Natural Diet of Aegla platensis Schmitt and Aegla ligulata Bond-Buckup & Buckup (Crustacea, Decapoda, Aeglidae) from Brazil[1].

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ABSTRACT: Natural diet of Aegla platensis Schmitt and Aegla ligulata Bond-Buckup & Buckup (Crustacea, Decapoda, Aeglidae) from Brazil. This work aimed to characterise the trophic ecology of Aegla platensis and A. ligulata, especially regarding the food habits and circadian and seasonal variations occurring in the diet of juveniles and adults. Samplings were done from August 1999 to August 2000 from Mineiro Creek, Taquara, and from another Creek forming the Tainhas River, São Francisco de Paula, RS, respectively. Monthly, on each place, five juveniles, five males and five females were collected, at four times of the day. Stomach contents were analysed using: an estimate of the Degree of Fullness (DF), the Frequency of Occurrence (FO) and the Point Method (PM). Analysis of variance (ANOVA) was used to detect statistical differences in the DF of males and females, adults and juveniles, for different seasons and times of the day sampled. Cluster Analyses and Principal Coordinate Analyses were used to compare the diet of juveniles and adults. A total 760 stomachs of A. platensis and 703 of A. ligulata were analysed. Aegla platensis had 650 stomachs with content and 110 had empty ones, while in A. ligulata 643 stomachs showed some content and 60 were empty. The most representative items found in the stomachs were plant debris, algae, sand, immature insects of the orders Diptera, Ephemeroptera, Trichoptera and microcrustaceans like Ostracoda and Cladocera, along with Amphipoda. There were no significant differences between the feeding habits of males and females on either species. However, values of DF were higher at 24h in A. platensis and at 18h in A. ligulata. The multivariate analyses detected differences in the diets of juveniles and adults of both species. Based on these information it can be concluded that these aeglids are, regarding their natural diet, omnivorous generalists, and opportunistic.
Key-words: Crustacea, Decapoda, Aeglidae, natural diet.

RESUMO: Dieta natural de Aegla platensis Schmitt and Aegla ligulata Bond-Buckup & Buckup (Crustacea, Decapoda, Aeglidae) do Brasil. Esta pesquisa visa caracterizar a ecologia trófica de juvenis e adultos de duas espécies de aeglídeos (Aegla platensis e A. ligulata) em diferentes altitudes, especialmente, quanto ao hábito alimentar e variações circadianas e sazonais nas dietas. De agosto/99 a agosto/00 foram coletados, mensalmente, juvenis, fêmeas e machos das duas espécies, em quatro horários; sendo que, A. platensis foi amostrada no Arroio do Mineiro (29° 30' 0,2"S e 50° 46' 50"W), Taquara, e A. ligulata no Arroio formador do Rio Tainhas (29° 15' 30,2"S e 50° 13' 12,5" W), São Francisco de Paula, RS. O conteúdo estomacal foi analisado utilizando-se: o Grau de Repleção (GR), a Frequência de Ocorrência (FO) e o Métodos dos Pontos (MP). Análise de Agrupamento e Análise de Coordenadas Principais foram utilizadas para comparar as dietas de juvenis e adultos, além da variação

nos itens alimentares nas classes de tamanho. Nos estômagos dos aeglíedos estudados foram encontrados detritos vegetais, algas, areia, Insecta imaturos das ordens Diptera, Ephemeroptera, Coleoptera, Trichoptera, microcrustáceos. Não houve diferença significativa entre a alimentação de machos e fêmeas de ambas as espécies. Entretanto, os valores de GR foram mais elevados às 24h em A. platensis e às 18h em A. ligulata. As análises multivariadas mostraram diferenças nas dietas de juvenis e adultos das duas espécies. Com base nestas informações pode-se concluir que estes aeglídeos são, quanto a sua dieta natural, omnívoras, generalistas e oportunistas.
Palavras-chaves: Crustacea, Decapoda, Aeglidae, dieta natural.

Introduction

The aeglids are anomuran crustaceans which inhabit rivers, creeks and lakes of the austral region of South America. The species Aegla ligulata Bond-Buckup & Buckup, 1994 is endemic in the northeast region of the southern Brazilian state of Rio Grande do Sul whilst Aegla platensis Schmitt, 1942 has a distribution which includes Brazil, Argentina, Paraguay and Uruguay (Bond-Buckup & Buckup, 1994).

Research on the evaluation of the stomach contents of the aeglids has been restricted to a few species and the information available is fragmented, although studies have been effected on the Chilean species Aegla laevis (Latreille, 1818) (Bahamonde & López, 1961; Burns, 1972), on Aegla perobae Hebling & Rodrigues, 1977 which is endemic to the Brazilian state of São Paulo (Rodrigues & Hebling, 1978) and on the species Aegla platensis (Magni & Py-Daniel, 1989).

