

PERSPECTIVES IN LIFE SCIENCES



Editor: Dr. M.V. Sudhakaran



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SCIENCE

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STUDIES ON THE BIOLOGY OF *EPINEPHELUS DIACANTHUS* FROM THE SOUTH WEST COAST OF INDIA

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Introduction

In the recent years culture of fishes and shell fishes in coastal waters has been given priority in the context of augmenting fish production, creating employment opportunities and improvement of rural economy. The coastal marine fishery resource of the country is stagnating in the last few years, in spite of the increased fishing pressure new technological innovations in the harvesting sector and industrialization. In this circumstance, to increase fish production, it is imperative to culture food fishes and shell fishes either in the brackish water environments or in the coastal marine habitats. Among cultivable marine fishes, rock cods are (Kalava) promising candidates for mariculture. During the last few years culturing of carnivorous fishes gained considerable importance and popularity in Honking, Singapore, Thailand and Malaysia. The stagnating or slow rate of growth in the annual production of Indian rock cods on the one side and rising demand in export markets on the other is a real impetus to find ways and means for their viable mariculture practice in the vast stretches of suitable coastal habitats along the Indian coast. In order to achieve the maximum production from well managed culture system it is essential to have a deep knowledge on the biology, behaviour and physiological requirements of the species cultured. The present work attempts to bring out important aspects such as age and growth, food and feeding, reproductive biology, racial studies and parasites of *E. diacanthus*.

Epinephelus is a demersal denizen of tropical areas ranging from shallow coastal waters to moderate depths, rarely occurring beyond 200m. Some *Epinephelids* prefer sea grass beds and mud or sandy bottom, while some others prefer coral and rocky grounds so they are also known as rock cods. Except for breeding aggregations, most of them are solitary. All are predators on fishes and invertebrates, sometimes including crabs and spiny lobsters. Most are either synchronous or transforming hermaphrodites that begin life as females and later as males; a few have separate sexes. They are caught in traps, on hook and lines, or on long lines and those inhabiting soft bottom are caught in bottom trawls. They are excellent food fishes sought in commercial fisheries for domestic consumption and export markets.

The genus *Epinephelus* have representatives in the Indo-Pacific fauna (Smith, 1961). *E. diacanthus* occurs in the depths of 2 to 50m in the Gulf of Oman and coasts of Pakistan, India and Srilanka. It occurs over a wide range of depths (4 to 280m) and habitats generally associated with coral reefs. Rock cods, Groupers, Kalava and perches are different names attributed to *Epinephelus*.

Perches are most important demersal fishes in the exploratory fishing grounds that foretell large developmental potential. They are abundant in the rock bound coral areas in the south west, south east and Gulf of Mannar region. John (1948), Chacko and Sheriff (1949) Gopinath (1954) and Menon and Joseph (1954) were discussed about the Kalava fishing grounds in the coasts of Kerala.

Methodology

Epinephelus diacanthus was collected from west coast of India. Total length, standard length and weight were taken then and there itself. Materials for age and growth included skeletal hard parts such as otoliths, scales and vertebrae. They were taken from the fish and kept in glycerine. The Lee method (Carlander, 1981) of back calculating body length from prior annuli was used. Analysis of gut contents were carried out qualitatively by identifying the organisms in the gut to the nearest taxon

possible and quantitatively by volumetric method (Hynes, 1950 and Natarajan and Jhingran, 1961).

Gonads were removed and weighed. Small piece of gonad was cut and sexed microscopically using Acetocarmine squash method (Guerrero, 1974). The remaining portion was kept in Bouin's fixative for histological examination. For racial studies *E. diacanthus* were collected from Kochi and Kozhikode, these two places belong to south west coast of India. Twenty four general morphometric were made on the lines described by Holden and Raitt (1974) and Eknath *et al.*, (1991). The external parasites obtained from the fish were removed and kept in 5% formalin for identification. Internal parasites obtained were preserved in 70% ethyl alcohol, passed through alcohol series, stained in Borax carmine and mounted in DPX for identification. The parasites were identified up to generic / specific level whenever possible.

Results and Discussion

Age and growth:

The mean back calculated lengths for the first eight years of life of *E. diacanthus* using otoliths were 92, 135, 176, 206, 244, 278, 310 and 339 mm respectively. The mean back calculated lengths for the first eight years of life of *E. diacanthus* using scales were 93, 131, 168, 210, 246, 278, 310 and 328 mm respectively. The mean back calculated lengths for the first eight years of life of *E. diacanthus* using vertebrae were 96, 137, 172, 204, 238, 270, 286, and 313 mm respectively. In *E. diacanthus* the marginal increment analysis using otoliths showed that marginal increment occurs from March through July, coinciding with the onset of reproductive activity. These studies satisfied the criteria established by Van Oosten (1924). The criteria that must be met before check marks on scales or bones can be considered annuli are, 1) Scales or bones must remain constant in number and identity throughout the life of the fish. 2) Growth of the scale or bone must be proportional to the overall growth of the fish.

3) Growth check marks must be formed at approximately same time of the year and 4) Back-calculated lengths should agree with empirical lengths of younger age groups.

