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Recent studies on rope trawls

by

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1. Introduction

About the German R + D work with rope trawls it was reported already several times, at last in the 1976 meeting in Paper C.M.1976/B:39. The statement made at that time: "no more problems are seen by the authors ... in the ropes themselves" has to be confined today in so far as it should say that the question if braided or twisted ropes are better for rope trawls, could be clearly decided in favour of braided ones. Recent results of investigations of which shall be given an account in the following allow further differentiations of this point in the meantime.

Two cruises of the FRV "Walther Herwig" and one of the FRV "Solea" with the further development of rope trawls as main research subject took place in 1977. Whereas the trials on "Walther Herwig" were mainly concerned with the development of rope trawls for the far-distance-fleet - especially under the point of view of testing the best suitable rope construction - the cruise of the FRV "Solea" served mostly for R + D work on two-panel rope trawls for the inshore and near-distance-trawlers. Main aim thereby was to find out which type is best suited for this kind of fishery. In addition these trials should deliver the experimental proofs for the advantages of the rope trawls which since some time are guessed theoretically.

2. Investigations on FRV "Walther Herwig"

During these trials a type of net was used whose parts made of netting corresponded exactly to the 630 ⁂ -net (800 mm Mesh-opening in the front part) which is very common in the German fishery. The rope-part of the net was constructed in such a way that theoretically 60 m width between the upper wing tips and 50 m height should be reached. The length of the ropes given in Figure 5 corresponds to the expected length of the ropes under uniformly distributed load. For the construction of the real net they had to be multiplied by correction factors different for each material. These had to be applied with regard to the different elastic elongation of each material. The real values for each forenet differ therefore more or less from the ones given in Fig. 5.

The following rope-materials or -constructions were tested during these cruises.

1. **Atlas-rope**
   This is a twisted rope, consisting of 6 strands and one core. Marking property of the strands is their construction of equal parts of strong monofilament wires and multifilament yarns. By this they gain a remarkable stiffness and resistande against wear and tear. The core being composed only of multifilament yarns (6/2) is considerably smoother and weaker.

2. **Steel wire**
   This is a twisted rope made of steel wires, especially made free of torsion for the use in elevators.

3. **Combined rope**
   The construction of this rope made of steel wire and PP split fibre is assumed to be sufficiently known.

4. **Plaited rope with core I**
   The core of this and the rope mentioned in 5. is a bunch of soft twisted PA multifilament yarns. It is cloaked in rope I by a 24-strand plait of PP-film yarns.

5. Plaited rope with core II

   This rope is covered by 24-strand plait from PP monofilament and PES multifilament yarns. By roughening of the PES yarns the rope was supposed to get an additional protective cloak which was hoped to decrease its vulnerability against abrasion.

6. Plaited rope with core III

   This rope has a core of soft laid PES yarns, sheathed in an inner braided cloak of PP-film yarns and an outer cloak braided of PES multifilament yarns.

Main purpose of these trials was to evaluate the influence of the different rope materials on the net opening dimensions and on the obtainable towing speed with a given value of thrust. Furthermore the mechanical resistance of those forenets had to be tested and their behaviour during the shooting and hauling operations as well as their influence on the parts of the net made of netting.

The following preliminary results have been obtained

a. The influence of the material of the rope part on the net opening dimensions is more or less the same with all kinds of ropes tested. Surprisingly this even proved right for steel wire rope where in account of its considerable weight negative influence on the net opening could not be straight away excluded.

b. Differences in the towing speed at a given value of thrust did only occur with steel wire. The observed decrease (0,3 kn in average) was not very big but actually measurable. Differences between the other ropes were so small that they can be neglected.

c. With regard to the mechanical resistance especially with the resistance against abrasion and to the influence of the rope construction on the netting considerable differences had been observed.

   Atlas-rope showed good resistance against abrasion. Being only available as twisted rope, often twisting of the net tips occured - in spite of the use of swivels between net tips and ropes. This twisting lead especially after some time of use to severe damages in the netting.

Steel-wire rope proved the best abrasion resistance of all tested materials. No twisting of the net tips could be observed in account of the special construction of this wire. One single disadvantage remains the low elasticity of this material whereby dynamic forces in towing warps and bridles are not hampered to spread deep into the netting and local peaks of tension which may occur in different operational conditions are not smoothed.