In the study of the trophic ecology of crustaceans, brachyurans have received special attention because of their economic and ecological importance (see Mantelatto & Christofoletti, 2001). The feeding activity of juveniles and adults has been characterized for some lobsters, e.g. Panulirus argus (Latreille, 1818) (Briones-Fourzon et al., 2003) while studies on circadian feeding activity has shown that some brachyuran species feed at different times of the day and night, as has been observed in Chionoecetes opilio (Fabricius, 1780) (Brêthes et al., 1984), Eriphia smithi MacLeay, 1863 (Vannini et al., 1989), Cancer polyodon Poeppig, 1986 (Wolff & Cerda, 1992), Thalamita crenata Milne Edwards, 1834 (Cannicci et al., 1996) and Callinectes danae Smith, 1869 (Branco, 1996).

There is little information on aeglids, and we decided to investigate the feeding habit of Aegla platensis and Aegla ligulata, two species from different altitudes, in relation to circadian and seasonal temporal variation.

Materials and methods

From August 1999 to August 2000 samples of intermoult (Haefner, 1990) juvenile (cephalothorax ‹9.0 mm long; Bueno & Bond-Buckup, 2000), non-ovigerous female and male (five of each) aeglids were collected once a month at 06:00, 12:00, 18:00 and 24:00 hours from two sites in the southern Brazilian state of Rio Grande do Sul, A. platensis being collected from a site 300m above sea level (ASL) at 29° 30¢ 0.2¢¢ S and 50° 46¢ 50¢¢ W in Mineiro Creek near the town of Taquara and A. ligulata from a site 965 m ASL at 29° 15¢ 30.2'¢¢ S; 50° 13¢ 12.5¢¢ W in the tributary of River Tainhas near the town of São Francisco de Paula. The crustaceans were kept in plastic bags inside an ice box to conserve them and reduce the digestion process during transport to the laboratory where they were kept frozen for up to 24h until analyses. In the laboratory, the stomachs (760 for A. platensis and 703 for A. ligulata) of the crustaceans were dissected out and the contents removed and the feeding items identified based on Edmondson (1959), Borror & DeLong (1969), Macan (1975) and Pérez (1988), insects being identified from wings, antennas and legs.

Data Analysis

Months were grouped into seasons, i.e. spring (September, October, November), summer (December, January, February), autumn (March, April, May) and winter (June, July, August).

The degree of fullness (DF) of each stomach was visually determined, before removal of its contents, according to the amount of food present using a scale divided into six classes (Williams, 1981): class 1 = 0% DF (empty), class 2 = < 5% DF (partially empty), class 3 = 5 to 35% DF (empty/intermediately full), class 4 = 35 to 65% DF (intermediately full), class 5 = 65 to 95% DF (intermediately full/full) and class 6 = > 95% DF (full).

The stomach contents were grouped by frequency of occurrence (FO: Williams, 1981; Wear & Haddon, 1987; Haefner, 1990) using the equation FO = b_i / N . 100 (where: b_i = number of stomachs containing item i and N = number of individuals sampled) and the point method (PM: Branco & Verani, 1997) using a subjective five-degree scale: degree 1 = < 5% (2.5 points), degree 2 = 5 to 35% (25 points), degree 3 = 35 to 65% (50 points), degree 4 = 65 to 95% (75) points and degree 5= > 95% (100 points). The number of points each item received was attributed according to the DF value by multiplying the number of points by an abundance-class value: class 1 = 0.00, class 2 = 0.02, class 3 = 0.25, class 4 = 0.50, class 5 = 0.75 and class 6 = 1.00. The total percentage of points for an item was expressed by the formula $\sum_{j=1}^{n} (a_{ij} / A)$. 100 (where: a_{ij} = number of points of the prey item i found in the stomachs of the individuals examined; A = total number of points for all items; n = total number of stomachs examined) (Williams, 1981).

Circadian and seasonal variations in the diet were characterized according to the variation in the DF value over 24 hours and across the seasons (Brêthes et al., 1984). Average DF values for females and males and adults and juveniles of both species were compared using analysis of variance (ANOVA) and the relative frequency of different food items consumed by A. platensis and A. ligulata adults and juveniles compared using the χ^2 test for association at the 95% confidence interval (CI).

