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HATCHERY DEVELOPMENT FOR SHELLFISH SEED PRODUCTION

63. HATCHERY DEVELOPMENT FOR SHELLFISH SEED PRODUCTION

—Theme Paper

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The evolving of hatchery techniques for producing seed of marine molluscs of economic importance is one of the important achievements in marine fishery research in this century. This field of research had its origin in the efforts of scientists who attempted towards the close of the last century and the early period of the twentieth century. Some of the earliest work in the subject is that of Brooks (1880) on the eggs and early larval stages of the American oyster *Crassostrea virginica* and the attempts by Ryder (1883) and Winslow (1884) to grow oyster larvae to metamorphosis. There was much skepticism and also severe criticism by experienced biologists like Nelson (1921) of the utility of the efforts. In the early twenties Wells (1926, 1927) succeeded for the first time in rearing the larvae of *Crassostrea virginica* to spat in glass jars. Cole (1937, 1939) reared the larvae of larviparous *Ostrea edulis* in tanks or small ponds and laboratory conditions.

The failure of the earlier workers in rearing the bivalve larvae up to seed stage was due to the poor quality of sea water used, the type of materials used like metal screens which were toxic and the absence of proper phytoplankton food for the larvae. Bruce *et al* (1940) have set up the first functional laboratory for rearing the larvae of the European oyster *Ostrea edulis*. In the middle of this century Loosanoff and his colleagues have investigated carefully hatchery techniques for culture of bivalve larvae and juveniles and contributed much to the subject by developing suitable techniques which could be adopted for large scale production of oyster larvae. Loosanoff (1945) found that if *Crasso-*

strea virginica are reared in warm water in winter season, maturation of gonads takes place and the oysters could be induced to spawn. This technique of obtaining sexually ripe oysters was a major breakthrough which led to the evolving of the Loosanoff-Davis method of effecting breeding of oysters and rearing oyster larvae successfully around the year (Loosanoff and Davis, 1963). It has also been shown that spawning could be delayed in mature oysters by keeping them at low temperature.

Hatchery techniques have been developed in other species of oysters, clams, mussels, scallops, pearl oysters and abalones and this has led to the establishment of hatcheries for molluscs in various countries like U.S.A., U.K., France and Japan. Some of the hatcheries have been established by Government or Universities and the rest by private companies.

The selection of site for a hatchery is an important aspect. The hatchery should be located at a place where the temperature, salinity and other hydrological conditions are favourable for culture of the larvae. Areas with wide fluctuations in hydrological conditions, high levels of suspended matter or blooms of harmful phytoplankton are unsuitable for the setting of a hatchery. The molluscan hatchery should have all the necessary infrastructural facilities viz., filtered sea water, aeration system, temperature controlled rooms for induced maturation of gonads and stock and mass cultures of selected species of microalgae and tanks for larval and spat rearing.

The hatchery production of molluscan seed consists of six phases viz., selection and maintenance of broodstock, conditioning of the molluscan species for maturation of gonads, induced spawning, fertilization, rearing of larvae to seed in optimum conditions in laboratory and mass culture of microalgae for feeding the larvae and spat.

CONDITIONING OF MOLLUSCS FOR MATURATION OF GONADS

In temperate countries where water temperatures are low marine molluscs are conditioned for maturation of gonads by rearing the animals in laboratory at higher than normal temperatures and feeding them with a rich supply of diet (Loosanoff and Davis, 1950). Loosanoff and Davis (1952) have shown that *Crassostrea virginica* and *Mercenaria mercenaria* could be made to reproduce repeatedly in a year if ecological conditions especially temperature are controlled. In the tropical water where the water temperature is higher than in temperate regions immature *Crassostrea madrasensis* are fed with adequate quantities of mixed phytoplankton especially diatoms and reared at a few degrees below normal temperature for conditioning the oysters for maturation (Nayar *et al.*, 1987). The oysters were found to attain several maturity in ten to twenty days.

INDUCED SPAWNING

Marine molluscs could be induced to spawn artificially by giving different kinds of stimuli like raising temperature, addition of sperm suspension to a tray in which ripe females are kept, mechanical stress or chemical stimuli by the addition of Hydrogen peroxide, Ammonium hydroxide, sodium hydroxide or tris buffered sea water (Galtsoff, 1930, Loosanoff, 1954, Loosanoff and Davis, 1963). *C. madrasensis* has been induced to spawn by raising the ambient temperature to 29°-34°C, addition of milt or 5 moles hydrogen peroxide.

FERTILIZATION

In oysters eggs are fertilized within 45

minutes after they are spawned, from a pooled sperm suspension obtained from different males (Dupuy *et al.*, 1977, Nayar *et al.*, 1987). A delay in adding sperms to freshly spawned eggs is harmful.

