

Rapid Communication

Spatial distribution and abundance of the giant tiger prawn, *Penaeus monodon* (Fabricius, 1798), in the Gulf of Urabá (Caribbean), Colombia, South America

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Abstract

The spatial distribution and abundance of the non-native giant tiger prawn *Penaeus monodon* (Fabricius, 1798) in the Gulf of Urabá, Colombian Caribbean, was examined using catch records made by trained fishermen. From 1 April to 30 November 2011, 397 individuals were recorded in 20 fishing localities in the Gulf. Individual weights ranged between 50 and 500 g (average 232 g). According to local fishermen, however, the giant tiger prawn has been present in the Gulf since 2007, possibly earlier. This non-native species was commonly captured along with the native white shrimp *Litopenaeus schmitti* (Burkenroad, 1936) in river mouths and mangrove habitat. The highest catches were from two sites near the Atrato river mouth (Boca del Roto, Boca del Leoncito) and one other site near the Turbo river mouth (Punta Yarumal). The effects of the giant tiger prawn, if it has become established, on the environment and the economy of the region areas is as yet unknown.

Key words: Asian species, decapod shrimp, invasion, South Caribbean Sea, estuary

Introduction

In tropical regions of the world, there is still very little known regarding the presence and impact of non-native species on estuarine environments. In fact, one of the largest obstacles for understanding the role of alien species in the tropics is that inventories of native species are incomplete, and non-native species sometimes are cryptogenic and considered native through misidentification (Grosholz 2002; Carlton 1996). The natural distribution of the giant tiger prawn *Penaeus monodon* (Fabricius, 1798) covers the Indo-West Pacific oceans including East Africa, South Asia, Southeast Asia, the Philippines, and Australia (Pérez-Farfante and Kensley 1997; Benzei

2000). Larval, juvenile, and sub-adult stages develop in estuaries, coastal lagoons, and mangroves, while adults inhabit the continental shelf (Hughes 1966; Holthuis 1980). Once mature, the giant tiger prawn reproduces only in tropical marine habitats. This crustacean however has been widely cultivated outside of its natural range, where conditions are suitable, e.g., Western Africa and areas of the Caribbean including Florida, USA (Salisbury 2004; Fuller et al 2014).

In South America, *Penaeus monodon* has been recorded in the wild in Brazil (Fausto-Filho 1987; Coelho et al. 2001; Santos and Coelho 2002), and in the Caribbean in waters of Venezuela (Aguado and Sayegh 2007), Colombia (Gómez-Lemos and Campos 2008), Cuba (Giménez Hurtado

et al. 2013), Mexico (Wakida-Kusunoki 2013), USA, Puerto Rico, and the Dominican Republic (Knott et al. 2012). Apparently, this prawn was intentionally introduced to Colombia from Brazil in the 1980's. There was a brief, non-successful, attempt of cultivation of this species along the northern coastal state of Cordoba (Álvarez-León and Gutierrez-Bonilla 2007; Baptiste et al. 2010). However, it is not clear how and when *P. monodon* reached the natural environment because it was not until 2005 that the species was first recognized and captured in the wild by shrimp-catching vessels in the northeastern coastal state of Guajira (Gómez-Lemos and Campos 2008; Galván-Guevara and De La Ossa 2011). Today, *P. monodon* is recorded extensively throughout the Caribbean coastal region of Colombia, with records of mature females in the northern continental shelf (Gracia et al. 2011), but it has not as yet become commercially important in the country.

Penaeus monodon has been included in Colombia's list of highly-dangerous non-native species due to limited knowledge of its impact on native ecosystems (Baptiste et al. 2010; Gracia et al. 2011). Control and management measurements by the Colombian government include the proposal to develop extended campaigns of public awareness and the generation of precise data on the abundance and distribution of *P. monodon* (MAVDT 2010). In accord with these proposals, this is a first examination of the distribution and relative abundance of the giant tiger prawn (*Penaeus monodon*) in the Gulf of Urabá.

Methods

The Gulf of Urabá, located at the southern end of the northern coast of Colombia (7°50' – 8°56' N 77°22' – 76°25' W), is considered to be the largest estuary along this coast. It is a semi-enclosed water body (area 4.291 km²), with a maximum width of 20 km, elongated from North to South. The delta of the Atrato River is located on the western side of the Gulf and carries the second largest volume of water, after the Magdalena River, from Colombia to the Caribbean (García 2007).

The artisanal shrimp fishery in the Gulf of Urabá targets the native southern white shrimp *Litopenaeus schmitti* (Burkenroad, 1936), but from time to time the non-native giant tiger prawn is caught. From April to November 2011, previously-trained fishermen collected catch information (number of individuals) of the non-native species caught by the artisanal shrimp

fishery in the three main landing centers along the Gulf of Urabá: El Totumo, Camerún, and El Uno (Figure 1). As well, there was a workshop in each of the three landing centers to determine the geographical coordinates and names of the fishing localities as well as the most used fishing methods to capture the non-native and native shrimps. The shrimp typically were caught using fixed, nylon, gill nets that were 1200 m long x 0.9 m high and with a 63.5 mm mesh size. Nets were set for 2 to 6 hours. Due to logistical difficulties, fishermen could not record the weight, sex, and sizes of all individuals captured.

