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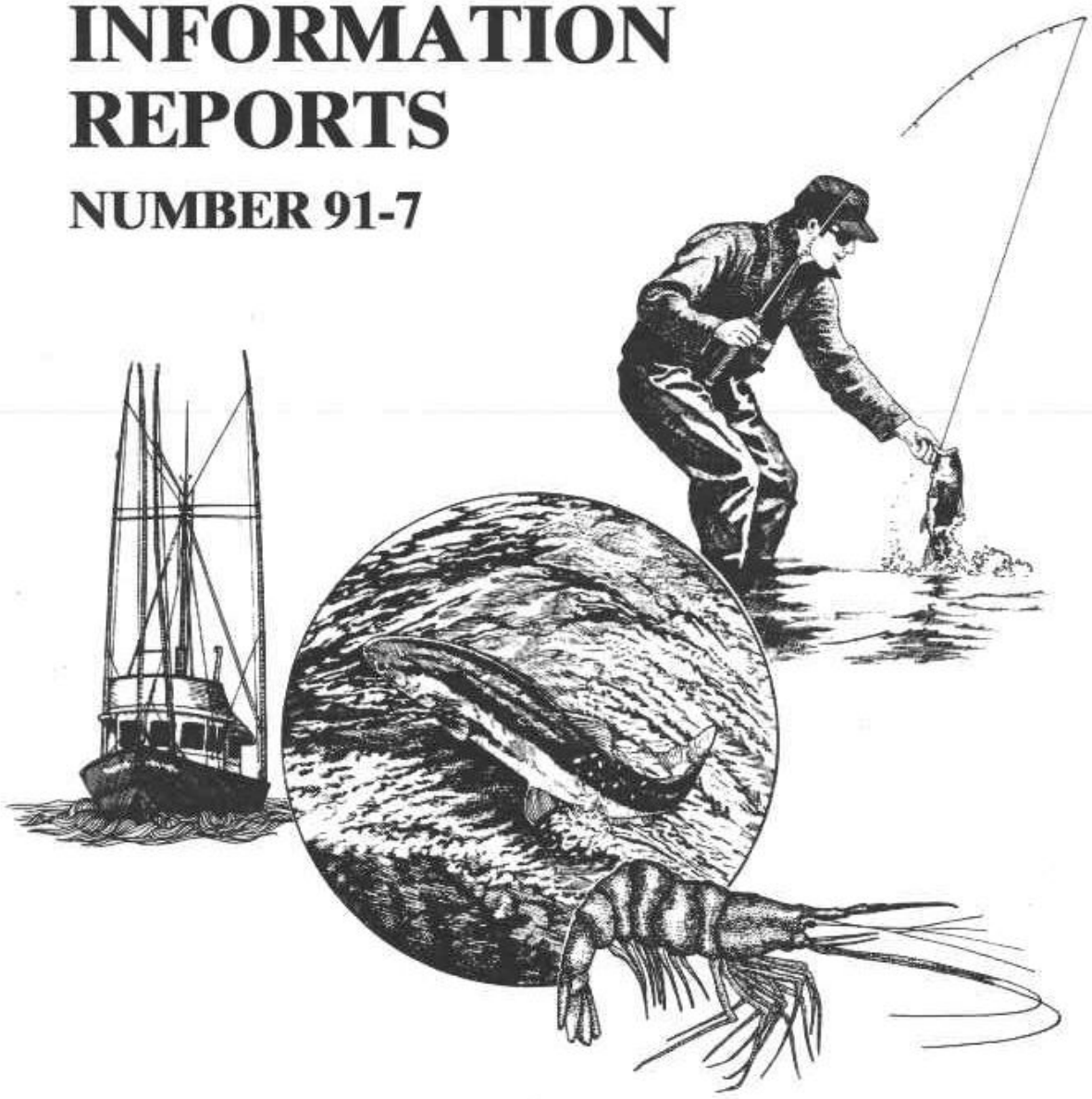

FISH DIVISION

Oregon Department of Fish and Wildlife

Age and Growth of Hybrid Bass
in the Tenmile Lakes System

Age and Growth of Hybrid Bass in the Tenmile Lakes System

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INTRODUCTION

As part of the 1982 Tenmile Lakes Management Plan, the Oregon Department of Fish and Wildlife (ODFW) introduced hybrid bass (striped bass *Morone saxatilis* x white bass *M. chrysops)* into North Tenmile Lake. Hybrid bass were chosen for experimental introduction to provide a new recreational fishery and to prey upon the abundant bluegill *Lepomis macrochirus* present in the lake. These releases began in 1982 and continued annually through 1988 with the exception of 1986.

