The dietary habits of the clariid catfish, *Heterobranchus bidorsalis* (Geoffroy St. Hilaire 1809) in Owena Reservoir, Southwestern Nigeria

Oyedapo A. Fagbenro

Tropical Zoology 5: 11-17, 1992

The dietary habits of the clariid catfish, *Heterobranchus bidorsalis* (Geoffroy St. Hilaire 1809) in Owena Reservoir, Southwestern Nigeria

OYEDAPO A. FAGBENRO [1]

Department of Fisheries & Wildlife, Federal University of Technology, P.M.B. 704, Akure, Nigeria

Received 9 October 1990, accepted 24 September 1991

The dietary habits of the giant African clariid catfish, *Heterobranchus bidorsalis* (Geoffroy St. Hilaire 1809) inhabiting Owena Reservoir (Southwestern Nigeria) were investigated. Stomach content analyses established that it had an euryphagous diet. The diet comprised mainly plankton, insects, fish and detritus although, plant parts, benthic invertebrates and tadpoles were consumed. Detritus was very prominent accounting for between 68.1-74.5% occurrence and 13.9-19.6% volume in all sizes of fish examined, which indicated that it was a benthic feeder.

There was a progression from planktivorous diet in fish below 12 cm standard length (SL) through a transitional insectivorous phase (SL, 12-27 cm) to a predominantly piscivorous diet in fish above 27 cm SL. It was capable of filter feeding only when young but later became predatory, consuming appropriately sized prey organisms as it grew older. No seasonal variation was established in food preference of any size of fish.

KEY WORDS: dietary habits, euryphagous, benthic feeder, clariid catfish, *Heterobranchus bidorsalis*.

[1] Present address: Institute of Aquaculture, University of Stirling, Stirling FK9 4LA, Scotland, Great Britain.

INTRODUCTION

Clariid catfishes are ubiquitous in Africa and constitute one of the main fish families of economic value as food fish. In Nigeria they are caught all year round in most freshwaters and swamps with a variety of gear and they command high market price either fresh or smoke-dried. There are two important genera in this family, namely *Clarias* and *Heterobranchus*. The genus *Heterobranchus* is endemic to Africa and has four species (TEUGELS et al. 1990) of which three namely *H. bidorsalis* (Geoffroy St. Hilaire 1809), *H. longifilis* (Cuvier & Valenciennes 1840) and *H. isopterus* (Bleeker 1863) have been described from West Africa (LOWE-MCCONNELL 1972). Despite their economic value and wide distribution there exists a dearth of information on the general biology of this genus.

The study of dietary habits based on stomach content analysis is widely used in fish biology and ecology. The information provided by previous studies on the dietary habits of *H. bidorsalis* from various West African bodies (ADIASE 1969, IMEVBORE & BAKARE 1970, TOBOR 1972, FAGADE 1983, ELLIOTT 1986, OLURIN & FAGADE 1990) have proved inadequate since few specimens were examined, and they failed to (i) indicate the position of *H. bidorsalis* within the aquatic communities it inhabits, (ii) provide information on the contribution of different food items to its diet. The objective of this study therefore was to investigate the dietary habits, using stomach content analysis, of *H. bidorsalis* in Owena Reservoir based on catches made by fishermen.

MATERIALS AND METHODS

Procurement of fish specimens

Live *H. bidorsalis* specimens were obtained, once weekly between October 1986 and September 1988 directly from landings of artisanal fishermen in Owena Reservoir.

Owena Reservoir has a surface area of 1450 ha (ITA et al. 1985) and lies within the derived Savanna zone of Southwestern Nigeria between Longitude 5°E and Latitude 7°N and 8°N. Fisheries exploitation in the Reservoir is haphazard and is based on individual fishermen. The fishermen operate from unpowered dug-out canoes and use a variety of traditional gear which include graded fleets of gill nets (mesh size, 26-179 mm), longlines (with baited hooks and unbaited hooks), traps (trigger type and non-return valve type) and cast nets. The fishery is based on a few genera, namely, *Alestes* Müller & Troschel 1844, *Channa* Scopoli 1777, *Chrisichthys* Bleeker 1858, *Clarias* Cuvier & Valenciennes 1840, *Heterobranchus* Geoffroy St. Hilaire 1809, *Hepsetus* Swainson 1838, *Synodontis* Cuvier 1817, *Mormyrus* Linnaeus 1758, *Mormyrops* Müller 1843, *Tilapia* Smith 1840, *Sarotherodon* Rüppell 1852, and *Oreochromis* Günther 1889.

