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ALIEN MARINE DECAPOD CRUSTACEANS IN THE CARIBBEAN: A REVIEW WITH FIRST RECORD OF *Athanas dimorphus* ORTMANN, 1894 (CARIDEA: ALPHEIDAE)

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ABSTRACT

The presence of marine alien species of decapod crustaceans in the Caribbean Sea is reviewed on the base of scientific records, with special emphasis to the Caribbean coast of Venezuela. Additionally, the presence of *Athanas dimorphus,* an Alpheidae shrimp from the Indo-West Pacific, previously reported in the western Atlantic on the Brazilian coast, is recorded for the first time in the area. With this finding, we confirm that *Penaeus monodon, Callinectes arcuatus, Charybdis helleri, Rhithropanopeus harrisii* and *Athanas dimorphus* are the only decapod crustaceans with wild populations already established in the Caribbean Sea.

Keywords: Biodiversity, Invasive species, Crustacea, Decapoda, Venezuela

Crustáceos decápodos marinos exóticos en el Caribe: Una revisión con el primer registro de *Athanas dimorphus* Ortmann, 1894 (Caridea: Alpheidae)

Resumen

Se hace una revisión de la presencia de especies exóticas de crustáceos decápodos en el Mar Caribe, con especial atención a las costas caribeñas de Venezuela, con base en la revisión de la literatura especializada. Adicionalmente, se señala por primera vez la presencia en la zona de *Athanas dimorphus*, un camarón Alpheidae proveniente del Pacífico indooccidental y que había sido reportado previamente en las costas de Brasil. Con este hallazgo se confirma que *Penaeus monodon, Callinectes arcuatus, Charybdis helleri, Rhithropanopeus harrisii* y *Athanas dimorphus* son las únicas especies de crustáceos decápodos con poblaciones silvestres establecidas.

Palabras clave: Biodiversidad, especies invasoras, Crustacea, Decapoda, Venezuela

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INTRODUCTION

Invasion by exotic species is exponentially increasing in the globalized world. The number of introduced species around the world has no precedent (Tavares and Mendonça, 2004). The introduction of exotic or non-native species into natural ecosystems has been identified as the second greatest threat to biodiversity after habitat destruction (Gracia *et al.*, 2011). This introduction may be accidental or incidental. Although aquatic introductions are most frequently associated to anthropogenic activities of socio-economic interest, such as maritime and fluvial transportation, aquariophily, aquaculture and transport of food and ornamental plants (Rodríguez and Suárez, 2001; Tavares and Mendonça, 2004), they can also result from oceanographic phenomena such as El Niño (Pérez *et al.*, 2007) and they produce dramatic effects to biological productivity, habitat structure and species composition (Pérez *et al.*, 2007; Gracia *et al.*, 2011).

North America is the second largest native region for crustaceans invasions, with 108 non-native species of crustaceans (15 of them being decapods) that were classified as having established populations in marine and estuarine (tidal) waters (Ruiz *et al.*, 2011). In the other end of the continent, at least 24 species of nonindigenous decapods have been reported in marine, brackish, and fresh waters just in Brazil (Almeida *et al.*, 2015), but only five alien marine species can be consider successfully established on the southwestern Atlantic (Tavares, 2011).

Little is known about established alien decapods in the Caribbean Sea. Rodríguez and Suárez (2001) reported three alien species, one marine, one estuarine and one of freshwater, established in the area: *Charybdis helleri* (A. Milne-Edwards, 1867), *Rhithropanopeus harrisii* (Gould, 1841) and *Macrobrachium rosenbergii* (De Man, 1879), respectively. Kairo and Ali (2003) only recognize *Macrobrachium rosenbergii* as an invasive decapod in the Caribbean region. Pérez *et al.* (2007) listed six species of decapods catalogued as exotic in Venezuelan waters (four shrimps and two brachyurans); these are: *Macrobrachium rosenbergii, Penaeus monodon* (Fabricius, 1798), *Litopenaeus stylirostris* (Stimpson, 1874), *L. vannamei* (Boone, 1931), *Charybdis helleri* and *Rhithropanopeus harrisii.* Brockerhoff and McLay (2011) listed three species of established (*Rhithropanopeus harrisii, Eriocheir sinensis* H. Milne Edwards, 1853, *Platychirograpsus spectabilis* De Man, 1896) and two of non-established alien crabs [*Neorhynchoplax kempi* (Chopra and Das, 1930) and *Charybdis hellerii*] in the Panamá/Caribbean region.

