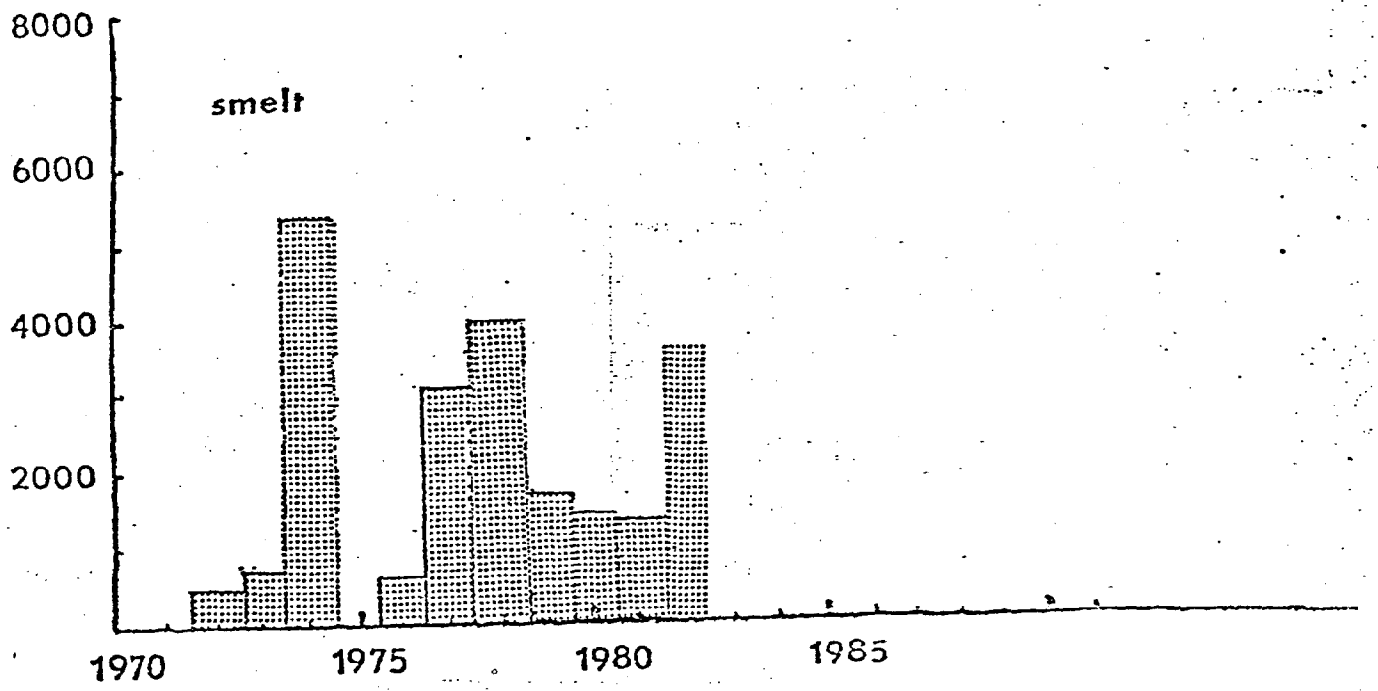


Figure 5. Young-of-year abundance indices of year classes of white bass and white perch. Values in number per 10 minute trawl tow.



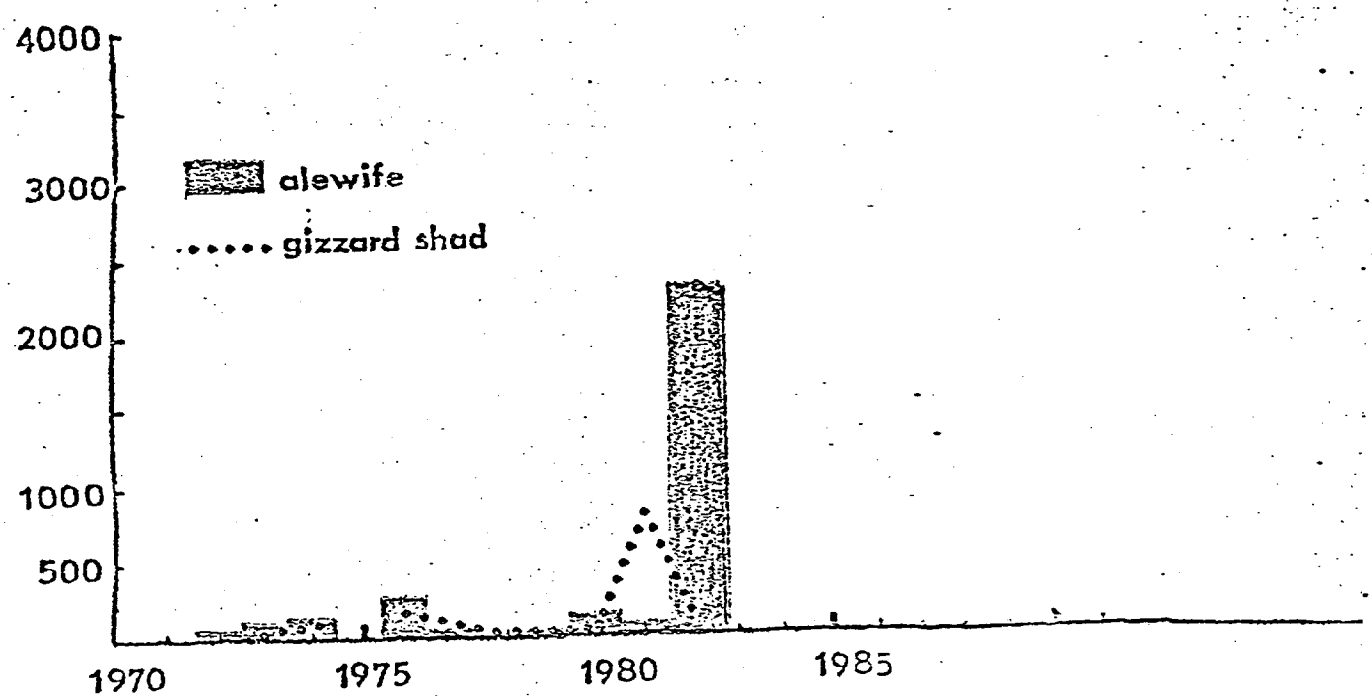
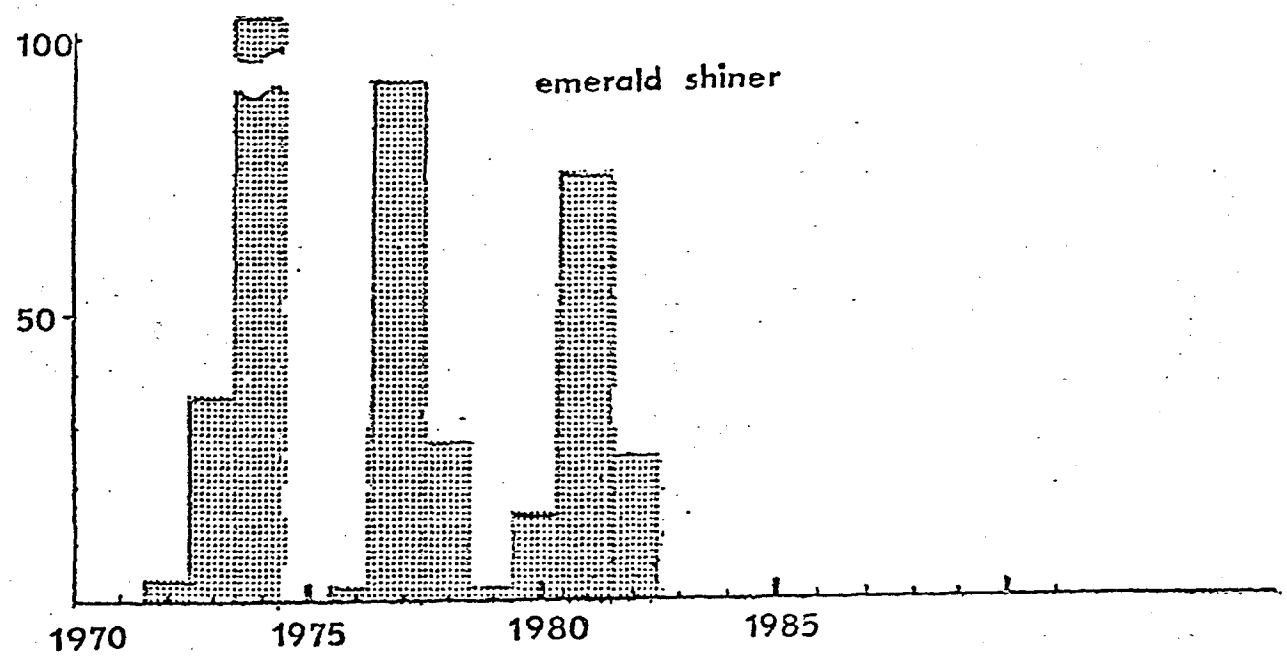


Figure 6. Young-of-year abundance indices of year classes of smelt, alewife, and gizzard shad. Values in number per 10 minute trawl tow.



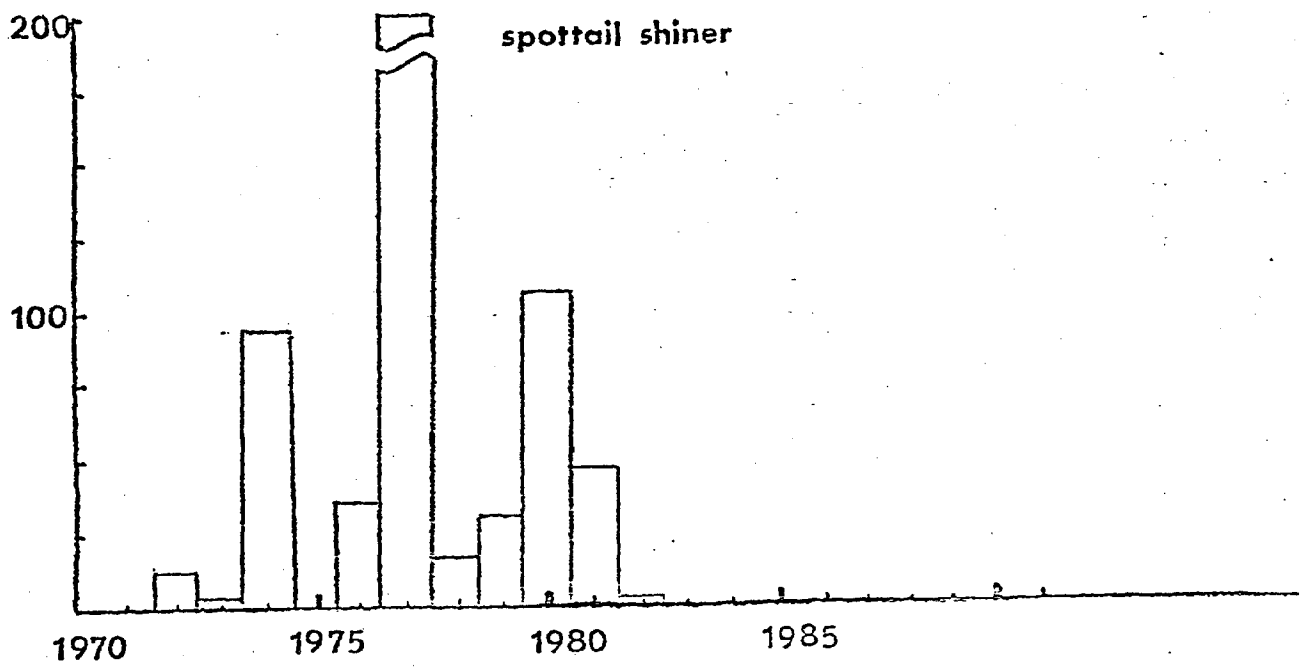


Figure 7. Young-of-year abundance indices of year classes of emerald shiner and spottail shiner. Values in number per 10 minute trawl tow.

