Rachycentron canadum (Linnaeus, 1766)

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IDENTIFICATION

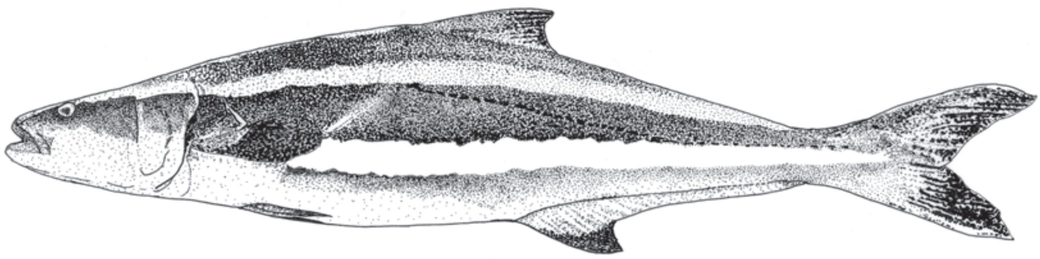
Order	:	**Perciformes**
Family	:	**Rachycentridae**
Common/FAO Name (English)	:	**Cobia**

Source of image : CMFRI, Kochi

Local names: Modasa **(Gujarati)**; Madusa, Maddus, Sakala, Sakla **(Marathi)**; Robal **(Kannada)**; Modha **(Malayalam)**; Kadal viral **(Tamil)**; Nalla matta **(Telugu)**

MORPHOLOGICAL DESCRIPTION

Cobia has an elongated fusiform (spindle-shaped) body and a broad, flattened head. Eyes are small and the lower jaw projects slightly past the upper. Fibrous villiform teeth line the jaws, the tongue, and the roof of mouth. Body of the fish is smooth with small scales. It is dark brown in colour, grading to white on the belly with two darker brown horizontal bands on the flanks. The stripes are more prominent during spawning, when they darken and the background colour lightens. The large pectoral fins are normally carried horizontally. First dorsal fin with 7-9 (usually 8) short but strong isolated spines each depressed into a groove, not connected by a membrane, 28-33 rays. Second dorsal fin long, anterior rays somewhat elevated in adults. Pectoral fins pointed, becoming more falcate with age. Anal fin similar to dorsal, but shorter; 1-3 spines, 23-27 rays. Caudal fin lunate in



adults, upper lobe longer than lower (caudal fin rounded in young, the central rays much prolonged). Scales small, embedded in thick skin; lateral line slightly wavy anteriorly.

PROFILE

GEOGRAPHICAL DISTRIBUTION

Cobia is distributed worldwide in tropical, subtropical and warm-temperate waters of the west and east Atlantic Ocean throughout the Caribbean and in the Indo-Pacific off India, Australia and Japan. In the western Atlantic Ocean, this pelagic fish occurs from Nova Scotia (Canada), south to Argentina, including the Caribbean Sea. It is abundant in warm waters off the coast of United States from the Chesapeake Bay south and throughout the Gulf of Mexico. In the eastern Atlantic Ocean, it ranges from Morocco to South Africa and in the Indo-West Pacific from East Africa and Japan to Australia. Cobia does not occur in the eastern Pacific Ocean.

During autumn and winter months, the fish migrates south and offshore to warmer waters. Cobia prefers water temperatures between 20-30 °C. Seeking shelter in harbors and around wrecks and reefs, the fish is often found off south Florida and the Florida Keys. In early spring, migration occurs northward along the Atlantic coast.

HABITAT AND BIOLOGY

Cobia is found in both coastal and continental shelf waters, although it is typically considered to be an offshore species. They are often found associated with structures in the sea, such as oil and gas platforms, weedlines, buoys, etc. Juvenile fish are found often among *Sargassum* patches or weedlines where they seek shelter from predators and can feed. It is also found inshore inhabiting bays, inlets and mangroves. It is eurythermal tolerating a wide range of temperatures, from 1.6 to 32.2 °C though it prefers warm water (>20 °C). It is also euryhaline living at salinities of 5 to 44.5 g/l. Cobia are opportunistic feeders and examination of stomach contents have revealed various fish, shrimp, squid, and in particular, crabs. In the northwestern Gulf of Mexico, it spawned multiple times from April to September, with a peak in July. Sexual maturity is reported in males at 1-2 years and in females at 2-3 years, with females growing both larger and faster with maximum sizes up to 60 kg. Spawning occurs in both nearshore and offshore waters where females release several hundred thousand to several million eggs (1.4 mm diameter). A recent study conducted from Indian waters estimated a mean fecundity of 1.24 million eggs. The viable eggs begin development, are heavily pigmented, buoyant, and hatch in approximately 24 h. Cobia larvae grow rapidly and are large in comparison to most marine species.

