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# A THREE LEVEL PELAGIC TRAWL FOR NEAR SURFACE SAMPLING OF JUVENILE FISH

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## ABSTRACT

In the northeast Atlantic Ocean catch rates of juvenile fish from pelagic trawls are used to calculate indices of relative abundance which are applied as a first indication of year class strength. A major constraint for a reliable time series of these indices may arise from a varying vertical fish distribution, particularly near the surface due to sampling gear behaviour.

In this paper a new three level trawl, which samples three separate depths simultaneously, is described in detail and catches are compared with catches from a standard juvenile survey trawl. The new trawl was highly more efficient in catching small juveniles in the near surface layers than the standard trawl. We concluded that changes in densities in this layer could significantly affect the reliability of the catch data from the standard trawl.

## INTRODUCTION

In the northeast Arctic, estimation of recruitment of demersal fish has been derived from standardized pelagic trawl surveys run during different phases of the pelagic stage (ANON 1992). Time series of abundance indices for northeast Arctic cod and haddock have been used to tune recruitment estimates in the assessment (ANON 1993). Godø et al. (1993) suggested that variation in fish size, vertical distribution and migration may strongly affect the efficiency of the standard sampling trawl used in these surveys, and consequently, reduce the reliability of estimated abundance indices of the pelagic stages of larval gadoids.

In this paper we present the design of a trawl for detailed studies of vertical distribution of juvenile fish, and some of the results from the first experiments.

## MATERIAL AND METHODS

Experiments with the standard sampling trawl and a new trawl were carried out onboard R/V "Michael Sars" (47 m LOA - 1500hp) during the period May 19-23 1992 at two locations off the Norwegian coast (Fig. 1).

The standard sampling trawl (ST) is a four panel, 16 fathoms capelin trawl with 200 mm mesh size in front and 20 mm in the 40 m long codend (Godø et al. 1993). A 10 mm liner was inserted as cover in 4 m of the rear part of the codend. Doors and rigging were the same as presented by Godø et al. (1993).

The experimental trawl (ET) consists of three equal trawls (Fig. 2), mounted on the top of each other (Fig. 3) to facilitate sampling of three equal volumes of water at different water depths.The headline of the upper trawl was equipped with 80 kg flotation whereas 40 kg weights were attached along the lower ground rope. In addition 35 kg weights were attached to the lower wingtips of the lowest trawl (Fig. 3). The trawl was rigged with 2 $m^2$ Suberkrub doors connected to the wing tips by 50 m bridles, which were extended with 0.5 m for the very upper and lower pairs (Fig. 3).

The experiments started with 14 experimental hauls towed alternatively with the headline of the upper trawl at surface and at 20 m. The tows were carried out in a limited area and were followed by 4 hauls using the standard trawl, alternatively sampling with the headline at surface and 20 m. The trials where then continued with 8 hauls with ST at surface position in the southern location followed by 11 hauls with the ET, 9 at surface and 2 with upper headline at 20 m. A standard tow with both arrangements consisted of the trawl being towed for 30 minutes at a speed of 2.8-3 knots. Those hauls taken between sunrise and sunset were considered day hauls and all others night hauls. Due to the short duration of darkness at the latitudes of the experiments in end of May, only 4 night hauls (2 at surface and 2 at 20 m) were taken in northern location and 2 night hauls at surface in the southern location.

Trawl geometry was observed with acoustic trawl instrumentation (SCANMAR and Simrad FS3300).

The experiments were carried out under favourable weather conditions.

## RESULTS

### Trawl geometry and performance

Trawl geometry measurements at surface position showed that the ST trawl mouth filters an area of about 300 $m^2$, from 0-30 m depth. When trawling with the headline at 20 m, the area filtered is unchanged but the depth range is reduced to about 20 m (see also Godø et al. 1993).

The individual trawl mouths of the ET, observed with the trawl sonar, had equal geometry, which did not change between depths. The mouths were almost circular with a diameter of 5.5 m (Fig. 3). Trawling depth changed with warp length as illustrated in Fig. 3. Standard depths in the experiments where the alternatives 1 and 3 in Fig. 3, i.e. upper headline at surface and at 20 m.

