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

Sharone Bajaba & Niall Vine

Fort Hare Aquaculture Research Unit (FHARU)

University of Fort Hare
Together in Excellence
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 Multifactoral 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 ± 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

<table>
<thead>
<tr>
<th>Variable tested</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>18 °C</td>
</tr>
<tr>
<td>Transport method</td>
<td>Dry</td>
</tr>
<tr>
<td>Stocking density</td>
<td>Up to 800 larvae cm(^{-2}) (using the Dry method)</td>
</tr>
<tr>
<td>Transport period</td>
<td>Up to 12 hours</td>
</tr>
</tbody>
</table>
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