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PROCAMBARUS (AUSTROCAMBARUS) LLAMASI: THE SHRIMP FROM THE POPALES TABASQUEÑOS PERSPECTIVE OF ITS USE AND BIOLOGY

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Abstract: The objective of the work was to carry out, from a participatory perspective and field monitoring, the approximation to the life cycle of the *Procambarus* (*Austrocambarus*) *llamasi* as well as the morphometric description of the species in Laguna Santa Anita, Centla, Tabasco. Five moments in the life cycle of the organism are recognized, the environmental conditions of the habitat presented a maximum depth of 120 cm and a minimum of 20 cm. The average temperature of the water bodies monitored at 06:00 hours was 12±2.4 °C and at 14:00 hours it was 26±3.2 °C. The average pH value in the wetlands analyzed was 7.3±0.30, considered neutral. The values found for total nitrogen do not pose a risk to the life of the aft shrimp. The organisms collected in this study had an average length of 85.2 mm. The population in general appeared healthy and with the construction of the life cycle future management plans can be developed.
Keywords: Acociles, Centla, Swamps, Wetlands, Lagoon.

INTRODUCTION

The popal shrimp is a decapod crustacean of the Cambaridae family. It is found mainly in lentic bodies, although it tolerates low concentrations of salinity, it is estimated that there are about 125 *Procambarus*para North America (Hobbs, 1974) grouped into 13 subgenera and in the *Austrocambarus the species of the section are included:Mexicanus* (Mendoza-Carranza, 1994) of these are reported for the State of Tabasco the presence: *Procambarus (Austrocambarus) acanthophorus*, *Procambarus (Austrocambarus) zapoapensis*, *Procambarus (Austrocambarus) veracruzanus*, *Procambarus (Austrocambarus) ruthveni* and *Procamburus (Austrocambarus) llamasi*, this last species is distributed exclusively in the Ríos subregion, in marshy environments with temporary flooding, the rest of the species in the Sierra subregion in areas of agricultural and mountainous land use (Montalvo-Urgel et al., 2010, Barba et al, 2015).

The distribution of *P. (A) llamasi* extends from Veracruz to Yucatan and northern Guatemala (Hobbs, 1974) but the highest incidence is confined to the humid tropics between 17° and 19° north latitude 92° and 95° west longitude. There are known sightings of *P. (A) llamasi* in Villa Vicente Guerrero, Centla, Tabasco (Padilla-Vega, 2020) generally associated with freshwater wetlands dominated by emergent herbaceous plants such as:Marantaceae (*Thalia geniculata* L.) The biological cycle and frequency of capture of the organisms is largely unknown, it is a species consumed and used by local residents in typical dishes of the region (Contreras-Carrillo et al., 2019).

METHODOLOGY

The work was carried out around the Santa Anita lagoon up to its mouth in the Gulf of Mexico, between the municipalities of Centla and Paraíso, Tabasco, as shown in Figure 1. According to García (1988), the climate is classified as as a humid tropical with a dry and short season (Am), the average temperature is 26.3°C with a rainfall of 1872 ml.

For the development of this work, collections were made from the *Procambarus* A. *llamasi* using pot-type traps (Arias-Pineda et al., 2015) distributed in 40 points located on the edges of the lagoon or the meander that forms towards the mouth of the sea. The collection months were from April to May 2022 with a frequency of twice a month and the exposure time of the trap was 12 hours, using fish heads as attractants. The establishment sites were those where a large number of floating aquatic plants were found on the shores, sometimes they were even flooded areas that are used for livestock or

Figure 1. Map of the sampling area.

agriculture, this ecosystem is called popal by local people. Some collected organisms were fixed with 4% formalin for preservation and preserved in 70% ethanol (Barba-Macías et al., 2015). The taxonomic identification was made with the dichotomous keys of Hobbs et al (1989). Biometrics were also made to these with the help of a digital vernier.

The following variables were measured at the sites; depth and turbidity for which the Secchi disk was used, the temperature of the water mirror was also measured with an infrared thermometer at two times: 06:00 and 14:00. The pH of the water was measured with a potentiometer and nitrogen ex situ using the Kjeldahl method. The floristic composition was also studied by taking an inventory by quadrants of 5 X 20 meters and direct counting (Mostacedo and Fredericksen, 2000) in the areas where the traps were established. For the identification of plant species, the Illustrated Guide for Plant Species was used. the identification of aquatic plants in wetlands of Tabasco de Barba et al (2013).

Finally, 125 people were interviewed (Troncoso and Daniele, 2004) who are dedicated to the collection and sale of wetland shrimp, the applied instrument covered questions such as habitat, commercialization of the species and life cycle. The technique used for the selection of the local wise men was the snowball (Becker, 2009), as well as the owners of the properties and their families.

