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Leo G. Nico; Donald C. Taphorn

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- BARRY CHERNOFF, *Department of Ichthyology, Academy of Natural Sciences of Philadelphia, 19th and the Parkway, Philadelphia, Pennsylvania 19103*. Accepted 19 Nov. 1984.

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DIET OF *ACESTRORHYNCHUS MICROLEPIS* (PISCES: CHARACIDAE) IN THE LOW LLANOS OF VENEZUELA.—The low llanos, or open savannahs of the Venezuelan Orinoco

River Basin, have distinct wet and dry seasons, resulting in large seasonal changes in fish habitats. During high water (May–Oct.) most of the area floods, but during the dry season standing water usually becomes limited to a few large permanent lagoons, large creeks and rivers. Recent years have seen construction of dikes around vast areas of savannah (called módulos) on the floodplain. These módulos lessen the extreme effects of seasonal changes within their boundaries. In the rainy season, dikes affect local fish movements and change runoff patterns. In the dry season, water is retained in deep borrow pits excavated during dike construction.

Several workers (Zaret and Rand, 1971; Lowe-McConnel, 1975) found food to be limiting in tropical aquatic systems during the dry season. However, Goulding (1980) found food of larger carnivorous fishes to be less affected by seasonality than is that of other fishes, but he did not examine small piscivores. *Acestrorhynchus microlepis* (Schomburgk) 1841, called "picua" in Venezuela, is a highly specialized pike-like characid (Roberts, 1969). It is generally smaller than 25 cm standard length and almost exclusively piscivorous (Menezes, 1969). Menezes (1969) looked at gut contents of six species of *Acestrorhynchus*, primarily from Brazil, including a few *A. microlepis* (N = 12?), but he did not give fish sizes, identify prey species nor present habitat or season information. We made collections of *A. microlepis* from a blackwater stream, Caño Maporal, and diked areas on the floodplain during both low and high water periods in the Apure-Orinoco River Basin, Estado Apure, Venezuela, for examination of stomach contents to determine if habitat or season influenced diet.

Study area.—The UNELLEZ (Universidad Nacional Experimental de los Llanos Occidentales Ezequiel Zamora) Módulo is some 80 km W of Mantecal, Apure, at approximately 7°25'50"N, 69°35'30"W. Caño Maporal, a low-gradient, blackwater stream with a mostly silt bottom and bordered by a narrow gallery forest, passes just outside the SW corner of the módulo. During the late dry season (Jan.–early April) there is little to no flow and depth is less than 1 m. During the rainy season flow is continuous and depth can reach 5 m or more, often overtopping the banks. Width ranges from 3–12 m during low water to well over 20 m during peak flooding.

The UNELLEZ Módulo, constructed in 1977,

TABLE 1. SUMMARY OF DATA ON *Acestrorhynchus microlepis* AND THEIR PREY FROM CAÑO MAPORAL AND THE UNELLEZ MÓDULO, ESTADO APURE, VENEZUELA.

| Habitat and season | Number of specimens examined (N = 170) | SL size range in mm (\bar{x}) | Number of specimens containing prey (mean fullness)* | Prey items (frequency of occurrence) |
|--------------------|--|-----------------------------------|--|--|
| Caño Maporal, wet | 19 | 41-96 (68) | 13 (2.1) | <i>Cheirodon pulcher</i> (2), <i>Hemigrammus levis</i> (2), characoid (7), fish (7) |
| Módulo, wet | 80 | 38-117 (75) | 49 (1.5) | <i>Astyanax bimaculatus</i> (1), <i>Hemigrammus levis</i> (1), <i>Pyrrhulina</i> cf. <i>lugubris</i> (2), <i>Curimatella immaculata</i> (1), curimatid (2), characoid (12), gymnotoid cf. <i>Eigenmannia</i> (1), <i>Microgeophagus ramirezi</i> (1), fish (29), fish scales (1) |
| Wet season totals | 99 | 38-117 (74) | 62 (1.6) | |
| Caño Maporal, dry | 31 | 70-122 (95) | 10 (0.7) | <i>Aphyocharax erythrurus</i> (1), characoid (1), fish (6), unidentified remains (2) |
| Módulo, dry | 40 | 71-128 (89) | 14 (0.7) | curimatid (1), characoid (2), fish (10), insect fragment (1), unidentified remains (1) |
| Dry season totals | 71 | 70-128 (92) | 24 (0.7) | |

* Includes both empty and nonempty stomachs.

a roughly rectangular area (12,600 ha) of open flat savannah interspersed with small forest islands (matas), is surrounded by earthen dikes approximately 2.5 m high. Before dike construction the entire area was completely dry during much of the dry season. Since construction, deeper borrow pits contain water throughout the year, but usually dry to less than 0.5 m depth during the dry season. They resemble permanent lagoons both in habitat and fish species composition. During the rains most of the módulo undergoes some flooding and low areas are covered with as much as 2 m of water.

