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Grouper reproductive biology and larval rearing

Reproductive biology

• Groupers are protogynous hermaphrodites, i.e., females transform into mares when they grow larger and older. The age and/or size at sex inversion so far reported are as follows: *Epinephelus akaara,* 4-5 years and 0.5-1 kg in body weight; *E. diacanthus,* 2-6 years and 70-200 g; *E. tauvina,* 7-11 kg; E. *mario,* 2-4 years and 1 -8 kg.

• Results of (1) induced sex inversion by oral administration of methyltestosterone (MT) for several consecutive months and/or (2) induced spawning by giving several intramuscular injection of human chorionic gonadotropin with or without salmon pituitary extract have been reported for *E. tauvina, E. akaara, E. fario,* and *E. malabaricus* or *E. suillus.* Induced sex inversion by intramuscular injection of MT is possible for *E. suillus.* However, fertilization rates in these experiments were variable and generally low.

• Spontaneous spawning was recorded as early as 1965 for *E. akaara.* Since then, this species has been made to spawn naturally at many fisheries stations in Japan, though the conditions to obtain quality eggs are still to be investigated.

Records of natural spawnings of other grouper species were very few until recent years and known only for *E. tauvina* at the Kuwait Institute for Scientific Research, Kuwait. Since mid-1980's, natural spawnings other than *E. akaara* have been reported for the following species: in Southeast Asia, *E. malabaricus* at the National Institute of Coastal Aquaculture, Thailand; *E. fuscoguttatus* at the Bojonegara Reseach Station for Coastal Aquaculture, Indonesia, and at the Marine Aquaculture Research Station, Singapore; and *E. suillus* at SEAFDEC, Philippines; in Japan, *E. fasciatus, E. salmoides, E. moara, E. microdon,* and *Plectropomus leopardus.*

• Spawning seasons of groupers in Asian waters are estimated to be as follows:

E. tauvina - around Aug in Singapore
E. diacanthus - Apr to May in Taiwan
E. akaara - June to Sept in Japan
Apr to June in Hongkong
E. malabaricus- Sept to Nov in Thailand
E. microdon - May to Sept in Japan
E. *salmoides* - Apr to June in Japan

Larval rearing

• Newly hatched larvae are inactive, passively flowing with the current created by aeration. They drift in the water with their heads down for 1 -2 days after hatching and, if aeration is stopped, they tend to sink to rest on the bottom and float up again.

Grouper larvae undergo morphological transformation, characterized by elongation of dorsal and pelvic fin spines from 10 to 40 days after hatching.

• The larvae of *E. malabaricus,* until 2 wk after hatching, produce mucus all over their bodies. So, they are very adhesive to one another when they group together by phototaxis. Sudden mortality was sometimes observed due to suffocation in the group.

Some researchers adjust aeration at a low level, less than 10 ml/min, to minimize physical shock to the larvae of *E. akaara* reared in 1-ton tanks. On the Other hand, others recommend stronger aeration at 200 ml/min for *E. tauvina* larvae reared in 0.5-t tanks to ensure even distribution of the larvae.

• The mouth of grouper larvae is so small that rotifers are possibly too large for their initial feeding. Several kinds of small food organisms, such as fertilized eggs and larvae (trochophores) of oysters, screened small rotifers, nauplii of copepods, and diatoms have been tested as initial larval feeds for *E. akaara.* However, larval rearing using these organisms has not yet resulted in remarkably successful larval survival. Several researchers have observed that larvae feed well on rotifers when tank is provided with green water.

• Researchers also reported the "point of no return" for *E. akaara* larvae as 9 h after the opening of the mouth. This period is very short compared to red seabream (2 days), yellowtail (1 day), etc. They obtained fairly good survival

during this period by applying illumination at night to accelerate initial feeding.

• Researchers also reported that, in *E. tauvina* larvae, the survival and growth of larvae reared in salinities between 25-39 ppt were not significantly different at the early larval stage, but those parameters were higher at a constant salinity of 25 ppt at more advanced larval stages. Best survival and growth were observed at 27-29°C for larvae from hatching to the 12th day and at 30-31°C for 19- to 33-day-old larvae.

• The larvae of *E. tauvina* were observed to die after they gorged themselves with *Artemia* nauplii. *Artemia* may be detrimental if consumed in large quantities.

• When larvae become juveniles, they show cannibalistic behavior.

• Due to the difficulties in larval rearing explained above, coupled with the difficulty in obtaining quality eggs, the survival of grouper larvae and juveniles so far reported was generally very low, the rate being < 10% on day 7 and 1% on day 50-60, even in rearing trials which were reported to be successful.

In 1989, remarkable results have been reported on survival rate and quantity of larvae produced. The Tamano Station of the Japan Sea-Farming Association produced about 400 000 juveniles of *E. akaara* in 60-t tanks with an average survival rate of 34.1% from day 1.

Source: Masanori Doi, Munir bin Hj. Mohd Nawi, Nik Razali bin Nik Lah, and Zulkifli bin Talib. *Artificial propagation of the grouper, Epinephelus suillus at the marine finfish hatchery in Tangong Demong, Terengganu, Malaysia.* Dep't of Fisheries,
Ministry of Agriculture, Malaysia 50628. Jan 1991.

Asian markets for reef fish

Reef fish comprise a variety of species such as grouper, snapper, bream, rock cod, and coral cod. Although able to command high prices in international markets, they are presently underutilized in many parts of the world. The four major markets for reef fish worldwide are Japan, Singapore, Hong Kong, and USA. Two important Asian markets, Singapore and Hong Kong, are described.

Singapore

With a population of only 2.6 million and a per capita fish consumption of 36 kg, Singapore by itself does not constitute a significant market for fishery products. Its importance lies in the fact that it serves as an export market for fishery products from Southeast Asian countries and also as a transshipment base for these products both within and outside the region.

From Jan to July 1988, Singapore imported 18 118 t of fresh/chilled marine fish and 10 8611 of frozen marine fish. Fresh/chilled fish are mainly imported from Malaysia and Thailand to augment local supplies as consumption of whole fresh fish is the most popular form of utilization in Singapore. Although import statistics are not classified by species, it can be safely said that a substantial portion of the imports constituted reef fish such as grouper, snapper, rock cod, coral cod, and seabream. Grouper and red snapper are two popular high value fish in this market. Red snapper sells at a wholesale price of about S$2.60 (approximately US$1.34) per kg while rock cod and coral cod are being sold at S$13.00/kg (approximately US$6.70/kg) and S$9.50/kg (approximately US$4.65/kg), respectively.

Imports are mostly delivered directly to the Jurong Market which was established in 1969 to facilitate the importation of fresh fish to