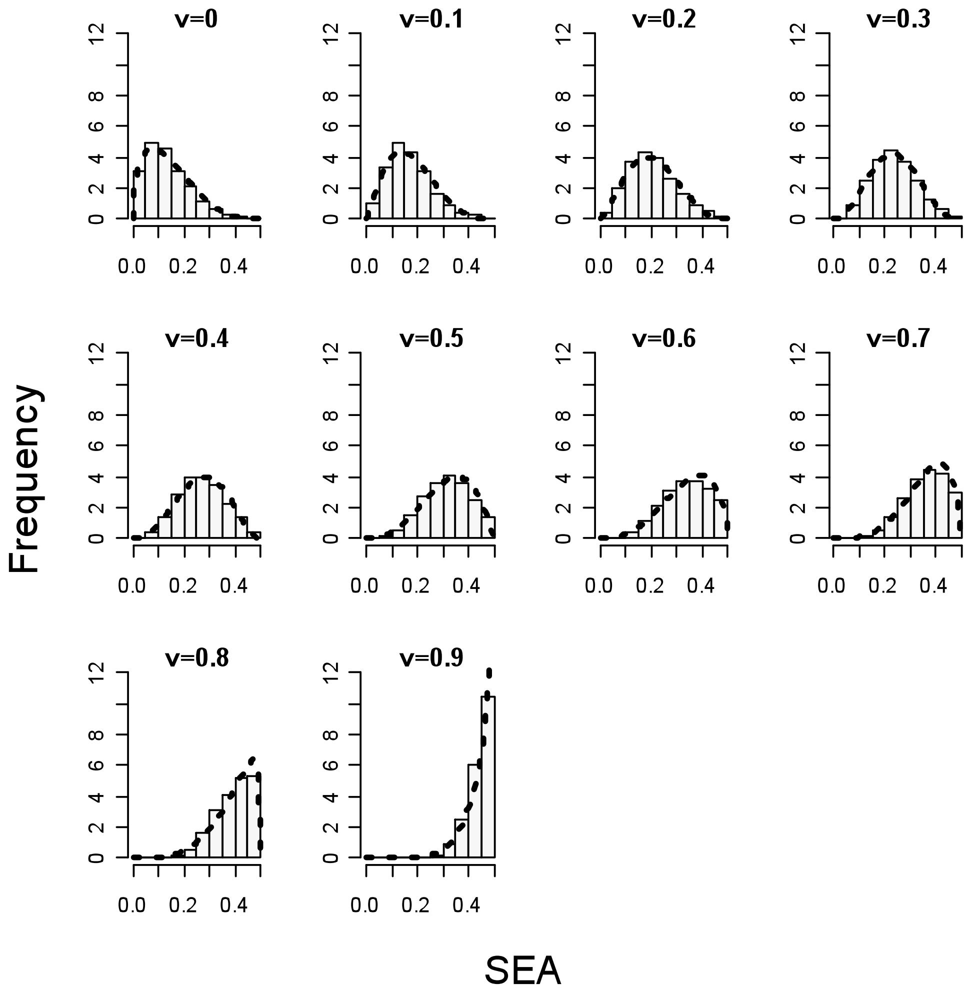
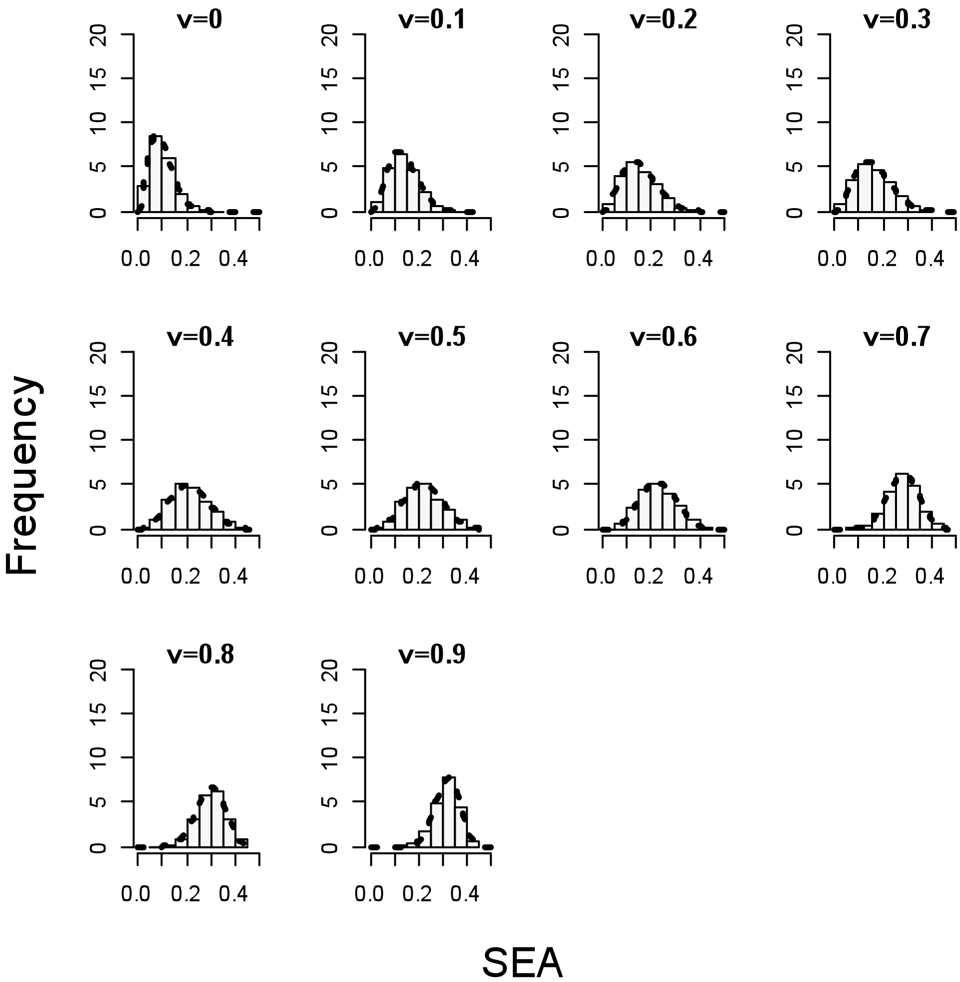
Electronic Supplementary Information

