Comparative Food Habits and Habitat Preference of Age-0 Largemouth Bass and Yellow Perch in West Point Lake, Alabama-Georgia

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Abstract: Yellow perch, *Perca flavescens,* and largemouth bass, *Micropterus salmoides,* segregated both spatially and by food choice throughout most of their first year. During the summer, largemouth bass inhabited mainly vegetated areas and soft silt and sandy areas, whereas yellow perch preferred soft silt, sand, and hard clay areas. Both species shared a common invertebrate diet until mid-summer. Largemouth bass consumed small fishes late in the growing season while yellow perch continued to consume only invertebrates. Largemouth bass were longer and weighed more than yellow perch at the end of the summer. Examination of diet overlap by the Schoener index suggested slight overlap in May (0.26) and June (0.29) for largemouth bass and yellow perch 25 to 49 mm long. High littoral water temperatures (>30° C) in summer may spatially segregate yellow perch from both largemouth bass and small fishes that inhabit littoral areas.

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Largemouth bass and yellow perch are 2 common fishes in West Point Lake which utilize similar prey at an early age (Timmons 1984, Timmons et al. 1981). Competition for food could be intense at the time of transition from insect to fish diet for age-0 fish. Earlier studies indicated that the 2 species share many species of prey, but did not indicate if they shared the food resource at the same time or were feeding in the same habitat.

Shelton et al. (1979) and Timmons et al. (1980*a*) observed a bimodal length-frequency distribution for largemouth bass in late summer at West Point Lake caused by a shortage of fish as prey for the smallest largemouth

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bass. The small largemouth bass often exhibited slow growth and higher mortality than larger largemouth bass. Competition for fish between age-0 largemouth bass and age-0 yellow perch during the summer could aggravate the problem of small bass with slow growth.

The objective of this study was to determine if age-0 largemouth bass and age-0 yellow perch ate similar food. And especially, if they did so at the time largemouth bass change to a fish diet.

Study Area

West Point Lake, a U.S. Army Corps of Engineers impoundment of the Chattahoochee River, extends from 5.1 km north of West Point, Georgia (near the Alabama state line), to Franklin, Georgia. It lies above the fall line in the Piedmont physiographic region. It was impounded in October 1974 and filled to full pool by May 1975. The lake is maintained at 194 m above mean sea level, except in winter when it is drawn down 3 m for flood control. At the summer pool elevation, the surface area is 10,482 ha, the shoreline length is 845 km, and the average depth is 7.1 m.

The lake is stratified in summer and may have areas below 24 m with <1 ppm dissolved oxygen, but inflowing water of the Chattahoochee River always exceeded 5 ppm dissolved oxygen (Davies et al. 1979). Summertime water temperatures ranged from 35° C on surface to 21° C below 24 m depth.

Methods

Age-0 yellow perch and largemouth bass were collected for food habits and growth analysis in 1977 and 1978 by electrofishing and seining. A boat-mounted, 100-volt AC generator with a pulsator unit which provided pulsed DC current was used in nearshore areas in the morning or early afternoon. Collections were also made with a 3.7 x 1.2-m seine (0.3-cm mesh) and a 15.2 x 1.8-m seine during daylight hours, including early morning and evening. Fish were placed on ice or in formalin and later measured to the nearest millimeter (total length).

Data from stomach analyses were tabulated by the mean percentage that each food category contributed to the total weight of food in each stomach (mean of the wet weight percentages). Food items were weighed wet to the nearest 0.1 mg. Disarticulated prey were enumerated by estimating the length and using the weight from a whole organism of the same length. Small invertebrates such as copepods or cladocerans were weighed in groups of 100 or more to determine a mean weight for individuals in each genus. This mean weight was used later for single copepods or cladocerans in stomachs.

Food overlap between species was calculated with the Schoener (1970) index:

$$\alpha = 1 - 0.5 \sum_{i=1}^{n} |P_{xi} - P_{yi}|$$

where P_{xi} equals the proportion by weight of food category i in the diet of species x, P_{yi} equals the proportion of food category i in the diet of species y, and n equals the number of food categories. The Schoener index gives values from 0 (no overlap) to 1 (complete overlap). A recent review of diet overlap indices found the Schoener index to be the best estimator (Wallace 1981).

