**Supplementary Material 1.** Mathematical details and description of the belief network model

The network is based on Bayesian Belief Networks (reviewed by Grover, 2013; see Hammond and Ellis, 2002 for an ecological example applied to species interactions), but with several important differences making the application of the networks much more intuitive for application to species interactions, especially for the roles of competition and ‘bottom up’ tropic interactions. Since only some aspects of the described networks are based on Bayesian inference, the models are referred to herein as simply Belief Networks (BNs).

The BN model is implemented using Microsoft Excel 2010, with the use of VBA programming to perform many of the calculations.

Given the parameters specified in the excel worksheets (see methods), intermediate probabilities of each species *increasing* given species interactions are calculated using the following Bayesian equation:

P(Xi|Y)=[P(Xi|Yi)\* P(Yi) + P(Xi|Yd)\* P(Yd)] ,

where X is the species under consideration, and Y are the interacting species, subscripts i and d indicate increasing or decreasing respectively for the species. These values are calculated for each interacting species.

Where there is no knowledge of a change in population of species Y (i.e. the prior probability of change is 0.5) then this species is not included in the above equation (however, such inclusion might occur in the second iteration of the model, see below for details).

At this point, no ‘prior’ information on species X is included in the calculation. To ensure any prior knowledge available is maintained in the network, the overall posterior probability for each species is calculated in two ways, the first ensuring that additional information on species interactions add to the certainty provided by the prior, the second will ignore prior values, if information on species interactions provide more certain information than the prior:

1) Post(Xi) = P(Xi) + |1 - P(Xi)| \* [Σ1-n (P(Xi) \* (P(Xi|Y)-0.5))/ n] ,

and

2) Post(Xi) = [Σ1-n(P(Xi|Y))] / n ,

where n is the number of interactions with species X. The final value of Post(Xi) is given by the value displaying the most certainty (i.e. furthest in magnitude from 0.5). The model is then repeated for a second iteration, but with updated prior probabilities such that:

P(Xi) = Post(Xi) .