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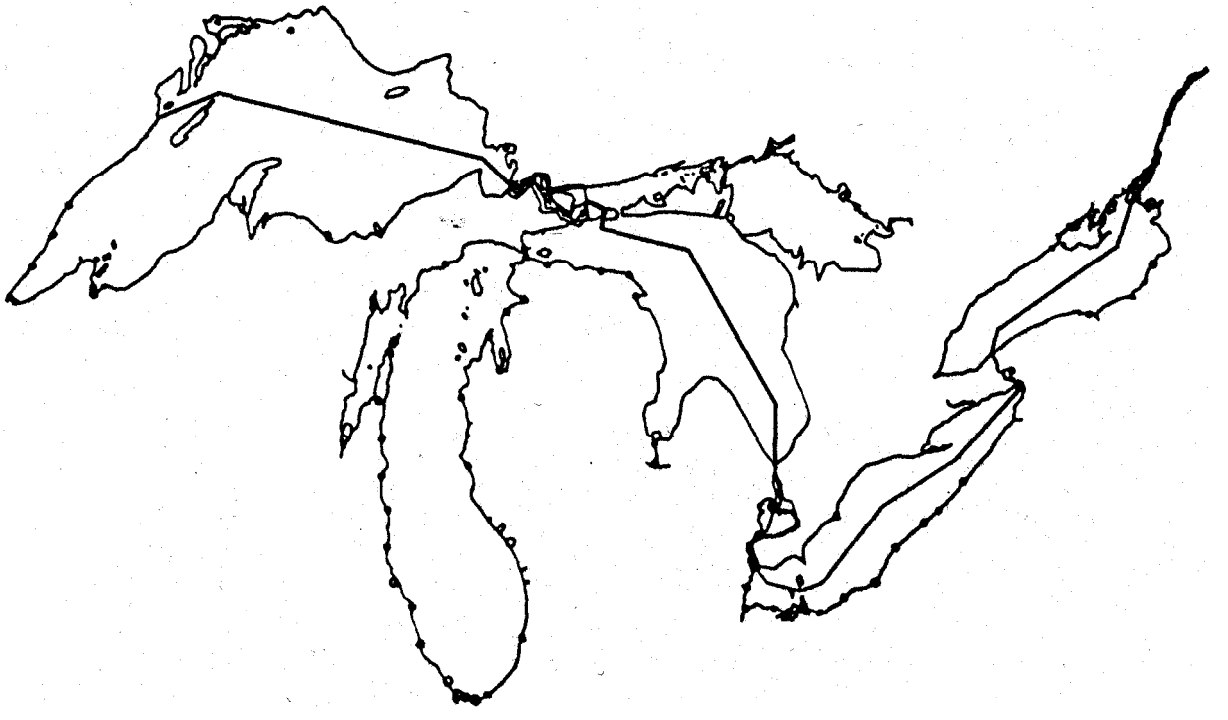
ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES

Volume XI - Lake Ontario

Great Lakes-St, Lawrence Seaway Navigation Season Extension Program



Fish and Wildlife Service
U.S. Department of the Interior

Corps of Engineers
U.S. Department of the Army

The Biological Services Program was established within the U.S. Fish and Wildllfe Service to supply scientific information and methodologies on key environmental issues that Impact fish and wildlife resources and their supporting ecosystems. The mission of the program is as follows:

- To strengthen the Fish and Wildlife Service in its role as a primary source of information on national fish and wildlife resources, particularly in respect to environmental impact assessment.
- To gather, analyze, and present information that will aid decisionmnakers in the identification and resolution of problems associated with major changes in land and water use.
- To provide better ecological information and evaluation for Department of the Interior development programs, such as those relatfng to energy development.

Information developed by the Biological Services Program is intended for use in the planning and decisionmaking process to prevent or minimize the impact of development on fish and wildlife. Research activities and technlcal assistance services are based on an analysis of the issues, a determination of the decisionmakers involved and their informatlon needs, and an evaluation of the state of the art to identify information gaps and to determine priorities. This is a strategy that will ensure that the products produced and disseminated are timely and useful.

Projects have been initiated in the following areas: coal extraction and conversion; power plants; geothermal, mineral and oil shale development; water resource analysis, including stream alterations and western water allocation; coastal ecosystems and Outer Continental Shelf development; and systems, inventory, including National Wetland Inventory, habitat classification and analysis, and information transfer.

The Biological Services Program consists of the Office of Biological Services in Washington, D.C., which is responsible for overall planning-and management; Natlonal Teams, which provide the Program's central scientific and technical expertise and arrange for contracting biological services studies with states, universities, consulting firms, and others; Regional Staffs, who provide a link to problems at theoperating level;and staffs at certain Fish and Wildlife Service research facilities, who conduct in-house research studies.

FWS/OBS-82/52
September 1982

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES

VOLUME XI
Lake Ontario

by

Carole D. Goodyear
Thomas A. Edsall
Diane M. Ormsby Dempsey
G. David Moss
Paul E. Polanski
Great Lakes Fishery Laboratory
U.S. Fish and Wildlife Service
1451 Green Road
Ann Arbor, MI 48105

Project Officer
Keith Kraai
U.S. Fish and Wildlife Service
Region 3
Federal Building, Ft. Snelling
Twin Cities, MN 55111

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PREFACE

The fish resources of the Great Lakes have changed markedly since the settlement of the Great Lakes Basin began in the late 1700s-early 1800s. Local declines in the abundance of some highly valued species that supported early Eisheries were reported in the 1800s. By the late 1950s-early 1960s, a number of important native species had disappeared from the catch, most once-productive stocks were depleted, and the fisheries that persisted were supported mainly by species of low value and utility. These undesirable changes have been attributed to the overharvest of desirable species, the invasion and introduction of undesirable exotic species, lowered water quality, and the destruction of portions of the physical habitat, including‘spawning grounds, vital to the maintenance of the resource base.

Since the 1950s, intensive efforts have been mounted to reestablish stable, self-sustaining fish communities, mainly by reducing sea lamprey abundance, limiting the harvest of remnant native stocks, and stocking desirable native or exotic species to replace or supplement depleted populations. Many of the native species and some of the desirable, introduced species have responded favorably and are now supporting valuable, productive fisheries. These successes suggest that continued judicious exercise of established management strategies will result in further significant improvements in the fish resources and the fisheries. An emerging perspective suggests, however, that enduring, major improvements in the fish resources and the fisheries will require greater emphasis on rehabilitation efforts directed more specifically at safeguarding and improving the quality of the fish habitat in general, and on ensuring fuller utilization of the specialized habitat required by sensitive, embryonic- juvenile life stages of species that are to be included in any future, self-sustaining resource base. We prepared this atlas to provide a comprehensive information base against which past changes in the condition and use of spawning and nursery habitat of Great Lakes fishes could be viewed and evaluated and the needs of the future, self-sustaining resource base could be projected.

The atlas is composed of the following *14* volumes:

I. Spawning and Nursery Areas of Great Lakes Fishes: A Summary by Geographic Area

IS. Lake Superior

III. St. Marys River

IV. Lake Michigan

V. Lake Huron

VI. St. Clair River

VII. Lake St. Clair

VIII. Detroit River

IX. Lake Erie

X. Niagara River

XI. Lake Ontario

XII. St. Lawrence River

XIII. Reproductive Characteristics of Great Lakes Fishes

XIV. Literature Cited

Volume I is designed to permit the reader to determine quickly whether a particular geographic area of interest contains fish spawning or nursery areas that are descri'oed in volumes II-XII. Volumes II-XII consolidate existing information describing spawning and nursery areas used by stocks of fish, including anadromous stocks, considered to be residents of the Great Lakes and their connecting waters. The information presented for each spawning or nursery area identified in volumes II-XII includes, when known, the area's precise location, history of use, season of use, water temperatures during the season of use, major substrate type, and water depth. Pre- and post-spawning migrations of mature fish and movements of young fish are also described, insofar as this information serves to better delineate spawning or nursery areas. Volume XIII contains concise descriptions of the reproductive characteristics of species included in volumes I-XII.

In the preparation of the atlas we found that considerable information was available for most of the species that support (or supported) major recreational or commercial fishes, or that are or were major components of the forage base; conversely, relatively little information was available for many other species not included in these general categories. For most species, spawning areas were more completely described than were nursery areas. The historical information in particular provided more extensive descriptions of spawning areas than of nursery areas, because much of this information was obtained from records of fisheries that had been conducted for spawning fish. Thus, although the information available to us for compilation was relatively extensive, it was nonetheless incomplete for the reasons given above. Users of the atlas ace therefore cautioned not to view the lack of explicit reference to a given area as conclusive evidence that the area is or was not used as a spawning or nursery area by Great Lakes fishes.

Sources of the information incorporated in the atlas are described in volume I. Acknowledgements are also given in volume I.

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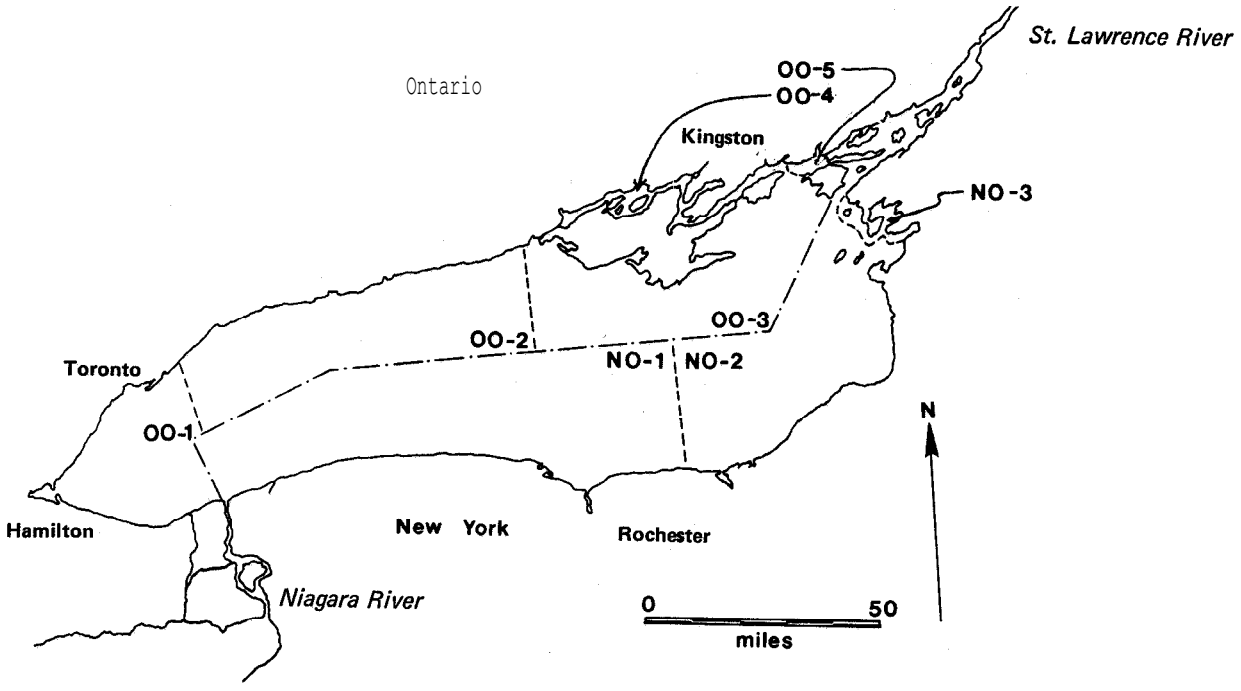
Volume XI. LAKE ONTARIO

INTRODUCTION



More than 90 species of fish have been recorded as residents in Lake Ontario (Elrod, pers. comm. 1979; Emery 1976; Crossman and Van Meter 1979). This volume describes the reproductive habitat used by the 67 species for which information was available. Fifty-five species treated in this volume were native to the lake. Most of these native species spawned (or spawn) in tributaries or in shallow, protected waters of the lake. Only the lake trout, lake herring, four species of ciscoes,,and the slimy sculpin, utilized the deep offshore waters for spawning. Four of these deepwater spawners, the blackfin cisco, shortjaw cisco, deepwater cisco, and kiyi are now believed to be extinct in Lake Ontario. Lake trout and lake herring spawned in the shallow nearshore waters and also the deeper offshore waters.

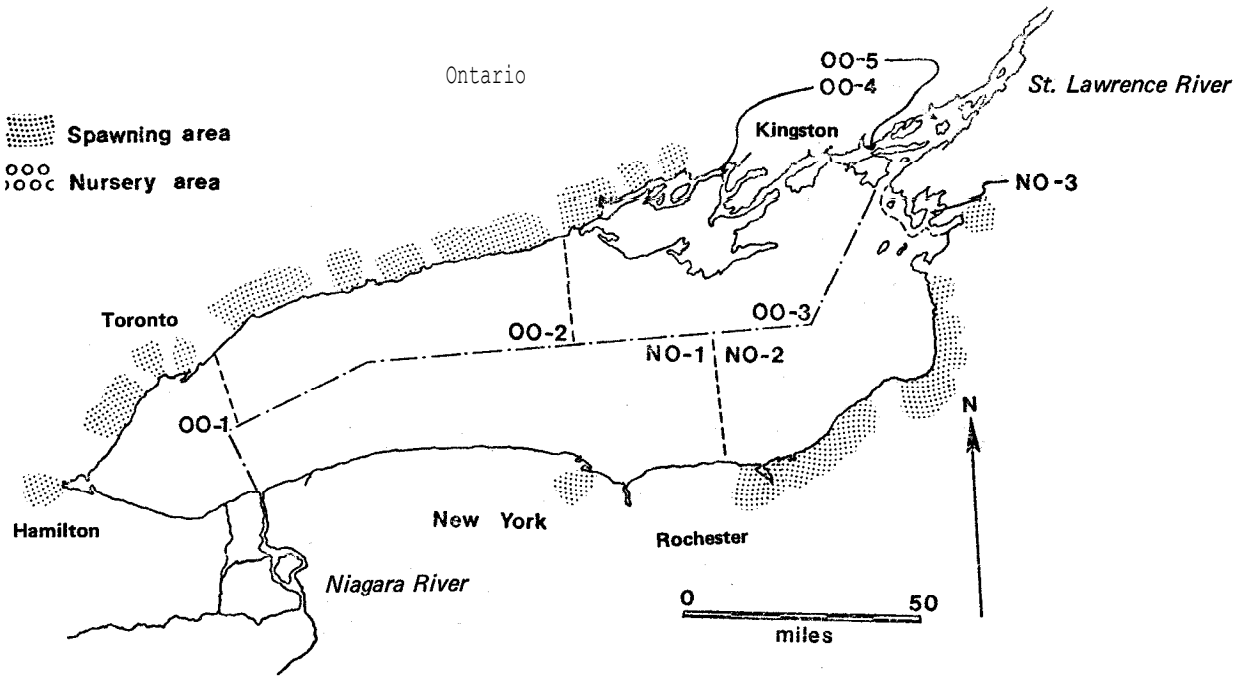
The 12 exotic species treated in this volume were introduced by man or immigrated to the lake during the period of record, from populations established elsewhere in the Great Lakes drainage. Six of these are salmonids which spawn in tributaries, the other six exotic species spawn in tributaries and also in protected nearshore waters in some areas.

Pnformation on nursery areas used by the 67 species treated in this volume is fragmentary, but as would be expected, it suggests that tributaries and nearshore waters are important as nursery areas, at least for the earliest life stages. Dispersal from spawning areas is rapid for some species which have small, pelagic larvae, whereas the juveniles of some salmonids that spawn in tributaries may remain in or near spawning

areas in those tributaries for as many as three years before entering the lake and dispersing.

The information in this volume is presented in narrative form, by species. A map accompanies each species narratiave when there was sufficient information to warrant graphic summarization. Each species narrative presents the available information systematically by statistical fishing district (Smith et al. 1961) beginning with district NO-1 and ending with district OO-5. Within each district the presentation proceeds systematically from one end of the district to the other, by shoreline segment and adjacent littoral and offshore water areas. For each referenced location within a district, the narrative first presents the available information for spawning areas and then for nursery areas. Historical information is presented before the more current information.

SEA LAMPREY



The first reported capture of the sea lamprey in Lake Ontario occurred in *1835* in Duffin Creek (Lark 1973). The sea lamprey may have entered the lake in the early 1820s via the Erie Canal; however, a fish tentatively identified as a sea lamprey was recorded from the lake in about 1817, prior to completion of the Erie Canal, suggesting that the sea lamprey in Lake Ontario may have been a relict species from the Pleistocene Epoch, or that it entered the lake via the St. Lawrence River (Lark 1973; Morman et al. 1980; Pearce et al. 1980).

Ammocoetes have been found in 55 tributaries to the lake (Dees 1980). Spawning occurs most extensively in tributaries along the New York shore from Oswego (43°28', *76°31')* to Stony Point (43°50', 76°18') and along the Ontario shore from Toronto (43°38', 79°25') to the Bay of Quinte (44°08', 77°15') (Pearce et al. 1980). Spawning runs are rare or absent along the west half of the southern shore of the lake (Morman et al. 1980). The tributaries listed below are classified as spawning streams based on the presence of ammocoetes, spawning adults, or both.

New York

The following streams have spawning runs (Bails et al. 1971; GLFC 1973b, 1975; NYDEC, unpubl. data; SLCC 1979a; Tibbles 1975; Tibbles et al. 1976a; Torblaa and Westman 1980, unless otherwise noted).

NO-1

Salmon Creek (43°18', 77°45') (Greeley 1940).

Black (Northrup) Creek (43°17', 77°43').

NO-2

First Creek (43°16', 77°00').

Second Creek (43°14', 76°59') (NYDEC 1977b).

Third Creek (43°14', 76°58'), Sodus Creek (43°13', 76°56'1, Wolcott Creek (43°16', 76°50'), Red Creek (43°18', 76°47*), Blind Sodus Creek (43°20', 76°44'1, Sterling Creek (43°20', 76°41'), Ninemile Creek (43°24', 76°38'), and Rice Creek (43°27', 76°34').

Oswego River (43°28', 76°31'). Ammocoetes are found in tributaries to the river and move into Lake Ontario via the river from the Oneida Lake and Finger Lakes systems (Braem and Rugen 1977b; Morman et al. 1980; Pearce et al. 1980).

catfish Creek (43°31', 76°19'), Butterfly Creek (43°31', 76°18'), Little Salmon River (43°31', 76°l5'), Sage Creek (43°32', 76°14'1, Snake Creek (43°32', 76°13'), Grindstone Creek (43°33', 76°13'), Salmon River (43°341, 76°12'), Deer and Little Deer Creeks (43°36', 76°10'), Little Sandy Creek (43°38', 76°10'), Blind Creek (43°39', 76°09'), Lindsey Creek (43°401, 76°10'), Skinner Creek (43°41', 76°10'), South Sandy Creek (43°43', 76°12'), and Stony Creek (43°50', 76°14').

NO-3

Black River (44°00', 76°04').

Ontario

The following streams have spawning runs (GLFC 1973b, 1975; Pearce et al. 1980; SLCC 1979a; Tibbles 1975; Tibbles et al. 1976a,b; Torblaa and westman 1980; and other references as noted).

OO-1

Ancaster Creek (43°15', 79°56'), Bronte Creek (43°24', 79°43'), and Oakville Creek (43°26', 79°40').

Credit River (43°33', 79°35') (Dymond et al. 1929).

Humber River (43°38', 79°28') (Coventry 1922).

Don River (43°39', 79°21') (Whillans 1977).

OO-2

Rouge River (43°48', 79°07'), Duffin Creek (43°49', 79°02'), Carruthers Creek (43°50', 79°00'), Lynde Creek (43°51', 78°57'), Oshawa Creek (43°52', 78°50'), Farewell Creek (43°52', 78°49'), Bowmanville Creek (43°54', 78°40'), Wilmot Creek (43°54' 78°36'), Graham Creek (43°54', 78°35'), Port Britain Creek (43°56', 78°23'), Gage Creek (43°57', 78°16'), Cobourg Brook (43°57', 78°11'), Grafton Creek (43°58', 78°02'), Shelter Valley Creek (43°58', 78°01°), Lakeport Creek (43°59', 77°54'), and Salem Creek (44°00' 77°50').

OO-3

Butler Creek (44°02', 77°43'), and Smithfield Creek (44°02', 77°40').

OO-4

Trent River (44°06', 77°34'), Moira River (44°09', 77°23'), and Salmon River (44°11', 77°15').

LAKE STURGEON

Historically, lake sturgeon moved into tributaries to spawn during late May to early July (Nash 1913; Rathbun and Wakeham 1897; Smith 1892). This species is no longer considered to be reproducing in the lake proper (Crossman and Van Meter 1979).

New York

NO-1

Youngstown (43°15', 79°03'). Historically, fishermen from Youngstown caught many spawning lake sturgeon during the summer on a bed about 2 mi long and 1/2 mi wide, located in U.S. waters near the Niagara River (Kerr and Kerr 1860-1898); this area may have been Rumsey Shoal (43°17', 79°03').

NO-3

Black River (44°00' 76°04'). Until the 1940s, spawning runs entered the river. Presently there is a dam one mi upstream from the mouth; potential spawning grounds are restricted to the area just below the dam (Eckert, pers. comm. 1979; Jolliff and Eckert, undated).

Ontario

OO-1

Don River (43°39', 79°21'). Until the population declined between 1841 and 1884, lake sturgeon migrated through Toronto Bay (43°38', 79°23') to spawn in the river (Whillans 1977, 197923).

OO-2

Ganaraska River (43°57', 78°18'). Lake sturgeon supplied early settlers along the river with food (Richardson 1946); this suggests that a spawning run entered the river.

OO-4

Trent River (44°06, 77°34'). Historically, many lake sturgeon attempted to pass over the dam in the lower river (Ont. Game Fish 1916); this suggests that a spawning run entered the river.

Napanee River (44°12', 77°01'). In 1914, large lake sturgeon entered Mohawk Bay (44°11', 77°02') and the river during the summer (Ont. Game Fish 1915); this may have been a spawning run.

LONGNOSE GAR

In Lake Ontario, longnose gars entered the smaller streams, often with the lake sturgeon, to spawn (Goode 1884).

New York

In New York waters, longnose gars are found in embayments along the east shore and are presumed to spawn there (Schneider, pers. comm. 1979).

NO-3

Sherwin Bay Marsh (43°59', 76°10'). In 1975, a few adults entered the marsh in mid-April (Marean 1976).

Point Salubrious (44°02', 76°10'). A spawning ground was located on a beach (precise location unknown) near the point, about one mi from the post office (Goode 1884).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). For many years, a resident population spawned in the bay in the spring (Down, pers. comm. 1979; Moccia, pers. comm. 1979). In the late 1920s, young 5 in. long were found in Burlington Bay (Dymond et al. 1929).

OO-4

Bay of Quinte (44°08', 77°15′). Spawning occurs here in weed beds (Hurley and Christie 1977).

BOWFIN

The bowfin spawns in weedy bays and marshes during May and June (Nash 1913).

New York

Bowfins are found in embayments along the east shore of the lake and are presumed to spawn there (Schneider, pers. comm. 1979).

NO-1

Genesee River (43°15′, 77°36′). Bowfins probably entered the lower Genesee River to spawn (Greeley 1927).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). Historically, bowfins spawned in the marshes of the bay; they were abundant in the 1890s, declined dramatically in 1961-62, and are now scarce (Whillans 1977).

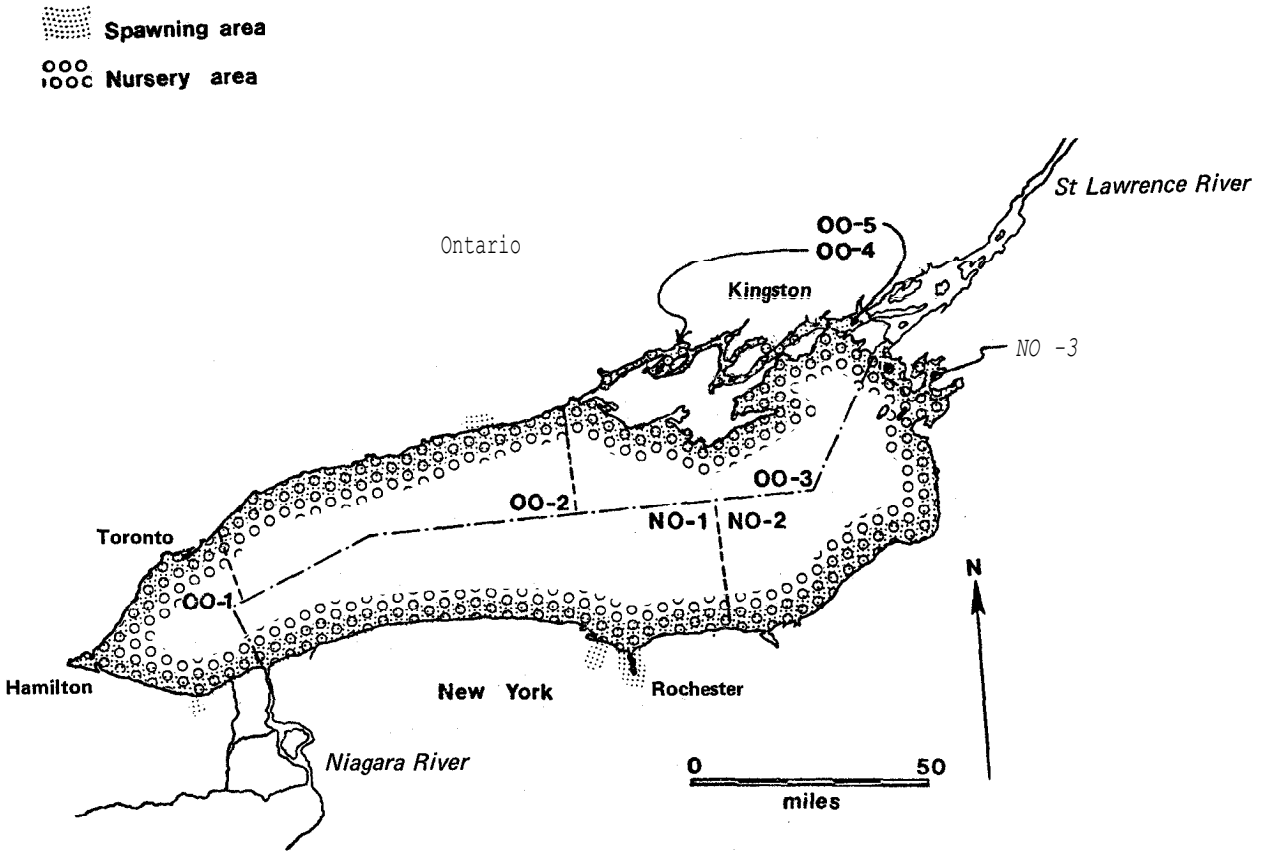
Toronto Bay (43°38', 79°23'). Bowfins spawned in the bay in 1913 (Whillans 1977).

Bay of Quinte (44°08', 77°15'). Spawning occurs here in weed beds (Hurley and Christie 1977).

AMERICAN EEL

The spawning grounds of the American eel are in the Atlantic Ocean. Tagging studies have shown that the spawning migration of adults from Lake Ontario down the St. Lawrence River occurs in September and October (Hurley 1972a). Interruption of this migration could be detrimental to the Lake Ontario population (LMS 1977).

ALEWIFE



various theories exist regarding the origin of the alewife population in Lake Ontario: the alewife may be native to Lake Ontario (Radforth 1944); may have been accidentally introduced in the 1870s, when American shad were planted in the lake by the U.S. Fish Commission (Bean 1884b); may have entered the lake from New York inland waters; or may have entered the lake via the St. Lawrence River (Smith 1892). Evidence that the alewife is native to Lake Ontario is based only on the fact that the earliest record of occurrence is *1873* (Bean *1884b).* A sharp population increase of alewives occurred during the *1870s,* and alewives were abundant in the lake by the late *1800s* (Miller *1957).*

In Lake Ontario, schools of alewives move inshore along the entire shoreline to littoral areas, shallow bays, harbors, and tributary streams where spawning occurs over sand and gravel in Late May to early July (Carter et al. 1977; Christie *1973;* Elrod, O'Gorman, and Bergstedt, pers. comm. 1979; Pritchard *1929;* Rathbun and Wakeham 1897; Schneider and Eckert, pers. comm. *1979;* Scott 1967; Smith *1892;* Werner and Ford *1972),*

at water temperatures of 55-60°F (Threinen 1958). The migration begins in early spring (LMS 1979a, as cited in LMS 1980), usually in April (Graham 1956). Spawning peaks between mid-June and mid-July (Graham 1956; LMS 1975c, as cited in LMS 1980). Adults tend to be attracted to the warm water outflow of tributaries during the inshore movement (Bergstedt, pers. comm. 1979). Spawning occurs earlier in creek mouths than in the lake (Greeley 1940).

Historically, the favored spawning grounds were around the shorelines in the eastern part of the lake (Smith 1892). In the western end of the lake, spawning occurred on sandy beaches with little vegetation at depths of 8 ft (Pritchard 1929). Adults leave the shore areas after spawning and return to deep water by late August (Graham 1956).

New York

In New York waters, the entire nearshore zone is spawning and nursery habitat (Elrod, O'Gorman, and Bergstedt, pers. comm. 1979; Schneider and Eckert, pers. comm. 1979; Werner and Ford 1972). Tributaries also provide spawning and nursery habitat (Werner and Ford 1972). Spawning starts in May in the warmer bays and continues into July (Schneider and Eckert, pers. comm. 1979). As the summer progresses, some young-of-the-year (YOY) alewives disperse offshore, but the majority are still in shallow water in late August (Elrod, O'Gorman, and Bergstedt, pers. comm. 1979; FWS, unpubl. data; GLFL, Cruise VIII, 1978).

NO-1

Olcott (43°20', 78°43'). In 1972, YOY were collected along shore (FWS 1978).

Russell Power Station (43°16', 77°38'). In 1977, most of the larvae collected from mid-June to August were alewives; larval abundance peaked in late July (Bio Systems 1978b).

Genesee River (43°15', 77°36'). Historioaliy, large numbers of alewives entered the lower river in the spring to spawn young were common near the river mouth in early September (Greeley 1927).

Irondequoit Bay (43°14', 77°32'), Spawning occurs in the bay and in the surrounding lake. In 1977, alewives were present in the bay only from mid-May to June. Spent fish were first found in late May (Haines et al. 1977).

Ginna Power Station (43°17', 77°18'). Alewives spawn in the nearshore area in June-August. The area of the discharge plume is a major spawning ground in July. Alewife eggs were the dominant food found in fish in the immediate vicinity (Rochester Gas Elec. 1972). Larvae and YOY dominate collections out to the 36 ft depth contour from late June through August; larval abundance peaks in early August (Bio Systems 1978a).

Little Sodus Bay (43°20′, 76°42′). Adults are abundant in the bay in the spring (O'Gorman, pers. comm. 1979); fry and YOY are abundant off Fair Haven from July to October (FWS 1978).

Sterling Power Plant site (43°23', 76°39'). In 1974, spawning occurred in the shallows here. Spawning began in late June and continued until mid-August (LOTEL 1977). Eggs were collected from late June to late July; peak abundance in July coincided with peak spawning. Alewife larvae were the most abundant larvae present in entrainment and lake collections out to the 46 ft contour during July and August; alewife larvae were 95% of total larvae collected in July (LOTEL 1977; Rochester Gas Elec. 1977).

oswego (43°28′, 76°31′). Adults are abundant in the harbor during the spring (Elrod, O'Gorman, and Bergstedt, pers. comm. 1979). Impingement of adults at the Oswego Steam Station (43°28', 76°31′) and collections of adults in the vicinity of the station indicate that inshore movement in the area begins in March or April and peaks in May or June (LMS 1976a, 1977b; Niagara Mohawk Power, undated b,c). Adults reach peak ripeness in late June to mid-July (LMS 1976a, 1977b). Peak spawning occurred in early July at water temperatures of 56-72°F (Niagara Mohawk Power, undated b). Eggs were first collected in early June, and peak abundance occurred in late June or early July. Up to 99% of eggs entrained and collected in the vicinity of the plant were alewife (LMS 1976a, 1977b; Niagara Mohawk Power, undated b,c), Alewives were the dominant larvae in the vicinity of the station. Larvae were collected from late May to September and abundance usually peaked in early August; YOY appeared in August (LMS 1976a, 1977b; Niagara Mohawk Power, undated b). Spawning occurred in the lake proper and possibly at the entrance to Oswego Harbor; no spawning occurred inside the harbor, which has a muck and silt bottom unsuitable for spawning. Ripe males and females were found in the turning basin and spawning may occur there; the turning basin is not a nursery area (Niagara Mohawk Power, undated b).

