Abundance of the Common dolphin (*Delphinus delphis*) in the north of the Iberian Peninsula.

**Camilo Saavedra**, Tim Gerrodette, Maite Louzao, Julio Valeiras, Salvador García, José Luis Murcia, Santiago Cerviño, Graham J. Pierce, M. Begoña Santos

**PELACUS Surveys**
PELACUS survey

- April: A pelagic acoustic survey is carried out by the Spanish Institute of Oceanography (IEO) in the northern shelf of the Iberian Peninsula.
- Duration: 1 month between March and April.
- Main objective: to provide abundance estimates of pelagic species (sardine, anchovy, mackerel, blue whiting, etc.)
- Scanning parallel transects (perpendicular to the coast) with an echosounder.
- Fishing stations with a pelagic trawl (estimate length and species composition).
- Oceanographic stations during the night (CTD, Bongo net).
PELACUS observers team

• Team of three observers of top predators since 2007

• Distance Sampling methodology:
  - Searching effort: Line-transects during the acoustic scanning (passing mode)
  - Search and record marine mammals, seabirds and others (fish, boats, floating debris, etc.)
  - 2 observers on-duty searching with naked eyes (7x50 binoculars used only for species identification)
PELACUS methodology

• Environmental conditions (each transect)
  – Oceanographic conditions (Beaufort, wind, swell, etc.)
  – Search conditions (visibility, sun glare, etc.)

• Distance sampling data
  – Distance to the sighting (stick method)
  – Angle (angleboard)
  – Group size (best estimate)
  – Behaviour (e.g. ATTRACTION)
## Sightings summary

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Small cetaceans</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common dolphin</td>
<td>12</td>
<td>18</td>
<td>17</td>
<td>27</td>
<td>17</td>
<td>20</td>
<td>22</td>
<td>25</td>
<td>158</td>
</tr>
<tr>
<td>Striped dolphin</td>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>2</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Bottlenose dolphin</td>
<td>10</td>
<td>13</td>
<td>8</td>
<td>11</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>21</td>
<td>75</td>
</tr>
<tr>
<td>Long-finned pilot whale</td>
<td>6</td>
<td>10</td>
<td>17</td>
<td>9</td>
<td>1</td>
<td>7</td>
<td>26</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>Risso's dolphin</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Harbour porpoise</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Unidentified dolphin</td>
<td>5</td>
<td>2</td>
<td>12</td>
<td>4</td>
<td>2</td>
<td></td>
<td>3</td>
<td>8</td>
<td>36</td>
</tr>
<tr>
<td><strong>Big whales</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minke whale</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Fin whale</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Sperm whale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>False killer whale</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Beaked whale1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Beaked whale2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Baleen whale</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Cetacean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td><strong>Turtles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leatherback turtle</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Bone fish</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sun fish</td>
<td>15</td>
<td>14</td>
<td>5</td>
<td>2</td>
<td>12</td>
<td>25</td>
<td>15</td>
<td>13</td>
<td>101</td>
</tr>
<tr>
<td><strong>Sharks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue shark</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
Distance sampling

Density (ER, GS, DF)

\[ \hat{D} = \frac{n \cdot \bar{D}(\alpha)}{c \cdot a \cdot \tilde{p} \cdot \tilde{g}} \]

Abundance (D, A)

Detection function (DF)
- Perpendicular distance
- Other covariates
  - Beaufort (sea state)
  - Group size
  - Swell
  - Visibility
  - Sun glare
  ...

Group size (GS)
Estimated number of animals

Encounter rate (ER) = number of sightings

SA = Strip Width x Line length

Truncation

pd

ld

\( \alpha \)
Attraction (I)

- **Distance Sampling methodology** assumes that animals do not respond to the searching platform (neither attraction nor avoidance movements)

- **Common dolphin** → High attraction rate → Overestimate abundance

**SCANS-II**

- Only absolute abundance estimate on the shelf
- Atlantic waters of the Iberian Peninsula
- Common dolphin abundance estimates
  - Conventional analysis (no attract. correction)
  - Mark and recapture (double platform)
Attraction (II)

SCANS-II correction factor (0.36):
- Mark recapture abundance estimate (corrected for attraction) is 36% of the abundance estimated with the conventional method

Recorded behaviour:
- Attraction
- No attraction

<table>
<thead>
<tr>
<th>Animal Type</th>
<th>Total</th>
<th>Attract</th>
<th>No attract</th>
<th>Prop. Attract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common dolphin</td>
<td>158</td>
<td>64</td>
<td>94</td>
<td>40.50%</td>
</tr>
<tr>
<td>Bottlenose dolphin</td>
<td>36</td>
<td>6</td>
<td>73</td>
<td>7.60%</td>
</tr>
<tr>
<td>Long-finned pilot whale</td>
<td>79</td>
<td>6</td>
<td>70</td>
<td>7.90%</td>
</tr>
</tbody>
</table>

We removed these observations assuming that those “attracted” dolphins should not have been seen:
- Some would have been sighted even if they had not approached the boat. They were already close to the track line. **Negative bias**?
- Some would have approached the boat (from far away) but not enough to have appreciated signs of attraction. **Positive bias**?
Distance sampling analysis

Bayesian approach
Tomoharu Eguchi and Tim Gerrodette, 2009

- Allows us to combine previous knowledge of data:
  - Attraction correction factor (SCANS)
  - Known distributions to some parameters (work with the scarcity and uncertainty of the data) -&gt; Small sample sizes

Half-normal Detection Function

- Truncation = 500 m
- Proportion within = 92%
- g(500) = 0.8
- Covariates = Beaufort + log(group size)
- DIC criteria
Results and comparison with SCANS-II

Our estimates

Mean abundance between 2007-14

<table>
<thead>
<tr>
<th></th>
<th>All sightings</th>
<th>SCANS correction</th>
<th>No attraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abundance (N)</td>
<td>6257 (0.07)</td>
<td>2255 (0.21)</td>
<td>2665 (0.08)</td>
</tr>
<tr>
<td>( \delta / \text{Km}^2 )</td>
<td>0.310 (0.07)</td>
<td>0.112 (0.21)</td>
<td>0.132 (0.08)</td>
</tr>
</tbody>
</table>

SCANS (rescaled)

Abundance in 2005

<table>
<thead>
<tr>
<th></th>
<th>SCANS-II conventional</th>
<th>SCANS-II mark-recapture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abundance (N)</td>
<td>7064 (0.25)</td>
<td>2597 (0.22)</td>
</tr>
<tr>
<td>( \delta / \text{Km}^2 )</td>
<td>0.352 (0.25)</td>
<td>0.129 (0.22)</td>
</tr>
</tbody>
</table>

Study Area = 20200 km²

6.9 times smaller

SCANS-II (BLOCK W) = 138600 km²
Annual abundance

Estimated abundance of Common dolphins:

- All sightings: $y = 934.57x + 2457.2$
- Only without attraction: $y = 336.7x + 885.71$
- SCANS correction: $y = 85.405x + 2288.9$

Graph shows the estimated abundance from 2007 to 2014.
Conclusions

• Non-dedicated surveys have some limitations. Good way to collect information that otherwise we would not get

• Using relative estimates we can analyse trends in the abundance (attraction correction methods affect)

• Absolute abundance estimates are roughly consistent with other studies (although do not cover the entire population)

• For absolute abundance need to improve the attraction correction method or data collection (double platform)
Acknowledgements to all observers who participated in the survey

Thank you for your attention!

Camilo Saavedra