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Evaluating shellfish gathering (*Lucina pectinata*) in a tropical mangrove system

S.F. Rondinelli, F. Barros *

Laboratório de Ecologia Bentônica, Depto de Zoologia, PPG em Ecologia e, Biomonitoramento, Universidade Federal da Bahia, Rua Barão de Geremoabo, s/n, Ondina, 40170-115, Salvador, Bahia, Brazil

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ABSTRACT

Fish resources are important sources of income and protein to traditional inhabitants of coastal zones. In Garapuá village, the shellfish *Lucina pectinata* is the main resource exploited in mangroves. This study tests whether if in less explored areas (far from the village) *L. pectinata* individuals have higher densities and greater lengths, and if there was a decrease in cpue's over the last years. Samples were taken monthly in two habitats (mangrove channels and mangrove roots) in six mangrove areas by random squares. The results indicated that closer areas showed significantly lower densities than areas far from the village. Densities were significantly higher in mangrove roots (quizangas) than at channels. There was a significant increase in monthly *L. pectinata* cpue, from 18.2 dz./shellfish gatherers/day in 2001 to 19.3 in 2007, showing that this stock does not seem to be overexploited. However, (i) a long-term monitoring of Garapuá shellfish gatherers to evaluate if the stock will support an increasing pressure and (ii) several manipulative experiments to better understand ecological processes are suggested.

1. Introduction

Mangroves are responsible for many ecological functions, such as biodiversity maintenance, are used as breeding, spawning and nursery areas and are used by many tropical marine organisms, as molluscs, crustaceans, sponges and fish as habitat during specific stages of their life cycle (e.g. Kaiser et al., 2005; Rönnbäck, 1999; Walters et al., 2008).

Moreover, some of the biological resources from mangroves have an important social role, because they generally are important sources of food and income for coastal communities (Diele et al., 2005; Walters et al., 2008). In some cases, these resources are essential to the local economy of human communities living near mangroves, estuaries, lagoons, inlets, reefs and the tidal plains (Diele et al., 2005; Walters et al., 2008), where people practice small scale fishing (De Boer et al., 2000; De Boer and Prins, 2002a; Kaiser et al., 2001; McGoodwin, 1990; Rönnbäck, 1999; Roy et al., 2003; Salayo et al., 2008).

In many coastal communities, the need to survive associated with regional economic pressure, mainly seafood market demand, is leading to situations of overexploitation of resources and, therefore, reduction in fish stocks (e.g. De Boer et al., 2000; De Boer and Prins, 2002a; McGoodwin, 1990; Morales-Bojórquez et al., 2001).

Negative effects on the stocks by fishing activities are not uncommon and might be due to the direct effects of harvesting or indirectly due to changes in habitat (Armstrong and Falk-Petersen, 2008; De Boer and Prins, 2002b). For instance, overfishing can change the size or structure of a population and can affect biological interactions, which may have indirect effects on other populations (Kaiser et al., 2005; Sharpe and Keough, 1998).

The relationship between competition and predation can explain the variations in size of certain populations (Peterson and Andre, 1980). In nature, the vulnerability of an individual to predation depends, among other things, on its size, on how many conspecifics are (i.e. number of preys) and on the quantity and quality of protection provided by the habitat (Ray-Culp et al., 1999). For instance, individuals of *Strombus gigas*, when in high densities, are more protected from predators (the xanthid crab *Micropanope* sp.) than when at lower densities (Ray-Culp et al., 1999). However, for other invertebrates such as abalone and littleneck clams, the probability of individual mortality increases as density increases (Ray-Culp et al., 1999), because predators spend more time in areas with higher densities of prey.

This also can be observed in fisheries, where fishing boats search for areas with higher fish densities to increase the capture efficiency (Abernethy et al., 2007). Thus, areas subjected to a large fishing effort may have reduced abundances of target species, and as many of the larger individuals are removed, there may be a decrease in the average individual size, resulting in smaller sizes than required by the consumer market (e.g. De Boer et al., 2000; De Boer and Prins, 2002a; Roy et al., 2003). This might have important consequences on the reproductive output of a population, since larger animals are generally more fertile than small individuals (e.g. De Boer and Prins, 2002b; Kaiser et al., 2005; Roy et al., 2003).

