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[1] A contribution from Dingell-Johnson Project F-35-R, Michigan.

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Population Characteristics of Assinica and Temiscamie Strains of Brook Trout in Two Michigan Lakes

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Abstract.--Matched numbers of Assinica and Temiscamie strains of brook trout (*Salvelinus fontinalis*) were stocked as fall fingerlings into two Michigan lakes. Survival, growth, movement, sex ratio, and maturity were determined for each strain to age V. Aside from a post-stocking mortality of Assinica fish, which was believed due primarily to a furunculosis infection contracted in the hatchery, there was little evidence of consistent or significant differences in the survival of either strain to age V. Long-term incremental increases in length were not significantly different among strains although Assinica tended to be significantly longer than Temiscamie at younger ages. Assinica were from 8 to 18% heavier than Temiscamie of the same length depending on the lake. There were no significant differences between the growth rates of the sexes. Sex ratios became progressively more weighted toward females each year, due to higher mortality rates for males of both strains. A majority of both strains matured at age I, and both were fully mature at age II. There was no appreciable difference among strains in vulnerability to capture by angling. Emigration rates for both strains within a lake were quite similar. Depending on the year, 40 to 90% of the populations attempted downstream movement out of the lakes during each spawning period, which could seriously deplete populations in lakes without fish barriers. Both Assinica and Temiscamie strains appear about equally suited for Michigan trout lake management.

Historically, brook trout (*Salvelinus fontinalis*) have been a significant part of Michigan's trout resource. They are held in high esteem both by anglers and non-anglers alike for their beauty and their association with clean water and a pristine environment. Brook trout have been designated the official state fish.

Wild brook trout populations have diminished somewhat since the early 1900s. We now use hatchery produced brook trout to augment wild populations in a number of streams where natural recruitment is insufficient to maintain desirable fisheries. In addition, Michigan has numerous cold-water lakes that are managed for brook trout and these waters require periodic stocking of hatchery reared fish. Hatchery fish have become an integral part of the management of Michigan's brook trout fisheries.

Fish culturists have traditionally used domesticated strains of brook trout for hatchery production. In Michigan and elsewhere, the highly domesticated strains generally exhibit poor survival and growth when stocked in natural waters (Vincent

1960, Trojnar and Behnke 1974, Gowing 1974). The poor performance of hatchery fish in the wild is believed due in part to genetic selection. Fish culturists have traditionally selected for trout that matured early and survived and grew best in their hatcheries. The resultant hatchery stocks were not necessarily the best suited for survival and growth in the wild. Many studies have now demonstrated the relatively poorer growth and/or survival of domesticated versus wild strains of trout (Green 1952, Flick and Webster 1976, Gowing 1978, Fraser 1981, Webster and Flick 1981).

In recent years efforts have been initiated to improve the stocks of hatchery trout for growth and survival in the wild. The impetus for this effort originated in the northeastern United States. Flick and Webster (1976) demonstrated that Assinica strain brook trout grew faster than New York domestic strain brook trout when stocked in Adirondack lakes and ponds. Through the efforts of Dwight Webster and William Flick of the State of New York, two wild strains of fast-growing brook trout were obtained from the Province of Quebec, Canada. The strains are called Assinica and Temiscamie. The Assinica strain came from Assinica Lake of the Broadback River watershed. The Temiscamie strain came from the Temiscamie River of the Rupert River watershed. Both of these watershed systems drain into James Bay, Quebec (Flick 1977).

In an effort to improve the hatchery product in Michigan, Assinica and Temiscamie strains of brook trout were obtained from the State of New York. Our approach was to determine the survival and growth performance of these strains in Michigan waters. If they proved to be superior to existing strains, their genes would be incorporated into the hatchery production fish, by rearing either pure strains or various hybrid crosses.

Gowing (1978 and 1986) reported on Michigan's field test of the Assinica strain versus the hybrid cross (Assinica *x* domestic). He found that Assinica grew better than the domestic strain and that there was no significant deference between pure Assinica and hybrids. The purpose of this report is to present the findings of our 6-year study of the relative growth, survival, movement, sex ratio, and catchability by anglers of Assinica strain versus the Temiscamie strain of brook trout in two Michigan trout lakes.

Study Sites

East Fish Lake and Fuller Pond are located at the Hunt Creek Fisheries Research Station, Montmorency County, Michigan. East Fish Lake is 16 acres in area, with an average depth of 20 feet and maximum depth of 40 feet. It stratifies thermally in the summer. Surface water temperatures rarely rise about 72°F and adequate oxygen for trout exists even in the deepest water throughout the year. East Fish Lake has a small inlet creek of 0.8 ft^3/s and a length of 0.3 miles. There are also numerous small springs contributing water to the lake. The outlet creek has a discharge of approximately 1.5 ft^3/s.

Fuller Pond is a 15-acre flowage with an average depth of 1.5 feet and a maximum depth of 7 feet. It is formed by an earthen dam built on the site of an old beaver dam. Surface water temperatures rarely rise above 74°F. A small creek with a discharge of 1.5 ft^3/s and a length of 0.5 miles flows into Fuller Pond. In addition, a number of small springs enter the pond. As a result of this cold-water inflow, a rather strong thermal stratification exists in the pond during hot weather. The surface water temperature may be 70°, whereas, the bottom waters in the old creek channel may be only 55°F. Adequate oxygen exists for trout throughout the year at all depths. The outlet creek has a discharge of approximately 3 ft^3/s.

