

International Council for  
the Exploration of the Sea

C.M. 1974/E:46  
Fisheries Improvement Committee  
Ref.: Shellfish and Benthos  
Anadromous and Catadromous Fish

MARICULTURE. A PROPOSAL.

by

E. Egidius and D. Møller<sup>x)</sup>

Aquaculture - defined as any kind of operation which subjects the organisms in question to at least one (frequently more than one) process of treatment before being finally harvested or caught - is a very ancient practice. In the far East the farming of different species, most herbivorous fish in ponds and ricefields, has more than a thousand years tradition. Also in Europe, freshwater culture has a long history and especially the later decades have generated a great deal of research work and practical applications in different cultivating aspects.

Mariculture - the aquaculture in marine environment - however, is of far more recent origin, and is in most countries less advanced than the freshwater culture, perhaps with the exception of oyster culture.

Mariculture today is headed by Japan where 18 % of the seaproducts consumed originate from mariculture. Species cultivated include algae, molluscs, crustaceans and bonefish. Some species are being cultivated through their full life cycle, whereas others, where the spawning, hatching and/or fry-rearing processes are not yet fully understood, are sampled from natural habitates as larvae or fingerlings and fed in confinement for better growth.

Several of the ICES member countries have started on different aspects of mariculture mostly on experimental scale, but also some commercial. The aim of this paper is to start a discussion

---

x)

Institute of Marine Research,  
Directorate of Fisheries,  
Bergen, Norway.

on the topic which is proposed to lead to the establishment of an ICES Working Group on mariculture. To prove the necessity of ICES support and cooperation on this topic, we will shortly describe and discuss the recent development and future views of mariculture in Norway.

In Norway the natural conditions for mariculture are excellent along large stretches of the coast. Factors worth mentioning are the coastal topography, vast areas consist of shallow waters; the relatively slight difference between high and low tide, the situation in regard to currents and the favourable sea temperatures. Also the highly developed coastal fisheries give an advantage as far as supplies of feeding are concerned. At present, generally speaking, pollution presents no problem for mariculture, even if it locally can be a hindrance.

Until now mariculture in Norway has concentrated on farming Salmonides and to a lesser degree bivalves as mussels and oysters. For farming fish in sea water, extensive knowledge of fish culture in fresh and brackish waters is important, but research and application of special methods and techniques for sea culture is of vital importance. Only in the last few years governmental supported research has started to work seriously on problems encountered in mariculture.

The main mariculture problems under research are:

Ecological relations - biological optimizing

Culture technology

Selected breeding

Hatching - rearing of egg/fry/fingerlings

Nutrition - diets

Pathology

Economics

Culture of bivalves

Culture of other species

Multiculture

Sea ranching

Voices have been raised against research money being spent on the culture of "luxury" aquatic organisms. The research done on the culture of Salmonides and other economically high-valued organisms will at first be advantageous mainly for the farmer of these products. But as long as the fish waste, and noxious and undersized fish, which are the main source of fish farms diets in Norway, cannot be utilized in more efficient ways for human consumption, the so called luxury farming is justified. Also the "luxury" species may in due course become less expensive as happened with rainbow trout in Japan.

On longer terms this research has a much larger goal. The knowledge acquired through the work on Salmonides will be applied on organisms that today are impossible to culture or where the culture is not economically feasible. Also, the experience and knowledge gained in fish culture research will in due course benefit the traditional fish resources.

It is not possible to predict the development of the traditional fisheries, but the prognosis is not very optimistic. The continued decrease in the natural fish populations will promote the further development of mariculture.

As to other species than Salmonides and bivalves, work is in progress with the aim of arriving at practical and economical feasible methods for cultivating several flatfish species as well as crustaceans.

Moreover, there is scarcely any doubt that soon the advantages of multiculture will be exploited. Fish culture today creates an environment rich in energy with a rapid turnover. Species of pelagic fish, some demersal fish and stationary organisms should be able to utilize different aspects of these "artificial" environments. Relevant plans for exploiting whole fjord systems in this country have yet to be drawn up.

Another form of mariculture and a reasonable alternative to controlled rearing in confinement is sea ranching. Sea ranching concerns that part of the organisms life cycle, usually the susceptible egg and fry stages, is spent under controlled conditions, while the rest of its life, usually the growth phases, is spent in open waters in the natural environment.

By sea ranching it is possible to make a genuine contribution to increase protein production rather than merely converting protein that is already collected. By starting a sea ranching program one takes the first small step towards laying the base for the commercial fisheries being more influenced by man which may lead to the possibility of avoiding occasional failure of fisheries.

In sea ranching one must accept that many of the organisms released will fall prey to natural and fishing mortality by other nations. It is not right, however, that the migration of fish stocks is without borders, so that a nation should at least be able to recapture its own ranched fish by concentrating on the right species.

Several countries are initiating sea ranching programs, for instance the U.S.S.R., the U.S. and Canada with different species of Pacific salmon. So far little information is available on this programs, but there are indications that the Canadian program is being very successful.

The problems encountered when starting mariculture will basically be similar for most ICES member countries and the research topics mentioned being started on in Norway are relevant fields for closer cooperation. Today information concerning mariculture is scattered through this and other committees within ICES and it is our feeling that this escalating field would benefit highly from a permanent Working Group.

Also such a Working Group could be most useful in the cooperation on mariculture between ICES and other international bodies as for instance EIFAC. As an example EIFAC has done fundamental work on the prevention of the spread of the major communicable fish diseases which has led to the proposal of an international convention. Such a convention is necessary, but to our belief the special problems of mariculture and disease in marine waters have not been considered seriously enough. This is mainly due to the fact that there has been no international body concerned specially with mariculture, the ICES Working Group on the introduction of none indigenous species in the marine environment, only touches on the mariculture field.

We therefore propose to the Fisheries Improvement Committee to recommend the establishment of a permanent Working Group on mariculture with the following terms of reference:

1. To encourage cooperation on mariculture research within ICES member countries with the goal of creating a sound scientific basis for a viable mariculture industry.  
Relevant fields of research includes:  
Ecological relations - biological optimizing  
Culture technology  
Selected breeding - exchange of genetic material  
Hatching - rearing of egg/fry/fingerlings  
Nutrition - diets - exchange of feed components  
Pathology - disease research on natural marine resources is highly neglected  
Economics  
Culture of other species  
Multiculture  
Sea ranching
2. To serve as liasson for ICES cooperation with other international bodies in questions related to mariculture.
3. To attend to international regulations concerning sea ranching of all marine fish species.