The point method values for females and males were pooled because the χ^2 test showed no significant differences between sexes and the absolute contribution of each food item used to detect the feeding patterns of adults and juveniles of both species during the different seasons using the multivariate analysis (MA) MULTIV program (Pillar, 1997: available electronically at http://ecoqua.ecologia.ufrgs.br) to conducted ordination analysis and multivariate cluster analysis on the data. Significance tests were conducted on the ordination axes by the analysis of principal coordinates (APC) technique (Pillar, 1999a) and the group partition sharpness of the cluster analyses was determined by self-resampling bootstrap analysis with 1000 iterations at a probability threshold (α) of 0.1 (Pillar, 1999b) and randomization tests (Pillar & Orloci, 1996). After several analyses the cord distance showed the best adjustment to the data. In the cluster analysis of the sample units the sum of squares minimum variance criterion was used based on the cord distance, the data being subjected to log (x+1) transformation. Congruence was determined according to the method of Mantel (1967).

Results

Degree of Fullness

The analysis of the 760 A. platensis stomachs showed that 110 (14.5%) were empty and 650 (85.5%) contained some contents, while 60 (8.53%) of the 703 A. ligulata stomachs were empty and 643 (91.47%) had some contents.

No significant difference in the degree of fullness was observed between the sexes or between adults and juveniles either for A. platensis (F=3.209; α= 0.05) or A. ligulata (F = 1.59; α= 0.05) and because of this the degree of fullness data were grouped for analysis.

When we investigated the seasonal variation in the degree of fullness we found that the amount of food in the stomachs of both species was between classes 4 and 5 (i.e. relatively full) all year round, with autumn giving the highest DF values for A. platensis and spring the highest values for A. ligulata it was spring (Fig. 1A). The analysis of diurnal variation also showed differences between the species, revealing higher DF values at 24h for A. platensis (F=4.99; α= 0.05) and at 18h for A. ligulata (F=10.98; α= 0.05) (Fig. 1B).

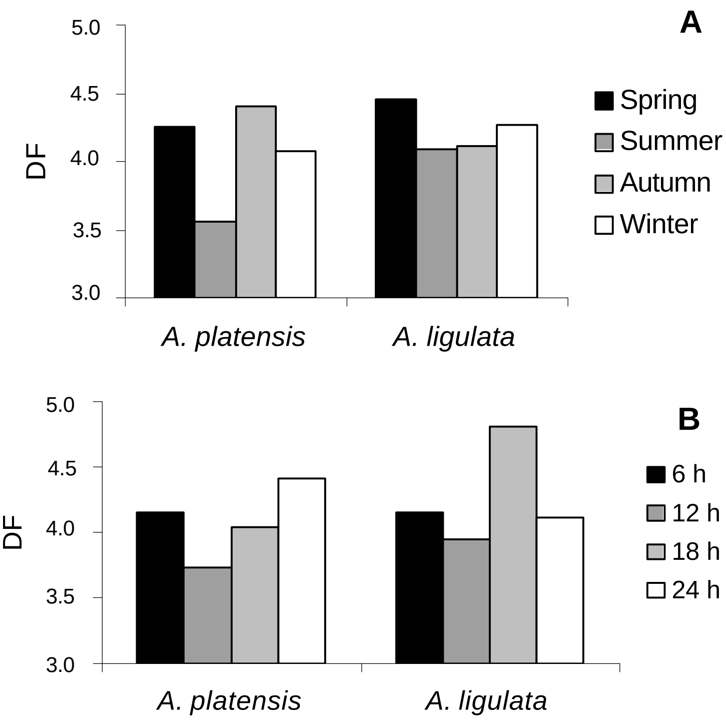

Figure 1: Degree of fullness (DF) of Aegla platensis and A. ligulata sampled in Mineiro creek, Taquara, and Tainhas creek, São Francisco de Paula, Rio Grande do Sul, Brazil, from August 1999 to August 2000. A- Seasonal variation; B- Circadian variation.

Trophic range

Analysis of the stomach contents identified 20 diet items for A. platensis (Tab. I) with only nine being common to both adults and juveniles, Planariidae being an item exclusive to the stomachs of juveniles. There were 19 diet items in the A. ligulata stomachs (Tab. II) with thirteen being common to both juveniles and adults; Nematoda, Metacercaria and Insecta (Lepidoptera, Plecoptera and Hemiptera) being found only in the stomachs of adults and Acarina only in the stomachs of juveniles. Analysis of the points method data using the c^2 test showed no significant differences between the relative frequencies of feeding category points.

Most of the insect parts found in the stomachs of both species indicated that the prey insects were in their immature form as larva, pupa or nymphs; although this varied, with immature insects being present principally in the diet of adult A. platensis whilst for A. ligulata both juveniles and adults fed on these organisms. Some insects could not be identified to order level.

