# Study for the Propagation and Aquaculture of Off-shore Bivalves in Shimane Prefecture


## Summary

The present study aimed to establish the fundamental techniques for artificial seed production and a natural spat collection of off-shore bivalves, i.e., the bay scallop *Pecten albicans* and Iwagaki oyster *Crassostrea nippona*.

This study was conducted to understand the effect of various diets and different water temperatures on the manipulation of the gonad development of broodstock, the establishment of favorable bacterial flora for growth and survival of the larvae, and the effect of cultivated parental stock for collecting natural spats of the bay scallop. This study also examined the growth, characters best representing growth and first maturation of hatchery-produced Iwagaki oyster.

The contents are summarized below.

Changes in filtering and digestion rates of adult bay scallop were examined by feeding four species of microalgae, *Chaetoceros gracilis, Pavlova lutheri, Nannochloropsis oculata*, and *Tetraselmis tetrathele* at various concentrations. Filtering rates ranged from 4.9 to 58.9 L/ind./h, and were the highest for *Ch. gracilis* and the lowest for *Nanno. oculata* among the four species. Maximal filtering rates were observed at algal concentrations between 19.3 to 49.2 $\times 10^{-8}$ g/ml. Ingestion rates ranged from 52.6 to 94.1 % within this range of concentrations and were the highest for *P. lutheri* and the lowest for *Ch. gracilis*. Ingestion rate decreased with increase of algal concentrations. Assimilation rates of organic matter, which were estimated from filtering rates and ingestion rates at the above algal concentrations, ranged from 24.1 to 201.0 $\times 10^{-5}$ g/ind./h for *Ch. gracilis*, 46.3 to 247.7 $\times 10^{-5}$ g/ind./h for *P. lutheri*, 6.0 to 23.3 $\times 10^{-5}$ g/ind./h for *Nanno. oculata*, and 101.7 to 720.2 $\times 10^{-5}$ g/ind./h for *Tetra. tetrathele*.

Two experiments were carried out to analyze the effect of different diets and water temperature regimes on the maturation of the bay scallop. The first experiment was designed to evaluate the effect of different diets on broodstock, by providing with each of the micro-algae, *Chaetoceros, Pavlova*, and *Tetraselmis*. In the second experiment, broodstock were kept in water at 17 ℃ after spending the period of the highest summer temperature in natural sea water. They were provided with either *Pavlova or Isochrysis* and *Tetraselmis* every day, the amount of which was 4 % of their dry weight. From the first experiment it was revealed that the broodstock group which was fed with *Tetraselmis* seemed to mature faster than other groups. From the second experiment it was shown that the growth of the broodstock group kept at 17℃ was similar to that of those suspended in the sea, and the former seemed to mature faster than the latter.

Larvae of bay scallop were cultured at 20 ℃ in 500 L polyethylene tanks, and fed with *Pavlova lutheri* and *Isochrysis galbana*. One μm cartridge-filtered seawater (1 μm-seawater), 3 μm cartridge-filtered seawater(3μm-seawater),0.4μm ceramic-filtered seawater(0.4μm -seawater),and ultraviolet irradiated 0.4μm-seawater (U.V.-seawater) were used as the culture media. Half of the culture waters were replaced with fresh media at 2 days intervals. During the culture period of scallop larvae, bacterial numbers in the culture media increased to more than 1 $\times 10^{5}$ CFU/ml in 3 μm-seawater,0.4 μm-seawater U.V.-seawater, but less than 1 $\times 10^{5}$ CFU/ml in 1 μm-seawater. Moreover, composition of the colonies was different in different media for the identical culture period. Appearance of brown spots or patches of larvae at the bottom of the tank was observed when bacterial numbers increased to more than 1 $\times 10^{5}$ CFU/ml.

The growth and survival of the larvae cultured

by two different sea water supply methods, i.e., a still water system and a flowing water system, were investigated. In the flowing water system, sea water in the 500 L larval tank flowed out continuously in the amount of 500 L per day. The growth and survival of the larvae in the still water system were found to be higher than those in the flowing water system. The amount of bacteria was almost equal in the two water systems, but generic compositions of bacteria in the flowing water system fluctuated more sharply than those in the still water system. Thus, it is inferred that the growth and survival of the larvae are more affected by the fluctuation of generic composition of bacteria in culture water than by the amount of bacteria. In conclusion, all the genera for the good larval growth and survival have to be stable.

To approach a practical method to stabilize genera, larvae were reared in cultivation water containing 5,000-10,000 cells/ml of *Nannochloropsis* sp. cells, with the results of higher rate of growth and survival compared with the control group.

The effectiveness of making an artificial parental stock of bay scallops was investigated for the natural spat collection in Uragou Bay. A total of 15,000 individual one-year old bay scallops divided into several groups were suspended at 5 m, 15 m, 25 m, and 35 m depths in June 1987.We measured the survival ratio of each depth group, the larval appearance at the four stations, and the appearance of post-settlement spat.

The 25 m depth group showed the highest survival ratio of 80 % over all and we also observed a small quantity of extraneous matter till March 1988. These results suggested that a depth from 20 m to 30 m was suitable for making parental stock due to the small influence of high temperature and extraneous matter.

It was clear that the ripening/spawning time of one-year old bay scallops was related to larval appearance/spat adhesion time. So making an artificial parental stock of bay scallops was estimated to increase the number of natural spat collection in Uragou Bay. However, the numerical relation between the number of parental stock and production number of spat could not be estimated.

Growth of hatchery-produced Iwagaki oyster suspended at mean depth of 7 m at Dozen Bay was examined over 23 months. Means of shell height, weight of whole body, and volume of whole body after hatching, respectively attained 52.2 mm, 25.6 g, and 19 $cm^3$ after 12 months and 106.2 mm, 183.9 g, and 126.9 $cm^3$ after 23 months. The growth of Iwagaki oysters was affected by spawning, gonad development, low water temperature and possibly food availability inferred from the abundance of phytoplankton. Eleven shell characters : total shell height, shell height, shell length, shell width, weight of whole body, soft tissue weight, weight of right valve, weight of left valve, volume of valves, volume of whole body, and volume of inner space were measured, and analysis was carried out to determine which characters best represent growth in whole body volume. The results showed that weight of the whole body and weight of the left valve were the most representative, but suggested that shell height was the most convenient for practical use.

The first maturation and season of hanging cultured Iwagaki oyster were examined over 8 months in Uragou Bay. Oysters of 0-year age were collected monthly from May to December in 1995, and shell height, soft tissue weight, gonad index and standard histological analysis were measured to observe the stages of gametogenic development and spawning. From the results, it was clear that the season for starting early gametogenic development of oysters of 0-year age was later than that of fishery size oysters in published reports. Most of the oysters were mature in August, with a mean shell length of 52 mm. It was estimated that the spawning peak occurred between August and September, coinciding with a decrease in water temperature from the highest temperature, which is the same

season for fishery size oysters.

From the results described above, both of artificial seed production and natural spat collection of off-shore bivalves i.e., bay scallop *Pecten albicans* and Iwagaki oyster *Crassostrea nippona* are demonstrated to be possible. The problems in establishing the fundamental method for these are also extracted through this study.