International Council for
the Exploration of the sea

C.M. 2000/J:05
Efficiency, Selectivity and Impacts
of Passive Fishing Gears

Reduced bycatch of red king crab *(Paralithodes camtschatica)* in the cod gillnet fisheries in northern Norway

Fishing trials with norsel mounted gillnets

by

Hallvard Godøy, Dag Furevik and Svein Løkkeborg

Institute of Marine Research, Fish Capture Division, P.O. Box 1870, N-58 17 Bergen, Norway

Abstract

Bycatch of red king crab *(Paralithodes camtschatica)* in stationary fishing gears, especially gillnets, is an increasing problem to the inshore fishermen in the northern part of Norway (Finnmark county). The results are large bycatches of king crabs together with the crabs' damages on the gear and catch. In the cod gillnet fisheries, the problem might be solved by using specially made gillnets ("norsel-mounted" nets) where the net itself is floated 0.5 meters above the seabed. The norsel-mounted nets were compared with standard nets in the Varangerfjord (eastern Finnmark) in the period 17 March – 28 May 1999. The trials showed that norsel nets needed more floats than the standard nets to get the net to stand properly in the sea (to get the norsels stretched out suitably). By using extra float (rings) on the norsel mounted nets the bycatches of king crab were reduced to an acceptable level with an average of 0.6 crabs/net, compared with 3.3 crabs/net on standard and 6.7 crabs/net on norsel nets without extra float. Norse1 nets caught only about 1/3 as many fish as standard nets.

The catch results indicated that the gear configuration functioned in order to reduce the bycatch of red king crab. Loss of fish up to 65% is, however not satisfying. Further work is needed to find a solution that gives a minimal loss of fish. Knowledge about the different species' behaviour is of importance in the further development of a more selective gear.

Introduction

The red king crab (*Paralithodes camtschatica)* is a new species in the Norwegian fauna. In order to establish a commercially exploitable king crab population in the Barents Sea the Russians transplanted juvenile and adult crabs off Murmansk in the 1960's (Orlov & Ivanov, 1978; Kuzmin & Olsen, 1994). The stock of red king crabs has increased radically over the past few years (Toresen et al., 1999). The government's intention is to take care of this resource. The king crabs are therefore protected and only allowed fished through a limited pot fishery with a total quota of 75,000 crabs (1999) shared by Russia and Norway.

The use of tradition& stationary fishing gears in eastern Finnmark (northern Norway) has come into conflict with the king crab as the species creates considerable bycatch problem, especially in the cod gillnet fisheries (Sundet, 1998). Since the king crab is only allowed caught through at limited pot fishery, the crabs caught in the gillnets are discarded. The crabs often get crushed in the net hauling system, and are also often crushed by the fishermen to make them easier to disentangle from the net. Large bycatches also tend to remain on deck because it takes a certain amount of time to disentangle them. In the winter time this can cause increased crab mortality because the crab may freeze to death. This means that discarded crabs are often dead or have considerable damages. The bycatch therefore seems to be an important contribution to the mortality in the crab population. The king crab also creates extra work for the fishermen and causes damages on gear and catch.

The bycatch problem is largest in the cod gillnet fisheries. In the spring cod fishery in 1999, king crab bycatches of several thousand (up to 5,000) individuals on one gillnetchain (10-15 nets) were often reported in the Varangerfjord area. This means that the bycatch of crabs probably are higher than the total research quota of 75.000 crabs. If the population continues to expand westwards more fjord and costal fishery areas will face the same problem. Proper management of king crab requires development of gear solutions that will reduce the bycatch.

Material and methods

An attempt to reduce the bycatch was made by using norsel-mounted nets floated of the bottom. The idea is that the crab can pass under the net without entangeling (see Figure 1).

The experiments were carried out in the Varangerfjord (eastern Finnmark), onboard the 35 feet long "Eskil", in the period 17 March – 28 May 1999.

