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THE MULLUSCAN RESOURCES OF THE WORLD

— A REVIEW

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The molluscan fishery resources of the world are second only to the fin-fish resources, and the prawns and shrimps qualify for the third place in the order of production. Of the average (of five years ending 1970) annual fishery production* of 63,020 thousand tonnes in the world, molluscs constitute 3,238 thousand tons (5.14%) and the crustaceans 1,452 thousand tonnes (2.30%), the two groups together being called shellfish in distinction against fin-fish. Although the shift in consumer perference and the consequent boost in trade have brought the prawns and shrimps to limelight in recent years, the molluscs, particularly oysters and clams, have been in association with human civilization from ancient times. This is because the oysters and clams being sedentary, were easily accessible to people living on the seaboard. Oysters were raised by the Romans in the pre-Christian era, by about 100 B.C., and the Chinese are believed to have been the first to have cultivated oysters several centuries before that.

* Source of landing figures – FAO Yearbook of Fishery Statistics, 1970.

The value of any edible resource depends on its nutritive value, popularity among the people, facility with which it could be harvested and the quantum of yield. Let us consider these factors in regard to the molluscan resources.

NUTRITIVE VALUE

The chemical composition of different molluscs is broadly as given below (data from several sources):

Chemical composition of different groups of molluscs

(Figures are percentages)

	Water content	Protein	Fat	Carbo-hyrdrates	Ash
Clams	75.26	10.33	2.10	3.75	2.06
Oysters	76.84	11.18	1.97	8.00	2.02
Cockles	89.01	5.32	0.35	2.05	...
Blood clams	76.30	12.30	1.40	7.20	2.80
Scallops	80.3	14.8	0.1	3.4	1.4
Mussels	84.2	8.7	1.1	4.1	1.9
Pearl oysters	74.0	19.0	2.5	2.5	2.0

The figures indicate that the molluscs are a valuable protein resource. Besides, the molluscs accumulate several mineral substances like iron, manganese, iodine etc. which add to the nutritive value. However, shellfish growing in polluted waters may harbour harmful bacteria. In such cases purification and sterilisation of the animals is necessary.

POPULARITY AS FOOD

Although molluscs are eaten all over the world they are esteemed only in a few countries. Oysters are gourmet's dish in developed countries, particularly U. S. A., Japan, France, U. K. and Canada, and in major cities of the developing countries. Mussels are relished in Spain, Netherlands and France. The oysters, mussels and clams are taken either in the fresh condition or canned, frozen or dried. In many other countries the molluscs form subsistence fishery for the people living along the coastline. The harvest of molluscs by the countries bordering the Indian Ocean, with the exception of Australia, is poor as they are not a popular food among the people. India, the most populous among these countries, has age-old prejudices amidst most sections of the society. In the South-east Asian countries shellfish has become quite popular. There is a great need for educating the people of most of the developing countries on the nutritive value of the molluscan resources.

METHODS OF HARVEST

Compared to the requirements for catching fish and prawns and shrimps, those for the molluscs are simpler as these animals are sedentary and occur close to the shore. Most often, no tools other than a canoe, a small bag net, a spade or a chisel are involved for gathering the molluscs from the shallow regions. In the intertidal areas hand-picking is the usual practice. Oysters and mussels from deeper waters are collected with powered boats and dredges. Hydraulic dredges using water under pressure have recently been employed for harvesting clams which are superficially buried. The squids which are pelagic in habit are caught in pole-and lines. Culture of oysters and mussels is done with the aid of rafts, poles, ropes etc.

PRODUCTION

The average (of three years ending 1970*) annual production of molluscs in the world is 3,343 thousand tonnes. Of this the molluscs of freshwater origin contribute 55 thousand tonnes. The landings of marine and brackish water species are as follows:

	In thousand tons	%
Cephalopods	1003	30.0
Oysters	797	23.8
Clams, cockles and ark shells	510	15.3
Mussels	323	9.7
Scallops	143	4.3
Gastropods	50	1.5
Miscellaneous	462	13.9

Cephalopods

Squids, octopuses and cuttle fishes form 73.7%, 16.9% and 9.4% of the cephalopd landings. To the 738 thousand tonnes of squids, a single species, the Japanese flying squid *Ommastrephes sloani pacificus*, contributes 70.4% and is caught entirely in Japan. Japan also leads in the production of cuttle fishes and octopuses.