SECTION II: WATER QUALITY MANAGEMENT

Water Quality Conditions - Status

The development of any fishing or boating program is ultimately dependent upon good water quality. To achieve this, two major factors must be controlled: 1. Accelerated eutrophication from cultural nutrient loading and 2. Contamination from toxic and hazardous wastes. Both of these factors have had significant effects on Pennsylvania's Lake Erie waters.

Accelerated eutrophication from cultural nutrient loading has become a lakewide problem as the result of rapid human population growth in the Lake Erie basin. Major problems occurred during the 1960's as the result of nutrient loading from municipal sewage treatment facilities, industrial discharges, and diverse non-point sources such as urban and rural drainage, shoreline erosion, and atmospheric deposition. Increasing levels of phosphorous, nitrogen and chlorides were all observed as signs of accelerating eutrophication but phosphorous was found to be the nutrient most detrimental to the environment (Burns and Ross 1972). By 1964, Lake Erie had received widespread publicity as a "dead lake" when dissolved oxygen levels below 2 mg/l were observed in an area covering over 2600 mi^2 (Dambach 1969). The most severe problems were observed in the central basin and extended into the northwest portion of Pennsylvania's jurisdiction. Although the city of Erie was cited as a major source of pollution during the 1970's, Pennsylvania's main lake waters further to the east never developed major oxygen problems, primarily because the more voluminous waters in the eastern basin were effective in diluting the nutrient concentrations. Water quality throughout the main lake has improved in recent years with the development of advanced wastewater treatment. Total phosphorous loading declined from 24,000 metric tons/year in 1970 to 15,000 metric tons/year in 1980 and further reductions are anticipated in the future (Fay and Herdendorf 1981). The city of Erie, once listed as a major polluter in the 1970's, was not listed as either a class "A" or class "B" area of concern in 1981 (Great Lakes Water Quality Board 1981). Although seasonal oxygen depressions still occur in portions of Pennsylvania's central basin waters, dissolved oxygen levels in most of Pennsylvania's waters exceed 5 mg/l year-round (Oxygen concentrations of 5 mg/l are marginally suitable for cold water species such as trout and salmon, and exceed the requirements of most warm- and coolwater species).

The more confined waters of Presque Isle Bay have suffered more serious pollution problems. Numerous pollution reports have been filed by the PFC for the bay over the years, but the most serious recent problem resulted in a massive fish kill during the 1977-78 winter. Oxygen depletion resulting from a protracted period of ice cover together with organic loading was believed to be the cause of the kill. The primary sources of pollution in the bay are sixty-seven overflows from combined storm and sanitary sewers. Diluted sewage enters the bay from these discharges during periods of

heavy rain. Over half of these overflows tie into the Mill Creek Tube. Mill Creek has been the main problem spot in the bay, even during periods of dry weather, as the result of illegal discharges of raw sewage into the tube. Most of these discharges have been sealed off in recent years resulting in significant improvements in the bay's water quality. However, problems continue to occur periodically when sewer lines become plugged with debris or during periods of heavy rain. Improvements are not likely until changes to the system, such as stormwater retention basins, or separated storm and sanitary sewer lines, are made. Separation of sewer lines is a high priority item in any future urban renewal project in the city of Erie.

Pollution problems have also occurred in Pennsylvania's tributary streams. Many tributaries have exceeded Pennsylvania Department of Environmental Resources (PDER) water quality criteria in the past (Table 14). Elk Creek has been particularly problematic with a 1.5 mile region north of Route 5 degraded by high ammonia and low dissolved oxygen levels as the result of sewage discharges (PDER 1976). Water quality has improved somewhat in recent years in Elk Creek. An Erie County Health Department (ECHD) Assessment in 1983 showed that all PDER water quality criteria were met. However, periodic problems still occur on this tributary downstream of the Lake City sewage treatment facility. Sixteen Mile Creek has been another problem area as a result of periodic malfunctions of the North East sewage treatment facility. Problems at this site have not been due to nutrient loading but to accidental spills of chlorine and lime. The most recent mishap, a lime spill on 24 June 1983, resulted in the death of over 2500 recently stocked steelhead trout. It is anticipated that procedural changes at the facility will prevent a reoccurrence of these spills. Siltation and discharges of brine wastes from natural gas drilling have also affected tributary streams in the coastal zone. Stricter enforcement of the industry is needed to prevent further degradation of these streams.

Toxic substances have impacted Pennsylvania's Lake Erie waters. Heavy metals, PCB's and pesticides have received most of the monitoring efforts. Mercury concentrations exceeding half the USFDA action level of 1.0 ppm were found during the early 1970's in the tissues of Pennsylvania's smallmouth bass, walleye, freshwater drum and white bass but concentrations of this metal in other species since that time have been substantially lower. High levels of mercury, lead, zinc, and aluminum have all been found in Pennsylvania's waters and/or sediments. PCB's approached the 5 ppm action level for fall run coho salmon and rainbow trout in 1976, but have declined since then. DDT, dieldrin, chlordane and other pesticides and toxic organic compounds have been identified in fish collected from Pennsylvania but recent samples have not exceeded FDA action levels. Concentrations of several toxic substances have either declined or stabilized in Pennsylvania and adjacent jurisdictions in recent years, but numerous substances have yet to be quantified.

Recent improvements in water quality in the Lake Erie basin can be credited to a number of international, federal, and state

efforts. The United States and Canada entered into the Great Lakes Water Quality Agreements of 1972 and 1978. Under these agreements, international objectives for the abatement of pollution problems were established. Reduced phosphorous loading was the focal point of the 1972 agreement. The 1978 agreement reinforced the goals of the 1972 agreement and furthermore stressed provisions for the elimination of toxic contaminants. The International Joint Commission (IJC) was mandated to assist federal, state and provincial governments in the implementation of programs to meet these goals.

The federal Clean Water Act of 1977 established water quality criteria as guidelines for each state. Section 303 of the act required that each state set standards for its waters and submit them to the U. S. Environmental Protection Agency (USEPA) for approval. Section 402 established the National Pollution Discharge Elimination System (NPDES), a permit system to regulate wastewater discharges from industrial and municipal facilities. Also on the federal level, the USFDA has established action levels for a number of toxicants in fish flesh.

Further regulation of Pennsylvania's Lake Erie waters is provided through Pennsylvania's Clean Streams Law. Specific water quality criteria are established in Chapter 93 of the 25 Pa. Code.

Water Quality Monitoring Programs - Status

Standardized water quality monitoring efforts on a lakewide basis have been ongoing since 1970 by the USEPA's Great Lakes National Program Office, the Canada Centre for Inland Waters, the Ohio State University Center for Lake Erie Research (CLEAR), and the New York State University at Buffalo's Great Lakes Laboratory. In addition, the IJC has conducted intensive lakewide studies in both 1978 and 1979 and less intensive programs are planned through 1986 on an annual basis.

Ambient water quality monitoring efforts specifically for Pennsylvania's waters have been conducted annually since 1972. The earliest studies were completed by the Great Lakes Research Institute under a Ford Foundation Grant (Great Lakes Research Institute 1974). The current program is a joint effort between the ECHD and the PDER. Sampling over the years has been conducted at as many as seven main lake sites and three sites in Presque Isle Bay. The current sampling sites include two PDER Water Quality Network (WQN) stations on the main lake, one WQN site in Presque Isle Bay, and three WQN sites on tributary streams. The station numbers, specific location, and sampling frequency of each site is as follows:

<u>WQN 601</u> - Erie city water intake from main lake waters off the West Filtration Plant, Sommerheim Drive, Mill creek Township; sampling done quarterly (May, August, November, February).
<u>WQN 622</u> - 1000 yds off Gibson Avenue between the Erie municipal sewer outfall and the harbor entrance; sampling done three times per year (no February sample).

WON 632 - Presque Isle Bay, midway between the Public Dock and the harbor entrance. Sampling done one time per year during either summer or spring.
WON 602 - Sixteen Mile Creek 220 yds downstream of Route 5 bridge; sampling done quarterly.
WON 603 - Walnut Creek, 40 yds upstream of first bridge upstream from the mouth; sampling done quarterly.
WON 601 - Elk Creek at Route 5 bridge; sampling done quarterly.

Two of the sites, WQN 601 and WQN 622 are included in the USEPA's nationwide network of "CORE" stations.

Over the years analyses have been done on both sediment and water samples at each site. Current efforts, however, are limited to water samples. Twenty-nine different parameters are measured at each site with two additional parameters at CORE sites (Table 15). Macroinvertebrates are also sampled at each tributary.

Other monitoring conducted by the ECHD includes annual sampling of effluents from municipal sewage and industrial facilities and periodic sampling of tributaries not included in the network system. Water quality controls are also provided through monthly reports of discharge quality required by NPDES permit holders. All WQN and NPDES data is available from the USEPA's computerized water quality data base STORET. Written reports for the ECHD studies are available for all years through 1979.

Additional water quality data is available from the Erie City Water Bureau. Twenty-eight parameters are analyzed for raw water on a regular basis (Table 16). In addition, finish water is periodically analyzed for pesticides and trihalomethanes. All of these data are available from Water Bureau files but none have been computerized.

Limnology students at Gannon University, under the direction of Dr. Stanley Zagorski, have analyzed water quality from three sites on Lake Erie since 1969. One site is located approximately 3 miles northeast of Presque Isle Peninsula. The second site is located directly over the Erie sewage treatment facilities outfall. The third site is located 300 yds off the mouth of Mill Creek in Presque Isle Bay. Five physical tests, four biological tests and eighteen chemical tests are performed at each station on a weekly basis from September through mid-November (Table 17). Results of these analyses have been computerized at the university.

Water quality studies by the PFC on the main lake were done on an annual basis from 1967 through 1972 when temperature, dissolved oxygen, pH, alkalinity, hardness and transparency were measured. Current studies on the main lake consist of periodic temperature and dissolved oxygen profiles in the vicinity of fish sampling index stations. In addition, water temperature, pH, dissolved oxygen, conductivity, alkalinity, and hardness are measured on tributary stations by the PFC during stream surveys for operation FUTURE.

