

Fishing with pots in deep-waters in the Antarctic region (Statistical Subareas 48.1, 48.2 and 88.3)¹

PATRICIO M. ARANA²

ABSTRACT

Results of the February-March 1998 exploratory and experimental fishing operations using pots are described. This research took place during the New Fisheries Project carried out by Chile to determine the presence of *Dissostichus* spp. in Statistical Subareas 48.1, 48.2 and 88.3. In each location where industrial bottom longlines were used, six pots were lowered, three at each end of the fishing gear, with a distance of approximately 90 m between them. The pots were lowered at a depth of 290-1920 m. A total of 300 pots of four different designs were used. Approximately 1 kg of either whole salted sardines (*Sardinops sagax*) or squid (*Illex argentinus*) were used as bait. According to total weight obtained with pots, the main resources were Antarctic crab (*Paralomis birsteini*) (28%), striped-eyed rockcod (*Lepidonotothen kempfi*) (17%), eelpout (*Lycenchelys bellingshauseni*) (13%) and smalleye moray cod (*Muraenolepis microps*) (11%). Regarding the number of individuals caught, amphipods (55%), were followed by Antarctic crab (15%) and eelpout (12%). Among the species caught, *P. birsteini* was the one resource that stood out the most with 110.7 g/pot, striped-eye rockcod (*L. kempfi*) with 67.4 g/pot and eelpout (*L. bellingshauseni*) with 51.2 g/pot. In general, *P. birsteini* was captured in all researched Subareas, with highest yield in Subarea 48.2 (548.8 g/pot).

Key words: Exploratory fishing, pots, yields, distributions, Antarctic.

Pesca con trampas en aguas profundas de la región Antártica (Subáreas Estadísticas 48.1, 48.2 y 88.3)¹

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RESUMEN

Se describen los resultados obtenidos en el crucero de pesca exploratoria y experimental realizado con trampas en febrero-marzo de 1998, aprovechando lances efectuados con espineles industriales de profundidad, como parte del Proyecto de Pesquerías Nuevas realizado por Chile, con el fin de determinar la presencia de *Dissostichus* spp. en las Subáreas Estadísticas 48.1, 48.2 y 88.3. En cada lugar en que se utilizaron los espineles, se calaron seis trampas, tres a cada extremo del aparejo, distanciadas entre si por ± 90 m. El rango de profundidad en que se calaron las trampas fue de 290 a 1920 m. Se utilizó un total de 300 trampas de cuatro diseños diferentes. Como carnada se utilizó aproximadamente 1 kg ya sea de sardina (*Sardinops sagax*), enteras y saladas o calamar (*Illex argentinus*). De acuerdo al peso total obtenido con estos aparejos, los principales recursos capturados correspondieron a centolla antártica (*Paralomis birsteini*) (28%), trama ojirayada (*Lepidonotothen kempfi*) (17%), anguila (*Lycenchelys bellingshauseni*) (13%) y gadimorena (*Muraenolepis microps*) (11%). En cuanto a número de individuos extraídos, la mayor cantidad correspondió a anfípodos (55%), centolla antártica (15%) y anguila (12%). De las especies capturadas, destacan principalmente la centolla antártica (*P. birsteini*) con 110.7 g/trampa, trama ojirayada (*L. kempfi*) con 67.4 g/

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trampa y anguila (*L. bellingshauseni*) con 51.2 g/trampa. En general, *P. birsteini* fue capturada en todas las Subáreas investigadas, presentando el rendimiento más alto en la Subárea 48.2 (548.8 g/trampa).

Palabras clave: Pesca exploratoria, trampas, rendimientos, distribuciones, Antártica.

INTRODUCTION

The Antarctic continent has fascinated the world population since its discovery, especially due to its extreme weather conditions and the special marine fauna living in its cold waters. Some species, because of either their abundance or value motivated an immediate interest in their exploitation. The first records available concerning fishing activity in the South Atlantic Ocean correspond to the work carried out by Edmund Fanning, who, in 1834, wrote in his log book journal that the officers of the vessel *Aspasia* had fished for fun something similar to a "codfish" near the South Georgia Islands (Balguerías, 1990). Subsequently, the fishing activities in this sub-Antarctic region concentrated on whale and seal hunting, as well as fishing various species of fish in the vicinity of the Antarctic Convergence or the Polar Front. In more recent years, big hopes were set on the extraction of krill (*Euphausia superba* Dana, 1850), which was even considered to become one of the most important fisheries in the world.

Nowadays, there are many nations interested in assigning new resources and locations for setting their fishing gears due to the depletion of the traditionally exploited resources and the increasingly stricter administrative standards and restrictions imposed on the Exclusive Economic Zones. Fishing prospects with deep-sea pots are still unknown in the Antarctic region. The most recent and comparable research of its kind was the exploration carried out by Otto and MacIntosh (1992) in waters surrounding South Georgia Island, in the South Atlantic Ocean.

This background information motivated an exploratory fishing campaign around the Antarctic peninsula and adjacent islands, to determine the presence of potential resources that could be susceptible for fisheries using deep-water pots in Subareas 48.1, 48.2 and 88.3 of the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). With this in mind, given the difficulty in accessing this region and with the intention of carrying out a research study, new fisheries projects activities carried out by Chile between February and March 1998 were used to establish the presence of *Dissostichus* spp. in the mentioned Subareas (Arana and Vega, 1999). This work was authorised by the CCAMLR (Conservation Measures 134/XVI, 135/XVI and 140/XVI) during the meeting held in Hobart, Tasmania, Australia, in November 1997.

MATERIAL AND METHODS

The Chilean longliner "*Tierra del Fuego*", property of Pesca Chile S.A., was used for fishing activities. On this 54-m-long ship, a vessel monitoring system ARGOS was installed. Two scientists in charge of research from the Universidad Católica de Valparaíso and a scientific observer nominated in accordance with the CCAMLR International Scientific Observation System took part in this scientific cruise.