We review here the history and distribution of the marine and estuarine alien species of decapods established in the Caribbean Sea. We register for the first time the presence of the alien alpheid shrimp *Athanas dimorphus* Ortmann, 1894 in the area, and we discuss on possible introduction vectors and dispersion potential in the Caribbean. Neither cryptogenic species nor

freshwater [e.g. *Platychirograpsus spectabilis* and *Macrobrachium rosenbergii,* respectively] species have been included. We didn't consider records of non-indigenous species in the area cited only in grey literature. We consider the Caribbean as the sea bordered on the north by Cuba, Hispaniola (Haiti and Dominican Republic) and Puerto Rico, on the east by the Lesser Antilles, on the south by Venezuela, Colombia and Panama, and on the west by Mexico (east coast of Peninsula of Yucatán), Belize, Guatemala, Honduras, Nicaragua and Costa Rica.

The following definitions are used: "native species", within its natural range; "alien", outside its natural geographic range; "established species", species with self maintaining populations (producing their own recruits) or with many records (Brockerhoff and McLay, 2011); "cryptogenic species", species that are not known to be native or introduced (Pérez *et al.*, 2007).

MARINE ALIEN DECAPODS

Eight species of alien marine decapods have been recorded in the Caribbean Sea: *Litopenaeus stylirostris, L. vannamei, Marsupenaeus japonicus, Penaeus monodon, Callinectes arcuatus, Charybdis helleri, Rhithropanopeus harrisii* and *Eriocheir sinensis*. *Platychirograpsus spectabilis* is considered here as cryptogenetic species since Buitendijk (1950) accounted it as native for both western and eastern Atlantic.

***Litopenaeus stylirostris* (Stimpson, 1874)** is native to the eastern Pacific, from Baja California (Mexico) to Peru (Tavares, 2011). In the late 1970s and 1980s, Pacific blue shrimp was transferred for cultivation from their natural range to the north-western Pacific coast of the Americas in the United States of America and Hawaii, and to the eastern Atlantic coast from Carolina and Texas in the north through Mexico, Belize, Nicaragua, Colombia, Venezuela and on to Brazil in the south (Briggs *et al.* 2005). In the Caribbean the Pacific blue shrimp has not been recorded in the wild. In Venezuela *Litopenaeus stylirostris* was introduced for cultivation in 1984 and it is suspected that the species is now established off the State of Anzoátegui, probably by escapement of specimens from aquaculture facilities (Pérez *et al.*, 2007). The risk associated with the escape of this species to the wild are that could either displace native shrimp populations by out-competing them, interbreeding with them, or killing them through contamination with fatal pathogens (i.e. viruses) to which they are susceptible (Briggs *et al.* 2005).

***Litopenaeus vannamei* (Boone, 1931)** native to the eastern Pacific, ranging from Mexico to Peru (Holthuis 1980), and is an alien species in most of the countries of Asia, and the Atlantic coast of America. The Pacific white shrimp was introduced for cultivation in several countries in Latin America and the Caribbean such as Brazil, Venezuela, Belize, Colombia,

Panamá, Suriname, Saint Kitts, Jamaica, Cuba, Dominican Republic and Bahamas; some of these countries are currently among the main producers in the word (Briggs, 2006). In the Caribbean the Pacific white shrimp has not been recorded in the wild. Escapees of *L. vannamei* are common in many areas worldwide, including several locations in Brazil (Tavares, 2011), and it is suspected that it is established off the State of Anzoátegui, Venezuela (Pérez *et al.*, 2007), probably because of mismanagement. The possible ecological impacts of the escape of this species to the wild are the same as those of *L. stylirostris.*

***Marsupenaeus japonicus* (Bate, 1888)** is native to the Indo-West Pacific, from Red Sea and east Africa to Fiji and invasive into Mediterranean and in north-east Atlantic (Noël, 2011). The kuruma shrimp was introduced in Venezuela for cultivation, but it was eliminated because the risk of transmission of pathogens (Pérez *et al.,* 2007). There are no records of specimens caught in the wild in the Caribbean. Escapees have been captured on the north-eastern Brazilian coast (Tavares, 2011). The possible ecological impacts of the escape of this species to the wild are the same as those of *L. stylirostris.*

