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HISTORY OF THE CHANGING FISH SPECIES OF THE GREAT LAKES

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INTRODUCTION

Before European man settled in the Great Lakes region, fish in the lakes consisted of stable salmonid populations including: Atlantic salmon, lake trout, lake whitefish, lake herring and ciscos (chubs). In the past two centuries, catastrophic changes have taken place in Great Lakes fish stocks. The human population has grown in size and its use of technology. Many of the once prized species were driven to near extinction by the middle of this century. Fisheries biologist, Stanford Smith has pointed out that individually or collectively, four factors disrupted the formerly stable and productive fish communities in the Great Lakes: 1) intensive exploitation by fishermen, 2) extreme modification of the upland drainage basins and tributaries, 3) establishment of marine (salt water) fish species by introduction and invasion (e.g. sea lamprey and alewife) and 4) cultural eutrophication (progressive physical and chemical modification of lake environments resulting from human introductions of excessive amounts of nutrients). The consequences of these factors have been somewhat different for each of the Great Lakes because of the varying geographic and morphometric characteristics of each basin. However, the net effect has been one of turmoil and species changes for fish stocks in the entire system. Only within the past decade have promising improvements been seen for fish populations in most of the lakes.

Lake Description

Geographically, centered at 45° N latitude, the Great Lakes lie midway between the equator and north pole. The natural drainage basin covers an area of 298,500 square miles, 59% in the United States and 41% in Canada. The dimensions, physical and chemical conditions and habitat characteristics of these lakes differ greatly (Table 1), resulting in distinct fish communities for each body of water.

TABLE 1

DIMENSIONS OF THE GREAT LAKES SYSTEM

Feature	Lakes					
	Superior	Michigan	Huron	St. Clair	Erie	Ontario
Surface Area (sq mi)	31,700	22,300	23,050	490	9,920	7.550
Drainage Basin (sq mi)	81,000	67,900	74,800	7,420	32,600	34,880
Length (mi)	350	307	206	26	241	193
Breadth (mi)	160	118	183	24	57	53
Shoreline Length (mi)	2,980	1,660	3,180	169	856	726
Maximum Depth (ft)	1,333	923	750	21	210	802
Mean Depth (ft)	489	279	195	10	62	283
Volume (cu mi)	2,935	1,180	849	1	116	393
Mean Elevation (ft)	600	579	579	573	570	245
Outflow River	St. Marys	Str. of Mackinac	St. Clair	Detroit	Niagara	St. Lawrence
Mean Outflow (ft/sec)	75,000	52,000	187,000	188,000	202,000	239,000
August Temp. (°F)	55	67	64	75	73	70
Dissolved Solids (ppm)	60	118	108	110	113	134
Transparency (ft)	39	20	31	10	15	18

Cold-water fish species dominate in the northern half of the basin and cool-water and warm-water species are most common in the lower lakes. Per unit surface area, the shallower, warmer lakes (Lake Erie and Lake St. Clair) are much more productive than the deeper, colder lakes. Over the past century, Lake Erie's annual commercial fish yield has averaged nearly 2.5 tons/square mile, while commercial harvests from the other large lakes have been well below 0.7 tons/square mile (Table 2).

The Great Lakes and their tributaries contain a wide variety of fish species. At least 237 species or subspecies have been reported from the waters within the basin. Of these, only about 20 are commonly harvested species (those which are marketable for profit or are enjoyed for sport and food by anglers):

Commercial Fish

channel catfish, lake trout, carp, lake whitefish, freshwater drum, cisco (lake herring), smelt, bloater, white bass, yellow perch, sauger and walleye.

Sport Fish

rainbow trout, brown trout, Pacific salmon, lake trout, northern pike, muskellunge, smallmouth bass, largemouth bass, yellow perch, walleye, bullhead, and sunfish.

