THAÍS BARBOSA SANTOS

Hábitos alimentares de *Isarachnanthus nocturnus* e *Pachycerianthus magnus*: uma análise morfológica e metagenômica do conteúdo estomacal (Cnidaria; Anthozoa; Ceriantharia)

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Orientador: Sérgio Nascimento Stampar

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AUTORA: THAÍS BARBOSA SANTOS
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Prof. Dr. SÉRGIO NASCIMENTO STAMPAR
Departamento de Ciências Biológicas / UNESP/Assis

Prof. Dr. ANDRÉ CARRARA MORANDINI
Departamento de Zoologia / USP/São Paulo

Prof. Dr. FABIÁN HORACIO ACUÑA
Argentina / Universidade Nacional de Mar del Plata

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SANTOS, Thaís Barbosa. **Hábitos alimentares de *Isarachnanthus nocturnus* e *Pachycerianthus magnus*: uma análise morfológica e metagenômica do conteúdo estomacal (Cnidaria; Anthozoa; Ceriantharia)**. 2020. 80 f. Dissertação (Mestrado Acadêmico em Biociências) - Universidade Estadual Paulista (UNESP), Faculdade de Ciências e Letras, Assis, 2020.

RESUMO

O filo Cnidaria é composto por animais que possuem uma grande importância na manutenção dos ecossistemas aquáticos. Um dos grupos que integram este filo é a subclasse Ceriantharia, considerado o menor e um dos grupos menos estudados dos cnidários. Embora o filo apresente diversos estudos referentes aos processos ecológicos da rede alimentar, os ceriantos não foram abordados sob esse tipo de análise. Como a subclasse possui particularidades em relação aos outros grupos do filo, os resultados obtidos nesses trabalhos podem não condizer com as apresentadas pelos ceriantos. Sendo assim, o presente trabalho realiza uma revisão bibliográfica em Anthozoa com a temática "alimentação" e identifica parâmetros nunca observados dos hábitos alimentares de duas espécies de Ceriantharia, coletadas em São Sebastião (Alcatrazes) (BR) e Okinawa (JP). As principais classes de animais que compõem a dieta desses ceriantários são descritas a partir de análises morfológicas e metagenômica do conteúdo estomacal.

PALAVRAS-CHAVE: Anêmonas-de-tubo; Cadeia trófica; Dieta; Invertebrados marinhos; Teia alimentar

SANTOS, Thaís Barbosa. **Feeding habits of *Isarachnanthus nocturnus* and *Pachycerianthus magnus*: morphological and metagenomic analysis of stomach contents (Cnidaria; Anthozoa; Ceriantharia)**. 2020. 80 f. Dissertation (Masters in Biosciences). São Paulo State University (UNESP), School of Sciences, Humanities and Languages, Assis, 2020.

ABSTRACT

The phylum Cnidaria is composed of animals that have great relevance in the maintenance of aquatic ecosystems. One of the groups that comprise the phylum is the subclass Ceriantharia, represented by members generally known as ceriantharians or tube-dwelling anemones. Although the phylum presents several studies related to the ecological processes of the food network, the knowledge about these processes in ceriantharians is non-existent. As the subclass has some particularities in relation to the other phylum members, the results obtained in these previous studies may not correspond to those present by these animals. Thereby, this study aims to make a bibliographic review on papers published in the class Anthozoa with the feeding theme and identify parameters never observed on the feeding habits in two species of Ceriantharia, from São Sebastião (Alcatrazes) (BR) and Okinawa (JP). The main classes of animals that compose the diet of this ceriantharians are described by morphological and metagenomic analysis of the stomach contents.

KEYWORDS: Diet; Food web; Marine invertebrates; Trophic chain; Tube-dweling anemones

SUMÁRIO

INTRODUÇÃO GERAL

Os conhecimentos sobre os processos ecológicos que envolvem uma determinada espécie são de suma importância para se compreender como determinado grupo atua perante o meio ao qual está inserido (Odum, 2004). Uma das principais atuações é expressa pelo processo de alimentação, o qual possui um papel fundamental na manutenção e conservação dos organismos (Olafsson et al., 1994).

A alimentação pode ser dividida em dois processos básicos: 1) a captura do alimento; 2) a ingestão/digestão do alimento. O primeiro processo é bastante variável, pois depende bastante da atuação trófica que cada espécie desempenha. O segundo é muito mais intrínseco à morfologia e a fisiologia de cada espécie. Em conjunto, os dois processos compõem uma das rotas evolutivas mais relevantes para a manutenção e diversificação das linhagens (Hughes, 2013).

No ambiente marinho, a atuação trófica é bastante complexa e apresenta uma série de aspectos que ainda não são bem compreendidas para vários grupos (Ribes et al., 1999a). Quando levamos em conta apenas os invertebrados, esse panorama se apresenta ainda mais problemático, visto que alguns grupos apresentam poucos estudos sobre os processos alimentares, especialmente aqueles que são formados por organismos bentônicos (Ribes et al., 1999b; 2003).

Apesar de complexo, algumas maneiras de estudar os processos alimentares no ambiente marinho já foram delineadas, entretanto, duas formas são as mais aplicadas. A primeira é voltada para o entendimento do mecanismo de captura, sendo baseada em filmagens *in-situ* ou *ex-situ* (ex. Lewis, 1982). Esta abordagem é basicamente descritiva, mas de grande importância para o entendimento ecológico em grande escala da espécie. A segunda abordagem é voltada para o reconhecimento da atuação trófica, sendo baseada em análises do tecido do animal via isótopos estáveis (Newsome et al., 2007; Leal et al., 2017; Conti-Jerpe et al., 2020) ou por análises do conteúdo gástrico dos organismos (Orejas et al., 2001). Os estudos realizados com o conteúdo gástrico podem ser mais tradicionais, por meio de análises dos materiais via técnicas de microscopia (ex, Zamer, 1986; Orejas et al., 2001) ou com a utilização de ferramentas moleculares, especialmente sequenciamento de nova geração com marcadores específicos (Leray & Knowlton, 2015). Uma das técnicas que vem sendo recentemente utilizada é a metagenômica. Essa é uma abordagem molecular amplamente utilizada para o reconhecimento da comunidade microbiana (Gilbert & Dupont, 2011), entretanto, ela pode ser utilizada como ferramenta para discutir outras vertentes, como: a descrição de atuações tróficas (Blankenship & Yayanos, 2005) e a identificação de relações simbióticas (Celis et al., 2018).

Harms-Tuohy e colaboradores (2016) realizaram uma análise da ecologia alimentar de uma espécie invasora, o peixe-leão (*Pterois volitans*), para reconhecer os impactos que esse organismo pode promover na região de Porto Rico. Para isso, os pesquisadores utilizaram a técnica de análise molecular de *metabarcoding* do conteúdo estomacal, a fim de identificar os fragmentos das sequências de DNA das presas. Com os resultados obtidos, os autores identificaram quais seriam os hábitos alimentares dessa espécie invasora e determinaram quais eram as espécies daquela região que seriam afetadas a longo prazo pela presença da mesma.

Embora existam trabalhos detalhados como o citado no parágrafo anterior, alguns grupos são bastante deficitários em relação às informações disponíveis sobre a sua atuação trófica. Um dos grupos de animais que se tem menos informações sobre o processo alimentar é Cnidaria. Esse filo é constituído por três clados bastante distintos em diversos aspectos, Anthozoa, Endocnidozoa e Medusozoa (Kayal et al., 2018). Um desses aspectos é o reconhecimento da atuação trófica em cada um deles. Uma vez que vários estudos já foram realizados com diversas espécies em Medusozoa (ex. Larson, 1976; Larson 1979; Larson et al, 1989; Davenport, 1998), nos outros dois grupos a concentração de estudos com essa vertente é menor.

Em Medusozoa o interesse é maior devido ao impacto que muitas espécies desempenham em organismos de interesse comercial (Arai, 2005; Condon et al., 2013). Desta forma, muitas espécies já foram estudadas das mais diversas formas para o reconhecimento da atividade trófica (ex. Brewer, 1989; Turk et al., 2008). Por outro lado, o estudo da atuação trófica em Anthozoa é mais ligada à aspectos de ecologia e preservação, em especial de recifes de corais (Ferrier-Pagès et al.,2003). Neste caso, alguns grupos menores não apresentam qualquer informação nesse aspecto, como o caso da subclasse Ceriantharia (anêmonas-de-tubo). Estes animais são caracterizados por serem solitários, semi-sésseis, com corpo cilíndrico e alongado, ao qual se enterram em substratos macios, formando um tubo com a secreção por eles liberada (Tiffon, 1987).

Apesar do reconhecimento da importância da obtenção de dados sobre a alimentação para a elaboração de quadros complexos de atuação trófica, pouco se sabe a respeito desse comportamento em grande parte das espécies de Cnidaria, especialmente na subclasse Ceriantharia (Stampar, 2012). Assim, mesmo que existam estudos relacionados com os processos ecológicos que intervêm os hábitos e o comportamento alimentar em Cnidaria, o grupo dos ceriantos foram infimamente abordados sob esse aspecto. Como a subclasse possui particularidades em relação aos outros grupos do filo (Stampar et al., 2016), os resultados obtidos nesses trabalhos podem não condizer com as apresentadas por esses animais.

Desta forma, o presente estudo tem como enfoque descrever a atuação trófica de duas espécies da subclasse Ceriantharia (*Isarachnanthus nocturnus e Pachycerianthus magnus*), coletadas em duas áreas distintas (Alcatrazes, São Sebastião, Brasil e Okinawa, Japão), com a realização de análises do conteúdo estomacal. As duas espécies pertencem a grupos diferentes dentro da subclasse, sendo *Isarachnanthus nocturnus* da ordem Penicillaria e *Pachycerianthus magnus* da ordem Spirularia. Assim, buscamos também verificar se há ou não semelhança nas classes de animais que compõe a dieta dessas duas espécies de ceriantos.

OBJETIVOS

O objetivo geral nesse estudo foi reconhecer a rede alimentar de duas espécies de Ceriantharia (*Isarachnanthus nocturnus* e *Pachycerianthus magnus*). De forma a atingir tal objetivo, foram delineados os objetivos específicos subsequentes:

- Revisar como os estudos com alimentação vem sendo abordados dentro da classe Anthozoa no decorrer dos anos;
- Identificar as classes de organismos que compõem a dieta de duas espécies de Ceriantharia baseada em análises morfológicas e metagenômica do conteúdo estomacal;
- Verificar se as classes de animais presentes na rede alimentar desse grupo são similares independentemente da espécie/localidade.

CAPÍTULO 1.

ALIMENTAÇÃO EM ANTHOZOA: UMA REVISÃO BIBLIOGRÁFICA

Thaís Barbosa Santos[1], Sérgio N. Stampar[1]

1. Unesp - Universidade Estadual Paulista, FCL/Assis, Departamento de Ciências Biológicas, Laboratório de Evolução e Diversidade Aquática – LEDA, Brasil

Correspondência

Thaís Barbosa Santos

thaisbarbosa_stos@hotmail.com

RESUMO

Nesse trabalho é apresentada uma revisão bibliográfica examinando a produção científica sobre o tema "alimentação em Anthozoa" até o ano de 2019. O estudo categorizou os artigos científicos publicados quanto a década de publicação, grupo alvo abordado dentro de Anthozoa, variabilidade das espécies estudadas em cada ordem e os principais temas abordados. Como resultado, foram obtidos 153 estudos, nos quais foi observado que dentro da classe Anthozoa diversos trabalhos foram realizados com essa temática, entretanto, existe uma concentração de estudos nas classes Actiniaria Hexacorallia), Scleractinia Hexacorallia) e Alcyonacea (Octocorallia). Isso indica que as demais ordens do grupo apresentam uma menor ou nenhum trabalho com essa vertente. Portanto, como os dados sobre alimentação em alguns grupos de Anthozoa são escassos, novos estudos precisam ser realizados para preencher as lacunas que permeiam esse importante grupo bentônico, a fim de compreender melhor sua ecologia.

Palavras-chave: Ceriantharia; Comportamento alimentar; Hábitos alimentares; Hexacorallia: Octocorallia

FEEDING IN ANTHOZOA: A BIBLIOGRAPHIC REVIEW

Thaís Barbosa Santos[1], Sérgio N. Stampar[1]

1. Unesp - Universidade Estadual Paulista, FCL/Assis, Departamento de Ciências Biológicas, Laboratório de Evolução e Diversidade Aquática – LEDA, Brasil

Correspondence

Thaís Barbosa Santos

thaisbarbosa_stos@hotmail.com

ABSTRACT

In this study, we performed a bibliographical review examining the scientific literature on "feeding in Anthozoa" theme until 2019, using scientific databases supplemented with additional literature. This study categorized published scientific papers on this topic by decade of publication, target taxa, variability of species studied in each order and main themes studied. As a result, 153 studies were found, and based on their content, it was observed that within Anthozoa, there has been a concentration of feeding studies on species in the orders Actiniaria (Hexacorallia), Scleractinia (Hexacorallia), and Alcyonacea (Octocorallia). This indicates that the other remaining orders of the group have been comparatively neglected with regards to their feeding aspects. Therefore, as data on feeding in some groups of Anthozoa are scarce, studies need to be carried out to fill the gaps that permeate this important benthic group, in order to better understand their ecology.

Keywords: Ceriantharia; Feeding behavior; Physiology; Feeding habits; Hexacorallia: Octocorallia

INTRODUCTION

Cnidaria is a phylum that comprises three major clades: Anthozoa, Endocnidozoa and Medusozoa (Kayal et al., 2018). The distinction between these clades is supported by anatomy of the animals, life history, genome structure and DNA sequences. Cnidarians present a very complex cell type, called cnidocyst (Daly et al., 2007). This cell contains a capsular organelle named cnidae, a structure used for protection and prey capture (Fautin, 2009; Kayal et al. 2013).

This phylum is composed of aquatic animals, mostly marine, which present a large morphological diversity due to the alternation of generations (Cunha, 2016; Morandini & Stampar, 2016). Its main representatives are jellyfish, hydras, gorgonians, Portuguese man-of-war, sea anemones and corals (Daly et al. 2007; Stampar et al., 2014). The most recent estimations show that the phylum has approximately 13,300 species described (Kayal et al., 2018).

The class Anthozoa is considered the largest group in the phylum, with 7.200 described species (Kayal et al., 2018). The representatives of this group have polypoid forms without a medusa stage in their life cycle and can be solitary or colonials (Marques & Collins, 2004; Kayal et al. 2013). The evolutionary history of this class still discussed, however, currently three subclasses are clearly recognized: Hexacorallia, Octocorallia and Ceriantharia. (Stampar et al. 2014).

There are several aspects that distinguish Anthozoa from Medusozoa, one of them, is in relation to the recognition of the trophic performance of the animals that are part of these groups. In Medusozoa, a lot of studies with this aspect have already been carried out with several species, since the interest is directly related to the impact they cause on commercial organisms. Comparing these two subphyla, it is observed that the interest in studies of this topic in Anthozoa is moderately reduced (Condon et al., 2013). This occurs because the subjects dealt with in Anthozoa are more linked to aspects of ecology and preservation, especially coral reefs (Ferrier-Pagès et al., 2003).

The understanding of diet and trophic performance of the groups are essential for comprehension of the ecology and evolution of the species, once the energy and nutrients derived from the feeding habits are vital for reproduction, development and growth (Leibold, 1995; Rossi, et. al., 2004). In this way, the recognition of the feeding patterns is extremely important, since it acts directly in the maintenance and conservation of the life of these organisms (Olafsson et al., 1994; Schwartz et al., 2002).

In view of the importance of obtaining data of food webs for the elaboration of complex tables of trophic performance, little is known about how the research related to this topic has performed over the years. Thus, in order to verify the productivity of research in Anthozoa with respect to the theme “feeding”, this bibliographic review was made. For this, standardized searches were carried out on what has been scientifically published with the theme “feeding in Anthozoa”. At the end, it is possible to observe how the publications on this subject behave over the years and what are the main characteristics and trends of production in this area.

