Epinephelus coioides (Hamilton, 1822)

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IDENTIFICATION

Order	:	**Perciformes**
Family	:	**Serranidae**
Common/FAO Name (English)	:	**Orange-spotted grouper**

Local Names: Hekaru, Gobra **(Marathi)**; Gobri, Wekhanu **(Konkani)**; Gopra, Muni meenu **(Kannada)**; Kalawa **(Malayalam)**; Kalava **(Tamil)**; Ratibonta, Bontha, Kodi punju **(Telugu)**; Bhala **(Oriya)**

MORPHOLOGICAL DESCRIPTION

Light greyish-brown dorsally, shading to whitish on sides and ventrally, with numerous small brownish orange or reddish brown spots on head and body and median fins; 5 slightly diagonal greyish brown bars on head and body which bifurcate ventrally, the first 4 extending basally into dorsal fin; brownish orange spots on body tend to be arranged in rows parallel to dark bars, this more evident on smaller than larger fish; large dark greyish brown blotches usually present on head, the most prominent behind the eyes and on opercle; fins whitish to light dusky with brownish orange to brown spots except distally on spinous portion of dorsal, caudal and pectoral fins. Small individuals of this species closely resemble *E. tauvina* and *E. malabaricus,* but have orange spots and lack hexagonal spots on the fins; body scales ctenoid except for nape, back, thorax, abdomen and above anal fin base with

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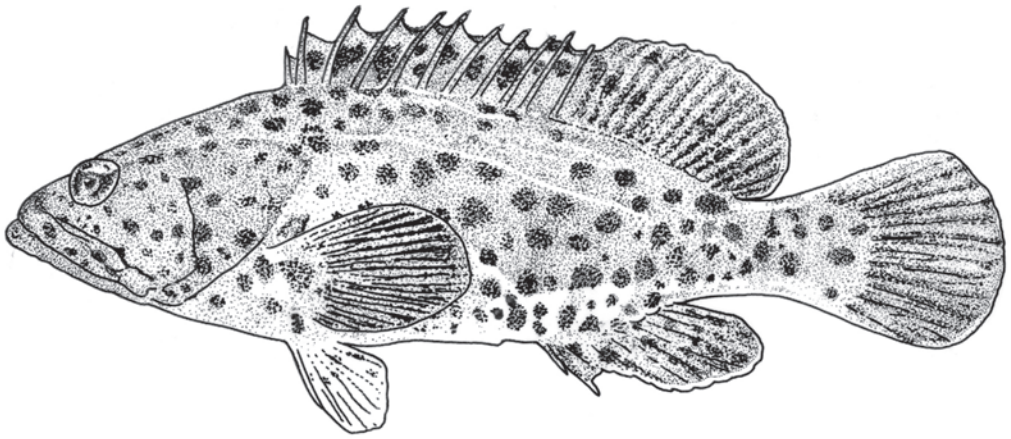


cycloid scales, teeth on midside of lower jaw in 2 rows; nostrils subequal; serrae at corner of pre-opercle moderately enlarged; maximum depth of body 2.9-3.7 in SL; rounded caudal fin; short pelvic fins, 1.9-2.7 in head length; fourth dorsal spine usually longest; membranes of spinous portion of dorsal fin incised; pelvic fins not reaching anus. Dorsal spines (total): 11; Dorsal soft rays (total): 13-16; Anal spines: 3; Anal soft rays: 8; lateral-line scales 58-65; anterior lateral-line scales of adults branched; longitudinal scale series 100-118; gill rakers 8-10 + 14-17; pyloric caeca about 50 in total.

PROFILE

GEOGRAPHICAL DISTRIBUTION

Orange- spotted grouper occurs in the western Indian Ocean from the southern Red Sea to Durban (South Africa) and east to the western Pacific where it is distributed from Ryukyu Islands (Japan) to New South Wales. It ranges east into Oceania only to Palau in the Northern Hemisphere and Fiji in the Southern. It has also migrated through the Suez Canal to the eastern Mediterranean. In India, this species is distributed all along the Indian coast from Gujarat to West Bengal including Andaman and Nicobar Island.

HABITAT AND BIOLOGY

Epinephelus coioides inhabit wide range of habitats including shallow reefs, lagoons, brackish water, over mud and rubble in depth to at least 30 m. Juveniles are commonly reported in the shallow waters of estuaries over sand, mud and gravel and among mangroves. *E. coioides* are eurythermal and euryhaline. It feeds mainly on fish followed by crabs, shrimps, squids, gastropods and bivalves.

