NATIONAL INSTITUTE OF OCEANOGRAPHY

WORMLEY, GODALMING, SURREY

The Neuston Net

A device for sampling the surface fauna of the ocean

by

P. M. DAVID

N.I.O. INTERNAL REPORT No. B 3

DECEMBER 1963

THE NEUSTON NET

A device for sampling the surface fauna of the ocean

by

P. M. David

N.I.O. INTERNAL REPORT No. B.3

National Institute for Oceanography

December 1963.

CONTENTS

Introduction.

A collection of animals taken with a hand net from the surface of the sea often contains forms seldom if ever caught in normal 'surface' plankton nets, many of these forms exhibit adaptations which suggest that they live exclusively at the surface and it would appear that in many cases they are dependent upon each other and that there are in fact surface biocoenoses worthy of investigation.

There seem to be two principal reasons why the usual 'surface' nets do not catch the surface animals. One is that the usual plankton net with a metal ring at the mouth sinks below the surface unless towed on a very short line, and although it can be kept at a constant depth by suspending it from a float it is still below the surface. The second reason is that nets are generally towed from the stern of a ship and although they pass through the surface layer both when being shot and when being recovered, the passage of the ship through the sea has caused the surface layer to be mixed by turbulence, disturbing the surface fauna and thus reducing the chances of its capture by a net. If a ring net is fished on a short line to keep it at the surface it will almost inevitably fish in this hiatus beneath the stern and will be unsatisfactory as a surface sampler.

It is evident therefore that a satisfactory surface net must fish throughout the entire haul in undisturbed surface water.

This paper describes an apparatus which to a large extent meets these requirements.

Previous work

The surface fauna was observed and collected with such simple devices as hand nets and buckets in the pre-Challenger era of Oceanography and after. Generations of seafarers, particularly in the days of sailing ships must have been familiar with the larger and the more conspicuous surface living organisms.

The advent of the townet, which although invented in 1829 did not come into general use until after 1850, diverted attention from the immediately visible surface fauna to the more mysterious deeper-living forms. Devices for capturing the plankton living at great depths have occupied the interest and attention of biological oceanographers to a large extent to the exclusion of the surface forms. However, Parr (1939) designed a surface sampler to catch floating Sargasso weed which was fished from a boom so as to avoid the disturbance due to the bow wave of the ship. It was towed at speeds up to 10 kts, and was very successful.

In recent years interest in the surface fauna has been rearroused, and Zaitsev has made a systematic examination of the problems of surface sampling (Zaitsev 1959, 1961, 1962) while several Russian workers have studied the results of sampling with these nets (Savilov 1956, 1958. Mednikov 1957, Zaitsev 1959, 1960, 1961, 1962. Heinrich 1960).

The nets which Zaitsev has designed are fished from a drifting ship or a ship at anchor in a current, the net is paid out to certain distance and then hauled in at a standard speed; the nets used by Savilov and Heinrich on the Vityaz are fished in the same way and are apparently very similar to Zaitsev's rectangular nets in design.

Perhaps the most interesting net of Zaitsev's series is the P.N.5. which consists of 5 rectangular nets each 60 x 20 cms. arranged one above the other and supported by floats. Even in such a narrow layer there are considerable differences in the vertical distribution of animals (Zaitsev 1961).

Willis (1963) has designed and described a small surface net of 200 mesh nylon with a mouth opening of 7" x 1½"; it is designed to fish at one knot from a drifting ship.

The Neuston net

At various times in the past few years the question of sampling the surface fauna has been discussed at the National Institute of Oceanography, but little was done until the spring of 1962 when it became known that the ornithological programme for the International Indian Ocean Expedition required a method of sampling the layers of the sea where birds might be expected to feed. This gave impetus to a scheme for a more extensive surface sampling programme, and an opportunity to design and test devices for that purpose.

The requirements were initially for an underway sampler which could be used by one man without needing to slow the ship down from its normal cruising speed, but it seemed after some experiments with a Hardy Plankton indicator secured to a surf board that in order to catch a wide size range of animals of varying degrees of activity it would be necessary to increase the size of the net; it was also evident from other experiments that the net would have to fish alongside and clear of the bow wave if it were to catch a sample from undisturbed surface water. Although a towing speed of 8 kts was aimed at, and achieved in calm conditions, it was soon found that 5-6 kts gave a sample in much better condition. The mouth area and mesh size of the net was chosen to be comparable with the Gulf III sampler. A four foot long prototype of the net with four inch deep keels was taken by Mr. M. H. Thurston of the British Antarctic Survey on the M.V. Kista Dan to the Antarctic. After the first few hauls he decided that deeper keels were necessary, and he fitted, on board, keels fourteen inches deep. With this modification the net worked well and Mr. Thurston brought back a series of 33 samples. As a result of these experiments and others carried out on board R.R.S. Discovery it was decided to make the frame larger and stronger, and the design described here was taken on R.R.S. Discovery to the Indian Ocean.

