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EEL-NET SELECTIVITY USING A DUAL COD-END BEAM TRAWL.

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Eel-net-selectivity using a dual-cod-end-beam-trawl.

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Abstract.

The fishery on eel is the most important inland fishery in the Netherlands. Unfortunately, adequate management has been hampered by the lack of data on the exploitation regime used in the fishing industry. Thus, survey results have been shown to be an essential tool in assessing eel fisheries (Dekker, 1987). Surveys were made using a 1 mm meshed electrified beam trawl. This small mesh retains even the smallest eels. However, conclusions on the exploitation level were based on nearly recruited length classes, and some doubts have risen to the efficiency of the small meshed nets for these size classes. Thus, mesh selection experiments are planned.
Cover cod end experiments were rejected because of the great influence of the cover on the selectivity of the inner cod end. Thus, a dual-cod-end-trawl was designed and tested in flume tank and preliminary field experiments.
The paper discusses the use of cover cod ends versus dual cod ends, presents a diagram of the net used, test data of the net and preliminary field data using the net.

Introduction

The eel fishery in the IJsselmeer has been quite prosperous, short after the second world war, yielding around 10 kg/ha/yr. But during the fifties and sixties, catches gradually declined to less than 5 kg/ha/yr. Deelder & de Veen, 1958 showed that overfishing occurred to a minor degree. Thus, in 1970, the fishing effort was reduced by banning the trawl. Following this strong reduction, no management actions were undertaken to limit a repeated growth of the fishing effort, and thus in 1989 a strong reduction of 50% in effort (fyke nets, eel boxes, long line) was necessary. However, since the total fishing effort was still largely unknown, this 50% reduction is a mere guess; only the catch composition and the overall decline of the catches indicated in this direction, without any hint of quantifying the appropriate decline in effort. Thus, the interpretation of survey results has been of utmost importance.
Dekker, 1987, analysed length frequencies of 25 years of eel catches, mostly based on survey results. In his interpretation, only relative changes in length frequencies were considered. Recently, Berg, 1989, presented a paper based on similar ideas, but attaching a definite interpretation to absolute catches: the downward slope of the length frequencies for the larger length classes is interpreted by Berg as the sole result of mortality of the stock. Thus, he estimates a natural mortality of 28.5 %, which - together with the growth rate given by Berg - results in an overall production/biomass ratio of less than 0.05. Clearly, the assumption that length frequencies in their upper limb are determined by the availability of eels only is incorrect. The steep decline of the right limb can equally be explained by reduced selectivity of the net for larger eels, for instance because of increased escape through the

mouth of the net of larger eels, possibly because of the decreased water flow through the net in small meshed nets.
Most survey catches of the IJsselmeer eel are made using a 1 mm net. Commercial fyke nets have a minimum mesh size of 20 mm. If too small meshes influence the catch considerably, then the survey results are not a standard for the fishing industry at all. Thus, we intend to test mesh sizes just below 20 mm.
Net size selectivity is traditionally evaluated, using cover cod end techniques (Anon, 1964). In this kind of experiment, a large meshed cod end is enveloped by a small meshed one, giving fish retained in the large mesh in the inner cod end, and fish escaped through the large mesh in the outer cod end. However, based on our experience with the effect of minor changes in net rigging on the overall efficiency of fishing nets, we doubted the effect of the cover cod end on the selectivity of the inner cod end. Moreover, the inference that a small meshed cod end increases the possibility of escape of larger eels from within the cod end, blocks the use of cover cod ends completely.
In earlier experiments (van Willigen, 1987), complete fishing gears with different mesh size were compared in alternate trials, but the variability from haul to haul was evident. Consequently, a single trawl with two mesh sizes was designed.

Net design

Figure 1 presents a drawing of the net we used. Regular survey catches of IJsselmeer eel are made, using a 3 m beam trawl, with a mesh size of 1 mm, and an electric pulse (D.C.) between the shoes of the net (Deelder & Boonstra, 1974). Thus, the dual-cod-end-net in the experiments was designed for the 3 m beam trawl, keeping the electric equipment intact. Furthermore, the final goal is to compare several mesh sizes; thus, the split in two cod ends is made as far as possible to the front of the net, allowing a large panel of the selected mesh size in both cod ends. Presumably, this early split has affected the overall efficiency of the net negatively. As a consequence of the two cod ends, the net tapers at four sides, and consequentially, the tapering rate is low compared to single cod ended trawls of this size.
Flume tank experiments in Hull showed, the rigging of headline and footrope are quite influential for the exact position of the joining line of the two cod ends. Thus, the exact rigging used in the field experiments might have been much more critical than the rigging of ordinary trawls. The tank experiments also showed upper and lower panels of both cod ends did not make direct contact, giving entering fish direct access to the rear part of the cod end, and thus to the differential mesh size.
The currently used net should be considered as a first draft only. Several improvements were noted: the footrope rather loosely contacts the bottom, the mesh size of the frontmost panels might be enlarged increasing the overall efficiency of the net, etc. Further experiments will be done with likewise improved designs.

