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# "Tank observations of prawns and small cod in relation to a moving model trawl"



by

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## Introduction

Prawn trawling for Pandalus borealis Krøyer is often associated with great bycatches of youngfish of commercial valuable fish species, especially cod, haddock and redfish.

During 1968 the development of an effective selective prawn trawl was started in the United States (High, W. L., Ellis, I. E. and Lusz, L. D., 1969). From 1970 fishing experiments with selective prawn trawling has been going on in Norway (Rasmussen and Øynes 1974). Lately an obliquely mounted sorting panel across the towing direction in the rear part of a prawn trawl has given promising results (Karlsen 1976).

The object of this preliminary investigation on the response of prawns (Pandalus borealis) and I-group cod (Gadus morhua L) to the sorting panel inserted in a model trawl, is to assess major differences in the behaviour of the species in order to separate fish from prawn catches. Further experiments will be undertaken in the laboratory accompanied with similar observations in situ.

## Material and methods

### Test animals

Prawns, Pandalus borealis and I-group cod, Gadus morhua were used in the experiments. The prawns were caught by trawl from 230 m depth in the Raunefjord near Bergen and the cod had lived in an aquarium for 8 months prior to the commencement of the experiments. The carapace length of the prawns are shown in Fig.1. Mean carapace length was 21.1 mm. The total-length of the cod ranged from 13 - 24 cm, with a mean of 20.0 cm. The animals were adapted to the test conditions in the circular tank usually three days prior to the experiments started up.

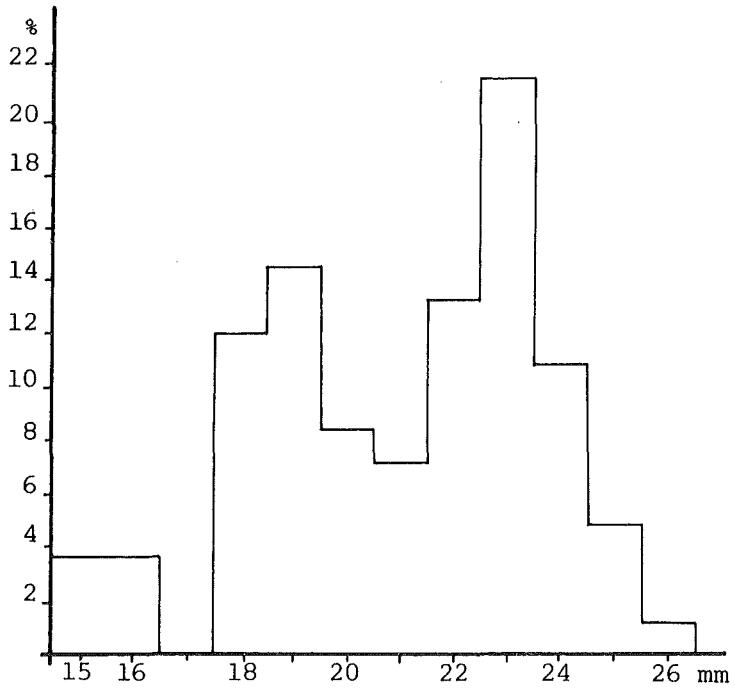


Fig. 1. Histogram showing the carapace length distribution of the prawns, based on 82 individuals.

## Test-tank

The experiments were undertaken in the circular tank at the Institute of Marine Research in Bergen during March-May 1976. The tank is circular, 2 m deep and 2 m wide with an inner circumference of 31 m. It holds approximately 200 $m^3$ of seawater. The temperature of the seawater was 6-7°C.

## Gear and equipment

The model trawl is made up of a frame of 8 mm Ø steel-rod and resembles a cut pyramid lying on one of its sides. The trawl mouth is rectangular and a tickler chain was introduced 40 cm in front of the "groundrope". The dimensions of the trawl are indicated on Fig. 2. The trawl narrows along its length with the posterior end open. The roof, bottom and lateral sides were inserted with white terylene net of 80 mm stretched meshes mounted diagonally. Near the posterior end of the trawl a sorting panel mounted on a frame was inserted across the towing direction. The sorting panel, 140 x 100 cm, was mounted to make an angle to the horizontal. The exit, a rectangular opening of about 140x50 cm through which the fishes were intended to escape, was placed in the roof just above the sorting panel.

