Impact of intensive larval rearing practices in oyster hatcheries : selective processes and loss of genetic variability

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INTRODUCTION

Early-life history of oysters, like in most marine bivalves, is characterized by high fecundity and low survival rate. In hatcheries, which are becoming more and more important for the production of juveniles for aquaculture production, rearing conditions are optimised (density, feeding, temperature…), and contrast with those observed in the wild. Additionally, slow growing larvae are culled by sieving.

OBJECTIVES

As previous studies have shown that genetic variability exists for several early development traits (Ernande *et al.* 2003), **we aimed to assess if intensive hatchery rearing practices exert specific selective processes at the larval stage.**

Research question :
Is there selection (**domestication**) at early development stage in hatchery ?

MATERIALS AND METHODS

Based on a multiplexed set of microsatellite markers (Taris *et al.* 2005) that efficiently traces parentage, we studied the variance of reproductive success and growth larval trait in two larval rearing controlled experiments :

We studied two types of specific selective process that are common in hatcheries :

- **effect of selective sieving**
- **effect of temperature** (20 versus 26°C; *i.e.* wild versus hatchery conditions).

RESULTS

I. Culling out :

-At the *phenotypic* level, relative survival and settlement success were higher for sieved batches of larvae. Culling appears to be a time-saving procedure associated with better relative survival of larger larvae.

-At the *genetic* level, culling at larval stage appears to be essentially mediated through its effects on timing to settlement, illustrating clearly the importance of later cohorts in minimizing the effects of genetic drift in hatchery propagated stocks (lowest values of effective population size for earliest cohorts (**Fig.1**).

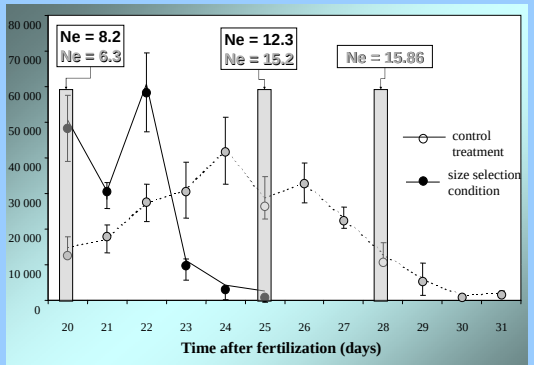

Figure 1 : Temporal evolution of numbers of ready to settled larvae and values of effective size at day 20, 25 and 28 for both conditions.

II. Temperature :

-At the larval stage, genetic variability for growth was expressed earlier during development in the batches raised at 26°C than those at 20°C (**Fig. 2**).

-We observed a positive correlation between larvae and spat growth at 20°C but not at 26°C (**Fig. 3**).

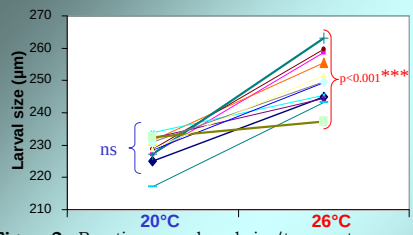

Figure 2 : Reaction norm larval size/temperature per family, 22 days after fertilization.

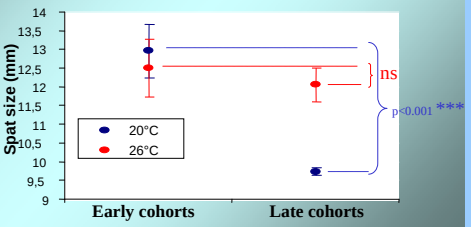

Figure 3 : Spat size (80 days after fertilization) for early and late cohorts from the 26°C and 20°C rearing condition

CONCLUSIONS

- 1. The results are consistent with previous observations and confirm the existence of significant genetic variability for early developmental traits in the Pacific oyster.

- 2. Because of these differential contributions, discarding the smallest larvae can lead to a significant loss of diversity at the larval stage. The early settled cohorts exhibited lower values of effective population size than those settled late.

- 3. Interpretation of temperature effect is more complex. Nevertheless, temperature exerted a phenotypic and genetic effect for both larval and spat stages.

- High rearing temperature (26°C) makes the expression of genetic and phenotypic variability earlier. Considering a coupled interaction with sieving process, that could increase the selective effect promoting the genetic drift in hatchery.

- Temperature also interacted with spat growth. The experiment partly supports previous studies where a positive correlation was observed between larvae and spat growth but only at 20°C. This underlines the difficulty and the interest to study the interaction between genotypic and environmental factors for complex life-history invertebrates.

References :

- Ernande, B., Clobert, J., McCombie, H., Boudry, P., 2003. Genetic polymorphism and trade-offs in the early life-history strategy of the Pacific oyster, Crassostrea gigas (Thunberg, 1795): A quantitative genetics study. Journal of Evolutionnary Biology 16 : 399-141.

-Taris, N., Baron, S., Sharbel, T.F., Sauvage, C., Boudry, P., 2005. A combined microsatellite multiplexing and boiling DNA extraction method for high throughput parentage analyses in the Pacific oyster (*Crassostrea gigas*). Aquaculture Research, 1-3.