CHAPTER - 5

FOOD AND FEEDING HABITS
Natural food of fishes is derived from many types of plants and/or animals that inhabit waterbodies, as well as from others that do not, but visit the waterbody occasionally. In addition, certain elements, such as calcium, are believed to be absorbed from the water directly. The classes of food substances represented include proteins, carbohydrates, fats, lipids and vitamins. They are of animal, vegetable and mineral origin (Lagler, 1956).

First feeding of most fishes in nature consists of bacteria, diatoms, desmids, unicellular protozoans, rotifers, microcrustaceans and microscopic plankters. Periphyton and associated tiny animalcules, forming more or less a slimy coating on bottom materials, on debries, and on plant stem/leaves are also browsed upon.

The natural food of fishes, according to Schaperclaus (1966) is classified under three groups, viz.

(a) ‘main food’, or the natural food which the fish prefers under favourable conditions and on which it thrives best,

(b) ‘occasional food’ or the natural food that is well liked and consumed as and when available, and

(c) ‘emergency food’ which is ingested when the preferred food items are not available and on which the fish is just able to survive.
Certain microscopic planktonic crustacean groups and rotifers form the ‘main food’ of spawn and fry (15 to 20mm size range) of the Indian major carps and majority of other culturable species, with phytoplankton forming the ‘emergency food’ (Alikunhi, 1952). Spawn and fry with a small and short straight intestine appear to digest rotifers and cladocerans fairly rapidly and thrive well on zooplankton. Phytoplanktonic algae are not so easily digested and, at least, some algal genera (*Euglena, Phacus, Eudorina, Oscillatoria, Microcystis*, some filamentous green algae, etc.) remain undigested, and ejested intact along with faecal matter. The food and feeding habits of the fingerlings of Indian major carps differ markedly from those of their hatchlings and fry (Jhingran, 1988).

Nikolskii (1963) divided food of fishes into four categories according to the relationship between the fishes and their food. These categories are

a) ‘basic food’ which the fish usually consumes, comprising the main part of the gut contents,

b) ‘secondary food’ which is frequently found in the guts of fishes, but in small amounts,

c) ‘incidental food’ which only rarely enters the gut unintentionally, and

d) ‘obligatory food’ which the fish consumes in the absence of basic food. Adult fishes, according to the character of diet they thrive on,
have been classified into herbivores if they feed on vegetable matter, carnivores, if their food comprises animal matters and omnivores, if they subsist on a mixed diet composed of both vegetable and animal matter. Hora and Pillay (1962) put plankton and detritus feeding fish into a separate group, including therein fishes like *Catla catla*, *Hypophthalmichthys molitrix*, *Labeo fimbriatus*, *Cirrhinus cirrhosa*, *C. reba* etc., which consume phyto and zooplankton, decayed micro-vegetation and detritus. Nikolskii (1963) grouped fishes into:

1. Herbivores and detritrophic, including in the group, species which feed on vegetable matter and detritus,

2. Carnivores, which feed on invertebrates, and

3. Predators which prey on fish.

Most of the culturable fishes are omnivorous in their feeding habit. Carnivorous species often behave as predators and vice-versa. Nikolskii (1963) categorised fishes according to the extent of variation in the types of food consumed by them, such as

1. Euryphagic, feeding on a variety of foods;

2. Stenophagic, feeding on a few selected types of food, and

3. Monophagic, feeding on a single type of food.

The feeding behaviour is species-characteristic.
Cultured fishes are often classified according to the trophic niche they occupy in a waterbody. Following this system, fishes have been grouped into;

1. Plankton eating surface feeders, such as *Catla catla* and *Hypophthalmichthys molitrix*

2. Column or mid-feeders, such as *Labeo rohita* and

3. Bottom feeders, such as *Cirrhus mrigala, C. reba, Labeo calbasu* and others.

In the last mentioned category, sand and mud almost invariably get into the stomach along with detritus. Fishes belonging to surface, column and bottom feeding categories have been sub-grouped according to character of food they consume into herbivores, carnivores and omnivores (Das and Moitra, 1955).

Feeding habits of adult fishes vary according to the amount and type of food present in a particular environment. Food spectrum of fish varies in different seasons, depending on maturity stages and the quantum of food supply. Herbivores and carnivores are recorded to show always definite peak periods in feeding, while omnivores show little variation through the year (Das and Moitra, 1955).