Vertical distribution

Mean catches from repeated hauls with ET at 0 and 20 m are assumed to reflect density distribution of juveniles at 5.5 m intervals to about 35-40 m, from 0 to 16.5m and 20 to 35 m respectively (Fig. 3 and 4).

Saithe: Saithe was the most abundant species in the trawl catches. In the northern location the highest concentrations appeared to be at 20-25 m (i.e. in the upper trawl of the deepest hauls) during the day (Fig. 4a). Although the lowest numbers were recorded in the surface layer during the day, these experiments demonstrated that 0-group saithe in the area are distributed in considerable quantities right up to surface. This is more obvious from the southern location (Moere) (Fig. 4a). Here the highest concentrations were found at surface during both day and night, and gradually decreased with depth. As in northern experiment, catches in general were lower at night, indicating that fish were dispersed over a wider depth range at night or that efficiency of the trawl was lower at night.

Cod: Catches of cod were much lower than saithe, particularly in the northern location. In the south, day catches indicated reduced densities towards surface, whereas no such trend appeared at night (Fig 4b). Catches in north are too low to draw any conclusion, although the almost complete absence of cod above 11 m at day, underline the same tendency as in south, i.e more fish in surface layers at night.

Standard trawl - experimental trawl comparison
The catches were first adjusted according to volume filtered by the trawl openings, i.e. the trawl catch of ET was arrived at by multiplying the individual trawls of ET by 10 before averaging them (Godø et al. (1993). The results showed that the efficiency of the ET exceeds the ST many times (Fig.5). This is particularly clear for saithe in south (Moere Fig. 5a).

Mean length comparisons
There is a great deal of variation in mean length at the different stations and samples within the same haul of the ET (Fig. 6). No systematic difference in mean length, indicative of a depth dependent size distribution, were found. For the ST hauls it should be mentioned that the substantial drop in mean length of saithe and the simultaneously peak in cod in southern area, co-occurred during the only night period sampled with ST (st.nos. 252-254).

## DISCUSSION

The new three level sampling trawl functioned according to expectation with only minor adjustments during the initial trials. If avoidance is a negligible problem for sampling pelagic juveniles, as indicated by Godø et al. (1993), then the sampling trawl and experimental design used in the presented experiment give resolved fish density and size distribution down to about 20 m. This depth range can of course be expanded by performing repeated hauls at different depths. The function tests indicated no difficulties by running the upper headline down to depths of 50 m.

Godø et al. (1993) showed that the low efficiency of the ST would have the strongest effect on indices of abundance when fish were distributed in the very surface layer, and when diurnal vertical movements occurred. In addition to the function test with the new trawl, we wanted to study such effects on results from the standard post larvae survey conducted in April-May, which covered the locations in the present study just before the start of the experiments (Bakkeplass et al. 1992). The main aim of that survey has been to estimate year class strength of saithe, however, the correlation with recruitment estimates from VPA has been poor (ANON 1993). The experiments with ET demonstrate an area difference in vertical distribution of saithe, i.e. in south the highest densities were found at surface while fish were more evenly distributed in north. No systematic diurnal migration appeared, but the saithe seemed to be more dispersed at night. With the expected lower efficiency of ST at surface due to its bigger mesh sizes and construction, compared to that estimated at deeper water (Godø et al. 1993), the recorded variability in vertical distribution may thus strongly reduce reliability of the estimated indices. Possibly geographic differences rather than diurnal, may represent the more important source of variability. Due to the design of the experiment, i.e. the ST hauls were performed either after or before the ET hauls, the catch comparison represent a poor basis from which to do accurate comparison of efficiency. The data, however, underline the results from previous experiments that the ST has a very low efficiency (Godø et al. 1993). Since no systematic size differences with depth was observed, then this indicates that the low and variable efficiency of ST will have a less effect on size distribution of the indices. The day-night differences in size indicated for ST in southern area, however, suggest that behavioural factors may affect ST catches. Although the material presented here is not extensive enough to draw firm conclusions on the effect of vertical distribution and migration on abundance indices, the new sampling trawl was found to represent a useful tool for such studies.

