

Trophic ecology of the lobster krill *Munida gregaria* in San Jorge Gulf, Argentina

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ABSTRACT. The “langostilla”, *Munida gregaria*, also called lobster krill or squat lobster, is a very common galatheid crustacean in San Jorge Gulf and around the southern tip of South America. Previous studies have shown that this species plays an important role in the trophic webs wherever it has been studied. In order to determine its natural food sources, we analyzed 10 samples (30-36 individuals each) taken from different sites in San Jorge Gulf. Moreover, stomach analyses were performed on 32 fish species, 4 mollusk species, and 7 crustacean species from the gulf. The lobster krill is primarily a detritivore or surface deposit-feeder and secondarily a predator and/or scavenger. Its main energy sources are particulate organic matter and their associated bacteria, small live organisms on the surface of the sediment layer (ostracods, copepods, foraminifers, other protists), and animal debris. Polychaetes are the main prey of lobster krill in the study area. This dual complementary feeding behavior is common in the studied galatheids, making them a fundamental link between detritus and benthic and demersal top predators. Some species of these predators constitute important fisheries. Different life-cycle stages of the squat lobster were preyed on by 32 of the examined species. However, the spectrum of predators is still incomplete, with other species feeding on larvae and juveniles of the species.

Key words: feeding, predators, lobster krill, *Munida gregaria*, San Jorge Gulf, Patagonia.

Ecología trófica de la langostilla *Munida gregaria* en el golfo San Jorge, Argentina

RESUMEN. La langostilla, también llamada bogavante ó langostino de los canales, es un crustáceo galateido de gran abundancia en el Golfo San Jorge y otras áreas del extremo sur de América. Trabajos previos han resaltado la importancia de esta especie en todos los lugares donde ha sido estudiada. Se analizaron 10 muestras de 30 a 36 animales cada una, provenientes de distintos sectores del golfo San Jorge, con el fin de reconocer su alimentación natural. Se revisaron también los estómagos de 32 especies de peces, cuatro especies de moluscos y siete especies de crustáceos del golfo. La langostilla se comporta principalmente como detritívoro o consumidor de depósitos superficiales, y secundariamente, como depredador y/o carroñero. Su fuente principal de energía está dada por materia orgánica particulada y sus bacterias asociadas, organismos vivos pequeños que se encuentran en la capa de sedimento superficial (ostrácodos, copépodos, foraminíferos y otros protistas) y restos de organismos muertos. Su presa principal en el área son los poliquetos. Esta dualidad complementaria en su alimentación es común en los galateidos estudiados y lo convierte en un eslabón fundamental entre el detrito y los depredadores terminales bentónicos y demersales, algunas de cuyas especies integran pesquerías de gran importancia. La langostilla ha sido registrada como presa en 32 de las especies analizadas, en distintas etapas de su vida. Sin embargo, el espectro de depredadores es aún incompleto y existirían otras especies que actuarían sobre larvas y juveniles.

Palabras clave: alimentación, depredadores, langostilla, *Munida gregaria*, golfo San Jorge, Patagonia.

INTRODUCTION

Three anomuran decapod crustaceans of the Family Galatheidae are known to live along the coasts and in the shelf waters of the southwestern Atlantic Ocean: *Munida gregaria* Fabricius, 1793, *M. subrugosa* White, 1847, and *M. spinosa* Henderson, 1855 (Boschi *et al.*, 1992). The first two, considered to be one species in Australia (Williams, 1973, 1980), live in sub-littoral waters generally no deeper than 200 m. *M. spinosa*, however, is found in deeper waters (100-1000 m deep) (Boschi *et al.*, 1992).

In Argentina and Chile, *M. gregaria* and *M. subrugosa* have almost always been considered to be different species due to morphological differences in adult specimens (Retamal, 1981, 2000, Boschi *et al.*, 1992, Arntz *et al.*, 1999; Vinuesa, 2005). Recent studies again propose the existence of one only species, *M. gregaria* (Pérez-Barros *et al.*, 2005), having two morphotypes or highly differentiated subspecies, with *M. subrugosa* being the morphotypes inhabiting the gulf.

