

EXPERIMENTS WITH COD POTS AS AN ALTERNATIVE TO GILL-NETS IN THE VARANGER FJORD IN APRIL-JUNE AND OCTOBER-DECEMBER 1996

by

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ABSTRACT

A newly developed cod pot (two-chamber pot) has been tested in the Varangerfjord area as an alternative to gill-net, with the purpose to reduce the periodically large unaccounted mortality of king crab in the gill-net fishery for cod and haddock. Even though crab are caught in pots as well, they may be put back to the sea unharmed. The experiments carried out in spring 1996, showed that the two-chamber pots might be an alternative to gill-nets for catching cod. However, in the experiments carried out in the autumn, the catches and the availability of cod were fairly low. Good catches of haddock were achieved by the longliners, but the catches of haddock in the pots were insignificant. Squid was used as bait in the pots, and another bait, i.e. mackerel, might have increased the catches of haddock.

INTRODUCTION

Stocks of king crab (*Paralithodes camtschatica*) in the Varanger Fjord have grown rapidly during the past few years. Fisheries for this crab is prohibited, and in Norway it is fished solely as part of the "King Crab Project", an integrated project that involves the Institute of Marine Research, the Head of Fisheries in the County of Finnmark, Arctic Products AS and local fishermen.

This is a limited trial fishery under the terms of an agreement in the Mixed Norwegian-Russian Fisheries Commission. Fishing takes place in the months of September to January. At other seasons, the quality of the crab is lower and it is of no commercial interest.

In the course of the year the crab is found at various depths. During the cod fisheries in winter and spring it remains in the fields used by the net-fishing fleet. As a result, large numbers of king crabs are taken by cod nets, reducing the effectiveness of this fishery. If the stock of king crabs continues to grow at the same rate as in recent years, it will be possible to launch a commercial fishery for this species in due course. As already pointed out, for reasons of quality, such a fishery will have to take place from the autumn until the end of the year, and in purely seasonal terms it will not be a substitute for the cod fishery.

At the same time as the king crab is creating difficulties for gill-net fishing, the fishery itself is depleting a stock that could be an important source of income for local fishermen in the future. For this reason, it is in the interest of all parties to maintain a winter fishery for cod while preventing unnecessary depletion of the crab stock.

Calculations based on the winter gill-net fishery in 1997 showed an average bycatch of about two crabs per net. Given that most vessels operate about 75 nets, this means that a single vessel takes out around 150 crabs per haul over a season of 10-12 weeks, i.e. a total of 4,000-

6,000 crabs in the course of the season. The local gill-net fleet, with the addition of foreign vessels, thus catches large quantities of crabs. In comparison the quota assigned to the trial fishery comes to a total of 22,000 crabs, equally divided between Norway and Russia.

If the stock of king crab continues to grow and spread westwards, the fisheries in other fjords and coastal areas will soon face the same problems as Varanger is doing already.

Several series of experiments have produced good results using a recently developed collapsible two-chamber pot for cod (Furevik 1993; Furevik and Skeide 1994a; Furevik and Skeide 1994b; Furevik 1997). The two-chamber pot is manufactured in two sizes, with surface areas of 150 x 100 cm and 120 x 80 cm respectively. The largest pot is shown in Fig. 1. The total weight in air and water for the big pot is 10.8 kg and 2.7 kg respectively. For the small pot, the corresponding weights are 7.5 kg and 2.4 kg respectively.

Pots used in other areas have also been studied. The modified king crab pot used for catching Pacific cod (*Gadus maxrocephalus*) (Furevik 1994) was found to be too big and heavy to be used by the coastal fleet. Many other pots were also looked into (Wolf and Chislett 1974; Whiteton et al. 1991; Collins 1990; Furevik and Løkkeborg 1994; Munor 1974, 1983; and Hull 1981), but no one were found that could be introduced directly into the coastal fishery in Norway.

In order to test these cod pots in place of gill-nets in the Varanger Fjord, project funding for the purchase of pots, training and use was sought via the Head of Fisheries in the County of Finnmark, in collaboration with the Institute of Marine Research, Fish Capture Section. The Norwegian Directorate of Fisheries provided funding for initial trials. In the first experiment in April and May 1996, 30 pots were fished, and for the experiments in autumn 1996, 50 pots were used.

