OPEN ACCESS International Journal of Zoological Research

ISSN 1811-9778
DOI: 10.3923/ijzr.2017.

# Research Article

# Food and Feeding of *Hypselobarbus kurali*, a Freshwater Cyprinid Endemic to Kallada River, Kollam, Kerala, India

[1]Sherly Williams, [1]Sarlin and [2]Vishnu Nair Manjari Sudhakaran

[1]Environmental Sciences, Aquaculture and Fish Biotechnology Lab, PG and Research Department of Zoology, Fatima Mata National College, Kollam, Kerala, India
[2]Mariculture division, Central Marine Fisheries Research Institute, Kochi, India

## Abstract

**Background and Objective:** Feed is a prerequisite for all forms of life. A study of the food and feeding habits of fish is very important in any fisheries research programme. If the experiment was under controlled condition, it was inevitable to know the feeding habits and food of the experimental fish. The ultimate aim was for the captive breeding and larval rearing of the fish. Thus, the objective behind the study was to understand the food preference of the adult and the young ones, there by culturing the preferred feeds under laboratory conditions. The live feed culture will open up a new way for aquaculture promotion. **Materials and Methods:** Monthly samples of *Hypselobarbus kurali* (*H. kurali*) were collected from the fishes caught by local or traditional fishermen along the Kulathupuzha region of Kallada river system. Data were calculated by annual feeding index which is the ratio of the number of specimens whose feeding were either active or moderate to the total number of specimens examined during that year×100. **Results:** For the present study, it was observed to be *Daphnia* sp. represented the major diet of young fishes. The feed preference was also noted to be the Daphnids. *Daphnia* sp. alone was consumed by *H. kurali* up to the size of 90-109 mm size class and dominated in the food up to 120-29 mm size class. Thus, if these zooplanktons are mass cultured under laboratory condition, then it will be a boon to the fisheries sector and there by fresh water fish aquaculture. **Conclusion:** So the present study provides a clear idea about the feeding profile of *H. kurali* and opens a new virtue for culturing the species under captivity providing its preferred food.

Key words: Captive breeding, *Hypselobarbus kurali*, *Daphnia* sp., zooplankton, juveniles

Citation: Sherly Williams, Sarlin and Vishnu Nair Manjari Sudhakaran, 2017. Food and feeding of *Hypselobarbus kurali*, a freshwater cyprinid endemic to Kallada River, Kollam, Kerala, India. Int. J. Zool. Res., CC: CC-CC.

Corresponding Author: Sherly Williams, Environmental Sciences, Aquaculture and Fish Biotechnology Lab, PG and Research Department of Zoology, Fatima Mata National College, Kollam, Kerala, India Tel: 9495036719



Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Captive breeding studies cannot get completed without knowing the feeding trend and status of the species which is going to be reared in captivity. Food and feeding of a species can be examined and studied in different steps. Information on food and feeding habits of fishes is essential for better understanding of their growth, breeding and migration. It was inevitable to have knowledge on natural diet of an animal which was required for the study of its nutritional requirements, its interaction with other organisms and its potential for culture[1]. The spectrum of prey consumed by a species helps to define its fundamental niche[2] and its realized niche terms of interaction with co-habituating species. Understanding the food and feeding of an individual species add on to the possibilities of culturing the same under captivity[3-8].

For the better management of fish stock, knowledge of food was inevitable as it forms the most important factor regulating or influencing the abundance, growth and migration of fishes. Several scientists have discussed the food of fishes in relation to sexual cycle, condition of feed, selectivity in feeding and drawn conclusions that bear upon the biology of the species concerned[9-15].

For analyzing fish stomach contents, occurrence method, numerical method, point method, volumetric method and gravimetric method are widely used[16-20]. Hence, to study food and feeding habits of fishes, the method chosen must suit the diet of the fish to be studied. The most appropriate measure of dietary importance was the one where both the amount and bulk of a food category were recorded[21]. Pre-ponderance method[22] takes into account the frequency of occurrence as well as bulk of food items that is the volume, providing a definite and measurable basis for grading different food items. As this method suits the carnivorous and omnivorous fishes, this method was used widely in investigations.

