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Aquatic Invasions Records

Assessment of larval distribution of invasive *Omobranchus punctatus* (Valenciennes, 1836) (Pisces: Blenniidae) in a subtropical estuary (Southern Brazil)

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Abstract

The occurrence and spatio-temporal distribution of the larvae of exotic Blenniidae *Omobranchus punctatus* (Valenciennes, 1836) was studied at Babitonga Bay, a subtropical estuary of Southern Brazilian Coast. Samples were collected in 26 ichthyoplankton surveys (28 stations) from April 2004 to August 2008. Oblique hauls were used, with both a conical plankton net fitted with 200µm mesh and by a cylindrical-conical plankton net fitted with 500µm mesh (two and five minutes hauls, respectively). Larvae occurred continuously throughout the sampling and an increase in density was observed in the period from November to April. Specimens were registered throughout the study area. The occurrence of a wide range of ontogenetic stages indicates that the species is maintaining the population within Babitonga Bay. The lack of information about the potential impacts of *O. punctatus* in the ichthyoplankton assembly, with regard to ecological interactions and the food chain suggests the need for further studies.

Key words: exotic fish; estuarine bioinvasion; ichthyoplankton; Southwestern Atlantic

Introduction

The muzzled blenny *Omobranchus punctatus* (Valenciennes, 1836) (Pisces: Blenniidae) is a coastal and brackish benthic water fish that can be found close to river mouths or mangroves, tidal pools and rocky areas (Springer and Gomon 1975). The original distribution is presumed to be the Indo-Pacific, from Japan to Persian Gulf, however, one established population is found in Trinidad since 1980, which has been attributed to the accidental transfer by slave boats. The spread of these populations, occurred, presumably, by ballast water, which could also be responsible for the introduction of this species into Venezuela and the Panama Canal (Springer and Gomon 1975; Golani 2004). Golani (2004) identified only one individual in Israel, and associating this occurrence with ballast water or biofouling. In Brazil, adult individuals have been identified in Coqueiro Beach (02º53'55"S-41º34'17"W) (Loebmann et al. 2010), Todos os Santos Bay (23º10'S-44º30'W) (Mendonça et al. 2005), Ilha Grande Bay (22º50'S-44º00'W) and Babitonga Bay (26º00'S-48º20'W) (Gerhardinger et al. 2006), with the main vector presumed to be biofouling.

Babitonga Bay is located in northern Santa Catarina state (26º02'-26º28'S and 48º28'-48º50'W) and is one of the largest estuarine systems off Southern Brazil. There are various habitats within the bay such as islands, rocky shores, estuarine beaches, mangroves, salt marshes and rivers (Cremer 2006). Despite the ecological importance, the bay works as a shelter for São Francisco do Sul Harbor, active since 1912 (Cremer 2006), the future Itapoá Harbor and important artisanal fisheries territories.

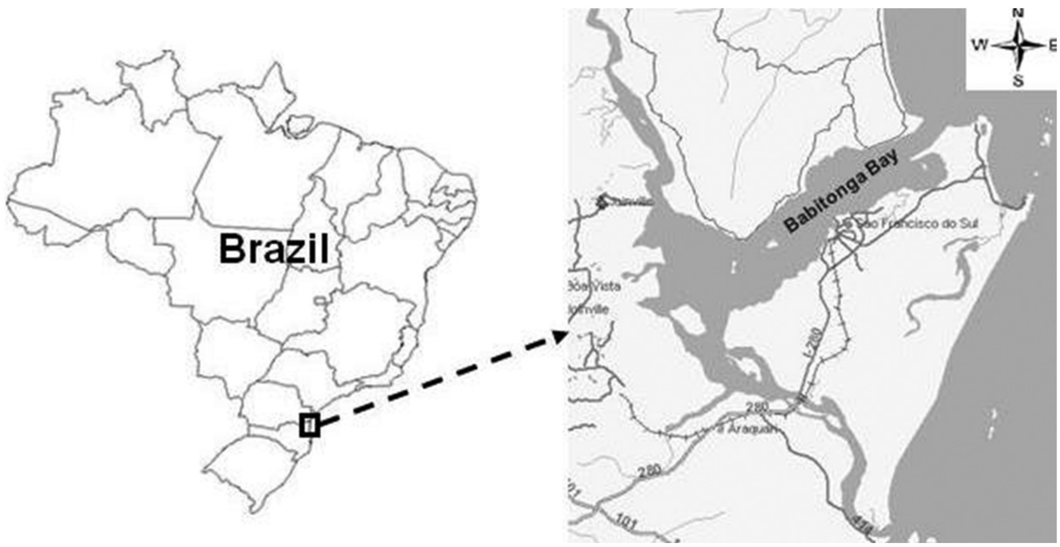

Figure 1. Babitonga Bay, Santa Catarina state, south of Brazil.

