International Council for the Exploration of the Sea

C.M.1976/B:7
Gear and Behaviour Committee

REPORT OF THE WORKING GROUP ON RESEARCH AND ENGINEERING ASPECTS OF FISHING GEAR, VESSELS AND EQUIPMENT

Convener and Rapporteur	:	E.J. de Boer, Netherlands Institute for Fishery Investigations, IJmuiden - The Netherlands
Meeting time and place	:	1 and 2 April, 1976 Hull - England
Terms of reference	:	C.Res.1975/2:6: (i) to discuss technical aspects of fishing gear, fishing vessels and fishing methods; to receive from Dr. A.I. Treschev his Manual in English on the "Application of the Swept Volume Method for Measuring Fishing Effort"; and to evaluate the F.A.O. methods for fishing effort measurement listed for different gears in Doc.C.M.1975/ D:6, Appendix 7; and aspects of electrical fishing.

PARTICIPANTS

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U.S.S.R.

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F.A.O.

J. Schärfe	Fishery Industries Division - Rome

AGENDA

The Working Group adopted the agenda as proposed by the Chairman.

1. Election of convener
2. Progress reports
3. Special address of Dr. J. Schärfe (F.A.O.) to the Working Group
4. Presentation of papers
   - 4.1 Further development of rope trawls
   - 4.2 Wind tunnel test with otterboards
   - 4.3 Rope trawl development
   - 4.4 The delagic trawl
   - 4.5 A simple net drag formula for pelagic nets
   - 4.6 Norwegian experiments with deepsea traps
   - 4.7 Deepsea trawling
   - 4.8 Norwegian experiments with prawn sorting trawls
   - 4.9 Remote sensing
   - 4.10 Rationalization of sole fisheries by means of electrified beam trawls

ELECTION OF CONVENER - Agenda item 1

Due to sudden health problems the acting convener of the Working Group Mr. J.G. de Wit could not be in the chair and he had to inform the Chairman of the Gear and Behaviour Committee about his stepping back. The working group members elected the stepping in convener Mr. E.J. de Boer as full-time convener.

PROGRESS REPORT - Agenda item 2

Objective to the progress report is to inform the participants about recently started and planned activities by member countries in the fields of gear technology and vessel development.

Belgium

- Experiments with a modified beam trawl (increased vertical netopening) for catching round fish.
- Testing a semi-pelagic net at the N.W. coast of Ireland.
- Development of a pulse generator for the electric stimulation of sole and shrimps.

France

- Development of a four panel semi-pelagic trawl which can be used with the otterboards on and off the bottom; special feature of this trawl is the very long square.

- Development of netdrum techniques.
- Completion of flume tank for both gear research and training at Lorient.
- Further research into the sinking speed of a tuna purse-seine.
- Participation in the German (F.R.G.) Antartic project (Krill).
- Termination of laboratory studies in the field of electric fishing and planning of field tests.

Federal Republic of Germany

- Development of rope trawl; instrumented trials in planning stage.
- Research on the performance of otterboards: full scale and model windtunnel tests.
- Deep sea trawling experiments with 200 ft high-headline bottom trawl.
- Modeltests (scale 1:4) with rope trawl and different types of otterboards planned for 1976.
- Started field tests with beam trawl electrified by new developed pulse generator.
- Research cruise of F.R.V. "Walter Herwig" and commercial freezer stern trawler to Antartic to test catching and processing techniques of Euphasids (Krill).
- Testing of computerized data logging system.
- Testing of netmaterials (polyamid).

Netherlands

- Collection of technical performance data of a 2700 h.p. freezer stern trawler during the herring season in the Hebrides area.
- Development of a rope trawl.
- Experiments with both a semi-pelagic and a high-headline trawl in an area with an undulated seabed (sand ridges).
- Development of an automatic feeding system for the rotating shrimp grader.
- Adaption of the rotating shrimp grader for brown shrimps Crangon crangon) to the processing of deepwater prawns (Pandalus borealis).
- Development of a new pulse generator for the electric stimulation of flatfish.
- Experiments with a small midwater trawl to catch deepsea prawns off the bottom.
- Experiments to collect mussels from the seabed by hydraulic dredging.
- Experiments to cleanse mussels from internal sand and silt while stored and transported in a vessel.

Norway

- Basic engineering studies on mechanized baiting of long-lines onshore for coastal vessels.
- Experiments with hydraulic operated gill net drums.
- Experiments with deepsea traps at various fishing grounds throughout the year.
- Development of a prawn sorting trawl to reduce capture of small/juvenile fish.
- Catching of blue whiting with a rope trawl were not successful; this experiment will be continued in 1976 with a midwater trawl with 2 m meshes in the front part.
- Preparation of Norwegian Krill expedition in the North Atlantic including development and testing of a special four panel trawl.
- Development of instrumentation for bottom discrimination.
- Development of an integrated trawl instrumentation system; proto-type will be tested March/April 1976 onboard F.R.V. "G.O. Sars".

United Kingdom (Scotland)

- A series of four-panel high opening bottom trawls have been developed and tested onboard commercial vessels of the Aberdeen fleet; versions of the basic design range from 200 to 2000 h.p.
- Continuation of development work on a semi-pelagic gear of which the net has been designed for improved resistance to damage when the seabed and the otterboards remain clear of the bottom.
- Study of the reaction of fish to various types of both natural and artificial long-line bait.
- Experiments manoeuvring pelagic trawls by spinning rotors built into the structure of the otterboards; the initial application of controlling the depth of the gear is extended by applying a lateral force to aid horizontal movement of the trawl.
- Comparative fishing experiments with electrified gears in catching flatfish species.
- Computer programs have been written to predict the geometry and towing loads of new designed fishing gears.
- Study of the dynamic behaviour of pelagic trawls when changing the depth or the direction of travel of the gear.
- A simple formula has been developed to calculate the drag of a net given only information of the net specification.

United Kingdom (White Fish Authority)

- Investigation of the loads imposed on the vessel when purse-seining.
- Mechanization of long-lining; conversion of Mustad automatic long-line system.
- Catching experiments of blue whiting are finished; the processing of this species will be investigated next.
- Research in the field of detecting and catching squid (trawling versus jigging).
- Introduction of midwater trawling in the inshore fisheries.
- Construction of flume tank and models of fishing gears.
- Preparations of training courses in fisheries engineering and management.
- Further expansion of the King Fisher fishing charts programme and the development of towing charts for specific areas.
- The work on the computerized simulator for training in fishing strategy and navigation is terminated.

U.S.S.R.

- Continuation of the investigations into the engineering aspects of the fishing industry.
- Research into the influence of netmaterials on the selectivity of bottom trawls.
- Investigations on the influence of electric stimulation on behaviour and survival of fishes.
- Trials to improve the netopening of midwater trawls.
- Research into the application of the "Swept Volume Method" in all types of fishing.

SPECIAL ADDRESS OF DR. J. SCHÄRFE (F.A.O.) - Agenda item 3

The participant from the F.A.O. Department of Fisheries (J. Schärfe) referred to a recent analysis which indicated that, as an adequate contribution to meeting the increasing demand for animal protein, during the coming 25 years, catches of conventional fish resources will probably have to be increased by about 30 million tons per annum and that in addition about 50 million tons per annum of so far not utilized unconventional resources (mainly Antartic krill, small meso-pelagic species and oceanic squid) may need to be exploited. This very substantial increase, more than doubling the present total world catches, will require *inter alia* energetic efforts in the rational transfer and adaptation of proven fishing technology from advanced to developing fisheries (mainly for conventional resources) and the development of at least partly new harvesting technology and systems (mainly for the unconventional resources). Obviously, the advanced fisheries will have to accept a major role in ensuring systematic and timely progress.

Since many of the advanced institutions involved in fishing technology research and development were represented in this Joint Working Group Meeting, the opportunity was taken to promote awareness of the formidable tasks lying ahead and to stress the need for intensified action in particular regard to:

- Systematic adaptation and transfer of proven small- and medium-scale fishing technology to developing fisheries for the benefit of bilateral, multilateral and other technical assistance and training programmes. It was suggested that national institutions seriously consider to assign an adequate part of their research and development capacity to this task for effectively meeting the specific techno-economic requirements of developing fisheries. The Fishery Industries Division of F.A.O. is ready to strengthen contacts and to actively cooperate with institutions and individuals in order to better utilize the available facilities and skills for the benefits of developing fisheries.

- Rational and economic development of feasible bulk harvesting technologies for the major unconventional resources the utilization of which may not be economically attractive, but could be of significant value if developed for food aid purposes. The considerable costs of the research and development work required, the international character of future expanded food aid programmes and the expected new international regime for the exploitation of the oceans outside the 200-mile exclusive economic zones where much of these resources occur, point to the high desirability of international cooperation. F.A.O. Department of Fisheries is already engaged in the preparatory phase of a global UNDP/FAO Programme of Fisheries Survey and Development in the Southern Ocean (south of Lat. 45°S) which fully includes Antartic krill, but much less meso-pelagic species and oceanic squid, the exploitation of which will be needed in due time. For year-round employment of fishing vessels a combined fishery for krill and one or both of the others may evolve and mass harvesting technologies for those should therefore also be developed well in time. Combined research and development could help to reduce costs. Since much of the advanced fishing technology capacity which will by necessity have to be involved in this development task, and which partly is already involved, is presented in the existing ICES Working Groups, it would appear logical to utilize this existing framework for promoting a concerted approach. It was therefore suggested to consider the feasibility of this approach, e.g., in the form of establishing in due time a new Working Group of the Gear and Behaviour Committee of ICES to be concerned with mass harvesting of major unconventional resources.

PRESENTATION OF PAPERS - Agenda Item 4

4.1 Further development of rope trawls

by E. Dahm, K. Lange, H. v. Seydlitz; Institut für Fangtechnik, Hamburg, Federal Republic of Germany. (Rapporteur: K. Lange).

During the last year further experiments have been performed by the Institut für Fangtechnik with a four panel rope trawl of 2500 meshes (200 mm stretched) circumference in the fore part.

The influence of changing different parts of the rigging was investigated:

a) Size of the otterboards (8 and 10 m^2 Süberkrüb)
b) Length of the bridles (100,150,200 and 250 m)
c) Trawl weights (800, 1250 and 1650 kg)

The results of these trials are presented in the figures 1a, 1b, 2a and 2b, which give an impression of the effect of different riggings on size and shape of the net mouth.

Some contructional details of rope trawls are given in fig. 3, 4 and 5.

When trawling close to the bottom there is a danger of abrasion at the connecting points of the ropes to the footrope. This can be avoided by pressing rubber discs on the footrope at both sides of these points (fig. 3).

The floats on the headline have to be connected in such a way that when shooting the net the ropes cannot entangle with the floats. In general strings of floats covered with fine mesh net material will be fastened to the headline (fig. 4b). Another method is shown in fig. 4a: the floats are fixed directly to the headline.

The connection points of ropes and webbing should be constructed very carefully in order to avoid damages (fig. 5). A construction according to fig. 5b seems to be the best solution of the problem: good force transition from the ropes to the net at low manufacturing costs!

The tension in all ropes should be equal. This can be obtained by assuming the frame wires as catenaries, whereas the connecting points of the ropes to the webbing are supposed to lie in a plane perpendicular to the towing direction. Based on these two assumptions, the length of the ropes can be calculated.

A certain difficulty is created by the elongation of the ropes when being under tension, but this effect can be taken into consideration by a simple calculation:

If the design length of a rope when towing shall be l_E, the construction length l_B (slack rope) must be shorter by the difference Δl (elongation).

$$l_E = l_B + \Delta l$$

If there is an equal load in all ropes, there is an elongation, which is defined as:

$$\varepsilon = \frac{\Delta l}{l_B}$$

From these formulae we find:

$$l_B = \frac{l_E}{1 + \varepsilon}$$

which gives the rope length when constructing the net.

The value of ε can be obtained from an elongation test which gives the elongation ε as a function of the tension. The tension in the ropes when towing the gear has to be calculated from the ship's data (thrust, towing speed) and the towing resistance of the doors.

Discussion

Because the elastic properties of the ropes vary with the material the rapporteur gave some further information about the influence of these properties when constructing a rope trawl. In the German Democratic Republic combination wire is used, but in the Federal Republic of Germany the material of the ropes is polyamid (P.A.).
Questions were raised about the different methods of attachment of the ropes to the meshed webbing. It was reported that the attachment as shown in figure 5b gave the best results, because of the favourable transfer of the loads. Answering a question about the resistance of a rope trawl in comparison with a normal midwater trawl the rapporteur stated that a commercial trawler towed the conventional midwater trawl with a speed of 4.5 knots.
After said midwater trawl was converted to a rope trawl the vessel could tow this gear with a speed of 5.2 knots.

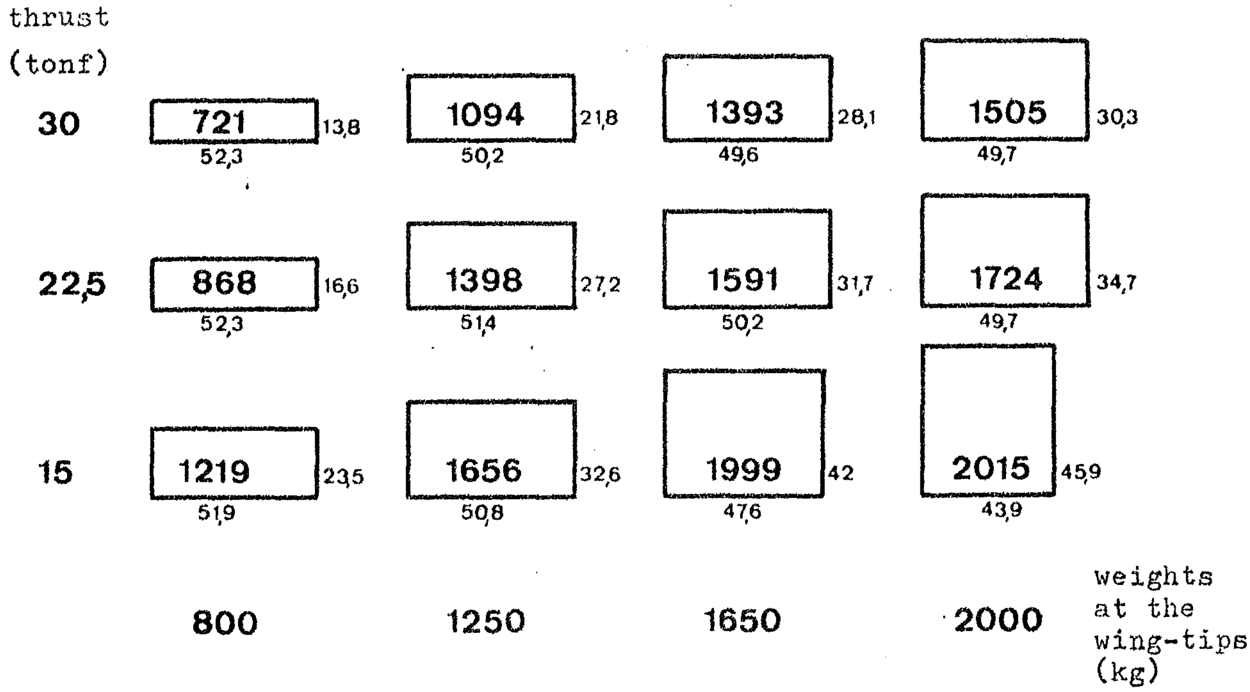


Fig. 1a Changes in form and size of the net mouth of a rope trawl

otterboards : 8 m² Süberkrüb
length of legs : 100 m
weights at the wing tip : 800-2000 kg
length and width of net mouth in meters.

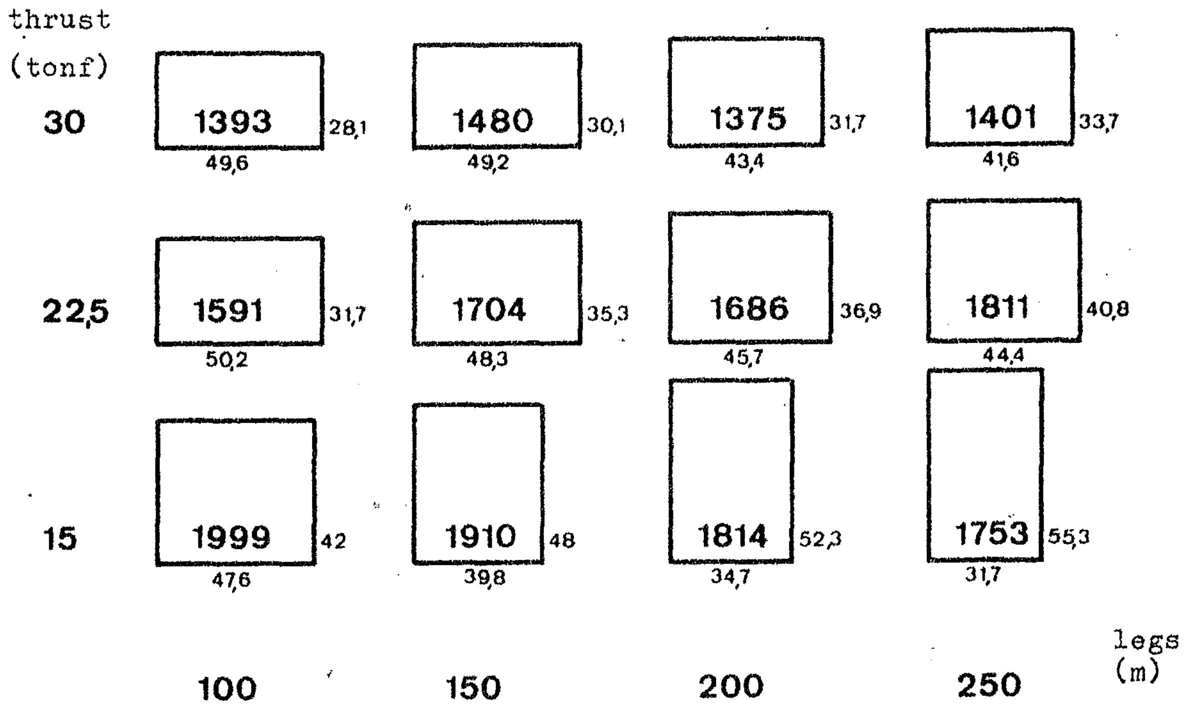


Fig. 1b Changes in form and size of the net mouth of a rope trawl

otterboards : 8 m² Süberkrüb
length of legs : 100-250 m
weights at the wing tip : 1.650 kg
length and width of net mouth in meters

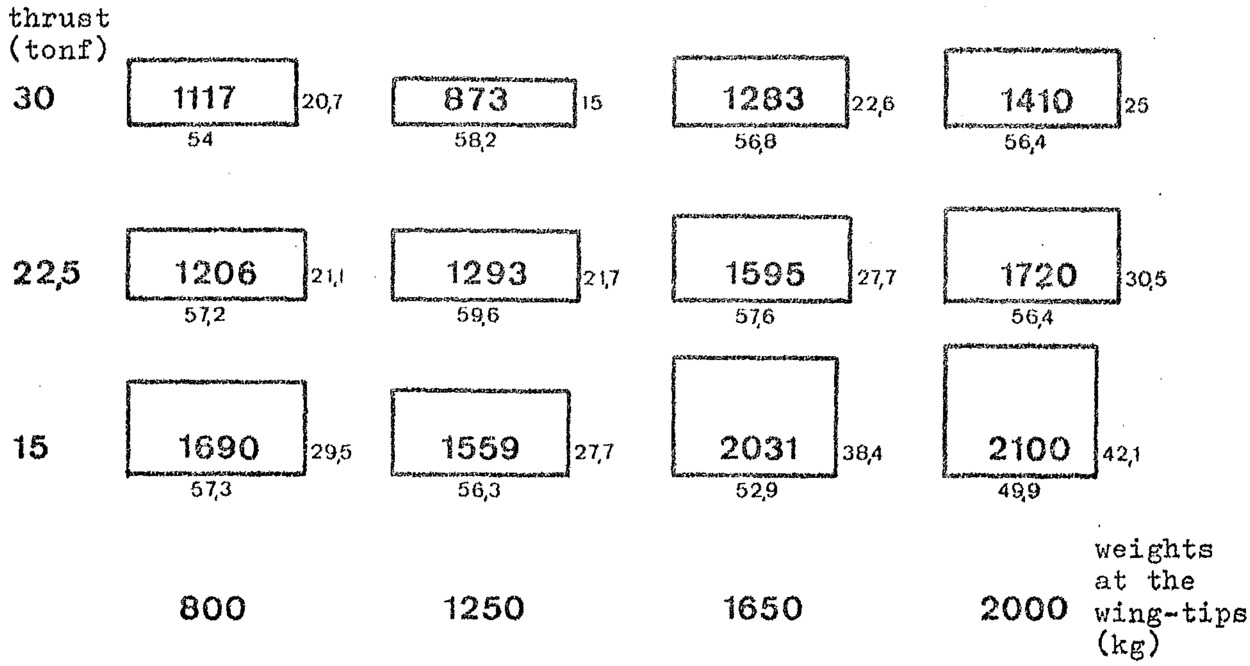


Fig. 2a Changes in form and size of the net mouth of a rope trawl

otterboards : 10 m^2 Süberkrüb
length of legs : 100 m
weights at the
wing tip : 800-2000 kg
length and width of net
mouth in metres.

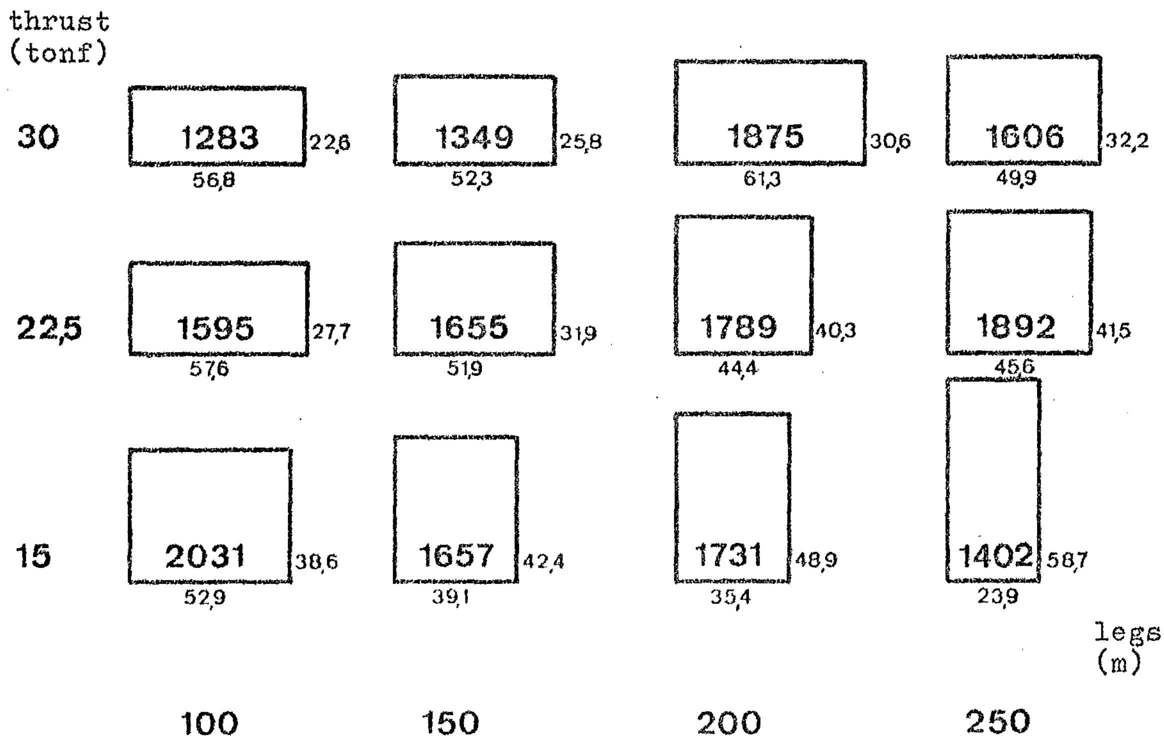


Fig. 2b Changes in form and size of net mouth of a rope trawl

otterboards : 10 m^2 Süberkrüb
length of legs : 100-250 m
weights at the
wing tip : 1650 kg
length and width of net
mouth in metres.

