Evaluating the impact of scallop (Argopecten purpuratus) cultivation on the benthic infaunal community in Sechura Bay, Peru

Presented by
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2nd Supervisor: Marc Taylor
Outline

1. Introduction
2. Objectives
3. Material & Methods
4. Results
5. Conclusion
Ecological Relevance

- Organic enrichment
  - Aerobic
  - Oxygen depletion
    - Hypoxic or anoxic
    - Anaerobic
    - Hydrogen sulfide production
      - Toxic
  - Change of community
    - "Peak of opportunists"
Evaluate impact of scallop cultivation on benthic infaunal community
Research Questions

1. Does the **benthic infaunal community** differ between areas with and without prolonged scallop cultivation?
   
   a. If there is a difference, can it be described by **certain species**?
   
   b. What is the **indication of these species** regarding the environmental state of the respective area?

4. Do **certain environmental features** distinguish the two areas?

5. If there are biotic and abiotic disparities between areas, can they be **related to scallop cultivation**?
Experimental Setup (I)

March 2014
10 m depth

Sechura Bay
Lot

Peru

Introduction  Objectives  Material & Methods  Results  Conclusion
Experimental Setup (II)

Control (C)
9 sampled plots

Treatment (T)
9 sampled plots
## Result 1: Diversity Indices

<table>
<thead>
<tr>
<th></th>
<th>Treatment</th>
<th></th>
<th>Control</th>
<th></th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Species Richness S</td>
<td>14.11  ± 4.17</td>
<td>10.33 ± 3.28</td>
<td>0.3401</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shannon-Wiener Diversity H</td>
<td>1.86 ± 0.35</td>
<td>1.69 ± 0.33</td>
<td>0.0625</td>
<td>0.7962</td>
<td></td>
</tr>
<tr>
<td>Pielou’s Evenness J</td>
<td>0.71 ± 0.09</td>
<td>0.74 ± 0.12</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No significant differences of diversity indices between areas.

Shannon-Wiener Diversity lower compared to previous studies.
Both areas are similar in their dominant groups. Lancelets (Leptocardii) contribute great share of biomass.
More of the larger lancelets found in control area.
Result 3: Infaunal Communities

Benthic infaunal communities differ significantly between control and treatment area.

\[ p = 0.0426 \]
Result 4.1: Characteristic Organisms

- **Nephtys sp.**
- **Glycine sp. 1**
- **Capitellidae 1**
- **Tharyx sp.**
- **Urothoidae**
- **Phoxocephalidae**
- **Branchiostomatidae**

**Stress = 0.182**
Result 4.2: Features of these Organisms

**Treatment**

- **Capitellidae**
  - detritus feeder

- **Tharyx sp.**
  - detritus feeder

- **Urothoidae**
  - fine sand as habitat

- **Phoxocephalidae**
  - fine sand as habitat

**Control**

- **Nephtys sp.**
  - motile carnivore

- **Glycimde sp. 1**
  - motile carnivore

- **Lancelets**
  - small individuals → fine sediment
  - large individuals → coarse sediment
Result 5: Community Disturbance

With Lancelets

Treatment: intermediately disturbed
Control: undisturbed
**Result 6: Features of Bottom Water Mass**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth [m]</td>
<td>10.2</td>
<td>± 0.43</td>
<td>9.27</td>
<td>11.1</td>
</tr>
<tr>
<td>Temperature [°C]</td>
<td>17.2</td>
<td>± 1.68</td>
<td>15.7</td>
<td>20.9</td>
</tr>
<tr>
<td>Salinity [pss]</td>
<td>35.1</td>
<td>± 0.17</td>
<td>32.7</td>
<td>35.2</td>
</tr>
<tr>
<td>Dissolved Oxygen [mg/l]</td>
<td>2.18</td>
<td>± 1.32</td>
<td>0.24</td>
<td>5.37</td>
</tr>
</tbody>
</table>

Bottom water mass is characterized by low levels of dissolved oxygen.
<table>
<thead>
<tr>
<th></th>
<th>Treatment</th>
<th>Control</th>
<th>p – value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>A. purpuratus abundance [ind./m²]</td>
<td>25.33 ± 11.02</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C. flagelliformis biomass [kg/m²]</td>
<td>0.58 ± 0.34</td>
<td>1.23 ± 0.72</td>
<td></td>
</tr>
</tbody>
</table>

No scallops found in control area.

