

**Mass mortality of *Canthigaster rostrata*
(Tetraodontiformes: Tetraodontidae) on the southern
Costa Rican Caribbean coast**

**Mortalidad masiva de *Canthigaster rostrata*
(Tetraodontiformes: Tetraodontidae) en la costa del
Caribe Sur de Costa Rica**

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ABSTRACT

In 2017 a mass mortality event of the reef fish *Canthigaster rostrata* was observed on the Southern Caribbean coast of Costa Rica. The 86 subjects collected, possibly juveniles, were less than 49 mm and below 2.8 g. Similar events have been reported in other Caribbean locations and may be associated with changes in sea temperature or resource exhaustion during their recruitment period.

Keywords: *Canthigaster rostrata*, mass mortality, reef fish, Caribbean, Costa Rica.

RESUMEN

Durante el 2017, observamos un evento de mortalidad masiva del pez de arrecife *Canthigaster rostrata* en el Caribe Sur costarricense. Los 86 individuos recolectados, posiblemente juveniles, presentaron tallas menores a los 49 mm y pesos debajo de 2.8 g. Eventos similares se han reportado en otras localidades del Caribe y podrían asociarse a cambios en la temperatura marina o al agotamiento de recursos durante su estrategia de reclutamiento.

Palabras claves: *Canthigaster rostrata*, mortalidad masiva, peces de arrecife, Caribe, Costa Rica.

INTRODUCTION

Canthigaster rostrata (Tetraodontiformes: Tetraodontidae) is a typical species in the Caribbean coral

reef, in areas characterized by coral heads and dense patches of marine sponges. Females defend their territory, which is used for shelter, feeding and spawning (Sikkel, 1990). In

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the Caribbean coast of Costa Rica, this species has been reported in the reefs of Puerto Viejo (Schaper, 1996), Isla Quiribí (Barrantes, 2010), Cahuita (Cortés *et al.* 2010), Cocles, Punta Uva, and Manzanillo (Arrieta, 2013).

Several reports of mass mortality of *C. rostrata* in the Greater Caribbean area have been made mainly by the press, blogs, or social networks (Castillo & Pérez, 2014; Gutiérrez, 2014; El Isleño, 2017); however, there is little documentation of this phenomenon in the scientific literature (Jordán-Garza *et al.* 2009), despite the fact that it may be a potential indicator of disturbances in marine environments.

The objective of this paper is to describe a mass mortality event of *C. rostrata* between April 17th and May 6th, 2017, in three sites along approximately 60 km of coastline and up to 1.35 km offshore of the Southern Caribbean coast of Costa Rica, as a recognition of the need to study indicators of changes in the ocean, and scientifically document mass mortality events.

MATERIALS AND METHODS

Dead individuals of *C. rostrata* were found and photographed on the sand and on the surface of the sea within the Gandoca-Manzanillo National Wildlife Refuge (REGAMA), specifically in Playa Gandoca (9° 35' 54.42''

N and 82° 36' 21.15'' W) (Fig. 1a.) and Punta Uva (9° 39' 11.12'' N and 82° 41' 33.94'' W) (Fig. 1b). Members of the Cieneguita Fishermen's Association reported a similar event near Isla Quiribí (9° 59' 34.32'' N and 83° 0' 44.95'' W). This is the only location where dead individuals, 86 to be exact, were collected floating on the surface of the sea.

The photographs taken were analyzed individually to establish the maximum number of dead fish per m². Fish collected were preserved in 70% alcohol and were later examined in the Laboratory of Natural Resources and Wildlife (LARNAVISI) at Universidad Nacional de Costa Rica (UNA) to determine whether they had external lesions and to measure total length (*Lt*) (Fig. 1c) and weight (g). Control specimens were taken to the Museum of Zoology of the School of Biological Sciences at UNA. These specimens did not constitute the total number of dead fish found.