A1 Scaled beta distributions fitted on secondary extinction area (SEA) frequency distributions (10^5 replicates)

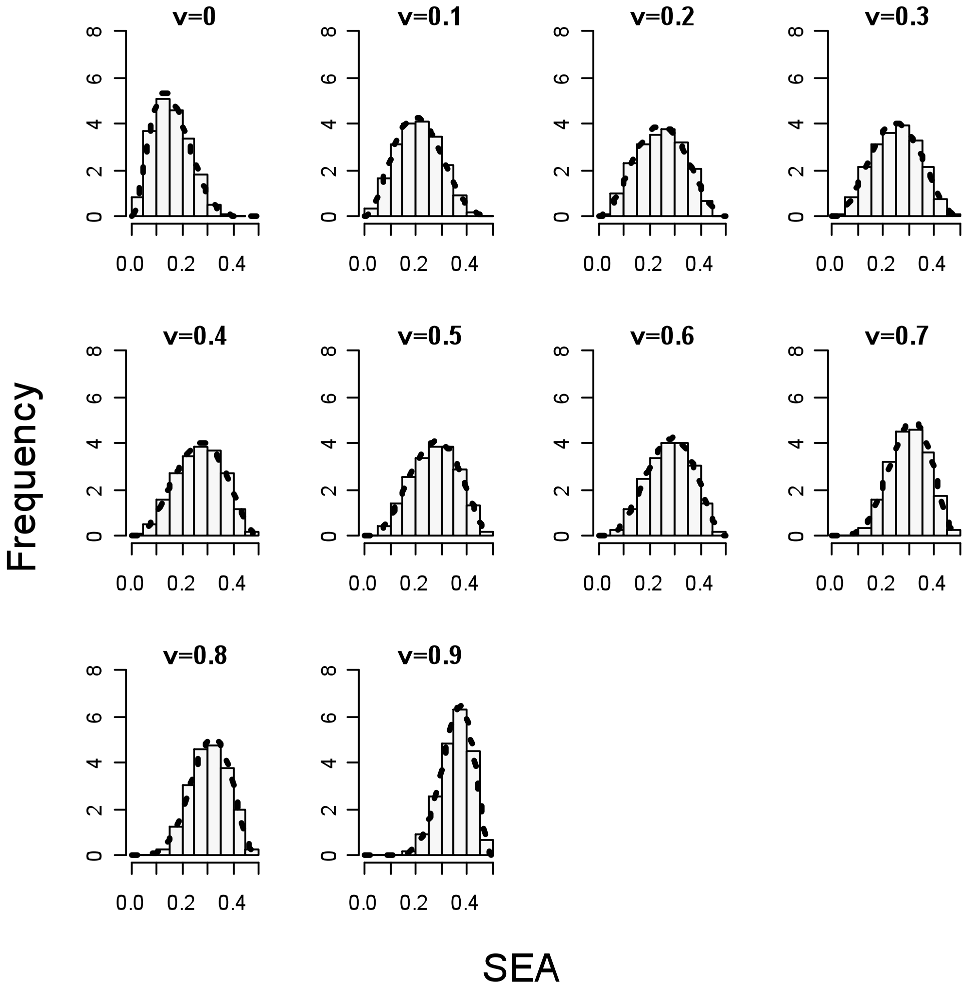
A1.1 NARRAGANSETT BAY FOOD WEB



