Infaunal mollusks as main prey for two sand bottoms sea stars off Puerto Quequén (Argentina)

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Abstract: In order to characterize the diet of *Astropecten brasiliensis* and *Luidia ludwigi scotti*, the stomach content of both starfish species was analyzed. Starfishes were sampled for two years off Puerto Quequén coast in the Buenos Aires province (Argentina), at a depth between 40 and 60 m. The main prey items were analyzed in relation to the starfish's sizes and identified to the lowest possible taxonomic category. *A. brasiliensis* showed the most diversified diet, comprising a total of twenty eight different prey species; bivalves and gastropods predominated. In contrast, *L. ludwigi scotti* only showed eight prey species with bivalves, foraminiferans and ophiuroids as the most frequently found groups. There were differences among the prey groups eaten by each sea star species, and prey in common differed by size. We found different prey species distribution according with *L. ludwigi scotti* sizes. There may be competition for food resources, and diet differences may allow the coexistence of *A. brasiliensis* and *L. ludwigi scotti* in the area. Rev. Biol. Trop. 56 (Suppl. 3): 328-334. Epub 2009 January 05.

Key words: *Astropecten*, *Luidia*, asteroids food items, sandy bottoms, Argentina.

Predators commonly show a variety of trophic strategies and prey selectivity, which are directly related to their geographic distribution and food availability. The study of such differences among predators provides helpful tools to predict further responses to environmental changes as well as to intra and interspecific competition for food.

The feeding behavior of asteroids has been thoroughly documented by a number of authors and information was mainly obtained from field and aquarium observations, as well as from studies on stomach content (Jangoux 1982). The latter can only be conducted in paxillosid starfishes groups because they ingest the prey entirely due to be not able to evert their stomachs (Jangoux 1982).

Astropecten brasiliensis Müller and Troschel, 1842 and *Luidia ludwigi scotti* Bell, 1917 coexist in sandy bottoms at a depth between 40 and 60 m off the coast of Buenos Aires province (Bernasconi 1964). In this area, studies carried out by Carcelles and Parodiz (1938) and Carcelles (1944) mentioned the presence of mollusks in the stomach contents of *Astropecten cingulatus* Sladen, 1889 but they confuse the specie and in fact work with *A. brasiliensis*. This was supported by Penchaszadeh (1973), who considered that the starfish in the picture accompanying the text of Carcelles and Parodiz (1938) is actually an individual of *A. brasiliensis*.

The trophic ecology of *A. brasiliensis* and *L. ludwigi scotti* has been study by Rios and Oleiro (1970), Penchaszadeh (1973) and Ventura *et al.* (1997, 2001) for the former, and Ventura *et al.* (1994, 2001) for the latter. In addition, Penchaszadeh (1973) reported

echinoderms in the diet of *L. ludwigi scotti*.

The objective of the present study was to describe the diet of *A. brasiliensis* and *L. ludwigi scotti* using stomach content analysis and taxonomical identification of the different prey items, and relating prey sizes with predator's size. Our results will provide additional information on the ecology of these starfish species of the Argentine coast.

MATERIALS AND METHODS

Between November 1998 and November 2000, individuals of *Astropecten brasiliensis* and *Luidia ludwigi scotti* were collected onboard of commercial fishing boats using a bottom-trawling net with a minimum mesh size of 40 mm. Sea stars were sampled from sandy bottoms between 8 and 35 km off Puerto Quequén coast (38º37' S, 58º50' W) in the Buenos Aires province, at a depth ranging from 40 to 60 m. The collected material was fixed in 10 % formaldehyde and then preserved in 70 % ethanol.

Because the proportion of *A. brasiliensis* individuals was higher than that of *L. ludwigi scotti* (approximately 25:1) throughout the whole sampling period, all caught individuals of *L. ludwigi scotti* (N=51) and an equivalent number of randomly-selected *A. brasiliensis* individuals (N=61) were separated for further analysis. Only starfishes having stomach contents were considered in the study. In each individual, the major radius was measured (R= length from disc center to the tip of the longest arm) and the stomach contents were examined under stereoscopic microscopy. All prey specimens contained in the stomach of each starfish were counted and identified to the lowest possible taxonomic category. Prey species found in common for both sea star species were measured to relate their size to the size of each species.

RESULTS

Forty nine specimens of *A. brasiliensis* and twenty seven of *L. ludwigi scotti* had stomach contents. The major radius in *A. brasiliensis* ranged between 32-66 mm (mean ±SD= 44.55 ±8.84 mm), and in *L. ludwigi scotti*, it ranged between 28-128 mm (mean ±SD= 79.05 ±29.05 mm).

