FISHING FOR TOOTHFISH USING POTS: RESULTS OF TRIALS UNDERTAKEN AROUND SOUTH GEORGIA, MARCH–MAY 2000

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Abstract

During the period March to May 2000, the UK undertook trials of a pot fishing method to catch Patagonian toothfish (*Dissostichus eleginoides*) around South Georgia (Subarea 48.3). This method has the potential to minimise, or eliminate, incidental bird mortality when compared to the standard longline method. This paper describes the trial and the results, and discusses the commercial viability of this fishing method for toothfish fisheries in the CCAMLR Convention Area. While the method successfully caught *D. eleginoides*, there was a large by-catch of crab species. The catch rate of toothfish was notably lower than that achieved in the longline fishery. Importantly, the use of pots eliminated bird by-catch. To capitalise on this feature, there is a need to improve the commercial viability of the method and minimise the quantity of by-catch. A number of potential changes are suggested to this end.

Résumé

De mars à mai 2000, le Royaume-Uni a fait une expérience de pêche au casier de légine australe (*Dissostichus eleginoides*) autour de la Géorgie du Sud (sous-zone 48.3). Par comparaison avec la méthode de pêche à la palangre standard, cette méthode devrait réduire, voire éliminer, la mortalité accidentelle des oiseaux. Ce document décrit l'expérience et ses résultats, en présentant une discussion de la viabilité commerciale de la méthode de pêche pour les pêcheries à la palangre de la zone de la Convention. Alors que cette méthode s'est révélée fructueuse en ce qui concerne la capture de *D. eleginoides*, elle causait une capture accessoire importante d'espèces de crabes. Le taux de capture de légine obtenu est nettement moins élevé que celui de la pêche à la palangre. Il est important de noter que l'utilisation de casiers éliminait les captures accessoires d'oiseaux. Pour pouvoir tirer profit de cet avantage, il est nécessaire d'améliorer la viabilité de la méthode et de réduire l'importance de la capture accidentelle. À cet effet, divers changements sont suggérés.

Resumen

Durante el período de marzo a mayo de 2000 el Reino Unido participó en la pesca experimental con nasas dirigida al bacalao de profundidad (*Dissostichus eleginoides*) frente a Georgia del Sur (Subárea 48.3). La posibilidad de minimizar o eliminar la mortalidad incidental de aves marinas es mayor con este método que con el método estándar de la pesca de palangre. Este trabajo describe el experimento y los resultados, y considera la viabilidad comercial de este método de pesca en las pesquerías de palangre en el Area de la Convención. Si bien el método sirvió para capturar *D. eleginoides*, hubo una abundante captura secundaria de centollas. La tasa de captura de bacalao de profundidad fue

significativamente inferior a la de la pesca de palangre. Notablemente, la captura incidental en la pesca con nasas fue eliminada. Para aprovechar al máximo esta observación se deberá mejorar la viabilidad comercial del método y minimizar la captura secundaria. Se proponen varios cambios para alcanzar este objetivo.

Резюме

С марта по май 2000 г. Соединенное Королевство провело эксперименты по ловушечному промыслу патагонского клыкача (*Dissostichus eleginoides*) в районе Южной Георгии (Подрайон 48.3). По сравнению со стандартным ярусным методом лова данный метод сможет минимизировать или свести на нет побочную смертность птиц. В настоящей работе описываются эксперименты и их результаты и обсуждается коммерческое будущее этого метода для промыслов клыкача в зоне действия онвенции АНТКОМ. При применении этого метода был получен *D. eleginoides*, однако наблюдался и большой прилов крабов. Коэффициент вылова клыкача был заметно ниже, чем при ярусном промысле. Примечательно, что использование ловушек устранило прилов птиц. Чтобы максимизировать пользу от этого, необходимо повысить экономическую эффективность метода и минимизировать объем прилова. Предлагается ряд соответствующих модификаций.

Keywords: Patagonian toothfish, pot fishing, trial, South Georgia, CCAMLR

INTRODUCTION

The longline fishery for Patagonian toothfish (*Dissostichus eleginoides*) in Subarea 48.3, as with other areas in the Convention Area, still catches significant numbers of seabirds. Calculations made by CCAMLR's Working Group on Fish Stock Assessment (WG-FSA) in 1999 suggest that 210 seabirds were killed during the 1999 longline fishery in Subarea 48.3 (SC-CAMLR, 1999, Table 52), a 65% decrease over the previous season (0.01 birds/thousand hooks in 1999 compared with 0.025 birds/thousand hooks in 1998; SC-CAMLR, 1998a and 1999). Despite this decrease, the UK continues to be concerned that incidental mortality of seabirds should be reduced as much as possible in toothfish fisheries in the Convention Area. This is mirrored by the call of the CCAMLR Scientific Committee for continued experimental work to combat the problem (SC-CAMLR, 1998b, paragraphs 4.52 and 4.71). To this end, the UK has examined methods to further reduce bird incidental mortality (e.g. line-weighting experiments undertaken during the 1998/99 fishing season; see Agnew et al., 2000).