The groundrope of a rope-trawl

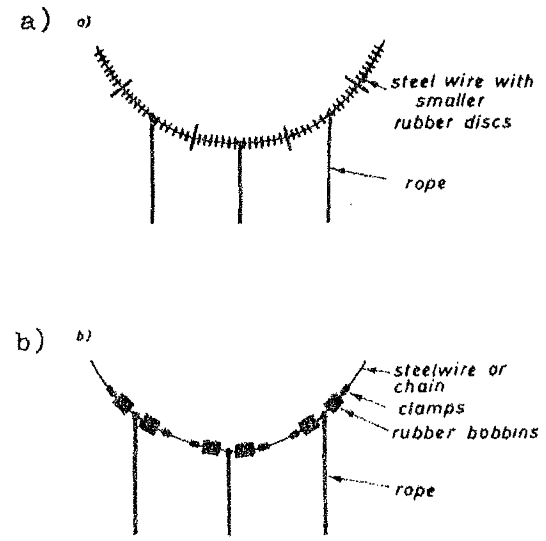


Fig. 3

Floats on the headline of a rope-trawl

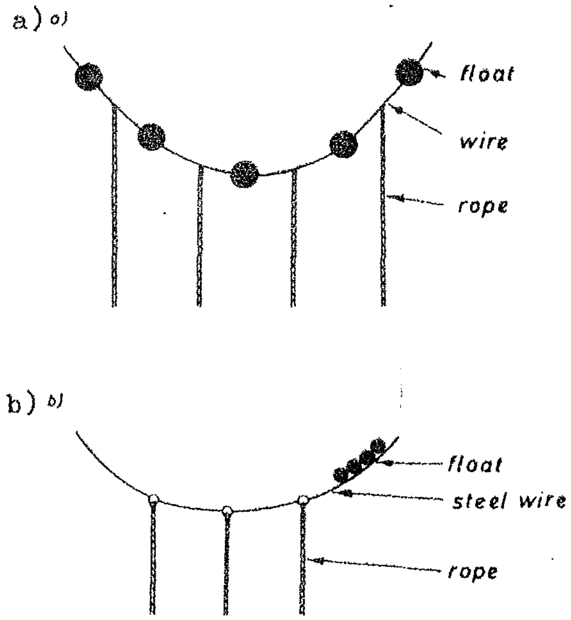


Fig. 4

Connections between ropes and netting

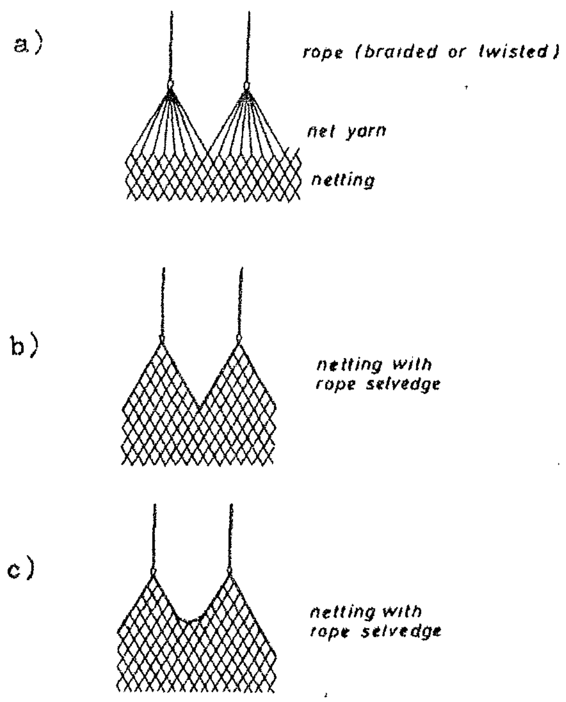


Fig. 5

4.2 Wind tunnel test with otterboards

by K. Lange; Institut für Fangtechnik, Hamburg, Federal Republic of Germany.
(Rapporteur: K. Lange).

In January 1976 the Institut für Fangtechnik started a serie of tests with 6 different types of otterboards in the wind tunnel of the Institut für Schiffbau (Universität Hamburg). First results of these tests will be presented in this paper.

The following otterboards were tested:

1. Flat rectangular otterboard
2. Süberkrüb "
3. V-form "
4. Polyvalent "
5. Norwegian type "
6. Round cambered "

Although some of the boards are used either on the bottom or in midwater, all types were tested in both trawling conditions. In bottom condition only the hydrodynamic influences of the bottom could be simulated but no frictional effects between bottom and otterboard.

The diagrams give the lift (C_L) and drag (C_D) coefficients plotted as polar-curves. The points at the curves represent the angles of attack measured between -5° and 60°.

With these coefficients, lift and drag are calculated as follows:

Lift: $$L = C_L \cdot \frac{\rho}{2} v^2 \cdot F$$

Drag: $$D = C_D \cdot \frac{\rho}{2} v^2 \cdot F$$

ρ = density of the water
v = trawling speed
F = area of the otterboard

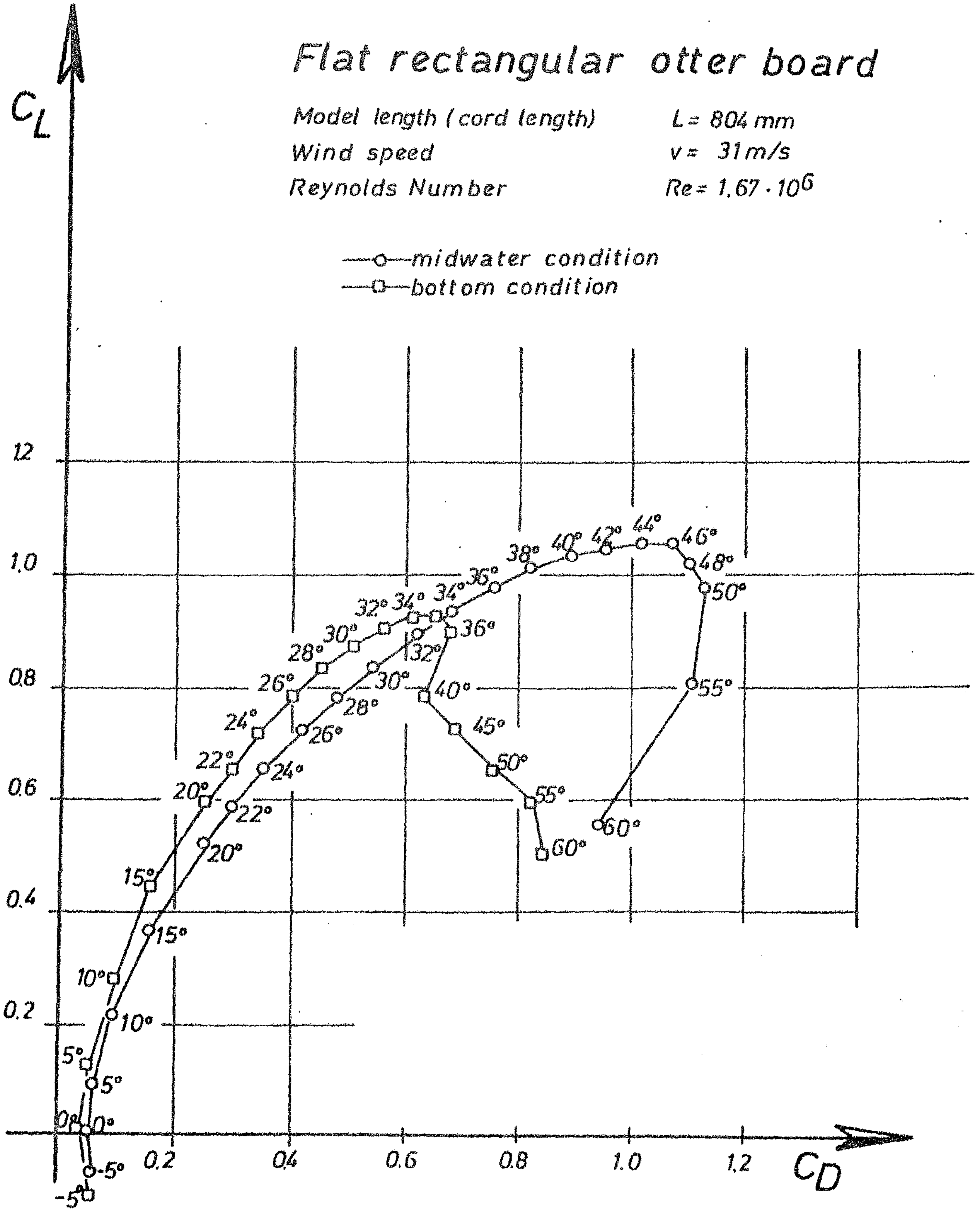
To check the influence of the Reynolds number on C_L and C_D, every board was tested at several wind speeds varying from 12 m/s to 37 m/s at an angle of attack corresponding to the maximum lift coefficient. In no case, there was an effect of the wind speed on C_L and C_D.

From the diagrams, it can be seen, that cambered otterboards (Süberkrüb, Polyvalent, Round otterboard) give a higher maximum lift coefficient than the flat ones. This corresponds with results of otterboard trials published by P. Crewe in "Modern Fishing Gear of the World Nr. 2".

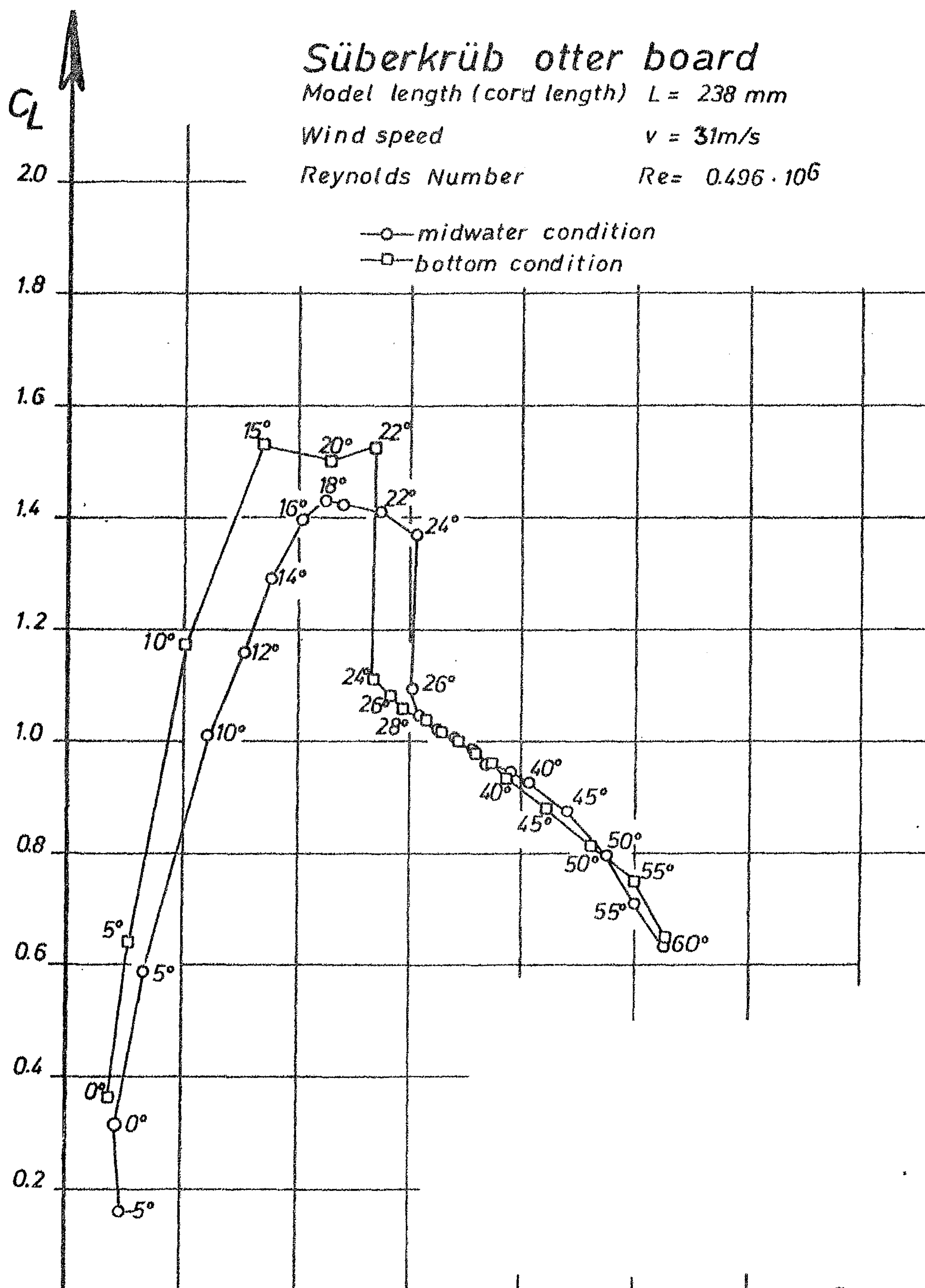
The highest lift coefficient was found with the round cambered otterboard ($C_L = 1{,}7$). The design is based on russian publications. There are some differences in the results, the russian scientists obtained a top lift coefficient of $C_L = 2{,}0$.

Discussion

In the discussion doubts were expressed about the value of wind tunnel tests with doors for bottom trawling because of the missing influence of the ground friction. The rapporteur stated that the results of wind tunnel tests can still be used for comparison of the efficiency of the doors. The tests show that the camber of the door has a large influence on the lift ratio C_L/C_D, but besides efficiency also the production costs have to be considered. Practice onboard German stern trawlers has shown that for bottom trawling on rough grounds the poly-valent type of doors are in favour. A very practical feature of these doors are the interchangeable shoe plates.
Special attention was paid to the Russian type round and cambered doors. Onboard distant-water stern trawlers upto 12 m^2 Süberkrüb-doors are needed to give sufficient lifting and spreading forces for the large midwater trawls. However, these large doors are very difficult to handle. By using the very efficient type of round and cambered doors the dimensions can be limited.
Another question dealt with the influence of the slot on the hydrodynamic performance of some type of doors. Doubts were expressed about the value of the slot for the performance of poly-valent doors. It was suggested that a large slot on the bottom of the rectangular flat doors could improve the efficiency by creating a circulation of water around the door.



Flat rectangular otter board
Model length (cord length) L = 804 mm
Wind speed v = 31 m/s
Reynolds Number Re = 1,67 · 10^6
—o— midwater condition
—□— bottom condition
C_L
C_D


Süberkrüb otter board
Model length (cord length) L = 238 mm
Wind speed v = 31m/s
Reynolds Number Re= 0.496 · 10^6
midwater condition
bottom condition
CL
CD
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.2
0.4
0.6
0.8
1.0
1.2
-5°
0°
5°
10°
12°
14°
16°
18°
20°
22°
24°
26°
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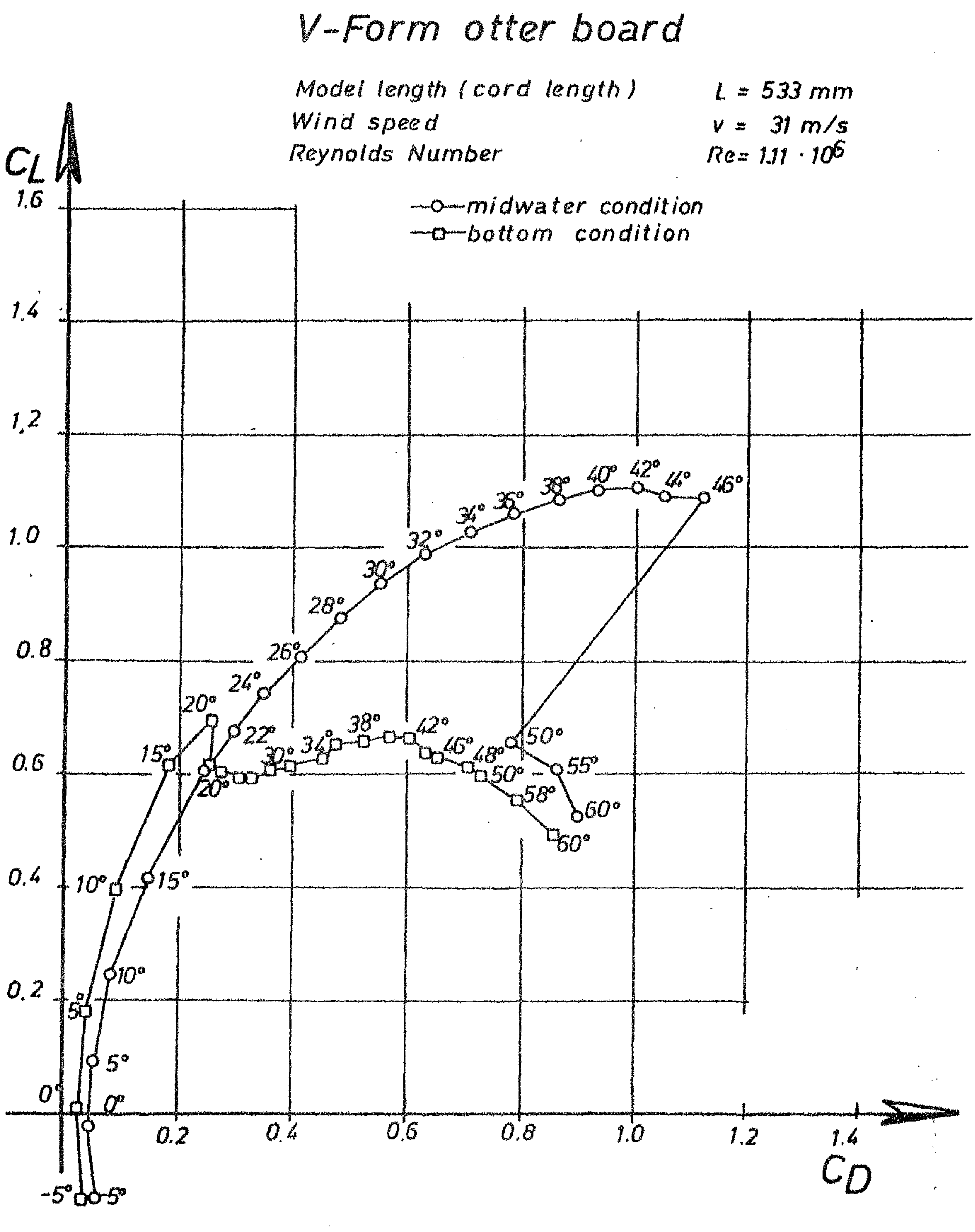
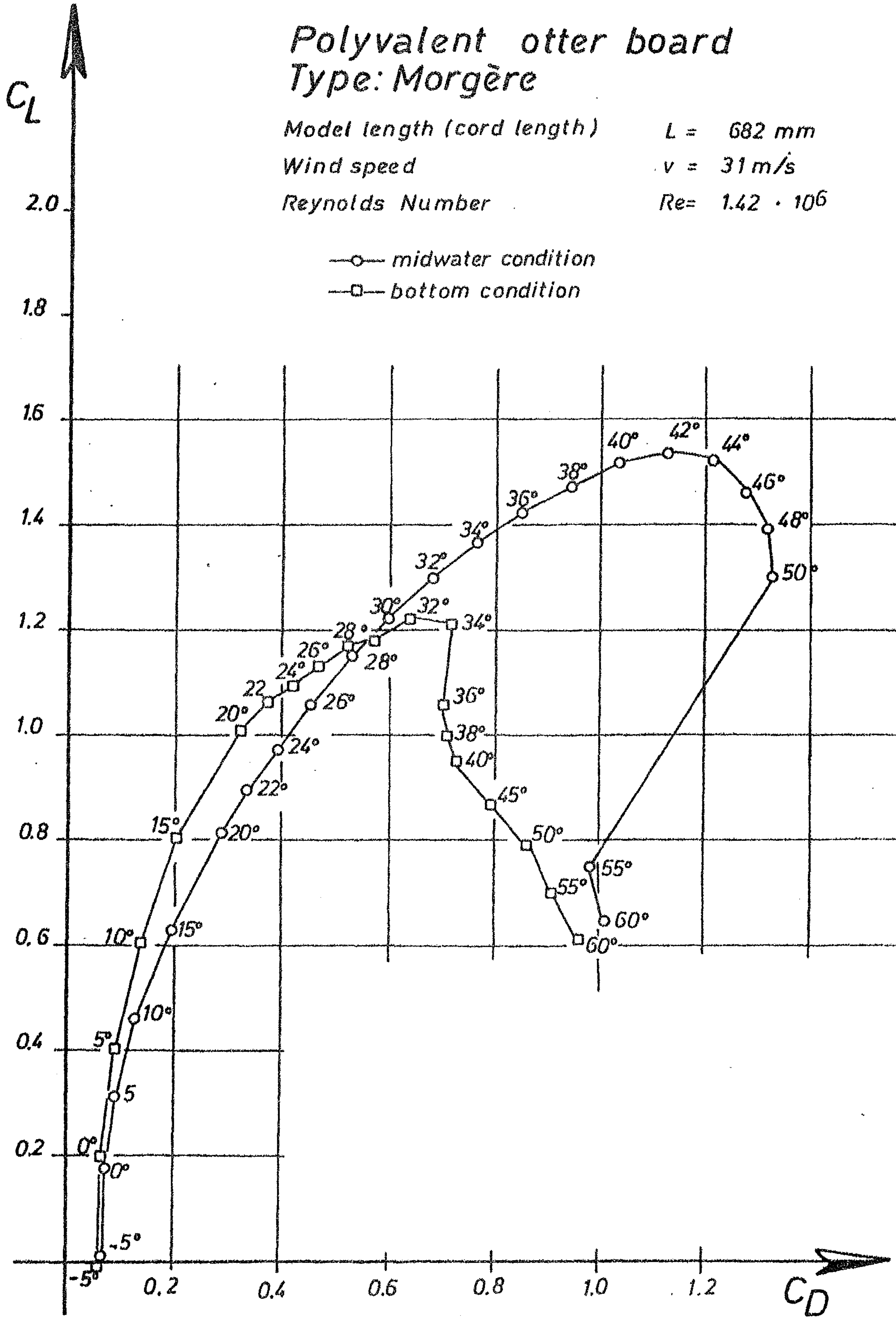
45°
50°
55°
60°
15°


V-Form otter board
Model length (cord length) L = 533 mm
Wind speed v = 31 m/s
Reynolds Number Re= 1.11 · 10^6
midwater condition
bottom condition
CL
CD
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.2
0.4
0.6
0.8
1.0
1.2
1.4