Preliminary field tests.

In June 1989, preliminary field trials using the dual-cod-end-trawl were made on the IJsselmeer (to be precise: in Wagenpad and Vaarwater). Each haul took 20 minutes, and covered a distance of ± 2750 m. The electricity applied was ±275 V, 15 A. In all hauls, the orietation of the electrodes relative to the two cod ends was the same. For a total of 40 hauls, length frequencies were collected for both cod ends. These length frequency counts were averaged over the 40 hauls, taking the mean of log(count+1), and anti-logging the result. The average length frequencies obtained are given in fig 2. Standard deviations of the log(count+1) were less than 1.1 for the 12 mm cod end, and less than 0.7 for the 20 mm cod end, i.e. ± 2 times resp. 3 times more or less than the average of the anti-logged average. The ratio of the catches of the two cod ends was calculated, and plotted in fig 3 on log scale. Below 25 cm length of the eel, catches in the 12 mm cod end were higher, above that length catches in the 20 mm cod end were higher. The larger catches of eels over 25 cm length in the 20 mm cod end averaged ± 2 times the catch in the small meshed cod end.

Discussion

The net described in this paper has two cod ends with different mesh sizes. The ultimate goal of the experiments is to select the best mesh size for future surveys of the IJsselmeer eel stock. The traditional way to handle such a problem, is to apply a cover cod end with a smaller mesh size, and to compare the catches of the inner (large meshed) and outer (small meshed) cod end. We did not follow this line, and designed a new type of net with two cod ends instead. Obviously, we should compare our results with the traditional cover cod end approach.
Using a double cod end to compare the effect of mesh size on catches, means one compares the catch of two cod ends which are tied to the same net, are in almost the same position, get the same amount of water flow through and the same amount of fish (assuming that fish retained in the larger mesh would certainly not have past the smaller one). We separated the two mesh sizes spatially, tying the two cod ends mirror-wise to the net, in nearby positions, with possibly different water flow through and possibly different amounts of fish entering them. Thus, it seems we are going the wrong way. However, based on practical experience, we hypothesized small meshes (and consequently blowing of the net) could repel fish just in front of the net or allow them to leave the mouth of the net after they have been caught, which in the case of cover cod ends would also affect the larger meshed inner cod end. Following this line of reasoning, we tried to design a net which would not have this draw back, but still compares two mesh sizes adequately. If, at the bottom line, we could show that the larger mesh size catches more fish of larger length classes under otherwise identical circumstances, our case would have been proven, and the use of our new design shown. Looking at fig 3, length classes over 25 cm, we make a good chance.
But were the circumstances of the two cod ends identical? As far as circumstances outside of the net are concerned, doubtlessly yes, since the cod ends were tied to one single beam, fishing at one single speed, at one bottom type etc. To make the circumstances inside the net as comparable as possible, we designed the net symmetrically, making the two halves identical, except for the cod ends. However, a few short comings were made: the anode was always at the same shoe. The obvious solution will be to switch anode and cathode seriously between hauls, but up till now we neglected the possible influence of the polarity of the electricity. Secondly, we do know for sure, that the net behaved symmetrical in the flume tank in Hull. But we do not know the exact behaviour of the net in the real environment in the IJsselmeer, and water turbidity hinders direct observation anyway. A final solution to this problem, would be to analyse the behaviour of passive particles in the net, checking whether they are distributed evenly between left and right cod end. Unfortunately, bycatches have not been quantified. We have often observed that adult perch is completely anaesthetized by the electricity, and thus could be viewed as passive particles in the net. Thus, in further experiments we will quantify the bycatch.
Incidentally, we mention the possibility of applying a cover cod end in one of our cod ends, giving one cod end a large mesh, and the other a large mesh enveloped by a small one, thus testing the cover cod end technique directly. Further experiments might include this facet.
Concluding: we designed a net with two cod ends, to test the negative effect of small meshes on the catch of larger eels. We were able to show this negative effect, but we have to improve several points in the experimental procedure. But overall, we were struck by the magnitude of the apparent negative effect, the larger mesh catching ca. twice the amount of the smaller mesh!