MATERIAL AND METHODS

This study was performed as a bibliographic review, aiming to gather information to create a database of the studies that have emphasized anthozoan feeding over the years. The data presented in this bibliographic review were collected from Google Scholar, covering publications that appeared in English, Spanish and Portuguese languages until August 2019. Other relevant publications not covered by Google Scholar were also added from the reference lists of the studies collected and based in our knowledge of the literature. Google Scholar was chosen as it is the most comprehensive among citation search services (Harzing and Alakangas 2016), and potential problems with so-called “gray literature” were avoided via subsequent quality filtering. The search was conducted with a combination of the following keywords: ‘feeding’, ‘diet’ and ‘food web’ combined with ‘Anthozoa’, between the dates of August 8 to 24, 2019.

In total, 339 pieces of literature were identified, and, after duplication exclusion and quality filtering removal of gray literature, 270 pieces of literature were initially included in our review. Subsequently, every title, abstract and methodology section were analyzed to confirm that each work truly examined anthozoan feeding. Thus, some studies were excluded as they focused other animal groups, or they were not focused on feeding topics. After this filtering, 153 papers remained in our dataset (see supplementary material). From each study the following data were extracted: (1) decade of publication; (2) Anthozoa groups found in articles; (3) observations of the species studied in each order; (4) approaches utilized in the studies.

For compilation of the articles' approaches, publications were analyzed and separated into the following categories: 'Feeding behavior', 'Feeding habits/Ecology' and 'Physiology'. Studies categorized into 'Feeding behavior' examined one or more of these subjects: prey capture, feeding rates, feeding performances, feeding mechanisms, and feeding strategies. In the category 'Feeding habits/Ecology', studies examined the following topics: analyses of the gastral cavity contents, diet, feeding patterns, feeding characteristics, food spectrum, and the index of filling of the gastral cavity. In the last category, 'Physiology' studies reported on: digestion processes, feeding regimes, digestive enzymes that influence the feeding process, nutritional aspects, and histological and/or morphological analyses of gastral cavity structures. Some studies analyzed more than one category and were counted for every category they represented.

RESULTS

Decade of publication

At total, 153 papers were examined in this bibliographic review (see supplementary material). Table 1 shows the number of papers published by decade.

Table 1. List of published papers per decade related to feeding in Anthozoa.

Decade	Number of published papers	Percentage (%)
1890-1899	1	0.7
1900-1909	1	0.7
1910-1919	2	1.3
1920-1929	2	1.3
1930-1939	4	2.6
1940-1949	1	0.7
1950-1959	2	1.3
1960-1969	5	3.3
1970-1979	33	21.6
1980-1989	25	16.3
1990-1999	28	18.3
2000-2009	25	16.3
2010-2019	24	15.6
Total	**153**	**100.0**

Based on this analysis, we were able to verify a growing interest on this topic from 1970 to 2019, with a total of 135 (=88.1%) studies conducted during this period. Despite the increase of publications from the early 1970s, the table shows that after this time, the number of publications on the subject slowly declined. We also observed that by the most recent decade (2010-2019), the number of articles published on this topic in the class Anthozoa (n=24) had decreased considerably when compared to the 1970s, period with the largest number of publications (n=33).

Anthozoa groups found in the selected papers

In Table 2, the species from the articles were summarizes into their subclasses and orders. The absolute number, at the end, was larger than the number of publications examined, as some studies were conducted with more than one species that belongs to different orders. Thus, the absolute number of orders (n=163) is different from the absolute number of studies (n=153). The papers in which this occurred were: Garrabou, 1999 (Alcyonacea and Zoantharia); Goreau et al., 1971 (Scleractinia, Alcyonacea and Zoantharia); Herndl, 1985 (Zoantharia, Actiniaria and Scleractinia); Lewis & Price, 1975 (Scleractinia and Alcyonacea), Sebens & Koehl, 1984 (Actiniaria and Alcyonacea); Sorokin, 1991 (Zoantharia, Scleractinia and Alcyonacea); Yonge, 1930 (Scleractinia and Alcyonacea).

Table 2. Anthozoa orders found in selected publications.

Subclass	Order	Absolute number	Percentage (%)
Hexacorallia	Actiniaria	56	34.4
	Antipatharia	1	0.6
	Corallimorpharia	2	1.2
	Scleractinia	54	33.1
	Zoantharia	11	6.8
Octocorallia	Alcyonacea	35	21.5
	Helioporacea	0	0.0
	Pennatulacea	1	0.6
Ceriantharia	Spirularia	3	1.8
	Penicillaria	0	0.0
	Total	**163**	**100.0**

Hexacorallia was shown to be the most investigated anthozoan subclass with a total of 124 studies (76.1%). This was the only subclass that had scientific papers for all its constituent orders. In this subclass, Actiniaria (n=56) and Scleractinia (n=54) were the two orders with the largest number of studies, (total 110 studies = 67.5% of absolute number of examined articles).

The subclass Octocorallia was second, with 36 studies (=22.1% of total number of examined articles). Within Octocorallia, although the order Helioporacea did not have any publications and Pennatulacea had only a single study, the order Alcyonacea was well represented (n=35). Finally, the subclass Ceriantharia had only a very limited number of studies on feeding topics, with the order Spirularia having three publications in total (1.8% of total number of articles), and no studies were observed for order Penicillaria.

<u>Observations of the species studied in each order</u>

Despite the Actiniaria order being the group that had the largest number of studies related to feeding patterns, the variety of species studied within these publications were not so broad among the Anthozoa groups. In total, 44 different species were observed in the publications, with the most analyzed species were *Actinia equina*, analyzed in seven studies, followed by *Anthopleura elegantissima* examined in five studies, and *Metridium senile* in four studies.

On the other hand, for some orders that had a smaller number of publications than Actiniaria, such as Scleractinia (=54 studies) and Alcyonacea (=35 studies), the number of species studied was actually higher, as some studies covered a large number of species. For example, in one study of Scleractinia (Hexacorallia), 47 species were analyzed (Younge 1930), and in a single study of the group Alcyonacea (Octocorallia), 30 species were examined (Lewis 1982). In total, Scleractinia had 137 different species examined and Alcyonacea 69 species.

In the orders that had a very small number of studies, few species were analyzed. In Hexacorallia, the order Corallimorpharia had two studies with one species each (*Paracorynactis hoplites* and *Amplexidiscus fenestrafer*), Antipatharia had a single study with three species (*Stichopathes lutkeni*, *Antipathes pennacea,* and *Antipathes* sp.) and Zoantharia had 11 studies examining 10 different species. In some studies of the order Zoantharia, more than one species was analyzed, and four species were most investigated: *Zoanthus sociatus* (=5 studies), *Palythoa caribaeorum* (=3 studies), *Parazoanthus axinellae* (=2 studies) and *Palythoa psammophilia* (=2 studies). The order Pennatulacea (Octocorallia) had a single study examining *Ptilosarcus gurneyi*. In Spirularia (Ceriantharia), of a total of three publications, two species were observed: *Pachycerianthus fimbriatus* (=2 studies) and *Cerianthus lloydii* (=1 study).

In total, the number of species analyzed in the class Anthozoa regarding feeding topics were 268 species. This number represents approximately 3.7% of the total described species for the class (~7200 described species; Kayal et al., 2018).

Approach observed in the studies

In Figure 1, it is possible to verify the approaches in the compiled studies, sorted into the following categories: "Feeding behavior", "Feeding habits/Ecology" and "Physiology". Some of them exhibited more than one category of study, so in the graph, it is possible to observe the number of studies that this occurred.

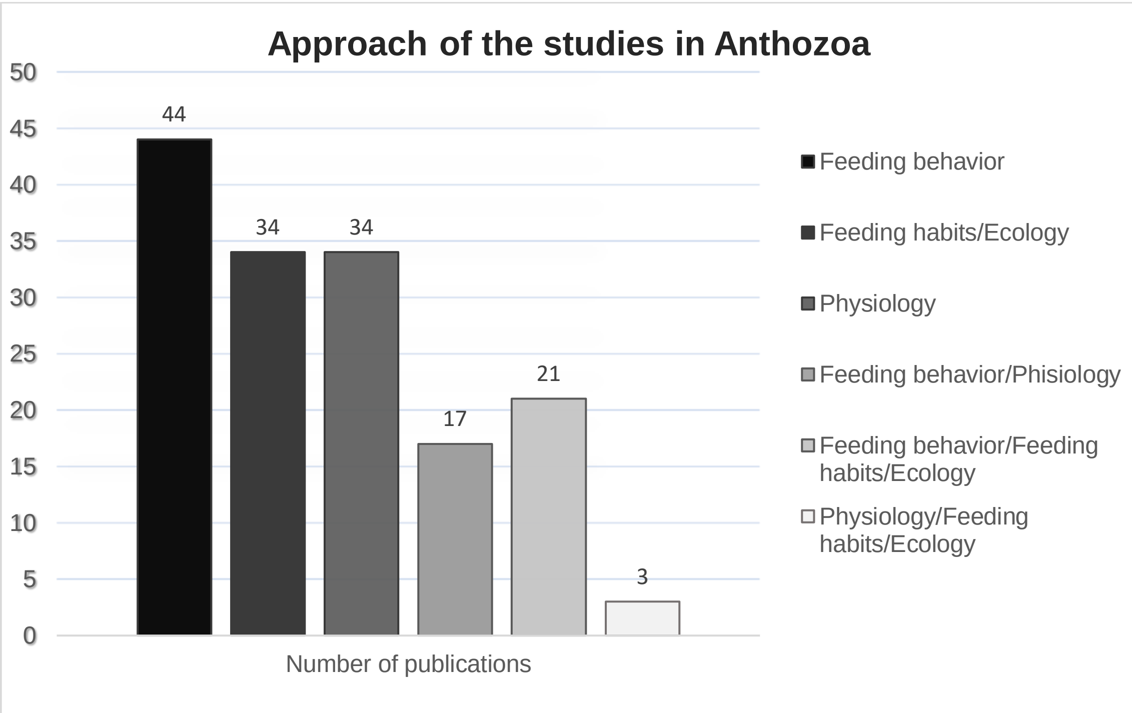

Figure 1. The number of published articles from each approach category of study about the feeding process.

The subjects related to the topic of "Feeding behavior" were observed in the most publications, with a total of 82 studies (=53.6% of the total) used this approach. Of these, 44 studies (28.8%) featured only topics related to "Feeding behavior", with the others including multiple topics. For "Feeding habits/Ecology", a total of 58 publications (=37.9%) were related to this approach, with 34 of these studies (=22.2%) including subjects only in this category. Studies related to “Physiology” had the lowest number of publications, with a total of 54 studies

(=35.3%), with publications analyzing only aspects associated with this topic in 34 studies (=22.2%).

Some studies combined more than one category of study about the feeding topics: 21 studies (=13.7%) were related to "Feeding behavior" and "Feeding habits/Ecology", 17 studies (=11.1%) were related to “Feeding behavior” and "Physiology", and 3 studies (=2.0%) were related to "Physiology" and “Feeding habits/Ecology”.

Hexacorallia

This subclass was the most investigated group in Anthozoa, with a total of 124 studies. In the analyzes below, it is possible to observe which category of studies were most conducted for each order.

Actiniaria

This order had 56 studies related to feeding aspects (Table 3). We observed that studies related to the topic “Feeding habits/Ecology” were the most investigated, with 28 publications related to this topic (=50.0%). The “Feeding behavior” approach was the second-most common, with 24 studies (=42.9%). “Physiology” topics were present in 19 publications (=33.9%).

Table 3. Approaches of feeding studies in Actiniaria.

Order	Approach	Absolute number	%
Actiniaria	Feeding Behavior	11	19.7
	Feeding Habits/Ecology	18	32.1
	Physiology	12	21.4
	Feeding Behavior/Physiology	5	8.9
	Feeding Behavior/Feeding Habits/Ecology	8	14.3
	Physiology/Feeding Habits/Ecology	2	3.6
	Total	**56**	**100.0**

Scleractinia

This order presented a total of 54 studies (Table 4). Of these studies, most were related to aspects of “Feeding behavior” (32 studies; =59.2%). “Physiology” and “Feeding habits/Ecology” were less common in the studies, with 22 (=40.8%) and 13 publications (=24.1%), respectively.

Table 4. Approaches of feeding studies in Scleractinia.

Order	Approach	Absolute number	%
Scleractinia	Feeding Behavior	20	37.0
	Feeding Habits/Ecology	6	11.1
	Physiology	15	27.8
	Feeding Behavior/Physiology	6	11.1
	Feeding Behavior/Feeding Habits/Ecology	6	11.1
	Physiology/Feeding Habits/Ecology	1	1.9
	Total	**54**	**100.0**

Zoantharia, Anthipatharia and Corallimorpharia

The order Zoantharia had 11 studies, with three related to the topic "Feeding habits/Ecology" (=27.3%), three to "Feeding behavior/Physiology" (=27.3%), two to "Feeding behavior" and "Physiology" categories (=18.2%), and one to "Feeding behavior/Feeding habits/Ecology" (=9.0%). Studies on the combined topics "Physiology/Feeding Habits/Ecology" were not observed.

The order Anthipatharia had only a single study related to “Feeding behavior” (=100.0%). The order Corallimorpharia had two studies related to “Feeding behavior” (=100.0%).

Octocorallia

This subclass was the second most investigated group in Anthozoa, with a total of 36 studies (=22.1% of total studies). The results of the categories studied in the three orders that compose this group is shown below.

Alcyonacea

There was a total of 35 studies on this order (Table 5). The topic “Feeding behavior” consisted of 19 studies (=54.3%), “Feeding Ecology” had 16 studies (=45.7%) and “Physiology” had 8 publications (=22.9%).

Table 5. Approaches of feeding studies in Alcyonacea.

Order	Approach	Absolute number	%
Scleractinia	Feeding Behavior	11	31.4
	Feeding Habits/Ecology	9	25.7
	Physiology	7	20.0
	Feeding Behavior/Physiology	1	2.9
	Feeding Behavior/Feeding Habits/Ecology	7	20.0
	Physiology/Feeding Habits/Ecology	0	0.0
	Total	**35**	**100.0**

Helioporacea and Pennatulacea

The order Helioporacea did not present any study correlated to the feeding process. However, there was one single publication on ‘Feeding behavior’ for the order Pennatulacea (=100.0 %).

Ceriantharia

The subclass represented by the tube anemones was the focus of only three publications (=1.8% of total studies) related to the feeding aspects. The order Spirularia had two studies focused on the topic 'Feeding behavior/Physiology' (=66.7%) and one study about the topic 'Feeding behavior/Feeding habits/Ecology' (=33.3%). No studies focused on the order Penicillaria.

DISCUSSION

In general, it can be said that due to the relevance of this theme, there are several studies regarding feeding aspects within Cnidaria (Purcell, 1991). As explained in the introduction, we know that several studies were carried out on feeding and trophic performance with Medusozoa (*e.g.* Fulton, 1963; Brewer, 1989; Purcell et al., 1999). These animals have a high number of studies, as they directly affect a large number of species of commercial interest (Condon et al., 2013). Although the members of Anthozoa demonstrate great ecological importance, since they help in the maintenance of the aquatic ecosystems (Lira et al., 2012). In the present bibliographic review, we can observe that over the decades the number of studies referring to this theme has not been so large, considering that Anthozoa is the biggest class of the phylum in number of species (Daly et al., 2007).

The studies compiled in this review are focused mainly on three groups: Actiniaria and Scleractinia, in subclass Hexacorallia, and Alcyonacea, in subclass Octocorallia. Given the studies on trophic activity in Anthozoa are more linked to aspects of ecology and preservation, especially coral reefs (*e.g*. Ferrier-Pagès et al., 2003). In this way, groups that are more abundant in these areas have presented a larger number of studies. Thus, smaller groups or that their occurrence is not associated with coral reefs, presented very few information on feeding topics.

Some feeding strategies have already been recognized in Anthozoa: there are species that are filters (*e.g*. Sebens, 1981), others that perform the feeding process in symbiosis with other organisms (*e.g.* Fitt et al., 1982; Schwarz et al.,2002), etc. However, since the groups belonging to the class Anthozoa have many particularities, studies carried out with some groups may not match the dietary and behavior patterns presented by others (Daly et al., 2007). Thus, conducting further studies with groups in this class would make the recognition of diet and feeding habits even more comprehensive and establish a more suitable scenario for organisms belonging to that group.