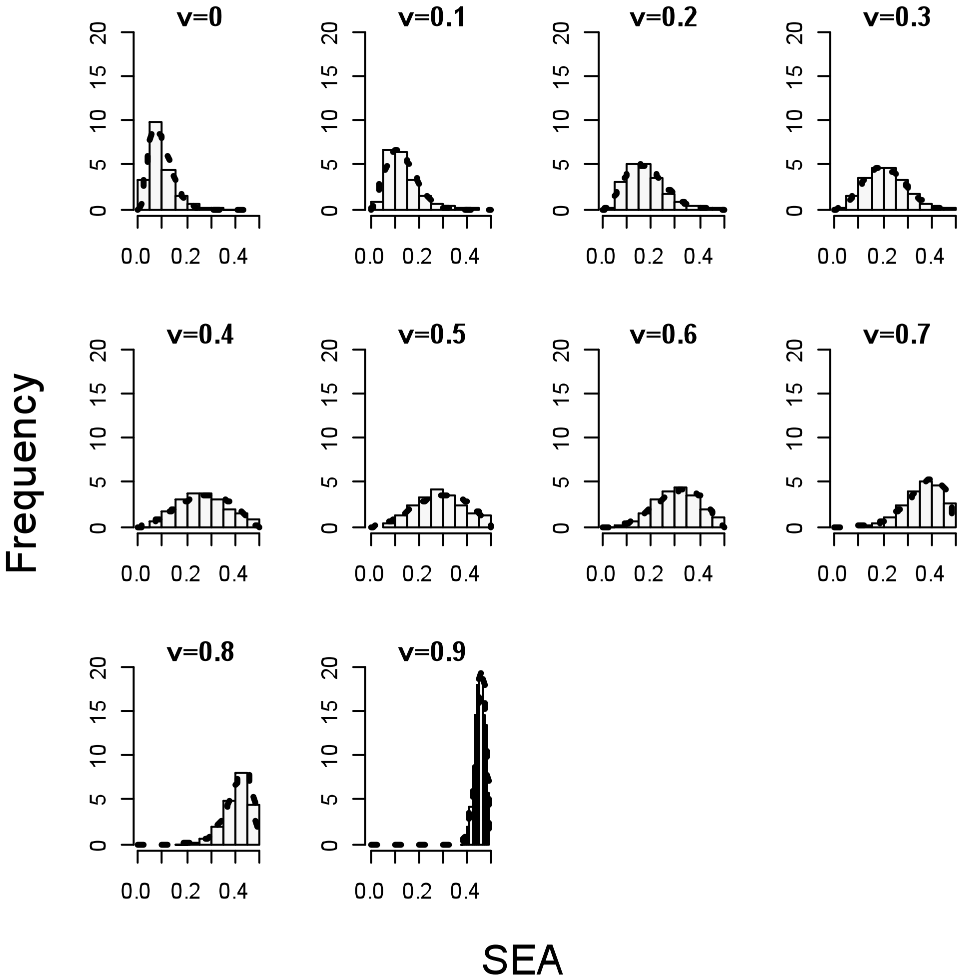
A1.2 CHEASEPEAKE LOWER FOOD WEB



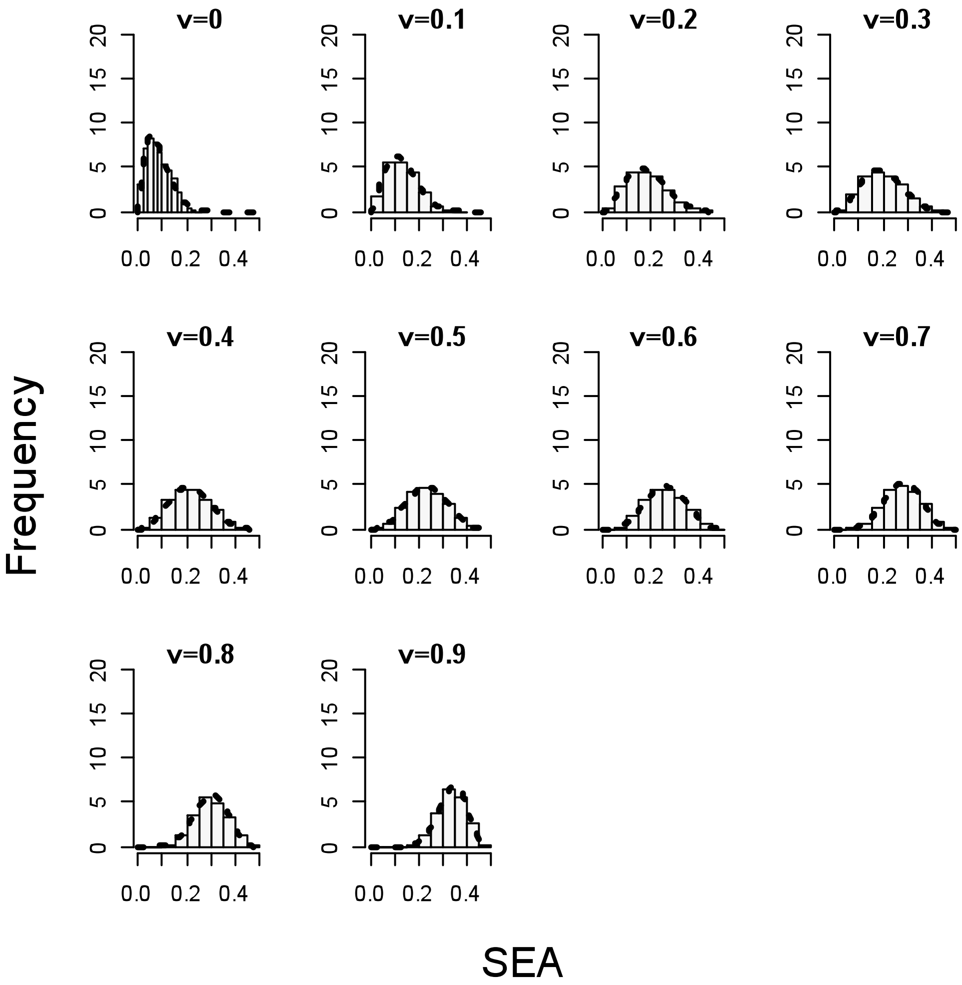
A1.3 CHEASEPEAKE BAY MESOHALINE FOOD WEB



