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ISSN 0792 - 156X

PUBLISHER:
Israeli Journal of Aquaculture - BAMIGDEH -
Kibbutz Ein Hamifratz, Mobile Post 25210,
ISRAEL
Phone: + 972 52 3965809
http://siamb.org.il

Short Communication

THE GUT CONTENTS OF GRASS CARP, *CTENOPHARYNGODON IDELLA*, DURING NURSING IN AN EARTHEN POND

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(Received 10.9.02, Accepted 9.10.02)

Key words: animal feed, fry, gut contents, grass carp, plant feed

Abstract

Grass carp fry (0.04±0.01 g avg wt; 1.48±0.03 cm total length) were stocked into an earthen pond in June. Every week for twelve weeks, fifteen fish were sacrificed and the content of their guts was examined. At the first week, animal material represented 74% of the gut contents. From the second week onwards, plant material was higher (mean value 79%). In the seventh week, when grass carp reached 4.83±0.09 cm, filamentous algae were replaced by macrophyte fragments. Besides the macrophytes, animal material such as the rotifers *Monostyla* and *Lecane* and the cladoceran *Bosmina* were found and the proportion of animal material in the gut varied 11-26%.

Introduction

The grass carp (*Ctenopharyngodon idella*, Val. 1844) is receiving worldwide attention as a biological control agent for aquatic vegetation and as a source of food (Van Dyke and Sutton, 1977). Since the 1980s, there has been growing interest in grass carp in Turkey (Altınayar et al., 1994).

The diet of grass carp changes rapidly during its early development. Animal material, zooplankton and benthic invertebrates are important dietary components during the early stages, rotifers being the most important component for fish up to 21 mm in total length. Crustacean plankton and chironomid larvae become more important as the fish grow (Opuszynski and Shireman, 1995). Previous studies reported that at about 50 mm total length the diet of grass carp changes to macrophytes. However, there is controversy as to whether the grass carp is truly an herbivorous fish (Cui et al., 1992).

This research was carried out to deter-

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mine the gut content of grass carp fry, at what size the fry change their feeding habits from omnivorous to herbivorous and the growth performance of grass carp fry during the nursing period.

Materials and Methods

The investigation was carried out from June 28 to September 14, 1998, in an earthen pond of about 1 hectare (1 m depth) at the Fisheries Department of the State Water Works of Keban, Eastern Anatolia. Prior to stocking, the pond was cleared and left to dry, then fertilized with organic manure. Five days after hatching, 14,000 larvae (avg wt 0.04±0.01 g; avg total length 1.48±0.03 cm) were placed in the pond.

Once a week for twelve weeks, fifteen fish were sampled with a handle net. Fish were immediately placed on ice to prevent digestion of food after sampling, then weighed, measured and preserved in 10% formaldehyde. The entire digestive tract was removed and divided into two regions for examination: the anterior region extended to the first coil of the intestine and the posterior region began at this coil. Food components were counted and the percentage of each was visually estimated under an inverted microscope. Food components were identified according to Edmondson (1959), Prescott (1973), Harding and Smith (1974), Macan (1975) and Koste (1978).

The water temperature, dissolved oxygen and pH of the pond were measured *in situ*.

Results

At the end of the experiment, fish reached 2.54±0.07 g and 5.66±0.05 cm total length (Table 1).

At the first week's sampling, the gut contained 74% animal material. From the second week (total length 2.21±0.01 cm) to the end of the investigation (Table 2), plant material was higher (mean value 79%) than animal. Animal material consisted of zooplankton and benthic fauna including ostracods and trace amounts of chironomidae larvae. Zooplankton consist-

Table 1. The growth of grass carp fry, by week.

Week	*Sampling date*	*Mean total length (cm±SE)*	*Mean body weight (g±SE)*
1	June 28	1.48 ± 0.03	0.04 ± 0.01
2	July 7	2.21 ± 0.01	0.12 ± 0.00
3	July 14	2.60 ± 0.02	0.20 ± 0.00
4	July 21	3.17 ± 0.03	0.48 ± 0.01
5	July 28	4.49 ± 0.98	0.64 ± 0.01
6	August 4	4.55 ± 0.07	1.37 ± 0.06
7	August 11	4.83 ± 0.09	1.65 ± 0.08
8	August 18	5.10 ± 0.07	1.93 ± 0.05
9	August 25	5.48 ± 0.04	2.27 ± 0.08
10	September 1	5.53 ± 0.05	2.32 ± 0.06
11	September 7	5.57 ± 0.05	2.38 ± 0.07
12	September 14	5.66 ± 0.05	2.54 ± 0.07

Table 2. Food components in the gut of grass carp (n=15) in an earthen nursing pond (%).

