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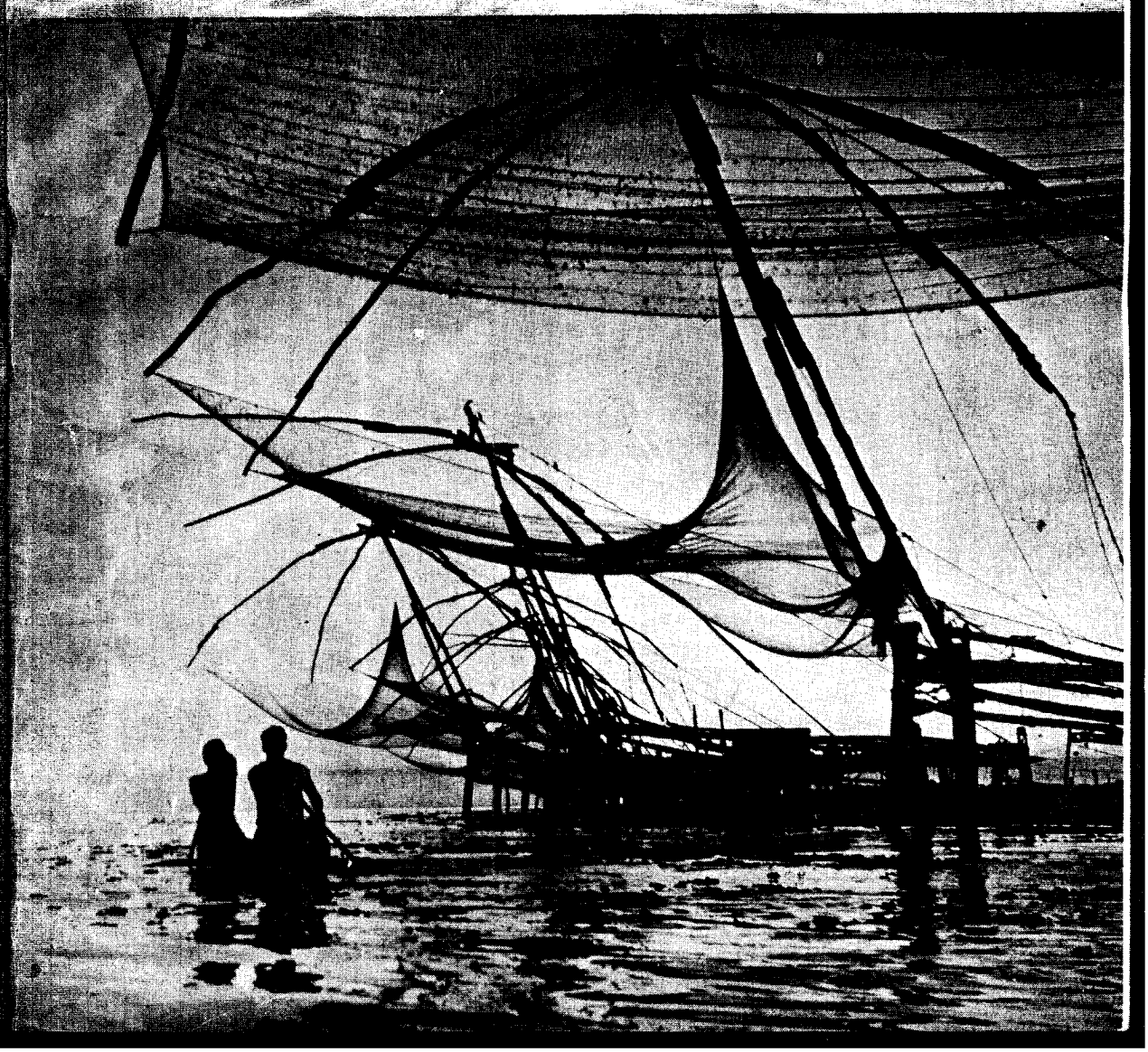
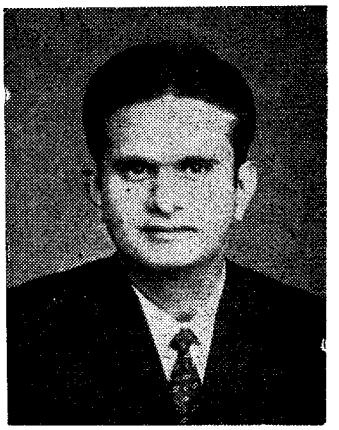