Galatheids fisheries have developed due to the very abundant populations of these organisms. Longhurst (1968) estimated the potential galatheids production in the Pacific Ocean, including the two *Pleuroncodes* species (*P. planipes*, *P. monodon*), to be 30,000 to 300,000 tons per year. In Chile, catches of the squat lobster (*P. monodon*) ranged from 809 tons per year in 2003 to 1254 tons per year in 2005. Landings of another species in this family, the yellow squat lobster (*Cervimunida johni*), were recorded at 1,929 and 3,002 tons per year tons in the same respective years (SERNAPESCA, 2006). There is no fishery exploiting the lobsters in San Jorge Gulf, although over 2,000 tons are estimated to be lost per year (CEDEPESCA, 2005).

It is important to study the feeding habits of species within a community, as such studies provide important information for understanding the regulation of the populations in a specific area; feeding habits affect abundance, growth, mortality, and possible migrations. It is also important to collect information on the trophic relationships existing between species that are abundant and/or important fishing resources and the rest of the species living in a given area, as this allows us to infer possible future effects on the populations when fishing pressure is applied to the species in question or those that interact with it.

The squat lobster, *Munida gregaria*, known as bogavante or langostilla in Argentina and langostino

in the Chilean channels, is one of the most abundant decapod crustaceans in the Atlantic Patagonian waters and the Tierra del Fuego Archipelago. Studies carried out in the coastal waters of the Strait of Magellan showed densities of 3 to 27 ind·m⁻² (Retamal & Gorny, 2001). In the Beagle Channel, densities of this species differ according to depth, with 1.03 ind·m⁻² at depths of less than 40 m and 0.27 ind·m⁻² at greater depths (Tapella, 2002).

The squat lobster is preyed on by various marine mammals such as whales (Matthews, 1932; Nemoto & Harrison, 1981), dolphins (Longhurst *et al.*, 1967; Schiavini *et al.*, 1997), sea lions (Rayner, 1935; Rodríguez & Bahamonde, 1986; Koen Alonso *et al.*, 1998), and the sea otter *Lutra felina* (Sielfeld, 1990). Other predators include a variety of marine birds including cormorants (Rodríguez & Bahamonde, 1986) and penguins (Thompson, 1993). However, most of the squat lobster's predators are fish that feed on the lobster during its different life stages (Moreno & Jara, 1984; Rodríguez & Bahamonde, 1986; Sánchez & Prenski, 1996). Mollusks such as *Octopus* sp. (Bahamonde & Rodríguez, 1985) and *Eledone massya* (Ré, 1998), the squid *Illex argentinus* (Brunetti *et al.*, 1998), and crustaceans such as the crabs *Lithodes santolla* and *Paralomis granulosa* (Campodónico & Hernández, 1983; Comoglio *et al.*, 1989; Balzi, 1999) are also mentioned as squat lobster predators in the literature.

San Jorge Gulf is located between 45 and 47° S, between 65°40'W and the coast. It represents an extremely important area within Argentinean fisheries. It is a rearing and fishing area for hake (*Merluccius hubbsi*), Patagonian prawn (*Pleoticus muelleri*), *Lithodes santolla*, and other important resources such as the elephant fish (*Callorhynchus callorhynchus*), and the pink cusk-eel (*Genypterus blacodes*), to name a few. All these species form a multispecific fishery that relies on fleets of highly differentiated fishing vessels, for example coastal or harbour-ria, high sea and mid-sea, and freezer vessels.

The diet of the studied galatheids covers a wide spectrum of feeding habits. Some species (e.g., *Pleuroncodes planipes*) feed almost exclusively on particulate organic matter (POM) (Aureoles-Gamboa & Pérez Flores, 1997) whereas others are detritivores (e.g., *Munida tenuimana*) (Cartés, 1993), opportunistic omnivores (e.g., *P. monodon*) (Madrid *et al.*, 1997), and even occasionally cannibals, as observed in *Munida gregaria* off New Zealand (Zeldis, 1985). Galatheids studied in the Beagle Channel showed

two different, simultaneous feeding behaviors: predation on algae, polychaetes, and crustaceans; and bottom-feeding, consuming POM and organisms associated with the surface sediment layer (Romero *et al.*, 2004).

The main objective of this article is to analyze squat lobster feeding and the diversity of the predators acting on this abundant species, which is an essential component of the demersal-benthic community in San Jorge Gulf.

MATERIALS AND METHODS

The present work was carried out along the central coast of San Jorge Gulf. Samples were taken between 1998 and 2000 in Caleta Cordova, Comodoro Rivadavia, and Caleta Paula using coastal vessels. Samples for the study of feeding behavior were obtained from freezer and high sea vessels in different sectors of San Jorge Gulf in 2005 and 2006 (Fig. 1). All samples were taken with bottom trawling nets with otters and/or beams; mesh sizes were 40 and 80 mm.

