



New occurrences of *Myoforceps aristatus* (Bivalvia: Mytilidae) in the Brazilian coast

Daniel C. Cavallari^{1,4}, Eric P. Gonçalves & Vanessa S. do Amaral

¹Museu de Zoologia da Universidade de São Paulo, Cx. Postal 42494; 04218-970 São Paulo, SP, Brazil.

⁴Corresponding author: dccavallari@usp.br; dccavallari@gmail.com

Abstract

In this paper, we report 18 new occurrences of the invasive bivalve *Myoforceps aristatus* (Dillwyn, 1817) in the Brazilian coast. These new records were carried out in 2007-2012, and included the northeastern states of Ceará and Bahia, as well as Santa Catarina, São Paulo and Rio de Janeiro in the south-southeastern regions. Specimens of *M. aristatus* were found boring into gastropod and bivalve shells, as well as dead hard coral substrate alongside *Lithophaga bisulcata* (d'Orbigny, 1842), Mytilidae, a native species. This shows that *M. aristatus* may be less selective towards the substrate than originally assumed, and indicates the need of further studies in order to clarify the ecological relationships between these species. The data we present here points out to the fact that the invasion has worsened considerably, or was more severe than previously stated, and endorse previous statements towards the need of financial support for studies on marine bioinvasions in Brazil.

Keywords: Ballast water, Brazilian coast, invasion, *Lithophaga bisulcata*.

Resumo

Neste artigo, apresentamos 18 novas ocorrências do bivalve invasor *Myoforceps aristatus* (Dillwyn, 1817) na costa brasileira. Esses novos registros ocorreram em 2007-2012, e incluem os estados do Ceará e Bahia na região nordeste, assim como Santa Catarina, São Paulo e Rio de Janeiro nas regiões sul-sudeste. Os espécimes de *M. aristatus* foram encontrados perfurando conchas de gastrópodes e bivalves, bem como substrato de coral pétreo morto juntamente com *Lithophaga bisulcata* (d'Orbigny, 1842), uma espécie nativa. Isso mostra que *M. aristatus* pode ser menos seletiva para o substrato do que inicialmente previsto, e aponta para a necessidade de mais estudos a fim de se esclarecer as relações ecológicas entre essas espécies. Os dados que apresentamos aqui apontam o fato de que a invasão piorou consideravelmente, ou era mais grave do que foi referido anteriormente, e apoiam as declarações anteriores para a necessidade de apoio financeiro para estudos sobre invasões biológicas marinhas no Brasil.

Palavras-chave: Água de lastro, costa brasileira, invasão, *Lithophaga bisulcata*.

Introduction

Myoforceps aristatus (Dillwyn, 1817) is a bivalve that bores into hard calcareous substrates, such as mollusk shells. Originally from the Caribbean, It is now widely distributed in the Atlantic and is considered an invasive species, spread through

ballast water in various regions of the world (Boss & Turner, 1962; Simone & Gonçalves, 2006). Records of its occurrence include the Pacific Ocean and the Atlantic, comprising the southwest coast of Brazil in the states of Rio de

Janeiro and São Paulo, where it was first reported in 2006, and Santa Catarina, in 2008 (Simone & Gonçalves, 2006; Breves-Ramos et al., 2010; Agudo-Padrón, 2011).

Research involving introduced species has received increased attention in recent years, mainly due to the increasing number of invasions and the impact which inevitably stems from them (Fernandes, Thiengo & Simone, 2003; Ferreira et al., 2009). The deleterious consequences of the invasion of *M. aristatus* on native species, which may include their extinction, have been documented for over a decade (Sax & Brown, 2000; Clavero & García-Berthou, 2005). In Brazil, its effects on oyster farming, as well as on the native biota, have been reported since 2006 (Breves-Ramos et al., 2010).

