FISHERIES DIVISION

TECHNICAL REPORT

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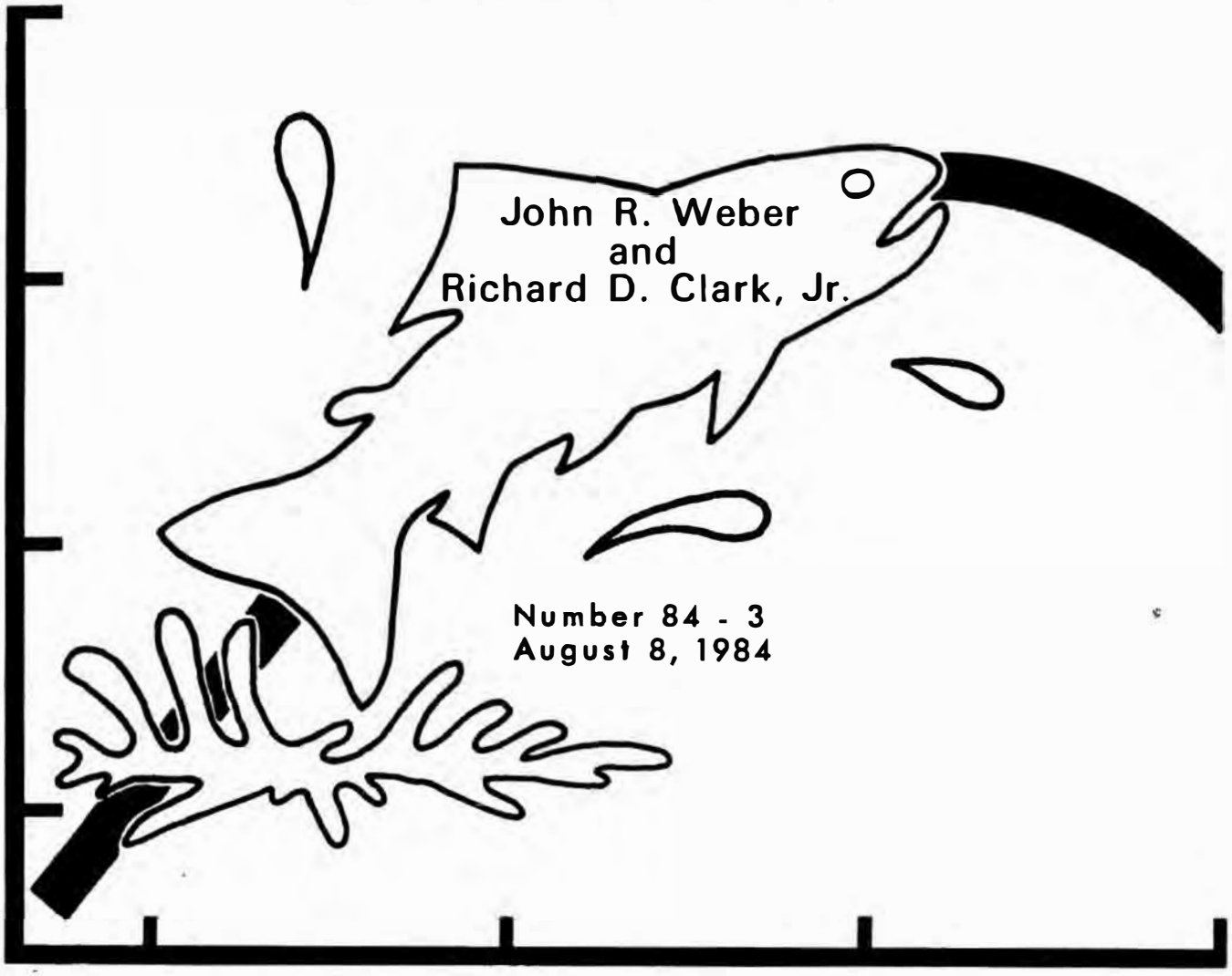

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and
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Michigan Department of
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MORTALITY AND GROWTH OF LAKE TROUT IN WESTERN LAKE HURON

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Introduction

We analyzed experimental gill net samples of lake trout (Salvelinus namaycush) collected at two index stations in western Lake Huron. The purpose was to estimate current mortality and growth rates in these areas. The first station was in Statistical District MH 3 about 5 miles southeast of Oscoda, Michigan, near Au Sable Point. The second was near Grindstone City, Michigan, on the border between Statistical Districts MH 4 and MH 5. The populations of lake trout in these areas are subjected only to sportfishing. Commercial fishing for lake trout is prohibited by the State of Michigan, and the waters of the lake which are commercially fished by Chippewa Indian tribes are more than 50 miles to the north.

