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Response to unintentional selection for faster development associated with inbreeding depression in *Crassostrea gigas* larvae, resulting from a broodstock selective breeding plan

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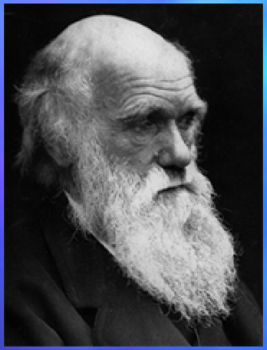
Domestication

« …condition wherein the breeding, care and feeding of animals is more or less controlled by man …» (Hale, 1969)



Genetical definition of domestication

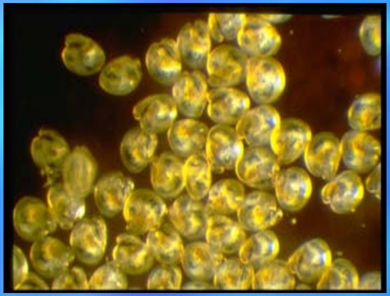
Intentional or Unintentional genetically determined changes resulting from domestication

What about genetic domestication in oysters ?

-No feeding, limited care…. limited domestication ?

But what about early stages in hatcheries ?

Hatchery propagation of oysters



☺ - few breeders for a mass production

☺ - optimized survival and growth rates

☺ - culling

☹ - low genetic diversity *Hedgecock et al. 1992; Zhang et al. 2005…*

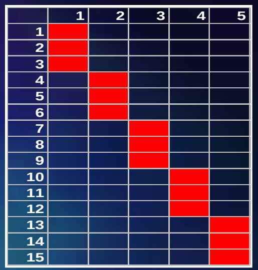
⇨few breeders + high variance of reproductive success *Boudry et al. 2002*

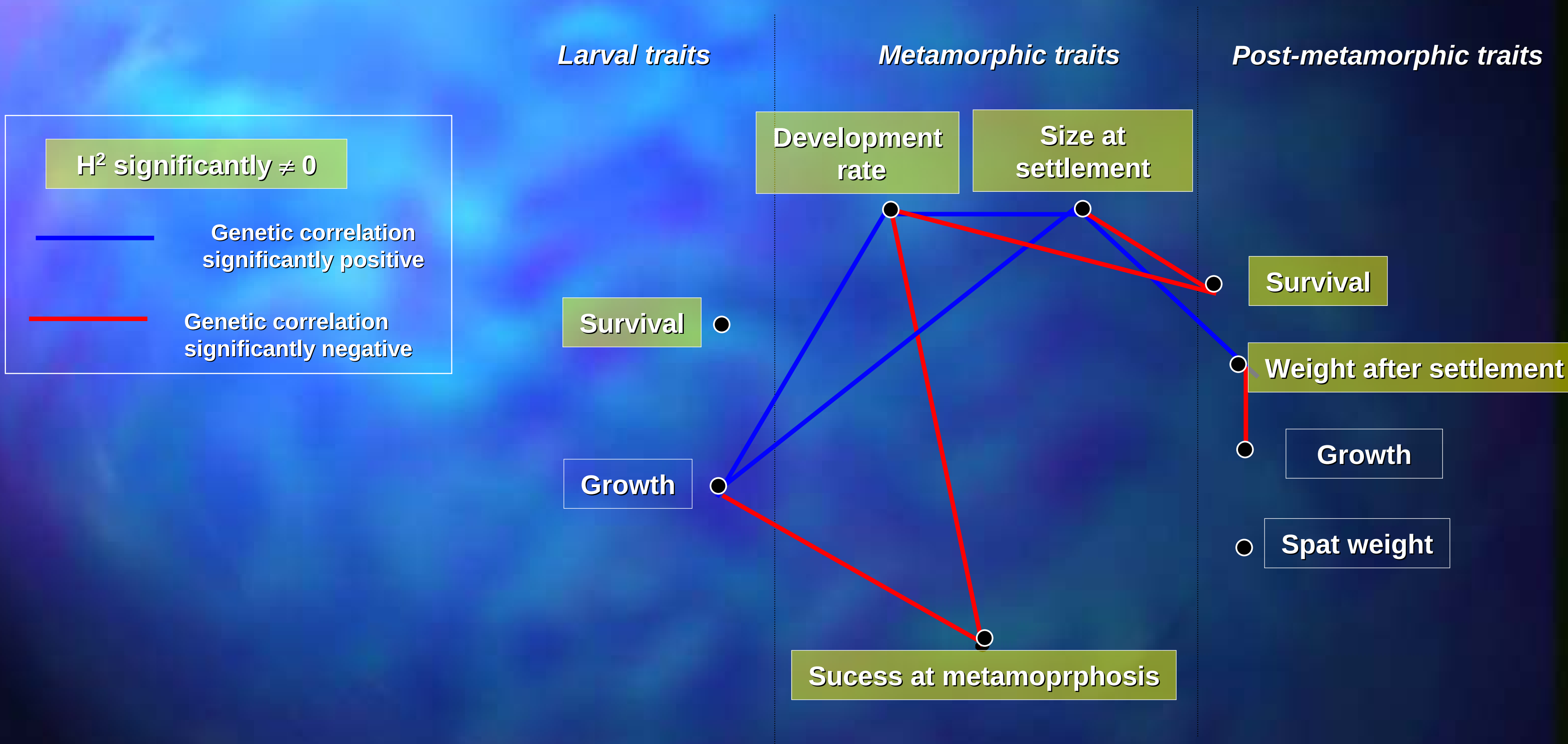
☹ - substantial risks of diversity loss and inbreeding