Biomass of macroalgae significantly higher in control area.
<table>
<thead>
<tr>
<th></th>
<th>Treatment</th>
<th>Control</th>
<th>p – value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Total Nitrogen [%]</td>
<td>0.030</td>
<td>± 0.008</td>
<td>0.031</td>
</tr>
<tr>
<td>Total Organic Carbon [%]</td>
<td>0.23</td>
<td>± 0.05</td>
<td>0.25</td>
</tr>
<tr>
<td>Total Inorganic Carbon [%]</td>
<td>28.13</td>
<td>± 11.27</td>
<td>41.06</td>
</tr>
</tbody>
</table>

No significant differences of TN, TOC and TIC between areas.

No enrichment of nitrogen or organic carbon.

Both areas are carbonate-rich.
### Result 9: Sediment Fractions

<table>
<thead>
<tr>
<th></th>
<th>Treatment</th>
<th>Control</th>
<th>p – value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Gravel [%]</td>
<td>16.15 ± 13.13</td>
<td>8.07 ± 4.15</td>
<td>0.0188</td>
</tr>
<tr>
<td>Coarse Sand [%]</td>
<td>21.03 ± 16.60</td>
<td>52.36 ± 17.02</td>
<td>0.0028</td>
</tr>
<tr>
<td>Medium Sand [%]</td>
<td>25.11 ± 10.65</td>
<td>23.92 ± 12.17</td>
<td>0.6665</td>
</tr>
<tr>
<td>Fine Sand [%]</td>
<td>32.81 ± 15.71</td>
<td>13.98 ± 7.17</td>
<td>0.0040</td>
</tr>
<tr>
<td>Silt &amp; Clay [%]</td>
<td>4.87 ± 2.93</td>
<td>1.64 ± 1.33</td>
<td>0.0216</td>
</tr>
</tbody>
</table>

Share of coarse sand significantly higher in the control area.

Share of gravel, fine sand, and silt & clay are significantly higher in the treatment area.
Result 10.1: Environmental Characteristics

Introduction

Objectives

Material & Methods

Results

Conclusion

- Coarse sand
- TIC
- Biomass of macroalgae

- Silt & clay
- Fine sand
- Abundance of scallops
### Result 10.2: Environmental Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. purpuratus Abundance</strong></td>
<td>0.233</td>
<td>0.383</td>
<td>-0.299</td>
</tr>
<tr>
<td><strong>C. flagelliformis Biomass</strong></td>
<td>-0.262</td>
<td><strong>0.61</strong></td>
<td></td>
</tr>
<tr>
<td>Gravel</td>
<td>0.352</td>
<td>-0.283</td>
<td></td>
</tr>
<tr>
<td>Coarse Sand</td>
<td>-0.461</td>
<td>-0.153</td>
<td></td>
</tr>
<tr>
<td>Medium Sand</td>
<td>0.364</td>
<td>-0.232</td>
<td>0.26</td>
</tr>
<tr>
<td>Fine Sand</td>
<td><strong>0.439</strong></td>
<td>0.156</td>
<td></td>
</tr>
<tr>
<td>Silt &amp; Clay</td>
<td>0.193</td>
<td><strong>0.511</strong></td>
<td>0.264</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>-0.272</td>
<td><strong>0.403</strong></td>
<td><strong>0.375</strong></td>
</tr>
<tr>
<td>Total Organic Carbon</td>
<td>-0.296</td>
<td>0.368</td>
<td><strong>0.372</strong></td>
</tr>
<tr>
<td>Total Inorganic Carbon</td>
<td><strong>-0.451</strong></td>
<td></td>
<td>-0.19</td>
</tr>
</tbody>
</table>

**Proportion of Variance Explained**

- Component 1: 0.4126
- Component 2: 0.2574
- Component 3: 0.1697

**Cumulative Proportion**

- Component 1: 0.4126
- Component 2: 0.6700
- Component 3: 0.8397
Conclusion (I)

Habitat

- Sandy
- Carbonate-rich
- Little nitrogen
- Little organic matter
- Little dissolved oxygen

Introduction  Objectives  Material & Methods  Results  Conclusion
Indications for higher organic input in treatment area.
Conclusion

scallop cultivation influences sediment characteristics

change in infaunal community

BUT

no signs of a severely disturbed environment

only slight impact of scallop cultivation on benthic infaunal community
Thank you for your attention!