

THE EXOTIC SPECIES *Litopenaeus vannamei* (BOONE, 1931) OCCURRENCE IN CANANEIA, IGUAPE AND ILHA COMPRIDA LAGOON ESTUARY COMPLEX

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ABSTRACT

Exotic species are an exponential problem throughout the world, being one of the main causes of alterations both of the environment and of biodiversity. The introduction of exotic species is typically linked to activities of socioeconomic relevance. The consequences of such invasions have ecological, economic and sanitary components, and these components sometimes operate synergistically. The present study records the presence of *Litopenaeus vannamei* in several areas of Cananéia, Iguape and Ilha Comprida estuary. A total of 109 samples taken with a gill net were examined to evaluate the presence of *L. vannamei* as a bycatch of fishing activities seeking *Farfantepenaeus paulensis*, *F. brasiliensis* and *Litopenaeus schmitti*, between March 2005 and December 2013. Sixty-four individuals of *L. vannamei* were captured the size and weight of the smallest and the largest specimens of which were, respectively: 1.68 and 6.30 cm and 26.70 and 31.78 g. The data give no indication that *L. vannamei* is proliferating in the region to the point of being considered an invasive species nor that it is causing economic problems.

Keywords: Biodiversity; Invasive species; Sao Paulo coast; American white shrimp.

A OCORRÊNCIA DA ESPÉCIE EXÓTICA *Litopenaeus vannamei* (BOONE, 1931) NO COMPLEXO ESTUARINO-LAGUNAR DE CANANÉIA, IGUAPE E ILHA COMPRIDA

RESUMO

As espécies exóticas constituem hoje em um problema exponencial de escala global e um dos principais fatores de modificações do meio ambiente e da biodiversidade de uma região. A introdução de espécies exóticas encontra-se tipicamente vinculada às atividades de interesse sócio-econômico. As invasões têm consequências ecológicas, econômicas e sanitárias, atuando, às vezes, de modo sinérgico. O presente trabalho registra a ocorrência de *Litopenaeus vannamei* em várias áreas do estuário de Cananéia, Iguape e Ilha Comprida. Para avaliar a ocorrência do *L. vannamei* junto à pesca de *Farfantepenaeus paulensis*, *F. brasiliensis* e *Litopenaeus schmitti* foram realizadas 109 amostragens com rede gerival, de março de 2005 a dezembro de 2013. Foram capturados 64 exemplares de *L. vannamei* com tamanhos e pesos médios da menor para maior espécime capturada de 1,68 para 6,30 cm e 26,70 para 31,78 g, respectivamente. Os dados não indicam que *L. vannamei* está proliferando na região, a ponto de ser considerado uma espécie invasora e causando problemas econômicos.

Palavras-Chave: Biodiversidade; Espécie invasora; Litoral paulista; Camarão branco americano.

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INTRODUCTION

The introduction of exotic species in the aquatic environment can cause severe consequences such as the removal, predation and exclusion of native species by competition, as well as by hybridization (WILLIAMSON, 1996), creating an impact on the ecosystem and fisheries in general. Organisms that have been introduced into an environment where they do not occur naturally are considered exotic species. Studies of these species have accompanied mankind throughout history (ROSIQUE & BARBIERI, 1992). However, the problems caused by the invasion of exotic species are growing and starting to become a phenomenon with worldwide consequences (TAVARES, 2003). The high frequency of invasion is associated largely with human activities (BARBIERI *et al.*, 2007) such as transport and accidental introduction via the ballast water of ships, or as a result of the escape of specimens from poorly planned and managed aquaculture activities.

According to TAVARES (2003), the consequences of the introduction of exotic species are commonly considered as ecological, health or socioeconomic problems. Often, according to the same author, these classifications have been shown to be unsatisfactory, either because the categories overlap, or because any consequences of an ecological order end up simultaneously having health and socioeconomic effects.

The introduction of exotic species can cause major impacts to the biota and the ecosystem as a whole. Examples such as the fish *Gambusia holbrooki* (GIRARD, 1859), which was introduced into Australia to control the incidence of a mosquito, has presented a large increase in its population and current studies show that it has been responsible for the extinction of several other species of fish both in Africa and Asia (HOWE *et al.*, 1997).

In recent years, the interest of the scientific community has focused on the issue of the introduction of exotic species in terms of ecological and economic impacts arising from the invasion of various ecosystems (SILVA *et al.*, 2002). However, the issue of biological

invasion goes far beyond academic concern, becoming in some cases, a question of public health (HOWE *et al.*, 1997).