Epinephelus coioides is a diandric protogynous species, where males are either derived from a

juvenile phase or the transition of post spawning females. Females mature at 320 mm total length(TL) at an age of 2 years, whereas primary males mature at 242 mm TL at an age of 1 year. The sexual transition occurs at a TL of 550-750 mm at the age of 5-6 years. The major spawning period is March to June. In the southern Persian Gulf, spawning has been documented from March to May. In New Caledonia, spawning aggregations form in late October to early December. They probably spawn during restricted periods and form aggregations for spawning after the full and new moon. Fecundity estimates varied from 8,50,186 ova in a 350 mm TL fish to 29,04,912 ova for 620 mm TL. Eggs and early larvae are pelagic.

PRODUCTION SYSTEMS

BREEDING IN CAPTIVE CONDITIONS

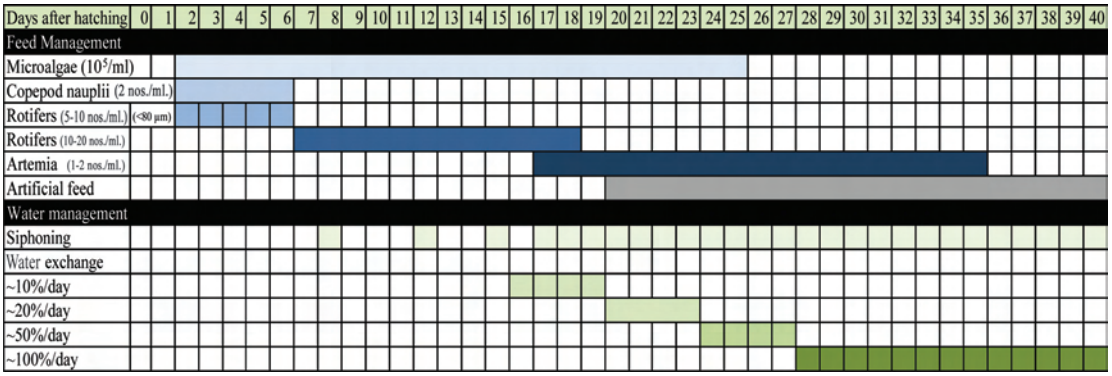
Usually brooders of *Epinephelus coioides* are collected from wild and reared in cages or tanks @ 1 kg/m^3 using sea water at a constant temperature of 27-29 °C and salinity 30-32 g/l. The fishes were either reared for a longer time (1-7 years) or were treated with hormonal manipulation for obtaining the male brooders. The fishes were fed with squid, sardine and clam @ 3-5 % body weight.

Fishes either spawned naturally or were induced to spawn with the help of human chorionic gonadotropin (hCG). At Visakhapatnam Regional Centre of ICAR-Central Marine Fisheries Research Institute, India, broodstock development was carried out in re-circulatory aquaculture system(RAS). The brooders spawned naturally in tank.

LARVAL REARING

Eggs were collected from spawning tank and were stocked in aquarium tank for segregating the floating eggs from the dead eggs. The floating eggs were collected and stocked at 200 nos./l in hatching tank and were incubated for 18-20 h at 29-30 °C with moderate aeration until they hatched. The newly hatched larvae were collected from the water surface by glass beakers and transferred to larval rearing tanks. Alternatively, the floating eggs were also directly stocked in larval rearing tanks @ 10 nos./l for hatching as well as for larval rearing.

Larval rearing was conducted using 2, 5 and 10 m^3 concrete or FRP tanks with a minimum of 1 m water depth. Different authors have reported various methods for larval rearing. The most appropriate feeding and water management protocol established at Visakhapatnam for semi-intensive rearing of *E. coioides* larvae is given below:



NURSERY REARING

Two production systems are used for the nursery stage - indoor and outdoor. The indoor system uses tanks of different sizes while the outdoor system uses hapa in ponds as well as in cage or directly pond itself.

INDOOR SYSTEM

Tanks of different sizes (30 to 50 m^3) were used in either semi-intensive or intensive nursery rearing. Tanks were stocked with 2.5 cm fry at 50-200/m^3. Higher densities (> 1000/m^3) were stocked in flow-through or re-circulatory aquaculture systems. Sorting and grading are essential during the nursery phase. Fishes were fed to satiation either with high protein formulated feeds of various sizes or with finely chopped frozen or fresh fish mixed with a vitamin-mineral premix 4-6 times/day. Once the fish reached 6-8 cm, they were transferred to grow-out ponds or floating cages.