For any species, food habits may change seasonally with the type of food available and vary with life history stages. Most fishes are
omnivorous even in early life, ingesting and digesting both plant and animal tissues. As fish grow towards adulthood however, specific adaptations develop and the diet varieties become slightly or highly restricted. Many fishes remain largely omnivorous throughout life (bluegill sunfishes and others). A few become plankton feeders at an early stage and remain so throughout their life, (carps, gizzard shad and paddle fish). *Pangasius pangasius* is an omnivore, feeding on a variety of food such as insects, molluscs, crustaceans, offal *etc.* (David, 1963) but according to Ramakrishnaiah (1986) the fish showed a preference to molluscs when they are available. Some become highly herbivorous (grass carp, stone roller minnows, red belly dace), others carnivorous (Perches, Bhekti, Pike, Gars - likely Piscivorous; trouts - quite insectivorous). Some species become cannibalistic (Murrels, Pike, largemouth bass). The freshwater cat-fishes - especially *Pangasius pangasius*, drum and shellcracker sunfish become quite malacophagus, utilizing snails and clams; the bullheads turn into efficient scavangers, and black basses eat quantities of crayfishes (carcinophagy) (Jhingran, 1988).

Studies on food and feeding habits of fishes is based on the food contents of digestive tracts and of defaecated droppings, which reflect as to what the fish have eaten. Food spectrum studies yield details of the ecological relationships among organisms. (Lagler, 1962)

Because of natural fluctuations in abundance, any one food organism is not of constant numerical availability to fishes. Such fluctuations of foraged organisms are often cyclic due to factors of
their life histories or to climatic or other environmental conditions. Abundance of a potential food species often determines whether or not it will be eaten by fishes, for indeed, availability is a key factor in determining what a fish will eat. Most fishes are highly adaptable in their feeding habits and utilize the most readily available foods. Relatively few kinds' approach being strictly herbivores or carnivores, and perhaps none at all feed solely on any one organism. Some, such as Bermuda angel fish (*Holacanthus bermudensis*), may even change their diet with the season and may be quite herbivores in winter and spring and become predominantly carnivores in summer and early fall (Lagler, 1962).

The chromids or the pearlspots (family cichlidae) form an important group among the brackishwater fishes of the tropics. The three species found in India are *E. suratensis* (Bloch), *E. maculatus* (Bloch) and *E. canarensis* (Day). Of these, the first two are commercially important and contribute a sizeable portion of the market landings from the brackishwaters of the South-west and North-east coasts of India. Inspite of their economic importance, the feeding ecology of these fishes is poorly known (Keshava *et al*, 1988). A note on the weed destroying habit of *E. suratensis* has been reported by Gopinath (1948). The study reveals that this fish is a vegetable feeder, depending mainly on aquatic plants, filamentous algae, and phytoplankton for food (Gopalkrishnan, 1972). During the present studies, feeding regimen of this species in a freshwater habitat like the Sankey tank are recorded for the first time.
5.1 GUT CONTENT ANALYSIS

5.1.1. FOOD OF FRY AND FINGERLINGS

The fry and fingerlings of *E. suratensis* collected from the Sankey tank were found to feed on a mixed diet consisting of diatoms and zooplankters. They showed a special preference for the diatoms *Navicula sp.* and the zooplankters composed of crustacean nauplii, *Moina, Daphnia* and other cladocerans. The food also consisted of decayed organic matter, plant parts, algal strands and sand. In the 75 fishes examined, the major food items encountered were nauplii in 73 of them, *Moina* and *Daphnia* in 70 and *Navicula sp.* in 52 fishes (Table 12).

From the pie diagram (Fig. 6a, b and c) it is evident that the major food item of juveniles comprised of zooplankton, plant parts and decayed organic matter.

5.1.2. FOOD OF ADULT FISHES

The fishes of this category were found to be mainly feeding on macrophytes, decaying organic matter (mainly plant roots and shoots), filamentous algae, insects, diatoms, fish larvae, prawn larvae and along with the partially digested flesh, sand particles and molluscan shells were also found. (Table 13)

From the pie diagram (Fig. 7 a, b and c) for adult fishes it is evident that the fish was mainly dependant on macrophytes, decaying,
Table - 12: Food preferences of juvenile *E. suratensis* (75 Numbers)

