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TRENDS IN ANGLING AND TROUT POPULATIONS IN THE MAIN AU SABLE AND NORTH BRANCH AU SABLE RIVERS FROM 1959 THROUGH 1976 [1]

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ABSTRACT

The anglers' fishing effort and catch of trout were lower in the Main Au Sable but higher in the North Branch of the Au Sable over the years 1959 through 1976.

Brown trout growth became poorer over time in the Burton's Landing to Wakeley Bridge segment of the Main Au Sable, but decreased little in the other river segments studied. Brook trout growth did not change significantly in any river segment. Survival rates of second and third summer brown trout were better in both streams during the later years of investigation. Brook trout survival rates remained relatively constant.

The total trout population (standing crop by weight) generally decreased in the Main Au Sable but increased in the North Branch of the Au Sable. Brown trout populations became progressively higher and brook trout lower during the study period.

The causes for the changes noted cannot be determined with certainty because of the many alterations made in the fish habitat, fish stocking policies and fishing regulations.

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Introduction

Anglers of the Au Sable River system of Michigan show an intense interest and awareness in the status of their fishery. These anglers desire current information on the magnitude of trout stocks, angler use and success, and even the magnitude of such uses as canoeing and boating.

The Michigan Department of Natural Resources Fisheries Division has monitored the status of the trout populations of the Au Sable by conducting fall surveys periodically since the late 1950's. Creel census information was also gathered from 1960 to 1967. However, budget constraints after 1967 eliminated the creel census. Because of strong angler interest, in the current status of the Au Sable fishery, and their concern that the fishing on the Main Au Sable was much poorer than during the 1960's, members of the William B. Mershon Chapter of Trout Unlimited financially supported a creel census in 1976.

The objective of this report is to present the findings of the 1976 creel census and incorporate trout population and angling statistics gathered over the past two decades. Evaluation of trout fisheries on various segments of the Au Sable River system will then be possible.

Study areas

Studies were undertaken on two adjacent river segments of the Main Au Sable and two on the North Branch of the Au Sable. The upper segment on the Main Au Sable began at the city of Grayling (Maple Street bridge) and extended to Burton's Landing about 5.6 miles downstream. The lower segment went from Burton's Landing to Wakeley Bridge which is about 8.7 miles. The upper segment on the North Branch of the Au Sable began at the Sheep Ranch, which is located approximately 2 miles upstream from the community of Lovells, and extended 4.8 miles downstream to Eaman's Landing. The lower segment commenced at Eaman's Landing and terminated at Kellogg's Bridge, a distance of 8.7 miles. Additional information about these river segments may be found in Table 1.

Methods

Creel census procedures were designed to estimate man-hours of fishing and boating, and the catch of trout, both creeled and released. A detailed description of the census methods was provided by Alexander and Shetter (1967). The procedure used to estimate the man-hours of fishing by wading and bank angling was to make progressive instantaneous counts. The census clerk counted all waders and bank anglers observed as he canoed past them in traversing the full length of the river segments (e.g., Burton's Landing to Wakeley Bridge on the Main Au Sable). The procedure used to estimate angling from boats or canoes was for the census clerk to make instantaneous counts of anglers fishing from floating craft within the boundaries of sixteen 0.1-mile randomly chosen subsections, within each survey segment. The sum of these 16 subsection counts was then multiplied by the appropriate inflation factor to arrive at an instantaneous count for the entire segment.

The catch per hour of trout per angler was obtained from random interviews. When census clerks encountered anglers, usually at the termination of a fishing trip, they would determine: (1) length of the fishing trip; (2) number, length, and identity of trout in the creel; (3) number of trout returned to the river, both legal and sublegal fish; and (4) proportion of the sublegal trout greater than 10 inches. By multiplying the estimated man-hours of fishing by the average catch of trout per hour per angler the total catch was computed. The total trout catch was then partitioned into catch by species and size class based upon the observed species composition and size frequency of trout seen in the anglers' creels.

Stocks of trout in the streams were assessed by crews using d-c electrofishing gear. Trout captured during the first sample run were marked by clipping a fin. The proportion of marked fish in the population was established during a second sample run. Population estimates (P) were calculated by the Petersen mark-and-recapture method: $P = m(u + r)/r$, where m signifies marked fish on the first electrofishing run, u the unmarked fish, and r the marked fish caught on the second electrofishing

run. Separate estimates were made for each inch group and species of trout as described by Shetter (1957).

These trout population estimates were made on sample sections of the rivers (four in the Main Au Sable, five in the North Branch Au Sable), each approximately one-quarter mile long. Estimates from these sample sections were then transformed into average estimates for the entire river segment under study (e.g., Burton's Landing to Wakeley Bridge).

The average size of trout at various ages was determined following Alexander and Ryckman (1976). Briefly, the procedure used to determine the average length of trout for a given age was to multiply the estimated number of trout of a specific age within each inch class (as determined by scale reading) times the class mid-point. Products similarly derived for this age group in all other inch classes were then summed and divided by the total number of trout of this particular age to arrive at the average length. Growth rates were determined from gains in length or weight made between successive ages.

We would like to emphasize that many alterations in the fishing regulations and the aquatic environment have occurred over the last two decades. A detailed account of the fishing regulations, by river segment and period of years, is given in Table 1. In addition, pertinent regulations are mentioned in appropriate places throughout the report. Activities of man have altered the river fertility levels. The city of Grayling stopped discharging its sewage effluent into the Main Au Sable in 1971. The State of Michigan phased out fish production, with its related waste discharge, at the Grayling Hatchery in the mid-sixties. Further, the construction of residential and cottage dwellings and their associated developments have been extensive along the rivers. Between 1963 to 1976 the number of dwellings increased by 49% on the North Branch of the Au Sable and 40% on the Main Au Sable. Also, the Michigan Department of Natural Resources spent about one-quarter million dollars on stream improvement during the 1970's, mostly in the Burton's Landing to Wakeley Bridge segment of the Main Au Sable. Undoubtedly, all of the above factors had some impact on the fisheries.

Results

Main Au Sable, Burton's Landing to Wakeley Bridge

Fishing regulations.--There were six changes in the fishing regulations in this river segment between 1955 and 1976 (Table 1). However, the rules in force during the two periods being compared in this report were: flies-only, creel limit of 3 trout, 8-inch size limit on brook trout and a 12-inch size limit on brown and rainbow trout in 1976; and flies-only, creel limit of 5 trout, and a 10-inch size limit on all trout in 1960-65.

Fishing pressure.--In 1976, 30,544 hours (306 hours per acre) of fishing were spent in this segment of the river (Table 2). Eighty-seven percent of the fishing was done by anglers either wading or bank fishing. The remaining 13% of the angling was done from boats or canoes. This fishing pressure was down by 29% from the 43,019 hours (431 hours per acre) measured in the 1960-65 period. Fishing from boats and canoes was down more than the fishing of wading and bank anglers. We want to emphasize that comparisons are being made using data from a single year (1976) with averages from an array of other years.

Catch of trout.--In 1976, anglers harvested 1,023 trout or 10.3 fish per acre (Table 3). The average total catch per year for the 1960-65 period was 6,447 trout or 64.6 trout per acre. Thus the catch in 1976 was down some 84% from the 1960-65 period. Most of the reduction was in the brown trout catch where only 439 trout (4.4 trout per acre) were caught in 1976 as compared to the former average catch of 5,840 trout (58.5 trout per acre). The rainbow trout catch was down to 58 fish per year (0.6 per acre) from 186 fish earlier (1.9 per acre). However, the brook trout catch was up to 526 fish (5.3 per acre) from the former average catch in 1960-65 of 421 fish (4.2 per acre). Much of the change noted was due to the impact of changing fishing regulations which are discussed below.

During the 1976 census we also made an estimate of the catch of legal size trout that were reported returned to the water by anglers. Some 1,315 additional legal size trout were caught, but released. If we add these

trout to the observed catch and compare this sum with the mean catch of 1960-65, the 1976 catch was reduced only 64%. Of course some legal trout were also caught and released by anglers during the 1960-65 period, but we have no measure of this. The 1976 anglers reported releasing more than half of the legal size trout they caught in this segment of the Main Au Sable which indicated a "catch-and-release fishery" might be acceptable here.

Also included in Table 3 are the average sizes of trout caught by species for the various census years. The average length of all trout in the creel in 1976 was 10.7 inches compared to 11.4 inches during the 1960-65 period. Brown and rainbow trout averaged larger, but brook trout averaged smaller in 1976 than in 1960-65.

By using the numbers of trout caught and their average weight the total weight (pounds) of trout creeled per year can be calculated. The total weight of trout caught in 1976 was 482 pounds (4.8 pounds per acre)--126 pounds of brook trout, 321 pounds of brown trout, and 35 pounds of rainbow trout.

The average total weight of the trout catch for the 1960-65 years was 3,284 pounds (32.9 pounds per acre)--170 pounds of brook trout, 3,037 pounds of brown trout, and 76 pounds of rainbow trout. The catch by weight in 1976 was down 85%.

In all comparisons--number creeled, number creeled plus those released, and weight creeled--the catch in 1976 was much poorer than in the 1960-65 period.

In further analysis we compared the catch of 12-inch and larger brown trout before and after the 12-inch size limit was imposed, and the brook trout catch after the size limit was reduced from 10 inches to 8 inches (Table 4). In 1976, the catch of brown trout was 497 fish, all 12 inches plus in length, however, in 1960-65, the total legal catch of brown trout per year was 6,026 with 1,756 of these 12 inches or longer in length. Thus in 1976, the catch of 12-inch plus brown trout was down considerably in spite of the more protective size and creel limits. In 1976, the total catch of brook trout was 526 fish with 117 of these 10 inches or longer. In the 1960-65 period the average catch of 10-inch plus brook

trout was 421, thus the more liberal size limit on brook trout resulted in the catch being greater overall, but with fewer 10-inch plus trout caught.

Catch per hour of trout. --The average catch per hour per angler of trout, by species, is shown in Table 3. Trout were caught and creeled at the average rate of only 0.033 fish per hour in 1976. This is down considerably, compared to the average rate of 0.150 fish per hour made during the 1960-65 period. In 1976 the catch rate of brook trout was higher, whereas the catch rate of both brown trout and rainbow trout was lower.

Trout population. --Estimated numbers and pounds of trout per acre in the fall standing crop by species and inch group for the 1959-63 and the 1974-76 periods, are given in Table 5. Brown trout in this segment of the Main Au Sable comprised 84% of the fall total standing crop by weight in 1959-63 and 90% in 1974-76. The weight of brown trout present during the fall of 1974-76 was lower than in 1959-63, although brown trout numbers were slightly higher. The major reduction in trout biomass was due to lower populations of browns over 12 inches (Table 5). Note that the populations of 9-, 10-, and 11-inch browns were up in 1974-76 over the 1959-63 period. It appears that the 12-inch size limit was successful in increasing the numbers of 9- to 11-inch fish by non-cropping.

Brook trout populations in 1974-76 were much lower than the fall stocks present during the 1959-63 period (Table 5). Rainbow trout populations were rather low and composed of small fish for both time periods and seem to have changed little (Table 5).

Fall standing crop of brook trout was about 7 pounds per acre in 1974-76 as compared to 20 pounds per acre in 1959-63. Brown trout fall standing crop was 101 pounds per acre in 1974-76, a decrease from the 129 pounds per acre in 1959-63. Rainbow trout biomass did not change much. Total trout biomass (brook, brown, and rainbow) decreased from 154 pounds per acre in 1959-63 to 113 pounds per acre in 1974-76.

Trout growth. --Changes in trout growth are shown in Table 6 and in Figures 1, 2, and 3. The average size of brown trout of all age classes was considerably smaller in 1974-76 than in 1959-63 (Fig. 1). Brook trout

averaged only slightly smaller during the later period (Fig. 2). Rainbow trout averaged smaller, like the brown trout during the later period (Fig. 3).

Trout survival.--Changes in the survival rate of trout are shown in Table 7 and in Figures 4, 5, and 6. The brown trout survivorship curve changed significantly from the 1959-63 to 1974-76 period (Fig. 4). Brown trout survival was better in 1974-76 for age I-II and II-III trout, but poorer for age 0-I and age III-IV trout. Survival of trout older than age IV did not appear to change. The survival rate of brook trout was about the same for the two time periods (Fig. 5). Rainbow trout survival rate appeared to have increased for ages I and older trout in recent years (Fig. 6).

The reasons for the population changes in this segment of the Main Au Sable are not clear. However, the more restrictive angling regulations probably have reduced the trout harvest hence increased survival, particularly for age I- to III-year-old fish. Further, the basic productivity of the Main Au Sable downstream from Grayling was lower due to the removal of nutrients that formerly entered the river from Grayling's sewage effluent (Heckathorn 1977).

The lower brook trout populations are not peculiar to the Main Au Sable but are generally lower in many of our Lower Peninsula trout streams (Alexander, unpublished).

Recreational boating.--In 1976, recreational boating totaled 55,112 hours as compared to an average of 68,596 hours for the 1960-65 period (Table 2). On the Burton's Landing to Wakeley Bridge segment of the Au Sable boating was reduced by 20%. Much of the loss was in fishing from boats, not through a reduction of recreational boating.

Main Au Sable, Grayling to Burton's Landing

Fishing regulations.--There was only one change in the fishing rules in this river segment between 1955 to 1976 (Table 1). During 1969-76 the rules were: any-lure, creel limit of 5 trout plus 5 additional brook trout, with a 7-inch size limit on brook trout, but a 10-inch size limit on brown and rainbow trout. Rules during the 1955-68 were: any-lure, creel limit of 10 trout, and a 7-inch size limit on all trout.

Fishing pressure.--In 1976 angling in this river segment amounted to 5,551 hours (85 hours per acre), a decrease of 56% (Table 8) from an average pressure of 12,605 hours (192 hours per acre) in the 1960-63 period. Fishing from boats and canoes showed a 78% decrease; wading and bank fishing were down 41%.

Catch of trout.--In this stretch of the river, anglers harvested 1,000 trout (15.3 per acre) in 1976 (Table 9). The average catch during the 1960-63 period was 2,856 trout (43.6 per acre), a decrease of 65% between 1960-63 and 1976. Undoubtedly much of the reduction in the catch here was due to elimination of stocking trout in this segment of river. The catch of rainbow trout dropped from an average of 780 trout in 1960-63 to zero in 1976. This portion of the river has few naturally produced rainbow trout, thus nearly all the 1960-63 catch was composed of hatchery fish. From 1959-63, about 1,050 to 2,400 legal-size rainbow trout were planted annually. The catch of brown trout and brook trout was also down considerably. We do not know what portion of the brown trout catch in 1960-63 was of hatchery origin, but during the years of 1959-63 from 400 to 800 legal-size brown trout were planted annually in this section of river. The brook trout catch was down about 47%, however, and this drop must be due to reduced stocks of wild brook trout since few brook trout were planted in the area.

During the 1976 creel census the catch of legal size trout that were returned to the river by the fishermen was estimated. The anglers fishing this segment of the Au Sable River returned only 22 legal fish to the river in contrast to anglers on the Burton's Landing to Wakeley Bridge waters who released 1,315 trout, or better than half their catch.

The average sizes of trout by species for the census years are given in Table 9. The average size of brook trout increased from 8.0 to 8.4 inches and brown trout increased from 11.2 to 12.8 inches. The average length of all trout in the creel in 1976 was 11.2 inches as compared with an average of only 9.9 inches for trout during the 1960-63 period.

In 1976 the anglers cropped a total of 536 pounds of trout as compared to 1,011 pounds (average) in 1960-63. The catch of brook trout dropped from 129 to 78 pounds, the brown trout catch from 644 to 458 pounds, and the rainbow catch from 238 pounds to zero. As mentioned earlier, much

of this reduction was probably due to the lack of hatchery stocking supplementing the catch in recent years.