References

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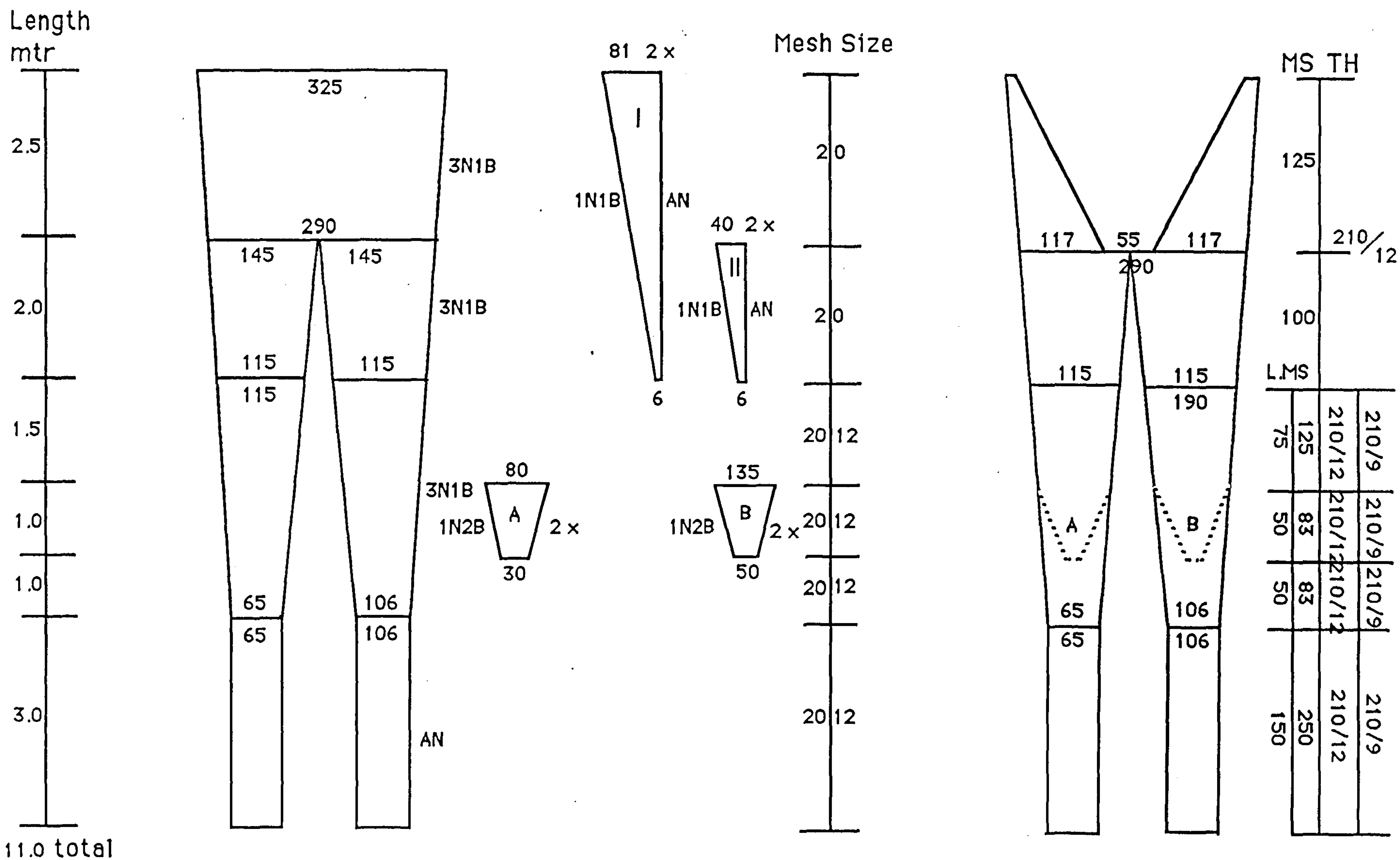
Figure 1: drawing of the net with the two cod ends.



length headline : 2.80 mtr
length footrope : 5.50 mtr
side panel I : 0.60 mtr
side panel II : 0.35 mtr

