Eco-evolutionary feedbacks promote fluctuating selection and long-term stability of species-rich antagonistic networks

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Supporting Information

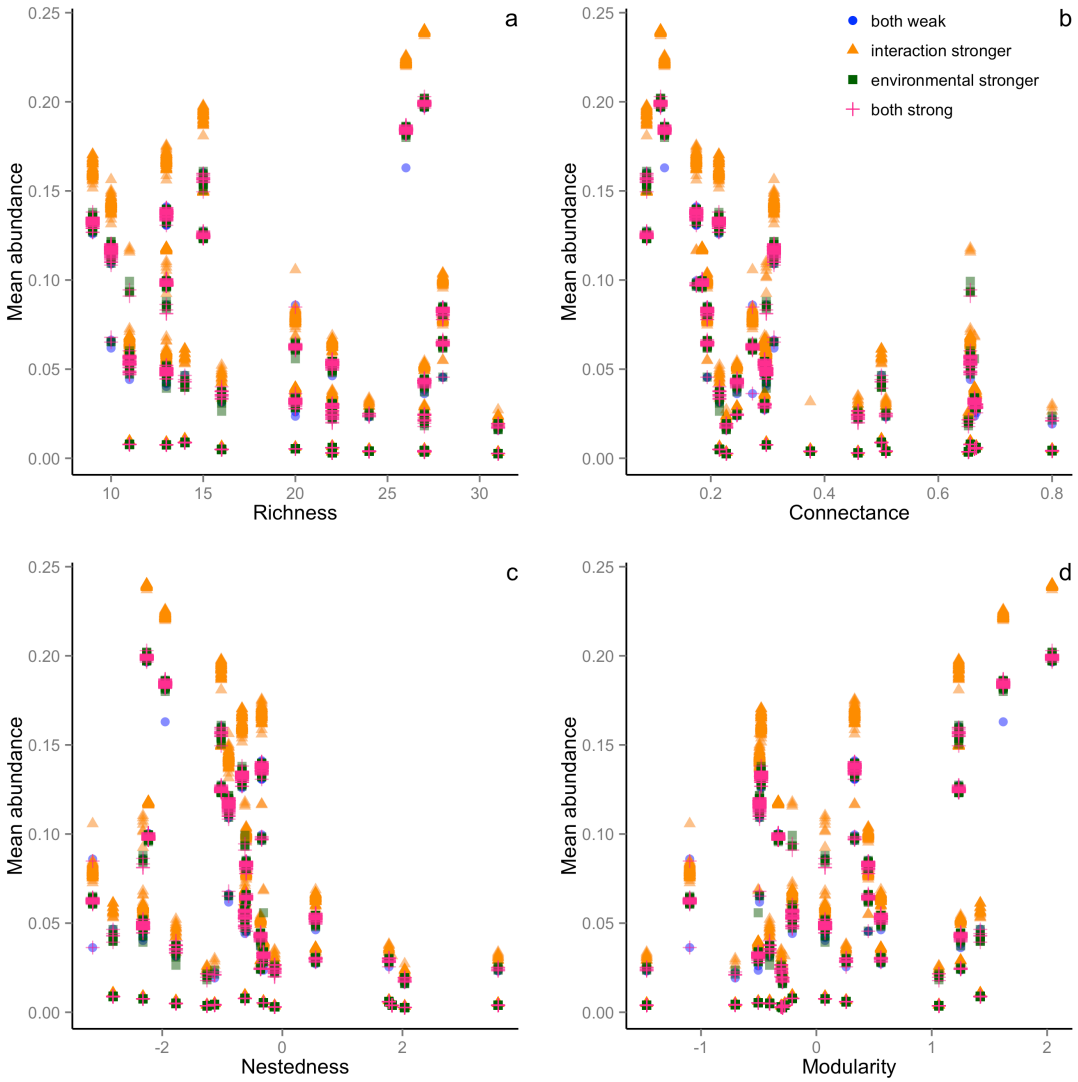

Figure S1: Effect of Richness (a), Connectance (b), Nestedness (c) and Modularity (d) on community mean abundance. Each dot represents species abundance, in average for a network on each replicate. Results shown for the scenarios with both environmental and interaction selection weak (blue), strong (pink), stronger interaction than environmental selection (orange) and stronger environmental than interaction selection (green). Colors are transparent such that darker colors represent a high overlay of points.

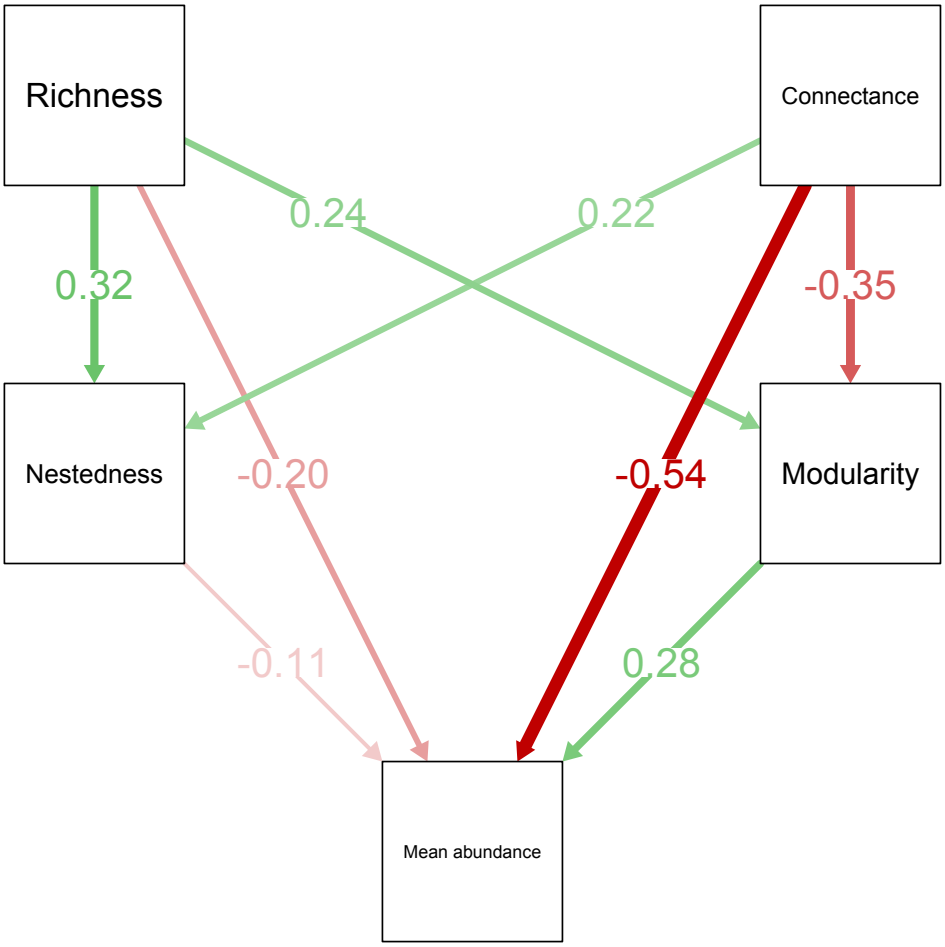

Figure S2: Summary diagram of the effects of network architectural patterns on community mean abundance. The thickness of the arrows is scaled to the standardized coefficients from the path analysis (Goodness of fit (GFI) = 0.93, Root Mean Square Error of Approximation (RMSEA) = 0.32, Comparative Fit Index (CFI) = 0.86) and illustrates the relative effect strength. Positive and negative effects are represented in green and red colors, respectivelly. The effects of connectance and richness are split between direct effects and indirect effects through changes in modularity and nestedness. The strength of the indirect effects are calculated as the product of the coefficients along the path. For example, connectance has a direct effect on community mean abundance (-0.54), an indirect effect through modularity (-0.098; -0.35 × 0.28), and an indirect effect through nestedness (-0.0242; 0.22 × -0.11), which leads to an overall connectance effect of -0.6622.

