FOOD AND FEEDING HABITS AND LENGTH-WEIGHT RELATIONSHIP OF CYPRINUS CARPIO SPECULARIS LINNAEUS OF DAL LAKE, KASHMIR

SHYAM SUNDER, KULDIP KUMAR AND H. S. RAINA
Srinagar Research Centre of CIFR Institute, Harwan, Kashmir.

ABSTRACT
Gut-content analysis of fish in size range 89-522 mm showed that the mirror carp, Cyprinus carpio specularis Linnaeus, is mainly a bottom feeder, all the sizes chiefly feeding on decayed plant matter. Other important items found in the gut, in the order of importance, are diatoms, algae and desmids and crustacea. The feeding intensity is in summer, while, in winter, the feeding is minimum. K values are highest in March.

The length-weight relationship, proved not significant between sexes, is expressed logarithmically by the general equation: \( \log W = -4.7929 + 2.9802 \log L \).

INTRODUCTION
German phenotype of mirror carp was transplanted in the Dal lake from Himachal Pardesh in 1955-56 (Jhingran and Sehgal 1978). The fish, locally known as 'Panjab gad,' is well established in Dal lake and connected water bodies of the valley. Owing to its hardy and highly domesticable nature the fish is best suited for culture purposes all over the world. However, no detailed work has been undertaken so far on its various biological features under the local conditions except the preliminary work of Subla (1967), Subla and Das (1970) and Jan and Das (1970), since its introduction. It is against this background the present study on the Cyprinus carpio specularis of Dal lake was taken up.

MATERIAL AND METHODS
Random samples comprising a total of 459 specimens of mirror carp in the size range of 89-522 mm and 13-1,625 g were collected from Dal lake catches, during August 1975 to July 1977. The length-weight relationship was determined by fitting the general allometric equation to the data \( W = CL^b \), where \( W \) = weight of fish in g and \( L \) = length of fish in mm; \( C \) = initial growth index and \( b \) =equilibrium constant.

The gut contents were analysed both qualitatively and quantitatively. The various food items were identified, as far as possible, up to generic level. For
volumetric studies the gut contents of individual fish, including sand grains, were taken as a unit, and various items were expressed in terms of percentage volume, based on "eye estimation" (Pillay 1952). The gut contents were also analysed by "Occurrence method". In this method, the number of gut containing a particular item of food were expressed as a percentage of total number of guts examined (Hynes 1950). The relative importance of various food items was calculated using Index of preponderence (Natarajan and Jhingran 1961).

The feeding intensity was measured by calculating gastro-somatic index and by recording the condition of feeding which was assessed by the degree of distension of the gut in each fish (full, 3/4 full, 1/2 full, 1/3 full and 1/4 full). For interpreting the feeding activity, the stages of fullness of gut were grouped as high (full and 3/4 full), normal (1/2 full) and poor (1/3 full and 1/4 full). The relative condition $K_n$ (Le Cren 1951) was estimated from the formula $\frac{W}{W'}$, where $W$ is the observed weight and $W'$ is the calculated weight of the fish.

**Observations**

**Food constituents and their seasonal variations**

Decayed organic matter: This item mainly consisted of unidentifiable plant matter in decayed or semidecayed state. It was found in appreciable quantities throughout the year (average 73.18% by volume). Its percentage of occurrence was highest in December (85.65%) and lowest in April (63.43%).

Bacillariophyceae (diatoms): Of the identifiable planktonic items, diatoms were most abundant (average 20.42% by volume) and occurred regularly in the food. Their availability was maximum during February (28.09%) and minimum during December (11.55%).

Chlorophyceae (green algae and desmids): Next important food item, occurring throughout the year, was green algae and desmids, which formed 2.51% of the gut contents by volume. The frequency of its occurrence was found to be more during the months of February (3.26%) to August (3.16%), with a maximum peak in May (5.68%). From September onwards, this group showed a decline and was scarce during November (0.46%) to December (0.49%).

Crustacea (Cladocera and Copepoda): Constituting by volume 1.79%, it was the food item next in rank, occurring regularly in the guts during the year. It was found maximum during April (2.83%) and minimum during October (0.37%).