Habitat preference was determined by collecting fish with rotenone in 0.01-ha littoral areas from April through September 1977. One hundred and twenty-two sites were randomly sampled. The area was surrounded with a 3-m deep block net and fish were collected as described by Timmons et al. (1978). Habitats were described as (1) vegetated: >50% of area filled with aquatic plants, mostly *Scirpus* spp., alligatorweed (*Alternanthera philoxeroides*), and smartweeds (*Polygonum* spp.), (2) soft silt and sand bottoms, and (3) sand and hard clay bottoms. Fish were collected during daylight hours.

The spawning dates for yellow perch were determined by observing the seasonal changes in percentages of body weights contributed by the ovaries. At capture, adults were weighed, the ovaries were excised, blotted with a paper towel, and weighed to the nearest 0.01 g. Fish were collected by electrofishing from 1978 to 1980.

Results

The monthly mean gonosomatic index over 3 years (1978–1980) indicated that yellow perch spawned between February and mid-March at West Point Lake (Fig. 1). Spent females appeared in early and mid-March 1978 and 1979 and in February 1980. Yellow perch finished spawning before the initiation of largemouth bass spawning in late April (Timmons et al. 1980*b*).

Age-0 yellow perch were 10 to 25 mm longer than age-0 largemouth bass until mid-July; but by mid-September, largemouth bass were larger than yellow perch (Fig. 2).

Yellow perch were most often collected over sand and hard clay and occasionally over soft silt and sand (Table 1). Largemouth bass were most common over vegetated areas and soft silt and sand areas in May, June, and July. They were not collected in vegetation after July.

Age-0 largemouth bass and yellow perch in West Point Lake consumed similar foods. Both species consumed cladocerans (especially *Bosmina* spp. and *Daphnia* spp.), copepods (especially *Cyclops* spp. and *Diaptomus* spp.), and chironomids in spring and early summer, and in mid-summer, larger insects such as Odonata and Ephemeroptera. By late summer, largemouth bass consumed fish; yellow perch continued to consume cladocerans and insects. Some largemouth bass as small as 25 mm ate fish. The importance of certain prey is shown by comparing the mean of the wet weight percentages of stomach

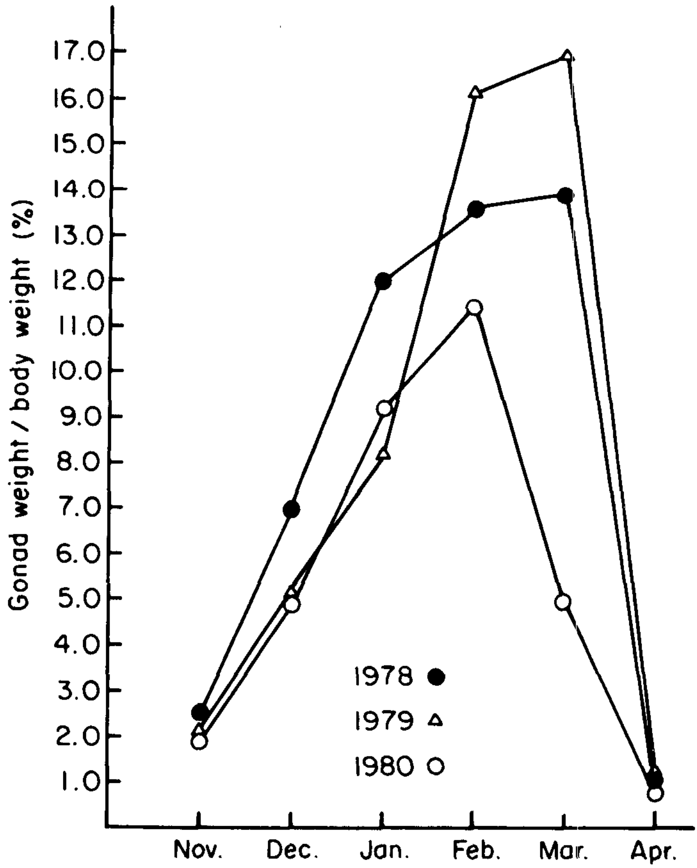

Figure 1. Mean monthly gonosomatic index for 63 female yellow perch from West Point Lake, 1978–1980.

contents (Table 2). Both species consumed mostly cladocerans, copepods, and chironomids at the 25 to 49 mm size group, but chironomids and fish provided the greatest weight for largemouth bass. After largemouth bass reached a length of 49 mm, fish were the most important food by weight, but fish did not enter the diet of small yellow perch.