## REFERENCES

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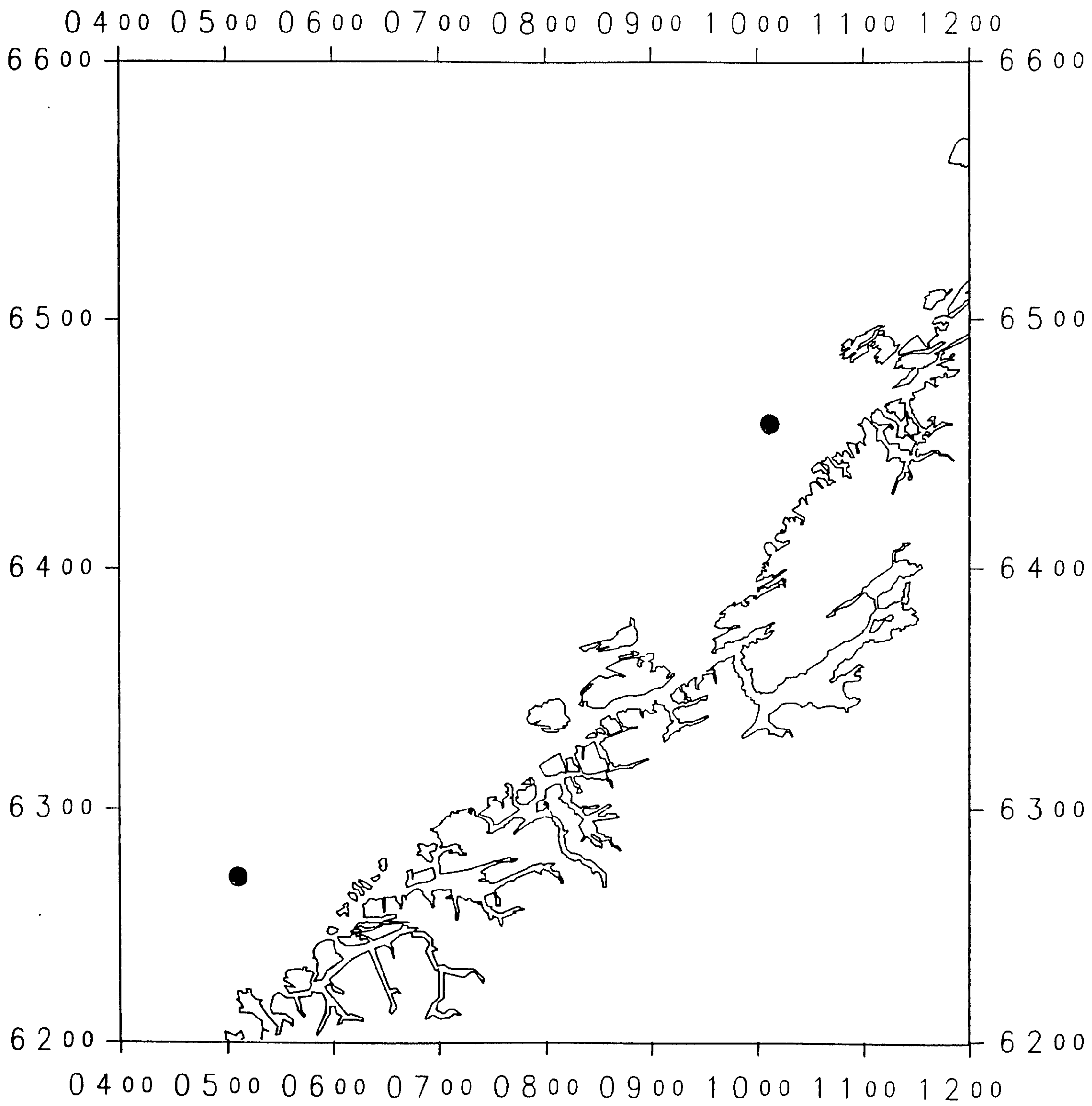



Fig. 1. Northern and southern experimental areas.