Is there unintentional selection (domestication) at early development stage in hatchery ?

Genetic variablity of early life traits ?

Ernande et al., JEB 2003





Culling at larval stage

Taris et al., JEMBE in press

✓ Phenotypic effect:

⇨Faster time to settlement
⇨Lower variability in size and time to settlement
⇨Limited effect on ready-to-settle larvae and spat « yield »:

⇨ positive phenotypic correlation between larval growth, survival and settlement success

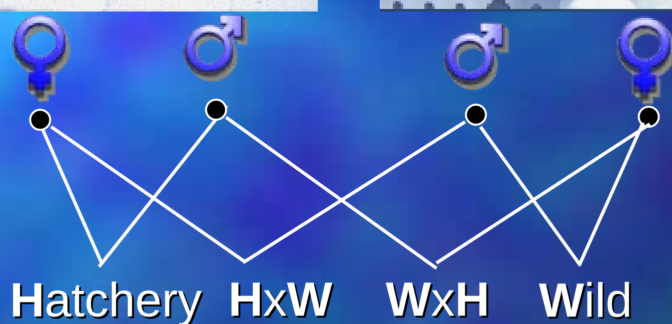
✓ Genetic effect:

⇨ Confirmation of significant genetic components for some larval developmental traits
⇨ Loss of genetic diversity through its effects on the timing of settlement

Culling = Selection of fast growing larvae ?