***Penaeus monodon* (Fabricius, 1798)** is native to the Indo-West Pacific (D'Udekem D'Acoz, 1999). The natural distribution of the giant tiger prawn covers the Indo-West Pacific oceans, ranging northward to Japan and Taiwan, eastward to Tahiti, southward to Australia, and westward to Africa (Sandoval *et al.,* 2014). In the Caribbean the giant tiger prawn has been recorded in the wild in Mexico (Wakida-Kusunoki *et al.,* 2016), Dominican Republic, Puerto Rico (Knott *et al.*, 2012), Cuba (Giménez-Hurtado *et al.*, 2013), Belize, Costa Rica (Alfaro-Montoya *et al.*, 2015; Wakida-Kusunoki *et al.*, 2016), Colombia (Medellín *et al.*, 2011a) and Venezuela (Aguado y Sayegh, 2007; Altuve *et al.*, 2008). Introductions of *P. monodon* into the western Atlantic are most likely explained by escapement of specimens from aquaculture facilities, by migration from areas where the tiger shrimp have previously become established in the wild, or via discharge of ballast water (Altuve *et al.*, 2008; Knott *et al.*, 2012; Wakida-Kusunoki *et al.,* 2016). Its presence in trawls and fishing activities is increasing, indicating that its population is successfully established. Its ecological impacts in areas where it has been introduced remains to be studied (Wakida-Kusunoki *et al.,* 2016), *P. monodon* is a more aggressive predator of soft-bodied invertebrate benthic organisms than other native shrimp species (Marte, 1980), and it could competes for food with larvae and juveniles of different species of fishes (Aguado and Sayegh, 2007).

***Callinectes arcuatus* Ordway, 1863**, species native to the Pacific coast of America, distributed from California (U.S.A.) to Mollenda (Peru) and Galapago Islands (Hendrickx, 1995). The only records of this species in the Caribbean are from Venezuela, in Margarita Island (Hernández and Bolaños, 1995) and in Sucre State (Muñoz and Blanco-Rambla, 1999). The

arched swimming crab must have migrated through the Canal de Panamá (Hernández and Bolaños, 1995). The presence of juveniles found in the samples collected in Sucre State (Muñoz and Blanco-Rambla, 1999) suggests that the species is successfully established in the locality. Nothing is known about its possible impacts on local species. Since *Callinectes danae* Smith, 1869 is very similar to *C. arcuatus* it is possible that some specimens of the former species previously collected in the Caribbean had been misidentified as the latter (Hernández and Bolaños, 1995).

***Charybdis hellerii* (A. Milne-Edwards, 1867)** is a species of Indo-West Pacific origin; it has been reported widely in the Red Sea, Djibouti, Somalia, South Africa, Madagascar, Persian Gulf, Pakistan, Andaman Islands, Hong Kong, Singapore, Ceylon, India, Mergui Archipelago, China, Japan, Indonesia, Australia and New Caledonia (Dineen *et al.*, 2001), and it was introduced in the Mediterranean through the Suez Canal (Mantelatto and Dias, 1999). In the Caribbean its first record was made by Campos and Türkay (1989) and it quickly spread all over the east coast of America. It has been recorded in Cuba (Gómez and Martínez-Iglesias, 1990), Belize (Felder *et al.*, 2009), Colombia (Campos and Türkay, 1989), and Venezuela (Bolaños *et al.*, 1997). The most recent reports extended the known range of *C. hellerii* in the western Atlantic from North Carolina (U.S.A.) to Santa Catarina (Brazil) (McMillen-Jackson, 2008). *Charybdis hellerii* spread has been attributed to larval transport (Tavares and Mendonça, 2004), via shipping along the coast (Tavares and Amouroux, 2003) and via migration of adult crabs (McMillen-Jackson, 2008). In the Caribbean, the species is established at least in some localities. In Margarita Island, Venezuela, the population of the Indo-Pacific swimming crab seems to be established since 1985. There are females brooding throughout the year but the reproductive potential of this population is low (Bolaños *et al.,* 2011). In Falcón State, Venezuela, it begins to interfere with the crab artisanal fishery, representing to 2003-2004, 5% of the capture in traditional crab net (Morán and Atencio, 2006). In Twin Cays, Belize it is possible displacing populations of large *Mithrax*, *Menippe*, *Callinectes*, and *Panulirus*, previously found there in abundance (Felder *et al.*, 2009).