Maximum ages observed for cobia in the Gulf of Mexico were 9 and 11 years for males and females respectively, while off the North Carolina coast maximum ages were 14 and 13 years. Females reach sexual maturity at 3 years of age and males at 2 years in the Chesapeake Bay region.

PRODUCTION SYSTEMS

BREEDING IN CAPTIVE CONDITIONS

In Taiwan broodstock fishes for spawning were initially caught from the wild; however, after the species became subsequently farmed, 1.5-2 year old cobia (approximately 10 kg) were selected from the grow-out cages and transported to onshore ponds. These spawning ponds (400-600 m^2 and 1.5 m deep) were stocked with 100 adult cobia at a sex ratio of 1:1. They spawn naturally year round, with peaks in the spring and fall when water temperatures were 23-27 °C.

Spawning efforts in the USA have also been successful, utilizing round fiberglass tanks 5.5-6.0 m in diameter and 1.5-1.8 m deep to hold adult cobia. The tanks have an egg collector and are either operated as recirculating systems, flow-through, or a combination of both, depending on the biological filtration capacity of the system. Broodstock collection generally involved capturing and transporting juvenile or adult wild-caught cobia (often during their natural spawning season) into the tank systems, where 2-3 year old fish would spawn either naturally or after being induced with photoperiod and temperature manipulations. Research on maintaining and extending the cobia spawning season in the USA has resulted in the production of fertilized eggs during 10 months of the year thus far, with the goal of realizing year-round egg production in the future.

Being a large fish, broodstock development in FRP/RCC tanks is possible only with recirculating aquaculture system because of its high metabolic rate. Alternatively, broodstock development is more effective in circular (6 m diameter and 4.5 m net cage length) or square (5 m × 5m) sea cages. In India, cobia broodstock was developed and induced breeding was achieved for the first time at Mandapam Regional Centre of the ICAR- Central Marine Fisheries Research Institute (CMFRI). The broodstock was developed in sea cages of 6 m diameter and 3.5 m depth. Sexes were separated about two months prior to the onset of breeding season and stocked in separate cages. Female with intra-ovarian egg diameter of 700 μm along with two males were selected for induced spawning.

The brooders were induced with human chorionic gonadotropin (hCG) at doses of 500 IU per kg body weight for females and 250 IU per kg body weight for males. Spawning was noted after 39 h of intra-muscular injection. The total eggs spawned were estimated as 2.1 million. About 90 % fertilization was recorded (fertilized eggs amounted to 1.9 million). The eggs were collected using a 500 μm mesh net and stocked in incubation tanks. The eggs hatched after 22 h of incubation at a temperature range of 28-30 °C.

LARVAL REARING

The fertilized eggs were collected, either from tanks or spawning ponds. After hatching and absorption of the yolk sac (usually by day 3), the larvae were provided with adequate amounts of proper sized feed, such as enriched rotifers (*Brachionus plicatilis*) at the rate of 10-12 nos./ml or copepod nauplii, four times a day till 10 dph. Newly hatched larvae normally measured 3.4 mm size. Larval mouth opens at 3 days post hatch (dph). From 8 dph, the larvae were fed with enriched *Artemia* nauplii at the rate of 1-3 nos./ml, 2-3 times per day. During the rotifer and *Artemia* feeding stage, green water technique was used in the larviculture system with the microalgae *Nannocloropsis occulata* at the cell density of $1x10^5$ cells/ml. Metamorphosis started from 18-21 dph. While weaning the fish larvae from rotifers to *Artemia* nauplii, co-feeding with rotifers was continued due to the presence of different size groups of larvae. The weaning to artificial larval diets was started from 15-18 dph. While weaning, formulated feed was given 30 minutes prior to feeding with live feed. Size of the artificial feed should be smaller than the mouth size of the fish. Continuous water exchange is required during weaning stage. Between 25-40 dph, the larvae are highly cannibalistic and hence size-grading should be undertaken at every four days interval. During this stage, the fry was weaned totally to artificial diets. Larval rearing was practiced both intensively in tanks and extensively in ponds.

The major factors affecting the growth and survival of larvae are nutrition, environmental conditions and handling stress. As there is a high demand for essential fatty acids (EFAs), enrichment are needed for live-feeds. The water exchange was practically nil till 7 dph and it was gradually increased from 10-100 % during 8-12 dph. The environmental conditions required during the larviculture period are DO: > 5 mg/l, NH_3: < 0.1mg/l, pH: 7.8-8.4, salinity: 25-35 g/l, water temperature: 27-33 °C. The rearing density of cobia in tank systems during the early stages remains a challenging aspect of culture that needs to be improved upon for scaling to commercial viability. So far, a modest harvest of 1 fish/l after weaning, regardless of the initial stocking rate is normal, although some promising research in the USA during 2005-2006 has resulted in the production of over 2 fish/l and researchers are hoping to double that number in future trials.

