

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
1	<i>Gasterosteus canadus</i> Linné [Latin]	[<i>No Abstract Available</i> - First known description of cobia morphology in Carolina habitat by D. Garden.]	Linnaeus, C.	Systema Naturæ, ed. 12, vol. 1, 491	1766	Habitat Wild (Atlantic/Pacific)
2	<i>Scomber niger</i> Bloch	[<i>No Abstract Available</i> - Description and alternative nomenclature of cobia.]	Bloch, M. E.	Ichthyologie, vol. 10, Iconibus ex illustratum. Berlin. p. 48	1793	Wild (Atlantic/Pacific)
3	The Fisheries and Fishery Industries of the United States. Section 1: Natural history of useful aquatic animals	Under this head was to be carried on the study of the useful aquatic animals and plants of the country, as well as of seals, whales, turtles, fishes, lobsters, crabs, oysters, clams, etc., sponges, and marine plants and inorganic products of the sea with reference to (A) geographical distribution, (B) size, (C) abundance, (D) migrations and movements, (E) food and rate of growth, (F) mode of reproduction, (G) economic value and uses.	Goode, G.B.	U.S. Commission on Fisheries, Washington, D.C., 895 p.	1884	Wild (Atlantic/Pacific)
4	Notes on the occurrence of a young crab-eater (<i>Elecate canada</i>), from the lower Hudson Valley, New York	[<i>No Abstract Available</i> - A description of cobia in the lower Hudson River.]	Fisher, A.K.	Proceedings of the U.S. National Museum 13, 195	1891	Wild (Atlantic/Pacific)
5	The nomenclature of <i>Rachicentron</i> or <i>Elacate</i> , a genus of acanthopterygian fishes	The universally accepted name <i>Elucate</i> must unfortunately be supplanted by one entirely unknown to fame, overlooked by all naturalists, and found in no nomenclator. A brief history of the nomenclature of the genus is timely.	Gill, T.	Proceedings of the U.S. National Museum 18, 217–219.	1896	Habitat Wild (Atlantic/Pacific)
6	Parasites of fishes collected in the Woods Hole Region	[<i>No Abstract Available</i> - A specimen taken in Buzzards Bay, July 15, 1899, was kept in a large pool at the Fish Commission laboratory until August 31, when it was examined for parasites. The stomach contained large numbers of bones, mostly vertebra of fish (squeteague, etc.) from which the flesh had been entirely digested. The stomach contained a large number of nematodes, which were very active and remained active for several hours in sea water. Indeed, they showed no tendency to come to rest at the time they were put in the killing fluid. While these worms have not yet been worked up, the following brief characterization may be given in this preliminary report. The general color of the body in life was dark ashy brown; head and anterior part of the body to the base of the esophagus white. Jaws prominent, head wider than neck, which is sharply serrated, being crossed by fine transverse lines at regular intervals. Posterior end acuminate. The preanal papillæ appear to be about 24 on each side, the posterior 10 of these small; postanal papillæ not seen distinctly, probably 4, very small. The following measurements of a female in acetic acid are given in millimeters: Length, 40; length of esophagus, 2.47; length of head 0.16, breadth 0.29; diameter of neck at head, 0.16; maximum diameter of body near posterior end, 0.8; diameter 1 mm. from posterior end, 0.44; diameter at anus, 0.44; distance of anus from posterior tip, 0.51; distance between striæ on neck, 0.024.]	Linton, E.	Bulletin of the United States Fish Commission 19, 452	1899	Wild (Atlantic/Pacific) Parasites Fish Health
7	Fishes of the Chesapeake Bay	[<i>No Abstract Available</i> - Description of cobia morphology, prey, and catch rates in the Chesapeake Bay]	Hildebrand, S. F., Schroeder W. C.	Bulletin of the United States Fish Commission 47, 235–236	1927	Habitat Wild (Atlantic/Pacific)
8	Food and feeding habits of the fishes of the Gulf of Manaar	The composition of the food of 59 species of marine fishes occurring in the Gulf of Manaar is recorded. Their feeding habits are discussed.	Chacko, P.I.	Proceedings of the Indian Academy of Sciences - Section B 29, 83–97	1949	Habitat Wild (Atlantic/Pacific)
9	Random notes on Texas fishes. Part II	This paper is the second section of a two-part annotated list summarizing both published and unpublished notes concerning certain species of Texas fishes. The list is taxonomically arranged and provides largely anecdotal information dealing with distribution, life history and systematics. An extensive bibliography of early literature on Gulf of Mexico fishes is included.	Baughman, J.L.	Texas Journal of Science 2, pp. 242–263	1950	Habitat Wild (Atlantic/Pacific)
10	Food habits of the sergeantfish, <i>Rachycentron canadus</i>	[<i>No Abstract Available</i> - In connection with my study of the utilization of menhaden on the Texas coast (Knapp, 1950, Trans. Amer. Fish. Soc., 79 (1949): 142), I reported the percentage frequency of occurrence of food organisms of 27 <i>Rachycentron canadus</i> (Linnaeus) as follows (22 stomachs analyzed): crabs 50.0, shrimp 50.0, squid 13.7, menhaden 0.0, other fish 95.5, and other invertebrates 59.1. Subsequently two additional fish were collected from the same area, making a total of 29 specimens taken between June and September 1948, near Port Aransas on the Texas coast.]	Knapp, F.T.	Copeia 1951, 101–102	1951	Wild (Atlantic/Pacific)
11	Parasitic crustacea from the Texas coast.	[<i>No Abstract Available</i> - The writer examined 803 fishes belonging to 138 species, three species of crabs and two of shrimps. From these he secured 57 species of copepods (19 new), 7 isopods (1 new), and 3 barnacles.]	Pearse, A.S.	Publications of the Institute of Marine Science, University of Texas 2, 5–42	1952	Parasites Wild (Atlantic/Pacific)
12	Parasitic copepoda of Texas coastal fishes	This paper reports the parasitic Copepoda collected from fishes examined at Port Aransas, Texas, during June and July, 1952.	Causey, D.	Publications of the Institute of Marine Science, University of Texas 3, 5–16	1953	Parasites Fish Health
13	An ecological study of the gulf of Mexico fishes, in the vicinity of Cedar Key, Florida.	An investigation of the fishes which inhabit the extensive shallow areas and channels in the vicinity of Cedar Key, Florida, was made from June, 1950, through May, 1951. The muddy sand-bottomed "flats" supported rich growths of vegetation during the warm months and a varied and abundant fish fauna found food and shelter among the plants. Over 13,000 specimens were collected and 122 species representing 100 genera and 58 families are included in an annotated list. The kinds and numbers of fishes varied seasonally, the greatest variety of species and abundance of individuals were found during the summer and early fall. Breeding occurred generally during the spring months. Food studies indicated that microcrustaceans, malacostracans, shrimps, annelid worms, mollusks, crabs, and fishes were the principal food organisms utilized by the shallow water fishes. Of the environmental factors, salinity did not appear to be critical while water temperature and bottom composition seemed to exert considerable influence on the local fish population. The Cedar Key fauna was found to consist predominantly of species more characteristically associated with temperate climate. However, comparison with the fauna of Texas and North Carolina shows a considerably greater proportion of West Indian forms at Cedar Key.	Reid, J., George K.	Bulletin of Marine Science 4, 1–12	1954	Wild (Atlantic/Pacific)
14	Parasitic copepoda from Gulf of Mexico fish	[<i>No Abstract Available</i> - Descriptions of parasitic copepods found in Gulf of Mexico fish.]	Causey, D.	Occasional papers of the Marine Laboratory, Louisiana State University. 9, 19	1955	Parasites Wild (Atlantic/Pacific)
15	Studies on the monogenetic trematodes of the Texas coast. I. Results of a survey of marine fishes of Port Aransas, with a review of Monogenea reported from the Gulf of Mexico and notes on euryhalinity, host-specificity, and relationships of the remora and cobia	[<i>No Abstract Available</i> -The Monogenea, one of the three orders of the class Trematoda, consists of ectoparasites the majority of which are found on the gills of marine and fresh-water fishes. Several species occur in the mouth and upper respiratory tract of turtles and in the urinary bladder of turtles, frogs and toads. A few have been found on crustacea, particularly on isopods, on copepods, and on Argulus. In fishes Monogenea are largely found on the gills and gill chambers and very rarely on the skin and cloaca. This group is not as well known as the digenetic trematodes because they have only slight economic importance. These worms do very little harm to their host; but rarely we find heavy infections and the host may suffer intensely resulting sometimes in death. This is observed mainly in fish-hatcheries, aquaria and similar places where hosts are crowded and kept in artificial containers.]	Koratha, K.J.	Publications of the Institute of Marine Science, University of Texas 4: 234–239	1955	Parasites Wild (Atlantic/Pacific)
16	Recent fish records from Puerto Rico	This paper brings up to date unpublished records of fishes from Puerto Rico. Distr. and abundance of 108 spp. are discussed. Interesting records are included of fishes which have been previously reported in the literature from Puerto Rico. Seasonal spawning records show periodicity. Several important fish spp. are marked by their absence in the waters in Puerto Rico.	Erdman, D.S.	Bulletin of Marine Science 6, 315–340	1956	Wild (Atlantic/Pacific)
17	The host specificity of monogenetic trematodes	The host-parasite relations of the 75 species of Monogenea in the present collection and many more from the literature have been considered and the following conclusions reached: 1. The species studied, and probably most other Monogenea, are highly host-specific. 2. Two phases or levels, infraspecificity and supraspecificity, are evident in monogeneid host-specificity. 3. Supraspecificity appears to present two facets, one phylogenetic, rigid supraspecificity and the other ecological, non-rigid supraspecificity, in basis. 4. Host-specificity may be either physiological and genetic and/or ecological in basis but existing knowledge concerning the life-histories, physiology and ecology of the Monogenea must be greatly augmented before more extensive and definite conclusions can be made concerning the causes and significance of host-specificity in this group. 5. The order Monogenea offers a sound base whence studies of the general phenomena of parasitism and host-specificity may be pursued. 6. It is possible that additional knowledge of the host distribution patterns of ectoparasitic trematodes will throw light on the phylogeny and taxonomy of the hosts and <i>vice versa</i> .	Hargis Jr., W.J.	Experimental Parasitology 6, 610–625	1957	Parasites Wild (Atlantic/Pacific)
18	A list of Florida fishes and their distribution	The fish fauna of Florida is far richer than that of any comparable area in North or Central America. The 1,120 species which occur in Florida waters represent approximately one-fourth the number of species recorded for the entire northern portion of the Western Hemisphere. Seventy-four of these apparently have a worldwide (circumtropical) distribution, while eighty-five have been taken only from Florida waters. More fish species occupy the marine shore zone than are found in all other habitats combined. This shore fauna has a great deal in common with that of the West Indies, South America, and Bermuda, perhaps more than with the rest of North America. The surprising number of Florida shore species that range to the eastern Atlantic indicates a closer relationship to that area than was previously suspected. The Florida Keys contain the greatest variety of fishes in the state. The majority of the mainland forms occur in the Keys, and, in addition, approximately 135 species that inhabit the Keys do not occur on the mainland. A distinct difference is present between the Gulf and Atlantic coast faunas with the former being a good deal richer in number of species. There is also a clear indication of a faunal difference between the northeastern and northwestern Gulf of Mexico. The rich freshwater fish fauna of the other southeastern states has been able to penetrate Florida to but a limited extent; almost all of those species present belong to six families of which the Cyprinodontidae, Centrarchidae, and Ictaluridae have been the most successful invaders. A systematic list provides information about the range, habitat, and common name of each species. A bibliography includes those references necessary for the identification of Florida freshwater, euryhaline, and marine shore fishes.	Briggs, J.C.	Bulletin of the Florida State Museum, Biological Sciences 2, 221–318	1958	Habitat Wild (Atlantic/Pacific)
19	Fluctuations in the relative abundance of sport fishes as indicated by the catch at Port Aransas, Texas 1952-1956.	[<i>No Abstract Available</i> - Port Aransas is a small coastal town located at the mouth of Aransas Pass inlet on Mustang Island, which is adjacent to the Texas mainland (Fig. 1). One of its primary industries is sport fishing and many of the inhabitants derive their livelihood directly or indirectly from it. Unfortunately quantitative data on sports fishing are scarce everywhere and especially in the western Gulf. This report of records gathered at Port Aransas provides a view of the annual cycle.]	Springer, V.G., Pirson, J.	Publications of the Institute of Marine Science, University of Texas 5, 169–185	1958	Wild (Atlantic/Pacific)

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20	Studies on helminth parasites from the coast of Florida. IV. Digenetic trematodes of marine fishes of Tampa, Boca Ciega bays, and the Gulf of Mexico	[<i>No Abstract Available</i> - This contribution is a continuation of a series of studies on the diseases and parasites of marine and coastal animals which is currently being sponsored by the Florida State Board of Conservation.]	Sogandares-Bernal, F., Hutton, R.F.	Quarterly Journal of the Florida Academy of Sciences 21(3): 259–273	1959	Parasites Wild (Atlantic/Pacific)
21	Fishes of worldwide (circumtropical) distribution	[<i>No Abstract Available</i> - The following annotated list of 107 species includes only those which, according to the present state of our knowledge, form homogeneous species populations extending entirely around the world in tropical or temperate waters. Fishes that seem to be worldwide at the species level but that apparently break up into subspecific populations in parts of their range are not included. Under each species are listed only those recent references that seem to give a reasonably good indication of circumglobal distribution. In many instances, these references are reinforced by the citation of a definite record from the Eastern Pacific area. Several species have been listed for which no Indian Ocean captures are yet known. Presumably, this is a reflection of the paucity of collections from that region rather than an actual discontinuity in the range of the species.]	Briggs, J.C.	Copeia 1960, 171–180	1960	Wild (Atlantic/Pacific)
22	A revision of the genera <i>Parapetalus</i> Steenstrup & Lütken and <i>Pseudopetalus</i> nov	During the course of a general survey of the copepod parasites of the fishes of the Kerala coast, India, I have been able to collect all but one of the species so far assigned to the genus <i>Parapetalus</i> . As certain aspects of the morphology and taxonomy of some of the species appear to need clarification a revision of the genus is attempted.	Pillai, N.K.	Crustaceana 3, 285–303	1962	Parasites Wild (Atlantic/Pacific)
23	Spawning of the Cobia, <i>Rachycentron canadum</i> , in the Chesapeake Bay Area, with observations of juvenile specimens	Pelagic eggs collected in Atlantic coastal waters adjacent to Chesapeake Bay have been identified as those of the cobia, <i>Rachycentron canadum</i> (Linnaeus). The egg diameters ranged from 1.16 mm to 1.42 mm with a mean of 1.27 mm. The single large oil globule had a mean diameter of 0.38 mm. The presence of gravid females and the appearance of cobia eggs in plankton collections indicated that spawning occurs between mid June and mid August. Sampling in 1960 showed spawning maxima to be in June and July. Although virtually all of the cobia eggs were collected in the Atlantic, knowledge of the current patterns in the survey area led to the conclusion that spawning occurred in lower Chesapeake Bay or in the immediate vicinity of the Virginia Capes. The color pattern and fin shape is described and illustrated from two juvenile cobia collected in August 1962. Observations made before capture of the juveniles point out that certain adult behavioral characteristics are already well established in the first few months of juvenile existence.	Joseph, E. B. Norcross, J. J. Massmann, W. H.	Chesapeake Science 5, 67–71	1964	Habitat Wild (Atlantic/Pacific) Spawning
24	Availability patterns of marine fishes caught by charter boats operating off Virginia's Eastern shore, 1955–1962.	Catch data logged by charter boat captains fishing off Virginia's Eastern Shore from 1955 through 1962 reflect seasonality, migrational patterns, and population trends of species caught. Nineteen percent of 2,369 trips recorded were for offshore "big game" species, 31% of the trips were for inshore "big game", species, and 50% of the trips were for the smaller game fishes. Seasonal patterns and catch data for bluefish, cobia, dolphin, weakfish, kingfish, Atlantic croaker, black and red drum, little tuna, Atlantic bonito, bluefin tuna, white marlin, summer flounder, and black sea bass are given. A discussion of factors affecting catch rate data is presented and related to these charter boat catches.	Richards, C.E.	Chesapeake Science 6, 96–108	1965	Wild (Atlantic/Pacific)
25	On two rare pelagic fishes, <i>Luvarus imperialis</i> and <i>Rachycentron canadum</i> , recently captured at Yoichi, Hokkaido, Japan	Some cosmopolitan pelagic fishes which are widely distributed in the tropical and subtropical regions have often been occurred in the waters of Hokkaido in recent time. In this paper, two species which have never been recorded or rarely found from Hokkaido were reported.	Ueno, T.	Japanese Journal of Ichthyology 12, 99–103	1965	Wild (Atlantic/Pacific)
26	On the habit of cobia, <i>Rachycentron canadum</i> (LINNAEUS), associating with sting ray, <i>Dasyatis maculatus</i> MIYOSHI	The author observed the behavior of a cobia (<i>Rachycentron canadum</i>) associating with a sting ray (<i>Dasyatis maculatus</i>) in a large circulating channel tank of the Oita Ecological Aquarium. The cobia never left the sting ray the whole day, but accompanied it as shown in the photographs from November 1965 until May 1966. As the sting ray never took food, a fish-keeper often dived in the tank wearing a SCUBA (Aqua lung) to feed the sting ray. Though the diver pushed some food into the mouth or throat of the sting ray, the food was thrown up at once in most, cases. The cobia, swimming around the sting ray, took the thrown-up food more, quickly than the diver picked it up. After the sting ray was removed from the tank, the cobia associated temporary with a leopard shark (<i>Triakis scyllia</i>), a sting ray (<i>Dasyatis akajei</i>), and a larger cobia, but did not associate with a nurse shark (<i>Orectolobus japonicus</i>), a horned shark (<i>Heterodontus japonicus</i>), and other large fish (<i>Seriola</i>). The behavior of the cobia suggests the associating behavior of a pilot fish (<i>Naucrates</i>) and that of a shark sucker (<i>Remora</i>) with large sharks. It is interesting that the cobia is quite similar to a shark sucker in form and stripes and to a pilot fish in the separate spinous dorsal fin which can be depressed in its groove.	Takamatsu, S.	Japanese Journal of Ichthyology 14, 183–188	1967	Habitat Behavioral Wild (Atlantic/Pacific)
27	Age, growth and fecundity of the cobia, <i>Rachycentron canadum</i> , from Chesapeake Bay and adjacent Mid-Atlantic waters	Age, growth, fecundity, and distribution of cobia, <i>Rachycentron canadum</i> , were studied. Data were collected primarily from lower Chesapeake Bay and adjacent mid-Atlantic waters. Age analysis by scale methods, growth estimates by use of Bertalanffy's equation, and observations of juvenile cobia indicate rapid growth. Ten age groups were represented in scale collections from 284 fish, 4.2–56.4 inches in fork length. Males and females can mature at two and three years, respectively. Growth equations are: males, Lt = 49(1-e ^{-0.21(t+0.67)}), Wt = 59 X (1-e ^{-0.13(t-0.62)}); females, Lt = 59(1-e ^{-0.20(t+0.65)}), Wt = 120(1-e ^{-0.10(t-0.80)}). Fecundity in hundreds of thousands of eggs was evaluated as a function of body weight where fecundity was equal to 0.98 times the weight in pounds minus 6.39. The spawning season, late June through mid-August, was defined through observation of gonadal tissue. A disproportionate sex ratio for areas within Chesapeake Bay was noted, 74:26 and 28:72 males to females, for eastern and western shore areas respectively. A possible relation between spawning and a high ratio of males to females was noted for eastern shore areas.	Richards, C. E.	Transactions of the American Fisheries Society 96, 343–350	1967	Habitat Wild (Atlantic/Pacific) Spawning
28	Spawning seasons of some game fishes around Puerto Rico	[<i>No Abstract Available</i> - Of 450 fish species recorded from Puerto Rico, I have original observations related to the spawning seasons of more than 120 species and notes on 100 additional species from the literature. The life history of not a single one of these fishes is known in all its details. The need for more information is self-evident. The purpose of this paper is to point out what is lacking, to summarize briefly what is known, and to add to knowledge in this important field.]	Erdman, D.S.	Proceedings of the 12th International Game Fish Conference. San Juan, Puerto Rico, pp. 11–19	1967	Wild (Atlantic/Pacific) Spawning
29	Age, growth and fecundity of the cobia, <i>Rachycentron canadum</i> , from Chesapeake Bay and adjacent Mid-Atlantic waters	Age, growth, fecundity, and distribution of cobia, <i>Rachycentron canadum</i> , were studied. Data were collected primarily from lower Chesapeake Bay and adjacent mid-Atlantic waters. Age analysis by scale methods, growth estimates by use of Bertalanffy's equation, and observations of juvenile cobia indicate rapid growth. Ten age groups were represented in scale collections from 284 fish, 4.2–56.4 inches in fork length. Males and females can mature at two and three years, respectively. Growth equations are: males, Lt = 49(1-e ^{-0.21(t+0.67)}), Wt = 59 X (1-e ^{-0.13(t-0.62)}); females, Lt = 59(1-e ^{-0.20(t+0.65)}), Wt = 120(1-e ^{-0.10(t-0.80)}). Fecundity in hundreds of thousands of eggs was evaluated as a function of body weight where fecundity was equal to 0.98 times the weight in pounds minus 6.39. The spawning season, late June through mid-August, was defined through observation of gonadal tissue. A disproportionate sex ratio for areas within Chesapeake Bay was noted, 74:26 and 28:72 males to females, for eastern and western shore areas respectively. A possible relation between spawning and a high ratio of males to females was noted for eastern shore areas.	Richards, C.E.	Transactions of the American Fisheries Society 96, 343–350	1967	Spawning Wild (Atlantic/Pacific)
30	On the habit of cobia, <i>Rachycentron canadum</i> (LINNAEUS), associating with sting ray, <i>Dasyatis maculatus</i> MIYOSHI	The author observed the behavior of a cobia (<i>Rachycentron canadum</i>) associating with a sting ray (<i>Dasyatis maculatus</i>) in a large circulating channel tank of the Oita Ecological Aquarium. The cobia never left the sting ray the whole day, but accompanied it as shown in the photographs from November 1965 until May 1966. As the sting ray never took food, a fish-keeper often dived in the tank wearing a SCUBA (Aqua lung) to feed the sting ray. Though the diver pushed some food into the mouth or throat of the sting ray, the food was thrown up at once in most, cases. The cobia, swimming around the sting ray, took the thrown-up food more, quickly than the diver picked it up. After the sting ray was removed from the tank, the cobia associated temporary with a leopard shark (<i>Triakis scyllia</i>), a sting ray (<i>Dasyatis akajei</i>), and a larger cobia, but did not associate with a nurse shark (<i>Orectolobus japonicus</i>), a horned shark (<i>Heterodontus japonicus</i>), and other large fish (<i>Seriola</i>). The behavior of the cobia suggests the associating behavior of a pilot fish (<i>Naucrates</i>) and that of a shark sucker (<i>Remora</i>) with large sharks. It is interesting that the cobia is quite similar to a shark sucker in form and stripes and to a pilot fish in the separate spinous dorsal fin which can be depressed in its groove.	Takamatsu, S.	Japanese Journal of Ichthyology 14, 183–186	1967	Behaviorial
31	Records of the barnacle <i>Conchoderma virgatum</i> from two Gulf of Mexico fishes	[<i>No Abstract Available</i> - Accounts of <i>Conchoderma virgatum</i> from two Gulf of Mexico fishes.]	Dawson, C.E.	Proceedings of the Louisiana Academy of Sciences 32, 58–62	1969	Habitat Wild (Atlantic/Pacific)
32	Occurrence and description of prejuvenile and early juvenile Gulf of Mexico Cobia, <i>Rachycentron canadum</i>	General morphology and coloration of young cobia, 12.6-55.0 mm SL, are described and illustrated. Prejuveniles were taken in offshore Gulf of Mexico surface nekton collections during June and July. Smallest fish were found 30-40 miles offshore, whereas larger specimens, 45-140 mm SL, have been most frequently taken in inshore localities. June collections of prejuveniles suggest late April or May spawning in northern Gulf waters	Dawson, C.E.	Copeia 1971, 65–71	1971	Habitat Wild (Atlantic/Pacific)
33	Investigations of coastal pelagic fishes	[<i>No Abstract Available</i> - Description of stomach contents of wild cobia in the waters off of Mississippi.]	Christmas, J.Y., Perry, A., Waller, R.S.	Completion Report, Project 2-128-R, Gulf Coast Research Laboratory, Ocean Springs, MS 39564, p. 105	1974	Habitat Wild (Atlantic/Pacific)
34	Techniques for hatching and rearing cobia, <i>Rachycentron canadum</i> , through larval and juvenile stages	[<i>No Abstract Available</i> - Description of early cobia larval rearing techniques.]	Hassler, W.W., Rainville, R. P.	Sea Grant Publication UNC-SG-75-30. University of North Carolina Sea Grant Program, Raleigh, NC 26 p.	1975	Culture Hatchery
35	Digenetic trematodes from marine fishes of Waltair Coast, Bay of Bengal. Family Acanthocolpidae.	[<i>No Abstract Available</i> - Description of parasitic trematodes in the Bay of Bengal.]	Madhavi, R.	Rivista de Parassitologia 37, 115–128	1976	Parasites Wild (Atlantic/Pacific)
36	Observations on the offshore reef and platform fish fauna of Louisiana	Observations, photographs and collections of fishes on the western reefs of the outer Louisiana continental shelf and around oil platforms have verified the presence of an extensive tropical fish fauna. Of 105 species recorded, about 50% were tropical species either unreported or rarely reported from the northwestern Gulf of Mexico. Reefs contained more species than oil platforms, although a number were common to both, and 12 species were found only around platforms. The 67 species of fishes found at the deeper reefs were all typical Caribbean-West Indian forms.	Sonnier, F., Teerling, J., Hoese, H.D.	Copeia 1976, 105–111	1976	Wild (Atlantic/Pacific)
37	Availability, morphometrics, feeding and breeding activity in a multi-species, demersal fish stock of the Western Indian Ocean	A multi-species demersal fish stock was studied from April 1969 to July 1970. If fish were carnivores, Rhynchobatus djeddensis, <i>Rachycentron canadum</i> and Arius sp. being primarily crustacean feeders, <i>Dasyatis kuhlii</i> feeding on polychaetes and crustaceans and Carcharhinus sealei and Psetodes erumei feeding mainly on fish. The increased number of all three bony fish noted in August/September (immediately prior to the short rains in October/November) is discussed in relation to feeding activity and the initiation of spawning activity.	Darracott, A.	Journal of Fish Biology 10, 1–16	1977	Habitat Wild (Atlantic/Pacific)
38	Cobia (<i>Rachycentron canadum</i>) tagging within Chesapeake Bay and updating of growth equations	Early summer concentrations discovered by sportfishermen in Chesapeake Bay allowed tagging and release of twenty fish. Six returns were received from sport catches up to five years after release (1,855 days). Sport fishing mortality was 0.30 ± 0.21 with P = 95%.	Richards, C.E.	Chesapeake Science 18, 310–311	1977	Habitat Wild (Atlantic/Pacific)
39	Test results of the Boothbay neuston net related to net length, diurnal period, and other variables.	Two models of the Boothbay neuston net were field-tested under various experimental conditions to determine relative catching ability, ease of handling, and specimen damage for ichthyoplankton. The 4.9 m (16-ft) neuston net was superior in ease of handling and caught slightly more, but not significantly more specimens than the 8.5 m (28 ft) net. Catches for many species varied significantly between day and night. Damage to specimens increased with increased towing speed.	Eldridge, P.J., Berry, F.H., Miller III, M.C.	(No. 18). South Carolina Marine Resource Center Technical Report	1977	Wild (Atlantic/Pacific)

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40	Migrations des poissons demersaux le long des cotes ouestafraicaines de J O a 24° de latitude nord	The migrations and biological cycles of demersal fish species along the continental shelf of XW Africa (10 to 24° N) are described in terms of their seasonal variations in abundance and size strnctw-e in the Senegal canoe fishery and along 7 trawl transects.	Champagnat, C., and F. Domain	Cahiers O.R.S.T.O.M, Série Océanographie 16, 239–261	1978	Habitat Wild (Atlantic/Pacific)
41	Monogenea of Australian marine fishes. the genera <i>Dionchus</i> , <i>Sibitrema</i> and <i>Hexostoma</i>	The following Monogenea collected at Heron and Lizard Islands, Great Barrier Reef, are described and figured: <i>Dionchus remorae</i> (MacCallum, 1916) from <i>Echeneis naucrates</i> ; <i>Dionchus agassizi</i> Goto, 1899 from <i>Echeneis naucrates</i> ; <i>Dionchus</i> sp. from <i>Rachycentron canadus</i> (L); <i>Sibitrema poonui</i> Yamaguti, 1966 from <i>Cybiosarda elegans</i> Whitley and <i>Euthynnus alleteratus a./finis</i> (Cantor); <i>Hexostoma euthynni</i> Meserve, 1938 from <i>Euthynnus alleteratus a./finis</i> (Cantor). The genus <i>Neohexostoma</i> Price, 1961 is considered to be a synonym of <i>Hexostoma Rafinesque</i> , 1815.	Rohde, K.	Publications of the Seto Marine Biological Laboratory 24, 349–367	1978	Parasites Wild (Atlantic/Pacific)
42	Development of fishes of the Mid-Atlantic Bight: an atlas of egg, larval, and juvenile stages. Vol. III. Aphredoderidae through Rachycentridae	[No Abstract Available - Description of various life stages of fish found in the mid-Atlantic bight.]	Hardy, J.D.Jr.	U.S. Fish and Wildlife Service, Washington, D.C. FWS / OBS-78/12, 394 p.	1978	Wild (Atlantic/Pacific)
43	Catch composition and relative abundance of trawl-caught fishes in the Visayan Sea	Twelve monthly trawl fishing operations at two hours per drag from April, 1976 to March, 1977 in the Visayan Sea caught a total of 14,540 kilograms and 2,535 kilograms of invertebrates. The fish catch was dominated by six families namely: (1) lizard fishes or kalaso (Synodontidae), 26.6%; (2) slipmouths or 50psap (Leionathidae), 14.33: (3) nemipterids or bisugo (Nemipteridae), 10.10%; (4) big eyes or dilat. (Priacanthidae), 6.7%; goatfishes or saramullete (Mullidae), 5.4%; and (6) glass -mojarras or hubad (Gerridae), 4.7%. A second group of families of lesser abundance with each family contributing 1 to 1.6% each are the crevalles and cavallas, sardines, scolopids, plotosid catfishes, groupers and devil fishes. The Visayan Sea trawl fishery is a typical multi-species fisheries of over 170 species which are mainly poor quality fish with relatively little value in the market. Quality fishes which are vulnerable to other gears occur as incidental catches.	Aprieto, V. L. Viloso, E. P.	Fisheries research journal of the Philippines 4, pp. 9–18	1979	Habitat Wild (Atlantic/Pacific)
44	Notes on fishes rare in the waters off the south shore of Long Island	[No Abstract Available - Description of stomach contents of wild cobia in the waters of New York.]	Briggs, P.T., Zawacki, C.S., Muschacke, F.M.	New York Fish and Game Journal 26, 195–197	1979	Habitat Wild (Atlantic/Pacific)
45	Survey of the charter boat troll fishery in North Carolina, 1977	North Carolina's 127 charter boats made 7,935 trips trolling for pelagic fishes in 1977. The number of boats fishing for pelagic species varied from 65 to 107 depending on the month. Excluding billfishes, 238,413 fish weighing 1.6 million pounds (726 metric tons) were caught, an average of 30 fish and 198 pounds per trip. Major species landed by weight were: king mackerel, <i>Scomberomorus cavalla</i> , 737,680 pounds (334.7t); bluefish, <i>Pomatomus saltatrix</i> , 244,618 pounds (110.0t); dolphin, <i>Coryphaena hippurus</i> , 174,735 pounds (79.3t); amberjack, <i>Seriola spp.</i> , 108,998 pounds (49.4t); and wahoo, <i>Acanthocybium solanderi</i> , 76,324 pounds (34.6t). Catch per unit effort varied with season and geographic area and reflected fish migrations. The highest catch rate occurred in October, 4.9 fish per trip, and the lowest in July, 16.3 fish per trip. Boats fishing out of Oregon Inlet and Hatteras Village usually caught a higher percentage of oceanic pelagic species (dolphin, tunas, etc.) and, as a result, had higher mean weights per fish landed.	Manooch III, C.S., Laws, S.T.	Marine Fisheries Review 41, 15–27	1979	Habitat Wild (Atlantic/Pacific)
46	Taxonomy and biology of North American species of <i>Goezia</i> (Nematoda: Anisakidae) from fishes, including three new species	Three new species of <i>Goezia</i> from fishes in North America are described and supplemental data for <i>G. minuta</i> and several unidentified adults and larvae are presented. Males, especially their caudal papillae, are necessary to identify most species. For the new species, <i>G. pelagia</i> sp. n. from <i>Rachycentron canadum</i> and <i>Chaetodipterusfaber</i> in the northern Gulf of Mexico possesses 12-19 preanal, two para-anal, and four postanal pairs of papillae; <i>G. kliksi</i> sp. n. from <i>Pogonias cromis</i> in Lake Borgne, Louisiana, has 10-16 preanal, two para-anal, and five postanal pairs of papillae, and <i>G. sinamora</i> sp. n. from <i>Tilapia aurea</i> , <i>Micropterus salmoides</i> , and <i>Morone saxatilis</i> in freshwater habitats in Florida possesses 13-16 preanal, two para-anal, and three postanal pairs of papillae.	Deardorff, T.L., Overstreet, R.M.	Proceedings of the Helminthological Society of Washington 47, 192–217	1980	Parasites Wild (Atlantic/Pacific)
47	New and rare records of Canadian fishes and the influence of hydrography on resident and nonresident Scotian shelf ichthyofauna	A recently initiated ichthyoplankton survey of the Scotian Shelf has discovered large numbers of subtropical/tropical expatriated fishes, mostly larvae, and at least two previously unrecognized populations. Thirty-three species in 25 primarily subtropical families (Carcharhinidae, Engraulidae, Synodontidae, Chlorophthalmidae, Ogcocephalidae, Antennariidae, Carapidae, Ophidiidae, Exocoetidae, Syngnathidae, Scorpaenidae, Triglidae, Dactylopteridae, Serranidae, Apogonidae, Branchiostegidae, Rachycentridae, Sciaenidae, Labridae, Scaridae, Callionymidae, Gobiidae, Bothidae, Cynoglossidae, and Ostraciontidae), seven species in four deepwater families (Gonostomatidae, Sternoptychidae, Myctophidae, and Moridae) and two gadoids are reported as new or rare records from the Canadian Atlantic. The frequency and quantity of subtropical expatriates raise the question of their ultimate fate. The existence of eastern Atlantic populations of some of these raises the possibility of transatlantic dispersal. Juvenile or adul..., Au cours d'un relevé ichthyoplanctonique récemment entrepris sur le plateau continental Scotian on a découvert un grand nombre de poissons subtropicaux/tropicaux expatriés, larves pour la plupart, et au moins deux populations ignorées jusqu'à maintenant. Nous signalons comme mentions nouvelles ou rares en Atlantique canadien 33 espèces appartenant à 25 familles principalement subtropicales (Carcharhinidae, Engraulidae, Synodontidae, Chlorophthalmidae, Ogcocephalidae, Carapidae, Ophidiidae, Exocoetidae, Syngnathidae, Scorpaenidae, Triglidae, Dactylopteridae, Serranidae, Apogonidae, Branchiostegidae, Rachycentridae, Sciaenidae, Labridae, Scaridae, Callionymidae, Gobiidae, Bothidae, Cynoglossidae et Ostraciontidae), sept espèces appartenant à quatre familles de profondeur (Gonostomatidae, Sternoptychidae, Myctophidae et Moridae) et deux gadoides. La fréquence et la quantité d'expatriés subtropicaux soulève la question de leur sort ultime. Comme il existe des populations de quelques-unes de ces espèces en Atla...	Markle, D.F., Scott, W.B., Kohler, A.C.	Canadian Journal of Fisheries and Aquatic Sciences 37, 49–65	1980	Habitat Wild (Atlantic/Pacific)
48	Studies on the digenetic trematodes from marine fishes from the Bay of Bengal, Part XVI	[No Abstract Available - On trematodes for various fish found in the Bay of Bengal.]	Ahmad, J.	Rivista di Parassitologia 42, 403–413	1981	Parasites Wild (Atlantic/Pacific)
49	Review of <i>Hysterothylacium</i> and <i>Iheringascaris</i> (both previously = <i>Thynnascaris</i>) (Nematoda : Anisakidae) from the northern Gulf of Mexico	The genus <i>Hysterothylacium</i> Ward and Magath (type-species <i>H. brachyurum</i> Ward and Magath) is resurrected to include those species previously considered as members of the junior synonym <i>Thynnascaris</i> Dollfus and others described in the genus <i>Contraecaeum</i> Railliet and Henry that mature in fishes	Deardorff, T.L., Overstreet, R.M.	Proceedings of The Biological Society of Washington 93, 1035–1079	1981	Parasites Wild (Atlantic/Pacific)
50	Observations on the intestinal pathology of the marine fish, <i>Rachycentron canadus</i> (Günther) infected with the Acanthocephalid worm, <i>Serrasentis nadakali</i> (George & Nadakal, 1978)	A study has been made on the intestinal pathology of the marine fish, <i>Rachycentron canadus</i> parasitised by the acanthocephalid worm, <i>Serrasentis nadakali</i> . Evidence indicates that the worm infection causes hyperplastic, metaplastic and hypertrophic changes involving respectively connective tissue, epithelial and muscle cells of the fish intestine. The worm attachment to the intestinal wall causes destruction of the villi, degeneration and necrosis of the mucosal epithelium. Cell types resembling epitheloids, lymphocytes, macrophages and cells of unknown identity aggregate at the infected area in response to inflammation. Excessive mucus secretion has also been observed.	George, P.V., Nadakal, A.M.	Hydrobiologia 78, 59–62	1981	Parasites Wild (Atlantic/Pacific)
51	Association of cobia, <i>Rachycentron canadum</i> , with cownose ray, <i>Rhinoptera bonasus</i>	Field and laboratory observations on an association of cobia, <i>Rachycentron canadum</i> with cownose ray, <i>Rhinoptera bonasus</i> are reported. Cobia main-tained a position in close proximity to the back of the rays. The cobia would move away from the rays to take food presented. This opportunistic and probably facultative feeding on rejected food scraps or displaced benthos may be the first step in the evolution of commensal attachment as has been shown for the remoras.	Smith, J.W., Merriner, J.V.	Estuaries 5, 240–242	1982	Habitat Wild (Atlantic/Pacific)
52	Life history requirements of selected finfish and shellfish in Mississippi Sound and adjacent areas	[No Abstract Available - Description of distribution and life history characteristics in Mississippi Sound.]	Benson, N.G.	FWS/OBS-81/51, U.S. Fish and Wildlife Service, p. 49-50	1982	Habitat Wild (Atlantic/Pacific)
53	Black kingfishes	[No Abstract Available - Description of distribution and landings of cobia in India.]	Pillai, P.K.M.	(No. 39), Technical and Extension Series. Marine Fisheries Information Service, Central Marine Fisheries Research Institute, Cochin, India, p. 12	1982	Wild (Atlantic/Pacific)
54	Division biologists complete inshore sportfish study	[No Abstract Available - Inshore study of sportfish and angling along Georgia Coastlines.]	Daigle, R.	Coastlines Georgia 7, 3–6	1984	Habitat Wild (Atlantic/Pacific)
55	Percoidei: Development and relationships	[No Abstract Available - As the largest and most diverse of the perciform suborders, the Percoidei exemplifies the inadequacies that characterize perciform classification. Regan (1913b) defined the Percoidei "by the absence of the special peculiarities which characterize the other suborders of the Percomorphi [=Perciformes]," and seventy years of research in systematic ichthyology have failed to produce a more meaningful definition. In the absence of even a single shared specialization uniting the percoids, the monophyly of this great assemblage of fishes is doubtful. In spite of our inability to adequately define the Percoidei, or because of it, half of the approximately 145 families of perciform fishes are usually referred to this suborder. Greenwood et al. (1966) listed 71 percoid families in their "highly tentative" familial classification of the Perciformes, and Nelson (1976) stated that the Percoidei contains 72 families, 595 genera and about 3,935 species.]	Johnson, G.D.	Percoidei: Development and relationships, in: Moser, H.G. (Ed.), Ontogeny and Systematics of Fishes, Special Publication Number 1, American Society of Ichthyologists and Herpetologists	1984	Wild (Atlantic/Pacific)
56	Catch composition and relative abundance of purse seine-caught fishes [Philippines]	Five settings of the purse seine on near shore fishing grounds in Southern Luzon and Central Visayas undertaken on August and October, 1983 on board the 390 gt m/v Sardinella, research and training vessel of the U.P. Visayas College of Fisheries, yielded a variety of dominant species of pelagic finfishes including <i>Auxis tapeinosoma</i> , <i>Euthynnus affinis</i> , <i>Rastrelliger faughni</i> , <i>Pempheris</i> sp., <i>Dusumiera acuta</i> and <i>Stolephorus</i> sp. and a number of incidentally-caught species often taken by pelagic as well as demersal gears. From 1 to 3 dominant species occur in great abundance comprising from 71.4 to 95.5% of catch in each haul. Different species dominated the catch in different fishing grounds. A variety of less abundant species contributed from less than 1 to 5% to each haul. Unlike in trawl fishing where each haul may yield over a hundred different species, no more than 20, but not less than 10 different species, were taken and no more than 3 species were dominant in each purse seine haul.	Aprieto, V. L.	University of Philippines Visayas Fishery Journal 1, 23–31	1985	Habitat Wild (Atlantic/Pacific)
57	FAO species identification sheets for fishery purposes. Field guide to the commercial marine and brackish-water species of Pakistan	This field guide includes the marine and brackish-water species of bony fishes, sharks, batoid fishes, lobsters, shrimps, crabs and cephalopods believed to be of interest to fisheries in Pakistan. Each major resources group is introduced by a general section on technical terms, followed by an annotated and illustrated list of the more important species which includes FAO names, local names commonly used (Sindhi, Baluchi and English), maximum size, habitat, fishing gear and interest to fisheries. A composite index of scientific and vernacular family and species names is also provided.	Bianchi, G.	Prepared with the support of PAK/77/033 and FAO (FIRM) Regular Programme. FAO, Rome. 200 pp.	1985	Wild (Atlantic/Pacific)
58	New records of fishes from the Mediterranean coast of Israel including Red Sea immigrants	Records of fishes found recently on the Mediterranean coast of Israel are presented. <i>Arius thalassinus</i> . <i>Rachycentron canadum</i> and <i>Pempheris vanicolensis</i> are of Red Sea origin and their presence is attributed to the proximity of the Suez Canal. <i>Caranx dentex</i> , <i>Dentex maroccanus</i> and <i>Chromogobius quadrivittatus</i> are known from the adjacent regions of the Mediterranean Sea.	Golani, D., Ben-Tuvia, A.	Cybius 10, 285–291	1986	Habitat Wild (Atlantic/Pacific)

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
59	Thoughts brought on by cobias	[No Abstract Available - A look into the behavior of cobia.]	Carr, A.	Animal Kingdom 90, 48–50	1987	Habitat Wild (Atlantic/Pacific)
60	Synopsis of biological data on the cobia <i>Rachycentron canadum</i> (Pisces: Rachycentridae)	Information on the biology and fisheries of cobia, <i>Rachycentron canadum</i> , is compiled and reviewed in the FAO species synopsis style. Topics include taxonomy, morphology, distribution, reproduction, pre-adult and adult stages, food, growth, migration, population characteristics, and various aspects of exploitation. Data and information were obtained from unpublished as well as published sources. Cobia, the only species in the family Rachycentridae, is a migratory pelagic fish that occurs in tropical and subtropical seas of the world, except in the central and eastern Pacific Ocean. In the western Atlantic Ocean, spawning occurs during the warm months. Eggs and larvae are planktonic. Females grow faster than males: at 1 year, females are 36 cm FL and 0.4 kg; at 4 years, 99 cm and 11 kg; and at 8 years, 137 cm and 31 kg. Comparable data for males are: at 1 year, 31 cm and 0.3 kg; 4 years, 82 cm and 6 kg; and 8 years, 108 cm and 15 kg. Sexual maturity is attained by males at about 52 cm FL in their second year and by females at about 70 cm in their third year. Fecundity for females 100-125 cm FL varies from 1.9 to 5.4 million eggs. Cobia favor crustaceans for food, but will feed on other invertebrates and fishes as well. They attain a maximum size of over 60 kg. Cobia are fished both commercially and recreationally. Commercially, they are usually caught incidentally in both hook-and-line and net fisheries. In the United States, which ranks behind Pakistan, Mexico, and the Philippines in commercial production of cobia, recreational landings exceed commercial landings by more than ten-fold.	Shaffer, R.V., Nakamura, E. L.	FAO Fisheries Synopsis. 153 (National Marine Fisheries Service/S 153), U.S. Department of Commerce, NOAA technical Report NMFS 82, National Marine Fisheries Service, Washington, D.C. 32 pp.	1989	Habitat Regulations/Policy Spawning Sustainability Wild (Atlantic/Pacific)
61	A comparative analysis of the fish assemblages associated with old and new shipwrecks and fish aggregating devices in Onslow Bay, North Carolina	As an aid to determining the best artificial habitat for use by North Carolina's pelagic sport fishermen, we examined the fish assemblages associated with three structurally different artificial reefs: an old dredge wreck (ca 1940s); a new tugboat wreck (placed February 1985); and four arrays of FADS (deployed May, 1985). The fish populations were estimated by use of the stationary diver survey technique. Surveys were performed on 19 days (weather permitting) during the period of June to December 1985. A total of 48 species was recorded in association with the structures during the survey period. Species richness was highest at the dredge (40 species), high on the recently sunken tugboat (37 species), and, low on the FADs (16 species). Species diversity for each site followed the same pattern, and species evenness did not differ significantly between the dredge and tugboat. Dense mixed schools of semipelagic baitfish (<i>Decapterus punctatus</i> and <i>Harengula jaguana</i>) were the most abundant species associated with each structure; however they were more abundant at the FADs than at the tugboat and dredge, and more abundant at the tug than at the dredge. Statistically significant differences occurred in the abundances of eight of the overall ten most abundant species between the tug and FADs, in five of the species between the tug and dredge, and in nine species between the FADs and dredge. The FADs attracted the greatest number of pelagic species, although a number of them were only present as juveniles. Adult Spanish mackerel (<i>Scomberomorus maculatus</i>), little tunny (<i>Euthynnus alletteratus</i>), and cobia (<i>Rachycentron canadum</i>) were present in similar abundances at all sites, while greater amberjack (<i>Seriola dumerilii</i>) was more abundant at the dredge and tug than the FADs. Two general temporal abundance curves for structure inhabitants were identified. The first showed a greater abundance of individuals between July and October and exemplified warm water or non-residential species such as Spanish mackerel and blue runner (<i>Caranx crysos</i>). The second type of curve did not show this pattern and was typical of more temperate species such as pigfish (<i>Orthopristis chrysoptera</i>) and spottail pinfish (<i>Diplodus holbrookii</i>).	Stephan, D.C., Lindquist, D. G.	Bulletin of Marine Science 44, 698–717	1989	Wild (Atlantic/Pacific)
62	Omega-3 polyunsaturated fatty acid content of some popular species of Arabian Gulf fish	Twenty of the popular species of fish caught in the Qatari water of the Arabian Gulf were analyzed for the fatty acid content of the edible portions. All species studied contained several fatty acids of the important omega-3 polyunsaturated group. The level of this group varied from a low of about 0.035 to a high of more than 3 g/100 g edible tissue most of which was made up of the two major acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Sardines had the highest content of the total omega-3 polyenoic fatty acids with more than 3 g/100 g edible tissue followed by Grey Sweet Lip which contained nearly 0.7 g/100 g. Medium levels of around 0.3–0.4 g/100 g were found in Malabar Cavalla, Orange Spot Trevally, Crevalle, Black Spot Snapper, Black-Fin Crevalle, King Mackerel and Mullet. Low levels of less than 0.2 g were found in Common Mojarra, Golden Trevally, Red Snapper, Cobia, Rabbit Fish, Porgy, Greasy Grouper, Grey Dog Shark and Orange Emperor. Low levels were also found in crab (0.22 g) and shrimp (0.08 g). This study shows that there are several species of Arabian Gulf fish considered as good sources of the omega-3 polyunsaturated fatty acids. The widely popular species of Greasy Grouper was found, however, a poor source for this essential group of fatty acids.	Kotb, A.R., Hadeed, A.F.A., Al-Baker, A.A.	Food Chemistry 40, 185–190	1991	Fish Nutrition Wild (Atlantic/Pacific)
63	Factors affecting the abundance of selected fishes near oil and gas platforms in the northern Gulf of Mexico	A logbook program was initiated to determine the relative abundance of selected fish species around oil and gas platforms off the Louisiana coast. Logbooks were maintained by 55 anglers and 10 charterboat operators from March 1987 to March 1988. A total of 36 839 fish were caught representing over 46 different species. Principal component analysis (PCA) grouped the 17 most abundant species into reef fish, pelagic fish, bluefish-red drum, Atlantic croaker-silver/sand seatrout, and cobia-shark-blue runner associations. Multiple regression analyses were used to compare PCA groupings to physical platform, temporal, geological, and angler characteristic variables and their interactions. Principal component analysis (PCA) grouped the seventeen most abundant species into reef fish, pelagic fish, bluefish-red drum, Atlantic croakersilver/sand seatrout, and cobia-sharkblue runner associations. Multiple regression analyses were used to compare PCA groupings to physical platform, temporal, geological, and angler characteristic variables and their interactions. Reef fish, Atlantic croaker, and silver/sand seatrout abundances were highest near large, structurally complex platforms in relatively deep water. High spotted seatrout abundances were correlated with small, unmanned oil and gas platforms in shallow water. Pelagic fish, bluefish, red drum, cobia, and shark abundances were not related to the physical parameters of the platforms.	Stanley, D.R., Wilson, C.A.	Fishery Bulletin 89, 149–159	1991	Wild (Atlantic/Pacific)
64	Larval development, distribution, and ecology of cobia <i>Rachycentron canadum</i> (Family: Rachycentridae) in the northern Gulf of Mexico	Cobia is a highly prized recreational species of worldwide distribution in tropical and subtropical seas, but the development, distribution, and ecolog-J of its early life stages are poorly known. Eggs are spherical, average 1.24mm in diameter, and have a single oil globule (mean diameter 0.45 mm). The perivitelline space is narrow and the embryo heavily pigmented. Eggs hatch in about 24h at 29°C based on the relationship between egg diameter and water temperature to predict development time in other marine fishes. Larvae hatch at about 2.5mmSL. Cobia spawn in both estuarine and shelf waters during the day, and eggs and larvae are usually collected in the upper meter of the water column. Larvae are recognized by the large supraorbital ridge with a single spine, laterally swollen pterotics, heavy body pigmentation, minute epithelial spicules covering the body integument, and a pair of moderate-to-large, simple spines on either side of the angle of the posterior preoperculum. Only 70 larvae <20mmSL were collected and identified from the Gulf of Mexico between 1967 and 1988; most occurred between June and September at surface temperatures ~25°C, salinities >27‰/00, and within the 100m depth contour. Similar patterns of head spination provide evidence of a sister-group relationship between cobia and dolphinfish rather than that previously hypothesized between cobia and remoras.	Ditty, J.G., Shaw, R.F.	Fishery Bulletin 90, 668–677	1992	Wild (Atlantic/Pacific)
65	Culture of cobia (<i>Rachycentron canadum</i>): cryopreservation of sperm and induced spawning	Studies toward the development of cobia (<i>Rachycentron canadum</i>) aquaculture were initiated. Methods of cryopreserving cobia sperm were compared and sperm motility was assessed after longterm frozen storage. Sperm stored in 10% dimethyl sulfoxide, 3 mM glucose, and 10% raw chicken egg yolk showed approximately 100% motility upon thawing after more than 1 year of storage at –80°C. Sperm motility declined after about 60 min at room temperature, but approximately 100% motility could be restored by addition of a few drops of 5 mM theophylline. Ripe, wild-caught female cobia were held in recirculating seawater systems and ovulation was induced by injection of human chorionic gonadotropin at a concentration of 275 IU/kg of body weight. Fertilization was attempted using the cryopreserved sperm. Although fertilization did not occur, we are optimistic that cobia aquaculture is feasible.	Caylor, R.E., Biesiot, P.M., Franks, J.S.	Aquaculture 125, 81–92.	1994	Spawning RAS
66	Biochemical and histological changes during ovarian development of cobia, <i>Rachycentron canadum</i> , from the northern Gulf of Mexico	Female cobia, <i>Rachycentron canadum</i> , were sampled on their spawning grounds in the northern Gulf of Mexico to study changes in proximate analysis (protein, lipid, carbohydrate, and ash) of the ovaries during gonadal maturation. Four major stages of oocyte development were studied: stage 1, pre-vitellogenesis; stage 2, vitellogenesis; stage 3, final maturation; and stage 4, post ovulation. Cobia are multiple spawning fish; therefore, ovaries engaged in a sequential round of oogenesis were distinguished as stages 1' and 2'. Protein was the major constituent of cobia ovaries and its contribution remained fairly constant (49-55% of the dry weight) throughout all stages of development. Lipid was the second most abundant component but the levels, ranging from 21 to 41%, changed depending on the stage of ovarian development. Lipid concentration increased from stage 1 through 3 and decreased slightly in stage 4; it was lower in stage-1 than in stage-1' ovaries but was the same in stages 2 and 2'. Carbohydrate was the least abundant component (3-4%) whereas ash ranked third (6-20%). Most cobia were in pre-spawning condition (stages 1-3) when they arrived in the northern Gulf of Mexico in April and May; some pre-spawning fish (stages 1 and 2) were also observed in August and September about a month or two before migration to the overwintering grounds normally occurs. Cobia undergoing sequential spawning episodes (stages 1' and 2') were captured from April through August. Gonosomatic indices (GSI) were calculated both for ovarian developmental stage and for month of capture. Mean GSI increased as ovarian development proceeded and decreased during post-ovulation; GSI for month of capture was highest during April and May when the pre-spawning fish first appeared in northern Gulf of Mexico waters.	Patricia, B.M., Caylor, R.E.	Fishery Bulletin 92, 686–696	1994	Spawning Wild (Atlantic/Pacific) Physiology
67	Stomach contents of juvenile cobia, <i>Rachycentron canadum</i> , from the northern Gulf of Mexico	[No Abstract Available - Knowledge of the feeding habits of juvenile cobia is necessary for understanding the role of diet in the recruitment processes of this economically important species and is a necessary prerequisite for management of this resource. The specific objective of this study was to analyze quantitatively the diet of juvenile cobia from the northern Gulf of Mexico.]	Franks, J.S., Garber, N.M., Warren, J.R.	Fishery Bulletin 94, 374–380	1996	Wild (Atlantic/Pacific)
68	Age and growth of cobia, <i>Rachycentron canadum</i> , from the northeastern Gulf of Mexico	We examined 1005 cobia, <i>Rachycentron canadum</i> , from recreational catches in the northeastern Gulf of Mexico from 1987 to 1995. Specimens ranged from 325 to 1651 mm fork length (FL); females had a mean FL of 1050 mm (n=730) and were significantly larger than males that had a mean FL of 952 mm (n=275). The overall male to female ratio was 1:2.7. Ages of 565 cobia were estimated from thinsectioned otoliths (sagittae). Marginal increment analysis of sagittal otoliths showed a single annual minimum during June. Male cobia (n=170; 525–1330 mm FL) ranged from age 0 to 9, and females (n=395; 493–1651 mm FL) ranged from age 0 to 11. The relationship of observed fork length and age was described by the von Bertalanffy growth equation for males $FL_t = 1171(1 - \exp[-0.432(t+1.150)])$ and for females $FL_t = 1555(1 - \exp[-0.272(t+1.254)])$. Growth in length for both sexes was relatively fast through age 2, after which growth slowed gradually. Estimates of the von Bertalanffy growth equation parameters L_∞ and K were significantly different for males and females, whereas estimates for t0 were not significantly different. Sagittal otolith weight was a good predictor of age. The instantaneous rate of total mortality (Z) estimated by catch curve analysis for fully recruited ages 4–8 was 0.75.	Franks, J.S., Warren, J.R., Buchanan, M.V.	Fishery Bulletin 97, 459–471	1999	Wild (Atlantic/Pacific)
69	Stock assessment and fishery evaluation report for king mackerel, Spanish mackerel, and cobia, Fishery management plan for coastal migratory pelagics. Volume I	The SAFE report for the mackerel/cobia fishery managed under the Coastal Migratory Pelagics Fishery Management Plan in the South Atlantic and Gulf of Mexico was compiled by South Atlantic Council staff with input from NMFS SERO and NMFS SEFSC. Our goal was to include the most recent information on issues that have been raised or are likely to be raised during the Council's review of the mackerel/cobia stock and fishery. The detailed information is found in the attached reports and we have only attempted to extract a very brief overview for inclusion in Sections 2, 3 and 4.	SAFMC	South Atlantic Fishery Management Council, Charleston, SC. 649 pp.	1999	Wild (Atlantic/Pacific)
70	<i>Dionchus</i> Postoncomiracidia (Monogenea: Dionchidae) on the Skin of Blacktip Sharks, <i>Carcharhinus limbatus</i> (Carcharhinidae)	Postoncomiracidia of <i>Dionchus</i> sp. are described from specimens collected from the skin of 2 blacktip sharks <i>Carcharhinus limbatus</i> , captured in the northern Gulf of Mexico. The parasites resemble nonciliated oncomiracidia hatched from eggs laid by <i>Dionchus</i> sp. on gills of a cobia <i>Rachycentron canadum</i> and adults of <i>Dionchus</i> remorae that were collected from gills of a common sharksucker <i>Echeneis naucrates</i> , captured in association with a third blacktip shark. The hamuli of the postoncomiracidia were morphologically similar to those of adult <i>D. remorae</i> . This is the first report of dionchids from an elasmobranch and from a location other than the gills. These findings support the idea that some dionchid oncomiracidia colonize the skin of sharks or other aquatic vertebrates that sponsor remoras, prior to transferring to other remoras and maturing.	Bullard, S.A., Benz, G.W., Braswell, J.S.	The Journal of Parasitology 86, 245–250	2000	Wild (Atlantic/Pacific) Parasites

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
71	Reproductive biology of cobia, <i>Rachycentron canadum</i> , from coastal waters of the southern United States	Reproductive biology of the cobia, <i>Rachycentron canadum</i> , is described from four coastal areas in the southern United States. Samples were obtained from recreational fishermen between December 1995 and November 1997 from the southeastern United States (Morehead City, NC, to Cape Canaveral, FL), the eastern Gulf of Mexico (Ft. Myers to Crystal River, FL), the north-central Gulf of Mexico (Destin, FL, to Chandeleur Islands, LA) and the western Gulf of Mexico (Port Aransas, TX). Histological evidence of spawning occurred from April through September in all areas. Some female cobia (17-32%) throughout the Gulf of Mexico had spent or regressed ovaries by July. Gonadosomatic index peaked between May and July throughout the region. Ovaries of females from all areas contained both postovulatory follicles (POF) and oocytes in final oocyte maturation (FOM) during all months of the reproductive season. Batch fecundity was calculated by using three different methods: oocytes [is greater than] 700 μ m were fixed in 1) Gilson's fixative or 2) 10% neutral buffered formalin (NBF), and 3) oocytes undergoing FOM were sectioned for histological examination. Mean batch fecundity ranged from 377,000 [+ or -] 64,500 to 1,980,500 [+ or -] 1,598,500 eggs; there was no significant difference among methods. Batch fecundity calculated with the NBF method showed a positive relationship with fork length ($P=0.021$, [r.sup.2]=0.132) and ovary-free body weight (OFBW; $P=0.016$, [r.sup.2]=0.143). Relative batch fecundity was not significantly different among months during the spawning season and averaged 53.1 [+ or -] 9.4 eggs/g OFBW for the NBF method and 29.1 [+ or -] 4.8 eggs/g OFBW for the FOM method. Although spawning frequencies were not significantly different among areas ($P=0.07$), cobia from the southeastern United States and north-central Gulf of Mexico were estimated to spawn once every 5 days, whereas cobia from the western Gulf of Mexico were estimated to spawn once every 9 to 12 days.	Brown-Peterson, N.J., Burns, K.M., Franks, J.S., Lotz, J.M., Overstreet, R.M.	Fishery Bulletin 99, 15	2001	Wild (Atlantic/Pacific)
72	Stomach content analysis of cobia, <i>Rachycentron canadum</i> , from lower Chesapeake Bay	[Tag-recapture data collected between 1995 and 1999 document localized movement of cobia within lower Chesapeake Bay during summer, as well as the return of individual cobia to specific locations or general regions of the lower Bay in subsequent summers. (1) Although Chesapeake Bay is an important destination for migrating cobia, feeding habits of cobia in the Bay have never been thoroughly examined. Our study documents cobia feeding habits in Chesapeake Bay and compares findings with similar cobia studies from North Carolina and the northern Gulf of Mexico.]	Arendt, M.D., Lucy, J.A., Olney, J.E.	Fishery Bulletin 99, 665-670	2001	Wild (Atlantic/Pacific)
73	Optimal dietary protein and lipid levels for juvenile cobia (<i>Rachycentron canadum</i>)	Two growth trials were conducted to investigate the optimal concentrations of dietary protein and lipid for cobia, a pelagic fish showing great potential for offshore cage culture in tropical and subtropical waters. In the first trial, casein was added to a fish meal-based basal diet to replace starch to render protein concentration gradation ranging between 36% to 60%. All seven diets were estimated to be isoenergetic. After an 8-week growth trial, juvenile cobia (initial weight 33 g) fed the diets containing protein concentrations of 44%, 48% and 52% generally attained higher weight gain and feed conversion than the other groups. Polynomial regression analysis revealed a weight gain peak at a dietary protein concentration of 44.5%, which is regarded as the most suitable level for maximum fish growth. In the second trial, the cobia were fed seven isonitrogenous and isoenergetic test diets containing lipid concentrations ranging from 3% to 18%. Growth of the fish (initial weight 41 g) was lowest when the dietary lipid concentration was 3%. Weight gain increased with increasing lipid inclusion and then leveled off. The broken-line analysis that best expressed the response pattern shows a breakpoint when dietary lipid concentration was 5.76%. No significant growth enhancement was observed when the lipid levels were increased beyond the breakpoint to the highest lipid concentration tested (18%).	Chou, R.-L., Su, M.-S., Chen, H.-Y.	Aquaculture 193, 81-89	2001	Fish Health Nutrition
74	Mass mortality associated with a <i>Sphaerospora</i> -like myxosporidean infestation in juvenile cobia, <i>Rachycentron canadum</i> (L.), marine cage cultured in Taiwan	Cultured cobia, <i>Rachycentron canadum</i> , of 45-80 g exhibited anaemia and ascites, and a mottled red and grey, extremely enlarged kidney with cream-coloured patches or spherical nodules. Cumulative mortality was about 90% within 1 month. Extrasporogonic or sporogonic stages of a myxosporidean appeared in the blood, glomerulus, renal tubules and renal interstitium. The renal tubules were the main target tissue of the parasite and were completely occluded by sporogonic pseudoplasmodia at various degrees of maturity. Many sporogonic stages were attached to the brush border of the epithelium of the renal tubules. Mature spores were seen in the lumen of the tubules. They were elongated or spherical with numerous refractile granules in the cytoplasm. The polar filament formed 3-5 coils. No bacteria or viruses were isolated from the diseased fish. Based on the results of microbiological, histopathological and electron microscopical examinations, the cobia disease was believed to be caused by a <i>Sphaerospora</i> -like myxosporidean. This is the first report of a myxosporidean in cobia in aquaculture.	Chen, S.-C., Kou, R.-J., Wu, C.-T., Wang, P.-C., Su, F.-Z.	Journal of Fish Diseases 24, 189-195	2001	Cage Culture Fish Health Parasites Microbiology
75	Susceptibility of fish cultured in subtropical area of Japan to Red Sea Bream Iridovirus	Susceptibilities of spangled emperor <i>Lethrinus nebulosus</i> , estuary cod <i>Epinephelus malabaricus</i> and cobia <i>Rachycentron canadum</i> cultured in subtropical Japan to red sea bream iridovirus (RSIV) were studied by experimental infections. Estuary cod showed as high susceptibility to RSIV as red sea bream <i>Pagrus major</i> . In contrast, the susceptibilities of spangled emperor and cobia to the virus were comparatively low. The result corresponds with the occurrence of the disease in the net cages.	Sano, M., Minagawa, M., Sugiyama, A., Nakajima, K.	Fish Pathology 36, 38-39	2001	Parasites Cage Culture Fish Health Microbiology
76	<i>Vibrio alginolyticus</i> infection in cobia (<i>Rachycentron canadum</i>) cultured in Taiwan	<i>Vibrio alginolyticus</i> was isolated from cobia (<i>Rachycentron canadum</i>) for the first time from floating marine cages placed near the Penghu Island, Taiwan during an epizootic outbreak in October of 2000. The identity of the isolate was confirmed as <i>Vibrio alginolyticus</i> by biochemical test. The epizootic was effectively controlled by the oral administration of oxytetracyclin.	Rajan, P.R., Lopez, C., Lin, J. H.-Y., Yang, H.-L.	Bulletin of the European Association of Fish Pathologists 21, 228-234	2001	Fish Health Cage Culture Parasites
77	Spontaneous spawning of cobia, <i>Rachycentron canadum</i> , induced by human chorionic gonadotropin (HCG), with comments on fertilization, hatching, and larval development	Two mature female cobia, <i>Rachycentron canadum</i> , injected with a single dose of human chorionic gonadotropin (HCG) at 275 IU/ kg of body weight, and one non-injected ripe male spawned spontaneously in captivity. Oocytes aspirated from each female prior to injection were maturing vitellogenic oocytes nearing the final oocyte maturation (FOM) stage and averaged 625 μ in diameter. Both females spontaneously spawned ~ 42 hours post-injection; spawned oocytes ranged 1.1 - 1.3 μ in diameter. Fertilized eggs hatched ~26 hours later. Estimates for number of eggs spawned (both females combined) and hatched were 3.2 million and 320,000, respectively. Aspects of embryogenesis and larval growth/development were observed. Critical survival period for larvae was day 3 at which time termination of yolk sac absorption occurred and first feeding commenced. Enriched rotifers, wild zooplankton, and artificial food were offered larvae during larval rearing treatments. Larvae contained in a black tank and fed a high density diet of enriched rotifers exhibited highest survival and were reared through day 13, post-hatch. The study documents the spontaneous spawning of wild-caught male and female <i>R. canadum</i> from the Gulf of Mexico, and provides comments on fertilization, hatching and larval development. Results of the study strongly suggest that <i>R. canadum</i> exhibits potential as an aquaculture species.	Franks, J.S., Ogle, J.T., Lotz, J.M., Nicholson, L.C., Barnes, D.N., Larsen, K.M.	Proceedings of the Gulf and Caribbean Fisheries Institute 52, 598-609	2001	Spawning Wild (Atlantic/Pacific)
78	Spawning of cobia <i>Rachycentron canadum</i> in captivity	[No Abstract Available - This report apparently represents the first natural spawn of cobia raised from subadult to sexual maturity in an indoor, recirculating tank system. These results show that spawning by cobia utilizing indoor tanks can be induced with photoperiod and temperature cycles. Manipulating and extending the spawning cycle is an essential first step to attain reliable, year-round egg production for the development of cobia aquaculture in the US.]	Arnold, C.R., Kaiser, J.B., Holt, G.J.	Journal of the World Aquaculture Society 33, 205-208	2002	Spawning RAS
79	Annual changes in germinal epithelium determine male reproductive classes of the cobia	Five reproductive classes of cobia <i>Rachycentron canadum</i> , caught along the Gulf of Mexico and the south-east Atlantic coast of the U.S.A., are described during the annual reproductive cycle. These are based upon changes in the testicular germinal epithelium and the stages of germ cells that are present: early maturation, mid maturation, late maturation, regression and regressed. During early maturation, the germinal epithelium is continuous from the testicular ducts to the periphery of the testis and active spermatogenesis occurs throughout the testis. In mid maturation, the germinal epithelium near the ducts becomes discontinuous, but it remains continuous distally. In late maturation, a discontinuous germinal epithelium extends all along the lobules to the testicular periphery; lobules are swollen with sperm and there is minimal spermatogenesis. The regression class is characterized by a discontinuous epithelium throughout the testis, sperm storage and widely scattered spermatocysts. Spermatogonial proliferation also occurs along the lobule walls and at the periphery of the testis. In regressed testes, spermatogonia exist only in a continuous or discontinuous germinal epithelium, although residual sperm are nearly always present in the lobules and ducts. The presence or absence of sperm is not an accurate indicator of reproductive classes. At the periphery of the testis in the regression and regressed classes, the distal portions of lobules elongate as cords of cells containing spermatogonia and Sertoli cells. All reproductive classes can be identified in paraffin sections, although plastic sections provide better resolution. Using maturation classes defined by changes in the germinal epithelium to describe testicular development and spermatogenesis gives a more accurate picture than does using the traditional terminology.	Brown-Peterson, N.J., Grier, H.J., Overstreet, R.M.	Journal of Fish Biology 60, 178-202	2002	Spawning Wild (Atlantic/Pacific)
80	Study on cobia, <i>Rachycentron canadum</i> , over-wintering using the high-density indoor recirculating system [Chinese]	This study was carried out in three stages under various stocking density of cobia, <i>Rachycentron canadum</i> , in a recirculating system for over-wintering. In the first stage, 12,000 fish averaged 4.1 g were evenly stocked in 6 FRP tanks. Stocking density was 571 fish/m ³ . After 15 days, rearing average body weight of cobia was 18±1 g and survival rate was 92.24%. In the second stage, the stocking densities were 365, 480 and 594 fish/m ³ and the trial was conducted with duplicates for each density. A diet of and commercial formulated eel floating pellets fed three times daily. After 45 days, rearing average body weights were 49±2, 47±2 and 46±3 g, growth rates were 0.69±0.05, 0.65±0.01 and 0.62±0.07 g/d, survival rates were 98.59±0.64, 98.69±0.25 and 98.94±0.15%, and productivities were 17.62, 22.19 and 26.78 kg/m ³ respectively. In the third stage the stocking densities were 143, 214 and 286 fish/m ³ . After 30 days, rearing average body weights were 114±2, 111±5 and 107±2 g, growth rates were 2.18±0.18, 2.13±0.17 and 2.04±0.03 g/d, survival rates were all 100%, and productivities were 16.33, 23.70 and 30.46 kg/m ³ , respectively. The results showed that higher stocking density increased the productivity, but reduced the growth rate. Also, the higher the water temperature was, the higher the growth rate would be. When water temperature was 20°C, cobia grew very slow. When water temperature was raised to 23°C, the fish grew fast.	Huang, T.-S., Lin, K.-J., Chen, C.-C., Tsai, W.-S.	Journal of Taiwan Fisheries Research 10, 53-62	2002	Culture RAS Fish Health Nutrition
81	Lipid nutrition and feeding of cobia <i>Rachycentron canadum</i> larvae	This study examined the fatty acid composition of cobia <i>Rachycentron canadum</i> eggs and yolk sac larvae, as well as the ovaries of wild caught females as an initial guide to lipid nutritional requirements. A 2-wk feeding study also was conducted to investigate the effectiveness of four dietary treatments on the growth and survival of cobia larvae. Cobia eggs from the tailbud stage contained 31.4 ± 1.3 μ g lipid/egg. After hatching, the amount of lipid decreased significantly ($P < 0.05$) from 28.3 ± 0.3 to 23.2 ± 0.1 μ g lipid/larvae during the yolk sac larval stage (days 1 to 3 after hatching). Ovaries from wild caught adults and captive spawned eggs and yolk sac larvae contained high levels of PUFAs with docosahexaenoic acid (DHA), eicosapentaenoic acid (EPA), and arachidonic acid (ARA) accounting for approximately 80% of the total suggesting that cobia larvae may have a high dietary requirement for these fatty acids. For the feeding study, larvae were fed: 1) <i>Artemia</i> only; 2) enriched rotifers for 1 d only + microparticulate diet (day 313); 3) enriched rotifers for 3 d (day 3-5) + <i>Artemia</i> (day 3-13); and 4) enriched rotifers for 6 d (day 3-8) + <i>Artemia</i> (day 3-13). Cobia larvae began feeding on rotifers 3 d after hatching and on newly hatched <i>Artemia</i> nauplii by the fifth day following the onset of exogenous feeding (day 7). On day 7, no differences in larval growth were found among larvae fed rotifers for 3 versus 6 d, whereas larvae fed only <i>Artemia</i> or rotifers for 1 d followed by microparticulate diet were significantly smaller ($P < 0.05$) and did not survive beyond day 9 and 13, respectively. The results of the feeding study indicate that cobia larvae require rotifers for a minimum of 4 d following the onset of exogenous feeding.	Faulk, C.K., Holt, G.J.	Journal of the World Aquaculture Society 34, 368-378	2003	Culture Fish Health Nutrition
82	Virulence of <i>Photobacterium damsela</i> subsp. <i>piscicida</i> in cultured cobia <i>Rachycentron canadum</i>	An outbreak of serious mortality among the cultured cobia <i>Rachycentron canadum</i> (weighing 3 kg) characterized by the presence of whitish granulomatous deposits on the kidney, liver and spleen occurred in July of 2000 in Taiwan. A non-motile strain CP1 was isolated from kidney and/or liver on tryptic soy agar and/or brain heart infusion agar plates (both supplemented with 1% NaCl, w/v). This strain was characterized and identified as <i>Photobacterium damsela</i> subsp. <i>piscicida</i> using biochemical characteristics and bionor mono-Pp tests. The bacterium and its extracellular products (ECP) were lethal to the cobia (weighing 10 g) with LD50 values of 1.03 × 10 ⁴ colony forming units and 1.26 μ g protein/g fish body weight, respectively. All the moribund/dead fish exhibited darkness in color with no gross or internal lesions. However, the bacteria could be reisolated from kidney and liver after bacterial challenge. The present results reveal that <i>Ph. damsela</i> subsp. <i>piscicida</i> is the causative agent of fish photobacteriosis in the cobia and the bacterium isolated from sub-adult cobia (chronic form) is virulent to young cobia causing acute form of the disease.	Liu, P.-C., Lin, J.-Y., Lee, K.-K.	Journal of Basic Microbiology 43, 499-507	2003	Culture Fish Health Parasites Microbiology
83	Effects of salinity on growth, survival, and selected hematological parameters of juvenile cobia <i>Rachycentron canadum</i>	Cobia <i>Rachycentron canadum</i> juveniles (119.7 mm TL, weight 8.5 g) were reared for 10 wk at three salinity levels: 5 ppt, 15 ppt, and 30 ppt. Growth and survival were determined through biweekly sampling. Blood samples obtained at termination of the study were analyzed to determine hematocrit, blood osmolality, and total protein. Results indicated that the overall growth of fish was significantly affected by salinity. Mean (\pm SE) total length (TL) and weight of fish reared at a salinity of 30 ppt were 201.7 ± 2.6 mm and 47.6 ± 1.9 g, respectively, followed by fish reared at 15 ppt (182.2 ± 1.7 mm, 34.1 ± 1.6 g), and 5 ppt (168.3 ± 5.8 mm TL, 28.3 ± 2.3 g). Differences in specific growth rates among treatments for the 10-wk period were also significant. No differences were detected in mean survival among fish reared at salinities of 5, 15, and 30 ppt (84, 94, and 94%, respectively). However, fish reared at salinity 5 ppt appeared to be in poor health as skin lesions, fin erosion, and discoloration were evident. Analysis of blood revealed that, while no differences existed among treatments with respect to plasma total protein, fish reared at a salinity of 5 ppt exhibited significantly reduced hematocrit (25% vs. > 30%) and plasma osmolality values (318 vs. > 353 mmol/kg) relative to fish reared at higher salinities. Cobia can tolerate exposure to low salinity environments for short periods of time without mortality; however, moderate to high salinities are required for sustained growth and health of this species.	Denson, M.R., Stuart, K.R., Smith, T.I.J., Weirlich, C.R., Segars, A.	Journal of the World Aquaculture Society 34, 496-504	2003	Culture Fish Health Water Quality

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
84	Fish tissue quality in the lower Mississippi River and health risks from fish consumption	Between 1990 and 1994, samples of three shellfish species (i.e. blue crab, <i>Callinectes sapidus</i> ; crayfish, <i>Procambarus acutis</i> ; and river shrimp, <i>Macrobrachium ohionii</i>) and 16 fish species and were collected at six sites along the lower Mississippi River by the Louisiana Department of Environmental Quality, Office of Water Resources in coordination with the US Environmental Protection Agency. The fish species included: bigmouth buffalo (<i>Ictiobus cyanelus</i>); blue catfish (<i>Ictalurus furcatus</i>); carp (<i>Cyprinus carpio</i>); channel catfish (<i>Ictalurus punctatus</i>); cobia (<i>Rachycentron canadum</i>); flathead catfish (<i>Pylodictis olivaris</i>); freshwater drum (<i>Aplodinotus grunniens</i>); largemouth bass (<i>Micropterus salmoides</i>); long nose gar (<i>Lepisosteus osseus</i>); red drum (<i>Sciaenops ocellatus</i>); red snapper (<i>Lutjanus campechanus</i>); smallmouth buffalo (<i>Ictiobus bubalus</i>); spotted gar (<i>Lepisosteus oculatus</i>); striped bass (<i>Morone saxatilis</i>); white bass (<i>Morone chrysops</i>); and white crappie (<i>Pomoxis annularis</i>). Organic compound and heavy metal concentrations were measured in 161 composite fish tissue samples where each composite included three to 10 individual fish. Nineteen chemicals, found at measurable levels in sample tissues, were used in calculations of lifetime excess cancer and non-cancer risks due to fish consumption. We calculated: 574 chemical-specific cancer risks; 41 total cancer risks; and 697 margins of exposure based on a consumption rate of one 8-ounce meal per week (0.032 kg/day), a body weight of 70 kg and reported cancer potency factors and reference doses. We identified nine species of concern (blue catfish, carp, channel catfish, cobia, crayfish, flathead catfish, red drum, spotted gar and striped bass) based on total cancer risk greater than 10 ⁻⁴ or margin of exposure greater than 1, and whether or not samples collected in subsequent years resulted in lower risks. The compounds primarily responsible for the elevated risks were aldrin, dieldrin, alpha-benzene hexachloride, gamma-benzene hexachloride, heptachlor epoxide, arsenic and mercury.	Watanabe, K.H., Desimone, F.W., Thiagarajah, A., Hartley, W.R., Hindrichs, A. E.	Science of The Total Environment 302, 109–126	2003	Wild (Atlantic/Pacific) Fish Health Nutrition
85	Species of <i>Stephanostomum</i> Looss, 1899 (Digenea: Acanthocolpidae) from fishes of Australian and South Pacific waters, including five new species	Nine species of <i>Stephanostomum</i> are described from Australian and Southern Pacific marine fishes: <i>Stephanostomum madhaviae</i> n. sp. [syn. <i>S. orientalis</i> of Madhavi (1976)] from <i>Caranx ignobilis</i> , off Hope Island, Queensland, with 30-34 circum-oral spines and vitelline fields almost reaching to the posterior extremity of the cirrus-sac; <i>S. bicoronatum</i> (Stossich, 1883) from <i>Argyrosomus hololepidatus</i> , off Southport Broadwater, Queensland; <i>S. vatonimoli</i> n. sp. from <i>Scamberoides lysan</i> , off Moorea, French Polynesia (type-locality) and Western Samoa, with 33-38 circum-oral spines, a uroproct and the vitelline fields not reaching the cirrus-sac; <i>S. nyoomwa</i> n. sp. from <i>Caranx sexfasciatus</i> , off Heron Island, Queensland, with 33-38 circum-oral spines, a uroproct and the vitelline fields reaching the cirrus-sac; <i>S. cobia</i> n. sp. from <i>Rachycentron canadum</i> , off Heron Island, with 36 circum-oral spines, a uroproct and the vitelline fields reaching the cirrus-sac; <i>S. petimba</i> Yamaguti, 1970 from <i>Seriola hippos</i> , off Rottneest Island, Western Australia; <i>S. pacificum</i> (Yamaguti, 1951) from <i>Pseudocaranx wrighti</i> , off Fremantle, Western Australia; <i>S. aaravi</i> n. sp. from <i>Lethrinus miniatus</i> , off Heron Island, with 36-39 circum-oral spines, probably a uroproct and the vitelline fields reaching the ventral sucker; <i>S. pagrosomi</i> (Yamaguti, 1939) from <i>L. nebulosus</i> , <i>L. miniatus</i> and <i>L. atkinsoni</i> off Heron Island, <i>Pagrus auratus</i> , off Rottneest Island, Western Australia and <i>Gymnocranius audleyi</i> , off Heron Island. A digest of described species of <i>Stephanostomum</i> is included as an appendix.	Bray, R.A., Cribb, T.H.	Systematic Parasitology 55, 159–197	2003	Parasites Wild (Atlantic/Pacific)
86	Genetic and antigenic analysis of betanodaviruses isolated from aquatic organisms in Taiwan	Viral nervous necrosis (VNN) is a worldwide disease among marine fishes. In Taiwan, NNN disease was first identified in 2 species of hatchery-reared grouper, <i>Epinephelus fuscogutatus</i> and <i>E. akaaya</i> in 1994. Since then, increasing mortalities have occurred among groupers <i>Epinephelus</i> spp., and also among European eels <i>Anguilla anguilla</i> L., yellow-wax pompano <i>Trachinotus falcatus</i> , firespot snapper <i>Lutjanus erythropterus</i> B., barramundi <i>Lates calcarifer</i> , cobias <i>Rachycentron canadum</i> , humpback groupers <i>Cromileptes altivelis</i> and Chinese catfish <i>Parasilurus asotus</i> . In the present study, samples were collected from affected fishes and processed for reverse transcriptase (RT) PCR amplification and virus isolation in cell culture. Infected cells (GF-1 cell line) exhibited cytopathic-effect characteristics of grouper nervous necrosis virus (GNNV). A RT-PCR product of approximately 830 bp was amplified from the brain homogenate of tested samples and sequenced. The nucleotide and deduced amino acid sequences of the amplified RT-PCR products from all isolates were strongly homologous (>97%) with the corresponding region of the published sequence of red-spotted grouper nervous necrosis virus (RGNV). Therefore, all Taiwan NNV (nervous necrosis virus) isolates studied in this report belong to the RGNV genotype. We used 5 neutralizing monoclonal antibodies (MAbs) against GNNV to analyze the antigenic relationship of Taiwan NNV isolates and striped jack nervous necrosis virus (SJNNV). The results of neutralization tests revealed that all Taiwan NNV isolates were closely related, but antigenically different from SJNNV in 3 neutralizing epitopes. To our knowledge, this is the first description of NNV infection in European eels, yellow-wax pompano, firespot snapper, cobia and Chinese catfish, and the first reported instance of natural NNV infection in freshwater fishes causing high mortality.	Chi, S.C., Shieh, J.R., Lin, S.J.	Diseases of Aquatic Organisms 55, 221–228	2003	Fish Health Culture Microbiology
87	Simple and rapid detection of <i>Photobacterium damsela</i> ssp. <i>piscicida</i> by a PCR technique and plating method	To detect <i>Photobacterium damsela</i> ssp. <i>piscicida</i> using the PCR technique and plating method. Two strains of <i>P. damsela</i> ssp. <i>piscicida</i> were isolated from cultured cobia (<i>Rachycentron canadum</i>) at two different fish farms in Taiwan. A pair of primers was designed to detect the capsular polysaccharide gene of <i>P. damsela</i> ssp. <i>piscicida</i> by PCR. Reference strains of different genus and different clinical strains were used for this study. The expected product (410 bp) was obtained from both <i>P. damsela</i> ssp. <i>piscicida</i> and <i>P. damsela</i> ssp. <i>damsela</i> , and they were differentiated by culturing on thiosulphate citrate bile salts–sucrose agar (TCBS-1). <i>Photobacterium damsela</i> ssp. <i>damsela</i> grew on TCBS-1 producing green colonies whereas <i>P. damsela</i> ssp. <i>piscicida</i> did not grow. The methods used are cost and labour effective when compared with the other methods and commercially available kits. This work provides an integrated set of methods to identify the species <i>P. damsela</i> and to differentiate <i>P. damsela</i> ssp. <i>piscicida</i> from <i>P. damsela</i> ssp. <i>damsela</i> .	Rajan, P.R., Lin, J.H.-Y., Ho, M.-S., Yang, H.-L.	Journal of Applied Microbiology 95, 1375–1380	2003	Fish Health Microbiology
88	Candidate species for open ocean aquaculture: The successful case of Cobia <i>Rachycentron canadum</i> in Taiwan	[No Abstract Available - Manuscripts represent submissions from the Open Ocean Aquaculture IV Symposium held in St. Andrews, New Brunswick, Canada, June 17-20. This volume is divided into broad issues dealing with open ocean aquaculture development and commercialization. Theme sections include: Marine Policy and Sociological Considerations, Environmental, Engineering, Candidate Species and Open Ocean Aquaculture Operations, and Economic Viability and Modeling.]	Liao, I.C.	Bridger, C.J., Costa-Pierce, B.A. (Eds.), Open Ocean Aquaculture: From Research to Commercial Reality. World Aquaculture Society, Baton Rouge, LA, pp. 205–213	2003	Culture Cage Culture Commercial
89	Substituting fish meal with soybean meal in diets of juvenile cobia <i>Rachycentron canadum</i>	An 8-week feeding trial was conducted with cobia to determine the amount of soybean meal that could replace fish meal in formulated diets without reducing growth. Juvenile cobia (initial mean weight, 32 g) were fed 48% crude protein diets in which dietary protein was supplied by brown fish meal or a mixture of hexane extracted soybean meal and the fish meal, resulting in 10%, 20%, 30%, 40%, 50% and 60% of fish meal protein being replaced by soybean protein. The fish readily accepted all seven experimental diets and no fish died during the trial. Detrimental effects on growth performance were obvious when half of the fish meal protein was replaced by soybean protein. There existed a significant difference in fish weight gain, feed conversion ratio (FCR), protein efficiency ratio (PER) and net protein utilization (NPU) when the replacement level for fish meal protein was increased from 40% to 50%, indicating that up to 40% of fish meal protein can be replaced by soybean meal protein without causing reduction in growth and protein utilization. On the other hand, quadratic regression analysis shows a growth optimum at 16.9% replacement of fish meal protein by soybean meal protein. Lipid concentrations in the cobia muscle increased significantly as dietary soybean meal increased. Muscle concentrations of free threonine and histidine decreased as use of the soybean meal increased in the diets. Since methionine concentration in the test diets decreased from 2.52 to 1.36 g 16 g ⁻¹ N as the soybean meal protein replacement level was increased from 0% to 60% while all other essential amino acids remained relatively constant, dietary requirement of methionine was calculated assuming it was equally available between the two proteins. The broken-line model analysis based on fish weight gain shows a breakpoint when dietary methionine+cystine concentration was 2.66 g 16 g ⁻¹ N or 1.28 g 100 g ⁻¹ diet.	Chou, R.L., Her, B.Y., Su, M. S., Hwang, G., Wu, Y.H., Chen, H.Y.	Aquaculture 229, 325–333	2004	Culture Fish Health Nutrition
90	Isolation and characterization of pathogenic <i>Vibrio harveyi</i> (<i>V. carchariae</i>) from the farmed marine cobia fish <i>Rachycentron canadum</i> L. with gastroenteritis syndrome	An outbreak of serious mortality among the cultivated juvenile cobia <i>Rachycentron canadum</i> L. (weighing 8–10 g) characterized by a swollen intestine containing transparent yellow fluid (ascites and gastroenteritis) occurred in August 2001 in Taiwan. Ten motile bacterial strains, C3d1–C3d10, were isolated from head kidney (an organ located near the head of the fish) and/or the intestinal yellow fluid on tryptic soy agar supplemented with 1% NaCl (TSA1) and/or thiosulphate citrate bile salt sucrose (TCBS) agar plates. These strains were characterized and identified as <i>Vibrio harveyi</i> (<i>V. carchariae</i>) on the basis of biochemical characteristics, and comparisons with those of three reference strains, originally identified as <i>V. harveyi</i> or <i>V. carchariae</i> . The strain C3d1 was selected as a representative strain for virulence tests and was found lethal to the cobia with an LD50 value of 7.48 × 104 colony forming units g ⁻¹ fish body weight. All the moribund/dead fish exhibited gastroenteritis as that observed in natural outbreak. The same bacteria could be reisolated from kidney and the transparent yellow fluid of swollen intestine of fish after bacterial challenge using TSA1 and TCBS plates. This is a first report showing that <i>V. harveyi</i> (<i>V. carchariae</i>) is the causative agent of gastroenteritis in the cobia.	Liu, P.-C., Lin, J.-Y., Chuang, W.-H., Lee, K.-K.	World Journal of Microbiology and Biotechnology 20, 495–499	2004	Culture Fish Health Microbiology
91	Resistance of cobia, <i>Rachycentron canadum</i> , juveniles to low salinity, low temperature, and high environmental nitrite concentrations	Resistance of juvenile cobia, <i>Rachycentron canadum</i> , to low salinity, low temperature and high nitrite concentrations was examined under laboratory conditions. After acclimating juveniles to a salinity of 20 g/L (27.3°C), salinity was decreased by 2 g/L/day. The first fish died at a salinity of 8 g/L and 80% offish were dead within 24 hours of exposure to 2 g/L. Acclimation offish to 22.6°C (21 g/L salinity) followed by a temperature reduction of 0.53°C/day resulted in initial mortality at 12.9°C. The median-lethal temperature was 12.1°C and all fish were dead by the time the temperature reached 10.4°C. Fish exposed for 96 hours to nominal < 32 mg/L nitrite-N survived. Results of this study indicate that cobia juveniles require a salinity and temperature of > 8.0 g/L and > 12.9°C, respectively, and that environmental nitrite should not be deleterious at concentrations normally found in aquaculture systems.	Atwood, H.L., Young, S.P., Tomasso, J.R., Smith, T.I.J.	Journal of Applied Aquaculture 15, 191–195	2004	Culture Fish Health Water Quality
92	Isolation and characterization of pathogenic <i>Vibrio alginolyticus</i> from diseased cobia <i>Rachycentron canadum</i>	Outbreaks of serious mortality among cultured juvenile cobia <i>Rachycentron canadum</i> (weighing 8–10 g) characterized by lethargy, dark skin and ascites in the peritoneal cavity while some fish possessing damaged eyes occurred in July and August of 2001 in Taiwan. Fifteen motile bacterial strains were isolated from head kidney and/or the ascites on tryptic soy agar supplemented with 1% NaCl (TSA1) and/or thiosulphate citrate bile salt (TCBS) sucrose agar plates during the two outbreaks. All the isolates were characterized and identified as <i>Vibrio alginolyticus</i> on the basis of biochemical characteristics, and comparisons with those of the reference strain <i>V. alginolyticus</i> ATCC 17749. The strain C3c01 (a representative of the 15 similar field isolates), was virulent to the cobia with an LD50 value of 3.28 × 104 colony forming units/g fish body weight. All the moribund/dead fish exhibited lethargy, dark skin and ascites in the peritoneal cavity as that observed in natural outbreaks. The same bacteria could be reisolated from kidney and the ascites of fish after bacterial challenge using TSA1 and TCBS plates. The results reveal that <i>V. alginolyticus</i> is an infectious agent of vibriosis in the cobia.	Liu, P.-C., Lin, J.-Y., Hsiao, P.-T., Lee, K.-K.	Journal of Basic Microbiology 44, 23–28	2004	Culture Fish Health Microbiology
93	Apparent digestibility of selected feed ingredients for juvenile cobia <i>Rachycentron canadum</i>	Apparent digestibility coefficients of dry matter (DM), crude protein (CP), crude lipid (CL), gross energy (GE), phosphorus, and amino acids in Peruvian fish meal, defatted soybean meal/roasted and solvent-extracted, defatted soybean meal/solvent-extracted, poultry meal, meat and bone meal, peanut meal, rapeseed meal, and corn gluten meal were determined for juvenile cobia. A reference diet (RF) and test diets (consisting of 70% RF diet and 30% of the feedstuff) were used with 0.5% Cr2O3 as an external indicator. The juvenile cobia, averaging 10 g, was stocked in 300-l fiberglass tanks at a density of 20 fishes per tank. Feces were collected from triplicate groups of fish using a fecal collection column attached to the fish rearing tank. Apparent digestibility coefficients of dry matter, crude protein, crude lipid, and gross energy were highest for fish meal and corn gluten meal. Statistics indicated that apparent dry matter digestibility for juvenile cobia ranged 60.42–87.56% for animal products and corn gluten meal and 58.52–70.51% for soybean meals, peanut meal, and rapeseed meal. The protein and lipid from both plant and animal sources were well digested by cobia. Apparent protein and lipid digestibility ranged 87.21–96.27% and 91.59–96.86%, respectively, for animal products, and 88.97–94.42% and 92.38–96.93%, respectively, for plant products. The cobia demonstrated a high capacity to utilize phosphorus in the ingredients. The apparent phosphorus digestibility ranges of animal feedstuffs and plant feedstuffs were 62.36–71.22% and 56.32–69.76%, respectively. Amino acid availability reflected protein digestibility, except in meat and bone meal, for which the availability of some amino acids was lower, possibly due to protein damage during processing. Digestibility information could promote the use of ingredient substitutions in least-cost formulated diets for cobia.	Zhou, Q.-C., Tan, B.-P., Mai, K.-S., Liu, Y.-J.	Aquaculture 241, 441–451	2004	Culture Fish Health Nutrition
94	Pond culture of larval and juvenile cobia, <i>Rachycentron canadum</i> , in the southeastern United States	The potential of growing larval and juvenile cobia, <i>Rachycentron canadum</i> , in ponds was investigated. Larval cobia, obtained from tank spawning of wild-caught adults, were stocked 48-72-h post-hatch at a rate of 700,000/ha into three fertilized 0.25-ha ponds. At one week post-stocking (WPS), fish were observed consuming formulated feed. Growth was rapid, with specific growth rates (SGR) ranging from 12.5-19.2% body weight/day. At harvest (5 WPS) fish reared in two ponds weighed 7.9 and 9.3 g and total length (TL) was 118.9 and 129.3 mm, respectively (all fish reared in remaining pond died the night prior to harvest due to aerator failure). Feed conversion ratio (FCR) was 3.8 for both ponds and survival was 5.3 and 8.5%. Low survival rates were thought to be due primarily to cannibalism. Immediately after harvest, fish were restocked into two 0.25-ha ponds at a stocking rate of 14,400/ ha. Fish were fed formulated, pelleted feeds. Growth was rapid up to ~9 WPS, after which pond water temperatures declined. Ponds were harvested at 13 and 15 WPS, respectively. Final weight of fish was 309.9 and 362.5 g. Final TL was 343.1 and 355.7 mm. FCR was 3.8 and 4.5 and survival was 27.5 and 30.5%. Major losses of fish were associated with avian predators and possibly a toxic algal bloom. Results of trials indicate that cobia larvae and juveniles can be reared in pond-based culture systems, however additional research is needed to refine this approach.	Weirich, C.R., Smith, T.I.J., Denson, M.R., Stokes, A.D., Jenkins, W.E.	Journal of Applied Aquaculture 16, 27–44	2004	Culture Pond Culture

