Hydrobiologia 144: 77–82 (1987)

Food Composition of *Clarias gariepinus* (= *C. lazera*) (Cypriniformes, Clariidae) in Lake Kinneret (Israel)

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Keywords: *Clarias gariepinus (Lazera),* Lake Kinneret, food composition

Abstract

The feeding behaviour of the freshwater piscivore, *Clarias gariepinus (C. lazera*) (C & V 1840) was studied over two periods: 1973–1975 and 1981–1982, in Lake Kinneret (Israel). The total number of fish analysed was 264 and their sizes (SL) and weights varied between 238 and 830 mm (146 to 5728 g). More than fifty species of plants and animals from the plankton, benthos and nekton of Lake Kinneret were identified in the intestines of *C. gariepinus.* Preyed fish were the most abundant food component (81%) and constituted the highest biomass, with *Mirogrex terraesanctae* representing the majority (although other species were also found). The potential impact of piscivory in the Kinneret ecosystem is considered.

Introduction

Clarias gariepinus (*C. lazera;* Valenciennes, 1840) (Teugels, 1984) is a widespread freshwater species, found from Turkey, the Middle East, throughout Central and South Africa. It inhabits natural lakes, impoundments, fish ponds, streams and natural ponds in both deep and shallow waters. In Israel catfish is found in Lake Kinneret, but not in high quantities and also in streams of the Jordan system and in the coastal plains (Ben-Tuvia, 1978). *C. gariepinus* was very abundant in the old shallow Lake Hula (Ben-Tuvia, 1978). In 1957 most of Lake Hula was drained; the remainder was left as a nature reserve and is at present densely inhabited by *C. gariepinus.*

This fish is very poorly marketed since it is scaleless and thus not consumed by Jewish or Moslem people. Consequently it might be that annual catches in Lake Kinneret are sometimes higher than official information since partial quantities are not recorded. The catch of catfish averages 0.2–0.4% of the total fisheries in Lake Kinneret (Table 1) (Sarid & Golani, 1950–1982).

Although many studies on the food composition of *Clarias* have been carried out, a consistent pattern has not emerged. *Clarias* can be classified as an omnivore or predator of a very wide trophic spectrum (Jocques, 1975; Thomas, 1966; Bruton, 1978; 1979; Greenwood, 1958; Hulot, 1950; Micha, 1973; De Kimp & Micha, 1974; Micha & Frank, 1976; Ben-Tuvia, 1978).

The food composition of *Clarias* in ponds, fed by artificial food, has also been studied (Hulot, 1950; Inam *et al.,* 1970; Bardach *et al.,* 1972; Micha, 1973; De Kimp & Micha, 1974; Pham, 1975; Micha & Frank, 1976; Pham & Rangel, 1978; Hogendoorn, 1980, 1981; Degani *et al.,* 1984) and a wide variety of food components was observed.

In Israel, Lake Kinneret, is the major water source, currently supplying 30% of the total national fresh water consumption. In this respect, proper management design, based on the knowledge of all food chain components (including fishery) is required. The present study, is a part of a Dutch-Israeli Research Project on *Clarias gariepinus,* in which we present data on the food composition of this fish in Lake Kinneret.

Table 1. Clarias gariepinus, Mirogrex terraesanctae and total annual fisheries (m. tons) (%) in Lake Kinneret, averaged for three periods (Sarid & Golani, 1950 – 1982).

Fish species	Annual catch					
	1968 – 1972		1973 – 1977		1978 – 1982	
	Catch	%	Catch	%	Catch	%
Clarias gariepinus	6.8	(0.4)	3.4	(0.2)	4.5	(0.2)
Mirogrex terraesanctae	1056	(58.0)	1042	(61.8)	1008	(52.5)
Total	1821	(100)	1685	(100)	1919	(100)

Materials and methods

Clarias specimens were collected mostly by purse-seine nets, and partly by hooks, in the northern part of Lake Kinneret from November 1973 to February 1975 and between December 1981 and February 1982. Since the gut contents of *Clarias*, fished by purse-seine might be affected by crowding predators (*Clarias*) together with prey (bleaks) inside the netbasket we examined also the food of fish collected by hooks during December 1981-February 1982. Total number of analysed fish was 264 and their sizes (SL) and weights varied between 238 mm and 830 mm (146 to 5728 g).

