PLANKTON AS A SOURCE OF HUMAN FOOD

P. K. SWAMY
Central Marine Fisheries Research Institute, Cochin-18

Biochemical studies carried out on the chemical composition of some of the major constituents of zooplankton biomass show a very high percentage of protein when compared to other organic contents present in the body of such animals. In fact plankton are highly nutritious and the liquids of the cell contents of these tiny organisms contain less salt than sea water. Most of these animals are edible and some palatable but are rarely eaten by man directly. People who have tasted plankton either dried to a biscuit or boiled agree that Copepods taste like good shrimp-paste.

The supply of plankton is potentially available in tremendous quantities and it has not so far been used directly as food for human beings or domestic animals on any substantial scale. The total world animal standing crop has been estimated at 33,500 metric tons of which 21,500 metric tons are zooplankton (Bogorov, 1965) (As for phytoplankton the estimates are extremely gross). It is on the standing crop of zooplankton that the pelagic fish and the whalebone-whale feed and less directly also the demersal fish. The main objection in adopting plankton as food directly is that its individual constituents are usually very small in size and so dispersed in water that they are difficult to collect economically. However, simple plankton especially the larger Crustacea is being collected for food in some local areas; e. g. Mysids in the East Indies. The northern 'krill' a Euhhasid, *Meganyctiphanes norvegica* is caught in the Norwegian fjords by using lights to attract it into dense enough concentrations and by small meshed nets in the Norwegian sea (Wiborg, 1966), It is used to supplement the diet used in fish farming.

There are cases where plankton is or has been used directly as food on a small scale and in special ways. Kishinouys (1899) has reported that in China and Japan the medusae of *Rhopilinema esculenta* and *R. verrucosa* are eaten and in the East Indies, species of Mysidae are caught in bulk and there is a trade in them as sauce or flavouring for other foods. In emergencies the direct consumption of raw plankton has been shown to be of potential vital service to the victims of ship wrecks drifting for long periods in open boats. This has been demonstrated by Dr. Alain Bombard (1956) who courageously crossed the Atlantic in a rubber dinghy with no initial food supply in order to investigate the condition of survival in such an extremity.

The chemical composition as the percentage dried weight for the various types of plankton given by Walford (1958) is shown below.

	Protein	Fat	Carbo-hydrate	Ash	P_2O_5	Nitrogen
Copepods	70.9—77.0	4.6—19.2	0—4.4	4.2—6.4	0.9—2.6	11.1—12.0
Sagittae	69.6	1.9	13.9	16.3	3.6	10.9
Diatoms	24.0—48.1	2.0—10.4	030.7	30.4—59.0	0.9—3.7	3.8—7.5
Dinoflagellates	40.9—66.2	2.4—6.0	5.9—36.1	12.2—26.5	0.7—2.9	6.4—10.3

It is seen from the above table that the plankton are very rich in proteins. Plankton can thus contribute to the supply of protein needed to relieve the world's food shortage if it is supplied at a price including processing transport, handling and storage cost that can be paid by those who most need it.

Plankton concentrations

Direct observation of plankton in the water is unfortunately generally limited to a few large animals and requires favourable circumstances. Hydromedusae, Jelly fish and colonies of Salps frequently lend themselves to good observation in surface waters but are not palatable as human food. However, attempts have been made to investigate the vertical distribution of the larger plankton animals from the diving boat. Large Copepods which show a higher percentage of protein amont the zooplankton probably represent the lower limit of identification by this method.

The mass occurrence of plankton organisms is frequently indicated by a change in the colour of the water. Well known examples are the reddish 'krill' of the whaler which consists of swarms of *Euphasiacea*, the green coloured phytoplankton blooms and the so-called 'red tides' produced by massive movements of certain dinoflagellates. This category also includes phosphorescence of the sea, which is generally produced by Noctiluca and other Dinoflagellates.

Indirect observations relating to the presence of plankton are made with the help of the echo-sounders. However, such observations require much experience as it is often very difficult or even impossible to differentiate between fish and plankton accumulations from the indications on the echo graphs. According to our present experience only macroplankton act as echo-sounders. In order to interpret echo-sound signals the supersonic frequency involved must be known.

Transparency or turbidity measurements offer another aid for the determination of plankton concentrations. However, these methods yield only approximate data relating to size.

Areas of abundance

The level of maximum biomass of zooplankton is highly variable, but it is usually about 100—200 m, though nearer to the surface in the higher latitudes; but the maximum number of different species is usually found much deeper, in the region of 1000 m. Number of individuals and species fall off rapidly below 2000 m. Zooplankton is, however, present at all depths eventhough numbers are greatly reduced. A formula for estimating abundance with depth is given by Johnston, (1962). Zooplankton following the development of primary photoplankton is also most abundant in areas of upwelling. In polar areas the biomass of zooplankton is also high. Its abundance in the coastal zones may be 20 to 40 times as great in the warm half of the year as in the colder half and 10 times as great in the summer in the slope zones at the edge of the continental shelf (Clarke, 1940).

Collection

Where it is possible to get concentrations of fairly large species, then a suitable mesh can be chosen to get the maximum efficiency from the ship and the collecting gear. This will be more helpful than a system of taking all from a wide range of sizes. Possible species for this could be Copepod *Calanus superba* in the high northern latitudes and Euphasia in the Antarctic where the Soviet have already experimental expeditions. Modern echo-sounders and sonar are sensitive enough to detect these and other plankton concentraticns and vessels searching for dense shoals would profit by having these equipment. However, if echosound signals are to be interpreted, the supersonic frequencies involved must be known.

Night catches are more likely to give good returns at practicable working depths as many plankton living at greater depths during day hours tend to come to the surface at night hours.

Processing

One way to deal with bulk catches of diverse plankton which might contain much silt and detritus as well as plankton is to process it in such a way that protein alone is extracted. Although it is a costly process, it removes the fats and oils and leaves the product more stable. The unwanted species that may be distasteful or dangerously toxic must be removed. Medusae feed on prey that they paralyse with stinging cells and concentration of plankton containing large quantities of medusae would be seriously harmful. Many dinoflagellates also produce toxins and shell fish like mussels feeding on these can concentrate enough poison in their own tissues to render them highly toxic for human consumption even after cooking. Luckily these are mostly very amall organisms and would escape fairly easily through most filters.

Problems facing the industry

Though the supply of plankton is available in enormous quantities, it is the cost of extraction that makes it at present a double proposition. It appears that it would be more economical to catch fish which are so much easier to harvest than to extract these plankton as they could be estimated. The crux of the matter is in its filteration. It is estimated that one has to filter some 5 million gallons of sea water to obtain one pound of plankton. There is also the vicious circle of supply and demand. Without knowing the demand and price for the end product, capital expenditure cannot be worked out. As production cost would be extremely high for small bulk, the growth of the industry would be affected gradually because production and prices find their own level.

Other major factors in costing are that the richest sources of plankton are in general farthest from the areas where they are most needed.

In conclusion it may be pointed out that there is good scope and much promise for progress in plankton culture in recent years. If the culture experiments are proved to be profitable, there is substantial grounds for hope that in the vital task of ensuring freedom from want, plankton, quite likely marine plankton will play an important role in the economy of the seafood industries. Until the problem of controlling the world population have been solved the sea will be looked to for more and more food and seafood is closely linked with the plankton resources.