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PRELIMINARY RESULTS FROM TESTS USING A HIGH-FREQUENCY SONAR AS TRAWL-SONDE

by

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ABSTRACT

A high-frequency, short-range sonar is tested for trawl-geometry measurements on pelagic and bottom trawls. The sonar was operated on a standard, coaxial trawl sonde cable, and produced excellent images of the trawl opening and panels. Data showing non-ideal performance of the pelagic sampling-trawl at several depths and speeds, together with corrected geometry are presented. At short range, the position of fish entering the bottom trawl could be measured.

INTRODUCTION

Investigations of fish behaviour and trawl performance is important both in fish assessment methods and commercially. At short distance in clear water, video cameras mounted on remotely operated vehicles are now used to obtain such information (MAIN and SANGSTER, 1981; WARDLE, 1984). With this technique, light is a limiting factor, and maximum trawl depth may be about 80 meters. At night, still photos must be used to obtain comparable information of fish reaction to the trawl. If the position of the fish when passing the opening, or anywhere along the path of the trawl, can be determined, this may help to quantify the reaction pattern of fish during the catching process. Light-weight, high-speed imaging sonars can be a non-light-limited tool in these investigations. Such sonars may also be the missing-link instrumentation for evaluation of at-sea performance of flume-tank-tested trawls. This report presents some results obtained with this type of sonar, the SIMRAD/MESOTECH mod 971 Color imaging sonar.

MATERIAL AND METHODS

The head of the standard SIMRAD/MESOTECH mod 971 imaging sonar, working at 675 kHz, was connected to the 1200 m trawl sonde cable of the Norwegian research vessel - R/V ELDJARN. The sonar processor with periferal units were, via cable interface, Fig. 1, connected at the cable terminals at the bridge. The basic specifications of sonar head and prosessor are shown in Table 1.

Mounting

To avoid mechanical contacts on the rotating sonar transducer, the head was mounted with rubber shock-absorbing material inside a PVC-tube, Fig. 2. This was further connected to the top panel of the trawl, about 10 cm behind the headline, with the sonar head at the front. The 1.7^{o} beam would then through rotation describe a 360^{o} transverse cut of the trawl panels and surrounding water masses. The standard tension-receptors for the trawl-sonde were used for cable protection.

Sonar data acquisition

The transducer head was powered by a 24 VDC source on the same coax bearing the digital instructions to the sonar head, and the analog, pre-amplified and TVG-corrected acoustic signals from the head to the processor unit. Within the surface prosessor the analog signals were A/D converted, stored in memory, and displayed as 128 colour intensity levels on the monitor.

Trawls

The sonar was tested on the standard Capelin trawl, a square 16x16 fathoms pelagic trawl with extended wings and 110 m bridles, and on the CAMPEL 1800 bottom sampling trawl.

The sonar was also tested on the towed ROV "OCEAN ROVER", but cable breakage prevented its use during trawling. Further investigations with the sonar mounted on this vehicle will be made in October 1986.

RESULTS

Even with slight impedance mismatch and high cable resistance (65 Ω), the sonar produced excellent images of the trawl panels. Examples of such, transformed from color video-tape to B/W photos, are shown in Figs. 3-8. Geometry measurements made on the trawls using the cursor-based measurement system, agreed to within 0.1 m with simultanous measurements made with SCANMAR's height and distance sensors. On the pelagic trawl, the standard rigging was shown to be non-optimal, with slack side panels and reduced opening, (Fig. 3). Increasing the length and adding weight on the lower bridles, combined with compensatory lifts on the upper bridles, gave the trawl the specified opening (Fig. 4-5). Non-ideal performance of the trawl at short warp lengths, often used in the fish-larvae sampling programme, were also demonstrated. Mounted on the CAMPEL 1800, bottom sampling trawl, the shape of the opening, gear distance at headline level, and fish entering the trawl could be observed, (Figs. 6-8).