Waters of both East Fish Lake and Fuller Pond are moderately hard with total alkalinity of 140 to 175 mg/L. The pH fluctuates slightly around 8.0.

Inclined-screen fish traps (Wolf 1951) are operated on the outlet creeks of both East Fish Lake and Fuller Pond. During this study all Assinica and Temiscamie brook trout trapped were returned upstream to the lakes.

Fish species present in these test waters other than the experimental brook trout were: northern redbelly dace (*Phoxinus eos*), brook stickleback (*Culaea inconstans*), fathead minnow (*Pimephales promelas*), and central mudminnow (*Umbra limi*). In addition, during the latter years of the study, small populations of naturally recruited brook trout were present in both East Fish Lake and Fuller Pond. Parents of these fish were stocked Assinica and Temiscamie, thus the offspring population probably was composed of an array of interstrain and intrastrain crosses of Assinica and Temiscamie brook trout.

Both waters had abundant populations of crayfish (*Orconectes virilis* and *O. propinquus*). Past studies of brook trout diets from these waters indicated that crayfish and minnows contribute the most substance by weight to the trout's food supply (Alexander 1975a, 1975b). Other foods also making significant contributions varied somewhat between East Fish Lake and Fuller Pond. Trout in East Fish Lake used Cladocera, Ephemeroptera, Tendipedidae, and Oligochaeta in descending order of importance, compared to trout in Fuller Pond, which consumed Hemiptera, Odonata, Mollusca, and Hirudinea.

Methods

On October 15, 1982, equal numbers of Assinica and Temiscamie strain brook trout were stocked into each experimental water: 800 of each strain into East Fish Lake, and 750 of each strain into Fuller Pond. The stocking rate was 50 fingerlings per acre of each strain for a total planting rate of 100 fingerlings per acre. The mean total length of fingerlings planted was 4.0 inches for Assinica and 3.7 inches for Temiscamie strain trout. A fin was excised to identify each strain: adipose for Assinica and left pectoral for Temiscamie.

Mark-and-recapture population estimates were made periodically over the course of the study (Bailey 1951). Samples of trout were caught by electrofishing, angling, or inclined-screen traps. Fish were then marked and returned to the water. Recapture ratios for calculating the population estimates were obtained from samples of trout taken on subsequent sampling dates. Sampling was generally done in October, January, and May. This sampling provided the basis for assessing rates of survival and growth.

Residual populations of trout present at the end of the study were captured by angling and gill netting and removed from the experimental waters.

Results

Survival.--Temiscamie survived better than the Assinica from planting in October 1982 to January 1984 in both East Fish Lake and Fuller Pond (Figure 1). The survival rate of the Assinica for this 15-month period was only 27% in East Fish Lake and 18% in Fuller Pond. Temiscamie had higher survival rates of 43% and 29% in East Fish Lake and Fuller Pond, respectively, during the first 15 months after stocking.

We believe the difference in survival between Assinica and Temiscamie over the first 15 months was primarily due to a furunculosis infection in planted stock of Assinica, whereas no furunculosis was detected in the stock of Temiscamie. Numerous Assinica were observed dying at both East Fish Lake and Fuller Pond at planting and for a week following planting.

Shorter transportation time between hatcheries and the experimental waters may also have favored initial survival of Temiscamie over Assinica. Assinica were trucked from the Thompson Hatchery located in the Upper Peninsula of Michigan.

Temiscamie were trucked from the Oden Hatchery in the Lower Peninsula of Michigan. The travel distance from Thompson Hatchery to the planting sites is about 190 miles, whereas from Oden it is only 80 miles. Because of the furunculosis and trucking complications in this study, we believe the differences in survival rates of Assinica and Temiscamie measured during the first 15 months of this study were not due to intrinsic differences in their survival potential.

A much better comparison of the relative survival potential of the two strains was their rate of survival from January 1984 until the termination of the study in May 1987. The average annual survival rate of Assinica in East Fish Lake from January 1984 through May 1987 was about 59% compared to 48% for Temiscamie. This difference was due to much poorer survival of Temiscamie from January 1986 to January 1987 (Figure 1). Survival of the two strains was similar from January 1984 to January 1986.

In Fuller Pond the Temiscamie had slightly better survival rate than Assinica from January 1984 to January 1987 (Figure 1). The average annual survival rate of Temiscamie strain trout was 61% for this 3-year period compared to 55% for Assinica strain trout.

There was little evidence of a consistent or significant difference in the survival potential of Assinica compared to Temiscamie strain brook trout in these Michigan waters.

Growth.--The general pattern of annual growth in length of both strains was similar during the 5 years of lake or pond life (Figure 2). The rate of growth of both strains was most rapid the first year following planting and, thereafter, gradually decreased each year. Growth of Assinica was somewhat better than Temiscamie during the second and third growing seasons following planting in Fuller Pond and for the second growing season in East Fish Lake (Table 1). Statistical analysis (*t*-test) comparing the average lengths of Assinica and Temiscamie stain trout for these time periods indicated that Assinica strain trout were significantly longer than Temiscamie ($P<0.05$).