37 individuals
from a commercial
hatchery
broodstock

47 oysters from
a natural bed



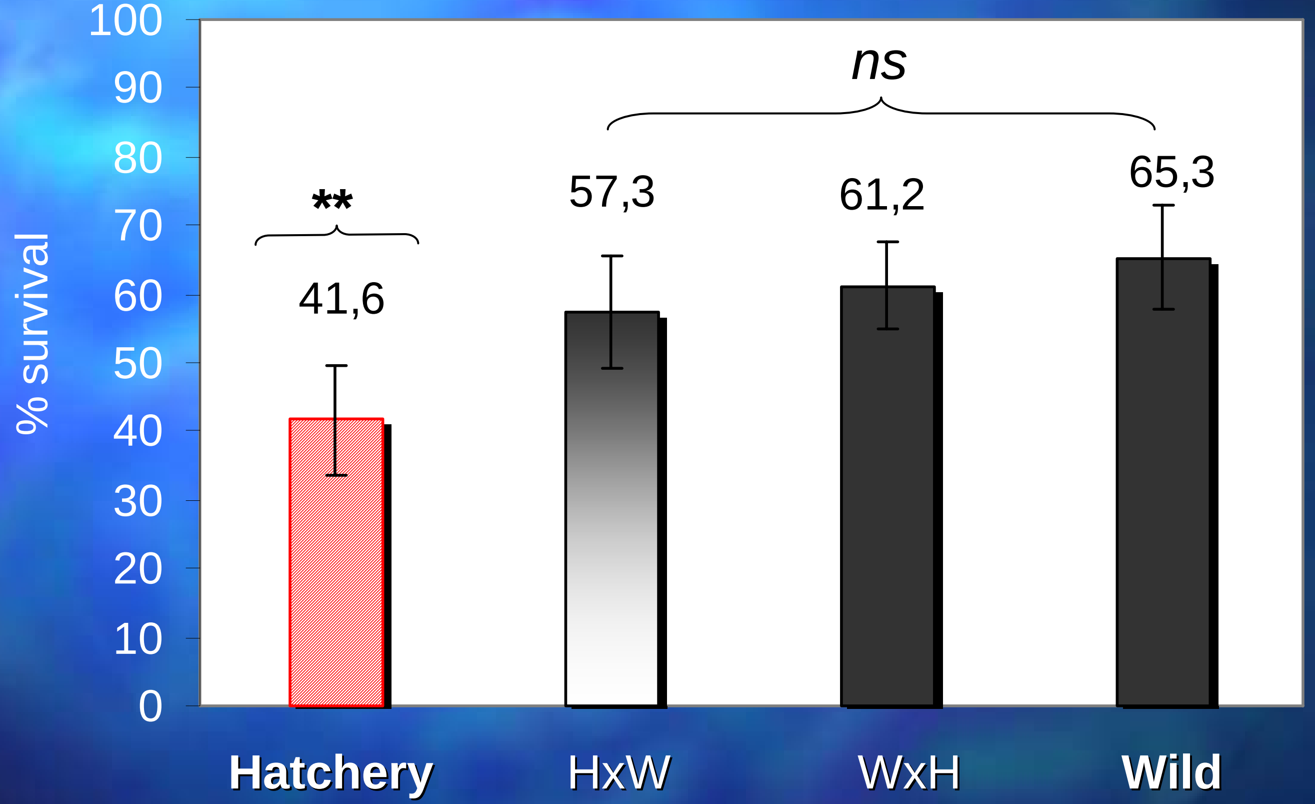
- 7 generations of closed hatchery matings
- allelic diversity loss ≈ 70%
- heterozygosity loss ≈ 20 %

Larval rearing conditions:

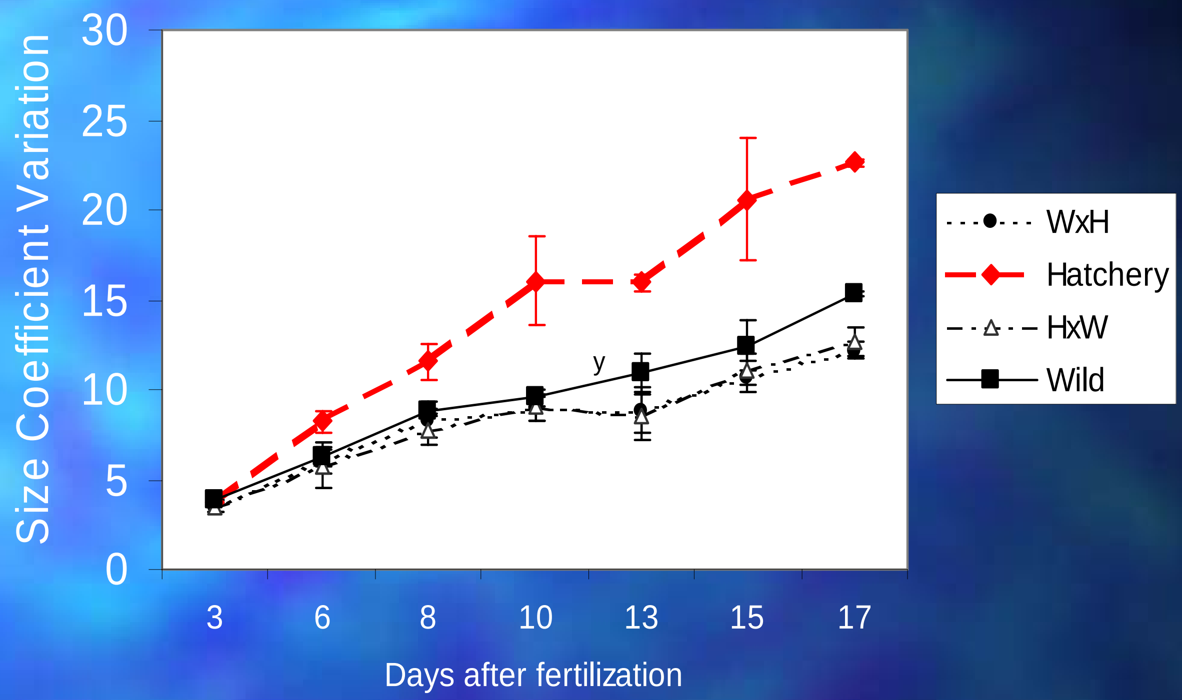
- 24°C
- no culling

Results

1. Larval survival

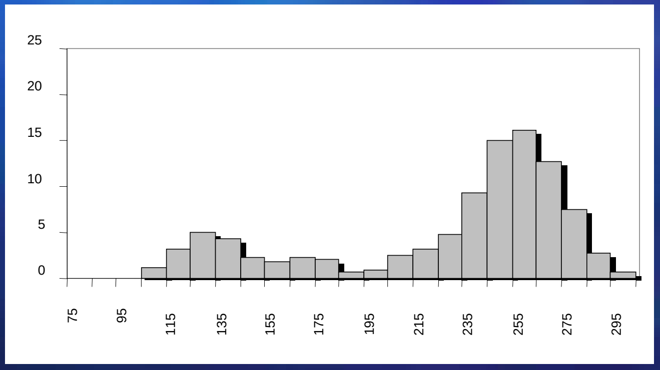


2. Coefficient of variation of larval length

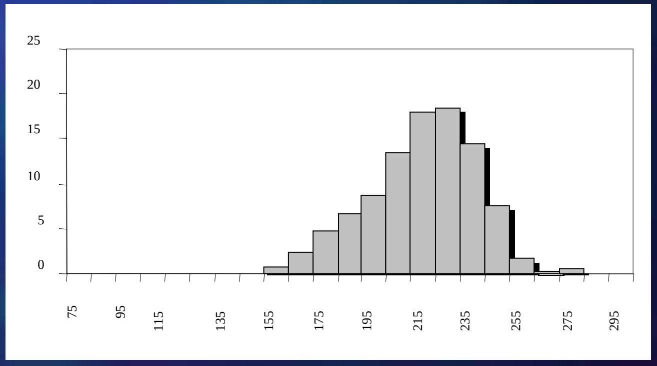


Day 17 a.f.