DISCUSSION

The SIMRAD/MESOTECH high frequency sonar produced important information in its first test in fishery environments. Within the TVG-range of the 675 kHz version (30 m), fish entering the trawl were also detected. Improvements of the total sonar concept will be necessary for future commercial applications. These have already been started on the basis of the tests.

The following information may be obtained from the taped data from the sonar mounted on the trawl and on the remotely operated vehicle.

a) 3-dimensional shape of the trawl-gear, from the doors to the cod-end.

b) Sand-cloud shape from the doors and backwards.

c) Two-dimensional fish position density diagrams at different sections along the inside, the trawl-gear, day and night.

All this information is of inestimable value to research on trawls as sampling devices, and for the fishing industry as well.

REFERENCES

ANON, (1984). SIMRAD/MESOTECH model 971 Colour Imaging Sonar; Operators manual: 110 p.

MAIN, J. and SANGSTER, G.I., (1981). A study on the fish capture process in a bottom trawl by direct observations from a towed underwater vehicle. Scott. Fish. Res. Rep., (23): 1-23.

WARDLE, C.S., (1984). Fish behaviour, Trawl Efficiency and Energy Saving Strategies. FIIT Working Paper, FAO, Fishing Technology Service, Rome, Sept. 1984, 42 pp.

Table 1. Basic data on the SIMRAD/MESOTECH colour imaging sonar, mod. 971, sonar prosessor and head.

Model 971-2 Sonar Processor

Display Modes: Sector, Polar, Perspective, Side-scan Linear, (and Test)

Ranges: 0-5, 10, 20, 50, 100 m.

Scanning Arcs: 360° continuous, or 30°, 60°, 120° sector.

Sector Centre: 0°, 30°, 60°, 90°, 120°, 150°, 180°, 210°, 240°, 270°, 300°, 330°.

Scanning Speed: Slow-1 shot per step
Medium-1 shot per 2 steps
Fast-1 shot per 4 steps

Side Scan: Transducer may be locked at any of the above sector centres.

Data Resolution: 512 x 512 x 128 levels (colours).

Timing Resolution: ±16 μs [≡ ±12mm(±0.5 in)].

Video Output: RGB with composite sync. on all channels. Analogue IV p-p into 75 Ω.

Cursor Control: Moveable to any point on display

Readout: Range and Bearing to cursor are displayed on screen.

Zoom: Area centred on the cursor is magnified x4 linear.

Data Input: RS-232-C for user labels date, time (to be written on screen).

Data Output: RS-232-C status & errors

Temperature: Operating −5°C to +40°C.
Storage −20°C to +60°C.

Power Supply: 120/240 V, 60/50 Hz, 2/1 A.

Dimensions: 483 mm (19 in) wide x 178 mm (7 in) high x 432 mm (17 in) deep.

Weight: 14 kg (31 lb).

Model 971-1 Option 3 Sonar Head.

Frequency: 675 kHz.

Beamwidth, Fan: 1.7° horiz., 30° vertical, (typical).

Beamwidth, Cone: 1.7° conical.

Mechanical Resolution: 0.225° (step angle).

Scanning: 360° continuous, or locked, any 30° step.

Power Supply: 22-32 Vdc at 1A max., at connector.

Connector: Glenair GL 30G4P-BC, bulkhead 4 pin.

Cable: 4000 m (13000 ft) maximum length.

Construction: Aluminum alloy 6061-T6, rigid PVC, 300 Series stainless steel, epoxy.

Finish: Hard anodise (MIL-A-8625 Type II) red.

Temperature: Operating −10°C to +40°C.
Storage −50°C to +50°C.

Depth: 1000 m (3300 ft) maximum working.

Dimensions: 89 mm (3.5 in) diameter x 406 mm (16.0 in) long, plus connector.

Option 2: Add 102 mm (4.0 in) to housing.