The trawl was towed by a remote controlled vehicle driven by electric power.

Four different kinds of nets were used in the sorting panels:

a. an orange coloured net of 80 mm stretched square meshes,
b. a white net of 60 mm stretched square meshes.
c. an orange coloured net of 40/20 (40x20 mm) rectangular meshes made up by dividing 80 mm square meshes horizontally.
d. an orange coloured net made up by 80/20 (80x20 mm) rectangular meshes with every other vertical bar in the 40/20 meshes' panel removed in the upper 30 rows and 40/20 meshes in the lower 20 rows of the sorting panel. This is referred to as the 80/20 meshes sorting panel.

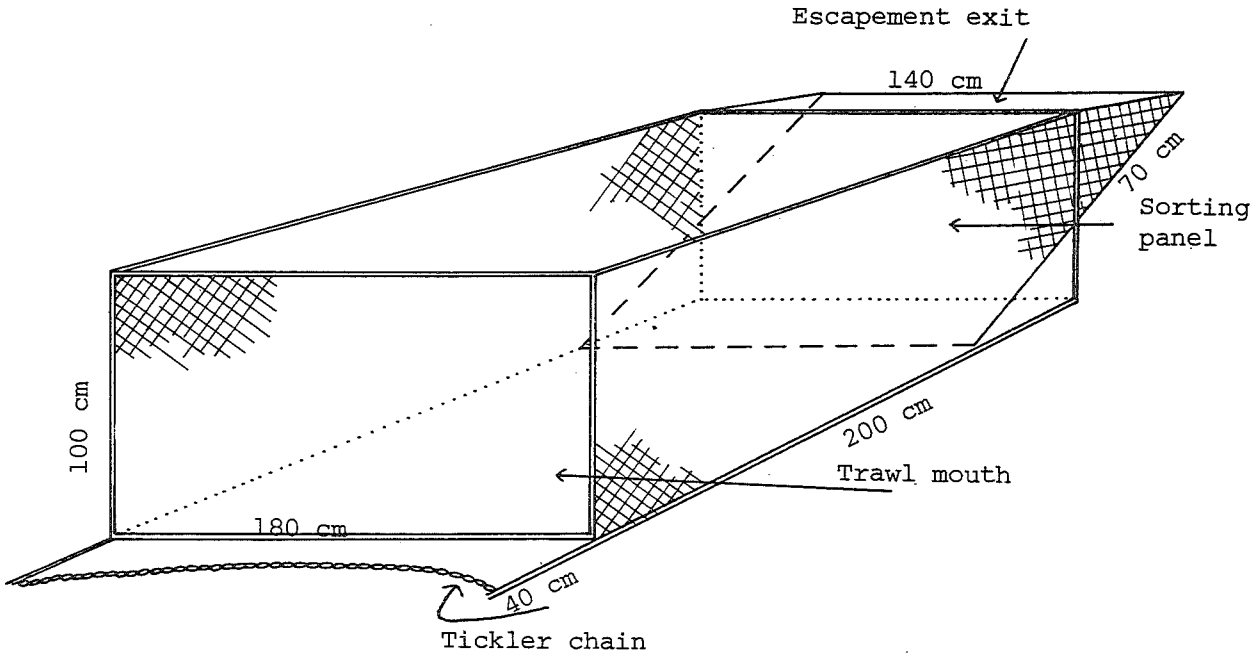


Fig. 2. Model trawl with the sorting panel inserted across the towing direction.

## Observation methods

The observations were usually recorded by two observers. One observer was placed on the towing vehicle, recording the towing speed and the number of prawns and fish entering the trawl mouth. The second observer made his observations from inside the tank through windows. The number of prawns and fish leaving the exit together with the number of prawns passing through the meshes of the sorting panel were recorded. Some sequences were recorded on video tape.

