Oikos

OIK-05575

Kuparinen, A., Perälä, T., Martinez, N. D. and Valdovinos, F. S. 2019. Environmentally-induced noise dampens and reddens with increasing trophic level in a complex food web. – Oikos doi: 10.1111/oik.05575

Appendix 1

Table A1. The Lake Constance food web with size-related parameters and prey ranges. Adapted from Boit et al. (2012) and Kuparinen et al. (2016). Node connectivity and short-weighted trophic level are calculated by Network3D (Yoon et al. 2004, Williams 2010).

ID	Name	Description	Body Mass†	x_i, r_i‡	Diet. ID*	Connectivity	Trophic level
0	DOC	Pool of dissolved organic carbon	n.a.	n.a.	n.a.	n.a.	n.a.
1	Alg1	Single-cell algae	6.40E-05	1	n.a.	1.015038	1
2	Alg2	Large, single-cell algae or colonies	2.56E-04	0.9	n.a.	0.7894737	1
3	Alg3	Filamentous blue and green algae	3.20E-05	1.09	n.a.	0.5639098	1
4	Alg4	Diatoms, algal colonies	1.28E-04	1	n.a.	0.6766917	1
5	Alg5	Small, coccal algae	8.00E-06	1.2	n.a.	1.015038	1
6	APP	Autotrophic picoplankton	2.50E-07	0.6	n.a.	0.6766917	1
7	Bac	Heterotrophic bacteria	1.56E-08	0.04	0	0.6766917	1
8	HNF	Heterotrophic nanoflagellates, **B**§	8.00E-06	0.43	6-7	1.353383	2
9	Cil1	Small ciliates, **B**	2.56E-04	0.14	6-7	0.9022556	2
10	Cil2	Small ciliates, **B/H**	2.05E-03	0.18	1,5-8	1.015038	2.1
11	Cil3	Medium-size ciliates, **H**	4.10E-03	0.15	1-2,5,8	0.9022556	2.125
12	Cil4	Medium-size ciliates, **H**	8.19E-03	0.15	1,5,8	0.6766917	2.166667
13	Cil5	Larger ciliates, **O**	6.55E-02	0.1	1-2,4-5,8-11	1.240602	2.278125
14	Rot1	Small rotifers, **B/H**	1.64E-02	0.13	1,5-8	1.12782	2.1
15	Rot2	Medium-size rotifers, **H**	3.28E-02	0.12	1-9	1.578947	2.111111
16	Rot3	Large rotifers, **O**	6.55E-02	0.11	1-5,8-9	1.353383	2.142857
17	Asp	Large rotifers, **C**	6.55E-02	0.12	2-4,8-16	1.804511	2.460313
18	Cru	Mostly cladocerans (daphnids), **H/O**	8.39E+00	0.07	1-16	2.932331	2.345235
19	Cyc	Cyclopoid copepods, **O/C**	1.05E+00	0.07	1-5,8- 17	2.706767	2.432272
20	Lep	Large, carnivorous cladocerans, **C**	6.71E+01	0.04	17-18	1.015038	3.402774
21	Lar1	whitefish larvae, **C**	1.28E+3	0.143	14-19	1.015038	3.265298
22	Lar2	perch larvae, **C**	4.56E+2	0.159	14-19	1.015038	3.265298
23	Juv1	whitefish juveniles, **C**	2.51E+6	0.062	18-20	0.5639098	3.560094
24	Juv2	perch juveniles, **C**	1.35E+6	0.066	18-20	0.5639098	3.560094
25	2yr1	2yr whitefish, **C**	1.32E+7	0.052	18-20	0.3383459	3.560094
26	2yr2	2yr perch, **C**	6.42E+6	0.056	18-22	0.5639098	3.642175
27	3yr1	3yr whitefish, **C**	3.10E+7	0.047	18-20	0.3383459	3.560094
28	3yr2	3yr perch, **C**	1.37E+7	0.051	18-24	0.7894737	3.761581
29	4yr1	4yr and older whitefish, **C**	5.24E+7	0.045	18-20	0.3383459	3.560094
30	4yr2	4yr and older perch, **C**	2.14E+7	0.049	21-24	0.4511278	4.412696

†in (µgC/ind).
‡mass-specific relative growth rate r and metabolic rate x of guild i (1/day); scaling is done with respect to the growth rate of guild 1.
*ID of resource guild.

[§]General diet description (B = bacterivore, H = herbivore, C = carnivore, O = omnivore).