The anthropogenic pressure and the presence of exotic species such as *O. punctatus*, strengthen the need for the implementation of an effective monitoring program in the port and adjacent areas of Babitonga Bay. For this reason, this study aimed to evaluate the occurrence and distribution of *O. punctatus* larvae in Babitonga Bay (south coast of Brazil).

Methods

Ichthyoplankton sampling was conducted in 28 stations in Babitonga Bay (Figure 1 and 2), comprising of 26 cruises for three research projects developed between 2004 and 2008. Oblique hauls were used with a 40cm diameter conical plankton net fitted with 200µm mesh and with a 50cm diameter cylindrical-conical plankton net fitted with 500µm mesh (with two and five minutes hauls, respectively undertaken), both equipped with a flow-meter (Table 1). The 200µm mesh was used to capture smaller larvae (Matsuura and Nakatani 1980; Johnson and Morse 1994; Chute and Turner 2001), thus reducing both escapement and extrusion. Samples were preserved in a 4% formalin solution.

In the laboratory, larvae of the Blenniidae family were sorted under a binocular stereo-microscope. The identification of *O. punctatus* larvae was conducted according to Kawaguchi et al. (1999) and abundance was estimated as the number of individuals per 100m^3. All individuals were measured with a micrometer rule, with precision of 0.1mm and the development stage was identified from notochord flexion into preflexion, flexion and postflexion stages, as described by Kawaguchi et al. (1999).

Results and discussion

A total of 701 Blenniidae larvae were collected, with 84 identified as *Omobranchus punctatus* (12%) (Table 2). The species occurred in all sampling programs, between April 2004 to May 2008, and in 23 of 28 sampling stations (Figure 2). The highest densities occurred in April 2005, April and December 2008, ranging from 5.5 to 129.9 larvae per 100m^3 (Table 3).

Larvae collected in Babitonga Bay for different development stages (preflexion, flexion and postflexion) ranged in length from 2.1 to 7.5mm (Figure 3). The preflexion stage was the most abundant (90.5%), followed by flexion stage (8.3%) and postflexion stage (1.2%).

The introduction of exotic species represents a major threat to global biodiversity and most of the world's ecosystems have suffered severe ecological damage (Rilov and Crooks 2009). Non-native species poses serious threats to the marine biodiversity of Brazil, which has a wide coast with several tropical and subtropical

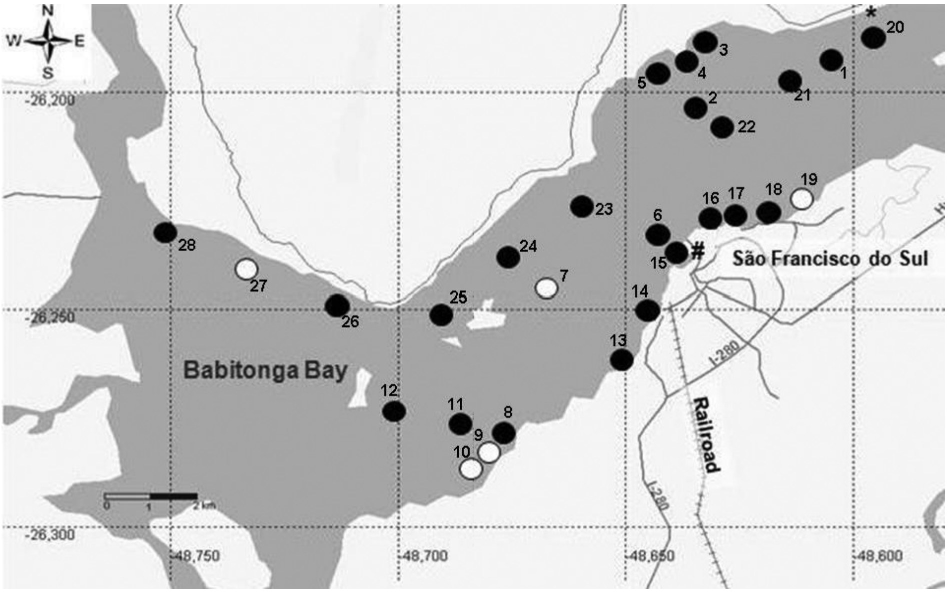

Figure 2. Positions of sampling stations in Babitonga Bay with reference to presence/absence of *Omobranchus punctatus* larvae (#: São Francisco do Sul Harbor, *: Itapoá Harbor) (filled circles: presence of *O. punctatus* larvae; empty circles: absence of larvae).

Table 1. List of ichthyoplankton sampling program in Babitonga Bay between 2004 and 2008, with period, number of stations and details of sampling and net used.