Most of *A. brasiliensis* and *L. ludwigi scotti* individuals preyed on bivalves (88.0 % and 83.3 %, respectively). *Pitar rostrata* (Koch in Philippi 1844) was the predominant prey species for both starfish species. Among *A. brasiliensis* individuals, gastropods were present in 58.0 %, cumaceans in 38.0 %, foraminiferans in 34.0 %, polychaete tubes in 16.0 % and amphipods in 6.0 % of the sea stars. A few number of specimens ingested ascidians, some faecal pellets, ophiuroids, and rests of shells. In *L. ludwigi scotti*, 40.0 % of the individuals fed on ophiuroids, 23.3 % on foraminiferans, and 6.7 % on amphipods.

Table 1 shows a detailed description of the number and percentage of each prey item in the diet of each starfish species. Among prey items, bivalves represented 49.5 % of *A. brasiliensis* diet. Bivalve species found were: *P. rostrata*, *Ennucula puelcha* (d´Orbigny 1842), *Corbula tryoni* (E.A. Smith 1880) and *Adrana patagonica* (d´Orbigny 1846). The less frequent bivalve species were: *Musculus viator* (d´Orbigny 1840), *Transenpitar americana* (Doello Jurado in Carcelles 1951) and other unidentified bivalves. Gastropods comprised 18.1 % of *A. brasiliensis* diet. Gastropod species found were: *Calliostoma coppingeri* (E.A. Smith 1880), *C. rioense* (Dall 1889), *Halistylus columna* (Dall 1890), *Turbonilla interrupta* (Totten 1835), *Turbonilla* sp., *Olivella puelcha* (Duclos 1835), *Acteon* cf. *punctostriatus* (Adams 1840), *Terebra doello-juradoi* (Carcelles 1953), *Crepidula argentina* (Simone, Pastorino and Penchaszadeh 2000), *Volvulella* sp. and *Acteocina* sp. Class Scaphopoda was represented by one specimen of *Polyschides tetraschistus* (Watson 1879). Other groups present were: cumacean *Diastylis argentata* (Calman 1912), foraminiferans, polychaetes, amphipods and ophiuroids.

Bivalves constituted 44.4 % of *L. ludwigi scotti* diet. Bivalve species were: *P. rostrata*, *A.*

TABLE 1
Number and percentage of prey found in the diet of A. brasiliensis *and* L. ludwigi *scotti*

	A. brasiliensis		L. ludwigi scotti	
	N	%	N	%
Groups				
Bivalvia	142	49.5	56	44.4
Ophiuroidea	1	0.3	45	35.7
Gastropoda	52	18.1	0	0.0
Cumacea	42	14.6	0	0.0
Foraminifera	39	13.6	21	16.7
Polychaeta	8	2.8	0	0.0
Amphipoda	3	1.1	4	3.2
Bivalvia species				
Pitar rostrata	60	20.9	27	21.4
Adrana patagonica	2	0.7	14	11.1
Ennucula puelcha	50	17.4	13	10.3
Corbula tryoni	17	5.9	0	0.0
Other Bivalvia	13	4.5	2	1.6

patagonica, *E. puelcha* and other less frequent bivalve species. No specimen of *C. tryoni* was found. Other food items were ophiuroid *Amphiura eugeniae* (Ljungman 1867), foraminiferans and amphipods.

We recorded a total of twenty eight different prey species in the diet composition of *A. brasiliensis* and only eight in that of *L. ludwigi scotti*, which showed a less heterogeneous diet since no gastropods, cumaceans and polychaetes were found among the prey items.

Figure 1 show sizes of bivalves in relation to sizes of each starfish species. Among prey species in common, *P. rostrata* individuals ingested by *A. brasiliensis* measured between 0.25-19.64 mm (mean ±SD= 5.33 ±0.86 mm) and those predated by *L. ludwigi scotti* ranged between 4.50-14.62 mm (mean ±SD= 7.53 mm ±2.12 mm); sizes of *E. puelcha* ranged between 0.47-6.90 mm (mean ±SD= 2.58 ±1.35mm) and 2.70-11.00 mm (mean ±SD= 6.92 ±1.97 mm) for *A. brasiliensis* and *L. ludwigi scotti*, respectively; and sizes of *A. patagonica* ranged between 4.50 mm-5.20 mm (mean ±SD= 4.85 ±0.49 mm) and 5.00-24.28 mm (mean ±SD= 14.13 ±6.89 mm) for *A. brasiliensis* and *L. ludwigi scotti*, respectively, but only two specimens of *A. patagonica* from the gut contents of *L. ludwigi scotti* were found.

