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Mitigating shell-boring spionid polychaetes infestation in Pacific oysters (*Magallana gigas*) using osmotic treatments for enhanced reproductive conditioning in recirculation aquaculture systems

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Key Words: Condition Index, Mud blisters, Pacific Oyster, osmotic shocks, recirculating aquaculture systems

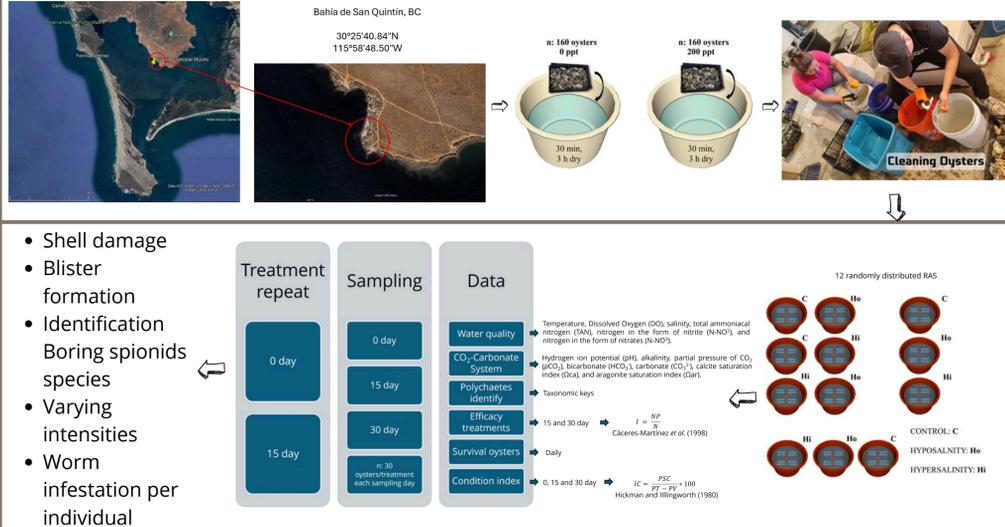
INTRODUCTION

Oyster farming is the most important economic activity in northwestern Mexico; however, its expansion is constrained by spat shortages and seasonal production cycles. To overcome these limitations, Recirculating Aquaculture Systems (RAS) are utilized to maintain precise control over water quality, the CO₂-carbonate system, and nutrition. This controlled environment facilitates broodstock conditioning, inducing maturation and synchronized gametogenesis outside natural breeding seasons, thereby ensuring a stable, year-round supply of high-quality larvae. Despite these technical advantages, RAS remain vulnerable to infestations by shell-boring spionid polychaetes. These parasites are highly adaptable and known for colonizing calcareous hosts, including abalone, clams, and Pacific oysters (Blake & Ruff, 2007). Often introduced through initial handling errors or a lack of standardized protocols, these infestations induce chronic physiological stress. As a result, the host redirects metabolic energy from gonadal development toward shell and tissue repair, leading to the formation of 'mud blisters' compromising reproductive success. Given that treatment protocols—especially for open farming—are still in the early stages of development (Spencer et al., 2021), controlling polychaetes remains a persistent challenge. Consequently, this study evaluates the efficacy of hyper- and hyposaline treatments in eliminating these parasites, identifies the specific species involved, and assesses the impact of such treatments on the physiological condition of oysters, RAS performance, and their culture in these systems.

