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REDUCTION OF FISH BYCATCH IN SHRIMP TRAWL USING A SOLID SEPARATOR GRID IN THE AFT BELLY

By

Bjørnar Isaksen *, John W. Valdemarsen* and Roger B. Larsen **

* Institute of Fishery Technology Research
P.O.Box 1964, N-5024 Bergen, Norway
** Norwegian College of Fisheries Science
P.O.Box 3083, Guleng, N-9001 Tromsø, Norway

ABSTRACT

During 1989-90 a new concept to avoid bycatch of fish in shrimp trawl has been developed in Norway. The system consists of an aluminium grid, 0.6 - 1.0 m wide and 1.3 - 1.5 m long, with bars spaced 19 mm. The grid is installed in the extention piece in front of the codend, angled 45°, and with a fish outlet on the top. In front of the grid is mounted a guiding funnel or flapper.

Several practical tests with commercial trawlers are conducted. Performance of the system and behaviour of fish and shrimp relative to it has been studied with a remote controlled underwater TV-vehicle.

Escapement of fish like cod, haddock, redfish and Greenland halibut is better than with any bycatch device tested earlier. Handling cause no significant problems, neither on small nor larger shrimp trawlers. Loss of shrimp when using the system is acceptable, less than 5 %.
An extensive effort is taking place to introduce this selective device in all Norwegian shrimp fisheries. From March 1, 1990 the separator grid was introduced by law in the northern coastal shrimp fishery.

INTRODUCTION

Bycatch of fish in shrimptrawls has for years been an assessment problem both in the Barents Sea and along the coast. While Norway has regarded the bycatch of small and undersized cod and haddock as the most serious problem, the USSR for a long period has claimed that the big bycatch of small redfish in the offshore fishery is very serious for this species. In addition, at the fishing grounds at Spitsbergen, large quantities of smallsized Greenland halibut are caught during the shrimp fishery, which of course is an unwise harvesting of a heavy exploited fish resource.

Since 1984 - 85 a separator panel of netting (Karlsen, 1981) has been used in the coastal shrimp fishery when the bycatch has exceeded 3 sublegal sized cod and/or haddock per ten kg of shrimp. This device has partly helped the fishermen to keep access to shrimp grounds that otherwise would have been closed for shrimp trawling. In the offshore shrimp fishery in the Barent Sea, a procedure has recently been introduced to close and open the shrimp grounds based on the number

of undersized fish relative to the shrimp catch. Such control has been done by official inspectors onboard chartered fishing vessels.

In 1988, the Soviet-Norwegian fishery commission approved that experiments should be performed to solve the problems of redfish bycatch in shrimp trawls. From the Norwegian side, a grant was allocated in 1989, and a reference group, with participants from research institutions, fishery administration, and fishermen's organizations, was appointed to follow up this project.

During the extensive work with separator panels in shrimp trawls (Karlsen 1981, Isaksen 1984) it was found that redfish was rather difficult to separate by means of the net panels used. Small redfish 8 - 14 cm would easily pass through the separator panel, while bigger ones had a tendency to mesh the panel. In some occasions the net did break under the load of meshed redfish.

In early 1989 some experiments were performed using a solid separator grid in the aft belly of shrimp trawls. This separator grid, that originally was developed to avoid jelly fish, and now known as the "Nordmøre-grid", proved to separate redfish without any meshing problems (Karlsen, 1989). During 1989 - 90 an extensive work has been performed to test this device, both in respect of selectivity and handling properties.

In addition to the officially controlled experiments, many shrimp trawlers have experience from using the separator grid when fishing on grounds that otherwise were closed due to high bycatch of cod/haddock. Because of their positive experiences many coastal shrimp trawlers continued to use the grid on grounds open for normal shrimp trawling. Their motivation was less sortingwork on deck and an improved quality of shrimp.

METHODS

A sketch of the grid mounted in a trawl is shown in Figure 1. The grid is installed in the extention piece, just in front of the codend and with a fish outlet on the top. In front of the grid is mounted a guiding funnel or flapper, that leads both fish and shrimps towards the lower part of the grid.

During the experiments performed, effects of the following parameters have been investigated:
- Distance between bars: 17 - 21 mm.
- Dimension of grid: Width 0.6 - 1.0 m, Length 1.3 - 1.5 m
- Grid mounted in single or twin codend
- Material: Aluminium and stainless steel
- Fish/shrimp guiding device: Flapper and funnel type
- Distance between flapper/funnel and grid
- Size of fish outlet
- Measurement of the angle of the grid in use.

In addition of fishing experiment, performance of the separating system and behaviour of fish and shrimp relative to it has been studied with the remote controlled underwater vehicle "Ocean Rover".

RESULTS

Installation and use/practical aspects.

Evaluation of the results from the different experiments has led to both compulsory and recommended specifications for installation and use of the separator grid.