However, during the latter part of the study the growth of Assinica strain trout slowed (after 1984 in Fuller Pond and after 1983 in East Fish Lake) relative to Temiscamie. As a result of this slowdown the Temiscamie caught up to the Assinica in average length (Figure 2). No significant difference in the average lengths of the two strains were evident at the end of the study. Both strains of brook trout in these waters attained an average size of nearly 17 inches by the end of the study (age V). A few fish of each strain reached 20 to 22 inches in length and weighed 3.0 to 3.5 pounds.

Incremental length increases were significantly higher for both strains in East Fish Lake than in Fuller Pond the first year after planting. However, incremental growth was significantly better for both strains in Fuller Pond compared to East Fish Lake during the second season after planting. Thereafter, growth was similar for both strains in both waters.

It can be seen from Figure 3 that the average weight of Assinica strain trout was greater than that of Temiscamie strain trout throughout the study, except fish in East Fish Lake at the very end of the study ($P<0.05$). Assinica had a significantly greater coefficient of condition than Temiscamie throughout the 5-year study period ($P<0.05$). Assinica trout of a given length were about 8% heavier than Temiscamie in East Fish Lake. The Assinica were 18% heavier than Temiscamie in Fuller Pond.

No significant difference in growth of the sexes was found for either Assinica or Temiscamie strain trout.

Sex ratio.--Males predominated in the fall 1983 trap catches at both East Fish Lake and Fuller Pond. Male Assinica trout outnumbered females by 2.3:1 in East Fish Lake and 1.7:1 in Fuller Pond. Similarly, male Temiscamie trout outnumbered females by 2.3:1 in East Fish Lake and 2.0:1 in Fuller Pond. We have no data on the sex ratio of trout in the general population, but assume it was 1:1. The sex ratio of trout at planting was also assumed to be equal. If this was the case, a higher proportion of males from the populations moved downstream out of the lake or pond presumably seeking spawning grounds.

One year later, in the fall of 1984, the sex ratio of trout entering the outlet traps was nearly the reverse of the previous year. Assinica females outnumbered males by 1.8:1 in East Fish Lake and by 2.3:1 in Fuller Pond. Similarly, female Temiscamie trout outnumbered males by 1.3:1 in East Fish and by 2.2:1 in Fuller Pond. Obviously, females were now more abundant in the populations than males. This indicated a much higher mortality rate of males than females between the fall of 1983 and fall 1984.

The ratio of females to males from 1984 until the termination of the study in 1987 increased progressively each year. In 1987, the sex ratio of the pooled age-V population from East Fish Lake and Fuller Pond showed the Assinica female to male ratio to be 4.5:1 and the Temiscamie female to male ratio to be 3.2:1.

Maturity.--No significant differences were found in the state of maturity between age-I Assinica and Temiscamie trout caught in the outlet traps of either East Fish Lake or Fuller Pond in the fall of 1983. Of the Assinica trout trapped at East Fish Lake; 60% were mature males, 25% were mature females, and 15% were immature fish of unknown sex. Temiscamie trout trapped from East Fish Lake were composed of 63% mature males, 26% mature females, and 11% immature fish of unknown sex. Similar observations were made at Fuller Pond. Hence, 52% of the trapped Assinica were mature males, 30% were mature females, and 18% were immature fish of unknown sex. By comparison, 64% of the Temiscamie were mature males, 24% were mature females, and 12% were immature fish of unknown sex.

Since most of the trout population present in the lake or pond were caught in the outlet traps, it was determined that the majority of both Assinica and Temiscamie matured at age I.

During the fall of 1984, and thereafter, all trap-caught Assinica and Temiscamie trout were found to be mature in both East Fish Lake and Fuller Pond. Thus, it appeared that both strains were fully mature at age II.

Movement.--Over the years of this study trout movement associated with maturity and spawning began in September or October and ended in November or December (Table 2). Movement varied somewhat from year to year. The earliest starting date was September 23, and the latest termination date was December 2. Peak movement usually occurred near mid-October.

Spawning movement appeared to be delayed in the fall of 1986, because of abnormally warm weather. Both strains of trout began spawning movement in Fuller Pond a week or so earlier than in East Fish Lake. This probably occurred because the water temperature at the outlet cooled earlier at Fuller Pond. Termination of spawning movement was similar in both waters and for both trout strains.

During the fall of 1983, when the trout were age I, 46% of the Assinica and 48% of the Temiscamie entered the outlet trap at East Fish Lake. At Fuller Pond, 62% of the Assinica and 42% of the Temiscamie attempted to migrate downstream.

During the fall of 1984, as age-II trout, 81% of both the Assinica and the Temiscamie trout attempted to migrate downstream. At Fuller Pond, 79% of the Assinica and 69% of the Temiscamie moved out of the pond. During the fall of 1985, only 46% of the age-III Assinica compared to 64% of the Temiscamie attempted emigration from East Fish Lake. At Fuller Pond, 92% of the Assinica and 90% of the Temiscamie attempted downstream migration.

