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Engineering

BALANOMORPHA COMMUNITY OF CONFINED ARTIFICIAL SUBSTRATE IN A THERMAL POWER PLANT OF PERNAMBUCO, BRAZIL

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ABSTRACT The fouling-forming organisms, because they present a rapid colonization, bring several damages to the activities. This fact is observed in the water collection pipes used for the cooling in Termopernambuco, which needs to stop its activities with a periodicity for scraping the organisms that are embedded in its walls, reducing or even rendering unfeasible the electric power production of this thermoelectric unit. The study searched identify the species of cirripedia that inhabit the tubes, being found four species of Balanomorpha, that cause fouling. It is noteworthy that three species are cryptogenic and one endemic to the Brazilian Coast.

KEYWORDS : Barnacles; Cirripedia; Fouling;

INTRODUCTION

Fouling is the group of sessile, animal or plant organisms that usually adhere to a variety of structures, from natural shells, coral reefs and manchurian roots, to artificial substrates such as boat hulls, pilasters and pipes (WAHL 1989) , Which are responsible for large concentrations of biomass in submerged consolidated substrates (RAILKIN, 2004).

This communities are highly diversified, they can be formed by one or more layers or strata composed of several organisms (DA GAMA et al., 2009). Algae, sponges, ascidians, bryozoans and barnacles, are some of the most common representatives of fouling (FARRAPEIRA et al., 2011).

Research funded by the The National Institute of Electrical Energy (ANEEL-TPE 53) carried out initial studies to identify the fauna of cirripeds that grow as fouling in the internal pipelines of the Pernambuco Thermoelectric Power Plant (Termope).

The barnacles are sessile crustaceans that have a forehead or carapace originated by rigid calcareous plates that inhabit all oceans and climates, from coastal environments to deep sea areas (FARRAPEIRA, 2008; ZULLO, 1992). This great capacity of adaptation ensures that these animals can colonize the most diverse substrates.

Callow and Callow (2011) says that this process of colonization of artificial substrates generates environmental impacts, damages to structures and damages to the economy. And in order to control it, it's necessary to understand this process. Thus, with the objective of developing eco-efficient technologies for scale control in metallic structures of the thermoelectric power plant of Pernambuco - TERMOPE, a taxonomic study occurred to know the species of balanomorphs that occur in the system of cooling of the power plant.

MATERIALS AND METHODS

Study area

The Termopernambuco power plant - TERMOPE (Fig. 1) is located in the Suape Port Industrial Complex, between the coordinates 8º15'00 " S and 8º30'00 " S and the meridians 34º55'00 " W and 35º05'00 " W, approximately 40 km from Recife, capital of Pernambuco (FERNANDES, 2000).

Figure 01: Location of TERMOPE.

Field Research

The organisms were collected manually by scraping the pumps and piping of the plant's cooling system, occasionally stopping to clean and maintain the structure, keeping the focus on keeping the carapace base intact. The material was kept in a vessel with a seawater ventilation system and transported to the laboratory of Instituto Avançado de Pesquisa e Inovação - IATI.

DATA ANALYSIS

In the laboratory the specimens were analyzed and identified with the aid of a stereoscopic microscope. For the identification of the species, the organisms were analyzed for their internal and external morphology, using relevant literature and specialist identification keys.

RESULTS AND DISCUSSION

During the study four species of cirripedes could be found in the TERMOPE cooling system: Amphibalanus amphitrite (Darwin, 1854); Balanus trigonus (Darwin, 1854); Megabalanus tintinnabulum (Linnaeus, 1758); and Megabalanus vesiculosus (Darwin, 1854).

***Amphibalanus amphitrite* (Darwin, 1854)**

Description

The shell of Amphibalanus amphitrite is conical or subcylindrical, smooth, ranging from white, gray, or even bluish-white with continuous purple or brown longitudinal stripes on the plates. The set of plates has characteristic starry appearance. In the shell has a growth of thin, slightly crenulated sulcus, articular crest with 3/5 of the length of the tergal margin, a straight adductor crest, moderately long and thick, a shallow articular groove (FARRAPEIRA, 2006; LACOMBE, 1977; HENRY; MCLAUGHLIN, 1975).

Distribution

They are widely distributed in tropical and temperate seas, being considered cosmopolitan (FARRAPEIRA, 2009; 2010; HENRY; MCLAUGHLIN, 1986). Brazil: Amapá to Rio Grande do Sul (FARRAPEIRA, 2009; 2010, YOUNG, 1998).

