UGC Training Course
on
Industrial Fish and Fisheries

BIOLOGY AND FISHERY OF FLATFISHES

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Flatfishes of the order Hetrosomata or Pleuronectiformes, comprising of the halibuts, flounders and soles occupy a place of importance among the marine fishery resources of India. Although Norman has described 91 species, only few species actually contribute to the fishery. Every year around 44836 tonnes of flatfish are being landed on an all – India basis. The major contributor to the all India landings is Kerala (39 %) followed by Gujarat (17 %) and closely by Karnataka (14.95 %).

On the global front, 1.2 million tonnes of flat fish was landed on an average from 1986 – 1992, forming 1.6 % of the total fish production of 98 million tonnes. Of this, only 2.6 % was contributed by Indian Ocean. The important species contributing to the world flatfish fishery are the European Plaice, *Pleuronectes platessa*, contributing nearly 14 % of the catch, followed by Greenland halibut, *Reinhardtius hippoglossoides*, 11 % and the Yellowfin sole *Limanda japonesa* (10 %). The minor contributors to the fishery are the Common sole, *Solea vulgaris*, the American plaice *(Hippoglossoides platessoides)*, the Rock sole, (*Lepidosetta bilineata*), and the Pacific halibut, (*Hippoglossus stenolepis*).

In India, though 91 species have been described, it is only the Malabar Sole, *Cynoglossus macrostomus* Norman that contribute a major share to the flatfish fishery especially along the South Karnataka and North Kerala coast. Species of the same genus, which occur in stray catches, are *C.arel, C.bilineatus, C.punticeps and C.dubius*. Species of Solea and Synaptura sometimes occur in small quantities in the miscellaneous catches. *Psettodes erumei*, the Indian Halibut occurs in small numbers on both the coasts and has been seen to occur in the deeper waters. Few species of the flounders, like *Pseudorhombus arsius, P.javanica, P. elevatus* also occur as seasonal or stray catches. It is quite possible that more species of flatfishes may occur in our waters.

Flatfishes are bottom fishes, characterised by an asymmetrical body, for in the adults the eyes lie either on the right or left side of the head. They are said to be closely related to the perch like fishes due to their remarkable capacity to change colour to match the surroundings. Most of them live in moderate depths, some in deeper waters and a few live close to the shore. They are generally predacious and carnivorous.

TAXONOMY

ORDER HETEROSOMATA

Body strongly compressed, flat, head asymmetrical, the skull twisted in front, with two orbits on one side in the adult. The eyed side, which is turned upwards in normal position, is either the left or the right one. Only in Psettodes , the number of dextral or sinistral individuals is about the same, in all the others, the species and even the genera are either left or right sided and individual divergences are rare. Order Heterosoma or Pleuronectiformes consists of the following families

Classification of the Pleuronectiformes according to Ahlstrom et al. (1984)

- Family Psettodidae
- Family Citharidae
- Family Scopthalmidae
- Family Bothidae
- Family Paralichthydae
- Family Pleeuronectidae
- Family Soleidae
- Family Cynoglossidae

FISHERY

The total flatfish landings along the Indian coast has been fluctuating from about 2000 tonnes in 1951 to about tonnes in 1998.With the advent of bottom trawling, there has been a distinct increase inn the total landings of flatfishes. The species *Cynoglossus macrostomus* occurs in the seas on both the coasts of India, but forms a major fishery in the south Karnataka – north Kerala coast. *C.macrolepidotus* forms the major fishery in the south Kerala and Gulf of Mannar region. 95.7 % of the landings at Mangalore and Malpe are constituted by *C. macrostomus*, 1.2 % by *C.bilineatus*, 1.6 % each by *C.arel* and *P.erumei*

. 94.4 % of the catch at Calicut and 71.3 % of the catch at Cochin is by *C.macrostomus*. At Vizhingam, *C. bilineatus* (93.2 %) was the dominant catch. *Pseudorhombus triocellatus* was also obtained (1.7 %). At Pamban, *C.macrolepidotus* formed 80 % of the catch followed by *C.bilineatus* (20 %).

