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Diet of the stauromedusa *Haliclystus auricula* from southern Chile

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The diet of *Haliclystus auricula* was studied from the gut contents of Stauromedusae collected every two months in southern Chile between November 2001 and November 2002. A total of 3790 medusae were collected and examined. Stauromedusae prey consisted primarily of harpacticoid copepods (68.4%), followed by gammarid amphipods (15.4%), chironomid fly larvae (9.2%) and podocopid ostracods (5.9%). The remaining 1.1% of the diet was made up of empidid fly larvae, polychaete worms, isopods, juvenile decapod crustaceans and gastropods. Gut content was observed in 31% of the stauromedusae collected and only in medusae with an umbrella height greater than 0.4 mm. Frequency of medusae with prey items in their gut content increased with stauromedusae size. The type of prey most frequently found in the smallest medusae were copepods, whilst larger individuals contained mainly amphipods. A strong tendency for the length of prey consumed to increase with medusae size was found.

INTRODUCTION

The Stauromedusae represent an order of small, stalked, benthic scyphozoans which live attached to seaweed or rocky substrata by means of a peduncle. About 45 species of Stauromedusae are known worldwide, but only 11 have been recorded from the southern hemisphere (Grohmann et al., 1999).

Although Stauromedusae are widely distributed, and are probably very active predators, the studies carried out so far on this order deal mainly with descriptions of new species or systematic revisions. Stauromedusae prey have been observed previously in a number of studies, these include: polychaete worms, gastropods, bivalves, copepods, amphipods, and fly larvae (Table 2). However, with the exception of Davenport (1998), who published a note on the trophic relationships of the stauromedusa *Haliclystus antarcticus* Pfeffer, 1889 from subantarctic South Georgia, there are no publications focusing on the diets of these scyphozoans. This is largely due to their cryptic coloration and small size which makes them hard to observe, and also because these animals are rarely found in such high abundances for performing quantitative studies.

Haliclystus auricula (Rathke, 1806) is a stauromedusa appearing frequently on intertidal algae at Los Molinos beach, southern Chile, reaching densities of up to 1405/m^2 during the summer (C.J. Zagal, unpublished data). In this paper, the natural diet of this species is described to increase knowledge on the trophic ecology of Stauromedusae.

MATERIALS AND METHODS

Haliclystus auricula were collected every two months from the seaweeds they were found on, at low spring tides on Los Molinos beach in Valdivia, between November 2001 and November 2002.

Stauromedusae were collected during the day, using 25×25 or 50×50 cm quadrats, which were placed in a surface area of 936 m^2 at 10, 12, 14, 16, 18 and 20 m distances from a predetermined point on the upper shore.

Specimens were preserved in 5% formalin solution after anaesthetization with 1% $MgCl_2$ for about 5 min. The medusae were measured, dissected and their partially digested gut contents were studied with a low power binocular microscope. The measurement used to represent the size of the stauromedusae was umbrella height (measured from the demarcation point between the umbrella and the peduncle, to the tip of eight arms, excluding the tentacular clusters). A total of 3790 specimens were collected and analysed.

In order to evaluate a size relationship between stauromedusa and its prey, the longest dimension of the largest prey found in each medusa was measured.

RESULTS

Gut content was observed in 31% of the 3790 stauromedusae collected. The gastric cavity of all medusae with an umbrella height smaller than 0.4 mm was empty. The frequency of individuals with empty guts decreased as size increased (Figure 1A). The most frequent prey item found in the gut of the smallest stauromedusae (0.4–6.0 mm) was copepods, whilst bigger medusae (6.1–14.0 mm) contained mainly amphipods (Figure 1B).

Size of prey ranged from 0.2–9.0 mm, with most averaging about 1.6 mm. Most frequent size of prey was 0.9 mm. Data presented in Figure 2B suggest there is a strong tendency for the length of prey consumed to increase with increases in size of the medusae.

The frequency of occurrence and relative abundance of prey items found in the gut content of *Haliclystus auricula* are shown in Table 1. Data indicate that the highest relative abundance was that of harpacticoid copepods (68.4%),

