

## Rapid Communication

## Mariculture-induced introduction of cobia *Rachycentron canadum* (Linnaeus, 1766), a large predatory fish, in the Tropical Eastern Pacific

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Received: 17 December 2015 / Accepted: 12 January 2016 / Published online: 22 January 2016

Handling editor: Demetrio Boltovskoy

### Abstract

The cobia *Rachycentron canadum* (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 *R. canadum* 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.

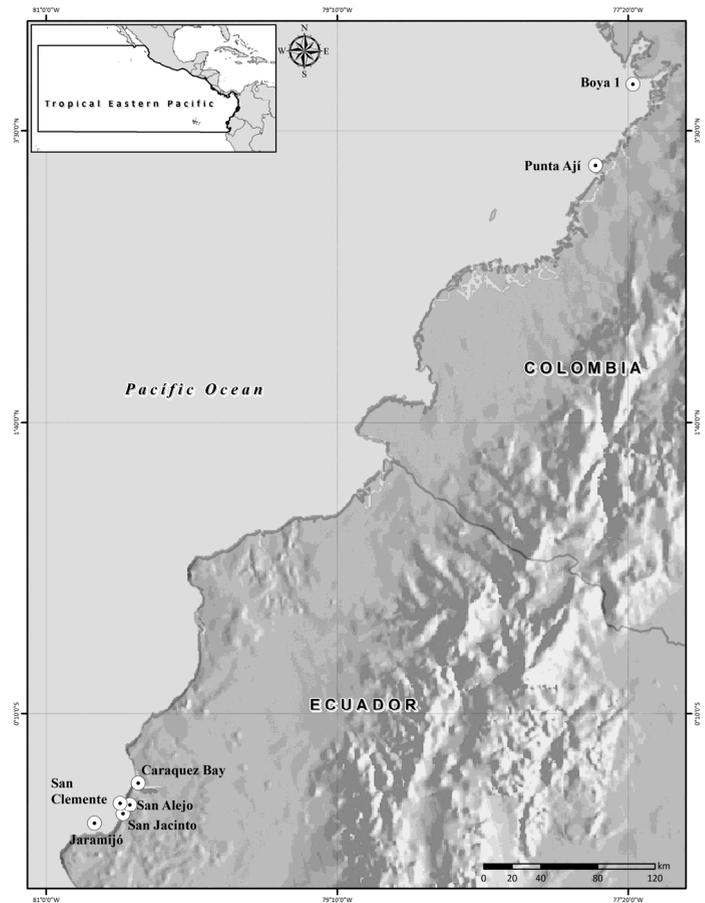
**Key words:** Rachycentridae, marine fish, introduction, invasive species, Colombian Pacific, Ecuador

### Introduction

Invasive species challenge the conservation of biological diversity and can also generate large ecological impacts, particularly in aquatic ecosystems where trophic links within food webs are thought to be strong (Simberloff et al. 2013; Gallardo et al. 2015). Until very recently, there were no documented cases of an introduced marine fish becoming an invasive species. This situation has now changed with the introduction of the Indo-Pacific lionfishes *Pterois volitans* (Linnaeus, 1758) and *P. miles* (J.W. Bennett, 1828) into the Western Atlantic Ocean. These fishes have rapidly spread and established throughout the Caribbean Sea producing dramatic changes in coral reef communities. Lionfish consume a wide variety of fish and invertebrates at high rates and, possessing venomous fin spines, are well defended against predators (Green et al. 2013). Consequently, lionfishes are now successful invaders in the Western Atlantic with very little likelihood of halting their spread.

After international shipping, aquaculture is the most common pathway for introduction of non-native species (Molnar et al. 2008). Accidental escapes from aquaculture facilities can cause irreversible and unpredictable ecological changes to the native communities and habitats (Naylor et al. 2001). Despite the known threats that the introduction of non-native species for aquaculture purposes can pose to aquatic ecosystems, controls and regulations on this industry are often weak or lacking in many developing countries. As a result, the introduction of non-native fish species for aquaculture is still promoted.

