Biological Services Program

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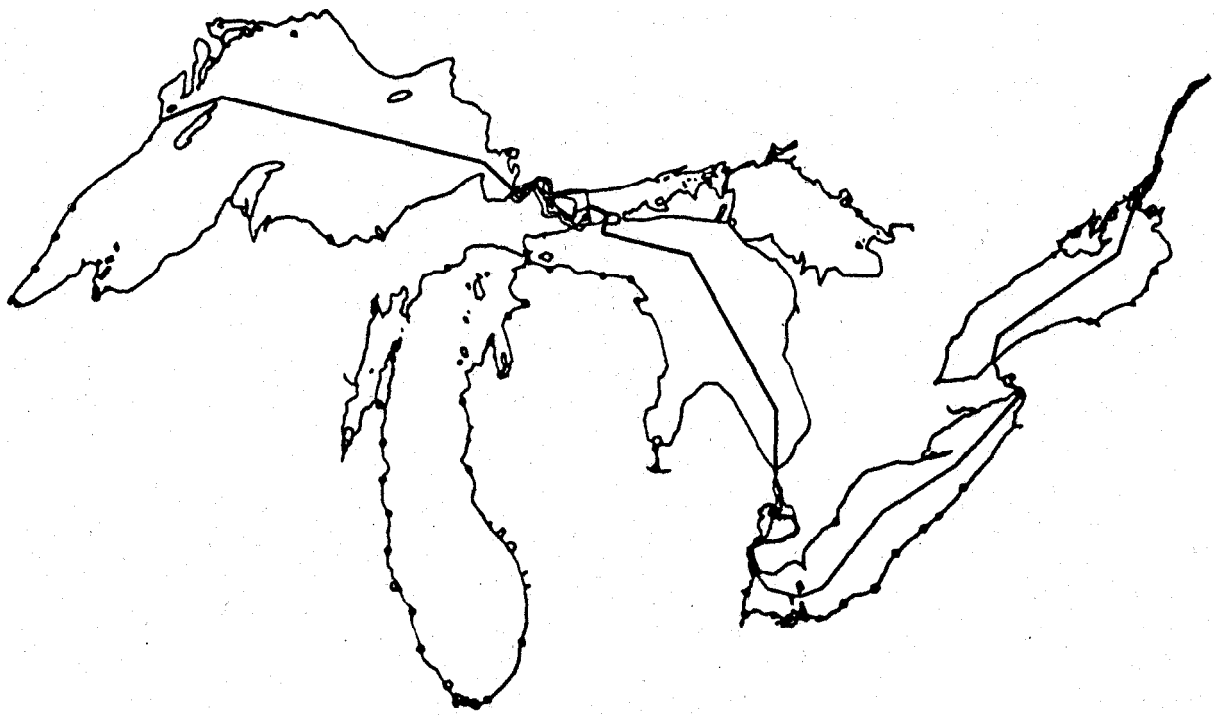
ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES

Volume II - Lake Superior

Great Lake - 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 Wildlife 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 decisionmakers 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 II
Lake Superior

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PREFACE

The fish resources of the Great Lakes have changed markedly since the settlement of the Great Lakes Rasin began in the late 1700s-early 1800s. Local declines in the abundance of some highly valued species that supported early fisheries 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

II. 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 described 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.

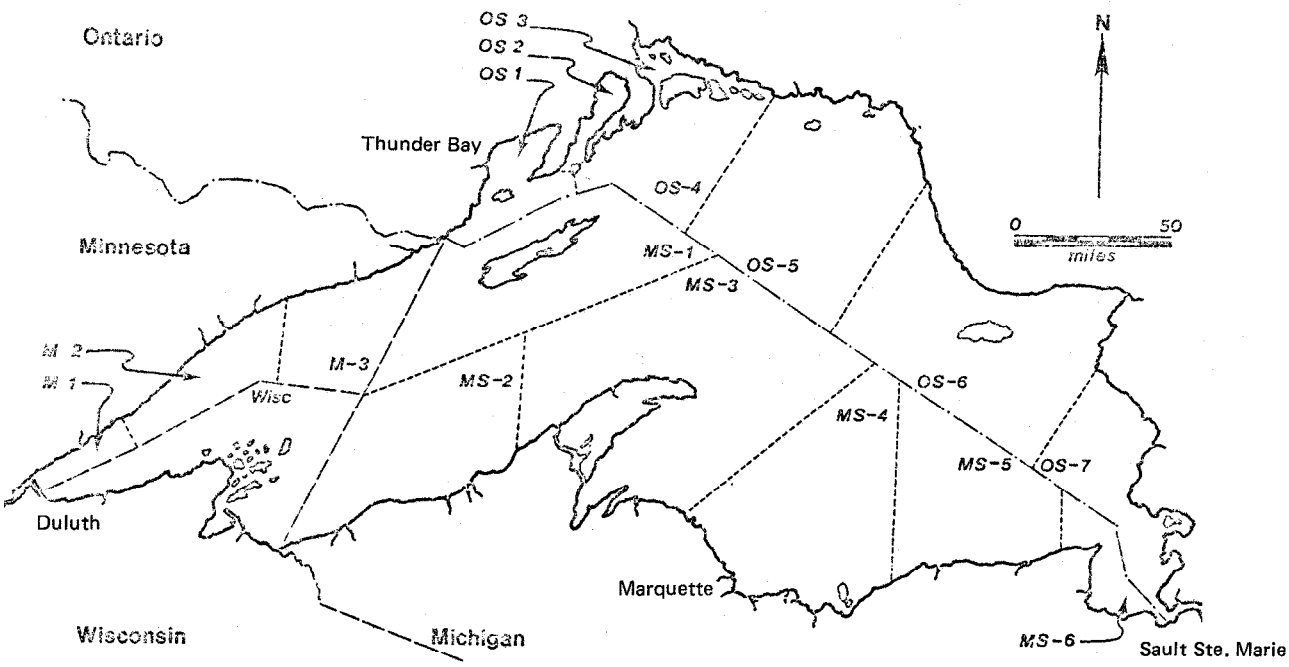
In the preparation of the atlas we found that considerable information was available for most of the species that support (or supported) major recreational or commercial fishes, or that are or were major components of the forage base; conversely, relatively little information was available for many other 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 are 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.

CONTENTS

Volume II. LAKE SUPERIOR

INTRODUCTION



More than 60 species of fish have been recorded as residents of Lake Superior (Berg et al. 1975; Emery 1976; Lawrie 1978; Lawrie and Rahrer 1973; MWRC 1975; Selgeby, pers. comm. 1979). This volume describes the reproductive habitat used by the 49 species for which information was available. Thirty-nine species treated in this volume were native to the lake. Most of these 39 native species spawned (or spawn) in tributaries or in shallow, protected waters of the lake. Only six species, including the lake trout, lake herring, three species of ciscoes, and the fourhorn sculpin, utilized the deep offshore waters for spawning. Two of these deepwater spawners, the blackfin cisco and shortnose cisco, are now believed to be extinct. Only the lake trout spawned in the tributaries, the shallow nearshore waters, and the deeper offshore waters.

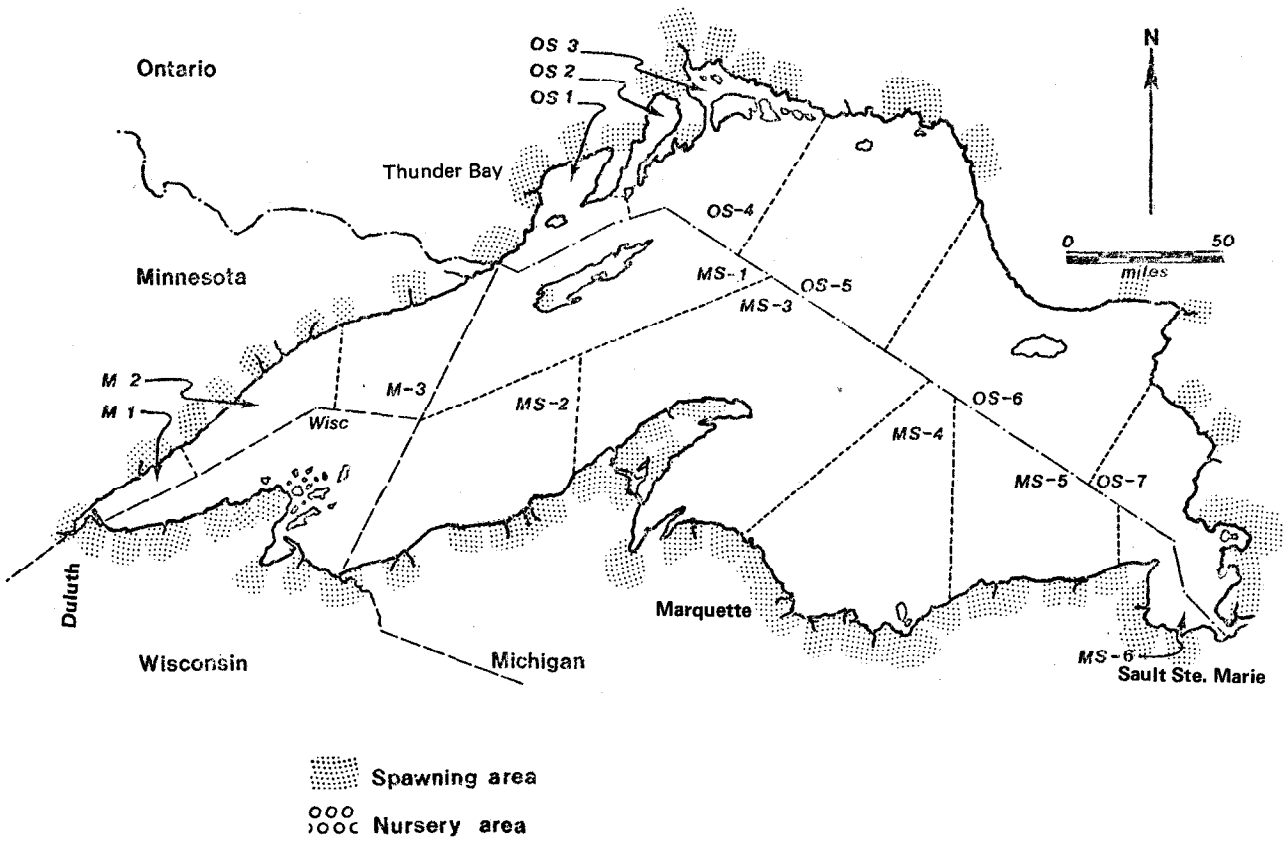
The nine exotic species treated in this volume were introduced by man, or immigrated to the lake during the period of record, from populations established elsewhere in the Great Lakes drainage. Five of these are salmonids which are believed to spawn exclusively in tributaries. The other four spawn in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

Information on nursery areas used by the 49 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-history stages. Dispersal from spawning areas is rapid for some species which have small, pelagic larvae, whereas the juveniles of 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 narrative 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 M-1 and ending with district OS-7. 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 sea lamprey presumably entered Lake Superior from Lake-Huron via the St. Marys River. The first recorded capture occurred near Marquette in 1938 (Dees 1980; Smith and Tibbles 1980). An immature adult was taken at Isle Royale in 1946 (Applegate 1947, 19501, and spawning runs were established by 1950 in the eastern half of the lake and also near Duluth (Applegate and Smith 1950, 1951; Applegate et al. 1952; Smith 1971). Spawning runs into Lake Superior tributaries occur in May-July and usually peak in late May to mid-June; adult in spawning condition may be found into September (Fish. Res. Board Can. 1955; GLFC 1973b; Hanson and Manion 1978; Lawrie 1974; Manion and McLain 1971; Price 1955, 1956; SLCC 1979b; Smith and Braem 1976).

Sea lamprey ammocoetes have been found in at least 133 tributaries (Dees 1980). Ammocoetes also commonly occur in many bays, harbors, and mouth areas of spawning streams and as far as 2 mi offshore from spawning streams, especially in dropoff areas (Braem and Rugen 1976; Gollat 1976; GLFC 1973b, 1975; Smith and Braem 1976; Thomas 1961a,b, 1962, 1966; Tibbles 1975; Tibbles et al. 1976a; Wagner and Stauffer 1962).

The tributaries listed below are classified as spawning streams based on the presence of ammocoetes, spawning adults, or both.

Minnesota

Spawning runs of sea lampreys are rare or absent in Minnesota tributaries because of barrier falls near stream mouths and unsuitable bedrock substrate in the streams (Eddy and Underhill 1974; Morman et al. 1980). Runs have occurred in the following streams (Smith and Braem 1976; Smith et al. 1974; Thomas 1961a; Torblaa and Westman 1980, unless otherwise noted).

M-1

St. Louis River (46°45', 92°06') (H. Johnson, pers. comm. 1979).

Big Sucker Creek (Sucker River) (46°55', 91°51'), Knife River (46°57′, 91°47'), and Stewart River (47°03′, 91°38′).

M-2

Gooseberry River (47°08', 91°27′), Split Rock River (47°11′, 91°24'), Baptism River (47°20', 91°12′), Cross River (47°32', 90°53'), and Poplar River (47°38', 90°42').

M-3

Cascade River (47°42', 90°31') (Hassinger, pers. comm. 1979).

Brule (Arrowhead) River (47°49', 90°03') and Pigeon River (48°00', 89°34').

Wisconsin

Spawning runs enter the following streams (Pails et al. 1971; Braem and Rugen 1976; FWS 1979a; GLFC 1973b, 1975; Moore and Braem 1965; Smith 1971; Smith and Braem 1976; Smith et al. 1974; Torblaa and Westman 1980).

Nemadji River (46°42', 92°02'), Amnicon River (46°41′, 91°51′), Middle River (46°42', 91°50'), Poplar River (46°42', 91°47′), Brule River (46°45′, 91°37′), Fish Creek (46°45', 91°31'), Reefer Creek (46°46', 91°30'), Cranberry River (46°50', 91°16'), Siskiwit River (46°51′, 91°06′), Sand River (46°56', 90°56'), Raspberry River (46°56', 90°50'), Fish Creek (46°35', 90°57'), Bad and White Rivers (46°38', 90°39'), and Montreal River (46°34', 90°25').

Michigan

The following streams have spawning runs (Bails et al. 1971; Braem and Rutgen 1976; Erkkila et al. 1956; FWS 1979a,c; GLFC 1973b, 1975; Loeb and Hall 1952; Moore and Braem 1965; Smith 1971; Smith and Braem 1976; Smith et al. 1974; Stauffer and Hansen 1958; Torblaa and Westman 1980; Wagner and Stauffer 1962).

MS-1

Washington Creek (47°55, 89°09').

MS-2

Black River (46°40', 90°03'), Union River (46°49′, 89°37′), Little Iron River (46°50′, 89°35'), Cranberry River (46°50', 89°25'), Potato River (46°51′, 89°23'), Ontonagon River (46°52', 89°20'), Flint Steel River (46°56′, 89°12'), Fire Steel River (46°56', 89°12'), Sleeping River (46°59', 89°04'), and Misery River (47°00', 88°59').

MS-3

Elm River (47°03', 88°55), Graveraet River (47°07', 88°51'), Mud Lake Outlet (47°08′, 88°17'), Salmon Trout River (47°09′, 88°46′), Boston-Lily Creek (47°11′, 88°38′), Smith Creek (47°15′, 88°34′), Gratiot River (47°21′, 88°27'), Trap River (Eliza Creek) (47°28', 88°10'), Little Gratiot River (47°22', 88°02'), Traverse River (47°11′, 88°14′), Trap Rock River (47°11', 88°24'), McCallum Creek (47°09', 88°24'), Pilgrim River (47°06′, 88°31'), Sturgeon River (47°02', 88°29'), Six Mile Creek (46°45′, 88°30′), Falls River (46°45', 88°27'), Silver River (46°49', 88°17'), Slate River (46°50', 88°16′), Ravine River (46°50′, 88°15′), Huron River (46°55', 88°02'), Pine River (46°53', 87°52'), and Salmon Trout River (46°52', 87°46').

MS-4

Little Iron River (46°49', 87°39'), Big Garlic River (46°43′, 87°34'), Little Garlic River (46°41′, 87°31′), Harlow Creek (46°38', 87°28'), Dead River (46°34', 87°23'), Carp River (46°31′, 87°23′), Chocolay River (46°30', 87°21'), Sand River (46°30', 87°06'), Laughing Whitefish River (46°31′, 87°02'), Deer Lake Creek (46°28', 86°57'), Rock River (46°28', 86°55'), Au Train River (46°26', 86°51'), Five Mile Creek (46°28′, 86°44'), Furnace Creek (46°26', 86°42'), Anna River (46°25′, 86°38′, Munising Falls Creek (46°27', 86°36'), Miners Creek (46°30', 86°33′, and Mosquito River (46°32′, 86°30′).

MS-5

Beaver Lake Creek (46°35', 86°21′), Seven Mile CreeK (46°37', 86°16′), Sullivan Creek (46°39', 86°11'), Hurricane River (46°40′, 86°10′), Sable Creek (46°40', 86°01'), Carpenter Creek (46°40', 85°59'), Sucker River (46°40', 85°56'), Blind Sucker River (46°41', 85°40'), Big

Two Hearted River (46°42', 85°25'), Little Two Hearted River (46°43', 85°22'), and Carp River three Mile Creek) (46°44', 85°19').

MS-6

Pendills Creek (46°27' 84°49'), Grants Creek (46°28', 84°52'), Halfaday Creek (46°28', 84°54'), Naomikong Creek (46°29', 84°58'), Ankodosh Creek (46°29', 85°00'), Galloway Creek (46°32', 85°03'), Tahquamenon River (46°33', 85°02'), and Betsy River (46°41', 85°01').

Ontario

Sea lamprey do not spawn as extensively in Canadian tributaries to Lake Superior as in U.S. tributaries. Most sea lamprey spawning in Ontario waters occurs in tributaries to whitefish Bay (46°40', 84°50') (Price 1955; SLCC 197933). Spawning runs enter the following streams (Gollat 1976; GLFC 1973b, 1975; Lawrie 1955b; Price 1955, 1956; SLCC 1979a,b; Smith 1971; Smith et al. 1974; Speirs 1955; Thomas 1961a; Tibbles 1975; Tibbles et al. 1976a,b; Torblaa and Westman 1980).

OS-1

Pine River (48°03', 89°30'), Cloud River (48°05', 89°26'), Kaministiquia River (48°23', 89°13'), Neebing River (48°24', 89°13'), McIntyre River (48°25', 89°13'), Current River (48°27', 89°11'), MacKenzie River (48°32', 88°57'), and Blende River (48°34', 88°46').

OS-2

Pearl River (48°37', 88°37'), Wolf River (48°49', 88°29'), and Black Sturgeon River (48°50', 88°24').

OS-3

Stillwater Creek (48°59', 88°16'), Nipigon River (48°57', 88°15'), Cash Creek (49°06', 88°15'), Jackfish River (49°00', 88°05'), Jackpine River (48°58', 85°00'), Cypress River (48°56', 87°52'), Little Gravel River (48°55', 87°46'), Gravel River (48°55', 87°46'), Pays Plat River (48°53', 87°34'), and Hewitson River (48°50', 87°27').

OS-4

Otter Cove Creek (48°34', 88°19').

OS-5

Steel River (48°46', 86°54'), Prairie River (48°47', 86°47'), Little Pic River (48°47', 86°38'), Pic River (48°36', 86°18'), and white River (48°33', 86°16').

OS-6

University (Dog) River (47°58', 85°12') and Michipicoten River (47°56′, 84°51′).

OS-7

Sand River (47°26', 84°44'), Agawa River (47°21′, 84°38′), Pancake River (46°58′, 84°40′), Sable River (46°57', 84°35'), Batchawana River (46°56′, 84°32′), Chippewa River (46°56', 84°27'), Sawmill Creek (46°53', 84°22'), Harmony River (46°51′, 84°23'), Stokely Creek (46°49', 84°25'), Havilland Creek (46°49', 84°25'), Goulais River (46°43', 84°27'), and Cranberry Creek (46°42', 84°25').

LAKE STURGEON

Lake sturgeon spawned later in the year in Lake Superior than in the other Great Lakes; in Lake Superior the females were still full of spawn in late July (Milner 1874a).

Minnesota

M-1

St. Louis River (46°45', 92°06'). Spawning runs occurred in this river in the spring (Kaups 1978; Schram, pers. comm. 19791, and a remnant population is still present (Hassinger, pers. comm. 1979).

M-3

Piqeon River (48°00', 89°34'), A remnant population is present at Grand Portage (47°58', 89°41') and may be associated with the river (Hassinger, pers. comm. 1979).

Wisconsin

Bayfield (46°49', 90°49'). Ripe fish were observed here in late July (Milner 1874a).

Bad River (46°38', 90°39'). A spawning run moves Upstream to Amherst Falls in the late spring-early summer (Bolton, pers. comm. 1979; King and Swanson, pers. comm. 1979). Sturgeon were collected here at the U.S. Fish and Wildlife Service (FWS) sea lamprey weir (Moore and Braem 1965).

Michigan

MS-3

sturgeon River (47°02', 88°29'). Sturgeon were observed at the FWS sea lamprey weir in this river (Moore and Braem 1954).

Pine River (46°53′, 87°52′). Sturgeon ran into the mouth of the Pine River (Hubbs 1929).

MS-6

Tahquamenon River (46°33', 85°02'). This river formerly supported a run (Hankinson 1916).

Ontario

Spawn was taken for caviar along the Canadian shore (Smith and Snell 1891).

OS-5

Big Pic River (48°36', 86°18'). This was a spawning ground (Ont. Game Fish 1912).

OS-7

Goulais River (46°43', 84°27'). Adults were captured at the FWS sea lamprey weir in the river in the mid-1950s (Price 1955). Sturgeon spawned in the river, and young about 3 in. long were present (Lamsa, pers. comm. 1979).

ALEWIFE

The alewife presumably entered Lake Superior through the St. Marys River (Miller 1957). Alewives were first observed in Lake Superior in about 1954, but the species has not reproduced very successfully and is not abundant (Gollat 1976).

Minnesota

M-1

Duluth Harbor (46°45', 92°05'). The harbor is a spawning and nursery area; alewives run into the harbor in late June-early July (Hassinger, pers. comm. 1979; H. Johnson, pers. comm. 1979).

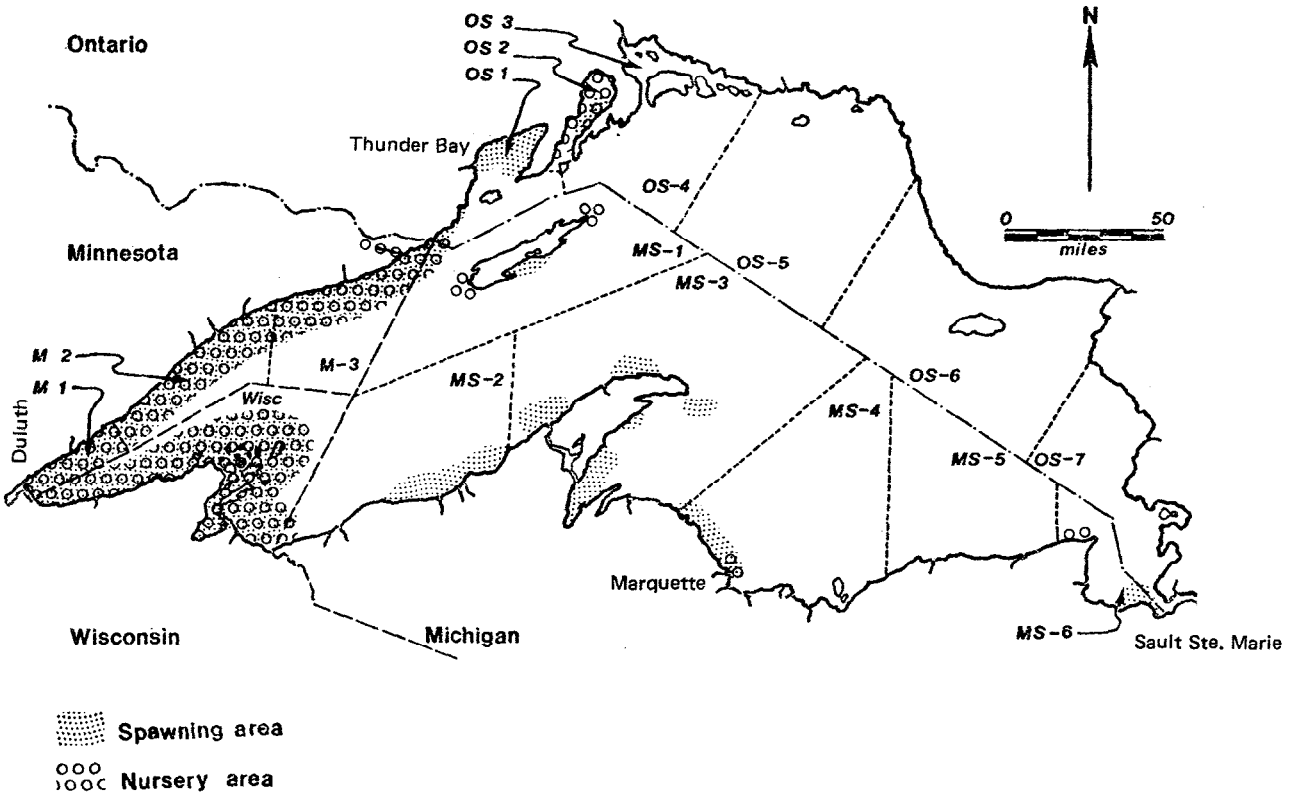
M-2

Split Rock River (47°11', 91°24'). Young-of-the-year (YOY) have been collected intermittently in the river (Hassinger, pers. comm. 1979).

Wisconsin

Chequamegon Bay (46°40', 90°50'). A population of alewives resides in the bay and may spawn there; YOY were present in weedy areas at the head of the bay (Pratte and Swanson, pers. comm. 1979).

Superior Harbor (46°42', 92°01'). This is a spawning area, and alewife fry have been collected here (CDM/Limnetics 1976b).



In Lake Superior, lake herring migrate inshore during October-December (USBCF 1969b). Peak spawning occurs during the last 2 weeks of November and the first week of December, when the water temperature drops to 37-40°F (Anderson 1969; Cook 1929; Dryer and Beil 1964; Eddy and Underhill 1974; Koelz 1926; Lawrie 1978; Peck 1975a; USDI 1970). Spawning occurs pelagically at depths of a few feet to 150 ft over a variety of substrates (Dryer and Beil 1964; Eddy and Underhill 1974; Peck 1975a). The most productive commercial fishing areas and most favorable spawning grounds were in the western part of the lake from Thunder Bay (48°25', 89°00'), Ontario, south to the Apostle Islands (47°00', 90°40'), Wisconsin (Koelz 1926). A very productive historic spawning and nursery area extended from the Knife River (46°57', 91°47'), to the Apostle Islands, (Hassinger, pers. comm. 1979; Sve, pers. comm. 1979). Herring in the west end of the lake are believed to be bottom spawners, whereas those in the eastern part of the lake spawn over deep water (GLFC 1968c).

Minnesota

Today, very little spawning occurs along the Minnesota shore, but historically, lake herring moved inshore in large numbers to spawn along the entire shore from the Pigeon River (48°00', 89°34') south to Duluth (46°48', 92°05'). Until the early 1950s, "blueback" herring came in during the fall to spawn pelagically from the shoreline out to depths of 300 ft, from Grand Portage (47°58', 89°41') to the Knife River (46°57', 91°47'). Ripe fish were taken with float nets at various depths from the surface down. "Bottom" or "redback" herring came in during the fall to spawn on the bottom from the shore out to depths of 300 ft, from the Knife River to Port Wing (46°47', 91°23'), Wisconsin. Ripe fish were taken with bottom nets (Hassinger, pers. comm. 1979). Shoreward migration began as early as October and spawning usually occurred in November and December. There are also records of nearshore catches in January.

various shoreline spawning migrations have been identified. One migration involved a westward movement along the Minnesota North Shore towards Duluth prior to the spawning season, followed by a return movement along the same route after the spawning season. A similar migration originating in the Apostle Islands (47°00', 90°40') occurred along the Wisconsin shore. Some North Shore fishermen also reported that the best catches were made in October while the herring were moving east on a southwest current, presumably to spawning grounds in Pigeon (48°01', 89°31'), Cloud (48°05', 89°26'), Thunder (48°25', 89°00'), or Black (48°40', 88°30') bays; catches were again good in December, when the herring were moving back to the west (Fenstad, pers. comm. 1979; FWS 1979d; W. Johnson, pers. comm. 1979; Kaups 1978; Koss and Koss, pers. comm. 1979; Minn. DNR 1937-59, 1946; Spry, pers. comm. 1979; Sve, pers. comm. 1979; Zerbach, pers. comm. 1979). Herring congregated along the North Shore in large numbers until mid-November, and then migrated into Wisconsin waters at the western end of the South Shore to spawn (Dunn 1918).

Post-spawning adults and younq-of-the-year (YOY) were pelagic. Young herring frequented the waters along the northern Minnesota shoreline. Fishermen often observed young herring, at the surface in bays and shoreline areas during the summer, and collected them for use as bait (Fenstad, pers. comm. 1979; Hassinger, pers. comm. 1979; Hendrickson, pers. comm. 1979; Koss and Koss, pers. comm. 1979; Spry, pers. comm. 1979; Zerbach, pers. comm. 1979).

M-1

Two Harbors (47°01', 91°40'). Fishing occurred inshore during the spawning season (Croft, pers. comm. 1979).

French River (46°54', 91°53'). Pelagic spawning occurred in this area during November in water 240-300 ft deep (W. Johnson, pers. comm. 1979). Eggs have been collected from fish caught at the mouth of the river (Eddy and Underhill 1974).

Duluth Harbor (46°45', 92°05'). The harbor area supported spawning until the 1940s, when the run declined because of pollution (Fenstad, pers. comm. 1979). During the late 1960s, ripe adults were collected in November and December, just outside the harbor at 46°46', 92°02', and eggs (Coregonus spp.) were found in late November. Hatching occurred in April and early May, and early larvae (Coregonus spp.) were collected near the surface beginning in late April. Densities of larvae peaked in late May and early June and declined dramatically in June and early July. The number of spawners in the area decreased recently, possibly due to large concentrations of smelt which may have crowded the herring off the spawning ground (Anderson 1969; Anderson and Smith 1971). [Authors* note: Eggs and larvae identified as "Coregonus spp." by Anderson 1969 and Anderson and Smith 1971 were presumed by these authors to be eggs and larvae of lake herring.]

M-2

Little Two Harbors (47°12′, 91°22′). Ripe and running adults were caught in November (Sve, pers. comm. 1979).

M-3

Pigeon Bay (48°01′, 89°31′). Pelagic spawners moved inshore on about October 15 to sandy areas 25-30 ft deep near the Pigeon River (48°00′, 89°34′). Young-of-the-year were found along the bay side of Pigeon Point (48°00', 89°30') and at the narrows in the bay (Fenstad, pers. comm. 1979; Hendrickson, pers. comm. 1979; Koss and Koss, pers. comm. 1979).

Wauswaugoning Bay (47°58', 89°37')--Grand Portage Bay (47°57', 89°40'). Very large numbers of herring entered the bays on about October 15, and young were found at the head of Wauswaugoning Bay, around the islands off the mouth of the Grand Portage River (47°58', 89°41') and in the river proper prior to 1955 (Fenstad, pers. comm. 1979; Hendrickson, pers. comm. 1979; Spry, pers. comm. 1979).

Big Bay (47°52', 89°55'). Young herring were caught here for use as bait (Koss and Koss, pers. comm. 1979).

Red Cliff Bay (47°47', 90°10'). The area off Kadunce Creek (47°48'. 90°09') was one of the best fishing areas during the peak of spawning in November-December (Zerbach, pers. comm. 1979).

Grand Marais (47°45', 90°20'). Fishing was carried out from early October to early December and peaked in November (Koelz 1929). Young were found during the summer in bays (Zerbach, pers. comm. 1979). In 1922, YOY were found in Grand Marais Harbor and at the mouth of the Devil Track River (47°46', 90°16′) in mid-July (Koelz 1929).

Wisconsin

Lake herring migrated through the Minnesota waters to spawn in large numbers in mid-November over the shallow mud bottom along the western Wisconsin shore; spawners were present on the spawning grounds for about 3 weeks and then disappeared (Dunn 1918). More recently, commercial fishermen reported that herring spawned on mud and silt along shore from Superior (46°44', 92°05') to the Apostle Islands (47°00', 90°40'). The run heqan earlier in the western end of the lake, peaked just before Thanksgiving, and ended on about December 7. Adults were also caught during the spawning season from the Apostle Islands to Marble Point (46°35', 90°30'), usually in water less than 240 ft deep (Coberly and Horrall 1980b).

In Wisconsin waters, there are two varieties of lake herring, both of which spawned during November-December: the "deep", "deepwater", "mud", or bottom herring that spawns in deep water, and the "reef" herring that, spawns slightly earlier on the shallow, rocky reefs used by whitefish (Coberly and Horrall 1980b; King and Belonqer 1970; King and Swanson 1975, pers. comm. 1979; Peck 1975a; Peck et al. 1974). Spawning also occurs at the following sites, most of which are in the Apostle Island region.

Superior' Harbor (46°42', 92°01'). Lake herrinq spawn at the harbor entry (Pratt and Swanson, pers. comm. 1979).

Port Wing (46°47', 91°23'). The spawning run beqan here in mid-November (Coberly and Horrall 1980b). The abundance of spawners recently has been very low (King and Belonqer 1970).