Nine Mile Point (43°31', 76°22'). Spawning occurs in this area; eggs are deposited in Cladophora mats near shore at depths of 3-8 ft (USAEC 1972g; Niagara Mohawk Power 1973). Historically, ripe-running males and females were present in this area in mid-April (Smith 1892). In recent years, most adults were collected during the inshore movement; catches decreased during the summer because of offshore migration (PASNY, undated a). The inshore movement, as reflected by increased impingement of adults at the Fitzpatrick Power Plant (43°31', 76°24') and Nine Mile Point Power Station (43°3 I′, 76°25'1, begins in April and peaks in April and May; more than 90% of the total fish impinged at the plant were alewives (LMS 1975a,b, 1976b; PASNY, undated a,b). Spawning begins in late May or early June and peaks during the first half of July at water temperatures of 56-72°F (LMS 1975b; PASNY, undated a). Many eggs were collected in the area and entrained by the plants from June to August; peak abundance usually occurred during the second week of July; up to 97% of the eggs entrained were alewife (LMS 1975b, 1976b; PASNY, undated a,b). Alewife is the dominant species of larvae in the area. Larvae and YOY are collected nearshore and offshore and entrained from June to October (LMS 1975a,b, 1976b; PASNY, undated a,b; QLM 1974).

Montario Beach (location unknown). Historically, large numbers of very young alewives were collected here in mid- and late July (Greeley and Bishop 1932).

Henderson Bay (43°54', 76°10') and Southwick State Park (43°46', 76°13′). In 1972, YOY were collected here from July to October (FWS 1978).

NO-3

Grenadier Island (44°03', 76°21′), Chaumont Bay (44°03', 76°12'), and Black River Bay (43°59', 76°05'). In 1972, YOY were collected here in July to October (FWS 1978).

Wilson Bay (44°05', 76°21'). Young-of-the-year are collected here (Schneider and Eckert, pers comm. 1979).

Ontario

In Ontario waters, large areas along the north shore are probably used for spawning; large numbers of YOY are found in the entire nearshore zone (Balesic 1979c). At most sites between Frenchman Bay (43°49', 79°06') and Wellington (43°57', 77°21′), adults were abundant inshore during the spawning season (Balesic 1979b). Early postlarvae less than 0.3 in. long were found throughout the nearshore surface waters; larvae less than 0.5 in. long were found in surface waters out to about the 10 ft depth contour; larvae larger than 0.5 in. long were found at the surface in offshore waters. The larger larvae appeared to be concentrated in the more protected areas near Brighton (44°02', 77°45') (Dunstall 1979b). Young-of-the-year remain on the spawning grounds until at least the late larvae stage (Graham 1956).

OO-1

Jordan Harbour (43°11′, 79°22′). Large runs of adults move into the bay in late spring (Down, pers. comm. 1979).

Burlington Bay (43°17', 79°50'). Since 1930, alewives have spawned in the northwest corner of the bay (Whillans 1977). Large runs enter the bay in about June, when the water temperature rises above 59°F (Down, pers. comm. 1979).

Port Credit (43°33', 79°35'). Inshore migration begins in April and may last until mid-July; most adults move onshore in mid-June, when spawning peaks (Graham 1956). In 1927, spawning did not occur until early July-early August; alewives moved inshore when the water temperature was about 60°F (Pritchard 1929). Adults leave for deeper water immediately after spawning (Graham 1956).

Lakeview Generating Station (43°34' 79°33'). In 1978, alewife eggs were entrained in early August. Early larvae, as small as 0.1 in. long were entrained until the third week in August; larvae as large as 0.7 in. long were entrained until the end of August (Dunstall 1979c).

Toronto Islands (43°37′, 79°23′). In 1973, large schools of adults in spawning condition were seen here in mid-June (Wainio et al. 1973).

OO-2

Pickering Generating Station (43°48', 79°04'). Alewives concentrate inshore in the spring (Balesic 1979c; Dunford 1976). Larvae are very abundant at temperatures above 60°F; about 98% of the larvae entrained at the station were alewives; 97% and 92% of the larvae taken along the shoreline and further offshore, respectively, from June to August were alewives (Balesic 1979c; Dunford 1977; Dunstall 1978b). Most eggs entrained from June to August were probably alewife eggs (Dunstall 1978b). In 1976, cold upwellings delayed spawning until early August. Spawning may have occurred at the intake groin, over Cladophora-covered stone; a concentration of larvae was found over sand near this site (Dunford 1977).

Darlington Generating Station site (43°52', 78°43'). Extensive spawning in this area was indicated by the abundance of early larvae there (Dunford 1979; Dunstall 1979b). Trap net catches indicated that adults migrate through the area in early summer (Dunford 1976c).

Wesleyville Generating Station site (43°55', 78°25'). Spawning occurs here (Dunford 1979). In 1978, YOY dominated trawl collections in early fall (Balesic 1979b).

Grafton Creek (43°58', 78°02'). In 1975, spawning alewives were found in the creek mouth in late May (Tibbles 1975).

OO-3

Brighton (44°02', 77°45'). Larger larvae appear to be concentrated in the protected areas here (Dunstall 1979b).

OO-4

Bay of Quinte (44°08', 77°15′). Alewives move into shallow areas and spawn over sand or mud, when the surface water temperature reaches about 60°F (Pritchard 1929). Inshore migration beqins in April and may last until late July; most adults arrive onshore in late June, and spawning peaks in late June or early July. There is a gradual movement of adults to deeper water after spawning (Graham 1956). Spawning occurs in Hay Bay (44°07', 77°01′) (Christie 1973) and also in the discharge canal of the Lennox Generating Station (44°09', 76°51'), where concentrations of adults, eggs, larvae and YOY were found in June-August (Balesic 1978; Dunford 1978a). Spawning near the Lennox station begins slightly earlier than at other locations on the north shore (Dunford 1979). Eggs were often found adhering to weeds near shore in the Bay of Quinte (Lam 1977). Alewife larvae were present throughout the bay during the entire summer (Hurley and Christie 1977; Lam 1977; Payne 1964); their presence until late August reflected the extended spawning season of the alewife (Noakes, pers. comm. 1979). In 1974, the greatest concentrations of larvae occurred in Hay Bay and the upper Bay of Quinte (Lam 1977). In 1975,

major concentrations of newly-hatched larvae were also found at Indian Point (44°07', 76°51') and Pig Point (44°08', 76°49'), suggesting that these were important spawning sites (Griffiths 1976b).

GIZZARD SHAD

The gizzard shad apparently entered Lake Ontario from Lake Erie. The first record of gizzard shad in the lake is in 1913, although a fish that probably was gizzard shad was reported about 1837 (Miller 1957).

New York

NO-2

Oswego (43°28', 76°31'). In 1975-76, spawning occurred in the harbor. Eggs were collected from early June to early July in the harbor turning basin; larvae were also collected (Niagara Mohawk Power, undated b).

Nine Mile Point (43°31', 76°22'). A spring inshore movement is indicated by the impingement of many adults at the Nine Mile Point Power Station (43°31', 76°25') during April (QLM 1974). Eggs were found in the lake and entrained at the station from mid-June to mid-July (LMS 1975b, 1976b; PASNY, undated a,b); larvae were also entrained (LMS 1976b).

Ontario

OO-1

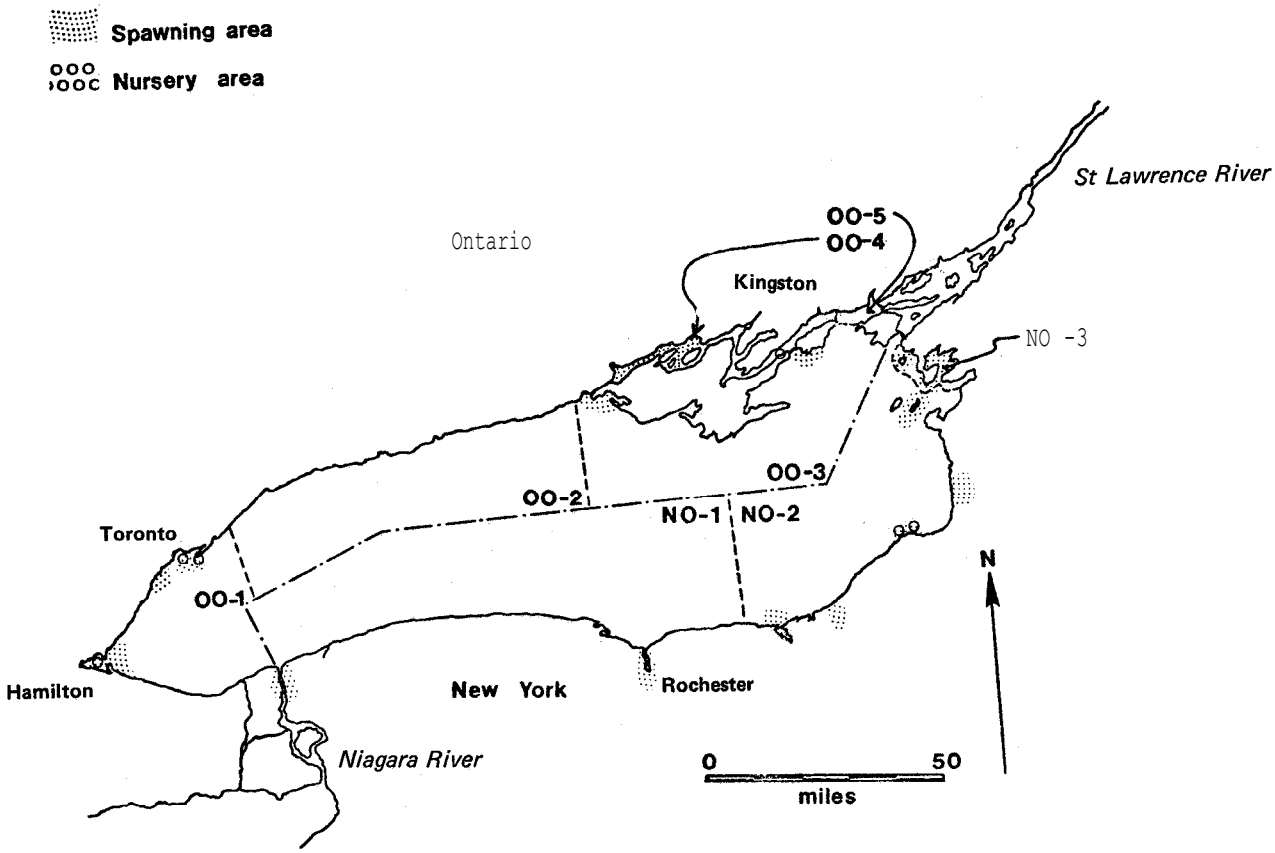
Jordan Harbour (43°11', 79°22'). Large numbers of gizzard shad enter the bay in late spring (Down, pers. comm. 1979).

Burlington Bay (43°17', 79°50'). Large numbers of gizzard shad enter the harbor area in late spring, when the water temperature rises above 59°F (Down, pers. comm. 1979). Gizzard shad spawn in the northwest corner of the bay (Whillans 1977). Many are caught off Hamilton Beach (43°17', 79°47'); they also enter Spencer Creek (43°15', 79°57') and Grindstone Creek (43°17', 79°53') at the head of the bay (Moccia, pers. comm. 1979).

OO-4

Bay of Quinte (44°08', 77°15'). Gizzard shad spawn in the bay. In 1974, eggs were observed attached to Myriophyllum. The adults probably migrated into the warmer shallow water of the upper bay to spawn. Larvae were present throughout the bay during June to September, but were concentrated in enclosed embayments in the upper bay and in upper Hay Bay (44°10', 76°56') (Lam 1977).

LAKE HERRING



Historically, the lake herring migrated to inshore areas of Lake Ontario in large numbers to spawn over sand or "finger rock" in mid- to late November; adults returned to deeper water in early December soon after spawning (Koelz *1926,* 1929; Nash 1913; Rathbun and Wakeham *1897;* Smith *1892).* Two forms of lake herring were present, A "shallow-water" or "greenback" herring, spawned on shoals and in bays at depths as shallow as *10* ft. A "deepwater" or "blueback" herring, was found primarily at the western end and spawned on the bottom at depths of *90-180* ft (Greeley 1940; Koelz 1929). Presently, lake herring are found throughout Lake Ontario in low numbers (Eckert and Schneider, pers. comm. *1979).*

New York

In New York waters, most lake herring were taken during the spawning season along the shoreline from Sodus Ray (43°15', 76°58') east to the St. Lawrence River (Koelz 1926). Spawning has occurred in the following areas:

NO-1

Wilson (43°19', 78°50'). Until 1900, lake herring were common here at depths of 90-120 ft in October and November (Koelz 1929).

Irondequoit Bay (43°74', 77°32'). A commercial fishery existed here during November (O'Gorman and Elrod, pers. comm. 1979); spawn was taken from ripe fish in early December (Greeley 1940; N.Y. Conserv. Dep. 1930). Spawning occurred in the bay in late November to early December; eggs were found on mud bottom at depths of 4-7 ft (Stone 1938).

NO-2

Sodus Bay (43°15', 76°58'). A run came inshore at Sodus Point (43°16′, 76°.59') on about October 1, moved onto beaches and into Sodus Bay on about November 1, and left in early December (Greeley 1940; Koelz 1929). For many years, spawn was collected from ripe lake herring in the bay in November (N.Y. Conserv. Dep. 1929, 1930, 1931; Redband 1915).

Little Sodus Bay (43°20', 76°42'). A commercial fishery existed here during November; this was probably an historical spawning area (O'Gorman and Elrod, pers. comm. 1979).

Nine Mile Point (43°31′, 76°22′). Two larvae collected here were identified as lake herring; spawning may occur in Mexico Bay (43°33', 76°17′) (O'Gorman, pers. comm. 1979).

North Pond (43°39', 76°11′). This is an historical spawning area. Gravid adults were also recently collected off the pond (Eckert and Schneider, pers. comm. 19791. Historically, lake herring came inshore in early October, entered the pond in early November, and left in early December (Koelz 1929).

Stony Island (43°54', 76°20'). Spawning occurred here (Rathbun and Wakeham 1897).

NO-3

Point Peninsula (44°00' 76°15"). Spawning occurred on the south side of the point (Rathbun and Wakeham 1897).

Grenadier Island (44°03', 76°21′) (Rathbun and Wakeham 1897).

Chaumont Bay (44°03', 76°12'). Lake herring came inshore to spawn in Chaumont Bay and Three Mile Bay (44<04', 76°13') during mid- to late November (Eckert and Schneider, pers. comm. 1979; Koelz 1929; Rathbun and Wakeham 1897).

Ontario

Historically, the western end of the lake was the major spawning area in the lake (Pritchard 1931b; Rathbun and Wakeham 1897). The deepwater

herring were found in the western end (Koelz 1929); very large numbers came inshore and then moved about 2 mi offshore some weeks later to spawn (Kerr and Kerr 1860-1898). Spawning occurs in November (Pritchard 1928).

OO-1

Niagara River (43°16', 79°04'). In 1878, runs entered the river in late September and fishing was very good upstream at Queenston in late November (Kerr and Kerr 1860-1898).

St. Catharines (Port Dalhousie) (43°12', 79°16'). In 1891, very large catches were made west of Port Dalhousie (Kerr and Kerr 1860-1898). Lake herring were plentiful in the fall at St. Catharines (Ont. Game Fish 1913a,b).

Winona (43°13', 79°39'). In 1917, spawning lake herring were collected off Winona in late November (Koelz 1929).

Burlington Bay (43°17', 79°50'). This was one of the best spawning areas for lake herring in the Great Lakes; large numbers moved inshore from the lake around November 15 to spawn in the bay and at Burlington Beach (43°18', 79°48') (Kerr and Kerr 1860-1898; Koelz 1929; Ont. Game Fish 1906, 1911, 1915, 1916; Whillans 1977). During the late 1800s, lake herring were speared in the bay and in Dundas Marsh (43°16', 76°57') at the head of the bay until mid-December. Adults were present in November in Mordon's Creek which entered Desjardins Canal (43°15', 79°57') at the head of the bay; fry were also present in the creek (Kerr and Kerr 1860-1898). Lake herring were abundant in Burlington Bay until the late 1920s (Whillans 1977).

Bronte (43°24', 79°43'). In 1886, fishing was very good in mid-December (Kerr and Kerr 1860-1898).

Port Credit (43°33', 79°35'). In 1926, ripe and spent lake herring were taken here in late October (Pritchard 1928).

Toronto (43°38', 79°25'). Historically, runs of gravid lake herring moved to the shore of Toronto Island (43°37', 79°24') and into Toronto Bay (43°38', 79°23'). During 1880-1893, the runs were heavily fished; these runs ceased in about 1900 (Whillans 1979b, pers. comm. 1979). In 1877, many lake herring fry were caught under the ice in February for use as bait (Kerr and Kerr 1860-1898).

OO-3

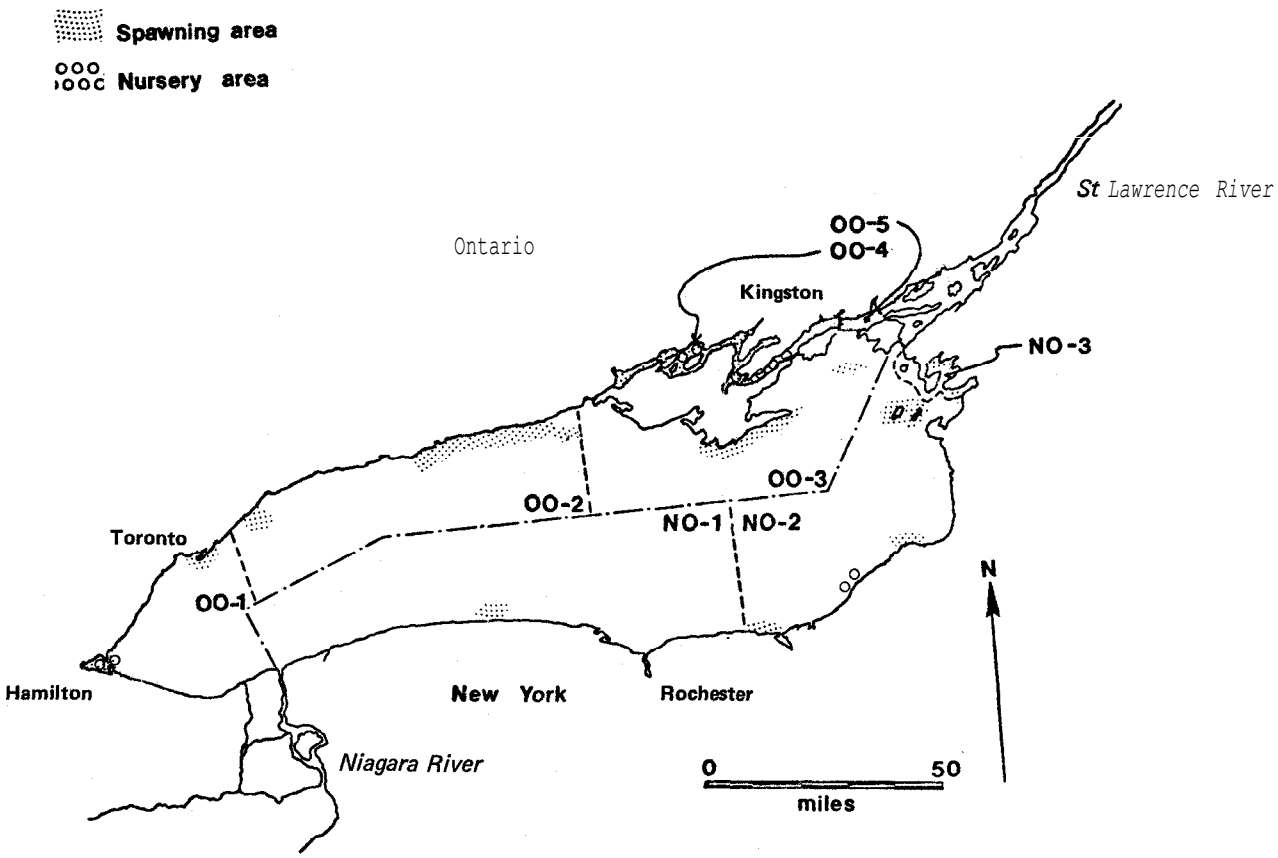
Brighton (44°02', 77°45'). Historically, lake herring moved onto shoals in the area on about October 1; by about November 1 they had moved into Wellers Bay (44°00' 77°35') and Presqu'ile Bay (44°01°, 77°42') (Koelz 1929). The east side of Bald Head Beach (44°00' 77°36') in Wellers Bay is a spawning area (Environ. Can. 1977a). Spawning also occurred just outside Wellers Bay (Whillans, pers. comm. 1979).

Amherst Island (44°09', 76°43'). Adults were collected off the southwest end of the island in late November; of these, 22% were spent, 21% were partly spent, and 32% were ripe (Fry 1937).

OO-4

Bay of Quinte (44°08', 77°15'). Large runs entered the bay; spawning occurred on gravel shoals in 10 ft of water in November at water temperatures of approximately 37-43°F (Dymond et al. 1929; Hurley and Christie 1977; Pritchard 1928, 1931a, 1931b; Rathbun and Wakeham 1897). Until 1928, a profitable fishery existed as far up the bay as Trenton (44°06', 77°34') (Dymond et al. 1929; Ont. Game Fish 1915). During the 1940s, spawn was still collected in the bay (Ont. Game Fish 1940, 1943, 1944, 1945) . Spawning occurred at Big Island (44°05', 77°15') and at Hogs Back Reef (900 ft north of Big Island), where eggs were found in crevices between stones at depths of 8-10 ft. Spawning also occurred at Cedar Island (44°09', 77°20'), and near Belleville (44°09', 77°23') (Pritchard 1931a, 1931b). Eggs remained on the bottom and hatched in April or May (Pritchard 1931a), 3-4 weeks later than the Lake Whitefish (Hart 1930). In the late 1920s, young herring were found at the head of Prinyer Cove (44°05', 76°53') in protected water among reeds (Pritchard 1929, 1931a).

LAKE WHITEFISH



In Lake Ontario, lake whitefish spawn on gravel, rock, or honeycombed rock reefs at depths of 6-60 ft during November and early December. Declining water temperatures initiate the inshore migration to spawning grounds in about mid-October, and spawning occurs at about 40°F (Elliot 1942; Geare 1884; Kerr 1874; Koelz 1929; MacKay 1969; Milner 1874b; Nash 1913; Rathbun and Wakeham *1897;* Smith 1892). Spawning grounds are concentrated in the eastern end of the lake and along the north shore, mainly in Canadian waters east of Brighton (44°02', 77°45'); these are generally the same areas that were used by lake trout (Koelz 1926, 1929; Rathbun and Wakeham *1897;* Rodd 1919; Smith *1892;* USBCF 1969a; USDI 1969b).

New York

NO-1

Oak Orchard (43°22', 78°12′). This was one of the few spawning grounds on the south shore; spawning had ceased here by the *1920s* (Koelz *1929).*

NO-2

Sodus Point (43°16', 76°59'). Historically, a large run occurred here (Smith 1892).

Sterling Power Plant site (43°23', 76°39'). In 1977, three larvae were collected here in late April (Rochester Gas Elec. 1977).

Nine Mile Point (43°31', 76°22'). This was one of the few spawning grounds on the south shore; spawning had ceased here by the 1920s (Koelz 1929).

Stony Island (43°54', 76°20') and Galloo Island (43°54', 76°25'). Spawning occurred here on the gravel shoals (Smith and Snell 1891).

NO-3

Horse Island (43°57', 76°09'). Historically, this was a favorite spawning site. Fishermen said that spawning stopped here because alewives died in large numbers on the spawning grounds (Smith and Snell 1891).

Chaumont Bay (44°03', 76°12'). Historically, lake whitefish spawned in Three Mile Bay (44°04', 76°13') during late fall (Schneider, pers. comm. 1979) and also on Johnson Shoal (44°03', 76°10') off the mouth of the Chaumont River (Green 1908; Ravenel 1898; Schneider, pers. comm. 1979).

Ontario

OO-1

Grimsby (43°12', 79°34')--Winona (43°13', 79°39'). Historically, many lake whitefish were caught in the fall in this area (Kerr and Kerr 1860-1898). Lake whitefish fry were planted on the *whitefish bar," 1 mi offshore from Winona (Ont. Game Fish 1915); this may have been an historical spawning ground.

Burlington Bay (43°17', 79°50'). Until the early 1930s, a large spawning run entered the bay in November (Whillans 1977). In the late 1800s, a school of fry was observed at Willow Point (Kerr and Kerr 1860-1898). Spawning "beds" were observed in the Hamilton area (Ont. Game Fish 1912) and 3/4 mi offshore from Burlington Beach (43°18', 79°48') (Ont. Game Fish 1908).

Toronto Island (43°37', 79°24'). Until the early 1880s, runs of ripe fish were recorded along Toronto Island and adjacent shores (Whillans 1977, pers. comm. 1979).

OO-2

Port Union (43°47', 79°08'). In 1865, spawning occurred here (Kerr and Kerr 1860-1898).

Darlington Park (43°52', 78°48'). In 1975 and 1977, a few adults in spawning condition were found here (Dunford 1976c, 1978c).

Raby Head (43°52', 78°43'). A few adults in spawning condition were found in shallow water in November; patches of gravel and rubble at depths of 10-40 ft provide good spawning substrate (Dunford 1978c).

Bouchette Point (43°54', 78°29')--Chub Point (48°58', 78°00'). The areas bounded by 43°54', 78°28' to 43°56', 78°12' to 43°57', 78°15' and by 43°51', 78°00' to 43°55', 78°30' are important spawning and fishing areas (Environ. Can. 1977a); included are spawning grounds just off Port Granby (at 43°54', 78°28'1, about 4-1/2 mi off Port Hope (at 43°53', 78°18'), and about 1 mi off Gage Creek (at 43°56', 78°16') (Balesic 1979c).

Colborne (43°59', 77°54'). Spawning occurs about 4-1/2 mi offshore in an area from Colborne, west to approximately 43°55', 78°00' (Balesic 1979c).

OO-3

Prince Edward County Peninsula (44°00' 77°15'). The south shore of the peninsula from Wicked Point (43°51', 77°14') east to Point Traverse (43°571, 76°52'), and including Gull Bar (43°56', 76°50'), has long been an important spawning ground (Balesic 1979c; Christie 1972, 1973; Environ. Can. 1977a; Sly, pers. comm. 1979; Whillans, pers. comm. 1979). Major areas used were Poplar Point (43°55', 76°55') and Ostrander Point (43°54', 76°59'). Since the 1940s, the catch along the shore in the fall has declined drastically (Sly, pers. comm. 1979).

Charity Shoal (44°03', 76°29'). This was one of the most important grounds; lake whitefish spawned here in large numbers in water 5-7 ft deep (Smith 1892; Smith and Snell 1891).

OO-4

Bay of Quinte (44°08', 77°15'). Large numbers of lake whitefish migrated to spawning grounds very close to shore between Glenora (44°02', 77°04') and Picton (44°01', 77°08') each fall (Lapworth 1956). The bay was a favorite spawning ground and was the site of one of the most important whitefish fisheries and spawn collecting operations in the lake in October and November; profitable fisheries were operated during the spawning runs as far up the bay as Massasauga Point (44°09', 77°19') and Belleville (44°09', 77°23') (Dymond et al. 1929; Koelz 1929; Ont. Game Fish 1910, 1911, 1913a, 1915, 1916, 1940; Ravenel 1898; Rodd 1914, 1917, 1918; Smith 1892). Spawning occurred on gravel shoals and beaches in the same areas used by lake herring (Hart 1930; Hurley and Christie 1977; Pritchard 1931). Historically, the most extensive spawning grounds were near Trenton (44°06', 77°34') at the head of the bay; these were probably degraded by sawdust and other mill wastes entering the bay (Rathbun and Wakeham 1897). Lake whitefish eggs were found at Hogs Back (Hogsback Shoal), 900 ft north of Big Island (44°05', 77°15'), in crevices between rocks and under stones in 8-10 ft of water (Hart 1930; Pritchard 1930).

Spawn was also collected in Hay Bay (44°07', 77°01°) (Ont. Game Fish 1943); the mouth of the bay was a very good fishing ground during the spawning season (Ont. Game Fish 1913b).

Lake whitefish were not common in the bay except during the fall spawning migration (Hart 1926). Movement into the bay was believed to be through the Upper Gap (44°07', 76°49'1, between Indian Point (44°07', 76°51') and Amherst Island (44°09', 76°43'). Tagging studies, however, suggested that more fish moved through the Lower Gap (44°10', 76°35') east of Amherst Island and into the North Channel (44°10', 76°45') (Christie 1954, 1955; Koelz 1929). A gradual movement into the bay from Lake Ontario may have begun as early as August. The adults concentrated in Adolphus Reach (44°07', 76°50') in September and moved upstream in October to spawning grounds. Spawning occurred during a IO-day period in early November, about 2 weeks earlier than lake herring, at water temperatures of 40-50°F. Adults remained in the bay until about February (Christie 1954; Hart 1930; Lapworth 1956; MacKay 1957f; Pritchard 1930, 1931; Rathbun and Wakeham 1897) and then moved slowly down the bay during the winter (Christie 1955).

In 1927-28, fry were collected in rather large numbers beginning in late March at nearshore sites in less than 3 ft of water (Hart 1929, 1930). Young-of-the-year were collected along the north shore of Big Island near Hogs Back, the south shore of Adolphus Reach, and Prinyer Cove (44°05', 76°53') (Dymond et al. 1929; Hart 1930; Hubbs and Brown 1929; Pritchard 1930). In 1974, ten larvae were found in the bay in mid-May (Lam 1977).

During 1940-1960, the spawning population in the Bay of Quinte declined drastically (Christie 19731, and the last strong year class was in 1955 (Christie 1972; GLFC 1979b).

BLOATER

Spawning occurred in Lake Ontario from November to January or March (Koelz 1929; Lagler 1948; Pritchard 1931).

Ontario

Winona (43°13', 79°39'). A male with pearl organs was taken off Winona in late November (Koelz 1929).

Port Credit (43°33', 79°35'). A spent female was found off Port Credit in late March (Koelz 1929).

KIYI

The kiyi was commercially important in Lake Ontario during the 1920s and 1930s, but the population is now almost nonexistent (Christie 1973; Scott and Crossman 1973).

No spawning areas were identified. In the 1920s, mature adults were found in New York waters in mid-July. Spent adults were found in early September and spawning was assumed to occur in August (Koelz 1929), September, and October (Pritchard 1928). It was also believed that spawning occurred in December and early January (Pritchard 1931b; Scott and Crossman 1973).

BLACKFIN CISCO

The blackfin cisco was commercially important in Lake Ontario but became extinct by 1900 (Koelz 1926; Scott and Crossman 1923).

No spawning areas were identified. Historically, spawning occurred in New York waters in January, when the fish moved to somewhat shallower water at depths of 240-300 ft (Koelz 1929).

SHORTNOSE CISCO

The shortnose cisco was commercially important in Lake Ontario until the 1940s, but the population is now almost nonexistent (Christie 1973; Scott and Crossman 1973).

No spawning areas were identified, but catches were made during the spawning season in New York waters and off Bronte (43°24', 79°43') and Port Credit (43°33', 79°35'1, Ontario (Koelz 1929; Pritchard 1931b; Stone 1944). Spawning occurred in 250 ft of water during April and the first 2 weeks of May. Spent fish were found as early as late January and February but were not common (Koelz 1929; Pritchard 1928, 1931 b).

COREGONID spp.

New York

NO-2

Nine Mile Paint (43°31', 76°22'). In 1974, among the more abundant larvae collected here in April were those of an unidentified coregonine (LMS 1975b). In 1975, eggs of an unidentified coregonine were entrained here at power plants in late April (LMS 1976b); unidentified coregonine larvae were also collected in the area (PASNY, undated a).

CISCO spp.

Ontario

00-1

Historically, an unidentified cisco spawned in deep water at the western end of the lake from late December to early February. Few were caught until late fall; catches increased at Niagara (43°15', 79°04'1, Bronte (43°24', 79°43'), and Port Credit (43°33', 79°35'1, Ontario, in December and were largest in January and February. Some fishermen reported that spawning occurred twice during the year or throughout the year (Kerr and Kerr 1860-1898).

