Klemens Ekschmitt:

Animal diversity and global change - when and why do species go extinct?

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Extinction risk "toss-the-coin" simulation:

Rules: Start with 1 or 4 sub-populations.
Toss the coin: "heads" = colonise a new habitat; "tails" = lose one sub-population.
Record number of tosses until extinction.

Any population can become extinct, but the smaller it is, the higher its probability of extinction. In this game, gains and losses are balanced, i.e. population is at equilibrium.

Landscape colonisation model:

- The landscape is represented by a grid of cells, each of which is attributed one habitat type and several environmental parameters.
- The community is represented by a set of species, with different affinities to habitat type and environmental parameters.
- The landscape is randomly generated, with a given number of habitat types and environmental parameters [here: 5 habitats & 3 gradients].
- The species [120] are randomly generated, with probabilities of colonisation (incidence) for the different habitats distributed around a given mean [0.1].
- Colonisation is random, i.e. there is no temporal autocorrelation.
- Random samples [200 cells] are taken.

In this case, all species are present in the region, but approximately 85/120 show up in the sample. New sets of species are generated with lower mean incidences [0.05, 0.01 & 0.001], which can be viewed as dividing the available plant biomass by respectively 2, 10 & 100. All 120 species remain present in the region (i.e. biodiversity is maintained), except in the last case [110 sp.]. On the other hand, as species become less abundant (lower incidence), they are less likely to be present in the sampled cells and the number of species in the samples decreases dramatically. Stochastic extinction is therefore not frequent if only the quantity of resources in each habitat is degraded.

A new landscape is generated with only 3 habitat types. The species and sample parameters are the same as in the first case [120 sp., 0.1 incidence & 200 samples]. There is a marked decrease in species richness [95] and number of species recorded in the samples [11].

Conclusions:

Regional stochastic extinction occurs if all local sub-populations become extinct simultaneously. In a large region, only extremely scarce species get eradicated by stochastic extinction, while species confined to a small region are at higher risk. Even in large regions, a species is endangered if resources, requisites or conditions change below that species' tolerance limit (deterministic extinction). One must be aware that species richness may be considerably underestimated, particularly if species' incidences are low.

Species are endangered if they are:

- rare, due to limited geographical distribution, small population density or confinement to one habitat type;
- long-lived, as they cannot respond to rapid changes in their habitat;
- dependant on other species, the loss of a keystone species endangering others;
- or, basically, if they suffer from any kind of narrowing.

"Death is one thing, an end to birth is something else." - Soulé & Wilcox