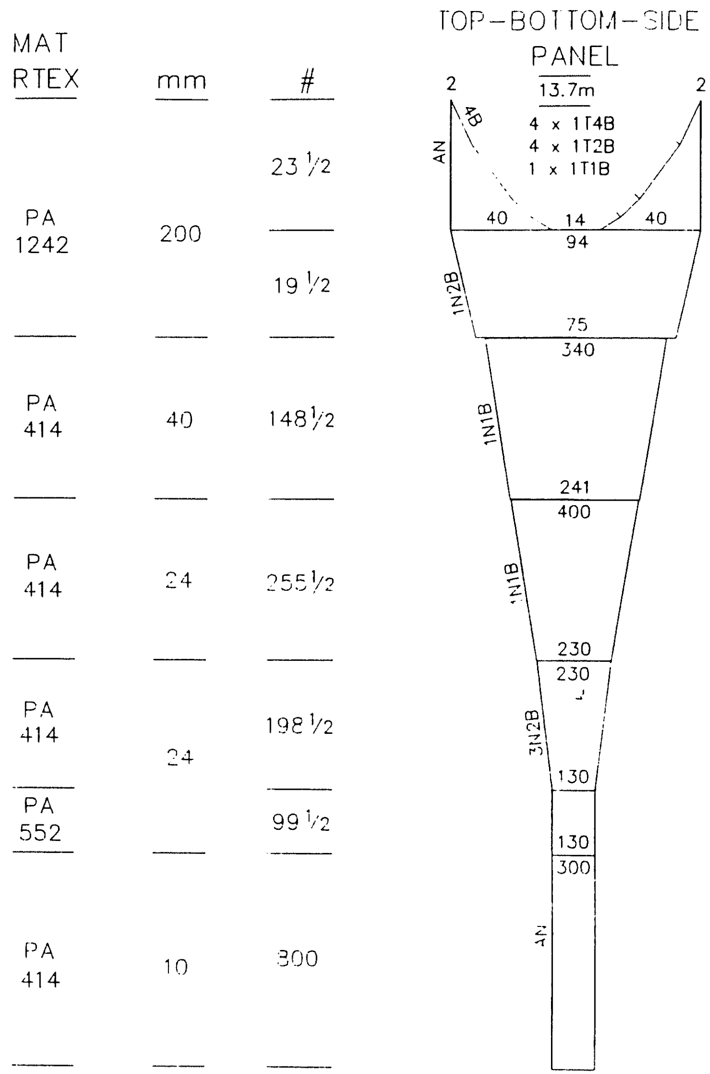



Fig. 2. The experimental trawl.