The net itself is made of 60 mesh to the inch nylon and is twelve feet in length. The mouth opening is rectangular and measures 30 cms wide by 15 cms deep. The net is stitched to a rectangular frame made of $\frac{1}{2}$" brass rod, and terminates at the after end in a 3" diameter bucket. The brass frame and net are mounted on wooden cross members between two wooden skis in such a way that the frame is immersed to a depth of 10 cms in still water.

The wooden structure consists of two plywood boards 6 ft. long by 1 ft. wide turned up at the bows like a ski, these are reinforced by red cedar strips 2" deep by $1\frac{1}{2}$" wide, two to each ski running the full length at the outside edges, screwed and glued in place. Joining the skis together are three ash planks 5 ft. by 4 ins. by 1 inch. The front one of these is raised 8 ins. above the skis to avoid the splashing against waves which occurred when it was secured directly to the longitudinal strips. The brass net frame fits into four holes in the two after cross members and is secured with butterfly nuts. Keels made of $\frac{1}{2}$" marine plywood 5 ft. 6 ins. long by 1 ft. 6 ins. deep are attached to the inside edge of the skis by long bolts. The keels are held 2 ins. sway from the skis by wooden spacers, this was done because it was thought that the flow of water under the skis would thereby be less disturbed; it may be easier and just as satisfactory to bolt the keels direct to the skis without the spacers. The keels are stayed to the underside of the skis by three 18" struts (on each ski) made of $\frac{1}{2}$" brass tube. In future versions of the net aerofoil section struts will be used. The struts are bolted right through the ski and the keel with a metal plate on the other side, this is necessary because the struts are most convenient for handling the net and therefore need to be strong.

In future versions of the net some slight alterations will be made in the light of experience at sea. The longitudinal red cedar strips will be increased in thickness to 3 ins high and the transverse ash members will be let into these to a depth of one inch so that the surface is flush. The blocks on which the front cross member is raised will be made of oak and faired off to prevent the bridles getting foul round them. These alterattions are shown on fig 1.

The net bridles are made from 4 mm hydrographic wire and are each 6 ft

in length, they pass through small stainless steel loops at the tip of the skis and are attached by rope tails to the two cross members at the back of the skis. The length of the bridles can be adjusted with the rope tails so that the net can be made to fish either to port or starboard of the ship.

A rope of convenient thickness is also attached through the steel loops to the cross members and is taken to the ship abreast of the sampler, this is used for launching and recovering the net.

Operation of the net

In R.R.S. Discovery the Neuston net is fished on the port side from a lightweight boom which extends 12 ft from forecastle at the level of the foremast. The boom is stayed to an eye on the forecastle bulwark and from the foremast platform. The net is towed on 4 mm hydrographic wire. By altering the length of the bridles the net can be made to sheer away from the ship's side, shortening the starboard bridle causes a sheer to port and vice versa. With the ~~starboard~~ port bridle 7 ft. 4 ins. long and the ~~port~~ starboard bridle 6 ft. long the net fished 33 ft. from the ship's side when towed on a 12 ft. boom.

The ship's course for towing was usually such that the wind was abeam, because this permits the speed to be maintained precisely. The net sheers further from the ship if the towing side is the weather side. The net fishes badly when the sea and wind are abaft the beam.

The net is launched and recovered from a point on the ship level with the net when it is fishing. The length of the towing wire is adjusted so that the net rides easily on the surface, and apart from slight adjustments to suit the weather conditions it can be left rigged and need not be paid out and hauled in each time the net is fished. The net is lowered into the sea by hand on its handling rope while the ship proceeds at 5-6 knots; some care is needed to ensure that it does not swing round or capsize as it reaches the surface; the towing wire then takes the strain and the net begins to fish. It is recovered by hauling in on the handling line which may most conveniently be lead through a block held out on a spar to clear the ship's side. The whole operation can be done by two men.

In R.R.S. Discovery it was found that 15 minutes tow gave an adequate sample and this was made the standard length of haul.

Organisms taken in the Neuston net

Although the hauls made with the Neuston net have not yet been examined in a systematic manner, notes were made of the contents of the catches and certain obvious features were apparent. The hauls were varied and variable, night hauls were usually much larger than those made by day, and at least in the S. Arabian Coast region, the specific composition of the catches was very patchy.

