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fish & shellfish larviculture symposium

Ifremer

Genetic effect of domestication selective pressures on Pacific oyster at larval stage

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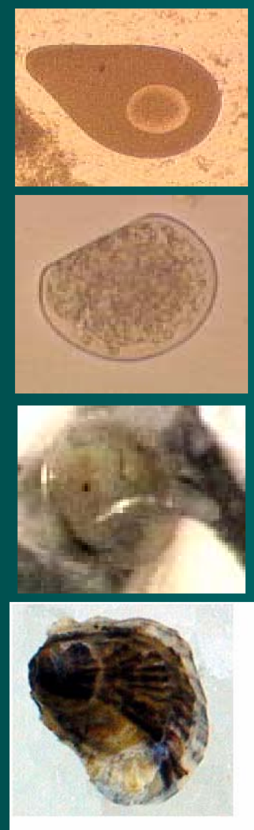
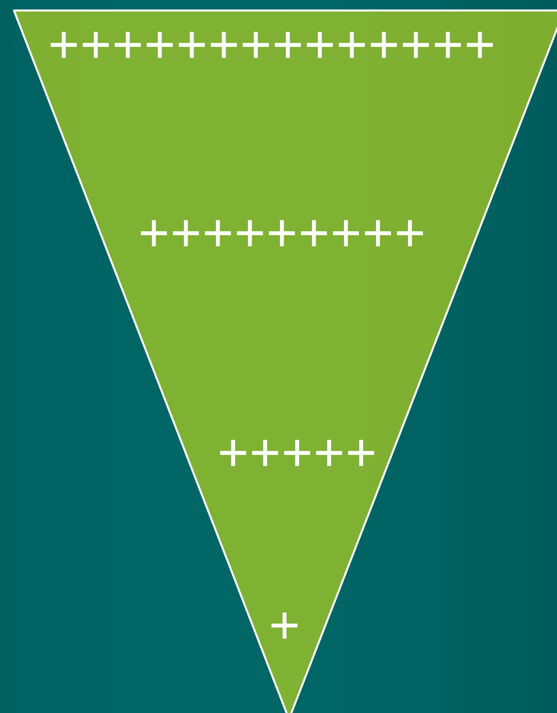
Crassostrea gigas life cycle

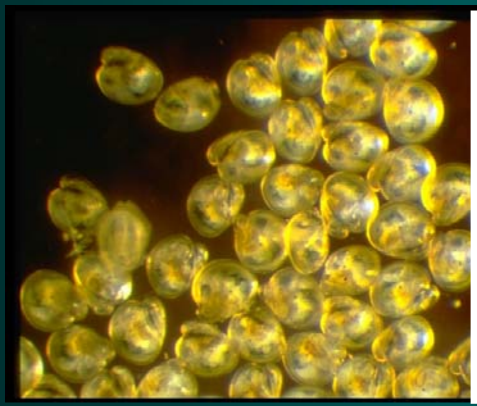
The “elm-oyster model”

Williams 1975

Stages	Survival
	

High fecundity and high mortality at early stages

Which consequences of such a life history strategy for hatchery production ?



☺ Few genitors needed for mass production of juveniles
☺ Culling (size selection)

☹ Low effective population size (Hedgecock *et al*., 1992)
☹ Risks of rapid loss of genetic variability and inbreeding in closed populations

Can specific rearing practices (culling) and/or environmental conditions (high temperature) lead to a specific genetic adaptation in *C. gigas* larvae ?

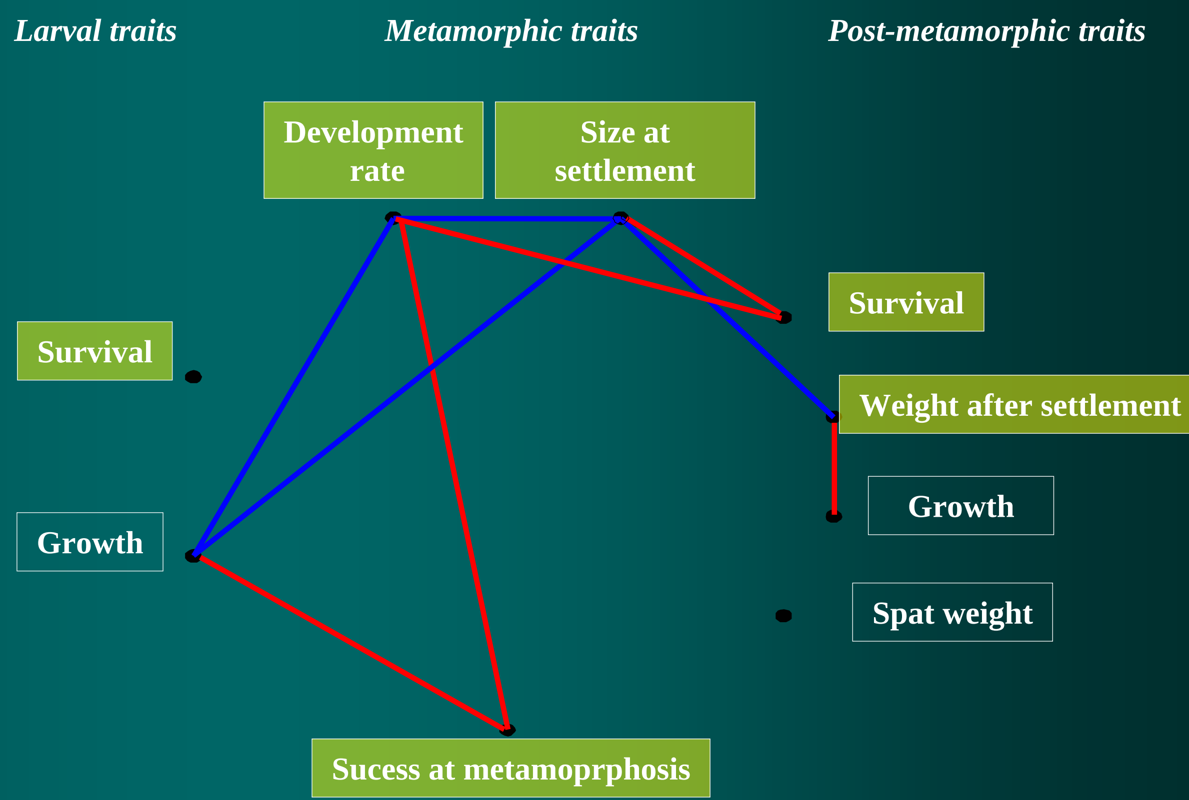
Genetic variability of early life traits in *C. gigas* ?

Ernande *et al*., 2003

H^2 significantly ≠ 0

Genetic correlation significantly positive

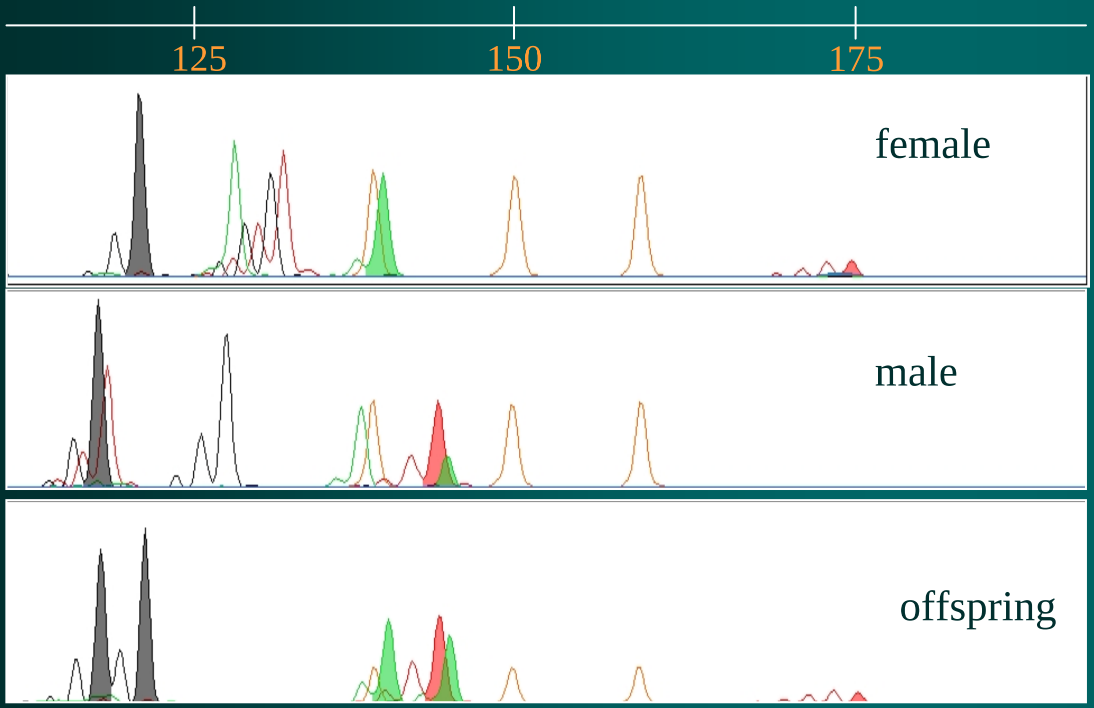
Genetic correlation significantly negative



