Trophic activity of Sea Anemones (Cnidaria; Actiniaria).

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Abstract. The trophic performance of Cnidaria species is an issue for several approaches, especially in species of the Medusozoa clade. However, the variation of eating habits in different regions and their subsequent characterization in food chains are practically non-existent. Due to the scarcity of studies focusing on the feeding behaviour of anthozoans, mainly of tropical species, the dietary and behavioral characteristics of the trophic ecology of the group, which are fundamental for their development, reproduction and survival, are poorly understood. In this study, therefore, research on the feeding behavior in Anthozoa was analyzed in order to gather important background information on the ecology and trophic performance of the group. This research is also based on an ongoing undergraduate project that focuses on comparing the trophic activity of four species of sea anemones using morphological and DNA analyses, which may help fill gaps that need clarification.

Keywords. Trophic ecology, anthozoans, feeding behaviour

1. Introduction

The size of the food niche, as well as the trophic position, influenced by resource availability, represent the primary functional aspects that describe the trophic ecology of a consumer, its response to environmental changes and its role in a community and ecosystem. Thus, in addition to the size of an organism conditioning its trophic position and prey diversity, the food niche may indicate that its trophic ecology is determined by a tradeoff between environmental factors and biological traits [1], [2].

Behavioral patterns and diet can vary over time among individuals, as the diet of a species can vary between different locations or even between different depths and times of day. Although the aspects that determine the size of a species' food niche are fundamental to ecology, there is a gap between trophic ecology of consumers and their functions in the ecosystem, factors that can be assimilated from the characterization of food niches and trophic position of consumers at global richness and geographic scales [3], [4], [5], [6].

The phylum Cnidaria, divided into three taxonomic groups: Anthozoa, Medusozoa and Endocnidozoa, whose distinction is supported especially by the anatomy, life history, genomic and phylogenetic structure of individuals, is represented by organisms that play a significant ecological role. Due to their diverse life cycles and wide adaptive plasticity, cnidarians are able to inhabit diverse substrates and present an enormous diversity of feeding strategies, indicating that studies performed on some groups may not be equivalent to the behavioral and feeding schemes of other groups [7], [8]. [9].

Sea anemones, part of the Anthozoa class and Actiniaria order, are distributed from tropical to polar seas, and from the coast to the abyss, often buried in sand or attached to substrates. Endowed with different flexible feeding habits and performing ecologically significant functions in benthic food webs, anemones are known as opportunistic polyphagous predatory organisms, whose diet becomes a unique and intriguing factor for research providing information about their trophic role. Most studies, however, focus on the diet of temperate anemones, resulting in scarce consideration of the trophic ecology of tropical species [4], [7], [10].

2. Materials and Methods

This study reviewed, in general, a number of researches focused on the trophic performance of cnidarians, specifically sea anemones, aiming to gather a considerable amount of information about the ecology of the group and the gaps that still need to be filled. One of the investigations analyzed is an ongoing Scientific Initiation project that seeks to evaluate the trophic behavior of 20 individuals from four different species of sea anemones: *Actinia bermudensis* **Fig. 1**, distributed throughout the Western Atlantic, from Bermuda and the Bahamas to southern Brazil; *Anemonia sargassensis* **Fig. 2**, subtidal species from the Brazilian coast; *Bunodosoma caissarum* **Fig. 3**, intertidal species from Brazilian rocky coasts; and *Bunodosoma cangicum* **Fig. 4**, found abundantly on the Amazon coast, in the intertidal zone [11], [12], [13], [14].

Fig. 1 – *Actinia bermudensis*, Júlia M. Molina, 2020.

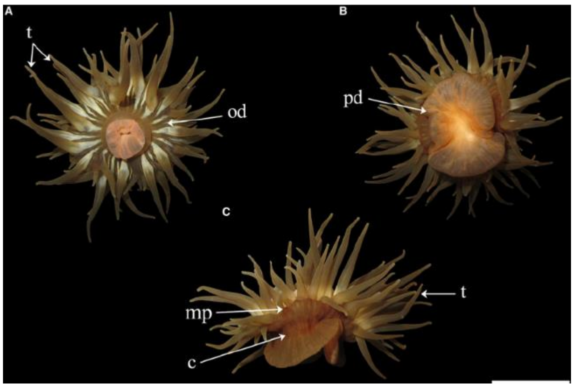

Fig. 2 – *Anemonia sargassensis*, Hargitt, 1908: (A) oral view, (B) pedal disc view, (C) lateral view. (t) tentacles, (od) oral disc, (pd) pedal disc, (mp) marginal projections, (c) column.