Polyvalent otter board
Type: Morgère
Model length (cord length) L = 682 mm
Wind speed v = 31 m/s
Reynolds Number Re= 1.42 · 10^6
midwater condition
bottom condition
C_L
C_D
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0, 6
0.4
0.2
0.2
0.4
0.6
0.8
1.0
1.2
-5°
0°
5°
10°
15°
20°
22
24°
26°
28°
30°
32°
34°
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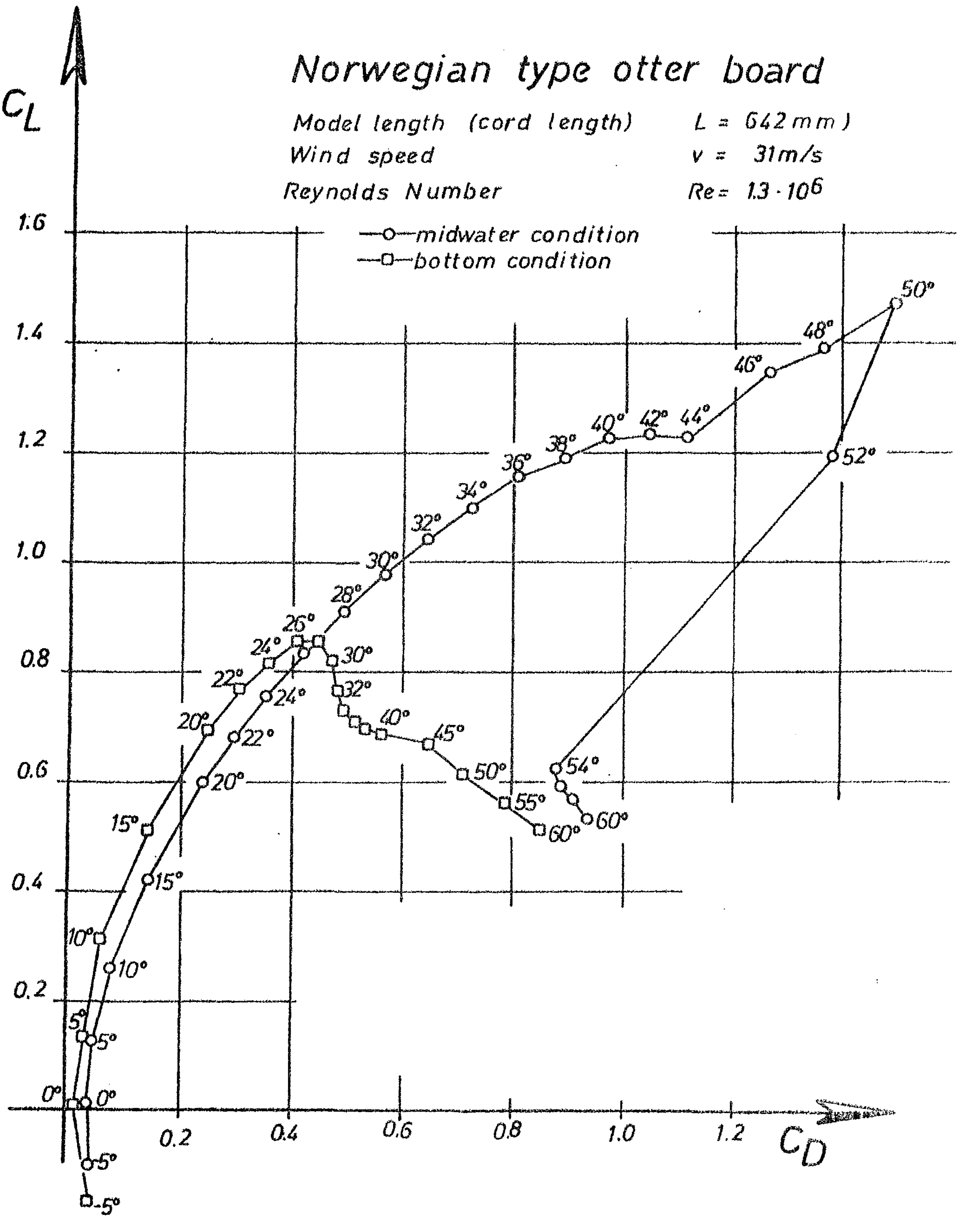
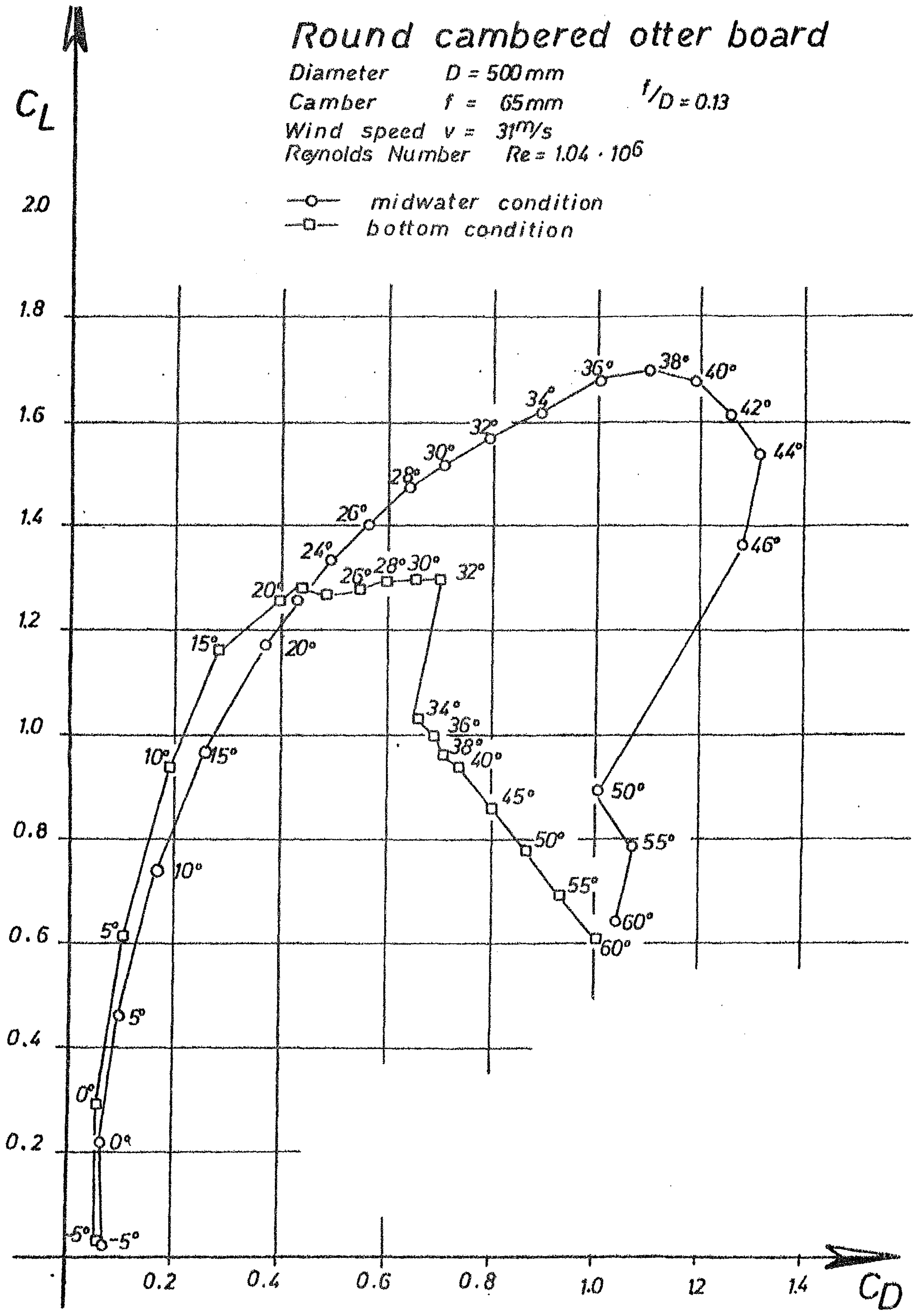
48°
50°
55°
60°
45°



Norwegian type otter board
Model length (cord length) L = 642 mm)
Wind speed v = 31m/s
Reynolds Number Re = 1.3 · 10^6
—o— midwater condition
—□— bottom condition
C_L
C_D
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.2
0.4
0.6
0.8
1.0
1.2



Round cambered otter board
Diameter D = 500 mm
Camber f = 65 mm
f/D = 0.13
Wind speed v = 31 m/s
Reynolds Number Re = 1.04 · 10^6
midwater condition
bottom condition
C_L
C_D
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.2
0.4
0.6
0.8
1.0
1.2
1.4

4.3 Rope trawl development

by E.J. de Boer, Netherlands Institute for Fishery Investigations, IJmuiden.

Introduction:

Since the introduction of one-boat midwater trawling in the Dutch fishing industry in 1965-6 this fishing method is adopted for catching herring by all stern trawlers and some side trawlers converted to stern trawling operation. In the early days this fishing method was a full pelagic operation. However, because herring is in daytime concentrating close to or just above the sea bed the skippers lowered their gears to the sea bed in areas with good bottom conditions. The groundrope and weights are in contact with the sea bed, the Süberkrüb-doors remain at a fair distance off the sea bed. This lowering operation is guided by the information supplied by the netsounder of the position of the net relative to the sea bed.
Practice has shown that in the Dutch fisheries the pelagic trawl is often used all the year around and, in the event of a good bottom condition, the skippers fish for long periods with this gear on the sea bed.
A spectacular development in midwater gears during the last years is the increase of the meshsize of the webbing in the most forward panels. The initial meshsize of 200 mm (stretched) has increased to 3.6 metres at this very moment. As a result the resistance of the gears decreased and this enabled, given an available propulsive power, to use larger nets at faster towing speeds.
Originating from the German Democratic Republic the next step was to replace the meshed webbing of the wings and the first panels by ropes (rope trawl). Although the main object was to further decrease the towing resistance of the net, research on rope trawls in the Netherlands was mainly directed to catch with this type of pelagic trawl herring on a rough bottom.

Rope trawl design

In January 1976 a prototype rope trawl was tested on board the F.R.V. "Tridens" (1800 h.p.). This prototype was a converted mid water trawl having originally a circumference of 434 meshes with a stretched length of 800 mm. This midwater trawl is used by vessels having a propulsive power of 1100-1300 h.p.
The wings and the first panels of 800 mm webbing (Rtex 4530) of the original net were replaced by nymplex (P.E.) ropes of 16 mm diameter (breaking load 2800 kgf), varying in length between 39/42 metres at the selvedges to 17 metres in the centre of upper, lower and side panels.

Gear rigging

Both the original midwater trawl and the rope trawl were extensively tested with the following rigging:

- 4.3 m^2 Süberkrüb-doors of 740 kg weight;
- 100 metre upper bridles of 15 mm diameter;
- 100 metre lower bridles of 21.8 mm diameter lengthened at the wings by 6.4 m chain;
- weights at wingtips of 450 kg.

Collected gear parameters

In order to compare the geometry and behaviour of midwater and rope trawl the following parameters for a range of speeds and warp lengths (200-325 ftms) were collected:

- distance of Süberkrüb-doors to the surface;
- spread of the doors;
- vertical and horizontal spread of wingtips;
- vertical and horizontal netopening and distance of headline to the surface;
- vertical and horizontal netopening at the connection points of the ropes to the webbing rope trawl or at the second net section (midwater trawl);
- warp tensions;
- shaft horsepower.

Gear characteristics

The diagrams of figures 2 to 7 give an impression of the differences in gear geometry between the "meshed" midwater trawl and the rope trawl. Although the horizontal spread at the wingtips of the midwater trawl is larger, the horizontal netopening at the centre of the headline/footrope of the rope trawl is slightly larger. At all positions the vertical dimensions of the rope trawl are favourable in comparison with the same dimensions of the midwater trawl.

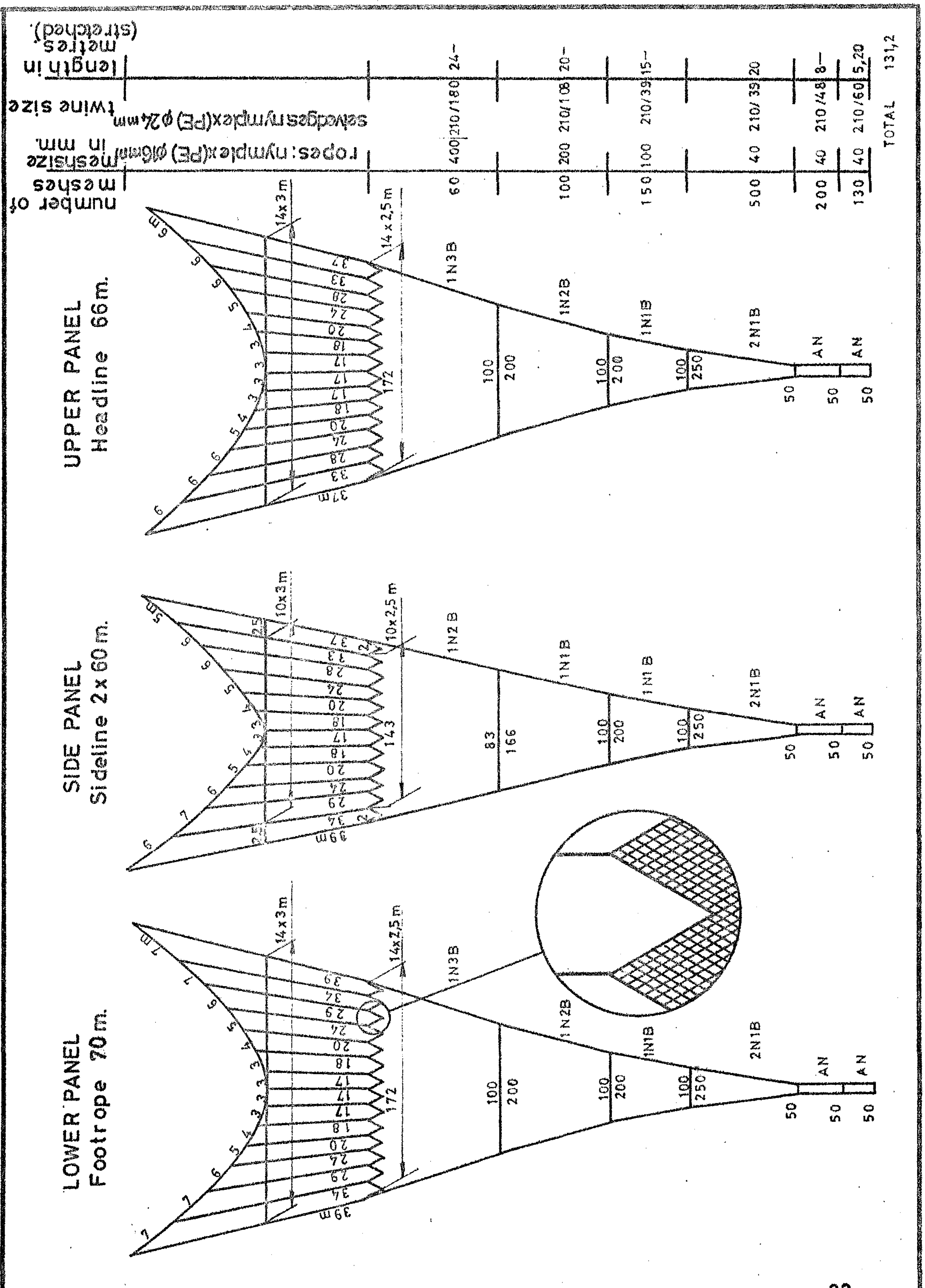
Measurements of the depth position of the doors relative to the net showed that the doors of both midwater and rope trawl were at an average 16-17 metres higher in the column of water than the headlines. The rope trawl was however, when towed at the same speed and warp length as the midwater trawl at a 21-22 metres deeper position. This difference in depth position is probably caused by the considerable reduced surface area of the ropes projected to the direction of the flow, resulting in a reduced lifting action.
As opposed to the reduced towing resistance experienced when testing rope trawls in other countries, the rope trawl under discussion had a higher resistance than the original midwater trawl. One has, however, to keep in mind that the Dutch midwater trawls are very light constructed because the stern trawlers do not have a slipway.

Discussion

The discussion on the applecation of rope trawls rigged as midwater trawls was concentrated on the missing herding effect of the bridles when fishing e.g. for roundfish species.
It was reported that for improved herding by the lower bridles of the recent developed delagic trawl the 17 metres long connections between weights and lower wings are made of chain. French experience showed good catches of cod when fishing in the Barents Sea on the bottom with a midwater trawl with the weights rigged about 50 metres in front of the wings.

The attentions was directed to the improved selectivity of cod ends constructed of ropes in Canada when catching dog fish.

A remark was made about the improved selectivity for species when fishing with a rope trawl on the bottom, e.g. crab selectivity in the pollack fishery.



Benaming

ROPE TRAWL FOR 1100-1300 hp. VESSELS.

FIGURE 1.

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Getekend AM.	Gezien	Rangschikmerk 74-A-0507-52	

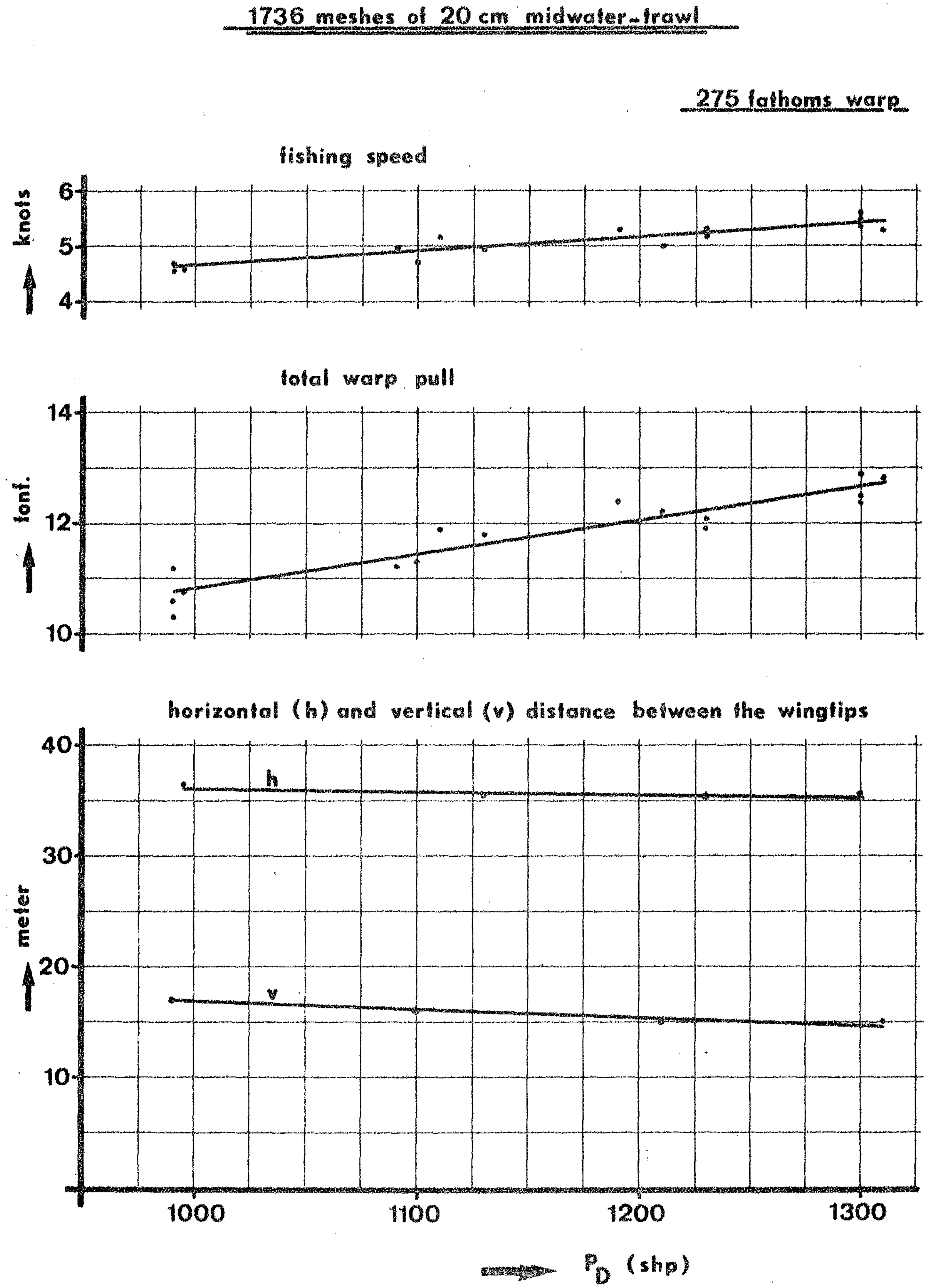

1736 meshes of 20 cm midwater-trawl
275 fathoms warp
fishing speed
knots
6
5
4
total warp pull
tonf.
14
12
10
horizontal (h) and vertical (v) distance between the wingtips
meter
40
30
20
10
h
v
1000
1100
1200
1300
P_D (shp)

FIGURE 2

1736 meshes of 20 cm midwater-trawl

275 fathoms warp

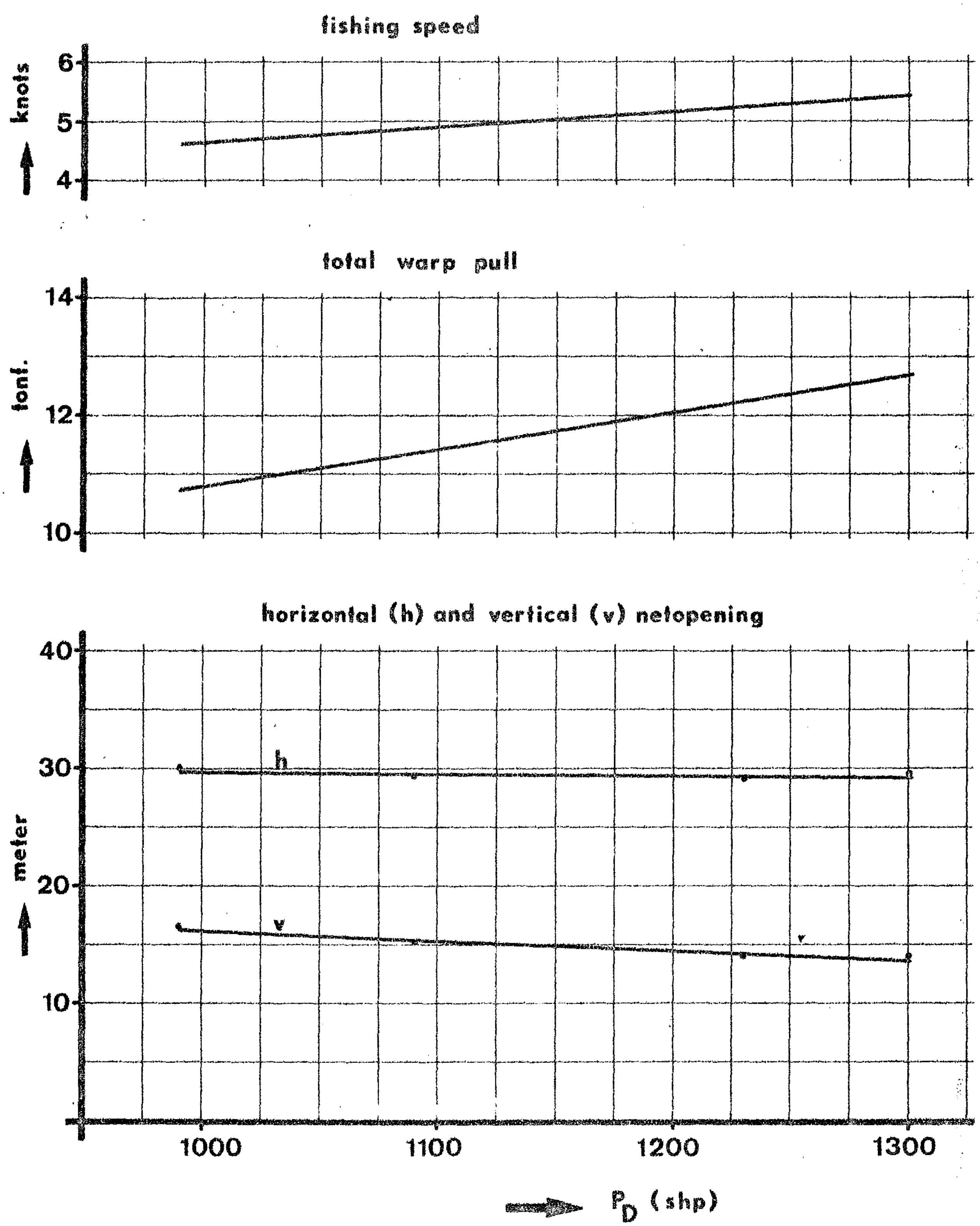


FIGURE 3

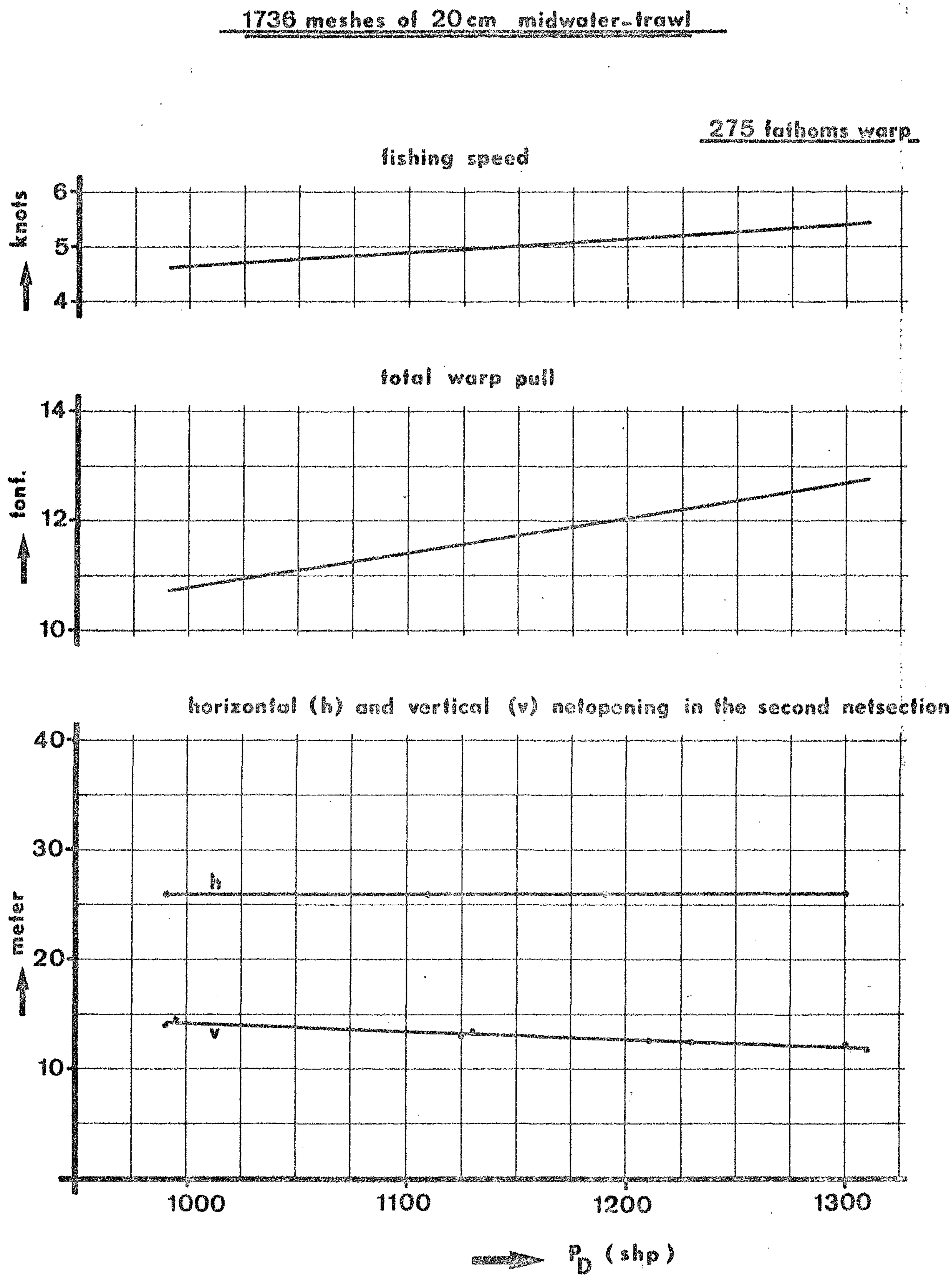

1736 meshes of 20 cm midwater-trawl
275 fathoms warp
fishing speed
knots
6
5
4
total warp pull
tont.
14
12
10
horizontal (h) and vertical (v) netopening in the second netsection
meter
40
30
20
10
h
v
1000
1100
1200
1300
P_D (shp)