The coastal shrimpers (40 - 60 feet) are recommended to use an aluminium grid 0,65 m wide and 1,35 long, while the bigger boats should use a grid 1.0 m wide and 1.5 m long (Figure 2) both with bars spaced 19 mm (compulsory). The mounting angle should be 45° (Figure 3), and two meshes should be taken into each bar space, both on top and bottom, and tied well. The rest of the meshes should be distributed evenly along the sides of the grid and tied quite loosely. The mounting should be accurate, with the middle of the top/bottom of the grid mounted at the middle of the top/bottom panel.

The fish outlet is cut on bars from the top corners of the grid, and reinforced by a 10 - 12 mm rope (Figure 4). Today funnels are mostly used as guiding device in front of the grid, with a front circumference similar of that of the extention piece (220 - 250 meshes in a coastal grid, 330 - 360 meshes in an offshore grid). One funnel design is shown in figure 5 and 6. The funnel is cut on bars, to give an outlet circumference of 80 - 100 meshes. The distance between the grid and the funnel outlet is 0,5 m, and the funnel should be mounted with a 5 % lengthwise slack relative to the extention piece. Instead of using a "distance thread" as illustrated in figure 6 a leadweight/rope (approximately 0,3 - 0,5 kg) is recommended to prevent the outlet to open too much.

To make the grid a little boyant, floats are mounted evenly on the upper half of the grid. Wear and tear on the webbing surrounding the grid is avoided by lashing a 10 - 12 mm rope around the frame of the grid (Figure 7).

Handling of the separator system has so far just caused minor problems. It is, however, important to be careful when shooting the trawl. There must be no twisting in the belly in front of the grid. Such a twist will not go off, and therefore fish/shrimp will accumulate in front of the separating system. When hauling, the twist may go off, and most of the catch will be lost through the fish outlet and get lost. Sharp turns should be avoided after shooting the separator system, as turns may bring twists in the belly. Another matter of importance is to check that the guiding funnel is undamaged. Aluminium is exclusivly used as grid material today. Stainless steel have also been testet, and is by no doubt a better material regarding strength and smoothness, but has the drawback of beeing almost three times as heavy as aluminium.

Underwater observations

Underwater observations of a shrimp trawl equipped with grid systems were performed in a Norwegian fjord at water depths of 100 - 120 meter. (Valdemarsen, Isaksen & Larsen, 1989). When shrimp hits the netting in the frontpart of the trawl, it will normally react with a few tailbeats in random directions. The conical shape of the belly will consentrate the shrimp as they are led backwards toward the codend and join the shrimp that comes backwards in the center of the trawl. This effect was demonstrated by a much higher density of shrimp close to the netting in the aft part of the belly compared to that further forward.

The funnel guide all shrimp towards the lower part of the grid, and most of them passed in a stright line through it. In exceptional cases some shrimp reacted when hitting the grid, and a few of these jumped out of the fish outlet by chance. Some shrimp were guided some distance upwards along the bars before they were carried through the grid.

Fish that came backwards in the trawl did normally stay some time in front of the guiding funnel, before passing through, usually with tail first. Evidently the smaller fish were exhausted and did hit the grid after passing the funnel outlet. Some of the small fish did pass through the grid, while others were guided upwards by the bars and out of the trawl. Bigger fish had no problems to swim in front of the grid and would after some time escape through the fish outlet.

Flatfish, like rough dab, happened to stay on the grid for some time before doing a few tailbeat and then sliding up along the grid and out the trawl. A few skates were caught, but this specie did not do any attempts to escape.

Fishing experiment

Shrimp
During the experiments the separator grid has given a low and fairly stable shrimploss, in the order of 2 - 5 %. With a bar distance of 19 mm there is no evident size dependant loss of shrimp up to 11 cm commercial length (eye-tail), (Karlsen & Valdemarsen 1989). Catchrates up to 1 ton/hour have been experienced and such high catch rates do not indicate increased shrimp loss (Isaksen and Larsen, 1990).

Cod/haddock
The separator grid has proved good escapement of smallsized species of cod and haddock. As can be seen from Figure 8 and 9 all haddock bigger than 20 cm are released from the trawl and about the same result is obtained for cod. At a length of 12 cm about 50 % of the fish is released. Presently the separating effect on 0-group fish is not fully acceptable.

Redfish
As can be seen from Figure 10 and 11, all redfish bigger than 18 cm escape from the trawl, and a 50 % release is obtained at a length of about 12 cm. As for cod and haddock, the escapement of "redfish-fry" (7 - 10 cm) is rather poor. In contrary to a separator net, however, there are no meshing problems when using a separator grid.

Flatfish
The only commercial flatfish caught by shrimp trawl in northern waters is Greenland halibut. Also for this species the effect of the separator grid is convincingly (Figure 12). At a length of about 15 cm, 50 % is released from the trawl. Because of the shape and swimming behaviour of this flatfish, the 100 % release length is rather high, about 30 - 32 cm. (Figure 13).