Stomach analyses were performed on ten samples taken in different sectors of the gulf and at different depths (Table 1). Sub-samples of 30-36 specimens of both sexes with carapace lengths (CL) over 10 mm were selected for the analysis. The CL was measured as in previous studies (Tapella *et al.*, 2002; Romero, 2003; Romero *et al.*, 2004). The repletion index was recorded for each stomach (RI: 0 = no content; 1 = < 25%; 2 = 25- 50%; 3 = 50-75%; 4 = > 75%).

Stomach contents were first observed with a stereomicroscope (20X) to identify the larger items and then under optical microscopes (40x and 100x). The frequency of occurrence of the different food items was calculated, as was the percentage of stomachs containing said item for the total stomachs analyzed in each sample.

Particulate organic matter (POM) has been defined as being composed of mucus from organisms, amorphous aggregates of previously dissolved organic matter, and complexes of associated microorganisms (Alldredge & Silver, 1988). Here, non-identified organic remains (RONI) were taken to be disintegrated and semi-digested tissular and cuticular animal remains that had been incorporated during feeding but that could not be identified.

In order to recognize *M. gregaria* predators, regardless of the squat lobster life stage, catches of diverse organisms from five coastal cruises were analyzed. A total of 124 specimens of 32 fish species, 26 specimens of 4 mollusk species, and 25 specimens of 6 crustacean species were collected. Possible predators were identified on board the fishing vessels. The animals were selected for study when haul catches also included squat lobster; only animals with squat lobster in their stomachs were considered. Large fish were dissected, their stomachs extracted, and the contents analyzed macroscopically *in situ*. For small fish, the stomachs were removed or entire specimens were fixed in 7-8% formalin solution in sea water for later analysis. Individuals caught in sport fishing and manually along the coastal shoals and beaches near Comodoro Rivadavia were also considered, including an important number of live crabs caught off the beaches of Rada Tilly (2001-2002).

Table 1. Capture dates, geographic position and depth of tows where samples were obtained.

Sample	Date	Geographic position	Depth (m)
1	Jan-05	45°10'S - 66°15'W	40
2	May-05	45°25'S - 66°45'W	45-50
3	Aug-05	45°12'S - 66°34'W	35-40
4	Nov-05	45°08'S - 66°01'W	40-45
5	Aug-00	45°56'S - 67°15'W	70
6	Aug-01	46°13'S - 67°30'W	40
7	Aug-01	46°25'S - 66°20'W	90
8	Oct-01	45°10'S - 66°20'W	20-30
9	May-01	45°52'S - 67°20'W	50-55
10	Jun-00	45°48'S - 67°08'W	84

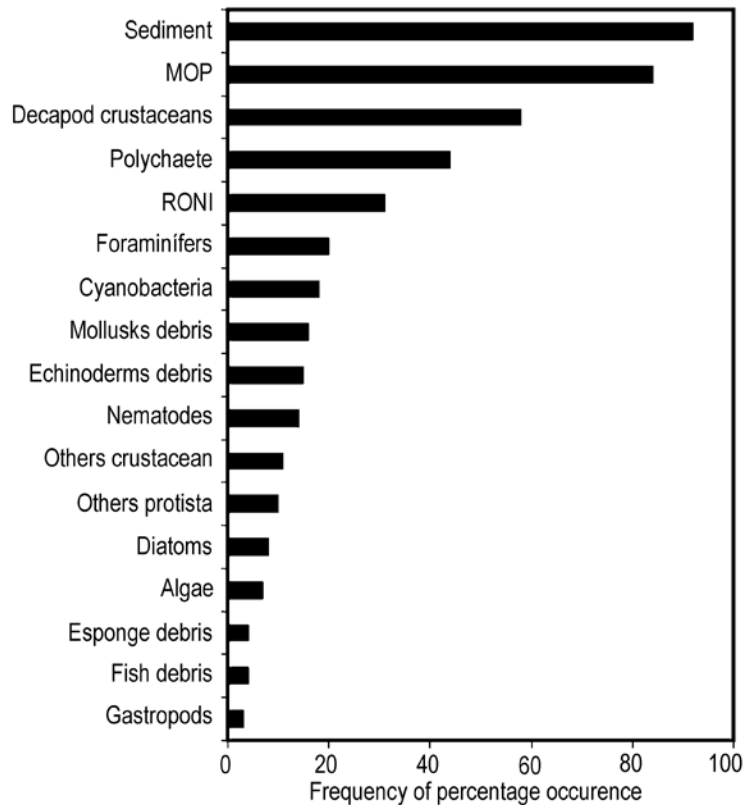


Figure 1. Diet composition of *Munida gregaria*. MOP: particulate organic matter, RONI: not identified organic debris.

