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6.1 COLLECTION OF MATERIAL

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6.1.1 History of plankton sampling:

Plankton sampling by nets started a little more than 150 years ago and it is therefore very much in its infancy compared to fishing operations. In 1828, a surgeon, Dr. J. Vaughan Thompson made a small net to sample crab and barnacle larvae. Darwin used a small net on the Beagle and in 1844 Muller used a small meshed conical net to catch a host of minute creatures. This simple tool was the foundation for our knowledge of plankton especially to the taxonomists.

Plankton was soon realised to be more than a systematist's concern, and because it had such significance in the productivity of the sea, the food chain and in the identification of water masses, planktologists wanted to know how to relate the number of organisms found in the volume of water filtered, their distribution in depth, space and time and their daily, seasonal and annual variations.

Icthyoplankton research has played an important role in marine science and its application to fisheries since the end of the last century. It has contributed not only to the clarification of basic problems of fish taxonomy, ecology, zoogeography and life history but also to the exploitation of fishery resources, a better understanding of the fish behaviour and the study of fish population dynamics. The fishery oriented targets of icthyoplankton surveys include exploration for potential fishery resources, location of spawning concentrations of fish stocks, monitoring of long term changes in the composition and abundance of resources and in spawning times and areas (Hempel, 1973). The study can be much more effective in tracing of fluctuations in spawning stocks by estimating the abundance of their eggs and young larvae, forecasting year class strength on the basis of the abundance of older larvae, estimating abundance of a stock based on its spawning population, and discriminating between stocks of the same species. In short inchyo-plankton surveys can be an additional method of estimating fish stock abundance complimentary to other methods of resource evaluation.

The need for so much comprehensive quantitative knowledge brought with it a number of sampling problems such as the sampler, its mesh size and material, the volume of water filtered, closing devices, measurement of the depth of sampling, speed of tow, avoidance and escapement. This was more so when it became necessary to make taxa specific sampling as in the case of icthyo-plankton.

The early life history stages of fishes are restricted, by depth, usually to the upper mixed layers. The passive eggs and feebly swimming larvae are quite vulnerable to capture. Many marine fishes have pelagic eggs and most have pelagic larvae. Thus it is easy to quantitatively sample several species over broad areas with a simple plankton net.

6.1.2 Collection of icthyoplankton

6.1.2.1 Collection with net

The most widely used apparatus for collecting plankton in general is a plankton net. Typically a plankton net consists of a cone of bolting silk or equivalent material mounted on a ring to which are attached three thin bridles spliced on to a smaller ring by means of which the net can be shackled to a towing rope. Modern nets of all patterns differ from this simple plan by having the first part of the net, i.e., the part attached to the ring, of thin canvass, thus making the net stronger. Also the end of the cone is left open and is reinforced by strong material and a small container - the plankton bucket - is attached to this end. This bucket receives most of the plankton as the net is towed along. (Fig. 6.1.1).

6.1.2.2 Hensen egg and larval net

This net developed by Hensen (1895) is used for collecting mostly macroplankton particularly fish eggs and larvae. The frame of the net consists of two metal rings connected vertically by four metal bars. The outer ring has a diameter of 75 cm and the lower ring has a diameter of 100 cm. The filtering portion of the net is 130 cm long and it is attached to an upper canvass portion, 55 cm in length. The opening at the head is reduced to increase the ratio of filtering area of the net to its mouth area and at the same time by means of the canvass head piece the back wash is minimised while the net is towed. There is a collecting bucket attached to the lower end of the net through a canvass piece of 10 cm long. At the top there are three bridles attached to the upper ring which are spliced to form an eye to which is shackled the towing line. From the lower ring three thin ropes are attached to the bucket which protects the netting from strain while hauled up. To maintain the vertical position of the net while hauling a sinker is attached to the bucket. (Fig. 6.1.2.).

6.1.2.3 Juday net

Juday (1916) made a net in which the non-filtering cone was of the same size and tapered as the net itself. (Fig. 6.1.3).

