RESEARCH REPORT 46

COMPARATIVE GROWTH OF EIGHT SPECIES OF FISH IN THIRTEEN NORTHERN WISCONSIN LAKES

By

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ABSTRACT

Fish from 13 lakes in northwestern Wisconsin were collected from 1 to 14 years. Eight species were chosen for this study: largemouth bass, rock bass, bluegills, black crappies, yellow perch, northern pike, pumpkinseeds, and walleyes. Total length and age were recorded for 17,329 fish.

Significant differences occurred in the growth of bluegills in drainage versus seepage lakes. Similar but smaller differences were found in rock bass, black crappies, yellow perch and pumpkinseeds. Growth rates differed within the same lake for a single species in different years; growth rates also differed within the same lake for different species. Most Wisconsin lakes were believed to be within the ranges for the fastest and slowest average growth for each of the 8 species of fish.

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Aerial photo of 3 drainage lakes showing Bolger Flowage in the foreground with Hemlock Lake and Red Cedar Lakes across the upper part of the picture (above). Aerial photo of Clear Lake, a seepage lake (below).

INTRODUCTION

Variation in growth rate is a normal characteristic of fish (Le Cren, 1965). It is well known that fish of the same species and age can be very different in size. Yet there is very little published information on the growth rates of fish in Wisconsin.

Since 1954, the Wisconsin Department of Natural Resources has sponsored the collection of information on the growth of the more important game fish and panfish in northwestern Wisconsin. This is a report on that effort.

In the beginning I sampled only Murphy Flowage. As the study progressed, other lakes were included in order to enable comparisons with the Murphy Flowage data. Bucks Lake was chosen because it was known to have fast-growing panfish, and Clear Lake because it had extremely slow-growing bluegills. Other lakes were sampled because they were regarded as "average", or in the cases where a lake was sampled only one or two years, gathering facts for this study was incidental to other field assignments.

In spite of this "uneven" collection of data (one lake was sampled for fourteen years and others for only one), I have gathered the information together in the belief that it may provide some insight into the characteristic growth of fish in this region and quite possibly in all of Wisconsin.

LOCATION AND DESCRIPTION OF LAKES

The lakes are in northwestern Wisconsin, except for Big Gibson Lake located in the north central part of the state. Eight of the thirteen lakes are in the upper Red Cedar River drainage basin (Fig. 1).

The lakes range in size from 11 acres (Lowland Lake) to 1,882 acres (Red Cedar Lake) (Table 1). Eight are drainage lakes and five are seepage lakes. For purposes of this report I have distinguished between drainage and seepage lakes in the following way: Drainage lakes have outlet streams while seepage lakes are landlocked or nearly so. A seepage lake has neither an inlet nor an outlet stream and loses water primarily by evaporation and seepage through the walls and floor of its basin. Generally, drainage lakes are more fertile than seepage lakes because they have a larger source of nutrients.

The following are brief descriptions of the individual lakes (Table 1).

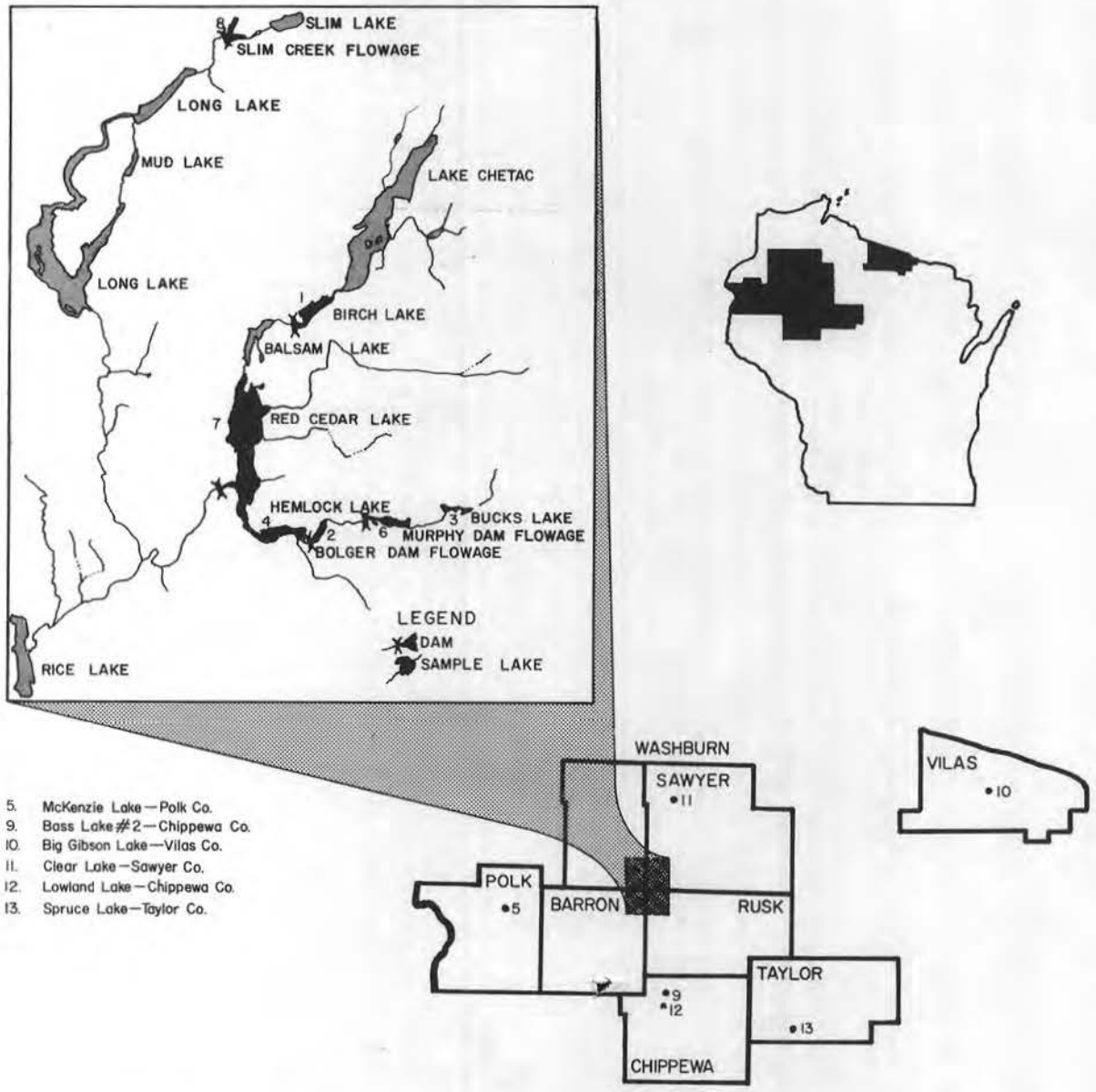

FIGURE 1. The location of the lakes sampled from this study.

Drainage Lakes

Birch Lake is a medium hard water lake on the Red Cedar River between Lake Chetac and Balsam Lake in Washburn County. Its outlet has a 19-foot water control structure that is maintained by Northern States Power Company. The most common species of fish are northern pike (Esox lucius), largemouth bass (Micropterus salmoides), walleye (Stizostedion vitreum vitreum), bluegill (Lepomis macrochirus), black crappie (Pomoxis nigromaculatus), yellow perch (Perca flavescens), and pumpkinseed (Lepomis gibbosus). White sucker (Catostomus commersoni), bowfin (Amia calva), smallmouth bass (Micropterus dolomieui), rock bass (Ambloplites rupestris), brook silverside (Labidesthes sicculus)

and several species of minnows are also present. Most of the shoreline is already developed. Ten resorts and 42 cottages or homes line the shore. There is one public access and one camping area on the lake.