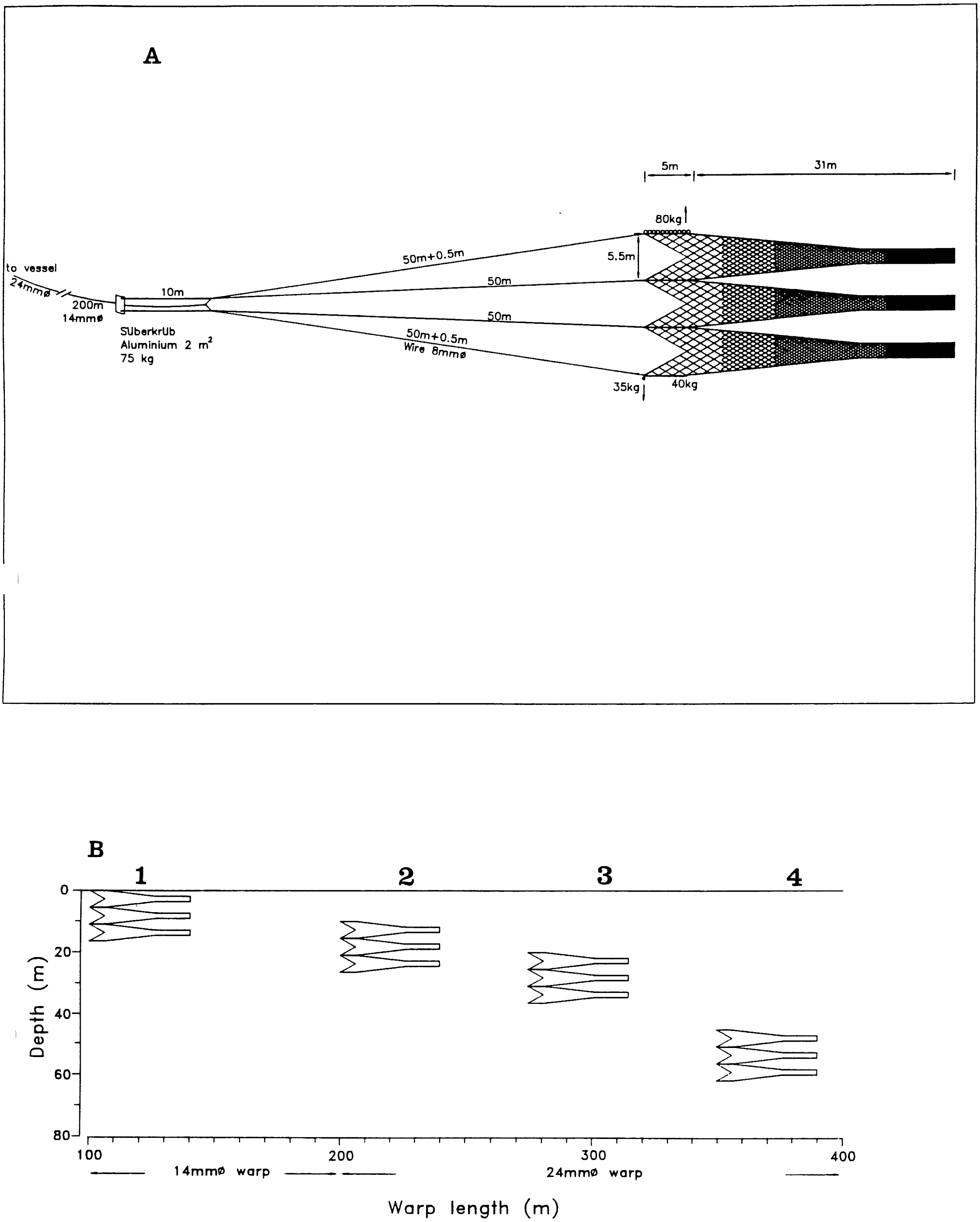



Fig. 3. Rigging of the experimental trawl and and sampling depth versus warp length at 2.8 kn..