The present study will put light on transportation, artificial maintenance set up, water quality and food and feeding of *H. kurali*. Several steps in transportation methods were practiced and refined into an efficient and effective technique. The anesthetized fish transportation technique assured 100% success. Once the fishes were transported and brought to lab, its water quality maintenance and providing suitable system which complements its natural system became the prime important issue which needed immediate attention. The fishes thus acclimatized to the system were provided with feed. The feeding biology studies done in the fish helped in determining the most suitable food for the fishes.

## MATERIALS AND METHODS

Monthly samples of *H. kurali* were collected from the fishes caught by local or traditional fishermen along the Kulathupuzha region of Kallada river system. After wiping the fishes in the lab each fish was measured to its total length and weight to the nearest mm and mg, respectively. After dissecting out the abdomen the fishes were examined for the sex, maturity stages and degree of fullness of stomachs. The variations in the fullness of fish stomach were classified as 'gorged', '¾ full', '½ full', '¼ full', trace and empty. The stomachs of fishes were removed, weighed and preserved in 7% formalin for further analysis.

The index of preponderance method [22] was adopted here. The index of preponderance was worked out by:

$$I = \frac{ViOi}{SViOi} \times 100$$

where, Vi and Oi represents the percentage of volume and percentage of occurrence indices of each food item, respectively and I the index.

Food items of fishes were identified up to generic level. It was counted and measured volumetrically. All unidentifiable and partially digested food items were grouped under digested food remains. There was detritus as the major food constituent as the fish was omnivorous. For the analysis of fullness of stomachs, they were grouped into actively fed (gorged, full and ¾ full stomachs), moderately fed (½ full stomachs), poorly fed (¼ full stomach) and stomachs with traces of food or empty. A total of 180 specimens were randomly selected, comprising of 98 males measuring between 165-348 mm and 71 females measuring between 160-339 mm total length. Eleven juveniles measuring between 92-160 mm. TL (total length) were also used for the present study. Food analysis was done in relation to months, sexes, maturity stages and size groups. The fishes were classified with a class interval of 10 mm length groups.

Annual feeding index[23] was calculated which is the ratio of the number of specimens whose feeding were either active or moderate to the total number of specimens examined during that year × 100.

## RESULTS

The list of food items occurred in the stomachs of *H. kurali* is given in Table 1. Analysis of stomach content showed that the food of *H. kurali* consists of two major components

Table 1: General diet composition of *H. kurali*

| Groups | Genus composition |
|---|---|
| Arthropods | *Daphnia* sp. |
| | *Sida* sp. |
| | *Daphanosoma* sp. |
| | *Moina* sp. |
| | *Bosmina* sp. |
| | *Cyclops* sp. |
| | *Holopedium* sp. |
| | *Lantana sp* |
| | *Tropocyclops* sp. |
| | *Calanoid* sp. |
| | *Diaptomus* sp. |
| | *Alonella* sp. |
| | *Eucyclops* sp. |
| | *Macrothrix* sp. |
| | *Mesocyclops* sp. |
| Rotifers | *Keratella* sp. |
| | *Brachionous* sp. |
| | *Chlamydomonas* sp. |
| | *Opalina* sp. |
| | *Vorticella* sp. |
| Miscellaneous | Insect larvae |
| | Detritus |
| | Mud |
| | Partly digested remnants |

Table 2: Index of preponderance values of different food items in the stomach of *H. kurali*

| Food items | Index value |
|---|---|
| *Daphnia* sp. | 38.710 |
| *Sida* sp. | 0.271 |
| *Daphanosoma* sp. | 8.723 |
| *Moina* sp. | 18.519 |
| *Bosmina* sp. | 4.378 |
| *Cyclops* sp. | 0.227 |
| *Holopedium* sp. | 0.158 |
| *Latona* sp. | 0.183 |
| *Trophocyclops* sp. | 0.007 |
| *Calanoid* sp. | 0.016 |
| *Diaptomus* sp. | 0.032 |
| *Alonella* sp. | 0.097 |
| *Eucyclops* sp. | 0.130 |
| *Macrothrix* sp. | 0.213 |
| *Mesocyclops* sp. | 0.337 |
| *Keratella* sp. | 0.100 |
| *Brachionous* sp. | 0.009 |
| *Chlamydomonas* sp. | 4.081 |
| *Opalina* sp. | 0.363 |
| *Vorticella* sp. | 0.001 |
| *Alona* sp. | 0.011 |
| Detritus | 27.729 |
| Digested unidentifiable reminants | 4.010 |
| Digested insect reminants | 0.071 |

