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Preliminary studies of selectivity of cod gill nets in the Baltic

by
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Abstract.
Studies of cod gill nets, carried out during three cruises on a commercial cutter in the Baltic, have shown that their selectivity is good and effectively protects young cod against capture. These good selective properties are characteristic for these nets only when the fish gest stuck in the meshes; when they become entangled by the nets, their selectivity deteriorates, especially with respect to juvenile fish.

1. Introduction

Opinions of Polish fishermen and persons responsible for the fishery industry, regarding selectivity and the general protective effect of cod gill nets on the exploited stock, varied considerably. That is why it was advisable to conduct special investigations of this problem at sea. Foreign reports clearly suggested that in commercial catches made with such set fishing gear as gill nets, their selective properties may deteriorate (Martins et al. 1990, Millner 1985, Losanes et al. 1992). Observations of Polish fishermen likewise confirmed the varying selectivity of this type of gear.

It was therefore decided to study in 1992 the length composition of cod captured with gill nets on 24-m fishing cutters. Three cruises were organized: two in spring and autumn on eastern fishing grounds of the Polish zone and one in late autumn on western grounds of this zone.

The objective of these studies was to determine changes in selectivity of cod gill nets during their exploitation, depending on the rate of increase of their entangling properties. Previous observations on fishing grounds had shown that entangling properties of gill nets increase with their wear. The main goal was thus to determine the range of these unfavourable changes.

2. Material and method

Typical, standard cod gill nets, purchased on Bornholm, with the following nominal mesh bar lengths "a" = 55, 60, and 65 mm, were used. The net in these gill nets was made of four parallel polyamide strands with a thickness of 0.15 mm each, factory tied with a double sheet bend. The gill nets formed segments, each consisting of 12 nets, and were run out in the form of fences with a varying number of segments.

General guiding principles given by Pope (1975) and Zaucha and Blady (1974) were followed during the study.

After being removed from each type of gill net cod were measured with a centimetre gauge to one centimetre below. For each net type, differing by mesh size, cod length composition was determined. The abundance of undersized fish (smaller than 33 cm) was calculated on this basis and expressed in percent, in comparison with all fish captured by the given type of gill net.

Tentatively, mean length of cod, characteristic for the given catch peak, was also measured.

The number of cod measured in each experiment and the share of undersized fish are presented in Table 1.

Table 1. Number of all fish measured and share of undersized fish.

Cruise	mesh bar length	No. of cod measured	share of undersized fish
spring	60	709	9,2
	65	1114	6,5
autumn	55	3484	9,8
	60	2546	7,1
late autumn	55	1692	3,1
	60	1895	28,4
	65	2799	29,2

The degree of wear was expressed as a percent index. The length of the upper rope of the net, along which the material became detached, as it had been torn off or torn at any distance from this rope, was measured. The ratio of this length to the total length of the rope in percent constituted the said index.

3. Results and discussion

Length composition of cod

During the first, spring cruise, the data collected served to plot curves depicting length compositions of cod captured by the nets with mesh bars lengths of 60 and 65 mm (Fig. 1).

Both of the analysed length composition curves were bi-modal. Each of them had two separate areas with characteristic catch peaks: one, less pronounced, corresponding to cod class with a length of about 35 cm, and the other, more pronounced (consisting in fact of several elevations), corresponding to the class most abundantly represented in the catches. The length of this class depended on the net mesh length. For nets with a mesh bar size of 60 mm, the peaks were formed by cod with a length of 46–58 cm, 52 and 54 cm fish prevailing. For nets with a mesh bar length of 65 mm, the bulk of cod captured had a length of 50–60 cm, 54 and 56 cm fish prevailing. Thus, mean length of cod calculated for the peaks was about 51 cm for the 60 mm mesh nets and 53 cm for the 65 mm mesh nets.

