Testing the Validity of Biodiversity Hotspots and Endemic Bird Areas for Invertebrates

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Introduction

Myers et al (2000) proposed areas with >0.5% plant endemism and >70% habitat loss as biodiversity hotspots (BHS). Similarly, areas with high bird endemism and high habitat loss were demarcated as endemic bird areas (EBA). Although proposed based on plant data, the BHS were later revealed to be also rich in endemic tetrapods and the BHS have become conservation priorities. However, it remains unclear whether the hotspots are also valid for invertebrates which comprise ca. 95% of all multicellular species.

In this study, I am testing the validity of Sub-Saharan Africa BHS and EBA for invertebrates from two families of Diptera by using specimen data for museum specimens as recorded in taxonomic revisions.

Materials

No. of species: 1380 (983 Asilidae, 397 Tephritidae)
No. of specimens: 150,612 (31,224 Asilidae, 119,388 Tephritidae)

Methods

1) Comparing species richness in “real” and “fake” hotspots by generating randomly placed areas of same size and shape as the original hotspots
   - African map in ArcGIS with its BHS/EBA
   - For each BHS/EBA:
     - a grid of replicates was created
     - grid was randomly placed to create 50 different grids
     - “valid” fake replicates from each grid used for analysis

2) Extracting and mapping specimen localities and numbers
   - Extraction and preparation of data from 23 revisions and databases (327 species: 12174 specimens)
   - Species and specimen localities mapped on hotspots in ArcGIS
   - Corresponding information for valid replicates retained

3) Comparing true and fake BHS/EBA
   - Development of several Perl scripts for data extraction
   - Species numbers for each fake replicate recorded after rarefaction
   - 50 randomized comparison for each fake replicate generated
   - 50 unique fake replicate comparisons taken for final analysis
   - Sign test for significance testing

Results

Result 1: Congruence

It is often thought that hotspots cannot be tested for invertebrates because too little data are available, but I here demonstrate that specimen data in taxonomic revisions provide sufficient information. Overall, the data demonstrates that hotspots have unusually high levels of endemism for Diptera.

24 out of 25 true BHS/EBA have more Endemics than their respective “fake” hotspots.

Result 2: Asilidae vs Tephritidae

According to Myers et al (2000), some hotspots perform better for some taxonomic groups than others, while other hotspots show a reverse pattern.

ASILIDA ( robber-flies): - predaceous
TEPHRITIDAE (fruit flies): - phytophagous

Q: Will there be similar patterns of complementarity between these two ecologically different groups?

A: YES! Higher species numbers and endemism in true BHS/EBA than fake ones. Areas with lower species numbers in true BHS/EBA tend to contain limited data.

Result 3: Phylogenetic Diversity

Areas rich in species may not necessarily be rich in phylogenetic diversity
- Lack of phylogenetic trees → Generic diversity used as proxy
- Element of subjectivity → Imperfect design

No. of genera: 119 (108 Asilidae, 11 Tephritidae)

Q: Will there be similar results as seen in species diversity?

A: To be continued...

Conclusions

1) High congruence between invertebrates and plant and bird hotspots → plants and birds may be satisfactory surrogates
2) Complementary patterns between Asilidae and Tephritidae → similar to tetrapod data for BHS
3) Phylogenetic diversity may also be higher in hotspots → more analysis needed

Discussion

- Scientifically interesting biological correlation
- Good technique to test existing areas for invertebrates
- Technique not powerful for proposing new hotspots

Table 1. True/fake species and endemics numbers in BHS/EBA.

Table 2. Overall results for species and endemics for true vs fake BHS/EBA. Green cells: higher percentage difference in the true BHS/EBA than its fake replicates.

Table 3. Percentage species and endemics difference between true BHS/EBA with their fake replicates for Asilidae and Tephritidae.

Table 4. Percentage species and endemics difference between true BHS/EBA with their fake replicates for Asilidae and Tephritidae, Green/Red cells: true hotspot has higher/lower numbers than fake replicates. Highlighted numbers: not significantly different.

References