SERVATIONS ON MARICULTURE SEARCH IN THE UNITED NGDOM



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The principal aim of mariculture re- ch programme in the United Kingdcm provide scientific advice to maximize yield. Recent trends in shell fish re- ch have been directed towards methcds ing new resources of seed and means proving natural settlement. Effects of ging patterns of exploitation and abun- e of the diffe rent kinds of stocks are tigated and promising new methcds of hing and cultivation are studied with eim of improving efficiency. Brief unts are given of a number of aspects he work on mariculture that were rved during my visit, 1972–73 at the rent laboratories in the United Kingdom h are of particular concern to the try. The work on shell fish cultivation vided both between the fisheries labo- ies at Burnham-on-crouch and the eries Experimental station, Conway; ork on artifical rearing of marine fish progress at Lowestoft Laboratory and arine Laboratory, Port Erin, Isle of man.

SHELL FISH CULTIVATION

Mussels

Relaid seed mussels:- *Morecambe Bay (Fig. 1) mussel seed were relaid in the Menai Straits to measure the growth and yield on small experimental plots on muddy shore at low tides, besides assessing the extent of predation by shore crab. Comparison of the results from unprotected plots of 20 m^2 stocked with mussel seeds with that of the seed at corresponding densities enclosed within small 2 m^2 crab proof cages

Fig. 1. Morecambe Bay seed mussel bed

America" bed with heavy seed mussel corp: mm at 70 tonnes/acre.

showed that after 10 months irrespective of relaying density, unprotected seed on plots experienced a poor survival of about 20% and their mean length increased from 28 to 46–48 mm, thus resulting in small losses in weight of standing crop. Caged mussels grew more slowly to 39-42 mm. but survival was far better and the standing crops more than doubled in weight.

The seed mussels 28 mm. (average length) grew to minimum market size, 50 mm. in 15 to 20 months, and to 59 mm. at the end of two years. Despite the massive losses by carb predation, standing crops of unprotected and undisturbed mussels show small gains in live weight. By the end of the 1st year, protected crops show weight gains of 90–130% and in more lightly stocked cages, and they increase further, to nearly 200%, by harvesting time. The crop yields attained densities equivalent to 80–120 tonnes per acre (195–292 tonnes per hectare).

The poor survival and crop growth of the exposed seed therefore appear to be attributable largely to predation by shore crabs. Bird predation and tidal action cause only small losses. Mussels with shells below 40 mm. in length are the most vulnerable to crab attack and their mortality declines rapidly in significance and the crops become more productive during the final phase of their growth to marketable size.

Rope culture with mussels:- Large quantities of winter spat are obtained by setting out coir ropes and fibrous rubberized matting* collectors over the stony settlement grounds for a few weeks at Morecamb for setting up floating culture in d more sheltered waters. Upto 28000 spat (mean length 1.5 to 2 mm.) be obtained per meter of 2 cm meter coir ropes. Spatted ropes 2 meters long, were suspended vertical a raft moored in deep, sheltered w Menai Straits (Fig. 2). Growth on

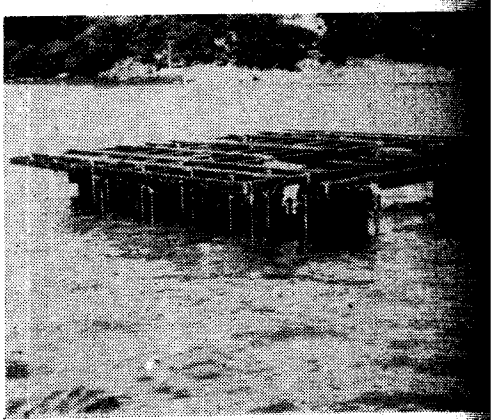


Fig. 2. Mussel culture raft moored at Menai N. Wales.

settled in winter was below expecta ranging from 32 to 44 mm. in the first probably due to heavy catch rate and of thinning producing grossly over crow crops; mussel clusters attained 20-25 diameter after only four months. The set out in spring season grow much b and reach minimum market size (50 m in 13–14 months and 60 mm. after years. The best ropes yield 16–18 kg metre with a maximum of 20 kg. (Fi in the first autumn though the mussels still below market size (30–40 mm.). a cooked meat yield of 17% by w these small mussels could still give 2.

* Fibrous rubberized matting, measuring 180 x 60 x 2.55 cm caught some 550,000 spat during two weeks.