We regarded the autumn as an interesting period for experimental fishing comparisons of pots and longlines. The longline fishery itself is not a problem for crab stocks, but crabs can take both line-bait and fish on the hooks.

Apart from being an alternative to gill-nets, pots are excellent for catching live fish. If profitable catches can be obtained with pots, interim and possibly long-term storage and feeding of cod might be possible. This in turn could lead to better prices on the market for fresh fish.

MATERIAL AND METHODS

The fishing trials were carried out in the area outside Bugøyenes by M/S "Eskil" and M/S "Trifon", two 35' fishing vessels from 15 April to 5 June 1996 and 23 October to 12 December 1996. During periods when gill-net fishing took place in the same areas as the pots were being used, the weight of the catches (gutted) and the number of crabs per fleet of pots were recorded. The pots were set in two fleets of 15-20 pots each and baited primarily with squid, as well as some mackerel. In order to reduce catches of crabs in the pots we tried to float some of the pots 0.5-1.0 m above the seabed. On some pots, three vertical cords were fastened to the short ends of the pots outside the outermost entrance, creating four fields, each with a width of 25 cm.

RESULTS AND DISCUSSION

First period

The first period is divided into two parts; from 15 April - 2 May and 8 May - 5 June; because the availability of cod changed greatly. Table 1 shows the average catch/fleet, maximum and minimum catches per fleet, and total average catch per pot for the two parts of the period. It can be seen that in the first part, the average catches of cod is fairly high, whereas in the second part the availability decreases.

Table 1. Average catches of cod per fleet, maximum and minimum catches per pot, and total average catch per pot from the two periods.

	Aver. catch/fleet		Fish per pot		Aver. catch of fish/pot	Aver. catch crab/pot		Crab/pot		Aver. catch of crab/pot
	Max	Min	Max	Min		Max	Min	Max	Min	
Period 1:										
First part 15.04.-01.05	15.2	5	36	0	9	7.3	0.4	16	0	2.6
Second part 08.05.-05.06.	5.9	1.5	10	0	2.8	10.5	1.0	29	0	3.4
Period 2: 23.10.-12.12	5.2	1.0	9	0	2.4	9.6	0	15	0	0.8

In Appendix 1 more details from the first trial period is given. We can see that by the beginning of May catches of cod are diminishing. This was also the case with gill-nets, where with fleet No.29 (May 9) 12 nets were hauled for a catch of 250 kg gutted fish, while with fleet No.41 (May 20), 30 nets were hauled giving a catch of 80 kg gutted fish. In the beginning, the catch in each pot was often between 25 and 30 cod. The average catch per pot per fleet varied, in the first period from 15.2 - 5, and in the second period from 5.9-1.5 (Table 1). The average catch during the whole period is 6 cod per pot. The catch rates obtained in the pots were sufficiently interesting to suggest that pots might be an alternative to gill-nets in the winter-spring cod fishery in the Varanger Fjord area.

As far as catch rates for pots compared to nets during the first period are concerned, the material is too sparse and uncertain to allow us too draw conclusions. Information regarding gill-net catches was provided by gill-net fishing vessels in the vicinity, and distances from pot fleet to net fleet varied a great deal. For this reason, it would be difficult to assume that the distribution of fish was the same for both types of gear under all comparative conditions.

In order to gain an indication of the catch rates of pots vs. gill-nets, however, a comparison is shown in Table 2. This shows that there were wide variations, and that 3.9 - 0.5 pots are equivalent to one gill-net. It must be assumed that this is partly due to large local differences in fish density and migration pattern.

Table 2. Number of pots needed to obtain a catch equivalent to that in one gill-net.

