# CMFRI bulletin 42

## Part Two

DECEMBER 1988

# NATIONAL SEMINAR ON SHELLFISH RESOURCES AND FARMING

## TUTICORIN

19-21 January, 1987

## Sessions II-VI

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
P. B. No. 2704, E. R. G. Road, Cochin-682 031, India

# 72. A SEMICONTINUOUS PROCESS FOR MOLLUSCAN HATCHERY

D. Samuel
*Dept. of Zoology, Christian College, Kattakada, Trivandrum-695 572*

ABSTRACT

This paper describes a continuous running water hatchery with a semicontinuous production. The system can be used not only for molluscs such as mussels, edibie oysters and pearl oysters; but also other ecologically similar marine organisms such as clams, prawns, crabs, lobsters and fishes. It is designed in such a way that all the flows could be regulated by operating appropriate valves.

The sea-water pumped into the overhead tank passes down by gravity through sand filter, micro-filter, supply tank and u. v. irradiator. From there they can be diverted to different tanks. The fluidised incubator is designed in such a way so as to purge out the excess sperms, tissue fluids and at the same time to retain the fertilized eggs. After incubation the eggs are transferred to the larvel rearing tanks, where continuous flow of water is maintained and spats are collected in the spat collectors. Then they are acclimatised to ordinary sea-water. The system can produce 15,00,000 seeds once in 10 days.

## INTRODUCTION

In recent years the demand for edible and commercially important molluscs have increased considerably. The mussels, oysters, clams and other shell fishes which were once considered to be cheap items of food exclusively meant for the fishermen community and other poor people dwelling in coastal areas, have in recent years attracted the attention of even the affluent population of the cities. The increased demand for edible molluscs as well as commercially important pearl oysters have persuaded several Research Institutes in the field of fisheries to come forward to develop a technology to culture most of the commercially important species. Here comes the necessity for the establishment of a full fledged hatchery which will be able to supply adequate quantities of good quality seeds round the year, for culture purposes.

Several countries have developed techniques to rear the larvae of bivalve molluscs under the laboratory conditions. Loosanaff and Davis (1963) standardised a method to culture the oyster larvae to metamorphosis in the mid 1940s. Walne (1958) succeeded in rearing the larvae of. *Ostrea edulis*. In French Polynesia, AQUACOP produced commercial size spat of green mussel *Mytilus viridis* in 1980.

In India, considerable work has been done on the development of the larvae of bivalve molluscs by several scientists including Devanesan (1955) on *Ostrea madrasensis* (= *Crassostrea madrasensis*), Rao et al (1976) on *Mytilus, viridis*, Rao (1983) on *C. madrasensis* and Desai (1983) on *C. rivularis, C. belchen, C. gryphoides* and *Ostrea cucullata*.

Small-scale hatcheries were attempted by Samuel (1983) on *Crassostrea madrasensis* (Preston), Alagarswami et al (1983) on *Pinctada fucata* and Nayar et al (1984) on *Crassostrea madrasensis* (Preston).

The conventional molluscan hatcheries use aerated still water for larval rearing, involving extensive labour in the periodical transfer of larvae, cleaning tanks, maintenance of quality of sea-water suited for larval rearing etc. Quite often contamination sets in resulting in high mortality. This paper describes a continuous running water hatchery with a semicontinuous production. This can overcome the difficulties encountered in the conventional hatcheries. This system is designed in such a way so as to regulate all the flows by operating appropriate valves. Another advantage in this hatchery is that not only molluscs such as mussels, edible oysters and pearl oysters, but also other ecologically similar organisms such as clams, prawns, crabs, lobsters and fishes could be hatched and seed produced either simultaneously or specieswise. This invention is illustrated in the drawings (Fig. 1)—the section elevation and plan. The diagrams are self explanatory.

## EQUIPMENTS

(1) Centrifugal pump of 10m$^3$/h. capacity & 2.5 KW Motor. Foot valve is suitably anchored by a buoy to have a clearance from sea bed of about 1 m and a depth of about 5 m.

(2) Overhead tank made up of puzzolona cement concrete of 10 m$^3$ capacity, erected over the top of a structure.