The fishery for Malabar soles is important only along the Malabar Coast, although these fish occur in some quantities along the adjoining coast of South Kanara as well. During monsoon months of June to August, the fish is not seen in inshore waters, but in the slightly deeper areas. This may be related to the absence of the polychaete *P.pinnata* in the inshore waters. During the monsoon period, the sea bottom is disturbed and hence, the food is dispersed. During September – October, and sometimes in November, large shoals are seen to occur in the inshore waters. This is probably related to the settling of polychaetes in inshore waters. The best season for fishery is immediately after the southwest monsoon, September being the month of peak abundance. The soles are inexpensive fish consumed by people of low income. Their market value also depends therefore on the catch of other fishes like sardine, mackerel and also on the fluctuations in its own landings. After November, the fish does not appear in shoals. Spawning seems to take place in the deeper waters.

Fishery of *Psettodes erumei:* With the introduction of trawling at Mumbai, the landings of these fishes have increased in the commercial catches.

BIOLOGY

C. macrostomus

Standard length – Total length relationship

$Y = 0.91 X - 0.09$
$X = 1.09 Y + 0.13$
Where X and Y are total length and standard length.
Roughly speaking, the standard length may be said to be nine – tenths of the total length. The r-value has been worked out to be +0.998. This indicates a good correlation between the two lengths and justifies the selection of either of the two for routine recording.
(Seshappa and Bhimachar, 1955)

Psettodes erumei

The length – weight relationship curve shows isometric growth with significant r-value. Calculated relationship is:

$W = 0.0028 L^{2.486}$
(Hussain, 1990)

Pseudorhombus arsius

The length weight relationship worked out was $W = 0.000020 L^{2.889}$ with a significant r-value. (Hussain, 1990)

AGE and GROWTH

The age and growth studies were studied by Seshappa and Bhimachar (1951) both by length frequency method and scale studies. The authors have found definite annual growth rings occurring in the scales of the species. Interestingly, otoliths did not reveal the presence of any growth rings. Scales rings were absent in the smaller sizes and present only in size groups from 12 cm onwards, though not in all. The rings were first formed at the margins and then it went deeper in as growth progressed. On the basis of the study, the present conclusion is that rings in the scales of Malabar sole are regular annuli, indicating the age of the fish and they are formed under the influence of the Southwest monsoon. The growth rings have therefore been called the monsoon rings. Rings are also formed due to the lack of food leading to starvation.

C.macrostomus has been reported to grow to about 17 cm in total length: but bulk of the commercial catches in the southwest coast is made up of 10 – 13 cm groups although the range is from 5.5 to 15.5 cm (Bensam et al., 2000). Seshappa and Bhimachar (1955) have reported that females tend to grow at a faster rate than males. The vast majority of fish during September – October fishing season measuring 10 – 12 cm are one year old and are products of the last years spawning.
According to Khan and Nandakumaran (1993), the fish grows to 6 cm when it is 6 months old, 10 cm at one year, 12 at 11/2 years, 13 cm at 2 years and 14 cm at 21/2 years. The length weight relationship worked out by them is
W = 0.00003759 t 2.6128 (mm)

FOOD AND FEEDING

Food is one main factor, which affects shoaling, behaviour, migration, condition and even fishery. Rathke (1824) has made a comparative study on the alimentary tract of 56 species of plaice, turbot and flounders. Some observations ewer made on their bottom feeding habit by George (1958) and Seshappa (1964). As the Malabar sole is a bottom feeder, the knowledge obtained on the bottom fauna is of considerable use in understanding the food problem of the fish. Productivity assessments of the sole fishery can be based, theoretically speaking, on the productivity assessment of the bottom fauna of the area where the exact relationships existing between the various elements of this fauna and the fish are fully known.

