Pakistan J. Zool., vol. 38(2), pp. 93-98, 2006.

Study on the Food and Feeding Habit of Palri, *Gudusia chapra* (Hamilton) from Fishpond in Distt. Thatta, Sindh, Pakistan

N. T. NAREJO
Department of Fresh Water Biology and Fisheries, University of Sindh, Jamshoro

Abstract.- A food and feeding habit study of Palri *(Gudusia chapra)* in fishpond was carried out for four months from April to July 2004. Fish fed on a range of food items including phytoplankton, zooplankton and detritus. Food analysis by point method indicated that fish feed on mainly detritus and phytoplankton having a change of food habit to mainly phytoplankton and debris over time. Dial pattern study showed that the fish has two peak feeding activity. Electivity analysis showed that the fish avoided zooplankton and strongly selected some genera of phytoplankton *(Cosmarium, Haematococcus* and *Euglena).* Gill-racker length and inter gill-racker space increased with the increase of body length.

Key words: Food and feeding habit, *Gudusia chapra*, fishpond.

INTRODUCTION

Only a few of the indigenous freshwater species have been assessed for aquaculture purposes. Out of the large number of clupeid fishes, which occur in the fresh water and estuaries, the fishes of the sub-family Alosine are of great significance (Rahman, 1989). There are two strictly Indo-Pacific genera *Hilsa* and *Gudusia,* the latter having a sole representative *Gudusia chapra* (Hamilton) is locally known as "Palri", commonly occurs in freshwaters of Pakistan, Bangladesh, India and Philippines (Narejo *et al.,* 2000).

Elsewbere, various workers such as Jhingran (1972) studied diet composition of *G. chapra* from Ganga river system. Quddus *et al.* (1991) published information on food and feeding habits of *G. chapra* in a lake. Rahmatullah *et al.* (1995) reported food and feeding habit of young *G. chapra* from fishponds. Earlier work on the food and feeding habit of *G. chapra* was carried out in India and Bangladesh. The environmental conditions in fishponds (Distt. Thatta, Sindh) are entirely different so the present investigations were carried out. At present no information is available related to the biology and fishery of *G. chapra* from Pakistan, except one report of Narejo *et al.* (2000). The aim of the present study was to assess the possibility of its culture as a compatible species along with major carps in fishponds.

0030-9923/2006/0002-0093 $ 8.00/0

MATERIALS AND METHODS

Collection of fish samples

A total of 140 fish specimen were collected fortnightly from fishponds of Chilya fish hatchery (District Thatta) Sindh, for a period of four months (April to July, 2004) by gill net. The collected fish were brought to the laboratory and preserved in 10% formalin. Eight samples of water comprising 10 liters were collected from different areas and depths of the fishpond to obtain plankton community at every fortnight. Samples were filtered through fine mesh (100 µm) plankton net, the collected material, being carefully washed into plastic jars were made up to a standard volume with water and preserved in 5% buffered formalin (Miah and Dewan, 1977).

Analysis

Plankton: The preserved materials containing plankton were analysed by using a Sedgewick-Rafter Counting Cell (model 550, Fisons), following the standard methods (APHA, 1985) for counting plankton, which was identified up to genus level.

Gut content: The preserved fishes were taken out, measured, the body cavity was carefully opened and gut fullness was assessed on a scale of 0 (empty) to 4 (full). The point method was used as

described by Miah and Dewan (1977), Dewan and Saha (1979). The volume of stomach contents as estimated by observation was recorded on an absolute scale and points were allotted to each stomach according to the volume of its contents. The stomach content of largest volume was allotted 100 points and each of the stomachs examined was then rated in one of the following categories; 0, 3, 6, 12, 25, 50 and 100 points according to the volume of food present (Rahmatullah *et al.,* 1993). The categories were based on inspection and estimation but a set of stomachs of all categories was made from extra stomach and was used in relating absolute volume to assigned points value. The gut contents from the anterior portion of the gut that is stomach were carefully washed into a Petri dish and observed under a light microscope (Olympus, model B-2000) using a Sedgewick-Rafter counting cell. All organisms were counted and identified up to genus level. Analysis was followed by the method of Ivlev (1961). Ivlev's index, Electivity (E) was calculated according to:

$$E = \frac{r_1 - P_1}{r_1 + P_1} \quad \text{Ivlev (1961)}$$

Where r_1 is the relative contents of any item in the ration, expressed, as a percentage of total numbers in the ration and P_1 is the relative proportion of the same item in the environment. The resultant value of E ranges from +1 to -1, positive values indicating selection for certain food item, negative values indicating avoidance.