Decreasing values of catch per unit effort (cpue) can be a result of overfishing (e.g. Morales-Bojórquez et al., 2001), since cpue estimates

* Corresponding author. Tel.: +55 71 32836552; fax: +55 71 32836513.
E-mail address: barrosf@ufba.br (F. Barros).

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the catch (number and weight) of a species and the associated fishing effort. Thus, cpue can be used to assess temporal and spatial trends of fish stocks (Hubert and Fabrizio, 2001).

On the coast of Bahia (Brazil), fishery is predominantly artisanal (SEAP, 2008). In Garapuá (13°28′S 38°54′W), the activities of fishing and shellfish gathering are the main sources of income and food for most of local people. This is the community with higher fishing activities in the Tinharé Archipelago (SEIA, 2006), like: lambreta (the popular name of *Lucina pectinata*), red-lobster (*Panulirus echinatus*), octopus (*Octopus vulgaris*), crab (*Ucides cordatus*), shrimp (penaeidae) and several fish (e.g. mullet) (Mendes, 2002).

According to the local shellfish gatherers, *L. pectinata* has been commercially exploited for over 30 years. It is the most important source of income (Poggio, 2002), being sold in local restaurants and regional consumer markets (Valença and Salvador), in addition it is also consumed by local families. *L. pectinata* is found in large quantities in mangroves throughout the year, even in winter time when most of the fishermen have their capture operations limited due to bad weather (Mendes, 2002).

L. pectinata (Lucinidae, Bivalvia, Mollusca) is from the family Lucinidae, which is the most diverse group of chemosymbiotic mollusks (Taylor and Glover, 2000; Taylor and Glover, 2006). This species can be found from North Carolina, USA, to Santa Catarina, southern Brazil (Rios, 1994). Individuals of *L. pectinata* are suspension feeders typically lives in calm waters, buried between 15 and 20 cm in the mud and, as many other species of mollusks in Brazil, there is a lack of basic information regarding its occurrence and conservation status (Beasley et al., 2005).

In Garapuá, lambreta is exploited mainly in a north mangrove, composed of six areas: Caduspau, Enseadinha, Vilesboa, Pedarta, Camboa Velha and Panã, named locally by inhabitants. It is found in two different habitats, and generally, (1) in mangrove channels, the sediment is soft and has a few roots, where water puddles are made, and (2) in quizangas (popular name of mangrove roots), the sediment is hard due to the greater presence of roots, and has no water puddles.

A good understanding of population biology of target species is necessary to understand how they can be affected by the environment and fisheries, and thus predict sustainable levels of catch without compromising future fisheries (Kaiser et al., 2005). To generate essential information for management of the *L. pectinata* exploitation in Garapuá, this study aims to test if in more exploited areas (i) there would be smaller densities and (ii) smaller lengths of *L. pectinata*; and (iii) if there would be a decrease in cpues from 2001 to 2007.

2. Study site

Garapuá (13°28′S 38°54′W) is located in the Tinharé Island, Tinharé Archipelago, which is part of Islands of Tinharé/Boipeba Environmental Protection Area. It belongs to the Cairu City (south coast of Bahia, Brazil) (Fig. 1), the only Brazilian city-archipelago, which consists of 36 islands, where the main are Cairu, Boipeba and Tinharé. The climate is hot and humid, the average annual temperature is 25.3 °C (minimum of 21.8 °C and maximum 31.4 °C) and rainy season occurs between the months of May and July.

Garapuá is a bell shape shallow bay with depths never exceeding 8 m, connected with coral and sand reefs. There are two well preserved mangrove areas, located in the extreme south (2.8 km long) and north (7.0 km long), two reef areas in the front of the mangroves and a sand beach in the center (Pires-Santos, 2006).

