

From the hatchery to the sea: Optimising transportation methods for South African abalone (*Haliotis midae*) larvae

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South Africa

Abalone aquaculture in South Africa

- Initiated in early 1990's
- Currently 14 farms with the majority of them situated in the Western Cape.
- All operate on-land using pump ashore where (the majority) utilise flow-through systems
- South Africa has serious energy stability issues, solutions of which are expensive and bureaucratically difficult to implement
- The Covid-19 pandemic highlighted the need for farms to have contingency plans when stock can't be held/sold
- Local wild abalone resource is under tremendous pressure



Ranching: An alternative to on-land farming

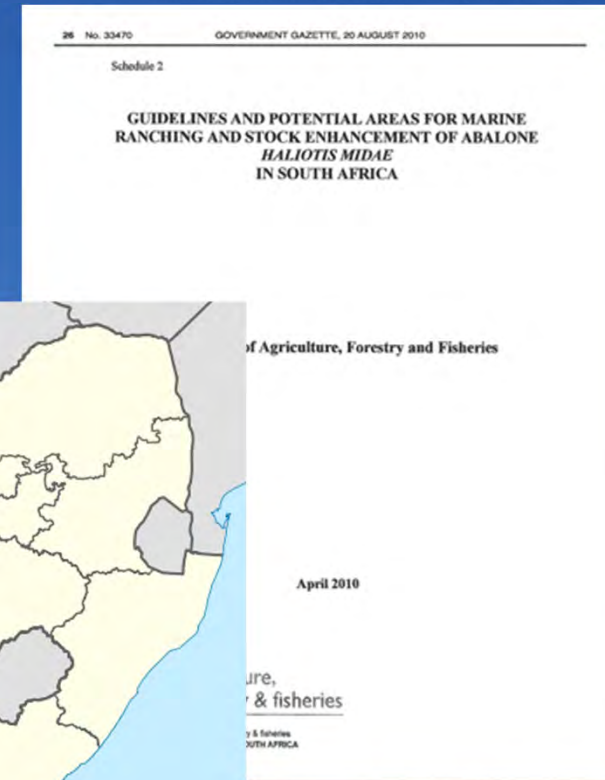
The mass release of hatchery-produced individuals at specific sites in the wild with the intention of subsequently harvesting them.

- Stock enhancement



Abalone ranching in South Africa

- Ranching guidelines published thirteen years ago
- Ten ranching concession areas
 - 4 in the Northern Cape (175 km)
 - 3 in the Western Cape (26 km)
 - 3 in the Eastern Cape (130 km)
- Four sites have been seeded



Abalone ranching in South Africa

- Currently, all seeding involves the release of juveniles
- Logistics of accessing suitable seeding areas



Seeding with larvae

- Cost
- Access to seeding sites
- Community projects
- Transporting larvae between hatcheries/farms