Fleet No.	29	31	32	41
No. of pots/gill-net	3.9	1.4	1.3	0.5

The mean number of crabs caught per pot within each fleet varied widely, from 10.5 to 0.4. (Table 1). The overall mean was 2.9 crabs per pot (Appendix 1). This wide variation in catch rates may be due to an extremely patchy distribution. The catch rates of gill-nets (fleets Nos. 29, 31 and 41) were 2.5 - 1.3 crabs per net. In the course of the period, however, much higher

catches of crabs were reported by some boats, though no figures were obtained. The gill-net vessel fishing fleet No.32, for example, was forced to give up for a while because of large bycatches of crab.

When gill-nets are left out for longer periods we must expect catches of crab to rise dramatically, as was demonstrated by fleet No.19 (Appendix 1).

To investigate whether an increasing number of crabs in the catches would reduce the catches of cod, the average number of cod per pot per fleet was compared to the average number of crab per pot per fleet. Fig. 2 shows that there is no clear connection between the amount of crab and the size of the catches of cod. The comparison were made with catch data from 15 April-2 May, when the cod catches were fairly stable.

The initial experiments of floating pots produced poor results. Although they did not catch crabs, they did not take any cod either. It is not certain whether these pots lay in the water in the way we had expected, and we will have to be look at this aspect more closely. Tying vertical cords around the outermost part of the entrance to the pots did not lead to any noticeable difference in catches of either cod or crabs. In future experiments, a slightly shorter distance between the bands may be tested.

Virtually all the crabs caught in the pots were released uninjured to the sea, and as far as bycatches are concerned, a pot fishery would not be a problem, although of course it would be preferable to catch as few crabs as possible. The only problems are that the pots may be somewhat heavier to lift aboard, and that it takes some time to remove the crabs from them. The latter problem can be solved by putting a large zip-fastener in the bottom of the pot.

Second period

Cod pots and longlines

These experiments were designed and carried out as for bottom longline fishing for cod, and for the most part, fishing was carried out on the traditional autumn line grounds used by inshore fishing vessels from Vadsø, Vestre-Jakobselv and Bugøyenes. This longline fishery normally starts in September/October and continues until the end of the following January. The proportion of haddock in the catches is normally about 50% at the beginning of the season, gradually tailing off towards Christmas.

In autumn 1996, the proportion of cod was abnormally low, and the longlining boats were catching 80-90% haddock throughout the period. The catch per tub of longline varied from 70-180 kg., with an average of just over 100 kg. The catch data for cod and crab are given in Table 1, with more details in Appendix 2. The catches per fleet were generally low, with the average number of fish per pot lying between 0.95 and 5.19. The overall average was 2.41 fish per pot, of which 71% were cod. The bycatch consisted largely of torsk (*Brosme brosme*), with a few spotted catfish (*Anarhicas minor*), wolf fish (*Anarhicas lupus*) and haddock (*Melanogrammus aeglefinus*). The catches of crabs per pot per fleet varied from 9.6-0 with a total average of 0.75 crabs per pot.

The cod pots caught very few haddock. This is due to the facts that haddock are more careful than cod when approaching a pot, that the pots were soaked outside the typical fishing areas for haddock, and that squid were used as bait. Mackerel as bait would have increased the catches of haddock.

Table 3 shows the average catch per pot after various soak times. The catch rate changes little with soak time. The data indicate that the pots caught little or nothing after the first 24 hours,

and that fish did not escape from pots to any extent. If they had done so, the catch rate would have decreased as soak time increased.

Table 3. Average catch per pot with regard to soak time.

Soak time (days)	No. of fleets	Average no. of fish/pot
1	20	2.28
2	10	2.37
3	10	2.78
4	7	2.57
5	4	2.30
6	4	2.08
7	2	2.27
8	2	2.44

The lower average of crabs caught in the second period may be due to the wider fishing area compared to period one. In several areas where the pots were tested in period 2, the king crab are less densely distributed.

Cod pots and bottom conditions

The pots were tried out on seabeds of all types of topography and character. Generally speaking, the pots seemed to function well irrespective of the seabed topography. Some empty pots were observed where they had been placed on very steep slopes, and they tended to catch fish more regularly on a flat bottom. Irregular stony bottoms caused very few pots to stick. There was some damage on stony bottoms, but in only one case was this so severe that the pot had to be taken ashore for repair. Stones occasionally were caught in the funnel entrance on stony bottoms. No pots were lost.