***Rhithropanopeus harrisii* (Gould, 1841)** is native to the north-west Atlantic, from Canada to Mexico (Williams, 1984), and invasive in the Black Sea, Mediterranean, North Sea, north-east Pacific, north- east Atlantic, south-west Atlantic (Brockerhoff and McLay, 2011), and the Caribbean (Rodríguez and Suárez, 2001; Medellín *et al.*, 2011b). In the Caribbean the estuarine mud crab has been recorded in Panamá, Colombia (Medellín *et al.*, 2011b) and Venezuela (Rodríguez, 1963; Rodríguez and Morales, 2000). The estuarine mud crab was observed by the first time in 1957 in several localities of the Tablazo and Strait of Maracaibo, Venezuela (Rodríguez, 1963; Rodríguez and Morales, 2000). As the species was already very abundant in this estuary in 1957, it should have been introduced several years before, possibly in the ballast water of oil tankers (Rodríguez and

Suárez, 2001). The ecological impacts of its presence in the Caribbean have to be studied. In Europe and in western coast of North America it competes for food with native species of crab and fishes (Medellín *et al.*, 2011b).

***Eriocheir sinensis* H. Milne-Edwards, 1854** is native to north-west Pacific, from China and North Korean Peninsula, and invasive in north-east Atlantic (Germany, Finland, Sweden, Russia, Poland, Germany, Czech Republic, Netherlands, Belgium, England, France, Spain and Portugal), Black Sea, Baltic, North Sea, Mediterranean; north-east Pacific (San Francisco Bay, Portland, Oregon, on the Columbia River) (Cohen and Carlton, 1997); Detroit River, Great Lakes, St. Lawrence River (Veilleux and de Lafontaine, 2007). The only record of the presence of the Chinese mitten crab in the wild in the Panamá/Caribbean region was mentioned by Brockerhoff and McLay (2011; Table 3) but it seems to be a mistake because the same authors did not mention the Panama/Caribbean region in the current distribution of the species (Brockerhoff and McLay, 2011; Table 1). Other authors also did not included the Caribbean in the distribution area of the species (Cohen and Weinstein, 2001; Veilleux and Lafontaine, 2007; Bentley, 2011; Clark, 2011 among others). Its vector of spread in the places where it is invasive has been attributed to ship ballast water. Ecological impacts of *Eriocheir sinensis* in the places where it is invasive include competing for resources with native freshwater invertebrates, modifying habitats and causing erosion through its intensive burrowing activity, feeding on bait and trapped fish which cost fisheries and aquaculture industries, and blocking water intakes in irrigation and water supply schemes (Brockerhoff and McLay, 2011).

A CASE OF STUDY: *Athanas dimorphus*, A NEW ALIEN BETWEEN US

The genus *Athanas* Leach, 1814 includes 34 species of alpheid shrimps distributed in the Indo-West Pacific, in the eastern Atlantic (Chace, 1988, Anker and Ahyong, 2007), and in the Pacific (Banner and Banner, 1983). Most of them live in shallow waters (< 30 m), on sand, mud, rocks, pebbles and coral reef bottoms (Anker and Ahyong, 2007). *Athanas dimorphus* was previously restricted to the Indo-West Pacific, and it was recently recorded for the first time in Brazil by Pachelle *et al.* (2011). Some specimens of this species have been collected in Venezuelan waters.

The examined material was collected at different localities of Margarita Island and from Mochima National Park, Anzoátegui state, Venezuela (see details of habitat and collection under Material examined). Samples were asleep at low temperature in order to prevent autotomy and subsequently preserved in ethanol 90% for analysis. Drawings of the specimens were obtained with the help of a camera lucida attached to a stereomicroscope.

Vouchers of the specimens were deposited in the Crustacean Collection of the Museo Oceanológico Benigno Román (MOBR) of the Estación de Investigaciones Marinas of Fundación La Salle de Ciencias Naturales campus Margarita and in the Reference Collection of the Grupo de Investigación en Crustáceos of Universidad de Oriente, Núcleo Nueva Esparta (GIC).