RESULTS AND DISCUSSION

In Playa Gandoca, up to 57 dead individuals/m² were found, arranged in a linear manner parallel to the coast, while in Punta Uva a maximum of 64 dead individuals/m² were counted on the sea surface, being moved in rows by the currents from the northwest to the southeast. It is important to note that during the dives performed at Punta

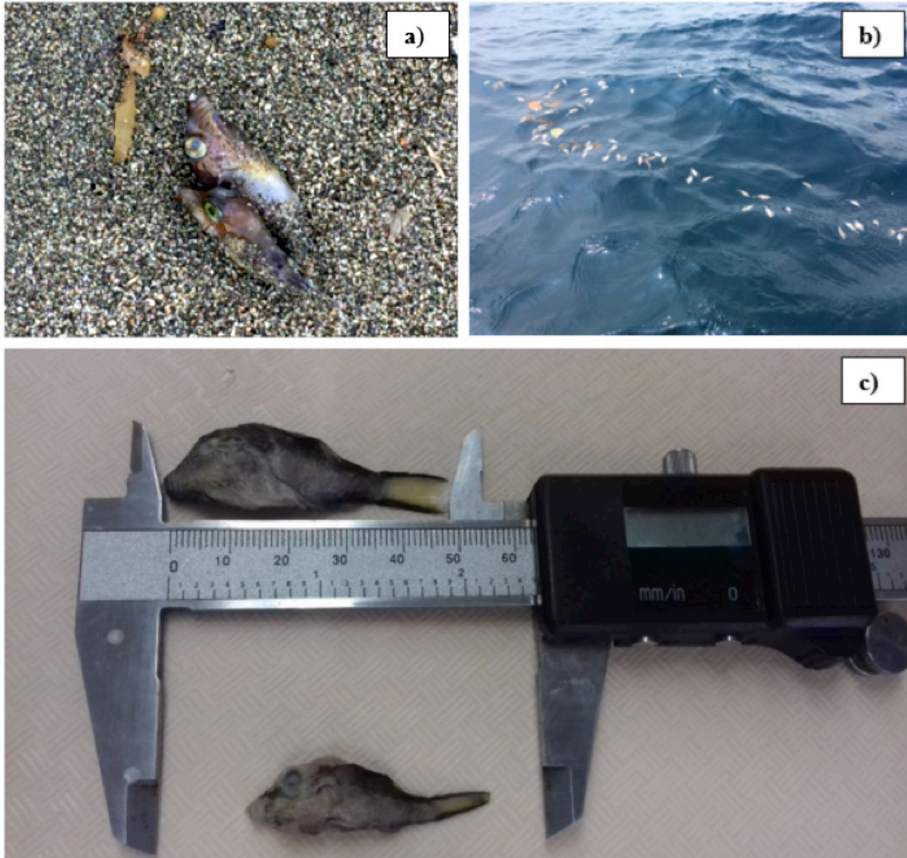


Fig. 1. *C. rostrata* individuals found dead in a) the sand of Playa Gandoca (photo provided by Felix Morrison), b) in the water near Punta Uva, and c) collected in the water in Isla Quiribí, which were measured for total length in mm (*Lt*)

Fig. 1. Individuos de *C. rostrata* encontrados muertos en a) la arena de la Playa Gandoca (fotografía suministrada por Felix Morrison), b) en el agua en las cercanías a Punta Uva y c) recolectados en el agua en Isla Quiribí que fueron medidos en *Lt* (mm)

Uva, live healthy specimens of *C. rostrata* were found, larger than the dead individuals on the surface. None of the dead individuals photographed or collected showed lesions, spots, presence

of ectoparasites, or morphological anomalies in external tissues that could indicate the cause of mortality.

The *Lt* of the collected fish varied between 25 and 49 mm, with

an average of 36.73 ± 4.72 mm, while their weight ranged between 0.40 and 2.08 g, with an average of 0.90 ± 0.37 g. These sizes are similar to those found by Jordán-Garza *et al.* (2009) in another *C. rostrata* mass mortality event reported on the northwest coast of the Yucatan Peninsula, where average *Lt* was 38 ± 2.6 mm, with densities of 39.5 ± 23.6 dead individuals/m².

