OBSERVATIONS ON LARVAL DEVELOPMENT AND SETTLEMENT OF *PATINOPECTEN YESSOENSIS* IN HATCHERIES

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ABSTRACT

The influence of density on *Patinopecten yessoensis* larval development was studied during production of an F2 generation. Setting behaviour of *P. yessoensis* on PVC removable spat collectors, previously tested with *Pecten maximus*, was determined. Poor larval growth of *P. yessoensis* was observed at a larval density of $7 \cdot ml^{-1}$ and postlarval settlement occurred mainly on the bottom of the baskets, as has been observed with the king scallop, *P. maximus*. The PVC collector is not suitable for either species of scallop.

INTRODUCTION

Production of an F1 generation of *P. yessoensis* in France (Cochard et al. 1993) enabled initial experiments to be undertaken on the culture of this species in the Mediterranean (Buestel et al. 1989). In spite of high mortalities (Coatanea, Pers. Comm.) the broodstock was maintained in France. This was necessary because of difficulties encountered during its introduction into France and the potential for further investigation on the feasibility of culture of this species on the Atlantic coast, where scallop farming is of considerable interest.

In Britanny, the scallop industry is based on harvest of the king scallop, *Pecten maximus*. Low survival rates (20 to 50%) observed during transfer of spat to sea is the major problem for culture of this species (Fleury et al. 1993). High mortalities at this time may be due to removal of spat from setting tanks because mortalities during transfer of unattached spat have been low. A change in the setting techniques using removable spat collectors has been suggested as a method to reduce mortalities. Consequently, experiments with *P. maximus* showed that spat settled mainly on the bottom of the baskets (Robert et al., unpublished data).

The aim of this study was to determine the suitability of removable spat collectors for *Patinopecten yessoensis* and to compare setting behaviour of both species. Experiments were carried out while producing an F2 generation.

MATERIALS AND METHODS

LARVAL REARING

Sexually mature *P. yessoensis* were collected from the Bay of Brest (France) in April 1992. Spawning was induced in the laboratory by increasing seawater temperature from 11°C to 13.5°C. After incubation (72 h), veliger larvae were put in five 450 l cylindrical-conical tanks at densities of $1.5 \cdot ml^{-1}$ in four tanks and at $7 \cdot ml^{-1}$ for one tank. This higher density is used in culture of *P. maximus* larvae under our standard conditions. All larvae were reared in 1 μ filtered seawater, renewed at 48 h intervals, at a salinity of

33-34 ppt and a temperature of 15°C. Bacterial contamination was controlled by adding chloramphenicol (8 $mg \cdot l^{-1}$) and the larvae were fed daily on a mixed algal diet of *Isochrysis* aff. *galbana, Pavlova lutheri* and *Skeletonema costatum* to give a final concentration of 30 to 60 $cells \cdot \mu l^{-1}$. Larval size was determined on a minimum of 50 individuals per tank, every second day, by measuring the shell length converted to equal shell diameter by means of an image analysis technique as described by de Pontual et al. (1993). Mortalities were assessed by counting the number of dead larvae in a sample of 200 individuals from each tank under a profile projector (Nikon V12). After grading on a 150 μ mesh screen, mature larvae were transferred to setting tanks.

POSTLARVAL REARING

The postlarval rearing containers used were 100 l flat bottomed rectangular tanks paired and connected to the same seawater supply. Each tank was continuously supplied with 400 $l \cdot h^{-1}$ of 15°C seawater, filtered to 1 μ for the first 10 days, and then only sand-filtered at ≈50 μ. The seawater, enriched with 0.2 $l \cdot h^{-1}$ of phytoplankton (*Isochrysis* aff. *galbana, Pavlova lutheri, Chaetoceros calcitrans* and *Skeletonema costatum*) was homogeneously distributed from above to each tank by means of PVC removable drilled tubes, connected perpendicularly to the primary circuit. Five rectangular containers with a mesh bottom, whose mesh size corresponded to spat size (125 to 250 μ), were placed in each tank (Fig. 1). PVC baskets (45 cm long, 35 cm wide and 12 cm high, for a total water volume of 15 l) were used as a setting surface. In these containers, the setting surfaces were 1535 cm^2 for the bottom and 1600 cm^2 for the edges. Supplementary collectors, formed by crossed PVC sheets (the same material as the edges of the baskets) with a setting surface of 4648 cm^2, were placed in some of these baskets.