Fig. 3. Growth of mussels on Rope

Fig. 4. Difference between shore and suspended mussel growth.

cooked meat per meter. After winter such rope populations could again to attain similar live weight yields by cond autumn when the mussels would marketable size. However, cooked rom a higher percentage (20–27 per- nd more mature crops would there- ield 3.0–4.5 kg. of cooked meat per Culture mussels were found to have rate of growth (Fig. 4) in general higher percentage of meat (Fig. 5).

mounts of carbohydrates and protiens d from the sublittoral mussels from me fishing grounds followed a pattern to that of body weight (Walne and

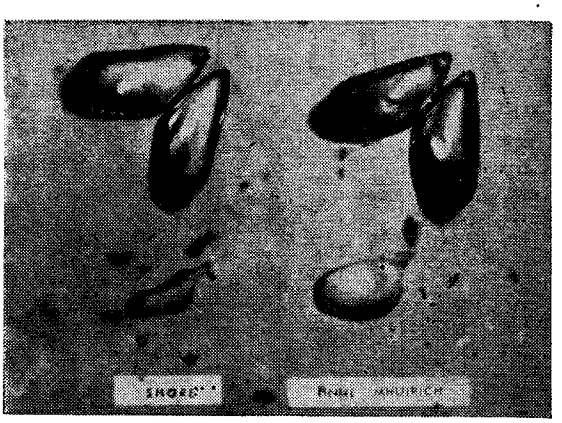


Fig. 5. Difference in meat growth between shore and suspended mussel.

Wood 1973). During the fishing season, carbohydrate content decreased by 80% and protein by 30%. Winter meat weight loss was due mainly to utilization of stored carbohydrate, though some derletion of protein also occurred. The net result of the above changes is a sharp fall in the food value of the meats which amounted to about 44% over the fishing season. These findings, therefore, have important implications for the optimum management of the cultivated, as well as natural mussel stocks.

Oysters

To take full advantage of the large number of hatchery-reared seed oysters (2.5 mm.) available in the United Kingdom, methods are devised for holding large number of small oysters in the sea until such time as they reach a suitable market size and for relaying on the grounds. (Walne and Wood 1972 & 1973).

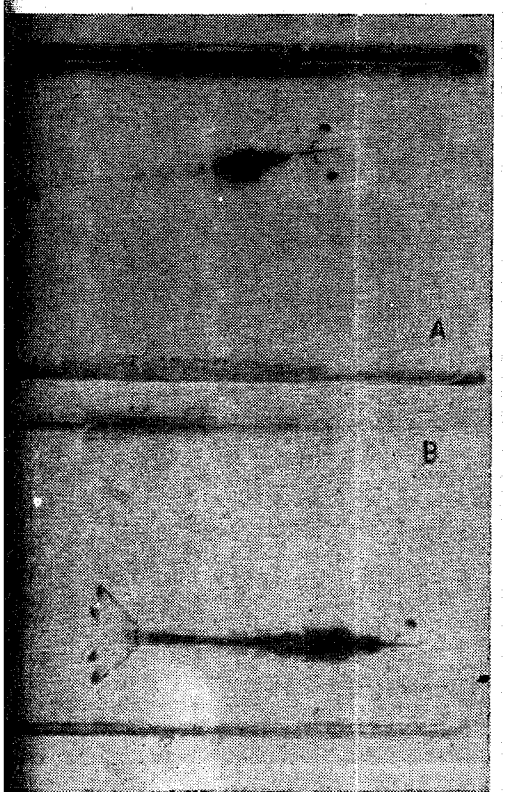
A raft culture technique by which 200000 seeds could be reared was developed by Walne and Wood (1972) in N. Wales for growing seed Pacific oyster *Crassostrea gigas*. Rafts holding a vertical stack of eight trays are placed in areas of oyster production. An average of 427 seed oysters of mean weight 0.06 g placed in each tray are cleaned at an interval of 4–6 weeks for removal of silt and fouling organisms. Mean growth and survival of Pacific oyster on each raft after 17 weeks showed that the survival and growth of the oysters were better in the top and bottom trays than in the inner trays. It is not yet clear whether this is due to the effects of light, restriction of water flow or the mechanical effects caused by excessive water movements. To reduce the number of variables, the samples were being ke standard wooden trays suspended rafts, 1–2 metres below the water surf In all cases, the trays measuring 4 ft x 2 4½ inch deep, are divided into two c partments and are covered at top and tom with ¼ inch plastic mesh, and are st ed with 55 spat each. The trays are dismantled for removal of silt and fou organism. Spats planted with initial m weight of 1.18 – 1.29 g. have been foun grow to 29.45 g – 40.30 g in 7 mo period.

