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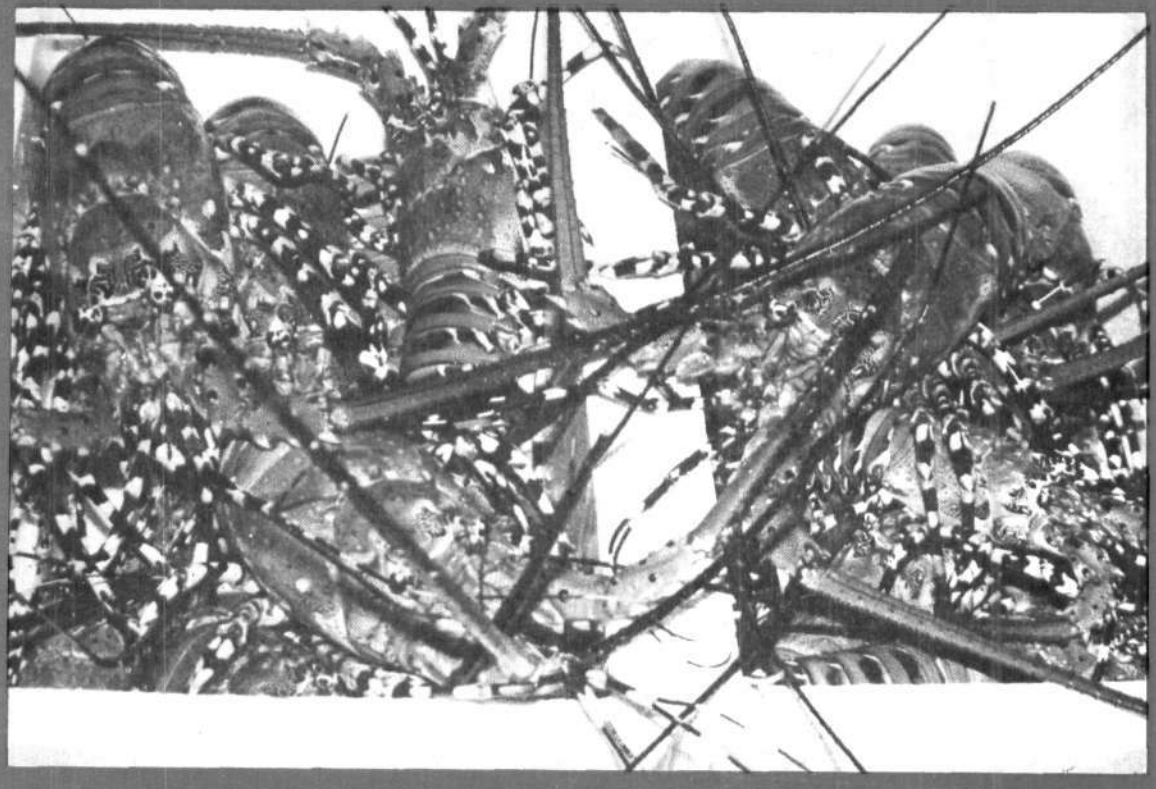

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INDIAN COUNCIL OF AGRICULTURAL RESEARCH

PROSPECTS OF FARMING "GROUPERS" IN INDIA

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Introduction

The "Groupers" belonging to the genus *Epinephelus* (Family *Serranidae* or *Epinephelidae*) are large-sized marine food fishes, many species reaching 25-100 cm in length and some species attaining more than 10 kg in weight. About 40 species of this genus have been reported from the seas around India, most of them are demersal, distributed in the tropical and subtropical areas, ranging from shallow coastal waters to moderate depths, but rarely occurring beyond 200 m. Most of the species inhabit coral reefs and rocky habitats, while some show a preference for seagrass beds as well as muddy and sandy bottom. Juveniles of some species are commonly found in the lower reaches of estuaries, sometime ascending to upper reaches also. Most species are solitary and all are predators on fishes and invertebrates including crabs and lobsters. Usually the groupers are hermaphrodites at the same time or in the younger stages they are females but transform as males in older stages. Many of them are excellent food fishes; and hence have assumed importance for commercial culture in recent years, especially in Indo-Pacific, Middle-East and Carribean regions.