Collected fish were dissected immediately after fishing and stomachs and intestines were removed into 6% formaldehyde solution. Degree of fullness of the stomachs and intestines were determined. Comparison of fragments found in the intestines to the complete organisms identified in the stomach enabled us to classify and count food items in all digestive systems of the analysed fishes. In the case of disintegrated preyed fish found in the digestive tracts, their identification was based on a classification of pharyngeal bones (Spataru & Gophen, 1985). Other food items, such as zooplankton or zoobenthic organisms, found intact or fragmented were also identified and counted using a M40 Wild inverted microscope.

Biomass assessment of the food components was based on the known volumes of each zooplankton species (Gophen, 1973), or by weighing organisms, identified in the intestines and collected from the entire lake benthos and nekton (Spataru, 1978; Spataru *et al.*, 1980).

To estimate the degree of satiation index (index of fullness) the following formula was used:

$$\text{Index of fullness} = w \times 100/W$$

where w is the weight of the gut contents and W is the weight of the fish.

Results and discussion

Analysis of the gut (from the oesophagus to the anus) contents (Tables 2 – 4), indicates a broad trophic food spectrum. More than 50 species of plants and animals, from the plankton, benthos

Table 2. Gut contents of *Clarias gariepinus* averaged for all analysed specimens.

Food organisms	Number of species found	Occurrence frequency (%)
Oligochaeta	2	1.5
Gastropoda	5	24.6
Cladocera	5	5.7
Copepoda	6	13.6
Ostracoda	2	11.0
Amphipoda	2	18.6
Decapoda	2	2.7
Hidracarina	1	0.8
Odonata	1	0.8
Coleoptera	1	6.8
Ceratopogonidae	3	6.1
Chironomidae: larvae	7	22.4
pupae	2	5.3
imago	3	3.4
Pisces	9	81.1
Spawn (fertilized fish eggs)	2	9.1
Macrophyta	2	11.0
Filamentous algae	4	5.3
Detritus	-	11.0
Empty intestines	-	8.7
Parasites: Trematoda	4	40.5
Nematoda	1	24.6
Cestoda	1	1.5

Table 3. Occurrence frequencies (%) of different fish species in the intestines of *Clarias gariepinus*.

Fish species	Maximum number found in one intestine	Occurrence frequencies*
Mirogrex terraesanctae	15	68.9
Acanthobrama lissneri	3	1.5
Capoeta damascina	1	0.8
Barbus longiceps	2	0.8
Tor canis	1	0.8
Tilapia zillii	1	3.8
Astatotilapia flaviijosephi	2	3.0
Tristramella simonis	3	6.1
Salaria fluviatilis	5	0.8
Cyprinidae	3	2.3
Cichlidae	2	3.8
Unidentifiable fish	4	7.6

* % of analysed fish containing each fish species.

and nekton of Lake Kinneret were identified in the digestive tracts. Results in Tables 2 & 4 show that the most abundant (81.1%) food component, which also represented the highest biomass, is preyed fish. Benthic organisms were also found relatively frequently (Table 2): Gastropods 24.6% (26.7 g), larvae of Chironomidae 22.4% (11 g) and Amphipoda 18.6% (2.5 g). Three species of gastropods were found in similar frequencies and biomass (Tables 2 & 4): *Teodoxus jordani, Bithynia hawaderiana,* and *Melanoides tuberculata.* The most frequent chironomids were *Tanypus punctipennis, Polypedilum tiberialis, Tanytarsus* sp., *Chironomus* spp. and *Procladius choreus,* while *Echinogammarus veneris* was the most abundant amphipod.