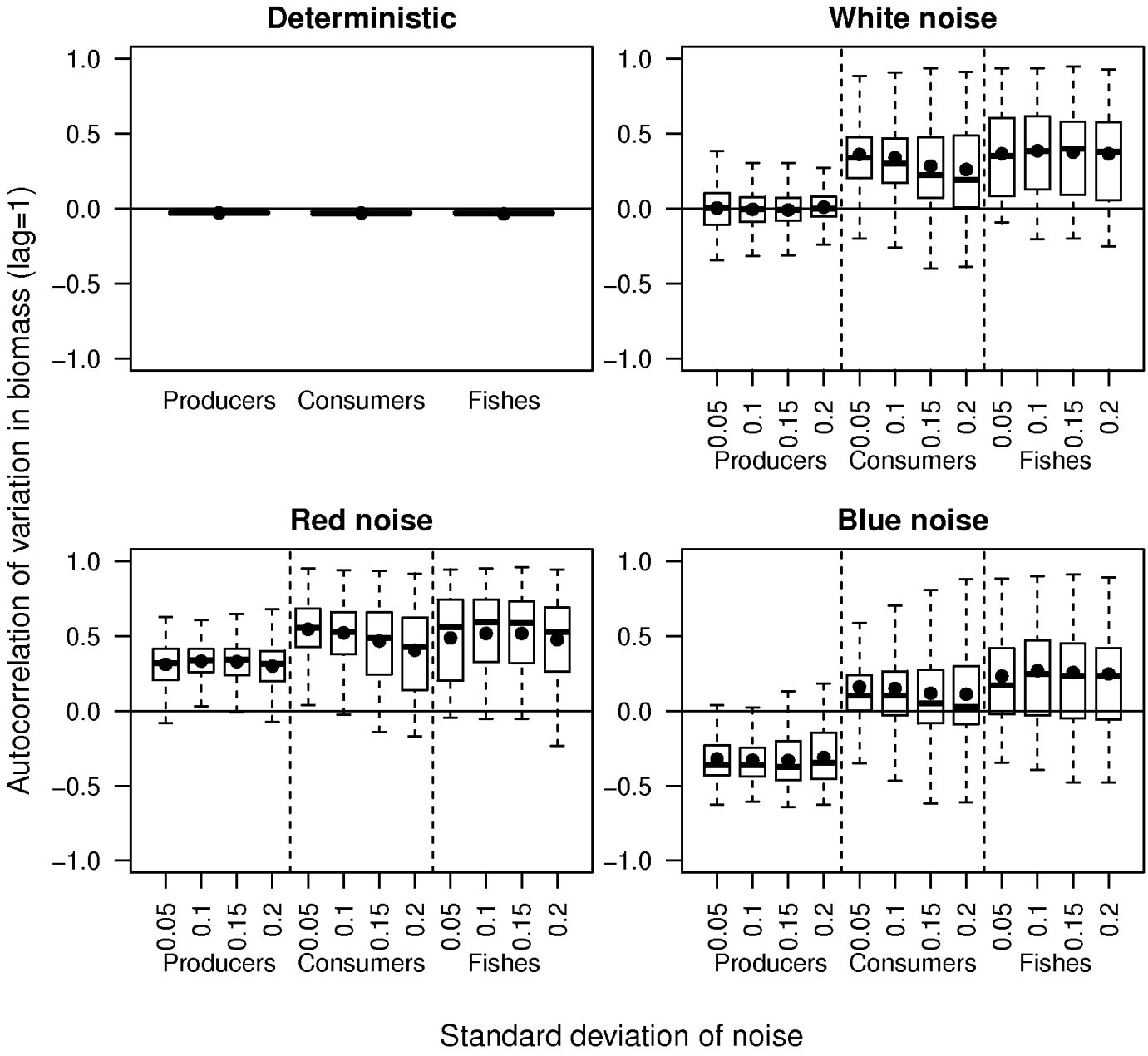

Figure A1. Autocorrelation coefficients at lag = 1 for the temporal abundance of producers, consumers, and fishes. Values above zero indicate positive autocorrelation, values below zero negative autocorrelation, and values about zero no autocorrelation. The standard deviations of normally distributed noise induced to the phytoplankton carrying capacity are indicated on the x-axis (0.05–0.2) and the noise colour scenarios as well as deterministic food web dynamics in the absence of noise are shown in separate panels. Medians are indicated by horizontal lines, boxes span the inter-quartile range, and whiskers encompass values 1.5 box lengths away from the box. Outliers are not shown.