Week	*Sampling date*	*Zooplankton*	*Phytoplankton*	*Benthos*	*Macrophytes*	*Sand*
1	June 28	58	26	16	-	-
2	July 7	27	72	1	-	-
3	July 14	16	79	4	-	1
4	July 21	12	80	7	-	1
5	July 28	15	76	7	-	2
6	August 4	6	89	5	-	-
7	August 11	17	24	9	50	-
8	August 18	15	34	1	50	-
9	August 25	15	40	3	42	-
10	September 1	19	36	1	44	-
11	September 7	18	28	4	50	-
12	September 14	17	16	3	64	-

ed of Rotifera and Cladocera (Table 3). From the seventh week (4.83±0.09 cm) to the end of the investigation, *Bosmina longirostris* belonging to Cladocera were consumed, in addition to *Monostyla* and *Lecane*.

Phytoplankton and macrophyte fragments formed the plant material. Chlorophyceae was dominant in one-week grass carp, followed by Mxyophyceae from the second to the sixth week. Filamentous algae, including *Oedogonium* and *Zygnema*, were dominant in the sixth week. Also, about 1% sand particles were found in 3-5 week carp. When the grass carp reached the seventh week, macrophyte fragments replaced filamentous algae. *Phacus* (Euglenophyceae) was found only in the seventh week. Of the Bacillariophyceae, only *Navicula* was found in the first five weeks; later, the members and abundance of Bacillariophyceae increased.

The mean water temperatures were 21.4±1.00°C, 22.0±0.50°C, 23.5±0.50°C and 20.4±1.00°C in June, July, August and September, respectively. Dissolved oxygen ranged 5.9±0.1 to 6.5±0.3 ppm and pH was about 8.0±0.1.

Discussion

The diet of two week old grass carp was dominated by rotifers, followed by benthic invertebrates. Trace amounts of benthic invertebrates and rotifers, especially *Lecane* and *Monostyla*, continued to dominate the animal material after two weeks. Cladocerans were represented by a small species, *B. longirostris*, in 6-week carp and no other cladocerans were found in the diet during the investigation. These results were similar to those of Opuszynski and Shireman (1995). However, the presence of sand in the gut contents of fry of 2.60±0.02-4.55±0.98 cm may indicate the abundance or absence of benthic invertebrates resulting from heavy predation on the benthos (Watkins et al., 1981).

Phytoplankton was the most important component of the diet (72-89%) in weeks 2-6. From week 7 onwards, macrophytes became the most abundant component and animal material, i.e., rotifers, *Monostyla* and *Lecane*, and cladoceran, *Bosmina* were found. The ratios of animal material in the gut varied 11-28% from week 2 to the end of the investigation.

It has been reported that the transition from

Table 3. Gut contents of grass carp fry, June 28-September 14.

Plant material		
Chlorophyceae	Protococcales	*Tetraedron* *Pediastrum* *Scenedesmus* *Crucigenia*
	Ulothricales	*Zygnema*
	Oedogoniales	*Bulbochaeta* *Oedogonium*
	Conjugales	*Closterium* *Cosmarium*
Bacillariophyceae	Pennales	*Calanois* *Cymatopleura* *Cymbella* *Fragilaria* *Gomphonema* *Navicula* *Synedra* *Surirella*
Phyrrhophyceae	Peridiniales	*Peridinium*
Euglenophyceae	Euglenales	*Phacus*
Mxyophyceae	Hormogonales	*Oscillatoria* *Anabeana*
Animal material		
Rotatoria	Monogononta	*Branchionus* *Asplanchna* *Trichocerca* *Colurella* *Lecane* *Monostyla* *Polyarthra*
Crustaceae	Cladocera	*Bosmina*
	Copepoda	*Nauplii*
Insecta	Diptera	*Chironomidae*

animal to plant food occurred at age 36-40 days (weight 1.1-1.8 g, body length 49-50 mm; Opuszynski and Shireman, 1995). Watkins et al. (1981) observed that grass carp of 50-100 mm total length consumed 32% invertebrate organisms. The results of our study were similar to these researchers. Apparently grass carp, while feeding on macrophytes, ingest all living organisms associated with plants, including rotifers, oligochaetes, chironomid larvae and other aquatic insects.

The grass carp grew at a rate of 0.05 cm and 0.03 g per day. This growth rate is slower than that mentioned by Colle et al. (1978; 0.59 g/day and 1.2 mm/day) but similar to Watkins et al. (1981) and Horvath et al. (1984). The growth of the carp may have been affected by temperature and the quantity of food available. As indicated by Watkins et al. (1981), the transition from a diet based on benthic invertebrates to periphyton may be influenced by decreased availability of invertebrates rather than by selection and subsequent substitution of another food item of comparable quality. Insufficient food quality can cause slow growth.

In conclusion, further studies should focus on good pond management, especially determining a proper rate and method of manure application to increase the natural food resources in the pond and improve living conditions of the grass carp.

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