Stomach content analysis

The specimens were selected randomly to include various sizes. The minimum monthly sample size contained 25 specimens. After recording length (standard length, cm) and weight (g) measurements of individual caftish, the specimens were gutted, the stomachs were removed and immediately preserved in 5% formalin inside labelled glass tubes. Individual stomachs were examined under a low-power stereo dissection microscope or, where necessary, under high-power magnification and the component dietary items were identified to the lowest convenient taxon. The % incidence of empty stomachs was also recorded. Dietary items were later analysed by occurrence (%O) and volumetric (%V) methods (HYSLOP 1980). The prominence of each dietary item was determined by computing ranking index I (ODA & PARRISH 1981) as follows:

$$I = (\%\ \text{Occurrence} \times \%\ \text{Vomume}) \times 10^{-2}$$

Partly digested food items were generally classified as unidentified food materials. For the presentation of results, catfish specimens were grouped into three size categories (based on SL measurements) as follows: Group I = below 12.0 cm (fingerlings); Group II = 12.1-27.0 cm (juveniles); Group III = above 27.0 cm (adults).

RESULTS

Altogether, 714 *H. bidorsalis* specimens with SL ranging from 8.2 to 60.5 cm were examined and the variety of dietary items in their stomachs comprised organisms of both plant and animal origin as well as detritus. Food composition analysis of the stomach contents with variation to the size groups are presented in Table 1 along with the I values. Irregularity in obtaining fish specimens due to infrequent fishing in Owena Reservoir prevented a monthly analysis of the dietary items. Despite this limitation, sufficient samples were taken for it to be apparent that there was no pronounced seasonal changes in the diet. The three size groups of specimens showed differences in the dietary items selected (Table 1).

Group I (<12.0 cm SL)

The incidence of empty stomachs was 7.3%. Plankton, immature insects and detritus were the dominant dietary items, all of which occurred in over 75% of stomachs with food. Plankton had the highest I values (Table 1) followed by insects and detritus. Other food items showed no great significance.

Group II (12.1-27.0 cm SL)

The incidence of empty stomachs was 10.9%. There was a decline in the % volume of plankton and detritus (compared with Group I) while insects became dominant, occurring in 90.7% of stomachs containing food and representing 22.2% volume (Table 1). The ranking index (I) values also established the prominence of insects. Less prominent food items included fish, detritus, molluscs and plankton.

Group III (>27.0 cm SL)

The incidence of empty stomachs was 9.3%. Plankton were almost totally absent from the diet. The diet was restricted mainly (based on the % volume) to large-sized prey organisms such as fish and molluscs (Table 1), hence the prominence of fish (mainly *Barbus* Cuvier & Cloquet 1816, *Alestes* Müller & Troschel 1844 and *Arnoldichthys* Myers 1926 spp.) and molluscs were reflected by relatively higher I values (Table 1) than the other dietary items. Detritus was relatively less prominent in this group than in Groups I and II, accounting for 15.5% volume and 70.1% occurrence. The remaining items were not prominent in the diet.

Table 1.
Analysis of the food composition in the stomachs of *H. bidorsalis* showing variation between the size categories.

