

## INTRODUCTION

As part of the Michigan Department of Natural Resources salmon management program for Lake Michigan, the Little Manistee River has been planted annually since 1967 with both coho and chinook salmon (Table 1). Construction of a blocking weir, fish ladder, holding ponds, and harvest facility on the river, about 5 miles upstream from Manistee Lake, Manistee County, began in 1967 and was completed in 1968 (Fig. 1). All chinook and coho salmon reaching the weir are harvested and sold to a commercial contractor. Normally, all other salmonids are passed upstream. The few salmon that enter the river when the weir is not in operation provide a limited stream fishery. The Little Manistee weir is Michigan's primary source for chinook eggs for in-state and out-of-state hatchery rearing and serves as a back-up (to the Platte River upper weir) for coho eggs. The facility is also used to monitor fall steelhead runs and each spring provides the majority of steelhead eggs for in-state hatchery rearing. Biological data have been collected on chinook and other anadromous salmonids since 1968.

From 1968 through 1978 chinook fingerlings were stocked in the Little Manistee River at an average rate of about 322,000 per year (Table 1). Beginning in 1979, the planting rate was increased by over 80% to an average of nearly 588,000 fingerlings. Substantial runs of returning adults have been produced but run size has not been closely related to stocking rate. The number of chinook actually harvested at the weir has varied between 11,136 (in 1977) and 39,359 (in 1983) (Table 2).

Chinook return to the weir at either age 0.1 (jacks), age 0.2, age 0.3, age 0.4, or age 0.5—but most commonly at age 0.2.<sup>1</sup> For the 1967, 1968, 1981, and 1982 year classes and plants, return rates were 0.4 to 1.9% at age 0.1, 3.1 to 3.5% at age 0.2, and 1.7 to 3.2% at age 0.3 (Table 3). For the 1981, and 1982 year classes, return rates were 1.2 and 1.1% at 0.4, respectively. Comparable estimates cannot be made for the 1969–80 plants because the age composition of the run has not been monitored consistently; however, for jacks alone returns have averaged 0.7%.

The return rate of chinook salmon to the weir was high initially (1960's), declined (1970's), then increased (1980's). Return rates by chinook of all ages were approximately 8.5% for the 1967 plant, 7.2% for the 1968 plant, 6.8% for the 1981 plant, and 8.9% for the 1982 plant (Table 3). Returns from plants in the 1970's must have been lower because relatively low

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<sup>1</sup>In aging anadromous fish, the number preceding the decimal denotes age at smolting (0 for most chinook, 1 for most coho) and the number following the decimal represents the number of annuli formed in the Great Lakes (mostly 1, 2, 3, 4, or 5 for chinook and 0 or 1 for coho). Note: a very recent study of scale samples from the Lake Michigan fishery indicates some chinook live to age 0.4 and 0.5. This finding suggests that some spawning chinook absorb one or two annuli from their scales while in the rivers and that the aging data given in preceding reports may be underestimates.

numbers came back to the weir in 1976–77 and 1980–82 (Table 2). Large runs, averaging 32,032 fish per year, occurred from 1983 through 1986. These originated from average plants of about 580,000 smolts in 1978–85—an average return rate of about 5.5% per plant. The return rates represent only the weir harvest and do not include the angler harvest, which has increased since the 1960's. In 1986, the estimated sport harvest from all stocks of chinook salmon in Michigan waters of Lake Michigan which were surveyed was 514,000 fish (G. Rakoczy, personal communication).

Growth rate of chinook has fluctuated considerably (Table 4, Fig. 2). Average weight has varied from 3.0 to 9.5 pounds for age 0.1, from 7.6 to 20.9 pounds for age 0.2, and from 12.7 to 29.2 pounds for age 0.3. The fluctuations were especially large during the 1970's. Overall, age-0.1 chinook salmon decreased in size from 5.9 pounds (1960's) to an average of 4.3 pounds (early 1980's), a 27% reduction. A similar but less dramatic reduction in size can be seen for older fish. Average size declined further in 1986 but this is due, in part, to better aging techniques.

