<u>Report of SCOR working group III on the
questionaire regarding plankton nets in
use in various laboratories.</u>


by

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# INTRODUCTION

During the third meeting of SCOR held in New York on the 29th and 30th August and on the 12th September 1959, the working group on biology met to further consider a biological programme for the projected International Indian Ocean Expedition, then scheduled for 1962 and 1963. One aim of these discussions was the recommendation of standard gear and methods to be used by all ships concerned with biological work during these cruises.

The advantage of such a recommendation will be obvious to all who have been concerned with the operation of gear and with the inter-pretation of the data from different nets. Too often it is the case that the gear and methods used are so different as to make comparisons impossible except by invoking conversion factors, often of doubtful accuracy. It thus follows that in any investigation whether it be a small regional survey or a large scale oceanic expedition the use of standardised gear and methods is not only desirable but essential.

With regard to the International Indian Ocean Expedition it was felt by the working group on zooplankton methods that recommendations could only be made when details were available of the gear and techniques employed by the various workers in the different countries interested in the venture. With this end in view a questionnaire was circulated requesting that details of gear and methods be sent to Mr. N.B. Marshall of the British Museum (Nat. Hist) who was at that time the convenor of the working group on biology. It was hoped that if the response were satisfactory it would be possible to publish a review of existing gear and methods.

Recipients of the questionnaire were asked to provide detailed information on all forms of sampling gear in routine use in their investigations, including bottom and midwater trawls. Answers were received from a total of eleven Institutions or departments in eight countries as follows:-

Denmark, Danmarks, Fiskeri-Og Havundersogelser: Netherlands, Rijksinstitut Voor Visseng Onderzoek: England, The National Institute of Oceanography:

U.S.A., Woods Hole Oceanographic Institution: Bureau of Commercial
Fisheries La Jolla: The Marine Laboratory, University of Miami:
Department of Oceanography, University of Washington, Seattle: Australia,
C.S.I.R.O. Division of Fisheries, Cronulla, N.S.W; Japan, Institute for
Fisheries Investigations; Hokkaido University: Indian, University of
Madras: U.S.S.R. Institute of Oceanology, Moscow. I should like to
take the opportunity of thanking all who have contributed the data on
which this paper is based.

The replies received varied somewhat in the detail of their
information and on the basis of this relatively limited response it is
unfortunately impossible to give a complete review of existing standard
gear and methods. While the data is insufficient in this respect it
does go some way to providing a basis for comparison allowing fundamental
differences to be discussed with a view to evaluating the requirements
that any Indian Ocean Standard Net must fulfill.

The data are summarised in table 1. It has also been impossible
to include all the gear referred to in some of the replies and indeed
little would be gained from such a list since in countries and institutions
where many diverse problems are being investigated so there is a vast
array of sampling gear in routine use. I have thus in table 1. listed
details of those nets which are most closely comparable not only in
design but in the sort of sampling to which they are best suited. In
compiling this table it has been necessary in some instances to augment
the information given in the replies to the questionnaire by reference
to published descriptions of nets and methods. To illustrate some of
the differences evident from the available data I have drawn in figure 1.
the outline shapes of the main types of net to scale. Again use has been
made of published descriptions, particularly in the case of the Juday nets.
Not all the samplers have been included in this figure, notable ommissions
being the Clarke-Bumpus sampler used at Cronulla and Seattle (see table 1)
Also excluded are the special plankton samplers of Professors Bogorov
and Stjemman Nielsen which, by enclosing large volumes of water (up to
100 litres) seek to avoid some of the sampling errors inherent in con-
ventional tow nets. High speed samplers are also not included since,
although their value in particular applications has been established, they

they have yet to be adopted generally. By the omission of these
samplers I do not wish to imply that they should not/be considered as
unsuitable for adoption as standards in the Indian Ocean sampling
programme but, as I have mentioned above, my intention has been to
consider these nets which are most closely comparable and which as a
consequence should, one might expect, provide a basis for standardisation.
Attention will be drawn in the discussion that follows to those aspects
of net design and operation which are illustrated in the data presented
in table 1 and figure 1 and which appear to be/are fundamental to the problem of
standardisation.

### The shape of the net

From the outline shapes of the nets shown in figure 1 it is
possible to distinguish three basic patterns:-

1. those of a simple conical shape e.g that used by Moore at
   Miami.

2. those in which a conical filtering section is preceeded by
   a non-filtering foresection of canvas in the form of a truncated
   cone. Examples are to be found in the classical Hensen egg
   net and in the Juday nets of the Institute of Oceanology,
   Moscow.

and
3. those in which the filtering section, which may be conical,
   is preceeded by a foresection having parallel sides, which
   may in part be of nylon mesh, ie. Woods Hole and the California
   Cooperative Oceanic Fisheries Investigations, or may be non-
   filtering and of canvas, ie National Institute of Oceanography.

The earliest plankton townets were almost certainly conical in
shape and the second of the basic patterns described above evolved as a
result of the efforts of Hensen to increase the filtering efficiency of
such nets. The use of a non-filtering conical foresection reduces the
the area of the mouth opening and so effectively increases the ratio
between the area of the filtering section ie. the nylon mesh, and the
mouth opening. The higher this ratio, for a mesh of given size, the
better will be the filtration in that a greater percentage of the theoreti-
cal water column (that is mouth area x distance towed) can be accepted
by the net before pressure builds up in the net and outspill at the mouth

occurs. This assumes that the net is being towed at its optimum speed - see below. Ideally a net should have a filtration of 100% and early calibration tests (Kunne 1929 ) suggest that the Hensen net approaches this figure and there can be little doubt that such nets are an improvement on those retaining the simpler conical shape. The use of a canvas forepart of such design however introduces peculiar difficulties not the least of which is the resulting increased drag of the net particularly when paying out during which the net may in certain conditions kite in the water. In the Juday net the canvas forepart retains only a slight angle of taper compared to that in the Hensen net, and this presumably reduces the effects of drag noted above.

The NF70V of the National Institute of Oceanography has a canvas forepart with parallel sides and it will be observed that between this and the conical filtering section there is also a cylindrical section of nylon mesh. The advantage of the tapered canvas foresection compared to one with parallel sides is not clear. Sysoev (1956) has shown that the former produces a better flow while M. Roessingh (communicated in the questionnaire) states that model experiments indicate that a parallel sided section gives a better flow compared to one with a conical section. Recent work at the National Institute of Oceanography (Currie & Foxton. unpublished) has shown the importance, not only of the parallel sided non-filtering section but also of the parallel sided filtering section in creating better conditions of flow in the net and reducing the possibility of outspill at the mouth.

From the available evidence one can thus only conclude that a net whose design includes a non-filtering foresection, either conical or parallel sided, is to be preferred to a net of simple conical shape. The exact form that the non-filtering foresection should take is not clear but on practical grounds the Juday and NF70V versions seem preferable to the Hensen shape which is steep sided. One concludes that there is an obvious and pressing need for fundamental research into the hydrodynamics of water flow through nets before the significance of these slight differences in design can be assessed in terms of filtering efficiency.