3. Methods

3.1. Sampling

The samples were made monthly, from October 2006 to September 2007, during low tide in six mangrove areas in Garapuá (Fig. 1). *L. pectinata* was sampled using a PVC square of 50 × 50 cm. In each habitat (i.e. channel and quizanga) of each area (i.e. Caduspau, Enseadinha, Vilesboa, Pedarta, Camboa Velha and Panã) twenty random samples were taken monthly. *L. pectinata* individuals inside the square were collected by two shellfish gatherers selected in the Garapuá community. In mangrove channels, the sediments were relatively softer, so the shellfish gatherers dug with their hands, and in quizangas, where the sediments were relatively harder, shellfish gatherers used a machete to dig. Both excavated till around 40 cm depth.

The individuals were counted and measured. The total length of individuals was obtained using a caliper accurate to 0.5 mm, which was used to measure the longest distance between the anterior and posterior edges of the shell line, parallel to the umbo.

3.2. Shellfish gathering data in Garapuá

To generate data on the lambreta catch in the six areas in the north mangrove of Garapuá, the shellfish gatherers selected at the beginning of the study reported their catches and effort every day over the 12 months. With the help of a local fisheries monitor, the following information was obtained: name of the shellfish gatherer,

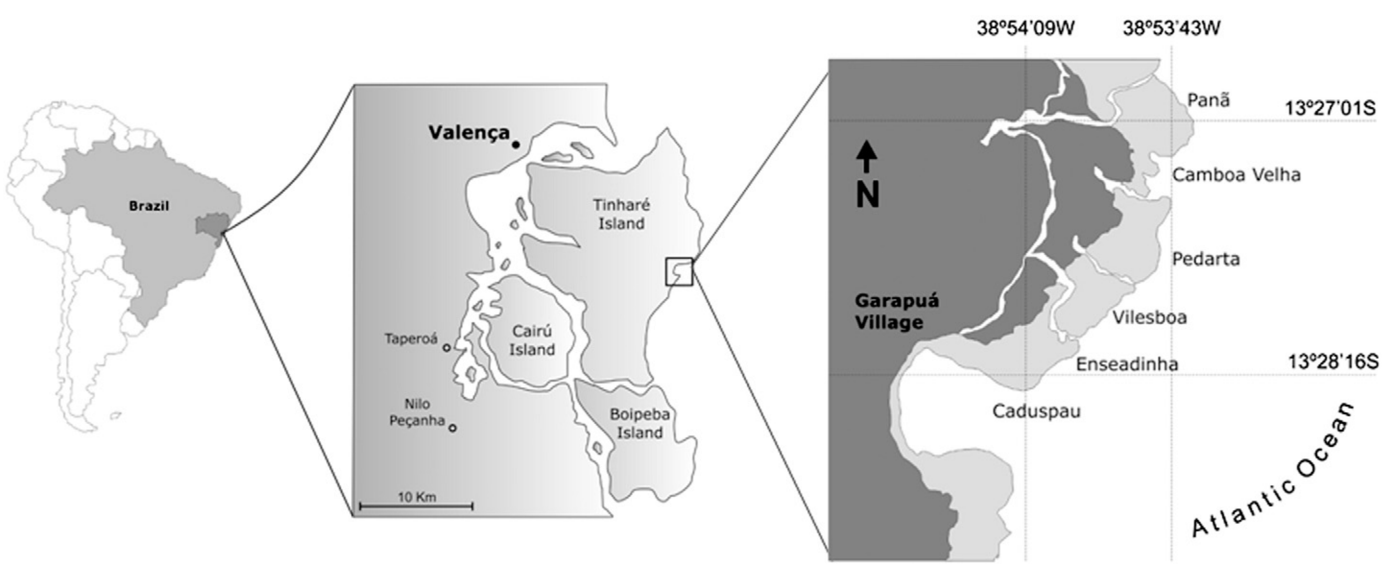

Fig. 1. Map of study area showing the mangroves that were sampled at Garapuá.