Siskiwit Bay (46°52', 91°07'). In the 1950s, this was a very important fishing area during the spawning run (Scott et al. 1978), which began in mid-November (Coberly and Horrall 1980b). The abundance of spawners at Cornucopia (46°51', 91°06') recently has been very low (King and Belonqer 1970).

Apostle Islands (47°00', 90°40')--Bayfield (46°49', 90°49'). Fishing was conducted during the spawning season in this historical spawning area. Herring congregated in large schools prior to spawning in water 90-150 ft deep (Dryer 1966; Dryer and Beil 1964; King, pers. comm. 1979; Lawrie and Rahrer 1973; Selqeby et al. 1978). In 1960, ripe adults were observed here as late as December 20 (Dryer and Beil 1964). Eggs (Coreqonus spp.) were collected in late November and early December (Anderson 1969; Anderson and Smith 1971). Larvae were collected mainly at the surface in this area, from late April to mid-June (Anderson 1969; Selqeby 1978; Selgeby et al. 1978; Smith 1954).

Sand Island (46°59', 90°57'). Reef herring spawned on the north and east shores of the island (Coberly and Horrall 1980b). Lake herring spawn north of the island over a clay and ooze substrate in water 600-930 ft deep (King and Swanson, pers. comm. 1979). This was one of the most productive fishing areas for mud herring (Coberly and Horrall 1980b).

York Island Shoals (47°01', 90°51')--Bear Island Shoal (47°02', 90°49'). Reef herring spawn here (Coberly and Horrall 1980b; King and Swanson, pers. comm. 1979). Larvae (Coregonus spp.), many with yolk sacs, were collected beginning in April at an unnamed site (47°05', 90°53') 6 mi N of York Island; eggs (Coregonus spp.) were also collected there in April and May (Anderson 1969, Anderson and Smith 1971).

Hear Island (47°01, 90°45'). Ripe adults were collected off the southeast shore in November and December, and eggs (Coreqonus spp.) were found in late November and early December. Larvae (Coregonus spp.), many with yolk sacs, were also collected beginning in late April (Anderson 1969; Anderson and Smith 1971). Reef herring were the main catch here (Coberly and Horrall 1980b).

Raspberry Island (46°58', 90°48'). This was a spawning area for reef herring. Mud herring spawned in the Raspberry-Oak Island Channel (Coberly and Horrall 1980b).

Rocky Island (47°02', 90°41')--South Twin Island (47°02', 90°39'). This was a spawning area for reef herring (Coberly and Horrall 1980b).

Outer Island Shoal (47°05', 90°25'). Reef herring spawn on Outer Island Shoal off the north side of the island (King and Swanson, pers. comm. 1979).

Stockton Island (46°56', 90°35'). Mud herring spawned along the north shore (46°58', 90°36') and reef herring spawned at Presque Isle Point (46°55', 90°33') (Coberly and Horrall 1980b).

Gull Island Shoal (46°57', 90°24'). This was a spawning area for mud herring (Coberly and Hort-all 1980b).

Michigan Island (46°53', 90°29'). Reef herring spawned along the southeast shore (Coberly and Horrall 1980b). Reef herring spawn on the shoals off the northeast end of the island at 46°51', 90°33' (King and Swanson, pers. comm. 1979).

Madeline Island (46°50', 90°40'). Spawning occurs in late November-early December from Big Bay (46°49', 90°38') to the soutnwest end of the island in a 100-150 ft deep trench with a bottom of clay and sand (Coberly and Horrall 1980b; King and Swanson, pers. comm. 1979). Big Bay was one of the most important fishing areas during the spawning season (Coberly and Horrall 1980b; Scott et al. 1978). In the late 1960s, some viable eggs (Coreqonus spp.) were present in Big Bay in April and early May, and larvae (Coregonus spp.), many with yolk sacs, appeared in late April. Ripe adults were present west of Pt. De Froid at 46°46', 90°50' in November and December, and viable eggs (Coregonus spp.) were found in early December (Anderson 1969; Anderson and Smith 1971). The North Channel

(46°51', 90°42') and Bayfield-Madeline Channel (46°48', 90°49') were also spawning areas for deep herring (Coberly and Horrall 1980b).

Hermit Island (46°53', 90°41'). Mud herring spawned in the west channel (46°54', 90°43') northwest of the island (Coberly and Horrall 1980b).

Long Island (46°43', 90°46'). Reef herring spawned all along the east shore of the island and along the Wisconsin shore to Marble Point (46°35', 90°30') (Coberly and Horrall 1980b). Spawning occurs between Houghton Point (46°42', 90°51') and the west tip of Long Island (46°43', 90°49) in 60-70 ft of water (King and Swanson, pers. comm. 1979).

Oronto Bay (46°35', 90°26'). Spawning occurred all along the shore of the bay (Coberly and Horrall 1980b). Spawning occurs west of Little Girls Point (46°37', 90°20') at a depth of more than 100 ft (King and Swanson, pers. comm. 1979). The nearshore area along the Wisconsin-Michigan boundary (46°34', 90°25') has been the main fishing ground for the Wisconsin fishery during the spawning run in November and December (King and Belonger 1970).

Michigan

Both the deepwater and "shallow water" herring also occur in Michigan waters, but the deepwater type is more abundant (Peck 1975a; Wilson, pers. comm. 1979). Commercial catches were taken in mid-November to the first or second week of December and were usually highest in late November (Anderson 1910-1926).

MS-1

Isle Royale (48°00', 88°50'). Since the early 1900s, lake herring spawned in Siskiwit Bay (47°57', 88°50') over sand bottom in 45-80 ft of water from mid-November to the end of December (Organ et al. 1978). A commercial fisherman identified one type of herring that spawned near the surface over deep water and another type that spawned in shallow water over sand. In 1905, young herring, 1 1/2 in. long, were collected at the head of Tobin Harbor (48°09', 88°30') in late July; young herring were also collected (date not specified) in a cove opposite Thompson Island (47°54', 89°14') (Hubbs and Lagler 1947).

MS-2

Union Bay (46°50', 89°37')--Misery Bay (47°00', 89°01'). The deepwater herring spawns in this area in November over mud and rock substrate in water 210-240 ft deep. Spawning shallow water herring were caught over shallow, rocky areas off Green City (49°50', 89°26') in November; spawning also probably occurs east and west of here along the shoreline (Wilson, pers. comm. 1979). At Green City, spawning occurs in rock gullies extending from Stony Creek (46°50', 89°30') east to the Potato River (46°51', 89°23'); in 1937-1954, spawning occurred in

mid-November through December (Organ et al. 1978). Large numbers of spawners moved into the shallows at Ontonagon (46°53', 89°19') in mid-November to early December (Koelz 1929).

MS-3

Keweenaw Peninsula (47°10', 88°30'). Spawning generally occurs in November at the following areas (Organ et al. 1978):

Redridqe (47°09', 88°46'). A rocky area (47°09', 88°46'--47°13', 88°41'), used since 1968 extends 5-6 mi along the shore north of Redridge. McGunn's Creek (47°15', 88°33'). A rocky area, used since 1968, extends for about 5 mi from 47°15', 88°34' --47°18', 88°30'. Eagle Harbor (47°28', 88°09')--Agate Harbor (47°28', 88°03'). A rocky area (47°28', 88°11'--47°29', 88°01') used since 1963 extends along shore in this area. Manitou Island (47°25', 87°37'). The rocky shoals around the island have been used at least since 1963. Point Isabelle (47°21', 87°56'). During 1936-73, a nearshore rocky area (47°17', 88°01') 5-6 mi S of the point was used. Traverse Point (47°08', 88°14'). The rock areas around the point were used at least until 1969 and a mud area (47°07', 88°14'--47°05', 88°17') between the point and Traverse Island (47°04', 88°16') was used until the 1960s.

Keweenaw Bay (46°58', 88°20'). In 1951, the first spent adult was collected on November 12 (Dryer and Beil 1964). Commercial fishermen report spawning occurs in the bay from November (sometimes mid-October) to mid-December in water 4-180 ft deep. Both shallow and deepwater forms spawn in the bay and several locations have been identified:

Traverse Island (47°04', 88°76'). Since the mid-1960s, herring spawned in November on the shoals around the island and also in the deep, mud gullies (47°07', 88°14'--47°05', 88°16'; 47°03', 88°13' --46°57', 88°20') extending south on both sides of the island into the bay (Organ et al. 1978; Wilson, pers. comm. 1979).

Portage River (46°58', 88°26'). Since 1965, spawning occurred over mud off the mouth of the river. Community of Keweenaw Bay (46°52', 88°29'). During the 1940s, spawning occurred at 46°52', 88°27' over sand. Assinins (46°49', 88°28'). During the 1940s, spawning occurred at 46°49', 88°27' over sand. Pequaming (46°51', 88°24'). Until 1974, spawning occurred at 46°51', 88°26' over sand (Organ et al. 1978).

MS-4

Big Bay (46°50', 87°43'), Sauk Head (46°43', 87°34')--Thoney Point (46°41', 87°31'), Granite Point (46°38', 87°27')--Little Presque Isle (46°38', 87°28'), and Partridge Island (46°36', 87°25'). Herring were taken here in November and December (Anderson 1910-26).

Marquette (46°33', 87°23'). During mid-November-early December large numbers of herring moved inshore to sand areas at depths as shallow as 48-60 ft east and northwest of Marquette (Koelz 1929). Herring were caught in November and December at Presque Isle (46°35', 87°23'). Larvae believed to be lake herring were found February-April 1975 in Presque Isle Harbor (46°34', 87°23'), but no spawning was observed (Wapora 1976b).

MS-5

Grand Marais (46°40', 85°59'). During late September herring moved onshore to sand areas at depths as shallow as 18-24 ft, then migrated out of the area in early December (Koelz 1929).

MS-6

Whitefish Point (46°46', 84°57'). In 1913, large schools of small herring were seined over sandy bottom in less than 3 ft of water near the Vermilion Life Saving Station in August (Hankinson 1914).

Iroquois Shoal (46°30', 84°40'). Commercial fishermen reported that herring spawned on the shoal over rock and gravel in October and November until 1963, when runs suddenly ceased (Organ et al. 1978). The shoal area, between Iroquois Island (46°30', 84°41'), and the mainland was an excellent spawning ground until dredging occurred there in the 1960s; thereafter the herring apparently moved their spawning qrounds to an unknown location on the Canadian side of Whitefish Bay (46°40', 84°40'). However, spawning adults were collected in the Iroquois Shoal area in November, 1978 (FWS 1977, 1979d; Gleason and Hehmer, pers. comm. 1979).

Ontario

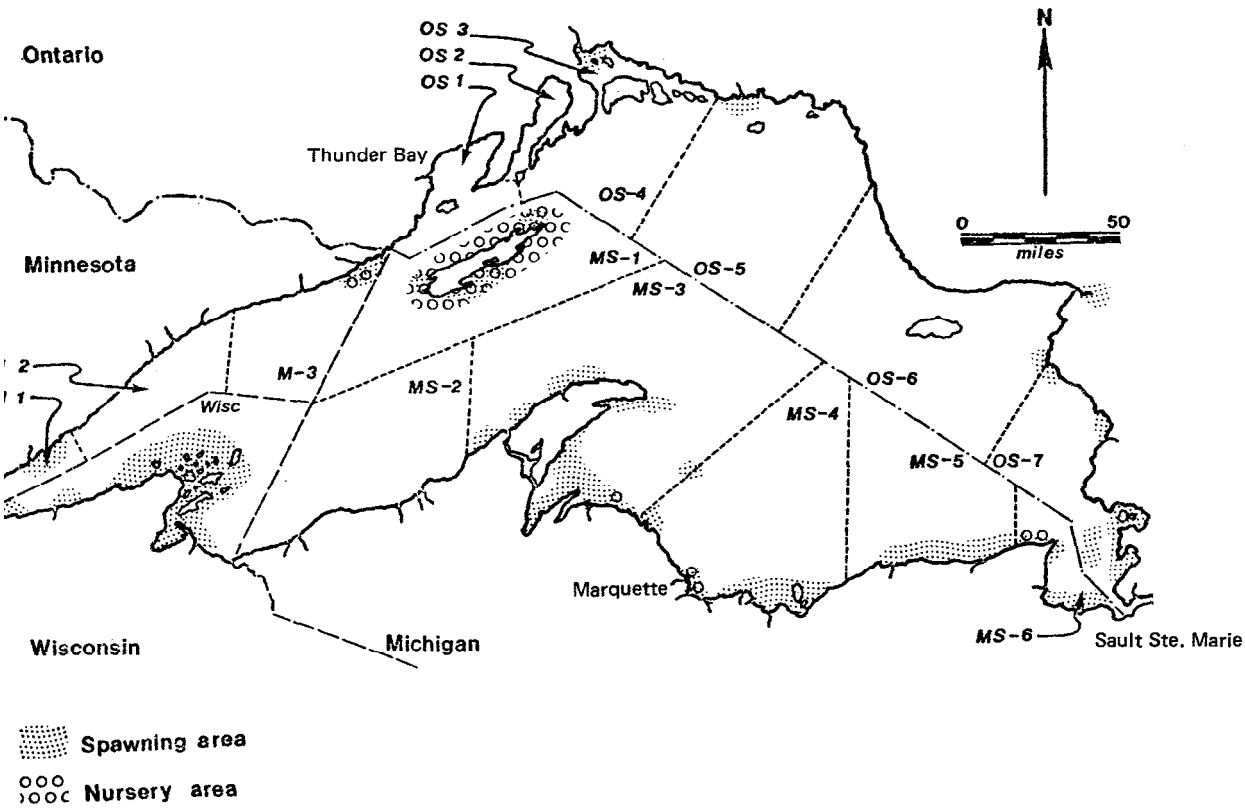
OS-1

Thunder Hay (48°25', 89°00'). Lake herring moved into the bay, spawned in mid-November and left in early December; spawning occurred during this time, pelagically over mud and clay in 36-150 ft of water (Koelz 1929), and large commercial catches were made (Ont. Game Fish 1909, 1912, 1913a,b, 1915, 1916). Large amounts of spawn were collected in the bay from ripe fish (Rodd 1917). In 1979, spawning continued into late December (Hendrickson, pers. comm. 1979).

OS-2

Black Hay (48°40', 88°30'). This is the site of the last large fishery for herring; the fish are caught by trawling during the spawning season (Selgeby et al. 1978). A spawning site extends 10-12 mi from George Point (48°29', 88°36') in a northerly direction (Gollat 1976). The deeper southern part of the bay and the deeper trenches of the northern portion of the bay have the greater abundance of spawning herring (OMNR 1975b). Larvae were present throughout the bay but were concentrated in the lower two thirds of the bay (Selgeby 1978; Selgeby et al. 1978). The concentration of larvae in Black Hay was 78 times higher than in the Apostle Islands (47°00', 90°40') (Pycha and Selgeby 1975).

LAKE WHITEFISH



Lake whitefish in Lake Superior move inshore in mid-September to late October, sometimes congregating at river mouths, and spawn in November at depths of 6-75 ft over sand, gravel, or small stones (Eddy and Underhill 1974; Hankinson 1916; Koelz 1929; MacKay 1957f, 1969; Rathbun and Wakeham 1897). The substrate used for spawning often consists of rock of smaller sizes than that used by lake trout (King and Swanson, pers. comm. 1979; Organ et al. 1978). Fry tend to swarm around docks along shore (Eddy and underhill 1974). The decline of many lake whitefish stocks has been attributed to loss of spawning habitat caused by deposition of lumbering wastes (Lawrie and Rahrer 1973).

Minnesota

Spawning occurred along the Minnesota North Shore from the end of October through the third week of November (Minn. DNR 1937-59). Lake whitefish preferred a substrate of sand, clay, or gravel for spawning, and were less discriminating than lake trout (Kaups 1978). Known Spawning areas are limited to the extreme northern and southern parts of the shore.

M-1

Sucker Bay (46°55', 91°50'). This was a spawning or feeding ground, where lake whitefish were abundant in about 1867 (Tomlin 1887a).

M-3

Pigeon Bay (48°01', 89°31'). The inshore areas are spawning and nursery areas (Hassinger, pers. comm. 1979). Fish were caught during the spawning season at the mouth of the Pigeon River (48°00', 89°34') (Henderson, pers. comm. 1979).

wauswaugoning Bay (47°58', 89°37'). The inshore waters of the bay are spawning and nursery areas (Hassinger, pers. comm. 1979). A commercial fisherman, who fished off St. Frances Island at the north side of the bay mouth (47°58', 89°37'), reported that lake whitefish moved into the bay on about November 10 and remained for only a couple of days (Hendrickson, pars. comm. 1979).

Grand Portage Bay (47°57', 89°40'). This is a spawning and nursery area (Hassinger, pers. comm. 1979). Fishing began in the bay during November 1-15, and the fish left the bay by November 20-25. Nets were fished at the mouth of the bay at Grand Portage Island (47°57', 89°40') for spawning lake whitefish; 21 million eggs were collected on one occasion for hatchery use (Spry, pers. comm. 1979). Small lake whitefish were also caught west of the island (Hendrickson, pers. comm. 1979).

Wisconsin

Except for Brule Point Reef (46°46', 91°33'), the only known spawning grounds in Wisconsin waters are in the Apostle Islands region (47°00', 90°40'), where spawning occurs during approximately the second and third weeks of November (Coberly and Horrall 1980b, King and Swanson, pers. comm. 1979). One fisherman reports spawning occurred along the breakwalls off the mouth of the Nemadji River (46°42', 92°02'), and alongshore to the mouth of the Amnicon River (46°41', 91°51'), where he collected spent fish over the sand and gravel substrate in early December (Coberly and Horrall 1980b). Schools of adults move to shallows and shoal areas in the Apostle Island area to spawn (Dryer 1966); they often spawned on shallower portions of the same reefs that were used for spawning by lake trout (Coberly and Horrall 1980b). Probably most rocky areas along shore and throughout the Apostle Islands are used for spawning (King, pers. comm. 1979). Discrete spawning populations may exist within the Apostle Islands (King and Belonger 1970). The following areas have been identified as spawning or nursery grounds:

Superior Harbor (46°42', 92°01'). In 1886, large numbers of young lake whitefish were observed at the entrance to Allouez Bay (46°41', 92°00') (Tomlin 1887b).

Rrule Point Reef (46°46', 91°33') (Coberly and Horrall 1980b).

Hark Point (46°53', 91°11') (King and Swanson, pers. comm. 1979),

Bark Bay (46°52', 91°10'), Siskiwit Bay (46°52', 91°07'), and Squaw Bay (46°53', 91°03') (Coberly and Horrall 1980b).

Eagle Island Shoals (46°55', 91°03') (Coberly and Horrall 1980b; King and Swanson, pers. comm. 1979).

Eagle Island (46°56', 91°02') (Coberly and Horrall 1980b).

Sand Island (46°59', 90°57'), Sand Island Shoals (47°00', 90°54'), York Island Shoals (47°01', 90°51'), and Bear Island Shoal (47°02', 90°49') (Coberly and Horrall 1980b; King and Swanson, pers. comm. 1979).

Bear Island (47°01', 90°45') (King and Swanson, pers. comm 1979).

Rocky Island (47°02', 90°41') (Dryer 1964; King and Swanson, pers. comm. 1979). Identified as one of the most productive spawning grounds (Coberly and Horrall 1980b).

South Twin Island (47°02', 90°39') (Coberly and Horrall 1980b).

North Twin Island (47°04', 90°35') (Coberly and Horrall 1980b; King and Swanson, pers. comm. 1979).

otter Island (47°00', 90°41'), Oak Island (46°56', 90°44'), Oak Island Shoal (46°58', 90°43'), Little Manitou Island (46°58', 90°41'), and Ironwood Island (47°00', 90°37') (Coberly and Horrall 1980b).

Cat Island and Cat Island Reef (47°02', 90°33') (Coberly and Horrall 1980b; Dryer 1964).

Outer Island Shoal (47°05', 90°25') (Coberly and Horrall 1980b; Dryer 1964; King and Swanson, pers. comm. 1979).

Outer Island Reef (47°05', 90°25'), Presque Isle Point (46°55', 90°33'), Trout Point (46°58', 90°31'), South Trout Point (46°57', 90°30'), Quarry Bay Point (46°55', 90°35'), Hermit Island (46°53', 90°41'), and Basswood Island (46°50', 90°45') (Coberly and Horrall 1980b).

Michigan Island (46°53', 90°29') (King and Swanson, pers. comm. 1979). South end and shoal (46°54', 90°27') (Coberly and Horrall 1980b).

Madeline Island Reef (46°51', 90°33') (Coberly and Horrall 1980b; King and Swanson, pers. comm. 1979). Spawning occurs over sand, rubble, and rocks up to several feet in diameter (Nourse, pers. comm. 1979).

Madeline Island Buoy (46°45', 90°48'), head of Big Bay (46°49', 90°40'), Big Hay Point (46°44', 90°39'), Van Tassells Point (46°46', 90°52'), Houghton Point (46°42', 90°51'), Soldiers Rock (46°45', 90°45'), Schoolhouse Road west (46°50', 90°37'), Schoolhouse Road east (46°50',

90°36'), Chequamegon Bay (46°40', 90°50'), Sand Cut Reef (46°44', 90°41'), and Marble Point (46°35', 90°30') (Coberly and Horrall 1980b).

Michigan

MS-1

Isle Royale (48°00', 88°50'). Spawning occurred in many small areas, over rock and gravel; records of spawning in these areas date back to the early 1900s. The areas are off McCargoe Cove (48°06', 88°41'), Little Siskiwit Island (47°57', 88°53'), Wright Island (47°58', 88°49') and east to Schooner Island (47°49', 88°45'), at Point Houghton (47°54', 88°54'), at McCormick Reef (47°51', 89°02'), and at Washington (47°54', 89°11') and Grace (47°53', 89°13') harbors. Spawning occurred in these areas in 6-8 ft of water during late October to mid-November (Organ et al. 1978). Young were seined along shore all around the island, and in 1905 one fry, 1 3/4 in. long, was collected at the head of Tobin Harbor (48°09', 88°30') in late July (Hubbs and Lagler 1947).

MS-3

Keweenaw Peninsula (47°10', 88°30'). Rock-bottomed spawning grounds occur all around the peninsula, including areas just off Redridge (47°09', 88°46') and the Graveraet River (47°07', 88°51'), the shoal just north of the north waterway entry (47°14', 88°38'), Hutchinson Shoal (47°23', 88°24') (Wilson, pers. comm. 1979), Five Mile Point (47°23', 88°22') to Eagle River Shoals (47°26', 88°18') and Great Sand Bay (47°26', 88°15') since 1916 (Organ et al. 1978; Wilson, pers. comm. 1979), all around Manitou Island (47°25', 87°37') since 1916, three scattered areas between Keweenaw Point (47°24', 87°43') and Bete Grise Bay (47°23', 87°56') since 1974, the large shoal area on the north side of Grand Traverse Bay (47°12', 88°12'), and a rock and gravel trench (47°08', 88°08') about 5 mi off shore from Traverse Point (47°08', 88°14') since 1916 (Organ et al. 1978).

Keweenaw Bay (46°58', 88°20'). Rock shoals of Traverse Island (47°04', 88°16') have been used for spawning since 1916; spawning has also occurred at a rock and gravel shoal area about 100 ft deep at 47°03', 88°13' and at sand-bottomed areas in Pequaming Bay (46°50', 88°24'), and Sand Bay (46°52', 88°22') since 1929 (Organ et al. 1978). Spawning grounds at Pequaming (46°51', 88°24') and Baraga (46°47', 88°29') were destroyed by sawdust and mill waste by 1887 (MSBFC 1887).

Huron Bay (46°55', 88°10'). Rock areas of Point Abbaye Reef (46°58', 88°06') and the Huron Islands (46°57', 87°59') were used for spawning since 1916 (Organ et al. 1978; Wilson, pers. comm. 1979). The bay was a very important ground (MSBFC 1895).

Huron River Point (46°55, 87°54')--Salmon Trout Point (46°52', 87°44'). All of the rocky points in this area, including Huron River (46°55', 88°02'), Pine River (46°53', 87°52'), and Conway (46°52', 87°47') and Salmon Trout (46°52', 87°44') points, have been used since 1916 (Organ

et al. 1978). Young-of-the-year whitefish were reported along shore in Pine River Bay (46°53', 87°51') (Hubbs 1929).

MS-4

Big Bay Point (46°51', 87°41'). Spawning occurred here since 1916 (Organ et al. 1978).

Marquette (46°33', 87°23'). No spawning grounds were known in this area, except those at "Standard' (Stannard) Rock (47°11', 87°14'), where limited amounts of spawn were collected (Smith and Snell 1891). Lake whitefish spawn in Presque Isle Harbor (46°34', 87°23'), over the rocks of the intake and discharge structures of the Presque Isle Power Station. Adults move into the harbor in November and December, and larvae were collected during April to mid-May (Wapora 1976a,b). Eggs were collected from the stomachs of fish in the harbor (FWS 1979d).

Munising (46°25', 86°39'). The entire area between Shot Point (46°30', 87°10') and Grand Portal Point (46°33', 86°28'), including Shelter Hay (46°29', 86°56'), Au Train Bay (46°27', 86°50'), Wood Island (46°31', 86°44'), and Grand Island (46°30', 86°40') is a major spawning ground. The area from Au Train Point (46°29', 86°48') to Powell Point (49°26', 86°40'), is a fishing ground and probably also a spawning ground (Swedberg and Nourse, pers. comm. 1979). The bay (probably South Bay 46°25', 86°39') was closed to fishing during the mid-1930s to protect spawning fish (Van Oosten 1938b). A local population still exists and probably spawns here (Organ et al. 1978; Swedberg, pers. comm. 1979). Spawning also occurred on November 15-30 along the east shore of Grand Island (Van Oosten 1927a).

MS-5

Au Sable Point (46°40', 86°09')--Crisp Point (46°45', 85°16'). Lake whitefish spawn along this entire shoreline, primarily over gravel in about 3-18 ft of water (Organ et al. 1978).

MS-6

Crisp Point (46°45', 85°16')--Whitefish Point (46°46', 84°57'). Spawning occurs here over gravel in 3-18 ft of water (Organ et al. 1978). Whitefish Point is an historical spawning site (Goodier, pers. comm. 1979). In 1913, a few young, 2-4 in, long, were seined in lees than 3 ft of water over a sand bottom of Whitefish Point (Hankinson 1914).

Whitefish Bay (46°40', 84°50'). Spawning occurred in the bay during late October to mid-December, but primarily in November (Organ et al. 1978; Van Oosten 1927a). Spawning sites include Tahquamenon Island . (46°32', 84°57'), and the shoals from Tahquamenon Island to Salt Point (46°28', 84°52'), High Hanks (location unknown), Pendills Bay (46°28' 84°50'), and Iroquois Shoal (46°30', 84°40') (FWS 1979d; Gleason and Behmer, pers. comm. 1979; Organ et al. 1978; Van Oosten 1927a).

Ontario

OS-2

Black Bay (48°40', 88°30'). Eggs were collected from ripe fish in the bay (Road 1917).

OS-3

Nipigon River (48°57', 88°15'). The best fishing here was during the spawning season, in October, when lake whitefish moved inshore from deep water and schooled on sand and gravel shoals (MacDonald 1978; Milner 1874a).

OS-5

Terrace Bay (48°46', 87°10'). Lake whitefish spawn over sand at the back of Terrace Bay (Goodier, pers. comm. 1979).

OS-6

Michipicoten River (47°56', 84°51'). Lake whitefish ran into the lower river below the falls and rapids to spawn and were captured there in seines (Barnston 1874; Goode 1884; Milner 1874a).

OS-7

Gargantua (47°35', 84°58'). A fishery "preserve" in the Gargantua area was one of the best spawning grounds in the lake (Ont. Game Fish 1911).

Agawa Bay (47°21', 84°39'). Lake whitefish spawn in the bay was destroyed by suckers (Ont. Game Fish 1912).

Whitefish Bay (46°40', 84°50'). Historical spawning grounds existed throughout Whitefish Bay including the area along the shore from Batchawana Bay (46°51', 84°30') to the St. Marys River (46°30', 84°37'). Specific locations included the area between North and South Sandy islands (46°49', 84°39'), the east side of Ile Parisienne (46°40', 84°43'), (Goodier, pers. comm. 1979). The best fishing ground in the lake was considered to be Persian Island (probably Ile Parisienne), located 30 mi from Sault Ste. Marie (46°30', 84°21') and within 4 mi of the international boundary (Ont. Game Fish 1912). A stock in the lower part of the bay ran into the St. Marys River to spawn (Goodier, pers. comm. 1979; Lawrie and Rahrer 1972, 1973).

BLOATER

The early literature reports that bloaters in Lake Superior may have spawned nearshore in November and December (Eddy and Underhill 1974; Koelz 1929; Lagler 1948). Ripe adults were not seen in catches and the spawning grounds were unknown (Koelz 1929).

Minnesota

Bloaters are believed to spawn on the offshore banks along the entire shore. Ripe adults are caught by fishermen in these areas in the spring (Hassinger, pers. comm. 1979).

Wisconsin

Apostle Islands (47°00', 90°40'). Ripe, spawning chubs, possibly bloaters, are found throughout the islands (Swanson, pers. comm. 1979). Although ripe individuals are found throughout the year, the occurrence of spent fish suggests most spawning takes place in February and March; spent fish were also observed in September. Ripe and spent fish were taken at depths of 120-300 ft and over all bottom types (Dryer and Beil 1968). Spawning occurred during the 1960s in a 350-375 ft deep trench between Stockton Island (46°56', 90°35') and Michigan Island (46°53', 90°29'); an occasional ripe fish is found there in early December and peak spawning is believed to occur in January and February (Pycha, pers. comm. 1979).

Michigan

MS-4

Marquette (46°33', 87°23'). In December 1976, four ripe males and four ripe females were collected at depths of about 425-490 ft, 10 mi NE of Marquette (Passino and Kramer 1980).

KIYI

The kiyi is generally common in deep waters of Lake Superior, but its numbers are declining and it is listed as a "threatened" species. The kiyi is probably extinct elsewhere in the Great Lakes (Todd, pers. comm. 1981). The kiyi spawns in late October to early December (Eddy and Underhill 1974; Koelz 1929; Lagler 1948; Scott and Crossman 1973).

Wisconsin

Apostle Islands (47°00', 90°40'). During the early 1960s, the kiyi. spawned in a 350-375 ft deep trench between Stockton Island (46°56', 90°35') and Michigan Island (46°53', 90°29') (Pycha, pers. comm. 1979).

Michigan

MS-4

Granite Island (46°43', 87°25'). Kiyi spawned off the island at a depth of 420 ft. In 1922, fish collected on November 22 were nearly ripe and most were spawning or spent on December 5 (Koelz 1929).

BLACKFIN CISCO

The blackfin cisco is believed to be extinct in the Great Lakes (Todd, pers. comm. 1981). In Lake Superior, this species spawned in September and early October at depths of 360-600 ft (Koelz 1929; Van Oosten 1938b).

Michigan

MS-5

Grand Marais (46°40', 85°59'). The species was most abundant here in September. In early October 1917, pearled males and ripe, spawning, and spent females were found here at depths of 390 ft (Koelz 1929).

Ontario

OS-3

Rossport (48°50', 87°31'). In 1921, pearled males and ripe, spawning, and spent females were found here at depths of 480-540 ft on October 4 (Koelz 1929).

SHORTNOSE CISCO

The shortnose cisco is believed to be extinct in Lake Superior. A small population in Georgian Bay (45°30', 81°00'), Lake Huron, is the only remaining population in the Great Lakes (Todd, pers. comm. 1981).

Spawning probably occurred in November on sand or mud bottom at depths of 250 ft or less (Eddy and Underhill 1974; Lagler 1948).

Minnesota

In 1942, eggs of an unidentified cisco were collected for hatchery use along the Minnesota North Shore during November 3-11 (Minn. DNR 1937-59); the time of collection coincided generally with the assumed spawning period of the shortnose cisco.

Ontario

OS-1

Thunder Bay (48°25', 89°00'). Spawning may have occurred in November, because most females collected in late November 1922 were spent (Koelz 1929).

SHORTJAW CISCO

The shortjaw cisco occurs in moderate numbers in Lake Superior, however, its numbers are greatly reduced, and it should be considered a "threatened" species (Todd, pers. comm. 1981). The shortjaw cisco is now considered to be taxonomically synonymous with the longjaw cisco (Todd and Smith, unpubl. data). Spawning occurs in late November-early December at depths of 120-240 ft over clay bottom (Van Oosten 1937b).

Minnesota

M-3

Grand Marais (47°45', 90°20'). Spawning may have occurred here along shore; large catches were made here in November (Koelz 1929).

Michigan

MS-4

Marquette (46°33', 87°23'). Large catches of spawners were made about 10 mi NW of Marquette (the approximate location of Granite Island, 46°43', 87°25') over a clay bottom at depths of 120-240 ft. In 1922, the run lasted about 1 week in late November-early December (Koelz 1929). Laughing Fish Point (46°32', 87°01') and Au Train Reef (46°30', 86°54'). In 1916, catches were made here in early November (Anderson 1920-26).

MS-5

Grand Marais (46°40', 85°59'), In 1963, eggs and sperm were stripped from ripe fish caught 7 1/2 mi off Grand Marais in mid-May; the fertilized eggs hatched to produce viable fry (Edsall, pers. comm. 1980).

CISCO spp.

Michigan

MS-2

Ontonagon (46°53', 89°19'). Spawning occurred in a 210-240 ft deep trench running offshore approximately from Union Bay (46°50′, 89°37') to Misery Bay (47°00', 89°01′) over a bottom of mud and rock (Wilson, pers. comm. 1979).