Pediveligers (950,000) were placed in five baskets, four of which (B1-B4) were equipped with additional collectors at a density of 190,000 (≈13 $larvae \cdot ml^{-1}$). Spat numbers were estimated six weeks later by counting the entire population on the collectors and by counting a sample of individuals settled on either 30 cm^2 on the bottom (30 squares of 1 cm^2 randomly selected) or 50 cm^2 on the edges. Spat size was estimated at the end of the trial by measuring the length (anteroposterior axis) of 100 individuals per treatment, under a profile projector. The experiment was undertaken from May to July 1992. Data were processed using Excel, Statview and Sigmaplot software.

RESULTS

LARVAL DEVELOPMENT

The average fecundity per female was low (5 million oocytes released) but development to the veliger larvae was high, 55%. The rate of abnormality was 10%. At lower larval densities, mortality was less than 5% until the end of the larval period. At higher densities, similar values were recorded during the first 10 days but then mortalities increased to 15%. Larval growth is shown in Figure 2. At the lower larval density, the increase in size was steadier with a daily length increment of 7 μ. In contrast, at the higher larval density, the growth rate declined from the 12th day onward which produced a difference in length of 50 μ on day 23. Consequently this brood was discarded before transferring larvae to the nursery. Excluding this brood, the average larval yield (number of mature larvae retained on 150 μ mesh screen compared to the initial number of veliger larvae) was high (65%).

SETTLEMENT ON REMOVABLE COLLECTORS

Spat survival rates and densities (number·cm^{-2}) are shown in Table 1. Low survival rates, less than 20%, were observed, with a high range of spat dispersal in the baskets with collectors representing a coefficient of variation of 23%.

Spat densities on collectors were low (Table 1). There was a difference at the 5% significance level in spat density between collectors, edges and bottoms of the baskets (Kruskal-Wallis test: H=7.038; P=0.0296) leading to the rank of classification shown in Table 2. Nevertheless, the average rate of collector settlement (number of spat on collectors compared to total number of spat), independent of the setting surface, was satisfactory (41.75 ± 6.00%).

No differences in spat size, at the 0.1% significance level, were noticed, at the end of the experiment, between spat settled on collectors (mean shell length = 1.51 ± 0.11 mm) and bottoms of the baskets (1.51 ± 0.13 mm).

DISCUSSION

It was impossible to rear *Patinopecten yessoensis* larvae at the same larval density as is used for *Pecten maximus*, 7·ml^{-1}. At a lower density, 1·ml^{-1}, a daily length increment of 7 μ was recorded, similar to that reported by Bourne et al. (1989). *P. maximus* reared at the same period but at the higher density of 7·ml^{-1} showed a similar growth with a daily length increment of 6.3 μ (Fig. 2). Larval overcrowding may explain the poor growth of *P. yessoensis* at the higher density, but this result may also be explained by underfeeding from day 12 onward, when the growth rate decreased. The potential amount of food per larva was constant during this experiment (4,500-9,000), whereas Bourne et al. (1989) recommended a higher ratio for older larvae (>12,000-20,000). Compared to *P. maximus*, *P. yessoensis* feeding requirements seem to be higher.

Low survival rates of spat were probably due to overcrowding and/or underfeeding. The setting density was 13·ml^{-1} whereas Bourne et al. (1989) recommended lower densities (<2·ml^{-1}). Under our standard culture conditions, *P. maximus* setting density is also lower, 6·ml^{-1}. The high spat mortality made interpretation of results difficult. Nevertheless, *P. yessoensis* appeared to settle mainly on the bottom of the baskets as was observed with *P. maximus* (Tables 3 and 4).

Consequently, in our postlarval culture system, these types of collectors are not considered effective for either scallop species. In future, we will focus on developing new techniques such as deeper raceways with recirculating systems and using new types of collectors such as Kinran which has been reported to be the best cultch (Bourne et al. 1989).