Bolger Flowage, in Barron and Rusk Counties, is a soft water impoundment on Hemlock Creek. Its outlet has an 8-foot water control structure owned by Barron County. The most common fish species are bluegills, northern pike, black crappies and pumpkinseeds. Muskellunge (Esox masquinongy), perch, largemouth bass, brown bullheads (Ictalurus nebulosus), white suckers, rock bass and several species of minnows are also present. There is one public access area which was completed in 1966. Before that time there was limited access through a private landowner's field. The shoreline is wooded (upland hardwoods and some tag alder) and has only one cottage.

Bucks Lake is a soft water impoundment on Hemlock Creek in Rusk County. It has a new 10-foot water control structure, built in 1967. The most common fish species include northern pike, black crappies, yellow perch, pumpkinseeds, bluegills, and several species of minnows. Rock bass and white suckers are also present. This is a wilderness lake with a shoreline covered by upland hardwoods and a number of tamarack bogs. There are 2 public access areas. The entire shoreline is in public ownership.

Hemlock Lake is a medium hard water lake on Hemlock Creek with an outlet flowing into Red Cedar Lake. The water control structure on Red Cedar Lake maintains the level of Hemlock Lake. Common species of fish in this lake are northern pike, walleyes, largemouth bass, yellow perch, bluegills, black crappies, and white suckers. Muskellunge, rock bass, smallmouth bass, pumpkinseeds, brown bullheads, redhorse (Maxostoma sp.), bowfins, brook silversides, and several species of minnows are also present. There are 2 resorts and 16 cottages on the lake. Upland hardwoods and scattered white pine surround the lake. There is one public access point.

McKenzie Lake is a hard water drainage lake on McKenzie Creek in Polk County. It has a navigable outlet and two non-navigable inlet streams. Northern pike, bluegills, yellow perch, black crappies, largemouth bass, pumpkinseeds and bullheads inhabit the lake. The entire shoreline is in public ownership.

Murphy Flowage is a large soft water lake in Hemlock Creek, Rusk County, between Bucks Lake and Bolger Flowage. It has a 10-foot water control structure on its outlet. Its most common species of fish are northern pike, bluegills, pumpkinseeds, black crappies, and yellow perch. Others include muskellunge, largemouth bass, rock bass, brown bullheads, white suckers and several species of minnows. The county

maintains the public campground and the state has a mandatory creel census station on the flowage. Access is available at either of these sites. There are 2 private cottages on the lake and the rest of the shoreline is covered with upland hardwoods belonging to Rusk County.

Red Cedar Lake is a medium hard water lake on the Red Cedar River. Its outlet has an 11-foot water control structure maintained by Northern States Power Company. The most common fish species are walleyes, northern pike, largemouth bass, smallmouth bass, yellow perch and rock bass. Others present include muskellunge, bluegills, bowfins, black crappies, pumpkinseeds, yellow bullheads (Ictalurus natalis), ciscos (Coregonus sp.), white suckers, redhorse and several species of minnows. There are 72 cottages and dwellings, and a Boy Scout camp on the lake. A large portion of the east shore is privately owned but presently undeveloped. Public camping is available at the Barron County Park on the northwest shore of the lake. There are 2 public boat access points on the west shore.

Slim Creek Flowage is a medium hard water lake located on Slim Creek in Washburn County. Its outlet has a dam that is maintained by the county. The common fish species include bluegills, northern pike, and black bullheads (Ictalurus melas). Largemouth bass, pumpkinseeds and yellow perch are also present. There are 2 private cottages on the flowage but the remainder of the land belongs to Washburn County. The county maintains both a campground and boat access.

Seepage Lakes

Bass Lake No. 2 in Chippewa County, Town of Cleveland, is a landlocked lake with very soft water. It is a wilderness lake, having no access roads or private development. It has largemouth bass, bluegills and muskellunge. The muskellunge are not native but were stocked.

Big Gibson Lake is a seepage lake of low fertility. Its principal fish species are bluegills, largemouth bass, walleyes, yellow perch, pumpkinseeds, rock bass and muskellunge. Access is possible by a town landing, but there are no use facilities on the lake. There are 3 cottages or dwellings on or near the shoreline.

Clear Lake in Sawyer County is a landlocked soft water lake. It has mainly muskellunge, walleyes, bluegills, black crappies, largemouth bass and pumkinseeds. Other fish species present include rock bass, yellow perch, black bullheads, white suckers, redhorse and several species of minnows. It has one resort, 13 cottages and one public access on the west side of the lake. Muskellunge and walleye have been stocked.

Lowland Lake, Chippewa County, is a landlocked lake with very soft water, and has a fish population of largemouth bass, pumpkinseeds and bullheads. It is subject to an occasional partial winterkill. There is one dwelling on its shore and no public access.

Spruce Lake is a soft water, landlocked lake in Taylor County. In 1960 it was chemically treated with Rotenone to remove all fish, and rainbow trout (Salmo gairdneri) and brook trout (Salvelinus fontinalis) have been planted every year since. Before 1960 the fish population included bluegills, yellow perch and largemouth bass. The shoreline is composed of bogs and upland hardwoods and has one public access area.

TABLE 1

Selected Water Quality Parameters of Lakes Studied

	Date Sampled	Area (acres)	Maximum Depth	Alk.	pH	Cond. (mmhos)
Drainage Lakes:						
Birch Lake	July 1963	270	73	56	8.8	118
Bolger Flowage	1965-67*	78	15	42	7.6	106
Bucks Lake	1965-67*	82	18	42	7.6	99
Hemlock Lake	Mar. 1964	410	21	45	7.1	100
McKenzie Lake	Feb. 1960	57	18	118	-	256
Murphy Flowage	1965-66*	180	14	38	7.9	85
Red Cedar Lake	Oct. 1962	1,882	53	66	7.2	127
Slim Creek Flow.	Nov. 1965	54	27	81	8.2	166
Seepage Lakes:						
Bass Lake No. 2	Oct. 1965	12	41	5	6.5	15
Big Gibson Lake	Sept. 1960	116	15	9	7.0	27
Clear Lake	July 1964	77	32	27	7.4	59
Lowland Lake	Feb. 1961	11	24	6	6.8	30
Spruce Lake	Aug. 1966	20	58	4	5.5	23

*Alkalinity, pH, and conductance data in these lakes are mean figures based on 2 to 56 samples covering periods of 2 to 24 months.

METHODS

All of the fish were captured by electrofishing, except those from Murphy Flowage before 1961 which were collected with fyke nets or caught by fishermen. During a part of each electrofishing survey, one man used a fine-mesh bobbin netting dip net to capture the smaller-sized fishes. Sampling was usually in October, but in some cases from September 15 through December. In every case it was at the end of the growing season. Therefore, in this report the age of fish is indicated by the number of growing seasons completed, and is expressed in arabic numerals.

All of the fish were measured to the nearest 1/10 inch, so that the lengths presented here are the total lengths at the time of capture. Length measurements for both sexes were combined even in species where a sexual growth differential is well known. This may be questioned, but in practice it is not always possible to determine the sex of fish when assessing the growth rate in a population.

Average lengths were weighted for sample size for each lake, each year. However, when growth data from several lakes were combined to get a regional growth rate, I took a simple, or unweighted, average of averages.

Although large numbers of all sizes of fish were captured, I collected a stratified sample of scales by length groups, usually from 1-5 fish per 1/10-inch group. From each fish sampled several scales were removed from below the lateral line, just posterior to the tip of the pectoral fin. Plastic impressions of these scales were examined with a binocular microscope at a magnification of 35 diameters in order to determine the age of the fish.