The average size of both brook and brown trout in the catch was larger in 1976 than in 1960-63. These larger trout helped compensate in weight for losses in trout numbers. The major reduction in catch came in small size trout (Table 10). Little change was evident in the catch of 10-inch plus brook trout. Further, the catch of 10-inch plus brown trout was down only 31% and the catch of 12-inch plus brown trout was down by only 14%. Much of the lower catch of brown trout was due to the loss of the 7- to 9.9-inch fish to the legal catch, because of the 10-inch minimum size limit of recent years.

Catch per hour of trout.--The average catch per hour per angler of trout by species is shown in Table 9. Trout were caught and creeled at the average rate of 0.180 trout per hour in 1976. The overall catch rate was down only slightly from the 1960-63 period. Both the catch rate of brook and brown trout was higher in 1976, but the rainbow catch was zero.

Trout populations.--Current trout population information on the Grayling to Burton's Landing segment of the Main Au Sable is lacking. However, the trout population data for the 1959-63 years and for 1972 only are summarized in Table 11. Using the 1972 data as representative of present day conditions it appeared that the total trout biomass in pounds had increased from about 10 to 21 pounds per acre since the 1959-63 period. The number of trout per acre was about the same however. The main change was the presence of more large brown trout in this area. The rainbow trout population had apparently disappeared, probably because hatchery-reared rainbow trout were no longer stocked.

Trout growth.--Trout growth within this river segment is shown in Table 6 and Figure 7. Brown trout growth does not appear to have changed much from the 1959-63 to the 1972 period. Too few brook and rainbow trout data were available to make growth comparisons for this river segment.

Trout survival.--The brown trout survivorship curves for the 1959-63 and 1972 periods are shown in Figure 8. Apparently there is

considerable recruitment into this river segment of young brown trout (age I and II) by movement or stocking as indicated by the shape of the survivorship curves. Survival of older trout appears to be similar for the two periods. Population levels of brook and rainbow trout were too meager in this area to determine their survival rates.

The trout populations in this segment of river were much poorer than those present in the Burton's Landing to Wakeley Bridge segment during both time periods. The average fall standing crop of trout in the Grayling to Burton's Landing area was only 10.5 pounds per acre as compared to nearly 154 pounds per acre in the Burton's Landing to Wakeley Bridge area of the river in the 1959-63 period. In numbers, there were only 42 fish per acre compared to nearly 1,400 trout per acre for these respective areas. A similar relationship existed between the populations of the two segments in 1972.

Recreational boating.--Total man-hours of boating in this river segment was 63,703 hours in 1976 as compared to an average of 53,032 in the 1960-63 period (Table 8), thus boating pressure was up about 20%, entirely due to increased recreational boating.

North Branch Au Sable, Eaman's Landing to Kellogg's Bridge

Fishing regulations.--From 1956 to 1976 there were three changes in the angling rules on this river segment (Table 1) but during the three time periods being compared in this report there were only two changes. They were: (1) in 1976, flies-only, creel limit of 5 trout, 8-inch size limit on brook trout, but a 10-inch on brown and rainbow trout; and (2) in 1958-60 and 1961-67, flies-only, creel limit of 5 trout, and a 9-inch size limit on all trout.

Fishing pressure.--In this segment of the North Branch Au Sable River anglers fished 11,110 hours (94.7 hours per acre) in 1976 (Table 12). The 1976 fishing pressure was about 10% higher than the average pressure of 11,005 hours in 1961-67 and 21% higher than the 9,151 hours expended

in 1958-60. Fishing statistics presented are for wading and bank fishermen since there was little boating or canoeing on the North Branch Au Sable River.

Catch of trout.--In 1976, anglers harvested 1,701 fish (14.5 trout per acre) (Table 12) in the Eaman's to Kellogg's segment of river. This catch was higher by 4% and 21% respectively, than the average catches made during the 1961-67 and 1958-60 periods. The catch of 1,123 brown trout in 1976 was down from the average catch of 1,434 fish made in 1961-67. This was undoubtedly due to the change from a 9- to 10-inch minimum length size limit. Under the 9-inch size limit, the brown trout catch increased from 948 fish in 1958-60 to 1,434 fish in 1961-67. As will be shown later the brown trout population has increased in the North Branch of the Au Sable.

The catch of 578 brook trout in 1976 is considerably larger than the average catch of 194 fish made in 1961-67. The change was again related to the size limit. In 1976, the minimum size limit on brook trout was 8 inches whereas in both earlier periods of years it was 9 inches. The average brook trout catch dropped noticeably from 462 fish in 1958-60 to 194 in 1961-67, with no change in fishing regulations. This decrease may be due to a suspected general reduction in brook trout populations in the entire Au Sable system and other Lower Peninsula trout streams.

In the 1976 census we made an estimate of the number of legal size trout that were reported returned to the river by fishermen. For this portion of the North Branch of the Au Sable 1,283 additional trout were estimated caught but released. According to the anglers' reports, the total catch was 75% higher than the harvest. Again, like the Main Au Sable "quality" waters, the anglers by performance were endorsing a "catch-and-release" fishery.

Included also in Table 12 are the average sizes of trout caught by anglers for the three different periods. Brook trout were generally smaller, but this was because of a lower size limit. Brown trout average size fluctuated between 10.7 and 11.5 inches. The average size of all trout in the creel did not change much. It was 10.4, 10.5, and 10.7 inches for the 1976, 1961-67, and 1958-60 periods, respectively.

Again by using the average weight with the numbers of trout caught, the total weight (pounds) of trout harvested per year was calculated. In 1976, the total weight of trout harvested was 689 pounds. This may be compared with the 681 pounds caught in 1961-67 and 634 pounds caught in 1958-60. The weight of trout harvested has increased slightly in recent years. The species composition of the catch by weight was quite different, however. Brook trout fluctuated in numbers and these changes were probably related to the general decline in brook trout populations and the change in size limit. Brown trout changes were probably related to a general increase in the populations and the size limit change.

The brook trout catch of 9- and 10-inch or longer fish in 1976 was not significantly lower than catches during 1961-67 even though considerable numbers of 8-inch trout were also caught under the lower size limit (Table 13). The brook trout catch did drop significantly from 1958-60 to 1961-67, and this decrease occurred with no change in regulations. The catch of brown trout 10 inches and 12 inches or longer increased from 1961-67 to 1976 after the size limit was increased from 9 to 10 inches minimum length. Probably this increase should be attributed to a general increase in the brown trout population in the North Branch Au Sable rather than the increase in the size limit because increases also occurred from 1958-60 to 1961-67 with no regulation change. However, the anglers' catch was reduced about 40% in going from a 9-inch to a 10-inch size limit.

Catch per hour of trout. --The average catch per hour per angler by species is shown in Table 12. Trout were harvested at the rate of 0.153 fish per hour in 1976. This rate was similar to the catch per hour of 0.154 and 0.148 for 1958-60 and 1961-67 periods, respectively.

Trout populations. --Average numbers and pounds of trout per acre for the years 1957-60, 1961-67, and 1974-76 are given in Table 14. Total trout populations have increased over the last two decades in this segment of the river. Pounds of trout per acre present in the fall have increased from 70 pounds in 1957-60, to 73 pounds in 1961-67, to 84 pounds in 1974-76. The increase was due to population increases of brown trout. Their levels

went from 34 pounds in 1957-60, to 45 pounds in 1961-67, to 60 pounds in 1974-76. Brook trout stocks had nearly commensurate decreases. Their levels dropped from 36 pounds in 1957-60, to 28 pounds in 1961-67, to 24 pounds in 1974-76. Brown trout of all sizes have generally increased with a commensurate decrease in the number of brook trout (Table 14).

Trout growth. --Changes in trout growth are shown in Table 15 and in Figures 9 and 10. It appears that brown trout growth was greater in the 1957-60 period than the later periods, particularly for older trout (Fig. 9). Greatest growth difference occurred between the 1957-60 to 1961-67 periods. Whether growth changed after the 1961-67 period is questionable for this river segment, because the average size of age IV and V brown trout was lowest in 1961-67. Brook trout growth tended to be slightly better in the 1974-76 period (Fig. 10).

Trout survival. --Changes in the survival rate of trout are shown in Table 16 and in Figures 11 and 12. The brown trout survivorship curve changed significantly in 1974-76 compared to both 1961-67 and 1957-60 (Fig. 11). Survival was better for age I-II and age II-III brown trout in 1974-76, but it also appeared to be poorer for trout older than age III. A similar change in brown trout survival was pointed out in the Burton's Landing to Wakeley Bridge segment of the Main Au Sable (Fig. 4).

The survival rate of brook trout seems to have remained nearly the same over the three study periods (Fig. 12).

We believe that most of the increased standing crop (biomass) is due to brown trout replacement of the brook trout. Even though the total standing crops of trout are higher, we estimate that the production per year is only slightly higher. This is because the ratio of standing crop to trout production (turnover ratio) as noted by Alexander and Ryckman (1976), is lower for brown trout (1:1.4) than for brook trout (1:1.9). The moderate increase (about 11%) in standing crop may in part be due to an increase in fertility resulting from an increase in human habitation and development along the river.

All of the biological reasons for the brown trout increase and brook trout decrease are at present speculative. However, we feel that

the gradual demise of the brook trout has occurred through competition and predation by the brown trout (Alexander 1977).

North Branch Au Sable, Ranch to Eaman's Landing

Fishing regulations.--There were four changes in the fishing rules in this river segment between 1956 to 1976. However, the rules in force during the three time periods being compared in this report were: (1) in 1976, flies-only, creel limit of 5 trout, 8-inch size limit on brook trout, but 10-inch on brown and rainbow trout; (2) during 1961-67, any-lure, creel limit of 10 trout and a 7-inch size limit on all trout; and (3) during 1958-60, flies-only, creel limit of 5 trout and a 9-inch size limit on all trout.

Fishing pressure.--In 1976, fishing amounted to 13,234 hours (215 hours per acre) for this segment of the river (Table 17). Fishing pressure in 1976 was 43% higher than the 9,231 hours expended per year during the 1958-60 period. During both of these periods special regulations were in effect. Fishing pressure amounted to 16,829 hours (273 hours per acre) during the 1961-67 period when normal fishing regulations were in effect. Angler pressure is presently about 21% lower than in 1961-67.

Catch of trout.--In 1976, anglers harvested 1,329 trout (21.5 per acre). The average total catch per year during the 1958-60 period, which was also fished under the special regulations, amounted to 1,200 fish, thus the catch in 1976 was up 11%. However, a comparison of the 1976 catch to the 7,139 trout catch made on the average during the 1961-67 years, reveals a decrease of 81%. Obviously the type of fishing regulation influences significantly the number of trout caught. Comparing the catches by species under the various fishing rules shows that the brook trout catch was higher in 1976 than in 1958-60, probably an effect of the size limit changing from 9 to 8 inches (Table 17). The large difference between the 1976 catch of brook trout and the 1961-67 catch was probably due to the more liberal 7-inch size limit and any-lure regulation in 1961-67. Also the regulations had a profound effect on the catch of brown trout. The 1976 catch of brown trout was lower than the 1958-60 catch, probably because of the 9-inch

versus the 10-inch size limit. Further, the large catch of brown trout in 1961-67 was undoubtedly a result of the more liberal 7-inch size limit and any-lure regulations during those years.

The estimated number of legal size trout caught but released by anglers in this section was 742 fish, thus about 56% more legal trout were caught than kept. Like the other "quality" water sections of the Au Sable system this section apparently had a partial "catch-and-release" fishery.

Also included in Table 17 are the average sizes of trout by species for the various census years. The average length of all trout harvested in 1976 was 9.6 inches, which may be compared with the average of 8.9 inches for 1961-67 and the average 10.8 inches for 1958-60. The pattern of change in the average size of brook trout for the three study periods closely followed changes in the size regulations. Brown trout average was largest in the 1958-60 period when the size limit was 9 inches.

Again using the average weight and numbers of trout caught, we calculated the total weight of trout harvested in 1976 to be 433 pounds. This represents a decrease of 15% compared to the 509 pounds creeled in 1958-60. However, the 1976 catch in pounds was down by 77% when compared to the 2,213 pounds creeled in 1961-67. The weight of trout caught by species follows the pattern pointed out earlier in the discussion for trout numbers.

Further consideration of the possible effects of the regulation changes on brook trout showed that the catch of brook trout was dropping for all size groups--8-inch plus, 9-inch plus, and 10-inch plus (Table 18). Part of the change is related to the regulations, but probably much is due to the general population decrease of brook trout over the years. Larger catches of 10-inch plus and 12-inch plus brown trout were made during the 1958-60 and 1961-67 periods than in 1976 even though the minimum size limit was higher in the latter year. In this river section the more liberal 7-inch size limit in 1961-67 did not diminish the catch of larger brown trout, but rather it permitted a significant increase in catch of smaller trout.

Catch per hour of trout. --The average catch per hour of trout by species is shown in Table 17. Trout were harvested at the rate of 0.100 fish per hour in 1976. This rate is similar to 0.130 in 1958-60 under the special fishing regulations. However it is considerably below the 0.424 catch per hour achieved in 1961-67 under the normal fishing rules.

Trout populations. --Average numbers and pounds of trout per acre present in the fall for the years 1957-60, 1961-67, and 1974-76 are presented in Table 19. Trout populations have generally increased over the years in this segment of the river. Weight of trout present in 1957-60 averaged about 90 pounds per acre, in 1961-67 about 73 pounds per acre and in 1974-76 some 132 pounds per acre. Fall stocks of trout were lower during the 1961-67 period, but angler exploitation was much heavier during this period particularly on brook trout because of the liberal fishing regulations. Brook trout showed a steady decrease and brown trout a steady increase over these years of study. A consideration of the fall standing crop of brown and brook trout by size categories shows that nearly all sizes of brown trout have increased, and that most size categories of brook trout have decreased (Table 19). The greater standing crop of trout present in recent years is in part due to the species composition changing to more brown trout but fewer brook trout. The North Branch of the Au Sable may be gradually becoming more productive of trout because of additional nutrient input from man and his activities.

Trout growth. --Changes in trout growth are shown in Table 17 and Figures 13 and 14. It appears from Figure 13 that the growth of brown trout has decreased steadily since the 1957-60 period. Growth of brook trout appeared to be poorest during the 1961-67 period (Fig. 14) when this section was fished under normal angling regulations. Growth rates were very similar between the 1957-60 and 1974-76 periods when special regulations were in force. The heavy exploitation of brook trout in the 1961-67 period probably cropped off the faster growing brook trout, causing the apparent reduced growth rate.

Trout survival.--Changes in the survival of trout are shown in Table 16 and Figures 15 and 16. The brown trout survivorship curves changed considerably in 1974-76 compared to 1961-67 and 1957-60 (Fig. 15). Survival rate is presently better for age I-II and age II-III brown trout. It is also poorer for age III and older trout. This change in survival rate for the brown trout from the Eaman's Landing to Kellogg's Bridge segment of the North Branch is similar to the changes for the Burton's Landing to Wakeley Bridge segment of the Main Au Sable.

The survival rate of brook trout older than age 0 appears to have changed little over the years in this river segment (Fig. 16). Thus, lower brook trout populations are due to fewer births or much poorer survival of fish during their first growing season.

