

ON THE PRESENCE OF *PARALOMIS SPINOSISSIMA* AND *PARALOMIS FORMOSA*
IN CATCHES TAKEN DURING THE SPANISH SURVEY ANTARTIDA 8611

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Abstract

This paper provides information on Antarctic crabs obtained during the 1986 Spanish survey *ANTARTIDA 8611*, which covered the shelf around all the archipelagos in the Scotia Sea. A total of 345 hauls was conducted, of which 29 took place around Shag Rocks, 104 at South Georgia, eight around the South Sandwich Islands, 93 around the South Orkneys, 46 at Elephant Island and 65 around the South Shetlands. Depths surveyed ranged from 63 m down to 643 m. In the whole of the area surveyed, the two crab species of the genus *Paralomis* (*P. spinosissima* and *P. formosa*) were found only around Shag Rocks and South Georgia. *P. spinosissima* was caught in seven hauls of the 29 made around Shag Rocks and in 20 of the 104 hauls made at South Georgia. *P. formosa* was caught twice, once in each zone. The bathymetric distribution of *P. spinosissima* ranged from 160 to 627 m and that of *P. formosa*, far less frequent in the catches, from 320 to 350 m. Field observations showed that these two species were absent from the southern archipelagos of the Scotia Arc (South Orkney, Elephant Island and South Shetland), at least in the depth range surveyed. The location of the hauls where *Paralomis* spp. were found, together with the qualitative composition of the fish fauna usually accompanying them in the catches, suggest that *P. spinosissima* and *P. formosa* tend to concentrate in areas close to the shelf break, where environmental conditions show some degree of stability.

Résumé

Ce document fournit des informations obtenues sur les crabes antarctiques pendant la campagne espagnole *ANTARTIDA 8611* effectuée en 1986, laquelle a couvert le plateau de tous les archipels de la mer du Scotia. Au total, 345 traits ont été effectués : 29 autour des îlots Shag, 104 en Géorgie du Sud, huit autour des îles Sandwich du Sud, 93 autour des îles Orcades du Sud, 46 à l'île Eléphant et 65 autour des îles Shetland du Sud. L'intervalle de profondeur couvert par la campagne s'étendait de 63 à 643 m. De tout le secteur couvert, seules les zones entourant les îlots Shag et la Géorgie du Sud étaient fréquentées par les deux espèces de crabes du genre *Paralomis* (*P. spinosissima* et *P. formosa*). La première espèce était présente dans sept des 29 traits effectués autour des îlots Shag et dans 20 des 104 traits proches de la Géorgie du Sud. *P. formosa* a été pêché à deux reprises : une fois dans chaque secteur. La répartition bathymétrique de *P. spinosissima* s'étendait de 160 à 627 m; celle de *P. formosa*, espèce nettement plus rare dans les captures, de 320 à 350 m. Les observations sur le terrain mettent en évidence l'absence de ces deux espèces dans les archipels du sud de l'arc du Scotia (Orcades du Sud, île Eléphant et Shetland du Sud) au moins dans l'intervalle bathymétrique couvert par la campagne. L'examen de la position des traits dans lesquels se trouvaient *Paralomis* spp., et celui de la composition qualitative de la faune ichtyologique qui les accompagnaient dans les captures laissent entendre que *P. spinosissima* et *P. formosa* ont tendance à se concentrer dans des régions proches de la rupture de pente, là où les conditions de l'environnement présentent un certain degré de stabilité.

Резюме

В настоящей работе приводится информация об антарктических крабах, полученных в ходе испанского рейса *АНТАРТИДА 8611*, проводившегося в 1986 г. и охватившего шельф вокруг всех архипелагов моря Скотия. В итоге выполнены 345 тралений: 29 вокруг скал Шаг, 104 в районе Южной Георгии, 8 у Южных Сандвичевых о-вов, 93 у Южных Оркнейских о-вов, 46 вокруг о-ва Элефант и 65 у Южных Шетландских о-вов. Съёмки проводились на глубинах 63 до 643 м. Во всем обследованном районе оба вида краба рода *Paralomis* (*P. spinosissima* и *P. formosa*) вылавливались только вокруг скал Шаг и Южной