The study area corresponds to the main continental bank and, only in some specific cases, to the continental shelf around the Antarctic Peninsula and adjacent islands of statistical Subareas 88.3, 48.1 and 48.2. At each location where Spanish-designed longlines were used, six pots were lowered, three at each end of the fishing gear, with a distance of approximately 90 m between them, while each set of three pots were left at approximately 3 to 4 nautical miles away from each other.

During the experiment, four different types of pots and entrances were used (Fig. 1 and 2): a) pyramidal truncate, with rectangular opening on one side (PR); b) pyramidal truncate, with a circular opening at one side (PC); c) tetragonal, with rectangular opening at one end (TR); and d) tetragonal, with circular opening at one end (TC). These pots were set at random along the line.

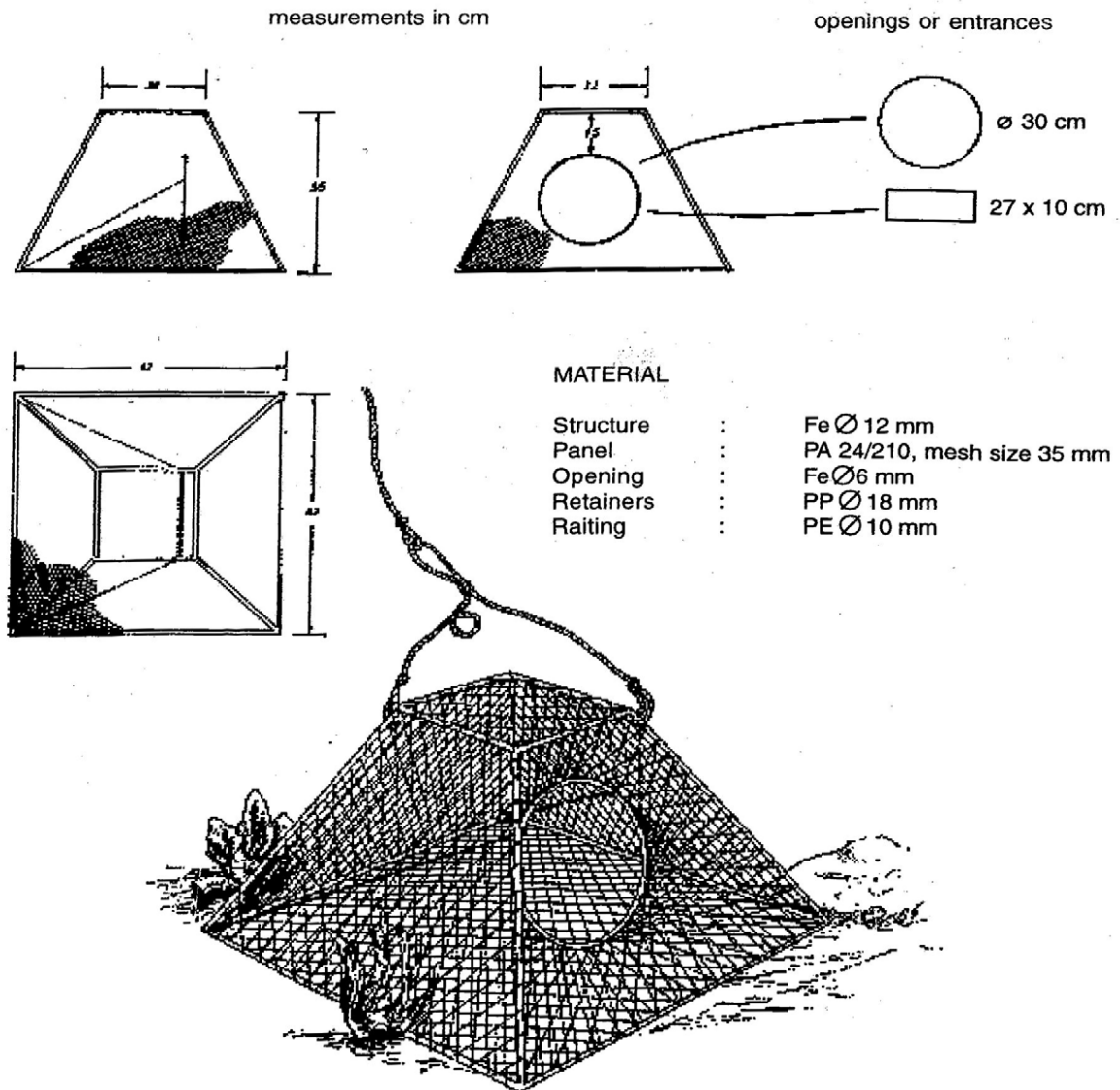


Fig. 1. Truncate pyramidal pot design used in the exploratory fishing cruise.