In this paper we report 16 new occurrences of *M. aristatus* on the southwest coast of Brazil, both in continental and island regions, and two new occurrences on the northeast coast in the states of Ceará and Bahia. We also report *M. aristatus* and the native species *Lithophaga bisulcata* simultaneously boring into hard coral substrate.

Materials and methods

Our research was based on 18 lots from different localities deposited in the malacological collection of the Museu de Zoologia da Universidade de São Paulo (MZSP), Brazil. They were originated from surveys linked to different research projects developed at MZSP, performed between January 2007 and May 2012 in 18 different sampling points (Fig 7).

Results

Family Mytilidae

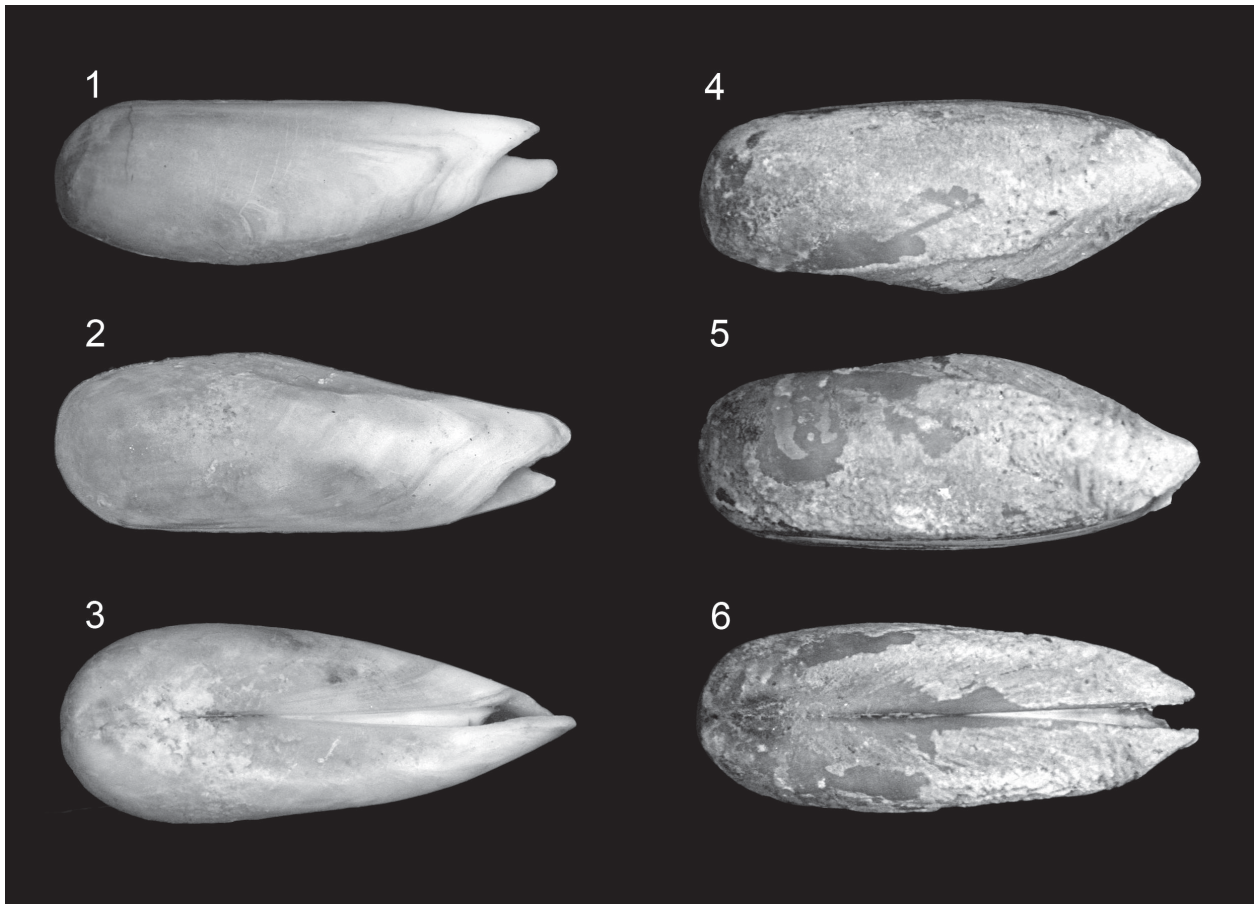
Genus *Myoforceps* Fischer, 1886

Myoforceps aristatus (Dillwyn, 1817)
(Figures 1-6)