RESULTS AND DISCUSSION

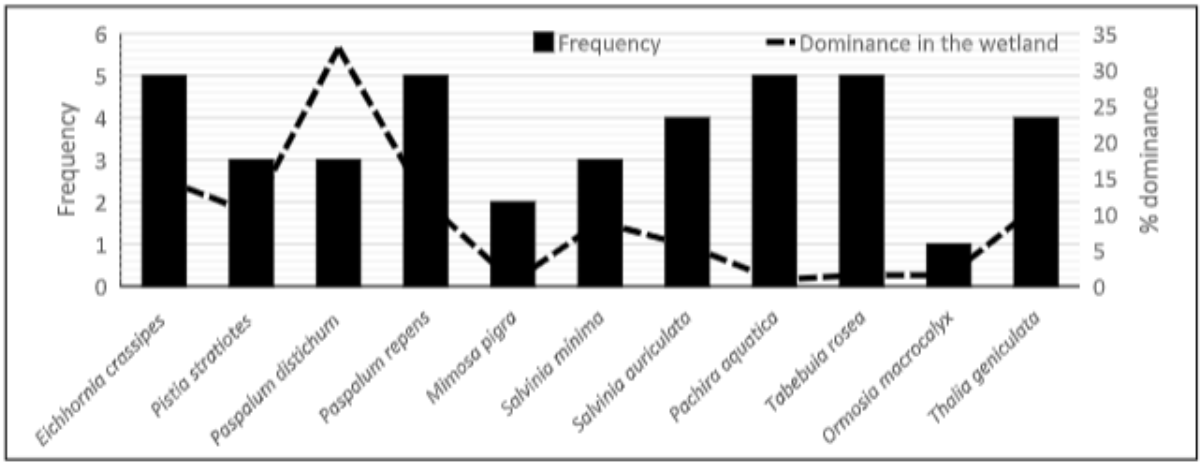
In the trapping sites, it was found that the greatest relative dominance of plant species per surface is found in the genus: *Paspalum* with the species *P. distichum* and *P. repens* as shown in Graph 1. These species are characteristic of loamy and sandy soils, in addition to being widely distributed on banks and roads, in the same way they tolerate

well flooded lands, which explains their dominance in the sampled sites. Of the most frequent hydrophytic species, it was found in five of the six sites *Eichhornia crassipes* y *Pistia stratiotes*, these species are floating and free, the importance of these two species in the stern shrimp habitat is significant since their root systems harbor different larvae or organisms (Meerhoff and Mazzeo, 2004). Takeda et al., (2003) mentions that the community of macroinvertebrates associated with the roots of floating plants is generally very abundant and presents a great specific richness, in the collection sites of the*P.* (A) *llamasi*, it was observed that the shrimp use them as hunting sites, holding on to the roots with their legs and leaving their pincers free to hunt. In addition, these plants provide protection for shrimp from bird attacks. As part of the components of the wetlands, two tree species were also found *Pachira aquatica* y *Tabebuia rosea*, the first is considered a typical species of the coastal plains where salinity is low, its distribution mixes with elements of flooded forest and is considered as the limit of the mangroves (Infante-Mata et al., 2014). It is not deliberately established.

Regarding *Tabebuia rosea,* this has been introduced mainly by the owners of the land and its cultivation is even promoted through government support since it covers two functions, both ornamental and timber, it grows from sea level to 1200 meters above sea level and can tolerate weather well. boggy terrain (Gutiérrez-Báez, 2004).

The variables measured at the sites, as well as the average number of organisms collected per site, are shown in Graph 2. The maximum and minimum depth of the trapping sites was 120 and 20 cm, respectively. Re-Araujo (1994) worked with *Procambarus clarkii*, in his work he subjected the organisms to a depth of 40 cm with the aim of validating feeding and reproduction, the depth was presented as ideal. In Louisiana, rice crops are intercropped with the production of *P. Clarkii* at a depth of 20 to 60 cm deep in shallow earthen ponds (FAO, 2009). Although there are no works on the cultivation of *P. (A) llamasi if the depth in the sampling periods are within those mentioned above.*

Temperature is one of the factors that have a direct influence on the metabolic processes of *Procamburus. The average temperature in*



Graph 1. Frequency and relative dominance of plant species found in popales.

the bodies of water monitored at 06:00 hours was 12±2.4 °C and at 14:00 hours it was 26±3.2 °C. The *Procambarus* can adapt to temperatures from 5°C to 35°C (Espina et al., 1993). The effect that high temperatures can have is the increase in the frequency of molts (Chen et al., 1995) as well as the increase in cannibalistic behavior, due to the alteration of metabolic rates in marine invertebrates (Brockinton and Clarke, 2001).). In the same way there is an alteration in the consumption of oxygen and feeding, Cordero and Voltolina (1990) report that *P. clarkii* better assimilated the diets offered at temperatures of 18 and 22 °C. In aquaculture, if it falls outside the optimal ranges, there is a risk of not having the best yields. However, the stern shrimp is a eurythermal species and this explains its wide distribution in different types of wetlands. Part of their survival success is behavioral adjustment to different environmental conditions. The *P. clarkii* Initially, it was classified as a phytophagous and a scavenger, but in Spain its diet includes spawns and amphibian larvae, which is why it is considered an omnivorous invasive species with a wide trophic spectrum (Magrama, 2012).