## Results

### Behaviour of prawns in relation to a moving trawl inserted with a sorting panel

About 80 % of the 300 prawns in the tank were distributed on the bottom, predominantely in patches. The prawns reacted immediately when touched by the trawl frame, making backward jumps. The direction in which the prawns made their avoiding jumps seemed to be determined haphazardly due to the orientation of their bodies relative to the trawl. Prawns not touched by any part of the gear were undisturbed. However, prawns being stimulated by some part of the gear usually made avoiding jumps 10 - 30 cm off the bottom. Repeated stimulation by some part of the trawl made the prawns more active. Observations have been made of prawns swimming for a distance of up to seven meters prior to being exhausted, but usually they swam only for about one or two meters before being caught up with the trawl. Even the most rapid moving prawns had great problems swimming away from the trawl at a towing speed of about 0.5 m/sec (1 knot). At a towing speed of approximately 0.4 - 0.5 m/sec, about 25 % of the prawns in physical contact with the tickler chain was observed to be damaged or pass underneath the chain because of reacting too late.
Fig. 3 indicates the percentage of prawns that were lost through the exit. The majority of the prawns were lost through the exit after hitting the sorting panel one or several times.

Fig. 3 indicates that at a certain kind of net in the sorting panel more prawns were lost through the exit as the mounting angle was reduced.

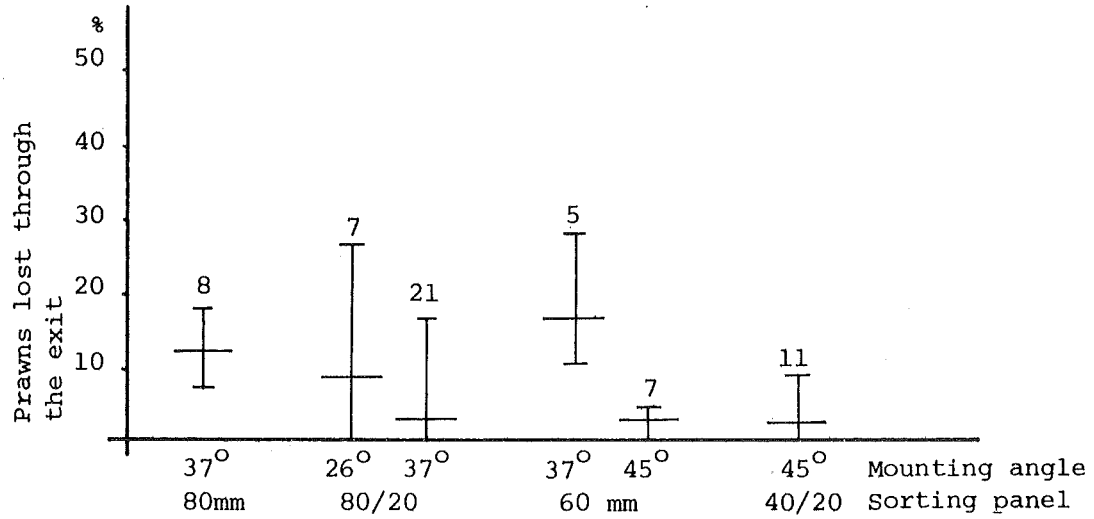


Fig. 3. Prawn loss through the escapement exit at different mounting angles and kinds of sorting panels. The loss is expressed in percentage of the number of prawns hitting the sorting panel during an observation period. The number above each column indicates the number of trials.

No significant difference concerning the amount of prawns lost through the exit was observed between sorting panels with 80 mm square meshes and 80/20 rectangular meshes of comparable opening areas (16 $cm^2$) of the meshes. A similar trend was observed with 60 mm square meshes and 40/20 rectangular meshes with approximate corresponding opening areas of 9 $cm^2$ and 8 $cm^2$.

60 mm square meshes' sorting panel let more prawns leave through the exit than the 80/20 rectangular meshes' panel at 30°, while the loss from the 60 mm meshes' panel at 45° tended to be minimal, less than 10 %. A serious problem concerning the sorting effect was the number of prawns clogging the meshes of the sorting panels. As Fig. 4 indicates, the effect of clogging by prawns tended to