The cobia *Rachycentron canadum* (Linnaeus, 1766) is the only known species from the family Rachycentridae. *R. canadum* is a pelagic, highly migratory species, found up to depths of 1200 m that also inhabits coral and rocky reefs and estuaries. Cobia forms spawning aggregations offshore and early juveniles are subsequently associated with shallow water habitats. Adult cobia can be solitary or swim in small groups (2-8 individuals) and are often associated with migratory megafauna (rays,



**Figure 1.** Map of the Colombian and Ecuadorian Pacific coasts in the Tropical Eastern Pacific. The locality in Ecuador (Jaramijó, Manabi) where cobias were accidentally released and the localities in Colombia where cobia individuals have been found are shown by white dots. See supplementary material Table S1 for geo-referenced localities.

sharks, and sea turtles). This species is considered a voracious carnivore whose main preys are crabs, benthic invertebrates, and fish (Shaffer and Nakamura 1989; Collette 1999). To date cobias have been reported in all tropical and subtropical seas (Atlantic and Indo-West Pacific) except for the Central and Tropical Eastern Pacific (Collette 1999; Robertson and Allen 2015; Gaither et al. *in press*). The nearest natural cobia population is ca.10.000 km from the East Pacific.

Cobia is considered a promising candidate for aquaculture in marine warm waters of the world (Benetti et al. 2007). The hardiness of cobia (the fish is able to adapt and live in different environments between 50 and 1200 m depth, at temperatures between 17 and 32°C, salinities between 5 to 44.5, Shaffer and Nakamura 1989; Resley et al. 2006), their exceptionally fast growth (up to 6 kg in one year, Benetti et al. 2006), and relative high market value have contributed to the boom in the cultivation of this species in

Taiwan, Vietnam, China, Philippines, Indonesia, Belize, Panama, and Brazil, among other countries (Benetti et al. 2010). This study reports the first captures of cobia, presumably escapees from newly established aquaculture sites on the coast of Ecuador, in the eastern Pacific Ocean.

## Methods

The reports of cobias documented here were made during regular fish landings monitoring carried out by the authors in Pueblo Nuevo, Buenaventura (Colombian Pacific coast), where landings are predominantly from the artisanal fishing fleet that operates in the central and southern Colombian Pacific coast. A second report of cobia was obtained from an artisanal fisherman near Buenaventura who provided a photograph and capture locality. The two cobias presented here were photographed and measured (total length in cm).

## Results

On 9 April 2015, the Government of Ecuador declared a “historic day for Ecuadorian mariculture” when the first cobia fry were put in cages offshore of Jaramijó in the province of Manabí (Vicepresidencia República de Ecuador 2015) (Figure 1). Since then, it was reported that the fish were growing fast, and the first cobias for export would be ready in mid-October (Tropical Aquaculture Products Inc. 2015). An official press release from the Ecuadorian Ministry of Environment presumed that, at the end of August 2015, numerous cobias escaped to the sea from one of these cages. Since then fishermen from Jaramijó, San Clemente, San Jacinto, San Alejo, Arenales, and Caráquez Bay (Figure 1) have reported cobias of about 50 cm total length in their catches (see report in Ministerio del Ambiente del Ecuador 2015). Several Ecuadorian national and local newspapers have reported about the situation (*El Diario* 26 September 2015; and *El Comercio* 19 October 2015).

On 8 October 2015, a cobia was captured by means of gillnet in Buenaventura Bay, near Punta Aji ( $3^{\circ}17'0.05''\text{N}$ ;  $77^{\circ}32'17.32''\text{W}$ ) on the central Colombian Pacific coast - about 600 km north of Jaramijó, Ecuador (See Figure 1). The cobia measured 54 cm TL and was gutted (Figure 2). On 16 November 2015, we were informed of another cobia of approximately the same size (56 cm TL) caught at Boya 1 at the entrance to Buenaventura Port (the photograph was clearly that of a cobia). These fish likely correspond to the cobias that escaped from the cages in Jaramijó two-three months prior. We have been monitoring in various ports along the Colombian Pacific coast for five years and have never before observed the capture of specimens of *R. canadum*.