Other monitoring efforts on Pennsylvania's Lake Erie waters have been short term in nature. These efforts include an evaluation of dissolved oxygen, Ca^{+2}, K^{+}, and pH on 12 tributaries by Mastellar et al. (1976), a study of PCB's by the PDER in 1974-75 (PDER 1980), an evaluation of toxic contaminants in dredge materials from Erie harbor for the Army Corps of Engineers (Applied Biology, Inc. 1982), detailed water quality studies from U.S. Steel's environmental impact report for its proposed Lake Front Plant (U.S. Army Corps of Engineers, undated), and the 316(b) study for Penelec in Presque Isle Bay (Bardarik et al 1973).

Fish Flesh Analysis - Status

Most toxic organic compounds and heavy metals are found in only trace amounts in the waters of Lake Erie. Concentrations in the sediments and fish flesh are, by comparison, much higher. Because the environmental effects of these substances in the sediment is not well understood, fish flesh has become the primary medium for toxic substance analysis. Bioaccumulation of heavy metals, PCB's, pesticides, and other compounds in fish flesh is a major concern with respect to both human health and health of the fishery resource.

Prior to 1980, most fish flesh studies on Pennsylvania's waters were short term in nature. During the early 1970's Penn State University and the USFDA analyzed Pennsylvania's fall-run coho salmon for pesticides and heavy metals. In 1976 the PDER conducted statewide studies of PCB's and heavy metals. Edible portions of white crappie, channel catfish, and brown bullhead from the main lake were sampled, while yellow perch and white suckers were analyzed from Presque Isle Bay (Brezina and Arnold 1977, PDER 1980). Also in 1976, the ECHD collected fish samples for PCB analysis by the Pennsylvania Department of Agriculture (PDA) and the USEPA (PDER 1980). In this study, yellow perch, white bass, smallmouth bass, rainbow trout, walleye, and coho salmon were sampled from the main lake, yellow perch, walleye, and white crappie were taken from Presque Isle Bay, and coho and rainbow trout were taken from Godfrey Run. Other studies for PCB's were conducted by the PDER in 1979 on whitefish, lake trout, and coho salmon from the main lake (PDER 1980), and by the ECHD in 1980 on northern hog suckers from Elk Creek.

The ECHD and PDER are currently participating in two ongoing fish flesh studies. Since 1979, yellow perch have been collected each year from EPA "CORE" stations (WQN 601, WQN 622). This program is being coordinated by the USEPA with analyses conducted by the PDER. A number of pesticides, PCB's, and heavy metals are monitored in this effort (Table 18). The second program is the coho sampling portion of the IJC's Great Lakes International Surveillance Plan (GLISP). This five year program commenced in 1980. Salmon are collected from Trout Run by the ECHD and shipped to the USFDA for analysis. As with yellow perch, PCB's, pesticides, and metals are monitored (Table 19).

The USFWS collects perch, drum, and suckers from waters off Erie, Pennsylvania; Clinton, Ohio; and Barcelona, New York, once every

three years as part of the National Pesticide Monitoring Program. The most recent collection was made in 1980. Analysis is conducted at the USFWS's Columbia Research laboratory. Again, monitoring includes pesticides, metals, and PCB's. The USFWS also collects annual samples of walleye and smelt from Barcelona and Clinton as a second portion of the IJC's international surveillance plan. Lake trout will be included in future samples if rehabilitation efforts are successful. Analyses for PCB's, DDT, and chlordanes are conducted by the USEPA in this program but metals have not yet been monitored due to analytical problems at the EPA lab.

Dr. David Kurtz from Penn State University has prepared aliquots of Lake Erie coho salmon tissue for PCB, mirex, photomirex, and kepone analyses since 1967. However, funding constraints have prevented him from completing the analyses on the samples.

Finally, the ECHD has recently reached a verbal agreement with the PDA for toxic substance monitoring of several fish species. Freshwater drum, rainbow trout, smelt, and white bass have already been collected for analysis, and walleye and smallmouth bass may be included in the future.

Although the PFC has not conducted any fish flesh studies of its own, it should be noted that the Commission has collected many of the samples for the monitoring efforts of other agencies. The PFC has been particularly active in collecting fish for the ECHD and PDER.

Most of the data accumulated to date for fish flesh in Lake Erie will be presented in an inventory of toxic and hazardous substances currently being prepared by the Toxic Substance Committee of the IJC's Great Lakes Water Quality Board.

Water Quality Conditions - Problems

There are two areas of seasonal oxygen depression in Pennsylvania's Lake Erie Waters. One is located in the eastern portion of the central basin in the northwest corner of Pennsylvania's jurisdiction. The other is Presque Isle Bay. Abatement of the problem in the main lake will be dependent on reductions in nutrient loading from wastewater discharges and non-point sources in Ohio and Michigan. Such improvements are anticipated in the near future (Fay and Herdendorf 1981). Abatement of the problem in Presque Isle Bay will be dependent on reductions in nutrient loading from Mill Creek and other combined sewer outfalls. Although extensive renovation of the sewer system in the city of Erie is not likely for some time to come, separation of stormwater and sanitary sewer lines is a high priority item in future urban renewal efforts.

Despite these two problem areas in Pennsylvania's waters, low oxygen does not appear to be having a major effect on the diversity or viability of Pennsylvania's fishery. Recent dissolved oxygen levels in the Commonwealth's main lake waters have exceeded 5 ppm year round, and no major fish kills have occurred in the bay since 1978.

Toxic and hazardous substances may pose more serious threats to Pennsylvania's waters. Over 30,000 components of commercial or industrial significance are produced in the Great Lakes Basin and 2-3,000 new chemicals are added each year (IJC 1980). Over 800 compounds have been identified from various media in the Great Lakes (IJC toxic substances inventory, in preparation) and additional substances could easily be present. Specific sources of toxic wastes in Pennsylvania's waters are likely runoff from orchards and crop land east and west of the city of Erie (pesticides), and urban runoff and industrial and municipal sewage discharges throughout the basin (heavy metals, toxic organic compounds). Although declines in the concentrations of several substances have been noted in Commonwealth waters, the specific health effects of most of these substances is poorly understood. In addition, numerous substances yet to be quantified could be causing serious problems. For example, environmental contaminants could be causing such things as goiters, depressed growth rates, and low egg viability in Pennsylvania's coho salmon. Yet, all substances measured thus far in coho have been below USFDA action levels. Intensified research in this area is definitely needed.

Water Quality Monitoring - Problems

The mechanisms are currently in place for monitoring the water quality in the Lake Erie coastal zone. However, increased sampling frequency is desirable in Presque Isle Bay to more thoroughly

document oxygen levels throughout the year. Current assessment is limited to summer or spring sampling by the BCED and fall sampling by Gannon University.

Fish Flesh Analysis - Problems

Monitoring efforts for contaminants in fish flesh are not adequate to fully address this problem. Current programs are not well coordinated. Very little analysis has been done for fish from the bay, where both fishing effort and the potential for contaminant problems is high. The only intensive, ongoing fish flesh programs in Pennsylvania's main lake waters are the GLISP and CORE efforts for coho salmon and yellow perch, respectively. The GLISP program will be terminated in 1985. A more comprehensive, ongoing, coordinated program is needed in Pennsylvania to insure public safety and to protect the health of the resource.

Water Quality Problems as Perceived by Sportsmen's Clubs

Only two water quality related issues were raised by area sportsmen in response to the fishing and boating questionnaire (Appendix III). One club recommended measuring contaminants in fish flesh and publicizing the results. Two clubs suggested opening an inlet from the main lake at the west end of Presque Isle Bay; one of these clubs suggested that this would allow the bay to "flush itself."

Water Quality Monitoring - Recommendations

1. Because ongoing programs are now in effect, the PFC should not get involved in additional long-term water quality monitoring efforts on Lake Erie. Current assessment is the responsibility of the PDER in coordination with the ECHD. Access to data from these efforts is provided by simply contacting the respective agencies. Information can also be obtained from the USEPA's computer data storage system STORET, the Erie Municipal Water Bureau, and Gannon University. These data sources can be referred to in the development of future fishery management programs.

2. The ECHD should be encouraged to monitor the bay on a year round basis to more thoroughly evaluate concentrations of dissolved oxygen and pollution.

Fish Flesh Analysis - Recommendations

The PFC should participate in developing an expanded, well coordinated, interagency fish flesh monitoring program. Efforts to rehabilitate and manage the fishery will prove to be futile if the resource cannot be utilized due to human health concerns. There is good potential for increased monitoring in the near future. The PDA has agreed to analyze samples collected by the ECHD. In addition, the USEPA's Great Lakes Program office has expressed an interest in including fish from Pennsylvania's waters in its near shore monitoring program (Mr. David DeVault, personal communication). Up to three size classes of three different species (bottom feeders and resident predators) from two sites could be included in this program. The ECHD has suggested that a meeting be arranged as early as 1984 between representatives from the PFC, ECHD, PDER, PDA, USEPA and other interested agencies to draft the details for initiation of a well coordinated plan. Much beneficial information could be obtained from such a plan at minimal cost to the PFC since it is probable that fish could be collected in sampling programs already being conducted by the Commission.

Table 14. Stream Water Quality Constituent Concentrations Compared to Stream Water Quality Criteria

Stream	Values Observed Which Do Not Meet WQ Criteria						
	pH	DO	Fe	TDS	Bacteria	NH_3-N	PO_4-P
Mill Creek		X			X	X	X
Four Mile Creek	X						
Sixteen Mile Creek	X				X		
Elk Creek					X		
Conneaut Creek					X		
Twelve Mile Creek							
Crooked Creek							
Trout Run			X		X		
Six Mile Creek					X		
Seven Mile Creek							
Eight Mile Creek					X		
Twenty Mile Creek							
Walnut Creek					X	X	
Little Elk Creek							
Raccoon Creek					X		

Source: "Executive Summary of the Comprehensive Waste and Water Quality Management Study of the Pennsylvania Portion of the Erie Basin and the Remaining Basin of Erie County," Pennsylvania Department of Environmental Resources, February 1976.

Table 15. Water Quality Criteria Monitored at Pennsylvania Department of Environmental Resources Water Quality Network Sites.

Turbidity	Manganese*
Specific Conductivity	Chromium*
Alkalinity	Copper* (mg/l)
Total Phosphorus	Nickel*
Iron	Zinc*
Suspended Solids	Aluminum*
Total Dissolved Solids	Lead
Nitrites	Cadmium
Nitrates	Mercury*
Ammonia	pH (Field)
Hardness	pH (Lab)
Calcium	Temperature
Magnesium	Dissolved Oxygen
Sulfate	Fecal Coliform
Chlorides	Chemical Oxygen Demand**
Kjeldahl Nitrogen**	

*Sampled only one time per year.
**Sampled only at joint WQN-USEPA CORE sites.

