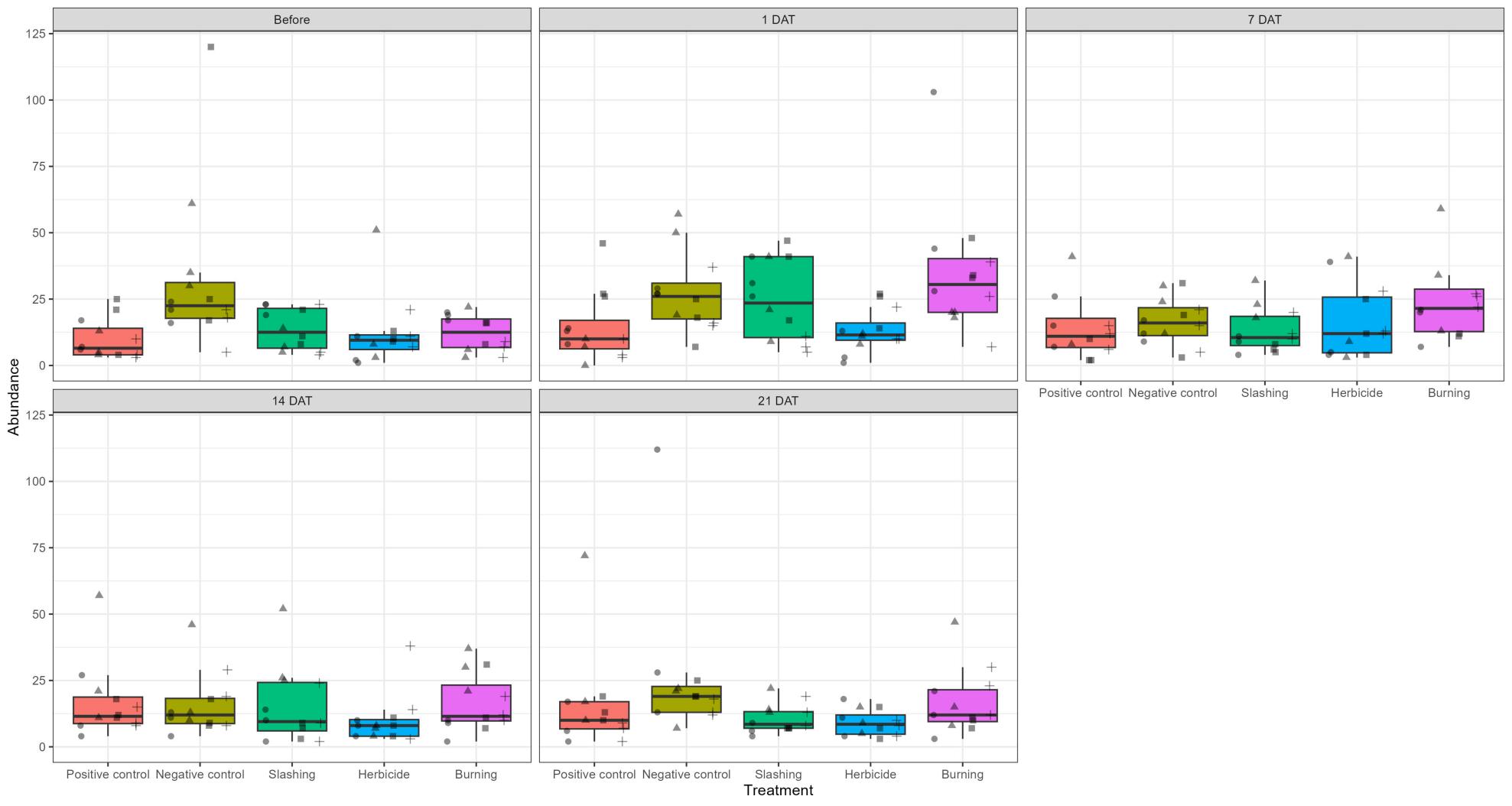
**Compaision of management methods and abundance and biodiversity metrices.**



**Arthropod abundance**

Arthropod abundance varied significantly across treatments and over time. Compared with the positive control (invaded and untreated), the negative control (uninvaded site) supported higher arthropod abundance (β = 0.41, p < 0.001). Burning also led to significantly higher abundance relative to the positive control (β = 0.50, p < 0.001). In contrast, herbicide application reduced arthropod abundance (β = –0.26, p < 0.001), while slashing did not differ significantly from the positive control (β = –0.01, p = 0.76).

Post-hoc comparisons (sidak) confirmed these patterns. Abundance in burned plots and the negative control was significantly higher than in the positive control and slashed plots, but there was no significant difference between burned plots and the negative control. Similarly, the positive control did not differ significantly from slashed plots. By contrast, herbicide-treated plots supported significantly lower abundance than all other treatments.

Estimated marginal means showed that abundance was lowest in herbicide plots (emmean = 2.47, 95% CI: 2.37–2.56), intermediate in slashed (2.71, 95% CI: 2.63–2.80) and positive control sites (2.73, 95% CI: 2.64–2.81), and highest in the negative control (3.13, 95% CI: 3.07–3.20) and burned plots (3.23, 95% CI: 3.16–3.29).

Across all treatments, arthropod abundance declined slightly but significantly with increasing time after treatment (β = –0.013 per day, p < 0.001). Site-level variation was also evident, with higher abundance in Sites 2 and 3 compared with Site 1, and reduced abundance in Site 4.

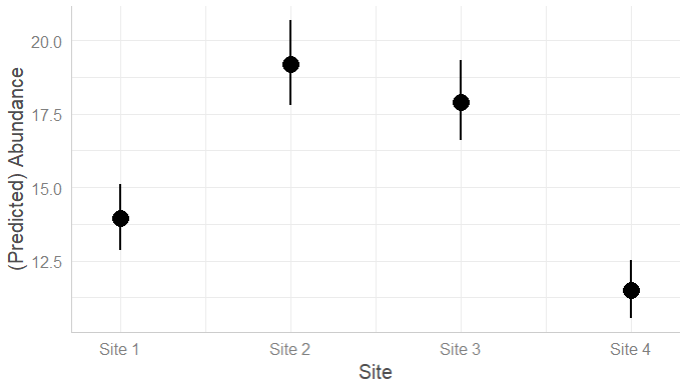
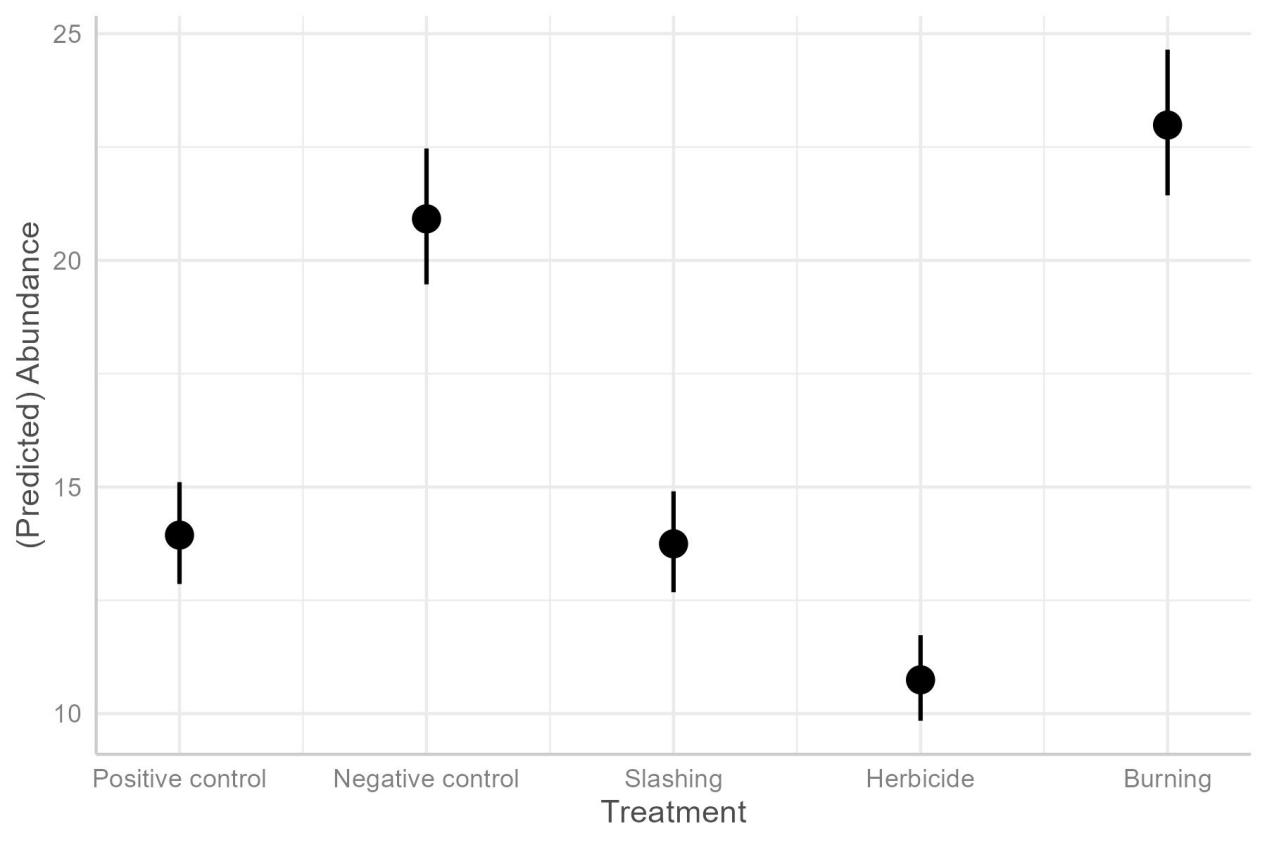


Figure \_: Predicted site-level abundance of arthropods controlling for Chromoleana management options. Dot and bars indicate the mean ± 95% confidence interval.