Discussion

It is difficult to evaluate data in terms of cause and effect when there are multiple variables and a paucity of experimental controls. Unfortunately this is the situation with much of the Au Sable River data. The known variables were: (1) numerous changes in fishing regulations with no experimental controls in most cases, (2) a likely trend of increasing fertility in the North Branch of the Au Sable and decreasing fertility in the Main Au Sable, (3) a stream improvement program in the Main Au Sable, (4) a variation in the numbers and kinds of hatchery-reared trout planted in the Main Au Sable, (5) a trend of increasing brown trout populations, and decreasing brook trout populations in both rivers, and (6) changes in fishing pressure. Notwithstanding these shortcomings, our conclusions are summarized herewith.

Brook trout populations have decreased in both the Main Au Sable and the North Branch of the Au Sable. The angler catch of brook trout has dropped and appears to be directly related to lower brook trout stocks. Survival rates of brook trout are unchanged for fall fingerlings (age 0) and older trout. Thus, possible causes for the reduced brook trout populations are: (1) lower trout fecundity, (2) reduced egg viability and hatch, and/or (3) lower survival of fry to fingerling age. Brook trout growth may have

decreased slightly in the Main Au Sable and increased slightly in the North Branch of the Au Sable. Interpretation of brook trout growth changes are difficult because of possible impacts from intensive angler removal of faster growing fish, on the "apparent growth rate."

Brown trout populations have generally increased except for the Burton's Landing to Wakeley Bridge segment of the Main Au Sable. In this river segment the number of brown trout was similar during the two time periods, but the total weight of trout present was considerably lower. Survival rates of brown trout changed. Generally, survival was better for age I through age III trout. This change may be a result of the higher size limits in force during recent years and the willingness of anglers to release many of the legal fish caught. However, the survival of trout older than age III appears to have decreased. Also, in the Burton's Landing to Wakeley Bridge segment of the Main Au Sable, the survival of age 0 to age I trout was reduced. Growth rates of brown trout did not change in the Grayling to Burton's Landing segment of the Main Au Sable, but were much poorer in the Burton's Landing to Wakeley Bridge segment. Brown trout growth decreased some in the sections of the North Branch of the Au Sable. The lower brown trout growth of the North Branch seemed to be inversely related to the magnitude of the brown trout population, but not on the Main Au Sable. However, changing fertility levels in these streams may have masked the growth relationships as they relate to trout density. Growth of brown trout was better in the Main Au Sable, both upstream and downstream where trout density was lower, than in the special regulation waters of Burton's Landing to Wakeley Bridge (White et al. 1975). Growth of trout was found to be slower in sections of the North Branch of the Au Sable being fished under more restrictive rules where trout densities were higher (Alexander and Ryckman 1976).

Wild rainbow trout were present only in significant numbers in the Burton's Landing to Wakeley Bridge segment of the Main Au Sable. In this section rainbow trout survival appears to have improved and growth rates have decreased following a similar pattern noted for brown trout. Stocks of hatchery rainbow trout for fishing were nearly eliminated from the upper segment of the Main Au Sable because of reduced hatchery trout stocking.

Angler use on these rivers has changed considerably. Fishing pressure in the lower Main Au Sable was probably reduced because of angler response to the more restrictive angling regulations (Shetter and Alexander 1952, 1966). However, part of the reduction must be related to an overall decrease in trout available, probably due to decreased stream fertility. Reduced planting of hatchery-reared fish in the upper river probably also played a part. Fishing pressure in the North Branch of the Au Sable increased when compared under similar special regulations. This increase probably was due to a general increase in trout stocks, which may be related to a progressive increase in stream fertility. However, the fishing regulations altered fishing pressure significantly under different fishing rules. For example, much higher angler use and catch occurred under the less restrictive angling rules (Shetter and Alexander 1966).

Total man-hours of boating and canoeing activity in the Main Au Sable was at approximately the same level of use in 1976 as in the early 1960's. However, there was a reduction in fishing from boats with a commensurate increase in purely recreational canoeing. Boating and canoeing activity on the North Branch of the Au Sable was not measured by the instantaneous counting procedure as done in the Main Au Sable. Thus no estimate of boating was computed. However, census clerks made notes on the boaters observed at the access sites. From these observations we judge that boating may have increased slightly on the North Branch, but boating is still probably under 1,000 hours per season for that part of the river under observation.

Fertility levels appear to have changed considerably in both rivers during the study period. The lower nutrient loading of the Main Au Sable decreased the growth of nuisance slimes, algae and macrophytes. Further, the minimum levels of dissolved oxygen have improved (Coopes 1974; Heckathorn 1977). Also, the diversity index of benthic macroinvertebrates increased between 1971 to 1973 (Gislason 1971; Reger 1973). A higher benthic diversity is an indicator of less nutrients and higher dissolved oxygen levels. The fall standing crop of trout has dropped from about 150 to 110 pounds per acre in the Burton's Landing to Wakeley Bridge segment

of the Main Au Sable, the former pollution recovery zone. The standing crop of trout increased from 11 to 21 pounds per acre in the Grayling to Burton's Landing segment, the former zone of pollution. These changes are believed to be due to the elimination of waste discharge into the river from the Grayling sewage treatment plant and the state fish hatchery at Grayling.

There is considerable evidence, supporting the hypothesis, of increased fertility loading of the North Branch of the Au Sable. The trout standing crops have increased. Much development has occurred as cited in this paper. Further, Curry (1958) found few Isopoda (aquatic sow bugs) in the benthos and trout stomachs. The trout and benthos samples at present contain many more isopods (an organic population indicator organism) particularly in the river below Lovells (Alexander and Gowing 1976; Alexander, unpublished).

Extensive "stream improvement" on the Main Au Sable, to date has demonstrated no measurable improvement in either fishing or trout stocks. Hunt (1969) demonstrated significant benefits from his stream improvement activities on a small Wisconsin stream. However, Hunt's treatment levels were much more intensive, in that he narrowed the stream width significantly and altered a larger portion of the total stream environment.

In summary: we have documented the magnitude of angling effort, catch and trout population characteristics for nearly two decades. However, in most instances we have not been able to determine the causes for changes in the fisheries or trout populations because of the many uncontrolled variables.

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Table 1.--Au Sable River study locations (with stream acreage and mileage) and fishing regulations.

Location, and year	Season	Size limit			Creel limit	Lure
		Brook	Brown	Rainbow		
Main Au Sable River						
Grayling to Burton's Landing (65.5 acres, 5.6 miles)						
1955-68	Regular[a]	7	7	7	10	Any
1969-76	Regular[b]	7	10	10	5, plus 5 additional brook trout	Any
Burton's Landing to Wakeley Bridge (99.8 acres, 8.7 miles)						
1955-63	Regular	10	10	10	5	Flies
1964-68	Regular and fall[c]	10	10	10	5	Flies
1969-72	Regular and fall[d]	7	10	10	5	Flies
1973	Regular and fall	7	12	12	3	Flies
1974	Regular and fall	8	12	12	3	Flies
1975	Winter[e]				no kill	Flies
1975	Regular and fall	8	12	12	3	Flies
1976	Regular and fall	8	12	12	3	Flies
1976	Remainder of year				no kill	Flies
North Branch Au Sable River						
Ranch to Eaman's Landing (61.7 acres, 4.8 miles)						
1956-60	Regular	9	9	9	5	Flies
1961-68	Regular	7	7	7	10	Any
1969-72	Regular	7	10	10	5, plus 5 additional brook trout	Any
1973	Regular and fall[d]	7	10	10	5	Flies
1974-76	Regular and fall	8	10	10	5	Flies
Eaman's Landing to Kellogg Bridge (117.3 acres, 8.7 miles)						
1956-67	Regular	9	9	9	5	Flies
1968	Regular and fall[c]	9	9	9	5	Flies
1969-73	Regular and fall[d]	7	10	10	5	Flies
1974-76	Regular and fall	8	10	10	5	Flies

[a] Last Saturday in April to second Sunday in September.

[b] Last Saturday in April through September.

[c] Fall season extends regular season 30 days.

[d] Fall season extends through October.

[e] From January 1, 1975 to April 25, 1975.

Table 2.--Average hours of fishing done by wading, bank, and boat anglers and total hours of recreational boating in the Burton's Landing to Wakeley Bridge segment of the Main Au Sable River for the years 1960-65 and 1976. (Per acre values in parentheses)

Year	Hours			
	Wading and bank fishing	Boat fishing	Total fishing	Total boating
1960-65	31,476 (315)	11,543 (116)	43,019 (431)	68,596 (687)
1976	26,503 (266)	4,041 (40)	30,544 (306)	55,112 (552)

Table 3.--Average total catch, catch per acre, length of trout caught, and catch per hour, by species, from the Burton's Landing to Wakeley Bridge segment of the Main Au Sable River for the years 1960-65 and 1976.

Year	Species of trout			Total
	Brook	Brown	Rainbow	
		Total catch		
1960-65	421	5,840	186	6,447
1976	526	439	58	1,023
		Catch per acre		
1960-65	4.2	58.5	1.9	64.6
1976	5.3	4.4	0.6	10.3
		Total length in inches		
1960-65	10.4	11.5	10.6	11.4
1976	8.8	12.8	12.2	10.7
		Catch per hour		
1960-65	0.010	0.136	0.004	0.150
1976	0.017	0.014	0.002	0.033

Table 4.--Average catch of brook, brown and rainbow trout, by length group, from the Burton's Landing to Wakeley Bridge segment of the Main Au Sable River for the years 1960-65 and 1976.

Year	Brook trout		Brown and rainbow trout	
	8-inch plus	10-inch plus	10-inch plus	12-inch plus
1960-65	---	421	6,026	1,756
1976	526	117	---	497

Table 5.--Average number and weight in pounds (in parentheses) of trout per acre by length group, in the fall, for the years 1959-63 and 1974-76 in the Burton's Landing to Wakeley Bridge segment of the Main Au Sable River.

Inch group	Year and trout species							
	1959-63				1974-76			
	Brown	Brook	Rainbow	Total	Brown	Brook	Rainbow	Total
2	15.1 (0.09)	36.0 (0.22)	103.4 (0.62)	154.5 (0.93)	77.8 (0.47)	69.3 (0.42)	74.7 (0.45)	221.8 (1.34)
3	142.3 (1.99)	205.5 (3.29)	115.7 (1.62)	463.5 (6.90)	189.2 (2.65)	104.2 (1.67)	39.6 (0.55)	333.0 (4.87)
4	167.4 (5.19)	90.2 (2.89)	35.0 (1.08)	292.6 (9.16)	122.8 (3.81)	15.9 (0.51)	1.8 (0.06)	140.5 (4.38)
5	21.1 (1.20)	26.4 (1.58)	0.3 (0.02)	47.8 (2.80)	30.0 (1.71)	13.1 (0.78)	2.1 (0.12)	45.2 (2.61)
6	36.8 (3.35)	25.1 (2.51)	0.2 (0.02)	62.1 (5.88)	63.5 (5.78)	12.9 (1.29)	5.7 (0.52)	82.1 (7.59)
7	79.5 (11.53)	25.9 (3.88)	1.3 (0.18)	106.7 (15.59)	63.4 (9.19)	7.3 (1.10)	5.0 (0.72)	75.7 (11.01)
8	87.5 (18.38)	15.0 (3.30)	1.9 (0.39)	104.4 (22.07)	44.2 (9.28)	2.1 (0.47)	1.3 (0.26)	47.6 (10.01)
9	46.0 (13.33)	5.6 (1.71)	1.0 (0.29)	52.6 (15.33)	53.7 (15.57)	1.0 (0.30)	2.2 (0.64)	56.9 (16.51)
10	37.7 (14.71)	1.2 (0.50)	0.5 (0.20)	39.4 (15.41)	56.4 (21.98)	0.1 (0.04)	1.3 (0.52)	57.8 (22.54)
11	24.3 (12.44)	---	---	24.3 (12.44)	31.1 (15.91)	---	0.7 (0.35)	31.8 (16.26)
12	20.8 (13.87)	---	0.1 (0.05)	20.9 (13.92)	13.0 (8.65)	---	0.9 (0.57)	13.9 (9.22)
13	11.4 (9.57)	---	---	11.4 (9.57)	3.0 (2.56)	---	0.1 (0.08)	3.1 (2.64)
14	9.7 (10.09)	---	---	9.7 (10.09)	1.0 (1.01)	---	---	1.0 (1.01)
15	3.5 (4.39)	---	---	3.5 (4.39)	1.4 (1.84)	---	---	1.4 (1.84)
16+	5.0 (9.16)	---	---	5.0 (9.16)	0.6 (1.07)	---	---	0.6 (1.07)
Total	708.1 (129.29)	430.9 (19.88)	259.4 (4.47)	1398.4 (153.64)	751.1 (101.48)	225.9 (6.58)	135.4 (4.84)	1112.4 (112.90)

Table 6.--Average total length of trout in October, by species and age group, in segments of the Main Au Sable River.

Species and year	Age group 0	I	II	III	IV	V
Burton's Landing to Wakeley Bridge						
Brown trout						
1959-63	4.0	7.9	10.7	13.6	16.6	19.0
1974-76	3.6	6.9	9.3	11.2	13.5	15.8
Brook trout						
1959-63	3.7	6.4	9.0	10.1	11.5	---
1974-76	3.2	6.4	8.8	10.0	11.2	---
Rainbow trout						
1959-63	3.2	7.8	9.7	12.5	---	---
1974-76	2.9	6.8	9.8	11.6	12.7	---
Grayling to Burton's Landing						
Brown trout						
1959-63	3.5	8.1	11.4	14.2	17.1	---
1972	4.4	8.1	11.4	14.2	16.2	18.0
Brook trout						
1959-63	5.5	8.0	---	---	---	---
1972	5.2	7.2	---	---	---	---
Rainbow trout						
1959-63	---	8.8	---	---	---	---
1972	---	---	---	---	---	---

Table 7.--Number of trout per acre by species and age group in segments of the Main Au Sable.

Species and year	Age group 0	I	II	III	IV	V	Total
Burton's Landing to Wakeley Bridge							
Brown trout							
1959-63	336.7	235.6	100.5	28.7	5.8	0.6	708.1
1974-76	396.8	154.3	113.9	80.0	5.5	0.8	751.1
Brook trout							
1959-63	324.0	93.0	13.2	0.7	...	...	430.9
1974-76	190.8	32.1	3.0	...	...	...	225.9
Rainbow trout							
1959-63	253.5	53.0	0.5	0.1	...	...	259.4
1974-76	115.7	14.1	3.9	1.2	0.5	...	135.4
Grayling to Burton's Landing							
Brown trout							
1959-63	14.9	16.7	6.9	2.0	0.7	...	41.2
1972	3.3	16.4	19.1	6.4	0.8	0.1	46.1
Brook trout							
1959-63	0.3	0.2	...	...	...	...	0.5
1972	0.7	0.4	...	...	...	...	1.1
Rainbow trout							
1959-63	...	0.3	...	...	...	...	0.3
1972	...	...	...	...	...	...	...

Table 8.--Average hours of fishing done by wading, bank, and boat anglers and total hours of recreational boating in the Grayling to Burton's Landing segment of the Main Au Sable River for the years 1960-63 and 1976. (Per acre values in parentheses)

Year	Hours			
	Wading and bank fishing	Boat fishing	Total fishing	Total boating
1960-63	7,475 (114)	5,130 (78)	12,605 (192)	53,032 (809)
1976	4,410 (67)	1,141 (18)	5,551 (85)	63,703 (972)

Table 9.--Average total catch, catch per acre, length of trout caught, and catch per hour, by species, from the Grayling to Burton's Landing segment of the Main Au Sable River for the years 1960-63 and 1976.