NURSERY REARING

Nursery is carried out in hapas or sea cages or indoor FRP/cement tanks. During nursery rearing, it is advisable to feed the juveniles with formulated feed of 1200 μm size, which can be increased to 1800 μm size from 55 dph onwards. Once the juveniles reach a size of 15 g, they are stocked in sea cages or land based ponds for grow-out farming.

In Taiwan Province of China, the fishes were raised in a series of outdoor ponds until they reached a large enough size to be stocked into a near shore or offshore grow-out cage system. During the larval rearing stage, 'greenwater' nursery ponds <5000 m^2 in area and 1-1.2 m depth with an adequate bloom of *Chlorella*, copepods, and rotifers were utilized. This method typically resulted in larval survival of 5-10 % from hatch to day 20, after which the fishes were moved to two or three pond systems during the next 2 months, depending on the characteristics of the operation. To reduce cannibalism and size variability, cobia were graded weekly after day 45 dph until they reached approximately 30 g (around day 75 dph), which was considered the minimum size for stocking in cages. Cobia were fed 5-6 times a day to satiation at a rate of 5 % body weight up to 30 g; after this the feeding rate was reduced to 2-3 % body weight as the fish approached 200 g. Some producers continue raising the juvenile fish from 30 g up to 600-1000 g in outdoor ponds, while others use smaller (20-200 m^3) near shore cages. From this point onwards the overall goal, whether in ponds or cages, is to raise the young cobia large enough to be stocked into a grow-out cage system, yet small enough to be transported in large numbers with minimal mortality.

GROW-OUT

Trials on sea cage farming carried out at Mandapam, India showed that the fishes attained an average weight of 2.5 kg in six months and 7.3 kg in twelve months. The species was grown in salinity as low as 15 g/l and experiments revealed that the growth and survival at 15 g/l is comparable to that in seawater.

The Taiwanese method, which utilizes outdoor ponds for broodstock and nursery phases, tends to be more extensive when compared to current efforts in the USA, which typically involve tank culture of broodstock and early juveniles. From that point on, however, grow-out methods are similar in both locations, as they utilize net pens or cages of various sizes and types to rear the cobia to harvestable size. Successful grow-out of cobia has been reported in near shore and offshore cages, utilizing both surface and submerged systems during the longest and final stage of production. Taiwanese producers' use 1,000-2,000 m^3 cages, while some operations in the Caribbean have used 3,000 m^3 submersible systems successfully. In order to minimize grow-out time as well as disease issues, cobia produced in cages are located in sites that provide warm (26 ^{0}C and above) clean water and adequate flow rates through the cage system to provide high dissolved oxygen levels continuously. Harvest numbers vary depending on the stocking rates and water temperature, but the grow-out period for pellet fed cobia is generally about 1-1.5 years, with fish reaching a final weight of 6-10 kg at harvest densities of 10-15 kg/m^3.

FOOD AND FEEDING

Cobia being voracious feeders, often engulf their prey whole. They are carnivores, feeding on crustaceans, cephalopods, and small fishes such as mullets, eels, jacks, snappers, pinfishes, croakers, grunts, and herring. A favorite food is crab, hence the common name of "crabeater". Cobia often cruises in shoals of 3-100 fish, hunting for food during migrations in shallow water along the shoreline.

They are also known to feed in a manner similar to remoras. Cobia follows rays, turtles, and sharks, sneaking into scavenge whatever is left behind.

GROWTH RATE

Growth rates of hatchery-reared cobia cultured in submersible cages off Puerto Rico and Bahamas was 6.035 kg (specific growth rate (SGR) = 2.10%/day) in 363 days and 3.545 kg (SGR = 2.04%/day) in 346 days.

Under hypersaline conditions in the Emirates of Abu Dhabi, within a growth period of 12 months, the average body weight attained was 2.87 kg, ranging in size from 1.78 to 3.86 kg. The feed conversion ratio attained was about 2.0.

In India, 37 g fish stocked in cages attained a size of 400 g after 85 days of farming. Similarly, fish of average length 26 cm and weight 118 g attained a size of 47 to 64 cm (average of 57.2 cm) and weight from 0.845 to 1.968 kg (average of 1.4 kg) after 4.5 months of culture in cages.

DISEASES AND CONTROL MEASURES

Parasites of cobia include a variety of trematodes, cestodes, nematodes, acanthocephalans, and copepods as well as barnacles. Thirty individuals of a single trematode species, *Stephanostomum pseudoditrematis*, were found in the intestine of a single cobia taken from the Indian Ocean. Infestations of the nematode, *Iheringascaris inquies* are quite common in the stomachs of cobia. Nephrocalcinosis (kidney stones) cause significant mortality during both the hatchery and grow-out stages. A Sphaerospora-like myxosporean infection caused 90 % mortality in Taiwan.

