A novel, data-driven approach to derive spatially coherent extent of occurrence maps for biogeographic studies

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Abstract

As a source of information on species' geographic distributions, macroecologists and biogeographers have had to rely on expert-derived range maps to study biodiversity patterns at large scales. In addition to being biased towards well-studied taxa and subjective by nature, such maps suffer from a lack of consistency in how species' absences are treated within the wider distribution. Using the finer resolution of the Interim Biogeographic Regionalization for Australia (subregions) and example sets of Australian species as study system, we developed a reproducible, data-driven approach to map the extent of occurrence (EOO) of hundreds—or even thousands—of species by combining presence-only data and subregions (i.e., non-equal-sized operational units that represent homogenous areas of unique environmental features) within a unifying quantitative framework. From data-driven and expert-derived range maps for 533 birds, species richness' estimates differ at three biogeographical scales—whit bias (mean error) at coarser resolution (ecoregion) being half that at subregional scale—and the spatial association between pairs of these birds' presence-absence maps vary from nearly zero to almost one (representing such pattern almost either differently or identically, respectively). Holes within the wider distribution of the EOO maps for pairs of amphibians, mammals, reptiles, and plants seem to respond to the demarcation of different subpopulations over Australia rather than causing an underestimation of a species' empirical distribution. These results demonstrate that this approach can reliably map EOO of species whose distributions aligns with three broad types of geographic patterns (wide-range, habitat-specialists, and range-restricted species). This alternative to expert-derived range maps can serve as a basis for more robust, data-driven studies of biogeographic biodiversity patterns, thus improving our understanding and conservation efforts of global biodiversity.

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