Year	Species of trout			Total
	Brook	Brown	Rainbow	
		Total catch		
1960-63	705	1,371	780	2,856
1976	372	628	0	1,000
		Catch per acre		
1960-63	10.8	20.9	11.9	43.6
1976	5.7	9.6	0.0	15.3
		Total length in inches		
1960-63	8.0	11.2	9.6	9.9
1976	8.4	12.8	---	11.2
		Catch per hour		
1960-63	0.056	0.109	0.062	0.227
1976	0.067	0.113	0.000	0.180

Table 10. --Average catch of brook, brown and rainbow trout, by length group, from the Grayling to Burton's Landing segment of the Main Au Sable River for the years 1960-63 and 1976.

Year	Brook trout		Brown and rainbow trout		
	7-inch plus	10-inch plus	7-inch plus	10-inch plus	12-inch plus
1960-63	705	15	2,151	912	458
1976	372	20	---	628	392

Table 11.--Average number and weight in pounds (in parentheses) of trout per acre by length group, in the fall, for the years 1959-63 and 1972 in the Grayling to Burton's Landing segment of the Main Au Sable River.

Inch group	Year and trout species							
	1959-63				1972			
	Brown	Brook	Rainbow	Total	Brown	Brook	Rainbow	Total
2	---	---	---	---	---	---	---	---
3	1.8 (0.02)	0.1 (tr)	---	1.9 (0.02)	0.2 (tr)	---	---	0.2 (tr)
4	12.0 (0.37)	---	---	12.0 (0.37)	2.6 (0.08)	0.3 (tr)	---	2.9 (0.08)
5	1.3 (0.07)	---	---	1.3 (0.07)	---	0.3 (0.01)	---	0.3 (0.01)
6	0.7 (0.07)	0.2 (0.02)	---	0.9 (0.09)	2.3 (0.21)	0.2 (0.01)	---	2.5 (0.22)
7	7.4 (1.08)	0.1 (0.01)	---	7.5 (1.09)	6.6 (0.96)	0.3 (0.03)	---	6.9 (0.99)
8	6.0 (1.26)	0.1 (0.01)	0.2 (0.04)	6.3 (1.31)	4.1 (0.87)	---	---	4.1 (0.87)
9	2.9 (0.85)	---	0.1 (0.01)	3.0 (0.86)	1.7 (0.49)	---	---	1.7 (0.49)
10	2.3 (0.88)	---	---	2.3 (0.88)	8.5 (3.31)	---	---	8.5 (3.31)
11	1.6 (0.80)	---	---	1.6 (0.80)	7.4 (3.76)	---	---	7.4 (3.76)
12	2.4 (1.59)	---	---	2.4 (1.59)	1.7 (1.13)	---	---	1.7 (1.13)
13	0.9 (0.73)	---	---	0.9 (0.73)	5.4 (4.51)	---	---	5.4 (4.51)
14	0.6 (0.58)	---	---	0.6 (0.58)	1.8 (1.92)	---	---	1.8 (1.92)
15	0.3 (0.33)	---	---	0.3 (0.33)	1.6 (1.98)	---	---	1.6 (1.98)
16+	1.0 (1.78)	---	---	1.0 (1.78)	1.1 (1.96)	---	---	1.1 (1.96)
Total	41.2 (10.41)	0.5 (0.04)	0.3 (0.05)	42.0 (10.50)	45.0 (21.18)	1.1 (0.05)	0.0	46.1 (21.23)

Table 12.--Average total catch, catch per acre, length of trout caught, and catch per hour, by species, and fishing hours, from the Eaman's Landing to Kellogg's Bridge segment of the North Branch Au Sable River for the years 1958-60, 1961-67, and 1976.

Year	Species of trout			Fishing hours
	Brook	Brown	Total	
		Total catch		
1958-60	462	948	1,410	9,151
1961-67	194	1,434	1,628	11,005
1976	578	1,123	1,701	11,110
		Catch per acre		Per acre
1958-60	3.9	8.1	12.0	78.0
1961-67	1.7	12.2	13.9	93.8
1976	4.9	9.6	14.5	94.7
		Total length in inches		
1958-60	9.5	11.5	10.7	
1961-67	9.0	10.7	10.5	
1976	8.8	11.3	10.4	
		Catch per hour		
1958-60	0.050	0.104	0.154	
1961-67	0.018	0.130	0.148	
1976	0.052	0.101	0.153	

Table 13. --Average catch of brook and brown trout, by length group, from the Eaman's Landing to Kellogg's Bridge segment of the North Branch Au Sable River for the years 1958-60, 1961-67, and 1976.

Year	Brook trout			Brown trout		
	8-inch plus	9-inch plus	10-inch plus	9-inch plus	10-inch plus	12-inch plus
1958-60	---	462	101	948	696	237
1961-67	---	194	6	1,434	842	281
1976	578	187	34	---	1,123	391

Table 14.--Average number and weight in pounds (in parentheses) of trout per acre by length group, in the fall, for the years 1957-60, 1961-67 and 1974-76, in the Eaman's Landing to Kellogg's Bridge segment of the North Branch Au Sable River.

Inch group	Year and trout species								
	1957-60			1961-67			1974-76		
	Brown	Brook	Total	Brown	Brook	Total	Brown	Brook	Total
2	16.7 (0.10)	248.4 (1.49)	265.1 (1.59)	28.5 (0.17)	159.0 (0.95)	187.5 (1.12)	36.0 (0.22)	124.1 (0.74)	160.1 (0.96)
3	179.6 (2.51)	546.7 (8.75)	726.3 (11.26)	254.9 (3.57)	439.7 (7.03)	694.6 (10.60)	243.2 (3.40)	346.0 (5.54)	589.2 (8.94)
4	126.7 (3.93)	119.5 (3.82)	246.2 (7.75)	131.7 (4.08)	88.8 (2.84)	220.5 (6.92)	180.5 (5.59)	100.8 (3.22)	281.3 (8.81)
5	11.6 (0.66)	54.8 (3.29)	66.4 (3.95)	4.9 (0.28)	46.0 (2.76)	50.9 (3.04)	10.4 (0.59)	17.2 (1.03)	27.6 (1.62)
6	6.4 (0.58)	75.7 (7.57)	82.1 (8.15)	15.6 (1.42)	51.9 (5.19)	67.5 (6.61)	15.7 (1.43)	28.4 (2.84)	44.1 (4.27)
7	26.0 (3.78)	43.4 (6.51)	69.4 (10.29)	41.6 (6.03)	36.6 (5.49)	78.2 (11.52)	39.4 (5.71)	39.0 (5.84)	78.4 (11.55)
8	29.0 (6.09)	16.3 (3.59)	45.3 (9.68)	32.9 (6.90)	13.4 (2.95)	46.3 (9.85)	41.9 (8.80)	13.7 (3.01)	55.6 (11.81)
9	15.4 (4.47)	3.0 (0.91)	18.4 (5.38)	14.3 (4.15)	2.9 (0.88)	17.2 (5.03)	16.7 (4.84)	4.7 (1.43)	21.4 (6.27)
10	4.4 (1.72)	0.5 (0.20)	4.9 (1.92)	10.1 (3.94)	0.3 (0.11)	10.4 (4.05)	17.3 (6.75)	0.8 (0.32)	18.1 (7.07)
11	7.1 (3.61)	---	7.1 (3.61)	10.7 (5.45)	0.1 (0.03)	10.8 (5.48)	15.5 (7.93)	0.1 (0.03)	15.6 (7.96)
12	2.1 (1.37)	0.1 (0.03)	2.2 (1.40)	4.8 (3.17)	0.1 (0.04)	4.9 (3.21)	8.7 (5.76)	---	8.7 (5.76)
13	1.5 (1.23)	---	1.5 (1.23)	2.8 (2.39)	---	2.8 (2.39)	4.8 (4.07)	---	4.8 (4.07)
14	0.9 (0.98)	---	0.9 (0.98)	1.0 (1.08)	---	1.0 (1.08)	2.6 (2.65)	---	2.6 (2.65)
15	0.5 (0.67)	---	0.5 (0.67)	0.6 (0.76)	---	0.6 (0.76)	0.5 (0.61)	---	0.5 (0.61)
16+	1.3 (2.39)	---	1.3 (2.39)	0.7 (1.26)	---	0.7 (1.26)	0.8 (1.55)	---	0.8 (1.55)
Total	429.2 (34.09)	1108.4 (36.16)	1537.6 (70.25)	555.1 (44.65)	838.8 (28.27)	1393.9 (72.92)	634.0 (59.90)	674.8 (24.00)	1308.8 (83.90)

Table 15.--Average total length of trout in October, by species and age group, in segments of the North Branch Au Sable River.

Species and year	Age group 0	I	II	III	IV	V
Eaman's Landing to Kellogg's Bridge						
Brown trout						
1957-60	3.9	8.1	11.1	14.6	16.8	19.2
1961-67	3.8	7.8	10.7	12.8	14.6	17.1
1974-76	3.7	7.7	9.9	12.2	15.2	18.5
Brook trout						
1957-60	3.4	6.4	8.4	9.3	12.5	---
1961-67	3.4	6.3	8.2	10.2	12.5	---
1974-76	3.5	7.0	9.1	10.5	12.1	---
Ranch to Eaman's Landing						
Brown trout						
1957-60	4.2	8.8	12.2	14.5	17.0	19.0
1961-67	3.7	8.2	11.6	13.5	15.8	18.0
1974-76	4.0	8.1	11.0	13.0	15.3	17.5
Brook trout						
1957-60	3.7	7.1	8.9	11.2	12.5	---
1961-67	3.4	6.7	8.1	9.8	12.2	---
1974-76	3.6	7.3	9.0	11.2	12.5	---

Table 16. --Number of trout per acre by species and age group in segments of the North Branch Au Sable River.

Species and year	Age group 0	I	II	III	IV	V	Total
Eaman's Landing to Kellogg's Bridge							
Brown trout							
1957-60	332.7	76.2	16.8	2.7	0.4	0.4	429.2
1961-67	417.5	100.7	29.3	5.4	1.4	0.8	555.1
1974-76	467.6	94.7	41.2	28.1	2.1	0.3	634.0
Brook trout							
1957-60	911.8	180.1	15.8	0.6	0.1	...	1,108.4
1961-67	680.1	141.2	17.0	0.4	0.1	...	838.8
1974-76	573.5	91.1	10.1	0.1	...	...	674.8
Ranch to Eaman's Landing							
Brown trout							
1957-60	205.2	49.0	18.2	5.1	3.0	1.8	282.3
1961-67	193.0	63.7	29.0	6.5	2.7	1.9	296.8
1974-76	360.9	111.7	70.4	48.4	9.5	1.3	602.2
Brook trout							
1957-60	943.2	177.3	14.3	0.3	0.1	...	1,135.2
1961-67	738.8	119.6	12.4	0.3	...	...	871.1
1974-76	374.0	59.3	7.4	0.2	0.1	...	441.0

Table 17. --Average total catch, catch per acre, length of trout caught, and catch per hour, by species, and fishing hours, from the Ranch to Eaman's Landing segment of the North Branch Au Sable River for the years 1958-60, 1961-67, and 1976.

Year	Species of trout			Fishing hours
	Brook	Brown	Total	
		Total catch		
1958-60	532	668	1,200	9,231
1961-67	4,743	2,396	7,139	16,829
1976	853	476	1,329	13,234
		Catch per acre		Per acre
1958-60	8.6	10.8	19.4	149.7
1961-67	76.9	38.8	115.7	272.8
1976	13.8	7.7	21.5	214.6
		Total length in inches		
1958-60	9.5	11.5	10.8	
1961-67	7.9	10.7	8.9	
1976	8.8	11.2	9.6	
		Catch per hour		
1958-60	0.058	0.072	0.130	
1961-67	0.282	0.142	0.424	
1976	0.064	0.036	0.100	

Table 18.--Average catch of brook and brown trout, by length group, from the Ranch to Eaman's Landing segment of the North Branch Au Sable River for the years 1958-60, 1961-67, and 1976.

Year	Brook trout				Brown trout			
	7-inch plus	8-inch plus	9-inch plus	10-inch plus	7-inch plus	9-inch plus	10-inch plus	12-inch plus
1958-60	---	---	532	126	---	668	581	162
1961-67	4,743	2,026	507	131	2,396	1,870	1,357	515
1976	---	853	295	98	---	---	476	99

Table 19.--Average number and weight in pounds (in parentheses) of trout per acre by length group, in the fall, for the years 1957-60, 1961-67 and 1974-76, in the Ranch to Eaman's Landing segment of the North Branch Au Sable River.

Inch group	Year and trout species								
	1957-60			1961-67			1974-76		
	Brown	Brook	Total	Brown	Brook	Total	Brown	Brook	Total
2	1.1 (0.01)	127.5 (0.76)	128.6 (0.77)	21.9 (0.13)	157.3 (0.94)	179.2 (1.07)	7.1 (0.02)	52.2 (0.31)	59.3 (0.33)
3	67.2 (0.94)	555.4 (8.89)	622.6 (9.83)	106.5 (1.49)	467.1 (7.47)	573.6 (8.96)	170.5 (2.39)	227.3 (3.64)	397.8 (6.03)
4	127.9 (3.96)	266.7 (8.53)	394.6 (12.49)	63.5 (1.97)	111.0 (3.55)	174.5 (5.52)	175.7 (5.45)	89.3 (2.86)	265.0 (8.31)
5	9.7 (0.56)	30.2 (1.81)	39.9 (2.37)	1.7 (0.10)	31.2 (1.87)	32.9 (1.97)	8.0 (0.46)	8.4 (0.50)	16.4 (0.96)
6	1.4 (0.13)	25.8 (2.58)	27.2 (2.71)	5.0 (0.45)	46.7 (4.67)	51.7 (5.12)	8.8 (0.80)	13.9 (1.39)	22.7 (2.19)
7	5.8 (0.84)	70.5 (10.57)	76.3 (11.41)	20.2 (2.93)	44.8 (6.72)	65.0 (9.65)	38.2 (5.54)	27.5 (4.12	65.7 (9.66)
8	19.3 (4.04)	50.6 (11.13)	69.9 (15.17)	28.7 (6.02)	11.1 (2.44)	39.8 (8.46)	47.7 (10.01)	17.9 (3.93)	65.6 (13.94)
9	19.7 (5.72)	6.5 (1.98)	26.2 (7.70)	9.6 (2.78)	1.6 (0.49)	11.2 (3.27)	28.2 (8.18)	3.4 (1.03)	31.6 (9.21)
10	6.2 (2.41)	1.1 (0.45)	7.3 (2.86)	8.0 (3.10)	0.3 (0.12)	8.3 (3.22)	28.0 (10.94)	0.8 (0.32)	28.8 (11.26)
11	5.4 (2.78)	0.8 (0.41)	6.2 (3.19)	8.9 (4.55)	tr (0.01)	8.9 (4.56)	31.6 (16.13)	---	31.6 (16.13)
12	6.2 (4.12)	0.1 (0.03)	6.3 (4.15)	9.7 (6.46)	tr (0.01)	9.7 (6.47)	20.4 (13.57)	0.3 (0.23)	20.7 (13.80)
13	3.3 (2.79)	---	3.3 (2.79)	6.1 (5.10)	tr (0.01)	6.1 (5.11)	16.9 (14.16)	---	16.9 (14.16)
14	2.4 (2.52)	---	2.4 (2.52)	2.5 (2.64)	---	2.5 (2.64)	13.0 (13.55)	---	13.0 (13.55)
15	0.9 (1.16)	---	0.9 (1.16)	1.7 (2.13)	---	1.7 (2.13)	4.8 (6.05)	---	4.8 (6.05)
16+	5.8 (10.77)	---	5.8 (10.77)	2.8 (5.12)	---	2.8 (5.12)	3.3 (6.12)	---	3.3 (6.12)
Total	282.3 (42.75)	1135.2 (47.14)	1417.5 (89.89)	296.8 (44.97)	871.1 (28.30)	1167.9 (73.27)	602.2 (113.37)	441.0 (18.33)	1043.2 (131.70)