Aim

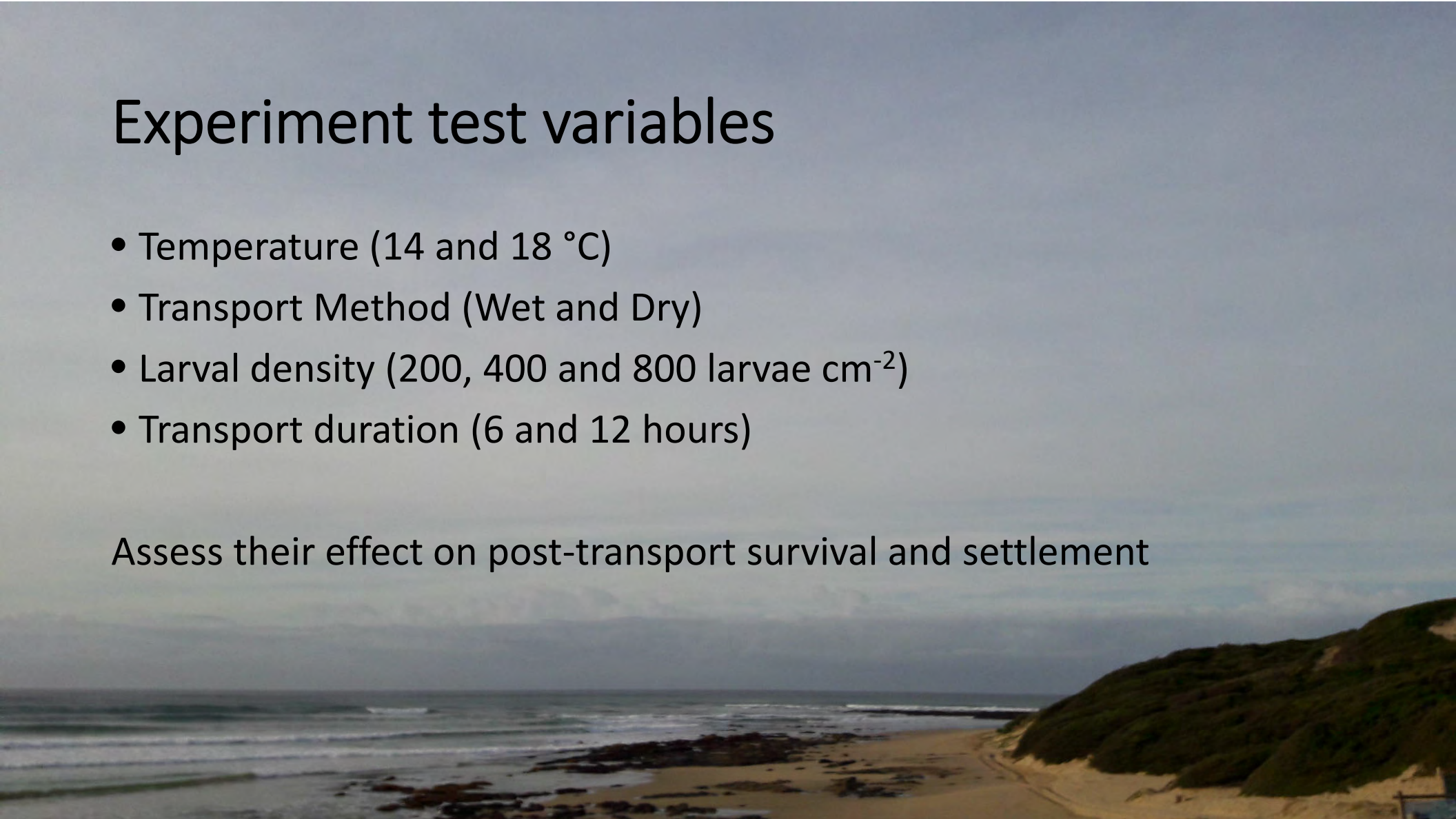
The aim of this research was to develop an economically practical transport method for *H. midae* larvae that minimises mortalities and stresses that might compromise settlement.



Experiment test variables

- Temperature (14 and 18 °C)
- Transport Method (Wet and Dry)
- Larval density (200, 400 and 800 larvae cm⁻²)
- Transport duration (6 and 12 hours)

Assess their effect on post-transport survival and settlement



Materials & methods

Abalone larvae spawned and reared at 18 °C at Wild Coast Abalone (Pty) Ltd

6 DAH larvae used for the experiments

Two Multifactorial experiments

- i. Temperature and transport method
 - ii. Larval density and transport period
- Control – not subjected to transport stress
 - Six replicates for each treatment
 - Post-transport transfer into 18 °C flowthrough system with diatom coated sheets
 - Sheets checked and photographed every 20 hours to quantify settlement
 - Samples of water taken to check for free-swimming larvae