Георгии. Из 29 тралений, проводившихся вокруг скал Шаг, вид *P. spinosissima* встречался в семи, а из 104 тралений в районе Южной Георгии - в 20. Вид *P. formosa* облавливался дважды - по одному разу в каждой зоне. Батиметрическое распределение в случае вида *P. spinosissima* - 160-627 м, а в случае вида *P. formosa*, который встречался в уловах намного реже, - 320-350 м. Согласно результатам полевых наблюдений эти два вида отсутствуют в южных архипелагах дуги Скотия, - по крайней мере в обследованном глубинном диапазоне. Местонахождение тралений, в которых присутствовали *Paralomis* spp., а также качественный состав сопутствующего прилова рыб, указывают на то, что *P. spinosissima* и *P. formosa* образуют концентрации в районах, близких к шельфовой границе, где условия окружающей среды в определенной степени стабильны.

Resumen

Este documento proporciona información relacionada con las centollas capturadas durante la campaña española ANTARTIDA 8611, que fue realizada en 1986 en la zona de la plataforma de todos los archipiélagos del mar de Scotia. Se efectuaron un total de 345 lances, de los cuales 29 se realizaron alrededor de las rocas Cormorán, 104 en Georgia del Sur, ocho alrededor de las islas Sandwich del Sur, 93 alrededor de las Orcadas del Sur, 46 en la isla Elefante y 65 alrededor de las islas Shetland del Sur. Las profundidades de estudio oscilaron entre los 63 y 643 metros. En toda la zona de prospección sólo se encontraron las dos especies del género *Paralomis* (*P. spinosissima* y *P. formosa*) en las proximidades de las rocas Cormorán y Georgia del Sur. *P. spinosissima* fue capturada en siete de los 29 lances llevados a cabo alrededor de las rocas Cormorán y en 20 de los 104 lances realizados en Georgia del Sur. *P. formosa* fue capturada una vez en ambas zonas. La distribución batimétrica de *P. spinosissima* osciló entre 160 y 627 metros y la de *P. formosa*, menos frecuente en las capturas, entre 320 y 350 metros. Las observaciones realizadas durante la campaña indican que estas dos especies no están presentes en los archipiélagos del sur del arco de Scotia (Orcadas del Sur, isla Elefante y Shetland del Sur), al menos en los estratos de profundidad estudiados. La situación de los lances donde se capturaron *Paralomis* spp., así como la composición cualitativa de la fauna íctica que generalmente se encontró en las capturas, indica que *P. spinosissima* y *P. formosa* suelen concentrarse en áreas próximas a la zona de ruptura de la plataforma donde las condiciones medioambientales presentan un cierto nivel de estabilidad.

Keywords: Southern Ocean, Scotia Sea, *Paralomis* spp., distribution, CCAMLR

INTRODUCTION

In July 1992 exploratory fishing for Antarctic crabs (*Paralomis spinosissima* and *Paralomis formosa*) was carried out in waters around South Georgia and Shag Rocks by the US vessel FV *Pro Surveyor*. The data collected during this experimental fishing cruise form an important basis for the estimation of the potential yield of these resources, and provide some valuable information on the biology of the two species fished. However, the information obtained was clearly insufficient to assess the state of the stocks and the CCAMLR Scientific Committee subsequently agreed to convene a workshop to specify the data needed and the actions required to acquire the data from the exploratory crab fishery that would allow the development of assessment methods and the estimation of appropriate harvest levels. This paper constitutes

a contribution to that workshop and contains the most relevant information on the general distribution of the two species of Antarctic crabs in the Scotia Sea, extracted from the data collected during the Spanish survey ANTARTIDA 8611.

MATERIAL AND METHODS

The Spanish survey ANTARTIDA 8611 was carried out from November 1986 to February 1987, covering the shelf around all the archipelagos in the Scotia Sea (Atlantic sector).