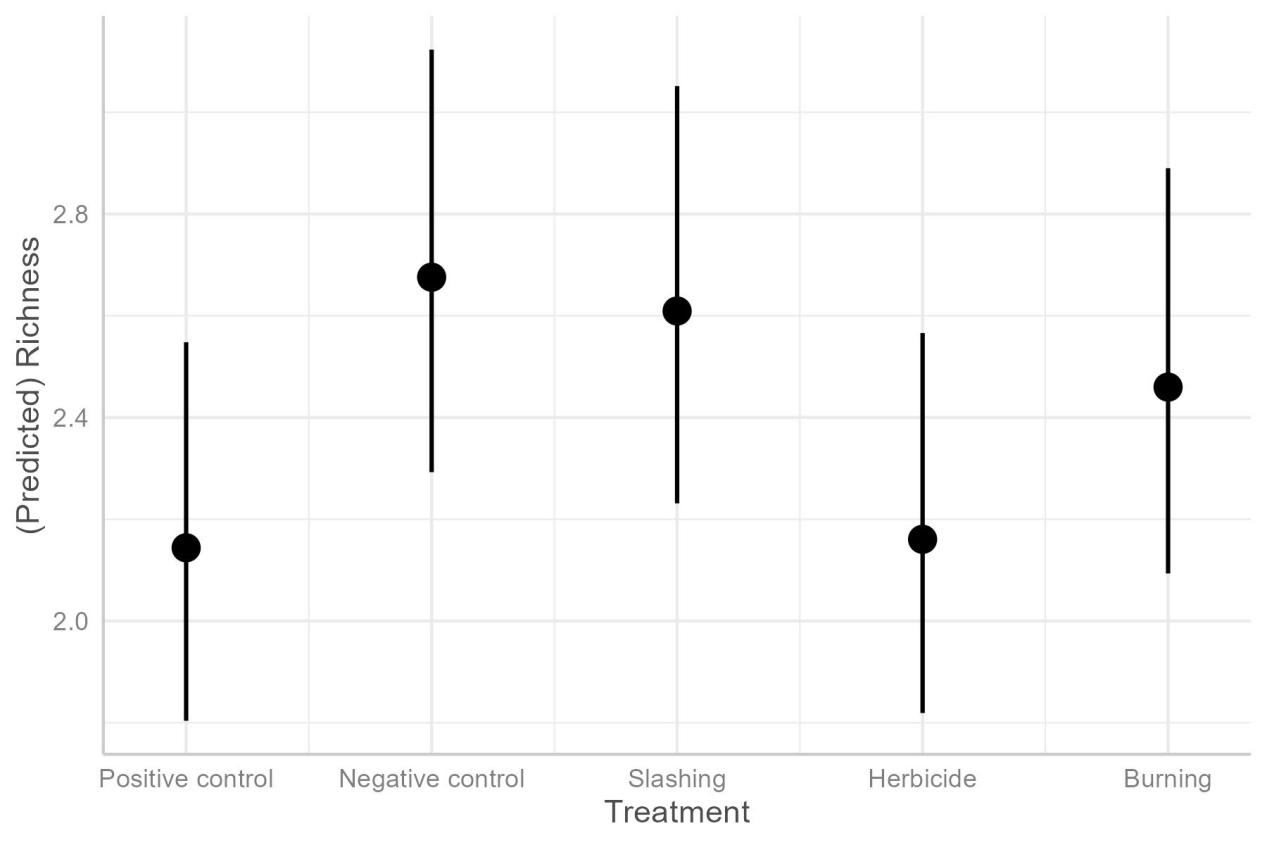
Figure\_ : Predicted Abudnance of arthropods for each Chromoleana managemnt options. Dot and bars indicate the mean ± 95% confidence interval.

**Arthropod richness**

Family richness did not differ significantly among treatments. Compared with the positive control, the negative control (β = 0.22, p = 0.06) and slashing (β = 0.20, p = 0.10) showed a tendency toward higher richness, but these effects were not statistically significant. Herbicide (β = 0.01, p = 0.95) and burning (β = 0.14, p = 0.25) did not differ from the positive control.

Post-hoc Sidak comparisons likewise did not detect any significant differences among treatments. However, the estimated marginal means shows slightly higher richness in the negative control (emmean = 0.98, 95% CI: 0.78–1.19) and slashing plots (0.96, 95% CI: 0.75–1.16) compared with the positive control (0.76, 95% CI: 0.54–0.99) and herbicide (0.77, 95% CI: 0.54–1.00).

Across treatments, species richness declined slightly but significantly with increasing time after treatment (β = –0.0095 per day, p = 0.045). Also, unlike for abundance, site level variation was not significant (P<0.05).



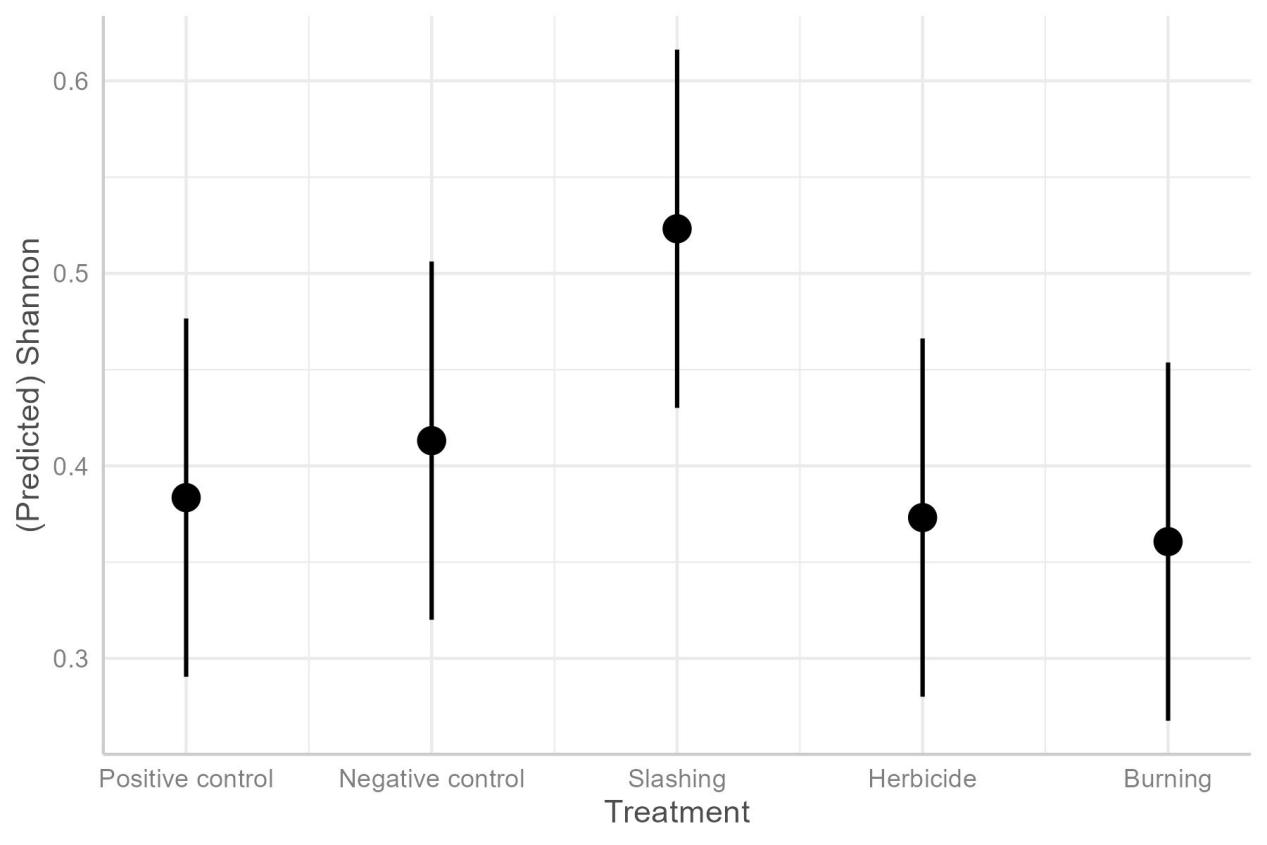
Figure\_: predicted family richness of arthropods under *Chromoleana* management options. Dots and error bars represent the mean ± 95% confidence intervals.

**Shannon diversity**

Shannon diversity differed only weakly among treatments. Compared with the positive control, neither the negative control (β = 0.03, p = 0.66), herbicide (β = –0.01, p = 0.88), nor burning (β = –0.02, p = 0.73) showed significant differences in diversity. However, slashing supported significantly higher Shannon diversity than the positive control (β = 0.14, p = 0.038).