The standard gillnets used were monofilament (0,55 mm) with 84 mm meshsize (bar mesh), hanging ratio of 0,5 and 50 meshes deep. Each net were approximately 27,5 meter long and 7,3 meter high. The "Megaflyt" headline has a buoyancy of 65 grams per meter, and the solerope a weight of 250 grams per meter.

The experimental nets were standard nets mounted on norsels (Figure 1). Even if the nets were mounted on norsel, the experience during the fishing trials was that the norsel-mounted nets needed extra floats to stand properly "stretched". Hence there were attached 3 rings (each with a buoyancy of 240 grams) on each net.

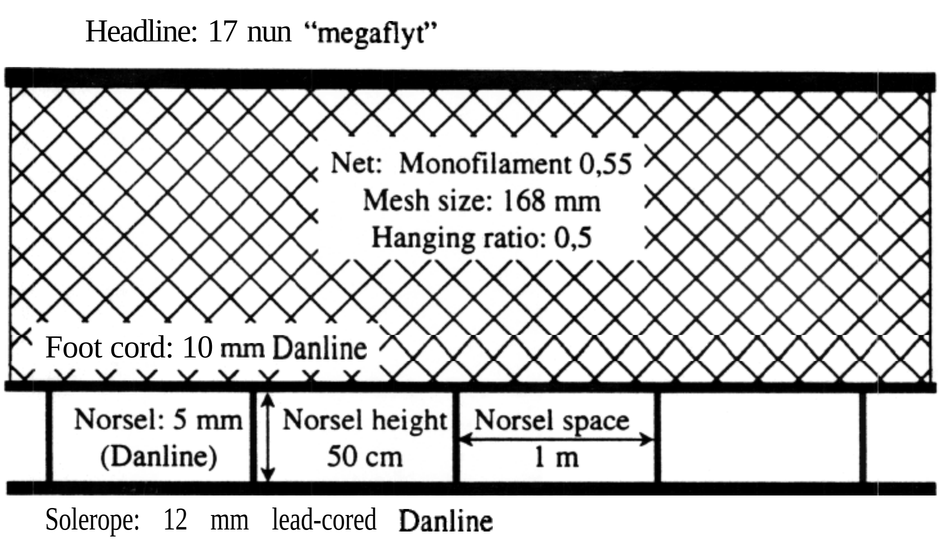

Figure 1 Sketch of a nor&mounted gillnet. The netting itself is lifted 0,5 meters above the seabed with use of norsels.

The norsel-mounted nets were compared with standard nets. The gillnet chains (10-15 nets in each chain) were thrown on locations parallel to each other with a distance of approximately 0.5 nautical miles. The next day the standard chain was thrown on the location of the norsel chain and vice versa. Setting and hauling time depended on the weather conditions, but the nets were usually hauled in the morning and thrown consecutive. Mean soak time was 26 hours.

Results

A total number of 458 nets caught 1430 king crabs and 2592 fish. The catch distribution for the different net types is shown in Figure 2. The number of fish caught was significantly lower on norsel-mounted nets than on standard nets ((student t-test) $p < 0,001$). About 90% of the number of fishes caught were cod (*Gadus morhua*) and the rest were mainly haddock (*Melanogrammus aeglefinus*) and long rough dab *(Hippoglossides platessoides).* There was also significant difference between numbers of crabs caught on norsel nets with rings versus standard nets and norsel nets ($p < 0,01$)