In total, 345 hauls (29 around Shag Rocks, 104 around South Georgia, eight around South Sandwich, 93 around South Orkneys, 46 at Elephant Island and 65 around the South Shetlands) were conducted at depths of 63 to 643 m using a commercial trawl and following a

stratified random sampling procedure as described in Balguerías (1989). In determining the sampling intensity in each stratum, account was taken of the size of the stratum and the abundance of the main species. Tows were 30 minutes in duration and the vessel speed was three knots.

The trawl used for sampling was selected according to the main objectives of the cruise, which were to determine the general distribution of the species of crustaceans, molluscs and fish present in the area, and to estimate the abundance of those species presenting some commercial interest. Thus, the bottom trawl had a horizontal opening of 12 m, a vertical opening of 3.5 m, a mesh size of 68 mm in the codend and was equipped with three sections of rollers (56 cm in diameter) on the footrope, to enable it to work on all kinds of seabed. The trawl headrope was 33 m long and the footrope 42 m long.

Obviously this is not the best way of estimating the total abundance of crabs because of the associated problems of catchability. Nevertheless, the results obtained have been considered useful in terms of improving the existing information and giving an approximation of the general pattern of distribution of Antarctic crabs in the Scotia Sea.

This paper includes all the information on the species studied which is available from the surveys carried out within the region. In the general context of the survey, the procedure used to collect information on by-catch species, among which *Paralomis* spp. were included due to their rare occurrence in the catches, was irregular. Sometimes the sex, individual weight or total weight of the specimens were not recorded.

RESULTS

Table 1 summarises the information regarding the presence of *P. spinosissima* and *P. formosa* in the catches including haul number, haul location, initial and final depths of the haul and the species of fish caught together with the crabs. It also contains information on the occurrence of ovigerous females in the hauls.

In total, 64 individuals of both species of crabs were caught during the cruise, with a maximum of nine specimens being taken in a single haul (station 140). They were found to be present only around Shag Rocks and South Georgia. Figures 1

and 2 show the position of the hauls conducted in the two archipelagos and also indicate the hauls in which specimens of crabs were caught.

P. spinosissima occurred far more frequently in the catches than *P. formosa*, occurring in seven of the 29 hauls (24.14%) carried out around Shag Rocks and in 20 of the 104 (19.23%) conducted around South Georgia. *P. formosa* was only present in two hauls (once in each archipelago), in one of which it appeared together with *P. spinosissima*.

From the 11 hauls for which information on sex was recorded, it was observed that 61.9% of *P. spinosissima* females were ovigerous, and in haul number 160 the only female caught was carrying hatched eggs. Ovigerous females were caught in five hauls conducted to the south and east of South Georgia, at depths ranging between 199 and 450 m; in these cases all the females were ovigerous.

P. spinosissima was found in hauls made to the north and south of Shag Rocks (Figure 1). At South Georgia (Figure 2), the species was found in hauls carried out all around the archipelago except in a small area traversed by a multitude of submarine canyons, situated to the northwest of the main island. A concentration of eight consecutive hauls, made on the southwestern shelf bordering an area of untrawlable grounds, contained *P. spinosissima*. This circumstance prevented any further evaluation of the size and extent of the concentration.

The bathymetric range covered during the whole cruise was from 63 to 627 m. Within these limits *P. spinosissima* appeared at depths of 160 to 627 m, whereas *P. formosa* was taken at depths of 350 and 320 m, at stations 44 and 178 respectively. Sedimentological analyses performed on the grounds surveyed (Acosta *et al.*, 1989) showed that crabs were mainly associated with areas where the bottom surface was composed of 60 to 90% mud, 25 to 30% sand and the remainder gravel. However, the presence of certain species of invertebrates in some of the hauls also suggests the possibility that the gear was trawling on a rough bottom.

Several species of fish were present in all catches containing crabs (Table 1). The most important in terms of the number of specimens present were *Muraenolepis* spp. (77.78%) and *Champscephalus gunnari* (66.67%), followed by *Gymnoscopelus nicholsi* (62.96%) and *Notothenia*

Table 1: Species caught around Shag Rocks and South Georgia, including an indication of their presence in various hauls.

