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A consideration of two types of trawl in a mixed fishery for Nephrops, Pandalid shrimps and white fish

by

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Introduction

Off the Northumberland coast of England, the area around the Farn Deeps supports a mixed population of white fish, Nephrops and Pandalid shrimps. The white-fish stock contains a high proportion of undersized cod, haddock and whiting, as well as other small gadoid species, and commercial fishing continues to be responsible for considerable losses of these fish. No comprehensive quantitative data are available, but estimates of gadoids in commercial catches made in April 1968 indicated that, of a total of 31 200 gadoids of all species, only 400 were cod, haddock and whiting above the minimum legal size. The rejection rate was therefore 99% by numbers at that time.

In addition to trawls designed specifically for white fish, numerous long-wing two-panel trawls (known as prawn trawls) are in use: they are designed to take Nephrops and white fish, and all are restricted to a legal minimum mesh size of 70 mm. Recently there has been increasing interest in trawling for Pandalid shrimps (mainly P. borealis) which are present on the Nephrops grounds. It is permitted to take shrimps using trawls with mesh sizes not less than about 25 mm in the cod-end, while continuing to land Nephrops and white fish as bycatch. When shrimps are available in sufficient concentration, this combination of species presents a considerable incentive to fishermen to adopt small-mesh trawls and, as a result, losses of young fish increase. However, whether or not small-mesh trawls are widely adopted, the conservation of undersized white fish is a serious problem, and it is worth reconsidering present gear and methods.

When small white fish comprise a majority of the catch, any method of reducing their numbers without an unrealistic reduction in crustacean species would provide a useful contribution to fish conservation. The possibility of achieving this by reducing the numbers of fish entering the trawl, rather than by catching them and relying upon mesh selection for their subsequent release, has been explored during recent fishing trials in the Farn Deeps. During 1972/73 preliminary results have been obtained using a long-wing two-panel (prawn) trawl, and a four-panel flat trawl, as used in the Penaeid shrimp fishery of the Gulf of Mexico. The choice of the four-panel flat trawl was based upon several premises:

1. It is an established shrimp trawl, albeit for Penaeid and not Pandalid shrimps.
2. It was developed to capture shrimps whose habit is to burrow into soft sediment in the Gulf of Mexico; it might therefore be effective in the Farn Deeps, where Nephrops has a similar habit and substrate preference.
3. In contrast to the long wings of the prawn trawl, those of the flat trawl are very short. This probably modifies the fish-herding characteristic of the long trawl wing and reduces the fish component of the catch.

Gear and methods

The preliminary results reported here relate to a comparison of an 86 foot headline, number 3 prawn trawl (Figure 1) and a 41 foot headline Gulf of Mexico flat trawl (Figure 2). Direct comparisons were made of relative catch composition of white fish, Nephrops and Pandalid shrimps. The selection of a common mesh size was dictated by the need to retain reasonable quantities of shrimps, and for this reason a mesh size of 35 mm was adopted throughout both nets.

The general specification of each trawl is as follows:

No. 3 prawn trawl

Material: Courlene throughout

Headline length: 86 feet, supported with eight 4" diameter floats

Groundrope length: 96 feet 6 inches bass rope, weighted with lead rings and lengths of light chain

Mesh size: Nominal 35 mm throughout. Measurements with an ICES mesh gauge indicate a mean mesh size of 36.2 mm full mesh (100 observations).

Flat trawl

Material: Ulstron throughout

Headline length: 41 feet, supported with six 4" diameter floats

Groundrope length: 43 feet bass rope, weighted with lead rings and lengths of light chain

Mesh size: Nominal 35 mm: measurements with an ICES mesh gauge indicate a mean mesh size of 34.8 mm full mesh (100 observations).

Both trawls were fished on the same wooden trawl doors (4'6" x 2'6"). These were attached to the wing ends by short strops: the upper of 3" Ulstron, the lower of heavy chain to ensure that the groundrope ends were held down. Quarter ropes were fitted to each net.

There has been no opportunity to conduct side-by-side trials and thus obtain an optimal comparison of relative trawl performance; the two gears were fished in daylight on alternate days over the same areas of soft substrate and on the same Decca co-ordinates. In the first trial (September 1972) the volume of total catch, the volume of Pandalid shrimp and the total number of Nephrops were recorded and adjusted to volume or numbers per trawling hour for the purpose of comparison. In the second and third trials (April 1973 and November 1973) the measure of total catch was discarded in favour of a count of white fish of all sizes.