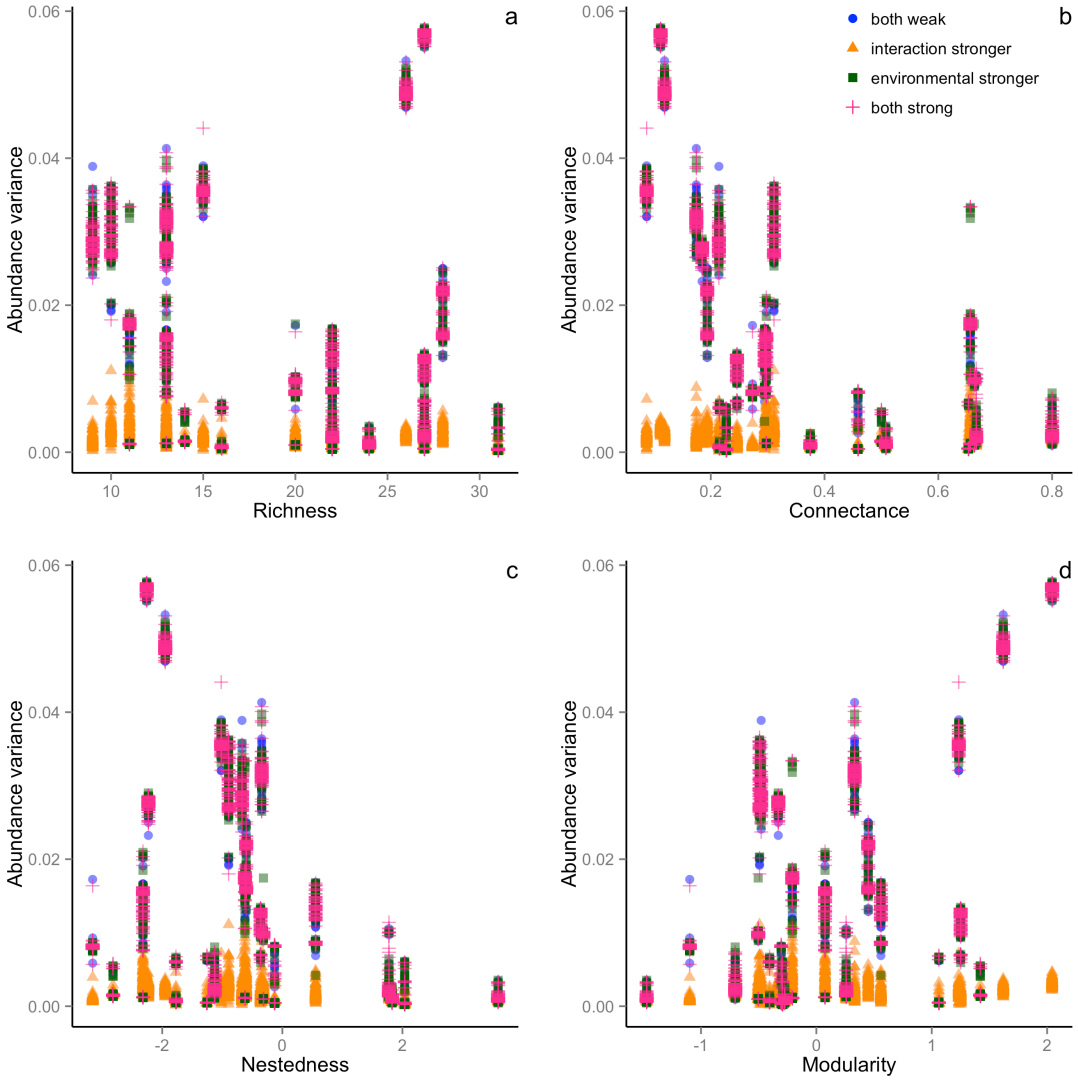

Figure S3: Effect of Richness (a), Connectance (b), Nestedness (c) and Modularity (d) on community abundance variance. Each dot represents a network average species abundance temporal variance on each replicate. Results shown for the scenarios with both environmental and interaction selection weak (blue), strong (pink), stronger interaction than environmental selection (orange) and stronger environmental than interaction selection (green). Colors are transparent such that darker colors represent a high overlay of points.