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
95	Cobia culture in Taiwan: Current status and problems	<i>Cobia</i> , <i>Rachycentron canadum</i> , is a widely distributed species from the Indo-Pacific waters to the southern Atlantic Ocean. In Taiwan, it is an indigenous and an ideal species for cage culture. Due to its high market value in both domestic and international markets, the technology for its culture has rapidly developed in the past few years. These include mass propagation through natural spawning of captive broodstocks, larval rearing techniques, nursery production in tanks, ponds and nearshore cages, and grow-out culture in offshore cages. Reproduction in captivity is relatively easy because sexual maturity often occurs within 2 years of culture. Spontaneous spawning occurs year around at water temperatures of 23–27 °C, with peak during spring and autumn. Fertilized eggs hatch within 21–37 h at water temperature of 31–22 °C. Larval growth is fast, and larvae are vitally robust and environment tolerant compared to other marine fishes. Fry can be mass-produced in outdoor ponds at relatively low cost. Weaning of fry from 20 days old onwards to pellet feeds is feasible. Nursery rearing from 10–30 to 1000 g can be done in either outdoor ponds or nearshore cages. Major diseases affecting cobia include bacterial (pasteurellosis, vibriosis and streptococcosis), parasitic (myxosporidea, <i>Trichodina</i> , <i>Neobenedenia</i> and <i>Amyloodinium</i> infestations), and viral (lymphocystis) ones. In recent years, intensive and super-intensive recirculation systems for nursery (from 2 to 100–150 g) were developed with survival rates of more than 90%. In nursery and grow-out offshore cages, 100–600 g cobia were cultured within 1–1.5 years when they reached 6–8 kg for export to Japan, or 8–10 kg for the domestic market. Currently, around 80% of marine cages in Taiwan are devoted to cobia culture. However, some problems still exist in cobia culture that needs to be addressed and solved to increase production. These include high mortality due to stress during transport from nursery tanks/inshore cages to grow-out cages and diseases during nursery and grow-out culture resulting in low survival, and consequently poor harvest.	Liao, I.C., Huang, T.-S., Tsai, W.-S., Hsueh, C.-M., Chang, S.-L., Leañó, E.M.	Aquaculture 237, 155–165	2004	Culture Hatchery RAS Cage Culture Fish Health
96	Feeding stimulatory effects of nucleotides and related compounds on juvenile cobia (<i>Rachycentron canadum</i>)	The feeding stimulative effects of nucleotides and their related compounds on juvenile cobia (<i>Rachycentron canadum</i>) were investigated. Among these nucleotides only inosine-5'-monophosphate (IMP), guanosine-5'-monophosphate (GMP), uridine-5'-monophosphate (UMP), and adenosine-5'-diphosphate (ADP) showed high feeding stimulative responses. In contrast, nucleosides, nitrogen bases, and ribose were not effective. The optimal concentrations of IMP, GMP, UMP, and ADP for juvenile cobia were 2.9, 8.1, 2.8, and 6.6 mmol/kg dry pellets, respectively. These effects of the nucleotides were synergistic when supplemented in pairs. The synergic effects disappeared when the 4 nucleotides were supplemented together.	Liou, B.-S., Chen, T.-I.	Journal of Taiwan Fisheries Research 12, 49–55	2004	Fish Health Nutrition Genetics/Molecular
97	Microsatellite DNA markers for population genetic studies and parentage assignment in cobia, <i>Rachycentron canadum</i>	Twenty nuclear-encoded microsatellites from a genomic DNA library of cobia, <i>Rachycentron canadum</i> , were isolated and characterized. The microsatellites include two tetranucleotide, one trinucleotide, three combination tetranucleotide/dinucleotide, nine dinucleotide, and five imperfect (dinucleotide) repeat motifs. Gene diversity ranged between zero to 0.910; the number of alleles among a sample of 24 fish ranged from one to 15. Cobia support an important recreational fishery in the southeastern United States and recently have become of interest to aquaculture. The microsatellites developed will be useful tools for studying both population genetics (e.g. stock structure, effective population size) and inheritance of traits important to aquaculture.	Pruett, C.L., Saillant, E., Renshaw, M.A., Patton, J.C., Rexroad III, C.E., Gold, J.R.	Molecular Ecology Notes 5, 84–86	2005	Genetics/Molecular
98	Partial replacement of fishmeal by soybean meal in diets for juvenile cobia (<i>Rachycentron canadum</i>)	An 8-week feeding experiment was conducted in floating cages (1.5 × 1.0 × 2.0 m) to determine the potential use of defatted soybean meal (roasted and solvent-extracted) as a partial replacement of fishmeal in the isonitrogenous (approximately 450 g kg ⁻¹ CP [crude protein]) diet for juvenile cobia with an initial average weight of about 8.3 g. Diets were formulated to include 0, 100, 200, 300, 400, 500 and 600 g kg ⁻¹ (diets D0, D10, D20, D30, D40, D50 and D60, respectively) of fishmeal protein being substituted by defatted soybean meal without methionine supplementation. The results showed that weight gain rate decreased significantly when the replacement level of fishmeal protein was increased from 400 g kg ⁻¹ to 500 g kg ⁻¹ , and the D60 diet was the lowest in all groups. These results indicate that up to 400 g kg ⁻¹ of fishmeal protein can be replaced by defatted soybean meal without causing significant reduction in growth. Feed conversion ratio (FCR) and protein efficiency ratio (PER) were significantly affected by the replacement level of fishmeal protein being substituted by defatted soybean meal, when the replacement level of fishmeal protein was 200 g kg ⁻¹ (diet, D20), FCR was the lowest and PER was the highest. There were no significant differences in the moisture, lipid, crude protein and ash content in whole body and muscle, while lipid content in liver increased as the dietary soybean meal replacement levels increased. There were significant differences in haemoglobin, haematocrit, red blood cell, plasma glucose and triglyceride concentration in fish fed diets with different soybean meal replacement levels. Results of this trial indicated that the optimum level of fishmeal protein replacement with defatted soybean meal, determined by quadratic regression analysis was 189.2 g kg ⁻¹ , on the basis of maximum weight gain.	Zhou, Q.-C., Mai, K.-S., Tan, B.-P., Liu, Y.-J.	Aquaculture Nutrition 11, 175–182	2005	Culture Cage Culture Fish Health Nutrition
99	Effect of dietary lipid level on growth performance, lipid deposition, hepatic lipogenesis in juvenile cobia (<i>Rachycentron canadum</i>)	A study was undertaken to evaluate the effect of the dietary lipid level on growth, feed utilization, lipid deposition and lipid metabolism by cobia juveniles. Three isonitrogenous diets containing 47% crude protein with increasing dietary lipid levels 5%, 15% and 25% (DM, dry matter) were fed to satiety to triplicate groups of 20 fish (7.71 g) for 6 weeks. At the end of the feeding trial, fish fed diets containing 5% and 15% lipid showed a higher growth than those fish fed with 25% lipid. Though daily feed intake (DFI) decreased with increasing dietary lipid, there was no significant difference in daily energy intake (DEI) among treatments. As dietary lipid level increased, energy retention (EI), daily energy gain (DEG), daily lipid intake (DLI), daily lipid gain (DLG), viscerosomatic index (VSI), intraperitoneal fat ratio (IPF) and body lipid content increased dramatically and the 25% group had the highest values. Hepatosomatic index (HSI) and muscle lipid content were higher at 25% lipid group than 5% lipid group, but no significant difference was found between 15% and 25% lipid group. Activities of G6PD and ME were reduced with increasing lipid intake, but activities of IDH and 6PGDH did not change among groups. In conclusion, high dietary lipid levels above 15% produced little practical benefit because of higher fat accretion in cobia.	Wang, J.-T., Liu, Y.-J., Tian, L.-X., Mai, K.-S., Du, Z.-Y., Wang, Y., Yang, H.-J.	Aquaculture 249, 439–447	2005	Culture Fish Health Nutrition
100	Advances in rearing cobia <i>Rachycentron canadum</i> larvae in recirculating aquaculture systems: Live prey enrichment and greenwater culture	<i>Cobia</i> <i>Rachycentron canadum</i> is a relatively hardy species which exhibits high rates of growth during the larval and juvenile periods. Currently, this species is considered to be a good candidate for commercial production in recirculating aquaculture systems. However, little information is available regarding the nutritional requirements of cobia larvae in such systems, and this information is required to advance commercial technologies for the successful production of cobia fingerlings. Experiments were conducted to examine the effects of enriching rotifers and <i>Artemia</i> with live algae or commercial preparations on the growth and survival of cobia <i>R. canadum</i> larvae and to evaluate the benefits of adding live algae to the systems. Prey items were enriched with live <i>Isochrysis galbana</i> , live <i>Nannochloris oculata</i> , Algamac 2000, Algamac 2000 supplemented with 10% or 20% Aquagrow arachidonic acid, or Algamac 3050. In addition, larvae fed prey enriched with Algamac 2000 were reared in the presence of live <i>I. galbana</i> (40,000 cells ml ⁻¹) or <i>N. oculata</i> (80,000 cells ml ⁻¹). Significant differences in the fatty acid composition of the rotifers and <i>Artemia</i> were found among treatments. Generally, prey enriched with the commercial preparations contained higher levels of highly unsaturated fatty acids than those enriched with live algae. Furthermore, a positive correlation was found between dietary docosahexaenoic acid (DHA) and the amount of DHA measured in the whole body tissues of 16-day-old larvae. Larval growth (measured as standard length) and survival of 16-day-old larvae were significantly higher (P < 0.05) when larvae were fed prey enriched with the commercial preparations (14.7–15.2 mm; 12.0–15.6%) compared to <i>N. oculata</i> (11.8 mm; 4.4%). However, when larvae were reared on <i>N. oculata</i> enriched rotifers and subsequently fed Algamac 2000 enriched <i>Artemia</i> there were no significant differences in growth or survival compared to larvae which were fed both rotifers and <i>Artemia</i> enriched with Algamac 2000. This suggests that the enrichment of rotifers may be less important than the enrichment of <i>Artemia</i> . No significant differences in growth or survival were found when larvae were fed prey enriched with live <i>I. galbana</i> (13.5 mm; 8.2%) or commercial preparations (12.4–12.6 mm; 12.9%). However, the presence of live algae (<i>I. galbana</i> or <i>N. oculata</i>) in the rearing tanks significantly improved larval survival to 23.3% and 24.7%, respectively. The results of this study suggest that enriching rotifers and <i>Artemia</i> with live <i>I. galbana</i> or commercial preparations such as Algamac 2000 and 3050 in conjunction with greenwater culture systems improves the growth and survival of cobia larvae in recirculating aquaculture systems.	Faulk, C.K., Holt, G.J.	Aquaculture 249, 231–243	2005	Culture RAS
101	Microsatellite markers for cobia, <i>Rachycentron canadum</i>	[No Abstract Available - Polymerase chain reaction (PCR) primers are reported for 35 nuclear-encoded microsatellites developed from a genomic library of cobia (<i>Rachycentron canadum</i>). All 35 microsatellites were tested for reproducibility and polymorphism using 24 cobia sampled offshore of Ocean Springs, MS. Thirty-three of the microsatellites were found to be polymorphic; genotypes at seven of these differed significantly from Hardy-Weinberg (HW) expectations, possibly because of the presence of null alleles. Levels of allele and gene diversity (expected heterozygosity) were lower on average than values reported previously for other marine fishes. The 26 microsatellites whose genotypes were in HW equilibrium should provide useful tools for future studies of cobia relating to both stock assessment and aquaculture.]	Renshaw, M.A., Pruett, C.L., Saillant, E., Patton, J.C., Rexroad, C.E., Gold, J.R.	Gulf of Mexico Science 23, 248–252	2005	Genetics/Molecular
102	Effects of flow velocity on growth of juvenile cobia	The objective of this study was to investigate the growth rate and feed conversion ratio (FCR) of juvenile cobia, <i>Rachycentron canadum</i> , in different flow velocities. In experiment A, fifteen groups of fish with an initial mean weight of 14.35 g were reared for 28 days in one of five flow velocities: 0, 5, 10, 15, and 20 cm/s. In experiment B, fifteen groups of fish with an initial mean weight of 30 g were reared for 21 days in the same velocities as in experiment A. In experiment C, fish weighing an average 77 g were raised for 21 days in 0, 10, 20, 30, and 40 cm/s. The optimal velocities in terms of growth rate were 10 cm/s for fish of 10-30 g (experiment A), 20 cm/s for fish of 30-60 g (experiment B), and 23 cm/s for fish of 60-200 g (experiment C); the optimal velocity increased as the fish weight increased. FCR and specific growth rate (SGR) also significantly (p<0.05) corresponded to the flow velocity for the different sized juveniles with the optimal FCR and weight gains occurring at 10-23 cm/s. FCR rapidly increased when the velocity exceeded 35 cm/s, regarded as the maximum flow velocity for fish growth.	Yu, S.-L., Ueng, P.-S.	Israeli Journal of Aquaculture - Bamidgheh 57, 241–249	2005	Culture
103	Effect of dietary fatty acids on the body tissues of larval and juvenile cobia and their prey	Polyunsaturated fatty acids (PUFAs) have been used as biomarkers in pelagic ecosystems although previous studies have failed to quantify the timing of conservation of dietary PUFAs in pelagic fishes and invertebrates. Here we investigated the influence of diet upon the timing of conservation of PUFAs throughout multiple trophic exchanges in larval and juvenile cobia (<i>Rachycentron canadum</i>) and their prey. Cobia, rotifers (<i>Brachionus plicatilis</i>), and <i>Artemia</i> (<i>A. franciscana</i>) were fed laboratory processed or natural diets resembling prey and dietary modification of fatty acid signatures was quantified using two-source mixing models. Specimens were collected throughout the experiment to track dietary influences over time. Cobia larvae underwent significant dietary modification of PUFAs after 24 h and conserved > 90% of dietary PUFAs after an average of 6 days. Similar results were identified in juvenile cobia as significant dietary modification of PUFAs took place after 3 days and > 90% were conserved after an average of 12 days. In addition, no significant ontogenetic changes in PUFA signatures were identified in juvenile cobia throughout the 30-day experiment. PUFA signatures in prey items (rotifers and <i>Artemia</i>) underwent significant dietary modification in 24 h, with over 90% incorporation after 5–7 days. Results from this study support the premise that fatty acids are promising dietary indicators and may be useful for future studies examining trophic relationships in marine ecosystems and habitat use of marine fishes.	Turner, J.P., Rooker, J.R.	Journal of Experimental Marine Biology and Ecology 322, 13–27	2005	Fish Health Nutrition Hatchery
104	Cobia aquaculture	[No Abstract Available - Aquaculture in the 21st Century is the second volume in the Manual of Fish Culture series. This volume provides the detail and utility for the culture of aquatic organisms that made the first volume indispensable to culturists. Additionally, historical and background material are provided for each of the 26 species covered, which makes this book useful to those more generally interested in aquaculture and the development of aquaculture. The extent of the material provided makes it not only a valuable reference tool, but an excellent resource for aquaculture courses.]	Kaiser, J.B., Holt, G.J.	Kelly, A.M., Silverstein, J.T. (Eds.), Aquaculture in the 21st Century, AFS Symposium 46. American Fisheries Society, Bethesda, MD, pp. 465–469	2005	Culture
105	Accumulation of butyltin compounds in cobia <i>Rachycentron canadum</i> raised in offshore aquaculture sites	Butyltin residues (monobutyltin, MBT; dibutyltin, DBT; tributyltin, TBT; tetrabutyltin, TeBT) in the sea water and in the cobia (<i>Rachycentron canadum</i>) from aquaculture sites located offshore of Penhu island, Taiwan, were collected and quantified. The average concentrations of MBT, DBT, TBT and TeBT in sea water were n.d.—28 ± 3, 4.0 ± 0.6–88 ± 13, n.d.—43 ± 4, and n.d.—7 ± 1 ng l ⁻¹ , respectively. The total butyltin (sum of MBT, DBT, TBT, TeBT) residues in the skin, dorsal muscle, ventral muscle, dark muscle, and liver of the cobia were in the range of 72 ± 12–2270 ± 85, 79 ± 11–688 ± 33, 82 ± 14–1715 ± 104, 93 ± 13–803 ± 47, and n.d.—52,745 ± 252 ng g ⁻¹ (wet weight), respectively. Although in this study in most cases, the highest concentration of total butyltin residues was found in liver or skin, in some cases, the highest concentration was found in muscle tissue. The crude lipid content in the skin, dorsal muscle, ventral muscle, dark muscle, and liver of these cobia was in the range of 7.9 ± 0.1–28 ± 1%, 11.7 ± 0.8–29 ± 1%, 11.5 ± 0.3–44 ± 3%, 24.2 ± 0.4–48.4 ± 0.4%, and 55.7 ± 0.1–87.7 ± 0.4% (wet weight), respectively. The concentrations of crude lipid content, and the concentrations of total butyltin residues in these tissues were not correlated.	Liu, S.-M., Hsia, M.-P., Huang, C.-M.	Science of The Total Environment 355, 167–175	2006	Culture Contaminants Fish Health Water Quality

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
106	Growth and survival of juvenile cobia, <i>Rachycentron canadum</i> , at different salinities in a recirculating aquaculture system	<i>Cobia (Rachycentron canadum)</i> is an emerging aquaculture candidate for both offshore cage culture and land-based systems such as recirculating aquaculture systems. The ability to grow cobia at salinities other than oceanic (34 ppt) could present culturists with additional production opportunities with this species. Culture at low salinities could also reduce the incidence of disease and simplify water management. In two trials of 8 weeks each, this study investigated growth and survival of juvenile cobia reared at salinities of 5, 15, and 30 ppt. The trials were conducted in 456-L tanks, with 10 fish per tank. Water temperature was maintained at 27 ± 1 °C and dechlorinated municipal tap water (0 ppt, 56.8 ppm Ca ²⁺) was added to seawater (30 ppt, 325.3 ppm Ca ²⁺) in order to achieve treatment salinities. Early juveniles were used in both trials with average initial weights of 6.0 g for the first trial and 6.7 g for the second trial. During both trials, fish were fed to satiation twice daily with a diet prepared on site, and the amount fed was measured to determine feed efficiency. Fish from each tank were counted and weighed collectively each week until the end of each of the 8-week trials to monitor growth and survival. Survival among treatments was not significantly different in the first trial, but in the second trial survival was significantly lower in the 5 ppt treatment (68.3%) than in the 15 (90%) or the 30 ppt (92.5%) treatments. Feed efficiency was extremely high in both trials with all treatments ranging between 1.05 and 1.13. Fish reared at a salinity of 5 ppt grew as well or better than the fish reared at salinities of 15 and 30 ppt (mean weight gained, 96.2–115.3 g). This study indicates that culture of cobia juveniles may be practical in salinities as low as 5 ppt.	Resley, M.J., Webb Jr., K.A., Holt, G.J.	Aquaculture 253, 398–407	2006	Culture Fish Health Water Quality RAS
107	Microsatellite multiplex panels for genetic studies of three species of marine fishes: red drum (<i>Sciaenops ocellatus</i>), red snapper (<i>Lutjanus campechanus</i>), and cobia (<i>Rachycentron canadum</i>)	Multiplex panels of nuclear-encoded microsatellites were developed for three species of marine fishes of interest to both public and private aquaculture ventures: red drum (<i>Sciaenops ocellatus</i>), red snapper (<i>Lutjanus campechanus</i>), and cobia (<i>Rachycentron canadum</i>). The multiplex panels will be useful in a variety of applications, including strain and hybrid identification, parentage assignment, pedigree reconstruction, estimating genetic diversity and/or inbreeding, mapping of quantitative trait loci, and marker-assisted selection. The panels also will be useful in studies of stock structure of 'wild' populations. Comparison of costs for expendable supplies revealed that four- and eight-panel multiplexes reduced expenditures four- and eight-fold, respectively, relative to single microsatellite gels. Personnel time also was reduced significantly.	Renshaw, M.A., Saillant, E., Bradfield, S.C., Gold, J.R.	Aquaculture 253, 731–735	2006	Genetics/Molecular
108	Responses of cobia <i>Rachycentron canadum</i> larvae to abrupt or gradual changes in salinity	<i>Cobia Rachycentron canadum</i> has recently been recognized as a potential candidate for aquaculture because this species exhibits high growth rates during the larval and juvenile stages. A series of salinity tolerance tests were performed on larval cobia in order to identify the salinity requirements of this species during culture. The effect of spawning salinity on larval tolerance is also discussed. The 18-h survival of cobia larvae 3, 5, 7 and 9 days post-hatch (dph) following abrupt transfer to salinities ranging from 4 to 48 ppt was evaluated using logistic regression. The salinity range within which 90% of the larvae would be expected to survive appeared to be age-dependent and was narrowest at 3 dph (20.1–35.6 ppt) and wider at 7 and 9 dph (7.5–32.8 ppt). The 18-h tolerance of larvae to abrupt changes in salinity was unaltered by spawning salinities of 28.0 and 36.5 ppt. In the second part of the study, rearing salinities were dropped by 5 ppt day ⁻¹ from 32–34 ppt (control) to 5, 10, 15 and/or 20 ppt beginning on 1, 4, 7, 10 or 13 dph. Larval survival from hatching through 10 days following the initial drop in salinity was significantly ($P < 0.05$) lower (<2%) in the low salinity treatments than the control (12–15%) when the salinity drop was initiated 1 and 4 dph. No significant differences in larval survival were detected between the control (12.5%) and 20 ppt treatment (8.9%) when the salinity drop began on 7 dph but survival in the 10 ppt treatment (3.2%) was significantly lower than the control. When the salinity drop was initiated on 10 dph, no significant differences in survival (10.7–14.7%) were detected among treatments. Finally, no significant differences in survival (9.6–15.4%) were found when the salinity drop was initiated 13 dph and terminated 22 dph. However, when a similar study was extended to 28 dph survival from 13 to 28 dph was significantly lower in the 5 (49.4%) and 10 (72.5%) ppt treatments than the control (96.5%) due to disease. No significant differences in standard length were observed for larvae within each experiment irrespective of rearing salinity. The results of this study indicate that rearing cobia larvae in salinities as low as 15 ppt may be possible beginning 13 dph.	Faulk, C.K., Holt, G.J.	Aquaculture 254, 275–283	2006	Culture Fish Health Water Quality
109	Vaccination with three inactivated pathogens of cobia (<i>Rachycentron canadum</i>) stimulates protective immunity	<i>Cobia (Rachycentron canadum)</i> , a warm water fish recently commercially cultured in Taiwan, has encountered severe mortalities with survival rates often below 20%. The major causative pathogens were <i>Vibrio alginolyticus</i> , <i>Vibrio parahaemolyticus</i> and <i>Photobacterium damsela</i> subsp. <i>piscicida</i> . We prepared a combined three inactivated bacterins antigen preparation and vaccinated cobia. This mixture of bacterins was safe, and the immune response in cobia stimulated specific antibody in 1 week that remained for at least 6 weeks until the end of the aquarium trial. Its efficacy in protecting fish was evaluated in aquarium and field trials. In the aquarium challenge, the vaccine gave a relative percentage survival of 93.8%, 91.1% and 84.7% after challenge with <i>V. alginolyticus</i> , <i>V. parahaemolyticus</i> and <i>P. damsela</i> subsp. <i>piscicida</i> , respectively. In two farm trials using two batches of fish from different hatcheries, one vaccination gave a survival rate of 86–92%. A single vaccination of three combined inactivated bacteria into cobia elicited specific antibodies, and protected fish in both the laboratory aquarium challenge and a farm trial.	Lin, J.H.-Y., Chen, T.-Y., Chen, M.-S., Chen, H.-E., Chou, R.-L., Chen, T.-I., Su, M.-S., Yang, H.-L.	Aquaculture 255, 125–132	2006	Culture Fish Health Microbiology
110	<i>Psettarium anthicum</i> sp. n. (Digenea: Sanguinicolidae) from the heart of cobia <i>Rachycentron canadum</i> (Rachycentridae) in the northern Gulf of Mexico	<i>Psettarium anthicum</i> sp. n. (Digenea: Sanguinicolidae) infects the myocardium and atrial wall of the cobia <i>Rachycentron canadum</i> (Linnaeus, 1766) (Rachycentridae) in the northern Gulf of Mexico off Mississippi, USA. It is the first member of <i>Psettarium</i> Goto et Ozaki, 1930 reported from other than the Indian Ocean or Pacific Ocean and the second species of the genus reported from cobia. It differs from its congeners by the combination of having posterior caeca with lateral projections appearing as thorns in lateral view and the male pore anterior to the oötype. The species of <i>Psettarium</i> , <i>P. japonicum</i> (Goto et Ozaki, 1929) (type species), <i>P. tropicum</i> Manter, 1940, <i>P. sebastodorum</i> Holmes, 1971, <i>P. rachycentri</i> (Lebedev et Parukhin, 1972) comb. n. (syn. <i>Psettarioides rachycentri</i> Lebedev et Parukhin, 1972) and <i>P. anthicum</i> sp. n., differ from other sanguinicolids by the combination of having an elongate body with a sinistral posterolateral protuberance, minute, straight tegumental body spines in ventrolateral transverse rows, posterior caeca greater than seven times the anterior caeca length, the oötype near the posterior end of the body, a uterus primarily between the ovary and oötype and an oviduct and vitelline duct extending posteriad primarily between the uterus and dextral body margin. We emend <i>Psettarium</i> and provide a diagnostic key to the species. <i>Psettarioides</i> is regarded as a junior synonym of <i>Psettarium</i> because herein we return its type species, <i>P. tropicum</i> , to <i>Psettarium</i> . Regarding the three other sanguinicolids formerly of <i>Psettarioides</i> , we suspect that <i>P. pseudupenei</i> Lebedev et Parukhin, 1972 belongs to <i>Psettarium</i> but include it only tentatively pending an examination of type or other material; we tentatively place <i>P. kurochikini</i> Parukhin, 1976 in <i>Cardicola</i> Short, 1952; and we designate <i>P. grandis</i> (Lebedev et Mamaev, 1968) as <i>incertae sedis</i> pending examination of type or other appropriate material.	Bullard, S.A., Overstreet, R. M.	Folia Parasitologica 53, 117–24	2006	Fish Health Wild (Atlantic/Pacific) Parasites
111	The effect of rearing density on growth and survival of cobia, <i>Rachycentron canadum</i> , larvae in a closed recirculating aquaculture system	[No Abstract Available - Stocking density has been shown to influence growth rate (Pickering and Stewart 1984), feeding behavior (Kentouri et al. 1994), disease resistance (Mazur and Iwama 1993), and survival (Sodeberg and Meade 1987) in finfish. Density effects on cultured fish may result in behavioral interactions among siblings including competition for food and space that often result in cannibalism. Reduced water quality in high-density rearing systems can also affect growth and survival. If water quality can be controlled and sufficient food provided, high rearing densities may still affect growth and survival through responses related to crowding. Reduced appetite is one of the effects associated with reduced growth of juveniles under crowded conditions (Wendelaar Bonga 1997). The effect that crowding has on larvae is not well understood, but it often results in reduced growth and survival (Houde 1975; Alvarez-Gonzalez et al. 2001). This study was conducted to evaluate the effects of different rearing densities on the growth and survival of cobia larvae in an RAS.]	Hitzfelder, G.M., Holt, G.J., Fox, J.M., McKee, D.A.	Journal of the World Aquaculture Society 37, 204–209	2006	Culture Fish Health Water Quality RAS
112	<i>Neobenedenia girellae</i> (Monogenea) infection of cultured cobia <i>Rachycentron canadum</i> in Taiwan	A benedeniid parasite infecting the body surface of cobia <i>Rachycentron canadum</i> cultured in net cages in Taiwan was identified as <i>Neobenedenia girellae</i> . This is the first confirmed case of <i>N. girellae</i> infection of marine fish from Taiwan. <i>N. girellae</i> was not randomly distributed on the host; it concentrated on the dorsal side of the head area (59.7%), especially on the eyes (23.7%), while it was less frequent on the ventral side and not detected on the fins. <i>N. girellae</i> caused considerable histological damage to the host through the attachment by the haptor and possibly through feeding activity by the pharynx. In infected eyes, epithelial cells of the cornea were often partially lost, and the collagenous stroma was considerably thickened and edematous, associated with massive inflammatory cell infiltration.	Ogawa, K., Miyamoto, J., Wang, H.-C., Lo, C.-F., Kou, G.-H.	Fish Pathology 41, 51–56	2006	Culture Cage Culture Fish Health Parasites
113	<i>Mycobacterium</i> sp. infection in cultured cobia (<i>Rachycentron canadum</i>)	Juvenile cobia, <i>Rachycentron canadum</i> , culture with chronic losses over a two-week period, showed symptoms of emaciation, lethargy, ulcerative dermal lesions, exophthalmia, hyper-pigmentation, and hypo-pigmentation. Bacterial cultures from the skin grew <i>Aeromonas hydrophila</i> and <i>Citrobacter</i> sp. on Tryptic Soy Agar (TSA), while bacterial cultures from the posterior kidney grew only <i>Aeromonas hydrophila</i> on TSA media. Histopathology of the skin lesions showed epithelial ulceration and deeper dermal necrosis with a few well-formed granulomas. Histopathology also showed numerous granulomas throughout the spleen, liver, anterior and posterior kidney, heart, pancreas and mesenteric tissues. A modified acid-fast (Fites) stain revealed numerous acid-fast bacteria within the granulomas and granulomatous inflammation of the tissues, suggesting a <i>Mycobacterium</i> sp. infection. Bacterial cultures of splenic tissues grown on Middlebrook agar developed small, white colonies in seven days that stained acid-fast positive. This mycobacterial isolate was further identified as <i>M. marinum</i> . Though the fish were externally and systemically infected with several species of bacteria, it was thought that these were secondary to the underlying mycobacterial infection. This is the first documented case of mycobacteriosis in cobia.	Lowry, T., Smith, S.A.	Bulletin of the European Association of Fish Pathologists 26, 87–92	2006	Fish Health RAS Microbiology
114	Growth and energy budget of juvenile cobia (<i>Rachycentron canadum</i>) relative to ration	Growth, faecal production, nitrogenous excretion and energy budget of juvenile cobia (initial body weight 10 g or so) at five ration levels (starvation, 3%, 6% and 9% of initial body weight per day, and ad libitum) were investigated. Feed consumption, faecal production and growth of juvenile cobia were directly measured. Faecal production (f , mg g ⁻¹ d ⁻¹) increased with the increase of ration level (RL, % per day), described as $\ln(f + 1) = 1.1804 \ln(RL + 1) - 0.0619$. Feed absorption efficiency (FAE, %) decreased as ration level increased, but the variation of feed absorption efficiency (FAE, %) was small, with ranges of 81.44–87.17% 96.57–98.377%, and 94.21–96.54% for FAEd, FAEd, and FAEd, respectively. The relationship between ration level (RL, % per day) and specific growth rate in wet weight (SGRw, % per day), dry weight (SGRd, % per day), protein (SGRp, % per day) and energy (SGRe, % per day) were decelerating curves described as logarithmical equations: $SGRw = 3.8759 \ln(RL + 1) - 3.7164$, $SGRd = 5.1068 \ln(RL + 1) - 5.2477$, $SGRp = 5.5611 \ln(RL + 1) - 5.6094$ and $SGRe = 6.1282 \ln(RL + 1) - 7.4385$. Feed conversion efficiency in wet weight (FCEw, %), dry weight (FCEd, %), protein (FCEp, %) and energy (FCEe, %) increased with ration level, peaked at 9% per day ration and then decreased at higher ration level. Energy intake (C), energy retained as growth (G) and energy lost in faeces (F) were estimated directly and energy allocated to excretion (U) and metabolism (R) were calculated by difference $(U + R) = C - F - G$. The partial energy budget of juvenile cobia at satiation ration was $100C = 7F + 76(U + R) + 17G$.	Sun, L., Chen, H., Huang, L., Wang, Z., Yan, Y.	Aquaculture 257, 214–220	2006	Nutrition Bioenergetics
115	Replacement of fish meal in cobia (<i>Rachycentron canadum</i>) diets using an organically certified protein	A six-week feeding trial was conducted to evaluate the use of a yeast-based, certified organic protein source as a replacement for fish meal in diets for cobia. Five experimental diets were formulated to provide 40% crude protein and 11% dietary lipid (dry matter basis) with the yeast-based protein source replacing Special Select® menhaden fish meal at 25%, 50%, 75% and 100% of dietary protein. Ten juvenile cobia (initial weight 11.5 g/fish) were randomly stocked in triplicate 300 l circular fiberglass tanks ($n = 30$ treatment ⁻¹) and hand-fed the diets based upon total tank biomass two times daily at 0900 and 1400 h. Fish were group weighed weekly to monitor performance and adjust feeding rations. Water temperature and salinity were maintained at 27 °C and 15‰, respectively. At the end of the feeding trial, weight gain, ranging from 86% to 512%, and feed conversion ratio values, ranging from 1.9 to 5.8, were significantly affected by the inclusion of the yeast-based protein source, with decreasing values as inclusion levels of the yeast-based protein source rose above 25% of dietary protein. Cobia fed the diet containing 25% of dietary protein from the yeast-based protein source had equal weight gain and feed conversion ratio values as fish fed the control diet composed of 100% fish meal (503 vs. 512 and 1.9 vs. 1.9, respectively). Biological indices including hepatosomatic index, visceral somatic index and muscle ratio were all similarly affected by inclusion of the yeast-based protein source, with significant impacts when inclusion levels rose above 25% of dietary protein. As with the weight gain and feed efficiency ratio values, fish fed the diet containing 25% of protein from the yeast-based source had similar values as those observed in the control animals. This study represents the first attempt to utilize an organically certified protein source as a replacement for fish meal in diets for juvenile cobia. Although levels of inclusion of the yeast-based protein source above 50% of dietary protein resulted in detrimental effects on production characteristics, the data clearly suggest that, at a minimum, 25% of dietary protein can be provided by this yeast-based protein in diets for cobia.	Lunger, A.N., Craig, S.R., McLean, E.	Aquaculture 257, 393–399	2006	Nutrition Fish Health RAS
116	Outdoor Tank and Pond Spawning of Cobia, <i>Rachycentron canadum</i> in Coastal South Carolina	Research was conducted at the South Carolina Department of Natural Resources Waddell Mariculture Center to evaluate the potential for captive reproduction of cobia, <i>Rachycentron canadum</i> in outdoor tanks and ponds. In May 2001, adult cobia (3 males, 1 female, and 1 suspected female) obtained from a local high salinity estuary were stocked into an outdoor tank (32,000-L) receiving ambient estuary water. Spawning occurred within 2 days after stocking. Over the course of 3 consecutive days, a total of 3.6 million eggs were collected with roughly equal numbers collected during each 24-hour period. Mean fertilization rate was 58.1%. Hatching occurred at approximately 24 hours after initiation of each spawning event. Mean percent hatch was 27.5%. Fish were relocated to a 0.25-ha circular pond 10 days after tank spawning activity ended. One female received pelleted GnRH before stocking. Eggs were observed 3 days after stocking and at 12 days after hatching, approximately 50,000 larvae were harvested. In May and June 2002, three groups of recently caught adult cobia, each consisting of 3 males and 1 female, were placed in one of three outdoor tanks. Spawning occurred within 2–4 days after stocking of Tanks 1 and 2. During a single spawning event, a total of 2.1 million and 560,000 eggs were collected from Tanks 1 and 2, respectively. Relative batch fecundity of females stocked in Tanks 1 and 2 was estimated to be 79.2 and 20.9 eggs/g, respectively. No fertile eggs were collected from Tank 2. Percent fertilization and hatch of eggs collected from Tank 1 was 3.2% and 1.5%, respectively. No spawning activity of fish stocked in Tank 3 occurred. Findings reveal that naturally conditioned recently caught adult cobia can readily spawn soon after capture and that ponds can be utilized for reproduction of this species in the U.S.	Weirich, C.R., Stokes, A.D., Smith, T.I.J., Jenkins, W.E., Denson, M.R.	Journal of Applied Aquaculture 18, 1–16	2006	Spawning Pond Culture

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
117	Optimal dietary methionine requirement for juvenile cobia (<i>Rachycentron canadum</i>)	An 8-week feeding experiment was conducted to quantify the dietary methionine requirement of juvenile cobia (initial weight of 11.61 ± 0.16 g, mean ± SD) reared in indoor flow-through and aerated aquaria. Six amino acid test diets (44% CP and 16% lipid), using fish meal and wheat gluten as intact protein sources supplemented with crystalline amino acids, were formulated to contain graded levels of methionine (0.61%, 0.83%, 1.05%, 1.30%, 1.48% and 1.68% of dry diet, respectively) at a constant dietary cystine level of 0.67%. Each diet was randomly assigned to three aquaria. Growth performance and feed utilization were significantly influenced by the dietary methionine levels ($P < 0.05$). Maximum weight gain, specific growth rate and protein efficiency ratio occurred at 1.05% dietary methionine ($P < 0.05$). The hepatosomatic index, viscerosomatic index and condition factor were not significantly affected by dietary methionine levels ($P > 0.05$). There were no significant differences in protein, lipid, ash and moisture contents in whole body or muscle, also red blood cell count and plasma protein content for fish fed graded methionine levels of diets; however, hemoglobin, hematocrit, leukocyte, plasma glucose and triacylglycerol concentrations showed significant differences among these treatments ($P < 0.05$). Methionine concentration in plasma significantly increased with an increase of dietary methionine ($P < 0.05$). Quadratic regression analysis of specific growth rate against dietary methionine levels indicated that the optimal dietary methionine requirement for maximum growth and feed utilization of juvenile cobia is 1.19% of dry diet in the presence of 0.67% cystine (corresponding to 2.64% of dietary protein on a dry weight basis).	Zhou, Q.-C., Wu, Z.-H., Tan, B.-P., Chi, S.-Y., Yang, Q.-H.	Aquaculture 258, 551–557	2006	Culture Nutrition Fish Health
118	Growth, faecal production, nitrogenous excretion and energy budget of juvenile cobia (<i>Rachycentron canadum</i>) relative to feed type and ration level	Growth, faecal production, nitrogenous excretion and energy budget of juvenile cobia (initial body weight ~ 28 g) at different ration levels (RL, % per day) ranging from starvation to ad libitum for three feed types, i.e., natural sardine fish (NSF), commercial eel formulated feed (CEFF) and commercial marine-fish formulated feed (CMFF), were investigated in this study. Both feed type and ration level affected significantly faecal production (f , mg g ⁻¹ day ⁻¹), and nitrogenous excretion (u , mg g ⁻¹ day ⁻¹). Feed type, not ration level, for the NSF-fed and CEFF-fed groups and both feed type and ration level for the CMFF-fed group affected significantly feed absorption efficiency (FAE, %). For each feed type group, faecal production and nitrogenous excretion increased whereas feed absorption efficiency in dry weight (FAEd, %), protein (FAEp, %) and energy (FAEe, %), with a small variation, tended to decrease as ration increased. Specific growth rate in wet weight (SGRw, % per day), dry weight (SGRd, % per day), protein (SGRp, % per day) and energy (SGRe, % per day) for the NSF-fed and CEFF-fed groups was much higher than that for the CMFF-fed group, and the growth–ration relationship was a decelerating curve described as a logarithmic equation for the NSF-fed and CEFF-fed groups, and a linearity described as a simple equation for the CMFF-fed group. There was a significant difference of the slopes in the regression equations among three feed type groups by analysis of covariance. Multiple regression analysis showed that the relationships between specific growth rate (SGR, % per day) and ration level in dry weight (RLd, % per day) as well as feed type (D1 D2) were $SGRw = -2.226 + 4.022\ln(RLd + 1) - 0.895D1 - 2.705D2$, $SGRd = -2.686 + 4.422\ln(RLd + 1) - 1.014D1 - 2.969D2$, $SGRp = -2.481 + 4.316\ln(RLd + 1) - 1.122D1 - 2.943D2$ and $SGRe = -3.239 + 4.972\ln(RLd + 1) - 0.954D1 - 3.053D2$. Feed conversion efficiency in wet weight (FCEw, %), dry weight (FCEd, %), protein (FCEp, %) and energy (FCEe, %) for the NSF-fed and CEFF-fed groups was much higher than that for the CMFF-fed group, and with increased ration FCE increased or first increased then decreased for the NSF-fed and CEFF-fed groups and increased significantly for the CMFF-fed group. Energy budgets of juvenile cobia at satiation ration were $100A = 59R + 41G$ for NSF-fed group, $100A = 67R + 33G$ for CEFF-fed group and $100A = 83R + 17G$ for CMFF-fed group, where A is assimilated energy R is energy spent in metabolism and G is energy stored as growth.	Sun, L., Chen, H., Huang, L., Wang, Z.	Aquaculture 259, 211–221	2006	Culture Fish Health Nutrition
119	Juvenile cobia (<i>Rachycentron canadum</i>) can utilize a wide range of protein and lipid levels without impacts on production characteristics	Two, 6 week feeding trials were conducted to evaluate the impacts of protein and lipid on weight gain, feed efficiency ratio values and biological indices of juvenile cobia (<i>Rachycentron canadum</i>). Utilizing a 2 × 3 factorial design, experimental diets containing two levels of crude protein (CP; 40 and 50%) and three levels of lipid (6, 12 and 18%), providing 14.4, 15.1 and 16.6 kJ available energy/g dry diet (calculated), respectively, were formulated for use in both feeding trials. In the first trial, cobia (initial weight 49.3 g per fish) was randomly assigned to one of the six experimental diets and fed to apparent satiation twice daily. At the end of the first trial, weight gain in cobia was not significantly impacted by protein levels with values ranging from 333% (50% CP) to 353% (40% CP). However, lipid significantly ($P < 0.05$) affected weight gain with fish fed the diet containing 18% total lipid returning the lowest growth of 293%. Feed efficiency ratio values were not significantly impacted by dietary protein or lipid levels and ranged from 0.46 (50% CP/18% lipid) to 0.51 (50% CP/6 and 12% lipid). Survival was significantly impacted by protein and lipid with fish fed the diets containing 50% CP and 18% lipid having lower ($P < 0.05$) survival rates of 90%. In the second trial, smaller fish were utilized (7.4 g average initial weight) under identical experimental conditions and dietary formulations. Weight gain was not significantly affected by protein or lipid levels and ranged from 1099% in fish fed the diet containing 40% CP/18% lipid to 1305% in fish fed the diet containing 50% CP/12% lipid. Feed efficiency ratio values, visceral somatic and hepatosomatic indices were significantly affected by protein and/or lipid. Muscle and liver lipid were impacted by dietary lipid ($P = 0.0203$ and 0.0012 , respectively). Muscle protein was significantly impacted by dietary protein levels, while liver protein was affected by both main effects. Dietary protein and lipid had no impact on muscle ash. These data suggest that juvenile cobia can thrive on a wide range of protein and lipid levels, as well as a range of protein to energy ratios. Positive impacts of optimizing the protein component in terms of economic and environmental concerns, coupled with the ability to maintain the rapid growth rates this species are renowned for at lower dietary lipid levels, point towards beneficial consequences of further refinement of commercial cobia production feeds.	Craig, S.R., Schwarz, M.H., McLean, E.	Aquaculture 261, 384–391	2006	Nutrition Fish Health
120	New records of parasites for culture cobia, <i>Rachycentron canadum</i> (Perciformes: Rachycentridae) in Puerto Rico	Intensive aquaculture sometimes provides conditions favorable for parasites that are not ordinarily found on culture fishes in the wild, and the use of introduced stocks sometimes introduces non-indigenous species to the habitat. When officially asked about the culture of Cobia <i>Rachycentron canadum</i> (Linnaeus) in Puerto Rico, the authors responded that it was unlikely to cause harm. It was assumed that a well-known culture facility in Florida would assure parasite-free stocks. Subsequent examinations of stocked juveniles surprisingly found parasites new to this fish. An outbreak of Slime-blotch disease, <i>Brooklynelia hostilis</i> Lom & Nigrelli, 1970 (Dysteriida: Hartmannulidae) occurred in juvenile Cobia after they were shipped from Florida and stocked. This apparently represents a local parasite that took advantage of the weakened and/or crowded fish. The universal aquarium and culture superparasite, Marine Ich, <i>Cryptocaryon irritans</i> Brown, 1951 (Colpoda: Ichthyophthiriidae) was introduced with a shipment of juvenile Cobia from Florida. This may not be serious, since the parasite occurs worldwide, unless it represents a new strain to Puerto Rico. Marine Costia, <i>Ichthyobodo</i> sp. (Kinetoplastida: Bodonidae) was introduced into Puerto Rico with juvenile Cobia shipped from Florida. This parasite has caused some severe problems in aquaculture hatcheries in Hawaii and Texas after it was introduced with cultured organisms. Thus far, it has not caused any problems locally, but Puerto Rico lacks the marine hatchery facilities where such outbreaks would occur. The question of whether it is established locally will have to wait the development of similar facilities in Puerto Rico. These three species of parasites represent new host records for Cobia. The non-indigenous <i>Ichthyobodo</i> sp. represents new locality records for the tropical Atlantic, Caribbean, and Florida and Puerto Rico. Cobia mature more quickly in culture than in the wild and thus female Cobia apparently mature sufficiently before harvest to attract wild male Cobia to the net pen culture facilities. This represents a potential source of parasite and disease infection for the cultured and wild fish.	Bunkley-Williams, L., Williams Jr.	Revista de Biologia Tropical 54, 1–7	2006	Culture Cage Culture Fish Health Parasites
121	Effect of temperature on growth and energy budget of juvenile cobia (<i>Rachycentron canadum</i>)	Growth and energy budget of juvenile cobia (initial body weight ~ 22 g) at various temperatures (23, 27, 31 and 35 °C) were investigated in this study. Maximal ration level (RLmax, %/day) increased as temperature (T , °C) increased from 23 °C to 31 °C but decreased at 35 °C, described as a quadratic equation: $RLmax = -0.023T^2 + 1.495T - 17.52$. Faecal production (f , mg g ⁻¹ day ⁻¹) increased with increased temperature (T , °C), described as a power function: $\ln f = 0.738 \ln T - 0.806$. As temperature increased, feed absorption efficiency in dry weight (FAEd, %), protein (FAEp, %) and energy (FAEe, %) all increased first and then decreased, but the variation of feed absorption efficiency was small, with ranges of 89.59–91.08%, 92.91–94.71%, 93.92–95.32%, respectively. Specific growth rate in wet weight (SGRw, %/day), dry weight (SGRd, %/day), protein (SGRp, %/day) and energy (SGRe, %/day) showed a domed curve relative to temperature (T , °C), described as quadratic equations: $SGRw = -0.068T^2 + 3.878T - 50.53$, $SGRd = -0.079T^2 + 4.536T - 59.64$, $SGRp = -0.084T^2 + 4.783T - 63.08$ and $SGRe = -0.082T^2 + 4.654T - 60.99$, and SGRw, SGRd, SGRp and SGRe maximized at 28.5 °C, 28.6 °C, 28.4 °C, 28.5 °C, respectively, as calculated from the regression equations. The relationships between feed conversion efficiency in wet weight (FCEw, %), dry weight (FCEd, %), protein (FCEp, %), energy (FCEe, %) and temperature (T , °C) also took on a domed curve described as quadratic equations: $FCEw = -0.726T^2 + 39.71T - 473.8$, $FCEd = -0.276T^2 + 15.31T - 190.6$, $FCEp = -0.397T^2 + 22.05T - 277.9$ and $FCEe = -0.350T^2 + 19.39T - 239.9$, and FCEw, FCEd, FCEp and FCEe maximized at 27.4 °C, 27.8 °C, 27.7 °C and 27.7 °C, respectively, as calculated from the regression equations. Energy budget of juvenile cobia fed satiation was $100C = 5F + 67(U + R) + 28G$ at water temperature 27 °C and $100C = 5F + 70(U + R) + 25G$ at water temperature 31 °C, where C is food energy, F is faeces energy, $(U + R)$ is excretion energy and metabolism energy, and G is growth energy.	Sun, L., Chen, H., Huang, L.	Aquaculture 261, 872–878	2006	Culture Nutrition Fish Health Bioenergetics
122	Local ecological knowledge of fishermen from Babitonga Bay, Santa Catarina, Brazil: Fishes from the Serranidae family and marine environmental changes	General aspects of the Local Ecological Knowledge (LEK) of long-line and spear fishermen on seven fish species of the Serranidae family (habitat use, maximum size and popular names) and on the main marine environmental changes were investigated in Babitonga Bay, Santa Catarina State, Brazil. In general, LEK on fishes corroborates the ichthyology literature, bringing original information in a local scale. Neighbor fishermen communities can develop different local species nomenclature and different LEK for fishery resources at the same area. We have verified that the fishing ban legislation on <i>Epinephelus itajara</i> in Brazil does not consider local species denominations, turning impossible its interpretation by local fishermen and generating conflicts on the law's applicability. The main environmental changes registered were: decreasing abundance of fishery resources in general (and in particular that of the "Parambijú" (Cobia) <i>Rachycentron canadum</i>), and the effects of the anthropogenic interruption of the Linguado Channel on the hydrological and sedimentological characteristics of the Babitonga Bay (channel-bed shallowing and increased water turbidity).	Gerhardinger, L.C., Marenzi, R.C., Hostim-Silva, M., Medeiros, R.P.	Acta Scientiarum - Biological Sciences 28, 253–261	2006	Wild (Atlantic/Pacific)
123	Application of dietary β-1,3-1,6-glucan in enhancing resistance of cobia (<i>Rachycentron canadum</i>) against <i>Photobacterium damsela</i> subsp. <i>piscicida</i> and <i>Streptococcus iniae</i> infections [Chinese]	This study evaluated the optimal concentration of the dietary incorporation of β-1,3-1,6-glucan (Glu) from <i>Schizophyllum commune</i> for enhancing the resistance to <i>Photobacterium damsela</i> subsp. <i>piscicida</i> and <i>Streptococcus iniae</i> infections in cobia (<i>Rachycentron canadum</i>). In experiment 1, fish were fed diets containing graded levels (0%, 0.1%, 0.2%, 0.4%, 0.8%, and 1.6%) of supplemental Glu for 10, 20, 30, and 40 days. Following these dietary treatments, the fish were challenged by an intraperitoneal injection of a <i>P. damsela</i> subsp. <i>piscicida</i> solution. The results showed that cobia fed the diet containing 0.4%, 0.8%, and 1.6% Glu showed a significantly ($p < 0.01$) enhanced resistance against <i>P. damsela</i> subsp. <i>piscicida</i> . In experiment 2, the weight gain and survival of cobia did not significantly differ ($p > 0.05$) after being fed the diets containing 0%, 0.5%, 1.0%, and 2.0% Glu for 15 weeks. The challenge tests showed that fish fed the diet containing 0.5% Glu for 10, 20, and 30 days showed significantly ($p < 0.01$) enhanced resistance against <i>P. damsela</i> subsp. <i>piscicida</i> . On the other hand, cobia fed the diet containing 0.5% Glu for 10 days showed significantly ($p < 0.001$) enhanced resistance against <i>S. iniae</i> . Results obtained from the two experiments strongly demonstrated that oral administration of 0.5% Glu for 10 days enhanced the resistance of cobia against <i>P. damsela</i> subsp. <i>piscicida</i> and <i>S. iniae</i> infections.	Chang, C.-F., Yang, J.-H., Chang, S.-L.	Journal of Taiwan Fisheries Research 14, 75–87	2006	Fish Health Nutrition Genetics/Molecular
124	An evaluation of using the total body electrical conductivity to estimate the proximate composition of cobia (<i>Rachycentron canadum</i>) [Chinese]	The proximate composition of Cobia (<i>Rachycentron canadum</i>) varies greatly and is difficult to discern by their appearance. In this study, a non-destructive electromagnetic (EM) scan method was applied to estimate the proximate composition of cobia. The predictive equations were obtained to assess the index of quality. Cobia, weighing 2880~8340 g, were scanned with an EM scan. The analytical results of the proximate composition indicated that the moisture content decreased while lipid content increased as the body weight of cobia increased. Results also showed a negative relationship between moisture and lipid contents ($R^2 = 0.965$). Ash and protein contents of cobia showed no significant differences with the body weight level in this study ($p > 0.05$). The TOBEC (total body electrical conductivity) value, body weight, fork length, and proximate composition were used to develop feasible predictive equations. The R^2 values of the equation for moisture, lean body mass, ash, and protein were 0.981, 0.983, 0.941, and 0.984, respectively. The R^2 value of the predictive equation for lipids was lower at 0.784. To evaluate the feasibility of the equation by paired t-test, the body weight, fork length, and TOBEC value of moisture and lipid contents of six new samples were checked by the predictive equation and experimental measurements. Results showed no significant differences between them. It is feasible to use equations for non-destructive analysis to predict the proximate composition of cobia.	Wang, W.-C., Yeh, H.-L., Liu, S.-C.	Journal of Taiwan Fisheries Research 14, 101–110	2006	Fish Health Nutrition
125	A mannose-specific tetrameric lectin with mitogenic and antibacterial activities from the ovary of a teleost, the cobia (<i>Rachycentron canadum</i>)	A tetrameric lectin, with hemagglutinating activity toward rabbit erythrocytes and with specificity toward d-mannosamine and d(+)-mannose, was isolated from the ovaries of a teleost, the cobia <i>Rachycentron canadum</i> . The isolation protocol comprised ion exchange chromatography on CM-cellulose and Q-Sepharose, ion exchange chromatography by fast protein liquid chromatography (FPLC) on Mono Q, and finally gel filtration by FPLC on Superose 12. The lectin was adsorbed on all ion exchangers used. It exhibited a molecular mass of 180 kDa in gel filtration on Superose 12 and a single 45-kDa band in sodium dodecyl sulfate-polyacrylamide gel electrophoresis, indicating that it is a tetrameric protein. The hemagglutinating activity of the lectin was stable up to 40°C and between pH 4 and pH 10. All hemagglutinating activity disappeared at 60°C and at pH 1 and pH 13. The hemagglutinating activity was doubled in the presence of 0.1 μM FeCl ₃ . The lectin exerted antibacterial activity against <i>Escherichia coli</i> with 50% inhibition at 250 μg. There was no antifungal activity toward <i>Coprinus comatus</i> , <i>Fusarium oxysporum</i> , <i>Mycosphaerella arachidicola</i> , and <i>Rhizoctonia solani</i> at a dose of 300 μg. The lectin exhibited maximal mitogenic response from mouse splenocytes at a concentration of 14 μM.	Ngai, P.H.K., Ng, T.B.	Applied Microbiology and Biotechnology 74, 433–438	2007	Microbiology

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
126	Ontogeny of the gastrointestinal tract and selected digestive enzymes in cobia <i>Rachycentron canadum</i> (L.)	The ontogeny of the digestive system of cobia <i>Rachycentron canadum</i> from hatching to 22 days post-hatch (dph) (20-1 mm standard length) was examined with light microscopy. The activities of selected pancreatic enzymes were also determined during this period in order to optimize current rearing methods for this species. At hatching (3-6 mm), the digestive tract consisted of a relatively undifferentiated, straight tube positioned dorsally to the yolk sac. The major morphological changes in the digestive tract primarily occurred over the first 1-4 dph (3-6-4-4 mm). During this time, larvae began exogenous feeding (3 dph) and the digestive tract differentiated into five histologically distinct regions: buccopharynx, oesophagus, stomach anlage, anterior intestine and posterior intestine. Yolk reserves were exhausted by 5 dph (4-5 mm) and the oil globule began rapidly decreasing in size disappearing entirely by 9-10 dph (6-3-6-8 mm). Gastric glands differentiated at this time, and by 12 dph (8-1 mm) surface mucous cells of the stomach anlage stained positive for neutral mucosubstances. By 16 dph (11-6 mm), the blind sac (fundic region) of the stomach formed as did the pyloric caecae which initially appeared as a single protrusion of the anterior intestine just ventral to the pyloric sphincter. Generally, enzyme activities (U larva ⁻¹) for amylase (0-0-1-8), chymotrypsin (0-0-7902-4), trypsin (0-2-16-6) and lipase (9-3-1319-0) were measurable at or soon after hatching and increased steadily from c. 8-22 dph (5-7-20-1 mm). The results of this study are discussed in terms of current and future weaning practices of this species.	Faulk, C.K., Benninghoff, A. D., Holt, G.J.	Journal of Fish Biology 70, 567-583	2007	Microbiology Fish Health
127	Impact of water temperature on growth in cobia, <i>Rachycentron canadum</i> , cultured in cages	Temperature is a major factor affecting fish growth in natural environments. The relationship between water temperature and growth rate in cobia, <i>Rachycentron canadum</i> , was examined at a fish farm in Penghu, Taiwan. Six cages, stocked with 300 fish each, were used in the year-long experiment. Growth rate was monitored by sampling 30 fish from each cage every month. Water quality was optimum throughout the experiment. Fish were fed commercial fish food to satiation twice a day. Cobia grew 0.84%/day in summer (March-September) and 0.41%/day in winter (October-February). The slowest growth occurred in late December at temperatures of 15.0-16.5°C and the fastest during summer at temperatures above 28°C.	Yu, S.-L., Ueng, P.-S.	Israeli Journal of Aquaculture - Bamidgeh 59, 47-51	2007	Culture Cage Culture
128	The effects of organic protein supplementation upon growth, feed conversion and texture quality parameters of juvenile cobia (<i>Rachycentron canadum</i>)	An eight week feeding trial was conducted to examine the impacts of organically certifiable alternate protein sources on growth, feed efficiency, biological indices, fillet proximate composition and fillet quality in juvenile cobia. Diets were formulated to be isonitrogenous and isocaloric. The control diet provided 45% crude protein from Special Select® menhaden fish meal and 10% total lipid. The remaining diets were formulated with 25 and 40% inclusion of NuPro® (an organically certified yeast-derived protein source), and 40% inclusion of organically certified soybean meal, soybean isolate, or hemp seed meal. Two additional diets were formulated to contain a mixture of all organic protein sources at 23% with 8% fish meal or 25% and no fish meal. Diets were fed to triplicate groups of juvenile cobia (initial weight 10 g/fish) in 300 L circular tanks connected as part of a recirculating aquaculture system. Weight gain ranged from 167 to 1138% increase from initial weight and was similar for all fish fed diets containing 40% of any given alternate protein source. Fish fed the blended diet with 8% fish meal exhibited significantly lower weight gain, SGR, and FE ratio values than all other fish. Cobia fed the diet without any fish meal did not survive to the end of the study. Biological indices such as muscle ratio (MR), visceral somatic index (VSI), and packed cell volume (PCV) were all similar between fish fed the control diet and those fed diets with up to 40% alternate protein. Fish fed the diet with only 8% fish meal had significantly lower MR, PCV, and plasma protein, and significantly higher VSI. All fish exhibited similar fillet proximate composition for protein, lipid, dry matter, and ash except for those fed the diet containing 8% fish meal. Alternate protein source did appear to impact the fillet texture of cobia. Generally speaking, plant protein sources returned higher textural characteristics than the fish meal control. At all time points and all texture parameters, cobia fed the diet containing hemp seed meal returned the highest values except for distance to rupture in the final time point. Results indicate that up to 40% fish meal protein can be replaced by any of the organically certifiable alternate proteins that were used in this study without detrimental impacts to weight gain, feed efficiency, biological indices, or fillet composition in juvenile cobia. Our results also suggest that alternate proteins have differential effects upon final product quality, which may have implications in terms of cobia processing and development of industrial products.	Lunger, A.N., McLean, E., Craig, S.R.	Aquaculture 264, 342-352	2007	Culture Fish Health Nutrition
129	Growth of juvenile cobia, <i>Rachycentron canadum</i> , at three different densities in a recirculating aquaculture system	Cobia (<i>Rachycentron canadum</i>) is an excellent aquaculture candidate and culture of this species continues to develop worldwide. Current culture practices generally include larviculture and production of early juveniles on land with final growout occurring in ocean cages. Data indicate that production and/or growout of juveniles in land based recirculating systems may be hampered by growth depression in fish held at even relatively low densities. The current study investigated the responses of early cobia juveniles cultured at three different stocking densities (0.04, 0.22, and 0.44 g of fish/L) over a 10-week period in a recirculating aquaculture system. Water temperature was maintained at 27 ± 1 C and salinity was 32.0 ± 3.0 ppt. Fluorescent light banks were used to maintain a light/dark cycle of 14 h light/10 h dark. Early juveniles used in this trial had an average initial weight of 6.7 ± 0.2 g and were stocked at 3, 10, or 20 per tank in order to reach target stocking densities. Fish were fed to satiation twice daily with a commercial diet and the amount fed was measured to determine feed efficiency. Fish from each tank were counted and weighed collectively each week until the end of the trial to monitor growth and survival. In addition, fish from the control (0.04 g/L) tanks were individually marked via clipping of the pectoral fins and weighed individually each week. Survival was high (≥ 96% in all treatments) and there were no significant differences among treatments. Growth was also not significantly different among treatments with weight gains between 2523 and 2747% of initial weight (SGR ranging from 5.18 to 5.29). Feed efficiency of the control (0.96 ± 0.02) was significantly lower than that of the 0.22 g/L treatment (1.04 ± 0.03).	Webb Jr., K.A., Hitzfelder, G.M., Faulk, C.K., Holt, G.J.	Aquaculture 264, 223-227	2007	Culture RAS
130	Effects of abrupt salinity stress on osmoregulation of juvenile <i>Rachycentron canadum</i> [Chinese]	<i>Rachycentron canadum</i> is a thriving mariculture species for offshore cage in southern Mainland and Taiwan of China, due to its rapid growth rate and high quality flesh. In this paper, the gill Na ⁺ -K ⁺ -ATPase (NKA) activity and iono- and osmoregulation of juvenile <i>R. canadum</i> were investigated in a 12 h stress of ambient salinities (0-45), and the results showed that after an abrupt transfer to the salinities of 0, 5, 15, 25, 37 (control) and 45, the death of juvenile <i>R. canadum</i> only occurred in salinity 0, with a mortality of 100% by the end of the experiment. In all treatments, the gill NKA activity and serum osmolality fluctuated in first 3 h, and then changed smoothly. The NKA activity varied with salinity grade in U shape, being significantly (<i>P</i> <0.05) higher in salinity 5 and the lowest in salinity 15 in 12 h, while the serum osmolality (ranged 293-399 mOsmol·kg ⁻¹) presented a positive correlation with salinity. Serum [Na ⁺] and [Cl ⁻] concentration slightly increased with salinity within the period of 3-12 h, while serum [K ⁺] displayed a reverse pattern. The isosmotic point was estimated as 328.2 mOsm·kg ⁻¹ and corresponded to salinity 11.48. The isoionic points for serum [Na ⁺], [K ⁺] and [Cl ⁻] were estimated as 155.2, 6.16, and 137.1 mmol·L ⁻¹ , which corresponded to the salinities of 10.68, 20.44 and 8.41, respectively. It was concluded that <i>R. canadum</i> could be characterized physiologically as a “higher-NKA-in-hyposmotic media” marine euryhaline teleost with the capability of rapid and effective hyper/hypo iono- and osmoregulation.	Xu, L.-W., Liu, G.-F., Wang, R.-X., Su, Y.-L., Guo, Z.-X., Feng, J.	Chinese Journal of Applied Ecology 18, 1596-1600	2007	Fish Health
131	A review of the larviculture of cobia <i>Rachycentron canadum</i> , a warm water marine fish	Cobia <i>Rachycentron canadum</i> is a marine finfish species with emerging global potential for mariculture. Positive culture attributes include capacity for natural and induced tank spawning, growth rates in excess of 6 kg/year, high disease resistance, high survival rates (post-larviculture stage) in tanks and net pens, adaptability to commercially available extruded diets, and high-quality filets suitable for the sashimi as well as white tablecloth restaurant markets. Nonetheless, cobia production faces several bottlenecks limiting industrial expansion including limitations in fingerling production per unit volume. This paper will provide an overview of production limitations, and focus on recent spawning and larviculture research results and ongoing research initiatives.	Joan Holt, G., Faulk, C.K., Schwarz, M.H.	Aquaculture, Larvi 2005 Proceedings of the 4th Fish and Shellfish Larviculture Symposium, Gent, Belgium, September 2005 268, 181-187	2007	Culture
132	Inverse PCR amplification of the complete major capsid protein gene of lymphocystis disease virus isolated from <i>Rachycentron canadum</i> and the phylogenetic analysis of the virus [Chinese]	The major capsid protein of lymphocystis disease virus isolated from <i>Rachycentron canadum</i> (LCDV-rc) was amplified and analysed. The 457bp DNA core fragment was amplified with the degenerate primers designed according to the conserved sequences of MCP gene of iridoviruses, then the flanking sequences adjacent to the core region were amplified by inverse PCR, and the complete sequence was obtained by combining all of them. The open reading frame of the gene is 1380bp in length, encoding a putative protein of 459 aa with molecular weight 51.12 kD and pI 6.87. Constructing the phylogenetic tree for comparing the MCP amino acid of iridoviruses, the results indicated that LCDV-rc is most homologous to the other Lymphocystis viruses and all of them constitute a branch. Accordingly LCDV-rc is identified as Lymphocystivirus.	Fu, X.Z., Shi, C.B., Li, N.Q., Pan, H.J., Chang, O.Q., Wu, S.Q.	Chinese Journal of Virology 23, 412-416	2007	Genetics/Molecular Microbiology
133	Growth and survival of larval and juvenile cobia <i>Rachycentron canadum</i> in a recirculating raceway system	Cobia <i>Rachycentron canadum</i> is a fast-growing, pelagic marine species that has recently attracted aquaculturists in both the research and commercial sectors. The typical method of grow-out for this species is in outdoor systems where production is limited to locations and seasons conducive for adequate growth and survival. Expanding the culture of cobia to indoor recirculating aquaculture systems (RAS) would allow for the production of fingerlings throughout the year and extend production to cooler regions. Two rearing trials were conducted to examine the growth and survival of cobia from hatching through 4 (trial 1, T1) or 35 (trial 2, T2) g in RAS. Cobia larvae were reared in circular tanks placed in a raceway to control water temperature and quality. During early juvenile grow-out, fish were transferred without grading to a second raceway on 29 dph (T1) or over a period of grading from 29-43 dph (T2). Larval growth (1-22 dph) measured as standard length was similar for both trials ranging from ~ 3.9 to 14.7 mm. However, larval growth measured as wet weight (0.033 g, T1; 0.026 g, T2) or dry weight (5.7 mg, T1; 3.9 mg, T2) was significantly greater on 22 dph during T1 as was the ratio between myotome height and standard length. These differences may have resulted from an increase in initial densities from 8.7 larvae l ⁻¹ (T1) to 14.7 larvae l ⁻¹ (T2) which apparently caused an increase in food competition and overall aggression. During juvenile grow-out, cobia reached 4.0 g on 43 dph in T1 and 35.4 g on 71 dph in T2 matching weights achieved during grow-out in outdoor ponds. Over the course of both trials, survival was similar to that reported in outdoor ponds. Mean survival (± S.D.) during the early rearing phase (hatching through 29 or 43 dph) averaged 13.2 ± 3.2 % and 10.4 ± 3.2 % corresponding to final densities of 0.9 ± 0.2 and 1.2 ± 0.4 fish/l for T1 and T2, respectively. During the first grow-out phase (29-43 dph), survival of fish moved into the open raceway was 64.5% in T1 and 88.7 % in T2. Survival of cobia during the second grow-out phase (43-71 dph) for T2 was 92.5%. The results of this study indicate that cobia can be successfully cultured in indoor systems from hatching through at least 35 g without negatively affecting growth or survival.	Faulk, C.K., Kaiser, J.B., Holt, G.J.	Aquaculture 270, 149-157	2007	Culture RAS
134	Phylogenetic analysis of LCDV-rc, a new genotype of lymphocystivirus isolated from China <i>Rachycentron canadum</i> [Chinese]	Lymphocystis disease virus (LCDV-rc), a kind of iridovirus, was isolated from Chinese <i>Rachycentron canadum</i> . Phylogenetic relationships of LCDV-rc, LCDV-cn, LCDV-jf, LCDV-sb, LCDV-rf, LCDV-1 and other iridovirus were analysed on the molecular level. Taking mcp gene as the molecular marker, partial nucleotide sequences(1356bp) containing 178 informative sites of mcp gene were acquired by PCR and cloning sequencing. Phylogenetic trees were reconstructed using maximum parsimony, maximum likelihood, neighbor joining and Bayesian methods based on mcp gene sequences. And supporting values were calculated. The results indicate that one of the clusters consists of LCDV-rc isolated from China cobio and LCDV-sb isolated from Korea weever. The next cluster includes LCDV-cn isolated from China flounder and LCDV-jf isolated from Japan flounder. The third cluster includes LCDV-rf isolated from Japan rockfish. LCDV-1 is the last cluster. The results of the analyses of phylogenetic relationships and genetic distance indicate that LCDV-rc is a new genotype of lymphocystivirus.	Yan, X., Sun, X., Wu, S., Wu, S., Zhang, J., Hong, X., Zheng, F., Qu, L.	Chinese High Technology Letters 17, 1087-1091	2007	Genetics/Molecular Fish Health Microbiology
135	Bioimpedance assessment of body composition in cobia <i>Rachycentron canadum</i> (L. 1766)	Sixty juvenile cobia (<i>Rachycentron canadum</i> ; 28.3 ± 0.13 g wet wt) were randomly distributed into each of 12 tanks in a recirculation unit (<i>n</i> = 5 tank ⁻¹). Fish were fed one of two diets (47:8 or 47:20 protein:lipid) at 6-8% body wt d ⁻¹ for 6 weeks. Each week, the composition of fish (<i>n</i> = 5) from each dietary treatment was calculated by measuring the impedance (resistance and reactance) of a current (<i>x</i> μA AC and kHz) passed through a live animal. Electrodes were positioned at morphologically discrete points on the dorsal left hand side of the animal. After bioimpedance (BIA) assessment, the identical fish were sacrificed and their body composition determined using traditional, chemical methods. Results generated by chemical analyses were regressed against BIA data. Linear regression analysis was performed utilizing compositional analysis (protein, lipid and ash) as the observed values and BIA assessment for the predicted. Regressions for each body composition parameter produced high correlations in all relationships: resistance (in parallel) and protein (adj. <i>R</i> ² = 0.9569), resistance (in parallel) and total body water (adj. <i>R</i> ² = 0.9894), reactance (in parallel) and total body ash (adj. <i>R</i> ² = 0.8547), reactance (in series) and dry matter (adj. <i>R</i> ² = 0.9272) and reactance (in series) and fat-free mass (adj. <i>R</i> ² = 0.9916). The <i>F</i> value tests (<i>P</i> < 0.0001) revealed significant correlations between the independent and dependent variables for each body composition parameter. Correlations for each regression indicate strong linear relationships between impedance and proximate analysis variables with values of 1:1. This indicates that this BIA methodology can be utilized as an inexpensive, non-lethal, on the farm determination of proximate composition.	Duncan, M., Craig, S.R., Lunger, A.N., Kuhn, D.D., Salze, G., McLean, E.	Aquaculture 271, 432-438	2007	Culture Nutrition Fish Health

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
136	Taurine supplementation to alternative dietary proteins used in fish meal replacement enhances growth of juvenile cobia (<i>Rachycentron canadum</i>)	Two separate 8 week feeding trials were conducted to examine the impacts of fish meal replacement with an organically certifiable yeast-based protein source with and without supplementation of methionine, tryptophan, and taurine to diets for juvenile cobia. In the first trial, diets were formulated to contain 41% crude protein and 13% lipid, and a yeast-based protein replaced fish meal at 50 and 75% of dietary protein with and without supplemental taurine at 0.5 g/100 g dry diet. The control diet contained 100% herring fish meal. Methionine and tryptophan were added to all diets except the control to resemble the amino acid profile of fish meal. Results from this study indicated that fish fed diets supplemented with taurine exhibited significantly higher weight gain and better feed efficiencies than all other fish. Diet significantly impacted biological indices such as muscle ratio (MR), visceral somatic index (VSI), and hepatosomatic index (HSI). The 75% yeast-based protein diet without taurine returned the lowest MR values and the highest VSI and HSI values. In the second trial, diets were formulated to contain 43% crude protein and 11% lipid, with the control diet containing 100% herring fish meal and the same yeast-based protein replacing fish meal at 50, 75, and 100% of dietary protein. All diets except the control were supplemented with taurine at 0.5 g/100 g dry diet. Results from this study indicated that increasing amount of yeast-based protein led to decreased weight gains and feed efficiencies regardless of taurine supplementation. However, weight gain and feed efficiencies did increase when compared to a previous study [Lunger, A.N., McLean, E., Craig, S.R., 2007. The effects of organic protein supplementation upon growth, feed conversion and texture quality parameters in juvenile cobia (<i>Rachycentron canadum</i>). <i>Aquaculture</i> 264, 342–352] using identical diet formulations except for taurine supplementation. MR values tended to decrease while VSI and HSI values tended to increase with increasing fish meal replacement. It is obvious from the results from both of the present studies that taurine supplementation does have a significant impact on growth and feed efficiency of juvenile cobia when they are fed diets containing high levels of plant-based proteins as replacements for fish meal. Additionally, alternate proteins, especially those of plant and yeast-based origin can be incorporated at very high levels in diets for cobia with proper amino acid supplementation.	Lunger, A.N., McLean, E., Gaylord, T.G., Kuhn, D., Craig, S.R.	<i>Aquaculture</i> 271, 401–410	2007	Nutrition Fish Health
137	Acute toxicity and sublethal effects of ammonia and nitrite for juvenile cobia <i>Rachycentron canadum</i>	Nitrogenous compounds can be toxic to aquatic animals especially when they are reared at high stocking densities. Cobia (<i>Rachycentron canadum</i>) is a fast growing fish currently reared in cages, but with expanding production in intensive recirculating aquaculture systems (RAS). Therefore, the objective of this study was to evaluate the acute toxicity of ammonia and nitrite to juvenile cobia. Juveniles (1.74 ± 0.11 g for ammonia and 0.88 ± 0.06 g for nitrite toxicity evaluation) were acclimated to test conditions (temperature 26 °C and salinity 22‰) and acutely exposed to ammonia (0.25–1.30 ppm NH3-N) and nitrite (30–210 ppm NO2-N) at 0.2 fish L ⁻¹ . Tests were run in 50 L semi-static tanks, experimental water was fully renewed daily, and all test concentrations plus the controls were run in triplicate. Mortality, feeding and swimming behavior were observed during 96 h, toxic concentrations for 50% the population and the respective 95% confidence intervals for these three end points were estimated using the Trimmed Spearman Karber Method. Cobia ceased to eat at 0.62 (0.56–0.70) ppm NH3-N and 76.1 (73.2–79.0) ppm NO2-N. Swimming behavior was affected at higher concentrations: 0.80 (0.74–0.85) ppm NH3-N and 88.8 (82.6–95.5) ppm NO2-N. Even higher concentrations were necessary to kill juvenile cobia, LC50–96 h for ammonia was estimated at 1.13 (1.06–1.19) ppm NH3-N, and within the range of concentrations tested for nitrite it was not possible to estimate the LC50–96 h, as only 30% of the individuals died at the highest concentration after 96 h (210 ppm NO2-N). The results of the present experiments demonstrate that ammonia could be problematic at relatively low levels for the intensive rearing of juvenile cobia; however, it is unlikely that the high levels of nitrite needed to harm juvenile cobia would be reached in a well designed and properly operating RAS.	Rodrigues, R.V., Schwarz, M.H., Delbos, B.C., Sampaio, L.A.	<i>Aquaculture</i> 271, 553–557	2007	Culture RAS Fish Health Water Quality
138	Elevated oxygen uptake and high rates of nitrogen excretion in early life stages of the cobia <i>Rachycentron canadum</i> (L.), a fast-growing subtropical fish	Physiological energetics of cobia <i>Rachycentron canadum</i> were quantified for 18 to 82 days post-hatch (dph) hatchery-reared juveniles to better understand energy transformation and its implications in growth and survival. Mean oxygen consumption rates ($\dot{V}O_2$; mg O ₂ h ⁻¹) of fish fed ad libitum and fish that were starved significantly increased with increasing wet mass (M; g), = 1.4291 M ^{0.8119} and = 1.1784 M ^{0.7833} , respectively, with a significant reduction in mean metabolic rates of starved fish (19 to 27% specific dynamic action; SDA). Total ammonia nitrogen excretion rates (AMM, $\mu\text{mol h}^{-1}$) also scaled with M and significantly decreased after starvation. Mean mass-specific AMM and urea excretion rates are the highest reported in the literature, with urea accounting for approximately half the total nitrogen excretion measured in both fed and starved fish. Relatively high energetic rates may allow cobia to develop rapidly into pre-juveniles and be less susceptible to predation and starvation at a comparatively early age.	Feeley, M.W., Benetti, D.D., Ault, J.S.	<i>Journal of Fish Biology</i> 71, 1662–1678	2007	Fish Health Bioenergetics
139	Performance of advanced juvenile cobia, <i>Rachycentron canadum</i> , reared under different thermal regimes: Evidence for compensatory growth and a method for cold banking	Two trials were undertaken to examine the growth response of juvenile cobia, <i>Rachycentron canadum</i> , at varying temperatures. The initial trial was conducted to determine the effect of various temperatures (18, 23, and 29°C) on weight gain and feed efficiency. The second trial investigated the effect of elevating water temperature in which fish maintained at 18°C and 23°C to a temperature close to their optimum (29°C). The latter study was undertaken in order to determine the effect of thermal shifts upon subsequent growth response of the species. Such information will assist commercial producers in developing various culture guidelines. As anticipated, differences ($P < 0.01$) in weight gain were recorded among all treatments, although remarkably, feed efficiency did not differ for cobia held at 23°C and 29°C. Following thermal shift, cobia subjected to the largest temperature change (18–29°C) illustrated an immediate growth response, but specific growth rates (SGR) did not exceed that of cobia held at 29°C for the duration of the trial. Nevertheless, when SGR were examined using fish of similar size (i.e., derived from different time points during the study) evidence for growth compensation was obtained. This study illustrates that cobia can be held at reduced temperatures, without detrimental impact on future performance, as a means of maintaining animals at smaller size for production and experimental purposes: “Cold banking.”	Schwarz, M.H., Mowry, D., McLean, E., Craig, S.R.	<i>Journal of Applied Aquaculture</i> 19, 71–84	2007	Culture RAS
140	Dietary lysine requirement of juvenile cobia (<i>Rachycentron canadum</i>)	An 8-week feeding trial was conducted to quantify the dietary lysine requirement of juvenile cobia with an initial average weight of 1.25 g reared in indoor flow-through and aerated aquaria. Six isonitrogenous and isoenergetic practical diets (44% CP and 16% lipid) containing six levels of dietary lysine ranging from 1.15 to 3.25% (dry weight) at about 0.4% increments, using fish meal and wheat gluten as sources of intact protein, supplemented with crystalline amino acids. Equal amino acid nitrogen was maintained by replacing lysine with nonessential amino acid mixture. Each diet was randomly assigned to three aquaria and was fed to apparent satiation by hand four times daily. The results indicated that there were significant differences in growth performance and feed utilization among the treatments. Maximum weight gain, special growth rate and protein efficiency ratio occurred at 2.38% dietary lysine; but with the increase of dietary lysine from 2.38 to 3.25%, weight gain, special growth rate and protein efficiency ratio did not significantly increase. The hepatosomatic index, viscerosomatic index, condition factor, crude protein content in whole body and main composition in muscle were significantly affected by dietary lysine levels; however moisture, lipid and ash content in whole body were not significantly affected by the dietary lysine. There were significant differences in total serum protein, glucose and triacylglycerol concentrations in fish fed diets with different dietary lysine levels. Haematocrit and leukocyte count were significantly affected by dietary lysine level, but hemoglobin and red blood cell count were not significantly affected. Lysine concentration in serum was significantly increased with the increase of dietary lysine level from 1.15 to 2.38%. Broken-line analysis on the basis of special growth rate showed that the dietary lysine requirement of juvenile cobia was 2.33% of dry diet (5.30% dietary protein).	Zhou, Q.-C., Wu, Z.-H., Chi, S.-Y., Yang, Q.-H.	<i>Aquaculture</i> 273, 634–640	2007	Nutrition Fish Health
141	Developmental expression of the G protein-coupled receptor 54 and three GnRH mRNAs in the teleost fish cobia	The cDNAs of the G protein-coupled receptor 54 (GPR54) and three prepro-gonadotropin-releasing hormones, GnRH-I (seabream GnRH), GnRH-II (chicken GnRH-II), and GnRH-III (salmon GnRH) were isolated and cloned from the brain of the teleost fish cobia, <i>Rachycentron canadum</i> . The cobia GPR54 cDNA was 95 and 51–56% identical to those of tilapia and mammalian models respectively. The GnRH cDNA sequences of cobia showed strong identities to those of tilapia, Atlantic croaker, red drum, and the seabass and seabream species. The real-time quantitative RT-PCR methods allowed detection of all three GnRH mRNAs on the first day after hatching (DAH). The GnRH-I mRNA levels, which were the lowest among the three GnRHs, increased gradually with two distinct peaks in larvae at 3 and 4 DAH. On the other hand, GnRH-II and GnRH-III mRNAs were significantly higher in larvae at 2 and 6 DAH compared with those on the preceding days. In addition, significant peaks of all the three GnRH mRNAs were observed in the brains of 26-day-old fish. The finding of higher GnRH-I and GnRH-II mRNAs in males than females at 153 DAH may be related to early puberty observed during the first year in laboratory-reared male cobia. Moreover, this study demonstrates for the first time the expression of GPR54 mRNA during larval development in a vertebrate species. The concomitant expression patterns of GPR54 and GnRH mRNAs during different stages of larval and juvenile developments, and during early puberty in male cobia suggest a potential relationship between GPR54 and multiple GnRHs during these stages of development consistent with the role of GPR54 in controlling GnRH release in mammals. The increase in GPR54 and GnRH mRNAs observed during early puberty in cobia is consistent with a similar change reported in pubertal rats. This finding together with the localization of GPR54 mRNAs on GnRH neurons in fish and mammals suggests that the GPR54–GnRH interactions may be conserved in different vertebrate groups.	Mohamed, J.S., Benninghoff, A.D., Holt, G. J., Khan, I.A.	<i>Journal of Molecular Endocrinology</i> 38, 235–244	2007	Genetics/Molecular
142	Bioaccumulation of mercury in pelagic fishes from the northern Gulf of Mexico	Total mercury (Hg) concentration was determined in the tissues of 10 pelagic fishes in the northern Gulf of Mexico, and dietary tracers (stable isotopes and fatty acids) were used to evaluate the relationship between Hg and feeding history. Highest Hg levels were observed in blue marlin (<i>Makaira nigricans</i>), carcharhinid sharks (<i>Carcha rhinus</i> spp.), and little tunny (<i>Euthynnus alletteratus</i>), ranging from 1.08 to 10.52 ppm. Moderate to low concentrations (<1.0 ppm) were observed in blackfin tuna (<i>Thunnus atlanticus</i>), cobia (<i>Rachycentron canadum</i>), dolphinfish (<i>Cory phaena hippurus</i>), greater amberjack (<i>Seriola dumerili</i>), king mackerel (<i>Scomberomorus cavalla</i>), wahoo (<i>Acanthocybium solandri</i>), and yellowfin tuna (<i>Thunnus albacares</i>). For the majority of species examined, Hg concentrations did not vary significantly between location (Texas vs. Louisiana) or collection period (2002 and 2003). Significant positive relationships between Hg concentration and body size and (or) weight were detected for 6 of the 10 taxa examined. Hg concentration was also positively associated with trophic position. Three natural associations were identified using stable isotope and fatty acid signatures. Still, no connection between these natural trophic associations and Hg concentration was observed, suggesting that Hg concentration in pelagic fishes was more closely linked to trophic position and size than feeding history.	Cai, Y., Rooker, J.R., Gill, G. A., Turner, J.P.	<i>Canadian Journal of Fisheries and Aquatic Sciences</i> 64, 458–469	2007	Fish Health Contaminants Wild (Atlantic/Pacific)
143	Low-Salinity Resistance of Juvenile Cobias	Juvenile cobias <i>Rachycentron canadum</i> were exposed to decreasing salinity (~1‰ per day) in a series of five experiments to assess their low-salinity resistance. All fish survived for 24 h at a salinity of 2‰, but 73% died within 24 h of a reduction to 1‰ salinity. Plasma osmolality decreased significantly with decreasing salinity. Fish held for 7 d at 2, 5, or 8‰ after an approximately 1‰ daily reduction differed significantly in plasma osmolality; fish held at a salinity of 2‰ exhibited significantly lower plasma osmolality than fish in the other treatments. Doubling the environmental Ca concentration did not affect plasma osmolality. The results indicate that cobias have limited euryhaline abilities but not enough to sustain low-salinity culture operations.	Burkey, K., Young, S.P., Smith, T.I.J., Tomasso, J.R.	<i>American Journal of Aquaculture</i> 69, 271–274	2007	Fish Health Physiology
144	Measurement of organic loading under an open-ocean aquaculture cage, using sediment traps on the bottom	Organic loading under a submerged fish cage in commercial operation has been quantified for the first time in the open ocean. Sediment traps out to 100 m sampled the loading continuously over the 15 months of a complete grow-out cycle for cobia (<i>Rachycentron canadum</i>). Typically 4% or 5% of the feed arrived directly to the sediment, although this benthic percentage became much higher in the last two months of this study. Almost all the loading (90%) lands within 30 m of the cage mooring block. The loading consists of fragments of feed pellets that wash out from the mouths and gills of the fish. The fragments sink rapidly and almost vertically; they are not carried horizontally into large dilution volumes. Dispersal on the sediment surface is much more extensive than dispersal in the water. This study developed expeditious and cost-effective techniques for sampling and analyzing organic loading, using a minimum of technological resources.	Rapp, P., Ramírez, W.R., Rivera, J.A., Carlo, M., Luciano, R.	<i>Journal of Applied Ichthyology</i> 23, 661–667	2007	Sediments Cage Culture Commercial Nutrient Impacts
145	Effects of amino acids added and soy-protein replacement on the growth of juvenile cobia (<i>Rachycentron canadum</i>) [Chinese]	This study compared the effect of amino acids (L-methionine, L-proline, betain hydrochloride) fortified test diets containing graded levels of soy-protein for juvenile cobia. In the test of adding one amino acid to pure soy-protein diet as a feeding stimulant, the results showed that the best feed intake rates were 1.84% for L-methionine replaced at level of 1.5%, 4.57% for L-proline replaced at level of 1.15% and 1.35% for betain hydrochloride replaced at level of 0.14%. Fortified amino acids (L-methionine, L-proline, betain hydrochloride, 2 : 1 : 0.1) as feeding stimulants were added to soy-protein replacement diets to find the best substitute level for juvenile cobia. The results showed the survival rate still maintain at 100% when the fish fed with diets of soy-protein replaced at levels of 20%, 60% and 80% for 3 weeks period. The highest feed intake rate was 6.2% when fish fed with diet of soy-protein replaced level at 0% and the lowest feed intake rate was 1.8% when fish fed with diet of soy-protein replaced level at 100%. However, the best weight gain and feed conversion ratio (FCR) occurred at soy-protein replaced level at 20%. They were 263% and 0.88, respectively. The results suggested that using amino acids as feeding stimulants added to soy-protein based diet at level of 20% could get the best feed intake, survival, weight gain and FCR results.	Liou, B.-S., Chen, T.-I.	<i>Journal of Taiwan Fisheries Research</i> 15, 55–61	2007	Fish Health Nutrition
146	Partial toxicity tests of copper (Cu2+), zinc (Zn2+) and cyanide (CN-) for young cobia fishes (<i>Rachycentron canadum</i>) with 45 day-old	The partial toxicity tests of copper (Cu2+), zinc (Zn2+) and cyanide (CN-) for young cobia fishes with (<i>Rachycentron canadum</i>) 45 day-old were conducted in the Doson station during ten days (yr 2005). These three toxic substances affected strongly the growth of the cobia fish (size and weight), even at the lowest treated concentration. The LC50 values of copper, zinc and cyanide were 0.32 mg/l; upper 1mg/l and 0.049 mg/l, respectively. Based on the calculated results of NOEC and LOEC, we have determined the safe concentrations of these two heavy metals and cyanide for the environmental aquaculture of the cobia fish which were lower than 0.025 mg Cu/l, 0.5 mg Zn/l and 0.005 mg CN/l respectively. The results is also showed that cyanide was the most toxic to Cobia, followed by copper and zinc.	Dung, L.Q., Cu, N.D.	<i>Tap Chi Sinh Hoc</i> 29, 78–83	2007	Fish Health Water Quality Contaminants Physiology

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
147	Effects of dietary phospholipid level in cobia (<i>Rachycentron canadum</i>) larvae: growth, survival, plasma lipids and enzymes of lipid metabolism	A study was conducted to determine the effects of dietary phospholipid (PL) levels in cobia (<i>Rachycentron canadum</i>) larvae with regard to growth, survival, plasma lipids and enzymes of lipid metabolism. Fish with an average weight of 0.4 g were fed diets containing four levels of PL (0, 20, 40 and 80 g kg ⁻¹ dry matter: purity 97%) for 42 days. Final body weight (FBW), weight gain (WG) and survival ratio were highest in the 8% PL diet group and mortality was highest in PL-free diet group. We examined the activities of lipoprotein lipase (LPL) and hepatic lipase (HL) in liver, lecithin-cholesterolacyltransferase (LCAT) in plasma as well as plasma lipids and lipoprotein. LCAT activity showed a decrease of more than two-fold in PL-supplemented diet groups compared with the PL-free diet group. HL activity was highest in the 8% PL diet group and the other three groups showed no difference. LPL activity was significantly higher in the PL-supplemented diet groups than in the PL-free diet group. The dietary intervention significantly increased plasma phospholipids and total cholesterol (TC) levels, and the higher free cholesterol (FC) level contributed to the TC level. However, the fish fed PL exhibited a significantly decreased plasma triglyceride (TG) level. The lipoprotein fractions were also affected significantly by the PL. The PL-supplemented diet groups had significantly higher high-density lipoprotein (HDL) compared with the PL-free diet group, but showed a marked decrease in very low-density lipoprotein (VLDL). The results suggested that PL could modify plasma lipoprotein metabolism and lipid profile, and that the optimal dietary PL level may well exceed 80 g kg ⁻¹ for cobia larvae according to growth and survival.	Niu, J., Liu, Y.J., Tian, L.X., Mai, K.S., Yang, H.J., Ye, C. X., Zhu, Y.	Fish Physiology and Biochemistry 34, 9–17	2008	Fish Health Nutrition Physiology
148	Growth and intestinal morphology in cobia (<i>Rachycentron canadum</i>) fed extruded diets with two types of soybean meal partly replacing fish meal	Juvenile cobias, <i>Rachycentron canadum</i> , were fed extruded diets containing toasted defatted soybean meal (SBM) or untoasted defatted SBM [white flakes (WF)] to study growth and feed conversion, and to study if SBM induces morphological changes in the gastrointestinal (GI) tract. Three diets were produced: a fish meal-based control diet (FM diet) with 558 g FM kg ⁻¹ , and two diets with 335 g FM and either 285 g SBM kg ⁻¹ (SBM diet) or 285 g WF kg ⁻¹ (WF diet). The diets were extruded at approximately 120°C with 280 g kg ⁻¹ moisture. Triplicate groups of cobias (mean weight: 25.9 g) were fed the diets during 6 weeks. Feed intake of the FM and SBM diets were not significantly different, whereas the cumulative feed intake of cobias fed the WF diet was lower ($P < 0.05$) than that of cobias fed the FM and SBM diets after the first 21-day period. Specific growth rate and feed conversion ratio were not significantly different between cobias fed the FM and SBM diets, but significantly poorer results were obtained in cobias fed the WF diet. No morphological differences in the GI tract could be attributed to the diets, and cobias fed soy did not develop enteritis in the distal intestine.	Romarheim, O.H., Zhang, C., Penn, M., Liu, Y.-J., Tian, L.-X., Skrede, A., Krogdahl, Å., Storebakken, T.	Aquaculture Nutrition 14, 174–180	2008	Fish Health Nutrition Physiology
149	Advances in hatchery and grow-out technology of cobia <i>Rachycentron canadum</i> (Linnaeus)	This paper describes advances in hatchery and grow-out technology of cobia (<i>Rachycentron canadum</i> , Linnaeus). In 2007, methods for capture, transport, acclimation, sampling, conditioned spawning, larval rearing, fingerling production, nursery, shipping and grow-out have been perfected. Survival rates ranging from 17.5% to 35% were achieved from egg to shipping size fingerlings (1.0 g) in 2007 at the University of Miami Experimental Fish Hatchery, with production of approximately 20 000 fingerlings per 12,000 L tank. Wild and F1 broodstock cobia have been conditioned to spawn through temperature manipulation producing viable eggs for experimental and production level larval rearing trials in several hatcheries. Brood fish have also been induced to spawn using hormones. Cobia appear to be susceptible to infestations by parasitic protozoa such as <i>Amyloodinium ocellatum</i> and to infections caused by deleterious bacteria such as <i>Photobacterium</i> spp. and <i>Vibrio</i> spp. Prophylactic methods used to prevent and control epizootic diseases at the hatchery are summarized. Improved techniques for cage management were implemented, and both novel designs of submerged cages deployed in exposed areas and traditional gravity cages in protected areas have been used for commercial on-growing of cobia in the Americas and the Caribbean region.	Benetti, D.D., Orhun, M.R., Sardenberg, B., O'Hanlon, B., Welch, A., Hoenig, R., Zink, I., Rivera, J.A., Denlinger, B., Bacoat, D., Palmer, K., Cavalin, F.	Aquaculture Research 39, 701–711	2008	Hatchery Culture Fish Health
150	The effect of different levels of dietary phospholipid on growth, survival and nutrient composition of early juvenile cobia (<i>Rachycentron canadum</i>)	This experiment was conducted to evaluate the effect of different levels of dietary phospholipid (PL) on growth, survival and nutrient composition of 25 days posthatch cobia <i>Rachycentron canadum</i> (0.4 g initial wet weight). For 42 days, fish were fed fish meal and protein hydrolysate based diets containing four PL levels (0, 20, 40 and 80 g kg ⁻¹ dry matter: purity 97%) and phosphatidylcholine purity was 60%. All diets were isonitrogenous and isolipidic by regulating the fish oil and maize oil levels. Weight gain (2601–10892%), specific growth ratio (7.82–11.18) and survival (49–100) were significantly affected by dietary PL. Intrapertoneal fat ratio (0.19–0.74) and hepatosomatic index (2.67–3.08) increased with dietary PL level. The effect of dietary PL levels on the chemical composition of tissues was significant only for whole body and liver. The contents of plasma total cholesterol (2.47–3.77 mmol L ⁻¹) and PL (1.03–2.97 mmol L ⁻¹) increased with an increase in dietary PL. In conclusion, in our study survival and growth continued to increase even at the highest PL levels used (80 g kg ⁻¹); therefore optimal dietary PL levels may well exceed 80 g kg ⁻¹ for early juvenile cobia requirement. It also indicated from the experiment that PL could affect lipid deposition and resulted in a higher lipid level in fish tissue.	Niu, J., Liu, Y.-J., Tian, L.-X., Mai, K.-S., Yang, H.-J., Ye, C. -X., Zhu, Y.	Aquaculture Nutrition 14, 249–256	2008	Fish Health Nutrition
151	Biochemical composition and quality of captive-spawned cobia <i>Rachycentron canadum</i> eggs	Interest in the commercial production of cobia <i>Rachycentron canadum</i> continues to rise as additional insight is gained into the hardy and fast growing nature of this species. However, research regarding the biochemical composition of captive-spawned eggs and egg and larval quality remains scarce. Such data is essential as a common bottleneck to production is a steady supply of fingerlings for grow-out. This study quantified the biochemical composition and quality of cobia eggs produced over 2 spawning seasons by broodstock on a traditional 'trash fish' diet which is commonly fed to tank spawning cobia. Throughout the study, batch fecundity, proportion of floating eggs and percent hatch averaged > 1 million eggs, ~ 0.8 and 70%, respectively. Batch fecundity was significantly higher during the second spawning season as a result of the increased size of the females which weighed 18/22 kg and 22/26 kg at the beginning of each season. A positive correlation was found between the proportion of floating eggs and hatch rate for both spawning seasons. No correlations were found between egg composition (total lipid (30.0 ± 1.1% dry wt), protein (25.4 ± 2.2% dry wt), carbohydrate (2.4 ± 0.3% dry wt), vitamin E (10.2 ± 0.6 µg/g wet wt) or dry weight (119.1 ± 5.5 µg/egg)) and egg quality (proportion of floating eggs, hatch rate, larval growth and larval survival). Further, no differences in egg composition were noted between seasons or over the course of each season. The fatty acid composition of cobia eggs varied between seasons possibly due to changes in the quality of frozen feed (fish, shrimp, squid) given to the broodstock. The only correlation between the fatty acid profile and egg quality was a decrease in the proportion of floating eggs as the total amount of n-3 highly unsaturated fatty acids increased. No relationship between egg quality and amino acid content was noted with the most prominent amino acids being glutamate, leucine, alanine, proline, lysine and aspartate nor were any differences detected between spawning seasons.	Faulk, C.K., Holt, G.J.	Aquaculture 279, 70–76	2008	Spawning RAS
152	Intensive larval husbandry and fingerling production of cobia <i>Rachycentron canadum</i>	Methods and results of two larval rearing trials of cobia (<i>Rachycentron canadum</i>) are presented. These trials were designed to test the efficacy of protocols developed over several years of research in cobia larviculture at the UMEH. The protocols incorporate the use of probiotics and prophylaxis, minimize microalgae use, and include commercially available ingredients for live feed enrichment. During the trials, fertilized eggs were stocked at 400/L and incubated in 1000-L cylinder-conical tanks with flow-through seawater at 500% daily exchange rate. Moderate aeration and pure oxygen were used to maintain dissolved oxygen concentrations above saturation (6.5 mg/L at 26 °C). Hatching occurred at 22–24 h post fertilization. Two day-post-hatch (dph) yolk-sac larvae were stocked in four 12,000-L cylinder-conical tanks at 5 and 10 larvae/L. Beginning on 3 dph, larvae were fed microalgae (<i>Isochrysis galbana</i> C-strain) at low concentrations (5–10,000 cell/ml) and enriched rotifers (<i>Brachionus plicatilis</i>) at 3–5/mL through 9 dph. Beginning on 7 dph, enriched Artemia (<i>Artemia franciscana</i> GSL Strain) nauplii were fed to larvae at 0.1–1/mL. Cobia larvae were reared at water temperatures ranging from 24.3 to 31.8 °C. Water quality parameters were within normal ranges for seawater: salinity 26–34 ppt, pH 7.92–8.16, and NH ₃ < 0.18 mg/L. Vigorous aeration and supplemental oxygen were used at all times during both larval rearing trials to maintain adequate water movement and levels of dissolved oxygen (DO) (7.0–9.0 mg/L). Water was filtered down to 10 µm using standard sand filters filled with broken glass media and bag filters prior to entering the tanks. Daily water exchange rates in the tanks ranged from 100% at 3 dph to 500% from 17 dph onwards. Between 20 and 22 dph, all post-larvae were fully weaned onto dry starting diets. Survival rates of post-larvae measuring 1.5–2.0 cm SL and weighing 0.5 g at 20–22 dph were estimated to be ≥ 50%. Further mortality during the nursery stage to 3–5 cm and 1–3 g fingerlings prior to shipping at 27 dph brought the overall survival rate to an average of 25.7%. Survival rates of fingerlings cultured in tanks initially stocked at lower densities (5 larvae/L) was significantly higher ($P = 0.0078$). From 15 dph, post-larvae and fingerlings were daily graded by size with large individuals singled out and stocked into another tank. These trials generated 125,328 fingerlings in four tanks in just two months, levels of production that could sustain a commercial operation and indicate that cobia aquaculture can be viable in the Americas.	Benetti, D.D., Sardenberg, B., Welch, A., Hoenig, R., Orhun, M.R., Zink, I.	Aquaculture 281, 22–27	2008	Hatchery Culture
153	Characteristic and antioxidant activity of retorted gelatin hydrolysates from cobia (<i>Rachycentron canadum</i>) skin	Alkali-pretreated cobia (<i>Rachycentron canadum</i>) skin was extracted in a retort (121 °C) for 30 min to obtain a retorted skin gelatin hydrolysate (RSGH). The molecular mass distributions and antioxidant activities of cobia RSGH and enzyme-treated RSGHs (ET-RSGHs) derived from bromelain, papain, pancreatin, and trypsin digestion were then characterized. The molecular mass distribution of the RSGH ranged mainly between 20,000 and 700 Da and those of ET-RSGHs ranged between 6500 and 700 Da. The DPPH (α,α-diphenyl-β-picrylhydrazyl) radical scavenging effects (%) of 10 mg/ml of RSGH and 10 mg/ml of the four ET-RSGHs were 55% and 51–61%, respectively. The lipid peroxidation inhibition (%) of RSGH and ET-RSGHs (10 mg/ml) were 58% and 60–71% on the fifth day in a linoleic acid model system, respectively. The 3Kd-ET-RSGHs, obtained by using a series of centrifugal ultrafiltration filters (molecular weight cut-offs of 10, 5, and 3 kDa done sequentially with decreasing pore size), exhibited dramatically improved antioxidant activity, with most of the molecular mass ranging below 700 Da. Compared to 10 mg/ml of the RSGH, 10 mg/ml of 3Kd-ET-RSGHs exhibited 45–65% more scavenging of DPPH radical and 24–38% more inhibition of lipid peroxidation. The peptides with molecular masses below 700 Da in the ET-RSGHs or 3Kd-ET-RSGHs significantly affect the antioxidant properties. These peptides are composed of a small number of amino acids or free amino acids and have the potential to be added as antioxidants in foods.	Yang, J.-I., Ho, H.-Y., Chu, Y. -J., Chow, C.-J.	Food Chemistry 110, 128–136	2008	Nutrition Physiology
154	Interaction between <i>Rachycentron canadum</i> and <i>Epinephelus itajara</i> , on the Paraná Coast, Brasil	[No Abstract Available - Following behaviour is a common interspecific feeding association in which nuclear species forage over the bottom, causing disturbance in the benthic community, while the followers (fishes) feed opportunistically [Sazima et al. 2007].]	Félix, F.C., Hackrad, C.W.	Coral Reefs 27, 633–633	2008	Behaviorial Wild (Atlantic/Pacific)
155	Factors affecting survival of cobia, <i>Rachycentron canadum</i> , during simulated transport	Interest in cobia, <i>Rachycentron canadum</i> , culture has shown significant growth in recent years, but few hatcheries are available to support this developing industry. To facilitate the transport of cobia between facilities, four 24-h experiments were conducted to examine the effects of density, temperature, and actual versus simulated transport on juvenile cobia (1.5–3.0 g) survival. Mortality during actual transport at fish densities of 5, 10, and 15 kg/m ³ (2.9 ± 0.6, 2.9 ± 1.8, and 6.3 ± 0.8%, respectively) did not differ by treatment but was significantly higher than that during simulated transport at each density (0%). No differences in mortality were found following simulated shipping at 19, 21, and 25 °C at 15 kg/m ³ . Significantly greater mortality occurred when juveniles were packed at 25 kg/m ³ (10.4 ± 0.7%) than at 20 kg/m ³ (1.9 ± 1.6%) and 15 kg/m ³ (0.1 ± 0.1%). Recovery following simulated and actual shipping was high in all treatment groups. Under the conditions examined, results indicate that transport density should not exceed 20 kg/m ³ .	Colburn, H.R., Walker, A.B., Berlinsky, D.L., Nardi, G.C.	Journal of the World Aquaculture Society 39, 678–683	2008	Commercial Fish Health
156	Microsatellite polymorphism in Iranian populations of cobia (<i>Rachycentron canadum</i> G.)	Genetic divergence within and between wild populations of cobia, <i>Rachycentron canadum</i> (L.) was assessed by means of microsatellite analysis in the Persian Gulf and Oman Sea. Ten microsatellite markers were used to estimate the level of genetic diversity within six wild populations of cobia and the degree of genetic differentiation between them was compared. Mean observed and effective allele number was 12.357 and 8.319, respectively. Mean observed and expected heterozygosity was 0.655 and 0.874, respectively. Based on Analysis of Molecular Variance highest F-statistics (0.063) was observed when comparing specimens from Dayer Port zone and Pozm of Chabahar zone. Highest genetic distance (0.258) and lowest genetic resemblance (0.223) were observed between specimens from Dayer Port zone and Beris of Chabahar zone. The present study showed that at least three different populations of <i>Rachycentron canadum</i> were found in the northern coasts of Persian Gulf and Oman Sea.	Salari Aliabadi, M.A., Rezvam Gilkolaei, S., Savari, A., Zolgharnein, H., Nabavi, S.M.B.	Biotechnology 7, 775–780	2008	Genetics/Molecular Wild (Atlantic/Pacific)
157	Cloning of peroxisome proliferators activated receptors in the cobia (<i>Rachycentron canadum</i>) and their expression at different life-cycle stages under cage aquaculture	We present the cDNA sequences and tissue mRNA expression of peroxisome proliferator-activated receptor (PPAR) α, β and γ isoforms in the cobia (<i>Rachycentron canadum</i>), a warm water pelagic fish that is becoming a fish of choice for offshore cage farming. RT-PCR and real-time PCR showed that PPARα mRNA predominated in red muscle, heart and liver whereas PPARβ was expressed mainly in liver and pyloric caeca. In contrast, PPARγ transcripts were detected in all of the tissues examined, with the highest level occurring in visceral fat depot. Our 52-wk time-series investigation showed that while the mRNA expression of PPARγ in the cobia was positively ($P < 0.05$) related to its body lipid deposition, a negative ($P < 0.05$) relationship was found between PPARα expression in the liver and body lipid deposition. There was a significant increase in body lipid deposition and hepatic PPARγ expression as the fish grew. The hepatic PPARγ expression could be a sufficient parameter describing the bodily expression of PPARγ because of its positive correlation with PPARγ expressions in all other tissues. These results showed that PPARγ and α played a pivotal role in the control of lipid metabolic and storage functions in the liver, muscle and visceral fat depot of the cobia.	Tsai, M.-L., Chen, H.-Y., Tseng, M.-C., Chang, R.-C.	Gene 425, 69–78	2008	Genetics/Molecular Physiology