(3) Sand filter, with dished ends having provision for backwash, of 2m$^3$ capacity filled with filter media in the order of pebble, gravel charcoal, sand if necessary kaolin.

(4) Micro filter of cartridge type, suitable for removal of particles above 5$\mu$

(5) Supply tank, Rubber lined, Carbon steel of 10 m$^3$ capacity.

(6) UV irradiator 2 Nos., connected in series, having a capacity of 2000 litrs/h.

(7) Fluidised incubator, test tube shaped, fitted with detachable ring sieve of BSS 300 mesh and having provisions for back wash, inlet, drain, filtrate drain, and outlet.

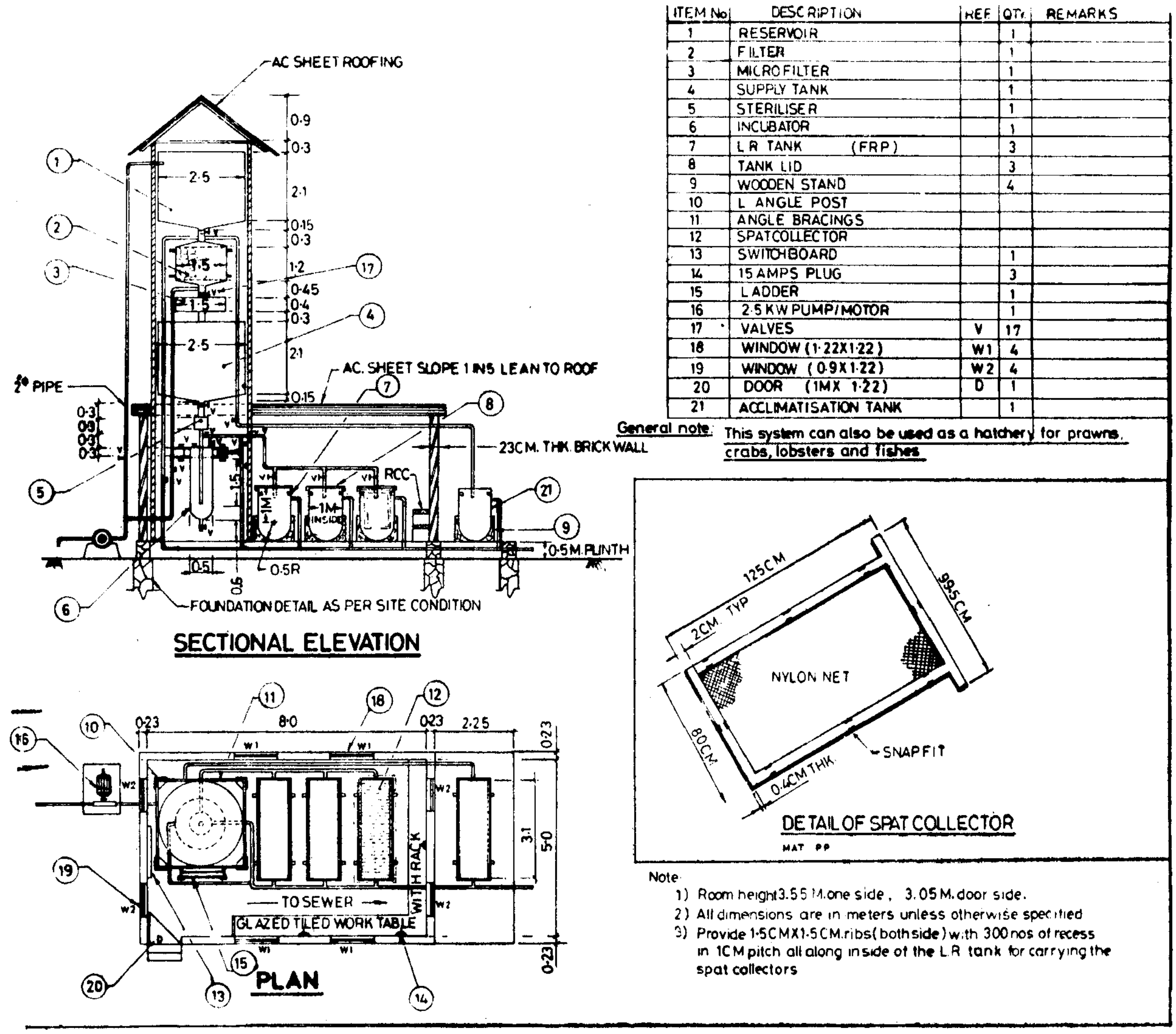
(8) Larval rearing tank— U-shaped having a capacity of 2000 l lined inside with removable polythene sheet. The tank is provided with detachable sieve cap of various meshes, drain and transparent cover plates. The tank can accommodate 300 suspended spat collectors made of nylon net of 1 m$^2$ area with a reusable plastic frame. The tanks are provided with longitudinal ribs with recess on both sides so as to accommodate the spat collectors.