Weight: In Air 4.1 kg (9.0 lb) Opt. 2: 5.3 kg (11.7 lb)
In Water 1.9 kg (4.2 lb) Opt. 2: 2.6 kg (5.8 lb)

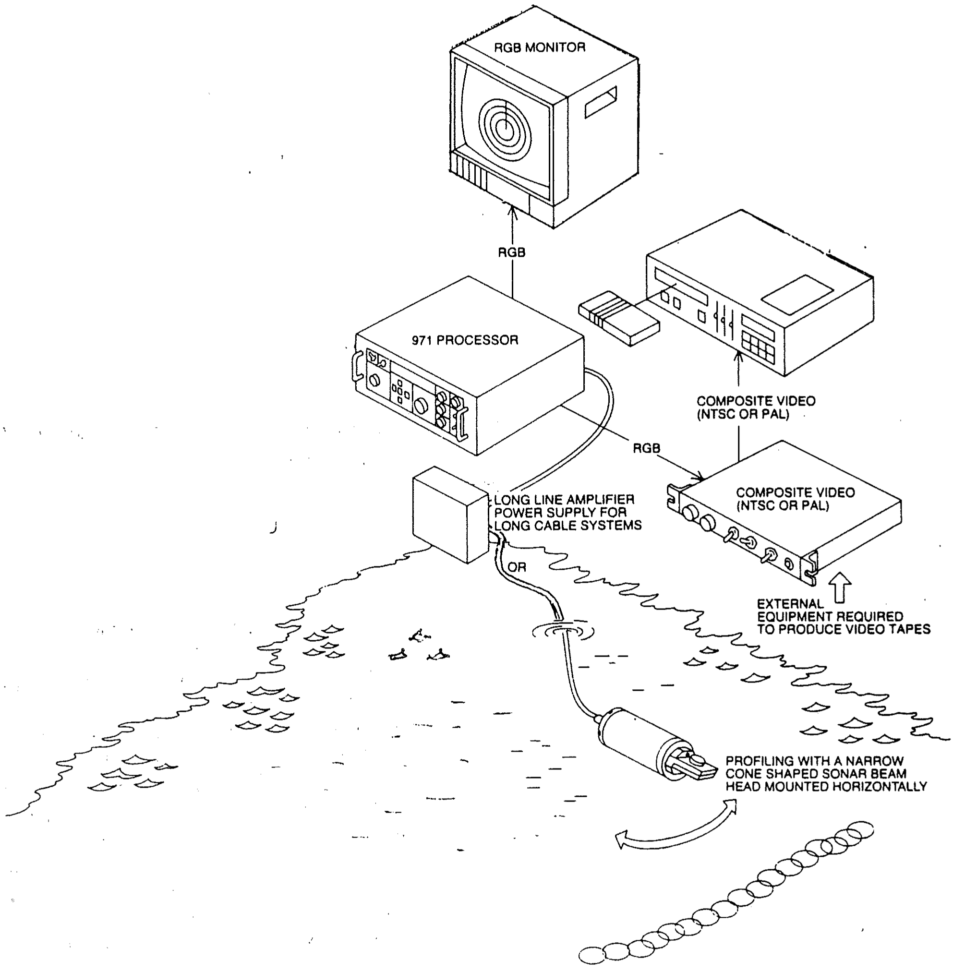

Fig.1. Basic instrumentation used during the tests. Sonde-cable system not shown.