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
158	Dietary mannan oligosaccharide enhances salinity tolerance and gut development of larval cobia	The potential beneficial effects of supplementing live feeds with mannan oligosaccharide (MOS; BioMos®) upon cobia <i>Rachycentron canadum</i> larval performance were examined. Characteristics of fish examined included survival to weaning, growth, ability to withstand osmotic stress and the degree of development of the brush border of the intestine. Live feeds included rotifers (<i>Brachionus plicatilis</i>) and <i>Artemia</i> which were enriched for 24 h with a commercial enrichment media alone or in combination with 0.2% (dry weight basis) MOS. Salinity challenges were performed at 6 days post-hatch (dph) and at 7, 13, and 14 dph (0 and 65 g L ⁻¹ for 6 dph; 0 and 55– 1 7+ dph) corresponding to transitions in feeding, to examine the ability of larval cobia to survive stress. Differences ($P < 0.05$) in survival, favoring cobia receiving MOS-supplemented feeds were discerned at 6 and 7 days post-hatch (dph) when fish were challenged at 0 g L ⁻¹ and at 13 dph when challenged with 55 g L ⁻¹ salinity water. Electron microscopy of the mid-intestine of developing larvae revealed that MOS-supplemented diets enhanced ($P < 0.05$) the height of microvilli while reducing ($P < 0.05$) the occurrence and size of supranuclear vacuoles. Supplementation of diets with MOS could assist cobia larvae in maintaining allostasis especially when reared at sub-optimal salinities.	Salze, G., McLean, E., Schwarz, M.H., Craig, S.R.	Aquaculture 274, 148–152	2008	Fish Health Nutrition Culture Hatchery
159	Detection and phylogeny of Lymphocystivirus in sea bream <i>Sparus aurata</i> based on the DNA polymerase gene and major capsid protein sequences	Lymphocystis disease virus (LCDV) is the causative agent of a condition affecting marine and freshwater fish worldwide. In this study, PCR primers based on the DNA polymerase gene sequence were employed for the detection of LCDV in gilthead sea bream <i>Sparus aurata</i> and for monitoring the course of the disease from onset to full clinical recovery. In spontaneously infected fish, viral DNA was detected in different organs, including skin, caudal fin, eyeball, brain, liver and kidney, and a correlation was found between PCR intensity and the persistence of the virus in organs of recovered fish with no residual clinical symptoms. In experimentally infected fish, PCR detection was achieved almost two weeks before appearance of external signs. LCDV remained detectable in skin, caudal fin and eyeball for up to four weeks after external signs of infection had cleared. A phylogenetic analysis based on the major capsid protein (MCP) gene sequence revealed that LCDV from sea bream cultured in Eilat, Israel, clusters within a genotype that includes two sub-clusters: one consisting of Japanese flounder isolates, the second of three isolates from three distinct host species belonging to different perciform families: sea bass <i>Lateolabrax</i> sp. (Lateolabracidae), sea bream <i>S. aurata</i> (Sparidae) and cobia <i>Rachycentron canadum</i> (Rachycentridae).	Kvitt, H., Heinisch, G., Diamant, A.	Aquaculture 275, 58–63	2008	Fish Health Genetics/Molecular
160	Efficacy of concentrated algal paste during greenwater phase of cobia larviculture	The purpose of this study was to determine if concentrated algal paste could effectively replace live algae during the greenwater stage of cobia fingerling production without negative impact upon larval growth or survival. Mean cobia survival per tank from 2 dph through post weaning at 28 dph for the live algae treatment was 24.44 ± 2.43% (mean ± SD) as compared to 24.47 ± 2.48% for the algal paste treatment. Furthermore, the number of fish produced per liter for the live algae treatment was 2.44 ± 0.24 fish/L compared to 2.47 ± 0.25 fish /L recorded from the algal paste treatment. Mean fish weight for cobia weanlings from the live algae treatment was 0.417 ± 0.059 g compared to 0.411 ± 0.026 g for the algal paste treatment. These observations demonstrate that during the greenwater stage of cobia larviculture, live algae can be completely replaced with commercially available, concentrated algal paste without negative impact upon cobia growth, survival, or resultant weaning production per unit volume.	Schwarz, M.H., Craig, S.R., Delbos, B.C., McLean, E.	Journal of Applied Aquaculture 20, 285–294	2008	Fish Health Culture Hatchery
161	Effects of Dietary β-1,3-1,6-glucan on Non-specific Immune Response of Cobia (<i>Rachycentron canadum</i>) [Chinese]	The present study was conducted to investigate the effects of dietary β-1,3-1,6-glucan (BG) from <i>Schizophyllum commune</i> on the innate immune response in cobia (<i>Rachycentron canadum</i>). Cobia (50-80 g) were fed a basal diet and supplemented with either 0 (control group) or 0.5% BG (glucan group) for 60 days. The superoxide anion (O ₂ ⁻), superoxide dismutase (SOD) concentration and lysozyme activity were analyzed at days 0, 1, 3, 6, 12, 20, 30, 40, 50 and 60. The results showed that the concentration of O ₂ ⁻ and SOD and activity of lysozyme in cobia at BG group was higher ($p < 0.001$) than those of the control group. They attained the highest levels at day 12, 20 and 24 after feeding, respectively. However, the concentration of O ₂ ⁻ on day 30, SOD on day 40 and activity of lysozyme on day 40 of the fish at BG group, dropped back to the same levels as the control group ($p > 0.05$). The results in this study showed that oral administration of 0.5% BG for 6 days enhanced immunity of the cobia, but prolonged use of BG would not increase the immunity of the cobia. Care therefore must be taken to maximize its effectiveness with suitable period.	Chang, C.-F., Yang, J.-H., Chou, R.-L.	Journal of Taiwan Fisheries Research 16, 87–95	2008	Fish Health Nutrition Genetics/Molecular
162	Ecological and economic analysis for cobia <i>Rachycentron canadum</i> commercial cage culture in Taiwan	The structure of cost and return for cobia cage culture in Taiwan was studied by considering two major factors, geographical location and production scale. Although the geographical location had little influence on the input intensities, the production scale would have a significant impact on the cost structure. However, the performances of profitability were significantly affected by not only the individual main effects but also their interaction. As a result, the studied effects on the cost and return were quantitatively estimated by a series of statistical models, in turn quantitatively measured by a set of indices. A short-term strategy of the management suggested that the best choice regarding profitability is to locate the farming system with a large-scale operation in the coastal waters of Pindong. Additionally, the profitability could be further increased by selecting better quality fingerlings and feeds based on a set of the computed indices. A long-term strategy of the management strongly recommends that to increase the system size in cobia production would be much more profitable due to the positive economies of scale. Finally, a future study shall be interested in whether current speed has a limiting effect on the profitability.	Miao, S., Jen, C.C., Huang, C.T., Hu, S.-H.	Aquaculture International 17, 125–141	2009	Culture Cage Culture Commercial
163	Cholesterol, lipid content, and fatty acid composition of different tissues of farmed cobia (<i>Rachycentron canadum</i>) from China	Marine fishes are rich in n-3 polyunsaturated fatty acids (PUFA), especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which are extremely important for human health. The objective of our work was to determine the content and composition of lipids and fatty acids in the different tissues of cobia from China and to evaluate their nutritional value. The results showed that cobia from China was rich in lipids; the neutral lipid content was above 82%; the content of cholesterol and phospholipid was low. Eighteen fatty acids were identified. Myristic (C14:0), palmitic (C16:0), and stearic acids (C18:0) were the main saturated acids; palmitoleic (C16:1n-7) and oleic acid (C18:1n-9) were the main monounsaturated fatty acids. EPA and DHA were the main PUFA; n-3 and n-6 PUFA were present as 12–18% and 2.6–3.2% of the total fatty acids, respectively. The n-6/n-3 ratio was in the range from 0.18 to 0.22, which was far lower than that (5:1) recommended by WHO/FAO. Therefore, cobia lipids from China have a high nutritional value.	Liu, S.C., Li, D.T., Hong, P.Z., Zhang, C.H., Ji, H.W., Gao, J. L., Zhang, L.	Journal of the American Oil Chemists' Society 86, 1155–1161	2009	Nutrition
164	Different ratios of docosahexaenoic and eicosapentaenoic acids do not alter growth, nucleic acid and fatty acids of juvenile cobia (<i>Rachycentron canadum</i>)	An experiment was performed to study the effect of different ratios of docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) on the growth, nucleic acid and fatty acids of cobia (<i>Rachycentron canadum</i>) juveniles. The juveniles were fed for 8 weeks using seven treatment diets (D-1-D-7) with the same amount of DHA and EPA (1.50 ± 0.1% of dried diet), but varying ratios of DHA to EPA (0.90, 1.10, 1.30, 1.50, 1.70, 1.90, 2.10, respectively) and a control diet (D-0, DHA + EPA = 0.8% of dried diet, DHA/EPA = 1.30). At the end of the experiment, the mean body weight (BW) of juveniles fed D-0-D-7 increased significantly (from 6.86 ± 1.64 in the week 0 to 58.52 ± 16.45 g at the end of week 8, $P < 0.05$). The mean RNA amount and RNA/DNA ratio in the muscle (from 39.62 ± 1.30 μg mg ⁻¹ and 2.29 ± 0.11 in the week 0 to 272.55 ± 10.70 μg mg ⁻¹ and 14.54 ± 1.75 at the end of week 8, respectively) and the mean weight in the liver (from 117.70 ± 11.15 μg mg ⁻¹ and 3.14 ± 0.25 in the week 0 to 793.07 ± 13.38 μg mg ⁻¹ and 13.16 ± 0.76 at the end of week 8, respectively) of cobia juveniles fed D-0-D-7 were significantly higher at the end of 8-week experiment than initially ($P < 0.05$). The RNA/DNA ratio in the muscle and liver of cobia juveniles increased with their growth and appeared an obvious positive relationship, especially in the muscle, based on regression analysis. The mean lipid content increased significantly in the liver (from 29.82 ± 0.99 to 37.47 ± 3.25% totally) and muscle (from 6.74 ± 0.25 to 10.63 ± 0.23% totally) of cobia juveniles ($P < 0.05$). However, no significant difference was found on the lipid contents of juveniles fed different diets for 8 weeks ($P > 0.05$). In the muscle and liver of juveniles, EPA decreased with its reduction in the diet; DHA, DHA/EPA ratio and poly unsaturated fatty acids (PUFAs) generally increased with their increment in the diet. The conclusion was drawn that the growth, nucleic acid and fatty acids of cobia juveniles were not significantly affected by different DHA/EPA ratios in our experiments.	Xu, Y., Ding, Z., Zhang, H., Liu, L., Wang, S., Gorge, J.	Lipids 44, 1091–1104	2009	Nutrition Fish Health
165	Efficacy of tricaine methanesulphonate and clove oil as anaesthetics for juvenile cobia <i>Rachycentron canadum</i>	Six experiments were designed to determine the optimal anaesthetic dosage of tricaine methanesulphonate (TMS) and clove oil that could be used safely on juvenile cobia <i>Rachycentron canadum</i> of two sizes [G1=4.9±0.8 g; G2=13.9±3.1 g]. We documented the stage of anaesthesia and the acute toxicity as 96 h LC50 (lethal concentration 50% population) at various exposure times of the two anaesthetics. At 10 min induction time, the TMS 96 h LC50 was 93.9 mg L ⁻¹ in G1 and 97.0 mg L ⁻¹ in G2. Compared with clove oil, the 96 h LC50 was 60.0 mg L ⁻¹ in G1 and 69.8 mg L ⁻¹ in G2. The difference between the two groups (G1, G2) did not influence anaesthesia safety ($P > 0.05$). <i>Rachycentron canadum</i> achieved stage 3 anaesthesia more rapidly at a lower clove oil concentration level (40 mg L ⁻¹ , 10 min) than TMS (60 mg L ⁻¹ , 10 min), but the recovery period of clove oil, was significantly longer. Clove oil was the most effective in reducing the short-term stress induced by routine biometry (20 mg L ⁻¹ , 10 min) and also by transporting (1 mg L ⁻¹ , 8 h). Whereas, for long-term exposure, 40 mg L ⁻¹ TMS was found to be safe.	Gullian, M., Villanueva, J.	Aquaculture Research 40, 852–860	2009	Fish Health Culture
166	Can umbrella-stage <i>Artemia franciscana</i> substitute enriched rotifers for Cobia (<i>Rachycentron canadum</i>) fish larvae?	Appropriate food of suitable nutritional value is crucial for first-feeding stages of the larvae of cobia <i>Rachycentron canadum</i> , a very fast growing marine fish species. Best survival and growth results in cobia larviculture have been reported with a starter diet of HUFA-enriched rotifers and –as mouth size permits – followed by freshly-hatched and eventually HUFA-enriched <i>Artemia</i> nauplii. Using the smaller-sized Vietnam <i>Artemia franciscana</i> (AF) strain instead of the Great Salt Lake <i>A. franciscana</i> strain, it has been shown that the rotifer-feeding period could be shortened with 3 days, resulting in significant improvements in larval survival and growth. This study verified the possibility to feed umbrella-stage <i>Artemia</i> for further shortening and eventually completely substituting rotifer start feeding. The experiment was conducted in 200-L tanks and lasted 18 days. AF umbrella <i>Artemia</i> was used as sole feed during the whole rotifer feeding period (UAF), compared to the use of enriched rotifers for the first 2 days followed by AF-umbrella (ER + UAF) and the use of enriched rotifers as control (ER). The feeding incidence of UAF treatments was significantly lower ($P < 0.05$) in the 1st feeding day, however, the ingestion and digestion of AF were evident. Growth and survival as well as deformities at day 18 post-hatching were not significantly different for all treatments ($P > 0.05$). The viability of cobia larvae after exposure to high salinity stress was lower in the ER treatment at day 8 post-hatching, but higher at day 18 post-hatching ($P < 0.05$). The ability of cobia larvae to ingest and digest AF umbrella at first feeding as well as the nutritional suitability of AF umbrella is discussed. The possibility to use umbrella-stage <i>Artemia</i> opens an opportunity to simplify the rearing protocol and to reduce production costs of cobia larviculture.	Nhu, V.C., Dierckens, K., Nguyen, T.H., Tran, M.T., Sorgeloos, P.	Aquaculture 289, 64–69	2009	Culture Nutrition
167	Dietary choline requirement for juvenile cobia, <i>Rachycentron canadum</i>	A 10-wk feeding trial was conducted to determine dietary choline requirement for juvenile cobia. The basal diet was formulated to contain 47.1 g crude protein 100 g ⁻¹ dry weight from vitamin-free casein, gelatin and fish protein concentrate. This premix provided methionine at 1.05%, slightly less than the optimal requirement of cobia (1.19%), so endogenous synthesis of choline from methionine would be limited. Choline chloride was supplemented to the basal diet to formulate six purified diets containing 133 (control group), 350, 548, 940, 2017 and 3981 mg choline kg ⁻¹ diet, respectively. Each diet was randomly fed to triplicate groups of juvenile cobia with initial average weight 4.2 ± 0.4 g in a flow-through system. Dietary choline level significantly influenced survival, feeding rate, weight gain, feed efficiency ratio, hepatosomatic index, as well as the choline concentrations in the liver and muscle of cobia. Broke-line regression of weight gain, liver and muscle choline concentration yield choline requirements of 696, 877 and 950 mg choline kg ⁻¹ diet in the form of choline chloride, respectively. In addition, dietary choline supplementation significantly increased muscle lipid content of cobia. Potential manipulation of muscle lipid and associated flavor and texture by choline supplementation warrants further investigation.	Mai, K., Xiao, L., Ai, Q., Wang, X., Xu, W., Zhang, W., Liufu, Z., Ren, M.	Aquaculture 289, 124–128	2009	Nutrition Fish Health
168	Time-course response of cobia (<i>Rachycentron canadum</i>) to acute stress	Cobia (<i>Rachycentron canadum</i>) is a promising candidate species for aquaculture. In order to evaluate potential problems resulting from husbandry practices, we conducted a study aimed to characterize their hematological response to acute stress. Levels of cortisol, glucose, lysozyme and ceruloplasmin were measured at five time intervals over 24 h following stress induction and compared to baseline levels. In this species stress had a rapid and short-term effect on cortisol and a fast but extended impact on glucose concentrations. We observed a short suppressive effect of stress on lysozyme activity, and late but continuous increase in ceruloplasmin throughout the study. This is the first report on baseline and stress response levels of these parameters in cobia, providing an indication of times for the examination of various indicators of stress.	Cnaani, A., McLean, E.	Aquaculture 289, 140–142	2009	Culture Fish Health Physiology
169	Physiological roles of fatty acyl desaturases and elongases in marine fish: Characterisation of cDNAs of fatty acyl Δ6 desaturase and elovl5 elongase of cobia (<i>Rachycentron canadum</i>)	In the present paper, we investigated the expression of fatty acyl desaturase and elongase genes in a marine teleost, cobia, a species of great interest due to its considerable aquaculture potential. A cDNA was cloned that, when expressed in yeast, was shown to result in desaturation of 18:3n-3 and 18:2n-6, indicating that it coded for a Δ6 desaturase enzyme. Very low desaturation of 20:4n-3 and 20:3n-6 indicated only trace Δ5 activity. Another cloned cDNA enabled elongation of 18:4n-3, 18:3n-6, 20:5n-3 and 20:4n-6 in the yeast expression system, indicating that it had C18–20 and C20–22 elongase activity. Sequence comparison and phylogenetic analysis confirmed that it was homologous to human ELOVL5 elongase. However, the cobia Elovl5 elongase also had low activity toward C24 HUFA. The cobia Δ6 desaturase had a preference for 18:3n-3, but the elongase was generally equally active with both n-3 and n-6 substrates. Expression of both genes was 1–2 orders of magnitude greater in brain than other tissues suggesting an important role, possibly to ensure sufficient docosahexaenoic acid (DHA, 22:6n-3) synthesis in neural tissues through elongation and desaturation of eicosapentaenoic acid (EPA; 20:5n-3).	Zheng, X., Ding, Z., Xu, Y., Monroig, O., Morais, S., Tocher, D.R.	Aquaculture 290, 122–131	2009	Nutrition Fish Health Physiology

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
170	No significant effect of additive ratios of docosahexaenoic acid to eicosapentaenoic acid on the survival and growth of cobia (<i>Rachycentron canadum</i>) juvenile	An experiment was conducted in the laboratory to investigate the effects of additive ratios of docosahexaenoic acid (DHA) to eicosapentaenoic acid (EPA) on the growth and survival of cobia (<i>Rachycentron canadum</i>) juveniles from August to October 2005. Three hundred and eighty cobia juveniles (56 days of age, body weight 6.9 ± 0.1 g, body length 9.2 ± 0.1 cm) were selected and 20 of them were freely taken for initial sample analysis in the week 0. Additional 360 juveniles were randomly assigned into eight groups with triplicate, total 24 tanks with 15 fish each. Cobia juveniles were reared in glass-steel tanks (200-L volume per tank) using filtered seawater with temperature 26-30.5 °C, salinity 25.4-33.0 g L ⁻¹ and pH 7.8-8.0. Cobia juveniles were fed for 8 weeks using seven treatment diets (D-1 to D-7) with the same amount of DHA and EPA (15.0 ± 1.2 g kg ⁻¹ of dried diet), but varying ratios of DHA to EPA (0.9, 1.1, 1.3, 1.5, 1.7, 1.9, 2.1, respectively) and a control diet (D-0, DHA + EPA = 8.0 g kg ⁻¹ of dried diet, DHA/EPA = 1.3). Five juveniles per tank were randomly taken for sample analysis at the end of weeks 4 and 8, respectively. The highest protein efficiency rate (PER; 1.5 in mean), average body weight (BW; 73.3 g per fish in mean) and the lowest feed conversion ratio (FCR; 1.6 in mean) were obtained in cobia juveniles fed the control diet at the end of week 8. These parameters were significantly different ($P < 0.05$) among juveniles fed the control and treatment diets; however, no significant difference ($P > 0.05$) was found among juveniles fed the treatment diets evaluated in this study. It was concluded that the survival and growth of cobia juveniles were not greatly influenced by additive ratios of DHA to EPA in our experimental conditions.	Ding, Z., Xu, Y., Zhang, H., Wang, S., Chen, W., Sun, Z.	Aquaculture Nutrition 15, 254–261	2009	Nutrition Fish Health
171	Effects of salinity on growth and energy budget of juvenile cobia, <i>Rachycentron canadum</i>	The effects of salinity on the growth and energy budget of juvenile cobia, <i>Rachycentron canadum</i> , were evaluated. Triplicate tanks with ten fish per tank (initial weight 17.58 ± 0.26 g/fish, mean \pm SD) reared at salinities of 5, 10, 15, 20, 25, 30, and 35 ppt were fed with fresh squid to satiety for 15 d. Results indicated that there were no significant differences in daily ration level in wet weight (RLw), dry weight (RLd), and energy (RLe) of the fish. There were also no significant variations in daily fecal production (fe) and apparent digestibility coefficient of energy (ADCe) among salinity treatments. Specific growth rates (SGRs) in wet weight (SGRw), dry weight (SGRd), and energy (SGRe) showed domed curves relative to salinity. Quadratic regression analyses of SGRw, SGRd, and SGRe against salinity indicated that the optimal salinity for maximal growth of juvenile cobia was 29.9, 29.9, and 28.5 ppt, respectively. Similar to the trend of SGR, food conversion efficiency for juvenile cobia in wet weight (FCEw), dry weight (FCEd), and energy (FCEe) increased with the increases in salinity, maximized at 30 ppt, and then decreased when salinity reached 35 ppt.	Chen, G., Wang, Z., Wu, Z., Gu, B., Wang, Z., Wang, Z., Wu, Z.	Journal of the World Aquaculture Society 40, 374–382	2009	Culture Fish Health Bioenergetics
172	Nutritional requirements of cobia, <i>Rachycentron canadum</i> (Linnaeus): A review	Cobia culture has been rapidly gaining in popularity since the early 1990s; however, the relative success of modified commercial diets in aquaculture has delayed the need for specific research into the nutritional requirements of cobia. Recent work has determined optimum dietary protein and lipid levels in juvenile cobia at 45 and 5-15% dry weight respectively. Maximum growth and feed conversion ratios have been recorded at 27-29 °C in juvenile cobia with an optimum ration level determined at 9% initial body weight per day. There is limited information on amino acid and essential fatty acids (EFA) requirements in cobia. Several studies have explored alternate protein sources in juvenile cobia with relative success observed with meat meal, yeast-based protein and various plant based sources including soybean meal. There is no literature on the vitamin or mineral requirements of cobia or the nutritional requirements of larger fish. Therefore future research should focus on the amino acid, EFA, vitamin and mineral requirements of cobia while the protein, lipid and energy requirements of larger cobia should be addressed. Additional work on feed ingredients, choice and palatability would also aid in maximizing culture production while minimizing costs thereby producing a more sustainable product.	Fraser, T.W.K., Davies, S.J.	Aquaculture Research 40, 1219–1234	2009	Culture Fish Health Nutrition
173	Effects of ration and temperature on growth, fecal production, nitrogenous excretion and energy budget of juvenile cobia (<i>Rachycentron canadum</i>)	A 4 × 3 factorial experiment was conducted for two weeks to determine the effects of ration level ranging from starvation to satiation and water temperature at 21, 27 and 33 °C on growth, fecal production, nitrogenous excretion and energy budget of 10-g-size cobia in this study. Over the temperature range, 21–33 °C, maximal ration (R max, % per day), optimal ration (R opt, % per day) and maintenance ration (R maint, % per day) all increased with temperature (T, °C), described as a quadratic equation $R \text{ max} = -0.046T^2 + 2.906T - 35.97$ ($R^2 = 0.989$), a simple equation $R \text{ opt} = -0.533T - 8.001$ ($R^2 = 0.993$), and a quadratic equation $R \text{ maint} = 0.028T^2 - 1.350T - 17.18$ ($R^2 = 1$), respectively. Both fecal production (f, mg g ⁻¹ d ⁻¹) and nitrogenous excretion (u, mg g ⁻¹ d ⁻¹) were affected significantly by ration and temperature and increased as ration and temperature increased. Feed absorption efficiency (FAE, %) varied small over the whole ration and temperature ranges though the effects of ration and temperature were significant in some data. Juvenile cobia grew fastest at 33 °C when fed at satiation but the growth rate was equal or better at 27 °C when food was restricted, whereas the fish showed overall significant lower growth rates at 21 °C except for the starved treatment. Among three temperatures specific growth rate in wet weight (SGR w, % per day), dry weight (SGR d, % per day), protein (SGR p, % per day) and energy (SGR e, % per day) all increased with ration, showing decelerating growth-ration relationships described as logarithmical equations at 27 and 21 °C and a linear growth-ration relationship described as a simple equation at 33 °C. Apart from starvation ration with a negative linear growth-temperature relationship growth all increased with temperature, described as quadric functions. Two-way ANOVA showed that ration and temperature had an interaction on growth. By using multiple regression analysis the relationships between specific growth rate (SGR, % per day) and ration level (RL, % per day) as well as temperature (T) took the forms: $SGR \text{ w} = -11.97 + 1.23\ln(RL + 1) + 0.91T - 0.02T^2 + 0.16T\ln(RL + 1)$ ($R^2 = 0.962$), $SGR \text{ d} = -17.04 + 0.72\ln(RL + 1) + 1.11T - 0.02T^2 + 0.12T\ln(RL + 1)$ ($R^2 = 0.968$), $SGR \text{ p} = -18.25 + 0.20\ln(RL + 1) + 1.28T - 0.03T^2 + 0.15T\ln(RL + 1)$ ($R^2 = 0.972$) and $SGR \text{ e} = -20.83 + 0.85\ln(RL + 1) + 1.40T - 0.03T^2 + 0.15T\ln(RL + 1)$ ($R^2 = 0.969$). Feed conversion efficiency in wet weight (FCE w, %), dry weight (FCE d, %), protein (FCE p, %) and energy (FCE e, %) at 27 and 33 °C was much higher than that at 21 °C, and the maximal FCE occurred at sub-satiation (i.e. feeding group 3) and 27 °C. All the relationships between FCE and temperature were described as quadric equations. Energy budgets of juvenile cobia at satiation ration were: $100C = 7.0F + 7.7U + 69.0R + 16.4G$ (or $100A = 81R + 19G$) at 33 °C, $100C = 6.8F + 7.9U + 68.0R + 17.3G$ (or $100A = 80R + 20G$) at 27 °C and $100C = 6.3F + 8.4U + 77.2R + 8.2G$ (or $100A = 90R + 10G$) at 21 °C, where C is food energy, A is assimilated energy, F is feces energy, U is excretion energy, R is metabolism energy and G is growth energy.	Sun, L., Chen, H.	Aquaculture 292, 197–206	2009	Culture Fish Health Nutrition Water Quality Bioenergetics
174	Population genetic structure of cobia, <i>Rachycentron canadum</i> revealed by microsatellite markers	Information on the genetic structure of fish species is essential for optimizing fisheries management and stock improvement programs. Ten microsatellite loci were analyzed to study the genetic variation in six populations of the cobia (<i>Rachycentron canadum</i>). Seven of the ten loci analyzed were polymorphic in all the populations. Locus Rca 1B-H09 had the highest numbers of alleles (18), while the locus Rca 1B-A10 and Rca 1B-E08A had the lowest (14). All the studied populations deviated from Hardy-Weinberg equilibrium proportions at a number of loci, mostly due to the deficiency of heterozygotes. A moderate level of population differentiation (FST) was observed among populations; however, highest significant differentiation was between the Dayer and Pozm populations. The genetic distance computed by Nei between the Dayer and Beris populations was higher than the genetic distances between all other population pairs. The study revealed a relatively moderate level of genetic variation at microsatellite loci within and between cobia populations.	Salari-Aliabadi, M.A., Gilkolaei, S.R., Savari, A., Zolgharnein, H., Nabavi, S. M.B.	Journal of Applied Biological Sciences 3, 94–98	2009	Genetics/Molecular Wild (Atlantic/Pacific)
175	Geographic information system applied to measuring benthic environmental impact with chemical measures on mariculture at Penghu Islet in Taiwan	Cobia, <i>Rachycentron canadum</i> , is currently grown by marine aquaculture in Taiwan, particularly on Penghu Islet. Although the effect of marine aquaculture on the environment has been the subject of many studies, an understanding of its environmental impact has yet to be attained, and the continuing expansion of cage farming has caused noticeable ecological declines. Nevertheless, useful tools to measure this environmental degradation are scant. The results of this study suggest that the combination of a geographic information system (GIS) with redox potential and sulfide measurements can be used to definitively assess the condition of the benthic environment near cobia aquaculture sites and to help develop environmental monitoring programs. These applications could easily be adopted to assess multiple marine environmental conditions.	Shih, Y.-C., Chou, C.L., Chiau, W.-Y.	Science of The Total Environment 407, 1824–1833	2009	Sediments Cage Culture Commercial Nutrient Impacts
176	A molecular phylogeny of the remoras and their Relatives	The Echeneoidea comprise three families of cosmopolitan tropical/subtropical marine fishes: the Echeneidae (remoras), Coryphaenidae (dolphinfishes), and Rachycentridae (cobia). Complete nucleotide sequences from the mitochondrial 12S rRNA, 16S rRNA, protein-coding ND2, and nuclear ITS-1 gene regions were used to reconstruct the phylogenetic history of these fishes. Parsimony, maximum likelihood, and Bayesian analyses of combined data sets resolved trees of similar topology. Congruent with evolutionary hypotheses based on larval morphology, a monophyletic Rachycentridae + Coryphaenidae was resolved with high support. Within a monophyletic Echeneidae, the subfamilies Echeneinae and Remorinae were monophyletic. In agreement with recent morphological analyses, the genus <i>Remora</i> was paraphyletic based on the position of <i>Remorina albescens</i> Temminck and Schlegel, 1850. Consistent resolution within the Remorinae using parsimony, maximum likelihood, and Bayesian inference was not achieved with the gene regions surveyed in this study.	Gray, K.N., McDowell, J.R., Collette, B.B., Graves, J.E.	Bulletin of Marine Science 84, 183–197	2009	Genetics/Molecular
177	Two new species of philometrids (Nematoda: Philometridae) from marine fishes off South Carolina	Two new species of philometrid nematodes, <i>Philometra gymnothoracis</i> n. sp. and <i>Philometroides marinus</i> n. sp., are described from female specimens collected from the body cavity of the spotted moray, <i>Gymnothorax moringa</i> (Cuvier) (Muraenidae, Anguilliformes), and the cobia, <i>Rachycentron canadum</i> (Linnaeus) (Rachycentridae, Perciformes), respectively, from off the Atlantic coast of South Carolina. <i>Philometra gymnothoracis</i> n. sp. is mainly characterized by the conspicuously depressed mouth, the presence of 8 small cephalic papillae arranged in 4 submedian pairs, the esophagus with an anterior bulbous inflation, 2 small papilla-like caudal projections, the body length of the gravid female 435–760 mm, short ovaries, the length of larvae from the uterus 474–544 μm, and by the location in the host (body cavity). <i>Philometroides marinus</i> n. sp. differs from its congeners parasitizing marine and brackish water fishes mainly in having small cuticular bosses only on the anterior part of the body; in possessing 4 markedly large cephalic projections, each with 2 minute papillae, 2 large caudal projections, and in the location in the host (body cavity); the body length of subgravid and gravid females is 130–550 mm and that of larvae from the uterus 600–642 μm.	Moravec, F., de Buron, I.	Journal of Parasitology 95, 722–727	2009	Wild (Atlantic/Pacific) Parasites
178	Application of a microdiet in cobia <i>Rachycentron canadum</i> (Linnaeus, 1766) larvae rearing	[No Abstract Available - The article focuses on the application of a microdiet in rearing of larvae of cobia <i>Rachycentron canadum</i> . The larvae were reared in 70 L plastic tanks with slight aeration. On average food was supplied four times daily. Debris and dead fish were taken out from the containers daily. About 50% of the tank water was replaced with fresh- filtered seawater.]	Tang, B.G., Gang Chen, Wu, Z.H.	Aquaculture Research 41, 315–320	2010	Culture Nutrition
179	Lower lethal temperature for juvenile cobia <i>Rachycentron Canadum</i>	Cobia are a migratory marine species that have recently gained popularity as foodfish in the aquaculture market and for stocking. Unfortunately, when culturing these species, aquaculturalists may unknowingly expose these fish to temperature extremes not normally experienced in situ. We set out to test for the critical thermal minimum temperatures of juvenile cobia by exposing them to a simulated freeze, at a drop rate of 0.33°C per hour. We observed and documented behavioral effects due to low temperature exposure using criteria for loss of equilibrium and death. We determined that the median temperature for loss of equilibrium was 12.1 ± 0.40 °C and the median lethal temperature was 9.7 ± 0.28 °C for low temperature tolerance. We recommend that precautions be taken well before water temperatures reach 13°C in a freeze scenario.	McDonald, D.L., Bumguardner, B.W.	Journal of Applied Aquaculture 22, 25–29	2010	Fish Health
180	Use of soy protein concentrate and novel ingredients in the total elimination of fish meal and fish oil in diets for juvenile cobia, <i>Rachycentron canadum</i>	Achieving true sustainability in fish farming requires the replacement of most of the fish meal and fish oil utilized as feedstuffs. The present experiment reports 2 feeding trials that resulted in the total replacement of fish meal and fish oil in juvenile cobia (<i>Rachycentron canadum</i>). The first trial was conceived as a 2 × 3 factorial design with three levels of fish meal replacement (FMR; 50, 75 and 100% of dietary protein) by soy protein concentrate (SPC), and two levels of mannan oligosaccharide (MOS) supplementation (0 or 0.3% of the diet). Since MOS has been reported to promote gut health and integrity, it was included in order to verify whether it would ease high levels of FMR. Lipids were supplied by menhaden oil. In the second feeding trial, fish meal was replaced by various combinations of SPC and soybean meal, again with or without MOS supplementation. In addition, some diets were supplemented with purified amino acids. Lipids were supplied by fish oil. A final diet (NOFM) was formulated using SPC, a marine worm meal, a nucleotide-rich yeast extract protein source, and MOS. In this last diet, lipids were supplied with a mix of soy oil and a DHA-rich algal meal, thereby completely eliminating both fish meal and fish oil. Over both feeding trials, juvenile cobia consistently exhibited excellent performance at 75% FMR and less. MOS did not have a significant effect, although a beneficial trend was observed in the first trial at 100% FMR. In the second trial, the fish fed the NOFM diet exhibited one of the best weight gains and feed efficiencies, with no mortality and no impact on muscle and liver composition. This result illustrates the crucial importance of the selection of feedstuffs for FMR and fish oil, since the NOFM diet did not receive amino acid supplementation. While this represents the first successful elimination of fish meal and fish oil in aquafeeds for cobia, the consistent, successful replacement of 94% of the fish meal in the other diets is actually more promising to the future as they solely utilized commodities traded (soy products) as replacement sources, which is the only road to true environmental and economical sustainability for the aquaculture industry.	Salze, G., McLean, E., Battle, P.R., Schwarz, M.H., Craig, S.R.	Aquaculture 298, 294–299	2010	Nutrition FishHealth

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
181	Establishment, characterization, virus susceptibility and transfection of cell lines from cobia, <i>Rachycentron canadum</i> (L.), brain and fin	Establishment and characterization of two cobia, <i>Rachycentron canadum</i> , cell lines derived from cobia brain (CB) and cobia fin (CF) are described. Caudal fin and brain from juvenile cobia were dissociated for 30 and 10 min, respectively, in phosphate-buffered saline containing 0.25% trypsin at 25 °C. The optimal culture condition for both dissociated cells (primary cell culture) was at 28 °C in Leibovitz-15 medium containing 10% foetal bovine serum. The cells have been subcultured at a ratio of 1:2 for more than 160 passages over a period of 3 years. Origin of the cultured cells was verified by comparison of their sequences of mitochondrial cytochrome oxidase subunit I genes (cox I) with the cox 1 sequence from cobia muscle tissue. The cell lines showed polyploidy. No mycoplasma contamination was detected. Susceptibility to grouper iridovirus was observed for the CB cell line but not the CF cell line. Both cell lines expressed green fluorescent protein after being transfected with green fluorescent reporter gene driven by the cytomegalovirus promoter.	Cheng, T.-C., Lai, Y.-S., Lin, I.-Y., Wu, C.-P., Chang, S.-L., Chen, T.-I., Su, M.-S.	Journal of Fish Diseases 33, 161–169	2010	Microbiology Fish Health Physiology
182	The Quality Control Status of Cobia, <i>Rachycentron canadum</i> , and Grouper, <i>Epinephelus malabaricus</i> , in Taiwan	Aquaculture industry has grown steadily over the past few years in Taiwan. In 2005 aquaculture production amounted to over 320,000 metric tons (MT); > .26% of the total seafood production. Aquaculture possessed > .55,000 ha of land and > .1 million cubic meters of cage culture. Tilapia and eel are the most important aquaculture products. Taiwan exports over 47,000 MT of tilapia annually, and is the world's second largest country exporting tilapia. The annual production of eel is approximately 33,480 MT. Other important aquaculture products in Taiwan include cobia, milkfish, grouper, oyster, and hard clam. Facing the demands for quality, nutrients, safety, and hygiene by both international and domestic consumers, Taiwan's government and Fishery Alliance have introduced "Traceability," "Supply chain management," and "HACCP Food Safety System," and also invited industrial, official, and academic experts to set up the system of "Regulations on Taiwan Fish Products." They include the certifications on young fish breeds, breeding management, harvesting control, and procedures of delivery and sales, in addition to the currently available certifications on processing procedures. This review will emphasize the strategies to ensure the aqua-fish quality, including the studies and operations of "Traceability," "Supply chain management," and "HACCP food safety system" in Taiwan.	Jiang, S.-T.	Journal of the World Aquaculture Society 41, 266–273	2010	Culture Commercial
183	Growth rates of cobia (<i>Rachycentron canadum</i>) cultured in open ocean submerged cages in the Caribbean	Growth rates of hatchery-reared cobia <i>Rachycentron canadum</i> cultured in submersible cages off Puerto Rico and the Bahamas were comprehensively studied and are presented, discussed and compared to those of other teleosts. Cobia grew to averages of 6.035 kg (specific growth rate (SGR) = 2.10%/day) in 363 days at the Puerto Rico site (PR) and 3.545 kg (SGR = 2.04%/day) in 346 days at the Bahamas site (BA). Growth in length is best expressed by the equations: $y = 12 + 0.18x$; $r^2 = 0.59$ at PR and $y = 12 + 0.16x$; $r^2 = 0.86$ at BA. The Laird–Gompertz model was used to represent growth in weight to best express the rate of decline in growth rate with age ($\alpha = 0.006194$ PR and $\alpha = 0.006323$ BA), which occurred at the onset of precocious maturation for this species at 2.0–4.5 kg in 300 days post hatch (dph). The exponents (b) of length–weight relationships calculated (3.31 at PR and 3.20 at BA) demonstrate that cultured cobia exhibit greater condition factors than their wild counterparts ($b = 2.8$) and explain the morphological differences observed between wild and culture cobia. Final stocking densities of 5 and 15 kg/m ³ were estimated at PR and BA, respectively. Average water temperatures for the duration of the growout cycle were 27.8 °C at PR and 25.5 °C at BA. Results show that growth rates of cobia vary widely and suggest a negative effect of lower temperature and increasing stocking density. These trials also demonstrate, for the first time, that growout of cobia is technically feasible in submerged open ocean cages.	Benetti, D.D., O'Hanlon, B., Rivera, J.A., Welch, A.W., Maxey, C., Orhun, M.R.	Aquaculture 302, 195–201	2010	Culture Cage Culture Hatchery Commercial
184	Energy budget of early juvenile cobia, <i>Rachycentron canadum</i>	Cobia, <i>Rachycentron canadum</i> , aquaculture is a rapidly developing field with considerable information known about juvenile production, but rearing conditions and protocols for hatchery production are not fully optimized. Setting up an energy budget for young cobia would facilitate the identification and optimization of factors controlling their rapid growth. This study measured several of the components of the energy budget of six different size classes (25-50 mm total length; 8.67-75.45 mg dry weight) of recently weaned cobia including growth rate, daily feed consumption, and metabolic rate. As expected, their specific growth rates were high ranging from 36.8% body dry weight/day in the smallest fish to 17.6% in the largest size class. Cobia grew an average of 2.6 mm/d or 6.9 mg dry weight/day. Daily ration levels were high, decreasing from 19 to 14% of body wet weight/day as the cobia grew. The high growth rates and food intake were concomitant with high feed conversion efficiencies that ranged from 1.66 in the smallest fish to 1.18 in the largest size class. Oxygen consumed by individual fish increased significantly with size from 0.10 to 0.54 mg/h with a scaling exponent for standard metabolic rate to dry weight of 0.805. The proportion of consumed energy used for metabolism remained fairly constant at 42-49% throughout the size ranges evaluated, while the cost of growth decreased with increasing size from 27% of consumed calories to 19%. Waste (fecal + urinary) calories, estimated by balancing the energy budget, averaged 34% of consumed calories. From this work, it is apparent that the rapid growth rates exhibited by cobia during the early juvenile phase result from high-energy intake (consumption) and high feed efficiencies and not from any metabolic efficiency.	Watson, A.M., Holt, G.J.	Journal of the World Aquaculture Society 41, 224–234	2010	Culture Bioenergetics
185	Chitinase and apparent digestibility of chitin in the digestive tract of juvenile cobia, <i>Rachycentron canadum</i>	A study was designed to determine the presence of chitinolytic enzymes in cobia. Additionally, the source of the chitinolytic enzymes (bacterial or endogenous) and apparent digestibility of chitinous waste meals were investigated to determine the viability of crustacean processing waste products in juvenile cobia diets. Antibiotics were used to eliminate potential chitinolytic gut flora and chitinolytic enzyme levels were compared to control fish fed an identical diet without antibiotic. Chitinase and chitobiase were measured in the stomach, pyloric caeca, and anterior intestine but were only detected in the stomach. Control stomach chitinase and chitobiase activities were 3075 ± 709 (mean ± SD) and 2076 ± 208 µg N-acetylglucosamine (NAG) g ⁻¹ h ⁻¹ , respectively, and not significantly different from antibiotic treatments. This suggests substantial endogenous production and that the activity, if any, from chitinolytic bacteria is not significant. Additionally, high chitobiase levels indicate breakdown of chitin to potentially nutritive NAG. To determine the apparent digestibility coefficient (ADC) of shrimp processing waste meal (shrimp meal) and crab processing waste meal (crab meal) in vivo, diets containing a 70:30 mixture of a reference diet and test ingredient with the inclusion of the non-digestible marker yttrium oxide were fed. Chitin ADC for both crab (mean = 66.8 ± 4.5% SD) and shrimp (78.2 ± 8.0%) meal was high and not significantly different. Organic matter digestion was significantly higher in crab meal than either shrimp meal or the reference diet. However, crude protein, lipid, and gross energy digestion for crab and shrimp meal were not significantly different from the reference diet. Both enzymatic and in vivo results indicate the capability for juvenile cobia to digest chitin through strong endogenous chitinolytic enzymes. The addition of crustacean processing wastes in cobia diets has the potential to reduce the cost of feed production and increase the sustainability of cobia aquaculture by reducing inclusion rates of fish meal and other more expensive ingredients.	Fines, B.C., Holt, G.J.	Aquaculture 303, 34–39	2010	Nutrition Fish Health
186	Population dynamics and stock status of cobia, <i>Rachycentron canadum</i> , caught in Australian recreational and commercial coastal fisheries	Age and growth of <i>Rachycentron canadum</i> (L.) was studied in northern and eastern Australia to provide data for a preliminary assessment of the stock and to explore possible fisheries management strategies using minimum legal lengths. Fish collected from commercial and recreational fisheries ranged in size and weight from 125 to 1633 mm fork length (FL) and 0.031 to 55 kg respectively. Annual growth increments in sectioned otoliths formed by November–December. Estimated ages ranged from 0 to 7 yr for both genders. Longevity was estimated to be at least 13 yr. Von Bertalanffy growth function parameters were $L_{\infty} = 1160$ mm FL, $K = 0.63$ yr ⁻¹ and $t_0 = -0.21$ yr ⁻¹ . <i>Rachycentron canadum</i> reach 600 mm FL in their first year and over 1000 mm FL in 3 years. Natural and total mortalities were estimated at 0.35 yr ⁻¹ and 0.85 yr ⁻¹ , respectively. Populations of <i>R. canadum</i> may be vulnerable to growth overfishing under the current minimum legal length of 750 mm total length (TL) in Queensland waters. An increase in minimum legal length to 850 mm TL is recommended.	Fry, G.C., Griffiths, S.P.	Fisheries Management & Ecology 17, 231–239	2010	Wild (Atlantic/Pacific)
187	Effects on digestibility and growth of juvenile cobia (<i>Rachycentron canadum</i>) fed fish or crab silage protein	The study was conducted in Cam Ranh, Vietnam, in 1000-L tanks supplied with recirculated and biofiltered saltwater (33‰ and 28.4 °C) to evaluate the potential use of lizard fish (<i>Saurida undosquamis</i>) or blue crab (<i>Portunus pelagicus</i>) acid silage protein for juvenile cobia (23-25 g). Six isoenergetic test moist diets (4915-5125 kcal kg ⁻¹), using either raw fish diet, fish silage diet (FSD), raw crab diet, crab silage diet (CSD), mixed raw fish/raw crab diet or mixed fish/crab silage diet (MSD), as part of the protein sources in the steam-cooked diets, were fed to satiety to triplicate groups of 20 fish each for a 6-week growth trial. Y2O3 was added as an inert indicator to determine the apparent digestibility coefficients (ADC) for macro nutrients and gross energy. Weight gain (185-286%) and specific daily growth rate (2.5-3.2% per day) were significantly higher in cobia fed the raw-based diets and FSD than in fish fed CSD and MSD (34-90 and 0.7-1.5% per day). Feed conversion ratios (FCR) were significantly higher in the groups fed CSD and MSD diets (2.1-6.5) than the groups fed the other diets (1.0-1.2), resulting in significantly lower protein productive values (0.1-0.2) in the groups fed CSD and MSD than in the other groups (0.3-0.4). The FCR results were confirmed by significantly lower ADC values in fish fed CSD and MSD than those in fish fed the other diets. We thus conclude that the present raw-based diets were better utilized by juvenile cobia than silage-based diets, particularly the diet made from crab silage.	Mach, D.T.N., Nguyen, M. D., Nortvedt, R.	Aquaculture Nutrition 16, 305–312	2010	Nutrition Fish Health
188	Cobia (<i>Rachycentron canadum</i>) hatchery-to-market aquaculture technology: recent advances at the University of Miami Experimental Hatchery (UMEH)	Among warm-water marine fishes, cobia is one of the best aquaculture candidate species in the world. Currently there are commercial culture operations in several Asian countries and the industry has started developing elsewhere, including the Western Central Atlantic region. Significant research has been conducted at the University of Miami's Aquaculture Program / University of Miami Experimental Hatchery (UMEH) during the last eight years, involving research to develop and optimize advanced technology to demonstrate the viability of raising hatchery-reared cobia in collaboration with the private sector. This paper reviews some of this recent advances for the development of Hatchery-to-Market Aquaculture Technology for commercial production of cobia.	Benetti, D., Sardenberg, B., Hoenig, R., Welch, A., Stieglitz, J., Miralao, S., Farkas, D., Brown, P., Jory, D.	Revista Brasileira de Zootecnia 39, 60–67	2010	Culture Cage Culture Hatchery Commercial
189	Effect of early co-feeding and different weaning diets on the performance of cobia (<i>Rachycentron canadum</i>) larvae and juveniles	Cobia (<i>Rachycentron canadum</i>) is a very fast growing species. This can only be achieved if sufficient amounts of feed are provided from early larval development onwards. In this study, we examined the effects of early co-feeding and different co-feeding formulated diets on growth, survival and vitality of cobia larvae and juveniles. Two experiments were conducted to test the possibility of early co-feeding of the two formulated diets for cobia larvae (8–18 dph) and one experiment was conducted to compare the effect of three formulated diets for cobia juveniles (20–38 dph). During the larval stage, two formulated diets: Proton® and an experimental diet (INVE, Belgium) were used along with live food from eight days post hatch (dph) and 13 dph compared to 18 dph as the control. Results from the study indicated that early co-feeding of Proton® from eight dph had a significantly positive effect on growth ($P < 0.05$), but not on survival and stress resistance in a salinity stress test ($P > 0.05$) of cobia larvae. In the second trial, no significant difference ($P > 0.05$) was detected between all treatments in terms of growth, vitality and survival. However, high mortality occurred in the treatment with the experimental diet as of 12 dph. The study suggested that early co-feeding of Proton® to cobia larvae from eight dph is possible and research on the appropriate nutritional composition of weaning diets needs to be addressed. In the juvenile stage, three formulated diets, i.e. the experimental diet, Proton® and NRD® (INVE Aquaculture NV) were evaluated for growth performance and survival of early cobia juveniles (20–38 dph). The diets were manually introduced from 22 dph at a feeding frequency of every 2 h until satiation, while feeding of enriched EG <i>Artemia</i> was maintained until 30 dph. Average length and weight of the 38-dph juveniles fed the experimental diet were significantly higher ($P < 0.05$) compared to larvae fed Proton® and NRD®. However, the coefficient of size variation as well as the cumulative stress index in a salinity challenge test was not significantly different ($P > 0.05$). Survival in the Proton® treatment was the lowest, while no significant difference was evident between the experimental diet and NRD® treatments. The mortality rate of all three treatments had two peaks: one at the beginning of the experiment and one when live food feeding was discontinued. This result indicates that the nutritional requirements of cobia are age-dependent and prolongation of live food co-feeding during weaning may be necessary. The higher DHA/EPA ratio in the experimental diet can be a clue for the improvement of growth and survival of cobia during the weaning stage.	Nhu, V.C., Dierckens, K., Nguyen, H.T., Hoang, T.M. T., Le, T.L., Tran, M.T., Nys, C., Sorgeloos, P.	Aquaculture 305, 52–58	2010	Culture Hatchery
190	<i>Anisakis simplex</i> (Nematoda: Anisakidae) third-stage larval infections of marine cage cultured cobia, <i>Rachycentron canadum</i> L., in Taiwan	The first confirmed case of <i>Anisakis simplex</i> infection of the marine cage cobia, <i>Rachycentron canadum</i> (L.), was recorded in Taiwan. The case investigation revealed the presence of third-stage larvae (L3) in either the stomach lumen or abdominal cavity of the cobia but never within the musculatures. Larvae were mainly encapsulated in the peritoneal mesentery on the outer surface of the stomach wall and occasionally on the liver surface. Part of the diet fed to the cobia includes chopped raw fish, and of these, seven species were found to harbor these larvae (as paratenic hosts), indicating that these particular fish might be the larval sources for this infection. To illustrate the course of infection and distribution of this parasite inside cobia, both juvenile and adult cobia were experimentally infected with live L3 by oral transmission. The prevalence of infection reached 100% at the end of all trials. The course of the infection was assessed after necropsy by histological and ultrastructural observations. <i>A. simplex</i> L3 recovered from various locations within juvenile cobia at different post-infection (p.i.) times were at the L3 stage and did not grow significantly. The L3 either adhered to or penetrated into the gastric mucosa of cobia by 2 h p.i. By 25 d p.i., many were trapped within the submucosa and encapsulated by fibroconnective tissue. This phenomenon was more apparent in adult cobia, such that 37.5–86.0% of the injected L3 were primarily found encapsulated within the gastric submucosa. Based upon a PCR-RFLP assay, the larvae encountered in this study were identified as having a recombinant genotype of <i>A. simplex sensu stricto</i> and <i>A. pegreffii</i> . Based upon the results of this study, strategies to ensure the safety of seafood manufactured from cobia and to prevent the potential risks of anisakiasis or allergies risk to consumers were suggested.	Shih, H.-H., Ku, C.-C., Wang, C.-S.	Veterinary Parasitology 171, 277–285	2010	Fish Health Cage Culture Microbiology Parasites

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
191	Dietary selenium requirement for juvenile cobia, <i>Rachycentron canadum</i> L.	A 10-week feeding trial was conducted to estimate the optimum dietary selenium (Se) requirement for juvenile cobia, <i>Rachycentron canadum</i> L. The basal diet was formulated to contain 50.6% crude protein from vitamin-free casein, gelatin. A control diet (no added seleno-dl-methionine) and five experimental diets containing 0.20, 0.40, 0.60, 0.80 and 1.00 mg seleno-dl-methionine kg ⁻¹ were prepared. Each diet was randomly fed to triplicate groups of juvenile cobia with initial weight 6.27±0.03 g in a flow-through system. The Se concentration in rearing water was monitored during the feeding period, and was not detectable. The dietary Se level significantly influenced the survival, specific growth rate (SGR), feed efficiency and the Se concentrations in the whole body and vertebra of cobia. The Se-dependent glutathione peroxidase (EC 1.11.119) activity increased with an increase in the dietary Se levels (P<0.05). Hepatic glutathione reductase (EC 1.6.4.2) activity was the highest in fish fed the diet with 0.21 mg Se kg ⁻¹ , and declined with an increase in the dietary Se levels. Based on broke-line regression of SGR, the Se concentration in the whole body and vertebra, the Se requirements of juvenile cobia were 0.788, 0.811 and 0.793 mg Se kg ⁻¹ diet in the form of seleno-dl-methionine respectively	Liu, K., Wang, X.J., Ai, Q., Mai, K., Zhang, W.	Aquaculture Research 41, e594–e601	2010	Fish Health Culture Hatchery Nutrition
192	Physiological responses of cobia <i>Rachycentron canadum</i> following exposure to low water and air exposure stress challenges	Prevention is the most viable disease management strategy in aquaculture, and prevention is primarily driven by strategies to avoid or minimize the effects of stress. Unfortunately, there is little information available regarding the stress physiology of emerging aquaculture species or appropriate experimental stressing protocols for these fishes, and thus very little context in which to evaluate mitigation strategies. Accordingly, the stress response of cobia was evaluated following exposure to 2 experimental stressors: low water and air exposure. Juveniles were exposed to air for 1 min (AIR EXPOSURE), held for 15 min in water lowered to the fish's lateral midline (LOW WATER), or unchallenged (CONTROL) prior to the collection of blood samples at 0 (pre-challenge), 0.5, 1, 2, 6, 12, 24, 48, and 72 h post-challenge. Both stressors elicited classical haematological changes indicative of the generalized stress response, however, the magnitude of the response was consistently greater in the AIR EXPOSURE group. Plasma cortisol, glucose, and lactate concentrations increased rapidly in the AIR EXPOSURE and LOW WATER groups, peaking within 1 h of challenge. Cortisol returned to basal levels rapidly, whereas glucose and lactate remained elevated for a longer period of time. Regardless of the stressor used, fish recovered within 12 h of the challenge. The primary and secondary responses of juvenile cobia challenged with low water and air exposure appear to respond in a similar fashion to other species exposed to these experimental stressors. Both low water and air exposure are suitable experimental stressors for use in cobia based on their ability to induce a classical stress response and ease of implementation.	Trushenski, J., Schwarz, M., Takeuchi, R., Delbos, B., Sampaio, L.A.	Aquaculture 307, 173–177	2010	Fish Health Physiology
193	Effects of dietary starches and the protein to energy ratio on growth and feed efficiency of juvenile cobia, <i>Rachycentron canadum</i>	Optimization of the protein to energy ratio in juvenile cobia (<i>Rachycentron canadum</i>) would allow the production of diets that maximize growth without the addition of excess energy that may increase costs or even be detrimental to the health of the fish. During a 6-week growth trial, juvenile cobia (5.6 ± 0.5 g fish ⁻¹ initial weight) were fed five isonitrogenous and isolipidic diets containing various protein to energy ratios using starch as the energy source. At the end of the trial, some fish were analysed for body composition characteristics while the rest were used to examine the excretion of dietary starch in the feces. Survival and growth were not significantly affected, but feed efficiency (ranging from 0.64 to 0.94) and daily consumption (ranging from 45.3 to 64.1 g kg ⁻¹ of body weight d ⁻¹) were affected. No reduction in consumption due to excess energy was noted. Analysis of the fecal carbohydrate data showed a linear relationship between dietary inclusion and excretion of carbohydrates with no sign of reaching saturation. Results of this study suggest that cobia can utilize dietary carbohydrates up to at least 340 g kg ⁻¹ of dry diet with an optimal protein to energy ratio of approximately 34 mg protein kJ ⁻¹ metabolizable energy.	Webb, K. A. Jr., Rawlinson, L.T., Holt, G.J.	Aquaculture Nutrition 16, 447–456	2010	Fish Health Nutrition
194	Effects of Dietary Essential Fatty Acid Levels on Broodstock Spawning Performance and Egg Fatty Acid Composition of Cobia, <i>Rachycentron canadum</i>	Broodstocks of cobia, <i>Rachycentron canadum</i> , were fed raw fish (RF) or three formulated diets of similar proximate composition but different n-3 highly unsaturated fatty acid (HUFA) levels: 0.94% (D1), 1.31% (D2), or 1.72% (D3) of the dry weight (dw). Egg fatty acid composition was significantly different between dietary groups and reflected that of the diets. The total n-3 HUFA and especially docosahexaenoic acid contents in eggs of groups fed formulated diets were significantly lower than in group fed RF, whereas the egg content of arachidonic acid (ARA) in groups fed Diets D2 and D3 were significantly higher than in groups fed Diets D1 and RF (P <0.05). Although no significant differences in spawning quality were found among dietary groups (P >0.05), a tendency of better spawning performance was observed in the group fed RF (1.86% n-3 HUFA of dw). A tendency of lower fertilization success was associated with groups that had higher egg content of ARA (D2 and D3). Results of this study suggest that cobia broodstock requirements of dietary n-3 HUFA should be higher than 1.86% dw and that high dietary levels of ARA (0.42-0.60% dw) may affect cobia fertilization success negatively.	Nguyen, H.Q., Tran, T.M., Reinertsen, H., Kjørsvik, E.	Journal of the World Aquaculture Society 41, 687–699	2010	Fish Health Nutrition Spawning
195	Effects of dietary carbohydrate sources on the growth performance and hepatic carbohydrate metabolic enzyme activities of juvenile cobia (<i>Rachycentron canadum</i> Linnaeus.)	An 8-week feeding trial was conducted to evaluate the effect of dietary carbohydrate sources on the growth performance and hepatic carbohydrate metabolic enzyme activities of juvenile cobia. Six experimental diets were formulated to contain 20% glucose, sucrose, maltose, dextrin, corn starch and wheat starch respectively. The results indicated that fish fed the wheat starch and dextrin diets showed significantly better weight gain, specific growth rate and protein efficiency ratio compared with those fed the other diets. However, fish fed the glucose diet had a significantly lower survival and condition factor than those fed the other diets. There were significant differences in the total plasma glucose and triglyceride concentration in fish fed diets with different dietary carbohydrate sources. Haematocrit, haemoglobin, red blood cell and leucocytes were significantly affected by the dietary carbohydrate sources. The activities of glucose-6-phosphate dehydrogenase (G6PD), 6-phosphofructokinase (PFK) and fructose-1,6-bisphosphatase (FBPase) were significantly affected by the dietary carbohydrate sources, while fish fed the glucose diet showed higher G6PD, PFK and FBPase activities than those fed the other diets. These data indicated that dextrin and wheat starch were the most optimal carbohydrate sources for juvenile cobia.	Cui, X.-J., Zhou, Q.-C., Liang, H.-O., Yang, J., Zhao, L.-M.	Aquaculture Research 42, 99–107	2010	Fish Health Nutrition
196	Dietary ascorbic acid requirement of cobia, <i>Rachycentron canadum</i> Linnaeus	A 10-week feeding trial was conducted to determine the optimal requirement of cobia (<i>Rachycentron canadum</i> Linnaeus) for dietary ascorbic acid (AA). Graded levels of L-ascorbyl-2-polyphosphate (LAPP) were supplemented in basal diet to formulate six semi-purified diets containing 2.70 (the control diet), 8.47, 28.3, 80.6, 241 and 733 mg AA equivalent kg ⁻¹ diet, respectively. Each diet was randomly fed to triplicate groups of fish in flow-through plastic tanks (300 L), and each tank was stocked with 25 fish with average initial weight of 4.59 ± 0.36 g. Observed deficiency signs included poor growth, higher mortality and lower feeding rate (FR) in the fish of the control group. Fish fed the control diet had significantly lower weight gain (WG), lower feed efficiency ratio (FER) and lower tissue AA concentrations in fish liver and muscle. With the increase of dietary AA, the survival, WG, FER, hepatic and muscular AA concentrations of cobia significantly increased and then levelled off. The dietary AA requirement of cobia was estimated to be 44.7 mg kg ⁻¹ based on WG, 53.9 mg kg ⁻¹ or 104 mg kg ⁻¹ based on either hepatic or muscular AA concentration, respectively.	Xiao, L.D., Mai, K.S., Ai, Q. H., Xu, W., Wang, X.J., Zhang, W.B., Liufu, Z.G.	Aquaculture Nutrition 16, 582–589	2010	Fish Health Nutrition
197	Reproductive biology of the commercially and recreationally important cobia <i>Rachycentron canadum</i> in northeastern Australia	The reproductive biology of 315 cobia, <i>Rachycentron canadum</i> , from northeastern Australia was studied for an 18-month period. Cobia ranged from 181 to 1,470 mm FL (0.06–55 kg). Length–frequency distributions of males and females did not differ significantly. The sex ratio of females to males was 2.18:1. Histological data showed that cobia developed hydrated oocytes during a protracted spawning season between September and June. Gonadosomatic index peaked from October to December, coinciding with the monsoon or “wet” season. Estimated length at first maturity for female cobia was 671 mm FL. Length at 50% maturity (L 50) for females was estimated at 784 mm FL (1–2 years of age). Batch fecundity ranged from 577,468 to 7,372,283 eggs with a mean of 2,877,669 (± SD 1,603,760) eggs. Relative batch fecundity was 249 eggs per g, and no relationship between relative fecundity and fork length was found. There was a significant positive relationship between the total number of eggs produced and fork length. Spawning frequency, estimated by the post-ovulatory follicle method, was 7.6 days. Based on the detection of hydrated oocytes in fish caught at night, cobia most likely spawn at night. Cobia also feed throughout the spawning period. This is the first report on the reproductive biology of cobia in Australian waters, and provides valuable data for future population assessments of cobia throughout the Indo-Pacific.	Velde, T.D. van der, Griffiths, S.P., Fry, G.C.	Fisheries Science 76, 33–43	2010	Spawning Wild (Atlantic/Pacific)
198	Advances in mariculture on the first decade of the XXI century: Marine fish and shrimp culture [Portuguese]	Marine fish culture is still in its infancy in Brazil. For several years the snook <i>Centropomus parallelus</i> and the flounder <i>Paralichthys orbignyanus</i> were considered for aquaculture, but their commercial application has not yet been achieved. However, once technology for culture of cobia <i>Rachycentron canadum</i> became available, several private companies showed interest for marine fish culture. Besides traditional rearing technologies, cobia is suitable for open ocean culture in cages. This species shows fast growth rates, fish can achieve 4 or 8 kg within one year of age and its flesh is highly appreciated. Shrimp farming has been questioned for environmental issues, use of fish oil and fish meal, and spreading diseases. Rearing shrimp in systems without water exchange, know as ZEAH (Zero Exchange Aerobic Heterotrophic Culture systems) or bioflocs applies methods that minimize these problems, contributing for the development of sustainable shrimp farming.	Sampaio, L.A., Tesser, M.B., Júnior, W.W.	Revista Brasileira de Zootecnia 39, 102–111	2010	Culture Cage Culture Hatchery
199	Comparison of meat quality related chemical compositions of wild-captured and cage-cultured cobia	Nine wild-captured cobia (<i>Rachycentron canadum</i>) and the compatible number and size of cultured cobia from two cage cultured sites, namely Penghu (PH) and Pingtung (PT) Counties, were sampled for chemical analyses. The condition factor of wild cobia was significantly lower than those of cultured fish. The wild cobia had higher moisture content than that of the cultured one, while fat contents in both dorsal and ventral muscles of the former were significantly lower than those of the latter. There were no significant differences between cultured and wild cobia in protein and ash contents. The total free amino acids (FAAs) contents in cultured cobia from two different localities were higher than those of wild fish. Taurine was the most prominent FAA in wild cobia, while glycine was more prominent in cultured fish than in the wild one. Lysine contents were significantly the highest in both dorsal and ventral muscles in PH-cultured cobia. The contents of glutamic acid, glutamine, alanine, ornithine and proline in cultured cobia were higher than those in wild cobia. There was no significant difference between wild and cultured cobia in anserine content, while carnosine was detected only in wild cobia. Inosine monophosphate was the major component in ATP-related compounds in both wild and cultured cobia, but no significant difference in its levels between the wild and cultured groups was found. The contents of ammonia was higher in PH-cultured cobia than those in both PT-cultured and wild cobia, yet no significant difference in urea content of both D and V muscles among the three groups.	Chuang, J.-L., Lin, R.-T., Shiau, C.-Y.	Journal of Marine Science and Technology 18, 580–586	2010	Culture Wild (Atlantic/Pacific) Fish Health Nutrition
200	An evaluation of mercury levels in Louisiana fish: Trends and public health issues	To characterize statewide fish tissue mercury levels in edible finfish the first comprehensive analysis of Louisiana's fish tissue mercury database was conducted. Analyses were based on fifteen years of fish tissue mercury data collected from 368 waterbodies between 1994 and 2008 (n = 14,344). The overall objectives of this study were to establish baseline fish tissue mercury levels; and evaluate species-specific temporal and spatial trends in fish tissue mercury levels. Fish tissue mercury levels ranged from 0.001 ppm (the detection limit) to 5.904 ppm for king mackerel; with an overall geometric mean of 0.218 ppm. Ninety-five percent of samples had mercury levels below the FDA's action level of 1.0 ppm for methylmercury in commercial food. Forty-four percent of all samples had mercury levels above the U.S. EPA's methylmercury fish tissue criterion of 0.3 ppm for sportfish. Species of potential concern include cobia, king mackerel, blackfin tuna, greater amberjack, spotted bass, bowfin, largemouth bass and freshwater drum. There was a significant but small decline in statewide length-adjusted largemouth bass mercury levels between 1994–1999 to 2003–2008 (p < 0.05). The highest fish mercury levels were observed in Pearl, Calcasieu, Mermentau, Ouachita, Pontchartrain and Sabine basins. Length-adjusted largemouth bass mercury levels were significantly higher in wetlands and rivers/streams vs. lakes; and in wetlands vs. estuaries (p < 0.05). Data were analyzed from a public health perspective to make recommendations for optimizing monitoring and outreach.	Katner, A., Sun, M.-H., Suffet, M.	Science of The Total Environment, Special Section: Integrating Water and Agricultural Management Under Climate Change 408, 5707–5714	2010	Wild (Atlantic/Pacific) Nutrition Contaminants
201	Production characteristics and body composition of juvenile cobia fed three different commercial diets in recirculating aquaculture systems	The effect of feeding three commercial diets on production characteristics and body composition of juvenile cobia <i>Rachycentron canadum</i> reared using recirculating aquaculture systems (RASs) was assessed in a 56-d growth trial. Juvenile cobia (mean weight ± SE, 29.2 ± 0.7 g) were stocked into three 8-m ³ tanks in each of four RASs at an initial density of 1.2 kg/m ³ . After stocking, fish were fed one of three commercial diets: Hybrid Striped Bass diet (HSB; 44% protein, 12% lipid), Finfish Gold diet (GOLD; 42% protein, 16% lipid), or Marine Grower diet (MG; 50% protein, 15% lipid), all at a targeted feed rate of 3–5% of body weight per day. At 2-week intervals, 10% of the population of each tank was collected to determine mean weight, weight gain, specific growth rate (SGR), feed conversion efficiency (FCE), and biomass. At the end of the rearing trial, the entire population of each tank was harvested to determine production characteristics and survival. In addition, fish were sampled to determine whole-body composition, hepatosomatic index, intraperitoneal fat ratio, energy retention (ER), protein efficiency ratio (PER), and protein productive value (PPV). Final weight (311.0 g), weight gain (281.8 g), SGR (4.23% per day), FCE (85.7%), biomass (11.20 kg/m ³), and ER (32.7%) of fish fed the MG diet were significantly greater than those of fish fed the HSB and GOLD diets. No differences in survival, gross energy, ash, or crude lipid content existed among fish fed the three diets. Lowest dry matter content, lowest PPV, and highest protein content were observed in fish fed the HSB diet. Highest PER was observed in fish fed the GOLD diet. Although the cost of production per kilogram for rearing juvenile cobia with the MG diet would be greater, this cost could be offset by the 15% reduction in rearing time required as compared with the HSB and GOLD diets.	Weirich, C.R., Wills, P.S., Baptiste, R.M., Riche, M.A.	North American Journal of Aquaculture 72, 43–49	2010	Fish Health Nutrition Culture Commercial RAS
202	Effect of drying and freezing of cobia (<i>Rachycentron canadum</i>) skin on its gelatin properties	The aim of this study is to determine the characteristics of the gelatin extracted from dried and frozen Cobia skin. The gelatin extracted from dried and frozen Cobia skin were analyzed for their proximate composition, gelatin yield, gel strength, colour, gelling properties and amino acid composition. It was found that dried Cobia skin gave higher gelatin yield compared to that of frozen Cobia skin. There were significant difference in protein, ash and fat content of both gelatin samples. Gelatin extracted from dried skin gave a snowy white, was light textured, and had bright and white appearances, while that of frozen skin was darker in color. This study also found that the gelatin extracted from dried skin gave higher gel strength. It was also found that there was no significant difference in gelling temperature and amino acid composition between both gelatin samples. This study shows that drying is a better method in preserving Cobia skin compared to freezing, prior to gelatin extraction.	Amiza, M.A., Siti Aishah, D.	International Food Research Journal 18, 159–166	2011	Fish Health Nutrition

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
203	Effects of early weaning strategies on growth, survival and digestive enzyme activities in cobia (<i>Rachycentron canadum</i> L.) larvae	The effects of weaning strategies of cobia (<i>Rachycentron canadum</i> L.) larvae to commercial microdiets, either from rotifers or from <i>Artemia</i> , on growth, survival and enzymatic digestive capacity, were investigated. In the first experiment, cobia larvae were weaned from rotifers by co-feeding with a microdiet (Otohime) from 8, 13 or 20 days post-hatching (dph). The larvae in the control treatment were fed rotifers (2–12 dph), <i>Artemia</i> nauplii from 7 dph, and co-fed with the microdiet from 20 dph. In the second experiment, the larvae were weaned from <i>Artemia</i> , which was fed to the larvae from 7 dph, by co-feeding with a microdiet (NRD) from 8, 13 or 18 dph. The larvae in control treatment were fed rotifers, then <i>Artemia</i> to the end of the experiment (28 dph). Weaning of cobia larvae onto a microdiet directly from rotifers significantly reduced growth, survival and digestive capacity of the larvae and did not lead to larval acceptance of the microdiet, compared to those weaned from <i>Artemia</i> in the first experiment. Early weaning of cobia larvae onto NRD microdiet (on 8 or 13 dph) from <i>Artemia</i> in the second experiment also reduced growth, survival rate and gut maturation index, compared to those fed live feed. With available microdiets, weaning of cobia larvae could start from <i>Artemia</i> at around 18 dph in order to obtain comparable growth, survival and gut maturation to larvae fed live feed.	Nguyen, H.Q., Reinertsen, H., Wold, P.-A., Tran, T.M., Kjørsvik, E.	Aquaculture International 19, 63–78	2011	Culture Hatchery Nutrition
204	Biosynthesis of long-chain polyunsaturated fatty acids in marine fish: Characterization of an Elovl4-like elongase from cobia <i>Rachycentron canadum</i> and activation of the pathway during early life stages	Marine fish, unlike freshwater species, have been generally considered to have a limited ability to biosynthesize long-chain polyunsaturated fatty acids (LC-PUFA) from C18 precursors due to apparent limited enzymatic activities involved in the pathway. Although LC-PUFA play important physiological roles throughout the entire life cycle, requirements for early life stages are especially high and provision of preformed LC-PUFA in egg lipids appears critical to support the formation of developing tissues where these compounds accumulate. No studies, however, have been conducted to explore the capability of marine fish embryos (here referring to life stages from zygote to the oesophagus opening) for <i>de novo</i> synthesis of the LC-PUFA required for normal growth and development. The present study aimed to investigate the activation of the LC-PUFA biosynthetic pathway during embryogenesis of the marine teleost cobia (<i>Rachycentron canadum</i>). First, a fatty acyl elongase with sequence similarity to mammalian elongase of very long-chain fatty acids 4 (Elovl4) was isolated, and its biochemical function characterized showing that it catalyzed the production of very long-chain fatty acids (VLC-FA) including both saturated and polyunsaturated fatty acids with chain lengths ≥ 24 carbons. Notably, cobia Elovl4 was able to elongate 22:5n-3 to 24:5n-3 and thus could play a key role in the biosynthesis of docosahexaenoic acid (22:6n-3), a critical fatty acid in neural tissues. Subsequently, the fatty acid dynamics of embryos at different developmental stages and the temporal expression patterns of target genes including <i>elovl4</i> , and the formerly characterized <i>elovl5</i> elongase and $\Delta 6$ fatty acyl desaturase, were analyzed in order to elucidate the overall activation of the LC-PUFA biosynthetic pathway in cobia embryos. Our results indicated that expression of the LC-PUFA biosynthetic pathway in cobia embryos is initiated at 12–18 h post-fertilization.	Monroig, Ó., Webb, K., Ibarra-Castro, L., Holt, G.J., Tocher, D.R.	Aquaculture 312, 145–153	2011	Fish Health Nutrition Physiology
205	Effect of replacing dietary fish oil with soybean oil on production performance and fillet lipid and fatty acid composition of juvenile cobia <i>Rachycentron canadum</i>	As a marine carnivore exhibiting exceptionally high growth rates, cobia are considered a species for which fish oil (FO) replacement may be difficult. However, partial, if not complete, FO replacement is necessary to ensure sustainability. We evaluated the effects of graded substitution of dietary FO with soybean oil (SO) in cobia culture. Feeds contained FO (100% FO), SO (0% FO) or blends of the two (67% FO, 33% FO) as the supplemental lipid source. Production performance was largely unaffected by partial replacement of FO with SO: feed intake and final weight were reduced only in the 0% FO dietary treatment. Fillet total lipid fatty acid (FA) composition differed among the dietary treatments, closely approximating dietary FA profile. As increasing amounts of FO were replaced, SO-associated FA became enriched within the fillet lipid at the expense of FO-associated FA. Fillet lipid classes were associated with a particular FA signature, regardless of dietary FA profile. SO can replace a substantial amount of dietary FO; however, juvenile cobia appear to exhibit a nominal requirement for intact long-chain polyunsaturated FA. Therefore, aggressive FO replacement may result in essential fatty acid deficiencies unless the feeds can be amended with alternative sources of these essential nutrients.	Trushenski, J., Schwarz, M., Lewis, H., Laporte, J., Delbos, B., Takeuchi, R., Sampaio, L.A.	Aquaculture Nutrition 17, e437–e447	2011	Fish Health Nutrition
206	Free amino acid distribution in plasma and liver of juvenile cobia (<i>Rachycentron canadum</i>) fed increased levels of lizardfish silage	Juvenile cobia (<i>Rachycentron canadum</i>) (100g) were fed four moist diets (447–476gkg-1drywt) where 0, 130, 260 or 390gkg-1 of concentrated lizardfish (<i>Saurida undosquamis</i>) silage replaced fresh lizardfish, respectively. Blood and livers were sampled at 0, 6, 12, 24 and 48h postfeeding at the end of the 3-week experiment. At 6h postfeeding in all groups, maximum concentrations of most plasma essential amino acids were observed, while significantly lower levels of most non-essential amino acid levels were recorded compared to the other sampled times. At 6 and 12h after feeding, the concentration of most plasma free amino acid (FAA) increased with an increase in dietary fish silage levels. Most FAA in livers of all groups peaked at 12 and 24h postfeeding. However, at 48h postfeeding, concentrations of most plasma FAA were significantly higher in fish fed 0% silage-based diet than in fish fed the other diets (4999 versus 3390–4339nmolAaMl-1plasma). Growth rates and feed utilization were significantly lower in cobia fed 26% or 39% silage-based diets than in fish fed 0% or 13% silage-based diets. Different levels of silage protein thus seemed to have effects on growth and feed utilization efficiency of juvenile cobia. Results from this study support the premise that fish silage can be included until 130gkg-1 in cobia diets.	Mach, D.T.N., Nortvedt, R.	Aquaculture Nutrition 17, e644–e656	2011	Fish Health Nutrition
207	Culture of cobia <i>Rachycentron canadum</i> (L) in near-shore cages off the Brazilian coast	[No Abstract Available - The article discusses a study which investigated cobia culture's performance in near-shore cages in Rio de Janeiro, Brazil. It states that at the end of the evaluation, the fish's average weight was 4.2 kilogram (kg.) which indicates great potential for producing cobia in Brazil. It says that the successful cobia culture in near-shore cages is an alternative for fishermen who could not afford offshore production.]	Sampaio, L.A., Moreira, C. B., Miranda-Filho, K.C., Rombenso, A.N.	Aquaculture Research 42, 832–834	2011	Culture Cage Culture Commercial
208	Morphological development of larval cobia <i>Rachycentron canadum</i> and the influence of dietary taurine supplementation	The morphological development of larval cobia <i>Rachycentron canadum</i> from 3 days post hatch (dph) until weaning (27 dph) was examined using S.E.M. Two groups of fish were studied: a control group (CF), reared under standard feeding protocol, and a group in which prey items were enriched with supplemental taurine (4 g l-1 day-1; TF). TF fish grew faster ($P < 0.001$), attained greater size (mean \pm s.e. 55.1 \pm 1.5 v. 33.9 \pm 1.0 mm total length) and had better survival (mean \pm s.e. 29.3 \pm 0.4 v. 7.1 \pm 1.2 %) than CF fish. Canonical variance analysis confirmed findings with respect to differences in growth between the treatment groups with separation being explained by two cranial measurements. S.E.M. revealed that 3 dph larvae of R. canadum (in both groups) possess preopercular spines, superficial neuromasts on the head and body, taste buds in the mouth, an olfactory epithelium which takes the form of simple concave depressions, and primordial gill arches. Gill filaments start to form as early as 6 dph and lamellae buds are visible at 8 dph in both groups. In CF fish, the cephalic lateral line system continues its development at 12–14 dph with invagination of both supra- and infraorbital canals. At the same time, a thorn-like or acanthoid crest forms above the eye. At 14 dph, invaginations of the mandibular and preopercular canals are visible and around 22 dph enclosure of all cranial canals nears completion. In CF larvae, however, completely enclosed cranial canals were not observed within the course of the trial, i.e. 27 dph. In TF larvae, grooves of the cephalic lateral line system form 4 days earlier than observed in CF larvae of R. canadum (i.e. at 8 dph), with enclosure commencing at 16 dph, and completed by 27 dph. Along the flanks of 6 dph larvae of either treatment, four to five equally spaced neuromasts delineate the future position of the trunk lateral line. As myomeres are added to the growing larvae, new neuromasts appear such that at 16 dph a neuromast is associated with each myomere. By 27 dph, the trunk lateral line starts to invaginate in CF larvae, while it initiates closure in TF larvae. These findings elucidate important features of the larval development of R. canadum and show that dietary taurine supplementation benefits larval development, growth and survival in this species. Moreover, they suggest a conditional requirement for taurine in larval R. canadum.	Salze, G., Craig, S.R., Smith, B.H., Smith, E.P., McLean, E.	Journal of Fish Biology 78, 1470–1491	2011	Culture Hatchery Fish Health Nutrition
209	Cobia <i>Rachycentron canadum</i> aquaculture in Vietnam: Recent developments and prospects	The paper presents a review of the recent developments in research and production of cobia in Vietnam in hatching and cage farming, which have made Vietnam the 3rd largest producer of farmed cobia in the world. Conservative estimations for the 2007 production for the Asian-Pacific region exceed 35,000 t, with remaining global production adding an additional 2000 t, while official farm production registered by FAO is considerably lower. Estimated 2008 production in Vietnam was 1500 t, following the major production of PR China and Taiwan Province of China. This review reports on the various aspects of hatchery technology such as broodstock management, intensive and semi-intensive larval rearing, fry transportation as well as small-scale grow-out in wooden raft cages and large-scale in Norwegian style circular HDPE cages. Some of the prospects for accelerating future development of this species in aquaculture and challenges to be solved are also identified.	Nhu, V.C., Nguyen, H.Q., Le, T.L., Tran, M.T., Sorgeloos, P., Dierckens, K., Reinertsen, H., Kjørsvik, E., Svennevig, N.	Aquaculture, Larvi 2009 Proceedings of the 5th Fish and Shellfish Larviculture Symposium, Gent, Belgium, September 2009 315, 20–25	2011	Culture Cage Culture Hatchery Commercial
210	The effect of process variables for production of cobia (<i>Rachycentron Canadum</i>) skin gelatin hydrolysates with antioxidant properties	Acid-treated cobia (<i>Rachycentron canadum</i>) skin was extracted in a retort (121C) to obtain retorted skin gelatin hydrolysates (RSGHs) containing antioxidant peptides with noticeable antioxidant properties. To improve the antioxidant activity of cobia RSGHs, five processing factors including alkali concentration, alkali pretreatment time, phosphoric acid concentration (PC), water/skin ratio (WS) and retorting time (RT) in RSGH production were screened using a fractional factorial design to identify critical factors. It indicated that PC, WS and RT had significant effects on α, α -diphenyl- β -picrylhydrazyl (DPPH) scavenging by RSGHs. Subsequently, the optimization of PC, WS and RT on the DPPH scavenging of RSGHs was studied using a central composite design to collect data that resulted in a response surface modeling. The highest value for the predicted DPPH scavenging (10mg/mL RSGH) was 73.63% (PC=6.5%, WS=1 and RT=180min), and it exhibited 39.9% more scavenging of DPPH than that of original RSGH.	Chow, C.-J., Yang, J.-I.	Journal of Food Biochemistry 35, 715–734	2011	Nutrition
211	Chromosome mapping of repetitive sequences in <i>Rachycentron canadum</i> (Perciformes: Rachycentridae): Implications for karyotypic evolution and perspectives for biotechnological uses	The cobia, <i>Rachycentron canadum</i> , a species of marine fish, has been increasingly used in aquaculture worldwide. It is the only member of the family Rachycentridae (Perciformes) showing wide geographic distribution and phylogenetic patterns still not fully understood. In this study, the species was cytogenetically analyzed by different methodologies, including Ag-NOR and chromomycin A3 (CMA3)/DAPI staining, C-banding, early replication banding (RGB), and <i>in situ</i> fluorescent hybridization with probes for 18S and 5S ribosomal genes and for telomeric sequences (TTAGGG). The results obtained allow a detailed chromosomal characterization of the Atlantic population. The chromosome diversification found in the karyotype of the cobia is apparently related to pericentric inversions, the main mechanism associated to the karyotypic evolution of Perciformes. The differential heterochromatin replication patterns found were in part associated to functional genes. Despite maintaining conservative chromosomal characteristics in relation to the basal pattern established for Perciformes, some chromosome pairs in the analyzed population exhibit markers that may be important for cytotoxicomic, population, and biodiversity studies as well as for monitoring the species in question.	Jacobina, U.P., de Bello Cioffi, M., Souza, L.G.R., Calado, L.L., Tavares, M., Manzella Jr., J., Bertollo, L. A.C., Molina, W.F.	Journal of Biomedicine & Biotechnology 2011, 1–8	2011	Genetics/Molecular Wild (Atlantic/Pacific)
212	Purification of a toxic metalloprotease produced by the pathogenic <i>Photobacterium damsela</i> subsp. <i>piscicida</i> isolated from cobia (<i>Rachycentron canadum</i>)	The aim of the present study was to purify and characterize a toxic protease secreted by the pathogenic <i>Photobacterium damsela</i> subsp. <i>piscicida</i> strain CP1 originally isolated from diseased cobia (<i>Rachycentron canadum</i>). The toxin isolated by anion exchange chromatography, was a metalloprotease, inhibited by L-cysteine, ethylenediaminetetraacetic acid (EDTA), ethylene glycol-bis(β -aminoethyl ether)N,N,N',N'-tetraacetic acid (EGTA), 1,10-phenanthroline, N-tosyl-L-phenylalanine-chloromethyl ketone (TPCK), and N- α -ptosyl-L-lysine-chloromethyl ketone (TLCK), and showed maximal activity at pH 6.0–8.0 and an apparent molecular mass of about 34.3 kDa. The toxin was also completely inhibited by HgCl ₂ , and partially by sodium dodecyl sulfate (SDS) and CuCl ₂ . The extracellular products and the partially purified protease were lethal to cobia with LD50 values of 1.26 and 6.8 μ g protein/g body weight, respectively. The addition of EDTA completely inhibited the lethal toxicity of the purified protease, indicating that this metalloprotease was a lethal toxin produced by the bacterium.	Liu, P.-C., Chuang, W.-H., Lee, K.-K.	Zeitschrift fur Naturforschung - Section C Journal of Biosciences 66 C, 287–295	2011	Fish Health Microbiology
213	Replacement of fishmeal in cobia (<i>Rachycentron canadum</i>) diets using poultry by-product meal	An 8-week feeding trial was conducted to evaluate the use of local poultry by-product meal (PBM) in replacement of imported fishmeal in the diets of cobia, <i>Rachycentron canadum</i> . Six isolipidic (12%) and isoproteic (45%) experimental diets were formulated using PBM to replace fishmeal at 20, 40, 60, 80 and 100% dietary protein. Eleven juvenile cobia (initial mean weight of 30.7 \pm 0.78 g) were randomly stocked in 300-L circular fibreglass tanks and hand-fed based on the total biomass of each tank, twice a day at 0900 h and 1500 h. The fish were group weighed at 2-week intervals to monitor their growth performance in order to adjust the feeding ratio. At the end of the feeding trial, weight gains (WGs) ranging from 221 to 322% were obtained. The specific growth rate (SGR), WG and protein efficiency ratio (PER) for fish fed with PBM-based diets were not significantly different ($P > 0.05$) when compared to fish fed the control diet. The best SGR was recorded for fish fed with 60PBM diet, which was significantly higher ($P < 0.05$) than those fed the control diet with values at 2.40 \pm 0.01 and 1.97 \pm 0.26%/day, respectively. The FCR of 1.83 \pm 0.05 for fish fed the 60PBM diet was not significantly different ($P > 0.05$) when compared to those fed the control diet. The PBM source and dietary level did not significantly ($P > 0.05$) affect the hepatosomatic index of the fish. The results from this study suggested that PBM could replace 100% dietary fishmeal without adversely affecting the growth performance, but an optimal replacement level at approximately 60% was recommended for better growth performance and efficient feed utilization.	Saadiah, I., Abol-Munafi, A. M., Utama, C.M.C.	Aquaculture International 19, 637–648	2011	Fish Health Nutrition
214	Study on regional production and economy of cobia <i>Rachycentron canadum</i> commercial cage culture	In recent years, cobia has become an emerging farmed species in Asia due to its quick growth and high economic value. This study collects biological and economic data affecting the economic performance of cobia farming in three countries, namely Taiwan, China, and Vietnam. The data are collected by questionnaire sampling and analyzed by multivariate statistical analysis in order to compare the key factors affecting the production and economy of cobia farming in these three countries. The results show that Taiwan, China, and Vietnam have significant differences in input intensities and profitability. China has the highest input intensity (3372.42 TWD/m ³), as its high stocking density increases feed input. Taiwan has the highest unit input cost (103.44 TWD/kg), as the high quality of the product increases the price of cobia in Taiwan, which offsets the high product costs. In terms of profitability, the benefit–cost ratio is over one in all three countries, indicating that the profitability of cobia farming is good in all three countries. Profitability analysis shows that fingerlings in China achieve 36.50, which is the highest among the three countries; whereas Taiwan has the highest feed profitability of 0.78, which reveals that the fingerlings produced in China are competitive in both price and quality, while Taiwan has the best feed management efficiency. The production costs and profitability of Vietnam fall between those of Taiwan and China. Feed cost is the main expenditure in cobia culture; thus, good feed management could effectively reduce production costs and increase business performance. The feed quality and input management model of Taiwan, in conjunction with the fingerling quality and stock model of China, could provide future reference for farming management in such areas as feed input and selection of fingerling.	Huang, C.-T., Miao, S., Nan, F.-H., Jung, S.-M.	Aquaculture International 19, 649–664	2011	Commercial Cage Culture