Quite big quantities of long rough dab are normally caught in the offshore fishery, but the use of separator grid will reduce this bycatch as well (Figure 14 and 15). Long rough dab and skates have from time to time caused some clogging of the grid. This is mostly due to wrong installation and a too steep angle of the grid.

Shark, stone, sponge, lay
During shrimp trawling at Spitsbergen, Greenland shark are frequently caught, and normally the shark ends up in the codend resulting in a lot of crushed shrimp. Experiments in this area did indicate that with a separator grid with dimensions of at least 1,0 x 1,5 m, Greenland shark (up to 3 meter) will pass through the separating system and out of the trawl fairly easy. Occasionally stone, sponge and clay are caught in shrimp trawlers. If not released through the fish outlet such debris will stop in front of the grid and thereby not cause damage to the already caught shrimp.

DISCUSSION AND CONCLUSION

The new concept of using a solid grid to avoid bycatch of fish in shrimp trawl has proved to be better than any bycatch device tested earlier in fishery for deepwater shrimp (*Pandalus borealis*). 100 % escapement is achieved for cod and haddock older than 14 - 17 months, and for redfish older than two-three years.

The separation of small fish that physically can pass between the bars is less, but significant. A smaller bar spacing will undoubtedly improve the small fish escapement, but will at the same time

give an unavoidable higher shrimploss. The chosen bar distance of 19 mm is a compromise between a fairly good separation of fish and an acceptable shrimploss limit of 5 %.

The shrimp catches are fairly clean, resulting in minor sorting work on deck. In addition, the quality of "grid" caught shrimp is regarded very good. Due to the very good results achieved, this selective device was made compulsory in the northern coastal shrimp fishery from March 1, 1990.

An extensive work is taking place to introduce the separator grid in most Norwegian shrimp fisheries. In this way, shrimp trawling will change status from being a "juvenile fish killer" to be one of the most species selective gears used in the Norwegian waters.

REFERENCES

ISAKSEN, B. 1984. Experiments with vertical sidesorting panels in Norwegian shrimp trawls 1982 - 1983. **Int.Coun.Explor.Sea, CM 1984/B:10.**

ISAKSEN, B. & R.B. LARSEN, 1989. Separator grid in offshore shrimp trawls. Experiments performed onboard M/Tr "Ståltor" 12.-22.10.1989. **FTFI-report. (in Norwegian, in press)**

KARLSEN, L. 1989. Preliminary results from fishing trials with a new shrimp sorting device. ICES **W.G. meeting, Dublin, 24 - 27 April 1989.**

KARLSEN, L. 1981. Experiments with separating panels in shrimp trawls 1975-1978. **FTFI-report, april 1981 (in Norwegian).**

KARLSEN, L. & J.W. VALDEMARSEN, 1989. Experiments with the Nordmøre grid on offshore shrimp trawler. Report, desember 1989 (in Norwegian).

VALDEMARSEN, J.W., B. ISAKSEN & R.B.LARSEN, 1989. Observations of the behavour of fish, shrimp and selective devices in shrimp trawl on board F/F "Fjordfangst" in June - July 1989. **FTFI-report 01.11.1989. (in Norwegian).**