Post-hoc Sidak comparisons did not detect significant pairwise differences among treatments. Nevertheless, the marginal means revealed consistent trends in diversity values. Shannon diversity was lowest in burned plots (emmean = 0.36, 95% CI: 0.24–0.48) and herbicide-treated plots (0.37, 95% CI: 0.25–0.50), intermediate in the positive control (0.38, 95% CI: 0.26–0.51) and negative control (0.41, 95% CI: 0.29–0.54), and highest in slashed plots (0.52, 95% CI: 0.40–0.65). Thus, although conservative post-hoc testing did not detect significant differences, slashed plots supported the greatest Shannon diversity, while burned and herbicide-treated plots tended to support the lowest.

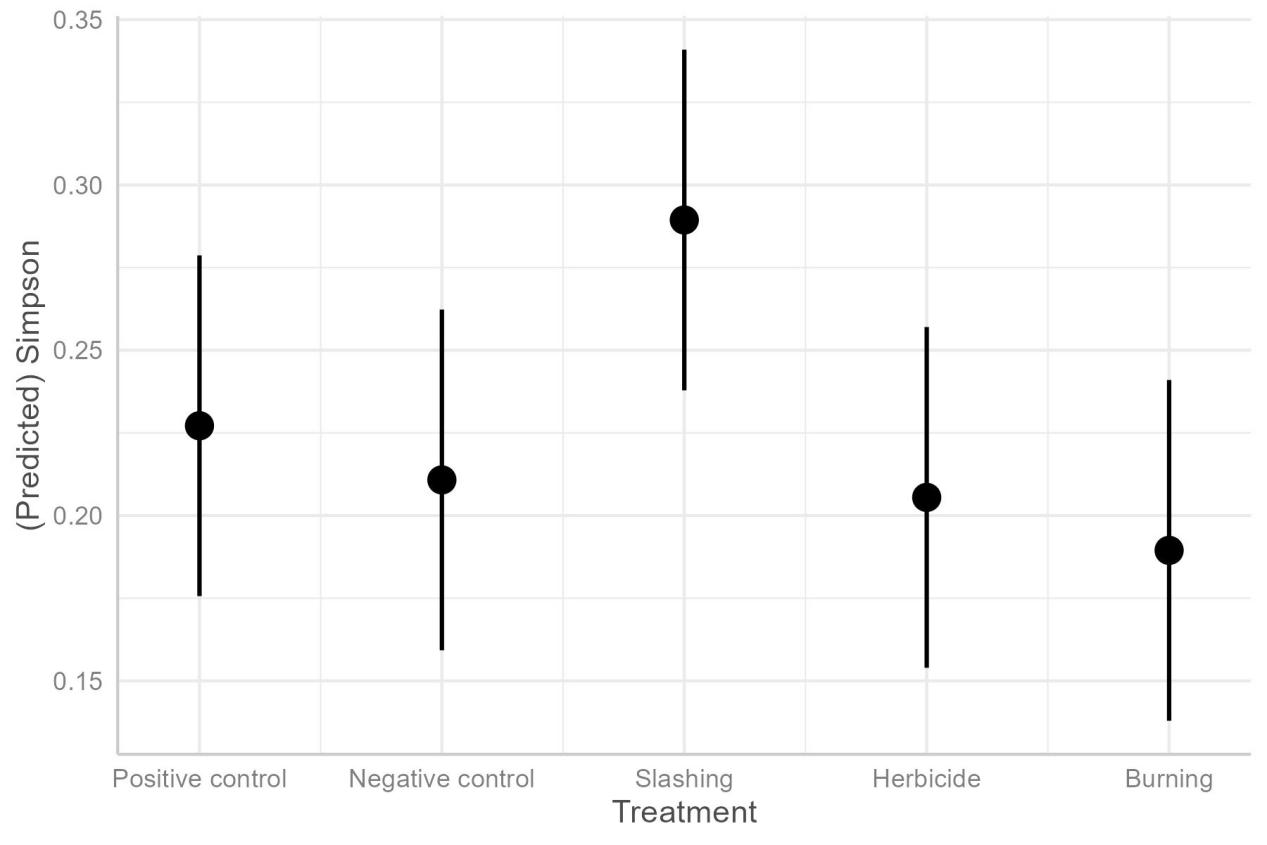
Across all treatments, Shannon diversity declined significantly with increasing time after treatment (β = –0.0065 per day, p = 0.014).



Figure\_: predicted Shannon diversity indices of arthropods under *Chromoleana* management options. Dots and error bars represent the mean ± 95% confidence intervals.

**Simpson’s diversity index**

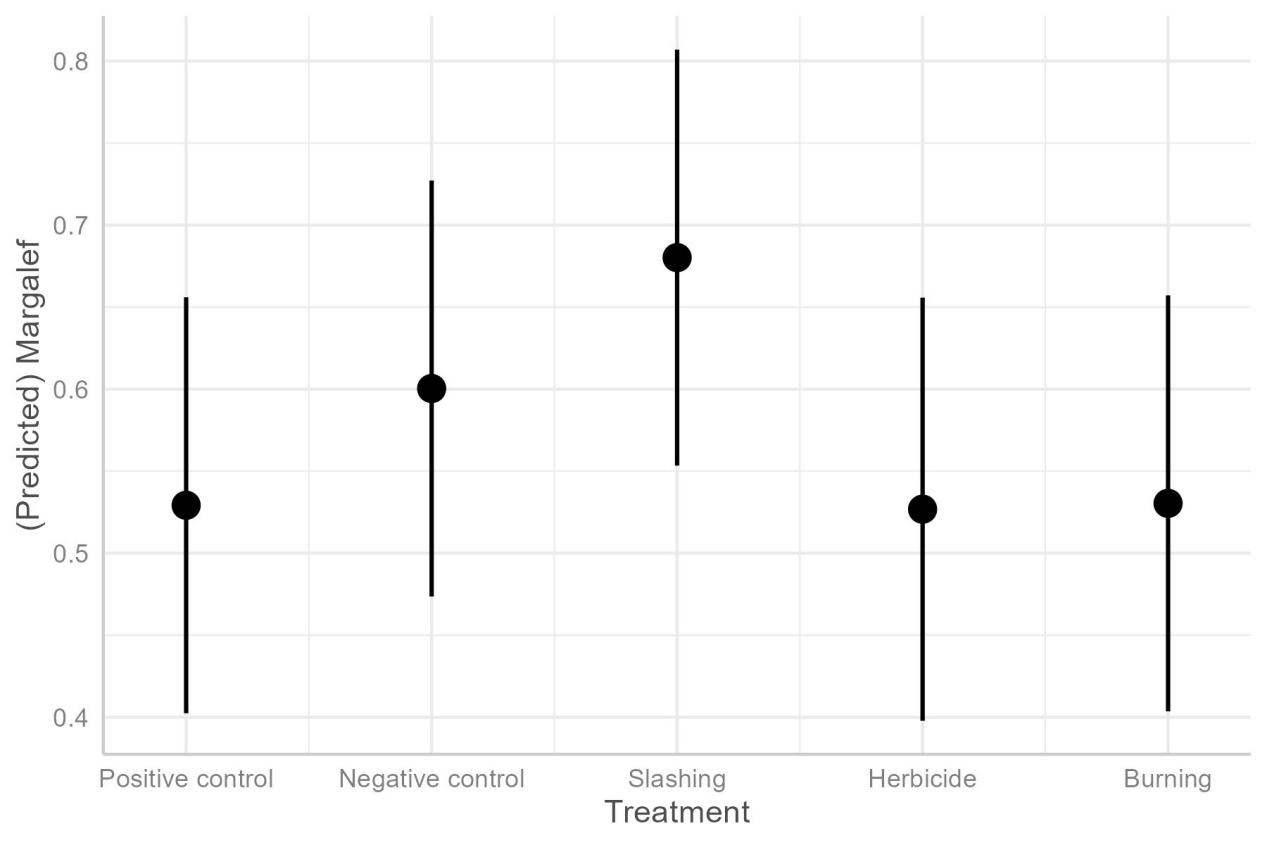
A linear model was fitted to test the effects of treatment and time (period) on Simpson’s diversity index. Among the predictors, survey period had a significant negative effect on diversity (β = –0.004 ± 0.002, p = 0.011), indicating a slight decline in Simpson’s index over time. In contrast, treatment effects were generally weak and non-significant. Compared to positive control, neither burning, herbicide, nor negative control plots differed significantly in Simpson’s index (all p > 0.30). Slashing treatment was marginally higher Simpson’s index (β = 0.062 ± 0.037, p = 0.094). Mean Simpson’s index values ranged from 0.189 (burning) to 0.289 (slashing), with overlapping confidence intervals.



Figure\_: Predicted Simpson diversity indices of arthropods under *Chromoleana* management options. Dots and error bars represent the mean ± 95% confidence intervals.