HaulNumber Initial Depth (m) Final Depth (m)	Shag Rocks							South Georgia																	No. of Hauls	%		
	13 415 503	14 167 162	15 199 232	32 213 213	34 382 627	36 335 321	44 350 348	52 330 336	74 177 170	75 390 420	76 215 184	84 185 190	87 393 396	88 397 396	89 538 381	90 449 370	136 234 238	140 216 199	142 283 276	147 248 215	150 480 460	154 160 215	160 250 205	163 265 304			172 450 343	173 342 373
<i>Paralomis spinosissima</i> No.	1	1	1	2	4	1	3	1	1	2	2	1	1	3	1	5	1	9	2	1	4	1	2	1	6	4	26	96.30
Weight (kg)	0.25	0.35	0.13	1.6	1.45	0.06		1.1	0.91										0.25	2.13		1.55						
Females	1								2-Ov				2-Ov		1		7-Ov	2				1	1-Ov		1-Ov	4		
Males										2				1	4		2							5				
<i>Paralomis formosa</i> No.						1																				2	2	7.41
<i>Pareledone</i> sp.				+				+	+	+		+	+				+			+	+	+					11	40.74
<i>Moroteuthys</i> sp.								+																	+	+	3	11.11
<i>Euphausia superba</i>	+							+																			2	7.41
<i>Raja georgiana</i>																									+		1	3.70
<i>Bathyraja murrayi</i>																											0	0.00
<i>Bathyraja</i> sp.	+							+																			2	7.41
<i>Pogonophryne</i> sp.									+													+					2	7.41
<i>Parachaenichthys georgianus</i>																				+							1	3.70
<i>Pseudoicichthys australis</i>																									+		1	3.70
<i>Mancopsetta maculata antarctica</i>			+			+				+											+						4	14.81
<i>Chaenocephalus aceratus</i>								+	+		+	+	+			+	+		+	+	+	+	+	+			10	37.04
<i>Champocephalus gunnari</i>		+	+	+		+		+	+	+	+	+				+	+	+	+	+	+	+	+	+	+	18	66.67	
<i>Pseudochaenichthys georgianus</i>								+			+					+	+					+	+		+	7	25.93	
<i>Micromesistius australis</i>													+														1	3.70
<i>Paraliparis</i> spp.	+				+	+	+			+		+	+	+	+			+	+	+	+			+	+	14	51.85	
<i>Genioliparis</i> sp.																											0	0.00
<i>Muraenolepis</i> spp.		+	+		+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	21	77.78	
<i>Gymnoscopelus nicholsi</i>	+	+			+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	17	62.96	
<i>Electrona</i> sp.	+									+										+	+	+	+	+	+	4	14.81	
<i>Dissostichus eleginoides</i>	+	+			+	+	+							+				+	+	+	+	+	+	+	+	12	44.44	
<i>Notothenia gibberifrons</i>								+	+		+	+				+	+	+	+	+	+	+	+	+	+	10	37.04	
<i>Notothenia kempii</i>			+		+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	17	62.96	
<i>Notothenia rossii</i>																		+	+							3	11.11	
<i>Notothenia squamifrons</i>																										0	0.00	
<i>Nototheniops larseni</i>								+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	15	55.56	
<i>Nototheniops nudifrons</i>									+							+	+	+	+			+	+		+	6	22.22	
<i>Pagothenia hansonii</i>				+																			+		+	3	11.11	
<i>Patagonotothen guntheri</i>	+	+	+		+	+	+																			7	25.93	
<i>Trematomus newnesi</i>	+	+																								2	7.41	