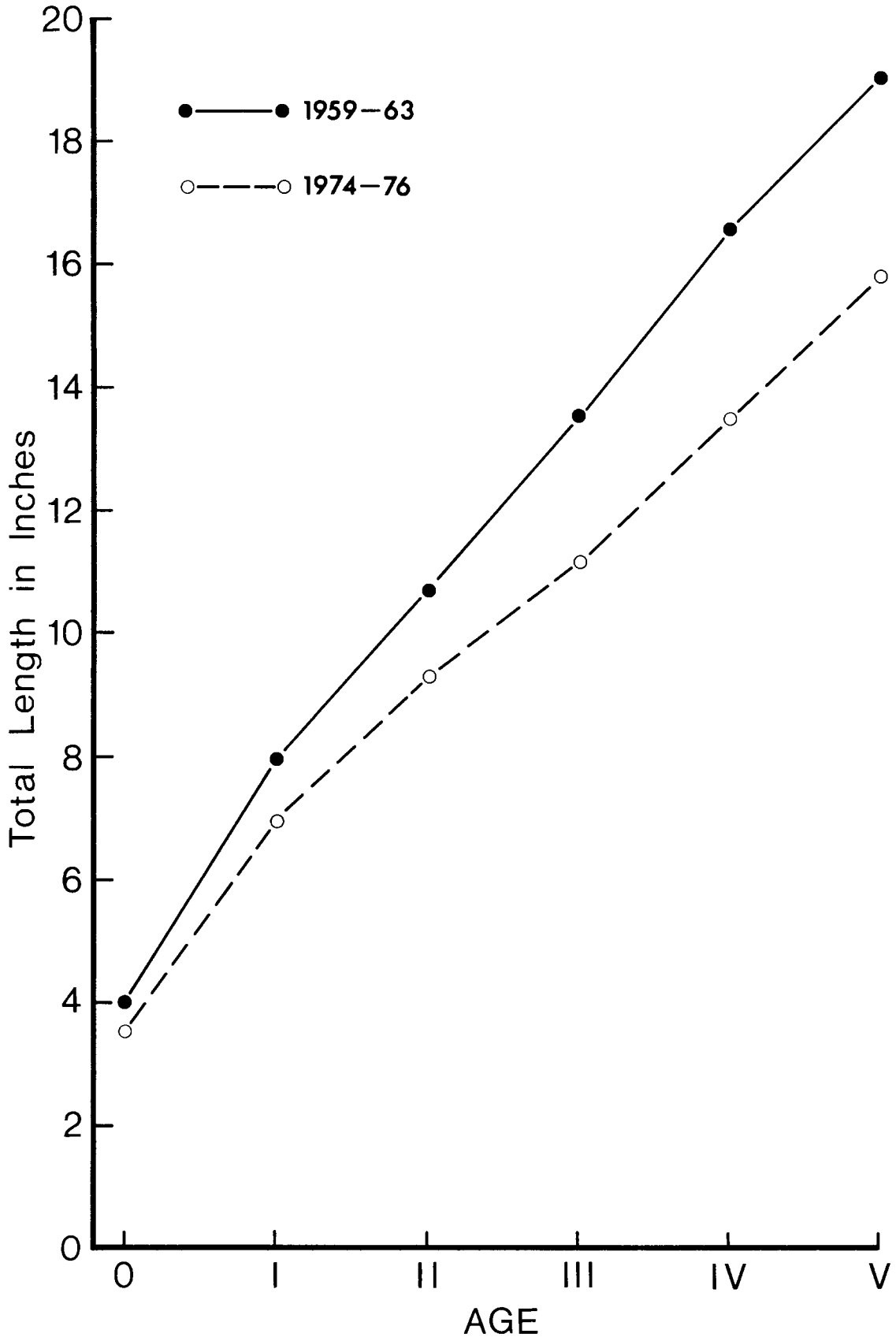

Figure 1.--Average length of brown trout of various ages in the Main Au Sable River from Burton's Landing to Wakeley Bridge in October 1959-63 and 1974-76.

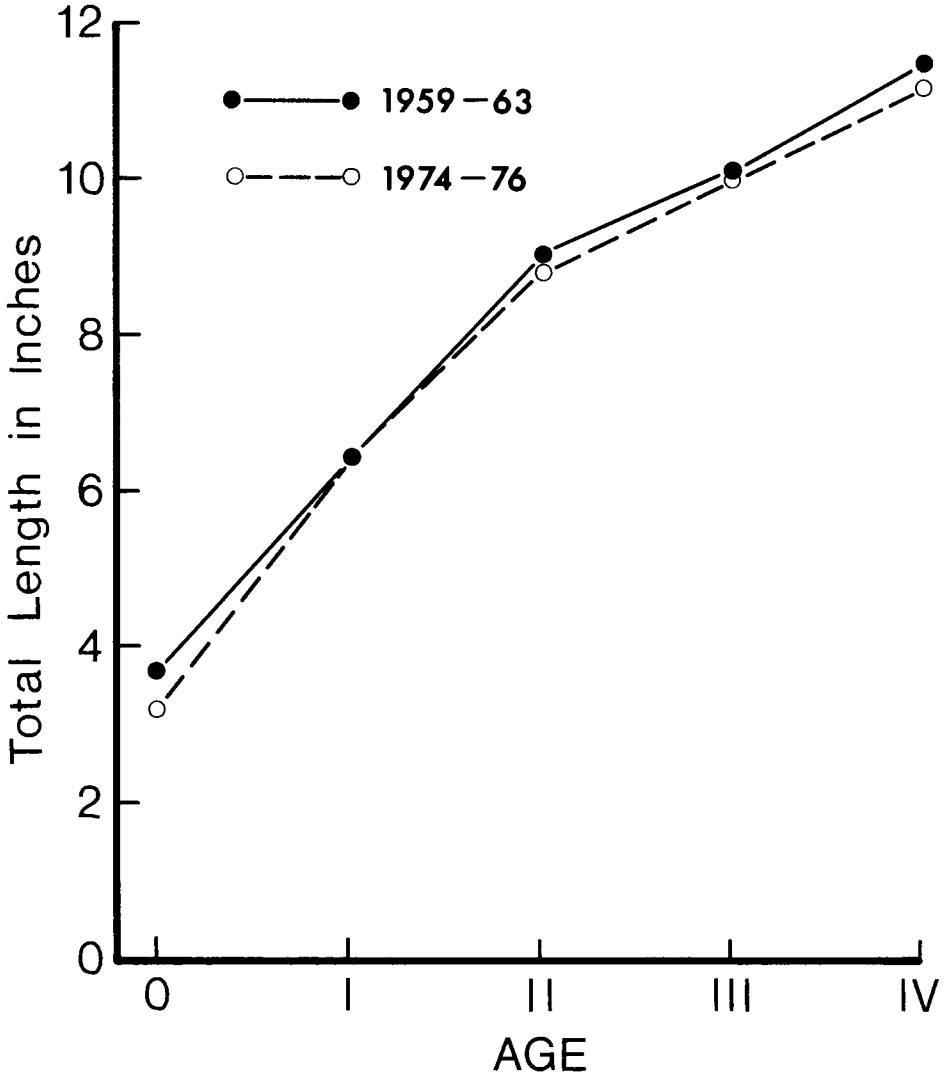

Figure 2.--Average length of brook trout of various ages in the Main Au Sable River from Burton's Landing to Wakeley Bridge in October 1959-63 and 1974-76.

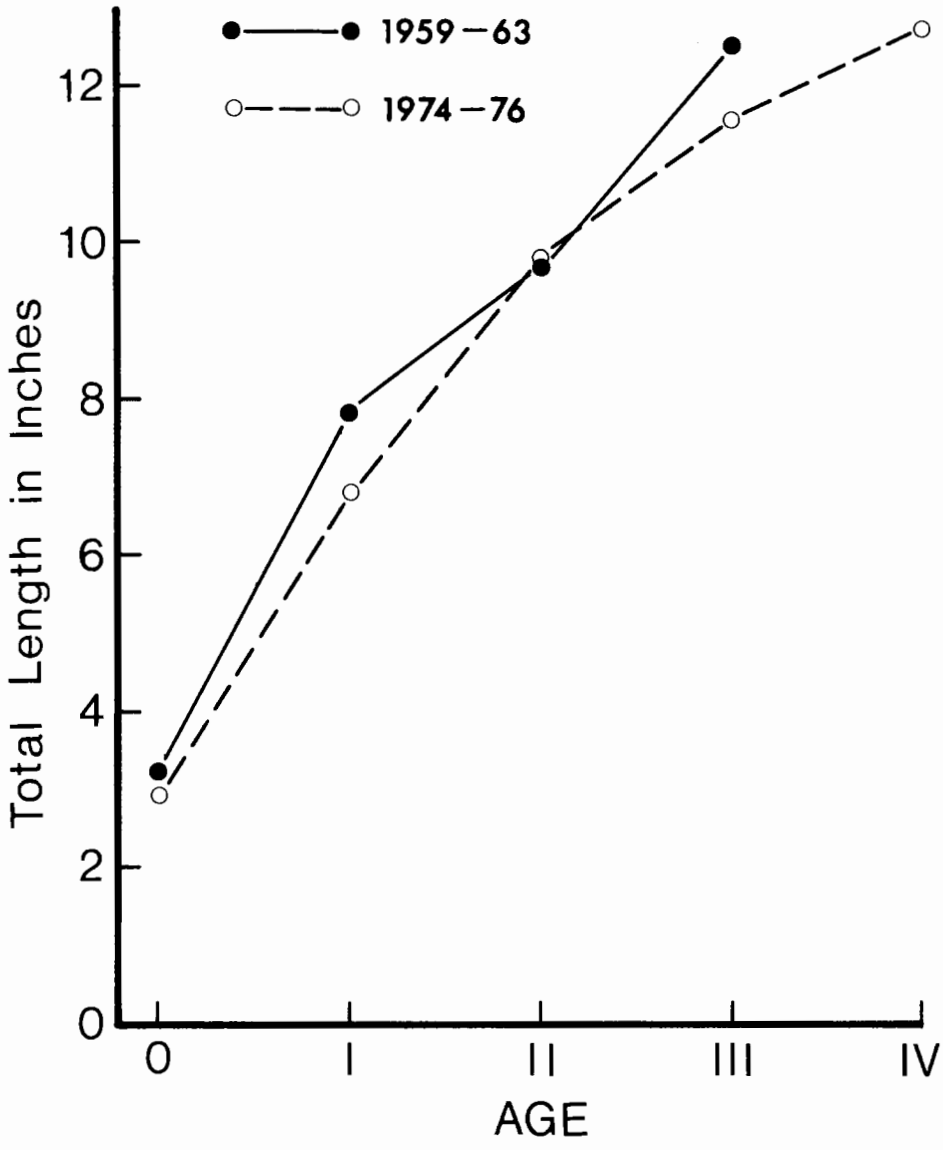

Figure 3.--Average length of rainbow trout of various ages in the Main Au Sable River from Burton's Landing to Wakeley Bridge in October 1959-63 and 1974-76.

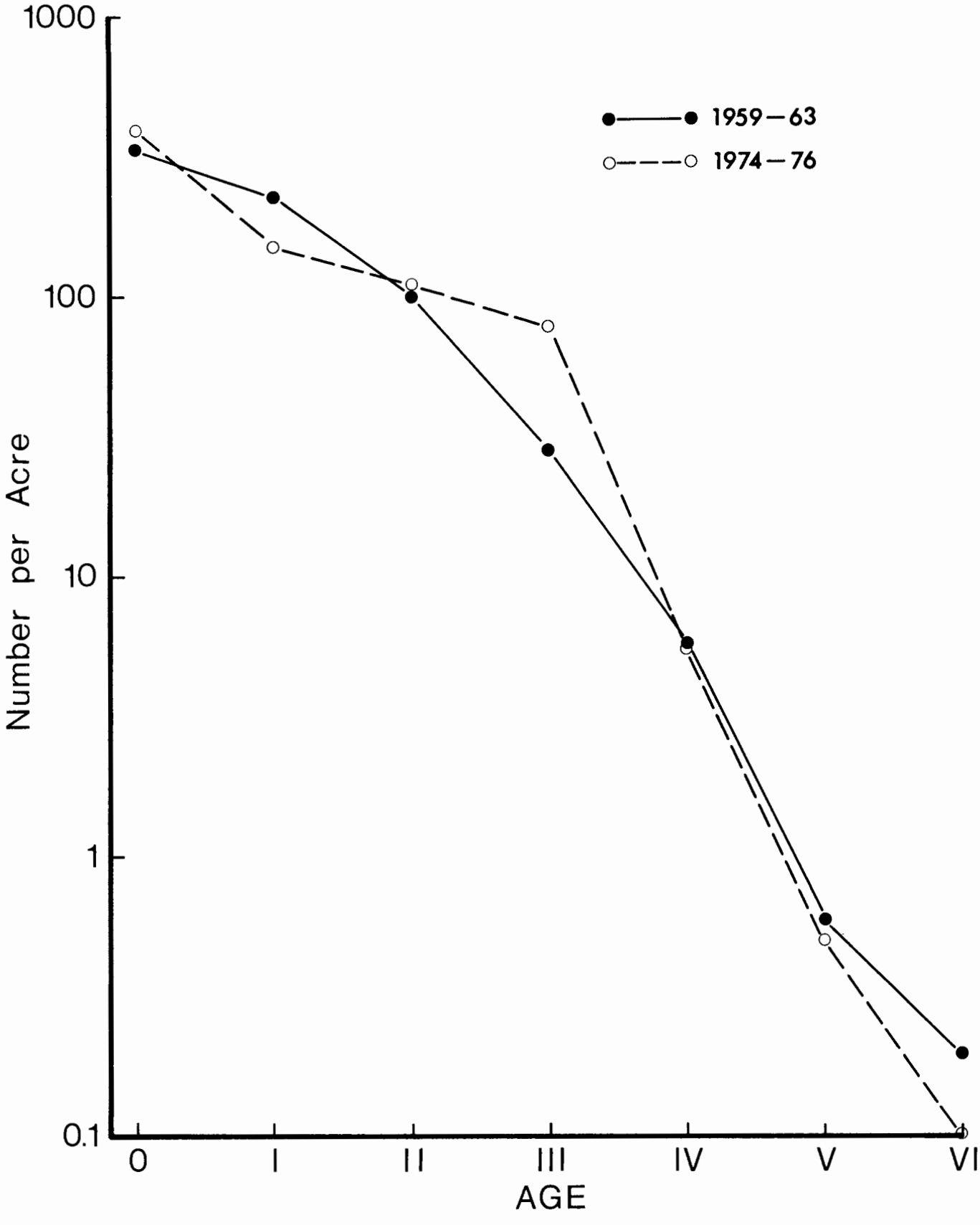

Figure 4.--Number per acre of brown trout of various ages in the Main Au Sable River from Burton's Landing to Wakeley Bridge in October 1959-63 and 1974-76.