During the fall of 1986, at age IV, there was less movement out of the pond and lake and the movement period was of shorter duration. Thirty percent of the Assinica and 42% of the Temiscamie left East Fish Lake. At Fuller Pond, 68% of the Assinica and

84% of the Temiscamie left the pond. Again movement was less at East Fish Lake than Fuller Pond even though the population of trout was larger in East Fish Lake.

No data were obtained on movement of trout upstream into the tributary streams of East Fish Lake and Fuller Pond. Part of the trout population undoubtedly moved into the tributaries and spawned. Naturally recruited age-0 trout were first found in both East Fish Lake and Fuller Pond during the fall of 1984. These trout presumably were progeny of age-I parents that spawned successfully in inlet tributary streams or spring areas.

The proportion of the two trout strains that attempted movement out of the lake or pond for spawning was variable from year to year and between lake to pond. However, within the lake or pond the percentage of Assinica and Temiscamie attempting downstream movement was quite similar. Finally, the proportion of the population that tried to move out of the lake or pond was substantial, 40 to 90%, depending on the year.

Vulnerability to angling.--A measure of the relative vulnerability of Assinica and Temiscamie trout to ice fishing and open-water angling was obtained during this study. Since trout were caught each January by ice fishing, as part of the mark-and-recapture procedure for population estimates, we calculated the proportion of the available Assinica and Temiscamie fish in each water body that were caught in January 1984, 1985, and 1986. Pooled data showed that 62% of the Assinica were caught in East Fish Lake compared to 70% of the Temiscamie. In Fuller Pond, anglers caught 65% of the Assinica compared to 62% of the Temiscamie. Relative vulnerability to angling was also measured at the termination of the study, when angling was used in May, prior to intensive gill netting to capture and remove test fish from the lake and pond. Angler's caught 52% of the Assinica and 57% of the Temiscamie from the test waters. These data suggest no appreciable difference in the vulnerability of the two strains to angling.

Discussion

Survival of Temiscamie strain brook trout was better than the Assinica strain during the first 15 months following planting in both East Fish Lake and Fuller Pond. This difference in survival was probably due to the presence of furunculosis in Assinica trout when planted. After this initial 15-month period, survival of Assinica and Temiscamie was not significantly different for the remainder of the 5-year study. Cone and Krueger (1988) in their study trials in New York ponds, found no difference in survival of age-0 Assinica and Temiscamie strain trout 3 months after stocking. However, Webster and Flick (1981) tested Temiscamie and Assinica strain trout in the same study ponds as Cone and Krueger, but concluded that the Temiscamie had a higher survival rate than Assinica. Cone and Krueger (1988) suggest that the differential survival reported by Webster and Flick (1981) may be in error due to greater emigration of Assinica strain fish from the experimental ponds. When Cone and Krueger (1988) corrected for emigration, no difference in survival was found between the two strains.

In our Michigan study, we believe that the lower survival of the Assinica strain was due mainly to furunculosis, not emigration, as found by Cone and Krueger (1988). Visual checks of the small inlet creeks entering Fuller Pond and East Fish Lake were made for a month following stocking, and no stocked Assinica or Temiscamie were observed. It is possible that Assinica might occupy the shallower waters of both Fuller Pond and East Fish Lake to a greater extent than the Temiscamie, thus exposing themselves to greater mortality. However, the relative survival rates of Assinica were not different in Fuller Pond compared to East Fish Lake. If Assinica, in fact, tended to occupy shallower water more than Temiscamie one would expect greater mortality of Assinica in Fuller Pond than in East Fish Lake. The data does show that the survival rates of both strains were lower in

Fuller Pond than in East Fish Lake, which is consistent with the greater expectation of predation mortality of trout in shallow water. Thus, we conclude that there is no real difference in the survival potential of these two strains in our study waters during the first 15 months or later.

Both strains of trout survived better in East Fish Lake than in Fuller Pond, particularly during the first year following stocking. Past studies have shown consistently better trout survival in East Fish Lake than in Fuller Pond (Alexander and Shetter 1969, Alexander 1975). Further, many studies have demonstrated better trout survival in deep lakes compared to shallow lakes (Gowing 1978, 1986). Great blue herons, belted kingfishers, common loons, common water snakes, mink, and otter frequent these waters. These animals are known to be significant trout predators (Alexander and Shetter 1969, Alexander 1977, Fraser 1981). Also, these predators, other than the loon, are more effective predators in shallow water. Fuller Pond has a maximum depth of 7 feet and extensive shallow water, whereas East Fish Lake is 40 feet deep with a relatively small littoral zone.

Survival was much poorer for male than female trout of both strains. This phenomenon has been noted in two previous studies of brook trout in Michigan lakes (Gowing 1978, 1986). Gowing's studies dealt with domestic, Assinica, and Assinica-domestic hybrid strains, which all showed much better survival of females. The greatest difference in survival occurred during the first year after planting (between fall age 0 and fall age I). As noted in this study, males mature at an earlier age, move to spawning areas sooner, and stay in spawning areas longer than females. From the literature, earlier maturity and greater movement of males compared to females also is generally the rule for salmonids. This is true for many other species of fish and many mammals. Apparently movement results in greater exposure to predators and higher mortality rates.