Table 16. Parameters Monitored on Raw Water from Lake Erie by the Erie Municipal Water Department.

Chemical Analysis	
Total Dissolved Solids	Detergents
Chlorine Demand	Dissolved Oxygen
pH	Total Manganese
Total Alkalinity	Cyanide
Total Hardness	Silver
Calcium Hardness	Chromium
Turbidity	Cadmium
Calcium	Arsenic
Magnesium	Lead
Sulfate	Barium
Chloride	Selenium
Phosphate	Mercury
Silica	Temperature
Total Iron	Conductivity

Biological Analysis
Plankton
Coliform
Standard Plate Count

Table 17. Water Quality Parameters Monitored by Gannon University at Three Sites on Pennsylvania's Lake Erie Waters.

Physical Tests
Wind Direction
Transparency
Depth
Light Intensity
Water Temperature
Biological Tests
Phytoplankton
Zooplankton
Benthos
Bacteria (total coliforms, fecal coliforms, staphlococcus, enterococcus)
Chemical Tests
Alkalinity
Ammonia Nitrogen
Carbon Dioxide
Chlorides
Chlorine
Chromium
Conductivity
Color
Copper
Dissolved Oxygen
Hardness
Iron
Nitrate Nitrogen
pH
Phosphates
Silica
Sulfates
Turbidity

Table 18. Parameters Monitored in Fish Flesh from Yellow Perch at USEPA "CORE" Stations.

Total DDT and its antilogs
Methoxychlor
BHC
Lindane
PCB
Arsenic
Cadmium
Chromium
Cooper
Mercury
Lead
Aldrin
Dieldrin
Endrin
Chlordane

Table 19. Parameters Monitored in Fish Flesh from Coho Salmon as Part of the Great Lakes International Surveillance Plan.

Hexachlorobenzene (HCB)
Trans Nonachdor
PCB 1248
PCB 1254
PCB 1260
Total PCB
$p.p^1$-DDE
Hexachlorohexane
Pentachlorophenyl Methyl Ether
Heptaclor
Trans Chlordane
Cis Chlordane
Total Chlordane
$p.p^1$-DDD
Total DDT
Dacthal
Dieldrin
Endrin
Diazinon
Mercury
Mirex
Early Eluters

SECTION III: FISHING AND BOATING ACCESS AREAS

STATUS OF FISHING AND BOATING ACCESS

Pennsylvania's Lake Erie waters receive high levels of recreational angling and boating use. Erie, Pennsylvania's third largest city, is located near the center of the state's coastline, and Pittsburgh, Pennsylvania's second largest city, is located just 128 miles south of the lake with direct access via Interstate Route 79. An angler and boater use survey conducted by the PFC revealed that approximately 1,957,900 hours of recreational angling and boating use were expended on the state's Lake Erie waters from June 1981-May 1982 (Table 20). The segregation of this use among various user groups was as follows: 35 percent non-angling boaters; 31 percent angling boaters; 29 percent shore anglers; and, 5 percent ice anglers. Total use segregated by area was: 27 percent west of Presque Isle Bay; 61 percent within the bay, and 13 percent east of the bay. Included with the figures east of the bay are East Avenue Ramp and John E. Lampe Marina, two heavily used sites located just outside the Erie harbor entrance. If these sites are excluded, only 4 percent of the total use can be attributed to the eastern region, which constitutes nearly 30 percent of Pennsylvania's shoreline. The major reason for this disparity in use is that adequate and safe boating access east of the city of Erie is severely limited. As a result, Western Erie County and Presque Isle Bay sites are often overcrowded during peak periods such as the fall salmon season. Inadequate access has precipitated user-landowner conflicts in the past, particularly during the record 1979 salmon run. Steps taken since that time to address the problem have included restrictions on night fishing in certain areas, increased enforcement, parking restrictions, and intensified communication efforts with landowners. Conditions have improved as a result of these efforts but inadequate access, the underlying cause of the problems, continues. Currently, access is provided at approximately 54 sites distributed along Pennsylvania's coastline (Figure 8). Thirty-seven of these sites furnish boat access, 17 of which are public. Thirty-five sites furnish shore access, 27 being public. Considering public facilities only, four are located west of Presque Isle Bay (two provide boat access, all provide shore access), 20 are located within the bay (ten boat, all shore), and six are located east of the Bay (five boat, four shore).

The PFC has been instrumental in providing access at three of the above facilities. In the Western Erie County region, the Commission owns and maintains the Walnut Creek access area. Open for use since 1977, Walnut Creek Access provides six launch ramps, a protected harbor, 169 parking stalls for cars with boat trailers, 129 single car stalls, and a 73 slip marina. This excellent facility has become the most heavily used access site on the entire Pennsylvania shoreline (Table 20).

The Commission also owns a small facility at North East. This site, which consists of a single concrete ramp, a rail and dolly launching apparatus, and a gravel parking lot, is unprotected from the lake and can only be used during times of minimal wave action.

Finally, the PFC provided partial funding for the construction of the John E. Lampe Marina, a public facility maintained by the Erie-Western Pennsylvania Port Authority. This recently completed facility, located in the city of Erie, provides four launch ramps, a 115 slip marina, and parking for 54 cars with trailers and 30 single cars.

Future access development in the coastal zone is impeded by private riparian ownership and shoreline bluffs ranging from 10 to 170 feet in height. Numerous sites have been considered by the PFC and other agencies for access development. As a result of these deliberations, three sites have emerged as providing the greatest potential. These sites are located at Twenty Mile Creek, Elk Creek, and North East.

Hill and Hill Engineers, Inc. (1980) completed a CZM funded study for Twenty Mile Creek in 1980. The study design provided for the development of an access road, parking lots for 96 cars with trailers and 86 single cars, a launch ramp, a small harbor of refuge, a picnic area, and comfort facilities. Further development of this site has been impeded by high land acquisition costs on both the east and west banks of the stream.

There have been several efforts to develop improved access at the mouth of Elk Creek. In 1965 the U.S. Army Corps of Engineers (1965) prepared detailed plans for an access area on the east bank of the stream. The PFC expressed interest in helping to develop this facility in both 1969 and 1972. The inability of local concerns to contribute sufficient financial support thwarted these efforts. In 1980, D.A. Johnson Associates (1980) completed a feasibility study for the west bank of the stream on land leased by the Pennsylvania Electric Company to Girard Township at no cost. This study, financed by CZM funds, detailed a seven stage developmental plan (Figure 9) consisting of: 1. Construction of an entrance road and 100 car parking lot, 2. Development of a second road connecting the entrance road to a lower parking lot adjacent to the stream, 3. Construction of a picnic area and trails, 4. Addition of comfort facilities, 5. Construction of a 12 foot wide boat ramp, 6. Channel improvements and construction of breakwaters at the mouth of the stream, and 7. Paving of gravel roads and parking areas. CZM funding was provided to begin construction at this site in 1983 and to date, stages 1-4 have been completed. The facility has substantially improved shore fishing access to the west bank of Elk Creek. Unfortunately the site does not yet provide boat access and additional funding for completion of the project is uncertain. A pending bill before the U.S. Senate to continue CZM funding is one possibility but funding requests have also been made to the PFC and the U.S. Army Corps of Engineers.

Access improvement at the North East site has been the subject of a CZM funded study recently completed by the PFC (1983). Five design alternatives were proposed in this study. From these five, one design was chosen as the most feasible. It included construction of

a small but significant harbor of refuge, 6 launch ramps, parking for 261 cars with trailers, 22 single car stalls, and a comfort station. Future development at this site will be contingent on a funding source. Development is favored by the fact that acquisition costs, which are prohibitive in some areas, are not required at this site since it is already owned by the PFC.

Fishing and Boating Access - Problems

Despite recent efforts to improve conditions in the coastal zone, limited shore and boat access continues to restrict public use. There are few public facilities east or west of Presque Isle Bay and many that do exist are in very poor condition. Future development is hindered by extremely high acquisition and construction costs. Whereas inland facilities can often be constructed at costs of $50,000 to $100,000, access facilities on Lake Erie often exceed costs of $1,000,000 because of high lake front property values and the high cost of constructing harbors of refuge, which are necessary on the Great Lakes to assure safe boat launching and retrieval. Another factor which must be considered is the extraordinarily high maintenance costs. Besides the usual tasks of mowing grass, cleaning restrooms, and ramp upkeep, maintenance at facilities on Lake Erie includes dredging on a regular basis to maintain channel depths. Dredging costs at the Walnut Creek facility alone approximate $15,000-$20,000 per year.

Access problems are particularly acute east of the city of Erie's East Avenue ramp. This region, which constitutes nearly 30 percent of Pennsylvania's shoreline, received only 4 percent of the total angling and boating use during the 1981-82 PFC survey (Young and Lahr 1982). There are only three public access areas in this eastern region, and all are unprotected from the lake and difficult to use. Boating in this region can be dangerous, since the nearest harbor of refuge east of Presque Isle Bay is located 30 miles away at Barcelona, New York.

Overcrowding at shore access areas is generally restricted to the fall salmon season at tributary sites east and west of Presque Isle Bay. Anglers standing "shoulder to shoulder" with others waiting to grab the next empty spot is a common occurrence each fall at popular sites such as Elk Creek, Walnut Creek, and Trout Run. Fishing pier construction, to expand shore access, or attempts to redistribute fishing pressure are needed.

Fishing and Boating Access problems as Perceived by Sportsmen's Clubs

Improved public access was the need most frequently listed by area sportsmen in response to the angling and boating questionnaire (Appendix III). Ten of the eleven clubs responding called for more

boat launching facilities on the main lake. Five clubs specified that the need was greatest east of Presque Isle Bay, and two clubs specified the west end. Only one club voiced a need for more ramps in the bay. A second club called for better ramp upkeep in the bay. Shore access comments were restricted to one club, which suggested that fishing piers were needed on the main lake.

FISHING AND BOATING ACCESS - RECOMMENDATIONS

1. The North East site should be given highest priority in future access area development. Current access to the east county region is very poor compared to that in other areas of the lake. The absence of acquisition costs at this facility favors its development potential. Besides significantly improving public access, this facility would double as the only safe harbor of refuge on Pennsylvania's shoreline east of Presque Isle Bay.

2. Fish Commission aid to the completion of the Elk Creek project should be given a lower priority. PFC involvement in this project would probably necessitate a major land purchase on the east bank of Elk Creek, since future development as now proposed would benefit private landowners and would probably not be adequate to supply the level of use that development at this site should optimally be able to accommodate.

3. The PFC should not participate in upgrading present unprotected ramps. Improving ramps without providing harbors of refuge would create potentially dangerous situations by increasing use levels beyond a site's capacity to allow safe boat retrieval during sudden storms.

4. High maintenance costs should be given much consideration prior to the initiation of any future access projects. Efforts should be made to have these costs assumed or shared by local governments and other agencies such as the U.S. Army Corps of Engineers.