**Margalef index**

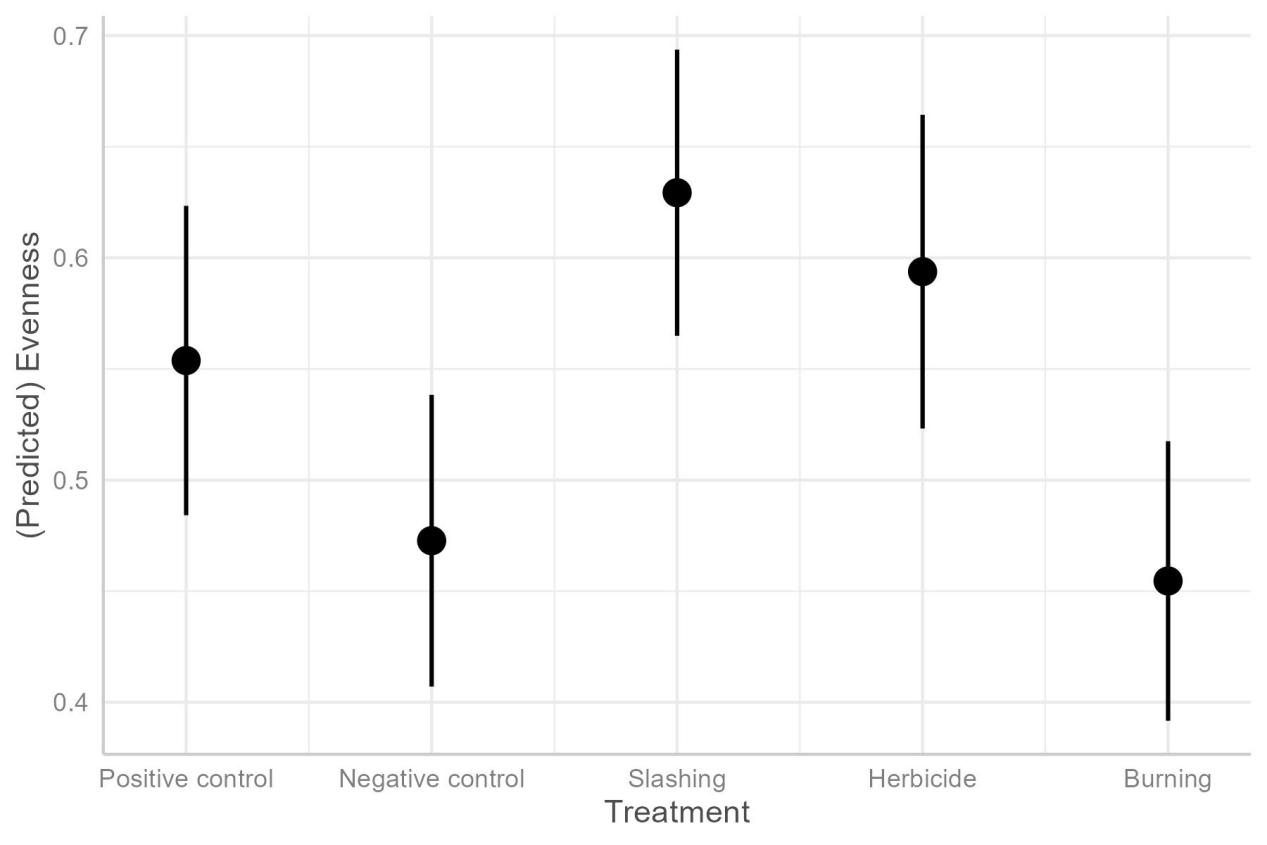
A linear model was fitted to test the effects of treatment and time (period) on Margalef diversity index. Among predictors, sampling period showed a significant negative effect (β = –0.0083 ± 0.0036, p = 0.023). Treatment effects were generally weak and not statistically significant. Compared to the positive control group, slashing treatment tended to increase Margalef’s index (β = 0.151 ± 0.091, p = 0.099), but this effect was only marginal. Negative control, herbicide, and burning treatments showed no meaningful differences in Margalef’s index (all p > 0.40).



Figure\_: predicted Margalef diversity indices of arthropods under *Chromoleana* management options. Dots and error bars represent the mean ± 95% confidence intervals.

**Evenness**

A linear model was fitted to test the effects of treatment and time (period) on arthropod evenness. Sampling period had no significant effect on evenness (β = –0.0009 ± 0.0019, p = 0.624). Treatment effects were generally weak, but some contrasts indicated differences among management options. Compared to the positive control, burning treatment showed a significant reduction in evenness (β = –0.099 ± 0.048, p = 0.038), while slashing and herbicide treatments did not differ significantly (both p > 0.11). Pairwise comparisons revealed that slashing maintained significantly higher evenness relative to the negative control (p = 0.009), and burning plots had significantly lower evenness than slashing (p = 0.002) and herbicide treatments (p = 0.040). Overall, mean evenness values ranged from 0.462 (burning) to 0.637 (slashing), with overlapping confidence intervals among most treatments.



Figure\_: predicted Evenness indices of arthropods under *Chromoleana* management options. Dots and error bars represent the mean ± 95% confidence intervals.

Table: Comparison of management methods from abundance and biodiversity metrices of arthropods in Chromoleana invaded and non-invaded sites.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Indices | Treatment | Mean | SE | asymp.LCL | asymp.UCL | Sidak group |
| Abundance | Positive control | 2.73 | 0.03 | 2.64 | 2.81 | b |
|  | Negative control | 3.13 | 0.03 | 3.07 | 3.20 | c |
|  | Slashing | 2.71 | 0.03 | 2.63 | 2.80 | b |
|  | Herbicide | 2.47 | 0.04 | 2.37 | 2.56 | a |
|  | Burning | 3.23 | 0.03 | 3.16 | 3.29 | c |
| Richness | Positive control | 0.76 | 0.09 | 0.54 | 0.99 | a |
|  | Negative control | 0.98 | 0.08 | 0.78 | 1.19 | a |
|  | Slashing | 0.96 | 0.08 | 0.75 | 1.16 | a |
|  | Herbicide | 0.77 | 0.09 | 0.54 | 1.00 | a |
|  | Burning | 0.90 | 0.08 | 0.69 | 1.11 | a |
| Shannon | Burning | 0.36 | 0.05 | 0.24 | 0.48 | a |
|  | Herbicide | 0.37 | 0.05 | 0.25 | 0.50 | a |
|  | Positive control | 0.38 | 0.05 | 0.26 | 0.51 | a |
|  | Negative control | 0.41 | 0.05 | 0.29 | 0.54 | a |
|  | Slashing | 0.52 | 0.05 | 0.40 | 0.65 | a |
| Simpson | Burning | 0.19 | 0.03 | 0.12 | 0.26 | a |
|  | Herbicide | 0.21 | 0.03 | 0.14 | 0.27 | a |
|  | Negative control | 0.21 | 0.03 | 0.14 | 0.28 | a |
|  | Positive control | 0.23 | 0.03 | 0.16 | 0.29 | a |
|  | Slashing | 0.29 | 0.03 | 0.22 | 0.36 | a |
| Margalef | Positive control | 0.53 | 0.06 | 0.36 | 0.70 | a |
|  | Negative control | 0.60 | 0.06 | 0.43 | 0.77 | a |
|  | Slashing | 0.68 | 0.06 | 0.51 | 0.85 | a |
|  | Herbicide | 0.53 | 0.07 | 0.36 | 0.70 | a |
|  | Burning | 0.53 | 0.06 | 0.36 | 0.70 | a |

**Species accumulation curves**

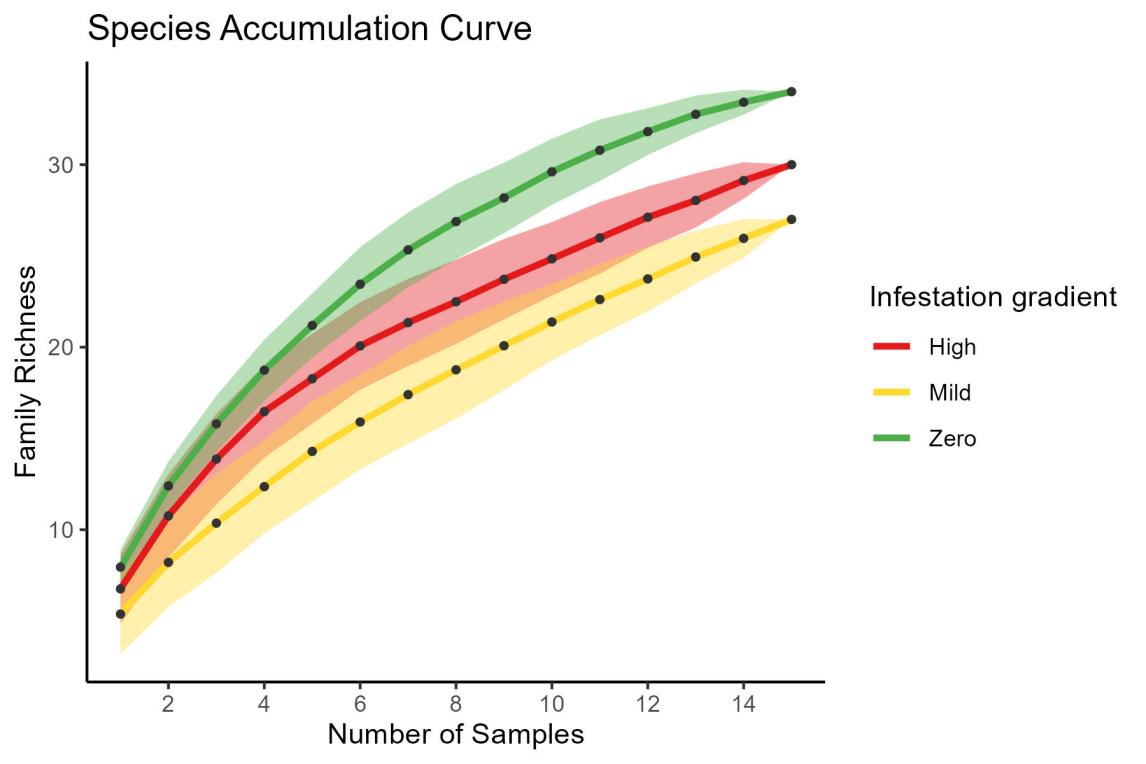


Figure \_: Family accumulation curve for Igueosagie for pitfall trap collections in the wet season.