LARVAL REARING

Molluscan larvae are reared in filtered sea water in rectangular or circular shaped tanks. The larvae are fed with microalgae like *Isochrysis galbana*, *Pavlova lutheri*, *Dicrateria* sp., *Chromulina*, *Pyramimonas virginica*, *Pseudoisochrysis pavadoxa*, *Chlorella* spp, *Tetraselmis* sp or *Synochocystis* after determining the acceptance of the particular species by the larvae (Dupuy *et al.*, 1977). During the course of larval rearing culling is done at different stages of development and slow growing ones are segregated and reared separately. The feeding density of the algal cells/larva/day is determined by trial feedings. In the case of sedentary species when the larvae grow to the creeping stage spat collectors are provided in the tanks for setting. The kind of spat collectors suitable for the purpose varies in the case of different species.

MASS CULTURE OF MICROALGAE

The microalgae mentioned above are isolated from sea water collections, the particular species selected is isolated and pure cultures are obtained by culturing them in controlled conditions in test tubes in Conway's or Walne's medium (Walve, 1974) and using these stock cultures in Haufkin's flasks and subsequently mass cultures in perspex tanks, glass carbuoys or polythene bags are carried out.

RELEVANCE OF MOLLUSCAN HATCHERIES

It is considered by some that development of molluscan hatchery systems is not of much significance but this is not correct. The establishment of a hatchery requires heavy expenditure but hatcheries have a very important role and are essential. The marine environment is polluted very much along several coasts and collection of seed from nature is often difficult. In this context, production of seed in hatchery

systems will be of great help to those intending to culture a particular molluscan species. By conducting breeding experiments in a hatchery it is possible to evolve strains of molluscs which are fast growing, are of high quality and disease resistant, characteristics which are looked for by the culturists and consumers.

REFERENCES

- BROOKS, W. K. 1880. The development of the American oyster. *Stud. Biol. Lab., Johns Hopkins Univ., IV* : 1-104.
- BRUCE, J. R., M. KNIGHT AND M. W. PARKE. 1940. The rearing of oyster larvae on an algal diet. *J. Mar. Biol. Ass. U. K.*, 24 : 337-374.
- COLE, H. A. 1937. Experiments in the breeding of oysters *Ostrea edulis* in tanks with special reference to the food of the larva and spat. *Fish. Invest., Min. Agric. Fish, London Ser. II. 15* : 1-28.
- COLE, H. A. 1939. Further experiments in the breeding of oysters (*Ostrea edulis*) in tanks. *Fish. Invest., Min. Agric. Fish. London, Ser. II, 16* : 1-47.
- DUPUY, J. L., NANCY T. WINDSOR AND C. E. SUTTON. 1977. *Manual for Design and operation of an oyster seed hatchery for the American oyster Crassostrea virginica*, VIMS Sea Grant Program Spec. Report No : 142, Gloucester Pt., 96 pp.
- GALTSOFF, P. S. 1930. The fecundity of the oyster. *Science*, 72 : 97-98.
- LOOSANOFF, V. L. 1945. Precocious gonad development in oysters induced in midwinter by high temperature. *Science*, 102 : 124-125.
- LOOSANOFF, V. L. 1954. New advances in the study of bivalve larvae. *Amer. Scient.*, 42 : 607-624.
- LOOSANOFF, V. L. AND H. C. DAVIS. 1950. Conditioning *Mercenaria mercenaria* for spawning in winter and breeding its larvae in the laboratory *Biol. Bull* 98, 60-65.
- LOOSANOFF, V. L. AND H. C. DAVIS. 1952. Repeated semiannual spawning of northern oysters. *Science*, 115 : 675-676.
- LOOSANOFF, V. L. AND H. C. DAVIS. 1963. Rearing of bivalve molluscs. In: *Advances in Marine Biology* (F. S. Russell Ed.) 1 : 1-136.
- NAYAR, K. N., K. SATYANARAYANA RAO, M. E. RAJAPANDIAN, C P. GOPINATHAN AND A. D. GANDHI. 1987. 8. Production of oyster seed in a hatchery system. In: *Oyster culture: Status and Prospects. Bull. Cent. Mar. Fish. Res. Inst.*, 38 : 52-58.
- RYDER, J. A. 1883. Rearing oysters from artificially fertilized eggs, together with notes on pond culture. *Bull. U. S. Fish. Comm.*, 13 : 281-294.
- WALNE, P. R. 1974. Culture of bivalve molluscs. Fishing News (Books) Ltd., Survey, 173 pp.
- WELLS, W. F. 1926. A new chapter in shellfish culture. *N. Y. St. Conserv. Comm., Fifteenth Ann. Rep.*, 1-36.
- WELLS, W. F. 1927. Report of the experimental Shellfish Station. N. Y. St. Conserv. Dep., Rep. 16 : 1-22.
- WINSLOW, F. 1884. Report of experiments in the artificial propagation of oyster conducted at Beaufort, N. C., and Fair Haven Conn., in 1882. *Rep. U. S. Comm. Fish.* for 1882, 741-761.