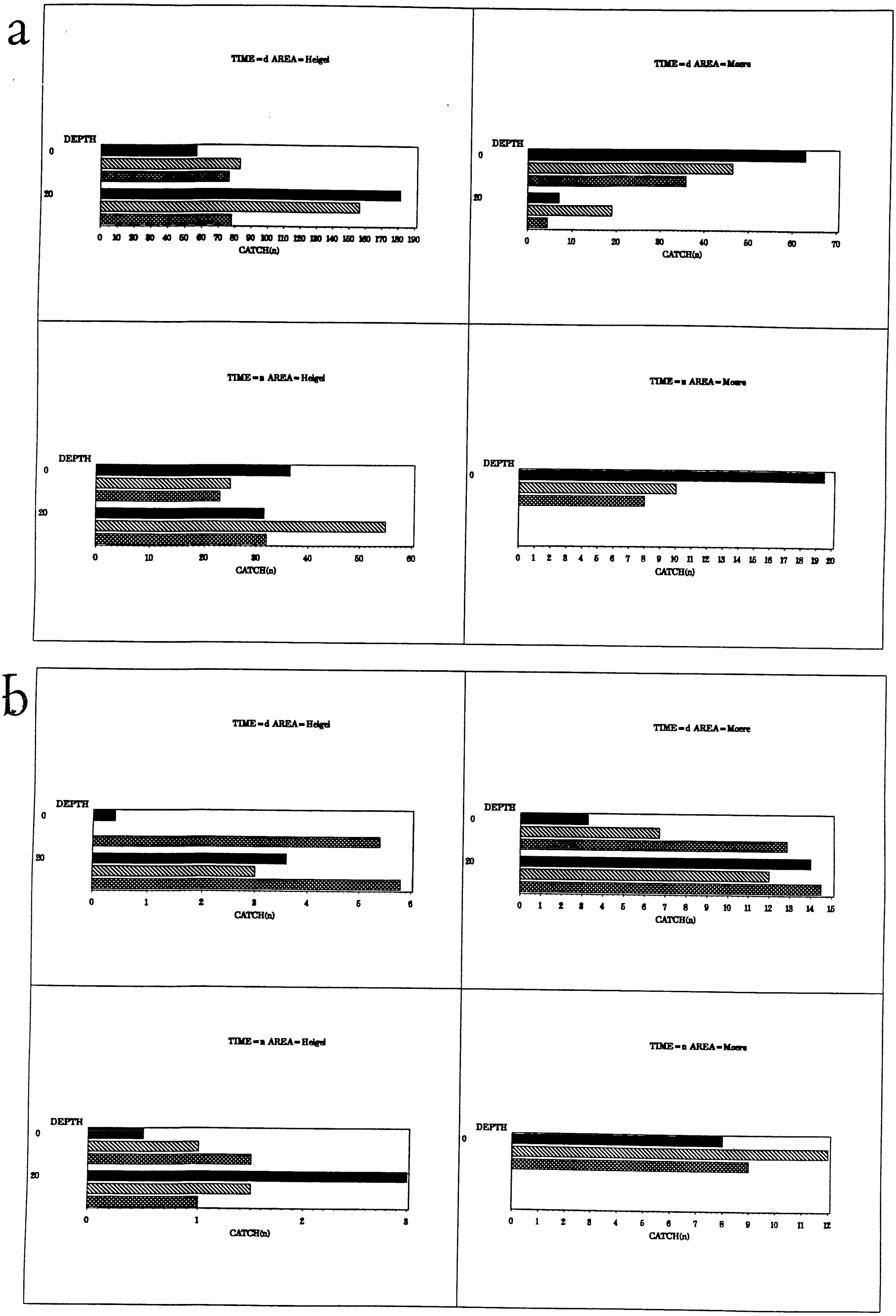



Fig. 4. Vertical distribution of cod in the northern (Helgel.) and southern (Moere) area at day (Time=d) and night (Time=n), a) Saithe and b) Cod.