RESULTS

Altogether, 306 specimens of both sexes were analyzed; 57.2% were male. The average CL was 16.7 ± 1.39 mm for females and 21.3 ± 2.36 mm for males. The RI varied from 0 to 4 in the studied specimens. Empty stomachs (RI = 0) were found in 9.2% of specimens ($n = 28$) and complete stomachs (RI = 4) in 5.5% of them.

Figure 2 indicates the frequency of occurrence of food items found in the stomachs with content. In 84% of the squat lobster, amorphous POM was found; 92% had sediments. In all cases, POM represented the highest relative proportion of stomach content in the studied animals.

Decapod crustaceans were the second most important food item (58%). Patagonian prawn (*Pleoticus muelleri*) was the most frequent item and bits of squat lobster were also observed, although less frequently. Non-determined peracarid crustacean remains, ostracods, and copepods were also found.

Polychaetes represented an important food item.

Parapodia bits and chaetae that were isolated or found with tissue remains were observed in 44% of the squat lobster, indicating that the squat lobster frequently prey on this group.

Non-identified organic remains were also important (31%); they are believed to come mainly from highly digested crustaceans and polychaetes.

Cyanobacteria of the genera *Chlorococcus* sp. and *Microcoleus* sp. and dinoflagellates such as *Ceratium* sp. and probably *Alexandrium* sp. were also observed in the stomach contents of the squat lobsters.

Remains of red algae were scarce and consisted largely of *Plocamium* sp. and other non-determined species not normally found on the bottoms frequented by the species (soft bottoms at depths greater than 30-40 m). Diatom frustules corresponded mainly to the centric groups; the genera found were *Coscinodiscus* sp., *Triceratium* sp., *Pseudo-nitzschia* sp. and *Chaetoceros* sp., although their presence was limited.

Foraminifera were represented by various species, mainly *Elphidium* sp., *Cassidulina* sp., *Quin-*

queloculina sp., *Oolina* sp., *Eponides* sp., *Pyrgo* sp., and *Lagena* sp. Remains of other loricate protists, probably thecamoebae and/or tintinnids, were also found.

Scarce remains of sponges were found, as were spicules having 2 to 4 radia and, possibly, spongin fibers. Mollusks were determined to be prey due to the presence of gastropod radulae. Other mollusk remains consisted exclusively of very disintegrated and small shell debris of gastropods and bivalves, probably ingested along with the sediments. The same seems to have happened with echinoderms, as highly disintegrated plates typical of Holothuroidea, spines, and remains of sea urchin and ophiuroid caprapaces, as well as fish scales were recorded.

In the predator stomachs, the bright orange color of the squat lobsters facilitated their identification in most cases. However, determining the amount of squat lobsters consumed was not so simple because the remains were usually divided and partially disintegrated or in an advanced state of digestion.

Table 2 shows the predator species and the number of animals analyzed. No squat lobsters were observed in the stomach contents of the following fish: *Galeorhinus galeus* (tope shark), *Myliobatis goodei* (southern eagle ray), *Parona signata* (Parona leatherjacket), *Stromateus brasiliensis* (butterfish), *Seriotelella punctata* (silver warehou), *Percophis brasiliensis* (Brazilian flathead), *Prionotus* sp. (searobin), and *Squatina guggenheim* (angular angel shark). Two fish of each species were studied, except for the tope shark, for which four specimens were analyzed.

Several of the analyzed species are very rare in the study area because they are distributed in the temperate-warm waters of the Argentina Province. This is the case of the angular angel shark, the southern eagle ray, and the searobin. Their presence in the gulf indicates an important penetration of a temperate-warm water mass.

No remains were found in the crabs *Peltarion spinulosum*, *Libidoclaea granaria*, and *Platyxanthus patagonicus*.