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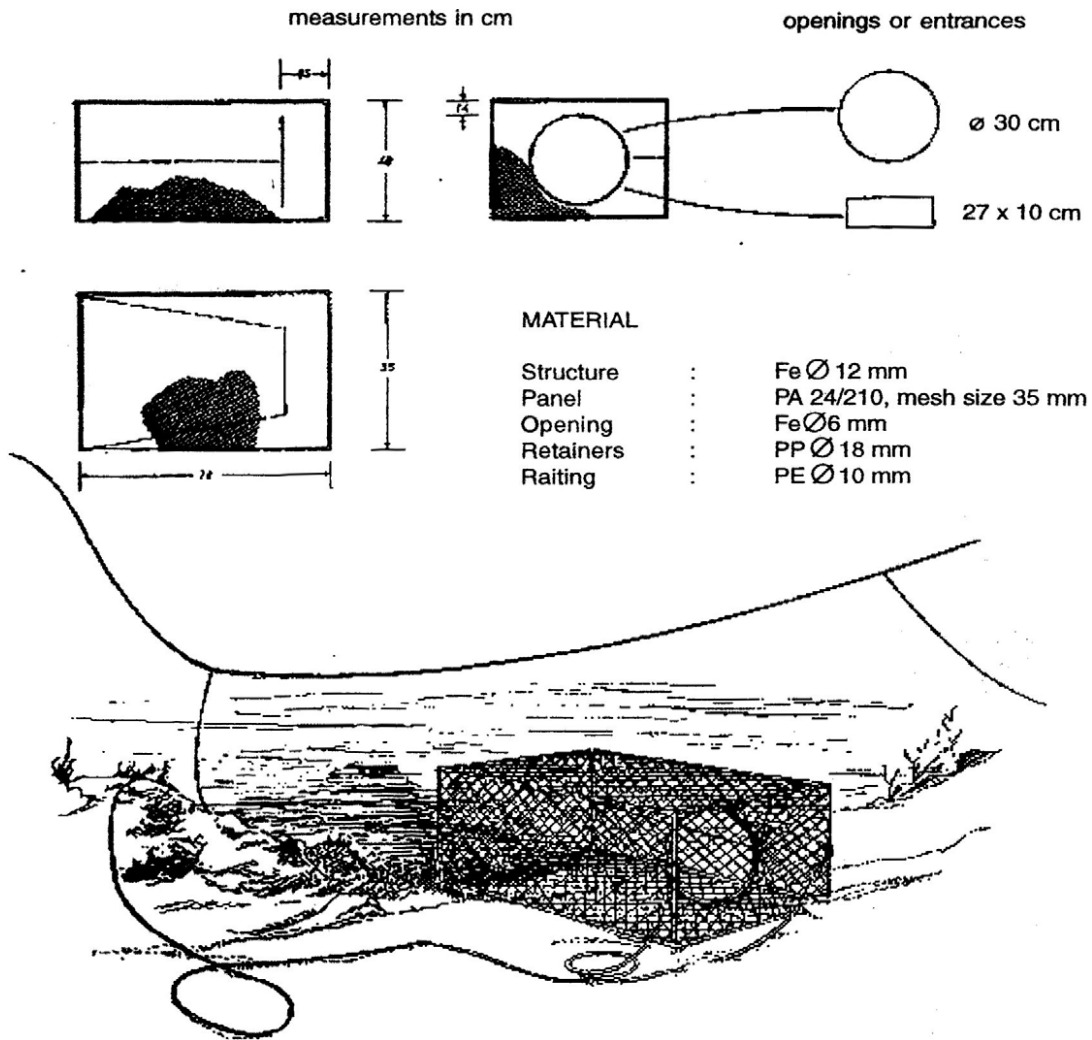


Fig. 2. Tetragonal pot design used in the exploratory fishing cruise.

The pyramidal (82 x 55 x 32 cm) and the tetragonal pots (78 x 55 x 40 cm) were built with iron bars, with circular sections of 12 mm in diameter, welded at the arch and covered with entwined polyamide net (24/210d), with a mesh size of 35 mm between knots. The openings or entrances were set up with iron handles of 6 mm sections. The rectangular ones measured 27x10 cm, and the circular ones were 30 cm in diameter. To the inside of each fishing gear a funnel shaped net was added to serve as a tunnel that would facilitate the entrance and, at the same time, make the escape of eventual catch more difficult. The pots were weighed down with 6 kg rocks, which made each pot dry weight approximately 16 kg. Whole and salted sardines (*Sardinops sagax*) and whole squids (*Illex argentinus*) were used as bait either mixed or separated. Approximately 1 kg of bait was placed, wrapped in a piece of net, and hung from the upper part of the pot.

Each sample station registered information on type of pot used, position of the pots, time of setting and hauling, soak time, water depth and bottom characteristics, type of bait used, and catch obtained by unit and weight. The pots average soak time at each station was determined as the time span counted from the estimated time of the pot arrival to the sea bottom until the moment it was hauled out. As a way of measuring the yield, the catch was calculated by unit of effort spent (CPUE), which corresponds to the quotient between the catch and the number of pots used, expressed in grams per pot (g/pot). No time correction for soak time was made due to the fact that a similar time period was used at every station. The CPUE was set for each type of pot, species and also jointly for all the extracted resources and pots used. The calculations were also made for each Subarea explored and for all of the area studied as a whole. Evaluation of the yields obtained by the different pot designs in each statistical Subarea explored was done by the analysis of variance with one factor with an uneven number of observations (Sokal and Rohlf, 1979).

Specimens caught were individually measured and weighed. The total length of the fish and its weight were determined, and the carapace length of the crustaceans was measured, as well as their sex and total weight. The carapace length is defined as the distance in a straight line over the middle dorsal axis, from the postocular arch to the posterior carapace end. Length measurements were made, in the case of fish, with a measuring board or metric tape, measured to the nearest unit below; regarding with crustaceans, a vernier micrometer with an approximate accuracy of 1 mm was used. The size frequency distribution was established by grouping those specimens into classes of a carapace length of 4 mm in the case of crustaceans and of 1 cm in total length in the case of fish. The weight of the individuals was determined using a clock-type scale with maximum weight of 2 kg and a precision of ± 2 g.

To confirm the identity of the fauna caught in the pots, a certain number of specimens were collected and frozen. Specialists carried out identification task at a later time.