Sampling Program	Period	Stations	Geographic coordinates	Sampling and Net
ICTIOP Project	2004 (April, July, September, November) 2005 (January, April)	1	26º11.644'S – 48º36.306'W	Oblique tows (two minutes) with a 40cm diameter conical plankton net fitted with 200µm mesh
		2	26º12.423'S – 48º37.976'W	
		3	26º11.345'S – 48º38.043'W	
		4	26º11.398'S – 48º38.391'W	
		5	26º11.706'S – 48º38.695'W	
		6	26º14.064'S – 48º38.538'W	
		7	26º14.820'S – 48º40.086'W	
		8	26º17.035'S – 48º40.725'W	
		9	26º17.098'S – 48º40.770'W	
		10	26º17.201'S – 48º40.875'W	
		11	26º17.778'S – 48º40.903'W	
		12	26º16.494'S – 48º42.090'W	
EIPPEB Project	2005 (August, September, October, November, December) 2006 (January, February, March, April, May, June, July)	13	26°15.807'S – 48°39.006'W	Oblique tows (two minutes) with a 40cm diameter conical plankton net fitted with 200µm mesh
		14	26°15.126'S – 48°38.634'W	
		15	26°14.340'S – 48°38.330'W	
		16	26°13.868'S – 48°37.819'W	
		17	26°13.807'S – 48°37.589'W	
		18	26°13.806'S – 48°37.127'W	
		19	26°13.623'S – 48°36.691'W	
PEINBA Project	2007 (October, November) 2008 (January, February, April, May, July, August)	20	26°11.318'S – 48°35.743'W	Oblique tows (two minutes) with a 40cm diameter conical plankton net fitted with 200µm mesh and oblique tows (five minutes) with a 50cm diameter cylindrical-conical plankton net fitted with 500µm mesh
		21	26°11.740'S – 48°36.881'W	
		22	26°12.318'S – 48°37.998'W	
		23	26°13.625'S – 48°39.638'W	
		24	26°14.380'S – 48°40.560'W	
		25	26°15.153'S – 48°41.430'W	
		26	26°15.058'S – 48°42.841'W	
		27	26°14.566'S – 48°43.920'W	
		28	26°14.001'S – 48°45.058'W	

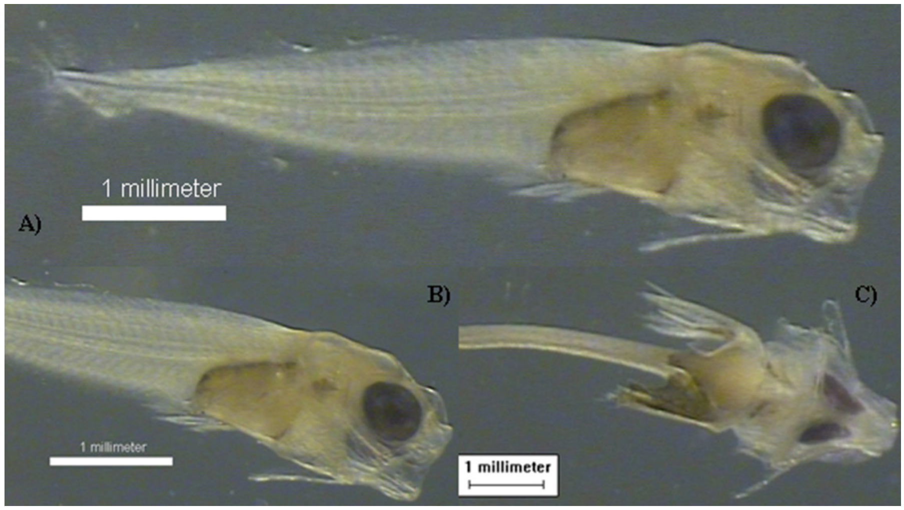

Figure 3. *Omobranchus punctatus* larvae collected in Babitonga Bay during 2008. A) Larvae of 4.75mm in flexion stage, B) Larvae of 5.66mm in flexion stage and C) 5.66mm in flexion stage.

Table 2. Number of *Omobranchus punctatus* larvae collected in sampling programs with different sampling nets in Babitonga Bay from 2004 to 2008 (N: total number of *O punctatus* larvae; Fs: frequency of stations with presence of *O. punctatus* larvae; - not applicable).

Sampling Program	200µm		500µm	
	N	Fs (%)	N	Fs (%)
ICTIOP Project	25	75.0	-	-
EIPPEB Project	22	85.7	-	-
PEINBA Project	9	44.4	28	77.7

estuaries. Ferreira et al. (2004a, b), Ferreira et al. (2009), and Lopes et al. (2009) suggest that, in Brazil, biofouling and ballast water are the most important vectors of introduced species in the marine realm, with a high risk to coastal habitats. Competition, predation and hybridization are ecological mechanisms that interfere with population and community structure and also cause impacts in fisheries and public health, changes in large-scale ecosystem process and loss of biodiversity (Carlton 1996; Vitousek et al. 1997; Anil et al. 2002; Lee 2002). In this context, coastal estuarine and marine systems are among the most heavily invaded systems in the world (Grosholz 2002).

