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ON THE BEHAVIOUR OF NEPHROPS AGAINST BOTTOM TRAWLS AS OBSERVED WITH AN UNDERWATER TV

by

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Abstract

Direct observations with an underwater TV camera in summer 1985 on conventional Nephrops trawls and the behaviour of Nephrops resulted in experimental fishing with new trawl types in 1986, including a two level trawl. The most interesting results - partly obtained with direct observations - are that the catching rates of Nephrops can be increased by using tickler chains and that the usual net slack in the wrings is not essential. Separation of Nephrops and haddock was much better than in earlier experiments with a two level trawl.

A short video-tape will be presented with this paper.

Background

Direct observations on the behaviour of fish species and other sea animals to be caught towards fishing gears are becoming increasingly important in the ICES member countries in order to increase the general efficiency of fishing gear and to get information on the unwanted mortality of uncaught fish. In Iceland a cooperation between private companies and the MRI has started on direct observations with an underwater TV camera. In this paper the main items of the behaviour of Nephrops will be described and the trawl rig alterations made according to the results of the direct observation will be dealt with.

Conventional Nephrops trawls

Icelandic Nephrops trawls are characterized by very long wings, a uniform meshopening of 80 mm in the whole trawl and a footrope rigged to fish very thight to the bottom. The most peculiar feature about this trawl design is however that much of the towing resistance is directed onto the headline in order to utilize the weight of the footrope to get a very close bottom contact. A simple method to express this is to find a figure which multiplied by the square length equals the length difference of the footrope and headline, i.e. footrope-headline = x · square length. The figure x is 2.2 or slightly higer for conventional Icelandic Nephrops trawls or definetely higher than for most other trawl designs indicating that the main towing resistance caused by the front part of the gear is directed onto the the headline.

Only 11-13 200 mm floats are used on the headline. The footrope consists of 14 mm wire covered with fibre ropes the total diameter being 50-100 mm along the wings but about 200 mm on the bosom. Otter boards of different designs of some 400 kg each are used. Braided PE netting yarn of R 1650 tex is used in the upper panel but stronger twine, usually R 2450 tex is used in the lower panel.

By mounting the bar cut wings to the headline some 3-10% slack in the netting is usual whereas 5-18% slack is used in the wings. The footrope is kept 1-3% shorter than the fishing line.

The observations in 1985

The observations were made with an underwater TV camera mounted onto a remote controlled vehicle (RCV), (see Priestley et al., 1985).

The shape of the trawl in operation was in accordance with the description. The danlenos were almost flat with the consequence that the headline height was very low at the

wingend or only 20 cm. The headline was rising extremely slowly so that the headline height in the middle of the bosom was only about 1 m. Almost all the netting of the lower wings was pulled along the bottom with the lacings on the bottom or close to it.

Not surprisingly the close footrope contact whirled up dense mud clouds preventing observations of the lower panel and the codend.

On the usual towing speed of 2.0-2.3 knots most fish species could swim for some time in front of the trawl opening. Saithe was shown to escape foreward out of the trawl and haddock frequently escaped over the headline. Other fish species frequently observed were different species of flatfish, mainly plaice and dab, which usually were caught and some Norway pouts and silver smelts which were not seen to escape to any extent.

Surprisingly many small fish were seen to escape through the netting in the front part of the belly. This is in contrast to many other observations but may be explained by the herding efficiency of the mud clouds inside the belly which seems to outweight the negative thigmotaxis (touch instinct) of the fish.

As the headline height was only half as big as the height of the RCV the Nephrops behaviour could not be observed in detail when using the conventional trawl rig. To overcome this problem the headline legs were extended by one foot each and 8 extra floats put on the middle of the headline. These alterations were drastic enough to increase the headline height sufficiently for the RCV.

In three hauls the TV camera was placed in the trawl opening with the above mentioned rig. In total 113 Nephrops were sean to enter the trawl whereas no less than 75 escaped under the footrope. This 60% catchability is almost certainly much lower than in commercial fishery since the

necessary alterations to make place for the RCV reduced the bottom contact of the footrope and the warp length had to be kept shorter than usual due to the short available camera cable length. All the observed Nephrops were very close to the bottom.

It is superfluous to say that nobody was happy with the 60% catchability and very soon a solution was found to increase the catch. With a simple tickler chain in front of the bosom the catching rate exceeded 90%. Perhaps the tickler chain compensated for the involuntary short warp lengths and the light trawl rig.