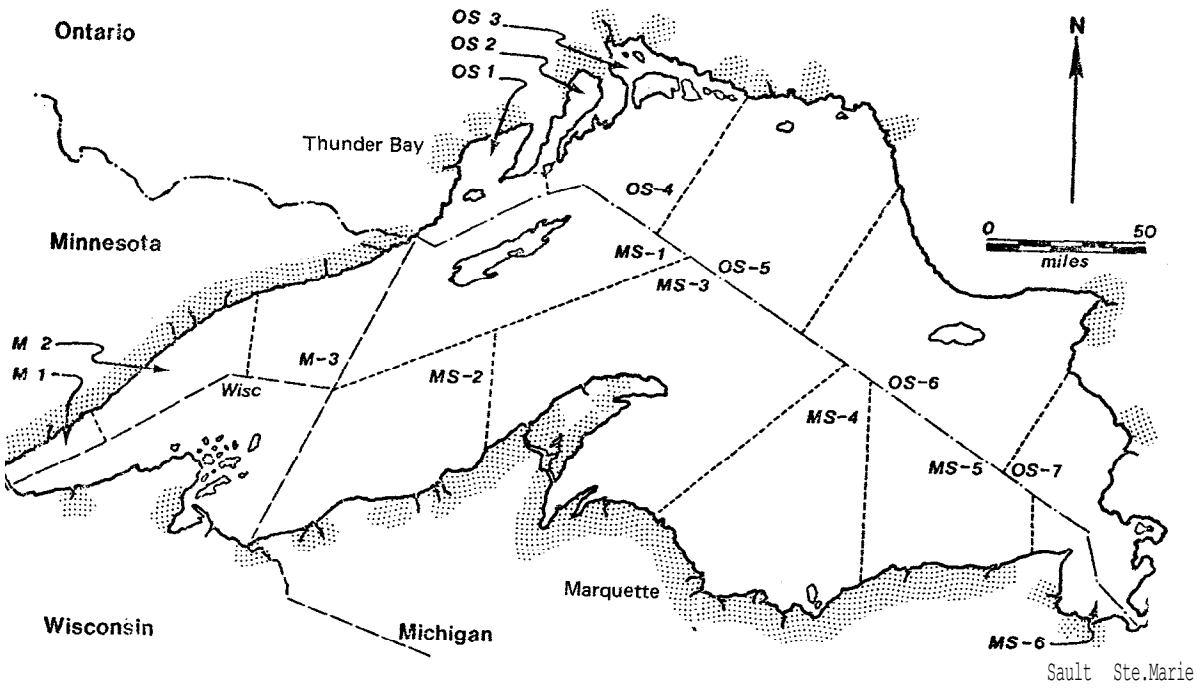
MS-3

Keweenaw Bay (46°58', 88°20'). Spawning occurs in a 200-250 ft deep trench running offshore along the east side of the bay from Pt. Abbaye (46°58′, 88°08') to Sand Bay (46°52', 88°22') (Wilson, pers. comm. 1979). Prom the 1920s to 1959, spawning also occurred in a small area (46°52', 88°24') northwest of Pequaming (46°51′, 88°24') during November over mud at depths greater than 300 ft and off the Assinins Keweenaw Bay Tribal Center (46°49', 88°28') over mud at depths of more than 100 ft. Spawning also occurred in October and November at depths of more than 300 ft over hard clay and rock in the area bounded by Pt. Isabelle (47°21′, 87°56′), Grand Traverse Bay (47°11', 88°13'), and Big Bay (46°50', 87°43') (Organ et al. 1978).

MS-5

Grand Marais (46°40, 85°59'). Since 1974, spawning has occurred off Grand Marais at 46°48', 86°00'--46°50', 85°43' over rock at depths of 300-656 ft (Organ et al. 1978).

PINK Salmon



Since this species was accidentally released into Canadian waters of Lake Superior in 1956, runs have developed in almost every tributary in the lake (Kwain and Chappel 1978; Parsons 1973; Smith 1978c; Tait 1973). Spawning occurred usually only in odd-numbered years (Wagner 1978a), but in 1976 an even-year run developed (Kwain and Chappel 1978), and 3-year-old spawners have been captured in three streams (Wagner and Stauffer 1980). Pink salmon first appear in tributaries in early September, and runs usually peak by mid-September (Rybicki 1973).

Minnesota

The first pink salmon run occurred in 1959 (Hassinger, pers. comm. 1979), and in 1979 they were probably successfully reproducing in all North Shore streams (H. Johnson, pers. comm. 1979). The adults are not seen in the lake until they begin to congregate off stream mouths in fall. The young-of-the-year (YOY) drift into the lake immediately after hatching

and have not been collected in the lake (Hassinger, pers. comm. 1979). Runs occur in the following tributaries:

M-1

Big Sucker Creek (Sucker River) (46°55', 91°51'). Some of the first pink salmon taken in the Lake Superior drainage were caught in the river mouth in September 1959 (Eddy and Underhill 1974; Schumacher and Eddy 1960; Schumacher and Hale 1962).

French River (46°54', 91°53'). Successful reproduction occurs. Even-year runs were observed in 1978 (H. Johnson, pers. comm. 1979).

M-2

Cascade River (47°42′, 90°31′). Spawning was observed (Eddy and Underhill 1974).

Poplar River (47°38′, 90°42′). Spawners were present on redds in mid-September 1961 (Parsons 1973; Schumacher and Hale 1962).

Cross River (47°32', 90°53'). Some of the first pink salmon taken in the Lake Superior drainage were caught in the river mouth in September 1959 (Eddy and Underhill 1974; Schumacher and Eddy 1960; Schumacher and Hale 1962); adults were found in the river in late September 1963 (Moore and Braem 1965).

M-3

Pigeon River (48°00', 89°34') (Hassinger, pers. comm. 1979; Nunan 1967; OMNR 1976b).

Wisconsin

Runs of pink salmon occur in almost every Wisconsin tributary to Lake Superior (Schram, pers. comm. 1979).

Brule River (46°45′, 91°37′). A run occurs in early October (Schram, pers. comm. 1979).

Sioux River (46°44', 90°52'). A run enters the Little Sioux River, a tributary of the Sioux River, in late August-September (Nourse, pers. comm. 1979; Swanson and King, pers. comm. 1979).

Fish Creek (46°35', 90°57'). A run occurs in late August-September (Swanson and King, pers. comm. 1979).

Montreal River (46°34', 90°25'). A run was first reported in 1975 (Wagner 1976a,b).

Michigan

Pink salmon congregate off river mouths in mid-late August, run upstream to spawn in early to mid-September, and spend 3-5 days in the stream. Spent fish usually leave the tributaries by mid-October (North woods Call 1979h,l; Wagner and Stauffer 1975). Spawning usually occurs where fish encounter the first suitable area of gravel; however, in the Sturgeon River (47°02', 88°29'), fish migrated 40-50 mi upstream until stopped by a dam (Wagner 1976a,b; Wagner and Stauffer 1975). Runs occur in the following streams:

MS-2

Black River (46°40', 90°03') and Presque Isle River (46°43', 89°58') (Richey 1976; Smith 1978a; Wagner 1974a, 1976a,b, 1977, 1978a, 1979; Wagner and Stauffer 1975).

Potato River (46°51', 89°23'). First run in 1977 (Wagner 1978a).

Fire Steel River (46°56', 89°12'). First run in 1979 (Wagner 1979).

Misery River (47°00', 88°59'). First run in 1975 (Wagner 1976a,b, 1979).

MS-3

Elm River (47°03', 88°55') (Richey 1976; Wagner 1974a, 1976a,b, 1977, 1978a, 1979; Wagner and Stauffer 1975).

Graveraet River (47°07', 88°51'). First run in 1975 (Wagner 1976a,b).

salmon Trout River (47°09', 88°46') and Schlot (Schlotz) Creek (47°11', 88°39'). First run in 1975 (Wagner 1976a,b, 1979).

Boston-Lily Creek (47°11', 88°38') and Pilgrim River (47°06', 88°31'). First run in 1979 (Wagner 1979).

Gratiot River (47°21', 88°27'). First run in 1975 (Wagner 1976a,b, 1977, 1979).

Fanny Hooe Creek (47°28', 87°52'). The first run occurred in 1975 (Wagner 1976a,b, 1977, 1979). In mid-September 1979, pink salmon blanketed the bottom of the stream; most spawned below the falls within "casting distance" of the lake (North Woods Call 19791).

Little Gratiot River (47°22', 88°02'). First run in 1979 (Wagner 1979).

Tobacco River (47°14', 88°09'). First run in 1975 (Wagner 1976a,b, 1979).

Traverse River (47°11', 88°14'). First run in 1975 (Wagner 1976a,b, 1979; Wagner and Stauffer 1975).

Trap Rock River (47°11', 88°24'). First run in 1975 (Wagner 1976a,b, 1979).

Sturgeon River (47°02', 88°29'). A very heavy run occurred in 1975 (Richey 1976; Wagner 1974a, 1976a,b, 1979; Wagner and Stauffer 1975).

Kelsey Creek (46°53', 88°28'). First run in 1979 (Wagner 1979).

Six Mile Creek (46°45', 88°30'). First run in 1975 (Wagner 1976a,b, 1977).

Falls River (46°45', 88°27'). Very heavy runs occur (Richey 1976; Wagner 1974a, 1976a,b, 1977, 1979; Wagner and Stauffer 1975).

Silver River (46°49', 88°17'). First run in 1975 (Richey 1976; Wagner 1974a, 1977, 1979; Wagner and Stauffer 1975).

slate River (46°50', 88°16') and Ravine River (46°50', 88°15'). First run in 1975 (Richey 1976; Wagner 1976a,b, 1979).

Big Huron River (46°55', 88°02'). Very heavy runs occur (Richey 1976; Smith 1978a; Wagner 1974a, 1976, 1977, 1979; Wagner and Stauffer 1975, 1980).

Little Huron River (46°54', 88°00'). First run in 1975 (Richey 1976; Wagner 1976, 1977, 1979).

Salmon Trout River (46°52', 87°46'). First run in 1977 (Wagner 1977, 1979).

MS-4

Little Iron River (46°49', 87°39'). A spawning pair of pink salmon was observed on September 25, 1967 (Richey 1976; Wagner 1974a; Wagner and Stauffer 1975).

Big Garlic River (46°43', 87°34'). First run in 1975 (Wagner 1976, 1979).

Little Garlic River (46°41', 87°31'). First run in 1975 (Wagner 1976, 1977, 1979).

Harlow Creek (46°38', 87°28') (Richey 1976; Smith 1978a; Wagner 1974a, 1976, 1977, 1978a, 1979; Wagner and Stauffer 1975, 1980).

Dead River (46°34', 87°23') (FWS 1979d; Richey 1976; Wagner 1974a, 1976, 1978a, 1979; Wagner and Stauffer 1975; Wapora 1976b). Spawning occurs in mid-September at 60°F and is probably successful (Berg 1976).

Carp River (46°31′, 87°23′) (Wagner 1974a, 1976, 1977, 1979; Wagner and Stauffer 1975).

Chocolay River (46°30', 87°21') (Richey 1976; Smith 1978a; Wagner 1974a, 1976, 1977, 1978a, 1979; Wagner and Stauffer 1975). Even-year spawning was first observed here in 1976 (Wagner 1977, 1978c).

Sand River (46°30', 87°06'). First run in 1975 (Wagner 1976).

Laughing Whitefish River (46°31′, 87°02′). Very heavy runs occur (Richey 1976; Wagner 1974a, 1976, 1977, 1979; Wagner and Stauffer 1975).

Rock River (46°28', 86°55') (Wagner 1977, 1979; Wagner and Stauffer 1975).

Furnace Creek (46°26', 86°42'). First run in 1977 (Wagner 1978a, 1979).

Anna River (46°25′, 86°38') (Wagner 1974a; Wagner and Stauffer 1975).

Miners Creek (46°30', 86°33') (Wagner 1977, 1979).

MS-5

Seven Mile Creek (46°37', 86°16'). First run in 1977 (Wagner 1978a, 1979).

Sable Creek (46°40', 86°01′). First run in 1975 (Richey 1976; Wagner 1976, 1977, 1979).

Sucker River (46°40', 85°56') (Wagner 1978a, 1979).

Blind Sucker River (46°41', 85°40') (Wagner 1974a, 1976, 1977, 1979; Wagner and Stauffer 1975). In 1979, fish were seen at the mouth in mid-September (Schmidt 1979).

Big Two Hearted River (46°42', 85°25') (Wagner 1974a, 1977, 1979; Wagner and Stauffer 1975).

MS-6

Tahquamenon River (46°33′, 85°02') (Wagner 1976, 1977, 1979; Wagner and Stauffer 1975).

water Wheel Creek (46°28', 84°55'). First run in 1979 (Wagner 1979).

Pendills Creek (46°27', 84°49') (Gleason and Behmer, pers. comm. 1979; Wagner 1974a, 1976, 1979; Wagner and Stauffer 1975, 1980).

Ontario

Pink salmon congregate offshore before entering tributaries in mid-September. Runs last about 2 weeks (OMNR 1976b). Sizable runs were not observed until 1969, but by 1971, pink salmon were in every major tributary between the Nipigon River (48°57', 88°15') and the Pic River (48°36′, 86°18′), except the Jackfish River (49°00', 88°05') (Gollat 1976). Runs occur in the following 22 tributaries (OMNR 1976b):

OS-1

Kaministiquia River (48°23', 89°13').

Current River (48°27', 89°11′). This is the site where pink salmon were first released in the Great Lakes.

MacKenzie River (48°32', 88°57'). One of the first very large runs occurred here in 1969.

OS-2

Wolf River (48°49', 88°29').

Black Sturgeon River (48°50', 88°24'). A ripe male was seen in Black Bay in early September 1961 (Nunan 1967).

OS-3

Nipigon River (48°57', 88°15'). A ripe male was seen here in late September 1961 (Nunan 1967).

Jackpine River (48°58', 88°00') and Gravel River (48°55', 87°46').

McKellar Creek (48°50', 87°28') and Hewitson River (48°50', 87°27').

OS-5

Schreiber Creek (48°46', 87°15').

Steel River (48°46', 87°54'). The first even-year run occurred here in late September to mid-October 1976 (Kwain and Chappel 1978).

Prairie River (48°47', 86°47'), Ripple Creek (48°47', 86°45'), Little Pic River (48°47′, 86°38'), and Angler Creek (48°45', 86°25').

Pic River (48°36', 86°18'). Many adults were observed here in early to mid-September 1975 (Schleen 1975).

OS-6

Magpie River (47°58', 84°52').

Michipicoten River (47°56', 84°51'). An extremely large run occurred here in 1975; most adults present in the river on October 1-2 had completed spawning (Schleen 1975).

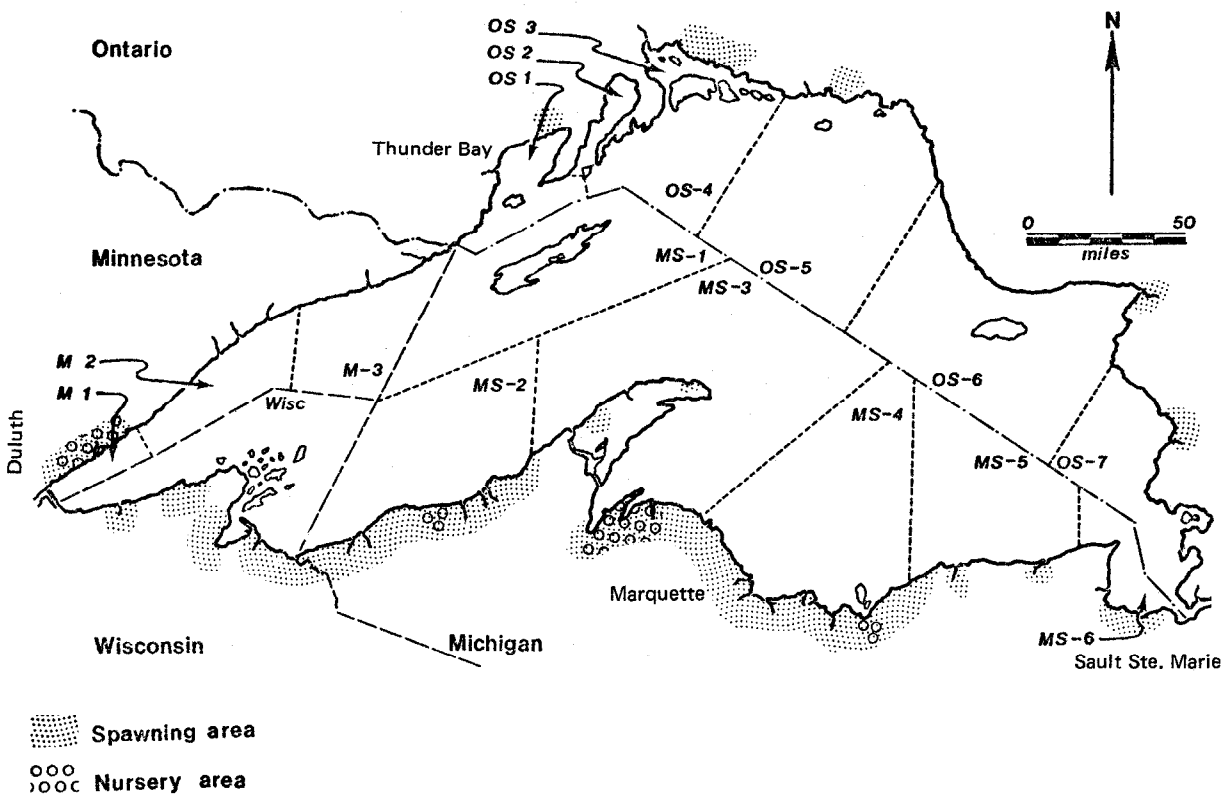
Old Woman River (47°47', 84°54').

OS-7

Agawa River (47°21', 84°38'). A large run entered the river in early September and most fish had finished spawning by mid-September (Schleen 1975).

Speckled Trout Creek (47°19', 84°36').

COHO SALMON



Coho salmon planted in Lake Superior in 1966 (Parsons 1973) produced spawning runs in a number of Lake Superior tributaries and established self-sustaining populations in some areas.

Minnesota

Coho salmon have been planted in the Beaver River (47°15′, 91°18′), Gooseberry River (47°08', 91°27'), Silver Creek (47°04', 91°36'), Stewart River (47°03', 91°38'), French River (46°54', 91°53'), and Grand Portage Creek (47°58', 89°41′) (GLFC 1973a,b, 1975, 1976). Straying occurs, and in 1974, it was reported that coho salmon probably ran into most streams along the shoreline (Wassinger 1971a, 1974c). An offshore migration appears to occur from the western Wisconsin area, beginning in late May or early June, past the Duluth-Superior Harbor entry, and up the Minnesota shore. By early July, coho salmon are in the vicinity of the

Knife River (46°57', 91°47') (H. Johnson, pers. comm. 1979). Spawning occurs in October and November. Many Minnesota streams have impassable falls near the mouth which prevent the fish from moving upstream to suitable spawning habitat. The Devil Track (47°46', 90°15'), Baptism (47°20', 91°12'), and Brule (47°49', 90°03') rivers offer marginal habitat (Eddy and Underhill 1974). Spawning runs occur in the following streams:

M-1

Silver Creek (47°04', 91°36'). Young-of-the-year (YOY) have been found and natural reproduction occurs (Hassinger 1974c, pers. comm. 1979). No reproduction has been observed in recent years (H. Johnson, pers. comm. 1979).

Stewart River (47°03', 91°38'). Four adults were caught in late October and mid-November (Hassinger 1971a), and YOY were also found (Hassinger 1974c). No reproduction has been observed in recent years (H. Johnson, pers. comm. 1979).

Knife River (46°57', 91°47'). Seven adults were caught in late October to mid-November 1970 (Hassinger 1971a), but no reproduction has been observed in recent years (H. Johnson, pers. comm. 1979).

Big Sucker Creek (Sucker River) (46°55', 91°51'). Two adults and two "jacks" were caught in late September and late October (Hassinger 1971a); YOY were also collected (Hassinger 1974c). Natural reproduction occurs (Hassinger, pers. comm. 1979), but none has been observed in recent years (H. Johnson, pers. comm. 1979).

Schmidt Creek (46°54', 91°53′). Natural reproduction occurs (Hassinger, pers. comm. 1979), but none has been observed in recent years (H. Johnson, pers. comm. 1979).

French River (46°54', 91°53'). Movement into the stream is correlated with increased water flow and temperature greater than 40°F. The run begins during the first week of September and continues until freeze-up in the last week of November or first week of December, with peak returns in late October to late November (Hassinger 1970, 1971b, 1974c). Jacks usually enter the stream in October (Hassinger 1974c). Natural reproduction occurs (Hassinger, pers. comm. 1979), but none has been observed in recent years (H. Johnson, pers. comm. 1979).

Talmadge River (46°53', 91°55′). Adults were present in late October and early November (Hassinger 1971a), and YOY have been found (Hassinger 1974c). No reproduction has occurred in recent years (H. Johnson, pers. comm. 1979).

Lester River (46°50', 92°00'). Thirty adults were caught in late October (Hassinger 1971a), but no reproduction has occurred in recent years (H. Johnson, pers. comm. 1979).

Temperance River (47°33', 90°52'). One adult was caught in late September 1970 (Hassinger 1971a).

Cross River (47°32', 90°53'). One adult was caught in mid-October 1970 (Hassinger 1971a).

Split Rock River (47°11', 91°24'). One adult was caught in early November 1970 (Hassinger 1971a). This river offers marginal spawning habitat (Eddy and UnderhilI 1974).

Wisconsin

Coho salmon have not been stocked in Wisconsin tributaries, but spawning runs occur from early October into January (King and Swanson, pers. comm. 1979; Schram, pers. comm. 1979), and natural reproduction occurs in several streams (King and Swanson 1975).

Brule River (46°45', 91°37'), Flag River (46°47', 91°23'), Cranberry River (46°50', 91°16'), and Bark River (46°51', 91°11') (King and Swanson, pers. comm. 1979; Schram, pers. comm. 1979).

Siskiwit River (46°51', 91°06'). Possible run (Schram, pers. comm. 1979).

Onion River (46°45', 90°53') (King and Swanson, pers. comm. 1979).

Sioux and Little Sioux Rivers (46°44', 90°52'), and Thompson Creek (46°40', 90°55') (King and Swanson, pers. comm. 1979; Schram, pers. comm. 1979).

Bono Creek (46°38', 90°55'), and Whittlesey Creek (46°36', 90°57'). Fish Creek (46°35', 90'57'). Runs progress upstream to North Fish Creek and Pine Creek. Bad and White Rivers (46°38', 90°39'), and Graveyard Creek (46°35', 90°29') (King and Swanson, pers. comm. 1979).

Montreal River (46°34', 90°25') (King and Swanson, pers. comm. 1979). Spawning runs progress upstream to Superior Falls (Anderson and Threinen 1969).

Michigan

Coho salmon plantings were first made in 1966 in Chinks Creek, a tributary of the Huron River (46°55', 88°02') (Taube 1975: USDI 1970), Subsequently, plantings were made in the Black (46°40', 90°03'), Presque Isle (46°43', 89°58'), Ontonaqon (46°52', 89°20'), Sturgeon (47°02', 88°29'), Falls (46°45', 88°27'), Huron (46°55', 88°02'), Dead (46°34',

87°23'), Anna (46°25', 86°38'), and Sucker (46°40', 85°56') rivers, and in Cherry Creek, a tributary of the Chocolay River (46°30', 87°21') (GLFC 1973a,b, 1975, 1976, 1978; MDNR 1970; Parsons 1973). Spawning runs occur in late September-late November, when the stream temperature drops to about 40°F (Miller and Scott 1967, as cited in Wapora 1976a). Runs usually peak in late October-early November (Hannuksela and Stauffer 1975). Straying occurs and runs have been noted in the following tributaries:

MS-2

Maple Creek (46°39', 90°07'), Black River (46°40', 90°03'), Presque Isle River (46°43', 89°58'), Little Carp River (46°45', 89°54'), and Carp River (46°46', 89°53') (MDNR 1970).

Union River (46°49', 89°37'). Natural reproduction occurs and YOY were present (Hannuksela and Stauffer 1975; Jenkins 1970, 1972; MDNR 1970; Parsons 1973; Peck 1970; Stauffer 1969a,b, 1971c,d, 1973a, 1974a,b, 1975b, 1977).

Big Iron River (46°50', 89°34'), Fire Steel River (46°56', 89°12'), and Sleeping River (46°59', 89°04') (MDNR 1970).

MS-3

Elm River (47°03′, 88°55′), McGunn's Creek (47°15′, 88°33′), and Fanny Hooe Creek (47°28′, 87°52′) (MDNR 1970).

Falls River (46°46', 88°28') (MDNR 1970). Young-of-the-year were collected (Peck 1970).

Silver River (46°49', 88°17′) (MDNR 1970). Young-of-the-year were collected (Peck 1970). A large run enters Kallio Creek (a tributary of Silver River), where spawning and redds were observed (Mich. Dep. Conserv. 1968b; Miller and Scott 1968).

Slate River (46°50', 88°16') and Ravine River (46°50', 86°15') (MDNR 1970).

Huron River (46°55', 88°02'). A run of naturally-recruited adults enters the river from mid-September to early December or later. Ripe adults and eggs were collected and redds were observed in the Huron River. Spawning was observed in late September to November in Chinks Creek, and YOY were found during June-November (Hannuksela and Stauffer 1975; Jenkins 1970, 1972; Mich Dep. Conserv. 1968b; MDNR 1970; Miller and Scott 1968; Parsons 1973; Peck 1970; Rybicki 1973; Stauffer 1969a,b, 1971c,d, 1972b,c, 1973a,b, 1974a,b, 1975a,b, 1976a, 1977; Tody 1970; USBCF 1969b). Adults dispersed equally into the east and west branches (Miller and Scott 1968). Low water temperatures delayed spawning by some fish until spring (MDNR 1970).

Little Huron River (46°54', 88°00'). Self-sustaining runs occur (Hannuksela and Stauffer 1975; Jenkins 1970, 1972; MDNR 1970; Parsons 1973; Peck 1970; Stauffer 1969a,b, 1971c,d, 1972b,c, 1973a,b, 1974a,b, 1975b, 1977).

Salmon Trout River (46°52', 87°46') (MDNR 1970).

MS-4

Little Iron River (46°49', 87°39'), and Big Garlic River (46°43', 87°34′) (MDNR 1970).

Little Garlic River (46°41′, 87°31′). Self-sustaining runs occur (Hannuksela 1978; Hannuksela and Stauffer 1975; Jenkins 1970, 1972; MDNR 1970; Peck 1970; Stauffer 1969a,b, 1971c,d, 1972b,c, 1973a,b, 1974a,b, 1975a,b, 1977).

Harlow Creek (46°38', 87°28') (MDNR 1970).

Dead River (46°34′, 87°23′). A spawning run enters the Dead River, and the nearby discharge canal of the Presque Isle Power Station. The major run occurs in mid-September to November, several weeks after the chinook salmon run (Wapora 1976b). Spawning occurs during mid-September to early November at about 47-57°F, but is probably not successful because of unsuitable habitat (Berg 1976; Hannuksela and Stauffer 1975; Stauffer 1974b).

Carp River (46°31′, 87°23') (MDNR 1970; Swedberg, pers. comm. 1979).

Chocolay River (46°30', 87°21') (MDNR 1970). Runs enter Cherry Creek, a tributary to the Chocolay River, beginning in late September and peak by mid-late October (Hannuksela and Stauffer 1975; Stauffer 1972b, 1973b, 1974b).

Sand River (46°30', 87°06'), Laughing Whitefish River (46°31', 87°02'), Rock River (46°28', 86°55'), Au Train River (46°26′, 86°51′), and Furnace Creek (46°26', 86°42') (MDNR 1970).

Anna River (46°25', 86°38'). Self-sustaining runs occur in mid-September to mid-November at 40-50°F, and YOY have been found (Hannuksela and Stauffer 1975; Jenkins 1970, 1972; Parsons 1973; Peck 1970; Stauffer, 1969a,b, 1971a,c,d, 1972b,c, 1973a,b,c, 1974a,b, 1975b, 1976a, 1977).

Miners Creek (46°30', 86°33') and Mosquito River (46°32', 86°30') (MDNR 1970).

MS-5

seven Mile Creek (46°37', 86°16') (MDNR 1970).

Sucker River (46°40', 85°56') (MDNR 1970; Rybicki 1973).

Big Two Hearted River (46°42', 85°25') (MDNR 1970).

MS-6

Halfaday Creek (46°28', 84°54') and Grants Creek (46°28', 84°52') (MDNR 1970).

Pendills Creek (46°27', 84°49') (MDNR 1970; Gleason and Behmer, pers. comm. 1979).

Ontario

Spawning runs occur in September-November (OMNR 1976b) in every major tributary between the Nipigon River (48°57′, 88°15') and the Pic River (48°36', 86°18′), except the Jackfish River (49°00', 88°05') (Gollat 1976). Runs occur in some years in the following streams (OMNR 1976b):

OS-1

MacKenzie River (48°32', 88°57'). Adults have been seen in mid-September at the mouth of the river (Tibbles 1979).

OS-3

Jackpine River (48°58', 88°00').

Gravel River (48°55', 87°46'). In 1971, the coho salmon run here exceeded the rainbow trout run (Gollat 1976).

OS-5

Steel River (48°46′, 87°54′). In 1977, the coho salmon run here exceeded the rainbow trout run (Gollat 1976).

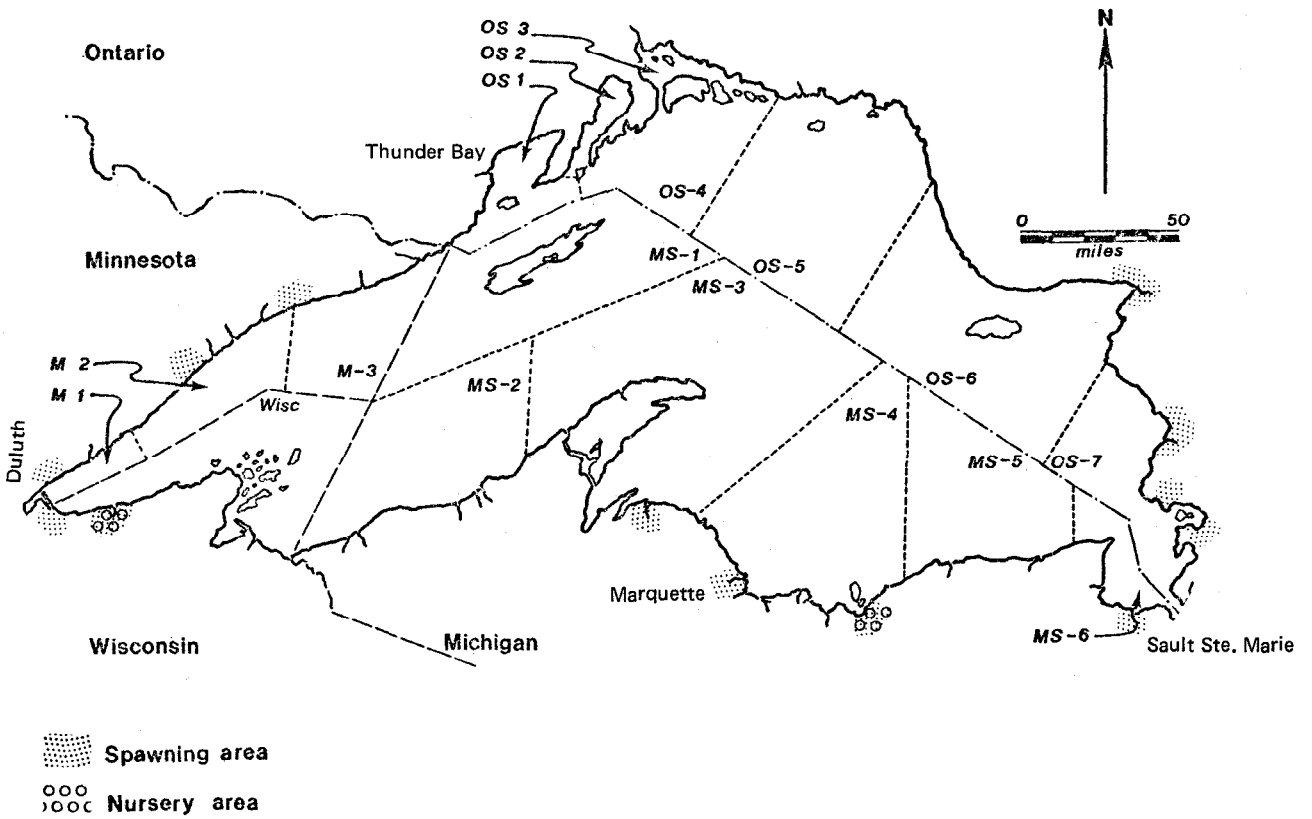
OS-6

Michipicoten River (47°56', 84°57').

OS-7

Agawa River (47°21′, 84°38') and Speckled Trout Creek (47°19', 84°36′).

CHINOOK SALMON



Chinook salmon were first introduced into Lake Superior in 1873, however, self-sustaining populations were not established. Chinook salmon planted in Lake Superior in 1967 (Parsons 1973) produced spawning runs in a number of Lake Superior tributaries and self-sustaining populations are established in some areas.

Minnesota

Runs usually begin in late August to September and peak in mid-October, but no natural reproduction is expected (H. Johnson, pers. comm. 1979). Some returns from plantings have occurred in the following rivers (GLFC 1976; Hassinger, pers. comm. 1979; H. Johnson, pers. comm. 1979).

M-1

French River (46°54', 91°53').