FIGURE 4

"NYMPLEX" ROPE TRAWL

275 fathoms warp

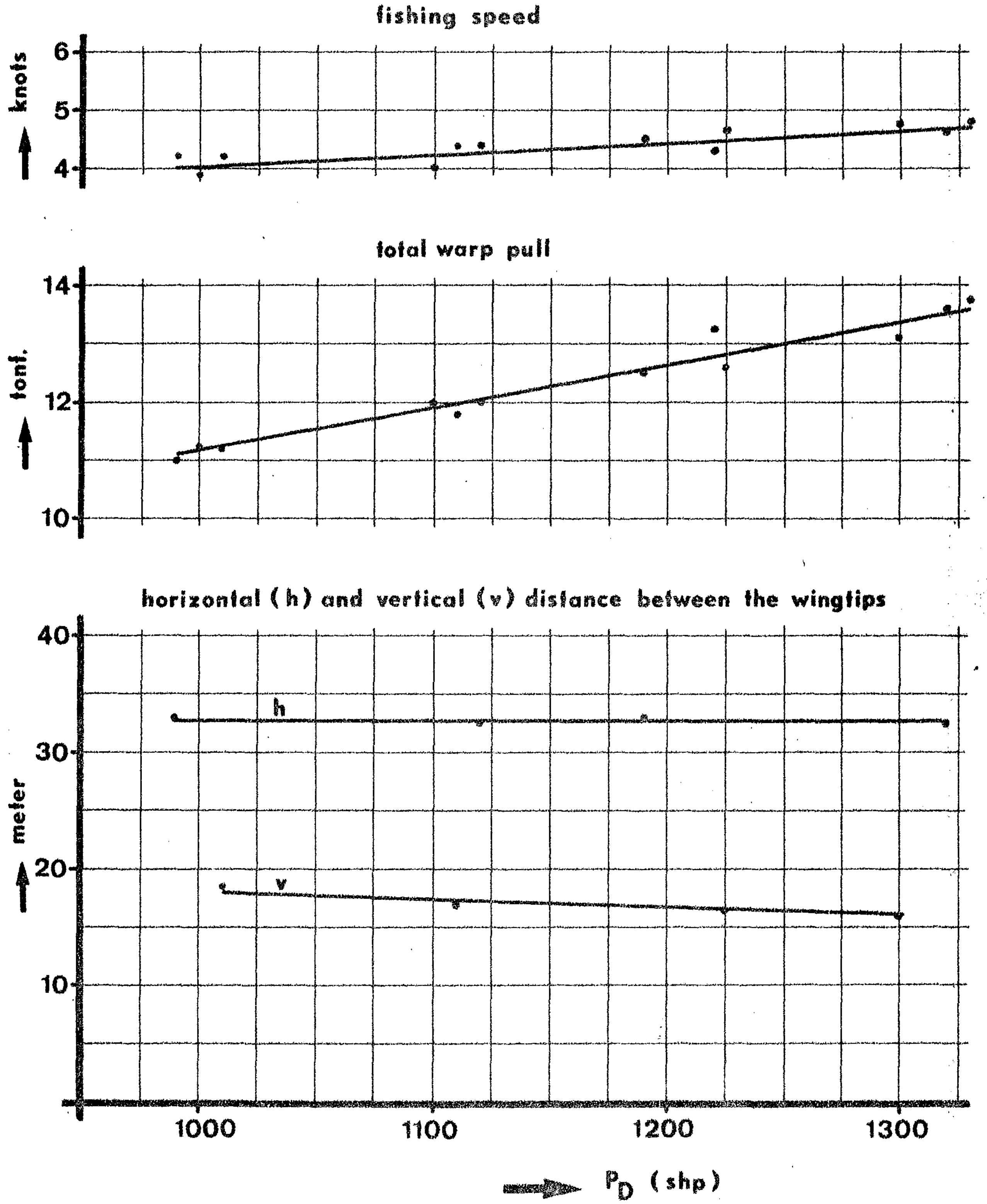


FIGURE 5

"NYMPLEX" ROPE TRAWL

275 fathoms warp

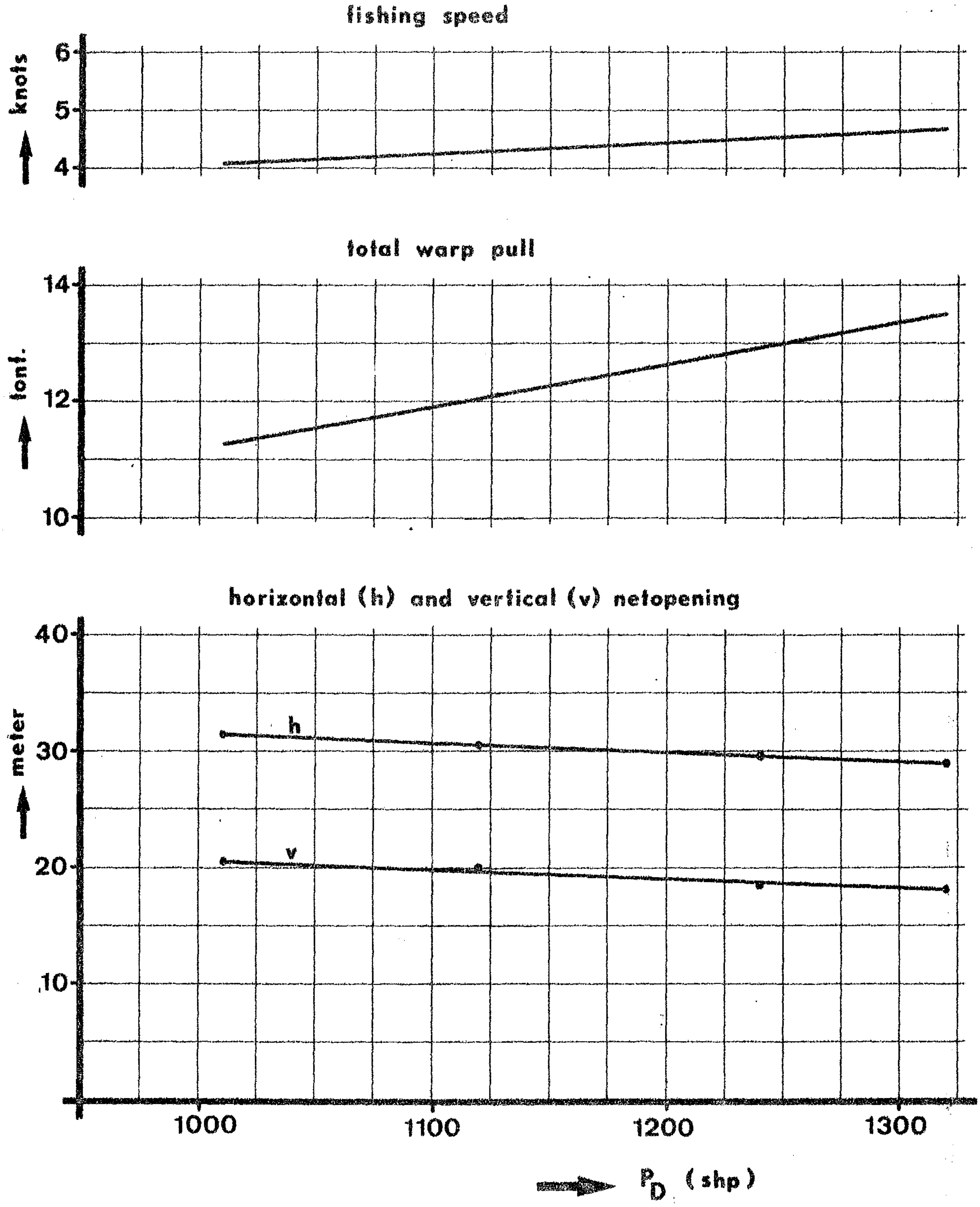


FIGURE 6

"NYMPLEX" ROPE TRAWL

275 fathoms warp

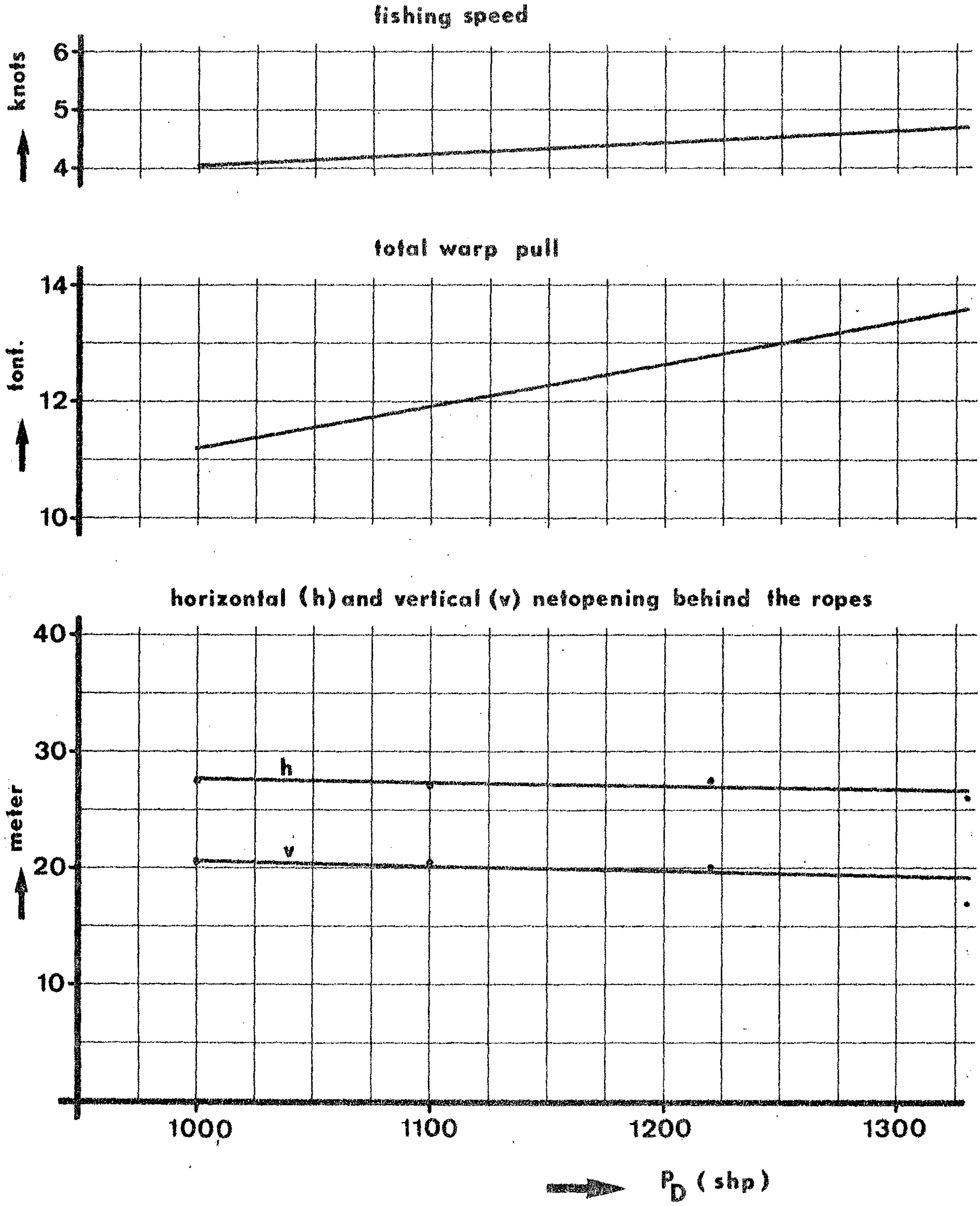


FIGURE 7

4.4 The delagic trawl

by S.T.R. de Silva; Marine Laboratory, Aberdeen, Scotland.

Introduction

For some years it has been recognised that there is a need for an all-purpose trawl which may be used either in midwater or on the bottom without changing the rigging. A trawl, which we have named the "delagic" trawl, has been designed at the Marine Laboratory to meet this need and, in particular, to catch demersal fish which at certain times may be up to eight fathoms off the sea bed, that is well beyond the reach of conventional bottom trawls and, to some extent, of the recent high headline designs.

Pelagic trawls are sometimes fished close to the sea bed but, owing to their tailoring and light construction, the lower panels are very susceptible to damage. Semi-pelagic trawls, such as those designed in France, for example, are basically modifications of bottom trawls with bottom-running otterboards and a rig which maintains a high headline. They are not, however, really suitable for fishing in midwater without rigging changes.

The delagic trawl was designed to overcome many of these difficulties and to provide a gear which may be used in the demersal or fully pelagic mode during the same haul. Trials of the delagic gear (1000 h.p.) were carried out on F.R.S. Explorer during November, 1974, and August 1975 and in January 1976 of both the 1000 and 600 h.p. versions.

Gear designs

The four panel construction (fig. 1) has similarities to that of a pelagic trawl in that large meshes are used in some panels, and in that it may be fished with efficient Süberkrüb-type doors which remain at least eight fathoms off the sea bed when the groundrope and weights are in ground contact.

The bottom and side panels are tailored in such a way that, when towed along the sea bed, the netting remains clear of the sea bed while the groundrope is in contact with the sea bed evenly along its whole length. In addition, to prevent contact between the lower panels and the sea bed, the netting hangs free of the groundrope from a bolshrope (fig. 2). To ensure that the bolshrope stapling does not fray, the groundrope consists of a steel wire rounded with courlene rope (fig. 2).

Operation

The gear was used in sea bed conditions varying from mud and sand to very rough ground with pinnacles. On good ground the footrope followed the ground profile well without change in ship speed (fig. 3). There was no damage to the net and the chain along the groundrope was evenly polished. When the net was fished on rough ground, where even a bottom trawl would have been damaged, the gear position was varied so that it just touched the tops of pinnacles. This control was achieved by monitoring the echosounder and net transducer and altering the ship's speed appropriately. The Süberkrüb-type doors generate an upward force (lift) which increases with speed, and very fine control of the depth of the gear is possible. Other types of semi Pelagic Cambered doors similar to Polyvalent, Waco, Japanese, may be used but at a sacrifice to the rate of lift and fine control.

Performance

Netsounder traces (fig. 3) obtained during the Explorer trials show the foot rope following the ground profile and traces of fish 0 to 5 fathoms off the bottom passing between the headline and foot rope. Capture rates of 50 baskets/hour were recorded during the limited trials. The overall capture rates when compared with those obtained by vessels fishing bottom trawls in the same area were better. While some flatfish were caught during the trials, it is likely that the net will not be as efficient as conventional demersal gears in catching fish actually on the sea bed, because the groundrope is in relatively light contact. The net is primarily designed to catch roundfish which are not as close to the bottom as flatfish.

The absence of a mud cloud, caused by the doors and sweeps, is not expected to have a significant effect on the catching capability of the trawl for fish clear of the sea bed. The Süberkrüb-doors generate a turbulent wake passing approximately along the line of the sweeps and it may be that the turbulence along it will act as a deterrent to fish passing over the sweeps. Furthermore, the weights on the lower sweeps create a sizeable mud cloud passing through the wing ends which are considered to be the main areas of escape. Indeed, because of the much larger mouth area of the delagic trawl compared to a demersal gear behavioural factors may be of less importance in the catching process.

Gear characteristics

Basic parameters for the 600 and 1000 h.p. gears are plotted in fig. 4 to 7. Detailed discussion of the characteristics of these parameters are not attempted in this paper but will be published later.

Headline Depth vs. speed (fig. 4 & 6)

These figures for the 600 and 1000 h.p. gears, show that as warp length increases the variation of depth, for a given change of speed, increases. In practice the speed change takes approximately the same length of time regardless of warp length. Hence, it is advisable when fishing on the bottom with the delagic trawl to use the lower speeds and larger warp as the rate of rise increases with increased warp lengths enabling the easy avoidance of pinnacles and other sea bed obstructions.

Headline height vs. speed (fig. 5 & 7)

Higher headline heights are obtained when using warp lengths greater than 183 m (100 fathoms).

Board spread vs. speed (fig. 8 & 12)

A similar effect is observed with board spreads and therefore with net spreads, both of which increase with increased warp lengths at a given speed reaching a maximum at around 366 m (200 fathoms). Hence the gear operates most efficiently at around these warp lengths.

Net drag vs. speed (fig. 9 & 11)

Detailed analysis of net drag is given in the paper presented at this meeting, by Dr. A. Reid of the Marine Laboratory. Nevertheless it may be of interest to see that mean values of net drag for the 1000 h.p. and 600 h.p. trawls at 4 knots are 10 and 6 tonnes respectively!

Gear drag vs. speed (fig. 12 & 14)

There is a significant increase in gear drag with increase in warp length. This is almost wholly due to the drag of the warp. This increase should be borne in mind, especially when the gear is being used for a deep water fishery such as Blue Whiting where warp lengths up to 2000 m may be used.

Gear h.p. vs. speed (fig. 13 & 15)

On a nominal basis, one quarter of the ships h.p. is available for overcoming the gear drag, the 600 h.p. delagic trawl can be towed at a maximum of 3.75 knots by a 600 h.p. vessel and 1000 h.p. delagic at about the same maximum value with a 1000 h.p. vessel.

Values of more than 1/4 are available for towing the gear of new vessels and those which have more efficient propellers.

Discussion

Trials on a 200 h.p. version of the delagic trawl will be conducted on FRV Mara during April 1976. Divers with low-intensity television cameras will be used to observe the gear. Further refinements will be made, from observations, to the tailoring of the bottom panels and the rigging to ensure the optimum ground contact of the footrope which is a vital operational requirement of the delegic trawl.

This gear is not a universal trawl but a versatile pelagic trawl which has the ability under controlled conditions to be trawled on the bottom or just off it, when the grounds are rough. Therefore, a headline transducer must be considered an essential part of the gear. Vessels used solely to fish bottom trawls, need to adopt further skills such as constant monitoring of the echosounder or the sonar and the headline transducer which is a necessary requirement to capture species near, off the bottom or in midwater.

Meeting's discussion

The reaction of the delagic trawl to an increase in towing speed when fishing with the groundrope on the bottom was discussed in detail. Because of the tailoring of the net and its rigging the net reacts first by lifting off the sea bed, while the weights keep ground contact. A further increase in towing speed results in lifting of the weights.

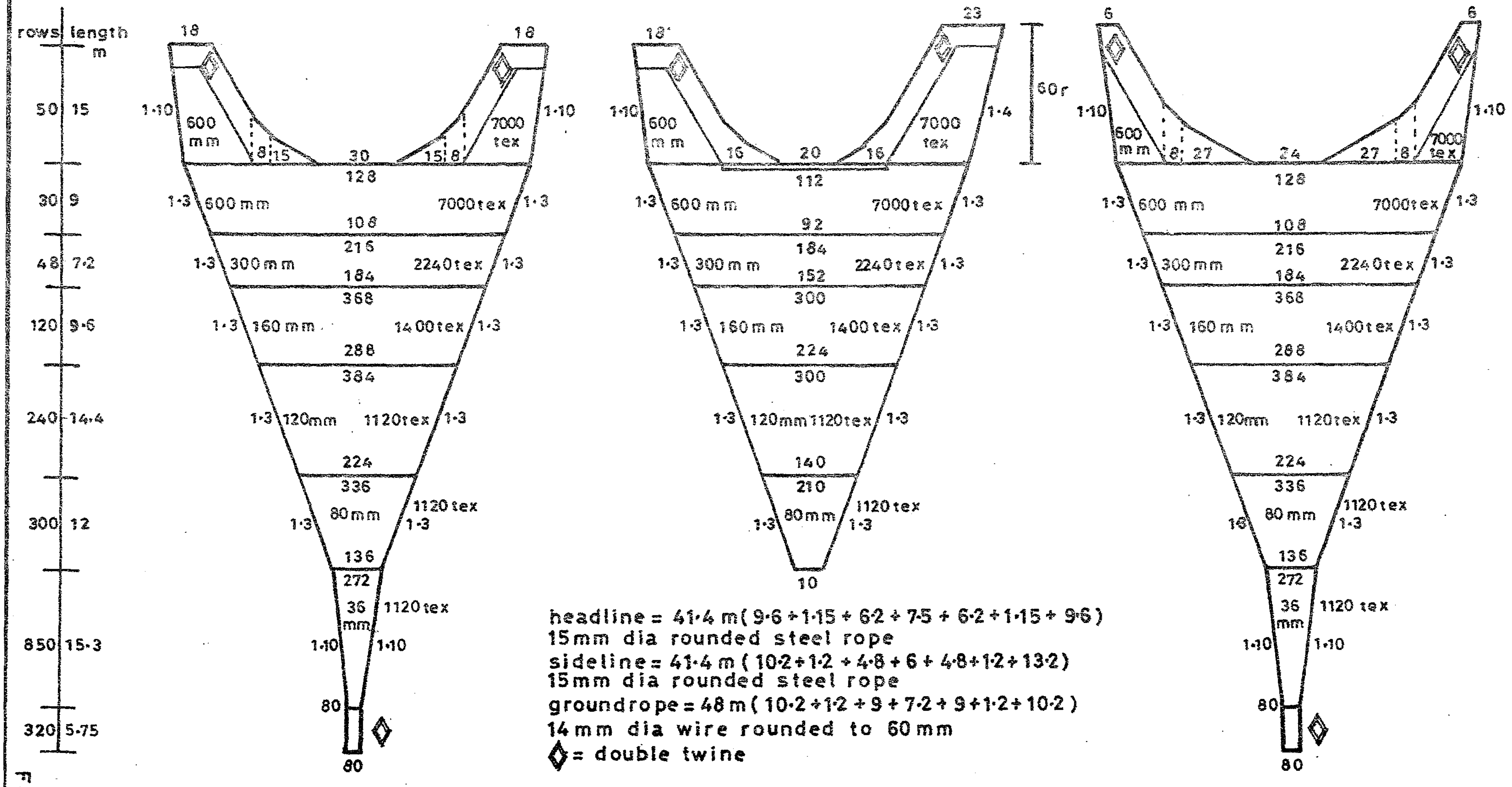
During trials a speed increase of one knot lifts the delagic trawl in three to four minutes about 20 fathoms.

A question was put forward about encountered difficulties when fishing in side currents and when turning. The rapporteur stressed that the behaviour of the delagic trawl, especially when fishing close to the sea bed, should be monitored by the netsounder.

The delagic trawl is primarily designed for catching species which are just off the sea bed, e.g. roundfish and herring.

The difference in behaviour and catching performance between the delagic trawl and the semi-pelagic trawl was discussed and it was proposed to present papers about this subject on the next working group meeting.