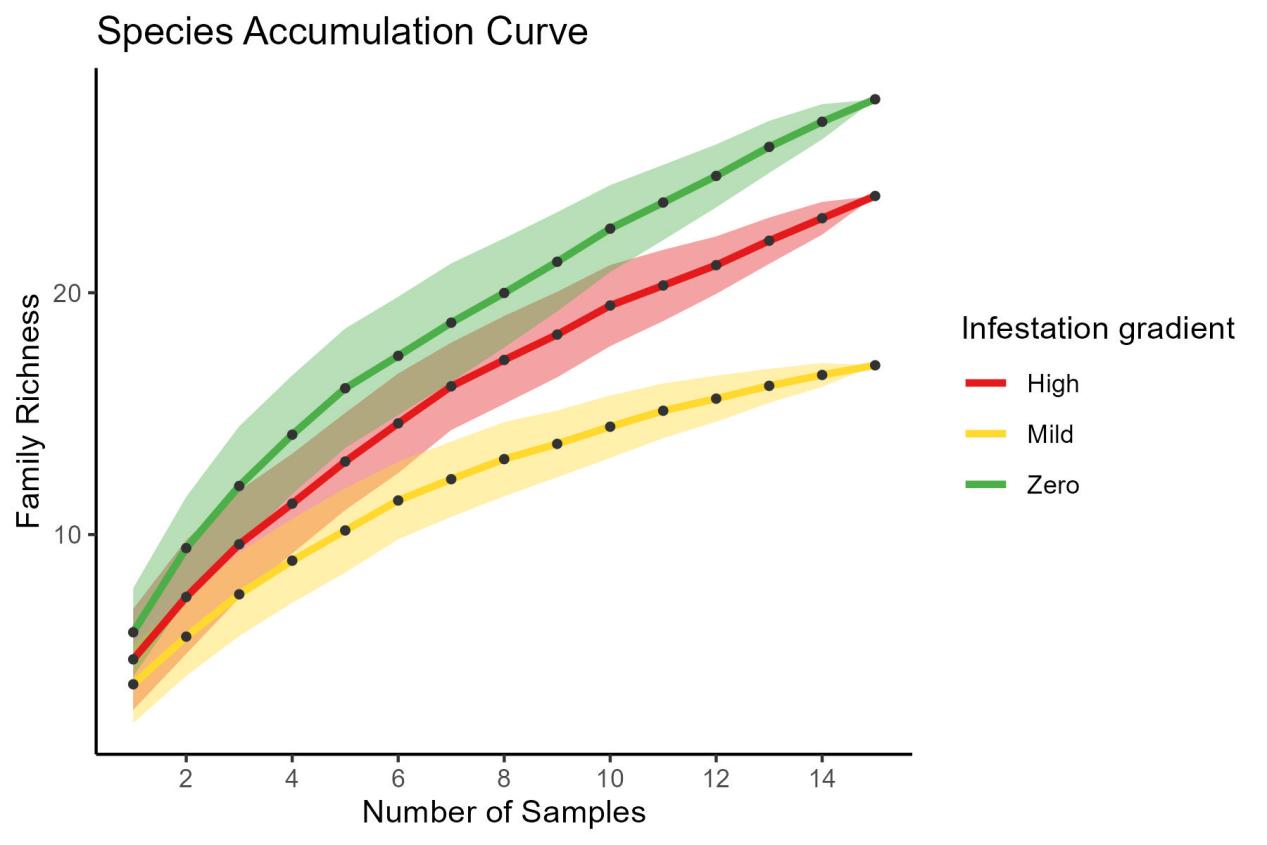
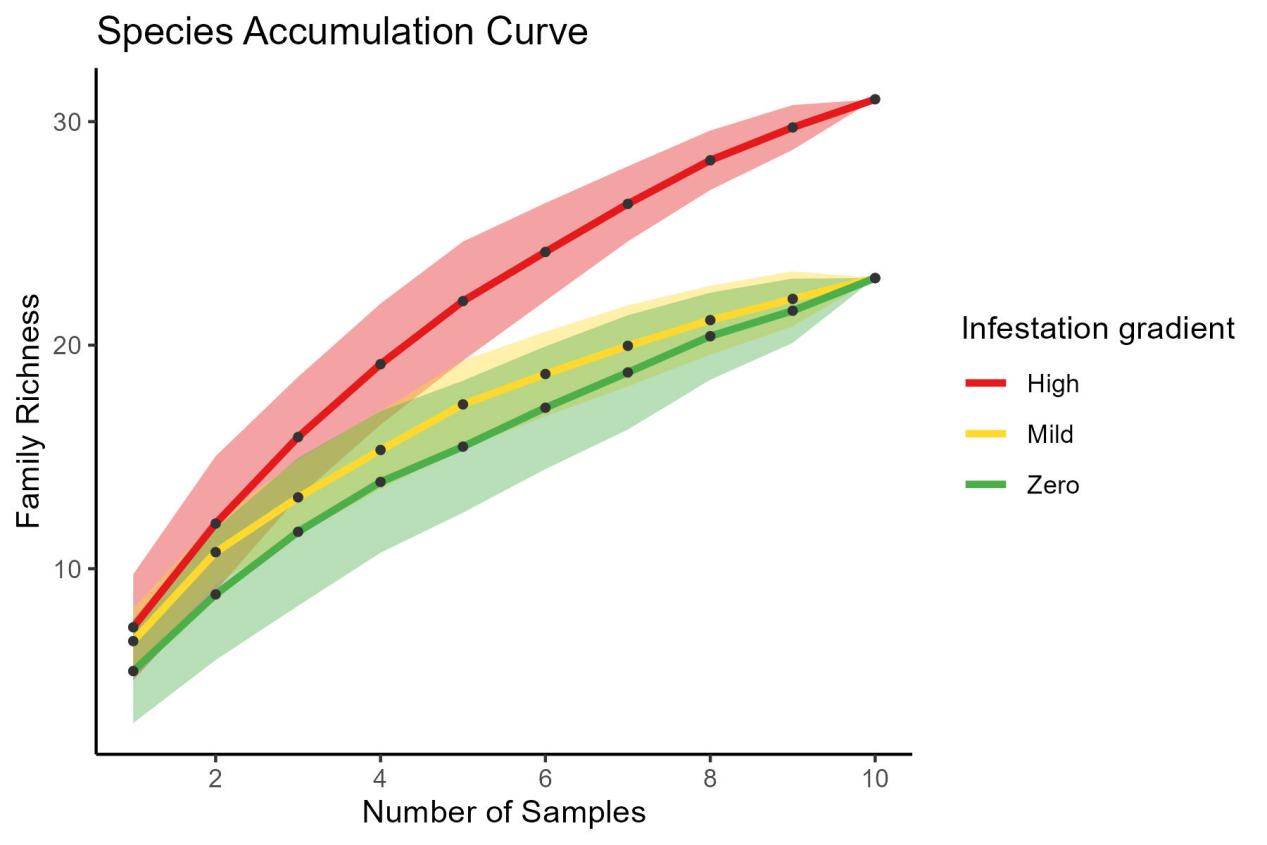
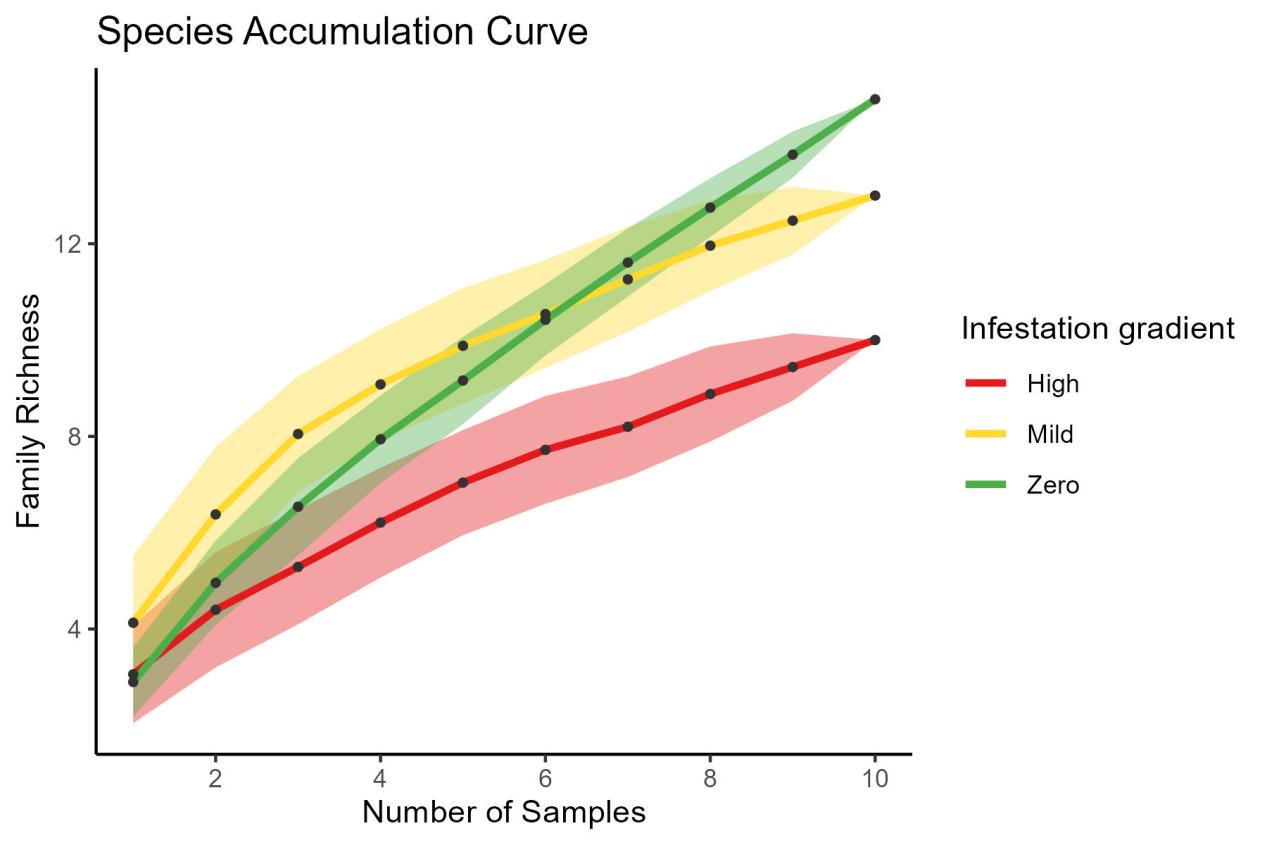