North Tenmile Lake was chosen for the release site to minimize interaction with efforts to enhance coho salmon *Onchorhynchus kisutch* in Tenmile Lake. Fish released in North Tenmile Lake were not expected to migrate to Tenmile Lake. This expectation has been shown to be false, as Tenmile and North Tenmile lakes have comparable populations of hybrid bass. Hybrid bass have also been collected by ODFW personnel in the Coos River to the south and in the Umpqua River to the north.

The purpose of this study was to examine the age and growth of hybrid bass introduced into North Tenmile Lake. Specific objectives included the following: (1) to determine the timing of annulus formation; (2) to compare the rate of growth among Tenmile Lake, North Tenmile Lake, and other drainage basins where those fish were found to stray; (3) to compare growth rate among brood years; (4) to compare growth rate between fry and fingerling releases; (5) to determine whether the fish that strayed from the Tenmile lakes system shared any age, growth, or release-group parameters; and (6) to determine if populations of hybrid bass in Tenmile lakes are at or near their carrying capacity. This work was undertaken as

part of the Tenmile Lakes Management Plan in the summer of 1988. The work was preliminary, but has set the stage for further study.

STUDY AREA

Tenmile and North Tenmile lakes are the largest in a series of 10 interconnecting lakes located on the Oregon coast between the Umpqua and Coos rivers (Figure 1). The combined area of the Tenmile Lakes basin is greater than 70 square miles, and the lakes are among the most heavily used by boaters and fishermen in the state. Most of the lake-front property is privately owned, and many homes have been built near the shoreline. Much of the drainage basin is in the Elliot State Forest or is owned by private timber companies and was logged extensively beginning in the 1940s. Brush and second-growth Douglas fir *Pseudotsuga menziesii* cover the logged areas.

The ecology of Tenmile and North Tenmile lakes is unusual among Oregon's coastal lakes because the lakes are shallow (mostly less than 15 ft) (Johnson, et al. 1985). The shoreline areas support a wide band of emergent and submergent aquatic vegetation. Of the aquatic vegetation, the most notable introduced species are Brazilian waterweed *Elodea densa,* water milfoil *Myriophyllum verticillatum*, and water lily *Nymphaea odorata*. Native shoreline species include cattail *Typha* spp., burrweed *Sparganium simplex*, water smartweed *Polygonum* sp., water shield *Brasenia schreberi*, and yellow pond lily *Nuphar polysepalum*.