DELAGIC TRAWL (1000 H. P.)



headline = 41·4 m(9·6 + 1·15 + 6·2 + 7·5 + 6·2 + 1·15 + 9·6)
15mm dia rounded steel rope
sideline = 41·4 m (10·2 + 1·2 + 4·8 + 6 + 4·8 + 1·2 + 13·2)
15mm dia rounded steel rope
groundrope = 48 m (10·2 + 1·2 + 9 + 7·2 + 9 + 1·2 + 10·2)
14mm dia wire rounded to 60mm
◊ = double twine

FIGURE 1

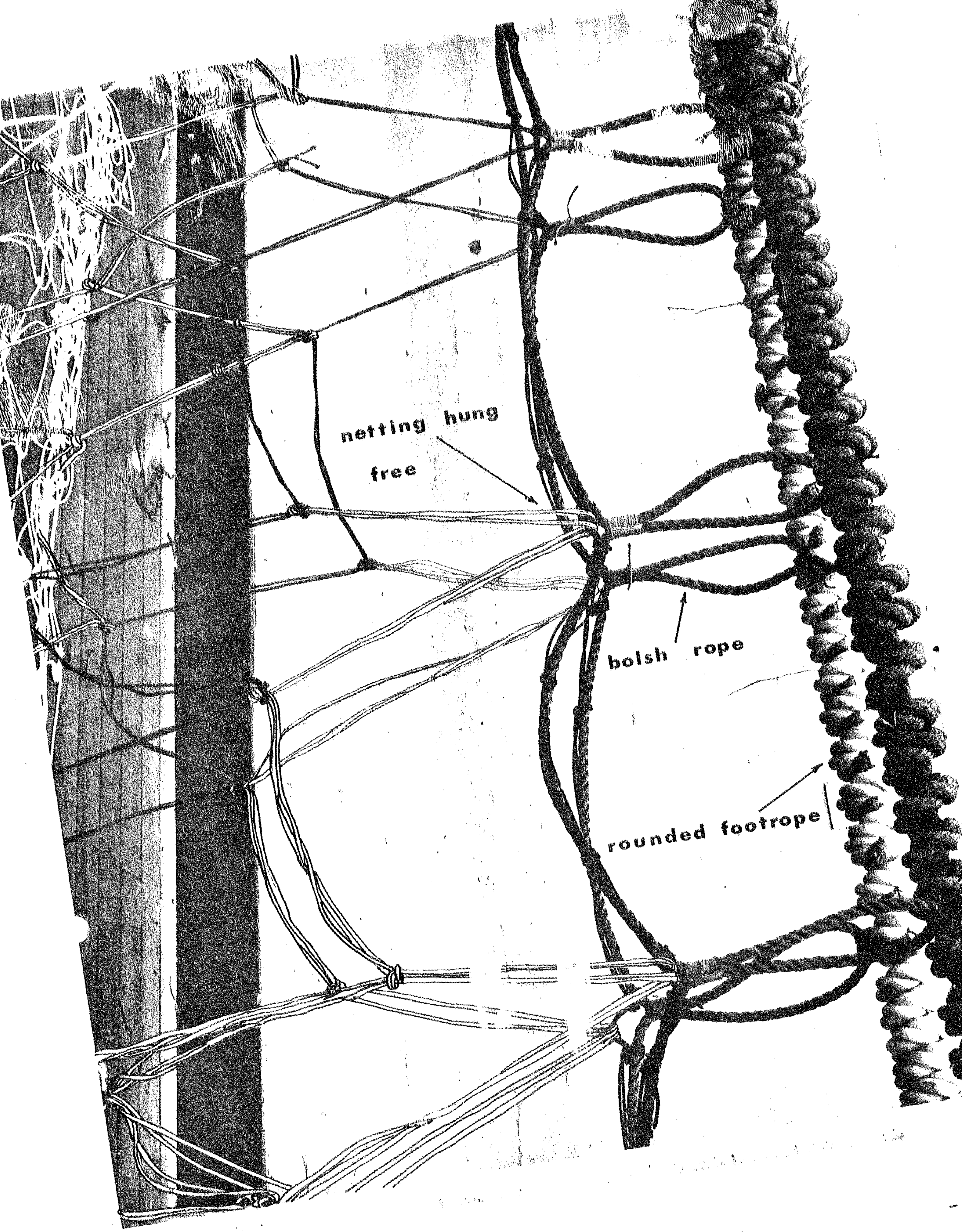
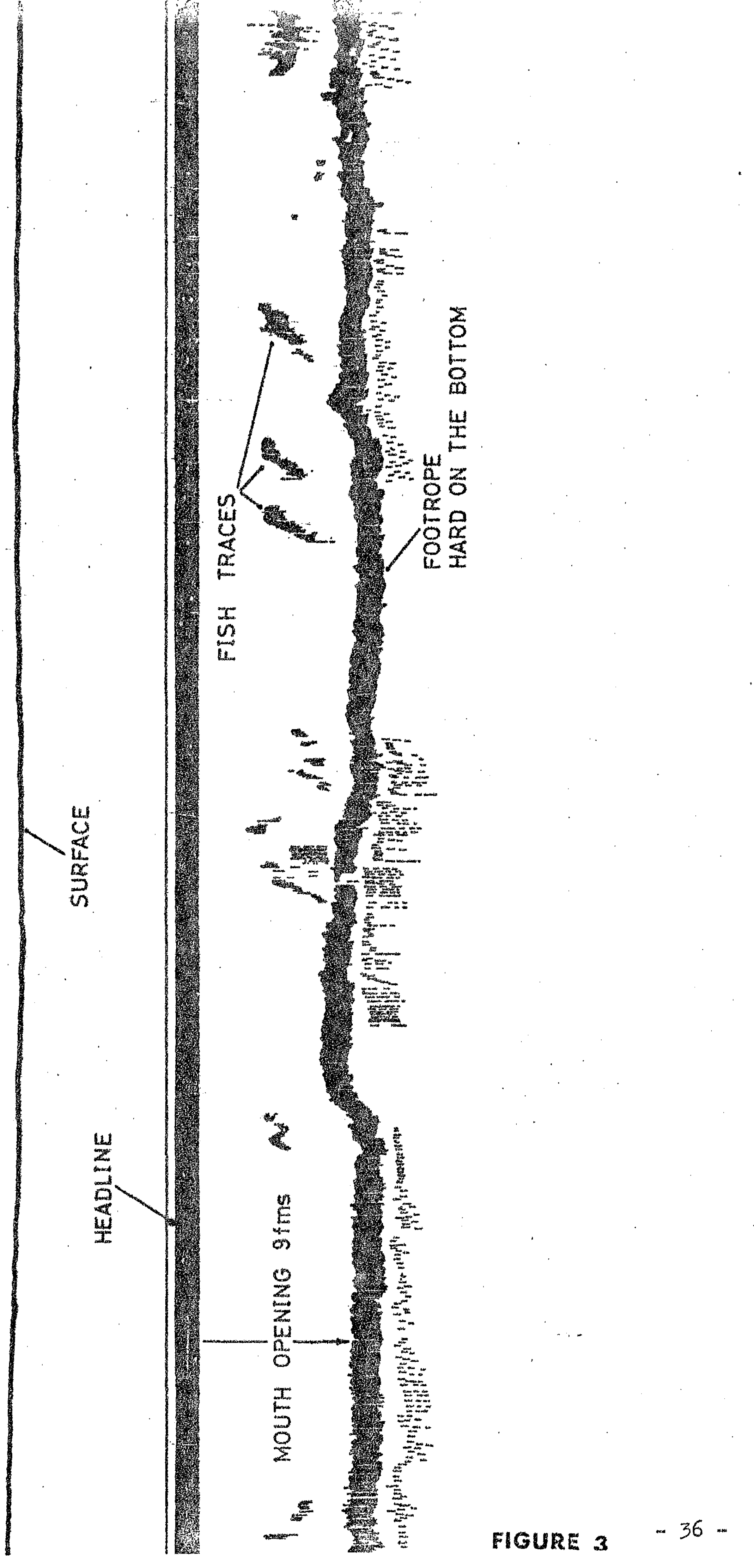
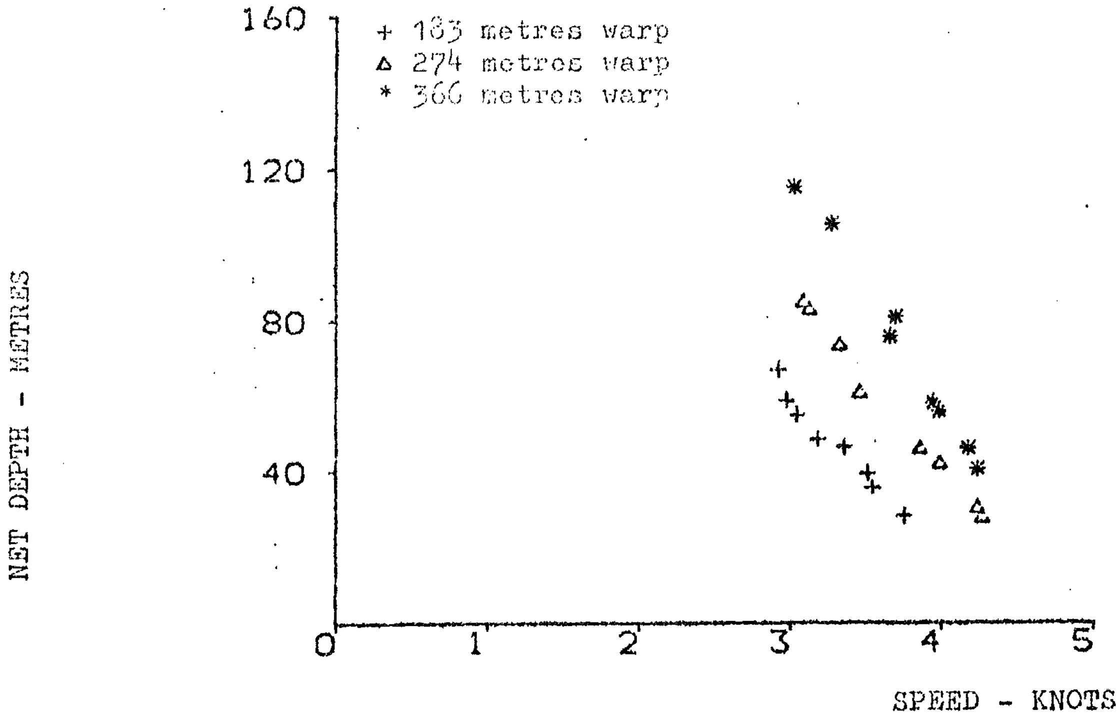