Penaeus monodon and the native *L. schmitti* were differentiated by their characteristic coloration. Giant tiger prawns typically are dark in color, with the carapace and abdomen transversely banded in black and white, and a variable color ranging from light brown to blue or red on the rest of the body (Grey et al. 1983). The native white shrimp is usually colored white or translucent bluish gray, sometimes with greenish or yellowish spots (Bermúdez 2002).

Collected specimens of *P. monodon* were deposited at the National Museum of Natural Marine History coordinated by the Institute for Marine and Coastal Research – INVEMAR, located in Santa Marta, Colombia.

The abundance of *P. monodon* was expressed as catch per unit effort (CPUE) calculated as number of individuals per meter of net per hour soak time × 100 (Sparre and Venema 1995). The CPUE was multiplied by 100 as a scaling factor.

Fishing localities were mapped using the software ArcMap 10.1 (ESRI; Environmental Systems Research Institute, Redlands, California).

Results

Fishermen recorded captures of 397 giant tiger prawns from 20 fishing localities associated with mangroves in the Gulf of Urabá (Figure 1; supplementary Table S1). The non-native species was caught throughout the Gulf in all sites traditionally fished for the native southern white shrimp. The CPUE of *P. monodon* ranged from 0.6 to 37.8, being particularly high at two sites near the Atrato river mouth (Boca del Roto and Boca del Leoncito) and one site near the Turbo river mouth (Punta Yarumal) (Figure 1). The weights of the individuals ranged between 50 and 500 g, with an average weight of 232 g. Based on interviews with fishermen, the giant tiger prawn first appeared in the Gulf of Urabá in about 2007.

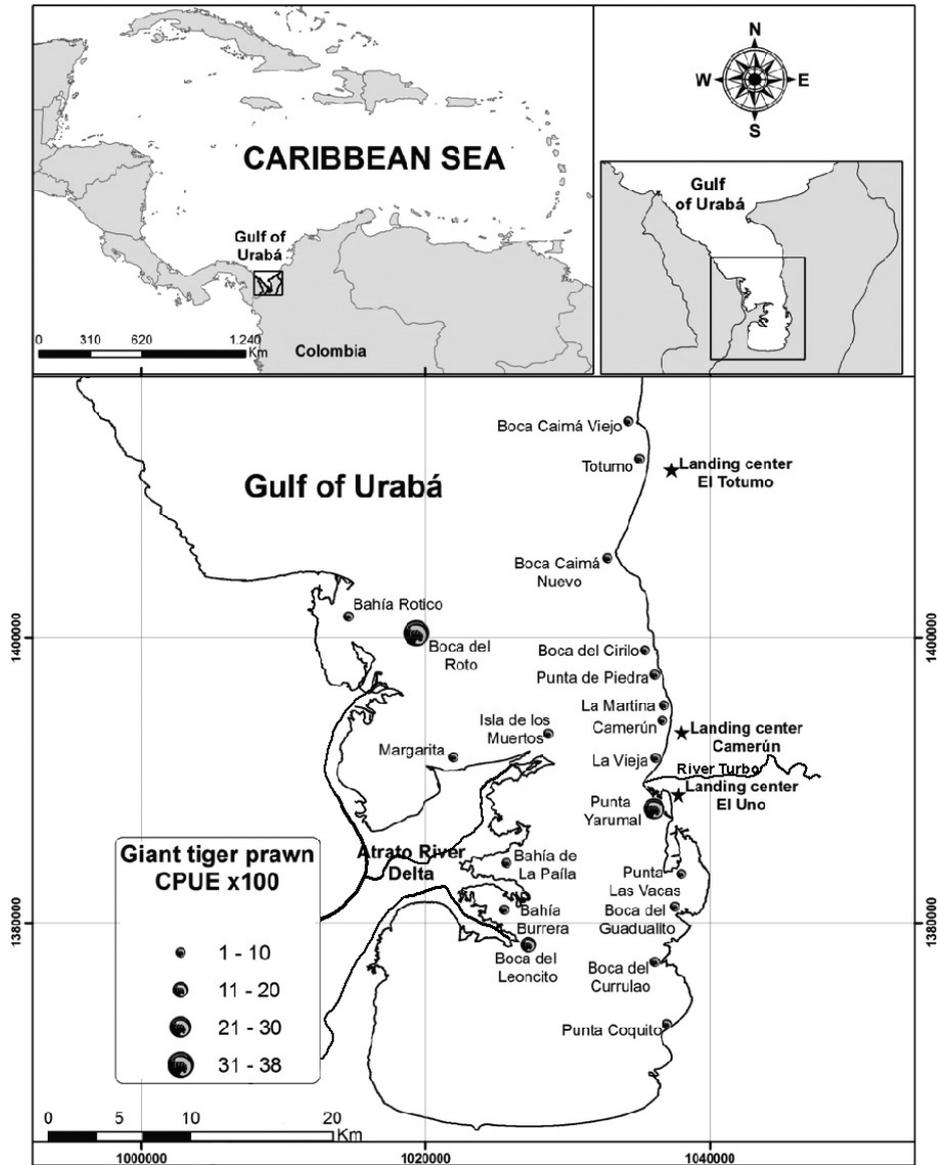


Figure 1. Locations of catch and abundance (CPUE as number per m of net per hour fished X 100) of giant tiger prawn *Penaeus monodon* in the Gulf of Urabá, Colombian Caribbean. See also supplementary Table S1.