Combined-rope showed a similar good abrasion resistance as Atlas-rope. Since steel wire is used in it as the main bearing element the same disadvantages as with steel wire are to be expected in account of its elasticity being to low. In addition to that the twisted rope caused twisting of the net tips as Atlas-rope did.

Plaited rope with core I turned out sufficient resistance agains abrasion and good elasticity. No twisting of the net tips occured. The resistance against abrasion of this rope has to be confined a bit with regard to the fact that by hauling this net with slings the outer sheath of the rope was here and then damaged. On ships with netdrums the danger of such damages ought to be much lower because the ropes are there much lesser stressed locally.

Plaited rope with core II showed similiar good properties as the one mentioned above. The rope part of this net did until now undergo the longest stress, since it has been used in over 40 hauls. It showed very few damages by abrasion.

Plaited rope with core III turned out to be less suitable for this range of application. Main reason for this judgment is its low abrasion resistance. As mentioned above this might be of less importance for ships with net drums but then the high price in comparison to the other ropes tested ought to prevent its use.

With regard to handling and maintenance of such rope trawls on vessels not equipped with net drums the point should be stressed that hauling is best be done with strong fibre slings. When slings of steel wire or chains are used the construction of the rope tends,is easily to be damaged, the sheath torn or the slings do even find no grip on the rope .

During shooting a very differing behaviour of the rope parts could be observed. Whereas the rope parts made of steel wire or Atlas resp. combined rope sunk immediately and left only the buoyant headline at the surface in the beginning of shooting, the headline of the other nets fell,due to the higher buoyancy of the ropes,not so easily apart.

With the many measuring and buoyant elements at the headline this lead often to a tumbling over and hooking of ropes which gave the crew apparently more work. Nevertheless this must be related to the special situation during the measurements. In a net for the commercial fishery there are much less snags at the headline, so that this small disadvantage does not count much.

According to the experience gained during the mentioned cruises in a future development of the rope trawls the following problems have still to be solved.

- Even when attaching very heavy weights to the wing tips, 2450 kg per side, they did not succeed to open the side panels of the nets in question to the height as assumed for their construction. Therefore it is necessary to reconstruct these panels and to adapt them to reached opening values to assure the equal distribution of boad on all ropes.

- As shown by Dutch experiments and also proved by German model tests the otterboards used with rope trawls run considerably above the head line. To avoid distortions of the net the actual differences between headline and otterboard height should be defined exactly. This differences should then be compensated by appropriate lengthening of the lower bridles.

- The frame lines of the side panels tend to a certain extent to twist together during the shooting and hauling operations. Made until nawadays from steel wire these ropes deform permanently under the twist forced on them, which rises new trouble when shooting again. The commercial fishery switches therefore already to frame lines made of synthetic fibres. Since longitudinal stability is a must in frame lines and the elasticity of synthetic fibre ropes is much higher than with steel wire bulky ropes have to be used to reduce this property to a tolerable amount. But this on the other hand increases the water resistance of the net. Recent developments of fibres which have a up to now unknown strength and longitudinal stability offer new ways to solve this problem definitively.

2. Investigations on the FRV "Solea"

In June/July 1977 the Institut für Fangtechnik started comparative trials with a two-panel midwater trawl and a rope trawl of the same size to get some data on the differences in towing resistance and net opening of these two types of trawls. The trials were performed in the Baltic east of Bornholm at the cruise No. 49 of FRV "Solea", a small stern trawler without ramp of L_{pp} = 32.32 m and N = 860 HP. A gear configuration as follows was used:

Trawls:	two-panel midwater trawl. 664 ✲ à 200 mm circumference, corresponding rope trawl of the same size.
Otterboards:	4.5 m^2 Süberkrüb otterboards 3.14 m^2 spherical otterboards

Warp length:	200 m
Bridle length:	50 m
Trawl weights:	200 kg/side
Ground rope weights:	75 kg
Headline floats:	100 floats à 3,2 kp buoyancy