Diet overlaps calculated by the Schoener index showed the greatest overlap for the 25 to 49 mm size group occurred in May (0.26) and June (0.29). The overlap values decreased for larger fish and by September there was no overlap between fish 100 mm and longer (Table 3). Largemouth bass fed on fish, and yellow perch fed on copepods, cladocerans, and chironomid and ceratopogonid larvae.

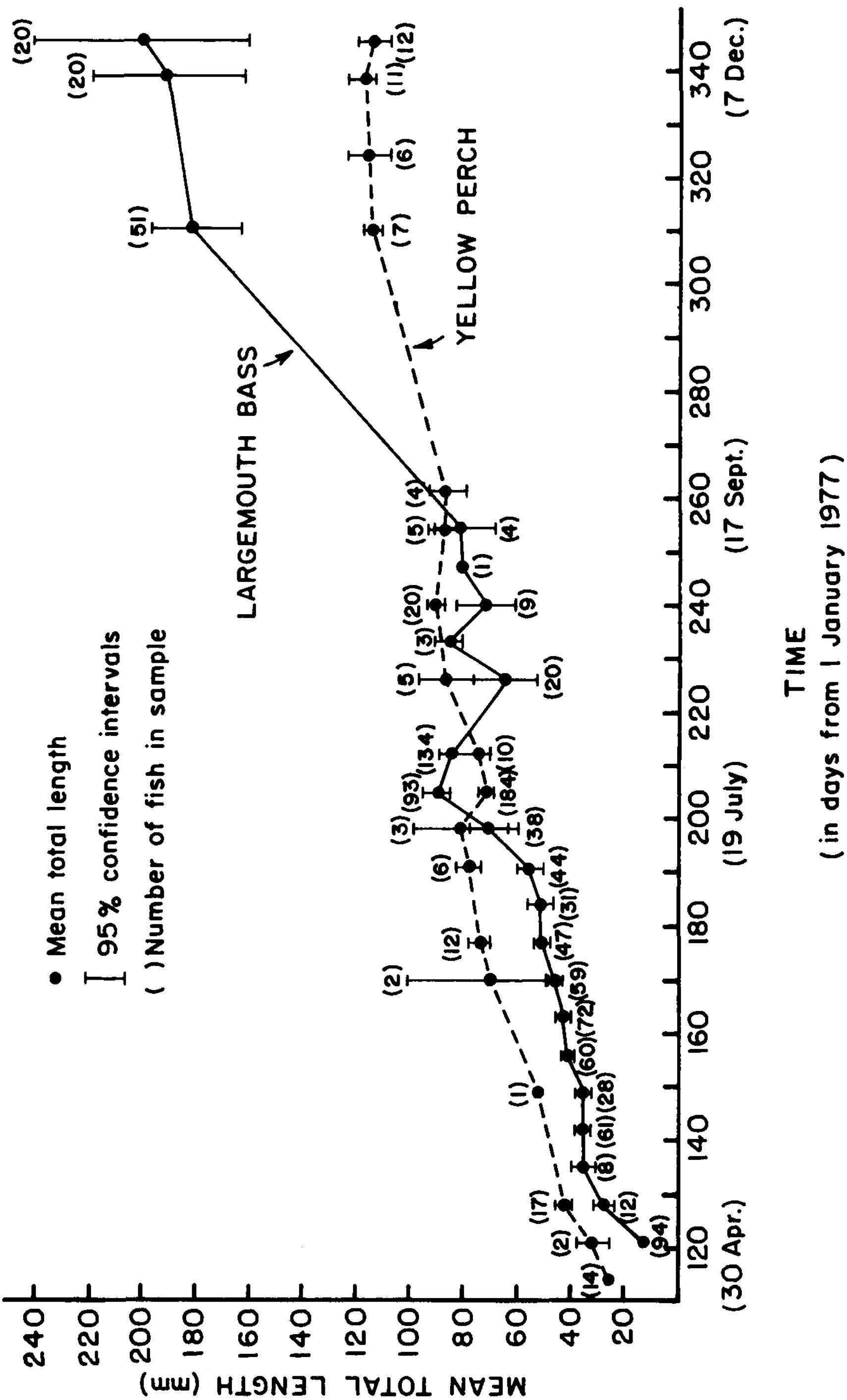

Figure 2. Total length of age-0 yellow perch and largemouth bass in West Point Lake, 1977.

Table 1. Population densities of yellow perch and largemouth bass young-of-the-year (fish/150 m²) in 3 habitat types from April through September 1977 at West Point Lake.

Month	Species	Habitat type		
		Vegetated	Soft silt sand	Sand-hard clay
April	Yellow perch		1.3	
May	Yellow perch			0.6
	Largemouth bass	2.3	13.1	3.4
June	Yellow perch		0.1	0.5
	Largemouth bass	10.5	15.1	5.0
July	Yellow perch		1.2	0.4
	Largemouth bass	14.0	3.5	2.4
August	Yellow perch			3.3
	Largemouth bass		2.5	1.5
September	Yellow perch			1.2
	Largemouth bass		1.0	0.2

Discussion

Diet overlap between age-0 largemouth bass and yellow perch was reduced or limited during the first months because yellow perch eggs hatched a month or more before largemouth bass; yellow perch fry are pelagic and moved out from the shallow littoral region (as indicated by their absence in shoreline samples); and yellow perch consumed larger invertebrate prey such as Odonata and Ephemeroptera.

The mean lengths of yellow perch and largemouth bass overlap by midsummer but competition was not evident. Diet overlap was not indicated by the Schoener index and was actually less than in early summer. Largemouth bass remained in the littoral areas with vegetation and also areas with sand and soft silt bottoms. Yellow perch were collected mainly in areas with sand and hard clay bottoms which were associated with regions barren of vegetation with much wave action. Largemouth bass moved away from the vegetated areas by August but remained in areas with soft silt and sand bottoms. These areas were better protected from wave action than were areas with clay bottoms.