Mortality

Catch-curve analysis (Ricker 1975) was used to estimate the total mortality rate of lake trout. Calculations were made with a computer program available in the Stock Assessment Package One (SAP1) designed by Clark and Smith (1984). Data for the mortality estimates were collected in May and June of 1982 and 1983. All lake trout collected were survivors of hatchery plants and their ages could be determined from fin clips.

We found the total annual mortality to be 56% at the Au Sable Point Station (Fig. 1) and 54% at the Grindstone City Station (Fig. 2). Data from Au Sable Point were very consistent and produced a high value for the coefficient of determination ($R^2 = 0.98$). From the statistical standpoint, this means the mortality estimate is a very precise one and, from the biological standpoint, we believe the estimate accurately reflects the mortality of lake trout in the area. Data from Grindstone City were not as consistent ($R^2 = 0.83$), due primarily to the relatively small number of

10-year-old fish collected (Fig. 2). If the actual number of 10-year-old fish was under-represented in our samples, then the mortality rate would be less than 54% at Grindstone City. Eliminating 10 year olds from this catch curve changes the total mortality estimate to 45%.

Growth

We calculated the parameters of the von Bertalanffy function, which relates length and age, and of a standard length-weight regression equation using computer programs in SAP1. Samples of lake trout used in the growth analysis were collected in May and June from 1977 to 1982. As in the mortality analysis, the planted lake trout were aged based on fin clips.

We found that growth in length, as expressed by the von Bertalanffy function, was similar at both sampling stations. The von Bertalanffy equation is written as follows:

$$L = L_{\infty} \left(1 - e^{-K (x - x_o)}\right)$$

where L is the length of a fish at a given age x, e is the base of the natural logarithms, and L_{∞}, K, and x_o are the parameters to be estimated. At Au Sable Point (Fig. 3), L_{∞} was 844, K was 0.2445, and x_o was 0.0675 for length expressed in millimeters. At Grindstone City (Fig. 4), L_{∞} was 868, K was 0.2414, and x_o was 0.0703. There were no statistically significant differences at the 95% level between the parameters estimated from the two areas. Observed mean lengths and sample sizes of lake trout at each age were as follows:

Age	Au Sable Point		Grindstone City	
	Mean length (mm)	Number sampled	Mean length (mm)	Number sampled
4	511	534	529	218
5	608	414	619	338
6	660	265	672	232
7	695	126	703	127
8	719	33	738	38
9	734	6	757	3

The weight at a given length, as expressed by a linear regression fit to the $\log_e$ - transformed data, was nearly identical for both sampling stations. The regression equation is written as follows.

$$\log_e (\text{weight}) = a + b \cdot \log_e (\text{length})$$

where a and b are the parameters to be estimated. At Au Sable Point, a was -18.50 and b was 3.033 for length in millimeters and weight in kilograms. At Grindstone City, a was -18.45 and b was 3.027. Sample sizes for these regressions were over 1,000 fish from each area and the coefficients of determination ($R^2 = 0.99$) were the same for both. The two regressions were not significantly different at the 95% level.

Discussion

We believe the lake trout mortality and growth data obtained at Au Sable Point and Grindstone City are probably representative of lake trout populations existing in the State of Michigan's non-treaty waters of Lake Huron (from Alpena, Michigan, south to Port Huron, Michigan). Also, the

mortality and growth rates we estimated for lake trout in these areas are very similar to those reported by Rybicki (1983) for southern Lake Michigan which is also closed to commercial lake trout fishing.

It is the policy of both the Michigan Department of Natural Resources and the U. S. Fish and Wildlife Service to use hatchery-reared lake trout to develop naturally reproducing and self-sustaining populations in the Great Lakes. Unfortunately, we would not expect self-sustaining natural reproduction to develop in western Lake Huron, unless current mortality rates are reduced. One of the key recommendations of the Lake Huron Lake Trout Technical Committee, organized by the Great Lakes Fishery Commission, was to reduce the total annual mortality of adult lake trout to 40%. They believed that this level of mortality was a necessary management goal if lake trout rehabilitation was to be achieved in Lake Huron in a reasonable time frame. Their recommendation was based on a study by Healey (1978) who found that lake trout populations could not maintain themselves if their total mortality rate was over 50%. Our gill-net samples showed that the total mortality of lake trout was over 50% at both sampling stations in western Lake Huron.