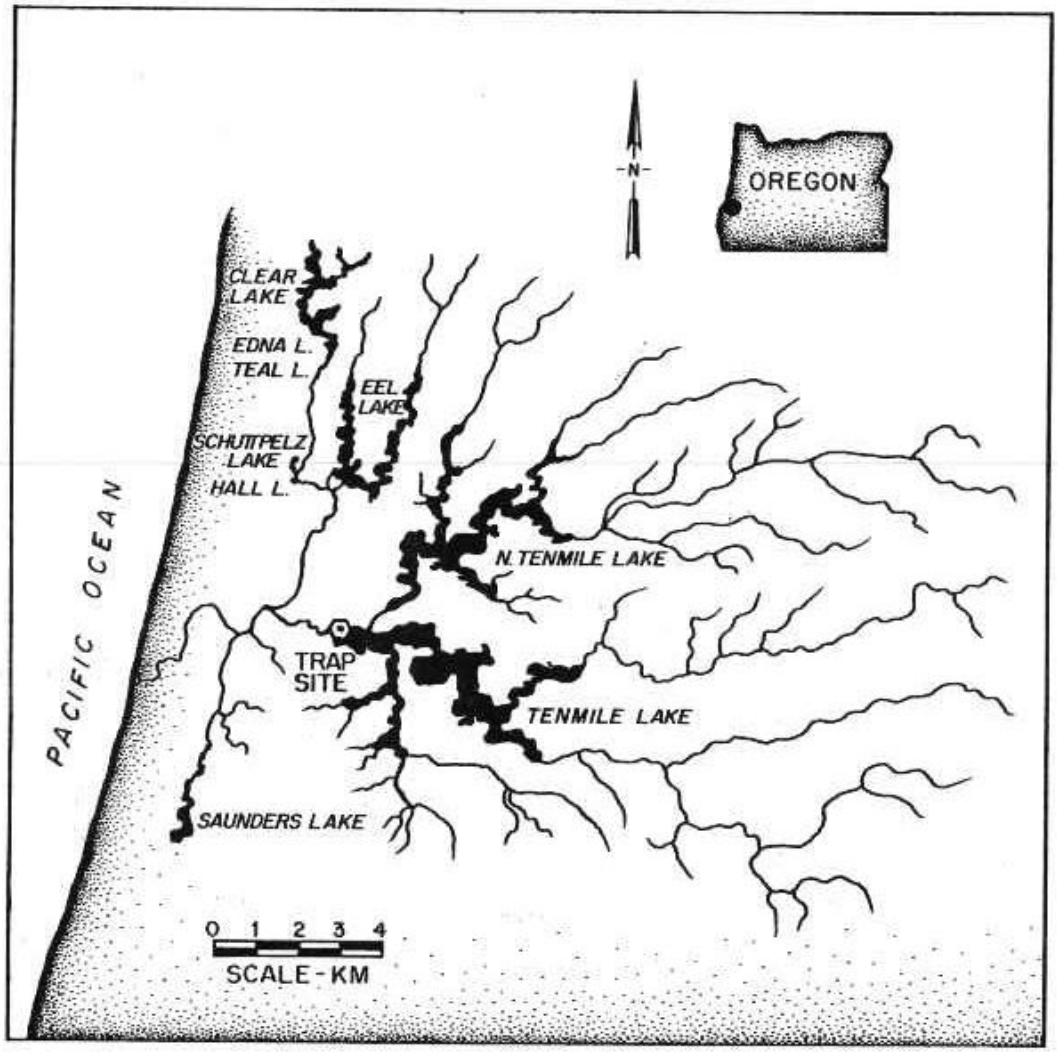

Figure 1. The Tenmile Lakes basin showing lakes and tributary streams.

A large variety of invertebrate species can be found in the waters of Tenmile and North Tenmile lakes. However, mysid shrimp *Mysis mercedes* are the dominant zooplantkon (Anderson 1985). Mysids form an important link in the Tenmile Lakes food chain as they are fed upon extensively by all fish species examined (Gestring 1987, 1988, 1991).

Presently 10 species of fish are commonly found in Tenmile and North Tenmile lakes. Coho salmon were once the dominant species throughout the entire Tenmile Lakes system but have dramatically declined since the late 1950s. Other common native species present are cutthroat trout *Onchoryhnchus clarki,* steelhead *O.mykiss,* rainbow trout *O. mykiss,* eulachon *Thaleichthys pacificus,* threespine stickleback *Gasterosteus aculeatus,* and prickly sculpin *Cottus asper.* Abundant introduced species include largemouth bass *Micropterus salmoides,* bluegill, brown bullhead *Ictalurus nebulosus* and hybrid bass which have been released since 1982 (Table 1).

Table I. Releases of hybrid bass into North Tenmile Lake, 1982-85 and 1987-88.

Year	Date	Number of fry	Date	Number of fingerling
1982	--	--	21 October	3,000
1983	--	--	13 August	1,300
1984	30 May - 04June	107,000	--	--
1985	27 May -15 June	343,000	26 July	10,494
1987	--	--	31 July	14,800
1988	25 May	100,000	2-3 August	4,383

METHODS

Scales were collected from a stratified subsample of all hybrid bass captured as part of the Tenmile Lakes Management Plan Evaluation (Mullarkey and Anderson 1984; Anderson 1985; Gestring 1987, 1988). Scales were collected from the key scale area between the dorsal fins and one row above the lateral line on each side of the fish. Scales were then

stored in scale envelopes along with the date and location of catch and sex, fork length, and weight of the fish.