According to Springer and Gomon (1975) *O. punctatus* is originally from the Indo-Pacific, and is known to be established in the western Atlantic, being recorded since 1930 in Trinidad and Tobago. In Todos os Santos Bay (Brazil), the high number of individuals recorded suggests that the population is capable of self-recruitment (Mendonça et al. 2005). Meanwhile, the few adult individuals collected by Gerhardinger et al. (2006) in Babitonga Bay were associated with mariculture, and it was not possible to conclude if the species was capable of maintaining a population. The adult individuals were found only at one site, while larvae of *O. punctatus* were found throughout the bay, even in the innermost estuary. The identification of different development stages and the wide spatial and temporal distribution of *O. punctatus* larvae in the present work suggest that the species maintains a population in Babitonga Bay.

Wonham et al. (2000) showed that species of Blenniidae and Gobiidae are dominant among the introduced species and often established in the environment. The invasive success of Blenniidae and Gobiidae may be explained by their crevicolous nature: both groups seek refuge and lay their eggs in small holes, and may take advantage of the ballast-intake holes on ship hulls and offshore structures. Besides the need to understand the impact of exotic species in biodiversity and in ecosystem functioning, it is essential to monitor the geographical expansion after an introduction event (Gerhardinger et al. 2006; Sol et al. 2008), a fact that must be considered for *O. punctatus* in Babitonga Bay.

The creation of artificial habitats may act as a facilitator for invasion and establishment of exotic species in estuarine environments, posing an increasing risk (Glasby et al. 2007; Sheehy

Table 3. Number (N), density (nº.100m^{-3}) and length (mean, minimum and maximum) of *Omobranchus punctatus* larvae collected in ichthyoplankton sampling from 2004 to 2008 in Babitonga Bay (N: number; SD: standard deviation).

Month/Year	N	Density (nº.100m^{-3})	Length (mm)		
			Mean±SD	Minimum	Maximum
April/04	4	46.10	2.27±0.05	2.20	2.30
July/04	1	11.80	2.40*	-	-
September/04	1	13.30	2.80*	-	-
November/04	5	57.70	2.80±0.46	2.40	3.50
January/05	3	49.70	2.40±0.20	2.20	2.60
April/05	11	129.90	2.50±0.20	2.10	2.70
August/05	1	5.50	3.00*	-	-
October/05	2	23.00	2.65±0.35	2.40	2.90
November/05	6	63.00	2.63±0.14	2.50	2.80
December/05	11	86.40	2.53±0.14	2.30	2.80
February/06	1	8.60	2.80*	-	-
March/06	1	4.90	2.50*	-	-
November/07	6	16.50	2.95±0.32	2.65	3.50
January/08	7	23.80	3.19±0.58	2.70	4.41
February/08	6	7.60	3.06±0.18	2.83	3.33
April/08	13	30.60	3.86±1.42	2.70	5.66
May/08	5	9.89	2.82±0.06	2.75	3.00

* occurrence of one individual.

and Vik 2010). The increase of bioinvasion risk may occur with the accumulation of continuous impacts to marine and estuarine environment, and is one important creator of stress and a source of changes in marine communities (Ruiz et al. 1999; Crooks et al. 2010). Since most Brazilian harbors are located in estuaries and invasion mediated by ship is the main pathway of exotic species, it is evident that there is a need to monitor these areas, as well as the application of rigorous controls of ballast water and biofouling. Despite the increasing rate in exotic species reports, Brazil does not have an effective control system for ballast water. Nowadays, NORMAM (Brazilian Navy Authority Norms) determines that ships exchange ballast water within an isobath of 200 meters, aiming to reduce spread of exotic species. However, control of any species present is not effective. Despite the efforts available for management of ballast water in Brazil, there is no legal instrument to minimize invasions by hull-fouling, which has been raised as an environmental problem in recent years (Ferreira et al. 2004a, b).

The high proportion of *O. punctatus* larvae found in early development stages in Babitonga Bay may be correlated with the fact that a 200µm plankton net was used in all collections and this favors the sampling of smaller individuals (Chute and Turner 2001). Therefore, in order to improve knowledge about the occupation of the estuary by the species, plankton nets with larger mesh size are suggested for future studies. The results of this study show the importance of ichthyoplankton investigations in areas with a record of exotic fish adults in terms of identifying an entire species life cycle in the environment, especially in cases of cryptic species such as *O. punctatus*.

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