Ease of handling, design and use

Because of their light weight and design the pots were easy to handle on board. Their aluminium frames were easily bent and a fixed crutch and boom are necessary when the pots are hauled inboard to be emptied. The location of the zips in the new pots made it easy to empty them of fish and crabs.

The line in the pots wears out along the frame, and it should be protected with rope. A larger number of snap-links should be installed on the fleet line, so that the distance between the pots can be adjusted according to fish density and seabed conditions. The line could also be produced in shorter lengths to make it easier to change the length of the fleets.

Most small fishing vessels are already equipped to handle pots easily, i.e. with a net winch, net hauler and boom with winch. Two men could turn over about 100 pots per trip, depending on amount of fish taken, distance between fleets, etc.

SUMMARY

Pots could be an alternative to gill-nets in the winter/spring fishery in the Varanger area. During the autumn fishery, when cod are few, pots would not be an alternative to other types of gear. The availability of cod during this period varies widely from one year to another, and the pots should be further tested in the spring and autumn fisheries in the Varanger Fjord.

In addition to the fact that pot-caught fish of high quality can be supplied directly to the market, pots are also an excellent means of catching fish for live storage. The potential for both interim storage and long-term storage and feeding should be further investigated. The technology is well-known and tested, e.g. in a number of studies carried out by the Institute of Marine Research, Fish Capture Section, and The Norwegian Fisheries Research Institute. This would make it possible to bring such catches to the fresh-fish market and to offer fresh fish when other supplies are low.

Methods of reducing bycatches of crabs in the pots should be further tested.

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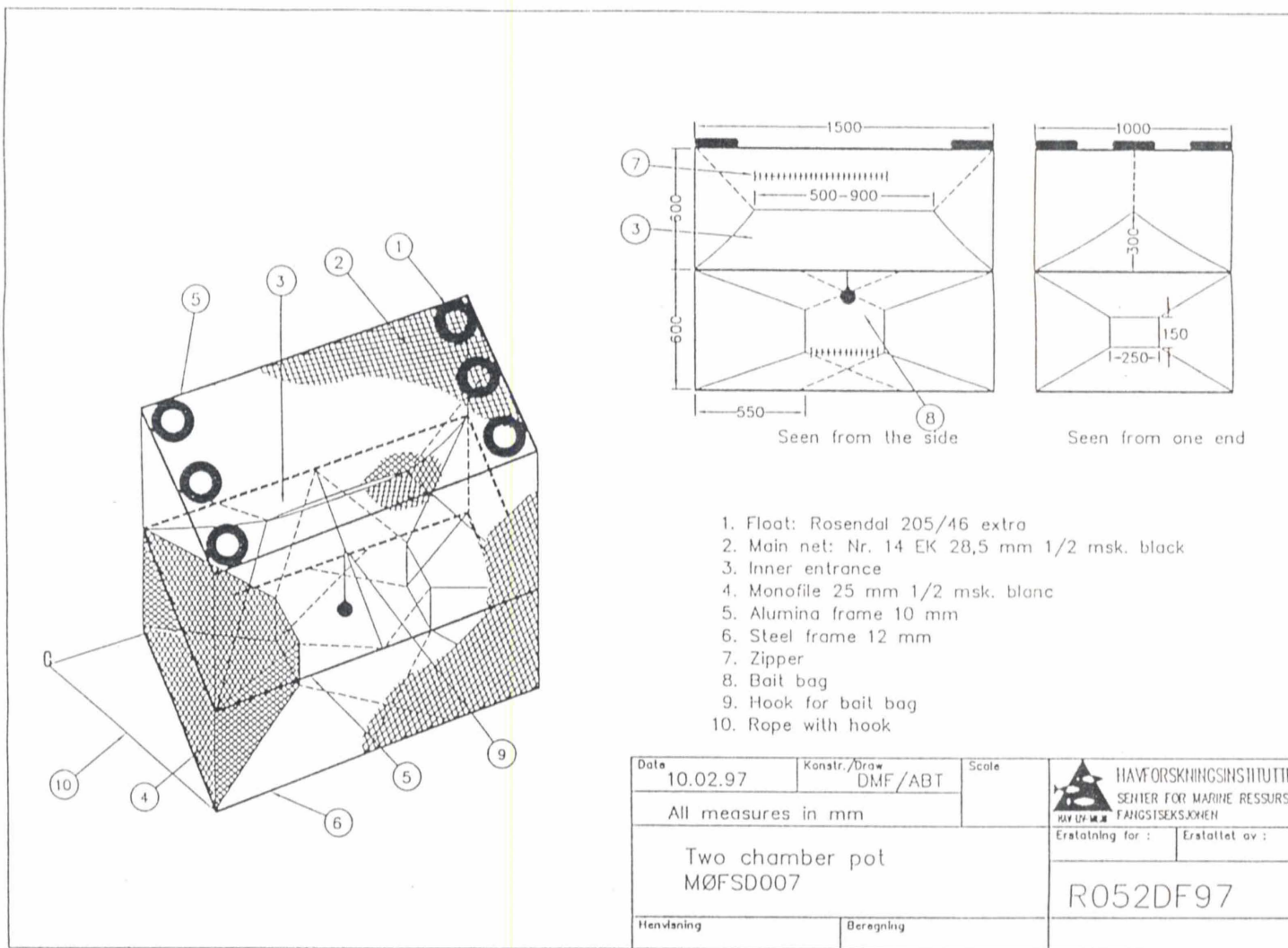