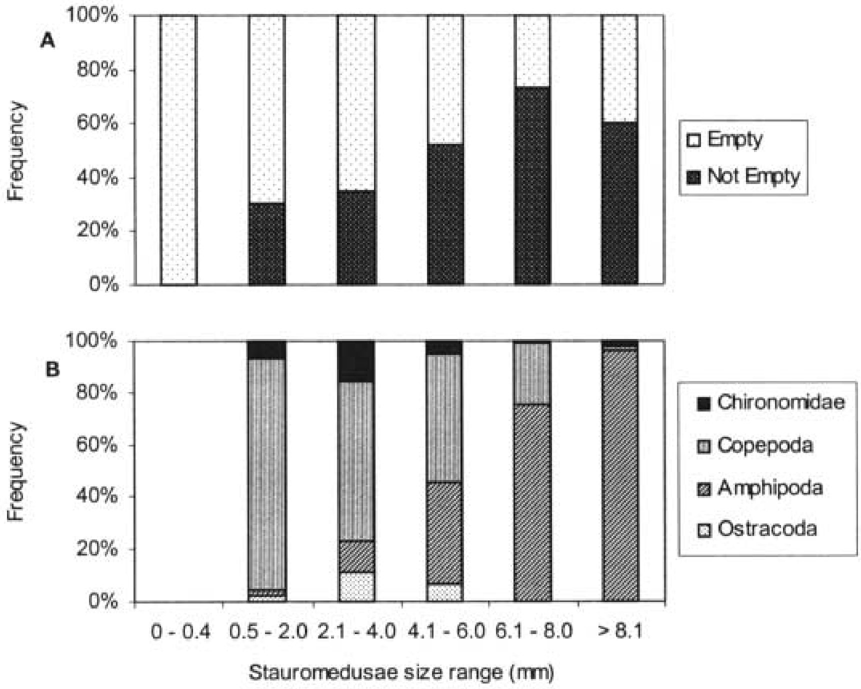

Figure 1. Frequency of individuals with empty guts (A) and main prey types found in the gut contents (B) of *Haliclystus auricula* according to stauromedusae size.

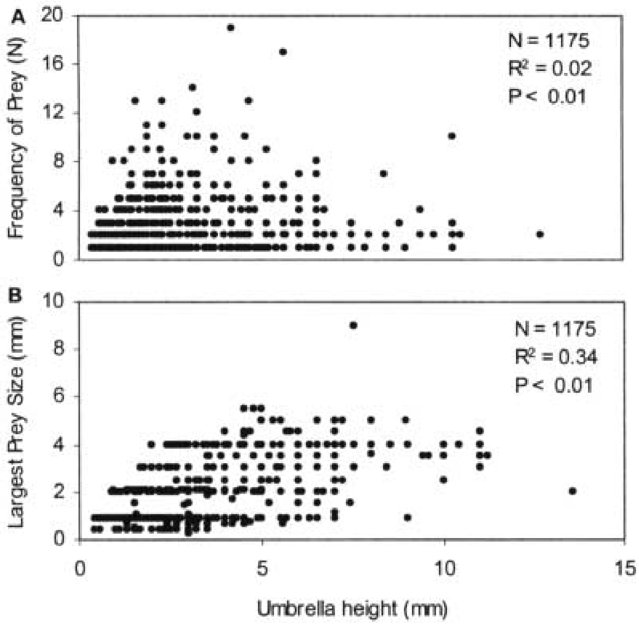

Figure 2. Relationship between number of prey (A) and largest prey (B) found in gut content of *Haliclystus auricula* (N) with stauromedusa size.

followed by gammarid amphipods (15.4%), chironomid fly larvae (9.2%), and podocopid ostracods (5.9%). The remaining 1.1% of the diet was made up of empidid fly larvae, polychaete worms, isopods, juvenile decapod crustaceans and gastropods.

Figure 2A shows the relationship between the number of prey found in gut contents and stauromedusa size. There was a relatively weak increase in prey ingested with stauromedusa size. The most frequent number of prey present was 1, and the maximum number of prey found in a single medusa was 19.

Table 1. *Frequency of occurrence (N) and relative abundance (R_a%) of the various prey types found in the gut contents of* Haliclystus auricula *collected at Los Molinos, southern Chile.*

Prey type	N	R_a %
Phylum ANNELIDA		
Class POLYCHAETA		
Order PHYLLODOCIDA		
Family NEREIDAE	10	0.34
Phylum MOLLUSCA		
Class GASTROPODA	1	0.03
Phylum ARTHROPODA		
Subphylum CRUSTACEA		
Class OSTRACODA		
Order PODOCOPIDA	174	5.92
Class COPEPODA		
Order HARPACTICOIDA	2010	68.41
Class MALACOSTRACA		
Order AMPHIPODA		
Suborder GAMMARIDEA	451	15.35
Order ISOPODA	7	0.24
Order DECAPODA		
Family PORCELLANIDAE (juveniles)	8	0.27
Class INSECTA		
Order DIPTERA		
Family CHIRONOMIDAE (larvae)	270	9.19
Family EMPIDIDAE (larvae)	7	0.24
TOTAL	2938	100%

DISCUSSION

A limited number of observations have reported what 14 species of Stauromedusae prey on. A representative selection of this information is given in Table 2. The prey items most frequently recorded in the literature are amphipods and copepods. This concurs with the highest relative abundance of these prey items reported in this study (Table 1).