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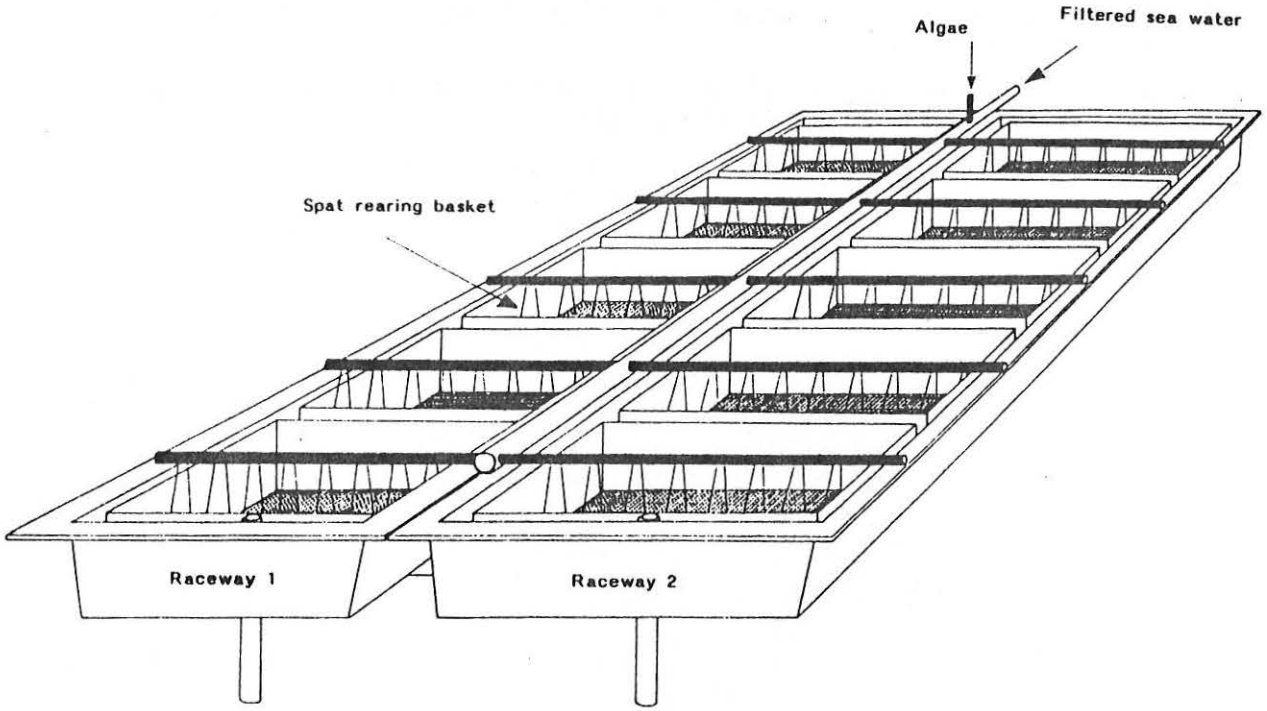

Fig. 1. Postlarval experimental unit.