* All landings figures given under this section refer to averages of 1968-1970 unless otherwise stated.

Korea, Spain, Italy and Philippines land considerable quantities of cephalopods.

Oysters

Although several species of oysters occur in the world, of considerable importance are only four, namely, the American oyster *Crassostrea virginica*, the Pacific or the Japanese oyster *Crassostrea gigas*, the Portuguese oyster *Crassostrea angulata* and the European oyster *Ostrea edulis*. These together form 97.7% of oyster production in the world, their respective contributions being 48.3%, 40.2%, 6.8% and 2.4%. The entire production of 383 thousand tonnes of the American oyster comes from the North-west and Western Central Atlantic Ocean, U. S. A , Mexico and Canada contributing 344, 38 and 1 thousand tonnes respectively. The Japanese oyster accounts for 321 thousand tonnes, Japan, Korea, U. S. A., Taiwan and Canada contributing 235, 38, 32, 13 and 3 thousand tonnes respectively. This oyster was introduced along the North-east Pacific coast of U. S. A. and Canada and is cultivated almost entirely from the seed imported from Japan. The Portuguese oyster is important mainly in France and Portugal and to the 54 thousand tonnes of annual production these two countries contribute 44 and 9 thousand tonnes respectively. *Crassostrea angulata* was originally imported from Portugal into France where it has thrived well and produce several times more than in its native waters. The European oyster, whose annual production is 19 thousand tonnes, comes largely from France which accounts for 17 thousand tonnes. Although this species is cultured in several other countries of Europe, their individual contributions are only fractional, only Netherlands and Spain contributing about 1 thousand tonnes each.

Clams, cockles and ark shells

The clams, cockles and ark shells form 78.3%, 8.4% and 13.3% respectively of the total production of 510 thousand tonnes of this group. To the 401 thousand tonnes of clams, the Japanese clam *Venerupis japonica* contributes 36.7%, the surf clam *Spisula solidissima* 29.0%, the hard clam *Mercenaria mercenaria* 12.9%, the soft clam *Mya arenaria* 7.2%, the stripped venus *Venus gallina* 4.2%, other venus clams 5.8% and Teleodesmids 3.1%. Of the total production of 147 thousand tonnes of the Japanese clam, 126 thousand tonnes come from Japan and the rest from the Republic of Korea. The entire production of 116 thousand tonnes of surf clam comes from the North-west Atlantic coast of U. S. A. although a little is produced in the Maritime Provinces of Canada. The hard clam production of 52 thousand tonnes also comes entirely from the North-west Atlantic coast of U. S. A. with very little coming from other parts of U. S. A. and Canada. Of the 29 thousand tonnes of soft clam, 26 thousand tonnes come from the North-west Atlantic coast of U. S. A. and the rest from the Maritime Provinces of Canada. The entire production of 17 thousand tonnes of the stripped venus clam comes from Spain.

Cockles are important mainly in Europe and Korea. Of the 43 thousand tonnes of total cockle production, Spain, U. K. and Korea account for 16, 15 and 9 thousand tonnes respectively. The most important species is the common cockle *Cardium edule* which contributes to the total cockle production of Europe.

The ark shells *Anadara granosa* (also called blood clam) and *A. subcrenata* ('Mogai' clam) contribute 29 and 35 thousand tonnes in Malaysia and Japan respectively. The remaining 4 thousand

tonnes of ark shells come from the Caribbean coast of Venezuela.