Feeding apparatus: The feeding apparatus (gill arches) were carefully excised from 45 fish and preserved in 10% formalin for morphometric analysis. The mid-section of the second gill arch from left side of each fish was used. The length of twenty gill rackers and the distance between twenty pairs of adjacent gill-rackers (from their base) were measured from each gill arch. Examination was done by a light microscope (Olympus, model B-2000) fitted with an eyepiece graticule.

RESULTS

Types and amount of food taken by the fish

The results of the analysis of stomach contents of *G. chapra* showed that the fish feed on a variety of food items. A total of 35 kinds of organisms were identified and recorded from the stomach contents of the fishes analysed along with debris of which 28 kinds belongs to phytoplankton and 7 kinds to zooplankton. All these food items were categoriesed into 6 main groups, which were (i) Chlorophyceae, (ii) Bacillariophyceae, (iii) Cynophyceae, (iv) Euglenophyceae, (v) Zooplankton and (vi) Debris (debris includes all types of decaying matter, sand and mud). According to the analysis of gut contents of the fish, debris occupies the soul place followed by Chlorophyceae while zooplankton possessed the last position in the diet (Table I).

Size group

The total length of the experimental fishes were grouped into 2 size groups for gut content analysis, named as A group (size ranged from 10.5 to 15.8 cm) and B group (size ranged from 17.2 to 22.8 cm). The average index of stomach fullness and percentage of total points of different food categories were divided according to size group, the results are shown in Tables II and III. The results show that average index of stomach fullness Increased with body size i.e., feeding activities increased with body size. The results also indicate that *G. chapra* is mainly a debris feeder with a pronounced tendency to be phytoplankton feeder. Among the phytoplankton Chlorophyceae was increased with body size. Zooplankton was observed only in the stomach content of smaller fishes.

Dial pattern of feeding

To determine the dial pattern of feeding of *G. chapra,* the stomachs of 65 fishes sampled on a day at 4 h interval, were analysed. Average index of fullness and percentage of empty stomach have been presented in the Table IV. A few empty stomachs have been observed at 0600 h sample. One empty stomach has also been found at 0200 h sample. The highest and lowest values of average index of fullness were 3.17 at 1000 h and 0.66 at 06:00 h, respectively. The result of the present investigation indicated that *G. chapra* has two peak timings of feeding activities, one was at 10:00 hour and other

Table I.- Percentage of total points of different categories of the stomach contents of Palri, *Gudusia chapra* from fishpond of (Dist. Thatta, Sindh) during April to July 2004.

Fortnight	Food categories					
	Bacillariophyceae	Chlorophyceae	Cyanophyceae	Euglenophyceae	Zooplankton	Debris
First	0.67	10.04	1.34	4.24	0.67	83.0
Second	1.12	27.53	7.49	9.74	0.60	54.1
Third	0.28	28.06	7.22	12.50	0.28	51.6/
Fourth	0.98	39.90	2.53	12.22	0.14	45.2
Fifth	0.76	30.23	1.98	13.13	0.15	53.7
Sixth	0.28	21.70	1.13	15.32	0.14	61.4
Seventh	0.28	55.16	1.27	12.31	0.00	30.9
Eighth	0.32	45.23	0.32	13.67	0.00	40.4

Table II.- Size group and average index of stomach fullness in different fortnights.

Size Group	Fortnight							
	1st	2nd	3rd	4th	5th	6th	7th	8th
10.5 to 15.8 cm	2.30	2.56	3.00	2.33	2.75	2.80	3.00	2.50
17.2 to 22.8 cm	0.00	3.00	3.44	2.58	3.00	3.00	4.00	3.50

Table III.- Percentage of total points of different food categories of various size groups of Palri, *Gudusia chapra* during different fortnights from fishponds of (Distt. Thatta) Sindh.