arthropods and detritus along with some negligible phytoplankton remnants. These two together formed 63.7% of the food (Table 2). Rotifers formed 25.29% whereas protozoans and miscellaneous together formed 11.01%. Among the total food item analyzed arthropods dominate in constitution by 55.91% of the diet. Among these, the major groups were crustaceans, copepods and cladocerans (39.74, 9.13 and 7.04%, respectively). Among crustaceans *Daphnia* sp., *Siola* sp., *Daphanosoma* sp. and *Moina* sp., were abundant. Among rotifers, *Brachionus* sp., dominated the most (17.00%) followed by *Keratella* sp., (5.31%) and the remaining unidentifiable rotifers (2.98%). Among miscellaneous items partly digested insect larvae, a fish head and some matters unidentifiable were present.

*Daphnia* sp., (crustaceans) was the most preferred food item in most of the months followed by *Brachionus* sp., (rotifers). Unidentified digested reminants were found plenty in certain months. Among protozoans, *Chlamydomonas* sp., *Opalina* sp., *Vorticella* sp., etc was found. *Cyclops* sp., (Copepods) was recorded during *Diaptomus* sp., was found. Zooplanktons other than *Daphnia* sp., was found only occasionally in the stomachs. While *Bosmina* sp., (arthropod) was observed in 6 months through out the study period. *Tropocyclops* sp., were recorded only for 2 months. *Holopedium* sp., *Alonella* sp., *Sida* sp., *Macrothrix* sp. and *Latona* sp., was recorded for the study. *Calanoid* sp., were found in the stomach for only 1 month. Mud and detritus were found in the food throughout the year, that also in a very well pronounced quantity (Table 3).

Juveniles preferred crustaceans as the major food item with an index value of 83 whereas in male and female the values were 29 and 22, respectively. The index value for detritus and mud was 13 for juveniles while in males and female which formed major component had index values of 69 and 74, respectively (Table 4).

*Daphnia* sp., alone was consumed by *H. kurali* up to the size of 90-109 mm size class (Table 4) and dominated in the food up to 120-129 mm size class. From 110-119 mm onwards, mud and detritus started dominating along with rotifers and protozoans, while rotifers were found dominant in 130-139 mm size class fishes. Insect larvae remnants in 200-209 mm size class and 240-249 mm size groups were found to have a mixed group of all zooplankton with no constant representatives. Mud and detritus along with arthropods were the only food item observed above 250 mm of *H. kurali*.

*Daphnia* sp., was the most favored food item in males of 160-199 mm length (Table 5). The index of preponderance values were 98.7, 69.4, 52.1 and 36.05 for 160-169, 170-179, 180-189 and 190-199 size groups, respectively. The index values for all crustaceans together, respectively were 99.8, 67.4, 53.6 and 39.5 from 210 mm onwards. Males of *H. kurali* fed on rotifers, protozoans, insect remnants, zooplankton mixtures, mud and detritus.

Table 3: Monthly index of preponderance of different food items of *H. kurali* pooled