Protozoa: This item was recorded to the extent of 0.64% and was not encountered in the food contents during the months of October and December; its availability being maximum in June (1.76%) and minimum in November (0.01%).
Myxophyceae (blue green algae): This group of algae, formed only
0.50% in the bulk of gut contents, was present throughout the year except
February. It was maximum in May (1.14%) and minimum in November
(0.06%).

Rotifera: This group too formed an insignificant component (0.33%) of
the food items occurring throughout the year except in October.

Miscellaneous: The other micro- and macro-organisms found in the guts
of mirror carp were occasional and not a common feature. They included semi-
digested fishes (Crossocheilus latius and Gambusia affinis), fish scales, aquatic
insects (mainly larvae of Chironomids, nymphs of Ephemeroptera and naids of
Odonata, etc), insect appendages, Nematodes, Oligochaetes (mainly representa­
tives from the families Tubificidae and Naididae), crushed paddy and maize
seeds, rice husk and spores, stems and leaves of aquatic plants, viz., Myriophyl­
hum, Ceratophyllum, Potamogeton, etc.

TABLE 1. Grading of various broad groups of the gut contents of C. c. specularis.
(Occ. = Occurrence).

<table>
<thead>
<tr>
<th>Food items</th>
<th>Composition by</th>
<th>Index of</th>
<th>Grading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vol. % Occ. %</td>
<td>preponderence</td>
<td></td>
</tr>
<tr>
<td>Decayed organic</td>
<td>73.81</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Bacillariophyceae</td>
<td>20.42</td>
<td></td>
<td>II</td>
</tr>
<tr>
<td>Chlorophyceae</td>
<td>2.51</td>
<td></td>
<td>III</td>
</tr>
<tr>
<td>Crustacea</td>
<td>1.79</td>
<td></td>
<td>IV</td>
</tr>
<tr>
<td>Protozoa</td>
<td>0.64</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Myxophyceae</td>
<td>0.50</td>
<td></td>
<td>VI</td>
</tr>
<tr>
<td>Rotifers</td>
<td>0.33</td>
<td></td>
<td>VII</td>
</tr>
</tbody>
</table>

\* I = \sum v_i O_i \times 100 / \sum v_i O_i

The order of preponderence of various broad groups in the guts of
mirror carp is shown in table 1. Fig. 1 depicts the monthly variations in the
food contents in terms of volume and occurrence.

Composition of diet in various size groups

Five groups, with 100 mm interval, were arbitrarily made to study if
there existed any diet succession with increase in size of the fish. The data on
gut contents of various size groups are presented in Fig. 2. The salient features
of these observations are described below:
Size group I (below 100 mm): The decayed organic matter formed the major item of food (73.96% by volume) followed by Bacillariophyceae (12.71%) and zooplankton ranked third (Crustacea 6.70%, Protozoa 4.41% and Rotifera 1.26%). Chlorophyceae were inconspicuous (0.96%), while Myxophyceae were totally absent.

Size group II (101-200 mm): The bulk of gut contents comprised of decayed organic matter (74.66%). Bacillariophyceae was next (18.85%), while zooplankton exhibited lower values (Crustacea 3.08%, Protozoa 1.07% and Rotifera 0.33%). The Chlorophyceae and Myxophyceae formed 1.55% and 0.46%, respectively.

Size group III (201-300 mm): The decayed organic matter constituted 74.15% by volume of the gut contents, followed by Bacillariophyceae (19.86%). The Chlorophyceae and Myxophyceae comprised 2.50% and 0.53%, respectively, while zooplankton showed a further decline (Crustacea 1.82%, Protozoa 0.61% and Rotifera 0.50%).

Size group IV (301-400 mm): In this group also decayed organic matter (75.65% by volume) was the main item, followed by Bacillariophyceae
(19.90%). Chlorophyceae and Myxophyceae decreased slightly from the succeeding group (2.24% and 0.48%). A further fall was recorded in zooplankton diet (Crustacea 1.11%, Protozoa 0.42% and Rotifera 0.18%).

Size group V (401-500 mm): Similar to the groups I-III, decayed organic matter (73.25%) and Bacillariophyceae (18.62%) formed the major food items of mirror carp. In comparison to other size groups, larger quantities of Chlorophyceae (5.50%) were encountered while Myxophyceae did not show any variation (0.52%) and zooplankton also did not exhibit much fluctuations from the fourth group.