The same prey species were found in the stomach contents of *A. brasiliensis* individuals of all sizes. In contrast, we found an apparent differential prey species distribution for different sizes of *L. ludwigi scotti*, where larger individuals (radius larger than 100 mm) fed almost exclusively on *A. patagonica*, and those with a radius between 58-100 mm ingested mainly *P. rostrata* and *E. puelcha*. Although ophiuroids were present in the stomach contents of *L. ludwigi scotti* of different sizes, they were the only food item present in smallest starfish individuals (smaller than 58 mm in radius).

DISCUSSION

Both *Astropecten brasiliensis* and *Luidia ludwigi scotti* showed a mollusk based diet, and

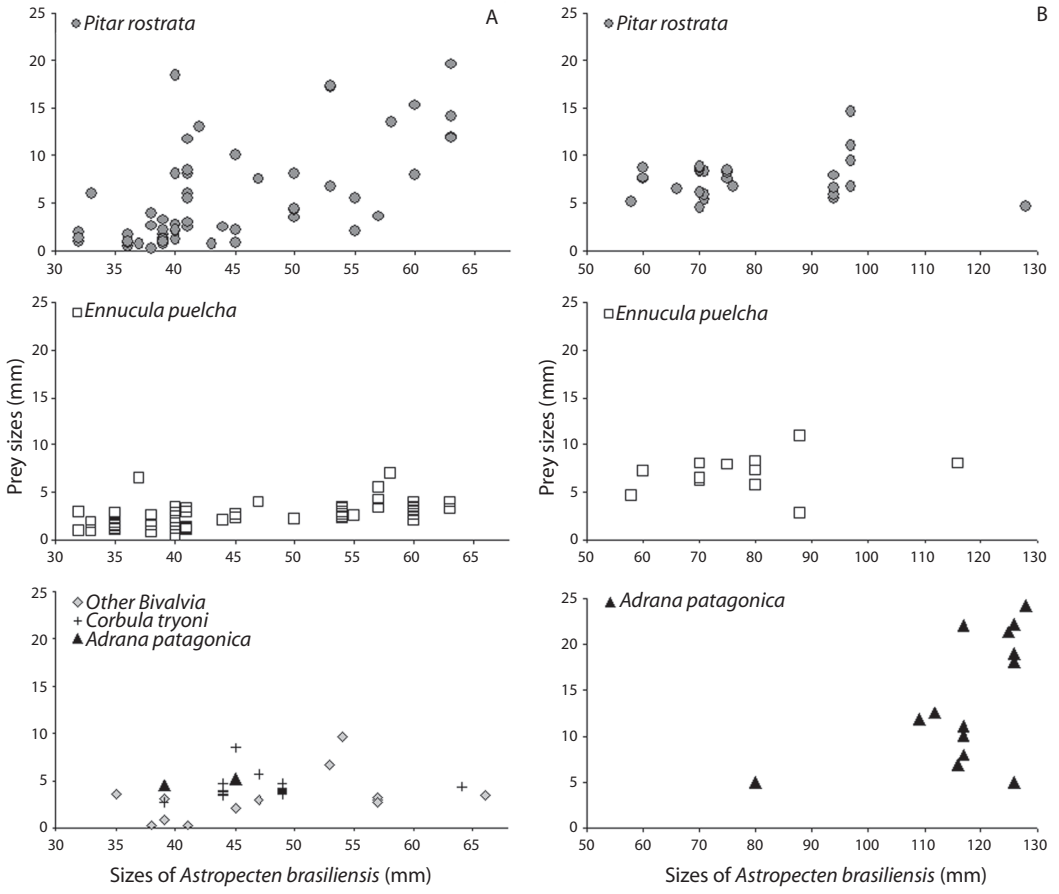

Fig.1. Sizes of prey in common for the studied sea star species, in relation to sea star size. (**A)** For *Astropecten brasiliensis*. (**B)** For *Luidia ludwigi scotti*.

bivalves may represent the main prey group where food niches of the studied species overlap. In genus *Astropecten*, bivalves has also been reported as main prey for *A. aranciacus* (Ribi and Jost 1978), *A. articulatus* (Schwartz and Porter 1977), *A. brasiliensis* (Ventura *et al.* 2001), *A. irregularis* (Christensen 1970), *A. latespinosus* (Nojima and Doi 1977) and *A. velitaris* (Christensen 1970), while other species prefer different groups of mollusks or show an opportunistic feeding behavior (Sloan 1980, Jangoux 1982, Bitter and Penchaszadeh 1983, Ventura *et al.* 2001). In species belonging to genus *Luidia*, the principal feeding group is represented by other echinoderms and foraminiferans, except for *L. clathrata* (Penchaszadeh and Molinet 1983), *L. foliolata* (Mauzey *et al.* 1968, Sloan and Robinson 1983), *L. ludwigi scotti* (Ventura *et al.* 2001) and *L. senegalensis* (Lima-Verde and Matthews 1969, Penchaszadeh and Lera 1983) which show mollusks as main prey group.