Results

In September 1972, seven hauls were completed with each trawl. Table 1 comprises quantitative observations on Nephrops, Pandalids and total catch per one hour's trawling.

Table 1a 86 foot headlinc prawn trawl

Haul	Total catch (baskets/h)	Pandalids (gallons/h)*	Nephrops (numbers/h)
1	7.7	2.9	168
2	6.4	8.2	82
3	8.7	13.6	1 154
4	4.8	1.9	260
5	3.0	1.5	106
6	5.0	1.0	34
7	5.5	1.5	892
Total	41.1	30.6	2 696
Mean	5.9	4.4	385

* 1 gallon equals 4.54 litres

Table 1b 41 foot headline flat trawl

Haul	Total catch (baskets/h)	Pandalids (gallons/h)	Nephrops (numbers/h)
1	3.1	3.8	857
2	3.0	4.0	391
3	3.8	4.1	1 452
4	2.8	3.8	907
5	2.5	2.8	737
6	3.6	4.1	602
7	3.2	3.0	1 090
Total	22.0	25.6	6 036
Mean	3.1	3.6	862

The total catch of the flat trawl was 2.8 baskets/h (47%) less than the total catch of the prawn trawl, which might be explained by the difference in their respective sizes. However, the Pandalid catch fell by only 0.8 gallons/h (19%), and numbers of Nephrops caught rose by 477/h (124%) in favour of the flat trawl.

The second group of data was collected in April 1973, when five more tows were completed with each trawl. The results are shown in Table 2.

Table 2a 86 foot headline prawn trawl

Haul	White fish (number/h)	Pandalids (gallons/h)	Nephrops (number/h)
1	1 749	7.3	29
2	600	6.5	90
3	238	4.0	0
4	96	3.6	0
5	227	5.6	2
Total	2 910	27.0	121
Mean	582	5.4	24

Table 2b 41 foot headline flat trawl

Haul	White fish (number/h)	Pandalids (gallons/h)	Nephrops (number/h)
1	205	1.9	4
2	276	3.5	10
3	170	1.5	22
4	156	2.0	94
5	213	1.9	19
Total	1 020	10.8	149
Mean	204	2.2	30

The flat trawl white fish count was 378/h (65%) less than that of the prawn trawl. Numbers of Nephrops were small during this period and the increased catch by the flat trawl can hardly be regarded as significant. Pandalid catch volume fell by 3.2 gallons/h (59%) when the flat trawl was used.

The third set of data was collected in November 1973. Ten hauls were completed with the flat trawl, but only seven hauls were possible with the prawn trawl before the work was halted by bad weather. The results are shown in Table 3.

Table 3a 86 foot headline prawn trawl

Haul	White fish (number/h)	Pandalids (gallons/h)	Nephrops (number/h)
1	998	7.0	776
2	1 052	12.0	390
3	750	6.0	174
4	848	6.5	134
5	630	10.0	58
6	795	7.7	340
7	527	3.7	200
Total	5 600	52.9	2 072
Mean	800	7.6	296

Table 3b 41 foot headline flat trawl

Haul	White fish (number/h)	Pandalids (gallons/h)	Nephrops (number/h)
1	504	3.0	430
2	482	5.0	1 100
3	588	5.0	718
4	254	7.3	192
5	448	9.5	80
6	480	5.0	106
7	302	2.2	151
8	410	0	201
9	442	1.5	154
10	340	1.0	170
Total	4 250	39.5	3 302
Mean	425	3.9	330

These data indicate that the flat trawl white-fish count was 375/h (47%) less than that of the prawn trawl. The number of Nephrops caught by the flat trawl did not fall pro-rata but rose by 34/h (11%), whilst the Pandalid catch fell by 3.7 gallons/h (48%).

The results of the three trials are summarized in Figure 3.

Discussion

It is acknowledged that these results constitute a limited sample, but they appear to demonstrate a consistent trend. In September 1972 the flat trawl took significantly less total catch than the prawn trawl ($P < 0.02$), and its shrimp catch was slightly less ($P < 0.80$). In April 1973 total numbers of fish were reduced ($P < 0.3$), and shrimp catch fell sharply ($P < 0.01$), when the flat trawl was used. In November 1973 white-fish catch showed a marked decrease ($P < 0.001$), and shrimp catch also declined ($P < 0.05$), in favour of the flat trawl. However, the Nephrops results appear not to follow this trend. Data from the flat trawl suggest a marginal improvement in catch on two occasions ($P < 0.9$, $P < 0.9$) and a considerable improvement ($P < 0.05$) on the third.