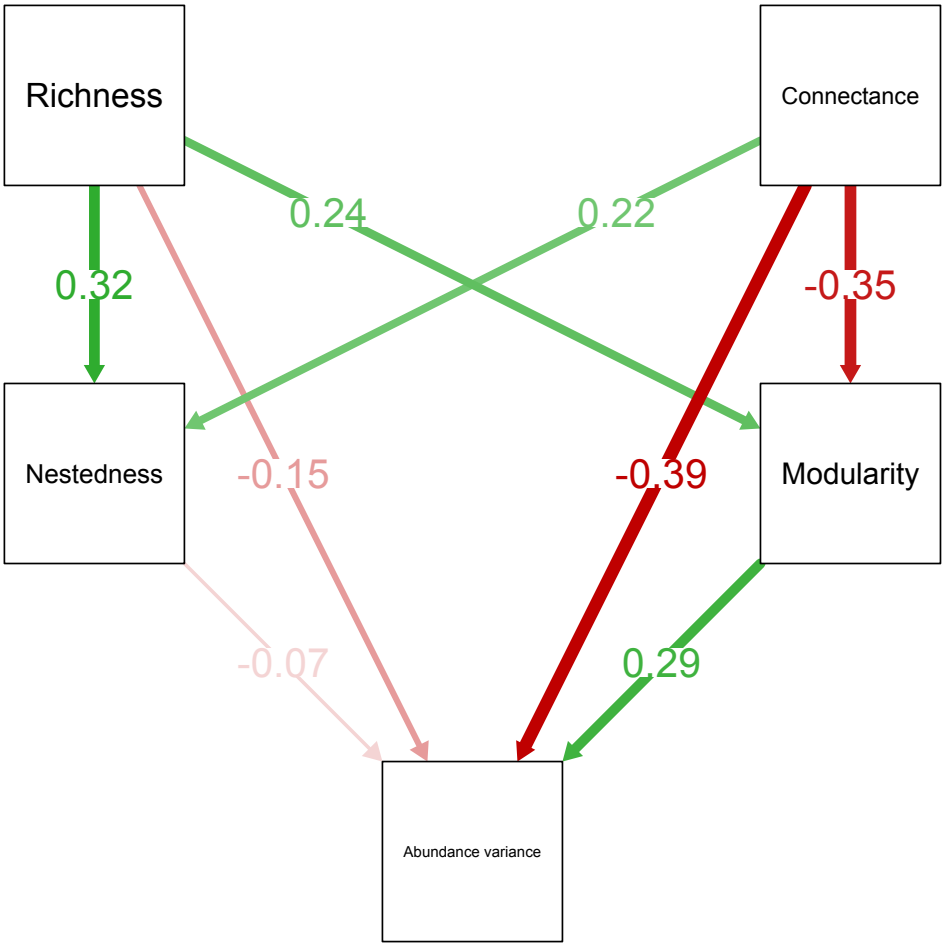

Figure S4: Summary diagram of the effects of network architectural patterns on community abundance variance. The thickness of the arrows is scaled to the standardized coefficients from the path analysis (Goodness of fit (GFI) = 0.93, Root Mean Square Error of Approximation (RMSEA) = 0.32, Comparative Fit Index (CFI) = 0.80) and illustrates the relative effect strength. Positive and negative effects are represented in green and red colors, respectivelly. The effects of connectance and richness are split between direct effects and indirect effects through changes in modularity and nestedness. The strength of the indirect effects are calculated as the product of the coefficients along the path. For example, connectance has a direct effect on community abundance variance (-0.39), an indirect effect through modularity (-0.1015; -0.35 × 0.29), and an indirect effect through nestedness (-0.0154; 0.22 × -0.07), which leads to an overall connectance effect of -0.5069.

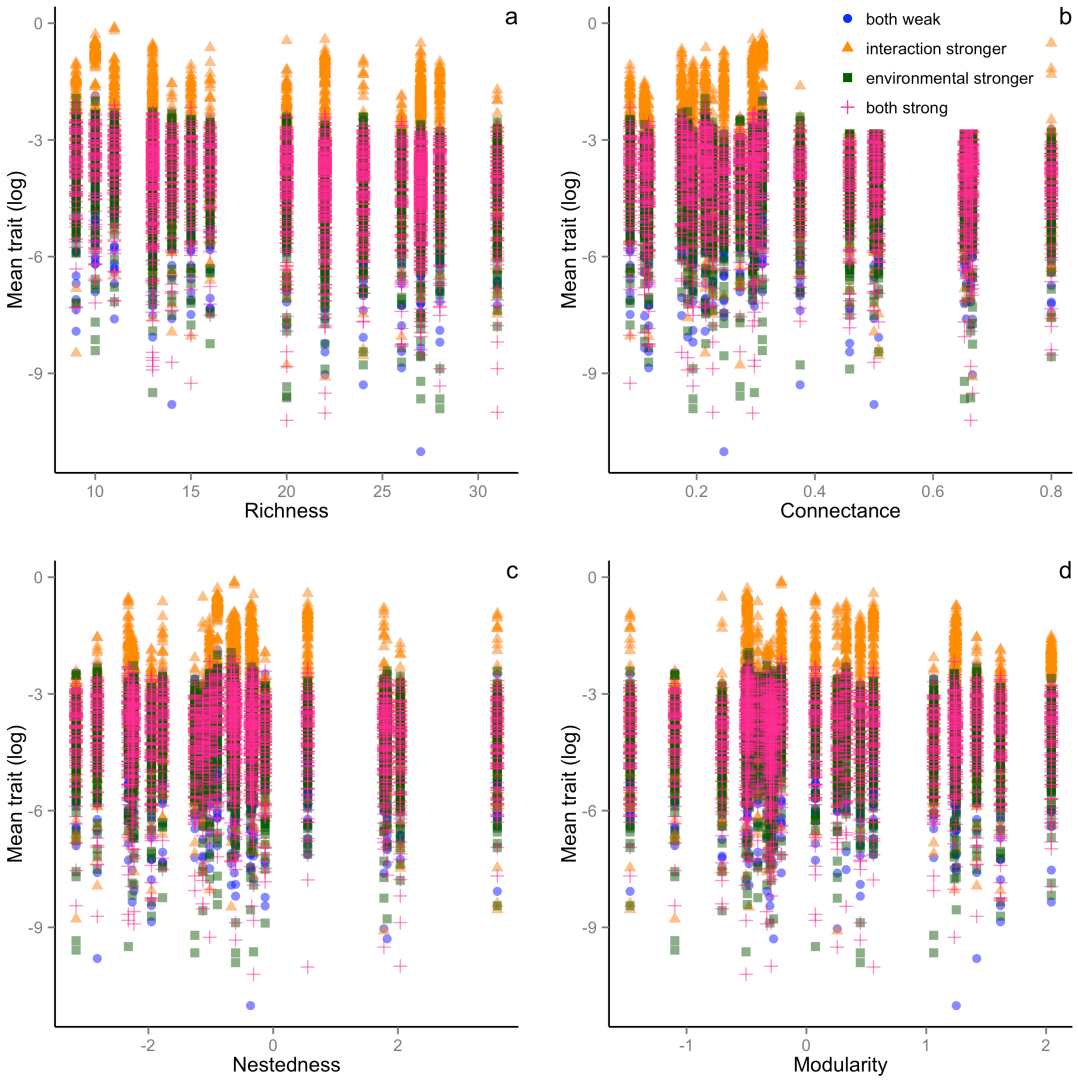

Figure S5: Effect of Richness (a), Connectance (b), Nestedness (c) and Modularity (d) on community mean trait (log values). Each dot represents a network average species mean trait on each replicate. Results shown for the scenarios with both environmental and interaction selection weak (blue), strong (pink), stronger interaction than environmental selection (orange) and stronger environmental than interaction selection (green). Colors are transparent such that darker colors represent a high overlay of points.