Food and feeding:

Epinephelus showed preference for crustacean and fish diet. The crustaceans include crabs, prawns, and hermit crabs. Among fishes *Stolephorus* and *Nemipterus* sp. were common. Cynoglossids, platycephalids, leognathids, carangids and lacterids were also met within frequently. The molluscs observed were *Umbonium* sp, *Nassarium* sp and *Pelecypoda* sp. Smaller fishes were found to be bottom feeders, while larger ones were column feeders. Smaller fishes have shown preference for crustacean diet while larger fishes for piscivorous diet. There were no sex wise difference in the food and feeding habits of *E. diacanthus*.

Reproductive biology:

Epinephelus is well known for its protogynous hermaphroditism, a condition in which the female show a tendency to change its sex to become male. Histological studies were conducted to study the oogenesis and spermatogenesis. Oogenesis is described in different stages like, Primary stage—in which the oocyte diameter is from 5 to 17 microns, Stage I-early oocyte, the ova diameter from 17 to 50 microns, Stage II-resting or pre-vitellogenic stage, ova diameter from 50-90 microns, Stage III-early vitellogenic oocytes, the ova diameter ranges from 90-200 microns Stage IV-vitellogenic oocytes, ova diameter from 200 to 520 microns and Stage V-egg stage (Moe, 1969).

Atretic bodies are formed from the remnants of yolk globules and yolk vesicles. The yolk vesicles tend to remain in situ after the yolk globules have dispersed in the lamella and undifferentiated ooplasm has been resorbed. Spermatogenesis: Takes place in five different stages like, Spermatogonia, Primary spermatocytes, Secondary spermatocytes, Spermatids and Spermatozoa.

The seasonal and ontogenic changes of gonad development is described in ten classes, which form the basis for seasonal analysis of sex distribution and spawning. In female, class I is immature and classes 2, 3 and 4 are seasonal. Class 5 and 6 respectively are transitional and immature male and classes 7, 8, 9 and 10 are seasonal classes in the mature male. Males are broadly divided as early males (primary males) and old males (secondary males) based on the presence or absence of early oocytes in the matrix of the testicular tissue.

The ova diameter frequency polygons of stages I-V were used to study the growth of the ova through different stages and also to determine the spawning frequency. *Epinephelus* spawns only once a year during March-July period. To explain the degree of ripeness of ovary, gonosomatic index was used. GSI was very low for immature females, while it was high for mature active (stage IV) females.

Composition of sex in different length groups were studied. The smaller size group fishes show higher distribution of females. The distribution of females is more till 270 mm SL. The percentage of females decrease as the length increases. The percentage of males increase with increase in size. Although sexual transition may occur at any length over 150 mm SL, most of the transition take place between 230 mm and 310 mm SL. Females were more in the lower size groups of 151-350 mm SL and males were more in higher length groups. Transitionals were seen from 231-330 mm SL. In *Epinephelus diacanthus*, the overall sex ratio between males and females were found to be 1:1.78. Average fecundity was 57,458.00. The lowest fecundity was 78,300.0 and the highest 1, 65,048.0. The relationship between fecundity and total length, standard length, ovary weight and relationship between ovary weight and total weight were also worked out. The various relationships were found to be linear.

Age studies have shown that mature active males were observed from the age 2 to 11, mature active females were encountered only in the age groups 3 and 4. Both male and female mature at the same time. Transitionals were seen from age 2 onwards to till 8. So it is assumed that a female can change sex before it attains maturity. The data on primary males

and secondary males show that there were less number of primary males and most of the males were derived from the females after sex reversal.

Racial studies:

The results of the morphometric studies revealed that the fishes collected from Kochi and Kozhikode belonged to two distinct population. This was further emphasized by Truss morphometric studies (Eknath, 1991) and were also tried to detect the subtle difference in variations of shape independent of size. For this 21 landmark points were selected and the characters were identified. Their mean variance, standard deviation and standard error were also found out. From 21 characters 10 important ones were selected for the principal component analysis and found that those characters were statistically significant. This study also revealed that the fish stocks of Kochi and Kozhikode belonged to heterogenous populations.

Parasites:

E. diacanthus was found to be infested with the external parasite *Lernaenicus sp.* often seen attached to body. The head of which is embedded in the body muscle and the black body and two greenish ovarian sacs were visible outside. (1934) described *L. ramosus* from *E. morrhua* caught in Ceylon waters. Other parasites include *Sagumepinepheli*, an anthostomatid was also seen attached to the gill region. Wilson (1913) reported the occurrence of *Sagum* species from *E. adscensionis* from Jamaica. A copepod parasite *Sarcotaces arcticus* was also reported from the trunk musculature of *E. diacanthus*. This is the first report from the Indian waters. The metacercariae of *Stephanostomum sp.* were often observed in the inner lining of swim bladder of *E. diacanthus*. Unidentified nematode worms were common in the viscera and gonads in all the three fish species.

Epinephelus diacanthus is a good candidate species for aquaculture operations in the Indian coastal areas. From age and growth studies it was found that annulus formation often coincided with the onset of reproductive activity. The spawning and associated physiological processes

seemed to be the primary cause of annulus formation. The food analysis of the fish revealed its preference for crustacean and fish diet. The fish is basically a protogynous hermaphrodite. Transitional males were observed during the study period. Ova diameter studies showed that the fish spawns only once a year and April-May formed the peak spawning season. The fish stock from the south west coast of India are from two independent population. The presence of parasites on fish indicate the demersal nature of the *E. diacanthus*.

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