Table S1. Count-based analyses conducted for animals and plants separately. A series of analyses were performed within each group to account for potential overlap in interaction types and traits among focal studies, for animals (A–C) and plants (D–F). Numbers of studies excluded because of overlap are shown in parentheses. For each analysis, Fisher’s exact tests were conducted both including and excluding those studies that found no significant increase or decrease in diversification rates associated with the species interaction in the focal clade (indicated as “Neither”). Note that a sequential Bonferroni correction does not impact which results are considered significant, since none are significant in this table.

|  |  |  |  |
| --- | --- | --- | --- |
| Analysis | Studies included | Individual-level effects | Fisher's exact test results |
|  |  | Positive | Negative | “Neither” studies included | “Neither” studies excluded |
|  |
| Inferred effects on diversification |
| Increase | Decrease | Neither | Increase | Decrease | Neither |
| A | All animal studies | 3 | 3 | 3 | 1 | 6 | 0 | *P*=0.1362, *n*=16 | *P*=0.2657, *n*=13 |
| B | All animal studies excluding Krüger et al. (2009) and Jezkova & Wiens (2017) | 2 (1) | 2 (1) | 3 | 1 | 6 | 0 | *P*=0.1434, *n*=14 | *P*=0.4909, *n*=11 |
| C | Same as B, but including Jezkova & Wiens (2017) and excluding Weinstein & Kuris (2016) | 3 | 2 (1) | 2 (1) | 1 | 6 | 0 | *P*=0.0536, *n*=14 | *P*=0.1026, *n*=12 |
| D | All plant studies | 11 | 1 | 1 | 0 | 1 | 0 | *P*=0.2143, *n*=14 | *P*=0.1538, *n*=13 |
| E | All plant studies excluding Marazzi & Sanderson (2010), Bolinder et al. (2016), and Bruun-Lund et al. (2018) | 9 (2) | 0 (1) | 1 | 0 | 1 | 0 | *P*=0.1352, *n*=11 | *P*=0.2222, *n*=10 |
| F | Same as E, but including Bolinder et al. (2016), and Bruun-Lund et al. (2018) and excluding Hernández-Hernández & Wiens 2020 | 9 (2) | 1 | 1 | 0 | 1 | 0 | *P*=0.2500, *n*=12 | *P*=0.1818, *n*=11 |

Table S2. Summary of effect sizes from individual studies. Studies compared differences in diversification rates associated with an interaction being stronger vs. weaker or present vs. absent. Overlap indicates that the study overlapped in both the interaction type and taxon sampling with another study, such that one of the overlapping studies was excluded. See Methods (main text) for further explanation and justification.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Study | Contrast in interaction | Measure of diversification rate | Analysis performed | Net diversification rate (stronger or present) | Net diversification rate (weaker or absent) | *R* | log2*R* | Overlap |
| Miraldo & Hanski (2014) | stronger/weaker | net diversification  | MEDUSA  | 0.19 | 0.38 | 0.5 | -1 | No |
| Machac *et al.* (2018) | stronger/weaker | gamma statistic  | regression (regional overlap) | NA | NA | NA | NA | No |
| Price *et al*. (2014) | stronger/weaker | gamma statistic  | comparison with null models | NA | NA | NA | NA | No |
| Farrell *et al*. (1991) | stronger/weaker | species richness | sister-group comparison (one-tailed signed test) | Multiple | Multiple | Multiple | -0.5347 | No |
| Arbuckle & Speed (2015) | stronger/weaker | net diversification  | BiSSE | 0.0566 | 0.0204 | 2.7745 | 1.4722 | No |
| Ge *et al*. (2010) | stronger/weaker | species richness, net diversification  | Slowinsky–Guyer test (1989); method-of-moments estimator  | 3.4771 | 4.2041 | 0.8271 | -0.2739 | No |
| Liu *et al*. (2018) | stronger/weaker | net diversification s | BiSSE | 0.136 | 0.46 | 0.2956 | -1.7580 | No |
| Przeczek *et al*. (2008) | stronger/weaker | species richness | sister-group comparison (Vamosi & Vamosi 2005) | NA | NA | Multiple | -1.8214 | No |
| Roalson & Roberts (2016) | presence/absence | net diversification  | BiSSE | 0.5899 | -0.0151 | -39.0662 | NA | No |
| Li *et al*. (2016) | presence/absence | net diversification rates | BAMM  | NA | NA | 0.25~0.5 | -1.5 | No |
| Bruun-Lund *et al*. (2018) | presence/absence | net diversification rates | MuSSE | 0.076 | 0.053 | 1.433962 | 0.520007 | No |
| Freudenstein & Chase (2015) | presence/absence | net diversification  | BiSSE | NA | NA | NA | NA | No |
| Givnish *et al*. (2014) | presence/absence | net diversification  | maximum likelihood estimator, BiSSE | 0.77 | 0.31 | 2.483871 | 1.31259 | No |
| Givnish *et al*. (2015) | presence/absence | net diversification  | BiSSE | 0.1 | 0.015 | 6.666667 | 2.736966 | No |
| Davis *et al*. (2018) | presence/absence | net diversification  | BAMM  | 0.03286099 | 0.03319158 | 0.99004 | -0.01444 | No |
| Lengyel *et al*. (2009) | presence/absence | species richness | sister-group comparison (Mitter *et al.* 1988) | NA | NA | multiple | 1.169045 | No |
| Marazzi & Sanderson (2010) | presence/absence | net diversification  | method-of-moments estimator  | NA | NA | NA | 1.177684 | with Weber & Agrawal (2014), excluded |
| Weber & Agrawal (2014) | presence/absence | net diversification | BiSSE, BAMM | NA | NA | NA | 0.50707 | with Marazzi & Sanderson (2010), included |
| Larson‐Johnson (2016) | presence/absence | net diversification rates | BiSSE, MEDUSA, BAMM | 0.061 | 0.02 | 3.05 | 1.608809 | No |
| Bolinder *et al*. (2016) | presence/absence | species richness | sister-group comparison (Slowinski & Guyer 1993) | NA | NA | NA | NA | with Bruun-Lund *et al*. (2018) and Hernández-Hernández & Wiens (2020), excluded |
| Bruun-Lund *et al*. (2018) | presence/absence | net diversification  | BiSSE | 0.071 | 0.052 | 1.3654 | 0.4493 | with Bolinder *et al*. (2016) and Hernández-Hernández & Wiens (2020), excluded |
| Hernández-Hernández & Wiens (2020) | presence/absence | net diversification  | method-of-moments estimator | 0.0303 | 0.0143 | 2.11888 | 1.083303 | with Bolinder *et al*. (2016) and Bruun-Lund *et al*. (2018), included |
| Afkhami *et al*. (2018) | presence/absence | net diversification | method-of-moments estimator | NA | NA | NA | NA | No |
| Lorion *et al*. (2013) | presence/absence | net diversification  | BiSSE | NA | NA | NA | NA | No |
| Litsios *et al*. (2012) | presence/absence | net diversification  | BiSSE | 1.3 | 0.9 | 1.4444 | 0.5305 | No |
| Weinstein & Kuris (2016) | presence/absence | species richness | Wilcoxon signed-rank test | NA | NA | NA | NA | with Jezkova & Wiens (2017), excluded |
| Medina & Langmore (2015) | presence/absence | net diversification  | BAMM, BiSSE | Multiple | Multiple | Multiple | -1.3438 | with Krüger *et al*. (2009), included |
| Jezkova & Wiens (2017) | presence/absence | net diversification  | method-of-moments estimator  | 0.0213 | 0.0102 | 2.0882 | 1.0623 | with Weinstein & Kuris (2016), included |
| Joy (2013) | presence/absence | diversification (D)  | NA | NA | NA | NA | NA |  |
| Krüger *et al*. (2009) | presence/absence | net diversification  | Bokma (2003) | 0.0158 | 0.0648 | -0.049 | -2.0361 | with Medina & Langmore (2015), excluded |
|  |  |  |  |  |  |  |  |  |