(9) Acclimatisation tank is similar to larval rearing tank but without lid.

## PROCESS

The sea-water from a depth of 5 m is pumped to the over-head tank as and when required. From the overhead tank water can be diverted to flow into the filtering unit and the acclimatisation tank simultaneously (Fig. 1). The filter media used will remove silt, sand particles and other sedimentary materials from the water. Kaolin used here has the advantage of adsorbing bacteria. The water then flows through the micro-filters where particles larger than 5$\mu$ in size are eliminated. This prevents the entry of large protozoans, algae, eggs and cysts of marine organisms and other organic materials into the culture tanks. The water emerging from the filters are collected in the supply tank which acts as a temporary reservoir. Here the water is subjected to U. V. irradiation by which organisms including bacteria which would have escaped the filteration process, are killed. This gives practically sterile water. From the steriliser, water is directed to flow into the incubator, larval rearing tanks, acclimatisation tank, breeding tanks and algal culture tanks (not shown in the figure).

Mussels or edible oysters or pearl oysters as the case may be are induced to breed in the breeding tanks. The eggs and sperms at a ratio of 1:10 are introduced into the incubator. At a time the incubator can contain a minimum of at least 80,00,000 eggs. The water from the steriliser is allowed to flow through the incubator at a very slow rate initially just sufficient to agitate the contents. This helps the eggs to remain in suspension which in turn increases the rate of fertilization. The fertilization will be over by about 45 minutes. After fertilization a water flow of 100 l per h is maintained in the incubator. Excess sperms



| ITEM No | DESCRIPTION | REF | QTY | REMARKS |
|---|---|---|---|---|
| 1 | RESERVOIR | | 1 | |
| 2 | FILTER | | 1 | |
| 3 | MICROFILTER | | 1 | |
| 4 | SUPPLY TANK | | 1 | |
| 5 | STERILISER | | 1 | |
| 6 | INCUBATOR | | 1 | |
| 7 | L R TANK (FRP) | | 3 | |
| 8 | TANK LID | | 3 | |
| 9 | WOODEN STAND | | 4 | |
| 10 | L ANGLE POST | | | |
| 11 | ANGLE BRACINGS | | | |
| 12 | SPATCOLLECTOR | | | |
| 13 | SWITCHBOARD | | 1 | |
| 14 | 15 AMPS PLUG | | 3 | |
| 15 | LADDER | | 1 | |
| 16 | 2·5 KW PUMP/MOTOR | | 1 | |
| 17 | VALVES | V | 17 | |
| 18 | WINDOW (1·22X1·22) | W1 | 4 | |
| 19 | WINDOW (0·9X1·22) | W2 | 4 | |
| 20 | DOOR (1MX 1·22) | D | 1 | |
| 21 | ACCLIMATISATION TANK | | 1 | |



Fig. 1. Semi continuous Molluscan hatchery system (Scale 1:100)

and tissue fluids and tissue pieces, which form a source of contamination are purged out through the ring filter. An incubation time of 24 h is allowed so that the larvae could reach the straight-hinge stage. After the incubation, the larvae are flushed into the larval rearing tanks by operating the valves. Most of the unfertilized eggs, dead and slow developing larvae will get collected at the bottom of the incubator. This is later removed by opening the drain pipe. Once the incubator is emptied, the water is allowed to by-pass the incubator. A flow of 400 l per h is maintained in the larval rearing tank so that the residence time of water will be 5 h approximately. Unicellular algae less than 10µ in size acceptable to the larvae can be fed into the larval rearing tanks as desired by the culturist.

