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A method to reduce survey bottom trawl variability

by

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ABSTRACT

A technique for limiting the variability of trawl doorspread is described. In addition, modifications of trawling technique which enable the doors to stay upright and maintain constant ground contact under different trawling conditions are presented. Observations were conducted using a standard Campelen 1800 otter trawl in 270 m of water. Doorspread was restricted by means of a restraining rope mounted between the warps, 150 m in front of the doors. When the restraining rope was in place, doorspread varied little and was not influenced by warp length; the doorspread was approximately 51 m for warp lengths of 600 to 800 m. With the restraining rope removed, doorspread increased from 54 to 63 m as warp length was increased over the same range. It was also demonstrated that doors would stay upright and maintain the same ground contact under varying conditions, if warp length was adjusted correctly according to depth. This was based on a requirement that warp tension and elevation angle be adjusted so that 2/3 of the door weight in water is counteracted by the upward pull of the warp at the end nearest the door.

INTRODUCTION

During the Barents Sea and Svalbard bottom trawl survey fishing is conducted at water depths of 50 to 600 m. One main problem regarding trawl geometry and performance during the surveys is that the equipment and procedures used give reduced door spread in shallow water and overextended door spread in deep water. Also, since it has been common practice to use a warp-to-depth ratio of approx. 3:1 regardless of the depth, it is believed that bottom contact of the trawl has varied with water depth. Differences in trawl geometry and performance from one haul to another may have had severe influence on catching efficiency for different species and length groups.

This report describes a preliminary test of a method which makes it possible to limit the variability of trawl geometry and enable the doors stay upright and maintain the same ground contact under different conditions.

MATERIAL AND METHODS

The experiment was carried out on a cruise with F/F "Johan Hjort" at water depth of 270 m. Our standard bottom sampling trawl, the Campelen 1800, rigged with 40 m sweeps and 6.4 m^2 Vee-doors (1500 kg in water), was used. The towing warps (6+19+1FC, 1.87 kg/m in sea water) had a diameter of 24 mm. The propeller pitch was kept constant, and speed recordings from a GPS (Global Positioning System), a Bergen Nautic log and a Scanmar speed sensor mounted on the headline were noted. Warp tension measured by the trawl winch system was recorded, but it is uncertain if these values are correct since the system has not been calibrated . Measurements of trawl geometry (vertical opening and door spread) were carried out when using different warp lengths with the trawl operated both in the standard survey mode and using the restraining technique described below.

The restraining technique was carried out by using a rope mounted between the warps, 150 m in front of the doors (Figure 1). The length of the rope, 8.9 m, was exactly the distance between the towing blocks. The restaining rope was mounted to the warps with slip hooks

such that the warps could rotate. To prevent the rope from sliding up or down the wire, stoppers (rope) were mounted on each side where the restraining rope was mounted. A Scanmar depth sensor was mounted in the middle of the restraining rope.

RESULTS AND DISCUSSION

The results obtained with the trawl operated as in standard survey mode and with the restraining technique are given in Table 1 and 2. Without a rope between the wires, the door spread increased from 54 to 63 m when warp length was increased from 600 to 800 m. With restraining technique, the door spread was maintained at approximately 51 m and was not affected by warp length. By using doors with enough spreading force in shallow water, combined with the restraining technique, a fairly constant trawl geometry may be kept with varying depths, as the door spread is independent of the length of warp used in front of the restraining rope.

To make the doors stay upright and maintain the same ground contact under varying conditions, warp length must be correctly adjusted according to depth. According to W. Dickson (pers. comm.), the length of the warps should be adjusted so that 2/3 of the trawl door weight in water is counteracted by the upward pull of the warp end nearest the door. This upward pull depends on the warp tension and the elevation angle of the warp at the bottom end. As seen from Table 2, the calculated elevation angle of the warps , i.e. between the door and the warp where the restraining rope was mounted, was 26.1 and 14.3 degrees when using 600 and 800 m of warp, respectively. The corresponding difference in upward pull clearly affected the bottom contact of the doors.

By mounting a Scanmar depth sensor on the restraining rope between the warps, it is possible to measure the distance from bottom, keeping the elevation angle of the warp and, thereby, the ground contact of the doors constant under varying conditions. Also, if the warp tension at the door end is known, it would be possible to determine the angle necessary to develop an upward pull at the door of 2/3 of the weight of the door in water.

In conclusion, if towing speed is kept constant, the variability of trawl geometry and performance with varying water depth can be reduced by using the restraining technique and keeping the elevation angle of the warp constant.

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Table 1.