In conclusion, while this study shows that relevant research has been and continues to be conducted about feeding habits in Anthozoa, there are several aspects that lacks information. Perhaps, most worrying was the small number of studies in two orders of Octocorallia and in subclass Ceriantharia. This indicate that these groups need more attention, since its presence may affect the trophic chain of several organisms.

ACKNOWLEDGEMENTS

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CAPÍTULO 2.

HÁBITOS ALIMENTARES DE *ISARACHNANTHUS NOCTURNUS E PACHYCERIANTHUS MAGNUS* (CNIDARIA; ANTHOZOA; CERIANTHARIA)

Thaís Barbosa Santos[1], James D. Reimer[2,3] & Sérgio N. Stampar[1]

1. Unesp - Universidade Estadual Paulista, FCL/Assis, Departamento de Ciências Biológicas, Laboratório de Evolução e Diversidade Aquática – LEDA, Brasil
2. University of The Ryukyus, Faculty of Science, Department of Biology, Chemistry, and Marine Science, MISE (Molecular Invertebrate Systematics and Ecology) Laboratory, Okinawa, Japan
3. University of The Ryukyus, Tropical Biosphere Research Center, Okinawa, Japan

Correspondência

Thaís Barbosa Santos

thaisbarbosa_stos@hotmail.com

RESUMO

Nesse estudo foram realizadas análises do conteúdo estomacal de *Isarachnanthus nocturnus* Hartog, 1977, coletados em São Sebastião, Brasil, e *Pachycerianthus magnus* Nakamoto, 1919, coletados em dois pontos da costa de Okinawa, Japão. Análises morfológicas e metagenômica foram feitas com o objetivo de identificar as principais classes de organismos que compõem a dieta dessas duas espécies. Os resultados mostraram que por meio das análises morfológicas não foi possível a identificação de organismos presentes no conteúdo estomacal. Nas análises metagenômicas foram observadas uma grande variedade de classes de animais, mostrando que a dieta dessas espécies é bastante diversa. As classes Anthozoa, Aconoidasida e Kinetoplastea, foram as mais abundantes no conteúdo estomacal das duas espécies. De fato, com a realização dessa abordagem conseguimos reconhecer os hábitos alimentares dessas duas espécies de Ceriantharia.

Palavras-chave: Anêmonas-de-tubo; Conteúdo estomacal; Hábitos alimentares; Teia alimentar; Metagenômica

FEEDING HABITS OF *ISARACHNANTHUS NOCTURNUS* AND *PACHYCERIANTHUS MAGNUS* (CNIDARIA; ANTHOZOA; CERIANTHARIA)

Thaís Barbosa Santos[1], James D. Reimer[2,3] & Sérgio N. Stampar[1]

1. Unesp - Universidade Estadual Paulista, FCL/Assis, Departamento de Ciências Biológicas, Laboratório de Evolução e Diversidade Aquática – LEDA, Brasil
2. University of The Ryukyus, Faculty of Science, Department of Biology, Chemistry, and Marine Science, MISE (Molecular Invertebrate Systematics and Ecology) Laboratory, Okinawa, Japan
3. University of The Ryukyus, Tropical Biosphere Research Center, Okinawa, Japan

Correspondence

Thaís Barbosa Santos

thaisbarbosa_stos@hotmail.com

ABSTRACT

This study analyzes the gastral cavity contents of *Isarachnanthus nocturnus* Hartog, 1977, collected in São Sebastião, Brazil, and *Pachycerianthus magnus* Nakamoto, 1919, collected in two points at the Okinawa coast, Japan. The morphology and metagenomic analysis were performed, aiming to identify the main classes of organisms that compose the diet of these species. The results demonstrate that the morphological analysis it was not possible to identify organisms. In metagenomic analyzes, a wide variety of animal classes were observed, showing the diverse diet of these ceriantharians. The classes Anthozoa, Aconoidasida, Kinetoplastea, Actinopterygii, Insecta, and Leptocardii were the most abundant in the contents of the two species. From this, a great cohesion was observed in the feeding habits of these two species. Thus, we are able to show a more comprehensive scenario of the feeding performance of two species of Ceriantharia.

Keywords: Diet; Food web; Metagenomics; Gastral cavity contents; Tube-dwelling anemones

INTRODUCTION

The recognition of the trophic niche of a species is of utmost importance for the understanding of its evolutionary process and ecological relevance since its diet provides the nutrients and energy that are essential to various processes in their life cycle, such as growth, development, and reproduction (Olafsson et al., 1994; Leibold, 1995).

Studies about the trophic performance in marine environments are overly complex, and as a result, several groups of organisms still have gaps in topics related to the food web. When we evidence the group of invertebrates that inhabit this ecosystem, the result becomes even worse, especially for benthic organisms (Ribes et al., 1999a; 1999b; 2003).

Some ways of recognizing food processes have already been outlined, among them, two forms of studies are the most applied. The first aim to understand the prey capture process, in which filming is done to recognize this mechanism (*e.g*. Price & Lewis, 1975; Bursey & Guanciale, 1977). The second approach aims to recognize the trophic performance, based on analyzes of the animal's tissue, via stable isotopes (Newsome et al., 2007; Leal et al., 2017; Conti-Jerpe et al., 2020), or by analyzes of the gastric contents (Orejas et al., 2001). The studies with the gastrovascular cavity contents may be more traditional, through analysis via microscopy techniques (e.g, Zamer., 1986; Orejas et al, 2001; Acuña et al., 2004) and with molecular tools, especially next-generation sequencing with specific markers (Leray & Knowlton, 2015). One technique that has been used recently is the metagenomics. This is a widely molecular approach used for the recognition of the microbial community (Gilbert & Dupont, 2011), however, it can be used as a tool to discuss other aspects, such as the description of trophic performances (Blankenship & Yayanos, 2005) and identification of symbiotic relationships (Celis et al., 2018).

In Cnidaria, there are some studies related to the trophic performance of several organisms, however, some groups have few information available. This is the case of some groups observed in the class Anthozoa (Subphylum Anthozoaria). Anthozoa is the largest class in Cnidaria, with 7,200 described species (Kayal et al., 2018). In this class, studies carried out and related to trophic performance are mainly directed to three orders: Actiniaria, Scleractinia (subclass Hexacorallia) and Alcyonacea (subclass Octocorallia). This occurs because, in Anthozoa, studies of trophic performance are closely related to aspects of ecology and preservation of coral reef environments. (Ferrier-Pagès et al., 2003). Thus, it is recognized that groups that typically do not inhabit coral reef environments have a very small amount of studies related to this topic. This occurs with the subclass Ceriantharia. The individuals that belong to this subclass are called ceriantharians or tube-dwelling anemones, due to the remarkable tube that they build around their body (Molodtsova et al., 2011).

Ceriantharia is a group that presents studies on different themes: morphology, taxonomy, life cycle, among others (Stampar et al., 2012; Stampar et al., 2015; Stampar et al., 2016; Stampar et al., 2019; Ceriello et al.,2020; Klompen et al., 2020). However, this subclass remains poorly studied and has several aspects not understood, such as studies related to the trophic performance of the group (Stampar, 2012). Despite the recognition of data about feeding patterns being of paramount importance, this subclass presents three studies about feeding topics (Arai & Walder, 1973; Eleftheriou & Basford, 1983; Arai, 1985), where one of them is related to the topic feeding habits.

Eleftheriou and Basford (1983) carried out a study of the feeding behavior and feeding habits of the species *Cerianthus lloydii.* The authors performed a footage of the prey capture and morphological analysis of the gastral cavity contents. With that, they observed some classes of animals that are found in the diet of this species. Besides this study, Ceriantharia does not have much information available about their feeding habits.

Based on the above, this study aims to describe the trophic performance of *Isarachnanthus nocturnus* and *Pachycerianthus magnus* through analysis of gastral cavity contents by microscopy techniques and metagenomic, to characterize the main classes of organisms that are present in the diet of these species.

MATERIAL AND METHODS

<u>Sampling and preservation</u>

The sampling was carried out in São Sebastião (Alcatrazes Island), São Paulo, Brazil, in Unten port and Oura bay, Okinawa, Japan. Four specimens of *Isarachnanthus nocturnus* (Hartog, 1977) (Fig. 1) and two specimens of *Pachycerianthus magnus* (Nakamoto, 1919) (Fig. 2) were collected manually by SCUBA diving. For complete dataset description (sampling sites, dates, number of cerianthids sampled and preservation) see Table 1.

These specimens were dislodged from their tubes and then, were kept separately in containers duly labelled regarding the species name, collect location and date. The preservation was made immediately after sampling with ethanol 100%, to stop the digestion process of these ceriantharians. It was used ethanol, because the gastral cavity contents of these samples were used to perform the morphological and metagenomic analysis. In addition, to the morphological analysis of the gastral cavity contents, one sample of *Pachycerianthus magnus*, collected in Unten port (Okinawa, Japan), was included. This third sample belong to the collection of MISE (Molecular Invertebrate Systematics and Ecology) laboratory and it was preserved in formaldehyde solution (10%). This sample was used only for the morphological study, once that the type of preservation is not the ideal for the molecular process.

Table 1. Sampling sites, dates, specie of ceriantharians, number of specimens collected and type of preservation.

Local	**Date**	**Species**	**Number of samples**	**Preservation**
Unten port	10/Sep/2016	*Pachycerianthus magnus*	1	Formaldehyde
São Sebastião (Alcatrazes Island)	22/May/2019	*Isarachnanthus nocturnus*	4	Ethanol
Oura bay	25/Sep/2019	*Pachycerianthus magnus*	1	Ethanol
Unten Port	12/Dec/2019	*Pachycerianthus magnus*	1	Ethanol

Figure 1. Specimen of *Isarachnanthus nocturnus* from São Sebastião (Alcatrazes Island). Scale: 1.0 cm.

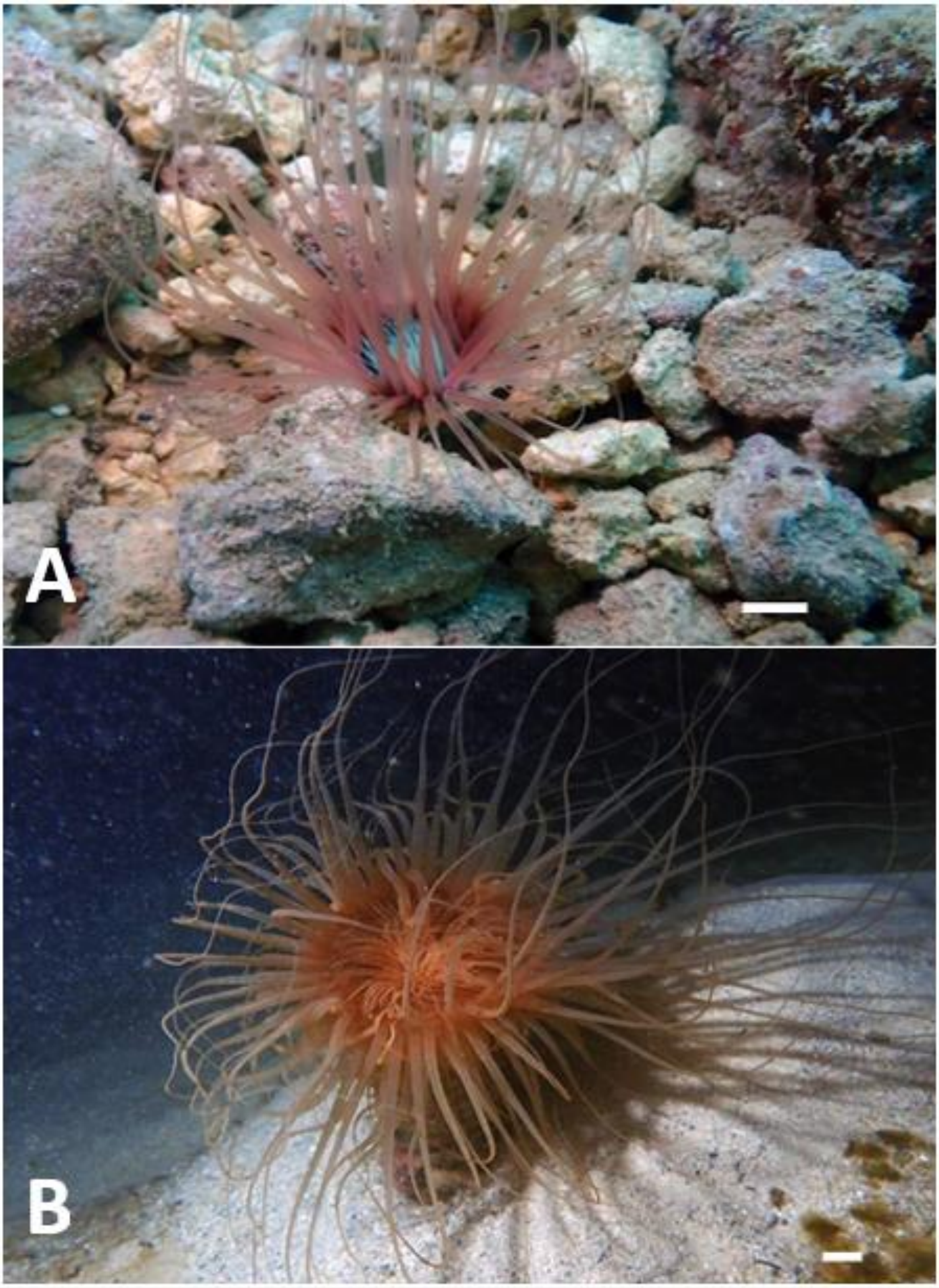

Figure 2. A. *Pachycerianthus magnus* that was found in Oura bay between rubbles around 5 m depth. Scale: 1.0 cm. **B.** *Pachycerianthus magnus* that was found in Unten Port in a sand area around 4 m depth. Scale: 1.0 cm.

Removal of gastral cavity contents

Each tube-dwelling anemone were cut longitudinally to open the gastrovascular cavity and kept opened with acupuncture needles. In the gastrovascular cavity was injected alcohol (100%) and then, the contents were removed with a disposable pipette. The mesenterial filaments were also sprayed with alcohol to release small prey items that possibly held there. Thereby, the gastral cavity contents present in this region were removed and then divided into two subsamples, to the morphology and metagenomic analysis, and kept refrigerated.

Morphology analysis of gastral cavity contents

The gastral cavity contents of each specimen, *Isarachnanthus nocturnus* (n=4) and *Pachycerianthus magnus* (n=3), were observed and sorted through optical microscopy techniques. The shapes found into the stomach contents were photographed and then morphologically studied.

Metagenomic analysis of the gastral cavity contents

For this approach, one sample of each locality (Brazil and Japan) were analyzed by Novogene (USA). Before the DNA extraction of the gastral cavity contents were conducted, the stomach contents were thoroughly homogenized and the ethanol was drained, from the samples prior, to subsampling the homogenized stomach contents for DNA extraction. For each DNA extract, it was used approximately 0.2 g of homogenized gut contents, and DNA extractions were conducted with a DNA Isolation Kit (Qiagen).

On the whole-genomic shotgun sequencing, a total of 1 µg of DNA per sample was used as input material for the DNA sample preparations. The sequencing libraries were generated using the NEBNext Ultra DNA Library Prep Kit for Illumina. After this, the DNA sample was fragmented, and then the DNA fragments were end-polished, A-tailed and ligated with the full-length adaptor for Illumina sequencing for further PCR amplification. Then, the PCR products were purified, and the libraries were analyzed for size distribution using an Agilent2100 Bioanalyser and quantified using real-time PCR. The clustering of the index-coded samples was performed on a cBot Cluster Generation System according to the manufacturer's instructions. After cluster generation, the library preparations were sequenced on an Illumina HiSeq platform, and paired-end reads were generated. In the end, 4 sequences were obtained (each sample had a replica from the same individual).

