UC Merced
Frontiers of Biogeography

Title
The importance of taxonomic effort in island biogeography

Permalink
https://escholarship.org/uc/item/84k8376j

Journal
Frontiers of Biogeography, 6(1)

Author
Burridge, Christopher Paul

Publication Date
2014

DOI
10.21425/F5FBG21420

Copyright Information

news and update

commentary

The importance of taxonomic effort in island biogeography

In the 50 years since MacArthur and Wilson's (1963) paper set the scene for their famous book, *The Theory of Island Biogeography*, there has been a wealth of publications investigating species richness on islands in terms of speciation and extinction rates, island sizes, and isolation (immigration). This body of literature attests to the pivotal insights provided by MacArthur and Wilson, but also highlights the complexity of the field and difficulties in our understanding of biodiversity on islands. This has again become apparent from Gray and Cavers' (2014) new investigation of the effects of taxonomic effort on explanations of species diversity on islands.

The importance of accurate taxonomic knowledge in biogeographic studies is implicit, and Gray and Cavers (2014) ask key questions, such as whether we even have adequate taxonomic knowledge for biogeographic inferences on well-studied islands. They focus on the biodiversity metric "single-island endemic species richness" (SIE *S*), representing the total number of single-island endemic species within a taxon in a given area (Emerson and Kolm 2005). Values of SIE *S* represent a subset of total species richness, and therefore will be more sensitive to changes in taxonomic effort than total species richness. Changes in taxonomic effort can reflect changes in *sampling effort*—field sampling—and also *description effort*—assessing specimens and describing new taxa (and also synonymising old ones).

Assessment of taxonomic effort for a flora or fauna is typically performed via inspection of historical species accumulation curves (Hortal et al. 2008), which will be influenced by both sampling and description effort, and can also be constructed for SIE *S*. Asymptotes for such curves indicate that taxonomic effort has been adequate, and should not influence downstream biogeographic inferences (Gotelli and Colwell 2001). Gray and Cavers (2014) examine whether SIE *S* exhibits asymptotes for plants, animals (predominantly land snails), and fungi by assessing species checklists for eight well-known island groups across five time periods, the most inclusive spanning 1750–2012, and describe other curve types that may result under different and dynamic backgrounds of taxonomic effort—for example, a rapid upward trajectory of a curve may result from changes in biases or technologies with respect to sampling (e.g., trapping approaches) or description (e.g., DNA identification of morphologically 'cryptic' species) effort. Gray and Cavers (2014) also employ a Bayesian approach to allow models to develop through time (posteriors from an earlier time period informing priors for a subsequent period), such that any improvement of the model relationship through time (e.g., narrowing confidence intervals) will indicate a contribution of changing taxonomic effort. This approach circumvents limitations of previous methods to assess taxonomic effort that require detailed knowledge of past activities (e.g., Schulman et al. 2007). Relationships of SIE *S* with island area and age were then assessed, mirroring the earlier study of Whittaker et al. (2008), along with assessment of island isolation to other islands and continents, and niche diversity (approximated by topographic diversity and evenness).

The sobering finding from Gray and Cavers (2014) is that asymptotes in SIE *S* were rare, observed for only two of the 16 datasets analysed, despite the inclusion of a range of 'well studied' islands (e.g., Hawai'i, Canary Islands), although five other datasets were approaching asymptotes. However, even asymptotic patterns should be treated with caution, as they may also reflect decreasing taxonomic effort. While geological island age has been commonly pursued to explain biodiversity on islands, given the paucity of asymptotes, might times of much shorter durations—those which encompass taxonomic effort—be driving some observed patterns?

For the combined islands dataset, regression coefficients with respect to island area and age appeared to be stabilising through time, although patterns from individual datasets were more variable, such that there was no systematic

relationship between SIE S and taxonomic effort. However, the Bayesian approach produced narrowing confidence intervals through time, indicating that the use of results from earlier time periods to inform priors for subsequent time periods is useful, particularly where temporal heterogeneity in relationships is likely to exist.

Island area seemed much more important for plants than for land snails, as was island age. Isolation from islands and continents were comparatively poor predictors of SIE S in both groups, and was rarely favoured by best subsets regression. While altitudinal diversity—a proxy for niche diversity—appeared important for land snails, it was not for plants, and this was explained ecologically in terms of snails adapting to specific humidity because they can select those habitats, compared to plants, which are non-motile, and therefore place greater importance on plastic environmental response. These relationships were fairly consistent through time—and therefore probably across taxonomic effort—when considering all islands (although they varied among island groups). However, this should not be cause for complacency; rigorous sampling and description of island biotas for future analyses are still highly valued, and Bayesian approaches such as that taken by Gray and Cavers (2014) have the potential to explain greater variation during meta-analyses where levels of taxonomic effort are disparate among islands.

Gray and Cavers (2014) finish by recommending that SIE S be regarded as an unknown and dynamic metric, and therefore its use requires assessment of taxonomic effort and its potential influence on results. Changes in taxonomic effort alone can strongly influence SIE S, and therefore values of this parameter should not be accepted by default.

Christopher Paul Burridge

School of Biological Sciences, University of Tasmania, Hobart, Australia.

chris.burridge@utas.edu.au; http://www.evogentas.org

References

Emerson, B.C. & Kolm, N. (2005) Species diversity can drive speciation. Nature, 434, 1015–1017.

Gotelli, N.J. & Colwell, R.K. (2001) Quantifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness. Ecology Letters, 4, 379–391.

Gray, A. & Cavers, S. (2014) Island biogeography, the effects of taxonomic effort and the importance of island niche diversity to single-island endemic species. Systematic Biology, 63, 55–65.

Hortal, J., Jiménez-Valverde, A., Gómez, J.F., Lobo, J.M. & Baselga, A. (2008) Historical bias in biodiversity inventories affects the observed environmental niche of the species. Oikos, 117, 847–858.

MacArthur, R.H. & Wilson, E.O. (1963) Equilibrium-theory of insular zoogeography. Evolution, 17, 373–387.

Schulman, L., Toivonen, T. & Ruokolainen, K. (2007) Analysing botanical collecting effort in Amazonia and correcting for it in species range estimation. Journal of Biogeography, 34, 1388–1399.

Whittaker, R.J., Triantis, K.A. & Ladle, R.J. (2008) A general dynamic theory of oceanic island biogeography. Journal of Biogeography, 35, 977–994.