Fortnight	Food category and size groups											
	Bacillariophyceae		Chlorophyceae		Cyanophyceae		Euglenophyceae		Zooplankton		Debris	
	10.5-15.8 cm	17.2-22.8 cm	10.5-15.8 cm	17.2-22.8 cm	10.5-15.8 cm	17.2-22.8 cm	10.5-15.8 cm	17.2-22.8 cm	10.5-15.8 cm	17.2-22.8 cm	10.5-15.8 cm	17.2-22.8 cm
First	0.67	-	10.04	-	1.34	-	4.24	-	0.67	-	83.04	-
Second	1.12	1.13	24.67	32.88	7.47	8.03	9.98	9.34	0.69	0.12	56.07	48.51
Third	0.14	0.31	24.17	32.78	7.02	7.26	12.55	12.40	0.32	0.00	55.85	47.25
Fourth	0.91	0.27	31.42	44.35	2.61	2.43	12.11	13.00	0.18	0.00	52.77	40.06
Fifth	0.78	0.72	21.44	37.51	1.82	2.18	11.24	14.67	0.23	0.00	64.49	44.92
Sixth	0.24	0.31	20.47	24.62	1.10	1.18	13.23	18.64	0.23	0.00	64.72	55.26
Seventh	0.28	0.28	54.76	60.16	1.10	1.34	12.36	0.00	0.00	0.00	31.56	25.87
Eighth	0.31	0.32	32.05	51.62	0.22	0.40	13.67	0.00	0.00	0.00	55.78	31.84

Table IV.- Average index of stomach fullness and percentage empty stomach at different times of a day.

Sample hours	Average index of stomach fullness	Percentage empty stomach (%)
1000	3.17	0.00
1400	2.60	0.00
1800	3.00	0.00
2200	2.89	0.00
0200	1.89	10.00
0600	0.66	50.00

was at 1800 hour. According to the finding *G. chapra* is a day feeder.

Electivity

Electivity indices with their fortnightly changes of various planktonic food organisms are given in Table V. The detrimental fragments (debris) were excluded from the numerical analysis of the stomach contents. The present investigation showed that *G. chapra* appeared to be a selective phytoplankton feeder under the pond conditions. All the planktons of bacillariophyceae group were

Table V.- Electivity of *Gudusia chapra* to different food organisms during different fortnights

Food items	Fortnight							
	1st	2nd	3rd	4th	5th	6th	7th	8th
Bacillariophyceae	-0.90	-0.89	-0.35	-0.93	-0.69	-0.73	-0.85	-0.79
Chlorophyceae	-0.19	-0.27	-0.16	-0.44	-0.33	-0.40	-0.49	-0.51
Cyanophyceae	-0.87	-0.83	-0.78	-0.65	-0.32	-0.64	-0.76	-0.71
Euglenophyceae	+0.17	+0.02	-0.43	-0.29	-0.39	-0.42	-0.56	+0.41
Zooplankton	-0.59	-0.97	-0.99	-0.99	-0.97	-0.82	-1.00	-1.00

Table VI.- . Standard length and gill-racker length and inter gill-racker space of different size groups of *Gudusia chapra* from fishponds (Dist, Thatta) Sindh.

Size groups	Mean standard length (cm)	Mean gill-racker length (mm)	Mean inter gill-racker space (mm)
12.5-14.0 cm	2.87	962	36
14.1-1.60 cm	3.43	1127	41
16.1-18.0 cm	4.27	1520	47
18.1-20.0 cm	4.99	1740	56
20.1-22.0 cm	5.66	2210	76

eluded or some times completely avoided. Among chlorophyceae *Cosmarium, Haematococcus* and *Tetraedron* were strongly selected while *Characium, Chlorella, Closterium, Glueococystis, Pediastrum, Secenedesmus, Sphaerocystis, Coelastrum* and *Triploceras* were eluded or avoided. All of the cynophyceae organisms were avoided. Among euglenophyceae *Euglena* was positively selected but *Phacus* and *Trachelomonas* were rejected. More or less all zooplanktonic organisms were avoided by the fish.

Gill racker length and intra-racker space

For the gill-racker morphometric study, experimental fish (n = 45) were divided into 5 size groups (9 fishes in each group). The average standard fish length, gill racker length and intra-gill racker space of each group are presented in Table VI. Gill racker length and fish standard length relationship may be described by the equation:

Gill-racker length = -0.424 (S.E±0.07252) + 0.045 (S.E.±0.00013) fish standard length (n = 45; $R^2 = 0.95$; F = 793.4; $p<0.01$).