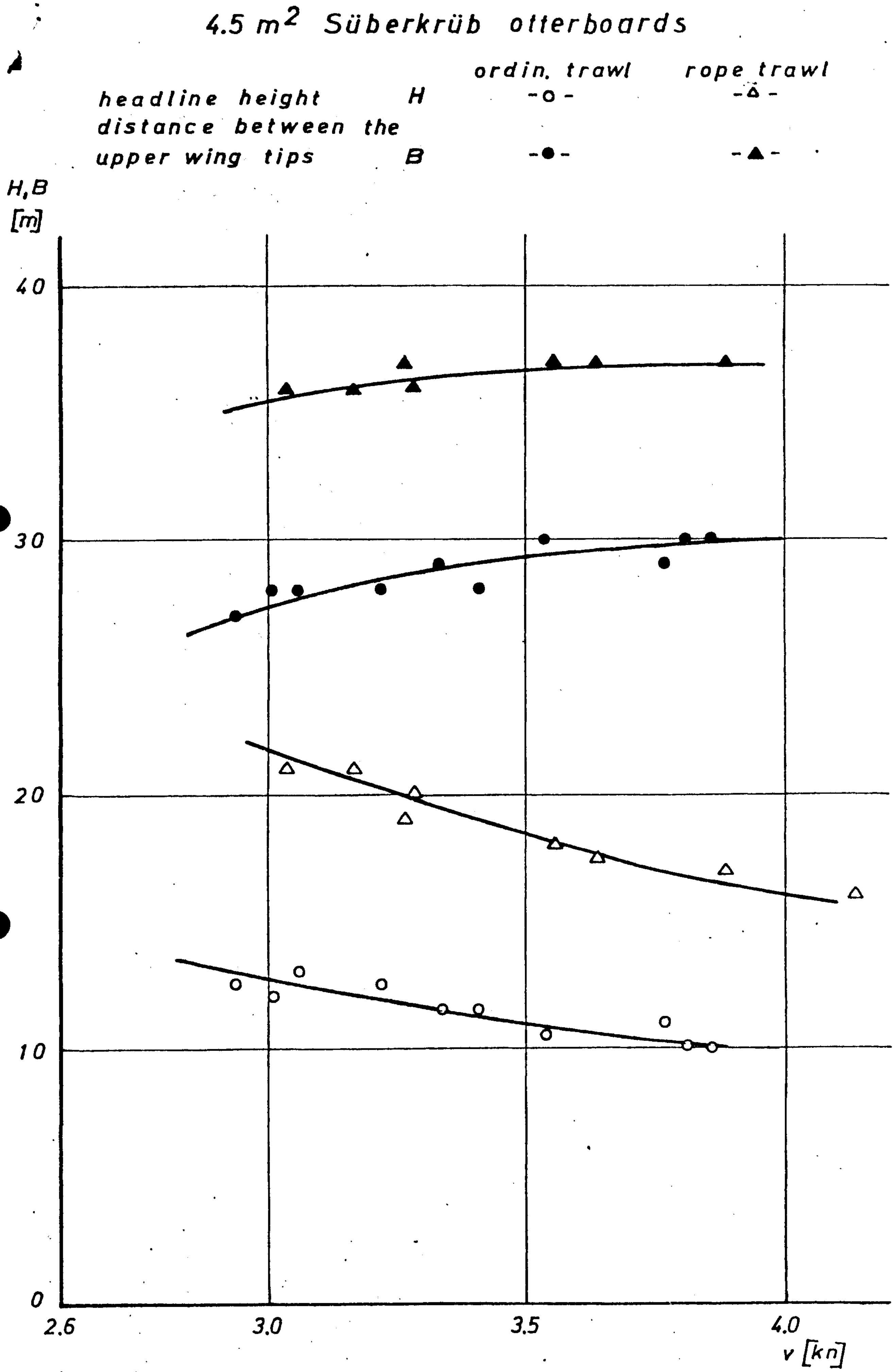
The rope trawl was developed from the two-panel trawl by replacing the netting of the wings and the first section (60 ◇ à 200 mm) of upper and lower panel by ropes. The length of headline, ground rope and side lines was kept constant.

Headline height (H) and distance between the upper wing tips (B) were measured simultaneously by a multi-netsonde, warp tension measurements were done with strain-gage loadcells, speed measurements with an electro-mechanical propeller log. The results are plotted in diagr. No. 1 - 4.