DEEP SEA SHRIMP TRAWL WITH THE "NORDMØRE-GRATE"
FISH-SHRIMP SEPARATION SYSTEM

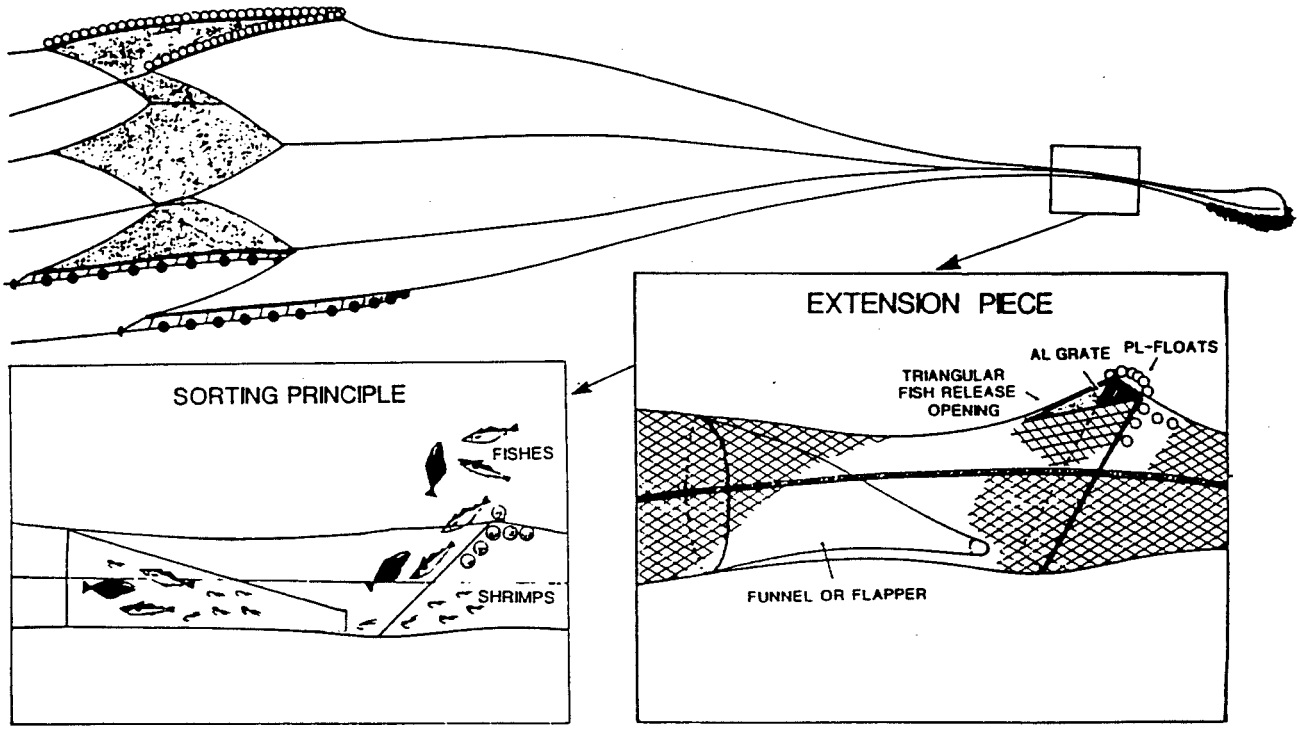


Figure 1. Sketch of a three-bridle high opening shrimp trawl with the "Nordmøre-grid" mounted in the aft belly.

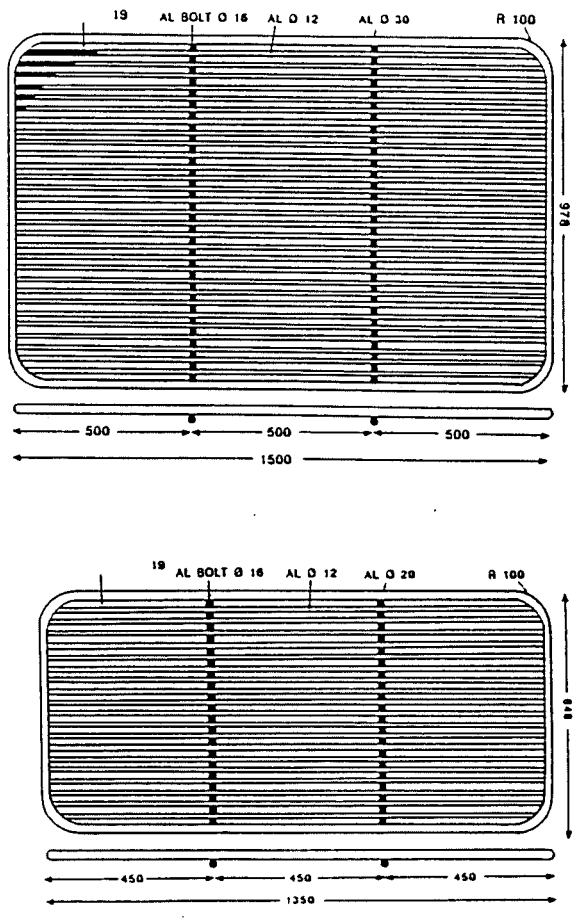


Figure 2. Dimensions of the aluminium separator grid used in the offshore and coastal shrimp fishery.

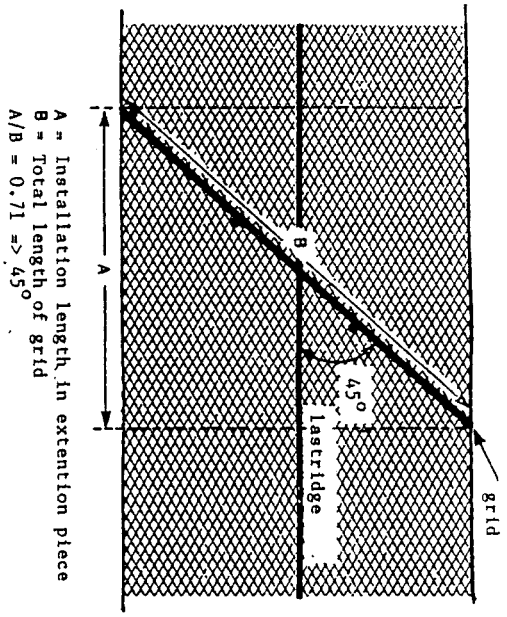
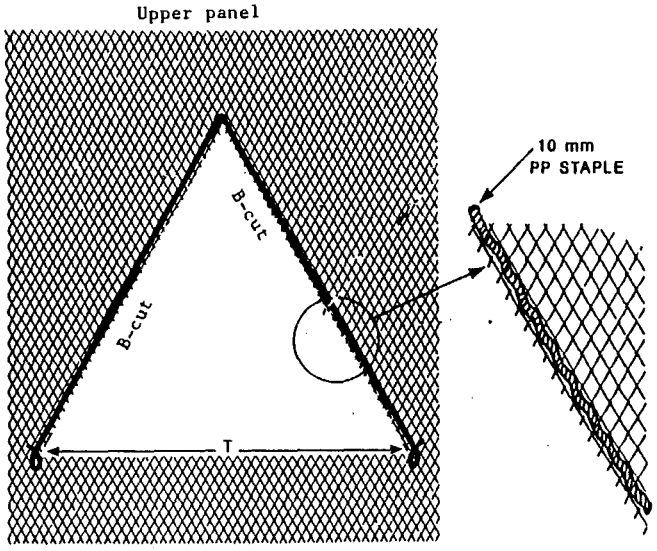