The composition of fish species in the Great Lakes has been modified greatly in the past 200 years by the decline of certain indigenous species and the introduction or immigration of exotic species. The carp was introduced in the 1870's, and substantial populations were well-established by 1900. This species, although commercialy harvested, is well-known as a "nuisance species" because of the turbidity and wetland plant destruction associated with its spawning behavior. Smelt was first stocked in a small lake tributary to Lake Michigan in the 1920's, and in a few decades this species spread throughout the upper Great Lakes and Lake Erie. (Smelt is native to Lake Ontario). The sea

TABLE 2

COMPARATIVE COMMERCIAL FISHING YIELDS FOR
THE GREAT LAKES 1880 - 1980
(Tons per Square Mile of Lake Surface)

Fish Yield (tons/sq mi)	Lakes: Superior	Michigan	Huron	St. Clair	Erie	Ontario
~1880	0.07	0.52	0.25	2.88	1.54	0.46
~1890	0.13	0.59	0.53	3.28	3.71	0.50
~1900	0.15	0.84	0.53	1.11	3.48	0.36
~1910	0.20	1.06	0.45	1.51	2.68	0.27
1920	0.20	0.45	0.39	1.56	2.47	0.35
1930	0.31	0.60	0.48	0.49	2.13	0.31
1940	0.38	0.51	0.32	0.98	1.65	0.29
1950	0.24	0.61	0.21	0.68	2.06	0.16
1960	0.26	0.55	0.22	0.81	2.54	0.15
1970	0.13	1.19	0.10	0.09	2.08	0.21
~1980	0.13	0.51	0.13	0.35	2.63	0.15
Mean	0.20	0.68	0.33	1.25	2.45	0.29
Std. Dev.	±0.09	±0.24	±0.15	±1.01	±0.68	±0.12
Std. Error	±0.03	±0.07	±0.05	±0.30	±0.30	±0.04

lamprey and alewife (which will be discussed in more detail later), now abundant in most of the lakes, were unknown except in Lake Ontario prior to the opening of the Welland Canal. The white perch is a recent immigrant which has established a large population in both Lake Erie and Lake Ontario. In most cases, the spread of an exotic in number and geographic range has been at the expense of native species. Fifty of the fishes most commonly associated with the Great Lakes are listed in Table 3 with data on size, thermal preference and native origin.

CATASTROPHE

Lake Ontario

Although most of the water in Lake Ontario comes from eutrophic (nutrient-rich) Lake Erie, and the Toronto-Hamilton area introduces additional pollutants, the lake is in somewhat better condition than Lake Erie by virtue of its much larger volume to surface ratio. The biotic changes in Lake Ontario, including fisheries, have been as dramatic as the more publicized one in Lake Erie, but of a somewhat different nature.

The Atlantic salmon was once the dominant piscivore (fish-eater) in Lake Ontario, but was not found in the upper Great Lakes because of the barrier presented by Niagara Falls. In the late 1700's and early 1800's, this species was fished intensively because it could be easily caught as it migrated up tributary streams to spawn. By 1850, the salmon population declined due to deforestation, causing the streams to be warmer and more turbid, and dam construction. And by 1890, Atlantic salmon was extinct in Lake Ontario, leaving behind deserted lakefront fishing communities.

The alewife is the first marine invader to become established in the Great Lakes. It probably entered Lake Ontario from the Atlantic Ocean via the Hudson River and Erie Canal. The alewife probably did not become abundant until the 1870's because prior to that time, the voracious Atlantic salmon held them in check.

TABLE 3

FIFTY COMMON FISHES OF THE GREAT LAKES
(Listed in Phylogenetic Order)

	Common Name	Scientific Name	Adult Size (in)	Thermal Preference	Origin
		Family Petromyzontidae (lampreys)			
1.	Sea lamprey	Petromyzon marinus	34	CD	MV
		Family Aciperseridae (sturgeons)			
2.	Lake sturgeon	Acipenser fulvescens	48	CL	N
		Family Lepisostedia (gars)			
3.	Spotted gar	Lepisosteus oculatus	20	W	N
4.	Longnose gar	Lepisosteus osseus	30	CL	N
		Family Amiidae (bowfins)			
5.	Bowfin	Amia calva	21	W	N
		Family Clupeidae (herrings)			
6.	Alewife	Alosa pseudoharengus	6	CL	MV
7.	Gizzard shad	Dorosoma cepedianum	10	W	FV
		Family Hiodontidae (mooneyes)			
8.	Mooneye	Hiodon tergisus	11	W	N
		Family Salmonidae (trouts)			
9.	Longjaw cisco	Coregonus alpenae	11	CD	N
10.	Cisco or lake herring	Coregonus artedii	10	CD	N
11.	Lake whitefish	Coregonus clupeaformis	15	CD	N
12.	Bloater	Coregonus hoyi	9	CD	N
13.	Deepwater cisco	Coregonus johannae	11	CD	N
14.	Kiyi	Coregonus kiyi	10	CD	N
15.	Blackfin cisco	Coregonus nigripinnis	13	CD	N
16.	Shortnose cisco	Coregonus reighardi	10	CD	N
17.	Shortjaw cisco	Coregonus zenithicus	11	CD	N
18.	Coho salmon	Oncorhynchus kisutch	25	CD	MT
19.	Chinook salmon	Oncorhynchus tshawytscha	34	CD	MT
20.	Rainbow or steelhead trout	Salmo gairdneri	20	CD	FT