From diagr. 2 and 4 it can be seen, that there is a lower towing resistance with rope trawls. At a trawling speed of 3.5 kn the warp tension (P. + St.B.) is reduced from 5.7 t to 5 t (diagr. 2) and from 5.9 t to 4.8 t (digagr. 4).

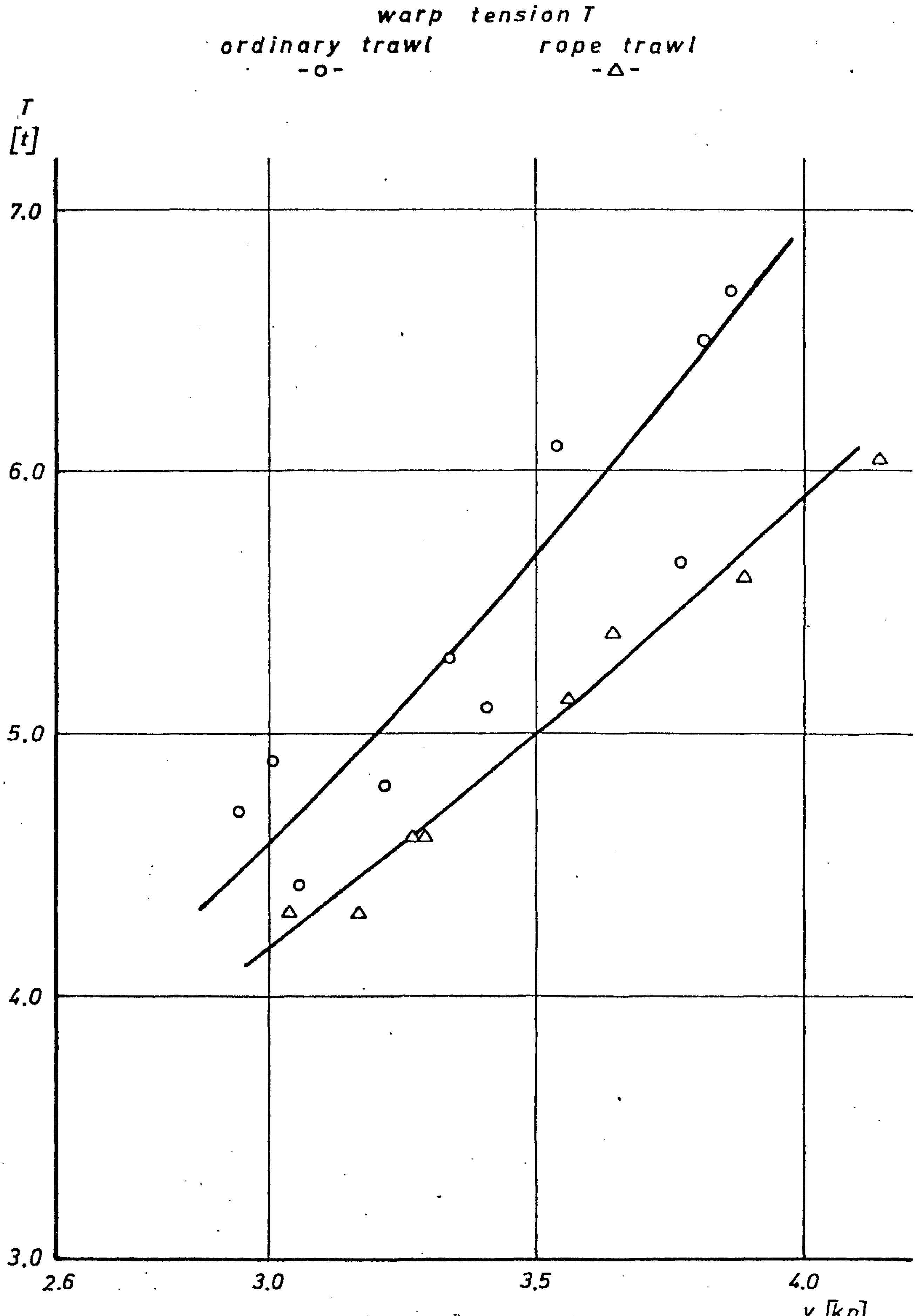
An additional advance of rope trawls is the increase of the net opening area compared with the ordinary trawl (diagr. 1, 3). Both effects make rope trawls an important improvement of until now used conventional trawls.