Table 2. *Known stauromedusae prey.*

Prey type	Stauromedusae predator species	Localities	Records
Phylum ANNELIDA			
Class POLYCHAETA	*Haliclystus antarcticus* Pfeffer, 1889	subantarctic	Davenport, 1998
Phylum MOLLUSCA			
Class GASTROPODA	*Sasakiella cruciformis* Okubo, 1917	Japan	Hirano, 1986
	Lucernaria quadricornis Müller, 1776	north-west Atlantic	Berrill, 1962
Class BIVALVIA	*Sasakiella cruciformis* Okubo, 1917	Japan	Hirano, 1986
Phylum ARTHROPODA			
Subphylum CRUSTACEA			
Class COPEPODA	*Craterolophus convolvulus* (Johnston, 1835)	north-west Atlantic	Larson, 1976
	Haliclystus antarcticus Pfeffer, 1889	subantarctic	Davenport, 1998
	Haliclystus borealis Uchida, 1933	Japan	Hirano, 1986
	Haliclystus stejnegeri Kishinouye, 1899	Japan	Hirano, 1986
	Haliclystus tenuis Kishinouye, 1910*	Japan	Hirano, 1986
	Manania gwilliami Larson & Fautin, 1989	north-east Pacific	Larson & Fautin, 1989
	Stenoscyphus inabai (Kishinouye, 1893)	Japan	Hirano, 1986
	Thaumatoschyphus distinctus Kishinouye, 1910	Japan	Uchida & Hanaoka, 1933
Class MALACOSTRACA			
Order AMPHIPODA	*Craterolophus convolvulus* (Johnston, 1835)	north-west Atlantic	Larson, 1976
	Haliclystus antarcticus Pfeffer, 1889	subantarctic	Davenport, 1998
	Haliclystus borealis Uchida, 1933	Japan	Hirano, 1986
	Haliclystus sanjuanensis Hyman, 1940	north-east Pacific	Hyman, 1940
	Haliclystus stejnegeri Kishinouye, 1899	Bering Island, Japan	Kishinouye, 1899; Hirano, 1986
	Haliclystus tenuis Kishinouye, 1910*	Japan	Hirano, 1986
	Kishinouyea corbini Larson, 1980	tropical Atlantic	Larson, 1980
	Lucernaria quadricornis (Müller, 1776)	north-west Atlantic	Berrill, 1962
	Manania gwilliami Larson & Fautin, 1989	north-east Pacific	Larson & Fautin, 1989
Order DECAPODA	*Kishinouyea corbini* Larson, 1980	tropical Atlantic	Larson, 1980
Class INSECTA			
Order DIPTERA			
Family CHIRONOMIDAE	*Craterolophus convolvulus* (Johnston, 1835)	north-west Atlantic	Larson, 1976

*, This species was referred to as *Haliclystus auricula* by Hirano (1986). Hirano (personal communication) has now identified the species as *H. tenuis*.

Copepods and amphipods are probably the most frequent prey items because they are very abundant on or near the seaweed where the medusae are attached, and their size may be optimal to feed on.

With the present study, ostracods and isopods are added as evidence of new prey items that make up the diet of Stauromedusae.

Since medusae were always collected at low tides, it is possible to assume that they were not feeding actively at this time. Therefore, the number of prey found in the gastric cavity of the stauromedusae may represent a sub estimate of the actual number. It is also important to note that most of the medusae examined in this study came from samples collected during the summer. This is due to their greater abundance during spring and summer and the fact that the population gradually disappeared during autumn and winter (C.J. Zagal, unpublished data).

Results of this study indicate that Copepoda are the most important prey in smaller medusae, whereas Amphipoda are the main prey item in larger medusae (Figure 1B). This corresponds with the tendency for the length of prey consumed to increase with medusae size (Figure 2B). These tendencies may be the effect of optimal foraging strategies. Stauromedusae maybe feed on the largest most available prey they can catch, handle, and ingest. In this study, the frequency of individuals with empty guts decreased with an increase in stauromedusae size (Figure 1A), and the frequency of prey in medusae gut content exhibited a relatively weak increase with medusae size (Figure 2A). Large medusae may be more efficient at capturing their prey, have a wider prey size range to choose from and possibly select larger prey to maximize energy. Due to the lack of quantitative knowledge of the species composition and size distribution of the prey population, it is impossible to make definitive statements about prey preference and selection.

Prey content was probably not observed in medusae with an umbrella height smaller than 0.4 mm because most of these individuals were still undergoing early metamorphosis and had not yet developed all of their secondary tentacles. Thus, these medusae were most likely unable to feed actively.

Further studies will probably confirm and broaden the spectrum of prey items reported in this work. If possible, samples should be taken over 24-h periods to determine the time of maximum feeding activity. Future field work and observations under laboratory conditions are necessary to understand stauromedusae foraging and should consider prey availability as well as energy content in order to determine selectivity. More studies on this topic will allow us to better understand the trophic ecology of these animals and their role in the energetic balance of marine ecosystems.

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