Figure 3. Sideview of separator grid mounted in extension piece.



T = No. of cross meshes mounted on grid
Coast T = 40
Offshore T = 60

Figure 4. Illustration of fish outlet.

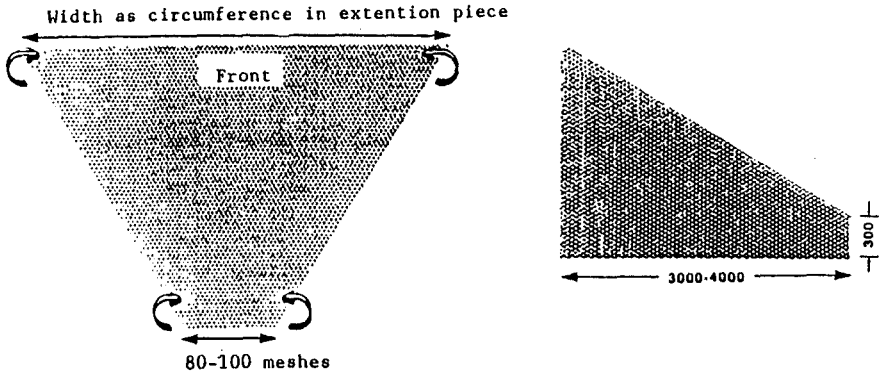


Figure 5. Cutting and construction of guiding funnel

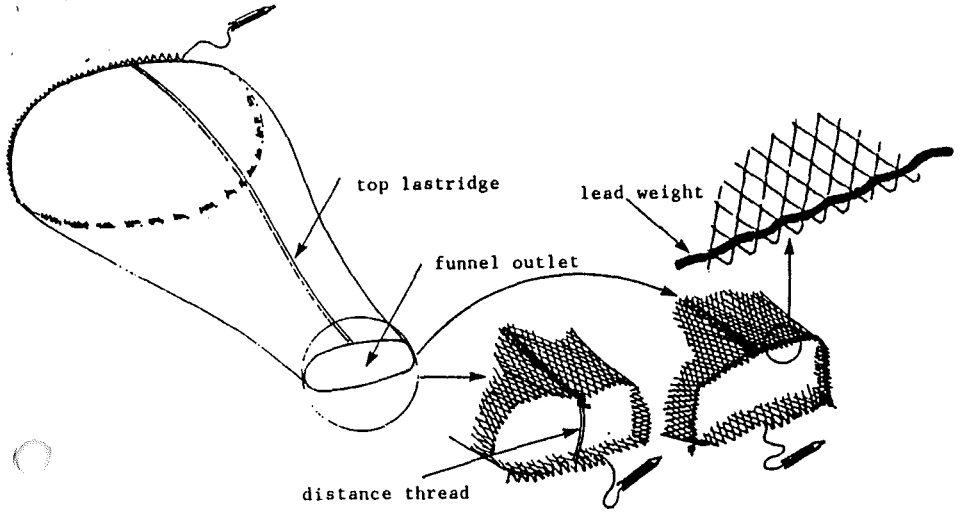


Figure 6. Illustration of guiding funnel

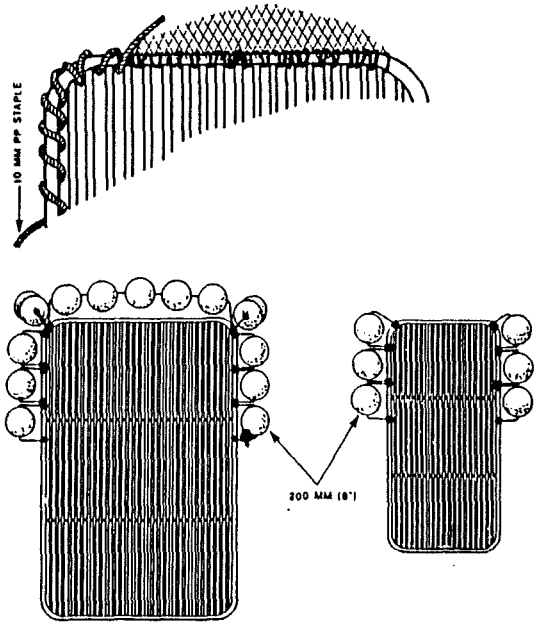


Figure 7. Illustration of protective rope and floats mounted on the separator grid.