6.1.2.4 Indian Ocean Standard Net

This is another vertically operated net designed by Currie (1963) for use during the International Indian Ocean Expedition. Since the basic plan of constructing the net is the same as that of a typical net, the material used and the various dimensions are given below (Fig.6.1.4).

Section	Diam (cm)	Length	Material	Mesh (mm)
A	113	70	Nylon netting	12.5
B	113	30	Terrylene sail cloth	-
C	113	100	Nylon	0.33
D	113-10 (Tapering)	300	Nylon	0.33

6.1.2.5. Closing net

Samples are taken vertically to give a measure of the plankton under one square metre surface. When it is required to sample a particular strata of the water column, the closing nets are used. Nansen has developed a simple type of net for this purpose. The net can be used for vertical hauls in which case it takes the form of step-wise catches from one depth to the next, in order to determine the vertical distribution of the plankton. The net can be closed at any desired depth, by means of a messenger which releases the bridles. (Fig. 6.1.5).

To sample the whole vertical column repeatedly by a single closing net is time consuming. This led to the development of multidepth sampling equipment (Be, 1962).

6.1.2.6 Bongo net

A high speed plankton sampler which is effectively used for catching fish eggs and larvae is the Bongo net.

(McGowan & Brown, 1966) It is a twin net fixed side by side on an axis or yoke to which the hauling line is attached.

Hanging from the axis in between the two nets is the depressor of prescribed weight. Two types of Bongo nets are usually used; one with 20 cm mouth diameter and the other with 60 cm mouth diameter. In the Bongo net, the turbulance in front of the net caused by the towing bridles is absent thus minimising the net avoidance by fast moving organisms like fish larvae. The Bongo net is used for making oblique hauls while the ship is in motion. The moving ship and the net hauling speed make the hauling faster and therefore the fast moving organisms like fish larvae are also caught in the net along with other zooplankton. (Fig. 6.1.6).

6.1.2.7 Continuous plankton recorder:

The plankton recorder developed by Hardy (1936, 1939) is a unique instrument. In this instrument the net guaze runs through the water in the same way as a film in a camera, filtering the plankton which streams through. The covering gauze then covers the collecting gauze and both together are rolled up into a container which is filled with formalin solution in order to preserve the plankton. The strip of gauze is moved by the action of a propeller, which is driven by purely mechanical means as the result of the movement of the vessel. The rate of transport of the gauze is regulated at the speed which is so small that the advance of 1 cm is equivalent to one knot of the travelling stretch. Despite the small mouth, measuring less than 2 cm^2 the collecting capacity - even for larger organisms - is very good. The instrument can sustain a travelling speed of 8 to 17 knots per hour. (Fig. 6.1.7).

6.1.3.1 Mesh size and material

Plankton varies considerably in size from microscopic protozoans and minute larval forms to fast moving fish larvae and therefore a range is needed both in mesh size and in amount of water filtered. The gauze used in plankton nets influences not only the size of the organisms caught but also filtration efficiency, drag, clogging, velocity and condition of the catch.

For effective sampling plankton gauze should have the following properties: (1) the meshes should be square, (2) the mesh apperture should be uniform, (3) the material of the strands should be stiff enough to resist bending or stretching, but flexible enough to allow self cleaning action, (4) the nature of the weave should prevent strands from sliding out of place and should prevent the meshes from distorting diagonally, (5) the porocity should not change when the net is immersed in water, (6) the material of the strand should not abrade easily and (7) it should resist degradation by sunlight and by chemicals used in cleaning.

The plankton gauze are usually made of nylon or silk. General industrial screening gauses, made of stainless steel are used for rigid nets. Metal and most synthetic gauzes have monofilament strands. Silk and some nylon gauzes have multifilament strands. (Fig. 6.1.8). The mesh size used for collecting fish eggs and larvae is 0.505 mm. For the collection of general zooplankton the net fabric with 0.33 mm is used.

