



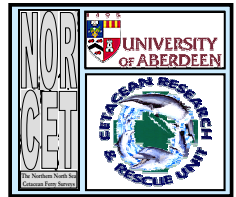
Variations in cetacean community composition and structure within the northern North Sea, UK

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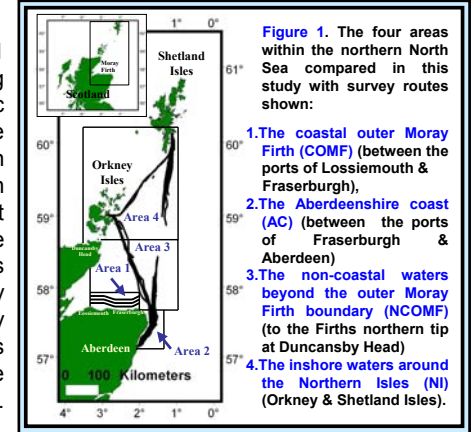
1. INTRODUCTION

A number of recent studies have examined local cetacean community composition and structure within the northern North Sea (e.g. Weir and Stockin, 2001; MacLeod *et al.* 2007; Robinson *et al.*, 2007). However, little work has been conducted on how and why these communities vary despite their close proximity.

This study compared the composition and structure of cetacean communities in four neighbouring areas of the northern North Sea (Fig. 1) to examine how they vary and investigate why these variations may exist.

2. METHODS

Data were collected in the summer months between 2001 and 2006. The study area was divided into four neighbouring areas (Fig. 1) according to coarse scale oceanographic parameters such as average water depth, distance from the coast and the influence of Atlantic water entering the North Sea. Data were collected within the COMF by the Cetacean Research and Rescue Unit (CRRU) following regular transect surveys. Within areas AC, NCOMF and NI, data were collected by the Northern North Sea Cetacean Ferry Surveys (NORCET), following regular transects along fixed ferry routes between Aberdeen and the Northern Isles. Community composition and structure were assessed for surveyed areas of each region only (see Fig. 1) and compared using three measures: 1. Species Diversity; 2. Species Ranking; and 3. Proportion of sightings of each species within each area.



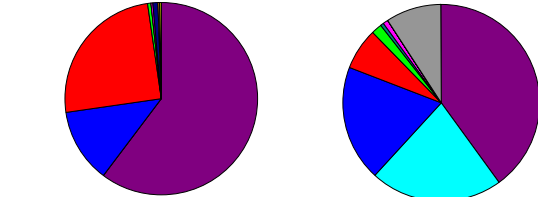
3. RESULTS

1. Species Diversity

Species diversity was measured in three ways: 1. Species richness; 2. The Shannon-Weaver diversity index; and 3. Species evenness.

The NI had the most diverse cetacean community in terms of all three measures, whilst the NCOMF had the least diverse cetacean community in terms of species richness and diversity index (Table 1 & Fig. 2). This may be because the NI has the most variable habitat thereby allowing a more complex community to co-exist, while the NCOMF has a more homogenous habitat which may only provide suitable habitat for a smaller number of species.

(1) Coastal Outer Moray Firth (COMF) (2) Aberdeenshire Coast (AC)



(3) Non-coastal Outer Moray Firth (NCOMF) (4) Northern Isles (NI)



Figure 2. Community composition in four neighbouring areas in the northern North Sea.

Harbour porpoise (HP) White-beaked dolphin (WBD) Bottlenose dolphin (BND) Minke whale (MW)
Risso's dolphin (RD) Common dolphin (CD) White-sided dolphin (WSD) Killer whale (KW)
Humpback whale (HW) Pilot whale (PW) Unidentified species

| Study Area | Species Richness | Diversity Index | Species Evenness |
|------------|------------------|-----------------|------------------|
| COMF | 8 | 1.032 | 0.496 |
| AC | 7 | 1.369 | 0.703 |
| NCOMF | 5 | 1.027 | 0.638 |
| NI | 9 | 1.565 | 0.712 |

Table 1. Species richness, diversity and evenness values for the four communities within the northern North Sea.

2. Species Rankings

While the harbour porpoise was the most common species in all four areas (Fig. 2), species rankings varied for the three remaining most common species (white-beaked dolphin, bottlenose dolphin and minke whale).

In particular, white-beaked dolphins ranked second within the AC community and third within the NCOMF and NI communities, while this species was not recorded at all within neighbouring COMF community. This is also the only area where bottlenose dolphins are seen commonly throughout the year.

Within the AC area, white-beaked dolphins were found to occupy a higher position in community rankings at times when bottlenose dolphin occurrence is at its lowest (i.e. between July and August, Table 2 & Fig. 3).

Therefore, white-beaked dolphins and bottlenose dolphins appear to form an antagonistic pairing where the relative occurrence of one species within a community affects the relative occurrence of the other, a feature that is often indicative of competitive interactions affecting community composition.

| Species Rankings | BND | WBD |
|------------------|-----|-----|
| May | 1 | N/R |
| June | 1 | 3 |
| July | 4 | 2 |
| August | 3 | 2 |
| Sept | 2 | N/R |

Table 2. Species rankings along the Aberdeenshire coast (AC) by month, for white-beaked (WBD) and bottlenose dolphins (BND). N/R – Not Recorded

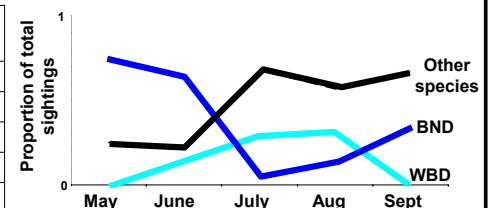


Figure 3. Proportion of sightings along the Aberdeenshire coast (AC) by month, for white-beaked (WBD) and bottlenose dolphins (BND).

3. Proportion Of Sightings Of Each Species

Significant variations existed in the proportion of sightings of each species within each of the four neighbouring areas (Chi-squared, $p < 0.01$, $n = 1115$, $df = 9$).

Within the COMF community there were significantly more HP and MW sightings and significantly fewer WBD sightings than expected in comparison to the other areas, whilst in the AC area there were significantly more WBD and BND sightings and significantly fewer HP and MW sightings than expected.

Within the NCOMF community there were significantly fewer BND sightings than expected, whilst within the NI community there were significantly more WBD sightings and significantly fewer HP and BND sightings than expected.

4. DISCUSSION & CONCLUSIONS

Even though it is a relatively small area, it appears that a number of distinct cetacean communities exist within the northern North Sea.

These fine-scale variations in community structure may be driven both by differences in available habitat between neighbouring areas (e.g. levels of habitat heterogeneity) and by competitive interactions between potential members within these communities, particularly between white-beaked and bottlenose dolphins.

These driving forces may also act in other geographic areas to produce similar fine-scale variations in cetacean communities. This may, in turn have implications for management actions, such as designating MPAs/SACs and implementing mitigation measures against anthropogenic activities.

5. References

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6. Acknowledgements

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