| Food items | June | July | August | September | October | November | December | January | February | March | April | May |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Daphnia* sp. | 0 | 8.290 | 7.940 | 0 | 8.870 | 1.621 | 80.53 | 87.72 | 51.81 | 95.15 | 69.43 | 55.71 |
| *Sida* sp. | 1.431 | 0.079 | 0 | 0 | 0.245 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Daphanosoma* sp. | 88.93 | 9.620 | 3.870 | 3.49 | 1.187 | 22.621 | 26.314 | 1.171 | 0.254 | 30.37 | 16.69 | 86.712 |
| *Moina* sp. | 0 | 0.463 | 0.618 | 0.216 | 7.240 | 0.358 | 0.561 | 0.319 | 0.041 | 0 | 0 | 0.749 |
| *Bosmina* sp. | 2.91 | 0 | 3.810 | 0.020 | 0.018 | 0 | 0 | 0.591 | 0.014 | 0 | 0 | 0 |
| *Cyclops* sp. | 0 | 0 | 0 | 0 | 0.846 | 0 | 0.037 | 0.050 | 0 | 0.159 | 0 | 0 |
| *Diaptomus* sp. | 1.439 | 0.614 | 0 | 0 | 0.158 | 0.014 | 0 | 0 | 0 | 4.519 | 0 | 0.143 |
| *Alonella* sp. | 0 | 0.067 | 0 | 0 | 0.014 | 0 | 0 | 0.151 | 0 | 0 | 3.41 | 0 |
| *Eucyclops* sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Alona* sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Holopedium* sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0.146 | 0 | 0 | 0 | 0 | 0 |
| *Macrothrix* sp. | 0.581 | 0 | 0 | 0 | 0 | 0 | 0 | 0.111 | 0 | 0 | 0 | 0 |
| *Mesocyclops* sp. | 0 | 0 | 0 | 0.113 | 0 | 0 | 0 | 0 | 0 | 1.31 | 0 | 0 |
| *Tropocyclops* sp. | 0 | 0.141 | 0 | 0 | 0 | 0.214 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Latona* sp. | 0 | 0 | 0 | 0 | 0 | 0.381 | 0.147 | 0.001 | 0 | 0 | 0 | 0 |
| *Brachionous* sp. | 0 | 0 | 30.34 | 0 | 86.91 | 88.93 | 0 | 0 | 0 | 0.314 | 0 | 0 |
| *Keratella* sp. | 0.107 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.214 | 0 |
| *Calanoid* sp. | 0 | 0 | 0 | 0 | 0 | 0.321 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Chlamydomonas* sp. | 0 | 0.317 | 0 | 0 | 0 | 0 | 0 | 0 | 0.074 | 0 | 0 | 0 |
| *Opalina* sp. | 0 | 0 | 0 | 0 | 0 | 0.079 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Vorticella* sp. | 0 | 0 | 0 | 0 | 1.014 | 0 | 0 | 0.007 | 0 | 0 | 0 | 0 |
| Detritus | 94.28 | 32.21 | 3.367 | 2.81 | 0.097 | 1.338 | 8.614 | 88.962 | 22.671 | 26.719 | 1.43 | 30.381 |
| Digested unidentifiable remnants | 0.98 | 94.29 | 9.780 | 74.08 | 0.260 | 3.210 | 0.908 | 32.27 | 3.61 | 2.804 | 6.1 | 10.15 |
| Digested insect remnants | 0 | 0 | 0.090 | 0 | 0.010 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 4: Size wise index of preponderance of different food items of *H. kurali*

| Food items | 90-99 | 100-109 | 110-119 | 120-129 | 130-139 | 140-149 | 150-159 | 160-169 | 170-179 | 180-189 | 190-199 | 200-209 | 210-219 | 220-229 | 230-239 | 240-249 | 250-259 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Daphnia* sp. | 98.7 | 69.4 | 52.1 | 36.05 | 11.60 | 2.49 | 6.541 | 0.898 | 2.4 | 7.81 | 3.672 | 1.41 | 0.29 | 12.41 | 0.392 | 9.41 | 0 |
| Detritus | 0 | 0 | 12.71 | 8.84 | 9.081 | 0.85 | 0.33 | 28.57 | 0 | 0 | 1.291 | 0 | 0.181 | 0.16 | 0 | 2.69 | 76.83 |
| Mud | 0 | 0 | 5.25 | 24.2 | 12.41 | 0.92 | 12.1 | 0.92 | 0.204 | 0 | 0.07 | 0 | 0.32 | 0 | 0 | 1.845 | 62.11 |
| Rotifers | 0 | 0 | 11.82 | 12.2 | 24.81 | 0.16 | 0 | 0 | 0.02 | 0.16 | 0.91 | 0 | 0.91 | 0 | 0 | 16.743 | 0 |
| Protozoans | 0 | 0 | 16.78 | 0.208 | 0.214 | 0.06 | 0 | 0.27 | 0.11 | 0.09 | 0.05 | 2.49 | 0.4 | 0.07 | 0 | 9.45 | 0 |
| Insect larvae | 0 | 0 | 4.08 | 0.4 | 2.319 | 0 | 0 | 0 | 13.81 | 20.697 | 19.69 | 27.418 | 22.319 | 0 | 10.61 | 10.192 | 0 |
| Remaining arthropods | 0 | 0 | 0.92 | 0.91 | 4.804 | 0 | 0.11 | 1.19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.92 | 42.71 |
| Remaining crustaceans | 0 | 0 | 0.16 | 0.11 | 0.249 | 0 | 0.85 | 0 | 0.07 | 0.183 | 0 | 0 | 0 | 0 | 0 | 0.818 | 0 |

