

## **Imposex in Endemic Volutid from Northeast Brazil (Mollusca: Gastropoda)**

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### **ABSTRACT**

*Imposex is characterized by the development of masculine sexual organs in neogastropod females. Almost 120 mollusk species are known to present imposex when exposed to organic tin compounds as tributyltin (TBT) and triphenyltin (TPT). These compounds are used as biocide agents in antifouling paints to prevent the incrustations on boats. Five gastropod species are known to present imposex in Brazil: Stramonita haemastoma, Stramonita rustica, Leucozonia nassa, Cymathium parthenopeum and Olivancillaria vesica. This paper reports the first record of imposex observed in the endemic gastropod Voluta ebraea from Pacheco Beach, Northeast Brazil. Animals presenting imposex had regular female reproductive organs (capsule gland, oviduct and sperm-ingesting gland) and an abnormal penis. As imposex occurs in mollusks exposed to organotin compounds typically found at harbors, marinas, shipyards and areas with high shipping activities, probably contamination of Pacheco Beach is a consequence of a shipyard activity located in the nearest areas.*

**Key-words:** Imposex, *Voluta ebraea*, Endemic, Brazil, Organotin, Contamination

### **INTRODUCTION**

Imposex in gastropod mollusks has been widely used to monitor the contamination by organotin compounds all around the world (Morcillo and Porte, 1998; Axiak et al., 2002; Minchin, 2003). The reliability of this bioindicator is derived from the fact that imposex originates in one highly specific hormonal alteration, occurring just in gastropods exposed to organotin compounds (Matthiessen and Gibbs, 1998). More than a

hundred gastropod species exhibited this response in a worldwide scale (Fioroni et al, 1991; Gibson and Wilson, 2003). Although imposex has already been observed in some studies in Latin America (Gooding et al., 1999; Penchaszadeh et al., 2001; Bigatti and Penchaszadeh, 2005; Cledòn *et al*, 2006), no monitoring studies over large areas have been carried out in this region.

In Central Chile, Osorio and Huaquín (2003) found symptoms of populational decline within populations of the muricid *Acanthina monodon*,

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found in the proximity of port terminals. In Brazil, imposex was observed in the muricids *Stramonita haemastoma* (Castro et al., 2000; Fernandez et al., 2002; Fernandez et al., 2005), *Stramonita rustica* (Camillo et al., 2004; Castro et al., 2004), and in the olivid *Olivancillaria vesica* (Caetano and Absalão, 2003).

