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Species Profile
Cobia

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Cobia, *Rachycentron canadum*, is the only species in the family Rachycentridae. It is also referred to as ling, lemon fish and crab-eater, among other common names. The species is distributed worldwide in warm marine waters, except for the central and eastern Pacific. Cobia are not abundant and are not heavily fished commercially. In 2002, worldwide production (the total caught and cultured) was reported to be about 10,416 tons, with Taiwan, Pakistan, Philippines, Brazil and the United Arab Emirates listed as the top five producers. Considered very good table fare, cobia is a prized catch for both commercial and recreational fishermen, the latter of which account for most reported landings in U.S. waters. Cobia's rapid growth rate, excellent flesh quality, and limited availability from the wild have stimulated aquaculture research, particularly in the U.S. and Asia.

As early as 1975, researchers in North Carolina collected cobia eggs from the wild and reared them successfully. However, it was not until the early 1990s that Taiwan reported captive spawning of cobia. Successful efforts in the U.S. followed in 1996. Taiwan now has a commercial industry that produced nearly 5,000 tons in 2004, most of which was cultured. An offshore cage project in Puerto Rico has successfully grown cobia to market size since 2003. Research in Florida, Mississippi, South Carolina, Texas and Virginia has resulted in many successful spawns, both natural and hormone induced. Grow-out trials of juvenile and market-size cobia in ponds, recirculating systems and cages will likely be conducted in the future.

Life history

Cobia inhabit both coastal and continental shelf waters, and adult fish have been found in bays and estuaries as well as at depths of 3,900 feet (1,200 m). Temperature appears to be the primary factor in determining their range; although specimens have been collected in waters from 60 to 89 °F (16 to 32 °C), they appear to prefer temperatures above 68 °F (20 °C). Capture data indicate that, during cooler months of the year throughout their range, cobia either migrate to warmer water in a north-south pattern or move farther offshore to deeper water. Cobia tolerate a wide range of salinities. Specimens have been collected in waters with 22 to 44 ppt salinity and reared in culture systems down to 5 ppt.

Cobia have elongated bodies and grow to 6.5 feet (2 m) and 135 pounds (61 kg). Females grow both larger and faster than males. The fish are brownish dorsally with a whitish ventral surface and often have alternating light and dark striping on their sides. There is a black lateral band running at about eye level along the length of the body to the tail. Cobia are thought to live up to 15 years in the wild. They are opportunistic carnivores that eat many species of fish, crab, shrimp and squid. Stomach content data show that they prefer crustaceans, particularly portunids (swimming crabs).

Cobia travel alone or in small schools and are often found near some kind of structure, whether floating or in the water column. In the Gulf of Mexico, anglers often target cobia around offshore oil and gas platforms, buoys, artificial reefs, or floating debris, and use both lures and live bait to entice them to bite. Cobia also tend to associate with rays, turtles and large fish in open waters. They often exhibit unusually curious behavior and will readily approach a boat or diver.

As spring approaches and water temperatures rise, fishermen anticipate the "run" of cobia moving north along the eastern coastline of the U.S. and northwest along the Gulf of Mexico. Cobia is considered an excellent sport fish that puts up a tenacious fight when hooked. The annual migration, which usually begins in March and April in the northern Gulf of Mexico, has

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received even more attention in recent years with sport fishing tournaments that target the migrating cobia.

Reproduction in the wild

Cobia have a protracted reproductive season that, in U.S. waters, generally runs from about April to September. Females spawn multiple times during the season. The exact size and age at which cobia are sexually mature varies with location; however, research has shown that males are generally 1 to 2 years old and females are 2 to 3 years old at first spawning. In the Gulf of Mexico, extensive collection data indicate that male cobia can reach sexual maturity at approximately 1 year of age and 25 inches (640 mm) fork length (FL), while the smallest female collected that had developing ovaries was 33 inches (834 mm) FL and 2 years of age.

Adult fish are thought to form small groups, with spawning taking place in coastal and offshore waters where females release 400,000 to more than 5 million eggs, depending on the size of the fish. Cobia eggs and larvae have been collected at the surface of both estuarine and offshore waters (out to 90 km), and at depths of 10 to 590 feet (3 to 180 m). Most of the larvae collected in the Gulf of Mexico were found from June to September in surface waters with temperatures higher than 77 °F (25 °C) and salinity greater than 27 ppt.