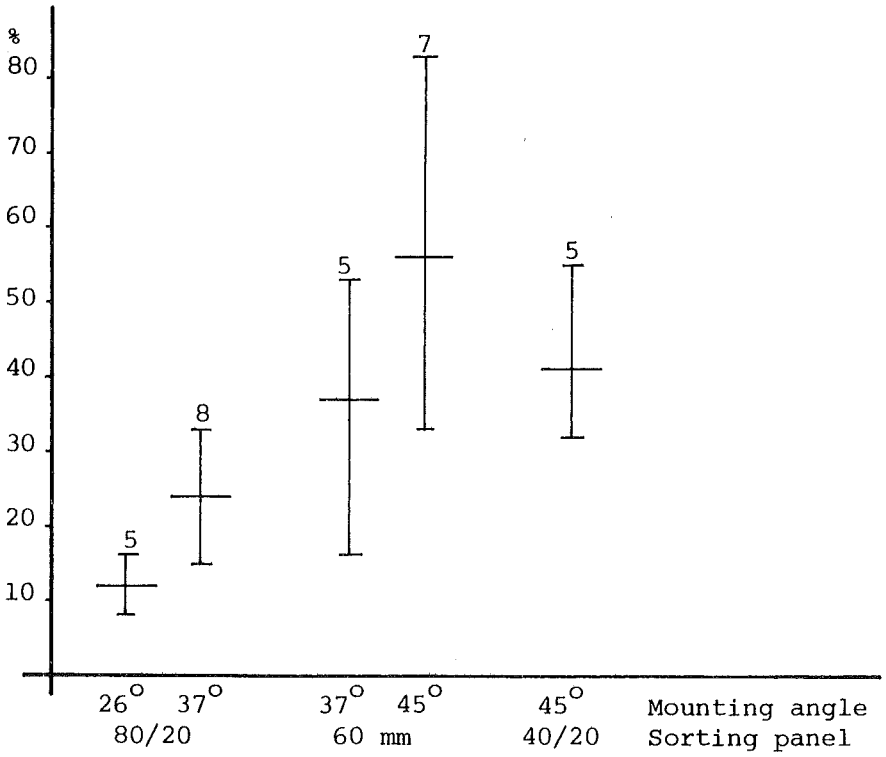


Fig. 4. Prawns clogging the meshes of the sorting panels at different mounting angles. The percentage is based on the total number of prawns in physical contact with the sorting panel. The number of trials is indicated above each culumn.

increase with the decreasing opening area of the meshes. The shape of the meshes, square or rectangular, seemed to be of minor importance. Increasing the mounting angle of the sorting panel also tended to retain more prawns on the panel.

Behaviour of I-group cod in the trawl.

During all observations the cod swam near the bottom of the tank. When the first cod in a school swimming downstream into the trawl hit the sorting panel or turned away from it, the other fishes also responded by turning and kept pace with the sorting panel in the towing direction. Very few cod escaped out of the trawl mouth after being caught. When cod swimming in the trawl became tired, they reduced their swimming speed until touching the sorting panel. This usually resulted in a sudden burst of swimming speed for some distance to keep pace with the sorting panel wich gradually came nearer. Concurrently they usually increased their off bottom distance until they escaped through the exit. On one occasion 19 out of 20 cod used this behaviour to escape at a towing speed of 0.5 m/sec (1.0 knots). At towing speeds more than approximately 0.8 m/sec (1.6 knots) the cod entering the trawl downstream were usually unable to escape after hitting the sorting panel and many cod resigned after a short struggle.

When lying across the panel some cod were observed to recover strength in an effort to escape. Others slid up along the panel to escape passively through the exit.

Occasionally some cod tried to swim through the meshes because they were incapable of seeing the escapement exit above the sorting panel.

Fig. 5 and 6 indicate the response of I-gr. cod in realtion to the sorting panel in the trawl. The percentage of 1. cod escaping through the exit and 2. cod passing through the meshes of the sorting panels, refer to the total number of cod having entered the trawl mouth during an observation period. The first two columns indicate the results from single turns with the trawl