In the second, autumn cruise,* fish were caught with nets with a mesh bar length of 55 and 60 mm; their length composition curves, also bi-modal, are presented

* The results from this cruise were collected by Mr. K. Radtke and made available to the authors of this paper.

in Figure 2. The characteristic feature of both these curves was the formation of the areas with distinct catch peaks by only 12 cod length classes; they covered 82–84% of all cod captured. These 12 classes for both mesh sizes were shifted with respect to each otherby one class only. For the 55 mm mesh size net, these were 41–52 cm classes; for the 60 mm mesh size net – 42–53 cm classes. Mean length of cod calculated for the peaks was about 47 cm for the 55 mm mesh nets and 49 cm for the 60 mm mesh nets. In addition to the catch peak proper, both curves revealed at the beginning a distinct elevation corresponding to the clases of very small cod. About 10% of undersized fish were captured with these nets, the peak in this group of fish being in both cases at length classes of about 25 cm.

In the third, late autumn cruise, nets with all the three mesh sizes were used; their cod length composition curves are plotted in Fig. 3. The nature and pattern of the curves for 60 and 65 mm meshes were almost identical; these were bi-modal curves. Each had two distinct catch peaks. One, lower, corresponding to undersized cod, covered the class with a length of about 25 cm (about 30% of all cod captured). The second peak area was two times higher and corresponded to those cod lengths which were retained by 60 and 65 mm meshes. One of them covered about 51%, the other – 56% of all cod taken. These peaks did not form one single elevation but consisted of a number of elevations corresponding to the classes more abundantly represented on the fishing ground. In the case of both these curves, these elevations covered the same cod lengths. The difference was that these elevations in the case of the 60 mm mesh were higher in the classes of smaller fish, and in the case of the 65 mm mesh – in the classes of longer fish. These differences were most visible for the classes of 44 and 45 cm – more of such fish were taken by gill nets with the 60 mm mesh; at the same time, these nets captured much fewer fish over 50 cm in length. As a result of these distributions, mean length of captured cod was about 48 cm for the nets with 60 mm meshes and about 49 cm for the 65 mm nets.

The pattern of length composition curve for cod taken with nets with 55 mm meshes was different. This curve was unmodal. The most significant difference in the case of these nets consisted in the fact that they did not capture almost any undersized cod. The catch peak characteristic for this mesh size covered about 92% of all cod taken. The curve forming the peak consists of several protrusions and depressions corresponding to cod composition in the commercial stock. Mean length of cod for this catch peak was about 45 cm.

Exploitation conditions influencing deterioration of selectivity

Gill nets have good and correct selective properties during catches only when each mesh in the net is opened according to desingning assumptions. In order to achieve this state, each mesh during catches must be subjected to a force expanding it both in the vertical and horizontal plane. As a result of the construction of the gill net, i.e., the correct choice of hanging coefficients on the upper and bottom rope, as well as floats and weights, each mesh during catches is opened so as to enable capturing

cod by their getting stuck in the meshes. However, during the net exploitation, conditions appear, which cause that the mesh does not capture cod according to the designer's intention, but in an entirely different way. As a result of the properties of the material used for the net construction, its elasticity and fineness, when the net becomes loose, it acquires extracting properties with respect to the environment, including fish. When the fish encounters such fishing gear, it is retained by it; its attempts to free itself result in entangling and capture. This different method of retention of fish by the net may be the result of a conscious and intentional action on the part of the fisherman or his allowing for too large mechanical wear of the net. A sufficient condition for the appearance of entangling properties of the net is, as mentioned previously, the release of meshes from the influence of expanding forces acting upon them. The fisherman may achieve this by removing weights. This is the case with catches effected with the help of a wreck, when the nets are consciously set against a bottom obstacle, on which the bottom rope of the net rests and the net material becomes loose.

Catches with mechanically damaged nets are unfavourable from the point of view of environment protection. Such nets have loose parts of the net, torn off or torn along one of the ropes. These net parts capture fish only as a result of their entangling. The matter becomes serious as it usually does not concern large fish (scarce on the fishing ground) but juvenile fish, prone to retaining in this way. These fish should be protected. The experiments made showed that, depending on the biological composition of the commercial stock inhabiting the given fishing ground, cod gill nets with a large degree of mechanical wear capture a large percent of fish smaller than those whose length follows from a given mesh size of the net. In the spring experiment, this "incorrect", first catch peak covered much smaller cod than those which were the main object of fishery. However, these cod could be captured from the point of view of protection as their mean length equalled 34–36 cm. In the case of the late autumn experiment the first catch peak covered very small cod (about 25 cm), which should be certainly protected. About 30% of these fish were captured. This was caused by the fact that the nets used were characterized by a large degree of mechanical wear. In the spring experiment the degree of wear was estimated at 35–40%, in the late autumn experiment – at 35–45%. At the same time, new nets used in the late autumn experiment did not capture almost any undersized cod, retaining fish with lengths following from the mesh size used. These tendencies are distinctly visible in graphs shown in Figures 1 and 3. The curves in Fig. 2 show catch composition attained with the help of nets with very little damage, whose degree of wear was estimated at 10–20%. In this case the percentage of captured undersized fish was about 10%. The curve in Fig. 3, depicting catches effected with undamaged nets, shows that the amount of retained undersized cod did not exceed 3%.