	Juveniles (below 12.0 cm)			Sub-adults (12.1-27.0 cm)			Adults (above 27.0 cm)		
No. examined	220			376			118		
Empty stomachs (%)	7.3			10.9			9.3		
	%O	%V	I	%O	%V	I	%O	%V	I
Cyanophytes	43.1	2.6	1.12	37.0	1.3	0.48	25.2	1.3	0.33
Diatoms	100.0	6.6	6.60	67.2	2.0	1.34	34.8	1.5	0.46
Dinoflagellates	100.0	6.5	6.50	67.2	2.0	1.34	34.6	1.5	0.52
Copepods	62.7	4.5	2.82	23.9	1.2	0.31	—	—	—
Cladocerans	59.3	2.8	1.66	26.0	1.2	0.23	—	—	—
Ostracods	80.9	4.7	3.80	31.0	1.3	0.37	—	—	—
Rotifers	67.2	4.8	3.23	44.8	1.8	0.81	26.2	1.3	0.34
Immature insects	81.9	6.7	5.49	83.9	7.5	6.29	38.3	3.1	1.19
Adults insects	56.4	6.8	3.84	90.7	6.5	5.90	40.2	3.2	1.29
Insect remains	49.5	6.8	3.37	67.2	8.2	5.51	30.8	2.7	0.83
Bivalves	—	—	—	51.0	6.2	3.16	68.2	9.0	6.14
Gastropods	—	—	—	54.9	6.4	3.51	72.9	10.2	7.44
Prawn	30.4	3.5	1.06	75.8	13.5	10.23	82.2	7.8	6.41
Annelids	18.1	2.3	0.42	11.0	1.4	0.15	—	—	—
Fish	21.1	3.0	0.63	44.8	6.5	2.91	87.9	15.8	13.89
Fish remains	9.3	3.0	0.28	62.1	7.3	4.53	100.0	20.0	20.00
Tadpoles	13.2	3.0	0.40	24.2	2.0	0.48	—	—	—
Plant parts	44.6	7.5	3.35	46.9	5.6	2.63	15.9	1.3	0.21
Detritus	74.5	19.6	14.60	68.1	13.9	9.47	70.1	15.5	10.87
Unidentified items	52.5	5.3	2.78	30.7	4.2	1.29	12.1	5.8	0.70

% O = % occurrence; % V = % volume; I = ranking index.

DISCUSSION

The study of diets based on stomach content analysis is widely used in fish ecology to indicate the position of a species within a food web and to provide information on the contribution of different prey items to the diets. The monogastric and sac-like structure of the stomachs is similar to that of the closely-related *Clarias gariepinus* (Burchell 1822) (Mills 1966). The stomach contained food materials at various stages of digestion, hence the classification of some as unidentified items.

Altogether, 68 empty stomachs were recorded, giving an incidence of 9.52% and this is considered low enough to suggest a faily regular feeding intensity by all size categories. The remaining stomachs were more than 3/4 full with food items, a condition described by Ikusemiju & Olaniyan (1977) as indicative of an abundance of prey/food in the habitat. The prominence of detritus in the diets of all size categories, as reflected by the I values (Table 1), revealed that *H. bidorsalis* fed mainly at the bottom, finding that a variety of benthic invertebrates (chironomid larvae and pupae, chaoborid larvae, annelids and molluscs) dominated the diet. Prey preference of the fingerling size group (< 12 cm) was markedly different from that of the juvenile size group (12.1-27.0 cm) and the adults (> 27 cm). This was due to resource partitioning (to avoid intraspecific competition). This prey plasticity also reflected the occurrence and relative abundance of the preferred prey within a particular niche. The same reason could be adduced for the progressive decline in % occurrence of plant parts in the stomachs with increasing fish size (Table 1).

The I values (Table 1) establish plankton as the main food item in fingerlings which suggest a filter-feeding habit. In juveniles, the diet became varied and included prawn (*Macrobranchium* sp.), fish (mainly *Barbus* sp.) and molluscs. Such inclusion of large-sized prey organisms indicated a switch from filter-feeding to procurement and consumption of appropriately sized prey. The divergence in the range of foods as the fish grew older also agrees with NIKOLSKII (1969) and AYINLA (1988).