- limited number of families
- no family replicates
- a single environment

Mixed-family approach

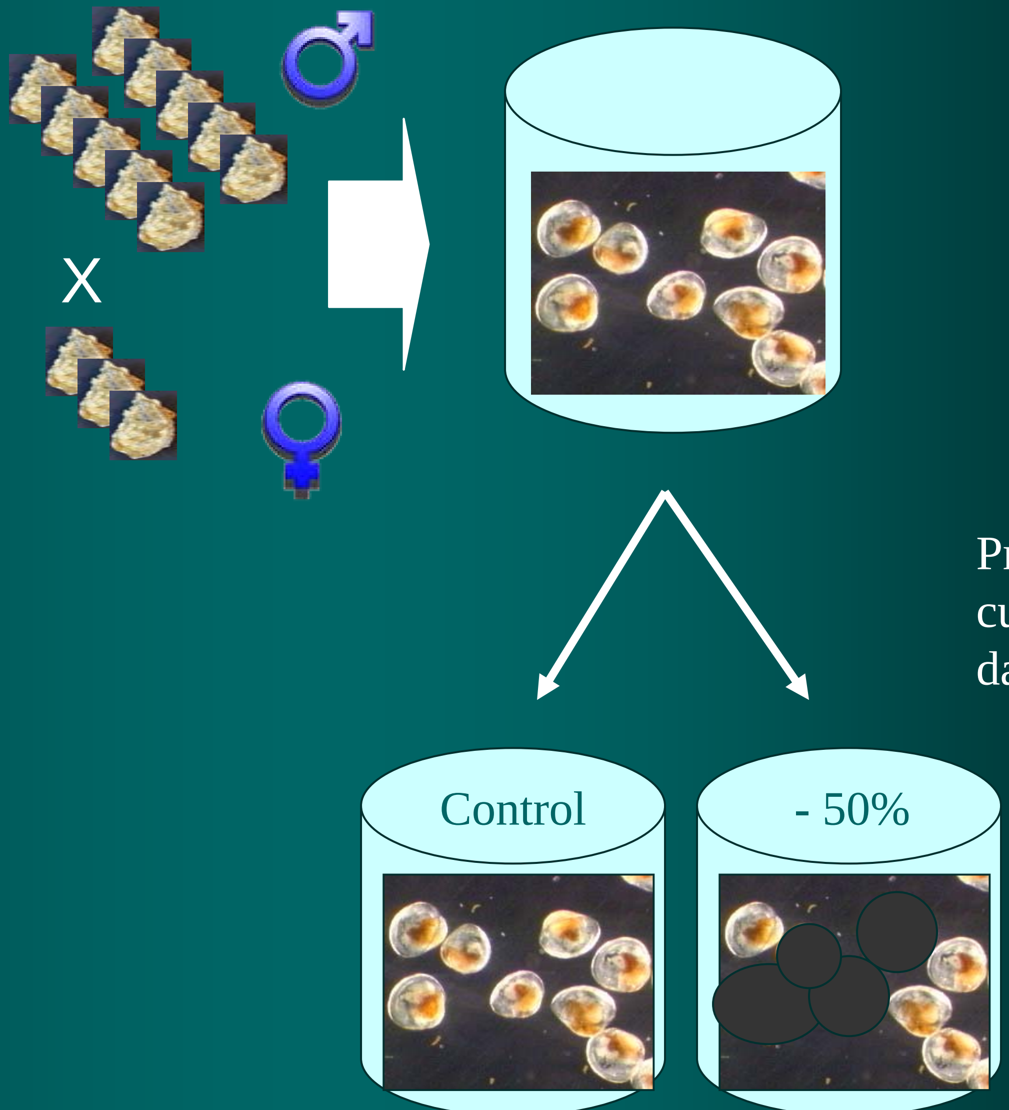
One set of 3 PCR-multiplexed markers allowing efficient parental assignment of larvae (Taris *et al.*, 2005)



- More families
- Homogeneous rearing conditions
- G x E ?

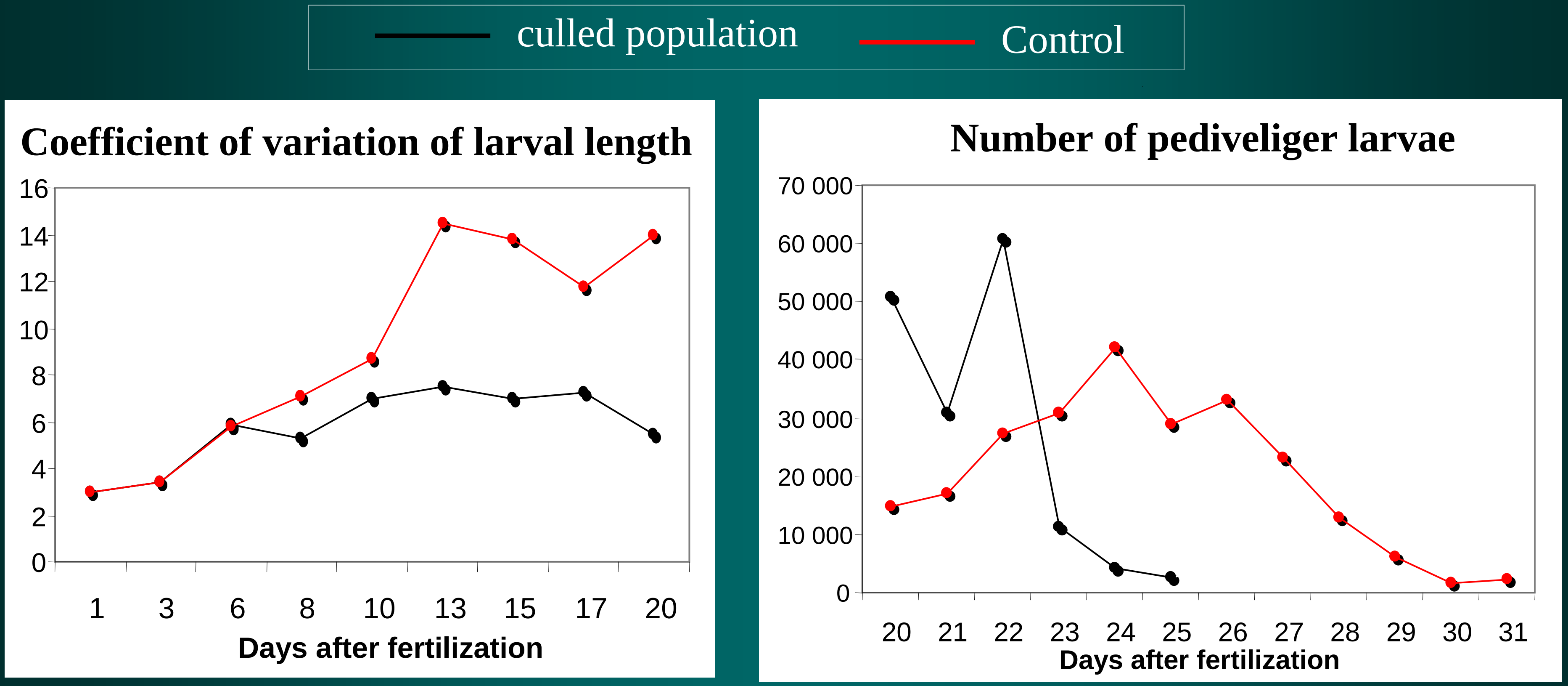
1. Effect of culling

Crossing of 3 females x 10 males with <u>equal</u> gametic contribution within each sex



