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The TV-3#930 trawl calibration experiment results obtained by the Polish r.v. "Baltica" (November 2002)

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INTRODUCTION

The issue of the inter-calibration of bottom trawls used by research vessels for Baltic fish catches has been addressed few times during the Study Group on Young Fish Surveys in the Baltic and the Baltic International Fish Survey Working Group meetings. Some of the first international experiments focused on this issue were conducted in December 1983 (Schulz and Grygiel 1984, 1987) and in March 1986 (Anon. 1987) under the co-ordination of the above mentioned ICES Study Group.

In light of the need to standardise the fishing gears used in research catches of Baltic fish, the international EU Study Project No. 98/099: ISDBITS was launched in January 1999 (Nielsen et al. 2001a). In November 1999 the new standard TV-3 bottom trawl was introduced and from spring 2000 is an applied in BITS survey (ICES 1998, Nielsen 2001, Nielsen et al. 2001b). One of the tasks of the above mentioned project was to inter-calibrate the trawls, which had been used previously by various research vessels with the new TV-3 trawl. The aim of these works was to evaluate the data conversion coefficient (Oeberst et al. 2000, Nielsen 2001, Oeberst and Grygiel 2002, Nielsen et al. 2001b, Gasyukov 2002).

This report presents the results of Polish research catches conducted in November 2002 aboard the r.v. Baltica which were part of the international calibration experiment (type 3) for the TV-3 bottom trawl. The aim of these investigations was to evaluate the impact of disturbances, mainly acoustic type, caused by the working trawl and the vessel on the fish aggregations in the given area. CPUE was used as the measure of fish concentration. This research was initiated and co-ordinated by the Baltic International Fish Survey Working Group (Anon. 2002).

MATERIALS AND METHODS

The basic biological and fishery studies were conducted aboard the r.v. Baltica in the period 5-9 November 2002, within the Polish EEZ (the southern part of ICES Sub-divisions 25 and 26; Fig. 1). Of the total of 25 control hauls conducted, 20 were aimed at calibrating the TV-3#930 bottom trawl with 10 mm bar length in the codend. Ten calibration hauls were made in each of the investigated basins - Gdansk and Bornholm. The type 3 of calibration experiment was comprised of two consecutive hauls made with the same trawl at the shortest possible time interval. Each haul started from the same location, followed the same route (ship's course) at a constant depth and lasted for 30 minutes. The term prime haul, which is used in the reminder of the text, refers to the first fish catch made in a particular location.

The fish were caught during the day at vessel working speeds of 3.1-3.4 knots. The depth range for all hauls was 17-65 m and the average was 32.5 m. The results of investigations were separated according to the catch depth criterion - of shallow (20-40 m) and medium-deep (50-65 m) waters. All catches were representative and were conducted properly from a technical point of view; during one haul the front, bottom part of the trawl was damaged while it was being hauled in. A CPUE of 0.0 kg/h was not reported in any of hauls. Each catch was sorted by species and weighed and the CPUE per one hour of trawling were calculated for the various fish species.

The following materials related to the experiment on trawl calibration were collected and analysed:

- detailed biological and exploitation data for 10 prime and 10 repeated hauls, including the CPUE for various fish species and their percentage in total catch;

- total length measurements in 1-cm classes for 2,273 cod specimens, i.e. all the specimens caught in 18 calibration hauls;
- length and mass measurements in 0.5-cm classes for 3,082 herring specimens from 18 random samples;
- length and mass measurements in 0.5-cm classes for 2,841 sprat from 14 samples;
- length measurements in 1-cm classes for 2,701 flounder specimens from 20 samples;
- the share (by numbers) of young cod, herring, sprat and flounder under the protection length limit, i.e. 35, 16, 10 and 25 cm total length, respectively in each of the samples representing a particular haul (Grygiel et al. 2002).