As a first step to understanding why these trends should have occurred, measurements of warp angle and warp length were made to establish the probable towed shape for each trawl. It was found that the doors of the flat trawl were approximately 40 feet apart and therefore that the trawl was fully spread (Figure 4a). Warp angle and warp length of the prawn trawl have been checked on several occasions and compared with those on a commercial vessel towing a prawn trawl on steel vee-shaped doors. It was found that the interdoor distance was little more than half the headline length, and that the trawl spread was little more than that of the flat trawl (Figure 4b). If this is so, the sampling area covered by both trawls is reasonably comparable, and catch variability is more likely to be associated with trawl configuration rather than headline length.

If the prawn trawl is only half spread, its configuration might be described as resembling an opened letter U, and the small angle subtended by the wing and the towing direction may influence trawl performance in two ways. The long wings of the prawn trawl are designed to inhibit fish escape and therefore it might be expected to catch more fish than the flat trawl. Secondly, an indication of wing function in relation to Nephrops capture may be contained in results obtained by Cole and Simpson (1965) during an investigation of Nephrops escape through various parts of a prawn trawl. In this work, six fine-mesh covers were attached at various points on the trawl and counts were made of Nephrops entering each cover. Of almost 13 000 Nephrops which passed into the covers, not one was found in a cover which was sited near the end of the wing. It is possible therefore that much of the wing serves no useful function in the capture of Nephrops and may, in fact, only invoke escape reactions into any available burrow.

Conclusions

To date, these gear trials have been little more than an adjunct to surveys of crustacean populations in the Farn Deeps; a more detailed comparison of relative trawl performance would require a controlled series of paired observations, including measurements of Nephrops and white fish taken by each trawl.

However, they indicate that although the Gulf of Mexico flat trawl was less effective than a No. 3 prawn trawl for catching Pandalid shrimps, it took substantially fewer white fish and at least maintained, and possibly increased, the catch of Nephrops. In areas where the conservation of small gadoids is a problem associated with Nephrops trawling, this aspect of the flat trawl's performance would justify further investigation.

SUMMARY

Off the north-east coast of England, white fish, Nephrops and Pandalid shrimps are exploited commercially. In this and other areas conservation of small gadoids is a matter of concern. Preliminary trials with a Gulf of Mexico shrimp trawl have suggested that this trawl reduces white-fish losses while maintaining the Nephrops catch.

Reference

COLE, H.A. and SIMPSON, A.C.(1965). Selection by trawl nets in the Nephrops fishery. Rapp.P.-Verb, Réun. Cons. int. Explor. Mer, Vol. 156: 203-205.

