

# reviews

## Aquaculture methods

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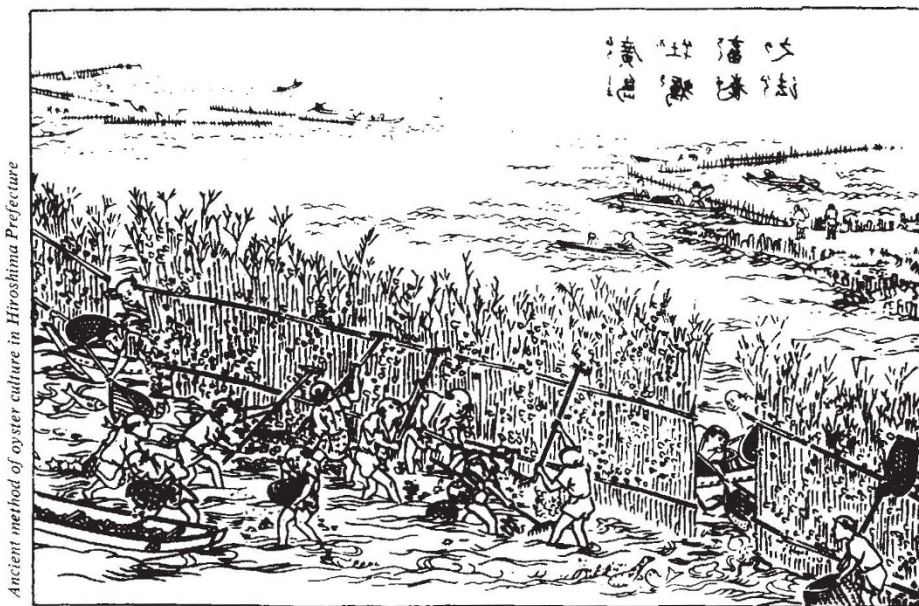
*Farming Marine Organisms Low in the Food Chain. Farming Cupped Oysters of the Genus Crassostrea. Farming the Flat Oyster of the Genus Ostrea. Farming Marine Fishes and Shrimps.* (Developments in Aquaculture and Fisheries Science, Vols 1-4.) By P. Korringa. (Elsevier: Amsterdam, Oxford and New York, 1976.) \$30.95; Dfl.80 each volume.

At this time of increasing competition for already over-exploited stocks of fish, any increase in marine productivity by aquaculture demands attention. No one is better qualified to write about this than Professor P. Korringa, Director, Netherlands Institute for Fishery Investigations. Responsible for restoration of the Dutch oyster beds following shell disease in the 1930s, he must since have visited every significant area of marine cultivation. This reviewer has memories of visits in his company to areas of oyster and mussel cultivation in France, Spain and Italy.

His descriptions of culture methods are based on actual procedures within selected aquacultural enterprises. For each he supplies a biological, geographical, oceanographic and even legal background—thus sheltered, pollution-free waters and security of tenure are all involved. Farming procedures include control of predators, parasites and disease. Economic problems including marketing are finally assessed.

Description of culture methods begins with that of the red seaweed 'Nori' (*Porphyra*) in Japan and concludes with that of rainbow trout and salmon in Norway. Cultivation of bivalve molluscs is inevitably the major theme; mussels (*Mytilus* spp.) clams and, above all, species of the flat oyster, *Ostrea*, are covered together with those of the ecologically more tolerant cupped oyster, *Crassostrea*, which are everywhere replacing them.

Mussels, strangely neglected in North America and Japan, are reared on stakes in the long established 'bouchot' system in France, by mass transplantation in the Netherlands, and with impressive productivity in the sheltered



Ancient method of oyster culture in Hiroshima Prefecture

'rias' in north-west Spain, where settlement and growth are on ropes suspended from moored pontoons or catamarans.

The great French oyster industry was initially based on studies of the surviving remnants of Roman culture methods in the Mediterranean. Large scale cultivation, between tide marks—first of *Ostrea edulis*, then of the Portuguese *Crassostrea angulata* and now of the ubiquitous Japanese, *C. gigas*—was established; and its methods have now been widely copied throughout the world. The highly successful suspended culture method was initiated in Japan some fifty years ago, at first to offset restrictions caused by limited intertidal space.

All these methods involve collection of naturally produced spat in areas of relatively still water and subsequent growth in water rich in phytoplankton. Only in hatcheries (about which Dr Korringa has surprisingly little to say), where oysters are induced to spawn and the larvae and spat fed on reared algal species, can full culture be established.

With fish, only the cultivation of herbivores—here described for mullets (*Mugil*) in Israel and in 'valli' round the mouth of the Po in the Adriatic, and for milk fish (*Chanos*) long culti-

vated in Indonesia—represents economic production of animal protein. Japanese cultivation of the carnivorous yellow-tail (*Seriola quinqueradiata*) and red sea bream (*Chrysophrys major*)—with that of the no less carnivorous penaeid prawns (*Penaeus japonicus*)—involves conversion, with much accompanying labour, of lower into higher or more acceptable forms of animal protein. The result is an expensive luxury product.

Conditions are somewhat different with eel culture in Japan—supplying such a demand that eelers are imported from so far afield as Europe—and salmonid rearing in Norway and Scotland. These have the advantage of supplying an insatiable demand at a lower cost than that involved in collection of these fish in Nature.

These admirably produced and illustrated books are a pleasure to review. They will be of the greatest value to aquaculturists; nothing is described that has not been personally inspected and judged in the light of Dr Korringa's uniquely wide experience. □

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