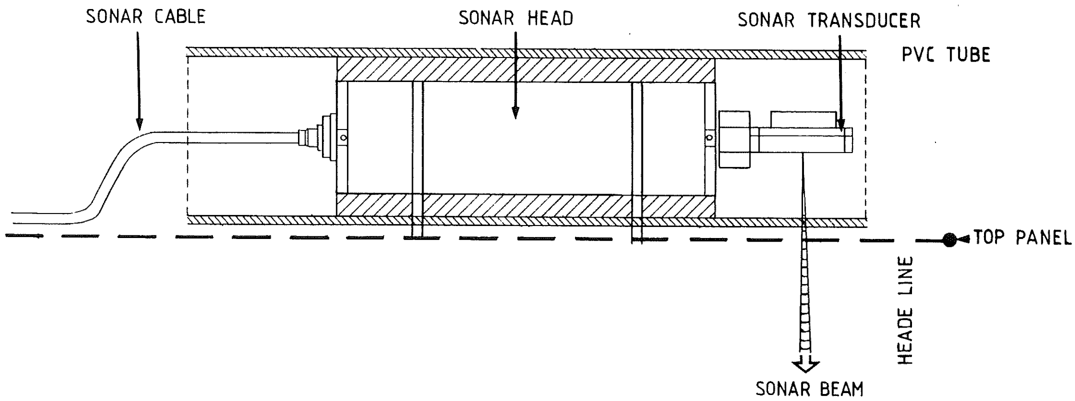

Fig.2. Protecting mounting of the sonar head on the top panel of the trawl.

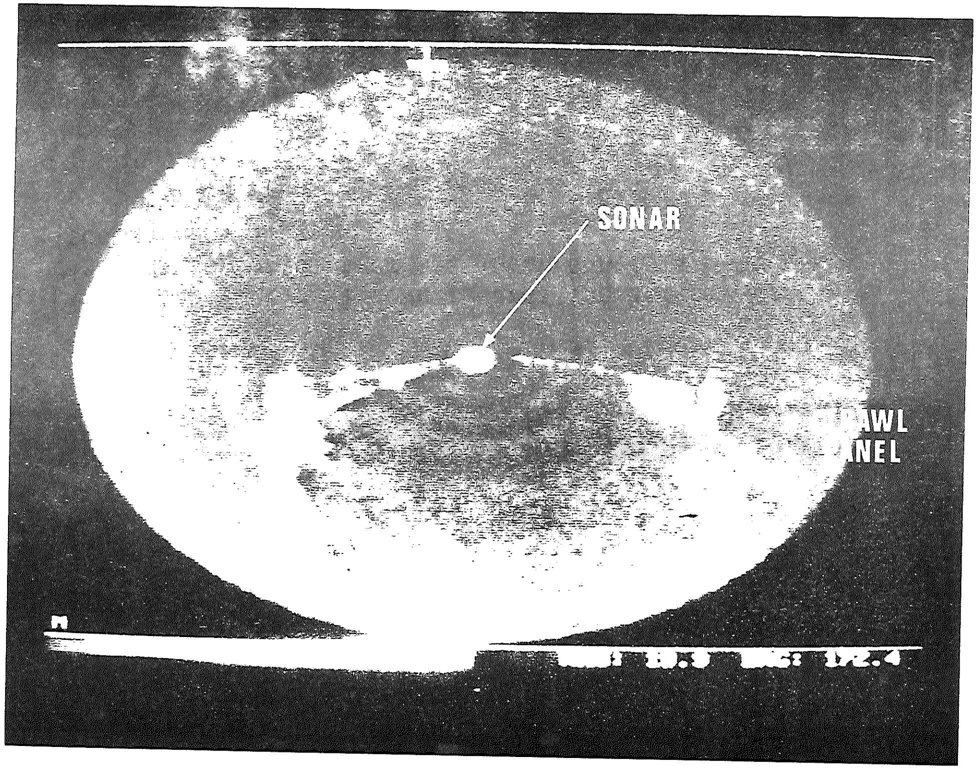

Fig.3. Image of the opening of the standard capelin trawl at 100 meters depth. Note the slack side panels. Distance from sonar to the dark area is 20 meters.