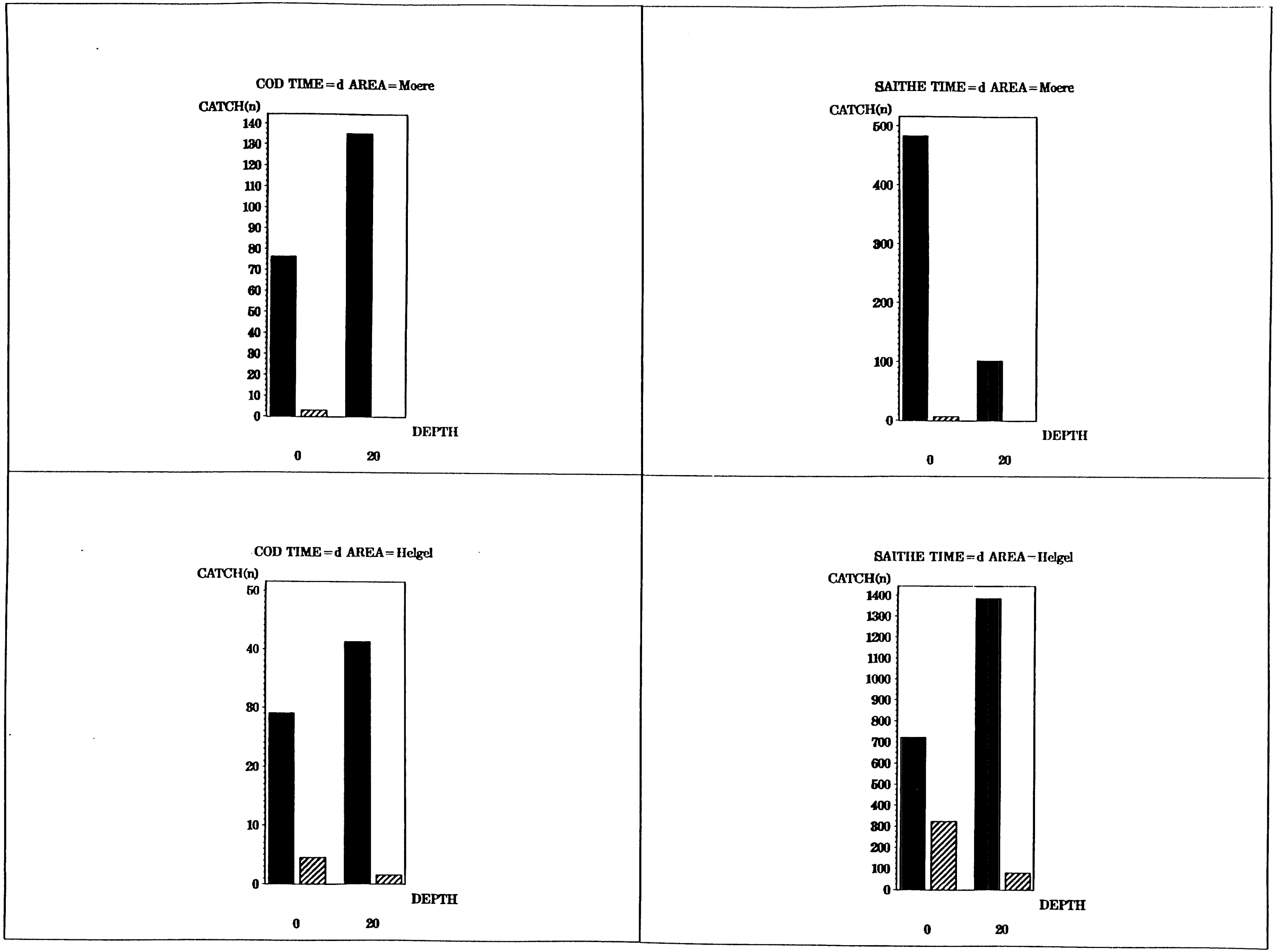
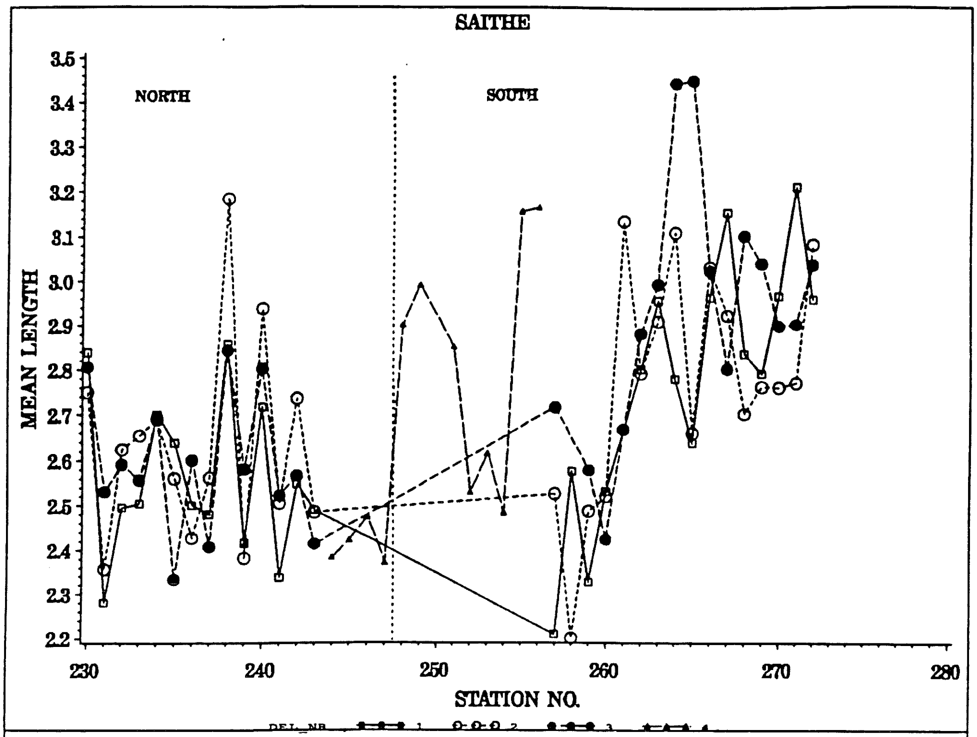