Experiment 1 - Temperature & Transport method

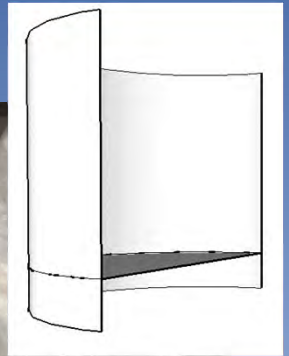
Temperature

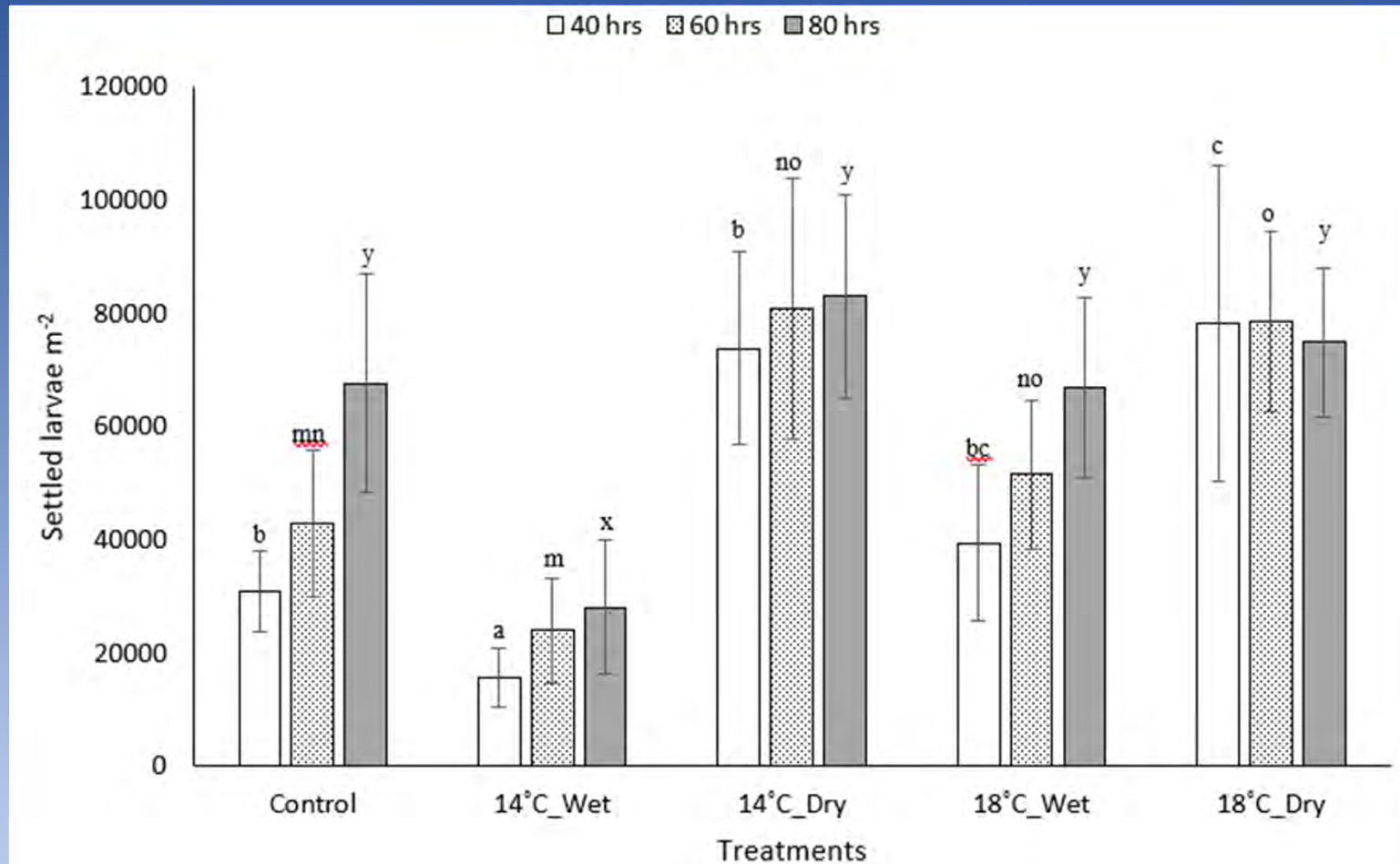
- 14 & 18 °C

Transport method

- Wet - 50 larvae mL⁻¹ in 25 L sealable buckets
- Dry – 200 larvae.cm⁻² in air-filled 30 L polyethene plastic bags packed into polystyrene boxes