Present status of culture

Groupers are usually cultured in floating net cages in the sea. Perhaps, the earliest attempt of a grouper culture has begun in Malaysia, Thailand, Singapore and Hong Kong in the mid seventies, when *Epinephelus tauvina* (Forksal) and *E. malabaricus* (Schneider) were cultured along with seabass, the rabbitfish, etc. The venture, although small in scale, has spread to Philippines also, where six species, including *E. malabaricus*, *E. tauvina*, *E. sexfasciatus* and *E. bleekeri* are cultured at present (Kohno *et al.*, 1988). In Taiwan, *E. suillus* and *E. amblycephalus* and in Hong Kong, the Red grouper *E. akaar* are also cultured; while in Kuwait and India *E. tauvina* has been cultured experimentally. The recent annual production of Groupers from these ventures are:- Thailand 450 t; Hong Kong: 365 t; Singapore: 153 t and Malaysia: 143 t.

Collection of seeds

Until recently the majority of the culturists had to depend only upon natural seed resources although induced breeding could be achieved in a few species of groupers. In Malaysia, the seeds of *E. tauvina* are collected from September to January period by using seine nets in the coastal waters. The young fish caught are transported by keeping them in a compartment made in the lower part of a rowing boat. Two small holes are provided on each side of the compartment to facilitate exchange of sea water in and out of the compartment. Alternatively, a triangular net cage made of wooden pieces and fine nylon netting towed through the water is also used for trasporting the seeds from the site of collection to that of culture. The seeds are collected by small-scale fishermen by using hooks and line, bamboo traps and dip nets. The fingerlings vary from 2 to 3 cm to more than 10 cm in total length. The seeds are sold either directly to the culturists or to the seed dealers. The latter own small nursery ponds or cages in which the fingerlings are stocked, before selling to the culturists. The designs of the nursery ponds and cages are almost the same as the production units, but smaller in dimensions. In India it has been reported that juveniles of 13-25 cm are caught from the wild by drag nets and traps.

Induced breeding and seed production

Most Groupers are hermaphrodites, the fish maturing at first as a female, but becoming a male with advacing age and size. In the case of *E. tauvina*, the fish of 45-50 cm in length mature as females while fish more than 74 cm and weighing 11 kg become males having ripe testes. In specimens of 66-72 cm length, transitional gonads contain male and female tissues. Mature spawners of *E. tauvina* caught from the wild have spawned in captivity in Kuwait. Sex reversal and induced spawing of the same species have been achieved in Singapore. Successful rearing of fingerlings to more than 3 cm in length was achieved in Kuwait. In Taiwan, advanced sex reversal at an earlier age and size has been

achieved through oral administration of male sex hormone androgen. In Singapore, induced breeding of 3 year old females and sex-reversal to males have been achieved by injecting human chorionic gonadotropin (HCG) and pituitory gland extract from Chum salmon or White snapper. Ovulation was achieved by a single injecion of 5,000 I U of HCG. By oral administration of alpha methyl testosterone over a period of 2 months, 2-3 year old fish were made to yield milt. In Taiwan, the males of *E. malabaricus* were injected with HCG for stripping and the females were induced to ovulate by hypohysation. Of about 0.2 million eggs spawned there, 78% were fertilised and 69% hatched with an ultimate survival of 38,400 fry. The fertilised eggs of *E. tauvina* were hatched in tanks within 23-25 hours at a temperature of 27°C in Singapore. It is reported that induced spawning of *E. tauvina* can be carried out throughout the year, depending upon the stage of gonadial development.