After 10 days a second batch of eggs are introduced into the incubator and fertilized. The larvae are flushed into the second larval rearing tank. Similarly, after 10 days third batch is also introduced into the third larval rearing tank.

Twelve days after the introduction of larvae into the larval rearing tanks, a maximum of 300 spat collectors are suspended in the larval rearing tank. The larvae get settled on the spat collectors. On the 30th day, the spat collectors with spat of the 1st larval rearing tank can be transferred to the acclimatisation tank. The used polythene sheet cover of the larval rearing tank, can be replaced by new one and the tank will be ready to receive another batch of larvae. The use of polythene sheet cover prevents the settlement of spat of the surface of the tank and thereby avoid considerable labour involved in cleaning the tanks.

Acclimatisation of spat to the ordinary sea water is done by gradually reducing the supply of sterile water and progressively increasing the supply of unfiltered sea-water coming directly from the over-head tank. This minimises the rate of mortality during acclimatisation and the spat produced will be well equipped to withstand the conditions prevalent in the natural environment.

For three larval rearing tanks, one acclimatisation tank is sufficient. When 30 days of rearing is completed in the first larval rearing tank the spat are transferred to the acclimatisation tanks. The first larval rearing tank can now be used io receive another batch of larvae. Acclimatisation is completed in 10 days and by this time the spat in the second larval rearing tank will be ready for acclimatisation. This can go on as a semi-continuous process. The proposed system will be able to produce at least 15,00,000 seeds once in 10 days i. e. 450,00,000 seeds in 300 days. If we are increasing the number of tanks 10 times we can expect a production of 15,00,000 seeds per day i. e. 45,00,00,000 seeds in 300 days.

The period of rearing in the tanks can be either increased or decreased according to the species reared. Another advantage is that different animals such as mussels, edible oysters, pearl oysters, clams, prawns, crabs, lobsters and fishes can be hatched and seeds produced simultaneously or species-wise as and when required.

All the drain pipes of the system will be connected to a sewage which opens into the the sea. Since this is a running water system not much pollution is envisaged.

## DISCUSSION

The problem of intake of sand along with the inlet water is prevented by giving a minimum of one meter clearance between the foot valve and the sea bed.

It is quite common that the filtering unit may get clogged with sediment due to continuous use. But here provision has been made to back flush the filtering unit and bring it back to use.

The U. V. irradiator used in the system will sterilize the filtered water. Loosanaff and Davis (1963) have also observed that the use of two U. V. units connected in series should give practically sterile water at a rate of 10 gallon per minute.

Several workers in this field of work have expressed difficulty in segregating fertilized eggs from excess sperms and tissue fluids which form a source of contamination in the culture. Loosanoff and Davis (1963) have adopted sedimentation method whereas Samuel (1983) adopted centrifugation method to overcome this difficulty. But in this system the specially designed fluidised incubator has the facility to purge out fhe excess sperms and tissue fluids at the same time to retain the fertilized eggs.

Culture of larvae in still water is normally prone to infection and use of antibiotics becomes necessity. The works of Walne (1958), Millar and Scott (1967) Loosanoff and Davis (1967), AQUACOP (1979) and Samuel (1983) have revealed that they have used antibiotics in the culture media to prevent contamination. Since this is a running water system with a residence time of just 5 hours the chance of contamination is very remote and therefore the use of antibiotics can be avoided.

The use of conventional spat collectors such as lime coated country tiles, corrugated asbestos, bamboo, pine branches, twings, shells of oysters and other molluscs, slate, stones, pebbles, earthen pipes and ropes have been reported by several scientists including Imai (1977), Nayar and Mahadeven (1977, 1983) and Thangavelu and Sundaram (1983). These spat collectors have been found to be difficult to handle and the isolation of spat collectors laborious, often leading to the mortality of the spat. The 2000 l U-shaped rearing tank suggested here is designed to accommodate a maximum of 300 no of $lm^2$ spat collectors made up of nylon net with reusable plastic frame. The advantage here is that these spat collectors help in the better utilisation of the available space in the tank, provide greater surface area for the settlement of the spat and easy handling of the spat as well as the spat collectors. The nylon nets with the spat settled on it, as such can be transferred to the culture beds whhereas the plastic frame can be reused.