PINK SALMON

Pink salmon were introduced into the Great Lakes when juveniles escaped from a hatchery in 1956 and entered Lake Superior (Parsons 1973); since then the species has spread throughout the Great Lakes.

New York

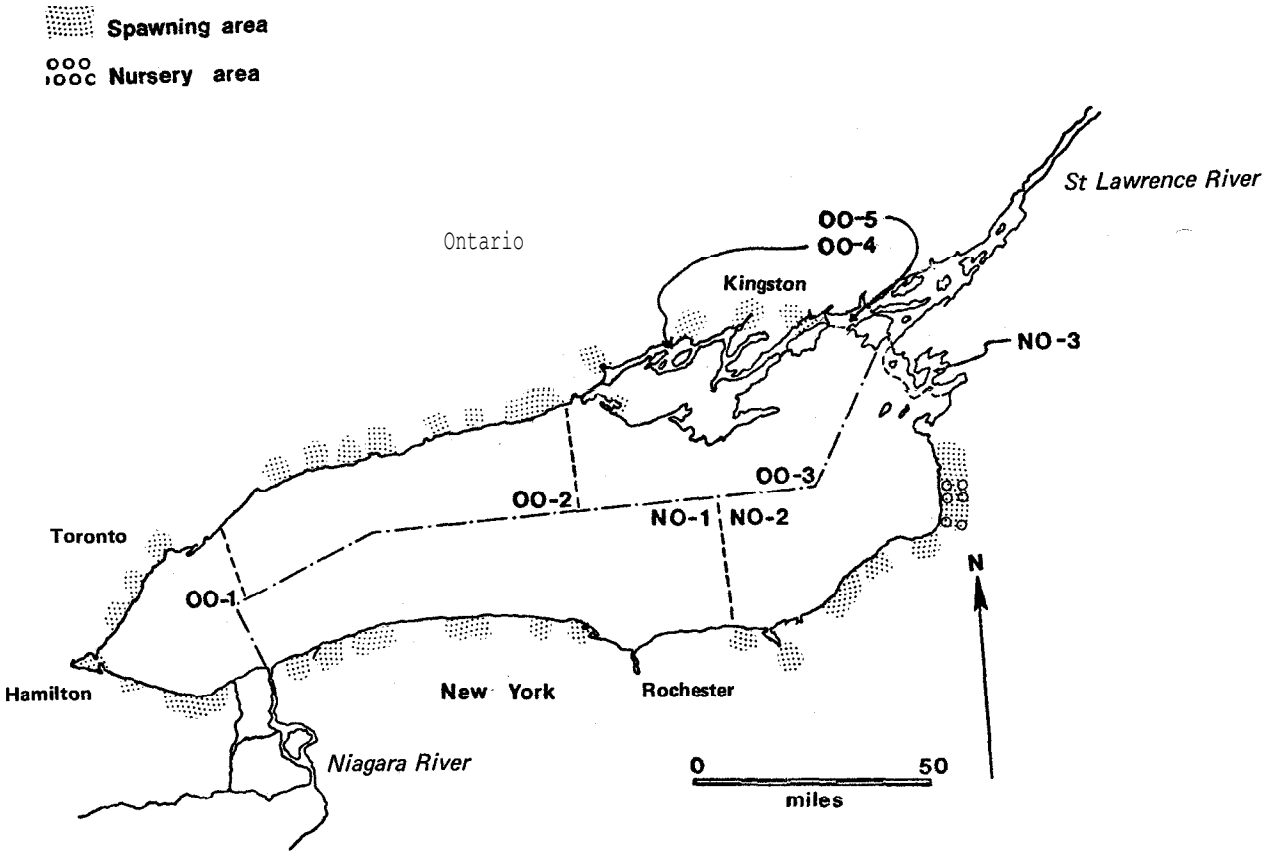
In 1979, there were several sightings of pink salmon in New York tributaries (Schneider, pers. comm. 1979). The species will probably establish runs in all tributaries with mouths not blocked by gravel or sand bars, and successful reproduction may occur (Bergstedt and Elrod, pers. comm. 1979).

Ontario

00-1

Spencer Creek (43°75', 79°57'), In 1979, 70 spawning pink salmon were seen in Spencer Creek at the head of Burlington Bay in late autumn. This may have been the first sizable run of pink salmon in Canadian waters of Lake Ontario. It is unknown if successful spawning occurred (Whillans, pers. comm. 1979).

COHO



Coho salmon were introduced into Lake Ontario in 1919; fry and adults in spawning condition were subsequently caught (Can. Fish. 1924b). Self-sustaining stocks did not become established from this early introduction. Recent plantings began in New York waters in 1968 and in Ontario waters in 1969 (GLFC, in press). Extensive natural reproduction is not expected in Lake Ontario tributaries (Parsons 1973).

New York

In New York waters, any tributary with a sustained flow and a mouth not blocked by gravel or sand bars attracts a spawning run (Bergstedt, pers. comm. 1979). Spawning runs occur in the following areas:

NO-1

Fourmile Creek (43°16', 79°00'). and Sixmile Creek *(43°17′, 78°57′)* (Buffalo Waterfront Devel. Comm., undated; NYDEC 1977b).

Twelvemile Creek (43°19', 78°51'). A fair spawning migration enters the creek (Buffalo Waterfront Devel. Comm., undated).

East Branch Twelvemile Creek (43°19', 78°50'). Coho salmon are present in the creek in the fall and also in the spring (Buffalo Waterfront Devel. Comm., undated).

Eighteenmile Creek (43°20', 78°43'). Exceptionally large runs enter the creek; spawning habitat is available in the lower 2 mi (Buffalo Waterfront Devel. Comm., undated; NYDEC 1977b).

Keg Creek (43°21', 78°39'). An occasional coho salmon is caught (Buffalo Waterfront Devel. Comm., undated).

Johnson Creek (43°22', 78°16') (NYDEC 1977b).

Oak Orchard Creek (43°22', 78°12'). A run moves upstream into Marsh Creek (NYDEC 1977b).

Sandy Creek (43°21', 77°54') and Salmon Creek (43°18', 77°45') (NYDEC 1977b).

NO-2

Salmon Creek (43°16', 77°02') and Sodus Creek (43°13', 76°56') (NYDEC 1977b).

Sterling Creek (43°20', 76°41'), Ninemile Creek (43°24', 76°38'), Eightmile Creek (43°25', 76°37'), Rice Creek (43°27', 76°34'), Oswego River (43°28', 76°31'), and Catfish Creek (43°31', 76°19') (Bergstedt, pers. comm. 1979).

Grindstone Creek (43°33', 76°13'). Natural reproduction occurs as far upstream as Spring Brook (NYDEC 1972; SLEOC 1978).

Salmon River (43°34', 76°12'). Runs start as early as August and natural reproduction occurs; redds, ripe fish, and smolts were found (Eckert, pers. comm. 1979; Ringler, pers. comm. 1979; SLEOC 1978). Naturally produced fry were most abundant in Orwell Brook, but were also abundant in other Salmon River tributaries including Pekin, Trout, and John O'Hara brooks (Ringler, pers. comm. 1979).

Little Sandy Creek (43°38', 76°10') (Bergstedt, pers. comm. 1979). Redds. ripe fish, and eggs were found (Eckert, pers. comm. 1979).

Lindsey Creek (43°40', 76°10'). Natural reproduction occurs; young were found in mid-June (Eckert and Panek, pers. comm. 1979).

Skinner Creek (43°41', 76°10') (Bergstedt, pers. comm. 1979; SLEOC 1978'). Natural reproduction occurs; young are present in mid-June (Eckert and Panek, pers. comm. 1979).

South Sandy Creek (43°43', 76°12'). Spawning was observed here (Bergstedt, pers. comm. 1979; SLEOC 1978).

Sandy Creek (43°44', 76°12'). Adults were observed entering the creek (Bergstedt, pers. comm. 1979; SLEOC 1978).

Ontario

In Canadian tributaries, both spring and fall runs occur (OMNR, undated).

OO-1

Martindale (Twelve Mile) Creek (43°10', 79°16'), Fifteen Mile Creek (43°09', 79°19'), Sixteen Mile Creek (43°09', 79°20'), Jordan Harbour (Twenty Mile) Creek (43°09', 79°22'), and Forty Mile Creek (43°12', 79°33') (Whillans, pers. comm. 1979).

Burlington Bay (43°17', 79°50'). Fall runs occur, but no successful reproduction is known (Down, pers. comm. 1979).

Bronte Creek (43°24', 79°43') (Down, pers. comm. 1979; Moccia, pers. comm. 1979; OMNR 1973; Whillans, pers. comm. 1979). Eggs were collected from ripe fish (OMNR 1977).

Oakville Creek (43°26', 79°40') (Moccia, pers. comm. 1979; Whillans, pers. comm. 1979).

Credit River (43°33', 79°35') (Down, pers. comm. 1979; Environ. Can. 1977a; OMNR 1973, 1976a,b; Parsons 1973; Tibbles et al. 1976a). Redd building was observed (Moccia, pers. comm. 1979), and were collected (OMNR 1977).

Humber River (43°38', 79°28') (Environ. Can. 1977a; OMNR 1973; Tibbles et al. 1976a).

OO-2

Duffin Creek (43°49', 79°02') (OMNR 1973).

Oshawa Creek (43°52', 78°50'), Farewell Creek (43°52', 78°49'), and Bowmanville Creek (43°54', 78°40') (Whillans, pers. comm. 1979).

Wilmot Creek (43°54', 78°36') (Environ. Can. 1977a; OMNR 1973, 1976a).

Graham Creek (43°54', 78°35') (Environ. Can. 1977a; OMNR 1973).

Ganaraska River (43°57', 78°18') (Environ. Can. 1977a; OMNR 1976a,b; Whillans, pers. comm. 1979).

Cobourg Brook (43°57', 78°11') (Whillans, pers. comm. 1979).

Shelter Valley Creek (43°58', 78°01') (Environ. Can. 1977a; OMNR 1973).

Lakeport Creek (43°59', 77°54'), Loughbreeze Creek (43°59', 77°52'), Salem Creek (44°00', 77°50'), and Spencer Point Creek (44°00' 77°48') (Environ. Can. 1977a).

OO-3

Wellers Bay (44°00', 77°35'). Spawning occurs at the head of the bay (Whillans, pers. comm. 1979).

OO-4

Bay of Quinte (44°08', 77°15'). Spawning runs enter four tributaries and one bay here.

Trent River (44°06', 77°34') (OMNR 1973).

Salmon River (44°11', 77°15') and Napanee River (44°12', 77°01') (Environ. Can. 1977a; OMNR 1973).

Milhaven Creek (44°12', 76°45') (Environ. Can. 1977a; OMNR 1973; Whillans, pers. comm. 1979).

Parrotts Bay (44°12', 76°42') (Whillans, pers. comm. 1979).

KOKANEE

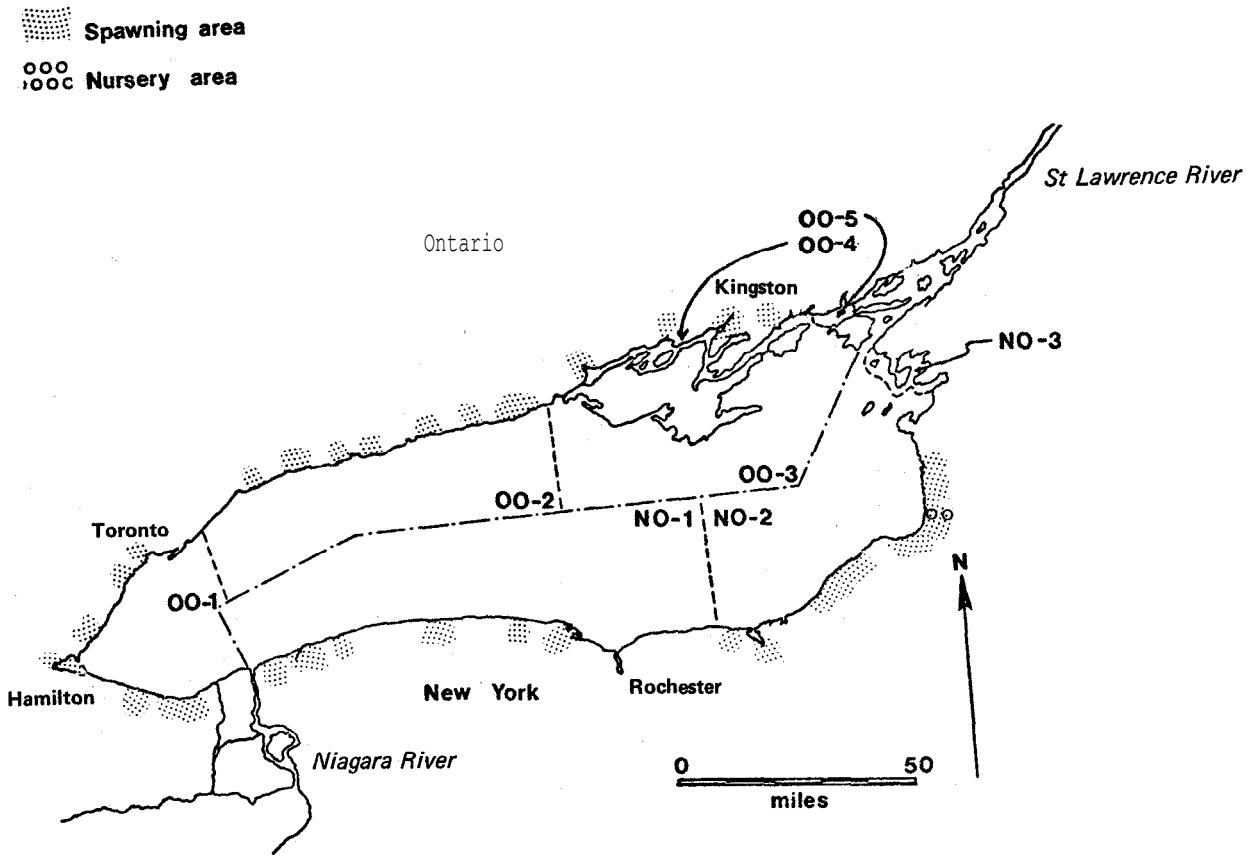
The first introductions of kokanee salmon into the Great Lakes system were made in the Oswego and Black rivers of Lake Ontario in 1950. Many were planted in New York waters since 1950 and in Canadian waters since 1964, but survival was poor (Parsons 1973). Spawning runs occur in the following tributaries:

Ontario

OO-2

Lakeport Creek (43°59', 77°54'1, Loughbreeze Creek (43°59', 77°52'1, Salem Creek (44°00', 77°50'), and Spencer Point Creek (44°00', 77°48') (Environ. Can. 1977a).

CHINOOK



Chinook salmon fry and fingerlings were first planted in Lake Ontario in 1873-1919 in New York waters and in 1875-82 in Ontario waters; these plantings were largely unsuccessful (Dymond et al. 1929; MacKay 1956a; Parsons 1973) and self-sustained stocks were not established or did not persist. Additional plantings were made in Ontario in 1919-25 (MacKay 1956a). Recent plantings began in New York waters in 1969 and in Ontario waters in 1971 (GLFC, in press). Spawning runs have developed in many tributaries as a result of these recent plantings, but little natural reproduction is reported.

New York

In New York waters, any tributary with a sustained flow and a mouth not blocked by gravel or sand bars attracts a spawning run (Bergstedt, pers. comm. 1979). Spawning runs enter the following tributaries:

NO-1

Fourmile Creek (43°16', 79°00') and Sixmile Creek (43°17', 78°57') (NYDEC 1977b).

Twelvemile Creek (43°19', 78°51'). Fair runs enter the creek in the spring and fall (Buffalo Waterfront Devel. Comm., undated).

East Branch of Twelvemile Creek (43°19', 78°50'). Chinook salmon are found in the lower river in the fall and in the spring (Buffalo Waterfront Devel. Comm., undated).

Eighteenmile Creek (43°20', 78°43'). Exceptionally large runs enter the creek. Spawning habitat is available in the lower 2 mi (Buffalo Waterfront Devel. Comm., undated; NYDEC 1977b).

Johnson Creek (43°22', 78°16') (NYDEC 1977b).

Oak Orchard Creek (43°22', 78°12'). Spawning runs move upstream into Marsh Creek (Makarewicz et al. *1979;* NYDEC 1977b).

Sandy Creek (43°21', 77°54') and Salmon Creek (43°18', 77°45') (NYDEC 1977b).

NO-2

Salmon Creek (43°16', 77°02') and Sodus Creek (43°13', 76°56') (NYDEC 1977b).

sterling Creek (43°20', 76°41'), Ninemile Creek (43°24', 76°38'), Eightmile Creek (43°25', 76°37'), Rice Creek (43°27', 76°34'), Oswego River (43°28', 76°31'), and Catfish Creek (43°31', 76°19') (Bergstedt, pers. comm. 1979).

Little Salmon River (43°31', 76°15'). Natural reproduction occurs as far upstream as Spring Brook (NYDEC, unpubl. data; Ringler, pers. comm. 1979; SLEOC 1978; Tibbles 1975).

Grindstone Creek (43°33', 76°13') (Bergstedt, pers. comm. 1979; SLEOC 1978).

Salmon River (43°34', 76°12'1. Runs starthere as early as August and natural reproduction occurs; redds, ripe fish, and smolts were found in the river (Ringler, pers. comm. 1979; SLEOC 1978). Beavy natural reproduction occurs in Orwell Brook (Ringler, pers. comm. 1979).

Little Sandy Creek (43°38', 76°10') (Bergstedt, pers. comm. 1979).

Skinner Creek (43°41', 76°10') (Bergstedt, pers. comm. 1979; SLEOC 1978).

South Sandy Creek (43°43', 76°12') (Bergstedt, pers. comm. 1979; SLEOC 1978). Redds were found here (Ringler, pers. comm. 1979).

Sandy Creek (43°44', 76°12') (Bergstedt, pers. comm. 1979; SLEOC 1978).

Ontario

Chinook salmon are found in greatest numbers during upstream spawning migrations in the fall (Dymond et al. 1929). A spring run also occurs, and these fish remain in deep pools in the streams until they spawn in mid-September to mid-November at water temperatures of 37-50°F (MacKay 1956a).

OO-1

Martindale (Twelve Mile) Creek (43°10', 79°16'), Fifteen Mile Creek (43°09', 79°19'), Sixteen Mile Creek (43°09', 79°20'), Jordan Harbour (Twenty Mile) Creek (43°09', 79°22'), and Forty Mile Creek (43°12', 79°33') (Whillans, pers. comm. 1979).

Burlington Bay (43°17', 79°50'). Fall runs enter the bay, but no successful reproduction is known; the fish appear to move into Spencer Creek (43°15', 79°57') (Down, pers. comm. 7979).

Bronte (Twelve Mile) Creek (43°24', 79°43') (Down, pers. comm. 1979; OMNR 1973; Whillans, pers. comm. 1979). Redd building was observed (Moccia, pers. comm. 1979), and eggs were collected from ripe fish (OMNR 1977). In 1927, a run was observed in late October, ripe and spent fish were collected, and redds and eggs were found at the foot of rapids 2 mi from the mouth (MacKay 1956a, 1969).

Oakville Creek (43°26', 79°40') (Moccia, pers. comm. 1979; Whillans, pers. comm. 1979).

Credit River (43°33', 79°35') (Down, pers. comm. 1979; Environ. Can. 1977a; OMNR 1973, 1976a,b). Redd building was observed (Moccia, pers. comm. 1979), ripe fish were collected (MacKay 1956a), and eggs were taken (OMNR 1977).

Humber River (43°38', 79°28') (Environ. Can. 1977a; OMNR 1973).

OO-2

Duffin Creek (43°49', 79°02') (Environ. Can. 1977a; OMNR 1973).

Oshawa Creek (43°52', 78°50'), Farewell Creek (43°52', 78°49'), and Bowmanville Creek (43°54', 78°40') (Whillans, pers. comm. 1979).

Wilmot Creek (43°54', 78°36') (Environ. Can. 1977a; OMNR 1973, 1976a,b).

Graham Creek (43°54', 78°35') (Environ. Can. 1977a; OMNR 1973).

Ganaraska River (43°57', 78°18') (Environ. Can. 1977a; Whillans, pers. comm. 1979).

Cobourg Brook (43°57', 78°11') (OMNR 1973).

Shelter Valley Creek (43°58', 78°01') (Environ. Can. 1977a; OMNR 1973).

Lakeport Creek (43°59', 77°54'), Loughbreeze Creek (43°59', 77°52'1, Salem Creek (44°00', 77°50'), and Spencer Point Creek (44°00', 77°48') (Environ. Can. 1977a).

OO-4

Bay of Quinte (44°08', 77°15'). In 1921, ripe chinook salmon were caught in the bay in October (MacKay 1956a). Runs enter four tributaries.

Trent River (44°06', 77°34'), Salmon River (44°11', 77°15'), Napanee River (44°12', 77°01'), and Milhaven Creek (44°12', 76°45') (Environ. Can. 1977a; OMNR 1973).

SALMON spp.

Ontario

OO-3

Bald Head Island (44°00' 77°37'). Unidentified species of salmon spawn along the lake shore here (Environ. Can. 1977a).

Wellington Bay (43°56', 77°21'). Unidentified species of salmon spawn in the bay from the town of Wellington (43°57', 77°21') to West Point (43°53', 77°17') (Environ. Can. 1977a).

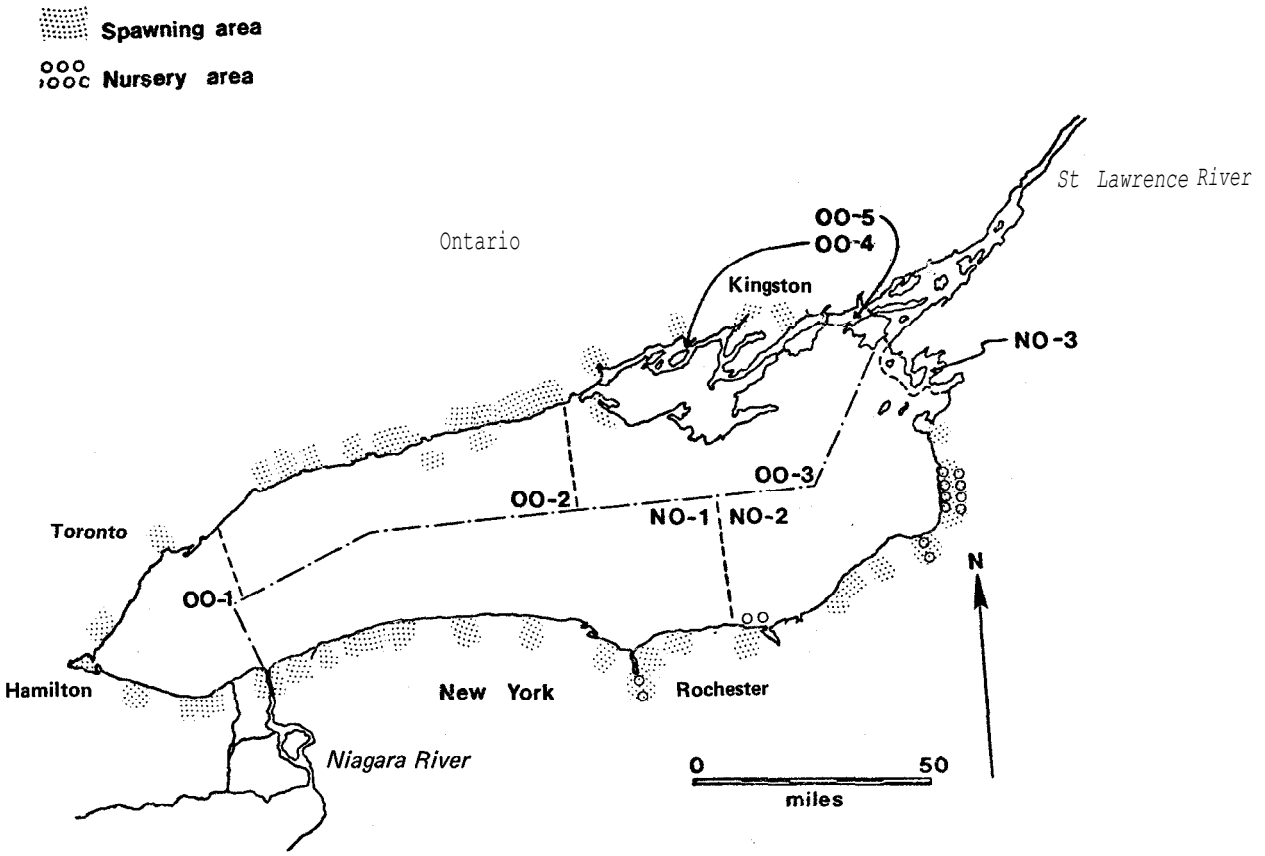
ROUND WHITEFISH

Ontario

OO-2

Raby Head (43°52', 78°43')--Bowmanville (43°54, 78°40'). Spawning occurs in this area (Balesic 1979c). Adults were found inshore in October-December (Balesic 1979a; Dunford 1976) and were ripe by late November. Spawning apparently occurred during the first week of December, when a spent female was collected at a water temperature of about 36°F. Most fish were collected in about 10-30 ft of water. Patches of gravel and rubble in about 10-40 ft of water at Raby Head are good spawning substrate (Dunford 1978c).

RAINBOW TROUT



The initial planting of rainbow trout in the Lake Ontario watershed occurred in the Genesee River, New York, in 1878; by 1884, some of these fish had moved downstream to the lake. The first planting in Lake Ontario proper occurred in 1897 off Grenadier Island (44°03', 76°21'), New York. Plantings by the Province of Ontario began in *1922.* Continued stocking of rainbow trout (steelhead) has produced spawning runs in several tributaries of Lake Ontario, but natural reproduction occurs mainly in Canadian tributaries (MacCrimmon and Gots 1972).

New York

In New York waters of Lake Ontario, any tributary with a reasonably sustained flow will attract a run (Bergstedt and Elrod, pers. comm. 1979). Runs start in September or October and continue sporadically through the winter; runs peak mainly in March and April (Bergstedt, pers. comm. *1979;*

Eckert and Panek, pers. comm. 1979; Ringler, pers. comm. 1979; SLEOC *1978).* Some redds are built in the fall; however, most spawning takes place in the- spring (Ringler, pers. comm. 1979). Almost every stream between Oswego (43°28', 76°31') and Stony Point (43°51', 76°18') is fairly good for reproduction (Eckert and Panek, pers. comm. 1979); many others along the south shore also support runs. Spawning runs enter the following streams:

NO-1

Fourmile Creek *(43°16',* 79°00') and Sixmile Creek *(43°17', 78°57')* (Buffalo Waterfront Devel. Comm., undated; NYDEC 1977b).

Twelvemile Creek (43°19', 78°50'). Rainbow trout enter the creek in the spring and fall; runs proceed into East Branch to a point about *1* mi below the Route 18 bridge (NYDEC, undated).

Eighteenmile Creek (43°20', 78°43') (Eckert, pers. comm. 1979; NYDEC 1977b).

Keg Creek *(43°21',* 78°39') and Fish Creek (43°22', 78°32') (Buffalo Waterfront Devel. Comm., undated).

Oak Orchard Creek (43°22', 78°12'). Spawning runs probably enter into the lower section of the creek below the dam (Eckert, pers. comm. *1979).* In *1978,* an adult was found in the creek in the fall (Makarewicz et al. 1979).

Sandy Creek (43°21', 77°54') (Eckert, pers. comm. 1979).

Genesee River (43°15', 77°36'). Large runs of ripe fish were observed (Eckert, pers. comm. 1979).

Irondequoit Creek (43°10', 77°32'). Spawning runs enter the creek and natural reproduction occurs; young have been collected (Eckert, pers. comm. 1979).

Forest Lawn (43°15', 77°30'). An unnamed tributary here supports natural reproduction (NYDEC 1977b).

Fourmile Creek (43°16', 77°26') (NYDEC 1977b).

NO-2

Salmon Creek (43°16', 77°02'). Fall and spring runs enter the creek, and substantial natural reproduction occurs (NYDEC 1977b); the young are probably forced into the lake by high summer stream temperatures (Eckert, pers. comm. *1979).*

Sterling Creek (43°20', *76°41').* Spawning runs enter the creek, and natural reproduction occurs (Eckert, pers. comm. *1979),*

Oswego River (43°28', *76°31'),* Eightmile Creek (43°25', 76°37'), and Ninemile Creek (43°24', 76°38') (Bergstedt, pers. comm. 1979).

Little Salmon River (43°31', 76°15'). Spawning runs enter the river, and natural reproduction occurs; redds, ripe fish, eggs, and smolts were found (Eckert, pers. comm. 1979; Ringler, pers. comm. 1979; SLEOC 1978).

Grindstone Creek (43°33', 76°13') (Bergstedt, pers. comm. 1979; Eckert, pers. comm. 1979; Ringler, pers. comm. 1979).

Salmon River (43°34', 76°12'). Large spawning runs of both naturally produced and stocked fish enter the river; redds, ripe fish, eggs, and smolts were found (Eckert, pers. comm. 1979; MacCrimmon and Gots 1972; Ringler, pers. comm. 1979; SLEOC 1978).

Little Sandy Creek (43°38', 76°10'). Spawning runs enter the creek, and natural reproduction occurs; redds, ripe fish, and YOY were found (Eckert, pers. comm. 1979; NYDEC, unpubl. data).

Lindsey Creek (43°40', 76°10'). Spawning runs enter the creek, and natural reproduction occurs. Redds, ripe fish, (Eckert and Panek, pers. comm. 1979; Ringler, pers. comm. 1979), and young were collected (Eckert, pers. comm. 1979).

Skinner Creek 143°41', 76°10'). Spawning runs enter the creek and natural reproduction occurs; redds, ripe fish with eggs, and young-of-the-year (YOY) were found in the creek (Eckert and Panek, pers. comm. 1979; Ringler, pers. comm. 1979; SLEOC 1978).

south Sandy Creek (43°43', 76°12'). Spawning runs enter the creek (Bergstedt, pers. comm. 1979; Eckert, pers. comm. 1979; Ringler, pers. comm. 1979; SLEOC 1978). Spawning occurs in the Ellisberg area (NYDEC, unpubl. data).

Sandy Creek (43°44', 76°12') (Bergstedt, pers. comm. 1979; MacCrimmon and Gots 1972; SLEOC 1978).

Stony Creek (43°50', 76°14'). Spawning runs, enter the creek (NYDEC, unpubl. data); redds were observed (Eckert, pers. comm. 1979).

Ontario

Many Ontario tributaries support spring and fall runs; spawning occurs in April (Christie 1973; OMNR, undated).

OO-l

Niagara River (43°16', 79°04') (MacCrimmon and Gots 1972; OMNR 1973).

Martindale (Twelve Mile) Creek (43°10', 79°16') (MacCrimmon and Gots 1972; Whillans, pers. comm. 1979).

Fifteen Mile Creek (43°09', 79°19'), Sixteen Mile Creek (43°09', 79°20'), Jordan Harbour (Twenty Mile) Creek (43°09', 79°22'), and Forty Mile Creek (43°12', 79°33') (Whillans, pers. comm. 1979).

Burlington Bay (43°17', 79°50'). Fall runs occur, but successful reproduction is doubtful (Down, pers. comm. 1979).

Bronte Creek (43°24', 79°43'). A major spawning run enters the creek (OMNR 1973; Whillans, pers. comm. 1979).

Oakville Creek (43°26', 79°40') (OMNR 1973; Whillans, pers. comm. 1979).

Humber River (43°38', 79°28') (Environ. Can. 1977a; OMNR 1973).

OO-2

Duffin Creek (43°49', 79°02') (Environ. Can. 1977a; OMNR 1973). The east branch supports more spawning than the west branch (Environ. Can. 1977a).

Oshawa Creek (43°52', 78°50') and Farewell Creek (43°52', 78°49') (Whillans, pers. comm. 1979).

Bowmanville Creek (43°54', 78°40') (MacCrimmon and Gots 1972; OMNR 1973; Whillans, pers. comm. 1979).

Soper Brook (43°54', 78°40') (MacCrimmon and Gots 1972; OMNR 1973).

Wilmot Creek (43°54', 78°36'). A major run enters the creek (MacCrimmon and Gots 1972; OMNR 1973, 1976a; Whillans, pers. comm. 1979).