The introduction of decapod crustaceans in areas in which they do not naturally occur has been cited in the scientific literature (MANTELATTO & GARCIA, 2001; MELO & CRIVELARO, 2002; SILVA *et al.*, 2002; MAGALHÃES *et al.*, 2005). RODRIGUES & SUAREZ (2001) have reported several cases of the dispersal of decapod crustaceans, both freshwater and marine, resulting from human activities.

The shrimp *Litopenaeus vannamei* (BOONE, 1931), native to the eastern Pacific, was brought to Rio Grande do Norte in 1981 for cultivation in nurseries (TAVARES & MENDONÇA, 1996), but did not produce good results for years. Only as from the early 90s did the species begin to show positive results, leading to its cultivation along almost the whole Brazilian coast. Marine shrimp farms are located mostly on the coast, often in mangrove areas.

Occasionally, during harvesting or due to the disruption of containment booms, unspecified quantities of individuals have ended up escaping from farm ponds and invading the natural environment (TAVARES, 2003).

L. vannamei was cultivated in excavated tanks in the estuarine lagoon complex of Cananeia, Iguape and Ilha Comprida until September 6, 2005. This fact has led to conflict between artisanal fishermen and recreational fisheries in the region, as the former (or latter?) used exotic species as live bait, leading to fishing competition with the native white shrimp (*Litopenaeus schmitti*, BURKENROAD, 1936). In addition, there is an imminent risk of transmitting diseases to native species of shrimp in the study area (BARBIERI & MELO, 2006). It is for these reasons that the present study seeks to report on the occurrence of *Litopenaeus vannamei* in the estuarine lagoon complex of Cananeia, Iguape and Ilha Comprida to make a critical assessment of the introduction of exotic species into the region and the need for greater control.

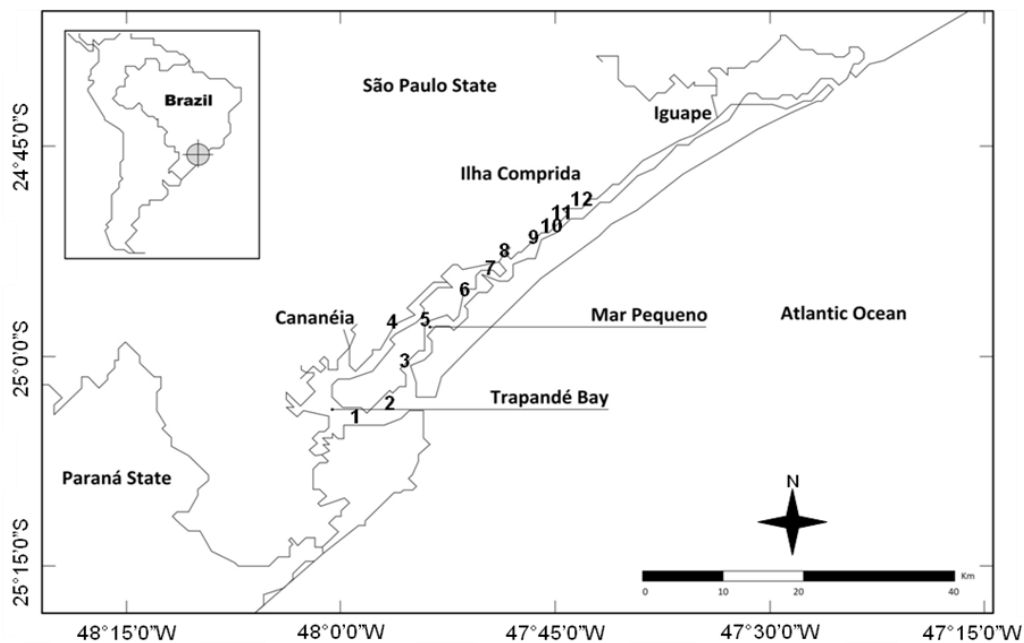
MATERIAL AND METHODS

In order to evaluate the use of *L. vannamei* for fishing for pink shrimp (*Farfantepenaeus paulensis* PÉREZ-FARFANTE, 1967 and *F. brasiliensis* LATREILLE, 1817) and white shrimp (*Litopenaeus schmitti*) as live bait in the region, 109 samples were taken with a type of fishing net called the Gerival (2 meter mouth by 2 meter depth) between March 2005 and December 2013, in the estuarine lagoon complex of Cananeia, Iguape and Ilha Comprida. Each sample consisted of three consecutive 45-minute hauls (bottom trawls: 500m), undertaken parallel to the shoreline, totaling 327 fishing operations during the period (109 samples x 3 consecutive hauls). Twelve sampling points were selected, two in

Trapandé Bay (Andrade and Prainha) and ten in Mar Pequeno (localities Boa Vista, Piçarro, São Paulo Bagre, Pedrinhas, Ubatuba, Sítio Arthur, Subauma, Pedra do Farol, Agrossolar and Cocaia) (Figure 1). These locations are often used by artisanal fishermen for fishing native shrimp (*F. paulensis*, *F. brasiliensis* and *L. schmitti*).