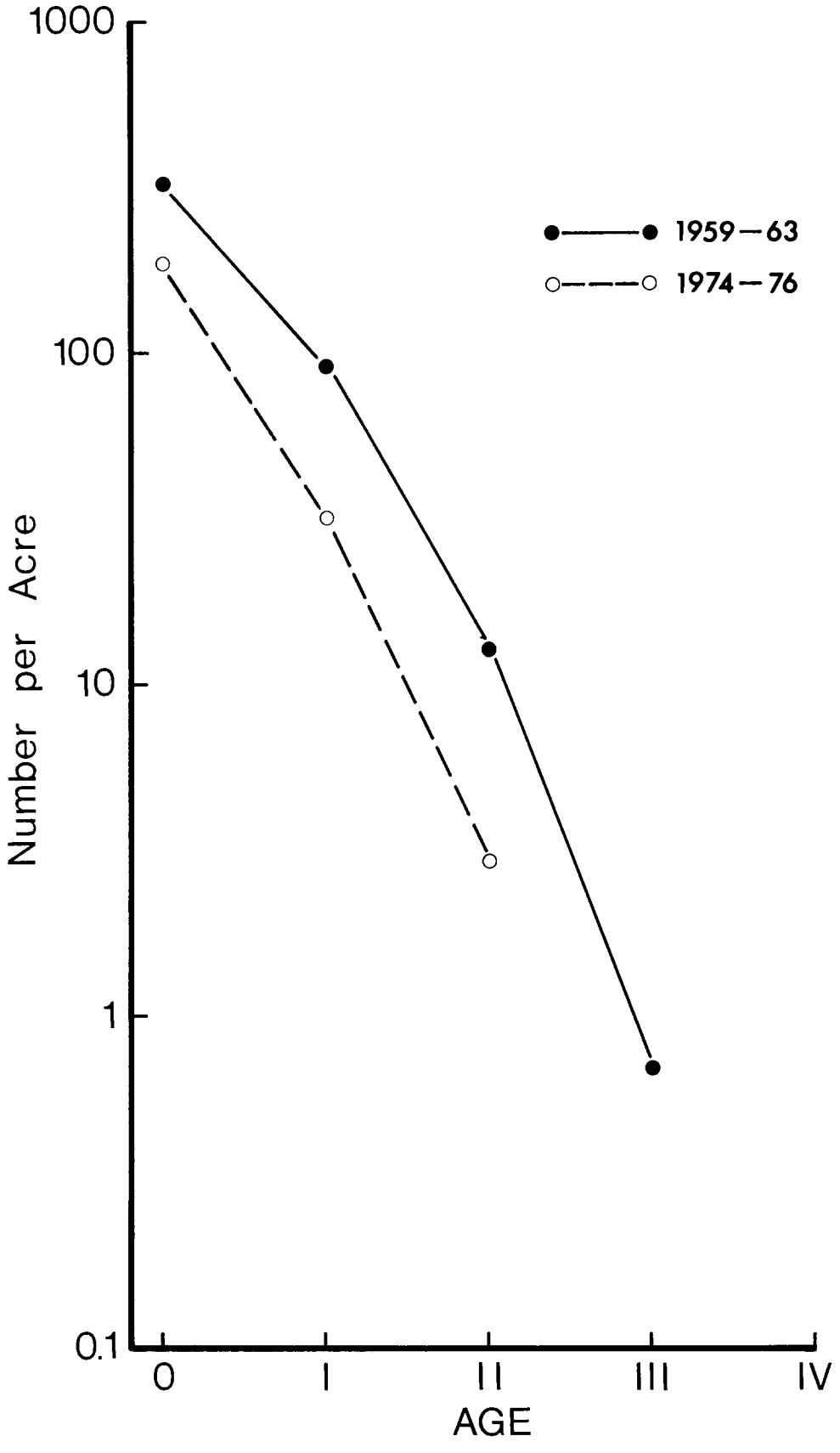

Figure 5.--Number per acre of brook trout of various ages in the Main Au Sable River from Burton's Landing to Wakeley Bridge in October 1959-63 and 1974-76.

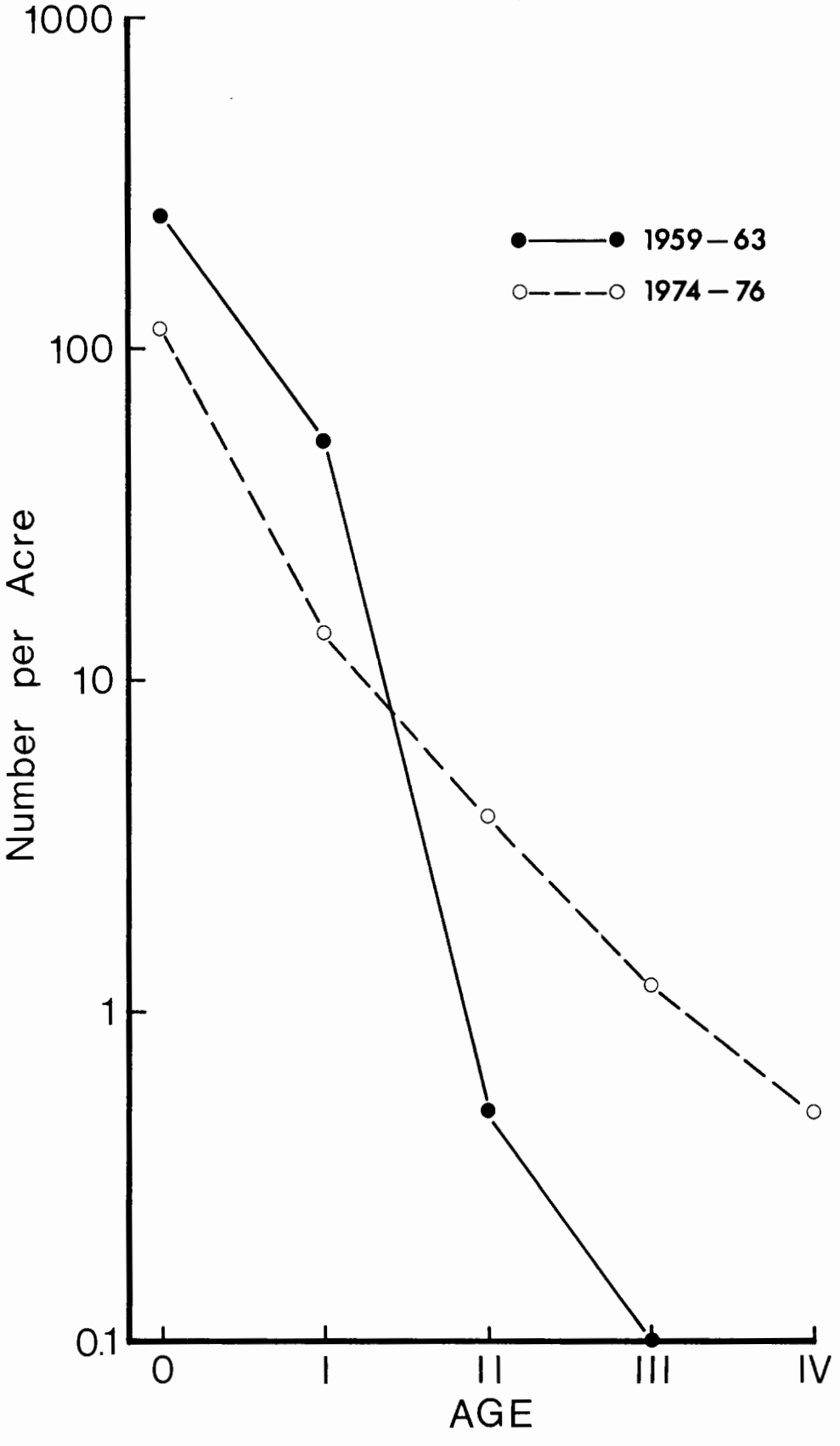

Figure 6.--Number per acre of rainbow trout of various ages in the Main Au Sable River from Burton's Landing to Wakeley Bridge in October 1959-63 and 1974-76.

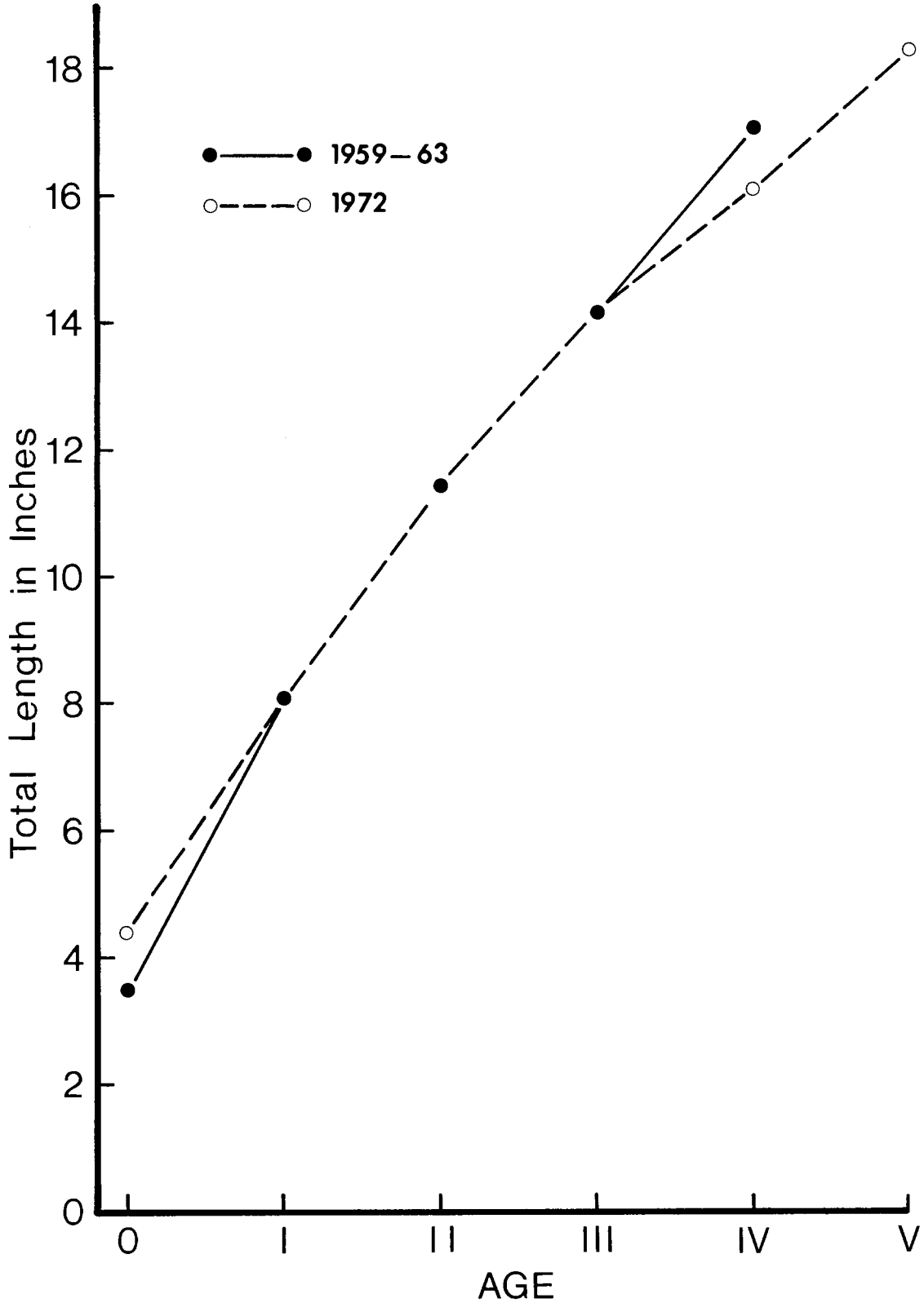

Figure 7.--Average length of brown trout of various ages in the Main Au Sable River from Grayling to Burton's Landing in October 1959-63 and 1972.

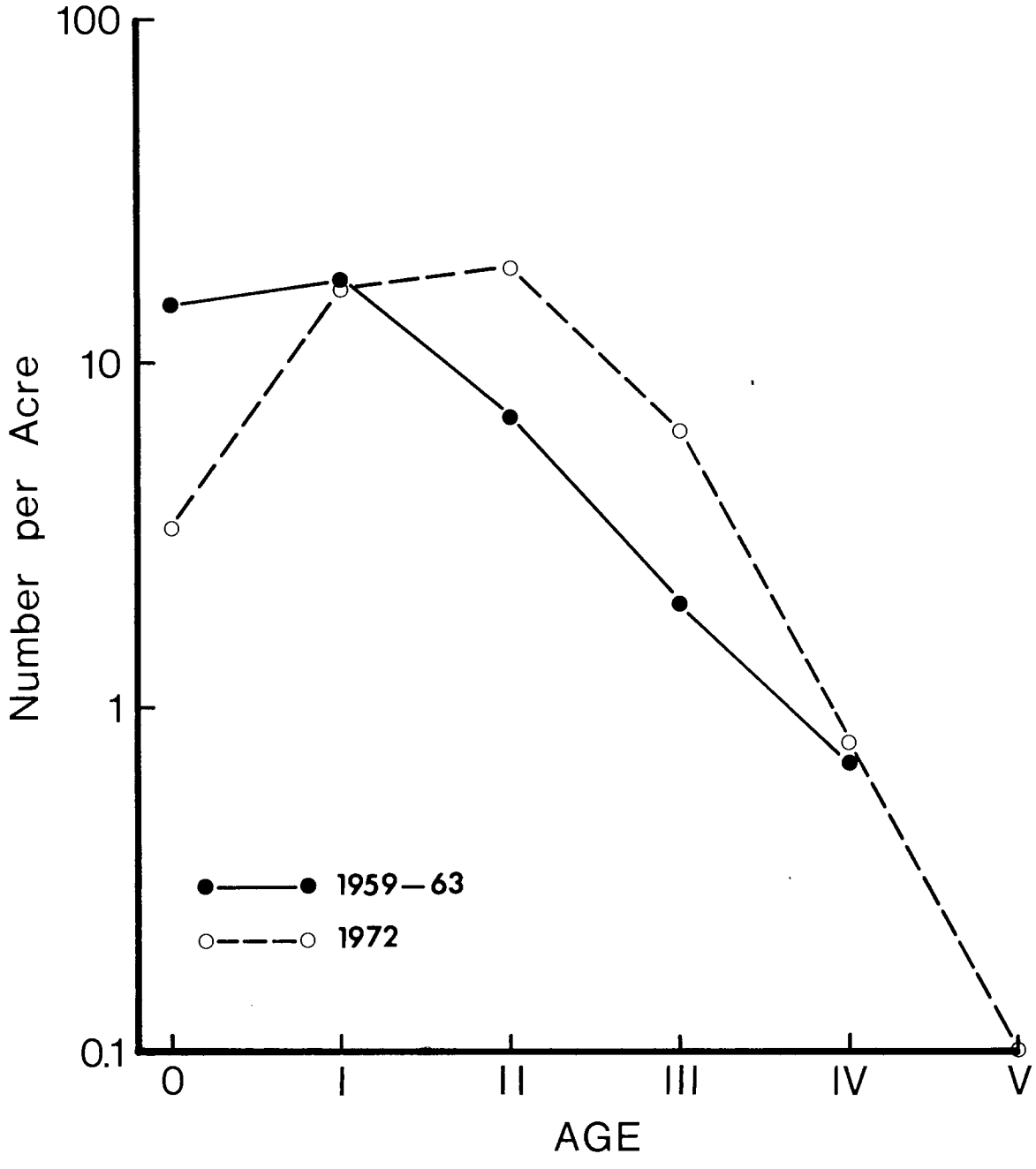

Figure 8.--Number per acre of brown trout of various ages in the Main Au Sable River from Grayling to Burton's Landing in October 1959-63 and 1972.