Mussels

The blue mussel *Mytilus edulis* forms 85 7% of the total mussel production of the world. The Cholga mussel *Aulacomya ater*, the South east Pacific mussels *Choromya* spp., the large mussel *Perna perna* and other species of mussels form the rest. The entire production of 277 thousand tonnea of blue mussel comes from the European countries — the Netherlands, Spain, France, Denmark and Italy contributing 102, 90, 34, 17 and 14 thousand tonnes respectively. Mussel production in Spain has been showing a consistent increase and in 1970 has reached 109 thousand tonnes and stood first among the mussel-producing countries. Chile produces 20 thousand tonnes from the Cholga mussel and South-east Pacific mussel resources.

Scallops

Among the scallops, the sea-scallop *pecten magellaanicus* occupies a predominant position contributing to 64.9% of the scallop production in the world. The common scallop *Pacten maximus* and the Japanese scallop *Pecten yessoensis* form 11% and 8.4% respectively. Of the 92 thousand tonnes of sea-scallops, Canada produces 52 thousand tonnes and U.S.A. 40 thousand tonnes, France accounts for 10 thousand tonnes out of 16 thousand tonnes of common scallop production. The entire production of 12 thousand tonnes of Japanese scallop comes from Japan.

Gastropods

Compared to the cephalopods and and bivalves, the gastropods form an insignificant group, contributing, an average of only 50 thousand tonnes a year. To this production the abalones (*Haliotis spp.*) contribute 25 thousand tonnes and the top-shells (*Turbo spp.*) 11 thousand tonnes. The abalones are of some importance in Australia, Japan and Mexico and the top-shells in Japan and Korea. The rest of the gastropod production is from the whelks, conchs, periwinkles, winkles etc.

OUTSTANDING SPECIES AND AREAS OF PRODUCTION

From a review of the production figures it could be seen that a few species and a few areas stand out as most productive. The Japanese flying squid *Ommastrephes sloani pacificus* contributes 519 thousand tonnes, the American oyster *Crassostrea virginica* 384 thousand tonnes, the Japanese oyster *Crassostrea gigas* 320 thousand tonnes, the blue mussel *Mytilus edulis* 277 thousand tonnes, the Japanese clam *Venerupis japonica* 147 thousand tonnes and the surf clam *Spisula solidissima* 116 thousand tonnes. These six species together account for about 53% of the total world production of molluscs, which highlight their importance as the most productive species.

Japan and U. S. A. produce 1316 and 633 thousand tonnes of molluscs respectively which together forms 58.3% of the total world production of molluscs. Comparatively smaller areas, next in importance, are, Spain, Korea, France and Netherlands producing 231, 182, 122 and 103 thousand tonnes respectively. The North-west Pacific, North-west, Western Central and North-east Atlantic are the most productive regions. The molluscan production from the entire Indian Ocean region is pitifully low, averaging only 28 thousand tonnes, a major share of which comes from Australia.

SITUATION IN INDIA

Narrowing down our consideration to India, it is seen that no appreciable contribution to the world production of molluscs has been made. Although several categories of molluscs are harvested at a subsistence level at various centres all along the coastline, no reliable data on production are available. The west coast has been found to possess more molluscan resources than the east coast. The major areas of production are the Gulf of Kutch, the numerous estuaries and creeks along the Maharashtra coast, Mahim Bay, the rivers Tiracol, Chapora, Sal, Mandovi and Zuari in Goa, Kalinadi estuary, Gangavali and Tadri rivers in North Kanara, Coondapur, Silanadi, Malpe, Mulki, Gurpur and Netravati rivers along the South Kanara and Korapuzha estuary and Vembanad Lake along the Kerala coast. On the east coast Pulicat Lake, Kakinada Bay and Chilka Lake are the important areas of production.

The mussel production based on the brown and green mussels is mainly concentrated along the Kerala coast although north of it at several places they are collected by fishermen. Sizeable patches of oysters are found in Bombay, Ratnagiri, Jaytapur, Goa, Karwar, Kutch creeks, Pulicat Lake and several other places. The clam resources which comprise principally *Meretrix meretrix, M. casta, Katelysia opima, K. marmorata, Paphia laterisulca, P. malabarica* and *Villorita cyprinoides* are far more important in India than other species of molluscs. The pearl oyster resources are rather limited in the sense that they contribute to intermittent fisheries only. The conch resource is comparatively more valuable as it is annually fished, particularly along the Tamil Nadu and Gujarat coasts. Incidentally the last two are the only molluscan resources which yield revenue to the governments and hence their production is accounted.