In banks of mussel *Mytilus platensis* d'Orbigny, 1846 off the Argentine coast, Penchaszadeh (1980) found that juveniles of this species were the main prey item for *A. brasiliensis*. In the coasts of Brazil, Ventura *et al.* (2001) reported that *A. brasiliensis* frequently fed on mollusks, being bivalve *Nucula puelcha* (=*Ennucula puelcha*) the predominant

prey item, while *L. ludwigi scotti* was eating preferably *Abra lioica* and a few other bivalves. Our results showed that ophiuroids also constituted an important resource in the diet of *L. ludwigi scotti*, in agreement with Penchaszadeh (1973) and Ventura *et al.* (2001), but in contrast ophiuroids were almost absent in the diet of *A. brasiliensis*. Concerning the diversity in the diet of *A. brasiliensis*, Carcelles and Parodiz (1938) and Carcelles (1944) found twenty nine mollusk species in the stomachs of sea stars collected from mussel banks.

The coexistence of *A. brasiliensis* and *L. ludwigi scotti* is probably allowed to reduce competition for available food resources, as suggested by the differences observed between their diets. Prey selection is a complex phenomenon involving important predator and prey characteristics, such as the ability of the former to search, locate and capture the prey as well as prey chemical composition, size and escape ability (Ventura *et al.* 2001).

The fact that *A. brasiliensis* showed the highest trophic diversity, with a total of twenty eight different prey species, may indicate that this species don't fed on any particular prey. However, our results suggest some kind of inclination over prey size, and at least in the case of ophiuroids, of prey type. Such tendency was likely to be restricted only to size and type of prey rather than to amount of prey, since the number of prey was not related to the starfish size. This agrees with data of Penchaszadeh (1973), who also observed that although the radius of *A. brasiliensis* and number of prey ingested per individual decreased as depth increased, the number of prey was independent of the starfish size along the bathymetric distribution. On the other hand, *L. ludwigi scotti* is restricted in regards to the prey items ingested. Most of the eight different prey species fed by this predator could probably been distributed over a few subgroups along its size distribution. *L. ludwigi scotti* could be showing a marked specialization concerning prey acquirement as a result of inter and intraspecific competition for food.

Resource partitioning between *A. brasiliensis* and *L. ludwigi scotti* is probably due to competition for food and to differences in population density. These factors that lead to the specialization or differentiation of feeding niches (Menge 1972) and the suggested behavioral features to avoid competition (Ventura *et al.* 2001) may have determined the relationship of coexistence between the studied sea star species. However, the availability of different food types may influence feeding behavior in the natural environment, but the observation of stomach contents may only indicate what the animal is eating, not what it may prefer (Lawrence 1975, McClintock *et al.* 1982). Consequently, other local studies involving availability and abundance of food resources should be carried out in order to corroborate the observations provided in the present paper.

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RESUMEN

Con el fin de caracterizar la dieta de *Astropecten brasiliensis* y de *Luidia ludwigi scotti* se analizó el contenido estomacal de ambas especies. Las estrellas fueron muestreadas durante dos años en Puerto Quequén (Buenos Aires, Argentina), entre los 40 y 60 m de profundidad. Los ítemes presa principales fueron analizados en relación al tamaño de las estrellas, e identificados a la más baja categoría taxonómica posible. *A. brasiliensis* presentó la dieta más diversa, comprendiendo un total de 28 especies presa diferentes, predominando los bivalvos y los gasterópodos. En contraste, *L. ludwigi scotti* sólo evidenció ocho especies presa, siendo los bivalvos, los foraminíferos y los ofiúridos los grupos más frecuentes. Se observaron diferencias entre los grupos presa consumidos por cada especie de estrella, y las presas en común presentaban distintas tallas. Además, se

encontraron diferentes especies presa entre distintas tallas de *L. ludwigi scotti*. Estas observaciones probablemente estén reflejando una respuesta a la competencia por los recursos alimenticios, y las diferencias permiten la coexistencia de *A. brasiliensis* y *L. ludwigi scotti* en el área.

Palabras clave: *Astropecten*, *Luidia*, ítems alimenticios de asteroideos, fondos arenosos, Argentina.

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