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
215	Replacement of fish oil by soybean oil in diets for cobia (<i>Rachycentron canadum</i>)	The replacement of fish oil for cobia (<i>Rachycentron canadum</i>) in diets was evaluated using five proportions of fish oil:soybean oil. Two hundred juveniles ($\pm 12g$) were randomly distributed in twenty 480L tanks and fed to apparent satiety twice daily for 42 days. Diets contained 12% lipids with different proportions of fish to soybean oils and were therefore named OP0, OP25, OP50, OP75 and OP100 according to the inclusion content of fish oil (0, 25, 50, 75 and 100%, respectively). Increasing dietary fish oil levels resulted in higher survival, growth and feed intake. Fish fed diets OP75 and OP100 presented higher weight gain than those fed diets OP0 and OP25, whereas fish fed diet OP50 had an intermediate weight gain. Overall, performance was enhanced at higher contents of dietary fish oil. No significant differences on protein and lipid content of fish carcass were observed, but moisture and ash content differed significantly between treatments. The inclusion of relatively higher contents of plant ingredients affected feed intake, which resulted in lower growth rates. The present results suggest the possibility of replacing up to 50% of fish oil with soybean oil in diets for cobia juveniles.	Silva Júnior, R.F., Nova, W. V., Farias, J.L., Costa-Bomfim, C.N., Tesser, M.B., Druzian, J.I., Correia, E.S., Cavalli, R.O.	Arquivo Brasileiro de Medicina Veterinária e Zootecnia 63, 980–987	2011	Fish Health Nutrition
216	Effects of dietary chitosan and <i>Bacillus subtilis</i> on the growth performance, non-specific immunity and disease resistance of cobia, <i>Rachycentron canadum</i>	The present study was performed to investigate the effects of various levels of dietary <i>Bacillus subtilis</i> and chitosan on the growth performance, non-specific immunity and protection against <i>Vibrio harveyi</i> infection in cobia, <i>Rachycentron canadum</i> . Fish were fed with the control diet and six different experimental diets containing three graded levels of <i>B. subtilis</i> at 2×10^{10} CFU g ⁻¹ (0.0, 1.0, 2.0 g kg ⁻¹ diet) for each of two levels of chitosan (3.0 and 6.0 g kg ⁻¹ diet). The results of 8 weeks feeding trial showed that the survival rate ranged from 81.3% to 84.0% with no significant difference ($P > 0.05$). The SGR (%) in the fish fed with dietary treatments was significantly higher than that of the control fish except diet 6 group with 2.0 g kg ⁻¹ <i>B. subtilis</i> and 3.0 g kg ⁻¹ chitosan. The serum lysozyme activities were significantly higher in 6.0 g kg ⁻¹ chitosan groups and no significant differences were observed among <i>B. subtilis</i> levels. The serum ACP activities were significantly higher in 3.0 g kg ⁻¹ chitosan groups at 0.0 and 1.0 g kg ⁻¹ <i>B. subtilis</i> levels; at low chitosan level, the cobia fed diets with 1.0 g kg ⁻¹ <i>B. subtilis</i> had significantly higher serum ACP activity, but at high chitosan level, the cobia fed diets with 2.0 g kg ⁻¹ <i>B. subtilis</i> had significantly higher serum ACP activity. The phagocytosis and respiratory burst activity in the fish fed with dietary treatments was significantly higher than that of the control fish except diet 3 group with 6.0 g kg ⁻¹ chitosan. Moreover, fish fed the diet containing 2.0 g kg ⁻¹ <i>B. subtilis</i> and 6.0 g kg ⁻¹ chitosan had significantly higher post-challenge survival on the 7th day following <i>V. harveyi</i> infection and post-challenge survival showed clearly the synergistic effect of chitosan and <i>B. subtilis</i> . Based on these results, the combination of 1.0 g kg ⁻¹ <i>B. subtilis</i> and 6.0 g kg ⁻¹ chitosan is optimal for the growth, innate immunity and disease resistance of cobia with an 8-week oral administration.	Geng, X., Dong, X.-H., Tan, B.-P., Yang, Q.-H., Chi, S.-Y., Liu, H.-Y., Liu, X.-Q.	Fish & Shellfish Immunology 31, 400–406	2011	Fish Health Nutrition Microbiology
217	Effect of dietary carbohydrate level on growth performance, body composition, apparent digestibility coefficient and digestive enzyme activities of juvenile cobia, <i>Rachycentron canadum</i> L.	A 9-week feeding trial was conducted to investigate the effect of dietary carbohydrate level on the growth performance, body composition and apparent digestibility coefficient and digestive enzyme activities of juvenile cobia. Six isonitrogenous and isolipidic diets containing graded levels of starch (1.3%, 6.5%, 12.5%, 18.4%, 24.2% and 30.4%) were fed to juvenile cobia. Specific growth rate (SGR), feed efficiency ratio (FER) and protein efficiency ratio (PER) increased with increasing dietary starch up to 18.4% ($P < 0.05$), and thereafter SGR declined but FER and PER remained nearly the same. Apparent digestibility coefficient of starch reduced significantly when dietary starch up to 30.4%. Fish fed the diets with starch from 18.4% to 30.4% showed higher amylase activities in intestinal tract than those fed diets containing starch 1.3% and 6.5% ($P < 0.05$). Significantly higher whole-body lipid contents were observed in fish fed the diets containing higher starch. Whole-body moisture content was inversely correlated with whole-body lipid content, while protein and ash showed no significant differences. Plasma glucose, hepatosomatic index, liver glycogen and liver lipid increased with an increasing dietary starch. Based on SGR and FER, the appropriate dietary starch supplementations of juvenile cobia were estimated to be 21.1% and 18.0 % of diet respectively.	Ren, M., Ai, Q., Mai, K., Ma, H., Wang, X.	Aquaculture Research 42, 1467–1475	2011	Fish Health Nutrition
218	First record of <i>neobenedenia melleni</i> (Monogenea: Capsalidae) in sea-farmed cobia (<i>Rachycentron canadum</i>) in Brazil	<i>Neobenedenia melleni</i> (MacCallum, 1927) (Monogenea) is a widespread pathogen in marine teleost cultures all over the world. The present paper reports this parasite species in farmed cobia (<i>Rachycentron canadum</i>) in Brazil, for the first time. Some comments on preventive actions for avoiding the disease are made.	Kerber, C.E., Sanches, E.G., Santiago, M., Luque, J.L.	Revista Brasileira de Parasitologia Veterinária 20, 331–333	2011	Fish Health Cage Culture Parasites
219	Broodstock development and controlled breeding of cobia <i>Rachycentron canadum</i> (Linnaeus 1766) from Indian seas	Cobia, <i>Rachycentron canadum</i> has emerged as one of the topmost finfish species for mariculture. In India, cobia broodstock was developed and induced breeding was achieved for the first time at Mandapam Regional Centre of the 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. During March 2010, a female with intra-ovarian egg diameter of 700 μ 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 female 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 μ mesh net and stocked in incubation tanks at varying densities. The eggs hatched after 22 h of incubation at a temperature range of 28–30 °C. The percentage of hatching was 80% and the total number of newly hatched larvae was estimated as 1.5 million.	Gopakumar, G., Abdul Nazar, A.K., Tamilmani, G., Sakthivel, M., Kalidas, C., Ramamoorthy, N., Palanichamy, S., Ashok Maharshi, V., Srinivasa Rao, K., Syda Rao, G.	Indian Journal of Fisheries 58, 27–32	2011	Spawning Culture Hatchery
220	Evaluation of poultry by-product meal in commercial diets for juvenile cobia (<i>Rachycentron canadum</i>)	A 10-week feeding trial was conducted to evaluate the potential use of poultry by-product meal (PBM) as a partial replacement of fish meal protein in the commercial diets for juvenile cobia. Five isonitrogenous (approximately 45%) and isolipidic (about 11%) diets were formulated to contain graded levels of PBM, and fish meal protein was replaced with a pet food-grade PBM at 15, 30, 45, 60% level (PBM15, PBM30, PBM45, PBM60, respectively) without lysine and methionine supplementation. The reference diet (PBM0) contained fish meal and soybean meal as protein sources. Each diet was fed to groups of 20 juvenile cobia initially averaging approximately 5.8 g in triplicate 500-L tanks twice daily to apparent satiation. The results showed that growth performance and survival for fish fed PBM-supplemented diets were not significantly lower compared to fish fed the reference diet ($P > 0.05$). However, protein efficiency ratio and feed efficiency ratio were significantly affected by the replacement level of fish meal protein with PBM, fish fed the PBM30 and PBM45 diets had higher PER and FER than fish fed the reference diet and the other diets. The condition factor, viscerosomatic index and intraperitoneal fat ratio were not significantly affected by the dietary treatments, however, fish fed the PBM45 diet had a higher hepatosomatic index than fish fed the other diets. There were no significant differences in moisture, crude lipid, ash, calcium and phosphorus content in whole body among all treatments, but the fish fed the reference diet had higher crude protein in whole body than fish fed the PBM-supplemented diets. There were no differences in liver superoxide dismutase, catalase, glutathione S-transferase and glutathione peroxidases activities among fish fed the experimental diets. Hematocrit, hemoglobin, red blood cell and total immunoglobulin were not significantly affected by the replacement level of fish meal protein with PBM. With the exception of plasma glucose content, there were no significant differences in plasma triglyceride, cholesterol and total protein concentration in fish fed the experimental diets. The results of this study indicated that good quality terrestrial PBM can successfully replace fish meal in the commercial diets for cobia, and the optimal level of fish meal replacement with PBM was determined by quadratic regression analysis to be 30.75% on the basis of maximum protein efficiency ratio.	Zhou, Q.-C., Zhao, J., Li, P., Wang, H.-L., Wang, L.-G.	Aquaculture 322–323, 122–127	2011	Fish Health Nutrition
221	Acute exposure of juvenile cobia <i>Rachycentron canadum</i> to nitrate induces gill, esophageal and brain damage	Cobia <i>Rachycentron canadum</i> is a fast growing fish with world-wide potential for aquaculture, and has been considered for rearing in recirculating aquaculture systems (RAS). Nitrate is considered the least toxic nitrogenous product in the ammonia nitrification process, but as it may accumulate in RAS, toxic levels can be reached. The objective of this study was to evaluate the acute toxicity and the histopathological effects of nitrate on juvenile cobia. Juveniles (6.87 \pm 0.36 g; 11.8 \pm 0.19 cm) were acutely exposed to six concentrations of nitrate (500–3000 ppm NO ₃ ⁻ -N) plus a control during 96 h. At the end of this period of exposure, juvenile cobia were sampled for histopathological evaluation. The estimated LC50 of nitrate to juvenile cobia was equal to 2407 and 1829 mg/L NO ₃ ⁻ -N at 24 and 96 h, respectively. Cobia exposed to sub-lethal nitrate concentrations showed histopathologic alterations in the gills, esophagus and brain. The gills revealed epithelial hyperplasia with complete lamellar fusion, telangiectasia, and lamellar shorting induced by necrosis, and the esophagus presented hyperplasia of epithelium and mucus cells. In the brain, glial cells proliferation, satellitosis (microglial cells surrounding neurons with swollen and pre-necrotic neurons), and Virchow-Robin spaces (enlarged perivascular spaces, EPVS) were observed. The results of the present study indicate that juvenile cobia have a high tolerance to acute exposure of nitrate. However, assorted histopathological responses were observed for cobia at sub-lethal nitrate concentrations. Therefore, further studies are needed to estimate safe chronic nitrate levels for juvenile cobia culture.	Rodrigues, R.V., Schwarz, M.H., Delbos, B.C., Carvalho, E.L., Romano, L. A., Sampaio, L.A.	Aquaculture 322–323, 223–226	2011	Fish Health Water Quality RAS Physiology
222	Distribution and accumulation of organotin species in seawater, sediments and organisms collected from a Taiwan mariculture area	The present study was undertaken to evaluate the distribution and accumulation of tributyltin (TBT) and triphenyltin (TPHT) in seawater, sediments and selected organisms from a cage mariculture area in southern Taiwan, Hsiao Liouchiou Island. Our results show that Σ OTs were found in concentrations as high as 196 ng/L in seawater collected from the sites in Pai-Sa harbor, and up to 1040 ng/g dry wt. in sediments dredged from sites within Da-Fu harbor. Also, Σ OTs concentrations of 859 ng/g dry wt. were observed in the liver of cobia (<i>Rachycentron canadum</i>) from mariculture cages. As most published studies have focused on the acute toxicity and bioaccumulation of organotins in mussels, the effects of organotins on cobia and other marine fauna are still poorly understood. This study highlights the significance of Σ BTs accumulation in cobia, as well as in the sediments and seawater surrounding their culture facilities.	Liu, L.-L., Wang, J.-T., Chung, K.-N., Leu, M.-Y., Meng, P.-J.	Marine Pollution Bulletin, 6th International Conference on Marine Pollution and Ecotoxicology 63, 535–540	2011	Sediments Cage Culture Commercial Nutrient Impacts
223	Environmental impact of fish farming in floating cages in Isla Arena, Campeche	Mariculture is the cultivation of marine species of commercial importance. This activity has intensified in recent decades due to the need for food production. The present study evaluated the impact of <i>Rachycentron canadum</i> (Cobia) and <i>Sciaenops ocellatus</i> (Red Drum) farming in floating cages along the coasts of Campeche, Mexico. The impact of this mariculture system was evaluated through the physicochemical analysis of the sediment from underneath the cages and the analysis of the quality of the water from the farming area. Results showed high concentrations of nitrogen (> 0.5 %) and organic matter (> 80 %), both in the farming area and in the control sites. The concentration of fine sediment showed no spatial or temporal changes. There were no detectable concentrations of nitrites, nitrates, ammonium and phosphates in the water, in a range of 0.1 to 100 mg L ⁻¹ . The impact caused by this farming system appeared to be non significant, at least in the area of study, due to the constant movement of the water caused by ocean currents which, very likely, carried the waste from the cages to other places.	Silva-Cruz, Y., Castañeda-Chávez, M. del R., Lango-Reynoso, F., Landeros-Sánchez, C.	Tropical and Subtropical Agroecosystems 13, 291–298	2011	Sediments Cage Culture Commercial Nutrient Impacts
224	First records of known endoparasitic species of pseudempleurosoma Yamaguti, 1965 (Monogenea: Dactylogyridae) from Tetraodontid and Rachycentrid fish off the northern coast of the Yucatan Peninsula, Mexico	Monogeneans infecting the rectum of the wild checkered puffer fish, <i>Sphaerooides testudineus</i> (Tetraodontidae), and the pyloric ceca of the cultured cobia, <i>Rachycentron canadum</i> (Rachycentridae), from the northern coast of the Yucatan Peninsula, Mexico, were morphologically identified as <i>Pseudempleurosoma carangis</i> Yamaguti, 1965 and <i>Pseudempleurosoma gibsoni</i> Santos, Mourão and Cárdenas, 2001 (Dactylogyridae), respectively. Morphometric comparison between the paratypes of <i>P. carangis</i> and those from <i>S. testudineus</i> showed that the latter differ only in the length of the body, germarium, and dorsal anchors. Similarly, a small form of <i>P. gibsoni</i> based on body size was detected in the present study. These metric differences may be attributable to the host effect, i.e., <i>S. testudineus/R. canadum</i> versus <i>Caranx lugubris</i> (Carangidae) (type host of <i>P. carangis</i>) from Hawaii and <i>Paralichthys brasiliensis</i> (Sciaenidae) (type host of <i>P. gibsoni</i>) from Brazil, or by the degree of maturity, or both. In view of these considerations, new illustrations and several supplemental observations for <i>P. carangis</i> and <i>P. gibsoni</i> are provided. The present findings also represent new geographical records, and new sites of infection, e.g., rectum and pyloric ceca, for species of <i>Pseudempleurosoma</i> , and the first known endoparasitic monogeneans infecting tetraodontid and rachycentrid fishes in Mexico.	Mendoza-Franco, E.F., Vidal-Martínez, V.M.	The Journal of Parasitology 97, 1020–1025	2011	Fish Health Culture Parasites
225	Preparation Method of <i>Photobacterium damselae</i> subsp. <i>piscicida</i> Vaccine for Cobia (<i>Rachycentron canadum</i>) [Chinese]	The aim of this study was to find an optimal preparation method of <i>Photobacterium damselae</i> subsp. <i>piscicida</i> vaccine for cobia (<i>Rachycentron canadum</i>). Various candidate vaccines combined with inactivated bacteria, extracellular products and Freund's adjuvant were used to assay their efficiency against photobacteriosis by the safety trials and antibody response. The results showed that both inactivated bacteria and all extracellular products did not decrease the proliferation of gill cell. The best candidate vaccine was an admixture of inactivated bacteria of $8.4 \times 10^9 \sim 1.7 \times 10^{10}$ cells/fish ($p < 0.05$) and Freund's adjuvant which produced high antibody titer from 1:416 to 1:960 during 29 ~ 35 days post-vaccination.	Guo, J.-J., Chen, C.-H., Yeh, C.-H., Kuo, C.-M., Chen, T.-I.	Journal of Taiwan Fisheries Research 19, 37–44	2011	Fish Health Microbiology

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
226	Effect of different environmental factors on embryo and larval development of cobia, <i>Rachycentron canadum</i> [Chinese]	<i>Cobia (Rachycentron canadum)</i> is one of potential candidate species for marine cage culture due to its fast growth and higher resistance to disease. Brood stock cultured in land-based pond in southern Taiwan spawns year round with a peak in spring and autumn. Spawning in the rainy and typhoon seasons results in a difficulty of larval rearing. This study aimed to investigate the effect of environmental factors on the embryonic development and early larval rearing of cobia. Salinity tolerance at early and late embryos stages and yolk-sac larvae determined the hatching rate and survival rate, respectively. Embryos and yolk-sac larvae were transferred from salinity 30 psu into different salinities (5, 10, 15, 20, 25, 30, 35, 40 and 45 psu). Different bottom substrates (soil, sand and no substrate) were evaluated in the development of yolk-sac larva. Finally, the effect of salinity (10, 15, 20 and 30 psu) on larval rearing was tested. The results showed that both early and late embryonic stages had better hatching rate at salinity of 25, 30 and 35 psu and the late stage of embryos was more tolerant to the changes of salinity. The highest larval survival rate was at salinity 25 psu. The late stage of yolk-sac larvae (2 dph) was more tolerant to the changes of salinity than the early stage (2-4 hph) of yolk-sac larvae. Survival rate on the larval rearing was significantly different (P<0.05) at salinity of 20 and 30 psu with 11.6 and 15.6%, respectively. The survival rates of yolk-sac larva cultured in different bottom substrates were 72.5% (no substrate), 57.5% (sand) and 13.5% (soil). In conclusion, the environment of no bottom substrate and salinity between 25 to 35 psu was good for the development of yolk-sac larva stages and cobia embryo. Larvae may have better survival and growth rates by culturing them in seawater of salinity 20-30 psu.	Lee, Y.-H., Chang, W.-C., Chang, S.-L., Jun, L.-, Liu, S.-C., Chen, T.-I.	Journal of Taiwan Fisheries Research 19, 29–36	2011	Culture Fish Health Hatchery
227	Effects of natural antioxidant (zataria multiflora boiss) on fatty acid profiles in cobia fillets during frozen storage	Marine fishes are rich in n-3 polyunsaturated fatty acids (PUFA), especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which are extremely important for human health. In this study, the effect of thyme essential oil (<i>Zataria multiflora</i> Boiss) on the fatty acid profiles of fish fillets during a further frozen storage in -18° C was investigated. Cobia fillets were treated with thyme essential oil (250ppm and 500ppm) then stored at -18°C for up to 6 months and compared to control conditions. As a result of the frozen storage, marked content decreases were found in fatty acid groups such as monounsaturated, polyunsaturated and n-3 polyunsaturated, as well as in the n-3/n-6 ratio. However, a preserving effect on such fatty acid parameters could be observed resulting from the thyme treatments. Assessment of the polyene index indicated an increased lipid oxidation development during the frozen storage time; this increase was partially inhibited by using the thyme essential oil. Results of our investigation revealed that thyme 250 and thyme 500 ppm retarded changes of fatty acids in fillets of Cobia fish during frozen storage although thyme 250 ppm was not as effective as thyme 500 ppm on stability of fatty acids.	Taheri, S., Ahmotallebi, A., Fazlara, A., Aghababayan, A.	Global Veterinaria 7, 460–467	2011	Nutrition
228	New data on the morphology of <i>Iheringascaris iniquies</i> (Linton, 1901) (Nematoda: Anisakidae), a specific parasite of the marine fish <i>Rachycentron canadum</i> (Linnaeus), as revealed by SEM.	Specimens of the type species of the ascaridoid genus <i>Iheringascaris</i> Pereira, 1935, <i>I. iniquies</i> (Linton, 1901) (Anisakidae), were collected from the digestive tract and mesentery of its type host <i>Rachycentron canadum</i> (Linnaeus) (Rachycentridae, Perciformes) from off the Atlantic coast of South Carolina, USA, during May of 2011. Scanning electron microscopical examination, used for the first time for specimens originating from the West Atlantic, made it possible to study in detail some taxonomically important morphological features, such as the number and distribution of male caudal papillae, cephalic and cuticular structures, deirids and cloacal (anal) lips. The allocation of other, poorly described, species from different hosts in Indian waters to this genus needs to be confirmed.	Moravec, F., Yost, J., Buron, I.	Folia Parasitologica 59: 315–318	2012	Parasites Wild (Atlantic/Pacific)
229	Effect of previous ascorbic acid treatment on the fatty acid profile of cobia (<i>Rachycentron canadum</i>) filets during frozen storage	The present research focuses on the nutritional value of the lipid retention associated with frozen cobia (<i>Rachycentron canadum</i>). The effect of a previous soaking in an aqueous ascorbic acid (AA) solution on the fatty acid profile of fish filets during a further frozen storage period (-18 °C) was investigated. Two different AA concentrations were tested (0.25% and 0.50%) and compared to control conditions. As a result of the frozen storage period (up to 6 months), marked decreases were found in the contents of fatty acid groups such as monounsaturated, polyunsaturated and n-3 polyunsaturated, as well as in the n-3/n-6 ratio. However, a preserving effect on such fatty acid parameters could be observed resulting from the previous AA treatment, which was greater when applying the 0.50% AA concentration. Assessment of the polyene index indicated an increased lipid oxidation development during the frozen storage time; this increase was partially inhibited by the previous AA soaking.	Taheri, S., Motallebi, A.A., Fazlara, A., Aftabsavar, Y., Aubourg, S.P.	Grasas y Aceites 63, 70–78	2012	Nutrition
230	Identification of a cobia (<i>Rachycentron canadum</i>) CC chemokine gene and its involvement in the inflammatory response	The chemokines regulate immune cell migration under inflammatory and physiological conditions. We investigated a CC chemokine gene (<i>RcCC1</i>) from cobia (<i>Rachycentron canadum</i>). The full-length <i>RcCC1</i> cDNA is comprised 673 nucleotides and encodes a four-cysteine arrangement 99-amino-acid protein typical of known CC chemokines. The genomic DNA of <i>RcCC1</i> consists of three exons and two introns. Phylogenetic analysis showed that <i>RcCC1</i> was closest to the MIP group of CC chemokines. Quantitative real-time RT-PCR (qRT-PCR) analysis revealed <i>RcCC1</i> was constitutively expressed in all tissues examined, with relative strong expression in gill, blood, kidney, spleen, and head kidney. The <i>RcCC1</i> transcripts in the head kidney, spleen, and liver were quickly up-regulated after stimulation with formalin-inactivated <i>Vibrio carchariae</i> (bacterial vaccine) or polyriboinosinic polyribocytidylic acid (poly I:C). These results indicate <i>RcCC1</i> not only plays a role in homeostasis, but also may be involved in inflammatory responses to bacterial and viral infection.	Su, Y., Guo, Z., Xu, L., Jiang, J., Wang, J., Feng, J.	Fish & Shellfish Immunology 32, 204–210	2012	Fish Health Genetics/Molecular Physiology
231	Effect of palm oil incorporation on the properties of biodegradable cobia (<i>Rachycentron canadum</i>) skin gelatin films	[The effects of incorporating palm oil (0-50%) on the biodegradable cobia skin gelatin films were determined in terms of film thickness, mechanical properties, water vapor permeability, color, light transmission properties, thermal properties, water solubility, and biodegradability. It was found that addition of oil increased film thickness, yellowness, elongation at break percentage, UV and visible light barrier properties, water solubility and biodegradability of the gelatin film. Meanwhile, the tensile strength increased at palm oil addition up to 15% and decreased afterwards. The thermal stability, which is the transition temperature and transition enthalpy, was not significantly affected by the increase concentration of palm oil incorporation. Scanning electron microscope (SEM) micrographs shows that the film without oil addition had smooth and continuous surface without porous structure while film with oil addition had irregular surface due to irregular distribution of oil droplets. This study suggested that gelatin film incorporated with 25% and 30% palm oil exhibited lowest water vapor permeability with high elongation at break percentage and medium tensile strength. Thus, incorporation of palm oil has positive effect on the cobia skin gelatin film in terms of elongation at break, water vapor permeability, light barrier properties, and biodegradability.]	Amiza, M.A., Wong, Y.P.	ums and Stabilisers for the Food Industry 16, pp. 269–277	2012	Nutrition
232	First experience in the larviculture of cobia, <i>Rachycentron canadum</i> (Linnaeus, 1752) in India	Cobia aquaculture has been gaining momentum internationally and has spread to more than 23 countries, half of them in the Asia-Pacific region. Envisaging the prospects of cobia farming in India, broodstock development was initiated and the first successful induced breeding was achieved in March 2010. Larviculture was experimented in Fibre Reinforced Plastic (FRP) tanks as well as Reinforced Cement Concrete (RCC) tanks and protocols were evolved. Green water technique employing the microalga, <i>Nannochloropsis oculata</i> was used. The critical stage for the larvae was from 5 to 9 days post-hatch (dph), when cumulative mortality reached around 90%. Enriched rotifers were fed from 3 to 10 dph and enriched <i>Artemia</i> nauplii from 9 to 18 dph. Weaning with larval inert feed was initiated from 18 dph and grading was carried out once in four days to avoid cannibalism. The study was conducted for 31 days and the final larval survival noted in the FRP and RCC tanks were 2 and 1%, respectively. At the end of the experiment, the specific growth rate of larvae in the FRP system was 30.1% of body weight per day, while the same in RCC tank was 28.3% of body weight per day. The low survival and specific growth rate of larvae in the RCC tanks could be attributed to the low densities of live feed maintained. The present experience indicated that cobia seed production can be successfully practised and by refining the methodology, the survival and growth can be enhanced to achieve commercial level fingerling production.	Gopakumar, G., Abdul Nazar, A.K., Tamilmani, G., Sakthivel, M., Kalidas, C., Ramamoorthy, N., Palanichamy, S., Ashok Maharshi, V., Srinivasa Rao, K., Syda Rao, G.	Indian Journal of Fisheries 59, 59–63	2012	Culture Hatchery
233	DHA is essential, EPA appears largely expendable, in meeting the n – 3 long-chain polyunsaturated fatty acid requirements of juvenile cobia <i>Rachycentron canadum</i>	Cobia may require both eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids to meet dietary n – 3 long-chain polyunsaturated fatty acid (LC-PUFA) demand. Growth performance is reduced when LC-PUFA-rich fish oil is replaced with soybean oil, a LC-PUFA deficient lipid, in cobia diets, but individual requirements for EPA and DHA have not been quantitatively determined. We assessed the growth performance and tissue fatty acid composition of juvenile cobia fed a fish oil-based positive control diet (FISH), a soy oil-based negative control diet (SOY), or experimental diets based on soy oil supplemented with EPA, DHA, or both at 50% or 100% of the concentrations typically observed in fish oil: (SOY + 50% EPA, SOY + 100% EPA, SOY + 50% DHA, SOY + 100% DHA, SOY + 50% BOTH, SOY + 100% BOTH). Growth performance of fish fed the SOY was impaired relative to those fed the FISH diet. Supplementing the soybean oil-based diet with DHA, alone or in combination with EPA, restored performance. EPA supplementation had no effect on growth performance. Fatty acid composition of cobia fillet, liver, brain, and eye tissues was significantly affected by diet, but tissue profile change among fish fed any of the soy oil-based diets was less overt in the brain compared to the periphery. Diets supplemented with DHA and/or EPA resulted in increased tissue levels of these fatty acids, however, the maximal levels were observed in the FISH treatment. Our data suggest the dietary n – 3 LC-PUFA requirement of juvenile cobia can be largely satisfied by DHA, and that EPA, if required, is required only in trace amounts. Soybean oil supplemented with DHA is an effective alternative to fish oil in juvenile cobia diets.	Trushenski, J., Schwarz, M., Bergman, A., Rombenso, A., Delbos, B.	Aquaculture 326–329, 81–89	2012	Fish Health Nutrition
234	Evaluation of egg quality in broodstock cobia <i>Rachycentron canadum</i> L	Twenty egg batches spawned naturally from 17 different females over two spawning seasons were used to evaluate the egg quality of cobia <i>Rachycentron canadum</i> . A reduction in egg size was observed towards the end of the spawning season for both years. The proportion of floating eggs demonstrated a positive linear relationship with both yolk-sac larval survival (r ² =0.91, P<0.05) and batch larval production (r ² =0.80, P<0.01). Viable egg batches (i.e. fertilization success >50%) were of higher batch fecundity, had larger eggs and a higher proportion of floating eggs than non-viable batches (i.e. 0% fertilization success). Also, biochemical analyses revealed that these viable eggs had significantly higher protein and amino acid contents. A multiple regression model based on the proportion of floating eggs, batch fecundity and fertilization success provided the most accurate predictions of batch larval production (r ² =0.95, P<0.001). Similarly, using the egg content of arginine/glycine and methionine significantly increased the correlation coefficient in the multiple regression model predicting larval deformity (r ² =0.92, P=0.002). This study reveals that accurate determination of egg quality in cobia can be improved using a combination of several variables rather than a single variable.	Nguyen, H.Q., Reinertsen, H., Rustad, T., Tran, T.M., Kjørsvik, E.	Aquaculture Research 43, 371–385	2012	Spawning Fish Health Culture Hatchery
235	Effects of dietary probiotic on the growth performance, non-specific immunity and disease resistance of cobia, <i>Rachycentron canadum</i>	The present study was performed to investigate the effects of a commercially available probiotic product (compound probiotic) containing <i>Bacillus subtilis</i> 7.0×10 ⁹ CFUg ⁻¹ , <i>Bacillus licheniformis</i> 3.0×10 ⁹ CFUg ⁻¹ , <i>Lactobacillus</i> spp. 5.0 ×10 ⁸ CFUg ⁻¹ and <i>Arthrobacter</i> spp. 1.0×10 ⁸ CFUg ⁻¹ on the growth performance, non-specific immunity and protection against <i>Vibrio harveyi</i> infection in cobia (<i>Rachycentron canadum</i>). Fish were fed diets containing six graded levels of compound probiotic (0.0, 1.0, 2.0, 3.0, 4.0 and 5.0gkg ⁻¹) for 8weeks. The results showed that the survival rate ranged from 81.1% to 84.4% with no significant difference among dietary treatments (P>0.05) after feeding experiment. Dietary compound probiotic significantly increased the specific growth rate (SGR), serum lysozyme, alternative complement pathway (ACP) activity, phagocytosis percentage (PP) and respiratory burst activity of head-kidney macrophages of cobia. Moreover, feeding of supplemented diets containing compound probiotic resulted in significantly lower mortality against the pathogens <i>Vibrio harveyi</i> compared with the control group. To elevate the growth and immune resistance ability of cobia, an optimal dose of dietary compound probiotic administration determined by second-order polynomial regression analysis was 3.3gkg ⁻¹ , on the basis of the SGR and mortality after challenge with <i>V. harveyi</i> .	Geng, X., Dong, X.-H., Tan, B.-P., Yang, Q.-H., Chi, S.-Y., Liu, H.-Y., Liu, X.-Q.	Aquaculture Nutrition 18, 46–55	2012	Fish Health Nutrition Microbiology
236	Effects of degree of hydrolysis on physicochemical properties of cobia (<i>Rachycentron canadum</i>) frame hydrolysate	The effect of degree of hydrolysis (DH) on the physicochemical properties of cobia frame hydrolysate was determined. Three levels of degree of hydrolysis of cobia frame hydrolysate were studied, which were 53%, 71% and 96%. After enzymatic hydrolysis using Alcalase®, the samples were spray-dried. Cobia hydrolysate powder samples were analyzed for their proximate analysis and physicochemical properties. The proximate analysis showed significant differences in fat and ash content only. DH96 hydrolysate showed desirable essential amino acid profile for human requirement except for methionine and isoleucine. The study found that cobia frame hydrolysate had good colour, emulsifying capacity and excellent foaming properties. However, there were no significant differences in water-holding capacity, oil-holding capacity and peptide solubility among the hydrolysate samples. This study suggested that cobia frame hydrolysate is a potential ingredient and foaming agent for food industry.	Amiza, M.A., Kong, Y.L., Faazaz, A.L.	International Food Research Journal 19, 199–206	2012	Nutrition
237	Acute toxicity of ammonia on juvenile cobia (<i>Rachycentron canadum</i> , Linnaeus, 1766) according to the salinity	Juvenile cobia (<i>Rachycentron canadum</i>) (total length 15.16 ± 0.92 cm and weight 19.26 ± 4.5 g) were exposed to different concentrations of ammonia-N (unionized plus ionized ammonia as nitrogen), using the static renewal method at different salinity levels of 5, 20, and 35‰ at pH 8.1 and 25°C. The 24, 48, 72, 96 h LC50 values of ammonia-N for <i>R. canadum</i> juveniles were 60.28, 48.57, 37.42, 22.73 mg l ⁻¹ at 35‰; 51.25, 43.63, 28.17, 19.05 mg l ⁻¹ at 20‰; and 39.48, 25.31, 19.50, 8.13 mg l ⁻¹ at 5‰, respectively. The 24, 48, 72, 96 h LC50 values of NH ₃ -N (unionized ammonia as nitrogen) were 1.81, 1.46, 1.12, and 0.68 mg l ⁻¹ at 35‰; 1.75, 1.49, 0.96, and 0.65 mg l ⁻¹ at 20‰; and 1.52, 0.97, 0.71, and 0.31 mg l ⁻¹ at 5‰, respectively. As the salinity decreased from 35 to 5‰, susceptibility of ammonia-N increased by 34.5, 47.88, 50.56, and 64.23% after 24, 48, 72, and 96 h exposure, respectively. Furthermore, we found that exposure of fish to ammonia-N caused an increase in oxygen consumption of 129.1, 157.5, and 192% and a decrease in the ammonia excretion level of 53.4, 38.2, and 23.3% with respect to the control.	Barbieri, E., Doi, S.A.	Aquaculture International 20, 373–382	2012	Fish Health Water Quality RAS Physiology

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
238	Textural and biochemical properties of cobia (<i>Rachycentron canadum</i>) sashimi tenderised with the ultrasonic water bath	The present study investigated the tenderisation effects ultrasound processing (UT) on farmed cobia sashimi. Age-treated cobia trunk muscles (AT) were used as the control. The pH, total volatile base nitrogen, trimethylamine nitrogen, thiobarbituric acid reactive substances, ATP catabolism components, K1 value, and texture were evaluated. The texture of AT sashimi reached the optimal firmness range with 8.53 N at day 7. However, AT samples could not be served raw after day 7 because of their poor freshness indexes, including a TVBN value of 18.53 g/100 g, a TMAN value of 3.25 mg/100 g, and a TBARS value 0.983 MDA mg/100 g. Moreover, the K1 value of AT sashimi was 20.21% at day 5. UT was employed to efficiently tenderise cobia sashimi with an initial firmness of 9.70–7.82 N after 90 min of treatment. The results of this study indicate that UT accelerates the biochemical reaction rate, as evidenced by the increases in the TVBN, TMAN, and TBARS contents; however, these values were very low. The results of this study could provide basic information for the development of a novel ultrasonic tenderisation technique in raw seafood designed for restaurants and consumers.	Chang, H., Wong, R.	Food Chemistry 132, 1340–1345	2012	Nutrition
239	Effect of dietary vitamin C on the growth performance and innate immunity of juvenile cobia (<i>Rachycentron canadum</i>)	This study was conducted to evaluate the effects of dietary vitamin C on growth performance, hematologic parameters and innate immune responses in juvenile cobia, <i>Rachycentron canadum</i> . Seven practical diets were formulated to contain 0.0 (as the basal diet), 13.6, 27.2, 54.4, 96.6, 193.4 and 386.5 mg ascorbic acid equivalent kg ⁻¹ diet. Each diet was fed to triplicate groups of juvenile cobia with initial body weight of 5.5 g in 500-L cylindrical fiberglass tank. The results of 8 weeks feeding trial showed that typical vitamin C-deficient signs such as spinal deformation and body nigrescence were observed in the fish fed the basal diet. Fish fed the basal diet had significantly lower weight gain, specific growth rate (SGR), protein efficiency ratio (PER) and feed efficiency (FE) than those fed the diets supplemented with vitamin C, but no significant differences were observed among diets supplemented with vitamin C. However, survival rate was significantly affected by the dietary vitamin C levels, fish fed the basal diet had lower survival rate than those fed the diets supplemented with vitamin C. The ascorbic acid concentration in liver was correlated positively with the dietary vitamin C levels, however, the thiobarbituric acid reactive substances (TBARS) concentrations in liver was not significantly affected by the dietary vitamin C levels, although, fish fed the basal diet had the highest TBARS values among all treatments. The activities of serum lysozyme, superoxide dismutase (SOD), alkaline phosphatase (AKP) and total immunoglobulin (Ig) were significantly influenced by the dietary vitamin C levels, fish fed the basal diet had lower lysozyme, SOD, AKP and total Ig than those fed diets supplemented with vitamin C. The serum glucose and triglyceride concentrations were significantly affected by the dietary vitamin C levels. Fish fed the basal diet had lower red blood cell and hemoglobin values than those fed the vitamin C supplemented diets. The challenge experiment with <i>Vibrio harveyi</i> showed that lower cumulative survival was in fish fed the unsupplemented diet, the cumulative survival were significantly increased with increase of the dietary ascorbic acid levels from 13.6 to 96.6 mg kg ⁻¹ , while the cumulative survival reached plateau when dietary ascorbic acid levels increased from 96.6 to 386.5 mg kg ⁻¹ . These results indicated that dietary vitamin C did significantly influence on growth performance and immune response of juvenile cobia.	Zhou, Q., Wang, L., Wang, H., Xie, F., Wang, T.	Fish & Shellfish Immunology 32, 969–975	2012	Fish Health Nutrition
240	Environmentally conditioned, year-round volitional spawning of cobia (<i>Rachycentron canadum</i>) in broodstock maturation systems	Year-round control of the spawning cycle of cobia (<i>Rachycentron canadum</i>) has been established by using water temperature manipulation. To compare the effectiveness of using this method to induce volitional spawning in cobia, two 80 m ³ recirculating aquaculture systems (RAS) were used. Temperatures in one of the maturation tanks ("Mat 1") were maintained between 27 and 29°C for 12 months of the 15.5-month study period. Temperatures in the second maturation tank ("Mat 2") were allowed to fluctuate naturally throughout the year and ranged from 20 to 32°C. A total of 101 spawning events occurred in the tanks between the spring of 2008 and the summer of 2009 (3 April 2008 to 17 June 2009). Of the 38 total spawning events in Mat 1, 17 of them (44.7% of all Mat 1 spawning events) occurred during the off-season (fall and winter). The egg viability rates did not differ significantly ($P > 0.05$) between on- and off-season spawns in Mat 1. Conversely, cobia broodstock exposed to natural water temperatures (no environmental manipulation) in Mat 2 followed the natural pattern of warm water (>26°C) dependence, limiting egg production to spring and summer seasons. This method of water temperature manipulation allows for effective control of the cobia reproductive cycle without compromising egg viability.	Stieglitz, J.D., Benetti, D.D., Hoenig, R.H., Sardenberg, B., Welch, A.W., Miralao, S.	Aquaculture Research 43, 1557–1566	2012	Spawning Hatchery Culture
241	First record of <i>Tuxophorus caligodes</i> (Siphonostomatoida, Tuxophoridae) in sea-farmed cobia, <i>Rachycentron canadum</i> , in Brazil	The cobia is the only representative of the Rachycentridae family and, because of its zootechnical qualities, production of this fish has been implemented in several countries, such as the United States, Mexico and Brazil. <i>Tuxophorus caligodes</i> is a widespread parasite of marine fish worldwide. For the present report, 15 juvenile cobias were collected from net cages on a fish farm in Ilhabela, state of São Paulo, Brazil, in the winter of 2011. The fish were sacrificed by means of cerebral concussion, and then weighed (280 ± 70.5 g) and measured (27 ± 1.97 cm). After external examination under a stereomicroscope, ectoparasites present on the body surface were collected, fixed and processed for identification. Out of the 15 fish examined, two were parasitized with <i>Tuxophorus caligodes</i> , thus indicating a prevalence of 13.3%. This is the first report of <i>Tuxophorus caligodes</i> in cobias in Brazil.	Da Silva, A.C., de Moraes, J. R.E., Antonucci, A.M., Shimada, M.T., Takemoto, R.M., Filho, J.R.E., de Moraes, F.R.	Revista Brasileira de Parasitologia Veterinaria 21, 421–423	2012	Cage Culture Fish Health Parasites Microbiology
242	Optimizing transport of live juvenile cobia (<i>Rachycentron canadum</i>): Effects of salinity and shipping biomass	Live juvenile cobia (<i>Rachycentron canadum</i>) transport methods were examined to determine opportunities for increasing packing density in closed containers for durations up to 24 h. Juvenile cobia (27 to 46 days post-hatch (dph)) were tested for salinity tolerance via abrupt transfer from 35 ppt salinity water to salinities ranging from 0 ppt to 55 ppt. Results indicated 100% survival at 24 h post-transfer at salinities between 11 ppt and 45 ppt. Using two different salinities within the range tested in the tolerance trials (12 ppt and 32 ppt), a 24 h simulated shipping trial was conducted comparing final survival between the two salinities at each of four packing densities (5 kg/m ³ , 10 kg/m ³ , 15 kg/m ³ , and 20 kg/m ³). At packing densities above 10 kg/m ³ , survival was significantly enhanced at 12 ppt relative to rates in the higher salinity (32 ppt) treatments. Additionally, there were no apparent effects on post-transport aquaculture performance of the fish shipped at high densities in reduced salinity water. Results of this study suggest that cobia fingerling producers can optimize their current shipping methods and protocols by increasing stocking densities in closed containers, allowing for reductions in labor, material, and mass-dependent transport costs.	Stieglitz, J.D., Benetti, D.D., Serafy, J.E.	Aquaculture 364–365, 293–297	2012	Fish Health Commercial
243	Changes of fatty acid profiles in filets of Cobia (<i>Rachycentron canadum</i>) during frozen storage	In this study changes in fatty acids profile during frozen storage at -18°C of Cobia (<i>Rachycentron canadum</i>), caught from the Persian Gulf (Bandar Abbas) were studied. Changes in saturated fatty acids (SFAs), monounsaturated fatty acids (MUFAs), polyunsaturated fatty acids (PUFAs), EPA+DHA/C16, n-3 PUFA/n-6 PUFA (n-3/n-6) and polyunsaturated fatty acids /saturated fatty acids (PUFA/SFA) were investigated during a six-month storage at -18°C. Eighteen fatty acids were found in Cobia, with higher percentage of saturated fatty acids (46.07%), monounsaturated fatty acids (33.72%) and polyunsaturated fatty acids (15.44%). The MUFAs and PUFAs reduced from 33.72 to 26.26% and 15.44 to 10.78%, respectively. Palmitic acid (C16:0, 27.42% of total fatty acids) and stearic acid (C18:0, 12.62%) were the dominant saturated fatty acids. The major unsaturated fatty acids were determined as docosahexaenoic acid (C22:6n3, 5.76%), oleic acid (C18:1n9, 25.76%) and linoleic acid (C18:2n6, 4.38%). As a result of the frozen storage (up to 6 months), marked content decreases were found in fatty acid groups such as monounsaturated, polyunsaturated and n-3 polyunsaturated, as well as in the n-3/n-6 ratio and it means that the nutritional value of Cobia has decreased.	Taheri, S., Motalebi, A.A., Fazlara, A., Aghababayan, A., Aftabsavar, Y.	Iranian Journal of Fisheries Sciences 11, 204–213	2012	Nutrition
244	Inshore spawning of cobia (<i>Rachycentron canadum</i>) in South Carolina	We documented inshore spawning of the recreationally important cobia (<i>Rachycentron canadum</i>) in Port Royal Sound (PRS) and St. Helena Sound (SHS), South Carolina, during the period from April to June in both 2007 and 2008. Histological analysis of ovaries confirmed the presence of actively spawning females inshore, and gonadosomatic index (GSI) values from females collected inshore (mean=7.8) were higher than the values from females caught offshore (mean=5.6); both of these mean values indicate that spawning occurred locally. Additionally, we conducted an ichthyoplankton survey in 2008 and found cobia eggs and larvae as far as 10 and 15 km inshore from the mouths of SHS and PRS, respectively. A study of egg development that we conducted in 2007 and 2008 using hatchery-reared cobia eggs provided descriptions of embryological development of cobia. Comparison of visual and quantitative characteristics of the field-collected eggs with those of the hatchery-reared eggs allowed positive identification of eggs collected in plankton samples. The ages of field-collected eggs and presence of females with hydrated oocytes in PRS and SHS observed in our ichthyoplankton survey and histological analysis indicated that wild cobia spawn in the afternoon and early evening. The inshore migration of cobia from April to June, the presence of actively spawning females, significantly higher GSI values, and the collection of eggs inside PRS and SHS all confirm that these estuaries provide spawning habitat for cobia. Because of the potential for heavy exploitation by recreational anglers as cobia move inshore to spawn in South Carolina, current management strategies may require review.	Lefebvre, L.S., Denson, M.R.	Fishery Bulletin 110, 397–412	2012	Spawning Wild (Atlantic/Pacific)
245	Antioxidant effect of ascorbic acid on the quality of cobia (<i>Rachycentron canadum</i>) filets during frozen storage	The effect of aqueous solutions of ascorbic acid (AA) on the rancidity development in Cobia (<i>Rachycentron canadum</i>) filets during frozen storage was studied. Cobia filets were treated with ascorbic acid (AA 0.25% and AA 0.5%) then stored at -18°C up to 6 months. Rancidity development was measured by several biochemical indices including free fatty acids (FFA), peroxide value (PV), and thiobarbituric acid (TBA) and complemented by the sensory analysis (odor, consistency and appearance). In addition, pH and expressible moisture (EM) were measured during 6 months storage. Proximate composition was also determined in the first day. TBA, PV and FFA levels increased on all treatments due to lipid oxidation. Ascorbic acid showed antioxidative effect on Cobia filets during frozen storage as indicated by TBA, PV and FFA levels. Results showed that free fatty acid, primary and secondary oxidation products, EM and pH value of AA-treated samples were significantly lower than those of the control samples ($P < 0.05$). A gradual decrease ($P < 0.05$) in sensory analysis were observed as the storage time increased. Results of our investigation revealed that ascorbic acid retarded oxidative changes in frozen Cobia filets whereas AA 0.25% was not as effective as AA 0.5% on oxidative stability. Best oxidation inhibition results on fish filets were obtained when employing a 0.5% AA solution.	Taheri, S., Motalebi, A.A., Fazlara, A.	Iranian Journal of Fisheries Sciences 11, 666–680	2012	Nutrition
246	Immunomodulatory response of mice Splenocytes Induced by RcaL, a lectin isolated from cobia fish (<i>Rachycentron canadum</i>) Serum	This work reports the isolation of a serum lectin from cobia fish (<i>Rachycentron canadum</i>) named RcaL. Immunomodulatory activity on mice splenocyte experimental cultures through cytotoxic assays and cytokine production were also performed. RcaL was obtained through precipitation with ammonium sulphate and affinity chromatography on a Concanavalin A-Sepharose 4B column. The ammonium sulphate fraction F3 showed the highest specific hemagglutinating activity and was applied to affinity chromatography. The lectin was eluted with methyl- α -D-mannopyranoside. RcaL showed highest affinity for methyl- α -D-mannopyranoside and D-mannose; eluted fractions of RcaL agglutinated rabbit erythrocytes (titre, 128–1) retained 66 % of chromatographed lectin activity, and the obtained purification factor was 1.14. Under reducing conditions, a polypeptide band of 19.2 kDa was revealed in sodium dodecyl sulphate polyacrylamide gel electrophoresis (PAGE). PAGE confirmed RcaL as an acidic protein revealed in a single band. Cytotoxic and immunomodulatory assays with RcaL in mice splenocyte cultures showed that the lectin was not cytotoxic and induced higher interferon gamma and nitric oxide production in splenocyte cultures. Purified RcaL induced preferential Th1 response, suggesting that it acts as an immunomodulatory compound.	Coriolano, M.C., Silva, C.D. C. da Melo, C.M.L. de, Bezerra, R. de S., Santos, A. J.G., Pereira, V.R.A., Coelho, L.C.B.B.	Applied Biochemistry and Biotechnology 168, 1335–1348	2012	Genetics/Molecular
247	Effects of dietary rapeseed meal on growth performance, digestion and protein metabolism in relation to gene expression of juvenile cobia (<i>Rachycentron canadum</i>)	A 60-day feeding trial in seawater floating cages (1.5 × 1.5 × 2.5 m) was conducted to investigate the effects of dietary rapeseed meal (RM) levels on feed intake, growth, survival, digestion and protein metabolism in relation to gene expression of juvenile cobia (initial body weight 94.6 g). Five isonitrogenous (crude protein 450 g kg ⁻¹ of dry matter) and isoenergetic (20 kJ g ⁻¹) practical diets were formulated by replacing 0 (the control), 125, 250, 375 and 500 g kg ⁻¹ fish meal protein with RM protein. Each diet was randomly fed to triplicate groups of fish, and each cage was stocked with 20 fish. Fish were fed twice daily (06:00 and 18:00) to apparent satiation. The survival ranged from 96.7 to 98.3%, and no significant difference was observed among dietary treatments ($P > 0.05$). With increasing dietary RM levels, feed intake (FI), specific growth rate (SGR) and feed efficiency (FE) decreased. Fish fed the diet with 250 g kg ⁻¹ or more protein from RM had significantly lower SGR and FE than the control group ($P < 0.05$), but there was no significant difference in FI at this level compared with the control group ($P > 0.05$). Apparent digestibility coefficients (ADCs) of dry matter (DM), crude protein and energy significantly decreased with increasing dietary RM levels ($P < 0.05$). Fish fed the diet with 250 g kg ⁻¹ or more protein from RM had significantly lower ADC values of crude protein and energy compared with the control group ($P < 0.05$). Whole-body crude protein and crude lipid decreased with increasing dietary RM levels. Fish fed the diet with 500 g kg ⁻¹ protein from RM had significantly lower whole-body crude protein and crude lipid compared with the control group ($P < 0.05$). However, whole-body moisture and ash showed opposite trends with crude protein and crude lipid. Moisture, crude protein and crude lipid contents in cobia muscle showed similar trends with those in whole body. There were no significant differences in plasma ammonia, urea, cholesterol and amino acids among fish fed the experimental diets ($P > 0.05$). Fish fed the diet with 500 g kg ⁻¹ protein from RM had significantly lower aspartate aminotransferase (AST) activity in liver than the control group ($P < 0.05$). Hepatic insulin-like growth factor I (IGF-I) gene expression level was significantly decreased in fish fed the diet with 500 g kg ⁻¹ protein from RM compared with the control group ($P < 0.05$). However, IGF-I gene expression level in dorsal muscle was significantly increased in fish fed this diet compared with the control group ($P < 0.05$). No significant differences were observed in target of rapamycin (TOR) expression levels in cobia liver and dorsal muscle at different RM levels ($P > 0.05$). Results of the present study indicated that protein from RM could substitute 125 g kg ⁻¹ fish meal protein without influencing the growth, feed utilization and protein metabolism in cobia. The higher substitution levels of RM induced negative influences on feed intake, growth and hepatic IGF-I expression level.	Luo, Y., Ai, Q., Mai, K., Zhang, W., Xu, W., Zhang, Y.	Aquaculture 368–369, 109–116	2012	Fish Health Nutrition Cage Culture
248	Structure and characteristics of acid and pepsin-solubilized collagens from the skin of cobia (<i>Rachycentron canadum</i>)	Acid-solubilized collagen (ASC) and pepsin-solubilized collagen (PSC) were extracted from the skin of cobia (<i>Rachycentron canadum</i>). The yields of ASC and PSC were 35.5% and 12.3%, respectively. Based on the protein patterns and carboxymethyl-cellulose chromatography, ASC and PSC were composed of α 1 α 2 α 3 heterotrimers and were characterised as type I collagen with no disulfide bond. Their amounts of imino acids were 203 and 191 residues per 1000 residues, respectively. LC–MS/MS analysis demonstrated the high sequences similarities of ASC and PSC. Fourier transform infrared spectroscopy spectra showed that the amide I, II and III peaks of PSC were obtained at a lower wave number compared with ASC. The thermal denaturation temperatures of ASC and PSC, as measured by viscometry, were 34.62 and 33.97 °C, respectively. The transition temperatures (T _{max}) were 38.17 and 36.03 °C, respectively, as determined by differential scanning calorimetry (DSC). Both collagens were soluble at acidic pH and below 2% (w/v) NaCl concentration.	Zeng, S., Yin, J., Yang, S., Zhang, C., Yang, P., Wu, W.	Food Chemistry 135, 1975–1984	2012	Genetics/Molecular

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
249	Fishery and diet composition of the cobia <i>Rachycentron canadum</i> (Linnaeus, 1766) exploited along Karnataka coast	The fishery and food of cobia, <i>Rachycentron canadum</i> caught off Karnataka, south-west coast of India was studied during 2007-2010. An estimated 302 t was landed annually along this coast which formed 0.1% of the total fish catch of the region. Peak landings were recorded during October followed by April. Gillnets landed large sized cobia and contributed to the bulk of the catch (53%). Maximum catch by this gear was during September-October. Next dominant gear was trawl which landed fishes of all size groups with maximum catch during April-May. Trawl landings contributed 45% of the total cobia landings. The fishery was comprised of fishes of length range 26 - 125 cm TL with the mean at 58 cm. Juveniles dominated the catch. Contents of 177 non-empty stomachs were analysed for the index of relative importance (IRI) and prey specific abundance (PSA). <i>R. canadum</i> was found to be nonselective generalist carnivore feeder, foraging on micronektonic pelagic or benthic organisms (crustaceans, fish and molluscs) available in the epipelagic waters. Teleost fish (55%), crustaceans (35%) and molluscs (10%) contributed to the diet. <i>Decapterus russelli</i> (18.0%) and <i>Encrasicholina devisi</i> (10.0%) were the dominant finfish groups; <i>Acetes</i> sp. (21.1%) followed by crabs (<i>Charybdis</i> spp. and <i>Portunus</i> spp.) with an IRI of 12.9% were dominant among crustaceans and squids (<i>Loligo</i> spp.) (5.8%) and octopus (4.1%) comprised the dominant molluscans prey items.	Rohit, P., Bhat, U.S.	Indian Journal of Fisheries 59, 61–65	2012	Wild (Atlantic/Pacific)
250	<i>Rachycentron canadum</i> (cobia) lectin promoted mitogenic response in mice BALB/c Splenocytes	The mitogenic lectins are invaluable tools to study the biochemical changes associated with lymphocyte activation and proliferation of various immune cells. <i>Rachycentron canadum</i> lectin (RcaL) was detected and purified from serum of cobia fish. The aim of this study was to evaluate the proliferative response and cytokine production in splenocytes of mice in vitro stimulated with RcaL lectin; Canavalia ensiformis lectin (Con A) was used as positive control. A high proliferation index was induced by RcaL in relation to control cells. Furthermore, RcaL induced higher IL-2 and IL-6 production in relation to control. The cell viability was 90% in splenocytes treated with RcaL lectin, but RcaL promoted significant late apoptosis after 24 and 48 h in relation to control. RcaL induced proliferative responses suggesting that this lectin can be used as a mitogenic agent in immunostimulatory assays.	Coriolano, M.C., Melo, C.M. L., Santos, A.J.G., Pereira, V. R.A., Coelho, L.C.B.B.	Scandinavian Journal of Immunology 76, 567–572	2012	Genetics/Molecular
251	Population dynamics of cobia <i>Rachycentron canadum</i> (Linnaeus, 1766) off Cochin coast, south-eastern Arabian Sea	Estimated landings of cobia from the Indian EEZ by the commercial fishing vessels are mostly as bycatch in hooks and line cum gillnet and trawl nets. However, the catches are substantial compared to that reported in several other countries of Asia. The species is also gaining considerable importance as a favoured candidate species for sea farming using cages. Very little is known about the fishery and biological characters such as maturation, fecundity and feeding preferences of cobia in Indian seas. Study indicated a fast growth rate with estimates of $L_{\infty} = 184$ cm (FL) and $K = 2.6$ (yr ⁻¹) in cobia. The total mortality rate (Z) was estimated as 5.18, natural mortality (M) was 2.01 and fishing mortality (F) was 3.17 with an exploitation rate (E) of 0.61. The length at first capture (LC50) estimated from the catch curve was 72 cm. Fecundity was found to be high and variable, with mean fecundity estimated as 12,37,545 eggs with a coefficient of variation (CV) of 16.7. As inferred from the oocyte development pattern, spawning activity is brief and fish is classified as synchronous ovulatory type. The growth parameters and condition factor estimated in this study indicate that relatively high growth rates are also possible in wild stocks considering that food is abundant and the environmental temperature is in the optimum range. Feeding preferences indicated balistid fish and shrimps with a wide variety of food items including finfishes, crustaceans and molluscs present.	Ganga, U., Pillai, N.G.K., Akhilesh, K.V., Rajool Shanis, C.P., Beni, N., Manjibrayakath, H., Prakasan, D.	Indian Journal of Fisheries 59, 15–20	2012	Wild (Atlantic/Pacific)
252	Population genetics of cobia (<i>Rachycentron canadum</i>) in the Gulf of Thailand and Andaman Sea: Fisheries management implications	Population genetics has been recognized as a key component of policy development for fisheries and conservation management and aquaculture development. This study aims to evaluate the genetic diversity and population structure of native cobia (<i>Rachycentron canadum</i>) in the Gulf of Thailand and Andaman Sea, establishing the existing population distributions and contributing information to aid in the development of policy, prior to extensive aquaculture development. Microsatellite analysis of natural cobia populations in these two ocean basins shows similar levels of gene diversity at 0.844 and 0.837, respectively. All populations and almost all microsatellite loci studied show significant heterozygote deficiency. Genetic differentiation between local populations is low and mostly not significant ($R_{ST} = -0.0109$ to 0.0066). The population shows no marked structure over the long geographic barrier of the Thai–Malay peninsula, either when analyzed using pairwise genetic differences or evaluated without predefined populations using STRUCTURE. Additionally, a Mantel test shows no evidence of isolation by distance between the population samples. The significant heterozygote deficiency at most of the loci studied could be explained by the possibility of null alleles. Alternatively, given the behavior of forming small spawning aggregations, seasonal migration, and hitchhiking on large marine animals, the population genetics could be complex. The population of cobia at each location in Thai waters may be inbred, as a result of breeding between relatives, which would reduce heterozygosity relative to Hardy–Weinberg frequencies, while some of these populations could be making long distance migrations followed by admixture between resident and transient groups. This migration would cause population homogeneity in allele frequencies on a larger geographic scale. The results suggest that fisheries management for this species should be considered at both national and international levels, and until the possibility of local adaptation is fully investigated, policy development should apply the precautionary principle to ensure the preservation of genetic diversity and the sustainability of local and regional fisheries.	Phinchongsakuldit, J., Chaipakdee, P., Collins, J.F., Jaroensutasinee, M., Brookfield, J.F.Y.	Aquaculture International 21, 197–217	2012	Genetics/Molecular Wild (Atlantic/Pacific)
253	Embryonic development of cobia, <i>Rachycentron canadum</i> (Linnaeus,1766) in controlled conditions	Cobia, <i>Rachycentron canadum</i> has emerged as a global species for aquaculture in the recent past. Even though seed production of cobia is being practiced at many tropical countries, there is very little information on the embryonic development of the species. The details of fertilized eggs, cleavage, embryonic phases and newly hatched larva are documented with photographs. The experiments were carried out at a temperature range of 28.5-30°C. The average diameter of the freshly spawned eggs ranged from 1.1 to 1.2 mm. The time of different stages of development after fertilization is provided. The larva hatched out after 22 hours of fertilization. The total length of the larvae ranged from 2.2 to 2.7 mm. The newly hatched larva was without mouth opening and with a prominent oil globule. The description given in the paper can be made use of in the larval production of cobia in hatcheries.	Sakthivel, M., Nazar, A.K.A., Tamilmani, G., Kalidas, C., Ramamoorthy, N., Maharshi, V.A., Rao, K.S., Gopakumar, G.	Journal of the Marine Biological Association of India 54, 29–32	2012	Spawning Culture Hatchery
254	Chemical and electrical approaches to sedation of cobia: Induction, recovery, and physiological responses to sedation	To support the growing interest in marine fisheries research in areas such as biotelemetry, tagging, and tracking, we assessed the ability of various sedatives to facilitate this research in juvenile cobias <i>Rachycentron canadum</i> (~300 g), namely, tricaine methanesulfonate (MS-222; 150 mg/L), carbon dioxide (CO ₂ ; ~750 mg/L), eugenol (60 mg/L), benzocaine (150 mg/L), and pulsed-DC electrosedation (100 V, 30 Hz, 25% duty cycle, 5-s exposure). Induction times (CO ₂ [z] > benzocaine [y] > eugenol [y] > MS-222 [y] > electrosedation [x]), recovery of equilibrium (CO ₂ [z] > eugenol [z] > MS-222 [y] > benzocaine [y] > electrosedation [x]), and responsiveness to tactile stimulus (eugenol [z] > MS-222 [y] > benzocaine [y] > CO ₂ [xy] > electrosedation [x]) differed significantly among the sedative treatments (treatments with the same letters are not significantly different). Total handling time from initial sedative exposure to recovery differed among the sedatives as well (CO ₂ [z] > eugenol [y] > benzocaine [x] > MS-222 [x] > electrosedation [w]), with cumulative means ± SEs of 5.9 ± 0.2 min for CO ₂ , 4.1 ± 0.2 for eugenol, 2.7 ± 0.2 min for benzocaine and MS-222, and 1.0 ± 0.2 min for electrosedation. Physiological responses differed significantly over time, with transient increases in plasma cortisol, glucose, osmolality, and lactate that were resolved within 6 h. The overall magnitude of the physiological responses differed among sedatives, depending on the response variable; however, in each case, CO ₂ elicited the greatest response. Although variations in induction and recovery times were observed, it is likely that these differences can be reasonably accommodated within the context of typical research by adjusting the sedative treatments or allowing for longer induction and recovery times as needed.	Trushenski, J.T., Bowzer, J. C., Bowker, J.D., Schwarz, M.H.	Marine and Coastal Fisheries 4, 639–650	2012	Fish Health Culture Physiology
255	Pepsin ontogeny and stomach development in larval cobia	The appearance of stomach pepsin activity in teleosts is one of the last ontogenetic events during the larval stages, and typically marks the completion of the shift from intracellular to extracellular mode of digestion. The present trial describes the morphological and functional ontogeny of cobia's stomach. Larvae were reared in a recirculated system and fed enriched rotifers in green water, followed by enriched <i>Artemia</i> , prior to being weaned on an artificial diet 25 days-post-hatch (dph). The stomach commenced differentiation at 6 dph, and displayed numerous gastric glands by 16 dph (11.1 mm TL). However, pepsin-like activity was not detectable prior to 22 dph (20.8 mm TL, $P < 0.05$), denoting a lack of functionality until this time point. Maximum pepsin-like activity reached 29.09 ± 1.47 UHb larvae ⁻¹ . Together with the observations of others, the results presented herein shed light on the ontogeny of proteolytic digestion in cobia.	Salze, G., McLean, E., Craig, S.R.	Aquaculture 324–325, 315–318	2012	Fish Health Culture Hatchery RAS Physiology
256	Quality and safety of fish curry processed by sous vide cook chilled and hot filled technology process during refrigerated storage	Fish curry, a traditional Indian dish was prepared from farmed fish Cobia (<i>Rachycentron canadum</i>), packaged by two different cook-chill processes namely, sous vide cook chilled and hot filled technology and held at 2 °C. Biochemical composition revealed that fish curry contained 5% protein and 6% fat. Omega-3 fatty acids, eicosapentaenoic acid (EPA) retained 55.44% while docosahexaenoic acid (DHA) retained 29% during cook-chilling process. The major fatty acids in fish curry were C18:2, C12:0, C16:0 and C18:1. Shelf-life of sous vide cook chilled and hot filled technology processed fish curry were 8 and 12 weeks, respectively. Total bacterial counts were detected after 4 weeks and 12 weeks in sous vide cook chilled and hot filled technology processes, respectively. Total staphylococci were detected in sous vide cook chilled and hot filled technology processed cobia fish curry after 4 and 12 weeks, respectively. Total bacilli, anaerobic sulfite reducing clostridia, <i>Salmonella</i> , and lactic acid bacteria were absent. Hot filled technology process was more efficient and could be applied for chilled fish curry preservation for 12 weeks without any safety problems.	Shakila, R.J., Raj, B.E., Felix, N.	Food Science and Technology International 18, 261–269	2012	Nutrition Food Safety
257	Fibre optic fluorescence spectroscopy for monitoring fish freshness	In this study, a portable Y-type fibreoptic fluorescence spectroscopy measurement system was used to evaluate the freshness of eight cobias (<i>Rachycentron canadum</i>). The results showed that the ratio of fluorescent intensity, which $F_{480\text{ nm}/F_{\text{exci}+50\text{ nm}}}$ was along with the range of collagen type I and type V characteristic spectra, was positive correlated to the frozen time by hours. It was a strong approach to be a potential index for differentiating the fish freshness during delivery process. Besides, the different pattern results of dorsum and abdomen were shown in this study. In further, fibreoptic fluorescence spectroscopy could be a way not only to measure and quantify the freshness of different fish body but also to verify the level of taste.	Wu, C.-W., Hsiao, T.-C., Chu, S.-C., Hu, H.-H., Chen, J.-C.	Presented at the Progress in Biomedical Optics and Imaging - Proceedings of SPIE	2012	Nutrition Food Safety
258	An NMR-based metabolomic assessment of cultured cobia health in response to dietary manipulation	Commercial aquaculture feeds rely heavily on fishmeal and fish oil, which can be expensive and ecologically unsustainable. To evaluate the efficacy of reduced fishmeal diets for outgrowth, a dietary study was conducted on the finfish cobia, <i>Rachycentron canadum</i> . NMR-based metabolomic techniques were used to assess the effect of decreasing dietary fishmeal on the health of the cobia. Filtered serum 1H NMR spectra analysed by principal components analysis (PCA) showed cobia fed reduced fishmeal diets were metabolically different than cobia on control diets. In particular, tyrosine and betaine increased in cobia fed reduced fishmeal diets while glucose decreased, suggesting that these cobia were not receiving the necessary nutritional components required for energy and growth. The formulated control diet contributed to enriched growth and significantly elevated lactate levels suggesting enhanced gut microflora metabolism in response to dietary components. The results show that NMR-based metabolomic analysis is a useful tool in aquaculture studies.	Schock, T.B., Newton, S., Brenkert, K., Leffler, J., Bearden, D.W.	Food Chemistry 133, 90–101	2012	Fish Health Nutrition Culture Moleculare/Genetics
259	Dietary taurine enhances growth and digestive enzyme activities in larval cobia	The establishment of a commercial cobia aquaculture is hampered by high mortality rates (> 90%) during the larval rearing. Dietary taurine supplementation has been reported to greatly improve survival rates; however, nutritional role of taurine remains poorly understood in fish. The purpose of this trial was to study the effect of taurine supplementation on growth, amylase, lipase, trypsin, and pepsin-like activities during larval cobia development and weaning. Taurine was delivered using bioencapsulation techniques wherein rotifer and <i>Artemia</i> nauplii were co-enriched with 4 g taurine L ⁻¹ d ⁻¹ . At first feeding (3 dph), amylase and trypsin activities were detectable while lipase and pepsin-like activities were not. On a per-larvae basis and regardless of taurine supplementation, enzymatic onset commenced around 16 dph, except for pepsin. However, taurine-supplemented larvae had higher specific trypsin and amylase activities prior to 16 dph. Lipase specific activity was significantly increased only at 11 and 22 dph. Pepsin-like activity remained undetectable until 22 dph, at which point the specific activity was higher ($P < 0.05$) in taurine-supplemented larvae. Overall, specific enzyme activities of control larvae were low during the first half of the larval period (3–16 dph) but increased during the second half (17–27 dph). Specific activities of taurine-supplemented larvae showed the opposite trend. Together with previous work, the present data strongly indicate that taurine is an essential nutrient for cobia larvae. Taurine supplementation does not affect the onset of total enzyme activities, but does increase specific amylase and trypsin activities in early larval stages. These heightened enzymatic activities may lead to enhanced nutrient availability, thus providing some explanation to the improved development, growth, and survival rates observed in taurine-supplemented larvae.	Salze, G., McLean, E., Craig, S.R.	Aquaculture, Smolt 2009: Proceedings of the 8th International Workshop on Smoltification	2012	Fish Health Hatchery Culture Nutrition
260	Quality changes of farmed cobia steaks held in cold stores (–18 °C)	Cobia (<i>Rachycentron canadum</i>) steaks held in cold store (–18 °C) were analysed aseptically in triplicates for the sensory, total aerobic bacterial count, proximate composition, pH, thiobarbituric acid-reactive substance (TBA- RS), formaldehyde, total volatile base nitrogen (TVB- N), trimethyl amine-nitrogen (TMA- N), salt soluble nitrogen (SSN), nonprotein nitrogen (NPN), sodium dodecyl sulphate-poly acrylamide gel electrophoresis (SDS- PAGE) pattern. Steaks were sensorially acceptable up to 5 months of storage and the total bacterial counts did not exceed 6 log CFU counts. There were no significant changes in the pH values. TBA- RS values increased significantly ($P < 0.05$) and reached 7.34 mg of malonaldehyde kg ⁻¹ fat at the end. Formaldehyde content remained constant upto 4th month and later increased to 2.06 µg g ⁻¹ ($P < 0.05$). TVB- N and TMA- N values did not exceed the acceptable limits. NPN contents showed no change, while SSN contents increased to 1.24% after 5 months. SDS- PAGE pattern indicated no protein denaturation in the fish tissue. Results indicated that TBA- RS value can only be considered as the valuable indicator in determining the quality of fish steaks held in cold stores.	Robinson, J., Barnabas, E.R., Nathan, F.	International Journal of Food Science & Technology 47, 2429–2435	2012	Food Safety Nutrition

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
261	Comparative effect of pesticides on brain acetylcholinesterase in tropical fish	Monitoring of pesticides based on acetylcholinesterase (AChE; EC 3.1.1.7) inhibition in vitro avoids interference of detoxification defenses and bioactivation of some of those compounds in non-target tissues. Moreover, environmental temperature, age and stress are able to affect specific enzyme activities when performing in vivo studies. Few comparative studies have investigated the inter-specific differences in AChE activity in fish. Screening studies allow choosing the suitable species as source of AChE to detect pesticides in a given situation. Brain AChE from the tropical fish: pirarucu (<i>Arapaima gigas</i>), cobia (<i>Rachycentron canadum</i>) and Nile tilapia (<i>Oreochromis niloticus</i>) were characterized and their activities were assayed in the presence of pesticides (the organophosphates: dichlorvos, diazinon, chlorpyrifos, temephos, tetraethyl pyrophosphate— TEPP and the carbamates: carbaryl and carbofuran). Inhibition parameters (IC50 and Ki) for each species were found and compared with commercial AChE from electric eel (<i>Electrophorus electricus</i>). Optimal pH and temperature were found to be 8.0 and 35–45 °C, respectively. <i>A. gigas</i> AChE retained 81% of the activity after incubation at 50 °C for 30 min. The electric eel enzyme was more sensitive to the compounds (mainly carbofuran, IC50 of 5 nM), excepting the one from <i>A. gigas</i> (IC50 of 9 nM) under TEPP inhibition. These results show comparable sensitivity between purified and non-purified enzymes suggesting them as biomarkers for organophosphorus and carbamate detection in routine environmental and food monitoring programs for pesticides.	Assis, C.R.D., Linhares, A.G., Oliveira, V.M., França, R.C. P., Carvalho, E.V.M.M., Bezerra, R.S., de Carvalho Jr., L.B.	Science of The Total Environment 441, 141–150	2012	Fish Health Pesticides Physiology
262	Biology and aquaculture of cobia: A review [Portuguese]	The present article presents a review of the biology and the state-of-the-art of the culture of cobia (<i>Rachycentron canadum</i>), a native species to Brazilian coastal waters, which, in the last few years, has been targeted as a potential candidate for marine fish farming in Brazil. Main research findings related to feeding, age and growth, reproduction, larviculture, growout, nutrition and feeding, diseases and market that were published until January 2013 are presented and discussed.	Hamilton, S., Severi, W., Cavalli, R.O.	Boletim do Instituto de Pesca 39, 461–477	2012	Culture Hatchery Cage Culture Spawning Nutrition Fish Health
263	Comparative effect of pesticides on brain acetylcholinesterase in tropical fish	Brain cholinesterases from four fish (<i>Arapaima gigas</i> , <i>Colossoma macropomum</i> , <i>Rachycentron canadum</i> and <i>Oreochromis niloticus</i>) were characterized using specific substrates and selective inhibitors. Parameters of catalytic efficiency such as activation energy (AE), <i>k</i> cat and <i>k</i> cat/ <i>k</i> m as well as rate enhancements produced by these enzymes were estimated by a method using crude extracts described here. Despite the BChE-like activity, specific substrate kinetic analysis pointed to the existence of only acetylcholinesterase (AChE) in brain of the species studied. Selective inhibition suggests that <i>C. macropomum</i> brain AChE presents atypical activity regarding its behavior in the presence of selective inhibitors. AE data showed that the enzymes increased the rate of reactions up to 1012 in relation to the uncatalyzed reactions. Zymograms showed the presence of AChE isoforms with molecular weights ranging from 202 to 299 kDa. Values of <i>k</i> cat and <i>k</i> cat/ <i>k</i> m were similar to those found in the literature.	Assis, C.R.D., Linhares, A.G., Oliveira, V.M., França, R.C. P., Carvalho, E.V.M.M., Bezerra, R.S., de Carvalho Jr., L.B.	Science of The Total Environment 441, 141–150	2012	Fish Health Pesticides Physiology
264	Influence of vacuum packaging and long term storage on some quality parameters of cobia (<i>Rachycentron canadum</i>) fillets during frozen storage	Cobia (<i>Rachycentron canadum</i>) has recently attracted a great interest as a farmed product. This study focuses on its commercialization as a frozen product. With this purpose, chemical and sensory evaluation of Cobia, with emphasis on the quality parameters in vacuum packaging (VP), was investigated. Quality assessment of Cobia stored in VP for up to 6 months at -18°C was done by the monitoring of sensory quality, free fatty acids (FFA), peroxide values (PV), thiobarbituric acid (TBA), pH and expressible moisture (EM). Results showed that free fatty acid, primary and secondary oxidation products, expressible moisture and pH value of vacuum packaging samples were significantly lower than those in control samples (p<0.05). Results indicated that VP was effective in reduce lipid oxidation and increased shelf life of Cobia frozen fillets. Thus the employment of VP alone or in combination with other protective strategies is recommended.	Taheri, S., Motallebi, A.A.	American-Eurasian Journal of Agricultural & Environmental Sciences 12, 541–547	2012	Food Safety Nutrition
265	Parameters hematological and histopathologic alterations in cobia (<i>Rachycentron canadum</i> Linnaeus, 1766) com amyloodiniose [Portuguese]	The aim of this study was to describe the hematological parameters and histopathologic alterations in cobia infected by <i>Amyloodinium ocellatum</i> . A group of 27 fish were anesthetized to collect blood samples and euthanatized to collect mucus and tissue fragments of skin and gills. The prevalence and parasitic intensity of the infection, besides hematologic parameters and histopathologic alterations, was measured. Parasite prevalence in the gills was 100% and in the mucus 80.8%, and the average intensity of infection in gills and skin was 683.5 e 67.1 respectively. The mean values of hematological parameters were: erythrocytes 4.3x10 ⁶ /μL; PCV 26%, MCV 64.2 fL, plasma protein 5.8mg/dL, thrombocytes 5.2x10 ³ /μL and leukocytes 3.6x10 ³ /μL. Furthermore was found hyperplasia of the respiratory epithelium accompanied by lamellar fusion, detachment of the epithelium, venous sinus dilatation, aneurysm formation and rupture of the lamellar epithelium, hemorrhage, necrosis and lymphocytic inflammatory reaction. The parasite was observed between the gills lamellae, the AMV ranged from mild to severe and AHI values were 76.8. The study assumes importance because it is the first study in <i>Rachycentron canadum</i> , a fish that stands out with potential for growing.	Guerra-Santos, B., Albinati, R.C.B., Moreira, E.L.T., Lima, F.W.M., de Azevedo, T.M.P., Costa, D.S.P., de Medeiros, S.D.C., Lira, A.D.	Pesquisa Veterinaria Brasileira 32, 1184–1190	2012	Fish Health Microbiology Parasites
266	Stocking density effects on production characteristics and body composition of market size cobia, <i>Rachycentron canadum</i> , reared in recirculating aquaculture systems	Culture density in excess of a critical threshold can result in a negative relationship between stocking density and fish production. This study was conducted to evaluate production characteristics of juvenile cobia, <i>Rachycentron canadum</i> , reared to market size in production-scale recirculating aquaculture systems (RAS) at three different densities. Cobia (322±69g initial weight) were reared for 119d at densities to attain a final in-tank biomass of 10, 20, or 30kg/m ³ . The specific objective was to determine the effects of in-tank crowding resulting from higher biomass per unit rearing volume independent of system loading rates. Survival was ≥96% among all treatments. Mean final weight ranged from 2.13 to 2.15kg with feed conversion efficiencies of 65-66%. No significant differences were detected in growth rate, survival, feed efficiency, or body composition. This study demonstrates that cobia can be reared to >2kg final weight at densities ≤30kg/m ³ under suitable environmental conditions without detrimental effects on production.	Riche, M.A., Weirich, C.R., Wills, P.S., Baptiste, R.M.	Journal of the World Aquaculture Society 44, 259–266	2013	Culture Fish Health RAS Commercial
267	Response to ocean acidification in larvae of a large tropical marine fish, <i>Rachycentron canadum</i>	Currently, ocean acidification is occurring at a faster rate than at any time in the last 300 million years, posing an ecological challenge to marine organisms globally. There is a critical need to understand the effects of acidification on the vulnerable larval stages of marine fishes, as there is potential for large ecological and economic impacts on fish populations and the human economies that rely on them. We expand upon the narrow taxonomic scope found in the literature today, which overlooks many life history characteristics of harvested species, by reporting on the larvae of <i>Rachycentron canadum</i> (cobia), a large, highly mobile, pelagic-spawning, widely distributed species with a life history and fishery value contrasting other species studied to date. We raised larval cobia through the first 3 weeks of ontogeny under conditions of predicted future ocean acidification to determine effects on somatic growth, development, otolith formation, swimming ability, and swimming activity. Cobia exhibited resistance to treatment effects on growth, development, swimming ability, and swimming activity at 800 and 2100 μatm pCO ₂ . However, these scenarios resulted in a significant increase in otolith size (up to 25% larger area) at the lowest pCO ₂ levels reported to date, as well as the first report of significantly wider daily otolith growth increments. When raised under more extreme scenarios of 3500 and 5400 μatm pCO ₂ , cobia exhibited significantly reduced size-at-age (up to 25% smaller) and a 2-3 days developmental delay. The robust nature of cobia may be due to the naturally variable environmental conditions this species currently encounters throughout ontogeny in coastal environments, which may lead to an increased acclimatization ability even during long-term exposure to stressors.	Bignami, S., Sponaugle, S., Cowen, R.K.	Global Change Biology 19, 996–1006	2013	Fish Health Physiology
268	Characterization and transcriptional analysis of a new CC chemokine associated with innate immune response in cobia (<i>Rachycentron canadum</i>)	Chemokines are small, secreted cytokine peptides, known principally for their ability to induce migration and activation of leukocyte populations under both pathological and physiological conditions. On the basis of previously constructed express sequence tags (ESTs) of the head kidney and spleen cDNA library of the perciform marine fish <i>Rachycentron canadum</i> (common name cobia). We used bi-directional rapid amplification of cDNA ends (RACE) and obtained a full-length cDNA of a new CC chemokine gene (designated <i>RcCC3</i>). The <i>RcCC3</i> putative peptide exhibits sequence similarity to the group of CCL19/21/25 CC chemokines. The reverse transcription quantitative polymerase chain reaction (RT-qPCR) was used in transcript expression studies of <i>RcCC3</i> . We examined the constitutive expression of the transcripts in 12 tissues of non-stressed cobia; <i>RcCC3</i> transcripts were detected in all tissues examined, with the highest expression in gill and liver, following by head kidney, kidney, spleen, skin, intestine, muscle, stomach, heart, blood and brain. Transcript expression of <i>RcCC3</i> was examined in immune-related organs, including head kidney, spleen and liver, following intraperitoneal injection of phosphate-buffered saline (control), polyriboinosinic polyribocytidylic acid (poly(I:C)) and formalin-killed <i>Vibrio carchariae</i> (bacterial vaccine). The transcripts in these tissues were quickly up-regulated by the injection of poly(I:C) and bacterial vaccine at early time points, although with different expression profiles. These results indicate <i>RcCC3</i> represents an important component of innate immunity in cobia.	Su, Y., Feng, J., Sun, X., Guo, Z., Xu, L., Jiang, J.	Molecular Biology 47, 389–398	2013	Genetics/Molecular Fish Health
269	Dietary vitamin E could improve growth performance, lipid peroxidation and non-specific immune responses for juvenile cobia (<i>Rachycentron canadum</i>)	An 8-week feeding trial was conducted to establish the dietary vitamin E requirement of juvenile cobia. The basal diet was supplemented with 10, 20, 30, 40, 60, 120 mg vitamin E kg ⁻¹ as all-rac- α -tocopheryl acetate. The results indicated that fish fed the diets supplemented vitamin E had significantly higher specific growth rate, protein efficiency ratio, feed efficiency and survival rate than those fed the basal diet. It was further observed that vitamin E concentrations in liver increased significantly when the dietary vitamin E level increased from 13.2 to 124 mg kg ⁻¹ . Fish fed the basal diet had significantly higher thiobarbituric acid-reactive substances concentrations in liver than those fed the diets supplemented vitamin E. Fish fed the diets supplemented with 45.7 and 61.2 mg kg ⁻¹ vitamin E had significantly higher red blood cell and haemoglobin than those fed the basal diet, while fish fed the diets supplemented with 61.2 and 124 mg kg ⁻¹ vitamin E had higher immunoglobulin concentration than those fish fed the basal diet. Lysozyme and superoxide dismutase were significantly influenced by the dietary vitamin E level. The dietary vitamin E requirement of juvenile cobia was established based on second-order polynomial regression of weight gain and lysozyme to be 78 or 111 mg all-rac- α -tocopheryl acetate kg ⁻¹ diet, respectively.	Zhou, Q.-C., Wang, L.-G., Wang, H.-L., Wang, T., Elmada, C.-Z., Xie, F.-J.	Aquaculture Nutrition 19, 421–429	2013	Fish Health Nutrition
270	Identification and expression analysis of a CC chemokine from cobia (<i>Rachycentron canadum</i>)	Chemokines are small, secreted cytokine peptides known principally for their ability to induce migration and activation of leukocyte populations and regulate the immune response mechanisms. The cobia (<i>Rachycentron canadum</i>), a marine finfish species, has a great potential for net cage aquaculture in the South China Sea. We isolated and characterized a CC chemokine cDNA from cobia-designated <i>RcCC2</i> . Its cDNA is 783 bp in length and encodes a putative protein of 110 amino acids. Homology and phylogenetic analysis revealed that the <i>RcCC2</i> gene, which contains four conserved cysteine residues, shares a high degree of similarity with other known CC chemokine sequences and is closest to the CCL19/21 clade. The mRNA of <i>RcCC2</i> is expressed constitutively in all tested tissues, including gill, liver, muscle, spleen, kidney, head kidney, skin, brain, stomach, intestine and heart, but not blood, with the highest level of expression in gill and liver. The reverse transcription quantitative polymerase chain reaction was used to examine the expression of the <i>RcCC2</i> gene in immune-related tissues, including head kidney, spleen and liver, following intraperitoneal injection of the viral mimic polyriboinosinic polyribocytidylic acid, formalin-killed <i>Vibrio carchariae</i> (bacterial vaccine) and phosphate-buffered saline as a control. <i>RcCC2</i> gene expression was up-regulated differentially in head kidney, spleen and liver during 12 h after challenge. These results indicate that the <i>RcCC2</i> gene is inducible and is involved in immune responses, suggesting <i>RcCC2</i> has an important role in the early stage of viral and bacterial infections.	Feng, J., Su, Y., Guo, Z., Xu, L., Sun, X., Wang, Y.	Fish Physiology and Biochemistry 39, 459–469	2013	Genetics/Molecular
271	Comparison of fillet composition and initial estimation of shelf life of cobia (<i>Rachycentron canadum</i>) fed raw fish or fish silage moist diets	Cobia, <i>Rachycentron canadum</i> (500 g) cultured in pond cages for a 3-month experiment were fed two moist diets based on raw fish with or without added fish silage. No significant differences in nutritional composition were observed between the fillet groups, which were of high quality with a balance of essential and non-essential amino acids (EAA/NEAA = 1) and medium levels of omega-3 fatty acid composition (210 g kg ⁻¹ total fatty acids). The total quality index method and quantitative descriptive analysis from both groups were correlated throughout storage (r ² = 0.83-0.86). After 15 days iced storage, the scores of most attributes were low compared to maximum accepted values. The thiobarbituric acid reactive substances and microbial counts were also below the accepted limits after the storage trial. It might be concluded that the nutritional composition and the fillet quality were similar for the groups fed raw fish with or without added fish silage, and the estimated shelf life for cobia was >15 days.	Mach, D.T.N., Nortvedt, R.	Aquaculture Nutrition 19, 333–342	2013	Fish Health Nutrition
272	Angiotensin I converting enzyme inhibitory activity and antihypertensive effect in spontaneously hypertensive rats of cobia (<i>Rachycentron canadum</i>) head papain hydrolysate	Cobia head protein hydrolysate (CHPH) with angiotensin I converting enzyme (ACE) inhibitory activity was prepared with papain. The 3 kDa ultrafiltration filtrate CHPH-IV of the hydrolysate exerted a potent ACE inhibitory activity with IC50 being 0.24 mg/mL. The fractions with molecular weight located between 1749 Da and 173 Da represented up 66.96% of CHPH-IV, and those between 494 Da and 173 Da represented up 31.37% of CHPH-IV. It was found that the ACE inhibitory activity of CHPH-IV was intensified from IC50 0.24 mg/mL to 0.17 mg/mL after incubation with gastrointestinal proteases. The CHPH-IV significantly decreased the systolic blood pressure in a dose-dependent manner after oral administration to spontaneously hypertensive rats (SHR) at dose of 150 mg/kg, 600 mg/kg and 1200 mg/kg body weight. These results suggested that CHPH-IV from cobia head protein hydrolysate by papain could serve as a source of peptides with antihypertensive activity in functional food industry.	Yang, P., Jiang, Y., Hong, P., Cao, W.	Food Science and Technology International 19, 209–215	2013	Nutrition
273	Effects of shrimp waste meal on growth performance and chitinase activity in juvenile cobia (<i>Rachycentron canadum</i>)	The effects of replacing fish meal (FM) with shrimp waste meal (SWM) in diets fed to juvenile cobia (<i>Rachycentron canadum</i>) were investigated through a 6-week trial. SWM was added to replace FM at fractions of 0%, 10%, 20% and 25% of the diet. The result showed the survival rates of the fish were higher than 86.7%. The weight gain and feed conversion rate showed an increasing trend as the SWM proportion in diet increased from 0% to 25%, but the protein efficiency ratio showed a decreasing trend in efficiency. In addition, the hepatosomatic index increased significantly when the SWM percentage was 20% and 25%. There were no significant differences in the protein and ash concentration of the muscle among all dietary groups. However, the muscle lipid content was low when fish fed in diets with high SWM level. Chitinase activity was extremely high in the pyloric caeca tissue of cobia, and increased specific activities of chitinase were only found in the foregut of cobia fed diets containing 10% SWM for a 6-week period. A challenge test showed that SWM could not enhance cobia resistance to <i>Photobacterium damsela</i> ssp. <i>piscicida</i> infection. Our results suggest that the administration of a 10% SWM diet could potentially reduce the use of FM in the diet of cobia.	Lu, C.-H., Ku, C.-C.	Aquaculture Research 44, 1190–1195	2013	Fish Health Nutrition

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
274	Dietary manganese requirement for juvenile cobia, <i>Rachycentron canadum</i> L.	A 10-week feeding trial was conducted to estimate the optimum dietary manganese requirement for juvenile cobia, <i>Rachycentron canadum</i> L. The basal diet was formulated to contain 501 g kg ⁻¹ crude protein from vitamin-free casein, gelatin and fish protein concentrate. Manganese sulphate was added to the basal diet at 0 (control group), 6, 12, 18, 24 and 36 mg Mn kg ⁻¹ diet providing 5.98, 7.23, 16.05, 23.87, 28.87 and 41.29 mg Mn kg ⁻¹ diet, respectively. Each diet was randomly fed to three replicate groups of cobia for 10 weeks, and each tank was stocked with 30 fish (initial weight, 6.27 ± 0.03 g). The manganese concentration in rearing water was monitored during the feeding period and was < 0.01 mg L ⁻¹ . Dietary manganese level significantly influenced survival ratio (SR), specific growth ratio (SGR), feed efficiency ratio (FER) and the manganese concentrations in the whole body, vertebra and liver of cobia. When the dietary manganese level rose from 5.98 mg kg ⁻¹ to 23.87 mg kg ⁻¹ , the superoxide dismutase (SOD; EC 1.15.1.1) activities in liver also increased ($P < 0.05$). But there was no significant change in SOD activities for the groups fed with diets containing manganese level higher than 23.87 mg kg ⁻¹ . On the basis of broken-line regression of SGR, manganese concentration in whole body and vertebra the manganese requirements of juvenile cobia were 21.72 mg kg ⁻¹ , 22.38 mg kg ⁻¹ and 24.93 mg kg ⁻¹ diet in the form of manganese sulphate, respectively.	Liu, K., Ai, Q.H., Mai, K. s., Zhang, W.B., Zhang, L., Zheng, S.X.	Aquaculture Nutrition 19, 461–467	2013	Fish Health Nutrition
275	Effects of dietary immunostimulant combination on the growth performance, non-specific immunity and disease resistance of cobia, <i>Rachycentron canadum</i> (Linnaeus)	This study investigated the effects of levan produced by <i>Bacillus licheniformis</i> FRI MY-55 on growth performance, intestinal count of viable bacteria, immune status, pathogen resistance and body composition of orange-spotted grouper (<i>Epinephelus coioides</i>). Orange-spotted grouper were fed diets supplemented with levan at concentrations of 0 (control), 5.0, 10.0, 25.0 and 50.0 g kg ⁻¹ for 12 weeks. The final weight and per cent weight gain were significantly higher in the 25.0 g kg ⁻¹ levan-supplemented group than in the control group ($p < 0.05$). All levan-supplemented diets significantly decreased the count of total viable aerobic bacteria and <i>Vibrio</i> spp. in the intestines of groupers ($p < 0.05$). Serum total protein levels, globulin levels, lysozyme activity and survival rate of orange-spotted grouper after challenge with <i>V. harveyi</i> were significantly higher in the 25.0 g kg ⁻¹ levan-supplemented group than in the control group ($p < 0.05$). This study also found that the 10.0, 25.0 and 50.0 g kg ⁻¹ levan-supplemented diets significantly increased the crude protein level in the body composition of orange-spotted grouper. Overall, the results of this study indicate that dietary levan (25.0 g kg ⁻¹) could be an effective method for enhancing the growth performance and disease resistance in orange-spotted grouper.	Dong, X.-H., Geng, X., Tan, B.-P., Yang, Q.-H., Chi, S.-Y., Liu, H.-Y., Liu, X.-Q.	Aquaculture Research [In Press]	2013	Fish Health Nutrition Microbiology
276	Taurine supplementation of plant derived protein and n-3 fatty acids are critical for optimal growth and development of cobia, <i>Rachycentron canadum</i>	We examined growth performance and the lipid content in juvenile cobia, <i>Rachycentron canadum</i> , fed a taurine supplemented (1.5 %), plant protein based diet with two fish oil replacements. The first fish oil replacement was a thraustochytrid meal (TM + SOY) plus soybean oil (~9 % CL) and the second was a canola oil supplemented with the essential fatty acids (EFA) docosahexaenoic acid (DHA) and arachidonic acid (ARA) (~8 % CL). The diet using the thraustochytrid meal plus soybean oil performed equivalently to the fish oil diet; both resulting in significantly higher growth rates, lower feed conversion ratios, and higher survival than the supplemented canola oil diet, even though all three diets were similar in overall energy and met known protein and lipid requirements for cobia. The poor performance of the canola oil diet was attributed to insufficient addition of EFA in the supplemented canola oil source. Increasing levels of EFA in the supplemented canola oil above 0.5 g EFA kg ⁻¹ would likely improve results with cobia. When fish fed either of the fish oil replacement diets were switched to the fish oil control diet, fatty acid profiles of the filets were observed to transition toward that of the fish oil diet and could be predicted based on a standard dilution model. Based on these findings, a formulated diet for cobia can be produced without fish products providing 100 % survivorship, specific growth rates greater than 2.45 and feed conversion ratios less than 1.5, as long as taurine is added and EFA levels are above 0.5 g EFA kg ⁻¹ .	Watson, A.M., Barrows, F. T., Place, A.R.	Lipids 48, 899–913	2013	Fish Health Nutrition
277	Effects of dietary corn gluten meal on growth performance and protein metabolism in relation to IGF-I and TOR gene expression of juvenile cobia (<i>Rachycentron canadum</i>)	A growth experiment was conducted on cobia (<i>Rachycentron canadum</i> , initial weight 108.2 g ± 3.0 g) to investigate the effects of dietary corn gluten meal (CGM) levels on the fish growth, whole body composition and protein metabolism in relation to specific gene expression. Five isonitrogenous (crude protein 45%) and isoenergetic (gross energy 20 kJ g ⁻¹) practical diets were formulated by replacing 0% (the control), 17.5%, 35.0%, 52.5%, and 70.0% of fish meal (FM) protein with CGM protein. No significant differences were observed in the survival, feed intake (FI), specific growth rate (SGR), feed efficiency (FE) and protein productive value (PPV) among fish fed diets with 0%, 17.5%, 35.0%, and 52.5% of CGM protein. However, these indices were significantly lower in fish fed the diet with 70.0% of CGM protein than those in fish fed the control diet ($P < 0.05$). The whole-body crude protein and lipid contents were significantly lower while the whole-body moisture content was significantly higher in fish fed the diet with 70.0% of CGM protein compared with the control group ($P < 0.05$). When 70.0% of FM protein was replaced by CGM, plasma total protein and cholesterol contents were significantly lower than those in the control group ($P < 0.05$). Fish fed the diet with 70.0% of CGM protein had significantly lower hepatic insulin-like growth factor I (IGF-I) expression levels than those in the control group ($P < 0.05$). However, no significant differences were observed in hepatic target of rapamycin (TOR), dorsal muscle IGF-I and TOR expression levels among dietary treatments. Results of the present study indicated that 52.5% of FM protein could be replaced by CGM in the diets without significant influences on the growth, feed utilization and protein metabolism of juvenile cobia. The present results might be useful for developing cost effective and sustainable cobia dietary formulations.	Luo, Y., Ai, Q., Mai, K., Zhang, W., Xu, W., Zhang, Y., Liufu, Z.	Journal of Ocean University of China 12, 418–426	2013	Fish Health Nutrition
278	Acute responses of juvenile cobia <i>Rachycentron canadum</i> (Linnaeus 1766) to acid stress	Fish are potentially submitted to water acidification when reared in recirculating aquaculture systems. This study evaluated the responses of juvenile cobia <i>Rachycentron canadum</i> after acute exposure to acid water. Juvenile cobia (12.6 ± 0.5 g; 14.2 ± 0.2 cm) were acutely exposed to four pH levels (7.9 (control), 6.5, 6.0, and 5.5). After 24 h of exposure to different pH values, fish were sampled for physiological and histopathological evaluation. Acid water affected physiological parameters and induced morphological histopathologies on gill and skin of juvenile cobia, and these effects were more conspicuous with decreasing pH values. Acid stress induced blood acidosis in juvenile cobia, coupled to a decrease in bicarbonate (HCO ₃ ⁻) and saturated O ₂ (SO ₂) in fish blood. On the other hand, haematocrit, haemoglobin and glucose concentration increased their values ($P < 0.01$) comparing to control level. Hyperplasia with completely fusion of secondary lamella was observed in all pH treatments (6.5, 6.0 and 5.5), while telangiectasia and proliferation of chloride cells were present for fish exposed to pH 6.0 and 5.5. In skin hyperplasia and hypertrophy of mucous cells, necrosis of these cells for fish exposed to pH 6.0 and 5.5 was observed. The results of this study demonstrate that acute acid water exposition affected physiology and histopathology in juvenile cobia, especially at pH values below 6.5. Accordingly, particular attention must be given to pH during cobia reared in recirculating aquaculture.	Rodrigues, R.V., Pedron, J. D.S., Romano, L.A., Tesser, M.B., Sampaio, L.A.	Aquaculture Research [In Press]	2013	Fish Health Water Quality RAS Physiology
279	Economic feasibility of cobia juvenile production (<i>Rachycentron canadum</i>) [Portuguese]	Cobia (<i>Rachycentron canadum</i>) is one of the most important marine fish cultured in Brazil. This study analyzes the economic viability of the cobia juvenile production. For evaluate the cost of production, were considered the effective operational cost (EOC), total cost operational (TCO) and the total cost of production (TCP). The indexes for the evaluation of the profitability were the Internal Return Rate (IRR), Pay Back Period (PP) and Net Present Value (NPV). Investment analyses were realized through cash flow and determination of economic viability indicators. The cash flow was determined through plane loads of investment elaborations, annual inputs and outputs for a period of ten years. The analysis showed that the decrease of the price of sale and survivor rate has a hard impact in economic viability. The land rental and labor represents the largest portion of the total cost of production (TCP). The Internal Return Rate (IRR) it varied from negative to 232% affected for the survival rates (from 5 to 20%) and for the three market prices (R\$ 1.50; 2.00 and R\$ 2.50/unit). It can be concluded that the cobia juvenile production is presented economically viable, when survival rate is higher at 10% and market price is higher at R\$ 2.00/unit, with attractive profitability indicators compared to other aquaculture ventures.	Sanches, E.G., Tosta, G.A. M., Souza-Filho, J.J.	Boletim do Instituto de Pesca 39, 15–26	2013	Culture Commercial
280	Diet supplementation of <i>Pediococcus pentosaceus</i> in cobia (<i>Rachycentron canadum</i>) enhances growth rate, respiratory burst and resistance against photobacteriosis	Cobia (<i>Rachycentron canadum</i>) is an economically important fish species for aquaculture in tropical and sub-tropical areas. Cobia aquaculture industry has severely damaged due to photobacteriosis caused by <i>Photobacterium damsela</i> subsp. <i>piscicida</i> (<i>Pdp</i>), especially in Taiwan. Antibiotics and vaccines have been applied to control <i>Pdp</i> infection, but the efficacy has been inconsistent. One species of lactic acid bacteria, <i>Pediococcus pentosaceus</i> strain 4012 (LAB 4012), was isolated from the intestine of adult cobia, and its culture supernatant can effectively inhibit <i>Pdp</i> growth <i>in vitro</i> . The acidic pH derived from metabolic acids in LAB culture supernatant was demonstrated to be an important factor for the suppression. After a 2-week feeding of LAB 4012, the growth rate of the fed cobia was 12% higher than that of the non-fed group, and the relative percentage of survival (RPS) of the fed cobia was found to be 74.4 in <i>Pdp</i> immersion challenge. In addition, the respiratory burst (RB) of peripheral blood leukocytes (PBL) in the LAB 4012-fed group was significantly higher than that of the non-fed group. Although feeding LAB 4012 did not improve specific antibody response in cobia after immunization with <i>Pdp</i> vaccine, it still significantly raised the survival rate by 22% over that of the non-fed group after <i>Pdp</i> immersion challenge. Judging by the quick induction of high protection against <i>Pdp</i> infection and promotion of growth in larvae, LAB 4012 was considered to be a viable probiotic for cobia aquaculture.	Xing, C.-F., Hu, H.-H., Huang, J.-B., Fang, H.-C., Kai, Y.-H., Wu, Y.-C., Chi, S.-C.	Fish & Shellfish Immunology 35, 1122–1128	2013	Fish Health Microbiology
281	Outbreak of mortality among cage-reared cobia (<i>Rachycentron canadum</i>) associated with parasitism	This study reports a disease outbreak among juvenile cobia (<i>Rachycentron canadum</i>) farmed in cages in the state of Rio de Janeiro, Brazil, caused by the dinoflagellate <i>Amyloodinium ocellatum</i> and the monogenean <i>Neobenedenia melleni</i> . Two thousand five hundred fish were stocked at 0.4 kg/m ³ in a set of 12 m ³ tanks, in autumn (mean weight 15.0 ± 7.3 g) and in winter (mean weight 43.0 ± 5.6 g). Freshwater baths were administered as a routine treatment, as the symptoms were detected followed by two collection samples. Firstly in May 2011 (n = 5) and secondly in September 2011 (n = 10). In the first sample, the prevalence of <i>N. melleni</i> on the body surface was 100% and the mean intensity was 42.0 ± 1.7, while in the second sample the prevalence was 60% with a mean intensity 3.0 ± 0.2 and mean abundance 1.8 ± 0.4. <i>Amyloodinium ocellatum</i> was only found in the second sample, at a prevalence 100% and mean intensity 46.8 ± 3.4. The cause of fish mortality was possibly associated with a decrease in fish resistance after the first contact with monogenean parasites, allied with respiratory difficulty caused by the presence of <i>A. ocellatum</i> in the gills.	Moreira, C.B., Hashimoto, G.S.O., Rombenso, A.N., Candiotto, F.B., Martins, M. L., Tsuzuki, M.Y.	Revista Brasileira de Parasitologia Veterinaria 22, 588–591	2013	Fish Health Parasites Cage Culture
282	Evaluation of iron methionine and iron sulphate as dietary iron sources for juvenile cobia (<i>Rachycentron canadum</i>)	An 8-week experiment was designed to determine the optimum dietary iron requirement of juvenile cobia <i>Rachycentron canadum</i> (mean initial weight, 15.89 ± 0.84 g) with iron sulphate (FeSO ₄ •7H ₂ O) and iron methionine (FeMet) as iron sources, using a semi-purified diet based on casein and white fish meal as the protein sources. The basal diet was supplemented with 0, 30, 60, 120, 240 and 480 mg iron kg ⁻¹ dry diet from either FeSO ₄ or FeMet, respectively. Survival was not significantly affected by the all dietary treatment. Weight gain (WG), feed efficiency (FE), serum catalase activity (SCAT), and haemoglobin were significantly affected by any of the dietary treatments from both of two iron sources. Based on broken-line regression analysis of WG, FE and SCAT, a minimum requirement for dietary iron was recommended to be 80.5–94.7 mg kg ⁻¹ from FeSO ₄ and 71.3–75.1 mg kg ⁻¹ from FeMet. Iron supplement to the basal diet had no significant effect on haematocrit, erythrocyte count, iron concentration in whole body and filet. Our experiment also showed that the bioavailability of FeMet and FeSO ₄ to juvenile cobia was similar for WG and FE, and the relative bioavailability of FeMet and FeSO ₄ to juvenile cobia was 275% for maximum SCAT.	Qiao, Y.-G., Tan, B.-P., Mai, K.-S., Ai, Q.-H., Zhang, W.-B., Xu, W.	Aquaculture Nutrition 19, 721–730	2013	Fish Health Nutrition
283	A Case Study on the Mortality of Cobia (<i>Rachycentron canadum</i>) Cultured in Traditional Cages	The mass mortality of cobia (<i>Rachycentron canadum</i>) within 2-3 days was reported by 3 private farms in Bukit Tambun, Pulau Pinang, in February and March 2007. Only cobia with body weights of 3-4 kg were affected. Most diseased cobia swam on the surface and displayed flashing behaviour. All samples were positive for viral nervous necrosis (VNN) with low to medium levels of infection. Infestations by leeches (<i>Zeylanicobdella arugamensis</i>), body monogeneans (<i>Benedenia</i> sp.) and copepods (<i>Caligus</i> sp.) were also found, but no pathogenic bacteria were isolated. All water quality parameters monitored were within optimal ranges for culturing cobia. The main causes of high mortality in cobia remain unclear during the study. However, we believe that the mass mortality of cobia could be probably due to VNN infection and that the rate of mortality will increase further when cobia are subjected to aquaculture-related stresses (e.g., limited space). Traditional cages with a size of 2 (length) × 2 (width) × 1 m (depth) should only be used for rearing cobia below 1 kg in weight given the species' natural behaviours. In addition, cobia fingerlings should be screened for VNN prior to stocking them in cages.	Chu, K.B., Abdulah, A., Abdullah, S.Z., Bakar, R.A.	Tropical Life Sciences Research 24, 77–84	2013	Fish Health Cage Culture Parasites Microbiology
284	Second record of the cobia, <i>Rachycentron canadum</i> (Actinopterygii: Perciformes: Rachycentridae), from the Mediterranean sea	On 2 August 2013, a specimen of the cobia, <i>Rachycentron canadum</i> (Linnaeus, 1766), was caught off Marmaris, south-eastern Aegean coast of Turkey. The fish was examined and morphometric characteristics of the specimen collected were determined. The species is being reported from the second time in the Mediterranean, preceded by its first occurrence off Haifa, Israel in 1978. The newly caught specimen was larger (SL) than the previously recorded individual (923 mm vs. 766 mm). All measurements, counts, and colour patterns determined were consistent with earlier published descriptions of the species.	Akyol, O., Ünal, V.	Acta Ichthyologica et Piscatoria 43, 315–317	2013	Wild (Atlantic/Pacific)