Table 5: Index of preponderance of different food items in different size groups of male *H. kurali*

| Food items | 160-169 | 170-179 | 180-189 | 190-199 | 200-209 | 210-219 | 220-229 | 230-239 | 240-249 | 250-259 | 260-269 | 270-279 | 280-289 | 290-299 | 300-309 | 310-319 | 320-329 | 330-339 | 340-349 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Daphnia* sp. | 98.7 | 69.4 | 52.1 | 36.05 | 9.18 | 25.53 | 58.77 | 13.07 | 3.08 | 0.98 | 29.2 | 0.22 | 0.85 | 0 | 0 | 0 | 0 | 0 | 0 |
| Other crustaceans | 0 | 0 | 0 | 0.38 | 0.64 | 99.80 | 67.40 | 53.6 | 39.5 | 0.726 | 0.49 | 0.37 | 0 | 0.109 | 0 | 0.09 | 0 | 0 | 0 |
| Rotifers | 0 | 0 | 0 | 0 | 0 | 0.86 | 0.49 | 0.22 | 0 | 0 | 0.05 | 0 | 0 | 0.42 | 0.12 | 0 | 0 | 0 | 0.118 |
| Protozoans | 0 | 0 | 0.12 | 0.19 | 0 | 0 | 0.319 | 0 | 0 | 0.05 | 0.09 | 0 | 0 | 0 | 0 | 0.012 | 0 | 0 | 0.11 |
| Insect remnants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.19 | 0 | 0 | 0 | 0 | 0.129 | 0 | 0 | 0.41 | 0 |
| Unidentifiable zooplankton remnants | 0 | 0 | 0 | 0 | 0.98 | 0.42 | 0 | 0 | 0 | 0 | 0.14 | 0 | 0 | 0 | 0 | 0.161 | 0 | 0 | 0 |
| Mud | 0 | 0 | 0.13 | 0.86 | 0.43 | 0.49 | 0.08 | 0 | 0.21 | 0 | 0 | 0 | 0 | 0 | 0.981 | 0.24 | 10.01 | 2.01 | 20.19 |
| Detritus | 0 | 0.48 | 0 | 0 | 0 | 63.1 | 85.39 | 51.65 | 61.49 | 86.04 | 6.66 | 22.05 | 25.53 | 0 | 28.89 | 47.147 | 97.99 | 86.2 | 79.31 |

Table 6: Index of preponderance of different food items in different size groups of female *H. kurali*

| Food items | 160-169 | 170-179 | 180-189 | 190-199 | 200-209 | 210-219 | 220-229 | 230-239 | 240-249 | 250-259 | 260-269 | 270-279 | 280-289 | 290-299 | 300-309 | 310-319 | 320-329 | 330-339 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Daphnia* sp. | 7.94 | 0 | 8.87 | 1.64 | 81.53 | 69.41 | 0 | 0 | 1.18 | 0.561 | 0.319 | 0.041 | 0.381 | 0.214 | 0.113 | 0.417 | 0.001 | 0.219 |
| Other crustaceans | 2.48 | 12.69 | 20.141 | 60.14 | 0 | 0 | 10.69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rotifers | 0 | 6.79 | 0 | 20.19 | 0 | 0 | 27.14 | 0 | 0 | 0 | 1.14 | 0.011 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mud | 0 | 0.029 | 0.71 | 1.391 | 9.02 | 51.81 | 8.87 | 80.53 | 87.53 | 95.15 | 69.43 | 55.71 | 88.93 | 62.71 | 88.41 | 30.34 | 80.189 | 72.614 |
| Detritus | 0 | 0.048 | 0.124 | 0.38 | 0.79 | 0.84 | 22.62 | 26.314 | 32.61 | 4.8 | 72.58 | 87.61 | 88.01 | 94.28 | 72.14 | 60.31 | 20.01 | 31.16 |
| Zooplankton mixture | 0 | 2.1 | 0 | 0 | 3.81 | 0 | 9.81 | 0 | 0 | 0 | 0.31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

The females fishes of 200-219 mm preferred *Daphnia* sp., and with growth the preference shifted to mud and detritus (Table 6). Crustaceans were an important diet in the size group from 160-199 mm. From 250 mm onwards the preference completely shifted to mud and detritus with mixtures of zooplanktons (rarely). Mud and detritus formed the chief food item in the size group ranging from 230-259 mm. The results showed that while smaller sized fishes prefer *Daphnia* sp., as the diet, larger ones feed exclusively on mud and detritus.