TABLE 3 (Continued)

	Common Name	Scientific Name	Adult Size (in)	Thermal Preference	Origin
		Family Salmonidae (Continued)			
21.	Atlantic salmon	*Salmo salar*	18	CD	N
22.	Brown trout	*Salmo trutta*	16	CD	FT
23.	Lake trout	*Salvelinus namaycush*	18	CD	N
		Family Osmeridae (smelts)			
24.	Rainbow smelt	*Osmerus mordax*	7	CD	MT
		Family Esocidae (pikes)			
25.	Northern pike	*Esox lucius*	25	CL	N
26.	Muskellunge	*Esox masquinongy*	38	CL	N
		Family Cyprinidae (carps and minnows)			
27.	Common carp	*Cyprinus carpio*	17	W	FT
28.	Goldfish	*Carassius auratus*	10	W	FT
29.	Emerald shiner	*Notropis atherinoides*	3	CL	N
30.	Spottail shiner	*Notropis hudsonius*	4	CL	N
		Family Catostomidae (suckers)			
31.	Quillback	*Carpiodes cyprinus*	15	W	N
		Family Ictaluridae (catfishes)			
32.	Brown bullhead	*Ictalurus nebulosus*	12	W	N
33.	Channel catfish	*Ictalurus punctatus*	20	W	N
		Family Gadidae (codfishes)			
34.	Burbot	*Lota lota*	15	CL	N
		Family Percichthyidae (temperate basses)			
35.	White perch	*Morone americana*	7	CL	MV
36.	White bass	*Morone chrysops*	12	W	N

TABLE 3 (Continued)

	Common Name	Scientific Name	Adult Size (in)	Thermal Preference	Origin
		Family Centrarchidae (sunfishes)			
37.	Rock bass	*Ambloplites rupestris*	9	W	N
38.	Pumpkinseed	*Lepomis gibbosus*	8	W	N
39.	Bluegill	*Lepomis macrochirus*	8	W	N
40.	Smallmouth bass	*Micropterus dolomieui*	12	W	N
41.	Largemouth bass	*Micropterus salmoides*	12	W	N
42.	White crappie	*Pomoxis annularis*	10	W	N
43.	Black crappie	*Pomoxis nigromaculatus*	9	CL	N
		Family Percidae (perches)			
44.	Yellow perch	*Perca flavescens*	10	CL	N
45.	Sauger	*Stizostedion canadense*	14	CL	N
46.	Walleye	*Stizostedion v. vitreum*	17	CL	N
47.	Blue pike	*Stizostedion v. glaucum*	14	CL	N
		Family Sciaenidae (drums)			
48.	Freshwater drum	*Aplodinotus grunniens*	20	W	N
		Family Cottidae (sculpins)			
49.	Mottled sculpin	*Cottus bairdi*	3	CL	N
50.	Deepwater sculpin	*Myoxocephalus thompsoni*	3	CD	N

Thermal Preference: CD = coldwater, CL = coolwater, W = warmwater

Origin: N = native, FT = freshwater introduced, MT = marine introduced, FV = freshwater invader, MV = marine invader

The alewife appears to dominate other fish species through food competition. Its ability to dramatically remove all large zooplankton from a lake deprives larger fishes of the food necessary for survival. Among the fish eventually affected by the alewife as it spread to Lake Erie in 1931 and on to Lake Superior by 1954, were shallow-water plankton feeders (e.g. yellow perch and rainbow smelt) and deep-water plankton feeders (e.g. deepwater cisco and deepwater sculpin), the preferred food for lake trout.