The practice of prosecuting toothfish fisheries using specialised pots has been carried out on a commercial basis within the Exclusive Economic Zone of Uruguay, with catch rates of between 1 and 2 tonnes/day (green weight) being reported. Such a method has the potential to reduce, or eliminate, bird by-catch. To examine the feasibility of commercial toothfish pot fishing around South Georgia, the UK proposed to perform trials of this method in Subarea 48.3 (UK, 1999). The proposal was accepted by the Commission (CCAMLR, 1999, paragraph 9.12).

The aims of the toothfish pot fishing trial were:

(i) to test the commercial viability of a credible alternative method of catching toothfish;

(ii) to obtain catch and effort data for toothfish pot methods over the whole Subarea 48.3 shelf area, over a number of months, including an overlap with longline fisheries to enable comparison of the CPUE (catchability) of longline pots;

(iii) to obtain information on the effectiveness of toothfish pot methods for reducing or eliminating the incidental mortality of seabirds in CCAMLR toothfish fisheries;

(iv) to obtain information on rates of by-catch in toothfish pot fisheries, especially in relation to crabs;

(v) to conduct experiments on crab discard survival rates; and

(vi) to tag toothfish for migration and mark–recapture studies.

A much larger proportion of toothfish had full stomachs than is usually encountered on longlines, and this yielded a comprehensive stomach-contents dataset. This is described and analysed in Pilling et al. (2000a). Task (vi) resulted in the tagging of

136 toothfish, and is fully described in Pilling et al. (2000b), which brings together the result of all UK tagging work undertaken in 2000.

METHODS

Following acceptance of the proposal, the UK-flagged vessel *Argos Georgia*, owned by Argos Ltd, fished for *D. eleginoides* using toothfish pots in Subarea 48.3. Trials were undertaken during the period from 16 March to 11 May 2000. The initial proposal was that the vessel would conduct experimental trials for a period of six months. Due to operational difficulties, however, the period of trial fishing was shortened to two months. Scientific observations were conducted by a UK and an international observer (authors T. Daw and M. Purves respectively) during the 53 days spent fishing. Work was carried out under the auspices of the CCAMLR Scheme of International Scientific Observation.

Fishing Gear and Bait

The semi-conical pots of approximately 80 cm height were constructed of a steel frame and covered with mesh. A collapsible funnel entrance was situated on the side of the pot, orientated horizontally, and tapering to the pot interior. A drawstring held the bottom mesh together in the middle. This allowed pots to be emptied easily when hauled aboard, and to be stacked on top of each other when not in use. A panel was sewn into pots using biodegradable string to ensure that crabs could escape from gear lost during hauls.

Using the Spanish system, pots were attached to longlines at 50 m intervals. A carabina clip was attached to the loose end of each pot branchline, and these were clipped onto a steel ring, secured to the mainline during setting operations. The gear was deployed in a similar fashion to longlines, with an anchor at each end preventing the line from dragging on the bottom. An anchor line was attached to five medium-sized buoys, a danlight and radio beacon on the surface. The anchor line was weighed down to prevent it floating on the surface. Almost all sets consisted of 100 pots with a line length of 5 000 m. During the 112 sets made in the trial period, 150 pots were lost, mostly at the start of the trials, before the correct gear and methodology had been established.

Bait included toothfish heads and squid (*Illex* spp.). Bait was protected from isopod and amphipod predation, a major problem in certain areas, through enclosure in mesh. This still allowed the odour to escape and attract the target species.

Fishing Strategy

The fishing strategy was determined by the experimental protocol submitted to CCAMLR under Conservation Measure 64/XII. According to this protocol, fishing was to be conducted over as wide an area as possible in similar depths as used in the longline fishery. The fishing area was divided into four zones, viz. east Shag Rocks, northwest South Georgia, east South Georgia and south South Georgia (see Figure 1). Effort was to be evenly spread throughout the areas, however due to problems with sea-ice, no sets were deployed in south South Georgia. Fishing effort in northwest and east South Georgia was also hampered by ice. Fishing around Shag Rocks was relatively unaffected (Table 1).