OBJECTIVE

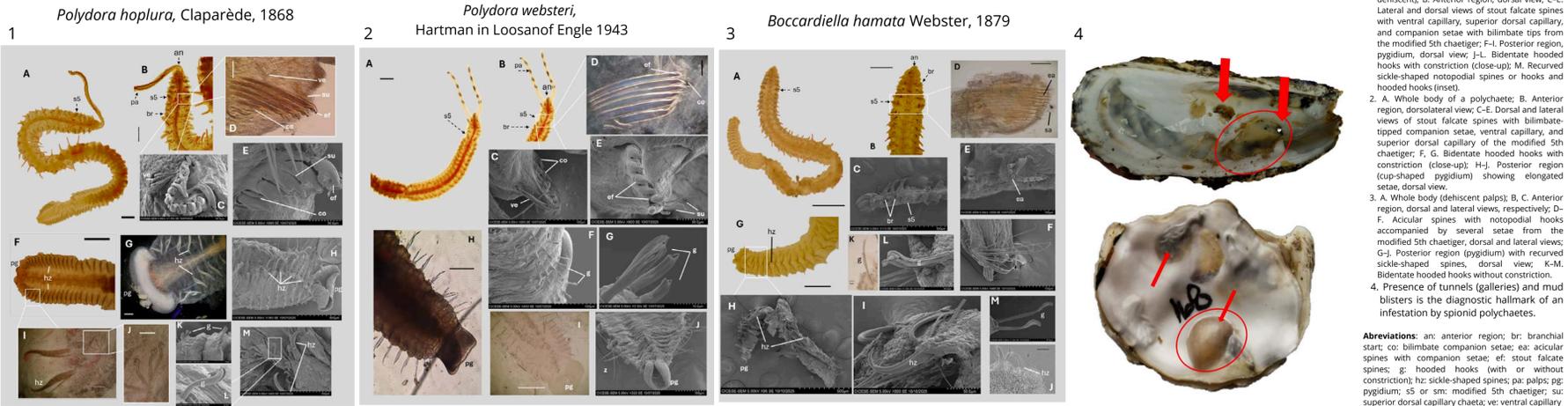
Identify the polychaetes species infesting Pacific oysters in Bahía Falsa, B. C., Mexico, and evaluate salinity-based control as a sustainable mitigation strategy, assessing its impact on oyster condition while ensuring that RAS performance remains unaffected.

METHODOLOGY



RESULTS

Identification polychaetes



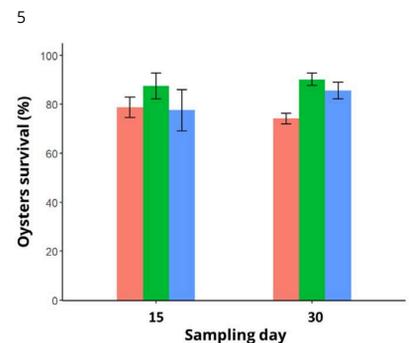
Water quality and survival

Table 1. Water quality during the 30-day trial of Pacific oyster (*M. gigas*) kept in RAS. Mean ± Standard Deviation (SD) of Temperature, Dissolved Oxygen (DO), salinity, Total ammonia-nitrogen (TAN), nitrite nitrogen (N-NO₂), nitrate nitrogen (N-NO₃).