Fig. 1. The two-chamber pot (TC-pot)

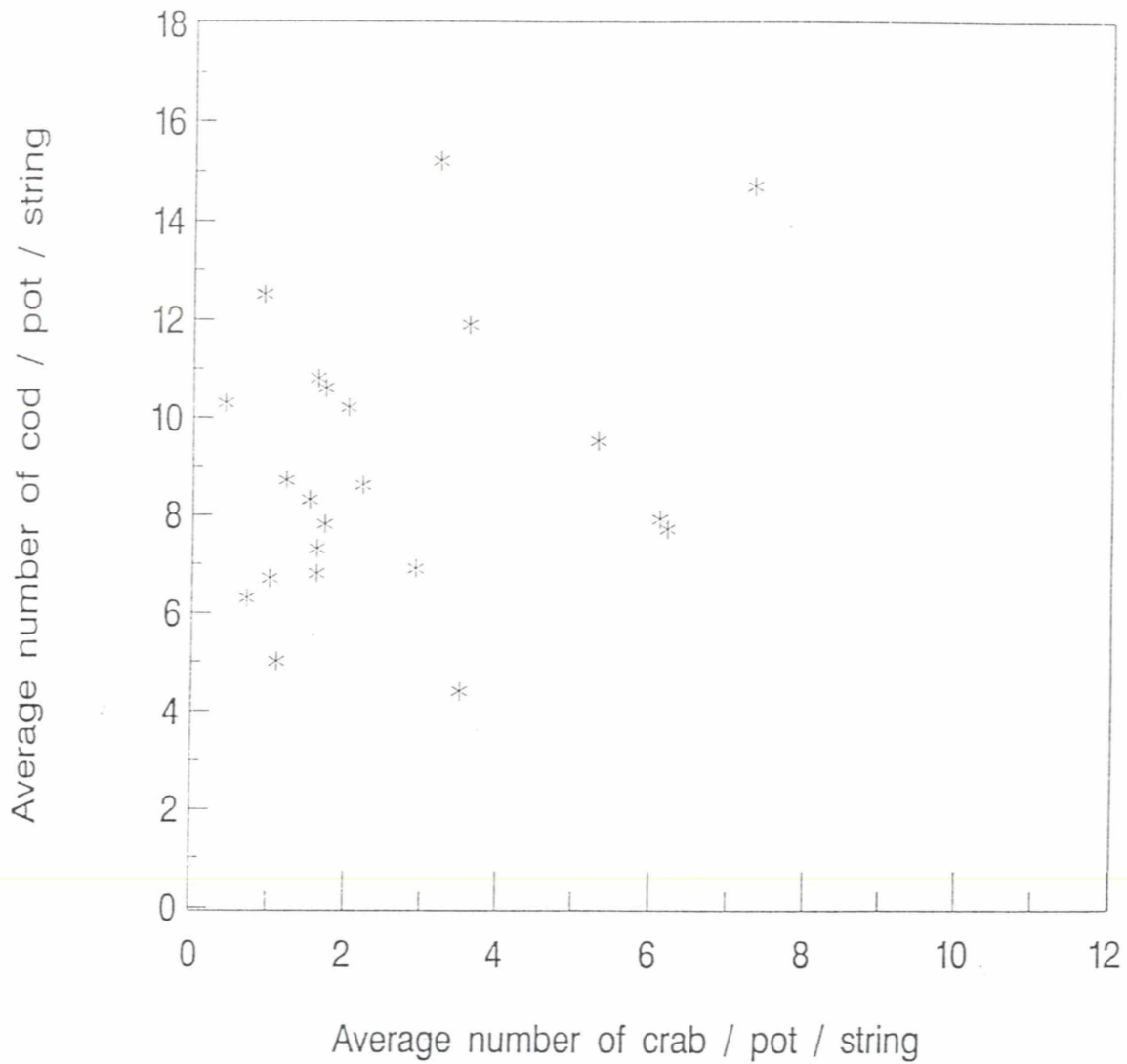


Fig. 2. Catch of crab per pot compared to catch of cod per pot in the beginning of the first period.

Appendix 1. Catch of cod and king crab with pots off Bugøynes in April – May 1996. Bait: squid.

Date	Set Hauled	Area	Depth (fathoms)	Fleet no	No of pots	No of fish	No of king crab		Average no of fish/pot	Average no of crab/pot	Gutted weight (kg)	Comments
							♂	♀				
1504	1604	Off Bugøy	140	1	15	143	21	59	9.5	5.3	250	
1604	1704	Across the fjord	90-130	2	13	57			4.4	3.5	75	
1604	1704	Off Bugøy	150	3	14	166	48	2	11.9	3.6	270	
1704	1904	Bugøyspissen	130-155	4	12	130	5	14	10.8	1.6	200	
1704	1904	Fugleskiten	140	5	14	111	37	49	7.9	6.1	160	
1904	2204	Bugøyspissen	130-155	6	15	102	24		6.8	1.6	150	
1904	2204	Off Bugøy		7	15	228	48		15.2	3.2	350	
2204	2404	Bugøyspissen		8	15	188	13		12.5	0.9	300	
2404	2504	Off Bugøy		9	15	221	110		14.7	7.3	350	
2404	2504	Bugøyspissen		10	15	75	16		5	1.1	110	