The most conspicuous change in fish communities of the Great Lakes came with the invasion of the parasitic sea lamprey. This jawless fish possesses a sucker-like mouth, ringed with horny teeth, capable of rasping its prey's flesh. It was identified in Lake Ontario as early as 1835, but did not become well established until the 1880's. Lampreys appear to have entered Lake Ontario by the same route as the alewife, eventually spreading to all the Great Lakes by 1946.

The unfavorable conditions (e.g. increased temperature of the tributaries) that resulted in the elimination of the Atlantic salmon population in Lake Ontario may have created more favorable conditions for lamprey reproduction. Therefore, as the salmon declined the sea lamprey increased.

In contrast to the upper Great Lakes, sea lampreys and lake trout have coexisted in Lake Ontario for the past 100 years. But, the lake trout population has been small during this period. The annual production from 1867 to 1940 averaged 165 tons and declined to only 15 tons in the years 1941-1967.

<u>Lake Erie</u>

Lake Erie is the most productive of the Great Lakes and produces about 25,000 tons annually, about 40% of the total Great Lakes harvest. However, the Lake Erie fishery has gone through dramatic and often rapid species succession over the past 200 years as a result of over exploitation, drainage basin changes, and within the past 50 years, cultural eutrophication. In 1885, about 2,500 tons of lake sturgeon were captured in the water of Lake Erie, but by the end of the century commercial fishermen had overharvested this species because it fouled gill nets set for more marketable species. By 1920, the lake sturgeon was a rare catch, and due to their slow growth and late maturity, the sturgeon population has never recovered in the lake. Today, lake sturgeon is on the endangered species list in Ohio.

Niagara Falls constituted a barrier to the sea lamprey until the Welland Ship Canal was constructed between Lake Ontario and Lake Erie in 1829. The first sea lamprey was reported from Lake Erie in 1921 and by 1934, lamprey were observed in Lake St. Clair. However, the shallow, warm waters of Lake Erie and Lake St. Clair are not suitable for sea lampreys and few streams support spawning runs. The population of lampreys has never been high in these lakes, and predation on fish has never been serious.

Lake Erie is the only one of the Great Lakes which experiences severe oxygen depletion in its bottom waters each summer. This condition is the result of the decay of excessive growths of algae, which in turn was stimulated by excessive amounts of nutrients (e.g. phosphorus and nitrogen) from sources such as agricultural fertilizers and household detergents. This process has been termed "cultural eutrophication" or man-accelerated aging of a lake. Of serious consequence to the fish of Lake Erie is that as a result of this process, starting in the 1940's, the summer oxygen content in large portions of the central part of the lake is too low to support fish life. Cold water species (e.g. lake herring and lake whitefish) which require the cold, bottom waters of the lake during the summer, were eventually extirpated from the lake due to this habitat degradation and heavy fishing pressure.

According to fisheries scientist John Van Oosten, a common practice in Lake Erie, as well as the other Great Lakes, is to commercially fish heavily for one species until it is no longer economical and then shift efforts toward another species. Effects of this selective fishery may have first become apparent in the 1920's when catches of Lake Erie's most valuable species (lake herring) declined sharply. Shortly after the lake herring declined, stocks of the commercially important lake trout and whitefish started to deteriorate. After 1940, Lake Erie's commercial fishery concentrated on blue pike, sauger, walleye and yellow perch. Blue pike catches fluctuated greatly during the first half of the century due to changing year class strength (number of yearlings recruited into the fish stock), but during the 1950's, stocks dwindled. Growth rates increased because of reduced foot competition, resulting in the commercial removal of large, but immature, fish from the stock with further reduced recruitment. Blue pike were considered commercially extinct in 1958, and now after interbreeding with walleye, this fish may be biologically extinct.

Other fisheries biologists, such as Thomas Huxley Langlois, believed that no single factor seems to have been the cause of the historical changes in Lake Erie fish populations. The invasion of the sea lamprey has never been important in Lake Erie because the tributaries lack the necessary conditions for successful breeding. Both commercial and sport fishing pressures have never been intense for particular species, but the impacts on the fishery are difficult to assess. Although lake trout fishing was never as important as in the upper lakes, the decline and disappearance of this species is likely related to the development of an unfavorable environment. Early reports indicate that the progressive change in the fish stocks began near the mouth of the Detroit River (found to be polluted as early as the 1920's). Decline of lake herring and lake whitefish production was first noted in Michigan waters between 1910 and 1920 and had spread slowly eastward throughout the lake by the early 1950's. The collapse of the blue pike and sauger fishery also occurred in the 1950's and appears to be related to the demise of certain benthic organisms (e.g. burrowing mayflies) which were important components of their food web.