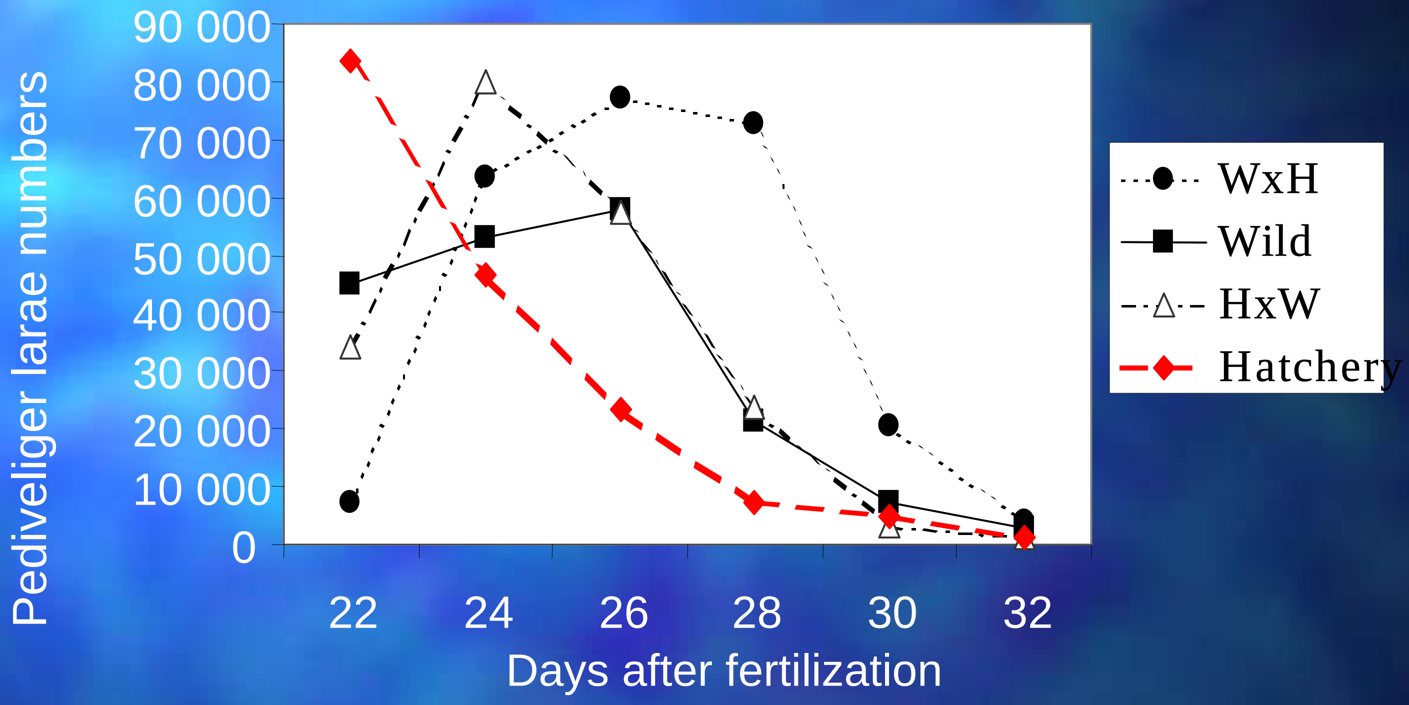
Hatchery



Wild



3. Temporal evolution of pediveliger larvae effectives and metamorphosis success



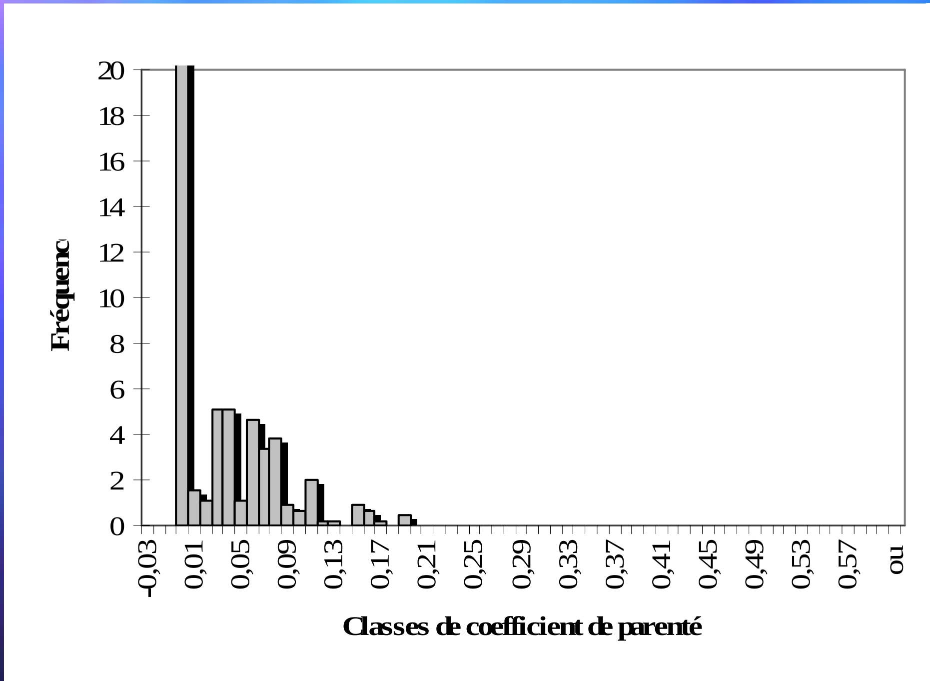
Metamorphosis success (%):