Simulated 6-hour transport





Mean \pm SD of abalone (*Haliotis midae*) larvae settled m^{-2} over 80 h after being exposed to two transport temperatures (14 °C vs 18 °C) and two packaging methods (Dry vs Wet). Different superscripts (a-c, m-o, x-y) indicate significant differences within each time interval across all treatments ($p < 0.05$).

Experiment 2 – Stocking density & Transport period

Temperature: 18 °C

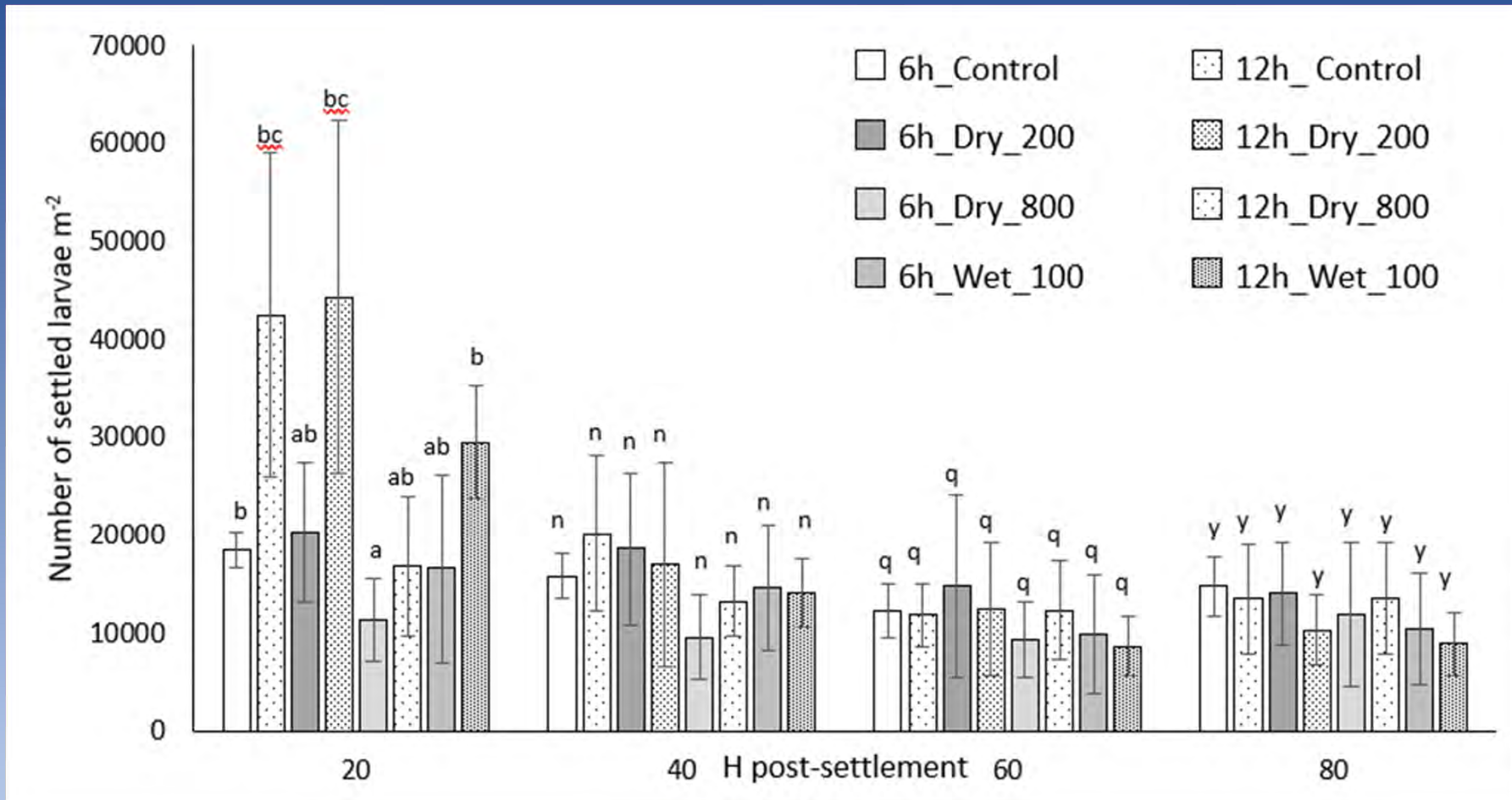
Stocking density

- Dry: 200, 400 and 800 larvae cm⁻²
- Wet: 100 larvae mL⁻¹

Transport period

- 6 & 12 hours





Mean number of settled abalone (*Haliotis midae*) larvae m⁻² ±SD over 80 h post-exposure (transport simulation lasting 6 and 12 h) to Dry method (D1=200 larvae cm⁻², D2=800 larvae cm⁻²), Wet method (100 larvae mL⁻¹) and Control (C). Different superscripts above each treatment indicate significant differences among treatments within each sampling time (p < 0.05).



Discussion

- Safely decreasing then increasing the water temperature for transport and reacclimation before settlement, might be problematic. However, either temperature (14 & 18 °C) are suitable when using the Dry method.