The precise placement of pots within each area depended on both bottom topography and character, and other technical fishing considerations. A relatively flat bottom on grounds with fewer corals was preferred for setting, as the risk of losing pots was lower. However, where possible fishing effort was distributed over the whole area and in all depths used by the longline fishery (i.e. 500–1 500 m). Some lines were, therefore, set on grounds with uneven bottom topography, and on hard grounds with presumably many corals.

RESULTS

Commercial Viability and CPUE Analysis

The first two aims of the toothfish pot fishery trial were to assess the commercial viability of this fishing method. This will be examined using the catch and effort data collected from the trial fishery. The catch of toothfish achieved during the pot trial is detailed in Table 2.

Most toothfish were lively and in good condition when hauled aboard. However, when pots had been soaking for longer periods (soak times varied from 4 h 25 min to 40 h 35 min, with an average time of 10 h 48 min) a number of toothfish with damage to their skins and scales were noted. This was particularly common in catches around east Shag Rocks. This may have

Table 1: A summary of *Argos Georgia* fishing operations by area fished around South Georgia. Fishing areas are detailed as shown in Figure 1.

Area	Number of			Total Pot Hours	Average Depth (m)	Depth Range (m)
	Days	Sets	Pots			
Shag Rocks	36	90	8 888	95 939	671	198–1 800
W(NW) Georgia	6	9	900	9 084	894	501–1 219
N(NW) Georgia	6	8	800	9 256	805	355–1 344
E Georgia	5	5	500	5 875	832	321–1 257

Table 2: Details of the catch of *Dissostichus eleginoides* obtained during pot trials around South Georgia.

	Retained	Discarded		
		Isopod Damage	Jelly Meat	Undersized
Live weight (kg)	38 973	1 607	167	9
Number	5 801	177	13	4

Table 3: Comparison of toothfish catches from pot and longline fishing vessels.

Method	Catch (kg)	Catch per Unit Gear
Pot	128	1.28 kg/pot, 128 kg per 5 km line
Longline	2 788	0.35 kg/hook, 830 kg per 5 km line

Table 4: Mean number of the most abundant seabird species observed during pot setting and hauling operations arranged by declining abundance on setting.

Species	Mean Number Observed	
	Setting	Hauling
White-chinned petrel (*Procellaria aequinoctialis*)	50	72
Black-browed albatross (*Diomedea melanophrys*)	19	57
Giant petrel (*Macronectes* spp.)	6	154
Cape petrel (*Daption capense*)	2	15
Wandering albatross (*Diomedea exulans*)	2	32

resulted from iso/amphipods attacking fish, or fish being confined in a small area and repeatedly coming into contact with abrasive crab carapaces. A total of 177 fish (3% of catch) with a size range of 62 to 136 cm were discarded due to isopod or amphipod damage (Table 2). These fish were generally large (mean size of 94 cm, 64% 90 cm or above). Most fish discarded for this reason were dead and half-eaten, although a few live fish with badly damaged skins were also discarded. Shortening the soak time generally decreased the number of damaged fish noted per set.

Thirteen fish were found with 'jelly meat', comprising 0.2% of the total catch. Affected fish ranged in size from 103 to 117 cm, with an average size of 109 cm. Four small toothfish of 47 to 64 cm were discarded, as they were deemed too small for processing.

To assess the commercial viability of the pot fishing method, catch rates achieved during the trial were assessed. Just less than 39 tonnes of *D. eleginoides* were caught during the 53 days spent fishing. A frequency distribution of CPUEs achieved is presented in Figure 2.

The majority of fishing occurred around Shag Rocks. The highest catch rates were achieved in this region and the NW Georgia area. Low catch

rates in other locations may have resulted from the difficulties experienced in fishing in waters where a large number of icebergs were present.

Comparisons of the catch rates achieved during the pot trial with those from the standard longline fishery will be affected by spatial and temporal differences in the fishing. To avoid this problem, a short period of fishing in parallel with a longline vessel was carried out during May 2000.

Catches were taken from 5 km of line and 100 pots and 16.8 km line and 8 000 hooks for the pot and longline fishing vessels respectively. Hauls were made approximately 0.8 km apart, in a depth of around 1 300 m. The resultant catches are detailed in Table 3.

When assessed on a per-unit-of-gear basis (per hook or per pot), the pot fishery performs well, catching almost four times the weight of toothfish per unit of gear. However, this is a relatively unrealistic comparison. The longline fishing method is more efficient, with many more hooks on the line than pots on a line. Further, the longline fishery has benefited from a long period of development, whereas the pot fishery is in its infancy. This undoubtedly contributes to the differences in catch rates.