In this report, fish ages are in most cases determined from scales. The exceptions to this are some of the fish in ages 1 and 2, where on all fish the frequency distribution of the lengths had distinct modes. After this had been repeatedly verified by scale examination, I discontinued the collection of scales on these length groups. Because older fish are difficult to age accurately, this report does not include data on fish that have lived more than 9 growing seasons. I personally aged about 75 percent of the scales and closely checked the remainder which were aged by experienced technicians.

DETERMINING AGE FROM SCALES

In order to determine the growth rate of a fish population it is essential to determine accurately the age of individual fish. Collecting scales at the end of the growing season and attempting to determine age through only 9 growing seasons helped to minimize the aging errors in this study. In general, centrarchid scales were the easiest to age and northern pike scales were the most difficult. Older yellow perch and walleye specimens were also difficult to age, but the ages reported here for these species are probably more reliable than those for northern pike.

In the course of several years I have aged several hundred northern pike using both scales and fin sections. Many of these were tagged fish of known age differential, so that it was possible to check the accuracy of the aging techniques. Based upon this experience, the ages of northern pike given here are considered reliable through 4-5 growing seasons. However, the age reported for older northerns should properly be considered "educated estimates." Runnstrom (1955) also reported having difficulties in reconciling the known age of northern pike with the apparent annuli on their scales.

Difficulties in aging centrarchid scales can also occur, especially within a slow-growing population. Bennett (1962), Lagler (1956), Sprugel (1953) and others have reported this. In 1968, I reported the aging of an extremely slow-growing bluegill population in Clear Lake, Wisconsin (also included in this study). In Clear Lake, bluegills rarely grow to be 6 inches in 10 years. They have very closely spaced annuli, yet they are relatively easy to age. The accuracy of the age determinations was verified by a comparison of the relative abundance of each year class.

The determination of the first annulus is somewhat difficult in all species and especially so in centrarchids, where the first annulus does not always show the crossing over typical of the later annuli. The first annulus is very close to the focus of the scale, which is understandable since the length of the entire fish at the time of annulus formation may be less than 1 inch. Because of this difficulty, however, I made an intensive effort to capture small fish for this study. In most lakes the lengths of bluegills, ages 1 and 2, form distinct frequency distributions. Where a first annulus was doubtful, the fish usually fell in the size range where the lengths of fishes from season 1 and 2 overlapped. Therefore, the doubtful specimens were assigned to age 2.

RESULTS

The length and age of 17,329 fish of 8 species constitute the basic data of this report and are shown in Tables 2-9. Sixty percent of these fish were bluegills. In order of decreasing numbers, other species were: black crappie, pumpkinseed, yellow perch, northern pike, largemouth bass, rock bass and walleye.

Occurrence of Species

Bluegills and largemouth bass were in 12 of the 13 lakes sampled. Yellow perch and pumpkinseeds were in 11, black crappies in 9, rock bass and northern pike in 8 and walleyes in 5 lakes. Each of these species was found in both seepage and drainage lakes except northern pike which did not occur in the seepage lakes.

Growth Variation

With Drainage and Seepage Lakes: While a comparison of drainage and seepage lakes was not intended when this study began, the data show a significant difference at the 1 percent level between the growth rates of bluegills in these two types of lakes (Fig. 2). This difference is evident by the end of the second growing season and increases with age. The average length of bluegills, age 2, in drainage (high alkalinity) lakes is 3.1 inches, compared to 2.7 inches for bluegills in seepage (low alkalinity) lakes (Table 2). By the end of growing season 5 this difference has increased to more than 2 inches. After the fifth

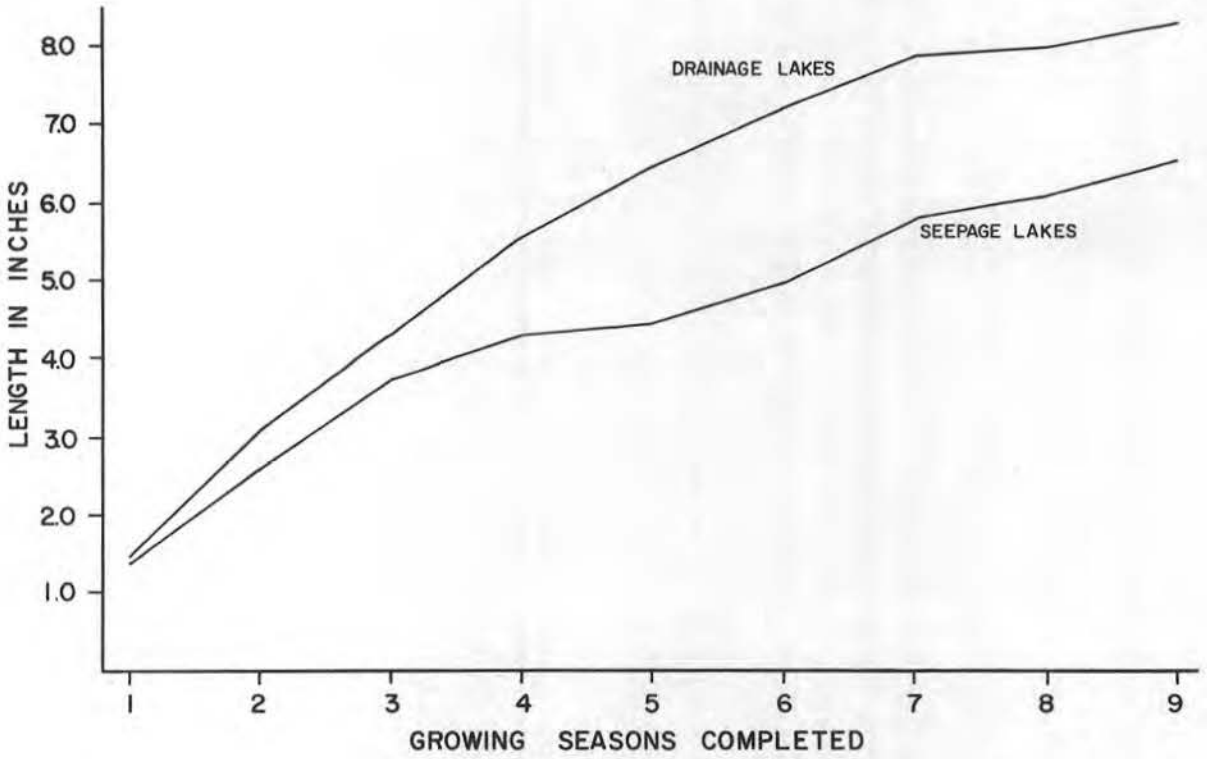

FIGURE 2. A comparison of bluegill growth in drainage versus seepage lakes.

growing season, bluegills in drainage lakes continue to average approximately 2 inches longer than those in seepage lakes. Churchill (pers. comm.) found similar differences in bluegills from lakes in northeastern Wisconsin.

The data on other species indicate that the same differential in growth rate between fish found in the 2 types of lakes also holds for pumpkinseeds, and quite possibly for all of the centrarchids (except largemouth bass) and walleye. The growth of largemouth bass shows no difference between these two lake types and the very limited data on walleyes show the differential in reverse, i.e., walleyes grew better in the seepage lakes we sampled than in the drainage lakes.

However, because this study was not designed with a comparison of these lake types in mind, seepage lakes, and in some cases both lake types, were not adequately sampled for most species. For this reason data on the effect of lake type on species other than the bluegill are inconclusive.

With Age: It is usually not until after the first summer that slow growth becomes apparent. Fish of both fast- and slow-growing populations are about the same size at the end of the first growing season.

