FOOD OF ADULT LARGEMOUTH BASS IN A SMALL IMPOUNDMENT WITH DENSE AQUATIC VEGETATION.

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Abstract: Stomachs of 240 adult largemouth bass *(Micropterus salmoides)* taken from a small impoundment with abundant aquatic vegetation, were evacuated and their contents examined. Thirty percent of the bass had empty stomachs. Crayfish, bluegill *(Lepomis macrochirus)*, and young-of-year largemouth bass were the predominant food items. Electivity values (E) indicated negative selection for bluegill and positive selection for young bass. Dense, aquatic macrophytes are probably the major factor influencing the feeding behavior of these bass.

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Predator-prey relationships can be affected by many factors. Although density of prey is often critical, the concept of accessibility or vulnerability of prey is also important to understanding their utilization by predators (Diggen et al. 1979). Bass-bluegill populations are generally considered the classic relationship in the management of ponds and small impoundments. In many fertile situations dense aquatic vegetation may provide additional cover thereby reducing beneficial predation. With increasing restrictions on chemical weed control, agencies are faced with increasing cost in reducing the quantity and extent of vegetation. Managers are often forced to watch a small impoundment become heavily infested with uncontrolled, undesirable macrophytes. Objectives of this investigation were to determine food habits of adult largemouth bass *(Micropterus salmoides)* in a bass-bluegill community with abundant shoreline vegetation and predict its long-term effects.

MATERIALS

American Horse Lake is a 40 ha impoundment in northwestern Oklahoma owned and operated by the Oklahoma Department of Wildlife Conservation. The lake receives heavy fishing pressure ($<$ 2000 hrs/ha, Summers, 1978) and is known for its excellent bluegill fishery. From 1969 through 1977 American Horse was treated regularly for undesirable aquatic vegetation. However, with the ban of 3-(3,4-Dichlorophenyl)-1, 1-dimethurea (Karmex), weed control was discontinued, and by June 1979, rooted macrophytes and filamentous algae covered about 20 percent of the lakes surface area.

Monthly sampling began in June 1979 and continued through November. Prey density was determined by shoreline seining. However, because the dense vegetation made seining difficult, the relative abundance of the prey species was confirmed using monthly primer cord explosive sampling. Adult largemouth bass (age class I and older) were obtained using A.C. electrofishing. The contents of 30 bass stomachs were evacuated monthly in the field using a gastroscope (Dubets 1954) and preserved in 10 percent formalin for laboratory analysis. Total lengths were taken on all bass and those with empty stomachs were recorded. In the laboratory, stomach contents were identified, enumerated, and individual volumes calculated for each food item.

Estimates of the percent occurrences of food items by number and volume were summarized by month and also for the entire study period. Ivlev's index (1961) was used to measure electivity (E) for young-of-year largemouth bass and bluegill in the adult largemouth bass ration: $E = (ri - pi) / (ri + pi)$ where ri is the relative quantity of a food item in the stomach as a percentage of the food consumed and pi is the relative quantity of the same item in the environment expressed as a percentage. Values of E range from -1 to

+1 with negative values indicating avoidance and positive E values indicating preference. An E value of O indicates no selection.

RESULTS AND DISCUSSION

The size of adult largemouth bass collected by electrofishing ranged from 207 to 596 mm. The most abundant size-group of bass in American Horse ranged from 250 to 340 mm by the end of November, 1979, and consisted of fish from age-classes 2 and 3. Of the 240 bass sampled only 10 fish were not of this size range. Scale analysis also revealed a complete absence of year-class I fish. The causes of this year-class failure are unknown.

Thirty percent of the largemouth bass collected during this 6-month study had empty stomachs. When calculated by month, this percentage varied from 53.3 percent to 26.7 percent (Table 1). The complexity of factors influencing feeding behavior and the apparent differences in the degree of satiation of largemouth bass are suggested by the variability in the relative numbers of empty stomachs reported by other workers. Larimore (1957) found empty stomachs in only 8 percent of the bass collected by electrofishing in Venard Lake, Illinois. Lewis et al. (1974) reported 50 percent of bass stomachs being empty in Crab Orchard Lake, Illinois electrofishing samples. Snow (1971) examined largemouth taken by angling from Murphy Flowage, Wisconsin and found 68 percent had empty stomachs. Seaburg and Moyle (1964) reported 35 percent of the bass collected by seining in Maple Lake, Minnesota had empty stomachs. Though the capture method is undoubtedly an influential factor in forming hypotheses about feeding behavior, the degree of diversity shown here and by others suggests that satiation is probably influenced by specific circumstances in each system, such as forage density and availability, predator stocks, time of day, and season.