The length-frequency distribution of toothfish caught using pots was compared to that caught by longlines. As the parallel fishing trial period was short, insufficient data were available from the longline vessel for this comparison. Therefore, pot data are compared with those collected by the *Argos Georgia*, which undertook longline fishing immediately after completion of the pot trials. Data from catches taken in the same area (Shag Rocks) and depth range (500–800 m) were compared, to minimise the influence of these factors. The resulting length-frequency distributions are presented in Figure 3.

The length-frequency distribution obtained from longline catches was remarkably similar to that from the pots.

Examination of Incidental Bird Mortality

The third aim of the trial was to examine the potential for pot fishing to reduce or eliminate the incidental mortality of seabirds in CCAMLR toothfish fisheries. This was assessed using information collected by the scientific observers on board, as per CCAMLR guidelines.

Observations indicated that the interaction of seabirds with either setting or hauling operations was minimal. The possibility of birds becoming entangled in the fishing gear was also very low; no bird mortalities were witnessed during the trial.

Due to their weight, pots sank quickly, reducing the time in which birds had access to pots. In turn, no birds were observed in the direct vicinity of sinking pots. This may result from the fact that, unlike baited hooks of longline fishing gear, bait enclosed inside pots was not easily identifiable by, or accessible to, scavenging birds. The only witnessed interaction with setting operations was when birds occasionally landed on the surface where a pot had sunk to feed on small pieces of bait on the surface.

Birds generally stayed away from the area where pots were hauled. Many birds were, however, attracted to the vessel due to the discarding of fish offal and used baits from the pots. High numbers of crabs were also discarded through the offal chute. Despite this, birds in the vicinity of the chute generally showed little interest in these discards. Only one instance of predation was noted when a giant petrel fed on a crab with a damaged carapace. The most abundant bird species observed in the vicinity of the vessel during setting and hauling are shown in Table 4.

Observations were also made of the interactions of marine mammals with fishing operations. No direct interactions were seen. Antarctic fur seals (*Arctocephalus gazella*), sperm whales (*Physeter catodon*) and killer whales (*Orcinus orca*) were occasionally observed in the vicinity of the vessel, but showed no interest in hauling operations.

By-catch

The fourth aim of the toothfish pot trials was to examine the rate of by-catch in the fishery. By-catch consisted of a number of crab and fish species.

Crabs

The majority of the by-catch comprised two species of stone crabs, *Paralomis spinosissima* and *P. formosa*. Both species have been previously reported in catches around Shag Rocks and South Georgia. These species formed a large proportion of the total catch (Table 5 and Figure 4). Crab species formed 45.5% of the total weight of all

Table 5: Details of the catch of the two commercial crab species during the pot trials around South Georgia.

Species		Kept	Discarded (undersized)
Paralomis formosa	Live weight (kg)	1 957	24 101
	Number	4 720	115 173
Paralomis spinosissima	Live weight (kg)	366	6 625
	Number	435	20 193

Table 6: The number and percentage of female *Paralomis formosa*, *P. spinosissima* and *P. anamerae* sampled during the period March to May 2000.

Maturity Stage		*P. formosa*		*P spinosissima*		*P. anamerae*	
		n	%	*n*	%	*n*	%
1. Eggs uneyed	Eggs orange to yellow in colour, no eye spots	1 520	65	220	42	171	56
2. Eggs eyed	Eggs orange to yellow in colour, with distinctive, black eye spots	299	13	74	14	17	6
3. Eggs dead	Eggs entirely white, black or brown	5	0.2	3	1	0	0
4. Empty egg cases	Eggs absent, but egg cases still attached to pleopods	120	5	67	13	13	4
5. Non-ovigerous	Eggs absent, no reproductive tissues attached to pleopods	410	17	160	31	103	34

Table 7: The number and size ranges of fish by-catch species observed during pot fishing operations of the *Argos Georgia* at South Georgia.

By-catch Species	Number	Size Range (cm)
Grey rockcod (*Lepidonotothen squamifrons*)	94	29–41
Bigeye grenadier (*Macrourus whitsoni*)	63	39–74
Blue antimora (*Antimora rostrata*)	7	42–64
Antarctic armless flounder (*Mancopsetta maculata*)	5	21–29
Smalleye moray cod (*Muraenolepis microps*)	4	35–46

species caught, including toothfish (Figure 3), and 96.1% of the total numbers of individuals caught. A third *Paralomis* species, *P. anamerae*, was also recorded.