M-2

Cascade River (47°42', 90°31').

Baptism River (47°20', 91°12'). Runs begin as early as mid-July (H. Johnson, pers. comm. 1979).

Wisconsin

Nemadji River (46°42', 92°02'). Some returns from plantings (DeVore 1978; FWS 1979d; Schram, pers. comm. 1979).

Brule River (46°45', 91°37'). Runs enter the river and move into Blueberry Creek, where spawning occurs and young-of-the-year (YOY) have been found. The first evidence of natural reproduction was found in 1979 (King and Swanson, pers. comm. 1979; Schram, pers. comm. 1979).

Michigan

Chinook salmon have been planted in the Black (46°40', 90°03'), Big Iron (46°50', 89°34'), Sturgeon (47°02', 88°29'), Falls (46°45', 88°27'), Huron (46°55', 88°02'), Dead (46°34', 87°23'), Anna (46°25', 86°38') and Sucker (46°40', 85°56') rivers, and Cherry Creek, a tributary of the Chocolay River (46°30', 87°21') (GLFC 1973a,b, 1975, 1976, 1978; MDNR 1970; Parsons 1973; USDI 1970).

MS-3

Huron River (46°55', 88°02'). A few spawners returned in 1969 and 1970 (Parsons 1973).

MS-4

Dead River (46°34', 87°23'). Adults begin congregating near the mouth of the river in early fall. Two separate runs tnat did not overlap were observed entering the river. One run occurred in late August to late September, when water temperatures were 55-63°F, and the other run in late October to early November, when the water temperatures were 37-45°F. Runs also enter the discharge canal of the nearby Presque Isle Power Station. Suitable spawning grounds do not exist in the river, no redds have been seen, and no successful reproduction occurs (Berg 1976; FWS 1979d; Wapora 1976a,b).

Anna River (46°25', 86°38'). Successful reproduction occurs from plantings in 1969 (Berg 1976; Stauffer 1974b). Naturally spawned YOY were observed in 1973 and 1974 (Stauffer 1974b, 1975).

MS-6

Pendills Creek (46°27', 84°49'). A spawning run enters this creek (Gleason and Behmer, pers. comm. 1979).

Ontario

Runs enter the following streams during September-November.

OS-6

Magpie River (47°58', 84°52') (OMNR 1976b).

Michipicoten River (47°56', 84°51'). Small numbers were seen spawning here on October 1-2, 1975 (OMNR 1976b; Schleen 1975).

OS-7

Agawa River (47°21', 84°38'), Montreal River (47°15', 84°39'), Pancake River (46°58', 84°40'), and Stokely Creek (46°49', 84°25') (OMNR 1976b).

PYGMY WHITEFISH

Minnesota

Spawning occurs in the fall all along the shore over rock and rubble bottom (H. Johnson, pers. comm. 1979).

Michigan

MS-1

Isle Royale (48°00', 88°50'). Young-of-the-year were found in September and October in Siskiwit Bay at 47°55, 88°57' (Eschmeyer and Bailey 1955).

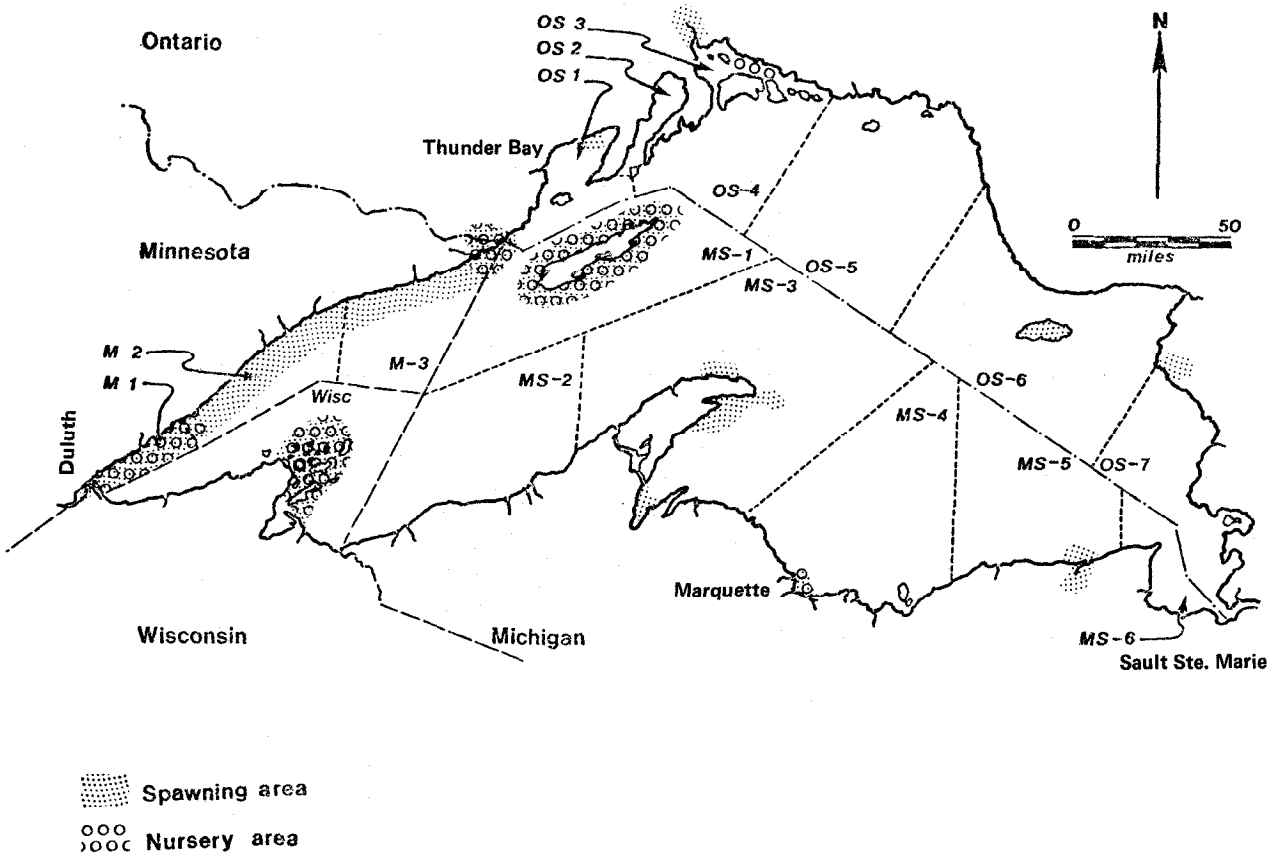
MS-3

Keweenaw Bay (46°58', 88°20'). Young-of-the-year were found off Point Abbaye (46°58', 88°08') in September and October (Eschmeyer and Bailey 1955).

MS-4

Laughing Fish Point (46°32', 87°01'). This species spawns during November and December, based on collections in 1953 at Laughing Fish Point; fish were not ripe in late October, but were spent in early January. The spawning grounds were not identified, but were assumed to be in relatively shallow water (78-108 ft deep), where young were found. Young-of-the-year were found off Laughing Fish Point in September and October (Eschmeyer and Bailey 1955).

ROUND WHITEFISH



Minnesota

The round whitefish spawns from late November into January in Minnesota waters. Adults move inshore to shallow beach areas where they spawn over rock and gravel. Spawning occurs along the shore from the Pigeon River (48°00', 89°34') to Duluth (46°48', 92°05') (Croft, pers. comm. 1979; Fenstad, pers. comm. 1979; Hassinger, pers. comm. 1979; Hendrickson, pers. comm. 1979; W. Johnson, pers. comm. 1979; Koss and Koss, pers. comm. 1979; Spry, pers. comm. 1979; Sve, pers. comm. 1979; Zerbach, pers. comm. 1979). Adults also enter rivers in the fall and may spawn there (Lawrie 1978). Specific locations of spawning and nursery areas are:

H-1

Knife River (46°57', 91°47')--Duluth (46°48', 92°05'). This entire inshore area is a spawning and nursery area (Hassinger, pers. comm. 1979).

A commercial fisherman caught spawners in December from Stony Point (46°56′, 91°49') to Talmadge River (46°53', 91°55') (W. Johnson, pers. comm. 1979).

Silver Creek (47°04', 91°36'). Spawning occurs off the mouth of the creek. Fisherman's Point (47°02', 91°38'). Spawning occurs off the point and in Flood Bay (47°02', 91°38') (Croft, pers. comm. 1979).

M-2

Split Rock Cabins (47°10', 91°25'). Ripe fish were taken here (Sve, pers. comm. 1979).

M-3

Pigeon Bay (48°01′, 89°31') and Pigeon River (48°00', 89°34'). Both the bay and the river are spawning and nursery areas (Hassinger, pers. comm. 1979; Hendrickson, pers. comm. 1979).

Wauswaugoning Bay (47°58', 89°37')--Grand Portage Bay (47°57', 89°40'). Both bays are spawning and nursery areas (Hassinger, pers. comm. 1979; Hendrickson, pers. comm. 1979). The reef (47°57', 89°40') on the west side of Grand Portage Island (47°57', 89°40') is a very good location for taking ripe adults (Spry, pers. comm. 1979). Young have also been found on the north side of Susie Island (47°59', 89°34') (Hendrickson, pers. comm. 1979).

Grand Marais (47°45', 90°20'). Spawning occurs throughout the area in December (Zerbach, pers. comm. 1979). The mouths of the Devil Track (47°46′, 90°16') and Cascade (47°42', 90°31') rivers are spawning areas (Koelz 1929).

Wisconsin

Round whitefish probably spawn on almost any rocky area less than 10 ft deep (Coberly and Horrall 1980b; Swanson, pers. comm. 1979). A few young-of-the-year (YOY) were collected in the Apostle Islands (47°00', 90°40') in late July 1953 (Eschmeyer and Bailey 1955).

Sand Cut Reef (46°44', 90°41'). A spawning area (Pycha, pers. comm. 1979).

York Island (46°59', 90°52'). Large numbers of spawning fish were observed off the east side of the island by fishermen. Raspberry Island (46°58′, 90°48′). Large numbers of spawning fish were observed all around the island by fishermen. Outer Island (47°02', 90°26'). Large numbers of spawning fish were observed at the south end (46°59', 90°27') of the island by fishermen. Michigan Island (46°53', 90°29'). Large numbers of spawning fish were observed all along the east shore by fishermen (Coberly and Horrall 1980b).

MS-1

Isle Royale (48°00', 88°50'). Round whitefish spawn in the bays around the island (Fenstad, pers. comm. 1979). Young were seined along shore (Hubbs and Lagler 1947).

MS-3

Keweenaw Peninsula (47°10′, 88°30′). Spawning occurs in several areas during mid-November to mid-December (Organ et al. 1978).

Copper Harbor (47°28', 87°54'). Spawning has occurred over rock at the west side of the mouth of the harbor since the 1930s. Manitou Island (47°25', 87°37'). Spawning has been observed all around the island on rocky shoals since the 1930s. Keweenaw Point (47°24', 87°43')--Point Isabelle (47°21, 87°56'). Spawning occurred over rock in an area extending from Keweenaw Point through Bete Grise Bay (47°23', 87°56') and around Point Isabelle in 1973. This includes an area (47°19', 87°58') west of Point Isabelle that has been used since the 1930s. Gay (47°14′ , 88°10′). Spawning has been observed in a rock area (47°15′, 88°06') about 3 mi N of Gay since the 1930s.

Keweenaw Bay (46°58', 88°20'). Several small spawning areas have been reported in the bay. A rock area (46°52', 88°27') north of the community of Keweenaw Bay (46°52', 88°29') has been used since the 1940s. Areas used since 1963 are rock along the shore of Pequaming Point (46°51′, 88°24′), rock along shore midway between Pequaming Bay (46°50', 88°24') and L'Anse Bay (46°46′, 88°28'), sand in deeper water north of Sand Point (46°47′, 88°28'), and sand in mid-bay (46°51′, 88°26') west of Pequaming (Organ et al. 1978).

MS-4

Marquette (46°33', 87°23'). Round whitefish are believed to spawn on rock and gravel areas in Presque Isle Harbor (46°34′, 87°23′), but this has not been confirmed (Wapora 1976a,b). Nearly ripe adults were found in the harbor during the fall (Wapora 1976b), and larvae believed to be of this species were found there in February-May (Wapora 1976b). Round whitefish eggs were found in stomachs of fish in the harbor in 1972 (FWS 1979d).

MS-5

Big Two Hearted River (46°42′, 85°25′). A run enters the river in the fall (Stauffer and Hansen 1958), and spawning has occurred in October and November over sand at the river mouth since 1945 (Organ et al. 1978).

Little Lake Harbor (46°43', 85°22'). A run occurs in the fall (Stauffer and Hansen 1958), and spawning has taken place in October and November over sand at the harbor mouth since 1945 (Organ et al. 1978).

Ontario

OS-1

MacKenzie Ray (48°31′, 88°57′). Small whitefish, 2-4 in. long, tentatively identified as round whitefish, were collected here; spawning probably occurred on the gravel shoals in the bay (SLCC 1979b).

OS-3

Nipigon River (48°57', 88°15'). Many round whitefish were caught in the lower river in mid-September and spawning is believed to occur there (Pycha, pers. comm. 1979).

Cypress River (48°56', 87°52') --Gravel River (48°55', 87°46'). Many YOY were collected in late July 1979 at the river mouths and were assumed to have hatched nearby (SLCC 1979b).

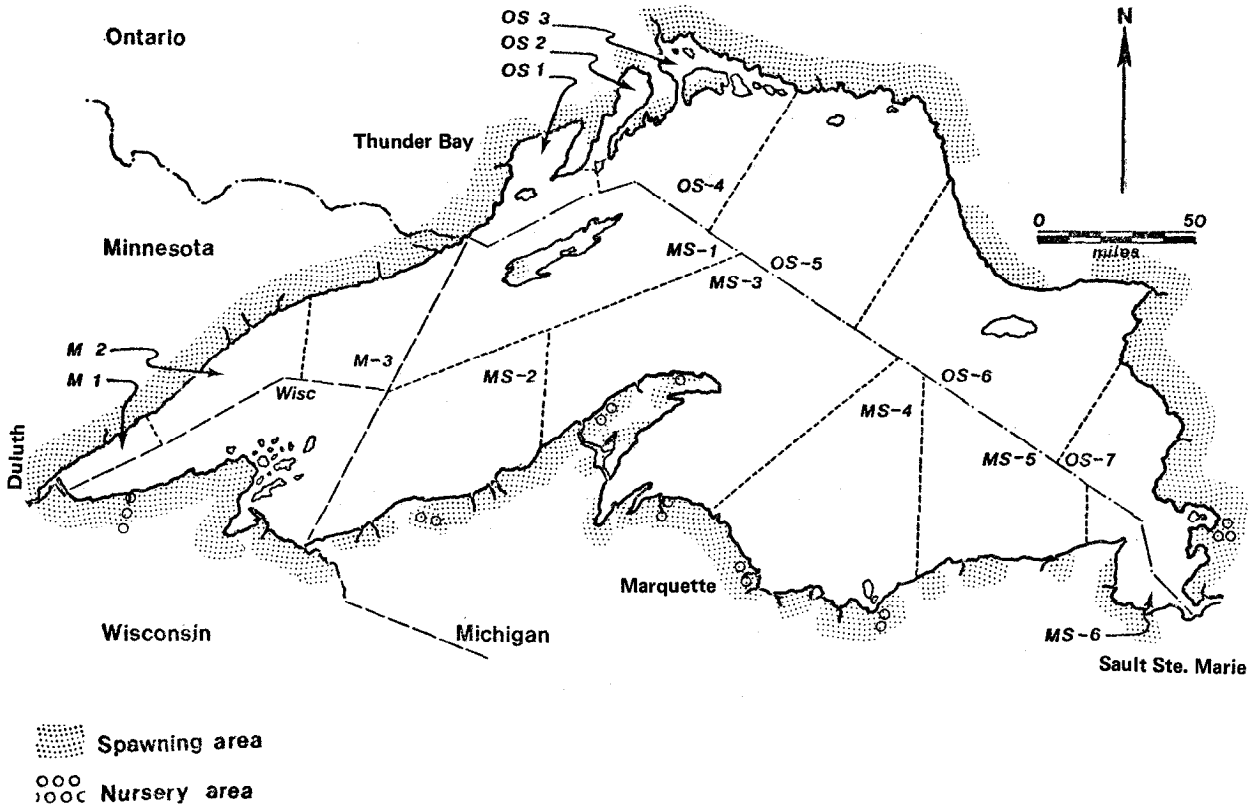
OS-6

Michipicoten Island (47°45', 85°47'). Fall runs entered creeks on the island and spawning probably occurred (Koelz 1929).

OS-7

Gargantua (47°35', 84°58'). Fall runs entered creeks near Gargantua and spawning probably occurred (Koelz 1929).

RAINBOW TROWT



Rainbow trout were first introduced in Lake Superior in 1889 when the U.S. Fish Commission stocked the Iron River (46°49', 87°39') in Michigan (U.S. Comm. Fish Fish. 1889-91 as cited in MacCrimmon and Gots 1972) and Wisconsin planted fry in waters of Ashland County (Wis. Fish. Comm. 1889 as cited in MacCrimmon and Gots 1972). The first rainbow trout taken in the Great Lakes was captured on the north shore of Lake Superior in July 1895 (Smedley 1895).

In 1956, the rainbow trout (steelhead trout) was described as the most important game fish that ran into Lake Superior tributaries (Erkkila et al. 1956). Most U.S. tributaries have spawning runs (FWS 1979d). Spawning runs may occur in spring and fall; major runs usually occur in the spring (OMNR 1976b). Incidental catches of rainbow trout in the spring were reported for 114 U.S. streams (Moore and Braem 1965); these

catches indicate spawning runs occur in these streams (Braem, pers. comm. 1980). Most Ontario tributaries support both spring and fall runs (OMNR, undated); 110 streams, some unnamed, have runs (OMNR 1976b).

Minnesota

Spawning runs and natural reproduction occur in most Minnesota tributaries on gravel in fast-flowing areas from mid-April to mid-June; runs peak in late April and May (Hassinger, pers. comm. 1979; H. Johnson, pers. comm. 1979; Surber 1920). Spawning occasionally continues into late July (Minn. Div. Fish Game 1963). Fall runs during October and November sometimes occur, but no spawning has been observed and no adults overwinter in the streams because of heavy ice and low flow (Hassinger et al. 1974). Stream discharge in the fall is also often low, and the fall runs are sporadic (MacCrimmon and Gots 1972). Upstream movement and the amount of spawning habitat are limited by waterfalls near the mouths of most streams (Smith and Moyle 1944; USDI 1970). Young spend at least one year and usually 2-4 years in the natal stream before migrating to Lake superior during May-July (Hassinger, pers. comm. 1979; Hassinger et al. 1974; H. Johnson, pers. comm. 1979). The following 59 streams support spawning runs (Hassinger, pers. comm. 1979; Hassinger et al. 1974):

M-1

Chester Creek (46°48', 92°05') and Tischer Creek (46°49', 92°03').

Lester River (46°50', 92°00') (Minn. Div. Fish Game 1963).

Talmadge River (46°53', 91°55') and French River (46°54', 91°53') (Minn. Div. Fish Game 1963; Moore and Braem 1965).

Schmidt Creek (46°54', 91°53').

Big Sucker Creek (Sucker River) (46°55', 91°51') (Minn. Div. Fish Game 1963).

Knife River (46°57', 91°47') and Stewart River (47°03', 91°38') (Minn. Div. Fish Game 1963; Moore and Braem 1965).

Silver Creek (47°04', 91°36') (Minn. Div. Fish Game 1963).

M-2

Encampment River (47°05', 91°34'), Crow Creek (47°06', 91°33'), and Castle Creek (47°07', 91°30').

Gooseberry River (47°08', 91°27') (Minn. Div. Fish Game 1963).

Twin Points Creek (47°10', 91°25').

Split Rock River (47°11', 91°24') (Minn. Div. Fish Game 1963).

Unnamed tributary (47°11', 91°23').

Beaver River (47°15', 91°18'), Palisade Creek (47°19', 91°12'), and Baptism River (47°20', 91°12') (Minn. Div. Fish Game 1963).

Little Marais River (47°25', 91°06'), Dragon Creek (47°25', 91°06'), Manitou River (47°27', 91°04'), and Little Manitou River (47°27', 91°03').

Caribou River (47°28', 91°02') (Minn. Div. Fish Game 1963).

Sugar Loaf Creek (47°29', 90°59'), Last Creek (47°30', 90°58'), Unnamed tributary (47°30', 90°57'), and Two Island River (47°31', 90°55').

Cross River (47°32', 90°53'), Temperance River (47°33', 90°52'), and Onion River (47°37', 90°46') (Minn. Div. Fish Game 1963).

Rollins Creek (47°37', 90°45').

Poplar River (47°38', 90°42') (Minn. Div. Fish Game 1963).

Lutsen Creek (47°39', 90°40'), and Jonvick Creek (47°39', 90°39').

Spruce Creek (47°40', 90°38') (Minn. Div. Fish Game 1963).

Indian Camp Creek (47°41', 90°33').

M-3

Cascade River (47°42', 90°31') (Minn. Div. Fish Game 1963; Moore and Braem 1965).

Cutface Creek (47°44', 90°26').

Rosebush Creek (47°44', 90°21') (Minn. Div. Fish Game 1963).

Devil Track River (47°46', 90°16') (Minn. Div. Fish Game 1963; Moore and Braem 1965).

Durfee Creek (47°47', 90°14') (Minn. Div. Fish Game 1963).

Cliff Creek (47°47', 90°11').

Kimball Creek (47°47', 90°11') (Minn. Div. Fish Game 1963).

Stone Creek (47°48', 90°09').

Kadunce Creek (47°48', 90°09') (Minn. Div. Fish Game 1963; Moore and Braem 1965).

East Colville Creek (47°48', 90°06').

Brule (Arrowhead) River (47°49', 90°03') (Minn. Div. Fish Game 1963; Moore and Braem 1965).

Myhr's Creek (47°49', 90°02').

Flute Reed River (47°50', 89°58') and Carlson Creek (47°51', 89°56') (Minn. Div. Fish Game 1963).

Farquhar Creek (47°52', 89°55').

Reservation River (47°52', 89°51') (Minn. Div. Fish Game 1963).

Unnamed Tributary (47°54', 89°46'), Hollow Rock Creek (47°55', 89°44'), Unnamed Tributary (47°56', 89°43'), Grand Portage River (47°58', 89°41'), and Pigeon River (48°00', 89°34').

Wisconsin

Large runs occur in tributaries during early spring (Calhoun and Coon 1941). Runs enter small rivers in April and May; in larger tributaries, runs may occur in late March under the ice. Some rivers have two runs, one in late winter-early spring, and another in late April-early May (King and Swanson, pers. comm. 1979). Rainbow trout also run in the fall and overwinter in the Brule River (46°45', 91°37') (Hassinger et al. 1974; Niemuth 1970; Schram, pers. comm. 1979). Runs occur in the following tributaries:

Nemadji River (46°42', 92°02') (DeVore 1978, pers. comm. 1979; DeVore et al. 1978; FWS 1979d; Moore and Braem 1965).

Amnicon River (46°41', 91°51') (Moore and Braem 1965; Schram, pers. comm. 1979).

Middle River (46°42', 91°50') and Poplar River (46°42', 91°47') (Moore and Braem 1965).

Brule River (46°45', 91°37') (GLFC 1961, 1967; King and Swanson, pers. comm. 1979; Moore and Braem 1965; Niemuth 1970; Pycha, pers. comm. 1979; Salli 1974; Schram, pers. comm. 1979). Stocking has occurred since the 1890s; spring runs have occurred since the 1920s and fall runs since at least the 1940s (Niemuth 1970). The principal run occurs in the fall (Niemuth 1970; O'Donnell and Churchill 1954). Young spend their first few years in the river before migrating to the lake (Salli 1974).

Iron River (46°46', 91°29'), Flag River (46°47', 91°23'), and Cranberry River (46°50', 91°16') (King and Swanson, pers. comm. 1979; Moore and Braem 1965).

Bark River (46°51′, 91°11′) (King and Swanson, pers. comm. 1979).

Siskiwit River (46°51′, 91°06′) (King and Swanson, pers. comm. 1979; Moore and Braem 1965; Schram, pers. comm. 1979).

Sand River (46°56′, 90°56') (King and Swanson, pers. comm. 1979; Moore and Braem 1965).

Raspberry River (46°56', 90°50') (King and Swanson, pers. comm. 1979; Pycha, pers. comm. 1979).

Brickyard Creek (46°50', 90°48') (Moore and Braem 1965).

Pike's Creek (46°47', 90°51') (King and Swanson, pers. comm. 1979; Moore and Braem 1965; Pycha, pers. comm. 1979).

Onion River (46°45′ , 90°53') (Moore and Braem 1965).

Sioux and Little Sioux Rivers (46°44′, 90°52') (King and Swanson, pers. comm. 1979; Moore and Braem 1965; Pycha, pers. comm. 1979).

Thompson Creek (46°40', 90°55') and Bono Creek (46°38', 90°55') (King and Swanson, pers. comm. 1979).

Whittlesey Creek (46°36', 90°57') (King and Swanson, pers. comm. 1979; Moore and Braem 1965).

Fish Creek (46°35', 90°57') (King and Swanson, pers. comm. 1979; Moore and Braem 1965; Pycha, pers. comm. 1979).

Bad and White Rivers (46°38′ , 90°39') (King and Swanson, pers. comm. 1979; Moore and Braem 1965; Sather and Threinen 1966).

Bell Creek (46°35', 90°33'), Graveyard Creek (46°35', 90°29'), Oronto Creek (46°34', 90°26'), Parker Creek (46°34', 90°26'), and Montreal River (46°34′ , 90°25') (Andrews and Threinen 1969; Moore and Braem 1965).

Michigan

Spawning runs occur in the following tributaries:

MS-1

Isle Royale (48°00', 88°50'). Runs occur in Washington (47°55', 89°09') and Grace (47°53', 89°12') creeks (Moore and Braem 1965).

MS-2

Little Speckled Creek (46°36', 90°17') and Maple Creek (46°39', 90°07') (Moore and Braem 1965).

Black River (46°40', 90°03') (Ann Arbor News 1979a).

Presqua Isle River (46°43', 89°58'). Spring and fall runs (Hansen and Stauffer 1967).

Carp River (46°46', 89°53') (Moore and Braem 1965).

Union River (46°49', 89°37'). Runs occur, and young-of-the-year (YOY) have been collected (Jenkins 1970; Moore and Braem 1965; Peck and Stauffer 1968; Stauffer 1969a,b, 1971c,d, 1973a, 1974a, 1975b, 1977, 1979a).

Little Iron River (46°50', 89°35') and Cranberry River (46°50', 89°25') (Moore and Braem 1965).

Ontonagon River (46°52', 89°20') (Moore and Braem 1965; Wagner 1961).

Flint Steel River (46°56′, 89°12') (Moore and Braem 1965).

Fire Steel River (46°56', 89°12') (GLFC 1967; Moore and Braem 1965).

Misery River (47°00', 88°59') (GLFC 1967; Moore and Braem 1965; Stauffer and Hansen 1958).

Little Elm River (47°02', 88°56') (Moore and Braem 1965).

MS-3

Elm River (47°03′, 88°55'), Graveraet River (47°07', 88°51′), Schlot (Schlotz) Creek (47°11′, 88°39'), Coles Creek (47°08', 88°37'), Lake Annie Outlet (47°11′, 88°37′), Boston-Lily Creek (48°11′, 88°38′), Smith Creek (47°15', 88°34′), and McGunn's Creek (47°15', 88°33') (Moore and Braem 1965).

Gratiot River (47°21′ , 88°27′) . Runs occur, and YOY were present at the river mouth (Moore and Braem 1965; Shetter 1950).

Garden City Brook (47°25', 88°18') and Trap River (Eliza Creek) (47°28′, 88°10') (Moore and Braem 1965).

Silver River (47°28', 88°04'). Runs occur, and YOY were present at the river mouth (Moore and Braem 1965; Shetter 1950).

Fanny Hooe Creek (47°28', 87°52') (North Woods Call 1979k).

Bear Creek (47°24', 87°55'), Little Gratiot River (47°22', 88°02'), Tobacco River (47°14′, 88°09′), Traverse River (47°11′, 88°14'), Mud Lake Outlet (47°08', 88°17′), Sturgeon River (47°02', 88°29'), Pike River 47°01′, 88°32'), Pilgrim River (47°06', 88°31'), Trap Rock River (47°11′, 88°24′), Kelsey Creek (46°53', 88°28'), Little Carp River (46°50', 88°29′), Falls River (46°45′, 88°27'), Meadow Brook (46°46', 88°27'), Little Silver Creek (46°49', 88°25') (Moore and Braem 1965).

Silver River (46°49', 88°17') (GLFC 1967; Moore and Braem 1965; Shetter 1950; Stauffer and Hansen 1958).

Slate River (46°50', 88°16'), Ravine River (46°50', 88°15'), and Gulskog Creek (46°55', 88°08') (Moore and Braem 1965).

Huron River (46°55', 88°02'). Supports heavy runs into Chinks Creek, a tributary; spawning fish, and YOY have been collected in the river (GLFC 1967, 1968b; Jenkins 1970; Miller and Scott 1968; Moore and Braem 1965; Peck and Stauffer 1968; Stauffer 1969a,b, 1971b,c,d, 1973a, 1974a, 1975a,b, 1977, 1979a; Stauffer and Hansen 1958; Wagner and Stauffer 1978).

Little Huron River (46°54', 88°00'). Spawning runs enter the river, and YOY have been collected (Jenkins 1970; Moore and Braem 1965; Stauffer 1969a,b, 1971c,d, 1973a, 1974a, 1975b, 1977, 1979a).

Pine River (46°53', 87°52') and Salmon Trout River (46°52', 87°46'). (Moore and Braem 1965).

MS-4

Little Iron River (46°49', 87°39') (Moore and Braem 1965).

Big Garlic River (46°43', 87°34') (Moore and Braem 1965; Stauffer 1971b).

Little Garlic River (46°41', 87°31'). Spawning runs enter the river, and YOY have been collected (Hannuksela 1978; Jenkins 1970; Moore and Braem 1965; Peck and Stauffer 1968; Stauffer 1969a,b, 1971b,c,d, 1974a, 1975a,b, 1977, 1979a).

Harlow Creek (46°38', 87°28') (Moore and Braem 1965).

Dead River-Presque Isle Harbor (46°34', 87°23'). A spring' run enters the harbor in April-June and peaks in late April or early May. Adults have not been seen in the river during the spring run, but adults ascend the discharge canal of the Presque Isle Power Station. No.evidence of spawning has been found in the harbor. A small run also occurs in October and November and fish ascend both the river and the discharge canal. There is little potential for successful spawning in either the harbor or the river (Berg 1976; Moore and Braem 1965; Wapora 1976b).

Shiras Hill Creek (46°33', 87°23'), Deertrack Creek (46°32', 87°23'), and Carp River (46°31', 87°23') (Moore and Braem 1965).

Chocolay River (46°30', 87°21') (Moore and Braem 1965; Stauffer and Hansen 1958).

Sand River (46°30', 87°06'), Laughing Whitefish River (46°31', 87°02'), and Deer Lake Creek (46°28', 86°57') (Moore and Braem 1965).

Rock River (46°28', 86°55') (Moore and Braem 1965; Stauffer and Hansen 1958).

Au Train River (46°26′, 86°51′) and Five Mile Creek (46°28', 86°44') (Moore and Braem 1965).

Furnace Creek (46°26', 86°42') (GLFC 1967; Moore and Braem 1965).

Anna River (46°25', 86°38'). Spawning runs enter the river, and YOY have been collected (Jenkins 1970; Moore and Braem 1965; Peck and Stauffer 1968; Stauffer 1969a,b, 1971c,d, 1973a, 1974a, 197513, 1977, 1979a).

Tannery Falls Creek (46°26', 86°37') and Munising Falls Creek (46°27′, 86°36') (Moore and Braem 1965).

Miners Creek (46°30', 86°33') (GLFC 1967; Moore and Braem 1965; Stauffer and Hansen 1958).

Mosquito River (46°32', 86°30') (Moore and Braem 1965; Stauffer and Hansen 1958).

MS-5

Beaver Lake Creek (46°35', 86°21′) (Moore and Braem 1965).

Seven Mile Creek (46°37', 86°16'). Runs occur, and YOY have been found (Moore and Braem 1965; Peck and Stauffer 1968).

Sullivan Creek (46°39', 86°11′) and Hurricane River (46°40', 86°10') (Moore and Braem 1965).

Sable Creek (46°40', 86°01′) (Moore and Braem 1965; Swedberg, pers. comm. 1979).

Sucker River (46°40', 85°56') (GLFC 1967; Moore and Braem 1965; Pycha, pers. comm. 1979; Stauffer and Hansen 1958).

Blind Sucker River (46°41′, 85°40') (Moore and Braem 1965).

Big Two Hearted River (46°42', 85°25') (GLFC 1967; Hansen and Stauffer 1967; Moore and Braem 1965; Stauffer and Hansen 1958).

Little Two Hearted River (46°43', 85°22') and Three Mile Creek (46°44′, 85°19') (Moore and Braem 1965).

MS-6

Betsy River (46°41′, 85°01'), Tahquamenon River (46°33′, 85°02'), Roxbury Creek (46°29', 85°01'), Ankodosh Creek (46°29', 85°00'), Naomikong Creek (46°29', 84°58'), Mill Creek (46°29', 85°57'), Halfaday Creek (46°28′, 84°54'), and Grants Creek (46°28', 84°52') (Moore and Braem 1965).