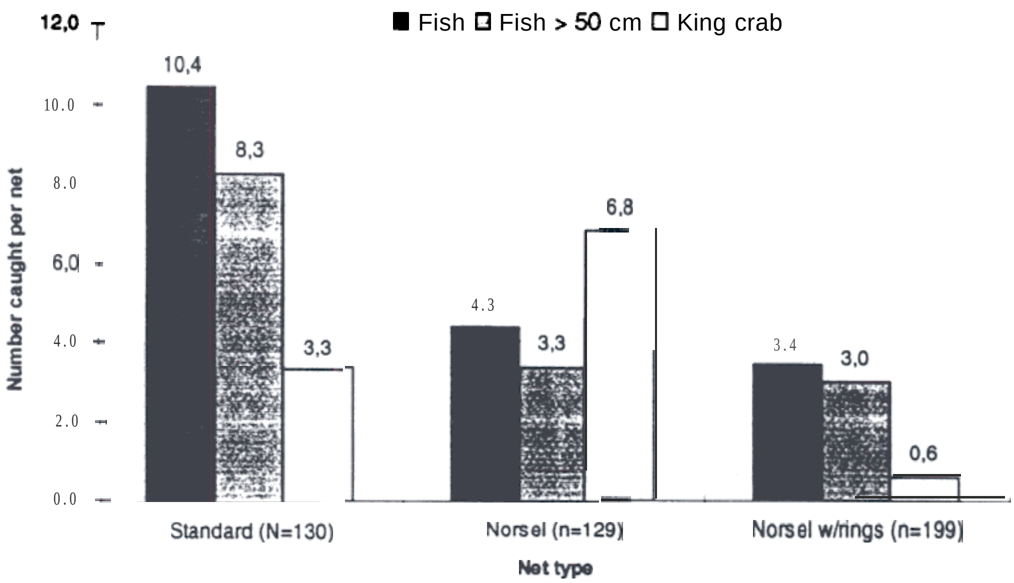

Figure 2. Catch rates on standard nets, norsel nets and norsel nets with rings for king crab, fish and fish above 50 cm.

The fish caught on norsel nets with rings had 3 cm longer mean length ($p < 0,01$) than those of standard and norsel nets. There was no correlation between number of fish and number of crab caught on the same netchain.

Table 1 Number of nets, soak time, number of fish and crab caught, standard deviation, mean lengths, fish mortality, highest number of king crab caught on a single net and crab sex composition for the three net types.

	Standard	Norsel	Norsel w/rings
Number of nets	130	129	199
Mean soak time (hours)	26,9	25,9	25,9
Number of fish caught	1352	561	679
Standard deviation (fish per net)	10,1	4,2	4,3
Mean fish length (cm)	63,1	63,3	66,4
Fish mortality (%)	17	26	17
Number of king crab caught	429	881	120
Standard deviation (king crab per net)	12,5	15,8	1,7
Mean length king crab (mm)	101	101	100
Highest number king crab caught on a single net	129	114	13
Sex composition king crab (% males)	38	39	37

Discussion

The intention of this study was to use norsel-mounted nets to avoid king crab entangling in the net. Gillnet fishery is affected by many factors which influence the efficiency and selectivity of the gear, directly or via interaction with other factors (e.g., Baranov, 1976; Hamley, 1975; Pope et al., 1975; Dickson, 1989; Engås & Løkkeborg, 1994; Machiels et al., 1994). It is therefore likely that mounting the net on norsels would affect several of the net characteristics. One of the most obvious “side effects” is loss of fish in the norsel area. Another factor that could be affected is the size selection.

The norsel nets gave significantly less fish and more king crab than standard nets, while norsel nets with extra floats caught significantly less fish and king crab compared to standard nets. If the norsel mounted nets shall avoid crab catches, it is important that the norsels stand properly in the sea (Figure 1). This means that the netting must be above the crabs’ movement area so that the crabs can not be entangled. Norse1 mounted nets are vulnerable to several factors which may influence the norsel height (the efficient distance between the foot cord and the sole rope). Some of these factors are: currents, large fish catches and the nets could be tangled during setting. UV-observations have also shown that the crabs might level a norsel and get entangled in the net if the net has too little buoyancy.

The low catch rates of fish on the norsel nets are surprising. The nets are only lifted 0,5 meter above the seabed and it seems unlikely that this should give a fish loss of 65%. Results from vertical distribution of the catch on the standard nets showed that about 50 % of the fish were caught in the lower part of the net (from the foot cord and 2,5 meters up in the net). Lifting the net 0,5 meter should therefore maximum cause a fish loss of 50 %. Since the fish loss was higher, it must be due to more indirect causes of mounting the nets on norsels.