The continuation of both developments - ropetrawls for big and smaller trawlers - is intended.

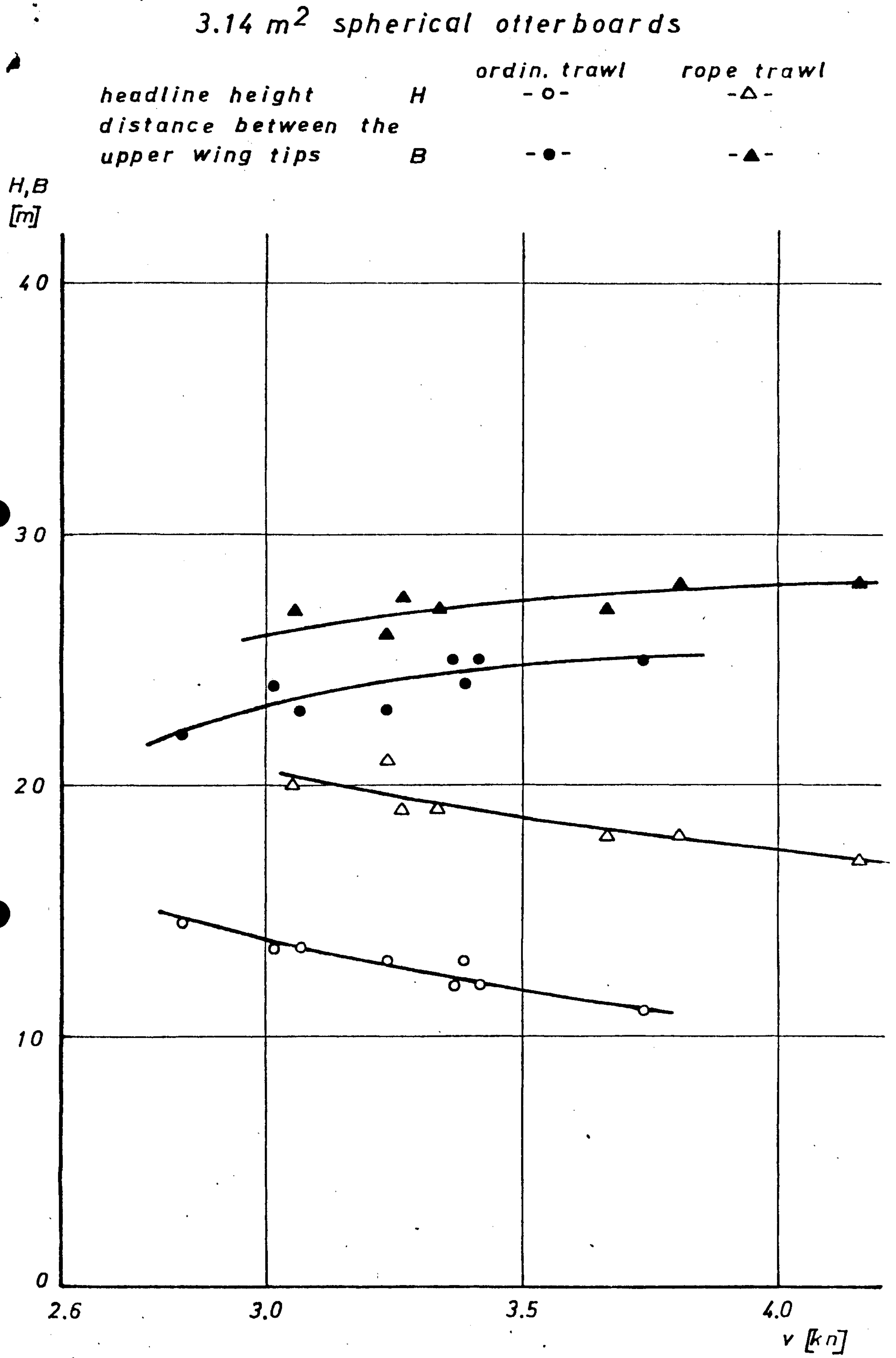

4.5 m2 Süberkrüb otterboards
ordin. trawl
rope trawl
headline height H
distance between the upper wing tips B
H,B [m]
40
30
20
10
0
2.6
3.0
3.5
4.0
v [kn]