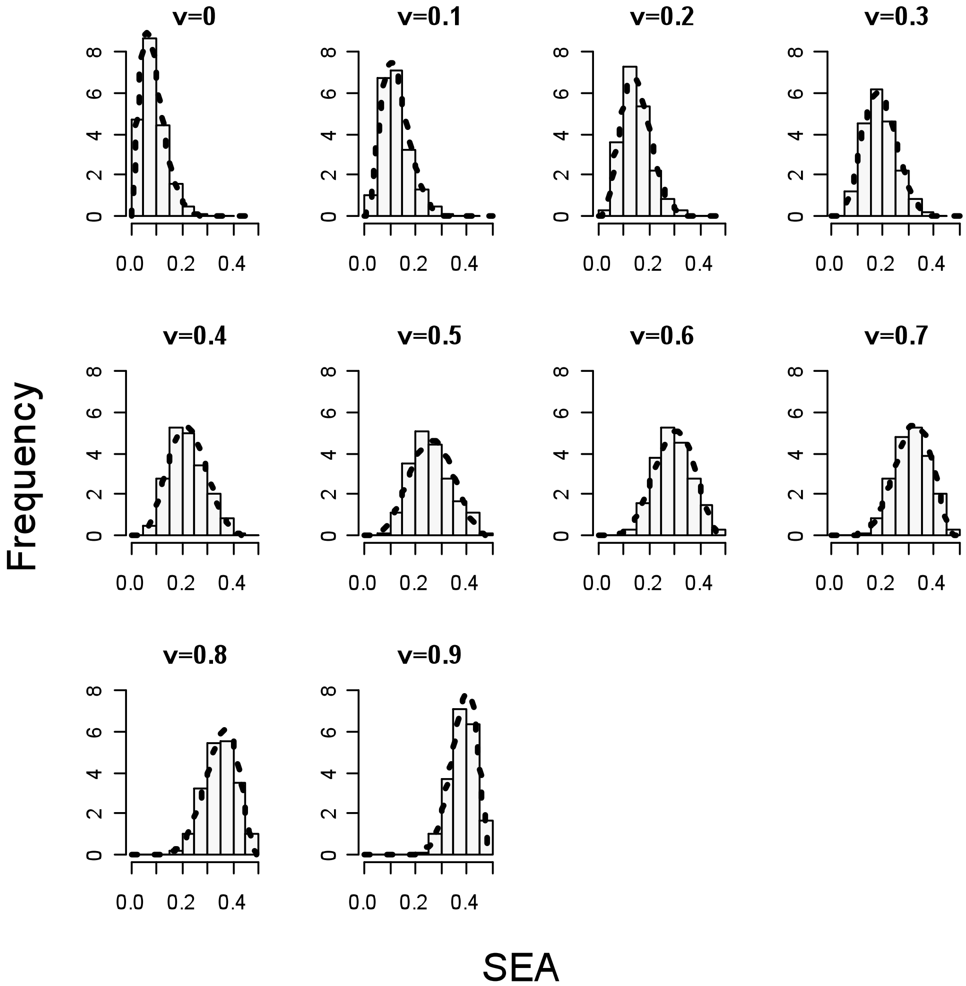
A1.4 LAKE MICHIGAN FOOD WEB



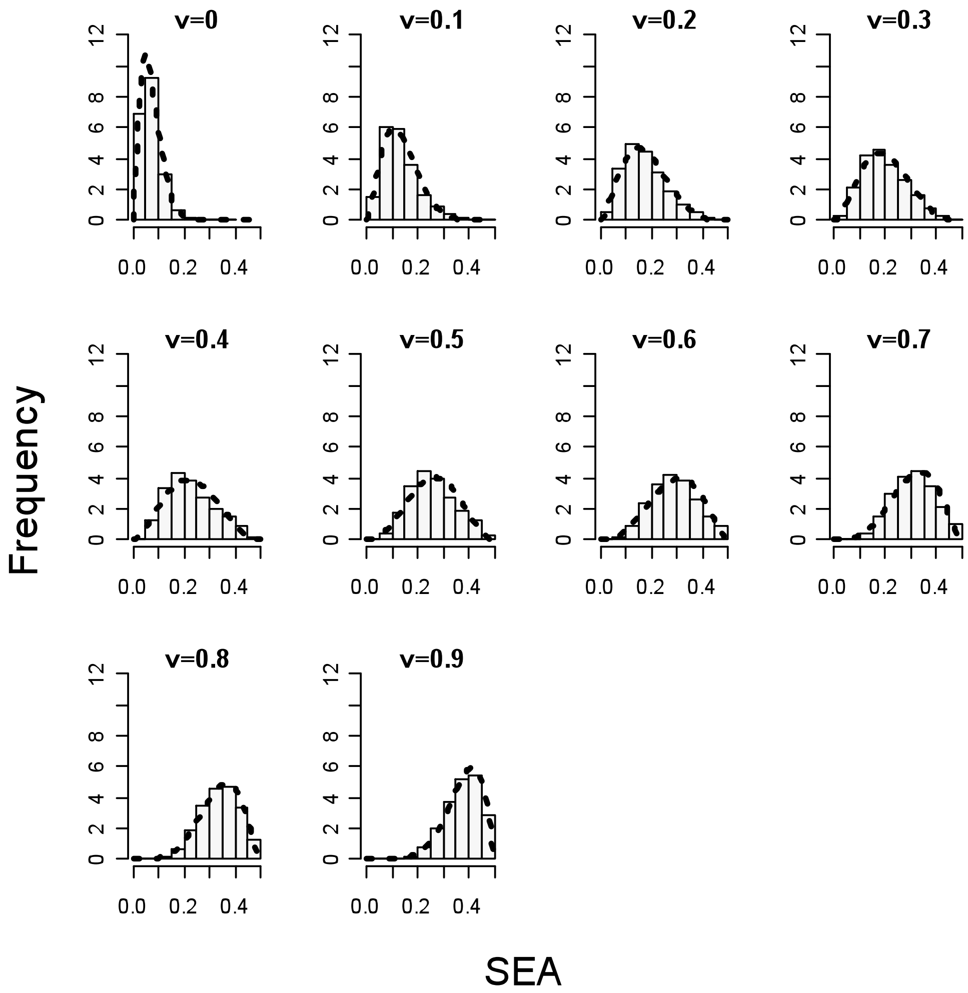
A1.5 MONDEGO ESTUARY FOOD WEB



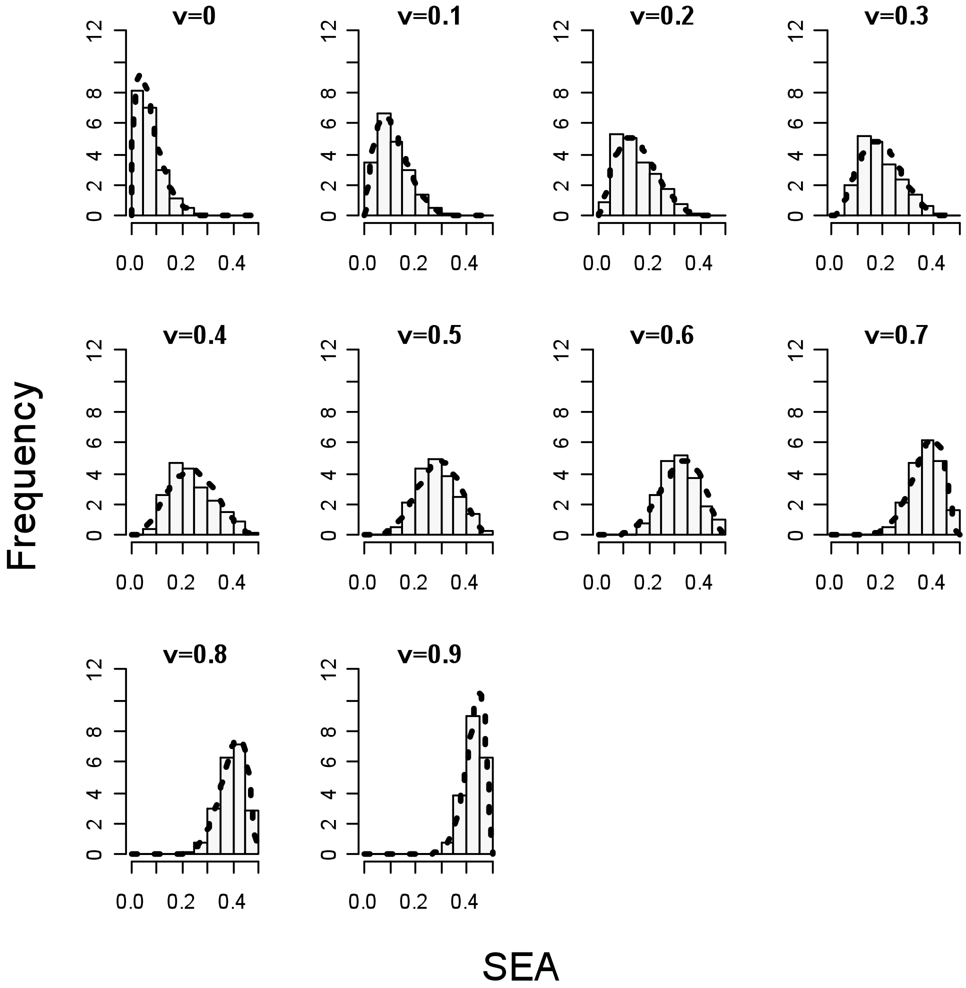
A1.6 ST. MARKS RIVER FOOD WEB



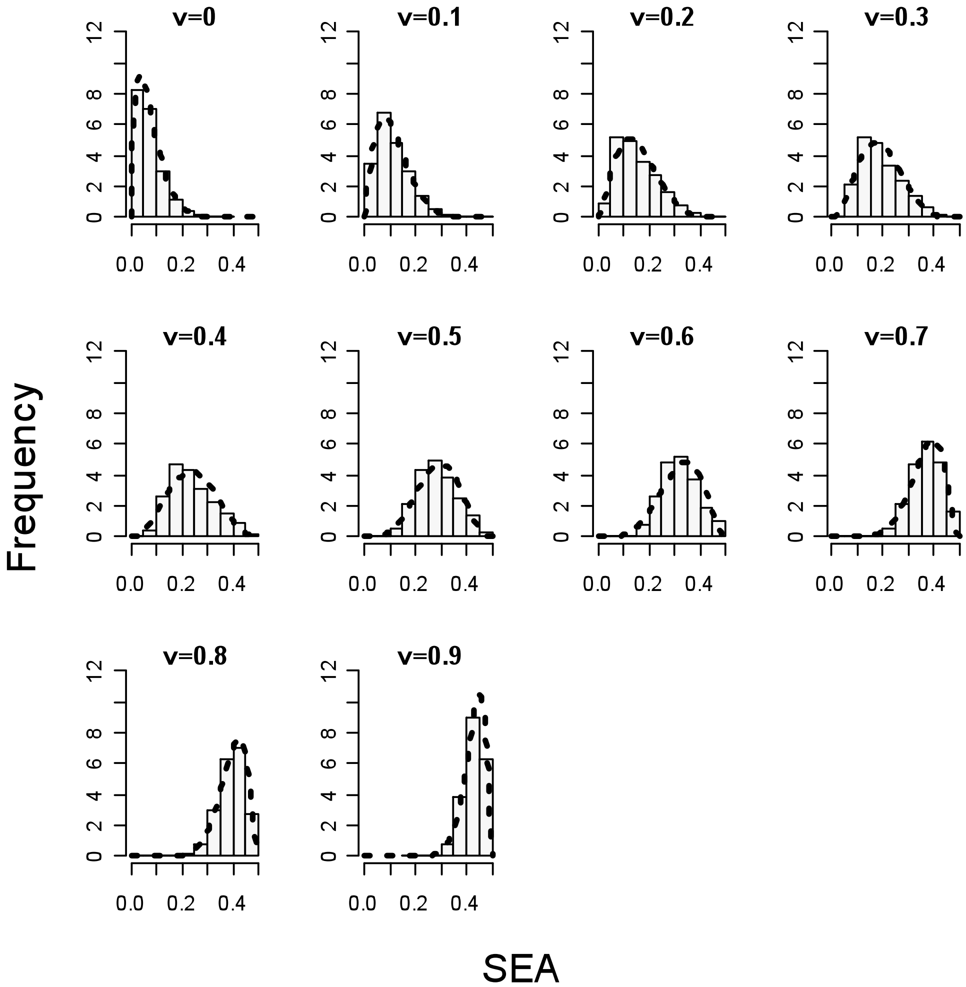
A1.7 EVERGLADES DRY FOOD WEB



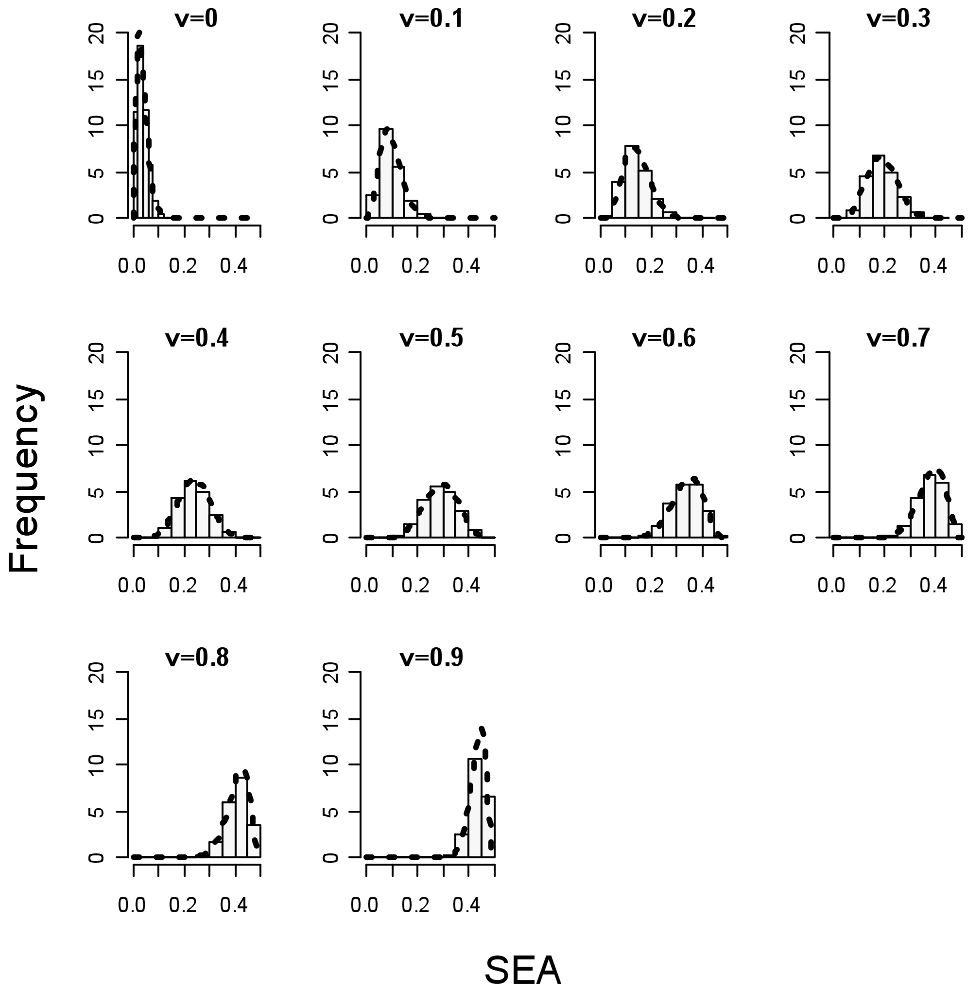
A1.8 CYPRESS WET FOOD WEB



A1.9 MANGROVE DRY FOOD WEB



A1.10 FLORIDA BAY WET FOOD WEB


v=0
v=0.1
v=0.2
v=0.3
v=0.4
v=0.5
v=0.6
v=0.7
v=0.8
v=0.9
Frequency
SEA

A2 Estimates of parameters α and β of scaled beta probability distribution of secondary extinction area.

TABLE A2.1. Estimates of parameters α and β of scaled beta probability distribution of secondary extinction area

2 SEA ~ Be(α,β)

Narragansett Bay	α	β
v=0	1.54	3.94
v=0.1	2.29	4.39
v=0.2	2.64	3.80
v=0.3	3.50	3.92
v=0.4	3.64	3.06
v=0.5	3.72	2.12