*Hypselobarbus kurali* quite often prey up on entire organisms and stomachs exclusively contained crustaceans, digested insect larvae, fish remnants, mud and detritus. The stomach often was gorged with detritus by 37.79% and arthropods representatives up to 55.91%.

## DISCUSSION

Knowing the feeding habit of a fish is inevitable for breeding it in captivity. By studying the gut content of the fish at different size range and for male and female a clear image of the diet preference and feeding trend could be figured out. For the present study it was observed that the fishes of the lowest size range mostly preferred *Daphnia* sp. As the fish grows the preference shifted to rotifers and protozoans and ultimately to mud and detritus. It was simply evident from the list of feed composition that the fish is strictly omnivorous, among which the planktons dominated the most. Studies points that fishes such as *Rutilus rutilus* also feeds extremely on zooplankton[24]. Insect feeding was also noticed in other fishes like *Wallago attu*[25].

The feeding intensity of fish was related to its stages of maturity, reproductive states and the availability of food items in the environment[26]. Live foods are able to swim in water column and are constantly available to fish and shellfish larvae are likely to stimulate larval feeding response. The small fingerlings, thus, studied in this study had showed minimal quantity and variety of feed and it may be due to the aforesaid reason. It was observed that for *H. kurali* juveniles preferred mostly the cladocerans. Studies revealed that the cichlids and cyprinids are zooplanktivorous when they are young. Rotifers, copepods, crustaceans and their nauplii were eated by *O. mossambica* less than 50 mm long[27]. About the same mixture of zooplankton is found in the stomach of *S. galilara* in a Nigerian pond[28]. Small specimens (11-21 mm) eat some phytoplankton also. The next stage of individuals shifted to zooplankton before yielding to an adult detritus feeding habit. The zooplanktivorous habit remains same in young marine detritivores[29]. The older fishes showed variation in feed composition and also quantity which also supports the statement of Ricker[26].

As the growth progress, the preference was shifted to protozoans and rotifers and ultimately to detritus. The result was same with that of some cichlids. In *O. mossambica* as it grows the diet typically changes from one zooplankton to one composed of algae, diatoms, amorphous detritus and sometimes the leaves of macrophytes upon which periphyton grows[30]. The gradual transition of cyprinid larvae to a juvenile and then to an adult, studied in lake Lucia, Zululand, was characterized by consuming about 70% of invertebrates food until the fish are about 50 mm in length to less than 10% of the same when they reaches 250 mm[31]. This so called detritivorous is labeled as a notorious diet switcher, varying all the way from algae-detritus diet to a carnivorous one[32,33]. Study was conducted on a novel approach to prey recognition and feeding behavior, in wild Goliath grouper (Epinephelus itajara) in the field consuming both mobile and non-mobile prey on an artificial reef in the Gulf of Mexico[34]. The DNA barcoding as a method for piscine prey identification of three catfish species (one native and two invasive) of Chesapeake Bay, USA was also worked out[35]. Study that integrates fatty acid and isotopic analysis to understand foraging ecology of Chinook salmon in the California Current and demonstrates the value of combining these analyses for resolving foraging ecology was also being worked out these days[36]. Study on Pacific cod (Gadus macrocephalus) diet data as a basis for estimating octopus complex natural mortality and minimum biomass was also a new arena of study these days[37]. Studies were also conducted on a meta-analysis of the diets of 18 commercially-important ground fishes and their life stages from the U.S. Pacific Coast[38]. The present study was focused on identifying its feed composition of *H. kurali* and thereby identifying its feeding trend. This study forms the stepping stone as the feed so identified could be cultured under controlled condition, which will definitely open a new door to the field of aquaculture. By understanding the feed composition in the gut of fingerlings also puts light to the scope for larval rearing and thereby aquaculture promotion.

## CONCLUSION

Study on food and feeding of *Hypselobarbus kurali* revealed the fact that the food preference of the fish right from its juvenile stage is for *Daphnia* sp. The knowledge on the feed preference had opened a new window to enhance the culture of the same under captivity. The live feed culture of *Daphnia* sp. will serve as food for the captively breed and reared new larvae of *H. kurali*. Thus this study forms a foundation for uplifting a new species on to the aquaculture scenario.

