Cod and sole behaviour in an offshore wind farm

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Response of fish to offshore wind farms

During the operational phase

- Potential adverse effects:
  - underwater sound
  - disturbance by activities

- Potential beneficial effects (in degraded ecosystems):
  - new habitats (‘artificial reefs’)
  - management measures (‘area closed for fisheries’)
Fish species selected for this study

Sole (*Solea vulgaris*)     Atlantic cod (*Gadus morhua*)
Mark-recapture experiment sole

If residence time of sole in wind farm is high then tag rate return from fisheries will be lower for OWEZ than REFZ groups

Oktober 2007: REFZ 150, OWEZ 150 sole tagged
June 2008: REFZ 400, OWEZ 400 sole tagged
Mark-recapture experiment sole

Both batches combined

<table>
<thead>
<tr>
<th></th>
<th>OWEZ</th>
<th>Reference</th>
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<tbody>
<tr>
<td>recaptured</td>
<td>60</td>
<td>74</td>
</tr>
<tr>
<td>not recaptured</td>
<td>490</td>
<td>476</td>
</tr>
<tr>
<td>totals</td>
<td>550</td>
<td>550</td>
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</tbody>
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Observed $G = 1.67$, William's correction $= 1.00$, p-value $= 0.20$
Mark-recapture experiment sole

Both batches combined
recaptured 60 74 134 Observed G= 1.67
not recaptured 490 476 966 William's correction= 1.00
totals 550 550 1100 p-value= 0.20
Mark-recapture experiment sole

- OWEZ October 2007
- REF October 2007
- OWEZ June 2008
- REF June 2008

- OWEZ June 2007
- OWEZ August 2008 (telemetry)

- Cormorant Colony (9)
- Offshore Wind farm Egmond aan Zee
Telemetric experimental set-up

Monopile (WT nr)

Detection station

Site for release of sole

Cod, catch release Sep 2008

Cod, catch release Jan 2009
Building the receiver network

Suction anchor with receiver
Rvs steel line
Anchored to J-tube
Sole using wind farm as habitat
Sole using wind farm as habitat

- Extreme site fidelity
- Attraction (‘pole-hopping’)
- Random movement within OWEZ

Graph showing detection rate during time at-large (%) against recorded time at-large per fish, from first to last record (days).
Coloured symbols for monopiles with a receiver, black dots for monopiles without a receiver

† Recaptured by fisheries outside the wind farm
Cod using wind farm as habitat
Cod using wind farm as habitat

**Extreme site fidelity**

**Attraction ('pole-hopping')**

**Random movement within OWEZ**

![Graph showing detection rate during time at-large for cod near wind farms.](image-url)
Individual diurnal patterns

Cod 51312, 38 cm: WT 20, 29, 19, 36, 21, 30, 24, 3

Hour

00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00
Preference for monopiles that are out of order?

Explorative analysis on cod telemetry dataset yields no indications for this occurring (no significant difference in monopile use)
Conclusions

- Sole appeared indifferent to wind farm
  - Individual movement patterns → larger scale than OWEZ

- Cod → high individual variation in wind farm use
  - Part of the cod showed strong attraction/side fidelity
  - Seasonal changes in habitat use (shelter/feeding?)
  - No preference for monopiles that were out of operation

- For cod, OWEZ might have a beneficiary effect
Acknowledgements ...  

... and thank you for your attention!

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End