The 96 hours old postlarvae of *E. malabaricus* in Taiwan were fed with oyster trochophore larvae and later with rotifers, cepepods, nauplii of *Artemia*, eel feed and frozen mysids. In about a month's time, the postlarvae reach a length about 1 to 1.5 cm; and in 3 month's time these reach about 8 cm, with an average survival of 14%. The larvae of *E. tauvina* in Singapore metamorphos into juveniles of about 2.5 cm length in about a month; and by fiftieth day they measure 7 cm. The Red grouper *E. akaar* has also been induced to spawn in Hong Kong.

Nursery rearing

The early fingerlings are first stocked either in a small nursery ponds as in Taiwan or in small floating nursery net cages as in Malaysia and Singapore. In Taiwan, the nursery ponds are made up of concrete, about 100 m^2 in area and 1 m depth. Fingerlings of 5-8 cm are stocked at a rate of 100/m^2 and fed on a diet of the frozen fish *Gambusia*. These fingerlings grow to 9-12 cm in 2-4 weeks, with upto 90% survival, when they are ready for stocking in production ponds or cages.

Floating nursery net cages called "Hapa" are about 1-2 m long, 1-2 m wide and 1-2 m in depth with mesh size of about 1.5 to 2.5 cm. The cages are made up of polyethylene netting supported by a wooden frame work. These are kept afloat with metal or plastic drums, anchored with concrete blocks and are stocked with 200-600 numbers of fry or fingerlings. In the first few days they are fed with mysids and small shrimps and in the first few weeks with minced trash fish or small shrimps. Gradually, the above food may be replaced by minced trash fish, fish meal, chicken feed, vitamins, minerals, and wheat flour as the binder, at about 10% of body weight. When the fingerlings reach 15-20 cm in total length, they are ready for transfer to production ponds or cages.

Growing for marketing

(a) *Pond culture*

The culture ponds in Taiwan are situated in the intertidal zone receiving tidal flushing or in ponds on land. The production ponds vary from 0.2 to 0.3 ha in area; and have vertical concrete dikes to hold a height of about 1.5 m of water and about 0.5 m of free board. For every hectare of water surface, eight aerators are provided. A continuous flow of good, crystal clear water supply is maintained, with a salinity of 33‰ and temperature of 16-32°C. If filamentous green algae grow in the ponds, these are removed regularly. Also, a pipe system is provided in Taiwan, for daily removal of debris and excerta accumulating at the bottom. The ponds are stocked with 9-12 cm long fingerlings at a density of upto 40,000/ha. Feeding with fresh trashfish is done twice a day at a certain spot and at 8% of the body weight. Under optimum management conditions, the fingerlings grow to 30 cm long and 600-800 g weight in the next 8 months with a survival of 80-90% and yield of more than 20 t/ha.

(b) *Net cage culture*

Intensive net cage culture is being carried out in Singapore, Malaysia and few neighbouring countries, in floating and fixed cages. Sheltered areas, protected from strong wind and waves, such as estauries, lagoons etc, are the best localities for net cages, with a total depth of about 3 to 5 m; shallower for fixed cages and deeper for the floating ones. The water temperature for farming should range from about 27 to 31°C; dissolved oxygen content at 5 ml/l or more; salinity between 26-31‰; pH 7.8-8.3; and Chemical Oxygen Demand at 3 mg/l or less. Areas of excessive phytoplankton growth have to be avoided as also areas of heavy growth of fouling organisms. Also, the farming area should be accessible from the shore.