Large amounts of plant debris (shoots, leaves and seeds of higher plants) were found in the stomachs of both species and points analysis by age groups showed that this item was more frequent in juvenile than adult A. platensis and A. ligulata.

Table I: Aegla platensis frequency of occurrence (FO), absolute and relative frequency of points (PM) (%) and c^2 test between relative frequencies of feeding items for juveniles and adults sampled at Mineiro creek, Taquara, Rio Grande do Sul, Brazil, from August 1999 to August 2000 (UM: undetermined material) (*) significant for a =‹ 0,05; (NS) non significant for a = 0,05.

Items	**Juveniles (n=204)**			**Adults (n=446)**			
	FO	**PM**	**%**	**FO**	**PM**	**%**	χ^2
Algae	7.84	693.75	4.71	3.81	515.00	1.87	1.23NS
Plant debris	58.33	8247.75	56.03	57.85	13756.50	49.83	0.36NS
Porifera	0.00	0.00	0.00	0.22	18.75	0.07	*
Platyhelmintes							
Metacercariae	0.49	37.50	0.25	2.02	175.50	0.64	0.16NS
Planariidae	0.49	37.50	0.25	0.00	0.00	0.00	*
Mollusca							
Gastropoda	0.00	0.00	0.00	0.45	125.00	0.45	*
Insecta							
Coleoptera	0.00	0.00	0.00	0.67	56.25	0.20	*
Diptera	3.43	600.00	4.08	3.14	313.00	1.13	1.66NS
Ephemeroptera	0.49	100.00	0.68	2.47	472.75	1.71	0.45NS
Hemiptera	0.00	0.00	0.00	0.22	75.00	0.27	*
Lepidoptera	0.00	0.00	0.00	0.67	200.00	0.72	*
Plecoptera	0.00	0.00	0.00	0.45	50.00	0.18	*
Trichoptera	0.00	0.00	0.00	0.22	25.00	0.09	*
Unidentified Insecta	3.43	575.00	3.91	8.52	1680.50	6.09	0.48NS
Crustacea							
Hyalellidae	0.00	0.00	0.00	0.22	6.25	0.02	*
Aeglidae	0.00	0.00	0.00	1.57	543.75	1.97	*
Scales	0.98	150.00	1.02	0.22	12.50	0.05	0.89NS
Sand	7.35	372.25	2.53	2.69	282.75	1.02	0.64NS
Calcareous material	0.00	0.00	0.00	0.90	187.50	0.68	*
UM	34.31	3906.25	26.54	41.03	9108.75	33.00	0.70NS
Total		14720.00			27604.75		

Table II: Aegla ligulata. frequency of occurrence (FO), absolute and relative frequency of points (PM) (%) and c^{2} test between relative frequencies of feeding items for juveniles and adults sampled at Tainhas creek, São Francisco de Paula, Rio Grande do Sul, Brazil, from August 1999 to August 2000 (UM: undetermined material) (*) significant for a =‹ 0,05; (NS) non significant for a = 0,05.

Items	**Juveniles (n=258)**			**Adults (n=385)**			
	FO	**PM**	**%**	**FO**	**PM**	**%**	χ^2
Algae	8.91	1070.75	6.62	12.73	1984.75	7.65	0.07NS
Plant debris	46.12	7434.50	45.98	34.29	7673.75	29.60	3.55NS
Porifera	2.71	281.25	1.74	0.78	75.00	0.29	1.03NS
Nematoda	0.00	0.00	0.00	0.78	150.00	0.58	*
Platyhelmintes							
Metacercariae	0.00	0.00	0.00	0.78	45.25	0.17	*
Acarina	0.78	43.75	0.27	0.00	0.00	0.00	*
Insecta							
Lepidoptera	0.00	0.00	0.00	1.04	250.00	0.96	*
iptera	3.88	414.50	2.56	7.27	609.25	2.35	0.01NS
Trichoptera	0.78	100.00	0.62	1.82	231.25	0.89	0.05NS
Ephemeroptera	0.39	75.00	0.46	2.86	712.50	2.75	1.62NS
Coleoptera	0.39	75.00	0.46	2.60	531.25	2.05	1.00NS
Plecoptera	0.00	0.00	0.00	0.78	225.00	0.87	*
Hemiptera	0.00	0.00	0.00	0.26	25.00	0.10	*
Unidentified Insecta	3.88	500.00	3.09	12.47	1960.25	7.56	1.87NS
Pupas	0.78	150.00	0.93	7.01	701.50	2.71	0.87NS
Scales	0.00	0.00	0.00	0.26	25.00	0.10	*
Sand	1.55	168.75	1.04	0.78	87.50	0.34	0.36NS
Calcareous material	0.39	50.00	0.31	0.52	100.00	0.39	0.01NS
UM	45.74	5807.00	35.91	51.69	10541.80	40.66	0.29NS
Total		16170.50			25929		

Diet variation between juveniles and adults

Cluster analysis of the sample unit similarity matrix showed four distinct groups for A. platensis and three groups for A. ligulata (Fig. 2A, 2B). The dendrogram groups show separation of the feeding items between adults and juveniles and in respect of seasons, with bootstrap values for A. platensis of 0.105, 0.131 and 0.158, and for A. ligulata of 0.118, 0.134 and 0.123.