2504	2604	East of Bugøy	100-130	11	15	125	23		8.3	1.5	150	
2504	2604	Bugøyfjord	120-130	12	15	154	30		10.2	2	270	
2504	2704	Off Bugøy	120-150	14	15	115	34	59	7.7	6.2	160	
2604	2704	Bugøyfjord	120-140	15	14	154	2	4	10.3	0.4	250	
2704	3004	Bugøyfjord	120-130	16	15	109	15	9	7.3	1.6	160	
2704	3004	Bugøyfjord	150	17	15	159	10	16	10.6	1.7	260	
3004	0105	Varanger-Bugøyfjord	120-150	18	15	129	28	5	8.6	2.2	180	
3004	0105	Bugøyfjord	60-130	19	15	94	9	2	6.3	0.7	120	300-400 crab, 12 gill nets (soaked more than 1 day)
0105	0205	Bugøyfjord	130-150	20	15	100	9	6	6.7	1	150	
0105	0205	Bugøyfjord	130	21	14	97	21	19	6.9	2.9	150	
0205	0305	Bugøyfjord	140	22	15	131	16	2	8.7	1.2	200	1 Greenland halibut, 1 redfish
0205	0305	Bugøyfjord	130	23	15	117	17	8	7.8	1.7	170	
0805	0905	Other side of Bugøy	60	28	15	22	23	15	1.5	2.5	30	
0805	0905	Bugøyfjord	150	29	15	55	15	2	3.7	1.1	80	1 torsk, 1 porbeagle, 12 gillnets, 25 kg gutted weight, 25 crabs

Appendix 1 cont.