Progressive culling from day 4 to day 15

1.1 Phenotypic effect of culling 50% of the smallest larvae

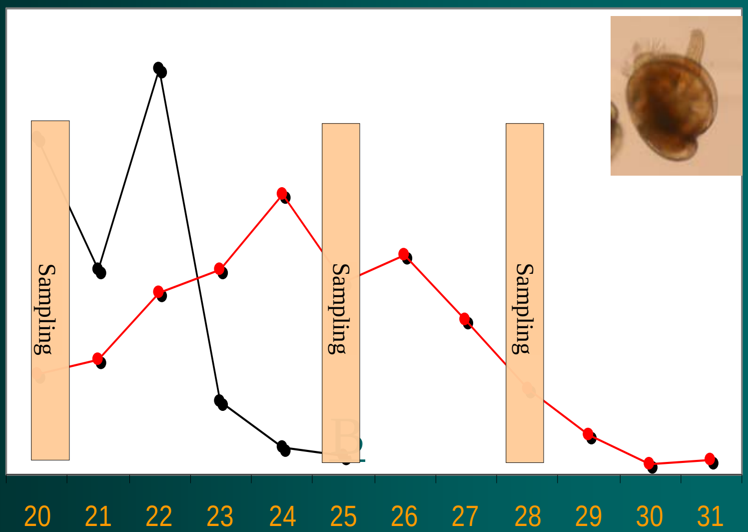


Limited effect on <u>yield</u>:

-30 % of ready-to-settle larvae (higher survival of fast growing larvae)

-15 % of spat (higher settlement success of fast growing larvae)

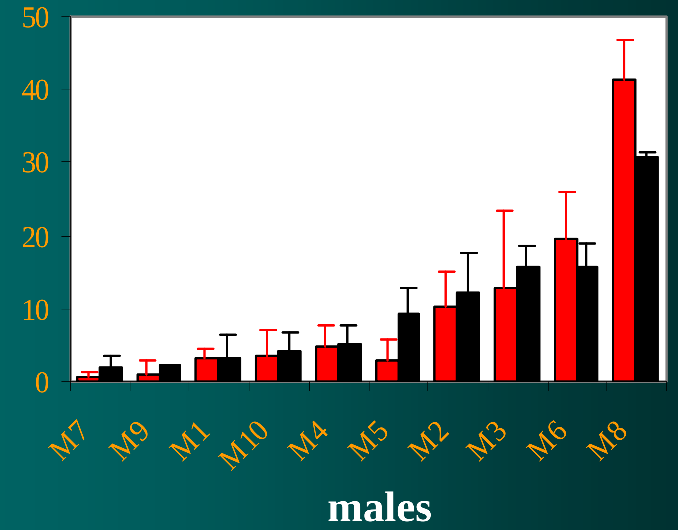
1.2 Genetic effect of culling



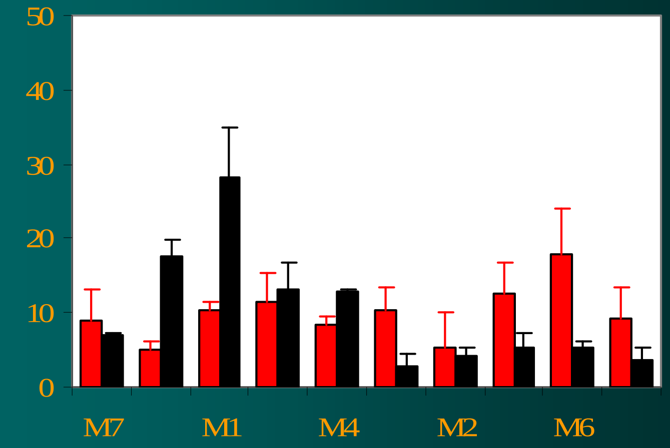
Ne = 8.2   12.3
6.3   15.2   15.9

The effect of culling on genetic diversity is mediated through its effects on the timing of settlement