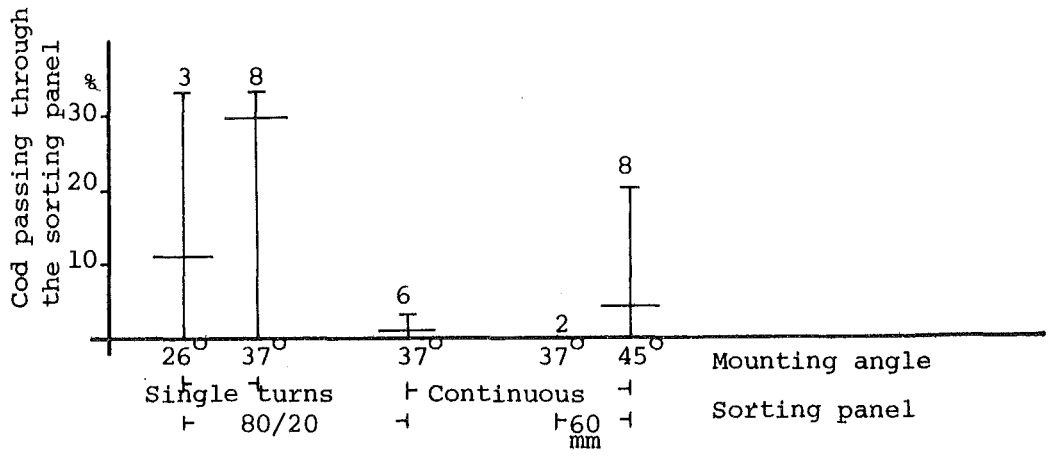


Fig. 5. Cod passing through the meshes of the sorting panels at different mounting angles. The percentage is based on the total number of cod having entered the trawl mouth. "Single turns" and "Continuous" refer to the length of the observation period, 1 minute and 10-20 minutes respectively.