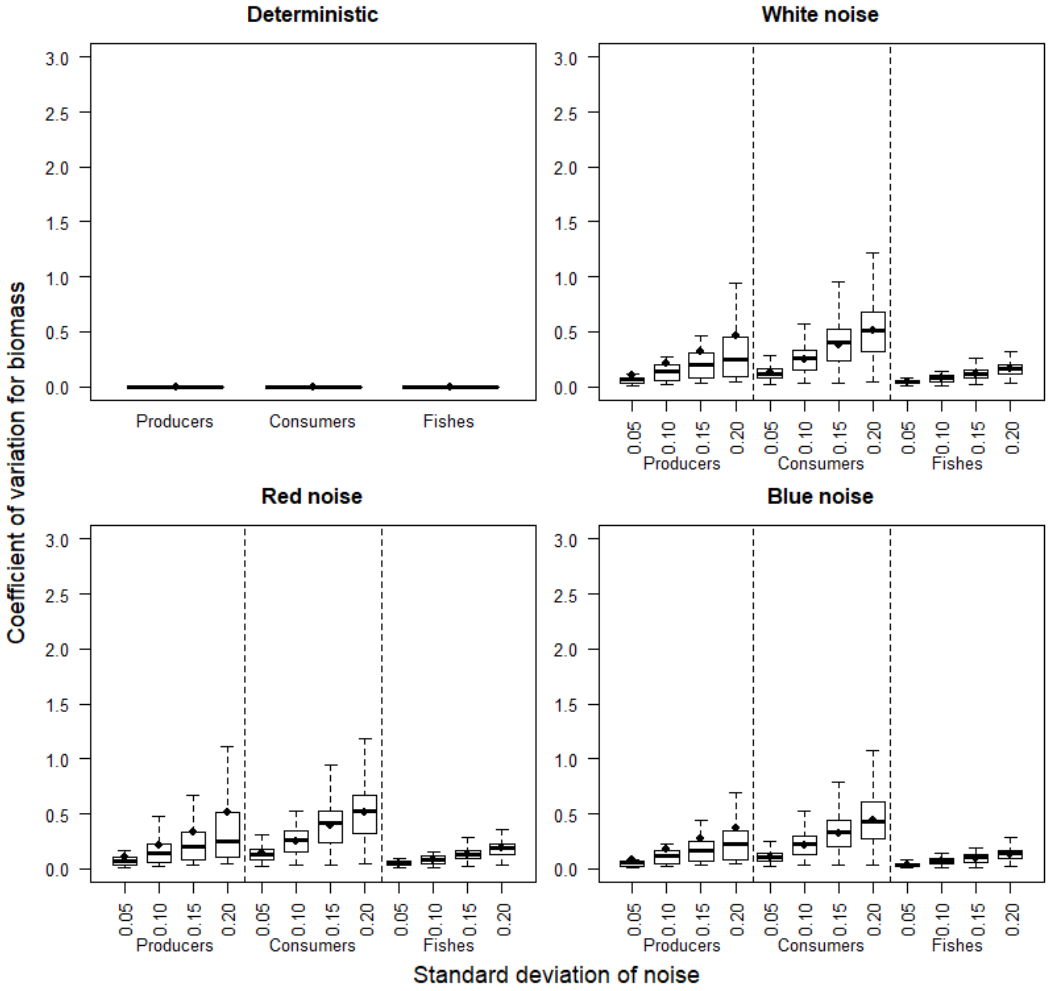

Figure A2. This figure is analogous to Fig. 3 in the main text and it shows results derived using the alternative method to introduce noise in the bottom of the food web (Eq. 11 in the main text). Coefficients of variation (*CV*) for the biomasses of producers, consumers, and fishes under alternative noise scenarios. The standard deviations of normally distributed noise introduced into the phytoplankton carrying capacity are indicated on the x-axis (0.05–0.2) and the noise colour scenarios as well as deterministic food web dynamics in the absence of noise are shown in separate panels. Medians are indicated by horizontal lines, boxes span the inter-quartile range, and whiskers encompass values 1.5 box lengths away from the box. Averages are plotted with black bullets. Outliers are not shown.