Pendills Creek (46°27', 84°49') (Gleason and Behmer, pers. comm. 1979; Moore and Braem 1965).

Ontario

Of the 110 known spawning streams, 30 support major runs (over 200 fish) (OMNR 1976b).

OS-1

Pigeon River (48°00', 89°34'), Little Pine River (48°02', 89°31'), and Pine River (48°03′, 89°30′). Cloud River (48°05', 89°26'), Jarvis River (48°07', 89°21'), and Lomond River (48°16′, 89°16′). Major runs. Whiskeyjack Creek (48°21′, 89°13′). Kaministiquia River (48°23', 89°13'), Neebing River (48°24', 89°13'), and McIntyre River (48°25', 89°13). Major runs. McVicar Creek (48°26', 89°13'), Current River (48°27′, 89°11′), Wildgoose Creek (48°29', 89°04'), and Blind River (48°30', 89°01'). MacKenzie River (48°32′, 88°57′). Major runs. Blende River (48°34', 88°46′).

OS-2

Joeboy River (48°29', 88°42'). Portage Creek (48°33', 88°38'). Major run. D'Arcy Creek (48°37', 88°37'). Pearl River (48°37', 88°37'). Major run. Welch Creek (48°39', 88°33'). Coldwater Creek (48°48', 88°31') and Wolf River (48°49', 88°29'). Major runs. Little Squaw Creek (48°51′, 88°27') and Black Sturqeon River (48°50', 88°24').

OS-3

Trout Creek (Big and Little) (48°57', 88°15'). Major run. Stillwater Creek (48°59', 88°16') and Cash Creek (49°06', 88°15′). Nipigon River (48°57', 88°15'). Major run. Firehill Creek (49°00', 88°06'), Jackfish River (49°00', 88°05'), and Ozone Creek (49°01', 88°02′). Jackpine River (48°58′ , 88°00') and Dublin Creek (48°57', 87°58′). Major runs. MacInnis Creek (48°56', 87°55'). Cypress River (48°56', 87°52'). Major run. Little Cypress River (48°56', 87°51′). Little Gravel River (48°55', 87°46') and Gravel River (48°55', 87°46'). Major runs. Pays Plat River (48°53', 87°34'), McKellar Creek (48°50', 87°28′), Hewitson River (48°50′, 87°27'), Unnamed Tributary (48°51′, 87°54′), Unnamed Tributary (48°47', 88°04'), and Unnamed Tributary (48°45′, 88°06′).

OS-4

Dawson Creek (48°37', 88°13′), Unnamed Tributary (48°38', 88°10′), Brook River (48°45', 87°58'), Tedesco Creek (48°46', 87°54'), and Unnamed Tributary (48°48', 87°48').

OS-5

Schreiber Creek (48°46', 87°15'), Aquasabon River (48°46', 87°07'), Steel River (48°46', 86°54'), Prairie River (48°47', 86°47'), Ripple Creek (48°47′, 86°45'), and Dead Horse Creek (48°48', 86°41′). Little Pic River

(48°47', 86°38'). Major run. Mink Creek (48°46', 86°30') and Angler Creek (48°45', 86°25'). Pic River (48°36', 86°18'). Major run. White River (48°33', 86°16').

OS-6

White Gravel River (48°18', 86°10'), Swallow River (48°10', 86°05'), Holly Creek (48°05', 86°00'), and Imogen River (48°02', 85°55'). Pukaskwa (Puckasaw) River (48°00', 85°53). Major run. Pipe River (47°56', 85°41'). University River (47°58', 85°12') and Dore' River (47°58', 84°57'). Major runs. Magpie River (47°58', 84°52').

Michipicoten River (47°56', 84°51'). Major run (OMNR 1976b). Contains the largest spawning ground (47°55', 84°48') in the area for Lake Superior rainbow trout (Environ. Can 1977c).

Old Woman River (47°47', 84°54') and Red Rock River (47°41', 84°59').

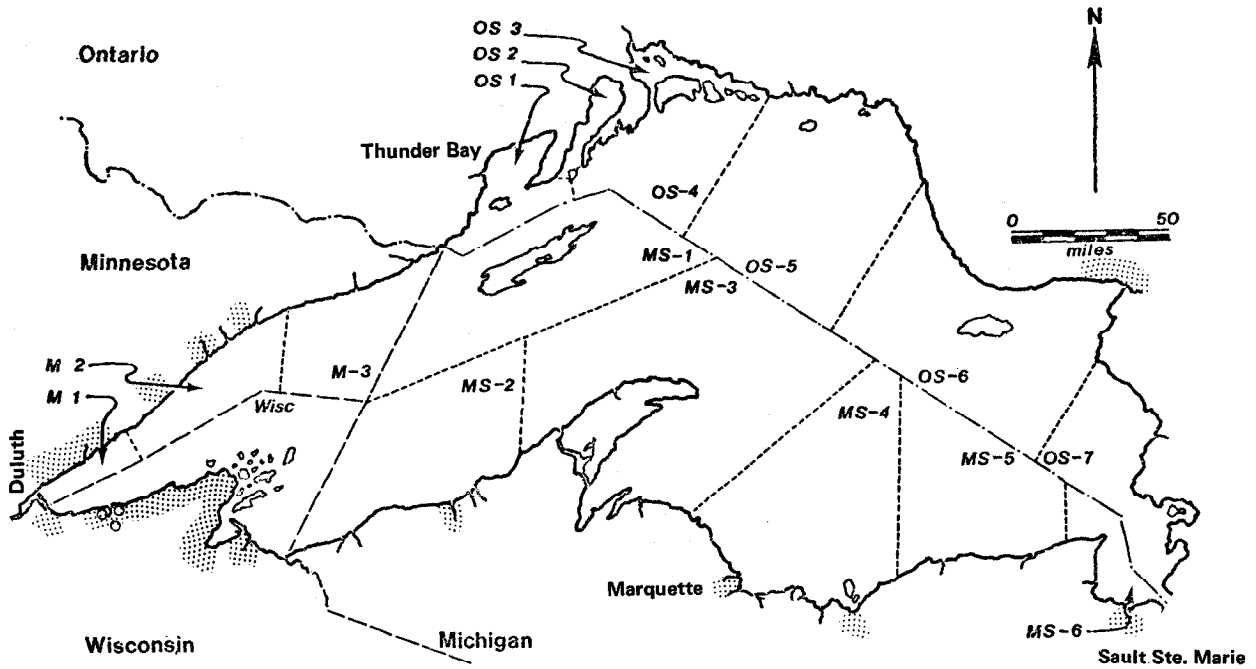
OS-7

Gargantua River (47°35', 85°00'), Buckshot Creek (47°31', 84°54'), Baldhead (Gravel) River (47°29', 84°50'), Coldwater River (47°28', 84°47'), Sand River (47°26', 84°44'), and Barrett River (47°24', 84°42'). Agawa River (47°21', 84°38'). Major run. Frater Creek (47°20', 84°37'), Speckled Trout Creek (47°19', 84°36'), and Laughing Brook (47°18', 84°35'). Montreal River (47°15', 84°39'). Major run. Unnamed Tributary (47°13', 84°40'), Metheany Creek (47°12', 84°41'), Alona Bay Creek (47°10', 84°42'), Dobson's Creek (47°09', 84°43'), Mica Bay Creek (47°07', 84°43'), Mamainse Creek (47°03', 84°46'), Breckenridge Creek (46°58', 84°46'), Unnamed Tributary (46°58', 84°45'), and Black Creek (46°58', 84°42'). Pancake River (46°58', 84°40'), Sable (Carp) River (46°57', 84°35'), and Batchawana River (46°56', 84°32'). Major runs. Chippewa River (46°56', 84°27'), Downey Creek (46°54', 84°23'), Jones Creek (46°53', 84°22'), Sawmill Creek (46°53', 84°22'), Government Creek (46°52', 84°22'), and Harmony River (46°51', 84°23').

Stokely Creek (46°49', 84°25'). Major run (OMNR 197633). A run of ripe fish was present in the creek May 21-June 18, and peak abundance occurred on June 1 (Lawrie 1954, 1955). In 1970, adults returned to the lake immediately after spawning (Kwain 1971). Fingerlings were also found in the creek (Lawrie 1954).

Havilland Creek (46°49', 84°25'1, Little Goulais River (46°46', 84°29'), Goulais River (46°43', 84°27'), Cranberry Creek (46°42', 84°25'), Unnamed Tributary (46°41', 84°26'), Unnamed Tributary (46°37', 84°32'), and Prince Creek (46°35', 84°35').

BROWN TROUT



Brown trout were introduced into the Great Lakes as early as 1883. Brown trout in Lake Superior may have originated from eggs hatched at the Bayfield Fish Hatchery at Bayfield (46°49', 90°49'), Wisconsin, in 1887 (Brynildson et al. 1963).

Most lake-run populations of brown trout occur in the western end of the lake (Moore and Braem 1965). Runs enter tributaries in fall, and spawning usually occurs in October-early December (Hassinger, pers. comm. 1979; H. Johnson, pers. comm. 1979; Surber 1920). If upstream migration is blocked, spawning occurs on sand and gravel bars at stream mouths (Eddy and Underhill 1974) and along rocky shorelines in the lake proper (CDM/Limnetics 1976c). Young brown trout remain in the streams for 1-2 years and then move downstream to the lake (Hassinger, pers. comm. 1979;

Lawrie 1978; Salli 1974). Runs have been reported for the following U.S. tributaries:

Minnesota

M-1

Knife River (46°57', 91°47'). Eggs were collected from wild stock during October 1937, 1939, and 1940 (Minn. DNR 1937-59).

Big Sucker Creek (Sucker River) (46°55', 91°51'). Substantial runs occur (Hassinger, pers. comm. 1979; Schumaker and Eddy 1960).

Schmidt Creek (46°54', 91°53') (Hassinger, pers. comm. 1979).

French River (46°54', 91°53'). Supported one of the best runs along the Minnesota shore (Surber 1920) and was one of the major sites for the collection of eggs for hatchery use during the late 1930s and early 1940s (Minn. DNR 1937-59). Runs still occur (Hassinger, pers. comm. 1979). Runs were very good until about 10 years ago and moderately good through the late 1970s (H. Johnson, pers. comm. 1979). The river has been stocked with fingerlings, but few fish have returned to spawn (H. Johnson, pers. comm. 1979).

Talmadge River (46°53', 91°55') and Lester River (46°50', 92°00') (Hassinger, pers. comm. 1979).

M-2

Cross River (47°32', 90°53'). Substantial run (Schumaker and Eddy 1960).

Baptism River (47°20', 91°12'). The river was stocked with fingerlings, but few fish returned to spawn (H. Johnson, pers. comm. 1979).

Split Rock River (47°11', 91°24'). Eggs were taken from wild stock in this river during October 1939 (Minn. DNR 1937-59). Considerable natural reproduction was still occurring below the falls in the early 1940s (Smith and Moyle 1944). Fingerlings were stocked recently, but few fish have returned to spawn (H. Johnson, pers. comm. 1979).

Gooseberry River (47°08', 91°27'). Eggs were collected from wild stock during October 1939 (Minn. DNR 1937-59).

Wisconsin

Nemadji River (46°42', 92°02'). Runs move through the Duluth-Superior Harbor, enter the river, and ascend to the headwaters (DeVore 1978, pers. comm. 1979; FWS 197911).

Brule River (46°45', 91°37'). Runs enter the river as early as July, and peak in August; spawning occurs in October (GLFC 1958, 1961; King and Swanson, pers. comm. 1979; Niemuth 1970; Salli 1974; Schram, pers. comm. 1979). Adults reportedly move east after spawning into bay areas along the south shore and into the Apostle Islands (47°00', 90°40') area (Niemuth 1970). Young spend their first few years of life in the river before migrating to the lake (Salli 1974).

Iron River (46°46', 91°29') (King and Swanson, pers. comm. 1979).

Flag River (46°47', 91°23'), Cranberry River (46°50', 91°16'), Dark River (46°51' , 91°11'), and Siskiwit River (46°51', 91°06') (King and Swanson, pers. comm. 1979; Schram, pers. comm. 1979).

Raspberry River (46°56', 90°50') (King and Swanson, pers. comm. 1979).

Pike's Creek (46°47', 90°51') (King and Swanson, pers. comm. 1979; Schram, pers. comm. 1979).

Sioux and Little Sioux Rivers (46°44', 90°52') (King and Swanson, pers. comm. 1979; Schram, pers. comm. 1979; Pycha, pers. comm. 1979).

Thompson Creek (46°40', 90°55') (King and Swanson, pers. comm. 1979; Schram, pers. comm. 1979).

Bono Creek (46°38', 90°55') and Whittlesey Creek (46°36', 90°57') (King and Swanson, pers. comm. 1979).

Fish Creek (46°35', 90°57') (King and Swanson, pers. comm. 1979; Pycha, pers. comm. 1979; Schram, pers. comm. 1979).

Bad and White Rivers (46°38', 90°39') (King and Swanson, pers. comm. 1979).

Michigan

MS-2

Ontonagon River (46°52', 89°20') (Wagner 1961).

MS-4

Dead River (46°34', 87°23')--Presque Isle Harbor (46°34', 87°23'). Brown trout are present throughout the year in the harbor, and spawning occurs in the river or in rocky areas of the harbor during early November at about 47°F (Berg 1976; Wapora 1976a,b). In 1975, gravid females were found in the harbor in mid to late October and in the river in November. Spent females were subsequently found in the harbor in December (Wapora 1976b). Successful reproduction probably does not occur in the Dead River (Berg 1976, FWS 1979d).

Anna River (46°25', 86°38'). Spawning occurred in early November 1970 (Stauffer 1971a).

MS-6

Pendills Creek (46°27', 84°49') (Gleason and Behmer, pers. comm. 1979).

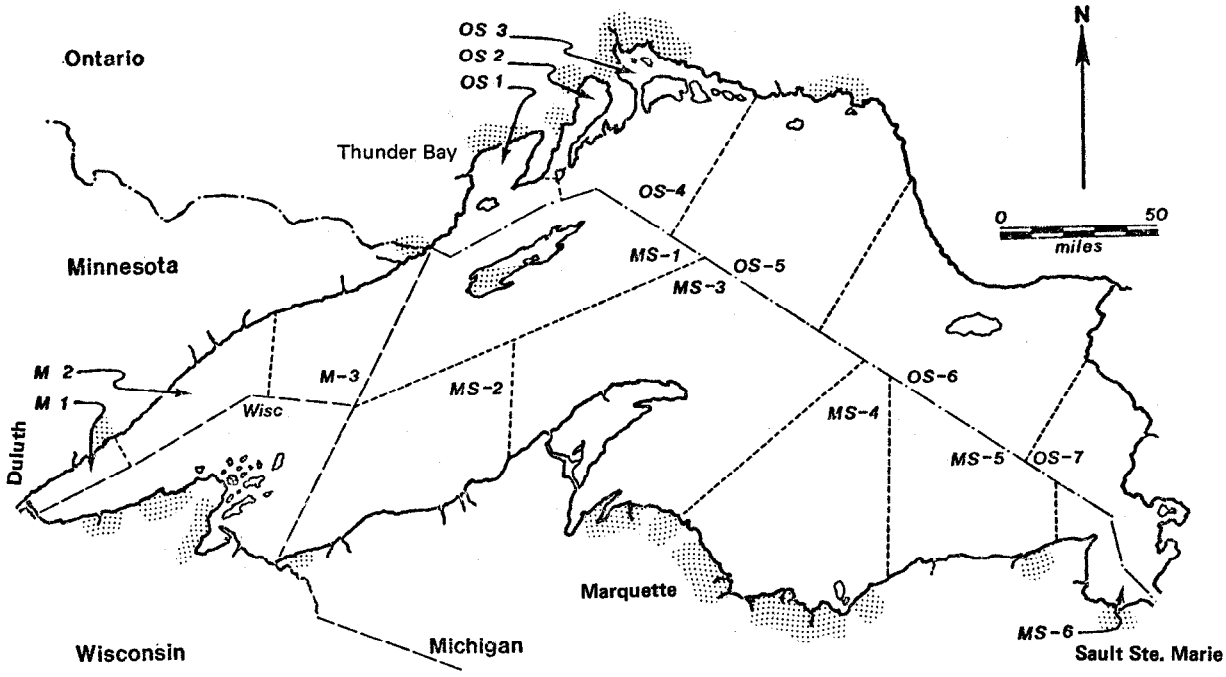
Ontario

Two Ontario tributaries in the eastern end of the lake support spawning runs in October and November (OMNR 1976b).

OS-6

Dore' River (47°58', 84°57'). Major run. Magpie River (47°58', 84°52'). Minor run.

BROOK TROUT



In Lake Superior, lake-run populations of brook trout, called "coasters," ascend streams in the fall to spawn (Brash et al. 1962; Hassinger, pers. comm. 1979; Lawrie 1978; OMNR 1976b). Runs begin in mid August-early September and last until late November-early December (Eddy and Underhill 1974; Speirs 1955; Surber 1920). Spawning occurs at 40-49°F (Eddy and Underhill 1974). The streams in the region serve as nursery areas (Hassinger, pers. comm. 1979; King and Swanson, pers. comm. 1979). Fry are free-swimming in early March (Hale and Hilden 1969). Runs have been reported for the following U.S. tributaries:

Minnesota

M-1

Stewart River (47°03', 91°38'). Redds were seen in mid-October (Hale and Hilden 1969).

M-3

Pigeon River (48°00', 89°34') (Hassinger, pers. comm. 1979).

Wisconsin

Brule River (46°45', 91°37') (King and Swanson, pers. comm. 1979).

Cranberry River (46°50', 91°16'). A few fish run this river in October (King and Swanson, pers. comm. 1979).

Bark River (46°51', 91°11') (Schram, pars. comm. 1979).

Saxine Creek (46°53', 91°03') (Swanson and Pratt, pers. comm. 1979).

Oak Island Streams (46°56', 90°44') and Birch Run (46°47', 90°51') (King and Swanson, pers. comm. 1979).

Pike's Creek (46°47', 90°51'). Light run (King and Swanson, pers. comm. 1979).

Sioux and Little Sioux Rivers (46°44', 90°52') and Thompson Creek (46°40', 90°55') . Heavy run (King and Swanson, pers. comm. 1979).

Bono Creek (46°38', 90°55') (Swanson and Pratt, pers. comm. 1979).

Whittlesey Creek (46°36', 90°57') and Fish Creek (46°35', 90°57'). Light run (King and Swanson, pers. comm. 1979).

Michigan

MS-1

Isle Royale (48°00', 88°50'). This area supports the only remaining large, self-sustaining populations of coasters in Michigan waters of Lake Superior. Coasters move into Siskiwit Bay (47°57', 88°50'), and Tobin Harbor (48°09', 88°30'), and spawning occurs in the Big (47°54', 89°00') and Little (47°56', 88°57') Siskiwit rivers and Washington Creek (47°55', 89°09') (North Woods Call 1980c).

MS-2

Omans Creek (46°36', 90°20'). Historical run (Stauffer 1976b).

MS-3

Silver River (46°49', 88°17'). Lake-run fish are present in this river in fall (Stauffer and Hansen 1958).

Huron River (46°55', 88°02'). Historical run (Stauffer 1976b).

Salmon Trout River (46°52', 87'46'). Eggs were collected from coasters taken in the bay in late September (Stauffer 1967b). This is believed to be the last tributary on the Michigan mainland that supports native coasters (North Woods Call 1980c).

MS-4

Big Garlic River (46°43', 87°34'), Campau Creek (46°35', 87°25'), Sand River (46°30', 87°60'), Rock River (46°28', 86°55'), Au Train River (46°26', 86°51'), Furnace Creek (46°26', 86°42'), and Mosquito River (46°32', 86°30'). Historical runs occurred here (Stauffer 1976b).

MS-5

Big Two Hearted River (46°42', 85°25') and Little Two Hearted River (46°43', 85°22') . Historical runs occurred here (Stauffer 197633).

MS-6

Halfaday Creek (46°28', 84°54') and Pendills Creek (46°27', 84°49') (Stauffer 1976b).

Ontario

Runs are reported in the following streams (OMNR 1976b):

OS-1

Current River (48°27', 89°11'), Blind River (48°30', 89°01'), and MacKenzie River (48°32', 88°57').

OS-2

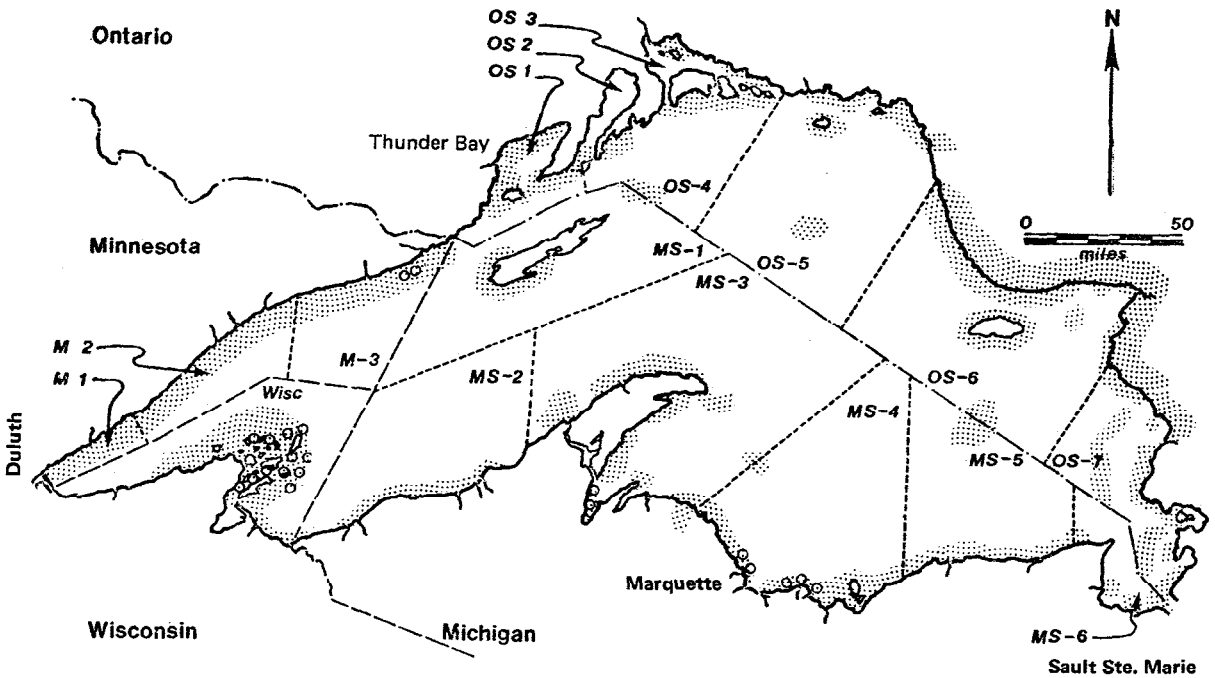
Pearl River (48°37', 88°37'), Coldwater Creek (48°48', 88°31'), and Black Sturgeon River (48°50', 88°24').

OS-3

stillwater Creek (48°59', 88°16'), Nipigon River (48°57', 88°15'), Firehill Creek (49°00', 88°06'), ozone Creek (49°01', 88°02'), Jackpine River (48°58', 88°00'), MacInnes Creek (48°56', 87°55'), Cypress River (48°56', 87°52'), and Little Gravel River (48°55', 87°46').

OS-5

Steel River (48°46', 86°54'), Prairie River (48°47', 86°47'), and Little Pic River (48°47', 86°38').



The many races and subpopulations of lake trout in Lake Superior are reproductively isolated by spawning time and spawning location (Eschmeyer 1957; Lawrie and Rahrer 1973; Pycha and King 1975). Peak spawning usually occurs from late September to early November, but the spawning season can extend from June to late November, with the "siscowet" spawning much earlier than other races (Budd 1955; Calhoun and Coon 1941; Cook 1929; Eschmeyer 1955, 1957, 1964; Eschmeyer et al. 1952; Goode 1884; Koelz 1926; Lagler 1948; Leach 1923: Milner 1874a: Peck 1975a; Pycha and King 1975; Rathbun and Wakeham 1897; Scott 1936; Slastenenko 1958; Stauffer 1974c; U.S. Fish Comm. 1900). Spawning occurs on rocky reefs throughout the lake in 6-480 ft of water, depending on the variety of trout (Atlantic Fisherman 1948; Dymond 1928; Eschmeyer 1955, 1957, 1964; Goode 1884; Lawrie and Rahrer 1973; Leach 1923; Pycha and King 1975; Smith 1937). Some lake trout populations also run into tributaries to spawn (Eschmeyer 1957, 1964; Lawrie and Rahrer 1973; Loftus 1958; Smith 1969). Lake trout home to established spawning grounds; some planted trout also home to stocking sites, which are often unsuitable for

successful reproduction (Eschmeyer 1955, 1957; Eschmeyer et al. 1952; Harris and Eschmeyer 1975; King and Swanson 1975; Lawrie and Rahrer 1973; Pycha and Dryer 1965; Pycha and King 1975; Pycha and Selgeby 1975). The adults remain on the spawning grounds for several weeks and then disperse to deeper water (Eschmeyer 1955; Eschmeyer et al. 1952; Scott 1936). Young-of-the-year (YOY) lake trout remain near the spawning ground through the first summer usually at depths of less than 120 ft (Eschmeyer 1956, 1964; GLFC 1957; Moffet, undated). No natural reproduction was observed during 1959-64 because sea lamprey predation and overfishing sharply reduced the abundance of adult trout. The first major plantings of hatchery reared juveniles were made in 1958, and some naturally spawned YOY were found in 1965. Natural reproduction is now most evident in Wisconsin waters (GLFC 1970a; USBCF 1969b). Areas where lake trout spawning has been reported in Lake Superior are described in greater detail below. Little information was available to permit description of lake trout nursery areas in Lake Superior.

Minnesota

The Minnesota shoreline was one of the major spawning grounds in the lake (Goode 1884). Lake trout spawned on rocky reefs all along shore, in 6-90 ft of water, in October and November (Cobb 1922; FWS 1979d; Kaups 1978; Surher 1920). The entire shoreline is still potential spawning area (Hassinger, pers. comm. 1979). From the 1930s to early 1950s, lake trout eggs for hatchery use were taken from fish netted during late September-early December; the greatest number of eggs was collected in late October-early November (Minn. DNR 1937-59).

M-l

Two Harbors (47°01', 91°40'). Lake trout in spawning condition were collected from the 1930s through 1942 in shallow rocky areas, at Fisherman's Point (47°02', 91°38') and at the mouth of Silver Creek (47°04', 91°36') .

Lester River (46°50', 92°00')--Big Sucker Creek (46°55', 91°51'). Nets were set by fishermen throughout this area to catch spawners (Jackson, pers. comm. 1979; W. Johnson, pers. comm. 1979). Eggs were collected from the lake bottom in the area between French River (46°54', 91°53') and Schmidt Creek (46°54', 91°53'). Lake trout began moving onto reefs on about October 10. The redfin trout spawned earliest and the "silver, grey" trout spawned latest. A 5-6 in. thick layer of green "moss" covered the bottom in the bays in this area (W. Johnson, pers. comm. 1979). The French River was a spawn collection site during September-November (Ravenel 1898). In the early 1920s, one male and one female lake trout in spawning condition were taken off the mouth of the French River (Surber 1924).

M-2

Black Point (47°42',90°33') (Koss and Koss, pers. comm. 1979; Zerbach, pers. comm. 1979).

Little Marais (47°24', 91°07'). In the early 1900s, many spawners were caught in this area (Koss and Koss, pers. comm. 1979). Presently, lake trout spawn during September-November at depths of 18-20 ft on reefs throughout the area, including Cedar Landing (47°24', 91°07'), Louie Hills Point (47°26', 91°04'), Little Marais Reefs (47°25', 91°06'), Manitou River (47°27', 91°04'), and Pork Bay (47°27', 91°02'). The first males move into spawning areas in late August; spent adults move to deeper water about 3 mi offshore (Fenstad, pers. comm. 1979).

Little Two Harbors (47°12', 91°22'). Spawning lake trout were collected in an area extending from the east side of Corundum Point (47°11' , 91°23') to the 22 ft deep shoal area off Little Two Harbors. Fishermen collected spawning lake trout on rocky reef ledges on both sides of the unnamed point (47°11', 91°24'), immediately north of the Split Rock River mouth (47°11', 91°24'). Lake trout spawned on the nearshore reef at Twin Points (47°10', 91°25') (Sve, pers. comm. 1979).

Encampment Island (47°05', 91°33'). Lake trout concentrated here in September; the "redfin" lake trout spawned earliest (Croft, pers. comm. 1979). The rocky shoreline around the Encampment River was heavily fished (Kaups 1978).

M-3

Wauswauqoning Bay (47°58', 89°37'). Commercial fishermen caught spawners until 1955, over rubble and boulders at depths of 30-60 ft around Frances Island (47°59', 89°37'); eggs were also seen there on the bottom. Adult trout began moving into the bay at the end of August, and spawning peaked during mid-October-mid-November. Spawners were also found in the western part of Clark Bay (48°00', 89°33') and on the shoals of Susie Island (47°59', 89°34'), Lucille Island (47°58', 89°35'), and Belle Rose Island (47°58', 89°35') between Clark and Wauswaugoning Bays (Hassinger, pers. comm. 1979; Hendrickson, pers. comm. 1979). Siscowets spawned in the bay at depths of 400-600 ft (Hendrickson, pers. comm. 1979) .

Grand Portage Bay (47°57', 89°40'). This area was heavily fished for spawning trout (Kaups 1978), and was a spawn collection site during September-November (Ravenel 1898). Fishing for spawners was conducted in the late 1940s or early 1950s on the reefs around Grand Portage Island (47°57', 89°40'), off Booth Rock (47°56', 89°41'), and at Twin Points (47°56', 89°43'). Most spawners were caught at depths of 24-60 ft but some were taken in water as shallow as 12 ft. Spawners entered the area in early October and left by November (Spry, pers. comm. 1979).

Grand Marais (47°45', 90°20'). Spawning occurred all along the shore in this area. Adults began moving inshore in mid-October, the movement

peaked in November, often around election day, and the return to offshore water was completed in December. Redfin trout which spawned earlier than the "Mackinaw" trout, moved inshore during September or even late August; redfin trout have not been seen since 1936. Siscowets could be found spawning in summer in deep water (Koss and Koss, pers. comm. 1979). Specific areas in the vicinity of Grand Marais where fishing took place for spawners are:

Chicago Bay (47°50', 89°58')--Red Rock Point (47°54', 89°46'). The reef in Big Bay (47°52', 89°55') was especially good; spawning and eggs were observed in shallow water (Koss and Koss, pers. comm. 1979). Young lake trout were seen in Cannonball Bay (47°53', 89°51') (Koss and Koss, pers. comm. 1979).

Brule River (47°49', 90°03'). Many spawners were caught in November in nets set at depths of 10-30 ft just west of the river mouth, at Marr Island (47°48', 90°04'), and on Brule Reef (47°49', 90°13') (Zerbach, pers. comm. 1979).

Kadunce Creek (47°48', 90°09'). Many spawners were caught at the mouth of the creek over large rocks. The bay substrate at the creek mouth was once covered with a 6-8 in. thick layer of moss; however this mossy cover disappeared many years ago (Zerbach, pers. comm. 1979).

Guano Rock (47°46', 90°14'). Spawning occurs on rough rock bottom (Zerbach, pers. comm. 1979).

Grand Marais Harbor (47°45', 90°20') and Powder Bay (47°45', 90°21') (Zerbach, pers. comm. 1979).

Good Harbor Bay (47°43', 90°26'). Spawners were caught at depths of 12-60 ft at Rock Island (47°43', 90°25') and Gaff Hook Point (47°44', 90°23'). Dead eggs were observed in the bay after a storm (Zerbach, pers. comm. 1979).

Cascade River (47°42', 90°31')--Terrace Point (47°43', 90°26'). This was the best place to obtain spawn from 1947 to the present. Eggs were seen in the area, and round whitefish were seen feeding on the eggs (Koss and Koss, pers. comm. 1979).

Wisconsin

Historically, lake trout spawned during October on almost every rocky area and reef along the shore, and throughout the Apostle Islands area (47°00', 90°40') (coberly and Horrall 1980b; Daly et al.. 1962; Goode 1884; King and Weigert, undated; Nevin 1896; Pycha, pers. comm. 1979; Swanson and King, pers. comm. 1979). Fishermen in the Apostle Islands referred to two types of "lean" lake trout: the Mackinaw or redfin

trout, which spawned over rock in 18-20 ft of water and the "bank" trout, whose spawning grounds are unknown (Coberly and Horrall 1980b). In recent years, the heaviest spawning occurred in the eastern portion of the Apostle Islands (Tait 1973). Spawning generally takes place when the water temperature falls to 48-52°F (Pycha, pers. comm 1979).

Bark Point (46°53', 91°11'). This is an historical spawning area (Swanson and King, pers. comm. 1979) used by redfin trout (Coberly and Horrall 1980b).

Squaw Point (46°53', 91°05'). Redfin trout spawned here over rock bottom in 18-60 ft of water; spawning also occurred at Squaw Bay Caves (46°55', 91°01') (Coberly and Horrall 1980b).

Eagle Island Shoals (46°55', 91°03'). This is an historical spawning area (Swanson and King, pers. comm. 1979) that was also a spawn collection site (Coberly and Horrall 1980b).

Eagle Island (46°56', 91°02') (Coberly and Horrall 1980b).

Sand Island Shoals (47°00', 90°54'). This historical spawning area (Swanson and King, pers. comm. 1979) was relatively unproductive (Coberly and Horrall 1980b).