In the Gulf of Mexico, small cobia (less than 1.8 inches, 45 mm SL or standard length) have been found both inshore under floating *Sargassum* weed and 30 to 40 miles offshore. Larger specimens (1.8 to 10 inches, 45 to 250 mm SL) are usually found in coastal waters near inlets, barrier islands and bays. Twenty juvenile cobia (5 to 8 inches, 120 to 200 mm SL) were collected during the summers of 2003 and 2004 in waters 13 to 55 feet deep (4 to 17 m) near Port Aransas, Texas. Interestingly, ten of those fish (all approximately 8 inches, 200 mm SL) were caught in a single trawl in the Corpus Christi ship channel in late August 2003 at a depth of 55 feet (17 m), suggesting that the young cobia might have been schooled up near the bottom of the channel (unpublished data). There is little collection data on this size cobia from the Gulf of Mexico. However, two fish in the size range of 8 to 20 inches (200 to 500 mm SL) were caught in September of 2004, also in the ship channel in approximately 45 feet (14 m) of water. So for at least part of their pre-adult life, cobia apparently inhabit inshore areas before heading offshore where most larger fish are caught.

Culture techniques

During the warmer months of the year, cobia can be caught and transferred to tanks or ponds to use as broodstock for spawning purposes (Fig. 1). In captivity, cobia of all sizes adapt fairly quickly to confinement, where they feed voraciously and grow rapidly. In a description of Taiwanese cobia aquaculture, Liao et al. (2004) report producing cobia eggs from 22-pound (10-kg) broodfish raised in grow-out cages near shore and in 0.1- to 0.15-acre (400- to 600-m^2) land-based spawning ponds. The ponds are typically designed

Figure 1. 10 to 20 kg cobia broodstock in recirculating tank systems.

as 5-foot-deep (1.5-m) flow-through systems and stocked with about 100 adult fish at a sex ratio of 1:1. Cobia are reported to spawn spontaneously at temperatures of 73 to 80 °F (23 to 27 °C). Peak egg production is in spring and fall. Fertilized eggs are collected from the surface of the ponds.

Cobia larvae (Fig. 2) are transferred to "green water" nursery ponds where they are reared on copepod nauplii and rotifers until day 20 (survival of larvae to day 20 is reported to be 5 to 10 percent). Then they enter a three-stage nursery pond system. During the first stage, days 20 to 45, the cobia are weaned onto pelleted floating food, size-graded every 4 to 7 days to reduce cannibalism, and grown to 2 to 5 g. The second stage (days 45 to 75) uses larger ponds (more than 0.07 acres, 300 m^2), where the fish are fed to satiation five to six times daily and reared to 30 g. In the final nursery stage (from day 75 to day 150 to 180), the cobia are grown to 1.3 to 2.2 pounds (600 to 1,000 g) either in large ponds or near-shore cages, depending on the operation. These fish are then stocked in grow-out cages for the last stage of production. The reported culture time is 6 to 8 months for a 13- to 22-pound (6- to 10-kg) final product. They are harvested at a density of about 0.12 pounds per gallon (14 kg/m^3). The feed conversion ratio (FCR) with pelleted diets (crude protein 42 to 45 percent) during grow-out in Taiwan is reported to be about 1.5:1, while the FCR in the Puerto Rico project and in recirculating tank systems is reported to be about 1:1.

Research in the U.S. has focused primarily on tank spawning of wild-caught and cultured adult cobia. Scientists in several states have produced fertilized eggs with varying degrees of success. Adult cobia can be anesthetized and moved fairly easily using eugenol (clove oil) at 10 to 20 ppm. When fish are anesthetized, a cannula (1.0-mm I.D.) can be used to check gonadal development (Figs. 3 and 4). Spawning is induced by manipulating photoperiod and water temperature. Cobia have spawned multiple times in covered, circular, fiberglass tanks 20 feet (6.1 m) in diameter and 5 feet (1.5 m) deep. These tank systems should have some sort of biological filtration, a sand filter, and a heat pump large enough to control water temperature throughout the year.

Figure 2. Six-day-old cobia larva.