Annual plants of yearling coho salmon in the Little Manistee River have varied widely, from 91,000 in 1971 to 700,000 in 1969 (Table 1). Annual runs of coho to the weir have varied from 2,314 (in 1972) to 108,400 (in 1970) (Table 5). The return rate of jacks (age 1.0) has been relatively low, <0.1% to 0.7%, compared to adults (age 1.1), 3.0% to 15.0% (Table 3, Fig. 3). The total return rate is usually between 11 and 15%, however, it declined to 8.5% for the 1983 plant and averaged only 3.8% for the 1984–85 plants. The return of the 1985 plant to the Platte River was low also (Pecor 1987). Possible reasons for the poor returns were discussed by Pecor (1987). As with chinook, these return rates represent only the weir harvest and do not include the angler harvest, which has also fluctuated annually. In 1986, anglers harvested an estimated 135,000 coho salmon from all stocks in Michigan waters of Lake Michigan which were surveyed (G. Rakoczy, personal communication).

The average weight of coho jacks (age 1.0) increased slightly from 1974–83, then gradually decreased (Fig. 4, Table 6). However, the size of adult coho decreased from 8.7 pounds in 1968 to less than 5.0 pounds in 1979, then stabilized at about 6.3 pounds. Like the chinook, there has been a decrease in average size of adult coho from the 1960's to the early 1980's, but in the last several years the average has been fairly constant. It is assumed that the annual variations in size are primarily related to a combination of predator density and forage density in Lake Michigan.

The Little Manistee River is one of the top quality steelhead streams in Michigan. The fishery is supported almost entirely by natural reproduction. However, a plant of 100,188 fall fingerlings was made in 1974, and from 1981 through 1983 annual plants were made in conjunction with a research project on steelhead production (Table 1). In 1984 a small planting of three strains of summer steelhead yearlings was made to extend the steelhead fishery. The

strains (Siletz, Rogue, and Umpqua River) were imported from the State of Oregon. The number of steelhead returning to the weir each fall has not been consistent, ranging from 320 in 1978 to 7,622 in 1971 (Table 7). Mean weight of steelhead (all age groups) has varied from 6.5 pounds in 1973 to 9.3 pounds in 1972 (Table 7). The estimated sport harvest of steelhead from all Michigan waters of Lake Michigan which were surveyed was 35,000 in 1986 (G. Rakoczy, personal communication). Indications are that the open-water catch will increase significantly in future years.

Small runs of anadromous brown trout occur in the Little Manistee River. The largest run, 238, was in 1975 (Table 8). Average size has ranged from 3.4 pounds (1974) to 6.8 pounds (1979). Annual runs in excess of 100 fish have occurred since 1984. In 1986, the estimated sport harvest from Michigan waters of Lake Michigan which were surveyed was 74,000 brown trout (G. Rakoczy, personal communication).

Atlantic salmon yearlings were first planted in the Little Manistee River in 1977 (Table 1). Subsequent plants have been made in an attempt to establish this new species. Until 1984 only an occasional fish had been captured. Of the several strains and hybrids planted only the Sebago strain (from Maine) shows promise.

A few pink salmon have been harvested in the last few years. Numbers harvested are generally less than 25.

#### HARVEST WEIR OPERATIONS, 1986

On August 22, 1986, the weir gates were installed to block anadromous fish. On September 4, the ponds were filled and the fish ladder was activated. Harvest began on September 8. The weir remained operational until November 12, at which time the gates were removed and the building was winterized. The weir was in operation for 83 days. All harvested chinook and coho salmon were sold on contract to Tempotech Industries, Hart, Michigan.

From September 9-11, 1986, heavy precipitation (5-7 inches) created severe flooding in the Little Manistee River. Water flowed over and around the weir for several days, allowing an unknown number of fish to negotiate the weir structure.

##### *Chinook salmon*

Harvest of chinook salmon began September 8 and ended November 7, a period of 61 days. Fish that were not ripe were harvested because, in other years, holding early-run chinook in maturation ponds resulted in high mortality. Two peak harvests occurred, the first during late September and the second near mid-October (Table 9). A relatively small, but significant run of chinook entered the facility in late August and early September. A second, major run began in mid-September and peaked in mid-October. A total of 22,131 chinook were harvested