Date			Depth (fathoms)	Fleet no	No of pots	No of fish	No of king crab		Average no of fish/pot	Average no of crab/pot	Gutted weight (kg)	Comments
Set	Hauled	Area					♂	♀				
0905	1005	Bugøyfjord	150	30	15	34		11	2.3	2.3	70	
0905	1005	Bugøyfjord	130	31	15	34	14	4	2.3	1.2	70	12 gillnets, 80 kg gutted weight, 15 crabs
1005	1105	Bugøyfjord	100-130	32	15	34	34	19	2.3	3.5	70	24 gillnets, 150 kg gutted weight, The gillnetter cut short the cruise due to large bycatches of crab
1005	1105	Bugøyfjord		33	15	29	14	4	2.1	1.2	60	1 Greenland halibut
1105	1305	Bugøyfjord	120	34	15	89	44	15	5.9	3.9	120	
1105	1305	Bugøyfjord	150	35	15	52	13	3	3.5	1.1	80	
1305	1405	Bugøyfjord	150	36	15	33	10	10	2.2	1.3	50	
1305	1405	Bugøyfjord		37	15	43	25	18	2.9	2.9	70	
1405	1805	Other side of Bugøy		38	15	42	101	37	2.8	9.2	70	1 catfish, 1 torsk
1405	1805	Bugøyfjord	130	39	15	65	15	0	4.3	1	100	
1805	2005	Bugøyfjord	130	40	15	54	27	24	3.6	3.4	90	
1805	2005	Other side of Bugøy	150	41	15	55	101	51	3.7	10.5	90	30 gillnets, 80 kg gutted weight, 75 crabs
2005	2405	Bugøyfjord	130	42	15	34	67	10	2.3	5.1	60	
2005	2405	Bugøyfjord		43	15	43	13	0	2.9	0.9	70	
2405	2905	Bugøyfjord	150	43b	15	28	30	0	1.9	2	50	3 torsk, 2 catfish. Bait: squid and mackerel
2405	2905	Bugøyfjord	150	44	15	21	23	6	1.4	1.9	40	5 torsk, 1 catfish. Crab with tag. Bait: mackerel
2905	0506	Bugøyfjord	100	45	15	19	73	21	1.3	6.3	30	Bait: mackerel
2905	0506	Bugøyfjord		46	15	31	97	4	2.1	6.7	50	Bait: mackerel
Total					620	3722	1064	508	6.0	2.9		In average ♂ 2.0, ♀ 1.0

Appendix 2. Catch of king crab and fish with pots off Bugøynes in October-December 1996.

