Role of the engineering species Laminaria digitata on the associated algal diversity

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Protecting biodiversity has become an essential issue...

But what to protect?

One solution: protecting species having essential influences on other species

- Umbrella species
- Keystone species
- Indicator species
- Engineering species
Marine ecosystems structured by engineering species
Introduction

What do engineering species do? (Badano et al., 2006, OIKOS)

- Facilitate recruitment of other species
- Stabilize the community composition overtime
- Increase species diversity

**OBJECTIVE:**
Study of these different putative roles with the model *Laminaria digitata*
Experimental design

**Aim**

Compare the behaviour of macroalgae communities after a perturbation in zones containing *Laminaria digitata* with zones without *Laminaria digitata*.

**Methodology**

1. Eradication of all macroalgae on the rock
2. Transplantation of juvenile *L. digitata*

- scraper or similar
- scraper + wire brush + burning
- scraper + wire brush + burning + transplanted
- no eradication
Regarding species diversity: «transplanted» versus «burnt»

- If *L. digitata* facilitates the recruitment of other species, recruitment faster in «transplanted»
- If *L. digitata* stabilizes the community composition overtime, species composition more stable in «transplanted»
- If *L. digitata* increases species diversity, species richness higher in «transplanted»

Comparison of genetic diversity between scrapped and burnt quadrats

Study of Lucía Couceiro
Schedule of the experiment

- Total duration: 24 months
- Sampling 2, 6, 12, 18 and 24 months after the eradication of all macroalgae inside the quadrats. At very low tide only!
- 3 replicates * 4 treatments * 5 sampling times = 60 quadrats
Equinox tide of March 2011

1. Positioning quadrats, regularly every 5m
Beginning of the experiment: T0

- Equinox tide of March 2011

1. Positioning quadrats, every 5m (N=60)
2. Control quadrats (N=15)
3. Remaining (N=45) >>> hand-clearing
Beginning of the experiment: T0

Equinox tide of March 2011

1. Positioning quadrats, every 5m (N=60)
2. Control quadrats (N=15)
3. Remaining (N=45) >>> hand-clearing
4. Hand-cleared quadrats (N=15)
5. Remaining (N=30) >>> sterilizing
Beginning of the experiment: T0
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Equinoxe tide of March 2011

1. Positioning quadrats, every 5m (N=60)
2. Control quadrats (N=15)
3. Remaining (N=45) >>> hand-clearing
4. Hand-cleared quadrats (N=15)
5. Remaining (N=30) >>> sterilizing
6. Sterilized quadrats (N=30)
7. Remaining (N=15) >>> Ld transplants
Beginning of the experiment: T0

Preparing transplants in the lab
Beginning of the experiment: T0

Equinoxe tide of March 2011

1. Positioning quadrats, every 5m (N=60)
2. Control quadrats (N=15)
3. Remaining (N=45) >>> hand-clearing
4. Hand-cleared quadrats (N=15)
5. Remaining (N=30) >>> sterilizing
6. Sterilized quadrats (N=30)
7. Remaining (N=15) >>> Ld transplants
8. Ld quadrats
9. Eradicating Ld around quadrats
Beginning of the experiment: T0

A = scrapped
B = burnt
C = transplanted
D = control
First sampling: T1

Done in May 2011 (2 months after perturbation)

Sampling the quadrats

- A1- A3
- B1- B3
- C1- C3
- D1- D3

For each quadrat

- identification of all the species
- biomass of the five most abundant species
Second sampling: T2

Done in August 2011 (6 months after perturbation)

Sampling the quadrats
- A4- A6
- B4- B6
- C4- C6
- D4- D6

For each quadrat
- identification of all the species
- biomass of the five most abundant species
First results: treatments distribution at T0

- MDS based on species presence/absence at T0
- PERMANOVA with the factor treatment: p = 0.5002
- Conclusion: treatments are randomly distributed at T0

Resemblance: S17 Bray Curtis similarity

Treatment
▲ B
▼ C

2D Stress: 0.23
First results: recovery at T1

- PERMANOVA based on species biomass of the five most abundant species with the factors « treatment » and « time »

  - Main test

    | Factor     | P (perm) |
    |------------|----------|
    | Treatment  | 0.0004   |
    | Time       | 0.0005   |
    | Tr*Ti      | 0.79     |

  - Pairwise test of the term « treatment »

    | Groups                | P (perm) |
    |-----------------------|----------|
    | Burnt, transplanted   | 0.1684   |
    | Burnt, control        | 0.0015   |
    | Transplanted, control | 0.0155   |

- Conclusion: Neither transplanted nor burnt quadrats have recovered at T1
**First results: recovery at T2**

- PERMANOVA based on species biomass of the five most abundant species with the factors « treatment » and « time »
  - **Main test**
    - | Factor     | P (perm) |
      |-----------|----------|
      | Treatment | 0.0126   |
      | Time      | 0.0017   |
      | Tr*Ti     | 0.5314   |
  - **Pairwise test of the term « treatment »**
    - | Groups              | P (perm) |
      |---------------------|----------|
      | Burnt, transplanted | 0.0690   |
      | Burnt, control      | 0.0101   |
      | Transplanted, control | 0.0712 |

**Conclusion:** Transplanted quadrats have recovered at T2 but not burnt quadrats
First results: species richness

Mean species richness (S) ± standard deviation

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burnt</td>
<td>23,33± 4,73</td>
<td>23,00± 6,24</td>
</tr>
<tr>
<td>Transplanted</td>
<td>14,67± 4,16</td>
<td>23,00± 3,61</td>
</tr>
<tr>
<td>Control</td>
<td>30,00± 1,00</td>
<td>27,33± 1,15</td>
</tr>
</tbody>
</table>

- at T1 « burnt » are richer than « transplanted »
- at T2: no more difference

Variance of species richness (V) between T1 and T2

<table>
<thead>
<tr>
<th></th>
<th>Burnt</th>
<th>Transplanted</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0,06</td>
<td>34,72</td>
<td>3,56</td>
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</table>

Conclusions: until T2, transplanted quadrats are not the richest and vary more than the other types of quadrats
Conclusion

Until T2, our results suggest

<table>
<thead>
<tr>
<th>L.digitata facilitates the recruitment of other species</th>
<th>YES</th>
</tr>
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<tbody>
<tr>
<td>L.digitata stabilizes the community composition overtime</td>
<td>NOT UNTIL T2</td>
</tr>
<tr>
<td>L.digitata increases species diversity</td>
<td>NOT UNTIL T2</td>
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Several explanations

- Facilitation VS competition
- Time
- Number of replicates

To be continued...
Acknowledgments

- My project partner: Lucía Couceiro

- My advisors: Line Le Gall (MNHN Paris) and Myriam Valero (Station biologique de Roscoff)

- People helping me in the field: Aliou Dia, Christophe Destombe, Alexandre Geoffroy, Daphné Grulois, Stacy Krueger-Hadfield, Catherine Leblanc, Fiona Lerck, Laurent Lévêque, Stéphane Mauger, Viviana Peña, Akira Peters, Denis Roze, Yaëlle Salaun, Wylfried Thomas...

- Fundings

- You for attending!