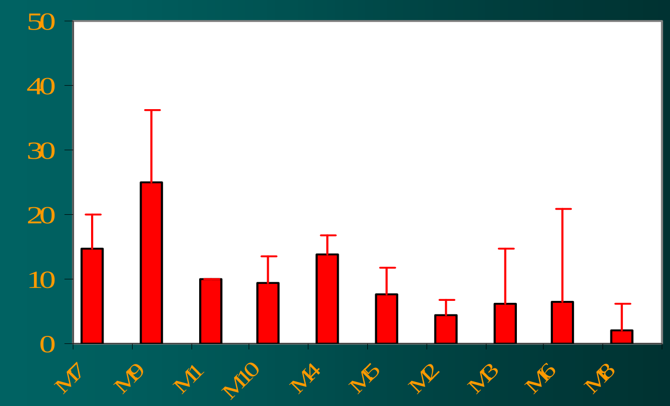
D20



D25

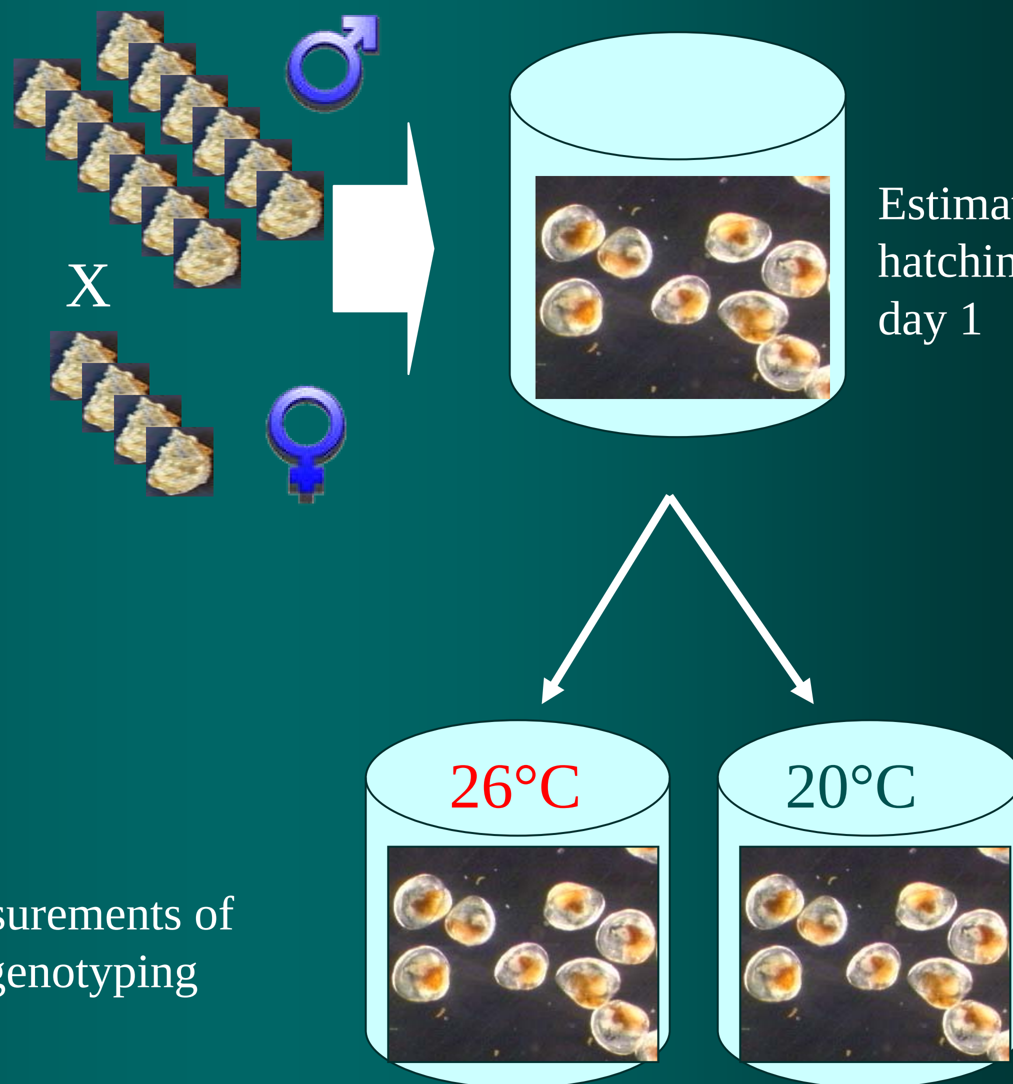


D28



2. Effect of temperature

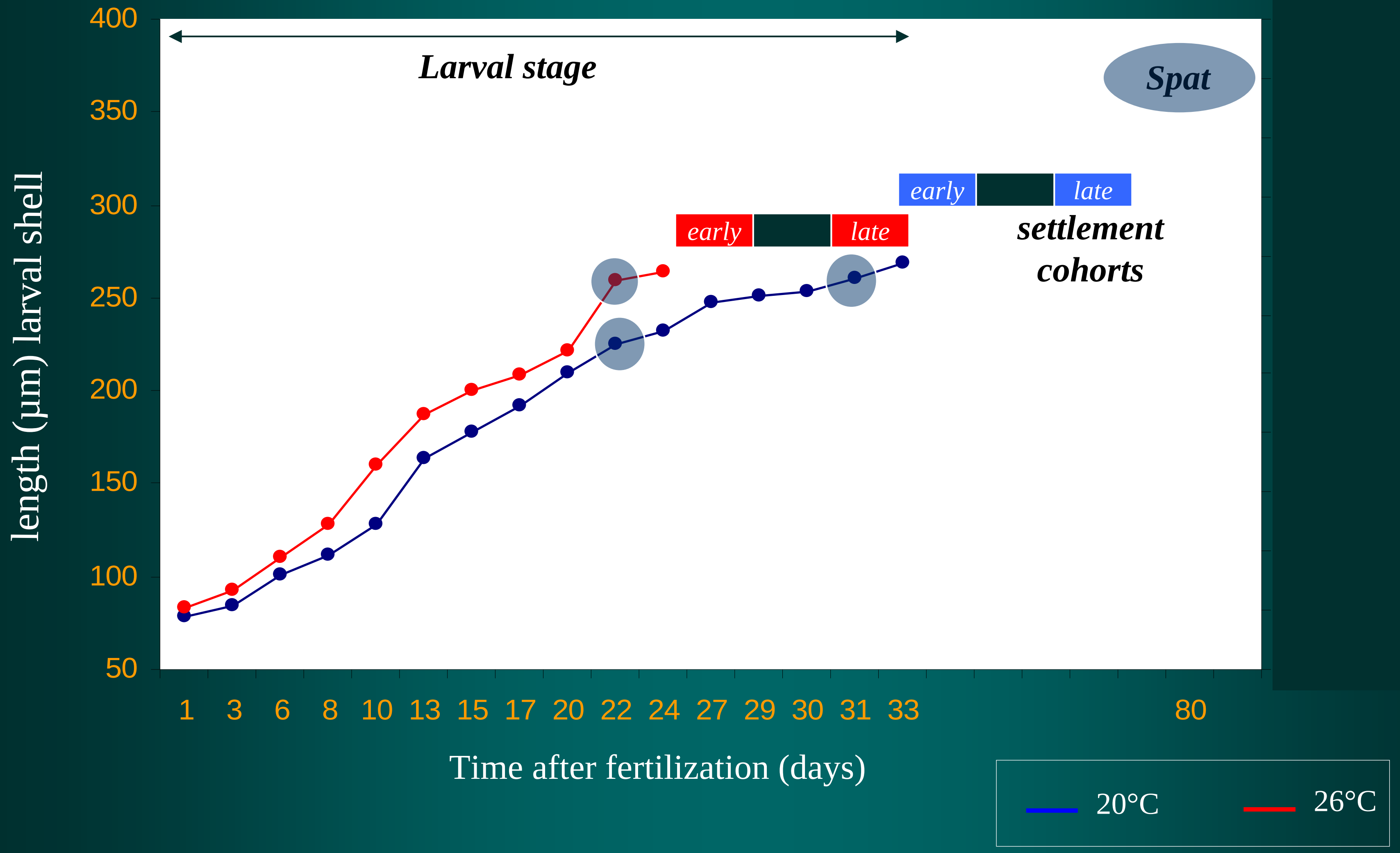
Crossing of 4 females x 12 males with <u>equal</u> gametic contribution within each sex



Estimation of hatching rate at day 1

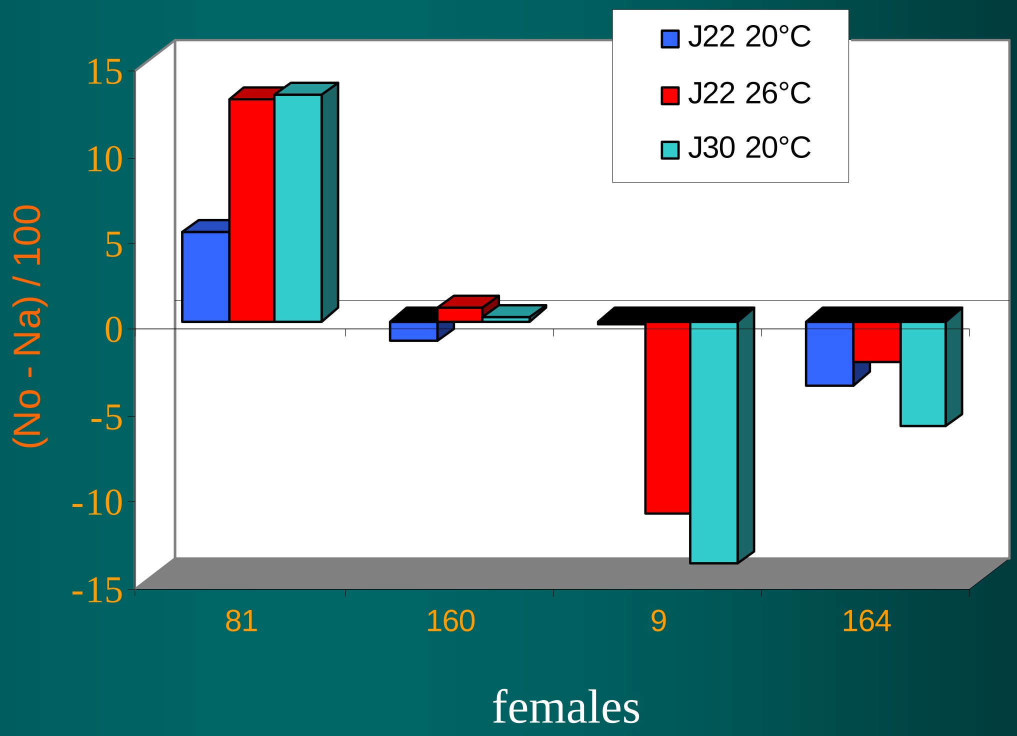
Individual measurements of larvae prior to genotyping

2.1. Phenotypic effect & sampling



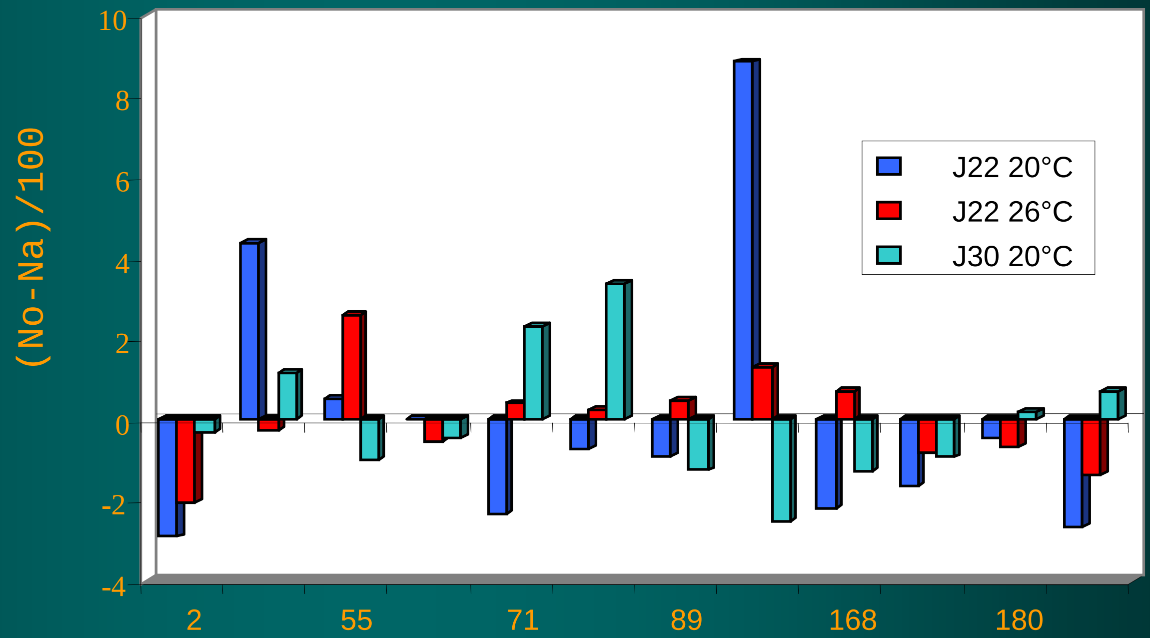
2.2. Variance of female reproductive success

