INTRODUCTION

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The culture and natural environment of Michigan is strongly linked to the Great Lakes. Food fishing, agriculture, and logging were major industries that fostered the settlement of the Great Lakes area. All severely abused what appeared to be the inexhaustible resources of the region. However, through the years, Michigan, as a centerpiece of the Great Lakes region, has become a leader in the drive to protect, utilize, and develop properly its Great Lakes resources.

In 1964, the Michigan Department of Natural Resources (MDNR) made a major policy decision to launch a full-scale program to rehabilitate the fisheries resource of its Great Lakes waters. The successful introductions of Pacific salmon, increased plantings of rainbow (steelhead) and brown trout, controls on commercial fisheries, the Great Lakes Fishery Commission's (GLFC) efforts to control the parasitic sea lamprey, and increased plantings of lake trout by the U. S. Fish and Wildlife Service (USFWS), have improved ecological balances, resulting in the creation of a multimillion dollar sport fishery. These changes have been heralded as one of North America's most outstanding achievements in fishery management. A complex set of biological, political, economic, and social changes has occurred. The large human population (40 million) in or near the Great Lakes region has been the source of many environmental problems but also constitutes a very large recreational demand. This demand led Michigan fishery managers to shift the allocation of fish stocks away from commercial harvest and to maintain healthy salmonid sport fisheries by judicious plantings of hatchery-reared fish.

The MDNR has active fishery research and management programs on the lake. These programs include monitoring sport and commercial catches, marking principal species, stocking predatory species, and studying fish community interactions. The research is aimed at understanding long-term trends in fish population dynamics, thus allowing better management of our fish communities. Much of the work is coordinated through the Great Lakes Fishery Commission in cooperation with the other state, federal, and tribal fishery agencies bordering the lake. The MDNR also supports short-term university research on various phases in the life history of fishes.

The MDNR, along with the other states bordering the Great Lakes, continues to implement progressive fishery management programs. However, the 1987 salmonid sport fishery in Michigan waters of Lake Michigan was atypically poor and has prompted a review of current fisheries programs on Lake Michigan. This review of the fishery has been assigned to a task

force consisting of Fisheries Division personnel and representatives from major user groups. The purpose of this report is to provide a data base combining all information available on the Lake Michigan salmonid fisheries. We will develop recommendations for future research and management of the stocks appropriate to maintaining the quality of the fishery.

A list of scientific names for species in this report is found in Appendix A. Appendix B is comprised of four maps. The first details state boundaries in Lake Michigan along with the zone designations used in this report (Appendix B-1). These zones are defined in the context of this report as a Southern zone (all waters south of and including the Montague-Whitehall area in Michigan to Port Washington, Wisconsin), a Northern zone (all waters north of and including Leland, Michigan to Sturgeon Bay, Wisconsin), and a Central zone (all waters between the Southern and Northern zone boundaries). The remaining three maps show hatchery and weir locations (Appendix B-2), creel survey ports (Appendix B-3), and lake trout refuge and treaty commercial waters as defined by the 1985 negotiated settlement (Appendix B-4). Appendix C contains two tables explaining commercial size limits by state and species (Appendix C-1) and gear and quota restrictions by state and species (Appendix C-2). Finally, Appendix D covers sportfishing regulations for lake trout by state (Appendix D-1) and sport regulations on the remaining salmonids by state (Appendix D-2).

The technique used for aging fish in the analyses described throughout the report follows one of two methods. The first describes the age of a fish as determined by the number of years in the stream (before smolting) followed by the number of years in the lake, separated by a decimal point. For example, an age-1.1 coho salmon has had one year of life in its natal stream (or hatchery) and 1 year of life in the lake environment, making the fish 2-years-old. This convention has been adopted by the MDNR in recent years to distinguish between stream and lake life. However, difficulties have arisen in the utilization of this method and it has been, at times, precluded for one reason or another. This aging procedure has been mainly used for chinook and coho salmon and, to some extent, on rainbow (steelhead) and brown trout. Although this age description may not be as important for short lived salmonids (e.g., coho salmon), it becomes very important for a species like rainbow (steelhead) trout which may spend 1 to 3 years in the stream before smolting. To understand both stages of this life cycle is very important in the management of these species. Therefore, in the future, this will be the primary means of representing the age of anadromous salmonids once all the problems in the actual aging process have been solved.

The second type of age description includes the actual number of annuli found on the scale. In this instance, the number of years in stream versus lake life was not determined for any

number of reasons. Thus, an age-2 coho (no decimal point) is probably the same as the above age 1.1 fish, assuming that the individual remained in the stream for 1 year as expected.

The rule to remember throughout the report is if the age contains a decimal point, then the number before the decimal represents the number of years spent in the natal stream before smolting while the number after represents the number of years in the lake. If no decimal is present, then the age refers to the number of observable annuli, regardless of the life stage at which it was formed.

Recent studies of scale samples from the Lake Michigan fishery indicate that chinook salmon live to age 0.4 and 0.5. It has also been demonstrated that mature chinook never develop an annulus in their spawning year. This suggests that aging techniques used in the analysis of scales collected from the weirs before 1986 and from the sport fishery creel survey before 1987 may have been incorrect. These earlier aging data are probably biased towards younger fish because of the missing annulus. Thus, the results of analyses pertaining to growth patterns over time for chinook salmon must be interpreted with caution.

Description of Lake Michigan

Lake Michigan ranks sixth in size among the world's freshwater lakes, and is the only Great Lake entirely within the United States. The lake is bounded on the north and east by Michigan, on the west by Wisconsin, and on the south by Illinois and Indiana. The outlet is through the Straits of Mackinac into Lake Huron, with a mean discharge of 55,000 cubic feet per second (Powers and Ayers 1960) and a flushing rate of 99 years. Its surface area is 22,400 square miles and its mean depth is 276 feet. The length of the north-south axis is 307 miles, its east-west maximum width is 118 miles, and the shoreline length is 1,661 miles. The drainage basin, including the lake, covers 67,860 square miles (Beeton and Chandler 1963). The lake's elevation above sea level averages about 579 feet. The northern part of the watershed is forested, the central part is primarily farm-orchard land, and the southern part highly urbanized.

Lake Michigan proper is divided into two rather distinct basins, the southern basin with a relatively smooth, gently sloping bottom and depths to 550 feet, and the northern basin with steep slopes, irregular bottom, and depths to 923 feet. The northern basin has several islands, the most prominent of which are the Beaver group, Fox, and Manitous. Extensive glacial till or lake sediment covers most of the bedrock in the lake basin (Beeton 1969).

The only prominent bays are Green Bay in the northwest and Grand Traverse and Little Traverse bays in the northeast part of the lake. Green Bay is 118 miles long and averages 23