Crayfish appeared as the dominant food item by number and volume in American Horse largemouth bass (Fig. 1 and 2). Dense aquatic vegetation generally provide adequate habitat for crayfish populations (Dean 1969). Although no population estimates on crayfish were made, it is thought that their numbers were considerably less than those of either bluegill or young-of-year bass. Several authors (Bennett 1948, Lewis and Helms 1964, Lambou 1961, Snow 1971) have suggested, also, that when crayfish occur in a body of water, they can become a significant part of largemouth bass diet. This implies that there is at least a certain degree of selection by bass for this food item.

In no other available study were young-of-year bass utilized by adult largemouth to the degree found here. Young bass constituted a major portion of diets by number and volume (Fig. 1) and were present in all monthly samples with the exception of October (Table 1). This feeding behavior is thought to be largely influenced by the dense growths of aquatic macrophytes. As young bass became piscivouous in July, electrofishing observations showed that the young bass and the adult bass were concentrated near the outer edges of the vegetation, perhaps searching for forage. The small bass may have became easy prey for the larger fish. Adult bass showed a positive selection (Fig. 2) for young bass up until the time (October) when the young became large enough to avoid predation.

The macrophytes played an opposite role in the utilization of bluegill, however. Forage-size bluegill (50 - 125 mm) were most often observed in the middle of the dense vegetation thereby affording adequate protection from predation by adult largemouth. Although they represented 84.6 percent of the fish captured in the seine samples, their comparative utilization by largemouth bass was low. The monthly E values (Fig. 2) show little change through the seasons with negative selection occurring in all months. As a rule, their relative occurrence in the stomachs increased slightly each month but not enough to produce positive electivity values. A second bluegill spawn observed in August may result in an overcrowded and stunted sunfish population, especially if predation remains low.

Table 1. Number of empty stomach and relative occurrence (%) of food organism in adult largemouth bass stomachs by month (N = 30 for each month).

Month		No. Empty	Crayfish	*Lepomis macrochirus*	*Micropterus salmoides*	Insects	Unidentified Fish	Misc.
June	Number	8 (26%)	17.9	5.0	9.0	28.6	10.7	28.6
	Volume		18.1	7.2	7.0	59.4	8.1	0.2
July	Number	9 (30%)	41.7	11.1	13.9	5.6	16.7	11.1
	Volume		74.8	12.1	15.3	0.3	3.6	0.2
August	Number	14 (46.6%)	40.0	10.0	25.0	10.0	15.0	0.0
	Volume		46.0	12.1	38.7	1.0	3.3	0.0
September	Number	12 (40%)	33.3	28.6	19.0	0.0	14.3	4.8
	Volume		53.5	17.0	23.4	0.0	4.2	1.9
October	Number	16 (53.3%)	35.3	11.8	0.0	41.2	0.0	11.8
	Volume		32.4	3.3	0.0	15.9	0.0	48.4
November	Number	13 (43.3%)	5.5	61.1	22.2	5.5	0.0	5.5
	Volume		9.2	38.1	17.0	2.0	0.0	35.1