The sequences obtained in the Metagenomic shotgun analysis were analyzed in the MGX metagenomic platform (Jaenicke et al., 2018 - https://mgx-metagenomics.github.io/). The reads were blasted to NCBI database by MGX Taxonomic Classification (E-value cutoff= 1e-5, relative identity=0.8) to identify metazoan groups. The phylum and classes of organisms were identified for each sequence.

For microbiome identifications, the reads were analyzed via Mothur algorithm (Schloss et al., 2009; Schloss & Westcott, 2011) for the identification of microbiota by 16S rRNA gene sequence implemented in MGX platform.

RESULTS

Morphology analysis

The analysis of the gastral cavity contents was performed, and it was observed that in this approach it was not possible to identify the presence of animals or other organism in the composition by optical microscopic techniques. In Figure 3 and 4 it is possible to verify that the contents of the specimens of *Isarachnanthus nocturnus* and *Pachycerianthus magnus* do not contain shapes recognizable by morphology, just irregular masses. No type of shell or exoskeleton was found.

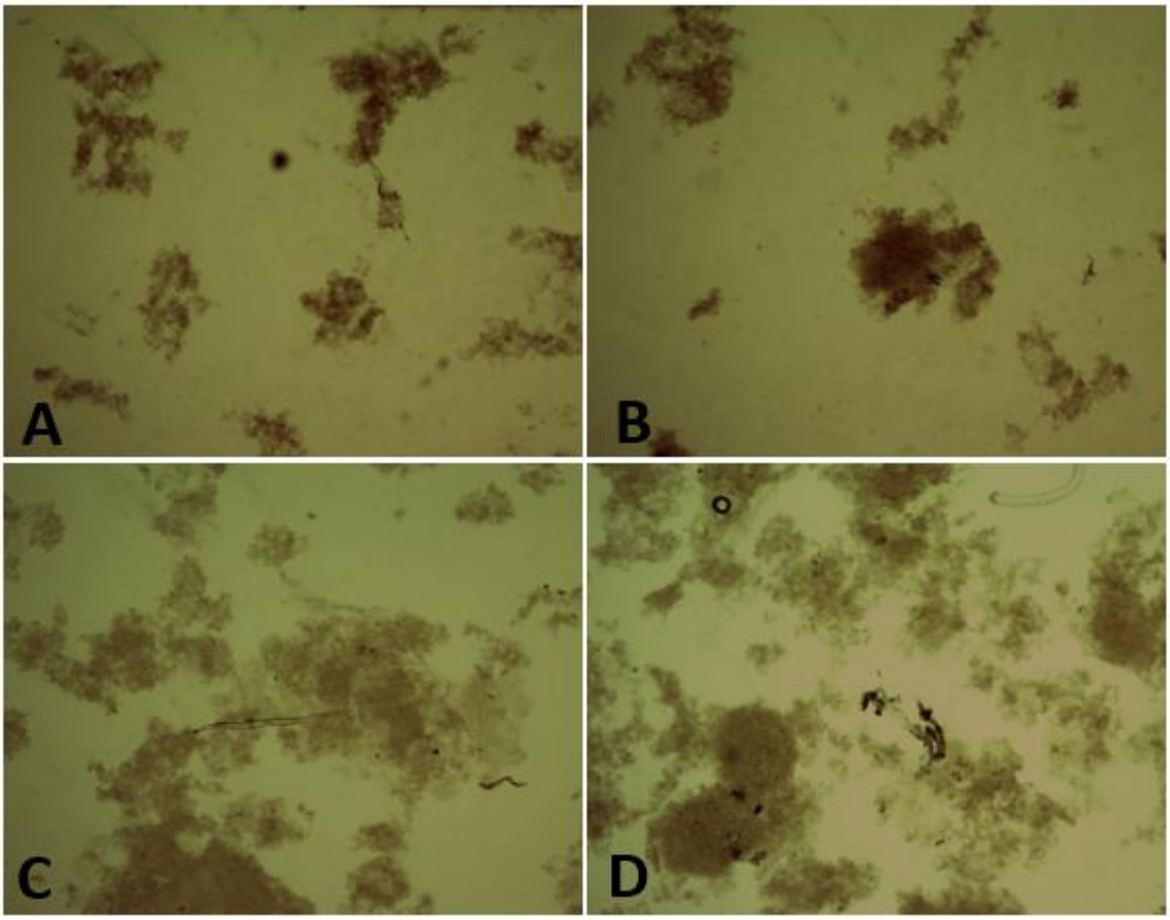

Figure 3. Gastral cavity contents of 4 specimens of *Isarachnanthus nocturnus from São Sebastião channel*.

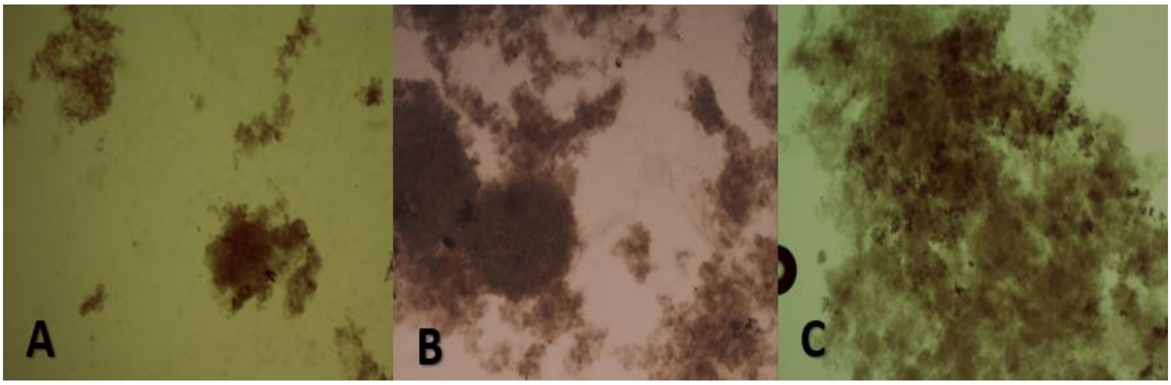

Figure 4. Gastral cavity of *Pachycerianthus magnus*. **A.** Specimen from Oura bay. **B.** Specimen from Unten Port. **C.** Specimen from Unten Port preserved in formaldehyde.

Metagenomics

The new-generation sequencing resulted in excellent quality reads and a distribution of the quality of the reads can be seen in Figure 5. Fortunately, all reads are in the green range, indicating high quality.

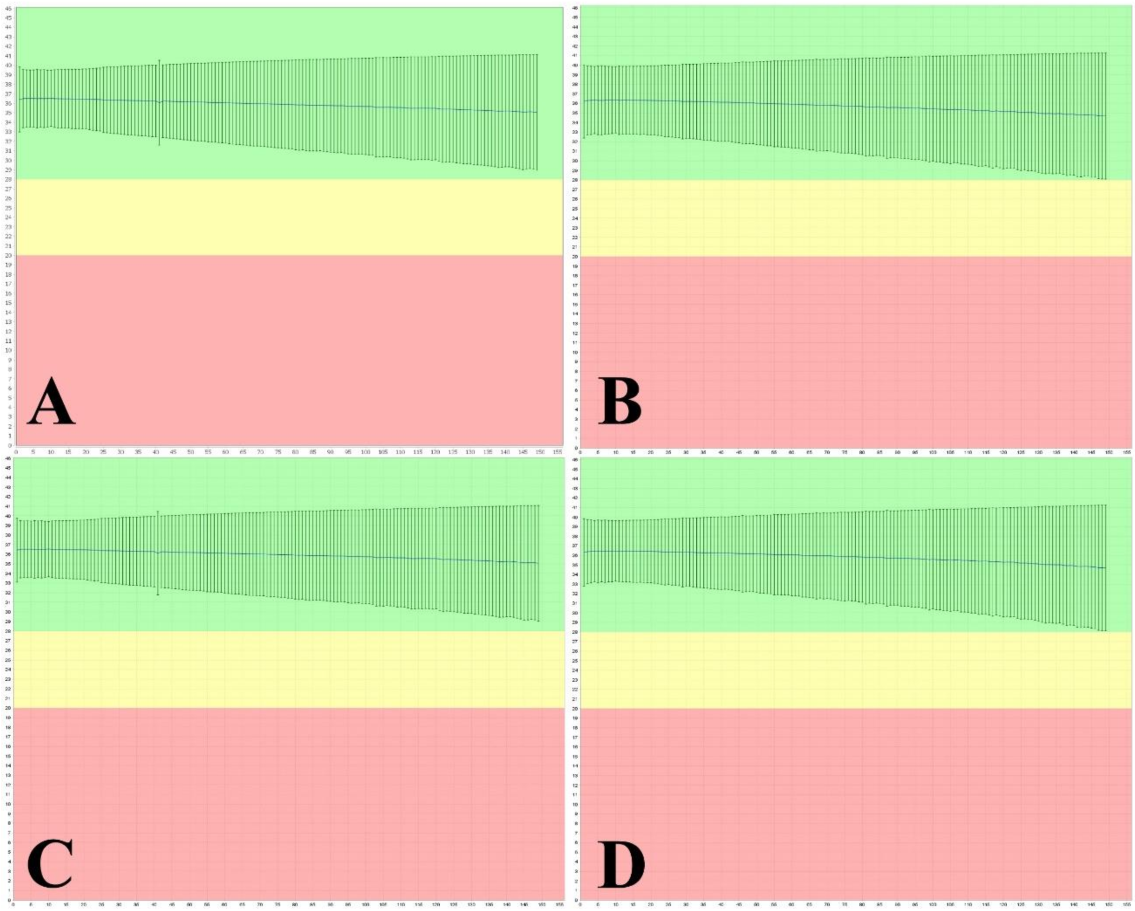

Figure 5. Quality analysis (MGX metagenomic platform) of the sequencing reads: *Isarachnanthus nocturnus* (A – Main sample; B – Replica) and *Pachycerianthus magnus* (C – Main sample; D – Replica).

Diet of Isarachnanthus nocturnus by metagenomics

The phylum and main classes observed in the gastral cavity contents of *Isarachnanthus nocturnus* were very diverse. In total, 34 phyla were identified in this sample. The five most abundant phyla identified in the analysis of the sequences were: Cnidaria (70.2%), Apicomplexa (10.7%), Euglenozoa (8.8%), Chordata (4.9%) and Arthropoda (1.5%). Table 2 lists the data for the ten most representative metazoan classes in the gastral cavity contents of *Isarachnanthus* *nocturnus* and the percentage of each, based on the number of reads found in the sequencing. The index values of Simpson and Shannon, respectively, were 0.633 and 1.749 and in the replica 0.659 and 1.693.

Table 2. Ten most representative Metazoan classes in the gastral cavity contents of *Isarachnanthus nocturnus* and the number of reads found in the sequencing (except Anthozoa).

Main sample			**Replica**		
Classes	**Number of reads**	**%**	**Classes**	**Number of reads**	**%**
Actinopterygii	10.307	5.8	Actinopterygii	10.065	5.7
Leptocardii	5.505	3.1	Leptocardii	5.621	3.2
Insecta	5.141	2.8	Insecta	4.945	2.8
Bivalvia	4.058	2.2	Bivalvia	4.065	2.3
Enteropneusta	2.935	1.7	Enteropneusta	2.909	1.7
Echinoidea	2.779	1.6	Echinoidea	2.733	1.6
Mammalia	2.019	1.1	Mammalia	1.902	1.0
Gastropoda	1.741	1.0	Gastropoda	1.772	1.0
Priapulimorpha	1.717	1.0	Hydrozoa	1.641	0.9
Hydrozoa	1.650	0.9	Priapulimorpha	1.588	0.9

Among the classes identified in the gastral cavity contents by metagenomics, Anthozoa was the most representative, probably this happened, because some fragments of the gastrovascular cavity or the mesenteries were in the samples. The preys that the cerianthid probably captured (Table 2), we see a predominance of fishes, Actinopterygii and Leptocardii (class of marine chordates). However, other preys were also representative, such as the case of Insecta, Bivalvia and Enteropneusta (marine hemicordate that are found in the mud or sand areas).

The difference that occurred comparing the results was the presence of some classes, that was not present in both. The classes Bangiophyceae (multicellular red algae from the phylum Rhodophyta) and Tremellomycetes (fungi) were observed in the main sample, and Trebouxiophyceae (green algae) and Filasterea (group of protozoa) were just in the replica.

Diet of Pachycerianthus magnus by metagenomics

The diversity of dietary items In *Pachycerianhtus magnus* spanned 56 classes belonging to 32 phyla. The most abundant phyla for this species were: Cnidaria (71.1%), Apicomplexa (11.8%), Euglenozoa (7.0%), Chordata (4.4%), Arthropoda (1.5%), and Mollusca (1.2%). Table 3 exhibited the ten most representative Metazoan classes in the gastral cavity of *Pachycerianthus magnus,* and the percentage of each, based on the number of reads in the sequences.

Table 3. Ten most representative Metazoan classes in the gastral cavity content of *Pachycerianthus magnus* and the number of reads found in the sequencing (except Anthozoa).

Main sample			**Replica**		
Classes	**Number of reads**	**%**	**Classes**	**Number of reads**	**%**
Actinopterygii	20.905	6.0	Actinopterygii	20.592	6.1
Insecta	11.757	3.4	Insecta	11.895	3.5
Mammalia	9.736	2.8	Mammalia	9.612	2.9
Bivalvia	8.784	2.5	Leptocardii	8.773	2.6
Leptocardii	8.754	2.5	Bivalvia	8.772	2.6
Enteropneusta	4.366	1.3	Enteropneusta	4.338	1.3
Gastropoda	4.235	1.2	Gastropoda	4.257	1.3
Hydrozoa	3.831	1.1	Hydrozoa	3.675	1.1
Echinoidea	3.717	1.1	Echinoidea	3.672	1.1
Priapulimorpha	3.354	1.0	Priapulimorpha	3.260	1.0

Based on Table 3, it was observed that in both reads exhibited the same Metazoan groups. Apart from Anthozoa, the most representative classes in the gastral cavity were Actinopterygii, Insecta, Mammalia, Bivalvia, and Leptocardii. Only two classes were identified only in one of the analysis of the sequences: Cryptophyceae (algae) and Chlorophyceae (green algae). The other groups were obtained in both analyses.

Feeding habits comparison

The feeding habits of both species looks really similar independent of the local that the species was sampled. The main classes obtained in the metagenomic approach for *Isarachnanthus nocturnus* and *Pachycerianthus magnus*, revealed that both species showed similar groups of organisms in the gastral cavity contents. The ten most representative classes in the gastral cavity contents were the same in both species.

Microbiota in gastrovascular cavity of *Isarachnanthus nocturnus* and *Pachycerianthus magnus*

The type of sequencing performed allowed the study of the entire biota present within the gastrovascular cavity of Ceriantharia, not only those that were the prey that the polyps fed on, but also the organisms involved in the digestion process. Thus, in Tables 4 and 5 are the main components of organisms, non-metazoans, present in the samples.

Table 4. Ten most representative non-Metazoan classes in the gastral cavity contents of *Isarachnanthus nocturnus* and the number of reads found in the sequencing.

Main sample		**Replica**	
Classes	**Number of reads**	**Classes**	**Number of reads**
Aconoidasida	68.378	Aconoidasida	67.733
Actinobacteria	57.878	Actinobacteria	62.567
Kinetoplastea	56.240	Kinetoplastea	55.818
Gammaproteobacteria	31.003	Gammaproteobacteria	31.396
Betaproteobacteria	15.780	Betaproteobacteria	13.125
Alphaproteobacteria	5.090	Bacilli	5.169
Bacilli	4.847	Alphaproteobacteria	4.637
Deltaproteobacteria	2.358	Flavobacteriia	2.439
Flavobacteriia	2.341	Deltaproteobacteria	2.286
Mixiomycetes	1.811	Mixiomycetes	1.979

Table 5. Ten most representative non-Metazoan items in the gastral cavity contents of *Pachycerianthus magnus* and the number of reads found in the sequencing.