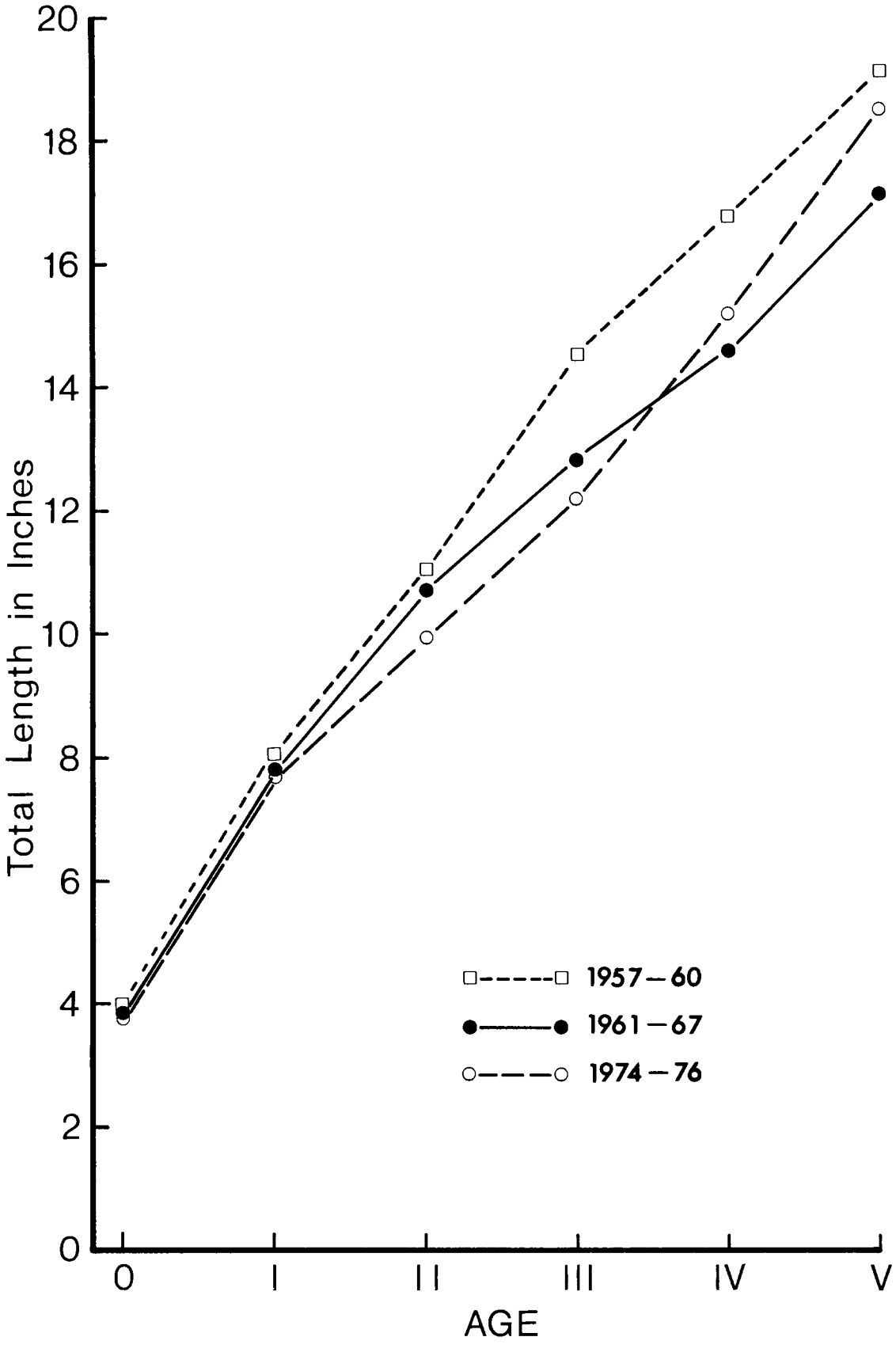

Figure 9.--Average length of brown trout of various ages in the North Branch of the Au Sable River from Eaman's Landing to Kellogg's Bridge in October 1957-60, 1961-67, and 1974-76.

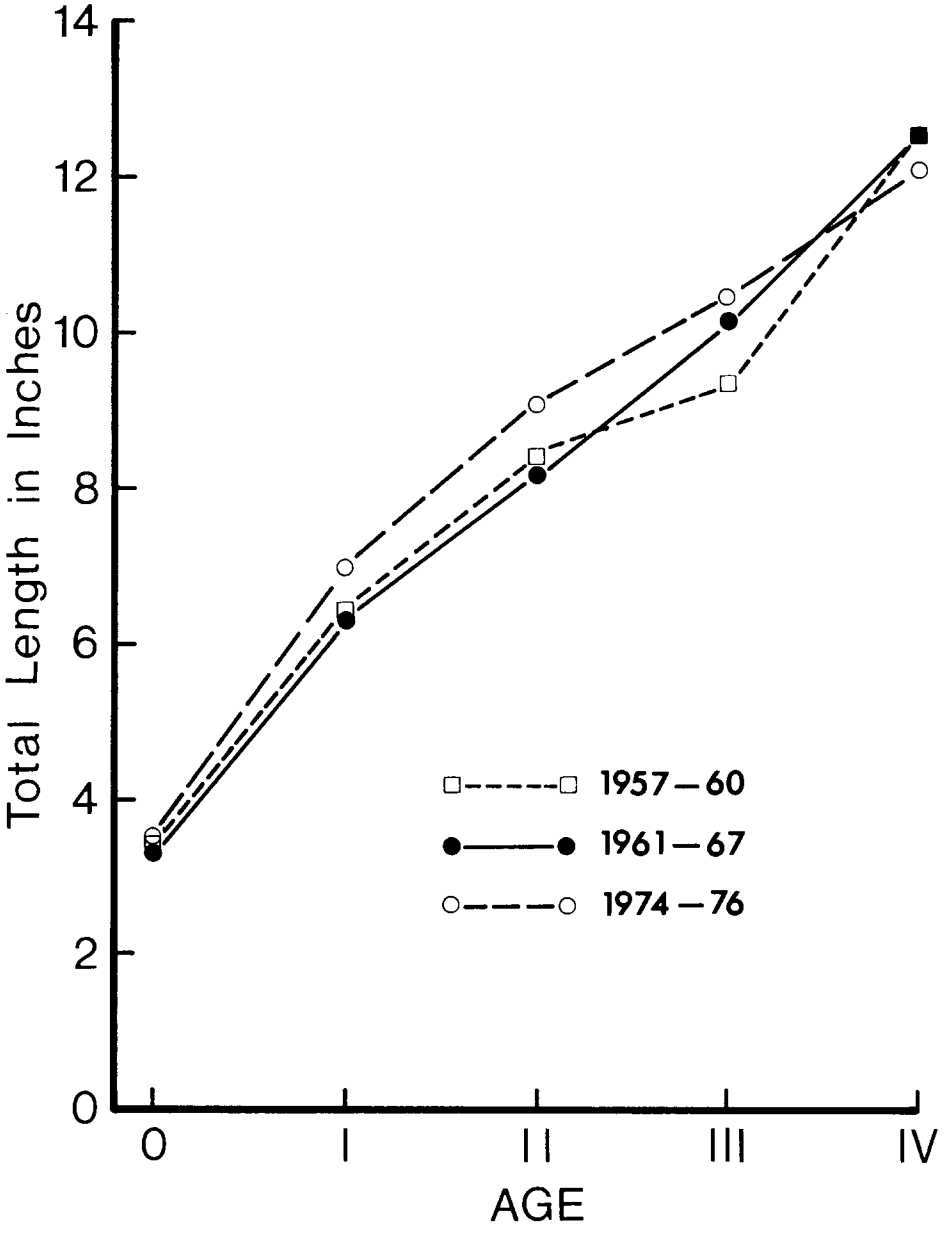

Figure 10.--Average length of brook trout of various ages in the North Branch of the Au Sable River from Eaman's Landing to Kellogg's Bridge in October 1957-60, 1961-67, and 1974-76.

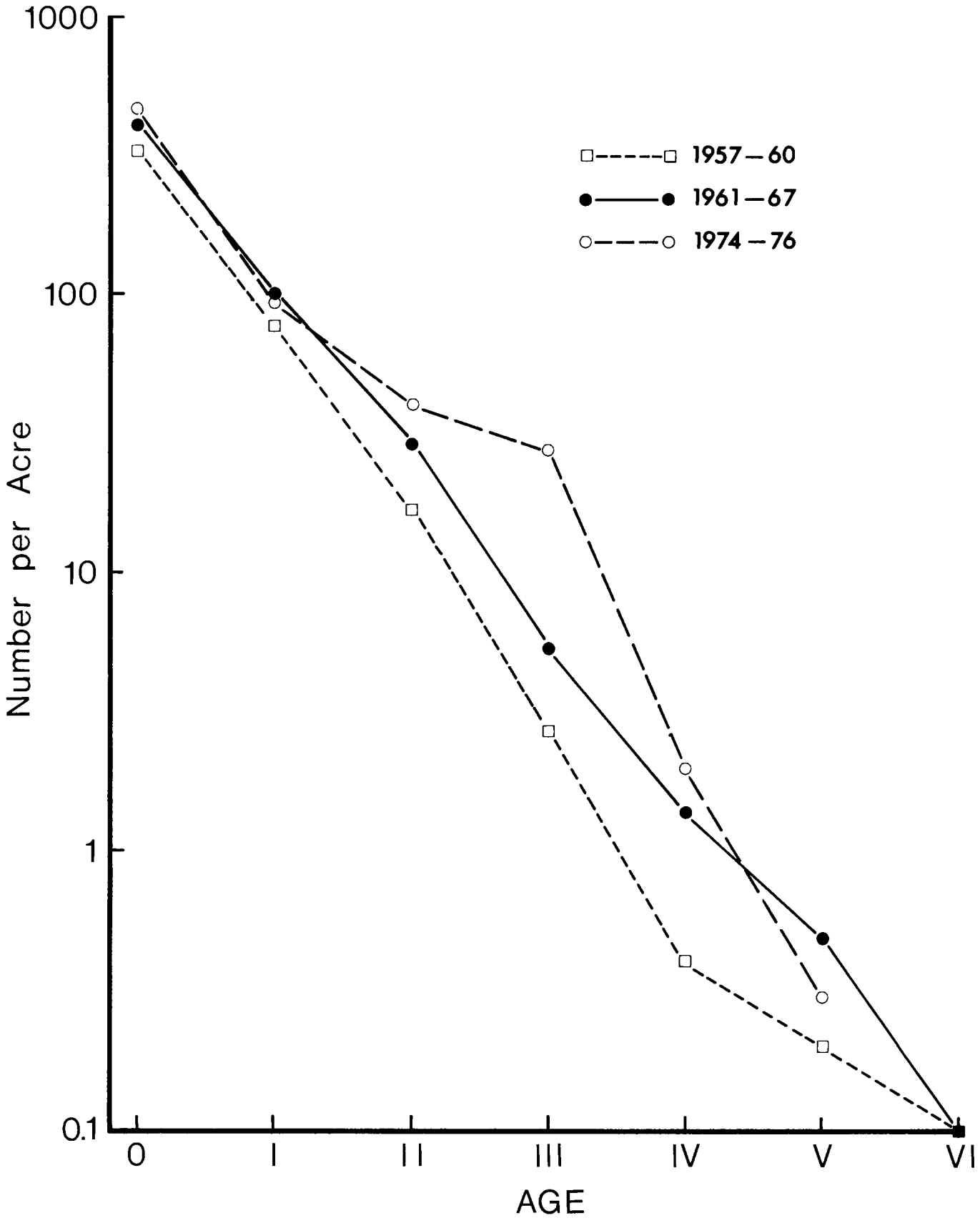

Figure 11.--Number per acre of brown trout of various ages in the North Branch of the Au Sable River from Eaman's Landing to Kellogg's Bridge in October 1957-60, 1961-67, and 1974-76.

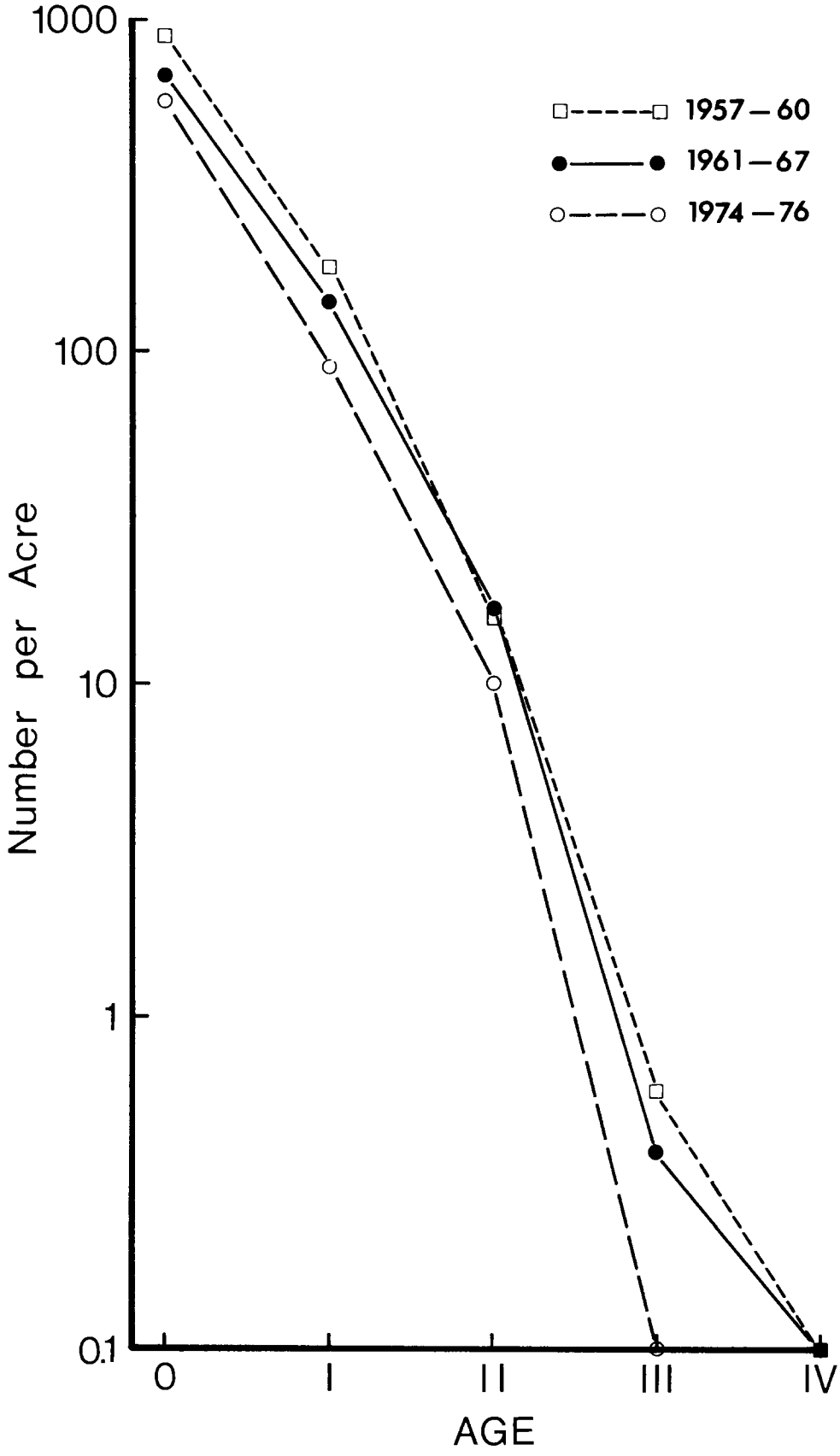

Figure 12.--Number per acre of brook trout of various ages in the North Branch of the Au Sable River from Eaman's Landing to Kellogg's Bridge in October 1957-60, 1961-67, and 1974-76.