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
285	Replacement of fish meal by a novel non-GM variety of soybean meal in cobia, <i>Rachycentron canadum</i> : Ingredient nutrient digestibility and growth performance	A constraint for the expansion of cobia aquaculture is the availability of high quality formulated diets which reduce or eliminate fish meal (FM) protein. Therefore, the nutritive value of a novel soybean cultivar, Navita™ (Navita, non-genetically modified and selectively bred soy), and regular, commodity soybean meal (SBM, de-hulled, defatted, roasted and solvent-extracted) was evaluated for cobia, <i>Rachycentron canadum</i> via separate digestibility and growth trials. In the first experiment Navita's apparent digestibility coefficients (ADC) were higher than those of SBM for nearly every nutrient evaluated. Crude protein ADCs were 82 and 69% for Navita and SBM, respectively. Apparent DC for amino acids ranged from 68 to 109% for Navita whereas, amino acid ADCs for SBM varied from 42 to 98%. The feeding trial utilized fish of a size that more closely resembles commercial cobia stocking (1.8 kg), and was conducted over a 91-day period. Experimental diets (iso-nitrogenous and iso-energetic) were formulated such that 67% of the FM protein in the reference diet was replaced by either a combination of SBM + soy protein concentrate (SPC, Solae Profine®) labeled MXSB-diet, or by a combination of SPC + Navita; Navita-diet, hereafter. A fourth experimental diet had 80% of the FM protein replaced by a combination of Navita + SPC and was identified as Navita-high. No significant differences ($P > 0.05$) were observed in fish fed the experimental diets for feed conversion ratio, protein efficiency ratio, feed efficiency, mean daily intake, gross protein intake, gross energy intake, visceral somatic index, muscle ratio, and hepatosomatic index. Fish fed the Navita-high diet had the lowest fish in:fish out ratio (FIFO) at 0.9 ± 0.16 . These results indicate that Navita meal can be incorporated at very high levels in the diet of marine carnivorous fish such as cobia with no detriment to performance, making it a prime candidate for FM replacement in aquafeeds.	Suarez, J.A., Tudela, C., Davis, D., Daugherty, Z., Taynor, M., Glass, L., Hoenig, R., Buentello, A., Benetti, D.D.	Aquaculture 416–417, 328–333	2013	Fish Health Nutrition
286	Population genetic comparisons among cobia from the northern Gulf of Mexico, U.S. Western Atlantic, and Southeast Asia	Nuclear-encoded microsatellites and mitochondrial DNA (mtDNA) sequences were assayed from Cobias <i>Rachycentron canadum</i> sampled in waters offshore of Virginia (U.S. Atlantic), Mississippi and Louisiana (Gulf of Mexico), and Taiwan (Southeast Asia). Global exact tests and analysis of molecular variance revealed that Cobias from U.S. waters were homogeneous for alleles and genotype distributions at 27 nuclear-encoded microsatellites and were homogeneous in mtDNA haplotype distribution, whereas both genetic markers in Cobias from Taiwan differed significantly from those of Cobias in U.S. waters. Based on these genetic differences, use of Cobia broodstock from Southeast Asia in U.S. aquaculture facilities is not recommended. Results are compatible with the use of Cobia broodstock from either the U.S. Atlantic or the Gulf of Mexico for aquaculture at U.S. facilities; caveats to the exchange of broodstock between these two regions are discussed.	Gold, J.R., Giresi, M.M., Renshaw, M.A., Gwo, J.-C.	North American Journal of Aquaculture 75, 57–63	2013	Genetics/Molecular Wild (Atlantic/Pacific) Wild/Farmed Interaction
287	Amending reduced fish-meal feeds with marine lecithin, but not soy lecithin, improves the growth of juvenile cobia and may attenuate heightened responses to stress challenge	Sparing of marine resources in aquafeeds can be environmentally and economically advantageous; however, fish meal (FM) replacement can affect the production performance and physiological competence. Phospholipids are increasingly understood to be involved in maintaining growth and vigour in fish and may be deficient in reduced FM formulations. Accordingly, we evaluated the growth and stress tolerance of juvenile cobia fed typical (50% FM) or reduced FM feeds (12% FM) with or without phospholipid amendment (1% marine lecithin (12% FM + Marine PL) or soy lecithin (12% FM + Soy PL)) for 6 weeks in triplicate tanks ($N = 3$) in a recirculation aquaculture system. The 50% FM feed yielded significantly superior growth and growth efficiency in comparison with the 12% FM and 12% FM+ Soy PL feeds, but the 12% FM+ Marine PL feed yielded comparable results to 50% FM feed. A low-water stress challenge induced elevated plasma glucose, cortisol and lactate levels in all treatments. However, a significant interaction (diet \times stress) effect suggested a lesser cortisol response among fish fed the 12% FM+ Marine PL and 50% FM diets. These findings demonstrate that growth performance and, perhaps, resilience of cobia raised on reduced FM feeds may be improved by the addition of marine-origin phospholipid to the diet.	Trushenski, J., Schwarz, M., Pessoa, W.V.N., Mulligan, B., Crouse, C., Gause, B., Yamamoto, F., Delbos, B.	Journal of Animal Physiology and Animal Nutrition 97, 170–180	2013	Fish Health Nutrition
288	Evaluation of commercial marine fish feeds for production of juvenile cobia in recirculating aquaculture systems	The effect of different commercially available marine fish diets on production characteristics and body composition of juvenile Cobia <i>Rachycentron canadum</i> reared in production-scale recirculating aquaculture systems was evaluated in a 57-d growth trial. Juvenile Cobia (mean weight \pm SE, 26.7 ± 0.9 g) were stocked at an initial density of 1.2 kg/m ³ . After stocking, fish were fed one of three closed-formula diets formulated for carnivorous marine finfish (coded diet A, 50% crude protein : 22% crude lipid; diet B, 49% crude protein : 17% crude lipid; and diet C, 48% crude protein : 17% crude lipid), all at a targeted feed rate of 3–5% body weight per day. At 2-week intervals, 10% of the population of each tank was sampled to determine mean weight, weight gain, specific growth rate, feed conversion efficiency, and biomass. At the termination of the trial, the entire population of each tank was harvested to determine the same characteristics and survival. In addition, fish were sampled to determine relative changes in whole body composition, energy retention, protein efficiency ratio, and protein productive value. Final weight (203.3 g), specific growth rate (3.6%/d), feed conversion efficiency (92.2%), biomass (7.3 kg/m ³), and protein productive value (25.2%) of fish fed the high-lipid diet A were significantly higher than those of fish fed the other two diets. No differences in whole body composition were observed among fish fed the three diets with the exception of dry matter composition. Contrary to previous reports, the results of the current study indicate that juvenile Cobia reared in production-scale recirculating aquaculture systems fed high-lipid diets exhibit protein sparing and better growth.	Wills, P.S., Weirich, C.R., Baptiste, R.M., Riche, M.A.	North American Journal of Aquaculture 75, 178–185	2013	Culture Nutrition RAS
289	Saturated fatty acids limit the effects of replacing fish oil with soybean oil with or without phospholipid supplementation in feeds for juvenile cobia	The high cost and limited availability of fish oil makes plant-derived lipids attractive for aquafeed manufacturing, but replacing fish oil with these lipids can result in long-chain polyunsaturated fatty acid (LC-PUFA) deficiencies. Fatty acid metabolism, specifically the efficiency of LC-PUFA utilization, may be influenced by the dietary saturated fatty acid (SFA) content versus that of C18 polyunsaturated fatty acids (PUFAs). We assessed the growth and tissue composition of Cobia <i>Rachycentron canadum</i> (55.3 \pm 0.2 g initial weight [mean \pm SE]; 10 fish/tank, 3 tanks/diet) fed diets (~49% protein, ~10% lipid) containing fish oil; 22:6(n-3)-amended standard, partially hydrogenated, or fully hydrogenated soybean oil; and these same soybean oils supplemented with soybean lecithin for 8 weeks. Although survival (range = 97–100%), final weight (160–189 g), and feed conversion ratio (1.40–1.52) were unaffected by diet, differences were observed in weight gain (185–241%), specific growth rate (1.87–2.19% body weight/d), and feed intake (2.94–3.44% body weight/d). Significant effects of soybean oil type on final weight, weight gain, feed conversion ratio, specific growth rate, and feed intake were noted, with standard soybean oil generally outperforming the other soybean lipids when oil types were pooled across phospholipid supplementation treatments, whereas phospholipid supplementation had no significant effect on any of the performance measures. Differences in dietary fatty acid profile yielded differences in tissue composition. Feeding standard soybean oil resulted in the most greatly modified profiles, whereas the profiles of fish fed fully hydrogenated, completely saturated soybean oil were most similar to those of the fish oil-fed fish. The magnitude of profile change was greatest in the liver and fillet tissues and smallest in the eye and brain tissues. Although further research is necessary to demonstrate whether SFA-rich lipids can effectively reduce the LC-PUFA requirements of Cobia, it is clear that SFA-rich oils offer a strategic advantage in minimizing the effects of fish oil replacement on tissue fatty acid profile.	Trushenski, J., Woitell, F., Schwarz, M., Yamamoto, F.	North American Journal of Aquaculture 75, 316–328	2013	Fish Health Nutrition
290	Ocean acidification alters the otoliths of a pantropical fish species with implications for sensory function	Ocean acidification affects a wide diversity of marine organisms and is of particular concern for vulnerable larval stages critical to population replenishment and connectivity. Whereas it is well known that ocean acidification will negatively affect a range of calcareous taxa, the study of fishes is more limited in both depth of understanding and diversity of study species. We used new 3D microcomputed tomography to conduct in situ analysis of the impact of ocean acidification on otolith (ear stone) size and density of larval cobia (<i>Rachycentron canadum</i>), a large, economically important, pantropical fish species that shares many life history traits with a diversity of high-value, tropical pelagic fishes. We show that 2,100 μ atm partial pressure of carbon dioxide (pCO_2) significantly increased not only otolith size (up to 49% greater volume and 58% greater relative mass) but also otolith density (6% higher). Estimated relative mass in 800 μ atm pCO_2 treatments was 14% greater, and there was a similar but nonsignificant trend for otolith size. Using a modeling approach, we demonstrate that these changes could affect auditory sensitivity including a ~50% increase in hearing range at 2,100 μ atm pCO_2 , which may alter the perception of auditory information by larval cobia in a high- CO_2 ocean. Our results indicate that ocean acidification has a graded effect on cobia otoliths, with the potential to substantially influence the dispersal, survival, and recruitment of a pelagic fish species. These results have important implications for population maintenance/replenishment, connectivity, and conservation efforts for other valuable fish stocks that are already being deleteriously impacted by overfishing.	Bignami, S., Enochs, I.C., Manzello, D.P., Sponaugle, S., Cowen, R.K.	PNAS 110, 7366–7370	2013	Fish Health Physiology
291	Effect of diet on the fatty acid composition of the copepod <i>Tisbe biminienis</i>	Success in rearing fish depends on the nutritional content of food offered to the larvae. The aim of this study was to test the effect of diets on fatty acid composition of the copepod <i>Tisbe biminienis</i> Volkman-Rocco, 1973 as a food source. The copepods were reared in 5 l vessels with aeration at 29–31°C, salinity 30–35, and natural photoperiod of 13 hours light/11 hours dark. The copepods were fed two diets: a mixture of microalgae <i>Thalassiosira weissflogii</i> and commercial fish food, and only the fish food. Lipids were extracted with chloroform and methanol and esterified by acid catalysis with BF ₃ . Three replicates were used in each treatment. Fatty acids were identified by comparison of retention times and co-injection with standard Mix C4–C24 using GC and GCMS apparatus. Thirty-one and 29 fatty acids were detected on copepods fed mixed diets and fish food, respectively. The most abundant fatty acids in copepod fed mixed diet were C18, C16, and C12. In the other treatment, predominant fatty acids were C18, C16, and C20:2. Thirty-one and 30 fatty acids were detected in the fish food and the microalgae, respectively. The predominant fatty acids of microalgae were C18, C21, and C20:2. For fish food, the predominant fatty acids were C16, C18, and C18:1n9. Essential fatty acids were detected and EPA and DHA contents of copepods fed mixture were significantly higher compared to those fed only ration, indicating that the mixed diet provided better source of HUFA for <i>T. biminienis</i> . However, its DHA level was lower than other harpacticoid copepods. This suggests that <i>T. biminienis</i> either needs to be fed a better quality diet, or be enriched with some fatty acids before they are offered to the cobia larvae. The copepod <i>T. biminienis</i> is capable of bio-converting fatty acid C18:0 into chains with 20 unsaturated carbons. <i>T. biminienis</i> fed mixed diet or the fish food alone showed DHA/EPA ratios of 1.3 and 3.3, respectively, suggesting that this copepod species may be suitable for use in fish larviculture.	Lima, L.C.M. de, Navarro, D. M.A.F., Souza-Santos, L.P.	Journal of Crustacean Biology 33, 372–381	2013	Culture Hatchery Nutrition
292	Effect of zataria multiflora Boiss (Avishan Shirazi) essential oil on oxidative progress in frozen cobia fish fillets during storage	Antioxidants have been widely used as additives to provide protection against oxidative degradation of foods by free radicals. The effect of thyme essence (<i>Zataria multiflora</i> Boiss) on the rancidity development in cobia (<i>Rachycentron canadum</i>) fillets during frozen storage was studied. Cobia fillets were treated with thyme essence (250 and 500 ppm) and then stored at –18°C for up to 6 months. Rancidity development was measured by several biochemical indices including free fatty acids (FFA), peroxide value (PV), thiobarbituric acid (TBA), and complemented by sensory analysis (flesh odor, consistency, and appearance). Also, pH and expressible moisture were measured during 6-month storage. Proximate composition was also determined in the first day. TBA, PV, and FFA levels increased in all treatments due to lipid oxidation. Thyme essence showed an antioxidative effect in cobia fillets during frozen storage as indicated by TBA, PV, and FFA levels. Results showed that FFA, primary and secondary oxidation products, expressible moisture (EM), and pH of thyme essence treated samples were significantly lower than those of the control samples ($p < 0.05$). Thyme essence retarded oxidative changes in frozen cobia fillets, and the best oxidation inhibition was obtained using thyme essence at 500 ppm.	Taheri, S., Motallebi, A., Fazlara, A., Aghababayan, A.	Journal of Aquatic Food Product Technology 22, 310–321	2013	Food Safety Nutrition
293	Feed intake and brain neuropeptide Y (NPY) and cholecystokinin (CCK) gene expression in juvenile cobia fed plant-based protein diets with different lysine to arginine ratios	Cobia (<i>Rachycentron canadum</i> , Actinopterygii, Perciformes; 10.5 \pm 0.1 g) were fed to satiation with three plant-based protein test diets with different lysine (L) to arginine (A) ratios (LL/A, 0.8; BL/A, 1.1; and HL/A, 1.8), using a commercial diet as control for six weeks. The test diets contained 730 g kg ⁻¹ plant ingredients with 505–529 g protein, 90.2–93.9 g lipid kg ⁻¹ dry matter; control diet contained 550 g protein and 95 g lipid kg ⁻¹ dry matter. Periprandial expression of brain NPY and CCK (<i>npv</i> and <i>cck</i>) was measured twice (weeks 1 and 6). At week one, <i>npv</i> levels were higher in pre-feeding than postfeeding cobia for all diets, except LL/A. At week six, <i>npv</i> levels in pre-feeding were higher than in postfeeding cobia for all diets. <i>cck</i> in pre-feeding cobia did not differ from that in postfeeding for all diets, at either time point. Cobia fed LL/A had lower feed intake (FI) than cobia fed BL/A and control diet, but no clear correlations between dietary L/A ratio and FI, growth and expression of <i>npv</i> and <i>cck</i> were detected. The data suggest that NPY serves as an orexigenic factor, but further studies are necessary to describe links between dietary L/A and regulation of appetite and FI in cobia.	Nguyen, M.V., Jordal, A.-E. O., Espe, M., Buttle, L., Lai, H.V., Rønnestad, I.	Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology 165, 328–337	2013	Fish Health Nutrition Physiology
294	Aquaculture species selection method applied to marine fish in the Caribbean	A five-phase method for the evaluation and selection of tropical marine fish for intensive culture is proposed and the application of the first four phases is presented for the Caribbean region. In phase-1, an initial list of 50 species was prepared from 2175 present in the Western Central Atlantic, based on their commercial importance, and certain relevant biological features. Phase 2 includes economic and technological development considerations. Eleven preselected, four non-preselected, and six traditionally cultivated species (controls) were evaluated in phase-3 using a score and weighting factor method with four categories, established according to the point score. Species preselection by environment and culture system (phase-4) was carried out according to estimated performance at the site and culture system under Caribbean conditions, as well as the species' tolerance to environmental factors and the total score obtained as final criteria. To be finally selected, species must be subject to practical pilot-scale (phase 5) trials with technical, financial and ecological feasibility analyses. Yellowtail amberjacks, <i>Seriola</i> spp., and cobia, <i>Rachycentron canadum</i> , ranked first for open water cage and supra-littoral tank culture. Ranking in the second category were Florida pompano, <i>Trachinotus carolinus</i> , pompano, <i>Trachinotus falcatus</i> , and common snook, <i>Centropomus undecimalis</i> , which were selected for ponds and floating cages on estuarine and coastal waters, and Nassau grouper, <i>Epinephelus striatus</i> and mutton snapper, <i>Lutjanus analis</i> , which were selected for cages on coastal or offshore clear waters. Two of the exotic tropical species: barramundi, <i>Lates calcarifer</i> and mangrove red snapper, <i>Lutjanus argentimaculatus</i> , as well as one of the subtropical control species: red drum, <i>Sciaenops ocellatus</i> , were highly scored and ranked in the first two priority categories, thereby confirming the effectiveness of the selection method applied.	Alvarez-Lajonchère, L., Ibarra-Castro, L.	Aquaculture 408–409, 20–29	2013	Culture Cage Culture Commercial

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
295	A novel agent (<i>Endozaicomonas elysicola</i>) responsible for epitheliocystis in cobia <i>Rachycentron canadum</i> larvae	Aquaculture of cobia has gained popularity in the last decade, and this species is now farmed in several countries in Latin America and Asia. Despite recent improvement in production techniques that allowed the expansion of the industry, little is known about the diseases that affect cobia during the larviculture stage. In this article we investigated the cause of mass mortalities occurring 13-20 d post-hatching in 3 cycles of cobia larviculture. Wet mounts from diseased larvae gills revealed the presence of cyst-like basophilic inclusions. DNA from the cysts was extracted and PCR amplified using the 16S rRNA gene universal primers for prokaryotes. The amplified products were sequenced and analyzed using BLAST, finding a similarity of 99% with <i>Endozaicomonas elysicola</i> , a Gram-negative bacterium. Confirmation of <i>E. elysicola</i> was conducted by designing a specific probe for <i>in situ</i> hybridization. Specific primers were also designed for diagnostic purposes. This is the first report of epitheliocystis in cobia larvae and also the first report of <i>E. elysicola</i> as an epitheliocystis-causing agent.	Mendoza, M., Giza, L., Martinez, X., Caraballo, X., Rojas, J., Aranguren, L.F., Salazar, M.	Diseases of Aquatic Organisms 106, 31–37	2013	Fish Health Culture Microbiology Genetics/Molecular Parasites
296	Biochemical characterization of a phospholipase A2 from <i>Photobacterium damsela</i> subsp. <i>piscicida</i>	<i>Photobacterium damsela</i> subsp. <i>piscicida</i> (<i>Phdp</i>) is the causative agent of fish photobacteriosis (pasteurellosis) in cultured cobia (<i>Rachycentron canadum</i>) in Taiwan. A component was purified from the extracellular products (ECP) of the bacterium strain 9205 by fast protein liquid chromatography (FPLC) and identified as a phospholipase. An N-terminal sequence of 10 amino acid residues, QDQNPDPGK, was determined by mass spectroscopy (MS) and found to be identical with that of another <i>Phdp</i> phospholipase (GenBank accession no. BAB85814) at positions 21 to 30. The corresponding gene sequence of the phospholipase (GenBank accession no. AB071137) was employed to design primers for amplification of the sequence by the polymerase chain reaction (PCR). The PCR products were transformed into <i>Escherichia coli</i> , and a recombinant protein product was obtained which was purified as a His-tag fusion protein by Ni-metal affinity chromatography. A single 43-kDa band was determined by sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE). Phosphatidylcholine was degraded by this protein to lysophosphatidylcholine and a fatty acid. These products were characterized by thin-layer (TLC) and gas chromatography (GC), respectively, allowing the identification of the protein as a phospholipase A2. The recombinant protein had maximum enzymatic activity between pH 4 and 7, and at 40 °C. The activity was inhibited by Zn ²⁺ and Cu ²⁺ , activated by Ca ²⁺ and Mg ²⁺ , and completely inactivated by dexamethasone and p-bromophenacyl bromide. A rabbit antiserum against the recombinant protein neutralized the phospholipase A2 activity in the ECP of <i>Phdp</i> strain 9205 and the recombinant protein itself. The recombinant protein was toxic to cobia of about 5 g weight with an LD50 value between 2 and 4 µg protein/g fish. The results revealed phospholipase A2 as a fish toxin in the ECP of <i>Phdp</i> strain 9205.	Hsu, P.-Y., Lee, K.-K., Lee, P.-S., Hu, C.-C., Lin, C.-H., Liu, P.-C.	Zeitschrift fur Naturforschung - Section C Journal of Biosciences 68 C, 471–481	2013	Culture Fish Health Parasites Microbiology
297	Microbiological and histopathological investigations of <i>Vibrio alginolyticus</i> infection in cobia <i>Rachycentron canadum</i> (Linnaeus, 1766) cultured in sea cage	The occurrence of disease caused by <i>Vibrio alginolyticus</i> in sea cage farming of hatchery produced cobia juveniles is reported in this paper. The affected animals showed signs of surfacing, sluggish swimming and bilateral exophthalmia followed by acute mortality. The bacterial pathogen <i>Vibrio alginolyticus</i> was isolated from systemic lesions of infected moribund cobia fingerlings which was confirmed based on biochemical characteristics. Further the 16S ribosomal RNA of the isolate was amplified and BLAST analysis of the sequence confirmed that the pathogen is <i>V. alginolyticus</i> . Histologically, the liver of affected fish showed fatty change, the eyes revealed congestion as well as infiltration of polymorphonuclear cells in the choroid layer and acute glomerulonephritis was observed in the kidney.	Rameshkumar, P., Kalidas, C., Tamilmani, G., Sakthivel, M., Nazar, A.K.A., Maharshi, V.A., Rao, K.S., Gopakumar, G.	Indian Journal of Fisheries 61, 124–127	2013	Fish Health Microbiology Genetics/Molecular Cage Culture
298	Optimization of enzymolysis extraction of fish oil from cobia (<i>Rachycentron canadum</i>) visceral based on neural network	The enzymolysis extraction process of fish oil from cobia (<i>Rachycentron canadum</i>) viscera was explored and the extraction conditions optimized by artificial neural network and hydrolysis protein was prepared. The results showed that the optimal extraction process parameters of fish oil using papain were as follows, the ratio of water and materials 2.5 : 1, the reaction temperature 50, the added dosage of enzyme 2.5%, and hydrolysis time 3h. Under these conditions, the yield and extraction rate of fish oil were 49.84% and 96.38% (dry basis), respectively, and the yield and extraction rate of enzymatic protein were 28.46% and 61.60% (dry basis), respectively. The main saturated fatty acids of fish oil from Cobia viscera were C14 : 0, C16 : 0 and C18 : 0, the main monounsaturated fatty acids were C16 : 1 and C18 : 1, and the main polyunsaturated fatty acids were C20 : 5(n-3) and C22 : 6(n-3). Moreover, enzymatic protein had the characteristics of high protein and low fat. This research would provide the conference for the comprehensive utilization of fish wastes.	Huang, W.Y., Li, D.T., Qu, X. J., Liu, S.C., Hao, J.M., Zhang, J.	Science and Technology of Food Industry 7, 35	2013	Nutrition
299	Transposable elements in fish chromosomes: A study in the marine cobia species	<i>Rachycentron canadum</i> , a unique representative of the Rachycentridae family, has been the subject of considerable biotechnological interest due to its potential use in marine fish farming. This species has undergone extensive research concerning the location of genes and multigene families on its chromosomes. Although most of the genome of some organisms is composed of repeated DNA sequences, aspects of the origin and dispersion of these elements are still largely unknown. The physical mapping of repetitive sequences on the chromosomes of <i>R. canadum</i> proved to be relevant for evolutionary and applied purposes. Therefore, here, we present the mapping by fluorescence <i>in situ</i> hybridization of the transposable element (TE) Tol2, the non-LTR retrotransposons Rex1 and Rex3, together with the 18S and 5S rRNA genes in the chromosome of this species. The Tol2 TE, belonging to the family of hAT transposons, is homogeneously distributed in the euchromatic regions of the chromosomes but with huge colocalization with the 18S rDNA sites. The hybridization signals for Rex1 and Rex3 revealed a semi-arbitrary distribution pattern, presenting differentiated dispersion in euchromatic and heterochromatic regions. Rex1 elements are associated preferentially in heterochromatic regions, while Rex3 shows a scarce distribution in the euchromatic regions of the chromosomes. The colocalization of TEs with 18S and 5S rDNA revealed complex chromosomal regions of repetitive sequences. In addition, the nonpreferential distribution of Rex1 and Rex3 in all heterochromatic regions, as well as the preferential distribution of the Tol2 transposon associated with 18S rDNA sequences, reveals a distinct pattern of organization of TEs in the genome of this species. A heterogeneous chromosomal colonization of TEs may confer different evolutionary rates to the heterochromatic regions of this species.	Costa, G.W.W.F., Cioffi, M. B., Bertollo, L.A.C., Molina, W.F.	Cytogenetic and Genome Research 141, 126–132	2013	Genetics/Molecular
300	Evaluation of feeding indices of cobia <i>Rachycentron canadum</i> (Linnaeus. 1766) from Northwest coast of India	Cobia <i>Rachycentron canadum</i> (Linnaeus. 1766) is an esteemed table fish occurring along both east and west coast of India. Feeding indices of the species inhabiting waters of the North West coast of Indian EEZ was studied to understand the variation of its feeding intensity based on season, sex and life history changes. Monthly variation of stomach condition of cobia male, female, pooled and size wise were analyzed. In general, 56% of fishes were found in either actively fed or moderately fed state. Except during April and July they were found in actively fed condition. Analysis of occurrence of empty stomach in different length classes of fishes revealed that the percentage of occurrence of empty stomachs decreased with the fish growth. Month-wise Mean Index of Feeding intensity (MIF) and Index of Fullness (IF) values showed that cobia fed well during post monsoon periods but poor feeding activity was noticed in July. Gastro-somatic index for male, female and pooled samples of matched with the MIF and IF values. The results indicated a seasonal variation in feeding intensity of cobia. On an average, feeding intensity during July was low.	Sajeevan, M.K., Madhusoodana Kurup, B. M.K.	Journal of the Marine Biological Association of India 55, 16–21	2013	Wild (Atlantic/Pacific)
301	SEDAR 28 - South Atlantic cobia stock assessment report (No. SEDAR28-SAR3)	SEDAR 28 addresses stock assessments for Gulf of Mexico and South Atlantic Spanish mackerel and cobia. The Data Workshop was held February 6-10, 2012 in Charleston, SC, the Assessment workshop was held May 7-11, 2012 in Miami, FL and the Review workshop concerning South Atlantic stocks was held October 29-November 2, 2012 in Atlanta, GA. Gulf stocks will undergo a CIE Desk Review. NOTE: SEDAR Working papers document the methods, datasets, and preliminary analyses that are under consideration at the various workshops and therefore do not necessarily represent final consensus opinions of workshop participants. Working paper findings and methods may change following workshop review. Working papers should not be cited without author permission.	SEDAR	SEDAR, North Charleston, SC. 420 pp.	2013	Wild (Atlantic/Pacific)
302	SEDAR 28 - Gulf of Mexico cobia stock assessment report (No. SEDAR28-SAR2)	SEDAR 28 addresses stock assessments for Gulf of Mexico and South Atlantic Spanish mackerel and cobia. The Data Workshop was held February 6-10, 2012 in Charleston, SC, the Assessment workshop was held May 7-11, 2012 in Miami, FL and the Review workshop concerning South Atlantic stocks was held October 29-November 2, 2012 in Atlanta, GA. Gulf stocks will undergo a CIE Desk Review. NOTE: SEDAR Working papers document the methods, datasets, and preliminary analyses that are under consideration at the various workshops and therefore do not necessarily represent final consensus opinions of workshop participants. Working paper findings and methods may change following workshop review. Working papers should not be cited without author permission.	SEDAR	SEDAR, North Charleston, SC. 616 pp.	2013	Wild (Atlantic/Pacific)
303	Cobia cage culture distribution mapping and carrying capacity assessment in Phu Quoc, Kien Giang province	Cobia fish cage is the most popular marine culture species raised in Phu Quoc Island, Vietnam. For its sustainable development, there is a need to determine the carrying capacity to avoid negative marine environmental impact in the future. This study was carried out to collect water samples each two months at the lowest and highest tides at four points around the farming area in Rach Vem, Phu Quoc Island, Kien Giang Province from February to October 2011. Water quality in cobia cage culture was surveyed to assess the environmental status of coastal aquaculture areas including seven parameters such as DO, COD, BOD, TSS, TN, TP and Chlorophyll-a. These parameters are suitable to rear cobia fish cage in this area. Nitrogen and phosphorus are considered as the principal nutrients produced by the cobia fish farm and affecting water environment. This study found that the carrying capacity for fish cage farming in the area is 290.96 to 727.81 tons (based on total nitrogen) and 428.64 to 1,383.88 tons (based on total phosphorus) from February to August 2011. The maximum number of cobia cages should be, based on total nitrogen, from 64 to 266 and, based on total phosphorus, from 94 to 253. Moreover, this study examined the possibility of remote sensing and geographic information system (GIS) technique based on Object-based Image Analysis (OBIA) method by THEOS imagery for mapping of cage culture facilities and detect the location for cobia cage culture in study area.	Nguyen, H.D., Wenresti, G. G., Nitin, K.T., Truong, H.M.	Journal of Vietnamese Environment 4, 12–19	2013	Cage Culture Commercial Nutrient Impacts Water Quality
304	Purification and characterization of a phospholipase by <i>Photobacterium damsela</i> subsp. <i>piscicida</i> from cobia <i>Rachycentron canadum</i>	Toxicity of the extracellular products (ECPs) and the lethal attributes of phospholipase secreted by pathogenic <i>Photobacterium damsela</i> subsp. <i>piscicida</i> from cobia <i>Rachycentron canadum</i> was studied. An extracellular lethal toxin in the ECPs was partially purified by using Fast Protein Liquid Chromatography system. A protein band (27 kDa) exhibited phospholipase activity on Native-PAGE (by 0.3% egg yolk agar-overlay), was excised and eluted. The pI value of the purified phospholipase was determined as 3.65 and was determined as a phospholipase C by using the Amplex™ Red phosphatidylcholine -Specific phospholipase C Assay kit. The phospholipase showed maximum activity at temperature around 4–40 °C and maximal activity at pH between 8 and 9. The enzyme was inhibited by ethylenediamine-tetraacetic acid (EDTA) and sodium dodecyl sulfate (SDS); but was activated by Ca ²⁺ and Mg ²⁺ and inactivated by Zn ²⁺ and Cu ²⁺ . Both the ECPs and phospholipase were hemolytic against erythrocytes of cobia and lethal to the fish with LD50 values of 3.25 and 0.91 µg protein g ⁻¹ fish, respectively. In toxicity neutralization test, the rabbit antisera against the phospholipase could neutralize the toxicity of ECPs, indicating that the phospholipase is a major extracellular toxin produced by the bacterium.	Hsu, P.-Y., Lee, K.-K., Hu, C.-C., Liu, P.-C.	Journal of Basic Microbiology 54, 969–975	2014	Fish Health Microbiology
305	Reanalysis and revision of the complete mitochondrial genome of <i>Rachycentron canadum</i> (Teleostei, Perciformes, Rachycentridae)	The complete mitochondrial genome of cobia, <i>Rachycentron canadum</i> , was reanalyzed and revised. The genome is 18,008bp in length, containing 13 protein-coding genes, 2 ribosomal RNA (rRNA) genes, 22 transfer RNA (tRNA) genes, and a control region or displacement loop (D-loop). The gene arrangement is identical to that observed in most vertebrates. Base composition on the heavy strand is 30.14% A, 25.22% C, 15.80% G and 28.84% T. The D-loop region exhibits an A+T rich pattern, containing short tandem repeats of TATATACATGG, TATATGCACAA and TATATGCACGG. The mitochondrial genome studied differs from the previously published genome in two segments; the control region to 12S and ND5 to tRNAGlu. The 12S sequence also differs from those published in the databases. Phylogeny analyses revealed that the differences could be due to errors in sequence assembly and/or sample misidentification of the previous studies.	Musika, J., Khongchatee, A., Phinchongsakuldit, J.	Mitochondrial DNA 25, 249–250	2014	Genetics/Molecular
306	Effects of supplemental coated or crystalline methionine in low-fishmeal diet on the growth performance and body composition of juvenile cobia <i>Rachycentron canadum</i> (Linnaeus)	We evaluated the effects of supplemental coated and crystalline methionine (Met) on the growth performance and feed utilization of juvenile cobia (<i>Rachycentron canadum</i> Linnaeus) in a 60-d feeding trial. Fish groups were fed one of six isonitrogenous and isolipidic diets: 1) fishmeal control; 2) un-supplemented experimental (low-fish-meal diet deficient in Met); or 3) one of four Met diets supplemented with crystalline L-Met, cellulose-acetate-phthalate coated L-Met, acrylic-resin coated L-Met, or tripalmitin-polyvinyl alcohol coated L-Met. The test diets were fed to triplicate groups of cobia (initial body weight 5.40±0.07 g) twice a day. The weight gain and specific growth rate of the fish fed the RES diet were highest among the Met-supplemented groups and were 23.64% and 7.99%, respectively, higher than those of the fish fed with the un-supplemented experimental diet (<i>P</i> <0.05). The protein efficiency ratio of the fish fed the MET diet was significantly higher than that of the fish fed the un-supplemented experimental diet and the fish in the other methionine supplementation groups (<i>P</i> <0.05). Our results suggest that supplementation of crystalline Met in low-fish-meal diets promotes the growth performance of juvenile cobia.	Chi, S., Tan, B., Dong, X., Yang, Q., Liu, H.	Chinese Journal of Oceanology and Limnology 32, 1297–1306	2014	Fish Health Nutrition
307	Evaluating the protective efficacy of antigen combinations against <i>Photobacterium damsela</i> ssp. <i>piscicida</i> infections in cobia, <i>Rachycentron canadum</i> L	Cobia, <i>Rachycentron canadum</i> L., is a very important aquatic fish that faces the risk of infection with the bacterial pathogen <i>Photobacterium damsela</i> ssp. <i>piscicida</i> , and there are few protective approaches available that use multiple antigens. In the present study, potent bivalent antigens from <i>P. damsela</i> ssp. <i>piscicida</i> showed more efficient protection than did single antigens used in isolation. In preparations of three antigens that included recombinant heat shock protein 60 (rHSP60), recombinant α-enolase (rENOLASE) and recombinant glyceraldehyde-3-phosphate dehydrogenase (rGAPDH), we analysed the doses that elicited the best immune responses and found that this occurred at a total of 30 µg of antigen per fish. Subsequently, vaccination of fish with rHSP60, rENOLASE and rGAPDH achieved 46.9, 52 and 25% relative per cent survival (RPS), respectively. In addition, bivalent subunit vaccines – combination I (rHSP60 + rENOLASE), combination II (rENOLASE + rGAPDH) and combination III (rHSP60 + rGAPDH) – were administered and the RPS in these groups (65.6, 64.0 and 48.4%, respectively), was higher than that achieved with single-antigen administration. Finally, in combination IV, the trivalent vaccine rHSP60 + rENOLASE + rGAPDH, the RPS was 1.6%. Taken together, our results suggest that combinations of two antigens may achieve a better efficiency than monovalent or trivalent antigens, and this may provide new insights into pathogen prevention strategies.	Ho, L.-P., Chang, C.-J., Liu, H.-C., Yang, H.-L., Lin, J.H.-Y.	Journal of Fish Diseases 37, 51–62	2014	Fish Health Microbiology Genetics/Molecular Physiology

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
308	Cobia <i>Rachycentron canadum</i> L. reared in low-salinity water: Does dietary sodium chloride affect growth and osmoregulation?	The effects of NaCl supplementation (0.0%, 2.5%, 5.0%, 7.5% and 10.0% dry weight of a basal diet) on growth, gill histological alterations and osmoregulation of juvenile cobia reared in low-salinity water (5 g L ⁻¹) were assessed. At the end of the experiment, gills were sampled for Na ⁺ , K ⁺ -ATPase activity determination and histological evaluation. In all treatments, no mortality was observed. Results showed that dietary NaCl supplementation did not alter growth. At the highest supplementations (7.5% and 10.0%), juvenile cobia showed higher feed intake and feed conversion ratio. Na ⁺ , K ⁺ -ATPase activity was higher in fish fed the diet without salt supplementation than in those fed with NaCl-supplemented diets. The number of chloride cells significantly increased with increasing dietary salt level, being 2.5-fold higher in fish fed with 10.0% NaCl supplementation (41 cells mm ⁻²) than in those from the non-supplemented fed group (16 cells mm ⁻²). These findings indicate that dietary salt supplementation stimulated chloride cell proliferation paralleled with a reduction in the gill Na ⁺ , K ⁺ -ATPase activity, suggesting a possible decrease in energy consumption associated with osmoregulation. However, the suggested energy sparing did not have a significant impact on juvenile cobia growth.	Santos, R.A., Bianchini, A., Jorge, M.B., Romano, L.A., Sampaio, L.A., Tesser, M.B.	Aquaculture Research 45, 728–735	2014	Fish Health Nutrition Physiology
309	The effect of TLR9 agonist CpG oligodeoxynucleotides on the intestinal immune response of cobia (<i>Rachycentron canadum</i>)	Cytosine-guanine oligodeoxynucleotide (CpG ODN) motifs of bacterial DNA are recognized through toll-like receptor 9 (TLR9) and are potent activators of innate immunity. However, the interaction between TLR9 and CpG ODN in aquatic species has not been well characterized. Hence, cobia TLR9 isoform B (RCTLR9B) was cloned and its expression and induction in intestine were investigated. RCTLR9B cDNA consists of 3113bp encoding 1009 amino acids containing three regions, leucine rich repeats, transmembrane domain, and toll/interleukin-1 receptor (TIR) domain. Intraperitoneal injection of CpG ODN 2395 upregulated RCTLR9 A and B and MyD88 and also induced the expressions of Mx, chemokine CC, and interleukin IL-1 β . Cobia intraperitoneally injected with CpG ODN 1668 and 2395 had increased survival rates after challenge with <i>Photobacterium damsela</i> subsp. <i>piscicida</i> . In addition, formulation of CpG ODN with formalin-killed bacteria (FKB) and aluminum hydroxide gel significantly increased expressions of RCTLR9 A (50 folds) and B (30 folds) isoforms at 10 dpi (CpG ODN 1668) and MyD88 (21 folds) at 6 dpv (CpG ODN 2395). Subsequently, IL-1 β increased at 6 dpv in 1668 group. No histopathological damage and inflammatory responses were observed in the injected cobia. Altogether, these results facilitate CpG ODNs as an adjuvant to increase bacterial disease resistance and efficacy of vaccines in cobia.	Byadgi, O., Puteri, D., Lee, J.-W., Chang, T.-C., Lee, Y.-H., Chu, C.-Y., Cheng, T.-C.	Journal of Immunology Research 2014, 1–15	2014	Fish Health Genetics/Molecular Physiology Microbiology
310	Potentially pathogenic bacteria isolated from beijupir (<i>Rachycentron canadum</i>) offshore system cultured [Portuguese]	Aiming at the isolation, identification and evaluation of antimicrobial resistance profile of potentially pathogenic bacteria from marine fish Beijupir <i>Rachycentron canadum</i> , 30 and 74 strains of <i>Vibrio</i> and <i>Aeromonas</i> were isolated from brain liver and kidney of 74 beijupira apparently healthy fingerlings and juveniles grown in offshore system in Pernambuco/Brazil. Sampling was performed between November 2010 and July 2011. The isolated species were <i>Vibrio alginolyticus</i> , <i>V. cincinnatiensis</i> , <i>V. fischeri</i> , <i>V. ichthyocentri</i> , <i>V. mediterranei</i> , <i>V. natriegens</i> , <i>V. natriegens</i> NCMB 1900 <i>Vibrio</i> spp., and <i>Aeromonas media</i> , <i>A. salmonicida</i> , <i>A. salmonicida</i> spp. <i>salmonicida</i> , <i>A. salmonicida</i> spp. <i>achromogenes</i> <i>A. schubertii</i> , <i>A. sobria</i> , <i>A. veronii</i> spp. <i>veronii</i> , <i>A. veronii</i> spp. <i>sobria</i> and <i>Aeromonas</i> spp. All isolates were susceptible to enrofloxacin (5 μ g), tetracycline (30 μ g), chloramphenicol (30 μ g), florfenicol (30 μ g) and gentamicin (30 μ g) other <i>Vibrio</i> spp. demonstrated that multiple resistance. On exposure to ampicillin (10mg), <i>Vibrio fischeri</i> was just sensitive. Due to the isolation of pathogenic bacteria in sterile organs in quantity and high variety, it is concluded that beijupiras, although apparently healthy, are infected with potentially pathogenic bacteria to fish and humans, with high level of sensitivity to most drugs tested.	Nascimento, D.L., Barros, C. N., Silva, A.D.R., Guimares, J.M., Pedrosa, V.F., Mendes, E.S.	Medicina Veterinria (Brazil) 8, 12–21	2014	Fish Health Microbiology
311	Characteristics and chemical composition of skins gelatin from cobia (<i>Rachycentron canadum</i>)	Gelatin was obtained from cobia (<i>Rachycentron canadum</i>) skins, which is an important commercial species for marine fish aquaculture, and it was compared with gelatin from croaker (<i>Micropogonias furnieri</i>) skins, using the same extraction methodology (alkaline/acid pre-treatments). Cobia skins gelatin showed values of protein yield, gelatin yield, gel strength, melting point, gelling point and viscosity higher than the values found from croaker skins gelatin. The values of turbidity and Hue angle for cobia and croaker gelatins were 403 and 74 NTU, and 84.8° and 87.3°, respectively. Spectra in the infrared region had the major absorption band in the amide region for both gelatins, but it showed some differences in the spectra. The proline and hydroxyproline contents from cobia skins gelatin (205 residues/1000 residues) was higher than from croaker skins gelatin (188 residues/1000 residues). SDS-PAGE of both gelatins showed a similar molecular weight distribution to that of standard collagen type I. Therefore, cobia skins could be used as a potential marine source of gelatin obtainment for application in diversified industrial fields.	Silva, R.S.G., Bandeira, S.F., Pinto, L.A.A.	LWT - Food Science and Technology 57, 580–585	2014	Nutrition
312	Reproductive performance of cobia (<i>Rachycentron canadum</i>) captured of Pernambuco, Brazil	The reproductive performance of wild cobia caught off the coast of Pernambuco, northeastern Brazil, was assessed. Six breeders (two females with 14-16kg and four males with approximately 12kg each) were maintained in a 70 ton tank from October to June and produced 48.7 million eggs. Females were able to spawn every 11.9 days (\pm 2.9), which resulted in 21 spawns. On average each spawn produced 2.4 million eggs with a fertilization of 52.4%, which resulted in approximately 1.0 million larvae per spawn. The present results demonstrate the feasibility of the methodology employed here in the formation and management of a cobia breeding stock and confirm the ease of spawning cobia in captivity. It was also confirmed that the spawning season may be extended under captivity when compared to the wild stock. This is the first report on the reproductive performance of cobia in captivity in Brazil.	Peregrino, R.B., Hamilton, S., Domingues, E.C., Manzella, J.C., Hazin, F.H.V., Cavalli, R.O.	Arquivo Brasileiro de Medicina Veterinria e Zootecnia 66, 681–687	2014	Spawning Wild (Atlantic/Pacific)
313	Probiotic effects on cobia <i>Rachycentron canadum</i> larvae reared in a recirculating aquaculture system	Cobia (<i>Rachycentron canadum</i>) is a marine finfish with good potential for mariculture. This study analyzes the effects of probiotic <i>Bacillus</i> spp. on the performance of cobia larvae reared in a recirculating aquaculture system (RAS). Larvae were stocked into two independent RAS for 26 days after hatching. One of the systems (Probiotic treatment) received the addition of a commercial probiotic consisting of <i>B. subtilis</i> , <i>B. licheniformis</i> and <i>B. pumilus</i> directly into the water and by live feed. Survival, final weight and water quality were not affected by probiotics. Results showed larvae of the probiotic treatment demonstrated a greater resistance to salinity stress. Immunohistochemical analysis showed a higher expression of CD4 in probiotic treatment. These results suggest that <i>Bacillus</i> spp. probiotics used in RAS have a potential stimulating impact on immune system differentiation and increases salinity stress resistance of cobia larvae.	Garrido-Pereira, M.A., Schwarz, M., Delbos, B., Rodrigues, R.V., Romano, L., Sampaio, L.	Latin American Journal of Aquatic Research 42, 1169–1174	2014	Culture RAS Fish Health Microbiology
314	Bioeconomics of cobia, <i>Rachycentron Canadum</i> , culture in Vietnam	This article presents an analysis of the profitability and intensity of cobia culture by small-scale farmers in Vietnam, especially focusing on current feeding practices and perceptions regarding adoption of manufactured diets. Bioeconomic modelling is used so the interactions between biological and economic processes can be analyzed. Overall, it is found that cobia farming is moderately to highly profitable when compared to other aquaculture species in Vietnam. Culture practices and the level of intensity of cobia farming differ significantly across Vietnam. Initial stocking density, total number of fish stocked, number and size of cages, and quantity of feed used are all higher in southern Vietnam than the north. The higher level of intensification in the south leads to significantly higher total costs, productivity and profitability. The dominant cost source is feed, which is predominantly low-value fish. To capture the environmental and potential economic benefits of adopting pelleted diets, then negative farmer perceptions regarding relatively slow growth rates, and lack of availability compared with low-value fish need to be overcome.	Petersen, E.H., Luan, T.D., Chinh, D.T.M., Tuan, V.A., Binh, T.Q., Van Truc, L., Glencross, B.D.	Aquaculture Economics & Management 18, 28–44	2014	Culture Commercial
315	Dietary arginine requirement of juvenile cobia (<i>Rachycentron canadum</i>)	A 9-week feeding trial was conducted to estimate the dietary requirement of arginine in juvenile cobia in indoor flow-through and aerated aquaria. Six isonitrogenous and isoenergetic practical diets were formulated to contain graded levels of arginine ranging from 1.76% to 3.75% (dry weight) at about 0.4% increments replaced by equal proportions of glycine. Survival was not significantly different among dietary treatments. Specific growth rate (SGR) and feed efficiency ratio (FER) increased with increasing dietary arginine up to the 2.96% diet ($P < 0.05$), and thereafter declined. The whole body crude protein content was significantly affected by dietary arginine ($P < 0.05$), while moisture, crude lipid and ash showed no significant differences among dietary treatments. The essential amino acid contents of muscle were not significantly affected by dietary arginine. The serum nitric oxide synthase activities in fish fed diets with arginine from 2.18% to 3.75% were significantly higher than activities in fish fed the diet with 1.76% arginine ($P < 0.05$). On the basis of SGR and FER, the optimal dietary arginine requirements of juvenile cobia were estimated to be 2.85% of the diet (6.20% of dietary protein) and 2.82% of the diet (6.13% of dietary protein), respectively, using second-order polynomial regression analysis.	Ren, M., Ai, Q., Mai, K.	Aquaculture Research 45, 225–233	2014	Fish Health Nutrition
316	Unusual dispersion of histone repeats on the whole chromosomal complement and their colocalization with ribosomal genes in <i>Rachycentron canadum</i> (Rachycentridae, Perciformes)	<i>Rachycentron canadum</i> , the only representative of the family Rachycentridae, has been the focus of biotechnological interest due to its significant potential in marine fish farming. The chromosome set of this species has been widely investigated with respect to the location of genes and multigene families. A FISH analysis was performed using 4 multigene families as probes, represented by 5S and 18S ribosomal genes and histones H2B-H2A and H3. Earlier data suggested that differential replication of heterochromatin could be partially associated with functional genes. Indeed, our results showed that the DNA contained in heterochromatic regions of <i>R. canadum</i> contains 5S and 18S ribosomal genes as well as the gene sequences of histones H2B-H2A and H3, which were colocalized. The distribution of H3 sequences in all heterochromatic regions, except in 13a, could indicate an important evolutionary role for this class of repetitive sequences. Besides, the presence of chromosome regions bearing multifunctional repetitive sequences formed by H2B-H2A/H3/18S rDNA and H2B-H2A/H3/5S rDNA clusters was demonstrated for the first time in fishes. The implications of differential histone gene extension and its functionality in the karyotype of <i>R. canadum</i> remain unknown.	Costa, G.W.W.F., Cioffi, M. B., Bertollo, L.A.C., Molina, W.F.	Cytogenetic and Genome Research 144, 62-67	2014	Genetics/Molecular
317	Population genetics of cobia (<i>Rachycentron canadum</i>): Implications for fishery management along the coast of the southeastern United States	Cobia (<i>Rachycentron canadum</i>) is a pelagic, migratory species with a transoceanic distribution in tropical and subtropical waters. Recreational fishing pressure on Cobia in the United States has increased substantially during the last decade, especially in areas of its annual inshore aggregations, making this species potentially susceptible to overfishing. Although Cobia along the Atlantic and Gulf coasts of the southeastern United States are currently managed as a single fishery, the genetic composition of Cobias in these areas is unclear. On the basis of a robust microsatellite data set from collections along the U.S. Atlantic coast (2008-09), offshore groups were genetically homogenous. However, the 2 sampled inshore aggregations (South Carolina and Virginia) were genetically distinct from each other, as well as from the offshore group. The recapture of stocked fish within their release estuary 2 years after release indicates that some degree of estuarine fidelity occurs within these inshore aggregations and supports the detection of their unique genetic structure at the population level. These results complement the observed high site fidelity of Cobias in South Carolina and support a recent study that confirms that Cobia spawn in the inshore aggregations. Our increased understanding of Cobia life history will be beneficial for determining the appropriate scale of fishery management for Cobia.	Darden, T.L., Walker, M.J., Brenkert, K., Yost, J.R., Denson, M.R.	Fishery Bulletin 112, 24–35	2014	Genetics/Molecular Wild (Atlantic/Pacific)
318	The effect of feeding frequency on growth performance of juvenile cobia, <i>Rachycentron canadum</i> (Linnaeus, 1766)	The present study was carried out to investigate the number of daily feeding sessions that results in maximum growth of juvenile cobia under laboratory conditions. Groups of eight fish (110 g) were randomly distributed in twenty 500-L tanks and hand-fed a commercial diet for 60 days. The same amount of feed was offered daily, divided in 1, 2, 3, four or six meals. None of the parameters associated with growth performance (survival, weight gain, specific growth rate, feed intake, condition factor or size variation) showed any significant differences among treatments. Although under the present conditions feeding frequency had no effect on the growth performance of cobia larger than 110 g, in commercial farming operations where large numbers of fish are kept within a single rearing structure, fish may have aggressive interactions during feeding. Under these conditions, it is difficult to ensure that all cobia are fed to satiation and thus it is usual to provide two or more meals per day. The present results indicate that for an individual cobia the provision of more than one daily meal has no significant effect on growth performance.	Costa-Bomfim, C.N., Pessoa, W.V.N., Oliveira, R. L.M., Farias, J.L., Domingues, E.C., Hamilton, S., Cavalli, R.O.	Journal of Applied Ichthyology 30, 135–139	2014	Culture Fish Health Nutrition
319	Identification and expression analysis of cobia (<i>Rachycentron canadum</i>) Toll-like receptor 9 gene	Cobia culture is hindered by bacterial infection (<i>Photobacterium damsela</i> subsp. <i>piscicida</i>) and in order to study the effect of <i>P. damsela</i> subsp. <i>piscicida</i> challenge and CpG ODN stimulation on cobia Toll like receptor 9 (RCTLR9), we used PCR to clone RCTLR9 gene and qRT-PCR to quantify gene expression. The results indicated that RCTLR9 cDNA contains 3141 bp. It encodes 1047 amino acids containing 16 typical structures of leucine-rich repeats (LRRs) including an LRR-TYP, LRR-CT and a motif involved in PAMP binding was identified at position 240–253 amino acid. Broad expression of RCTLR9 was found in larval, juvenile and adult stages irrespective of the tissues. In larval stage, RCTLR9 mRNA expression decreased at 5 d and then increased at 10 dph. At juvenile stage cobia, the expression was significantly high ($p < 0.05$) in spleen and intestine compared to gill, kidney, liver and skin. However, at adult stage, the significant high expression was found in gill and intestine. Cobia challenged with <i>P. damsela</i> subsp. <i>piscicida</i> showed significant increase in RCTLR9 expression at 24 h post challenge in intestine, spleen and liver, while in kidney the expression was peak at 12 h and later it decreased at 24 h. The highest expression was 40 fold increase in spleen and the lowest expression was ~3.6 fold increase in liver. Cobia stimulated with CpG oligonucleotides showed that the induction of these genes was CpG ODN type and time dependent. In spleen and liver, CpG ODNs 1668 and 2006 injected group showed high expression of RCTLR9, IL-1 β , chemokine CC compared to other groups. Meanwhile, CpG ODN 2006 has induced high expression of IgM. The CpG ODNs 2395 have induced significant high expression of Mx in spleen and liver. These results demonstrates the potential of using CpG ODN to enhance cobia resistance to <i>P. damsela</i> subsp. <i>piscicida</i> infection and use as an adjuvant in vaccine development.	Byadgi, O., Puteri, D., Lee, Y.-H., Lee, J.-W., Cheng, T.-C.	Fish & Shellfish Immunology 36, 417–427	2014	Genetics/Molecular Fish Health Microbiology Physiology

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
320	Imbalanced lysine to arginine ratios reduced performance in juvenile cobia (<i>Rachycentron canadum</i>) fed high plant protein diets	Cobia (8.4 ± 0.1 g body weight) were fed to satiation with three test diets of high plant protein-based ingredients and different lysine to arginine ratios, and one commercial diet (currently used for cobia rearing in Vietnam as a control for growth) for 6 weeks. The test diets contained 206 g marine ingredients kg ⁻¹ , including fishmeal, krill meal and fish protein concentrate (in order of high to low inclusion), while the rest of the dietary protein was a blend of soya and pea protein concentrate, wheat protein and sunflower meal. Crystalline lysine and arginine were added in the test diets to produce either a balanced lysine to arginine ratio (BL/A; 1.1) and a high or low lysine to arginine ratio (HL/A; 1.8 and LL/A; 0.8, respectively). There were no significant differences in final body weight, weight gain, feed conversion ratio or protein gain between cobia fed BL/A- and commercial control diet (CCT). Cobia fed BL/A diet performed better than fish fed either HL/A- or LL/A diet. This was partly due to a higher feed intake and protein and lipid gain in cobia fed BL/A diet as compared to HL/A- and LL/A diet.	Van Nguyen, M., Rønnestad, I., Buttler, L., Van Lai, H., Espe, M.	Aquaculture Nutrition 20, 25–35	2014	Fish Health Nutrition
321	Species specific in vitro protein digestion (pH-stat) for fish: Method development and application for juvenile rainbow trout (<i>Oncorhynchus mykiss</i>), cobia (<i>Rachycentron canadum</i>), and Nile tilapia (<i>Oreochromis niloticus</i>)	Aqua feed manufacture requires flexible formulations and effective methods to screen suitable feed ingredients. <i>In vitro</i> digestion may assist in the characterization and quality control of protein in feedstuffs for fish species once standardized species-specific digestive enzyme extracts are available. This study aimed to develop a species-specific <i>in vitro</i> enzymatic method to assess protein digestion in fish under the pH-stat concept. Two carnivorous (rainbow trout, <i>Oncorhynchus mykiss</i> , and cobia, <i>Rachycentron canadum</i>) and one omnivorous (Nile tilapia, <i>Oreochromis niloticus</i>) fish species were used as models. Crude digestive enzyme extracts were recovered from stomach and pyloric caeca or intestine of individuals of different weight groups, feeding status, and farming systems. The hydrolytic capacity of the species-specific enzyme extracts was standardized on purified protein substrates and measured as degree of protein hydrolysis (DH) in the pH-stat assay. A group of twenty-four feed ingredients, including fish meals and by-products of plant and animal origin, was assessed for DH using the recovered enzymes from stomach and pyloric caeca/intestine. Ingredients were hydrolyzed with fish (i) stomach extract, (ii) pyloric caeca/intestine extract or (iii) stomach enzymes followed by pyloric caeca/intestine extract. Among plant by-products, cotton seed meal presented the highest DH with stomach plus pyloric caeca/intestine enzymes, followed by soy protein concentrate and soybean meals. Blood meals were the land animal by-product with higher DH outputs compared to poultry by-product meals and feather meals. No significant difference was observed among the DHs of fish meals. The significance of measuring the DH with stomach enzyme extract is still not well understood but, overall, the pre-hydrolysis of feedstuffs with stomach enzymes increased pyloric caeca/intestine DH value. For cage and pond farmed Nile tilapia, ingredient DHs followed the same trend, describing a significant correlation and a high determination coefficient regression. Routine use of the method may yet depend on the prompt availability of more practical sources of enzymes. The determination of the degree of protein hydrolysis by the <i>in vitro</i> pH-stat with species-specific enzymes has shown to be a precise method that may be a useful tool to rank feed ingredients, and also an accessory method in the quality control of feedstuffs.	Yasumaru, F., Lemos, D.	Aquaculture 426–427, 74–84	2014	Fish Health Nutrition Physiology
322	Effects of water temperature and fish size on growth and bioenergetics of cobia (<i>Rachycentron canadum</i>)	The effects of water temperature at 23, 27, 31, 33 and 35 °C on growth and bioenergetics of cobia <i>Rachycentron canadum</i> with initial body weights about 10, 30, 70 and 200 g were investigated in this paper. Food consumption, fecal production, nitrogenous excretion, growth rate and metabolic rate of cobia were affected significantly by both water temperature and fish size. However, the relationships between food energy and feces, excretion, growth and metabolism energy exhibited linear curves and seemed independent of water temperature and fish size in the present study. For each fish size growth increased with temperature up to 33 °C and then declined at 35 °C. The optimal temperature for growth (Topt.G) of 10–200 g cobia was 33 °C. For each water temperature growth was negatively correlated to fish size and the model, SGR = a + blnW or SGR = aWb, provided a good fit to the data obtained for 10–200 g cobia. Food conversion efficiency (FCE) was highest at 31 °C and lowest at 35 °C for each size cobia. The optimal temperature for FCE (Topt.FCE) of 10–200 g cobia was 31 °C. An increasing trend of FCE with fish size was seen at each temperature and indicated that larger cobia had a superior capacity of food utilization. Energy budgets of cobia were also influenced significantly by water temperature and fish size. However, energy budgets were relatively constant over the 27–33 °C temperature and 70–200 g size ranges for cobia. Over the whole temperature and size ranges the proportion of food energy lost in feces and excretion for cobia was small (< 15%) and a large proportion of food energy was allocated to growth and metabolism. The ratios of metabolism energy to assimilated energy (range: 57–84%, average: 69%) were much higher than the ratios of growth energy to assimilated energy. For cobia fast growth was attributable mainly to large food consumption though improved energy utilization with increased fish size at 27–33 °C made a certain contribution.	Sun, L., Chen, H.	Aquaculture 426–427, 172–180	2014	Fish Health Culture Bioenergetics
323	Optimization of Enzymatic Protein Hydrolysis from Cobia (<i>Rachycentron canadum</i>) Frame Using Alcalase®	The combined effects of hydrolysis time, temperature, pH, and ratio of enzyme to substrate on the degree of hydrolysis (DH) of cobia frame were determined using Response Surface Methodology. The effects of these factors were employed using a three-level factors face-centered central composite design. The proximate compositions of cobia frame and cobia hydrolysate powder were determined as well. The generated model equation gave a quadratic fit with experimental data. It is suggested that hydrolysis conditions for obtaining the optimum DH using Alcalase® were: temperature of 58°C, hydrolysis time of 134 min, pH of substrate at 9.4, and an enzyme concentration of 8.3%. Proximate analyses revealed that cobia frame contained 47.0% protein, 27.6% fat, and 24.8% ash; whereas cobia frame hydrolysate powder contained 88.8% protein, 0.58% fat, and 5.05% ash. The high protein content indicated that cobia frame hydrolysate is a potential ingredient for food and feed.	Amiza, M.A., Mohamad, J., Hasan, R.	Journal of Aquatic Food Product Technology 23, 303–312	2014	Nutrition
324	Genetic characteristics of <i>Streptococcus dysgalactiae</i> isolated from cage cultured cobia, <i>Rachycentron canadum</i> (L.)	Disease outbreaks occurred during 2007–2013 in Taiwan with 2.5–10% mortality among the cage cultured cobia, <i>Rachycentron canadum</i> (L.), characterized by the presence of polyserositis, pericarditis and peritonitis. The micro-organisms isolated from internal organs were Gram-positive cocci. The isolates were confirmed as <i>Streptococcus dysgalactiae</i> by a polymerase chain reaction assay that yielded the expected specific 259 bp amplicon. Additionally, partial sequence of the 16S–23S rDNA intergenic spacer region of the GCS strain isolates from fish was also compared and produced 100% sequence identity with <i>S. dysgalactiae</i> (GenBank accession number AB252398). The genetic characterization was then determined by pulsed-field gel electrophoresis (PFGE) analysis. Based on PFGE, the <i>Apa</i> I or <i>Sma</i> I digestion patterns of chromosomal DNA of these isolates were grouped into three main clusters. Taiwanese strains were divided into two clusters, and the <i>tet</i> (M) gene was detected in cluster 1 (pulsotypes: A1–A2 and S1–S3), but not in cluster 2 strains (pulsotypes: A3–A4 and S4–S5). Three Japanese strains from amberjack, <i>Seriola dumerili</i> (Risso), were grouped into cluster 3 (pulsotypes: A5–A7 and S6–S8) and displayed no mortality to cobia in the challenge experiment. Conversely, Taiwanese strains from cobia and snubnose pompano, <i>Trachinotus blochii</i> (L.), displayed a mortality rate of 50–87.5% in cobia.	Tsai, M.-A., Wang, P.-C., Yoshida, T., Chen, S.-C.	Journal of Fish Diseases [In Press]	2014	Fish Health Microbiology Genetics/Molecular
325	Partial replacement of fishmeal, poultry by-product meal and soy protein concentrate with two non-genetically modified soybean cultivars in diets for juvenile cobia, <i>Rachycentron canadum</i>	Fishmeal (FM) replacement in diets for intensive aquaculture has become a high priority area for the global aquaculture industry. In this study, a twelve week growth trial was conducted with juvenile cobia (18 g initial weight) to examine the effects of non-genetically modified soybean meals as potential replacement protein sources. Genetically modified (GM) crops and their intended and unintended effects have become major topics of controversy worldwide, with several regions banning their use in food and feeds. Therefore, it is especially critical to develop and evaluate non-GM feedstuffs for use in aquaculture diets where GM products are prohibited as the global aquaculture industry continues its expansion to meet increasing demands. Navita Premium Feed Ingredients (NPFi's) 3010 solvent extracted meal and 3032 cold-pressed cake meal were utilized to replace 50, 60 or 70% and 40, 50, or 60% of FM protein, respectively and were compared to a FM based reference formulation. None of the experimental diets performed significantly different from the reference diet in terms of weight gain (WG) or specific growth rate (SGR). However the 3010 50% diet performed significantly better than the 3032 50 and 60% diets in regard to WG, SGR, and protein efficiency. There were no significant differences between the seven diets at the conclusion of the trial in regard to their effects on filelet quality as determined by organoleptic testing. These two non-GM soybean protein sources appear to be valuable FM replacement options for juvenile cobia, with none of the typical indicators of intestinal enteritis developing as has been observed in various other teleost species when high quantities of commodity soybean meal have been utilized.	Watson, A.M., Buentello, A., Place, A.R.	Aquaculture 434, 129–136	2014	Fish Health Nutrition
326	Purification, characterization and molecular cloning of alpha-2-macroglobulin in cobia, <i>Rachycentron canadum</i>	Alpha-2-macroglobulin (α-2-M) is a broad spectrum protease inhibitor which is abundant in the plasma of vertebrates and several invertebrates. The α-2-M was purified from cobia (<i>Rachycentron canadum</i>) plasma by a four-step procedure: poly ethylene glycol fractionation, affinity chromatography, hydrophobic interaction chromatography and ion exchange chromatography on Fast Protein liquid chromatography system in the present study. It migrated as one protein band with a molecular mass of about 360 kDa in the native state, whereas in SDS-PAGE it was about 180 kDa under non-reducing condition. This result revealed that the native protein was a dimer. In addition, it was cleaved into two different fragments of molecular mass about 93 and 87 kDa when reduced by dithiothreitol (DTT). The anti-protease activity of the purified α-2-M was apparently decreased as temperature elevated above 50 °C. The α-2-M exhibited highest protease inhibitory activity at pH 9. The results indicate that the α-2-M is a heat-labile and alkaline protease inhibitor. The purified α-2-M exhibited more than 50% protease inhibitory activity against extracellular products (ECP) of <i>Vibrio alginolyticus</i> isolated from diseased cobia. It seems that the protease activities in ECP may be affected by the plasma α-2-M. The protease inhibitory activities of cobia plasma or purified α-2-M were decreased when incubated with 10 mM methylamine for 30 min. The α-2-M cDNA consisted of 4611 bp with an open reading frame of 4374 bp had been cloned from cobia liver. This sequence contained thioester domain (GCGEQ) and thirteen predicted N-linked glycosylation sites. In addition, the amino acid sequence of thioester domain and genes of adjacent regions of cobia α-2-M were further compared with sequences of known fish species in GenBank. The unweighted pair group method using arithmetic average (UPGMA) was employed to construct the phylogenetic trees of α-2-M among different fish species (freshwater fish, sea water fish and primitive fish), and all these fish species were then clustered into three groups. The cobia α-2-M was closer to that of sea water fish than that of freshwater fish compared basing on its similarity of amino acid sequence and phylogenetic analysis of the partial gene.	Chuang, W.-H., Liu, P.-C., Hung, C.-Y., Lee, K.-K.	Fish & Shellfish Immunology 41, 346–355	2014	Fish Health Genetics/Molecular Microbiology
327	Comparison of nutritional value and microbiological status of new imported fish species on the German market	Proximate composition, fatty acid profile, other nutritional values and spoilage indicators were examined in the muscle meat of five species: barramundi (<i>Lates calcarifer</i>) from various origins, tilapia (<i>Oreochromis</i> spp.) of different qualities, cobia (<i>Rachycentron canadum</i>) and leather jacket (<i>Aluterus monoceros</i>) from the Pacific Ocean and Patagonian grenadier (<i>Macruronus magellanicus</i>) from South America. Lowest lipid contents (0.4% and 0.8%) were found in leather jacket and cobia. Leather jacket fillets had lowest protein (16.2%) and highest sodium chloride content (4.9%). Concentrations of ΣEPA + DHA were 0.1 g 100 g ⁻¹ for tilapia and leather jacket, 0.2 g 100 g ⁻¹ for barramundi and cobia and 0.7 g 100 g ⁻¹ for Patagonian grenadier. Barramundi and tilapia were characterised by high taurine content (215 and 276 mg 100 g ⁻¹ ww.), and cobia had only low levels (41 mg 100 g ⁻¹ ww.). Iodine contents were low and selenium levels varied between 303 and 570 µg kg ⁻¹ ww. No sign of spoilage was detected.	Karl, H., Lehmann, I., Manthey-Karl, M., Meyer, C., Ostermeyer, U.	International Journal of Food Science & Technology 49, 2481–2490	2014	Food Safety Nutrition
328	Analysis of quality on modified atmosphere packaged cobia fillet during freezing-point storage [Chinese]	Changes in quality of cobia fillet in freezing-point storage with modified atmosphere packaging (MAP), air packaging (AP) and vacuum packaging (VP) were studied. During the experimental process, some quality indexes such as K value, total bacterial number, TVB-N value, pH value, water holding capacity, drip loss, sensory quality, texture indexes and color were measured. The results showed that, under the MAP condition, it cost 18 d for K value arrive 60% of early corruption by 106 CFU/g of the total number of bacteria, comparing to AP or VP 6d and 2 d were extended respectively. It is 23 d for TVB - N content arrive 0.30 mg/g storing under MAP condition, comparing to AP or VP, 9d and 6 d were extended respectively. Drip loss and pH value of the cobia fillet with MAP increased slowly than with AP or VP. Change rate of water holding capacity, sensory quality, texture and color with MAP was slower than control samples. After the comprehensive comparison of the conclusion: MAP cobia fillet could has a 8~10 days and 2~6 days longer storage time than AP or VP, which showed that MAP cobia fillet during freezing-point storage has the obvious delay the deterioration. It is more suitable for application in high quality cobia fillet storage.	Wu, Y.-Y., Sun, J.-Y., Yang, X.-Q., Ma, H.-X., Huang, H., Cen, J.-W.	Modern Food Science and Technology 30, 117–124 and 230	2014	Food Safety Nutrition
329	Economic feasibility of offshore cobia farming in pernambuco, northeastern Brazil [Portuguese]	The farming of cobia (<i>Rachycentron canadum</i>) in offshore floating cages has been a subject of recent research efforts and commercial ventures in Brazil. This study presents an economic feasibility analysis of an experimental farm off the coast of Pernambuco, northeastern Brazil. Different levels of productivity (5, 10 and 15 kg m ⁻³), sale prices (R\$ 7.00, R\$ 11.00 and R\$ 15.00 kg ⁻¹) and farm size (6, 12 and 24 cages of 1,600 m ³) were considered. Given these scenarios, the offshore farming of cobia will only be profitable when the sale price is R\$ 15.00 kg ⁻¹ and the productivity is equal or higher than 10 kg m ⁻³ . If the sale price is R\$ 11.00 kg ⁻¹ , cobia farming would only be feasible if 15 kg m ⁻³ are produced in 12 or more cages. Feed ranged from 39.8 to 76.4% of operating expenses according to the productivity level. Offshore farming of cobia in northeastern Brazil may be economically feasible, but it becomes more attractive with an increased number of production units. The needs for capital may be beyond the financial means of small/medium-sized producers.	Domingues, E.C., Hamilton, S., Bezerra, T.R.Q., Cavalli, R.O.	Boletim do Instituto de Pesca 40, 237–249	2014	Culture Cage Culture Commercial

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
330	More Judicious Use of Fish Oil in Cobia Feeds: I. Assessing the Relative Merits of Alternative Lipids	Limited availability and high prices underscore the need to use fish oil more judiciously in aquafeeds. Most alternative lipids contain little to no n-3 long-chain (LC) polyunsaturated fatty acids (PUFAs). If alternative lipids are fed exclusively, growth performance may be impaired and tissue fatty acid composition may be altered in fish such as the Cobia <i>Rachycentron canadum</i> . Alternative lipids that are rich in saturated fatty acids (SFAs) and monounsaturated fatty acids (MUFAs) may increase the efficiency of LC-PUFA metabolism and may limit or attenuate the tissue LC-PUFA loss associated with fish oil sparing. Cobias (weight [mean \pm SE] = 77.4 \pm 0.2 g) were fed diets containing either fish oil (control) or a 50/50 blend of fish oil and standard soybean oil, partially hydrogenated soybean oil, fully hydrogenated soybean oil, pork lard, or beef tallow. After 8 weeks, the feed conversion ratio (mean \pm SE = 1.56 \pm 0.04), weight gain (180 \pm 6%), and specific growth rate (1.83 \pm 0.04% of body weight/d) were equivalent among groups. Dietary fatty acid profiles influenced tissue composition; fatty acid profiles of control fish were more similar to those of fish that received higher levels of SFAs and MUFAs than to those of fish that were fed higher levels of C18 PUFAs. The SFA- and MUFA-rich lipids, such as fully hydrogenated soybean oil and beef tallow, may be useful in reducing the fish oil quantities needed in Cobia feeds while maximizing fillet LC-PUFA content.	Woitel, F.R., Trushenski, J. T., Schwarz, M.H., Jahncke, M.L.	North American Journal of Aquaculture 76, 222–231	2014	Fish Health Nutrition
331	Effects of graded taurine levels on juvenile cobia	Taurine, which has multiple important physiological roles in teleost fish and mammals, is an amino acid not found in alternative protein sources not derived from animals. Although taurine is found in fish-meal-based feeds, its high water solubility leads to lower taurine levels in reduction-process-based feeds, which marine carnivores such as Cobia <i>Rachycentron canadum</i> are adapted to in their natural diets. Graded taurine supplementation (0, 0.5, 1.5, and 5.0%) added to a traditional fish-meal-based formulation was examined in two growth trials with Cobia: one initiated with 10-g individuals and the second initiated with 120-g individuals. During the first trial, in which growth as weight gain ranged from 123 to 139 g per fish, there was an increase in dietary taurine and a decrease in the feed conversion ratio from 1.04 to 0.99. During the second trial, in which growth ranged from 227 to 313 g gained per fish, there was no significant difference in performance characteristics between dietary treatments. Messenger RNA transcript expression levels for two of the genes involved in taurine synthesis, cysteine dioxygenase (CDO) and cysteamine dioxygenase (ADO), as well as the membrane-bound taurine transporter, TauT, were also measured at the conclusion of the second trial. Increasing dietary taurine in a diet containing 34.5% fish meal did not result in significantly different growth or production characteristics in Cobia, but did result in significantly increased taurine levels in fillet, liver, and plasma.	Watson, A.M., Barrows, F. T., Place, A.R.	North American Journal of Aquaculture 76, 190–200	2014	Fish Health Nutrition Genetics/Molecular
332	Two novel strains of bacteriocin-producing <i>Lactobacillus plantarum</i> and their application as biopreservative in chill-stored fresh cobia meat	The use of bacteriocins as a biopreservative has been shown to be effective in the control of food pathogenic and spoilage microorganisms. This research aims to screen novel strains of bacteriocin-producing lactic acid bacteria and investigate their application for the preservation of chilled fresh cobia meat. Among a total of 69 strains of lactic acid bacteria isolated from traditional Vietnamese fermented cabbage, two strains T8 and T13 were found to express the broadest, strongest and supplemented inhibitory spectra against 16 indicator strains of food-borne pathogenic and spoilage bacteria. Their bacteriocins may belong to Class I (Lantibiotic), which remain active at 121°C for 15 min, at pH 4–10 and with proteinase K but deactivated by α -chymotrypsin treatment. These two strains were identified as <i>Lactobacillus plantarum</i> using a combined genotypic and phenotypic analysis. The application of culture extract from the strain T13 with cell concentration of 1010 CFU/ml or crude bacteriocin extract from the strain T8 with bacteriocin activity of 800 AU/ml was shown to prolong the chilling preservation of fresh cobia meat compared to control within first 7 days. To our knowledge, this is the first study that has used bacteriocin or its producer as a biopreservative in fresh cobia meat.	Nguyen, V.D., Pham, T.T., Pham, N.M.Q.	Journal of Pure and Applied Microbiology 8, 1547–1557	2014	Food Safety Nutrition Microbiology
333	More judicious use of fish oil in cobia feeds: II. Effects of graded fish oil sparing and finishing	Replacement of long-chain (LC) polyunsaturated fatty acid (PUFA)-rich fish oil with alternative lipids in aquafeeds typically reduces the LC-PUFA content and associated nutritional value of farmed fish even if production performance is unaffected. Finishing can be used to augment tissue LC-PUFA levels prior to harvest; however, the effectiveness of this strategy for use with the Cobia <i>Rachycentron canadum</i> is relatively unknown. For 8 weeks, Cobias (initial weight [mean \pm SE] = 59.8 \pm 0.2 g) were fed diets in which the supplemental lipid consisted of 100% fish oil; 100% beef tallow; a blend of 33% beef tallow and 67% fish oil; or a blend of 67% beef tallow and 33% fish oil. After the 8-week grow-out period, all treatment groups received the 100% fish oil feed for 6 weeks to simulate finishing. Differences in production performance were observed, but growth and growth efficiency were not reduced by inclusion of beef tallow in the grow-out feeds. Prior to the finishing period, fatty acid profiles of fillet, liver, eye, and brain tissues varied considerably among treatments. As finishing progressed, tissue profiles converged on the profiles of fish that were fed the 100% fish oil diet exclusively. Specifically, saturated fatty acids (SFAs) and monounsaturated fatty acids (MUFAs) declined, whereas LC-PUFA levels varied relatively little during the trial. Results indicate that SFA- and MUFA-rich alternative lipids like beef tallow minimize LC-PUFA loss during grow-out and that finishing feeds can be used to modify Cobia tissue profiles prior to harvest.	Woitel, F.R., Trushenski, J. T., Schwarz, M.H., Jahncke, M.L.	North American Journal of Aquaculture 76, 232–241	2014	Fish Health Nutrition
334	Evaluation of a high plant protein test diet for juvenile cobia <i>Rachycentron canadum</i> in comparison to commercial diets	Cobia culture is hampered by a lack of feeding protocols and optimized diets. The present study was conducted to evaluate whether a plant based protein test diet (TD) containing low amounts of fishmeal (108 g kg ⁻¹ diet) would support growth in juvenile cobia at similar levels as two commonly used commercial diets available in Vietnam, CD1 and CD2. The TD diet contained 206 g kg ⁻¹ marine (fishmeal, krill meal and fish protein concentrate) and a blend of plant ingredient and added crystalline lysine and arginine to fulfill the predicted requirements. Cobia (9.3 \pm 0.1 g initial body weight) were fed to satiation for four weeks and more than tripled their initial body weight for all treatments. No significant differences in weight gain (WG), feed conversion ratio (FCR), or, protein gain, were observed between cobia fed TD or CD2. However, cobia fed CD2 deposited more lipid than cobia fed TD diet. Cobia fed TD had better WG, FCR and protein gain than cobia fed CD1, while lipid gain was less in fish fed TD. No differences in plasma amino acid profiles of 24 h-unfed cobia were observed between cobia fed any of the three diets. In summary, the results show that juvenile cobia tolerate diets with low fishmeal content provided dietary amino acid profiles are balanced towards the anticipated requirements.	Nguyen, M.V., Rønnestad, I., Buttle, L., Van Lai, H., Espe, M.	Journal of Agricultural and Crop Research 2, 117–125	2014	Nutrition Fish Health Culture
335	Hepatic steatosis in cage-reared young cobia, <i>Rachycentron canadum</i> (Linnaeus, 1766), in Brazil	This article discusses the pathophysiology of hepatic steatosis in cage-reared cobias from two fish farms with low growth rate record and predisposition to opportunistic diseases. We performed necropsies of cobias with a history of slow growth, high mortality, lethargy, fin ulceration, skin depigmentation, physical deformities, and certain external parasites. Macroscopically, liver volume was increased with pale, softened and friable consistency. Liver samples were collected and fixed in 10% formaldehyde buffer or frozen in liquid nitrogen for histological analysis. Therefore, the samples were stained with hematoxylin-eosin or Sudan black, respectively. The histopathological exam revealed increased volume of hepatocytes, cytoplasmic macrovacuoles with well-defined edges, and peripheral nuclei. Hepatocytes staining with Sudan black showed black-colored vacuoles, a characteristic finding typical of steatosis. After having performed the evaluation of fatty acids in the diet, we verified an imbalance in the proportion of fatty acids, which presented higher quantities of oleic acid than docosahexaenoic acid. This imbalance may have favored the observed accumulation of lipids. After supplementation of fish meal in the diet, a reduction of the severity of steatosis in these fish was observed.	Filho JR, E.	Journal of Veterinary Science & Medical Diagnosis 3	2014	Fish Health Cage Culture Nutrition Microbiology Parasites
336	Model diagnostics for the Stock Synthesis 3: Examples from the 2012 assessment of cobia in the U.S. Gulf of Mexico	This document summarizes common model diagnostics available for Stock Synthesis 3 and describes their interpretation. Examples of model misspecification are described and the resulting diagnostics are illustrated. Solutions to improve model performance are also discussed.	Cass-Calay, S.L., Tetzlaff, J. C., Cummings, N.J., Isely, J.J.	Collective Volume of Scientific Paper 70, 2069–2081	2014	Wild (Atlantic/Pacific)
337	Relative contribution of alternative proteins to the growth of Juvenile Cobia, <i>Rachycentron canadum</i> (Linnaeus)	Five isonitrogenous and isocaloric diets were fed to juvenile cobia, to assess the relative contribution of different proteins (fish meal, soybean meal, corn gluten and beer yeast) to the growth of cobia. The dietary effects on nitrogen and carbon turnover and on the isotopic diet-consumer discrimination factors (Δ 15N and Δ 13C) were also assessed. Growth results showed that the final body weight, growth rate, feed conversion ratio and protein efficiency ratio of cobia fed diets with alternative protein were significantly lower ($P < 0.05$) than cobia fed diet formulated with 100% fish meal. The estimated half-lives of nitrogen and carbon ranged between 9–11 days and 6–8 days, respectively, with significant differences among treatments ($P < 0.05$). Δ 15N ranged between 0.0–1.2‰ and –0.1–1.6‰ in whole fish and muscle and Δ 13C ranged between 3.8–5.1‰ and 4.0–5.1‰ in whole fish and muscle respectively. Diets were formulated with low levels of dietary nitrogen (10%) supplied by alternative protein sources substituting fish meal. The relative contributions of the dietary nitrogen supplied from these sources to the growth of whole fish and muscle tissue ranged between 4.9–5.2% and 5.9–7.7% respectively. Results indicated that growth accounted for the majority of observed isotopic change in animals under all treatments. In whole animals and muscle tissue, isotopic change due to metabolism occurred faster for carbon stable isotopes than for nitrogen stable isotopes. Cobia fed diets formulated with alternative proteins showed reduced nitrogen turnover rate and increased Δ 15N.	Zhou, H., Chen, G., Gu, B., Lin, X.	Aquaculture Research [In Press]	2014	Nutrition Fish Health Physiology
338	Physical properties of cobia (<i>Rachycentron canadum</i>) surimi: Effect of washing cycle at different salt concentrations	This study aimed to determine the effects of 2–5 wash cycles and the addition of tetrasodium pyrophosphate (TSPP) (0%, 0.05 Surimi% and 0.1% w/w)—with or without the addition of 0.4% calcium chloride (CaCl ₂)—on the physical properties such as texture, colour, expressible moisture and microstructure of Cobia (<i>Rachycentron canadum</i>) surimi gel. The highest breaking force (484.85 g) was obtained with the addition 0.1% TSPP alone on the fifth wash. However, a combination of 0.1 and 0.4% CaCl ₂ in surimi gels at wash cycle 5 resulted in the highest degree of whiteness (86.8%), as well as total expressible moisture (2.785%) and deformation (17.11 mm). The highest surimi gel strength (6,923 g.mm) was obtained after three wash cycles with the addition of 0.1% TSPP +0.4% CaCl ₂ . The physical properties of Cobia fish surimi gels were affected by the number of wash cycles and treatments with TSPP and CaCl ₂ .	Hamzah, N., Sarbon, N.M., Amin, A.M.	Journal of Food Science and Technology 1–12	2014	Food Safety Nutrition
339	Dynamic monitoring of the shelf life of cobia (<i>Rachycentron canadum</i>): A study on the applicability of a smart photochromic indicator	To ensure the marketing of fresh fish-based products, it is necessary to develop fast methods that assess its freshness in real time. This study therefore evaluated the applicability of a photochromic time–temperature indicator (TTI) to monitor the time and temperature history during the period of validity of the whole fish of the cobia specimen stored in ice. The TTI response was both visibly interpreted as well as adaptable to measurement using suitable equipment. The results showed that the smart indicator activated during 6 s of ultraviolet light showed a similar rate of deterioration of the analysed product visual response, proving to be a dynamic shelf life indicator that can assure consumers the ultimate quality point of the entire cobia easily, cheaply and accurately.	Brizio, A.P.B.R., Gonzaga Junior, M.A., dos Santos Fogaça, F.H., Prentice, C.	International Journal of Food Science & Technology [In Press]	2014	Food Safety Nutrition
340	Replacement of fish meal in cobia (<i>Rachycentron canadum</i>) diet with squid waste and squid waste silage	The effects of squid waste and squid waste silage feeds on the growth and feed utilization in the juveniles of cobia, <i>Rachycentron canadum</i> were investigated. There was significant decrease in protein and increase in lipid and ash ($P < 0.05$) in the squid waste silage than that of squid waste. Five isonitrogenous (45% protein) and isolipidic (15% lipid) experimental diets were formulated incorporating squid waste (SW) and squid waste silage (SWS) at 50 and 100% dietary protein (SW 50, SW 100, SWS 50 and SWS 100) respectively. A control feed without the incorporation of squid waste and squid waste silage was also prepared. Each diet was fed to three replicate groups of fish with an initial weight 10.71 – 11.23 g for 45 days. The fishes fed all diets had similar ($P > 0.05$) mean weight gain (53.44–60.28g) and SGR (3.87 – 4.14%). The fishes fed control and SW 50 had similar and best FCR (1.98–1.99), PER (1.12) and mean feed intake (106.50 – 119.65 g) which differed significantly ($P < 0.05$) from SW 100, SWS 50 and SWS 100 diets. The HSI was similar (2.00 – 2.20) in fishes fed all squid waste and squid waste silage based diets which was significantly ($P < 0.05$) higher than the fish meal based diet (control). There was no significant difference observed in survival between treatments. The whole body composition of cobia fed the squid waste and squid waste silage diets did not show any variations in moisture, protein, lipid and ash. The present study indicated that fish meal can be replaced up to 100% by squid waste and squid waste silage based diets without any adverse effect on the growth, feed utilization and body composition of cobia.	Felix, N., Kalaivani, S., Murugan, U.B., Rajaram, K.	International Journal of Fisheries and Aquatic Studies 1, 256–260	2014	Nutrition Fish Health
341	Osteological features of cobia, <i>Rachycentron canadum</i> (Linnaeus 1766)	The Cobia, <i>Rachycentron canadum</i> (Linnaeus 1766), is a large, fast-growing coastal pelagic fish belonging to the monotypic family Rachycentridae. In this study, we describe in detail the osteological characters of the Cobia from Indian waters. The skull, appendicular, and axial skeletons were disarticulated, examined, and illustrated. We characterize the species based on morphometry, meristic counts, and osteological features and briefly review the phylogenetic relationships proposed for the species.	Sajeevan, M.K., Kurup, B.M. K.	Journal of the Ocean Science Foundation 11, 40–49	2014	Fish Health Physiology Wild (Atlantic/Pacific)
342	The effects of garlic-supplemented diets on antibacterial activities against <i>Photobacterium damsela</i> subsp. <i>piscicida</i> and <i>Streptococcus iniae</i> and on growth in cobia, <i>Rachycentron canadum</i>	Photobacteriosis and streptococcosis are the most threatening diseases in cage-cultured cobia, <i>Rachycentron canadum</i> , due to high mortality of 50–80% and annual outbreaks in Taiwan. Garlic, <i>Allium sativum</i> , has long been known to have broad antibacterial properties. This study aimed to examine the in vitro antibacterial activities of garlic and the effects of dietary garlic on disease resistance against <i>Photobacterium damsela</i> subsp. <i>piscicida</i> and <i>Streptococcus iniae</i> and on growth in cobia. The results revealed the marked inhibitory effect of garlic against both <i>P. damsela</i> subsp. <i>piscicida</i> and <i>S. iniae</i> , and feeding garlic diet significantly conferred resistance to challenge with <i>P. damsela</i> subsp. <i>piscicida</i> or/and <i>S. iniae</i> . Cobia fed garlic powder at doses of 0.5 and 1.5 g/kg b.w. for 28 days produced significantly ($p < 0.05$) lower mortality after a challenge with <i>P. damsela</i> subsp. <i>piscicida</i> and higher percent weight gain. Cobia fed garlic powder at a dose of 1.2 g/kg b.w. for 21 days and at doses of 0.4 and 1.2 g/kg b.w. for 28 days provided significant ($p < 0.01$) resistance against <i>S. iniae</i> infection. A diet containing garlic powder at a dose of 1.2 g/kg b.w. for 28 days provided significant ($p < 0.05$) protection against <i>P. damsela</i> subsp. <i>piscicida</i> plus <i>S. iniae</i> combined infection in cobia.	Guo, J.J., Kuo, C.M., Hong, J. W., Chou, R.L., Lee, Y.H., Chen, T.I.	Aquaculture 435, 111–115	2015	Fish Health Nutrition Microbiology