RESULTS

CPUE of cod, herring, sprat and flounder in the prime hauls and repeated hauls

The weather conditions during the survey and the lack of significant seawater temperature gradients up to 80-90 m isobaths not determined conducting the planned control catches or the depth range of vertical fish migrations. The mean seawater temperature, salinity and oxygen contents at the catch sites were 8.65ºC, 7.48 PSU and 7.03 ml/l, respectively. The values of these hydrological parameters were stable and relatively high throughout the study area.

A total of 23 fish species were recorded in the control hauls with flounder being the most common and occurring in 100% of the hauls, followed by cod in 96%, herring in 92% and sprat in 76%. These species dominated in terms of CPUE in all the investigated areas.

The mean CPUE was higher in prime hauls than in repeated hauls by 31.3% for all fish species, 37.3% - cod, 46.4% - herring and 17.5% - flounder. The maximum differences in CPUE (in kg/h) of the individually compared pairs of hauls conducted for the first time in the same place and then repeated were as follows:

- all species – 629.2;
- cod – 152.2;
- herring – 739.7;
- flounder – 206.7 (Figures 2 and 3).

Exceptionally, the CPUE of sprat was higher (on average by 28.8 kg/h = 29.1%) in repeated hauls versus prime hauls in the 20-40 m water layer. The average percentage of sprat was also 10.5% (by weight) higher in repeated hauls (mean = 24.6%) than in prime hauls (Fig. 3). The difference in CPUE of sprat in the prime and repeated hauls might be caused by their reaction to the mechanical and acoustic stress (disturbance) which occurs in the vicinity of the working vessel and trawl and differs from that of the other species. Sprat, pelagic and shoal types of fish are more mobile than cod, flounder and adult herring. Additionally, it is a natural defence mechanism for these small fish to reassemble immediately after the disturbance ceases.

The next stage of the study was to statistically analyse the CPUEs for cod, herring, sprat, flounder and altogether species obtained in both prime and repeated calibration hauls (Fig. 2). The results of the applied regression analysis (linear model) of the CPUE in repeated hauls versus the CPUE in prime hauls show statistically significant dependence between the variables ($r = 0.957$, $\alpha = 1.90E\text{-}27$, F-ratio = 522.4; Fig. 2.D). Used statistical model in 91.6% explains the variation of the dependent variable. The CPUE in both the prime and repeated hauls exhibited similar increasing tendencies; however, in terms of absolute values, the prime hauls were almost always higher.

Length distribution of cod, herring, sprat and flounder in the TV-3 trawl calibration experiment

The length distribution of cod, herring, sprat and flounder specimens in prime and repeated hauls during the TV-3 trawl calibration experiment for the entire investigation area are presented in Figure 4. The length range of the fish in the studied samples was as follows:

- cod − 4.0-68.0 cm (plus one specimen 102.0 cm in length);
- herring − 8.0-31.5 cm (plus one specimen 34.0 cm in length);
- sprat − 6.5-16.0 cm;
- flounder − 12.0-44.0 cm.

The length distributions for cod, herring and flounder were similar in both the prime and repeated hauls. A slight shift of the frequency peaks towards higher length classes was observed in the repeated hauls (Fig. 4). The length distribution between the prime and repeated hauls differed slightly only with sprat. The distribution curve in the latter haul type was flatter, and the frequency peaks in the group of fish above 10 cm were divergent.

Two dominant groups of fish, which were nearly equal in terms of frequency, were clearly distinguishable in the length distribution of cod – classes 20-26 cm and 32-40 cm (Fig. 4). Young herring specimens from the 11-13 cm length classes clearly dominated the samples, while the percentage of those from the 17-19 cm classes were of secondary importance. In the sprat samples young specimens from the 8.0-9.5 cm classes dominated and longer, older fish from the 11.0-14.0 cm classes were of secondary importance. So-called 'undersized' flounder specimens from the 16-24 cm length classes clearly dominated.

