



First step in the preparation of stock-enhancement for the European abalone (*Haliotis tuberculata*) in France

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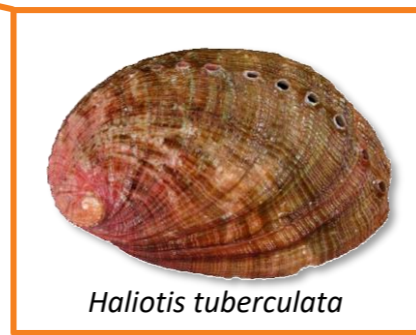
Introduction

Prior to large stock enhancement programs of abalone, the ability of hatchery-reared organisms to survive and develop in the wild must be assessed [1]. The aquaculture facilities can drive domestication [2].

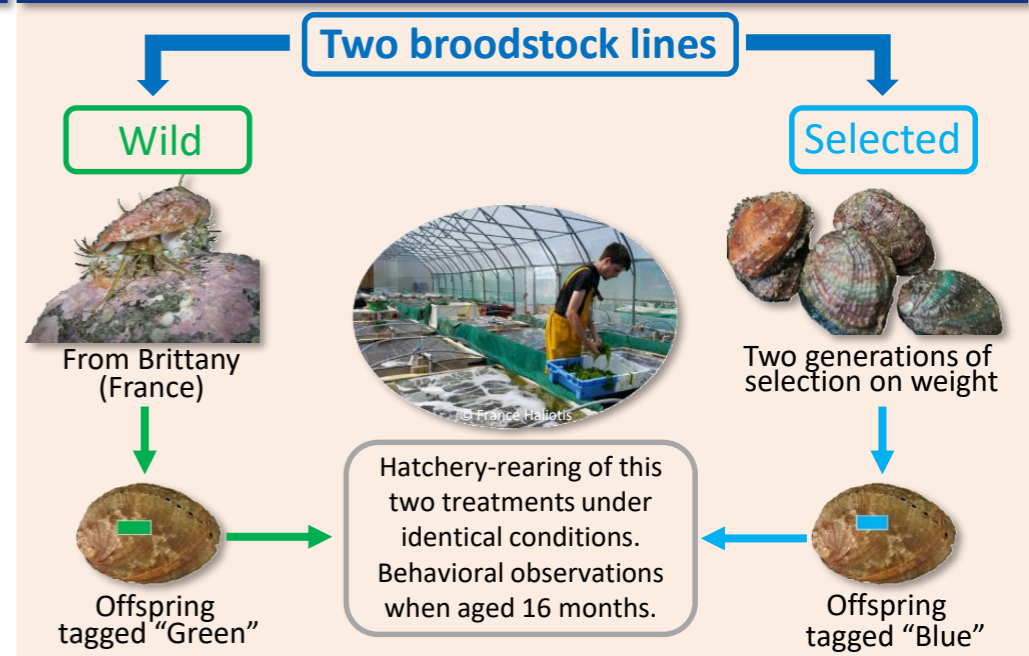
During the domestication process, abalones may be unintentionally selected on physiological or behavioral traits, due to the specific hatchery conditions, as well as intentionally selected based on production traits [3].

We present here three experiments to explore the following question:

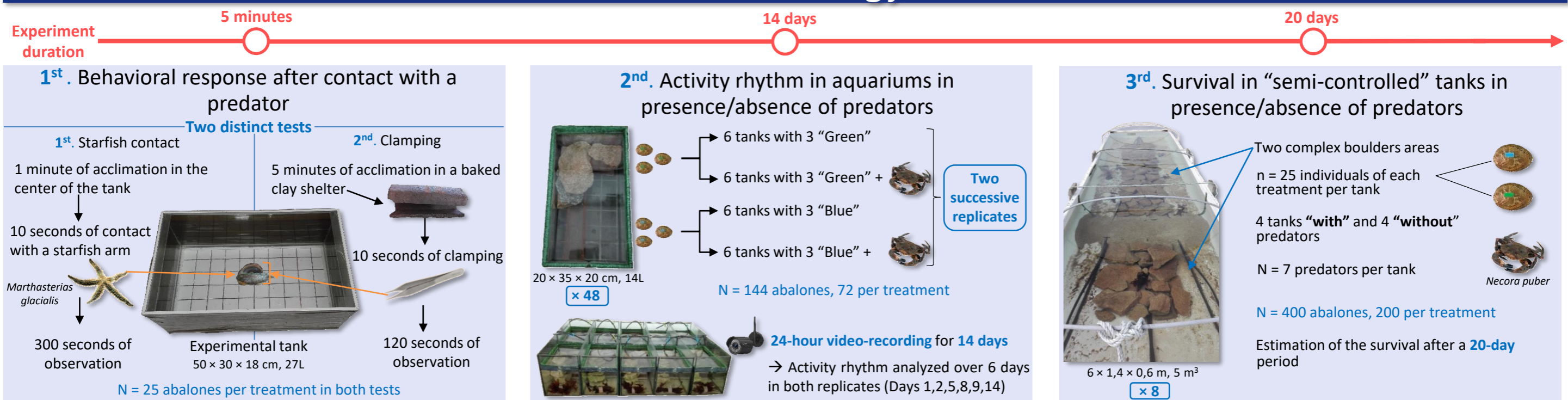
- Are the **behavioral activity** and the **survival** of selected and wild lines different in the presence of predators ?



Material



Methodology



Results

Statistical analyzes:

We performed linear mixed effect models to compare the treatments. Covariates and random factors were also taken into account.

1st. Behavioral response after contact with a predator

Table 1: Behavioral comparisons between the two treatments (blue and green offspring). "NS" indicates a p-value > 0,05.

Experiments	Behaviors analyzed between the two treatments	Statistical results
1 st . Starfish contact	Time spent mobile after predator contact	NS
	Distance travelled during the experiment	NS
	Number of mucus ejection after predator contact	NS
2 nd . Clamping	Time spent immobile	NS
	Time needed to return to initial state	NS

2nd. Activity rhythm in aquariums in presence/absence of predators

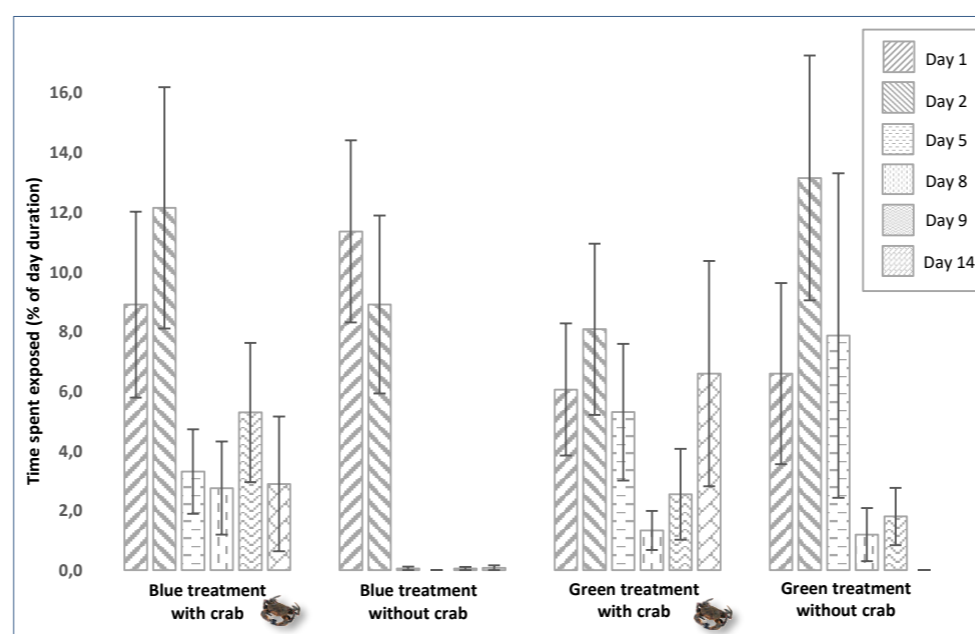


Fig 1: Daily percentage of time abalones from both treatments spent in exposed area.