OUTDOOR SYSTEM

Hatchery reared or wild-caught fry were stocked in ponds or hapa nets until they reached 6-8 cm. Hapa nets (1 x 2 x 1.5 m; of 2 mm mesh size) were set in ponds or inside floating net cages and were stocked with fry of 2.5 cm @ 1000-2000 nos./net. The fishes were graded once in every 5-7 days until they reached 6-8 cm after 45-60 days. Fishes were fed to satiation (4-6 times/day) either with high protein formulated feeds of various sizes or with finely chopped frozen or fresh fish mixed with a vitamin-mineral premix.

GROW-OUT

Orange spotted grouper are cultured both in ponds and cages. However, they are preferably cultured in cages.

EARTHEN POND SYSTEMS

Ponds were prepared and fertilized for production of natural phytoplankton and zooplankton. Once natural food is abundant, adult tilapia were stocked at density of 5000-10000 nos./ha to

produce fingerlings to serve as live food for the groupers. After one month of stocking tilapia, grouper fingerlings (6-8 cm TL) were stocked at the rate of 5000-10000 nos./ha. If tilapia fingerlings are not abundant, supplementary feeding can be carried out using chopped fish at 5 % of grouper fingerlings body weight (BW) per day, divided into two rations, in morning and late afternoon. When the fish reached an average size of 200 g, feeding was reduced to once daily with fresh or frozen chopped fish at 5 % BW or with pellets at 2 % BW. Around 20-50 % water was exchanged at least twice in a week. Paddle wheel aerators were used when DO fell below 4 mg/l. Water quality was maintained at pH 7.5-8.3, temperature 25-32 °C, salinity 20-35 g/l, DO 4-6 mg/l; NO_2-N <0.05 mg/l and NH_3-N <0.02 mg/l.

FLOATING NET CAGE SYSTEMS

Floating net cages are used for culturing grouper. Eight mm mesh size is used for stocking 8-10 cm fingerlings whereas, 25 mm mesh are used for larger fishes. Grouper fingerlings were stocked at 15-20 nos./m^3. Fishes were fed with fresh or frozen chopped fish daily at 10 % BW or with pelleted feeds at 3 % BW, divided into two rations in the morning and late in the afternoon. Around 0.5 % vitamin and mineral premix is added to the properly thawed trash fish before feeding. The duration of culture in the grow-out phase was 6-12 months and depended on the preferred size at harvest.

FOOD AND FEEDING

Orange spotted groupers are carnivorous in nature. They require feed containing 45 % protein for optimal growth. They are fed on fresh/frozen trash fish or artificial pellet.

GROWTH RATE

The rearing system was found to influence the growth rate, where highest average daily weight gain of 0.59 g/day observed in RAS, followed by 0.4 g/day in pond and 0.26 g/day in cement tanks after one month when stocking fingerlings of 2-3 g and feeding with 45 % pellet feed @ 10 % body weight daily. Advanced orange spotted grouper fingerlings (15-20 g) had grown to 770.67±32.51 g and 35.28±0.87 cm after 9 months and 1014±82.44 g and 41.53±0.91 cm after 12 months of grow-out in cages.

DISEASES AND CONTROL MEASURES

The rapid development of *Epinephelus coioides* culture has led to the incidences of infectious diseases caused by bacteria, viruses and parasites that have become more and more severe which have resulted in serious economic losses in farms and hatcheries. The list of disease causing organisms reported in *E. coioides* and their control measures are listed below.

Disease & Causative agent	Control measures
Bacterial diseases	
Vibriosis (*Vibrio* sp.) *V. carchariae*	OmpK vaccination; freshwater bath for 10-15 minutes; oxalinic acid mixed with feed at 20 mg/kg of fish; terramycin added to feed at 7.5 g/kg for 5 days, reduced to 3.75 g/kg for the succeeding 5 days and prefuran bath treatment for 1 h at 2 mg/l
Pseudomonas spp.	-
Acinetobacter sp.	-
Viral infections	
Nervous necrosis virus (Betanodavirus)	Screening of broodstock both pre- and post-spawning; disinfection of fertilized eggs using ozone or iodine; proper hatchery management; vaccination of fish
Singapore grouper iridovirus	Follow best management practice
Grouper iridovirus	Follow best management practice
Nodavirus	Follow best management practice
Megalocytivirus	Follow best management practice
Parasitic disease	
Cryptocaryon irritans	Immobilized vaccination; freshwater bath for 1 h over 2-3 days; 0.5 mg/l copper sulfate ($CuSO_4$) treatment 2-3 times at 3-days interval for 5-7 days with strong aeration and the infected stocks should be transferred to parasite-free tanks
Trichodina sp.	Bath with freshwater for 1 h for 3 days; 200 mg/l formalin bath for 30-60 minutes with strong aeration and 25-30 mg/l formalin treatment for 1-2 days
Neobenedenia girellae	Freshwater bath for 5-10 minutes and 150 mg/l hydrogen peroxide (H_2O_2) bath for 10-30 minutes
Lepeophtheirus sp.	Freshwater bath for 10-15 minutes; 150 mg/l hydrogen peroxide (H_2O_2) bath for 30 minutes and 200-250 mg/l formalin bath for 1 h
Gonapodasmius epinepheli	The intermediate hosts (gastropod molluscs) should be eliminated from the culture facility
Pseudohabdosynchus lantauensis	250 mg/l formalin bath for 2 h and 200 mg/l hydrogen peroxide (H_2O_2) bath for 1 h