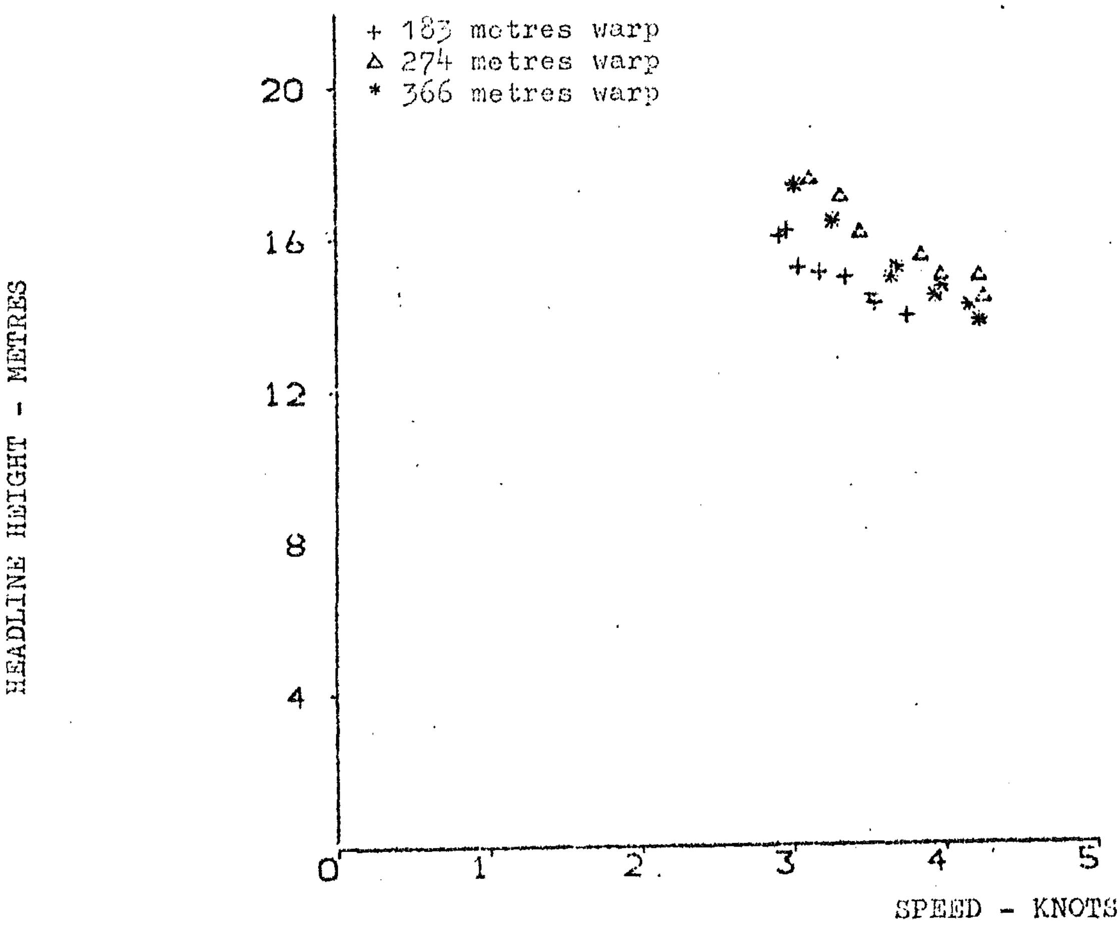
FIG 2 TAILORING OF FOOTROPE



SURFACE
HEADLINE
MOUTH OPENING 9fms
FISH TRACES
FOOTROPE
HARD ON THE BOTTOM

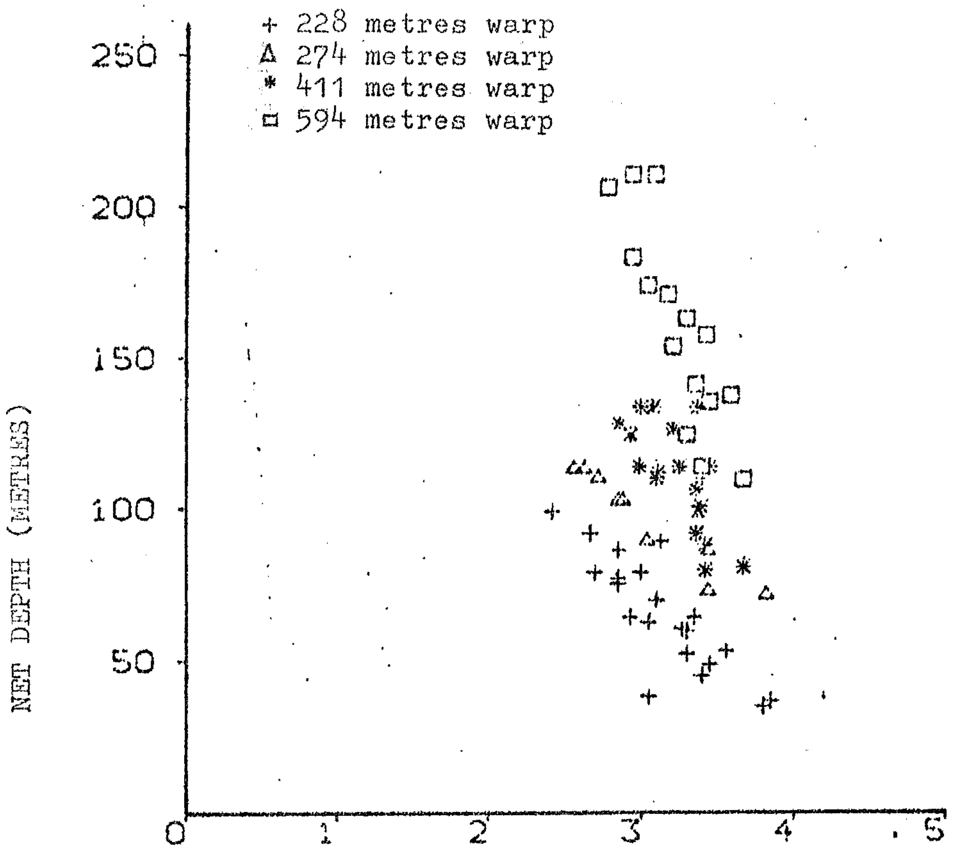
FIGURE 3

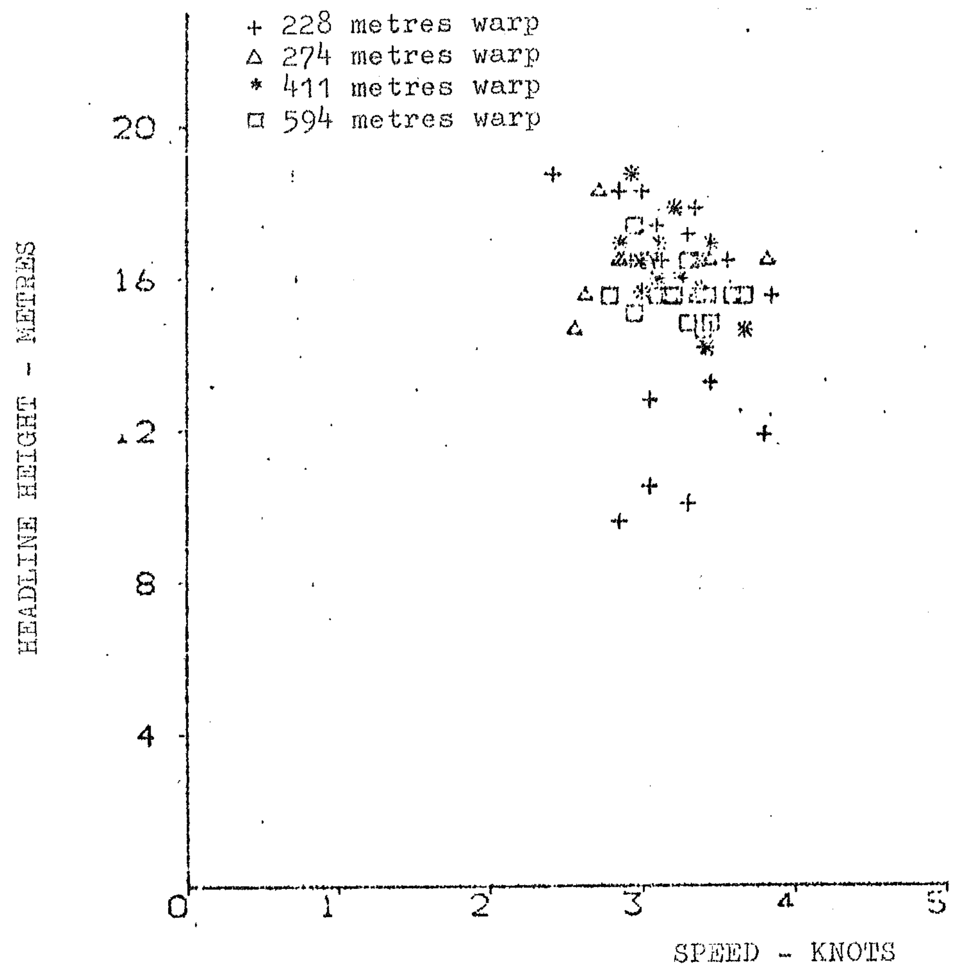




600 HP DELAGIC TRAWL

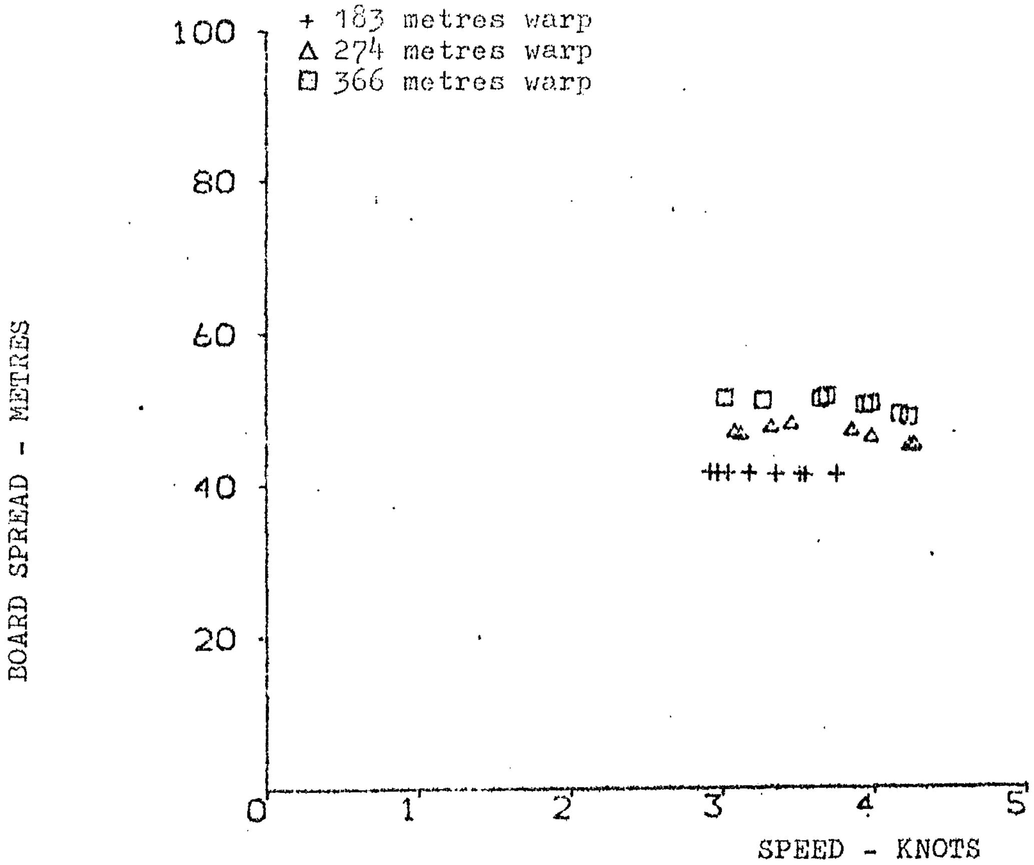
FIGURE 4 & 5

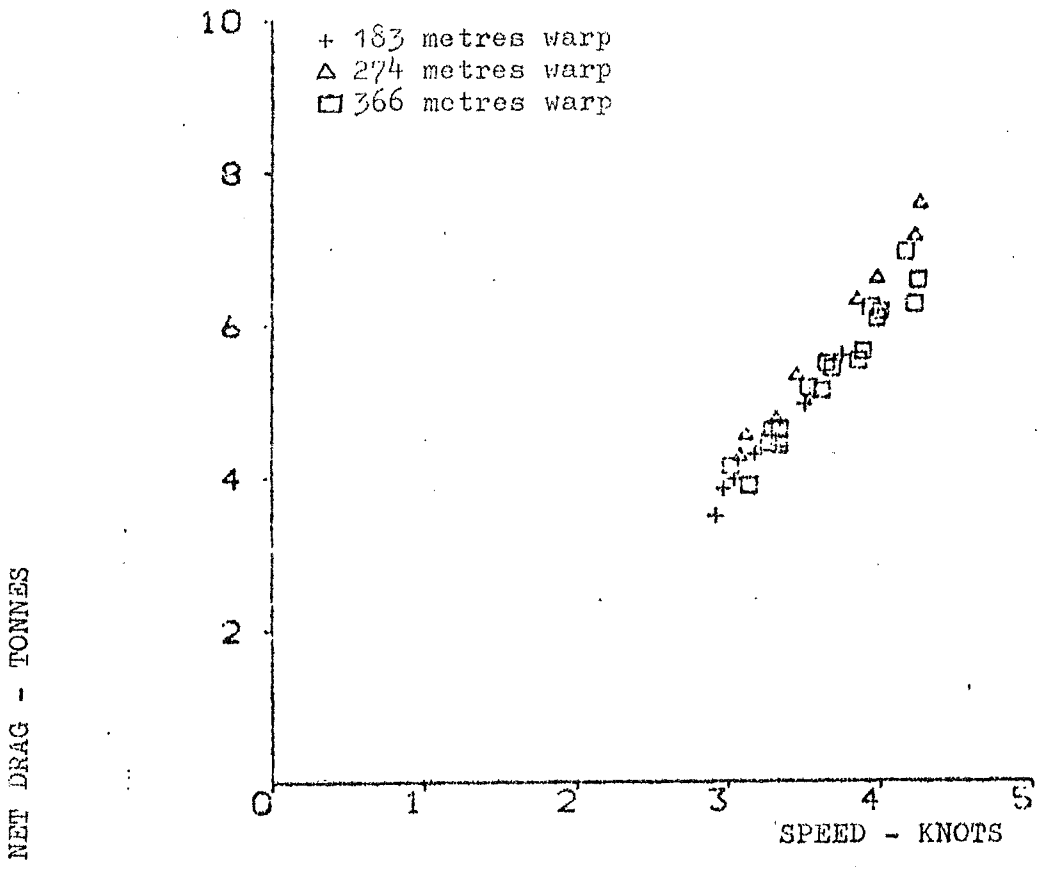




1000 HP DELAGIC TRAWL

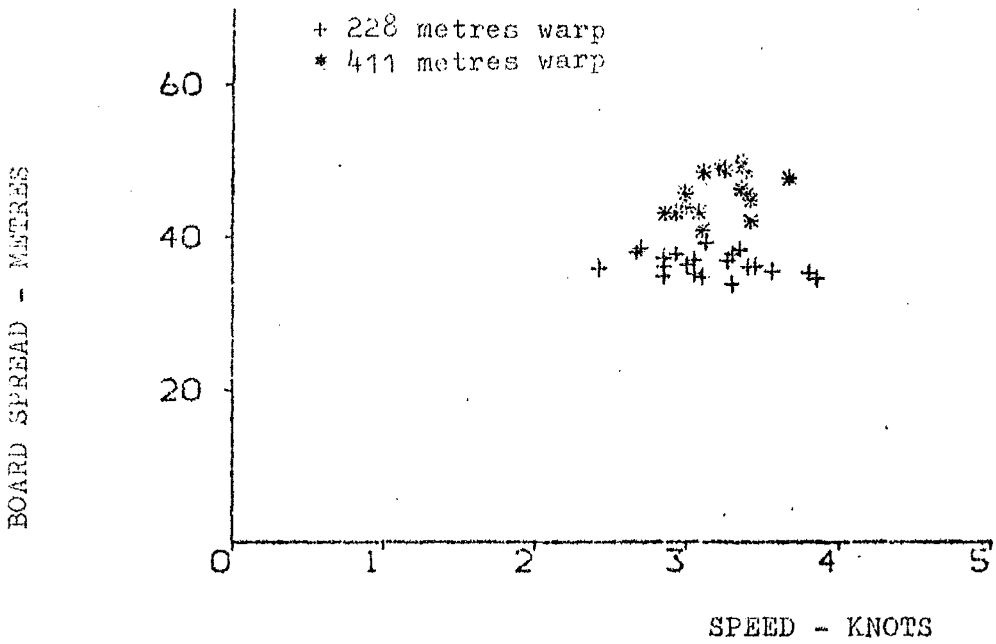
FIGURE 6 AND 7

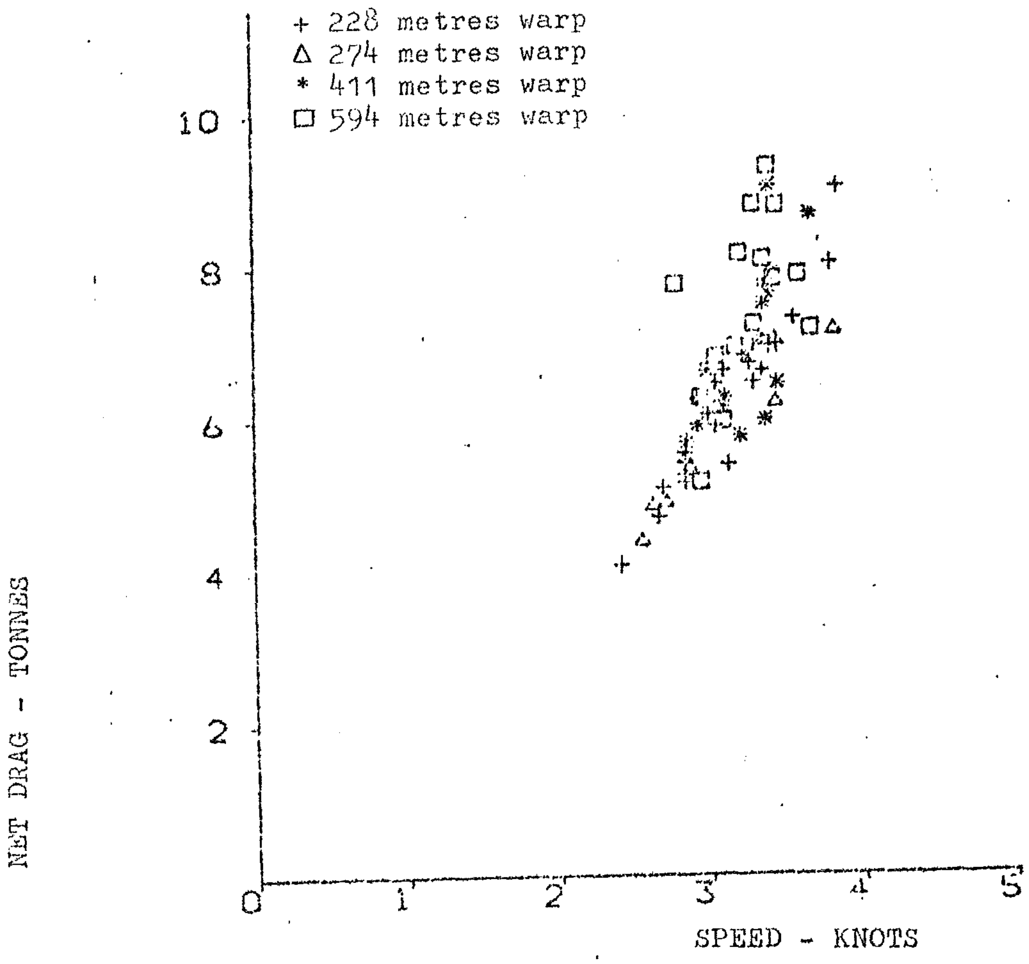




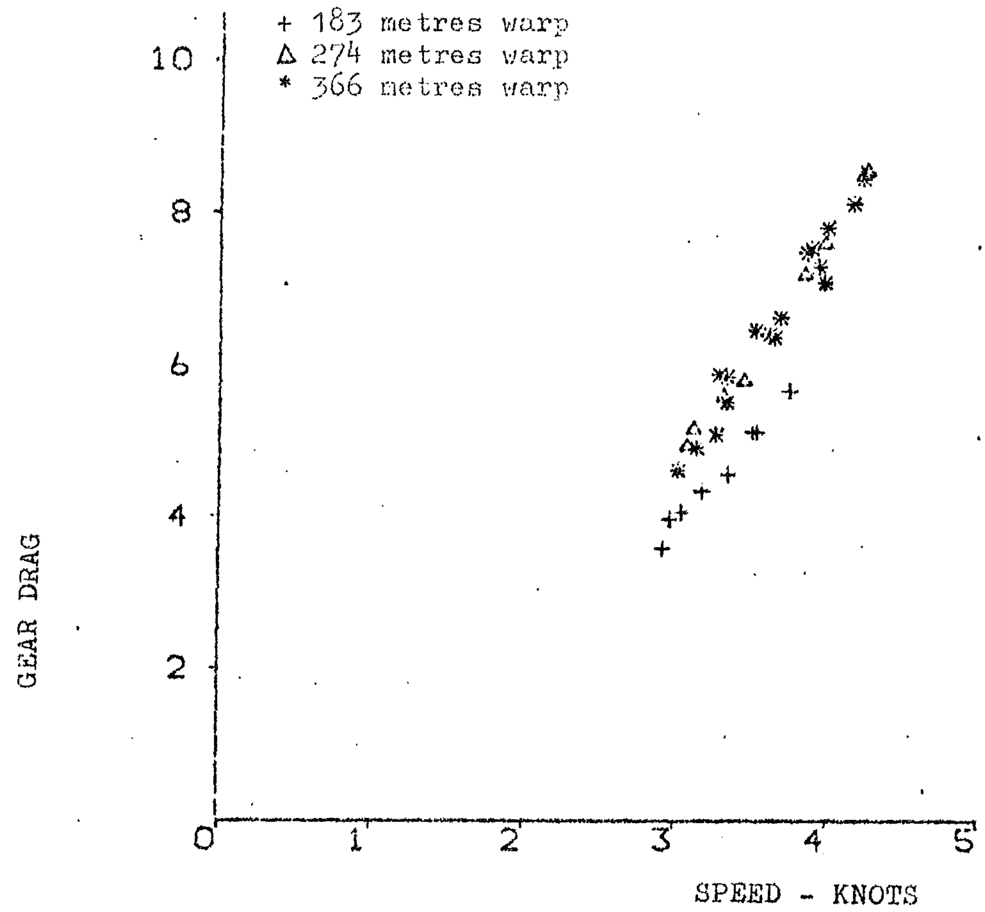
600 HP DELAGIC TRAWL

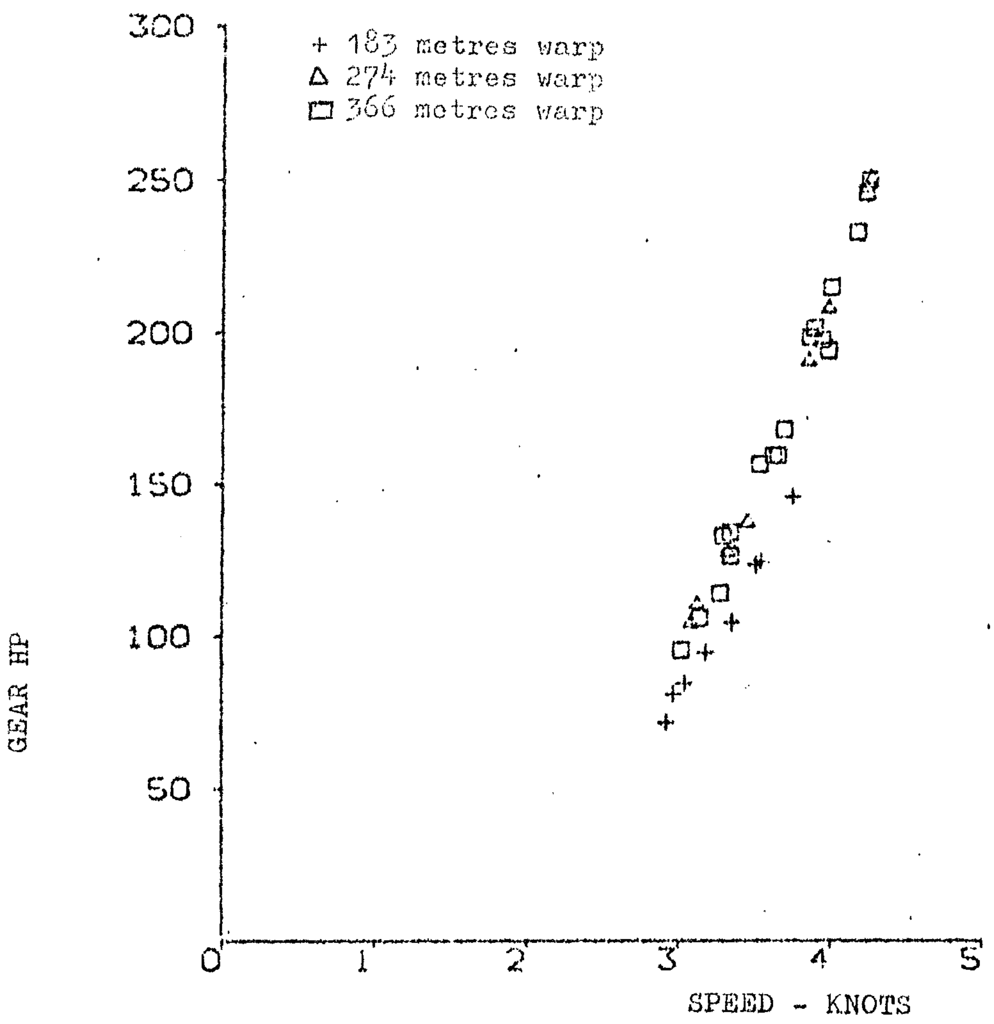
FIGURE 8 AND 9





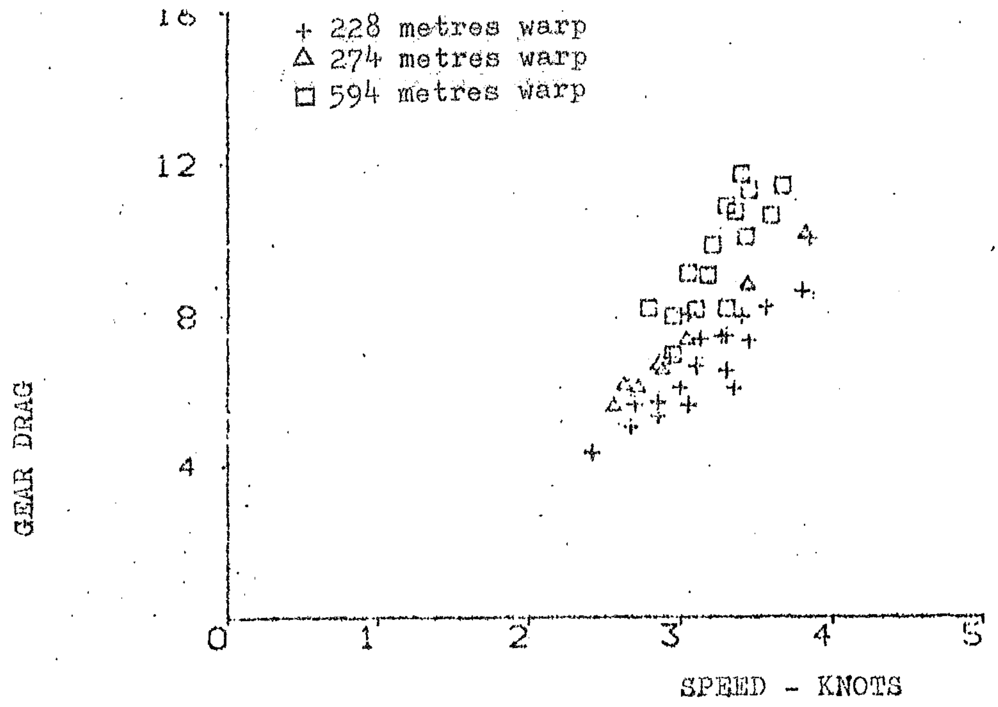
1000 HP PELAGIC TRAWL FIGURE 10 and 11

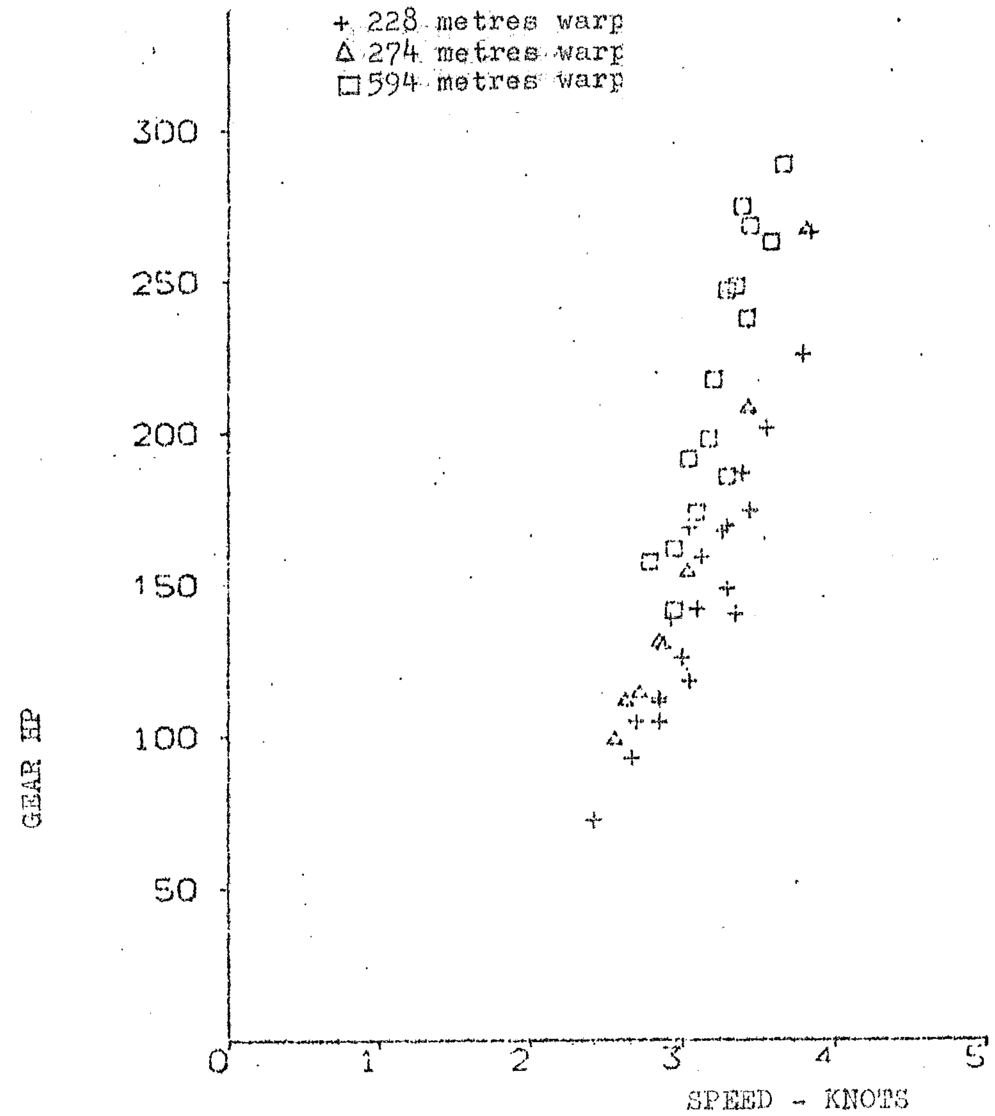




600 HP DELAGIC TRAWL

FIGURE 12 AND 13





2000 HP DELAGIC TRAWL FIGURE 14 AND 15

4.5 A simple net drag formula for pelagic nets of similar design

by Dr. Aenea J. Reid; Marine Laboratory, Aberdeen.

Introduction

The formula discussed in this paper is designed to predict the net drag of a pelagic net at varying towing speeds from information available simply from a net drawing. Such a formula has various uses; it can be used at the design stage to assist the designer in the matching of net size to vessel power or it can be used to help in the choice of gear required for the rigging of a net. It is not claimed that this formula is highly accurate -experimental data is not yet of the quality to assess such a claim anaway- but it is a simple formula, readily evaluated, which has been found to be in fair agreement with experimental data collected by the Marine Laboratory.

Basic hypothesis

The basic formula for the drag of a body in water takes the form:

$$D = \frac{1}{2}\rho V^2 A C_D$$

where D= drag, ρ = density of water, V= velocity of water flow past the body, A= projected area of the body perpendicular to the direction of flow and C_D is the coefficient of drag [4] . This last parameter is an empirical constant depending on the shape of the body and on Reynolds number $R_e = VL/\nu$ where L=body length and ν is the kinematic viscosity of water. The extent to which C_D varies with R_e depends on the shape of the body and the nature of its surface.

A fishing net, however, is not riged and its shape and total surface area vary with the speed of water flow through the net. Thus the paramater A varies with speed and the relationship between C_D and R_e varies from net to net.

In two papers published on the subject of net drag [2 and 3] , the authors have derived formulae for the drag of a panel of netting having the form:

$$D = \frac{1}{2}\rho V^2 R C_D (\alpha)$$

where R is the area of twine in the net panel and the coefficient of drag, $C_D(\alpha)$ is a function of the angle of incidence, α , of the netting to the direction of flow.

Fridman and Dvernik [2] generalise this further, obtaining a formula for a whole net taking the form:

$$D = \frac{1}{2}\rho V^2 R C_D(\bar{\alpha}) \qquad (1)$$

where R is the total area of twine in the net (see appendix 1) and $\bar{\alpha}$ is the mean angle of incidence of all the netting panels which together make up the net. To evaluate $\bar{\alpha}$, however, it is necessary to know the overall shape of the net as it is being towed. Proceeding on the assumption that the net is roughly conical in shape, having eliptical cross-section, a fair estimate of $\bar{\alpha}$ can be made provided that values of net headline height and wingend spread, corresponding to particular towing speeds, are known. Until engineering trials are performed on a net, values of headline height and wingend spread cannot yet be accurately predicted.

To avoid the problem of the estimation of $\bar{\alpha}$, it was postulated that the relationship between towing speed and mean angle of incidence would remain reasonably constant over a range of nets of similar design. This assumption then implies that, for such a range of nets, the coefficient of drag will be a function solely of the towing speed, V.

Derivation of formula

To test this hypothesis, experimental data relating to six pelagic nets of similar design was examined. The data indicated that D/V^2 varied inversely with V and so, for each net, $V^2 R/D$ ($=2/\rho C_D$) was plotted against V. The resulting graphs suggested a linear correlation between V^2R/D and V. For each net, a set of mean points ($V, V^2R/D$) was estimated and then these points were used to calculate a mean linear relationship between V^2R/D and V (see figure 1). The relationship thus obtained was:

$$2/\rho \ C_D = V^2 R/D = 54.72 V + 115.2 \qquad (2)$$

where V is in knots, R is in square metres and D is in tonnes.

Substituting this relationship into equation (1) gives:

$$D = V^2R/(54.72V + 115.2) \qquad (3)$$

which is our simple drag formula. The method for evaluating the twine area, R, is explained in Appendix 1.

In Table 1 a comparison is made of the drag predicted by equation (3) and average experimental drag values for the six nets used in the derivation of the formula. The overall agreement obtained is within 10% of the experimental results. Since this figure is within the order of accuracy of experimental results (see figs.2,3,4 and 5), the level of agreement is felt to be acceptable.

Comparison of formula with experimental results

To test the ability of the formula to predict net drag, furter experimental results were collected and compared with the formula's predictions (see figs. 5,6 and 7). Some of these results are from the MK1E, a net already considered (see fig. 5) but have been collected since the formula was derived. The other results (figs 6 and 7) are from two nets, the MK1C and the DELAGIC, not used in the development of the formula. In Table 2 the average experimental drags with the formula's predictions. In the case of the MK1E agreement is seen to be within 7% while in the case of the MK1C and the DELAGIC nets, agreement with the mean points is within 2%.

Sphere of application

The formula stated in equation (3) should only be used in predicting the net drag of a net design similar to the six nets used in the derivation of the formula. That is, the net should be a four panel pelagic trawl, constructed of nylon twine, with the dimensions of its four panels roughly equal. Net drawings of the six nets used may be found in a Marine Laboratory Internal Report by S.T.R. de Silva (1). These nets range in size from one suitable for 150-400 h.p. vessel to one suitable for 1200-2000 h.p. vessel. Of the six, four were designed at the Marine Laboratory while the other two (the C600 and the 1000E) are commercial nets. Thus this restriction on the use of the formula does permit considerable variation in surface, mesh size and twine size.

All eight nets on which the formula has been tested so far are made out of nylon twine. It is likely that a net made of another material would not give rise to exactly the same relationship between towing speed and coefficient of drag in which case the coefficients 54.72 and 115.2, derived for nylon nets, would not be applicable. Thus, for the moment, use of the formula must be restricted to nylon nets.

References

1. S.T.R. de Silva — "Marine Laboratory Pelagic Trawling Gears; Net Specifications and a Summary of Essential Gear Parameters", Marine Laboratory Internal Report 1974

2. A.L. Fridman and A.V. Dvernik — "Development of a Method for the Calculation of the Resistance of a Trawl Net", Fischerei Forschung, 11 part 2 (1973), pp 7-13

3. T. Kowalski and J. Giannotti — "Calculation of Fishing Net Drag", University of Rhode Island Marine Technical Report No.15, 1974.

4. E.G. Richardson "Dynamics of Real Fluids", Edward Arnold and Co., London 1950.

Notation

A surface area, projected into a plane perpendicular to the direction of flow.

C_D coefficient of drag

D drag

L length of a body

R twine area (see Appendix 1)

R_e Reynold's number $= VL/\nu$

V velocity of water flow or towing speed of net

α angle of incidence

$\bar{\alpha}$ mean angle of incidence

ν kinematic viscosity of (sea)water

ρ density of (sea)water

Discussion

In the discussion the author asked for gear and performance data in order to test the formula for net drag calculation for different gears.

APPENDIX 1

The twine area of a net is calculated in the following manner:

Partition the net into trapezium shaped panels, P_1, P_2, ..., P_n: each panel having constant mesh size and twine size.

