Master’s Research

500, 1500, 2500, 3500 and finally 5000 words on each topic.

Topics:

* Ryan’s model
* Robert MacArthur and Edward Wilson’s ‘The Theory of Island Biogeography’ (1967)
* Stephen Hubble’s ‘The Unified Neutral Theory of Biodiversity and Biogeography’ (2001)
* The Small-Island Effect
* Microbial biogeography
* What have I been doing with other datasets?
* What have I been doing with the simulation?

Maintenance of biodiversity on islands (2016) (word count: )

In 2016 Chisholm *et al.,* published a paper in the Royal Society Proceedings B, detailing their theory explaining biphasic island species-area relationships (SAR).

MacArthur and Wilson’s widely held theory of island biogeography predicts that species richness should increase with island area. Larger islands and those closer to the mainland should exhibit greater species richness at the colonisation-extinction dynamic equilibrium. Whilst this is often true, there are a significant number of cases where smaller islands do not exhibit increasing species diversity with area. These cases tended to occur within archipelagos, where the smallest islands exhibited variations in species richness independent of area. This is known as the small island effect (SIE) and has been found across a variety of habitats and taxonomic groups. So, how to unify these two SAR phenomena into a unifying theory?

Previous attempts to explain the SIE have suggested that extinction events on small islands are common due to environmental instability. Due to rapid turnover, species richness never reached dynamic equilibrium and appears low in contrast to increasing area. It has also been suggested that small islands have low numbers of niches in contrast to area, due to their relatively homogenous habitats (larger islands have the potential for more complex habitats). However, these theories do not explain why small islands seem to be unimpacted by that fact that larger small islands should still receive great migration than smaller small islands. Even if smaller islands experience episodic disturbances that completely wipe out any present communities, those of increasing area (within the small island bracket) should receive a greater number of immigrant individuals, therefore recover more quickly, and exhibit more species richness. These theories would also seem to suggest that small islands would show anomalously low species richness, whilst the opposite is often true.

Chisholm et al., (2016) posit their theory that as island area increases, the number of immigrants increases at a greater rate than niche diversity. A parsimonious (frugal) mechanistic (directly relating to real-world processes) model is presented and fit to 100 archipelago datasets.

The biphasic SAR is interpreted as showing a transition from a niche-structured regime (where number of species are limited by the number of niches) to a colonization-extinction balance regime (where the number of species is dictated by stochastic events). It is predicted that the transition between these regimes will occur at smaller areas where migration from source populations is stronger (islands closer to other islands or mainland).

The niche-structured regime is typical of classic deterministic theories. These state that the species richness of a given area is dictated by deterministic factors such as species traits and environmental factors (Zhou & Ning, 2017).

Colonization-extinction balance regimes are typical of neutral theories that suggest community structure is independent of species-specific traits, and relies on a combination of stochastic birth/death processes, migration, extinction and speciation.

The model suggests that diversity across all island sizes is controlled by niche constraints and immigration rate, with the former increasing slowly with are and the later increasing more quickly.

References

Zhou, J. & Ning, D. (2017) Stochastic Community Assembly: Does It Matter in Microbial Ecology?