Another difficulty encountered in the conventional hatcheries is the settlement of spat on the inner wall of the rearing tanks. The removal of these spat is very difficult, laborious and the remains of the spat cause contamination to subsequent cultures. Lining the inner side of the rearing tanks with disposable polythene sheets suggested here can solve these problems.

## REFERENCES

ALAGARSWAMI, K., S. DHRMARAJ, T. S. VELAYUDHAN, A CHELLAM AND A. C. C. VICTOR. 1983. On controlled spawning of Indian pearl oyster *Pinctada* fucata (Gould). *Proc. Symp. Coastal Aquaculture,* Mar. Biol. Ass. India, Pt. 2: 590-597.

AQUACOP, 1979. Larval rearing and spat production of green mussel *Mytilus viridis* Linnaeus in French Polynesia. *10th Meeting of the world Mariculture Society.*

DESAI, K. M., BHARAT PATEL AND HARESH DAVE. 1983. Laboratory rearing of eggs and larvae of edible oysters of the Gulf of Kutch. *Proc. Symp. Coastal Aquaculture,* Mar. Biol. Ass. India, Pt. 2 : PP 704.

DEVANESEN, D. W. 1955. Report No. 1 on the Madras edible oyster (*Ostrea madrasensis*). *Govt. Press. Madras,* ii : 66pp.

IMAI, T. 1977. Evolution in seed-oyster production. *Aquaculture in shallow seas, progress in shallow see culture.* Amerind publishing Co. Pvt. Ltd., New Delhi. pp. 215-219.

LOOSANOFF, V. L. AND H. C, DAVIS. 1963. Rearing of Bivalve Mollusks. *Advances in Marine Biology,* 42 (4) : 607-624.

MILLAR, R. H., AND J. M. SCOTT. 1967. Bacteria-free culture of oyster larvae. *Nature,* 216(5120) : 1139-1140.

NAYAR, K. NAGAPPAN AND S. MAHADEVAN. 1977. Large scale culture of edible oyster. *CMFRI Newsletter,* 5, Nov. 1976-Mar. 1977.

NAYAR, K. NAGAPPAN AND S. MAHADEVAN. 1983. Oyster culture in Tuticorin. *Proc. Symp. Coastal Aquaculture,* Mar. Biol. Ass. India, Pt. 2 : 427–435.

NAYAR, K. NAGAPPAN, M. E. RAJAPANDIAN, A.D. GANDHI AND C.P. GOPINATHAN 1984. Larval rearing and production of spat of the oyster *Crassostrea madrasensis* (Preston) in an experimental hatchery, *Indian J. Fish.,* 31 (2) : 233-243.

RAO, K. VIRABHADRA. 1983. Induced spawning of the adults and laboratory rearing of the larvae of the edible oyster *Crassostrea madrasensis. Proc. Symp. Coastal Aquaculture,* Mar. Biol. Ass. India, Pt. 2 : 479-482.

RAO, K. V., L. K. KUMARI AND S. Z. QASIM. 1976. Aquaculture of green mussel *Mytilus viridis* L. : Spawning, fertilization and larval development. *Indian Journal of Marine Science,* 5:113-116.

SAMUEL, D. 1983. Early larval development of edible oyster *Crassostrea madrasensis* (Preston) *Proc. Symp. Coastal Aquaculture,* Mar. Biol. Ass. India, Pt. 2 : 483-487.

THANGAVELU, R. AND N. SUNDARAM. 1983. Experiments on edible oyster spat collection at Tuticorin. *Proc. Symp. Coastal Aquaculture,* Mar. Biol. Ass. India, Pt. 2 : 460-466.

WALNE, P. R. 1958. The importance of bacteria in laboratory experiments on rearing the larvae *Ostrea edulis* (L). *J. Mar. Biol. Ass. U. K.,* 37 : 415–425.