Discussion

In the Gulf of Urabá, *P. monodon* is currently common in the commercial shrimp catches. It is associated mainly with estuarine environments and the river mouths where mangroves exist. Such habitats favor the establishment of the larvae, juvenile, and sub-adult stages of this species (Hughes 1966; Holthuis 1980). The presence of all stages of a non-native species in a new environment is the first evidence of establishment

of a self-sustaining population in the region and is part of the process of naturalization described by Lockwood et al. (2007). In order to confirm the establishment of *P. monodon* in the region, it is necessary to develop further research that should focus on all life stages as only information on large juveniles and adults is currently available.

Although young individuals of giant tiger prawn are distinguishable from the adults of the native white shrimp (*L. schmitti*) by their

different coloration, this study may have been underestimated or missed evidence of small individuals of *P. monodon*. The 63.5 mm mesh size of the gill nets used by the fishermen will not retain the small (< 50 g) individuals of giant tiger prawn. In addition, fishermen often remove the heads of *P. monodon* and mix the individuals in with the native shrimps to confuse the buyers at local markets – local people prefer the native white shrimp.

There is no explanation for the gap between the timing of the first introduction of the giant tiger prawn in Colombian waters (1981) and its first report in the Gulf of Urabá (2007). Nevertheless, in recent years, records of the giant tiger prawn have increased throughout the Colombian Caribbean, as well as in other areas of the rest of the Atlantic coast of the continent, such as the southeastern coast of the United States. In the southeastern USA, reported catches have increased from 4 individuals in 2007 to several hundred adults plus juveniles in 2011; the presence of juveniles indicating establishment likely has occurred (Fuller et al. 2014). This general trend could mean an increase of its abundance in this side of the continent.

There are still a lot of unknown factors concerning the ecology of the giant tiger prawn in Colombian waters, such as the feeding or reproductive habits and the impacts of this species on the local environment and fishery. However, information on its biological features in its native range could provide useful insights. In its native range, the diet is comprised mainly of crustaceans and mollusks, while polychaetes, fishes, vegetation and detritus are of lesser importance (Marte 1980; Su and Liao 1986). These feeding habits suggest a possible negative effect on the populations of the native counterpart *L. schmitti* in the Gulf of Urabá due to predation and competition for prey (Gracia et al. 2011). Further studies are needed evaluate the possibility of negative effects on the native species in the region.

Another potential threat of *P. monodon* to native species, is the introduction of viral diseases such as YHV (Yellow-Head Virus), IHNV (Infectious Hypodermal and Hematopoietic Necrosis Virus), HPV (Hepatoprancreatic Parvo-like Virus), BMNV (Baculoviral Midgut Gland Necrosis Virus), MBV (*P. monodon*-type Baculo Virus), LPV (Lymphoidal Parvo-like Virus), RLV (Reo-Like Virus) and WSBV (White Spot Syndrome Associated Baculo Virus) (Chang et al.

1998; Tavares and Braga 2004; Atencio et al. 2006). Research in Taiwan, in which the WSBV was isolated from *P. monodon* and inoculated into native marine lobsters, crabs, and freshwater shrimps, indicate that the virus adversely affects these native species, causing varying degrees of infestation and mortality. The least affected species were freshwater shrimps (Chang et al. 1998; Gómez-Lemos and Campos 2008). Until now there are no records of such diseases within the native species in the Gulf of Urabá, but the arrival of new individuals of giant tiger prawn carrying one of these viruses cannot be ruled out.

In conclusion, this was the first study undertaken in Colombia to estimate the distribution and abundance of *P. monodon* in the Gulf of Urabá. It was found in the most estuarine habitats and river mouths associated with mangroves, and it is frequently caught by commercial shrimp harvesters. The presence of small sizes of the giant tiger prawn in the region suggests that it may have established a self-sustaining population in the Gulf of Urabá but direct confirmation is still needed. The effects of this invasive species on the structure and functioning of the ecosystem, and the economy of the region, are as yet unknown. It is a priority to monitor its population growth and perform ecological studies that will provide the necessary information to implement measures of control, mitigation and management of this species in a region where shrimp fishery has been historically important for the economic sustenance of its coastal inhabitants.

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Supplementary material

The following supplementary material is available for this article:

Table S1. Records of *Penaeus monodon*, in the Gulf of Urabá, Colombian Caribbean.

This material is available as part of online article from:

http://www.reabic.net/journals/bir/2014/Supplements/BIR_2014_Sandoval_et al_Supplement.xls