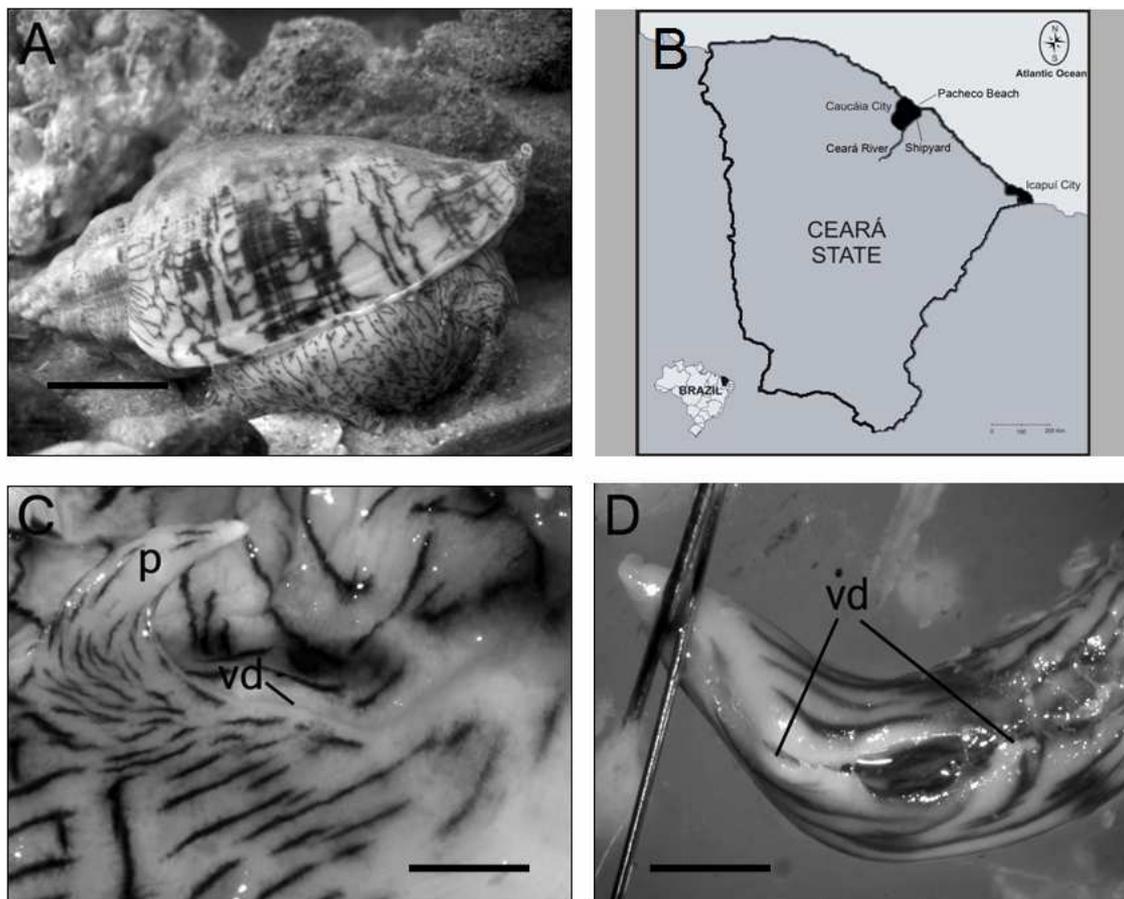
*Voluta ebraea* (Fig. 1A) is an endemic species from Northeast Brazil, occurring along the coast of Maranhão, Ceará, Rio Grande do Norte and Alagoas States (Matthews, 1969; Weaver and du Pont, 1970).

This study was aimed to verify the occurrence of imposex in volutid *Voluta ebraea* from Ceará State coast, Northeast Brazil.

## MATERIALS AND METHODS

Adult specimens of *V. ebraea* were examined: three animals from Pacheco Beach, Caucaia County and eight animals from Icapuí County, in Ceará State coast (Fig. 1B).

Their shells were measured from the tip of the spiral to the siphonal canal using vernier caliper. The shell of each organism was then removed in order to examine the soft parts. Sexual identification was performed based on the presence of a capsule gland, oviducts and seminal receptacle in the females, and a prostate gland in the males. Animals with penis and capsule gland, oviducts and sperm-ingesting gland were considered imposexed females.



**Figure 1** - *Voluta ebraea*. **A.** Adult individual from Northeast Brazil. **B.** Study areas at Ceará State, Northeast Brazil. **C.** Penis and *vas deferens* of an imposexed female from Pacheco Beach, Northeast Brazil. **D.** Detail of penis and *vas deferens* of a male from Pacheco Beach, Northeast Brazil. Abbreviations: p, penis; vd, *vas deferens*. Scale bars: **A** = 2.6 cm; **C** = 4 mm; **D** = 0.5 mm.

Penis lengths were measured to the nearest millimeter. Imposex quantification was usually made by an index initially developed for the neogastropod *Nucella lapillus* (Gibbs and Bryan, 1987; Gibbs et al., 1987) and successfully used for others neogastropods (Minchin et al., 1996; Gooding et al., 1999).

The Relative Penis Length Index (RPLI = (Mean length of female penis) / (Mean length of male penis) X 100). Was also investigated the relation between penis size and shell size in the collected animals.

## RESULTS

Eleven adult animals were collected: 4 males and 7 females. 2 females from Pacheco Beach presented imposex. Other females from Icapuí County didn't show any evidence of this abnormality.

Imposex in *Voluta ebraea* was characterized by the development of a small conical penis (8.8 and 8.1 mm in length) and the presence of a gutter-shaped *vas deferens*, like an opened channel, as seen in the males of Volutinae (Fretter and Graham, 1994) (Figs. 1C and 1D). This channel was long, passing from the bottom of palial cavity to the penis tip.

RPLI index for *V. ebraea* from Pacheco Beach was 31.2 and males showed a higher relationship between penis size/shell size than imposexed females (0.57 and 0.17, respectively).