Jordán-Garza *et al.* (2009) considered that the dead fish were probably juveniles of the same cohort, since their *Lts* were smaller than those of the adults of reproductive age reported by Sikkell (1990). This could also be the case for most of the individuals collected for the present study. Similar events have been reported in blogs and other electronic media in Costa Rica and elsewhere in the Caribbean (Table 1), in which the sizes of dead individuals were approximately 40 mm (Castillo & Pérez, 2014).

Some of the possible causes of death documented in other mass mortality events of tetraodontidae and reef fish include infection by ectoparasite copepods in *Diodon maculatus* (Sri Lanka) (Kirtisinghe, 1934), paralytic toxins produced by dinoflagellates (Baja California, Mexico) (Ochoa *et al.* 1997), outbreaks of diseases in surgeonfish such as *Ctenochaetus striatus* (French Polynesia) (Stier *et al.* 2013) and toxicosis (Hawaii), which caused vacuolar changes in the liver of *Aro-*

thron hispidus and death (Work *et al.* 2017). The artisanal fishing practices in the area were ruled out as potential causes, since the event only affected *C. rostrata*, which is not a species of commercial interest. The phenomenon lasted three weeks and was observed in locations at least 10 km apart from each other.

High mortality could also be associated with increase in sea surface temperatures, which can intensify metabolic requirements and reduce survival when exceeding the optimal ranges for the species (Holt & Jørgensen, 2015). The adverse effects of temperature on the recruitment of fish have also been studied by Berlinsky *et al.* (2004), Trujillo (2009) and Shi *et al.* (2010). For the dates of the event reported, sea surface temperature fluctuated between 29 and 30°C (Universidad de Costa Rica, 2016), higher than that reported by Piedra-Castro (2017) in the period 2003-2013 in the same area. This could possibly affect survival.

However, these *C. rostrata* mass mortality events seem to be rather related to a recruitment strategy reported in fish of the family Tetraodontidae, such as *Diodon holocanthus*. These balloon fish form aggregations of up to 400 juvenile individuals/m² in order to establish larger populations of adults at important feeding sites (Debrot & Nagelkerken, 1997). Local resources present in the reefs and marine

Table 1. Locations in the Greater Caribbean with reports of high *C. rostrata* mortalities

Cuadro 1. Localidades con reportes de mortalidades altas de *C. rostrata* en el Gran Caribe

Year	Location	Event	Reference
2008	Yucatan Peninsula (Mexico)	Mass mortality	Jordán-Garza <i>et al.</i> (2009)
2009	Roatán (Honduras)	Increases in density and mortality, but no mass mortality	N. Bolaños-Cubillos, Personal communication, January 31, 2018*
2013	San Andrés (Colombia), Turneffe, South Water Caye, Gladden Spit, Silk Cayes, Sapodilla Cayes, Central & South Barrier Reef (Belize), Roatán (Honduras), Southern Caribbean (Costa Rica)	Mass mortality and noticeable increase in density.	N. Bolaños-Cubillos, personal communication, January 31, 2018*
2014	Guna Yala and Bocas del Toro (Panama), Southern Caribbean (Costa Rica)	Mortality	Castillo & Pérez (2014) Gutiérrez (2014)
2017	San Andrés (Colombia), Southern Caribbean (Costa Rica)	Mass mortality and increased density	El Isleño (2017). (see bibliography of this paper).

* N. Bolaños-Cubillos allowed the citation of information of similar events in other locations in the Greater Caribbean reported in “Coral List” emails.

phanerogams may, therefore, not be sufficient to sustain these large aggregations of juveniles.

Vali & Sinclair-Taylor (2011) reported a similar recruitment and mortality event for fish of the same genus (*C. bennetti*) in Sulawesi, during which the recruits had sizes similar to those discussed in this paper (approximately 40 mm). This could indicate

an insufficiency of available resources in the environment required to satisfy the metabolic needs of high densities of individuals, which would constitute a stressor for the recruits causing the death of many individuals.

Although some possible causes of these mass mortality events have been presented in this paper, it is important to conduct exhaustive studies and im-

plement strategies to monitor these phenomena and their consequences in marine ecosystems.

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