4. Conclusions

1. Selectivity of cod gill nets is good.

2. The nets have good selectivity properties only when they are used in agreement with their construction, i.e., when they capture cod stuck in the meshes only. The appearance of entangling properties results in deterioration of selective properties of the nets.
3. Exploitation of the cod stock with gill nets is more effective as regards the protection of juveniles than other techniques, especially those using trawls.

References

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Figures

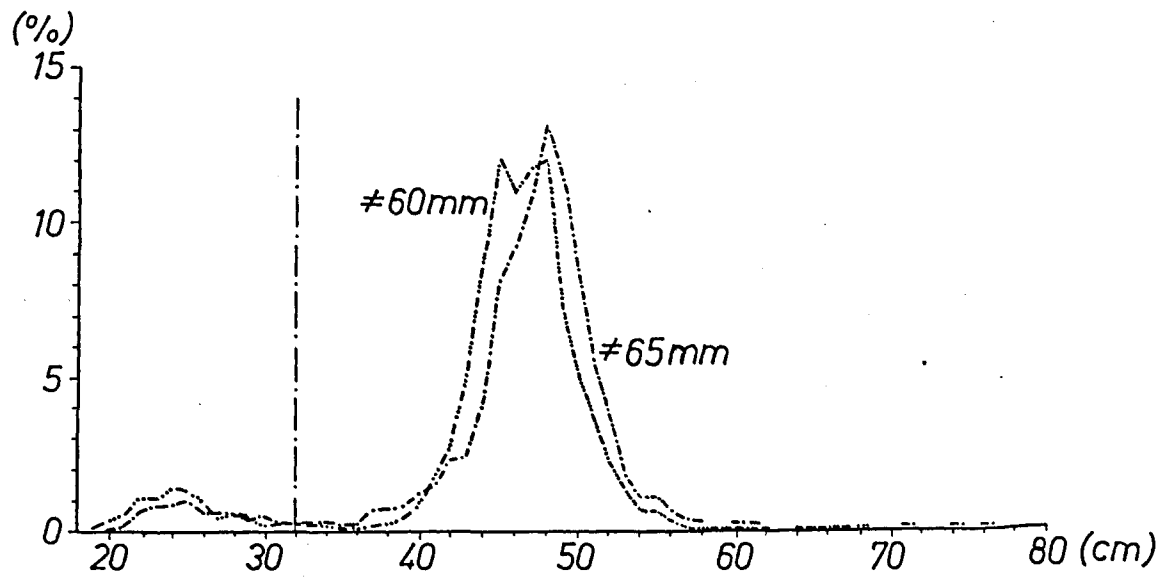

Fig. 1. Length composition of cod captured during spring cruise.