Table 2: Statistical analysis of the potential parameters explaining changes in the time abalones spent in exposed area. "NS" indicates a p-value > 0,05.

Variable studied	Parameters	Statistical results
Time spent exposed (% of day duration)	Treatment (blue or green)	NS
	Presence of predator	NS
	Period (night or day time)	p-value < 0.05 *
	Day (1,2,3,8,9,14)	p-value < 0.001 ***
	N° of repetition (1 or 2)	NS
	Treatment × Presence of predator	NS
	Treatment × Period	NS
	Treatment × Day	NS

3rd. Survival in "semi-controlled" tanks in presence/absence of predators

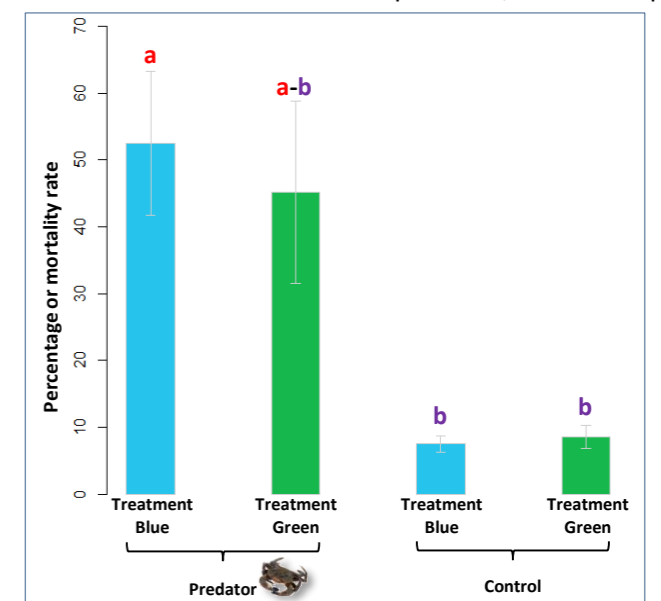


Fig 2: Mortality rates (%) of the two treatments (blue and green), in "control" and "predator" tanks. The letters "a" and "b" show significant differences (p-value < 0,05, liner mixed effect models).

Table 3: Statistical analysis of the potential parameters explaining differences in the mortality rate. "NS" indicates a p-value > 0,05.

Parameters	Statistical results
Predator effect	p-value < 0,001 ***
Treatment effect (blue or green offspring)	NS
Predator × Treatment effect	NS

Main findings:

- No difference in the behavioral responses after predator contact, in both predator tests.
- The presence of a predator (*Necora puber*) does not significantly influence the time spent in exposed area, in any treatment. However, the time spent in exposed area decreases over time (day effect) and differs between night and day time.
- The mortality rate is significantly greater in tanks with crabs (*Necora puber*), but is not significantly different between treatments.

Discussion & Conclusion

The objective of the three experimental tests, performed at different scales, was to explore the behavioral differences between two lines of hatchery-reared abalones. The hypothesis was that the juveniles from the wild and farmed selected origins would behave differently because of distinct degree of domestication. Even if we need to deepen statistical analysis, we didn't detect significant differences in response to predators between the two treatments. These results suggest that after hatchery-rearing, 16 months old juveniles from selected parents would not show differences in their behavioral responses, compared to juveniles from wild parents.

In the future, it would be interesting to compare wild and hatchery-reared abalones (from wild or selected parents), based on behavioral and survival criteria, after settlement in wild environment.

References:

- [1] Hansen S. C. & Gosselin L. A. *Aquaculture research* 47(6), 1727-1736 (2014)
- [2] Roussel S. et al., *Aquaculture Environment Interactions* 11, 129-142 (2019)
- [3] Prince. *The quarterly review of biology* 59(1), 1-32 (1984)



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