The food organisms can be grouped under four distinct categories, namely, polychaetes, amphipods, lamellibranches and other organisms. Polychaetes form the dominant food animals during the months following the

southwest monsoon. *Prionospia pinnata* was the most frequent of these polychaetes. It is sometimes seen that during these months, the gut is gorged with these individuals and no other food item is seen. Amphipods and lamellibranches become dominant in the gut contents when the polychaetes are poorly represented. The amphipods represented were *Cheiriphotis megachelis* and an ampeliscid species. The lamellibranches noticed were – Pholas orientalis, *Nucula, Tellina cuneolus, Arca gubernaculam, Cardium*. The other category of organisms consisted of heterogeneous elements such as decapod remains, gastropod remains, copepods and an acarinid. Diatoms also occur in few numbers. (Seshappa and Bhimachar, 1955). In the case of *Psettodes erumei*, younger fishes take invertebrates (Sepia and crab) as their major food, but as the fish grows the invertebrates are gradually replaced by small fish mostly *Engraulis* sp. And Clupea sp. ((Hussain, 1990). Same is the case noticed in *Pseudorhombus arsius*. Crustaceans formed the main food item of *C. macrolepidotus*. The next major food component is bivalves, polychaetes supplemented by other dietary components such as fish larvae, phytoplankton (Benthic forms) an algal matter. (Ramanathan et al., 1977)

SEX RATIO, MATURITY AND SPAWNING

The sexes are distinguishable in the Malabar sole of 6 to 7 cm total length on examination. External differentiation is not possible, but in the case of females with gonads in the advanced stages of maturity, the ovaries are easily seen through the body wall when the fish is held against light. Stages III and IV are dominant in the fishery at the commencement of September.

Female *P. arsius* attains maturity at 33 – 35 cm length. Mature fish have three prominent ocelli on the lateral line. Observations also reveal that males attain maturity little earlier at 29 – 30 cm total length. Mature males have milky white testis in appearance and females have bulging triangular shaped ovaries lying on either side of the body. Soon after the southwest monsoon, the male and female gonads undergo development and become ripe by September. The spawning seems to prolong till November. The gonads as in *P.erumei* have different batches of eggs in ovaries. The counts of mature eggs in eight females ranged from 8000 – 12000 (mean 9500).

P. erumei attains maturity at 35 cm total length and spawns before the southwest monsoon. Fecundity is high (mean 22000). The gonads contain different batches of eggs suggesting multiple batch of spawning in a single season. (Hussain, 1990).

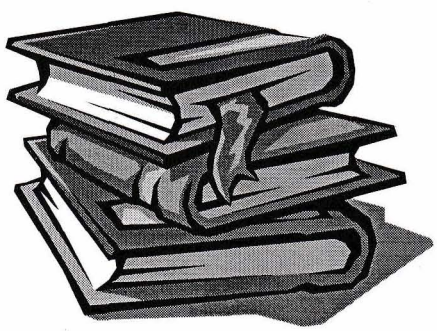
Fecundity studies on eleven ovaries of *C.macrolepidotus* showed the increase in eggs as the length of fish increases – from 25,663 in fish of size 203 mm to 3,17,577 in a fish of length 334 mm. Size at first maturity was seen to be about 191 mm. (Ramanathan et al., 1977)

LARVAL STAGES, METRAMORPHOSIS AND EARLY GROWTH.

Only few accounts of the eggs and larvae of Indian flatfishes have been published. The free eggs of the Malabar sole *C. semifasciatus* are pelagic, spherical, and transparent and have an average diameter of 0.65 mm in the living condition. (Bensam). Seshappa and Bhimachar (1955) has worked on the larval stages and studied the metamorphosis of the larval stages. Young asymmetrical individuals that were metamorphosed were reared in the laboratory. It was noticed that the shifting of the eye invariably took place at night. The first sign of approaching metamorphosis is the further development of the rostral projection into a prominent beak like structure called the rostral hook. This projects inwards and downwards enclosing a small space between itself and the interorbital region of the head where a slight depression is developed. Once the fusion of the beak is complete, the eye shifts.

BEHAVIOURAL PATEERN

The majority of flatfish species spawn eggs that are plank tonic and there seems to be little evidence that these eggs show some behaviour that results in their distribution. Their distribution is therefore wholly based on hydrodynamic forces. Immediately after hatching the larvae have limited powers of locomotion, which increase as they grow. Ryland (1964) described a movement of larval plaice towards the surface during the day. Diel vertical migrations have also been described in the larvae of *Platicthys flesus* and *Limanda limanda*. In the North Sea. (Campos 1996) Following metamorphosis, many flatfish species spend at least the first six months of their life in the coastal nursery grounds (Gibson.1997). The major changes in the adults phase are caused by movement to and from the spawning grounds.



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