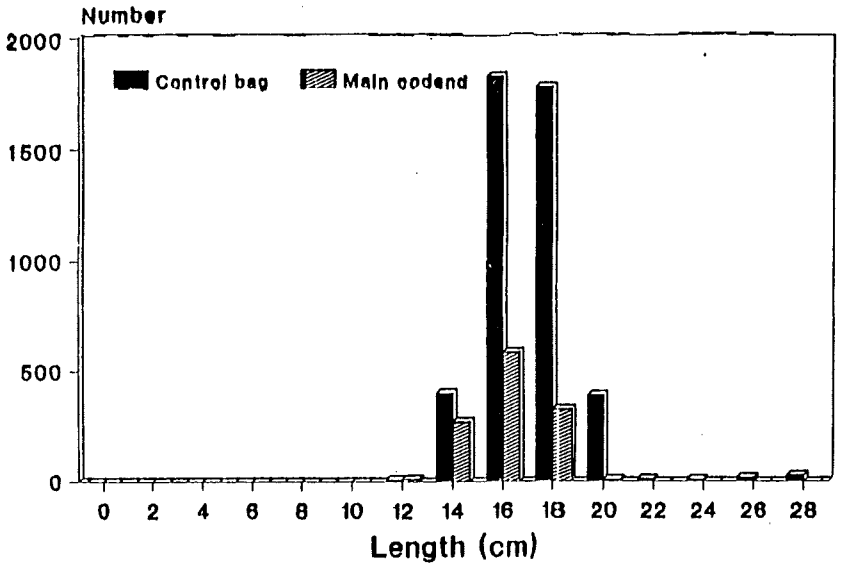


Figure 8. Length distribution of haddock in the main codend and the control bag.

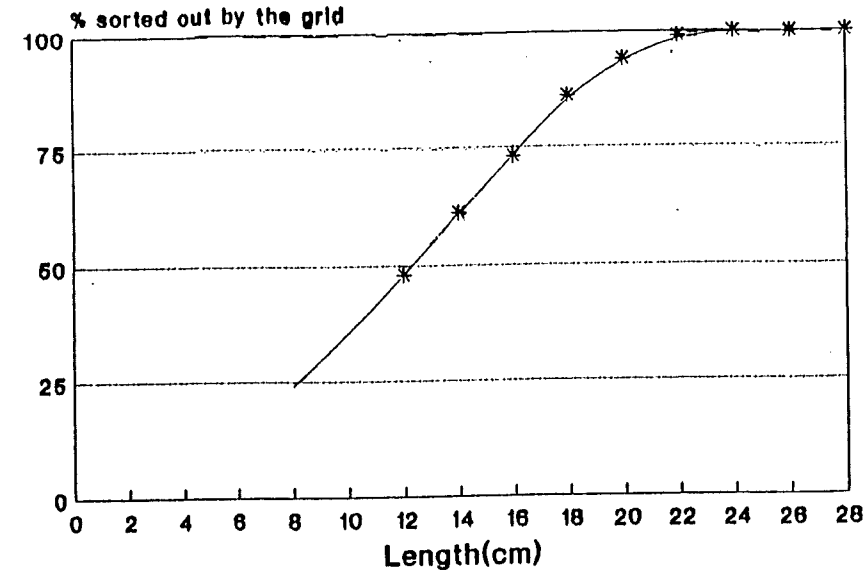


Figure 9. Selection curve for haddock using the fish/shrimp separator grid.