With Lake: The growth of northern pike varied most among the different lakes; growth of largemouth bass varied the least. Figures

3 through 10 show the fastest and the slowest average growths for each species. These curves were plotted to show the extremes in growth for each age. For most species growth rates were spread quite evenly between the extremes. However, this was not true of bluegills. In 10 out of the 12 lakes the growth rate of bluegills fell within a fairly definite range (see dotted lines in Fig. 3). When plotted on a graph the range appears rather narrow. Nevertheless, within that range the difference between bluegills at age 6 is from 5 to 8 inches, which can mean the difference between desirable and undesirable fish for anglers.

It is interesting to note that Beckman (1946) found no consistent growth differences in the growth of fish in three different zones in Michigan, while these data show drastic differences even within the same watershed. (Northern pike and walleye were not included in Beckman's study.)

Bluegills grew fastest in Bucks Lake and most slowly in Clear Lake. In Bucks Lake, bluegills averaged 6 inches by age 3; in Clear Lake they did not average 6 inches until age 7. If anglers consider 6 inches the minimal "desirable" size of bluegills, about 50 percent of the lakes in this study produced bluegills of a desirable size sometime during the fifth growing season. The variation in the growth of large game fish such as the northern pike is considerably greater than for panfish. Northern pike, age 5, averaged only 16 inches in Slim Creek Flowage compared to 30 inches in McKenzie Lake.

With Year: The growth of bluegills in Murphy Flowage varied considerably over the 14 years of this study. In 1955, age 5 bluegills averaged 7.1 inches long, compared to 4.9 inches in 1967. While the size of the fish decreased, the number of fish in the population increased

Scales from bluegills 8.2 inches long (left) and 3.8 inches long (right). Both fish had 5 summers of growth.

greatly according to the population estimates that have been made each year since 1955. This is true for the other centrarchids as well.

With Species: Growing conditions may be different for each species within the same lake. For example, Clear Lake had the slowest-growing bluegills, but average or above average growth of largemouth bass. Bucks Lake had the fastest-growing panfish but almost the slowest-growing northern pike. For this reason lakes should be evaluated for fish growth in terms of particular species.

SUMMARY

This study has documented the growth variation for the more important game fish and panfish occurring in 13 northern Wisconsin Lakes. Differences of statistical significance occurred in the growth of bluegills in drainage versus seepage lakes. Similar differences probably hold for the other centrarchids as well. In addition, growth differed within the same lake in different years, and within the same lake for different species.

This work points up the necessity of determining the age structure of a fish population when assessing the fishery of a given lake. All of the lakes had bluegills that were 6 inches long. The important differences were in the proportion of the population that attained any given size, and in the length of time required to do so. In order to determine the age structure of a population, one must capture representative samples of all sizes of fish and determine their ages.

It is my judgment that the ranges graphed in Figures 3-10 for the fastest and slowest average growth for each species would be applicable to most northern Wisconsin lakes, and very probably to most lakes throughout the state. However, what constitutes "average" growth may vary with the latitude or with the region.

Finally these data suggest that further studies are needed to analyze the biological, chemical and physical characteristics of lakes in relation to fish growth. It would seem that a comparative study of drainage and seepage lakes with their related differences might be particularly productive.

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TABLE 2

Bluegill: Average Total Lengths at the End of the Growing Season in 12 Lakes (in Inches)

Lake	No. Fish	Growing Season Completed								
		1	2	3	4	5	6	7	8	9
Drainage										
Birch Lake	914	1.3	2.9	4.4	5.6	6.7	7.4	8.0	8.7	9.0
Bolger Flowage	519	1.4	2.6	3.6	4.5	5.1	5.8	6.3	6.6	6.7
Bucks Lake	790	1.8	3.8	6.0	7.0	8.2	9.2	10.5		
Hemlock Lake	239	1.6	2.8	4.1	5.5	6.9	7.3	7.8	8.4	8.5
McKenzie Lake	117	1.4	2.9	3.9	4.7	5.4	6.4	7.2	7.6	8.3
Murphy Flowage	5,888	1.5	2.9	4.1	5.3	6.1	6.7	7.1	8.0	9.0
Red Cedar Lake	45	1.5	3.5	4.4	6.4	6.8	7.2	8.3	8.9	
Slim Creek Flowage	210	1.2	-	4.0	6.0	6.8	7.8	8.3		
Average		1.5	3.1	4.3	5.6	6.5	7.2	7.9	8.0	8.3
Seepage										
Bass Lake No. 2	84	-	2.5	3.2	4.1	4.6	5.2	6.5	-	6.8
Big Gibson L.	41	1.3	3.2	4.4	5.7					
Clear L.	1,115	1.4	2.2	2.6	3.2	3.8	4.3	5.0(6)*	5.4	5.8
Spruce Lake	337	1.6	2.9	3.7	4.2	4.9	5.4	6.0	6.8	7.2(3)*
Average		1.4	2.7	3.4	4.3	4.4	5.0	5.8	6.1	6.6

*Numbers in parenthesis indicate the number of fish in the sample when that number is than less than ten.

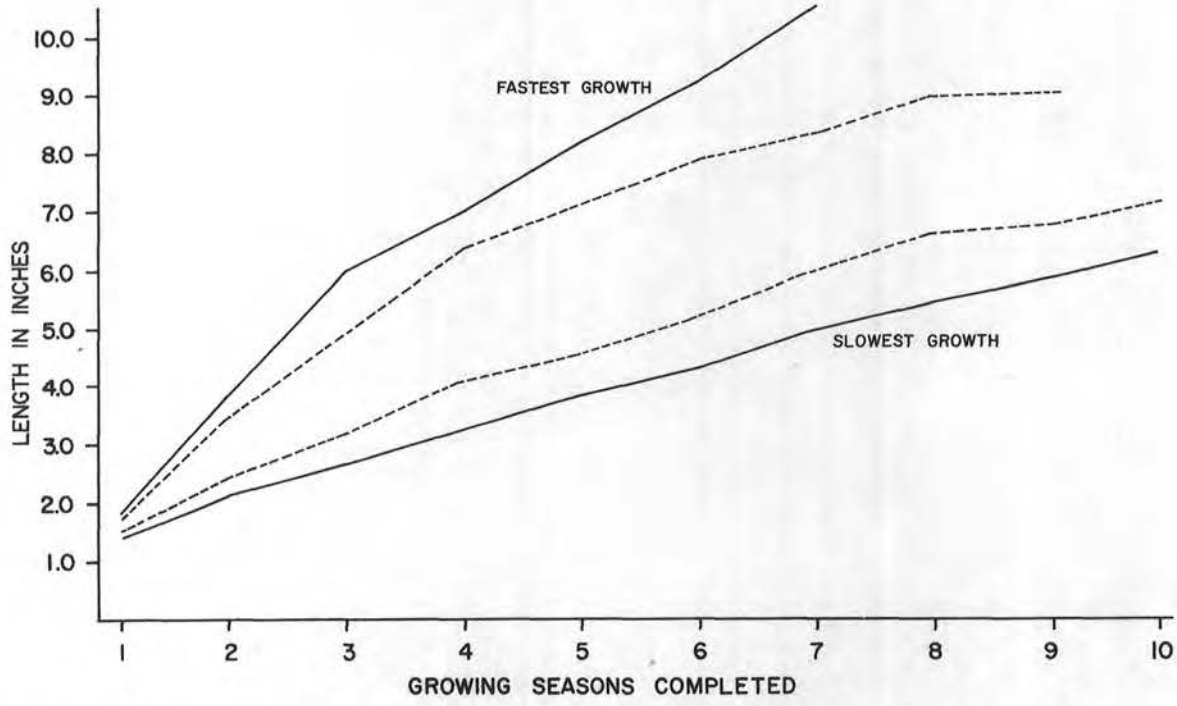

FIGURE 3. Bluegill: Fastest and slowest average growths observed. (Data for different ages may be from different lakes.) The dotted lines indicate the range within which 10 of the 12 lakes fell.