Graham (Newcastle) Creek (43°54', 78°35') (MacCrimmon and Gots 1972; OMNR 1973; Whillans, pers. comm. 1979).

Port Granby (43°54', 78°28'). Spawning occurs about 5 mi off shore at a depth of 36 ft; the substrate is glacial sediment (Balesic 1979c).

Port Britain Creek (43°56', 78°23') (Environ. Can. 1977a; MacCrimmon and Gots 1972; OMNR 1973; Whillans, pers. comm. 1979).

Ganaraska River (43°57', 78°18') (Environ. Can. 1977a; OMNR 1973, 1975, 1976a; Whillans, pers. comm. 1979).

Gage Creek (43°57', 78°16'). A spawning run enters the creek (Environ. Can. 1977a; OMNR 1973). Spawning also occurs in the lake about 1 mi off the creek mouth (Balesic 1979c).

Cobourg Brook (43°57', 78°11') (Whillans, pers. comm. 1979).

Hortop Creek (43°58', 78°03') (Environ. Can. 1977a; MacCrimmon and Gots 1972; OMNR 1973).

Grafton (Prentice) Creek (43°58', 78°02') (MacCrimmon and Gots 1972; Whillans, pers. comm. 1979).

Shelter Valley Creek (43°58', 78°01°) (Christie 1973; Environ. Can. 1977a; MacCrimmon and Gots 1972; OMNR 1973; Whillans, pers. comm. 1979).

Colborne River and Lakeport Creek (43°59', 77°54')-(Environ. Can. 1977a; MacCrimmon and Gots 1972; OMNR 1973).

Salem Creek (44°00' 77°50') (Environ. Can. 1977a; MacCrimmon and Gots 1972; OMNR 1973).

Spencer Point Creek (44°00' 77°48'). Spawning occurs at the creek mouth (Environ. Can. 1977a).

OO-3

Bald Head Beach (44°00', 77°36'). Spawning occurs along the lakeshore at the beach and also around Bald Head Island (44°00', 77°37') (Environ. Can. 1977a).

Wellers Bay (44°00', 77°35'). Spawning occurs along the northwest shore of the bay at 44°02', 77°36' (Environ. Can. 1977a).

OO-4

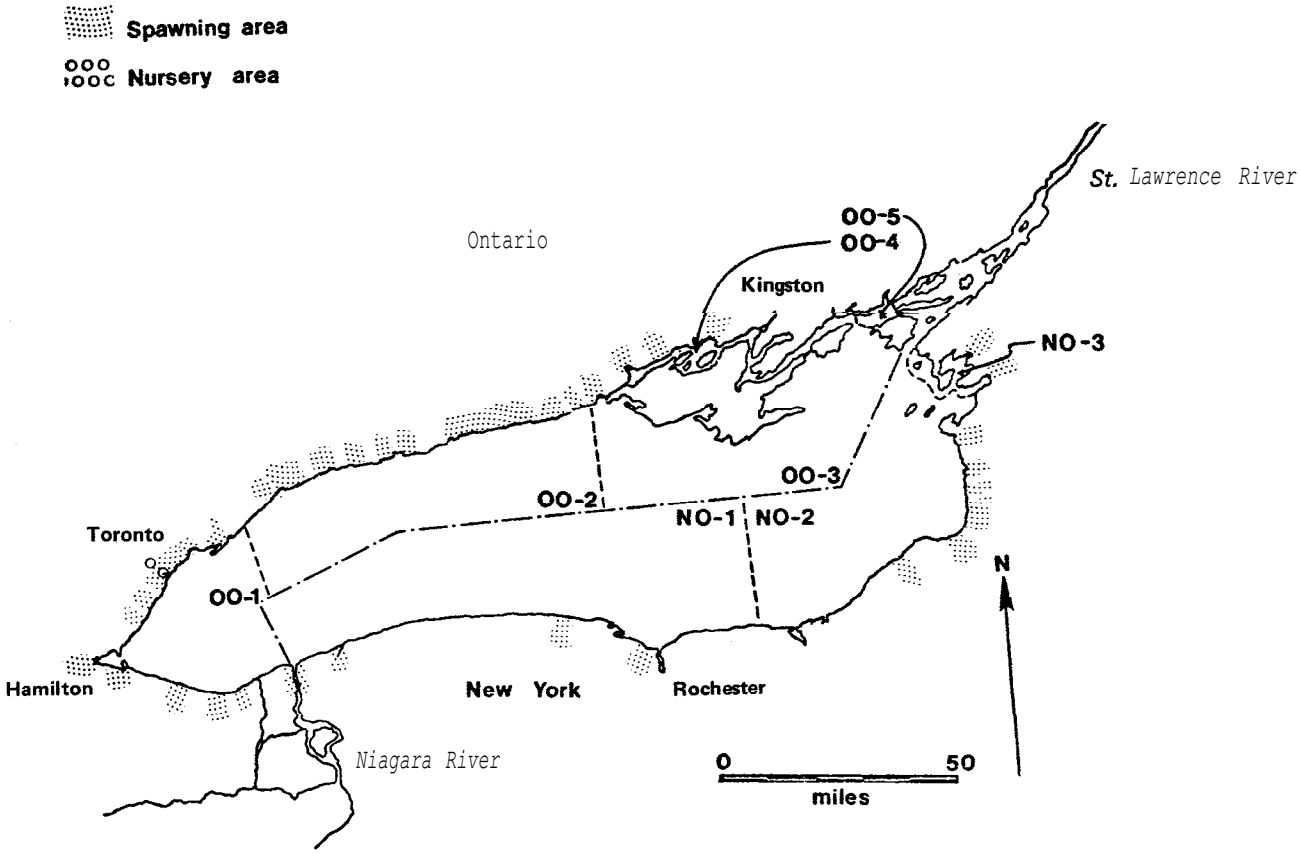
Trent River (44°06', 77°34') (MacCrimmon and Gots 1972; OMNR 1973).

Salmon River (44°11', 77°15') (OMNR 1973).

Napanee River (44°12', 77°01') (Environ. Can. 1977a; MacCrimmon and Gots 1972; OMNR 1973).

Milhaven Creek (44°12', 76°45') (Environ. Can. 1977a; OMNR 1973).

ATLANTIC SALMON



At the time of the earliest settlements on Lake Ontario, a large native landlocked population of Atlantic salmon existed in the lake. These fish entered almost every tributary along both the U.S. and Canadian shores to spawn in the fall (Blair 1938; Kerr and Kerr 1860-1898; McCrimmon 1950, 1951; Skiff et al. 1950; Smith 1892; USDI 1969b). Runs began in October, and spawning began in mid-November. Adults rarely remained in the streams longer than 1 week; none were present in the streams in December (Kerr and Kerr 1860-1898; Parsons 1973).

Runs also occurred during periods of high flow in the summer, notably in the Salmon and Oswego Rivers (Bean 1903; Goode 1884; Kerr and Kerr 1860-1898; Parsons 1973; Smith 1892). Spawning occurred on gravel shoals in clear, cold streams with rather steep gradients (Parsons 1973). Prior to 1850, the Atlantic salmon was the most important species in Lake Ontario (Parsons 1973). Most spawning runs disappeared during 1880-1890, and the last native Atlantic salmon was taken in 1898 (Kerr and Kerr 1860-1898; McCrimmon 1950; Parsons 1973; Smith 1892). The decline of the Lake Ontario stock has been attributed to several factors: the construction of mill dams during the late 1700s and early 1800s that

blocked many spawning streams and inhibited reproduction; overfishing during spawning runs, when the salmon were easily netted, clubbed, or speared at stream mouths and below dams; deforestation that resulted in siltation and increased temperatures in spawning streams; and pollution of spawning streams by sawdust, paper-mill waste, and other factory refuse (Bean 1903; Dymond 1964; Edmunds 1874; Edsall 1971; Follett 1932; Kerr and Kerr 1860-1898; OMNR 1973; Parsons 1973; SLEOC 1978; Smith 1892; USBCF 1969a; USDI 1969b).

New York

Plantings in New York waters during 1950-70 failed to re-establish spawning runs (Parsons 1973). Historically, runs occurred in the following New York tributaries.

NO-1

Twelvemile Creek (43°19', 78°51'). Spawning was last seen here in 1880 (Smith 1892).

Sandy Creek (43°21', 77°54') (Parsons 1973).

Genesee River (43°15', 77°36'). The run declined because a high dam was constructed and overfishing occurred below the dam (Edmunds 1874; Follett 1932).

Little Salmon Creek (location uncertain) (Smith 1892).

NO-2

Three-mile Creek (location uncertain) (Parsons 1973).

Oswego River (43°28', 76°31'). Spawning runs were recorded here as early as 1657-1672 (Greeley 1940; Parsons 1973; Skiff et al. 1950; Smith 1892; USDI 1969b). Spawning grounds were at the headwaters of the river in the Finger Lakes (Edmunds 1874; Follett 1932; Parsons 1973). In 1884, the run consisted only of stragglers (Goode 1884) and by 1890, the run ceased (Smith 1892).

Little Salmon River (43°31', 76°15') (Smith 1892).

Grindstone Creek (43°33', 76°13') (Goode 1884; Parsons 1973).

Salmon River (43°34', 76°12'). Spawning runs were recorded here as early as 1657-1672 (Parsons 1973). During 1810-1900, the river supported the best run in U.S. waters; the run proceeded 25-30 mi upstream and supported an important fishery for the settlers of Pulaski, The stock steadily declined after a series of dams was built starting in 1837. In 1890, a few spawners were still found in the river; but by 1900 the run had disappeared (Collins 1885; Edmunds 1874; Follett 1932; Goode 1884; Greeley 1940; Greene 1940; Skiff et al. 1950; Smith 1892; USBCF 1969a;

USDI 1969b). Overfishing, dams, sawdust, and tannery waste contributed to the decline (Goode 1884).

Deer Creek (43°36', 76°10') (Goode 1884; Parsons 1973).

Little Sandy Creek (43°38', 76°10') (Smith 1892).

Sandy Creek (43°44', 76°12'). A run of native fish entered this creek (Parsons 1973; Smith 1892). Spawning runs ceased here long before the 1870s (Edmunds 1874).

Stony Creek (43°50', 76°14'). Historically, a run of native fish entered this creek (Parsons 1973).

NO-3

Black River (44°00' 76°04'). The run was destroyed by impassable dams and acid waste from paper mills (Edmunds 1874; Smith 1892).

Chaumont River (44°04', 76°09'). By the 1870s, the native population here declined due to impassable dams and overfishing (Edmunds 1874). By 1884, the run into Chaumont Bay ceased (Goode 1884).

Ontario

In Canadian waters, Atlantic salmon were found along the beaches in late September prior to the upstream migrations, which occurred in October and November (Huntsman 1944; Kerr and Kerr 1860-1898). Small runs were still occurring in 1879, but most had disappeared by the 1860s (McCrimmon 1950). Artificial propagation and stocking during 1866-1883 failed to restore the population and the last salmon was caught in 1898 (OMNR 1973). Stocking during the 1940s also failed (McCrimmon 1950, 1951; Parsons 1973). Historical runs occurred in the following tributaries:

OO-1

Niagara River (43°16', 79°04'). Spawning runs occurred here (OMNR 1973), although spawning grounds below the falls were scarce (Parsons 1973).

Martindale (Twelve Mile) Creek (43°10', 79°16') and Jordan Harbour (Twenty Mile) Creek (43°09', 79°22') (OMNR 1973; Parsons 1973). By 1873, the spawning runs were almost extinct because fish were destroyed on spawning grounds (Kerr and Kerr 1860-1898).

Forty Mile Creek (43°72', 79°33') (OMNR 1973).

Burlington Bay (43°17', 79°50'). Until 1885, substantial spawning runs moved through the bay and into Redhill Creek (43°15', 79°46'), Dundas Creek (43°16', 79°56') (Kerr and Kerr 1860-1898; Whillans 1977), and Grindstone Creek (43°17', 79°53') (Parsons 1973).

Bronte Creek (43°24', 79°43') and Oakville Creek (43°26', 79°40') (OMNR 1973; Parsons 1973).

Credit River (43°33', 79°35'). The Credit River supported the largest run in the lake (Follett 1932; OMNR 1973; Parsons 1973); spawning occurred around November 10-20 (Kerr and Kerr 1860-1898). The river was also a major nursery area (Ricker 1964). Runs were recorded until 1878 (Kerr and Kerr 1860-1898; Parsons 1973); the decline was attributed to overfishing and to siltation following deforestation (Follett 1932) and to dams that blocked spawning migrations (Ricker 1964).

Cooksville Creek (43°34', 79°34') and Etobicoke Creek (43°35', 79°33') (OMNR 1973).

Garrison Creek (location uncertain) (Parsons 1973).

Mimico Creek (43°37', 79°29') (OMNR 1973). By 1873, the spawning runs had almost ceased because fish were destroyed on the spawning grounds (Kerr and Kerr 1860-1898).

Humber River (43°38', 79°28'). During the 1790s-1876, Atlantic salmon migrated upstream to spawn on the rapids; this run declined by 1845 (Fox 1930; Kerr and Kerr 1860-1898; OMNR 1973; Parsons 1973; Whillans 1977).

Don River (43°39', 79°21'). Atlantic salmon migrated through Toronto Bay (43°38', 79°23') to spawn in the river. The run declined by 1829, although fish were still being speared on the spawning beds in early November 1873 (Follett 1932; Fox 1930; Kerr and Kerr 1860-1898; OMNR 1973; Whillans 1977).

OO-2

Highland Creek (43°46', 79°10'). A decline in the run was noted in 1881 (Kerr and Kerr 1860-1898); stocking did not re-establish the run (Parsons 1973).

Rouge River (43°48', 79°07'). Spawning occurred on the rapids until 1882 (Huntsman 1944; Kerr and Kerr 1860-1898; OMNR 1973; Parsons 1973).

Petticoat Creek (43°08', 79°06'). The run was destroyed because stream flow was reduced (Kerr and Kerr 1860-1898).

Duffin Creek (43°49', 79°02'). Runs were recorded until 1882; this was one of the better Atlantic salmon streams and one of the last streams to support runs of native Atlantic salmon. Adults began moving into the creek and to the rapids around October 15, spawned until mid-November, and were gone by the end of November. Stocking during 1944-48 did not re-establish the run, although in 1950 a ripe female returned in the fall (Huntsman 1944; Kerr and Kerr 1860-1898; McCrimmon 1950, 1951, 1954; OMNR 1973; Ricker 1964; Smith 1978c).

Lynde Creek (43°51', 78°57'). Runs were recorded until 1878 (Kerr and Kerr 1860-1898; OMNR 1973; Parsons 1973).

Pringle Creek (43°52', 78°56') and Oshawa Creek (43°52', 78°50') (OMNR 1973).

Farewell Creek (43°52', 78°49') (OMNR 1973; Parsons 1973).

Bowmanville Creek (43°54', 78°40') (OMNR 1973).

Soper Creek (43°54', 78°40') (OMNR 1973; Parsons 1973).

Wilmot Creek (43°54', 78°36'). Many salmon entered the creek in October; by 1866 the run was declining (Follett 1932; Moenig, undated; OMNR 1973; Parsons 1973; Smith 1892).

Graham Creek (43°54', 78°35') and Port Britain Creek (43°56', 78°23') (OMNR 1973).

Ganaraska River (43°57', 78°18') (OMNR 1973; Parsons 1973). The stream historically supported many Atlantic salmon; the population declined, probably because the river was blocked by dams. The first dam was built in 1799, and by 1861 there were 36 dams on the creek (Richardson 1946).

Gage Creek (43°57', 78°16') and Cobourg Brook (43°57@, 78°11') (OMNR 1973; Parsons 1973). Spawning runs moved upstream in Cobourg Brook into Percy Creek (OMNR 1973).

Brookroad Creek (43°57', 78°07'), Livingstone Creek (43°58', 78°05'), and Hortop Creek (43°58', 78°03') (OMNR 1973).

Grafton Creek (43°58', 78°02') (Huntsman 1944).

Shelter Valley Creek (43°58', 78°01°) (OMNR 1973; Parsons 1973).

Colborne River (43°59', 77°54') and Salem Creek (44°00' 77°50') (OMNR 1973).

OO-3

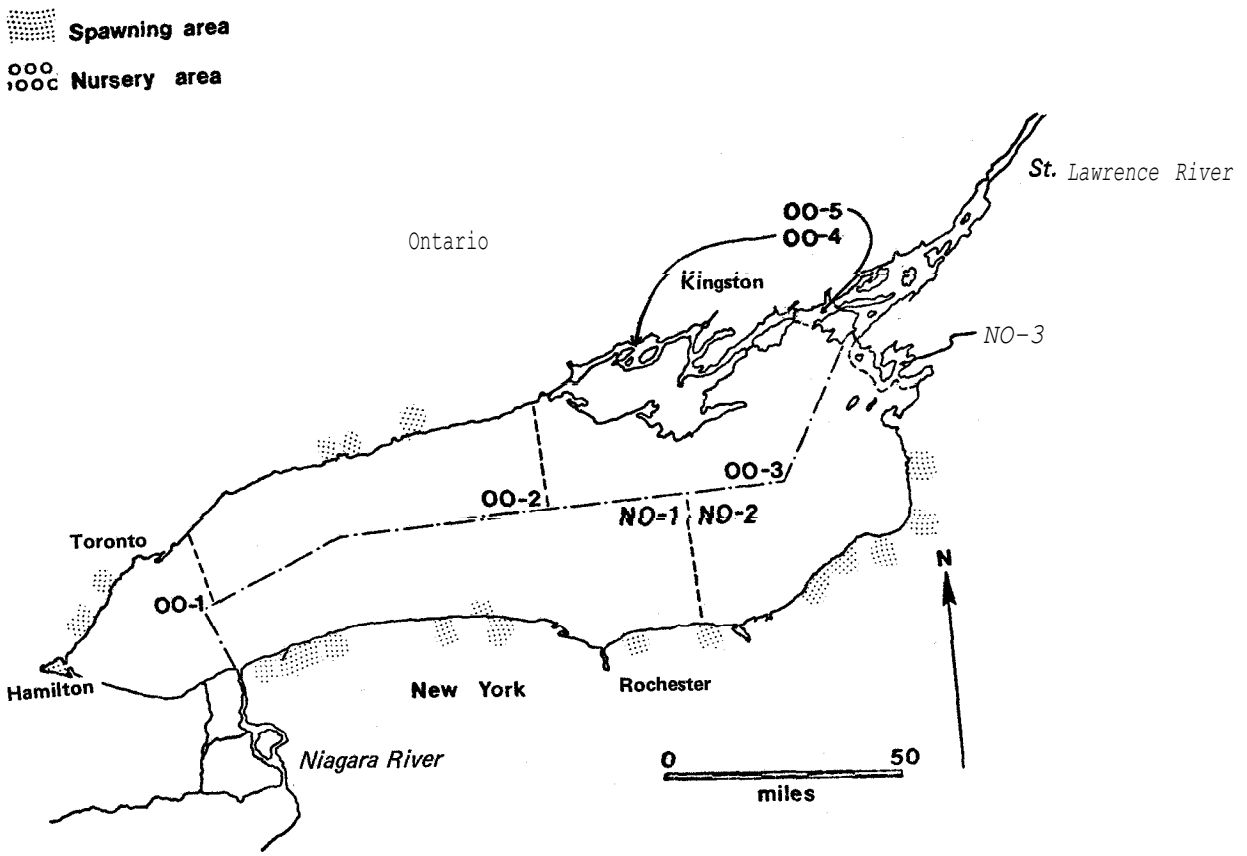
Butler Creek (44°02', 77°43') (OMNR 1973).

OO-4

Bay of Quinte (44°08', 77°15'). Many tributaries supported spawning runs (Follett 1932), but only three were identified:

> Trent River (44°06', 77°34'), Moira River (44°09', 77°23'), and Salmon River (44°11', 77°15') (Parsons 1973).

BROWN TROUT



The brown trout, a native of Europe and western Asia, was introduced into the United States in about 1883 and subsequently entered the Great Lakes, probably from stream stockings (Moffett 1958; Scott and Crossman *1973).* Plantings in Lake Ontario and its tributaries have produced spawning runs in several streams.

New York

In New York waters of Lake Ontario, any tri'outary with a reasonably sustained flow and a mouth not blocked by gravel or sand bars will attract a run (Bergstedt, pers. comm. 1979). In the fall, many fish move from the lake into stream mouths, but it is not known if these fish spawn successfully. Spawning is also believed to occur on rocky areas in the lake proper (Eckert, pers. comm. *1979).* Spawning runs occur in the following areas:

NO-1

Fourmile Creek (43°16', 79°00') and Sixmile Creek (43°17', 78°57'). Spawning runs enter these creeks in the fall (NYDEC 1977b).

East Branch Twelvemile Creek (43°79*, 78°50') and Twelvemile Creek (43°19', 78°51'). A fair run enters these creeks (Buffalo Waterfront Devel. Comm., undated).

Eighteenmile Creek (43°20', 78°43'). Exceptionally large runs enter the creek in the fall. Spawning habitat is present in the lower 2 mi, and spawning occurs from Burt Dam downstream for about 1,000 ft (Buffalo Waterfront Devel. Comm., undated; NYDEC 1977b).

Oak Orchard Creek (43°22', 78°12'). In 1978, adults were caught in the creek in autumn (Makarewicz et al. 1979).

Hamlin Beach State Park (43°21', 77°57'). Spawning occurs along the lake shoreline in late fall (Haines et al. 1977).

Sandy Creek (43°21', 77°54'). The creek supports an excellent fishery for lake-run fish in the fall (NYDEC 1977b).

Fourmile Creek (43°16', 77°26') (NYDEC 1977b).

NO-2

Salmon Creek (43°16', 77°02'). Substantial natural reproduction occurs in the creek (NYDEC 1977b).

Sterling Creek (43°20', 76°41'), Ninemile Creek (43°24', 76°38'), Eightmile Creek (43°25', 76°37'), Rice Creek (43°27', 76°34'1, Oswego River (43°28', 76°31'), Catfish Creek (43°31', 76°19'1, Grindstone Creek (43°331, 76°13'), and South Sandy Creek (43°43', 76°12') (Bergstedt and Elrod, pers. comm. 1979).

Sandy Creek (43°44', 76°12') (Bergstedt, pers. comm. 1979; Eckert, pers. comm. 1979).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). A minor run enters the bay in October, but reproduction is not known to be successful (Down, pers. comm. 1979).

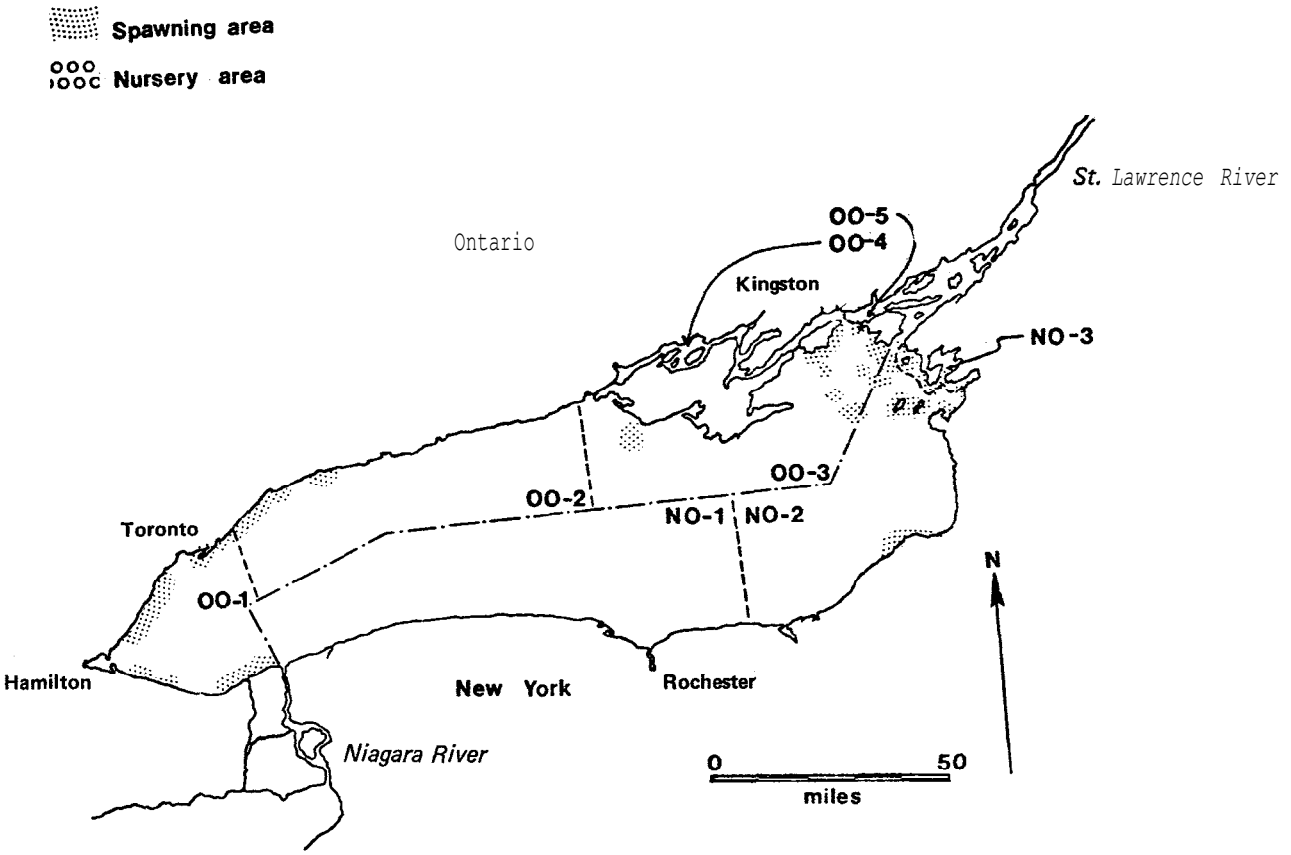
Bronte Creek (43°24', 79°43'), Oakville Creek (43°26', 79°40'1, and Credit River (43°33', 79°35'). Minor runs occur (Moccia, pers. comm. 1979).

OO-2

Bowmanville Creek (43°54', 78°40') (Whillans, pers. comm. 1979).

Wilmot Creek (43°54', 78°36') (OMNR 1976a).

Ganaraska River (43°57', 78°18') (Environ. Can. 1977a; OMNR 1975, 1976a; Whillans, pers. comm. 1979).



Historically, native lake trout spawned in Lake Ontario from October to mid-November or December on reefs at depths of *10-100* ft, at the same sites used by lake whitefish (Cahill, pers. comm. *1977;* Nash *1913;* Rathbun and Wakeham *1897;* Smith 1892). Most of the spawning grounds were concentrated in the eastern end of the lake in Canadian waters (Cahill, pers. comm. *1977;* Goode 1884; Pasko 1956; USBCF 1969a; USDI 1969b). Historical records from the National Fish Hatchery at Cape Vincent show that lake trout eggs were collected from fish captured in shallow water from mid-October to early November in eastern Lake Ontario (Schneider, pers. comm. *1980).* By the late 1800s, only a few fish were moving to shoreline areas to spawn (Smith 1892). In 1940, lake trout spawn was still being collected by the Cape Vincent Station (Leach et al. 1941). By 1950, the population had declined almost to extinction (Christie 1973). Lake trout have been stocked in Lake Ontario since 1972 (Crossman and Van Meter *1979;* GLFC, in press). No natural reproduction has been recorded since the 1950s. In the fall of *1979,* fish of hatchery origin spawned along the eastern shore in *New* York waters.

New York

NO-2

Nine Mile Point (43°31', 76°22'). In 1978, a few ripe and gravid adults were collected off the point in mid-September, and a spent adult was found west of the point near Oswego (43°28', 76°31') (Eckert and Schneider, pers. comm. 1979).

Snow Shoe Bay (43°53', 76°14'). In 1979, spawning was documented on a gravel shelf 8 ft deep on the lake side of the bay on November 14 and 15 at a water temperature of 51°F. Spawning was observed by divers, and eggs were found on the bottom (Eckert and Schneider, pers. comm. 1979; Sly, pers. comm. 1979).

Stony Island (43°54', 76°20'). This was a major historical ground (Cahill, pers. comm. 1977; Eckert and Schneider, pers. comm. 1979; Pasko 1956; Redband 1912; Smith and Snell 1891). In 1978, eggs were stripped from ripe fish collected off the north tip of the island (Eckert and Schneider, pers. comm. 1979; Sly, per-s. comm. 1979).

Calf Island Shoal (43°52', 76°22'). This was an historical spawning ground; plantings were recently made here (GLFC 1975, 1976a).

Galloo Island (43°54', 76°25'). This was an historical spawning ground (Pasko 1956; Smith and Snell 1891).

Allan Otty Shoal (44°04', 76°27'). This was an historical spawning ground (Eckert and Schneider, pers. comm. 1979).

NO-3

Horse Island (43°57', 76°09'). Historically, this was a favorite spawning site. Fishermen believed that spawning stopped here because alewives died in large numbers on the spawning grounds (Smith and Snell 1891).

Point Peninsula (44°00', 76°15'). Historically, spawning occurred here on most of the shallow points (Cahill, pers. comm. 1979).

Grenadier Island (44°03', 76°21'). This was an historical spawning ground (Eckert and Schneider, pers. comm. 1979).

Ontario

OO-1

In western Lake Ontario, lake trout began to move from deep water on about September 1 (Kerr and Kerr 1860-1898).

Niagara (43°16', 79°04')--Winona (43°13', 79°39'). Historical spawning grounds were located at Winona and Grimsby (43°12', 79°34'), and

along almost the entire shoreline from Niagara to Twenty Mile Creek (43°09'; 79°22') (Kerr and Kerr 1860-1898).

Bronte (43°24', 79°43')--Port Credit (43°33', 79°35'). Spawning occurred on shoals off Bronte, Oakville (43°26', 79°40'), Clarkson (43°301, 79°37'), and Port Credit at depths of about 13-16 ft (Kerr and Kerr 1860-1898; Ont. Game Fish 1913b; Ruple 1978; Whillans 1977). At Port Credit, lake trout spawned on two shoals 1/4 mi off shore. Peel County, which includes Clarkson and Port Credit, had the most important lake trout fishery in the western part of Lake Ontario; fish were caught here in September and October (Ruple 1978). A new, man-made shoal at Clarkson, just off the Gulf Oil Refinery (Ruple 19781, is composed of large boulders to a depth of 35 ft and is a potential spawning ground (Sly, pers. comm. 1979).

Toronto (43°38', 79°25'). Historically, spawning occurred south of the eastern gap of the Toronto Islands (43°38', 79°20'), off the foot of church Street, southeast of Ashbridges Bay (43°40', 79°19'), and off Scarborough Bluffs (43°43', 79°14') (Kerr and Kerr 1860-1898; Ruple 1978; Whillans 1977). Spawning declined at Toronto in the 1870s. "Stone hooking," removal of rock from the bottom for use as building material, occurred during 1830-1930 and probably severely altered spawning grounds at Toronto and along the entire shore from Burlington (43°21', 79°46') to Whitby (43°51', 78°56') (Ruple 1978; Whillans 197913). "Trout" grounds were also almost destroyed by oil and tar materials dredged out of Toronto Bay (43°38', 79°23') and dumped in the lake (Ont. Game Fish 1912).

OO-2

Frenchman Bay (43°49', 79°06'). Spawning occurred at the mouth of the bay; lake trout taken here were full of spawn from September 1 to October 30 (Kerr and Kerr 1860-1898).

Whitby (43°51', 78°56'). Spawning occurred on reefs here and also at Shoal Point (location unknown) (Kerr and Kerr 1860-1898; Whillans 1977).

OO-3

Prince Edward County Peninsula (44°00' 77°15'). Historical spawning areas existed off the south shore; these included Nicholson Island (43°55', 77°31') and Scotch Bonnet Island (43°54', 77°33') (Christie 1973; Sly, pers. comm. 1979).

Main Duck Island (43°56', 76°37'). This was a major historical spawning ground. Yorkshire Bar (43°56', 76°35') was an especially important area; plantings were made here during the 1970s (Christie 1973; Eckert and Schneider, pers. comm. 1979; GLFC 1975; Pasko 1956; Ruple 1978; Sly, pers. comm. 1979).

Amherst Island (44°09', 76°43'). This was an historical spawning area (Cahill, pers. comm. 1977; Eckert and Schneider, pers. comm. 1979).

Big Bar Shoal (44°04', 76°44'). This was an historical spawning area (Eckert and Schneider, pers. comm. 1979).