v=0.6	3.65	1.71
v=0.7	4.64	1.77
v=0.8	4.57	1.19
v=0.9	6.89	0.87

Cheasepeake Mesohaline	α	β
v=0	3.06	6.53
v=0.1	3.17	4.32
v=0.2	3.22	3.35
v=0.3	3.45	3.46
v=0.4	3.64	3.13
v=0.5	3.85	3.18
v=0.6	4.11	3.22
v=0.7	5.71	3.75
v=0.8	6.12	3.82
v=0.9	9.20	3.71

Cypress wet	α	β
v=0	1.67	9.64
v=0.1	2.21	7.63
v=0.2	2.59	5.81
v=0.3	3.45	5.55
v=0.4	3.54	3.82
v=0.5	5.24	3.88
v=0.6	5.54	3.06
v=0.7	8.30	2.93
v=0.8	10.46	2.75
v=0.9	14.49	2.47

St. Marks river	α	β
v=0	2.68	12.63
v=0.1	3.81	11.67
v=0.2	4.51	10.48
v=0.3	5.20	8.45
v=0.4	4.97	6.22
v=0.5	4.67	4.27
v=0.6	6.00	4.16
v=0.7	7.01	4.12
v=0.8	8.27	3.53
v=0.9	12.71	3.82

Everglades dry	α	β
v=0	1.67	9.64
v=0.1	2.21	7.63
v=0.2	2.59	5.81
v=0.3	3.45	5.55
v=0.4	3.54	3.82
v=0.5	5.24	3.88
v=0.6	5.54	3.06
v=0.7	8.30	2.93
v=0.8	10.46	2.75
v=0.9	14.49	2.47

Mangrove dry	α	β
v=0	1.68	9.68
v=0.1	2.21	7.65
v=0.2	2.59	5.81