Water depth (m)	Warp length (m)	Speed (kn)			Warp tension (t)	Pitch	Vertical opening (m)	Door spread (m)	Warp depth (150 m)	Warp elevation angle
		GPS	Bergen N	Trawl speed						
270	600	2.8	2.3	2.7	2.5	30	4.2	54.1	-	-
270	700	2.9	2.3	2.9	2.6	30	3.7	59.5	-	-
270	800	3.0	2.3	2.9	2.6	30	3.4	63.7	-	-

Table 2.

Water depth (m)	Warp length (m)	Speed (kn)			Warp tension (t)	Pitch	Vertical opening (m)	Door spread (m)	Warp depth (150 m)	Warp elevation angle
		GPS	Bergen N	Trawl speed						
270	600	2.7	2.5	2.7	2.5	30	4.2	50.9	204	26.1°
270	650	2.8	2.2	2.7	2.5	30	4.2	51.2	211	23.2°
270	700	2.9	2.3	3.0	2.5	30	4.2	52.6	219	19.9°
270	750	2.7	2.5	2.6	2.5	30	4.2	50.9	227	16.7°
270	800	3.0	2.7	3.1	2.5	30	4.2	51.2	233	14.3°

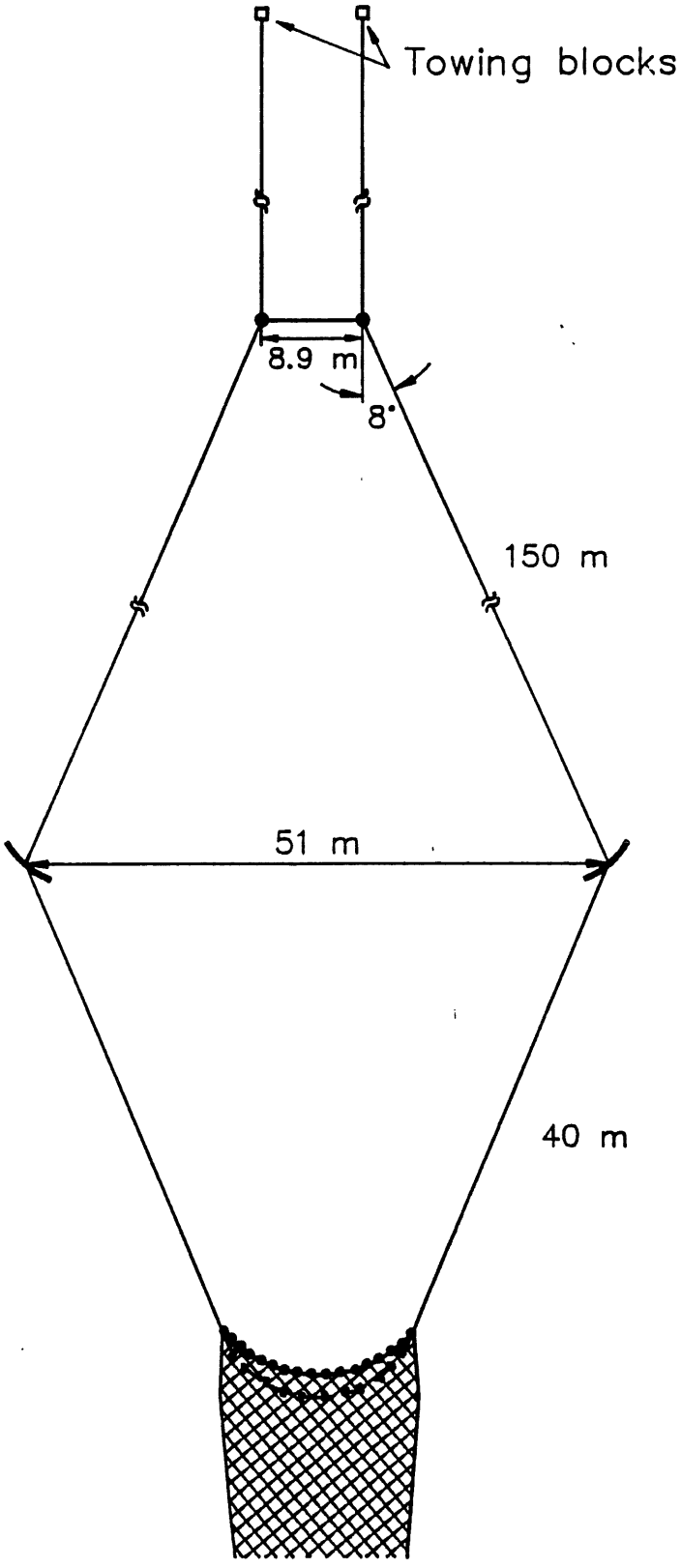

Figure 1. Schematic outline of the restraining technique.