Material examined: BRAZIL. **Ceará;** Caucaia, Pacheco Beach, 03°41'07"S 38°38'21"W, MZSP 101704, 03 specs (09/ix/2011, Simone, LR leg.). **Bahia;** Morro de São Paulo, Garapuá Beach, 13°29'4.12"S 38°54'24.2"W, MZSP 100792, 01 spec (2011, in coral reef, Coelho-Filho, PA leg.),

13°29'4.81"S 38°54'28.49"W, MZSP 101254, 01 spec (2011, in coral reef, Coelho-Filho, PA. leg.). **Rio de Janeiro;** Niterói, Piratininga Beach, 22°57'19.84"S 43°5'57.62"W, MZSP 101683, 02 specs (2011, Tavares, MDS leg.); Angra dos Reis, Macacos Island, 23°04'36"S 44°13'46"W, MZSP 104682, 01 spec (16-23/iii/2011, 2-4 m depth, Tavares, MDS leg.); Paraty, Comprida Island, 23°10'16.81"S 44°40'44.25"W, MZSP 90962, 01 spec (18/i/2008, Cunha, CM leg.). **São Paulo;** Ilhabela, Pedra do Sino Beach, 23°44'52.80"S 45°20'57.65"W, MZSP 89380, 01 spec (30/xi/2008, boring into empty shell of *Stramonita haemastoma*, Dornellas, APS leg.); Búzios Island, Coroa de Búzios, 23°47'0.80"S 45°8'2.65"W, MZSP 103973, 02 specs (2011, 5 m depth, Simone, LR & Lima, POV leg.); Vitória Island, Saco do Paiá, 23°44.658'S 45°01.343'W, MZSP 105741, 54 specs (15/v/2012, in dead *Palythoa*, 15-25 m depth, Simone, LR & Gonçalves, EP leg.); São Sebastião, Therezina Shipwreck, 23°54'26.80"S 45°27'59.65"W, MZSP 103789, 01 spec (20/ii/2012, 10 m depth, Lima, POV leg.); Alcatrazes Archipelago, Farol Island 24°5'44.79"S 45°42'14.65"W, MZSP 102234, 01 spec (05/x/2011, Dornellas, APS leg.), Saco do Funil, 24°5'51.79"S 45°41'18.66"W, MZSP 102145, 02 specs (06/x/2011, 8 m depth), Oratório, 24°5'44.79"S 45°42'10.65"W, MZSP 102365, 04 specs (05/x/2011, 14 m depth, Amaral VS & Dornellas, APS leg.), Saco da Tartaruga, 24°6'24.79"S 45°42'25.66"W, MZSP 102203, 01 spec (05-07/x/2011, 17 m depth, Simone, LR leg.); Cananéia, Castilho Island, 25°16'17.75"S 47°57'33.69"W, MZSP 83432, 02 specs (25/i/2007, 19 m depth, Guimarães, CH leg.). **Santa Catarina;** Arvoredo Island, 27°16'0.861"S 48°19'4.7058"W, MZSP 105274, 07 specs (12/xii/2010, boring into empty shells of *Zidona dufresneyi* and *Stramonita haemastoma*, Tavares, MDS leg.); off Florianópolis, Costeira do Ribeirão, 27°44'6.85"S 48°33'47.71"W, MZSP 84820, 02 specs. (26/iv/2007, boring into live specimens of *Crassostrea*, Silveira, N leg.) Caieira da Barra do Sul, 27°49'0.85"S 48°34'2.71"W, MZSP 84818, 14 specs (02/v/2007, boring into live specimens of *Nodipecten nodosus*, Silveira, N leg.).