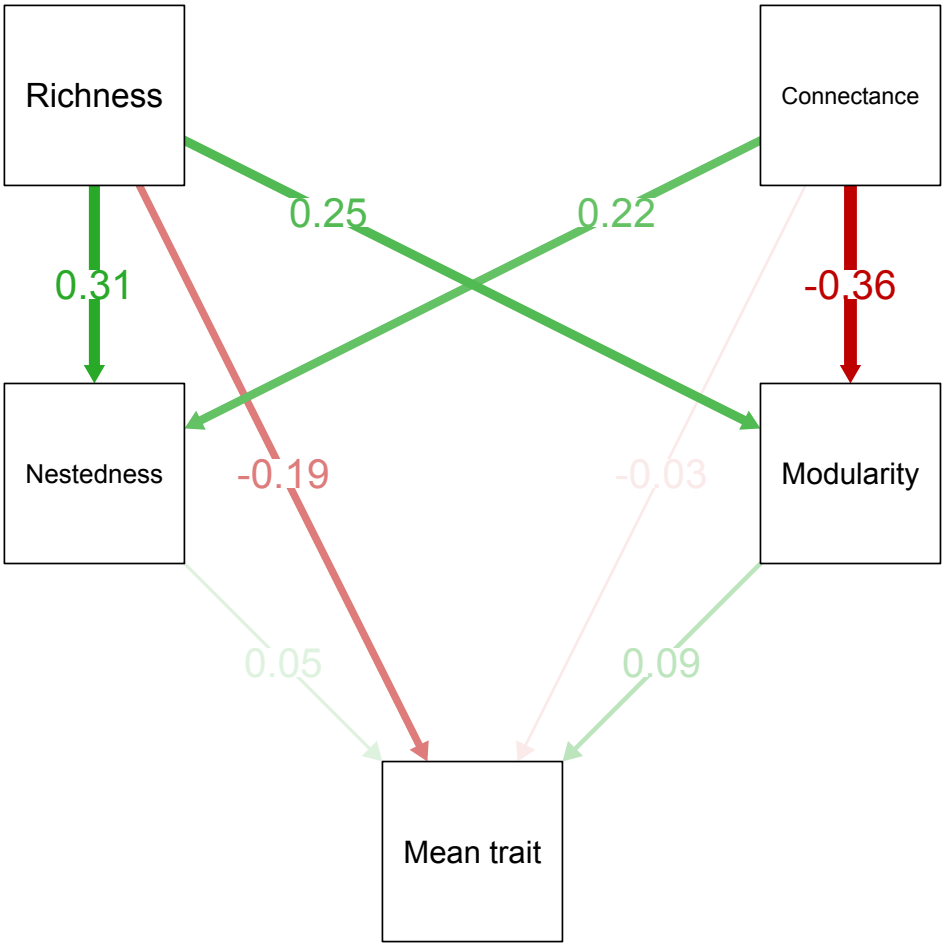

Figure S6: Summary diagram of the effects of network architectural patterns on community mean trait values. The thickness of the arrows is scaled to the standardized coefficients from the path analysis (Goodness of fit (GFI) = 0.93, Root Mean Square Error of Approximation (RMSEA) = 0.32, Comparative Fit Index (CFI) = 0.66) and illustrates the relative effect strength. Positive and negative effects are represented in green and red colors, respectivelly. The effects of connectance and richness are split between direct effects and indirect effects through changes in modularity and nestedness. The strength of the indirect effects are calculated as the product of the coefficients along the path. For example, connectance has a direct effect on community mean trait values (-0.03), an indirect effect through modularity (-0.0324; -0.36 × 0.09), and an indirect effect through nestedness (0.011; 0.22 × 0.05), which leads to an overall connectance effect of -0.0514.

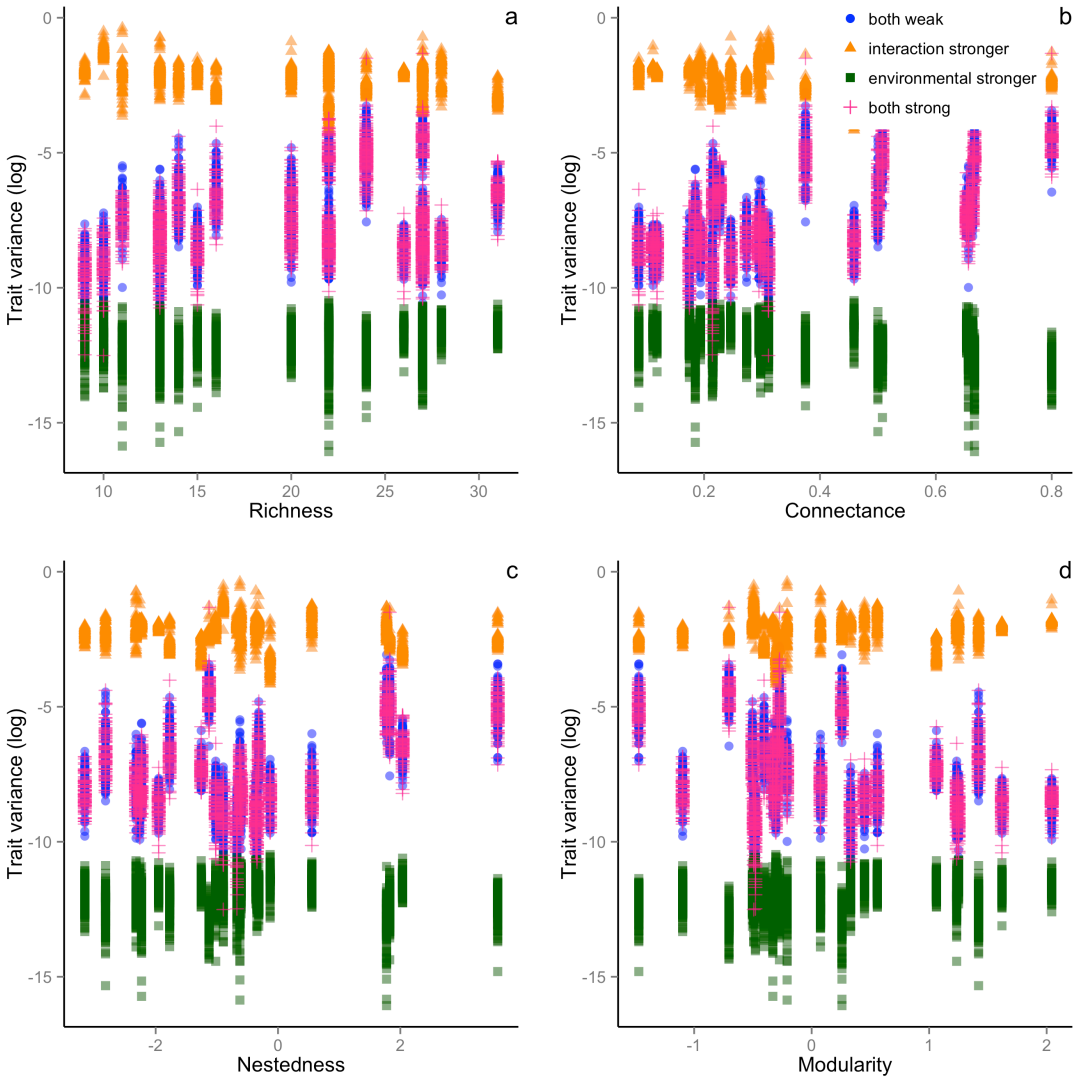

Figure S7: Effect of Richness (a), Connectance (b), Nestedness (c) and Modularity (d) on community trait variance (log values). Each dot represents a network average species trait temporal variance on each replicate. Results shown for the scenarios with both environmental and interaction selection weak (blue), strong (pink), stronger interaction than environmental selection (orange) and stronger environmental than interaction selection (green). Colors are transparent such that darker colors represent a high overlay of points.

