biology letters

Is climate change the most likely driver of range expansion for a critically endangered top predator in northeast Atlantic waters?

Stephen C Votier, Stuart Bearhop, Martin J Attrill and Daniel Oro

Biol. Lett. 2008 **4**, 204-205
doi: 10.1098/rsbl.2007.0558

biology letters
Global change biology

Biol. Lett. (2008) **4**, 204–205
doi:10.1098/rsbl.2007.0558
Published online 15 January 2008

Comment

Is climate change the most likely driver of range expansion for a critically endangered top predator in northeast Atlantic waters?

Wynn *et al.* (2007) report an apparent northwards expansion in the non-breeding range of the Balearic shearwater (*Puffinus mauretanicus*) in northeast Atlantic waters, and interpret increasing sea surface temperature (SST) as an underlying mechanism. We contend that these interpretations require re-evaluation as there are two major shortcomings to this work. First, the analytical approach is inappropriate. Second, even if we disregard these serious analytical issues, there are several other highly plausible explanations for the increase in Balearic shearwater records that the authors either dismiss out of hand or fail to consider. We highlight this discrepancy owing to the urgent need to correctly diagnose threats to this critically endangered predator and to understand the influence of global change on marine ecosystems.

We extracted data from fig. 2*a* of Wynn *et al.* (2007) and identified a linear trend over time in both the number of Balearic shearwater records ($F_{1,23}=24.389$, $p<0.001$) and SST ($F_{1,23}=35.897$, $p<0.001$). Such strong temporal associations can often be driven by another unmeasured factor that also changes over time (see Legendre & Legendre 1998). Thus, it is imperative to control for temporal trends before reliable inferences can be made, which can be achieved by separately plotting each variable against time and using the residuals for subsequent analysis. If changes in one factor are indeed dependent on another, departures from the linear predictions (residuals) should still be correlated after detrending. Having detrended the data, annual Balearic shearwater records in UK and Irish waters are not correlated with annually averaged SST in the same region (Spearman's rho$=0.153$, $n=24$, $p=0.480$), even if the SST data are lagged by 1 year (Spearman's rho$=0.277$, $n=23$, $p=0.201$).

Even if one argues that this methodological approach is overly conservative (which we would dispute), there are several equally parsimonious non-SST-related explanations for patterns described by Wynn *et al.* (2007). While we do not dispute that UK and Irish records of Balearic shearwater has increased in recent years, this does not prove that the number of birds visiting the UK has increased. Following work by Bourne *et al.* (1988), the Mediterranean shearwater was split from Manx shearwater *Puffinus puffinus* in 1991. This elevated taxonomic status undoubtedly increased awareness of the species. Splitting Balearic Shearwater records into three groups of years we find no clear trend during 1980–1990 (Spearman's rho$=0.009$, $n=11$, $p=0.979$), a significant increase from 1991 (the year of the split) to 1996 (Spearman's rho$=0.829$, $n=6$, $p=0.042$) and no clear trend 1997–2003 (Spearman's rho$=0.036$, $n=7$, $p=0.480$). Thus the increase in records between 1980 and 2003 can be explained by increasing records over six years in the early 90s, around the time that Balearic shearwater acquired species status. Importantly, this apparent step change is not associated with changes in oceanographic conditions, such as the documented regime shift in the North Sea between 1983 and 1988 (McQuatters-Gollop *et al.* 2007). Therefore the apparent increases could simply reflect a change in observer awareness. The authors acknowledge the role of observer bias in their results, arguing that the consistency of temporal and spatial trends indicates that observer bias has not significantly influenced the results. We counter that this is consistent with wide-scale increases in observer-related bias. Furthermore, data from three northeast Atlantic observatories, where observer-related bias is reduced, reveals inconsistent trends in Balearic shearwater records (fig. 2 in Wynn & Yésou 2007), with records decreasing since 1992 at one of the three observatories.

While Wynn *et al.* (2007) do not claim a direct causal connection between SST variability and Balearic shearwater numbers, the title implies this. We suggest that the evidence to support this speculation is not robust. Although the dietary information presented by Wynn *et al.* (2007) is correct, they fail to recognize that fishery discards may comprise more than 50% of the energy requirements of Balearic shearwaters in the Mediterranean (Arcos & Oro 2002). Interactions between seabirds and fisheries are poorly understood, but there is evidence that seabirds are sensitive to changes in discard availability (Votier *et al.* 2004). Complex changes in stock structure and management have lead to variation in the availability of fishery discards at a global scale. Given the importance of this resource to Balearic shearwater, we cannot exclude the possibility that these changes in fisheries may have had an influence on their distribution, although we currently have no information on the foraging behaviour of Balearic shearwaters in the Atlantic.

We accept that changes in SST could have driven an increase in the number of non-breeding Balearic shearwaters in UK and Irish waters, but the data presented by Wynn *et al.* (2007) do not support this and other equally parsimonious explanations exist. Given the current conservation status of this species, it is vital that we consider all potential mechanisms that might explain changes in numbers or distribution to enable appropriate conservation strategies to be set in place.

The accompanying reply can be viewed on page 206 or at http://dx.doi.org/doi:10.1098/rsbl.2007.0624.

Received 7 November 2007
Accepted 26 November 2007

Stephen C. Votier[1,*], Stuart Bearhop[2], Martin J. Attrill[1] and Daniel Oro[3]
[1]*Marine Biology and Ecology Research Centre, School of Biological Sciences, University of Plymouth, Plymouth PL4 8AA, UK*
[2]*Centre for Ecology and Conservation, School of Biosciences, University of Exeter, Cornwall Campus, Penryn Cornwall TR10 9EZ, UK*
[3]*Population Ecology Group, IMEDEA (CSIC-UIB), Miquel Marquès 21, 07190 Esporles, Mallorca, Spain*
**stephen.votier@plymouth.ac.uk*

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

Bourne, W. R. P., Mackril, E. L., Paterson, A. M. & Yésou, P. 1988 The Yelkouan Shearwater (*Puffinus (puffinus?) yelkouan*). *Br. Birds* **81**, 306–319.

Legendre, P. & Legendre, L. 1998 *Numerical ecology*. Amsterdam, The Netherlands: Elsevier.

McQuatters-Gollop, A., Raitsos, D. E., Edwards, M., Pradhan, Y., Mee, L. D., Lavender, S. J. & Attril, M. J. 2007 A long-term chlorophyll dataset reveals regime shift in North Sea phytoplankton biomass unconnected to increasing nutrient levels. *Limnol. Oceanogr.* **52**, 635–648.

Votier, S. C. *et al.* 2004 Changes in fisheries discard rates and seabird communities. *Nature* **427**, 727–730. (doi:10.1038/nature02315)

Wynn, R. B. & Yésou, P. 2007 The changing status of Balearic Shearwater in northwest European waters. *Br. Birds* **100**, 392–407.

Wynn, R. B., Josey, S. A., Martin, A. P., Johns, D. G. & 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)