Barbus (Cyprinidae), *Alestes* and *Arnoldichthys* spp. (Characidae) were the commonly observed prey fish in the stomachs of adult *H. bidorsalis*, although few juvenile tilapias (Cichlidae) were also recorded. The preference for cyprinids and characoids was possibly because of their small size, cylindrical shape, soft fins and high population levels in the reservoir. Equally important was the fact that being shoaling planktivores, they occupy open waters and were thus vulnerable to predation by the lurking *H. bidorsalis*; unlike the spinous juvenile cichlids that inhabit shallow and weedy shores as an adaptive strategy to discourage and evade predation. The plankton that occurred in the stomachs of adult *H. bidorsalis* are regarded as 'non-target' food items possibly derived from prey fish, according to the observation of CORBET (1961).

The switch from filter-feeding to a predatory habit with increasing fish size is a common phenomenon of piscivorous catfishes as reported by LOWE-MCCONNELL (1975) and WELCOMME (1985) and is particularly true for *H. bidorsalis* in this study (Table 1). Also, the progression from planktivorous through insectivorous to a predatory dietary habit with increasing fish size agrees with IKUSEMIJU & OLANIYAN (1977), WILLOUGHBY (1979) and OCHIENG (1982) that most predatory catfishes show great plasticity in their diets using different prey as they grow.

Brief accounts of the dietary habits of adult *H. bidorsalis* in Volta Lake (ADIASE 1969), Lake Kainji (IMEVBORE & BAKARE 1970), Lake Chad (TOBOR 1972), River Benue (FAGADE 1983), Asejire Lake (ELLIOT 1986) and Oyan Lake (OLURIN & FAGADE 1990) confirm this catfish species as a piscivore. From the results of this study, it appears that *H. bidorsalis* is omnivorous but with a high propensity for being piscivorous. Ominivory is a characteristic feature of widely distributed fishes, which has also been reported of other clariid catfishes (OLATUNDE 1983, HUISMAN & RICHTER 1987, AREERAT 1987, FAGBENRO & SYDENHAM 1988). This wide variability and adaptiveness in their natural diet, among other reasons, is responsible for their success in the wild (LOWE-MCCONNELL 1975) as well as their desirability for pond cultivation (ELLIOTT 1975, FAGBENRO 1990).

CONCLUSION

This study complements previous studies on the dietary habits of *H. bidorsalis* from West Africa and for the first time indicates that this catfish is a benthic feeder and has an euryphagous diet, which makes it well suited for pond culture. Being predominantly piscivorous as adults further suggests that *H. bidorsalis* could be used as a suitable predator to control undesiderable tilapia recruitment in ponds.

ACKNOWLEDGEMENTS

This study was funded by a Research Grant (Ref. SAAT/D/SRC/137) from the School of Agriculture and Agricultural Technology, Federal University of Technology, Akure, Ondo State, Nigeria. This support is hereby acknowledged with gratitude.

REFERENCES

ADIASE M.K. 1969. A preliminary report on the food of fish in the Volta Lake, pp. 235-237. In: Obeng L.E., Edit. Man-made lakes. *Accra: Ghana University Press*, 320 pp.

AREERAT S. 1987. *Clarias* culture in Thailand. *Aquaculture* 63: 355-362.

AYINLA O.A. 1988. Nutrition and reproductive performance of *Clarias gariepinus* (Burchell, 1822). *Ph.D. Thesis, University of Ibadan*, 433 pp.

CORBET P.S. 1961. The food of non-cichlid fishes in the Lake Victoria basin, with remarks on their evolution and adaptation to lacustrine conditions. *Proceedings of the Zoological Society of London* 136: 1-101.

ELLIOTT O.O. 1975. Biological observations on some species used for aquaculture in Nigeria. *FAO/CIFA Symposium on Aquaculture in Africa, Accra, Ghana*, CIFA/T4: 373-384.

ELLIOTT O.O. 1986. Some aspects of the biology of the fishes of Asejire Lake. *Ph.D. Thesis, University of Ibadan, Nigeria*, 301 pp.

FAGADE S.O. 1983. The food and feeding habits of the fishes of Lower River Benue (Nigeria). *Bulletin de l'Institut Fondamental d'Afrique Noire* (*A*) 45: 3-8.

FAGBENRO O.A. 1990. Some aspects of the biology and aquacultural potential. *Ph.D. Dissertation, Federal University of Technology, Akure, Nigeria*, 162 pp.