In addition, scales were taken by ODFW personnel as part of survey work river systems adjacent to Tenmile lakes. When evaluation of the hybrid bass program began in 1984, hybrid bass were found to have moved into Tenmile Lake, and by 1985 hybrid bass were found to have strayed to Isthmus and Catching sloughs in the Coos River system. Beginning in 1988, increased sampling efforts have been made on the Umpqua and Coos rivers in order to obtain scales and gain more information on the relative abundance, age, and growth of hybrids in these systems.

Scales used in the analysis were selected randomly in an attempt to meet a minimum sample size of 30 for each category examined. Scales were placed under a microfiche reader and examined at 41x. Scale distances were measured in millimeters directly on the screen. Measurements were made to the last complete circuli at the beginning of each annulus, to the edge of the scale, and to the fingerling release check, if present.

Scales from known stray fish were examined in an attempt to determine the time of straying, age at straying, brood years which were straying, relative contribution of fry and fingerlings to the stray population, and any growth factors that may contribute to the straying process.

With two types of exceptions, age was determined by counting the number of annuli present on the scale. The first exception occurred when the first annulus was not readily

visible. When this happened, a measurement to the first annulus was not included in the data set, and total age was determined by counting the visible annuli and then adding one year for the invisible first annulus to obtain total age. The second type of exception occurred when fish were captured between 1 January and annulus formation. These were aged by counting the number of annuli present and then adding one because the last annulus had not yet been formed.

The Statistical Processing System (SPSS)™ program was used to calculate a linear regression of total scale distance (in millimeters at 41x) on fork length in millimeters ($r^2 = 0.982$, $N = 214$). The equation obtained ($y = 15.466 + 0.6368x$) was then used to back-calculate fork length at the time of release (fingerling check) and at annulus formation (size at age).

The measurement data were then analysed using a microcomputer and the spreadsheet program in order to calculate the mean scale distance at annulus formation for fish grouped by collection site (Tenmile lake, North Tenmile lake, and strays), by brood year (year of release), and by stage at planting (fry or fingerling release). Sizes of fish within these categories were then compared at each age using pairwise *t*-tests with a Bonferroni adjustment (Zar 1984).

RESULTS

The annuli of hybrid bass in the Tenmile Lakes system were laid down between 15 April and 31 May, with most laid down between 1 May and 15 May. Annuli were characterized by broken and narrowly spaced circuli followed by unbroken and more widely spaced circuli.

The growth rate of hybrid bass in the Tenmile Lakes system was rapid, with fish reaching legal size of 12 in (305 mm) by the end of the second growing season (Figure 2).

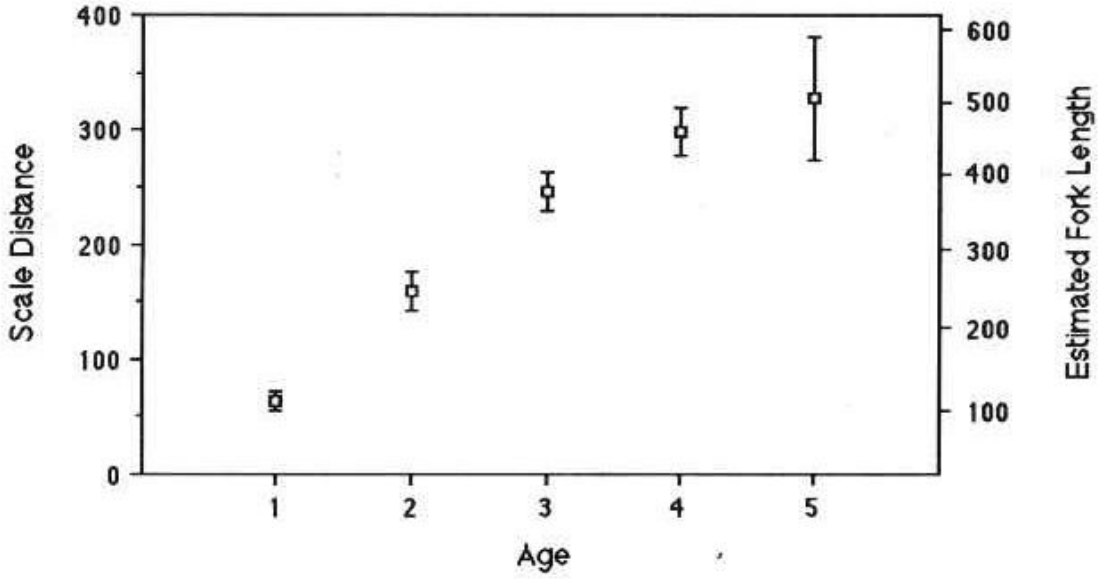

Figure 2. Relationship between measured scale distance at 41x and back-calculated fork length (mm) for all (N = 214) hybrid bass scales examined in this study. Means (boxes) and standard deviations (vertical lines) are given.