The growth in length of Assinica and Temiscamie was generally similar within the lake or pond. However, growth in weight was greater for Assinica because this strain has a more robust body morphology. This difference in body form has also been noted by Cone and Krueger (1988). Further, Cone and Krueger (1988) reported Temiscamie growth to be better than Assinica. However, their test fish were considerably different in average size at stocking, and the test ran for only 3 months. They estimated growth based on specific growth rates, which are biased in favor of the fish that are smallest at the beginning of a test period. Further, many of the Assinica emigrated to inlet creeks, where they grew more slowly than lake-dwelling fish.

Even though the growth performance in this study showed similar overall incremental annual growth in length for Assinica and Temiscamie, it does not prove that the ultimate growth potential of these strains is the same. In this study Assinica strain fish were larger than Temiscamie through age I in East Fish Lake and through age II in Fuller Pond. It is possible that food was not sufficient for the Assinica strain fish to maintain or achieve their maximum growth potential in the test waters. Thus growth of Assinica slowed relative to Temiscamie and the Temiscamie caught up to the Assinica around age III. Thereafter, growth of the two strains was similar. We postulate that neither strain could demonstrate its full growth potential because of a less than optimum food supply. These field tests show relative growth under the available habitat and food conditions, but did not necessarily demonstrate the full growth potential of either strain. In this study a few Temiscamie and Assinica attained weights of 3.0 to 3.5 pounds. These strains commonly growth to 6 to 9 pounds in some Canadian waters.

The proportion of males to females in the population changed over time in both waters during this study. It was assumed that the sex ratio was equal at the onset of the study. As the population aged, the proportion of females increased progressively.

At age V the female-to-male ratio was 4.5:1 for Assinica and 3.2:1 for Temiscamie. Strong weighting of the sex ratio toward females has been noted by Gowing (1978) for domestic and Assinica strain brook trout and for Assinica *x* domestic hybrids (Gowing 1986). Male brook trout in lakes generally appear to experience higher mortality, probably due in part to their behavior as noted earlier. The sex ratio of wild brook trout in Hunt Creek, Michigan, is about 1:1 (McFadden et al. 1967). It is interesting to note that extensive data (Alexander, unpublished) shows that the sex ratios of old brown trout in lotic habitats of Michigan are balanced. Further, the sex ratio of age-V brown trout in four small Michigan lakes was only 1.2:1 (Alexander, unpublished). The sex-ratio imbalance observed in this and other Michigan studies suggests that differences in survival of the sexes may be specific to brook trout in lentic habitats.

No difference was found between Assinica and Temiscamie trout in the age of first maturity or the proportion of mature fish in the population. Further, no difference was observed between trout from East Fish Lake or Fuller Pond. A point of interest here is that the first three generations of Assinica trout in Michigan waters have shown a shift in age of maturity. Gowing (1986) observed a marked plasticity in the age at which Assinica trout first reached sexual maturity in Michigan waters, including Fuller Pond. The first generation of Assinica stocked in Michigan in 1973 attained sexual maturity mostly at age III, particularly females (Gowing 1978). By 1977, the second generation of Assinica matured on average 1 year earlier, or age II. In the present study, the third generation of Assinica matured at age I, the same as resident stocks of brook trout. It is of interest to note that the growth rate and maximum size attained for Assinica strain brook trout has not changed over these three study periods in Fuller Pond. Assuming that the relative food conditions for trout did not change in Fuller Pond since 1973 (over the three tests) the earlier maturity has not adversely affected the growth rate of Assinica strain trout. We can only speculate on the reasons for the reduction in age at maturity over time. Hynes et al. (1981) reviewed a broad array of studies illustrating how changes in stocks can be caused by either genetic selection or changes in environmental conditions, such as higher incubation temperatures during winter, artificial diets, and photoperiod, the last being an apparent difference. In this study there was no intentional genetic selection, but it could have occurred.

Movement of both Assinica and Temiscamie trout out of both the lake and the pond, mostly in the fall spawning period, was shown to be extensive. Forty to 90% of the trout population moved out depending on the year. In this study the trout that emigrated downstream were captured in inclined-screen traps and returned upstream, and were not a loss to their respective waters. However, in lakes with outlet streams, trout would be free to move downstream, and we believe that most would probably not survive in the small creek environment to return back upstream to the lake after spawning.

No appreciable difference was found in the relative catchability of Assinica compared to Temiscamie strain trout. This was true for both open-water angling and ice fishing.

There is a current effort in brook trout management to attempt to identify and utilize strains of trout that survive and grow well in natural environments. Flick and Webster (1976) and Gowing (1978, 1986) have shown Assinica strain fish to be superior in growth to domestic stocks normally used in management. Further, Fraser (1981) and Gowing (1986) demonstrated the advantage of hybrids (wild strains *x* domestic strains) over domestic strains for stocking lakes. Moreover, Webster and Flick (1981) reported that hybrids of Assinica and Temiscamie strain trout showed better survival and yield.