For A. platensis the dispersion diagram (Fig. 3A; points for adults to the left, for juveniles to the right) expresses the variation in sample units during the year and shows different feeding habits for adults and juveniles, descriptors with the highest level of correlation being shown in axis 1 (Aeglidae (-0.9), Coleoptera (-0.79), calcareous material (- 0.79), plant debris (0.61), algae (0.8)) and axis 2 (Ephemeroptera (- 0.74), plant debris (- 0.65), Diptera (0.87), insect parts (0.94)). For A. ligulata the dispersion diagram (Fig. 3B; adults to the left, juveniles to the right) also shows the variation in the sample units during the year and, as in A. platensis, differences can be seen in the feeding habits of adults and juveniles, descriptors with the highest level of correlation being shown in axis 1 (insect parts (-0.89), nematodes (-0.82), plant debris (0.86)) and in axis 2 (Coleoptera (0.78), Trichoptera (0.8)).

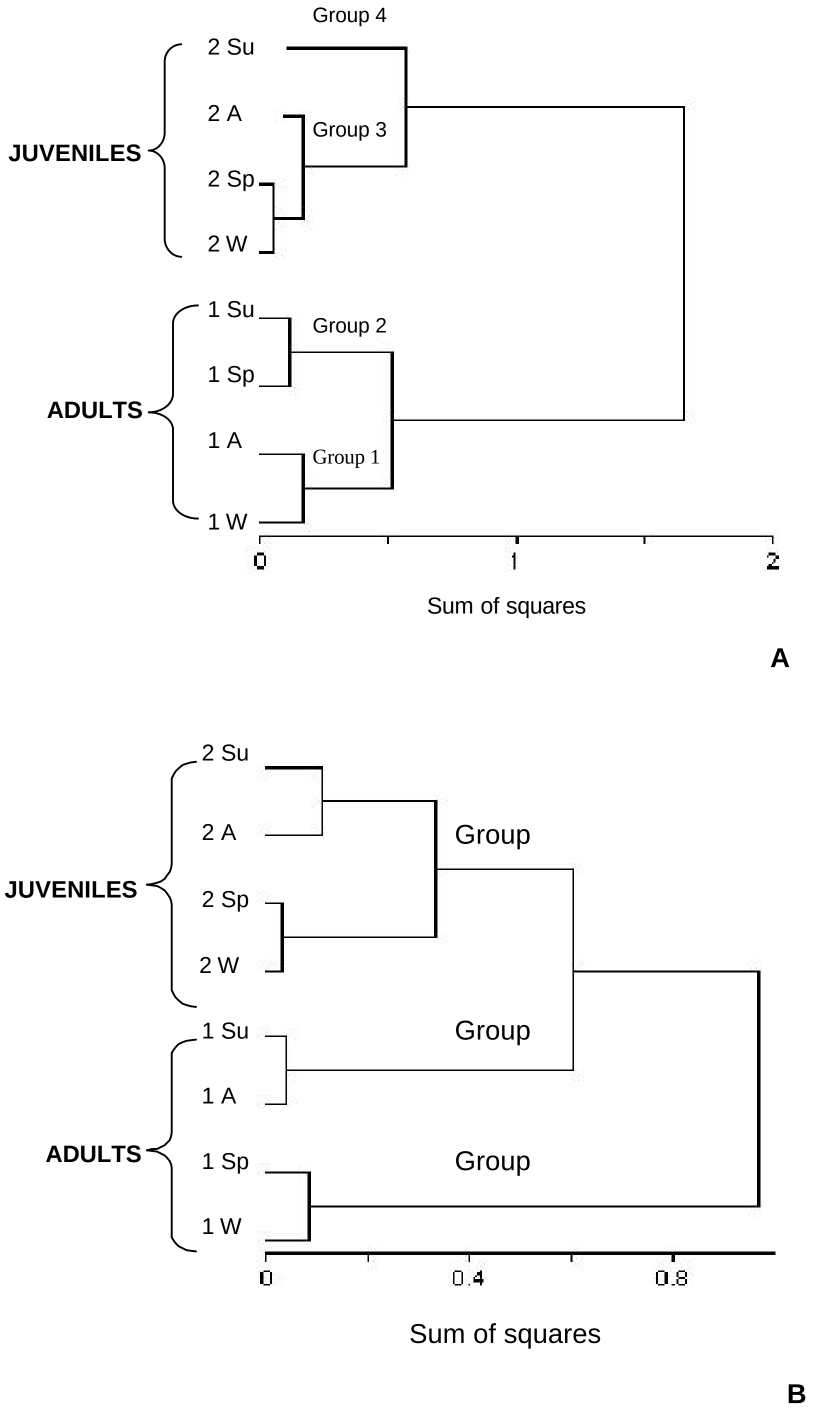

Figure 2: Dendogram of the sample units showing the group structure according to the cluster analysis by the sum of squares method (minimum variance) using the Cord Distance. Numbers 1 and 2 correspond to adults and juveniles, respectively, and letters refer to the seasons (Sp: spring; Su: summer; A: autumn and W: winter). Groups formed after the clarity test are indicated. A- *Aegla platensis*; B- *Aegla ligulata*.