Point Detour (46°58', 90°51'). Historical spawning area (Coberly and Horrall 1980b; Swanson and King, pers. comm. 1979).

Raspberry Point (46°56', 90°48'). Historical spawning area (Coberly and Horrall 1980b).

York Island Shoals (47°01', 90°51'). Historical spawning area (Swanson and King, pers. comm. 1979).

Raspberry Island (47°58', 90°48') (Coberly and Horrall 1980b).

Bear Island Shoal (47°02', 90°49'). This historical spawning area (Pycha, pers. comm. 1979; Swanson and King, pers. comm. 1979) was quite productive in the early 1900s; thereafter its productivity declined (Coberly and Horrall 1980b).

Bear Island (47°01', 90°45'). Areas north (47°02', 90°46') and south (47°00', 90°45') of the island were spawning areas (Coberly and Horrall 1980b). The sand-bottomed area between Bear Island and Otter Island (47°00', 90°41') at depths of 4-25 ft was the second best nursery area in the Apostle Islands (47°00', 90°40') (Griswold 1970).

Devils Island Shoal (47°05', 90°42'). This was the second largest spawning area in Wisconsin; many spawners were caught here as late as 1950 (Coberly and Horrall 1980b), but the area has not had a spawning run since the late 1950s (Schram, pers. comm. 1979; Swanson and King, pers. comm. 1979). Spawning was reported to begin several days earlier than in

other areas (Coberly and Horrall 1980b). This area is presently being stocked with eggs, fingerlings, and YOY (Horrall, pers. comm. 1979).

Rocky Island (47°02', 90°41'). Historical spawning area (Nourse, pers. comm. 1979).

North Twin Island (47°04', 90°35'). Shoals at both ends of the island are spawning areas (Coberly and Horrall 1980b; Nourse, pers. comm. 1979; Swanson and King, pers. comm. 1979).

Otter Island (47°00', 90°41') and Ironwood Island (47°00', 90°37') (Coberly and Horrall 1980b).

Cat Island (47°02', 90°33'). This is an historical spawning area; 75% of the spawners currently using the area are native fish (Coberly and Horrall 1980b; King and Belonger 1970; King and Swanson 1975; Pycha, pers. comm. 1979; Swanson and King, pers. comm. 1979). Young-of-the-year are also found here (Pycha, pers. comm. 1979).

Outer Island Shoal and Reef (47°05', 90°25'). This historical spawning area (Coberly and Horrall 1980b) is currently used (Pycha, pers. comm. 1979). Young-of-the-year were collected off the south end of the island during the 1950s (Dryer and King 1968; Eschmeyer 1956), and the west side of the island was reported to be a nursery area (Griswold 1970). Mackinaws spawned on the unnamed reef (47°03', 90°21') located 5 mi SE of the shoal and also 1-2 mi SE of this reef at depths of 108-120 ft; catches here were sometimes qreater than at Gull Island Shoal (46°57', 90°24') (Coberly and Horrall 1980b).

Manitou Island Reef (46°57', 90°41'). This reef is currently used for spawning (Pycha, pers. comm. 1979; Swanson and King, pers. comm. 1979). Little Manitou Island (46°58', 90°41') is also a spawning area (Coberly and Horrall 1980b).

Oak Island Shoal (46°58', 9O°43'). This is an historical spawning area (Coberly and Horrall 1980b; Pycha, pers. comm. 1979; Swanson and King, pers. comm. 1979), where YOY lake trout were found in late summer-fall (Pycha, pers. comm. 1979).

Stockton Island (46°56', 90°35'). Trout Point (46°58', 90°31') and Quarry Bay Point (46°55', 90°35') are historical spawning areas, which may presently be used (Coberly and Horrall 1980b; Pycha, pers. comm. 1979; Swanson and King, pers. comm. 1979).

Hermit Island (46°53', 90°41'). Spawning occurs over the rock and log remains of a dock (Swanson and King, pers. comm. 1979).

Basswood Island (46°50', 90°45'). An historical spawning area is located at the south end of the island (Pycha, pers. comm. 1979; Swanson and King, pers. comm. 1979). The area between Basswood and Madeline (46°50', 90°40') islands at depths of 90-150 ft was the best nursery area in the Apostle Islands (47°00', 90°40') (Griswold 1970).

Red Cliff Bay (46°53', 90°46') and Roys Point (46°51', 90°47') (Coberly and Horrall 1980b).

Madeline Island (46°50', 90°40'). Madeline Island Reef (46°51, 90°33') was a spawning area (Coberly and Horrall 1980b), and Big Bay (46°49', 90°38') is a nursery area (Griswold 1970).

Gull Island Shoal (46°57', 90°24')--Michigan Island Shoal (46°54', 90°27'). These shoals and the waters between them are the largest spawning area in the Apostle Islands (47°00', 90°40'); 75-80% of the spawners in this area are native lake trout (Dryer and King 1968; GLFC 1973, 1978; Harris and Eschmeyer 1974, 1975; Horrall, pers. comm. 1979; King and Swanson 1975; King and Weigert, undated; Pycha 1978, pers. comm. 1979; Pycha and King 1975; Rahrer 1968; Schram, pers. comm. 1979; Scott et al. 1978; Swanson 1976; Swanson and King, pers. comm. 1979; Swanson and Swedberg 1980; USBCF 1968). Spawning occurs at depths of 18-120 ft in October, and usually peaks during October 16-24 (Coberly and Horrall 1980b; Harris and Eschmeyer 1974; Pycha 1978, pers. comm. 1979; Rahrer 1968; Swanson and King, pers. comm. 1979). Young-of-the-year have been collected in the area (Pycha and Selgeby 1975).

Michigan Island (46°53', 90°29'). Spawning occurs on the northeast side of the island (Dryer and King 1968; Pycha, pers. comm. 1979); YOY were found there in late summer and fall (Dryer and King 1968; Griswold 1970; Pycha, pers. comm. 1979) indicating this is also a nursery area. Siscowets spawned about 3 mi SE of the island (Swanson, pers. comm. 1979).

Sand Cut Reef (46°44', 90°41'). A native population presently spawns here (Coberly and Horrall 1980b; King and Belonger 1970; King and Swanson 1975; Swanson and King, pers. comm. 1979).

Bayfield (46°49', 90°49'). Bayfield was a spawn collection site during September-November (Ravenel 1898). Spawning occurs over the sunken remains of an old coal dock south of town (Swanson and King, pers. comm. 1979).

van Tassells Point (46°46', 90°52') (Coberly and Horrall 1980b; King and Belonger 1970; King and Swanson 1975; Swanson and King, pers. comm. 1979).

Bad River (46°38', 90°39'). Spawn was collected from fish taken off the river mouth in the early 1950s (Buettner 1961). The Bad River Reef (46°39', 90°39') was also a spawning site (Coberly and Horrall 1980b).

Marble Point (46°35', 90°30') (Coberly and Horrall 1980b).

Michigan

Spawning occurs in mid-October to early November, usually at temperatures of 48-54°F (Peck 1979a).

MS-1

Isle Royale (48°00', 88°50'). Fishermen historically identified this as one of the best spawning grounds in the lake (MSBFC 1895). The grounds were mainly off the south and southeast shores (Kumlien and True 1887; Organ et al. 1978). Hatchery spawn was collected mainly in October and November (Minn. DNR 1937-59; Ravenel 1898). In 1957, twice as many eggs were collected from Isle Royale as were taken from the Minnesota North shore (Minn. DNR 1937-59). Most spawning begins in mid-October (Organ et al. 1978), but early runs of redfin trout, "humpers," and "halfbreeds" begin in mid-September (Cook 1929; Organ et al. 1978; Pycha, pers. comm. 1979; Rahrer 1965). [Authors' note: The terms "Mackinaw" and "redfin" trout are used synonymously for Wisconsin waters by Coberly and Horrall (1980b)]. Siscowets may spawn from June through November (Eschmeyer 1955).

Rock of Ages Reef (47°52', 89°19'). This is an historical spawning reef (Peck 1979a), where the *Rock of Ages" trout has spawned since the 1900s (Organ et al. 1978).

Washington Island (47°52', 89°15'). "Native" and redfin trout have spawned on the rock reef off the southwest end of the island since the 1900s (Organ et al. 1978). [Authors' note: For Michigan waters, Organ et al. (1978), use the terms "native" and "Mackinaw" trout synonymously. 1

Washington Harbor (47°54', 89°11'). "Channel salmon" have spawned on rock and moss at the back of the harbor since the 1900s (Organ et al. 1978).

Cumberland Point (47°51', 89°14'). Native and redfin trout have spawned over rock around the point since the 1900s (Organ et al. 1978).

Rainbow Point (47°50', 89°11')--Isle Royale Light (47°57', 88°46') . Native and redfin trout have spawned over rock and moss along the entire southwest shore since the 1900s (Organ et al. 1978).

McCormick Reef (47°51', 89°02'), and McCormick Rocks (47°52', 88°57') . These are historical spawning areas (Peck 1979a) used by native and redfin trout since the 1900s (Organ et al. 1978).

Brandsford Reef (47°54', 88°52'). This is an historical spawning reef (Peck 1979a); native trout spawned here over rock and gravel (Organ et al. 1978).

Harlem Reef (47°54', 88°50'). This is an historical reef (Peck 1979a); native trout spawned here over rock (Organ et al. 1978).

Siskiwit Bay (47°57', 88°50'). Several spawning areas exist along the north shore of the bay.

Hay Bay Reef (47°56', 88°55'). This historical spawning reef (Peck 1979a), was used by native trout. Spawning also occurred around Little Siskiwit Island (47°57', 88°53') (Organ et al. 1978).

Domen and Doden Reef (47°58', 88°50'). This is an historical spawning reef (Peck 1979a); native trout spawned here over rock and gravel. Channel salmon spawned over rock and moss in Malone Bay (47°59', 88°49') since the 1900s (Organ et al. 1978).

North Shore (48°13', 88°25'--47°55', 89°11'). Native trout have spawned at four rocky areas along the shore since the 1900s; these areas are Todd Cove (48°02', 88°54'1, a reef south of Gull Rocks (48°01', 88°57'), an unnamed area (48°01', 88°59'), and Finlander Reef (47°58', 89°05') (Organ et al. 1978).

Gull Islands (48°16', 88°16'). Siscowets, humpers (also called "paperbellies" or "popeyes"), and halfbreeds spawn here. Spawning may occur as early as June; in 1953, a nearly spent female, and a nearly ripe female were found in early June. Eggs have been taken from fish collected in mid-September at depths of 156-180 ft (Eschmeyer 1954; Goodier, pers. comm. 1979).

MS-2

Little Girls Point (46°37', 90°20'). This historical spawning area is now presently used almost exclusively by planted fish (Coberly and Horrall 1980b; FWS 1979d; Pycha, pers. comm. 1979). Spawning occurred in 1974 (Organ et al. 1978), and ripe and spent adults of both sexes were caught in 1975; the "reproductive potential" here is good (Peck 1976, 1979a).

Black River (46°40', 90°03')--Union Bay (46°50', 89°37'). Spawning presently occurs on rocky shorelines throughout the area (Wilson, pers. comm. 1979). Native trout spawned in the area from Presque Isle River (46°43', 89°58') to Union Bay until the 1950s (Organ et al. 1978). Planted trout have returned to spawn at planting sites in Black River Harbor (Peck 1979a).

west Ontonagon Reef (46°52', 89°24'). This reef was used for spawrling until 1954 (Organ et al. 1978). The reproductive potential at this reef is fair, based on the capture of a few ripe and spent fish in 1975 (Nourse, pers. comm. 1979; Peck 1976, 1979a).

East Ontonagon Reef (46°54', 89°17'). Spawning occurred on rock and gravel prior to 1954 and again in 1974 (Organ et al. 1978). Although ripe fish were collected during the mid-1970s (Nourse, pers. comm. 1979), the reproductive potential at the reef presently is poor (Peck 1976, 1979a).

Fourteen Mile Point (47°00', 89°07'). Spawning occurred here until 1954 (FWS 1979d; Organ et al. 1978). A few ripe adults were collected in the mid-1970s (Nourse, pers. comm. 1979), but the reproductive potential presently is poor (Peck 1976, 1979a).

MS-3

Redridge (47°09', 88°46'). Spawning occurred from 1917 through the 1960s, over rock extending 5-6 mi N along shore from Redridge (Organ et al. 1978).

West Upper Entry Reef (47°14', 88°39'). Spawning occurred here from the early 1900s through 1972, but the reproductive potential presently is poor (Organ et al. 1978; Peck 1976, 1979a).

East Upper Entry Reef (47°15', 88°36'). Spawning has occurred from the early 1900s through 1972 (Organ et al. 1978), but the reproductive potential is presently poor (Peck 1976, 1979a). Until 1972, siscowets spawned about 4 mi offshore in 400 ft of water in early July (Organ et al. 1978).

Hutchinson Shoal (47°23', 88°24')--Great Sand Bay (47°26', 88°15'). Lake trout spawned along shore from Hutchinson Shoal to Great Sand Bay during 1916-1975 (Organ et al. 1978). Hutchinson Shoal, an historical spawning reef (Nourse, pers. comm. 1979; Peck 1976, 1979a), was used in 1975 (Organ et al. 1978). Eagle River Shoals (47°26', 88°18'), is also an historical spawning reef; few ripe fish have been caught here recently, and the reproductive potential presently is poor (Nourse, pers. comm. 1979; Peck 1976, 1979a). Ripe fish were collected on the shoals of Great Sand Bay during October in the early 1970s (Nourse, pers. comm. 1979).

Eagle Harbor (47°28', 88°09')--Agate Harbor (47°28', 88°03'). Spawning occurred over rock in this area since 1963 (Organ et al, 1978; Wilson, pers. comm. 1979). Little Grand Marais Harbor (47°28', 88°06') is an historical spawning reef, where reproductive potential presently is excellent, based on collections of ripe and spent fish (Nourse, pers. comm. 1979; Peck 1976, 1979a).

Devils Wash Bowl (47°29', 87°57'). A traditional reef between Agate Harbor (47°28', 88°02') and Copper Harbor (47°28', 87°54') (Peck 1976, 1979a).

Copper Harbor Reef (47°29', 87°52'). This is an historical spawning area (Peck 1976, 1979a; Wilson, pers. comm. 1979); spawning grounds were located both inside and outside the harbor (Van Oosten 193833). Spawning has occurred here since 1917 (Organ et al. 1978), and the reproductive potential is good, based on the capture of ripe males and females (Nourse, pers. comm. 1979; Peck 1976, 1979a).

Keweenaw Point (47°24', 87°43'). This is an historical spawning reef (Peck 1976, 1979a); spawning occurred here from 1916 through the 1970s (Organ et al. 1978). Fishermen reported one of the best spawning grounds to be at the head of the point (MSBFC 1895).

Manitou Island (47°25', 87°37'). This is an historical spawning area (Peck 1976, 1979a; Van Oosten 1938b; Wilson, pers. comm. 1979), which fishermen identified as one of the best (MSBFC 1895). Spawning occurred all around the island (Peck 1976), and especially on the shoals on the south side (Nourse, pers. comm. 1979). Spawning has occurred here since 1917 (Organ et al. 1978), but the reproductive potential is poor, based on the low numbers of spawners caught (Peck 7976, 1979a).

Port Gentre (location unknown). A reef 4 mi offshore was a major spawning qround (Goode 1884).

Point Isabelle (47°21', 87°56'). This is an historical spawning reef (Peck 1976, 1979); spawning has occurred here since 1916 (Organ et al. 1978). The reproductive potential based on the presence of ripe and spent fish is excellent (Peck 1976, 1979a). Bete Grise Bay (47°23', 87°56') was also a major spawning area (Goode 1884).

Betsy Reef (47°18', 88°03'). This historical spawning reef (Peck I 976, 1979a) was used by native trout until the 7950s (Organ et al. 1978).

Gay (47°14', 88°10′). Native and redfin trout spawned over a rock reef (47°15', 88°07') north of Gay (Organ et al. 1978), and spawning has occurred since 1916 at Buffalo Reef (47°12', 88°12') (Organ et al. 1978; Peck 1976, 1979a). The reproductive potential at Buffalo Reef is considered to be excellent, based on the presence of ripe and spent lake trout and the presence of lake trout eggs in the stomachs of other fish in 1975 (Peck 1976, 1979a); many ripe and spent lake trout were also found here in 1977 (Stauffer 1978).

Traverse Point (47°08', 88°14'). This historical spawning area (Peck 1976, 1979a) was used from the 1900s through 1969 (Organ et al. 1978).

Hallberg Reef (47°07', 88°10'). This historical spawning reef located in just over 100 ft of water has poor reproductive potential (Peck 1976, 1979a). A rock and gravel area used for spawning from 1916 through 1970s extends north from the reef for about 5 mi (Organ et al. 1978).

Red Rocks Reef (47°07', 88°17'). Spawning has occurred on this reef, at least since the 1900s (Organ et al. 1978; Peck 1976, 1979a). The reproductive potential here is excellent, based on the presence of ripe and spent adults and of lake trout eggs in the stomachs of other fish (Peck 1976, 1979a).

Traverse Island (47°04', 85°16'). This is an historical spawning area (Peck 1976, 1979a; Pycha, pers. comm. 1979), where the reproductive potential is excellent (Peck 1976, 1979a). Spawning has occurred since 1916 over a rock and gravel shoal area (47°03', 88°13′) 3 mi SE of the island in 85-100 ft of water (Organ et al. 1978).

Trout Reef No. 1 (47°01′, 88°19′). This historical spawning area (Peck 1976, 1979a) was used in 1975 (Organ et al. 1978), but reproductive potential here is poor (Peck 1976, 1979a). Spawning also occurred from

1917 through the 1960s, along the mainland shore adjacent to the reef from 47°00', 88°23' to 47°02, 88°21' (Organ et al. 1978). Fair numbers of YOY were found in this area in August 1952 (Eschmeyer 1956).

Trout Reef No. 2 (46°56', 88°25'). This historical spawning area (Peck 1976, 1979a) was used in 1975 (Organ et al. 1978), but the reproductive potential here is poor (Peck 1976, 1979a).

Keweenaw Bay (46°58', 88°20'). Native trout spawned over rock, just north of the town of Keweenaw Bay (46°52', 88°29') during the 1940s (Organ et al. 1978).

Pequaminq Point Reef (46°52', 88°22'). This historical spawning reef (Peck 1979a) was used until the 1960s and then again in 1975 (Organ et al. 1978). The reproductive potential here is good, based on collections of mature males and females (Peck 1976, 1979a).

Sand Point (46°47', 88°28'). Planted trout have spawned over rock and gravel from Sand Point along shore to 46°50', 88°29' since 1970 (Organ et al. 1978).

L'Anse (46°46', 88°27')--Pequaming Bay (46°50', 88°24'). This shoreline was a spawning area; the reef area (location unknown) off L'Anse (Goode 1884) and the area between Rock Reach (location unknown) and Pequaming (46°51', 88°24') (Van Oosten 1938b) were used most intensively. Planted trout have spawned over rock along shore in this area since 1970 (Organ et al. 1978).

Point Abbaye Reef (46°58', 88°06'). This spawning reef (Nourse, pers. comm. 1979; Peck 1979a; Van Oosten 1938b) has been used since 1916; spawninq occurs from mid-October to late November, from shore out to a depth of about 90 ft (Organ et al. 1978). The reproductive potential of the reef presently is good (Peck 1976, 1979a).

Huron Islands Reefs (46°57', 87°58'). This historical spawning area (FWS 1979d; Peck 1979a; Wilson, pers. comm. 1979) has been used since 1916 (Organ et al. 1978). Spawning occurred between the islands and the mainland (Van Oosten 1938b). The reproductive potential is good (Peck 1976, 1979a).

Huron River Point (46°55', 87°54')--Salmon Trout Point (46°52', 87°44'). Spawning occurred on all rocky bottoms in nearshore areas along this shoreline (FWS 1979d; Wilson, pers. comm. 1979). Spawning occurred at Huron River Point from 1916 to 1975 (Organ et al. 1978), but the reproductive potential is poor (Peck 1976, 1979a). Conway Point (46°52', 87°47') was used from 1916 to the 1970s and Salmon Trout Point from 1917 to the 1960s (Organ et al. 1978). A spawning run entered the Salmon Trout River (46°52', 87°46') in late summer (Hubbs 1929).

MS-4

Big Bay Point (46°51', 87°41'). This historical spawning reef (Peck 1977, 1979a) was used from 1916 to the 1970s (Organ et al. 1978). The reproductive potential is excellent, based on the presence of ripe and

spent adults and of lake trout eggs in the stomachs of other fish (Peck 1975b, 1979a). Spawn was collected from fish in Big Bay during the early 1900s (Anderson 1910-26).

Yellow Dog Point (46°49, 87°38')--Sauk Head (46°43', 86°34'). This shoreline was used for spawning from 1917 to the 1960s (Organ et al. 1978). Sauk Head was a major spawning ground (Goode 1884).

Sauk Head (46°43', 86°34')--Marquette (46°33',87°23'). Several areas between Sauk Head and Marquette were used for spawning. Garlic Island Reef (46°44', 87°32') is an historical spawning area where reproductive potential is excellent (Peck 1975b, 1979a); native trout spawned here in 1974 (Organ et al. 1978). Spawn was taken from fish collected at Sauk Head and at Thoney Point (46°41', 87°31′) during the early 1900s (Anderson 1910-26). Spawning occurred between Thoney Point and Little Garlic River (46°41', 87°31′) (Organ et al. 1978). Granite Island (46°43', 87°25') and Granite Point (46°38', 87°27') are spawning areas (Nourse, pers. comm. 1979) ; spawn was collected at Granite Point in the early 1900s (Anderson 1910-26). Partridge Island Reef (46°37', 87°25') is an historical spawninq reef (Peck 1975b, 1979a); planted trout reportedly spawned here in 1973 and 1974 (Organ et al. 7978), and the reproductive potential is excellent, based on the presence of ripe and spent adults and of lake trout eggs in the stomachs of other fish (Peck 1974b, 1975b, 1979a). Two newly-hatched fry and one egg were found at a depth of 60 ft in this area in March 1953 (Eschmeyer 1955). Presque Isle (46°35', 87°23) was a major spawning ground (Goode 18841, where spawn was collected (Anderson 1910-26). Lake trout were most abundant at Marquette during October, when they came inshore to spawn (Smith and Snell 1891). Fishermen's records for years 1910-26 show that spawn from ripe and spawning adults in this area was taken from mid-October to early November with largest collections in the third and fourth weeks of October. The adults at this time were over rocky substrate in waters shallower than 60 ft (Anderson 1910-26). During the late 1920s, spawning occurred at Marquette during October 16-November 6 (Van Oosten 1927a). Historically, the earliest run at Marquette occurred in October and was composed of "shoal" trout (Cook 1929). In the early 1950s, the density of adults on the spawning grounds north of Marquette was highest during October lo-November 4 (Eschmeyer 1955). Siscowets spawned in December off Marquette over mud bottoms at depths of 420-600 ft (Smith and Snell 1891) and spawned in the Marquette area in July at depths of at least 120 ft (Van Oosten 1938b).

At Marquette, planted lake trout spawned successfully for the past few years on rocky areas at the intake and discharge structures of the Presque Isle Power Station in Presque Isle Harbor (46°34', 87°23'). Adults are present in the harbor from early September to December and spawn in mid-October to early November at a water temperature of about 50°F. Concentrations of spawning adults have been seen, eggs have been collected from gravel and rock bottom, and fry have been collected from early April through July. Fry remain in nearshore areas until mid-July and then move to deeper water (Brown 1977; GLFC 1977b; Organ et al. 1978; Peck 1978, 1979b; Rybicki and Keller 1976; Stauffer 1979b; Stauffer and Peck 1977; Stauffer et al. 1976; Stauffer and Wagner 1976; Wagner 1974b;

Wapora 1976b). Spawning also occurs on two natural rock reefs, one 2,500 ft E and another 4,000 ft SE of the mouth of the Bead River (46°34', 87°23') (Peck 1978, 1979b; Stauffer 1978b, 1979b).

Stannard Rock (47°11', 87°14'). Fishermen identified this as one of the best spawning areas (Kumlien and True 1887; MSBFC 1895). The grounds were reported to extend 10-12 mi out in every direction (Kumlien and True 1887). Spawn was collected from fish during the early 1900s (Anderson 1910-26). Native lake trout are presently abundant here, and the population is self-sustaining (Pycha, Swedberg, and Nourse, pers. comm. 1979).

Shot Point (46°30', 87°10'). Spawn was collected here from fish in the early 1900s (Anderson 1910-26). This spawning area is currently used (FWS 1979d; Nourse and Pycha, pers. comm. 1979).

Laughing Fish Point (46°32', 87°01'). This area, along with the associated reef (46°32", 86°59'), is an historical spawning area (Eschmeyer 1955, 1956; Peck 1975b, 1979a; Pycha and Nourse, pers. comm. 1979), where spawn was collected (Anderson 1910-26). Planted fish spawned here in 1973 and 1975 (Organ et al. 1978), and the reproductive potential is excellent, based on the presence of ripe and spent males and females and of lake trout eggs in the stomachs of other fish (Peck 1974b, 1975b, 1979a). Young-of-the-year were collected in August 1952 and June-October 1953 over a sand bottom at depths of less than 120 ft just outside the rocky spawning reef; they were more abundant here in 1953 than in any other area sampled in the lake (Eschmeyer 1955, 1956). Laughing Fish Island (location unknown) was a major spawning site (Goode 1884).

Sharp Point (location unknown). A major spawning site (Goode 1884).

Au Train Island (46°29', 86°54'). Brownstone Reef (46°28', 86°53) and Au Train Island Reef (46°30',86*54') are historical spawning areas (Organ et al. 1978; Peck 1975b, 1979a); spawn was collected from fish on these reefs and in Au Train Bay (46°27', 86°51') in the early 1900s (Anderson 1910-26). Spawning occurred during the latter half of October (Van Oosten 1927a). Based on the presence of ripe and spent adults and of lake trout eggs in the stomachs of other fish, the reproductive potential is excellent at Au Train Reef and good at Brownstone Reef (Peck 1975b, 1979a).

Munising (46°25', 86°39). Spawning occurred along the rock shoreline from Au Train Point (46°29', 86°48*) to Five Mile Point (46°28', 86°44') and around Williams Island (46°29', 86°43') and, in 1974, at Wood Island (46°31', 86°44') (Organ et al. 1978). Spawning occurred during October at Williams Island Reef (46°28', 86°43') (Van Oosten 1927a). Wood Island Reef (46°31', 86°45') is an historical spawning area; the run declined here in the late 1950s, but the reproductive potential presently is fair (FWS 1979d; Peck 1979a). Spawning occurred historically at Wood Island Shoal (,46°35', 86°46'), at depths of 50-75 ft (Peck 1975b, 1979a); spawning occurred there in 1974 (Organ et al. 1978), but only a few ripe and spent adults have been found and reproductive potential presently is poor (Peck 1975b, 1979a). Spawning occurred during October-early November

at Trout Point Reef (46°30', 86°36') (Van Oosten 1927a). In 1953, very few YOY were collected around Grand Island (46°30', 86°40*) in August (Eschmeyer 1956).

Grand Portal Point (46°33′, 86°29'). This historical spawning reef (FWS 1979d; Organ et al. 1978; Peck 1975b, 1979a) supported a large spawning run until the late 1950s (Pycha, pers. comm. 1979). Spawning here usually occurred from mid-October to early November (Van Oosten 1927a). The reproductive potential is excellent based on the presence of ripe and spent males and females and of lake trout eggs in the stomachs of other fish (Peck 1975b, 1979a).

MS-5

Beaver Hump (46°37', 86°21'). This historical spawning reef is located at a depth of 72-108 ft (Organ et al. 1978; Peck 1979a; Pycha, pers. comm. 1979). Spawning occurred here from mid-October to early November and also at the same time along the adjacent mainland shore including the Pictured Rocks area (Van Oosten 1927a).

Au Sable Point Reef (46°41′, 86°09'). This is an historical spawning reef (FWS 1979d; Peck 1977, 1979a; Pycha, pers. comm. 1979). Planted fish spawned here in 1974 (Organ et al. 1978), but based on the numbers of ripe adults present, the reproductive potential is poor (Peck 1977, 1979a).

Grand Marais Reef (46°42', 86°02'). This is probably the "Big Reef," which was fished out of Grand Marais (46°40', 85°59′) from mid-October to early November (Van Oosten 1927a). The reproductive potential of the Grand Marais Reef is presently poor (Peck 1977, 1979a). In 1974, planted trout spawned at the mouth of Sable Creek (46°40', 86°01') (Organ et al. 1978) . Lake trout also spawn on any shoal or hump between Grand Marais and Caribou Island (47°22', 85°49') at depths of 180 ft or less including Southwest Bank (47°14′, 85°59'), Southeast Bank (47°15', 85°47') and the unnamed 155-185 ft deep shoal at 47°06', 85°52' (Pycha, pers. comm. 1979).

Grand Marais (46°40', 85°59')--Little Lake (46°43', 85°22'). Lake trout spawn along the shoreline over gravel at depths of 12-18 ft (Organ et al. 1978).

MS-6

Crisp Point (46°45', 85°16'). Native lake trout spawned on the 30 ft deep shoal just off the Point, until the 1930s (FWS 1979d; Organ et al. 1978).

Tahquamenon Island (46°32', 84°57'). Spawning occurred historically on the shoals around the island and north for about 4 mi (Organ et al. 1978; Peck 1979a), during October (Van Oosten 1927a).

Salt Point Reef (46°28', 84°50'). Native trout spawned here historically (Organ et al. 1978; Peck 1979a) during October (Van Oosten 1927a).

Iroquois Island Reef (46°30', 84°40'). The extensive shoal area around the island and off Nadoway Point (46°29', 84°41') and Iroquois Point (46°29', 84°38') was used historically for spawning by native lake trout (FWS 1979d; Organ et al. 1978; Peck 1979a) in October (Van Oosten 1927a).

Ontario

Many populations of lake trout exist in the Ontario waters of Lake Superior. At least three major types of lake trout ("deep, fat," "banker," and "shallow water" trout) are recognized (Loftus 1954b). Several populations also make spawning runs into tributaries. Eight rivers along the eastern shore support runs, which occur over a 2-week period sometime in September and October. Spawners may move in and out of a river several times during a run. Adults usually remain near the river in which they spawn, but a few range as far as 50 mi during the year. Young-of-the-year appear to move into the lake soon after hatching (Loftus 1954b, 1958; OMNR 1976b).

OS-1

Thunder Bay (48°25', 89°00'). Commercial fishermen reported that redfin, "black," "grey," and little grey trout spawned in the bay (Goodier, pers. comm. 1979). Spawning usually occurs durinq September 25-December 1 (MacKay 1956b, 1969). Spawning occurred at the following locations (Goodier, pers. comm. 1979):

> Flatland Island (48°13', 89°14'). Spawning occurred on the north and west sides of the island from about mid-September to October 5. Pie Island (48°14', 89°07'). Native redfins and large grey trout spawned in October at depths of 12 ft or less on the north side and at Keefer Point (48°13', 89°10'). Redfin trout also spawned in areas such as Turtle Head (48°15', 89°02') beginning about October 20. Wyllie Point (48°11', 89°16')-- Squaw Bay (48°18', 89°14'). An early run of little grey trout spawned here. Grand Reef (48°18', 89°11'). Spawning occurred on about September 25. Welcome Island (48°21', 89°08'). Schwitzer Shoal (48°23', 89°03'). This was a very good spawning area. Port Arthur Harbor breakwall (48°27', 89°12'). Black trout spawned here. Papoose Island (48°29', 89°02'). Spawning occurred on the shoal area (48°29', 89°02') just northwest of the island. Mary Island (48°30', 88°59'). Spawning occurred along the southwest shore. Buck Island (48°31', 88°55'), Keshkabuon (Caribou) Island (48°31', 88°51'), and Hare Island (48°19', 88°58').

Thunder Cape (48°19', 88°55'). Spawning occurred along the east side of the cape, at the Tee Harbour (48°19', 88°53') peninsula, and at Silver Islet Landing (48°19', 88°49') (Goodier, pers. comm. 1979).

Clark Island (48°20', 88°43') and Carney Rock (48°21', 88°43') (Goodier, pers. comm. 1979).

OS-2

Black Bay (48°40', 88°30'). Most spawning in the bay was limited to the mouth of the bay, south of George Point (48°29', 88°36') on the east shore, and south of Foster Point (48°23', 88°43′) on the west shore; the rest of the bay has a sandy bottom. Spawning areas included are (Goodier, pets. comm. 1979) :

> Foster Point (48°23', 88°43'). Foster Point and south along Middlebrun Channel (48°22', 88°43'). George Point (48°29', 88°36') . May have been a spawning area of minor importance. Cowie Point (48°27', 88°35'), Seagram Rock (48°26', 88°34'), and Magnet Point and Magnet Island (48°24', 88°34'). Edward Island (48°23', 88°38′). The west side of the island and Edward Harbour (48°22', 88°39'). Hardscrabble Island (48°21', 88°40'). Porphyry Island (48°21', 88°38'). Most spawning occurred in the Point Porphyry area (48°20', 88°39'). Gravel Island (48°21', 88°43′). Was a minor spawning area.