Survival and growth was sufficient in this study to produce standing stocks of seven trout per acre with an average length of 16 inches and a weight of 1.4 pounds at age IV. Standing stocks at age II averaged 24 trout per acre and these trout averaged 12 inches long and weighed about 0.65 pounds. We believe that either strain can produce standing crops of the above order in almost any trout lake in Michigan with no fishing. Under normal fishing rules and angler effort in Michigan waters, few brook trout survive to attain even a 12-inch size. Under catch-and-release fishing regulations or a trophy-size regulation of 16-inches minimum length, managers could achieve and maintain an improved fishery in both numbers and size of brook trout if anglers complied with the regulations. Even with the put-grow-and-take management option, using Assinica or Temiscamie brook trout will enhance most brook trout fisheries over existing ones.

Acknowledgments

Much appreciated assistance was given by the fisheries staff in Districts 5 and 7 in conducting the numerous population estimates over the study period. Jack Rodgers of the Hunt Creek Fisheries Research Station did much of the field work and data summarization. Jane Alexander typed the draft.

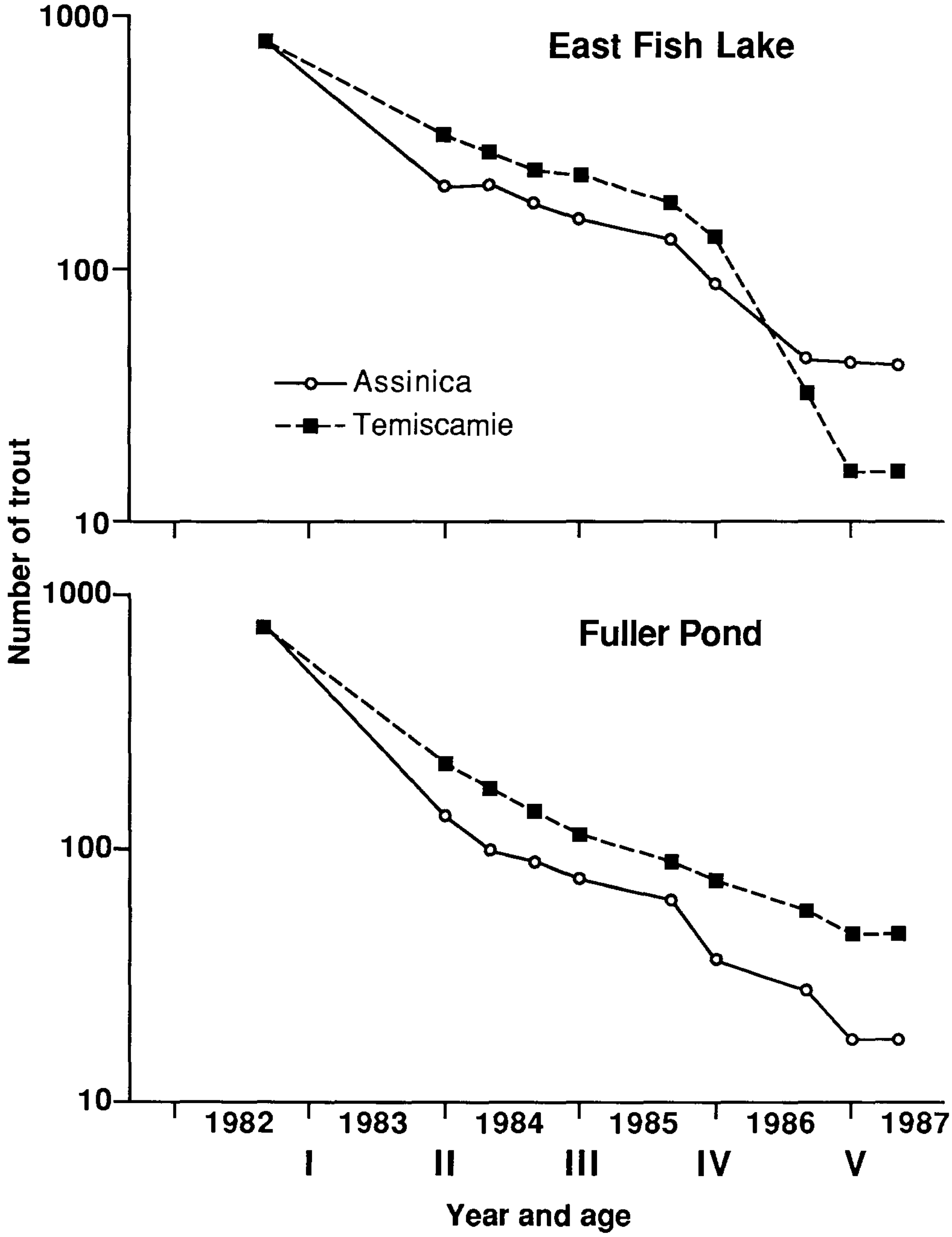

Figure 1. Survivorship curves for the Assinica and Temiscamie strains of brook trout from East Fish Lake and Fuller Pond.