Observed maternal contributions relative to mean hatching rate at Day 1



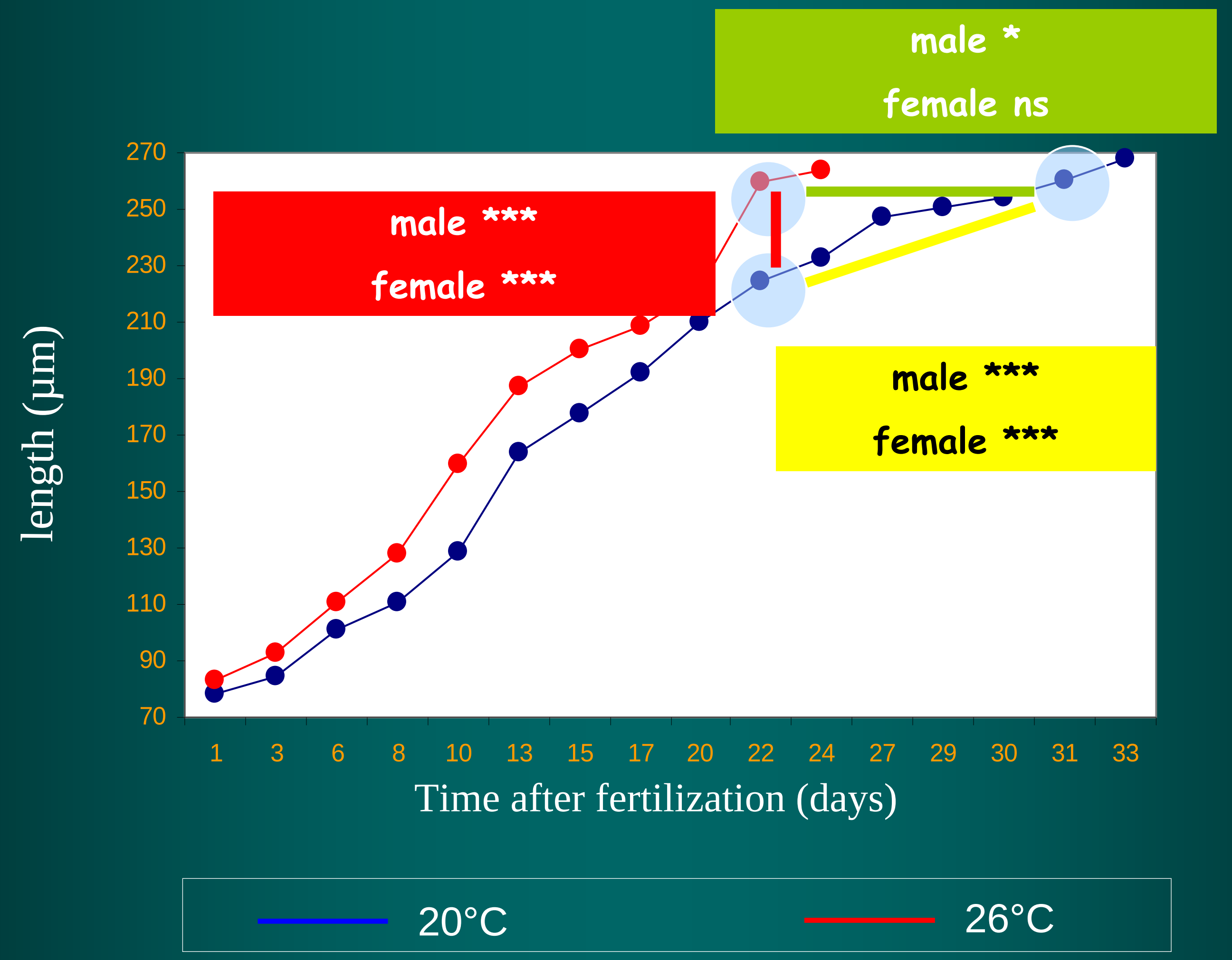
2.2. Variance of parental reproductive success

Observed paternal contributions relative to mean hatching rate at Day 1

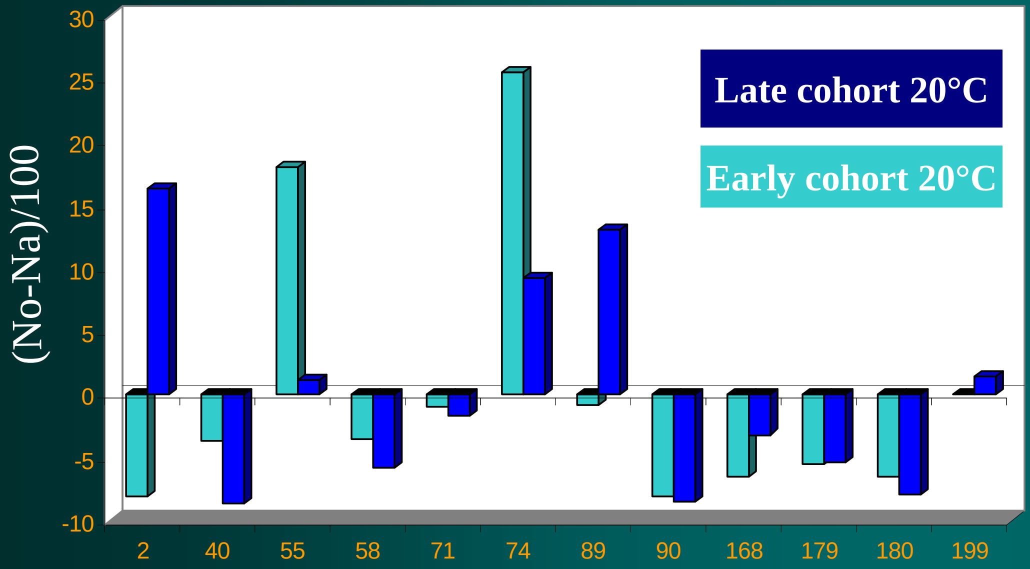


males

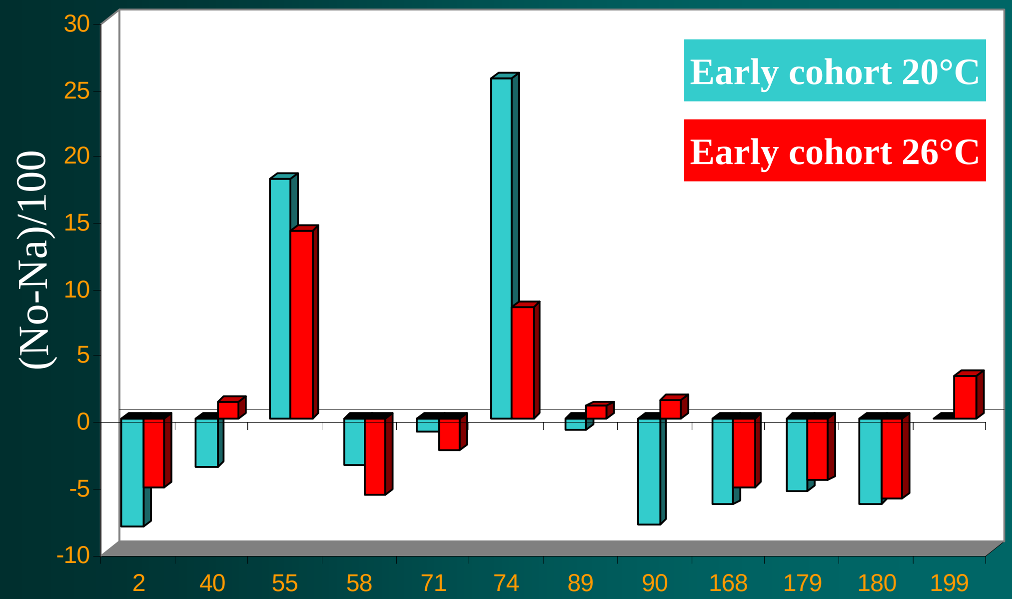
2.2. Variance of parental reproductive success