RESULTS

General aspects

The scientific cruise took place between February 9th and March 23rd, 1998, with fishing operations carried out between February 14th and March 18th. Throughout the entire research process, 300 pots were lowered (121 in Subarea 88.3, 138 in Subarea 48.1 and 41 in Subarea 48.2) in 104 sample stations, at a depth ranging between 290 and 1920 m (Fig. 3). From the total number of pots, only 6 pots (2%) were lost. The total soak time was 3 450 hours with an average of 11.5 hours per pot (sd = 3.75). The total catch reached 115.6 kg.

Fishes were mainly caught in the pots, being the most outstanding resources eelpout (*Lycenchelys bellingshauseni* Andriashev and Permitin, 1968), striped-eye rockcod (*Lepidonotothen kempfi* Norman, 1937), icefishes (*Chionobathyscus dewitti* Andriashev and Neyelov, 1978, and *Cryodraco antarcticus* Dollo, 1900), smalleye moray cod (*Muraenolepis microps* Lönnberg, 1905, and *Muraenolepis* sp.), transparent fishes (*Paraliparis thalassobathyalis* Andriashev, 1982, and *Paraliparis* sp.), humped rockfish (*Gobionotothen gibberifrons* Lönnberg, 1905), Antarctic toothfish (*Dissostichus mawsoni* Norman, 1937) and bigeye grenadier (*Macrourus whitsoni* Regan, 1913). In the case of the crustaceans, mainly three types of the Lithodidae family were registered: *Paralomis birsteini* Macpherson, 1988, *Lithodes turkayi* (Macpherson, 1988), and *Neolithodes diomedea*

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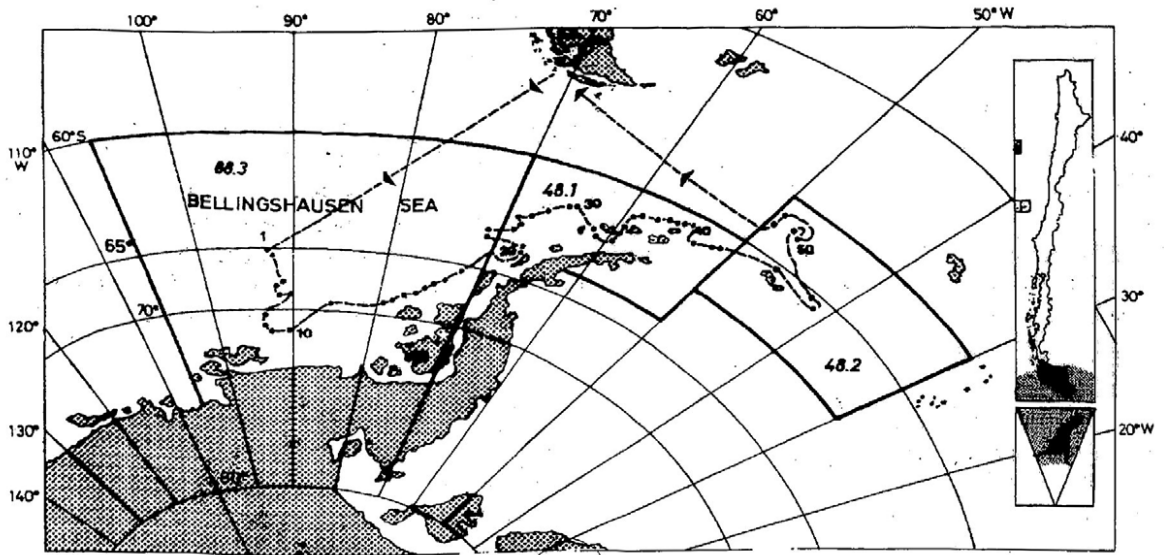


Fig. 3. Cruise track (—) and stations (•) where pots were set (Antarctic Statistical Subareas 48.1, 48.2 and 88.3, February-March 1998).

(Benedict, 1894)), as well as benthic amphipods (Gammaridae, Lysianassidae), and a caridean shrimp (*Nematocarcinus longirostris* Bate, 1888). Among the molluscs, one Charcot's octopus (*Pareledone charcoti* (Joubi, 1905)) and trophon (*Provocator pulcher* Watson, 1882, and *Harporolula charcoti* (Lamy, 1910)) were found (Table 1).

In addition to the above-mentioned species, a great variety of invertebrates was obtained in Subarea 48.1, between 487 and 1357 m. The species caught were *Tylosesma vestibularis* Wilson, 1904, *Alcyonum* sp., *Sisyonis crassa* Hertwig, 1882, *Isosicyonis alba*, *Aphrodita magellanica* Malard, 1891, *Arbacia dufresnei* (Blainville, 1925), *Pseudechinus magellanicus* (Phillipi, 1857), *Pseudosticopus villosus* var. *violaceus* Theel, 1881, *Labidiaster annulatus* Sladen, 1889, *Ceramaster patagonicus* (Sladen, 1889), *Henricia studeri* (Perrier, 1891), *Ophionotus victoriae* Bell, 1902, *Ophiacantha vivipara* Lyman, 1881, and *Astrotoma agassizii* Lyman, 1875.

Considering the total weight registered, the resources that mainly made up the catch corresponds to the Antarctic crab (*P. birsteini*) (28%), striped-eye rockcod (*L. kempi*) (17%), eelpout (*L. bellingshauseni*) (13%), smalleye moray cod (*M. microps*) (11%) and other species (31%). With regard to the number of individual species extracted in higher quantities they were amphipods (55%), Antarctic crab (15%) and eelpout (12%). Three Antarctic toothfishes (*Dissostichus mawsoni*) were also found in the pots and represented 3.3% of the total catch in weight. The specimens of these species were within the range of 45 and 55 cm in total length, the average being 50 cm.