Interesting observations were also made along the lower wing where it joins the square. The netting was somewhat undulatory on this place facilitating the Nephrops to get a firm hold to the netting. Some specimen were seen to lose the contact with the net and disappear into the belly. Others were observed to escape through the netting going with the tail first. Meshed flatfish specimen and starfish apparently impeded the escapement. These observations were certainly not extensive enough to make a conclusion of a size selectivity in this part of the trawl net but indicate that smaller specimen more easily escape.

The experiments in 1986

Many netmakers and skippers got the opportunity to watch (in situ) the observations in 1985. It was felt by many that some superfluous netting was used in the front part of the trawl and that the footrope rig was perhaps not as efficient as generally believed. In this connection it must be mentioned that footropes with smaller diameters have been tested some years ago resulting in increased quantities of mud and trash with unclear effect on the catch rate of Nephrops. It should also be noted that tickler chains are never used in Icelandic fisheries. It is further worth mentioning that the Icelandic Nephrops fishery is regulated by quota per vessel which easily can be reached. The reason

for improving the gear is therefore only to reach the TAC with the smallest possible effort, preferably with reduced by-catch of undersized fish.

To prepare a program of the continued experiments in 1986 a working group was established to prepare the experiments. Two experimental trawls shown in Fig. 2 and 3 were designed and tested in comparison with a conventional trawl shown in Fig. 1. A two level trawl with a 40 mm seperating panel between the lacing and two codends was also observed.

The trawl design called Gaflari (Fig. 2) is characterized by streched netting in the wings. Actually there is good slack in the lines or 5.6% in the headline and 8.8% in the fishing line as compared to the length of the netting. This is very remarkable as many Icelandic fishermen believe that some net slack in the wings is essential in the Nephrops fishery.

The centre part of the footrope of the Gaflari design consisted of a 1/2" chain instead of rope wound steel wire . During the observations the chain footrope was replaced by a conventional footrope but in this case the chain was used as a tickler held 13 cm shorter than the 5.43 m centre footrope part.

The trawl called Benni (Fig. 3) is designed like a wing shrimp trawl with 4 panels and 15% net slack in the upper wings and 20% in the lower wings. It is further characterized by the omission of the danlenos and double bridles of 12.5 fm length in addition to 12.5 fm single bridles.

Results

The 1986 observations were made off the SW-coast on 65-70 fm depth. The average catch was 18.3 kg of tails above 7 cm. in length per trawling hour, corresponding 60.4 kg/h of legal size Nephrops. Fourteen hauls were made with a total towing time of 35 1/2 hours. Observations were made in 12 hauls.

The wing end spread was measured once for each trawl being on average 20.1 m for the separeting trawl, 20.7 m for the conventional trawl, 24.1 m for the Benni-trawl and 25,0 m for the Gaflari-trawl. The headline height could not be measured but compared with the height of the RCV it was about 1 m for the conventional and the separeting trawls without modifications, about 1.6 m for Benni and about 2 m for the Gaflari. Modifications had to be made for the three mentioned trawls to get the RCV into the trawl mouth.

The by-catch of fish was rather low in all trawl designs with the exception of some flatfish species (mainly plaice, long rough dab and witch). The average flatfish catch was 3.7 to 6.4 baskets/hour in the different trawl designs.

The relative catch in the lower codend in the two tows with the separating trawl was: Nephrops 99.3%, cod 80%, haddock 16% and flatfish 95%. The good Nephrops separation is remarkable as earlier experiments showed 25% of catch to be in the upper codend. The improved separation can be explained by the higher headline height due to different rigging and 40 instead of 80 mm meshopening in the separating panel.

In the 1986 experiments the Nephrops was found to be more active than in 1985. During a short observation time at the wingend some specimen were observed to swim actively from the danleno and the wingend. On the other hand the herding efficiancy of the bridles was very low and in good accordance with Scottish observation (Main and Sangster, 1985).

Due to the increased activity the Nephrops more easily swam and rolled over the footrope than in 1985. Often the Nephrops collided with the footrope before scrambling over it into the netmouth or pushed down under it. Due to a dense mud cloud it was sometimes difficult to decide whether the Nephrops entered the net mouth or escaped between the footrope and fishing line. In general this is in good

accordance with the Scottish obervations (Main and Sangster, 1985). From 283 valid Nephrops observations in front of the middle part of the footrope on the Benni-trawl 242 individuals entered the trawl opening (85.5% catching efficiancy). A corresponding figure for the Gaflari trawl with a chain footrope was slightly higher or 87.5% calculated from 120 single observations. With a conventional footrope and a tickler chain 30 individuals were observed to enter the trawl whereas only one specimen was overrun by the footrope. The limited number of observations do not allow definite conclusion to be drawn on the advantage of the tickler chain in the Nephrops fishery. It should be mentioned however that commercial fishermen who used tickler chain after the end of the experiments felt that it had increased the catch rates on some fishing grounds.