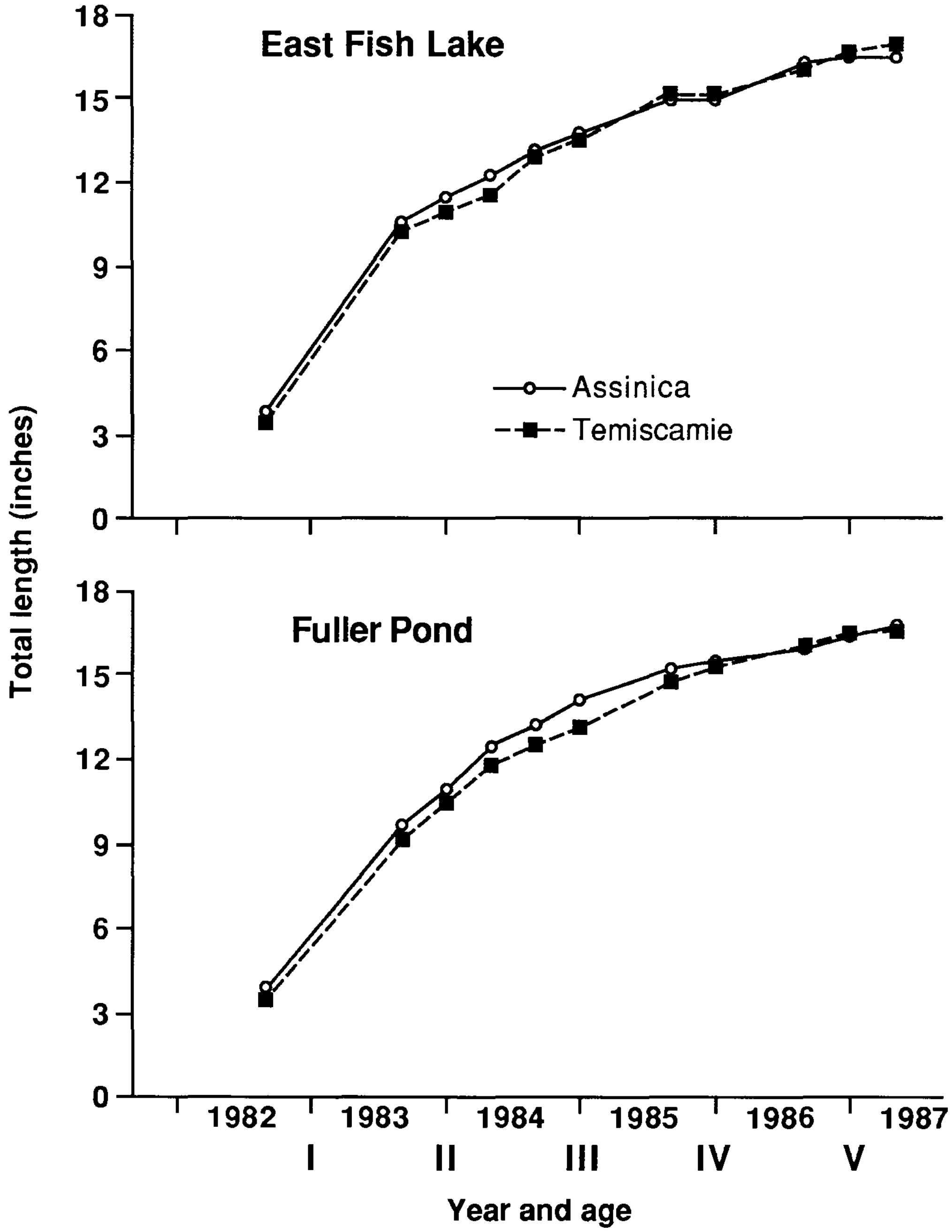

Figure 2. Growth in total length of the Assinica and Temiscamie strains of brook trout from East Fish Lake and Fuller Pond.