2.3. Paternal contributions at day 80 (spat)

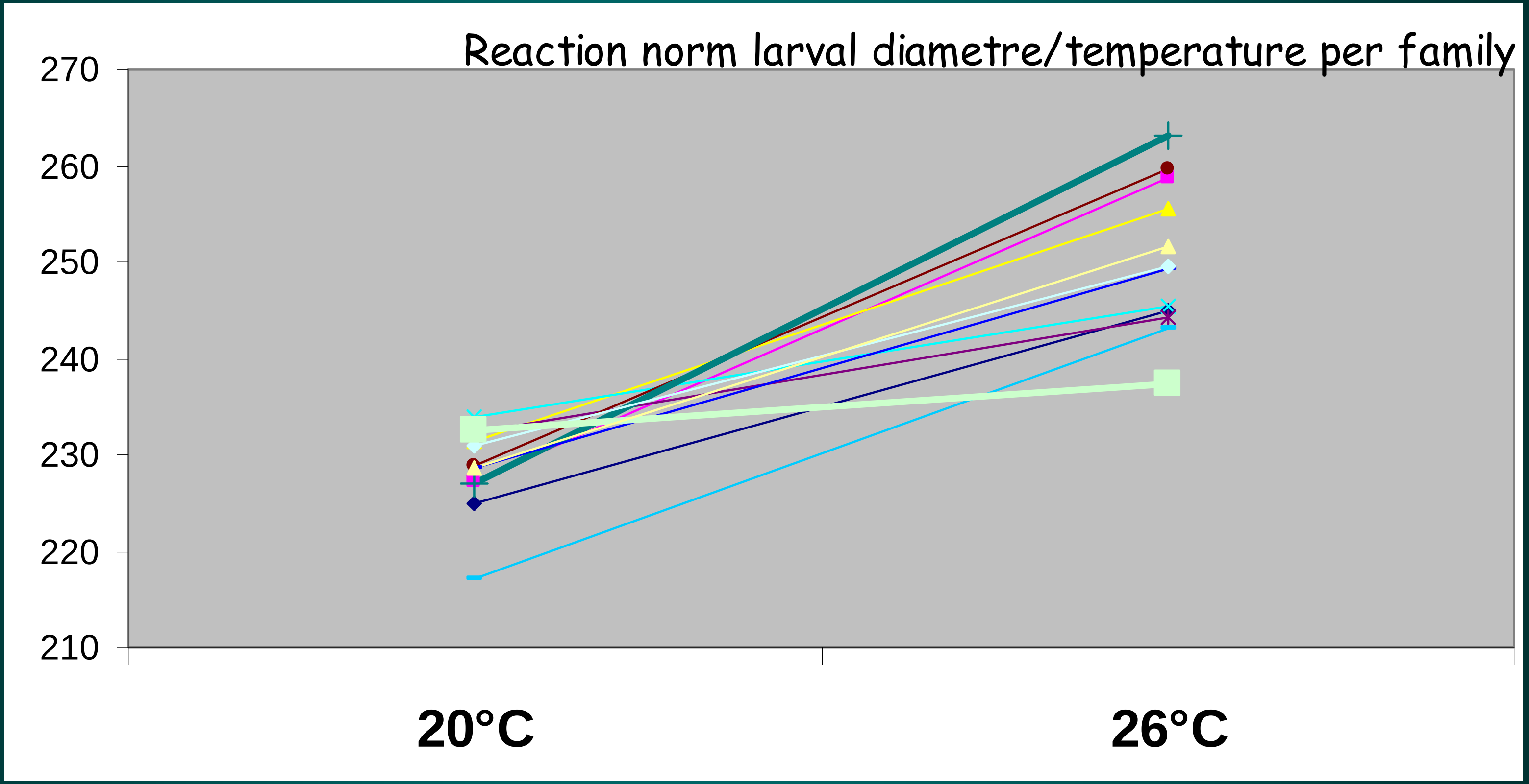


Significantly different contributions between early and late cohorts at 20°C (same result at 26°C)



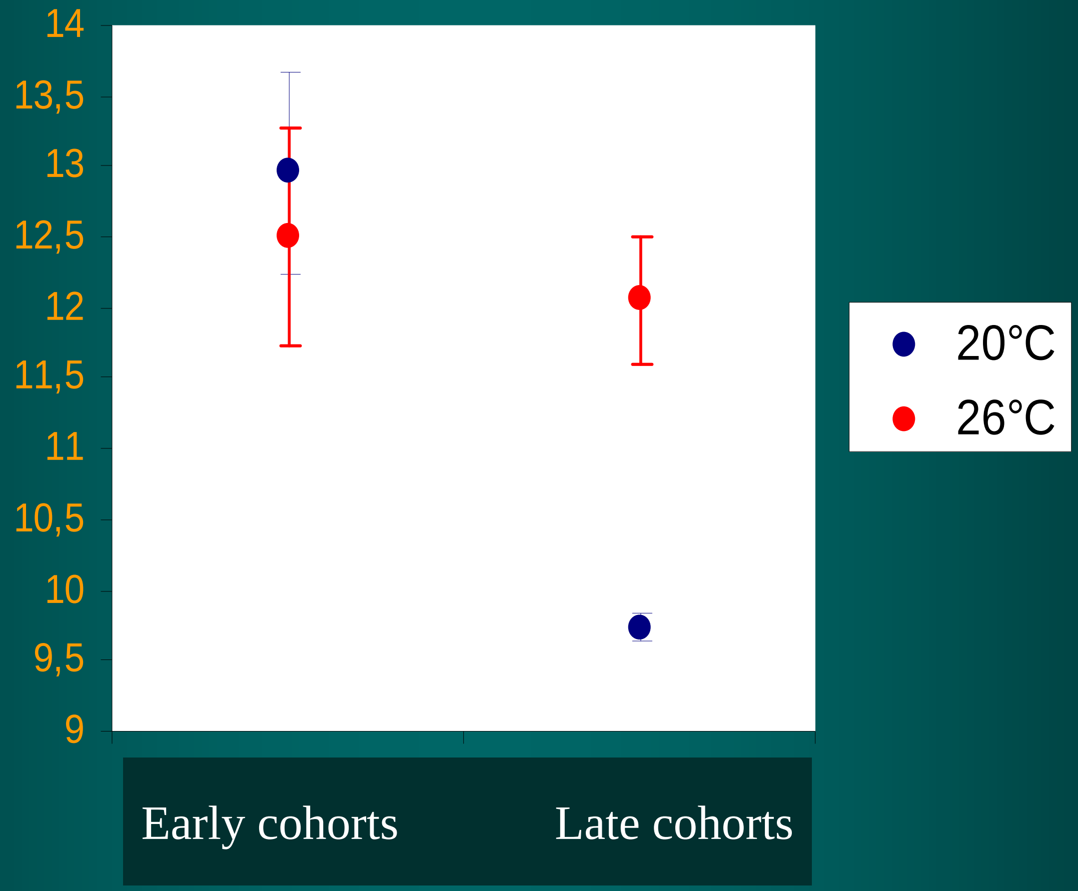
Significantly different contributions between early cohorts at 20°C and 26°C (same result for the late cohort)