Several observations were made on the Nephrops behaviour inside the most aft part of the wings close to the lower quarters. These observations were in good accordance with those made in 1985 already described. It became obvious however that the netting in the experimental designs was much more straight than on the conventional trawl. This should impede the escapement of Nephrops through the netting although the relatively short observation time could not prove this. Considerable amount of flatfish, starfish and other trash got meshed inside the wings, blocking the meshes but hindering the rolling of the Nephrops into the belly. Some specimen were seen to escape through the netting in this part of the trawl. A small meshed net bag covering 9x10 bar meshes was attached to the netting of the conventional trawl on one occation to check on the number and size of the released induviduals. Nine Nephrops were found in the cover with an average carapace length of 39.0 mm as compared with 44.5 mm in the codend. The catch in this particular haul was rather poor or 22 kg tails (1116 individuals. This is in accordance with earlier Icelandic experiments.

Observations on the Nephrops behaviour in belly and codend were restricted to some few glimpses due to poor visibility caused by mud clouds. Some specimen were seen rolling into the codend but none in firm contact with the netting.

During one haul observations made in front of the separating panel of the two level trawl indicate that the most probable "escape route" of the few individuals entering the upper codend is close to the side seams.

It should finally be mentioned that both experimental trawl designs were used commercially after the end of the experiments. The Gaflari design was reported to catch some 25% more than conventional trawl types. A second trawl of the same design was rigged and used commercially.

The Benni design was found to reduce the towing resistance as compared with conventional trawls without reducing the catchability. The twin bridles on the other hand were found combersome in use due to twisting together.

References

Main J. and G.I. Sangster: The behaviour of the Norway lobster, Nephrops norwegicus (L.) during trawling. Scottish Fisheries Research, Report.No.34, 1985.

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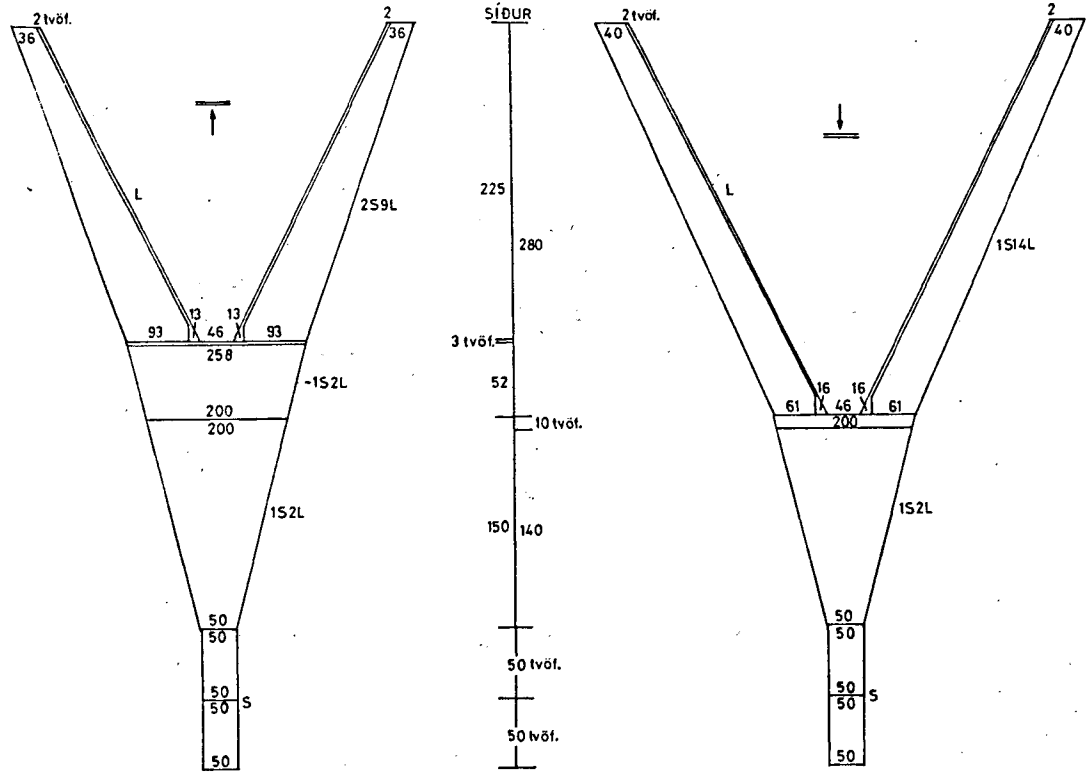
SKURÐUR

Fig. 1: Conventional Icelandic Nephrops-trawl.