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
343	Factors affecting toxicity test endpoints in sensitive life stages of native gulf of Mexico species	Indigenous species are less commonly used in laboratory aquatic toxicity tests compared with standard test species due to (1) limited availability lack of requisite information necessary for their acclimation and maintenance under laboratory conditions and (2) lack of information on their sensitivity and the reproducibility of toxicity test results. As part of the Natural Resource Damage Assessment aquatic toxicity program in response to the Deepwater Horizon Oil incident (2010), sensitive life stages of native Gulf of Mexico species were evaluated in laboratory toxicity tests to determine the potential effects of the spill. Fish ($n = 5$) and invertebrates ($n = 2$) selected for this program include the following: the Florida pompano (<i>Trachinotus carolinus</i>), red drum (<i>Sciaenops ocellatus</i>), spotted sea trout (<i>Cynoscion nebulosus</i>), cobia (<i>Rachycentron canadum</i>), red porgy (<i>Pagrus pagrus</i>), blue crab (<i>Callinectes sapidus</i>), and the common moon jellyfish (<i>Aurelia aurita</i>). Initially in the program, to establish part of the background information, acute tests with reference toxicants (CdCl ₂ , KCl, CuSO ₄) were performed with each species to establish data on intraspecies variability and test precision as well as identify other factors that may affect toxicity results. Median lethal concentration (LC50) values were calculated for each acute toxicity test with average LC50 values ranging from 248 to 862 mg/L for fish exposures to potassium chloride. Variability between test results was determined for each species by calculating the coefficient of variation (%CV) based on LC50 values. CVs ranged from 11.2 % for pompano (96-h LC50 value) to 74.8 % for red porgy 24-h tests. Cadmium chloride acute toxicity tests with the jellyfish <i>A. aurita</i> had the lowest overall CV of 3.6 %. By understanding acute toxicity to these native organisms from a compound with known toxicity ranges and the variability in test results, acute tests with nonstandard species can be better interpreted and used appropriately when determining risk.	Echols, B.S., Smith, A.J., Rand, G.M., Seda, B.C.	Archives of Environmental Contamination and Toxicology 1–8	2015	Fish Health Water Quality Contaminants Physiology
344	Growth performance of hybrid striped bass, rainbow trout, and cobia utilizing asian carp meal-based aquafeeds	Fish meal sparing is more difficult for nutritionally demanding carnivorous fishes, but economic considerations and the limited supply of fish meal continue to incentivize investigations of alternative protein sources for aquafeeds. A promising alternative to traditional, marine-origin fish meal is fish meal derived from undesirable freshwater species, such as the invasive Asian carp <i>Hypophthalmichthys</i> spp. To assess the relative value of such ingredients, we evaluated growth performance of juvenile hybrid Striped Bass (White Bass <i>Morone chrysops</i> × Striped Bass <i>M. saxatilis</i> ; initial weight, 21.9 ± 0.2 g [mean ± SE]), Rainbow Trout <i>Oncorhynchus mykiss</i> (15.1 ± 0.2 g), and Cobia <i>Rachycentron canadum</i> (57.2 ± 0.5 g) reared for 8 weeks on practical diets containing different levels of menhaden fish meal (MFM), Asian carp meal (CFM), or a 50:50 blend of these ingredients such that 0, 20, 40, or 60% of the estimated digestible protein content was derived from fish meal. Growth performance was generally consistent across taxa, and weight gain tended to increase with fish meal inclusion, regardless of its origin. However, Cobia did perform better on CFM-based diets, suggesting that MFM or CFM can yield improved performance for some taxa or life stages, but these differences are likely to be marginal in most circumstances. We conclude CFM is a suitable and perhaps lower-cost alternative to MFM in feeds for carnivorous fishes.	Bowzer, J., Trushenski, J.	North American Journal of Aquaculture 77, 59–67	2015	Nutrition Fish Health Culture
345	Effects of different fatty acids on cell differentiation and lipid accumulation in preadipocytes of warm water fish cobia (<i>Rachycentron canadum</i> Linnaeus, 1766)	This study investigates the effects of four predominant constituent fatty acids of fish oils, including palmitic acid (16:0, PAM), oleic acid (18:1n-9, OLA), eicosapentaenoic acid (EPA, 20:5n-3) and docosahexaenoic acid (DHA, 22:6n-3), on cell differentiation and lipid accumulation in the primary culture of cobia preadipocytes. Time-serial (0–20 days) comparisons of the changes in the expression of relevant genes and late-stage (Day 20) adiposity including lipid droplet size and lipid accumulation of the differentiating preadipocytes were also studied. Lipid accumulation was significantly higher when adipocytes were incubated with OLA compared to EPA and DHA and with DHA compared to EPA. Although the expressions of transcription factors <i>C/EBPβ</i> and <i>PPARγ</i> were significantly higher when treated with EPA than with DHA in the early stage (Day 4), the lipogenic genes <i>FABP1</i> , <i>FATP2</i> and <i>LPL</i> were equally upregulated. The upregulation by EPA was greater than that by DHA in the late stage (Day 20). Among the fatty acids studied, OLA, which is also abundant in plant oils such as olive or canola oil, was most adipogenic. Although both EPA and DHA were antiadipogenic, EPA was more adipogenic than DHA.	Cheng, Y.-C., Chen, H.-Y.	Aquaculture Research 46, 590–601	2015	Genetics/Molecular Fish Health Culture Nutrition Physiology
346	Dynamic monitoring of the shelf life of cobia (<i>Rachycentron canadum</i>): A study on the applicability of a smart photochromic indicator	To ensure the marketing of fresh fish-based products, it is necessary to develop fast methods that assess its freshness in real time. This study therefore evaluated the applicability of a photochromic time–temperature indicator (TTI) to monitor the time and temperature history during the period of validity of the whole fish of the cobia specimen stored in ice. The TTI response was both visibly interpreted as well as adaptable to measurement using suitable equipment. The results showed that the smart indicator activated during 6 s of ultraviolet light showed a similar rate of deterioration of the analysed product visual response, proving to be a dynamic shelf life indicator that can assure consumers the ultimate quality point of the entire cobia easily, cheaply and accurately.	Brizio, A.P.B.R., Gonzaga Junior, M.A., dos Santos Fogaça, F.H., Prentice, C.	International Journal of Food Science & Technology 50, 790–796	2015	Food Safety Nutrition
347	First multilocus and densely sampled timetree of trevallies, pompanos and allies (Carangoidei, Percomorpha) suggests a Cretaceous origin and Eocene radiation of a major clade of piscivores	Carangoid fishes (trevallies, pompanos, jacks, dolphinfishes, cobias and remoras) include about 159 species of marine fishes found in tropical and temperate waters worldwide (Froese and Pauly, 2014). Many carangoids are powerful swimmers and active piscivores in and around coral-reef ecosystems. Some carangoid lineages, such as dolphinfishes, have evolved a pelagic lifestyle, while remoras spend their adult life attached to cetaceans, sharks, manta rays and large teleosts, feeding off skin parasites or leftovers from their host’s meals. In spite of their taxonomic diversity, ecological dominance, economic importance to humans, and a rich fossil record dating to the Paleogene, relatively little is currently known about the tempo of evolution of this group. Here we present the results of the first time calibration study of carangoid fishes. Using a fossil-calibrated molecular timetree that includes 133 species of carangoids (~85% of extant species), we show that this group originated in the Late Cretaceous and that several major lineages were already present before the K-Pg extinction. All major clades were in existence by the end of the Eocene, even though significant diversification has continued to occur throughout the history of this group.	Santini, F., Carnevale, G.	Molecular Phylogenetics and Evolution 83, 33–39	2015	Genetics Molecular Wild (Atlantic/Pacific)
348	Two new species of <i>Dichelyne jagerskioldi</i> (Nematoda: Cucullanidae) from marine food fishes of Sindh.	Two new nematode species, <i>Dichelyne (Neocucullanelus) sindensis</i> and <i>D. (N.) haemulus</i> of family Cucullanidae Cobbold, 1964 (Spiruridea Diesing, 1861) obtained from the intestine of commercial marine fishes of Sindh are described. <i>D. (N.) sindensis</i> harboured by <i>Lutjanus johni</i> and <i>Rachycentron canadum</i> is characterised chiefly by the presence of a fleshy mass like gubernaculum on male tail whereas <i>D. (N.) haemulus</i> yielded by <i>Pomadasys argenteus</i> is distinguished mainly by chitinous horse-shoe-shaped structure at its tail tip. <i>Indocucullanus tongispiculum diacanthi</i> Bilquees was reclassified and transferred to <i>Dichelyne</i> as <i>D. (Neocucullanelus) longispiculum diacanthi</i> n.comb.	Akram, M	Marine Research 1, 49–54.	1992	Parasites Commercial
349	Preparation and characterisation of <i>Punica granatum</i> pericarp aqueous extract loaded chitosan-collagen-starch membrane: role in wound healing process.	Engineered scaffolds made from natural biomaterials are crucial elements in tissue engineering strategies. In this study, biological scaffold like chitosan-collagen-starch membrane (CCSM) loaded with the antibacterial agent, <i>Punica granatum</i> pericarp aqueous extract was explored for enhanced regeneration of epithelial tissue during wound healing. Collagen was extracted from <i>Rachycentron canadum</i> fish skin. Membranous scaffold was prepared by mixing collagen, starch and chitosan in a fixed proportion, loaded with aqueous extract of <i>P. granatum</i> and its anti-pseudomonal activity was studied. Morphological characterization by SEM and mechanical property like tensile strength of the membrane were studied. Excision wound of 2 cm ² size was induced in Guinea pig and the effect of <i>P. granatum</i> extract loaded CCSM in wound healing was studied. The SEM image showed deep pores in the membrane and also possessed good tensile strength. Wound surface area was reduced prominently in the experimental group with <i>P. granatum</i> extract loaded CCSM when compared to the group with unloaded membrane and the one with no membrane. <i>Punica granatum</i> extract loaded CCSM has antipseudomonal property and supported enhanced epithelial cell proliferation without leaving a scar after wound healing. This has significant therapeutic application in membranous scaffold mediated skin repair and regeneration.	Amal, B., Veena, B., Jayachandran, V.P., Shilpa, J	Journal of Materials Science: Materials in Medicine 26, 181. doi:10.1007/s10856-015-5515-2	2015	Pharmacology
350	Optimization of gelatin extraction conditions from cobia (<i>Rachycentron canadum</i>) skin and its physicochemical characteristics as compared to bovine gelatin	This study reported the extraction optimization and characterization of cobia (<i>Rachycentron canadum</i>) skin gelatin. Optimization study was carried out to determine the effect of CH ₃ COOH concentration, skin to water ratio, extraction temperature and extraction time on gelatin yield (GY) and gel strength (GS) using Response Surface Methodology (RSM). The optimum conditions were 0.15mol/L for CH ₃ COOH concentration, 82.4oC of extraction temperature, 6 h of extraction time and 1:6 of skin to water ratio, which produced cobia gelatin with GY of 20.10% and GS of 205.6 g. Characteristics of cobia skin gelatin (CG) were then compared to that of commercial bovine gelatin (BG). It was found that the most dominant amino acid in CG was glycine, proline and alanine. There was no difference in foaming and emulsifying properties of CG and BG at 1% concentration, but at 2% and 3% concentration, BG performed better. CG was found to have higher fat binding capacity but lower water holding capacity than BG. Least gelling concentration for CG was recorded at 2% while for BG at 1%. CG and BG had a pl at pH 6.05 and 4.82, respectively. This study shows that cobia skin gelatin has potential as halal alternative to bovine gelatin in food industry.	Amiza, M.A., Shima, W.M. W.M., Hayati, N.I., Juhaida, N.M.	International Food Research Journal; Selangor 22, 213–224	2015	Food Safety
351	Sustainable development of marine aquaculture off-the-coast and offshore - a review of environmental and ecosystem issues and future needs in tropical zones	The ecological impacts of intensive tropical coastal mariculture have reduced its potential for expansion. The increasing opposition to projects such as shrimp farms and the eutrophication of coral reef habitats in the tropics is among the chief incentives driving offshore operations. Tropical off-the-coast and offshore mariculture is a growing industry with considerable economic and ecological potential. However, its growth in the tropics will require a major allocation of capital, knowledge and planning resources to tropical nations, most of which are poor, underdeveloped, lack infrastructure and are distant from target markets. Hence, the benefits and costs of off-the-coast and offshore farms in tropical regions are not directly comparable, since extensive pond aquaculture and other low-tech production systems benefit the rural poor, whereas offshore mariculture is currently restricted to corporate initiatives which have the capacity for large capital investment, import of technology and assumption of significant risks. Individual offshore farmer ownership and operation in the tropics is therefore still a substantial socioeconomic challenge due to the large initial investment required. While the warm climate regime between the tropics of Cancer and Capricorn offers numerous advantages and potential for the cultivation of various marketable species, these are different to the species reared in temperate offshore farms. Whereas this may appear to be a trivial point, it is essential to note that the high cost and capital investment involved in offshore mariculture dictates the production of high-value species intended for export to the rich developed world. Most offshore projects have thus, focused on high-value predator species such as cobia, snapper, amberjack, seabream, red drum, pacific threadfin, seabass and tuna.	Angel, D.L., Edelist, D	Lovatelli, A., Anguilar-Manjarrez, J., Soto, D. (Eds.), Expanding Mariculture Farther Offshore: Technical, Environmental, Spatial and Governance Challenges. FAO Technical Workshop, 22-25 March 2010, Orbetello, Italy, FAO Fisheries and Aquaculture Proceedings. FAO, Rome, FAO, pp. 173–200	2013	Commercial Cage Culture Culture
352	Predicting the effects of copper on local population decline of 2 marine organisms, cobia fish and whiteleg shrimp, based on avoidance response	The present study focuses on avoidance response to predict population decline of the marine fish <i>Rachycentron canadum</i> (cobia) and larvae of the estuarine shrimp <i>Litopenaeus vannamei</i> (whiteleg shrimp). Avoidance of approximately 60% was recorded for the cobia fry exposed to 1.0 mg Cu/L, 1.60 mg Cu/L, and 1.80 mg Cu/L. For the shrimp larvae, avoidance was approximately 80% for all Cu concentrations. The population decline of cobia fry was conditioned by avoidance in lower concentrations. However, in higher concentrations mortality begins to play an important role. The displacement toward uncontaminated habitats might determine shrimp population decline. A Cu-contaminated environment can determine the habitat selection of both species and, therefore, their local population decline.	Araújo, C.V.M., Cedeño-Macias, L.A., Vera-Vera, V. C., Salvatierra, D., Rodríguez, E.N.V., Zambrano, U., Kuri, S., 2016	Environmental Toxicology and Chemistry 35, 405–410. doi:10.1002/etc.3192	2016	Contaminants
353	Spatio-temporal variation in organic nitrogen and carbon in sediments associated with tropical submerged-cage aquaculture (cage aquaculture, <i>Rachycentron canadum</i> , carbon, aquaculture off-shore, nitrogen, marine sediments)	The diminution of marine fish populations due to over-fishing has stimulated the increase of mariculture activities, including in cages located near the coast. However, these activities may be detrimental influence to marine sediments near the culture sites in coastal sites. The first open-ocean mariculture operation began during 2002 south of Culebra Island, Puerto Rico to culture the fish <i>Rachycentron canadum</i> and <i>Lutjanus analis</i> . The purpose of this study was to evaluate the concentrations of total organic nitrogen (TON), total carbon (TC), and organic matter (OM) in marine sediments near the mariculture site to determine the spatial and temporal dynamics of these nutrients during the first culture period. Results indicate significant differences in the concentration of TON between the cage and control sites. The <i>L. analis</i> cage had a higher mean concentration of TON (0.442 mg N/g) than the <i>R. canadum</i> cage (0.380 mg N/g) and control site (0.300 mg N/g). TC and OM mean concentrations were not significantly different; however, mean TC concentrations had fluctuations similar to those of the mean TON concentrations. TON and TC mean concentrations were significantly different over time, with an increase in the mean TON (0.66 mg N/g) and TC (199 mg C/g) concentrations from April 2003 to August 2003, with a peak in June 2003, which agreed with the increase in the mean monthly feed input at the culture site (12,947 kg) and the increase of wastes because the fish had reached a commercial weight (4.5 kg). Harvesting began in June 2003, so numbers of fish decreased during subsequent months. Organic matter decreased during June, but peaked during October 2003. Although the increase of the nutrient concentration is relatively low compared with other studies, data represent only the first year of mariculture activity. As the company increases the number of cages, this site should be monitored to determine possible increases in nutrient concentrations in the sediments.	Beltran Rodriguez, D.M.	University of Puerto Rico, Mayaguez, Puerto Rico	2008	Cage Culture Sediments Water Quality Organic Wastes

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
354	<i>Chimaerarhynchus</i> n. g. and <i>Patellobothrium</i> n. g., two new genera of trypanorhynch cestodes with unique poeciloacanthous armatures, and a reorganisation of the poeciloacanthous trypanorhynch families.	<i>Chimaerarhynchus rougetae</i> n. g., n. sp. is described from <i>Squalus acanthias</i> and <i>Centrophorus</i> sp. from the coast of Senegal, and differs from all other trypanorhynch genera in having a chainette composed of dissimilar elements, that is, double-winged hooks alternating with pairs of hooks each with a single lateral wing. The new genus is allocated to the Gymnorhynchidae Dollfus, 1935. <i>Patellobothrium quinquecatenatum</i> n.g., n. sp. is described from the spiral intestine of <i>Sphyrna mokarran</i> from Darwin, Northern Territory, Australia and plerocercii from <i>Rachycentron canadus</i> from Queensland, Australia. The genus is distinguished from all others in possessing five chainettes. It is allocated to the family Mustelicolidae Dollfus, 1969. The relationships of all genera of trypanorhynch possessing chainettes are discussed, and they are divided into three groups: (1) Dasyrhynchidae Dollfus, 1935, Lacistorhynchidae Guiart, 1927, Mustelicolidae and Hornelliellidae Yamaguti, 1954 are considered closely related since all genera possess two bothridia, a hermaphroditic duct and have hollow hooks; (2) Gymnorhynchidae, amended to contain only <i>Gymnorhynchus</i> Rudolphi, 1819 and <i>Chimaerarhynchus</i> n.g., is distinct in possessing four bothridia, an accessory seminal vesicle and hollow hooks; (3) Mixodigmatidae Dailey & Vogelbein, 1982, amended to include <i>Mixodigma</i> Dailey & Vogelbein, 1982 and <i>Halysiarhynchus</i> Pintner, 1913 has four bothridia, lacks seminal vesicles and a hermaphroditic duct and has solid hooks. A new family Molicolidae n. fam. is erected for <i>Molicola</i> Dollfus, 1935 and <i>Stragulorhynchus</i> Beveridge & Campbell, 1988. The new family has a poeciloacanthous armature, and is distinguished by possessing a band of hooks on the external surface of the tentacle, four sessile bothridia and an accessory seminal vesicle. <i>Myrmillorhynchus</i> Bilquees, 1980 is suppressed as a synonym of <i>Pterobothrium</i> Diesing, 1850. <i>Neogymnorhynchus</i> Bilquees & Shah, 1982, is suppressed as a synonym of <i>Pterobothrium</i> , with the type species, <i>N. platycephali</i> becoming a synonym of <i>P. heteracanthum</i> Diesing, 1850. <i>Eulacistorhynchus</i> Subhadrappa, 1957 is considered a <i>genus inquirendum</i> ; <i>Gymnorhynchus cymbiumi</i> Chincholikar & Shinde, 1977 is also a synonym of <i>Pterobothrium heteracanthum</i> Diesing, 1850.	Beveridge, I., Campbell, R. A.	Syst Parasitol 14, 209–225. doi:10.1007/BF02187055	1989	Parasites Wild (Pacific)
355	Economic analysis of cobia (<i>Rachycentron canadum</i>) cage culture in large- and small-scale production systems in Brazil.	Economic feasibility studies regarding aquaculture systems are relatively scarce, but they are important to potential investors and for the allocation of resources for research and technological development. This study evaluated the economic viability of cobia cage culture from the actual investment and operational costs of a large-scale operation off Recife, northeastern Brazil (industrial system; IS), and a family-run farm located in a near-shore area of Rio de Janeiro (familiar system; FS). The IS had twenty-four 1607 m ³ floating cages deployed at a depth of 24 m, while the FS had six 75 m ³ wooden cages installed in a sheltered 6- to 7-m-deep area. Analyses of profitability (gross revenue, operational profit, cost price and break-even production) and investment (net present value—NPV; and payback time) were performed. An analysis of sensitivity was also carried out. The IS required an initial investment of approximately US\$ 1.5 million dollars and was more sensitive to FCR, selling price and productivity fluctuations than the FS. The FS required a relatively small initial investment (US\$ 16,000 dollars), which makes it more flexible to variations in production parameters and market fluctuations. The NPV was positive for both systems, and the payback times were estimated to be 3.88 years for the IS and 2.07 years for the FS. Therefore, given the assumptions of this study, cage culture of cobia in Brazil may be considered economically feasible in offshore production systems and in near-shore, FSS. Governmental support through decreased import taxes is recommended as a way to accelerate the early development of the cage culture of marine fish in Brazil.	Bezerra, T.R.Q. de, Domingues, E.C., Filho, L.F. A.M., Rombenso, A.N., Hamilton, S., Cavalli, R.O.	Aquaculture International 24, 609–622. doi: 10.1007/s10499-015-9951-2	2016	Socie economics Culture Commercial
356	Biochemical and histological changes during ovarian development of cobia, <i>Rachycentron canadum</i> , from the northern Gulf of Mexico.	Female cobia, <i>Rachycentron canadum</i> , were sampled on their spawning grounds in the northern Gulf of Mexico to study changes in proximate analysis (protein, lipid, carbohydrate, and ash) of the ovaries during gonadal maturation. Four major stages of oocyte development were studied: stage 1, previtellogenesis; stage 2, vitellogenesis; stage 3, final maturation; and stage 4, postovulation. Cobia are multiple spawning fish; therefore, ovaries engaged in a sequential round of oogenesis were distinguished as stages 1' and 2'. Protein was the major constituent of cobia ovaries and its contribution remained fairly constant (49–55% of the dry weight) throughout all stages of development. Lipid was the second most abundant component but the levels, ranging from 21 to 41%, changed depending on the stage of ovarian development. Lipid concentration increased from stage 1 through 3 and decreased slightly in stage 4; it was lower in stage-1 than in stage-1' ovaries but was the same in stages 2 and 2'. Carbohydrate was the least abundant component (3–4%) whereas ash ranked third (6–20%). Most cobia were in prespawning condition (stages 1–3) when they arrived in the northern Gulf of Mexico in April and May; some prespawning fish (stages 1 and 2) were also observed in August and September about a month or two before migration to the overwintering grounds normally occurs. Cobia undergoing sequential spawning episodes (stages 1' and 2') were captured from April through August. Gonosomatic indices (GSI) were calculated both for ovarian developmental stage and for month of capture. Mean GSI increased as ovarian development proceeded and decreased during postovulation; GSI for month of capture was highest during April and May when the prespawning fish first appeared in northern Gulf of Mexico waters.	Biesiot, P.M., Caylor, R.E., Franks, J.S.	Fishery Bulletin 94, 686–696	1994	Wild (Atlantic) Spawning
357	Immunostimulatory effects of non-CpG oligodeoxynucleotides on cobia (<i>Rachycentron canadum</i>).	Oligodeoxynucleotides (ODNs) with unmethylated CpG dinucleotides mimic the immunostimulatory activity of bacterial DNA in vertebrates through the recognition of cellular Toll-like receptor 9 (TLR9). We previously demonstrated that CpG motif, 5'-GACGT-3' (1668), and 5'-GTCGT-3' (2395) were highly immunostimulatory in cobia. In this study, motifs containing CpA, CpC, and CpT were used to evaluate their effects on cobia TLR9 (RCTLR9) gene expression. RCTLR9 expression increased significantly in response to CpT ODN in comparison with other ODN motifs. The optimal dosage of CpT ODN was 10 µg/fish. Furthermore, when the endosomal acidification was blocked using chloroquine immersion, the CpT ODN-induced expression of RCTLR9 in spleen and liver was inhibited in a dose-dependent manner. Our results demonstrated that ODNs containing motifs other than CpG, such as CpT ODN, can stimulate RCTLR9 expression, which is mediated, at least partially, by the interaction between CpT ODN and RCTLR9.	Byadgi, O., Chang, C.-I., Lee, J.-W., Huang, C.-C.J., Cheng, T.-C.	Aquaculture International 24, 595–608. doi: 10.1007/s10499-015-9950-3	2016	Genetics Molecular Fish Health
358	Bioaccumulation of mercury in pelagic fishes in NW Gulf of Mexico and its relationship with length, location, collection year, and trophic level.	Total mercury (Hg) concentrations were determined in the tissues of 11 species of pelagic fishes, with a special emphasis on apex predators (large vertebrates). Highest mercury concentrations were observed in blue marlin (<i>Makaira nigricans</i>), Carcharhinid sharks (genus <i>Carcharhinus</i>) and little tunny (<i>Euthynnus alletteratus</i>), ranging from 1.0 to 10.6 ppm. Moderate to low concentration (< 1.0 ppm) were observed in greater amberjack (<i>Seriola dumerili</i>), blackfin tuna (<i>Thunnus atlanticus</i>), cobia (<i>Rachycentron canadum</i>), king mackerel (<i>Scomberomorus cavalla</i>), little tunny (<i>Euthynnus alletteratus</i>), wahoo (<i>Acanthocybium solandri</i>), yellowfin tuna (<i>Thunnus albacares</i>) and dolphinfish (<i>Coryphaena hippurus</i>). For the majority of species examined, contaminant loads of mercury did not vary significantly between two consecutive years (2002 and 2003) and between two adjacent locations (Texas and Louisiana). The relationship between Hg concentration and fish size was also observed in certain species. Several species showed a positive relationship between mercury level and body size. Natural dietary tracer, stable isotopes of nitrogen also showed that Hg levels in fish tissues were positively associated with trophic position. Our findings in this study not only added to the information on mercury contamination in pelagic fish, but also furthered our understanding on mercury accumulation in these fish.	Cai, Y., Rooper, J.R., Gill, G. A.	Proceedings of the Gulf and Caribbean Fisheries Institute 5, 317–326	2006	Contaminants Wild (Atlantic) Food Safety
359	Mariculture-induced introduction of cobia <i>Rachycentron canadum</i> (Linnaeus, 1766), a large predatory fish, in the Tropical Eastern Pacific.	The cobia <i>Rachycentron canadum</i> (Linnaeus, 1766) is a highly valued fish by aquaculture producers and anglers. In spite of its wide-ranging distribution in tropical and subtropical seas, this species was absent in the Tropical Eastern Pacific until recently. In 2013 the government of Ecuador allowed the cultivation of cobia in offshore cages and in April 2015 three cages were deployed in Ecuadorian waters of the Pacific Ocean (Jaramijó, Manabí). Cobias escaped from one of these cages in August 2015 and we present the first report of <i>R. canadum</i> in the Colombian Pacific coast, ca. 600 km from the Ecuadorian escape locality. This is the first report of its occurrence for the entire Tropical Eastern Pacific biogeographical region. Given its predatory nature, it is to investigate the potential ecological and socio-economic consequences of the introduction of the cobia in the region. © 2016 The Author(s).	Castellanos-Galindo, G.A., Baos, R., Zapata, L.A.	BioInvasions Records 5, 55–58. doi:10.3391/bir.2016.5.1.10	2016	Cage Culture Fish Escapes Wild (Pacific) Wild/Farmed Interaction
360	Histopathological study on lymphocystis disease of <i>Rachycentron canadum</i>	The cage-culture of cobian <i>Rachycentron canadum</i> , was developed rapidly in southern China in recent years. In 2005, a similar lymphocystis disease of cage-cultured cobia broke out in Guangdong Province, China, and papilloma-like tissues appeared in the body and fin of diseased fish. In order to diagnose the disease of <i>Rachycentron canadum</i> suspected of lymphocystis disease, the histopathologic changes in the fish and the morphology of the virus particles were observed under optic and electronic microscope. The results showed that the papilloma tissues in the derm of the <i>Rachycentron canadum</i> were actually constituted by many lymphocystis cells which aggregated tightly. The size of the lymphocystis cells varied and ranged from 10 to 150 µm in diameter. Infected cells were round, cone-shaped or anomalous. A thick enveloped membrane layed in outside of lymphocystis cell. A lot of basophilic inclusion bodies existed in the lymphocystis cell and most of them were located on the edge of the cytoplasm. Under electronic microscope, there were a lot of particles icosahedron-shaped in the cytoplasm of infected cells and the size of the viruses was approximately 220 nm in diameter. In addition, swollen lymphocystis cells were observed in heart, liver, spleen and head kidney under optic microscope. According to the results above, the disease was diagnosed as lymphocystis disease. The main histopathologic changes of the other organs under optic microscope show that the damage to heart presents as cardiac cell vacuolar degeneration and swelling of cardiac muscle fiber; lymphocytosis and melanin-macrophage centers present in interrenal tissue and spleen; denaturalization and necrosis emerge in renal tubule epithelial cell; livers shows fatty degeneration of hepatocyte; and the gill lamellar epithelial cells are swollen.	Chang, O., Shi, C., Ma, H., Pan, H., Yu, D.	Journal of Fishery Sciences of China/Zhongguo Shuichan Kexue 13, 973–979	2006	Fish Health Cage Culture
361	Biological characteristics of wild-caught cobia and their progeny	Cage-farmed cobia (<i>Rachycentron canadum</i>) juvenile is susceptible to <i>Photobacterium damsela</i> subsp. <i>Piscicida</i> resulting in low survival rate. This study aims to realize the breeding habit of cobia reared from wild cobia juvenile caught by set net in Taitung area, as well as intending to evaluate growth performance and disease resistance of their progeny. Results showed that the natural spawning of cobia brooder reared from wild-caught cobia juvenile had not found in captivity. Fertilized eggs must be obtained from induced spawning. The growth rate of wild-caught cobia juvenile is much faster than inbred cobia. The disease resistance of their progeny is also markedly stronger than inbred cobia. This study proved that using the wild-caught cobia as brood fish is one of important strategy to improve the growth performance and disease resistance.	Chang, S.L., Chang, C.F., Chen, T.I., Su, M.S	Journal of the Fisheries Society of Taiwan 32, 87	2005	Fish Health Habitat Wild (Pacific) Spawning
362	Survey on the status of the offshore cage culture in Hsiao Liu Chio island	There are four cage farms in the offshore of Hsiao Liu Chio island. The types of cage include PVC frame cage, submerged free frame cage (soft cage), circular PE frame cage and submersible circular PE frame cage. The main cultured species include amberjack <i>Seriola dumerili</i> , orange spotted grouper <i>Epinephelus coioides</i> , cobia <i>Rachycentron canadum</i> , red fish <i>Lutjanus erythropterus</i> and red sea bream <i>Pagrus major</i> . In addition, scat <i>Scatophagus argus</i> , lembus rudder fish <i>Kyphosus vaigiensis</i> , small scal-blackfish <i>Girella</i> sp. and five-striped damselfish <i>Abudefduf vaigiensis</i> could be served as additional culture species. The ectoparasite of <i>Neobenedeniensis</i> sp., sea lice <i>Caligus</i> sp., <i>Dactylogyrus</i> sp. and digestive tract disease have ever been occurred in those cage culture area. At present, the serious problem of cage culture is the marketing. The status and problems of offshore cage culture are presented in this report. Further improvement of culture techniques and developing directions will be discussed.	Chang, S.-L., Hsieh, C.-S., Chang, C.-F., Cheng, C.-S., Cheng, S.-H., Su, M.-S.	Journal of Taiwan Fisheries Research 5, 115–128	1997	Cage Culture Parasites Siting
363	Morphological observation on the skeleton of cobia, <i>Rachycentron canadum</i> (Linnaeus)	This paper presents a morphological description of the skeleton of cobia, <i>Rachycentron canadum</i> (Linnaeus). The frontal, nasal and epiotic are well-developed. There are teeth on the vomer and the palatine. The right and left parietal are detached by the supraoccipital. The cobia has dorsal rib as well as ventral rib, but it has no orbitosphenoid. Some bones of the skull are not eudipleural.	Chen, G., Zhang, J., Wu, Z.	Journal Of Zhanjiang Ocean University 24, 6–10	2004	Fish Health Wild (Pacific)
364	Hematological study and observation on development of blood cells in cobia, <i>Rachycentron canadum</i>	Hematological indices of cobia, <i>Rachycentron canadum</i> , were investigated. The erythrocyte counts and leukocyte counts of cobia was 2.69±0.86×10 ⁶ /mm ³ and 1.50±0.09×10 ⁴ /mm ³ respectively. The hemoglobin content was 7.42±0.22g/L, the erythrocyte osmotic fragility was 0.43±0.07%, and the erythrocyte sedimentation rate was 1.18±0.46mm/h. On the stained smears of peripheral blood, erythrocyte and thrombocytes, lymphocytes, neutrophils and monocytes, were recognized, but bsophilic granulocytes and eosinophilic granulocytes were not found. Some immature blood cells and direct dividing of erythrocytes could also be observed on the smears. The percentages of thrombocytes, lymphocytes, neutrophils and monocytes in total leucocytes, were 61.20±6.30%, 16.60±3.28%, 16.00±3.61 % and 6.20±3.90% respectively. The development of blood cells in liver, spleen, pronephros and mesenephros of cobia was studied. The results showed that the blood cells of cobia generates mainly in pronephros and mesenephros; spleen is another tissue for the generation of granulocytes; liver can generate lymphocytes and granulocyte; the generation of thrombocyte had not been observed in these four tissues.	Chen, G., Zhou, H., Zhang, J. -D., Wu, Z.-H.	Acta Hydrobiologica Sinica 29, 564–570	2005	Fish Health
365	Biological characteristics and artificial breeding technique in a large scale of cobia, <i>Rachycentron canadum</i>	The biological characteristics such as morphology, distribution, feeding, reproduction and larval and juvenile development, and the artificial breeding technique of cobia (<i>Rachycentron canadum</i>) were illustrated simply in the paper. In marine cage culture 2~3 years old cobia selected as a brood-stock could be artificially induced to spawn time after time during the period of their reproduction seasons by enhancing nutrition and using hormones. The whole reproduction period lasted from April to October at Daya Bay and the suitable temperature and salinity for cobia reproduction were 25~31℃ and 30~34, respectively. In this paper the fertilization rate was 30%~60% and the hatching rate was 55%~82% for cobia. Large-scale artificial breeding for cobia was carried out in outdoor ponds, and under the conditions of temperature 26~32℃ and salinity 28~33, cobia fry could reach 8~11cm in total length for sale after 35~40 d breeding.	Chen, H., Sun, L., Hu, J., Yan, Y.	Marine Sciences 30, 5–9,90	2006	Cage Culture Spawning

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
366	Cobia (<i>Rachycentron canadum</i>) feeding and its influencing factors at early developmental stages.	The feeding rhythm and intensity of Cobia (<i>Rachycentron Canadum</i>) and the influences of food densities, temperatures and salinities on larvae and juvenile were investigated. The results showed that an obvious feeding circulation rhythm of 8 d larvae (fed on rotifers), 23 d juvenile (fed on artemia larvae) and 38 d juvenile (fed on non-living food) were observed. Feeding mainly proceeded in daytime, which accounted to more than 68% of the all-day total feeding intensity, and there was little or no feeding in the darkness of night. The feeding intensity during the period of 6:00-8:00 am and 16:00-18:00 pm was maximum. It seemed that the Cobia feeding rhythm was characterized by twilight feeding. The suitable food densities of 8 d larvae and 23 d juvenile were ranged at 15 ind-mL-1-20 ind-mL-1 and 7 ind-mL-1-12 ind-mL-1 respectively in the experiments of different food densities. The curves of the effects of temperatures and salinities on the feeding intensity of 18d juvenile cobia were displayed in the parabola type. The suitable temperature and salinity for juvenile were ranged 27°C-31°C and 28‰-32‰ respectively. The relationship between feeding intensity and food density, temperature and salinity were well described by a binomial equation.	Chen, H., Sun, L., Wang, Z., Yan, Y.	Ecological Science 23, 299–304	2004	Culture
367	Effects of dietary cholesterol level on growth performance, blood biochemical parameters and lipid metabolism of juvenile cobia (<i>Rachycentron canadum</i>).	Cobia (<i>Rachycentron canadum</i> L.) with body weight (24±0.19) g were fed with diets (Soybean meal 33%, Casein 17%, Fish meal 15%) containing six levels of cholesterol (mass fraction is 0.0%, 0.4%, 0.8%, 1.2%, 1.6% and 2.0%, respectively) for 8 weeks. The experiment was conducted to investigate the effects of dietary cholesterol supplementation on growth performance, body composition, serum biochemical index and enzymes activity of fat metabolism. The results showed that the weight gain rate (WGR), survival rate (SR), and feed conversion ratio (FCR) got better in group 0.4%, with the difference from the control level of $P > 0.05$, $P < 0.05$ and $P > 0.05$, respectively, and the three index got worse with the increase of cholesterol supplementation. The hepatosomatic index (HSI), viscerasomatic index (VSI), and ratio of liver lesion tend to have an increase tendency in experimental groups. The crude lipid of whole body and liver changed similar to growth index, namely increased in group 0.0%-0.4% and declined in group 0.4%-2.0%. The crude protein of whole body showed an increased tendency and cholesterol in liver had a trend from decline to rise, but the moisture and ash changed weakly ($P > 0.05$). The plasma total cholesterol (TC) and LDL-C were elevated. The activity of hormone-sensitive triglyceride lipase (HSL) in liver showed a trend from rise to decline. These results suggested that dietary cholesterol might improve the growth ranged from supplement 0-0.4% and affect the fat metabolism of cobia. Too much dietary cholesterol could bring saturated toxic effects and growth inhibition to cobia. Based on SR, according to cubic polynomial analysis, the optimum dietary cholesterol level was 0.566%.	Chen, Q., Liu, H., Tan, B., Dong, X., Chi, S., Yang, Q., Zhang, S.	Journal of Zhanjiang Ocean University 36, 35–43	2016	Fish Health Nutrition
368	Challenges and strategies of cage aquaculture development in Taiwan	Offshore cage aquaculture is regarded as the most important aquaculture industry in Taiwan. It has been realized that the key to the successful development of this industry in Taiwan lies on preventing and minimizing the damage by typhoons, which occur during summer and fall, the peak-growing season. To play safe, this industry started in the protected bay area of Penghu islands in 1977. Even under such consideration, the traditional square wooden frame cages used then could not stand the surge of typhoon and severe losses were encountered. The discouragement impeded further development of this industry until early 90s when some durable type cages were developed and Norwegian salmon cage culture industry had shown remarkable growth. Without rigid frame, a flexible submerged cage system was developed in Taiwan and had been welcome by the farmers since. Successful cases using Norwegian polar Circle cages also provided another popular alternative. In recent years, a submergible cage system, which was developed jointly by industry, government, and research institutes, has survived well through several strong typhoons. The regained confidence in farmers, supportive government policy, and a favorable international and domestic market have facilitated significant increase of investment and expansion of this industry. There are about ten high price fishes being cultured in 1,500 offshore cages. Among them, cobia (<i>Rachycentron canadum</i>) is recognized as the most promising species for its fast growth and great market potential. Well-established hatchery industry guarantees stable and sufficient fry supply. A 6-8 kg weight gain can be obtained in one year. Production has reached 1,000 mt in 1999, of which 450 mt was exported to Japan at a price of US\$ 50-60/kg. Being equipped with typhoon-resistant cage systems and possessing with experience and technologies on the suitable cultured species, the industry is moving on the right track. However, strategies still need to be formulated and implemented regarding the integration of research and development resources from all sectors to establish an efficient cage culture model suitable for tropical and subtropical sea and ensure sustainable development of this new industry.	Chen, Y.-H., Su, M.-S., Liao, I.C.	Aquaculture 2001: Book of Abstracts. Presented at the Aquaculture 2001, World Aquaculture Society, 143 J.M Parker Coliseum Louisiana State University Baton Rouge LA 70803 USA, Lake Buena Vista, FL, USA, p. 373.	2001	Cage Culture Siting
369	Ecological considerations of cage aquaculture in Taiwan	The success of aquaculture in Taiwan over the years has resulted in tremendous capital investment and the development of advanced techniques and technologies. However, after the collapse of the shrimp farming industry in the late 1980s, the government has devoted much effort to the development of modern offshore fish farming as a top priority for its national aquaculture plan. The recent and continuing expansion of cobia (<i>Rachycentron canadum</i>) cage farming in inshore areas, and the intention to develop offshore potential, has led to questions on the degree of the ecological impact that can be anticipated in the future. In this paper we first briefly review the history of aquaculture development in Taiwan particularly focusing on marine cage culture. We then outline the challenges facing Taiwanese cage aquaculture including potential environmental impacts.	Chen, Y.-S., Hsu, C.-Y.	Journal of the Fisheries Society of Taiwan 33, 139–146	2006	Socio economics Cage Culture Commercial Waste/Discharge Nutrient Impacts
370	Effect of supplementation microcapsule or crystalline methionine in diets on related enzyme activity of cobia (<i>Rachycentron canadum</i>)	The present study was conducted to compare the effect of microcapsule methionine or crystalline methionine in low-fishmeal diets on protein metabolism and digestive enzyme activities in cobia (<i>Rachycentron canadum</i>). Seven iso-nitrogen and iso-lipid diets, including fishmeal (positive control), low-fishmeal (negative control) and five types of methionine supplementation of crystalline L-methionine (MET), hydroxyl-methionine calcium (MHA), cellulose-acetate-phthalate coated methionine (CAP), resin coated methionine (RES) and tri-palmitin-polyvinyl alcohol coated methionine (TPA), respectively were prepared to investigate utilization of coated and crystalline methionine in intestine of juvenile cobia. Each treatment was randomly assigned to triplicate groups of 20 fish with initial weight of (5.40 ± 0.07) g per aquarium. Fish were maintained in flow-through aquaria for eight weeks at water temperature ranged from 29°C to 31°C. The results showed that trypsin activities of intestine of fish fed microcapsule methionine were significantly higher than those of fish fed crystalline methionine and the positive control diet ($P < 0.05$). Compared to positive and negative groups, fish fed the diets with MET and TPA had significant difference in liver GOT activities ($P < 0.05$). After feeding 0.5 h, Na ⁺ , K ⁺ -ATP activities in intestine of fish fed MET were significantly higher than those of fish in other groups ($P < 0.05$). After feeding 3 h, Na ⁺ , K ⁺ -ATP activities of fish fed RES and positive control diet increased and was higher than those of fish fed CAP and MHA, and those activities of fish fed positive control diets and microcapsule methionine were significantly higher than those of fish fed MHA and MET after feeding 8 h ($P < 0.05$). It could be concluded that cobia fed low fishmeal diet with crystalline methionine could improve their metabolism of amino acid and synthesis of protein. Microcapsule could contribute to control methionine release in intestine and enhance the activities of intestinal protease.	Chi, S., Tan, B., Dong, X., Yang, Q., Liu, H., Xu, Y., Huang, H.	Journal of Fishery Sciences of China 18, 110–118	2011	Fish Health Nutrition Culture
371	Effects of exogenous methionine in diet for juvenile cobia with feeding frequency interference	The effects of exogenous methionine in diet for juvenile cobia with feeding frequency interference were evaluated. Feeding frequency was 2, 3, 4 and 5 times daily, respectively. Diets containing crystalline methionine (MET) and microcapsule methionine with resin (RES) were fed with juvenile co-bia with an initial weight of (5.40±0.07) g. A 30-day feeding experiment was conducted to determine the effects of feeding frequency on the growth, body composition and digestive enzymes in juvenile cobia. The results showed that feeding frequency had no significant impact on the survival rate ($P > 0.05$). Weight gain of fish fed with MET and RES significantly increased with increasing feeding frequency. The fish fed RES diet treated with 5 meals per day had significantly higher weight gain compared with the other treatments ($P < 0.05$) and higher condition factor compared with the fish treated with 2 and 4 meals per day. The fish fed RES diet treated with 5 meals per day had significantly higher crude protein of whole body compared with the fish fed RES diet treated with 2 and 4 meals per day ($P < 0.05$). Digestive enzyme activities of fish significantly decreased with increasing feeding frequency ($P < 0.05$). T-protease activities in liver of fish significantly increased with increasing feeding frequency ($P < 0.05$). The fish fed MET diet treated with 5 meals per day had significantly higher T-protease activities than the fish treated with 2 meals per day ($P < 0.05$). Results of this study suggest that the utilization of exogenous methionine and growth performance of juvenile cobia were improved by increasing feeding frequency.	Chi, S., Tan, B., Yang, Q., Dong, X., Liu, H., Zhang, S.	Feed Industry 36, 15–20	2015	Fish Health Nutrition
372	The apparent digestibility coefficients of 13 selected animal feedstuff for cobia, <i>Rachycentron canadum</i>	The apparent digestibility coefficients (ADCs) of crude protein, lipid, phosphorous, and amino acids, as well as energy, of 13 animal feedstuffs were determined for cobia, <i>Rachycentron canadum</i> (initial weight 130.0 g). The feedstuffs tested included five types of fishmeal, two of blood meal, one of poultry meat meal, two of meat-and-bone meal, two of feather meal, and one type of shrimp meal. A reference diet was formulated and the test diets contained 70% of the reference diet and 30% of each feedstuff. The ADCs of crude protein, lipid, energy, phosphorous, and amino acids of the test ingredients ranged from 68.97 to 92.5%, 69.3 to 95.7%, 77.5 to 98.3%, 58.2 to 80.1%, and 72.5 to 97.0%, respectively. The ADCs of crude protein of white fishmeal, steam-dried brown fishmeal, imported flame-dried fishmeal, spray-dried blood cells, poultry byproduct meal, meat-bone meal, and meat meal were significantly higher than those of dried blood meal, fermented feather meal, and hydrolyzed feather meal ($P < 0.05$). The ADCs of lipid of dried blood meal and hydrolyzed feather meal were significantly lower than those of other feedstuffs ($P < 0.05$). The ADCs of energy of fermented feather meal and hydrolyzed feather meal were significantly lower than those of other feedstuffs ($P < 0.05$) and the ADCs of phosphorus of white fishmeal, steam-dried brown fishmeal, and imported flame-dried fishmeal were significantly higher than those of the other ingredients ($P < 0.05$).	Chi, S., Wang, W., Tan, B., Dong, X., Yang, Q., Liu, H., Zhang, S.	Journal of the World Aquaculture Society n/a-n/a. doi:10.1111/jwas.12347	2016	Fish Health Nutrition
373	Antibiotic resistance and molecular typing of <i>Photobacterium damsela</i> subsp. <i>damsela</i> , isolated from seafood	Aim The objectives of our study is to determine the antibiotic susceptibility of this organism to different antibiotics to determine the discriminatory power of the molecular typing methods. Methods and Results In this study, 50 <i>Photobacterium damsela</i> subsp. <i>damsela</i> isolates from <i>Scomber australasicus</i> and <i>Rachycentron canadum</i> were collected in Taiwan and their resistance to 15 different antimicrobial agents was determined. In addition, random amplification of polymorphic DNA (RAPD) and pulsed-field gel electrophoresis (PFGE) were performed to study the epidemiology and clonal relationship of <i>P. damsela</i> subsp. <i>damsela</i> . The results showed that the 50 isolates generated 25 typeable profiles with multidrug resistance to 3–7 antimicrobials. The results also indicate that the RAPD and PFGE methods have high discriminatory power for molecular subtyping. Conclusion <i>Photobacterium damsela</i> subsp. <i>damsela</i> isolates from fish to examine for multidrug resistance to antimicrobials. RAPD and PFGE methods revealed the high discriminatory power for molecular subtyping and provided information that could be used for risk assessment of <i>P. damsela</i> subsp. <i>damsela</i> infections. Significance and Impact of the Study These results may help in epidemiological investigations of <i>P. damsela</i> subsp. <i>damsela</i> and may be useful in controlling or treating <i>P. damsela</i> subsp. <i>damsela</i> infections in aquaculture and clinical therapy.	Chiu, T.-H., Kao, L.-Y., Chen, M.-L.	J Appl Microbiol 114, 1184–1192. doi: 10.1111/jam.12104	2013	Antibiotics Fish Health
374	Chemical compositions of commercial cobia feeds in Taiwan and the effects of the practical finisher diets on the fish meat quality	The chemical compositions of fifteen commercial feeds of cobia (<i>Rachycentron canadum</i>) from six feed manufacturers were analyzed. The effect of two diets designated as A (low protein: 46.3%, low fat: 16.8%) and B (high protein: 48.6%, high fat: 19.9%) on the chemical compositions and meat quality of the fish raised in a practical commercial production scale were also investigated. The commercial cobia feeds had different sizes and shapes according to the culturing stages of the fish. The moisture contents of the feeds ranged from 3.56% to 9.91%, ash 9.40% to 13.32%, protein 41.15% to 50.86%, fat 10.85% to 21.34%, and carbohydrate 15.24% to 24.32%. The major fatty acids were C16:0 and C18:1n-9. The levels of n-3 polyunsaturated fatty acids including EPA and DHA were also high (ranged from 6.05% to 14.22% and from 4.42% to 14.81%, respectively); suggesting that the feeds contained good levels of fish oil. When two finisher diets were fed to two groups of cobia for two months to grow the fish to their marketable size (5~6 kg/fish), the protein, fat, ATP-related compounds, free amino acids and anserine in both dorsal (D) and ventral (V) meats of the fish tended to increase with a raise of 2.37% protein plus a raise of 3.14% fat in the diets. The fatty acid profiles of D and V meats from A and B groups were relatively similar to those of the two diets. The predominant fatty acids were C16:0, C18:1n-9, C16:1n-7, EPA and DHA. However, n-6/n-3 ratios in both D and V meats changed from 0.51 or 0.50 to 0.66 or 0.69 with the raise of protein and fat levels in the diets.	Chuang, J.-L., Chiou, W.-R., Shiau, C.-Y.	Journal of the Fisheries Society of Taiwan 36, 91–103	2009	Fish Health Nutrition

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
375	The relationship between chemical compositions and body weight of cultured cobia (<i>Rachycentron canadum</i>) of different growing stages	The condition factor of 31 cage-cultured cobia (<i>Rachycentron canadum</i>) with body weight ranging from 1.5 to 8730 grams was significantly and positively correlated with body weight for fish below 1.4 Kg ($r=0.79$), while no good correlation was found among fish above 1.4 Kg. The pH value of white muscle in cobia was between 5.5 and 6.3, which was similar to that of pelagic fishes. The levels of ammonia and urea were low in cobia. This is also similar to the most teleosts. No significant correlation was found between fish body weight and pH, ammonia and urea. There were large variations in fat and moisture contents of white muscle among different size of cobia, but not in protein and ash. The fat level in the ventral meat was two times higher than that of the dorsal meat of the same fish. Fat contents of both dorsal and ventral meats were significantly and positively correlated with body weight ($r=0.8$ and 0.78 , respectively). In contrast, moisture content decreased gradually as fish body weight increased. The predominant free amino acids (FAAs) in cobia were taurine, glycine, alanine and glutamic acid. The contents of these FAAs and total FAAs tended to decrease as body weight increased. When comparing with glycine, alanine and glutamic acid, taurine was most significantly and negatively correlated with fish size. Anserine, a dipeptide, was detected in the meat of cultured cobia, and its content ranged from 14 to 80 mg/100g; however, it was not significantly correlated with fish body weight. Inosine monophosphate (IMP) was the most prominent component of ATP-related compounds. Both ATP-related compounds and IMP had no significant correlation with fish size.	Chuang, J.-L., Lin, R.-T., Shiau, C.-Y.	Journal of the Fisheries Society of Taiwan 34, 21–30	2007	Cage Culture Fish Health Nutrition
376	Cultivo de bijupirá (<i>Rachycentron canadum</i>) em Cananeia, SP, Brasil. Avaliação da viabilidade utilizando geoprocessamento	The Food and Agriculture Organization of the United Nations (FAO) frequently publishes reports about world fisheries production. These reports state wild fish stocks increasingly depleted and mariculture production growth in the past decade. The mariculture emerged then as an alternative to food production and generating income. Cobia, <i>Rachycentron canadum</i> , has been highlighted in recent years and is being studied in different aspects aiming its commercial production in Brazil. As mariculture has expanded, the development of management instruments for coastal zone is shown increasingly necessary. As establishing a sustainable basis to select the proper location to install fish farming it is possible to maximize the efficiency mariculture, producing raising the maximum number of organisms with minimal costs. This viability occurred through the understanding of the relationship between the physiological requirement of the aquatic organism selected and the environmental conditions. Data were obtained through literature searches, documents from government agencies, restitution of satellite images and field sampling organized in a manager geodatabase and analyzed using geostatistical interpolation, distance and density analysis to define ideal areas of Cananéia's estuary and coastal zone to cultivate Cobia. The current work indicates areas suitable for growing Cobia in the studied region considering environmental, socioeconomic and logistics variables. The Geographic Information System (GIS) has shown itself capable of contributing effectively, facilitating potential shell fishermen and manager decision making.	Collaço, F.L., Sartor, S.M., Barbieri, E.	Revista de Gestão Costeira Integrada 15, 277–289. doi:10.5894/rgci538	2015	Siting
377	Structurally complex organization of repetitive DNAs in the genome of cobia (<i>Rachycentron canadum</i>)	Repetitive DNAs comprise the largest fraction of the eukaryotic genome. They include microsatellites or simple sequence repeats (SSRs), which play an important role in the chromosome differentiation among fishes. <i>Rachycentron canadum</i> is the only representative of the family Rachycentridae. This species has been focused on several multidisciplinary studies in view of its important potential for marine fish farming. In the present study, distinct classes of repetitive DNAs, with emphasis on SSRs, were mapped in the chromosomes of this species to improve the knowledge of its genome organization. Microsatellites exhibited a diversified distribution, both dispersed in euchromatin and clustered in the heterochromatin. The multilocus location of SSRs strengthened the heterochromatin heterogeneity in this species, as suggested by some previous studies. The colocalization of SSRs with retrotransposons and transposons pointed to a close evolutionary relationship between these repetitive sequences. A number of heterochromatic regions highlighted a greater complex organization than previously supposed, harboring a diversity of repetitive elements. In this sense, there was also evidence of colocalization of active genetic regions and different classes of repetitive DNAs in a common heterochromatic region, which offers a potential opportunity for further researches regarding the interaction of these distinct fractions in fish genomes.	Costa, G.W.W.F., Cioffi, M. de B., Bertollo, L.A.C., Molina, W.F.	Zebrafish 12, 215–220. doi:10.1089/zeb.2014.1077	2015	Genetics Molecular
378	Growth, feed efficiency and body composition of juvenile cobia (<i>Rachycentron canadum</i> Linnaeus, 1766) fed increasing dietary levels of shrimp protein hydrolysate	A shrimp protein hydrolysate (SPH) containing 894.2 g kg ⁻¹ crude protein (CP) and 54.3 g kg ⁻¹ total lipids was tested as a partial replacement for fish meal (FM) in diets of juvenile cobia. The effects of increasing dietary levels of SPH on the survival, weight gain (WG), specific growth rate (SGR), feed conversion ratio (FCR), nitrogen retention efficiency (NRE) and daily feed intake (DFI) of cobia with initial body weight of 11.9 g were evaluated. Four isoproteic (from 431.1 to 439.7 g kg ⁻¹) and isoenergetic (20 825–21 347 MJ kg ⁻¹) diets were formulated to contain 0 (Control), 120, 240 or 360 g kg ⁻¹ of dietary CP derived from SPH. Survival, WG, SGR, FCR, NRE and DFI ranged from 90 to 100%, 40.2–56.5 g, 4.7–6.1% day ⁻¹ , 1.04–1.54, 26.3–44.0% and 4.7–6.0% fish ⁻¹ day ⁻¹ respectively. Survival and DFI were not affected by the dietary treatments. On the other hand, fish fed the control diet and the one containing 120 g kg ⁻¹ SPH had higher WG, SGR and FCR. Nitrogen retention efficiency was significantly higher for fish fed diets 0 and 120. It is concluded that up to 120 g kg ⁻¹ of SPH in cobia diets can be used with no significant effects on feed utilization and fish performance.	Costa-Bomfim, C.N., Silva, V.A., Bezerra, R. de S., Druzian, J.I., Cavalli, R.O.	Aquaculture Research n/a-n/a. doi:10.1111/are.13013	2016	Nutrition
379	New Mediterranean biodiversity records (October 2015)	The Collective Article "New Mediterranean Biodiversity Records" of the Mediterranean Marine Science journal offers the means to publish biodiversity records in the Mediterranean Sea. The current article is divided per countries, listed according to a Mediterranean west-east geographic position. New biodiversity data are reported for 7 different countries, although one species hereby reported from Malta is overall new for the entire Mediterranean basin, and is presumably present also in Israel and Lebanon (see below in Malta). Italy: the rare native fish <i>Gobius kolombatovici</i> is first reported from the Ionian Sea, whilst the alien jellyfish <i>Rhopilema nomadica</i> and the alien fish <i>Oplegnathus fasciatus</i> are first reported from the entire country. The presence of <i>O. fasciatus</i> from Trieste is concomitantly the first for the entire Adriatic Sea. Finally, the alien bivalve <i>Arcuatula senhousia</i> is hereby first reported from Campania (Tyrrhenian Sea). Tunisia: a bloom of the alien crab <i>Portunus segnis</i> is first reported from the Gulf of Gabes, from where it was considered as casual. Malta: the alien flatworm <i>Marrigrella fuscopunctata</i> is first recorded from the Mediterranean Sea on the basis of 25 specimens. At the same time, web researches held possible unpublished records from Israel and Lebanon. The alien crab <i>P. segnis</i> , already mentioned above, is first formally reported from Malta based on specimens collected in 1972. Concomitantly, the presence of <i>Callinectes sapidus</i> in Maltese waters is excluded since based on misidentifications. Greece: the Atlantic northern brown shrimp <i>Penaeus atzecus</i> , previously known from the Ionian Sea from sporadic records only, is now well established in Greek and international Ionian waters. The alien sea urchin <i>Diadema setosum</i> is reported from the second time from Greece, and its first record date from the country is backdated to 2010 in Rhodes Island. The alien lionfish <i>Pterois miles</i> is first reported from Greece and concomitantly from the entire Aegean Sea. Turkey: the alien rhodophyte <i>Antithamnion hubbsii</i> is first recorded from Turkey and the entire eastern Mediterranean. New distributional data are also offered for the native fishes <i>Alectis alexandrina</i> and <i>Heptanchias perlo</i> . In particular, the former record is constituted by a juvenile of 21.38 mm total length, whilst the latter by a mature male. Cyprus: the rare native cephalopod <i>Macrotritopus defilippi</i> , and the alien crab <i>Atergatis roseus</i> , sea slug <i>Plocamopherus ocellatus</i> and fish <i>Cheilodipterus novemstriatus</i> are first recorded from the entire country. Lebanon: the alien crabs <i>Actaea savignii</i> and <i>Matuta victor</i> , as well as the alien fish <i>Synanceia verrucosa</i> , are first recorded from the entire country. In addition, the first Mediterranean record of <i>A. savignii</i> is backdated to 2006, whilst the high number of <i>M. victor</i> specimens observed in Lebanon first suggest its establishment in the basin. The Atlantic fishes <i>Paranthias furcifer</i> and <i>Seriola fasciata</i> , and the circumtropical <i>Rachycentron canadum</i> , are also first reported from the country. <i>P. furcifer</i> record backdate its presence in the Mediterranean to 2007, whilst <i>S. fasciata</i> records backdate its presence in the eastern Mediterranean to 2005. Finally, two of these latter species have been recently ascribed to alien species, but all the three species may better fit the cryptogenic category, if not a new one.	Crocetta, F., Agius, D., Balistreri, P., Bariche, M., Bayhan, Y.K., Çakir, M., Ciriaco, S., Corsini-Foka, M., Deidun, A., Zrelli, R.E., Ergüden, D., Evans, J., Ghelia, M., Giavasi, M., Kleitou, P., Kondylatos, G., Lipej, L., Mifsud, C., Özvarol, Y., Pagano, A., Portelli, P., Poursanidis, D., Rabaoui, L., Schembri, P.J., Taşkin, E., Tiralongo, F., Zenetos, A.	Mediterranean Marine Science 16, 682–702. doi:10.12681/mms.1477	2015	Wild (Atlantic)
380	Forecasting the genetic impacts of net pen failures on gulf of Mexico cobia populations using individual-based model simulations	Offshore net pen fish farming provides a cost-efficient means for production of marine finfish, and there is great interest in development of net pen operations in domestic waters. However, there are concerns over the possible genetic and ecological impacts that escaped fish may have on wild populations. We used individual-based simulations, with parameter values informed by life history and genetic data, to investigate the short-term (50 yr) impacts of net pen failures on the genetic composition of cobia, <i>Rachycentron canadum</i> , stocks in the Gulf of Mexico. Higher net pen failure rates resulted in greater genetic impacts on the wild population. Additionally, the use of more genetically differentiated source populations led to larger influxes of non-native alleles and greater temporal genetic change in the population as a result of net pen failure. Our results highlight the importance of considering the appropriate source population for broodstock collection in net pen aquaculture systems and help to provide a general set of best management practices for broodstock selection and maintenance in net pen aquaculture operations. A thorough understanding of the genetic diversity, stock structure, and population demography of target species is important to determine the impact escapees can have on wild populations.	Darden, T.L., Robinson, J.D., Strand, A.E., Denson, M.R.	Journal of the World Aquaculture Society n/a-n/a. doi:10.1111/jwas.12333	2016	Siting Cage Culture
381	The isozyme analysis of different tissue in <i>Rachycentron canadum</i>	By the vertical polyacrylamide gel electrophoresis, five isozymes (LDH, MDH, ME, POD, EST) from several tissues (brain, heart, muscle, kidney, gonad, liver, blood, spleen, pancreas) of <i>Rachycentron canadum</i> were studied, the results showed that all isozymes presented tissue specificity. These specificities were related to their special physiological function. Compared with other teleosts, the isozymic phenotypes of <i>R. canadum</i> were much simple with, which may be related to its generic diversity.	Deng, S., Liu, C., Chen, J., Ye, G.	Journal of Zhanjiang Ocean University 22, 1–5	2002	Fish Health
382	Analysis of heavy metals in marine fish from Mumbai Docks	Seafood containing heavy metals as a result of environmental contamination causes toxicity in human beings. To evaluate such kind of contamination, our study targeted the analysis of metals such as lead, copper, cadmium, mercury, and arsenic in muscle tissue of the fish. The fish commonly consumed such as <i>Brama brama</i> (Pomfret), <i>Rachycentron canadum</i> (Surmai/King Fish), <i>Rastrelliger kanagurta</i> (Mackerel), <i>Eleutheronema tetradactylum</i> (Ravas/Indian salmon), and <i>Metapenaeus monaceros</i> (Brown Prawn) were collected from four different docks in the city. The heavy metals in tissue samples of fish were estimated using voltammeter and cold vapor atomic absorption spectrophotometer. Heavy metal concentration in the tissues varied significantly depending upon the locations from where the fish were collected. Although the concentration of arsenic, copper, cadmium, and lead were in normal range, the concentration of mercury was found to exceed the daily permissible levels (1 µg/g) as a food source for human consumption. We have analyzed heavy metals from different locations in Mumbai—Versova dock, Sassoon dock, Navi Mumbai dock, and Mazgaon dock.	Deshpande, A., Bhendigeri, S., Shirsekar, T., Dhaware, D., Khandekar, R.N.	Environmental Monitoring and Assessment 159, 493. doi:10.1007/s10661-008-0645-3	2008	Fish Health Food Safety Wild (Pacific)

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
383	Results of trolling line operations in Goa waters during 1965-68.	The results of trolling line operations conducted for the first time in Goa waters by the Directorate of Fisheries, Panaji, during the years 1965-68 have been discussed. These operations, in later years, led to starting of a small commercial fishery. The trolling line catches are constituted by <i>Scomberomorus commerson</i> , <i>Chorinemus lysan</i> , <i>Caranx sanson</i> , <i>Sphyraena</i> sp., <i>Chirocentrus dorab</i> , <i>Rachycentron canadus</i> , <i>Euthymus affinis</i> and <i>Thynnus mapropterus</i> . The size groups, gonadal condition and food of <i>Scomberomorus commerson</i> and <i>Chorinemus lysan</i> which were the two main species in the fishery have been described.	Dhawan, R.M., Namboothiri, P.V.S., Gopinathan, V.G.	Indian Journal of Fisheries 16, 181-187	1969	Wild (Pacific)
384	Dietary alanyl-glutamine and vitamin E supplements could considerably promote the expression of GPx and PPAR α genes, antioxidation, feed utilization, growth, and improve composition of juvenile cobia	This experiment was conducted to study the effect of various dietary alanyl-glutamine dipeptide (AGD) and/or vitamin E (VE) supplement(s) on the expression of glutathione peroxidase (GPx) and peroxisome proliferator-activated receptor α (PPAR α) genes, antioxidation, feed utilization, growth, and composition of juvenile cobia (<i>Rachycentron canadum</i>). Six groups of the juveniles in triplicate were fed for 12 weeks using 6 diets: Control diet (D0) contained only basic ingredients; Diet 1 (D1) contained single added AGD 10 g kg ⁻¹ dried feed; Diet 2 (D2) contained single added VE 100 IU kg ⁻¹ dried feed; Diet 3 (D3) contained added AGD 10 g kg ⁻¹ dried feed and VE 100 IU kg ⁻¹ dried feed; Diet 4 (D4) contained added AGD 5 g kg ⁻¹ dried feed and VE 50 IU kg ⁻¹ dried feed; Diet 5 (D5) contained added AGD 2.5 g kg ⁻¹ dried feed and VE 25 IU kg ⁻¹ dried feed. The juveniles were sampled randomly for analysis in week 0 and week 12. The main results were as follows: the diets with combined AGD and VE supplements could considerably promote feed utilization, growth, and improve composition of the juveniles; the combined AGD and VE supplements could significantly promote (P < 0.05) glutathione peroxidase (GPx), catalase (CAT), glutathione S-transferase (GST), total antioxidant capacity (T-AOC), the expression of PPAR α and GPx genes, and significantly decrease (P < 0.05) malondialdehyde (MDA) in the liver and muscle of the juveniles; the effect of AGD supplement alone on the expression of GPx gene was significantly greater (P < 0.05) than that of VE supplement alone in the liver; whereas the effect of VE supplement alone on the expression of PPAR α gene was significantly greater (P < 0.05) than that of AGD supplement alone in the liver and muscle. We concluded that the combined AGD and VE supplements could cooperate and considerably promote the expression of GPx and PPAR α genes, antioxidation, feed utilization, growth, and improve composition of juvenile cobia; the optimum was D4, with 5 g of AGD and 50 IU of VE added per kg of dried feed. Statement of relevance There is a need to assess light effect on lice settlement in controlled conditions due to conflicting results. We analyzed lice settlement while taking into account preexisting fin erosion and fish size. Findings confirm that light is not requirement for lice infestation. Fin erosion influenced the number of lice on paired fins suggesting the importance of considering fin erosion as a potential biophysical parameter	Ding, Z., Li, W., Huang, J., Yi, B., Xu, Y.	Aquaculture 470, 95-102. doi:10.1016/j.aquaculture.2016.12.015	2017	Genetics Molecular Fish Health Nutrition
385	Preliminary guide to the identification of the early life history stages of <i>Rachycentrid</i> fishes of the Western Central Atlantic (No. 460 (12))	The family <i>Rachycentridae</i> , contains a single cosmopolitan species, <i>Rachycentron canadum</i> , found primarily in tropical and subtropical waters, except those of the eastern Pacific (Briggs 1960). Cobia are a highly prized recreational species that are also taken incidentally in commercial fisheries (Shaffer and Nakamura 1989). In the western Atlantic, cobia occur from Massachusetts to Argentina but are most common along the U. S. Atlantic and Gulf coasts. Cobia are usually absent from northern Gulf of Mexico and temperate Atlantic waters along the U. S. coast during late fall and winter when they are found off the Florida Keys. Cobia migrate north along the Atlantic and Gulf coasts during spring (Hassler and Rainville 1975; Shaffer and Nakamura 1989) reappearing in the northern Gulf during March and April (Springer and Pirson 1958). Cobia are taken off Louisiana and Texas (Shaffer and Nakamura 1989) associated with oil and gas platforms or rafts of Sargassum.	Ditty, J.G.	Technical Memorandum NMFS SEFSC. NOAA.	2001	Wild (Atlantic)
386	Effects of dietary immunostimulant combination on the growth performance, non-specific immunity and disease resistance of cobia, <i>Rachycentron canadum</i> (Linnaeus).	The aim of this study was to examine the effects of the immunostimulant combination (IC) containing β -glucan, A3 α -peptidoglycan, vitamin C and vitamin E on the growth performance, non-specific immunity and protection against <i>Vibrio harveyi</i> infection in cobia (<i>Rachycentron canadum</i>). Fish were fed diets containing six graded levels of IC (0, 1, 2, 3, 4 and 5 g kg ⁻¹ diet) for 8 weeks. The results showed that the survival rate ranged from 81.1 to 84.4% with no significant difference among all the groups (P > 0.05) after the feeding experiment. Dietary IC significantly increased the specific growth rate (SGR), serum lysozyme, alternative complement pathway (ACH50) activity, phagocytosis percentage (PP) and respiratory burst activity of head kidney macrophages of cobia. Moreover, feeding of supplemented diets containing 3.0 g kg ⁻¹ IC resulted in significantly lower mortality against the pathogens, <i>V. harveyi</i> compared with the control group. To elevate the growth and immune resistance ability of cobia, the optimal dose of dietary IC administration, determined by second-order polynomial regression analysis was 3.43 and 2.71 g kg ⁻¹ diet, respectively, on the basis of the SGR and mortality after challenge with <i>V. harveyi</i> .	Dong, X.-H., Geng, X., Tan, B.-P., Yang, Q.-H., Chi, S.-Y., Liu, H.-Y., Liu, X.-Q.	Aquaculture Research 46, 840-849. doi: 10.1111/are.12257	2015	Fish Health
387	Analysis of sexually dimorphic growth in captive reared cobia (<i>Rachycentron canadum</i>) and the occurrence of intersex individuals.	The growth of three cohorts of captive reared cobia, grown in a combination of flow-through and recirculating aquaculture systems, was progressively measured to determine the existence and extent of sexually dimorphic growth in cobia. Approximately 100 fish from each cohort were individually identified and regularly weighed until the average weight of the fish was approximately 5 kg. The sex of individuals was determined through gonadal observations at the conclusion of each trial and the gender fitted retrospectively to the growth data set. Intersex gonads were observed in the first two cohorts of cobia, with 16.9% incidence in cohort 1 and 6.8% in cohort 2. Cobia is considered a gonochoristic species. This was the first reported observation of intersex gonads in cobia and the first reported occurrence of intersex gonads from a gonochoristic fish species from Australian waters. Only one fish out of the 182 examined in the third cohort was identified as intersex. There was no sexually dimorphic growth in cobia when there was a relatively high incidence of the intersex anomaly, as seen in the first two cohorts of fish. In the relative absence of the intersex condition, female cobia was significantly larger than males from 2 kg onwards. The weight of female cobia was almost 30% more than that of males at 17 months of age when average weight of the cohort was 4.6 kg. It is likely that the first two cobia cohorts were exposed to endocrine disruption in some form, and the possible sources are discussed. Statement of relevance This study demonstrated that female cobia grow significantly faster than male fish and that investigations into monosex culture could lead to significant productivity gains for cobia aquaculture. It also demonstrated that cohorts containing intersex fish did not exhibit sexually dimorphic growth. It is likely that the reproductive anomaly is the result of disruption to the endocrine system.	Dutney, L., Elizur, A., Lee, P.	Aquaculture 468, Part 1, 348-355. doi: 10.1016/j.aquaculture.2016.09.044	2017	Culture Fish Health
388	Cobia (<i>Rachycentron canadum</i>): A Selected Annotated Bibliography on Aquaculture, General Biology and Fisheries 1967-2015.	The good-quality white flesh of cobia (<i>Rachycentron canadum</i>) and high value in some markets make it one of the most important marine fish species for future aquaculture production. Commercial cobia farming from hatchery-produced seed stock began in the late 1990s and some aspects of broodstock management, larviculture, nutrition and health, among others, still need research and improvements. The present compilation covers the period between 1967 and 2015 and includes publications on cobia general biology, fisheries and aquaculture for the potential benefit of students, researchers, farmers, and the industry.	Estrada, U.R., Yasumaru, F. A., Tacon, A.G.J., Lemos, D.	Reviews in Fisheries Science & Aquaculture 24, 1-97. doi:10.1080/23308249.2015.1088821	2016	Review
389	Bacteriological evaluation of fresh, salted and smoked cobia meat from fish culture of Ilha Grande Bay, Rio de Janeiro state, Brazil.	The objective of this study was analyzing the microbiota of cobia meat samples grown in cages from Ilha Grande Bay, Rio de Janeiro state. Evaluating the efficiency of salting and smoking processing controlling the microbial frequency. The following results show an enumeration of Staphylococcus aureus: in fresh meat average of 8.1 CFU/g; smoked meat averaged 0.6 CFU/g; the salted meat was negative. Total coliforms, the results were: mean of 3.7 CFU/g for fresh meat; salted meat, an average of 2.2 CFU/g; the smoked fish was negative. Results for Escherichia coli and Salmonella spp. were negative in the three groups (fresh, smoked and salted). The Heterotrophic Aerobic Mesophilic Bacteria count presented for fresh meat an average of 307.5 CFU/g; for salted meat mean of 133.2 CFU/g; while the smoked meat an average of 0.4 UFC/g. All samples were within the standard of the Brazilian legislation for microbiological quality of the product.	F. A.A. Calixto	Boletim do Instituto de Pesca 42, 209-215. doi:10.5007/1678-2305.2016v42n1p209	2016	Food Safety
390	Effects of mixture of certain traditional Chinese medicines on growth performance, whole-body proximate composition and immunity in juvenile cobia, <i>Rachycentron canadum</i> .	Equal amount of dry <i>Isatis tinctoria</i> L., <i>Isatis indigotica</i> (Fort), <i>Forsythia suspensa</i> (Vahl), <i>Corydalis bungeana</i> (Turez), <i>Pogostemon cablin</i> (Blanco) Benth and <i>Astragalus membranaceus</i> (Fisch.) Bge were mixed. Five diets added the mixture of the six traditional Chinese medicines (TCM) at the levels of 0, 0.1%, 0.2%, 0.4%, 0.8% respectively were conducted to determine the weight gain (WG), survival rate, feed conversion (FCR), protein efficiency ratio (PER) and whole body composition of juvenile cobia (<i>Rachycentron canadum</i>). The results showed that: (1) After 4-week feeding experiment, there was no significant difference in survival rate. However, the WG of cobia fed the diet supplemented with 0.1% TCM was significantly higher than all of the other groups; and the feed conversion value was also significantly superior to the other treatments. The WG decreased with the increasing of the TCM supplementation, while the FCR increased. At the end of the feeding trial, the trend of the WG was similar to that of the first 4 weeks. Survival rate of the control group was significantly lower than all of the other groups. (2) The hepatosomatic and visceral somatic index were slightly decreased with the increasing of TCM in the diets, although dietary TCM did not affect the condition factor. There were no significant differences in moisture, crude protein and ash of the whole body among the different groups whereas the lipid content of cobia fed diets supplemented with 0.4% and 0.8% TCM were significantly lower than those of fish fed the other three diets. (3) Lysozyme activity in the serum and potential killing activity in blood leukocytes of cobia were enhanced by the supplementation of TCM in the feed. Lysozyme activity in the serum increased with the increasing of the TCM concentration and potential killing activity of blood leukocytes of the trial group was significantly higher than that of the control group, but no significant differences in cobia fed diets supplemented with different level of TCM. The mortality of the fish resulted from the <i>Vibrio carchariae</i> infection decreased due to the supplementation of TCM.	Feng, J., L. I. N., H., G. U. O., Z., X. U., L.	Guangdong Agricultural Sciences 39, 136-141.	2012	Food Safety

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
391	Effects of salinity on growth and several immune parameters of juvenile cobia, <i>Rachycentron canadum</i> .	Cobia (<i>Rachycentron canadum</i>) is a new aquaculture candidate for offshore cage in Taiwan Province and southern coast of China due to its high growth rate. The effects of salinity [(5, 10, 20, 30 and 37 as control)] on growth, serum lysozyme activity, alkaline phosphatase (ALP), alternative complement pathway (ACP) activity and total immunoglobulin (T-Ig) in serum of cobia juvenile were determined on days 7 and 14 after adapting to the final treatment salinity. The results showed that the highest SGR of 5.77%/d was obtained at salinity 30, and SGR was significantly lower (P<0.05) at salinities 5 and 10 (4.24%/d and 4.38%/d, respectively). The lysozyme activity, in some extent, increased in low salinity treatments on day 7, with the activity at salinity 20 being significantly higher than those in other treatments. But no significant differences were found among treatments on day 14. Inversely, compared with the control, the ALP activities in low salinity treatments were evidently restrained with a positive correlation to salinity. Juvenile serum ACP activities among treatments were not distinctly different on day 7, but showed significant raise in salinities 5 and 10 treatments on day 14. The T-Ig content in treatment of salinity 10 was higher than those in other treatments throughout the experiment, moreover, significantly higher than those in salinity 30 and the control. The results indicate the cobia juvenile can obtain well-growth at salinity ranging from 20 to 37. Though the juvenile can tolerate hyposalinity environments as low as 5 for a short period without mortality, such salinity clearly influences its growth rate and induces and results in poor health appearance such as fin erosion, discoloration, hyperirritability, etc.. Salinity also effects some immune parameters of cobia juvenile, for instance, rearing at salinities 5 and 10 can increase the serum ACP activity and total Ig content, contrarily restrain the activity of ALP.	Feng, J., Xu, L., Lin, H., Guo, Z., Guo, G.	Journal of Fishery Sciences of China 14, 120–125	2007	Fish Health Culture
392	Appraising the shelf life of farmed cobia, <i>Rachycentron canadum</i> , by application of a quality index method.	Freshness is the main concern of seafood quality, and the principal method to evaluate seafood freshness is sensory evaluation. The aim of this work was to study the quality changes of cobia, <i>Rachycentron canadum</i> , under ice storage through sensory and physical analysis as well as bacterial counting of specific spoilage organisms (SSOs). In particular, the utilization of a quality index method (QIM) scheme was proposed. Samples stored for 0–30 d were analyzed with the QIM. Ten panelists observed and registered the changes occurring in the fish starting on day zero and ending when the fish were spoiled. After developing the scheme, 11 sensory attributes were described in 23 points, which detailed the appearance of skin, eyes, abdomen, gills, and flesh deterioration. The volatile nitrogen compound measurements and microbiological data of the SSOs determined a shelf-life of 19 d for the samples. Sensory analysis showed a rejection point at 15.67 d of ice storage. The natural degradation of myofibrillar proteins and collagen was observed during ice storage. In conclusion, a shelf-life of 15 d was defined for raw cobia stored on ice.	Fogaça, F.H. dos S., Gonzaga Junior, M.A., Vieira, S.G.A., Araujo, T.D. S., Farias, E.A., Ferreira-Bravo, I.A., Silva, T.F.A., Calvet, R.M., Pereira, A.L. M., Prentice-Hernández, C.	Journal of the World Aquaculture Society n/a-n/a. doi:10.1111/jwas.12329	2016	Food Safety
393	Enzymatic hydrolysis of cobia (<i>Rachycentron canadum</i>) meat and wastes using different microbial enzymes.	Some proteins, beyond to their technological, functional and nutritional properties, exhibit biological activity, being one of them, the antioxidant activity, associated to bioactive peptides released after hydrolysis. The industrial processing wastes of fishes are a great source of proteins, and the cobia (<i>Rachycentron canadum</i>), that it is a large and easily adaptable to aquaculture emerges as an option to obtain peptides. Thus, the aim of this study was to obtain peptides by hydrolyzing meat and wastes of cobia with different enzymes. Six hydrolysates through the hydrolysis of the meat and wastes with Alcalase, Flavourzyme and Protamex were obtained, wherein the last one presented greater hydrolytic capacity for the substrates, reaching a DH of 27.94% in 760 min for meat and 33.14% in 580 min for wastes. The free tyrosine content varied depending on the substrate and the enzyme, and the highest values for the hydrolysate wastes by Alcalase (8.46%) and by Protamex (6.46%) and hydrolysate meat by Protamex (6.47%). Therefore, these results indicate the potential utilization of the hydrolysates from cobia meat and wastes in food formulations.	Fonseca, R.A.S., Silva, C.M., Silva, G.R., Prentice, C.	International Food Research Journal; Selangor 23, 152–160	2016	Food Safety
394	Bovine pancreatic trypsin inhibitor immobilized onto sepharose as a new strategy to purify a thermostable alkaline peptidase from cobia (<i>Rachycentron canadum</i>) processing waste.	A thermostable alkaline peptidase was purified from the processing waste of cobia (<i>Rachycentron canadum</i>) using bovine pancreatic trypsin inhibitor (BPTI) immobilized onto Sepharose. The purified enzyme had an apparent molecular mass of 24 kDa by both sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) and mass spectrometry. Its optimal temperature and pH were 50 °C and 8.5, respectively. The enzyme was thermostable until 55 °C and its activity was strongly inhibited by the classic trypsin inhibitors N-p-tosyl-L-lysine chloromethyl ketone (TLCK) and benzamidine. BPTI column allowed at least 15 assays without loss of efficacy. The purified enzyme was identified as a trypsin and the N-terminal amino acid sequence of this trypsin was IGGYECTPHSQAHQVLSNSGYHFC, which was highly homologous to trypsin from cold water fish species. Using N α -benzoyl-DL-arginine p-nitroanilide hydrochloride (BAPNA) as substrate, the apparent km value of the purified trypsin was 0.38 mM, kcat value was 3.14 s ⁻¹ , and kcat/km was 8.26 s ⁻¹ mM ⁻¹ . The catalytic proficiency of the purified enzyme was 2.75 \times 10 ¹² M ⁻¹ showing higher affinity for the substrate at the transition state than other fish trypsin. The activation energy (AE) of the BAPNA hydrolysis catalyzed by this enzyme was estimated to be 11.93 kcal mol ⁻¹ while the resulting rate enhancement of this reaction was found to be approximately in a range from 109 to 1010-fold evidencing its efficiency in comparison to other trypsin. This new purification strategy showed to be appropriate to obtain an alkaline peptidase from cobia processing waste with high purification degree. According with N-terminal homology and kinetic parameters, R. canadum trypsin may gathers desirable properties of psychrophilic and thermostable enzymes.	França, R.C. da P., Assis, C. R.D., Santos, J.F., Torquato, R.J.S., Tanaka, A.S., Hirata, I.Y., Assis, D.M., Juliano, M. A., Cavalli, R.O., Carvalho Jr, L.B. de, Bezerra, R.S.	Journal of Chromatography B 1033–1034, 210–217. doi:10.1016/j.jchromb.2016.08.028	2016	Food Safety
395	A pugheaded cobia (<i>Rachycentron canadum</i>) from the north central Gulf of Mexico.	A pugheaded cobia (<i>Rachycentron canadum</i>) captured in the northcentral Gulf of Mexico represents the first record of pugheadedness in cobia. The specimen, a 4-year-old gravid female, exhibited considerable distortion of the premaxillary and maxillary bones, with the length of the snout 46% shorter than that of a normal cobia of the same length. The anomaly had no apparent effect on feeding, since the stomach contained a substantial amount of food, and the fish was the same length expected of a normal 4-year-old cobia.	Franks, J.S.	Gulf Research Reports 9, 143–145	1995	Wild (Atlantic)
396	A review of age, growth, and reproduction of cobia, <i>Rachycentron canadum</i> , from U. S. waters of the Gulf of Mexico and Atlantic Ocean.	A review of available scientific information on the age, growth, and reproduction of cobia, <i>Rachycentron canadum</i> , from United States waters of the Gulf of Mexico and Atlantic Ocean is provided. Periodicity of annulus formation on sectioned sagittae has been partially validated by marginal-increment analysis, and age in years is estimated as the number of observed opaque bands. Growth in length for both sexes is rapid through age 2. Females grow faster and live longer than males and dominate all age groups. Gulf males reached age 9 and 1,390 mm FL; females reached age 1 and 1,651 mm FL. Atlantic males reached age 14 and 1,360 mm FL; females reached age 13 and 1,420 mm FL. Estimates of the von Bertalanffy growth parameters (L ∞ , K, and t0) within studies showed significant differences in L ∞ and K for the sexes, whereas estimates for t0 were not always significantly different. Ages 2 - 5 dominated the age structure of Gulf and Atlantic samples. Cobia were fully recruited to the northeastern Gulf recreational fishery at age 4, and the instantaneous rate of total mortality (Z) estimated for fully recruited cobia ages. 4 - 8 was 0.75. Cobia have an extended spawning season throughout their range in United States waters, averaging five months (mid-April-August) in the Atlantic Ocean and six months (April-September) in the Gulf of Mexico. Some Gulf females appear to cease spawning by July. Female cobia can obtain sexual maturity as small as 700 mm FL. Histological analysis shows cobia are a multiple spawning species; females are estimated to spawn once every five days throughout most of the U.S. region. Batch fecundity increases significantly with FL and ovary-free body weight (OFBW); mean relative batch fecundity is 53.1 \pm 9.4 eggs/g OFBW. While the testis of males contain sperm year-round, spermatogenesis only takes place from February - August, and spermatogonial proliferation is observed during non-spawning months.	Franks, J.S., Brown-Peterson, N.J.	Proceedings of the Gulf and Caribbean Fisheries Institute 53, 553–569	2002	Wild (Atlantic)
397	Investigation on genetic structure of cobia (<i>Rachycentron canadum</i>) using microsatellite markers.	The genetic diversity of Cobia, <i>Rachycentron canadum</i> populations in the Persian Gulf and Oman Sea were assessed using microsatellite technique. We removed about 3-5g of pectoral and dorsal fin tissue from 184 samples in winter 2006 and spring 2007, and stored it in pure ethylic alcohol (96%). Polymerase chain reactions (PCR) were conducted on the target DNA using 10 paired microsatellite primers. The dendrogram was constructed and drawn using MEGA software package version 4. Based on the analysis of molecular variance, the highest Fst (0.063) was observed when comparing specimens from Dayer Port and Pozm zones. Significant differences (P<0.01) were not observed between Rst recorded for the specimens studied in the same region but were observed between Rst recorded for different regions. The dendrogram of genetic distance showed two major clusters: the Bushehr and Dayer populations were in one cluster, and the remaining four populations in the other. The second cluster was further separated into two sub-clusters: the Lengehand Bandar Abbas populations composed one cluster and the Pozm and the Beris populations were in the other cluster. The present study showed that at least three different populations of <i>R. canadum</i> are living in the Persian Gulf and Oman Sea. The populations include Bushehr, Bandar Abbas and Chabahar populations.	Gilkolaei, S.R., Aliabadi, M. A.S., Savari, A., Algharney, H.Z., Nabavi, S.M.B.	Iranian Scientific Fisheries Journal 18, 67–78	2009	Genetics Molecular Wild
398	Selection of probiotic bacteria and its use in the culture of copepod <i>Pseudodiaptomus annandalei</i> .	The research of probiotics for aquatic animals is increasing with the demand for environment-friendly aquaculture. The candidate probiotics were isolated from the waste liquid produced among the fermentation process of hydrogen generation and based on their in vitro antagonistic activity towards aquatic pathogens to screen and evaluate their application in aquaculture in this study. The waste fermented liquid showed significant antagonism to <i>Vibrio vulnificus</i> , <i>Listonella anguillarum</i> , <i>Photobacterium damsela</i> subsp. <i>piscicida</i> and <i>Streptococcus</i> sp. Of the 4 strains isolated from the fermented waste liquid, 2 fulfilled the probiotic criteria of inhibiting the growth of aquatic pathogens, not causing mortality of cobia (<i>Rachycentron canadum</i>) following oral administration at 10 super(8)-10 super(9) CFU/ml bacterial concentration, and increasing the growth and survival of copepod <i>Pseudodiaptomus annandalei</i> by incubation in bacterial suspension of 10 super(5)-10 super(6) CFU/ml and micro-algae (<i>Isochrysis galbana</i> tml) together. Antagonistic activities of potential probiotics through 4.5- and 24-hour incubation before pathogen inoculation were better than no pretreatment.	Guo, J.-J., Cheng, S.-H., Hsu, Y.-O., Yang, J.-Y., Chen, H.-C., Liu, K.-F., Chang, C.-I., Lay, J.-J., Chen, T.-I.	Journal of the Fisheries Society of Taiwan 32, 85	2005	Fish Health Culture
399	The efficacy of inactivated <i>photobacterium damsela</i> subsp. <i>Piscicida</i> combined with Levan/Alum as vaccine against Photobacteriosis in cobia, <i>Rachycentron canadum</i> .	<i>Photobacterium damsela</i> subsp. <i>piscicida</i> (Phdp) is a major pathogen of cultured cobia (<i>Rachycentron canadum</i>), a primary target species for offshore cage culture in Taiwan. Serum antibody titers as well as efficiency and duration of protection against Phdp were evaluated following intraperitoneal administration of a candidate vaccine prepared with formalin-inactivated whole cells in combination with levan/alum adjuvants. The results showed vaccinates delayed the disease onset and had significantly (P < 0.05) less mortality than control nonvaccinates during Days 21–105 postvaccination with highest relative percentage of survival (RPS) and antibody titer up to 81.4% and 1:614, respectively. There was a highly significant positive linear correlation between the RPS and antibody titer (R2 = 0.841). Long-lasting and significant protection against Phdp can be achieved with inactivated Phdp plus levan/alum, a potential cobia vaccine against photobacteriosis. Levan/alum complex may represent a promising adjuvant formula for the development of a Phdp vaccine.	Guo, J.-J., Huang, M.-Y., Hong, J.-W., Chuang, Y.-C., Chou, R.-L., Lee, Y.-H., Chen, T.-I.	Journal of the World Aquaculture Society 46, 549–556. doi:10.1111/jwas.12216	2015	Fish Health

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
400	Identification and phylogenetic analysis of a pathogenic <i>Vibrio</i> sp. isolated from <i>Rachycentron canadum</i> .	A pathogenic bacterial strain JT2 was isolated from cobia (<i>Rachycentron canadum</i>). Morphological observation showed that it was a mobile short-rod gram negative bacterium with polar flagella and translucent. It was proved to be the pathogen of the cobia (<i>Rachycentron canadum</i>) by the challenge test. The traditional physiological and biochemical experiments were done, and API- ID32E system were applied in the bacterial classification. Identified with Biolog-GN (gram negtive) system again, results showed that strain JT2 was similar to that of <i>Vibrio carchariae</i> in most of the phenotypes. To investigate the phylogenetic position of this pathogen, 16S rDNA of JT2 was sequenced and compared with that of other related strains. Molecular phylogenetic dendrogram was constructed based on the genetic distance analysis. The results showed that strain JT2 exhibited the highest levels of similarity to the <i>V. carchariae</i> . Analysing all the results of several methods, strain JT2 was identified as <i>Vibrio carchariae</i> .	Guo, M., Liu, G., Feng, J.	Journal of fishery sciences of China/Zhongguo Shuichan Kexue 13, 823–828	2006	Fish Health
401	Present status on studies of cobia <i>Rachycentron canadum</i> in China.	Due to the advantages of fast growth, less diseases and high nutrition value, cobia <i>Rachycentron canadum</i> has become one of the major marine cultivated species and the scale of culture has expanded rapidly in recent years in China. This paper reviews the biology, artificial breeding and fry culturing, net-cage farming, nutritional requirement, disease and genetic diversity of cobia. The prospect for the future study is also presented.	Guo, X., Ou, Y., Rui, L.	Marine Fisheries 29, 84–89	2007	Culture Fish Health
402	Effects of galacto-oligosaccharides in feed on growth performance, serum immunological and biochemical factors of cobia.	To study the effects of galacto-oligosaccharides (GOS) on the growth performance, serum immunological and biochemical factors of cobia (<i>Rachycentron canadum</i>), we supplemented GOS in the feed at different levels (0, 0.2%, 0.4%, 0.8% and 1.6%) and fed the cobia for 8 weeks. The addition level lower than 0.4% improves the growth rate insignificantly (P>0.05). The activity of serum lysosome and superoxide dismutase is improved significantly by GOS supplementation. However, the catalysase activity is inhibited significantly. The serum biochemical factors including the total protein, albumin, globulin, total bilirubin and direct bilirubin are influenced significantly by GOS supplementation, but no significant influence is observed on the indirect bilirubin. The concentration of serum cholesterol is significantly higher in the experimental group supplemented with 0.2% GOS than in the control, and the concentration of aspartate aminotransferase (AST) is significantly lower in the group supplemented with 0.4% GOS than in the control. The AKP activity decreases with the increase of GOS concentration when GOS concentration is lower than 0.8%. In conclusion, the growth rate and immunological function of cobia can be improved by GOS supplementation in the feed at proper level, and the optimal concentration is 0.2%~0.4%.	Guo, Z., Liu, H., Xu, L., Su, Y., Feng, J.	South China Fisheries Science 7, 56–61	2011	Fish Health Nutrition
403	Physical properties of cobia (<i>Rachycentron canadum</i>) surimi: effect of washing cycle at different salt concentrations.	This study aimed to determine the effects of 2–5 wash cycles and the addition of tetrasodium pyrophosphate (TSP) (0%, 0.05 Surimi% and 0.1% w/w)—with or without the addition of 0.4% calcium chloride (CaCl ₂)—on the physical properties such as texture, colour, expressible moisture and microstructure of Cobia (<i>Rachycentron canadum</i>) surimi gel. The highest breaking force (484.85 g) was obtained with the addition 0.1% TSP alone on the fifth wash. However, a combination of 0.1 and 0.4% CaCl ₂ in surimi gels at wash cycle 5 resulted in the highest degree of whiteness (86.8%), as well as total expressible moisture (2.785%) and deformation (17.11 mm). The highest surimi gel strength (6,923 g·mm) was obtained after three wash cycles with the addition of 0.1% TSP +0.4% CaCl ₂ . The physical properties of Cobia fish surimi gels were affected by the number of wash cycles and treatments with TSP and CaCl ₂ .	Hamzah, N., Sarbon, N.M., Amin, A.M.	Journal of Food Science and Technology 52, 4773–4784. doi:10.1007/s13197-014-1622-1	2015	Food Safety
404	Effect of different fish protein hydrolysate (FPH) level of dietary supplements on growth and body composition of larvae of cobia (<i>Rachycentron canadum</i>).	Four isonitrogenous and isoenergetic test diets were studied. The control diet contained only fish meal as the sole protein source. Fish Protein Hydrolysate (FPH) was used to partially replace fish meal. The replacement levels were 17%, 34% and 51% of the fish meal protein, respectively. Larvae cobia (<i>Rachycentron canadum</i>) with an initial weight of (3.79±0.22) g were randomly stocked in triplicate groups in 300L indoor flow-system tanks fed with the test diets for 6 weeks. No significant differences in survival were observed among dietary treatments (P>0.05). The results showed that the percent weight gain (WG) and feed intake (FI) were also positively linearly correlated to dietary FPH percentage, except the replacement levels were 51% of the fish meal protein group was the lowest. In conclusion, the tested FPH replacement fish meal protein 34% proved an efficient growth and feed intake stimulant in larvae of cobia <i>Rachycentron canadum</i> . Plasma total cholesterol concentrations increase with water FPH replacement fish meal protein, but the plasma total protein concentration did not have this regularity, among the dietary treatments groups the plasma triglyceride concentration were not significant (P>0.05).	Han, T., Wang, Z., Wang, Y., Tian, L., Liu, Y.	Acta Hydrobiologica Sinica 34, 94–100	2010	Nutrition
405	Effects of probiotics on growth performance, digestive enzyme and immune enzyme activities of juvenile cobia (<i>Rachycentron canadum</i>).	This experiment was conducted to study the effects of <i>Bacillus subtilis</i> and <i>Lactobacillus acidophilus</i> as separate or mixed in diets on the growth performance, digestive enzyme and immune activities of juvenile cobia (<i>Rachycentron canadum</i>). Eight hundred and forty healthy juvenile cobia with an initial body weight of (22.00±0.15) g were randomly divided into 7 groups (groups T0, T1, T2, T3, T4, T5 and T6, respectively) with 3 replicates per group and 40 fish per replicate. The group T0 was used as control group, and fish in this group were fed a basal diet for 50 days; the fish in groups T1, T2 and T3 were fed diets containing 1×10 ⁷ CFU/g <i>B. subtilis</i> , 1×10 ⁷ CFU/g <i>L. acidophilus</i> and 2×10 ⁷ CFU/g <i>B. subtilis</i> and <i>L. acidophilus</i> mixture (mass ratio of <i>B. subtilis</i> and <i>L. acidophilus</i> =1:1) for 30 days and then 20 days switched to basal diet, respectively; the fish in groups T4, T5 and T6 were fed diets containing 1 × 10 ⁷ CFU/g <i>B. subtilis</i> , 1 × 10 ⁷ CFU/g <i>L. acidophilus</i> and 2×10 ⁷ CFU/g <i>B. subtilis</i> and <i>L. acidophilus</i> mixture for 50 days, respectively. The results showed as follows: compared with control group, the weight gain rate (WGR) in groups T1 and T2 had no significant difference (P>0.05), but the WGR in groups T3, T4, T5 and T6 was significantly increased (P<0.05), and the group T6 had the maximum value which was significantly higher than that in other groups (P<0.05). The specific gain rate (SGR) had a similar changing trend to WGR. The feed conversion ratio (FCR) in groups T2, T3, T4, T5 and T6 was significantly lower than that in control group (P<0.05), meanwhile, the FCR in groups T4 and T6 was significantly lower than that in other probiotics supplemental groups (P<0.05). Diets with supplementation of probiotics could significantly enhance the activities of amylase and protease in liver (P<0.05), and improve the activity of protease in intestine (P<0.05). The activity of amylase in intestine in control group, groups T3 and T4 was significantly lower than that in groups T5 and T6, and significantly higher than that in groups T1 and T2 (P<0.05). Diet with supplementation of probiotics could significantly improve the activity of serum lysozyme (LZM) (P<0.05). The serum total superoxide dismutase (T-SOD) activity in continuous feeding groups (groups T4, T5 and T6) was significantly higher than that in control group (P<0.05), and the serum T-SOD activity in group T6 was significantly higher than that in groups T4 and T5 (P<0.05). However, the serum T-SOD activity in non-continuous feeding groups (groups T1, T2 and T3) was significantly lower than that in control group except group T1 (P<0.05). Compared with the control group, the serum alkaline phosphatase (AKP) activity in probiotics supplemental groups was significantly decreased (P<0.05). The serum acid phosphatase (ACP) activity in groups T2 and T3 was significantly higher than that in control group (P<0.05), and group T6 had no significant difference with control group (P>0.05), while that in other groups was significantly lower than that in control group (P<0.05). These results indicate that supplementation of <i>B. subtilis</i> and <i>L. acidophilus</i> as separate or mixed (1:1, mass ratio) in diets can promote the growth, and increase the activities of immune enzymes and digestive enzymes of juvenile cobia. Continuous feeding is better than non-continuous feeding and the mixed probiotics has the best effect.	He, W., Dong, X., Tan, B., Yang, Q., Chi, S., Liu, H., Zhang, S.	Acta Zoonutrimenta Sinica 27, 3821–3830	2015	Nutrition Molecular
406	Cobia: the rising star.	For some years now there has been talk of a 'new star' in aquaculture. Cobia grows extremely fast, has a mild, white flesh with practically no bones, and it is a marine fish, which gives it an advantage in important whitefish markets. Until now, farmed production has been very limited, but developments in Vietnam indicate that this fish is to be reckoned with in the coming years. Original Abstract: Desde hace unos años se viene hablando de una 'nueva estrella' en la acuicultura: la cobia. Se trata de un pez que tiene un crecimiento extremadamente veloz, y que presenta una carne suave y blanca, prácticamente sin espinas. Al ser un pescado de mar, esas características le otorgan importantes ventajas en el mercado del pescado blanco. Si bien hasta ahora la producción de cultivo ha sido muy limitada, los avances registrados en Vietnam indican que este pescado será altamente apreciado en los próximos años.	Hempel, E.	Infopeca Internacional 13–17	2011	Socioeconomics
407	Seasonal movements and migratory patterns of cobia in coastal waters of the Southeastern United States.	The cobia, <i>Rachycentron canadum</i> , is a coastal pelagic species that supports both recreational and commercial fisheries in the southeastern United States. Cobia exhibit seasonal migrations in the Gulf of Mexico and along the U.S. Atlantic coast, but the extent to which those fish migrate is not well-documented. This study was conducted to determine the seasonal movements and migratory behavior of cobia in southeastern U.S. waters in order to develop information pertinent to effective regional management of the cobia fishery. From 1988 through July 2007, participants in an angler-cooperative research program tagged and released 15,003 cobia ranging from Gulf waters off Texas to Atlantic waters off Virginia, and 962 (6.4%) of those fish were recaptured. Data indicate a general migratory trend of cobia over-wintering in south Florida coastal waters, followed by northerly movement in late winter and early spring along both coasts of the Florida Peninsula to spawning grounds in northern Gulf and central U.S. Atlantic coastal waters. A subsequent return to south Florida waters in late fall was common. Results of this research support the regional scale of cobia management currently implemented by the Gulf of Mexico and South Atlantic Fishery Management Councils.	Hendon, R.J., Franks, J.S., Fulford, R.S.	Proceedings of the Gulf and Caribbean Fisheries Institute 60, 645	2008	Wild (Atlantic)
408	Viral nervous necrosis infection of marine fish cultured in Khanh Hoa, Vietnam.	Viral nervous necrosis (VNN) has spread worldwide among cultured marine fish with the number of susceptible host species continuing to grow (Munday and Nakai 1997). Affect fish exhibit a range of neurological signs, such as abnormal swimming behaviors and pale-grey discoloration of the body. In Khanh Hoa (Viet Nam), grow-out fish (grouper- <i>Epinephelus</i> spp., sea bass- <i>Lates calcarifer</i> and cobia <i>Rachycentron canadum</i>) had been suffering from a disease characterized by similar clinical signs with high mass mortality. Histological investigations in moribund fish revealed marked vacuolation in the retina and brain. The size of vacuolation was varying from 4-30 μm with different shape from oval to circle. These results indicate the presence of VNN in cultured marine fish in Khanh Hoa.	Hich, T.V., Duyen, P.T.	Review of science-technology of fisheries 19–24	2008	Fish Health
409	Sea lice (Copepoda, Caligidae) parasitic on marine cultured and wild fishes of the Philippines.	Four species of sea lice were found parasitic on ten species of marine fishes either cultured in the coastal ponds or occurring in the sea water supply canals in the Philippines. They are: <i>Caligus epidemicus</i> Hewitt, 1971 on <i>Acanthurus mata</i> Cuvier), <i>Epinephelus coioides</i> (Hamilton), <i>Glossogobius celebius</i> (Valenciennes), <i>Liza parrmata</i> (Cantor), <i>Lutjanus argentimaculatus</i> (Forsskål), <i>Monodactylus argenteus</i> (Linnaeus), <i>Oreochromis urolepis hornorum</i> (Trewavas), <i>Oreochromis mossambicus</i> (Peters), <i>Rachycentron canadum</i> (Linnaeus), and <i>Siganus guttatus</i> (Bloch); <i>Caligus quadratus</i> Shiino, 1954 on <i>L. argentimaculatus</i> and <i>S. guttatus</i> ; <i>Lepeophtheirus sigani</i> n. sp. on <i>S. guttatus</i> ; and <i>Pseudocaligus uniartus</i> n. sp. on <i>S. guttatus</i> and <i>L. argentimaculatus</i> . These ten species of fishes are new host to <i>C. epidemicus</i> , except for <i>O. mossambicus</i> which has been reported to carry <i>C. epidemicus</i> from Taiwan. <i>Caligus quadratus</i> is new to the Philippines and the two species of fish harboring it are the new host. While <i>L. sigani</i> was found only on <i>S. guttatus</i> , <i>P. uniartus</i> was recovered mostly from <i>S. guttatus</i> , and <i>C. quadratus</i> , largely from <i>L. argentimaculatus</i> . <i>Caligus epidemicus</i> exhibits extremely low host specificity and was found on all species of fishes examined.	Ho, J.-S., Kim, L.-H., Cruz-Lacierda, E.R., Nagasawa, K.	Journal of The Fisheries Society of Taiwan 31, 235–249	2004	Fish Health Wild (Pacific) Parasites
410	<i>Parapetalus occidentalis</i> Wilson (Copepoda, Caligidae) parasitic on both wild and farmed cobia (<i>Rachycentron canadum</i>) in Taiwan.	A species of sea lice (Caligidae, Siphonostomatoida), <i>Parapetalus occidentalis</i> Wilson, 1908 is reported for the first time from Taiwan. It was discovered first in November 1999 on the cobia [<i>Rachycentron canadum</i> (Linnaeus)] caught in the Strait of Taiwan and a year later on the cobia being cultured in an offshore cage-net in Penghu Islands (Pescadore). The eight nominal species of <i>Parapetalus</i> are briefly reviewed and a key to the four valid species is given. <i>Caligus parapetalopsis</i> Hameed and Pillai, 1973 is discussed and proposed to be relegated to the junior synonym of <i>Parapetalus longipennatus</i> Rangnekar, 1956.	Ho, J.-S., Lin, C.-L.	Journal of the Fisheries Society of Taiwan 28, 305–316	2001	Fish Health Wild (Pacific) Cage Culture Parasites