The larvae of the species *Coryneura scutellata* (Chironomidae) (Johannsen, 1973) was identified in several fish intestines. It is a new description of this species in Israel (Kugler & Chen, 1968).

Mirogrex terraesanctae was the most abundant among preyed fish found in the guts of *C. gariepinus* (68.9%) (Table 3). Most of the preyed bleaks were smaller than commercial size (> 11 cm), ranged from 45 mm to 120 mm SL and ingested cichlids were also below commercial size, ranging from 3.00 cm to 14.5 cm SL (Bruton, 1978). In the stomachs of two *Clarias* (SL = 650 and 670 mm; W = 3115 and 4091 g) 15 and 11 individuals of preyed *Mirogrex* were found respectively. The lengths (SL) of these bleaks ranged between

Table 4. Occurrence frequencies (%) and maximum quantity (number and wet weight biomass, mg) of the analysed major organisms in the guts of *C. gariepinus*.

Food organisms	Occurrence frequencies %	Maximum number found in one intestine	Maximum biomass in one intestine (mg) wet wt.
Gastropoda			
Teodoxus jordani	24.6	345	9.7×10^3
Bithynia hawaderiana	20.0	132	8.0×10^3
Melanoides tuberculata	15.5	89	9.0×10^3
Amphipoda			
Echinogammarus veneris	18.6	832	2.5×10^3
Copepoda			
Eucyclops serrulatus	12.9	151205	1.28
Microcyclops minutus	11.7	5830	0.90
Thermocyclops dybowski	12.5	11003	0.88
Onychocamptus mohammed	13.6	2980	0.07
Chironomidae			
Tanypus punctipennis	21.6	102	542.64
Procladius choreus	13.3	503	1.9×10^3
Polypedilum tiberialis	14.8	99	104.94
Tanytarsus sp.	21.6	47	46.53
Chironomus spp.	21.2	1005	8.4×10^3
Pisces			
Mirogrex terraesanctae	68.9	15	183.0×10^3

82–115 mm. The intensive predation of *Mirogrex* is probably due to its high availability (Gophen, 1984; Landau, 1984), their small size and low shape, soft spines (Popova, 1978), and the large schools they produced.

In most specimens of which the stomach contained food other than prey fish, filamentous algae, macrophytes and detritus were found. It is likely that while searching for its specific prey food, *C. gariepinus* accidentally consume algal filaments, macrophytes fragments and detritus from the bottom of the lake, together with larvae of Chironomidae and other benthic organisms.

The ingested microcrustaceans are mostly benthic forms or those who live on submerged macrophytes such as the cladocerans, *Leydigia acanthocercoides* and *Alona affinis*, and the copepods *Onychocamptus mohamed*, *Microcyclops minutus* and *Eucyclops serrulatus*. It is likely that, in Lake Kinneret, as in other African ecosystems, *Clarias* prefer pelagic bleaks (*Mirogrex*) (Bruton, 1978; 1979). Nevertheless, other food sources are also utilized by this fish.

Clarias is generally known as a fish which ingests large food quantities during a short time, filling its stomach to the maximum. Indicies of intestine fullness show the variations according to seasons (Fig. 1). In winter when water temperatures (Serruya, 1978) are unsuitable for *Clarias* (Hogendoorn *et al.*, 1983) values of satiation index are the lowest (3.80). These low temperatures are probably the reason for *Clarias* migrations to the northwest part of the lake where underwater hot springs ('Barbutim Springs': Barbutim is the Arabic name for *C. gariepinus*) inflow into the lake, causing temperatures to rise up to 17–19 °C in this area. During the stratification period (June-September), when lake temperatures rise (Serruya, 1978) the availability of benthic organisms in shallow waters is increasing due to the upward migrations (Gophen, 1979) and/or production enhancement (Gitay, 1968). Therefore, the intestine fullness indicies of *C. gariepinus* are higher (4.89 and 4.88) in the summer and fall relative to spring.