The space between gill-rackers also increases with fish length, the relationship between the intra gill-racker space and fish standard length may be expressed as:

Intra gill-racker space = -0.0096 (S.E.±0.006) + 0.00142 (S.E.±0.00013) fish standard length (n=45; $R^2 = 0.72$; F = 115.21, $p<0.01$).

The fishes were observed to take their food in a group following a circular movement in the upper layer of the pond. This observation indicated that *G. chapra* is a surface feeder with a choice of school formation.

DISCUSSION

The results of the present study indicated that the debris is the most important food item of the fish (*G. chapra)* this finding agrees with Das and Moitra (1955), Bhuiyan (1964), Jhingran (1972) and Rahmatullah *et al.* (1995) in *Gudusia chapra.* From the size group and percentage of total points of debris, it can be concluded that the fish (*G. chapra*) changes its food habit as it grows. This phenomenon is observed in many fishes (Keast, 1965). *G. chapra* has two peak feeding activities found during the present study. At dawn the stomach of the fish is more or less empty with a increasing feeding intensity towards noon and at around 1000 h feeding activities reached at a peak level. Then feeding activities decreased followed by increasing feeding activities once again before sunset and then feeding activities decrease till dawn when it was at its lowest limit. Such two peaks of feeding activities

were also found by Javaid (1971) in *Heteropneustes fossilis* and *Puntius sophore.* The present study indicates that *G. chapra* has pronounced electivity for different food items and that electivity varies over time. Selective feeding can be expected from fishes when the energy gained by feeding on preferred food items exceeds the energy that has been lost during selection (AI-Akel *et al.,* 1987). In the present study the fish positively selected some genera of phytoplankton. Some genera of phytoplankton and zooplankton were negatively selected and others were completely avoided. Similar observations have been reported by Quddus *et al.* (1991) and Rahmatullah *et al.* (1995) in *G. chapra.* The branchial mesh size of *G. chapra* has been measured 32-80 µm. Some fish having 60-80 µm inter gill-racker space were observed to ingest *Tetraedron* in an amount greater than *Pediastrum, Oscillatoria* etc. Dev (1994) measured the size of various planktonic food organisms. The diameter *Tetraedron, Pediastrum* and *Oscillatoria* are 41, 73 and 418 µm respectively. So the study indicates that some mechanism of particle retention other than passive branchial sieving is involved in the feeding mechanism of *G. chapra.* Beveridge *et al.* (1988) found particle entrapment among the gill apparatus in a mucus film in tilapia. Rahmatullah (1992) have described that passive branchial sieving is not the only mechanism of particle retention in filter feeding carps fishes. Rahu, Thaila and Silver carp can ingest small planktonic particles than its ranchial mesh size~ During the study the fish eluded some genera like *Trachelomonas, Phacus, Secenedesmus* and *Pediastrum* having dias 37, 139, 69 and 73 µm (Dev, 1994) respectively, suggesting that fish may have the ability to select suitable or non-suitable food items. Beveridge *et al.* (1993) concluded that the filter feeding carps have the abilities to distinguish between toxic and non-toxic strains of the Cyanobacterium. The inter gill-racker space of Rahu, Thaila and Silver carp are 80-90, 110-120 and 25-30 µm, respectively (Rahmatullah, 1992). The branchial mesh size of both Silver carp and *G. chapra* are smaller than Rahu and Thaila and related to each other. Thus *G. chapra* may be cultured with Rahu and Thaila as a substitute of Silver carp. Moreover, Silver carp is an exotic fish, which ingest many kinds of bacteria (Rahmatullah and Beveridge, 1993), which ultimately reduces biodiversity of the system and *G. chapra* is an indigenous fish, which is friendly to the environment. From the present investigations it is evident that *G. chapra* is a school farming surface feeder which was also reported by Rahman (1989) and Rahmatullah *et al.* (1995). Very little work on the biology of *G. chapra* has been done and much more is required for culturing this fish.

REFERENCES

AL-AKEL, SHAMSI, M.J.K. AND AL-KAHEM, H.F., 1987. Selective feeding behaviour of the Arabian freshwater fish, *Aphanius dispar. Pakistan J. Zool.,* **19**: 211-215.

APHA (American Public Health Association). 1985. *Standard methods for the examination of water and wastewater, including bottom sediments and sludge*. 16th ed. APHA, Washington. 1268 pp.