## Discussion

There are a number of documented introduced fish species in the Tropical Eastern Pacific region, especially species that have crossed the Panama Canal from the Atlantic Ocean (Cohen 2006, Robertson and Allen 2015). Interestingly, none of these introductions have spread significantly in the Tropical Eastern Pacific. Most species have remained in the Gulf of Panama and only a few have been sighted on the Pacific coast of Costa Rica and Colombia, e.g., the tarpon *Megalops atlanticus* Valenciennes, 1847. Despite



**Figure 2.** Cobia captured by an artisanal fisher near Punta Aji and landed in Buenaventura on 8 October 2015. Photograph by Rodrigo Baos.

being occasionally reported in the Eastern Pacific Ocean since at least 1939 (Hildebrand 1939), there is no evidence that the tarpon has been able to establish reproducing populations.

The 4000-7000 km stretch of deep open-ocean known as the East Pacific Barrier has prevented the circumtropical distribution of many organisms, including cobias, in the Tropical Eastern Pacific (Gaither et al. *in press*). The presence of cobias in waters of the Colombian Pacific coast after release in Ecuador is not surprising given the highly migratory characteristic of this species. Cobias have not been previously reported in waters of the Colombian Pacific coast, nor has aquaculture of this species been authorized by the Colombian government on this coast. The fact that cobias released in Ecuador were not mature might hinder the establishment of this species in Tropical Eastern Pacific. However, given the life history characteristics (migratory, fast growth, voracious feeder) documented for this species and the possibility that large number of individuals were stocked in Ecuador (ca. 100,000 juveniles were stocked in the single cage where the escape took place), these cobias could survive and reach sexual maturity in a few months. Cobia matures at about 70 cm fork length but has been reported to mature at 42.6 cm TL in Indian waters (Brown-Peterson et al. 2001; Shaffer and Nakamura 1989). The ecological and socio-economic (e.g. fisheries) consequences of the establishment of cobias in the Tropical Eastern Pacific are unknown. However, due to the predatory nature of species, it is possible that cobias can alter trophic pathways in pelagic and coastal ecosystems of the region. This will need to be carefully monitored.

It is unknown if the cobias released in Ecuador will be able to establish in the Tropical Eastern Pacific region. However, a lesson from this unfortunate experience is that permitting

aquaculture of non-native fish species will ultimately end in the release of these non-natives into the environment (e.g. sea). Therefore, governments and environmental agencies from countries in the Tropical Eastern Pacific should carefully consider the Ecuadorian experience when thinking about giving licenses for the cultivation of “holy grails of aquaculture” (e.g. cobias), and evaluate the potential deleterious effects that such introductions could bring for marine ecosystems in the Tropical Eastern Pacific.

## Acknowledgements

We thank the artisanal fishermen who reported the presence of cobia in the Colombian Pacific coast. The continuing support of the people at Pesquera Natipez during the last years has allowed monitoring landings and the current report. We thank L. Cuadros (World Wildlife Fund – WWF, Cali Colombia) for providing Figure 1 and DR Robertson (Smithsonian Tropical Research Institution – STRI, Panama City, Panama), Demetrio Boltovskoy (handling editor), John Mark Hanson (Co-Editor-in Chief) and two anonymous reviewers for commenting on an early draft of this note.

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## Supplementary material

The following supplementary material is available for this article:

**Table S1.** Records of cobia *Rachycentron canadum* off the coasts of Ecuador and Colombia, Tropical Eastern Pacific.

This material is available as part of online article from:

[http://www.reabic.net/journals/bir/2016/Supplements/BIR\\_2016\\_Castellanos-Galindo\\_etal\\_Supplement.xls](http://www.reabic.net/journals/bir/2016/Supplements/BIR_2016_Castellanos-Galindo_etal_Supplement.xls)