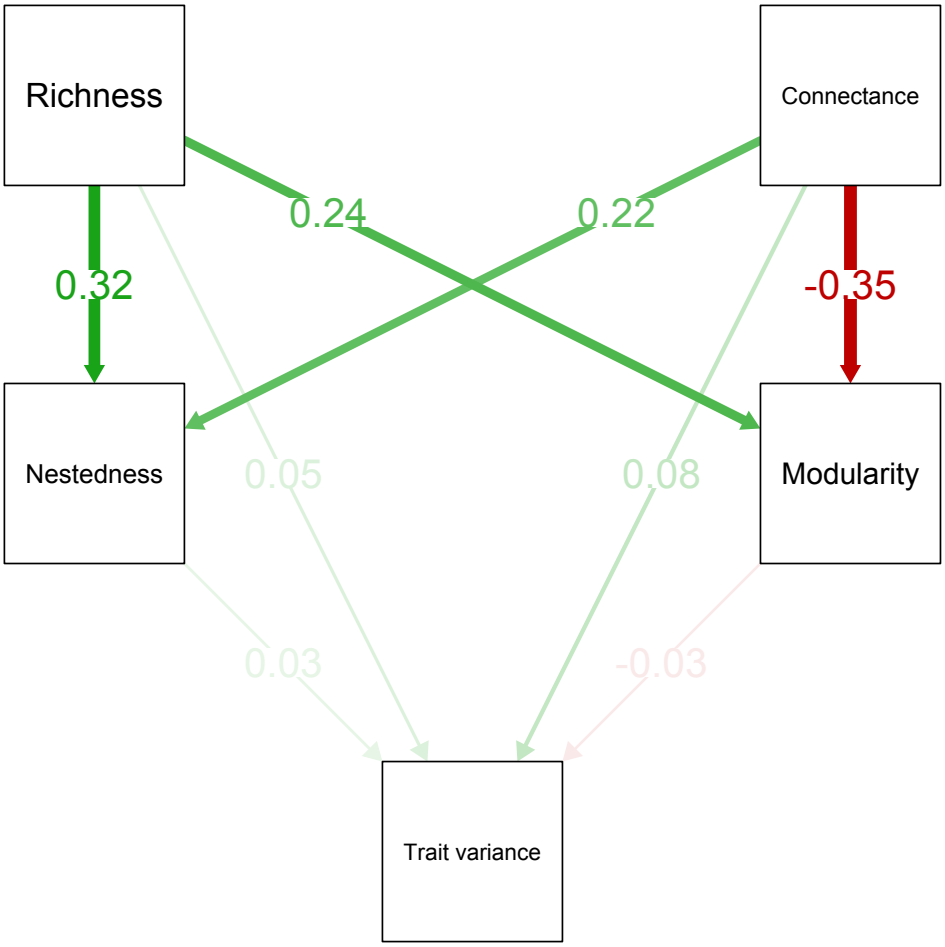

Figure S8: Summary diagram of the effects of network architectural patterns on community trait variance values. The thickness of the arrows is scaled to the standardized coefficients from the path analysis (Goodness of fit (GFI) = 0.93, Root Mean Square Error of Approximation (RMSEA) = 0.32, Comparative Fit Index (CFI) = 0.65) and illustrates the relative effect strength. Positive and negative effects are represented in green and red colors, respectivelly. The effects of connectance and richness are split between direct effects and indirect effects through changes in modularity and nestedness. The strength of the indirect effects are calculated as the product of the coefficients along the path. For example, connectance has a direct effect on community trait variance values (0.08), an indirect effect through modularity (0.0105; -0.35 × -0.03), and an indirect effect through nestedness (0.0066; 0.22 × 0.03), which leads to an overall connectance effect of 0.0971.

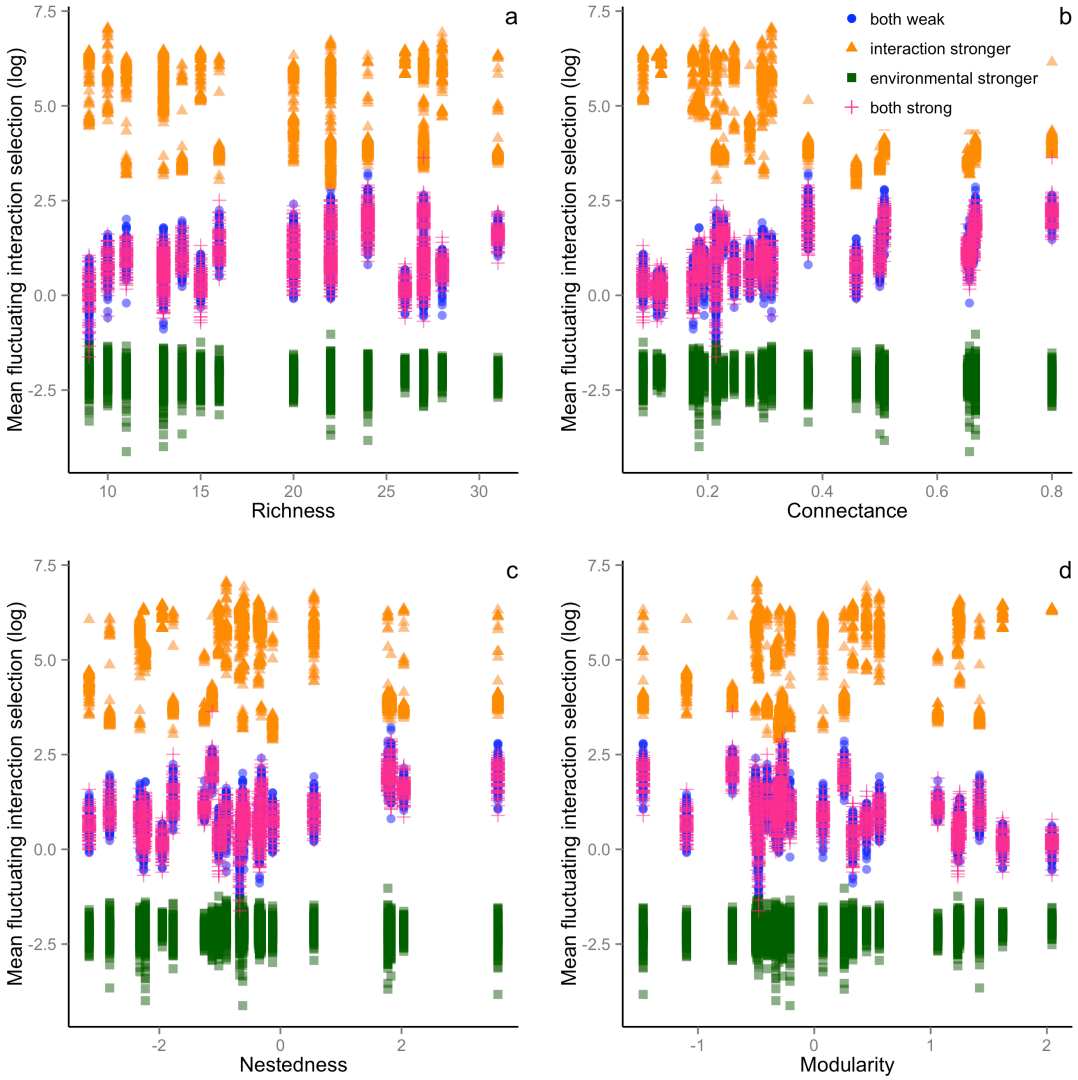

Figure S9: Effect of Richness (a), Connectance (b), Nestedness (c) and Modularity (d) on community mean fluctuating interaction selection, *s* (log values). Each dot represents a network average mean fluctuating interaction selection, *s*, on each replicate. Results shown for the scenarios with both environmental and interaction selection weak (blue), strong (pink), stronger interaction than environmental selection (orange) and stronger environmental than interaction selection (green). Colors are transparent such that darker colors represent a high overlay of points.