Captured cobia can be induced to spawn at the desired time by putting them through simulated seasons at regular intervals. In the typical conditioning cycle (Table 1) photoperiod ranges from 10 (winter) to 14 (summer) hours of daylight and water temperature ranges from 68 to 79 °F (20 to 26 °C). Tank spawning generally begins at 13 to 14 hours of daylight and 76 to 80 °F (25.5 to 27 °C). It will continue for several months if these conditions are maintained. This method of inducing cobia to spawn naturally has allowed scientists to extend the spawning season and obtain fertilized eggs for 9 months of the year thus far.

Researchers in the U.S. have also used hormones to induce adult cobia caught during their natural spawning season to produce eggs. Both HCG (human chorionic gonadotropin) injected at 275 IU/kg and a slow-release pellet containing salmon GnRHa (gonadotropin-releasing hormone analog) implanted in fish have resulted in spawns. Both of these spawning methods have advantages and disadvantages, but the goal is the same—consistent production of high-quality eggs and larvae for use in the aquaculture industry and research.

Cobia eggs are 1.20 to 1.40 mm in diameter, heavily pigmented, and hatch in about 24 hours at 80 to

Figure 3. Anesthesized fish being checked for gonadal development.

Figure 4. Reviving anesthetized fish.

Table 1. Typical photoperiod and temperature regime used for cobia broodstock tanks at the University of Texas Fisheries and Mariculture Laboratory. Each interval listed below represents approximately 2 weeks.

Photoperiod (hours light - hours dark)	Water temperature (°C)
13-11	25
13-11	25
12-12	24
12-12	24
11-13	23
11-13	23
10-14	22
10-14	21
10-14	20
11-13	21
11-13	22
12-12	23
12-12	23
13-11	24
13-11	24
13-11	25
14-10	26

Continue the 14-10 photoperiod and 26-27 °C temperature to maintain spawning.

84 °F (27 to 29 °C). The fertilized eggs are buoyant and can be gathered easily in a recirculating culture system using a side-looped egg collector with an 800-micrometer mesh bag. After collection, the eggs are counted (approximately 420 eggs/ml) volumetrically using graduated cylinders, which also allow separation of viable (floating) and nonviable eggs. Eggs are usually stocked into rearing tanks at a density of 5 to 10 per L, although this phase of cobia production is still being researched in order to optimize yield per tank.

Researchers in the U.S. and Taiwan have had difficulty raising cobia larvae at high densities, and the typical tank harvest yields one cobia (2.75 inches, 7 cm, 1g) per liter at 40 days post-hatch. Larvae in tanks are fed enriched rotifers 3 to 5 rotifers/ml) beginning on the third day post-hatch and continuing for a minimum of 4 days. Enriched *Artemia* preparations are fed from that point until weaning (generally day 25 to 30), after which the cobia are given only dry feed (Fig. 5).

Some juveniles reared in recirculating raceway systems have reached 8.8 pounds (4 kg) in 1.5 years when fed a commercially available floating pellet.

Dissolved oxygen levels must be maintained during all stages of culture. Cobia show signs of stress at levels below 5 mg/L (ppm). They require warm water for optimal growth, preferably warmer than 79 °F (26 °C), so temperature during grow-out is critical when determining where to locate production facilities or cages. Other than reports from Taiwan, there is very little information about cobia production beyond this stage. The protein and lipid requirements, rearing density, and salinity tolerance of juveniles are all being investigated in the U.S. with the hope that large-scale domestic production of cobia will be a reality in the near future.

One of the most critical aspects of cobia production is the transportation of juvenile fish. Dissolved oxygen levels, shipping density, and handling stress are just some of the factors that must be controlled by both the shipping and receiving facilities. A commercial