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
411	Full-length cDNA cloning of IgM heavy chain of cobia <i>Rachycentron canadum</i> and quantitative analysis in different tissues.	Full-length cDNA of IgM heavy chain of cobia (<i>Rachycentron canadum</i> Linnaeus) was amplified by the techniques of Rapid Amplification of cDNA ends (RACE) and PCR, and expression of target gene was analyzed by the method of real time RT-PCR in different tissues. The full-length cDNA of μ of cobia is 1 933 bp, with a 5' terminus untranslated region (UTR) of 26 bp and a 3' terminus UTR of 164 bp, carried an open reading frame (ORF) of 1 743 bp, encoding 580 amino acids with estimated molecular weight of 64.83 ku and the theoretical isoelectric point of 6.6. The similarity of the deduced Ig μ amino acid sequences of cobia was less than 30%, when compared with those of other animals. Moreover, similarities of the conservative CH4 region of cobia, to other fish were 64% - 71%. But, to other living things, similarity was only 31% - 33%, having a strong specificity. Cluster X analysis indicated that there existed conserved amino acid sites (cysteines, tryptophans) and two E-box motifs GKGLEW at framework region two and YYCAR at framework region three, respectively in the IgM heavy chain of cobia. Ig μ gene was ex-pressed in all the tissues but kidney in healthy cobia and the expression with the highest quantity was pre-sent in intestine by real time RT-PCR. The target gene was respectively expressed in all tissues of cobia after stimulation by intraperitoneal injection with <i>Vibrio carchariae</i> for 48 h, 96 h and 192 h. The expression of Ig μ gene was significantly increased in heart, gill and intestine after 48 h. Increased expression of gene in spleen, stomach, brain was after 0 h and in liver, head kidney and kidney was after 192 h. Conclusion could be drawn that mucosal immune defended against foreign pathogens as the first barrier, followed by the liver, spleen, kidney, head kidney immune response, which indicated that immune system plays an important role in defense against foreign pathogens for a long time.	Hou, Y., Feng, J., Guo, Z., Guo, J., Xu, L., Su, Y.	Journal of Fisheries of China 36, 838–848	2012	Genetics Molecular Fish Health
412	Molecular cloning and tissue expression analysis of immunoglobulin light κ chain cDNA from cobia <i>Rachycentron canadum</i> Linnaeus.	The technique of homologous cloning and Rapid Amplification of cDNA Ends (RACE) was used to amplify full length cDNA gene of immunoglobulin light chain (κ chain) from cobia (<i>Rachycentron canadum</i> Linnaeus). The full length cDNA of κ in cobia is 969 bp, containing a 3' untranslated region (UTR) of 188 bp, a 5' UTR of 52 bp, and an open reading frame (ORF) of 729 bp, encoding 242 amine acids. The estimated molecular weight of Ig κ is 26.255 kD, and the theoretical isoelectric point is 7.52. The deduced Ig κ amino acid sequences of cobia were compared with those of other teleost species. For the constant region of Ig κ , higher percentage similarity was obtained from comparisons between R. canadum and <i>Seriola quinqueradiata</i> and between R. canadum and <i>Salmo salar</i> , which was higher than 77%. For the variable region, higher percentage similarity was obtained from comparisons between R. canadum and <i>S. quinqueradiata</i> , which reached 87%. By the phylogenetic tree of immunoglobulin light chain constant region, Ig κ amino acid sequences of cobia were clustered with <i>S. quinqueradiata</i> (1, 2, 3) and <i>Ictalurus punctatus</i> G chain which belong to the type of κ chain, so IgL of cobia was supposed to type of κ . <i>Salmo salar</i> L2 chain, <i>Danio rerio</i> L2 chain, <i>Cyprinus carpio</i> L2 chain that belong to the type of λ chain were clustered together. The expression of Ig κ gene in healthy cobia was initially measured by semi-quantitative RT-PCR. It was found that the expression of the Ig κ existed more obviously in liver and gill than in other tissues, but they were hardly expressed in intestine and brain. The expression of the target gene in head kidney, spleen, intestine and gill increased obviously after cobia was immunized by intraperitoneal injection with <i>Vibrio carchariae</i> strain JT2, while the expression in liver decreased. The result indicated that head kidney, spleen, intestine and gill are main organs for Ig κ production after stimulation, and play a critical role in host-pathogen interaction.	Hou, Y., Feng, J., Ning, Z., Mao, L., Guo, Z., Xu, H., Kong, X.	Journal of Fishery Sciences of China 18, 48–58	2011	Genetics Molecular Fish Health
413	Pericardial adhesions in the cobia <i>Rachycentron canadum</i> (Linnaeus).	Pericardial adhesions are reported in diseased hearts of the cobia <i>Rachycentron canadum</i> (Linnaeus). The epicardium and pericardium are either tightly fused or connected by numerous thick collagenous adhesions over most of the heart surface.	Howse, H., Franks, J., Welford, R.	Gulf and Caribbean Research 5, 61–62. doi: 10.18785/grr.0501.07	1975	Fish Health
414	Productivity analysis on marine cage culture species-Taiwan cobia, Norwegian salmon and Japanese yellowtail kingfish.	Marine cage culture is one of the fastest growing seafood supply methods and the most potential ones. Among the cage culture industries today, Japan leading the world with 2.14 billion USD worth annual production and Norway contributed more than half a million metric tons of Atlantic salmon production in 2002, leading the world farm salmon production exceed 1 million tons. The industry structure of Norway and Japan are very different. Norwegian salmon mostly exported as fresh gutted whole fishes while Japan supply almost all fishes for domestic market live. The scale of the farmers are also different; Norwegian farmers produces 10 times the quantity of those Japanese yellowtail farmers averagely. However, landing price of Japanese yellowtail kingfishes are 2-3 times more than Norwegian salmon which enable Japanese yellowtail king fishes annual revenue close to there-venues of Norwegian farm salmon. This study applied Benchmarking over Norwegian salmon, Japanese yellowtail kingfish and Taiwan cobia cage culture during 1992 and 2002 on the industry scale and productivity. The result can be used as a guide on developing Taiwan cobia cage farming industry. Finally, the study find that Taiwan marine cage culture cobia has good potentials to be a very competitive product and suggest Taiwan cobia industry needed to be improved on productivity, marketing, R&D and socioeconomic structure reinforcement.	Hsu, C.-Y., Chen, C.-C.	Journal of the Fisheries Society of Taiwan 32, 62	2005	Cage Culture Socioeconomicss
415	Economic analysis of cobia's (<i>Rachycentron canadum</i>) phase nursery stage culture in Taiwan.	Economic profits of cobia's aquaculture are the main element to influence its development. According to researches about cobia's fry culture, they pointed out the running of cobia's culture, and analyzed the factors affecting benefits of cobia's culture. Distinguishing the advantages and disadvantages in cobia's culture is the main purpose of this paper. Nowadays, there are three kinds of techniques in cobia's fry culture in Taiwan: pond aquaculture, cage aquaculture, and recirculation system aquaculture. By this research, each technique in cobia's fry are significant differences in production costs and productivities, but there is insignificant difference in profitability (net profit/total cost). Through cooperation, aquaculture farms adopting ponds aquaculture make a planned production by signing contracts. In this way, they can increase the profit. If farmers adopting cages aquaculture wants to get more profit, they can lower capitals by advancing the techniques of feeding methods. In comparison, farmers adopting recirculation system aquaculture have the advantage of high productivity. If there is a breakthrough in length limitation of cobia's fry size, they will have more choices to cobia's commercial culture.	Huang, C.-T., Miao, S., Farok, A.	Journal of the Fisheries Society of Taiwan 35, 133–146	2008	Socioeconomics Culture Hatchery
416	Bioeconomic analysis of improving management productivity regarding cobia <i>Rachycentron canadum</i> cage culture in Taiwan.	The economic benefit of the culture industry is a key factor affecting industry development. Based on related studies of the production economy of cobia cage culture, this study investigated operational outcomes of the industry, and reviewed various factors influencing industry profits in order to compare its advantages and disadvantages. Data were sourced from the fishers' economic survey data concerning Taiwan's cobia cage culture from 2002 to 2007. Data contents were divided into biological data and economic followed by a then multi-variable statistical analysis. This study investigated whether different years and different culture areas affected production input and output during the culture processes of cobia cage culture operators. Furthermore, biological and economic variables affecting industry management performance were studied. Results showed that different regions and years have significant effects on both the input and output of cobia culture, as unit production input costs of cobia tend to increase on a yearly basis. Production costs at Penghu are higher than those of Pingtung. In terms of cost structure, the main production costs are dominated by feed costs in Penghu, and by feed, personnel, and maintenance costs in Pingtung. In terms of profit, the overall cobia culture achieved excellent productivity in 2003, with benefit-cost ratios of 1.41 in Penghu and 2.77 in Pingtung. The greater profits achieved in Pingtung rather than in Penghu are mostly related to the scale of operation. The benefit-cost ratio was the highest in 2007, reaching 2.95, while in the same year, productivity reached over 1.9, indicating that excellent managerial performance was achieved in that year. In terms of biology, both fish breeding specifications and survival rate may affect management performances. Lastly, the analysis chart of cost input and principal components of productivity highlights the key factors affecting the production performance of individual culture operators. Future studies can conduct in-depth surveys on individual operators, as such surveys would help to identify those with poor culture performance and operators with good culture performance, as the discrepancy would provide reference for adjusting cobia culture strategies and operational management for decision-makers.	Huang, C.-T., Miao, S., Hieu, T.K.	Journal of the Fisheries Society of Taiwan 38, 239–262	2011	Socioeconomics Cage Culture
417	Comparision of feeding cobia (<i>Rachycentron canadum</i>) with moist pellet feed and frozen trash fish in deep-water cages.	In order to compare the feeding effect of moist pellet feed and frozen trash fish on cobia (<i>Rachycentron canadum</i>), the 10-week culture trial was conducted, in which the juvenile cobia with an average weight of 93 g were cultured in deep-water cages. The results showed that: the moist pellet feed with crude protein and crude fat content of 46.3% and 7.6% respectively (on dry matter basis), could basically met the nutritional requirements of the cobia. Compared with the frozen fish group, the weight gain rate (WGR), specific growth rate (SGR) of cobia in the moist pellet feed group were slightly lower, with the survival rate (SR) higher by 9.0%, the feed coefficient rate decreased by 61.2%, and the production cost (per kilogram) slightly higher by 3.85%. Above all, the results indicated the feeding effect of moist pellet breeding on cobia was similar to that of frozen trash fish, and had the characteristics of high survival rate, high effectiveness and environmental protection.	Huang, M., Shi, H., Zhou, Q., Li Xi, N., Luo, W., Huang, J., He, W., Li, Z.	Fishery Modernization 6, 20–23	2013	Fish Health Cage Culture Nutrition
418	Exuberant granulation tissue response associated with <i>Neobenedenia</i> sp. (Monogenea: Capsalidae) infestation in two cobia, <i>Rachycentron canadum</i> (Linnaeus).	Monogenean parasite infestations are common in captive marine teleosts, and are generally found on the skin and gills. This report describes an unusual pathological presentation of exuberant granulation tissue of the gills, suspected to be related to <i>Neobenedenia</i> infestation in two cobia housed together at a North Carolina aquarium.	Hurley-Sanders, J., Harms, C., Christiansen, E., Clarke, E., Law, J.	Journal of Fish Diseases 39, 277–283. doi: 10.1111/jfd.12360	2016	Fish Health Parasites
419	Molecular cloning, tissue distribution and ontogenetic expression of growth hormone in cobia, <i>Rachycentron canadum</i> .	Worldwide, the growth of marine aquaculture is limited by a number of factors. One of the most important is the development of larviculture protocols to produce adequate numbers of juveniles to stock grow-out systems at a convenient cost. In order to develop a tool to assess the nutritional status of cobia larvae, we have cloned and sequenced the Growth Hormone (GH) from the pituitary gland of adult fish, and examined the ontogenetic expression in embryonic and larval specimens by qPCR, as well as tissue distribution in wild adult animals by RT-PCR. The cobia GH sequence showed similarity to the GH sequence of <i>Coryphaena hippurus</i> (mahi mahi), <i>Seriola dumerili</i> (Greater amberjack) and <i>Seriola quinqueradiata</i> (Yellowtail). GH gene expression was studied in 18 different tissues, but was only detected in the pituitary gland, eyes, gill and red muscle. Expression levels were very low in embryos and in early larvae but just before the first feeding, gene expression increased dramatically (~1000 fold) and remained high for the rest of the collection period (to 300 h post fertilization). This pattern of expression is similar to that seen in other rapidly growing temperate marine fish and underscores the rapid somatic growth that begins with the onset of feeding in cobia.	Ibarra-Castro, L., Webb, K. A., Jr., Joan, H.	Revista de Biología Marina y Oceanografía 51, 421–428	2016	Molecular Hatchery Genetics

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
420	Investigation of otolith's characteristics in <i>Rachycentron canadum</i> in the Persian Gulf and Oman Sea.	This study aimed to investigate otolith in <i>Rachycentron canadum</i> in the Persian Gulf and Oman Sea. Sampling lasted from March 2014 to April 2015 in Khuzestan to Sistan and Baloochestan waters. During this period 30 specimens of <i>R. canadum</i> were caught and studied. Trawling time was 2-21/2 hours and trawling depth was considered as 10-100 m daily. All the fish were identified and their otolith was extracted for verification. Investigation of otolith morphometric characteristics (length, breadth, weight, perimeter and area) were conducted. Otolith in <i>R. canadum</i> was small, with average stretch and low thickness. We conclude that the otolith appearance and morphometry can be used as a key to identify the species.	Javadzadeh, N., Mabudi, H., Taghi, A.	Iranian Journal of Fisheries Sciences 15, 973–979	2016	Wild
421	Isolation and characteristics of pathogen of vibriosis in cobia (<i>Rachycentron canadum</i>) maricultured in cage.	A pathogenic JA 46 strain was isolated from kidney, liver and ascites of moribund fish. The bacterium shared following characteristics: Gram negative, short rod, single polar flagellum, motile, (1.2) $\mu\text{m} \times (0.5-1) \mu\text{m}$ in size, oxidase and catalase positive, sensitive to the vibriostatic agent O/129 at 150 mg/L, fermentation of glucose without production of gas, growth only in medium contained NaCl, optimal temperature of 25-30°C, no luminescence, yellow colonies in TCBS medium. The JA 46 strain was identified as <i>Vibrio vulnificus</i> by the data of API 20E kit and ATB system. The 50% lethal dose of the bacterium was 4.1×10^4 cpf/mL. The data of drug sensitivities indicated that chloramphenicol, sulfamethoxazole, gentamycin, erythromycin, ciprofloxacin, norfloxacin, cefalexin and amikacin could inhibit growth of JA 46 strain, but penicillin and ampicillin didn't.	Jian, J., Wu, Z., Chen, G., Zeng, M.	Chinese Journal of Veterinary Science 23, 329–330	2003	Fish Health Pharmacology
422	Optimization of technology for preparation of angiotensin-I-converting enzyme inhibitory peptides by hydrolyzing the head of cobia with papain.	The technology for preparation of angiotensin-I-converting enzyme inhibitory peptides by hydrolyzing heads of cobia with papain was optimized by using the index of the Angiotensin-I-Converting Enzyme (ACE) inhibitory activity. The peptides with high ACE inhibitory activities were selected. Experimental results indicated that the peptides with optimum ACE inhibitory activity were obtained when the enzymic hydrolysis parameters are composed of 73 °C, pH 6.0 and enzyme dosage 2300 U/g, ratio of material to water was one to two, hydrolysis time was four hours. In those conditions, the ACE inhibitory activity was the maximum with 82.63% and the degree of hydrolysis was 17.21%	Jiang, Y., Hong, P., Yang, P.	Food Science and Technology 36, 49–54	2010	Molecular Pharmacology
423	Preliminary recommendation on essential amino acids in juvenile cobia.	This article described the lysine and methionine requirement of juvenile cobia. And made use of essential amino acids in the fish muscle and the essential amino acid pattern of body to derive essential amino acid demand of cobia.	Jin, H.-T., Yuan, W.-D.	Siliao Yu Xumu 9, 20–21	2010	Fish Health Nutrition
424	Weak genetic differentiation in cobia, <i>Rachycentron canadum</i> from Indian waters as inferred from mitochondrial DNA ATPase 6 and 8 genes.	Cobia, <i>Rachycentron canadum</i> , is an economically important migratory fish distributed in tropical waters worldwide and is a candidate fish species for aquaculture practices. The genetic stock structure of <i>R. canadum</i> distributed along the Indian waters was identified using mitochondrial ATPase 6 and 8 genes. A total of 842 bp sequence of ATPase 6/8 genes obtained in this study revealed 15 haplotypes with mean low nucleotide diversity ($\pi = 0.001$) and high haplotype diversity ($h = 0.785$). AMOVA indicated the genetic differentiation of 90.47% for individuals within the population. This is well supported by co-efficient of genetic differentiation (FST) values obtained for pairwise populations that were low and non-significant with an overall value of 0.002. The parsimony network tree revealed star-like phylogeny and all the haplotypes were connected with each other by single mutational event. The findings of the present study indicated the panmixia nature of the species which can be managed as a unit stock in Indian waters.	Joy, L., Mohitha, C., Divya, P.R., Gopalakrishnan, A., Basheer, V.S., Jena, J.K.	Mitochondrial DNA Part A 27, 2819–2821. doi:10.3109/19401736.2015.1053083	2016	Genetics Wild
425	Age and growth of <i>Rachycentron canadum</i> (L.) (cobia) from the nearshore waters of South Carolina.	The purpose of this study was to define growth parameters, age-at-length, and the sex ratio for <i>Rachycentron canadum</i> (Cobia) in Port Royal Sound and the nearshore waters of South Carolina. We sampled Cobia from recreational-fishing efforts, and used otoliths to estimate age. Female Cobia ($n = 245$) fork length (FL) ranged from 798 mm to 1425 mm (mean = 1059 mm) and male ($n = 221$) FL ranged from 670 mm to 1183 mm (mean = 936 mm). The ratio of females to males was 1.1:1.0. Cobia ranged in age from 2 to 11 years; most (60.8%) were age 3. Estimates of von Bertalanffy growth parameters for Cobia were $L_{\infty} = 1212$, $K = 0.53$, and $t_0 = -0.13$ for females and $L_{\infty} = 1101$, $K = 0.51$, and $t_0 = -0.13$ for males. Life-history characteristics of Cobia as defined by this study provide managers with critical age-at-length and growth information necessary for the effective management of the species.	Kalinowsky, C.A., Curran, M.C., Smith, J.W.	Southeastern Naturalist 15, 714–728. doi: 10.1656/058.015.0413	2016	Wild (Atlantic)
426	Histopathology of stomach of fish <i>Rachycentron canadus</i> (L.) infected with the nematode <i>Raphidascaris</i> sp. (Railliet et Henry, 1915).	Stomach wall of fish, <i>Rachycentron canadus</i> (L.) infected with adult nematodes <i>Raphidascaris</i> sp. shows degeneration of stomach wall, erosion of gastric mucosa at the site of contact with the nematode and abnormalities in the blood vessels and underlying muscle layers. Detached gastric cells are accumulated in the lumen and appear as granular mass. Giant cell formation in the damaged superficial layer was obvious.	Khatoon, N., Bilqees, F.M.	Proceedings of Pakistan Congress of Zoology 16, 37–40	1996	Wild Parasites Fish Health
427	Nephrocalcinosis and kidney stones in <i>Rachycentron canadum</i> .	Nephrocalcinosis cases have been reported in fish, with different causes attributed for calcium deposition in the kidneys. We report the diagnosis of nephrocalcinosis in the presence of kidney stones in cobia, describing the main changes caused by the disease. On gross examination, an increase in kidney size was observed, with the presence of several grouped stones in the renal parenchyma. Microscopically, interstitial fibrosis and tubular dilation with basophil granules due to calcium deposits in the lumen were observed. By infrared spectroscopy, the stones were found to be composed of pure calcium (65%), oxalate (15%), calcium phosphate (16%) and non-specific salts (4%). This report of nephrocalcinosis and kidney stones is the first reported case of the disease occurrence in aquatic cultivation environments, it was not possible to identify the real cause of the emergence of lesions in the fish necessitating the study of the predisposing factors.	Klosterhoff, M. da C., Virginia Fonseca, P., Sampaio, L.A., Ramos, L.R. V., Tessier, M.B., Romano, L. A.	Bulletin of the European Association of Fish Pathologists 35(4), 138-144	2015	Fish Health
428	Investigation and treatment of <i>Parapetalus occidentalis</i> Wilson (Copepoda, Caligidae) infestation in sea cage-cultured cobia (<i>Rachycentron canadum</i>) at Penghu Islands (Pescadores), Taiwan.	The occurrence of <i>Parapetalus occidentalis</i> Wilson (Copepoda, Caligidae) on sea cage-cultured cobia (<i>Rachycentron canadum</i>) at Penghu Islands (Pascadores) was reported. <i>P. occidentalis</i> was specific to cobia among the Penghu sea cage-cultured fish. Two health conditions of cultured cobia (healthy market size and diseased juvenile) were examined. The abundance of <i>P. occidentalis</i> on market size cobia cultured in Erkan, Chiyuan and Chuwan farming areas was 0.04, 7.39, and 6.17, respectively; however, on moribund cobia, these values were 0.47, 29.58, and 7.20, respectively. The overall sex ratio of adult <i>P. occidentalis</i> (1932 parasites) on cobia was 10.3:1, females to males. The fecundity of gravid female <i>P. occidentalis</i> averaged 120 eggs per parasite. Tentative treatments were performed by completely enclosing the cage within tarpaulins; treatment with 10 ppm Parasiticide-MS for 1 h was efficacious at removing <i>P. occidentalis</i> from cobia, without toxic side effects to the treated fish. Although <i>P. occidentalis</i> has not yet caused a serious problem for Penghu cobia aquaculture, its high abundance makes it as a potentially serious risk.	Ku, C.-C., Lu, C.-H.	Journal of the Fisheries Society of Taiwan 36, 161–169	2009	Cage Culture Fish Health Parasites
429	Cold tolerance of sea cage cultured cobia <i>Rachycentron canadum</i> in Penghu, Taiwan.	This paper investigated the survival of sea cage cultured cobia when sea temperature dropped down to 12°C during the winter time. 30 fish were stocked in a 50-L recirculating aquarium in a display refrigerator and the water temperatures were decreased at a rate of less than 0.5°C per hour. When the water temperature reached 15.1°C, most of cobia settled to the bottom of the aquarium. The LD50 of cobia for low temperature was 12.1°C. Initial mortality was observed at 13.3°C, but all fish were dead by the time the temperature reached 11.2°C. The survival of sea cage cultured cobia were also observed when a serious cold current occurred in February 2008, Penghu. Sea cage cultured cobia began to die when the temperature dropped to 14°C, and 100% mortality had occurred by 11.5°C. Results of this study indicated cultured cobia required sea water temperature higher than 14°C.	Ku, C.-C., Lu, C.-H.	Journal of the Fisheries Society of Taiwan 35, 127–131	2008	Cage Culture Fish Health
430	A vaccination trial using attenuated <i>Photobacterium damsela</i> ssp. <i>piscicida</i> in cobia.	Attenuated bacterin was prepared from <i>Photobacterium damsela</i> subsp. <i>piscicida</i> (Ph. d. p.) against cobia pasteurellosis by immersion vaccination. In the laboratory aquarium challenge, the vaccine gave a relative percentage survival (RPS) of 55.7% after challenge with Ph. d. p. Moreover, these laboratory aquarium challenge survivors got RPS values of 83.3% and 91.6% after receiving a second challenge with Ph. d. p. But in farm trial, the mortality rate was 79.3% for the vaccine group and was even higher than the control group (77.3%). These field trial survivors also never developed pasteurellosis again during the sea cage culture period. The variation among the agglutinating antibody titers in non immunized, immunized and survivors cobia was irrelevant to the protection against Ph. d. p.	Ku, C.-C., Wang, C.-S., Lu, C.-H.	Journal of the Fisheries Society of Taiwan 35, 281–288	2008	Fish Health Pharmacology
431	In vitro antimicrobial susceptibility of <i>Photobacterium damsela</i> ssp. <i>piscicida</i> from cobia (<i>Rachycentron canadum</i>) at Penghu (Pescadores) Islands, Taiwan during 1999-2008.	Acute bacterial septicemic infection in sea cage-cultured juvenile cobia (<i>Rachycentron canadum</i>) has occurred at Penghu (Pescadores) Islands, Taiwan, since October of 1999 with a 30-80% mortality rate. Diseased fish exhibited no apparent surface lesions; however, the kidney and spleen demonstrated swelling and white tubercles. The bacterium was identified as <i>Photobacterium damsela</i> ssp. <i>piscicida</i> , based on the results of the API-20E system and Bionor Mono-Pp kit. The pathogenicity of the isolate to cobia was confirmed by intraperitoneal injection and immersion. From histological examinations, multifocal necrosis and/or granulomatous inflammation were found in tissue sections. Drug sensitivity testing indicated this pathogen were sensitive to amoxicillin, chloramphenicol, oxolinic acid, oxytetracycline, trimethoprim-sulfamethoxazole (SXT), and flumequine in 1999. However, amoxicillin-, chloramphenicol-, and oxytetracycline-resistant <i>Photobacterium damsela</i> ssp. <i>piscicida</i> were isolated in 2000. SXT-, oxolinic acid- and flumequine-resistant <i>P. damsela</i> ssp. <i>piscida</i> were isolated from sea cage-cultured cobia at Penghu in 2002, 2006, and 2007, respectively.	Ku, C.-C., Wang, C.-S., Nan, F.-H., Lu, C.-H.	Journal of the Fisheries Society of Taiwan 36, 151–160	2009	Fish Health Cage Culture
432	The cage culture production analysis of cobia (<i>Rachycentron canadum</i>) in Taiwan.	In this study, we use the survey data of 1998-2002 to analysis the production economic of cobia cage aquaculture industry. The results showed seed cost and diet cost were highest in direct costs; wage was highest in indirect costs. The mean net profit of 1998-2002 was bad; benefit-income ratio and profit rate were negative. We found the man-made technical inefficiency were greater than not-man-made technical inefficiency from Cobb-Douglas stochastic production frontier model. The adoption of recommended large cage and increased aquaculture are found to be critical for improved performance of cobia fish farmer.	Kuo, J.C., Lin, M.N.	Journal of the Fisheries Society of Taiwan 32, 123–124	2005	Cage Culture Socioeconomicss
433	Preliminary comparison between grouper iridovirus of Taiwan (TGIV) and other fish iridoviruses.	In recent year, the iridoviral infections in marine-culture fish have become a problem in aquaculture in Taiwan. The host range includes many seawater fish like red sea bream, grouper, perch and cobia. An iridoviral agent was isolated from disease grouper. Based on its general (properties and viral morphology, we propose the name Grouper iridovirus of Taiwan (TGIV). Diseased fish observed an enlarged spleen and the hypertrophy cell observed in liver, spleen, kidney and gills. These kinds of pathological changes were similar with iridoviral infection of red sea bream (RSIV) in Japan. This study first use the cell line we had established, grouper swim bladder cell (SB cell) and grouper brain cell (GB), and other two fish cell lines GF cell (grouper fin cell) and BF-2 cell (blue-gills fish fin cell). In the susceptibility study, TGIV and RSIV were inoculated onto the cell line we established, grouper swim bladder cell (SB cell); grouper brain cell (GB), and other two fish cell lines GF cell (grouper fin cell) and BF-2 cell (blue-gills fish fin cell). GB cell (grouper brain cell), GF cell (grouper fin cell) and BF-2 cell (blue-gills fish fin cell). Compared the susceptibility of virus infect cell, TGIV inoculated onto SB cells appeared cytopathic effect of cell rounding. That's RSIV tend to propagated in GF cells. Otherwise, use TGIV and RSIV primer for PCR, and the result showed the RSIV primer can detect the TGIV from virus challenge fish. And the same result in use TGIV primer to detect RSIV. Further use the anti-RSIV monoclonal antibody immunofluorescent staining, compared with strong signal in positive control (RSIV), the fluorescent found in TGIV was slight. Those results showed the two viruses were similar but there's a little different between them. In addition, the ill cobia and giant perch were iridoviral-like infectious and the virus isolation and PCR detection were analysis. The cytopathic effect observed on SB cells. For PCR detection, there's only primer sets referred to RSIV could amplified the viral DNA and no PCR product was amplified use TGIV primer sets.	Lai, S.-C., Chen, L.-J., Pao, T.-W., Chou, H.-Y.	Journal of the Fisheries Society of Taiwan 32, 2–3	2005	Fish Health Culture

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
434	Levamisole enhances non-specific immune response of cobia, <i>Rachycentron canadum</i> , fingerlings.	Two experimental runs were undertaken to assess the effect of levamisole supplementation on the non-specific immunity of cobia fingerlings, as well as on its resistance to <i>Photobacterium damsela</i> subsp. <i>piscicida</i> infection. Levamisole was given to cobia fingerlings through feed incorporation at a dosage of 500 and 1000 mg/kg feeds. Control feed is without levamisole. Cobia fingerlings were fed to satiation with control and levamisole supplemented feeds for two weeks. One day after the last feeding, blood was collected from 10 fish samples from each replicate for the analysis of non-specific immune response, including potential killing and phagocytic activities of blood leukocytes and bactericidal and lysozyme activities of blood plasma. Challenge experiment using <i>P. damsela</i> subsp. <i>piscicida</i> was also undertaken after the immunostimulation. Five (Run I) and 15 (Run II) experimental and control fish were intraperitoneally injected with 10 ⁷ CFU/fish, and mortality was monitored up to five days post-injection. Results show that levamisole supplementation has no significant effect on lysozyme activity of blood plasma. Bactericidal activity, on the other hand, is significantly higher (P<0.05) in levamisole treated fish than the control fish. Potential killing activity of blood leukocytes also increased significantly (P<0.05) in levamisole treated fish compared to the control. Similar results were obtained for phagocytic activity of blood leukocytes where higher index of phagocytosis was observed in cobia fingerlings fed with levamisole supplemented feeds. Dose-response was also observed in the activities of blood leukocytes with higher killing activities at 1000 mg/kg dose than at 500 mg/kg dose. Significantly lower (P<0.05) cumulative mortality was observed in immunostimulated fish (16-30%) than control fish (70-93%) after experimental challenge with <i>P. damsela</i> subsp. <i>piscicida</i> . Results of this study showed that levamisole can enhance the non-specific immune response of cobia fingerlings, thus increasing its resistance to potential infection. Two experimental runs were undertaken to assess the effect of levamisole supplementation on the non-specific immunity of cobia fingerlings, as well as on its resistance to <i>Photobacterium damsela</i> subsp. <i>piscicida</i> infection. Levamisole was given to cobia fingerlings through feed incorporation at a dosage of 500 and 1000 mg/kg feeds. Control feed is without levamisole. Cobia fingerlings were fed to satiation with control and levamisole supplemented feeds for two weeks. One day after the last feeding, blood was collected from 10 fish samples from each replicate for the analysis of non-specific immune response, including potential killing and phagocytic activities of blood leukocytes and bactericidal and lysozyme activities of blood plasma. Challenge experiment using <i>P. damsela</i> subsp. <i>piscicida</i> was also undertaken after the immunostimulation. Five (Run I) and 15 (Run II) experimental and control fish were intraperitoneally injected with 10 ⁷ CFU/fish, and mortality was monitored up to five days post-injection. Results show that levamisole supplementation has no significant effect on lysozyme activity of blood plasma. Bactericidal activity, on the other hand, is significantly higher (P<0.05) in levamisole treated fish than the control fish. Potential killing activity of blood leukocytes also increased significantly (P<0.05) in levamisole treated fish compared to the control. Similar results were obtained for phagocytic activity of blood leukocytes where higher index of phagocytosis was observed in cobia fingerlings fed with levamisole supplemented feeds. Dose-response was also observed in the activities of blood leukocytes with higher killing activities at 1000 mg/kg dose than at 500 mg/kg dose. Significantly lower (P<0.05) cumulative mortality was observed in immunostimulated fish (16-30%) than control fish (70-93%) after experimental challenge with <i>P. damsela</i> subsp. <i>piscicida</i> . Results of this study showed that levamisole can enhance the non-specific immune response of cobia fingerlings, thus increasing its resistance to potential infection.	Leaño, E.M., Guo, J.-J., Chang, S.-L., Liao, I.-C.	Journal of the Fisheries Society of Taiwan 30, 321–330	2003	Fish Health Pharmacology Culture
435	The biochemical compositions in muscle of cultured canadian sergeant fish. <i>Rachycentron canadum</i> (Linnaeus).	The biochemical composition in muscle of Canadian sergeant fish, <i>Rachycentron canadum</i> (Linnaeus) were reported. The contents of protein and fat of the muscle of Canadian sergeant fish were 21.2% and 5.5% respectively. The ratios of essential amino acids and delicious amino acids to total amino acids were 50.39% and 44.92%. The ratio of unsaturated fatty acids to total fatty acids was 65.2%, and the ratios of EPA and DHA to total fatty acids were 4.5% and 12%. The result indicated that the ratio of essential amino acid and delicious amino to total amino acid in muscle of Canadian sergeant fish were the highest when the Canadian sergeant fish weigh about 3.4 kg. The nutritive value and delicious extent of Canadian sergeant fish, <i>Rachycentron canadum</i> (Linnaeus) were better than other fish as sea group in cultured net-cage.	Li, L., Chen, B., Feng, J., Ke, H., Cai, J., Fan, K.	Journal of Zhanjiang Ocean University 21, 30–34	2001	Nutrition
436	Effects of dietary carbohydrate levels on the gene expression and the activity of pepck in marine fishes with different food habits.	Phosphoenolpyruvate carboxykinase (PEPCK, E.C.4.1.1.32) is a key gluconeogenic enzyme in aquatic organisms. In this experiment, three marine fish species with different food habits—omnivorous Tilapia (<i>Oreochromis niloticus</i>), moderate carnivorous Derbio (<i>Trachinotus ovatus</i>) and ferocious carnivorous Cobia (<i>Rachycentron canadum</i>) were selected as the experimental subjects. Dextrin was used as the main dietary carbohydrate source to generate three equal-nitrogen groups of diets with different carbohydrate levels (low dextrin LD, middle dextrin MD and high dextrin HD). Sixty juvenile fish with normal size were randomly selected from each species and fed for 8 weeks during the experimental period. To identify the effects of dietary carbohydrate levels on the gene expression and the enzymatic activity of PEPCK, we also cloned and analyzed the full-length sequence of PEPCK gene cDNA of <i>Trachinotus ovatus</i> . The full-length cDNA of Derbio PEPCK was 2652 bp and encoded 624 amino acids. The bioinformatics study showed that PEPCK gene was highly conserved between the three species and the homology was higher than 90%. The PEPCK activity of Derbio and Cobia were reduced by 28.05% and 26.03% respectively in the HD groups compared to the LD groups (P<0.05), suggesting the increased carbohydrate level may cause decrease in the enzymatic activity. The expression of PEPCK in the liver of Tilapia, Derbio and Cobia was also reduced with the increase in the carbohydrate level. Compared to the LD group, the PEPCK mRNA level of the HD group exhibited a 100-, 4.3- and 4.77-fold decrease in Tilapia, Derbio and Cobia respectively. These results suggested that the gluconeogenic capacity might be related to the food habit of the fish, and that the gene expression and the enzymatic activity of PEPCK of the three fish species could be significantly inhibited by the elevated dietary dextrin level. The degree of inhibition in mRNA expression also varied probably due to different food habits, and the highest inhibition appeared in Tilapia and the lowest in Cobia.	Li, S.-Y., Liu, H.-Y., Tan, B.-P., Dong, X.-H., Yang, Q.-H., Chi, S.-Y., Zhang, S.	Acta Hydrobiologica Sinica 39, 80–89	2015	Molecular Nutrition
437	Aquaculture practices in Taiwan and its visions.	Aquaculture in Taiwan began more than 300 years ago. In general, the history of aquaculture development in Taiwan can be divided in three stages: 1) Traditional stage (1661-1962); 2) Prosperous stage (1963-1987); and, 3) Transition stage (1988-present). At present, Taiwan is recognized as one of the countries with the most advanced and practical aquaculture technologies in the world. The significant achievements of aquaculture in Taiwan are the development of mass propagation and culture techniques for many aquaculture species including grass prawn, grey mullet, milkfish, tilapia, eel, and cobia among others. Biotechnological achievements are also noteworthy and these include the production of transgenic fish for the aquarium industry (e.g. zebrafish), development of molecular diagnostic techniques for most viral diseases of prawns, and the use of bioproducts for disease prevention in prawns. As aquaculture continued to prosper which contributed significantly to the country's fisheries production, food supply, rural livelihood, employment generation and socio-economic growth, problems were also encountered which resulted in the partial collapse of the industry. And the fact that most aquafarmers are too profit-oriented, overseeing these problems in exchange for higher production also resulted in negative effects on the aquaculture industry in the long run. Some government rules and policies, as well as bureaucracy, hinder the advancement of the industry towards sustainable aquaculture. With the current situation of the aquaculture industry in Taiwan, which is somehow not in harmony of what is happening in the world aquaculture, there is an urgent need to propose strategies that can sustain the industry in the future, including: strengthening of traditional techniques (e.g. on mass larval production); scientific research on nutrition and health; development of environment-friendly aquaculture systems; value-addition among processed aquaculture products; and, institutional cooperation locally, nationally and internationally.	Liao, I.-C.	Journal of the Fisheries Society of Taiwan 32, 193–206	2005	Socioeconomics
438	Effects of water temperature and fish size on growth and nitrogen budget of cobia (<i>Rachycentron canadum</i>).	In order to investigate the relationships among growth, nitrogen budget, water temperature and fish size of cobia, by using the principles and methods of fish bioenergetics, a laboratory experiment was carried out to study the effects of water temperature (21, 27 and 33 °C) and fish size (about 10, 20, 50 and 100g) on growth and nitrogen budget, and furthermore, the growth models in relation to water temperature and fish size and the nitrogen budgets at different temperature and size treatments were established in this paper. The results showed that: (1) Growth of cobia was affected significantly by water temperature and fish size as well as their interaction. The fastest growth rate occurred for cobia with initial body weight about 10g at 33 °C and the lowest growth rate occurred for cobia with initial body weight about 100g at 21 °C within the experimental temperature and size ranges. (2) In a given size group for cobia, SGR increased with temperature. At a given temperature, SGR decreased with fish size, and the relationships between SGR and W could be described as power functions for cobia. By using multiple regression analysis, the model, LnSGR=a+bLnW+cT+dT ² +eTLnW, provided a good fit to the data of specific growth rate (SGR), water temperature (T) and fish size (W). (3) Within the experimental water temperature and body size weight ranges, food nitrogen, feces nitrogen, excretion nitrogen and growth nitrogen of cobia were influenced significantly by water temperature and fish size, and increased with temperature but decreased with fish size. (4) Nitrogen budgets differed as water temperature and fish size changed, and were more sensitive to water temperature than to fish size. In a given size group the proportion of food nitrogen allocated to growth at 27 and 33 °C was much higher than that at 21 °C, but contrary to the proportion of food nitrogen lost in excretion. At a given temperature the variation of nitrogen budgets among different size groups was small. (5) More than 68% of food nitrogen was lost in excretion. So it could be concluded that relatively low water temperature made an obviously depressed impact on cobia growth, and nitrogen excretion was the main way of nitrogen expenditure from food for cobia, and nitrogen budgets of cobia were relatively constant at 27-33 °C within the experimental temperature and size ranges.	Lihua, S., Haoru, C.	Journal of Fisheries of China 1527–1534	2013	Nutrition Fish Health
439	Development of a multivalent bacterial vaccine for <i>Vibrio Alginolyticus</i> , <i>V. Parahaemolyticus</i> and <i>Photobacterium damsela</i> subspecies <i>piscicida</i> and its evaluation in cobia (<i>Rachycentron canadum</i>).	The farming of new fish, cobia (<i>Rachycentron canadum</i>) began in Taiwan several years ago. Soon after the initial 3 years of farming, the average survival rate fell below 20%. The major pathogens were identified as <i>Vibrio alginolyticus</i> , <i>V. parahaemolyticus</i> and <i>Photobacterium damsela</i> subsp. <i>piscicida</i> . In this study we used the inactivated pathogens as antigen to immune cobia. The effectiveness of this multivalent vaccine was evaluated by the serum antibody as assayed, and level of protection after challenge in an aquarium trial, and in an actual cage farm trial.	Lin, H.Y., Chen, T.Y., Chen, M.S., Chen, H.E., Chou, R.L., Chen, T.I., Su, M.S., Yang, H. L.	Journal of the Fisheries Society of Taiwan 32, 80	2005	Fish Health Pharmacology
440	Effect of different feeds on the cobia (<i>Rachycentron canadum</i>) anti-oxidation ability and lipid metabolism.	In this paper, the impacts of different feeds (group 1: foundational diet + 20% fish paste; group2: foundational diet + 30% fish paste; group 3; foundational diet + 30% fish paste + 5% fish oil; control group; ice fresh fish) on the cobia anti-oxidant and lipid metabolism were studied. The following are the results: the difference of the liver SOD among the four groups is not significant (P > 0.05). The GSH-Px and serum SOD activity of the control group is higher than the other groups significantly (P < 0.05). The T-AOC of 30% fish paste +5% fish oil group is higher than the other three groups significantly (P <0.05). The levels of cholesterol and liver lipid difference were not significant among the groups (P > 0.05). The cobia of control group has the highest level of LDL cholesterol, and the 30% fish paste + 5% fish oil group is healthier than the other groups for the lowest level of triglyceride. The results indicated that the feeds mixed fish paste and fish oil is beneficial for the cobia anti-oxidation ability and lipid metabolism, and better for the fish growth.	Lin, S., Zhang, T., Rao, K., Shi, H., Huang, J., Li, Z.	Fishery Modernization 41, 21–25	2014	Fish Health Nutrition
441	Studies on molecular genetic characteristics of cobia <i>Rachycentron canadum</i> .	Molecular genetic characteristics of cobia <i>Rachycentron canadum</i> was studied. Random amplified polymorphic DNA (RAPD) technique was used to investigate the genetic variation of natural population of cobia. Totally 119 loci were obtained with 17 primers. The percentage of polymorphic loci (P) was about 80.85%. The genetic distance (D) between the individuals was 0.260 0 on average. The Nei's gene diversity index (H) was 0.300 9 on average. The Shannon information index was 0.449 8 on average. The results show that the nuclear genetic variability of cobia was comparatively rich. The restriction fragment length polymorphism (RFLP) of mitochondrial DNA (mtDNA) of cobia was studied using 19 restriction endonucleases recognizing 5, 6 base pairs. The physical map of mtDNA has been constructed based on 6 endonucleases selected from 20 restriction endonucleases. A 850-bp segment of the mtDNA cytochrome b was amplified using primers like 5'-GTG ATC TGA AAA ACC ACC GTT G -3' and 5'-AAT AGG AAG TAT CAT TGC GGT TTAG ATG -3'. The RFLP of mtDNA cytochrome b of cobia was studied using 18 restriction endonucleases recognizing 4-6 base pairs. The assay showed that the genetic marker was suitable for studies on cobia genetics and breeding.	Liu, C., Liu, L., Wang, Z., Li, Y.	Journal of Tropical Oceanography 24, 77–85	2005	Genetics Molecular
442	Study on the processing of smoked cobia fillets by liquid smoking.	Taking cobia fillets as raw material, through liquid-smoked technology, the orthogonal experiment and the sensory analysis to study the impregnation, smoked and drying conditions on the quality of the smoked cobia fillets product. The condition of using liquid-smoked technology smoked cobia fillets was obtained. The results showed that the concentration of smoke solution SmokeZ P-50 was 6%, dipping time was 2h, and dipping temperature was 25°C. The first drying temperature controlled at 5°C, drying 1h, then sprayed the SmokeZ Enviro 24P on the surface of the fish for the second drying, the temperature controlled at 8°C, drying 2h. Through these parameters, the end smoked cobia fillets product had high sensory and excellent quality, and rich in nutrition, whose score was 93.2. All the physicochemical and microbial index of the products accorded with the national standards.	Liu, F., W. U., Y., Li, L., Yang, X., Chen, S., Zhou, W., Deng, J.	Science and Technology of Food Industry 33, 256–259	2011	Food Safety

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
443	Effects of different dietary carbohydrate levels on growth and glucose tolerance ability in fishes of different feeding habits.	To study the effects of different dietary carbohydrate levels on growth, glucose metabolism indicators and tolerance ability in fishes of different feeding habits after an 8-week feeding trial, this experiment was conducted taking Tilapia (GIFT, <i>Oreochromis niloticus</i>), Derbio (<i>Trachinotus ovatus</i>) and Cobia (<i>Rachycentron canadum</i>) as the research objects, dextrin as the sugar source, three levels of dietary carbohydrate for each fish at low, medium and high levels (C_L, C_M, C_H; Tilapia: 20%, 30%, 40%; Derbio: 13%, 26%, 39%; Cobia: 12%, 24%, 36%) respectively. The results showed that: the different carbohydrate levels had no significant effect on survival rate of Tilapia ($P > 0.05$); The feeding conversion rate (FCR) showed an increasing trend after the first decline with elevated levels of dietary carbohydrate and the C_L group in Tilapia was the highest ($P < 0.05$); The weight gain rate (WGR) and specific growth rate (SGR) were all the highest in C_H group and significantly higher than the C_L group ($P < 0.05$). The survival rate in C_H groups of Derbio and Cobia were significantly lower than the other groups ($P < 0.05$). However, the WGR and SGR in C_M were the highest significantly ($P < 0.05$). The FCR first increased, then decreased with dietary carbohydrate levels elevated and the C_M lowest groups were the lowest (Tilapia: 1.47, Derbio: 1.61, Cobia: 1.49). Different dietary carbohydrate levels have different effects on glucose metabolism indicators of fish. With rising levels of dietary carbohydrate in Tilapia, the plasma glucose, insulin, hepatic/muscle glycogen and triglycerides of C_H group were significantly higher than the other groups ($P < 0.05$). The plasma glucose, insulin, hepatic / muscle glycogen, triglycerides of C_H groups in Derbio and Cobia are the highest, but there was no significant difference in plasma glucose and insulin between C_L and C_M groups in Derbio ($P > 0.05$). There were also no significant differences in plasma glucose and insulin levels of C_M and C_H in Cobia ($P > 0.05$). The glucose tolerance test (GTT) results showed that: (1) After injection of glucose, the plasma glucose levels of Derbio and Tilapia groups reached the peak at 1 h ($P < 0.05$) and returned to the initial level at 12 h while the Cobia until 24 h after a peak at 3 h. (2) The plasma insulin levels in tilapia and cobia groups rose slowly after the injection of glucose and reached the highest level at 3 h ($P < 0.05$), while the lever in Derbio group was significantly decreased within 1 h ($P < 0.05$). (3) The glycogen levels in Derbio and Tilapia increased slowly and reached the peak at 3 h and 6 h respectively ($P < 0.05$) while the Cobia declined within 1 h. (4) after the injection of glucose, the triglyceride levels in Tilapia and Derbio reached the peak at 3 h and 6 h after injection of glucose respectively ($P < 0.05$) while the Cobia decreased significantly within 1 h ($P < 0.05$). The results of this study suggest that dietary carbohydrate levels have varying degrees of effects on the growth, glucose metabolism indicators, glucose utilization and tolerance of three feeding habits, fish. The omnivorous Tilapia can utilize the dietary carbohydrate better than carnivorous fish. The glucose tolerance ability of omnivorous Tilapia is the strongest, followed by Derbio the intermediate, and Cobia the lowest.	Liu, H., Mao, Y., Tan, B., Dong, X., Yang, Q., Chi, S., Zhang, S., Chen, L.,	Journal of Fisheries of China 52, 1852–1862	2015	Fish Health
444	Toxic effects of two sources of dietborne cadmium on the juvenile cobia, <i>Rachycentron canadum</i> L. and tissue-specific accumulation of related minerals.	In the present study, juvenile cobia, <i>Rachycentron canadum</i> L. were fed diets contaminated by two different sources of cadmium: squid viscera meal (SVM-Cd, organic form) and cadmium chloride (CdCl ₂ -Cd, inorganic form). The Cd concentrations in fish diet were approximate 3.0, 5.0 and 10.0 mg Cd kg ⁻¹ for both inorganic and organic forms. In the control diet (0.312 mg Cd kg ⁻¹ diet, Cd mainly come from fish meal), no cadmium was added. The experiment lasted for 16 weeks and a statistically significant inverse relationship was observed between specific growth rate (SGR) and the concentration of dietary Cd. The SGR of cobia fed a diet with SVM-Cd increased at the lowest doses and decreased with the increasing level of dietary SVM. Fish fed diet contaminated SVM-Cd had significantly higher SGR than those fed diets contaminated CdCl ₂ -Cd among the high Cd level diets treatments. The dietary Cd levels also significantly affected the survival rate of the fish. Among the hematological characteristics and plasma constituents, glutamic-pyruvic transaminase activities and alkaline phosphatase activities in serum and liver increased and hepatic superoxide dismutase activity decreased with the increasing dietary Cd levels. The cobia fed diet contaminated by high level of CdCl ₂ -Cd had significantly higher ALP activity than cobia fed diet contaminated by high level of SVM-Cd. The results from these studies indicate no differences in toxicity response to dietborne SVM-Cd and CdCl ₂ -Cd at a low level of Cd. However, at a higher level, cobia was more sensitive to dietborne CdCl ₂ -Cd than SVM-Cd. Based on quadratic regression of SGR, The Cd concentrations was 3.617 mg kg ⁻¹ in the optimal diet, Cd source was SVM (126 mg Cd kg ⁻¹ in SVM) which stimulate the growth of cobia and the added level was determined to be 26.7 g kg ⁻¹ diet in the present study. Cd accumulations in the kidney of cobia fed both types of Cd were higher than other tissues, and the order of Cd accumulation in tissues were kidney > liver > intestine > gill > muscle. Iron accumulation in liver and kidney and calcium accumulation in vertebra and scale were also significantly affected by dietary Cd levels.	Liu, K., Chi, S., Liu, H., Dong, X., Yang, Q., Zhang, S., Tan, B.	Aquatic Toxicology 165, 120–128. doi: 10.1016/j.aquatox.2015.05.013	2015	Contaminants Fish Health
445	Dietary pyridoxine requirement for juvenile cobia (<i>Rachycentron canadum</i>).	Vitamin B6 or pyridoxine in the form of pyridoxal phosphate participates as a prosthetic group of enzymes in a large number of metabolic reactions, particularly those associated with the metabolism of proteins and amino acids. With the success of artificial propagation and larval production, the culture of cobia becomes widely distributed in southern coastal provinces of China (especially in Guangdong and Hainan Provinces) as well as Southeast Asia. However, currently the growth of cobia heavily depends on trash fish and the development of formulated feeds for cobia is still in its infancy. The objective of this study is to detect the optimal requirement of pyridoxine in diet of juvenile cobia <i>Rachycentron canadum</i> . Basal diet was formulated using vitamin-free casein, gelatin and fish protein concentrate as the protein source. The graded levels of PN (0, 2, 4, 8, 16 and 32 mg/kg diet) were added to the basal diets to formulate six experimental diets containing 0.22, 1.89, 3.87, 7.54, 14.75 and 29.88 mg PN/kg diet, analyzed by HPLC, respectively. Each diet was fed to three replicate groups of cobia in 300 L tanks for 9 weeks, and each tank was stocked with 25 fish [initial weight (3.23 ± 0.06) g]. The water salinity was from 30 to 34, temperature fluctuated from 28 to 32 °C and dissolved oxygen was above 7 mg/L. The results showed that specific growth rate (SGR) have an increasing trend with the increase of dietary pyridoxine (from 0.22 to 3.87 mg/kg), but no significant differences were observed among diets containing 3.87 mg/kg PN or above. The contents of PN and AST in liver of fish fed diets with 3.87 mg/kg were significantly higher than the treatments with the contents of PN lower than 3.87 mg/kg, however, there were no significant differences among diets containing 3.87-29.88 mg/kg PN. The contents of PLP and the activities of ALT of the diet containing 7.54 mg/kg PN were significantly higher than the diets containing PN < 7.54 mg/kg, however, no significant differences were discovered among diets containing PN > 7.54 mg/kg. The dietary pyridoxine requirement was estimated to be 3.09-3.26 mg/kg by the broken-line model based on the SGR, and the activities of ALT in fish liver.	Liu, K., Mai, K., Ai, Q., Zhang, W., Wang, X., Xiao, L., Ren, M.	Journal of Fisheries of China 34, 307–314	2010	Fish Health Nutrition
446	A genetic analysis of population of cobia, <i>Rachycentron canadum</i> around Zhanjiang waters of South China Sea with microsatellite markers.	Vitamin B6 or pyridoxine in the form of pyridoxal phosphate participates as a prosthetic group of enzymes in a large number of metabolic reactions, particularly those associated with the metabolism of proteins and amino acids. With the success of artificial propagation and larval production, the culture of cobia becomes widely distributed in southern coastal provinces of China (especially in Guangdong and Hainan Provinces) as well as Southeast Asia. However, currently the growth of cobia heavily depends on trash fish and the development of formulated feeds for cobia is still in its infancy. The objective of this study is to detect the optimal requirement of pyridoxine in diet of juvenile cobia <i>Rachycentron canadum</i> . Basal diet was formulated using vitamin-free casein, gelatin and fish protein concentrate as the protein source. The graded levels of PN (0, 2, 4, 8, 16 and 32 mg/kg diet) were added to the basal diets to formulate six experimental diets containing 0.22, 1.89, 3.87, 7.54, 14.75 and 29.88 mg PN/kg diet, analyzed by HPLC, respectively. Each diet was fed to three replicate groups of cobia in 300 L tanks for 9 weeks, and each tank was stocked with 25 fish [initial weight (3.23 ± 0.06) g]. The water salinity was from 30 to 34, temperature fluctuated from 28 to 32 °C and dissolved oxygen was above 7 mg/L. The results showed that specific growth rate (SGR) have an increasing trend with the increase of dietary pyridoxine (from 0.22 to 3.87 mg/kg), but no significant differences were observed among diets containing 3.87 mg/kg PN or above. The contents of PN and AST in liver of fish fed diets with 3.87 mg/kg were significantly higher than the treatments with the contents of PN lower than 3.87 mg/kg, however, there were no significant differences among diets containing 3.87-29.88 mg/kg PN. The contents of PLP and the activities of ALT of the diet containing 7.54 mg/kg PN were significantly higher than the diets containing PN < 7.54 mg/kg, however, no significant differences were discovered among diets containing PN > 7.54 mg/kg. The dietary pyridoxine requirement was estimated to be 3.09-3.26 mg/kg by the broken-line model based on the SGR, and the activities of ALT in fish liver.	Liu, L., Liu, C., Liang, N.	Journal of Tropical Oceanography 27, 57–61	2008	Genetics
447	Pathogenesis of extracellular phospholipase of <i>Photobacterium damsela</i> Subsp. <i>piscicida</i> in Cultured cobia (<i>Rachycentron canadum</i>).	This study investigated the pathogenesis of <i>Photobacterium damsela</i> subsp. <i>piscicida</i> , isolated from swollen kidney of diseased cobia (<i>Rachycentron canadum</i>) in the fish. The virulence tests were conducted in cobia (10 g) and the LD sub (50) values of <i>Ph. damsela</i> subsp. <i>piscicida</i> was 1.03 × 10 super(4) cfu/g fish body weight; the LD sub(50) value of extracellular products (ECP) from <i>Ph. damsela</i> subsp. <i>piscicida</i> in cobia (10 plus or minus 0.5 g) was 126 mu g protein / g fish body weight. Phospholipase was partially purified from ECP of <i>Ph. damsela</i> subsp. <i>piscicida</i> by using anion exchange columns (Q Sepharose High Performance, RESOURCE Q and Mono Q) on High Performance Liquid Chromatography (HPLC). Partially purified phospholipase fraction contained 30 kDa and 14.3 kDa protein band on SDS - PAGE, and the 14.3 kDa protein band exhibiting phospholipase activity on Native - PAGE. The partially purified phospholipase was lethal to cobia. All the cobias were killed after intraperitoneal (i.p.) injection of the partially purified phospholipase with a dose of 7 pg protein / g fish body weight within 72 hours. This phospholipase may play an important role in the pathogenesis of <i>Ph. damsela</i> subsp. <i>piscicida</i> infection in the cobia.	Liu, P.-C., Hu, C.-C., Lee, K.-K.	Journal of the Fisheries Society of Taiwan 32, 82–83	2005	Fish Health Culture Pharmacology
448	Evaluation of protein nutritional value in different tissues of cobia.	The basic nutrient composition in the different tissues of cobia was determined by food analysis method and the nutritional value of their protein was evaluated. The results showed that cobia was rich in protein and fats, the protein nutritional value of back muscles and abdominal muscle from cobia was higher than that of head, skin and visceral, the ratio of BCAA/AAA in the different tissues of cobia ranged from 2.4 ~ 2.6, which was close to the body's normal level, and the total flavor amino acid of cobia muscle accounted for 38% ~ 40% in the total amino acids.	Liu, S., Li, D., Hong, P., Zhang, C., Yang, P., Ji, H.	Food Science and Technology 158–160,165	2010	Fish Health Nutrition
449	Dietary phosphorus requirement of cobia (<i>Rachycentron canadum</i>).	A feeding experiment was conducted to determine the requirement of dietary phosphorus for cobia in flow-through systems. Five practical diets were formulated to contain 0.62%, 0.98%, 1.10%, 1.33% and 1.71% available phosphorus from ingredient and monocalcium phosphorus. Juvenile fish [initial average weight (1.80±0.30) g] were randomly divided into 15 tanks of 20 fish, and fed one of 5 diets for 8 weeks. The results showed that specific growth rate (SGR) of fish fed the highest dietary phosphorus (1.71%) was significantly lower ($P < 0.05$) than other groups, while 0.62% dietary available phosphorus could meet the requirement for growth. The body composition analysis showed that the carcass ash and lipid were significantly affected by dietary available phosphorus ($P < 0.05$).	Liu, X., Tan, B., Ai, Q.	Feed Industry 33, 28–31	2012	Fish Health Nutrition Culture
450	Effects of dietary n-3 highly unsaturated fatty acids on growth and fatty acid composition of juvenile cobia (<i>Rachycentron canadum</i>).	A feeding experiment was conducted in floating sea cages (1.0m × 1.5m × 1.0m) to determine the requirement of juvenile cobia (<i>Rachycentron canadum</i>) for n-3 highly unsaturated fatty acids (n-3 HUFA). Six semi-purified diets were formulated to contain graded levels of n-3 HUFA, ranging from 0.6 to 2.11%. Juvenile fish (weighing 8.3 ± 0.5g) were randomly divided into 18 cages of 20 fish, and fed one of 6 diets for 8 weeks. The water temperature fluctuated from 29 to 23.5°C, the salinity from 20.9 to 23.9‰, and dissolved oxygen content was approximately 7 mg/L during the experimental period. No significant differences (ANOVA, $p > 0.05$) in survival were observed among dietary treatments. However, specific growth rate (SGR) was significantly ($p < 0.05$) affected by dietary n-3 HUFA. SGR significantly increased with increasing dietary n-3 HUFA from 0 to 1.24%, and reached a peak at 1.56% of n-3 HUFA. Then, SGR slightly decreased for the groups fed the diets containing higher than 1.56% of n-3 HUFA. The content of 18: 1n-9 in muscle and liver decreased, while 22: 6n-3 increased with increasing dietary n-3 HUFA. Based on SGR, the requirement for n-3 HUFA of juvenile cobia is about 1.49% of dry diet by broken-line analysis.	Liu, X.-W., Tan, B.-P., Mai, K.-S., Ai, Q.-H., Zhou, Q.-C.	Acta Hydrobiologica Sinica 31, 190–195	2007	Fish Health Nutrition
451	Effects of dietary starch on biochemical indexes of the serum of cobia (<i>Rachycentron canadum</i>).	To investigate effects of re-feeding following fasting on plasma glucose, total protein, triacylglycerol, total cholesterol, low-density lipoprotein-cholesterol (LDL-C) and high-density lipoprotein-cholesterol (HDL-C) contents in cobia fasted for 24h, six diets were formulated to contain 0% (control), 6%, 12%, 18%, 24% and 30% starch, respectively. The results showed that the serum glucose levels of cobia after re-feeding with each diet elevated from 0h to 5h and then started to decline till 7h that the glucose levels were similar to those at 0h. Different dietary starch and post-prandial time did not significantly influence the total protein levels in serum. The triacylglycerol levels in serum elevated from 0h to 5h and then began to decline. At 7h, the levels were similar to those at 0h. In the control group, the concentration of cholesterol in serum increased from 0h to 2h and then decreased from 2h to 7h that reached to fasting level. In other groups, the serum cholesterol levels increased from 0h to 5h and then began to decline; then, it also reached to fasting level at 7h. The levels of LDL-C increased from 0h to 5h and then began to decline. At 7h, the levels of LDL-C declined to the basal level. However, different dietary starch and postprandial time did not significantly influence the levels of LDL-C in serum. In the group of 24%, the levels of HDL-C at 5h were significantly higher than those at 0 and 24h. No significant differences were found for the levels of HDL-C among other groups. In conclusion, the glucose levels increased and then declined. The peak glucose levels increased with the increase of dietary starch level up to 12% and remained nearly the same thereafter. The levels of triacylglycerol and cholesterol in serum increased after re-feeding, but there were no significant differences in the LDL-C and HDL-C levels in serum after re-feeding.	Liu, Y.-L., Mai, K.-S., Xu, W., Zhang, Y.-J., Wang, Z., Ai, Q.-H.	Acta Hydrobiologica Sinica 39, 46–51	2015	Fish Health Nutrition

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
452	Occurrence of <i>Rachycentron canadum</i> (Linnaeus, 1766) (Actinopterygii: Rachycentridae) in Todos os Santos Bay, State of Bahia, Brazil. Sitientibus.	<i>Rachycentron canadum</i> (Linnaeus, 1766) is recorded for the Todos os Santos Bay (State of Bahia, Brazil) Three specimens were analyzed, collected in Itapema Beach, Santo Amaro da Purificacao Municipality (about of 12 degree 42'S - 38 degree 45'W), measuring between 178,4 mm and 307,4 mm in total length Gut contents, morphometrics and meristics data, as well as a diagnosis, are presented for the examined specimens, which are housed in the collection of the Laboratorio de Ictiologia, Universidade Estadual de Feira de Santana.	Lopes, P.R.D., Oliveira-Silva, Jt., Sena, M.P.	Serie Ciencias Biologicas 1, 56–59	2001	Wild (Atlantic)
453	Gonadal maturation in the cobia <i>Rachycentron canadum</i> from the Northcentral Gulf of Mexico.	Gonadal maturation of cobia, <i>Rachycentron canadum</i> , was evaluated by examining 508 specimens from its recreational fishery. Specimens were collected off southeast Louisiana to northwest Florida by hook-and-line during February through October 1987–1991. Fork lengths (FL) of these fish ranged from 580–1,530 mm, with corresponding weights of 2.0–43.5 kg. The female:male ratio was 1:0.37. Using a combination of oocyte size frequency and histological assessment of many of the fish, we determined that females were ripe from May through September, with atretic oocytes occurring in some fish from July through October. Degenerating hydrated oocytes in July and October and the presence of resting ovaries in July suggest two major spawning periods; however, monthly gonosomatic indices peaking in May, followed by a steady decline, do not support that finding. Ovaries were placed into undeveloped, early developing, mid-developing, or late developing categories based upon oocyte size-frequency distributions. Developing ovaries had two or three modes of oocytes larger than 30 µm. Batch fecundity was estimated to be 2.6×10 ⁶ - 1.91×10 ⁸ oocytes, depending on the size of fish/ovaries. The smallest female with oocytes exhibiting vitellogenesis was 834 mm FL. This fish was 2 years old based its otolith evaluation. The smallest male with an abundance of spermatozoa in its testes was 640 mm FL and 1 year old based on otolith evaluation; smaller males were not examined. Females larger than 840 mm FL had vitellogenic oocytes in March and April. A few fish still had vitellogenic oocytes in early October, but none did by late October. When Gilson's fluid was used to assess ovarian tissue, the fresh weight of the tissue was reduced by 20% after being stored for 3 months. The diameter of oocytes shrunk about 25% in Gilson's fluid which was 11% less than those fixed in formalin, embedded in paraffin, and sectioned. Tissue sections from specific individuals, each demonstrating a variety of different developmental stages, were similar regardless of whether they were obtained from the anterior, middle, or posterior portion of either ovary.	Lotz, J., Overstreet, R., Franks, J.	Gulf Research Reports 9, 147–159	1996	Wild (Atlantic) Spawning
454	Cloning and characterization of MX gene from cobia.	The fast growth and high feed conversion rate of cobia make it become a new potential species for marine cage culture. However, the disease cause by parasites, bacteria and viruses is one of the major hurdles of cobia culture. Because there is no cure for virus diseases, the cloning and characterization of MX gene that is related to virus tolerance of other land animals are conducted. The total length of MX cDNA is cloned by PCR with degenerate primers, and RACE. Six hours after the adding of 50ng/kl of poly I:C, the inducibilities of MX expression are found in cobia cell lines derived from brain, and kidney. Cloning and analysis of MX promoter is being conducted.	Lu, S.-Y., Wang, Y.-C., Li, J.-H., Wu, C.-P., Cheng, T.C.	Journal of the Fisheries Society of Taiwan 32, 11	2005	Fish Health Molecular Genetics
455	Full length cDNA cloning and tissue expression of major histocompatibility complex (MHC)-II α from cobia (<i>Rachycentron canadum</i>).	Degenerate primer was designed according to the conserved part of MHC-II α gene sequences of other fishes, and the techniques of homology cloning and RACE PCR were used to clone the MHC-II α gene from cobia (<i>Rachycentron canadum</i>). The cDNA sequence and amino acid sequence were analyzed, and the differences between MHC-II α amino acid sequence of cobia and other species were compared. QRT-PCR assay was developed to assess the mRNA expression of MHC-II α in normal tissues and the tissues after injected with LPS. The results showed that the full length cDNA of MHC-II α comprises 998 bp with a 5' untranslated region (UTR) of 53 bp, a 3' UTR of 234 bp and an open reading frame (ORF) of 711 bp, which encoding a polypeptide of 236 amino acid residues with a predicted molecular weight of 25.94 ku and theoretical isoelectric point of 4.39. The putative protein showed homology varying from 25.0% to 69.5% compared to some known MHC-II α amino acids in other fish, mouse (<i>Mus musculus</i>) and human (<i>Homo sapiens</i>), respectively. The protein sequence showed that all the important features: leader peptide, α 1, α 2 and CP/TM/CYT regions, and conserved cysteines. Real-time PCR indicated MHC-II α gene expressed in all detected tissues with different expression level. High expression was detected in head kidney, gill, moderate expression in spleen and intestine, and low expression in heart, brain and muscle. MHC-II α expression in the head kidney decreased after LPS stimulation.	Mao, L., Feng, J., Li, Y., Hou, Y., Guo, Z., Xu, H.	China Animal Husbandry & Veterinary Medicine 37, 48–57	2010	Genetics Molecular
456	Cloning of full length cDNA and tissue expression analysis of hepcidin gene from cobia (<i>Rachycentron canadum</i>).	The techniques of homology clone and RACE were used to clone the Hepcidin gene from cobia (<i>Rachycentron canadum</i>). The full length cDNA of Hepcidin gene was 714 bp with a 213 bp 5' untranslated region (UTR), a 228 bp 3' UTR and a 273 bp open reading frame (ORF) encoding a polypeptide of 90 amino acid residues with a predicted molecular weight of 10.03 ku and theoretical isoelectric point of 7.54. The predicted molecular included signal peptide, prodomain peptide and mature peptide. Phylogenetic tree of Hepcidin amino acid sequences was constructed and homology comparison of amino acid sequences showed that homologies were varied from 24.4% to 85.6% with some known Hepcidin amino acids in other fishes and mammals. Quantitative Real-time PCR (qRT-PCR) analysis revealed that Hepcidin gene was expressed in all tissues with different expression levels, which expressed most in liver. The Hepcidin gene expressions in liver, head kidney and spleen were up-regulated after stimulation of LPS and formalin-inactivated <i>Vibrio</i> carchariae.	Mao, L., Zhang, H., Feng, J., Guo, Z., Xu, H., Su, Y.	China Animal Husbandry & Veterinary Medicine 1630–1639	2015	Fish Health Molecular Genetics
457	Full length cDNA cloning and tissue expression of major histocompatibility complex (MHC)-II β in cobia (<i>Rachycentron canadum</i>).	The homology cloning and RACE PCR were employed to clone the MHC-II β gene from cobia (<i>Rachycentron canadum</i>). The full length cDNA of MHC-II β comprises 1161 bp with a 20 bp 5' untranslated region (UTR), a 394 bp 3' UTR and a 747 bp open reading frame (ORF) encoding a polypeptide of 248 amino acid residues with a predicted molecular weight of 27.99 ku and theoretical isoelectric point of 6.21. The putative protein showed homology varying from 28.5% to 77.5% when compared with other fishes, mouse (<i>Mus musculus</i>), chicken (<i>Gallus gallus</i>) and human (<i>Homo sapiens</i>). The protein sequence showed all the important features including leader peptide, β 1, β 2, CP /TM /CYT regions and conserved cysteines. The MHC-II β expression was detected in all tested tissues with different expression levels. The high expression was detected in head kidney, moderate expression was detected in gill, spleen and intestine, while low expression was detected in heart, brain and muscle.	Mao, L.-N., Feng, J., Li, Y.-G., Hou, Y.-E., Guo, Z.-X., Xu, H.-D.	Chinese Journal of Zoology 45, 118–128	2010	Fish Health Molecular Genetics
458	Parasites, diseases and deformities of cobia.	Cobia, <i>Rachycentron canadum</i> , is the only member of the family Rachycentridae (Order Perciformes) and as a warm–water fish is to be found in tropical and subtropical waters. The species has been reported in eastern Mediterranean waters and it is likely that in this particular case, cobia are lesseespian. Cobia has been farmed in Taiwan since the early 1990s and today nascent cobia aquaculture operations operate throughout South East and Eastern Asia, in Gulf of Mexico and Caribbean Sea as well as in the United States. Many other nations are presently considering adopting cobia as a new species for aquaculture. Production by aquaculture experienced a 700–fold increase from 1995 to 2005. The increased interest in the species has evolved due in large part to its many excellent characteristics which include good growth, with production of 6 kg live weight fish being possible over a year–long production cycle. Cobia are accepting of pond, net pens and recirculation–based culture; their fillet quality is high and meat delectable; They readily take formulated feeds and respond well to alternate proteins in their diets. Like other species new to aquaculture however, enlarged farming activities have been accompanied by increased incidence of commonly–encountered and emerging diseases. As an aid to current and potential producers as well as researchers, the following provides an overview of the published literature on cobia diseases, parasites and physical deformities.	McLean, E., Salze, G., Craig, S.	Croatian Journal of Fisheries 66, 1–16	2008	Review
459	Food of cobia, <i>Rachycentron canadum</i> , from the Northcentral Gulf of Mexico.	The stomach contents of 403 cobia, <i>Rachycentron canadum</i> , caught in the northcentral Gulf of Mexico recreational fishery from April through October of 1987–1990 were examined. Cobia ranged from 373–1,530 mm in fork length. Of the 403 stomachs, 287 (71.2%) contained at least one identifiable prey taxon. Crustaceans, consisting primarily of portunid crabs, were the predominant food. Crustaceans occurred in 79.1% of the stomachs and comprised 77.6% of the total number of identifiable prey. The second most important prey category was fish which was dominated by hardhead catfish, <i>Arius felis</i> , and eels. Fish occurred in 58.5% of the stomachs but only accounted for 20.3% of the total number of prey. The importance of fish as prey increased with increasing size (length) of cobia, with the largest size class of cobia (1,150–1,530 mm FL) showing the highest percent frequency occurrence of fish prey (84.4%). There were no significant differences between the diets of male and female cobia. Species composition of the diet indicated that cobia examined in this study were generalist carnivores in their feeding habits and fed primarily on benthic/epibenthic crustaceans and fishes. However, the occurrence of pelagic prey provided evidence of diversity in the foraging behavior of cobia. Feeding in cobia indicated their dependence upon prey availability rather than upon a few specific food organisms.	Meyer, G., Franks, J.	Gulf Research Reports 9, 161–167. doi: 10.18785/grr.0903.02	1996	Wild (Atlantic)
460	Feeding frequency affects growth of juvenile cobia <i>Rachycentron canadum</i> cultured in near-shore cages.	Growth performance of juvenile cobia <i>Rachycentron canadum</i> (15.7 ± 0.4 g; mean ± SD) reared in 1 m ³ near-shore cages, 24.0 ± 2.1 °C, fed a Brazilian commercial feed (45% crude protein and 16% lipid) until apparent satiation, in a single feeding (F1), two (F2) or three (F3) feedings per day, for 30 days was assessed. The initial stocking density was 0.6 kg m ⁻³ . Production performance of juvenile cobia was significantly affected by feeding frequency. Groups fed two and three equal feedings per day presented greater and more efficient growth than F1 groups. There was no difference between F2 and F3 treatments for weight gain (15.6 ± 1.5 g and 16.3 ± 2.0 g, respectively), specific growth rate (SGR: 2.3 ± 0.3% and 2.5 ± 0.4% of body weight per day, respectively) and feed conversion ratio (FCR: 2.3 ± 0.2 and 2.5 ± 0.3, respectively). However, these parameters were reduced in F1 treatment (weight gain of 8.4 ± 1.1 g; SGR = 1.4 ± 0.2% and FCR = 3.2 ± 0.6) (P<0.05). The coefficient of variation was inversely proportional to the increase in feeding frequency. There was no significant difference in terms of survival rates, being superior to 90% in all treatments. We suggest that growth performance of juvenile cobia cultured in near-shore cages can be optimized at a feeding frequency of two times a day, facilitating husbandry procedures and minimizing costs related to labor and vessel utilization.	Moreira, C.B., Rombenso, A.N., Candiottto, F.B., Tsuzuki, M.Y.	Boletim do Instituto de Pesca, Sao Paulo 41, 219–226	2015	Cage Culture
461	Digenetic trematodes from marine fishes off the coast of Kuwait, Arabian Gulf: Superfamily Hemiuroidea.	Eight species of Hemiuroidea are reported: <i>Allotostomachicola secundus</i> Yamaguti, 1958 from <i>Chirocentrus nudus</i> (Chirocentridae); <i>Ectenurus trachuri</i> from <i>Trachurus trachurus</i> , <i>Caranx kalla</i> , <i>Scomberoides commersonianus</i> (Carangidae) and <i>Rachycentron canadum</i> (Rachycentridae); <i>Eriolepturus hamati</i> Manter, 1947 from <i>Lutjanus russelli</i> (Lutjanidae); <i>Otolithes ruber</i> (Sciaenidae); <i>Pseudorhombus arsius</i> (Bothiidae); <i>Scomberoides commersonianus</i> (Carangidae) <i>Therapon</i> sp. (Theraponidae); <i>Lecithocladium angustiovum</i> Yamaguti, 1953 from <i>Caranx kalla</i> (Carangidae); <i>Lecithochirium acutum</i> , Chauhan, 1945 from <i>Trichiurus lepturus</i> (Trichiuridae); <i>Aponurus laguncula</i> Looss, 1907 from <i>Siganus oramin</i> (Siganidae); <i>Lecithaster indicus</i> Srivastava, 1935 from <i>Otolithes ruber</i> ; <i>Aphanurus stossichii</i> Looss, 1907 from <i>Sardinella perforata</i> , <i>Ilisha elongata</i> (Clupeidae); <i>Thryssa whiteheadi</i> (Engraulidae) and <i>Mulloidichthys auriflamma</i> , (Mullidae).	Nahhas, F.M., Sey, O.	Acta Zoologica Academiae Scientiarum Hungaricae 48, 1–20	2002	Parasites Wild
462	Effects of dietary manganese sources and levels on growth performance, relative manganese bioavailability, antioxidant activities and tissue mineral content of juvenile cobia (<i>Rachycentron canadum</i> L).	This study was conducted to compare the effects of manganese sulphate (Mn-S), glycine manganese (Mn-Gly) and manganese 2-hydroxy-4-(methylthio)butyrate (Mn-HMB) on juvenile cobia, <i>Rachycentron canadum</i> L. Treatments consisted of 0, 2, 4, 8, 16 or 32 mg supplemental Mn kg ⁻¹ from Mn-S, Mn-Gly or Mn-HMB. Growth performance, manganese status, antioxidant activities and tissue mineral content were analysed after a 70-day feeding period. Specific growth rate (SGR) increased with feeding 6.29 to 12.65 mg Mn kg ⁻¹ diet from the Mn-S or 6.86 to 12.39 mg Mn kg ⁻¹ from the Mn-Gly or 6.50 to 8.33 mg Mn kg ⁻¹ from the Mn-HMB and then plateaued above these levels. Feed conversion ratio (FCR) show decreasing first and then increased trend. Survival rate (SR) were not affected by the dietary treatments (P > 0.05). Fish fed diets supplemented with manganese at levels of 4–32 mg Mn kg ⁻¹ had obviously higher hepatic Mn-SOD activity (P < 0.05); on the contrary, hepatic has lower malondialdehyde (MDA) content (P < 0.05) than fish fed the basal diet. The manganese concentrations of whole body and vertebrae increased with increasing dietary Mn levels from 2–32 mg Mn kg ⁻¹ (independent on manganese sources). Dietary Mn supplementation did not significantly influence the copper concentrations of whole body and vertebrae, the zinc concentrations of whole body and liver. Analysis by the broken-line regression of SGR indicated that the optimal dietary Mn requirements in juvenile cobia were 15.42, 11.22 and 10.50 mg Mn kg ⁻¹ diet from Mn-S, Mn-Gly or Mn-HMB respectively.	Nie, J., Dong, X., Tan, B., Chi, S., Yang, Q., Liu, H., Shuang, Z.	Aquaculture Research 47, 1402–1412. doi: 10.1111/are.12598	2016	Fish Health Nutrition
463	Morphometric variations among three different populations of cobia, <i>Rachycentron canadum</i> (Linnaeus 1766) in Peninsular Malaysia.	Cobia <i>Rachycentron canadum</i> , is one of the emerging aquaculture species but is usually a non-target resource in fisheries industry and within Malaysia, their landings are among the highest worldwide. Identification of stocks with unique morphological characters is important for effective management and sustainable utilization. Morphometric variations among three different cobia populations from Kedah, Terengganu and Johor were studied. All the morphometric characteristics varied among the three populations as all the elements of the first Eigen vector were positive. Discriminant analysis suggested that head depth (HD) and maximum body depth, (MaxD) were the most varied among the populations. Cobia populations from Kedah and Johor were in a single cluster in the dendrogram with a 63.69% similarity while Terengganu was in another cluster with a similarity of 8.01% from Kedah and Johor. The differences in the observed morphometry may be resulted from different trophic activities and/or habitat productiveness explored by each of the populations.	Nurul, A., Babatunde, T.A., Ihab, M.M.M., Usman, B.I., Ara, R.	Sains Malaysiana 45, 891–898	2016	Wild
464	Stress response in transport of juvenile cobia <i>Rachycentron canadum</i> using the anesthetic benzocaine.	This experiment evaluated the efficacy of benzocaine to reduce stress response during transport of juvenile cobia. Fish (30 g) were packed in bags and transported for 8 h (stocking density = 10 g L ⁻¹). Three concentrations of benzocaine were evaluated: 0, 2, and 6 mg L ⁻¹ . Blood samples were taken for glucose and hematocrit before transportation, and then at 0, 2, 24, and 48 h after. Water quality parameters were verified. No mortality was observed. Total ammonia nitrogen was higher (2.46 mg L ⁻¹) and pH was lower (6.92) at 2 mg benzocaine L ⁻¹ . There was an increase in blood glucose for all treatments on arrival, and it was higher for those exposed to benzocaine at 6 mg L ⁻¹ , although at 48 h they were all similar. The hematocrit did not differ among treatments. The results suggest: 1) the density 10 g L ⁻¹ is considered safe for juvenile cobia transport; 2) benzocaine did not mitigate stress response on cobia during transport, therefore its use is not recommended for this purpose.	Pedron, J.S., Miron, D.S., Rodrigues, R.V., Okamoto, M.H., Tesser, M.B., Sampaio, L.A.	Latin American Journal of Aquatic Research; Valparaiso 44, 638–642. doi:http://dx.doi.org/10.3856/vol44-issue3-fulltext-22	2016	Culture Fish Health Pharmacology

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
465	Hiperplasia em t�nicas de art�rias coron�rias de beijupir�s criados em sistema offshore.	The coronary lesions have been reported in species of anadromous fish with similar characteristics as those observed in human atherosclerosis, but not in farmed fish without interference of reproductive patterns. This study aimed to describe coronary lesions in beijupir� (<i>Rachycentron canadum</i>) farmed in an offshore system, in 54 specimens collected along an eight month cultivation period. Samples of heart tissue of fry and juveniles were subjected to histopathological analysis and transmission electron microscopy (TEM) for visualization of coronary lesions, the histology slides were stained using hematoxylin-eosin, periodic acid Schiffh, alcian blue, and reticulin of Gomori. Examinations performed by light microscopy showed arterial lesions characterized by hyperplasia of the intima and media tunics, respectively in 29.63% and 79.63 % of the animals, with reduced lumen. In TEM changes in the structure of the coronary endothelium and thickening of the basement membrane, proliferation of fibroblasts and collagen fibers, with subendothelial accumulation of lipid material, cellular debris adhering to the basement membrane and presence of pinocytotic vesicles and isolated lysosomes were observed. It has been found that the <i>Rachycentron canadum</i> fish species farmed in captivity develop arterial lesion of the chronic inflammatory degenerative type.	Pedrosa, V.F., Romano, L.A., Santos, F.L. dos, Guimar�es, J.M., Silva, A.D.R. da, Mendes, E.S., Pedrosa, V.F., Romano, L.A., Santos, F.L. dos, Guimar�es, J.M., Silva, A.D.R. da, Mendes, E.S.	Arquivo Brasileiro de Medicina Veterin�ria e Zootecnia 67, 747–754. doi:10.1590/1678-4162-7497	2015	Cage Culture Fish Health
466	Recent changes in the bioeconomic of finfish mariculture in Vietnam.	Finfish mariculture farmers in Vietnam are making careful practice change decisions in reaction to a number of economic drivers. These economic drivers are centered on trends of increasing input costs and decreasing output prices. In general, mariculture farmers are adapting to the cost-price squeeze in a number of ways, including increasing stocking densities and area, and by adopting risk-reducing strategies (decreasing grow-out periods and using a larger number of smaller ponds to spread mortality risk). However, there is still a shortage of good quality low-cost fingerlings which is constraining farmers' ability to adapt to the cost-price squeeze. The dominant input cost source is feed. Most farmers are still reliant on trash-fish feeds. With low and decreasing feed conversion ratios for trash-fish, there is decreasing incentive for these farmers to change to pelleted diets. Southern Asian seabass farmers have made the practice change to pellets, but feed conversion ratios are high preventing significant economic gains from making the change. This research highlights two key areas where policy, research and extension initiatives can have a significant impact on the long-term economic and environmental viability of mariculture operations in Vietnam while protecting fish stocks: firstly, ensuring the widespread availability of low-cost hatchery-produced fingerlings, and secondly, encouraging practice change from trash-fish diets to the well-managed use of manufactured pelleted diets.	Petersen, E.H., Glencross, B.D., Van Tien, N., Tuan, L. A., Tuan, V.A., Phuong, T.H.	Journal of Aquaculture Research & Development 6, 1	2015	Socioeconomics
467	Farming of cobia, <i>Rachycentron canadum</i> (Linnaeus 1766) in open sea floating cages in India.	Experiments on culture and growth performance of cobia were undertaken in marine cages installed in the Arabian Sea off Karwar on the south-west coast of India. Hatchery produced cobia fingerlings were stocked at two densities of 3.5 fish cubic m-1 and 14.1 fish cubic m-1 in circular HDPE cages. Mean weight and specific growth rate (SGR) of cobia stocked @ 3.5 fish cubic m-1 were 10.5 kg and 2.2% day-1, respectively, at 300 days of culture (DOC). Cobia stocked @ of 14.1 fish cubic m-1 attained an average weight of 3.68 kg and SGR of 1.9% day-1 at 300 DOC. SGR was found to be positively correlated with water temperature and salinity during the culture period. No significant variation was found in SGR and feed conversion ratio of cobia stocked at two different densities. However, absolute growth rate, relative growth rate and mean weight of cobia varied significantly between the two groups.	Philipose, K.K., Loka, J., Sharma, S.R.K., Divu, D., Rao, K.S., Sadhu, N., Dube, P., Gopakumar, G., Rao, G. S.	Indian Journal of Fisheries 60(4), 35-40	2013	Cage Culture
468	Description of a new species of <i>Parapetalus</i> (Caligidae: Copepoda) from Kerala.	A new species of <i>Parapetalus</i> collected from the fish <i>Rachycentron canadus</i> (Linnaeus) is described in detail. Affinity of this species is discussed with other related members of the genus.	Pillai, N.S., Hameed, M.S.	Journal of the Marine Biological Association of India 23, 77	1981	Wild Parasites
469	Determination of the dietary copper requirement for cobia (<i>Rachycentron canadum</i>).	The present experiment was conducted to determine the optimum dietary copper requirement of juvenile cobia (<i>Rachycentron canadum</i>) with copper sulfate (CuSO4 5H2O) and copper methionine (CuMet) as copper sources by using a semi-purified diet with casein and white fish meal as the protein sources. The basal diet was supplemented with 0, 4, 8, 16, 32 and 64 mg copper kg-1 from either copper sulfate or copper methionine. Eleven semi-purified diet containing graded levels of copper (3.3~57.4 mg/kg) were fed to juvenile cobia (initial weight, 9.92 0.47 g), respectively. The results showed that fish fed the basal diet had the obviously lower survival rate. Both the weight gain rate (WGR) and feed efficiency (FE) were significantly affected (P<0.05) by the dietary copper from two copper sources and increased with increasing dietary copper. The requirements for dietary copper using CuSO4 and CuMet as the supplemental copper sources as was determined by broken-line regression analysis on the basis of WGR were 11.5 mg/kg and 8.3 mg/kg and on the basis of FE were 11.9 mg/kg and 8.2 mg/kg, respectively. The activity of liver copper zinc-superoxide dismutase (Cu,Zn-SOD) and body composition were not significantly affected (P>0.05) by graded levels of dietary copper from two copper sources. The copper concentration in the fillet and plasma were not affected by different copper levels from two copper sources. The copper concentration in the whole fish and vertebrae increased with increasing dietary copper. Based on these results, a minimum requirement for dietary copper (either 11.5~11.9 mg/kg from CuSO4 or 8.2~8.3 mg/kg from CuMet) was recommended. This experiment also showed that the bioavailability of dietary copper with CuMet was approximately 1.5~1.8 times as high as that with CuSO4 for juvenile cobia.	Qiao, Y.-G., Tan, B.-P., Mai, K.-S., Ai, Q.-H.	Periodical of Ocean University of China 34–41	2013	Nutrition Fish Health
470	Molecular cloning and expression analysis of Interleukin-1� from cobia <i>Rachycentron canadum</i> Linnaeus.	IL-1� is a pleiotropic proinflammatory cytokine with a wide spectrum of inflammatory, metabolic, hematopoietic and immunological activities and is responsible for the symptoms of sickness during the host response to infection. IL-1� is produced by many cell types, including monocytes, macrophages, langerhans cells, dendritic cells, endothelial, epithelial cells and fibroblasts, even in sperm. Tremendous progress has been made in gene cloning of cytokines from fish in recent years, especially TNF� and IL-1� et al. Several evidences provided by biological cross reaction have strongly suggested that interleukins exist in fish. IL-1� bioactivity has been known in fish for over a decade, but only since 1999, IL-1� gene has been cloned in a number of teleost species and at the same time confirmed those initial findings. To date most analysis has been made on rainbow trout (<i>Oncorhynchus mykiss</i>) and carp (<i>Cyprinus carpio</i>) genes. More recently, seabass (<i>Dicentrarchus labrax</i>), seabream (<i>Sparus aurata</i>), turbot (<i>Scophthalmus maximus</i>), dogfish (<i>Scyliorhinus caniculus</i>) and catshark (<i>Scyliorhinus canicula</i>) IL-1� genes have been cloned and sequenced. The techniques of homology cloning and anchored PCR were used to clone the IL-1� gene from cobia (<i>Rachycentron canadum</i> Linnaeus). The full length cDNA of IL-1� is 1104bp, containing a 5' untranslated region (UTR) of 108bp, an ORF of 741bp, an encoding polypeptide of 246 amino acids with an estimated molecular mass of 27. 68kD, and a 3' UTR of 255bp. The searches for nucleotides and protein sequence similarities with BLAST analysis indicated that the deduced amino acid sequence of cobia IL-1� was homologous to the IL-1� in another fish species and even the mammalian. Conserved signature sequences of IL-1� gene family and several potential glycosylation sites were found in the cobia IL-1� deduced amino acid sequence. Analysis with the Signal P software revealed that there was no signal peptide in the sequence, which was common with the other known IL-1� molecules. Just as other nonmammalian IL-1� genes sequenced to date, the sea perch IL-1� lacked an aspartic acid in cut region of mammalian IL-1� which was required for cleavage by ICE (interleukin-1 converting enzyme). The temporal expressions of IL-1� gene in cobia were measured by semi-quantitative RT-PCR. The mRNA transcripts of IL-1� could be detected in most of the examined tissues including head-kidney, spleen, liver, brain, gill and heart. The IL-1� expression in most of examined tissues of cobia was up-regulated by the stimulation of LPS, but the expression varied in different tissues. The expression was the highest in kidney. The result indicated that sea perch IL-1� was a constitutive and inducible acute-phase protein that play a critical role in the host-pathogen interaction.	Qui, L., Feng, J., Jiang, S., Zhang, H., Song, L.	Journal of Fishery Sciences of China 12, 119–125	2005	Genetics Molecular
471	Combined effect of O2 scavenger and antimicrobial film on shelf life of fresh cobia (<i>Rachycentron canadum</i>) fish steaks stored at 2 �C.	The present study was carried out to understand the combined effect of O2 scavenger (OS) and antimicrobial film (AM) in extending the shelf life of fresh cobia (<i>Rachycentron canadum</i>) fish steaks stored at 2 �C in a plastic pouch of multilayer film of ethylene-vinyl alcohol. The chitosan based film containing ginger essential oil as an active antimicrobial agent was used as primary wrap for fish steaks. During storage, a significant (p < 0.05) reduction in the rate of total volatile base nitrogen formation and lipid oxidation as indicated by thiobarbituric acid value was observed for fish steaks wrapped with antimicrobial film and packed with O2 scavenger (OSAM). There was a lag phase of 5 days observed for total mesophilic count of OSAM compared to control sample. The limit of 7 log cfu g-1 of total mesophilic count was exceeded by control sample on 15th day of storage. OS application significantly reduced the growth of aerobic Pseudomonas spp. and AM film showed good inhibition against lactic acid bacteria and Brochothrix thermosphacta. Sensorily, the OSAM cobia steaks was acceptable up to 30 days compared to 15 days for samples in the control pouch.	Remya, S., Mohan, C.O., Venkateshwarlu, G., Sivaraman, G.K., Ravishankar, C.N.	Food Control 71, 71–78. doi:10.1016/j.foodcont.2016.05.038	2017	Food Safety
472	Mass culture of the harpacticoid copepod <i>Tisbe biminensis</i> fed inert diets.	This paper aims to improve the culture techniques and test different diets for the harpacticoid copepod <i>Tisbe biminensis</i> . <i>T. biminensis</i> was cultured in plastic trays with 15 L of seawater. The tested diets were: Alcon Basic� (control diet); an experimental diet for <i>Rachycentron canadum</i> juveniles Op0 (ED); a commercial diet for post-larvae and fingerlings of omnivorous fish Nutripeixe AL55� (FD); and a commercial diet for post-larvae of marine shrimp Camaronina CR1� (MSD). The ED diet differed from the control by exhibiting a decrease of 47% of offspring production during the exponential phase of population growth. The MSD diet was poorer in comparison to the control diet both in total numbers, during the stationary phase, as well as in offspring production. The FD performance was similar to the control diet. The results of the daily production and the satisfactory acceptance of the different diets make production feasible and can allow the continuous production <i>T. biminensis</i> to be tested as live feed in marine larvicultures.	Ribeiro, A.C.B., Souza-Santos, L.P.	Blue Biotechnology Journal; Hauppauge 2, 583–593	2013	Culture
473	Acute responses of juvenile cobia <i>Rachycentron canadum</i> (Linnaeus 1766) to acid stress.	Fish are potentially submitted to water acidification when reared in recirculating aquaculture systems. This study evaluated the responses of juvenile <i>cobia Rachycentron canadum</i> after acute exposure to acid water. Juvenile cobia (12.6 � 0.5 g; 14.2 � 0.2 cm) were acutely exposed to four pH levels (7.9 (control), 6.5, 6.0, and 5.5). After 24 h of exposure to different pH values, fish were sampled for physiological and histopathological evaluation. Acid water affected physiological parameters and induced morphological histopathologies on gill and skin of juvenile cobia, and these effects were more conspicuous with decreasing pH values. Acid stress induced blood acidosis in juvenile cobia, coupled to a decrease in bicarbonate (HCO3-) and saturated O2 (s O2) in fish blood. On the other hand, haematocrit, haemoglobin and glucose concentration increased their values (P < 0.01) comparing to control level. Hyperplasia with completely fusion of secondary lamella was observed in all pH treatments (6.5, 6.0 and 5.5), while telangiectasia and proliferation of chloride cells were present for fish exposed to pH 6.0 and 5.5. In skin hyperplasia and hypertrophy of mucous cells, necrosis of these cells for fish exposed to pH 6.0 and 5.5 was observed. The results of this study demonstrate that acute acid water exposition affected physiology and histopathology in juvenile cobia, especially at pH values below 6.5. Accordingly, particular attention must be given to pH during cobia reared in recirculating aquaculture.	Rodrigues, R.V., Pedron, J. dos S., Romano, L.A., Tesser, M.B., Sampaio, L.A.	Aquaculture Research 46, 1241–1247. doi: 10.1111/are.12282	2015	Fish Health Culture