Main sample		Replica	
Classes	**Number of reads**	**Classes**	**Number of reads**
Aconoidasida	147.541	Aconoidasida	146.164
Kinetoplastea	87.292	Kinetoplastea	78.764
Gammaproteobacteria	49.661	Gammaproteobacteria	50.602
Actinobacteria	44.337	Actinobacteria	60.243
Betaproteobacteria	21.935	Bacilli	13.503
Bacilli	12.808	Betaproteobacteria	12.871
Alphaproteobacteria	7.802	Alphaproteobacteria	7.283
Mixiomycetes	5.433	Mixiomycetes	5.547
Methanomicrobiota	5.371	Methanomicrobiota	4.890
Eurotiomycetes	4.360	Eurotiomycetes	4.411

The results demonstrate a surprising cohesion between the microbiota of specimens from Brazil and from Japan. Practically the ten groups with the biggest representativeness in the samples are the same in both locations. There is clearly a dominance of four groups, Aconoidasida, Kinetoplastea, Gammaproteobacteria and Actinobacteria. Apicomplexa of the class Aconoidasida (class of apicomplexan parasites) were the most representative. These are the intestinal parasites of many organisms and, apparently, do not aid digestion with the currently recognized patterns. On the other hand, Actinobacteria and Gammaproteobacteria, which are represented in large quantities in both species, contains several genera that are active in the digestive tract of many organisms. Thr class Kinetoplastea, group of free-living and parasitic flagellates, found in soil and aquatic environments, probably are involved in digestion process

DISCUSSION

Feeding habits in Ceriantharia

Different from other studies about the feeding habits in Anthozoa, which recognized several species of animals in the stomach contents by morphological techniques (*e.g*. Eleftheriou, A. & Basford, 1983; Chintiroglou & Koukouras, 1991,1992; Acuña & Zamponi, 1996; Tsurpalo & Kostina, 2003), in these specimens of Ceriantharia it was not possible. Thus, it can be said that the gastral cavity contents of these organisms were at a more advanced level of digestion. In this way, the animals captured by these tube-dwelling anemones do not fully or partially present their original shape, making it impossible to identify them.

The recognition of feeding and diet patterns in some Anthozoa groups are very scarce (Ribes et al., 1999a; 2003). Most of the studies are concentrated in only two groups, Actiniaria and Scleractinia (*e.g.* Chintiroglou & Koukouras, 1991,1992; Lasker, 1976; Kuanula et al., 2016). Despite the recognition of the importance of obtaining this type of data, almost nothing is known about this behavior in most of the species of Cnidaria, especially in smaller groups, such as the subclass Ceriantharia (Stampar, 2012; Stampar et al., 2015b, Stampar et al., 2016). In gorgonians (Alcyonacea), aspects of the feeding process are one of the least aspects that are understood in their biology. Possibly, the aspect that corroborated for this is due to the difficulty to find in the gastral cavity contents samples, a significant quantity of prey and identify the items (Lasker, 1981). In the study about feeding habits of *Cerianthus loydii* by Eleftheriou & Basford (1983), one of the problems was that in part of the samples were not possible identify the organisms in the gastral cavity contents, since the digestion process was in an advanced level or the gastrovascular cavity was empty.

Thus, the possibility of developing a molecular approach in samples where it is not possible to identify organisms by morphology in the gastrovascular contents becomes much more interesting. In the literature, among the various of techniques used to characterize the food web and the diet of organisms, the molecular analysis of the gastral cavity contents becomes more powerful, since species-diagnostic in DNA fragments can be revealed after several hours of digestion (Symondson, 2002; Leray et al., 2015).

In the metagenomic analysis, it was possible to observe the groups that were present in the gastral cavity contents of the two species of Ceriantharia. Regardless of whether the specimens are, from Brazil or Japan, there seems that the feeding pattern is quite clear, once that the classes of animals observed on both were similar. Differently from the study by Chintiroglou and Koukouras (1992), where they observed that in some anemone species, there were changes in feeding habits under influence in the changes of location. It is important to highlight that, most likely, the prevalence of prey in Ceriantharia refers to larvae from different groups. Thus, the main trophic activity of this group is in planktonic organisms and large populations can have a great impact on the pressures of organisms with planktonic larvae. This is quite different from the organisms that are always used as a reference for Ceriantharia, the Actiniaria. Several studies demonstrate that these organisms act much more in benthic organisms (*e.g.* Acuña et al., 2001), thus acting in a food niche totally different from Ceriantharia.

Another truly relevant aspect is the priority action in fish. As these organisms are unlikely to be feeding on adult fish, we believe that Ceriantharia feed on eggs and, mainly, fish larvae. Interestingly, crustaceans were not a major part of the food menu of these organisms. As a general concept, different groups of crustaceans are used as a food reference for Cnidaria. In this case, the present study proves that this standard cannot be applied to Ceriantharia.

Therefore, we strongly encourage the development of approaches related to dietary studies, especially for groups where the amount of information is minimal. Thus, with the development of more studies on this topic, there will be a better understanding of the trophic performance, food chain and the trophic niche of the species that make up the class Anthozoa.

<u>Microbiota in gastrovascular cavity of *Isarachnanthus nocturnus* and *Pachycerianthus magnus*</u>

Several marine metazoans are dependent on a specific microbiota in order to survive. In this way, the host-associated microorganisms may also have fundamental impacts on their ecology and evolution (Fraune & Bosch, 2010). Some authors argue that organisms are born germ-free and obtain the microbiota associated with different systems in the environment and, normally, this microbiota reflects the surrounding area (Tietjen, 2014). Some studies show that the larvae acquire the microbiota shortly after the egg hatches, and the eggshell itself may contain part of that microbiota and thus transfer to the new organism (Broderick & Lemaitre, 2012). Our results indicate that there is a great cohesion of microbiotes, but it is not possible to suggest an acquisition mechanism. On the other hand, the results make it clear that at least part of this microbiota has an important role in the digestion process in these organisms. Another very relevant point and based on the similarity between organisms from completely different areas, this microbiota must have a very strong evolutionary relationship. In any case, further study of these results may indicate more specific profiles of the performance of this microbiota.

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CONCLUSÃO GERAL

Com base nos resultados obtidos foi possível observar que a realização de estudos sobre a performance trófica e dos padrões alimentares em Anthozoa ainda são pouco conhecidos. Visto que essa é a maior classe filo Cnidaria, o número de estudos realizados é pequeno se comparado com o número de espécies que essa classe apresenta (137 artigos para 7200 espécies descritas dentro do grupo). Grupos menores e que tipicamente não são encontrados em recifes de corais são os que apresentam a menor quantidade de estudos relacionados a esse tópico. Ceriantharia, é a subclasse que apresentou a menor quantidade de pesquisas (3 estudos) e desta forma, a realização de estudos relacionados à essa vertente, é de extrema relevância para se compreender sobre como os organismos desse grupo impactam no ecossistema ao qual estão inseridos.

Na realização das análises do conteúdo estomacal de duas espécies de Ceriantharia, *Isarachnanthus nocturnus* e *Pachycerianthus magnus*, demonstramos que por meio de análises morfológicas, via técnicas de microscopia, não foi possível identificar as possíveis classes de animais que estavam presentes. Não foi observado nenhum vestígio, como conchas ou exoesqueleto, no conteúdo retirado da cavidade gastrovascular dos espécimes coletados (n=7). Desta forma, a realização de análises moleculares do conteúdo estomacal dessas espécies é extremamente relevante.

As análises metagenômicas evidenciaram que os hábitos alimentares de *Isarachnanthus nocturnus* e *Pachycerianthus magnus* são bastante similares, uma vez que majoritariamente, as mesmas classes foram identificadas no conteúdo estomacal de ambas as espécies. O nicho trófico das duas espécies é bastante abrangente, visto que houve uma grande diversidade de classes de organismos observados no sequenciamento do conteúdo estomacal desses espécimes.

Assim, a partir de nossas análises foi possível verificar que independente espécie e localidade, as duas espécies de ceriantos apresentam as mesmas classes de animais em sua rede alimentar. Além disso, evidenciamos que as análises moleculares do conteúdo estomacal, principalmente para amostras que apresentam um nível mais avançado de digestão, são as mais recomendadas.

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Zamer, W. E. (1986). Physiological energetics of the intertidal sea anemone *Anthopleura elegantissima*. Marine Biology, vol. 92(3): 299-314.

Material suplementar – Lista dos estudos examinados na revisão bibliográfica.

STUDY	APPROACH(ES)	SUBCLASS	ORDER	GENUS and/or SPECIES
Abe, N. (1938). Feeding behaviour and the nematocyst of *Fungia* and 15 other species of corals. Stud. Palao Trop. Biol. Stn., vol. 1: 469–521.	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Fungia*
Acuña, F. H. & Zamponi, M. O. (1995). Feeding ecology of intertidal sea anemones (Cnidaria, Actiniaria): food sources and trophic parameters. Biociencias, vol. 3: 73–84.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Phymactis clematis*; *Aulactinia marplatensis*; *Aulactinia reynaudi*
Acuña, F. H. & Zamponi, M. O. (1996). Ecología trófica de las anémonas intermareales *Phymactis clematis* (Dana, 1849); *Aulactinia marplatensis* (Zamponi, 1977) y *A. reynaudi* (Milne-Edwards, 1857) (Actiniaria: Actiniidae): relaciones entre las anémonas y sus presas. Ciencias Marinas, vol. 22(4): 397–413.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Phymactis clematis*; *Aulactinia marplatensis*; *Aulactinia reynaudi*
Acuña, F. H.; Excoffon, A. C. & Zamponi, M. O. (1999). Population Structure, Sex Ratio and Feeding in *Tricnidactis errans* Pires, 1988 (Actiniaria, Haliplanellidae) from a Subtidal Aggregation. Biociências, vol. 7(2): 3-12.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Tricnidactis errans*
Acuña, F. H. & Zamponi, M. O. (1999). Estructura poblacional y ecologia trófica de *Oulactis muscosa* Dana, 1849 (Actiniaria, Actiniidae) del litoral bonaerense (Argentina). Physis, vol. 57(132-133): 11-16.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Oulactis muscosa*
Acuña, F. H.; Excoffon, A. C. & Genzano, G. N. (2001). Feeding of *Anthothoe chilensis* (Actiniaria, Sagartiidae) in Mar del Plata Port. (Buenos Aires, Argentina). Biociencias, vol. 9(1): 111–120.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Anthothoe chilensis*
Acuña, F. H.; Excoffon, A. C.; Zamponi, M. O. & Genzano, G. N. (2004). Feeding habits of the temperate octocoral *Tripalea clavaria* (Studer, 1878) (Octocorallia, Gorgonaria, Anthothelidae), from sublittoral outcrops off Mar del Plata, Argentina. The Belgian Journal of Zoology, vol. 134(1): 65-66.	FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Tripalea clavaria*

Agostini, S; Suzuki, Y.; Higuchi, T.; Casareto, B. E.; Yoshinaga, K.; Nakano, Y. & Fujimura, H. (2012). Biological and chemical characteristics of the coral gastric cavity. Coral Reefs vol. 31: 147–156	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Galaxea fascicularis*
Alamaru, A., Bronstein, O., Dishon, G., & Loya, Y. (2009). Opportunistic feeding by the fungiid coral *Fungia scruposa* on the moon jellyfish Aurelia aurita. Coral Reefs, 28(4), 865–865. doi:10.1007/s00338-009-0507-7	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Fungia scruposa* (*Danafungia scruposa*)
Anthony, K. R. N. (1997). Prey Capture by Sea Anemone *Metridium senile* (L.): Effects of Body Size, Flow Regime, and Upstream Neighbors.The Biological Bulletin, vol. 192(1): 73-86.	FEEDING BEHAVIOR	HEXACORALLIA	ACTINIARIA	*Metridium senile*
Anthony, K. R. N. (1999) Coral suspension feeding on fine particulate matter. Journal of Experimental Marine Biology and Ecology, vol. 232 (1): 85-106.	FEEDING BEHAVIOR/PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Pocillopora damicornis*; *Montipora digitata*; *Acropora millepora*; *Porites cylindrica.*
Arai, M. N. & Walder, G. L. (1973). The feeding response of *Pachycerianthus fimbriatus* (Ceriantharia). Comparative Biochemistry and Physiology Part A: Physiology, vol. 44(4): 1085–1092. doi:10.1016/0300-9629(73)90246-6	FEEDING BEHAVIOR/PHYSIOLOGY	CERIANTHARIA	SPIRULARIA	*Pachycerianthus fimbriatus*
Arai, M. N. (1985). Electrical activity associated with withdrawal and feeding of *Pachycerianthus fimbriatus* (Anthozoa, Ceriantharia). Marine Behaviour and Physiology, vol. 12(1): 47-56. doi:10.1080/10236248509378632	FEEDING BEHAVIOR/PHYSIOLOGY	CERIANTHARIA	SPIRULARIA	*Pachycerianthus fimbriatus*
Ayre, D. J. (1984). The Sea Anemone *Actinia tenebrosa.* An Opportunistic Insectivore. *Ophelia,* vol. 23(2): 149-153. doi:10.1080/00785326.1984.10426610	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Actinia tenebrosa*; *Actinia equina*
Bak, R. P. M.; Joenje, M.; de Jong, I.; Lambrechts, D. Y. M. & Nieuwland, G. (1998). Bacterial suspension feeding by coral reef benthic organisms. Marine Ecology Progress Series, vol. 175: 85–288.	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Madracis mirabilis*
Best, B. A. (1988). Passive suspension feeding in a Sea Pen: Effects of Ambient Flow on Volume Flow Rate and Filtering Efficiency. The Biological Bulletin, vol. 175(3): 332–342. doi:10.2307/1541723	FEEDING BEHAVIOR	OCTOCORALLIA	PENNATULACEA	*Ptilosarcus gurneyi*

Bos, A. R.; Mueller, B. & Gumanao, G. S. (2011). Feeding biology and symbiotic relationships of the Corallimorpharian *Paracorynactis hoplites* (Anthozoa: Hexacorallia). The Raffles Bulletin of Zoology, vol. 59(2): 245–250.	**FEEDING BEHAVIOR**	**HEXACORALLIA**	**CORALLIMORPHARIA**	*Paracorynactis hoplites*
Boschma, H. (1925). The Nature of the Association between Anthozoa and Zooxanthellae. Proceedings of the National Academy of Sciences, vol. 11(1): 65–67.	**FEEDING BEHAVIOR**	**HEXACORALLIA**	**SCLERACTINIA**	*Astrangia*
Boschma, H. (1925) On the feeding reactions and digestion in the coral polyp *Astrangia danae,* with notes on its symbiosis with zooxanthellae. The Biological Bulletin (Woods Hole) vol. 49: 407–439. doi:10.2307/1536652	**FEEDING BEHAVIOR/PHYSIOLOGY**	**HEXACORALLIA**	**SCLERACTINIA**	*Astrangia danae*
Bumann, D. (1995). Localization of Digestion Activities in the Sea Anemone *Haliplanella luciae*. The Biological Bulletin, vol. 189(2): 236–237. doi:10.1086/bblv189n2p236	**PHYSIOLOGY**	**HEXACORALLIA**	**ACTINIARIA**	*Haliplanella luciae*
Bursey, C. R. & Guanciale, J. M. (1977). Feeding behavior of the sea anemone *Condylactis gigantea*. Camp. Biochem. Physiol, vol. 57A: 115-117.	**FEEDING BEHAVIOR**	**HEXACORALLIA**	**ACTINIARIA**	*Condylactis gigantea*
Carpenter, F. W. (1910). Feeding reactions of the rose coral (*Isophyllia*). Proceedings of the American Academy of Arts and Sciences, vol. 46(6):149–162.	**FEEDING BEHAVIOR/PHYSIOLOGY**	**HEXACORALLIA**	**SCLERACTINIA**	*Isophyllia sinuosa*
Chang-Feng, D. & Ming-Chao, L. (1993). The effects of flow on feeding of three gorgonians from southern Taiwan. Journal of Experimental Marine Biology and Ecology, vol. 173(1): 57–69. doi:10.1016/0022-0981(93)90207-5	**FEEDING BEHAVIOR**	**OCTOCORALLIA**	**ALCYONACEA**	*Subergorgia suberosa*; *Melithaea ochracea*; *Acanthogorgia vegae*
Chintiroglou, C. & Koukouras, A. (1991). Observations on the feeding habits of *Calliactis parasitica* (Couch, 1842), Anthozoa, Cnidaria. Oceanologica Acta, vol. 14(4): 389-396.	**FEEDING HABITS/ECOLOGY**	**HEXACORALLIA**	**ACTINIARIA**	*Calliactis parasitica*