DISCUSSION

Previous studies indicate that galatheids characteristically feed on surface organic detritus. This strategy is alternated with other feeding methods such as predation and necrophagia (Nicol, 1932; Garm &

Hoeg, 2000; Madrid *et al.*, 1997; Romero, 2002; Romero *et al.*, 2003).

In San Jorge Gulf, the squat lobster feeds on a reduced variety of benthic organisms. The stomach contents of nearly all the studied animals were mostly POM and sediments (fine sand, silt) with detritus (mollusk shells, skeletal remains of crustaceans and echinoderms) that were at times nearly reduced to the size of coarse sand grains. The squat lobster stomach contents also included sponge spicules, fish scales, and other remains that are were probably part of the surface sediments on the bottoms where these animals live.

In general, few findings indicate that this species acts as an active predator. The presence of algae, for example, indicates the ingestion of algal remains from shallow waters, since there are no algae on the bottoms where the samples were taken. Mollusks are also underrepresented in the diet and it is possible that their frequency is underestimated due to the consistency of their meat. The observed radulae indicate predation on some unidentified gastropod. Although there are various abundant bivalves in the area (e.g., *Nuculana sulculata*, *Nucula puelcha*, *Kennerleya patagonica*; Roux & Fernández, 1997), no remains were found that indicated predation on these species. Selectivity studies carried out on decapod crustaceans have demonstrated a negative selection on the mollusks, probably due to the species' inability to handle the specimens (Juanes, 1992). In the Beagle Channel, mollusks represented less than 1% of the relative abundance of the prey (Romero *et al.*, 2004).

Necrophagia is a typical feeding behavior of decapod crustaceans. It is likely that crustaceans probably avoid feeding on some species when they are alive, but do feed on them when they are dead or decomposing. This can be seen in the decapod crustacean fisheries that bait their traps with dead animal remains. Sampling in Nuevo Gulf is being done by baiting the squat lobster traps with hake spines; this method has been very successful (P. Barón, pers. comm.) The presence of *Pleoticus muelleri* and squat lobster in the stomachs may result from feeding on dead animals that are quite common in the by-catch of coastal and beam-fishing vessels. This could also be the case with fish, although only scales were found and these at very low frequencies.

Only polychaetes and some gastropods seem to be preyed on by the squat lobster, although it is possible that this extends to peracarid crustaceans in some isolated cases. The animals in which these

prey were found were all males. This could be due to the large size and development of the chelipods, which would give them an advantage over the female squat lobsters. This reveals an important correlation, as females have a higher rate of POM assimilation than males, whereas males assimilate prey organisms better than females (Romero *et al.*, 2006).

The number of species involved in feeding in San Jorge Gulf is lower than that recorded in the Beagle Channel. Here, the species presents the two aforementioned habits: preying on small macroalgae and crustaceans and bottom-feeding, with POM constituting the main energy source for the species (Romero, 2002). This has also been observed in other galatheids, such as *Munida tenuimana* (Cartés, 1993) and *Pleuroncodes planipes* (Aureoles-Gamboa & Pérez Flores, 1997).

In San Jorge Gulf, the squat lobster is basically a bottom-feeder that sweeps the sea floor, scavenging particles with its third pair of maxillipeds. When doing this, they find non-digestible material such as sand, silt, and the hard remains of dead organisms, but also living organisms such as bacteria and protists, the remains of decomposing organisms, and POM that can be assimilated. The squat lobster tears up the dead organisms and eats the meat and organs. Thus, as found in the Beagle Channel, the species represents an important link between POM and many benthic and demersal top predators.

Due to its particular bathymetry, San Jorge Gulf is a very favorable environment for the accumulation of organic substances, principally contributed by organisms that develop their life cycle in this area. In the coastal areas, the bottoms are made up of gravel and sand, and mud predominates in deeper areas, without algae and colonial fauna, which are common in shallow waters with coarse granulometry (Roux *et al.*, 1995; Fernández *et al.*, 2003). Here, there is an important flux of organic matter to the sea bottom, mainly in the central area, that represents a depositional environment with fine-textured sediments and an accumulation of organic detritus from the water column (Fernández *et al.*, 2005). These elements are taken advantage of by the fauna, which is dominated by filtering bivalves, sea urchins, polychaetes (Roux & Fernández, 1997) and, temporarily, adult squat lobster. The area in the western sector of the gulf with depths of less than 80 m is covered with sand and mud with deposits of mixed organic detritus; this area is the most frequented by the species.