The mean length, the mean weight and the percentage (by numbers) of undersized fish in the samples from the prime and repeated hauls were almost similar (see the following table):

		mean		percentage of under-sized specimens
		weight [g]	length [cm]	
cod	prime hauls	486.30	33.76	72.1
	repeated hauls	415.33	33.30	67.4
herring	prime hauls	29.95	15.86	55.7
	repeated hauls	35.99	16.78	50.2
sprat	prime hauls	8.03	10.55	56.5
	repeated hauls	7.49	10.31	54.5
flounder	prime hauls	200.22	24.91	86.1
	repeated hauls	201.38	25.02	89.8

CONCLUSIONS:

A) The mean CPUE of fishes, caught in November 2002 in the Polish EEZ, was higher in the prime hauls than in repeated hauls (made in the same location) with the exception of sprat - to, which were lower:
- 31.3% for all fish species,
- 37.3% for cod,
- 46.4% for herring,
- 17.5% for flounder,
- 29.1% for sprat (in the 20-40 m water layer); the mean share of sprat in repeated catches was 10.5% higher than in prime hauls.

B) The results of the regression analysis (linear model) of the CPUE in repeated calibration fish catches versus the CPUE obtained for the prime catches show a statistically significant dependence between the variables (r = 0.957, probability level = 1.90E-27, R^2 = 91,6%, y = 37.226 + 1.211x).

C) The length distribution of cod, herring, flounder and, to some extent, sprat were almost similar in both prime and repeated hauls. A slight shift in frequency peaks towards longer length classes was observed in repeated hauls.

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Figure 1. The geographical distribution of bottom control hauls conducted by r.v. "Baltica" during the BITS survey (5-9 November 2002) in the Polish EEZ