OS-3

Nipigon Bay (48°53', 87°50'). Only parts of Nipigon Bay proper were important lake trout spawning areas. A stock of "black-colored" trout is believed to have resided in the bay. Lake trout spawned 8-10 days later in Nipigon Bay than in the lake proper. Spawning areas in the bay were: cooper Point (48°59', 88°04;'), the rocky shoreline between Jackpine River (48°58′, 88°00') and MacInnes Point (48°56', 87°56'), Clay Shoal (48°56', 88°11'), and Holden Shoal (48°57', 88°09), the reefs between Ile La Grange (48°56′, 88°08') and Outan Island (48°54', 88°07'), the southwest shore of Vert Island (48°56', 88°04'), Burnt Point (48°52', 87°56'), the shoreline from Cavers Bay (48°53', 87°40') to Crow Point (48°51', 87°39'), the east shore and mossy area at the northwest end of Salter Island (48°47', 87°34'), the east end of Anguros Island (48°51', 87°35'), and the eastern shore of Pays Plat Bay (48°52', 87°33') to Rossport Point (48°49', 87°33') (Goodier, pers. comm. 1979).

Rossport (48°50', 87°31′). This was a spawn collection site (Ravenel 1898). Red trout spawned around Whiskey Island (48°49', 87°31'). Spawning also occurred on Spider Reef (48°49', 87°24') at the northeast end of Channel Island (48°48', 87°29') and at a mossy area (48°49', 88°30') off the northwest shore of the island (Goodier, pers. comm. 1979). Ripe and running males and females were more recently collected from the channels amonq the Rossport Islands (48°50', 87°31′) (FRBC 1968).

OS-4

Magnet Point (48°24', 88°34')--Herron Point (48°35', 88°15'). Many of the islands just outside Sturgeon Bay (48°32', 88°26') and Shesheeb Bay (48°34', 88°19') supported spawning, including the Borden Island-Gourdeau Island (48°31', 88°22') area, Barclay Island (48°28', 88°28') area, and Stanton Island (48°30', 88°27'). The northern shoal area of Shaganash Island (48°26', 88°28') was used mainly by black trout (Gollat 1976; Goodier, pers. comm. 1979). No spawning occurred in Sturgeon Bay proper because the bottom is mud (Goodier, pere. comm. 1979). Herron Point also

was a spawning area, as was Bateau Rock (48°16', 88'06') (Goodier, pers. comm. 1979).

Island Area (48°39', 88°05'--4846', 8730') off the mouth of Nipigon Bay (4853', 87°50'). The island shoals at the mouth of Nipigon Bay historically were extensive and important spawning qrounds. Several varieties of lake trout spawned among the islands. Runs of black trout appeared first, followed by "red" and redfin trout in early October, as the black trout were beginning to leave. These were followed by large "yellowfin" trout and then finally by very large grey trout, which spawned in late November and December. Specific locations are as follows (Goodier, pers. comm. 1979, unless otherwise noted):

Fluor Island (48°39', 88°06'). Spa-wning occurred all along the southeast shore and also on the inside, protected shores of Cedar (48°38', 88°06'), Provost (48°38', 88°05'), Tremblay (48°38', 88°04'), Willard (48°39', 88°05'), and Puff Islands (48°39', 88°03').

st. Ignace Island (48°48', 87°55'). Lake trout spawn was collected here (Ravenel 1898). Ripe and running adults were collected here in 1967 (FRBC 1968). This was one of the best spawning areas in the entire lake; almost the entire south shore, including every island and shoal, was used (Gollat 1976). Spawning areas were: the tip of Newash Point (48°41', 88°01') and Devil's Gap Shoal (48°41', 88°01'), Longcroft Island (48°41', 87°59'), Angelica Island (48°42', 87°58'), Talbot Island (48°42', 87°57'), Agate Island (48°42', 87°59'), Owl Island (48°43', 87°59'), Paradise Island (48°43', 87°58'), Bowman Island (48°44', 87°59'), reportedly the best area on St. Ignace, Nest Island (48°45', 87°56'), Fraser Point (48°45', 87°55'), Hope Island (48°45', 87°54'), the shoals between Hope and Burnet islands (48°45', 87°53'), Armour Island (48°45', 87°52'), the bay (48°45, 87°48') south of French Harboor (48°45', 87°48'), St. Joe Islands (48°45', 87°47'), Bignell Point (48°45', 87°48'), St. Ignace Harbour (48°46', 87°47'), the southwest shore of Head Island (48°46', 87°46'), Moffett Strait from Grotto Point (48°45', 87°45') to south of Wickham Bay (48°46', 87°43').

Simpson Island (48°47', 87°40'). Spawning occurred along the entire south shore from Grebe Point (48°44', 87°42') to Morn Point (48°45', 87°36'), on rock or gravel shoals.

Salter Island (48°47', 87°34'). Chubby Harbour (48°47', 87°33') was an excellent spawning area, as was the north shore of Battle Island (48°45', 87°33').

Wilson Island (48°46', 87°29'). Spawning occurred along the entire west shore and the north shore of Cobinosh Island (48°45, 87°29') .

Copper Island (48°46', 87°24'). Southeast point.

OS-5

Worthington Ray (48°46', 87°15')--Santoy Bay (48°46', 86°54'). Spawning occurred along this shoreline, at Almos Shoal (48°46', 87°04'), Lawson Island (48°45', 86°55'), Jack Rock (48°46', 86°55'), in Worthington Bay, in Moberly Bay (48°48', 87°00') which was a minor spawning area for large salmon trout, and in the northeast inlet (48°49', 86°58') of Jackfish Bay. No trout were found in the fall in Terrace Bay (48°46', 87°10') (Goodier, pers. comm. 1979). At Jackfish (48°48', 86°58'), a run of ripe grey and black trout occurred August 15-September 15, and large salmon trout arrived on about November 1 (Ont. Game Fish 1912).

Slate Islands (48°40', 87°00'). Spawning occurred throughout the islands (Goodier, pers. comm. 1979).

Leadman Islands (48°41', 86°56'). Spawning occurred here (Goodier, pers. comm. 1979).

Ashburton Bay (48°46', 86°42'). Spawning occurred at McKellar Harbor (48°48', 86°43') at the head of the bay, at Fitzsimmons Rocks (48°46', 86°45'), and to the southwest along shore for about 3 mi (Goodier, pers. comm. 1979).

Pic Island (48°42', 86°37')--Playter Harbour (48°35', 86°16'). An important fishery for siscowets was carried out from Port Coldwell (48°45', 86°32') (Koelz 1926). "Fat" trout probably spawned on Uncle Bob's Bank (48°41', 86°27'). Black and yellowfin trout moved onto some of the shoals and islands east of Pic Island such as Detention Island (48°44', 86°31') and into Thompson Channel (48°43', 86°36') in August and probably spawned in these areas or near Port Coldwell Harbor and Detention Island. Spawning occurred at Port Munro (48°46', 86°26'), Ypres Point (48°44', 86°27'), Peninsula Harbor (48°44', 86°24'), along shore around Craigs Pit (48°41, 86°22'), Randle Point (48°39', 86°21'), Heron Bay (48°38', 86°20'), Ogilvy Point (48°36', 86°21'), and the points outside Playter Harbour (Goodier, pers. comm. 1979). Lake trout also spawned in the mouth of the Pic River (48°36', 86°18') (OMNR 1976b).

Superior Shoal (48°03', 87°07'). Historically this was a spawning area for lean trout, fat trout, halfbreeds, and humpers (paperbellies); humpers spawned here in late July to mid-August (Goodier, pers. comm. 1979; Loftus 1952).

OS-6

Sewell Point (48°26', 86°14')--La Canadienne Point (48°01', 85°57'). Almost every shoal and point along the shoreline supported spawning, including Stench Rock (48°16', 86°10'), the islands off the White Spruce River (48°17', 86°09'), and Otter Island (48°06', 86°03'). The shoreline from Otter Head (48°05', 86°01') to La Canadienne Point was one of the best inshore spawning areas on the east shore. Spawning runs entered the White Gravel River (48°18', 86°10') and Swallow River (48°10', 86°05'), and spawning occurred at the mouth of the Falls River (48°08', 86°03') (Goodier, pers. comm. 1979).

Puckasaw (Pukaskwa) River (48°00', 85°53')--Michipicoten Bay (47°57', 84°52'). A major spawning run entered the Puckasaw River and spawning also occurred along shore around the river mouth (Goodier, pers. comm. 1979; Loftus 1954a, 1955; OMNR 1976b; Speirs 1955b). This was the earliest tributary run and occurred in early September (Goodier, pers. comm. 1979; Loftus 1952). The fish climbed steep rapids to reach the spawning site 1/2 mi upstream, below a waterfall (Loftus 1958). A "beach" trout came inshore northwest of Puckasaw (48°01', 85°55') on October 15-20 and a "sand" trout at Puckasaw October 20-November 30 (Loftus 1952). Spawning occurred along shore about 5 mi S of the Puckasaw River (47°57', 85°47'), at Ganley Harbor (47°56', 85°43'), the mouth of the Pipe River (47°56', 85°41'), where a minor run occurred, and Pilot Harbor (47°55', 85°35'). Runs occurred at the mouth of the Ghost River (47°55', 85°26') and in the Eagle (47°56', 85°22'), University (Dog) (47°58', 85°12'), and Makwa (Bear) (47°57', 85°04') rivers; spawning also occurred along shore near these river mouths (Goodier, pers. comm. 1979; Loftus 1952, 1955, 1958; Spiers 1955b). The run entered the Eagle River in mid-September (Loftus 1952), and spawning occurred at the foot of the second rapids (Loftus 1958). The University River run persisted from mid-September until October 1, and the fish ascended several steep rapids to reach the spawning site 2 mi upstream, at the foot of a waterfall (Goodier, pers. comm. 1979; Loftus 1952, 1958). The Bear River run occurred during the third and fourth weeks in September (Loftus 1952). Spawning also occurred around Minnekona Point (47°57',85*00') and around Dore' Point (47°57', 84°58'). In the Michipicoten River (47°56', 84°51'), the run moved upstream as far as 10 mi; this run was first recorded in 1850. Fat trout spawn during October in an area (47°51', 85°18') 360-390 ft deep extending 4-10 mi offshore between the Eagle and Dog Rivers (Goodier, pers. comm. 1979).

Old Woman Bay (47°47', 84°54')--Cape Gargantua (47°36', 85°02'). Spawning occurred throughout this area. A minor run entered the Old Woman River (47°47', 84°54') (Goodier, pers. comm. 1979). A fishery preserve maintained in the vicinity of Gargantua (47°35', 84°58') was one of the best spawning qrounds in the lake (Ont. Game Fish 1911).

Michipicoten Island (47°45', 85°47'). Spawning' primarily by large redfin trout, occurred around most of the island and on the Clay Banks (47°48', 85°51') and The Shingles (Bank) (47°47', 85°52'). The best spawning areas were along the northwest shore, where large "shore" trout came in during early November, and along the south shore. Spawning also took place amonq The Breeders (47°42', 85°54') and other islands off the south shore (Goodier, pers. comm. 1979; Loftus 1952). Spawn collection began on about September 15 (Ravenel 1898).

Caribou Island (47°22', 85°49'). Spawning occurs during the first 3 weeks of October (Goodier, pers. comm. 1979; Loftus 1952; Peck 1975a; Rahrer 1965) and also in late November (Loftus 1952) at depths of 30 ft or less (Goodier, pers. comm. 1979). Males in spawning condition have been collected here in September (Mich. DNR 1968a).

Klondike Bank (location unknown, near Caribou Island). Ripe humpers and siscowets were taken here in early October 1973 (Stauffer 1974c).

Cape Gargantua (47°36', 85°02')--Agawa Bay (47°21', 84°39'). Spawning occurs on the south side of Devils Warehouse Island (47°34', 55°00'), at Gull Island Shoal (47°29', 84°56), Leach Island (47°27', 84°56'), Rowe Island (47°26', 84°48'), Lizard Islands (47°25', 84°49'), and along the shoreline between Robertson Cove (47°27', 84°46') and the Sand River (47°26', 84°44'). The Sand River had a spawning run; the Baldhead (Gravel) River (47°29', 84°50') has a spawning run in late September (Loftus 1952; OMNR 1976b). In 1912, suckers destroyed lake trout spawn in Agawa Bay (Ont. Game Fish 1912).

Montreal River (47°15', 84°39'). Runs enter the river between late September and mid-October and progress 200 yd upstream to a spawning area, where the stream bottom consists of boulders and gravel. Spawning also occurs at the river mouth (Baldwin 7956; Budd 1954; Goodier, pers. comm. 1979; Loftus 1952, 1954a,b, 1955, 1958; MacKay 1956b, 1969; OMNR 1976b; Speirs 1955). Lake trout also spawn around Montreal Island (47°14', 84°43') (Environ. Can. 1977c).

Theano Point (47°11', 84°42')--Corbiel Point (46°53', 84°37'). Spawning occurs along almost the entire shoreline and on several offshore shoals, including Siesta Shoal (47°08', 84°51'), Mica Shoal (47°06', 84°50'), Rousseau Bank (47°01', 84°53'), Pancake Shoal (46°55', 84°48'), and Outer Pancake Shoal (46°54', 84°50') (Environ. Can. 1977c; Goodier, pers. comm. 1979; Pycha, pers. comm. 1979). A minor run may have entered Alona Bay Creek (47°10', 84°42') (Goodier, pers. comm. 1979).

Whitefish Bay (46°40', 84°40'). Black trout spawned here October 10-25; spawning by redfin trout followed. River spawning has been reported in this area, and a minor run may have occurred in the Chippewa River (46°56', 84°27'). Spawning areas were identified as the bank (46°52', 84°34') off the west side of Batchawana Island (46°54', 84°30'), North (46°50', 84°40'), and South (46°48', 84°39') Sandy islands, Maple Island (46°46', 84°35'), along the adjacent mainland shoreline south to Goulais Point (46°41', 84°33'), Parisienne Shoal (46°45', 84°43'), especially the west side, the north point (46°43', 84°44') of Ile Parisienne (46°40', 84°43'), and along the shoreline from Kelly Creek (46°40′, 84°29') to Gros Cap (46°32', 84°35'), where a fisherman observed lake trout cleaning spawning gravel in 6 ft of water (Environ. Can. 1977c; Goodier, pers. comm. 1979).

Spruce Harhor (location unknown). Spawn taking began on about September 15 (Ravenel 1898).

Pueblo River (location unknown). A spawn collection site (Ravenel 1898).

SPLAKE

Splake (eastern brook trout x lake trout hybrid) were first stocked in the Great Lakes in Lake Huron in 1954 (OMNR 1973). No information was found concerning the introduction of splake into Lake Superior; presumably splake were planted in the lake during the late 1950s.

Minnesota

On November 21, 1957, splake eggs were collected from ripe fish along the Minnesota shore for incubation in hatcheries (Minn. DNR 1937-59).

Michigan

MS-4

In 1978, a "mature pair in ripe to spent condition" were collected October $-November 14 in Presque Isle Harbor (46°34', 87°23'); they may have spawned on the rock and rubble covering the intake pipe of the Presque Isle Power Station (Peck 1979b).

RAINBOW SMELT

Rainbow smelt eggs planted in Crystal Lake (44°40', 86°10') (Lake Michigan drainage) in 1912, are believed to be the source of smelt found in all of the Great Lakes except Lake Ontario (Van Oosten 1937a). The first record of rainbow smelt in Lake Superior was established in Whitefish Bay (46°40', 84°50'), at the east end of the lake, in 1930 (Gollat 1976; USBCF 1969b; Van Oosten 1937a); these fish presumably entered the lake via the St. Marys River. In 1936, spawning runs were reported in tributaries at the east end of the lake (Van Oosten 1937a). After 1940, runs developed along the Ontario and Wisconsin shores (H. Johnson, pers. comm. 1979; Van Oosten 1953). During the 1950s, runs developed along the Minnesota shoreline (H. Johnson, pers. comm. 1979). Most tributaries receive major spawning runs in early April-early May (FWS 1979d). Runs into tributaries begin when the ice melts and peak in May. Some spawning may also occur on shoals and beaches where sufficient lake current exists (Eddy and Underhill 1974). In western Lake Superior, runs begin in the latter half of April and last about 3 weeks; spawning occurs over substrate varying from fine sand and rubble to coarse gravel (Fluegel 1978). Young smelt move out of tributaries soon after hatching (DeVore, pers. comm. 1979).

Minnesota

Spawning runs enter most streams along the North Shore (Hassinger, pers. comm. 1979; H. Johnson, pers. comm. 1979; USDI 1970). The runs do not progress beyond the first rapids; spawning also occurs in stream mouths and on sandy lake beaches at water temperatures of 33-58°F (Hale 1960). Runs usually occur late in April-early May (H. Johnson, pers. comm. 1979), and most of the catch is made at this time (USBCF 1969b). Since the 1950s, when the first runs appeared in the Duluth-Superior area, smelt have dispersed northward along the shore. The bulk of the run occurred in the French (46°54', 91°53') and Lester (46°50', 92°00') rivers during the mid-1960s and in the Grand Marais (47°45', 90°20') area during the 1970s (H. Johnson, pers. comm. 1979). Runs occur in the following areas along the Minnesota shore:

M-1

Stewart River (47°03', 91°38') (H. Johnson, pers. comm. 1979).

Silver Creek (47°04', 91°36') (Hale 1960).

Two Harbors (47°01', 91°40'). Smelt spawn along the beach in April to mid-May (FWS 1979d; Odin 1979). In 1977, spawning peaked on May 5 (Schaefer 1979).

Knife River (46°57', 91°47') (Adelman 1979). Spawners were present during March 15-April 15 (Jilek et al. 1979), and in early May (Schaefer 1979).

Big Sucker Creek (Sucker River) (46°55', 91°51') (H. Johnson, pers. comm. 1979).

French River (46°54', 91°53') (Adelman 1979; H. Johnson, pers. comm. 1979). Runs were first reported in 1946 (Hubbs and Lagler 1947). In 1953, the run occurred April 16-17 at a water temperature of 33°F; spawning substrate was rubble and boulders (Hale 1960).

Talmadge River (46°53', 91°55') (Adelman 1979).

Lester River (46°50', 92°00') (Adelman 1979; H. Johnson, pers. comm. 1979; Laundergan 1976). In 1953, eggs were collected on rocks on April 21 (Hale 1960). In 1977, spawning peaked on May 4 (Schaefer 1979).

St. Louis River (46°45', 92°06'). Extensive spawning occurs in the estuary and its tributaries from late April to early May at about 69°F (DeVore 1978; FWS 1979d; Minn. Power Light 1977; Schaefer 1979). Important areas in the estuary are the sandy beaches of the barrier island at the estuary mouth including Park Point at 46°44', 92°03', where spawning occurs in late April-early May (Hale 1960; Hassinger, pers. comm. 1979; Jilek et al. 1979; Pycha, per-s. comm. 1979; Schaefer 1979). Heavy runs occur in the St. Louis River (Hale 1960; Hassinger, pers. comm. 1979;

DeVore et al. 1978; DeVore, pers. comm. 1979). Eggs and larvae were collected in St. Louis Bay (46°45', 92°07') (CDM/Limnetics 1976b; Siefert 1972). The estuary serves as an important nursery area (DeVore 1978; Schram, pers. comm. 1979). Larvae are extremely abundant during June and July (Anderson and Smith 1971). Smelt larvae were the second most abundant larvae in the lower St. Louis River in 1975; peak density occurred during early May to mid-June (Schaefer 1979).

M-2

Cascade River (47°42', 90°31') (Adelman 1979). In 1977, spawning peaked on May 6 (Schaefer 1979).

Poplar River (47°38', 90°42') (Adelman 1979).

Temperance River (47°33', 90°52'). In 1977, spawning peaked on May 6 (Schaefer 1979).

Taconite Harbor (47°32', 90°55'). At the Taconite Harbor Power Plant, smelt eggs were most abundant in mid to late May, peak impingement of adults occurred in May and June, and larvae were most abundant in the first half of July (Garmaker 1977).

Baptism River (47°20', 91°12') (Adelman 1979),

Beaver River (47°15', 91°18') (Adelman 1979; Schaefer 1979). Spawners were collected March 15-April 15 (Jilek et al. 1979), and in 1977, spawning peaked May 6 (Schaefer 1979).

Split Rock River (47°1 I', 91°24') (Adelman 1979).

M-3

Pigeon River (48°00, 89°34') and Grand Portage Bay (47°57', 89°40') (Hassinger, pers. comm. 1979).

Brule River (47°49', 90°03'), Kadunce Creek (47°48', 90°09'), Durfee Creek (47°47', 90°14'), and Devil Track River (47°46', 90°16'). (Adelman 1979).

Wisconsin

Smelt probably spawn in tributaries and on beaches along the entire shoreline (DeVore, pers. comm. 1979; King and Swenson, pers. comm. 1979; Schram, pers. comm. 1979). Runs begin when water temperatures reach approximately 40°F (Pycha, pers. comm. 1979; Schram, pers. comm. 1979). Spawning peaks on April 30 at Cornucopia (46°51', 91°06') and Herbster (46°50', 91°16') (Schaefer 1979). Runs occur in the following tributaries:

Superior Harbor (46°42', 92°01'). Heavy runs occur in the Nemadji River (46°42', 92°02') (DeVore et al. 1978; DeVore, pers. comm. 1979). Spawning also occurs on the sandy beaches of Wisconsin Point (46°42', 92°00') in late April-early May (Schaefer 1979). The harbor is an important nursery area; larvae drift downstream to the harbor after hatching (Devore, pers. comm. 1979; De Vore et al. 1978; Schram, pers. comm. 1979). Young-of-the-year were found at the river mouth and at the harbor entrance (Schaefer 1979).

Amnicon River (46°41', 91°51'). Spawners were collected March 15-April 15 (Jilek et al. 1979), and in early May (Schaefer 1979). Very large numbers were collected in the FWS sea lamprey weir (FWS 1979c).

Middle River (46°42', 91°50'). Large numbers of spawners were collected in the FWS sea lamprey weir (FWS 1979c).

Brule River (46°45', 91°37'). Spawners were collected during March 15-April 15 (Jilek et al. 1979). Large runs begin and peak in early May (Bailey 1964; Pycha, pers. comm. 1979; Schaefer 1979; Schneider and Leach 1979) . Approximately 426,000 adults were collected in the FWS sea lamprey weir in 1971 (FWS 1979c).

Iron River (46°46', 91°29'). Large numbers were collected in the FWS sea lamprey weir (FWS 1979c).

Chequamegon Bay (46°40', 90°50'). Chequamegon Bay is a major producer of smelt (Schneider and Leach 1979); large numbers run into shallow water to spawn along almost the entire shoreline (Kmiotek and Daly 1957; Sather and Threinen 1966). Spawning occurs on beach areas in the bay immediately before or after the ice moves out, in water as shallow as 2 ft (Pycha, pers. comm. 1979). In 1960, the on-shore run began April 21 (Bailey 1964). Spawning is reported to occur along most of the shoreline in Ashland Harbor (46°36', 90°53'), although success is probably reduced by the "littered" condition of the bottom (FWS 1979d). A run also enters Whittlesey Creek (46°36', 90°57'). Runs on the Apostle Islands (47°00', 90°40') shores are later than those in the bay (Pycha, pers. comm. 1979). Smelt larvae are found in the vicinity of the Apostle Islands at depths of less than 60 ft (Dryer 1966), first in late May, near the spawning beaches (Selgeby 1978).

Vandeventer (Washburn) Hay (46°39', 90°54'). Smelt eggs were collected from the bottom along the Washburn Bay beach area (Pratt and Swanson, pers. comm. 19791.

Had River (46°38', 90°39'). Supports a large run (Schneider and Leach 1979).

Michigan

Runs last about 10 days and peak between April 19 and May 6 (Van oosten 1953). Spawning occurs in the following areas:

MS-1

Isle Royale (48°00', 88°50'). In 1945, many young smelt were seined in late July around the mouth of the Big Siskiwit River (47°54', 89°00'), suggesting that a spawning run had become established in the river (Hubbs and Lagler 1947).

MS-2

Fire Steel River (46°56', 89°12') and Misery River (47°00', 88°59'). Many smelt were collected in the FWS sea lamprey weirs (FWS 1979c).

MS-3

Portage River (46°58', 88°26'). Spawning occurs at the entry to the river in April and May (Swedberg, pers. comm. 1979); runs also enter the Sturgeon River (47°02', 88°29') (Pycha, pers. comm. 1979).

Silver River (46°49', 88°17') and Huron River (46°55', 88°02'). Many were collected in the FWS sea lamprey weir (FWS 1979c).

MS-4

Dead River (46°34', 87°23'). Smelt move into Presque Isle Harbor (46°34', 87°23') in mid-April and are present until early June (Wapora 1976b). Runs enter the Dead River during late April-early May and spawning occurs at water temperatures of about 42°-47°F (Berg 1976; Swedberg, pers. comm. 1979; FWS 1979d; Wapora 1976b; Warner 1979). Larvae hatch in mid-May and then drift downstream to the harbor, where they spend the first 2 growing seasons before moving to the lake. Smelt eggs were observed just off the discharge canal of the Presque Isle Power Station in mid-April and near Picnic Rocks (46°33', 87°23') in early June (Wapora 1976b).

Chocolay River (46°30, 87°21'), Furnace Creek (46°26', 86°42'), and Anna River (46°25', 86°38') (Warner 1979).

MS-5

Sucker River (46°40', 85°56'). Smelt were collected in the FWS sea lamprey weir. Big Two Hearted River (46°42', 85°25'). Many were collected in the FWS sea lamprey weir (FWS 1979c).

Little Lake Harbor (46°43', 85°22'). Spawning occurs over cobble, rock, and gravel on the east side of the harbor. Carp River (46°44', 85°19'). Spawning occurs over gravel at the mouth of the river (Organ et al. 1978).

MS-6

Betsy River (46°41', 85°01'). Many smelt were collected in the FWS sea lamprey weir (FWS 1979c).

Naomikong Creek (46°29', 84°58'). A run occurs here, and probably in most creeks and on the sand beaches of Whitefish Bay (46°40', 84°50'), after ice breakup (Swedberg, pers. comm. 1979).

Ontario

OS-1

Current River (48°27', 89°11') and Mcvicar Creek (Vicar's Creek?) (48°26', 89°13'). Runs first occurred in 1941 (Dymond 1944).

OS-2

Black Bay (48°40', 88°30'). Spawning runs into tributaries were first seen in 1955 (Schneider and Leach 1979). Smelt are very abundant during the spawning season (Selgeby 1978).

OS-3

Cook Point (48°58', 88°04') and Five Mile Point (48°56', 88°04'). Smelt larvae were observed in the nearshore surface waters (Leslie and Kelso 1977).

OS-7

By 1941, runs were occurring in every small stream between Sault Ste. Marie (46°30', 84°21') and Cape Gargantua (47°36', 85°02') (Dymond 1944).

Goulais Bay (46°42', 84°30'). The first run here occurred in 1941 in Palmer Creek (location unknown). A run entered Kelly Creek (46°40', 84°29') in 1941 during mid-April to early May (Dymond 1944).

Batchawana Bay (46°51', 84°30'). Runs first occurred in tributaries to the bay in 1939. In 1941, a run entered Stokely Creek (46°49', 84°25') during mid-April to early May (Dymond 1944).

NORTHERN PIKE

Minnesota

M-1

St. Louis River (46°45', 92°06') and Duluth Harbor (46°45', 92°05'). The early literature reports what appear to have been spawning runs in the river. During 1875-80, a large seine and dip net fishery existed at Fond du Lac, 10 mi upstream from Duluth; the fishing was conducted for several weeks in spring when pike became very abundant. By 1885, the fishery had declined and thereafter was of little importance (Kaups 1978; Smith and Snell 1891). A population of northern pike resides and spawns in the St.

Louis River estuary and harbor area (DeVore 1978; Hassinger, pers. comm. 1979; H. Johnson, pers. comm. 1979; Minn. Power Light 1977; Schram, pers. comm. 1979). Spawning occurs in April after the ice melts, in essentially all shallow, vegetated bays and backwaters and particularly in areas of flooded, emergent vegetation (DeVore 1978), including the shallows around dredge spoil islands in the outer harbor (FWS 1979d). The most important spawning and nursery areas are in the river upstream from the Arrowhead Bridge (46°43', 92°08') (DeVore 1978; Schram, pers. comm. 1979).

M-2

Gooseberry River (47°08', 91°27'). A population spawns in the estuary of the river (H. Johnson, pers. comm. 1979).

Wisconsin

Superior Harbor (46°42', 92°01'). Allouez Bay (46°41′, 92°00') is one of the most important spawning and nursery areas in the harbor area (DeVore 1978, FWS 1979d; Schram, pers. comm. 1979).

Amnicon River (46°41′, 91°51′), Middle River (46°42′, 91°50′), and Brule River (46°45', 91°37'). A population resides and spawns in the mouths of these rivers (Schram, pers. comm. 1979).

Flag River (46°47', 91°23'). A population resides and spawns in the sloughs at the mouth of the river. Fish from the lake probably migrate up the Flag River about 1/4 mi to spawn in Bibon Lake (King, pers. comm. 1979; Schram, pers. comm. 1979; Swanson and Pratt, pers. comm. 1979).

Bark Bay (46°52', 91°10'). A population resides and spawns in the sloughs at the head of the bay (King, pers. comm. 1979; Schram, pers. comm. 1979).

Madeline Island (46°50′, 90°40′). Spawning occurs in weedy areas along the shore of the island, including the back of Big Bay (46°49', 90°38'), the west side of the island (King, pers. comm. 1979), and Madeline Marina sloughs (46°46', 90°47', south of La Pointe) (Swanson and Pratt, pers. comm. 1979).

Chequamegon Bay (46°40', 90°50'). Northern pike move into and spawn in the Sioux River (46°44', 90°52') (King, pers. comm. 1979), the sloughs of Fish Creek (46°35', 90°57'), the Shortbridge Sloughs (46°35', 90°56') (Pycha, pers. comm. 1979; Swanson and Pratt, pers. comm. 1979), the Kakagon River (46°39', 90°45') (King, pers. comm. 1979; Pycha, pers. comm. 1979), the Washburn Mill Slips area (46°40', 90°54') (Swanson and Pratt, pers. comm. 1979) and possibly in the Sand Cut area at Oak Point (46°40', 90°43') (Pycha, pers. comm. 1979).

Had River (46°38', 90°39'). Spawning occurs at the mouth of the river, and there is substantial movement of fish between the river and the lake (King, pers. comm. 1979).

Michigan

MS-3

Keweenaw Bay (46°58', 88°20'). Northern pike presently spawn over sand and bulrushes in late April to mid-May in Chassell (Pike) Bay (47°02', 88°30'). Spawning also occurs in May over vegetation in an area beginning 60-80 ft off Haraga (46°47', 88°29') (Organ et al. 1978).

MS-4

Presque Isle Harbor (46°34', 87°23'). Larvae are present in the harbor for a brief time in early June (Wapora 1976b), and spawning occurs in the Dead River (46°34', 87°23') (FWS 1979d; Odin 1979).

MS-6

Vermilion (46°46', 85°09'). Spawning probably occurred in the sedge marshes near Vermilion (Hankinson 1916).

Ontario

OS-3

Rays Plat River (48°53', 87°34'). A spawning run occurs in the river (SLCC 1979b).

MUSKELLUNGE

Minnesota

M-1

St. Louis River (46°45', 92°06'). Spawning occurs in the estuary (Hassinger, pers. comm. 1979).

Wisconsin

Superior Harbor (46°42', 92°01'). A native population spawns in the harbor (Schram, pers. comm. 1979).

Amnicon River (46°41', 91°51'). A resident population spawns in the mouth of the Amnicon River (Hassinger, pers. comm. 1979; Schram, pers. comm. 1979).

LAKE CHUB

The early literature reports that this species was probably common along the Canadian shore of the lake and in the coastal streams during the spawning season (Hubbs and Brown 1929).

CARP

Small populations of carp have been established for some time in shallow bays along both shores of Lake Superior (Lawrie and Rahrer 1973). Carp were planted in Lake Superior at Duluth in 1889, but this planting probably failed to establish a self-sustaining population in either the Duluth area or in Lake Superior proper. The source of the present population is unknown (McCrimmon 1968). Information on specific spawning sites was available only for U.S. waters.

Minnesota

M-1

St. Louis River (46°45', 92°06') and Duluth Harbor (46°45', 92°05'). A resident population spawns in the lower river and harbor in June (Hassinger, pers. comm. 1979; H. Johnson, pers. comm. 1979; Schram, pers. comm. 1979).

Wisconsin

Amnicon (46°41', 91°51'), Brule (46°45', 91°37'), Flag (46°47', 91°23'), and Siskiwit (46°51', 91°06') Rivers. Carp spawn in the mouths of these rivers (Schram, pers. comm. 1979; Swanson and King, pers. comm. 1979).

Bark Bay (46°52', 91°10'). Spawning occurs in the sloughs at the head of the bay (Schram, pers. comm. 1979).

Chequamegon Bay (46°40', 90°50'). Spawning occurs in the sloughs near the mouth of Fish Creek (46°35', 90°57') (Pycha, pers. comm. 1979), in the Shortbridge Sloughs (46°35', 90°56'), the sloughs in the Sioux River (46°44', 90°52'), and in the Kakagon River (46°39', 90°45') (Swanson and King, pers. comm. 1979).

Michigan

MS-4

Dead River (46°34', 87°23'). An observed increase in the abundance of ripe adults during July may have been caused by an influx of spawners from Lake Superior (Berg 1976).

EMERALD SHINER

Minnesota

Duluth Harbor (46°45', 92°05'). Emerald shiners spawn along the lake side of the sandy barrier island (46°44'. 92°03) separating the lake and the harbor (Hassinger, pers. comm. 1979).

Wisconsin

M-1

Superior Harbor (46°42', 92°01'). Adults have been collected during spawning runs from the lake into Superior Harbor (Schram, pers. comm. 1979). At the Winslow Power Plant in Superior (46°44', 92°05'), emerald shiners impinged in June and July possessed mature gonads, whereas most of those impinged in August were spent (CDM/Limnetics 1976). Fry were also collected in the area (CDM/Limnetics 1976b; Siefert 1972).