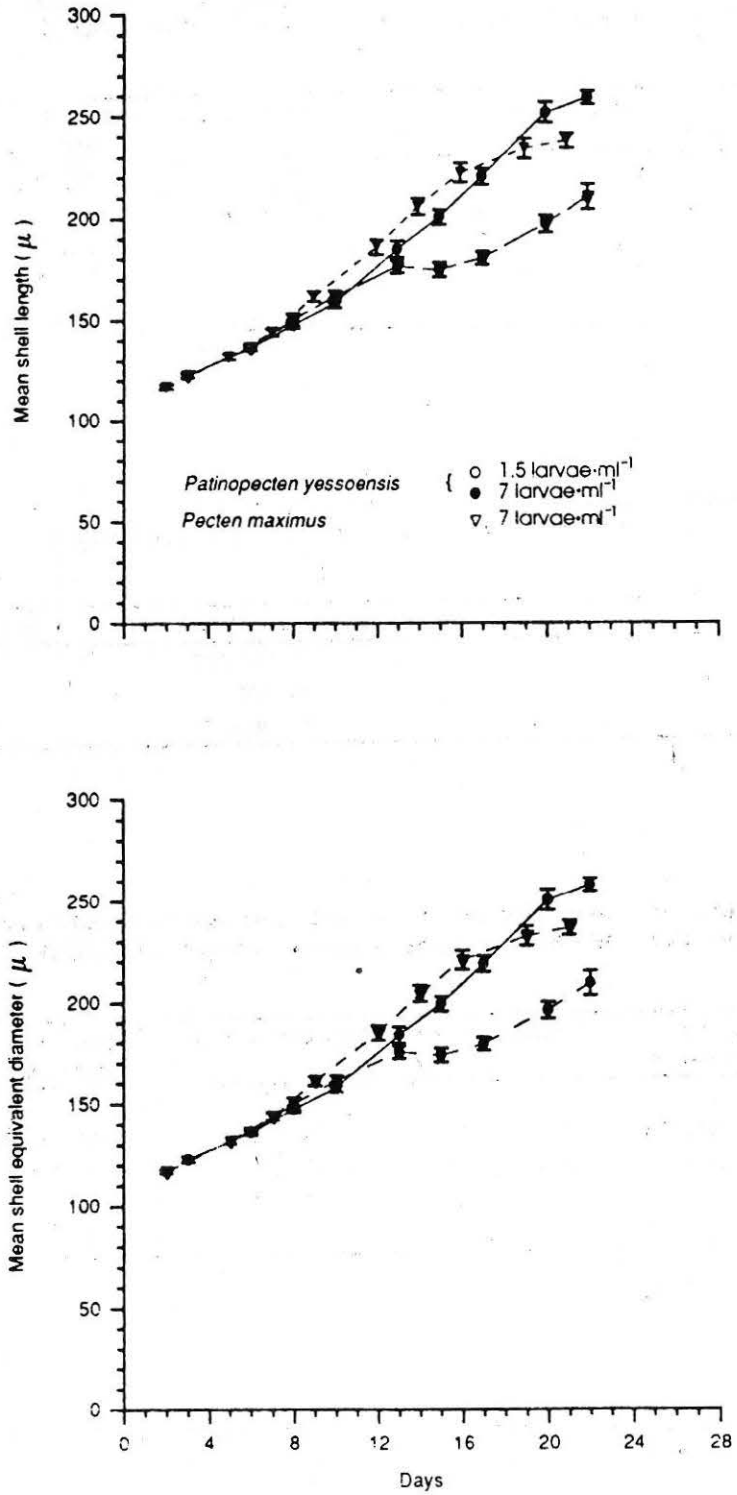

Fig. 2. Larval growth of *Patinopecten yessoensis* and *Pecten maximus* at different densities.

Table 1. *Patinopecten yessoensis*. Percentage survival of spat (number·cm^{-2}) on removable collectors (B1-B4), edges and bottom of the baskets.

	Survival rate	Collector	Basket edge	Basket bottom	Total
B0 (control)	17.50	*	7.38	14.00	10.62
B1	20.80	3.15	6.26	9.67	5.07
B2	15.70	2.79	2.26	8.60	3.83
B3	11.80	2.00	3.42	5.03	2.89
B4	16.20	3.05	4.80	5.87	3.96

Table 2. *Patinopecten yessoensis*. Kruskal-Wallis rank classification for density of spat on collectors, edges and bottom of the baskets.

	Count	Sum ranks	Mean ranks
Collector	4	13.00	3.25
Edge	4	25.00	6.25
Bottom	4	40.00	10.00

Table 3. *Pecten maximus*. Percentage survival and density of spat (number·cm^{-2}) on removable collectors (B1-B4), edges and bottom of the baskets.

	Survival rate	Collector	Basket edge	Basket bottom	Total
B0 (control)	39.20	*	9.60	15.53	12.50
B1	35.19	2.61	4.82	10.00	4.52
B2	38.24	2.65	7.14	9.43	4.91
B3	51.02	2.61	7.32	17.70	6.55
B4	45.80	2.72	5.14	16.23	5.88

Table 4. *Pecten maximus*. Kruskal-Wallis rank classification for density of spat on collectors, edges and bottom of the baskets.

	Count	Sum ranks	Mean ranks
Collector	4	10.00	2.50
Edge	4	26.00	6.50
Bottom	4	42.00	10.50