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nauplii</td>
<td>73</td>
</tr>
<tr>
<td><em>Moina &amp; Daphnia sp.</em></td>
<td>70</td>
</tr>
<tr>
<td><em>Navicula sp.</em></td>
<td>52</td>
</tr>
<tr>
<td>DOM</td>
<td>36</td>
</tr>
<tr>
<td>Other Cladocerans</td>
<td>26</td>
</tr>
<tr>
<td>Sand</td>
<td>15</td>
</tr>
<tr>
<td>Plant Parts</td>
<td>6</td>
</tr>
</tbody>
</table>
Fig. 6a - Pie diagram showing the percentage of different food items found in the stomach of juvenile specimens of *E. suratensis*
Fig. 6b: Pie diagram showing the percentage of major food items consumed by Juvenile specimens of *E. suratensis*.
Fig. 6c: Exploded Pie diagram showing the percentage of major food items consumed by Juvenile specimens of E. suratensis
Table - 13: Food preferences of adult fishes (248 Numbers)

<table>
<thead>
<tr>
<th>Food Type</th>
<th>Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macrophytes</td>
<td>225</td>
</tr>
<tr>
<td>DOM</td>
<td>187</td>
</tr>
<tr>
<td>Sand</td>
<td>187</td>
</tr>
<tr>
<td>Insect</td>
<td>92</td>
</tr>
<tr>
<td>Flesh</td>
<td>89</td>
</tr>
<tr>
<td>Algae</td>
<td>63</td>
</tr>
<tr>
<td>Navicula sp.</td>
<td>42</td>
</tr>
<tr>
<td>Molluses</td>
<td>24</td>
</tr>
<tr>
<td>Cladocera</td>
<td>14</td>
</tr>
</tbody>
</table>
Fig. 7a - Pie diagram showing the percentage of different food items found in the stomach of adult specimens of *E. suratensis*
Fig. 7b: Pie diagram showing the percentage of major food items consumed by Adult specimens of *E. suratensis*.
Fig. 7c - Exploded Pie diagram showing the percentage of major food items consumed by adult specimens of *E. suratensis*
organic matter and algae. It is evident from the graph that in the juvenile stages the fish is an omnivore and as it grows up it turns into a herbivore.

5.2. GUT LENGTH VS TOTAL LENGTH

The stomach shows various adaptations, one of which is shape. In fish-eating fishes, the stomach is typically quite elongate as in the gars (*Lepisosteus*), bowfin (*Amia*), Pikes (*Esox*), barracudas (*Sphyraena*), and the striped bass (*Rouns sexatilis*). In omnivorous species, the stomach is most often sac-shaped similar to that in human (*Lagler, 1962*). In *E. suratensis* also the stomach is sac-shaped which shows that even though it feeds mostly on plant matters, occasionally it is also an omnivore. 510 fishes were analysed and the average total length to gut length was 1:3.8

The intestine too, has many variations. It is shortened in essential carnivores such as the pike (*Esox lucius*). Perhaps because meaty foods can be digested more readily than vegetable ones. In opposite fashion, it is often elongated and arranged in many folds in predominantly herbivorous species, as in the present fish *E. suratensis*. The graph shows the relationship between the length of the gut with the total length of the fish (Fig. 8a, b). The relationship can be expressed as

\[
\ln (\text{LAC}) = 20.9966 + 9.9534 \ln(\text{TL}) - 0.8972 \ln(\text{TL})^2.
\]
Fig. 8a - Total length of E. australis vs length of alimentary canal

Ln (Total Length - cm)

Ln (Length of alimentary canal - cm)
Fig. 8b - Total length of *E. suratensis* Vs length of alimentary canal
(logarithmic transformation)
5.3. FEEDING INTENSITY

During the present study, dominance of empty stomachs were noticed during most of the months. High feeding intensities were noticed during July, September and May. During the rest of the periods the feeding intensity was comparatively low (Fig. 9).

Feeding intensities were calculated only for the adult specimens. Keshava et al., (1988) observed that feeding intensity is related to maturation of gonads and spawning activity, besides food availability and the present observations agree with the observations made by earlier workers in brackishwater habitats.

It is evident from Fig. 9 that lowest feeding intensity was during January and February. High feeding intensity was noticed during June, July and September. Thus low feeding intensity is related to maturation of gonads and spawning activity in adult populations of *E. suratensis* during January, February and March in Sankey tank. Empty stomachs were also observed during these months.
Fig. 9: Feeding intensity of the fish calculated with respect to the weight of gut with food.