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Comment

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Recently, MacLeod *et al.* (2007) analysed data from harbour porpoises (*Phocoena phocoena*) stranded on Scottish North Sea coasts in March–May of 1993–2003. Comparing 2002–2003 data against baseline data from previous years, they suggest that reductions in sandeel prey have increased the likelihood of starvation, and that future climate change could negatively impact conservation status of North Sea porpoises. We argue that small sample sizes and uncertainty over biases in these data cast doubt on the study's evidence for any impact of climate change, and the paper serves to confuse, rather than contribute to, current conservation efforts.

Several hundred harbour porpoises are stranded annually around UK coasts. Over 40% are killed traumatically (primarily fisheries by-catch or attacks by bottlenose dolphins *Tursiops truncatus*) and the remainder die from various natural causes including starvation (Jepson 2006). Fishing effort and *Tursiops* distribution are patchy, so the relative occurrence of traumatic and natural deaths varies in time and space, while differences in body condition of healthy and sick animals may affect the probability of floating ashore.

These factors lead to two fundamental problems with MacLeod *et al.*'s (2007) analyses. First, presenting results from small sample sizes as percentage changes distorts their biological significance. For example, the results state that 'the proportion of porpoises from which any sandeel remains were recovered in March 2002–2003 was 50% of that in the baseline period'. But table 1 reveals that this reflects a change equivalent to one of four (25%) rather than two of four (50%) individuals. Similarly, the central claim that the percentage of porpoises that starved increased from 5 to 33% was based on only 11 starved individuals. Furthermore, the authors treat individual food items in stomachs as independent sampling units, whereas it would be more appropriate to use porpoises as the independent analysis unit, in which case even had no stomachs contained sandeels in March 2002–2003, this difference would not be significant (baseline = 7/14 porpoises contained sandeels; if 2002–2003 = 0/4 contained sandeels; Fisher's exact test: $p = 0.12$).

Second, assessments of the biological significance of changes in the frequency of sandeels in the diet, or numbers of starving porpoises, require closer examination of alternative states. The authors suggest that a decline in the mean number of prey per stomach in 2002–2003 provides support for the hypothesis that porpoises failed to switch to alternative prey. But animals could have switched to larger prey, each representing the energetic content of many sandeels. Interpreting how changes in numbers of stranded individuals relate to population size or mortality rates is problematic (Evans & Hammond 2004), and inferences are based on the relative importance of different mortality factors in these datasets. MacLeod *et al.*'s (2007) reference data came from a wider year-round study of 188 strandings; 112 of which were killed traumatically (Santos *et al.* 2004). Increases in the proportion of reported deaths from natural causes could, therefore, result from a change in reported traumatic deaths and/or locations of strandings and need not reflect any absolute change in natural mortality rate. Indeed, data in Santos *et al.* (2004) suggest a 40% decline in the proportion of stranded porpoises killed by *Tursiops* over the period 1992–2003 (logistic regression, individual mortalities assumed independent; 95% CI on 2003 proportion/1992 proportion: 0.41–0.89). We do not suggest that this reflects underlying changes in ecological interactions, but it highlights potential biases in this dataset, particularly as sandeel prey are more prevalent in porpoises killed by *Tursiops* (Santos *et al.* 2004).

Assessments of relationships between diet and starvation require more detailed analyses, ideally based on full datasets from other North Sea coasts (Jepson 2006). We also question the predicted effects of climate change. Regional variation in the influence of climate on sandeel abundance (Arnott & Ruxton 2002) suggests that availability of sandeels to porpoises will vary across their range. Crucially, while seabird reproduction is related to water temperature, reproductive success is also depressed by industrial sandeel fisheries (Frederiksen *et al.* 2004), which have reduced in Scottish waters since 2000. A central tenet of MacLeod *et al.*'s (2007) paper is that North Sea sandeel abundance has declined, for which they cite ICES Fisheries Management Advice (Anonymous 2006). While true for the whole North Sea, this ICES report also highlights that, since 2000, stock monitoring along the east coast of Scotland (approx. 50% of MacLeod *et al.*'s (2007) study area), showed a large increase in sandeel biomass. Efforts to prioritize conservation action under these complex scenarios must be underpinned by more rigorous analysis of all available data.

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Anonymous 2006 ICES ACFM advice 2006, vol. 6. See http://www.ices.dk/advice/icesadvice.asp.

Arnott, S. A. & Ruxton, G. D. 2002 Sandeel recruitment in the North Sea: demographic, climatic and trophic effects. *Mar. Ecol. Prog. Ser.* **238**, 199–210.

Evans, P. G. H. & Hammond, P. S. 2004 Monitoring cetaceans in European waters. *Mamm. Rev.* **34**, 131–156. (doi:10.1046/j.0305-1838.2003.00027.x)

Frederiksen, M., Wanless, S., Rothery, P. & Wilson, L. J. 2004 The role of industrial fisheries and oceanographic

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change in the decline of North Sea black-legged kittiwakes. *J. Appl. Ecol.* **41**, 1129–1139. (doi:10.1111/j.0021-8901.2004.00966.x)

Jepson, P. (ed.) 2006 Cetacean strandings investigation and co-ordination in the UK 2000–2004. Final report to DEFRA, pp 1–79. See http://www.defra.gov.uk/wildlife-countryside/resprog/findings/index.htm.

MacLeod, C., Santos, M., Reid, R. J., Scott, B. & Pierce, G. J. 2007 Linking sandeel consumption and the likelihood of starvation in harbour porpoises in the Scottish North Sea: could climate change mean more starving porpoises? *Biol. Lett.* **3**, 185–188. (doi:10.1098/rsbl.2006.0588)

Santos, M. B., Pierce, G. J., Learmonth, J. A., Reid, R. J., Ross, H. M., Patterson, I. A. P., Reid, D. G. & Beare, D. 2004 Variability in the diet of harbor porpoises in Scottish waters 1992–2003. *Mar. Mamm. Sci.* **20**, 1–27. (doi:10.1111/j.1748-7692.2004.tb01138.x)

NOTICE OF CORRECTION

The category section is now correct.

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