HÖFUÐLÍNA VÍRM. 16 mm ø 37,1 m (17,65 + 1,80 + 17,65) LEGGIR 1,5 m
FISKÍLÍNA -"- -"- " 48,0m (19,5 + 9,0 + 19,5)
FÓTREIPI -"- 18 -"- " VAFIÐ 46,5 m (21,15 + 4,2 + 21,15)
FLOT 13 (3 + 7 + 3)

YFIRFARIÐ GÞ	KVARÐI 1:200	TITILL HUMARVARPA FRÁ HORNAFIRÐI	EFNI PE
TEIKNAÐ	MÓSKVASTÆRÐ 80 mm		DAGSETNING 23/11-1982
		HAFRANNSÓKNASTOFNUNIN SKÚLAGÖTU 4 REYKJAVÍK	TEIKNING NR 62

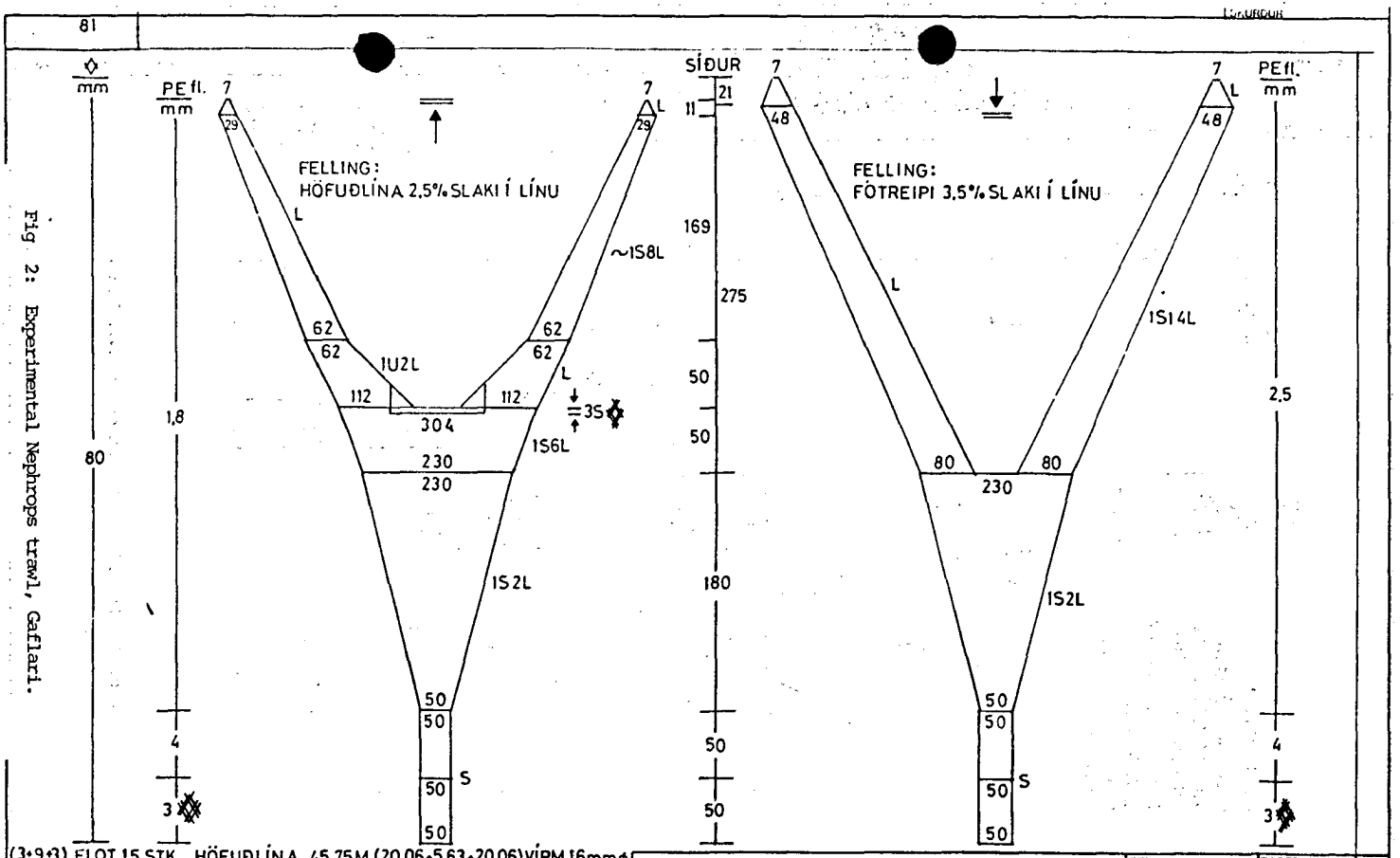


Fig 2: Experimental Nephrops trawl, Gaflari.