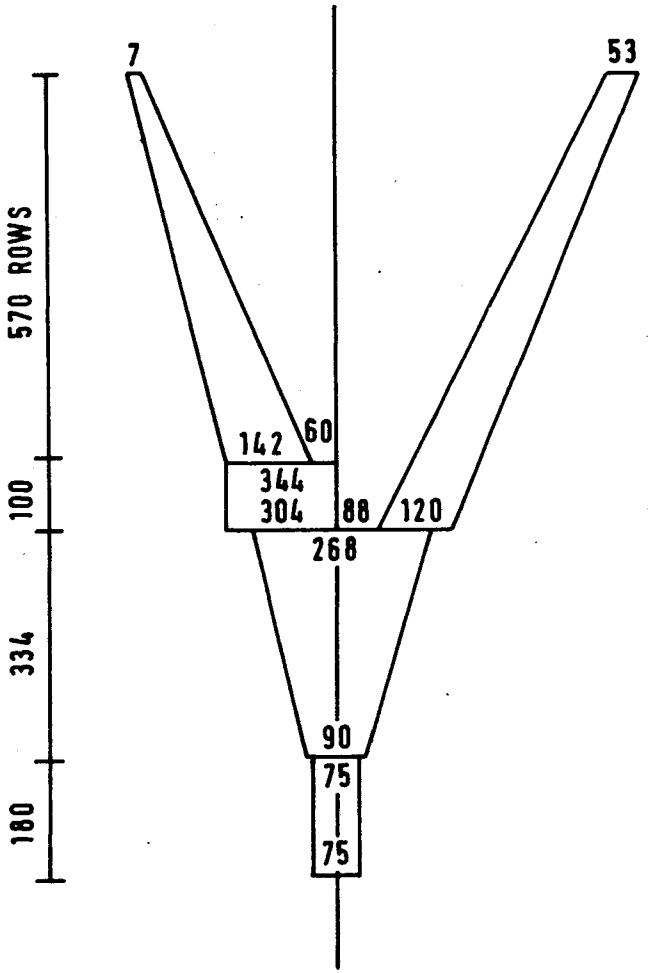

Figure 1. No 3 prawn trawl. Units indicate numbers of meshes (vertical scale in rows of knots)

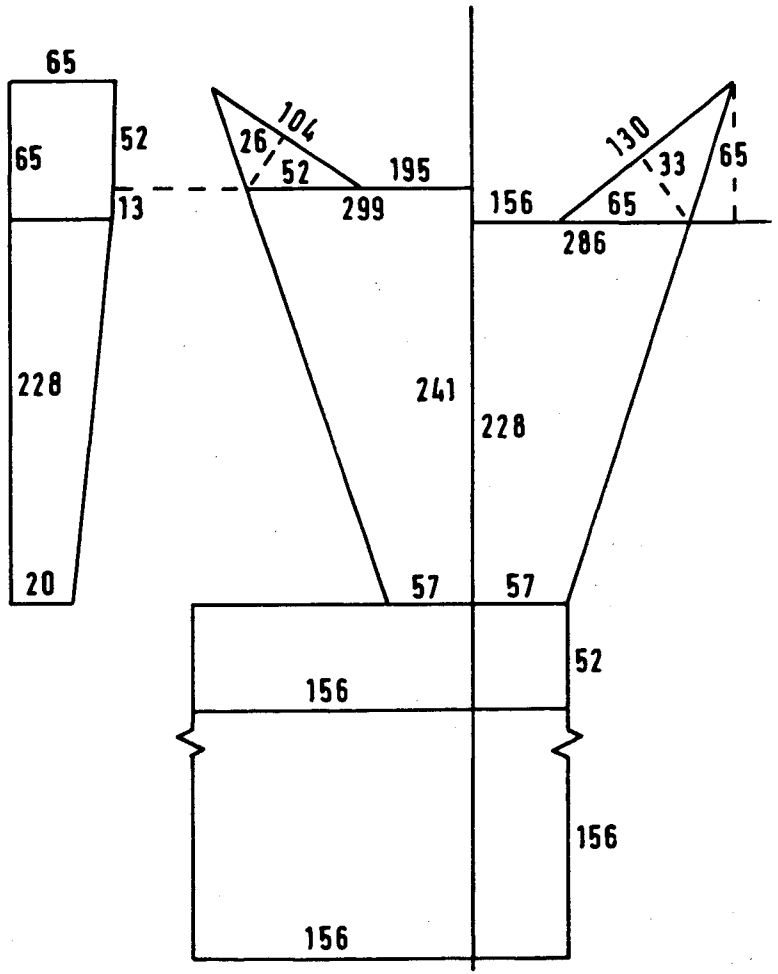

Figure 2. Gulf of Mexico flat trawl. Units indicate numbers of meshes.