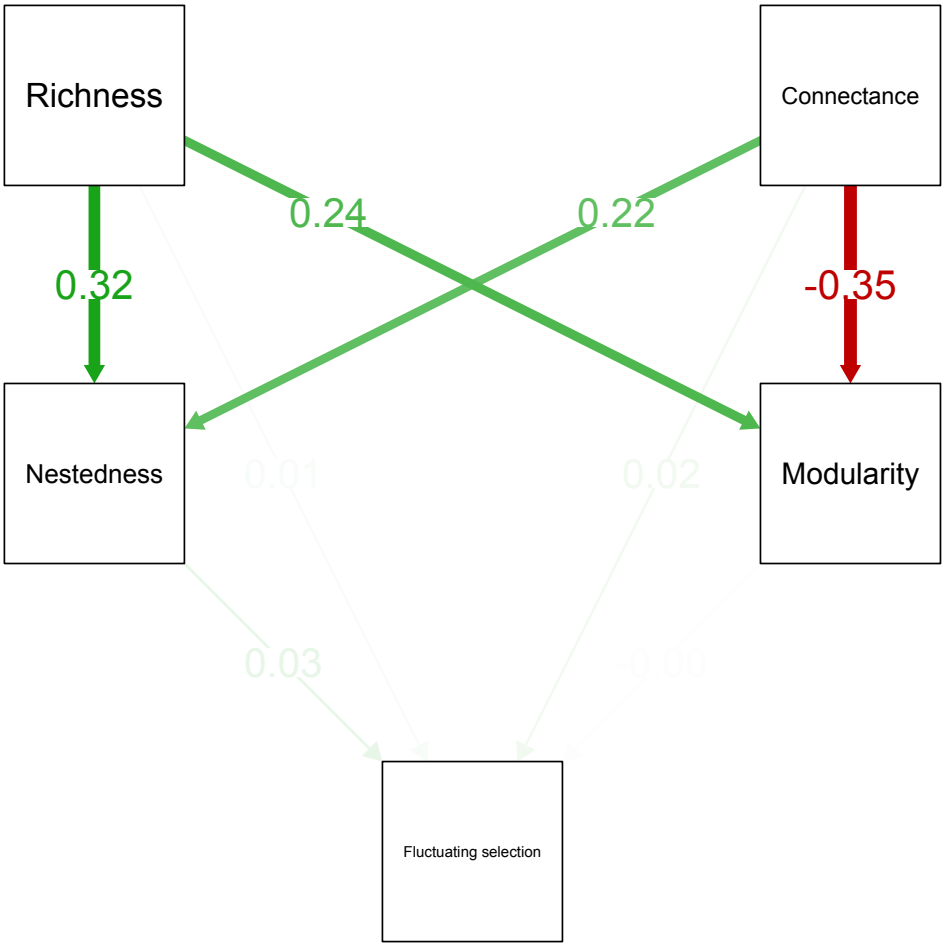

Figure S10: Summary diagram of the effects of network architectural patterns on community mean fluctuating selection, *s* (log values). The thickness of the arrows is scaled to the standardized coefficients from the path analysis (Goodness of fit (GFI) = 0.93, Root Mean Square Error of Approximation (RMSEA) = 0.32, Comparative Fit Index (CFI) = 0.64) and illustrates the relative effect strength. Positive and negative effects are represented in green and red colors, respectivelly. The effects of connectance and richness are split between direct effects and indirect effects through changes in modularity and nestedness. The strength of the indirect effects are calculated as the product of the coefficients along the path. For example, connectance has a direct effect on community mean fluctuating selection (0.02) and an indirect effect through nestedness (0.0066; 0.22 × 0.03), which leads to an overall connectance effect of 0.0266.

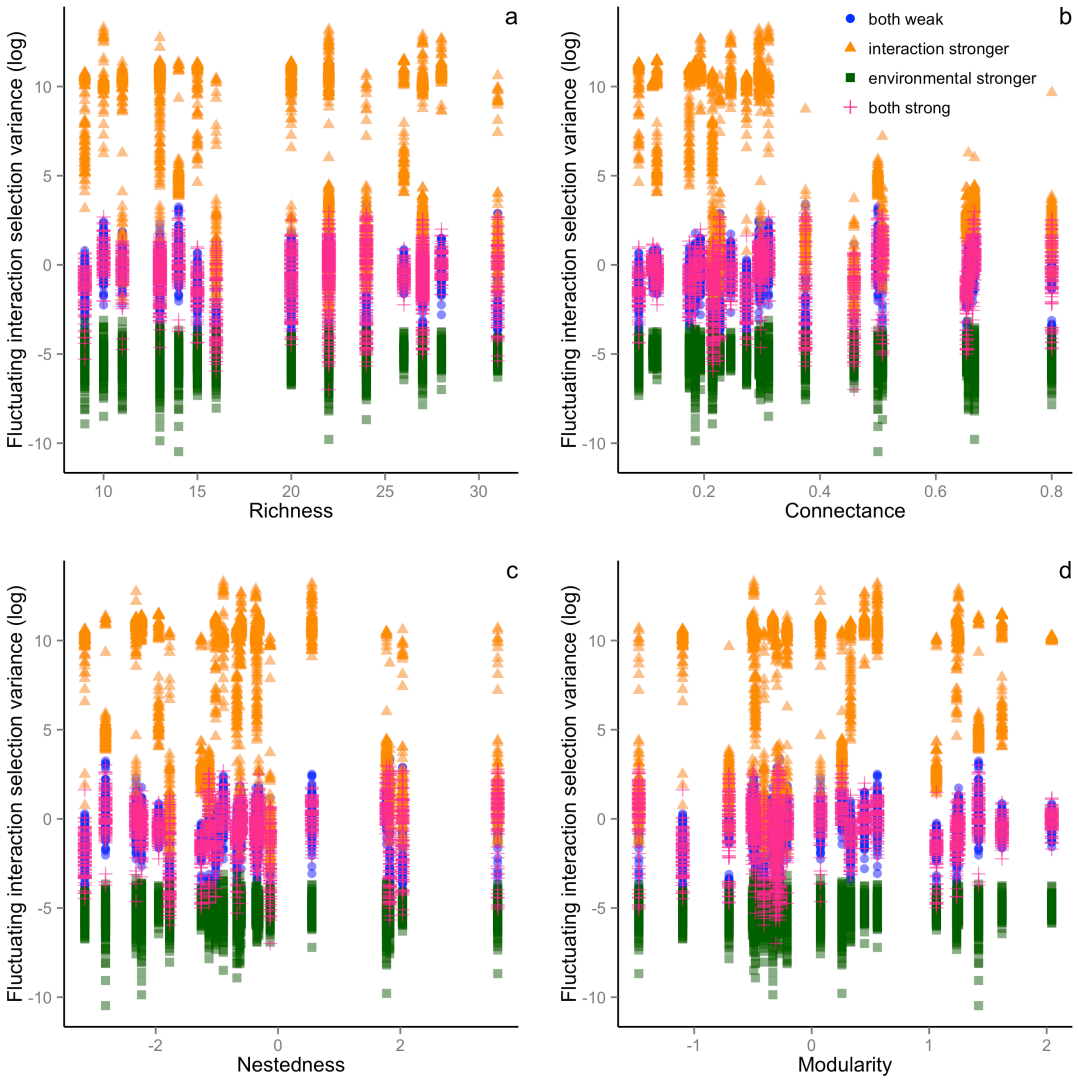

Figure S11: Effect of Richness (a), Connectance (b), Nestedness (c) and Modularity (d) on community fluctuating interaction selection variance, σ_s^2 (log values). Each dot represents a network average fluctuating interaction selection variance, σ_s^2, on each replicate. Results shown for the scenarios with both environmental and interaction selection weak (blue), strong (pink), stronger interaction than environmental selection (orange) and stronger environmental than interaction selection (green). Colors are transparent such that darker colors represent a high overlay of points.