(1) Taxonomy

SUPERFAMILY ALPHEOIDEA Rafinesque, 1815
FAMILY ALPHEIDAE Rafinesque, 1815
Athanas Leach, 1814
Athanas dimorphus Ortmann, 1894
Figure 1a-j.

Athanas dimorphus Ortmann, 1894: 12, pl. 1, Figure 1. Coutière, 1903: 6, Figure 12. Pachelle *et al.*, 2010: 90, Figures 2-3.- Almeida *et al.*, 2012: 2, Figure 1. Almeida *et al.*, 2015: 121, Figure 1.

Briefly description (based on the specimens herein reported): Rostrum styliform (Figure 1a), reaching distal margin of the second antennular segment; supra-corneal spine absent; acute extra-corneal spine (Figure 1b), exceeding basal margin of the cornea; small infra-corneal spine, blunt. Pleura of fourth abdominal somite with acute posteroventral angle; fifth abdominal somite shorter than sixth (Figure 1c). Exopod of uropods with transverse suture and a distolateral movable spine. Telson armed with two pairs of lateral spines on posterior margin and two pairs of dorsal spines (Figure 1j).

Antennular peduncle with first segment longer than others, second and third segment subequal in length; stylocerite overreaching distal margin of second antennular segment (Figure 1b). Scaphocerite overreaching slightly the distal margin of antennular peduncle, lateral spine exceeding the anterior margin of the blade (Figure 1b). Third maxilliped pediform, penultimate segment about half the length of ultimate segment, ultimate segment distally furnished with spiniform setae. Exopod long, reaching distal margin of antepenultimate segment (Figure 1g).

First pair of pereiopods (= first chelipeds) of females asymmetrical in length of palm and fingers; merus and carpus subequal in length (Figure 1d); palm about 1/2 of the length of carpus, fingers about 1/3 and 1/4 palm length on major (Figure 1e) and minor cheliped (Figure 1f), respectively. First chelipeds asymmetrical in shape in male; merus of major cheliped laterally compressed, wider than palm; ventral portion excavated to accommodate the chelae when folded (Figure 1l, 1m); carpus short, about ¼ palm length; palm compressed laterally, fingers less than 1/2 palm length; dactylus strongly arched, pollex almost straight (Figure 1n, 1ñ).

Second pereiopods (= second chelipeds) with ischium and merus short, carpus five-segmented, first article almost as long as four others combined; second, third and fourth article of same length; fifth article as long as the two precedent combined; palm of chela slightly shorter than fifth article of carpus, fingers as long as palm (Figure 1j). Third pereopod slender, propodus armed with six spines on flexor margin, the largest near articulation with dactylus, dactylus short, slightly curved (Figure 1k).