5. Construction of shore fishing piers should be considered in future access development. Communication efforts aimed at directing anglers to lesser used sites will help to alleviate shore access problems in the interim.

6. The city of Erie , Erie County, and other local governments, should be encouraged to finance a large portion of future acquisition, development, maintenance and access improvement costs. In a recent economic study, Hammer, Siler, George Assoc. (1983) recommended that the Erie-Western Pennsylvania Port Authority coordinate future access development in the coastal zone. Access development, along with promotional, business service, and fishery management improvements could significantly boost the area's economy by generating annual fishing related expenditures of $13.0 million by 1990. This compares to current expenditures of $6.7 million and a moderate increase in expenditures to $7.7 million predicted for 1990 without these improvements (Hammer, Siler, George Assoc. 1983).

Table 20. Recreational Angling and Boating Use on Pennsylvania's Lake Erie Waters, June 1981-May 1982, (NB = Non-angling Boater, AB = Angling Boater, S = Shore Angler, I = Ice Angler

ID	Site Name	Man Hours (Hundreds) NB	AB	S	I	Total
West End						
1.	Raccoon Creek	16	22	23	0	61
2.	Eagley Road	0	0	1	0	1
3.	Crooked Creek	25	90	11	0	126
4.	Elk Creek	48	536	492	<1	1076
5.	Godfrey Run	0	0	74	7	81
6.	Trout Run	1	1	801	34	837
7.	Walnut Creek	247	1702	1021	3	2973
8.	Hansen's Bait	9	1	27	0	37
	Total	348	2352	2450	44	5194
Presque Isle Bay						
9.	West Point	81	165	62	257	565
10.	Swan Cove	91	<1	107	17	215
11.	Niagara Ramp	333	216	14	133	696
12.	Marina	949	175	88	6	1218
13.	Marina Ramp	534	522	3	1	1060
14.	West & East Piers	<1	1	399	8	408
15.	Long/Duck Pond	5	22	106	0	133
16.	Big Pond	0	0	10	0	10
17.	Crystal Point	3	<1	52	3	58
18.	Lagoon's Ramp	161	509	328	211	1209
19.	Horseshoe Pond	26	5	35	40	106
20.	Erie Yacht Club	987	55	19	3	1064
21.	Private Launch Ramp	1088	522	57	10	1677
22.	Erie Public Dock	1346	367	914	165	2792
23.	North/South Piers	0	0	643	0	643
	Total	5603	2559	2837	854	11853
East End						
24.	Lampe Marina	770	471	4	0	1245
25.	East Avenue Ramp	84	303	52	<1	439
26.	Four Mile Creek	<1	10	7	0	17
27.	Shade's Beach	0	0	4	0	4
28.	Twelve Mile Creek	13	141	25	0	179
29.	Sixteen Mile Creek	19	25	180	0	224
30.	Charlie's Boat Livery	<1	134	19	0	153
31.	N.E. Twp. Boat Launch	39	131	<1	0	170
32.	Twenty Mile Creek	2	4	96	0	102
	Total	925	1219	387	<1	2531
	Grand Total	6876	6130	5675	898	19579

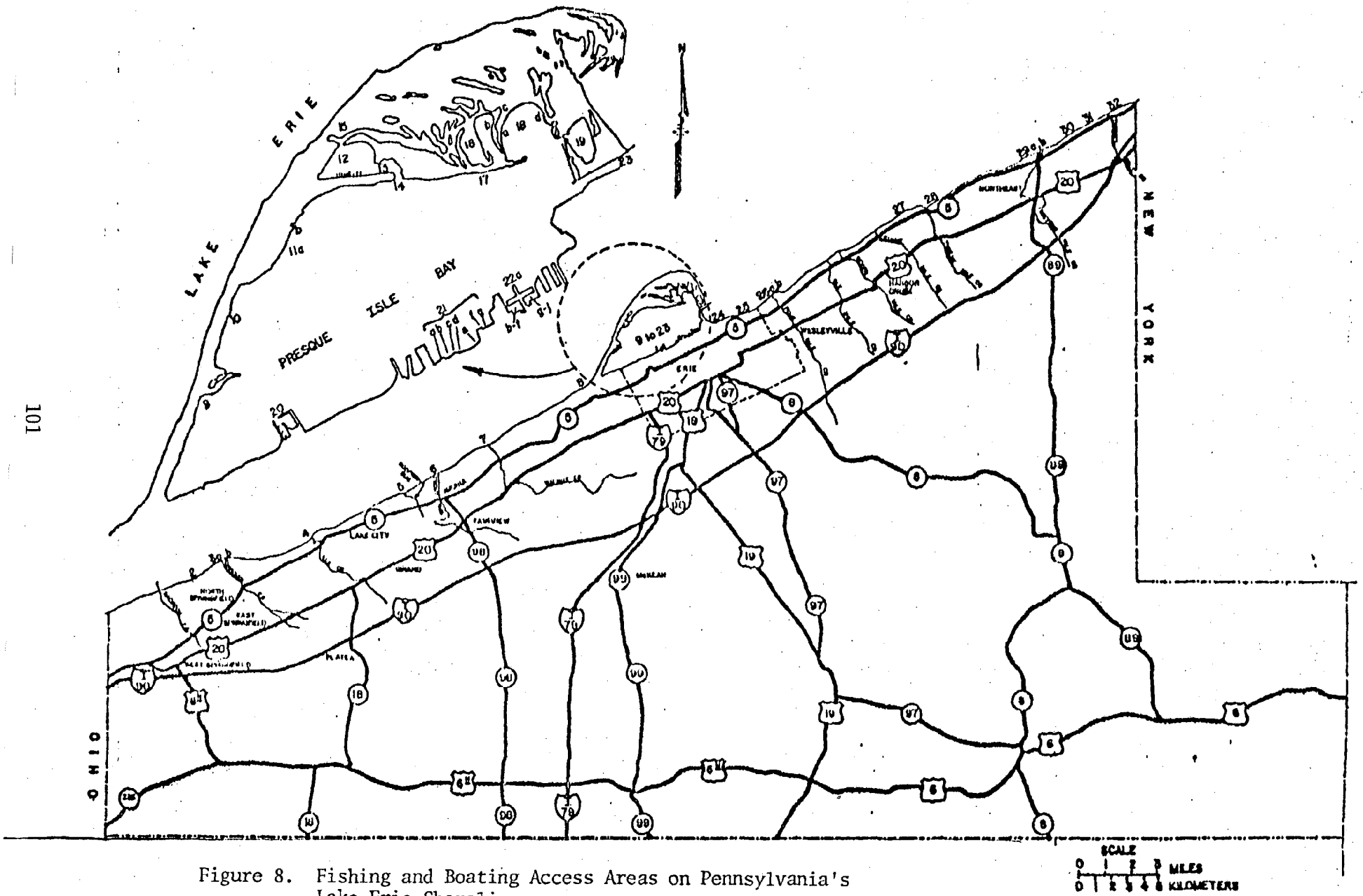


Figure 8. Fishing and Boating Access Areas on Pennsylvania's Lake Erie Shoreline.

Figure 8. (Cont'd.)

Site No.		Access		Ownership		Approx. Boat Capacity (s=slip, r= rental, t= trailer)
		Boat	Shore	Public	Private	
	WEST END					
1	Raccoon Creek	X	X	X		20t
2	Eagley Road		X	X		
3a	Virginia's Beach	X	X		X	35t
3b	Crooked Creek*		X		X	
4	Elk Creek	X	X		X	73s, 50t
5	Godfrey Run		X		X	
6	Trout Run	X	X	X		30s
7	Walnut Creek	X	X	X		72s, 265t
8	Hansen's Bait		X		X	
	PRESQUE ISLE BAY					
9	West Point	X	X	X		18t
10	Swan Cove		X	X		
11a	Niagra Boat Ramp	X	X	X		37t
11b	Ferry Slip*		X	X		
12	Presque Isle Marina	X	X	X		498s
13	Marina Ramp	X	X	X		50t
14	West & East Piers		X	X		
15	Long Pond & Duck Pond		X	X		
16	Big Pond		X	X		
17	Crystal Point		X	X		
18a	Lagoons Boat Ramp 1	X	X	X		18t
18b	Lagoons Boat Ramp 2	X	X	X		45t
18c	Stefans's Boat Livery	X	X		X	55r
18d	Lawrence Parking		X	X		
19	Horseshoe Pond		X	X		
20	Erie Yacht Club	X			X	439s
21a	Cascade St. Ramp	X		X		35t
21b	Commodore Perry Yacht Club	X			X	139s
21c	Cherry St. Marina	X			X	240s
21d	Bob's Wharf	X			X	30s
21e	Chestnut St. Ramp	X		X		40t
21f	Waterworks Ramp	X	X	X		50t
21g	Private Launch Ramp* (Erie Outboard Club)	X			X	35t
22a	Erie Public Dock		X	X		
22b	Presque Isle Yacht Club	X			X	90s
22c	Gem City Marina	X			X	38s

Figure 8. (Cont'd.)

Site No.		Access		Ownership		Approx. Boat Capacity (s=slip, r=rental, t=trailer)
		Boat	Shore	Public	Private	
	PRESQUE ISLE BAY (Cont'd.)					
22d	Paasch Marine	X			X	8s
22e	West State Street	X	X	X	X	54s
22f	Erie Marine	X			X	60s
22g	Brockway Marine	X			X	100s
22h	East State Street	X			X	8s
22i	McCallister & Sons Ltd.	X			X	70s
22j	Bayshore Marine	X			X	75s
23	North & South Piers		X	X		
	EAST END					
24	John E. Lampe Marina	X		X		115s, 54t
25	East Avenue Launch Ramp	X	X	X		60t
26a	Four Mile Creek		X		X	
26b	Lawrence Park Fishing Club	X			X	55s
27	Shades Beach	X	X	X		40t
28	Twelve Mile Creek	X	X	X		25t
29a	Sixteen Mile Creek		X	X		
29b	Freeport Yacht Club	X			X	28s
30	Charlie's Boat Livery	X	X		X	15s, 20r
31	North East Twp. Boat Launch	X		X		50t
32	Twenty Mile Creek		X		X	