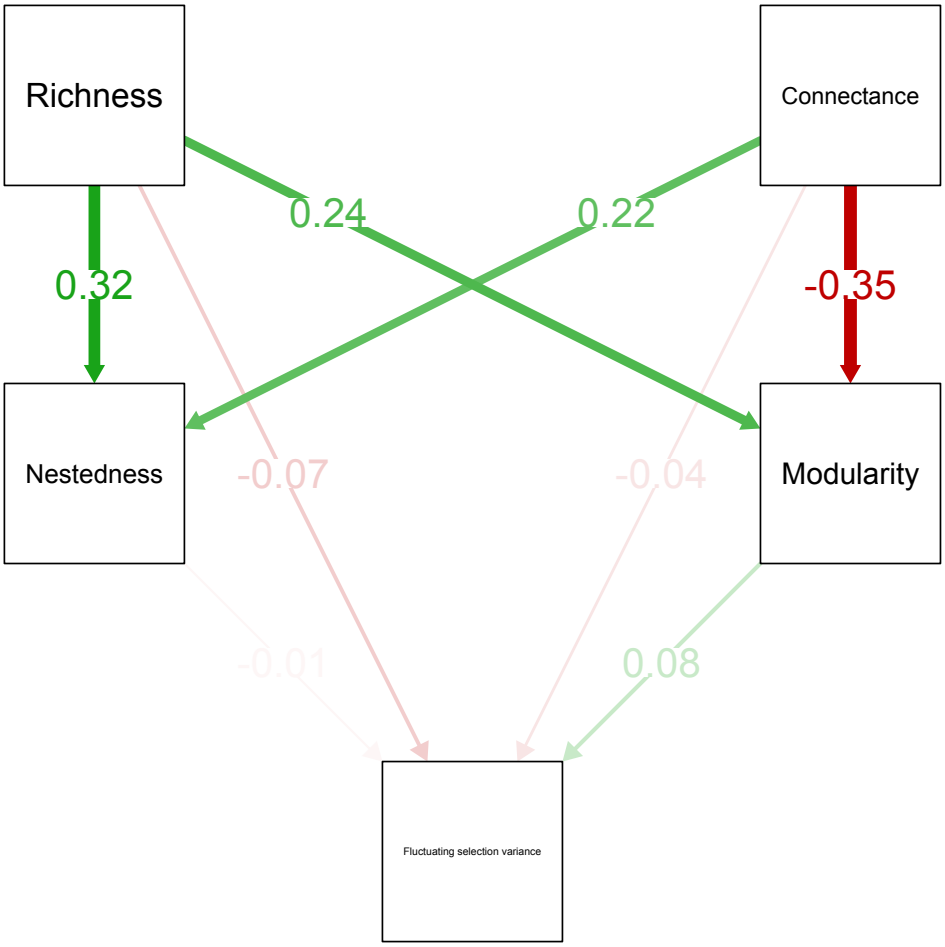

Figure S12: Summary diagram of the effects of network architectural patterns on community fluctuating selection variance, σ_s^2 (log values). The thickness of the arrows is scaled to the standardized coefficients from the path analysis (Goodness of fit (GFI) = 0.93, Root Mean Square Error of Approximation (RMSEA) = 0.32, Comparative Fit Index (CFI) = 0.65) and illustrates the relative effect strength. Positive and negative effects are represented in green and red colors, respectivelly. The effects of connectance and richness are split between direct effects and indirect effects through changes in modularity and nestedness. The strength of the indirect effects are calculated as the product of the coefficients along the path. For example, connectance has a direct effect on community fluctuating selection variance (-0.04), an indirect effect through modularity (-0.028; -0.35 × 0.08), and an indirect effect through nestedness (-0.0022; 0.22 × -0.01), which leads to an overall connectance effect of -0.0702.

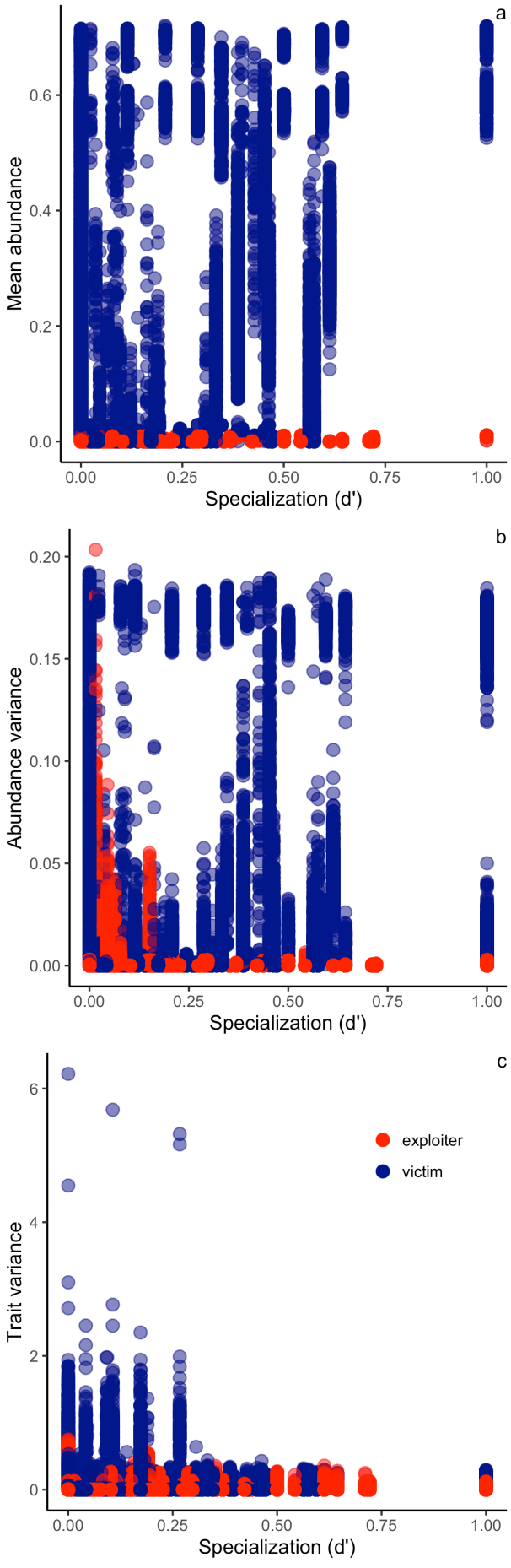
a
Mean abundance
0.0
0.2
0.4
0.6
0.00
0.25
0.50
0.75
1.00
Specialization (d')
b
Abundance variance
0.00
0.05
0.10
0.15
0.20
0.00
0.25
0.50
0.75
1.00
Specialization (d')
c
Trait variance
0
2
4
6
exploiter
victim
0.00
0.25
0.50
0.75
1.00
Specialization (d')

Figure S13: Effect of species on exploiter (red) and victim (blue) specialization (d') on mean abundance (a), abundance coefficient of variation (b), and trait coefficient of variation (c) in the four scenarios. Each dot represents the value of a single species in a replicate. Colors are transparent such that darker colors represent a high overlay of points.