Ov = Ovigerous females

SOUTH GEORGIA

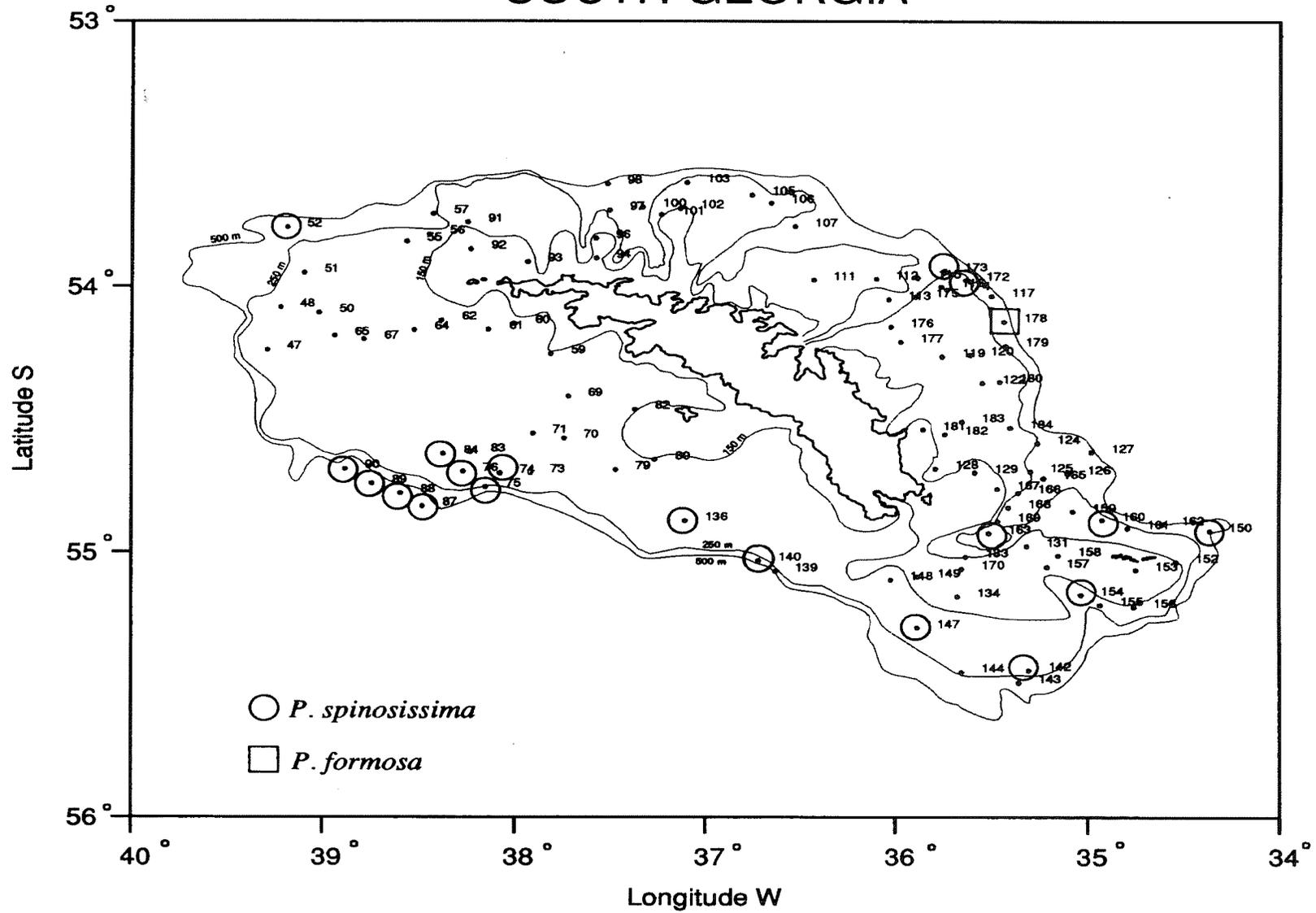


Figure 1: Trawls carried out around South Georgia. Location of the hauls with catches of *Paralomis* spp.