Only 3.3% of the sampled *P. spinosissima* individuals were of legal size (carapace width greater than 102 mm), of which only 0.6% were females. Only 11.1% (n = 596) of *P. formosa* were larger than the minimum legal size of 90 mm. Of the total sample, only 0.5% (n = 13) of female *P. formosa* were larger than the minimum size, indicating that few females would remain if carapace width were the only criterion used to select legal crabs.

Although a legal limit is not specified for *P. anamerae*, none were larger than the legal limit for *P. formosa* (90 mm), with sizes in the sample ranging from 40 to 90 mm. All crabs not sampled for biological analysis were therefore discarded. A peak in the length distribution of this species occurred between 55 and 57 mm, and few crabs were larger than 77 mm.

P. formosa formed a high proportion of the catches achieved to the northeast of South Georgia (regions E Georgia and NW Georgia). In contrast, *P. spinosissima* formed a notably high proportion of the catch around the Shag Rocks region. A clear depth distribution was found, with *P. spinosissima* occurring in shallow waters (<800 m, with highest densities in <400 m) and *P. formosa* in very high densities from 800 to 1 400 m. *P. anamerae* tended to occur at intermediate depths. Two other species, *Neolithoides diomedeae* and *Lithodes murrayi*, were also caught in small numbers.

Males were dominant in samples of all three species. Of the 5 009 *P. formosa* specimens examined, 46.1% were female. For *P. spinosissima* and *P. anamerae*, the percentage of females were 37.5% and 42% respectively. The number and percentage of female *Paralomis* crabs at different maturity stages are shown in Table 6. For all species, the largest percentage of females sampled had eggs present. The majority of these were at maturity stage 1. Very few crabs with eggs at maturity stage 3 (eggs dead) were found. A higher percentage of non-ovigerous crabs (maturity stage 5) were found among *P. spinosissima* and *P. anamerae* than among *P. formosa*. The smallest *P. formosa* with eggs (uneyed) had a carapace width of 39 mm. For *P. spinosissima* and *P. anamerae*, the minimum size of females with eggs was 58 and 41 mm respectively.

All crabs sampled for carapace length, sex and maturity were also examined for the presence of rhizocephalan parasites. Levels of infection were 2% for *P. formosa* (2.3% for females and 1.7% for males, n = 5 418), 4% for *P. spinosissima* (5.8% and 2.3% for females and males respectively, n = 1 410) and 10% for *P. anamerae* (14.8% for females and 6.2% for males, n = 724). In all the species, higher rates of parasite infection were found for females. The mean size of infected crabs was 66, 74 and 57 mm for *P. formosa*, *P. spinosissima* and *P. anamerae* respectively. A number of crabs were also observed with abdominal scars where parasites had been attached at an earlier stage, and it is likely that these individuals remained sterile.

Some preliminary estimates of crab discard survival rates were made. A number of alive and active crabs from one haul were tagged in the abdomen with Hallprint™ plastic T-bar tags, and maintained in running seawater before they were placed in pots prior to the next setting. Once these pots were rehauled, their vitality was assessed using the four-point relative scale: lively, lively but limp, dead and dead-eaten. This is similar to the experiment that Stevens et al. carried out on the Alaskan king crab (Stevens, 1990). As a control, a number of crabs were kept on board in running seawater.

A total of 32 *P. formosa* and 42 *P. spinosissima*, representing a cross-section of sizes and sexes, were subjected to reimmersions. All individuals were 'lively' before reimmersion. Of these crabs 76% were still 'lively' when hauled aboard after reimmersion and were able to support their own weight when clinging to the smooth end of a pair of forceps by one claw. A further 13% of crabs were still alive but limp, while only 11% of crabs did not survive the reimmersion. Of the latter, two suffered damage before reimmersion.

As a control, 35 untagged crabs were kept on board. A similar proportion died during the experiment (8%), while a lower proportion were 'lively' (63%). Control crabs suffered from an interrupted supply of fresh seawater during the experiment, which may have affected their condition.

No crabs had vitality stage 3 after the experiment; all dead crabs were attacked by isopods and amphipods, leaving only the shell. It is possible that these organisms were in fact responsible for killing the crabs, particularly where damage to the shell allowed access to the softer tissues of the crab. Physical damage appears to significantly increase discard crab mortality.