Simcoe Island (44°10', 76°32'). This was a major historical ground; lake trout eggs were taken here for the National Fish Hatchery (Eckert and Schneider, pers. comm. 1979).

Wolfe Island (44°10', 76°25'). Long Point (44°06', 76°29') was an historical spawning ground (Eckert and Schneider, pers. comm. 1979).

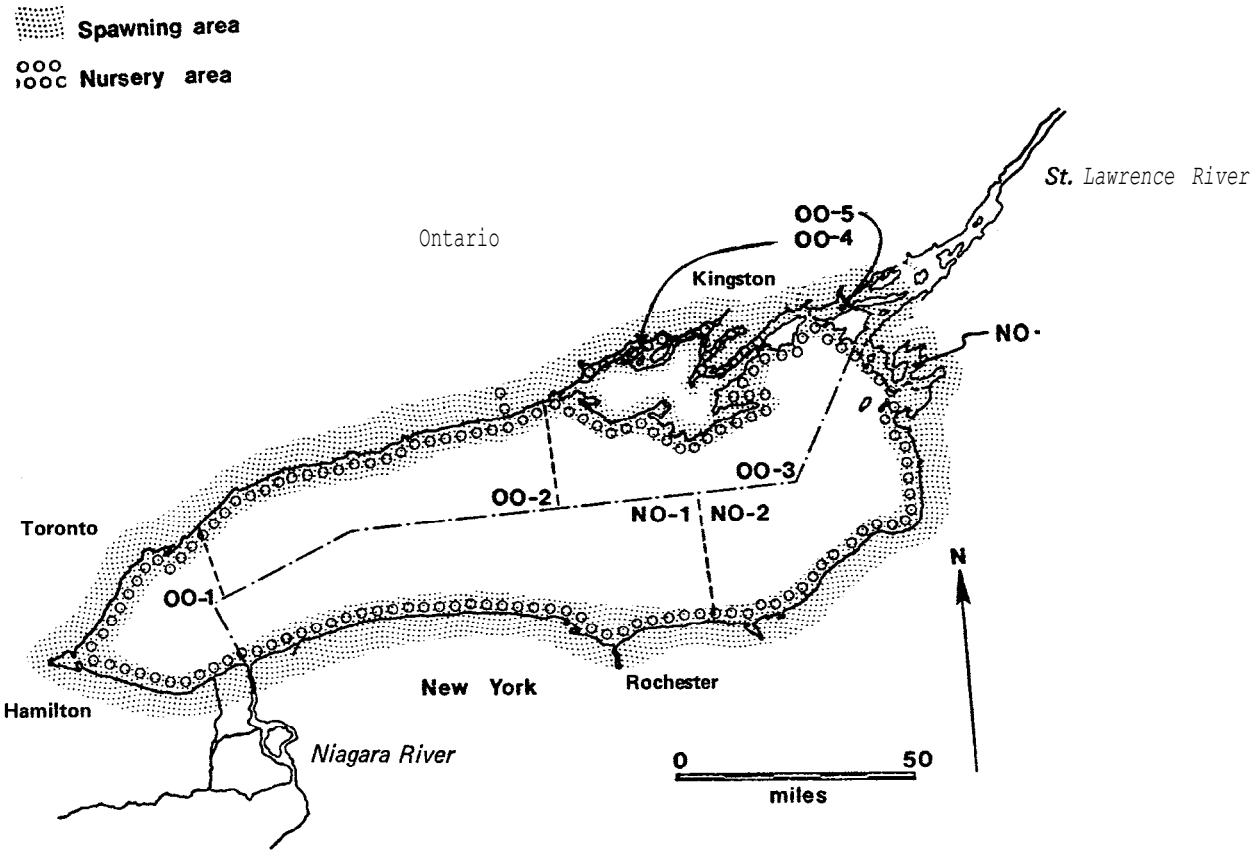
Pigeon Island (44°04', 76°33'). This was an historical spawning area; it was also the major site of spawn taking for hatcheries (Cahill, pers. comm. 1977; Christie 1973; Eckert and Schneider, pers. comm. 1979; Sly, pers. comm. 1979).

Charity Shoal (44°03', 76°29'). This was one of the most historically important reefs; ripe lake trout were caught here in large numbers and plantings are presently being made (Christie 1973; Eckert and Schneider, pers. comm. 1979; GLFC 1973, 1975; Pasko 1956; Sly, pers. comm. 1979; Smith 1892; Smith and Snell 1891). Fishermen suggested that spawning historically occurred on the shoal between South Charity Shoal (44°02', 76°30') and Main Duck Island (43°56', 76°37') (Eckert and Schneider, pers. comm. 1979; Sly, pers. comm. 1979).

OO-4

Bay of Quinte (44°08', 77°15'). During the 1930s, spawn was still being collected at Belleville (44°09', 77°23') (Ont. Game Fish 1933).

RAINBOW SMELT



The first records for rainbow smelt in Lake Ontario were established in *1929* at Sodus Point, New York (Greeley *1929),* and in 1931 at Bowmanville, Ontario (Mason 1933). These fish probably originated from plantings in New York waters (Christie *1973;* Scott and Crossman 1973). Runs developed in several streams along the U.S. and Canadian shores after 1940 (Van Oosten 1948); by 1942, sportsmen had begun to fish the runs (SLEOC 1978), and they are still heavily fished (USBCF 1969a).

Every tributary with a mouth not blocked by gravel or sand bars supports a run, usually in April. Spawning also occurs on rocky or sandy shoals and points throughout the lake proper in late April (Eckert and Schneider, pers. comm. 1979; Scott 1967; Slastenenko 1957). Runs usually occur at water temperatures of 40-65°F (Niagara Mohawk Power, undated a; USDI 1969b). In years when some of the mouths of smaller tributaries are blocked by sand or gravel, lake spawning may be more important (Eckert, pers. comm. 1979). The nearshore waters of the entire lake are nursery habitat (Schneider, pers. comm. *1979;* Werner and Ford *1972).*

No-1

Niagara Bar (43°17', 79°05'). Many young-of-the-year (YOY) were collected here (Schneider, pers. comm. 1979).

Braddock Bay (43°19', 77°43'). Good spawning runs occur here in the early spring (N.Y. State Dep. Conserv., undated c).

Russell Power Station (43°16', 77°38'). In 1977, smelt larvae dominated collections here in June (Bio Systems 1978b).

Irondequoit Bay (43°14', 77°32'). Smelt spawn on the lake shores near the bay; in 1977, adults were collected nearshore from mid-April to mid-May (Haines et al. 1977).

Ginna Power Station (43°17′, 77°18′). In 1977, 86% of the larvae caught in early June were rainbow smelt (Bio Systems 1978a).

NO-2

Sterling Power Plant site (43°23', 76°39'). In 1974, the dominant larvae collected in May were rainbow smelt; these had probably drifted into the area from nearby streams, where spawning occurred in early April to mid-May (LOTEL 1977). In 1977, eggs were collected in early May, and larvae were collected out to the 46 ft contour from mid-May to September; rainbow smelt were the dominant larvae in the area in June (Rochester Gas Elec. 1977).

Oswego (43°28′, 76°31′). Adults were most abundant in the area and were impinged in greatest numbers at the Oswego Steam Station in April and May (LMS 1976a, 1977b; Niagara Mohawk Power, undated b,c). Eggs were collected in the area and entrained at the station from early April to late June (LMS 1977b; NMPC, undated b,c). Larvae were found as early as mid-March (LMS 1977b) and were present throughout the summer (LMS 1976a; Niagara Mohawk Power, undated b,c).

Nine Mile Point (43°31′, 76°22′). Most adults are collected in the area from March to May during the inshore migration (LMS 1975a,b, 1976b; PASNY, undated a,b). Spawning occurs in April (LMS 1975b; PASNY, undated a). Eggs were collected from April 10 to June 18 (LMS 1975b, 1976b; PASNY, undated a,b). Larvae and YOY are very abundant (QLM Engineers 1974). Larvae appeared in early April and were present near shore and off shore throughout the spring and summer (LMS 1975b, 1976b; PASNY, undated a,b; QLM 1974). Young-of-the-year first appeared in June (PASNY, undated b).

Grindstone Creek (43°33', 76°13'). (Eckert, pers. comm. 1979).

Salmon River (43°34', 76°12'). A spawning run occurs in April and May (Eckert, pers. comm. 1979; SLEOC 1978).

NO-3

Black River (44°00', 76°04'). Rainbow smelt enter Black River Bay (43°59′, 76°05') and the river in April and May (Eckert, pers. comm. 1979; SLEOC 1978).

Tibbets Point (44°06', 76°22'). The spawning run begins at a water temperature of 44°F; running ripe adults are collected on the shoals around the point (Eckert, pers. comm. 1979).

Ontario

In Canadian waters, rainbow smelt runs usually begin when the ice breaks up. In southern Ontario, tributary runs occur in late March-early May; in more northern areas, runs occur in April and continue for about 3 weeks. Spawning also occurs along the lake shore (MacKay 1958a). Commercial fishermen report that a "jumbo" smelt spawns at depths of 80 ft or more 1-1/2 to 5 mi off shore (Balesic 1979c). Along the north shore, larvae are concentrated inshore in May and June just after hatching, but disperse rapidly to deeper water after they become demersal (Dunstall 1979a,b).

OO-1

Welland Canal (43°13', 79°13'). Smelt enter the canal and spawn over gravel in April and May (Moccia, pers. comm. 1979).

Burlington Bay (43°17', 79°50'). Since 1950, smelt have spawned in Dundas Creek (43°16', 79°56') and also in the northwest corner of the bay (Whillans 1977). Spawning also occurs on Hamilton Beach (43°17', 79°47') (Moccia, pers. comm. 1979). In 1958, the run in Burlington Canal (43°18′, 79°48') occurred in late March-early May; it began at a water temperature of 38°F and peaked April 18-24 at 46-48°F (Wolfe 1958, 1959).

Credit River (43°33', 79°35') and Etobicoke Creek (43°35', 79°33'). Spawning occurs at the mouths of these streams (Environ. Can. 1977a).

Toronto (43°38', 79°25'). In 1954, a spawning run entered Toronto Bay (43°38', 79°23'); spawning may have occurred in the Cuter Harbour (43°38′, 79°20') (Wainio et al. 1973; Whillans 1977). Runs entered the discharge canal of the R. L. Hearn Generating Station (43°39', 79°20') at the same time that runs entered nearby streams and moved onto beaches in the area (Everest 1973).

OO-2

Rouge River (43°48', 79°07'). Spawning occurs at the river mouth (Environ. Can. 1977a).

Duffin Creek (43°49', 79°02'). In 1977, ripe adults were taken at the creek mouth on April 25 (Griffiths 1978a).

Pickering Generating Station (43°48', 79°04'). Eggs were collected at the station in mid-May and in the lake in early June (Dunstall 1978b). Early postlarvae were collected from late May through July: there appeared to be a concentration of these larvae on the east side of the intake groin (Dunford 1977; Dunstall 1978b). Young-of-the-year were entrained at the station in early August (Dunstall 1978b). In 1978, one of the areas of high larval density was at this station (Dunstall 1979a).

Darlington Generating Station (43°52', 78°43') and Wesleyville Generating Station (43°55', 78°25'). Spawning occurs near shore in these areas (Dunford 1979).

Graham Creek (43°54', 78°35'), Port Britain Creek (43°56', 78°23'), Ganaraska River (43°57', 78°18'), Gage Creek (43°57', 78°16'), Cobourg Brook (43°57', 78°11'), and Hortop Creek (43°58', 78°03'). Spawning occurs at the mouths of these streams (Environ. Can. 1977a).

Shelter Valley Creek (43°58', 78°01′). A spawning run begins in about the second week of April at a water temperature of 40°F and extends into early May. Spawning occurs over gravel in 1-2 ft of clear, slowly flowing water. Young-of-the-year were collected in the creek (Chen 1970).

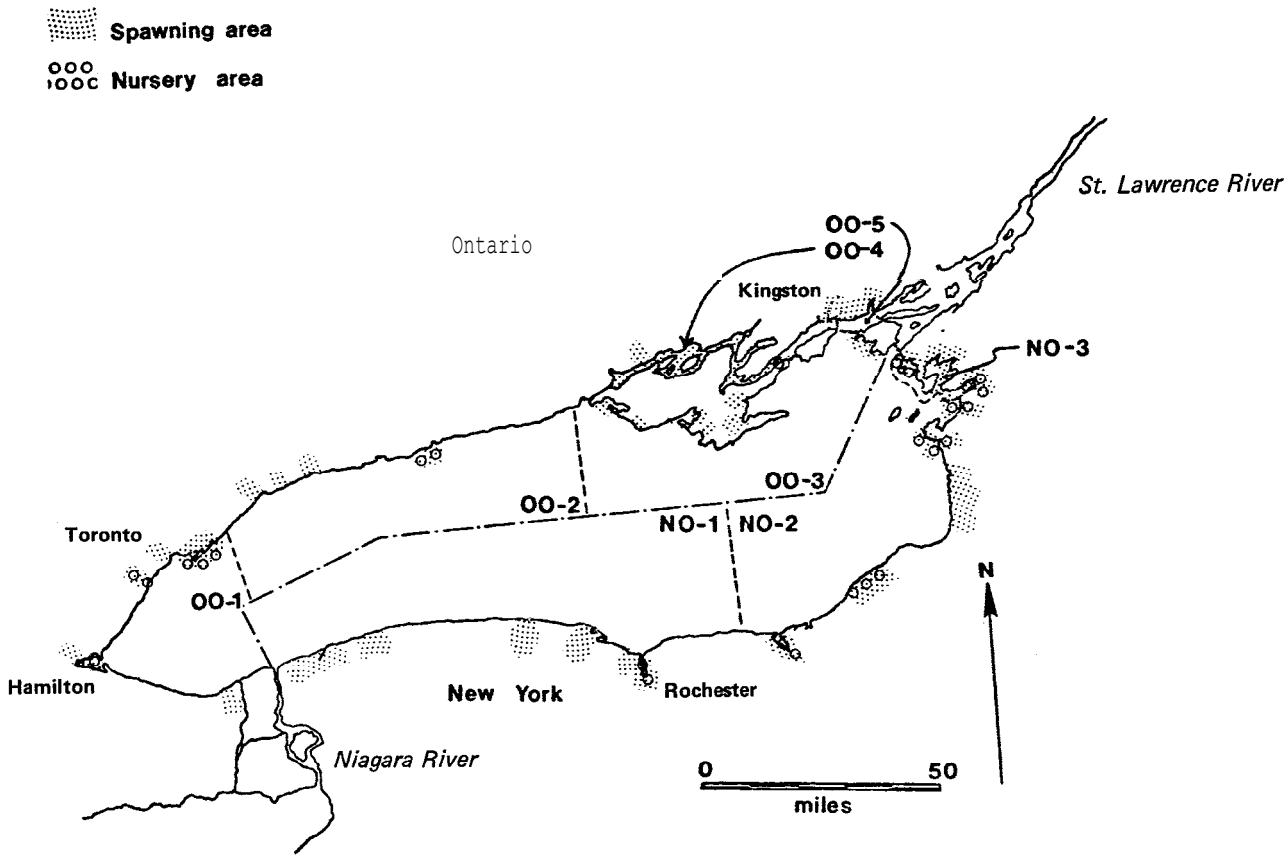
OO-3

Presqu'ile (44°00', 77°44'). In 1978, high densities of larvae were found just west of here (Dunstall 1979a).

OO-4

Bay of Quinte (44°08', 77°15′). Until the late 1950s and 1960s, spawning runs entered bay tributaries. In 1942, smelt entered the Trent River (44°06', 77°34') (Dymond 1944). Recently, reproduction occurred only over limestone ledges off the points of Prince Edward County (Christie 1972; Schneider and Leach 1979). Spawning presently occurs in the area of the Lennox Generating Station (44°09', 76°51′) (Dunford 1979); an inshore migration occurs here in late April to early May (Balesic 1978). Spawning occurs in the discharge canal of the station. Eggs were found in late April to mid-May attached to Cladophora in the canal and to the bottom and walls of the canal; hatching apparently occurred in the canal (Dunford 1978a). In 1974, larvae were collected throughout the bay from mid-May to June, but abundance was greater in the lower bay than in other locations (Lam 1977). Larvae were widely distributed in all areas around the Lennox Station from May to early August; highest densities occurred just east of the station at Pig Point (44°08', 76°49') (Dunford 1978a; Griffiths 1976b).

NORTHERN PIKE



New York

In the New York waters of Lake Ontario, populations of northern pike exist in almost all of the marshy bays along the eastern shore; these fish enter the marshes and streams to spawn (Eckert, pers. comm. *1979;* O'Gorman, pers. comm. 1979). Spawning runs begin before ice breakup, usually in March; ripe fish can be found in the bays for up to one month after the runs have ended in the creeks (Eckert, pers. comm. 1979). Young-of-the-year (YOY) are found in the streams and marshes; they begin moving out of the streams in June when freshets occur (Eckert and Schneider, pers. comm. 1979).

Along the northeast shore, small marshes are usually much more productive spawning areas than larger ones. Good spawning marshes in this area have a central channel with a slow flow and flooded shallow areas along shore, an average depth of not more than approximately 1.6 ft, dead

and decaying vegetation on the bottom, and a supply of fathead minnows as food for the young (Marean *1976).*

NO-1

Fourmile Creek (43°16', 79°00'). Spawning occurs in the lower section of the creek (Buffalo Waterfront Devel. Comm., undated; NYDEC 1977b).

Sixmile Creek (43°17', 78°57'). Spawning occurs in the lower section of the creek (NYDEC 1977b).

Twelvemile Creek (43°19', 78°51'). The lower section of the creek is a spawning area (Buffalo Waterfront Devel. Comm., undated; NYDEC 1977b).

East Branch Twelvemile Creek *(43°19',* 78°50'). The lower *1* mi of the creek and Tuscarora Bay at the creek mouth are spawning areas (Buffalo Waterfront Devel. Comm., undated; NYDEC 1977b).

Eighteenmile Creek (43°20', 78°43'). The lower 2 mi of the creek is a spawning area (Buffalo Waterfront Devel. Comm., undated; NYDEC 1977b).

Keg Creek (43°21', 78°39'). Spawning occurs in the lower section of the creek (NYDEC 1977b).

Sandy Creek (43°21', 77°54'). The mouth of the creek (Straight Lake) is a productive spawning area (NYDEC 197733).

Braddock Bay (43°19', 77°43'). A large resident population of northern pike spawns in the bay (NYDEC 1977b).

Genesee River (43°15', 77°36'). Historically, a run from the lake entered the marshes of the lower river to spawn (Greeley 1927).

Irondequoit Bay (43°14', 77°32'). A resident population exists in the bay (Eckert, pers. comm. 1979). Lake residents are also believed to enter the bay to spawn (Haines et al. 1977).

NO-2

Sodus Bay (43°15', 76°58'). A resident population exists in the bay; spawning occurs in the marshy areas of the bay (Eckert, pers. comm. 1979).

Sterling Creek (43°20', 76°41'), Ninemile Creek (43°24', 76°38'), Bightmile Creek (43°25', 76°37'), and Rice Creek (43°27', 76°34'). Resident populations spawn in these creek mouths (Bergstedt, pers. comm. *1979).*

Salmon River (43°34', 76°12'). A resident population spawns in the mouth of the river (Eckert, pers. comm. *1979).*

Deer Creek (43°36', 76°10'). This is a spawning area (SLEOC 1978).

North Pond (43°39', 76°11'). Northern pike spawn in the outlet area of Skinner Creek just after ice breakup (O'Gorman, pers. comm. 1979).

Lakeview Game Management Area (43°44', 76°12'). Adults enter the marsh in April to spawn; the area also supports a resident population (Panek, pers. comm. 1979).

Little Stony Creek (43°48', 76°13'). In 1974-75, adults entered the creek in April, and fry moved downstream in July and August (Marean 1976).

Ray Bay Marsh (43°50', 76°16'). In 1974-75, adults entered the marsh in late March and April, and most fry moved out in June and July (Marean 1976).

Campbell Marsh (43°55', 76°08'). The marsh is a good spawning and nursery area. Adults entered Bedford Creek (43°55', 76°07') in early April to early May, and fry moved downstream in June and July (Marean 1976; R. Werner, pers. comm. 1979).

NO-3

Muskalonge Creek (43°59', 76°02'). The creek is a good spawning area. In 1974-75, many adults entered the creek in late March to early May, and fry moved downstream in June (Marean 1976; R. Werner, pers. comm. 1979).

Perch River (44°00', 76°05'). Historically, spawning occurred in the lower river (Greene et al. 1932).

Sherwin Bay Marsh (43°59', 76°10'). In 1974-75, adults entered the marsh in April, but no fry were found. Little spawning habitat is available; the bay is larger and deeper than other areas and has a mud bottom (Marean 1976; Werner and Ford 1972).

Guffin Bay Marsh (44°02', 76°07'). This area supports spawning (Werner and Ford 1972).

Chaumont Bay (44°03', 76°12'). The bay supports a large resident population of northern pike (Eckert, pers. comm. 1979), which spawns at the mouth of the Chaumont River (44°04', 76°09') (Werner and Ford 1972). Historically, spawning occurred in the lower river (Greene et al. 1932). Isthmus Marsh (44°01', 76°17') also is good spawning habitat (Werner and Ford 1972).

Fox Creek (44°04', 76°18'). This is a qood spawning and nursery area (Werner, pers. comm. 1979). Adults move into the marsh in late March and April, and fry move downstream in June (Marean, pers. comm. 1979). After the run into the creek is over, ripe fish can still be found off Fox Island (44°02', 76°20') (Eckert, pers. comm. 1979).

Mud Bay (44°05', 76°19'). Northern pike spawn in the marsh (SLEOC 1978); in 1979, YOY were very abundant in the marsh in September (Panek,

pers. comm. 1979). In 1974-75, adults entered Kents Creek (44°05', 76°19') in April to early May, but no fry were found moving downstream (Marean 1976).

Wilson Bay Marsh (44°05', 76°21'). This marsh is a spawning and nursery area and is a major producer of northern pike (SLEOC 1978; Werner and Ford 1972). Many adults enter the marsh in April to early May (Dunning et al., undated; Marean 1976); runs also enter tributaries of the marsh (Eckert, pers. comm. 1979). Young-of-the-year are found throughout the weedy shallows of the bay; some of these fish move out from June to August before low water levels close the outlet to the lake. When a freshet reopens the outlet in the fall, the larger YOY move out to the lake (Eckert and Schneider, pers. comm. 1979; Mare-an 1976).

Ontario

OO-1

Martindale (Twelve Mile) Creek (43°10', 79°16') Historically, northern pike entered the creek to spawn; many fish were caught here in April (Kerr and Kerr 1860-1898).

Burlington Bay (43°17', 79°50'). The bay was historically an important spawning area; northern pike were present for 5-10 days in the shallows during the spawning season. In 1886, the bay and Dundas Marsh were "swarming" with pike in early April. Until about 1905, the best spawning areas were along the south shore and included Harvey's, Gages, Lottridges, Depcios, Secords, Jones, and Harris Inlets, and Big Creek Pond (exact locations unknown) (Kerr and Kerr 1860-1898; Whillans 1977). A large resident population of northern pike exists in the bay (Down, pers. comm. 1979). Dundas Marsh (43°16', 79°57') is the major spawning ground in the bay (Whillans 1977), but northern pike also enter tributaries of the bay to spawn. Spent adults were collected in the spring in Cootes Paradise at the western edge of the bay (Down, pers. comm. 1979). In 1927, YOY were collected in the bay in late August (Dymond et al. 1929).

Credit River (43°33', 79°35'). In 1866, spawning occurred in the river (Kerr and Kerr 1860-1898). In 1927, YOY were collected below the rapids and near the river mouth in June (Dymond et al. 1929).

Humber River (43°38', 79°28'). In 1866, northern pike spawned in the river (Kerr and Kerr 1860-1898).

Toronto Bay (43°38', 79°23'). Historically, large spawning runs entered the bay. In the 1860s, spawning occurred in the Don River (43°39', 79°21') (Kerr and Kerr 1860-1898; Whillans 1977). During the 1880s, northern pike also migrated by the thousands into Ashbridges Bay (43°40', 79°19') to spawn in the extensive Ashbridges Marsh at the west end of the bay (Whillans 1977). This stock declined in 1898-1919 due to the destruction of the marsh (Whillans 1979b). During the 1890s-1915, Toronto Island (43°37', 79°24') was a spawning and nursery area (Whillans

1977). Northern pike are now found only occasionally in Toronto Bay (Whillans 1977); spawning still occurs in a lagoon in the Wildlife Sanctuary on Toronto Island (Whillans, pers. comm. 1979).

OO-2

Highland Creek (43°46', 79°10'). Historically, northern pike entered the creek every spring (Kerr and Kerr 1860-1898).

Duffin Creek (43°49', 79°02'). Spawning occurred in the 1860s (Kerr and Kerr 1860-1898).

Lynde Creek (43°51', 78°57'). In the 1860s, spawning occurred here (Kerr and Kerr 1860-1898); the marshes at the creek mouth still support spawning (Environ. Can. 1977a).

Wesleyville Generating Station (43°55', 78°25'). Two marshes in the vicinity are spawning and rearing grounds (Dunford 1979).

OO-3

Prince Edward County Peninsula (44°00', 77°15'). There are several spawning sites along the south shore (Whillans, pers. comm. 1979).

Wellers Bay (44°00', 77°35'). Inside the barrier bar, between Pine (44°01', 77°36') and Smoke (44°01', 77°35') points, and around the shores near the mouth of Consecon Lake (44°00', 77°30').

Pleasant Bay (43°57', 77°30'). In the lower section of the creek feeding the bay.

Huycks Bay (43°56', 77°29'). In the lower section of Hubbs Creek.

West Lake (43°56', 77°17'). Along the inside of the barrier bar on both sides of Garratt Island (43°57', 77°18') and in the stream entering the northeast corner (43°58', 77°15').

East Lake (43°55', 77°12'). At the mouth of the stream feeding the bay (43°57', 77°10') and along shore in the southwest corner (77°14', 43°55').

South Bay (43°56', 77°02'). At the head of the embayment on the west shore (43°55', 77°03').

Smith Bay (44°00', 77°01'). At the head of the bay (43°59', 77°02'), on the north shore (44°00', 77°01°), and along the east side of Pickerel Point (43°59', 77°01').

Wolfe Island (44°10', 76°25'). Spawning occurs along the shoreline (Environ. Can. 1977a), and at a site (44°06', 76°26') in Big Sandy Bay (Whillans, pers. comm. 1979).

OO-4

Bay of Quinte (44°08', 77°15'). Northern pike spawn in the shallow marshy areas of the bay (Hurley and Christie 1977; Int. Great Lakes Levels Board 1973). The only spawning site specifically identified is the mouth of the Moira River (44°09', 77°23') (Environ. Can. 1977a). In 1928, YOY were found in mid-June in Prinyer Cove (44°05', 76°53') and in the weedy stream entering the cove (Dymond et al. 1929).

OO-5

Collins Bay (44°14', 76°37'). Spawning occurs at the head of the bay and along the eastern shore (Whillans, pers. comm. 1979).

Cataraqui Bay (44°13', 76°33'). Spawning occurs at the head of the bay at the mouth of Little Cataraqui Creek (Environ. Can. 1977a; Whillans, pers. comm. 1979).

Cataraqui River (44°14', 76°28'). Spawning occurs in the lower river along the east shore opposite Bells Island (Whillans, pers. comm. 1979).

MUSKELLUNGE

In Lake Ontario, muskellunge probably spawn in the bays and marshes of the eastern basin. Young-of-the-year are usually found around docks and boathouses (Eckert, pers. comm. 1979).

GOLDFISH

Goldfish are native to eastern Asia. It is not known when they were introduced into U.S. waters, but by 1889 a goldfish farm was operating in Maryland (Scott and Crossman 1973).

In Lake Ontario, goldfish enter marshes, bays, and harbors to spawn (Schneider and Eckert, pers. comm. 1979).

Nsw York

NO-1

Irondequoit Bay (43°14', 77°32'). In 1977, spent fish were collected in the bay; spawning probably occurs in shallow weedy areas in May or June (Haines et al. 1977).

NO-2

Oswego (43°28', 76°31′). In 1974, eggs were entrained at the Oswego Steam Station (43°28', 76°31′) in early July (Niagara Mohawk Power, undated c).

Nine Mile Point (43°31', 76°22'). In 1973, a few larvae were found here in late June (QLM 1974).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). A resident population exists in the area, and spawning occurs at Cootes Paradise (43°16′, 79°55'), a shallow marsh at the western edge of the bay (Down, pers. comm. 1979). Since 1962, goldfish have spawned in Dundas Marsh (43°16′, 79°57') and in almost every shallow area of Burlington Bay (Whillans 1977).

Toronto Islands (43°37', 79°23'). In 1973, goldfish were observed spawning in late May and early June in flooded lowland areas, including the Lighthouse Pond area (43°37', 79°23'), and large concentrations of newly hatched larvae were found there in early July (Wainio et al. 1973).

LAKE CHUB

Historically, lake chubs were common along shore and in coastal streams of Lake Ontario during the spawning season (Hubbs and Brown 1929). Young lake chubs were found in creeks and along the lake shore (Greeley 1940).

New York

NO-1

Sixmile Creek (43°17', 78°57'), Fish Creek (43°22', 78°32'), and Oak Orchard Creek (43°22', 78°12′). Young were found in the creeks (Greeley 1940).

Fourmile Creek (43°16', 77°26'). In 1939, several adults in breeding condition were found in the creek about 4 mi upstream in mid-April. Young were also found in the creek (Greeley 1940).

NO-2

Red Creek (43°18′, 76°47′) and Kay Kat Pond (43°19′, 76°45′). Young were found in the pond (the mouth of Black Creek) and in Red Creek (Greeley 1940).

Ontario

OO-1

Port Credit (43°33′, 79°35'). In 1927, ripe females were collected off Port Credit in June and July (Dymond et al. 1929).

Etobicoke Creek (43°35', 79°33'). In 1928, a few breeding adults were captured in the creek 1/2 mi above the mouth in late May (Hubbs and Brown 1929).

CARP

Carp were present in the New York waters of Lake Ontario prior to 7890; they originated from plantings and from accidental releases when dams on tributary streams broke (Smith 1892). Carp were probably not present in the lake before 1880 but had gained importance in the fishery by 1908 (Christie 1973).

Carp spawn in most shallow areas and bays throughout Lake Ontario (Eckert and Panek, pers. comm. 1979). Carp were also observed spawning in tributaries and in heated power plant discharges (LMS 1979a, as cited in LMS 1980). Areas that support reproduction include:

New York

NO-1

Oak Orchard Creek (43°22', 78°12′). In 1979, spawning was observed in the creek in the spring; the large size of many spawners indicated that they were lake residents (Makarewicz et al. 1979).

Genesee River (43°15′, 77°36′). Historically, carp were abundant in the river below Rochester when spawning runs from the lake entered marshes at the river mouth (Greeley 1927).

Irondequoit Bay (43°14', 77°32'). In 1977, spawning and spent carp were found in the bay; spawning probably occurred in shallow, weedy areas in May or June (Haines et al. 1977).

Ginna Power Station (43°17', 77°18'). In 1977, larvae were collected nearshore from late June to early August (Bio Systems 1978a).

NO-2

Sterling Power Plant site (43°23', 76°39'). In 1974, a few newly hatched larvae were found here, mainly in mid-July; spawning probably occurred in early July (LOTEL 19771. In 1977, larvae were collected out

to the 46 ft contour from late June to mid-August; abundance peaked in early July (Rochester Gas Elec. 7977).

Oswego (43°28′, 76°31′). Eggs were entrained at the Oswego Steam Station (43°281, 76°31′) in early June (Niagara Mohawk Power, undated c); larvae were entrained in June to August (LMS 1976a, 1977; Niagara Mohawk Power, undated c). Newly hatched larvae were collected in the harbor turning basin from late May to mid-August and are likely the result of spawning in the basin, possibly in the lush vegetation along its south shore (Niagara Mohawk Power, undated b).

Nine Mile Point (43°31', 76°22'). Eggs were collected in late June and early July (PASNY, undated b). Larvae, including newly hatched specimens, were abundant throughout the summer (LMS 1975b; PASNY, undated b; QLM 7974).

Lakeview Game Management Area (43°44', 76°12'). In 1978, spawning and spent carp were found here (Panek, pers. comm. 1979).