Yields

The main part of the catch in weight throughout the entire scientific cruise was principally of fishes (59.9%), followed by crustaceans (39.8%) and molluscs (0.4%). Regarding the Subareas

TABLE I
Species composition in experimental deep-water pot catches by
Antarctic CCAMLR Statistical Subarea

Species	Station number at which each species was captured (CCAMLR Statistical Subarea)			Depth range (m)	Southerly-most latitude (S) from which each species was collected
	88.3	48.1	48.2		
PISCES					
<i>Lycenchelys bellingshauseni</i>		21, 26, 30-36, 38, 40-42	40	375-1583	66°31,44'
<i>Dissostichus mawsoni</i>	4, 5	20, 21		350-972	68°45,60'
<i>Macrourus whitsoni</i>		43, 45		964-1812	61°12,17'
<i>Muraenolepis microps</i>	1, 3, 4, 6, 8, 18, 23	25, 30, 36, 43, 44	48	616-1885	70°38,07'
<i>Muraenolepis</i> sp.	1			660	65°25,60'
<i>Chionobathyscus dewitti</i>	19			1701	66°36,41'
<i>Cryodraco antarcticus</i>	22	26, 27, 29, 30, 35-37, 39, 41, 42		535-1379	65°42,64'
<i>Lepidonotothen kempi</i>	9, 12, 22	20, 21, 32-39, 38, 41	48	290-1150	70°37,34'
<i>Gobionotothen gibberifrons</i>			46	530	60°26,47'
<i>Paraliparis thalassobathyalis</i>		32, 33, 37		687-1379	63°11,40'
<i>Paraliparis</i> sp.			47	1253	60°54,20'
CRUSTACEA					
<i>Paralomis birsteini</i>	2, 4, 5	25	50-52	621-1876	68°46,00'
<i>Lithodes turkayi</i>	1, 2, 5	34	49-52	622-1696	68°45,60'
<i>Neolithodes diomedea</i>	4			1129	68°42,10'
Lysianassidae	2, 15, 18	28, 30-34, 36-39, 41	49, 51	535-1876	68°56,37'
Gammaridea		24		1054	65°40,07'
<i>Serolis plana</i>	7			920	70°36,00'
<i>Nematocarcinus longirostris</i>	15	38, 39		871-1268	68°54,98'
<i>Chorismus antarcticus</i>		34		1114	62°33,60'
MOLLUSCA					
<i>Pareledone charcoti</i>		30		1583	62°34,02'
<i>Provocator pulcher</i>		33		687	62°59,23'
<i>Harpovoluta charcoti</i>		36		750	61°24,87'
OTHER INVERTEBRATES					
<i>Tylosesma vestibularis</i>		x		487-1337	
<i>Alcyonium</i> sp.		x		487-1337	
<i>Sicyonis crassa</i>		x		694	
<i>Isosicyonis alba</i>		x		750	
<i>Aphrodita magellanica</i>		x		1027	
<i>Arbacia dufresnei</i>		x		1027	
<i>Pseudechinus magellanicus</i>		x		580-664	
<i>Pseudosticopus villosus</i>		x		1027	
<i>Labidiaster annulatus</i>		x		487-1337	
<i>Ceramaster patagonicus</i>		x		1027	
<i>Henricia studeri</i>		x		1027	
<i>Ophionotus victoriae</i>		x		487-1337	
<i>Ophiacantha vivipara</i>		x		487-1337	
<i>Astrotoma agassizii</i>		x		580-664	

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studied, the analysis of variance revealed significant statistical differences between them ($\alpha = 0.05$, $P = 0.03$), with the highest CPUE in Subarea 48.2 (638.8 g/pot, $sd = 1233.6$), mainly due to crustaceans, followed by Subarea 48.1 (430.4 g/pot, $sd = 698.9$), where fishes were the most prominent, and Subarea 88.3 (267.4 g/pot, $sd = 667.4$), where the catch was at the same level in weight for both fishes and crustaceans (Table 2).

TABLE 2

Effort applied, catch and yields obtained by Antarctic CCAMLR Statistical Subareas

Subarea	N° of pots	Pots lost	Soak time (hours)	Average soak time per pot (h)	PISCES			CRUSTACEA			MOLLUSCA			TOTAL CATCH		
					Catch (kg)	Catch (N°)	CPUE (g/pot)	Catch (kg)	Catch (N°)	CPUE (g/pot)	Catch (kg)	Catch (N°)	CPUE (g/pot)	Catch (kg)	Catch (N°)	CPUE (g/pot)
88.3	121	3	1219.1	10.1	18.5	49	156.8	13.1	60	110.6	0.0	0	0.0	31.6	109	267.4
48.1	138	2	1804.5	13.1	47.7	161	350.7	10.4	419	76.5	0.4	16	3.1	58.5	596	430.3
48.2	41	1	426.6	10.4	3.0	9	75.0	22.6	112	563.8	0.0	0	0.0	25.6	121	638.8
Total	300	6	3450.1	11.5	69.2	219	235.4	46.0	591	156.5	0.4	16	1.4	115.6	826	393.3

In general, the truncate pyramidal design with the round opening at the side (PC) showed the highest yields, equivalent to 548.7 g/pot ($sd = 1010.7$), followed by the truncate pyramidal shape with the rectangular opening on the side (PR) with 4275.4 g/pot ($sd = 742.7$); the tetragonal with the rectangular opening at an end (TR) with 333.8 g/pot ($sd = 740.0$), and the tetragonal with a round opening in one end (TC) with only 249.5 g/pot ($sd = 574.6$) (Table 3). However, after statistical analysis it was observed that the various designs of pots made no difference in yields ($\alpha = 0.05$; $P = 0.09$).

Among the species caught, the Antarctic crab (*P. birsteini*) was the one resource that stood out the most with 110.7 g/pot, striped-eye rockcod (*L. kempi*) with 67.4 g/pot and eelpout (*L. bellingshauseni*) with 51.2 g/pot (Table 4). In general, *P. birsteini* was caught in all researched Subareas, with highest yield in Subarea 48.2 (548.8 g/pot).