## DISCUSSION

According to Maia (1998), the predominant maritime current direction of Ceará coast is from east to west and, a lot of water and sediment from Ceará River is carried by this current to Pacheco Beach. There is a shipyard near Ceará River's estuary which repairs and constructs the boats and small ships. It is known that shipyards, harbors, marinas and other places with high shipping activities are potential areas of contamination by organotin compounds from antifouling paints (Sekizawa et al., 2003; Sudaryanto et al., 2004). Probably, the imposex observed in *V. ebraea* females from Pacheco Beach was induced by the animals exposition to these organotin compounds

that were brought from Ceará River the by maritime current.

Studies conducted by Castro *et al.*, 2000 didn't show imposex in muricid *Stramonita haemastoma* at Pacheco Beach. This semblable contradiction come reflect two different situations: the species *Voluta ebraea* might present high natural sensibility for organotin compounds which induced imposex or, and probably, the species *S. haemastoma* was not exposed to contamination as *V. ebraea* because the first one usually live upon rocky sediment and the second one live upon sandy sediment. According to Stronkhorsta et al., (2003) and Wezel and Vlaardingen, (2004) organotin compounds have high affinity for sediments.

High levels of imposex could lead some gastropod populations with intracapsular development to extinction (Gibbs and Bryan, 1986). Imposex high levels cause a tissue proliferation which blocks the females' genital system. This situation usually causes sterilization and death due to the presence of aborted capsules in the capsule gland (Gibbs and Bryan, 1986, Gibson and Wilson, 2003). Reproductive failure was observed in populations of muricid *Nucella lapillus* which severely declined during the 80's in southern England (Gibbs e Bryan, 1986) due to imposex effects and intracapsular development (no larval migration from healthy populations)(Spence et al., 1990).

*V. ebraea* imposexed females showed penis and *vas deferens* with a high level of development and RPLI index of 31.2, reflecting high levels of contamination by organotin compounds of Pacheco Beach. High RPLI values had been observed in some populations of *Nucella lapillus* of England southeastern (Bryan *et al.*, 1986) and of *Nassarius reticulatus* from Spain (Barreiro *et al.*, 2001). In these populations, high sterility index were observed in imposexed females. Thus, it would be very important to verify the occurrence of sterility in *V. ebraea* populations from Pacheco beach.

*V. ebraea* has an intracapsular metamorphosis larval development type (Matthews-Cascon, personal communication), i.e, there are no plancton larval stages. This development type does not allow larval migration from a population to another one. Then, if one of these populations becomes sterile due to imposex abnormality, the risk of extinction is very high. This is an extreme concern with a preservationist point of view, once

*V. ebraea* is an endemic mollusk species from Northeast Brazil (Matthews, 1969).

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## RESUMO

O imposex caracteriza-se pelo surgimento de estruturas sexuais masculinas, em fêmeas de gastrópodes. Cerca de 120 espécies de moluscos que exibem o fenômeno quando expostas a contaminação por compostos orgânicos de estanho tais como o Tributilestanho (TBT) e o Trifenilestanho (TPT). Esses compostos são utilizados, sobretudo em embarcações, no intuito de evitar a bioincrustação que danifica as embarcações e eleva os custos das viagens marítimas. No Brasil se conhecem 5 espécies de moluscos gastrópodes que manifestam imposex, são elas: *Stramonita haemastoma*, *Stramonita rustica*, *Leucozonia nassa*, *Cymathium parthenopeum* e *Olivancillaria vesica*. No Nordeste, monitoramentos da contaminação por organoestânicos foram realizados utilizando o imposex em gastrópodes como biomarcador. O presente estudo tem por objetivo notificar a primeira ocorrência de imposex na espécie endêmica do Nordeste brasileiro, *Voluta ebraea*. De um total de 11 animais observados, duas fêmeas apresentaram imposex, provenientes da Praia do Pacheco no litoral do Ceará. Observou-se nesses indivíduos a presença de glândula de cápsulas, ovidutos e receptáculo seminal concomitantemente ao pênis o que caracteriza o imposex. Como o imposex só se manifesta em moluscos expostos a compostos organoestânicos tipicamente encontrados em portos, marinas, estaleiros e locais com grande fluxo de embarcações atribui-se a origem dessa contaminação provavelmente a um estaleiro localizado nas proximidades da área de coleta.

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