Some largemouth bass changed to a diet of fish by September. Other largemouth bass continued to consume invertebrates and grow at a slower rate, thus creating a bimodal length frequency distribution (Timmons et al. 1980*a*). The monthly "available prey weight/predator weight" ratio (Jenkins and Morais 1978) was calculated in 1977 for West Point Lake predators (Timmons et al. 1980*a*). It suggested a shortage of fish prey for largemouth bass <10 cm long and for yellow perch <20 cm long at West Point Lake from April through September except in June (Fig. 3). The difference in comparative sizes was because the mouth width of yellow perch is only 8% of the standard length, instead of 16% of the standard length of largemouth bass

Table 2. Average of wet weight percentages of stomach contents of young-of-the-year largemouth bass (1977) and yellow perch (1977 and 1978) from West Point Lake, Alabama-Georgia.

Length (mm)	0–24		25–49		50–74		75–99		100–124		125–149	
	LMB	YP	LMB	YP	LMB	YP	LMB	YP	LMB	YP	LMB	YP
N sampled	23	0	344	25	157	63	78	86	52	52	14	14
N empty			33	0	33	0	26	6	18	15	8	4
Bryozoa						tr.[a]		tr.		3		5
Crustacea												
Cladocera	66		12	38	1	2		9		26		61
Ostracoda			tr.		tr.	3		1		tr.		
Copepoda	7		8	56	2	15		9		2		8
Arachnoidea												
Hydracarina					tr.	1		2				
Insecta												
Ephemeroptera												
Ephemeridae					2	2	tr.	14				
Odonata												
Anisoptera			4		1	4		4				
Hemiptera												
Gerridae			2		4	tr.	tr.					
Notonectidae					2		tr.					
Trichoptera												
Leptoceridae			tr.		tr.			1		1		
Diptera												
Ceratopogonidae			2		tr.	30		32		45		
Chironomidae	26		27	6	5	42		28		23		26
Vertebrata												
Ictalurus spp.			6									
Gambusia affinis	1		7									
Labidesthes sicculus			6		5		tr.					
Lepomis spp.			6		12		7		6			
L. cyanellus							1				6	
L. macrochirus			6		15		15		19			
Micropterus spp.			3		4		7		6			
Pomoxis nigromaculatus			3		4							
Undetermined fish			8		42		69		69		94	