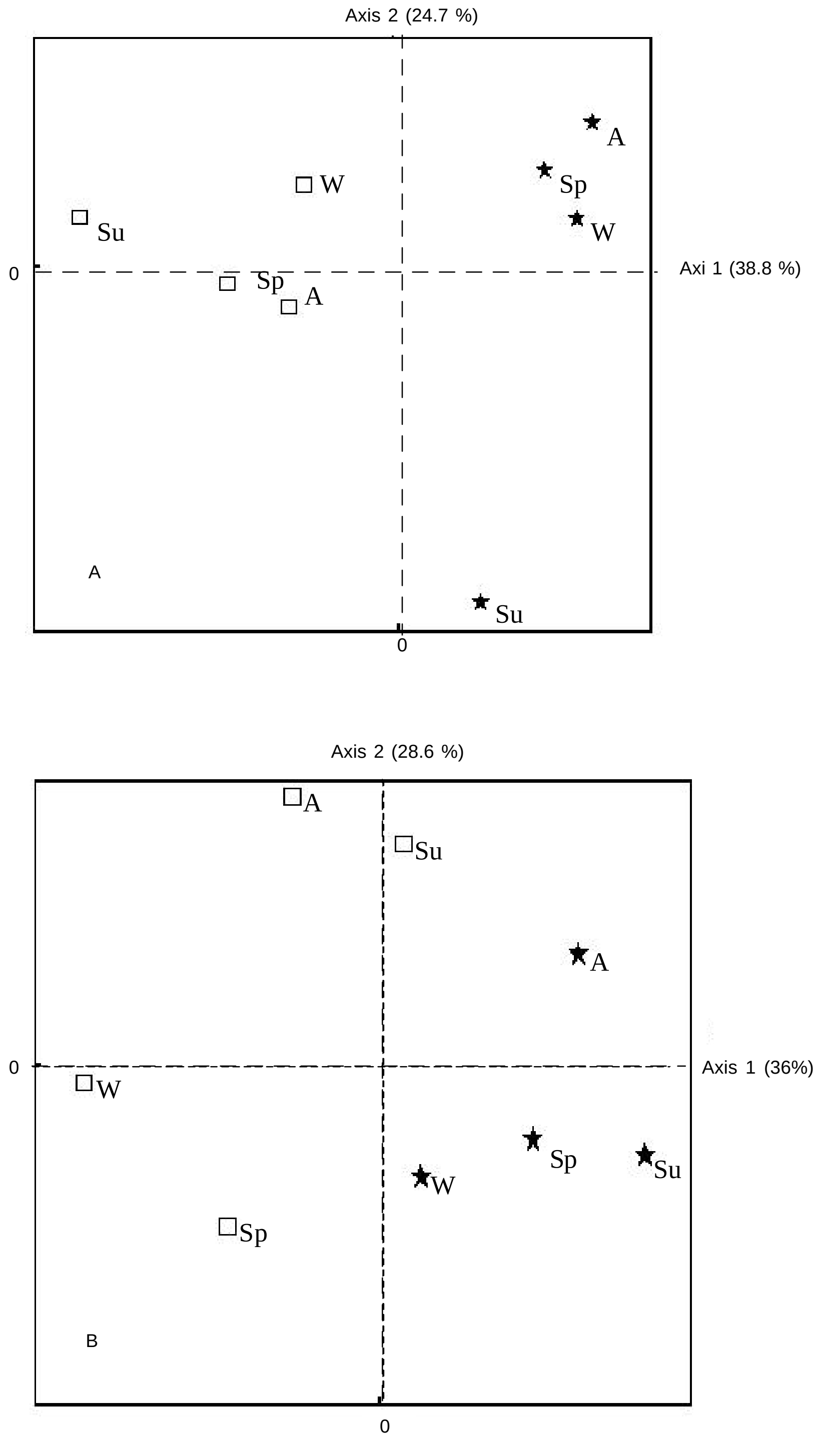

Figure 3: Diagram of dispersion of the sample units of feeding items on axes 1 and 2, obtained by Principal Coordinate Analysis, based on Cord Distances. Symbols refer to juveniles (stars) and adults (squares). Letters correspond to seasons (Sp: spring; Su: summer; A: autumn and W: winter). A- *Aegla platensis*; B- *Aegla ligulata*.

Discussion

Degree of Fullness (DF)

For both A. platensis and A. ligulata, the degree of fullness and the relative volume of food were similar for both sexes and for juveniles and adults, this having been previously recorded for some Brachyura (Mantelatto & Christofoletti, 2001).

We found that for A. platensis the seasonal variation in the degree of fullness was highest in autumn, coinciding with the greater diversity of available feeding resources during this season especially as regards benthonic macrofauna (Bueno et al., 2003). Autumn is also the season preceding the reproductive period of A. platensis, with the concomitant need to invest in the accumulation of energy reserves which will be spent during reproduction and in the parental care of offspring which is normal found in aeglids (Bueno & Bond-Buckup, 2000). According to Mantelatto & Petracco (1997), autumn was also the season during which the highest volume of food was present in the stomachs of Hepatus pudibundus even though the reproductive peak for this organism occurred during summer and not winter as is the case for aeglids. Our results for A. ligulata showed that the highest DF values occurred in spring, which supports the findings of Oliveira et al. (2003) who investigated the intermediary metabolism of this species and found that the highest levels of haemolymphatic glucose occurred in springtime.

Circadian variation in the degree of fullness not only differs between species but is related to the feeding behavior of crustaceans and to the specific environmental variables, especially, temperature of the water body (creek, river, etc.) in which they live. We found that in A. platensis the DF values were highest at 24h, indicating a tendency to nocturnal foraging, whilst in A. ligulata the highest DF vales occurred at 18h, suggesting that feeding activity was concentrated in the afternoon. Although the DF values were lower at times other than the peak feeding time there appeared to be no period in which feeding was completely suspended for either species This may have been because prey items were abundant at any time of the day or night or because some prey items have a slower rate of digestion and remain longer in the stomach, as has been recorded in Scylla serrata (Hill, 1976).