Ray Bay Marsh (43°50', 76°16′). In 7975-76, fry moved out of the marsh in June (Marean 1976).

Campbell Marsh (43°55', 76°08'). In 1974-75, fry moved out of the marsh in late May to mid-June (Marean 7976).

NO-3

Muskalonge Creek (43°59', 76°02'). In 1974-75, fry moved out of the marsh in early June (Marean 1976).

Sherwin Bay Marsh (43°59', 76°10'). In 7974-75, fry moved out of the marsh in mid-June to early July (Marean 1976). Historically, fry were common here in late June (Greeley and Bishop 1932).

Fox Creek Marsh (44°04', 76°18'). In 1974-75, fry moved out of the marsh in late May and early June (Marean 1976).

Ontario

In Canadian waters, carp spawning peaks in the spring, but may extend throughout most of the summer (Down, pers. comm. 1979).

OO-1

Jordan Harbour (43°17′, 79°22′). A resident population spawns in the harbor in the spring; gravid females were also found in the harbor in October, but it is doubtful that any significant spawning occurred in the fall (Moccia, pers. comm. 1979).

Burlington Bay (43°17', 79°50'). A resident population spawns in Hamilton Harbor, especially in Cootes Paradise (43°76°, 79°55'), a shallow marsh at the western end of the bay (Down, pers. comm. 1979). Spawning has occurred in Hamilton Marsh (location unknown) (McCrimmon 1968); since 1908 spawning has occurred in Dundas Marsh (43°16', 79°57') and most shallow areas of Burlington Bay (Whillans 1977). In 7927, YOY were collected in a shallow vegetated area near La Salle Park (43°79°, 79°49') in late July (Dymond et al. 1929).

Credit River (43°33', 79°35'). In 7927, spawning was observed in a shallow weedy backwater at the river mouth in early June at a water temperature of about 56°F. Spawning activity resumed at the end of June, after being interrupted by cool weather (Dymond et al. 7929).

Toronto Islands (43°37', 79°23'). In 1902-15, spawning occurred during the spring (Whillans, pers. comm. 1979). Carp entered Toronto Bay (43°381, 79°23*) during the spawning season (Ont. Game Fish 1975). In 7973, spawning was observed in flooded lowland areas, especially around Lighthouse Pond (43°37', 79°23') in late May and early June; large concentrations of newly hatched fry were found there in early July (Wainio et al. 7973).

OO-2

Pickering Generating Station (43°48', 79°04'). Carp may be resident in the discharge area from April to November (Dunford 1976); they spawn in the discharge in late May and early June (Dunford 7979). In 7976-77, larvae were collected in small numbers along shore in the area (Dunford 7977; Dunstall 1978b).

Wesleyville Generating Station (43°55', 78°25'). Carp spawn in late May and early June in two marshes in the vicinity (Dunford 7979).

OO-4

Bay of Quinte (44°08', 77°75'). Carp spawn in the marshy areas of the bay (Hurley and Christie 7977).

GOLDEN SHINER

New York

NO-3

Black River Bay (43°59', 76°05'). A resident population spawns in Black River Bay (Eckert and Panek, pers. comm. 1979).

EMERALD SHINER

New York

NO-1

Eighteenmile Creek (43°20′, 78°43′). Adults were abundant at the creek mouth during a run from the lake into the creek (Greene 1940).

Oak Orchard Creek (43°22', 78°12′). Emerald shiners spawn in the lake in this area, and juveniles enter the creek (Makarewicz 7979).

NO-2

Sterling Power Plant site (43°23', 76°39'). In 7977, eggs were collected in late June (Rochester Gas Elec. 7977).

Oswego (43°28*, 76°31′). Larvae were collected in late June and early August in the harbor turning basin (Niagara Mohawk Power, undated b).

Nine Mile Point (43°37', 76°22'). In 1973, a few larvae were found here on June 20 (QLM 7974).

NO-3

Black River Bay (43°59', 76°05'). In 7972, young-of-the-year were found in the bay from mid-July to October (FWS 1978).

Ontario

OO-1

Burlington Bay (43°17′, 79°50′). In 7928, young were found along the north shore in shallow, protected water off La Salle Park (43°79*, 79°49') (Dymond et al. 1929).

OO-2

Pickering Generating Station (43°48', 79°04'). In 1976, concentrations of adults were seined in the discharge area during July and August (Dunford 1976).

BRIDLE SHINER

Ontario

OO-4

Bay of Quinte (44°08', 77°15'). In 1928, breeding adults were caught at the head of Prinyer Cove (44°05', 76°53') in late May (Hubbs and Brown 7929).

COMMON SHINER

New York

NO-2

Oswego (43°28', 76°31'). Eggs were entrained at the Oswego Steam Station (43°281, 76°31′) in mid-May (NMPC, undated c); larvae were entrained in early July (LMS 7976; Niagara Mohawk Power, undated c).

Nine Mile Point (43°37', 76°22'). Eggs were collected here in late May to late June (LMS 1975b, 1976b; PASNY, undated b), and a few early larvae were taken in late June and early July (LMS 1975b; QLM 1974).

Ontario

OO-1

Etobicoke Creek (43°35', 79°33'). In 7928, breeding adults were collected at the mouth of the creek in late May (Hubbs and Brown 1929).

OO-2

Highland Creek (43°46', 79°10'). In 1928, ripe adults were collected in the creek in late May (Hubbs and Brown 7929).

Duffin Creek (43°49', 79°02') and Soper Brook (43°54', 78°40'). In 1928, a few ripe females were collected in these creeks in late May (Hubbs and Brown 7929).

SPOTTAIL SHINER

In Lake Ontario, spottail shiners move inshore to spawn (LMS 1975c, as cited in LMS 1980).

New York

NO-1

Irondequoit Bay (43°74', 77°32'). Spawning occurs along the northern shoreline of the bay and the adjacent lake shoreline. In 1977, the presence of many mature, but few spent, fish indicated that spawning was not completed by mid-June (Haines et al. 1977).

NO-2

oswego (43°28', 76°31′). In 1972, YOY were taken along shore and at the 20 ft depth contour from mid-July to October (FWS 1978). Larvae were collected in early August in the harbor turning basin (Niagara Mohawk Power, undated b).

Nine Mile Point (43°37', 76°22'). In 1973, a few larvae as small as 0.2 in. long were found in late June and late August (QLM 1974).

Grindstone Creek (43°33', 76°13'). Spottail shiners spawned in the creek mouth (Greene 1940).

Henderson Bay (43°54', 76°10'). In 1972, young-of-the-year (YOY) were captured in the bay from mid-July to October (FWS 1978).

NO-3

Grenadier Island (44°03', 76°27'). In 1907, several ripe adults were found in a very large school of several thousand fish present in 3 ft of water at the head of Grenadier Island in late June (Evermann and Kendall 1902b).

Ontario

OO-1

Burlington Bay (43°77°, 79°50'). In 1927, young were found along the north shore in shallow, protected water off LaSalle Park (43°79', 79°49') (Dymond et al. 7929).

OO-4

Sandhurst (44°08', 76°52'). In 7928, breeding adults were captured on the Bay of Quinte shoreline opposite Prinyer Cove (44°05', 76°53') in late May (Hubbs and Brown 1929).

SPOTFIN SHINER

New York

NO-1

Salmon Creek (43°17', 77°11'). Historically, good spawning areas were present at the mouth of the creek (Greene 1940), but spawning at this site was not confirmed.

BLUNTNOSE MINNOW

New York

NO-1

Salmon Creek (43°17', 77°11'). Good spawning areas existed at the mouth of the creek (Greene 1940), but spawning was not confirmed at this site.

Ontario

OO-1

Etobicoke Creek (43°35', 79°33'). In *1928,* breeding adults were found at the mouth of the creek in late May (Hubbs and Brown 1929).

FATHEAD MINNOW

New York

NO-2

Ray Bay Marsh (43°50', 76°16'). In 1974-75, many fry were found here in the summer, beginning in mid-June (Marean 1976; R. Werner, pers. comm. 1979).

NO-3

Fox Creek Marsh (44°04', 76°18') and Wilson Bay Marsh (44°05', *76°21').* In 1974-75, large numbers of fry were found at the mouths of these marshes in the summer, beginning in mid-June (Marean 1976; R. Werner, pers. comm. 1979).

BLACKNOSE DACE

Ontario

OO-2

Highland Creek (43°46', 79°10'), Duffin Creek (43°49', 79°02'1, and Soper Brook (43°54', 78°40'). In 1928, breeding adults were found in the lower sections of these streams in late May (Hubbs and Brown 1929).

LONGNOSE DACE

Ontario

OO-l

Credit River (43°33', 79°35'). In 1927, ripe males and females were collected from the river mouth in mid-July (Dymond et al. 1929).

OO-2

Highland Creek (43°46', 79°10'). In 1928, breeding adults were collected in the creek in late May (Hubbs and Brown 1929).

OO-4

Sandhurst (44°08', 76°52'). In 1928, breeding adults were seined on the Bay of Quinte shore opposite Prinyer Cove (44°05', 76°53') in late May (Hubbs and Brown 1929).

CREEK CHUB

Ontario

OO-1

Burlington Bay (43°17', 79°50'). In 1927-28, young creek chubs were found on the north shore of Burlington Bay, in shallow water off La Salle Park (43°19', 79°49') (Dymond et al. 1929).

FALLFISH

Fallfish probably move from Lake Ontario into streams to spawn. Historically, many adults and nests were found in lower sections of tributaries (Greeley 1940), but these locations were not identified.

CYPRINID spp.

New York

NO-1

Russell Power Station (43°16', 77°38'). In 1977, larvae of carp or goldfish were collected here near shore from mid-June to late August; they were 30% of the catch of larvae made in June (Bio Systems 1978b).

SHINER spp.

New York

NO-2

Sterling Power Plant site (43°23', 76°39'). In 1974, larvae of unidentified species of shiners were collected here during mid-June to mid-August (LOTEL 1977).

LONGNOSE SUCKER

Ontario

OO-1

Credit River (43°33′, 79°35′). In 1927, young-of-the-year were collected in the river mouth in mid-July (Dymond et al. 1929).

OO-3

Smith Bay (44°00', 77°01′). In 1928, two postlarvae were found in the creek mouth and cove just west of Waupoos (44°00', 77°00') in late May (Hubbs and Brown 1929).

WHITE SUCKER

In Lake Ontario, white suckers enter many tributaries to spawn, and fry are abundant in the streams (Dymond et al. 1929; Greeley 1940; Greene 1940) 1 Almost every tributary, at least along the eastern shore, has a spawning run during April (Bergstedt and Elrod, pers. comm. 1979; Eckert and Schneider, pers. comm. 1979).

New York

NO-1

Johnson Creek (43°22', 78°16′). The white sucker run in the creek supports a spear fishery (Buffalo Waterfront Devel. Comm., undated; Greene 1940; NYDEC 1977b).

Marsh Creek (43°22', 78°22'). The white sucker run in the creek supports a spear fishery (Buffalo Waterfront Devel. Comm., undated).

Irondequoit Bay (43°14′, 77°32′). It was assumed that runs entered Irondequoit Creek (43°10', 77°32'). In 1977, large numbers of adults were not seen in the bay; however, sampling did not start until April 12, perhaps after the major part of the run had occurred (Haines et al. 1977).

NO-2

Nine Mile Point (43°31′, 76°22′). White sucker larvae were found here in small numbers in late May and the first half of June (LMS 1975b; QLM 1974). Spawning probably occurred in area streams.

Grindstone Creek (43°33', 76°13'.) and Little Salmon River (43°31′, 76°15′). White suckers were found at the stream mouths during the spawning runs (Greene 1940).

Little Stony Creek (43°48', 76°13'). In 1974-75, adults entered Black Pond and moved up into the creek in April (Marean 1976).

Ray Bay Marsh (43°50', 76°16'). In 1974-75, many adults entered the marsh in April, and a few fry were collected in late June (Marean 1976; R. Werner, pers. comm. 1979).

Bedford Creek (43°55', 76°07'). In 1974-75, many adults entered the creek in mid-April (Marean 1976).

No-3

Sherwin Bay Marsh (43°59', 76°10'), and Muskalonge Creek (43°59', 76°02'). In 1974-75, adults entered these areas in mid-April (Marean 1976; R. Werner, pers. comm. 1979).

Wilson Bay Marsh (44°05', 76°21'), Kents Creek (44°05', 76°19'), and Fox Creek (44°04', 76°18'). In 1974-75, adults entered these areas in mid- to late April (Marean 1976).

Ontario

OO-1

Jordan Harbour (43°11', 79°22'). Spawning occurs at the back of the harbor (Moccia, pers. comm. 1979).

Burlington Bay (43°17', 79°50'). White suckers migrate into the bay via the Burlington Canal (43°18', 79°48'), and run through Dundas Marsh (43°16', 79°57') and into Spencer (43°15', 79°57'), Dundas (43°16', 79°56'), and Grindstone (43°17', 79°53') creeks (Moccia, pers. comm. 1979; Whillans 1977, 1979b). The run occurs soon after ice breakup in late March or early April and is completed by early May (Moccia, pers. comm. 1979). Young have been found along the north shore in quiet, weedy water off La Salle Park (43°19', 79°49') (Dymond et al. 1929).

Bronte Creek (43°24', 79°43') and Credit River (43°33', 79°35'). These streams support large runs of white suckers; spawning fish have been observed (Moccia, pers. comm. 1979).

Humber River (43°38', 79°22'). A spawning run enters the river (Moccia, pers. comm. 1979).

Toronto Bay (43°38', 79°23'). Spawning occurred in this area soon after ice-out (Wash 1913). Historically, large numbers of white suckers entered bay tributaries. After 1923, runs became irregular; there are no recent records of runs in the Don River (43°39', 79°21'), the major tributary to the bay (Whillans 1977).

OO-2

Duffin Creek (43°49', 79°02'). In 1973, several hundred white suckers were found in the creek in early June (Davis et al. 1974).

Farewell Creek (43°52', 78°49'). In 1973, many white suckers were found in tributaries to the creek in early May (Davis et al. 1974; Tibbles 1978).

Graham Creek (43°54', 78°35'). In 1973, a few thousand white suckers were found in the creek in mid-May and early June (Davis et al. 1974).

Wesleyville Generating Station site (43°55', 78°25'). Two marshes in the area are spawning and rearing grounds (Dunford 1979).

OO-4

Bay of Quinte (44°08', 77°15'). In 1974, a few small larvae less than 0.5 in. long were collected in the bay from mid-May to early June. Spawning evidently occurs in bay tributaries (Lam 1977).

SILVER REDHORSE

New York

NO-1

Irondequoit Bay (43°14', 77°32'). In 1977, two spent fish were collected in Irondequoit bay; spawning was assumed to have occurred in Irondequoit Creek (43°10', 77°32') (Haines et al. 1977).

SHORTHEAD REDHORSE

Ontario

OO-1

Humber River (43°38', 79°28') and Don River (43°39', 79°21'). Runs entered these rivers in the spring (Nash 1913).

CATOSTOMID spp.

Almost all of the streams that support salmon runs, also have runs of catostomids (Bergstedt, pers. comm. 1979).

SUCKER spp.

New York

NO-2

Nine Mile Point (43°31', 76°22'). Sucker eggs were found here in benthic samples (PASNY, undated b).

Ontario

OO-1

Four Mile Creek (43°15', 79°08'), Six Mile Creek (43°15', 79°09'), Eight Mile Creek (43°14', 79°11'), Ten Mile Creek (43°13', 79°13'), Martindale (Twelve Mile) Creek (43°10', 79°16'), Fifteen Mile Creek (43°09', 79°19'), Sixteen Mile Creek (43°09', 79°20'), Jordan Harbour (Twenty Mile) Creek (43°09', 79°22'), Thirty Mile Creek (43°12', 79°28'), Forty Mile Creek (43°12', 79°33'), Fifty Mile Creek (43°14', 79°37'), Stony Creek (43°14', 79°45'), Big Creek (location unknown), Dundas Creek (43°16', 79°56'), Applegarth's Creek (location unknown), Bronte Creek (43°24', 79°43'), Oakville Creek (43°26', 79°40'), Credit River (43°33', 79°35'), tributaries at Port Nelson (location unknown), Mimico Creek (43°37', 79°29'), Humber River (43°38', 79°28'), and Don River (43°39', 79°21′). Historically, runs of suckers and "mullets" occurred in these tributaries (Kerr and Kerr 1860-1898).

OO-2

Highland Creek (43°46', 79°101), Rouge River (43°48', 79°07'), Duffin Creek (43°49', 79°02'), and Lynde Creek (43°51', 78°57'). Historically, runs of suckers and "mullets" occurred in these tributaries (Kerr and Kerr 1860-1898).

Diamond (location unknown). Suckers entered the area in the millions from late May to early June (Ont. Game Fish 1910).

Soper Brook (43°54', 78°40'). In 1974, about 2,500 spawning suckers were found in the brook in late May (Davis et al. 197533).

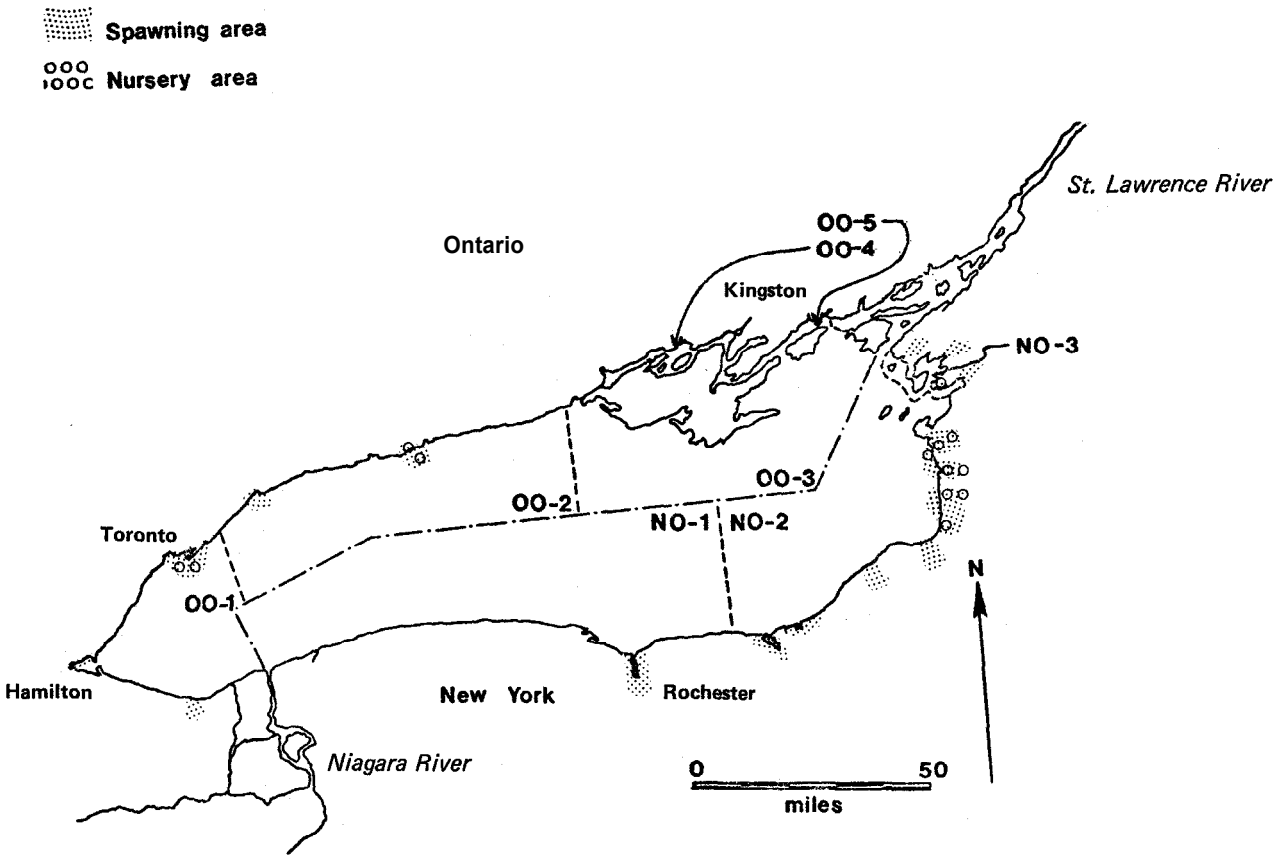
Cobourg Brook (43°57', 78°11'). In 1974, a spawning run of suckers entered the brook in late May (Davis et al. 197513).

YELLOW BULLHEAD

New York

NO-2

North Pond (43°39', 76°11'). A resident population exists in (North) Sandy Pond (Eckert, pers. comm. 1979).



The brown bullhead enters marshes, bays, and creek mouths to spawn. In Lake Ontario, these spawning runs are so large that they support major sport and commercial fisheries. Almost every stream, at least along the eastern shore, that has an embayment at the mouth attracts a spawning run from April to early June, after the sucker runs. The brown bullhead builds nests in the mud or sand in shallow, weedy areas; schools of fry are found in this habitat (Eckert and Schneider, pers. comm. 1979; Greeley and Bishop 1932; Nash 1913).

No-1

Oak Orchard Creek (43°22', 78°12′). In 1979, both mature and immature bullheads were found in the creek (Makarewicz et al. 1979); spawning runs may move into the creek from the harbor.

Irondequoit Bay (43°14′, 77°32′). A population resides in the bay (Eckert and Schneider, pers. comm. 1979). Spawning occurs in the marshy

areas of the bay or in the lower ends of the tributaries (Eckert pers. comm. 1979). Adults also enter the bay from the lake. In 1977, several adults were collected from nests under logs in the northwest corner of the bay. A spent female was found in early June; spawning was completed by early or mid-June (Haines et al. 1977).

NO-2

Sodus Bay (43°15′, 76°58′). A population resides in the bay (Eckert and Schneider, pers. comm. 1979). Both resident and lake-run brown bullheads spawn in the marshy areas of the bay or in the lower ends of the tributaries (Eckert, pers. comm. 1979).

The Pond (43°20', 76°41′; mouth of Sterling Creek). A spawning run enters the creek (Bergstedt and O'Gorman, pers. comm. 1979).

Rice Creek (43°27', 76°34'). Spawning runs enter the estuary (Elrod and O'Gorman, pers. comm. 1979).

Little Salmon River (43°31′, 76°15′). Many brown bullheads were captured in the river in April-July (Dahl and McDonald 1980).

Salmon River (43°34', 76°12'). A population resides at the river mouth and enters the lower river to spawn (Eckert and Schneider, pers. comm. 1979). Both resident and lake-run brown bullheads spawn in the marshy areas of the bay or in the lower ends of the tributaries (Eckert, pers. comm. 1979).

North Pond (43°39', 76°11'). The mouths of Lindsey (43°40', 76°10′) and Skinner (43°41', 76°10') creeks have brown bullhead populations (Eckert and Schneider, pers. comm. 1979). Resident and lake-run brown bullheads spawn in the marshy areas of the bay or in the lower ends of the tributaries (Eckert, pers. comm. 1979). Historically, very large numbers of brown bullheads spawned at the mouth of North Little Sandy Pond (probably North Pond) (Smith and Snell 1891).

Lakeview Management Area (43°44', 76°12′). The marshes and creeks are important producers of brown bullheads (Werner and Ford 1972).

Black Pond (43°48', 76°14′). In 1974-75, adults entered the pond in April (Marean 1976).

NO-3

Sherwin Bay Marsh (43°59', 76°10'). In 1974-75, adults entered the marsh in mid- to late April, and a few fry were collected as they moved out of the marsh in late July (Marean 1976).

Perch River (44°00', 76°05'). Historically, the lower section of the river was a spawning area (Greene et al. 1932).

Chaumont Bay (44°03', 76°12'). Three tributaries, Three Mile (44°05', 76°12′), Shaver (44°05', 76°12′), and Soper (44°05', 76°12')

creeks, may be spawning areas (Werner and Ford 1972). Historically, brown bullheads spawned in the lower section of the Chaumont River (44°04', 76°09') (Greene et al. 1932).

Kents Creek (44°05', 76°19'). Historically, this was an important spawning site (Greeley and Bishop 1932).

Ontario

OO-1

Jordan Harbour (43°11', 79°22'). Spawning occurs in the harbor; these fish are probably residents of the harbor (Moccia, pers. comm. 1979).

Burlington Bay (43°17', 79°50'). A population resides in the Hamilton Harbor area and probably spawns in Cootes Paradise (43°16', 79°55') at the western end of the harbor (Down, pers. comm. 1979). Spawning has been observed in the northwest corner of the bay (Whillans 1977).

Toronto (43°38', 79°25'). Historically, spawning was observed in Ashbridges Bay (43°40', 79°19') (Whillans 1977). Bullheads still spawn at the Toronto Islands (43°37', 79°23'); nest building was seen at the edges of flooded areas in June (Wainio et al. 1973; Whillans 1977). In 1906, large schools of young were observed near shore in lagoons on Toronto Island (43°37', 79°24') in July (Dymond et al. 1929).

OO-2

Pickering Generating Station (43°48', 79°04'). In 1976, large numbers of adults were found in the discharge area during April to July; abundance peaked in May (Dunford 1976). This may have been a spawning concentration, but very few young bullheads were found near the'station. Most spawning appeared to take place in Frenchman Bay (43°49', 79°06'), which may be a nursery area (Dunford 1978d, 1979).

Wesleyville Generating Station (43°55', 78°25'). Two marshes in the area are spawning and rearing grounds (Dunford 1979).

OO-4

Bay of Quinte (44°08', 77°15'). Spawning occurs in the weed beds here (Hurley and Christie 1977).

CHANNEL CATFISH

New York

NO-3

Perch River (44°00', 76°05') and Chaumont River (44°04', 76°09'). Historically, the lower sections of these rivers were spawning areas (Greene et al. 1932).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). Spawning was observed in the bay; most spawning occurred in the northwest corner of the bay (Whillans 1977).

Toronto Island (43°37', 79°24'). In the early 1870s, this was recognized as a nursery area (Whillans 1977).

TROUT-PERCH

New York

NO-2

Nine Mile Point (43°31', 76°22'). In 1974, most adults were collected in May, during the spawning period. Trout-perch larvae were found in July (LMS 1975b).

NO-3

Chaumont Bay (44°03', 76°12'). In 1972, young-of-the-year were collected in the bay from July to October (FWS 1978).

Ontario

OO-1

Credit River (43°33'. 79°35'). In 1927, ripe fish were collected on the beach just outside the river mouth in late July and early August (Dymond et al. 1929).

OO-3

Pleasant Point (44°07', 76°42'). In 1928, breeding adults were found in 125 ft of water off the point in late May (Hubbs and Brown 1929).

BURBOT

Burbot spawn in nearshore areas of the lake in early April (Bio Systems 1978a).

New York

NO-2

Sterling Power Plant site (43°23', 76°39'). In 1977, two larvae were collected in late April (Rochester Gas Elec. 1977).

Oswego (43°28′, 76°31′). In 1974-76, burbot eggs were entrained by the Oswego Steam Station (43°28', 76°31') in mid-February and late April to mid-May (Niagara Mohawk Power, undated c) and were collected in the harbor turning basin in early September (Niagara Mohawk Power, undated b). In 1974-76, burbot was the earliest species of larvae collected; larvae were first found in early to mid-April (LMS 1976a; Niagara Mohawk Power, undated b).

Nine Mile Point (43°31′, 76°22′). In 1974-75, burbot eggs were entrained at power plants here in mid-March and early April (LMS 1975b; PASNY, undated b). Burbot is one of the most abundant larvae present (LMS 1975b); burbot larvae were collected from early April to early May (LMS 1975b; PASNY, undated a,b).

Ontario

OO-l

Port Credit (43°33', 79°35'). Spawning occurred in the Port Credit area in late January and early February (Dymond et al. 1929).

THREESPINE STICKLEBACK

In Lake Ontario, threespine sticklebacks run into creek mouths and areas further upstream to spawn (Greeley 1940; Greene 1940) and are ripe at least until late July (Dymond et al. 1929). The young are found in shallow, protected marshes and coves (Greeley 1940).

New York

NO-l

Irondequoit Bay (43°14′, 77°32′). Threespine sticklebacks are present in the bay only during the spawning period. In 1977, mature

adults of both sexes were first collected in early May and were common by mid-May when spawning probably began. Nesting fish were also collected in the bay (Haines et al. 1977).

NO-2

Salmon Creek (43°16', 77°02'). Good spawning habitat was present in the creek mouth (Greene 1940).

Sterling Power Plant site (43°23', 76°39'). In 1977, eggs were collected here in late June (Rochester Gas Elec. 1977).

Oswego (43°28', 76°31'). In 1975-76, adults were impinged at the Oswego Steam Station (43°28', 76°31'), usually only in April and May, when they arrived on the inshore spawning grounds (LMS 1977b; NMPC, undated c).

Nine Mile Point (43°31', 76°22'). Spawning occurs in the area. In the 1970s, large numbers of adults were impinged at power plants here in May and June; eggs and larvae were also collected (PASNY, undated a,b).

Grindstone Creek (43°33', 76°13'). Adults were present at the creek mouth, presumably for spawning (Greene 1940).

Ontario

OO-1

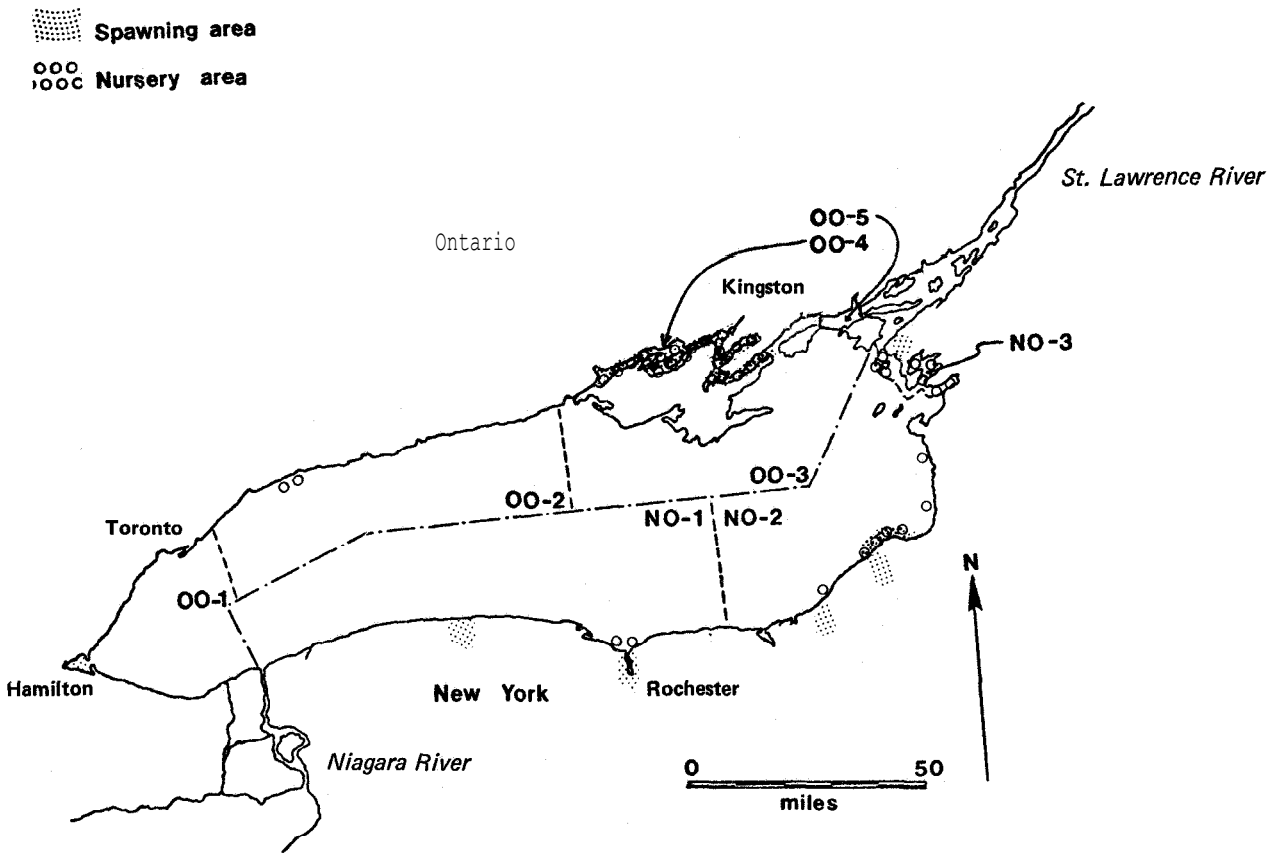
Toronto Islands (43°37', 79°23'). In 1973, spawning adults and adults in spawning condition were seen here (Wainio et al. 1973).