We think these data and results are sufficient evidence to warrant action in restricting the sportfishing harvest of lake trout in Lake Huron because sport fishing is the only major mortality factor which can be controlled. The Michigan Natural Resources Commission took such action at their January 1984 meeting by reducing the lake trout fishing season in Lake Huron from a year-round season to one extending only from May 1 to August 15 of each year. We hope future monitoring at Au Sable Point and Grindstone City will find that this regulation was effective in reducing mortality and enhancing reproduction of lake trout in Lake Huron.

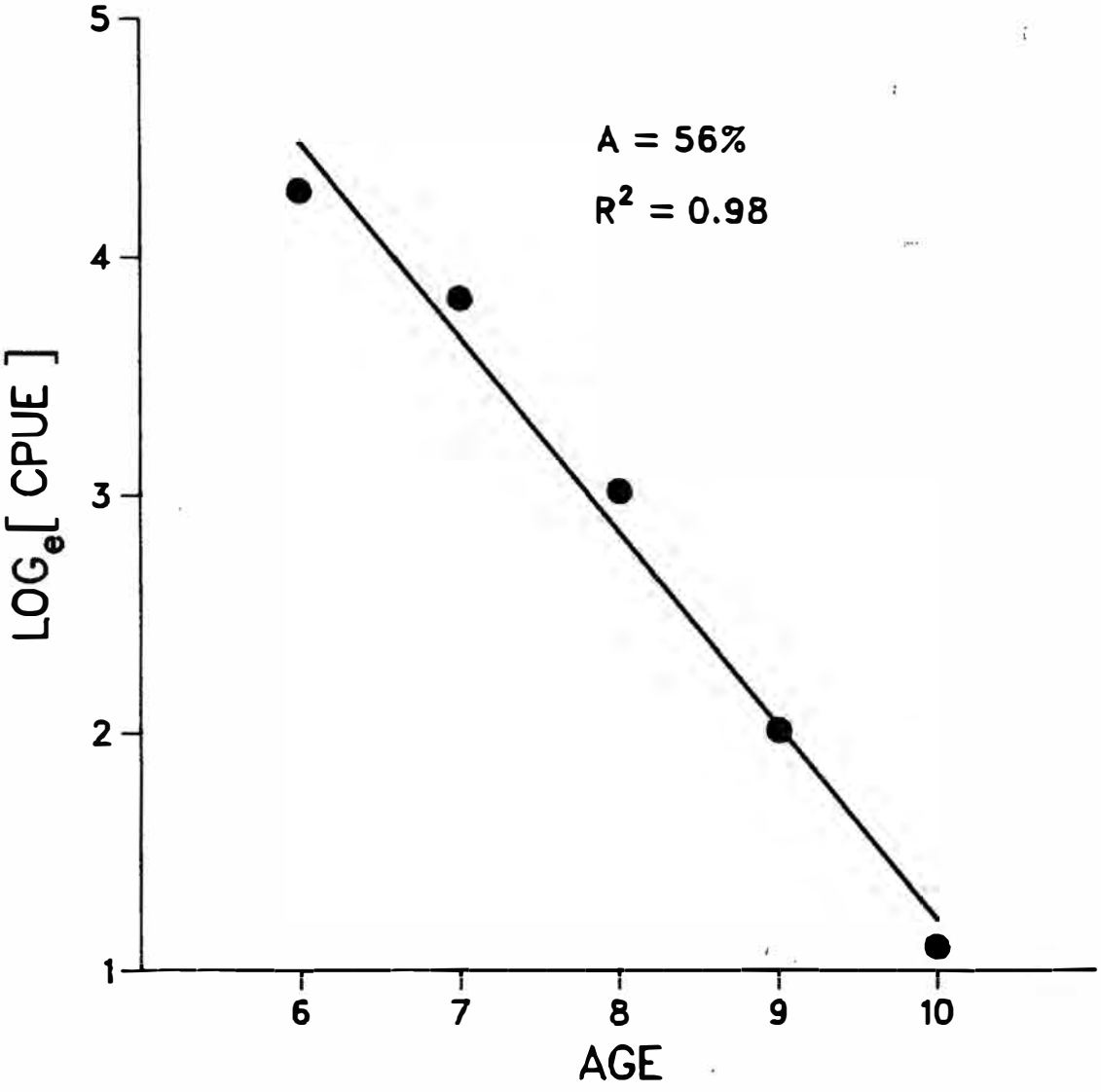

Figure 1. Catch curve for lake trout taken with experimental gill net in 1982 and 1983 at the Au Sable Point Station. CPUE on the vertical axis stands for catch per unit of effort. A is the total mortality rate.

