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SHORT NOTE

New Net for Sampling the Ocean Surface

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ABSTRACT: The 'Manta Net', a new design capable of continuous-flow collection of organisms and flotsam at the sea surface, is described and compared to the Neuston Net. The Manta Net stays reliably at the surface during the entire sample period; its handling requires 2 persons.

During the past several decades, increased attention has been given to nets for sampling the surface of the ocean. The most important feature distinguishing these from conventional plankton nets is some kind of flotation device to keep the front opening of the net at the water surface. Some of the problems associated with sampling of ocean surfaces and the designs of several early neuston samplers have been briefly discussed by David (1965), who designed a net ('David Sampler') with a rectangular mouth opening, kept afloat by a pair of wooden skis. The David Sampler and modifications of it (nets stacked vertically for sampling different strata of the surface water) have been used rather extensively, especially in studies of ichthyoplankton and surface zooplankton (e.g. Hartmann, 1970; Zaitsev, 1970; Hempel and Weikert, 1972; John, 1976). Several other nets, all more or less variations of the David Sampler, have been proposed over the years; e.g. the Otter Surface Sampler (Sameoto and Jaroszynski, 1969), the Norwegian multi-layered sampler (Ellertsen, 1977), an integrating sampler for collecting small planktonic organisms (Hinton and Boney, 1979), and a Boothbay neuston net for catching live fish (Hettler, 1979). Almost all of these nets are rather clumsy to use and relatively ineffective in following the undulations of the sea surface in a manner that would yield quantitative data. Miller (1973) designed a 'push-net' reasonably capable of quantitative sampling, but its use is mostly limited to inshore waters as it has to be operated from twin-hulled boats.

In this paper we describe a newly designed net, the Manta Net, capable of continuous-flow collection of organisms and flotsam (tar lumps, etc.) at the ocean surface, and we compare some of its features with the so-called Neuston Net which has been in use by research vessels of various institutions in the United States. A brief description of the Neuston Net by Cheng (1975) is, as far as we know, the only one so far published.

A well-designed surface neuston or pleuston net should always ride at the sea surface regardless of the state of the sea; its mouth should remain at the water surface during the entire period of towing in order to yield quantitative data. Moreover, to minimize interference, e.g. from bow waves, the net should tend to veer away from the ship and should have no towing lines in front of the opening, which might scare away some of the faster-moving surface organisms. Observations on the reactions of such organisms have revealed that, when disturbed or approached by a shock wave, they tend to escape by moving to one side, but not downward.

The paired, anterior extensions flanking the mouth of the Manta Ray *(Manta birostris)*, a surface-feeding elasmobranch, appear to be well-designed for capturing prey organisms at the sea surface. We call the newly designed surface neuston net the 'Manta Net' as it incorporates some of the adaptations of this fish. The salient features of the Manta Net are illustrated in Fig. 1 and a scale model is shown in Fig. 2. It consists of a frame (made with ½" aluminum pipe) supported at the sea surface by a pair of wings (¼" plywood) or aquaplanes projecting at right angles beyond the paravanes. The net is towed by a wire yoke with one short bridle (135 cm) and one long bridle (206 cm). This dissymmetry causes the paravanes to steer the net at an angle to the ship's path. (If the angle is too large, the paravanes will stall, and the net will trail behind the tow point.) The distance veered from the side of the ship depends on the towing speed, the attack angle of the paravanes, and the drag of the net itself. The wings, made of a buoyant material (¼" plywood backed by 1" urethane foam), cause the frame to float

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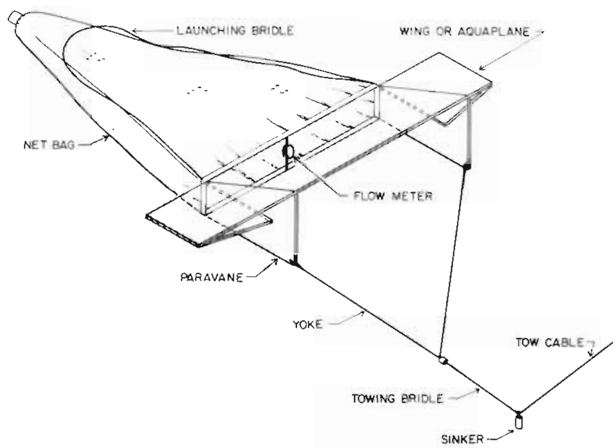