v=0.3	3.44	5.56
v=0.4	3.55	3.83
v=0.5	5.19	3.83
v=0.6	5.53	3.05
v=0.7	8.31	2.93
v=0.8	10.33	2.73
v=0.9	14.35	2.44

Florida Bay wet	α	β
v=0	2.59	31.10
v=0.1	3.96	16.52
v=0.2	5.39	13.31
v=0.3	6.44	10.50
v=0.4	7.80	8.42
v=0.5	7.74	5.55
v=0.6	10.012	4.71
v=0.7	11.988	3.82
v=0.8	16.161	3.61
v=0.9	26.294	3.97

Cheasepeake bay lower	α	β
v=0	3.28	13.59
v=0.1	3.78	10.04
v=0.2	3.23	7.25
v=0.3	3.28	6.97
v=0.4	4.19	5.74
v=0.5	4.63	5.91
v=0.6	5.17	6.07
v=0.7	8.31	6.54
v=0.8	10.14	6.87
v=0.9	14.06	8.17

Lake Michigan	α	β
v=0	3.37	14.77
v=0.1	3.32	9.42
v=0.2	3.18	5.43
v=0.3	3.69	5.21
v=0.4	2.89	2.40
v=0.5	3.11	2.26
v=0.6	4.11	2.5
v=0.7	5.94	2.12
v=0.8	10.79	2.38
v=0.9	43.8	4.72

Mondego Estuary	α	β
v=0	2.18	10.79
v=0.1	2.95	8.31
v=0.2	3.13	5.73
v=0.3	3.47	5.34
v=0.4	3.85	5.13
v=0.5	4.43	4.99
v=0.6	4.9	4.57
v=0.7	6.24	4.94
v=0.8	7.76	5.29
v=0.9	11.39	5.54