Genus *Lithophaga* Röding, 1798



Figures 1-6. *Myoforceps aristatus*: **1**) MZSP 105741, left lateral view (L 20.1 mm, H 8.0 mm); **2**) same, right lateral view; **3**) same, dorsal view; **4**) MZSP 101704, left lateral view (L 14.1 mm, H 5.0 mm); **5**) same, right lateral view; **6**) same, dorsal view.

Lithophaga bisulcata (D'orbigny, 1853)

Material examined: BRAZIL; **São Paulo;** Vitória Island, Saco do Paiá, 23°44.658'S 45°01.343'W, MZSP 105742, 07 specs (15/v/2012, in dead *Palythoa*, 15-25 m depth, Simone, LR & Gonçalves, EP leg).

Remarks: According to sampling notes, specimens of *M. aristatus* were found by chance, boring into gastropod shells (e.g. *Zidona dufresnei* (Donovan, 1823), Volutidae, *Stramonita brasiliensis* (Linnaeus, 1767), Thaididae) and bivalves (e.g. *Crassostrea* Sacco, 1897, Ostreidae, *Nodipecten nodosus* (Linnaeus, 1758), Pectinidae), or dead hard coral heads (*Palythoa* Lamoroux, 1816, Sphenopidae). Infested bivalves were frequently collected still alive. A substantial amount of specimens were collected in May 2012 inside dead hard coral in Victoria Island, São Paulo. Specimens of *M. aristatus* with intact soft parts

were found alongside *Lithophaga bisulcata*, a native species, in the same coral block in a 9 to 1 ratio. Many empty shells of *L. bisulcata* were found in the same coral blocks.

Discussion

The present study shows that *M. aristatus* is widespread on the southeastern coast of Brazil, which is congruent with what was previously reported by Simone & Gonçalves (2006) and Breves-Ramos et al. (2010). Still regarding this region, localities such as Niterói, Macacos Island and Paraty, in Rio de Janeiro, as well as the Alcatrazes Archipelago, Cananéia and Ilhabela, in São Paulo, and Florianópolis and Arvoredo Island in Santa Catarina are new records. *M. aristatus* now also reaches different parts of the northeast coast where it had not been previously reported.

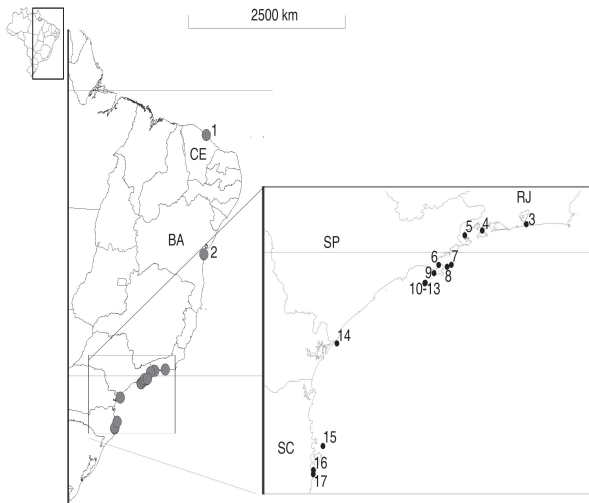


Figure 7. New records of *Myoforceps aristatus* along the Brazilian coast: 1) Ceará – CE, Pacheco Beach; 2) Bahia – BA, Garapuá Beach; 3) Rio de Janeiro – RJ, Piratininga Beach; 4) same, Macacos Island; 5) same, Comprida Island; 6) São Paulo – SP, Pedra do Sino Beach; 7) same, Búzios Island; 8) same, Vitória Island; 9) same, Therezina Shipwreck; 10-13) same, Alcatrazes Archipelago; 14) same, Castilho Island; 15) Santa Catarina – SC, Arvoredo Island; 16) same, Florianópolis; 17) same, Caieira da Barra do Sul.