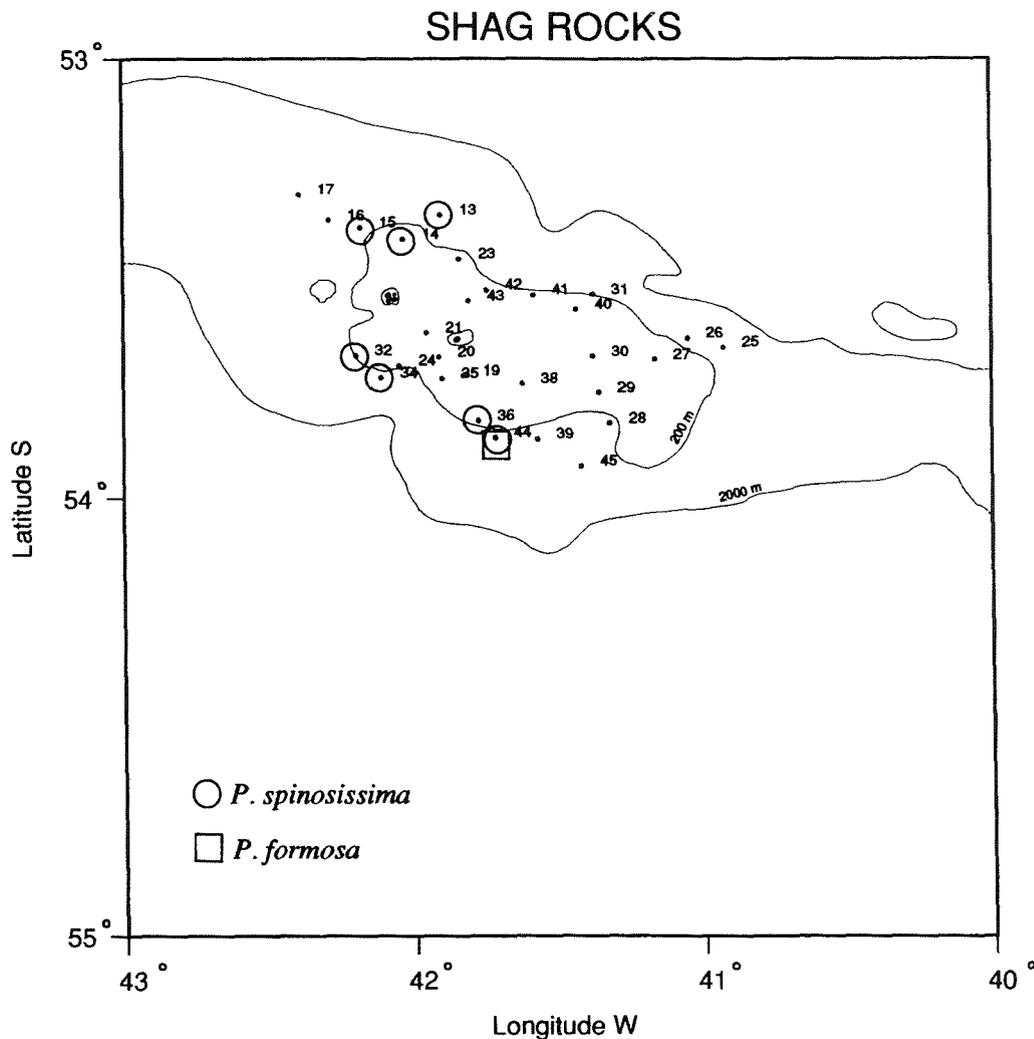


Figure 2: Trawls carried out around Shag Rocks. Location of the hauls with catches of *Paralomis* spp.

kempi (62.96%). *Nototheniops larseni* was observed in 55.56% of the hauls carried out around South Georgia. Other species with levels of occurrence close to 50% were *Paraliparis* spp. (51.85%) and *Dissostichus eleginoides* (44.44%).

DISCUSSION

The information collected during the Spanish survey ANTARTIDA 8611 suggests that neither of the two species of Antarctic crabs is present in the archipelagos which make up the Scotia Arc apart from Shag Rocks and South Georgia, at least in the bathymetric range of 63 to 643 m. However, at the time of the cruise there were some well grounded doubts as to whether this assertion was valid for South Sandwich, given that the quality of the sea bed over the shelf did not allow a good coverage of the area to be made (only eight hauls were possible). In fact during the 1992/93 season, a Chilean longliner fishing for *D. eleginoides* in the northern

part of the archipelago caught a few specimens of *Paralomis* spp. (Rubilar *et al.*, 1993) grasping onto baited hooks.