OO-2

Pickering (43°48', 79°04') and Darlington (43°52', 78°43') Generating Stations. Adults became abundant in June and appeared to be moving to shallow water to spawn; a few larvae were found at Darlington (Dunford 1979; Dunstall 1979b).

Wesleyville Generating Station (43°55',. 78°25'). Adults became abundant in June and appeared to be moving to shallow water to spawn; no larvae were found (Dunford 1979).

WHITE PERCH



The white perch probably entered Lake Ontario in about 1950 via the Erie Barge Canal system from the Atlantic watershed. The first recorded catch was made in 1952 in the Bay of Quinte; by 1960, there was a large population in the bay (Scott and Christie 1963).

In Lake Ontario, white perch spawn from May to July at water temperatures of 52-59°F (Carter et al. 1977; Eckert and Schneider, pers. comm. 1979; Sheri and Power 1968). Spawning occurs generally throughout the lake in shallow water areas and embayments; gravid females are present in the spring along most of the lakeshore. Young-of-the-year (YOY) are found in shallow water (O'Gorman, pers. comm. 1979; Eckert and Schneider, pers. comm. 1979).

New York

NO-1

Oak Orchard Creek (43°22', 78°12'). White perch run into the creek to spawn from mid-May to July. White perch is one of the most common species found in spawning condition in the harbor area. Gravid adults were also found in autumn (Makarewicz 1979).

Irondequoit Bay (43°14', 77°32'). The'bay is a major spawning site. In 1977, the numbers of adults entering the bay peaked in mid-May. Many fish found in late May and June were spent, indicating that spawning peaked in mid-May (Haines et al. 1977). Young-of-the-year were collected off the mouth of the bay (O'Gorman, pers. comm. 1979).

NO-2

Little Sodus Bay (43°20', 76°42'). A spring run occurs here (O'Gorman, pers. comm. 1979).

Sterlinq Power Plant site (43°23', 76°39'). Very few larvae were found here, but the presence of two prolarvae in early June suggests that spawning begins in the area in late May or early June (LOTEL 1977). Larvae were collected out to the 46 ft contour from mid-May to mid-August (Rochester Gas Elec. 1977).

Oswego (43°28', 76°31'). A large spring run of white perch enters the Oswego River (43°28', 76°31'); YOY are found off Oswego (Bergstedt and O'Gorman, pers. comm. 1979). Eggs were entrained from Lake Ontario at the Oswego Steam Station (43°28', 76°31') and were collected from the harbor from May to July. Larvae are found from late May to September (LMS 1976a, 1977b; Niagara Mohawk Power, undated b,c). Spawning is estimated to occur from mid-April to late June or July (LMS 1977b).

Nine Mile Point (43°31', 76°22'1. Many adults were impinged at the Nine Mile Point Power Station (43°31', 76°25') in April, probably during the inshore spawning run. Spawning is believed to occur from early June to mid-July at water temperatures of 50-72°F. Larvae, 0.1-0.2 in. long, are abundant in the area from June to August, and YOY up to 2.3 in. long are present in large numbers in August (QLM 1974); YOY are found in shallow water from August to October (Bergstedt 1978; O'Gorman, pers. comm. 1979). In 1974-76, eggs were collected from April to September (LMS 1975b, 1976b; PASNY, undated b).

North Pond (43°39', 76°11'). In 1972, YOY were found in the lake off the mouth of the pond in October (O'Gorman, pers. comm. 1979).

Southwick Beach State Park (43°46', 76°13'). In 1972, YOY were found here (O'Gorman, pers. comm. 1979).

NO-3

Guffin Bay (44°02', 76°07') and Black River Bay (43°59', 76°05'). In 1972, YOY were found in these bays (O'Gorman, pers. comm. 1979).

Chaumont Bay (44°03', 76°12'). In 1972, YOY were collected in the bay and at the mouth of the bay from July to October (FWS 1978; O'Gorman, pers. comm. 1979).

Grenadier Island (44°03', 76°21'). In 1972, YOY were collected from July to October (FWS 1978).

Kents Creek (44°05', 76°19'). In 1974-75, adults entered the creek from late April to early May (Marean 1976).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). Large numbers of white perch reside and spawn in the bay, probably in Cootes Paradise (43°16', 79°55') at the western end of the bay (Down, pers. comm. 1979).

OO-2

Pickering Generating Station (43°48', 79°04'). The abundance of adults in the discharge area peaked in May and June (Dunford 1976a). Young-of-the-year white perch were first recorded in Lake Ontario in July, 1953, about 12 mi E of Toronto (Scott and Christie 1963); this location is in the vicinity of the Pickering Generating Station.

OO-4

Bay of Quinte (44°08', 77°15'). In 1967, the collection of ripe and spent fish indicated that spawning occurred in the bay from mid-May through June. Gravid females were collected off the dock of the Glenora Fisheries Station (44°02', 77°04') (Sheri and Power 1968). Both shores of Adolphus Reach from Keith Shoal (44°02', 77°00') to Upper Gap (44°07', 76°49') are important spawning areas (Environ. Can. 1977a). In 1974, white perch larvae and YOY were collected throughout the bay from mid-May to mid-September. Larvae were most abundant in the upper bay and especially in upper Hay Bay (44°10', 76°56'); this suggested that the white perch ran into the warmer waters in the upper bay to spawn. Eggs were found in the bay, often adhering to Myriophyllum (Lam 1977). White perch also spawn in the discharge canal of the Lennox Generating Station (44°09', 76°51'); eggs were found among Cladophora on the bottom of the canal. Ripe adults moved inshore in early June and spawned in June and July at water temperatures of 59-73°F (Dunford 1978a; Griffiths 1976b). Larvae first appeared in the vicinity of the station in early June and were most abundant in the discharge canal; the canal may be an important spawning area (Dunford 1978a). Larvae were present in surface waters for about 6 weeks and were found at sampling sites east and west of the Lennox Generating Station and at Pig Point (44°08', 76°49') and Indian Point (44°07', 76°51'). The highest densities of newly hatched larvae, as small as about 0.1 in. long, were at Indian Point. Fry were generally associated with heavy growths of Myriophyllum. Young-of-the-year were collected near the station from July to September (Griffiths 1976b). Adults disappeared from catches in about mid-July and may have moved westward into the Bay of Quinte (Dunford 1976b).

WHITE BASS

New York

NO-2

Oswego (43°28', 76°31'). Larvae were collected in June and July in Oswego Harbor (Niagara Mohawk Power, undated b).

Nine Mile Point (43°31', 76°22'). In 1973, some early larvae about 0.1-0.2 in. long were collected here during the first half of June (QLM 1974). Larvae were entrained at the Fitzpatrick Power Plant (43°31', 76°24') in May (PASNY, undated b).

Ontario

OO-1

Toronto (43°38', 79°25'). Gravid females were collected from the bay just off the outfall of the Hearn Generating Station (43°39', 79°20') (Whillans, pers. comm. 1979).

OO-2

Lynde Creek (43°51', 78°57'). Spawning occurs at the creek mouth (Balesic 1979c; Environ. Can. 1977a).

Second Marsh [location uncertain; west of McLaughlin Bay (43°52', 78°48')] and Bowmanville Creek (43°54', 78°40'). Spawning occurs in these areas (Balesic 1979c).

ROCK BASS

Rock bass move inshore to spawn over gravel in 3-20 ft of water. Migration begins at a water temperature of 55°F; spawning occurs in June and July and begins at a water temperature of about 60°F (Schneider, pers. comm. 1979).

New Park

NO-1

Oak Orchard Creek (43°22', 78°12'). The rock bass is not a year-round resident of the creek but is one of the most common species found in spawning condition in the harbor area. Spawning was observed along shore in the lower creek. The shallow, vegetated sites are important nursery areas (Makarewicz et al. 1979).

Irondequoit Bay (43°14', 77°32'). A large spring run occurred (Odell 1940).

NO-2

Sodus Bay (43°15', 76°58'). The spawning run into the bay did not reach the head of the bay or proceed east of the islands in the bay every year (Odell 1940).

Blind Sodus Bay (43°20', 76°44'). This is a spawning area (NYDEC 1977b).

Little Salmon River (43°31', 76°15'). Spawning occurred at the river mouth (Greene 1940).

NO-3

Chaumont Bay (44°03', 76°12'). This is a spawning and nursery area (Schneider, pers. comm. 1979). Unspent females and many males guarding nests were found on the rocky shoals of the bay in mid-June at a water temperature of 67°F (Greeley and Bishop 1932).

Wilson Bay (44°05', 76°21'). Spawning occurs over gravel in the corners of the bay (Schneider, pers. comm. 1979).

Fuller Bay (44°06', 76°22'). Spawning occurs over gravel areas (Schneider, pers. comm. 1979).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). Young rock bass were found in shallow, vegetated water along the north shore of the bay off La Salle Park (43°19', 79°49') (Dymond et al. 1929).

OO-2

Pickering Generating Station (43°48', 79°04'). Rock bass are significantly more abundant here from April to July (Dunford 1976), but very few larvae have been collected (Dunford 1977).

PUMPKINSEED

In Lake Ontario, the shallow areas and embayments, especially in the eastern basin, are spawning and nursery areas (Eckert, pers. comm. 1979).

New York

NO-1

Oak Orchard Creek (43°22', 78°12'). The lower creek is a major spawning and nursery area. The pumpkinseed is one of the most common

fishes found in spawning condition in the harbor. Many adults guarding nests were found in the creek (Makarewicz 1979).

Irondequoit Bay (43°14', 77°32'). In 1977, nesting fish were observed here, most commonly in the northwest corner of the bay. Some fish deserted nests during cold weather in late May and then returned to the nests in June (Haines et al. 1977).

NO-2

Black Pond (43°48', 76°14'). In 1974-75, several adults moved into the pond and into Little Stony Creek (43°48', 76°13') in April, but no fry were found in the area (Marean 1976).

Ray Bay Marsh (43°50', 76°16'). In 1974-75, several adults entered the marsh in mid-April, and several fry were found there in late July (Marean 1976).

Henderson Bay (43°54', 76°10'). A very large resident population spawns in the littoral zone of the bay (Schneider, pers. comm. 1979).

Campbell Marsh (43°55', 76°08'). In 1974-75, several adults entered the marsh in April and a few fry were found there in July (Marean 1976).

NO-3

Muskalonge Creek (43°59', 76°02'). In 1974-75, several adults entered the marsh in the lower creek in April, and a few fry were found there in July (Marean 1976).

Sherwin Bay Marsh (43°59', 76°10'). In 1974-75, adults entered the marsh in late April; a few fry were found in the marsh in mid- to late July (Marean 1976).

Chaumont Bay (44°03', 76°12'). A very large resident population spawns in the littoral zone of the bay (Schneider, pars. comm. 1979).

Fox Creek (44°04', 76°18'). In 1974-75, adults entered the marsh from late April to early May, but no fry were found there (Marean 1976).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). Pumpkinseeds have always spawned in the bay (Whillans 1977). In 1927-28, young were found along the north shore in shallow protected water off La Salle Park (43°19', 79°49') (Dymond et al. 1929).

Toronto Bay (43°38', 79°23'). Spawning was observed in the bay and at Toronto Islands (43°37', 79°23'); nest building was seen at the margins of flooded areas in June (Wainio et al. 1973; Whillans 1977).

OO-2

Wesleyville Generating Station (43°55′, 78°25′). Two marshes in the area are spawning and rearing grounds (Dunford 1979).

OO-4

Bay of Quinte (44°08', 77°15′). A few young-of-the-year were found in the vicinity of the Lennox Generating Station (44°09', 76°51′) in August and September (Dunford 1978a).

BLUEGILL

In Lake Ontario, the shallow areas and embayments, especially in the eastern basin are spawning and nursery areas (Eckert, pers. comm. 1979).

New York

NO-1

Oak Orchard Creek (43°22', 78°12'). The creek is a major spawning and nursery area (Makarewicz et al. 1979).

No-2

Ray Bay Marsh (43°50', 76°16'). In 1974-75, fry were found here (Marean 1976).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). In 1927-28, young were found in a protected inlet at the western end of the bay (Dymond et al. 1929).

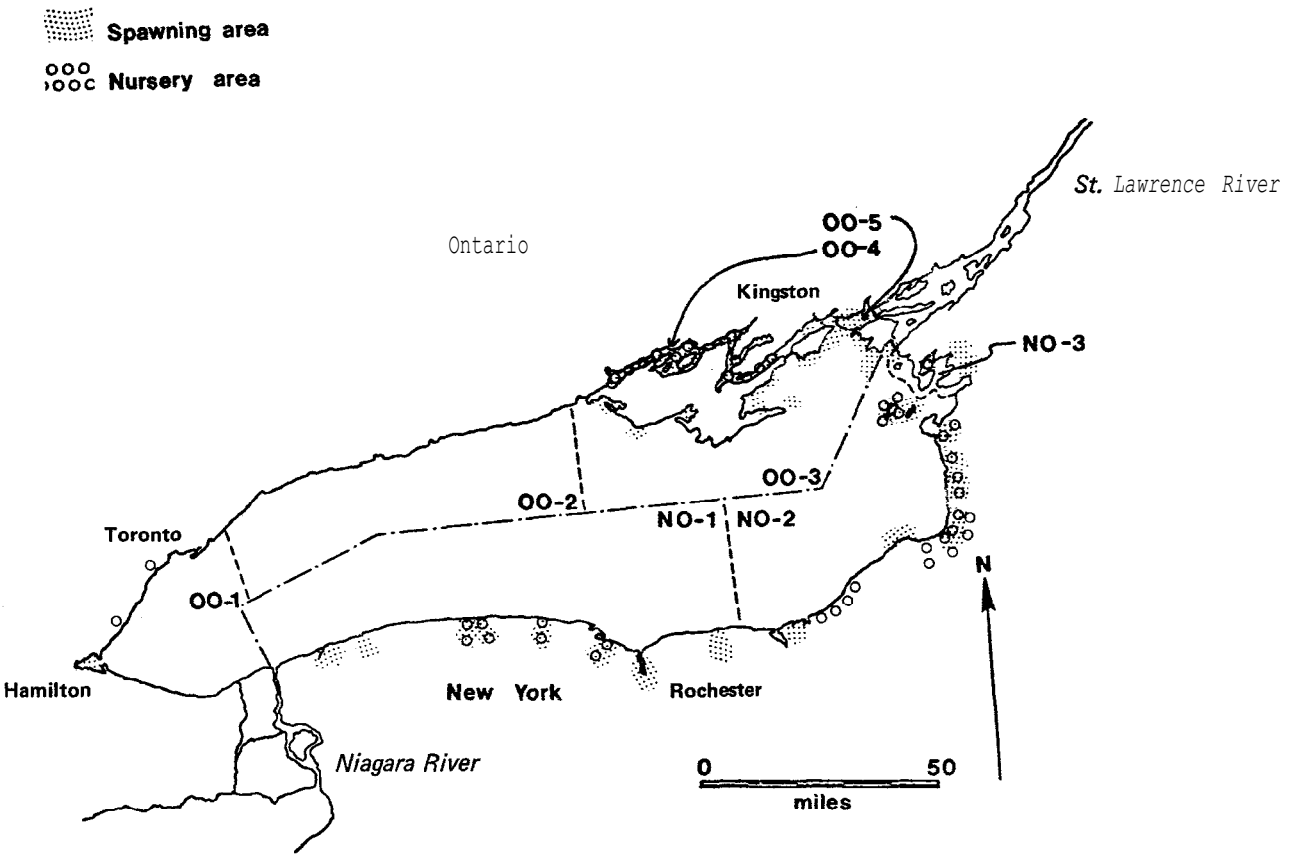
SUNFISH spp.

Ontario

OO-4

Bay of Quinte (44°08', 77°15'). In 1974, sunfish larvae were collected in the bay from June to September (Lam 1977).

SMALLMOUTH BASS



In Lake Ontario, smallmouth bass move inshore at a water temperature of about 55°F and spawn over gravel in *3-15* ft of water at a temperature of about 60°F. Spawning runs also enter tributaries in some areas of the lake; these streams are important spawning and nursery areas. The young move out of the tributaries during the summer and fall (Eckert and Schneider, pers. comm. 1979; Greeley, undated). Spawning runs do not usually enter streams at the eastern end of the lake north of Stony Point, because the streams in that area lack suitable substrate. Along the south shore, most spawning occurs in the lower sections of streams (Eckert and Schneider, pers. comm. 1979). Much of the rocky shoreline from Sodus Bay to Salmon River is an important spawning area for smallmouth bass (O'Gorman, pers. comm. 1979). Several distinct smallmouth bass populations exist in Lake Ontario, each of which spawns in a localized geographic area (Eckert, pers. comm. 1979). The exact time of spawning is dependent on water temperature. Spawning in tributaries and embayments may occur from late May to early June; in the lake proper, spawning may be delayed until late June or July (Greeley, undated; Stone et al. 1951,

1954). Early records report that smallmouth bass were still full of spawn in July (Kerr and Kerr 1860-1898); in some years spawning did not occur before July 15 (Ont. Game Fish 1910; Taudvim 1910).

New York

NO-1

Twelvemile Creek (43°19', 78°51'). The lower creek is a spawning area (Buffalo Waterfront Devel. Comm., undated; NYDEC 1977b).

East Branch Twelvemile Creek (43°19', 78°50'). Tuscarora Bay at the mouth of the creek and the lower 1 mi of the creek are spawning areas (Buffalo Waterfront Devel. Comm., undated; NYDEC 1977b).

Eighteenmile Creek (43°20', 78°43'). The lower 2 mi section of the creek is a spawning area (NYDEC 1977b).

Johnson Creek (43°22', 78°16'). Historically, this creek was an excellent spawning and nursery area; nests and fry were seen here (Greeley 1940; Greene 1940).

Oak Orchard Creek (43°22', 78°12'). This creek is an excellent spawning and nursery area; spent adults and young were found here (Makarewicz et al. 1979; NYDEC 1977b).

Sandy Creek (43°21', 77°54'). This is an excellent spawning stream; the mouth area (Straight Lake) is especially productive (NYDEC 197713).

Black (Northrup) Creek (43°17', 77°43'). This creek is a spawning and nursery area (NYDEC 1977b).

Irondequoit Bay (43°14', 77°32'). This has long been a spawning area (NYDEC 1977b).

Salmon Creek (43°17', 77°11'). Spawning occurs at the creek mouth (NYDEC 1977b).

NO-2

Port Bay (43°18', 76°50'). This is a spawning area (NYDEC 197733). Wolcott Creek (43°16', 76°50') has favorable substrate and is a potential spawning area (Eckert and Schneider, pers. comm. 1979).

Blind Sodus Bay (43°20', 76°44'). This is a spawning area (NYDEC 1977b).

Sterling Creek (43°20', 76°41'), Sterling Valley Creek (43°21', 76°40'), Ninemile Creek (43°24', 76°38'), and Eightmile Creek (43°25', 76°37'). Fry were observed in the lower reaches of these creeks (Eckert and Schneider, pers. comm. 1979).

Nine Mile Point (43°31', 76°22'). Peak spawning occurred here in late June and July. Very few males were collected, possibly because they were on nests (QLM 1974). No eggs and only one larva were found, but the presence of adults suggested that spawning occurred in the area (PASNY, undated a).

Butterfly Creek (43°37', 76°18'). Fry were found in the lower section of the creek (Eckert and Schneider, pers. comm. 1979).

Little Salmon River (43°31', 76°15'). A spawning run enters the lower section of the creek; fry and nests were observed there (Eckert and Schneider, pers. comm. 1979; Greeley 1940; Greene 1940).

Sage Creek (43°32', 76°14'). A spawning run enters the lower section of the creek (Eckert and Schneider, pers. comm. 1979).

Grindstone Creek (43°33', 76°13'). A spawning run enters the lower section of the creek; fry and nests were observed (Eckert and Schneider, pers. comm. 1979; Greeley 1940; Greene 1940).

Salmon River {43°34', 76°12'). In the late 1930's, a heavy spawning run entered the river, and fry were abundant there; however, spawning was believed to have been adversely affected by fluctuating water levels caused by dams and by lack of spawning sites (Greene 1940). Nests and fry were seen in shallow coves in June and in deeper water in July (Greeley 1940).

Lindsey Creek (43°40', 76°10') and Skinner Creek (43°41', 76°10'). Smallmouth bass enter these creeks; the lower sections are spawning and nursery areas (Eckert and Schneider, pers. comm. 1979).

Lakeview Game Management Area (43°44', 76°12'). This area, which includes Sandy (43°44', 76°12') and South Sandy (43°43°, 76°12') creeks, is an important producer of smallmouth bass (Werner and Ford 1972). The creeks support spawning runs (SLEOC 1978); a major run enters South Sandy Creek (Eckert and Schneider, pers. comm. 1979). The lower sections of the creeks are spawning and nursery areas (Eckert and Schneider, pers. comm. 1979).

Stony Creek (43°50', 76°14'). Many smallmouth bass enter the creek; the lower section is a spawning and nursery area (Eckert and Schneider, pers. comm. 1979). Spawning occurred earlier here than farther out in the lake (Stone et al. 1951, 1954). Smallmouth bass fry were abundant in the creek 2 mi above the mouth in late June (Greeley and Bishop 1932).

Stony Island (43°54', 76°20'). A discrete spawning population exists in the area (SLEOC 1978; Stone et al. 1954).

Galloo Island (43°54', 76°25'). A discrete population exists in the area (SLEOC 1978; Stone et al. 1954). Spawning occurs later here than in tributaries; spawning and unspent adults were found in late July. Young-of-the-year (YOY) were abundant on the "gas buoy" shoals (location unknown), off Galloo Island, in late July (Greeley, undated).

NO-3

Perch River (44°00', 76°05'). Historically, smallmouth bass spawned in the lower section of the river (Greene et al. 1932).

Chaumont Bay (44°03', 76°12'). A discrete population moves into the bay from the open lake at spawning time (SLEOC 1978; Stone et al. 1951, 1954). The western part of the bay is a spawning and nursery area (Eckert and Schneider, pers. comm. 1979). Historically, spawning occurred in the lower Chaumont River (44°04', 76°09') (Greene et al. 1932).

Wilson Bay (44°05', 76°21'). A discrete population exists in the area (SLEOC 1978; Stone et al. 1951, 1954); spawning occurs in gravel areas in the corners of the bay (Eckert and Schneider, pers. comm. 1979). Smallmouth bass move into the bay from the lake to spawn (Webster et al. 1959).

Fuller Bay (44°06', 76°22'). A discrete smallmouth bass population spawns in Fuller Bay (Eckert, pers. comm. 1979) over gravel (Eckert and Schneider, pers. comm. 1979).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). Historically, the south shore, including Harvey's, Lottridges, Gages, Depcios, Secords, Jones, and Harris inlets, and Big Creek Pond (specific locations unknown) were major spawning areas. Since 1876, spawning has occurred in Dundas Marsh (43°16', 79°57') (Kerr and Kerr 1860-1898; Whillans 1977).

Bronte (Twelve Mile) Creek (43°24', 79°43'). In 1927-28, YOY were found in Bronte Creek in late July and mid-August (Dymond et al. 1929).

Credit River (43°33', 79°35'). In 1927-28, YOY were found in a backwater in late July and mid-August (Dymond et al. 1929).

OO-3

Prince Edward County Peninsula (44°00', 77°15'). Spawning occurs in the following areas:

> Wellers Bay (44°00', 77°35'), Sugar Point (44°00', 77°34'), Smoke Point (44°01°, 77°35'), and the first point inside the barrier bar (43°59', 77°34') (Whillans, pers. comm. 1979).
>
> Huycks Point (43°56', 77°29') (Environ. Can. 1977a).
>
> West Lake (43°56', 77°17'). Around the point on Poplar Island (43°57', 77°18'). False Ducks Island (43°57', 76°48'1, and Timber Island (43°57', 76°50') (Whillans, pers. comm. 1979).

Flatt Point (43°56', 77°00'). East shore. Waupoos Island (44°00', 76°58'). North end and along the mainland shore opposite the island (44°00', 76°59'). Green Island (44°01', 76°56') and Cressy Point (44°04', 76°53'). Along the south shore (Whillans, pers. comm. 1979).

Amherst Island (44°09', 76°43'). Spawning occurs at Gull Point (44°06', 76°46'), along the entire shoreline between Wemps Bay (44°07', 76°47') and Amherst Bay (44°06', 76°44'), at Nut Island 144°06', 76°43'), and at Emeric Point (44°06', 76°42') (Whillans, pers. comm. 1979).

Simcoe Island (44°10', 76°32'). Central south shore (Environ. Can. 1977a; Whillans, pers. comm. 1979).

Wolfe Island (44°10', 76°25'). The shoreline areas around the island provide much spawning habitat (Environ. Can. 1977a,b).

Hinckley Point (44°08', 76°22') to Bear Point (44°06', 76°26') (Environ. Can. 1977b).

Big Sandy Bay (44°06', 76°28') (Eckert and Schneider, pers. comm. 1979; Whillans, pers. comm. 1979).

Long Point (44°06', 76°29') (Environ. Can. 1977b; Whillans, pers. comm. 1979).

Reeds Bay (44°08', 76°29') (Eckert and Schneider, pers. comm. 1979; Environ. Can 1977b; Whillans, pers. comm. 1979).

Bells Point (44°08', 76°30'). East of the point along shore to Reeds Bay (Environ. Can. 1977b).

Sand Bay (44°09', 76°31') (Environ. Can. 1977a; Whillans, pers. comm. 1979).

Mill Point (44°11', 76°28'). From the point west to the boat channel (Environ. Can. 1977b).

Barrett Bay (44°12', 76°27') (Environ. Can. 1977b).

Pigeon Island (44°04', 76°33') (Whillans, pers. comm. 1979).

Charity Islands (44°02', 76°30'). The gravel shoals have long been known as a spawning area (Eckert and Schneider, pers. comm. 1979; SLEOC 1978; Stone et al. 1951, 1954; Whillans, pers. comm. 1979).

OO-4

Bay of Quinte (44°08', 77°15'). Smallmouth bass spawn on the gravel shoals in the bay (Hurley and Christie 1977). Spawn was collected from ripe fish in the bay (Rodd 1913). In 1974, a few larvae were collected in mid-May (Lam 1977).

Kerr Point (44°10', 76°43') (Environ. Can. 1977a).

OO-5

Amherst Bar (44°12', 76°37')--Brother Islands (44°12', 76°38') (Whillans, pers comm. 1979).

Collins Bay (44°14', 76°37'). Spawning occurs along the east shore at the bay mouth. Salmon Island (44°12', 76°35') and Snake Island (44°11', 76°33') (Whillans, pers. comm. 1979).

Melville Shoal (44°11', 76°35') (Environ. Can. 1977a).

Everett Point (44°13', 76°35') (Whillans, pers. comm. 1979).

Little Cataraqui Creek (44°13', 76°33'). Spawning occurs at the creek mouth (Environ. Can. 1977a).

Simcoe Island (44°10', 76°32'). North shore around Four Mile Point (44°11', 76°31') (Environ. Can. 1977a; Whillans, pers. comm. 1979).

Garden Island (44°12', 76°28'). Spawning occurs along the north shore (Environ. Can. 1977a; Whillans, pers. comm. 1979).

LARGEMOUTH BASS

In Lake Ontario, largemouth bass are common residents of the shallow, marshy areas, including most creek mouths and embayments; they also reproduce in these areas (Schneider, pers. comm. 1979).

New York

NO-1

Oak Orchard Harbor (43°22', 78°12'). In 1979, two gravid adults were found here in the spring (Makarewicz et al. 1979).

Braddock Bay (43°19', 77°43'). A large resident population reproduces in the bay (NYDEC 1977b).

Irondequoit Bay (43°14', 77°32'). In 1977, nesting fish were found in early June after a cold spell had forced them to desert nests in late May (Haines et al. 1977).

NO-2

Sterling Creek (43°20', 76°41'). Fry were observed here (Schneider, pers. comm. 1979).

Lakeview Game Management Area (43°44', 76°12'). This area, including Sandy (43°44', 76°12') and South Sandy (43°43', 76°12') creeks, is an

important producer of largemouth bass (Werner and Ford 1972). A population resides in the area and spawns at the confluence of the creeks (Schneider, pers. comm. 1979).

Black Pond (43°48', 76°14'). In 1974-75, a few adults entered the pond and Little Stony Creek (43°48', 76°13') in April, and several fry were found in the pond and the creek in late June and July (Marean 1976), indicating that the site is a nursery area (R. Werner, pers. comm. 1979).

NO-3

Black River Bay (43°59', 76°05'). In 1972, YOY were captured in the bay from mid-July to October (FWS 1978). Historically, spawning occurred in the lower reaches of the Perch River (44°00', 76°05') (Greene et al. 1932).

Chaumont River (44°04', 76°09'). Spawning occurred in the lower river (Greene et al. 1932).

Kents Creek (44°05', 76°19'). A few fry were found in the creek in late July; young-of-the-year (YOY) are found in Mud Bay at the mouth of the creek in the fall (Marean 1976; Panek, pers. comm. 1979).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). Since 1876, spawning has occurred in Dundas Marsh (43°16', 79°57') (Whillans 1977). In 1928, young were found along the north shore of the bay in shallow protected water off La Salle Park (43°19', 79°49') (Dymond et al. 1929).

Toronto (43°38', 79°25'). Young-of-the-year were abundant in Ashbridges Bay (43°40', 79°19') and also in the shallows of Toronto Bay (43°38', 79°23') (Dymond et al. 1929).

OO-3

Prince Edward County Peninsula (44°00', 77°15'). Spawning occurs in several areas in water slightly deeper than that in which northern pike spawn (Whillans, pers. comm. 1979).

Wellers Bay (44°00', 77°35'). Inside the barrier bar (43°59', 77°35'), and at the lower end of Consecon Lake (44°00', 77°30').

West Lake (43°56', 77°17'). Inside the barrier bar on both sides of Garratt Island (43°57', 77°18') and at the mouth of the stream entering the northeast side (43°58*, 77°15').

East Lake (43°55', 77°12'). At the head of the bay (43°57', 77°10') and in the southwest (43°54', 77°14') and southeast (43°541, 77°12') corners.

Black River (43°58′, 77°02′). At the river mouth.

Smith Bay (44°00', 77°01′). At the head of the bay (43°59′, 77°02′).

OO-4

Bay of Quinte (44°08', 77°15′). Largemouth bass spawn in the weedy areas of the bay (Hurley and Christie 1977). A few larvae were found in the marshy area at the head of Prinyer Cove (44°05', 76°53') in late May (Hubbs and Brown 1929).

OO-5

Collins Bay (44°14′, 76°37′). Head of the bay (Whillans, pers. comm. 1979).

Cataraqui Bay and mouth of Little Cataraqui Creek (44°13', 76°33'). (Environ. Can. 1977a; Nhillans, pers. comm. 1979).

Cataraqui River (44°14′, 76°28′). East shore of the lower river (Whillans, pers. comm. 1979).

Garden Island (44°12′, 76°28′). South shore (Whillans, pers. comm. 1979).

BASS spp.

New York

NO-2

Pleasant Point (43°31', 76°20'). An unidentified species of bass spawned on the gravel shoals just off the point (Smith and Snell 1891).

Ontario

OO-1

Martindale (Twelve Mile) Creek (43°10′, 79°16′). Many bass were seined here in early April (Kerr and Kerr 1860-1898).

Bronte (43°24', 79°43'). Tributaries at Bronte were spawning areas (Kerr and Kerr 1860-1898). Bronte Creek (43°24', 79°43') was a well known spawning site for black bass; some fish migrated 10 mi upstream to spawn (Ont. Game Fish 1911).

Oakville (43°26', 79°40'). Tributaries at Oakville were spawning areas (Kerr and Kerr 1860-1898).

Credit River (43°33', 79°35'). Spawning occurred here in 1866 (Kerr and Kerr 1860-1898).

Mimico (43°37', 79°29') and Port Nelson (location unknown). Tributaries here were spawning areas (Kerr and Kerr 1860-1898).

Humber River (43°38', 79°28') and Don River (43°39', 79°21'). In 1866, bass spawned in these rivers (Kerr and Kerr 1860-1898).

OO-2

Rouge River (43°48', 79°07'), Duffin Creek (43°49', 79°02'), and Lynde Creek (43°51', 78°57'). In 1866, bass spawned in these tributaries (Kerr and Kerr 1860-1898).