*Not Sampled

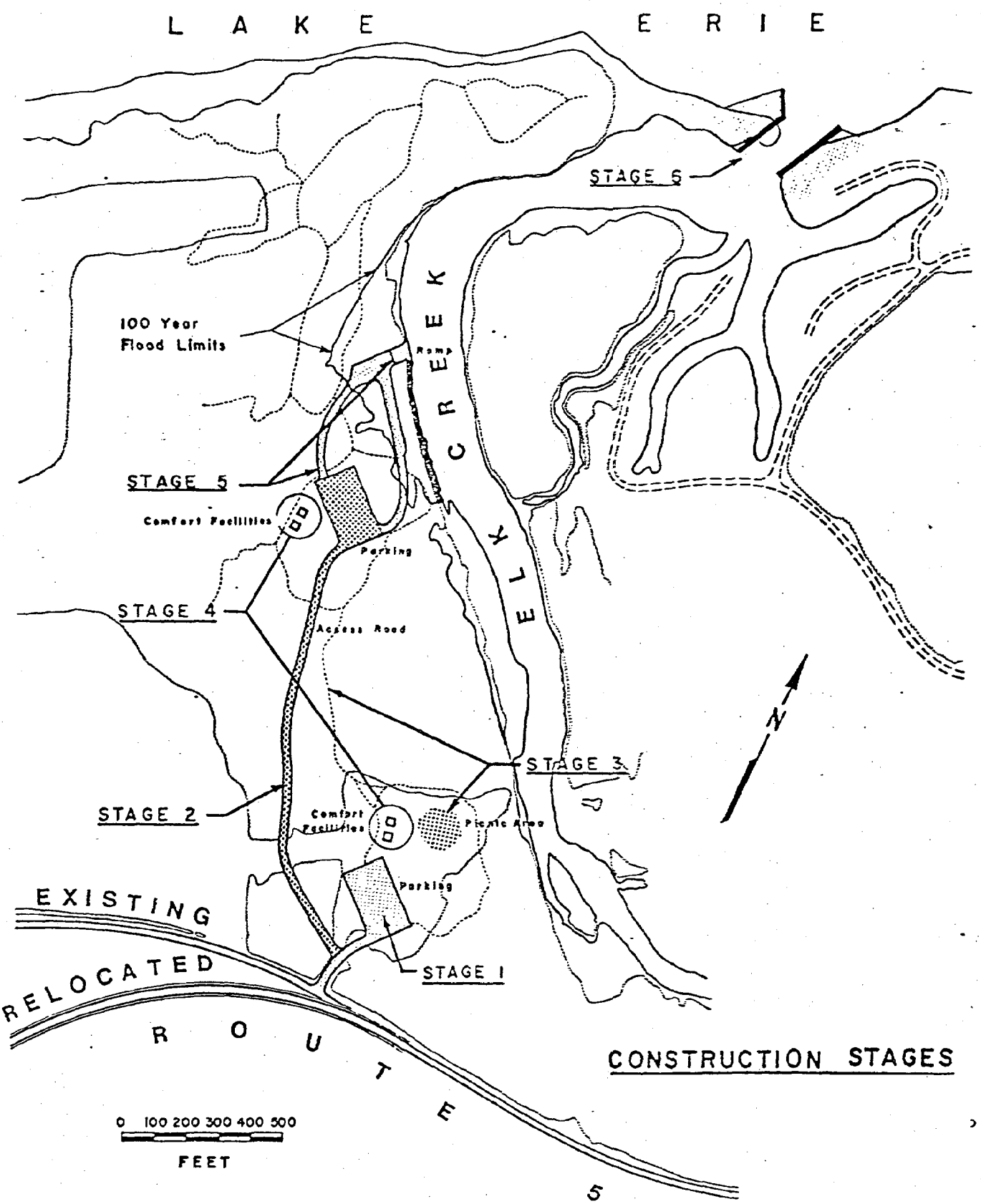


Figure 9. Construction stages of Elk Creek Public Access Area (D.A. Johnson and Associates 1980).

SECTION IV: COMMUNICATION

STATUS OF COMMUNICATION PROGRAMS

Open lines of communication between the PFC and the angling and boating public are essential to the success of the fishing and boating program. In the past, poor communication, and written attacks on the PFC by the local press, both helped to develop extraordinarily high levels of anti-Fish Commission sentiment in the Lake Erie region. Public demonstration reached a critical level in July 1981 when local sportsmen angrily voiced opposition to the Lake Erie program at a project FUTURE public meeting. Since that time, there has been a concerted staff effort to improve communication through such things as news releases and public meetings attended by senior staff members. As a result of these efforts, public opinion appears to have improved, but continued attention is needed.

The PFC's statewide communication program is the responsibility of the Office of Information. This office is mandated to promote the sports of fishing and boating while promotion of particular areas of the state for tourism is left to local Chambers of Commerce. By virtue of the Office's funding, 80 percent of all information and education programs are devoted to fishing and 20 percent to boating. Most programs target a statewide audience and may or may not focus on issues of local interest.

Numerous pamphlets and booklets have been produced by the Office of Information. Several of these publications, including "Trout Fishing in Pennsylvania," "Favorite Lakes of Western Pennsylvania," "Bass Hotspots in Pennsylvania," and "A Guide to Boating Access in Pennsylvania" contain <u>some</u> information specific to the Erie area. Other statewide information efforts which occasionally focus on Lake Erie issues include weekly press releases, a weekly radio program, and the <u>Pennsylvania Angler</u>, the Commission's monthly magazine. In addition, the Commission has developed the PLAY program (Pennsylvania League of Angling Youth), an innovative information and education effort aimed at the state's angling youth. Television has been an infrequently used medium of the Office of Information, but this will change in the near future with the production of half hour video programs for release on public television.

Information and education programs designed specifically for the Erie area have focused on promotion of the salmon fishery. A pamphlet entitled "Salmon Fishing--A Great New Experience" provides fishing tips and information on Lake Erie regulations, access areas, species identification, and boating safety. Other leaflets have been produced on salmon cooking instructions and identification of local business services such as motels, restaurants, tackle shops, and charter boats. In recent years, personnel from the Harrisburg office have traveled to the Erie area to help coordinate public relations efforts during the peak of the salmon season. The Commission also maintains a "Salmon Hotline" each fall, which furnishes fishing tips, near shore weather forecasts, and other related information.

Besides the efforts of the Office of Information, public relations are included in the day-to-day tasks of various PFC employees. Waterways patrolmen are involved in more one-on-one contact than any other PFC personnel, and are frequently called upon to provide information to interested individuals, members of the news media, and sportsmen's groups. The Area 2 Fisheries Manager and the Lake Erie Research Biologist are also involved in public relations through presentations at sportsmen's club meetings and various forms of correspondence. Fish culture stations are another primary source of public information, and hatchery personnel are frequently requested to furnish answers on a wide range of public inquiries. Hatchery personnel are also periodically called upon to conduct guided tours through the culture facilities.

Intraagency communication is achieved either on an informal basis by interpersonal contact, or by formal means such as distribution of weekly news releases, formal presentations by the area fisheries manager describing new management programs, and various meetings.

COMMUNICATION - PROBLEMS

Poor communication between the PFC and the angling and boating public has been a major problem in the Erie area. Insufficient public education concerning past PFC actions and the rationale for these actions has caused the agency to take a defensive posture on a number of issues, resulting in what has appeared to be a "crisis" management approach and fostering a perception of incompetence and insensitivity for the PFC. Emphasis on promotion of the salmon program created an impression that the Commission was neglecting the management of native species. This resulted in the formation of a large sportsmen's club, the SONS (acronym for Save Our Native Species), who along with other groups openly opposed the Commission's management program. Although conditions have improved considerably in the recent past, efforts should be made to prevent the reoccurrence of similar problems in the future.

Because of the complexity of managing the Lake Erie fishery, regulation changes have been more frequent here than in other areas of the state. At times this has created a confusing situation. For example, during the 1982 spring, changes were made in the panfish creel limit and the walleye creel and size limits. Because these changes occurred after the 1982 rule books had gone to press, they never appeared in the books until the following year. By law, the new regulations take effect 60 days after publication in the Pennsylvania Bulletin. However, few anglers apparently consult this publication. As a result, there was much confusion concerning regulations during the 1982 year. Better communication would have prevented this problem.

Fragmentation of sportsmen's clubs in the Erie area has made the dissemination of information to these groups difficult. Because many local clubs do not belong to the County Federation, waterways

patrolmen must make numerous contacts to "spread the word." News releases made available to regional directors of the Pennsylvania Federation are not received by non-members.

Five local newspapers and three radio stations were contacted as part of this study to solicit their views on perceived problems with the Commission's communication program. Most media members expressed general satisfaction in the PFC's present efforts but two major concerns surfaced. One was the need for more material of regional interest since many newspapers print only those articles dealing with local issues. A second problem, voiced by radio stations, was difficulty in contacting a PFC spokesman for information on fast breaking stories. Clarification of who should serve as a spokesman would be helpful.

Finally, intraagency communication efforts should be improved. A number of PFC personnel in the coastal zone are active in public relations efforts to varying degrees. These individuals should be kept well informed on those matters within the agency that are of significant public interest. This has not always been the case in the past resulting in failure or delays in adequately answering public inquiries. Improved communication would enable PFC personnel to be more effective in this area, thus promoting an appearance of professionalism. In addition, better intraagency communication would result in more efficient operation of duties within the agency.

Communication Problems as Perceived by Sportsmen's Clubs

One question included in the fishing and boating questionnaire specifically addressed the issue of communications. Sportsmen were asked how present PFC efforts might be improved and what new methods should be explored (Appendix III). Responses were varied. Several clubs noted that recent improvements were evident, but most groups listed further improvements which could be made. Four clubs requested more public contact via newsletters to sportsmens clubs and/or semi-annual or annual public meetings. Two clubs called for the instatement of a Lake Erie commissioner and two clubs suggested more newsletters be released to the local media. Other suggestions included greater use of radio, increased coverage of boating in the Pennsylvania Angler, giving subscriptions of the Pennsylvania Angler to all license holders with expenses to be covered through advertising, and more emphasis on such things as conservation, and education of students through the public school system.

COMMUNICATION - RECOMMENDATIONS

An expanded, aggressive, communication program should be initiated in the Erie coastal zone to promote an atmosphere of professionalism for the PFC, and to better inform the public of the full breadth of the Commission's Lake Erie program. This can be accomplished by regionalizing the communication program to provide more information of local interest, and by broadening the focus of these efforts to include coverage of the management of species other than the currently emphasized salmonids. Specific recommendations include:

1. Development of a brochure on Lake Erie fishing similar in format to "Salmon Fishing--A Great New Experience," but much broader in scope, emphasizing the unique and diversified fishing opportunities offered by Pennsylvania's only access to the Great Lakes.

2. Prepare news releases and feature articles addressing such things as:

   a. The work of the Lake Erie Research Unit--Types of work involved in, management techniques employed, summary of annual findings on status of the stocks, special research efforts, etc.
   b. Findings of other PFC studies such as the Presque Isle Bay Management Report and the Lake Erie Angling and Boating Use and Angler Harvest Summary.
   c. Biology of various Lake Erie fishes. At first, emphasis should be placed on subjects perceived by the public as controversial (e.g. salmon feeding biology, reasons for differences in walleye populations in different areas of the lake) but many other topics should be included as the program evolves.
   d. Promotion of underutilized game species such as northern pike, muskellunge and steelhead trout, and rough fish such as freshwater drum.
   e. Regulation changes.
   f. Status of the water quality, drawing attention to recent improvements and future prospects. Included in this effort would be information on toxic substances in fish flesh. (The PDER should have primary responsibility for this item with additional support from the PFC.)

3. Develop educational materials which can be utilized in the public school system addressing many of the same issues previously described.