In the South Orkneys and South Shetlands and at Elephant Island the intensity of sampling was sufficiently high in terms of area, as well as in the range of depths surveyed, to have found traces of the two species if they had been present. Moreover, the shelf around South Orkney has been more recently worked over, 130 hauls having been made during the Spanish survey ANTARTIDA 9101 without a single specimen of Antarctic crab having been caught (Balguerías, pers. comm.). Therefore, the only possibility that these species are to be found in the southern archipelagos of the Scotia Arc, given the high level of sampling reached in both surveys (93 hauls in 1986 from 50 m to 516 m and 130 hauls in 1991), is that they occur in waters deeper (below 500 m) than those around Shag Rocks and South Georgia.

This evidence would seem to be in contradiction with the area of distribution of *P. spinosissima* and *P. formosa* proposed by Macpherson (1988), which includes South Georgia and the Scotia Sea for the former species and South Georgia, South Orkney and surrounding areas for the latter. Therefore, it would also be in opposition to the direct calculation made by Otto and MacIntosh (1992), in which they extrapolate the mean density of both species around Shag Rocks and South Georgia to the South Orkney shelf in order to estimate their potential yield in the Atlantic sector.

Analysis of the available literature, together with the information contained in this paper, indicates that the area studied is on the southernmost limit for the species family *Lithodidae* in the Atlantic Ocean. Therefore, a theoretical southern boundary around 60°S could be proposed for the distribution of these crabs. This boundary could be applied to the *Lithodidae* from the Indian and Pacific Ocean based on information contained in Fischer and Hureau (1988). *P. formosa* would be the southernmost species, located to the west (59°58'S to 32°24.6'W) of Thule Island (south of South Sandwich) (Macpherson, 1988). However, *P. spinosissima* would have its southern distribution limit to the north of this, around 57°S, if the specimens located around the north islands of the South Sandwich archipelago (Rubilar *et al.*, 1993) do in fact belong to this species.

As regards the bathymetric distribution of *P. spinosissima*, the available information establishes its depth distribution as 132 m to 650 m (Macpherson, 1988, although this author reports one specimen to the north of South Georgia caught between 796 and 824 m), or 200 to 830 m (Otto and MacIntosh, 1992). Both of these estimates are in good agreement with the depth range provided in this paper (160 to 627 m). Thus, the known range for this species around South Georgia and Shag Rocks is 160 m to 830 m. This range, as well as the shallower range established for the north of Falkland Islands (132 m) (Macpherson, 1988), suggest that the depth distribution of this species tends towards deeper waters as the latitude increases.

In the case of *P. formosa* the depth distribution given by Macpherson (1988) is 400 m to 1 600 m. Otto and MacIntosh (1992) caught specimens of this species at somewhat shallower depths during the *Pro Surveyor* cruise. Too little data were

collected during the Spanish survey to enable any conclusions to be drawn on this subject, but the depths at which the specimens of *P. formosa* were taken (320 and 350 m) are more in accordance with the information provided by the latter authors.

The absence of crabs from the hauls conducted in the north-northwestern sector of South Georgia during the Spanish survey may have been caused by a low density of these species in the area, or more possibly by a low level of sampling in the zone of concentration of these species, because the random sampling omitted this zone. Of 21 hauls carried out in the zone, seven (100 m to 157 m) are outside the published depth distribution of *P. spinosissima* and the remaining 14 (161 m to 325 m) are located at the shallower end of this range.

The location of hauls containing crabs, together with the qualitative composition of the fish fauna usually taken in the same catches as Antarctic crabs, suggests that these crabs tend to concentrate in areas close to the shelf break, where there is some degree of stability in environmental conditions.

It is usual for deep-sea crabs, including lithodids, to form concentrations of ovigerous females which migrate to shallower waters where hatching takes place. This behaviour has been reported in the Antarctic for *Lithodes murrayi* at Prince Edward and Crozet Islands (Fischer and Hureau, 1988). It is very possible that this also occurs in *P. spinosissima* and *P. formosa* but the observations made during the Spanish survey did not allow that possibility to be confirmed. Ovigerous females of *P. spinosissima* were caught to the south and east of South Georgia, and at various depths. However, the highest number of ovigerous females caught in a single haul (seven specimens) was obtained at around 200 m, in the shallower range of the species' bathymetric distribution.

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