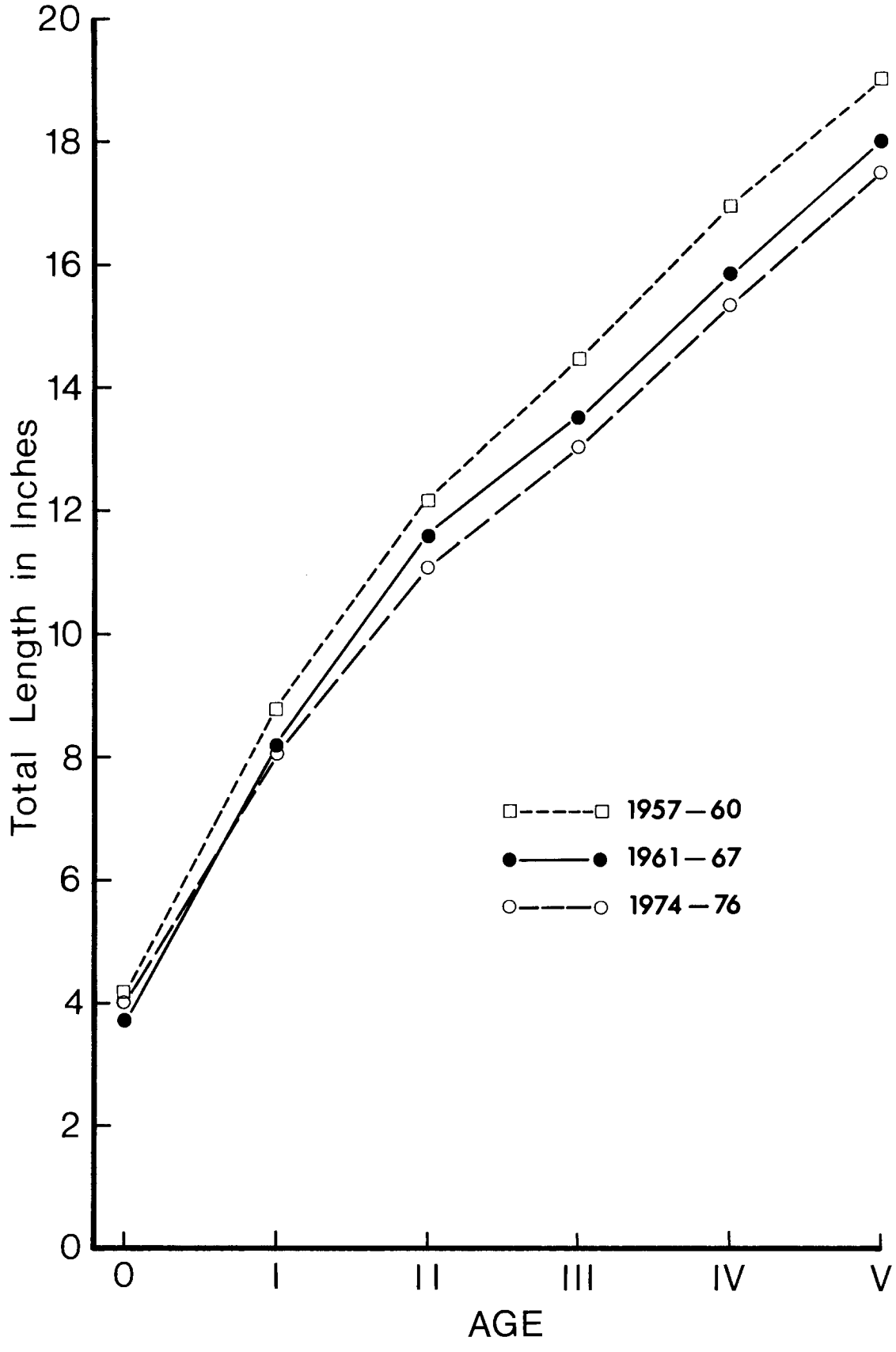

Figure 13.--Average length of brown trout of various ages in the North Branch of the Au Sable River from the Ranch to Eaman's Landing in October 1957-60, 1961-67, and 1974-76.

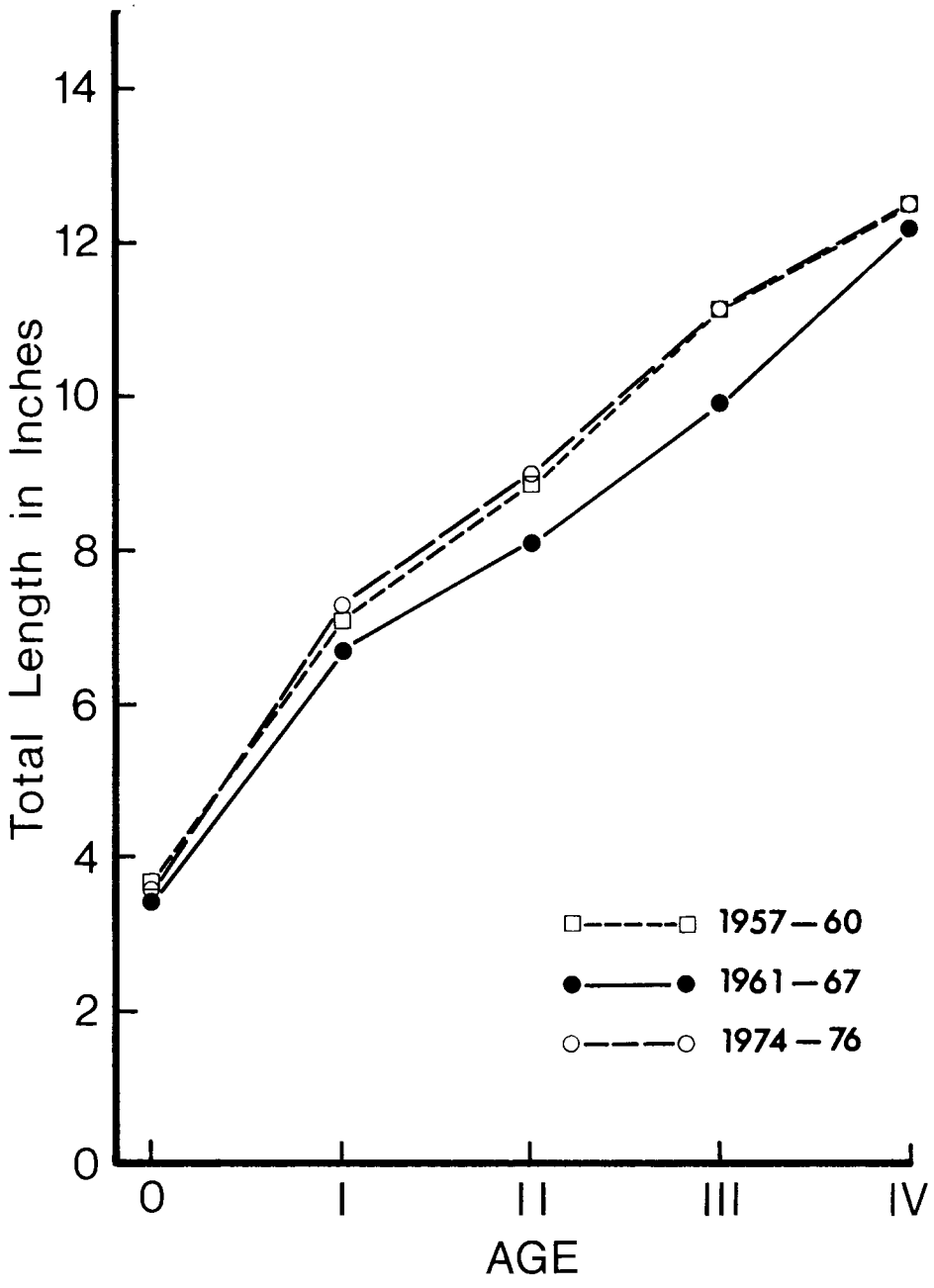

Figure 14. --Average length of brook trout of various ages in the North Branch of the Au Sable River from the Ranch to Eaman's Landing in October 1957-60, 1961-67, and 1974-76.

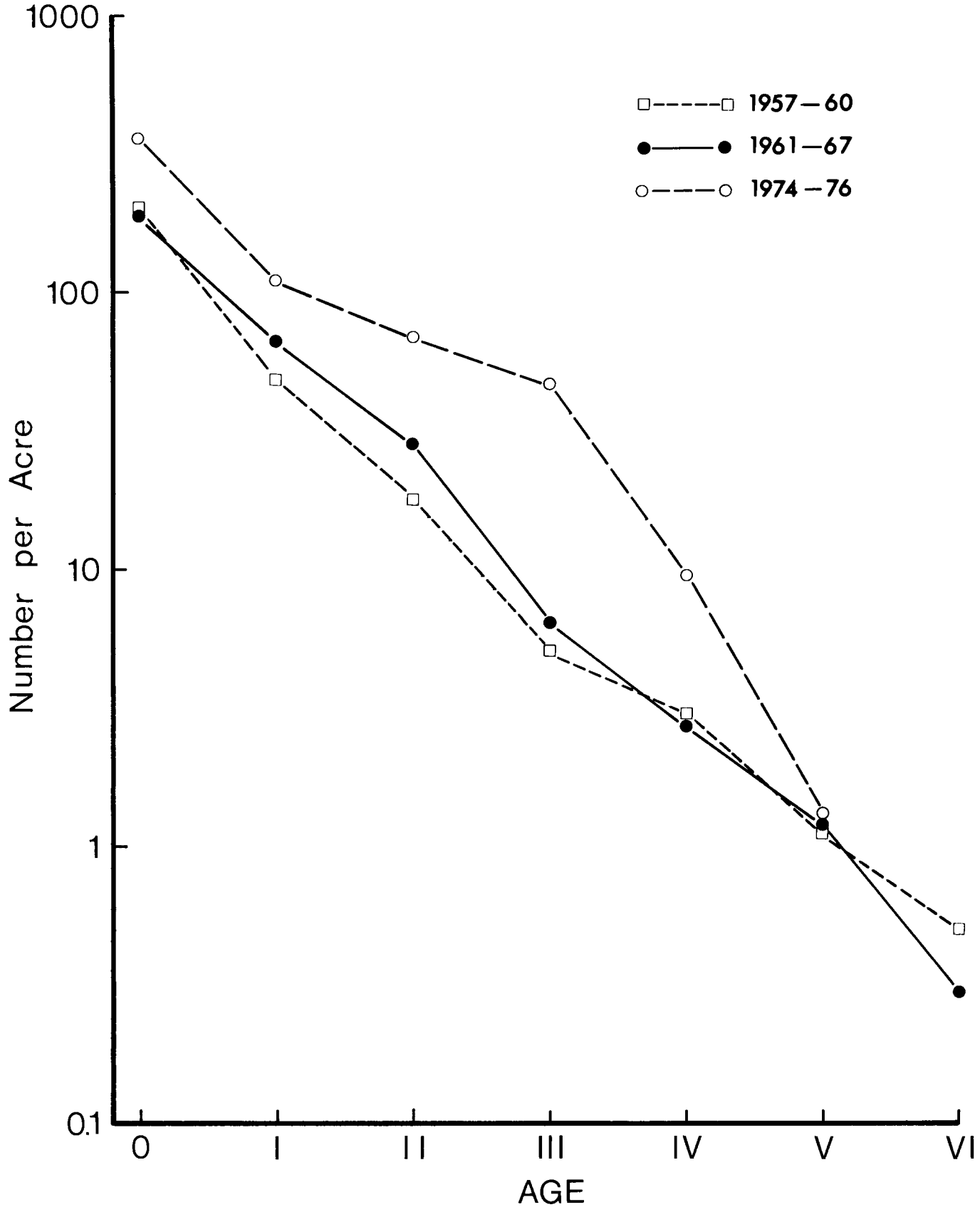

Figure 15. --Number per acre of brown trout of various ages in the North Branch of the Au Sable River from the Ranch to Eaman's Landing in October 1957-60, 1961-67, and 1974-76.

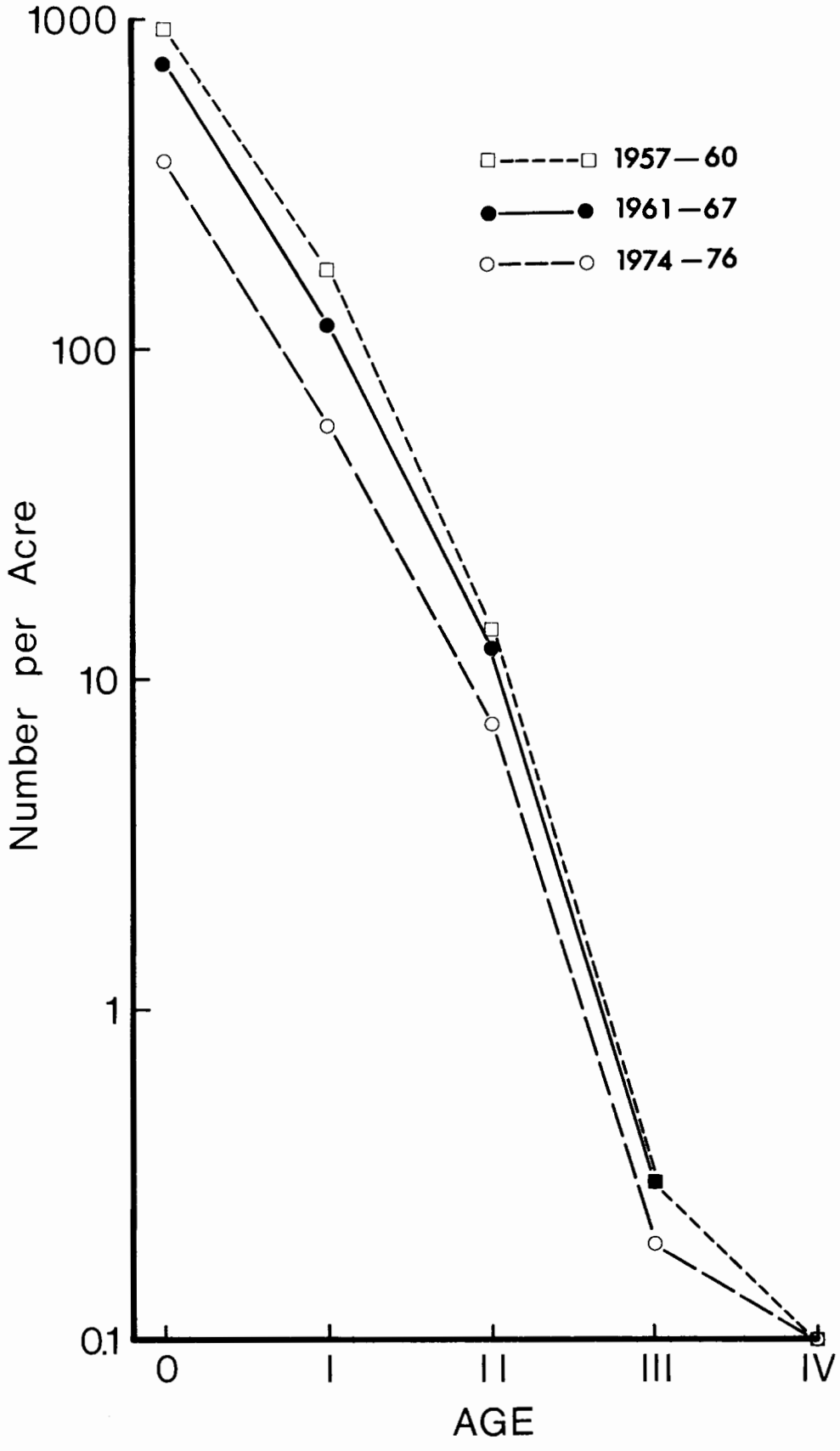

Figure 16.--Number per acre of brook trout of various ages in the North Branch of the Au Sable River from the Ranch to Eaman's Landing in October 1957-60, 1961-67, and 1974-76.

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