2.2. « G x E » interaction on larval size



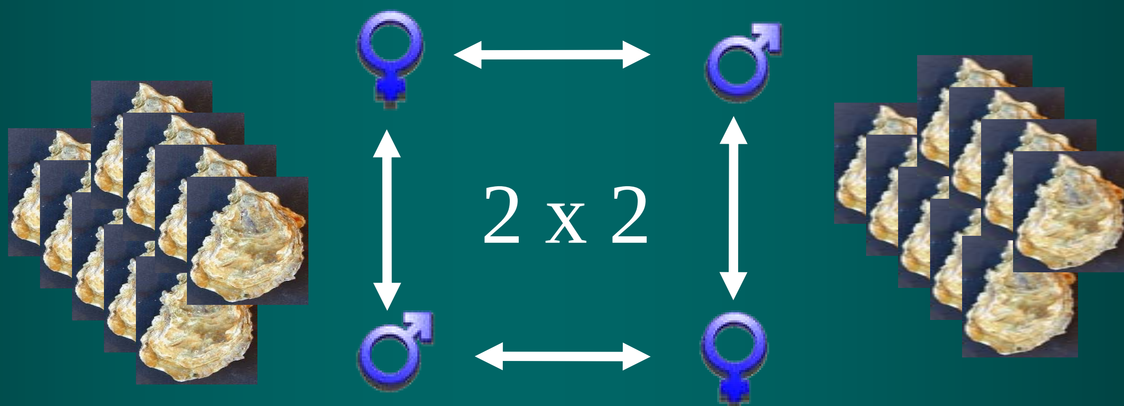
Male	ns	p<0.05
Female	ns	p<0.05

2.4. Effect of temperature during larval rearing on spat growth



3. Selection for fast growing larvae in hatcheries ?

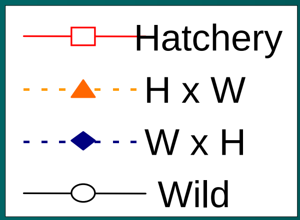
Hatchery broodstock **Wild broodstock**



7 generations of breeding

Loss in allele diversity ≈ 70%

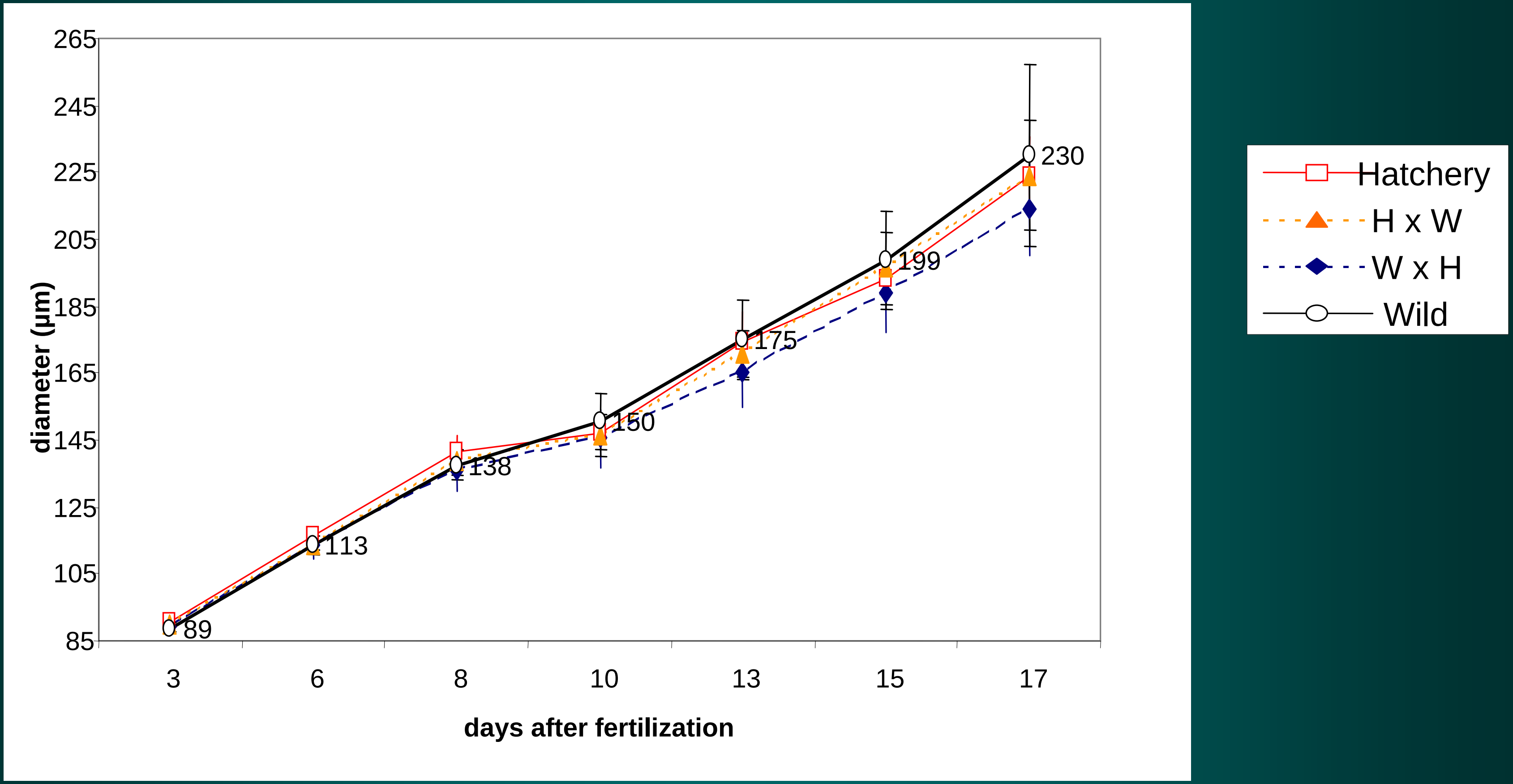
Loss in heterozygosity ≈ 20%



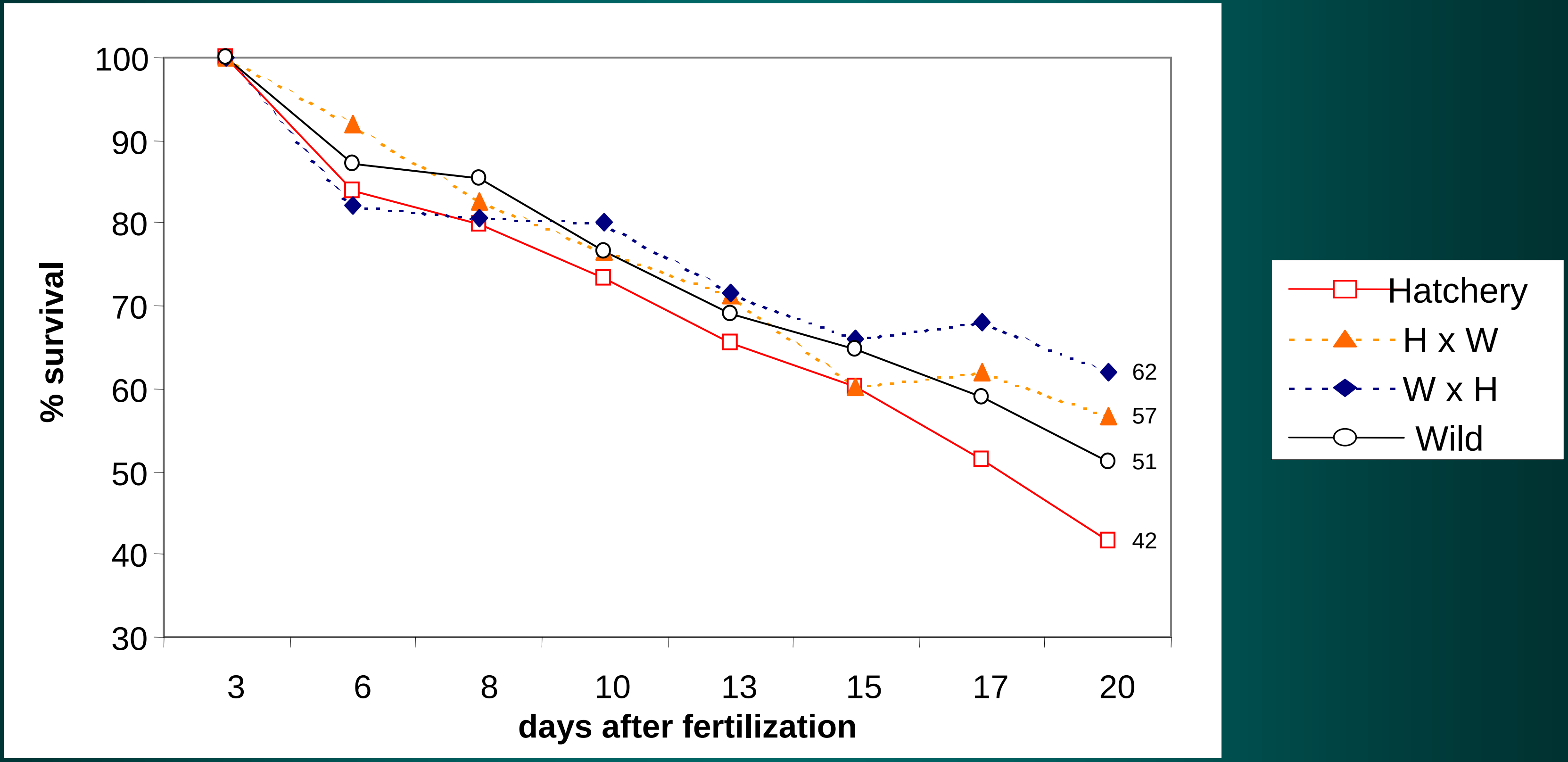
Rearing conditions:

- 24°C
- no culling

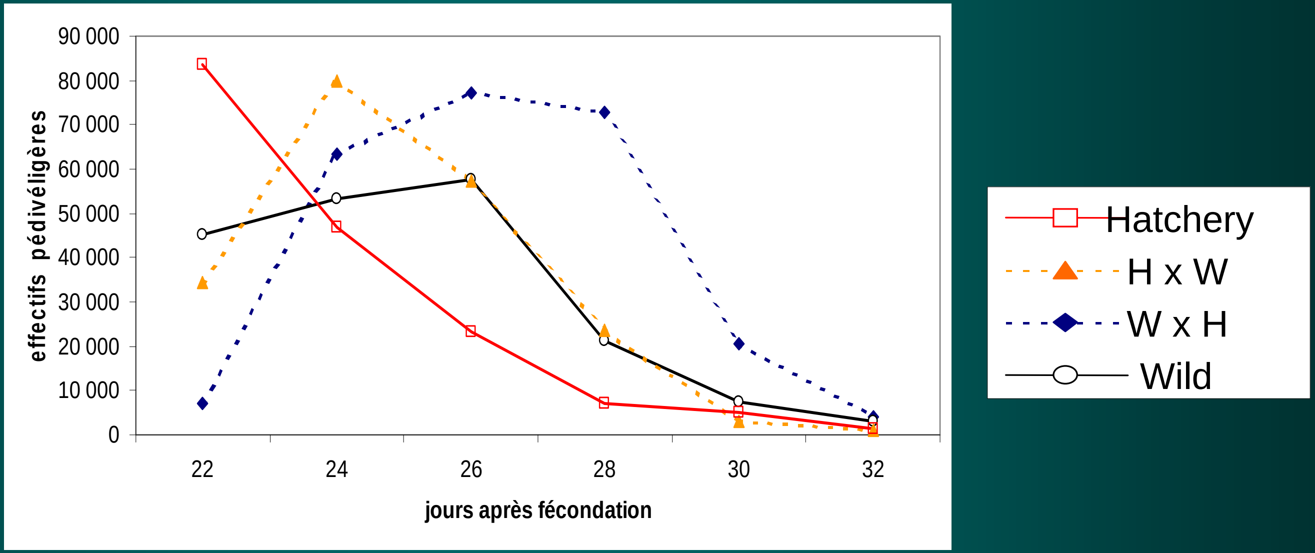
3.1. Larval growth



3.2. Larval survival



3.3. Timing to reach the pediveligere stage and settlement success

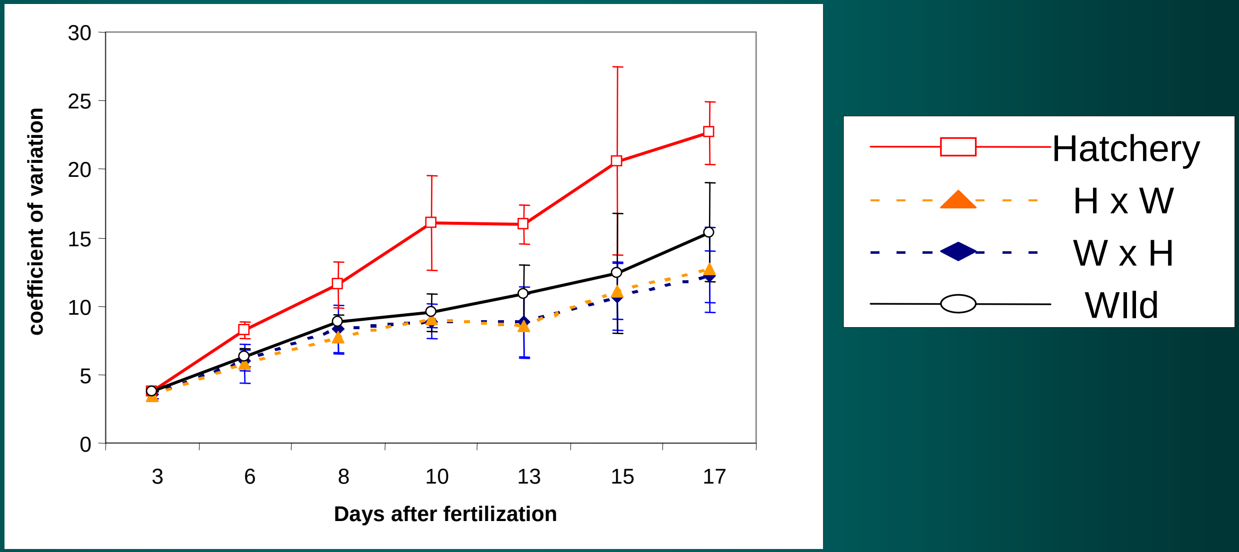


Settlement success (%):

Hatchery 90.7 > HxW 78.1 > Wild 72.3 > WxH 68.7

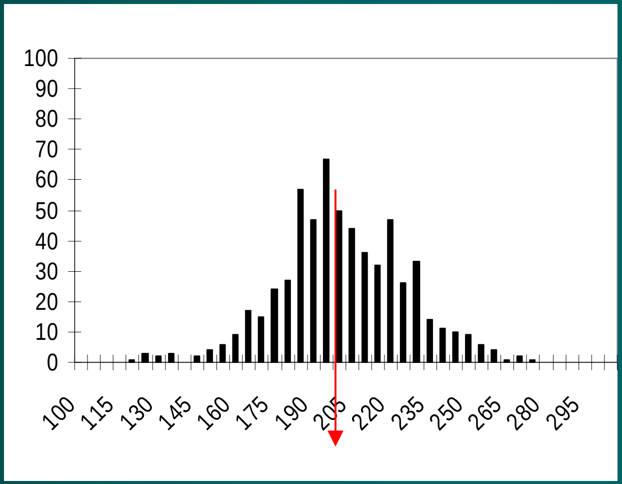
3.4. Within progeny variation for larval size

C.V. of larval length



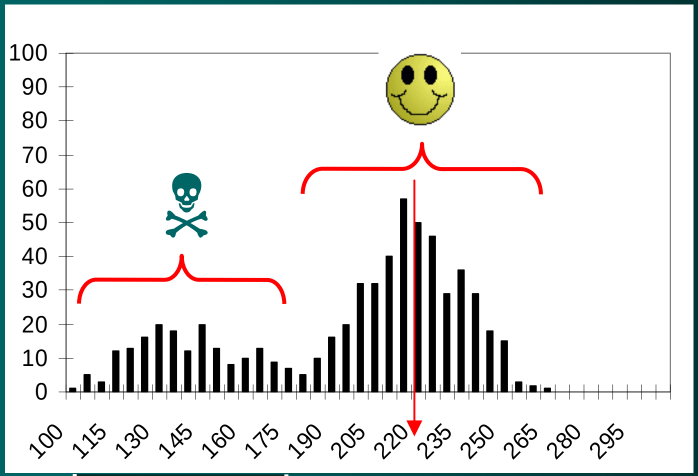
Distribution of larval length at Day 15

Wild progeny



205 µm

Hatchery progeny



225 µm **

Inbred larvae ?

Conclusions

Methodology

- As individual tagging is impossible at early life stages, marker-based parentage analysis of mixed families represents an efficient tool to study genetic variability of larval traits.

Selection at larval stage

- Significant differences are observed between progenies, confirming the existence of genetic variation for several traits.

- Temperature influences the expression of genetic variability for growth and survival and therefore is likely to increases the genetic effect of culling.

- Intensive rearing practices can lead to the selection of faster growing / higher settlement larvae, despite inbreed depression.


Thanks