Growth in flow trays at the labora was found to be relatively poorer those planted in trays, cages or suspe from rafts and they fall to reach 2 g b end of two months whereas the 50 mg planted on the raft reach 5 g in 102 Higher rate of growth of oysters observed in salinities ranging bet 20% – 30%. The growth was faste 28°c when campared with tempera 22 to 25°c.

Prawns

If prawn culture is to become a self-reliant industry it is essential to in and control the breeding of penaeid pra in captivity. Male prawns mature rea in the laboratory tank, but the ovari females do not develop fully and appea cease development at the stage when yolk should be accumulating in the o This has been considered to be due to a ability to produce the vitellogenic prot which are carried in the blood and needed for yolk production in the (Walne & Wood 1973). Breeding seem be possible when vitellogenic protei injected into the body of the prawn enable the ovaries to develop fully. It

been found possible to induce matura- in penaeid prawns by removal of one stalk because these contain glands h secretes an ovary-inhibiting har- e. This removal seems to reduce this bition and allow maturation to proceed. emoval of both eye stalks at the same usually results in death within a few . Untreated animals kept under identical ditions as the experimental animals no sign of ovarian development 6),



The effect of removal of one eye stalk on ovarian development in *Penaeus orientalis*. (A) Both eye stalks intact, no ovarian development visible; (B) one eye stalk removed, the ovary clearly visible as a dark area extending almost the entire length of the prawn (Figure from Walne *et. al.* 1973).

Of the various species of penaeid prawns experimented so far at Conway, *Penaeus monodon* was found to be most promising specie for intensive cultivation. Successful large-scale cultures of this type will need careful control of the chemistry of the recirculating system of the culture tanks. A programme to measure the tolerance of prawns to ammonia, nitrate and dissolved carbonaceous material is in progress at the same time as a study of the efficiency of biological filters to control the level of these factors. However the most hopeful prospects for prawn culture in the United Kingdom probably lies in intensive cultivation in a warm indoor environment. At the same time this is the drawback in United Kingdom because these tropical prawns cannot be grown there in the normal way.

Lobster

Egg-carrying lobsters are kept in warm water to accelerate hatching and these give a supply of larvae. Then these larvae are grown upto a considerable size in various conditions of temperature, feeding and water volume. Cannibalism was found to be one of the factors in the depletion of the stocks grown in the experimental tanks.

FISH CULTIVATION

Techniques for the cultivation of fish for the past few years have been directed towards the cultivation of turbot and sole which are sufficiently valuable to justify commercial production. Details of the production of turbot and sole eggs, their incubation and growth of larvae to metamorphosis have been published in the report

of the Director of Marine Fishery Research Laboratory Lowestoft for the years 1969-71.

Soles have been reared through metamorphosis each year (Fig. 7) using rotifers

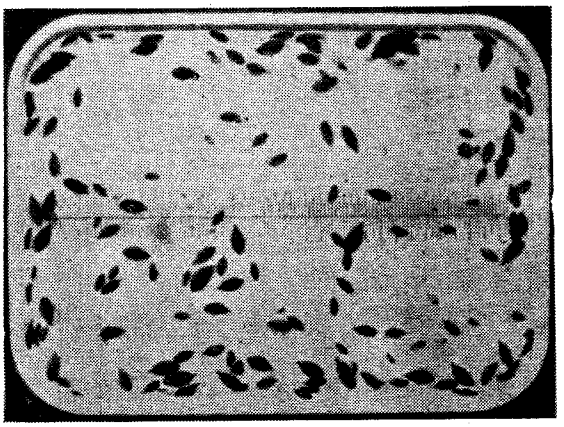


Fig. 7. Soles reared to metamorphosis in the hatchery. (Figures from the report of the Director, Marine Fishery Research Laboratory, Lowestoft).

for early feeding (upto 6 days after hatching) and brine-shrimp nauplii thereafter. In static conditions, a sole could be reared to metamorphosis at densities of upto 800 fish per square foot of tank (Approximately 8000per sq.m.) Hatchery-reared sole matures and produces viable eggs and spermatozoa. Growth trials with sole shows that the fish could be reared to market size in about 2 years. Heavy mortality occurs amongst small fish (5 - 15 cm. in length) mainly due to ciliate infestations, and were controlled with regular formaldehyde treatments.

