

the standard deviation does not. This is because changing the units corresponds to multiplying the data with a constant (a), which adds a constant to the log values: $\ln aN_i = \ln a + \ln N_i$. The resulting change in 'synchrony' depends both on $\text{stdev}_{\text{all } i}(\ln N_i)$, which is specific to each year's set of abundances, and on the choice of unit (specifically, $\text{sync}(aN) = \text{sync}(N) + \ln(a)/\text{stdev}_{\text{all } i}(\ln N_i)$). Therefore, a change of unit may qualitatively reverse comparisons of synchrony between data sets.

This problem is not resolved by addition of a constant to all log-transformed musk-ox abundances to ensure that these are positive before calculating 'synchrony' (Post and Forchhammer, personal communication), as the relationship between mean $\ln aN$ and $\text{stdev} \ln aN$ remains entirely arbitrary. Biological conclusions should not be affected by whether American, metric or other units are used.

Post and Forchhammer's analyses show an apparent tendency for cross-species correlation to decrease with increasing interpopulation distance. However, the few strong correlations describe concurrent trends over decades, rather than the year-to-year variation that was Post and Forchhammer's focus. Plotting cross-species correlation against each ($\omega_{\text{musk ox}}^{(i)}, \omega_{\text{caribou}}^{(i)}$) pair shows no consistent pattern. We also correlated growth rates instead of raw abundances and found unsystematic and weak correlations. Although other approaches might be more successful, the data may not be sufficiently precise or relevant to detect the phenomenon if it exists. We conclude that there is currently no proper evidence of climate-induced synchrony between musk oxen and caribou on Greenland.

Jon Olav Vik*, **Nils Chr. Stenseth***, **Giacomo Tavecchia*†**, **Atle Mysterud***, **Ole Chr. Lingjærde‡**

*Centre for Ecological and Evolutionary Synthesis, Department of Biology, and ‡Department of Informatics, University of Oslo, PO Box 1050 Blindern, 0316 Oslo, Norway
e-mail: n.c.stenseth@bio.uio.no

†Present address: IMEDA-UIB/CSIC-c Miquel Marques 21, 07190 Esporles, Spain

1. Moran, P. A. P. *Aust. J. Zool.* **1**, 291–298 (1953).
2. Post, E. & Forchhammer, M. C. *Nature* **420**, 168–171 (2002).
3. Hurrell, J. W. *Science* **269**, 676–679 (1995).
4. Forchhammer, M. C., Post, E., Stenseth, N. C. & Boertmann, D. M. *Population Ecol.* **44**, 113–120 (2002).

Post and Forchhammer reply — Vik *et al.* question whether we documented spatial synchrony between caribou and musk oxen from Greenland, and whether spatial synchrony within each species related to the North Atlantic Oscillation (NAO)¹. Attributing spatial synchrony to climate is difficult but possible², and the questions raised by Vik *et al.* are readily addressed. Contrary to their incorrect statement of our

definition of the NAO effect ratio¹, a strong climatic effect on any pair of populations is not a requisite of climate-induced synchrony. As Moran³ argued, and as our analysis illustrated¹, populations may be synchronized if climate influences each of them similarly, regardless of the magnitude of that influence. Moreover, the standardized NAO effect ratio is associated statistically with the degree of climatic correlation across populations⁴ and hence the degree of synchrony between populations³.

As stated previously¹, we used cross-population covariance (CV) to produce a time-series index of spatial synchrony, an approach validated in empirical⁵ and theoretical⁶ studies, which have demonstrated the relationship of CV to population synchrony⁷. The simplest test of whether the use of log-transformed data confounds our results is to compare them with results obtained using raw (not log-transformed) data. The correlation between the NAO and 1/CV of the raw musk-ox data⁸ ($r = -0.57, P = 0.001$) matches exactly the correlation between the NAO and 1/CV of the log-transformed musk-ox data ($r = -0.59, P = 0.001$). Similarly, results do not vary for caribou, using log-transformed ($r = 0.35, P = 0.002$) or raw ($r = 0.24, P = 0.04$) data. Hence, log-transformation does not influence relationships between the NAO and spatial synchrony.