Chintiroglou, C. & Koukouras, A. (1992). The feeding habits of three Mediterranean Sea anemone species, *Anemonia viridis* (Forskål), *Actinia equina* (Linnaeus) and *Cereus pedunculatus* (Pennant). Helgoländer Meeresuntersuchungen, vol. 46(1): 53–68. doi:10.1007/bf02366212	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Anemonia viridis*; *Actinia equina*; *Cereus pedunculatus*
Chintiroglou, C.-C.; Valkouma, T. & Culley, M. (1996). Allometry of Feeding and Body Size in a Population of the Sea Anemone *Paranemonia vouliagmeniensis* . Journal of the Marine Biological Association of the United Kingdom, vol. 76(03): 603-616. doi:10.1017/s0025315400031313	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Paranemonia vouliagmeniensis*
Chomsky, O.; Kamenir, Y.; Hyams, M.; Dubinsky, Z. & Chadwick-Furman, N. E. (2004). Effects of feeding regime on growth rate in the Mediterranean Sea anemone *Actinia equina* (Linnaeus). Journal of Experimental Marine Biology and Ecology, vol. 299(2): 217–229. doi:10.1016/j.jembe.2003.09.009	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Actinia equina*
Clayton, W. S., & Lasker, H. R. (1982). Effects of light and dark treatments on feeding by the reef coral Pocillopora damicornis (Linnaeus). Journal of Experimental Marine Biology and Ecology, VOL. 63(3): 269–279. doi:10.1016/0022-0981(82)90183-6	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Pocillopora damicornis*
Clayton, W. S. & Lasker, H. R. (1984). Host feeding regime and zooxanthellal photosynthesis in the anemone, *Aiptasia pallida* (Verrill). The Biological Bulletin, vol. 167(3): 590–600. doi:10.2307/1541412	PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Aiptasia pallida*
Coffroth, M. A. (1984). Ingestion and incorporation of coral mucus aggregates by a gorgonian soft coral. Marine Ecology Progress Series, vol. 17(2): 193-199.	PHYSIOLOGY	OCTOCORALLIA	ALCYONACEA	*Pseudoplexaura porosa*
Coles, S. L. (1969). Quantitative estimates of feeding and respiration for three scleractinian corals. Limnology and Oceanography, vol. 14: 949-953.	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Manicina areolata*; *Montastrea cavernosa*; *Porites porites*
Coma, R.; Gili, J. M.; Zabala, M. & Riera, T. (1994). Feeding and prey capture cycles in the aposymbiotic gorgonian *Paramuricea clavata* . Marine Ecology Progress Series, vol. 115: 257-270.	FEEDING BEHAVIOR	OCTOCORALLIA	ALCYONACEA	*Paramuricea clavata*

Conlan, J. A.; Humprey, C. A.; Severati, A. & Francis, D. D. (2017). Influence of different feeding regimes on the survival, growth, and biochemical composition of Acropora coral recruit. Plos One, vol. 12(11): e0188568.	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Acropora hyacinthus*; *Acropora loripes*; *Acropora millepora*; *Acropora tenuis*
Dalby, J. E. (1992). Prey on the sea snemone *Stomphia didemon* (Anthozoa: Actiniaria) on the West Coast of Canada. *Can. Field-Naturalist,* vol. 10(3):403-404.	FEEDING BEHAVIOR	HEXACORALLIA	ACTINIARIA	*Stomphia didemon*
Daly, M.; Perissinotto, R.; Laird, M.; Dyer, D. & Todaro, A. (2012). Description and ecology of a new species of *Edwardsia* de Quatrefages, 1842 (Anthozoa, Actiniaria) from the St Lucia Estuary, South Africa. Marine Biology Research, vol. 8(3): 233–245. doi:10.1080/17451000.2011.617757	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Edwardsia isimangaliso* sp.
De Santana, E. F. C.; Alves, A. L.; Santos, A. D. M.; Cunha, M. D. G. G. S;, Perez, C. D. & Gomes, P. B. (2014). Trophic ecology of the zoanthid *Palythoa caribaeorum* (Cnidaria: Anthozoa) on tropical reefs. Journal of the Marine Biological Association of the United Kingdom, vol. 95(02): 301–309. doi:10.1017/s0025315414001726	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ZOANTHARIA	*Palythoa caribaeorum*
Del Valle, J. C.; F. H. Acuña and A. A. López Mañanes. 2015. Digestive flexibility in response to environmental salinity and temperature in the nonsymbiotic sea anemone *Bunodosoma zamponi*i. Hydrobiologia, vol. 759(1): 189-199.	PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Bunodosoma zamponi*
DiSalvo, L. H. (1971). Ingestion and assimilation of bacteria by two scleractinian coral species. in: Experimental Ceolenterate Biology, edited by H.W. Lenhoff, L. Muscatine & L.V. Davis, University of Hawaii Press, Honolulu, 129-136.	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Lobactis scutaria*
Durden, J. M.; Bett, B. J. & Ruhl, H. A. (2015). The hemisessile lifestyle and feeding strategies of *Losactis vagabunda* (Actiniaria, Iosactiidae), a dominant megafaunal species of the Porcupine Abyssal Plain. Deep Sea Research Part I: Oceanographic Research Papers, vol. 102: 72–77. doi:10.1016/j.dsr.2015.04.010	FEEDING BEHAVIOR	HEXACORALLIA	ACTINIARIA	*Losactis vagabunda*
Eleftheriou, A. & Basford, D. J. (1983). The general behaviour and feeding of *Cerianthus lloydli* Gosse (Anthozoa, Coelenterata). Cahiers de Biologie Marine, vol. 24: 147-158.	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	CERIANTHARIA	SPIRULARIA	*Cerianthus lloydli*

Fabricius, K.; Benayahu, Y. & Genin, A. (1995). Herbivory in asymbiotic soft corals. Science, vol. 286: 90–92. doi: 10.1126/science.268.5207.90	FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Dendronephthya hemprichi*
Farrant, P. A.; Borowitzka, M. A.; Hinde, R. & King, R. J. (1987). Nutrition of the temperate Australian soft coral *Capnella gaboensis*. Marine Biology, vol. 95(4): 575–581. doi:10.1007/bf00393101	PHYSIOLOGY	OCTOCORALLIA	ALCYONACEA	*Capnella gaboensis*
Ferrier-Pagès, C.; Witting, J.; Tambutté, E. & Sebens, K. P. (2003). Effect of natural zooplankton feeding on the tissue and skeletal growth of the scleractinian coral *Stylophora pistillata*. Coral Reefs, vol. 22(3): 229-240.	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Stylophora pistillata*
Garrabou, J. (1999). Life-history traits of *Alcyonium acaule,* and *Parazoanthus axinellae* (Cnidaria, Anthozoa), with emphasis on growth. Marine Ecology Progress Series, vol. 178: 193–204.	FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Alcyonium acaule*
	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ZOANTHARIA	*Parazoanthus axinellae*
Goldberg, W. M. (2002). Gastrodermal structure and feeding responses in the scleractinian Mycetophyllia reesi, a coral with novel digestive filaments. Tissue and Cell, vol. 34(4): 246–261. doi:10.1016/s0040-8166(02)00008-3	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Mycetophyllia reesi*
Goldberg, W. M. (2002). Feeding behavior, epidermal structure and *Mucus cytochemistry* of the scleractinian *Mycetophyllia reesi,* a coral without tentacles. Tissue and Cell, vol. 34(4): 232–245. doi:10.1016/s0040-8166(02)00009-5	FEEDING BEHAVIOR/PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Mycetophyllia reesi*
Gomes, P. B.; Lira, A. K. F.; Naud, J-F.; Santos, A. M. & Pérez C. D. (2012). Prey selectivity of the octocoral *Carijoa riisei* at Pernambuco, Brazil. Anais da Academia Brasileira de Ciências, vol. 84(1): 157–164.	FEEDING BEHAVIOR	OCTOCORALLIA	ALCYONACEA	*Carijoa riisei*
Goreau, T. F.; Goreau, N. I. & Yonge, C. M. (1971). Reef corals: autotrophs or heterotrophs? Biological Bulletin, vol. 141:247-260.	FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Briareum hamrum*; *Xenia hicksoni*
	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ZOANTHARIA	*Zoanthus sociatus*
	FEEDING HABITS/ECOLOGY	HEXACORALLIA	SCLERACTINIA	*Lobactis scutaria*

Gori, A.; Reynaud, S.; Orejas, C. & Ferrier-Pagès, C. (2015). The influence of flow velocity and temperature on zooplankton capture rates by the cold-water coral *Dendrophyllia cornigera*. Journal of Experimental Marine Biology and Ecology, vol. 466: 92–97.	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Dendrophyllia cornigera*
Griffiths, R. J. (1977). Temperature acclimation in *Actinia equina L.* (Anthozoa). Journal of Experimental Marine Biology and Ecology, vol. 28(3): 285–292. doi:10.1016/0022-0981(77)90097-1	PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Actinia equina*
Grigg, R. W. (1965). Ecological studies of black coral in Hawaii. Pucif. Sci., vol. 19: 244-260.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	SCLERACTINIA	*Acropora grandis*
Grover, R.; Maguer, J.-F.; Reynaud-Vaganay, S. & Ferrier-Pagès, C. (2002). Uptake of ammonium by the scleractinian coral *Stylophora pistillata:* effect of feeding, light, and ammonium concentrations. Limnology and Oceanography, vol. 47(3): 782–790.	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Stylophora pistillata*
Hamner, W. M. & Dunn, D. F. (1980). Tropical *Corallimorpharia* (Coelenterata: Anthozoa): feeding by envelopment. Micronesica, vol. 16(1): 37-41.	FEEDING BEHAVIOR	HEXACORALLIA	CORALLIMORPHARIA	*Amplexidiscus fenestrafer*
Hartog, J.C. den. (1986). The Queen Scallop, Chlamys opercularis (L., 1758) (Bivalvia, Pectinidae), As a Food Item of the Sea Anemone *Urticina eques* (Gosse, 1860) (Actiniaria, Actiniidae). Basteria, vol. 50: 87-92.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Urticina eques*
Herndl, G. J. & Velimirov, B. (1985). Bacteria in the coelenteron of Anthozoa: control of coelenteric bacterial density by the coelenteric fluid. J Exp Mar Biol Ecol, 93: 115–130. doi:10.1016/0022-0981(85)90153-4	PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Anemonia sulcata*; *Stoichactis giganteum*
	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Leptopsammia pruvoti*; *Cladocora caespitosa*
	PHYSIOLOGY	HEXACORALLIA	ZOANTHARIA	*Parazoanthus axinellae*
Herndl, G. J.; Velimirov, B. & Krauss, R. E. (1985). Heterotrophic nutrition and control of bacterial density in the Coelenteron of the giant sea anemone *Stoichactis giganteum*. Marine Ecology Progress Series, vol. 22(1): 101-105.	PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Stoichactis giganteum*
Hii, Y.-S.; Soo, C.-L. & Liew, H.-C. (2008). Feeding of scleractinian coral, *Galaxea fascicularis*, on *Artemia salina* nauplii in captivity. Aquaculture International, vol. 17(4): 363–376. doi:10.1007/s10499-008-9208-4	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Galaxea fascicularis*

Hoeksema, B. W. & Waheed, Z. (2012). It pays to have a big mouth: mushroom corals ingesting salps at northwest Borneo. Marine Biodiversity, vol. 42(2): 297–302. doi:10.1007/s12526-012-0110-y	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	HEXACORALLIA	SCLERACTINIA	*Ctenactis albitentaculata*; *Ctenactis echinata*; *Ctenactis crassa*; *Cycloseris costulata*; *Cycloseris cyclolites*; *Cycloseris fragilis*; *Cycloseris mokai*; *Cycloseris sinensis*; *Cycloseris somervillei*; *Cycloseris tenuis*; *Danafungia horrida*; *Danafungia scruposa*; *Fungia fungites*; *Halomitra pileus*; *Heliofungia actiniformis*; *Herpolitha limax*; *Lithophyllon concinna*; *Lithophyllon repanda*; *Lithophyllon scabra*; *Lithophyllon spinifer*; *Lithophyllon undulatum*; *Lobactis scutaria*; *Pleuractis granulosa*; *Pleuractis gravis*; *Pleuractis moluccensis*; *Pleuractis paumotensis*; *Pleuractis taiwanensis*; *Podabacia crustacea*; *Podabacia motuporensis*; *Podabacia sinai*; *Polyphyllia talpina*; *Sandalolitha dentata*; *Sandalolitha robusta*; *Zoopilus echinatus*
Hoeksema, B. W.; Tuti, Y. & Becking, L. E. (2014). Mixed medusivory by the sea anemone *Entacmaea medusivora* (Anthozoa: Actiniaria) in Kakaban Lake, Indonesia. Marine Biodiversity, vol. 45(2): 141–142.	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Entacmaea medusivora*
Höfer, J.; González, H. E.; Laudien, J.; Schmidt, G. M.; Häussermann, V. & Richter, C. (2018). All you can eat: the functional response of the cold-water coral *Desmophyllum dianthus* feeding on krill and copepods. PeerJ 6:e5872. doi:10.7717/peerj.5872	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Desmophyllum dianthus*
Houlbrèque, F.; Tambutté, E.; Richard, C. & Ferrier-Pagès, C. (2004). Importance of a micro diet for scleractinian corals. Marine Ecology Progress Series, vol. 282: 151–160.	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	HEXACORALLIA	SCLERACTINIA	*Stylophora pistillata*; *Galaxea fascicularis*; *Tubastrea aurea*
Ishida, J. (1936). Digestive enzymes of *Actinia Mesembryanthemum.* Annot. zool. jap., vol. 15: 285-305.	PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Actinia mesembryanthemum*
Ivanova, N. Y. & Grebelnyi, S. D. (2016). On the food of the Antarctic sea anemone *Urticinopsis antarctica* Carlgren, 1927 (Actiniidae, Actiniaria, Anthozoa). Journal of the Marine Biological Association of the United Kingdom, vol. 97: 29–34.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Urticinopsis antarctica*
Jarms, G. & Tiemann, H. (2004). *Actinostola callosa* (Verrill, 1882) (Actinostolidae, Anthozoa), a medusivorous sea anemone and its mass occurrence in the Lurefjord, Norway. Helgoland Marine Research, vol. 58(1): 15–17.	FEEDING BEHAVIOR	HEXACORALLIA	ACTINIARIA	*Actinostola callosa*
Johannes, R. E.; Coles, S. L. & Kuenzel, N. T. (1970). The role of zooplankton in the nutrition of some scleractinian corals. Limnology and Oceanography, 15(4): 579–586. doi:10.4319/lo.1970.15.4.0579	PHYSIOLOGY/FEEDING HABITS/ECOLOGY	HEXACORALLIA	SCLERACTINIA	*Diploria strigosa*; *Diploria labyrinthiformis*; *Porites astreoides*; *Montastrea annularis*
Johannes, R. E. & Tepley, L. (1974). Examination of feeding of the reef coral *Porites lobata* in situ using time lapse photography. Proc. Second Int. Coral Reef Symp., vol. 1: 127-131.	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Porites lobata*