Materials and methods.—Fish were collected during daylight hours using 5 × 2 and 10 × 2 m seines with mesh sizes of ca 4 and 7 mm, respectively. *A. microlepis* were taken from Caño Maporal on 13 Feb. 1979, 6 Feb., 16 June, 17 Aug., 17 Sept. 1981, and 8 Jan. 1982; and from módulo pools on 3-6 Feb., 19 and 21 July, 16 Aug. 1981, and 11 July 1984. Specimens collected during the transitional periods between seasons (Oct.-Dec. and April-May) were not examined. Stomach contents of 170 fish were examined and frequency of occurrence, number and dominance (the item contributing greatest volume or bulk to contents of each stomach) were recorded for each food item. For each specimen, a partially subjective estimate of

stomach fullness (modified from Thomerson and Wooldridge, 1970) was made as follows: 0 = empty; 1 = food items present but significantly less than half full; 2 = approximately half full; and 3 = full. All specimens examined are deposited at the Museo de Ciencias Naturales, UNELLEZ, Guanare, Portuguesa, Venezuela.

Results and discussion.—A summary of results is given in Table 1. Fish were the dominant food item in all 83 specimens with stomach contents that could be identified. Number of empty stomachs and low mean fullness suggest there was significantly less food available to *A. microlepis* during the dry season. Thirty-seven percent of the fish collected during high water had empty stomachs compared to 66 percent during low water ($\chi^2 = 13.75$, $df = 1$, $P < .005$). The mean fullness value of wet season specimens (N = 99) was more than double that of dry season specimens (1.6 vs 0.7). Although fish populations are less dense during the wet season because of the tremendous increase in water surface area, the majority of tropical fish species reproduce during high water after the first few weeks of heavy rains. Thus, an abundance of small fishes is present throughout most of the rainy season (Lowe-McConnel, 1975; Taphorn and Lilyestrom, 1984).

No significant differences were found in the

number of empty stomachs (wet: $\chi^2 = 0.33$; dry: $\chi^2 = 0.06$; $df = 1, P > .005$) or relative quantity of food consumed by *A. microlepis* from Caño Maporal and those from módulo pools taken during the same seasons. No differences in diet composition were seen between creek and módulo pool or dry and wet season samples, but the gut of *A. microlepis* is very short and digestion proceeds rapidly so identification of many prey fish was difficult or impossible. The ragged condition of most prey items suggested extensive handling following initial seizure. Most fish eaten were small rather streamlined species, primarily characoids, taken whole or nearly whole; a feeding habit typical of the genus (Menezes, 1969). Prey fish that could be measured ranged between 12–40 mm standard length (SL) or 16–44 ($\bar{x} = 29$) percent of the SL of the predator. The most common small fishes taken with *A. microlepis* in módulo samples were *Aphyocharax erythrurus*, *Astyanax bimaculatus*, *Ctenobrycon spilurus*, *Curimata* sp., *Curimatella immaculata*, *Gymnocorymbus thayeri*, *Hemigrammus* spp., *Odontostilbe pulcher* and *Poptella orbicularis* (Taphorn and Lilyestrom, 1984), yet no deep-bodied species (*C. spilurus*, *G. thayeri* and *P. orbicularis*) were identified in *A. milepis* stomachs except for a small *A. bimaculatus*.

Our data indicate little or no major seasonal change or shift in food by *A. microlepis* even though its normal prey of small fishes becomes limited during the dry season. More fish containing prey, and perhaps a wider variety of fish prey species, during the rainy season probably reflect greater availability of small fishes. *A. microlepis* is piscivorous at a very small size. The smallest young feed on invertebrates and gradually change to a piscivorous diet at approximately 35 mm SL. The breeding cycle of *A. microlepis* is such that young are present at that size or larger when the most juvenile characins are available.

In both módulo pools and Caño Maporal, *A. microlepis* most often occupied areas near shore. In the módulo *A. microlepis* usually moved about alone or in small groups of some 8–10 individ-

uals at or near the surface, hunting along the periphery of floating and emergent shoreline vegetation (DCT, pers. obs.). A strike was typically a quick dash or dive into the vegetated areas after small characins. In aquaria, *A. microlepis* hunt by stalking much as Hoogland et al. (1956) described for *Esox lucius*.

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