Update TRENDS in Ecology and Evolution Vol.xxx No.x

Letters Response

Response to Benedetti-Cecchi: Neutrality and environmental fluctuations

David Alonso[1], Rampal S. Etienne[2] and Alan J. McKane[3]

[1] Ecology and Evolutionary Biology, University of Michigan, 830 North University Av, Ann Arbor MI 48109-1048, USA
[2] Community and Conservation Ecology Group, Centre for Ecological and Evolutionary Studies, University of Groningen, PO Box 14, 9750 AA Haren, the Netherlands
[3] Theory Group, School of Physics and Astronomy, University of Manchester, Manchester, M13 9PL, UK

Benedetti-Cecchi [1] argues that 1/*f* environmental fluctuations can produce the same patterns as neutral theory and, hence, present an alternative explanation for the sort of spatio-temporal variability observed in ecological systems. However, environmental fluctuations are not an alternative to neutral theory, but should instead be embedded in it. Current neutral models use demographic stochasticity, but neutral theory does not exclude other sources of stochasticity. Neutrality does not imply a homogeneous and constant habitat, as is sometimes mistakenly assumed. Neutrality only means ecological equivalence; that is, that spatial and temporal heterogeneities do not translate into differential probabilities for each species to persist in the present and future community. Therefore, the current neutral framework should be extended [2], particularly to include environmental stochasticity.

1/*f* noise is defined according to the shape of the power spectrum of a fluctuating time signal [3]. For instance, when all frequencies are equally represented, we usually call this signal 'white noise'. The power spectra for the fluctuations in population abundance caused by demographic stochasticity can be calculated exactly [4,5]. In standard neutral theory [6], which considers only demographic stochasticity, populations fluctuate through birth and death events, performing a Brownian random walk. It is known that the associated spectrum for this kind of dynamic is not red noise but scales as $1/f^2$ [3]. Moreover, red noise dynamics is known to be scale free. However, in neutral theory speciation and immigration will introduce characteristic timescales.

The effect of environmental fluctuations on community dynamics is highly nonlinear and, unfortunately, poorly understood. Currently, we only have well-established theory on how this link works under simple assumptions [4,7,8]. If the type of environmental fluctuations affecting communities is 1/*f*, as has been suggested [9,10], then it is not self-evident that ecological variables, such as species abundances and beta diversity, also exhibit this type of variability [11]. Experimental and theoretical–observational approaches should be combined to develop predictive models that also take environmental variability into account.

References

1 Benedetti-Cecchi, L. (2007) Neutral theory and 1/*f* noise make similar predictions of assemblage dynamics. *Trends Ecol. Evol.* 22, DOI: 10.1016/j.tree.2007.02.008
2 Alonso, D. *et al.* (2006) The merits of neutral theory. *Trends Ecol. Evol.* 21, 451–457
3 Halley, J.M. (1996) Ecology, evolution and 1/*f*-noise. *Trends Ecol. Evol.* 11, 33–37
4 Nisbet, R.M. and Gurney, W.S.C. (1982) *Modelling Fluctuating Populations,* John Wiley & Sons
5 McKane, A.J. and Newman, T.J. (2005) Predator–prey cycles from resonant amplification of demographic stochasticity. *Phys. Rev. Lett.* 94, 218102
6 Hubbell, S.P. (2001) *The Unified Neutral Theory of Biodiversity and Biogeography,* Princeton University Press
7 Lande, R. *et al.* (2003) *Stochastic Population Dynamics in Ecology and Conservation,* Oxford University Press
8 Engen, S. *et al.* (2005) Estimating the pattern of synchrony in fluctuating populations. *J. Anim. Ecol.* 74, 601–611
9 Steele, J.H. (1985) A comparison of terrestrial and marine ecological systems. *Nature* 313, 355–358
10 Vasseur, D.A. and Yodzis, P. (2004) The color of environmental noise. *Ecology* 85, 1146–1152
11 Zillio, T. *et al.* (2005) Spatial scaling in plant communities. *Phys. Rev. Lett.* 95, 098101

DOI of original article: 10.1016/j.tree.2007.02.008
Corresponding author: Alonso, D. (dalonso@umich.edu).
Available online xxxxxx.

  doi:10.1016/j.tree.2007.02.011

Please cite this article in press as: Alonso D. et al., Response to Benedetti-Cecchi: Neutrality and environmental fluctuations, Trends Ecol. Evol. (2007), doi:10.1016/j.tree.2007.02.011