TABLE 3

Black Crappie: Average Total Lengths at the End of the Growing Season in 9 Lakes (in Inches)

Lake	No. Fish	Growing Seasons Completed 1	2	3	4	5	6	7
Drainage								
Birch Lake	584	2.3	4.9	7.3	8.7	9.7	10.9	11.3
Bolger Flowage	168	2.1	4.0	5.2	6.0	7.1	7.8	8.2
Bucks Lake	461	2.4	6.0	8.6	10.3	11.2		
Hemlock Lake	107	2.4	4.5	6.7	8.2	9.0	10.4	9.6
McKenzie Lake	13	-	4.9	-	9.1	8.6		
Murphy Flowage	432	2.5	4.2	5.3	6.6	7.3	8.5	9.7
Red Cedar Lake	72	2.7	5.6	7.8	-	10.3	11.6	-
Average		2.4	4.9	6.8	8.0	9.0	9.8	9.7
Seepage								
Clear Lake	50	-	-	6.4	6.6	7.7	8.6	9.9
Spruce Lake	7	-	-	-	-	7.7	9.4	8.9
Average		-	-	6.4	6.6	7.7	9.0	9.4

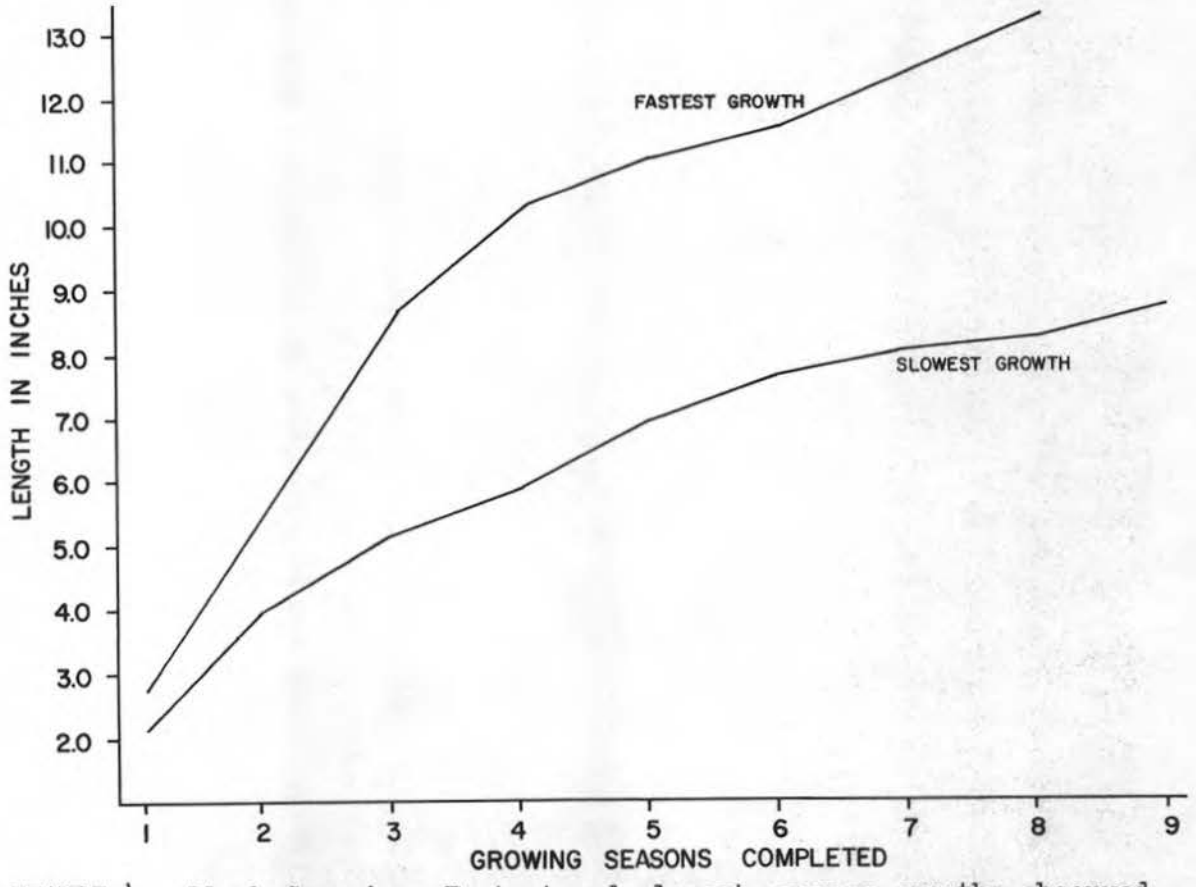

FIGURE 4. Black Crappie: Fastest and slowest average growths observed. (Data for different ages may be from different lakes.)

TABLE 4

Yellow Perch: Average Total Lengths at the End of the Growing Season in 11 Lakes (in Inches)

Lake	No. Fish	Growing Seasons Completed					
		1	2	3	4	5	6
Drainage							
Birch Lake	646	3.0	5.0	6.5	7.4	8.3	8.9
Bolger Lake	2	-	2.9	4.4			
Bucks Lake	150	2.9	5.1	6.0	9.5	-	11.6
Hemlock Lake	73	2.7	4.0	5.1	6.3	9.0	
McKenzie Lake	22	-	4.3	5.0	5.9	6.4	
Murphy Flowage	58	2.7	4.4	5.2	5.8	7.0	7.1
Red Cedar Lake	120	2.4	4.3	6.5	7.9	9.0	9.7
Average		2.7	4.3	5.5	7.1	7.9	9.3
Seepage							
Big Gibson L.	45	2.4	3.9	4.9	6.7	7.0	
Clear L.	220	2.6	3.6	4.7	5.2	6.2	7.2
Spruce Lake	29	2.9	4.2	5.3	5.8		
Average		2.6	3.9	5.0	5.9	6.6	7.2