## SIGNIFICANCE STATEMENT

This study discovers the feeding profile of the fish which is planned to be reared under captivity. Thus knowing the feeding priority will definitely help the researchers to develop the feed under controlled condition and to raise the larvae of the fishes providing their staple diet. This study will help the researcher to uncover the most crucial part of captive breeding which is the feed. Thus, this study helps to understand the feed requirement of a species which is planning to be breed under captivity.

## ACKNOWLEDGMENT

The authors are grateful to the Western Ghat Cell, Department of Planning and economic affairs for their support.

## REFERENCES

1. Royce, W.F., 1987. Fishery Development. Academic Press, New York, Pages: 248.
2. MacIsaac, H.J., T.C. Hutchinson and W. Keller, 1987. Analysis of planktonic rotifer assemblages from Sudbury, Ontario, area lakes of varying chemical composition. Can. J. Fish. Aquat. Sci., 44: 1692-1701.
3. Mann, D.A., J.V. Locascio, F.C. Coleman and C.C. Koening, 2009. Goliath grouper *Epinephelus itajara* sound production and movement patterns on aggregation sites. Endangered Species Res., 7: 229-236.
4. McClenachan, L., 2009. Historical declines of goliath grouper populations in South Florida, USA. Endangered Species Res., 7: 175-181.
5. Graham, R.T., K.L. Rhodes and D. Castellanos, 2009. Characterization of the goliath grouper *Epinephelus itajara* fishery of southern Belize for conservation planning. Endangered Species Res., 7: 195-204.
6. Badhul Haq, M.A., M. Srinivasan, C. Tiwary, S. Vaitheeswari and M. Kalaiselvi *et al*., 2011. Food and feeding biology of fish *Epinephelus malabaricus* of Palk Bay and Gulf of Mannar coastal waters. Int. J. Curr. Res. Multidisciplinary, 1: 12-19.
7. Abilhoa, V., R.R. Braga, H. Bornatowski and J.RS. Vitule, 2011. Fishes of the Atlantic Rain Forest Streams: Ecological Patterns and Conservation. In: Changing Diversity in Changing Environment, Grillo, O. (Ed.). InTech Publisher, Rijeka, ISBN: 978-953-307-796-3, pp: 259-282.
8. Aguiar, A.A. and J.L. Valentin, 2010. [Feeding biology and ecology of elasmobranchs (Chondrichthyes: Elasmobranchii): A review of methods and the state of the art in Brazil]. Oecol. Aust., 14: 464-489.