Until 1950, the commercial walleye fishery (known as pickerel) was relatively unimportant compared to blue pike. In the first half of the century, it was largely an Ohio trap net fishery. However, in 1948, the intensity of fishing increased when Canadian fishermen converted from cotton to nearly invisible nylon gill nets. The commercial catch peaked in 1956 at nearly 8,000 tons, then declined to less than 1,000 tons by 1960. Several conditions are believed to have led to the decline of walleye. By the 1940's, walleye spawning populations were restricted to reefs and shoals in western Lake Erie because nearly all of the river spawning grounds had been destroyed. Adverse weather conditions and environmental degradation during the 1940's and 1950's, coupled with overfishing resulted in only sporadic year class success, which was inadequate to maintain a stable population.

As the other species diminished in the commercial catch, the importance of yellow perch to the fishery increased. The yellow perch harvest increased nearly 5-fold between 1950 and 1970. Since 1970, however, yellow perch catches have decreased, but it still remains the most important commercial species in United States water, while smelt, the latest species to be exploited, is the leading commercial fish on the Canadian side.

Lake Huron

Most of the inflow to Lake Huron is from Lake Superior and the relatively pollution-free waters of upper Lake Michigan. Therefore, Lake Huron displays many of the same characteristics as Lake Superior. Water quality has been stable for the past century. The only significant deterioration of water quality is confined to areas of human activity, chiefly Saginaw Bay, various harbors and estuaries in Georgian Bay and the North Channel.

Historically, Lake Huron, Lake Michigan and Lake Superior were characterized by native fish communities typical of oligotrophic (youthful, low nutrient) lakes. In all three, the original fish stocks have been substantially depleted.

Over a century of intense exploitation by man, coupled with the destabilizing influence of strong competition and predation by such exotic species as alewife, smelt and sea lamprey have played a major role in depleting the native stocks of mainly lake trout and ciscos (chubs).

Primarily as a result of sea lamprey predation, the lake trout production in Lake Huron dropped from nearly 2,300 tons in 1938 to less than 80 tons in 1954, and continued to decline until the fishery collapsed in 1959. Besides the lake trout, populations of other large, cold-water species such as burbot, rainbow trout, and lake whitefish also decline abruptly due to lamprey predation. The first sea lampreys were reported for Lake Huron in 1936.

Although yellow perch had its peak commercial production in the first 15 years of this century, for the past 70 years the total catch has been relatively stable. Historically most of this production was from Saginaw Bay, but in the last several decades, pollution has taken its toll. The Canadian waters of Lake Huron now yield more than half of the commercial catch. Walleye has shown similar distributional patterns, but the total lake catch has been much reduced in the past 40 years.

Lake Michigan

Major environmental deterioration has not been detected in most of the open waters of Lake Michigan, but Green Bay and the southern part of the lake (south of a line between Milwaukee and Muskegon) has experienced some water quality degradation. In Green Bay and other restricted harbor areas, normal clean water organisms have been replaced by pollution tolerant species. In the first half of the century, Green Bay was the location of the major lake herring fishery in the lake. By 1953, the fishery in this bay had collapsed due largely to pollution.

In Lake Michigan, the lake trout catch decreased from almost 3,000 tons in 1944 to less than one ton in 1953 due to the sea lamprey invasion which was first observed in 1937. Fishermen lost annual incomes totaling $3 million for this one species alone.

In Lake Michigan, the indirect effects of the lamprey invasion on smaller species of fish have been equally devastating. Native species present in the commercial catch before the invasion included lake trout, lake herring, lake whitefish and seven species of cisco (chubs). The relative abundance of these fishes showed no change until 1945 when the depletion of the lake trout and burbot resulted in an increase in the smaller ciscos, the primary food for the larger salmonids. The production of ciscos soared from 1,500 tons per year for 1890-1945 to over 4,000 tons per year during 1951-1957. Because no other prey were present in the deep water, the chubs then received the full impact of the lamprey predation, resulting in the eradication of the two largest species, the deepwater cisco and the blackfin cisco, by 1961. Although the smallest chub, the bloater, became more abundant, the general reduction in the chub populations favored a rapid increase in the recently established alewife.