[a] tr. = less than 0.5%.

(Keast and Webb 1966). Figure 3 is plotted to express available prey in "largemouth bass equivalents," as described by Jenkins and Morais (1978). Yellow perch in West Point Lake did not switch to a fish diet as they sometimes do in northern lakes (Parsons 1950, Kutkuhn 1955, Tharratt 1959, Clady 1974).

Why don't yellow perch consume fish in June while yellow perch are larger than largemouth bass and fish are available? Yellow perch could get a "jump" on largemouth bass young and change to fish as prey with a probable increase in growth, as is seen in largemouth bass in late summer. But yellow perch don't make the switch to fish prey. Under unusual conditions, such as summer cove rotenone surveys, yellow perch did consume fishes. The Auburn University Department of Fisheries conducted annual cove rotenone studies

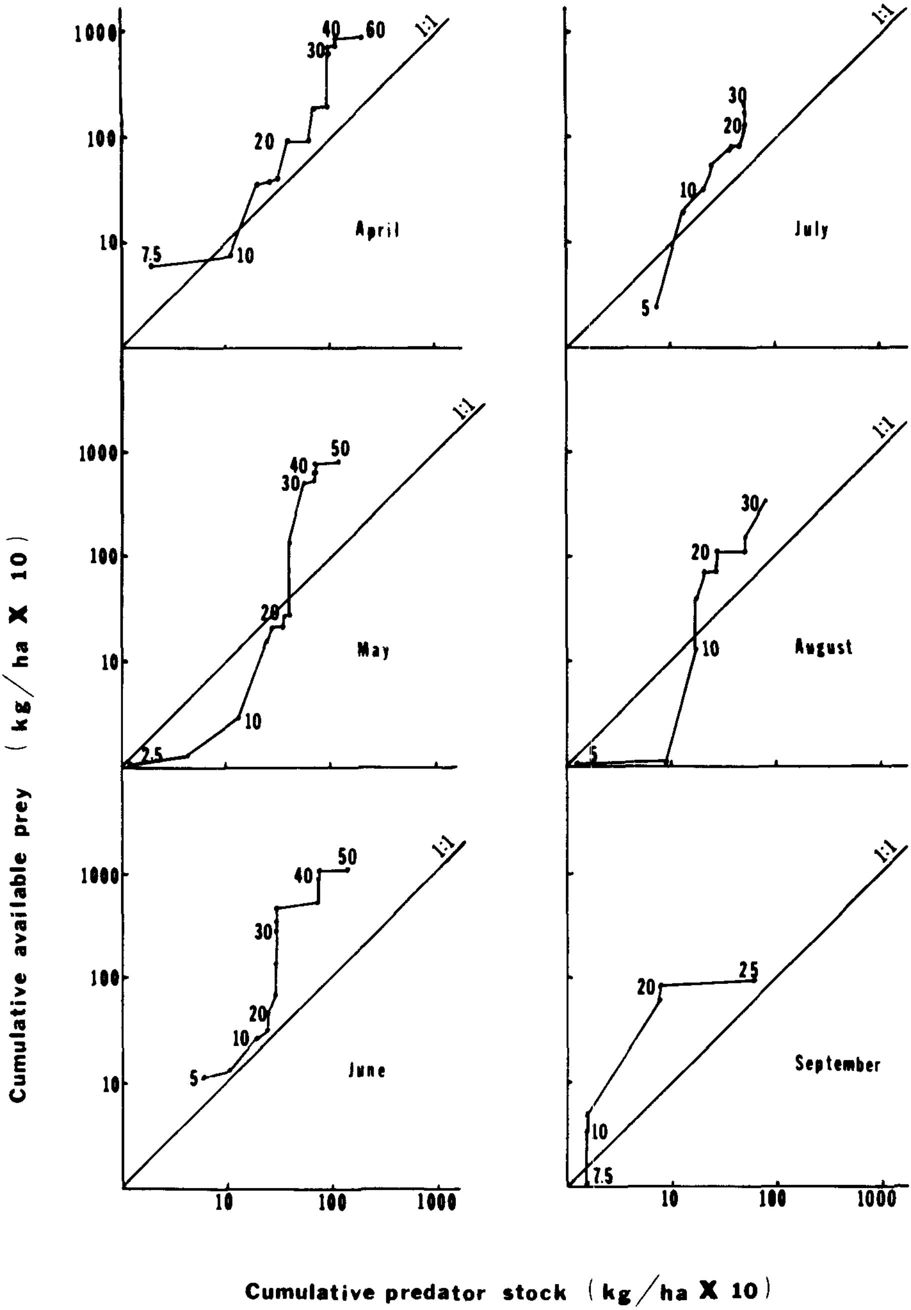

Figure 3. Logarithmic plots of the AP/P ratio (available prey/predator) in West Point Lake based on the monthly mean weight from 0.01-ha samples from April through September 1977; numbers on graph are size groups (cm) of largemouth bass; points above the 45 line indicate a surplus of prey for largemouth bass in that length group.

Table 3. Monthly diet overlap as calculated by the Schoener index based on the average of wet weight percentages for largemouth bass ($N = 725$) and yellow perch ($N = 240$) from West Point Lake.

Month	Length (mm)			
	25–49	50–74	75–99	100–124
May	0.26			
June	0.29	0.12		
July		0.09	0.005	
August			0.015	
September			0.009	0

in West Point Lake and yellow perch were observed with stomachs distended by fish prey. The smaller shad (*Dorosoma* spp.) and bluegills (*Lepomis macrochirus*) were affected by the poison before the yellow perch and were thus susceptible to predation. Although those stomachs could not be used for a food study, the yellow perch feeding activity indicates that shad and bluegills were acceptable food when available. The results of the rotenone study may indicate that prey were affected by the rotenone in the warmer littoral areas before it affected fish in cooler, deeper water.