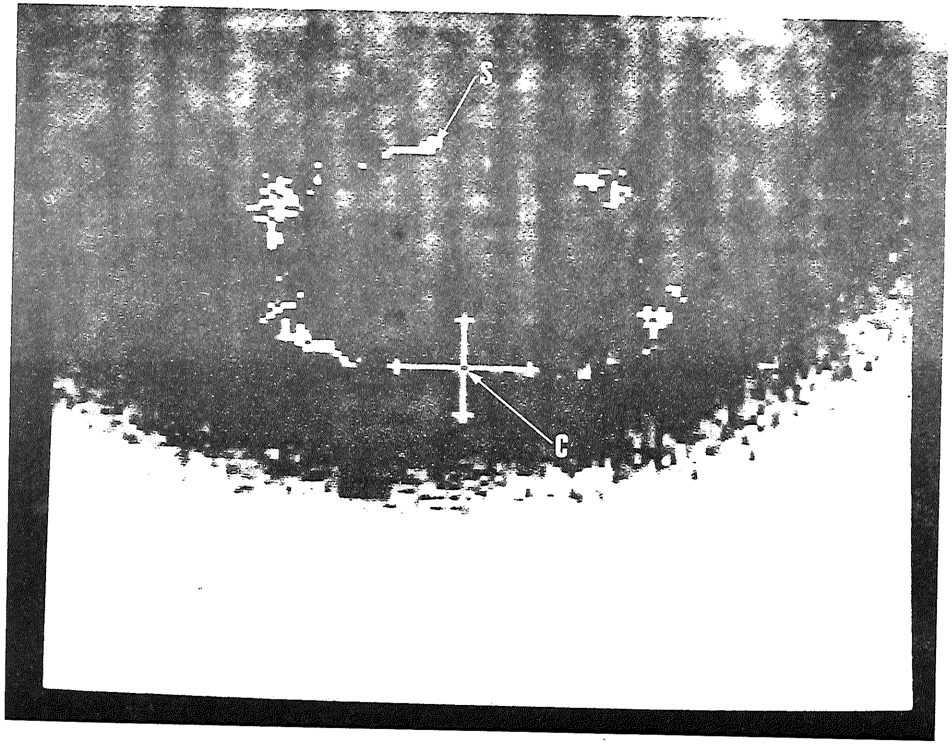

Fig.4. Image of the capelin trawl, zoomed to 2X. Trawl panels stretched, horisontal opening 21m, vertical opening 23m.

S - sonar
C - cursor

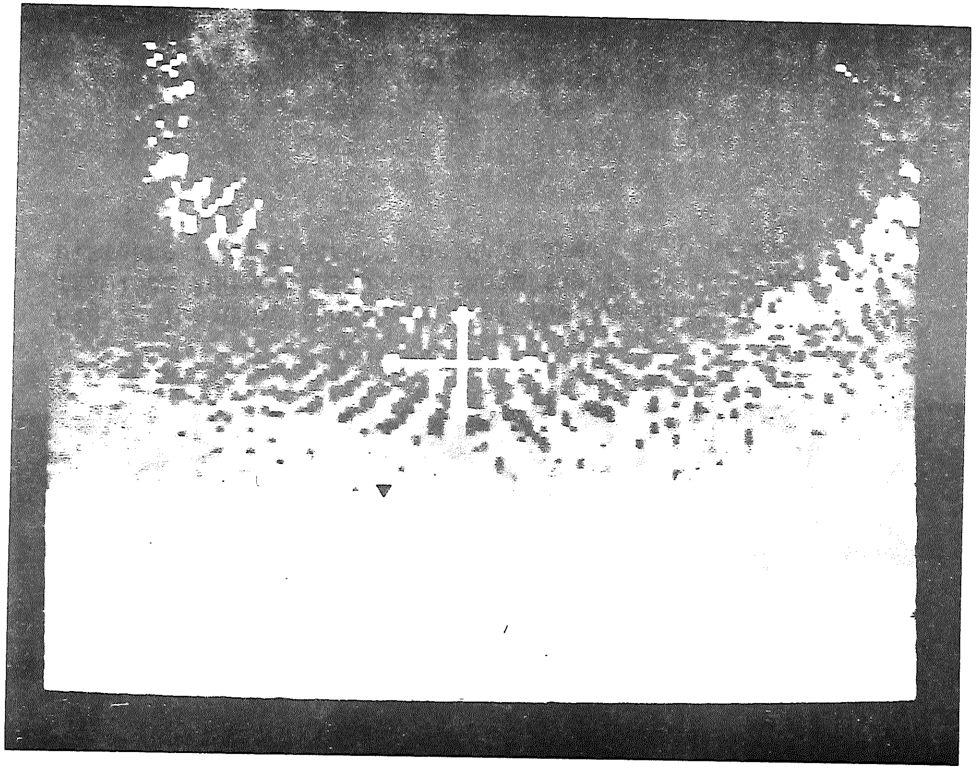

Fig.5. Capelin trawl down towards the bottom. Center distance to bottom from the lower panel is 8 meters. (zoomed to 4X)