Diamond (location unknown). This area was a good breeding ground for bass (Ont. Game Fish 1910).

WHITE CRAPPIE

Ontario

OO-1

Burlington Bay (43°17', 79°50'). In 1927-28, young-of-the-year were found in a protected inlet of a sluggish creek entering the northwest corner of the bay (Dymond et al. 1929).

BLACK CRAPPIE

New York

NO-1

Irondequoit Bay (43°14', 77°32'). In 1977, young-of-the-year (YOY) were found in the bay, but spawning was not confirmed (Haines et al. 1977).

NO-2

Black Pond (43°48', 76°14'). In 1974-75, adults entered the pond in mid-April (Marean 1976).

NO-3

Muskalonge Creek (43°59', 76°02'). In 1974-75, a few adults entered the creek in late March to April (Marean 1976).

Perch River (44°00', 76°05'). Spawning occurred in the lower section of the river (Greene et al. 1932).

Sherwin Bay Marsh (43°59', 76°10'). In 1974-75, adults entered the marsh in late April (Marean 1976).

Chaumont River (44°04', 76°09'). Spawning occurred in the lower section of the river (Greene et al. 1932).

Fox Creek (44°04', 76°18'). In 1974-75, adults entered the creek in mid- to late April (Marean 1976).

Kents Creek (44°05', 76°19'). In 1974-75, adults entered the creek in mid- to late April (Marean 1976); YOY were also found in the creek (Eckert, pers. comm. 1979).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). In 1877, ripe adults were found in Dundas Marsh (43°16', 79°57') in late May (Dymond et al. 1929).

Credit River (43°33', 79°35'). In 1928, a ripe female was found among aquatic vegetation in the river (Dymond et al. 1929).

Toronto Island (43°37', 79°24'). In about 1895, spawning occurred at Toronto Island; since 1913, black crappies have not been abundant here (Whillans 19771.

CRAPPIE spp.

Naw York

NO-2

Blind Sodus Bay (43°20', 76°44'). This is a spawning area for unidentified species of crappie (NYDEC 1977b).

JOHNNY DARTER

Historically, ripe adults were collected in Lake Ontario in late June (Dymond et, al. 1929).

New York

NO-1

Russell Power Station (43°16', 77°38'). In 1977, johnny darter larvae were collected from mid-June to August; they were most abundant on July 14, when they made up 85% of the catch of benthic larvae (Bio Systems 1978b).

Irondequoit Bay (43°14', 77°32'). In 1977, nesting fish were found in the northwest corner of the bay during May (Haines et al. 1977).

Ginna Power Station (43°17', 77°18'). Johnny darters spawn in the nearshore areas here. In 1977, larvae were collected out to the 36 ft depth contour in late June to August; they were most abundant in mid-July and were 75% of the larval catch at this time (Bio Systems 1978a).

NO-2

Blind Sodus Bay (43°20', 76°44'). Ripe adults in breeding colors were collected over rock in 30 ft of water off the bay in late June (Bergstedt, pers. comm. 1979).

Sterling Power Plant site (43°23', 76°39'). In 1977, larvae were collected from May 10 to late June (LOTEL 1977).

Oswego (43°28', 76°31'). Larvae were entrained from Lake Ontario at the Oswego Steam Station (43°28', 76°31') in June and July (LMS 1976a, 1977b; Niagara Mohawk Power, undated c); larvae were collected in the lake from June to September (LMS 1976a, 1977b) and in the harbor turning basin from late May to August (Niagara Mohawk Power, undated b). In 1974, 83% of the benthic larvae collected on July 8 were johnny darters (LMS 1976a).

Nine Mile Point (43°31', 76°22'). Eggs were found here in early June (PASNY, undated b). In 1973-76, johnny darter larvae were one of the most abundant larvae in the area; they were present near shore and off shore from May to September (LMS 1975b, 1976b; PASNY, undated a,b; QLM 1974).

NO-3

Chaumont Bay (44°03', 76°12'). In 1972, young-of-the-year were found in the bay from mid-July to October (FWS 1978).

Ontario

OO-1

Toronto Islands (43°37', 79°23'). In 1973, spawning adults and adults in spawning condition were found in the area (Wainio et al. 1973).

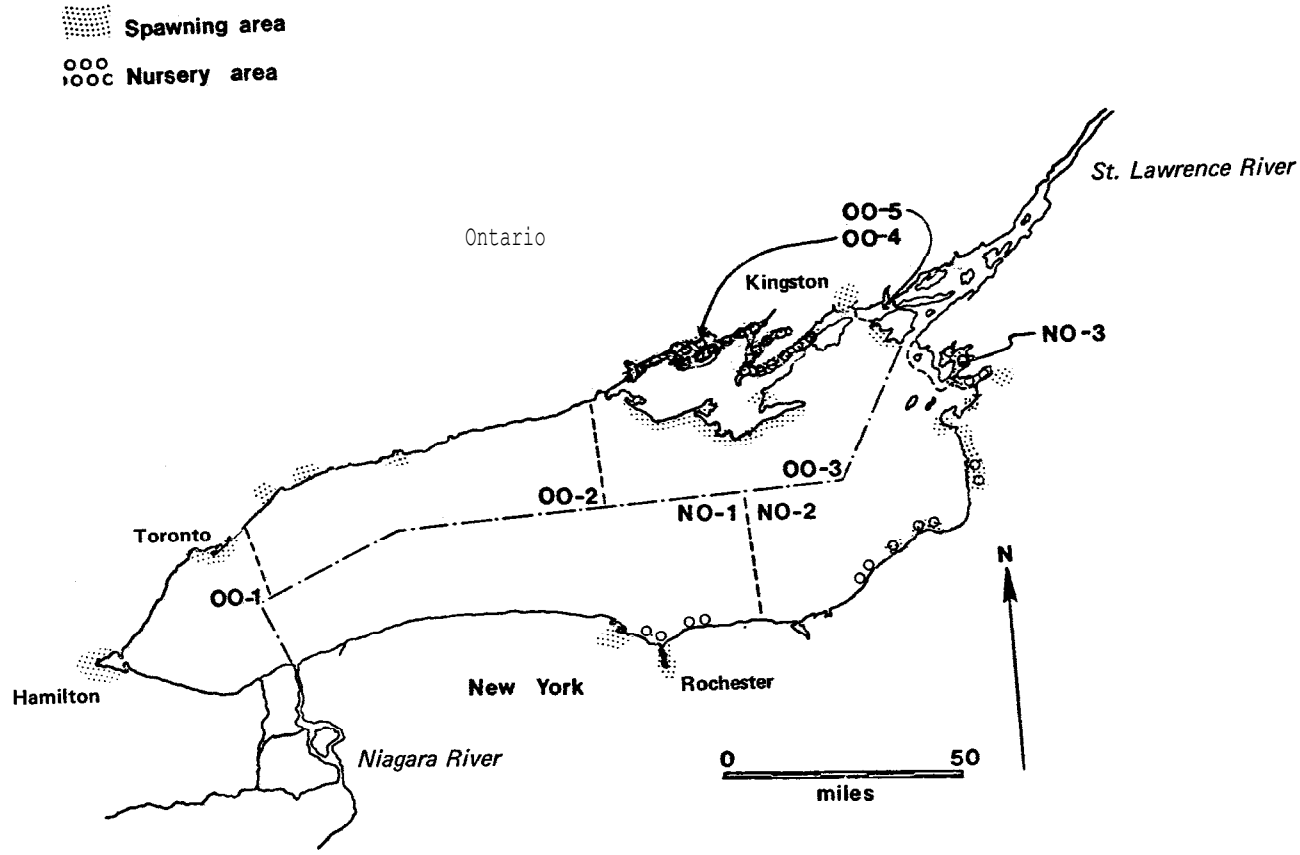
DARTER spp.

New York

NO-2

Sterling Power Plant Site (43°23', 76°39'). In 1977, darter larvae were the second most abundant of larvae collected at the site. Darter larvae were collected out to the 46 ft contour from mid-June through August; highest densities occurred in mid-July (Rochester Gas Elec. 1977).

YELLOW PERCH



In Lake Ontario, yellow perch spawn from late April to July in shallow, weedy areas, in the embayments and marshes along the eastern shore; they also spawn along the lake shore proper (Balesic 1979c; Carter et al. 1977; Eckert and Schneider, pers. comm. 1979; O'Gorman, pers. comm. 1979). Resident populations of yellow perch exist in the shoreline embayments; lake residents also enter these embayments to spawn (O'Gorman, pers. comm. 1979; Skiff et al. 1950).

New York

NO-1

Oak Orchard Creek (43°22', 78°12'). The creek mouth provided excellent spawning habitat (Greene 1940).

Cranberry Pond (43°18', 77°42') and Long Pond (43°18', 77°41′). Large runs occurred here in the spring (Odell 1940).

Russell Power Station (43°16', 77°38'). In 1977, larvae were collected near shore in the vicinity of the station in mid-June and early July (Bio Systems 1978b).

Irondequoit Bay (43°14′, 77°32′). Large runs of yellow perch occurred here in the spring (Odell 1940). A few young-of-the-year (YOY) were captured off the mouth of the bay in September (O'Gorman, pers. comm. 1979).

Ginna Power Station (43°17′, 77°18′). In 1977, larvae were collected near shore in the vicinity of the plant in June (Bio Systems 1978a).

NO-2

Fair Haven State Park (43°20', 76°42'). In 1972, some YOY were caught here from mid-July to October (FWS, 1978).

Sterling Power Plant site (43°23', 76°39'). In 1977, yellow perch larvae were collected out to the 46 ft depth contour until late June; 89% of the catch of larvae in April and May were yellow perch (Rochester Gas Elec. Co. 1977).

Oswego (43°28′, 76°31′). Eggs were entrained from Lake Ontario at the Oswego Steam Station (43°28', 76°31') in late June (Niagara Mohawk Power, undated c) and were also collected from Oswego Harbor in late June (Niagara Mohawk Power, undated b). Larvae were collected here beginning in mid-May (LMS 1976a); the harbor turning basin is a nursery area for a large part of the year (Niagara Mohawk Power, undated b).

Nine Mile Point (43°31', 76°22'), Yellow perch moved inshore here to spawn in mid- to late April (Smith 1892). A few eggs have been collected in the area (LMS 1975b, 1976b; PASNY, undated a,b). A few larvae were found here from late April to June (LMS 1975b, 1976b; Niagara Mohawk Power, undated a; PASNY, undated a,b; QLM 1974); YOY appeared in the catch in July (PASNY, undated b).

North Pond (43°39', 76°11′). Tagging studies have shown that yellow perch overwinter and spawn in North Pond, then move west to the Nine Mile Point area (43°31′, 76°22′). In the fall, these fish return to North Pond (Eco Research 1978; Niagara Mohawk Power, undated d; Storr 1977). This is an important nursery area (O'Gorman, pers. comm. 1979).

Lakeview Game Management Area (43°44', 76°12′). This area, including Sandy (43°44', 76°12') and South Sandy (43°43°, 76°12′) creeks, is an important spawning area for yellow perch (Werner and Ford 1972).

Black Pond (43°48', 76°14'). In 1974-75, a few adults moved into the pond and into Little Stony Creek (43°48', 76°13') from April to early May (Marean 1976).

Ray Bay Marsh (43°50', 76°16'). In 1974-75, many adults entered the marsh in April (Marean 1976).

Henderson Bay (43°54', 76°10'). In 1974-75, a few adults moved into Campbell Marsh in April (Marean 1976).

NO-3

Black River Bay (43°59', 76°05'). Adults moved into Muskalonge Creek (43°591, 76°02') from mid-April to early May (Marean 1976); YOY are found in the bay (O'Gorman, pers. comm. 1979).

Sherwin Bay Marsh (43°59', 76°10'). In 1974-75, many adults entered the marsh from late March to early May, but no fry were found there (Marean 1976).

Chaumont Bay (44°03', 76°12') and Guffin Bay (44°02', 76°07'). Both lake and bay residents spawn in these bays, and YOY are found there (FWS 1978; O'Gorman, pers. comm. 1979).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). Yellow perch spawn in many of the small creeks entering the bay (Whillans, pers. comm. 1977).

Toronto (43°38', 79°25'). In 1901, ripe males were collected in May and June at Centre Island (43°37', 79°22'). In 1891, spawning was completed in Ashbridges Bay (43°40', 79°19') by April 23 (Dymond et al. 1929).

OO-2

Rouge River (43°48' , 79°07') and Pickering (Duffin) Creek (43°49', 79°02'). In 1912, it was reported that fishing at the tributary mouths was spoiled because carp ate the yellow perch spawn (Ont. Game Fish 1912).

McLaughlin Bay (43°52', 78°48'). This is a spawning area (Balesic 1979c).

OO-3

Prince Edward County Peninsula (44°00', 77°15'). Spawning occurs in sheltered areas from Wellers Bay east along the south shore (Balesic 1979c); areas specifically identified are:

> Wellers Bay (44°00', 77°35'). Head of the bay at 44°00', 77°32' (Whillans, pers. comm. 1979).
>
> Huycks Point (43°56', 77°29'). Wellington Bay (43°56', 77°21'). From the village of Wellington (43°57', 77°21') to West Owen Point (43°53', 77°17') (Environ. Can. 1977a).

South Bay (43°56', 77°02'). Along west shore. Black River (43°58', 77°02'). Smith Bay (44°00', 77°01'). Along northwest shore (Whillans, pers. comm. 1979).

Amherst Island (44°09', 76°43'). Wemps Bay (44°07', 76°47') is a major spawning area (Dunford 1979).

Wolfe Island (44°10', 76°25'). Spawning occurs in several shoreline areas (Environ. Can. 1977a); areas specifically identified are:

Horseshoe Island (44°09', 76°31'). Sand Bay (44°09', 76°31')--Yotts Point (44°08', 76°29'). Reeds Bay (44°08', 76°29'). Back of bay. Long Point (44°06, 76°29'). South shore (Whillans, pers. comm. 1979).

OO-4

Bay of Quinte (44°08', 77°15'). In 1974, yellow perch larvae were found throughout the bay in mid-May and early June; greatest densities were found in upper Hay Bay (44°10', 76°56') and the upper Bay of Quinte, indicating that spawning occurred in the warmer waters in the upper reaches of the bay (Lam 1977). Spent or partly spent females were found in the Bay of Quinte from early May through June (Sheri and Power 1969).

Lennox Generating Station (44°09', 76°51'). Trap net catches at the station and to the west at Sandhurst (44°08', 76°52') and to the east at the cement plant (44°10', 76°48') showed that adults began to move inshore in about mid-April at water temperatures of 34-36°F, and that by late April, large numbers were present nearshore at these locations (Griffiths 1976b). The presence of ripe and spent fish and of egg strands showed that spawning occurred at these locations and also in the discharge canal of the station from late April through May at water temperatures of 37-55°F (Dunford 1978a; Griffiths 1976b). Egg strands were almost always found among aquatic plants, such as Myriophyllum (Griffiths 1976b). Yellow perch often spawned in the discharge canal, but spawning in the canal was often unsuccessful (Balesic 1978). Trap net catches west of the station indicated a pre-spawning movement into the Bay of Quinte and an eastward, post-spawning movement out of the bay in late May (Dunford 1976b). Larvae were widely distributed in the area, but were most abundant at Sandhurst (Dunford 1978a; Griffiths 1976b).

Upper Gap (44°07', 76°49'). Larger numbers of adults and larvae were found in this area than along the north shore (Dunford 1979). Pig Point (44°08', 76°49') is a major spawning area; many eggs were found there from late April to early June among aquatic plants at depths of 6-20 ft; the water temperature in late April was 37°F (Dunford 1978a; Griffiths 1976b). Densities of larvae were higher at Pig Point than elsewhere in the area (Griffiths 1976b).

OO-5

Collins Bay (44°14', 76°37'). Spawning occurs in the shallow areas of the bay (Whillans, pers. comm. 1979).

SAUGER

Ontario

OO-1

Burlington Bay (43°17', 79°50'). Saugers spawned in the rivers entering the bay. They were abundant until the mid-1870s, but the runs declined by the turn of the century (Whillans 1977).

Toronto Bay (43°38', 79°23'). Saugers spawned in the rivers entering the bay. The population declined by the 1870s and never recovered. In 1913, the sauger was listed as rare (Whillans 1977).

BLUE PIKE

The blue pike was once an abundant and commercially important fish in the lower Great Lakes. Populations of blue pike were mainly confined to western and southern Lake Ontario, central and eastern Lake Erie, and the Niagara River (Blue Pike Recovery Team 1975). It is hypothesized that the blue pike in Lake Ontario originated in Lake Erie. The fishery for blue pike in Lake Ontario collapsed in about 1955, just prior to the collapse of the fishery for blue pike in Lake Erie (Christie 1973). The last confirmed catch of blue pike in the lower Great Lakes was made in 1965 (Blue Pike Recovery Team 1975). In Lake Ontario, blue pike spawned over rocky or sand and mud substrate at depths of 15-130 ft and water temperatures of 38-48°F (Cahill, pers. comm. 1977; Stone 19481, possibly as late as July (Rathbun and Wakeham 1897).

New York

NO-1

Niagara County (43°17', 78°55'). In 1946 and 1947, adults in spawning condition were found at several locations between the Niagara River (43°16', 79°04') and Olcott (43°20', 78°43') from late April to early May. The catches often included ripe females surrounded by several milting males. A movement westward along the shore was observed during spring and early summer. Adults were first caught in early March, just east of Olcott in 60-90 ft of water; they remained near Olcott Harbor for about a month and then began moving westward in late April, always at depths qreater than 40 ft. By mid-May, the migration passed Wilson (43°19', 78°50') and by early June reached Niagara Bar where the adults remained for a few weeks. The adults disappeared from catches about July 1 (Stone 1948).

NO-2

Selkirk (43°33', 76°12'). Blue pike appeared in deep water here in early spring (Stone 1948).

NO-3

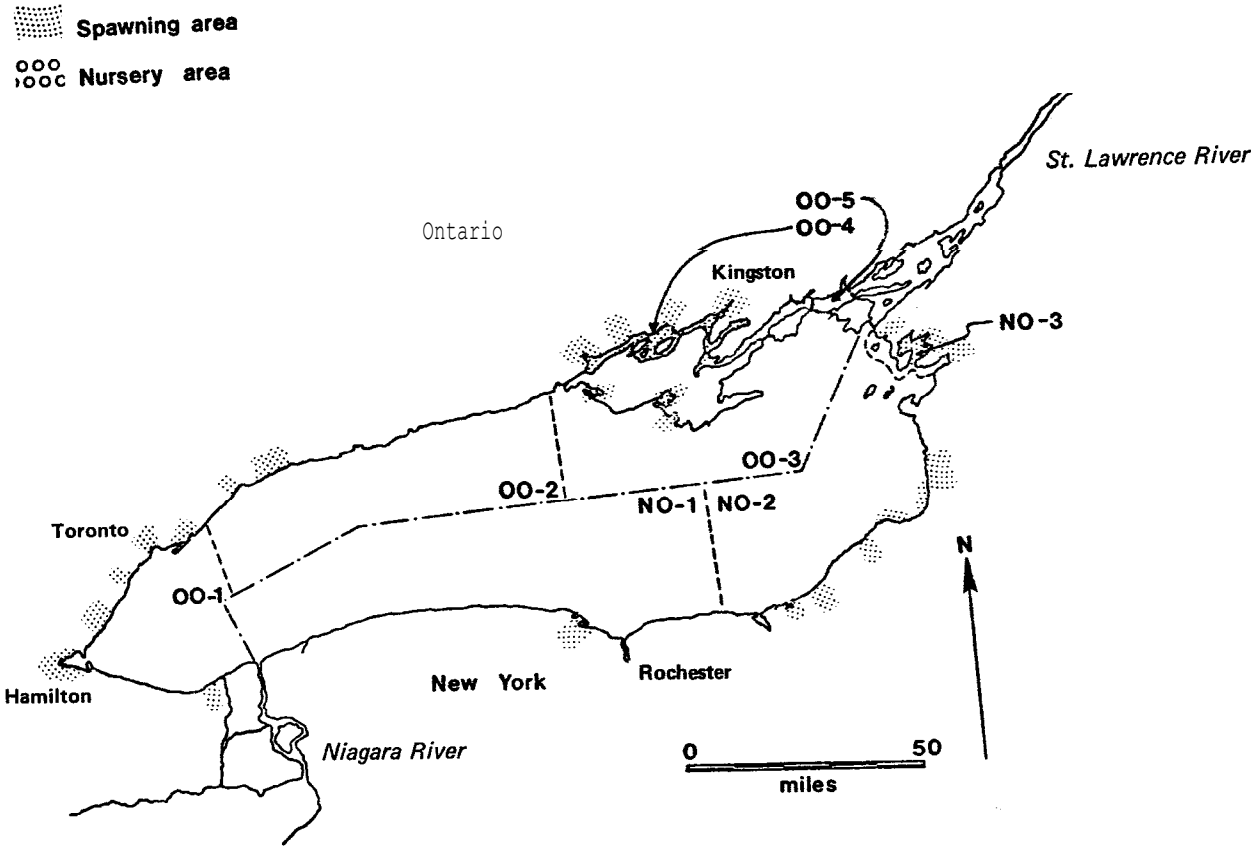
Chaumont Bay (44°03', 76°12'). Spawning occurred here (Cahill, pers. comm. 1977).

Ontario

OO-1

Burlington Bay (43°17', 79°50'). Spawning occurred in rivers entering the bay. The stock decreased in the late 1800s and recovered slightly in about 1930. Blue pike supposedly were observed recently in the bay (Whillans 1977).

Toronto Bay (43°38', 79°23'). Spawning occurred in rivers entering the bay. The stock decreased in the mid-1870s and never recovered (Whillans 1977).



Historically, walleyes moved inshore to spawn in creeks, river mouths, and along the shoreline in April (Nash 1913; Rathbun and Wakeham *1897;* Smith 1892; Stone 1948).

New York

NO-1

Long Pond (43°18', 77°41'). A spawning run occurred here (Odell 1940).

NO-2

Port Bay (43°18', 76°50'). A spawning run occurred here (Odell *1940).*

Blind Sodus Bay (43°20', 76°44'). This is a spawning area (NYDEC 1977b; Odell 1940). In 1942, running-ripe males and females were found over stone and sand in 4 ft of water i:n mid-April at the mouth of the bay (Stone 1948).

Oswego River (43°28', 76°31'). In the spring walleyes concentrate below the lowermost dam on the river (N.Y. State Dept. Conserv., undated c).

Nine Mile Point (43°31', 76°22'). Eggs were entrained at the Fitzpatrick Power Plant (43°31', 76°24') and collected in the vicinity of the plant in late May (PASNY, undated a,b).

South Sandy Pond (43°37', 76°11'). Spawning was observed at the pond outlet; in 1947, running-ripe adults were seen along the east shore over stone and sand in 3-8 ft of water in mid-April at temperatures of 42-43°F (Stone 1948).

North Pond (43°39', 76°11'). Fishermen reported that runs entered North Pond and Lindsey (43°40', 76°10') and Skinner (43°41', 76°10') creeks, but there is no evidence of successful reproduction (Schneider, pers. comm. 1979).

NO-3

Historically, spawning occurred around almost all the islands at the eastern end of the lake (Rathbun and Wakeham 1897).

Black River Bay (43°59', 76°05'). In the late 1800s, no spawning occurred in the bay or lower portion of the Black River (44°00', 76°04') because of pollution from mills at Watertown (Rathbun and Wakeham 1897). Hatchery records, however, show'that a spawning run occurred in the bay and river around 1900 (Schneider, pers. comm. 1979).

Chaumont Bay (44°03', 76°12'). Historically, extensive spawning grounds were located here; the bay was one of the two major spawning areas in the lake (Bile, pers. comm. 1979; Rathbun and Wakeham 1897; Schneider, pers. comm. 1979). Spawning grounds also existed in Three Mile Bay (44°04', 76°13') (Rathbun and Wakeham 1897).

Mud Bay (44°05', 76°19'). Historically, ripe adults were collected in tributaries to the bay (Schneider and Leach 1979). In the early 1900s, spawning occurred in Mud (Kents) Creek (44°05', 76°19') (Schneider, pers. comm. 1979). In 1911, eggs were first collected in Mud Creek in late April, about 3 weeks later than normal" due to heavy ice (Bean 1912).

Ontario

OO-1

Martindale (Twelve Mile) Creek .(43°10', 79°16'). Historically, many walleyes were seined in the creek in early April (Kerr and Kerr 1860-1898).

Burlington Bay (43°17', 79°50'). Around 1840, walleyes were common in the bay during spawning season (Dymond et al. 1929); until the late 1870s or early 1880s, they spawned in tributaries to the bay. The population increased slightly until about 1930, but spawning no longer occurs in the bay (Whillans 1977).

Bronte Creek (43°24', 79°43'), Oakville Creek (43°26', 79°40'), Port Nelson (location unknown), Credit River (43°33', 79°35'), Mimico Creek (43°37', 79°29'), and Humber River (43°38', 79°28'). Spring Spawning runs occurred here (Kerr and Kerr 1860-1898).

Don River (43°39', 79°21'). During the late 1860s, spawning still occurred here, but after 1874 the population essentially disappeared (Kerr and Kerr 1860-1898; Whillans 1977).

OO-2

Rouge River (43°48', 79°07'), Duffin Creek (43°49', 79°02'), and Lynde Creek (43°51', 78°57'). Spring spawning runs historically occurred in these tributaries (Kerr and Kerr 1860-1898).

OO-3

Prince Edward County Peninsula (44°00', 77°15'). Spawning areas here include (Whillans, pers. comm. 1979):

> Wellers Bay (44°00', 77°35'). East shore of Sugar Point (44°00', 77°34'); a large run also enters the stream flowing out of Consecon Lake (44°00', 77°30').
>
> West Lake (43°56', 77°17'). In the creek between Poplar and Gasket Islands (43°57', 77°17'), along the northwest shore of Tubbs Island (43°56', 77°16'), and along shore south of Tubbs Island (43°55', 77°16').
>
> East Lake (43°55', 77°12'). Along the southeast shore north of Parr Island (43°54', 77°12').

OO-4

Bay of Quinte (44°08', 77°15). Historically, the bay was one of the two major spawning areas in the lake (Hile, pers. comm. 1979), and spawn was collected from ripe fish in the bay (Ont. Game Fish 1943). Spawning occurred in the lower sections of tributaries and on shoals and along rocky shorelines in Hay Bay (44°07', 77°01°) and the upper bay (Christie 1973; Int. Great Lakes Levels Board 1973; Leach et al. 1977; Ont. Game Fish 1945; Ont. Min. Lands Forests 1948; Payne 1964; Schneider and Leach 1979). "Pickerel" spawned at Twelve O'clock (44°04', 77°35'), Wallbridge (44°09', 77°21'), Massasauga (44°09', 77°19'), Horse (44°09', 77°18'), Ox (44°09', 77°19'), and Anne (44°09', 77°18') points in the upper bay; along the north shore of Big Island east from Richson Point (44°06', 77°17'); at unnamed sites (44°07', 77°02' and 44°10', 76°56') in Hay Bay; and in Long Reach (44°08', 77°04') (Environ. Can. 1977a). Spawning occurred at water temperatures of 35-50°F in April (Payne 1964). The walleye population

declined in the 1960s after white perch invaded the area (Schneider and Leach 1977), and now spawning occurs only in tributaries (Leach et al. 1977). Spawning occurred in the four major tributaries; the Trent (44°06', 77°34'), Moira (44°09', 77°23'), Salmon (44°11', 77°15'1, and Napanee (44°12', 77°01°) rivers, just below the dams (Can. Fisherman 1924a; Hurley 1972b; Ont. Dep. Lands Forests 1971; Ont. Game Fish 1910, 1913b; Payne 1964). The run in the Trent River was the last to decline and is still producing at a low level (Christie 1973; Schneider and Leach 1979). Spawning still occurs at the mouths of the Trent and Moira Rivers (Environ. Can. 1977a). An extensive post-spawning migration occurs out of the bay (Payne 1964; Schneider and Leach 1977). One walleye tagged in the upper bay was recovered 48 mi away on the south shore of Prince Edward County (44°00', 77°15'). Walleyes return to the bay in the fall (Payne 1964; Schneider and Leach 1979). In 1974, a few larvae were collected in the bay in mid-May (Lam 1977). Young remain in the bay for 3 years and then migrate to the lake (Schneider and Leach 1979).

PERCIDAE spp.

New York

NO-2

Sterling Power Plant site (43°23', 76°39'). In 1977, percid eggs were collected here in early July (Rochester Gas Elec. 1977).

FRESHWATER DRUM

In Lake Ontario, freshwater drum reproduction is limited because the water temperature reaches the spawning temperature of 70°F for only a short time (Daiber 1950). Spawning occurs in nearshore waters in July and August (Bio Systems 1978a).

New York

NO-2

Sterling Power Plant site (43°23', 76°39'). In 1977, a few freshwater drum eggs were collected in the vicinity in late June and late July (Rochester Gas Elec. 1977).

Oswego River (43°28', 76°31'). A substantial spawning run enters the river during June (O'Gorman, pers. comm. 1979).

NO-3

Chaumont Bay (44°03', 76°12'). In 1979, young-of-the-year were found in the western part of the bay (O'Gorman, pers. comm. 1979; Schneider, pers. comm. 1979).

Ontario

OO-4

Bay of Quinte (44°08', 77°15'). Freshwater drum are most abundant in the warm, shallow waters of the bay (Daiber 1950). Spawning occurs in the bay in July and August. In 1974, eggs were collected from early July to mid-August; one larva was also found (Lam 1977).

MOTTLED SCULPIN

New York

NO-2

Oswego (43°28', 76°31'). In 1974-76, larvae were collected from late June to September; up to 56% of the larvae in samples taken near the bottom in late June were mottled sculpins (LMS 1976a, 1977b).

Nine Mile Point (43°31', 76°22'). In 1973-76, mottled sculpin larvae were one of the most abundant larvae collected in the area; they were present from mid-June to mid-September and peak abundance occurred in late June. Most larvae were longer than about 0.2 in., but some smaller than 0.1 in. were present in late June (LMS 1975b, 1976b; PASNY, undated b; QLM 1974).

SLIMY SCULPIN

In Lake Ontario, slimy sculpins spawn in deep water throughout the lake (Eckert and Schneider, pers. comm. 1979). Adults are ripe in April and May (O'Gorman, pers. comm. 1979) and usually spawn in June (Schneider, pers. comm. 1979). Eggs were found in the eastern end of the lake on a log retrieved in a trawl in June (Schneider, pers. comm. 1979).

New York

NO-1

Rochester (43°15', 77°35'). In 1979, young-of-the-year were found in 66 ft of water off Rochester in September (O'Gorman, pers. comm. 1979).

Ontario

OO-3

Pleasant Point (44°07', 76°42'). In 1928, a ripe female was collected off the point in late May (Hubbs and Brown 1929).

SCULPIN spp.

New York

NO-1

Russell Power Station (43°16', 77°38'). In 1977, 20% of the total catch of benthic larvae were sculpins; most were collected in early July (Rio Systems 1978b).

NO-2

Sterling Power Plant site (43°2:3', 76°39'). In 1974 and 1977, sculpin larvae were collected near the bottom from mid-June to early August (LOTEL 1977; Rochester Gas Elec. 1977).

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Department of the Interior/Fish and Wildlife Service
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15. Supplementary Notes
This document is one of a set of fourteen volumes.

16. Abstract (Limit: 200 words)
This atlas is a compilation of current spawning and nursery information concerning the fishes of the Great Lakes. The complete set consists of fourteen volumes. The information may be used to support permit and project reviews, impact statement reviews, planning of baseline research, and coordination with other agencies, and identification of data gaps. The report locates spawning and nursery areas in the Great Lakes and describes spawning and nursery characteristics, timing, and habitats of major fish species of the Great Lakes area.
The first volume is a summary by geographic area, volumes II through XII contain the specific areas refe.rented in volume I. Volume XIII contains the species spawning and nursery characteristics for the major species, and Volume XIV cites the references used in compiling this work.
The titles of the volumes addres-sing the spawning and nursery areas for each fish species site specifically are: II, Lake Superior; III, St. Mary's River; IV, Lake Michigan; V, Lake Huron; VI, St. Clair River; VII, St. Clair Lake; VIII, Detroit River; IX, Lake Erie; X, Niagara River; XI, Lake Ontario; XII, St. Lawrence River. The title of Volume XIV is, Species Reproduction Characteristics.

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