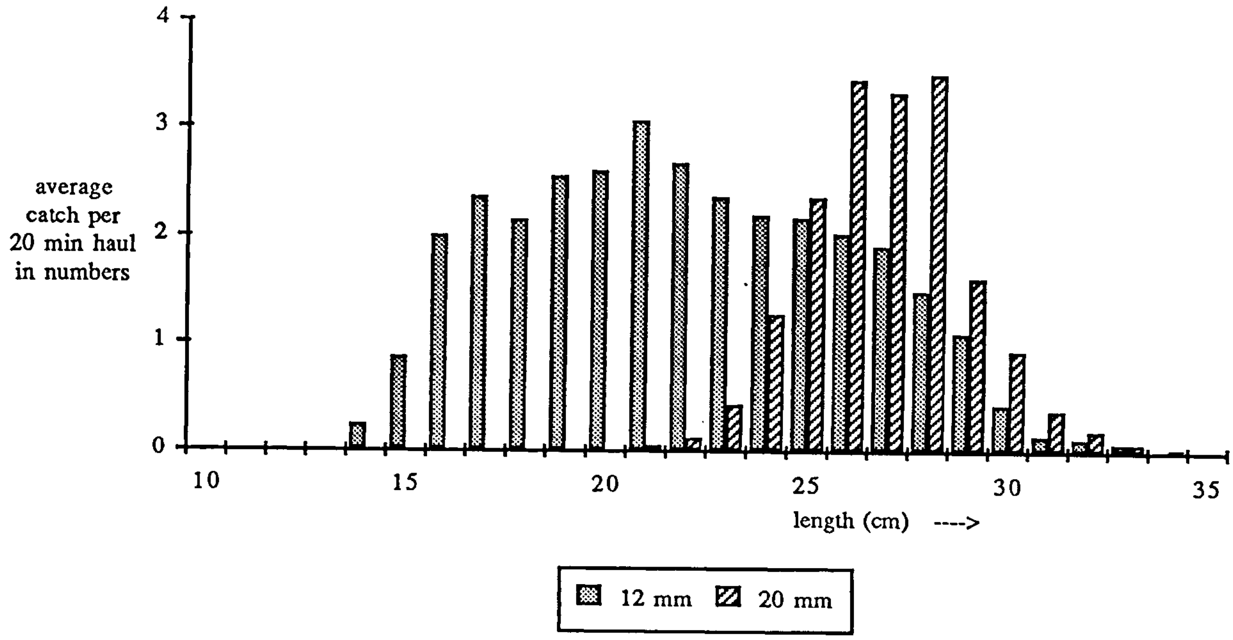


Figure 2: Length frequencies of IJsselmeer eel using an electrified 3m beam trawl with two cod ends with 12 and 20 mm mesh size (see fig 1).

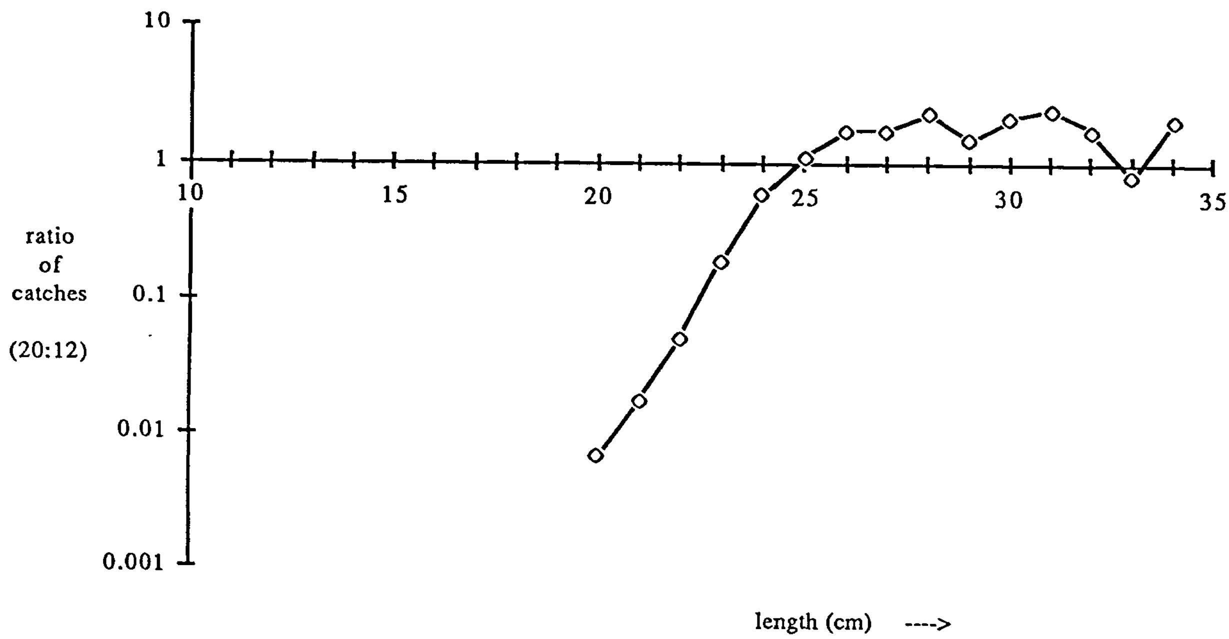


Figure 3: Ratio of length frequencies of IJsselmeer eel using an electrified 3m beam trawl with two cod ends with 12 and 20 mm mesh size (see fig 1 and 2).