A stock of mature turbot caught at sea was established in a temporary pool of 25,000 litres capacity. Natural spawning occurred sporadically. Regular supply of fertilized eggs were made available by stripping eggs and milt by hand. Eggs successfully incubated and the larvae fed with rotifers and mussel larvae. 10 days feeding, the larvae measured 6.0 mm and began to take brine sh nauplii. Growth trials with turbot (r length 6 cm) taken from the beaches sh that these fishes are ideal for cultiva They feed voraciously on trash fish and a marketable size of 30 cm within 12 m (Fig. 8). Over a period of 16 month

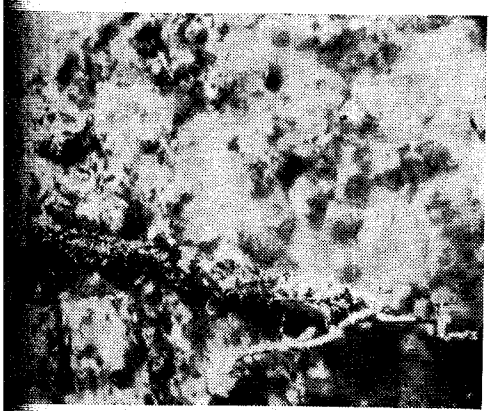
Fig. 8. Turbot in experimental rearing t (2 years old).

turbot reached a total weight of 121 kg consumed three times this weight of f

GENERAL REMARKS

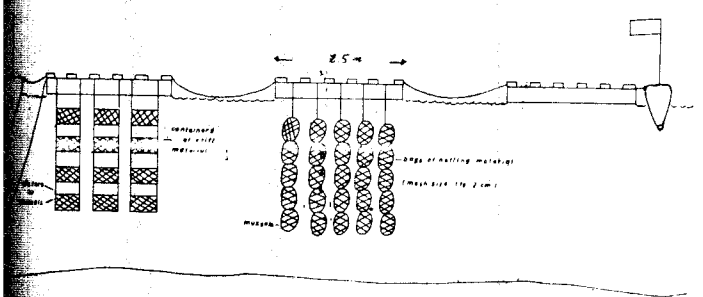
Through intensive farming Hollan Spain have greatly increased their m production. They produce together 1 million tonnes (F.A.O. 1970) which is 62% of the world mussel production. very recently mussel culture, by using has been given importance in the U Kingdom and the production rates per

ir rope and per hectare compares well those of Holland and Spain (Meixner, , suggesting a promising develop- for mussel farming by rope method. xperimental ground coir rope culture d at Morecambe Bay revealed specta- results yielding 12—15 kg. per metre e. Since this method (Fig. 9) is rather



Ground coir rope with mussel attachment at Morecambe Bay.

nsive, this type of culture could as attempted in India wherever there is mussel spat fall. Apart from this, g the seed mussel could also be tried them from the area of abundance to places where conditions are suitable ir growth. Mussels and oysters are d in perforated plastic containers t bags suspended from floats (Fig.10)



Mussels and oysters cultured in perforated plastic containers at Flensburg.

at Flensburg, West Germany. This is done in the open sea also and I was told that they could withstand rough weather. Since the culture practice is to be undertaken in areas where pollution is most minimal, the method employed in West Germany appears to be a suitable one for this purpose in the long-range mussel culture development programmes. Emphasis is given at present for the culture of edible oysters in United Kingdom. It is possible that they would undertake culture of pearl oysters also from the seed brought from the tropical regions in the same way as they are doing for prawns.

Techniques on marine fish cultivation are now well established in the United Kingdom and soles, plaice and turbot are reared to market size each year. A method has also been developed for doubling the number of egg chromosomes by subjecting eggs to cold water shocks just after fertilization. The result of this is that the two sets of egg chromosomes and the single set in the spermatozoon fuse to produce an embryo whose cells contain three sets of chromosomes instead of the normal two sets. Such triploid fish grow faster than diploid ones but, more importantly, they are sterile and therefore do not use energy in the development of reproductive organs.

It is essential to induce and control the breeding of penaeid prawns in captivity if prawn culture is to become a safely self reliant

industry in India since shrimps are the highly valued of the marine products. The results of the experiments conducted in U.K. on the injection of vitellogenic protein into the body and removal of one eye stalk showed spectacular results on ovarian development and penaeid prawns produced many thousands of eggs (Walne and Wood, 1973). This elimination of one of the most important links in the life history of prawns namely, seaward migration for spawning, readily makes available the young ones of prawns for cultivation. It is worthwhile to pursue this line of work and evaluate its usefulness for increasing the export of marine products in India.

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