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
474	On mtDNA cytochrome b gene sequence variation of cobia (<i>Rachycentron canadum</i>).	<p><i>Rachycentron canadum</i> is a species widely distributed in warm waters of the bottom of the Atlantic, Indian and western Pacific. It is also a kind of important economic fish. For a long time, affected by natural and human factors, the number of wild <i>Rachycentron canadum</i> has decreased sharply. In order to provide valuable and referable data for the making of <i>Rachycentron canadum</i> conservation policy and for management of the shrinking population, researches on genetic diversity needs to be started. In this study, 883 bp mtDNA cytochrome b sequences from 34 individuals collected from Lianyungang (LYG, n = 11), Zhoushan (ZS, n = 8), Fangcheng (FC, n = 15) were sequenced. Results were as follows:</p> <ol style="list-style-type: none"> Genetic diversity: Five variable sites detected in aligned sequences defined six haplotypes, the average haplotypes (h) and nucleotide diversity (π) were 0.324 and 0.0004 respectively, indicating a low genetic diversity. LYG contained the highest values of genetic diversity, the haplotype and nucleotide diversity were 0.473 ± 0.162 and 0.00057 ± 0.00593 respectively, whereas ZS showed no genetic variation. Genetic differentiation: Pairwise FST from LYG to ZS and FC were 0.029 (P = 0.00) and 0.042 (P = 0.00) respectively, and FST between ZS and FC was -0.04803 (P = 0.00), indicating that there was only relatively low differentiation between LYG and the other two populations, and no obvious differentiation was found in ZS and FC. Analysis of Molecular Variance (AMOVA) showed that most of genetic variation in three populations distributed within populations. This may be due to the fact that the East China Sea, South China Sea and the Yellow Sea have continuity, which promotes groups of communication between genes. Chinese offshore <i>Rachycentron canadum</i> showed low genetic diversity (Hd = 0.324 ± 0.103, π = 0.0004), and FST, AMOVA and TCS network showed no genetic variation and no obvious geographical pattern system within populations. Population expanding: The haplotype network was star-like, Tajima's D and Fu's Fs values in three populations of combined neutrality tests were significantly negative (FST = -1.92240, P < 0.00; FST = -5.735, P < 0.00), indicating that cobia in coastal waters of China had experienced populations expansion in history. According to observed τ value (0.364), the deduced population expansion of Cobia occurred about 3.1 - 1.2 million years ago, in last glacial of the maximum. We can speculate that these three groups maybe belong to the same population, for their geographic genetic differentiation was not obvious. It should be noted that these results do not exclude the possibility of difference in other regions for the number of geographic populations and samples is small. In order to understand and assess the genetic diversity of <i>Rachycentron canadum</i>, we need to use AFLP fingerprinting, microsatellite DNA and relevant techniques, which can understand the genetic differentiation of <i>Rachycentron canadum</i> and provide a theoretical basis for the protection of wild germplasm. 	Ruan, Y., Zhou, W., Li, G., Zhang, Q.	Marine Fisheries 36, 97–101	2014	Genetics Molecular Wild (Pacific)
475	Fecundity and spawning frequency of Cobia, <i>Rachycentron canadum</i> (Linnaeus, 1766) from the North West coast of India.	An attempt has been made to provide some vital aspects on spawning frequency and fecundity of Cobia based on the samples collected from fishery exploratory surveys and from the landing centers at Mumbai. Frequency of spawning was determined based on the modes of ova diameters in the mature ovaries. The Ova Diameter study indicated that Cobia follows a protracted spawning season with the individual spawning more than once in a season. Absolute fecundity estimated ranged from 1,231,630 to 1,800,350 numbers. Fecundity index obtained was from 2,123 to 2,372 eggs per gram ovary weight. The results obtained in the present study were compared with similar studies round the world and discussed.	Sajeevan, M.K., Kurup, B.M.	Indian Journal of Geo-Marine Sciences 45 (8), 933-936	2016	Wild Spawning
476	Distribution, abundance and sustainable yield of cobia <i>Rachycentron canadum</i> (Linnaeus 1766) occurring in Indian waters.	<i>Cobia Rachycentron canadum</i> (Linnaeus 1766) is distributed widely in tropical and subtropical waters except in the eastern Pacific and the Pacific plate. Information on the distribution and abundance of cobia in Indian waters are limited. Results of the present study provided first hand information on the spatio-temporal distribution and biomass of the cobia along the east and west coast of India. Exploratory fishing data collected by the resource survey vessels along both east and west coasts for a period of January 1980 to December 2007 were utilised for this study. Results revealed that cobia occur along both east and west coast of India and are abundant along the northern latitudes of both coasts. Bathymetrically, they were caught between 33-229 m and found to be more abundant in near shore waters i.e. depth zone 30-50 m. Results of the present study indicated that cobia were caught along both east and west coast throughout the year. The present study estimated the potential yield of cobia from Indian waters as 798.66 tonnes.	Sajeevan, M.K., Kurup, B.M.	Asian Fisheries Science 27, 274–285	2014	Wild
477	Microsatellite polymorphism in Iranian populations of cobia (<i>Rachycentron canadum</i> G.).	Genetic divergence within and between wild populations of cobia, <i>Rachycentron canadum</i> (L.) was assessed by means of microsatellite analysis in the Persian Gulf and Oman Sea. Ten microsatellite markers were used to estimate the level of genetic diversity within six wild populations of cobia and the degree of genetic differentiation between them was compared. Mean observed and effective allele number was 12.357 and 8.319, respectively. Mean observed and expected heterozygosity was 0.655 and 0.874, respectively. Based on Analysis of Molecular Variance highest F-statistics (0.063) was observed when comparing specimens from Dayer Port zone and Pozm of Chabahar zone. Highest genetic distance (0.258) and lowest genetic resemblance (0.223) were observed between specimens from Dayer Port zone and Beris of Chabahar zone. The present study showed that at least three different populations of <i>Rachycentron canadum</i> were found in the northern coasts of Persian Gulf and Oman Sea. © 2008 Asian Network for Scientific Information.	Salari Aliabadi, M.A., Rezvam Gilkolaei, S., Savari, A., Zolgharnein, H., Nabavi, S.M.B.	Biotechnology 7, 775–780. doi:10.3923/biotech.2008.775.780	2008	Genetics Molecular Wild
478	Investigations on the incidence of cystic calculus in female cobia <i>Rachycentron canadum</i> (Linnaeus, 1766) broodfish leading to spawning failure and mortality.	The morphological, chemical and high resolution electron microscopic analysis of a cystic calculus (urinary bladder stone) from a ready-to-spawn female broodfish of cobia <i>Rachycentron canadum</i> (Linnaeus, 1766) is reported. The stone was elliptical in shape with 31 mm dia having chalky, amorphous and fragile consistency with several concentric major layers covering the core. Chemically the stone was uniform in composition with 52.63% calcium oxalate monohydrate (COM), 31.58 % uric acid and 15.70% hydroxyapatite (HAP). However, the peripheral layer differed significantly from the middle and the core in elemental composition. Ultrastructurally, each of the individual layers were made of multiple finesub-layers. Additionally, all the layers/portions of the stone displayed a hard, coral-like structure entrapping spherical sacs and contained isolated and fused spherules inside and outside the sacs. However, hexagonal forms of COM crystals were unique to the peripheral layers. While the obstruction of the oviduct due to the large sized stone was probably the cause of spawning failure. Continuous but futile contraction of the musculature during the unsuccessful spawning effort might have caused energy exhaustion and ultimate death of the animal.	Samal, A.K., Nazar, A., Jayakumar, R., Tamilmani, G., Sakthivel, M., Rameshkumar, P., Gopakumar, G.	Indian Journal of Fisheries 62, 144-148	2015	Spawning Fish Health
479	Sensory, biochemical, and microbial qualities of canned farmed cobia processed with Indian spice masala mix.	Farmed cobia (<i>Rachycentron canadum</i>) was processed with Indian spice masala mix and examined for sensory, biochemical, and microbial qualities during storage at $30 \pm 2^\circ\text{C}$. The shelf life of canned cobia was 12 months, and it was microbiologically safe from anaerobia clostridia. The slight acidic pH and high water activity provided juiciness and softness to the product. The changes in fatty acids revealed that there was a remarkable increase in C18:2 and C18:3; whereas the omega-3 fatty acids, C20:5, resulted in a 50% loss. The omega-6:omega-3 ratio of the product was found to be 0.07.	Shakila, R.J., Raj, B.E., Felix, N.	Journal of Aquatic Food Product Technology 24, 330–339. doi:10.1080/10498850.2013.775210	2015	Food Safety
480	First report of isolation and characterization of <i>Photobacterium damsela</i> subsp. <i>damsela</i> from cage-farmed cobia (<i>Rachycentron canadum</i>).	[Short communication, No Abstract Available]	Sharma, S.R.K., Pradeep, M. A., Sadu, N., Dube, P.N., Vijayan, K.K.	Journal of Fish Diseases n/a-n/a. doi: 10.1111/jfd.12557	2016	Fish Health Cage Culture
481	Characterization of chemical composition of cage cultured cobia (<i>Rachycentron canadum</i>).	Cobia is an important offshore cage culture fish in Taiwan. The factors influencing its chemical compositions were investigated in this study. An extraordinary feature present in cobia was that its meat accumulated a high amount of fat. The fat content in the ventral meat was 2 times higher than that of dorsal meat in the same fish. There was remarkable variation in fat among different size of fish. The amount was significantly and positively correlated with fish size. The predominant free amino acids (FAA) were taurine (Tau), glycine, alanine and glutamic acid. The FAA tended to decrease gradually as fish size increased. A dipeptide, anserine (Ans), was detected in the meat of cobia. Among ATP-related compounds (ARC), inosine monophosphate (IMP) was the most predominant compound. The amount of IMP in dark meat and viscera were much lower than that in ordinary meat. Both ARC and IMP had no significant correlation with fish size. The wild cobia had higher moisture content than that of cultured fish; however, the fat in dorsal or ventral meat of the former was significantly lower than the latter. The content of Tau in wild cobia was higher than cultured fish. Ans level was not significantly different between wild and cultured cobia. However, another dipeptide, carnosine was detected only in wild fish. The seasonal variations of fat and taste compounds such as FAA and ARC showed that the cobia was probably more tasty at August to December. This fish was more easily spoiled than other fish. The pH value in white muscle was usually lower than 6.0, which is similar to that of pelagic fish. The drastic degradation of ATP and AMP occurred at the initial 3 hour of storage at 4 degree C, and IMP accumulated. The rapid degradation of IMP to inosine and hypoxanthine took place, after decomposition, and hypoxanthine became the dominant compound. The K value of 27% was proposed as the limit of quality acceptability. Conclusively, due to its good taste and high lipid content, this fish is suitable for serving as sashimi (raw fish), roasted, and smoked products.	Shiau, C.-Y., Lin, R.-T., Li, Y.-L., Chiou, T.-K.	6th Asian Fisheries Forum Book of Abstracts. Presented at the Asian fisheries : diversification and integration, Asian Fisheries Society, Unit A, Mayaman Townhomes 25 Mayaman Street UP Village, Quezon City Philippines, p. 338.	2001	Fish Health Nutrition
482	Morphological studies on the development of lymphoid organs in cobia <i>Rachycentron canadum</i> .	Histological and histochemical methods were applied to study the development of the head kidney, spleen and thymus in cobia <i>Rachycentron canadum</i> , during 1~44 day post-hatch (dph). The pronephric ducts were first observed, near which some primordial haemopoietic stem cells were observed 3 d later. The haemopoietic stem cells gradually differentiated into erythrocytes and large lymphocytes. The spleen developed later, and soon became rich in blood capillaries and erythrocytes, but had only a few macrophage. The thymus was the last lymphoid organ appeared but developed very quickly. An outer zone and inner zone in the thymus could be observed clearly. It was concluded that the sequence of appearance of lymphoid organs, from first to last, was head kidney, spleen and thymus. Before the small lymphocytes developed, cellular types involved in non-specific immunity mechanisms, such as macrophage and reticular cells, were observed in the lymphoid organs. The respective lymphoid organ anlage became thymus, head kidney and spleen successively. No plasma cells were observed in the samples, indicating that the lymphoid organs were not fully grown during this period.	Su, You-lu, Feng, J., Guo, Z., Xu, L., Wang, J., Liu, P. G., Wang, R.	Progress in Fishery Sciences 29, 7–14	2008a	Fish Health Physiology
483	Morphological studies on development of mucosal immune tissues in cobia <i>Rachycentron canadum</i> .	Methods of histology and histochemistry were applied to study the development of the mucosal immune tissues in cobia (<i>Rachycentron canadum</i>), from the first to the 44th day post-hatchery (dph). The results showed that the leucocytes appeared in mucosal immune tissues in the order of gill, skin, stomach and intestine. At 3rd dph, macrophage-like cells were first detected in the base of gill filament and lamella, and 3 days later, macrophages or lymphocytes appeared in the lamina propria of stomach and the epidermis dermis of skin. However, only a few lymphocytes were found in the lamina propria of intestines after 9th dph. When the fish were exposed to a great deal of antigen, the leucocytes appeared in the mucosal immune tissues followed the same time order as above. Abundant leucocytes distribution in gastric lamina propria suggested stomach play an important role in mucosal immunity just like intestines. The mucous cells were first observed in stomach at 6th dph, but they were not observed in skin and intestines until 8 days later, and the gill was the last mucosal immune tissues where mucous cells appeared. In addition, a large number of mucous cells like gland on the base of gill lamella were observed at 44th dph. It was proved by AB-PAS staining that mucous cells in stomach began to secrete mucus 3 days later than those cells appeared. Similarly, the mucus was secreted much later in skin and intestines. Unlike stomach, skin and intestines, the mucus had been secreted before the mucous cells appeared in gill lamell. The neutral or acidic mucus was detected on the base of gill lamell at 34th dph, but the mucous cells were not found then. The quantity of mucus increased gradually with the development of the fish. Plasma cells were not observed in mucosal immune tissues among the samples we collected. Although B lymphocytes were not mature, the mucosal tissues had possibly acquired immunity. It was suggested that the mucosal tissues possess the cell base of immune response according to the development of leucocytes distribution in them.	Su, You-lu, Guo, Z., Xu, L., Kong, X., Yu, B., Wang, J., Feng, J.	Journal of Fishery Sciences Of China 15, 644–651	2008b	Fish Health Physiology

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
484	Morphological and histological observations of digestive system of cobia <i>Rachycentron canadum</i> .	The morphology and histology of the digestive system of <i>Rachycentron canadum</i> was studied using anatomy and light microscope. The results showed that the digestive tract in <i>R. canadum</i> was consisted of buccal-pharynx cavity, esophagus, stomach, pyloric caeca, foregut, midgut and hindgut. The buccal-pharynx cavity was large, and its mucosa was composed of stratified squamous epitheliums with a few goblet cells. The esophagus was very short, and stratified and simple columnar squamous epitheliums were identified. The stomach was expanded and Y-shaped and many goblet cells were observed in the epitheliums of cardiac stomach and pyloric stomach. Many gastric glands cells were found under the mucosa of the stomach. The pyloric caeca were very developed, and the intestines was short and divided into three parts: foregut, midgut and hindgut. The average intestinal coefficient of <i>R. canadum</i> was calculated, which was about 0.43. From foregut to hindgut, the number of goblet cells and intestinal villus reduced gradually. The digestive glands were composed of liver and pancreas. The liver lobule was not clear but its hepatic cells were rich in fat. Pancreas was diffused and the exocrine section of pancreas was consisted of many pancreatic acinar cells. The pancreas islets were located in the exocrine section.	Su, Youlu, Sun, X., Feng, J., Guo, Z., Xu, L., Wang, J.	South China Fisheries Science 4, 88–94	2008	Fish Health Physiology
485	Study on the morphology of peripheral blood cells of juvenile cobia <i>Rachycentron canadum</i> .	The peripheral blood was collected from cobia (<i>Rachycentron canadum</i>) on the 60th day after hatching, and blood cells were studied by light microscope. Five types of blood cells were observed as follow: erythrocyte, lymphocyte, monocyte, neutrophil and thrombus cells. The erythrocyte counts and leukocyte counts of cobia was (2.97±0.82)×10 ⁹ ind·mL ⁻¹ and (1.39±0.94)×10 ⁶ ind·mL ⁻¹ , respectively. The percentages of lymphocytes, neutrophils, monocytes and thrombocytes in total leucocytes, were (53.00±8.51)%, (17.59±4.28)%, (4.78±1.37)% and (24.63±4.08)%, respectively. Neither eosinophil nor basophil was found. The quantity of erythrocytes was much larger than that of leucocytes. Among the leucocytes, the lymphocytes were the most abundant, while that of monocytes was the least. The immatured and dividing erythrocyte were found. The small lymphocytes with pseudopod and large lymphocytes with the villus were observed also. In addition, the monocyte, neutrophil and thrombu cells were recognized by different shapes of nucleolus.	Su, Y., Xu, L., Feng, J., Guo, Z., Wang, J.	South China Fisheries Science 3, 48–53	2007	Physiology
486	Sterilization and quality effects of ozone water on cobia filets.	In order to study the sterilization and quality effects of ozone water on cobia filets, flowing ozone water at various concentrations of 4 mg·L ⁻¹ , 5 mg·L ⁻¹ , 6 mg·L ⁻¹ and 7 mg·L ⁻¹ was experimented to screen the optimal condition at 15 °C. Comparing the effects of sterilization ratio, sensory evaluation and color difference in different groups, we find that the treatment with 7 mg·L ⁻¹ flowing ozone water for 10 min on cobia filets gets a better sterilization ratio of 81.12% without reducing the quality.	Sun, J., Wu, Y., Yang, X.-Q., Ma, H.-X., Deng, J.-C., Hu, X., Zhou, W.-J.	South China Fisheries Science 9, 66–71	2013	Food Safety
487	Controlling freezing point of cobia by using freezing point regulators.	We investigated the effect of three kinds of freezing point regulators including CaCl ₂ , NaCl and VC on cobia (<i>Rachycentron canadum</i>) by single factor comparison experiment. 4% CaCl ₂ treatment for 60 min decreased freezing point to -1.21 °C; 2% NaCl treatment for 90 min decreased freezing point from -1.01 °C to -1.36 °C; 0.5% VC treatment for 30 min decreased freezing point to -1.30 °C. Orthogonal experiment was conducted to determine the best proportion between NaCl and VC. The results show that treatment with 3% NaCl and 0.3% VC for 60 min decreased freezing point by 60.4%, from -1.01 °C to -1.62 °C.	Sun, J.-Y., Wu, Y.-Y., Yang, X.-Q., Ma, H.-X.	South China Fisheries Science 10, 86. doi:doi:10.3969/j.issn.2095-0780.2014.02.013	2014	Food Safety
488	Effects of ration and temperature on growth and nitrogen budget of young cobia <i>Rachycentron canadum</i> .	Growth and nitrogen budget of young cobia (initial body weight 28g or so) at different ration levels (from starvation to satiation) for different feed types (i.e. NSF-natural sardine fish, CEFF-commercial eel formulated feed and CMFF-commercial marine-fish formulated feed) were studied, and the relationships between growth as well as nitrogenous excretion and ration were established in this paper. The results showed that as ration increased specific growth rate (SGR) of young cobia increased with a decelerating pattern for NSF and CEFF and with a linear pattern for CMFF. Among three feed type groups young cobia had a similar SGR between NSF and CEFF, but the SGR for NSF and CEFF was much higher than that for CMFF. As ration increased feed conversion efficiency (FCE) of young cobia increased or first increased then decreased and maximized at satiation or sub-satiation ration for NSF and CEFF, and increased along and maximized at satiation ration for CMFF. Among three feed type groups feed conversion efficiency in dry weight and nitrogen for NSF was highest, second for CEFF and both were much higher than that for CMFF. Food nitrogen (CN), feces nitrogen (FN), growth nitrogen (GN) and excretion nitrogen (UN) all increased with increased ration for three feed types. CN, GN and UN for NSF and CEFF were much more than those for CMFF, but FN for CMFF was the most, second for CEFF and both were much more than that for NSF. The nitrogen budgets at satiation and sub-satiation ration for NSF, CEFF and CMFF were 100CN = 1.1 (0.9) FN + 22.0 (22.3) GN + 71.9 (62.8) UN, 100CN = 2.2 (2.3) FN + 22.0 (22.7) GN + 62.8 (62.0) UN and 100CN = 2.9 (2.4) FN + 21.6 (10.1) GN + 62.5 (81.5) UN (the data in bracket expressed those at sub-satiation ration), respectively. Both the proportions of feed nitrogen lost in feces and the variations of the proportions for three feed types were small. For NSF and CEFF at sub-satiation ration the proportion of feed nitrogen stored as growth was a little more than and the proportion of feed nitrogen lost in nitrogen was a little less than those at satiation ration, but for CMFF at satiation ration the proportion of feed nitrogen stored as growth was much more than and the proportion of feed nitrogen lost in nitrogen was much less than those at sub-satiation ration. So, nitrogenous excretion and nitrogen budget of young cobia were affected obviously by both ration level and feed type, and increased feed nitrogen was the major reason for the increased excretion nitrogen no matter what feed was used. Based on the specific growth rate, feed conversion efficiency, nitrogenous excretion and nitrogen budget it could be concluded that NSF was proposed as the preference for the diet choice in cobia artificial breeding and CEFF secondly. Ration level with the range 70% - 100% of satiation ration was thought suitable for cobia artificial breeding at this growth stage when fish fed on NSF and CEFF and only satiation ration on CMFF.	Sun, L., Chen, H.	Journal of Tropical Oceanography 33, 37–44	2014	Fish Health Nutrition
489	Effects of ration level and feed type on growth and nitrogen budget of young cobia (<i>Rachycentron canadum</i>).	Effects of ration (from starvation to satiation) and temperature (21 °C, 27 °C and 31 °C) on growth and nitrogen budget of young cobia (initial body weight about 10g) were studied, and the relationship between specific growth rate (SGR) and ration as well as temperature and the nitrogen budget were established in this paper. The results showed that at a given temperature, as ration increased, SGR increased significantly, exhibiting a linear pattern described as a simple function at 33 °C whereas a decelerating pattern described as a logarithmical equations at 27 °C and 21 °C. At a given ration, except for starvation, as temperature increased, SGR increased or first increased then decreased, all described as quadric functions. At a given temperature, as ration increased, feed conversion efficiency (FCE) increased at 21 °C and 33 °C whereas first increased then decreased at 27 °C. At a given ration (except for the starvation), as temperature increased, FCE increased or first increased then decreased and peaked at 27 °C for fish fed restricted food while there was no significant difference between 27 °C and 33 °C though FCE peaked at 33 °C for fish fed satiation. Over the experimental ration and temperature range excretion nitrogen of young cobia increased significantly with increasing ration and temperature.	Sun, L., Chen, H., Huang, H., Huang, L.	Journal of Tropical Oceanography 29, 94–101	2010	Fish Health Nutrition
490	A primary study on feeding technique of cobia (<i>Rachycentron canadum</i>) during artificial breeding.	Suitable feeding schedule and ration level for young cobia (<i>Rachycentron canadum</i>) weighing about 10g were established by studying their diel feeding rhythm and body composition, specific growth rate and food conversion efficiency at different ration levels. An obvious diel feeding rhythm of young cobia was observed. Feeding mainly proceeded by day and was most active during the periods of 06:00–08:00 and 18:00–20:00, forming two feeding peaks in a day. Feeding decreased remarkably in the darkness of night and no feeding happened during the period of 00:00–04:00, which formed a feeding vale in a day. Thus it could be seen that the feeding rhythm of young cobia was characterized by daytime feeding and inclined to twilight feeding. Five ration levels (RL) were set as follows: starvation, 3%, 6%, and 9% of initial body weight per day, and satiation. The protein and lipid contents in the body of young cobia generally increased with increased ration, with a marked decrease of lipid content at 6% ration and no significant difference of protein content from 3% to satiation ration. The relationship between ration level and specific growth rate in wet weight (SGR _w), dry weight (SGR _d) and protein (SGR _p) was a decelerating curves described as SGR _w = 3.876ln (RL+1) - 3.716, SGR _d = 5.107ln (RL+1) - 5.248, and SGR _p = 5.561ln (RL+1) - 5.609 respectively, and there was no significant difference of SGR _w , SGR _d and SGR _p between 9% and satiation ration. The specific growth rate in lipid (SGR _l) increased linearly as ration increased, described as SGR _l = 1.731RL - 7.702. Food conversion efficiencies in wet weight, dry weight and protein showed a domed curve as ration level increased and maximized at 9% ration, which was regarded as the optimum feeding level in our experimental conditions and amounted to 70% of maximal ration level (RL _{max} , 12.87% per day). So the suitable feeding schedule for young cobia should proceed in daylight, especially at the two feeding peaks, and the suitable feeding level for young cobia fed on a commercially formulated feed at this growth stage amounted to about 70% of RL _{max} .	Sun, L., Chen, H., Huang, L., Wang, Z., Yan, Y.	Journal of Tropical Oceanography 25, 24–30	2006a	Fish Health Nutrition
491	Effect of salinity on embryonic and larval development of cobia (<i>Rachycentron canadum</i>).	The sinking and floatation of fertilized eggs and the hatching rates and abnormal rates of eight broods of fertilized eggs under different salinities (20, 23, 26, 29, 32, 35, 38, 41 and 44) were observed and compared, and the SAI (survival activity index) values of larvae were evaluated under different salinities (10, 14, 18, 22, 26, 30, 34, 38, 42 and 44) for cobia. The results showed that the fertilized eggs entirely sank in the seawater with salinity lower than 26, and entirely floated in the seawater with salinity higher than 32. The suitable salinity for hatching was from 26 to 41 and the optimum was from 29 to 38. The ranges of 23~26 and 41~44 might be two critical salinity causing notable differences in hatching rate of fertilized eggs and abnormal rate of newly hatching larvae. The SAI values of cobia larvae in different salinities were 2.32~16.24. The suitable salinity range for larvae survival activity was 22~38 and the optimum was 26~34 according to SAI values. The salinities from 18 to 22 and from 38 to 41 might be two critical ranges causing notable differences in SAI values.	Sun, L., Chen, H., Wang, Z.	Ecological Science 25, 48–51,55	2006b	Culture Spawning Hatchery
492	Alimentary canal contents of cobia (<i>Rachycentron canadum</i>) larvae cultured in ponds.	The species, numbers and sizes of the alimentary canal contents of cobia larvae of 1~20 days after hatching (DAH) cultured in ponds were studied by anatomization and observation with optical anatomical lens. The results showed that the first-feeding occurred on 2 DAH, and preyed mainly on copepod nauplius, larval copepod and cladocera, the recipe was chiefly composed of copepod, and large zooplanktons. Larval shrimp and crab could also be fed from 13 DAH. There was significant difference in food selective indexes between the two stages.	Tang, B., Chen, G., Shi, G., Wu, Z.	Journal of Zhanjiang Ocean University 26, 12–16	2006	Culture Hatchery
493	Effect of diet series on growth, activity of digestive enzymes and body composition of larval cobia, <i>Rachycentron canadum</i> .	Diet is one of the most important conditions during fish early stage especially for marine fishes, and it changes continuously as the fish develops. The experiment was conducted to evaluate the effect of different diets on cobia larvae and acquire the optimal diet combination. The eggs were hatched in a 750 L tank in which larvae were stocked for 2 days, then larvae were cultured in a concrete pool on for 4 days (3 - 6 DAH), feeding on rotifers. On 7 DAH, 240 larvae were transferred randomly to twelve 70 L tanks with 20 larvae per tank labeled group I, group II, group III and group IV (3 tanks per group). During 7 - 15 DAH, the larvae were fed with rotifers, artemia nauplii, copepods and copepods respectively; during 16 - 42 DAH, with rotifers, artemia nauplii, copepods and fish meal respectively. On 42 DAH, all larvae were sampled, weighed and store in - 80 °C. Crude digestive enzymes were produced from the supernatant by centrifuging homogenized solution of the fish bodies, and the activities of protease, amylase and lipase were analyzed. At the same time, body composition, as well as growth indices of larval cobia were determined. The results showed that: (1) the growth performance of group IV was the best; (2) the survival of group III was the highest; (3) the activities of digestive enzymes and body composition were extremely affected by diet; (4) the protease activity of group III, amylase and lipase activity of group I was the highest respectively among the 4 groups, and group I was highlighted for its 6.8 - 11.9 times higher amylase activity than other groups; (5) the crude protein contents of fish bodies were lower than them of corresponding diets, on the contrary, crud fat contents of fish bodies were higher than them of diets. So, there might be compensatory secretion of digestive enzymes, and glucide & fat were utilized preferentially for chronically hungered larvae with fat being more effectively deposited than protein for larval cobia.	Tang, B.-G., Chen, G., Zhang, J.-D., S. H. I., G., W. U., Z.-H.	Acta Hydrobiologica Sinica 31, 479–484	2007	Culture Fish Health Nutrition
494	Genetic characteristics of <i>Streptococcus dysgalactiae</i> isolated from cage cultured cobia, <i>Rachycentron canadum</i> (L.).	Disease outbreaks occurred during 2007–2013 in Taiwan with 2.5–10% mortality among the cage cultured cobia, <i>Rachycentron canadum</i> (L.), characterized by the presence of polyserositis, pericarditis and peritonitis. The micro-organisms isolated from internal organs were Gram-positive cocci. The isolates were confirmed as <i>Streptococcus dysgalactiae</i> by a polymerase chain reaction assay that yielded the expected specific 259 bp amplicon. Additionally, partial sequence of the 16S–23S rDNA intergenic spacer region of the GCS strain isolates from fish was also compared and produced 100% sequence identity with <i>S. dysgalactiae</i> (GenBank accession number AB252398). The genetic characterization was then determined by pulsed-field gel electrophoresis (PFGE) analysis. Based on PFGE, the Apa I or Sma I digestion patterns of chromosomal DNA of these isolates were grouped into three main clusters. Taiwanese strains were divided into two clusters, and the tet(M) gene was detected in cluster 1 (pulsotypes: A1–A2 and S1–S3), but not in cluster 2 strains (pulsotypes: A3–A4 and S4–S5). Three Japanese strains from amberjack, <i>Seriola dumerili</i> (Risso), were grouped into cluster 3 (pulsotypes: A5–A7 and S6–S8) and displayed no mortality to cobia in the challenge experiment. Conversely, Taiwanese strains from cobia and snubnose pompano, <i>Trachinotus blochii</i> (L.), displayed a mortality rate of 50–87.5% in cobia.	Tsai, M.-A., Wang, P.-C., Yoshida, T., Chen, S.-C.	Journal of Fish Diseases 38, 1037–1046. doi:10.1111/jfd.12289	2015	Genetics Molecular Fish Health Cage Culture
495	Estimation of pellet feeding rate of cobia <i>Rachycentron canadum</i> in culture tanks under video monitoring.	Pellet feed loss is a major concern in sea cage culture. Underwater camera connected to a TV recording system for estimating pellet feed loss was employed in the tank experiments of cobia <i>Rachycentron canadum</i> . The results showed that fish in camera-monitored tank gave better control and a lower rate of pellet loss. The average improvement was approximately 10%. It is also concluded that subsurface-feeding activities is a better indicator of satiety in cobia culture.	Ueng, P.-S., Yu, S.-L., Ou, C.-H.	Journal of the Fisheries Society of Taiwan 29, 67–71	2002	Cage Culture

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
496	Reproductive biology of <i>Rachycentron canadum</i> in the Persian Gulf (Hormozgan Province waters).	We collected 478 specimens of <i>Cobia</i> , <i>Rachycentron canadum</i> , from Hormozgan province waters during October 2005 till September 2006, and studied reproductive parameters such as spawning season, sex ratio, maturity stages, fecundity and ova diameter. The maturity and spawning season were investigated through macroscopic and microscopic (ovarians histology) observation. Studying average Gonado-Somatic Index (GSI), the percent of maturity stages and ova diameter average changes revealed that the spawning occurred from July to the beginning of September. The total male to female sex ratio was 1.3:1.0 which was significantly different from the normal ratio, 1:1 (P<0.05). The highest sex ratio difference was seen in April. The average absolute fecundity was 1,684,954 eggs. Our records indicated that the maximum ova diameter was 0.575 mm belonging to the stage 4 and the minimum was estimated at 0.250 mm belonging to the stage 2. Ova diameter average increased from April onwards and its peak was in July. We found the <i>Cobia</i> has partial synchronism in oocytes and is a total spawner species.	Valinassab, T., Ashtari, S., Sedghi, N., Daghoghi, B.	Iranian Scientific Fisheries Journal 17, 143–152	2008	Wild Spawning
497	Development of a nutritional model to define the energy and protein requirements of cobia, <i>Rachycentron canadum</i> .	This study assessed the protein and energy requirements of <i>Cobia</i> (<i>Rachycentron canadum</i>) using a bio-energetic factorial approach. Using a series of inter-related studies, several parameters were defined to enable the construction of a bio-energetic factorial model for this species. The studies included two controlled laboratory experiments and also extensive field-data collection from commercial and research farms in Vietnam. The devised model includes parameters for both maintenance and protein demands; the effect of fish live-weight on maintenance protein (LW0.697), lipid (LW0.972), and energy demands (LW0.815); the efficiencies of protein, lipid and energy utilisation at various protein, lipid and energy intake levels; and the variability in whole body composition with varying live-weight. The protein utilisation efficiencies (0.456 · [protein intake] – 0.445), lipid utilisation efficiencies (1.292 · [lipid intake] – 1.120) and energy utilisation efficiencies (0.651 · [energy intake] – 48.41) were similar to other carnivorous fish species. However, the maintenance requirements for both energy (74.3 kJ/kgBW0.8/d – at 28 °C) and protein (0.99 g/kgBW0.7/d at 27.9 °C) were about double to other species. Using this modelling approach it was possible to iteratively derive optimal dietary protein and energy specifications for this species.	Van Tien, N., Chinh, D.T.M., Huong, T.T.M., Phuong, T. H., Irvin, S., Glencross, B.	Aquaculture 463, 193–200. doi:10.1016/j.aquaculture.2016.05.037	2016	Nutrition
498	Antibiotic resistance of vibrio strains isolated from cobia (<i>Rachycentron canadum</i>) farming water and their digestion guts.	Antibiotic susceptibility tests were carried out by K-B diffusion method on 41 vibrio strains isolated for one year both from farming seawater (18 strains) and digestion guts (23 strains) of the cobia, <i>Rachycentron canadum</i> . We chose 10 different species of antibiotics and referred to NCCLS performance standards for antimicrobial susceptibility testing, while taking <i>Staphylococcus aureus</i> ATCC25923 and <i>Escherichia coli</i> ATCC25922 to control the test. Results showed that the most effective antibiotic for inhibiting growth of vibrio strains were Chloramphenicol (percentage of sensitive strains was 100%) and Gentamicin (percentage of sensitive strains from water and intestine was 100% and 90% respectively), followed by Norfloxacin, Compound Sulfamethoxazole Polymyxin B. It also showed that Penicillin G and Ampicillin were non-effective to majority of vibrio strains in the intestine, as 78% and 60% strains resisted to Penicillin G and Ampicillin respectively. Strains from farming water and intestine of cobia showed different sensitivity to the same antibiotic. 4 strains which resisted to 3 or more than 3 species antibiotics were sieved from this study.	Wang, R., Wang, J., Xu, L., Feng, J.	South China Fisheries Science 3, 1–6	2007	Fish Health Pharmacology
499	Annual changes of heterotrophic bacteria and vibrios in intestine and rearing water of maricultured cobia, <i>Rachycentron canadum</i> Linnaeus.	Heterotrophic bacteria and vibrios in intestine and rearing water of cobia farmed in Dapeng County, Shenzhen, Guangdong province, were analyzed annually by 2216E plate smearing and TCBS smearing, respectively. quantities of heterotrophic bacteria and vibrios during early days of breeding ranged from 0.63×10^4 - 6.2×10^4 CFU/mL and 0.30×10^2 - 1.03×10^4 CFU/mL in the rearing water, and 0.80×10^6 - 0.75×10^7 CFU/g and 0 - 1.30×10^7 CFU/g in intestine of the cobia, respectively, in early stage of development. Quantities of heterotrophic bacteria and vibrios were very low at very beginning. When juvenile cobia cultured in the cage, quantities of heterotrophic bacteria and vibrios ranged from 4.20×10^3 - 5.40×10^6 CFU/mL and 0.70×10^2 - 0.14×10^5 CFU/mL in the seawater, and 1.50×10^7 - 8.78×10^8 CFU/g and 1.00×10^7 - 3.50×10^8 CFU/g in intestine of the cobia, respectively. Quantities of heterotrophic bacteria and vibrios in cage - cultured water and intestine of cobia increased rapidly and soon reached their peak numbers. Highest value appeared in September for heterotrophic bacteria and vibrios in the water and July in intestine of cobia. 407 bacterial strains were isolated and identified. Pseudomonas, Xanthomonas and Bacillus were the most dominant species at early stage in the seawater (prevalence of the three genera 70%), and followed by the Vibrio and Photobacterium, Pseudomonas, Xanthomonas, and Bacillus presenting in the water throughout the whole year. Heterotrophic bacteria in intestine of cobia showed well - distributed. Pseudomonas and Bacillus were the most dominant species, and followed by Enterbacteriaceae. Vibrio, Photobacterium, Aeromonas and Microccus were also detected from the intestine of cobia in annual monitor.	Wang, R., Wang, J., Xu, L., Yang, H., Feng, J.	Journal of Fishery Sciences of China 15, 1008–1015	2008a	Cage Culture Pharmacology
500	Antibiotic resistance of heterotrophic bacteria of digestion guts isolated from cobia (<i>Rachycentron canadum</i> Linnaeus) farming waters.	The antibiotic susceptibility tests were carried out by K-B diffusion method on 188 heterotrophic bacteria strains (including 9 genera) isolated for one year both from farming seawater and digestion guts of the cobia. 15 different species antibiotics selected were tested to NCCLS performance standards for the antimicrobial susceptibility test, and <i>Staphylococcus aureus</i> ATCC25923 and <i>Escherichia coli</i> ATCC25922 were controlled in the test. The results showed that the most effective antibiotic for the inhibiting growth of the bacteria was Ciprofloxacin (percentage of antibiotic resistance strains was 0), in the next places were chloramphenicol, norfloxacin, gentamicin, polymyxin B and compound sulfamethoxazole, as the percentage of antibiotic resistance strains were less than 40%. The strains resisted of carbenicillin, penicillin G, ampicillin, furazolidone and rifampin was above 40%. It also showed that 12 strains comprised of 9 strains from the farming water and 3 strains from the intestine of cobia resisted to 4 or greater than 4 species antibiotics.	Wang, R., Xu, L., Wang, J., Liu, X., Feng, J.	Marine Environmental Science 27, 588–591	2008b	Fish Health Pharmacology
501	A genetic analysis of cultured populations of cobia (<i>Rachycentron canadum</i>) with microsatellite markers.	Eight microsatellite loci were employed to elucidate genetic diversity of five cobia (<i>Rachycentron canadum</i>) cultured stocks in the South China Sea (named population HN1, HN2, ZJ, FJ and LS). The result showed as follows: the overall genetic characteristics of the total cultured population were consistent with the wild (the mean allele number was 3.910 ± 0.440 , and mean observed heterozygosity was 0.595 ± 0.049 , and AMOVA revealed the proportion of genetic variation within individual was 46%), and the genetic diversity of cultured populations was moderate with minor decrease. While the obvious deviation from Hardy-Weinberg equilibrium and heterozygote deficiency or excess were observed in each cultured population because of their small founding broodstocks. Although the overall gene flow was obvious for gene flow value Nm was 2.595 9 and the fixation index Fst was 0.087 8, two distinct groups of strains (HN2 and the others) were shown by a population assignment analysis and a phylogenetic tree.	Wang, Z., Chen, T., Guo, Z., Luo, J., Liu, L., Liu, C.	Journal of Zhanjiang Ocean University 30, 16–21	2010	Genetics Wild (Pacific)
502	Effect of dietary L-carnitine supplements on growth and body composition of juvenile cobia (<i>Rachycentron canadum</i>).	A 2x2 factorial design was utilized to test the efficacy of dietary L-carnitine at 0 and 1500 mg/kg diet at lipid levels of 6% and 14%. Juvenile cobia initially averaging (9.67 ± 0.14) g/fish were cultured in a flowing sea water system and fed twice daily at a rate approaching apparent satiation. At the end of the 8-week feeding trial, carnitine administration did not cause any effect on growth and feed efficiency under the experiment conditions. At 14% dietary lipid level, carnitine administration increased fatty acid oxidation and altered liver fatty acids profile, but it wasn't obvious at 6% dietary lipid level.	Wang, Z., Han, T., Tian, L., Wang, Y., Liang, G., Liu, Y.	Journal of Zhejiang Ocean University (Nature Science) 26, 125–131	2007a	Nutrition
503	Impact of three vegetable oil sources on growth, body composition and tissue fatty acid composition of juvenile cobia (<i>Rachycentron canadum</i>).	An 8 - week feeding experiment was conducted to investigate the effects of dietary vegetable oils on growth, body composition and tissue fatty acid profiles of juvenile cobia. Four isonitrogenous diets containing 10% of added marine fish oil (MFO), soybean oil (SO), rapeseed oil (RO) or linseed oil (LO) were fed to triplicate groups of 15 fish (initial body weight: 10.29 ± 0.22 g) grown in sea water at the temperature of 28.9 ± 1.5 °C. After 56 days, growth rates of cobia fed the VO diets were low and probably reflective of a lack of sufficient essential fatty acids. Tissue fatty acid compositions of fish were directly reflected by dietary fatty acid composition, but a selective reserve of essential fatty acids was observed. The percentages of flesh 20: 5n - 3 and 22: 6n - 3 were higher in fish fed VO compared to them in diets. The percentages of flesh 20: 5n - 3 were not significantly different among treatments, while percentages of 22: 6n - 3 were significantly lower in fish fed VO (5.15% - 9.10%) compared to fish fed FO (10.84%). Although 20: 4n - 6 (AA) was scarce in diets containing vegetable oil, AA muscle contents of these fish in LO, SO and RO groups (2.97%, 2.06% and 2.92%, respectively) were higher than their content in the respective diet. The results suggest that juvenile cobia had apparently absolute requirement of dietary DHA, EPA and AA for growth in the present experiment. High deposition of flesh 18: 2n - 6 in fish fed VO is disadvantage for human nutrition.	Wang, Z., Han, T., Tian, L., Wang, Y., Liang, G., Liu, Y.	Journal of Zhejiang Ocean University (Nature Science) 26, 237–245	2007b	Nutrition Fish Health
504	Effects of starvation and compensatory growth on energy budget of juvenile cobia <i>Rachycentron canadum</i> .	The effect of starvation for different days (0, 2, 4, 6 and 8 days) and compensatory growth on energy budget of juvenile cobia (<i>Rachycentron canadum</i>) was estimated by an experimental ecological method. Results in present study indicated that energy content and body weight of juvenile cobia decreased significantly after starvation, and during the re-feeding period, ingestion rate in energy and specific growth rate in energy, wet weight and dry weight in the deprived fish were higher than those of control fish. Results also indicated that juvenile cobia showed complete compensatory effect in the recovery growth and it was contributed by the increase of ingestion rate. Energy budget of juvenile cobia fed to satiation was 100.00 C = 38.33 G + 15.06 F + 7.22 U + 39.39 R, and expression by assimilated energy was 100.00 A = 49.32 G + 50.68 R.	Wang, Z., Huang, Y., Chen, G., Zhang, J., Tang, B., Zhou, Z., Shi, G., Pan, C., Huang, J.	Journal of Jishou University(Natural Science Edition) 33, 102–106	2012	Fish Health Nutrition

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
505	Dietary methionine level influences growth and lipid metabolism via GCN2 pathway in cobia (<i>Rachycentron canadum</i>).	<p>This study investigated the effect of dietary methionine level on growth and lipid metabolism via the general control nonderepressible2 kinase (GCN2) pathway in cobia (<i>Rachycentron canadum</i>). Cobia were fed diets with six levels of methionine (0.62%, 0.84%, 1.02%, 1.15%, 1.25% and 1.42% of dry diet) with a constant cystine level (0.42% dry diet). The feeding experiment began in September 2013 and ended in December 2013; during the experiment, cobia were fed ad libitum twice daily (7:00 and 18:00 h) for 10 weeks. Cobia fed the diet with 1.02% methionine showed elevated weight gain (WG) and feed efficiency ratio (FER) compared with those fed the other diets (P < 0.05). The content of liver lipid, total triglyceride, and total cholesterol were first enhanced significantly with increasing dietary methionine level from 0.62% to 1.02%, and then decreased markedly with higher levels of dietary methionine level (1.02% to 1.42%). Crude lipid was markedly elevated when the dietary methionine level was 1.02%, and then plateaued with higher dietary methionine level. The expression of genes associated with hepatic lipid synthesis (sterol regulatory element binding protein-1, peroxisome proliferator activated receptor γ, fatty acid synthetase, and stearyl-CoA desaturase-1) were markedly up-regulated in fish fed the diet containing 1.02% methionine, whereas the transcriptional levels of lipolytic genes (peroxisome proliferator activated receptor α, carnitine acyl transferase-1, and lipase lipoprotein lipase) were elevated in fish fed the methionine-deficient diet (0.62%; P < 0.05). The expression of insulin-like growth factor-I (IGF-I) was suppressed by the methionine-deficient diet, whereas the hepatic mRNA expression levels of genes related to amino acid responses (AAR), i.e., GCN2, activating transcription factor 4 (ATF4), CCAAT enhancer binding protein β (C/EBPβ), and asparagine synthetase (ASNS), were significantly up-regulated. In conclusion, the dietary methionine requirement of cobia was estimated to be 1.04% and 1.15% of dry matter (2.23% and 2.45% dietary protein) on the basis of WG and FER, respectively. Results of this study suggested that methionine deficiency could suppress growth, decrease lipid content, and inhibit expression of IGF-I and some genes related to lipid synthesis in cobia; these changes might be regulated by inducing the expression of genes related to the GCN2 pathway (GCN2, ATF4, C/EBPβ, and ASNS).</p> <p>Statement of relevance</p> <p>The present study was conducted to investigate the effect of dietary methionine on growth performance, plasma biochemical indexes, lipid content and gene expression involved in lipid metabolism and GCN2 pathway in cobia (<i>Rachycentron canadum</i>). Our findings have showed that methionine deficiency could suppress growth, decrease lipid content and inhibit expressions of IGF-I and some lipid synthesis related genes of cobia, which may be regulated by inducing the mRNA expressions of GCN2 pathway related genes (GCN2, ATF4, C/EBPβ and ASNS). The results are reliable and of both theoretical and practical importance.</p> <p>The work described has not been submitted elsewhere for publication, in whole or in part, and all the authors listed have approved the manuscript that is enclosed. I have read and have abided by the statement of ethical standards for manuscripts submitted to Aquaculture.</p>	Wang, Z., Mai, K., Xu, W., Zhang, Y., Liu, Y., Ai, Q.	Aquaculture 454, 148–156. doi:10.1016/j.aquaculture.2015.12.019	2016	Nutrition Physiology Fish Health
506	Analysis on population genetic structure of cobia (<i>Rachycentron canadum</i>) with AFLP markers.	Ten primer pairs of AFLP, E-aga/M-cgt, E-aga/M-cga, E-agg/M-cga, E-agg/M-cga, E-act/M-cgc, E-aag/M-cgc, E-aca/M-cga, E-aac/M-cgc, E-aac/M-cac and E-aac/M-cat, were selected to determine genetic structure of 4 cultured cobia (<i>Rachycentron canadum</i>) populations (Hainan1, Hainan2, Liushawan and Zhanjiang, and 30 individuals for each) based on 0/1 matrix of 500 loci. Total percentage of polymorphic loci (83.9%), Nei's (1973) gene diversity (0.4278) and Shannon diversity index (0.6149) showed high values and genetic diversity. Differences between LS-HN2 and ZJ-HN1 were evident, evaluated by Principal Coordinates Analysis and Neighbor-Joining (NJ) tree of Nei's genetic distance. However, estimate of gene flow (Nm) from Gst was 10.327 and analysis of molecular variance showed that the variance within the population (53%) was slightly greater than that among populations (47%).	Wang, Z., Shi, P., Su, H., Zhao, J., Shen, E., Liu, C.	Journal of Zhanjiang Ocean University 31, 12–17	2011	Genetics Molecular
507	The complete mitochondrial dna of cobia (<i>Rachycentron canadum</i>) and phylogenetics of carangoid.	<i>Cobia Rachycentron canadum</i> is the only species of Rachycentridae distributing widely in subtropical and tropical oceans and seasonally in temperate waters. Cobia has the qualities that define an excellent candidate and emerging global potential for mariculture. Numerous comparative studies have been conducted in attempt to resolve the relationship (to be monophyletic) between Rachycentridae and the other teleosts using anatomical and behavioral methods. The Coryphaenidae and the Rachycentridae and Echeneidae were thought to form a monophyletic group, with Coryphaenidae being the sister group to the clade of Rachycentridae and Echeneidae. Nematistiidae and Carangidae were also hypothesized to be part of a clade with these three families, perhaps forming a trichotomy. However, molecular research regarding the evolutionary relationship of these families remained scarce. Adequate resolution of relationships in any organisms required longer DNA sequences. In this study, the whole mitogenome sequence was determined for cobia, using an approach that employs a long polymerase chain reaction technique and primer walking. It was the first complete mtDNA sequence of cobia (Accession No. FJ154956 and NC_011219, 16758 bp) in GenBank. The mitochondrial genomic sequence contained the same 37 mitochondrial structural genes (two ribosomal RNA, 22 transfer RNA, and 13 protein-coding genes) as found in other vertebrates, with the gene order identical to that in typical vertebrates. All following analyses were based on two datasets. Dataset 1 consisted of highly similar DNA sequences of mitogenomes (score=10055-30213) from GenBank; and dataset 2 included the 20 ND2 gene complete sequences of the representative species within Coryphaenidae, Nematistiidae, Echeneidae and all branches with high support values in the trees based on dataset 1. The phylogenetic relationship among cobia and other teleost were reconstructed using maximum parsimony (MP), neighbor-joining (NJ), and maximum likelihood (ML) with dataset 1. MP bootstrap scores were much lower than those of NJ or ML, and the MP resolution among higher-level classification were also the lowest. While the NJ and ML analyses provided strong support for a sister group relationship between two clades of Perciformes, in which one clade contained cobia, Carangidae (<i>Carangoides armatus</i> , <i>Trachurus japonicus</i> , and <i>T. trachurus</i>), Istiophoridae (<i>Makaira indica</i> , <i>Istiophorus platypterus</i>) and Xiphiidae (<i>Xiphias gladius</i>) (bootstrap=78 and 97). Unexpectedly, another clade was composed of the other taxa of order Perciformes and two typical species (<i>Ostracion immaculatus</i> and <i>Triacanthodes anomalus</i>) of order Tetraodontiformes. The origin time of cobia was estimated by Bayesian analysis of the dataset 2 under the GTR + G + I + relaxed model for 8.0x106 generations resulted in a posterior probability distribution containing 1000 samples per analysis. The results support that: (1) the relative between cobia and dolphinfish is the closest (posterior probability=0.997), and identical with the period of first occurrence of cobia fossil, their most recent common ancestor (MRCA) lived in 56 million years ago (Ma), i.e. Thanetian. (2) Rachycentridae, Coryphaenidae and Echeneidae of the superfamily Echeneoidea proposed by Johnson (1984) cluster in a monophyletic group with low posterior probability (0.593). However, Nematistiidae and Carangidae are placed in clusters of scombridae and Tetraodontidae, respectively. Conclusively, Carangoid lineage is not a monophyly.	Wang, Z.-D., Guo, Y.-S., Liu, C.-W., Liu, Y.	Acta Hydrobiologica Sinica 35, 229–237	2011	Wild Genetics Molecular
508	Endocarditis associated with blood fluke infections (Digenea: Aporocotylidae: <i>Psettarium cf. anthicum</i>) among aquacultured cobia (<i>Rachycentron canadum</i>) from Nha Trang Bay, Vietnam.	We herein diagnose blood fluke (Digenea: Aporocotylidae) infections in sea cage-reared cobia (<i>Rachycentron canadum</i>) from Nha Trang Bay, Vietnam, using morphology, nucleotide sequences, scanning electron microscopy, and histopathology. This is the first report of this blood fluke beyond the Gulf of Mexico and contributes to our understanding of the disease implications of aporocotylid infections among marine aquacultured fishes. Blood flukes were morphologically identified as <i>Psettarium cf. anthicum</i> by having the combination of an extremely elongate body with rows of straight, ventrolateral tegumental spines and a sinistral posterolateral protuberance, an H-shaped intestine with asymmetrical posterior caeca, a lobed ovary, an ootype posterior to the male genital pore, and an extensively convoluted uterus located between the ovary and ootype. A comparison of the large subunit ribosomal DNA (28S), small subunit ribosomal DNA (18S), and internal transcribed spacer 2 (ITS2) derived from blood flukes infecting cobias in Nha Trang Bay and Gulf of Mexico revealed 5 (99.5% similarity in 28S), 3 (99.8%, 18S), and 12 (98.9%, ITS2) nucleotide differences between the geographic isolates. Adult blood flukes pierced the endocardium and penetrated the spongy myocardium or lesioned endocardium of the cobias from Nha Trang Bay. The associated heart lesion comprised fibro-granulomatous endocarditis with accompanying endocardial thrombi, including focal effacement of the endocardium adjacent to thrombi, hyperplasia of endocardial cells yielding a thickened endocardium within which adult flukes resided or fluke remnants were located, clusters of large epithelioid granulomas within thrombi and within the basal endocardium, and minute granulomas in spongy myocardium enclosing probable blood fluke eggs. These pathological alterations suggested that heavily-infected cobia may suffer reduced cardiac output via thrombi blocking normal blood flow and emboli causing infarcts. Acute mortality may be likely for heavily-infected cobias during periods of high cardiac output, e.g., during feeding in a sea cage, if concomitant with, or resulting in, circulation of emboli. The lesioned endocardium may reduce efficiency of respiratory gas exchange to cardiac myocytes as well as impair endocardial cell immune function.	Warren, M.B., Oréllis-Ribeiro, R., Ruiz, C.F., Dang, B.T., Arias, C.R., Bullard, S. A.	Aquaculture 468, Part 1, 549–557. doi: 10.1016/j.aquaculture.2016.11.009	2017	Cage Culture Parasites Genetics Molecular
509	Study on the best modified atmosphere packaging parameters of cobia during freezing-point storage.	Packaged cobia under different conditions during modified atmosphere packaging and freezing-point storage, the effects on the quality of cobia were studied to determine the best packaging parameter. The experimental group of different gas ratio were taken 100% N ₂ , 75% N ₂ +25% CO ₂ , 50% N ₂ +50% CO ₂ , 30% N ₂ + 65% CO ₂ +5% O ₂ , 25% N ₂ +75% CO ₂ , 100% CO ₂ as study object, and packaging bags of different materials were taken PE, general barrier property and high barrier as study object, the control group was air storage. Stored at a temperature range of -1.01 to 0 °C after modified atmosphere packaging, some quality indexes such as K value, TVB-N value, total bacterial number and drip loss were measured during storage. The results showed that, to varying degrees, an increase was founded for all indexes through the storage period, and there was significant difference (p<0.05) between the experimental group and the control group. Taken slower growth of K value, TVB-N value, total bacterial number and less drip loss as evaluation standard, after the comprehensive comparison of these quality indexes, the high barrier and a gas ratio of 50% N ₂ +50% CO ₂ were determined as the best modified atmosphere packaging and freezing-point storage parameter.	Wu, Y., Sun, J., Yang, X., Ma, H., Yang, S.	Science and Technology of Food Industry 336–340, 365	2014a	Food Safety

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
510	Analysis of quality on modified atmosphere packaged cobia fillet during freezing-point storage.	Changes in quality of cobia fillet in freezing-point storage with modified atmosphere packaging (MAP), air packaging (AP) and vacuum packaging (VP) were studied. During the experimental process, some quality indexes such as K value, total bacterial number, TVB-N value, pH value, water holding capacity, drip loss, sensory quality, texture indexes and color were measured. The results showed that, under the MAP condition, it cost 18 d for K value arrive 60% of early corruption by 106 CFU/g of the total number of bacteria, comparing to AP or VP 6d and 2 d were extended respectively. It is 23 d for TVB- N content arrive 0.30 mg/g storing under MAP condition, comparing to AP or VP, 9d and 6 d were extended respectively. Drip loss and pH value of the cobia fillet with MAP increased slowly than with AP or VP. Change rate of water holding capacity, sensory quality, texture and color with MAP was slower than control samples. After the comprehensive comparison of the conclusion: MAP cobia fillet could has a 8~10 days and 2~6 days longer storage time than AP or VP, which showed that MAP cobia fillet during freezing-point storage has the obvious delay the deterioration. It is more suitable for application in high quality cobia fillet storage.	Wu, Y., Sun, J., Yang, X.-Q., Ma, H., Juang, H., Cen, J.	Modern Food Science & Technology 117–124, 230	2014b	Food Safety
511	Effects of medicinal herbs “ <i>Plantago asiatica</i> ”, “ <i>Houttuynia cordata</i> ” and “ <i>Mentha haplocalyx</i> ” on non-specific immune responses of cobia (<i>Rachycentron canadum</i>).	This study investigated the effects of orally administered <i>Plantago asiatica</i> , <i>Houttuynia cordata</i> , and <i>Mentha haplocalyx</i> on the growth and nonspecific immune responses of cobia (<i>Rachycentron canadum</i>). The nonspecific immune parameters assessed were weight gain, feed conversion ratio, superoxide anion (O ₂ ⁻) production, superoxide dismutase (SOD) activity, phagocytic rate, phagocytic index, lysozyme activity, serum albumin and globulin, and albumin: globulin (A/G) ratio. The growth experiment indicated that 6-week dietary treatments did not significantly affect on the growth of cobia. Nonspecific immune responses showed that O ₂ ⁻ production, SOD and lysozyme activity, and phagocytosis were significantly increased after the oral administration of <i>P. asiatica</i> and <i>H. cordata</i> , and the serum albumin:globulin ratio (A/G) gradually decreased. In this study, treatment of the <i>Mentha haplocalyx</i> on the cobia didn't present with the inducing of the phagocytosis ability compared with the treatment of <i>P. asiatica</i> and <i>H. cordata</i> . We suggest that oral administration of the 10 g/kg or 20 g/kg of the <i>P. asiatica</i> and <i>H. cordata</i> is exactly inducing the phagocytosis, ROS production, lysozyme activity and SOD production in the cobia.	Wu, Y.-S., Chen, Y.-Y., Ueng, P.-S., Nan, F.-H.	Fish & Shellfish Immunology 58, 406–414. doi:10.1016/j.fsi.2016.09.043	2016	Fish Health Pharmacology
512	Effect of salinity on hematology and gill Na ⁺ -K ⁺ ATPase activity of juvenile cobia, <i>Rachycentron canadum</i> Linnaeus.	The hematology and gill Na ⁺ -K ⁺ ATPase (NKA) activity in juvenile cobia <i>Rachycentron canadum</i> [body weight (6.52±0.71) g] were investigated after rearing for 14d at salinity of 5, 10, 20, 30, and 37 (control). The results showed that the specific growth rates (SGR) in 5 and 10 treatments were significantly (P < 0.05) lower than others. Simultaneously, the hemoglobin content, hematocrit and erythrocyte count in 5 and 10 were significantly lower, but serum cortisol and lactate contents significantly higher than those in 30 and 37. The glucose is high in 5 and 10, but no significant difference among the treatments. Serum aspartate aminotransferase (AST) is increased with low salinity but alkaline phosphatase (ALP) changed reversibly. The positive correlation between serum osmolality, Na ⁺ and Cl ⁻ with salinity was found, while K ⁺ is negative. Lowest gill NKA activity was detected in 20 treatments, and a notable increase in 10. This study showed that the cobia juvenile well acclimatized itself to salinity change. The moderate salinity does not affect the growth of cobia, but cobia juvenile presented a stress response at excess hyposalinity circumstance. Moreover, many physiological and biochemical indices in blood were effected by salinity.	Xu, L., Feng, J., Guo, Z., Lin, H., Guo, G.	Marine Environmental Science 27, 602–606	2008	Physiology
513	Nutrient requirement of cobia <i>Rachycentron canadum</i> .	Cobia (<i>Rachycentron canadum</i>), commonly known as cobia, also known as the Dragon fish, sea fish Zhu, bamboo Five, sea grasses, pewter and white, is Perciformes, percoidei, cobia families, cobia genus. Cobia is a rapid development in recent years inshore fish cage culture, widely distributed in higher sea water temperatures, except in the eastern Pacific and other tropical and subtropical. China's coastal areas have also been distributed, but lower yields. Pakistan, the Philippines, Mexico and other major fishing producing countries. Meat tender, delicious taste, high nutritional value, is a good material for sashimi, muscle protein content of 21.5%.	Xu, X., Zhi-Xiong, Dong, X.-H., Wang, H.-L.	Shui chan ke xue 27, 684–685	2008	Nutrition
514	Cloning and gene expression of delta 6 fatty acid desaturase cDNA of cobia (<i>Rachycentron canadum</i>).	N-3 highly unsaturated fatty acids (HUFAs), eicosapentaenoic (EPA) and docosahexaenoic acids (DHA), are particularly important in the physiological procedures of human beings and animals. However, human and animals including some marine fish species cannot synthesize HUFAs from linoleic and linolenic acids since they have no or less activity of delta 6norr 5 fatty acid desaturases and elongase that are a key for the synthesis of HUFAs. Therefore, they have to ingest HUFAs from their diets for the normal growth and development. Actually, this is a question that should be further explored in some marine fishes. Cobia (<i>Rachycentron canadum</i>) is a worldwide marine fish in tropical, subtropical and warm temperate seas. Cobia is an excellent candidate for aquaculture because of its fitting to wide salty, high resistance to diseases, and rapid growth, reaching 6-10 kg in 12-14 months. Marine fish is main source of HUFAs, DHA and EPA for human beings. With the decline of fishing and rapidly expanding aquaculture, feed-grade fishing has reached sustainable limits. A developing cobia commercial fishery needs to solve sustainable developing problems of artificial nutrition feed, using plant products to replace fish products, in which the basis of nutrition, physiology and biochemistry of cobia is necessary to study. Accordingly, delta 6 fatty acid desaturase, a key enzyme in the synthesis of HUFAs in cobia was studied in our experiments. Delta 6 fatty acid desaturase cDNA of cobia (<i>Rachycentron canadum</i>) was cloned and sequenced as well as its expression in different tissues was determined. Total RNA was extracted from the liver of juvenile cobia and amplified using real time-PCR (RT-PCR). The amplified product was a fragment with 743bp. The sequence of the fragment of delta 6 fatty acid desaturase from cobia showed great identity (87%) with that of European seabass (<i>Dicentrarchus labrax</i>). The protein sequence of the fragment included two transmembrane regions and two histidine boxes which were composite characteristics of a microsomal fatty acid desaturase. The enzyme gene expression in different tissues of cobia was determined using real-time quantity PCR (RTQ-PCR) and their expressive orders were as follows: brain > liver > heart, intestine, spleen, kidney and gill > muscle and skin; while no expression was detected in adipose tissue. A conclusion is that cobia has delta 6 fatty acid desaturase, which is a key enzyme for the synthesis of HUFAs. The enzyme gene is maximally expressed in the brain of the fish suggesting that the HUFAs has an important role in central nervous system.	Xu, Y., Zheng, Y., Ding, Z.	Journal of Fishery Sciences of China 17, 1183–1191	2010	Nutrition Physiology
515	Cobia (<i>Rachycentron canadum</i>) culture and its formulated feed.	Cobia (<i>Rachycentron canadum</i>) is one of the most popular object of study and future potential of the most promising species. Cobia known arowana or dragon fish, medium-sized tropical and subtropical marine fish in the water 23 ~ 29 °C of rapid growth, one year can grow to 5 ~ 6kg market. Cobia individual large, fast growth, disease resistance, suitable for high density intensive culture, high yield, good benefits; while cobia nutrient-rich, delicate meat, plump, cool and tender and delicious, good taste, can be eaten raw, cooked can also be pickled and smoked, stockpiling food, can also be frozen, and the texture of the meat is very good, it is a new global seafood, Japan alone takes about 2.0 × 10 ^ 5t / high-price, high-quality cobia sashimi.	Xu, Y.-Q., Zheng, J.-Z., Ding, Z.-K., 2006	Shui chan ke xue 25, 34–36	2006	Nutrition
516	Dietary zinc requirement of juvenile cobia (<i>Rachycentron canadum</i>).	The dietary zinc (10, 20, 30, 40 and 50 mg/kg) was added to the purified diet (zinc content 5.65 mg/kg) based on albumin as the protein source, in order to meet the dietary zinc content of 15.97, 25.66, 33.90, 45.85 and 55.88 mg/kg. The feeding trial on cobia (<i>Rachycentron canadum</i>) was conducted for eight weeks. The results showed that there were no significant differences in feed conversion rate on cobia fed the experimental diets regardless of concentration of supplemental zinc compared to fish fed the basal diet; but the survival rate, weight gain rate and serum alkaline phosphatase (AKP) activity were significantly affected by dietary zinc level (P < 0.05), there was a significant difference in zinc concentrations in muscle, bone, liver and serum for the fish fed the distinct zinc supplementation levels (P < 0.05). The survival rate, weight gain rate, serum alkaline phosphatase activity and zinc concentrations in fish tissues and serum were responded in broken-lines models to increase in dietary zinc levels. Over signs of zinc deficiency such as slow growth, anorexia, erosive skin, cataract and increased mortality were observed in fish fed the low-zinc diet. Determined by broken-lines regression analysis, with zinc sulfate as the zinc sources, the minimum requirement for dietary zinc was recommended for 42.86 mg/kg. The dietary zinc (10, 20, 30, 40 and 50 mg/kg) was added to the purified diet (zinc content 5.65 mg/kg) based on albumin as the protein source, in order to meet the dietary zinc content of 15.97, 25.66, 33.90, 45.85 and 55.88 mg/kg. The feeding trial on cobia (<i>Rachycentron canadum</i>) was conducted for eight weeks. The results showed that there were no significant differences in feed conversion rate on cobia fed the experimental diets regardless of concentration of supplemental zinc compared to fish fed the basal diet; but the survival rate, weight gain rate and serum alkaline phosphatase (AKP) activity were significantly affected by dietary zinc level (P < 0.05), there was a significant difference in zinc concentrations in muscle, bone, liver and serum for the fish fed the distinct zinc supplementation levels (P < 0.05). The survival rate, weight gain rate, serum alkaline phosphatase activity and zinc concentrations in fish tissues and serum were responded in broken-lines models to increase in dietary zinc levels. Over signs of zinc deficiency such as slow growth, anorexia, erosive skin, cataract and increased mortality were observed in fish fed the low-zinc diet. Determined by broken-lines regression analysis, with zinc sulfate as the zinc sources, the minimum requirement for dietary zinc was recommended for 42.86 mg/kg.	Xu, Z.-X., Dong, X.-H., Liu, C.-W.	Shui chan ke xue 26, 138–141	2007	Nutrition Fish Health
517	Analysis of the genetic diversity of the lymphocystis virus and its evolutionary relationship with its hosts.	Lymphocystis disease virus (LCDV) is the causative agent of lymphocystis disease. In this study, the <i>mcp</i> gene of LCDV and the <i>cyt b</i> gene of the host fish were selected as molecular markers, and the phylogenetic relationships between LCDV and its host were analyzed. The 25 LCDV isolates examined in this study were attributed to seven LCDV genotypes: genotype I (LCDV-1), genotype II (LCDV-cn, etc.), genotype III (LCDV-rf), genotype IV (LCDV-rc and LCDV-sb), genotype V (LCDV-cb), genotype VI (LCDV-tl), and genotype VII (LCDV-sa). Genotype VII is a new genotype. LCDV1 was found to have differentiated first, followed by LCDV-rf; then LCDV-tl; LCDV-cb; and then LCDV-sa; and by LCDV-rc and LCDV-sb; and finally by LCDV-cn, LCDV-C, and LCDV-jf. From the host evolutionary perspective, <i>Rachycentron canadum</i> was found to have differentiated first, followed by <i>Trichogaster leeri</i> , <i>Chanda baculis</i> , and <i>Sebastes schlegelii</i> , <i>Lateolabrax</i> sp., <i>Sparus aurata</i> , <i>Platichthys flesus</i> , and <i>Paralichthys olivaceus</i> . Comparison of the phylogenies of the host fish species and LCDVs revealed no significant evidence of cospeciation between LCDVs and their host fish. In-depth studies of the genetic variation in LCDVs can enhance our understanding of the mechanism of LCDV infection, which may provide important insights into the prevention and treatment of lymphocystis disease.	Yan, X.-Y., Wu, Z.-H., Jian, J.-C., Lu, Y.-S., Sun, X.	Virus Genes 43, 358. doi:10.1007/s11262-011-0646-0	2011	Fish Health Genetics Molecular
518	Effects of temperature and salinity on the growth and activities of antioxidant enzymes of cobia (<i>Rachycentron canadum</i>) juveniles.	Two-factor-intersecting experiment was designed to evaluate the effects of temperature and salinity on the antioxidant enzymatic activities in the muscles of cobia (<i>Rachycentron canadum</i>) juveniles under the laboratory conditions. In this experiment three levels of water temperature (26, 29, 32) were set, and four levels of salinity (11, 19, 27, 35) were set respectively. Two factors engendered 12 combinations in all on each level. The cobia juveniles had been reared in the glass fiber tanks for 20 days. Then the fish samples were obtained randomly from each tank to examine the activities of SOD (Superoxide dismutase), CAT (Catalase) and GPX (Glutathione Peroxidase). The results showed that salinity induced adaptive responses such as increase in the antioxidant enzymatic activities, mainly those of SOD and CAT, as well as in GPX values. The activities of SOD, CAT and GPX increased from 17.74 ± 3.38, 19.44 ± 2.66 and 13.70 ± 2.99 U/mg at 35 to 30.14 ± 1.76, 35.63 ± 10.59 (P < 0.05) on the activities of SOD and CAT. Except temperature, the salinity and interaction all had significant effect (P < 0.05) on the activity of GPX.	Yang, J., Chen, G., Huang, J., Zhang, J., Shi, G., Tang, B., Zhou, H.	Journal of Guangdong Ocean University 27, 25–29	2007	Culture Physiology

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
519	Effects of different diets on digestive enzymatic activities in several tissues of juvenile cobia (<i>Rachycentron canadum</i>).	The objective of the study was conducted to determine the effects of two diets (ice fresh trash fish and formulated feed) on the activity of digestive enzymes (protease, trypsin, amylase and lipase) in stomach, proximal intestines and liver of juvenile cobia (<i>Rachycentron canadum</i>). The diets were fed to the juveniles with initial mean weight of (10.79±2.12)g for 14 days indoor flow-through and aerated aquaria at a rate of 20 individuals per tank with triplication. The results showed that the juveniles fed the ice fresh trash fish had significantly higher protease activity in the stomach than the juveniles fed the formulated feed (P < 0.05), but the case were contrary in the proximal intestines and liver (P < 0.05). There was significantly higher activity of trypsin in the stomach of the animals fed the ice fresh trash fish than that in the stomach of the animals fed the formulated feed (P < 0.05), but the case were contrary in the proximal intestines and liver (P < 0.05). The significantly higher activity of lipase was found in the liver of the fish fed the ice fresh trash fish than that in the fish fed the formulated feed (P < 0.05), and there was no significant difference in lipase activity in the stomach and the intestines in the fish fed the two diets (P > 0.05). The juveniles fed the ice fresh trash fish had significantly higher amylase activity in the stomach than the juveniles fed the formulated feed (P < 0.05). For the same enzyme, the case in the intestines was opposite to that in the stomach, and there was no significant difference in lipase activity in the liver in the fish fed the two diets (P > 0.05). The changes in the four enzymatic activities between the two groups in the experiment suggested that the different diets had different effect on activities of the digestive enzymes, and the enzymes activities showed tissue specificity for cobia juveniles. The objective of the study was conducted to determine the effects of two diets (ice fresh trash fish and formulated feed) on the activity of digestive enzymes (protease, trypsin, amylase and lipase) in stomach, proximal intestines and liver of juvenile cobia (<i>Rachycentron canadum</i>). The diets were fed to the juveniles with initial mean weight of (10.79±2.12)g for 14 days indoor flow-through and aerated aquaria at a rate of 20 individuals per tank with triplication. The results showed that the juveniles fed the ice fresh trash fish had significantly higher protease activity in the stomach than the juveniles fed the formulated feed (P < 0.05), but the case were contrary in the proximal intestines and liver (P < 0.05). There was significantly higher activity of trypsin in the stomach of the animals fed the ice fresh trash fish than that in the stomach of the animals fed the formulated feed (P < 0.05), but the case were contrary in the proximal intestines and liver (P < 0.05). The significantly higher activity of lipase was found in the liver of the fish fed the ice fresh trash fish than that in the fish fed the formulated feed (P < 0.05), and there was no significant difference in lipase activity in the stomach and the intestines in the fish fed the two diets (P > 0.05). The juveniles fed the ice fresh trash fish had significantly higher amylase activity in the stomach than the juveniles fed the formulated feed (P < 0.05). For the same enzyme, the case in the intestines was opposite to that in the stomach, and there was no significant difference in lipase activity in the liver in the fish fed the two diets (P > 0.05). The changes in the four enzymatic activities between the two groups in the experiment suggested that the different diets had different effect on activities of the digestive enzymes, and the enzymes activities showed tissue specificity for cobia juveniles.	Yang, Q.-H., Zhou, Q.-C., Zheng, H.-J., Li, B.-H., Dong, X.-H., Chi, S.-Y.	Shui chan ke xue 27, 633–636	2008	Nutrition Physiology
520	Study on the optimal zinc level in diets of juvenile cobia.	Two hundred and thirty four juvenile cobia (<i>Rachycentron Canadum</i>) were divided into 6 treatments. There were 3 replicates in every treatment with 13 cobia per replicate. 6-week feeding trial by commercial diet with supplements of 0, 30, 70, 110, 150 and 190 mg/kg Zn was conducted to determine the optimum zinc supplementation level of juvenile cobia (<i>Rachycentron Canadum</i>). The results showed that there were no significant differences in survival rate, weight gain rate, feed conversion rate, serum alkaline phosphatase activity, muscle and serum zinc concentrations of all treatment. There was a significant difference among the zinc concentrations, which were on the rise with the increase in the zinc supplements, in bone and liver for fish fed the diet with zinc supplementation levels (P < 0.05). The bone and live zinc concentrations were responded in broken-lines models with the increase of dietary zinc levels. By considering survival rate and specific growth rate, it was demonstrated that there were not necessary adding zinc to the commercial diets and the zinc content in the feedstuff of the diets was enough for the juvenile cobia.	Yang, Yuanzhi, Xu, Z., Dong, X.	China Feed 18, 32–34	2007	Nutrition Fish Health
521	Bioavailabilities of zinc sulfate and zinc methionine for juvenile cobia, <i>Rachycentron canadum</i> .	An 8-week trial was conducted to compare the bioavailabilities of zinc methionine (ZnMet) and zinc sulfate (ZnSO4) for Juvenile Cobia, <i>Rachycentron canadum</i> by using purified diet based on egg-white as the protein source. The diets were formulated by adding either ZnMet or ZnSO4 to the control diet, 0, 10, 20, 30 and 40 mg·kg ⁻¹ , respectively. There were 9 treatments and each treatment included three replicates. At the end of 8th week, cobia was killed, then muscle, liver and bone Zn content; serum Zn and alkaline phosphatase of serum were determined. The results showed that the survival rate, weight gain rate, serum alkaline phosphatase activity (AKP) of fish in control was low (P<0.05), but there was no significant difference in each zinc level of two sources. Zinc concentrations in muscle, bone, liver and serum were increased linearly as dietary zinc increased and there were the most significant differences among control and treatments (P<0.01). Fish fed 10 mg·kg ⁻¹ supplemental zinc from ZnSO4 had slightly lower weight gain, zinc concentrations in muscle and bone than fish fed the same zinc level supplied as ZnMet. Significant differences were observed in weight gain and serum alkaline phosphatase activity of fish fed 20 mg·kg ⁻¹ from two different diets (P<0.05). Serum alkaline phosphatase activity and serum zinc concentration were significant differences of fish fed 30 mg·kg ⁻¹ from two different diets (P<0.05). As far as weight gain and bone zinc saturation concerned, the relative bioavailabilities of ZnMet, with ZnSO4 as standard, were 117.72% and 140.38%.	Yang, Yanzhi, Xu, Z., Dong, X.	Feed Review 20, 8–12	2007	Nutrition Fish Health
522	Optimum iron and zinc supplementation in commercial feed for juvenile cobia, <i>Rachycentron canadum</i> .	A 2×3 factorial feeding trial including 3 levels of iron (100, 200, and 300 mg/kg diet) and 3 levels of zinc (30, 110, and 190 mg/kg diet) was conducted to determine the optimum dietary iron and zinc supplemental levels in juvenile cobia, <i>Rachycentron canadum</i> . The fish (initial average weight 7.0 g) were stocked into 0.3 m ³ plastic tanks at a rate of 13 individuals per tank and fed the diets for 56 days with triplication. There were significant differences in survival, weight gain, total red blood cell count, iron concentration in muscle, and zinc and iron levels in bone and liver in cobia fed the diets containing different iron and zinc levels (P < 0.05). The activity of serum alkaline phosphatase (AKP) and feed conversion rate were significantly influenced by the interaction of iron and zinc (P < 0.05). It is suggested from the survival and weight gain that the optimum supplemental levels in juvenile cobia commercial diet be 200 mg/kg diet for iron and 110 mg/kg diet for zinc.	Yang, Y.-Z., Dong, X.-H., Xu, Z.-X., Guo, Y.-X., Yang, Q.-H., Chi, S.-Y., Tan, B.-P.	Shui chan ke xue 30, 567–572	2010	Nutrition Fish Health Physiology
523	Trace metals health risk appraisal in fish species of Arabian Sea.	Fish is a vital food for humans and many animals. We report an environmental monitoring study to assess the trace metals in fish species caught from Arabian Sea and commercially available in the coastal city Karachi, Pakistan. Heavy metals such as copper, iron, lead and cadmium were determined in the skin, fillet and heart of the fish species <i>Pampus argenteus</i> , <i>Epinephelus chlorostigma</i> , <i>Rachycentron canadum</i> , <i>Scomberomorus commerson</i> , <i>Johnius belangerii</i> , <i>Labeo rohita</i> , <i>Lutjanus argentimaculatus</i> , <i>Trachinotus blochii</i> , <i>Pomadasys olivaceum</i> and <i>Acanthopagrus berda</i> by the atomic absorption spectrophotometer. The concentration (mg kg ⁻¹ , dry weight) range was: Cd (0.00–0.041), Cu (0.006–0.189), Fe (0.413–4.952) and Pb (0.00–0.569). Cadmium, copper and iron levels were below the tolerable limits whereas concentration of lead in the skins of <i>S. commerson</i> , <i>E. chlorostigma</i> , <i>J. belangerii</i> , <i>A. berda</i> ; <i>L. argentimaculatus</i> , filets of <i>J. belangerii</i> , <i>E. chlorostigma</i> and in the heart of <i>J. belangerii</i> exceeded the recommended limits. Therefore fish skin should be discouraged as food for humans or animals. The results indicate that a number of fish species have higher concentration of heavy metals dangerous for human health. Since the fish <i>P. olivaceum</i> (Dhotar) has the lowest level of trace metals therefore we recommend it for breeding and human consumption.	Yasmeen, K., Mirza, M.A., Khan, N.A., Kausar, N., Rehman, A., Hanif, M.	SpringerPlus 5, 859. doi:10.1186/s40064-016-2436-6	2016	Fish Health Food Safety Wild
524	Prevent fish disease using high quality feedstuff, cure the cobia juvenile syndrome using Chinese-Western medicines.	Viruses, bacteria, parasite and other pathogens resulted in serious cobia diseases. The cobia diseases were prevented and cured by using high quality feedstuff and Chinese-Western medicines in different time, in addition to put attention to manage seeding and water quality. The result was excellent and cost less.	Youqing, X., Yimin, Z., Weifeng, L., Jinhua, H., Zhaokun, D.	Feed Industry 34, 48–51	2013	Fish Health Nutrition Pharmacology
525	Effects of diet soybean protein concentration on carbon and nitrogen isotope fractionation of juvenile cobia (<i>Rachycentron canadum</i> L.).	In order to investigate the effects of diet soybean protein concentration on carbon and nitrogen isotope fractionation of juvenile cobia (<i>Rachycentron canadum</i> L.), three isonitrogenous and isocaloric diets were formulated: the protein source in D1 was fish meal, soybean meal protein replaced 10% and 20% fish meal in D2 and D3, and the diets were fed to juvenile cobia (21.34±1.54 g) for 24 days. The results showed that, with the extending of experiment time, the δ13C of cobia increased and δ15N decreased. Although the changing speed of δ13C and δ15N were different. The whole fish and muscle of cobia fed with different diets had reached isotope equilibrium with their diet when the feeding experiment accomplished, except for D3 muscle. The δ13C and δ15N of cobia whole fish and muscle increased with protein concentration in soybean diet. δ13C increased from 4.19‰ and 5.04‰, and δ15N increased from 0.18‰ to 2.20‰. The δ13C and δ15N of cobia whole fish and muscle were similar, but the changing speed of cobia whole fish and muscle δ13C and δ15N were different. This indicated that muscle can represent the isotope character of cobia whole fish in trophic level study of ecosystem (long time scale), but cannot represent the isotope character of whole fish in physiology study (short time scale).	Zhang, Z., Zhou, H., Shi, G., Chen, G.	Journal of Zhanjiang Ocean University 30–36	2013	Fish Health Nutrition
526	Studies of arginine requirement for juvenile cobia.	The effects of varying arginine levels (1.84%, 2.07%, 2.30%, 2.53%, 2.76% in diet or 4.0%, 4.5%, 5.0%, 5.5%, 6.0% in dietary protein) on growth and body composition in juvenile cobia, <i>Rachycentron canadum</i> with approximately 14.7 g initial body mass were evaluated in a 56-day study. The results indicated that special growth rate, mass gain and survival rate increased when arginine level was increased from 2.30% to 2.76%. Crude protein (CP) content and arginine content of whole body was higher in fish fed 2.30% arginine diet than other groups. Crude fat (CF) content was higher in fish fed 2.76% arginine diet than other groups. For juvenile cobia, the optimum level of dietary arginine, determined by quadratic regression analysis, was 2.38% in diet or 5.17 % in dietary protein, on the basis of maximum mass gain.	Zhao, H., Cao, J., Wu, J., Tan, Y., Zhou, M., Liang, H., Yang, D.	Journal Of South China Agricultural University 28, 87–90	2007	Fish Health Nutrition
527	Research on methionine requirement for juvenile cobia, <i>Rachycentron canadum</i> .	Select body weight (14.7 ± 0.3) g of cobia (<i>Rachycentron canadum</i>) 225 juveniles, were divided into five groups, were fed diets containing methionine 0.69%, 0.92%, 1.15%, 1.38% and 1.61% of nitrogen, etc. can be refined feed. After 56d feeding, weight gain rate index, quadratic regression analysis showed that cobia suitable feed methionine requirement of 2.67g / 100gCP. And through the essential amino acid pattern of fish calculate the other essential amino acids requirement (g / 100gCP) are: 7.58 lysine, arginine, 7.22, 6.37 leucine, isoleucine, 2.71, 4.09 phenylalanine, histidine, 2.00, 4.66 threonine, valine 3.83.	Zhao, H., Cao, J., Wu, J., Zhou, M., Liang, H., Ma, L., Lan, H., Tan, Y., Yang, D.	Feed Industry 27, 32–34	2006	Fish Health Nutrition
528	Study on vitamin C requirement of juvenile cobia (<i>Rachycentron canadum</i> L.).	The experiment was carried out to determine the dietary vitamin C requirement of juvenile Cobia (<i>Rachycentron canadum</i> L.). Two hundred and twenty-five fish with an average body weight of 25.85 g were randomly divided into 5 groups with 3 replicates and each replicate contained 15 fish; Five test forages containing different doses of vitamin C (0, 37.5, 75, 150, 300 mg/kg) were used to feed the fish for 56 days. The optimal dietary vitamin C requirement was evaluated based on growth performance, vitamin C accumulation contents in tissues and non-specific immunity in cobia juveniles. The results indicated that fish fed with 75 mg/kg of vitamin C had highest weight gain rate (WGR) and special gain rate (SGR), which were significantly higher than that of 0 and 300 mg/kg group (P<0.05). With the increase of dietary vitamin C, the crude protein content of whole fish increased at first and then decreased, which reached a peak at 75 mg/kg. But in each group, no significant difference was obtained in the content of dry matter, crude protein, crude fat and crude ash of whole body (P>0.05). With the increase of the level of dietary vitamin C, vitamin C accumulations of serum in fish increased and reached a peak, and then decreased, and the highest vitamin C accumulations of serum were found in the fish fed with 150 mg/kg of vitamin C, which was significantly higher than that of 0 mg/kg group (P<0.05). The vitamin C accumulations in liver and brain of fish fed with 300 mg/kg of vitamin C were the highest. The vitamin C accumulations in the brain of 300 mg/kg group were significantly higher than that of 0, 37.5 and 75 mg/kg groups (P<0.05), and the vitamin C accumulations in the liver were significantly higher than that of 0, 37.5 and 150 mg/kg groups (P<0.05). Lysozyme increased at first and then decreased with the increase of the level of dietary vitamin C, and the lysozyme in 75 mg/kg group was the highest, which was significantly higher than that of 0, 37.5 and 300 mg/kg groups. Total antioxidant competence (T-AOC) levels increased significantly when the levels of dietary vitamin C increased from 0 to 300 mg/kg, and 75, 150, 300 mg/kg groups were significantly higher than 0 mg/kg group (P<0.05). The highest renal antioxidant ion free radicals were found in the fish fed with 150 mg/kg of vitamin C, but no significant difference was obtained in each group (P>0.05). Set the weight gain ratio of the fish and the serum lysozyme content as the indices, the regression analysis of turning curve model showed that the optimal vitamin C requirement for juvenile cobia growth was 70 and 80.72 mg/kg respectively.	Zhao, H., Gao, J., Tan, Y., Liang, H., Wu, J., Yang, D.	Chinese Journal of Animal Nutrition 20, 435–441	2008	Fish Health Nutrition

Article Number	TITLE	DESCRIPTION	AUTHORS	SOURCE	YEAR	TOPICS
529	The effects of valine level on plasma biochemical indexes, lipid content and gene expression involved in lipid metabolism in cobia (<i>Rachycentron canadum</i>).	The present study was conducted to investigate the effects of dietary valine on plasma biochemical indexes, lipid content and gene expression involved in lipid metabolism in cobia (<i>Rachycentron canadum</i>). Fish [mean initial weight, (40.9 ±0.8) g] were fed with soybean meal based on diets with graded levels of valine (1.26%, 2.21% and 2.62%) for 10 weeks. Results showed that lipid content of the whole body and muscle of fish fed the diet with deficient valine (1.26%) was significantly lower than that fish fed the moderate (2.21%) and excess (3.23%) valine treatment groups (P<0.05). Plasma total protein (TP) fish increased significantly as dietary valine increased from 1.26% to 2.21% (P<0.05), and kept relatively constant when dietary valine level was above 2.21% (P>0.05). Plasma total cholesterol (TC) and the lipid content of liver increased with dietary valine increasing from 1.26% to 2.21% (P<0.05), but decreased with higher levels of dietary valine (2.21% to 2.62%) (P>0.05). Hepatic mRNA levels of lipid synthesis related genes (SREBP-1, and FAS) were significantly up-regulated in fish fed the diet with moderate level of valine (2.21%) (P<0.05), while hepatic mRNA transcriptional levels PPAR α were significantly elevated in fish fed the diet with high level of valine (P<0.05). Overall, results of this study suggested that valine deficiency could decrease lipid content and inhibit expressions of some lipid synthesis related genes of cobia. This may contribute to understanding the mechanisms related to the physiological effects of dietary valine in cobia.	Zhen, W., Wei, X.U., Kang-Sen, M. a. I., Kai, L.U., Ying-Long, L.I.U., Qing-Hui, A.I.	Acta Hydrobiologica Sinica 40, 744–751	2016	Genetics Molecular Nutrition
530	Research advances in nutrient requirement of cobia (<i>Rachycentron canadum</i>).	Nutrient requirement of cobia (<i>Rachycentron canadum</i>) including protein, amino acid, fat, essential fatty acid, mineral and vitamin were reviewed.	Zhong, G., Shao, Q.	China Feed 19, 22–25	2008	Fish Health Nutrition Review
531	Contribution rate of dietary corn protein to protein growth of juvenile cobia (<i>Rachycentron canadum</i> L.).	The purpose of this experiment was to investigate the contribution rate of dietary corn protein to protein growth of juvenile cobia (<i>Rachycentron canadum</i> L.), and estimate the turnover time of carbon and nitrogen elements in juvenile cobia. Two isonitrogenous and isocaloric diets were formulated: the control group diet was prepared with fish meal as a protein source, and experimental diet was prepared with corn protein (corn gluten meal form) to replace 10% fish meal on the basis of the control group diet. After 24 days feeding for juvenile cobia with an average body weight of (21.34 ± 1.54) g, the carbon and nitrogen stable isotope values of sampled fishes were measured and assessed by mathematical model. There were 3 replicates in control group and experimental group, respectively, and each replicate had 40 fish. The results showed that there was no significant difference in feed intake between the experimental group and control group (P > 0.05), but the weight gain rate, feed conversion ratio, protein efficiency ratio and special growth rate of fish fed experimental diet were significantly lower than those of fish fed control diet (P < 0.05). There was no significant difference between the turnover half-life (represented by T50) of carbon and nitrogen for experiment group (5.72 and 9.88 days, respectively) and control group (6.03 and 9.55 days, respectively) in whole fish (P > 0.05), and there was a significant difference between T50 of carbon and nitrogen for experimental group (7.79 and 10.01 days, respectively) and control group (6.99 and 9.37 days, respectively) in muscle (P < 0.05). The contribution rate of corn protein to the protein growth of juvenile cobia whole fish and muscle was 7.64% and 9.62%, respectively, and there was a significant difference between them (P < 0.05). It is concluded that the actual contribution rate of dietary corn protein to the protein growth of juvenile cobia is lower than its percentage in the dietary protein; when 10% fish meal in the diet is replaced by corn protein, the growth performance and turnover rate of carbon and nitrogen elements are reduced. The corn protein should not replace more than 10% fish meal in the diet when it is used as a substitute for fish meal (without essential amino acid supplementation).	Zhou, H., Chen, G., Gu, B., Dong, X.	Acta Zoonutrimenta Sinica 25, 2633–2642	2013	Fish Health Nutrition
532	Relative contribution of alternative proteins to the growth of juvenile cobia, <i>Rachycentron canadum</i> (Linnaeus).	Five isonitrogenous and isocaloric diets were fed to juvenile cobia, to assess the relative contribution of different proteins (fish meal, soybean meal, corn gluten and beer yeast) to the growth of cobia. The dietary effects on nitrogen and carbon turnover and on the isotopic diet-consumer discrimination factors ($\Delta 15N$ and $\Delta 13C$) were also assessed. Growth results showed that the final body weight, growth rate, feed conversion ratio and protein efficiency ratio of cobia fed diets with alternative protein were significantly lower (P < 0.05) than cobia fed diet formulated with 100% fish meal. The estimated half-lives of nitrogen and carbon ranged between 9–11 days and 6–8 days, respectively, with significant differences among treatments (P < 0.05). $\Delta 15N$ ranged between 0.0–1.2‰ and –0.1–1.6‰ in whole fish and muscle and $\Delta 13C$ ranged between 3.8–5.1‰ and 4.0–5.1‰ in whole fish and muscle respectively. Diets were formulated with low levels of dietary nitrogen (10%) supplied by alternative protein sources substituting fish meal. The relative contributions of the dietary nitrogen supplied from these sources to the growth of whole fish and muscle tissue ranged between 4.9–5.2% and 5.9–7.7% respectively. Results indicated that growth accounted for the majority of observed isotopic change in animals under all treatments. In whole animals and muscle tissue, isotopic change due to metabolism occurred faster for carbon stable isotopes than for nitrogen stable isotopes. Cobia fed diets formulated with alternative proteins showed reduced nitrogen turnover rate and increased $\Delta 15N$.	Zhou, H., Chen, G., Gu, B., Lin, X.	Aquaculture Research 47, 1639–1651. doi: 10.1111/are.12625	2016	Fish Health Nutrition
533	Effects of partial replacement of fish meal by three types of protein sources on growth performance and approximate compositions of juvenile cobia (<i>Rachycentron canadum</i>).	Five isonitrogenous and isocaloric diets were prepared by the dietary fish meal (D1), and the fish meal replaced by defatted soybean meal for 10% (D2) and 20% (D3), by corn gluten meal for 10% (D4), and by beer yeast meal for 10% (D5), and fed juvenile cobia (<i>Rachycentron canadum</i>) (with body weight of 30 38 g) for 35 days to investigate the effects of replacing fish meal in formulated diet on growth and approximate compositions. There was no significant difference in survival rate between the treatment groups and the control group (P > 0.05). There were significantly lower final body weight, weight gain, food conversion efficiency, protein efficiency ratio and specific growth rate in D3 than those in D1 (P < 0.05), without significant difference between other groups (P > 0.05). The juvenile cobia in D3 had significantly lower crude fat content in muscles than the fish in D1 and D5 did (P < 0.05), whereas significantly higher ash content than other groups did (P < 0.05). The hepatosomatic indexes were significantly lower in the juvenile cobia in D3 group than in other groups (P < 0.05). There were no significant differences in visceral index, hepatopancreas crude fat content and Fulton's condition factor in all treatment groups (P > 0.05). The results showed that defatted soybean meal, corn gluten meal and beer yeast meal can replace 10% fish meal for diet and did not cause significant effects. But if the replacement proportion reached 20% for fishmeal, there were significant negative effects on growth, food consumption rate, approximate compositions and health in bigger juvenile cobia. Five isonitrogenous and isocaloric diets were prepared by the dietary fish meal (D1), and the fish meal replaced by defatted soybean meal for 10% (D2) and 20% (D3), by corn gluten meal for 10% (D4), and by beer yeast meal for 10% (D5), and fed juvenile cobia (<i>Rachycentron canadum</i>) (with body weight of 30 38 g) for 35 days to investigate the effects of replacing fish meal in formulated diet on growth and approximate compositions. There was no significant difference in survival rate between the treatment groups and the control group (P > 0.05). There were significantly lower final body weight, weight gain, food conversion efficiency, protein efficiency ratio and specific growth rate in D3 than those in D1 (P < 0.05), without significant difference between other groups (P > 0.05). The juvenile cobia in D3 had significantly lower crude fat content in muscles than the fish in D1 and D5 did (P < 0.05), whereas significantly higher ash content than other groups did (P < 0.05). The hepatosomatic indexes were significantly lower in the juvenile cobia in D3 group than in other groups (P < 0.05). There were no significant differences in visceral index, hepatopancreas crude fat content and Fulton's condition factor in all treatment groups (P > 0.05). The results showed that defatted soybean meal, corn gluten meal and beer yeast meal can replace 10% fish meal for diet and did not cause significant effects. But if the replacement proportion reached 20% for fishmeal, there were significant negative effects on growth, food consumption rate, approximate compositions and health in bigger juvenile cobia.	Zhou, H., Chen, G., Lin, X.-T.	Shui chan ke xue 31, 311–315	2012	Fish Health Nutrition
534	The effects of different diet protein sources on carbon and nitrogen isotope fractionation of juvenile cobia <i>Rachycentron canadum</i> L.	In order to investigate the effects of different diet protein sources on carbon and nitrogen isotope fractionation of juvenile cobia <i>Rachycentron canadum</i> L., three isonitrogenous and isocaloric diets were formulated. The protein source in D1 was fish meal; beer yeast meal and corn gluten meal protein replaced 10% fish meal in D2 and D3, respectively. The diets were fed to juvenile cobia for 24 days. The results showed that, when 10% fish meal was replaced, the weight gain rate (WGR) of cobia decreased significantly. The carbon isotope ratio $\Delta 13C$ of cobia increased in time and nitrogen isotope ratio $\Delta 15N$ decreased in time in all groups. Although the change speeds of $\Delta 15N$ were different, the whole fish and muscle of cobia fed with different diets reached isotope equilibrium states with their diets when the feeding experiment was accomplished. When 10% fish meal was replaced by beer yeast meal (corn gluten meal) protein, the carbon isotope fractionation $\Delta 13C$ decreased while nitrogen isotope fractionation $\Delta 15N$ increased in the whole fish and muscle of cobia; $\Delta 13C$ of the whole fish decreased from 4.19‰ to 3.94‰ and 3.63‰, $\Delta 13C$ of the muscle decreased from 4.46‰ to 3.98‰ (to 3.67‰), and $\Delta 15N$ of the whole fish increased from 0.18‰ to 0.88‰ (to 0.94‰), $\Delta 15N$ of the muscle increased from 0.18‰ to 0.74‰ (to 0.87‰). When the three diets with different protein sources were fed, the variation trends of $\Delta 13C$ and $\Delta 15N$ were similar between whole fish and muscle of cobia, but the change speed of whole fish $\Delta 15N$ was slower than that of muscle. These results indicated that cobia muscle can represent the $\Delta 13C$ and $\Delta 15N$ characters of whole fish in trophic level study of ecosystem (long time scale), but cannot represent the change process of whole fish $\Delta 15N$ in metabolic physiology study (short time scale).	Zhou, H., Chen, G., Shi, G., Zhang, J., Dong, X.	Journal of Tropical Oceanography 13, 35–40	2014	Fish Health Nutrition Physiology
535	Effects of feedstuff n-3/n-6 fatty acid ratio on growth, fatty acid composition in tissues of juvenile cobia (<i>Rachycentron canadum</i>).	The effects of different feedstuff n-3/n-6 ratios on growth and tissue fatty acids composition of juvenile cobia were studied with refined fish oil and soy oil as n-3 and n-6 series of fatty acids source. The results showed that the cobia had the highest weight gain rate and feed efficiency when n-3/n-6 fatty acid ratio was 2.57, and five serum biochemical indices of five trial groups had no significant difference, but ALT, AST and TC inclined to decrease with the n-3/n-6 fatty acid ratio decreasing. n-3 and n-6 PUFA in the muscle were positive correlated with that in the feedstuff. The optimum feedstuff n-3/n-6 fatty acid ratio for cobia was 2.98.	Zhou, M., Cao, J., Liang, H., Wu, J., Lan, H., Zhao, H., Ma, L.	Guangdong Agricultural Sciences 42, 77–81	2006	Fish Health Nutrition
536	Research on lysine requirement of juvenile cobia (<i>Rachycentron canadum</i>).	Five isonitrogenous and isoenergetic purified diets with different levels of lysine (2.30%, 2.53%, 2.76%, 2.99% and 3.22%) were fed to juvenile cobia (<i>Rachycentron canadum</i>) (body weight 14.7 g ± 0.3 g) to test lysine requirement of the species. The results showed that the optimal requirement for lysine of cobia was 6.06 g · (100 g CP) ⁻¹ , and requirement for other amino acids were calculated by amino acid mode of the fish body to be: arginine 4.97 g · (100 g CP) ⁻¹ ; tryptophan 0.83 g · (100 g CP) ⁻¹ ; leucine 5.49 g · (100 g CP) ⁻¹ ; isoleucine 3.12 g · (100 g CP) ⁻¹ ; methionine + cystine 2.66 g · (100 g CP) ⁻¹ ; phenylalanine + tyrosine 5.22 g · (100 g CP) ⁻¹ ; serine 2.96 g · (100 g CP) ⁻¹ ; threonine 3.26 g · (100 g CP) ⁻¹ ; valine 3.26 g · (100 g CP) ⁻¹ .	Zhou, M., Wu, J., Cao, J., Zhu, W., Ma, L., Liang, H.-T., Zhang, H.-T., Zhao, H., Yang, D.	Journal of Yangtze University (Natural Science Edition) Medicine V 50–52, 107	2005	Fish Health Nutrition
537	Effect of bile acids on growth and body composition of cobia (<i>Rachycentron canadum</i>).	To study the effect of bile acids on the growth performance and body composition of cobia (<i>Rachycentron canadum</i>), we added four levels of bile acids (0, 0.015%, 0.03% and 0.045%) to four iso-energetic and iso-nitrogenous practical diets. The cobia with an initial wet weight of (5.4±0.12) g was fed for 8 weeks, and its weight gain rate (WGR, %), special growth rate (SGR, %), feed conversion rate (FCR) and liver and serum were analyzed. The results show that the WGR of 0.03% group is significantly higher than that of the control group and 0.015% group (P<0.05), and the FCR is significantly lower than those two groups. The cholesterol in serum and the fat content of liver show a negative correlation with the bile acids amount in diets. There is no significant difference among the survival rate, SGR, ash and moisture in the whole fish body and meal. The results indicate that adding bile acid to diet can promote the growth of cobia and reduce the accumulation of body lipid.	Zhou, S., Liu, Y., Liang, H., Zhao, L., Tian, L., Yang, H., Liang, G.	South China Fisheries Science 6, 20–25	2010	Fish Health Nutrition