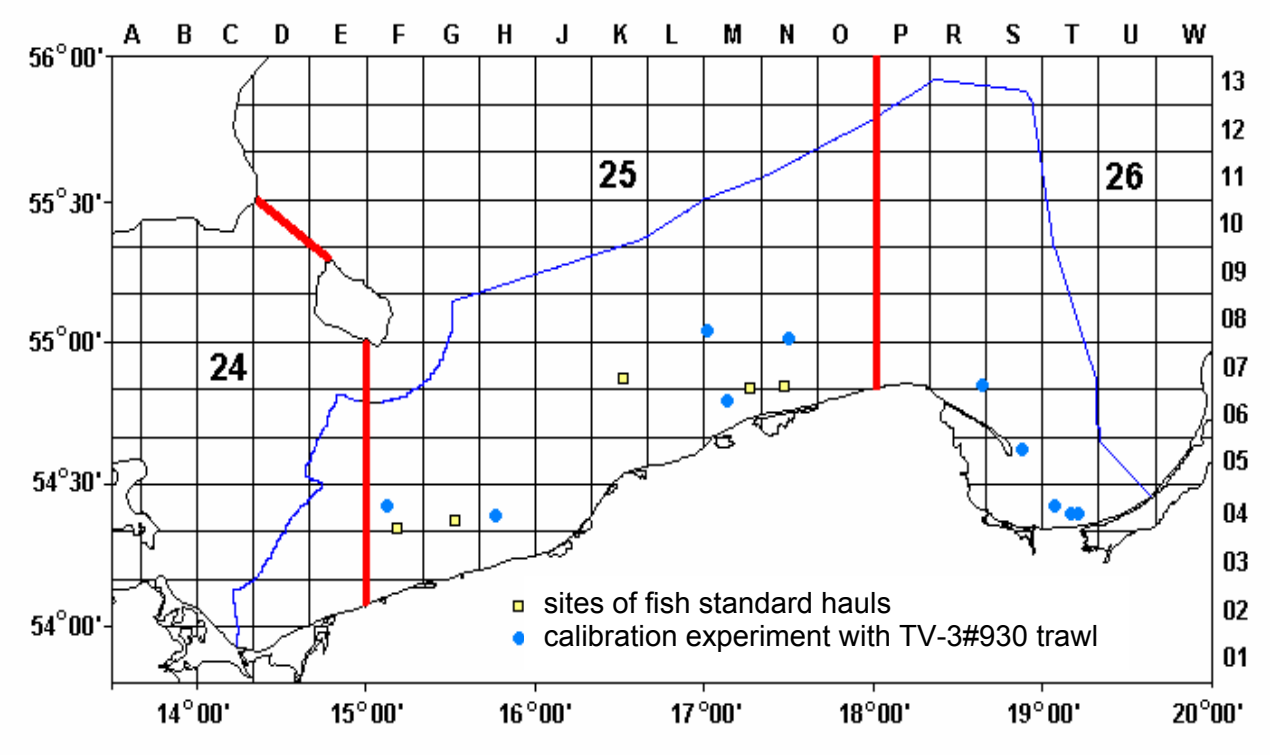
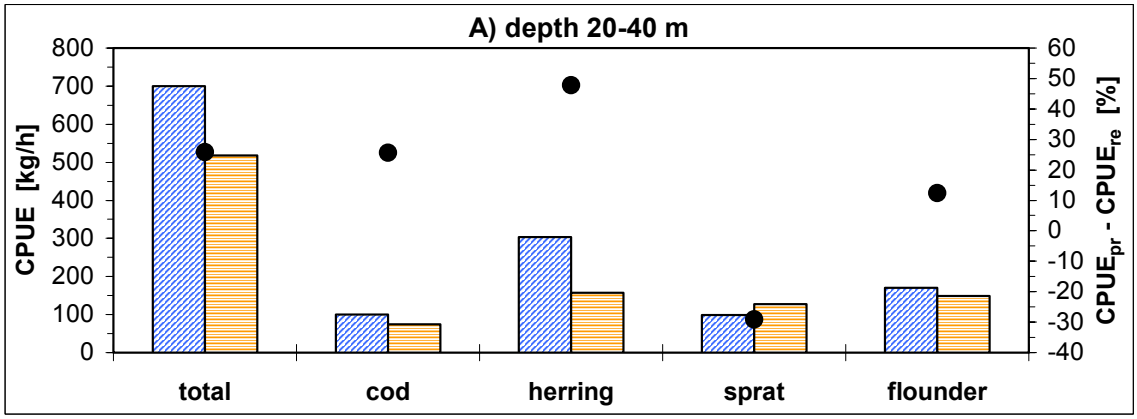
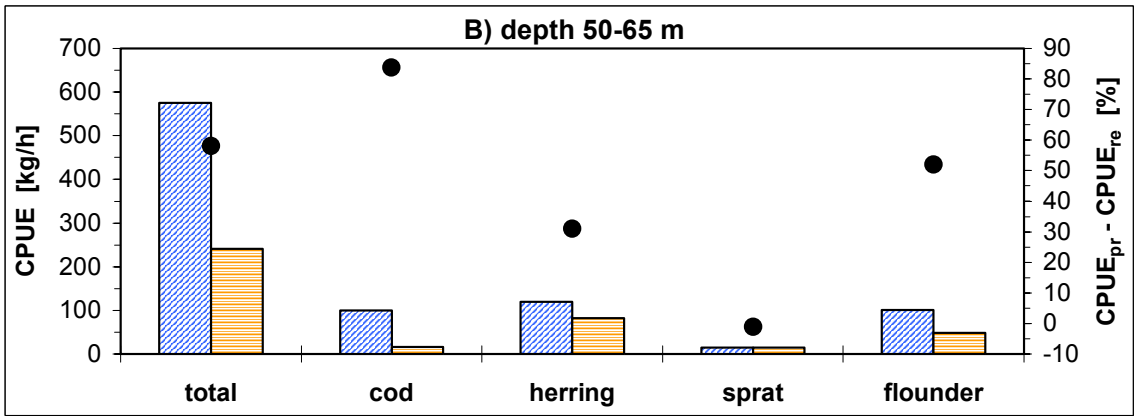
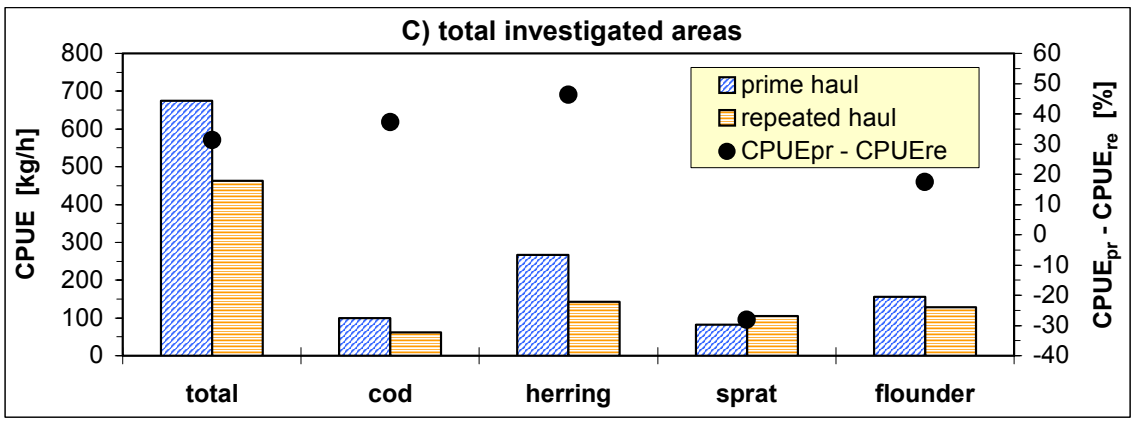