A3 Secondary extinction area and extinction threshold

TABLE A3.1. Mean value of secondary extinction as a function of extinction threshold and in the binary degree removal scenario.

	v										
	0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**BDR**
NARRAGANSETT	0.14	0.17	0.2	0.23	0.27	0.32	0.34	0.36	0.39	0.44	0.37
CHEASE LOWER	0.096	0.14	0.15	0.16	0.21	0.22	0.23	0.28	0.3	0.32	0.23
CHEASEPEAKE MESO	0.16	0.21	0.24	0.25	0.27	0.27	0.28	0.3	0.31	0.36	0.29
LAKE MICHIGAN	0.092	0.13	0.17	0.21	0.27	0.29	0.31	0.37	0.41	0.45	0.32
MONDEGO ESTUARY	0.084	0.13	0.18	0.19	0.21	0.23	0.26	0.28	0.3	0.34	0.12
ST MARKS	0.08	0.12	0.15	0.19	0.22	0.25	0.29	0.31	0.35	0.38	0.27
EVERGLADES DRY	0.071	0.13	0.17	0.2	0.22	0.26	0.3	0.31	0.34	0.38	0.24
CYPRESS WET	0.073	0.11	0.14	0.17	0.24	0.29	0.32	0.37	0.39	0.43	0.28
MANGROVE DRY	0.073	0.11	0.15	0.19	0.24	0.29	0.32	0.37	0.39	0.42	0.16
FLORIDA WET	0.038	0.096	0.14	0.19	0.24	0.29	0.33	0.38	0.4	0.43	0.14

TABLE A3.2. Parameters estimates±se for the linear regression of mean SEA on extinction threshold for all food webs. p is always less than 0.01.

	Slope	**Intercept**
NARRAGANSETT	0.33± 0.0097	0.14±0.0052
CHEASE LOWER	0.24±0.0120	0.10±0.0064
CHEASEPEAKE MESO	0.17± 0.0018	0.19± 0.0096
LAKE MICHIGAN	0.39±0.012	0.09±0.0057
MONDEGO ESTUARY	0.25±0.014	0.10±0.0078
ST MARKS	0.33± 0.005	0.09± 0.00264
EVERGLADES DRY	0.32± 0.0013	0.09± 0.0072
CYPRESS WET	0.41± 0.014	0.07± 0.0073
MANGROVE DRY	0.40± 0.0112	0.07± 0.006
FLORIDA WET	0.44± 0.015	0.05± 0.0081

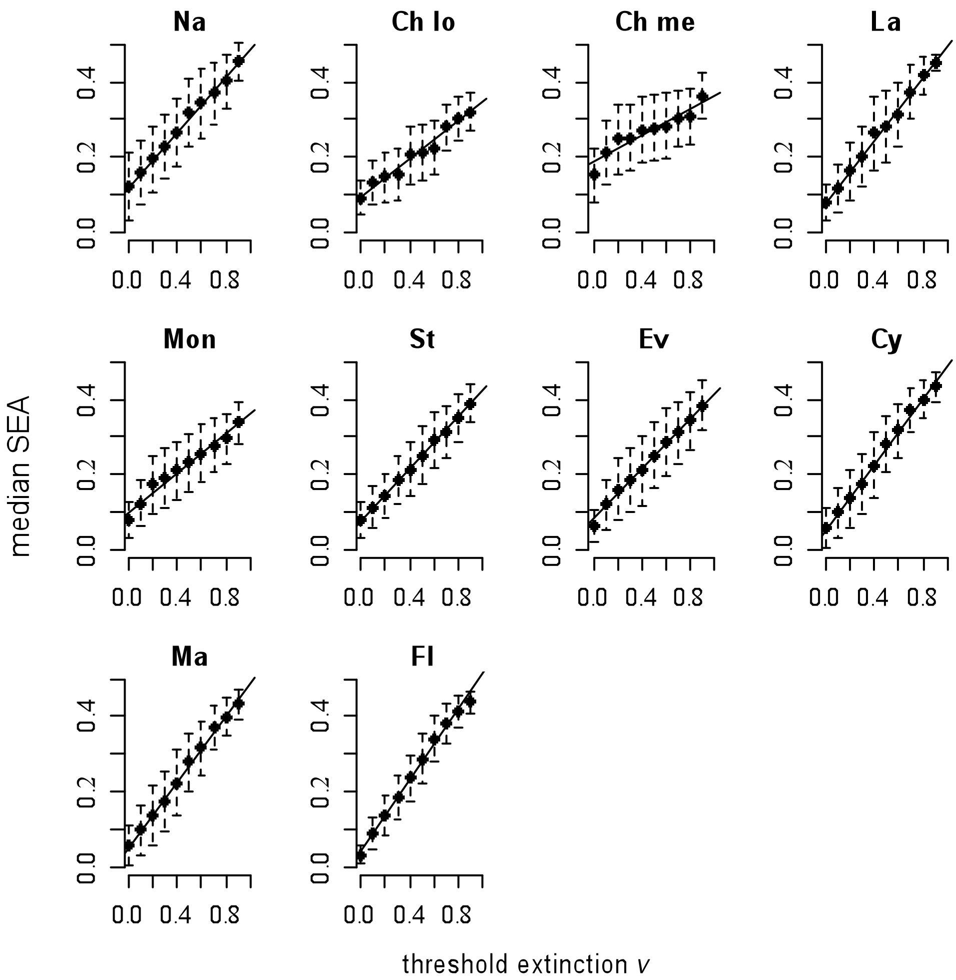
TABLE A3.3. Fraction of secondary extinction events higher than binary most connected removal as a function of extinction threshold. BDR indicates the secondary extinction area by removal from the most-connected to the least-connected. BDR reported in the table is the average of 100 replicates, since there species may have the same number of number of links.