Fig. 1. Manta Net. Schematic diagram

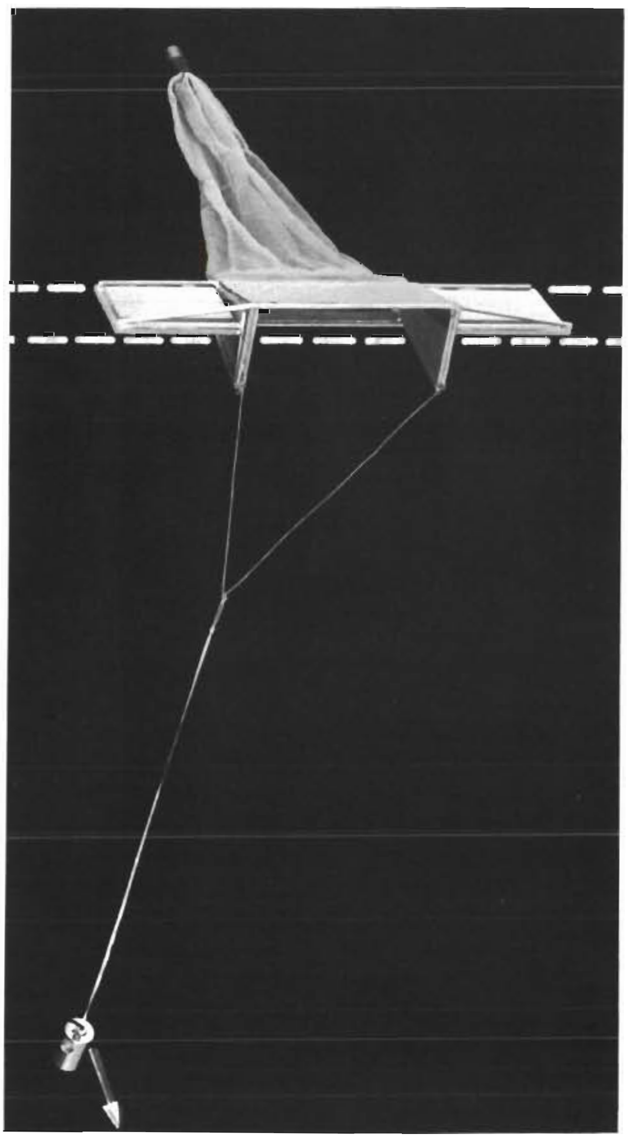

Fig. 2. Manta Net. Scale model. Dashed lines show relative position of sea surface while net is in operation. Arrow: direction of towing

when the net is resting on the water When underway, the wings exert a dynamic lift that offsets the downward towing force of the sinker in proportion to the tow speed, and the aquaplanes have a suction-like effect which keeps them down on the sea surface. The dynamics of the systems are such that the aquaplanes always hinge around their trailing edge, which is also the top edge of the net. Thus the top edge of the net always rides on the sea surface. The flow meter attached to the lower edge of the net indicates the distance covered during collection: from this and the dimensions of the mouth opening the area sampled can be easily calculated.

The size of the mouth opening may be varied to accommodate whatever types of net may be available. We built a net frame with a rectangular mouth 100 cm × 20 cm which could be used with a conventional plankton net or a 'Bongo' net with a 240-cm circumference. The net we used had a mesh size of 505 µm. We tested the device at different tow speeds with different bridle lengths and sinker weights, and found that with a 100-kg weight, submerged at a depth of 3 m, and a 15-m towing bridle, the Manta Net could be towed well at speeds between 0.5 and 5 knots (1 to 9 km h^{-1}). The best result was obtained at a tow speed of 2–3 knots. The exact size of the net frame, bridle length, sinker weight and towing speed, etc., can be varied and adapted by individual investigators. The design of the Manta Net is such that it is not limited in its performance by size or towing speed. Brown (1979) discussed briefly some of the problems of handling this net at sea.

The Neuston Net (Fig. 3) has a semi-rectangular frame, with a mouth opening 100 cm × 30 cm, supported at the sea surface by a styrofoam float at each end. The lower edge of the net frame is weighted (we used a pair of 2-kg shackles) so that it remains under water even while the net is being towed. A flow meter attached at this edge gives some measure of the through-put of the water. During calm seas this net is capable of giving quantitatively reliable sample data, but at sea states of more than 2 or 3 (with wave heights of more than 10 to 20 cm) the net tends to leap over the

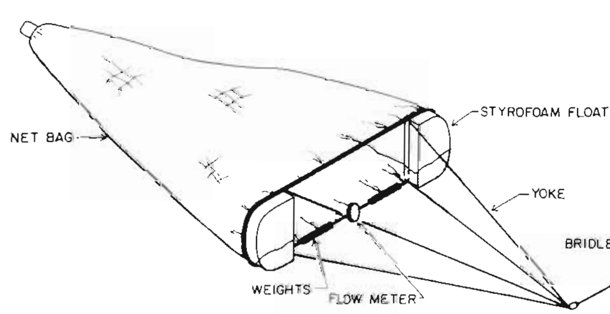

Fig. 3. Neuston Net. Schematic diagram

surface and thus does not sample the surface continuously (data are biased on the low side).

Both Manta and Neuston nets can be mounted on a deck crane and towed off the side of the ship. They can thus be operated at the same time and speed as the mid-water trawl (4 to 8 km h^{-1}), thereby saving valuable ship-time. Since the bridle and tow lines of the Manta Net are weighted down by the sinker several meters under water, net avoidance by organisms during operation is much reduced. The bridle and tow lines of the Neuston Net are normally above water, and they and the styrofoam floats at both ends of the net opening probably scare away many of the surface organisms during towing. However, the Neuston Net is very light in weight and very easy to handle, even by one person. It is thus routinely being used on all Scripps research vessels for collecting qualitative pleuston or surface neuston samples. The Manta Net requires at least 2 persons to handle, but because of its reliability in staying at the surface continuously during the entire sampling period, it is being used routinely on California Cooperative Fisheries Investigations cruises for collecting surface samples, especially of floating fish eggs and fish larvae.

Although we do not yet have comparative data on the catches of the two nets, we do have some preliminary observations made during a series of test tows using both of the nets at noon and at night. The Neuston Net was held about 3 m off the side of the ship, while the Manta Net was allowed to veer away from the side of the ship, well clear of the bow waves. During the noon period we caught neither fish nor squids in the Neuston Net, but small fish (up to 5 cm long), squids and sea-skaters *(Halobates)* were all caught by the Manta Net. During the night we caught many more myctophids, sauries, and *Halobates* with the Manta Net than with the Neuston Net.

The surface layer of the ocean is perhaps one of the least known of the marine habitats. Many pleustonic animals and plants have unique adaptations which help them to cope with the special chemical and physical features peculiar to this habitat. Marine pleuston, and some of the special problems that one encounters at the sea-air interface, has been reviewed by Cheng (1975). We hope that, with improved nets such as the Manta Net described in this paper, information on these rather neglected ocean-surface organisms will become more easily obtained in the future.

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