I found no significant differences ($P > 0.05$)in the size at annulus formation among the releases from five brood years (Figure 3). Fingerlings pairwise *t*-tests were conducted on scale data collected from the 1984 brood year (fry only) and the 1982 and with the 1983 brood year (fingerling only) fish with the exception of age 2. Statistical tests revealed no significant differences ($P > 0.05$) in size at annulus formation in all brood ages years (Figure 3). At age 2, 1982 brood year fish were signicantly smaller ($P \leq 0.05$) than 1984 brood year fish; however, this difference is not present at ages 1 or 3.

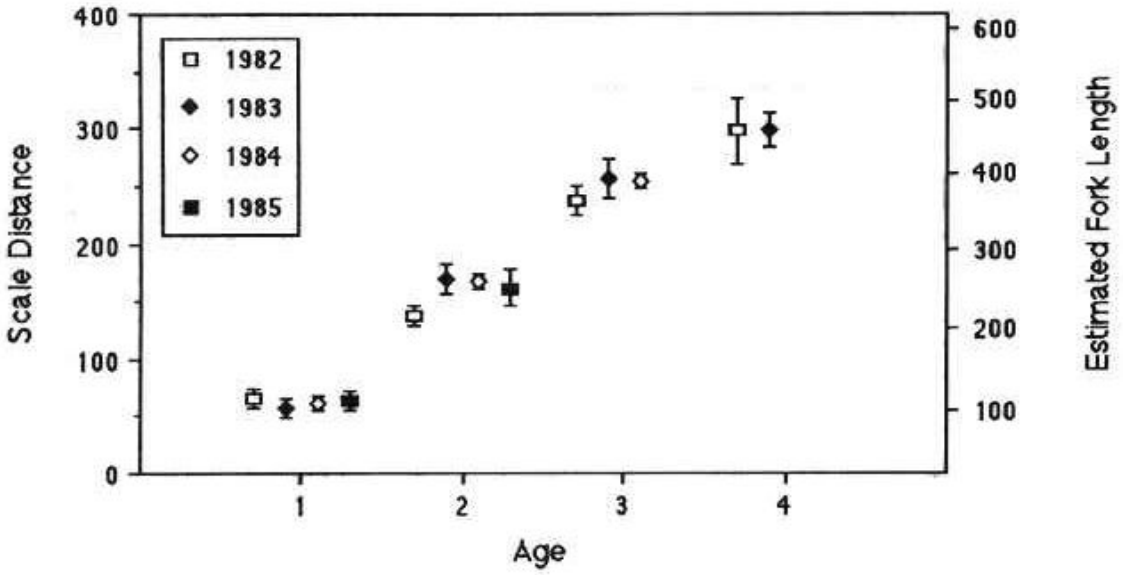

Figure 3. Relationship between measured scale distances at 41x and back-calculated fork length (mm) of hybrid bass from brood years 1982-1985.

I detected and recognized a distinct fingerling-release check that corresponded to the approximate fork length at time of release in each year fingerling were released. This pattern was not observed on hybrid bass from brood years planted only as fry (1984). However, in

brood years with only fingerling plants (1982 and 1983), I found those checks in only 57% of the scales examined. For the 1985 brood, the check was observed on 29 of 91 scales examined. This leaves 62 scales which could have been fingerlings lacking the check or fish planted as fry.

An effort was made to determine the factors that contributed to the formation of fingerling-release checks. Growth was compared for 1982 and 1983 broods between those fish that showed the release check ("fingerling") and those that did not show the fingerling release check ("fry"). Although the sample sizes were extremely small, fish showing the check were significantly larger ($P \leq 0.05$) at the end of the second year of life than those not showing the check. This relationship, however, fell apart after year two, and made conclusions regarding the significance of this release check difficult (Figure 4).