Fish

Fish species were caught in small numbers; the pot fishing method appeared to be species selective for *D. eleginoides*. The most abundant by-catch fish species was *Lepidonotothen squamifrons*, with 94 individuals ranging in size from 29 to 41 cm (Table 7). These nototheniids were found in only six hauls around Shag Rocks. A maximum of 46 individuals was observed in a single haul. The second most abundant by-catch species was bigeye grenadier (*Macrourus whitsoni*) with 63 individuals recorded in 18 hauls (16% of total hauls). Grenadiers were caught over a wide geographic range at depths ranging from 496 to 1 661 m. Blue antimoras (*Antimora rostrata*), Antarctic armless flounder (*Mancopsetta maculata*) and smalleye moray cods (*Muraenolepis microps*) were the only other fish by-catch species recorded during pot fishing.

DISCUSSION

These trials were successful in demonstrating that pots can be used to catch toothfish in Subarea 48.3 with zero incidental mortality of seabirds. By-catch of fish in toothfish pots was very low, but the by-catch of crabs was high. This was expected, since previous US crab fisheries using pots have caught both crabs and toothfish (Watters, 1997). However, there were some areas where by-catch of crabs could be minimised.

The trials were unable to confirm the commercial viability of using pots to fish for toothfish. The pots used in the trial were certainly less efficient at

catching toothfish than longlines set in the same place, and the overall catch rates achieved on the trials were lower than would be required for commercial viability. In some areas relatively high catch rates were obtained (Figure 2). For instance, 40% of the sets achieved catch rates of greater than 4 kg/pot, which would equate to 2 tonnes/day if 500 pots were set. Even the average of 3.5 kg/pot could become commercially viable if more pots were set per day. This could be achieved with a stronger hauler, with stronger gear to attach pots to the longline to prevent pots being lost. Shorter soak times should decrease the crab by-catch, since soak times appear not to improve toothfish catches, but do increase the by-catch of crabs and the likelihood of increased damage to fish by isopods and amphipods.

It is not clear why pots caught fewer toothfish than the longline. It is possible that because pots were only attached every 50 m, rather than every 2 m as was the case with the longline hooks, the encounter rate or the attraction area was lower for pots. However, the longline catch rate of 0.35 kg/hook implies 8.75 fish per pot, and the pots may have simply been too small to accommodate this number of fish.

The presence of crabs is likely to have acted as a disincentive to toothfish to enter pots. Figure 2 shows that high toothfish catches corresponded with low crab catches. This relationship requires confirmation, as it is also affected by the distribution of crabs and fish. However, anecdotal evidence suggests that high numbers of crabs in pots may repel toothfish, thereby reducing catches; video footage taken by Aberdeen University's baited camera system, AUDOS (Bagley et al., 1999), suggested that toothfish are repelled by crabs. Similar behaviour was also noted during tank experiments undertaken during the pot trial. Alternatively, crabs may block the single entrance of pots, effectively stopping them fishing for toothfish. Reduction in the crab by-catch may therefore result in improved toothfish catches. This reduction is desirable in itself, since time is wasted during the discarding of the high proportion of undersized crabs.

On the other hand, Basson (1994) has suggested that retaining parasitised crabs rather than returning them to their populations could reduce rates of parasitism in crab populations around South Georgia. The presence of so many crabs in the pot fishery might provide the opportunity for removing such crabs from their populations.

Although extensive trials of alternative pot designs could not be undertaken on this cruise, a number of pots were modified by changing an area of panel for one of larger mesh, with the aim of aiding the escape of small crabs. Unfortunately, no reduction in crab by-catch or sizes of crabs caught was evident in these pot. The larger mesh might have actually facilitated entry into pots by small crabs.

Further pot fishing is planned for the 2000/01 season. This will examine alternative pot designs and methods of increasing toothfish catch rates at the same time as minimising crab by-catch. It will also see if there are any areas within Subarea 48.3 for which a pot fishery could be viable for toothfish. The attractiveness of such a fishery is increased by the possibility of retaining legal-sized crab by-catch and fishing at all times of the year. This is possible because of the confirmed zero incidental mortality of seabirds when using pots.

CONCLUSIONS

(i) The toothfish pot trials confirmed that such a fishing method has zero incidental mortality of seabirds. The restriction of the longline fishery for toothfish to the winter months therefore need not apply to a toothfish pot fishery.

(ii) There was a significant by-catch of crabs. Various methods of reducing the crab catch, and increasing the toothfish catch, should be investigated in future trials planned for 2000/01.

(iii) The catch rates achieved in the trial were not commercially viable, but modifications to gear design and fishing strategy may yet prove that the method is commercially attractive.