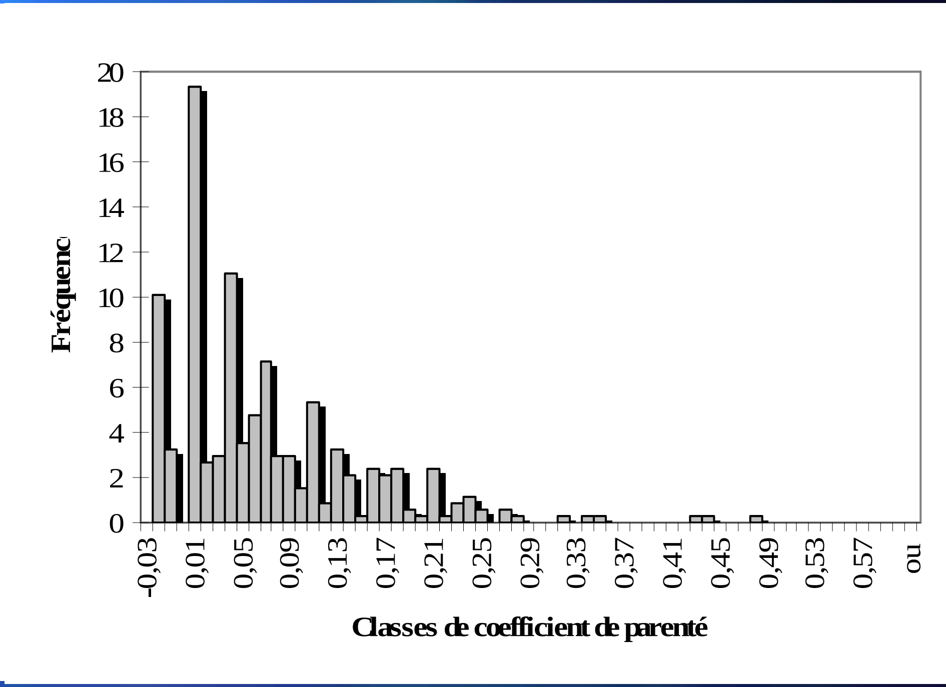
Hatchery > HxW > Wild > WxH

90,7 78,1 72,3 68,7

How to explain our data ?

✓ What about pairwise relatedness in the two broodstocks ?



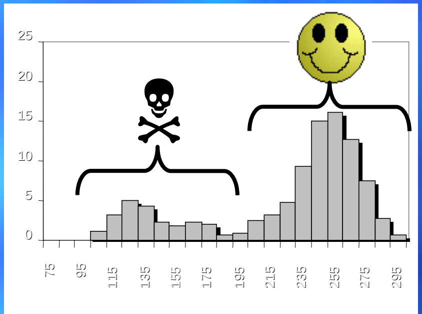


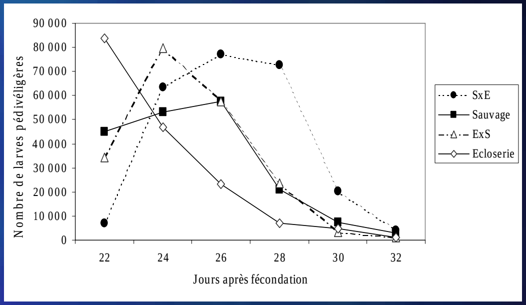
Wild broodstock:
R = 0,012 ± 0,001

Hatchery broodstock:
R = 0,068 ± 0,005

How to explain our data ?