Quite large organisms were taken, for example flying fish up to 14 cms in length, and as many as 43 flying fish have been caught in a 15 minute haul. Fish larvae were commonly caught in the night hauls. Larvae which seemed to agree with the published descriptions of Tuna larvae were frequently taken, one 15 min. haul contained 1071 individuals. 887 Clupeoid larvae were taken in a single haul, and 740 post-larval Carangids ranging in size from 1.2 - 4 cms. in length in another. 90 small squid were caught in a single haul but this was exceptional and the other hauls seldom contained more than 5 or 10 specimens. Myctophid fish up to 6 cms. long were caught but not in large numbers.

In the daylight hauls the most commonly occurring organisms were Halobates, Ianthina, Velella, Physalia, Porpita, pontellid copepods and very small fish larvae. Large hauls of cyprid ostracods, Squilla larvae and crab megalopas were also taken.

In the Mediterranean fuel oil in lumps about 0.5 - 1 cm. long was the commonest constituent of the catches and this proved a difficult problem,

for it not only ruins the catch by sticking to the animals, but also sticks to the net. It can be removed with Benzene. Fortunately this hazard was not encountered East of Suez.

Discussion

The Neuston net was used as a regular part of the station routine on R.R.S. Discovery during her survey of the South Arabian coast. The net is easy to handle and fishes satisfactorily. In force 9 weather it tends to jump from wave to wave, but it still catches well.

Perhaps one of the chief advantages of the net is that it can be fished from any vessel capable of 5-6 knots, no special equipment or winches are needed, and it might be most valuable in exploratory fishing when specially equipped ships were not available.

It has been difficult to decide on a name for the biocoenosis sampled by the net; Savilov (1958) has used the word Pleuston ("an ecologically peculiar group of animals living at the ocean surface, at the water-air interface"). Henderson's Dictionary of Scientific Terms (5th edn. 1953) defines Pleuston as "Free-floating plants", but there is nothing in the derivation of the word (Gk. pleustikos, ready for sailing) to suggest that it might not equally well apply to free-floating animals, the derivation implies objects sailing at the surface and would be most appropriate to animals like Physalia, Velella and Ianthina.

Zaitsev (1961) refers to his nets as "plankton-neuston" nets, but in a later paper (1962) calls the animals collected by his nets "hypo-neuston". Henderson's dictionary defines Neuston as "Organisms floating or swimming in surface water or inhabiting surface film" and this seems wide enough to allow for the lack of definition of what are the precise limits of 'surface water', which is one of the objects of study for these nets.

It may be worthwhile to construct the net frame from tubular metal and fibreglass to give it a longer life but the wooden construction used at present has the advantages that it is cheap, easy to repair on board ship, and it floats so if it should break adrift it can be recovered.

The frame was fished experimentally with a much larger net which almost filled the space between the keels and had a mouth area of 30 x 16 inches. The net was 10 ft. long and had a mesh size of 4 mm. A half hour tow at $5\frac{1}{2}$ kts yielded a catch of 320 fish mostly garfish about 4-6 inches long and a large number of swimming crabs. It is intended to experiment with a wider frame and larger net in the future, though this will probably only be effective in fairly calm weather.

Acknowledgments.

I am most grateful to Mr. K. J. H. Andrews for making the early experimental nets and for helping at the trials of these and later models. I wish to thank the Director of the Marine Biological Laboratory at Plymouth for allowing me to test nets from the R.V. Sula and the R.V. Sarsia. Professor J. E. G. Raymont of Southampton University most kindly allowed me to make some tests from the launch Acartia, and I would like to thank Mr. Hockley of Southampton University for his help on this occasion. I am also particularly indebted to Mr. M. H. Thurston of the British Antarctic Survey for undertaking to use an almost untested piece of apparatus to the Antarctic, for testing it and for making modifications and many helpful suggestions for improving it.

References

Heinrich, A.K., 1960 Surface plankton of the Central Pacific. Trudy Inst. Okean. 41, p 42-47.

Henderson, I.F., and Henderson, W.D., 1953. A dictionary of scientific terms. 5th edition by J.H. Kenneth. Oliver and Boyd, London.

Mednikov, B.M., 1957 The spread of Velella lata biocoenosis in the Pacific. Priroda 6, p 126.

Savilov, A.I., 1956 The pleuston biocoenose of Velella lata Ch. et Eys in the Pacific. Dokl. Akad. Nauk S.S.S.R. 110,(3).

Savilov, A.I., 1958 Pleuston of the Western Pacific. Dokl. Akad. Nauk S.S.S.R. 122,(6), p 1014-1017.