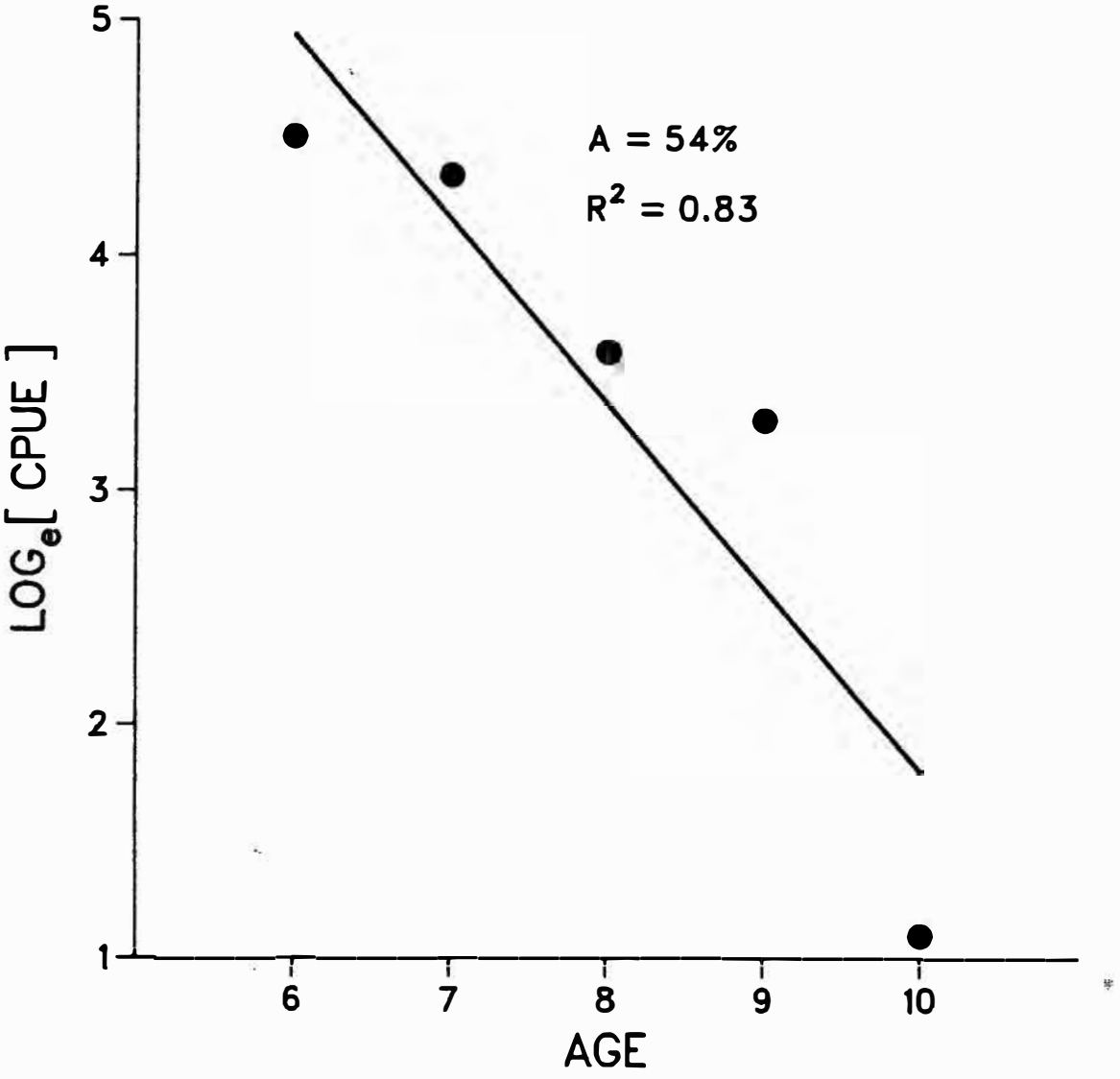

Figure 2. Catch curve for lake trout taken with experimental gill net in 1982 and 1983 at the Grindstone City Station. CPUE on the vertical axis stands for catch per unit of effort. A is the total mortality rate.