Warm water temperatures in the summer may discourage yellow perch from entering shallow water during the day. Temperatures of 32° to 35° C were observed in shallow littoral waters in July and August. Hart (1952) found that adult yellow perch in Canada could not survive for more than a few hours at temperatures >32° C. Ferguson (1958) found that yellow perch in Lake Nipissing in Canada preferred temperatures of 19° to 21° C, whereas, northern largemouth bass preferred temperatures of 27° to 28° C. Hart (1952) determined experimentally that the preferred range for largemouth bass was 30° to 32° C. Thus yellow perch may be spatially separated from small fish in summer because the prey are in warm littoral areas. A similar situation occurred in Lake West Okoboji, Iowa, where yellow perch were restricted to deep cool water in some years. They consumed chironomid larvae in deep waters when the shallow water areas were hot and dissolved oxygen was low (Bardach 1955). In years when they could inhabit shallow water, plankton and fish made up the bulk of stomach contents.

MacLean and Magnuson (1977) classified yellow perch as temperate-zone mesotherms and suggested that the preferred temperatures of yellow perch segregated them during summer from temperate-zone eurytherms such as centrarchids. They considered yellow perch adults as habitat specialists in regard to temperature, but food generalists because they eat zooplankton, benthos, or fish. This study at West Point Lake provides evidence that MacLean and Magnuson's generalizations are true for populations in the southeastern United States. Yellow perch from West Point Lake shared some food items with largemouth bass in early summer but there was no overlap by late summer. The yellow perch appeared to be segregated from largemouth bass and small fishes by habitat preference. Habitat preference may be synonymous with temperature preference at West Point Lake.

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