Nocturnal foraging is characteristic of several species of crustaceans and can be interpreted as a response to prey exploration and/or escape from diurnal predators (Brêthes et al., 1984; Wolff & Cerda, 1992). Similar to A. ligulata, the portunid Thalamita crenata feeds in the late afternoon, this behavior being attributable to the fact that the main predators of T. crenata have a nocturnal habit and by feeding before dark T. crenata reduces its risk of being caught and eaten during feeding (Cannicci et al., 1996).

During fieldwork, we found Aegla carapaces on top of rocks along the riverbed, indicate that aeglids may be predated by terrestrial nocturne animals such as the raccoon Procyon cancrivorus which inhabits densely vegetated sites near to rivers, creeks etc (Silva, 1994).

In spite of the circadian and seasonal variations found in the diets of various species of crustaceans there seems to be no differences between the sexes, our results for female and male A. platensis and A. ligulata agreeing with those observed for Callinectes ornatus (Haefner, 1990), Callinectes danae (Branco & Verani, 1997), Callinectes larvatus (Carqueja & Gouvêa, 1998) and Hepatus pudibundus (Mantelatto & Petracco, 1997).

Trophic range

In our study, the diversity of feeding items found in the stomachs of Aegla platensis and Aegla ligulata was higher than that observed in the other aeglids so far studied. For example, only unidentified plant and animal debris have been found in the stomachs of Aegla laevis, although the presence of juvenile A. laevis near aquatic plants and algae could indicate that plants and algae are used not only as as physical refuges but also as feeding sites, the fauna associated with this crustacean including Amphipoda, Nematoda, Oligochaeta and various orders of immature Insecta that are potential prey items (Bahamonde & Lopez, 1961; Burns, 1972).

Another fact that must be mentioned is the difference between the diets of organisms from different regions. The diets of Brachyura from tropical and sub-tropical regions are relatively uniform due to the high diversity and prey availability in these environments, but the diets of species from temperate regions are governed by the low diversity and seasonal changes in the availability of prey species (Choy, 1986). This would explain the shorter and less diverse feeding range of the Chilean species A. laevis in relation to the species studied by us.