- Larvae transported using the Dry method settled at 40 h while took 80 h when transported Wet.
 - Implications for ocean larval seeding

Discussion

Stocking densities up to 800 larvae cm^{-2} in the Dry method did not affect post-transport settlement.

There was no difference in the post-transport settlement between six and twelve hours

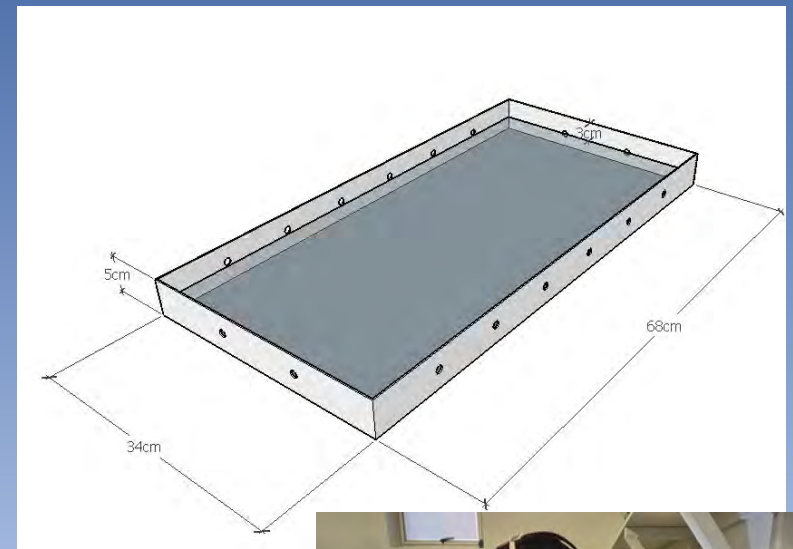


Optimisation of *Haliotis midae* larval transport requirements

Variable tested	Recommendation
Temperature	18 °C
Transport method	Dry
Stocking density	Up to 800 larvae cm ⁻² (using the Dry method)
Transport period	Up to 12 hours

Future research

- Design of Dry method system
- Quantify larval respiration rates in Wet and Dry methods to then help model stocking density range.
- Investigate the addition of settlement cues (i.e. GABA) to Dry method (either when packed or immediately prior to release)
- Assessment of stress/resilience of settled larvae using molecular techniques.



Acknowledgments



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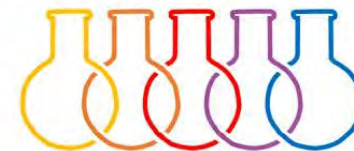


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