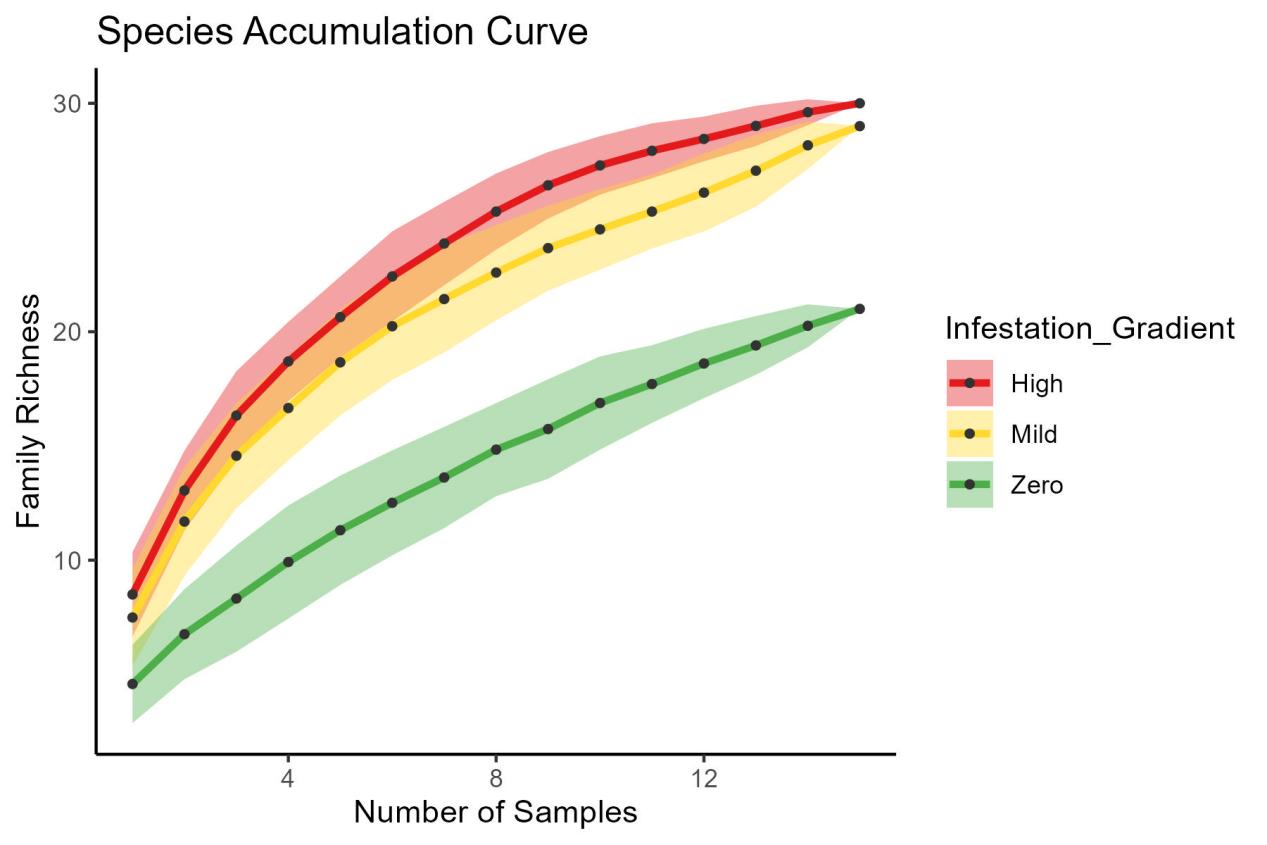
Figure \_: Family accumulation curve for Igueosagie for pitfall trap collections in the dry season.



Figure\_: Family accumulation curve for Igueosagie for beating tray collections in the wet season.



Figure\_: Family accumulation curve for Igueosagie for beating tray collections in the dry season.



Figure\_: Family accumulation curve for Ogua for pitfall trap collections in the wet season.