Diagr. No. 1

4.5 m² Süberkrüb otterboards

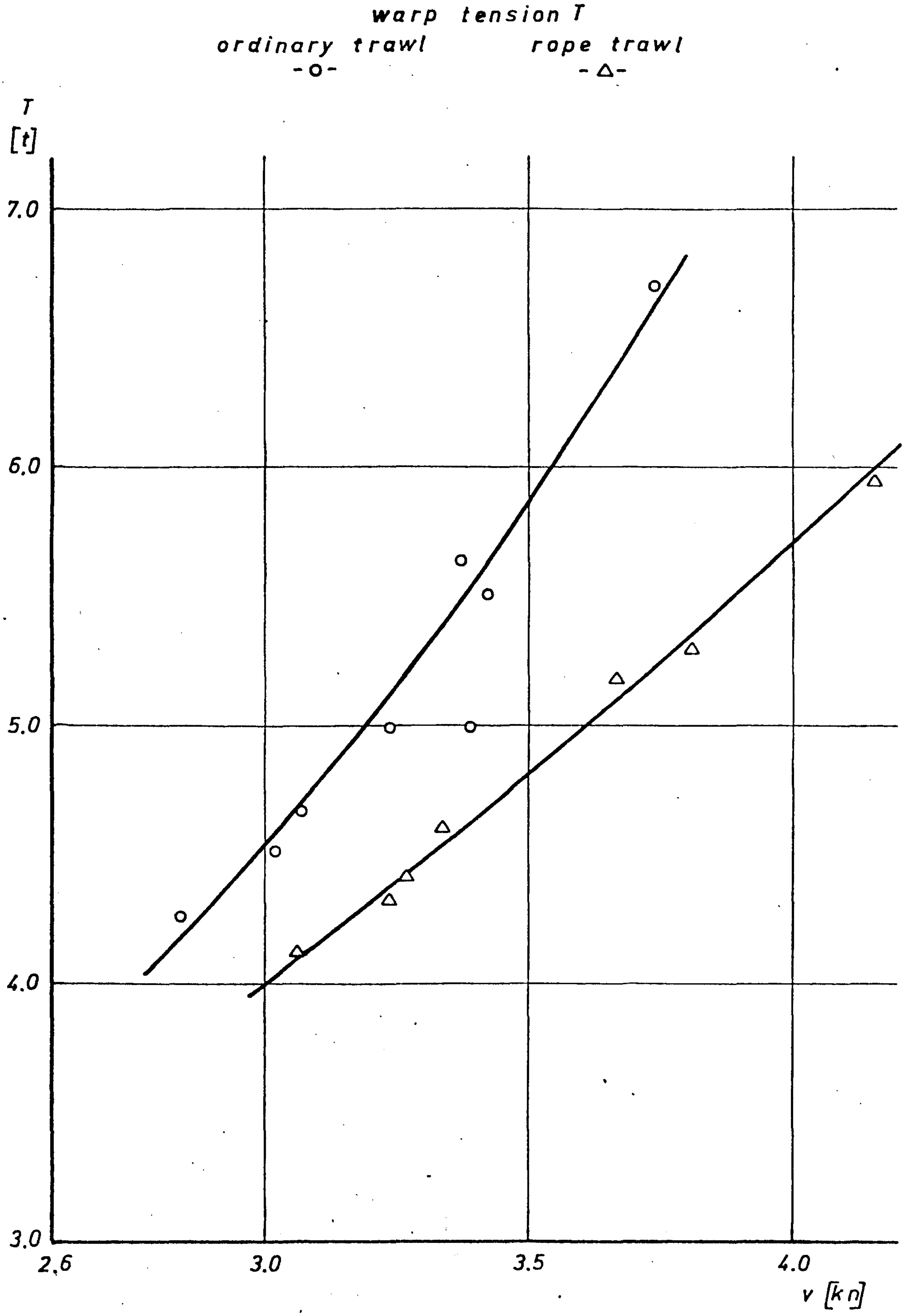


Diagr. No. 2


3.14 m² spherical otterboards
ordin. trawl
rope trawl
headline height H
distance between the upper wing tips B
H,B [m]
40
30
20
10
0
2.6
3.0
3.5
4.0
v [kn]