BEVERIDGE, M.C.M, BARID, D.J., RAHMATULLAH, S.M., WATOON, L.A., BEATTIC, K.A. AND CODD, G.A., 1993. Grazing rates on toxic and non-toxic strains of cyanobacteria by *Hypophthalmichthys molitrix* and *Oreochromis niloticus. J Fish Biol.,* **43**: 901-907.

BEVERIDGE, M.C.M., BRIGGS, M.R.P., MOWAT, A., NORTHCOTT, M.E. AND ROSS, L.G., 1988. The function of microbrachiospines in tilapias. In: *The second international symposium on tilapia in Aquaculture* (eds. R.S.V. Pullin, T. Bhukaswan, K. Tonguthai and J.L. Maclean), p. 311-317. ICLARM Conference Proceedings, p. 632.

BHUIYAN, A. L. 1964. *Fishes of Dhaka.* Asiatic Society of Bangladesh, Dhaka, pp. 148.

DAS, S. M. AND MOITARA, S.K., 1955.Studies on the food of some common fishes of Uttar Pradesh, India. *Proc. natl. Acad. Sci.* (India), **26**: 213-223.

DEV, B. C. 1994. *Food selection and electivity indices of the Thai barb* Puntius (Barbodes) gonionotus *in extensively managed, rain- fed ponds in Bangladesh.* M.Sc. thesis, Department of Aquaculture and Management, Bangladesh Agricultural University Mymensingh. 110 pp.

DEWAN, S. AND SAHA, S.N., 1979. Food and feeding habits of *Tilapia nilotica* (L.): Diel and seasonal pattern of feeding. *Bangladesh J. Zool.,* **7**: 75-80.

IVLEV, V. S., 1961. *Experimental ecology of the feeding of fish.* Yale University Press, New Haven, Connectient. pp. 302.

JAVAID, M.Y., 1971. Diurnal periodicity in the feeding activity of some freshwater fishes of West Pakistan. II. Studies on *Heteropneustes fossilis* and *Puntius sophore. The Nucleus,* **3**: 131-144.

JHINGRAN, A.G., 1972. Diet composition of *Gudusia chapra*

(Ham.) from the Ganga River System. *Proc. Indian natl. Sci. Acad. (B),* **38**: 94-105.

KEAST, A., 1965. Resource subdivisions among cohabiting fish species in a bay, lake Opinion, Ontario. *Proc. Eighth Conf. Great Lake. Res. Div. Univ.,* Michigan. pp. 106-132.

MIAH, J. U. AND DEWAN, S., 1977. Diel pattern of feeding of a major carp *Labeo rohita* (Ham.) in a Bangladesh pond. *Bangladesh J. agric. Sci.*, **4**: 81-88.

NAREJO, N.T., JAFRI, S.I.H. AND SHAIKH, S.A., 2000. Studies on the age and growth of Palri, *Gudusia chapra* (Clupiedae: Teleostei) from the Keenjhar lake (District: Thatta) Sindh, Pakistan. *Pakistan J Zool.,* **32**: 307-312.

QUDDUS, M.M.A. RAHMAN, O., RAHMAN, A., RAHMAN, S.M.M. AND AHMED, M.K., 1991. Food and feeding habits of *Gudusia chapra* (Hamilton-Buchanan, 1822) in a lake. *J. Zool.,* 6: 1-8.

RAHMAN, A. K.A., 1989. *Freshwater fishes of Bangladesh.* Zoological Society of Bangladesh, University of Dhaka, pp. 364.

RAHMATULLAH, S. M. 1992. *Studies of filter feeding carps of commercial importance in Bangladesh with particular emphasis on the use of automated counting methods*. Ph.D. thesis, Institute of Aquaculture, University of Stirling, UK. pp. 190.

RAHMATULLAH, S. M., ALAM, M.T., HOSSAIN, M.M., AMIN, M.R. AND HOQUE, M.J., 1995. Study on the food feeding habit of young habit of young chapila, *Gudusia chapra. Bangladesh J. Fish.,* **15-18**: 91-100.

RAHMATULLAH, S. M. AND BEVERIDGE, M.C.M., 1993. The ingestion of bacteria in suspension by Indian major carp *(Catla catla* and *Labeo rohita)* and Chinese carps *(Hypophthalmichthys molitrix* and *Aristichthys nobilis). Hydrobiologia,* **264**: 79-84.

(Received 10 February 2005, revised 30 January 2006)