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 $\Delta k = \left( r_j - r'_j \right) S = (1 - c) r_j S$ anticipated prey unaccounted for after the range reduction. To account for this, $\Delta k$ 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