(3+9+3) FLOT 15 STK. HÖFUÐLÍNA 45,75M (20,06+5.63+20,06) VÍRM.16mmø
FISKILÍNA 56,50 M (KEÐJA)
FÓTREIPI 54,75 M (24,66+5,43+24,66) VÍR 18 mmø vafið með sísal

YFIRFARID GÞ	KVARDI 1:200	TITILL HUMARTROLL (GAFLARI)	EFNI	DAGSETNING 30/7 1986
TEIKNAD GHÓ		GÖGN NETAGERÐ JÓNS HOLBERGSSONAR Hafn.f.		TEIKNING NR 81

HAFRANNSÓKNASTOFNUNIN
SKÚLAGÖTU 4
REYKJAVIK

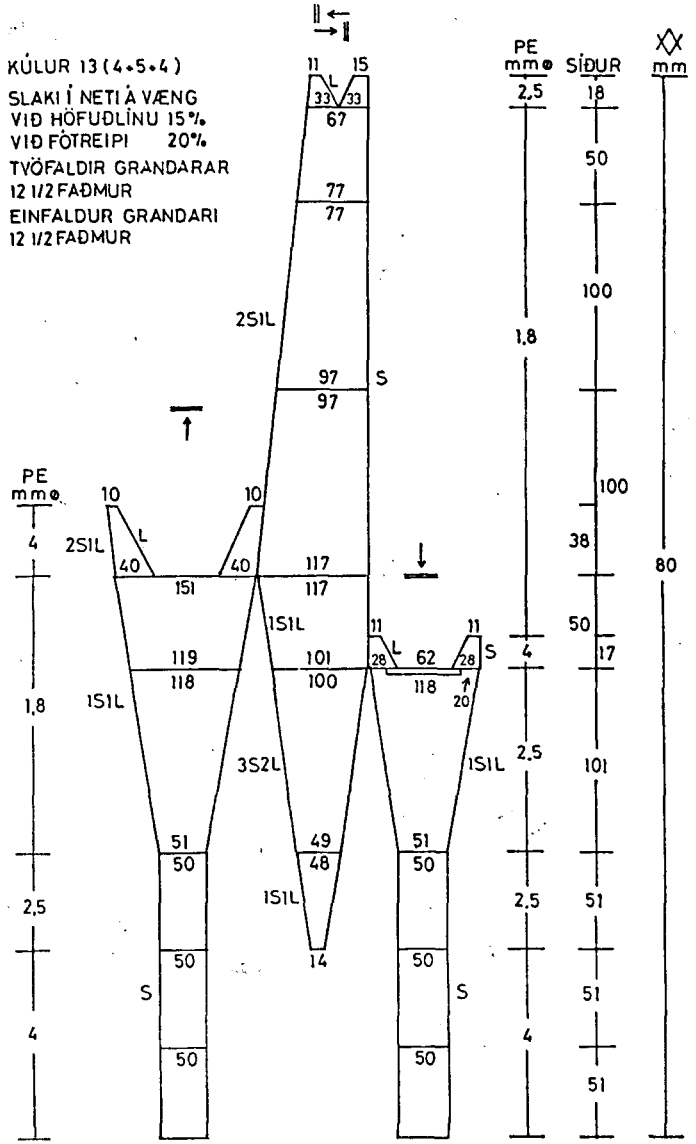


Fig. 3: Experimental Nephrops trawl, Benni.

Explanations regarding Figs. 1-3.
(Icelandic - English vocubulary).

einfalt:	single
felling:	hanging
fiskilína:	fishing line
flot:	float
fótreipi:	footrope
grandari:	Bridle
höfuðlína:	head line
í:	in
keðja:	chain
kúla (pl: kúlur):	float
L:	B (bar)
leggur (pl:leggir):	leg
lína (dat.:línu):	line
möskvastærð:	mesh opening
S:	N(normal), P(point)
tvöfalt:	double
vafið með:	covered with
vængur:	wing