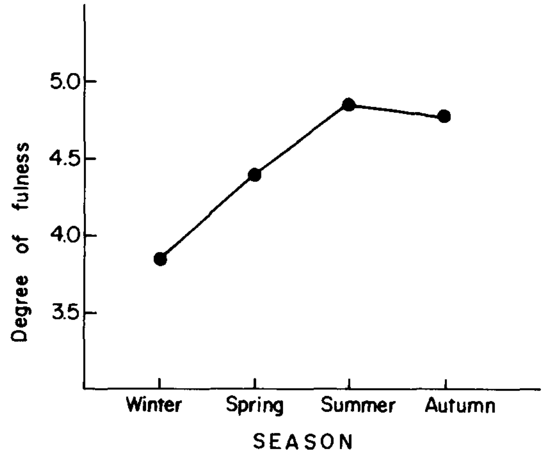

Fig. 1. Seasonal changes of gut fullness indices of *C. gariepinus* in Lake Kinneret (see text).

A high degree of infestation by parasites which probably penetrated into the *Clarias* intestines with the ingested food was observed. In the intestine of one fish (520 mm SL, W = 1760 g) which consumed *Tristramella simonis*, *Mirogrex terraesanctae*, Copepoda and Cladocera, 995 trematods and a few nematods were counted.

We suggest that the common *Mirogrex* (Table 1), smaller than 120 mm, and young cichlids serve as a suitable prey for catfish. *Clarias* predation rates may be significant as suggested by the high percentage of stomachs containing multiple prey. Bleaks and fingerlings of cichlids were found in digestive systems of hooked fish, similar to those collected from purseseines. The *Clarias* population of Lake Kinneret probably 'competes' with fishermen on *Mirogrex* and cichlids, preying them at precommercial stages.

Quantities of commercial size *Mirogrex* in *Clarias* intestines as presented here could be partly an artifact due to the crowded conditions in the internal 'seine-basket' which make them more vulnerable to predators than in nature. On the other hand, the sizes of the most abundant bleaks in the analysed gut contents of *Clarias* were below commercial size. These small *Mirogrex* can be scarcely found in the 'seine-basket' with mesh size suitable for commercial fishing of larger bleaks (110–120 mm minimum). Moreover, we identified fragments (mostly bones) of bleaks in all posterior parts of the digestive system, down to the rectum as well as digested specimens but incompletely degraded in mid parts of the intestines. These digested specimens and fragments indicate that predation occurred long time before being captured inside the 'seine-basket'. Moreover, similar proportions of bleaks and cichlids in the gut contents of hooked fish and those caught by purse seine were observed.

Populations of predator fishes in Lake Kinneret, *Tor canis* (Spataru & Gophen, 1985) and *C. gariepinus*, are relatively small (Serruya *et al.*, 1980). The potential fishing pressure existing in Lake Kinneret is probably sufficient to fill the niche of 'predators' in this ecosystem, consequently, introduction of exotic piscivore is not highly recommended.

Marten (1978; 1979) has proposed ideas concerning the enhancement of fisheries yield by increasing harvest of predator populations. We think that these proposals should be carefully considered for Lake Kinneret, because piscivores populations in the lake are small and fishing effort on planktivorous fish is high.

Nevertheless, more information on population dynamics, predation rates and prey selectivities of *C. gariepinus* in Lake Kinneret is required. Without such background data any considerations of fishery management of the predator catfish are incomplete.

Acknowledgements

We wish to express our warm thanks to Prof. P. G. W. J. Van Oordt, Prof. C. Serruya, Dr. C. Richter, Mr. F. Meijndert and Mrs. R. Pinkas for encouragement of the Dutch-Israeli *Clarias* Project, and Dr. D. Wynne for reviewing the manuscript.

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Received 12 August 1985: in revised form 20 June 1986; accepted 1 July 1986.