The alewife was first reported for Lake Michigan in 1949 and by the 1960's it dominated the fish stocks in the lake. Because of its occupation of various area and depths of the lake, at different periods of the year it has had an adverse effect on many species, through food competition, including yellow perch, emerald shiner, and smelt. In 1967, the alewife experience a die-off of tremendous magnitude, apparently due to the cumulative stresses of high population density. Chicago and other Lake Michigan harbors and beaches were clogged with over 50,000 tons of dead alewife, resulting in losses to industry, municipalities, and recreational interests in excess of $100 million.

Lake Superior

Lake Superior is a typical oligotrophic lake, low in nutrients, dissolved and suspended solids, and temperature, and high in oxygen content. It has the greatest clarity of any of the Great Lakes. This lake has changed little in physical and chemical character in the past 200 years. Lake Superior provides an ideal habitat for deep, cold-water fish. Nutrient limitations, however, result in lower density fish populations than the lower Great Lakes.

Lake trout production from Lake Superior dropped from an average of 2,000 tons per year for the period 1931-1952 to less than 200 tons in 1961, again due to the sea lamprey predation. The rapids of the St. Marys River and the Sault Saint Marie Ship Lock at the lower end of Lake Superior apparently hindered the lamprey invasion. The first confirmation of this species was in 1946, 25 years after it first entered Lake Erie.

Not until 1946, was research initiated which would eventually lead to the control of the sea lamprey in the Great Lakes. Construction of weirs to block spawning migrations up tributaries was the initial stage of lamprey control. The Great Lakes Sea Lamprey Committee (GLSLC) was established as an international body at this time to address the problem of lamprey predation of prized species and implement control measures. In 1956, the GLSLC was reorganized to form the Great Lakes Fishery Commission with a goal of re-establishing the once abundant salmonid fish stock. The research of these organizations produced a selective toxicant that would kill young lamprey before they reached the lakes from spawning streams but would not harm other aquatic life. Starting in 1958, all known lamprey-producing tributaries of each of the Great Lakes, excpet Lake Erie which did not have a sea lamprey problem, were treated with the larvicide TFM (3-trifluoromethyl-4-nitrophenol). By the early 1960's, the results of lamprey control in Lake Superior were positive as shown by decreasing lamprey catches at mechanical weirs.

RESTORATION

Once some degree of sea lamprey control had been accomplished, the next step in restoring a balanced Great Lakes fishery was to re-introduce cold-water predator species. Lake trout introductions were initiated in Lake Superior in 1952, and in the other lakes between 1965 and 1975. The objective of these stocking programs was the re-establishment of self-sustaining populations, but successful natural reproduction has only been minimal. This lack of success may be due to the homing instinct of lake trout which causes this species to return to inshore planting areas that may have unsuitable spawning substrate. This problem can be overcome by careful selection of stocking sites.

Although the re-establishment of natural reproduction within the Great Lakes has been slow taking hold, the survival rates of yearling lake trout have been good. In Lake Michigan, about 270,000 lake trout were caught in 1971, but by 1978 the open water harvest exceeded one million fish. Even in Lake Erie, small numbers of harvestable sized lake trout were reported by 1980 in the offshore waters of the eastern basin.

In recent times, coho and chinook salmon were first stocked in Lakes Michigan and Superior in 1966, and in Lakes Erie, Huron and Ontario in 1968. The salmon stocking program was primarily initiated to provide a sport fishery while the lake trout populations were developing. The recovery rates for these stocked salmon over the first several years were encouraging, except for Lake Ontario, particularly since earlier attempts to stock Pacific salmon in the 1870's and 1930's failed:

Lake	Percent Recovery
Michigan	21%
Huron	17%
Erie	8%
Superior	6%
Ontario	1%

Natural reproduction of coho and chinook salmon have been documented in Lakes Michigan and Superior and to a lesser degree in Lakes Erie and Ontario. However, large annual stocking programs are necessary in each lake to maintain sufficient populations for sport fishing. With the growing interest in salmonid fishing, particularly for coho and chinook, it is unlikely that stocking programs will be discontinued even if the lake trout populations are re-established to their former importance.