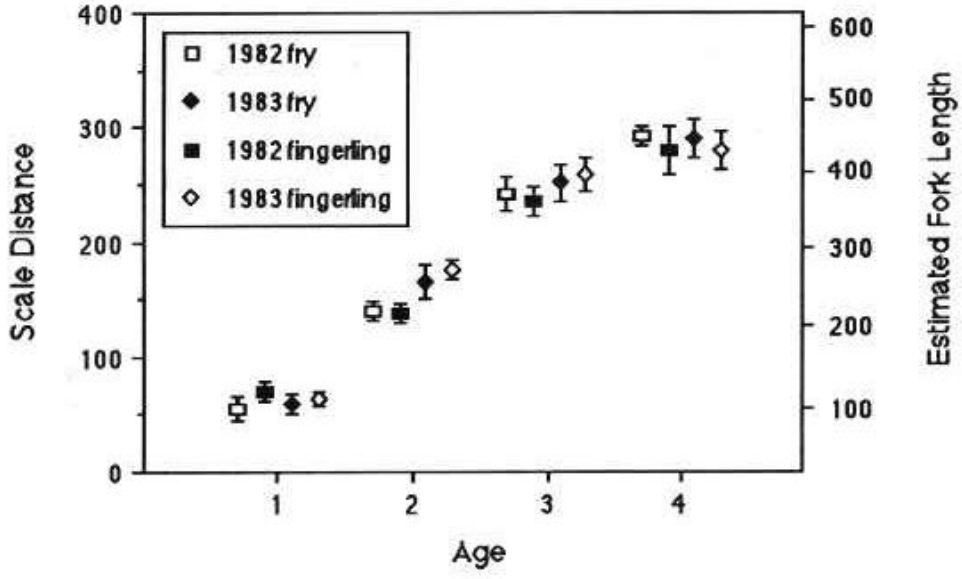

Figure 4. Relationship between measured scale distance at 41x and back-calculated fork lengths for 1982 and 1983 brood year fish with (fingerling) and without (fry) the fingerling release check.

No significant differences ($P > 0.05$) in rate of growth were found between fish captured in Tenmile and North Tenmile lakes, or in the Coos or Umpqua river systems (Figure 5) at ages 1 through 4. Therefore, our success in answering questions regarding the timing of outmigration, age at straying, and growth factors which may contribute to the straying process is extremely limited at present. A limited amount of data was obtained, however, on the relative contribution of fry and fingerlings to the stray population. A total of 14 strays have been identified from the 1982, 1983, and 1985 brood years. All four of the 1982 and 1983-brood strays, were fingerlings but only 3 of 4 showed the fingerling check. Because I could not identify a fingerling check on all fingerling scales, sorting all the 1985-brood strays into fry and fingerlings was not possible. I did observe a fingerling check on 4 of 10 strays from the 1985-brood. Therefore, 8 of 14 strays (57%) are known fingerling releases. The remaining 6 fish could have been either fry or fingerlings.

