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Origin of compartmentalization in food webs

(Digital Appendices)

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C The generalized niche model

In the niche model (Williams and Martinez, 2000), one assigns to each of S species a niche value n_i drawn from a uniform distribution in the interval $[0, 1]$. Each predator j preys on the species in a range $r_j = n_j x$ of the niche axis, where x is drawn from a beta-distribution $p(x) = \beta(1-x)^{(\beta-1)}$ and $\beta = (S^2/2L) - 1$, where L is the total number of trophic interactions in the network. The center of the range r_j is selected uniformly at random in the interval $[r_j/2, n_j]$.

The generalized niche model (Stouffer et al., 2006) builds upon this formulation by allowing for tunable prey contiguity (Fig. C1). First, a reduced range r'_j for predator j is set to $r'_j = c r_j = c n_j x$, where c is a fixed parameter in the interval $[0, 1]$. Because species are distributed uniformly at random on the resource axis, a predator j with range r_j has on average $r_j S$ prey. The same applies to the reduced range r'_j , and therefore a predator has $\Delta k = (r_j - r'_j) S = (1 - c) r_j S$ anticipated prey unaccounted for after the range reduction. To account for this, Δk prey (rounded to the nearest integer value) are selected randomly from those species i with niche value $n_i \leq n_j$ that are not already a prey of species j . The parameter c is thus a measure of prey contiguity: for $c = 0$ all prey of j are selected randomly among species with $n_i \leq n_j$ and one recovers the generalized cascade model (Stouffer et al., 2005), whereas for $c = 1$ all prey are contiguous and one recovers the niche model.

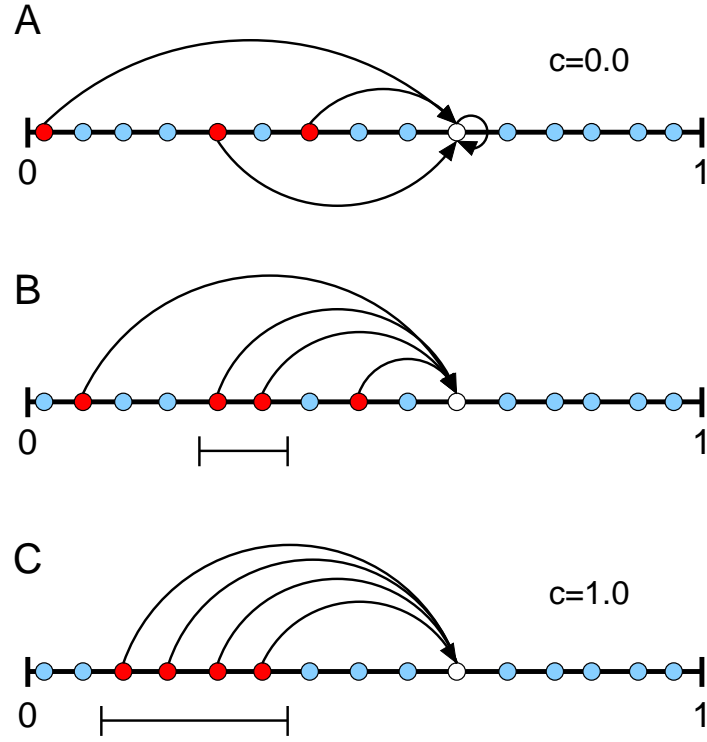


Figure C1: Graphical illustration of the generalized niche model of Stouffer et al. (2006). The circles represent the species i and their location $n_i \in [0, 1]$ is assigned at random from a uniform distribution. We show examples of what predators' diets would resemble for various values of diet contiguity c . In all panels, the white circle represents the example predator and the red circles represent the prey. **A**, The lower limit of diet contiguity, $c = 0$. This limit is equivalent to the generalized cascade model of Stouffer et al. (2005). **B**, Intermediate values of diet contiguity, $0 < c < 1$. **C**, The upper limit of diet contiguity, $c = 1$. This limit is equivalent to the niche model of Williams and Martinez (2000).

References

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