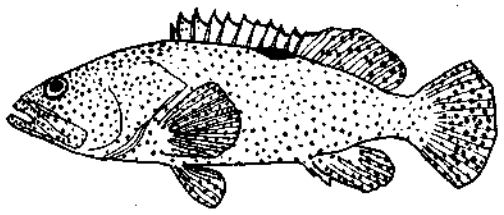
The floating net cages are made of wooden logs of 7 m length (L), 0.01 m width (W) and 0.07 m height (H) fastened by suitable bolts, nuts, nails, washers and brackets. The raft system is floated by the required number of plastic drums, each of 200 l capacity. The net cages area made of synthetic fibres like polyamide (PA) and plyethylene (PE) and are either rectangular or square in shape. The production cages have a mesh size of 2.5 - 5.0 cm, for growing the fish to a market size of 50 - 75 cm. The raft system is anchored suitably with concrete blocks, in order to make it suitable. Fixed net cages are also similar to the above; but the horizontal frames are fixed up with a vertical prop in shallower areas.

Fingerlings of 12-15 cm are stocked in production cages at a rate of 40-50/m^2; and are fed with trash fish (goat fish, jew fish, etc) chopped to a size of about 1.5-2.5 cm size. Feeding is done once or twice a day at a rate of 3-5% of the body weight. The feed conversion ratio is 4.5:1.

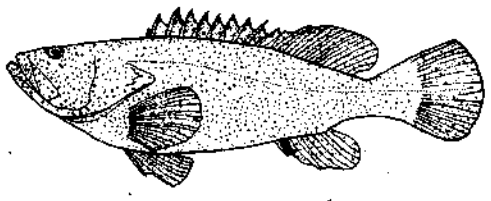
The groupers grow fast, putting on a weight of 80-100 g/month and attain a market size of 600-800 g in about 6-8 months, from an initial weight of 80-100 g. In less saline conditions of 10-25‰, the growth rate is more than the above. Regular changing of the nets to eradicate fouling organisms would ensure good exchange of water in net cages. Proper management procedures such as feeding, minimising handling stress while changing nets, control and treatment of diseases, etc, would go a long way in reducing the mortality of the stocked material and enhacing production.

Protozoan pathogens like *Cryptocaryon irritans* cause the loss of scales and skin in groupers, especially in the head region. The diseased fish may be kept in formalin of about 200 ppm strength for half to one hour for treatment, depending upon the endurance of the fish. Vibriosis is another disease, marked by inflamation and haemorrhage of the body. This is treated by feeding the fish with a variety of antibiotics such as Oxytetracycline and Sulphanomides, mixed with the diet.

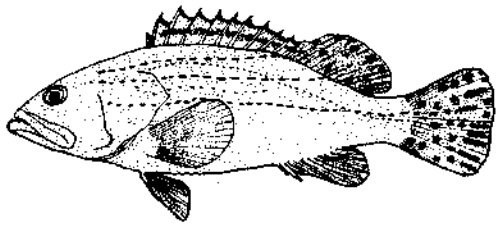
Based on the estimate of 600 g weight for the fish at harvest, a net cage of 5x5x3 m dimension would yield 600 kg of fish in about 6-7 months; and from an area of about 5,000 m^2 water space, an annual yield 76.8 t/ha has been obtained in Singapore.