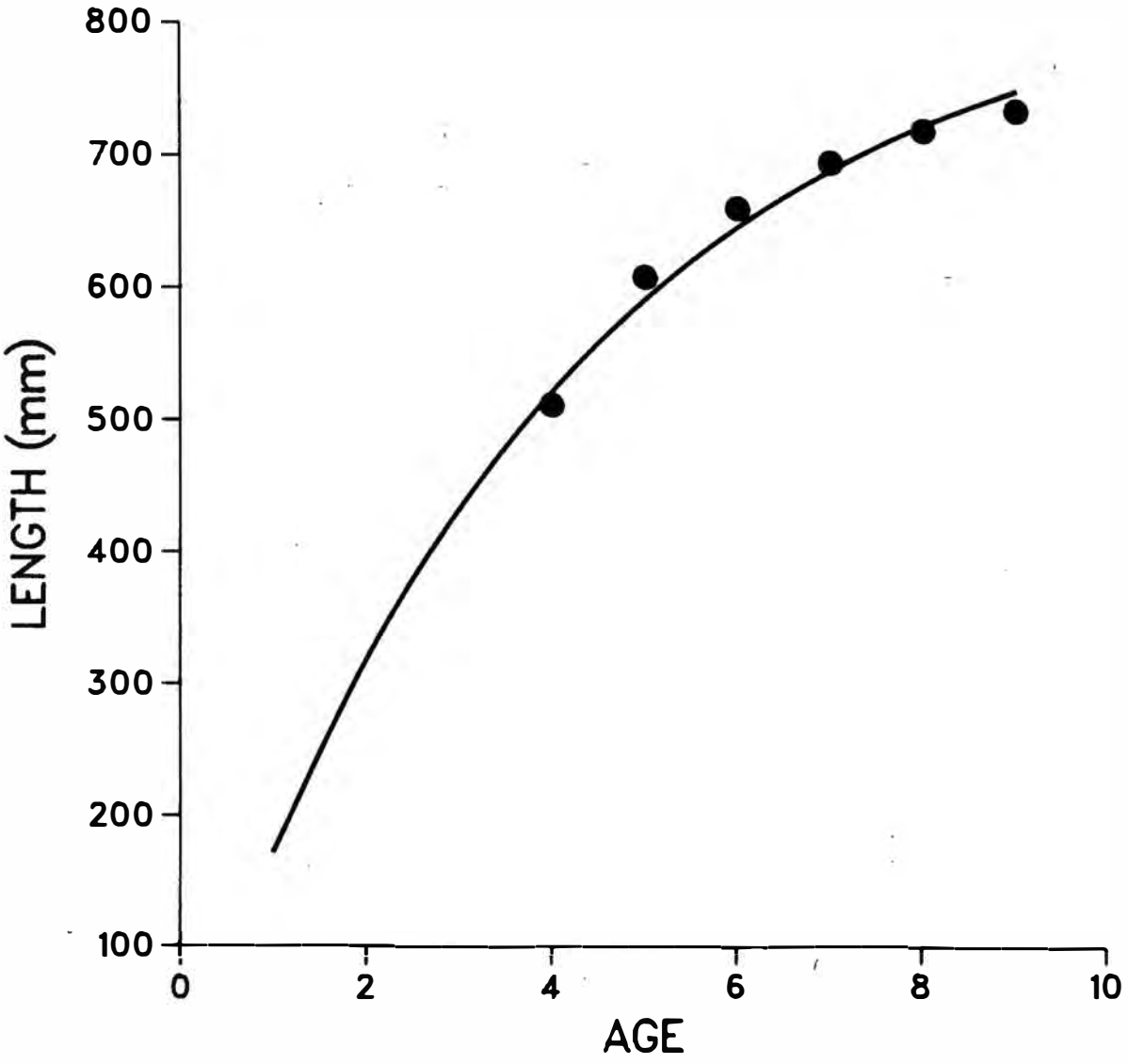

Figure 3. The estimated von Bertalanffy growth curve plotted through observed mean lengths at age for lake trout taken from 1977 to 1982 at Au Sable Point. Parameters for the function are given in the text.

