biology letters

Reply to comment: is climate change the most likely driver of range expansion of a critically endangered top predator in northeast Atlantic waters?

Russell B Wynn, Simon A Josey, Adrian P Martin, David G Johns and Pierre Yésou

Biol. Lett. 2008 **4**, 206-207
doi: 10.1098/rsbl.2007.0624

biology letters
Global change biology

Biol. Lett. (2008) **4**, 206–207
doi:10.1098/rsbl.2007.0624
Published online 15 January 2008

Invited reply

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The comment by Votier *et al.* (2008) on our recently published article (Wynn *et al.* 2007) contains two main criticisms: (i) that our analytical approach is inappropriate and (ii) that we have failed to acknowledge other factors that may have contributed to the change in Balearic Shearwater numbers recorded throughout northwest European waters. We strongly disagree with both these criticisms.

First, we defend our analytical approach. Votier *et al.* (2008) argue that the strong temporal association between the numbers of Balearic Shearwaters and sea surface temperature (SST) around the UK and Ireland could be driven by 'another unmeasured factor which also changes over time'. They suggest that 'if changes in one factor are indeed dependent on another, departures from the linear predictions (residuals) should still be correlated after de-trending'. Votier *et al.* (2008) have clearly misunderstood the main point of our paper, as detrending the data will remove one of our key findings, that is, that there is a *simultaneous increasing trend* in SST and Balearic Shearwater numbers in the UK and Ireland. Given the complexity of marine trophic interactions (Beaugrand & Reid 2003), we do not expect a significant correlation once these major upward trends have been removed. To expect a strong point-by-point correlation between two factors separated by a number of nonlinear processes is unrealistic. However, our statistical analysis has enabled us to establish that there is a significant correlation between SST and Balearic Shearwater numbers in the UK and Ireland regions. We support this with further data providing initial indications for propagation of this signal through the food web, for example, indications for recent distribution changes in prey fish species. Understanding the details of intermediate processes which give rise to this correlation is the subject of ongoing research.

On a related theme, Votier *et al.* (2008) contend that the title of our original contribution (Wynn *et al.* 2007) implies 'a direct causal connection between SST variability and Balearic Shearwater numbers'. This is not correct. We chose this title carefully as we do not believe there is a direct causal connection between SST variability and Balearic Shearwater numbers, but rather that there is an *indirect* relationship mediated through various intermediate levels, as described above.

Second, we address the alternative explanations for the trend put forward by Votier *et al.* (2008), although they only provide two examples: changes in taxonomic status and changes in availability of fishery discards. We are fully aware that the taxonomic status of Balearic Shearwater is complex, and has undergone multiple changes in a non-uniform manner across northwest Europe. In the UK, taxonomic splits were implemented in 1991 and 2001, following recommendations outlined in Bourne *et al.* (1988) and Sangster *et al.* (2002). These changes are not reflected in the numbers of Balearic Shearwaters recorded, as apparent in fig. 2*b* of Wynn *et al.* (2007). Instead this time series reveals a marked upwards step-change in numbers after 1995, both in the UK and across northwest Europe. There is also evidence for a progressive northwards range expansion in 2003 (the last year covered in this study), with record numbers of birds reaching Scandinavia, Scotland and Wales. These data fit well with a sustained increase in SST, and confirm that taxonomic changes are not a significant source of bias.

Votier *et al.* (2008) also suggest that variations in availability of fishery discards may have affected the numbers of Balearic Shearwaters recorded, and refer to Arcos & Oro (2002) in support. However, Arcos & Oro (2002) refer specifically to the situation in the Mediterranean Sea during the breeding season, whereas our study looks at Balearic Shearwater occurrence in the northeast Atlantic outside of the breeding season. Neither Votier *et al.* (2008) nor Arcos & Oro (2002) present any data that are relevant to our study, so their argument is purely speculative.

In summary, although we recognize that our original study is reliant upon non-effort-based data, our statistical analysis of a multinational dataset has shown our findings to be robust. We have documented a northwards range expansion of the Balearic Shearwater, and propose that climate change is a key (but not the only) driver. Although Votier *et al.* (2008) conclude with a bold statement about 'conservation strategies', their response to our study presents no new data and fails to undermine our findings. However, we agree that further monitoring is clearly required. Consequently, we are already progressing with a new effort-based monitoring initiative of the Balearic Shearwater in northwest European waters. SeaWatch SW (http://www.seawatch-sw.org) has been set up with the support of major international conservation organizations, for example, Birdlife International, and will provide further valuable insights into the species distribution, occurrence and feeding behaviour in northeast Atlantic waters.

Russell B. Wynn[1,*], Simon A. Josey[1], Adrian P. Martin[1], David G. Johns[2] and Pierre Yésou[3]
[1]*National Oceanography Centre, European Way, Southampton SO14 3ZH, UK*
[2]*SAHFOS, The Laboratory, Citadel Hill, Plymouth PL1 2PB, UK*
[3]*ONCFS, 53 rue Russeil, 44000 Nantes, France*
**rbw1@noc.soton.ac.uk*

The accompanying comment can be viewed on page 204 at http://dx.doi.org/doi:10.1098/rsbl.2007.0558.

Received 13 December 2007
Accepted 21 December 2007

Arcos, J. M. & Oro, D. 2002 Significance of fisheries discards for a threatened Mediterranean seabird, the Balearic Shearwater *Puffinus mauretanicus*. *Mar. Ecol. Prog. Series* **139**, 209–220. (doi:10.3354/meps239209)

Beaugrand, G. & Reid, P. C. 2003 Long-term changes in phytoplankton, zooplankton and salmon related to climate. *Global Change Biol.* **9**, 801–817. (doi:10.1046/j.1365-2486.2003.00632.x)

Bourne, W. R. P., Mackrill, E. J., Paterson, A. M. & Yésou, P. 1988 The Yelkouan Shearwater *Puffinus* (*puffinus?*) *yelkouan*. *Br. Birds* **81**, 306319.

Sangster, G., Collinson, M., Helbig, A. J., Knox, A. G. & Parkin, D. T. 2002 The specific status of Balearic and Yelkouan Shearwater. *Br. Birds* **95**, 636–639.

Votier, S. C., Bearhop, S., Attrill, M. J. & Oro, D. 2008 Comment: is climate change the most likely driver of range expansion for a critically endangered top predator in northeast Atlantic waters? *Biol. Lett* **4**, 204–205. (doi:10.1098/rsbl.2007.0558)

Wynn, R. B., Josey, S. A., Martin, A. P., Johns, D. J. & Yésou, P. 2007 Climate-driven range expansion of a critically endangered top predator in northeast Atlantic waters. *Biol. Lett.* **3**, 529–532. (doi:10.1098/rsbl.2007.0162)