Biological aspects

Depth range distribution of the organisms and the southerly-most latitude from which each species was collected is presented in Table 1. *P. birsteini* was caught between 612 and 1 876 m, while *L. turkayi* appeared between 660 and 1696 m. Among the crustaceans caught, benthic amphipods presented the most variable bathymetric distribution, appearing at depths ranging from 535 m to 1876 m. In the case of fishes, *L. kempi* was found between 290 and 1150 m; *L. bellingshauseni*, between 375 and 1583 m; *C. dewitti* and *C. antarcticus* between 535 and 1701 m; and *M. microps*, between 616 and 1885 m.

In numbers, *P. birsteini* was the most predominant in the pots (15.6%), followed by *L. bellingshauseni* (11.6%), *L. kempi* (5.9%), *C. dewitti* and *C. antarcticus* (3.8%), *M. microps* (2.7%) and *P. pulcher* (1.8%). The higher quantity of specimens caught facilitated the task of establishing the size distribution frequency and some of their population characteristics (Table 5, Fig. 4).

Effort applied, catch and yields obtained by type of pot in Antarctic CCAMLR Statistical Subareas

Type of pot	N° of pots	Pots lost	Soak time (hours)	Average soak time per pot (h)	PISCES			CRUSTACEA			MOLLUSCA			TOTAL CATCH		
					Catch (kg)	Catch (N°)	CPUE (g/pot)	Catch (kg)	Catch (N°)	CPUE (g/pot)	Catch (kg)	Catch (N°)	CPUE (g/pot)	Catch (kg)	Catch (N°)	CPUE (g/pot)
PC	78	1	870.2	32.8	26.3	71	341.6	16.4	198	212.3	0.2	12	1.9	42.8	281	555.8
PR	71	1	810.8	33.8	22.4	66	320.0	8.0	99	113.6	0.0	0	0.0	30.4	165	433.6
TC	57	1	681.4	34.7	9.8	38	174.1	9.3	82	165.2	0.0	1	0.4	19.0	121	339.7
TR	94	3	1087.8	33.7	10.8	44	118.1	12.5	212	136.8	0.3	3	2.7	23.5	259	257.7
Total	300	6	3450.1	135.0	69.2	219	235.4	46.0	591	156.5	0.4	16	1.4	115.6	826	393.3

PC: Pyramidal truncate pot with circular opening

PR: Pyramidal truncate pot with rectangular opening

TC: Tetragonal pot with circular opening

TR: Tetragonal pot with recti

TABLE 4

Summary of catch and yields obtained with experimental deep-water pot employed by Antarctic CCAMLR Statistical Subareas

Common name	Scientific name	SUBAREA 88.3			SUBAREA 48.1			SUBAREA 48.2			TOTAL CATCH					
		Catch weight (kg)	Catch number	CPUE (g/pot)	Catch weight (kg)	Catch number	CPUE (g/pot)	Catch weight (kg)	Catch number	CPUE (g/pot)	Catch weight (kg)	Catch number	CPUE (g/pot)			
PISCES																
Eelpout	<i>Lycenchelys bellingshauseni</i>				14.9	95	109.2	0.2	1	5.0	15.1	96	51.2			
Antarctic toothfish	<i>Dissostichus mawsoni</i>	1.8	1	15.3	2.0	2	14.7				3.8	3	12.9			
Bigeye grenadier	<i>Macrourus whitsoni</i>				2.5	2	18.4				2.5	2	8.5			
Smalleye moray cod	<i>Muraenolepis microps</i> , <i>Muraenolepis sp.</i>	4.9	13	41.1	7.6	8	55.9	0.7	1	17.5	13.2	22	44.7			
Icefishes	<i>Chionobathyscus dewitti</i> , <i>Cryodraco antarcticus</i>	0.6	2	5.1	11.3	29	83.1				11.9	31	40.5			
Striped-eye rockcod	<i>Lepidonotothen kempi</i>	11.3	32	95.3	8.1	16	59.2	0.5	1	12.5	19.8	49	67.3			
Humped rockfish	<i>Gobionotothen gibberifrons</i>							1.5	5	37.5	1.5	5	5.1			
Transparent fishes	<i>Paraliparis thalassobathyalis</i> , <i>Paraliparis sp.</i>				1.4	9	10.3	0.1	1	2.5	1.5	10	5.1			
CRUSTACEA																
Antarctic crab	<i>Paralomis birsteini</i>	10.3	35	87.3	0.3	2	2.2	22.0	88	548.8	32.6	125	110.7			
Subantarctic stone crab	<i>Lithodes turkayi</i>	1.2	2	10.2	0.1	4	0.7	0.4	2	10.0	1.7	8	5.8			
Crab	<i>Neolithodes diomedea</i>	1.0	1	8.5							1.0	1	3.4			
Amphipods	Lysianassidae	0.6	23	4.7	9.9	409	72.4	0.2	22	5.0	10.6	454	36.1			
Shrimp	<i>Nematocarcinus longirostris</i>				0.2	4	1.1				0.2	4	0.5			
MOLLUSCA																
Charcot's octopus	<i>Pareledone charcoti</i>				0.2	1					0.2	1	0.7			
Trophon	<i>Provocator pulcher</i>				0.2	15					0.2	15	0.8			
TOTAL					31.6	109	267.4	58.5	596	430.4	25.6	121	638.8	115.6	826	393.3

Arana, P. M.