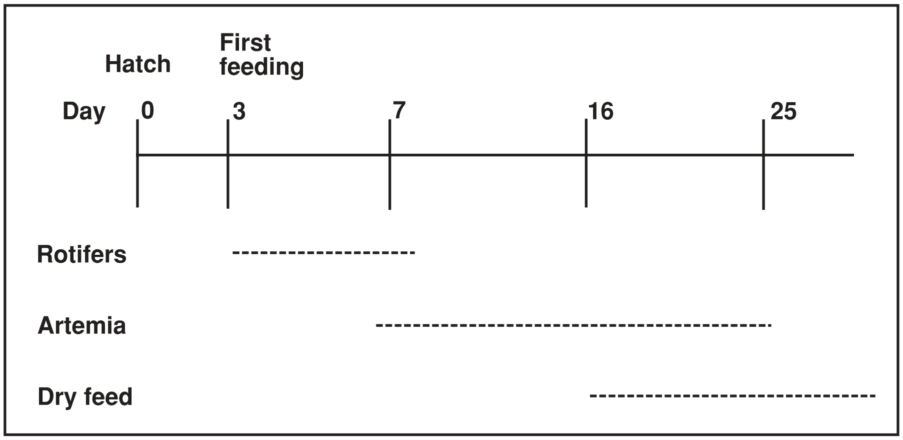

Figure 5. Summary of larval cobia feeding regime used at the University of Texas Fisheries and Mariculture Laboratory. Note: Both rotifers and Artemia *are enriched with a commercially available preparation.*

producer of cobia in the U.S. reports packing fish at a density of 0.08 pounds per gallon (10 g fish/L) for live-haul trucking (less than 24 hours) and 4 to 5 g fish/L for overseas air transport.

Diseases

Although cobia is a fairly hardy species, the fish are susceptible to the parasites, bacteria and viruses that typically affect other warm-water marine species. Bacterial diseases that affect cobia include pasteurellosis (caused by *Photobacterium damselae* subsp. *piscicida*), vibriosis and streptococcosis. The viral disease lymphosystis and the parasites myxosporidea, *Trichodina* and *Neobenedenia* also cause problems.

Because cobia are a very active, rapidly growing species, any pathogen that interrupts or reduces the transfer of oxygen across the gills can be especially devastating. The parasite *Amyloodinium* is a particular problem. It kills juvenile cobia within days if left untreated. Afflicted fish typically exhibit flashing or scratching behavior, coughing, or a reluctance to feed. Because of its resilient nature and high reproductive rate, this parasite can be especially destructive in recirculating culture systems.

Improved production strategies could alleviate some of the disease and parasite problems in the cage production of cobia. In Taiwan it was noted that fish in near-shore cages in protected areas with less water flow had more disease problems than fish in offshore grow-out sites. Cultured cobia will certainly need to be monitored and disease outbreaks treated if the species is to be cultured successfully.

Marketing and economics

Cobia is considered an excellent table fish, but because the volume of product in the market is low, many consumers have probably never tasted cobia. If it were widely available through aquaculture, potential markets for its firm, white meat could be developed.

The Taiwanese report producing both a 13- to 17-pound (6- to 8-kg) market size fish for export to Japan and a 17- to 22-pound (8- to 10-kg) fish for domestic consumption; processed fillets also are exported. The current market value in Taiwan for cobia 17 pounds (8 kg) and larger is about $2.50 US per pound ($5.50 per kg), with smaller fish bringing less. The cost of producing cobia in Taiwan is estimated to be $1.10 US per pound ($2.40 per kg) live weight, which is low compared to several other species.

Prices for cobia produced in Puerto Rico and shipped to Miami whole and gutted are about $3.00 to $4.00 US per pound ($6.50 to $9.00 US per kg) for 13- to 15-pound (6- to 7-kg) fish. There is also a market for weaned juveniles for stocking into grow-out systems. In the U.S., juveniles 1 to 1.5 g are available for part of the year at a price of $1.00 to $2.50 each, depending on the amount ordered.

Conclusion

Cobia culture worldwide is just beginning and shows great potential for expansion. Cobia's phenomenal growth rate, good flesh quality, and good feed conversion rates are desirable aquaculture characteristics. The expansion of Taiwanese cobia production in the last 5 years demonstrates that the species can be raised profitably. Other countries in Asia are likely to begin producing significant quantities of cobia in coming years. Production in and near the U.S. is slowly developing, primarily in the Caribbean, as investors and aquaculturists investigate the species' potential. Continued research with recirculating systems, pond grow-out, and offshore cage culture could offer producers alternative production techniques for cobia. Controlled spawning, larval and juvenile rearing, and grow-out of cobia have all been successfully demonstrated. Global production is projected to increase in the future.

Suggested Readings

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