Let

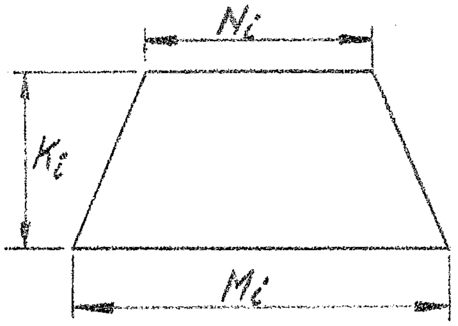
N_i = number of meshes along the top of panel P_i

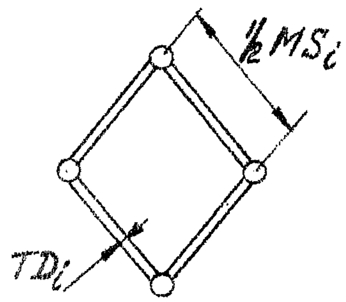
M_i = number of meshes along the foot of panel P_i

K_i = number of rows (of knots) in the panel P_i

MS_i = mesh size in panel P_i

TD_i = twine diameter in panel P_i





Then

$$R_i = \text{twine area in panel } P_i = \frac{(N_i+M_i)}{2} \times \frac{K_i}{2} \times 2 \times MS_i \times TD_i$$

in units of mesh size x twine diameter. This must be converted into square metres before using in the drag formula. Let C be the appropriate conversion factor *. Then the total twine area, R, is given by

$$R = C \times \sum_{i=1}^{n} (N_i+M_i) \times K_i \times MS_i \times TD_i/2 \text{ m}^2$$

* If MS_i and TD_i are in inches then $C=6.452 \times 10^{-4}$; if they are in mm then $C=10^{-6}$

TABLE 1

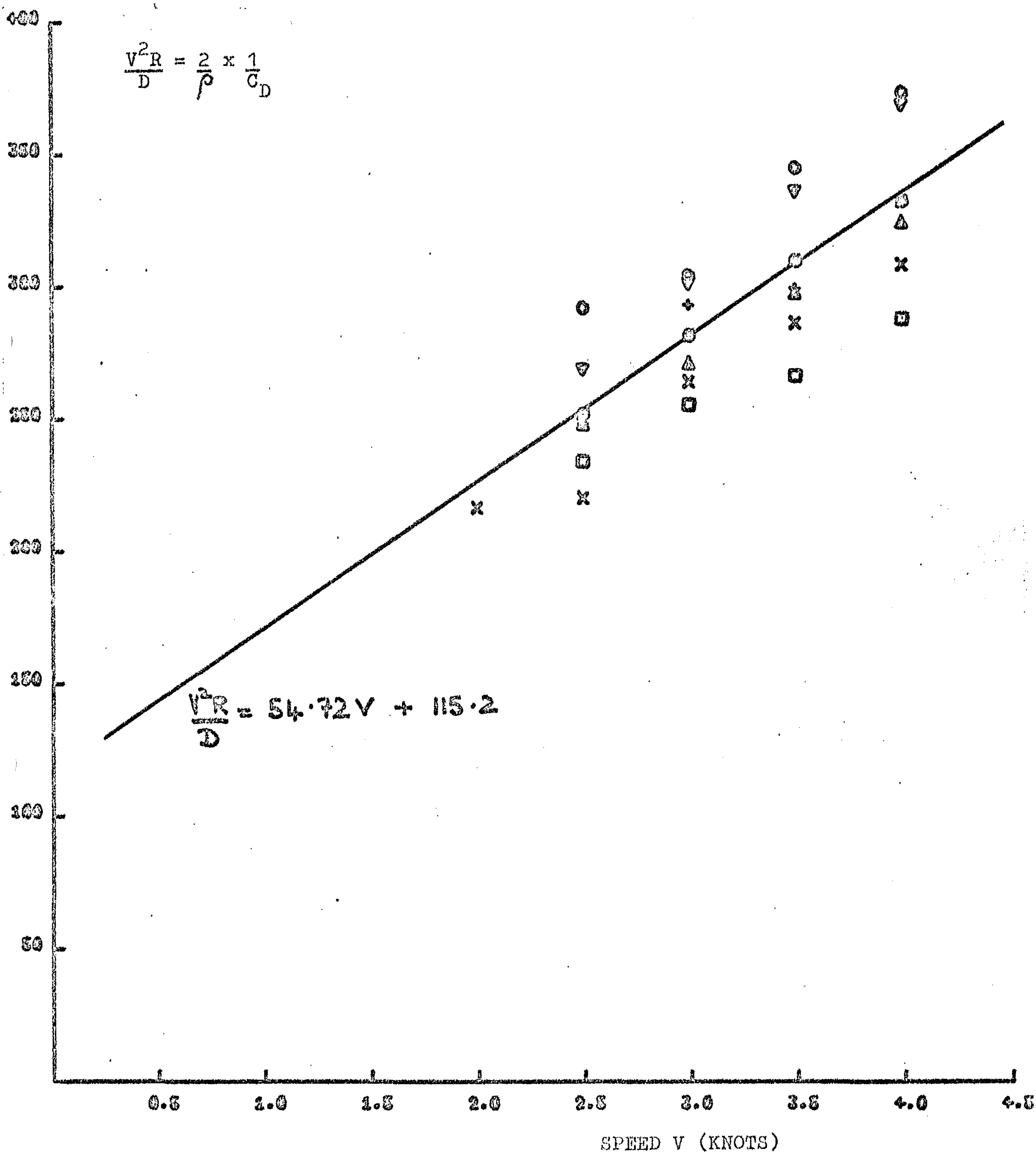
COMPARISON OF FORMULA DRAG WITH MEAN EXPERIMENTAL DRAG OF NETS USED IN THE DERIVATION OF THE FORMULA

NET	SPEED (KNOTS)	AVERAGE EXPERIMENTAL DRAG (TONS)	FORMULA DRAG (TONS)	RELATIVE ERROR
MK1M	1.5	0.465	0.418	0.10
	2.0	0.695	0.653	0.06
	2.5	1.08	0.910	0.16
	3.0	1.23	1.18	0.04
	3.4	1.39	1.41	0.01
C600	2.0	2.06	2.16	0.05
	2.5	2.96	3.01	0.02
	3.0	3.80	3.91	0.03
MK2C	2.5	1.97	2.01	.02
	3.0	2.40	2.61	.09
	3.5	3.00	3.24	.08
MK1E	2.6	2.95	2.80	.05
	3.0	3.79	3.43	.09
	3.5	4.79	4.25	.11
	4.0	5.68	5.10	.10
1000E	2.5	4.37	4.1	.06
	3.0	5.67	5.33	.06
	3.5	7.15	6.60	.08
	4.0	8.20	7.92	.03
MK2S	3.0	7.78	8.01	.03
	3.5	9.67	9.94	.03
	4.0	11.20	11.91	.06
	4.2	11.8	12.72	.08

TABLE 2

COMPARISON OF FORMULA DRAG WITH MEAN EXPERIMENTAL DRAG TAKEN FROM EXPERIMENTAL DATA NOT USED IN THE DERIVATION OF THE FORMULA

NET	SPEED (KNOTS)	AVERAGE EXPERIMENTAL DRAG (TONS)	FORMULA DRAG (TONS)	RELATIVE ERROR
MK1E	3.1	3.36	3.59	0.07
	3.3	3.66	3.92	0.07
	3.8	4.29	4.25	0.01
	3.8	4.94	4.75	0.04
	4.0	5.33	5.10	0.05
	4.2	5.72	5.44	0.05
MK1C	2.5	2.23	2.22	0.004
	2.7	2.44	2.49	0.02
	3.0	2.86	2.89	0.01
	3.3	3.27	3.30	0.01
DELAGIC	2.7	5.46	5.35	0.02
	3.0	6.15	6.22	0.01
	3.3	7.17	7.11	0.01
	3.5	7.65	7.71	0.01
	3.7	8.23	8.32	0.01

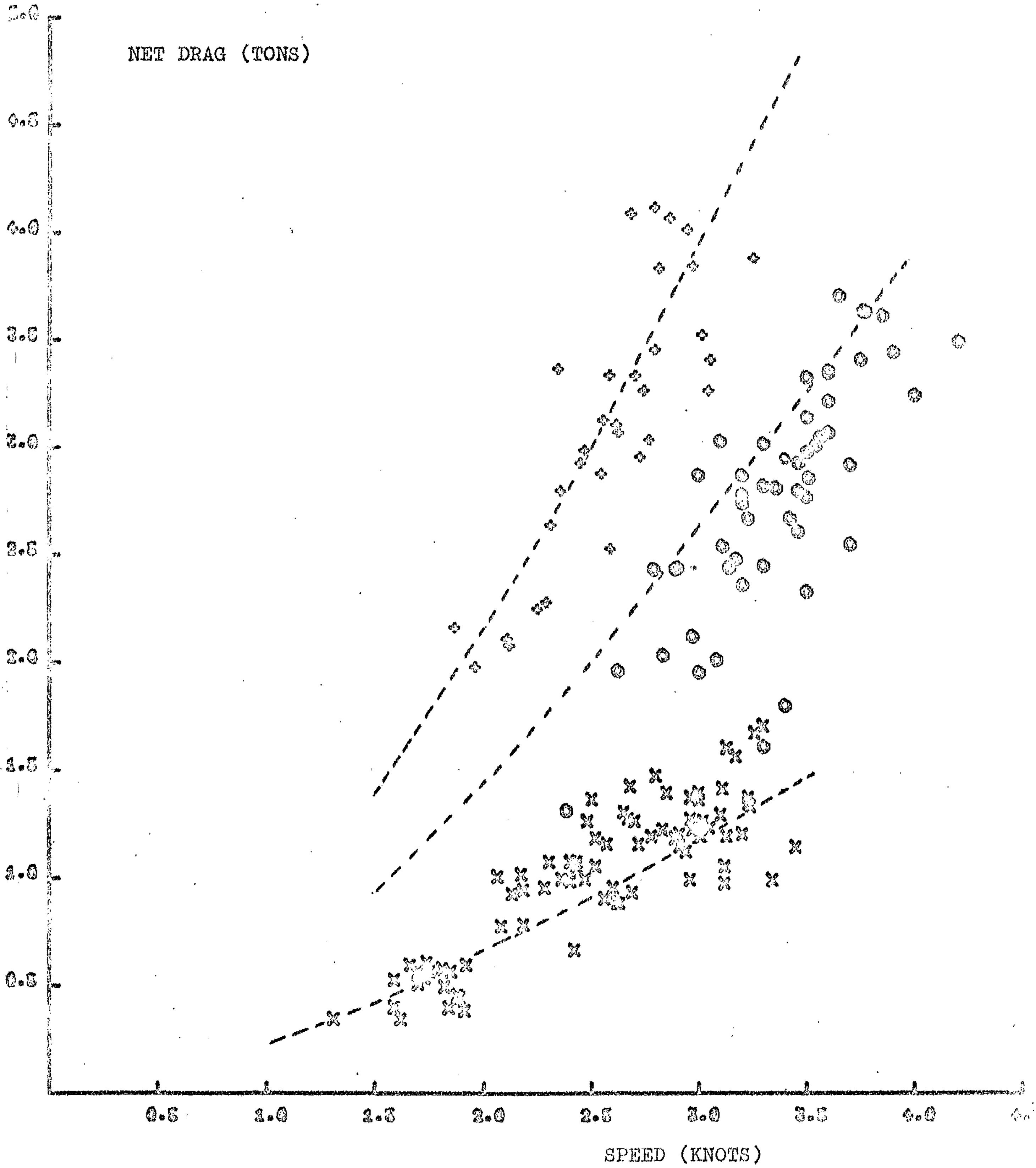


Relationship between C_D and V

FIGURE 1

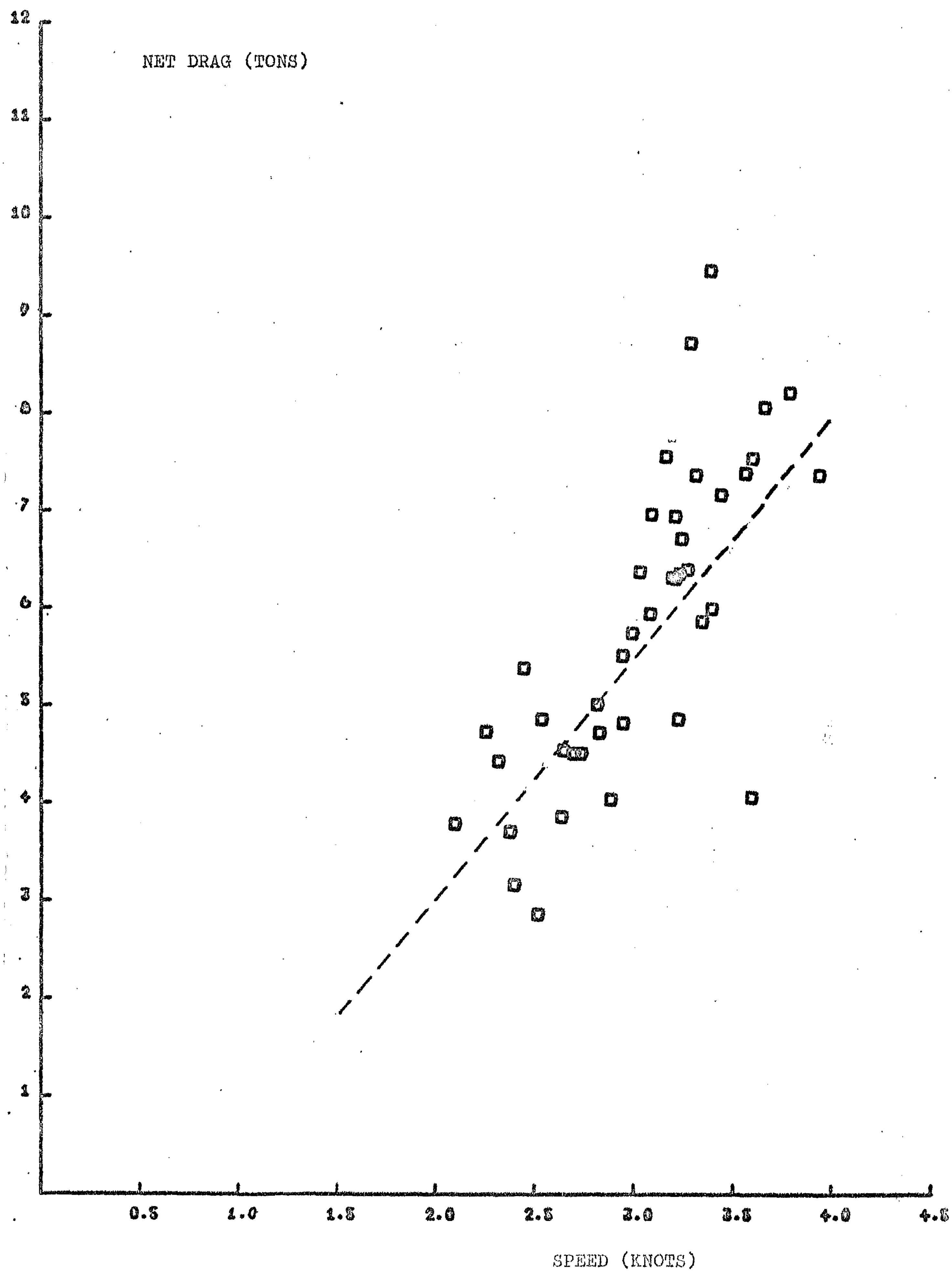
Average values for each net MK1M (X), C600 (+), MK2C (O)
MK1E (▲), 1000E (◘), MK2S (▼) mean of averages (●)

In figures 2-7 the dashed curves denote net drag as predicted by equation (3).



NETS: MK1M, MK2C AND C600

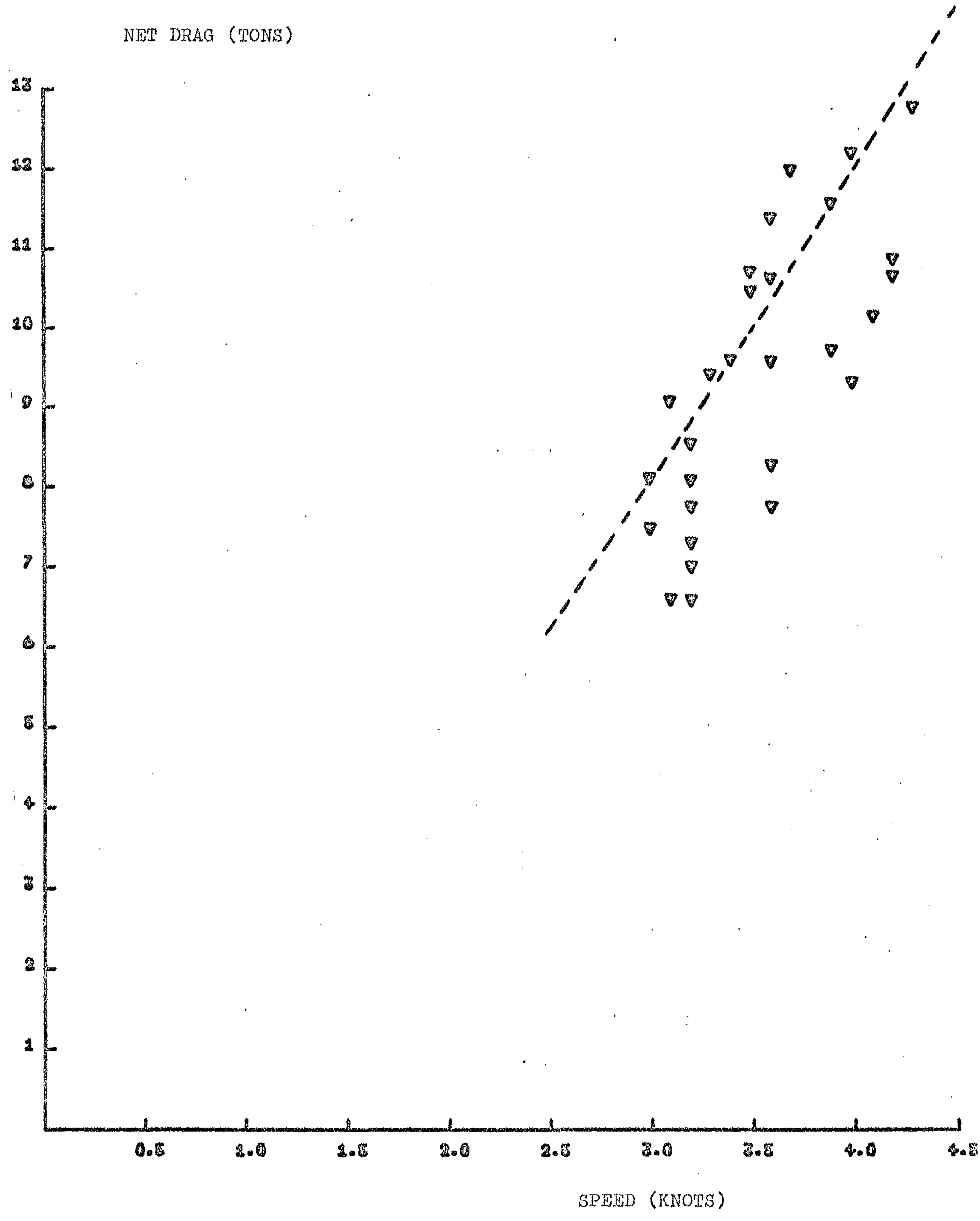
Comparison of formula with experimental results FIGURE 2
MK1M (X) MK2C (O) C600 (+)



NET: 1000 E

FIGURE 3

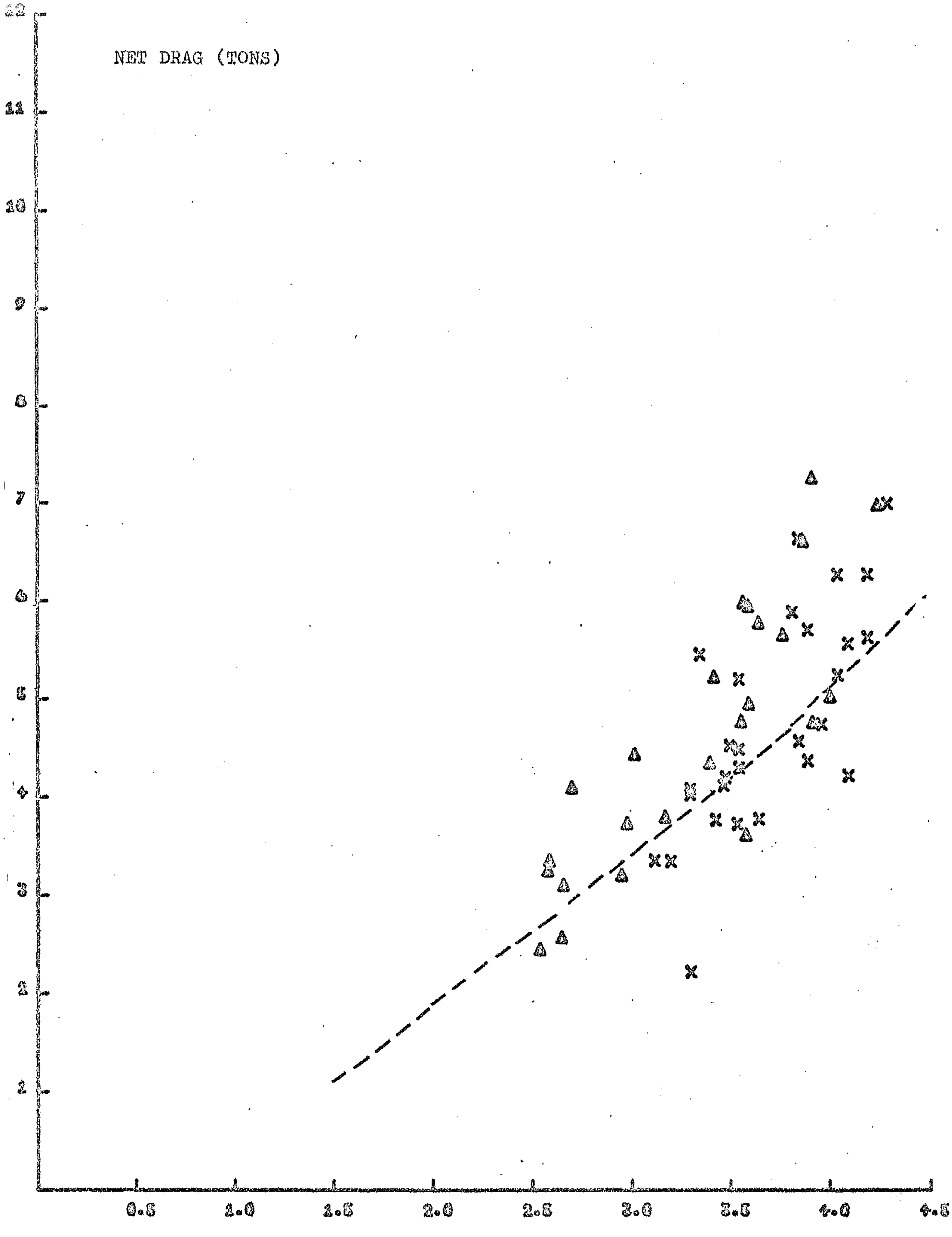
Comparison of formula with experimental results



NET: MK2S

FIGURE 4

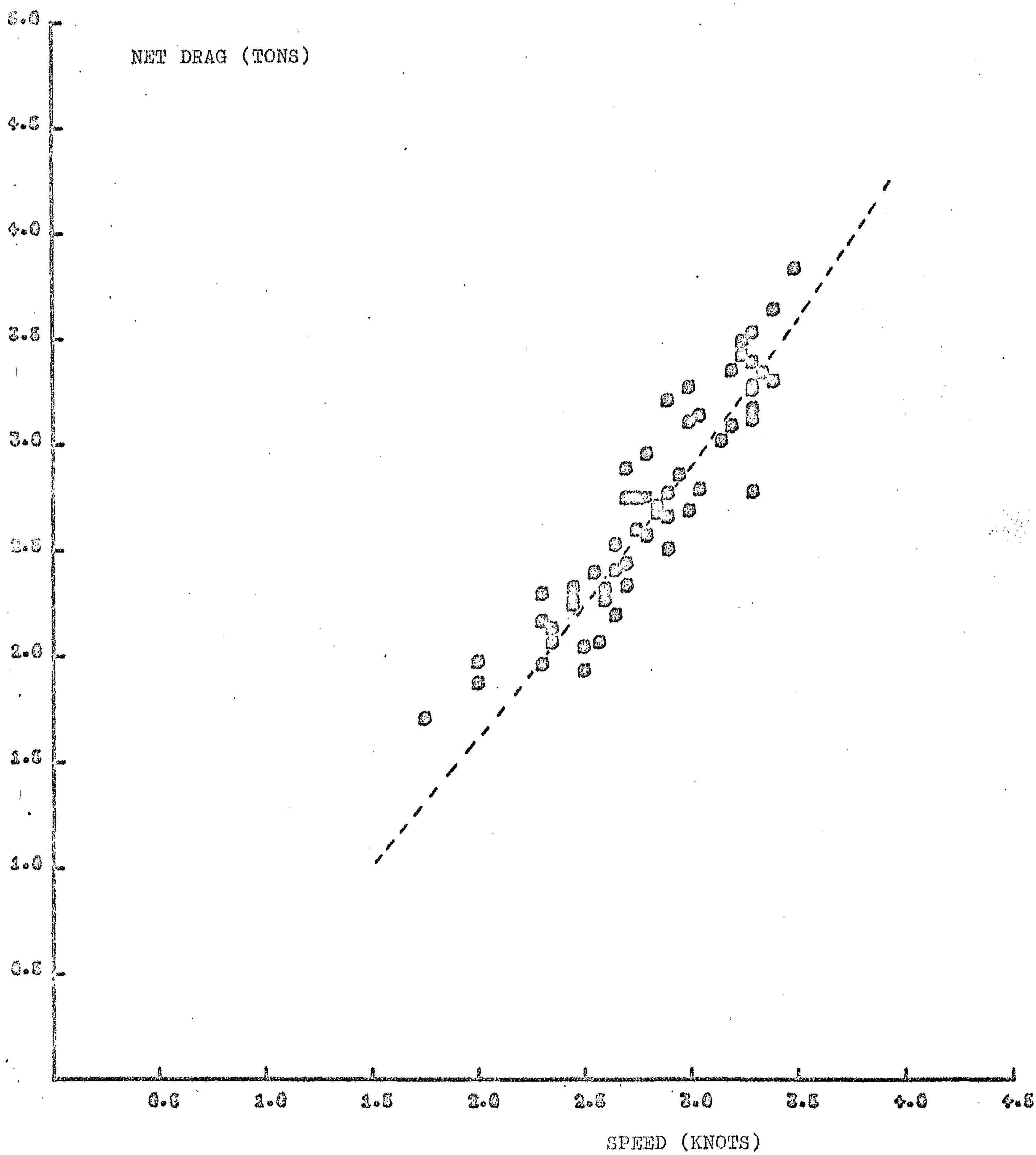
Comparison of formula with experimental results