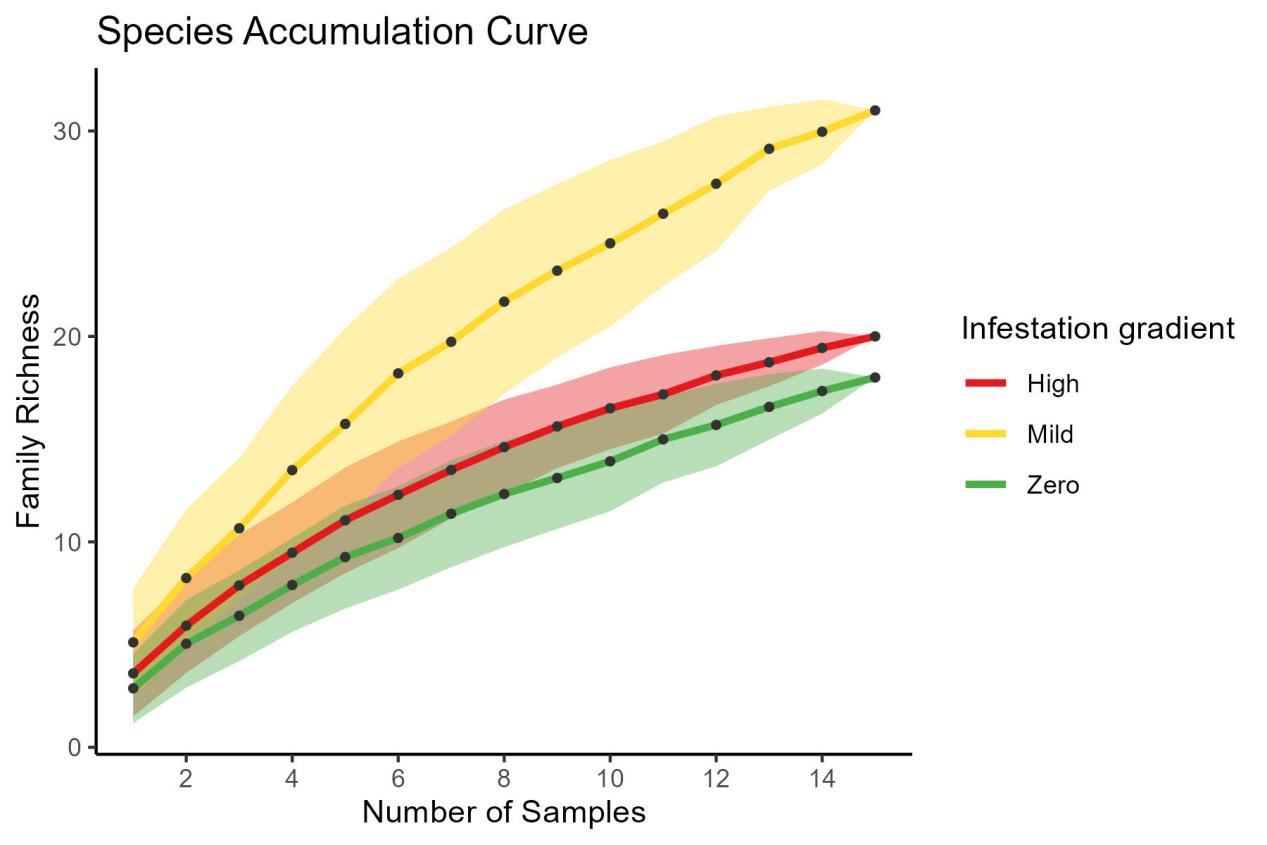
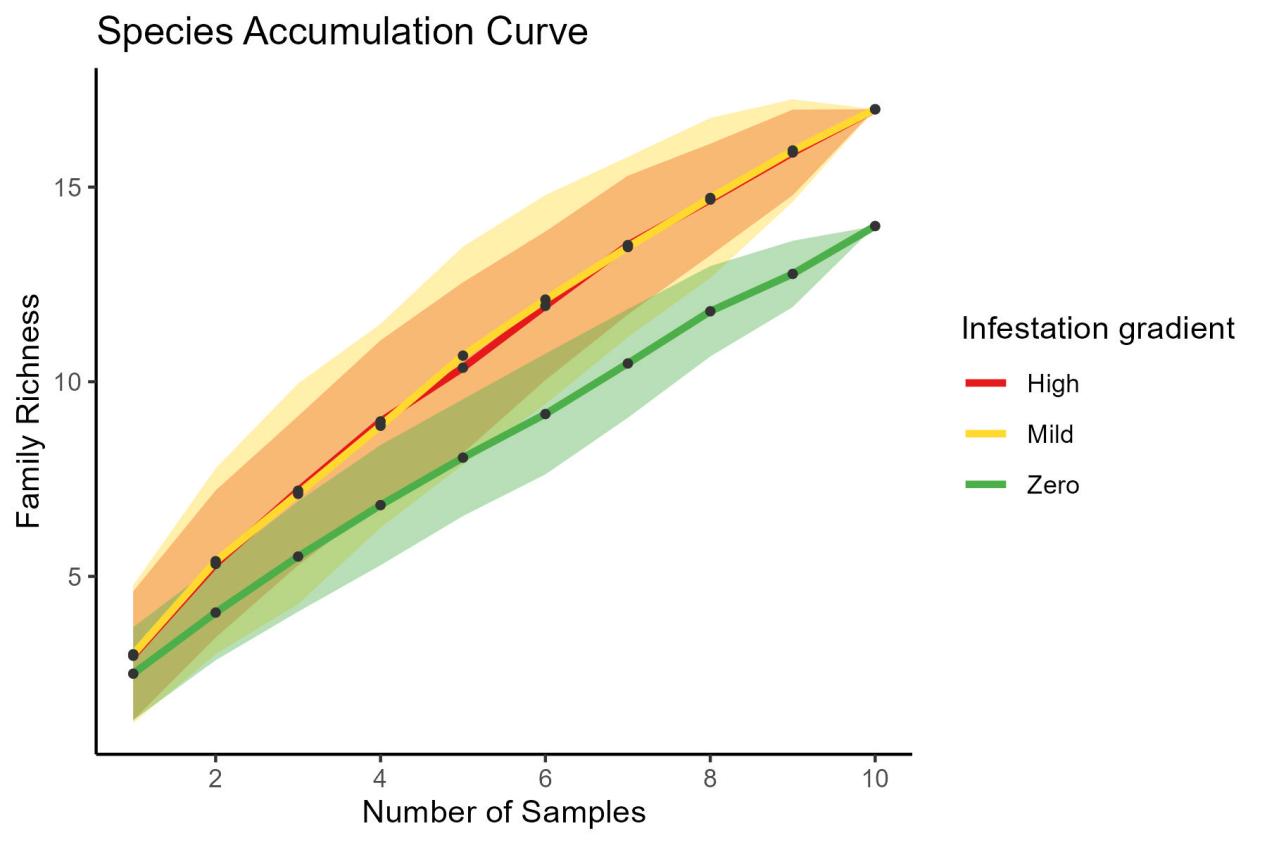
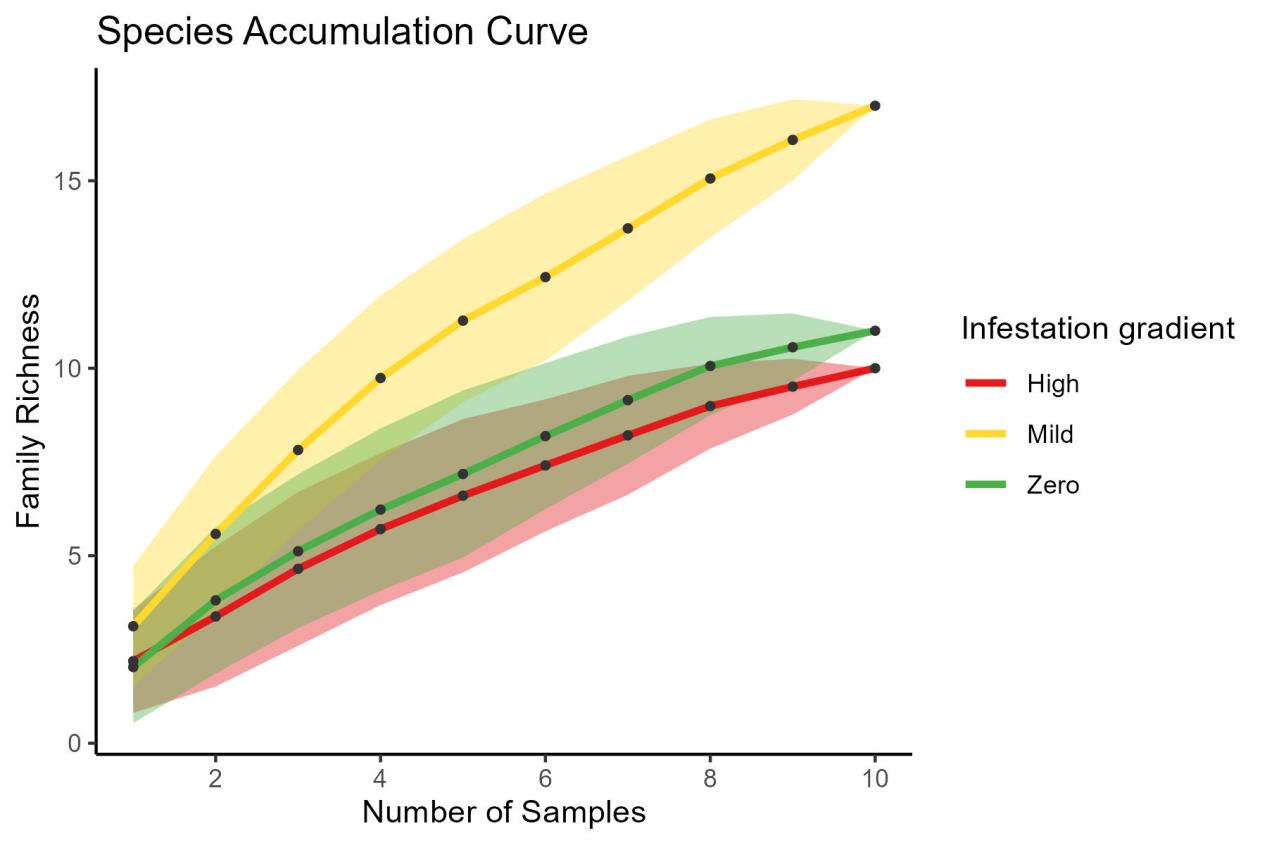


Figure: Family accumulation curve for Ogua for pitfall trap collections in the dry season.



Figure\_: Family accumulation curve for Ogua for beating tray collections in the wet season.



Figure\_: Family accumulation curve for Ogua for beating tray collections in the dry season.