Johnson, A. S. & Sebens, K. P. (1993). Consequences of a flattened morphology: effects of flow on feeding rates of the scleractinian coral *Meandrina meandrites.* Marine Ecology Progress Series, vol. 99: 99–114.	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Meandrina meandrites*
Kim, K. & Lasker, H. R. (1997). Flow-mediated resource competition in the suspension feeding gorgonian *Plexaura homomalla* (Esper). Journal of Experimental Marine Biology and Ecology, vol. 215(1): 49–64. doi:10.1016/s0022-0981(97)00015-41	FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Plexaura homomalla*
Kostina, E. E.; Tsurpalo, A. P. & Frolova, L. T. (2006). Features of biology of the sea anemone *Charisea saxicola* Torrey, 1902 (Actiniaria: Condylanthidae) from the northwest Pacific. Russ J Mar Biol, vol. 32: 214–222. https://doi.org/10.1134/S106307400604002X	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Charisea saxicola*
Krijgsman, B. J. & Talbot, F. H. (1953). Experiments on digestion in sea anemones. Archives Internationales de Physiologie, vol. 61(3): 277-294. doi:10.3109/13813455309144314	PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Pseudactinia flagellifera*
Kruger, L. M. & Griffiths, C. L. (1997). Digestion rates of prey eaten by intertidal sea anemones from the south-western Cape, South Africa. South African Journal of Zoology, vol. 32(4): 101-105. doi:10.1080/02541858.1997.11448439	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Actinia equina*; *Anthothoe stimpsoni*; *Anthopleura michaelseni*; *Bunodosoma capensis*; *Pseudactinia flagellifera*; *Pseudactinia varia*; *Bunodactis reynaudi*
Kuanuia, P.; Chavanicha, S.; Viyakarna, V.; Parkb, H. S. & Omori, M. (2016). Feeding behaviors of three tropical scleractinian corals in captivity. Tropical Zoology, Vol. 29(1): 1–9.	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Pocillopora damicornis*; *Acropora millepora*; *Acropora nobilis*
Lampitt, R. S. & Paterson, G. L. J. (1987). The feeding behaviour of an abyssal sea anemone from in situ time lapse photographs and trawl samples. Oceanologica, Acta, vol. 10(4): 455-461.	FEEDING BEHAVIOR	HEXACORALLIA	ACTINIARIA	*Sicyonis tuberculata*

Lasker, H. R. (1976). Intraspecific variability of zooplankton feeding in the hermatypic coral *Montastrea cavernosa*. In: Coelenterate ecology and behavior, 101-109.	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	HEXACORALLIA	SCLERACTINIA	*Montastrea cavernosa*
Lasker, H. R. (1981). A comparison of the particulate feeding abilities of three species of gorgonian soft coral. Marine Ecology Progress Series, vol. 5: 61-67.	FEEDING BEHAVIOR	OCTOCORALLIA	ALCYONACEA	*Briareum asbestinum*; *Antillogorgia americana*; *Pseudoplexaura porosa*
Lasker, H. R.; Gottfried, M. D. & Coffroth, M. A. (1983). Effects of depth on the feeding capabilities of two octocorals. Marine Biology, vol. 73: 73-78. doi:10.1007/bf00396287	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Plexaura homomalla*
Leversee, G. J. (1976). Flow and feeding in fan- shaped colonies of the gorgonian coral, *Leptogorgia*. The Biological Bulletin, vol. 151(2): 344–356. doi:10.2307/1540667	FEEDING BEHAVIOR	OCTOCORALLIA	ALCYONACEA	*Leptogorgia virgulata*
Lewis, J. B. & Price, W. S. (1975). Feeding mechanisms and feeding strategies of Atlantic reef corals. Journal of Zoology, vol. 176: 527-544. doi:10.1111/j.1469-7998.1975.tb03219.	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Siderastrea siderea*
	FEEDING BEHAVIOR	OCTOCORALLIA	ALCYONACEA	*Plexaura homomalla*
Lewis, J. B. (1978). Feeding mechanisms in black corals (Antipatharia). Journal of Zoology, vol. 186: 393-396.	FEEDING BEHAVIOR	HEXACORALLIA	ANTIPHATARIA	*Stichopathes lutkeni; Antipathes pennacea; Antipathes* sp.
Lewis, J. B. (1982). Feeding behaviour and feeding ecology of the Octocorallia (Coelenterata: Anthozoa). J. Zool. Lond., vol. 196: 371–384. doi:10.1111/j.1469-7998.1982.tb03509.x	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Cladiella sphaerophora*; *Lobophytum crassum; Sarcophyton trocheliophorum*; *Sinularia densa; Sinularia microspiculata; Sinularia capillosa; Sinularia microclavata; Sinularia inelegans; Sinularia firma; Sinularia* n. sp.; *Capnella lacertiliensis; Dendronephthya* sp.; *Lemnalia* sp.; *Paralemnalia digitiformis; Eflatournaria* sp.; *Xenia elongata; Heteroxenia elisabethae; Isis hippuris; Rumphella aggregata; Junceella fragilis; Subergorgia reticulata; Briareum asbestinum; Eunicea tourneforti; Antillogorgia americana; Antillogorgia acerosa; Muriceopsis flavida; Eunicea flexuosa; Gorgonia ventalina; Carijoa riisei; Tubipora musica*
Lindstedt, K. J.; Muscatine, L. & Lenhoff, H. M. (1968). Valine activation of feeding in the sea anemone *Boloceroides* . Comp. Biochem. Physiol., vol. 26: 567-572. doi:10.1016/0010-406x(68)90650-6	PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Boloceroides* sp.

Lindstedt, K. J. (1971). Biphasic feeding response in a sea anemone: control by asparagine and glutathione. Science, vol. 173(3994): 333-334. doi:10.1126/science.173.3994.333	PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Anthopleura elegantissima*
Lira, A. K. F; Naud, J. P.; Gomez, P. B. et al. (2009). Trophic ecology of the octocoral *Carijoa riisei* from littoral of Pernambuco, Brazil. Composition and spatio-temporal variation of the diet. Journal of Marine Biology Association, U.K., vol. 89: 89–99.	FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Carijoa riisei*
Mariscal, R. N. & Lenhoff, H. M. (1968). The chemical control of feeding behaviour in *Cyphastrea ocellina* and in some other Hawaiian corals. Journal of Experimental Biology, vol. 49: 689-699.	FEEDING BEHAVIOR/PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Cyphastrea ocellina* and other Hawaiian corals
McFarlane, I. S. (1970). Control of preparatory feeding behaviour in the sea anemone *Tealia felina.* J. exp. Biol., 53: 21 1-220.	FEEDING BEHAVIOR	HEXACORALLIA	ACTINIARIA	*Tealia felina*
Migne, A. & Davoult, D. (2002) Experimental nutrition in the soft coral *Alcyonium digitatum* (Linnaeus, 1758). Cahiers de Biologie Marine, vol. 43: 9–16.	FEEDING BEHAVIOR/PHYSIOLOGY	OCTOCORALLIA	ALCYONACEA	*Alcyonium digitatum*
Minchin, D. (1983). Predation on Young *Pecten maximus* (L.) (Bivalvia), by the anemone *Anthopleura ballii* (Cocks). Journ of Molluscan Studies, vol. 49: 228-231.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Anthopleura ballii*
Möller, H. (1978). Investigations on the feeding ecology of *Anemonia sulcata*. Zoologischer Anzeiger, vol. 200: 369–373.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Anemonia sulcata*
Mueller, C. E.; Larsson, A. I.; Veuger, B.; Middelburg, J. J. & van Oevelen, D. (2014). Opportunistic feeding on various organic food sources by the cold-water coral Lophelia pertusa. Biogeosciences, vol. 11: 123–133. doi:10.5194/bg-11-123-2014	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Lophelia pertusa*
Muller-Parker, G. (1985). Effect of feeding regime and irradiance on the photophysiology of the symbiotic sea anemone *Aiptasia pulchella.* Marine Biology, vol. 90(1): 65–74. doi:10.1007/bf00428216	FEEDING BEHAVIOR/PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Aiptasia pulchella*
Murdock, G. R. (1978a). Circulation and digestion of food in the gastrovascular system of gorgonian octocorals (Cnidaria; Anthozoa). Bulletin of Marine Science, vol. 28(2): 363-370.	PHYSIOLOGY	OCTOCORALLIA	ALCYONACEA	*Rhytisma fulvum*

Murdock, G. R. (1978b). Digestion, assimilation, and transport of food in the gastrovascular cavity of a gorgonian octocoral (Cnidaria, Anthozoa). Bulletin of Marine Science, vol. 28(2): 354-362.	PHYSIOLOGY	OCTOCORALLIA	ALCYONACEA	*Rhytisma fulvum*
Muscatine, L. & Porter, J. W. (1977). Reef corals: mutualistic symbioses adapted to nutrient-poor enviroments. BioScience, vol. 27(7): 454-460.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	SCLERACTINIA	*Montastrea cavernosa*
Naumann, M. S.; Orejas, C.; Wild, C. & Ferrier-Pages, C. (2011). First evidence for zooplankton feeding sustaining key physiological processes in a scleractinian cold-water coral. Journal of Experimental Biology, vol. 214(21): 3570–3576. doi:10.1242/jeb.061390	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Desmophyllum dianthus*
Navarro, E.; Ortega, M. M. & Madariaga, J. (1981). Effect of body size, temperature and shore level on aquatic and aerial respiration of *Actinia equina* (Anthozoa). Journal of Experimental Marine Biology and Ecology, vol. 53(2-3): 153–162. doi:10.1016/0022-0981(81)90016-2	PHYSIOLOGY/FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Actinia equina*
Nicol, J. A. C. (1959). Digestion in sea anemones. Journal of the Marine Biological Association of the United Kingdom, vol. 38(03): 469-476. doi:10.1017/s0025315400006895	PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Calliactis parasitica*
Orejas, C.; Gili, J. M.; López-González, P. J. & Arntz, W. E. (2001). Feeding strategies and diet composition of four Antarctic cnidarian species. Polar Biology, vol. 24(8): 620-627. doi:10.1007/s003000100272	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Anthomastus bathyproctus*; *Clavularia frankliniana*
Orejas, C.; Gili, J. M. & Arntz, W. (2003). Role of small-plankton communities in the diet of two Antartic octocorals (*Primnoisis antartica* and *Primnoella sp*.). Marine Ecology Progress Series, vol. 250:105–116.	FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Primnoisis antarctica*; *Primnoella* sp.
Ormond, R. F. & Caldwell, S. (1982). The effect of oil pollution on the reproduction and feeding behaviour of the sea anemone *Actinia equina*. Marine Pollution Bulletin, vol. 13(4): 118–122. doi:10.1016/0025-326x(82)90367-8	FEEDING BEHAVIOR/PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Actinia equina*
Osinga, R.; Van Delft, S.; Lewaru, M. W.; Janse, M. & Verreth, J. A. J. (2011). Determination of prey capture rates in the stony coral Galaxea fascicularis: a critical reconsideration of the clearance rate concept. Journal of the Marine Biological Association of the United Kingdom, vol. 92(04): 713–719.	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Galaxea fascicularis*

Palardy, J. E.; Grottoli, A. G. & Matthews, K. A. (2005). Effects of upwelling, depth, morphology and polyp size on feeding in three species of Panamanian corals. Marine Ecology Progress Series, vol. 300: 70-89.	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	HEXACORALLIA	SCLERACTINIA	*Pocillopora damicornis*; *Pavona clavus*; *Pavona gigantea*
Palardy, J. E.; Grottoli, A. G. & Matthews, K. A. (2006). Effect of naturally changing zooplankton concentrations on feeding rates of two coral species in the Eastern Pacific. Journal of Experimental Marine Biology and Ecology, vol. 331(1): 99-107.	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	HEXACORALLIA	SCLERACTINIA	*Pocillopora damicornis*; *Pavona gigantea*
Pantin, A. M. P. & Pantin, C. F. A. (1943). The stimulus to feeding in *Anemonia sulcata* . J. Exp. Biol., vol. 20: 6-13.	FEEDING BEHAVIOR/PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Anemonia sulcata*
Parker, G. H. (1896). The reactions of *Metridium* to food and other substances. Bull. Mus. Comp. Zool., vol. 29: 107-119.	FEEDING BEHAVIOR/PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Metridium*
Parker, G. H. (1917). Actinian Behaviour. Journal of Experimental Biology, vol. 22: 193- 219.	FEEDING BEHAVIOR	HEXACORALLIA	ACTINIARIA	—
Patterson, M. R. (1991). Passive Suspension Feeding by an Octocoral in Plankton Patches: Empirical Test of a Mathematical Model. The Biological Bulletin, vol. 180(1): 81–92. doi:10.2307/1542431	FEEDING BEHAVIOR	OCTOCORALLIA	ALCYONACEA	*Alcyonium siderium*
Porter, J. W. (1974). Zooplankton feeding by the Caribbean reef-building coral *Montastrea cavernosa*. Proceedings of the Second International Symposium on Coral Reefs, vol. 1: 111-125.	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	HEXACORALLIA	SCLERACTINIA	*Montastrea cavernosa*
Pratt, E. M. (1905). The Digestive Organs of the *Alcyonaria* and Their Relation to the Mesogleeal Cell Plexus. The Quarterly Journal of Microscopial Science, vol. 49: 327-362.	PHYSIOLOGY	OCTOCORALLIA	ALCYONACEA	Alcyonaria

Price, W. S. (1973). Aspects of feeding behaviour of West Indian reef corals. M.Sc. thesis: McGill University.	**FEEDING BEHAVIOR**	**HEXACORALLIA**	**SCLERACTINIA**	*Porites porites*; *Porites astreoides*; *Madracis mirabilis*; *Eusmilia fastigiata*; *Montastrea cavernosa*; *Mussa angulosa*; *Isophyllia multiflora*; *Dichocoenia stokesi*; *Favia fragum*; *Stephanocoenia michelini*; *Colpophyllia* sp.; *Diploria clivosa*; *Diploria strigosa*; *Diploria labyrinthiformis*; *Mycetophyllia lamarckiana*; *Siderastrea siderea*; *Siderastrea radians*; *Agaricia agaricites*; *Agaricia lamarcki*; *Helioseris cuculata*; *Mycetophyllia danaana*; *Mycetophyllia* sp.; *Mycetophyllia ferox*; *Montastrea annularis*; *Acropora palmata*; *Acropora cervicornis*; *Dendrogyra cylindrus*; *Meandrina meandrites*
Price, W. S. & Lewis, J. J. (1975). Feeding mechanisms and feeding strategies of Atlantic reef corals. Jour. Zool., vol. 176: 527-544.	**FEEDING BEHAVIOR**	**HEXACORALLIA**	**SCLERACTINIA**	*Stephanocoenia michelinii*; *Madracis mirabilis*; *Madracis decatis*; *Acropora palmata*; *Acropora cervicornis*; *Agaricia agaricites*; *Agaricia lamarcki*; *Helioseris circullata*; *Siderastrea siderea*; *Siderastrea radians*; *Porites astreoides*; *Porites porites*; *Porites furcata*; *Porites divaricata*; *Favia fragum*; *Diploria clivosa*; *Diploria strigosa*; *Diploria labyrinthiformis*; *Manicina areolata*; *Colpophyllia natans*; *Montastrea annularis*; *Montastrea cavernosa*; *Meandrina meandrites*; *Dichocoenia stokesi*; *Dichocoenia stellaris*; *Dendrogyra cylindrus*; *Mussa angulosa*; *Scolymia lacera*; *Isophyllia sinuosa*; *Isophyllia multiflora*; *Isophyllastrea rígida*; *Mycetophyllia lamarckiana*; *Mycetophyllia danaana*; *Mycetophyllia ferox*; *Eusmilia fastigiate*
Purcell, J. E. (1977). The diet of large and small individuals of the sea anemone Metridium senile. Bulletin South Calif. Acad. Sci., vol 76: 168-172.	**FEEDING HABITS/ECOLOGY**	**HEXACORALLIA**	**ACTINIARIA**	*Metridium senile*
Purser, A.; Larsson, A. I.; Thomsen, L. & van Oevelen, D. (2010). The influence of flow velocity and food concentration on *Lophelia pertusa* (Scleractinia) zooplankton capture rates. Journal of Experimental Marine Biology and Ecology, vol. 395(1-2): 55–62. doi:10.1016/j.jembe.2010.08.013	**FEEDING BEHAVIOR**	**HEXACORALLIA**	**SCLERACTINIA**	*Lophelia pertusa*