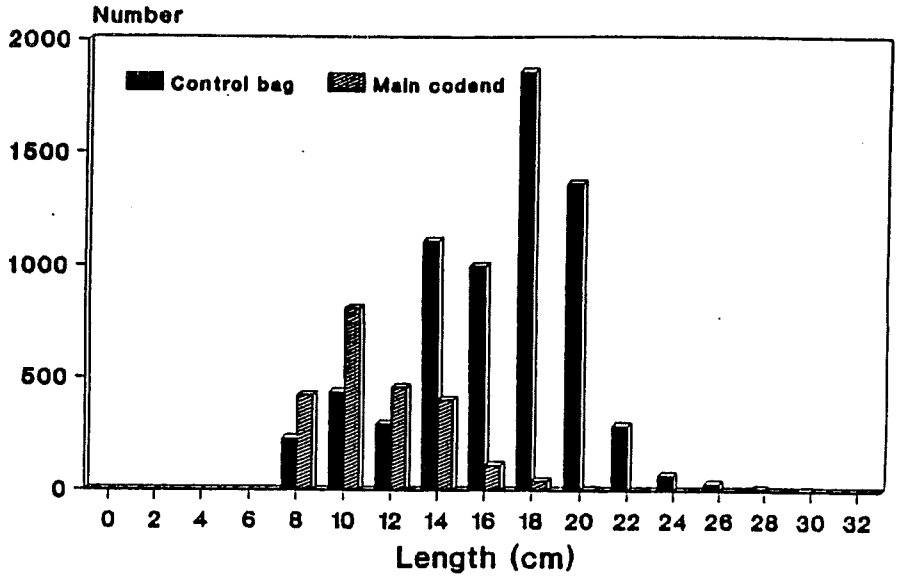


Figure 10. Length distribution of redfish in the main codend and the control bag.

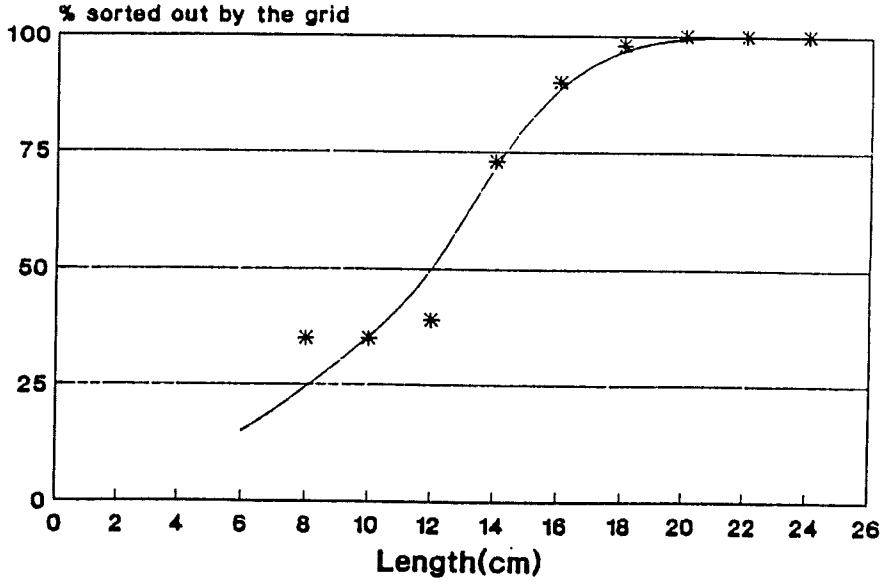


Figure 11. Selection curve for redfish by using the fish/shrimp separator grid.

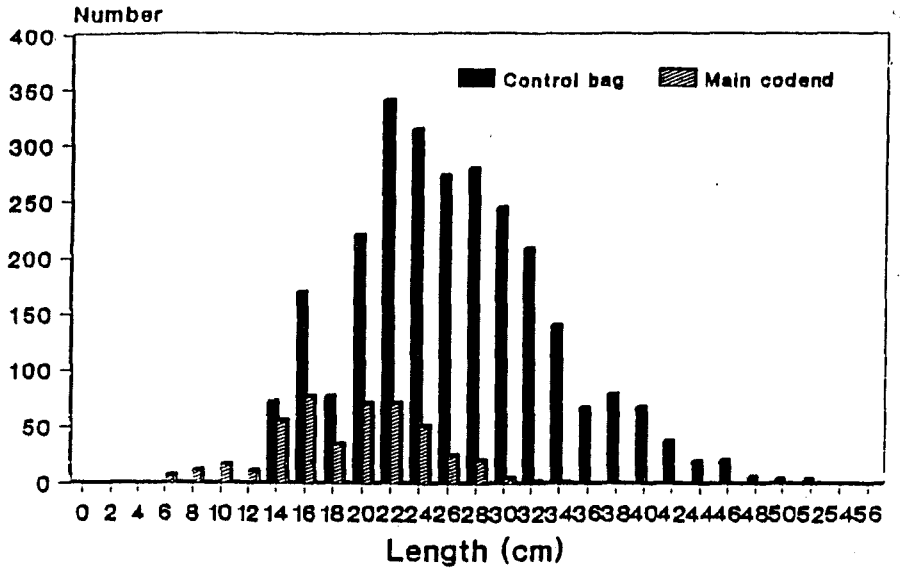


Figure 12. Length distribution of Greenland halibut in the main codend and the control bag.