Outbreed larvae ?





Why such an early settlement ?

Inbreed larvae ?

(inbreeding depression at larval stage:

Launey and Hedgecock, 2001)

Is our "Unintentional selection of fast growing larvae » hypothesis realistic ?

⇨ breeder's equation

$$\Delta \mu = h^2 \times S$$

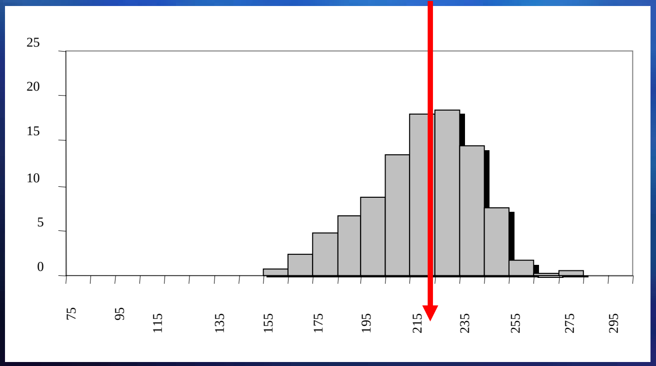
***$\Delta \mu$** = gain in the mean phenotype across generations*
***h^2** = heritability*
***S** = selective pressure = within-generation difference of the mean trait after and before selection mean*

h^2 = 0.16 (*Dégremont, 2003*)
S = 20µm (*Taris et al., in press*)

$\Delta \mu$ = 0.32µm per generation

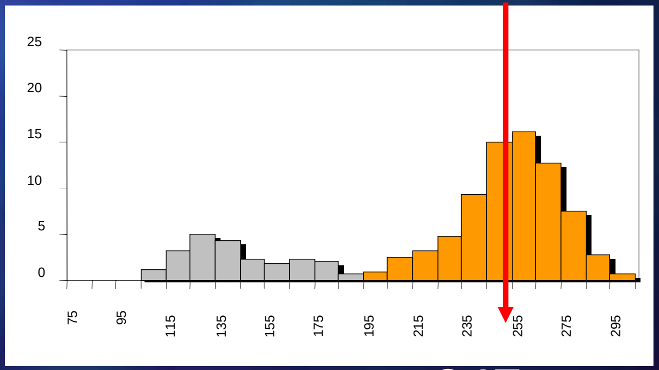
$\Delta \mu$ ~20µm over 7 generations

Wild



223µm

Hatchery



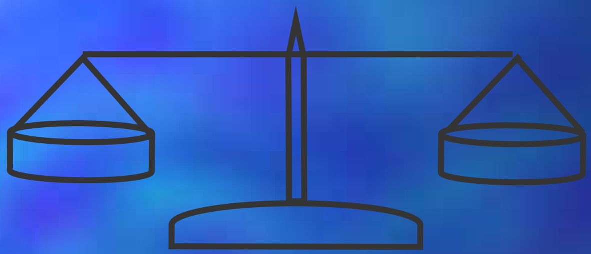
247µm

Discussion

<u>Opposition of two effects in the HxH progeny :</u>

- inbreeding depression leading to the death of a part of population
- selection of faster growing larvae showing better metamorphosis success

Inbreeding depression



Response to (unintentional) selection

<u>In the hatchery</u>:

Culling of slow growing larvae masks inbreeding depression of part of the population

Paradoxically, culling may help to preserve genetic diversity by further selecting heterozygous fast growing larvae

… but this is an unstable situation !

Perspectives

Optimal level of culling during larval rearing that would minimize loss of genetic diversity and consequent inbreeding and maximize larval growth and settlement ?

Genetic management of hatchery stocks ?

- family (or mixed family) approach
- minimal kinship approach

Intentional selection of early life traits ?

Genetic correlation between early life traits and later ones ?


Thanks