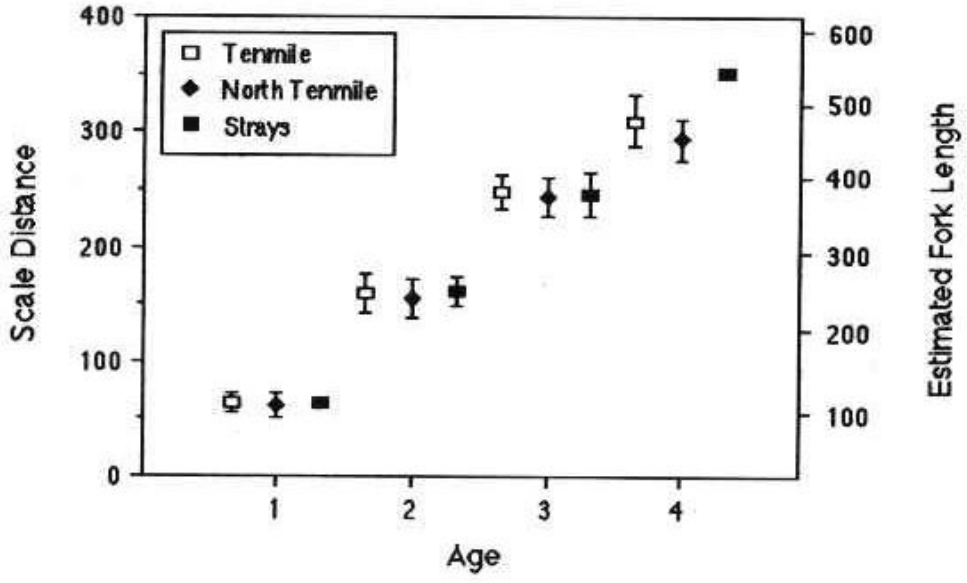

Figure 5. Relationship between measured scale distance at 41x and back-calculated fork length of hybrid bass capture in Tenmile and North Tenmile lakes compared with strays.

DISCUSSION

The pattern of growth of hybrid bass in the Tenmile Lakes system is one of rapid growth from the late spring through the late fall and slow growth in the winter and early spring. Although evidence is limited, gillnet and angler catchability levels (ODFW, unpublished data) seem to indicate that hybrid bass are inactive from October through April. Despite the short growing period, rate of growth of hybrid bass in the Tenmile Lakes system was rapid. However, the size at each annulus is lower than average when compared with studies conducted in other freshwater systems (Table 2). By age one Tenmile fish reached an average size of 127 mm. Other populations studied showed an average fork length of 244 mm at age one. This relative difference between Tenmile and other systems continues through the 5th year of life.

Table 2. Comparison of average back-calculated lengths at annulus formation for hybrid bass in Tenmile Lake and elsewhere in the USA. Lengths in those reports marked with an asterisk were given in total length, but were converted to fork length using the conversion fork length = 0.93 (total length) (Manseuti 1961).

Location	Study	Fork length (mm) at age				
		1	2	3	4	5
Tenmile Lakes	Herein	127	275	409	497	536
Alabama	Moss and Lawson (1982)	229	362	468	545	
Florida	Yeager et al. (1983)	281	406			
Georgia	Ott and Malvestuto (1981)*	265				
	Keefer (1981)*	279	391	577		
	Germann and Bunch (1983)*	259	399	457	499	556
Illinois	Douglas (1986)*	290	341	462		
Kentucky	Kinman (1987)*	233	397	472	526	572
Virginia	Kerby, et al. (1971)	119	271			

A comparison of growth increments (Table 3) indicated that fish from Tenmile Lakes showed a slow growth rate to age 1, but this pattern quickly shifted. In years 2 through 4 the Tenmile Lakes fish show a growth rate higher than the average of other studies. Comparison at age 5, however, is probably not meaningful because of small sample size of older fish.

Table 3. Comparison of average annual growth increments for hybrid bass in Tenmile Lakes and elsewhere in the USA.

		Average annual growth increments (mm)				
Location	Study	1	2	3	4	5
Tenmile Lakes	Herein	127	148	139	88	39
Alabama	Moss and Lawson (1982)	229	133	106	77	
Florida	Yeager et al (1983)	281	125			
Georgia	Ott and Malvestuto (1981)	265				
	Keefer (1981)	279	112	186		
	Germann and Bunch (1983)	259	140	58	42	57
Illinois	Douglas (1986)	290	51	121		
Kentucky	Kinman (1987)	233	164	75	54	46
Virginia	Kerby et al. (1971)	119	159			

As these results indicate no change in rate of growth as a result of the increasing population size over time, and stocking rate has been shown to have significant effects on growth rates in other systems (Austin and Hurley 1987; Germann and Bunch 1983), we can only infer that the carrying capacity of Tenmile Lakes has not been reached.

Although scales have provided an excellent record of growth, they have so far failed to provide key information needed to distinguish fry from fingerlings or to determine the age and time of straying from Tenmile Lakes system. In the 1988 season fingerlings were

coded-wire-tagged to allow separation of fingerling from fry releases. Rate of growth alone is not enough to evaluate the relative success of the fry versus fingerling programs. Estimates of survival rates are needed. Unfortunately, data were not available on relative survival of the brood years present in the lake. However, relatively few 1984-brood year fish (fry-only release) have been recovered, indicating a lower survival rate than the fingerling plant years. Future sampling should include efforts to determine population size and relative survival rates of the various brood years using fingerlings marked with coded-wire tags.

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