Fig. 5. Comparison of ST and ET catches of cod and saithe after standardization to volume filtered by the trawl openings.



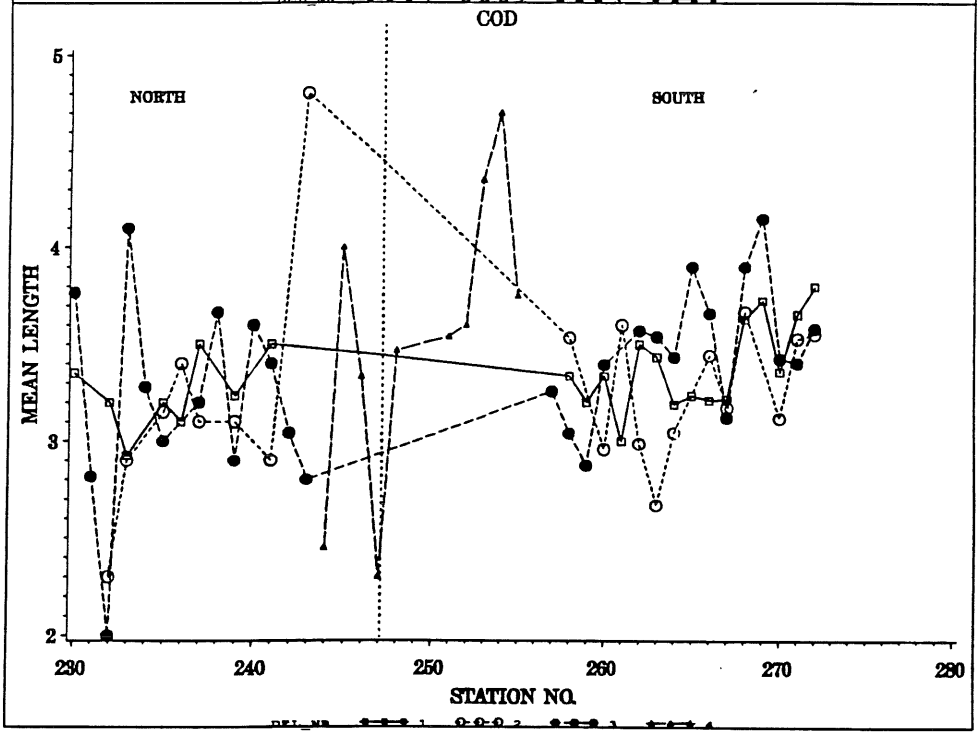




Fig. 6. Comparison of mean length in the individual trawl hauls and samples within the ET hauls (1) upper, 2)middel,3) lower sample) and ST (4).