Fig. 3 – *Bunodosoma caissarum*, Júlia M. Molina, 2020.

Fig. 4 – *Bunodosoma cangicum*, Sérgio N. Stampar, 2005.

The immersion of the specimens in ethanol immediately after collection and longitudinal dissection of the individuals allows the gastrovascular cavity to be exposed and washed with the same product. In this manner, the entire content can be packed in a falcon tube for homogenization and divided into two vials, which are then analyzed morphologically and molecularly. From the morphological analysis, conducted with a stereomicroscope, it is possible to identify part of the organisms ingested by the anemones. Obtaining genetic material using the DNA extraction method via a column kit, Qiagen DNeasy Blood & Tissue Kit, additionally, enables the acquisition of DNA sequences, which can be amplified with the use of primers for Metazoa, isolated, and sent for sequencing in a MiSeq Illumina system, an outsourced service in Brazil. Although the undergraduate project, supervised by Sérgio Nascimento Stampar, has not been finalized yet, fundamental information for the understanding of the dietary behavior of the organisms was obtained for this study, especially from researches by partners of the Laboratory of Evolution and Aquatic Diversity (LEDA) - UNESP Bauru, SP, Brazil.

3. Results and Discussion

Comparing the structure of food webs with phylogenetic signals allows the coevolution of species to be explored from their interactions, since webs reflect the link between groups in nature. Changes in food availability are, therefore, expected to be followed by levels of diversity, in which the energetic advantages and disadvantages of an individual's diet establish the total energy available for its development and reproduction [3], [4], [5], [6].

In terrestrial ecosystems, interactions between prey and predators occur primarily through visual contact and senses. In aquatic ecosystems, in contrast, the release of chemical substances is considered a communication and signaling mechanism between individuals. Although the aspects that determine the size of the food niche of a species are fundamental to ecology, there is a gap between the trophic ecology of consumers and their functions in the ecosystem, factors that can be assimilated from the characterization of food niches and trophic position of consumers at global richness and geographic scales [1], [2].

In marine environments, mutualistic nutritional symbioses occur frequently, and to emphasize the primary sources of nutrients, tracking their acquisition and exchange within the association, stable isotope analysis has proven proficient, especially in studies of invertebrate food webs. Fleming and colleagues (2015), for example, accurately evaluated the trophic ecology of three co-occurring species of cyclosporine jellyfish within a temperate coastal food web through this analytical tool. In summary, for aquatic organisms, values of δ15N, stable nitrogen isotopes, can provide information about their trophic levels, while values of δ13C, stable carbon isotopes, provide data about their feeding grounds [15], [16], [17].

The direct investigation of feeding in aquatic environments is complex and enigmatic, a factor responsible for the development of indirect mechanisms that help in the study of trophic configurations and dynamics. Content analysis, for example, is considered a fundamental tool for trophic studies, as it provides objective indications of food sources and concrete taxonomic resolutions. In addition, DNA techniques, such as DNA barcoding, enable the resolution and construction of food webs in aquatic and terrestrial systems by improving the resolution of web nodes and their linkages, and fatty acids, commonly used as biomarkers, provide estimates of trophic relationships in food webs [5], [10], [18].

A literature review conducted by Santos et al. (2020), with the objective of verifying the scientific literature on feeding in Anthozoa, considered the largest class of the phylum Cnidaria, showed that studies on feeding behavior in Anthozoa are scarce. Understanding the dietary and behavioral characteristics and trophic levels of these organisms, however, is essential to understand the ecology and evolution of the group's species, whose energy and nutrients from feeding habits are crucial for their development, reproduction, survival and trophic performance.

The Scientific Initiation research aforementioned, aims to evaluate the trophic performance of sea anemones of different species in different regions, São Paulo and Santa Catarina, Brazil. Through the study approach, the project will be able to test if there is a specific trophic performance of each species or if the organisms are strictly opportunistic. Thus, in the near future, it will be possible to describe the trophic behavior of the species *Actinia bermudensis*, *Anemonia sargassensis*, *Bunodosoma caissarum* and *Bunodosoma cangicum* using metabarcoding techniques and morphological analysis of their gastrovascular contents, enriching the collection of information about the trophic ecology of the group and clarifying whether the feeding behavior of the species is influenced by their locality.

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5. References

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