Figure 2. The mean CPUEs of fishes in the prime and repeated hauls and difference between the CPUE in two type of hauls in the TV-3#930 bottom trawl calibration experiment conducted in the Polish EEZ (05-09 Nov. 2002; parts A, B, C) and the regression analysis of the CPUE in repeated hauls vs. the CPUE in prime hauls (part D); total - all fish species including the by-catch







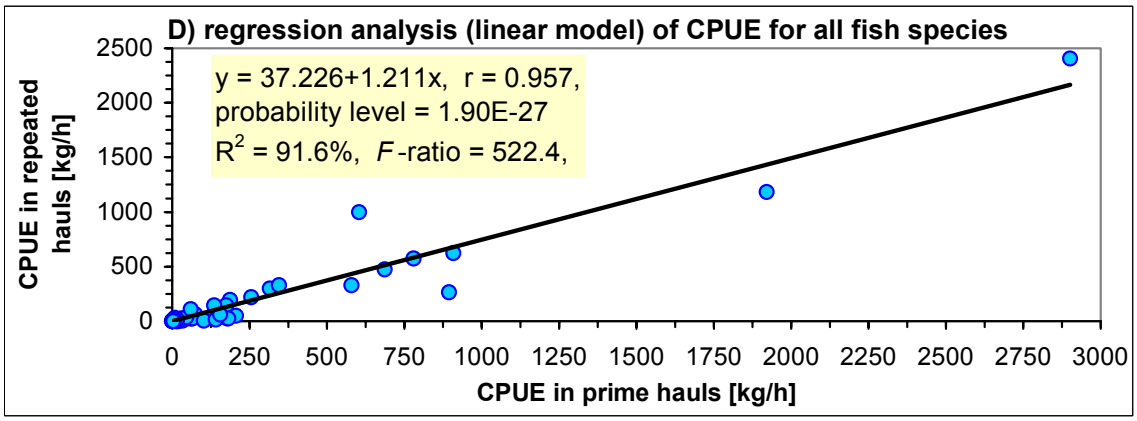


Figure 3. The share (in %) of particular fish species in the prime and repeated hauls conducted during the TV-3 bottom trawl calibration experiment on r.v. "Baltica" (05-09 Nov. 2002) in the Polish EEZ at different depth strata