The molluscan landings of India, as published in the FAO Year book of Fishery Statistics, are 1.5, 0.8 and 1.2 thousand tonnes for the years 1968 through 1970. The cephalopod landings were 1,561 tonnes in 1971. Besides harvesting the clams and oysters for culinary purposes, the shells are used in the manufacture of lime and cement. Several thousand tonnes of shells are used for this purpese. Although the submerged shell deposits are the main source, the contribution from live shell resources in substantial,

AQUACULTURE OF MOLLUSCS

Aquaculture has become an important means of getting additional source of human food from the inland waters and the edge of the sea: In mariculture the molluscs enjoy a supreme position, as the quantity of molluscs far exceed the amount of fish or shrimps produced under culture. Being sedentary creatures, the oysters, clams and mussels are admirably suited for culture.

The practices of aquaculture of molluscs range from simple transplantation of the seed from the natural grounds to areas where ideal conditions for faster growth and fattening exist, to producing the seed from the adults under controlled conditions in hatcheries, growing them up to the juvenile stage and farming them subsequently. The molluscs under culture are generally laid on prepared grounds which have been taken on lease wherever such a system exists. But to gain the advantage of volume over area, three-dimensional culture has been adopted making use of rafts. Culture of food oysters, pearl

oysters and mussels is done by hanging them on ropes, cages, framed nets etc. from the rafts. In France a peculiar method of collecting mussel spat by providing wooden posts for settlement and subsequently transferring them to fences (bouchots) for growth and fattening is practised. Our knowledge of culture technology has vastly increased during recent years, thanks to the developments that have taken place in U.S.A., Japan, France, Spain, Canada and a few other countries. Culture practices have advanced so much that a species which has no natural distribution in an area, is grown there by importing the seed. The oyster industry of the Pacific coast of U.S.A. and Canada is based almost entirely upon the Japanese oyster *Crassostrea gigas,* whose seed is imported from Japan for culture.

Oyster culture is practised in several areas, the important among them being the east and north-west coasts of U.S.A., Gulf of Mexico, Hiroshima, Okayama, Miyagi, Iwate, Saga and Fukuoka prefectures in Japan, English coast of Britain, Bay of Arcachon, Ile d'Oleron, Marennes and Morbihan district in France, British Columbia and Maritime Provinces of Canada and New South Wales in Australia. Mussel farming is prosperous in the Galician Bays of Spain and Waddensea and Zealand of Netherlands. Clam farming is mainly practised in U.S A. and Japan although some culture is done in U.K., Korea and Malaysia. Pearl culture is a well-established industry in Japan and has come to stay in Australia also recently. Smaller areas of pearl culture are Palau Islands, Celebes, Philippines and Hong Kong.

In India simple culture practises have been in existence for oysters, particularly in the Bombay region. Some experiments on oyster culture were begun in the Pulicat Lake near Madras but were subsequently not pursued with the same interest. It is about time that we take a new look at the molluscan fishery resources and their exploitation. The clams are by far the most abundant resource and simple transplantation experiments could raise the level of production several times. Mussel farming has a bright future in India. Oyster culture could be developed at several places along both the east and west coasts of India. Pearl culture has a great trade potential within the country as well as outside. The increased attention paid by the Central Marine Fisheries Research Institute to evolving suitable techniques of mariculture will, in the near future, pave the way for a brighter and better harvest of the molluscan resources besides the others.

Although aquaculture has not reached the stage equal to the poultry industry, the scientists the world over are working towards achieving this. Despite making great inroads into the realm of aquaculture there are several lacunae in our knowledge. Stock improvement for achieving faster and better growth through artificial selection and breeding, is a line which requires our attention. Disease control is another major aspect of research that has to be investigated further. Pollution of waters where these sedentary animals live, may cause wholesale destruction of the resources from particular areas. Research on this aspect is also vital to the future of shellfish farming.