6.1.4.1 <u>Types of haul:</u>

6.1.4.2 <u>Vertical haul:</u>

In a vertical haul the entire water column is filtered through from the bottom to the surface, or only a top part is filtered. The net is lowered to the determined depth from the anchored ship and slowly hauled up. The hauling speed is determined principally by the mesh width of the net (1 m/sec. for a 300 μ net).

a weight is attached to the net bucket.

6.1.4.3 Horizontal haul: The horizontal haul is used to obtain plankton samples from a particular water layer. A weight holds the net while it is being towed in the depth. The depth position of the net can be determined from the wire angle and the length of the cable paid out. Horizontal haul can be done at any water depth from surface to bottom.

6.1.4.4 Oblique haul: It is a combination of the two other types of haul. The net is lowered to a particular depth from a stationary ship. Afterwards the vessel is slowly moved forward and slowly the net would come up to the surface filtering an oblique column of water. The advantage of this method is that the water column is more intensively filtered in this manner than in a vertical haul. In another type of oblique haul, the ship will be in motion while the net is being lowered as well as hauled up.

6.1.5 Volume of water filtered

One of the first essentials in quantitative plankton sampling is to know the volume of water filtered. The simple calculation is based on the length of tow and the area of mouth ($\Pi r^2 h$). Clogging of the meshes introduces an error into this calculation. One method to overcome this was to increase the filtering area. An alternative was to reduce the area of the mouth by a nonfiltering cone. Inspite of all these modifications, the unknown variable factor - clogging - limited the accuracy of calculation. Here the need of the flow meter becomes significant.

The simplest flow meters indicate the number of revolutions of the impeller blades on a series of dials or on a counter. The TSK flowmeter (Nakai, 1954) has proved to be a highly reliable and sturdy meter of the dial type.

The flowmeter used in recent times is the digital flow meter of the hydrobios type. It is a small device with a propeller at one end. There is a small window on one side where the revolutions of the propellor being transmitted through a series of toothed wheels are indicated in numbers.

The flowmeter is to be calibrated before using. The number of revolutions is to be transformed into the quantity of water filtered by the net in which it is used. For this, the flow meter fitted to the net has to be towed several times in an experimental tank for known distance and calculated for the volume of water filtered.

6.1.6. <u>Some problems confronting plankton collection</u>

The critical problem area in sampling as regards quality is that of net avoidance by larvae. To decrease this there has been a tendency to increase hauling speed. However, the value of the increased catch of larger larvae has to be weighed against two adverse effects of increased speed; increased loss of small eggs and larvae through mesh aperture of the net due to increased filtration pressure at higher speed (the extrusion problem) and poorer condition of the specimens retained. It has been found that for all gears fish eggs and larvae were in the best condition from hauls made at slow vessel speed and damage to specimens became increasingly greater with increase in speed of hauling.

6.1.7 <u>Criteria for fixing and preserving eel larvae</u>

Although many characters are used in identifying leptocephali, those of body shape and pigmentation are most likely to be affected by unsatisfactory preservation. Distortion of body can occur in formaldehyde fixed and preserved material through absorption of liquid into the tissues with resultant swelling and occasionally final splitting of the specimen. Considerable shrinkage in body length can occur in alcohol held material and it may reach as much as 5%. Accurate body lengths are particularly impprtant in growth studies.

Alcohol and cork combination should never be used because the muscle tissue of leptocephalus readily takes up the colouring matter which dissolves out of the cork. If this happens, important internal structures such as vertical blood vessels to and from the viscera are obscured as well as the deep pigment around the vertebral column and on the spinal cord if the latter is present.

Most preserved leptocephali can be held for microscopic observation between glass slips, but the more rigid bodied metamorphic forms should be preserved flat or extended. The number and disposition of larval teeth is often an important character as in the delicate median fin. Careful handling of leptocephali during preservation and storing is therefore essential. The specimen is satisfactorily preserved for identification if it shows the following characteristics: (a) body undistorted, relatively flexible, but still with a certain amount of rigidity, (b) melanophores and chorioid pigment of the eyes jet black or even very dark brown, (c) myomeres translucent white or colourless, not coloured brown, (d) larval teeth complete and (e) fins undamaged.

6.1.8 References

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