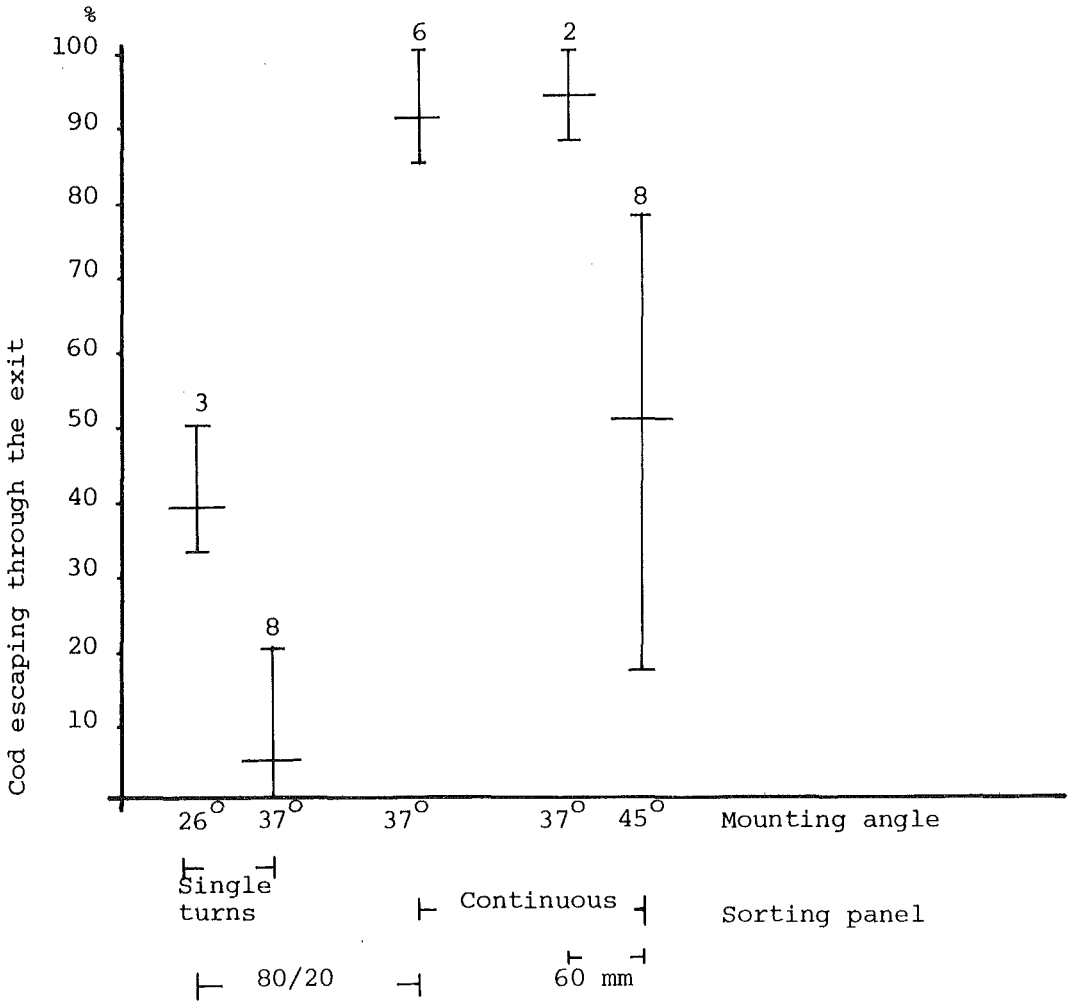


Fig. 6. Cod escaping through the escapement exit, expressed in percentage of the total number of cod having entered the trawl mouth. The number of trials is indicated above each column.

around the tank at a towing speed of approximately 0.5 m/sec (1.0 knot). The remaining columns indicate the results from trawling during longer time intervals (10-20 min).

Fig. 6 indicates that at a certain mesh-size more cod escaped through the exit when the mounting angle of the sorting panel was reduced.

No significant difference in number of cod escaping through the exit was observed between sorting panels mounted at $37^{o}$ with 80/20 rectangular and 60 mm square meshes respectively ($p > 0.05$). At the interruption of the experiment many cod were swimming in the towing direction in the trawl. Due to the relatively few trials undertaken the results must be interpreted with caution.

## Discussion

A serious problem concerning the efficiency of the sorting panel was the relatively great number of prawns clogging the meshes of the sorting panel with the kinds of nets used in the experiments. The clogging leads to a reduction in the effective sorting area for prawns.

Relatively good sorting results for both prawns and cod were obtained with 80/20 rectangular meshes in the sorting panel. Both with 60 mm square meshes and 40/20 rectangular meshes in the sorting panel the percentage of prawns clogging the meshes was relatively high.

The vertical distribution of prawns in relation to depth is beyond the scope of this investigation in which the majority of prawns were distributed on the bottom. However,the vertical distribution of prawns is assumed to show great variations, as Beardsley (1973) observed for Pandalus jordani.Noise at the low levels that we had in the tank did not seem to disturb or frighten the prawns, though this factor was not investigated in detail. Light is another factor not especially investigated. However, on two occasions, similar behaviour of the prawns was shown in darkness as in the preceeding artificial light experiments. How cod behaves in relation to the sorting panel at light levels below

the threshold of their own light perception when senses other than visual are used, is essential to know.

Parrish, B.B., Blaxter, J.H.S. and Dickson,W. (1964) observed that below a certain light threshold value, panels of netting ceased to be effective barriers for herring. They also observed that in darkness cod were less active and less orientated than in daylight relative to the groundrope.
Colour, stiffness and thickness of the thread in the meshes in the sorting panel may also affect the behaviour of the cod though they were not investigated in detail.

The extent to which the cod have learned to escape when being exposed to the sorting panel several times is unknown, but undobtedly important.

Presence of predator and prey animals in the same trawl may excite the fishes to show erroneous behaviour. On one occasion when a 40 cm haddock entered the trawl, the small cod swam as far away from the haddock at the trawl allowed, instead of their usual pace keeping with the sorting panel.

Summary

The behaviour of prawns (Pandalus borealis) and I-group cod (Gadus morhua) in relation to a moving model trawl inserted with a sorting panel, was studied in a circular tank at the Institute of Marine Research in Bergen.

The prawns made no response to the trawl unless they were tactile stimulated by some part of it. They then responded to the stimulus initiator by avoiding it in a few bachward jumps in an apparently random direction. The prawns never made any specific escape reactions.

The behaviour of cod (13-24 cm) in relation to the sorting panel within the trawl, was not uniform. It seemed to depend in a great degree on the towing speed. At lower towing speeds ($\leq$ 0.5 m/sec) the cod were able to make active escape reactions, while at higher towing speeds ($\geq$ 0.8 m/sec) many cod fell back to the sorting panel, being unable to escape from it.

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