Feeding intensity

The observations on feeding intensity of mirror carp based on condition of feeding (combined percentages of full and 3/4 full guts only) and gastro-somatic index are depicted in Fig. 3. Complete absence of feeding activity was not noticed in any specimen during the course of study. Table 2 shows the trends of feeding intensity during different months of the year. The fish fed actively during the summer months, i.e., June to September, having 31.15-64.25% guts full and 3/4 full, while low feeding was recorded during winter, when only 3.33-17.24% of the guts were full and 3/4 full.

The gastro-somatic indices were comparatively lower (2.8-3.5) during winter months, i.e., November to February, moderate (4.0-4.6) during spawning months, March to May, and higher (5.0-5.6) during summer months, June to October.

<table>
<thead>
<tr>
<th>Month</th>
<th>High</th>
<th>Normal</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>13.33</td>
<td>43.33</td>
<td>43.34</td>
</tr>
<tr>
<td>February</td>
<td>14.28</td>
<td>42.86</td>
<td>42.86</td>
</tr>
<tr>
<td>March</td>
<td>13.04</td>
<td>28.26</td>
<td>58.69</td>
</tr>
<tr>
<td>April</td>
<td>17.24</td>
<td>31.04</td>
<td>51.72</td>
</tr>
<tr>
<td>May</td>
<td>12.50</td>
<td>20.00</td>
<td>67.50</td>
</tr>
<tr>
<td>June</td>
<td>50.00</td>
<td>23.53</td>
<td>26.47</td>
</tr>
<tr>
<td>July</td>
<td>37.15</td>
<td>22.85</td>
<td>40.00</td>
</tr>
<tr>
<td>August</td>
<td>64.29</td>
<td>14.28</td>
<td>21.43</td>
</tr>
<tr>
<td>September</td>
<td>48.93</td>
<td>10.64</td>
<td>40.43</td>
</tr>
<tr>
<td>October</td>
<td>13.95</td>
<td>11.63</td>
<td>74.42</td>
</tr>
<tr>
<td>November</td>
<td>3.33</td>
<td>20.00</td>
<td>76.67</td>
</tr>
<tr>
<td>December</td>
<td>6.96</td>
<td>32.58</td>
<td>60.46</td>
</tr>
</tbody>
</table>
Relative condition

$K_a$ values during different months are presented in Fig. 3, which shows a peak in March (1.25) followed by a fall and attaining a minimum in July (0.95). Thereafter, a gradual increase till December was recorded (0.98-1.21) and again declined during January (1.10).

Length-weight relationship

The length-weight relationship of *Cyprinus carpio specularis* was computed for specimens ranging between 112 and 415 mm in total length, taken all the year round for two years. While computing the relationship, juveniles and fishes above 415 mm length were not taken into account due to their meagre numbers. The data have been grouped separately for males and females. The
According to Hile (1936) and Martin (1949), the values of the exponent $b$ usually ranges between 2.5 and 4.0, while Allen (1938) suggests that the value for $b$ remains constant at 3 for the ideal fish. A perusal of length-weight relationship, worked for mirror carp from Dal lake, shows that the value of $b$ was 2.98, slightly less than 3, thus not satisfying the Cube law. It may be said that the weight of the fish in Dal lake increases in proportion slightly less than the cube of its length. Soni et al (1979) have worked out $b$ value for *C. carpio* as 3.75 from a tropical lake, Sagar.

**ACKNOWLEDGEMENT**

The authors wish to express their gratitude to the present Director, Dr. A. V. Natrajan, Central Inland Fisheries Research Institute, Barrackpore, and ex-Director, Dr. V. G. Jhingran, for their encouragement. They are grateful to Dr. A. G. Jhingran, former Head, R & L Division, Allahabad, for kindly going through the paper critically and to Dr. K. K. Vass, Officer-in-Charge, for making valuable suggestions while preparing the manuscript. They are also thankful to Shri R. A. Gupta, Allahabad, for helping in some statistical interpretations.

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FOOD AND FEEDING OF MIRROR CARP