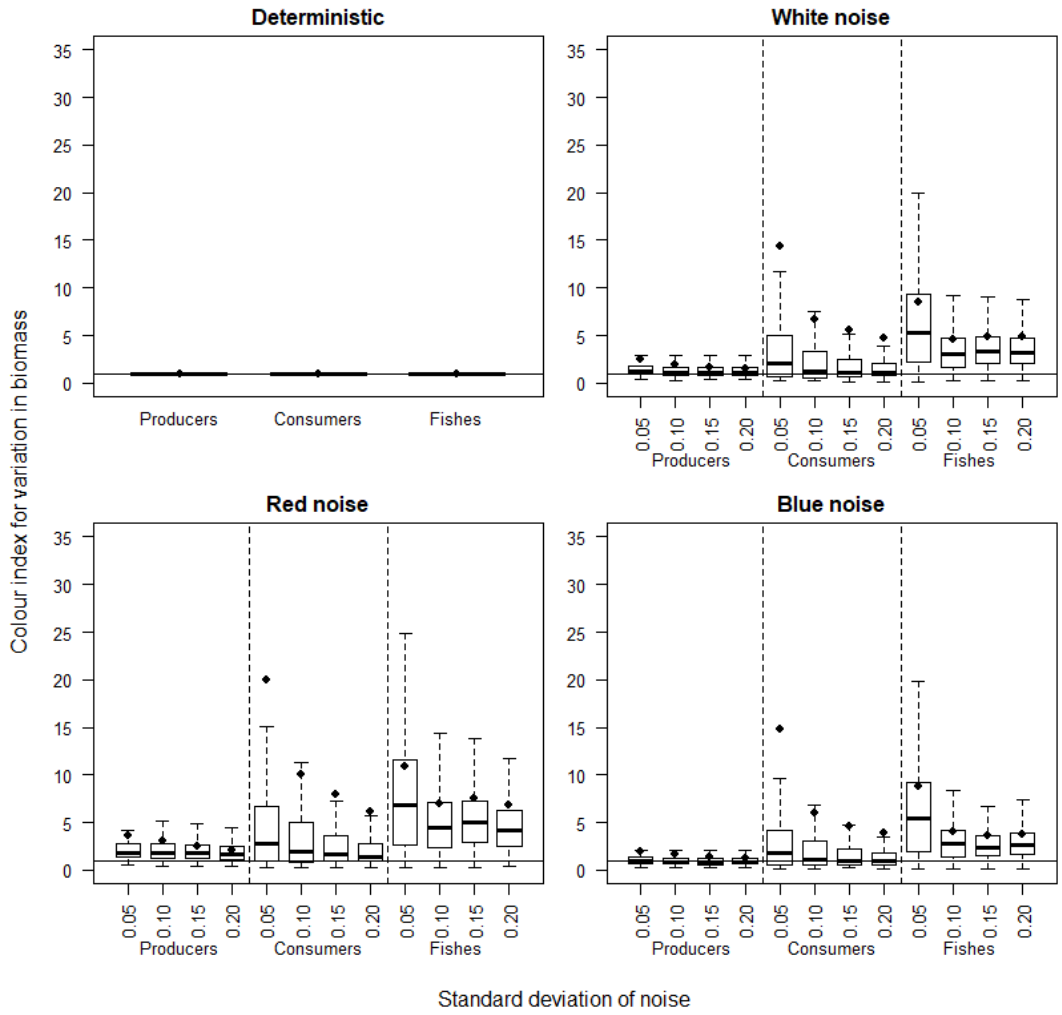

Figure A3. This figure is analogous to Fig. 4 in the main text and it shows results derived using the alternative method to introduce noise in the bottom of the food web (Eq. 11 in the main text). Colour indexes for the temporal biomass variability of producers, consumers, and fishes under alternative noise scenarios. Colour index values below one (horizontal line) indicate blue (negatively autocorrelated) variation, values above one red (positively autocorrelated) variation, and values close to 1 indicate white (non-autocorrelated) variation. Other figure elements are the same as in Fig. A3. The distributions of the colour index values were highly skewed, which is reflected in the discrepancy between the averages and the medians, the latter being generally more robust with respect to outliers than the former.

References

Boit, A. et al. 2012. Mechanistic theory and modelling of complex food-web dynamics in Lake Constance. – Ecol. Lett. 15: 594–602.

Kuparinen, A. et al. 2016. Fishing-induced life-history changes degrade and destabilize harvested ecosystems. – Sci. Rep. 6: 22245.

Williams, R. J. 2010. Network 3D: visualizing and modelling food webs and other complex networks. – Microsoft Research - Cambridge. <http://networkvisualization.org/918>.

Yoon, I. et al. 2004. Webs on the Web (WoW): 3D visualization of ecological networks on the WWW for collaborative research and education. – Proc. IS&T/SPIE Symp. on electronic imaging, visualization and data analysis 5295: 124–132.