The abundance of walleye in western Lake Erie increased throughout the 1970's-

During the 1960's, the "fishable" population of walleye (age two and older) was below two million fish. The Ohio Division of Wildlife estimates that the fishable population present in 1982 was 25 million walleye. This represents a more than 10-fold recovery of this species within one decade (Figure 1). The increased walleye population has been attributed to good young-of-the-year recruitment into the fish stock and to the international management programs implemented to control sport and commercial harvests. These programs are coordinated by the Great Lakes Fishery Commission. Hopefully this international management strategy will serve as a model for other species and for other lakes.

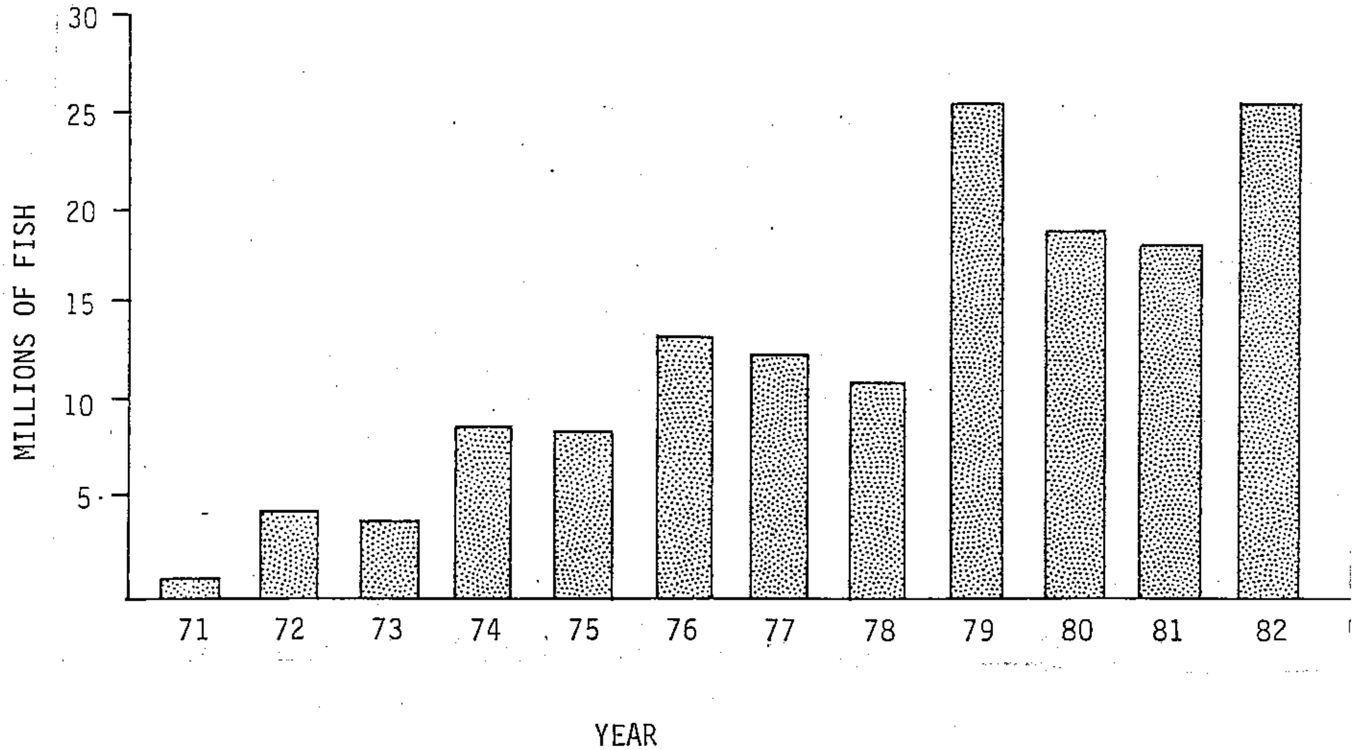

FIGURE 1. FISHABLE WALLEYE POPULATION IN WESTERN LAKE ERIE 1971-1982.

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