B - bottom

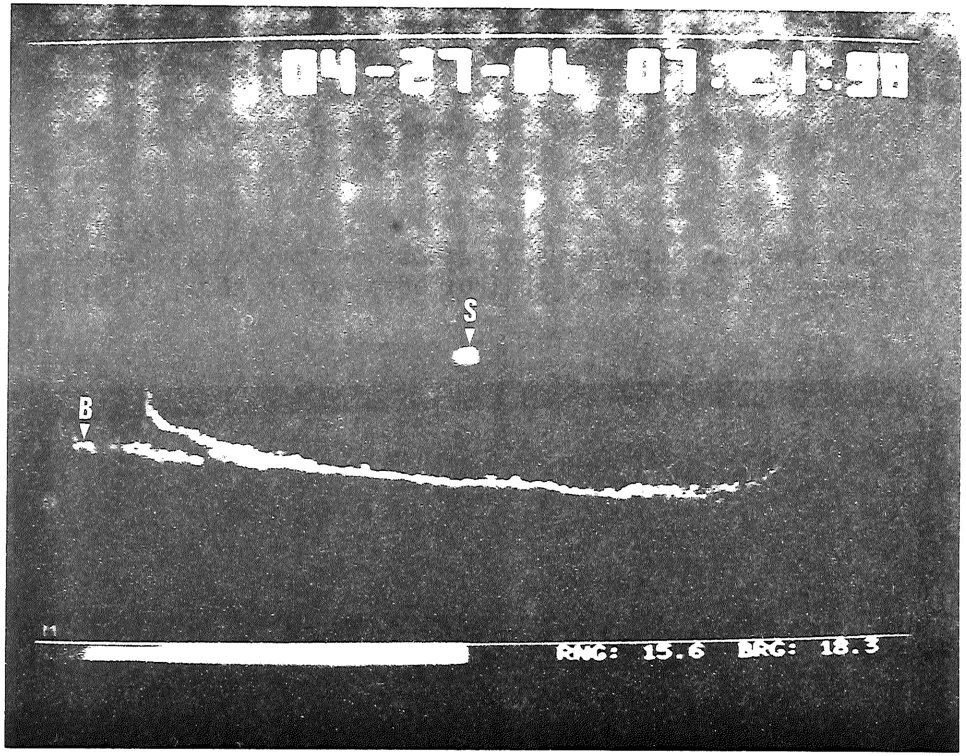

Fig.6. Image of the opening of the Campel 1800 bottom trawl at 320 meters depth. Height of the trawl is 4.5 meters, and width of the trawl at head-line-level is 15.5 meters.