Quesada, A. J.; Acuña, F. H. & Cortés, J. (2014). Diet of the sea anemone *Anthopleura nigrescens*: composition and variation between daytime and nighttime high tides. Zoological Studies, vol. 53:26. doi:10.1186/s40555-014-0026-2	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Anthopleura nigrescens*
Raz-Bahat, M.; Douek, J.; Moiseeva, E.; Peters, E. C. & Rinkevich, B. (2017). The digestive system of the stony coral *Stylophora pistillata*. Cell and Tissue Research, vol. 368(2): 311–323.	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Stylophora pistillata*
Reimer, A. A. (1971a). Chemical control of feeding behavior and role glycine in the nutrition of *Zoanthus* (Coelenterata, Zoanthidea). Comp. Biochem. Physiol., vol. 39: 743-759.	FEEDING BEHAVIOR/PHYSIOLOGY	HEXACORALLIA	ZOANTHARIA	*Zoanthus*
Reimer, A. A. (1971b). Chemical control of feeding behavior in *Palythoa* (Zoanthidea, Coelenterata). Comp. Biochem. Physiol., vol. 40: 19-38.	FEEDING BEHAVIOR/PHYSIOLOGY	HEXACORALLIA	ZOANTHARIA	*Palythoa*
Reimer, A. A. (1971c). Feeding behavior in the Hawaiian zoanthids Palythoa and Zoanthus. Pacif. Sci., 25: 512-520.	FEEDING BEHAVIOR	HEXACORALLIA	ZOANTHARIA	*Palythoa psammophilia*; *Zoanthus pacificus*
Reimer, A. A. (1971d). Specificity of feeding chemoreceptors in Palythoa psammophilia (zoanthidea, coelenterata). Comparative and General Pharmacology, vol. 2(8): 383–396. doi:10.1016/0010-4035(71)90034-6	PHYSIOLOGY	HEXACORALLIA	ZOANTHARIA	*Palythoa psammophilia*
Reimer, A. A. (1973). Feeding behavior in the Sea Anemone *Calliactis polypus* (Forskal, 1775). Comparative Biochemistry and Physiology, vol. 44: 1289-1301.	FEEDING BEHAVIOR	HEXACORALLIA	ACTINIARIA	*Calliactis polypus*
Reynaud, S.; Martinez P.; Houlbrèque, F.; Billy, I.; Allemand, D. & Ferrier-Pagès, C. (2009). Effect of light and feeding on the nitrogen isotopic composition of a zooxanthellate coral: role of nitrogen recycling. Marne Ecology Progress Series, vol. 392:103-110.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	SCLERACTINIA	*Stylophora pistillata*
Ribes, M.; Coma, R. & Gili, J. M. (1998). Heterotrophic feeding by gorgonian corals with symbiotic zooxanthellae. Limnology Oceanography, vol. 43: 1170–1179.	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Eunicea flexuosa*

Ribes, M.; Coma, R. & Gili, J. M. (1999). Heterogeneous feeding in benthic suspension feeders: the natural diet and grazing rate of the temperate gorgonian *Paramuricea clavata* (Cnidaria: Octocorallia) over a year cycle. Marine Ecology Progress Series, 125- 137.	FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Paramuricea clavata*
Ribes, M.; Coma, R. & Rossi, S. (2003). Natural feeding of the temperate asymbiotic octocoral- gorgonian *Leptogorgia sarmentosa* (Cnidaria: Octocorallia). Marine Ecology Progress Series, vol. 254: 141-150.	FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Leptogorgia sarmentosa*
Rossi, S.; Ribes, M.; Coma, R. & Gili, J. M. (2004). Temporal variability in zooplankton prey capture rate of the passive suspension feeder *Leptogorgia sarmentosa* (Cnidaria: octocorallia), a case study. Marine Biology, vol. 144(1): 89–99.	FEEDING BEHAVIOR	OCTOCORALLIA	ALCYONACEA	*Leptogorgia sarmentosa*
Rossi, S.; Gili, J. M.; Coma, R.; Linares, C.; Gori, A. & Vert, N. (2006). Temporal variation in protein, carbohydrate, and lipid concentrations in *Paramuricea clavata* (Anthozoa, Octocorallia): evidence for summer–autumn feeding constraints. Marine Biology, vol. 149(3), 643–651.	PHYSIOLOGY	OCTOCORALLIA	ALCYONACEA	*Paramuricea clavata*
Schwarz, J; Weis, V. M. & Potts, D. C. (2002). Feeding behavior and acquisition of zooxanthellae by planula larvae of the sea anemone *Anthopleura elegantissima.* Marine Biology, vol. 140(3): 471-478. doi:10.1007/s00227-001-0736-y	FEEDING BEHAVIOR	HEXACORALLIA	ACTINIARIA	*Anthopleura elegantissima*
Schlichter, D. (1982). Nutritional strategies of cnidarians: the absorption, translocation and utilization of dissolved nutrients by Heteroxenia fuscescens. Am. Zool., vol 22: 659-669.	PHYSIOLOGY	OCTOCORALLIA	ALCYONACEA	*Heteroxenia fuscescens*
Sebens, K. P. (1977). Autotrophic and heterotrophic nutrition of coral reef zoanthids. Proc. Int. Coral Reef Symposium, vol. 1: 397-406.	FEEDING BEHAVIOR//FEEDING HABITS/ECOLOGY	HEXACORALLIA	ZOANTHARIA	*Palythoa variabilis*; *Palythoa caribaeorum*; *Zoanthus sociatus*; *Zoanthus solandri*
Sebens, K. P. (1981). The allometry of feeding, energetics, and body size in three sea anemone species. The Biological Bulletin, vol. 161(1): 152–171. doi:10.2307/1541115	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Anthopleura elegantíssima*; *Anthopleura xanthogrammica*; *Metridium senile*
Sebens, K. P. & Koehl, M. A. R. (1984). Predation on zooplankton by the benthic anthozoans Alcyonium siderium (Alcyonacea) and Metridium senile (Actiniaria) in the New England subtidal.	FEEDING BEHAVIOR//FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Metridium senile*

Marine Biology, vol. 81(3): 255–271. doi:10.1007/bf0039322	FEEDING BEHAVIOR//FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Alcyonium siderium*
Sebens, K. P.; Vandersall, K. S.; Savina, L. A. & Graham, K. R. (1996). Zooplankton capture by two scleractinian corals, *Madracis mirabilis* and *Montastrea cavernosa*, in a field enclosure. Marine Biology, vol, 127: 303–317.	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Madracis mirabilis*; *Montastrea cavernosa*
Sebens, K. S.; Grace, S. P.; Helmuth, B.; Maney, E. J. Jr. & Miles, J. S. (1998). Water flow and prey capture by three scleractinian corals, *Madracis mirabilis*, *Montastrea cavernosa* and *Porites porites* in a field enclosure. Marine Biology, vol. 131:347–360.	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Madracis mirabilis*; *Montastrea cavernosa*; *Porites porites*
Sheperd, S. A. & Gray, J. D. (1985). Food of the anemone *Anthothoe albocincta* at West Island, South Australia. Trans. R. Soc. S. Aust., vol. 109: 191-192.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Anthothoe albocincta*
Siebert Jr., A. E. (1974). A description of the embryology, larval development, and feeding of the sea anemones *Anthopleura elegantissima* and *A. xanthogrammica*. Canadian Journal of Zoology, vol. 52(11): 1383-1388. doi:10.1139/z74-1751541115	FEEDING BEHAVIOR	HEXACORALLIA	ACTINIARIA	*Anthopleura elegantissima*; *Anthopleura xanthogrammica*
Slattery, M.; McClintock, J. B. & Bowser, S. S. (1997). Deposit feeding: a novel mode of nutrition in the Antartic colonial soft coral *Gersemia antarctica*. Marine Ecology Progress Series, vol. 149: 299-304.	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Gersemia antarctica*
Sorokin, Y. I. (1973). On the feeding of some scleractinians with bacteria and dissolved organic matter. Limnol. Oceanogr., vol. 18: 380-385.	FEEDING HABITS/ECOLOGY	HEXACORALLIA	SCLERACTINIA	*Montipora* sp.; *Pocillopora damicornis*; *Pocillopora caespitosa*; *Pocillopora damicornis*; *Pocillopora bulbosa*; *Pavona* sp.; *Acropora pulchra*; *Porites compressa*

Sorokin, Y. I. (1991). Biomass, metabolic rates and feeding of some common reef zoantharians and octocorals. Marine and Freshwater Research, vol. 42(6): 729-741. doi:10.1071/mf9910729	FEEDING BEHAVIOR	OCTOCORALLIA	ALCYONACEA	*Klyxum molle*; *Alcyonium* sp.; *Capnella* sp.; *Cladiella humesi*; *Dendronephthya gigantea*; *Lemnalia rhabdota*; *Litophyton arboreum*; *Lobophytum gazallae*; *Paralemnalia clavata*; *Sarcophyton trocheliophorum*; *Sinularia densa*; *Sinularia* sp.; *Xenia elongata*; *Melithaea hicksoni*; *Bebryce indica*; *Echinogorgia praelonga*; *Hicksonella princeps*; *Isis hippuris*; *Melithaea aurantia*; *Manela lenzii*; *Rumphella aggregata*; *Tubipora musica*
	FEEDING BEHAVIOR	HEXACORALLIA	ZOANTHARIA	*Palythoa caesia*; *Zoanthus sociatus*
	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Stylophora pistillata*
Sponaugle, S. & LaBarbera, M. (1991). Drag-induced deformation: a functional feeding strategy in two species of gorgonians. Journal of Experimental Marine Biology and Ecology, vol. 148(1): 121–134. doi:10.1016/0022-0981(91)90151-I	FEEDING BEHAVIOR	OCTOCORALLIA	ALCYONACEA	*Antillogorgia acerosa*; *Antillogorgia americana*
Szmant-Froelich, A. & Pilson, M. E. Q. (1980). The effects of feeding frequency and symbiosis with zooxanthellae on the biochemical composition of *Astrangia Danae* Milne Edwards & Haime 1849. Journal of Experimental Marine Biology and Ecology, vol. 48(1): 85-97. doi:10.1016/0022-0981(80)90009-X	FEEDING HABITS/ECOLOGY	HEXACORALLIA	SCLERACTINIA	*Astrangia danae*
Tremblay, P.; Peirano, A. & Ferrier-Pagès, C. (2011). Heterotrophy in the Mediterranean symbiotic coral *Cladocora caespitosa*: comparison with two other scleractinian species. Marine Ecology Progress Series, vol. 422: 165–177.	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Cladocora caespitosa*; *Oculina patagonica*; *Turbinaria reniformis*
Trench, R. K. (1974). Nutritional potentials in *Zoanthus sociathus* (Coelenterata, Anthozoa). Helgoländer Wissenschaftliche Meeresuntersuchungen, vol. 26: 174-216. doi:10.1007/bf01611382	FEEDING BEHAVIOR/PHYSIOLOGY	HEXACORALLIA	ZOANTHARIA	*Zoanthus sociathus*
Tsounis, G.; Rossi, S.; Laudien, J.; Bramanti, L.; Fernández, N.; Gili, J. M. & Arntz, W. (2005). Diet and seasonal prey capture rates in the Mediterranean red coral (*Corallium rubrum L.*). Marine Biology, vol.149: 313–325.	FEEDIND BEHAVIOR/FEEDING HABITS/ECOLOGY	OCTOCORALLIA	ALCYONACEA	*Corallium rubrum* L.

Tsounis, G.; Orejas, C.; Reynaud, S.; Gili, J.; Allemand, D. & Ferrier-Pagès, C. (2010). Prey-capture rates in four Mediterranean cold-water corals. Marine Ecology Progress Series, vol. 398: 149–155. doi:10.3354/meps08312	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Dendrophyllia cornigera*; *Desmophyllum cristagalli*; *Madrepora oculata*; *Lophelia pertusa*
Tsuchida, C. B. & Potts, D. C. (1994). The effects of illumination, food and symbionts on growth of the sea anemone *Anthopleura elegantissima* (Brandt, 1835). J. Exp. Mar. Bio. Ecology, vol. 183: 227-242.	PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Anthopleura elegantissima*
Tsurpalo, A. P., & Kostina, E. E. (2003). Feeding Characteristics of Three Species of Intertidal Sea Anemones of the South Kuril Islands. Russian Journal of Marine Biology, vol. 29(1): 31–40. doi:10.1023/a:1022823819872	FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Oulactis orientalis*; *Cnidopus japonicus; Aulactinia* sp.
Van der Meij, S. E. T. & Reijnen, B. T. (2011). First observations of attempted nudibranch predation by sea anemones. Marine Biodiversity, vol. 42(2): 281–283. doi:10.1007/s12526-011-0097-9	FEEDIND BEHAVIOR/FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	Edwardsiidae
Wijgerde, T.; Diantari, R.; Lewaru, M. W.; Verreth, J. A. J. & Osinga, R. (2011). Extracoelenteric zooplankton feeding is a key mechanism of nutrient acquisition for the scleractinian coral Galaxea fascicularis. Journal of Experimental Biology, vol. 214(20): 3351–3357. doi:10.1242/jeb.058354	FEEDING BEHAVIOR/PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Galaxea fascicularis*
Williams, R. (1972). Chemical control of feeding behaviour in the sea anemone *Diadumene luciae* (Verrill). Comparative Biochemistry and Physiology Part A: Physiology, vol. 41(2): 361–371. doi:10.1016/0300-9629(72)90067-9	FEEDING BEHAVIOR/PHYSIOLOGY	HEXACORALLIA	ACTINIARIA	*Diadumene luciae*
Winkler, L. R. & Tilton, B. E. (1962). Predation on the California sea hare, *Aplysia californica* Cooper, by the solitary great green sea anemone, *Anthopleura xanthogrammica* (Brandt), and the effect of sea hare toxin and acetylcholine on anemone muscle. Pac Sci, vol. 16: 286–290.	PHYSIOLOGY/FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Anthopleura xanthogrammica*
Yeo, T. K. (1976). Observations on the feeding mechanisms of some local *Fungiidae* (Order Scleractinia). Department of Zoology, University of Singapore, Honours thesis.	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Fungia* sp.

Yonge, C. M. (1930a). Studies on the physiology of corals: I. Feeding mechanism and food. Great Barrier Reef Expedition, vol. 1: 13- 57.	FEEDING BEHAVIOR	HEXACORALLIA	SCLERACTINIA	*Flabellum rubrum*; *Caryophyllia smithii*; *Galaxea horrescens*; *Oculina diffusa*; *Lophohelia prolifera*; *Seriatopora hystrix*; *Pocillopora bulbosa*; *Stylophora pistillata*; *Euphyllia glabrescens*; *Eusmilia fastigiata*; *Cyphastrea agassizi*; *Cyphastrea chalcidicum*; *Echinopora lamelosa*; *Galaxea fascicularis*; *Dipsastraea pallida*; *Favites* spp.; *Goniastrea* spp.; *Meandra* spp.; *Merulina ampliata*; *Hydnophora exesa*; *Pectinia lactuca*; *Manicina areolata*; *Astrangia danae*; *Caulastraea furcata*; *Acanthastrea echinata*; *Lobophyllia recta*; *Lobophyllia corymbosa*; *Trachyphyllia geoffroyi*; *Isophyllia sinuosa*; *Danafungia horrida*; *Cycloseris cyclolites*; *Lobactis scutaria*; *Heliofungia actiniformis*; *Psammocora contigua*; *Pavona danai*; *Coeloseris mayeri*; *Pachyseris speciosa*; *Agaricia agaricites*; *Siderastrea radians*; *Tubastraea micranthus*; *Balanophyllia regia*; *Astreopora ocellata*; *Turbinaria* spp.; *Montipora angulata*; *Acropora aspera*; *Goniopora tenuidens*; *Porites solida*
	FEEDING BEHAVIOR	OCTOCORALLIA	ALCYONACEA	*Heliopora*; *Tubipora*
Yonge, C. M. (1930b). Studies on the physiology of corals II: Digestive enzymes, with notes on the speed of digestion. Sci. Rep. Great Barrier Reef Expedition, vol. 1: 59-81.	PHYSIOLOGY	HEXACORALLIA	SCLERACTINIA	*Danafungia horrida*
Zamponi, M. O. (1979). Sobre la alimentación em actiniaria (Coelenterata Anthozoa). Neotrópica, vol. 25(74): 195-202.	FEEDING BEHAVIOR/FEEDING HABITS/ECOLOGY	HEXACORALLIA	ACTINIARIA	*Phymactis clematis*; *Bunodactis marplatensis*