Table S3. Effect sizes from 18 studies that are included in the t-tests.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Study | Type of interaction | Presumed fitness effect | Contrast in interaction | Method | log2(*R*) |
| Miraldo & Hanski (2014) | competition | negative | stronger/weaker | MEDUSA | -1 |
| Farrell *et al*. (1991) | herbivory | negative | stronger/weaker | maximum-likelihood | -0.53473 |
| Arbuckle & Speed (2015) | predation | negative | stronger/weaker | BiSSE | 1.47223 |
| Ge *et al*. (2010) | predation | negative | stronger/weaker | maximum-likelihood | -0.27391 |
| Liu *et al*. (2018) | predation | negative | stronger/weaker | MuSSE | -1.75803 |
| Przeczek *et al*. (2008) | predation | negative | stronger/weaker | maximum-likelihood | -1.82145 |
| Li *et al*. (2016) | commensalism | positive | presence/absence | BAMM | -1.5 |
| Bruun-Lund *et al*. (2018) | commensalism/ epiphytism | positive | presence/absence | BiSSE | 0.52001 |
| Givnish *et al*. (2014) | commensalism/ epiphytism | positive | presence/absence | maximum-likelihood | 1.31259 |
| Givnish *et al*. (2015) | commensalism/ epiphytism | positive | presence/absence | BiSSE | 2.73670 |
| Davis *et al*. (2018) | commensalism-parasitism | positive | presence/absence | BAMM | -0.01444 |
| Lengyel *et al*. (2009) | mutualism/plant-disperser | positive | presence/absence | maximum-likelihood | 1.16904 |
| Weber & Agrawal (2014) | mutualism/plant-defender | positive | presence/absence | BAMM | 0.50707 |
| Larson‐Johnson (2016) | mutualism/plant-disperser | positive | presence/absence | BiSSE | 1.60881 |
| Hernández-Hernández & Wiens (2020) | mutualism/plant-pollinator | positive | presence/absence | method-of-moments | 1.08330 |
| Litsios *et al*. (2012) | mutualism | positive | presence/absence | BiSSE | 0.53052 |
| Medina & Langmore (2015) | parasitism | positive | presence/absence | BiSSE | -1.34378 |
| Jezkova & Wiens (2017) | parasitism | positive | presence/absence | method-of-moments | 1.06228 |

Table S4. Grand means and 95% confidence intervals for effect sizes. A Wilk-Shapiro normality test requires a minimum sample size of 3. Confidence intervals were not calculated for groups with fewer than three studies (labeled in table as NAs). Results are considered significant if the confidence intervals do not overlap with zero. Means in these cases are boldfaced.

|  |  |  |  |
| --- | --- | --- | --- |
| Group | Mean | Lower | Upper |
| Harmful (all, *n*=6) | -0.6526476 | -1.9277079 | 0.6224128 |
| Harmful (competition, *n*=1) | -1 | NA | NA |
| Harmful (herbivory/predation, *n*=5) | -0.5831771  | -2.253238 | 1.086883 |
| Beneficial (all, *n*=12) | **0.8272286** | 0.1876138 | 1.4668434 |
| Beneficial (mutualism, *n*=5) | **0.9797484**  | 0.4015042 | 1.5579925 |
| Beneficial (commensalism, *n*=4) | 0.7673907 | -2.04608 | 3.580862 |
| Beneficial (parasitism, *n*=2) | -0.140748 | NA | NA |

**References (not cited in the main text)**

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