The specimens collected in Victoria Island show that the invasive species and *Lithophaga bisulcata* can occupy the same niche. Thus, further study is needed in order to clarify the ecological relationships between these two species. While Simone and Gonçalves (2006) have reported the preference of *M. aristatus* for mollusk shells as substrate, evidence presented here suggests that this initial assumption may have resulted from a sampling bias, as the selectivity towards the substrate of the invasive species seems to be smaller than originally assumed.

Several occurrences reported here are close to large, busy ports. It is the case of the records in Ceará (Figs 1-3), between the ports of Fortaleza and Pecém, and Bahia, near the ports of Salvador and Aratu. This apparently corroborates previous reports on the spreading of the species through ballast water. Moreover, the fact that the new records included here encompasses islands (some of them protected by environmental laws, such as in the Alcatrazes Archipelago) and spots much farther north along the Brazilian coast, indicates that the invasion

has worsened considerably, or was more severe than initially stated. Ferreira et al. (2009) have already mentioned the growing concern of the Brazilian authorities regarding invasive species brought in by ballast water. Despite the recent measures taken by the Brazilian maritime authority against marine bioinvasions in the Brazilian Coast, such as the Regulation Norman 20 issued in 2005, Ferreira mentioned the lack of financial support for studies on the subject. The data presented here constitute further evidence of the need for greater investment.

Acknowledgements

The authors wish to acknowledge Professor Luiz R. L. Simone, from MZSP, for the identification of specimens and several thoughtful suggestions. We also thank Rodrigo César Marques, from MZSP, for many helpful comments on the paper. We also thank the anonymous reviewers for their contributions.

References

- AGUDO-PADRÓN, A.I. 2011. Exotic molluscs (Mollusca, Gastropoda et Bivalvia) in Santa Catarina State, Southern Brazil region: check list and regional spatial distribution. *Biodiversity Journal* 2(2): 53-58.
- BREVES-RAMOS, A.; A. PIMENTA; M.T.M. SZÉCHY & A.O.R. JUNQUEIRA. 2010. Mollusca, Bivalvia, Mytilidae, *Myoforceps aristatus* (Dillwyn, 1817): Distribution and new record localities at Ilha Grande Bay, Brazil. *Checklist* 6(3): 408-409.
- CLAVERO, M. & E. GARCÍA-BERTHO. 2005. Invasive species are a leading cause of animal extinctions. *Trends in Ecology and Evolution* 20(3): 110.
- FERNANDES, M.A.; S.C. THIENGO & L.R.L. SIMONE. 2003. Distribution of the introduced freshwater snail *Melanoides tuberculatus* (Gastropoda: Thiaridae) in Brazil. *The Nautilus* 117(3): 78-82.
- FERREIRA, C.E.L.; A.O.R. JUNQUEIRA; M.C. VILLAC & R.M. LOPES. 2009. Marine bioinvasions in the Brazilian coast: Brief report

on history of events, vectors, ecology, impacts and management of non-indigenous species. *Biological Invasions in Marine Ecosystems, Ecological Studies* 204: 459-478.

TURNER, R.D. & K.J. BOSS; 1962. The genus *Lithophaga* in the Western Atlantic. *Johnsonia* 4(41): 81-116.

SAX, D.F. & J.H. BROWN. 2000. The paradox of Invasion. *Global Ecology & Biogeography* 9(5): 363-371.

SIMONE, L.R.L. & E.P. GONÇALVES. 2006. Anatomical study on *Myoforceps aristatus*, an invasive boring bivalve in S. E. Brazilian coast (Mytilidae). *Papéis Avulsos de Zoologia* 46(6): 57-65.

Received: January 25, 2012. Accepted: June 15, 2012