S - sonar
B - bottom

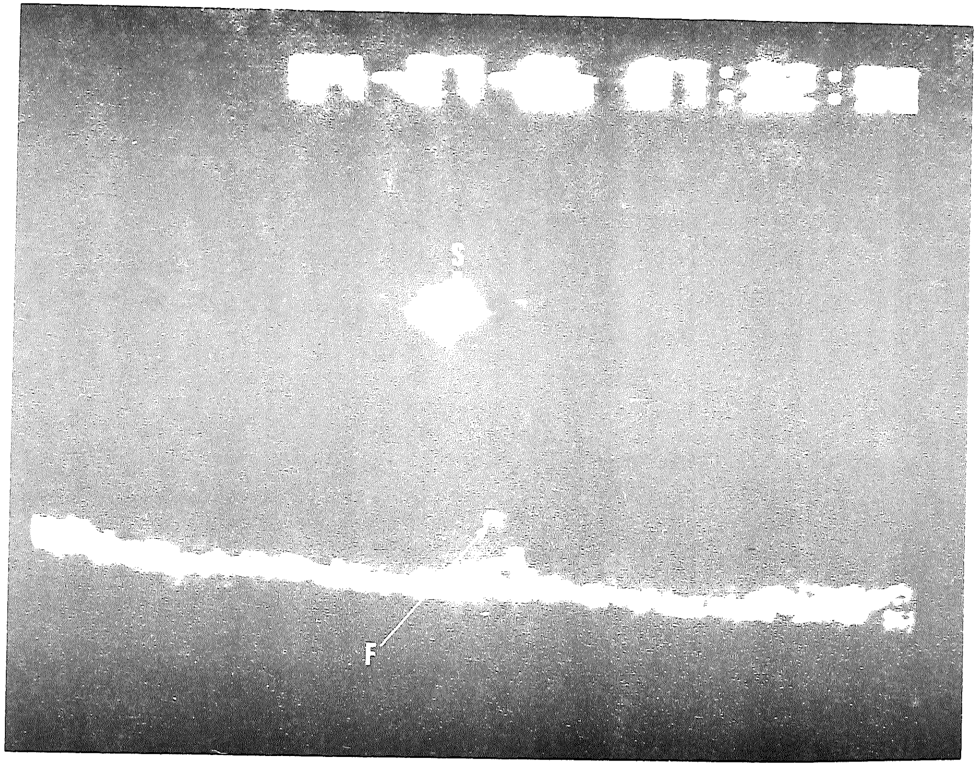

Fig.7. Fish entering the bottom trawl at center.

S - sonar
F - fish entering the trawl

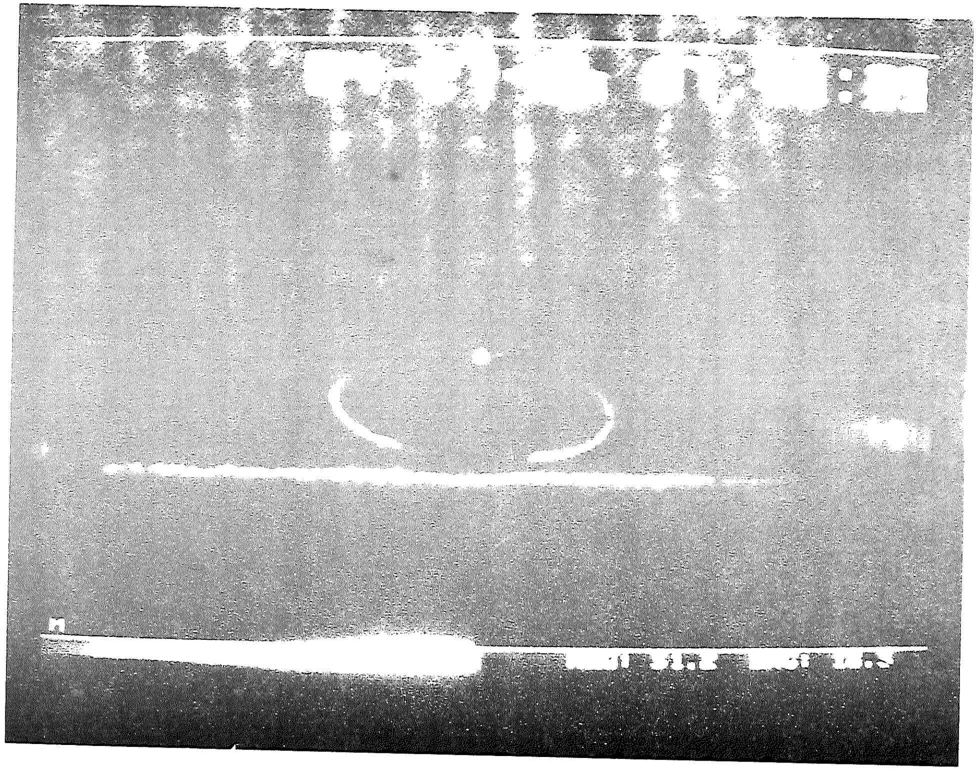

Fig.8. Bottom trawl just lifting off the bottom.