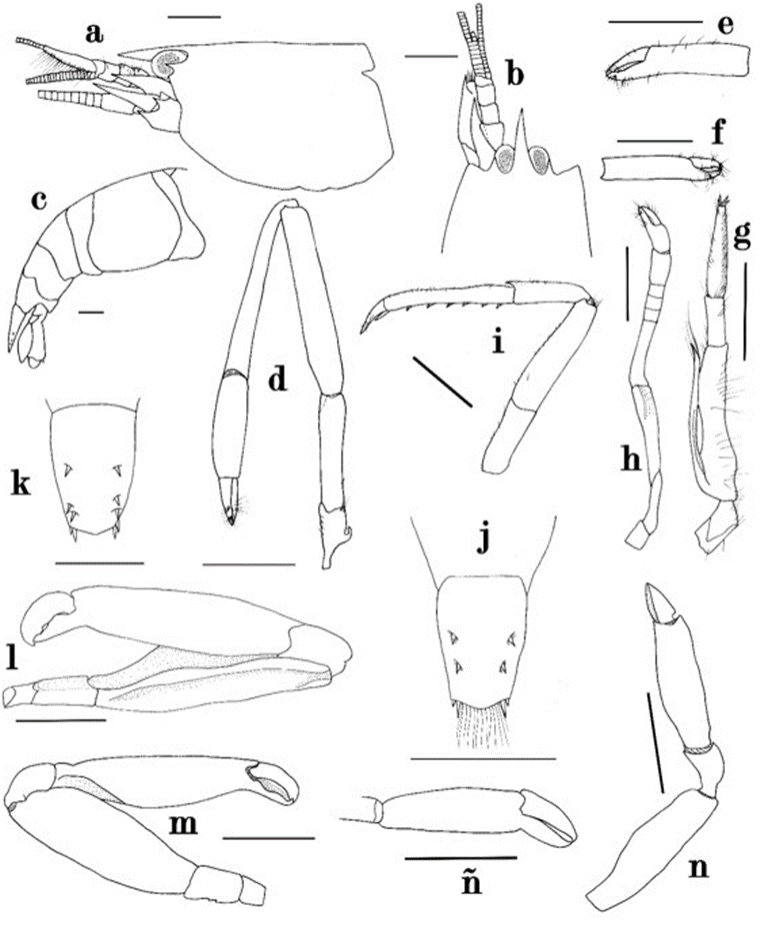

Figure 1. *Athanas dimorphus* Ortmann, 1894, from El Manglillo, Margarita Island, Venezuela (MOBR-C-1791), female: a.- frontal region, lateral view; b.- same, dorsal view; c.- abdominal region, lateral view; d.- major first cheliped; e.- palm and fingers of major first cheliped; f.- palm and fingers of minor first cheliped.- g.- third maxiliped; h.- second cheliped (= second pereiopod); i.- third pereiopod; j.- telson, dorsal view; male: k) telson, dorsal view, l) major cheliped, mesial view, m) same, lateral view, n) minor cheliped, ñ) palm and fingers of minor cheliped (Scale: 1 mm).

(2) Material examined

Venezuela, Margarita Island: Punta Arenas (345641 E – 1214837 N): 1 ovigerous female, 1 male; underneath rocks among meadows of *Thalassia* sp., 1 m, 18/II/2009 (MOBR-C-1791). El Horcón (355553 E – 1211474 N): 1 female; manually collected associated to reefs of the polychaete *Phragmatopoma* sp., 0.50 m, 06/XII/2008. El Manglillo (355705 E - 1211566 N): 4 females (2 ovigerous); 1 male (GIC-740); under rocks, 0.5 m, 18/II/2009.- 1 male, under rocks, 0.75 m 31/III/2011.- 1 ovigerous female, under rocks, 0.5 m date (GIC-851).- 1 ovigerous female, 0.5 m, under rocks, 31/III/2011 (GIC-852). Anzoátegui State: Mochima National Park, Chimana Grande Island (317908 E – 1138102 N), 1 ovigerous female, underneath rocks among meadows of *Thalassia* sp., 0.5 m, 17/VII/2010.

Size: Non-ovigerous females: 3,79 – 3,81 mm carapace lenght (CL; measured along the dorsal mid-line from the tip of the rostrum to the posterior margin of the carapace); ovigerous females 4,32 – 5,07 mm CL; males: 3.90 mm CL.

Distribution: East Africa, Red Sea, Thailand, Japan, north of the Arabian Sea, Hong Kong, Philippines, Australia (Banner and Banner, 1983). Western Atlantic: Ceará, Pernambuco, and São Paulo, Brazil (Pachelle *et al.*, 2011, Almeida *et al.*, 2012, 2015); Caribbean Sea: Isla Margarita, Venezuela (present study, Figure 2).

(3) Observations

One of the specimens analyzed (male; MOBR-C-1791) had three pairs of spines on the dorsal surface of the telson instead of two (Figure 1k), but this looks like a teratological condition, since all the other characters shown by this specimen, including the color pattern were consistent with those of the species. *Athanas dimorphus* presents, besides the previously described morphological features, a characteristic color pattern, showing a dorsal patch of white chromatophores mixed with reddish chromatophores; dorsal bands of white chromatophores on abdominal somites and in-between reddishbluish bands (Pachelle *et al.*, 2011).

DISCUSSION

Four of the eight species of alien marine decapods previously recorded are considered to be successfully established on the Caribbean Sea: *Penaeus monodon, Callinectes arcuatus, Charybdis helleri* and *Rhithropanopeus harrisii;* a new species, *Athanas dimorphus*, must be added to this list. There are suspicions that two other species, *Litopenaeus stylirostris* and *L. vannamei* have established populations on the coast of Anzoátegui state, Venezuela (Pérez *et al.*, 2007), but there is no conclusive evidence to date.