SPOTTAIL SHINER

Wisconsin

Superior Harbor (46°42', 92°01'). A run, possibly a spawning run, enters the harbor from the lake (Schram, pers. comm. 1979).

Ontario

OS-7

Sable River (46°57', 84°35'), Harmony River (46°51', 84°23'), and Stokely Creek (46°49', 84°25'). In 1954, hundreds of ripe spottail shiners were taken at the mouths of these tributaries on June 11-20; these were assumed to be spawning aggregations (Scott and Crossman 1973).

LONGNOSE DACE

Michigan

MS-1

Isle Royale (48°00', 88°50'). Young were captured at the mouth of the Little Siskiwit River (47°56', 88°57'), and a male in breeding color was observed here in mid-July (Hubbs and Lagler 1947).

LONGNOSE SUCKER

Each spring, large numbers of longnose suckers enter Lake Superior tributaries to spawn (Dryer 1966). The spawning runs generally occur at the same time as those of the sea lamprey (Erkkila et al. 1956).

Minnesota

Runs occur in every tributary on the Minnesota North Shore in late May, just after the major part of the steelhead run (Hassinger, pers. comm. 1979; H. Johnson, pers. comm. 1979). Large runs were also observed on about July 1 (Jordan 1885). Fingerlings also are common in the mouths of most North Shore streams (Smith and Moyle 1944). Spawning runs have been reported specifically in the following areas:

M-1

Big Sucker Creek (Sucker River) (46°55', 91°51'), French River (46°54′, 91°53′), and Lester River (46°50′, 92°00′). Major run (H. Johnson, pers. comm. 1979).

St. Louis River (46°45, 92°06'). Large runs enter the harbor and migrate up the St. Louis River (46°45', 92°06'), and the smaller tributaries of the estuary; there are also runs to the natural and man-made gravel shoals in the estuary (Devore 1978; DeVore et al. 1978; FWS 1979d; Hassinger, pers. comm. 1979). Longnose suckers spawn in the same riffle areas as the walleye (DeVore 1978), below the dam at Fond du Lac (46°40', 92°16') (Minn. Power Light 1977). After spawning, the adults return to Lake Superior (DeVore 1978). The newly hatched larvae, which are concentrated at the surface, drift downstream from the tributaries into the estuary and Lake Superior (DeVore et al. 1978). Fry have been seined in shallow areas of the estuary (CDM/Limnetics 1976b).

Wisconsin

Runs probably occur in most warm-water streams along the Wisconsin shore (King, pers. comm. 1979).

Nemadji River (46°42', 92°02'). Supports a large run (DeVore 1978; DeVore et al. 1978; Schram, pers. comm. 1979). Newly hatched larvae drift downstream to Superior Harbor (46°42', 92°01') (DeVore et al. 1978).

Amnicon River (46°41', 91°51'). Supports a spawning run (Schram, pers. comm. 1979).

Poplar River (46°42', 91°47'). May support a spawning run (Pycha, pers. comm. 1979).

Brule River (46°45', 91°37'). The river supports a spawning run (Bailey 1969; Pycha, pers. comm. 1979), which usually reaches a peak sometime in mid-April to late May, when the water temperature rises to about 55°F. If the temperature drops during the run, a second run sometimes occurs'when the temperature again increases. Water temperatures above 60°F cause the run to decline sharply (Bailey 1969). No young-of-the-year (YOY) were found at the mouths of the Brule or adjacent streams; the larvae probably drift out into the lake soon after hatching (Bailey 1969).

Apostle Islands (47°00', 90°40'). Longnose suckers spawn along shore among the islands (King, pers. comm. 1979). The inshore movement is reflected in reduced catches farther offshore in the lake during spring and early summer (Dryer 1966).

Sioux River (46°44', 90°52'). A large run occurs here after the rainbow trout run (Swedberg, pers. comm. 1979).

Bad River (46°38', 90°39'). Many longnose suckers were captured in the FWS sea lamprey weir in April-July (Dahl and McDonald 1980).

Michigan

MS-1

Isle Royale (48°00', 88°50'). Longnose suckers move from the shoreline areas into streams to spawn, A running-ripe male was collected in late July. Young are most common around the shoreline (Hubbs and Lagler 1947).

MS-3

Pine River (46°53', 87°52'). A spawning run occurred here (Hubbs 1929).

MS-4

Dead River (46°34', 87°23'). The river supports a spawning run (Wapora 1976a,b). In 1975, males in breeding colors were found in the river on May 6, and spawning occurred in the river from the second week of April into early May, at water temperatures of about 36-43°F. Large numbers of adults remained in Presque Isle Harbor (46°34', 87°23') through summer and fall. No larvae or YOY were found in the harbor during the summer, but spawning was probably successful (Berg 1976; Wapora 1976b).

MS-6

Pendills Creek (46°27', 84°49'). A run begins in late April and is heaviest in May (Gleason and Behmer, pers. comm. 1979).

Ontario

OS-3

Nipigon River (48°57', 88°15′). Until 1964, when kraft mill pollution evidently stopped the run, longnose suckers spawned in the lower river at the town of Nipigon (49°01', 88°16') on the same grounds used by walleye. The longnose sucker was still common in Nipigon Bay (48°53', 87°50') in 1968, and other spawning areas must have been in use (Ryder 1968).

OS-7

Pancake River (46°58', 84°40'). Supports a very heavy run in April-June, which reaches a peak in May. Batchawana River (46°56', 84°32′). Supports a run in May (Price 1955).

WHITE SUCKER

White suckers are found in tributary streams throughout the year, but large numbers also migrate from Lake Superior into streams to spawn (Moore and Braem 1965). All warm-water streams in Wisconsin probably have runs (King, pers. comm. 1979). The white sucker and sea lamprey spawning runs occur at the same time in Lake Superior tributaries (Erkkila et al. 1956). In U.S. waters, runs have been reported for the following areas:

Minnesota

M-1

Big Sucker Creek (Sucker River) (46°55′, 91°51′). Run occurs in late May. Lester River (46°50', 92°00'). Run occurs in May (H. Johnson, pers. comm. 1979).

St. Louis River (46°45', 92°06'). Spawning runs occur in the river and other smaller tributaries of the estuary; concentrations of spawners are also found on the natural and man-made gravel shoals in the estuary (DeVore 1978; DeVore et al. 1978; FWS 1979d; Hassinger, pers. comm. 1979). Newly hatched larvae drift downstream to the lake (DeVore et al. 1978). Fry have been collected in the lower river, mainly during early June to mid-August (Minn. Power Light 1977).

Wisconsin

Nemadji River (46°42', 92°02'). Supports a spawning run (DeVore 1978; DeVore et al. 1978; Schram, pers. comm. 1979). Newly hatched larvae drift downstream to Superior Harbor (46°42', 92°01') (DeVore et al. 1978).

Amnicon River (46°41', 91°51'), A run occurs in the river (Schram, pers. comm. 1979).

Brule River (46°45', 91°37'). A run occurs in the river (Schram, pers. comm. 1979). Many white suckers have been captured at the FWS sea lamprey weir in April-July (Dahl and McDonald 1980). Young-of-the-year have been found in the mouth of the river during July and August (Bailey 1969).

Apostle Islands (47°00', 90°40'). White suckers have spawned along shore among the islands (King, pers. comm. 1979).

Bad River (46°38', 90°39'). Many white suckers were captured at the FWS sea lamprey weir in April-July 1956 (Dahl and McDonald 1980).

Michigan

MS-4

Dead River (46°34', 87°23'). A run enters the river and spawning usually begins about the second week of May, when the water temperature reaches 50°F. Ripe adults have been collected in the river in late April and mid-May. Larvae drift downstream into Presque Isle Harbor (46°34', 87°23'): In 1975, larvae were found at the river mouth on June 2-24 and in the harbor throughout the summer. The discharge area of the Presque Isle Power Station, close to the river mouth, is a nursery area (Berg 1976; Wapora 1976a,b).

MS-6

Pendills Creek (46°27', 84°49'). The run begins in late April and is heaviest in May (Gleason and Behmer, pers. comm. 1979).

Ontario

OS-3

Nipigon River (48°57', 88°15'). Until 1964, when kraft mill pollution evidently stopped the run, white suckers spawned in the lower river at the town of Nipigon (49°01', 88°16') on the same grounds used by walleye. The white sucker was still common in Nipigon Bay (48°53', 87°50') in 1968, and other spawning areas must have been in use (Ryder 1968).

OS-7

Heavy runs occur in April-June in the eastern end of the lake in the Pancake River (46°58', 84°40'), Sable River (46°57', 84°35'), Batchawana River (46°56', 84°32'), Chippewa (Harmony) River (46°56', 84°27'), Harmony (Creek) River (46°51', 84°23'), Stokely Creek (46°49', 84°25'), Goulais River (46°43', 84°27'), and Cranberry Creek (46°42', 84°25') (Price 1955).

SUCKER spp.

Suckers of all species probably run into all of the streams along the south shore of Lake Superior (DeVore, pers. comm. 1979).

Minnesota

M-1

Duluth Harbor (46°45', 92°05'). Spawning occurs in the tributaries to the harbor, and larvae are found in shallow areas of the harbor in rather high densities (DeVore 1978; Schram, pers. comm. 1979). Larvae present in the harbor probably include those of the four species (white suckers, longnose suckers, silver redhorse, shorthead redhorse) that spawn in the harbor tributaries (DeVore 1978).

Wisconsin

Superior Harbor (46°42', 92°01'). Sucker fry were found in the harbor (Schram, pers. comm. 1979); they were found earliest at Barkers Island (46°43', 92°03'), and spawning probably occurs there (DeVore 1978).

Michigan

MS-3

Falls River (46°45', 88°27'). A dipnet fishery for suckers was conducted in the spring at the mouth of the river (Smith and Snell 1891).

Ontario

OS-3

Rays Plat River (48'=°53', 87°34'). Supports a spawning run (SLCC 1979b).

SILVER REDHORSE

Minnesota

M-1

St. Louis River (46°45', 92°06'). Adults migrate to the tributaries and the natural and man-made gravel shoals in the estuary to spawn; the newly hatched larvae drift downstream from the tributaries to the estuary (Devore 1978; DeVore et al. 1978; FWS 1979d; Hassinger, pers. comm. 1979). Adults may remain in the harbor through the summer (DeVore 1978; Schram, pers. comm. 1979). Newly hatched larvae drift downstream to Superior Harbor (46°42', 92°01') (DeVore et al. 1978).

Wisconsin

Nemadji River (46°42', 92°02'). Spawning runs occur (DeVore 1978; DeVore et al. 1978).

SHORTHEAD REDHORSE

Minnesota

M-1

St. Louis River (46°45', 92°06'). Adults migrate to the tributaries and the natural and man-made gravel shoals in the estuary to spawn; newly hatched larvae drift downstream to the estuary (DeVore 1978; DeVore et al. 1978; Hassinger, pers. comm. 1979). Adults may remain in the estuary through the summer (DeVore 7978).

Wisconsin

Nemadji River (46°42', 92°02'). Spawning runs occur (DeVore 1978; DeVore et al. 1978; Schram, pers. comm. 1979). Newly hatched larvae drift downstream to Superior Harbor (46°42', 92°01') (DeVore et al. 1978).

REDHORSE spp.

Ontario

OS-7

Heavy runs of an unidentified species of redhorse have been reported in three Ontario tributaries (Price 1955): Hatchawana River (46°56',

84°32'), Chippewa (Harmony) River (46°56', 84°27'), and Goulais River (46°43', 84°27').

BLACK BULLHEAD

Minnesota

M-1

St. Louis River (46°45', 92°06'). A large resident population spawns in the estuary (Hassinger, pers. comm. 1979; Schram, pers. comm. 1979). Small numbers of young were collected in the lower river, from mid-July to late August, and spawning was assumed to occur throughout the lower river and estuary in areas where there was firm bottom and cover (Minn. Power Light 1977).

Wisconsin

Superior Harbor (46°42', 92°01'). Spawning occurs in Allouez Bay (46°41', 92°00') (Schram, pers. comm. 1979).

TADPOLE MADTOM

Wisconsin

Superior Harbor (46°42', 92°01'). A resident population spawns in Superior Harbor and Allouez Bay (46°41', 92°00') (Schram, pers. comm. 1979).

TROUT-PERCH

During July and August, trout-perch move from depths of more than 210 ft into very shallow areas of the lake or into tributary streams to spawn. A return migration to deeper water occurs by late September and early October (Bostock 1967).

Minnesota

M-1

Duluth Harbor (46°45', 92°05'). Spawning also occurs on the east side of the barrier island separating the harbor from the lake (Hassinger, pers. comm. 1979).

Wisconsin

Superior Harbor (46°42', 92°01'). A resident population spawns in the harbor (Schram, pers. comm. 1979), and fry have been collected there (CDM/Limnetics 1976b).

Michigan

MS-3

Keweenaw Bay (46°58', 88°20'). Three young-of-the-year were collected here in early September (Bostock 1967).

BURBOT

Minnesota

M-1

Knife River (46°57', 91°47'). A spawning run occurs here and young-of-the-year (YOY) have been observed (H. Johnson, pers. comm. 1979).

M-3

Pigeon River (48°00', 89°34'). A spawning run may occur here (H. Johnson, pers. comm. 1979).

Wisconsin

Nemadji River (46°42', 92°02). A spawning run enters Superior Harbor and the river in early November and peaks in mid-winter (DeVore 1978; DeVore et al. 1978; FWS 1979d; Schram, pers. comm. 1979; Swanson, King, and Pratte, pers. comm. 1979). The adults remain in the harbor until about mid-June, when they return to the lake. Tagging studies showed some post-spawning movement of adults out of the Superior Harbor along shore to the Brule River (46°45', 91°37') (Schram, pers. comm. 1979).

Amnicon River (46°41', 91°51'). A spawning run occurs here (DeVore, pers. comm. 1979; Schram, pers. comm. 1979).

Apostle Islands (47°00', 90°40')--Chequamegon Bay (46°40', 90°50'). Spawning in this area generally occurs in December and January. Spawning occurs off Washburn (46°40', 90°54') and may also occur about 3 mi E of Outer Island (47°02', 90°26') (Swanson, King, and Pratte, pers. comm. 1979), where numerous juveniles are found in the spring (Coberly and Horrall 1980b). The collection of ripe and spent adults in 1968 indicated

a prolonged spawning season, a migration to inshore spawning areas, or differences in spawning dates between the Apostle Islands and locations to the south. Most adults collected near shore south of Bayfield (46°49', 90°49') had spawned by February 26 and all were spent by March 11. In the Apostle Islands, recently spent burbot were first seen in early to mid-May (Bailey 1972).

Had River (46°38', 90°39'). A spawning run occurs here (DeVore, pers. comm. 1979; Swanson, King, and Pratte, pers. comm. 1979).

Michigan

MS-3

Keweenaw Bay (46°58', 88°20'). Spawning occurs in November in the middle of the bay at depths of 360-480 ft and at the mouth of the Portage River (46°58', 88°26'), over mud, sand, and gravel. Runs peak in the Sturgeon River (47°02', 88°29') under ice in late December and early January; spawning is reported in the river as early as November over mud, sand, and gravel (Organ et al. 1978).

MS-4

Presque Isle Harbor (46°34', 87°23'). An influx into the harbor from the lake is suggested by the increased catch of adults, including gravid females, in October (Wapora 1976b). Spawning occurs throughout the harbor in January-March (Wapora 1976a). Larvae are found throughout the harbor in June-August (Wapora 1976a,b), and larger YOY are collected there in August-October (Berg 1976). Spawning also probably occurs in the lower Dead River (46°34', 87°23'). Spent females, probably returning to the lake, were captured in the Dead River in late October and November (Berg 1976).

Ontario

OS-7

Ile Parisienne (46°40', 84°43'). Hurbot spawn on clay banks along the west side of Ile Parisienne in Whitefish Bay (Goodier, pers. comm. 1979).

BROOK SILVERSIDE

Michigan

MS-4

Dead River (46°34', 87°23'). This species is rare in Lake Superior and was first collected June 4, 1974, in the lower Dead River. Two of the three fish collected were gravid adults (Berg et al. 1975).

WIRESPINE STICKLEBACK

Large catches of this species are occasionally made at depths of 18-30 ft during the inshore spawning migration in June and July (Tait 1973). The species is common or abundant along the entire south shore of the lake (Pycha, pers. comm. 1980).

Wisconsin

Apostle Islands (47°00', 90°40'). Spawning occurs throughout this area during June and July after an inshore movement to shoal areas (Griswold 1970; Griswold and Smith 1973; Pycha, pers. comm. 1979). At this time, adults are found over sand and rubble along the west shore of Madeline Island (49°50', 90°40') at depths of less than 35 ft (Pycha, pers. comm. 1979). On the south side of Oak Island (46°56', 90°44'), ripe males and females in breeding colors were found in a dense growth of Nitella and were assumed to be spawning. Ripe adults were also found at 72-144 ft on the south side of Stockton Island (46°56', 90°35') over a substrate of organic mud and were assumed to be spawning (Griswold 1970; Griswold and Smith 1973).

Michigan

MS-4

Presque Isle Harbor (46°34', 87°23'). Successful reproduction occurred in 1975-76. Adults moved into the harbor in late May-early June, larvae were entrained at the Presque Isle Power Station, and larger young-of-the-year were subsequently collected. The spawning site is unknown because no nests were found; if a weedy area is required, the only one in the harbor is off the ore dock in the northern portion of the harbor (Wapora 1976b).

WHITE BASS

Michigan

MS-4

Presque Isle Harbor (46°34', 87°23'). This species is rare in Lake Superior. On August 18, 1975, one young-of-the-year white bass was collected in a sandy area about 2-3 ft deep in the northern part of Presque Isle Harbor (Hatch and Clark 1975).

ROCK BASS

Minnessta

M-1

St. Louis River (46°45', 92'06'). The estuary has a resident population (Hassinger, pers. comm. 1979).

SMALLMOUTH BASS

Minnesota

M-1

St. Louis River (46°45', 92°06'). The estuary contains a resident population (Hassinger, pers. comm. 1979).

Wisconsin

Bark River (46°51', 91°11'). Extensive spawning grounds existed at the mouth of the river, and numerous fry were seen there (Van Oosten 1938b).

Ashland (46°36', 90°53'). Spawning occurs at the head of Chequamegon Bay (46°40', 90°50') at the old docks adjacent to the Ashland Power Plant (Pratte, pers. comm. 1979).

Sand Cut (46°40', 90°43'). Spawning occurs in the Sand Cut area. Bad River (46°38', 90°39'). A population exists at the mouth of the Bad River, and extensive movement occurs between the lake and the river; spawning occurs in both the Bad and the White Rivers (King and Swanson, pers. comm. 1979).

Michigan

MS-4

Presque Isle Harbor (46°34', 87°23'). In 1975, divers observed a few adults in late June over gravel bottom at the intake of the Presque Isle Power Station; depressions in the gravel that may have been spawning beds were seen, but no eggs were observed. Two young-of-the-year (YOY) or yearlings were found at the plant's forebay in November (Wapora 197613). Spawning may be occurring in the harbor but is not confirmed. Smallmouth may migrate into the Dead River (46°34', 87°23'); YOY were seen in the river during June-September (Berg 1976).

BLACK CRAPPIE

Minnesota

M-1

St. Louis River (46°45', 92°06'). The estuary contains a resident population (Hassinger, pers. comm. 1979).

JOHNNY DARTER

Wisconsin

Superior Harbor (46°42', 92°01'). A resident population spawns in the harbor (Schram, pers. comm. 1979).

YELLOW PERCH

Minnesota

M-1

French River (46°54', 91°53'). Young-of-the-year (YOY) were found at the mouth of the river in early July 1976 or 1977. This is the only known occurrence of yellow perch here (H. Johnson, pers. comm. 1979).

St. Louis River (46°45', 92°06'). The estuary and Duluth Harbor (46°45', 92°05') are spawning and nursery areas; yellow perch rarely move from the estuary into the lake (Hassinger, pers. comm. 1979; H. Johnson, pers. comm. 1979; Schram, pers. comm. 1979). Spawning occurs from mid-April to mid-May in many shallow areas, where the substrate is sand, muck, silt, rip-rap, submerged vegetation, or brush (DeVore 1978; Schram, pers. comm. 1979). The distribution of fry indicates that the most extensive spawning takes place upstream in the backwaters and bays of the St. Louis River estuary (DeVore 1978). The estuary and the harbor are important nursery areas; YOY are found here in stands of weeds (DeVore 1978; H. Johnson, pers. comm. 1979; Schram, pers. comm. 1979). Yellow perch fry are more abundant than fry of other species in the lower river (Minn. Power Light 1977).

M-3

Pigeon Bay (48°01', 89°31'). The western shore at the head of the bay is a spawning and nursery area (Hassinger, pers. comm. 1979).

Wisconsin

Superior Harbor (46°42', 92°01'). Allouez Bay (46°41', 92°00'), the area around dredge spoil islands in the outer harbor, the sand bar at the harbor entrance, and Barker's Island (46°43', 92°03') are spawning areas (DeVore 1978; FWS 1979d; H. Johnson, pers. comm. 1979; Schram, pers. comm. 1979). In 1975, both mature and spent adults were found in the estuary April 3 to May 24 (CDM/Limnetics 1976b). In 1975, larvae were abundant in June and July and reached maximum density on June 17 (CDM/Limnetics 1976b).

Port Wing (46°47', 91°23') and Bark Bay (46°52', 91°10'). Spawning occurs here (Swanson, King, and Pratte, pers. comm. 1979).

Chequamegon Bay (46°40', 90°50'). Yellow perch spawn in shallow, weedy areas of the bay (Swanson, King, and Pratte, pers. comm. 1979) and the shallows to depths of 10-12 ft are nursery areas, especially along the east shore (Pycha, pers. comm. 1979). Spawning occurs off Washburn (46°40', 90°54'), at the pilings near the old docks by the Ashland Power Plant, around Oak Point (46°40', 90°46'), at the Sand Cut (46°40', 90°43') (Pycha, pers. comm. 1979; Sather and Threinen 1966; Swanson, King, and Pratte, pers. comm. 1979), and in areas south of Bayfield (46°49', 90°49') (Coberly and Horrall 1980b).

Michigan

MS-3

Keweenaw Bay (46°58', 88°20'). Yellow perch spawn in June over vegetation off Baraga (46°47', 88°29'), south of Sand Point (46°47', 88°28'). Since 1929, spawning also occurred in June over sand in Pequaming Bay (46°50', 88°24') (Organ et al. 1978).

MS-4

Big Garlic River (46°43', 87°34'). In 1967, yellow perch by-passed barriers in the river during a flood and spawned in April and May. Adults and YOY moved downstream in fall (Manion 1977).

Presque Isle Harbor (46°34', 87°23'). Ripe adults are present by May. In 1975, collections of larvae showed that spawning occurred in the harbor and also in the Dead River (46°34', 87°23'). Larvae first appeared in mid-May and were found throughout the harbor; the major nursery area may be the northwest section of the harbor near the discharge of the Presque Isle Power Station. Larvae are numerous by July. Young-of-the-year yellow perch remained here during the summer, and large schools were often seen by divers (Berg 1976; Wapora 1976b).

MS-6

Tahquamenon Bay (46°30', 85°00'). Spawning occurs during the spring and early summer at depths of about 9-13 ft over rock and vegetation off

the mouth of Galloway Creek (46°32', 85°03') (Organ et al. 1978). A large run entered the Tahquamenon River (46°33', 85°02') (Stauffer and Hansen 1958); this may have been a spawning run.

Ontario

OS-2

Black Bay (48°40', 88°30'). Spawning occurs at the head of the bay (Gollat 1976).

WALLEYE

Minnesota

M-1

St. Louis River (46°45', 92°06'). Spawning runs enter the river from Lake Superior, and the estuary of this river is perhaps the prime spawning area in the entire western end of Lake Superior (DeVore 1978; Schram, pers. comm. 1979). Before the arrival of the white man, the Ojibway Indians at Fond du Lac fished the spawning runs on the rapids for about 3 weeks in April (Kaups 1978). The large riffle area above Hwy. 23 Bridge at Fond du Lac is the major spawning area in the river and perhaps in the entire western part of Lake Superior (DeVore 1978). Despite problems with water quality, runs have persisted (Schneider and Leach 1979). The run into the estuary begins under the ice in late February or early March and peaks when the ice breaks up. Spawning occurs during mid-April to early May over sand, rock and rubble substrate (DeVore 1978; Hassinger, pers. comm. 1979; H. Johnson, pers. comm. 1979; Schram, pers. comm. 1979). In 1977, many ripe adults were found on riffles in the estuary on April 28, and the first spent fish was found on May 2; no adult walleyes were found after May 6 (DeVore 1978). Adults may remain in the harbor area for 2-3 months, but most return to the lake by mid-July (FWS 1979d). After entering the lake, the adults move along the south shore at least as far as the Apostle Islands (47°00', 90°40'); by February they have returned to the St. Louis River estuary area (DeVore, pars. comm. 1979; H. Johnson, pers. comm. 1979; Schram, pers. comm. 1979). The lower estuary and Duluth Harbor (46°45', 92°05') are important walleye nursery areas (Hassinger, pers. comm. 1979; Schram, pers. comm. 1979). walleye fry were the third most abundant fry collected in the lower river; abundance was highest during mid-May to early August (Minn. Power Light 1977). In 1977, fry were first seined on June 14 (DeVore 1978). Some young-of-the-year (YOY) remain in the harbor while others move out into the lake (Schram, pers. comm. 1979). Fingerlings are often found in fair numbers in the lake (DeVore 1978).

M-3

Pigeon River (48°00', 89°34'). Substantial spawning runs occur here, and the western end of Pigeon Bay is a nursery area (Hassinger, pers. comm. 1979; H. Johnson, pers. comm. 1979).

Wisconsin

Pokeqama River (46°41', 92°10')--Allovez Bay (46°41', 92°00'). A run also occurs in the Pokeqama River, a tributary to the lower St. Louis River (46°45', 92°06') (DeVore 1978; DeVore et al. 1978), and spawning occurs in the Pokegama Bay (46°42', 92°10') area (Minn. Power Light 1977). Almost immediately after spawning, adults move downstream; areas of concentration during the downstream movement include Allouez Bay (46°41', 92°00') and the Nemadji River (46°42', 92°02') (DeVore 1978). Good nursery habitat is provided by the inlets and shoreline areas below Pokeqama Bay (Devore 1978). In 1975, larvae first appeared in the cooling water of the Winslow Power Plant (46°44', 92°05') in late May and reached maximum density on June 9 (CDM/Limnetics 197613). Superior Harbor (46°42', 92°01') is an important nursery area (Hassinqer, pers. comm. 1979; Schram, pers. comm. 1979).

Amnicon River (46°41', 91°51'). A small spawning run occurs here just after ice-out in late April to early May (DeVore 1978, pers. comm. 1979; King, pers. comm. 1979; Schram, pers. comm. 1979). By late August, YOY are found at the mouth of the river (Schram, pers. comm. 1979).

Kakaqon River (46°39', 90°45')--Chequameqon Bay (46°40', 90°50'). A distinct population of walleyes runs up the Kakaqon River into the Kakagon sloughs beginning in late February and spawns in April-early May (Daly 1954; King, pers. comm. 1979; Kmiotek and Daly 1957; Pycha, pers. comm. 1979; Schram, pers. comm. 1979; Swedberq and Selgeby 1979). After spawning, the adults leave the sloughs and return to the bay (Pycha, pers. comm. 1979). The return migration can begin as early as late May, and most have left the river by August (Daly 1954). There is little movement between Chequameqon Bay and the lake proper (Swedberg and Selgeby 1979). Young-of-the-year have been collected in the bay; areas along the east shore at depths to 10-12 ft are nursery grounds (Swedberg, pers. comm. 1979).

Bad River (46°38', 90°39'). A spawning run enters the river and a tributary, the White River, (King, pers. comm. 1979; Pycha, pers. comm. 1979). After spawning, the adults return to Lake Superior and move along the shore to Long Island (46°43', 90°46') and Marble Point (46°35', 90°30') (Swedberg, pers. comm. 1979).

Michigan

MS-2

Ontonagon River (46°52', 89°20'). A large spawning run entered the lower river (Stauffer and Hansen 1958).

MS-3

Keweenaw Peninsula (47°10', 88°30'). Spawning probably occurred in area rivers. By the 1940s, catches in the area had declined to almost nothing (Schneider and Leach 1979).

Sturgeon River (47°02', 88°29'). A run enters the river from Lake Superior in the spring (Stauffer and Hansen 1958).

Huron Bay (46°55', 88°10'). Spawning probably occurred in area rivers (Schneider and Leach 1979).

MS-4

Little Iron River (46°49', 87°39'). On May 2, 1948, viable walleye eggs were collected below a dam at the outlet of Lake Independence, 2-3 mi upstream from Lake Superior (Eschmeyer 1950).

MS-6

Whitefish Bay (46°40', 84°50'). The bay supported one of the largest populations of walleye, and spawning probably occurred in area rivers. Catches declined to almost nothing by the 1940s (Schneider and Leach 1979).

Ontario

OS-1

Thunder Bay (48°25', 89°00'). The bay supports a minor population (Schneider and Leach 1979), but no spawning sites have been documented.

OS-2

Black Bay (48°40', 88°30'). During 1948-75, 84% of the Ontario walleye harvest came from Black Bay. Spawning occurred on the shoals at the north end of the bay. A small spawning run also entered the Black Sturgeon River (48°50', 88°24'). The harvest declined rapidly in the mid 1960s and was almost nonexistent in 1972 (Ryder 1968; Schneider and Leach 1979).

OS-3

Nipigon River (48°57', 88°15'). Nipigon Bay (48°53', 87°50') supported a large population, and a spawning run entered the lower river (Ryder 1968). Adults first appeared in late April and spawned in early May near the town of Nipigon (49°01', 88°16'). This is the only known spawning area in the Nipiqon watershed; areas of large pebbles and boulders out of the main channel or in a back eddy are the preferred spawning substrate. By June, the adults dispersed upstream to Polly Lake 9 mi from the tagging site and downstream to Nipigon Bay (48°54', 87°50).

Between 1958 and 1966, the walleye runs were nearly extinguished, apparently as a result of pollution from kraft mills (Ryder 1957, 1968; Schneider and Leach 1979).

Jackfish River (49°00', 88°05'). This was a very important walleye stream in the 1950s; many spawners were found at the CDFO sea lamprey barriers (Speirs 1955).

Pays Plat River (48°53', 87°34'). Supports a spawning run of "pickerel" (SLCC 1979b).

OS-7

Agawa Bay (47°21', 84°39') and Batchawana Bay (46°51', 84°30'). Each supports a minor population (Schneider and Leach 1979), but no spawning sites have been documented.

Goulais Bay (46°42', 84°30'). Supports a minor population (Schneider and Leach 1979). Walleye spawn in the Goulais River (46°43', 84°27') at the Goulais Rapids (46°45', 84°16') (Environ. Can. 1977c).

MOTTLED SCULPIN

Michigan

MS-4

Presque Isle Harbor (46°34', 87°23'). Spawning occurs in May, probably on rocks covering the intake and discharge structures of the Presque Isle Power Station or under submerged logs. Ripe females were collected in May, larvae in mid-June to mid-July, and young-of-the-year in late summer and fall (Wapora 1976a,b),

SLIMY SCULPIN

This species is common throughout the lake and probably spawns in many places along the shore (Pycha, pers. comm. 1979).

Michigan

MS-4

Presque Isle Harbor (46°34', 87°23'). The slimy sculpin is believed to spawn on the large rocks covering the water intake and discharge system of the Presque Isle Power Station. Ripe females were found in April, larvae in mid-June to mid-July, and young-of-the-year in late summer and fall (Wapora 1976b).

MS-6

Whitefish Point (46°46', 84°57'). Ripe adults were collected here over sand bottom (Nourse, pers. comm. 1979).

SPOONHEAD SCULPIN

Michigan

MS-4

Presque Isle Harbor (46°34', 87°23'). Adults were not common in the harbor, but spawning occurred in or near the harbor, probably in rocky areas or under logs. Larvae were present in the harbor in April-June and were fairly abundant in the discharge plume area of the Presque Isle Power Station (46°34', 87°24') (Wapora 1976a,b).

FOURHORN SCOLPIN

All collections of fourhorn sculpins made in southern Lake Superior in May through August 1952 contained a few ripe or nearly ripe females. Individuals 20 mm long were found at depths of 60-714 ft; most small fish, with an average length of 29 mm, were found at depths of 60-174 ft (Jacoby 1953).

Wisconsin

Stockton Island (46°56', 9O°35'). Spawning occurs primarily in mid-winter but could extend from late November to mid-May. In 1974, two ripe females were found here in mid-May at a depth of 690 ft. Young-of-the-year were captured in fall, but summer nursery areas were not located (Selqeby 1979).

Michigan

MS-4

Presque Isle Harbor (46°34', 87°23'). Spawning apparently occurred in or near the harbor in fall, because sculpin larvae, some of which were identified as fourhorn sculpin larvae, were collected throughout the harbor in the winter and early spring. Large numbers of sculpin larvae were also entrained at the Presque Isle Power Station from mid-December to May; these larvae were not subjected to rigorous taxonomic scrutiny but appeared to be of the same species as the larvae collected in the harbor in winter and early spring. A clump of eggs believed to be sculpin eggs was found at the power plant intake near growths of Chara in mid-December 1975 (Wapora 1976b).

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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 referenced 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 addressing 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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