The squat lobster also plays a preponderant role

in the gulf's ecosystem due to its abundance. Coastal hauls between 40 and 60 m depth have been recorded in which squat lobster was the main catch, reaching over 300 kg per haul (G. Giannotta, pers. comm.). Some trawls have resulted in densities of 0.1 to 2.1 lobsters·m² (Vinuesa, unpublished). Considering that the mesh size of the nets is 4 to 8 cm in diameter, these figures can be seen to be underestimates of the real amounts.

Its small size, its considerable chemical composition (33.5% proteins, 11.25% lipids) (Vinuesa *et al.*, 2002), and its ability to form large agglomerations makes this species a favorite prey of many animals.

Our findings show 24 fish species, four crustacean species, and four mollusk species that prey on the squat lobster. In San Jorge Gulf, nine species were found to feed on the squat lobster: *Dyscophye tschudi*, *Atlantoraja cychlophora*, *Cheilodactylus bergi*, *Patagonotothen ramsayi*, *Odonthestes smitti*, *Eurypodius latreillei*, *Ovalipes trimaculatus*, *Loligo gahi*, and *Enteroctopus megalocyathus*. These species have not been mentioned in previous studies.

Squat lobster is the main prey year-round of many benthic-demersal fishes also recorded in this study: *Genypterus blacodes* and *G. brasiliensis*, *Dipturus flavirostris*, *Psammobatis scobina*, *Sympterigia bonapartei*, *Acanthistius brasilianus*, *Salilota australis*, *Sebastes oculatus*, *Pseudoperca semifasciatus*, *Xistreuris rasile*, and *Cottoperca gobio* (Sánchez & Prenske, 1996).

In Chile, nine species mentioned in Table 2 also belong to those preying on the squat lobster: *Schroederichthys bivius*, *Salilota australis*, *Macrurus magellanicus*, *Merluccius hubbsi*, *Cottoperca gobio*, *Callorhynchus callorhynchus*, *Dipturus flavirostris*, *Lithodes santolla*, and rays of the genera *Psammobatis* (Rodríguez & Bahamonde, 1986). Three cormorant species are also mentioned, as are three species of sea lions *Arctocephalus australis*, *A. gazella*, *Otaria byronia*, and several flounder and other fish in the area, including snoek (*Thyrssites atun*). The Notothenidae from the Magellanic area deserve a special mention since six of the eight species frequent in the Tierra del Fuego channels have been recorded as predators of the squat lobster (Moreno & Jara, 1984; Isla & San Román, 1995). *Lithodes santolla* has also been mentioned as a predator of the species, both in the Beagle Channel (Comoglio *et al.*, 1989; Tapella *et al.*, 2002) and in San Jorge Gulf (Balzi, 1999), as has *Paralomis granulosa* in

Table 2. Registered predators, and total number of analyzed animals and with *Munida gregaria* in its stomachs.