TABLE 5

Somatometric characteristics of the main taxonomic groups caught with experimental deep-water pot employed in Antarctic CCAMLR Statistical Subareas

Common name	Scientific name	SAMPLE					TOTAL CATCH		
		Total length (cm)					Average weight (g)	% in numbers	% in weight
		Minimum	Maximum	Average	sd	n			
<i>PISCES</i>									
Eelpout	<i>Lycenchelys bellingshauseni</i>	19	43	31.65	6.03	57	156.77	11.62	13.02
Antarctic toothfish	<i>Dissostichus mawsoni</i>	45	55	50.00	5.00	3	1266.67	0.36	3.29
Bigeye grenadier	<i>Macrourus whitsoni</i>	46	55	50.50	6.36	2	1250.00	0.24	2.16
Smalleye moray cod	<i>Muraenolepis microps</i>	26	54	34.55	8.93	11	597.73	2.66	11.37
Icefishes	<i>Chionobathyscus dewitti</i> , <i>Cryodraco antarcticus</i>	20	41	32.76	4.23	29	383.87	3.75	10.29
Striped-eye rockcod	<i>Lepidonotothen kempfi</i>	18	40	31.20	5.42	35	404.08	5.93	17.12
Humped rockfish	<i>Gobionotothen gibberifrons</i>	30	40	34.33	5.13	3	300.00	0.61	1.30
Transparent fishes	<i>Paraliparis thalassobathyalis</i>	15	26	20.96	3.38	9	150.00	1.21	1.30
<i>MOLLUSCA</i>									
Charcot's octopus	<i>Pareledone charcoti</i>				11.7	1	200.00	0.12	0.17
Trophon	<i>Provocator pulcher</i>	3.1	4.3	3.56	0.33	14	15.33	1.82	0.20
<i>CRUSTACEA</i>									
Antarctic crab	<i>Paralomis birsteini</i>						260.40	15.13	28.15
- males		50.8	110.2	81.10	10.92	76			
- berried females		66.9	93.6	78.59	9.39	10			
- non berried females				61.50		1			
Subantarctic stone crab	<i>Lithodes turkayi</i>	79.1	113.7	99.07	17.91	4	212.50	0.97	1.47
Crab	<i>Neolithodes diomedea</i>			115.40		1	1000.0	0.12	0.86
Amphipods	Lysianassidae						23.35	54.96	9.17
Shrimp	<i>Nematocarcinus longirostris</i>	24.0	33.0	27.25	4.03	4	37.50	0.48	0.13
TOTAL								100.00	100.00

Fishing with pots in deep-waters in the Antarctic region

consists of specifying depth distribution ranges for each one of them (Table 1), since through the use

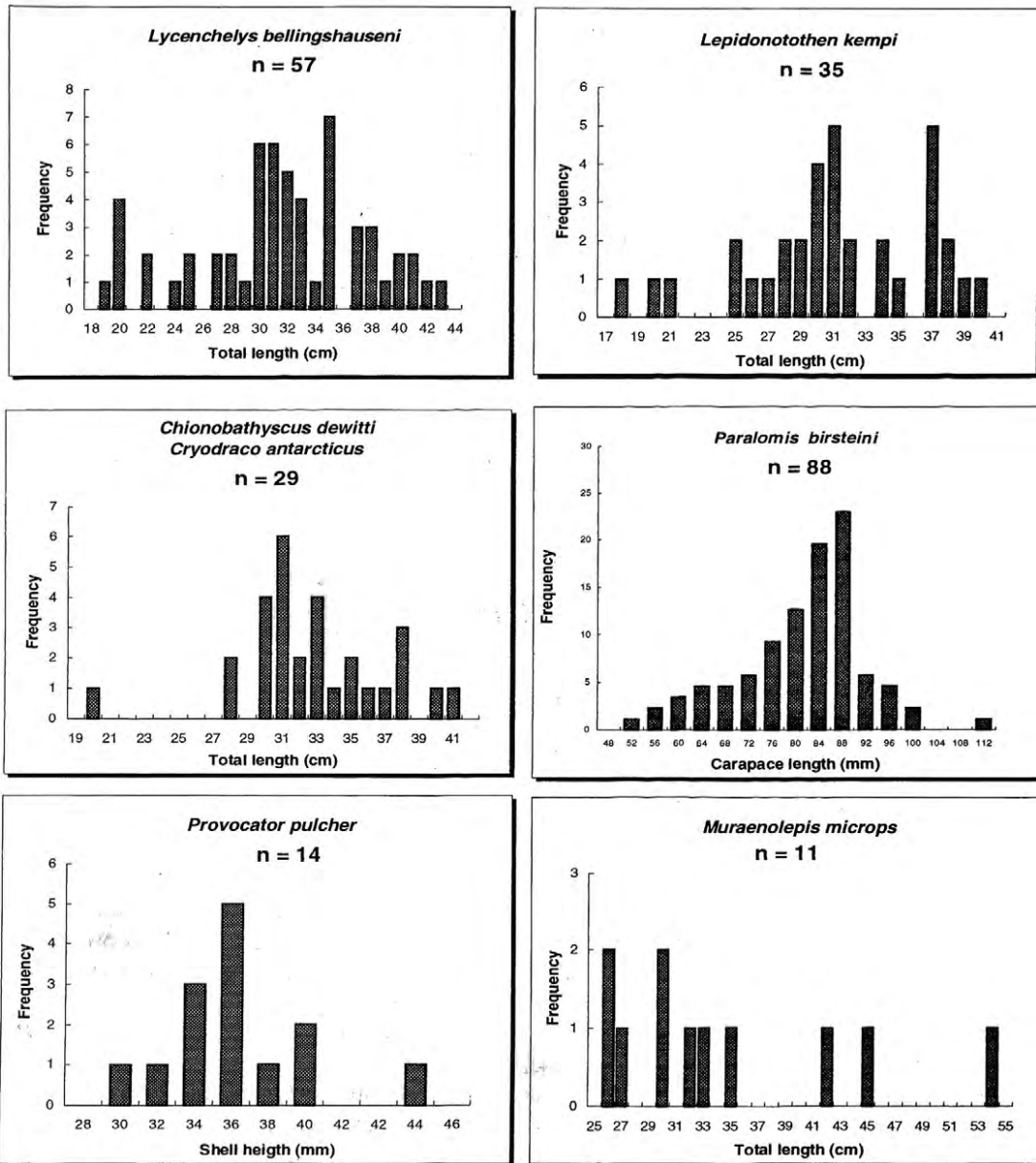


Fig. 4. Size distribution of the main taxonomic groups caught with experimental deep-water pot employed in Antarctic CCAMLR Statistical Subareas.