4. Reevaluate the effectiveness of current communication efforts with sportsmen's clubs.

5. One individual should be assigned as a PFC spokesman for issues of public interest. This individual should be kept

well informed at all times and be able to handle most public inquiries. Questions of a more technical nature would be referred to the appropriate staff member. The spokesman should either be available for contact at a central location such as the Fairview hatchery or be equipped with a portable communication device.

6. Public forums should be considered as a means whereby the PFC, other state and local agencies, educational institutions, and sportsmen's clubs could discuss the development of management programs in the Lake Erie coastal zone. These meetings could be held on a regular annual basis.

7. The expanded communication program should extend to the intraagency level. Regular quarterly or semi-annual meetings should be arranged in which biologists, waterways patrolmen, hatchery personnel and other staff members from the Lake Erie region can discuss ongoing programs each is involved in.

SECTION V: BOATING

STATUS OF BOATING PROGRAMS

There are three major aspects of the PFC's boating program: 1. Development of access areas; 2. Boating education; and 3. Boating safety. The issue of access areas was discussed previously in this report. Therefore, this section will deal only with the related subjects of boating education and boating safety. These two issues are the joint responsibility of the Boating Education Division and the Law Enforcement Division within the Bureau of Waterways. All boating programs in which the PFC is involved are administered on a statewide basis and none have been developed specifically for the Lake Erie region. The education and safety programs consist of the following components:

1. A series of booklets and pamphlets on self-training and boating safety available upon request.

2. Operation of two vans equipped for boating safety education. One of these vans is based in the Erie area but it serves the entire western Pennsylvania region. The vans are driven to boat shows each winter, and to various sites, including conservation camps, YMCA camps, scout camps, and U.S. Army Corps of Engineer training seminars each summer.

3. Law enforcement. The PFC is authorized to enforce the Pennsylvania Boat Law.

4. Teacher training sessions to enable school teachers to in turn give instruction on safe boating.

5. River rescue training. In this program, volunteer firemen and river rescue crews are trained in proper rescue techniques. This program does not receive much emphasis in the coastal zone since most rescues on Lake Erie are performed by the U.S. Coast Guard and the PFC.

Although the PFC is active in boating safety, boating education, and access programs, there is a general lack of public recognition that the PFC is involved in boating. More emphasis on communication would help to promote public awareness of the agency's role in these areas.

Boating on Lake Erie presents dangers unique to this area of the commonwealth. Many boats used on inland lakes are inadequate for boating on the Great Lakes. In addition, boaters must pay particularly close attention to weather forecasts, since sudden storms and shifting winds can quickly result in life threatening conditions. Accidents occur each year due to neglect of these factors by boaters.

Other boating safety problems are of a more universal nature and can largely be attributed to that small segment of the population which either lacks common courtesy or makes a practice of operating a boat while under the influence of alcohol. It is this segment of the population which typically causes most boating accidents.

Finally, information which could be used to characterize non-angling boaters would benefit the Boating Education Division in structuring future programs. Unfortunately, this factor was overlooked during the 1981-1982 angler and boater survey and little information was collected from this contingent. Attempts to better coordinate future studies should be made.

Boating Problems as Perceived by Sportsmen's Clubs

Six sportsmen's clubs made comments related to boating safety on the fishing and boating questionnaire (Appendix III). Unfortunately, non-angling boaters were poorly represented in this survey. Although questionnaires were mailed to four boating clubs and ten private marinas, only one boating club responded. Suggestions offered by the various groups included better enforcement (four clubs), development of enforceable regulations for intoxication (two clubs), establishment of water ski only areas (two clubs), and establishment of a minimum age limit for boat operators (one club).

BOATNG - RECOMMENDATIONS

1. Expand communication efforts to increase public awareness of the PFC's statewide boating program. This effort will require close coordination with the Office of Information.

2. Make efforts to better educate boaters on the special safety precautions which must be considered when boating on Lake Erie. This could be accomplished by using prominent displays at heavily used access areas and news releases in those areas from which heavy boating use is received.

3. Develop legislation to enable PFC waterways patrolmen to better respond to the problem of drunken boat operators (ammendments to the Pennsylvania Boating Law are currently being considered in an attempt to address this problem).

4. Increase emphasis on boating enforcement (instatement of the third Erie County waterways patrolman will do much to alleviate this problem).

5. Consult the Boating Education Division prior to future use and harvest surveys to determine if information on non-angling boaters is needed. Incorporate these needs into the survey plan.

CONCLUDING REMARKS

Incorporation of all the recommendations listed in this fishing and boating plan would represent a considerable expansion of the current Lake Erie program. To oversee development and coordination of this plan, enstatement of a Lake Erie Program Coordinator, as was suggested by Hoopes (1980), should be considered. However, for any expansion to be possible, additional sources of funding must be identified. Possible sources include special use stamps and federal grant programs (e.g. CZM, passage of Dingell-Johnson expansion bill). In the interim, priority consideration should be given to those recommendations (there are many) which can be undertaken at the current funding and manpower levels. Detailed plans for specific programs should be the responsibility of those sections within the agency which possess the required expertise. Student interns should be considered as one source of additional manpower in future programs since the intern program is implemented at very little cost to the PFC. When properly supervised, interns can be very effective in collecting certain types of much needed data, as was evidenced during the 1983 stream assessment for lampreys.

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Appendix I. Outline of Proposed Lake Erie Fishery Program (Hoopes 1980).

LAKE ERIE FISHERY PROGRAM

I. COORDINATION PROGRAM

- A. Planning Program
- B. Budgeting Program
- C. Data Services Program
  1. Accounting
  2. Data Processing
  3. Data Analysis
- D. Purchasing Program
- E. Reporting Program
- F. Personnel Training Program

II. FISHERY ASSESSMENT PROGRAM

- A. Commercial Fishery Program
  1. Commercial Fish Sampling
     - a. Age and Growth
     - b. Optimum Yield Modeling
  2. Commercial Fishery Use and Harvest
- B. Sport Fishery Program
  1. Open Lake Fish Sampling
  2. Presque Isle Bay Fish Sampling
  3. Tributary Sampling
  4. Fish Age and Growth Program
- C. Water Quality Monitoring Program
- D. Fish Flesh Analysis Program
- E. Fisheries Use Program
  1. Angling and Boating Use Program
  2. Angling Harvest Program
- F. Riparian Assessment Program (Ownership & Accessibility)

III. FISHERY IMPLEMENTATION PROGRAM

A. Salmonid Production Program

1. Disease Free Stock Program
2. Disease Control Program
3. Hatchery Program

a. Rearing
b. Distribution

B. Land Acquisition Program

C. Access Development Program

D. Facilities Maintenance Program

E. Regulations Program

IV. FISHERY ENFORCEMENT PROGRAM

A. Fish Law

1. Pollution
2. Regulations

B. Boat Law

V. COMMUNICATION PROGRAM

A. News Media Program

B. Technical Information Program

Appendix II. Personal Contacts Made to Obtain Information for Use in Development of Fishery and Boating Programs for the Lake Erie Coastal Zone.

Pennsylvania Fish Commission

Gene Sporl, Assistant Executive Director, Bureau of Waterways
Vincent Mudrak, Chief, Research Section
Roger Kenyon, Lake Erie Research Biologist
Joseph O'Grodnick, Fisheries Research Biologist
Kenneth Stark, Pathologist
Richard Snyder, Chief, Fisheries Management Section
Rickalon Hoopes, Warmwater Unit Leader
Martin Marcinko, Coldwater Unit Leader
Ronald Lee, Area 2 Fisheries Manager
Shyrl Hood, Chief, Warmwater Propagation Section
Neil Shea, Superintendent, Fairview Fish Culture Station
J. Gary Moore, Western Erie County Waterways Patrolman
James Carter, Eastern Erie County Waterways Patrolman
Michael Bickler, Director, Office of Information
David Wolf, Media Relations
John Simmons, Administrative Officer, Administrative/Safety Division
Virgil Chambers, Boating Safety Education Specialist
Joseph Greene, Boating Safety Education Specialist
Ronald Weis, Chief, Engineering & Architectural Section
E. Jon Grindall, Chief, Dams and Engineering Branch
John Hoffman, Chief, Real Estate Section
Glen Reed, Federal Aid Coordinator

Other Agencies

Paul Vidal, Lake Michigan Program, Illinois Department of Conservation
Lee Kernan, Great Lakes Section Chief, Wisconsin Department of Natural Resources
Asa Wright, Great Lakes Program Manager, Michigan Department of Natural Resources
William James, Chief of Fisheries, Indiana Department of Natural Resources
Thomas Wasson, Executive Administrator, Fisheries Management and Research, Ohio Department of Natural Resources
Richard Hassinger, Fisheries Chief, Minnesota Department of Natural Resources
A. S. Holder, Director, Fisheries Branch, Ontario Ministry of Natural Resources
Floyd Cornelius, Senior Aquatic Biologist, New York Department of Environmental Conservation
Ronald Drynan, International Joint Commission
David DeVault, Great Lake National Program Officer, U.S. Environmental Protection Agency
Gary Milburn, U.S. Environmental Protection Agency
Wiley Williamson, U.S. Food and Drug Administration
Wayne Wiliford, Great Lakes Fishery Lab, U.S. Fish and Wildlife Service
U.S. Department of Agriculture
Robert Frey, Pennsylvania Department of Environmental Resources
Larry Toth, Pennsylvania Department of Environmental Resources
Pennsylvania Department of Agriculture

Robert Wellington, Erie County Health Department
Charles Posway, Erie City Water Bureau
Robert Chandler, Erie Area Chamber of Commerce

Universities

John Leatherland, University of Guelph, Guelph, Ontario
Peter Morrison, University of Guelph, Guelph, Ontario
Edwin Mastellar, Pennsvlvania State University-Behrend, Erie, Pa.
Stanley Zagorski, Gannon University, Erie, Pa.

Manufacturers

Edward Leslie, Hammermill Paper Company
William Litzenburg, Koppers Company, Inc.

Newspapers

Frank DeSantis, Erie Daily Times
David Heberle, Erie Daily Times
Peter Strozniak, Mill Creek Sun
Val Struble, Cosmopolite Herald
Roger Coda, North East Breeze
Michael Manos, Union City Times

Erie Radio Stations

WJET
WLKK
WRIE

Appendix III. Response of Western Pennsylvania Sportsmen's Clubs to Lake Erie Fisheries and Boating Questionnaire.