NET: MK1E

FIGURE 5

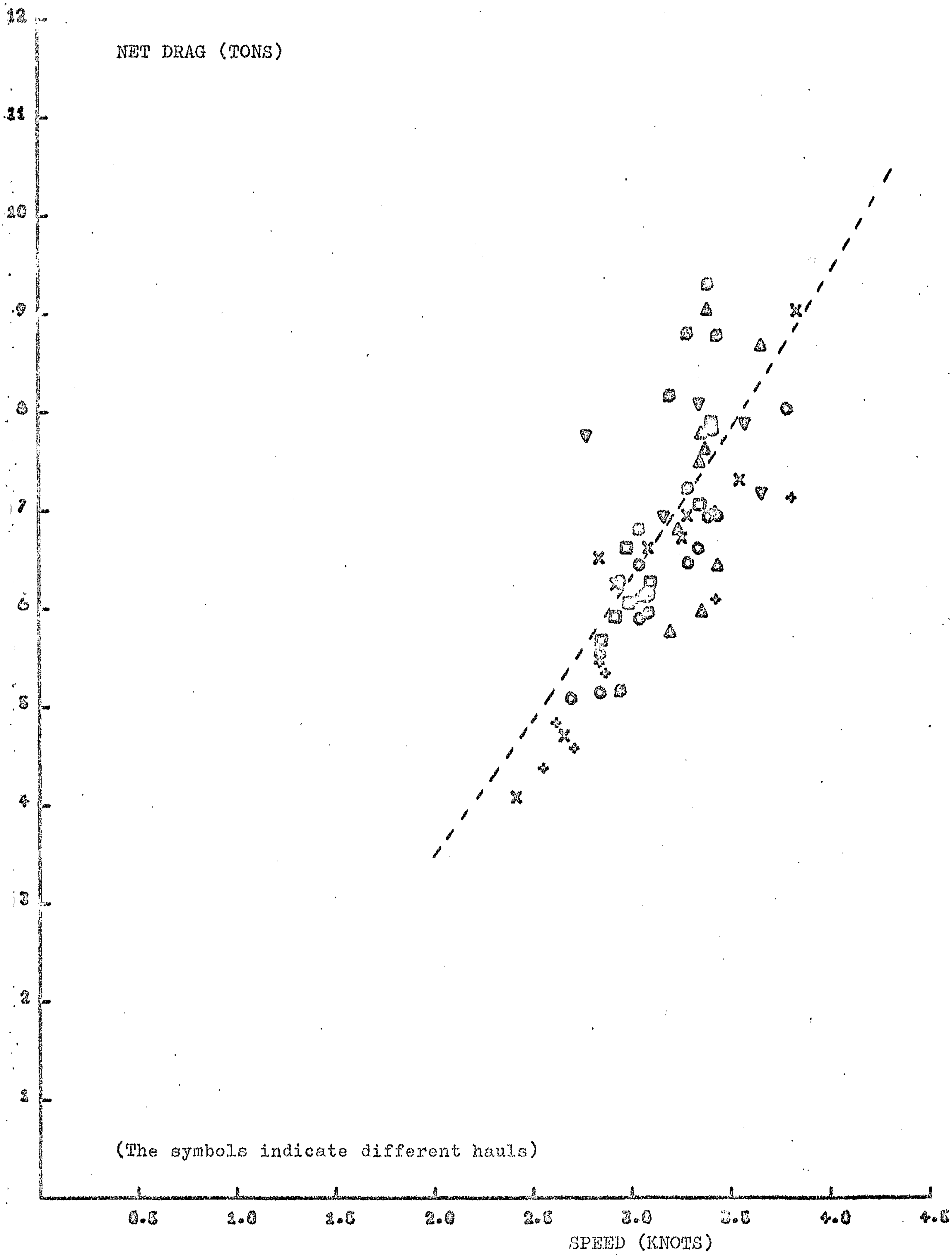
Comparison of formula with experimental results
△ points used in derivation of formula; (X) new points



NET: MK1C

FIGURE 6

Comparison of formula with experimental results
this net is not used in derivation of formula



NET: DELAGIC 1000 HP FIGURE 7

Comparison of formula with experimental results
This net is not used in derivation of formula

4.6 Norwegian experiments with deep sea traps

by John W. Valdemarsen, Institute of Fishery Technology Research, Bergen.

Development of efficient and selective gears to capture high-quality fish is an essential part of the research program of the Institute of Fishery Technology Research. In this connection fish traps have become of special interest, and since 1974 the Institute has carried out experiments with a modified U.S.-designed deep sea trap. The trap is rectangular, collapsible and measures 0.75x0.75x2.25 m. An isometric view of this trap is shown in Figure 1. The traps are set in strings of 20 units, and attached to a groundline at intervals of 40-50 fathoms.

The aim of our experiments was to find if any of the demersal fishes in Norwegian waters could be captured in commercial quantities with this kind of gear, and to see whether conventional Norwegian coastal fishing vessels were able to operate it rationally.

So far five extensive fishing trials have been conducted at different times of the year and on different fishing grounds along the Norwegian coast, where most of the actual demersal fishes have been available in good concentrations.

The trap used has shown to be very species-selective for torsk (Brosmius brosme), which was captured in commercial quantities in most of the trials. The best catches were obtained outside the Senja Island in northern Norway and on the continental slope northwest of the Shetland Islands (250-300 fm depth) with average catches of 30-50 kg per trap and individual catches upto 100 kg per trap.

The fishing trials have further shown that conventional Norwegian fishing vessels in the size-group 60-100 feet and with a crew of 5-6 can easily operate 150 traps per day. These results indicate commercial application of this type of gear to capture torsk, and presently an eighty feet vessel is fishing with traps for a couple of months in order to test the profitability of such a fishery.

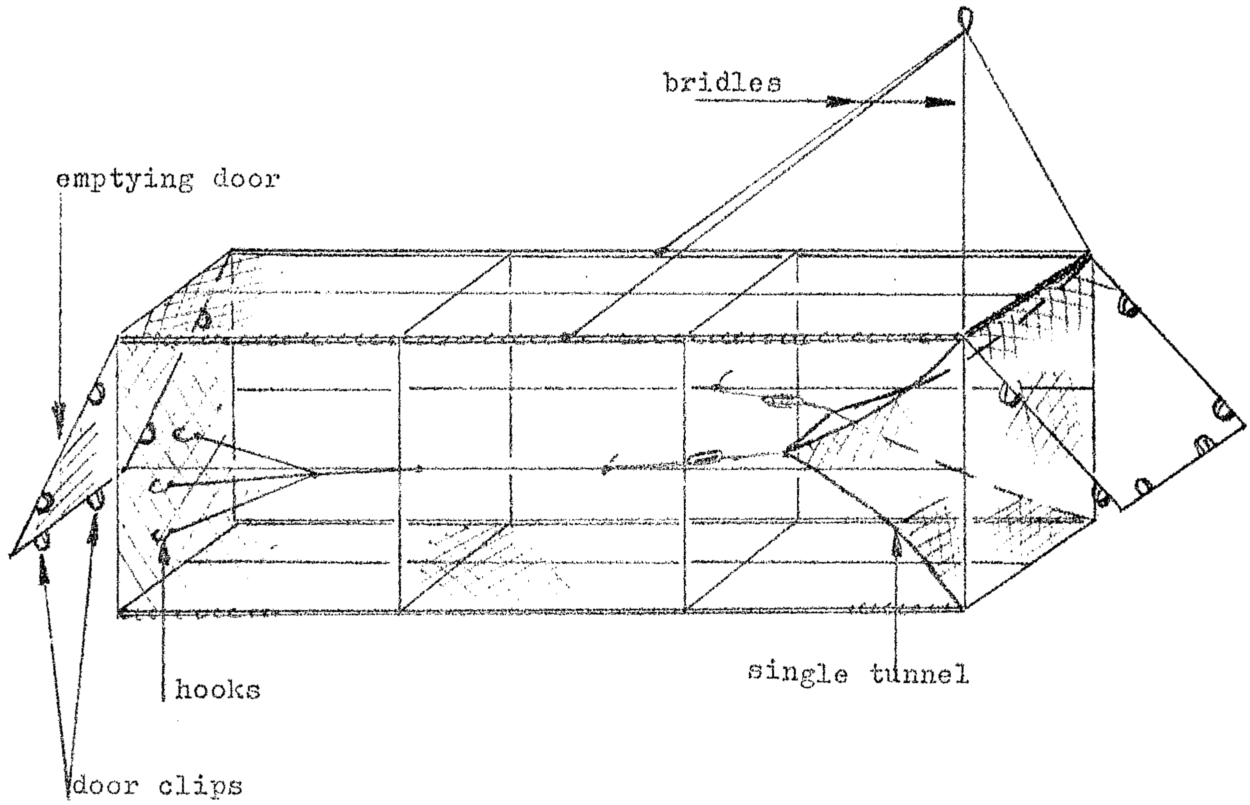
Another application for the traps was reported from a cruise to the Azores with the Norwegian research vessel "G.O. Sars". Large quantities of conger eel (Conger conger) were caught in traps, with individual catches up-to 150 kg per trap.

During our trials the most common demersal species e.g. cod, haddock etc. were not taken in sufficient numbers to indicate prespects for commercial application.

Some recent observations of the behaviour of these fishes in relation to traps, however, indicate that changes in the construction and in use of the traps might improve the catching efficiency considerably.

Positioning of the bait within the trap, the shape of the tunnels and the position of the trap entrance in relation to the direction of the current are factors which seem to play an important role for the catching efficiency.

Detailed studies of these and similar factors under actual fishing conditions are now undertaken by use of a low light UWTV set attached to the trap.



All frames are made of 10 mm dia. steel rod.

FIGURE 1 - Isometric view of a 0.75x0.75x2.25 m Deep Sea Trap

Discussion

The strings of traps are positioned at both ends by 35 kg anchors. The material of the 16 mm diameter groundline is polypropyleen, which is buoyant.

A question about the specification of the deck machinery was answered by the author. The traps can be hauled by a normal line-hauler of 1000-2000 kg pull. The weight of a trap in air is 35 kg.

During the trials the traps with two tunnels proved to be most efficient.

Interests were expressed about the application of trap fishing around wrecks e.g. in the North Sea.

Participants from the United Kingdom reported about the encountered problems during experiments when shooting strings of traps in areas with tidal currents.

4.7 Deep sea trawling

by G. Freytag, Institut für Fangtechnik, Hamburg, Federal Republic of Germany.
(Rapporteur: G. Freytag)

Dr. Freytag reported on further investigations onboard the F.R.V. "Walter Herwig" into deep sea trawling which took place in May 1975 on the slope of the continental shelf west of the British Isles.

For these trials a bottom trawl of 200 feet headline was used. This gear was rigged with a 80 feet groundrope of plastic bobbins, 60 metres bridles, 6 m^2 otterboard and two kites attached to the headline. Up to a depth of 800 metres the performance of the gear was monitored by means of a netsounder. For studying the bottom profile and its condition at great depths a 12 kHz echosounder was used.

Like on preceding cruises at each depth a particular species was prevailing. Fishing at a depth of 800 metres the grenadier (Cory haenoides rupestris) was dominant; catch rates up to 10 metric ton per hour were recorded. At a depth range of 1000 to 1200 metres a lot of sharks were caught. At 1500 metres depth the rabbit fish (Chimaera monstrosa) was prevailing. During this cruise the maximum towing depth of the gear was 2000-2200 metres.

Discussion

The discussion concentrated on the limitations of both echosounder and netsounder equipment in deep sea trawling operations.

In order to extend the detection range of vertical fish finding equipment it is imperative to use a stabilized, narrow beam transducer with high efficiency. The depth range can also be extended by mounting the transducer(s) in a towed body. In Canada and Norway these towed bodies are in the designing stage.

The limiting factor of the netsounder in deep sea trawling is the breaking load of the netsounder cable. German calculations showed that at normal towing speed and 900 metres cable of 13 mm diameter paid out, the cable tension is 1.5 tonf (breaking load 1.9 tonf).

It was expressed that the moment the gear sets on the bottom is distinctively observed by the warptension meters.

4.8 Norwegian experiments with prawn sorting trawls

by Ludvig Karlsen, Institute of Fishery Technology Research, Bergen.
(Rapporteur: S. Olsen).

Work on prawn sorting trawls continued with gear trials last fall in Northern (Varangerfjord) and Western Norway (Karmøy area). The experiments included further testing of:

- a 60 mm (stretched mesh) separation panel vertically mounted in the mouth of a 1156 meshes (40 mm) semi-balloon Kodiak trawl;
- side sorting panels (60 and 80 mm) in a 1400 meshes high-headline (Campelen-Super) trawl and
- 50 and 60 mm separation panels mounted in the Super-trawl obliquely from about the middle of the belly to the aft edge of the baiting.

The experiments with the vertical separation panel at the mouth of the trawl confirmed the previous findings that with such a net good separation of fish is achieved, but the catch of prawn is significantly reduced.

Only small amounts of prawn were separated by the side sorting panels in the Super-trawl, evidently because in this high-headline trawl the flow of water at the top is much greater than at the sides.

The installation of separation panels inside the belly part of the trawl is a new concept, which appears to have no observable effect on the prawn catching performance of the gear. The two tested nets, in addition to variations in mesh size, differed also somewhat in method of mounting of the panels and in shape of the meshes. Passage of prawn through the separation nets into the trawl codend averaged 85 percent for the 60 mm separation panel and 80 percent for the 50 mm separation panel. Fish separation varied with species. With both separation panels 80 to 90 percent of the cod and haddock were sorted, while about half of the numbers juvenile redfish, flatfish and Norway pout passed through the separation panel and were collected in the trawl codend.

Further experiments are planned in Spring and Autumn of 1976.

4.9 Remote sensing

by G. Freytag, Institut für Fangtechnik, Hamburg, Federal Republic of Germany.
(Rapporteur: G. Freytag).

In his verbal contribution the rapporteur described the procedure and equipment used for spotting pelagic stocks by taking aerial photographs. An experiment was carried out in Ivory Coast by a Dornier water-plane equipped with four Hasselblad camera's making colour photographs using different types of filters.

The evaluation of the numerous photographs created a serious problem. The experiment showed that in this area the best results were obtained with black and white films in combination with a blue filter. The photographs were taken of 200 to 300 m. flying-height and the exposure time was 1/500 sec. Practice has shown that this method of spotting fish stocks is applicable under good weather conditions and up to a sea state 2-3.

However, although in the coastal area of this country a lot of fish schools were spotted, the overall result of this experiment was disappointing. Further experiments will be directed to the spotting of fish stocks with low-light television camera's by recording the bioluminescense of fish in the surface layer.

Discussion

Mr. Steinar Olsen told about his experience over a period of three year with aerial survey's for spotting and estimating the abundance of mackerel and sardine species on the west coast of India. The aircraft flew block shaped tracks parallel to the coastline at a flying-height of 1000 m in an area 5 to 20 miles off-shore. The spotted fish schools were photographed by a Minolta camera using a high speed U.V. film. The experiment showed that schools of 10 to 15 m diameter could be observed from a distance of 3 miles. In general the schools had an elliptical shape, the abcissa being 2 times larger than the ordinate. In order to complete the observations the spotted schools were reported to vessels which, among others, determined the specific species.

It was reported that the Herring Industry Board have carried out experiments with an infra-red television camera for detecting of herring.

4.10 Rationalization of sole fisheries by means of electrified beam trawls

by W. Horn, Institut für Fangtechnik, Hamburg, Federal Republic of Germany.
(Rapporteur: G. Freytag).

Because of good prices fishing for sole (Solea solea) is the most lucrative coastal fishery in European waters. The catch is made with beam trawl gear, which is specially designed for this purpose and uses heavy tickler chains. The operational costs have recently taken on such a magnitude that due to financial and biological factors the economic feasibility is questionable. For example, special beam trawlers are constructed up to 2000 h.p. and with 10-11 m beams supporting up to 2 metric tons of chain. The construction costs of such a trawler as well as maintenance and fuel costs and the wear of the fishing gear are correspondingly high. The extent of biological damage caused by heavy gear on the sea bed is still a topic for debate among experts. The "Institut für Fangtechnik" is attempting to develop, with the aid of electrical current, a method which is less destructive to the sea bed and at the same time allows a less expensive and perhaps selective fishing for sole.

The tests were carried out by the F.R.V. "Solea". The vessel was for sole fishing equipped with two 7 meter beam trawls. The starboard trawl was a conventional gear with heavy tickler chains, the port trawl was electrified. In this way an ideal comparison was achieved. The electrified gear consisted of a pulse-generator which produced pulses with variable amplitudes, pulse lengths and frequencies, a special cable to transmit the current to the net, underwater transformers and electrodes.

The electrified net was rigged with only one tickler chain attached approx. 1/2 meter in front of the ground rope. In comparative fishing trials without electricity, in 6 hauls 28 soles were caught with the lighter gear, compared with a total of 141 soles with the heavy gear.

A high tensile cable was specially designed for these tests. During 85 hauls the cable was damaged only 5 times, mostly due to an inappropriate cable thimble used at the beginning of the tests.

After various experiments 2 pairs of electrodes proved to be best (Fig. 1). These consist of normal iron-chains intertwined with copper bands. This electrode system was tested during 75 hauls and showed no breakdowns. After the previous prolonged tests the pulse-generator, cable and underwater transformers proved to work satisfactory.

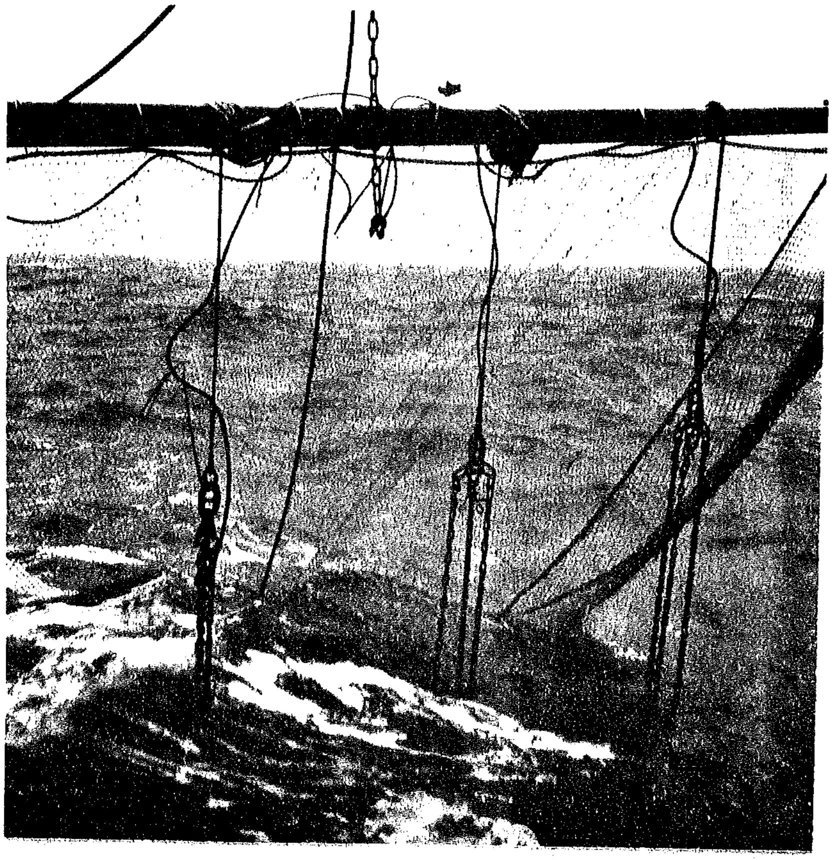


FIGURE 1

Rigging of electrodes and underwater transformers on the beam

In the comparative fishing trials with the electrified and the conventional gears, after the initial adjustments, very marked differences in favour of the electro-fishing system were observed (Fig. 2).

It was observed that by using electricity, commercial fish species were not only caught in greater numbers but also with improved selectivity. In the diagram (Fig. 2) the number of soles in the catches of both the conventional and the electrified gear are approximately equal. However, the weight of the soles caught by the electrified gear was twice as much.

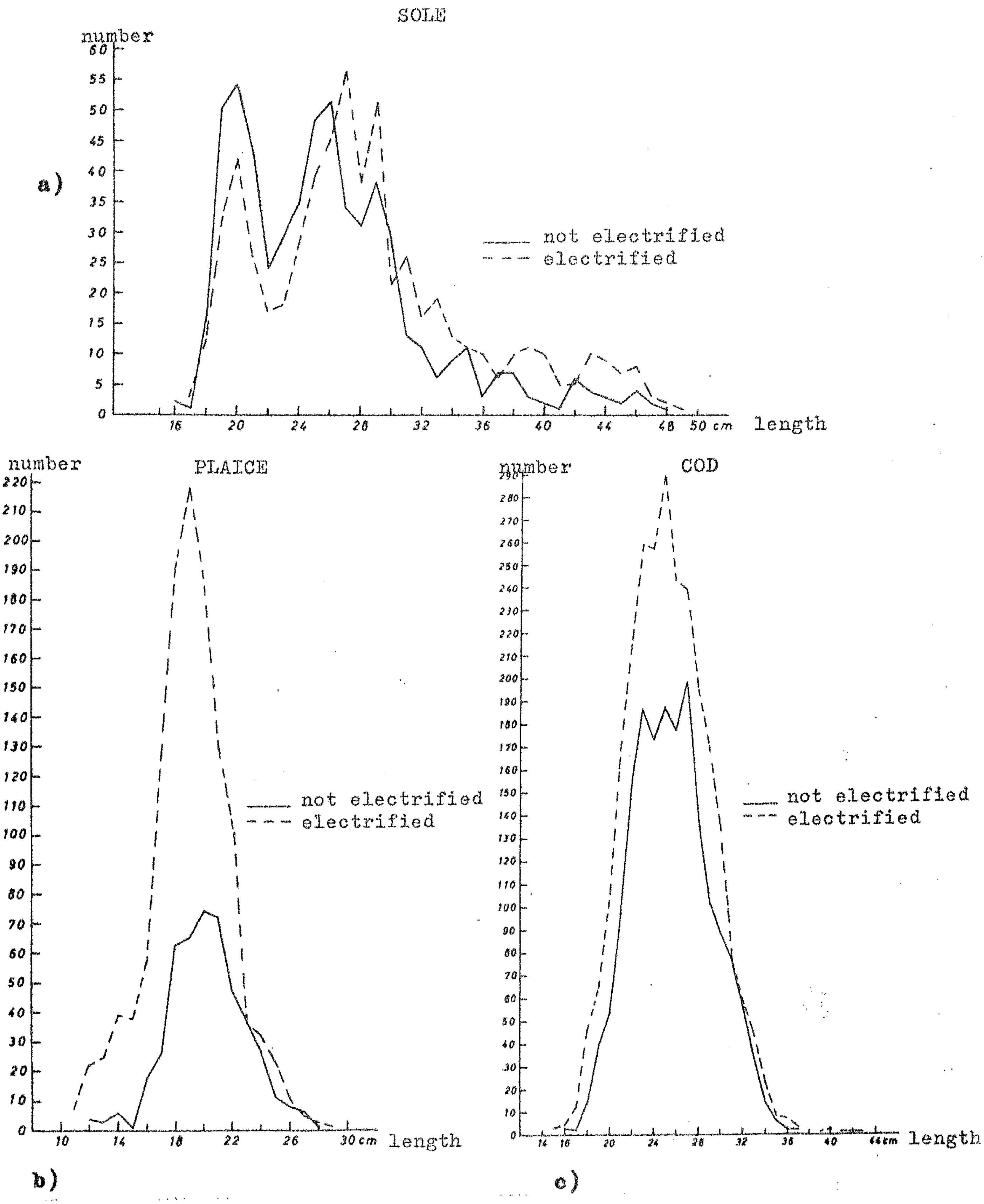


FIGURE 2 - Fish distribution according length and number by conventional and electrified beam trawls (condensor discharge impulse, peak voltage between electrodes 82 V, peak current 1950 amps, frequency 25 Hz)
a) commen sole (Solea solea);
b) plaice (Pleronectes platessa);
c) cod (Gadus callarias)

Since the pulse-generator was limited in capacity, it could not be determined how selectivity changes with increased electrical field strength.

Summarizing it can be stated, that the electrified fishing system, as far as the easy handling of the cable, underwater transformers and electrodes are concerned, is ready to be introduced commercially, but further experiments to optimize the pulse-generator are desirable.

Discussion

In the discussion a request was made for papers on electric fishing systems for the next years meeting in Hamburg.
Apart from the behaviour of fish species to electric stimulation, participants to the meeting expressed interests in the specification of the equipment, the arrangement of special deck machinery and the rigging of the gears.
It was stressed that, because of the possible improved selectivity of electrified gears, the exchange of information can be valuable for protection of the fish stocks.

IJmuiden (The Netherlands), June 1976

E.J. de Boer