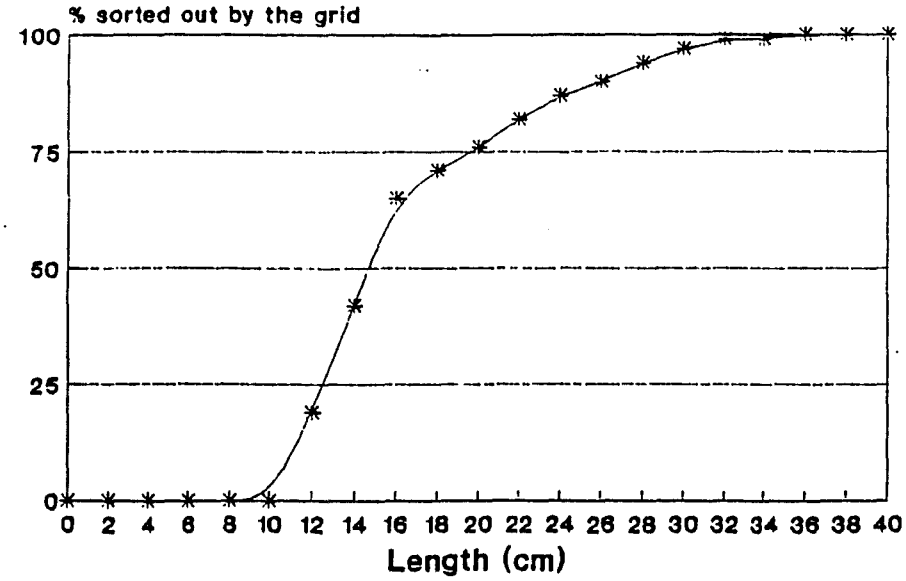


Figure 13. Selection curve for Greenland halibut by using the fish/shrimp separator grid.

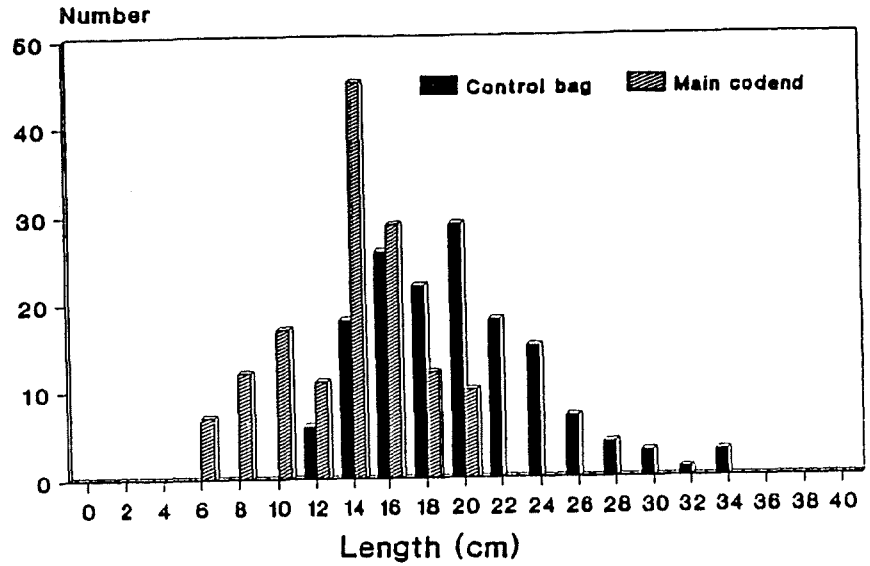


Figure 14. Length distribution of long rough dab in the main codend and the control bag.

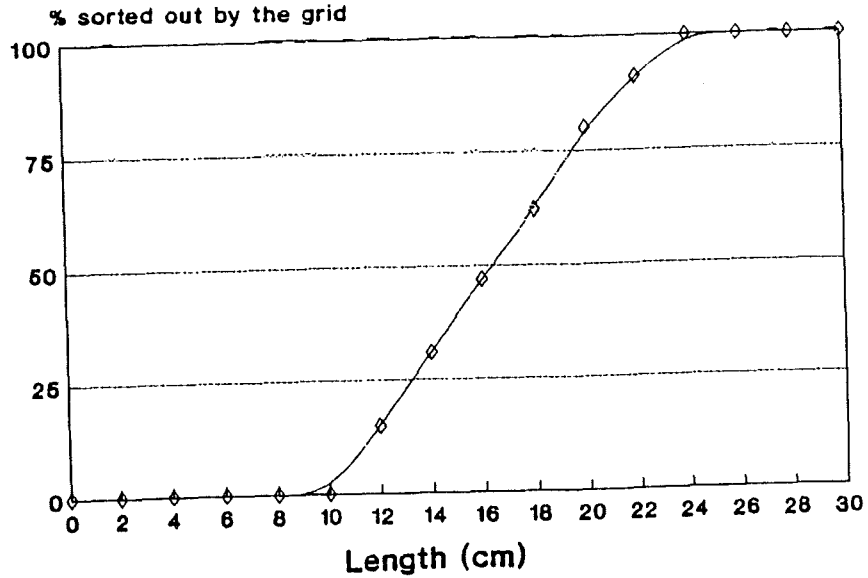


Figure 15. Selection curve for long rough dab using the fish/shrimp separator grid.