PENNSYLVANIA FISH COMMISSION

LAKE ERIE
FISHERIES AND BOATING QUESTIONNAIRE

1. NAME OF YOUR ORGANIZATION.
2. WHAT IS THE SIZE OF YOUR ORGANIZATION'S MEMBERSHIP.

	COUNTY	MEMBERS
1. East Side Salmon Club	Erie	125
2. Elk Valley Sportsmen Club	Erie	426
3. Erie Downriggers	Erie	250-300
4. Northwest Pa. Chapter of Trout Unlimited	Erie	55
5. Presque Isle Yacht Club	Erie	125
6. Reel Anglers of Erie Co.	Erie	15
7. S.O.N.S. of Lake Erie	Erie	1548
8. 3-C-U Trout Association	Erie	1000
9. Wesleyville Conservation Club	Erie	50
10. Sandy lake Sportsmen's Club	Mercer	104
11. Ohio Valley Bass Club	Beaver	20

3. LIST WHAT YOU FEEL ARE THE GREATEST FISHERY AND/OR BOATING NEEDS IN PENNSYLVANIA'S LAKE ERIE REGION. LIST MOST PRESSING NEEDS FIRST, PARTICULARLY THOSE NEEDS WHICH YOU FEEL THE PENNSYLVANIA FISH COMMISSION WILL BE ABLE TO MEET. IF POSSIBLE, GIVE SEPARATE ANSWERS FOR:

A) LAKE ERIE

1, 2, 3, 6, 8-	Launch areas/safe harbor on East Side
3, 8-	Launch Areas/safe harbor on West Side
7, 9, 10, 11-	Launch Areas,safe harbor-unspecified
5-	Complete Elk Creek launch facility
1, 2-	More effort on walleye & perch-native species
4-	Protect perch, walleye, smallmouth bass during spawning
3-	Reinstitute bass season
3-	Stock more salmon (1.2-1.5 million annually & more rainbow & brown trout (.5 to .75 million annually)
1-	Stock more salmon
3-	Lamprey control
3-	Public fish cleaning stations
7-	Provide shore fishing piers
8-	Better enforcement of commercial regulations
11-	Less PFC harassment
9-	Measure contamination in fish and publicize

B) PRESQUE ISLE BAY

6-	Increase berths at P.I. Marina
9-	Better upkeep of ramps
11-	More launch ramps
6-	Restrooms at launch ramp-P.I. Marina
2-	More effort on native fish
3-	Stock warm water species (walleye, northern pike, muskellunge, etc.)
4-	Protect largemouth bass, musky, perch during spawning
7-	Stock native species
5-	Fish hatchery
3-	Reinstitute bass season
3-	Stock more salmon & trout
7-	Artificial reefs
3-	Designated fishing area where racing/waterskiing banned
3-	Public fish cleaning stations
8-	Provide freshwater inlet at west end of Bay
11-	Less PFC harassment
9-	Measure contamination in fish and publicize

C) TRIBUTARY STREAMS

7, 10-	Launch facilities
7-	Shore fishing piers
10-	Lights at Walnut Creek
6-	Make size limits same as those in lake
3-	Lamprey control
4-	Stimulate sport fishing, fish at disadvantage on spawning run
2-	Stock salmon north of Rt. 5, stock trout south of Rt. 5

4. LIST ANY FISHING REGULATIONS YOU FEEL SHOULD BE MODIFIED. STATE HOW AND WHY THIS SHOULD BE DONE FOR:

A) LAKE ERIE

1, 2, 7, 8-	Reinstate bass season
3-	Trophy season on bass--March 15th to third Saturday in June; 1 bass 15 inches or greatr
6-	15 inch length limit for bass
11-	14 inch length limit for bass
4-	Better enforcement

B) PRESQUE ISLE BAY

1, 2, 7, 8-	Reinstate bass season
3-	Trophy bass season, March 15--to third Saturday in June, 1 bass 15 inches or greater
11-	14 inch length limit for bass
4-	Prohibit fishing inside 8 ft. of water in April and May. Refuge to be marked by buoys.

C) TRIBUTARY STREAMS

2, 7-	Reinstate bass season
2	Make creel limits the same statewide
4, 8-	3 fish creel limit
3-	Trophy trout season only for trout; 18 inch size limit; 3 fish creel limit; single hooks only
4-	12 inch or 15 inch size limit
6-	Make size limits same as lake
4, 7, 8, 9-	Year around season
8-	No opening day for steelhead--would improve landowner-fisherman relations
4, 8	No put and take stocking
4, 8-	Single hooks only
4, 8-	Prohibit landing nets or gaffs
4, 8-	No night fishing

5. LIST ANY BOATING REGULATIONS YOU FEEL SHOULD BE MODIFIED. STATE HOW AND WHY THIS SHOULD BE DONE FOR:

A) LAKE ERIE

3, 5-	Enforceable regulations for intoxication
4, 5, 7, 10-	Better enforcement
7-	Set up water skiing areas

B) PRESQUE ISLE BAY

3, 5-	Enforceable regulations for intoxication
4, 5, 7	Better enforcement
2-	Minimum age limit for operators
3, 7-	Fishing only area--banned to water skiing

6. HOW COULD THE PRESENT COMMUNICATION EFFORTS BETWEEN THE PENNSYLVANIA FISH COMMISSION AND THE PUBLIC BE IMPROVED? WHAT NEW METHODS SHOULD BE EXPLORED?

1, 6, 10-	Recent improvements are evident
2, 5-	Newsletters to sportsmen's clubs
2-	More public contact
3, 8-	Annual or semi-annual public meetings
3, 8-	Instate a Lake Erie commissioner

4-	More emphasis on pretecting the resource, sport fishing, educating young people in schools
5-	Improve Angler to cover education article on safe boating
7-	Give Angler to every license holder with expense paid by selling ads
5, 9-	More newsletters to local media
10-	Use radio stations more

7. IN THE LAST TEN YEARS HAVE THE FOLLOWING FISHERIES IMPROVED, DECLINED, OR STAYED THE SAME?

	PRESOUE ISLE BAY				LAKE ERIE			
	I	D	S	NR	I	D	S	NR
SALMON	6	3	1	1	7	3	0	1
STEELHEAD TROUT	8	2	1	0	10	1	0	0
YELLOW PERCH	0	9	1	1	0	11	0	0
WALLEYE	1	8	0	2	1	7	2	1
WHITE BASS	4	2	1	4	5	2	0	4
CHANNEL CATFISH	2	3	1	5	1	4	0	6
BULLHEADS	2	1	2	6	1	2	1	7
SMALLMOUTH BASS	4	3	2	2	7	3	0	1
LARGEMOUTH BASS	3	5	2	1				
NORTHERN PIKE	3	6	1	1				
MUSKELLUNGE	3	6	1	0				
SUNFISH	2	4	1	4				
CRAPPIE	1	7	1	2				

(I = IMPROVED, D = DECLINED, S = SAME, NR = NO REPLY)

8. BASED ON YOUR KNOWLEDGE OF THESE FISHERIES, DO YOU PREDICT THEM TO IMPROVE, DECLINE OR STAY THE SAME DURING THE NEXT TEN YEARS?

	PRESQUE ISLE BAY				LAKE ERIE			
	I	D	S	NR	I	D	S	NR
SALMON	4	1	1	5	4	2	2	3
STEELHEAD TROUT	3	2	2	4	6	2	1	2
YELLOW PERCH	5	2	1	3	6	2	1	2
WALLEYE	6	1	0	4	7	1	0	3
WHITE BASS	1	1	5	4	2	1	4	4
CHANNEL CATFISH	1	1	4	5	1	1	3	6
BULLHEADS	1	1	4	5	1	1	3	6
SMALLMOUTH BASS	0	6	2	3	1	6	2	2
LARGEMOUTH BASS	1	5	1	4				
NORTHERN PIKE	2	1	4	4				
MUSKELLUNGE	2	1	3	5				
SUNFISH	0	2	4	5				
CRAPPIE	1	1	4	5				

(I = IMPROVED, D = DECLINED, S = SAME, NR = NO REPLY)

9. PLEASE LIST ANY ADDITIONAL COMMENTS.

3- Bass need protection during spawning. Trophy bass season during this time should be considered.
4- Shold place more emphasis on limiting the kill and protecting spawning fish.
7- Should set aside areas in Presque Isle Bay as "no fishing" or "no wading" in June to allow bass to spawn with minimum disturbance; club would agree to purchase signs and put in place.
6- Advocate catch and relase of bass.
1- Need to plant more perch and walleye and king salmon in Lake Erie. Lake should be able to support larger fishery than now exists.
7- With continued cooperation between PFC and sport fishing groups we can rebuild the perch and walleye fisheries. New regulations should help.

2- 50 minnows/bucket is a stupid law.
3- Need continued strong enforcement of commercial fishing.
6- Acid rain may be a future problem but realize problem and solutions are beyond scope of PFC.
9- Channel should be opened between lake and head of the Bay (to allow bay to flush itself).

Appendix IV. Organizational Framework of the Fisheries Division of the Pennsylvania Fish Commission.

PENNSYLVANIA FISH COMMISSION
FISHERIES DIVISION

FISHERIES DIVISION CHIEF

Secretary
Stocking Program Manager
Statistical Analyst

Headquarters: Pleasant Gap

FISHERIES RESEARCH

Section Chief
Secretary

Pathology - 2 Bio.
Fish Culture - 1 Bio.
- 1 Tech.
Water Quality - 2 Tech.

Headquarters: Benner Spring Fish Research Sta., Bellefonte - statewide responsibility

Major emphasis in 1979-80 on dealing with hatchery diseases, developing best ways to treat hatchery effluents and working with shad for the Susquehanna.

FISHERIES MANAGEMENT

Section Chief
Secretary

Coldwater Unit - 1 Bio.
- 1 Tech.
Warmwater Unit - 1 Bio.
- 1 Tech.
Herpetology & Endangered Species Coordinator

Headquarters: Pleasant Gap

- - - - - - - - - - - - - - -

Area Managers - 1 Bio.
- 1 Tech.

Headquarters:
Area 1 - Erie
2 - Tionesta
3 - Pleasant Gap
4 - Sweet Valley
5 - Bushkill
6 - Revere
7 - Huntsdale
8 - Somerset

Major emphasis in 1979-80 will be to continue survey and inventory--statewide--and develop comprehensive trout management plan.

PROPAGATION - WARMWATER

Section Chief
Secretary

Headquarters: Linesville

Hatcheries
Linesville
Corry/Union City
Tionesta
Pleasant Mount
Fairview

Lake Erie Research Project

Major emphasis in 1979-80 to meet Fish. Mgt. needs, produce primarily muskellunge and walleye. Also continue Lake Erie coho/chinook/steelhead program.

PROPAGATION - COLDWATER

Section Chief
Secretary

Cooperative Nursery Unit
- 1 Supt.
- 2 Tech.
- 1 Secretary

Headquarters: Pleasant Gap

Hatcheries
Pleasant Gap
Bellefonte
Benner Spring
Huntsdale
Reynoldsdale
Oswayo
Big Spring

Major emphasis to produce catchable size trout for statewide program.

Continue to add new units improve old, provide best services possible.

FISHERIES ENVIRONMENTAL SERVICES

Section Chief
Secretary

Hydraulic Technician
Fisheries Biologist
Temporary Laborer

Headquarters: Pleasant Gap

Major emphasis in 1979-80 is on review of permits for any project affecting aquatic resource, habitat improvement project design, and planning and program development to respond to new Federal Surface Mining Act.

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