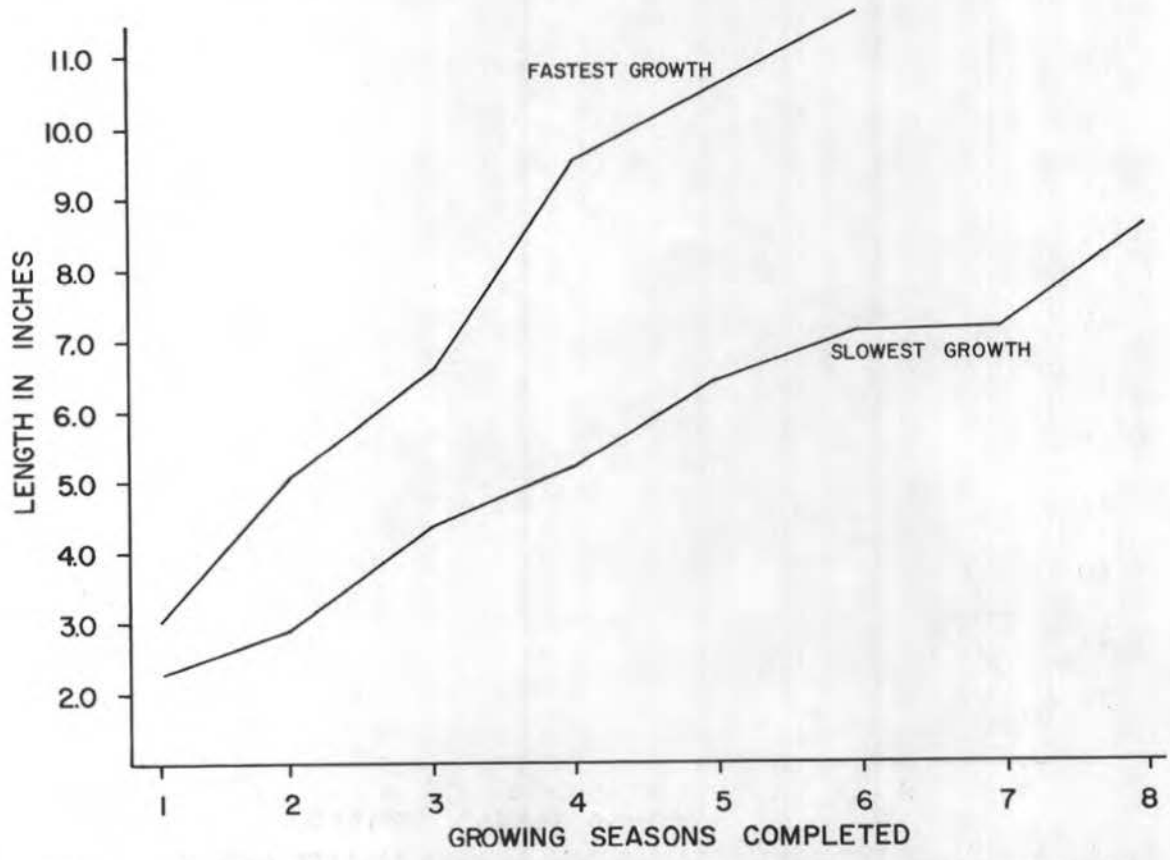

FIGURE 5. Yellow Perch: Fastest and slowest average growths observed. (Data for different ages may be from different lakes.)

TABLE 5

Pumpkinseed: Average Total Lengths at the End of the Growing Season in 11 Lakes (in Inches)

Lake	No. Fish	Growing Seasons Completed					
		1	2	3	4	5	6
Drainage							
Birch Lake	175	1.7	2.9	4.4	5.2	5.8	5.8
Bolgers Lake	4	1.5	-	-	3.6	-	6.9
Bucks Lake	839	1.8	3.2	5.4	6.7	7.4	7.5
Hemlock Lake	30	-	2.5	4.3	5.5	6.2	6.9
McKenzie Lake	37	-	2.9	-	4.3	6.0	6.5
Murphy Flowage	149	1.7	2.7	3.7	4.7	5.4	6.1
Red Cedar Lake	4	2.3	3.4	5.1			
Slim Creek Flowage	9	-	-	3.8	4.9	5.8	
Average		1.8	2.9	4.5	5.0	6.1	6.6
Seepage							
Big Gibson L.	3	-	3.1				
Clear L.	53	-	2.5	3.3	3.8	4.4	5.3
Lowland Lake	132	-	2.0	2.5	3.1	3.7	3.8
Average			2.5	2.9	3.5	4.1	4.6

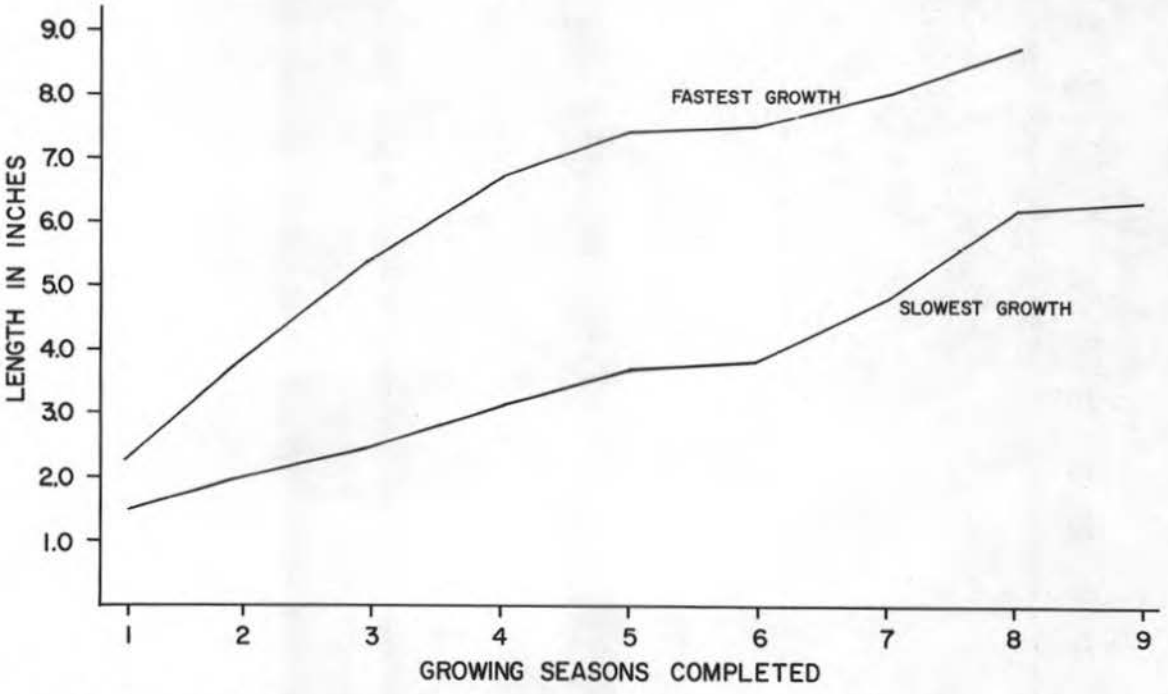

FIGURE 6. Pumpkinseed: Fastest and slowest average growths observed. (Data from different ages may be from different lakes.)

TABLE 6

Rock Bass: Average Total Lengths at the End of the Growing Season in 8 Lakes (in Inches)

Lake	No. Fish	Growing Seasons Completed					
		1	2	3	4	5	6
Drainage							
Birch Lake	117	1.8	2.9	4.4	5.9	6.9	8.2
Bolger Lake	24	1.7	3.1	3.8	5.1	6.6	7.7
Bucks Lake	27	2.2	5.1	7.2	9.0	9.8	11.5
Hemlock Lake	1				6.4		
Murphy Flowage	76	1.7	2.9	4.2	6.0	6.6	7.4
Red Cedar Lake	56	1.8	3.2	4.0	6.4	7.6	
Average		1.8	3.4	4.7	6.5	7.5	8.7
Seepage							
Big Gibson L.	12	-	2.5	4.2	5.8		6.7
Clear L.	33	1.8	2.3	3.9	4.9	6.2	7.2
Average		1.8	2.4	4.1	5.4	6.2	7.0