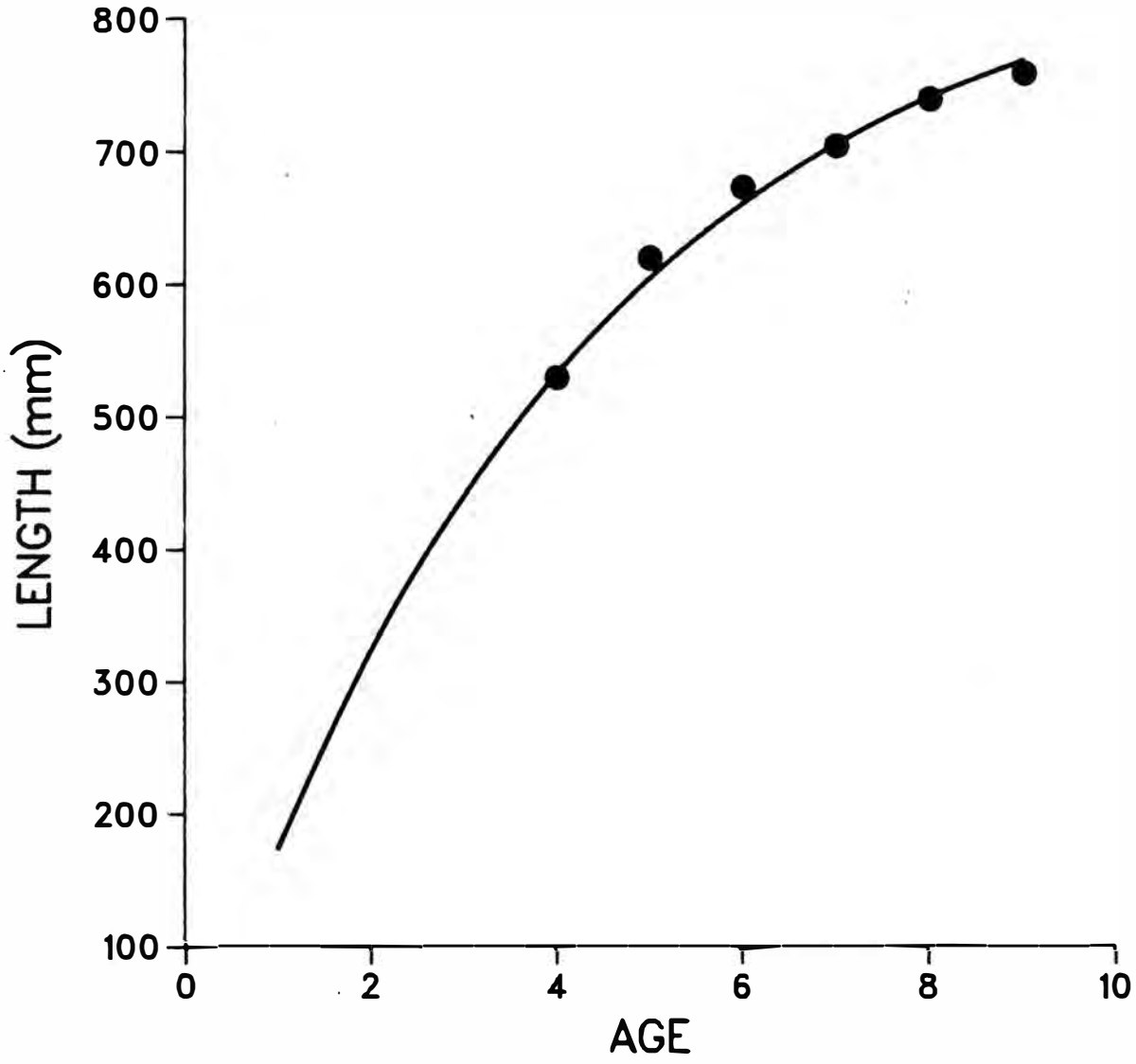

Figure 4. The estimated von Bertalanffy growth curve plotted through observed mean lengths at age for lake trout taken from 1977 to 1982 at Grindstone City. Parameters for the function are given in the text.

Literature Cited

Clark, R. D., Jr., and K. D. Smith. 1984. Stock Assessment Package One. Michigan Department of Natural Resources, Institute for Fisheries Research, Ann Arbor, Michigan, USA.

Healey, M. C. 1978. The dynamics of exploited lake trout populations and implications for management. The Journal of Wildlife Management 42:307-328.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada Bulletin 191, Ottawa, Canada.

Rybicki, R. W. 1983. Lake trout populations in Michigan waters of Lake Michigan, 1976-1982. Michigan Department of Natural Resources, Fisheries Research Report 1914, Ann Arbor, Michigan, USA.

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