Date	Fleet no	Total no of pots	No of pots with fish	Total no of fish	No of cod	No of other species	Average no of fish/pot		No of king crab		Average no of crab/pot	% cod of total catch	% pots with fish	Landed (kg)	
							of fish	of crab	♂	♀				Cod	Other
23.10	25.10	1	12	35	33	2	1.94	12	13	2.1	94	67			
23.10	25.10	2	12	22	18	4	1.16	13	40	4.4	82	63			
25.10	28.10	3	9	24	22	2	1.33	26	59	9.4	92	50			
25.10	28.10	4	16	55	45	10	2.89	0	3	0.2	82	84	159	48	
28.10	29.10	5	12	40	31	9	2.11	0	19	1.6	78	63			
29.10	29.10	6	15	61	46	15	3.39	1	3	0.2	75	83			
29.10	31.10	7	13	44	38	6	2.32	2	4	0.3	86	68			
29.10	31.10	8	10	30	28	2	1.76	2	6	0.6	93	59			
31.10	31.10	9	16	88	78	10	4.63	0	10	0.6	89	84			
31.10	01.11	10	13	25	20	5	1.32	0	1	0.1	80	68	190	20	
31.10	01.11	11	11	19	18	1	1.19	0	0	0	95	69			
01.11	01.11	12	11	18	14	4	0.95	0	5	0.4	78	58			
01.11	04.11	13	13	40	25	15	2.11	2	3	0.4	63	68			
01.11	04.11	14	15	51	30	21	3.19	2	1	0.2	59	94			
04.11	04.11	15	10	26	18	8	1.53	47	49	9.6	69	59	125	40	
04.11	05.11	16	16	45	22	23	2.37	7	8	0.9	49	84			
04.11	05.11	17	15	42	15	27	2.63	5	3	0.5	36	94			
05.11	05.11	18	18	31	20	11	1.72	42	27	3.8	65	78			
05.11	06.11	19	18	38	25	13	2.11	2	1	0.2	66	78			
05.11	06.11	20	16	47	25	22	2.94	10	0	0.6	53	94			
06.11	06.11	21	19	64	40	24	3.37	0	0	0	63	100			
06.11	07.11	22	19	35	14	21	1.84	2	1	0.2	40	84			
06.11	07.11	23	18	51	35	16	2.83	16	13	1.6	69	89			
07.11	07.11	24	16	54	21	33	3.38	7	3	0.6	39	81			
07.11	08.11	25	16	39	20	19	2.44	18	3	1.3	51	94			
07.11	08.11	26	18	54	28	26	3.00	1	0	0.1	52	89	345	289	
08.11	11.11	27	16	80	42	38	4.21	8	5	0.8	53	84			
08.11	11.11	28	15	83	38	45	5.19	31	5	2.4	46	94			

Appendix 2 cont.

Date	Fleet no	Set Hauled	Total no		No of other species	Average no		No of king crab		Average no of crab/pot	% cod of total catch	% pots with fish	Landed (kg)	
			of pots	with fish		of fish	cod	of fish/pot	of crab/pot				of fish	Cod
11.11	12.11	29	16	16	16	31	16	8	4	0.8	66	89		
11.11	12.11	30	12	12	4	21	4	22	7	2.4	84	80		
11.11	13.11	31	16	16	13	20	13	11	1	0.8	61	84		
12.11	13.11	32	15	15	18	32	18	5	1	0.4	64	83		
12.11	13.11	33	15	15	16	34	16	0	0	0	68	94	300	190
13.11	18.11	34	15	15	10	34	10	5	2	0.5	77	79		
13.11	18.11	35	16	15	15	28	15	5	0	0.3	65	94		
13.11	18.11	36	16	14	12	22	12	2	3	0.3	65	88		
13.11	20.11	37	18	15	2	38	2	18	10	1.6	95	83		
14.11	20.11	38	19	14	3	29	3	12	8	1.1	91	74	134	30
18.11	26.11	39	16	16	12	24	12	0	0	0	67	100		
18.11	26.11	40	16	14	17	25	17	5	0	0.3	53	88		
20.11	26.11	41	19	17	7	60	7	23	17	2.1	90	89		
20.11	27.11	42	18	16	9	31	9	10	1	0.6	78	89		
26.11	29.11	43	16	14	9	39	9	0	1	0.1	81	88	191	30
26.11	29.11	44	19	17	4	48	4	11	5	0.8	92	89		
26.11	30.11	45	16	12	9	20	9	4	2	0.4	69	75		
27.11	30.11	46	18	15	14	33	14	2	0	0.1	70	83		
29.11	03.11	47	19	19	9	52	9	2	3	0.3	85	100		
29.11	03.11	48	16	13	8	25	8	2	1	0.2	76	81		
30.11	03.11	49	18	17	9	49	9	1	0	0.1	84	94		
30.11	04.11	50	16	14	4	31	4	4	0	0.3	89	88		
03.12	04.11	51	19	14	4	22	4	0	0	0	85	74	92	49
03.12	05.11	52	18	13	6	31	6	0	0	0	84	72		
03.12	05.11	53	16	15	21	17	21	0	0	0	48	94		
04.12	10.11	54	16	15	8	20	8	8	3	0.7	71	94		
06.12	10.11	55	16	15	13	17	13	1	0	0.1	57	94		
04.12	10.11	56	19	15	3	23	3	4	5	0.5	88	79		