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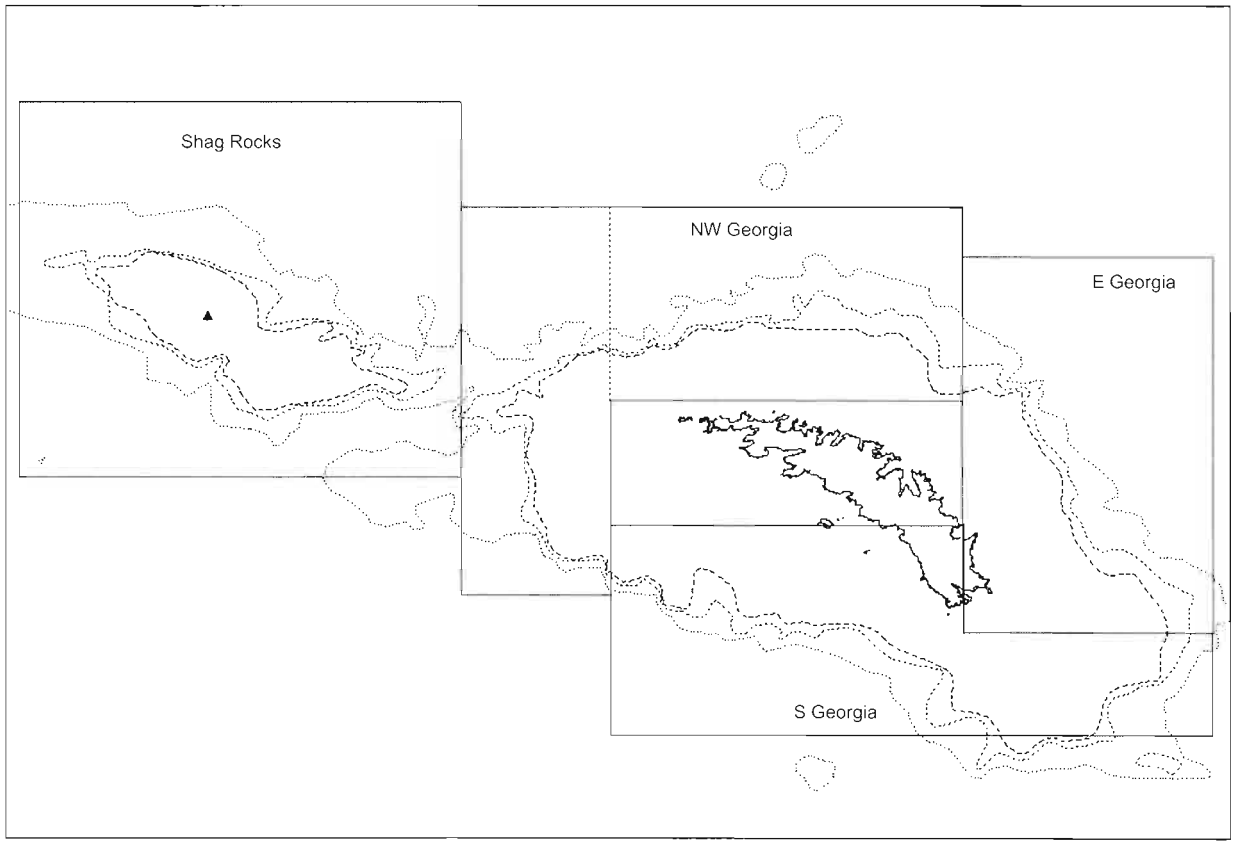

Figure 1: The four trial fishing zones around South Georgia. NW Georgia zone is divided into two regions: W(NW) and N(NW) Georgia.