Concerning *P. birsteini*, 87% of the specimens collected were males. Out of all the females analysed, 91% were found to have eggs in their abdomens. The carapace length of males ranged between 50.8 and 110.2 mm with an average of 81.1 mm (sd = 10.4); females, ranging between 61.5 and 93.6 mm with an average of 77.0 mm (sd = 10.3).

The fish caught in the pots had a total length ranging between 15 and 55 cm, with *M. whitsoni* (50.5 cm, sd = 6.4), *D. mawsoni* (50.0 cm, sd = 5.0), and *M. microps* (34.6 cm, sd = 8.9)

being the largest on average. In the case of trophon *P. pulcher*, the height of the shells varied between 30 and 43 mm, with an average of 35.6 mm and $sd = 3.3$.

DISCUSSION

Unlike the marine organisms that live or feed in the Antarctic surface water, knowledge of the composition of deep-water fauna is still quite vague. The reason for this lies in the higher possibility of catching organisms in pelagic fishing operations geared to known resources, such as krill (*E. superba*) or icefishes (Channichthyidae). To study the fauna of the Antarctic continent shelf and slope, it would be necessary to conduct high-cost exploratory operations, requiring suitable vessels and specially trained personnel. This is why this research cruise, although done with only a few pots, provides valuable information on the species living in the researched Subareas and depths, as well as on the potential yields one could expect to obtain when operating this type of fishing gear.

Information obtained on this scientific cruise determined the presence of 11 species of fishes, 8 of crustaceans, 3 of molluscs and 14 other species of marine invertebrates in pots set at a depth between 290 and 1920 m. The more relevant taxonomic groups according to their abundance correspond to fishes and crustaceans. Among the first, *L. kempii*, *C. dewitti* and *C. antarcticus*, *M. microps*, *L. bellingshauseni* and *P. thalassobathyalis* stand out. Among the second, *P. birsteini*, *L. turkayi*, and the Lysianassidae family. The great variety of invertebrates extracted with pots can, in many cases, be blamed on slips or tangling of the fishing gear on the marine bottom.

However, among the variety of species caught with pots, none showed to have potential suitability for commercial exploitation, due to low yields, reduced size, or low potential value of the specimens. In general, the results of the activities carried out with these types of fishing gear indicated a very poor level of marine organisms, both in diversity and quantity in the entire sea bottom where the pots were set. This is probably due to the scarcity of food at such depths, the low environmental temperatures and the extreme flatness of the marine bottom, where most of the stations located.

Among the organisms caught, *P. birsteini* was the species with the highest yield and present in all researched Subareas. The presence of this crab in the continental shelf and slope west of the Antarctic Peninsula, in the Gerlache submarine seamounts and around Pedro I Island, at depths ranging between 621 and 1876 m, certainly expands the *P. birsteini* geographical and bathymetric distribution (Arana y Retamal, 1999). A similar situation was found with *L. turkayi*, which was described for the Falkland Islands (Takeda and Hatanaka, 1984; Boschi, 1992) and from the coast of Chile (Campodonico and Guzmán, 1972; Revuelta and Andrade, 1978; Retamal, 1981, 1994), at depths covered ranging from 70 to 600 m. Also Klages *et al.* (1995) collected four individuals of this species off Peter I Island, between 180 and 260 m. The data presented here also contributed to expand the geographic and bathymetric distribution of *L. turkayi*, since it was caught on the continental shelf and slope, west of the Antarctic Peninsula, on the Gerlache submarine seamounts and Pedro I Island, at depths ranging between 60 and 1696 m.

Among the fishes, the contribution in weight was provided in order of importance by *L. kempii*, *L. bellingshauseni*, *Muraenolepis* spp., *C. dewitti* and *C. antarcticus*, while *L. bellingshauseni* stood out in quantity. Most of these species have already been described for this region, since they were previously caught by means of trawl fishing (Kock, 1988, 1992; López-Abellán and Balguerías, 1994), or accidentally caught during exploratory fishing with pots in the surrounding waters of the South Georgia (Otto and Macintosh, 1992, 1996). In this case, the contribution of this research

of pots there is a better chance of determining depths at which these organisms were caught.

Another interesting aspect worth mentioning is that, in spite of no significant statistical differences between the different pot designs used, it was obvious that the highest yields were obtained with pyramidal pots with round openings (PC) and the lowest with the tetragonal pots with rectangular openings (TR), which was specially evident in the fish catch (Table 3). On the other hand, in the case of crustaceans, it was also observed that the round openings yielded the highest results.

Finally, it is important to reiterate the convenience of carrying out such experiences, to increase progressively the information on benthonic and demersal distribution and composition of the fauna in CCAMLR administrative area. Only when this information is available, it will be possible to assess the fishing potential and the inter- and intraspecific relationships between the organisms. The present data may be considered as a technical and scientific basis for the measures to be adopted for the conservation of the Antarctic marine living resources. Furthermore, these records could also serve as a definite element for planning new experiences or expeditions in this cold and far-off region.

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