planted black walnut seedlings should reduce water stress shock through the maintenance of a plant water balance.

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FOOD OF A SOUTHEASTERN UNITED STATES POPULATION OF YELLOW PERCH, *PERCA FLAVESCENS* (MITCHILL), IN WEST POINT LAKE, ALABAMA-GEORGIA

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ABSTRACT

Cladocera were the major food item for small (<75mm) and medium size (75-150 mm) yellow perch from West Point Lake; ostracods, hydracarina, and insects (especially chironomids and ceratopogonids) were consumed in lesser amounts. By late summer and fall, young of the year consumed cladocera and dipterans. Adults fed on a variety of insects and small fishes, especially sunfishes, *Lepomis* spp. There may have been a shortage of prey in winter since stomachs of all sizes of yellow perch contained bryozoan statoblasts and there was a high percentage of empty stomachs. Other cohabitating fishes in West Point Lake did not utilize bryozoans during winter. West Point Lake may lack certain fishes that are important prey in open water in northern United States lakes.

INTRODUCTION

Yellow perch, *Perca flavescens* (Mitchill), are not considered native to Alabama or Georgia (Dahlberg and Scott 1971; Jenkins et al. 1971; Lee 1980). Its range is continuing to expand in the southeastern United States and it is creating problems in some lakes because of stunting and over-population (Dahlberg and Scott 1971). Factors limiting survival should be more obvious near the extremes of their range of distribution. West Point Lake has the southernmost population yet studied. The objectives of this study were to determine food utilization and compare yellow perch from West Point Lake with other populations. The results will complement future studies in progress of yellow perch dynamics in West Point Lake.

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West Point Lake, a U. S. Army Corps of Engineers impoundment of the Chattahoochee River, extends from 5 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 level is maintained at 194 m above sea level except for a 3 m drawdown in the winter for flood control. At the summer pool elevation, the surface area is 10,482 ha, the volume 746 million m^3, the shoreline length 845 km, and the average depth 7.1 m.

METHODS

Yellow perch were collected by electrofishing and seining from March 1977 to February 1980. A boat-mounted

110-Volt AC generator with a pulsator unit providing pulsed DC current was used for electrofishing in nearshore areas in the morning or early afternoon. A 3.7 x 1.2 m seine (0.3 cm mesh) and a 15.2 x 1.8 m bag seine were used during daylight hours, including early morning and evening hours. Fish were placed on ice or in formalin and later measured to the nearest millimeter (total length) and weighed to the nearest gram. The percent frequency of occurrence and the average number of food items were determined seasonally for three size groups of perch. The groups approximated the sizes of early young of the year (25-74 mm), late young of the year and yearlings (75-150 mm), and adults (>150 mm) based on our age and growth studies.

Young-of-the-year yellow perch were also analyzed separately by 25-mm size groups. The 1977 and 1978 young of the year were combined to examine changes in food with changes in size. Yellow perch less than 25 mm are pelagic (Thorpe 1977) and were not collected by sampling techniques for littoral areas of lakes. Invertebrates found in stomachs were identified to the lowest practical taxon, using keys by Pennak (1978).

In addition, a study of food habits for 11 cohabitating fishes during the winter period provided a basis for comparing food utilization. Stomachs from at least ten individuals of each species were examined for food during the winter period.

Results

Small young-of-the-year yellow perch (25-49 mm) consumed mostly cladocera and copepods (92% and 88% frequency of occurrence respectively) and a few dipteran larvae (16%). The dominant copepods were *Cyclops* spp. and *Diaptomus* spp. and the dominant cladocera were *Bosmina* spp., and *Daphnia* spp. The occurrence of copepods steadily declined later in the year for successive size groups (Table 1); from 62% (50-74 mm size group) to 7% (125-150 mm size group). Cladocerans, however, were still utilized by larger fish (57% frequency of occurrence for 125-149 mm fish). Yellow perch from the 50-74 and 75-99 mm size groups consumed: chironomid larvae (68% and 51% respectively), ceratopogonid larvae (50% and 51% respectively), ostracods (33% and 33%), and hydracarina (30% and 26%). By late summer and fall, the 100-124 mm and 125-149 mm size groups consumed cladocera, dipterans, and statoblasts of the bryozoan, *Pectinatella magnifica* (31% and 21% frequency of occurrence as indicated by statoblasts). The incidence of feeding on statoblasts increased as the number of empty stomachs increased later in the year. Only one of 240 young of the year consumed fish, while a few others consumed fish eggs (mostly *Dorosoma* spp.).

Yellow perch less than 150 mm long consumed cladocera throughout the year (Table 2). Adults (>150 mm) consumed the most in fall (33% frequency of occurrence) and the least in summer (5%). Cladocera may provide little nutritive value for large adults, since prey volume was so small in relation to fish size.

Adult yellow perch often had little or no food in their stomachs. A few fed on small fish in summer and winter, while fish eggs were consumed in spring (Table 2). Threadfin shad, *Dorosoma petenense,* and bluegill, *Lepomis macrochirus,* were the most common prey. Eggs were common in stomachs; especially shad eggs, and occasionally eggs from *Esox* spp. and *Labidesthes sicculus.* Chironomid and ceratopogonid larvae as well as some larger insects (Odonata, Ephemeroptera, and Trichoptera), were often consumed by adults.

Yellow perch of all sizes fed throughout the year on statoblasts from the bryozoan, *Pectinatella magnifica* although the greatest consumption was during the winter. Statoblasts were often the only food item in stomachs in winter and were observed floating on the water surface by the thousands in January. Yellow perch occasionally fed on bryozoan colonies as evident from the gelatinous colony material present in some stomachs.