FAGBENRO O.A. & SYDENHAM D.H.J. 1988. Evaluation of *Clarias isheriensis* (Sydenham) under semi-intensive management in ponds. *Aquaculture* 74: 287-291.

HUISMAN H.B.N. & RICHTER C.J. 1987. Reproduction, growth, health control and aquacultural potential of the African catfish, *Clarias gariepinus* (Burchell, 1822). *Aquaculture* 63: 1-14.

HYSLOP E.J. 1980 Stomach contents analysis, a review of methods and their application. *Journal of Fish Biology* 17: 411-429.

IKUSEMIJU K. & OLANIYAN C.I.O. 1977. Food and feeding habits of the catfishes, *Chrisichthys walkeri* (Günther), *C. filamentosus* (Boulenger) and *C. nigrodigitatus* (Lacépède) in Lekki Lagoon, Nigeria. *Journal of Fish Biology* 10: 105-115.

IMEVBORE A.M.A. & BAKARE O. 1970. The food and feeding habits of non-cichlid fishes of the River Niger in the Kainji Reservoir area, pp. 49-64. In: Visser S.A., Edit. Kainji: a Nigerian man-made lake. Vol. 1: Ecology. *Ibadan: NISER*, 175 pp.

ITA E.O., SADO E.K., BALOGUN J.K., PANDOGARI A. & IBITOYE B. 1985. Inventory survey of Nigeria Inland Waters and their fishery resources. *Kainji Lake Research institute, (KLRI) Technical report Series No. 14. KLRI, New Bussa*, 51 pp.

LOWE-MCCONNELL R.H. 1972. Freshwater fishes of the Volta and Kainji Lakes. *Accra: Ghana University Press*, 22 pp.

LOWE-MCCONNELL R.H. 1975. Fish communities in tropical freshwater: their distribution, ecology and evolution. *London: Longman*, 337 pp.

MILLS H.D. 1966. The African mudfish, *Clarias lazera*. *Ibadan: University Press*, 42 pp.

NIKOLSKII G.V. 1969. Fish population dynamics. *Edinburgh: Oliver & Boyd*, 323 pp.

OCHIENG J. 1982. Reproductive biology and feeding ecology of a predatory siluroid catfish: *Bagrus docmac* Forskal (Pisces: Bagridae) in Winam Gulf of Lake Victoria; East Africa. *M.Sc. Thesis, University of Nairobi, Kenya*, 147 pp.

ODA D.K. & PARRISH J.D. 1981. Ecology of commercial snappers and groupers introduced to Hawaiian reefs. *Proceedings of the Fourth International Coral Reef Symposium* 1: 59-67.

OLATUNDE A.A. 1983. Length-weight relationship and the diets of *Clarias lazera* in Zaria. *Proceedings of the Third Conference of Fisheries Society of Nigeria*: 183-192.

OLURIN K.B. & FAGADE S.O. 1990. The food and feeding relationships of the fishes in Oyan Lake, Ogun State, Nigeria. *Nigerian Journal of Science* 25: 18-22.

TEUGELS G.G., DENAYER T. & LEGENDRE U. 1990. A systematic revision of the African catfish genus *Heterobranchus* Geoffroy-Saint-Hilaire, 1809 (Pisces: Clariidae). *Zoological Journal of the Linnean Society* 98: 237-257.

TOBOR J.G. 1972. The food and feeding habits of some Lake Chad commercial Fishes. *Bulletin de l'Institut Fondamental d'Afrique Noire (A)* 34: 1-5.

WELCOMME R.L. 1985. River fisheries. *FAO Technical Paper 262. Food and Agriculture Organisation, Rome,* 330 pp.

WILLOUGHBY N.G. 1979. Some aspects of the ecology of *Synodontis* (Pisces: Siluroidei) in Lake Kainji during its early years. *Proceedings of the International Conference on Kainji Lake and River Basins, Development in Africa, Ibadan, Nigeria* 2: 376-386 (Kainji Lake Research Institute, New Bussa).