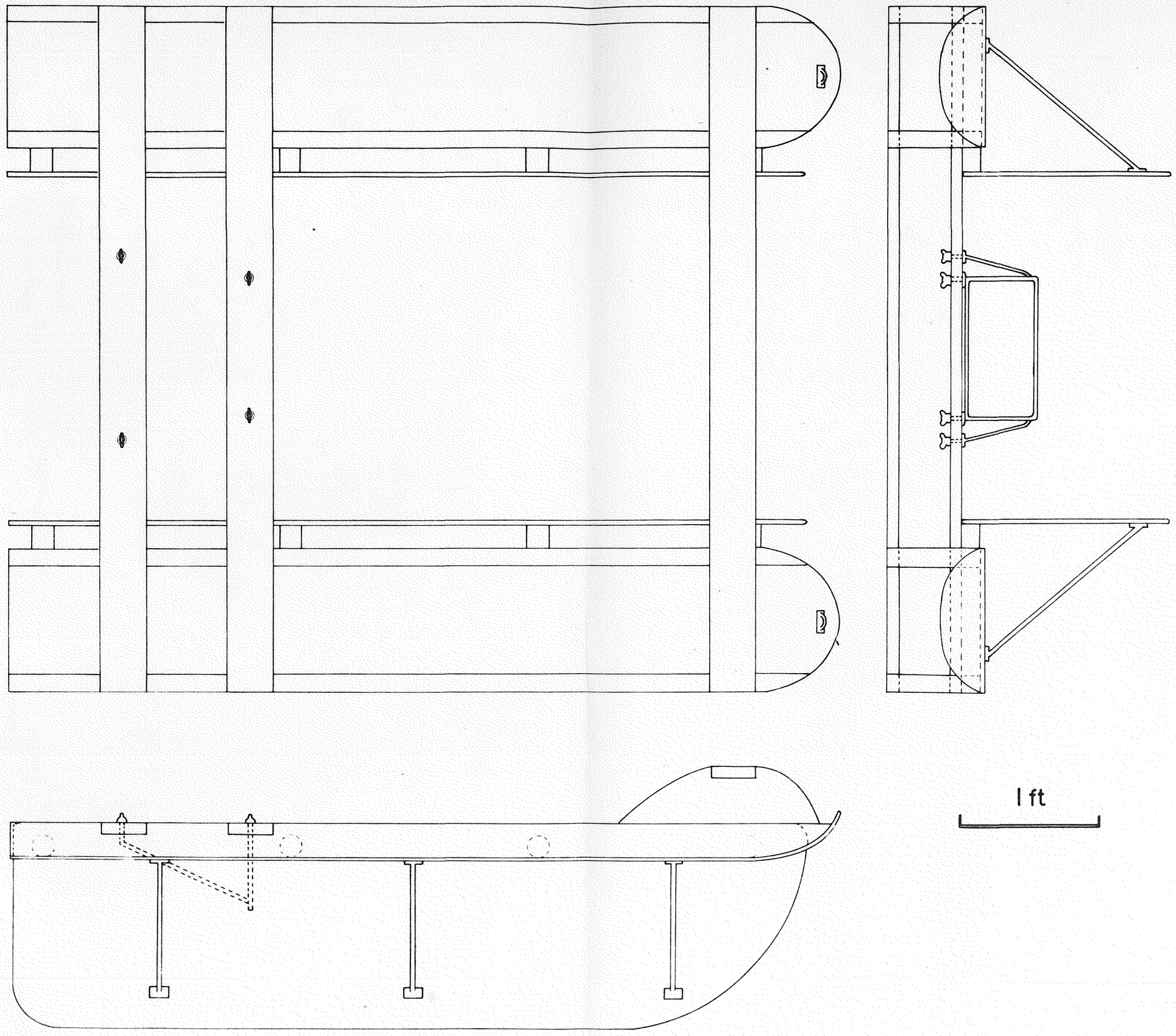
Willis, R.P., 1963 A small towed net for ocean surface sampling. N.Z.J. Sci. 6, p 120-126.

Zaitsev, Yu.P., 1959 The collection of pelagic eggs and fish larvae in parts of the sea not subject to appreciable freshening. Zool. Zhurnal, 38,(9), p 1426 - 1428.

Zaitsev, Yu.P., 1960 The biocoenose neuston in marine pelagic life. Naukovi Zapiski Odess. Bid. Stants. 2, p 19-31.

Zaitsev, Yu.P., 1961 Surface pelagic biocoenosis of the Black Sea. Zool. Zhurnal. 40,(6). p 818-825.

Zaitsev, Yu.P., 1962 Apparatus and Technique for studying Hyponeuston. Voprosy Ekologii IV. p 107-110.


1 ft