Stomachs from ten other fish species from West Point Lake were examined in January 1978 when most yellow perch stomachs contained statoblasts. Ten individuals of each species were examined (range of total length in parentheses) and no statoblasts were found in stomachs: gizzard shad, *Dorosoma cepedianum* (70-150 mm); threadfin shad (60-100 mm); creek chubsucker, *Erimyzon oblongus* (170-220 mm); brown bullhead, *Ictalurus nebulosus* (120-180 mm); flier, *Centrarchus macropterus* (80-130 mm); redbreast sunfish, *Lepomis auritus* (80-120 mm); green sunfish, *L. cyanellus* (50-100 mm); bluegill (30-120 mm); spotted sunfish, *L. punctatus* (50-100 mm); and black crappie, *Pomoxis nigromaculatus* (70-130 mm). Stomachs from 3,000 largemouth bass (15-660 mm) were examined from West Point Lake over three years and no statoblasts were observed (Timmons et al. 1981).

Discussion

The food habits of yellow perch from northern United States waters are well known. The young feed primarily on small crustaceans, then on insects and larger crustaceans; as adults they feed on fish, large insects, and crayfish (Parsons 1950; Kutkuhn 1955; Pycha and Smith 1955; Tharratt 1959; Clady 1974; Paxton and Stevenson 1978). The major food items are similar to those consumed by yellow perch in West Point Lake, especially cladocerans, copepods, ostracods, odonates, trichopterans, chironomids and ceratopogonids. Crayfish were important food for yellow perch in some northern lakes (Paxton and Stevenson 1978), but crayfish were uncommon in West Point Lake and thus were absent from stomachs. Yellow perch are probably opportunistic feeders, but select for size and quality of food (Siefert 1972). Fish enter the summer diet of larger yellow perch and can comprise the major calorific intake (Kelso 1973). Cannibalism is intense in some lakes (Tarby 1974).

Daily feeding periodicities coincide with diurnal movement of yellow perch. The start of active feeding began at sunrise and again at sunset in Lake Opinicon, Ontario (Keast and Welsh 1968). Yellow perch remain inactive on the lake bottom at night, migrate offshore shortly after sunrise and return onshore at dusk (Carlander and Cleary 1949; Hasler and Bardach 1949; Sieh and Parsons 1950; Scott 1955; and Engel and Magnuson 1976). Some of the largest collections of yellow perch at West Point Lake were along shallow shorelines at dusk.

Except in summer, there is probably a shortage of prey for yellow perch (>150 mm) in West Point Lake. The seasonal percentage of empty stomachs was 10% in summer, 37% in fall, 36% in winter, and 43% in spring. A high incidence of empty stomachs is common in winter for many fishes because cool temperatures inhibit feeding. But most resume feeding in spring and continue through fall (Nikolskii 1969). Zooplankton standing crop varied significantly from month to month in West Point Lake (Davies et al. 1979). Highest numbers were encountered in May 1978 followed by July 1978, November 1977 and a low in January 1978. There was a shortage of fish prey in fall and winter for small largemouth bass and other predators during the same years, 1977 and 1978 (Timmons et al. 1980). Floating bryozoan statoblasts were abundant in the lake in January 1978. Yellow perch may be attracted to them because of their movement by the wind and waves. Statoblasts were observed throughout the digestive system of yellow perch and may not have been digested. Statoblasts apparently provided little nourishment because of their hard structure and indigestibility. Nyberg (1979) suggested that growth of perch in certain Swedish lakes ceases at an early age when a transition to a fish diet does not take place. With increasing fish size it is uneconomical, in terms of energy, for perch to eat zooplankton.

Reports of fish feeding on bryozoans are uncommon. Osburn (1921) reported the consumption of statoblasts by young fishes in Ohio, including gizzard shad, bluegill, largemouth bass, and white crappie, *Poxomis annularis.* Dendy (1963) observed bluegill feeding on colonies of the bryozoan *Plumatella* in Alabama farm ponds. Parsons (1950) reported yellow perch utilizing bryozoans in Clear Lake, Iowa.

West Point Lake may lack certain fishes that are important prey in northern United States lakes. Small cyprinids, *Notropis* spp., were important fish prey in Lake Opinicon (Keast 1965), Clear Lake, Iowa (Parsons 1950), and Lake Michigan (Wells 1980); although the major prey fish in Lake Michigan were slimy sculpins, *Cottus cognatus,* and alewives, *Alosa pseudoharengus.* In some lakes, the major fish prey for yellow perch are smaller yellow perch (Clady 1974; Tarby 1974). Alm (1946) found that perch in small lakes in Sweden ceased to grow at a small size due partly to the lack of an appropriate prey fish (especially smelt, *Osmerus eperlanus).* Tesch (1955, in Lindstrom and Bergstrand 1979) considered available prey fish to be an important precondition for the production of high perch yields, and Deelder (1951) suggested that for satisfactory growth, perch required a prey fish which remained available in open water. Although Alm, Tesch, and Deelder studied European *Perca fluviatilus,* many consider them conspecific with *P. flavescens* (Thorpe 1977).

Available prey may be lacking in West Point Lake, especially prey in open water. Yellow perch readily consume small fishes when they are available as evident from feeding during samples with rotenone. But unless the prey are swimming irregularly or swimming outside of shoreline cover during rotenone samples, the yellow perch fed very little on fish. Yellow perch may not grow as large as they could if sufficient prey were available throughout the year.

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