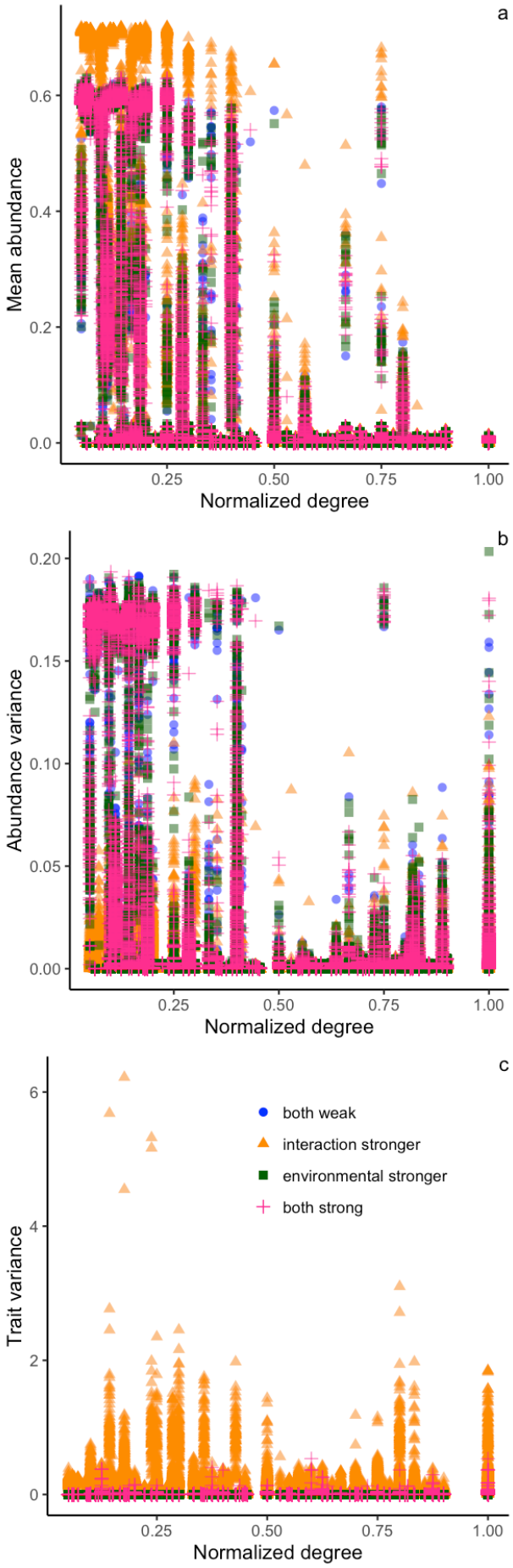
a
Mean abundance
0.0
0.2
0.4
0.6
0.25
0.50
0.75
1.00
Normalized degree
b
Abundance variance
0.00
0.05
0.10
0.15
0.20
0.25
0.50
0.75
1.00
Normalized degree
c
Trait variance
0
2
4
6
both weak
interaction stronger
environmental stronger
both strong
0.25
0.50
0.75
1.00
Normalized degree

Figure S14: Effect of species normalized degree on species mean abundance (a), abundance coefficient of variation (b), and trait coefficient of variation (c) in the scenarios with both environmental and interaction selection weak (blue), strong (pink), stronger interaction than environmental selection (orange) and stronger environmental than interaction selection (green). Each dot represents the value of a single species in a replicate. Colors are transparent such that darker colors represent a high overlay of points.

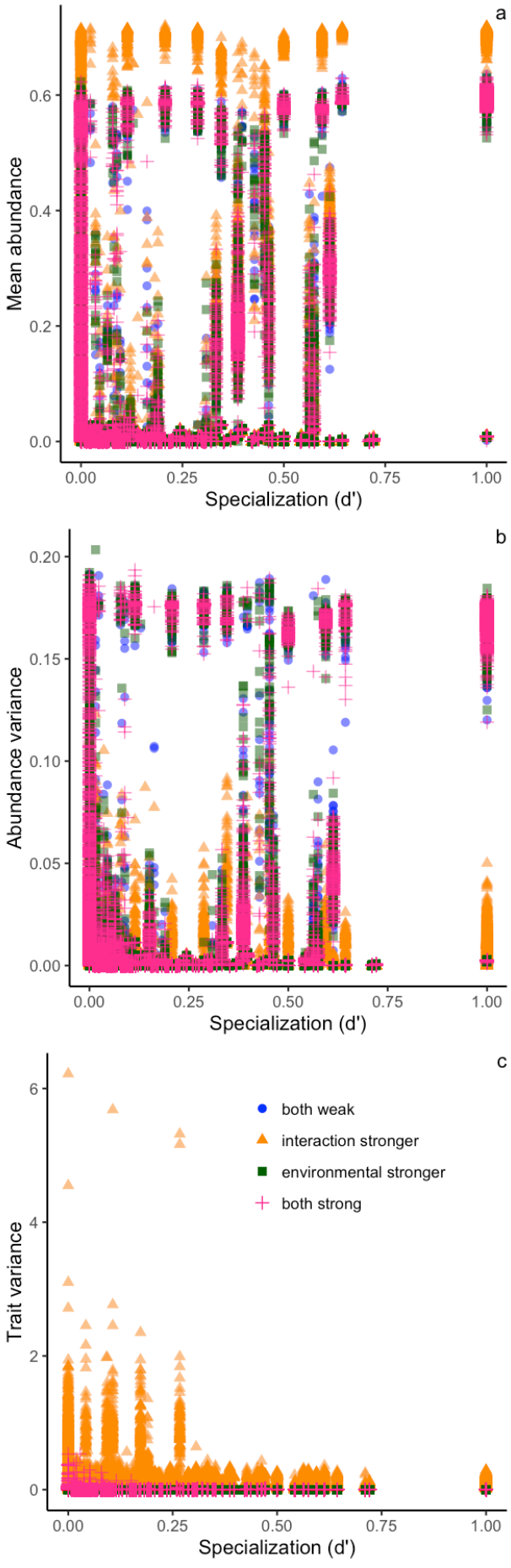
a
Mean abundance
0.0
0.2
0.4
0.6
0.00
0.25
0.50
0.75
1.00
Specialization (d')
b
Abundance variance
0.00
0.05
0.10
0.15
0.20
0.00
0.25
0.50
0.75
1.00
Specialization (d')
c
Trait variance
0
2
4
6
both weak
interaction stronger
environmental stronger
both strong
0.00
0.25
0.50
0.75
1.00
Specialization (d')

Figure S15: Effect of species specialization (d') on species mean abundance (a), abundance coefficient of variation (b), and trait coefficient of variation (c) in the scenarios with both environmental and interaction selection weak (blue), strong (pink), stronger interaction than environmental selection (orange) and stronger environmental than interaction selection (green). Each dot represents the value of a single species in a replicate. Colors are transparent such that darker colors represent a high overlay of points.