9. Lovern, J.A. and T.H. Wood, 1937. Variations in the chemical composition of herring. J. Mar. Biol. Assoc., 22: 281-293.
10. Nickolsky, G.V., 1963. The Ecology of Fishes. Academic Press, New York, pp: 178.
11. Radhakrishnan, N., 1957. A contribution to the biology of Indian sand whiting *Sillago sihama* (forskal). Indian J. Fish., 4: 254-283.
12. Venkataraman, G., 1960. Studies on the food and feeding relationships of the inshore fishes off Calicut on the Malabar coast. Indian J. Fish, 7: 275-306.
13. Popova, O.A., 1963. Soviet fisheries investigations in the northwest Atlantic. Vniro-Pinro, 114: 584-589.
14. Jayabalan, N., 1991. Food and feeding habits of the ponyfish, *Leiognathus splendens* (Cuvier) from Proto Novo coast. Indian J. Mar. Sci., 20: 157-160.
15. Link, J.S. and J. Burnett, 2001. The relationship between stomach contents and maturity state for major Northwest Atlantic fishes: New paradigms? J. Fish Biol., 59: 783-794.
16. Hynes, H.B.N., 1950. The food of fresh-water sticklebacks (*Gasterosteus aculeatus* and *Pygosteus pungitius*), with a review of methods used in studies of the food of fishes. J. Anim. Ecol., 19: 36-58.
17. Borutsky, B.V., A.V. Assman, E.N. Bokova, L.A. Chuchanova, K.P. Fortunatova, A.F. Karpevich and M.V. Zheltekova, 1952. Handbook for the Study of the Food and Feeding of Fish under Natural Conditions. Akad. Nauk Press, Moskva, Pages: 262.
18. Pillay, T.V.R., 1952. A critique of the methods of study of food of fishes. J. Zool. Soc. India, 1: 185-200.
19. Lagler, K.F., 1949. Studies in Freshwater Biology. Ann Arbor Press, Chelsea, Michigan, pp: 119.
20. Windell, J.T., 1968. Food Analysis and Rate of Digestion. In: Methods for Assessment of Fish Production in Fresh Water, Ricker, W.E. (Ed.). Blackwell Scientific Publications, Oxford, UK., pp: 215-226.
21. Hyslop, E.J., 1980. Stomach contents analysis-A review of methods and their application. J. Fish. Biol., 17: 411-429.
22. Natarajan, A.V. and A.G. Jhingran, 1961. Index of preponderance-a method of grading the food elements in the stomach analysis of fishes. Indian J. Fish., 8: 54-59.
23. Tham, A.K., 1950. The food and feeding relationships of the fishes of singapore straits. Colonical Office Fishery Publications, No. 1. His Majesty's Stationery Office, pp: 1-35.
24. Martin, A.R., 1986. Feeding association between dolphins and shearwaters around the Azores Islands. Can. J. Zool., 64: 1372-1374.
25. Chaudhary, C. and D.K. Singh, 2006. Food of some common fishes of Birganj (Nepal). Environ. Ecol., 2: 345-347.
26. Ricker, W.E., 1956. Handbook of Computations for Biological Statistics of Fish Populations. Fisheries Research Board of Canada, Ottawa, Canada.
27. Costa, H.H. and R.R. Abeysiri, 1978. The hydrobiology of Colombo (Beira) lake. IX-productivity of *Tilapia mossambica*. Spolia Zeylanica, 32: 129-139.
28. Ita, N.O., 1971. Bibliography of Nigeria: A Survey of Anthropological and Linguistic Writings from the Earliest Times to 1966. Frank Cass, London, ISBN: 9780714624587, Pages: 271.
29. Zismann, L.V., V. Berdugo and B. Kimor, 1975. The food and feeding habits of early stages of grey mullets in the Haifa Bay region. Aquaculture, 6: 59-75.
30. Bowen, S.H., 1982. Feeding, Digestion and Growth-Qualitative Considerations. In: The Biology and Culture of Tilapias, Pullin, R.S.V. and R.H. Lowe-MConnell (Eds.). ICLARM., Manila, pp: 141-156.
31. Whitfield, A.K. and S.J.M. Blaber, 1978. Food and feeding ecology of piscivorous fishes at Lake St Lucia, Zululand. J. Fish Biol., 13: 675-691.
32. De Silva, S.S., R.M. Gunasekera and D. Atapattu, 1989. The dietary protein requirements of young tilapia and an evaluation of the least cost dietary protein levels. Aquaculture, 80: 271-284.
33. De Silva, S.S. and M.K. Perera, 1985. Effects of dietary protein level on growth, food conversion and protein use in young *Tilapia nilotica* at four salinities. Trans. Am. Fish. Soc., 114: 584-589.
34. Litz, M.N.C., J.A. Miller, L.A. Copeman, D.J. Teel, L.A. Weitkamp, E.A. Daly and A.M. Claiborne, 2017. Ontogenetic shifts in the diets of juvenile Chinook Salmon: New insight from stable isotopes and fatty acids. Environ. Biol. Fishes, 100: 337-360.
35. Aguilar, R., M.B. Ogburn, A.C. Driskell, L.A. Weigt, M.C. Groves and A.H. Hines, 2017. Gutsy genetics: Identification of digested piscine prey items in the stomach contents of sympatric native and introduced warmwater catfishes via DNA barcoding. Environ. Biol. Fishes, 100: 325-336.
36. Collins, A.B. and P.J. Motta, 2017. A kinematic investigation into the feeding behavior of the Goliath grouper *Epinephelus itajara*. Environ. Biol. Fishes, 100: 309-323.
37. Rohan, S.K. and T.W. Buckley, 2017. Spatial and ontogenetic patterns of Pacific cod (*Gadus macrocephalus* Tilesius) predation on octopus in the eastern Bering Sea. Environ. Biol. Fishes, 100: 361-373.
38. Bizzarro, J.J., M.M. Yoklavich and W.W. Wakefield, 2017. Diet composition and foraging ecology of U.S. Pacific Coast groundfishes with applications for fisheries management. Environ. Biol. Fishes, 100: 375-393.