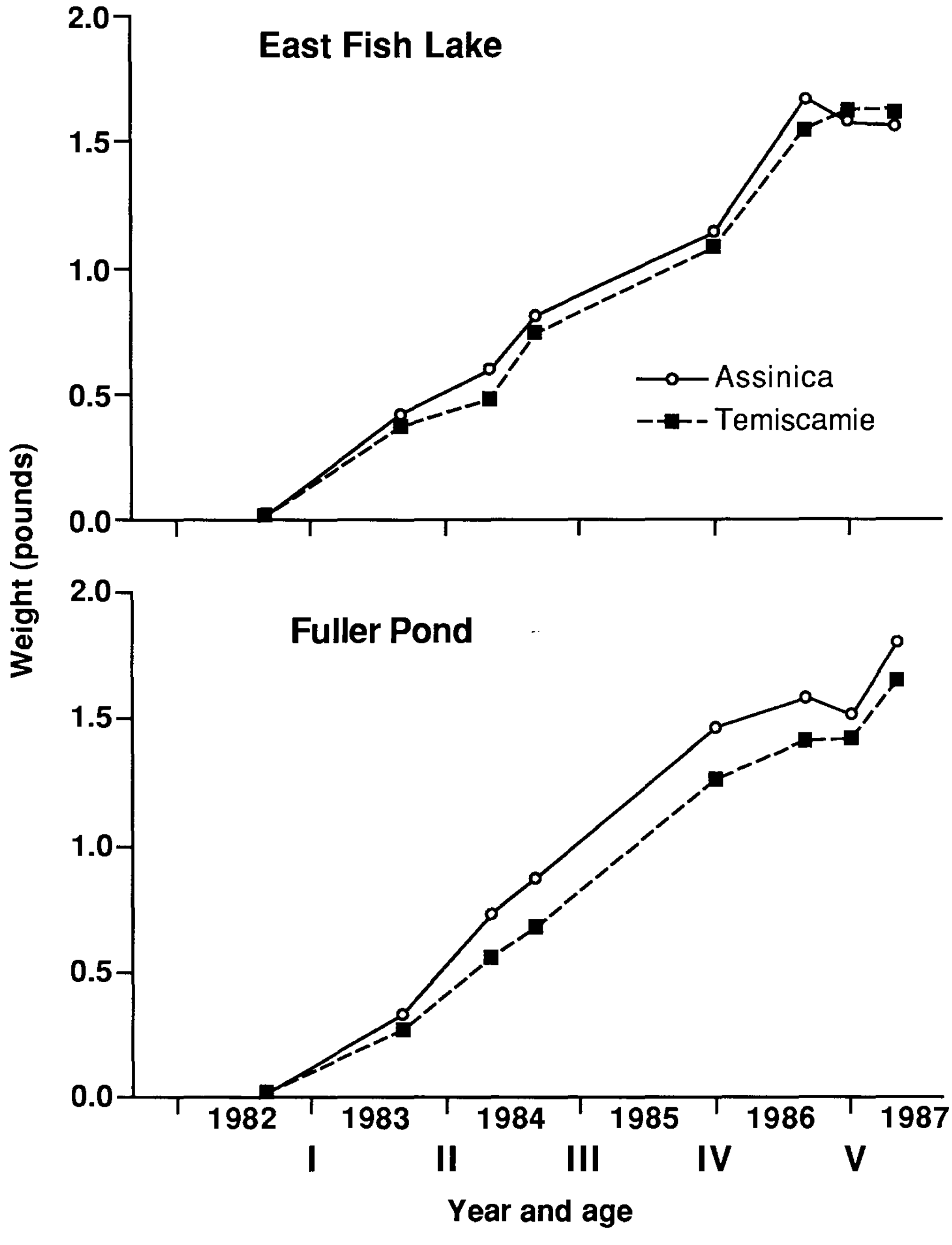

Figure 3. Growth in weight of the Assinica and Temiscamie strains of brook trout from East Fish Lake and Fuller Pond.

Table 1. Mean total length, two standard errors and sample size for the Assinica and Temiscamie strains of brook trout from East Fish Lake and Fuller Pond, 1982-87. Asterisk denotes significant difference between strains ($P<0.05$).

	East Fish Lake						Fuller Pond					
	Assinica			Temiscamie			Assinica			Temiscamie		
Date	(inches)	(2 SE)	(N)	(inches)	(2 SE)	(N)	(inches)	(2 SE)	(N)	(inches)	(2 SE)	(N)
Oct 1982	4.0*	0.06	800	3.7*	0.05	800	4.0*	0.06	750	3.7*	0.05	750
Oct 1983	10.6	0.24	74	10.3	0.18	104	9.7*	0.22	65	9.2*	0.20	69
Jan 1984	11.5*	0.20	128	11.0*	0.16	151	11.0*	0.26	79	10.6*	0.20	108
May 1984	12.3*	0.20	100	11.6*	0.18	99	12.6*	0.32	42	11.9*	0.20	77
Oct 1984	13.2	0.21	81	13.0	0.14	111	13.3*	0.25	59	12.6*	0.23	78
Jan 1985	13.8	0.23	79	13.6	0.18	95	14.2*	0.41	40	13.2*	0.24	74
Oct 1985	15.0	0.26	60	15.2	0.23	119	15.3	0.34	58	14.8	0.27	80
Jan 1986	15.1	0.27	59	15.2	0.25	82	15.5	0.34	26	15.4	0.30	60
Oct 1986	16.3	0.30	13	16.1	0.28	14	16.0	0.33	19	16.1	0.31	49
Jan 1987	16.5	0.33	34	16.7	0.31	14	16.4	0.35	12	16.5	0.32	33
May 1987	16.5	0.34	42	16.9	0.32	16	16.8	0.36	18	16.7	0.33	47

Table 2. Beginning and ending dates of the fall downstream movement of the Assinica and Temiscamie strains of brook trout from East Fish Lake and Fuller Pond, 1983-86.

Year	Strain	East Fish Lake	Fuller Pond
1983	Assinica	Oct 4 - Nov 28	Sep 23 - Nov 28
	Temiscamie	Oct 4 - Dec 8	Sep 23 - Dec 16
1984	Assinica	Oct 8 - Dec 7	Sep 26 - Nov 19
	Temiscamie	Oct 3 - Dec 11	Oct 1 - Dec 21
1985	Assinica	Oct 10 - Nov 13	Sep 30 - Nov 4
	Temiscamie	Oct 10 - Nov 14	Sep 30 - Nov 14
1986	Assinica	Oct 27 - Nov 11	Oct 13 - Oct 27
	Temiscamie	Oct 25 - Nov 11	Oct 13 - Nov 10

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