The gerival is the fishing gear normally used to catch shrimp for use as live bait, it consists of a conical trawl net made of nylon mesh, kept near the bottom with the help of a lead fishing line at its largest opening (the mouth). The gerival is dragged with the tidal stream, catching the shrimp that rise by opening its mouth into the shape of a hood in which they are trapped.

Figure 1 - Sampling Points in Cananeia, Iguape and Ilha Comprida Estuarine Lagoon Complex. (1) Andrade, (2) Prainha, (3) Boa Vista, (4) Piçarro, (5) São Paulo Bagre, (6) Pedrinhas, (7) Ubatuba, (8) Sítio Arthur, (9) Subauma, (10) Pedra do Farol, (11) Agrossolar and (12) Cocaia.



RESULTS

During the harvesting, the three species of native shrimp in the region (*F. brasiliensis*, *F. paulensis* and *L. schmitti*), the exotic shrimp *Litopenaeus vannamei* (Table 1) and the accompanying characteristic fish fauna were captured. Although few individuals of *L. vannamei* (n = 64) were caught, this alien species was captured at all the sampling sites,

which shows that the species is already quite widespread within the estuary (Table 1 and Figure 1). The average sizes and weights of the specimens found were: 14.32 (± 7.48) cm and 13.59 (± 5.92) g, respectively. The size and weight of the smallest and the largest specimens captured were: 1.68 to 6.30 cm and 26.70 to 31.78 g, respectively. The proportion of males to females was 55.94% to 44.06%. The

largest number of individuals captured occurred during October 2005 (Table 2) but in January, February and March 2006 no specimens were captured. In 2007, specimens

were captured in February (3) and March (1). No specimens were captured during the period from 2008 to 2013.

Table 1 - Number of individuals of the native and exotic shrimp species captured in Cananea, Iguape and Ilha Comprida Estuarine Lagoon Complex.

Localities	Initial Coordinates	Number of Individuals of Native Shrimps	Number of Individuals of Exotic Shrimps
Trapandé Bay			
Andrade	25.07565°S 47.97662°W	200	2
Prainha	25.06331°S 47.93537°W	700	2
Mar Pequeno			
Boa vista	24.99800°S 47.89547°W	150	2
Piçarro	24.96015°S 47.92054°W	300	5
São Paulo Bagre	24.95916°S 47.88739°W	380	5
Pedrinhas	24.89288°S 47.80006°W	558	8
Ubatuba	24.86973°S 47.76749°W	358	12
Sítio Arthur	24.85841°S 47.75830°W	259	5
Subauma	24.83057°S 47.71901°W	500	5
Pedra do Farol	24.81733°S 47.69928°W	432	4
Agrossolar	24.57578°S 47.54114°W	450	10
Cocaia	24.53412°S 47.51213°W	322	4
Total of Individuals		4609	64

Table 2 - Numbers of individuals of *L. vannamei* captured in the Estuarine Lagoon of Cananea, Iguape and Ilha Comprida, by year (2005-2013).

Localities	Initial Coordinates	2005	2006	2007	2008- 2013	Total
Andrade	25.07565°S 47.97662°W	2	0	0	0	2
Prainha	25.06331°S 47.93537°W	1	1	0	0	2
Boa vista	24.99800°S 47.89547°W	1	1	0	0	2
Piçarro	24.96015°S 47.92054°W	2	1	2	0	5
São Paulo Bagre	24.95916°S 47.88739°W	3	0	2	0	5
Pedrinhas	24.89288°S 47.80006°W	6	2	0	0	8
Ubatuba	24.86973°S 47.76749°W	8	4	0	0	12
Sítio Arthur	24.85841°S 47.75830°W	3	2	0	0	5
Subauma	24.83057°S 47.71901°W	4	1	0	0	5
Pedra do Farol	24.81733°S 47.69928°W	3	1	0	0	4
Agrossolar	24.57578°S 47.54114°W	6	4	0	0	10
Cocaia	24.53412°S 47.51213°W	3	1	0	0	4
Total of Individuals		42	18	4	0	64

DISCUSSION

A total of 64 *L. vannamei* were captured by this project in the years 2005-2007 but no record was kept for the years 2008-2013.