Turbidity indicates the particles in suspension in a body of water and these can be of mineral or biological origin. Generally, when high values of suspended solids are found, this could have negative implications on the biochemical quality of the water and an increase in temperature. Under these conditions there is a high risk of decreased oxygen levels and dangerous increases in carbon dioxide. for shrimp production (*Macrobrachium Spp*) ponds must generally have a Secchi disk visibility between 30 and 45 cm (Rojas et al., 2005). The lagoon is influenced by the connectivity of the Grijalva and Usumacinta rivers since in this region is the delta of these rivers whose fluvial discharge is 27,013 and 55,832 hm3, respectively. Musalem-Castillejos et al (2018) mention that the Grijalva River in the middle basin presented turbidity values higher than those set by the Mexican Standard AA-079 in the rainy season, so part of these sediments could be reaching the wetlands.

The average pH value in the analyzed sites was 7.3±0.30, considered neutral. El *Procambarus regiomontanus* was subjected to a feeding influence experiment at a pH of 7.8-8.1, having this range as optimal for its reproduction. The dynamics of the lagoon is extremely interesting since in the dry seasons some parts of the shore become dry and the stern shrimp buries themselves to seek more humid places and form burrows. The floating plants of the site decompose and release a large amount of nutrients that are used by the grasses, which are used by the cattle that occasionally arrive in the area, thus reducing the large amount of organic matter that could increase the levels of nitrates. and in the same way increase the pH values. Another activity that was observed during the sampling is the hauling of sludge by the owners in order to use it as a fertilizer for ornamental or fruit trees. The removal of mud and the growth of grasses could have an effect of the neutral value of the pH in the sampled wetlands, although this does not seem to be a problem for the life of the aft shrimp.

The organic nitrogen content in a water includes the nitrogen of amino acids, amines, polypeptides, proteins and other organic nitrogen compounds. Nitrogen values of 0.18% do not pose a risk to the life of the aft shrimp. Based on different water quality criteria, it is considered that maximum levels of dissolved inorganic nitrogen within the range of 8.91 mg NO2 -N/l with a 96-h exposure have a lethal concentration (LC50) for:

Procambarus clarkii (Camargo y Alonso, 2007). Contact with rivers can also help

lower nitrogen concentrations. Rodríguez et al (1997) found that urban lagoons caused by fluvial processes are the least affected by eutrophication processes, which would also lower toxic nitrogen levels.

Of the 272 organisms that fell into the traps, 56% were male and 44% female, none of which had eggs. The collected organisms did not present ectoparasites or physical lesions. It is important to mention that in the sites near the sea there were no captures of organisms. Generally, the captures coincided with the presence of decomposing trunks, as also related by Montalvo-Urgel et al (2010).

The organisms collected in this study had an average length of 85.2 mn, being 3.8 mn longer than those reported by Rodríguez-Serna (2000) in the case of males. However, females were found to be 5.9 and 4.5 mn shorter in the aforementioned studies (Table 1). It was observed that there is a difference in sizes by sex. However, the most important thing to highlight is the ability to identify wetlands immersed in agrosilvopastoral systems as viable ecosystems for the development of stern shrimp and even exceed the sizes of males from another ecosystem.

With the result of the interviews carried out, it was possible to construct the life cycle as shown in Figure 2, in which some coincidences in dates and periods with respect to the work of Alcorlo et al. (2008). For example, hibernation coincided with a four-month period beginning in November and ending in February. Recruitment is identified this work during the fall, unlike shrimp in sand ponds, where recruitment is done in the winter months. Copulation occurs for seven months in the wetland area, one month less than in the other study. There is a coincidence of four months in the presence of ovigerous females that goes from June to September in both ecosystems. The presence of eggs in females has a coincidence for four months. The shelters or burrows begin to be seen in the month of May for this study.