Moreover, our results were not influenced by addition of a constant to the log-transformed musk-ox data, which Vik *et al.* describe as analogous to changing units of abundance. Such a problem would be apparent if the means of the N_i , $\ln(N)_i$, or $[\ln(a) + \ln(N)_i]$ showed significant and inconsistent correlations with the NAO, but none did (r_i values of 0.14, 0.07 and 0.07, respectively; all P values ≥ 0.50). Vik *et al.* obtained different results because their direct log-transformation of the decimal-form musk-ox data produced negative values, giving statistically invalid CVs^{9,10}. We added 4 to the log-transformed musk-ox data to convert negative values to positives before calculating the CV precisely to avoid a spurious correlation.

If the NAO–spatial synchrony correlation were, in fact, influenced by the use of log-transformed data, such an artefact should be apparent in two ways, neither of which is discussed by Vik *et al.* First, the sign of the correlation between the NAO and musk-ox spatial synchrony should change with addition of constants greater than 4. Second, adding constants to log-transformed caribou data (to which none was originally added¹) should also alter the NAO–caribou synchrony correlation. We checked this by adding constants of up to 10, and in neither case was the correlation altered (Fig. 1).

We conclude that our previous results still stand and that Vik *et al.* cannot offer a

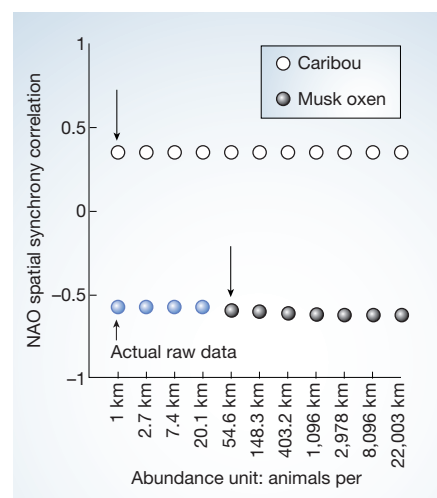


Figure 1 Addition of constants from zero to ten (corresponding to abundance units shown on the x-axis) to \ln -transformed density estimates does not influence the sign of the correlation between the NAO index and spatial synchrony for musk oxen or caribou. Points designated by an arrow are the correlations reported in our original analysis¹. For the \ln -transformed musk-ox data, addition of constants less than four, as done by Vik *et al.*, produces spurious correlations because the resulting negative values do not give statistically valid coefficients of variation^{9,10}. Thus, the blue points indicate the correlations obtained when using the raw musk-ox data⁸ with constants of zero to three added; note that the point denoted as raw data in Fig. 1 of Vik *et al.* is in fact a direct \ln -transformation of the actual raw data.

means of analysing or an alternative explanation for spatial synchrony within and across these species.

Eric Post*, **Mads C. Forchhammer†**

*Department of Biology, The Pennsylvania State University, 208 Mueller Lab, University Park, Pennsylvania 16802, USA

e-mail: esp10@psu.edu

†Department of Population Biology, Biological Institute, University of Copenhagen, 2100

Copenhagen, Denmark

1. Post, E. & Forchhammer, M. C. *Nature* **420**, 168–171 (2002).
2. Cattadori, I. M., Merler, S., & Hudson, P. J. *J. Anim. Ecol.* **69**, 620–638 (2000).
3. Moran, P. A. P. *Aust. J. Zool.* **1**, 291–298 (1953).
4. Sokal, R. R. & Rohlf, F. J. *Biometry: The Principles and Practice of Statistics in Biological Research* (Freeman, New York, 1995).
5. Holyoak, M. & Lawler, S. P. *J. Anim. Ecol.* **65**, 640–652 (1996).
6. Ims, R. A. & Steen, H. *Oikos* **57**, 381–387 (1990).
7. Buonaccorsi, J. P. *et al. J. Theor. Biol.* **224**, 107–114 (2003).
8. Forchhammer, M. C. & Boertmann, D. M. *Ecography* **16**, 299–308 (1993).
9. Koenig, W. D. & Knopps, J. M. H. *Am. Nat.* **155**, 59–69 (2000).
10. Wallis, W. A. & Roberts, H. V. *Statistics: A New Approach* (Free, New York, 1956).

corrigendum

Fat-1 mice convert n-6 to n-3 fatty acids

Jing X. Kang, Jingdong Wang, Lin Wu, Zhao B. Kang *Nature* **427**, 504 (2004)

J. X. K. is the inventor and co-applicant (with Massachusetts General Hospital, a non-profit organization) of a patent application relevant to this work (USSN 60/275,222; WO02072028), which should therefore have been declared as a competing financial interest.