Diagr. No. 3

3.14 m² spherical otterboards



Diagr. No. 4

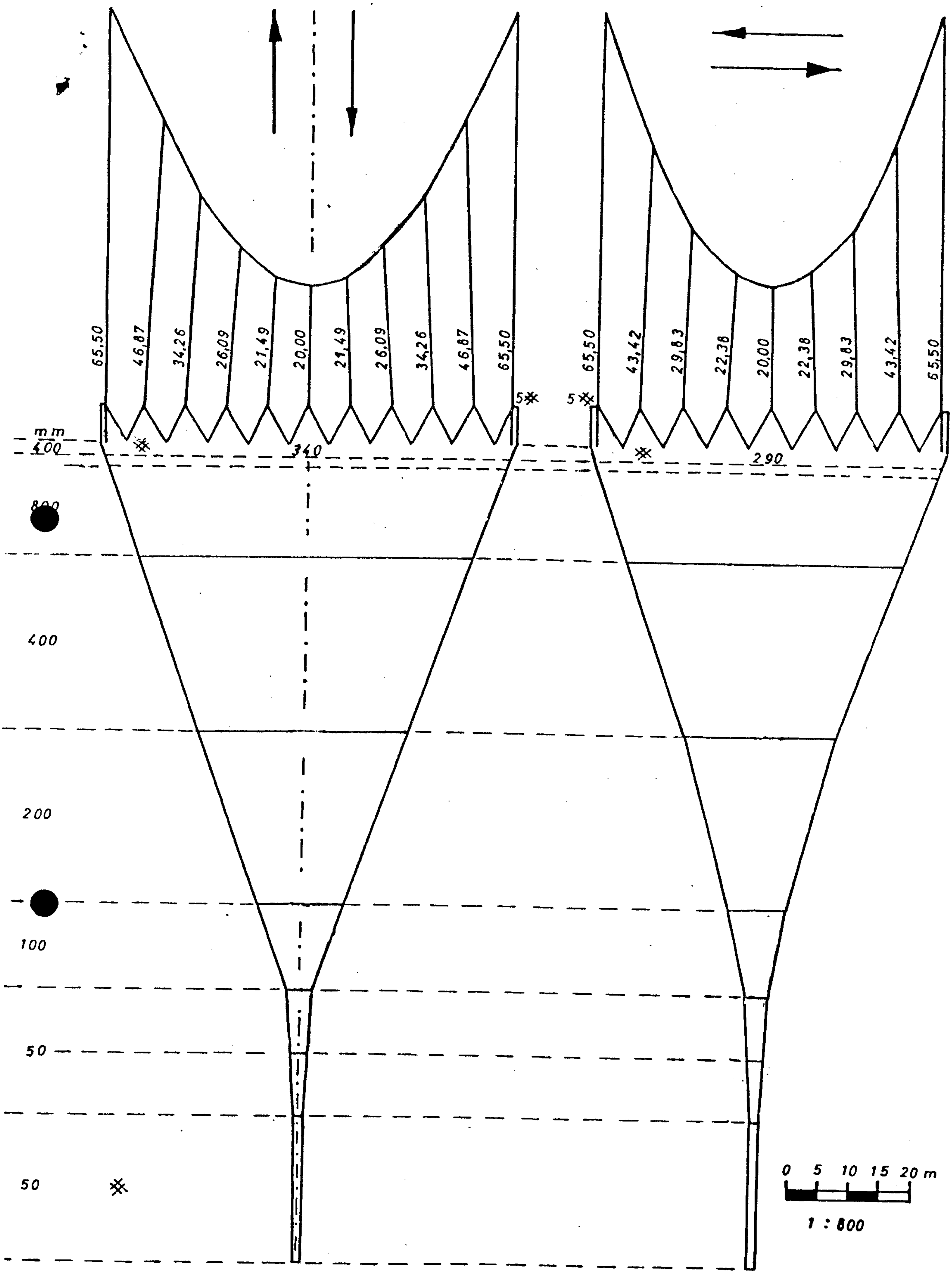


Fig. 5: Experimental rope trawl design based on 630 ⋇ circumference pelagic trawl of the German deep sea fishery.