Species introduced, such as *L. vannamei*, can bring parasites, bacteria and virus pathogens (such as white spot) with them, doing enormous damage to the native species

(ROYO *et al.*, 1999). The Japanese oyster *Crassostrea gigas* (THUNBERG, 1793) may have been the origin of the viral disease that decimated the population of native oysters *Ostrea edulis* (LINNAEUS, 1758) off the coast of Spain and France (BARBIERI, 1998). Whether accidental or deliberate, the introduction of *L. vannamei* may bring pathogens which affect other species by competing with native species

for the same habitat or food as well as possibly leading to genetic contamination, thus impacting the entire ecosystem involved.

L. vannamei, as well as other species, is affected by various diseases of viral origin. In 1995 over 95% of the stocks in southern Texas were decimated by TST viruses (Syndrome Taura Virus), and in 1996, the stocks of *L. vannamei* in Texas and South Carolina were again severely affected (JSA, 1997 *apud* TAVARES & MENDONÇA, 2004). In Brazil, in February 2005, several farms in Santa Catarina which cultivated *L. vannamei* were affected by the White Spot Virus (White Spot Syndrome). According to TAVARES & MENDONÇA (2004), the introduction of exotic species will always involve the risk of contamination of native species by exotic pathogens. In the complex case of the estuarine lagoon of Cananeia, Iguape and Ilha Comprida, the contamination of native species may arise directly from nursery cultivation, whether in adults or infected larvae.

The estuarine lagoon complex of Cananeia, Iguape and Ilha Comprida is in an area of significant environmental interest, being considered by the IUCN (International Union for the Conservation of Nature) as the third estuary in the world in terms of primary productivity and as a nursery of Atlantic Ocean species. The region also includes the Biosphere Reserve of the Atlantic and contains many protected areas, such as the APA Federal Cananeia Iguape and Peruíbe, the APA State Ilha Comprida, the Ecological Station of Chauás, Parque Estadual da Ilha do Cardoso and Mandira Extractive Reserve.

There are already records of the introduction of at least 18 species of exotic decapod crustaceans into this region, five (27.77%) of them being among populations reproductively active such as *Charybdis helleri* (MILNE-EDWARDS, 1867), *Rhithropanopeus harrisi* (GOULD, 1841), *Pyromaia tuberculata* (LOCKINGTON, 1877), *Macrobrachium rosenbergii* (DE MAN, 1879) and *Procambarus clarkii* (GIRARD, 1852); two, *Pilumnoides perlatus* (POEPPIG, 1836) and *Panaeus monodon* (FABRICIUS, 1798), probably reproduce in Brazilian waters, while the other eleven species (61.11%) are represented by just a few

individuals (TAVARES and MENDONÇA, 2004).

The data of this present study give no indication that (as to whether?) *L. vannamei* is proliferating in the region to the point of being considered an invasive species and causing economic problems; they show, rather, that since 2008 no specimen has been caught in the estuary. If this species had achieved success in the environment to the point of reproducing, certainly we would be capturing it now, even if there were but few individuals in the estuary, but this has not occurred since 2008.

Whether accidental or deliberate, the introduction of exotic species can bring pathogens to other species, competition for the same resource or habitat with native species, in addition to genetic contamination, thus impacting the entire ecosystem involved (TAVARES, 2003). An important aspect in studies of ecology and population dynamics of invasive species is their relationship to the existing ecosystem. Invasive species always interact with the native species, either by predation or competition, resulting in local extinction (BYERS, 2002). Native and invasive species may compete for space or food, leading to extinctions, or invasive species can take advantage of a vacant niche and maintain a balance with a native one (APOLINÁRIO, 2002). However, to consider invasive species just as threats or pests, can only be a superficial reading of a larger ecological process. According to WILLIAMSON (1996), one of each ten species introduced by humans into a new environment becomes an invasive species, one in each ten invasive species succeeds in establishing itself, and one in each ten established species becomes a pest. Comparing this statement with our data, we may conclude that *L. vannamei* has not become a pest nor even succeeded in establishing itself in the estuarine lagoon complex of Cananeia, Iguape and Ilha Comprida.

The classic ecological view that large changes in natural populations would upset the balance of the planet has recently been changing in the light of new studies and definitions of terms, such as population balance (ACKEFORS, 1999, BARBIERI & MELLO, 2006, BARBIERI *et al.*, 2007).

CONCLUSION

The data of the present study give no indication that *L. vannamei* is proliferating in the region to the point of being considered an invasive species or causing economic problems.

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