Disease & Causative agent	Control measures
Bacterial diseases	
Pasteurellosis/*Photobacterium damsela* sub sp. *piscicida*	No known treatment but vaccine is being developed
Vibriosis/*Vibrio alginolyticus*; *V. vulnificus* and *V. parahaemolyticus*	Administer antibiotics; remove diseased fish; disinfect system; reduce stress
Secondary bacterial infection (after *Neobenedenia* infestation)/ *Streptococcus* sp	Administer antibiotics; remove diseased fish; disinfect system; reduce stress
Viral infections	
Lymphocystis/Iridovirus	No known treatment; disinfect system; quarantine fish
Parasitic disease	
Marine velvet disease; Amyloodiniosis/*Amyloodinium ocellatum*	Copper sulphate pentahydrate; decreasing salinity (freshwater dip); flushing; formalin bath/treatment; mechanical filtration at a minimum of 40 μm

Cryptocaryonosis; marine whitespot/ *Cryptocaryon irritans*	Prolonged copper immersion; freshwater dips; formalin treatment; decreasing salinity to 15 g/l or less for 2 weeks; decreasing system temperature to <19 °C
Sessile, colonial, ciliate infestation/*Epistylis* spp	Formalin treatment; freshwater bath/dip; antibiotics for severe bacterial infection
Trichodinosis/*Trichodina* sp.	Formalin treatment; freshwater bath; copper treatment; praziquantel bath or prolonged immersion
Monogenean infestation/*Neobenedenia* sp.	Formalin treatment; freshwater bath; copper treatment; praziquantel bath or prolonged immersion
Myxidiosis/ Sphaerospora-like myxosporidean	No known treatment; disinfect system; quarantine fish
Coccidiosis/*Coccidia* spp.	Treat fish with oral monensin; reduce stress

PRODUCTION, MARKET AND TRADE

PRODUCTION

According to FAO, the aquaculture production of cobia was 961 t in 1998, which increased to 40,329 t in 2014. Of the production reported to FAO in 2004, 80.6 % was produced in China and the remaining rest in Taiwan Province of China. The total value of the global production of this species in 2004 was US$ 3,62,06,000.

MARKET AND TRADE

In China and Taiwan Province of China, both the rapid growth rate and good flesh quality makes cobia potentially one of the most important marine finfish for future production. In these two countries, the fish has a relatively high market value when compared to other finfishes. Larger fishes (8-10 kg) are sold whole domestically, while Japan is the primary destination for smaller (6-8 kg) fish sold, both whole and headless (some for sashimi), with fillet product typically exported to other markets. The prices vary according to size; the market value in Taiwan Province of China for whole fish weighing 17 lb (7.7 kg) and larger was US$ 5.50/kg in 2004. Cobia in Taiwan Province of China are typically starved the day before harvest and 6 kg fish or larger are selected, killed, bled and chilled before whole fish or fillets are packed in ice. Cobia enters the market whole/gutted, headless, or filleted, depending on the final market destination. As the wild caught fish does not represent a major fishery and the farming of cobia is in its infancy, details on market and trade are lacking elsewhere.

In India, it is sold as whole or steaks in domestic market. It has a very good demand in states like Kerala, Tamil Nadu, Maharashtra, West Bengal, Karnataka and Goa. Cobia also commands a good price in the export market. During 2011 nearly 2,377 t of cobia was exported from India. Cobia is mainly exported as frozen whole fish, IQF, head on gutted fish and steaks. The present production is not enough to meet the increasing demand both in domestic and export market. The preferred export size of cobia is above 3 kg. Though, China is a major producer, it also imports cobia from other countries for domestic consumption.

CHALLENGES TO MARICULTURE

The Mandapam Regional Centre of ICAR-CMFRI has developed the technology for broodstock development, larval rearing, nursery rearing and grow-out culture of this species. However, there are several researchable issues which need to be sorted out for this species in India.

Year round spawning and seed production

High density larval rearing techniques

Enhancement of larval survival

Pond culture of the species under different environmental parameters

Standardization of feed for grow out culture (artificial feed vs low value fish)

Disease management

FUTURE PROSPECTS

Cobia has all the qualities needed for a successful species in aquaculture. The fast growth rate, adaptability for captive breeding, low cost of production, good meat quality and high market demand especially for sashimi industry are some of the attributes that make cobia an excellent species for aquaculture. This species are cultured in varying salinity, which suits perfectly the coastal mariculture in India. Additionally, the seed production technology is available in India. Thus this species is a good candidate species for mariculture if the seed production technology percolates to the aquaculture industry.

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