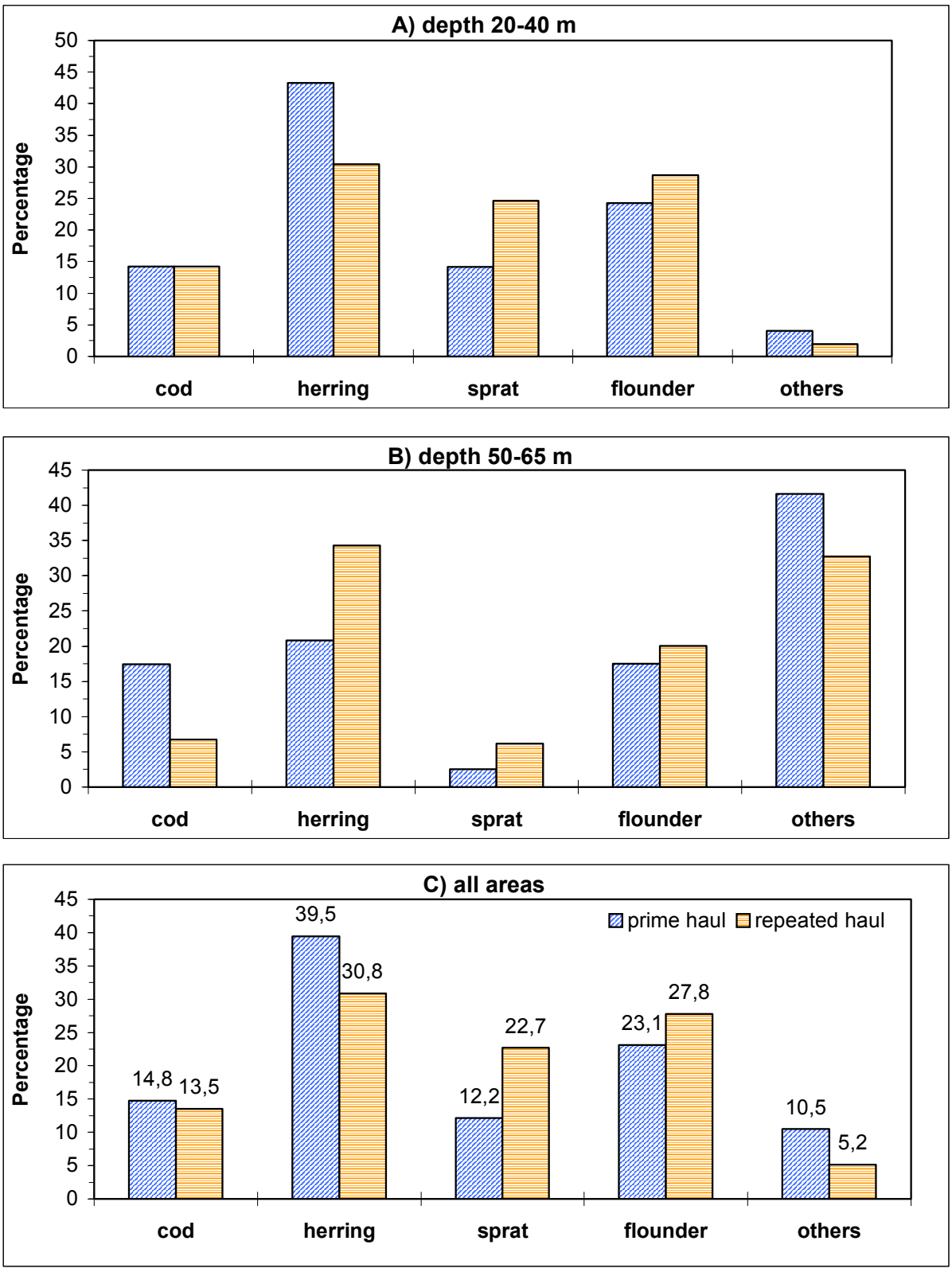


Figure 4. Length distribution of cod, herring, sprat and flounder in the prime and repeated hauls, conducted during the TV-3 bottom trawl calibration experiment on r.v. "Baltica" in November 2002 (all investigated areas)