	v										
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	BDR
NARRAGANSETT	0.02	0.027	0.049	0.069	0.149	0.295	0.393	0.489	0.657	0.91	0.37
CHEASE LOWER	0.009	0.069	0.156	0.179	0.39	0.43	0.49	0.80	0.88	0.95	0.23
CHEASEPEAKE MESO	0.04	0.193	0.34	0.35	0.43	0.45	0.47	0.56	0.59	0.85	0.29
LAKE MICHIGAN	0.002	0.012	0.047	0.084	0.3	0.36	0.46	0.76	0.96	1	0.32
MONDEGO ESTUARY	0.27	0.57	0.84	0.9	0.95	0.97	0.992	0.997	1	1	0.12
ST MARKS	0.002	0.015	0.04	0.11	0.24	0.4	0.61	0.72	0.89	0.98	0.27
EVERGLADES DRY	0.004	0.079	0.207	0.296	0.390	0.5496	0.693	0.792	0.891	0.967	0.24
CYPRESS WET	0.004	0.018	0.074	0.15	0.293	0.5	0.69	0.92	0.98	0.998	0.28
MANGROVE DRY	0.08	0.212	0.56	0.804	0.963	0.993	0.999	1	1	1	0.16
FLORIDA WET	0.0003	0.15	0.47	0.79	0.96	0.997	0.999	1	1	1	0.14

TABLE A3.4. Median value of secondary extinction as a function of extinction threshold.

	v									
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
NARRAGANSET	0.1215	0.1581	0.1935	0.2290	0.2667	0.3193	0.3419	0.3688	0.4021	0.4537
CHEASE LOWER	0.0913	0.1312	0.1462	0.1526	0.2043	0.2139	0.2247	0.2795	0.3000	0.3204
CHEASEPEAKE MESO	0.1534	0.2102	0.2471	0.2509	0.2727	0.2774	0.2831	0.3020	0.3077	0.3617
LAKE MICHIGAN	0.0806	0.1159	0.1639	0.2025	0.2630	0.2823	0.3109	0.3731	0.4159	0.4513
MONDEGO ESTUARY	0.0773	0.1237	0.1736	0.1905	0.2096	0.2317	0.2561	0.2770	0.2950	0.3374
ST MARKS	0.0784	0.1134	0.1418	0.183	0.2136	0.2508	0.2907	0.3133	0.3506	0.3874
EVERGLADES DRY	0.0640	0.1195	0.1612	0.1863	0.2114	0.2511	0.2864	0.3110	0.3425	0.3837
CYPRESS WET	0.0598	0.0986	0.1361	0.1764	0.2244	0.2803	0.3158	0.3715	0.3992	0.4311
MANGROVE DRY	0.0599	0.0981	0.1374	0.1754	0.2244	0.2797	0.3157	0.3715	0.3990	0.4322
FLORIDA WET	0.0341	0.0890	0.1371	0.1836	0.2365	0.2882	0.3416	0.3813	0.4122	0.4374

FIGURE A3.1. Linear models of median SEA as a function of extinction threshold . (Na) Narragansett food web, species richness S = 31; (Ch lo) Cheasepeake bay lower food web, S = 31; (Ch me) Cheasepeake bay mesohaline food web, S = 33; (La) Lake Michigan food web, S = 35; (Mo) Mondego Estuary food web, S = 42; (St) St Marks, S = 48; (Ev) Everglades dry food web, S = 63; (Cy) Cypress wet food web, S = 65; (Ma) Mangrove dry food web, S = 91; (Fl) Florida Bay wet food web, S =123. Dashed lines represent ± sd of the empirical distribution of SEA.



A4 Further work

Our extinction scenario assumes that all species have the same sensitivity to energy intake decrease. It is likely that different species will display different sensitivity to the loss of their resources [1]. This variability may depend on a species' population size, body mass, diet specialization or trophic level. A straightforward and intriguing extension of the model presented in our work is the analysis of how food web robustness changes when there is heterogeneity in species sensitivity to loss of incoming energy.

Another relevant assumption in our study is that species go extinct at random, although this happens rarely (i.e. as after a catastrophic event), and the order in which species are lost largely affects network response [2,3]. An additional extension is thus the analysis of food web response to species loss combining energetic criteria with different extinction sequences, based on traits such as the number of links of the species, trophic level, body size or others specific and relevant characteristics.

The model presented in this study is in a bottom-up perspective and does not take into account top–down extinction cascades. Detecting such cascades requires an analysis based on dynamical models, such as Lotka-Volterra and allometric bioenergetic models, where changes in the abundances of species are introduced [4,5]. However, the acquisition of such information for empirical food webs is clearly cumbersome and rarely available for complex food webs.

Finally, the scenarios we analysed can be interpreted as worst-case scenario, since changes in trophic interactions ("rewiring") are likely to follow species loss, a process potentially increasing the robustness of the food web [6].

A5 References

1 Binzer, A., Brose, U., Curtsdotter, A., Eklöf, A., Rall, B. C., Riede, J. O. & De Castro, F. 2011 The susceptibility of species to extinctions in model communities. *Basic and Applied Ecology* **12**, 590–599. (doi:10.1016/j.baae.2011.09.002)

2 Allesina, S. & Pascual, M. 2009 Googling food webs: can an eigenvector measure species' importance for coextinctions? *PLoS Computational Biology* **5**, e1000494. (doi:10.1371/journal.pcbi.1000494)

3 Srinivasan, U. T., Dunne, J. a, Harte, J. & Martinez, N. D. 2007 Response of complex food webs to realistic extinction sequences. *Ecology* **88**, 671–82.

4 Eklof, A. & Ebenman, B. 2006 Species loss and secondary extinctions in simple and complex model communities. *Journal of Animal Ecology* **75**, 239–246. (doi:10.1111/j.1365-2656.2006.01041.x)

5 Berlow, E. L. 1999 Strong effects of weak interactions in ecological communities. *Nature* **398**, 330–334.

6 Staniczenko, P. P. A., Lewis, O. T., Jones, N. S. & Reed-Tsochas, F. 2010 Structural dynamics and robustness of food webs. *Ecology Letters* **13**, 891–9. (doi:10.1111/j.1461-0248.2010.01485.x)