The fish faculty of vision is considered to be an important factor which determine whether fish are caught in a gillnet or not (Jester, 1973; Cui et al., 1992; Wardle et al., 1991). One reason that norsel mounted nets caught less fish than standard nets could therefore be that the foot cord makes the net more visible to the fish, so the fish manages to steer clear of the net or swim under the foot cord.

Increased float amount makes the net stand more rigid, which affects how easy the fish are caught or entangled in the net. The number of small fish entangled in a rigid net is less than in a more loose net, which may be the cause of longer fish mean length on norsel nets with rings.

It is also probably that a crab will entangle easier in a loose net than in a rigid net. It is therefore possible that use of extra floats on the standard nets also could reduce the bycatch king crab.

Conclusion

The incitement to mount nets on norsels is to reduce the bycatch of red king crab. Mounting the nets on norsels affects several properties of the net, like selectivity and catching efficiency. To reduce the bycatch of king crab is it of importance that the nets stand properly at sea with proper amount of floats.

The catch results indicate that the gear configuration functions in order to reduce the bycatch of red king crab. Loss of fish up to 65% is on the contrary not satisfying. Further work is needed to find a solution that gives a minimum loss of fish. Knowledge about the different species' behaviour is of importance in the further development of a more selective gear.

References

Baranov, F.I., 1976. Selected works on fishing gear. Vol. 1: Commercial fishing techniques. Keter Publishing House Ltd, Jerusalem, 63 1 pp.

Cui, G., C.S. Wardle, C.W. Glass, A.D.F. Johnstone & W.R. Mojsiewicz, 199 1. Light level thresholds for visual reaction of mackerel, Scomber scombrus L., to coloured monofilament nylon gillnet materials. Fish. Res., Elsevier Science Publishers B.V., Amsterdam, 10, 255-263.

Dickson, W., 1989. Cod gillnet effectiveness related to local abundance, availability and fish movement. Fish. Res., Elsevier Science Publishers B.V., Amsterdam, 7, 127-148.

Engås, A. & S. Løkkeborg, 1994. Abundance estimation using bottom gillnet and longline - the role of fish behaviour. In: A. Fernö & S. Olsen (editors), Marine fish behaviour in capture and abundance estimation. Fishing news books, Oxford, pp. 134- 165.

Hamley, J.M., 1975. Review of gillnet selectivity. J. Fish. Res. Board Can., 32, 1943-1969.

Jester, D.B., 1973. Variation in catchability of fishes with color of gillnets. Trans. Ameri. Fish. Soc., 1, 109-l 15.

Kuzmin, S & S. Olsen, 1994. Barents Sea king crab *(Paralithodes camtschatica)*. The transplantation were successful. ICES, Shellfish committee. C.M. 1994/K12, 12 p.

Machiels, M.A.M., Klinge, M., Lanterns, R., & van Densen, W.L.T., 1994. Effect of snood length and hanging ratio on efficiency and selectivity of bottom-set gillnets for pikeperch, *Stizostedion lucioperca* L., and bream, ***Abramis brama***. Fish. Res., 19: 23 1-239.

Orlov, Y.I. & B.G. Ivanov, 1978. On the introduction of the Kamchatka King Crab *Paralithodes camtschatica* (Decapoda: Anomura: Lithodidae) into the Barents Sea. Mar. Biol. 1978 vol 48, no 4, pp 373-375.

Pope, J.A., A.R. Margetts, J.M. Hamley & E.F. Akyuiz, 1975. Manual of methods for fish stock assessment. Part III. Selectivity of fishing gear. FAO Fish. Tech. Pap. No. 41, 65 pp.

Sundet, J.H., 1998. Bifangst av kongekrabbe i det ordinære fisket. En kartlegging blant fiskere i Øst-Finnmark. Rapport Fiskeriforskning 1-1998, Tromsø, 15 p.

Toresen, R et al., 1999. Havets ressurser 1999, FiskenHav, Samr. 1: 1999 (In Norwegian)

Wardle, C.S., G. Cui, W.R. Mojsiewicz & C. W. Glass, 1991. The effect of colour on the appearance of monofilament nylon under water. Fish. Res., Elsevier Science Publishers B.V., Amsterdam, 10, 243-253.