Other information

The species can be found on different substrates. It is generally detected in subtiral and intertidal zones, in rocky areas, brackish water, mangrove areas, boat hooves, coastal and epibiosis facilities on carapace of the turtle species Caretta caretta (Linnaeus, 1758) and shells of other marine organisms (AMADOR, 2007; HENRY; MCLAUGHLIN, 1975).

Figure 02: Barnacle *Amphibalanus amphitrite* (featured) attached in another barnacle.

Balanus trigonus (Darwin, 1854)

Description

The species *Balanus trigonus* (Figure 03) presents conical-globose shell, calcareous plaques with broad ribs, white, without growth lines and having reddish purple spots, with a wide and triangular opening. They have longitudinal tubes in series and are filled at the level of the sheath, limestone base with row of radial tubes. Observed in the external region, the growth lines are thick, not protruding, but smooth (OLIVEIRA, 2011; YOUNG, 1987; LACOMBE, 1977).

Distribution

Species characterized as an opportunistic, widely distributed (GARCÍA, MORENO, 1998, AYLING, 1976, WERNER, 1967). Brazil: Rio de Janeiro, Santa Catarina, São Paulo and Pernambuco, in Port of Recife (GEBIO, 2017; FARRAPEIRA et al., 2007).

Other information

B. trigonus inhabits marine and estuarine environments, in intertidal zones low to subtidal, found in encrustation in cnidarians and sponges, in rocky shores, reefs, mangroves, boats (LIRA et al., 2010; FARRAPEIRA, 2009; 2010; AMADOR, 2007), between 20m and 30m deep (AMARAL et al., 2010; PONTI et al., 2002).

Figure 03: Exemplary Balanus trigonus attached in other barnacle.

***Megabalanus tintinnabulum* (Linnaeus, 1758)**

Description

Megabalanus tintinnabulum (Fig. 04) has a cylindrical, cylindrical-conical, or conical, often elongated shell. Calcareous plaques are smooth, and may have reddish, bluish-purple, reddish-brown, yellow, pink, and often darker longitudinal stripes on the outside, and may have narrow or broad transverse bands, dark or light. The hole can be small or large, subtriangular or subcircular. The basal margin may be flat or slightly sloping at the spur of both sides (HENRY; MCLAUGHLIN, 1986; OLIVEIRA, 1941).

Distribution

It occurs in shallow waters, in the tropical and subtropical zone, in the South American continent. It has about 40 occurrences along the Brazilian coast (GEBIO, 2017). It is worth mentioning: Fernando de Noronha Archipelago and Atol das Rocas (OLIVEIRA, 2011) and Suape Port (SILVA, 2003).

Other information

The species can establish epibitic relationships, being found in oyster shells, carapaces of other barnacles and boat hoofs (OLIVEIRA, 1941), can also be found in the mid-coast in intertidal zones fixed in rocks and reef structures (YOUNG, 1987). Farrapeira (2009; 2010) showed that the species is unique to marine environments, intertidal zones low to subliters, rocky shores, reefs and biogenic substrates, can be found fixed in artificial substrates.

Figure 04: Specimen Megabalanus tintinnabulum found in the tubes.

***Megabalanus vesiculosus* (Darwin, 1854) (Figura 05)**

Description

Megabalanus vesiculosus (Fig.05) has a conical shell, globule or conical, subcylindrical, bluish or purple-pink at least in the lower half of the plates, with longitudinal white ribs on the plates. The hole is small, usually less than ½ the diameter of the base. The basal margin slopes to the spur on both sides (OLIVEIRA, 2011).

Distribution

Endemic to all Brazilian coast (ABREU et al., 2016).

Other information

Observed in the middle coast, fringe and infralittoral up to 20 m deep. For Mclaughlin and Lacombe (1979) and Young (1987) the species is found in intertidal and subtidal zones, fixed in mussels. Farrapeira (2009; 2010) explains that M. vesiculosus only inhabits marine environments, in low intertidal zones to the sublittoral, rocky coastlines, reefs, piers on the quay, boat hulls and biogenic substrates.

Figure 05: Megabalanus vesiculosus found in TERMOPE structures and tubes.

CONCLUSIONS

During the study it can be noticed that presence of these species in representative quantities along the artificial structures, this contributes to demonstrate the great capacity of these animals to be able to adapt to new environments, even if they are confined, with little availability of light, and with high temperatures, such as the TERMOPE cooling system.

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