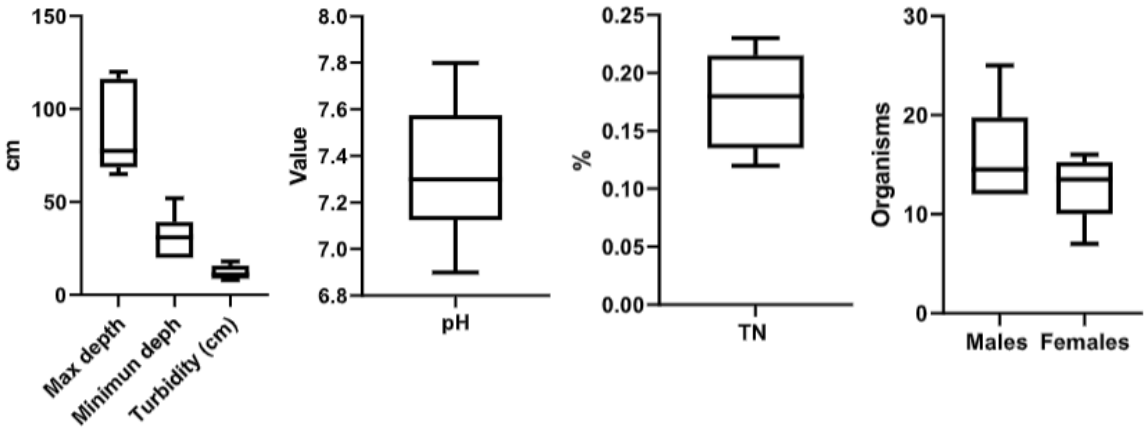
The use of the popal shrimp is done through the artisanal collection of the organisms with a basket with a metallic structure lined with plastic mesh that is generally used to prevent the entry of mosquitoes into homes. In the popales of Tabasco, the shrimp collection is done in the season from February to March when the water has flooded the land and with it the nests, the individuals that are inside are forced to leave. The inhabitants are unaware of any alternative for breeding or protection of the species and the differentiation of sex can only be done when the female presents with the eggs.

CONCLUSIONS

Despite the fact that the popal shrimp has formed an important part of the local idiosyncrasy, actions for its protection or rational use are unknown. Although wetlands provide a viable ecosystem for the life of shrimp, these spaces must begin to be managed with an aquaculture approach beyond being a freshwater reservoir and collection sites, not doing so will run the risk of not having this more species and if diversity is lost, there is a risk of losing an important part of the cultural identity of the lives of the inhabitants.

The description of the study sites can be an approach to the management and propagation of the species, in addition to the values of pH and total nitrogen can be used as initial values for the development of a sustainable production and management plan. *Procambarus* (Austrocambarus) *llamasi.*

There is knowledge of the life cycle of the popal shrimp by the inhabitants, but there are no formal or financed initiatives for the reproduction of the organisms, despite the fact that these are in demand by the local inhabitants and are highly sought after for gastronomic dishes. region of. Therefore, it



Graph 2. Evaluated aspects of the water and average of organisms captured in the sites.

Measured variables	Rodríguez-Serna, 2000			In this study		
	M:I (mm)	M:II (mm)	H (mm)	M:I (mm)	M:II (mm)	H (mm)
Total length	82.0	81.0	80.0	85.2	60.7	75.5
Carapace: total length	42.0	40.0	39.0	28.7	21.1	22.8
Carapace: Postorbital length	21.0	19.0	19.0	18.3	11.7	15.7
Areola: Length	15.0	11.0	13.0	7.6	7.3	6.4
Areola: Wide	2.0	1.0	1.0	2	3.4	2.1
Belly: Long	42.0	42.0	41.0	17.1	21.6	25.4
Face: Back Width	8.0	5.0	6.5	4	3	3.1
Chela: Length	39.0	38.0	26.0	15.6	16	14.3
Dactyl length	20.0	16.0	19.0	9.6	7.5	6.2

Where: M: I Male form I: Adult reproductive form

M: II Male form II: Adult non-reproductive form

H: female

Table 1. Morphometric variables of the stern shrimp

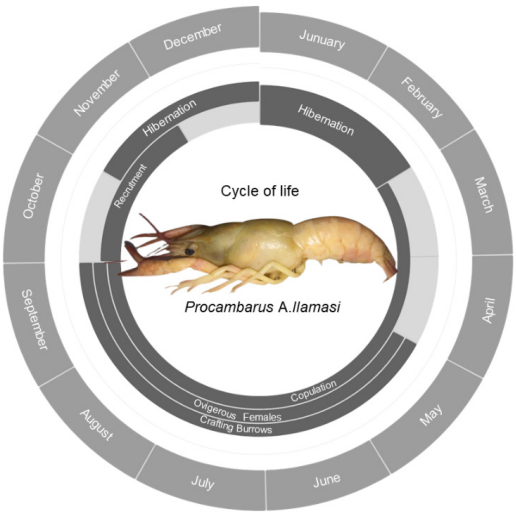


Figura 2. life cycle of *Procambarus* A. *llamasi.*

could be considered that the rearing of the stern shrimp would be a profitable alternative for people from nearby towns, in addition to the fact that there are experiences with the rearing of similar species such as: *Procambarus Clarkii*.

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