According to Rodrigues & Hebling (1978) the diet of the subtropical crustacean A. perobae is quite different to that of other aeglids because this species is primarily carnivorous and feeds mostly on aquatic insects, the habitat of this species characterizing its feeding habit because there is no vegetation available as food.

Experiments done by Magni & Py-Daniel (1989) with A. platensis suggest that this species could be used in the biological control of Simullidae (Insecta), these authors also suggesting that the predation of insects from other genera, such as the Ephemeroptera, would be unlikely. However, as can be seen from our study the diet of adult A. platensis was quite varied and, contrary to the suggestion of Magni & Py-Daniel (1989), insects from genera such as the Ephemeroptera were present and were even more frequent diet items than members of the Diptera. Although we did not identify to family level the items found in the stomachs of Aegla platensis we did observe that among the Diptera identified Chironomidae were more abundant than Simullidae, indicating that because it quite frequently feeds on other immature insects A. platensis cannot be characterized as an efficient predator of members of the Simullidae.

Plants also had a key role in the aeglids diet, as is the case for other crustaceans. According to D'Incao et al. (1990), plant debris were the second most important item in the diet of the estuarine crab Chasmagnathus granulata, although these authors also state that detritivorous crustaceans do not assimilate some plants but can extract benefits in other forms, either by ingestion of microorganisms present on the plants or by using substances which the plants may contain. Choy (1986) found that algae were also more frequent in the stomachs of adult Liocarcinus puber, corresponding to 45.6% of the total volume of the stomach.

We consistently found sand in the stomachs of the aeglids studied, especially in the case of juveniles. The ingestion of sand could have been accidental or because it was association with organic matter where algae, bacteria and other microorganisms grow, as has been recorded for the estuarine crab Chasmagnathus granulata by D'Incao et al. (1990).

Parts of the exoskeleton and appendices of Aegla were present in the stomachs of male adults of A. platensis, predation or cannibalism being common among brachyuran crustaceans, especially against juveniles or recently moulted animals (Branco & Verani, 1997). Cannibalism can also occur among juveniles as observed in Cancer magister, caused by high levels of intra-specific competition (Stevens et al., 1982). In herbivorous crustaceans cannibalism fulfills an additional need for nitrogen, vitamins and other substances when plant quality and quantity are low or insufficient (Luppi et al., 2001).

Variation in the diet of juveniles and adults

Cluster analysis, taking into account quality and quantity of the items present in the stomachs, showed that these vary both in juvenile and adult A. platensis and A. ligulata, although the differences did not correlate significantly with age. Three groups were identified in A. ligulata and four in A. platensis. Ontogenetic variation has also been observed in various species of crustaceans (Briones-Fourzan et al., 2003).

The variation found in the diets of juvenile and adult crustaceans can occur because of two factors, one being differences in the functional morphology of the mouthparts, locomotion system, sensory capacities and the other being differences in life cycles which produce distinct size classes at different times of the year when different food items are available (Laughlin, 1982) or are needed for the processes of growth and reproduction.

In our study, with the exception of sensory capacity, differences in morphology may not have influenced variation in diet because aeglids exhibit direct development and have the mouth parts and locomotion apparatus already developed in the early juvenile stages (Bueno & Bond-Buckup, 1996; Bond-Buckup et al., 1996). The different growth pattern of A. platensis and A. ligulata, including differences in size, could, however, have influenced variation in diet. The species A. platensis lives about two-and-a-half years and passes from the juvenile to the adult stage during the first year (Bueno & Bond-Buckup, 2000), juveniles starting to appear in spring and extending until summer, the season with the lowest diversity of available food (Bueno et al., 2003). In the following year the crustaceans become sexually mature during winter, the season when the benthonic river fauna is amply distributed and highly diverse.

Ontogenetic changes in diet have also been observed for three co-existent species of Callinectes, associated seasonal variations in reproductive behavior allowing these crustaceans to use the same resources without competing (Rosas et al., 1994). Other authors consider ontogenetic changes to be a common age-related phenomenon in various populations (Stevens et al., 1982).

Our results show that A. platensis and A. ligulata can be considered predatory species which successfully use animals from other trophic levels and which have an important role in energetic transfer in limnic environments. We suggest that A. platensis and A. ligulata are omnivores because of their wide feeding range and use of available resources. They can also be considered generalists due to their use of both plants and animals as sources of food, their wide feeding range and the availability of suitable prey in their environment. Due to the fact that Aegla platensis and Aegla ligulata use the most abundant resources in the river bodies they inhabit they can also be considered opportunists.

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