Species	Common name	Total number	Number of animals with lobster krill	English name
FISHES				
<i>Sympterygia bonapartei</i>	Raya marmolada	5	5	Smallnose fanskate
<i>Discopyge tschudii</i>	Torpedo	4	4	Electric ray, Apron ray
<i>Dipturus chilensis</i>	Raya nariguda	5	5	Yellownose skate, Barn-door skate
<i>Psammobatis</i> sp.	Raya	6	6	Sand skate
<i>Atlantoraja cychlophora</i>	Raya ojona	2	2	Eyespot skate
<i>Mustelus schmitti</i>	Gatuzo	5	3	Narrownose smooth-hound
<i>Schroederichthys bivius</i>	Pintarroja	5	5	Narrowmouthed catshark
<i>Callorhynchus callorhynchus</i>	Pez gallo	7	4	Elephantfish
<i>Engraulis anchoita</i>	Anchoíta	12	3	Argentine anchovy
<i>Merluccius hubbsi</i>	Merluza común	10	4	Argentine hake
<i>Macruronus magellanicus</i>	Merluza de cola	3	1	Patagonian grenadier, longtail hake
<i>Genypterus blacodes</i>	Abadejo	5	3	Pink cusk-eel, Golden King ling
<i>Genypterus brasiliensis</i>	Abadejo	2	1	Kingclip
<i>Acanthistius brasilianus</i>	Mero	3	2	Argentine sea bass
<i>Salilota australis</i>	Bacalao del sur	2	2	Tadpole codling, Tadpole mora, Patagonian cod
<i>Cottoperca gobio</i>	Cotoperca	3	2	Thorfish
<i>Cheilodactylus bergi</i>	Castañeta	2	1	Hawkfish
<i>Sebastodes oculatus</i>	Cabrilla	3	1	Scorpionfish
<i>Patagonotothen ramsayi</i>	Nototenia	2	1	No common name
<i>Eleginops maclovinus</i>	Róbalo	6	1	Antartic rock cod, Nullet, Patagonian blenny
<i>Xystreuris rasile</i>	Lenguado	3	2	Large-tooth flounder
<i>Polyprion americanus</i>	Chernia	2	1	Wreckfish
<i>Pseudopercis semifasciata</i>	Salmón de mar	3	2	Argentinian sandperch
<i>Odonthestes smitti</i>	Pejerrey	6	1	Silverside
CRUSTACEAN				
<i>Eurypodius latreillei</i>	Cangrejo araña	10	1	Spider crab
<i>Leurocyclus tuberculosus</i>	Cangrejo araña	4	1	Spider crab
<i>Ovalipes trimaculatus</i>	Cangrejo nadador	6	1	Swimming crab
<i>Lithodes santolla</i>	Centolla	5	3	Southern king crab
MOLLUSKS				
<i>Illex argentinus</i>	Calamar	20	18	Argentine shortfin squid (FAO)
<i>Loligo gahi</i>	Calamarete	4	3	Patagonian squid
<i>Enteroctopus megalocyathus</i>	Pulpo colorado	1	1	Southern octopus
<i>Eledone massyae</i>	Pulpo blanco	1	1	Combed octopus

the Beagle Channel (Comoglio *et al.*, 1989).

It is clear that the list of predators indicated in this article is partial, although it includes the extensive study on demersal fishes carried out by Sánchez & Prenski (1996). Nonetheless, it is very possible that other fish species and sea animals feed on the squat lobster in the waters of San Jorge Gulf. Some fish in which the squat lobster was not found probably feed on it occasionally, as is the case of the southern eagle ray and the angular angel shark, both benthic species. No squat lobsters were found in the pelagic parona leatherjackets, which feed mainly on juvenile fish and zooplankton (Cousseau & Perrotta, 2000). Although benthic, the Brazilian flathead feeds only on fish (Cousseau & Perrotta, 2000). Oddly, the squat lobster was not found in the tope shark (it was also not mentioned by Sánchez & Prenski, 1996), nor was it found in the searobin, which feeds on benthic crustaceans (Cousseau & Perrotta, 2000).

Birds and mammals were not included in this work; however, many species prey on the squat lobster in other places. In some seasons of the year, it is very common to see seagull guano with disintegrated remains of squat lobster carapaces; the same has been observed in places frequented by cormorants, penguins, and other sea birds. The ever-increasing frequency of the whale *Eubalaena australis* in the gulf's waters may be due to a search for food, as this species has also been mentioned as a predator of squat lobsters in Patagonian waters (Mathews, 1932; Rayner, 1935).

Many organisms have been observed to feed on adult specimens of *M. gregaria*, but fewer feed on postlarvae and juveniles of the species. Only the Argentine anchovy, (Table 2) and, previously, squid have been found to feed on the larvae (Brunetti *et al.*, 1989). Other fish and planktophagous organisms in the gulf could possibly feed on larvae, for example the sardine *Sprattus fuegiensis*. Still others could feed on squat lobster larvae and juveniles, for example both parona leatherjackets analyzed herein, the choicy ruff (*Seriotelella porosa*), and other fish and animals.

The species is also found in the Nuevo, San José, and San Matías gulfs, where other benthic-demersal fish, also possible predators, are abundant (e.g., porgies, croakers, sandperchs, flounders, silver sides and other rays). These species are not present in San Jorge Gulf and the more southern temperate-warm waters.

Squat lobster may be easy for the fishing industry

to extract if a decision was made to exploit them, as has occurred with similar species in the Pacific Ocean. However, mid-scale and especially small-scale fishing can reduce the stability of the gulf's trophic web. The squat lobster approaches the coast during the breeding season (Vinuesa, 2007) where it forms considerable concentrations, making it easy to catch. It is believed that, if exploitation of this resource begins, it should be done through the by-catch of the current fisheries, which has been estimated to be approximately 2,000 tons (CEDEPESCA, 2005).

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