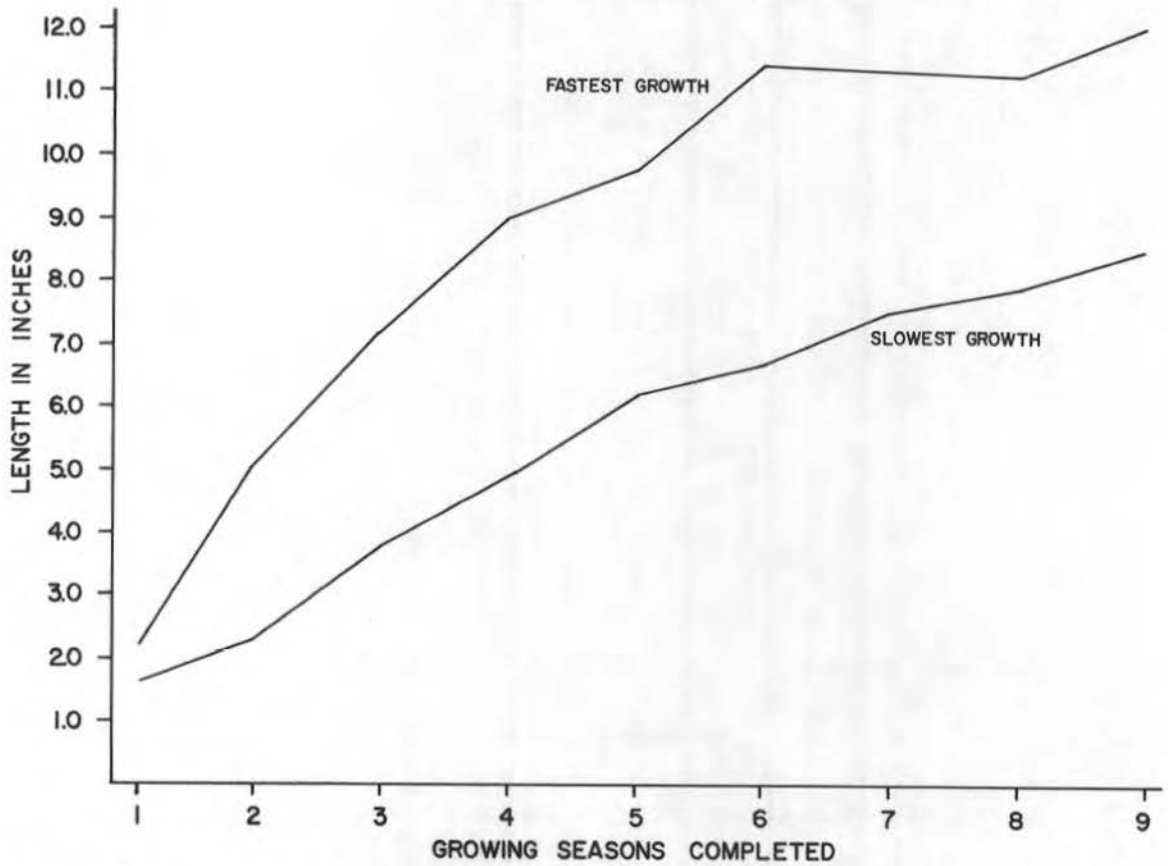

FIGURE 7. Rock Bass: Fastest and slowest average growths observed. (Data for different ages may be from different lakes.)

TABLE 7

Largemouth Bass: Average Total Lengths at the End of the Growing Season in 12 Lakes (in Inches)

Lake	No. Fish	Growing Seasons Completed						
		1	2	3	4	5	6	7
Drainage								
Birch Lake	228	3.2	7.6	10.1	12.8	14.3	15.4	17.0
Bolger Lake	14	2.7	5.9			11.9	13.0	
Hemlock Lake	59	3.6	7.1	10.0	12.5	13.4	14.9	16.4
McKenzie Lake	22	2.7	5.3	8.3	10.5	12.5		16.4
Murphy Flowage	165	2.9	5.5	7.8	11.0	13.2	15.4	16.9
Red Cedar Lake	28	4.1			15.2			
Slim Creek Flowage	5	2.7		9.3				
Average		3.1	6.3	9.1	12.4	13.1	14.7	16.7
Seepage								
Bass Lake No. 2	50	3.3	5.4	7.2	11.0	11.9	15.7	
Big Gibson L.	5	3.3	8.0	10.8	13.2		15.8	
Clear L.	72	2.2	6.5	8.8	10.3	13.1	15.2	16.5
Lowland Lake	91	3.0	5.6	11.6	14.4			
Spruce Lake	20	2.7	5.7	7.5	9.3	9.9	13.1	
Average		2.9	6.2	9.2	11.6	11.6	15.0	16.5

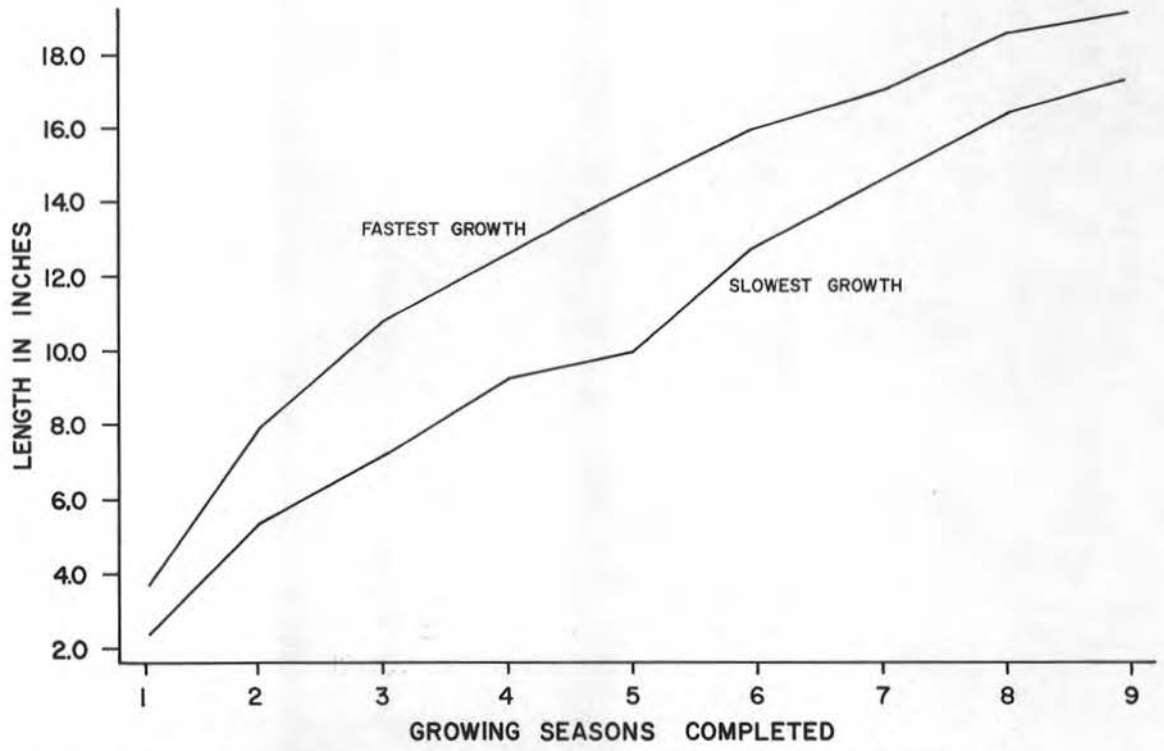

FIGURE 8. Largemouth Bass: Fastest and slowest average growths observed. (Data for different ages may be from different lakes.)