Figure 2. Place and date of collecting of *A. dimorphus* in Venezuela.

The most common vectors of introduction are escapement of specimens from aquaculture facilities (*P. monodon*, *L. stylirostris* and *L. vannamei*) and transportation by ships ballast water (*Charybdis helleri*, *Rhithropanopeus harrisii* and now *Athanas dimorphus* too) while migration from the Pacific through the Canal de Panamá (*Callinectes arcuatus*) and from Brazil by means of Guyana stream (Venezuelan population of *P. monodon*) is another possible way of introduction.

Introduction of exotic species may have severe ecological consequences, such as loss of biodiversity, among other possible damage. The damages on the new area of distribution of non-indigenous species could be direct, or indirect (Rodríguez and Suárez, 2001; Tavares, 2003). Direct damages could be by displacement of indigenous ones or predation on members of the invaded community, such as the displacement of some species of brachyuran crabs by *Charybdis hellerii* in Belize (Felder *et al.*, 2009), and indirect ones by means of transmission of pathogens (Shields and Overstreet, 2003).

The national strategy for the conservation of biological diversity of the Bolivarian Republic of Venezuela includes a strategic line of action for the prevention, control and eradication of alien species (MPPA, 2010), but yet it has neither facilities aiming for early detection of exotic species nor a long-term monitoring program of marine invasions. *Athanas dimorphus* has cryptic habitat and it was collected during inventories of decapod crustaceans in different localities and not as a part of such type of program.

This species was previously restricted to the Indo-West Pacific, and it was recently recorded in Brazil by Pachelle *et al.* (2011) and Almeida *et al.* (2012, 2015), and has been catalalogued as an invasive species by Pachelle *et al.* (2011), but according to Lockwood *et al.* (2007) the invasion process has four stages: transport, establishment, spread and impact, and only when the non-native population is widespread and abundant that it will cause some sort of ecological or economic harm, can be call "invasive".

The most likely dispersal mode for this species is through larvae present in ballast waters and/or juveniles or adults attached to fouling on hulls of boats coming from South Asia, which frequently arrive at the International Port of El Guamache in Margarita Island, and in ballast waters of oil tankers and cargo ships arriving at oil terminals of Petróleos de Venezuela and Bolivariana de Puertos in Anzoátegui state. In Brazil, this species was found in three localities, two of Ceará State: a beach near a Petrobras oil terminal with a long pier; a site facing Mucuripe port, with both cargo and oil terminals (Pachelle *et al.*, 2011), a beach at São Paulo and at Pernambuco (Almeida *et al.*, 2012; 2015). Pachelle *et al.* (2011) suggest three ways of introduction of the species in Brazil: ballast water of large vessels, transport among hull fouling and transport as epibiotic on marine turtles.

Because of the place and date of collecting of *A. dimorphus* in Brazil and Venezuela, it seems evident that: (1) introduction of the species in Brazil and Venezuela occurred independently of one another; (2) the species is in process of establishment (because of the presence of ovigerous females). There are not evidence yet about spread and/or impact of the alien in these places to properly call it invader, but it has to be monitored.

Almeida *et al.* (2012) suggested that introduction of *A. dimorphus* in Brazil possibly happens in more than one site, so as has been suggested for *C. hellerii. Athanas dimorphus* seems to have an extended development which would allow him to survive for several months in ballast water of large vessels, and arrive to new areas (Pachelle *et al.*, 2011). Adding to this the reproductive potential of *A. dimorphus* seems to be low because the ovigerous females do not carry a lot of eggs (C.L. pers. obs.) so the introduction event of the species in Venezuela should have happened in several opportunities and maybe they still occurs.

Pachelle *et al.* (2011) pointed that the ecological impact of this species on the intertidal communities in Brazil is expected to be minimal due to its ecological characteristics, but it can compete with, and maybe displace, several species of crustaceans, some of them maybe not yet known, so it possible effects should not be underestimated.

The present study constitutes the first report of the species in Caribbean Sea and would represent the eighth exotic species of marine decapod reported in Venezuela. Because the presence of ovigerous females of *A. dimorphus* let us consider that it would be the fifth species of decapod with established populations in Venezuela and in the Caribbean.

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