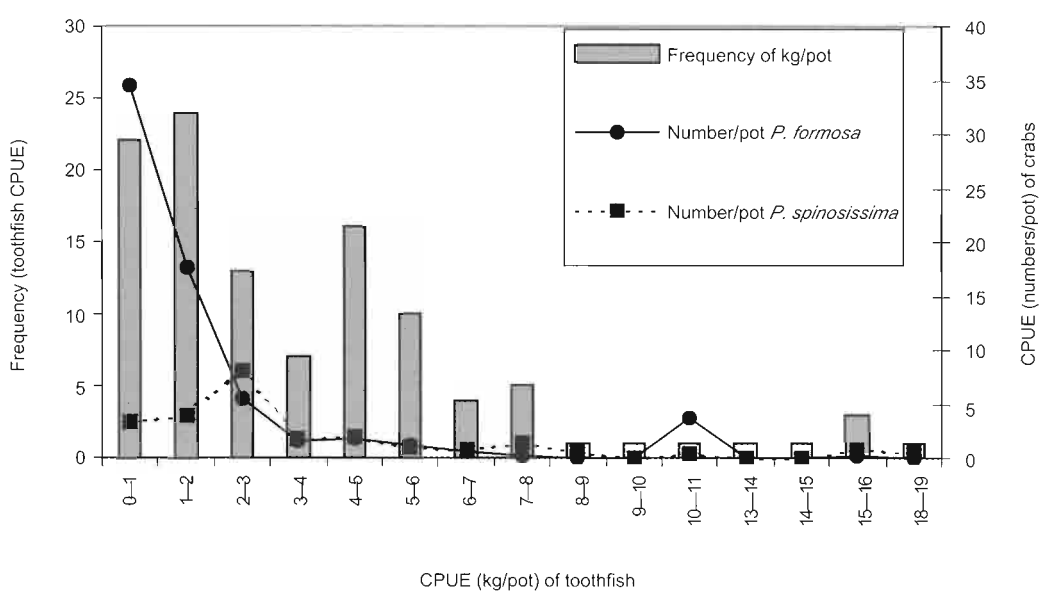

Figure 2: Frequency distribution of toothfish catches (CPUE, kg/pot), with corresponding average CPUE of crabs for those toothfish CPUEs.

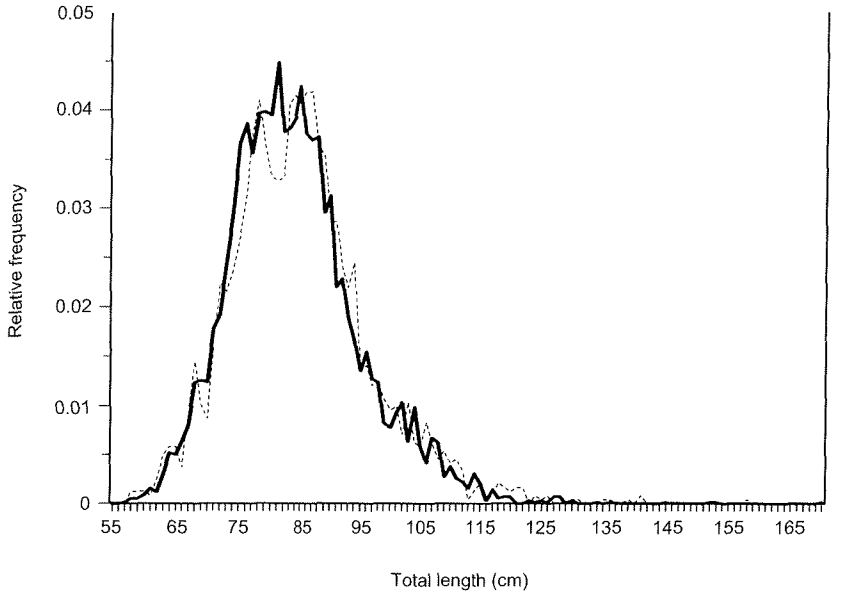

Figure 3: Comparison of *Dissostichus eleginoides* catch length frequencies by gear type. Solid line represents frequency from longline catches, dotted line represents frequency from pot catches.

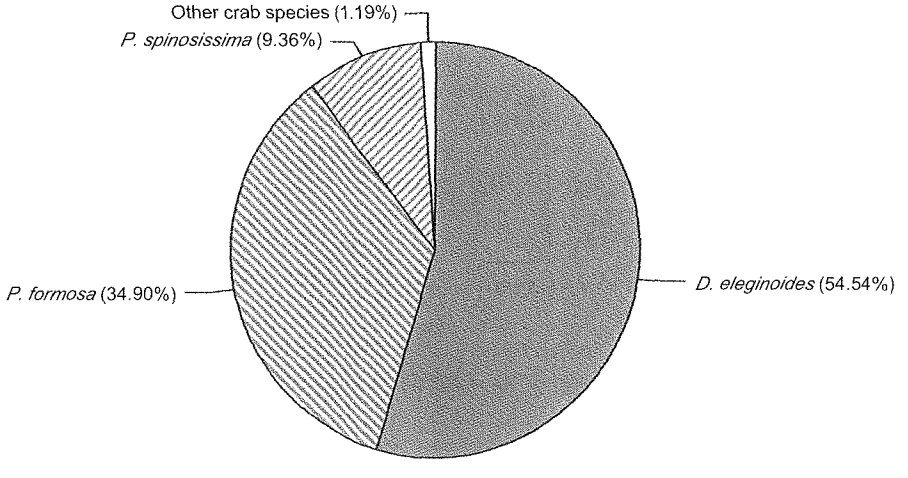

Figure 4: Abundance of each species in the catch as a percentage of total weight.

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