TABLE 8

Northern Pike: Average Total Lengths at the End of the Growing Season in 8 Lakes (in Inches)

Lake	No. Fish	Growing Seasons Completed							
		1	2	3	4	5	6	7	8
Drainage									
Birch Lake	257	8.9	13.4	16.5	18.2	19.3	22.0	26.7	26.0
Bolger Lake	38	6.9	12.9	16.4	19.8	21.0	23.8	25.7	
Bucks Lake	420	7.9	12.8	15.6	17.9	19.3	20.7	21.6	22.7
Hemlock Lake	44	10.4	13.5	16.3	20.9	22.6	28.3		
McKenzie Lake	26	9.4	15.4	22.9	21.0	30.0	30.0		
Murphy Flowage	68	7.5	14.5	17.0	22.6	24.1			30.0
Red Cedar Lake	29	9.4	16.6	20.3	20.8	24.2	26.0	31.2	23.3
Slim Creek Flowage	60	7.9	11.5	14.3	17.2	16.0	18.0		
Average		8.5	13.8	17.4	19.8	22.1	24.1	26.3	26.3

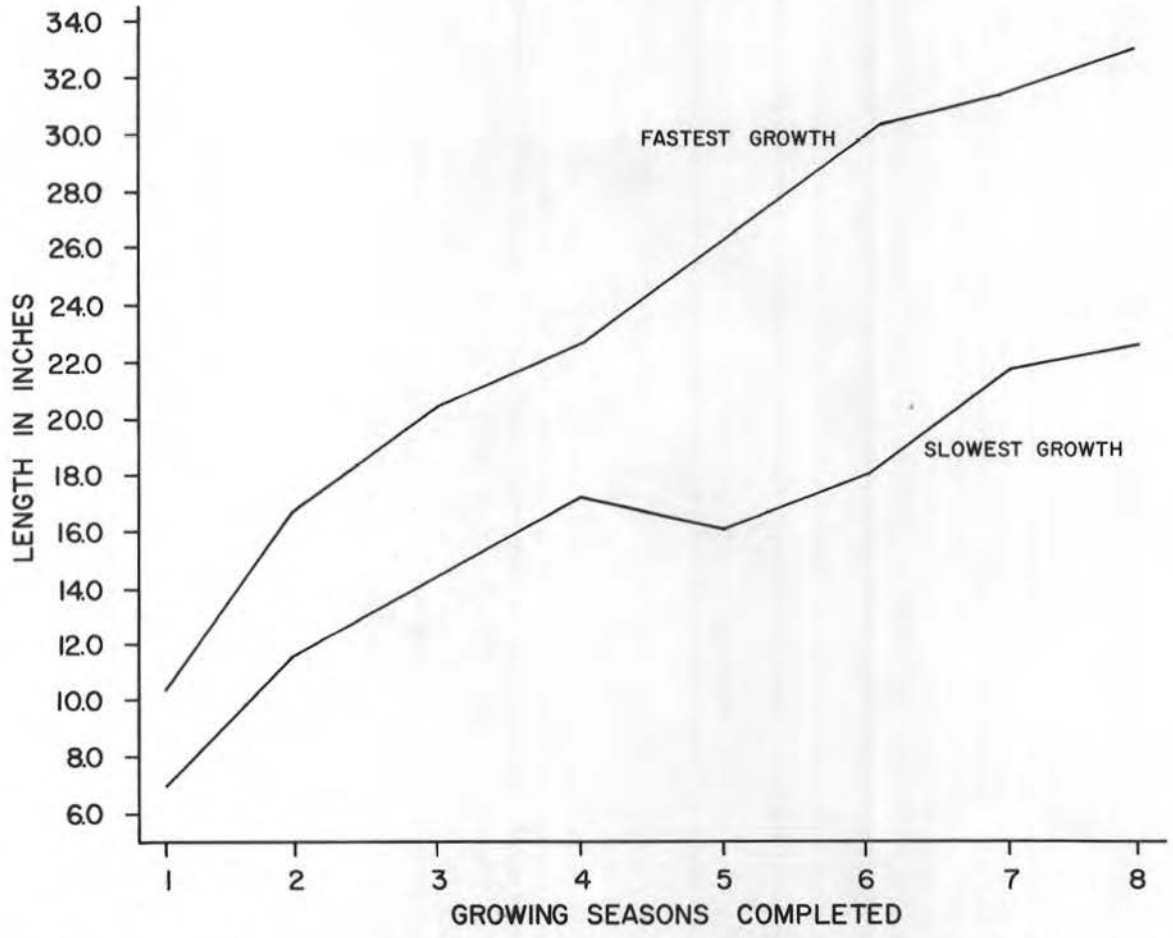

FIGURE 9. Northern Pike: Fastest and slowest average growths observed. (Data for different ages may be from different lakes.)

TABLE 9

Walleye: Average Total Lengths at the End of the Growing Season in 3 Lakes (in Inches)

Lake	No. Fish	Growing Seasons Completed 1	2	3	4	5	6
Drainage							
Birch Lake	94	6.3	10.0	11.9	14.4	16.3	19.5
Hemlock Lake	12	5.7	8.8				
Red Cedar Lake	124	5.1	9.7	12.6	14.7	16.8	17.7
Average		5.7	9.5	12.3	14.6	16.6	18.6
Seepage							
Big Gibson L.	44	5.9	10.3	12.0	14.2	17.5	
Clear L.	11	3.9	12.0	16.7	16.0	21.0	21.0
Average	55	4.9	11.2	14.4	15.1	19.3	21.0

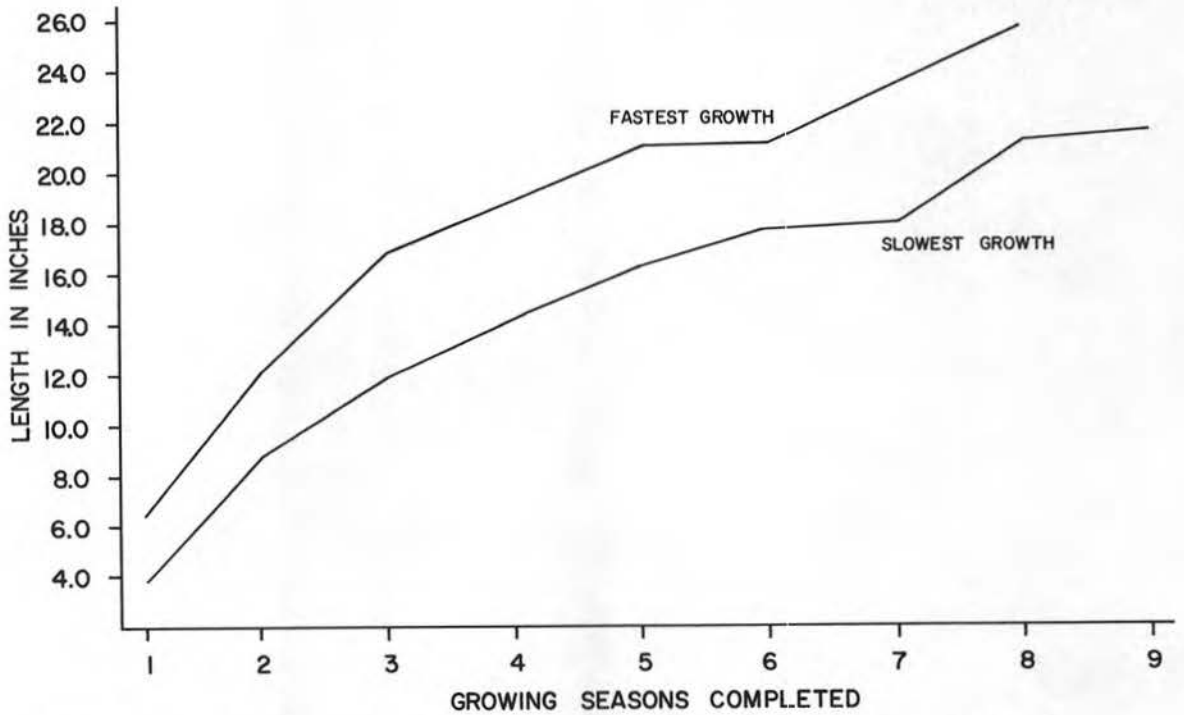

FIGURE 10. Walleye: Fastest and slowest average growths observed. (Data for different ages may be from different lakes.)