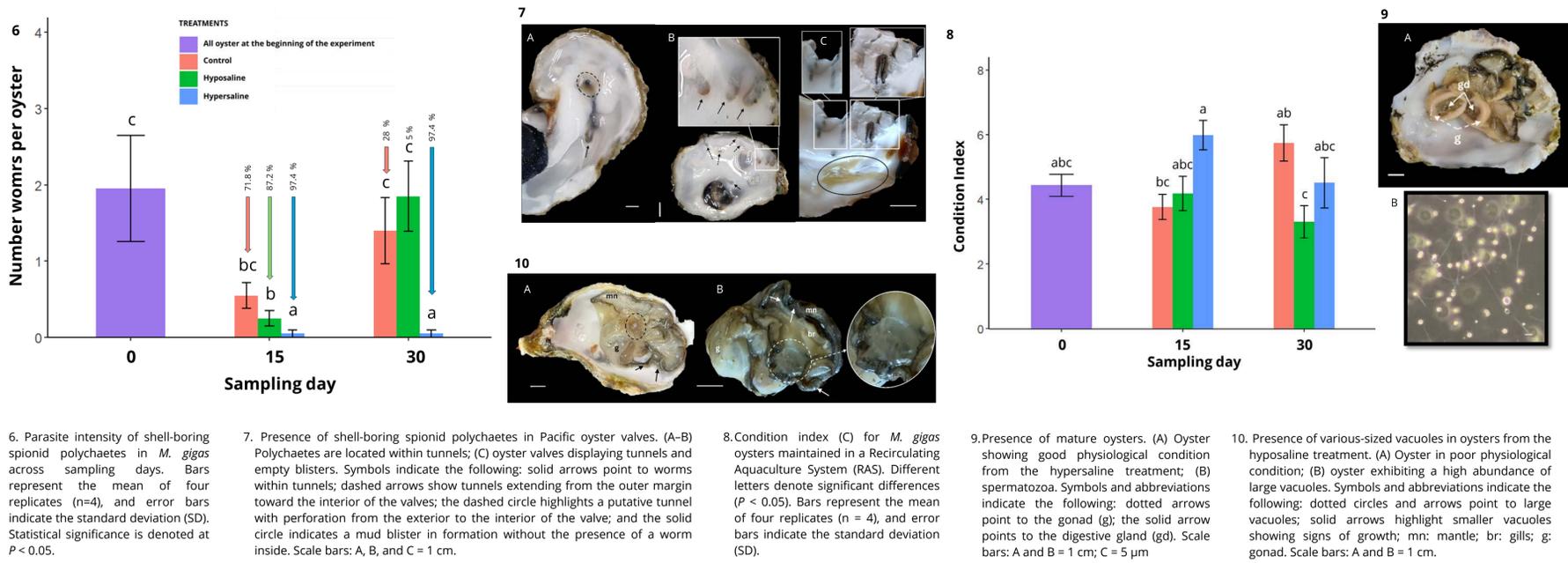
Parameter	Treatments		
	Control	Hyposaline	Hypersaline
Temperature (°C)	22.17 ± 0.88	21.97 ± 0.65	21.92 ± 0.57
OD (mg/L)	5.87 ± 0.34	6.02 ± 0.26	6.02 ± 0.25
Salinity (ppt)	35.46 ± 0.28	35.46 ± 0.18	35.48 ± 0.17
TAN (mg/L)	0.08 ± 0.1	0.08 ± 0.1	0.09 ± 0.14
N-NO ₂ (mg/L)	0.2 ± 0.21	0.19 ± 0.19	0.2 ± 0.29
N-NO ₃ (mg/L)	7.78 ± 4.97	7.56 ± 4.9	7.63 ± 4.73

Table 2. CO₂-Carbonate dynamics factors during the 30-day trial of Pacific oyster (*M. gigas*) kept in RAS. Mean ± Standard Deviation (SD) of hydrogen ion potential (pH), alkalinity, partial pressure of CO₂ (pCO₂), bicarbonate (HCO₃⁻), carbonate (CO₃²⁻), calcite saturation index (Ω_{ca}), and aragonite saturation index (Ω_{ar}).

Parameter	Treatments		
	Control	Hyposaline	Hypersaline
pH	8.05 ± 0.09	8.04 ± 0.08	8.05 ± 0.09
Alkalinity (mg/L)	137.03 ± 20.52	137.66 ± 21.29	138.28 ± 19.72
pCO ₂ (µatm)	707.36 ± 223.49	722.97 ± 214.16	712.14 ± 234.31
HCO ₃ ⁻ (µmol/kgSW)	2237.36 ± 331.61	2258.68 ± 351.98	2259.84 ± 328.89
CO ₃ ²⁻ (µmol/kgSW)	180.11 ± 46.89	176.33 ± 43.45	181.02 ± 45.41
Ω _{ca}	3.97 ± 1.03	3.89 ± 0.96	3.99 ± 1
Ω _{ar}	2.74 ± 0.71	2.68 ± 0.66	2.75 ± 0.69



Efficacy polychaete elimination and oysters physiological impact



CONCLUSIONS AND RECOMMENDATIONS

- The RAS for *M. gigas* successfully maintained optimal water quality and carbonate-CO₂ chemistry, keeping all parameters within the established ranges for *M. gigas*.
- Three species of shell-boring spionid polychaetes—two invasive and one native—were identified in association with *M. gigas* from Bahía Falsa, San Quintín, Baja California: *Polydora hoplura*, *P. websteri*, and *Boccardiella hamata*. Notably, the predominant species in the infestation was *P. hoplura*, which represents the first record in Mexico.
- The hypersaline treatment proved most effective, achieving a removal efficiency of 97%. Furthermore, this treatment successfully maintains and enhances the condition index, facilitating sexual maturation during the experiment.
- Future research should incorporate molecular tools and genetic stress analysis to validate hyper-salinity treatment effectiveness and assess potential sub-lethal effects on the Pacific oyster.

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