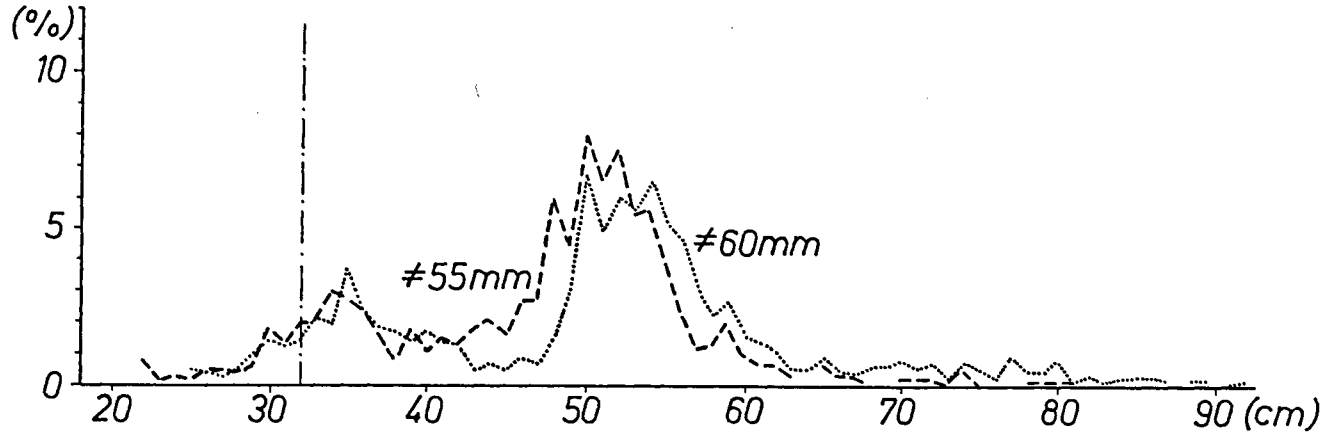

Fig. 2. Length composition of cod captured during autumn cruise.

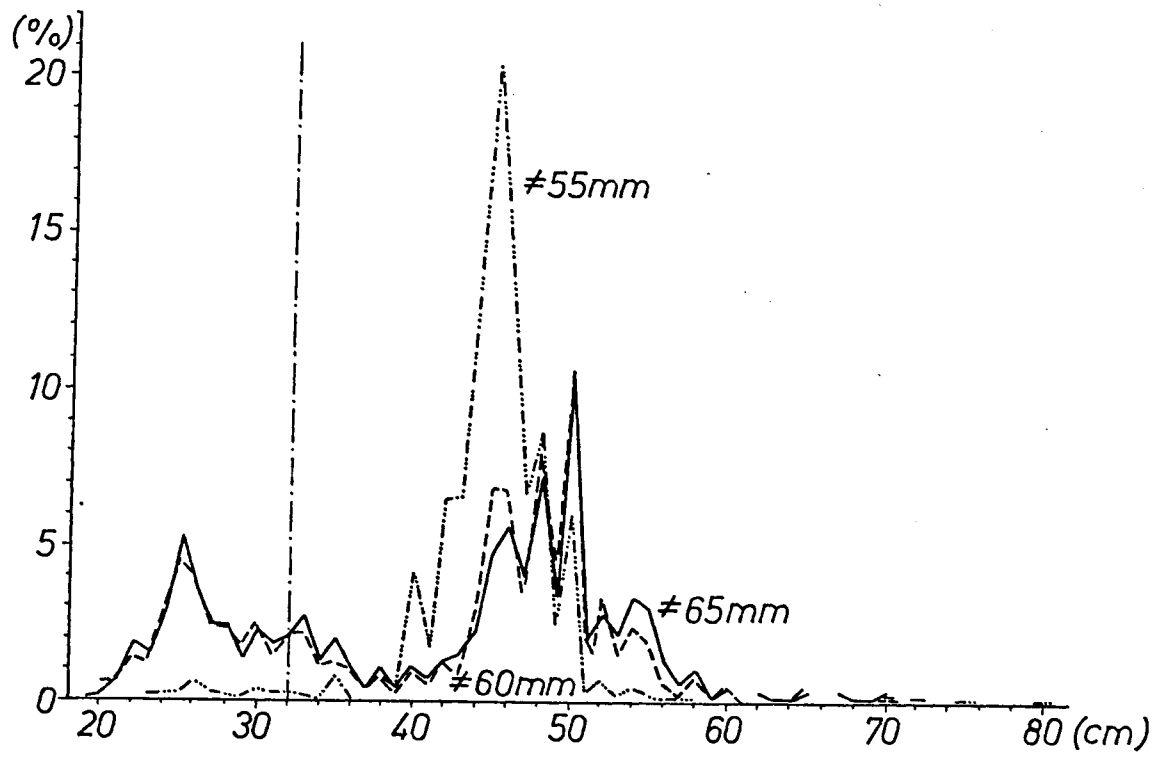

Fig. 3. Length composition of cod captured during late autumn cruise.