Philometra sp., *Anisakis* sp. and *Raphidascaris* sp	Avoid feeding with infected trash fish; eliminate intermediate hosts (copepods); dry the pond bottom and disinfect the culture facilities with quicklime to destroy the eggs of the nematode
Rhexanella sp.	Manual removal; 200 mg/l formalin bath for 30-60 minutes and disinfect infected facility by drying the pond bottom for several weeks followed by liming
Zeylanicobdella arugamensis	Manual removal using wet cloth; 200-250 mg/l formalin bath for 1 h and culture facilities must be cleaned with detergent, disinfected with chlorine and exposed to intense sunlight for several weeks prior to use to eliminate cocoons of the parasite
Riboscyphidia sp., *Vorticella* sp., *Dactylogyrus* sp.	Follow best management practice

PRODUCTION, MARKET AND TRADE

PRODUCTION

The global production of groupers has increased tremendously because of its escalated demand with 60,774 t; 99,378 t; 1,63,093 t and 1,98,690 t being produced in 1990; 2000; 2005 and 2007 respectively. The orange spotted grouper production from aquaculture was 596 t in 2015.

MARKET AND TRADE

Groupers form the basis of the multimillion-dollar live reef food fish (LRFF) trade based in Hong Kong. Live Reef Food Fish (LRFF) are supplied by around 20 countries in the Asia-Pacific region and at least 60 % of the international trade is through export to Hong Kong where, as much as 50 % is re-exported to mainland China. The majority of the live marine fish consumed in Hong Kong is imported by sea or air.

The major grouper supplier countries are Indonesia, People's Republic of China, Pakistan, Philippines and Malaysia. Hong Kong is the largest consumer of LRFF worldwide with around 60 % of the trade arriving by air. In 2008, the import by air of live grouper alone into Hong Kong totalled 6,766 t worth US$ 101 million. Austrade reported that in 2009 Hong Kong imported more than 38,000 t of live fish. Singapore is the second largest market in the region for live grouper, importing 1,228 t worth US$ 10 million in 2008. China imported 6,111 t and 7,711 t live food fish (mainly reef fish) in 2008 and 2009 respectively. Live groupers fetched higher prices than any other group of top-graded fish, and a price of 3-5 times or more is paid for live specimens of the right size (600-1000

g). A premium is also paid on products with "clean", "green" and "organic" credentials (10 % - 50 % premium for foods carrying China's Green Food certification). The wholesale price of live market-size orange spotted grouper was about US$ 21.45/kg (11.70 to 40.30/kg) in December 2016 in Hong Kong and other South East Asian countries. The price of orange spotted grouper is around ₹400/kg in India.

CHALLENGES TO MARICULTURE

Visakhapatnam Regional Centre of ICAR-CMFRI, Visakhapatnam, Andhra Pradesh, India has developed the technology for broodstock development, larval rearing, nursery rearing and grow-out culture of the species. However, the following researchable issues need to be sorted out for this species in India.

High density larviculture with high survival rate

Standardization of culture protocol in different culture systems

Standardization of feed for culture

Disease management

FUTURE PROSPECTS

Groupers are ideal candidate species for intensive aquaculture particularly in the Asia-Pacific region because of high consumer demand, desirable taste, hardiness in a crowded environment, fast growth and efficient feed conversion. Groupers are popular carnivorous fish with a high market demand in many parts of the world, such as in Kuwait, Indonesia, Singapore, Malaysia, Thailand, Philippines, Hong Kong, Taiwan, China, Mexico, Japan, and the USA. Orange spotted grouper fetches very high price of US$ 21.45/kg (varying from 11.70 to 40.30 $/ kg) in international market (Hong Kong and other South East Asian countries). It also fetches a fairly good price (₹ 400/ kg) in Indian domestic market. Orange-spotted grouper are cultured either in ponds or cages and being euryhaline, it thrives well in even brackishwater environment. Thus, it possesses a good prospect for the Indian farmer as an alternate species to compensate the decrease in shrimp production caused by environmental and pond deterioration.

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