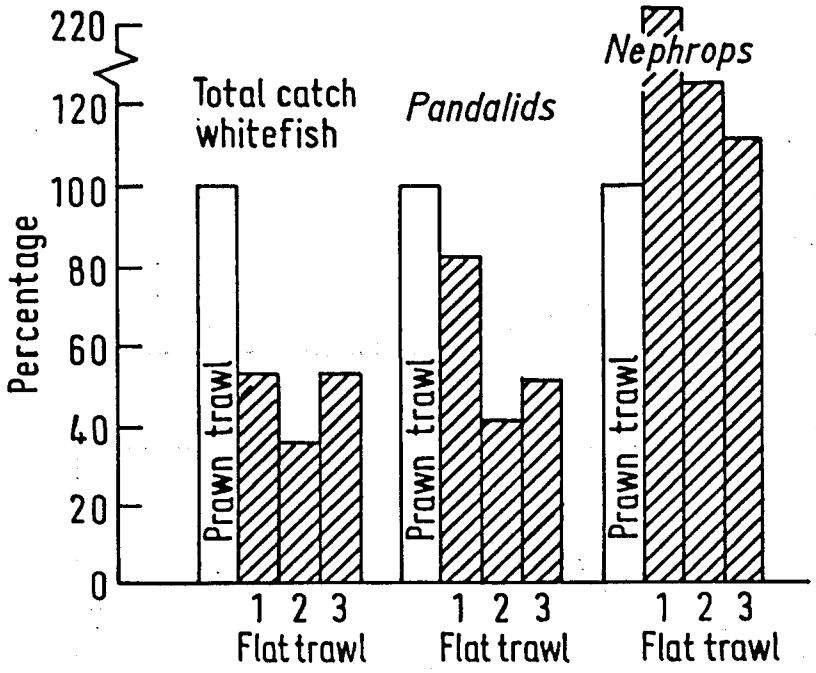

Figure.3. Flat trawl catch expressed as percentage of prawn trawl catch (=100%) Mean data from tables 1,2,3.

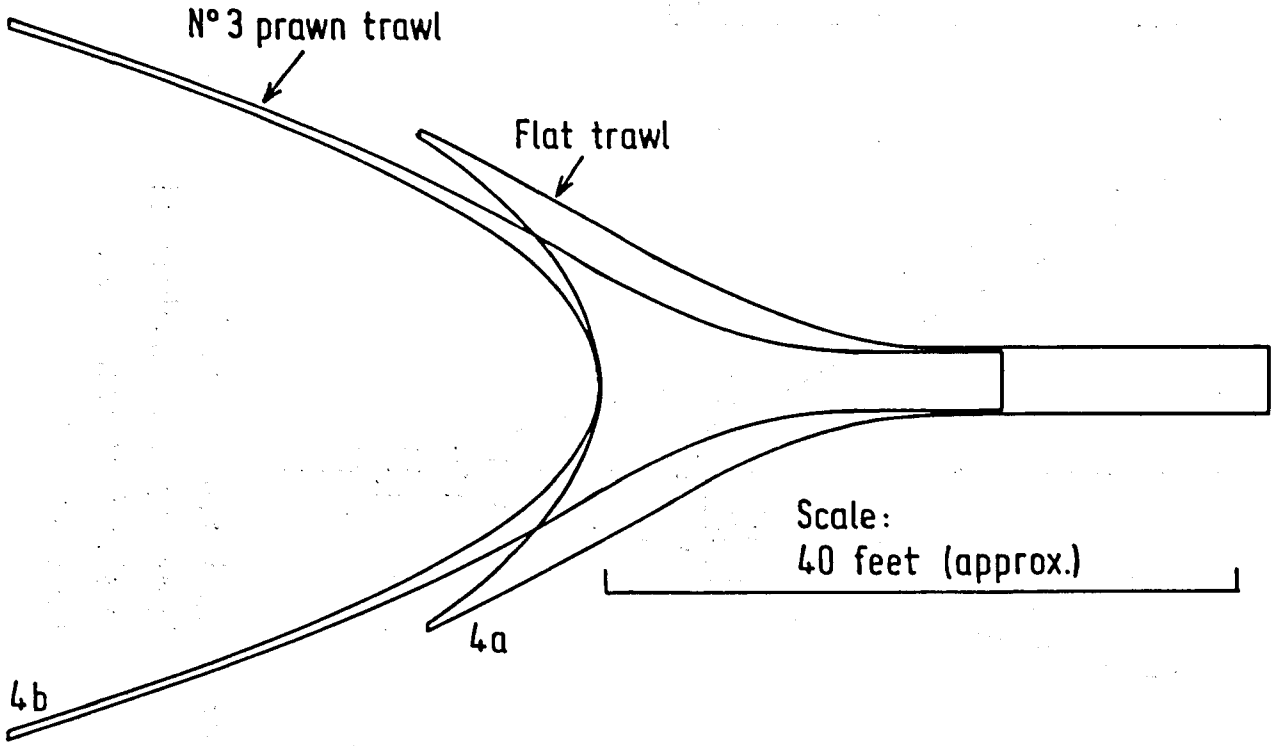

Figure 4. Probable fishing shapes, N°3 prawn trawl and flat trawl