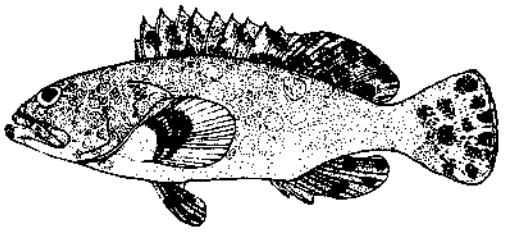
Epinephelus tauvina



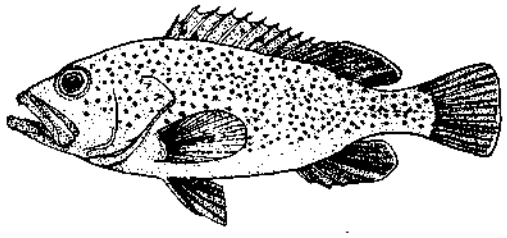
Epinephelus malabaricus



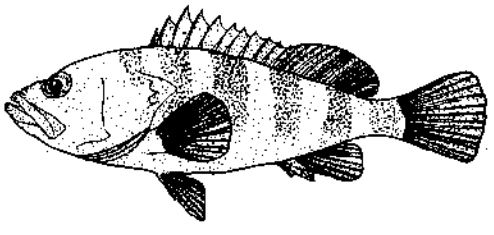
Epinephelus latifaciatus



Epinephelus faveatus



Epinephelus albomarginatus



Epinephelus diacanthus

Prospects in India

In India, both the grouper species viz. *E. tauvina* and *E. malabaricus* which are cultured on a large scale in neighbouring countries are available, besides such as; *E. blekeri* and *E. faveatus* which inhabit coral reefs, seagrass beds, silty sand areas etc. At present in this country, the marine finfish receiving priority attention for culture and breeding is the seabases, *Lates calcarifer*. Since the groupers are all equally valuable and as some species could be artificially induced to breed and succesfully cultured as in Malaysia, Singapore, Philippines etc. it is high time that in India also the groupers are brought into the list of priority species for breeding and culture.

It may not be out of place in this connection to point out that an experimental work on the culture of *E. tauvina* was carried out sometime back at the Central Marine Fisheries Research Institute at Mandapam (Hamsa and Kasim, 1992, *J. mar. biol. Ass. India*, **34** : 271-277). In a 5x5x2 m fixed net cage culture, it is reported that a net income of Rs. 2,193/- can be realised, for a period of 11 months. Although this experiment is not comparable to the practices in Malaysia and Singapore, it gives some indication on the possibility of developing grouper culture on a viable basis in India also. Hence, it is felt that breeding and culture of the groupers are included in the priority areas of Research Institutes as well as developmental agencies such as the Marine Products Export Development Authority (MPEDA).

At present, little is known on the breeding biology of even the important species of groupers in India. Hence, it is an essential prerequisite to take up a research project on the reproductive biology of atleast *E. tauvina* and *E. malabaricus* in centres where these species are commonly available.

The present state of our knowledge on the natural seed resources of Groupers in general and the more important species in particular is scanty. In view of the potential culture value of the species in our waters, it is essential to take up a detailed project on the survey of seed resources of these species at the earliest. With the knowledge already available on the characteristic features of the early developmental stages of the Groupers from other Asian countries, it should be possible to identify the early developmental stages of these species in India also, for an sassesment of the seed resources in space and time, in the natural state. In countries like Singapore, there is a good demand for the seeds of groupers. If it will be possible to locate seed collection centres in India, export of the seeds to such countries can be undertaken.

Another area which should be given priority attention is the induced breeding of Groupers, atleast for *E. tauvina* and *E. malabaricus*, to begin with. Induced breeding of these species has already been achieved in Malaysia, Singapore, Kuwait etc. With knowledge on the technique already available, it should be possible to develop induced breeding of these species in India also.

For both breeding and culture of the candidate species, the essential prerequisite is to select a few suitable centres and sites, such as bays, lagoons, etc. where the waters are unpolluted, calm, deep, with enough tidal amplitude, etc. for establishing net cage culture farms and hatcheries. In order to make the operations economically viable throughout, the areas should also be free from strong winds, tidal conditions, etc. Also facilities may be built up to study and treat diseases of culture stocks. Work on survey and selection of such areas may be taken up at an early date.

Although the techniques of culturing microalgae and rotifers are developed in Central Marine Fisheries Research Institute, it is necessary to develop a proper balanced diet acceptable to various growth stages of the candidate species. Some amount of basic research is essential to formulate pelletted feed and to manufacture it on a large scale for feeding in grow-out structures. This aspect may be taken up as a research project.

After achieving a continuous supply of seed and experiment culture in selected areas for working out the cost of cultivation and economic viability of the project in relation to the enviornmental conditions prevailing in the localities, large-scale commercial culture may be attempted.