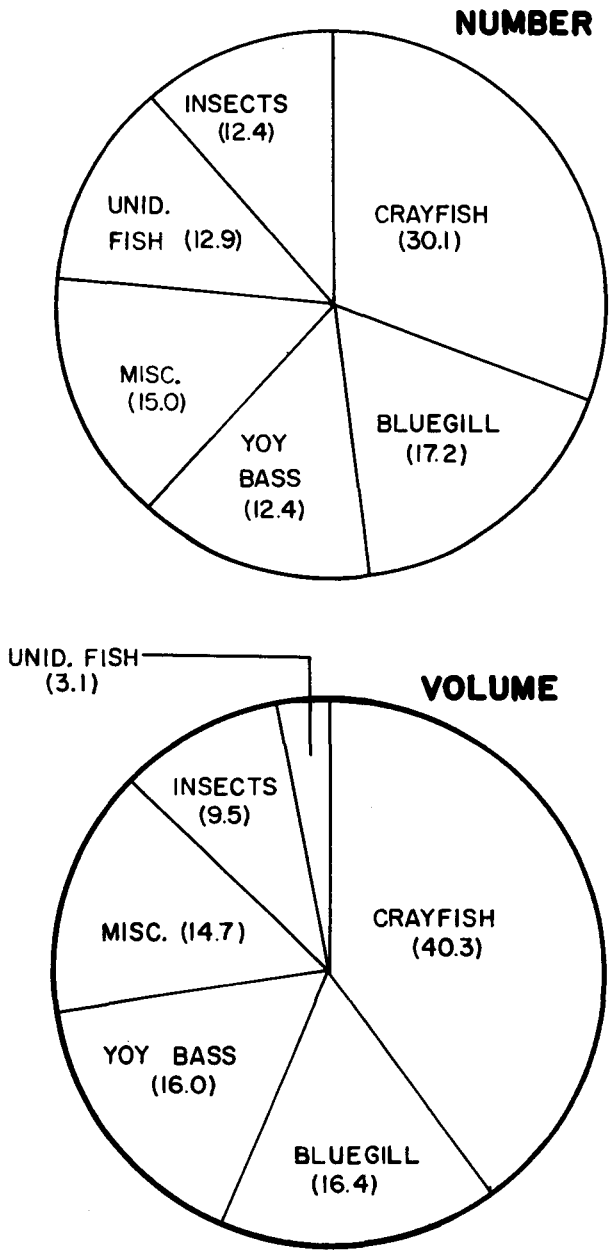

Fig. 1. Relative occurrence (%) of food items from American Horse Lake largemouth bass (n=180) from June through November, 1979.

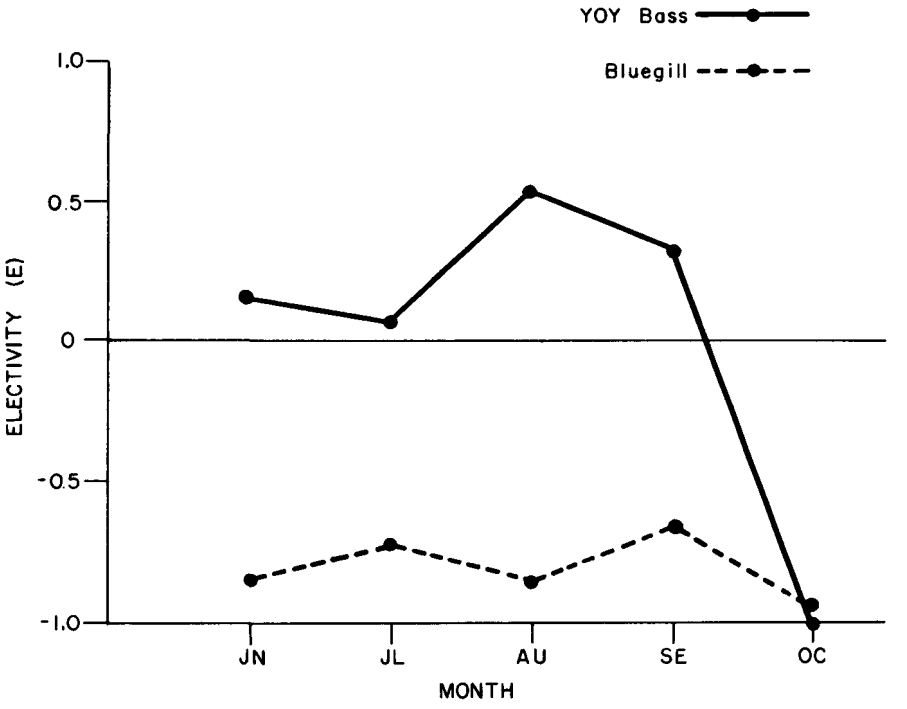

Fig. 2. Monthly electivity indices for bluegill and young-of-year largemouth bass by adult largemouth bass in American Horse Lake.

With the occurrence of dense aquatic vegetation it appears that Ivlev's electivity values take on a slightly different meaning. As suggested here and possibly elsewhere by other authors, the bass are not so much displaying avoidance or preference for a species as much as the prey species maybe displaying marked differences in vulnerability due to extreme habitat limitations. High utilization of young bass, low predation on bluegill, and substantial angling mortality of adult bass (Summers 1980) suggest that predator stocks are being drastically reduced while prey numbers are steadily increasing. It would therefore appear that the favorable predator-prey relationship in American Horse Lake (Bennett 1978) is now shifting toward the prey species and points to the need for renewed control of aquatic vegetation.

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