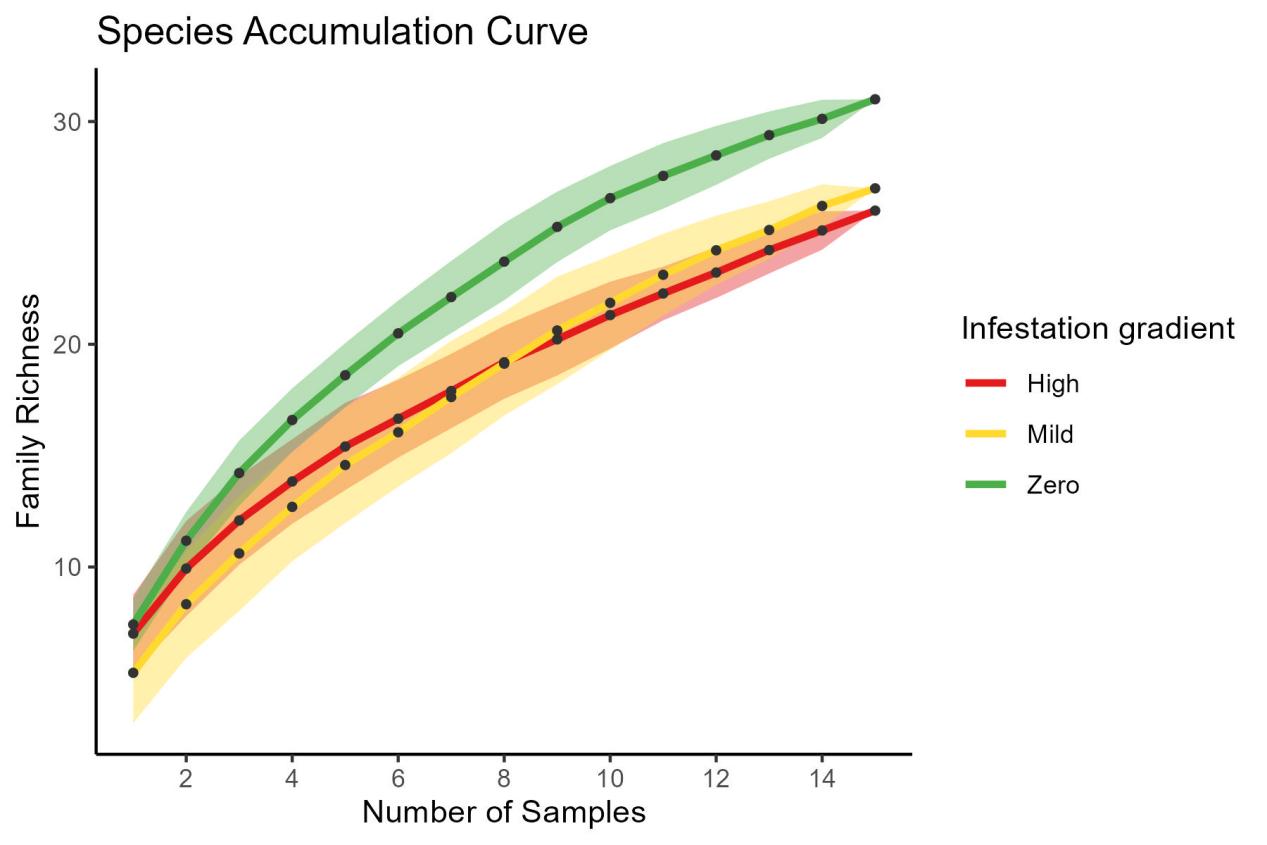


Figure \_ : Family accumulation curve for Iguovbiovo for pitfall trap collections in the wet season.

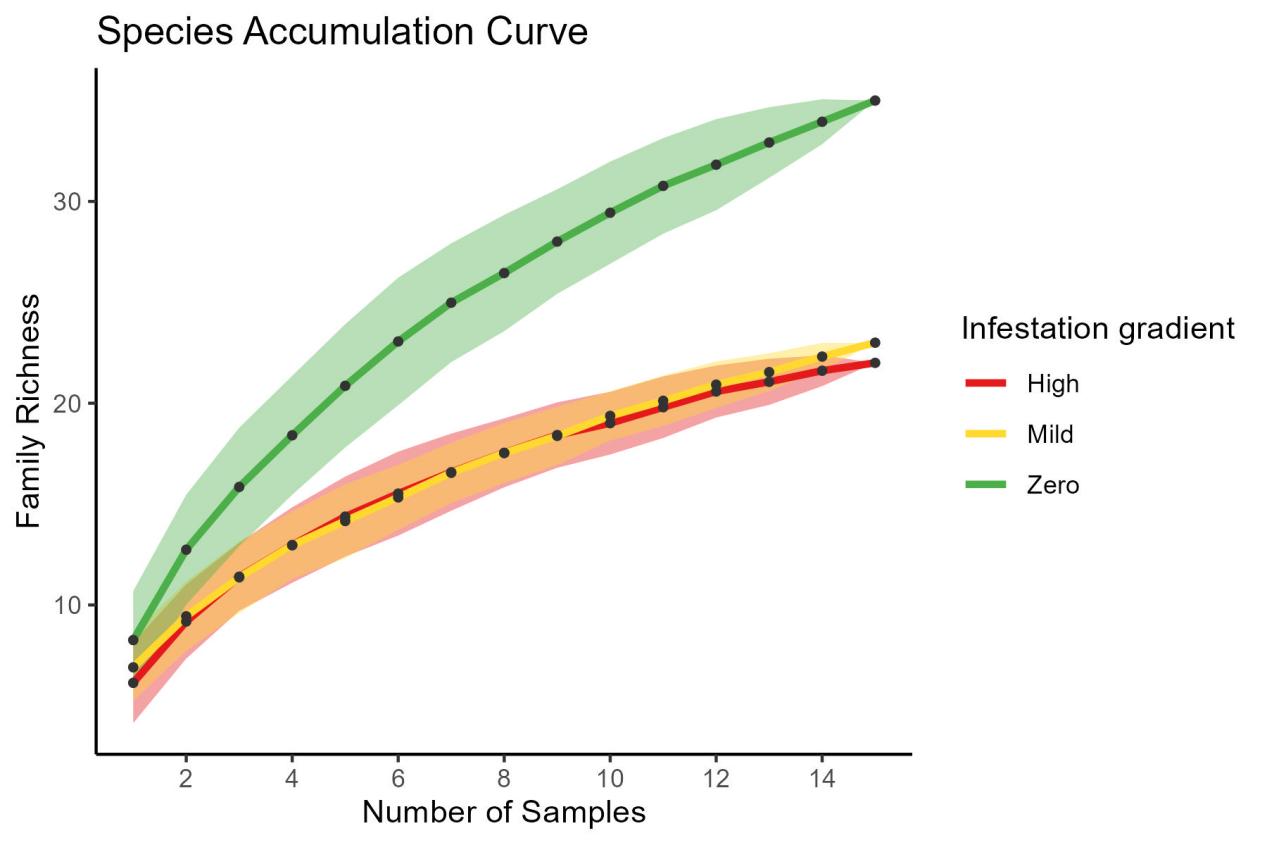


Figure \_ : Family accumulation curve for Iguovbiovo for pitfall trap collections in the dry season.

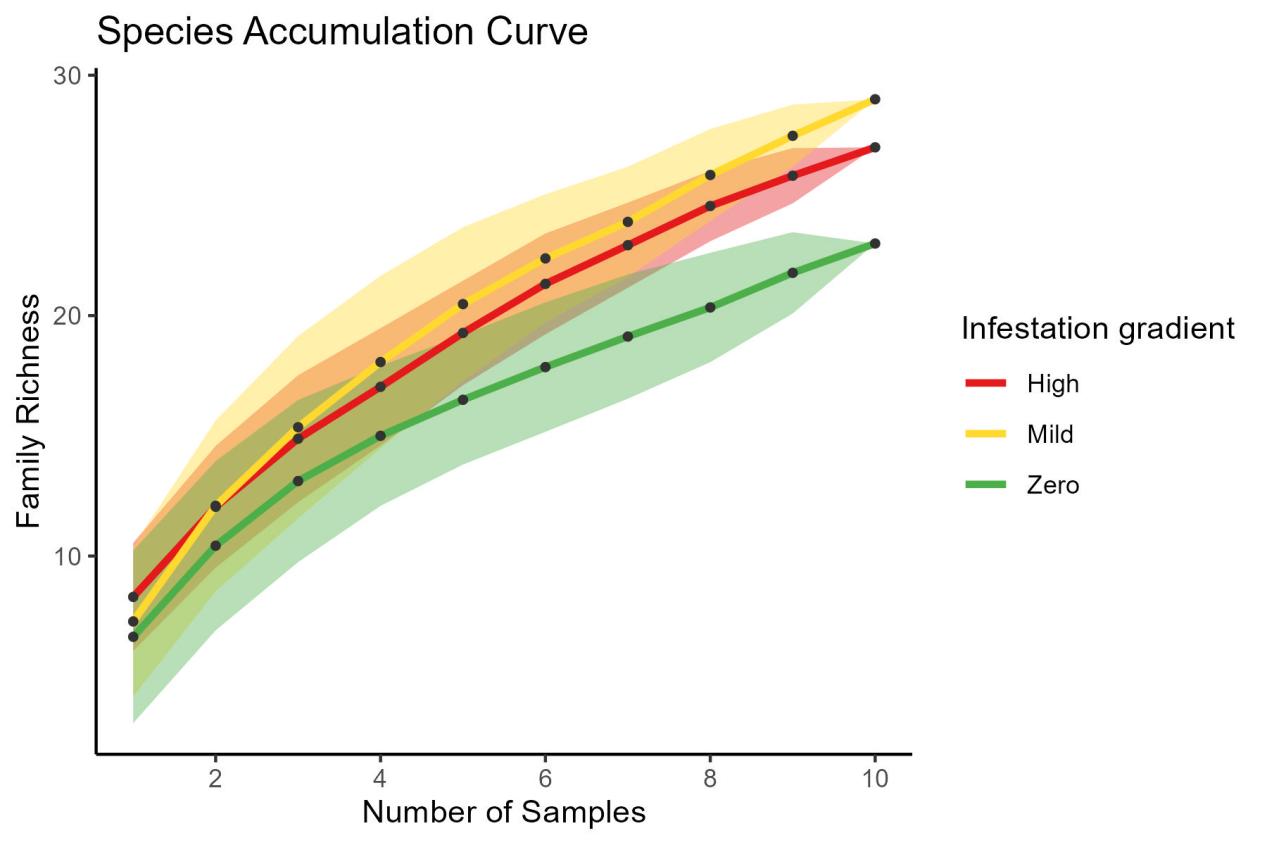
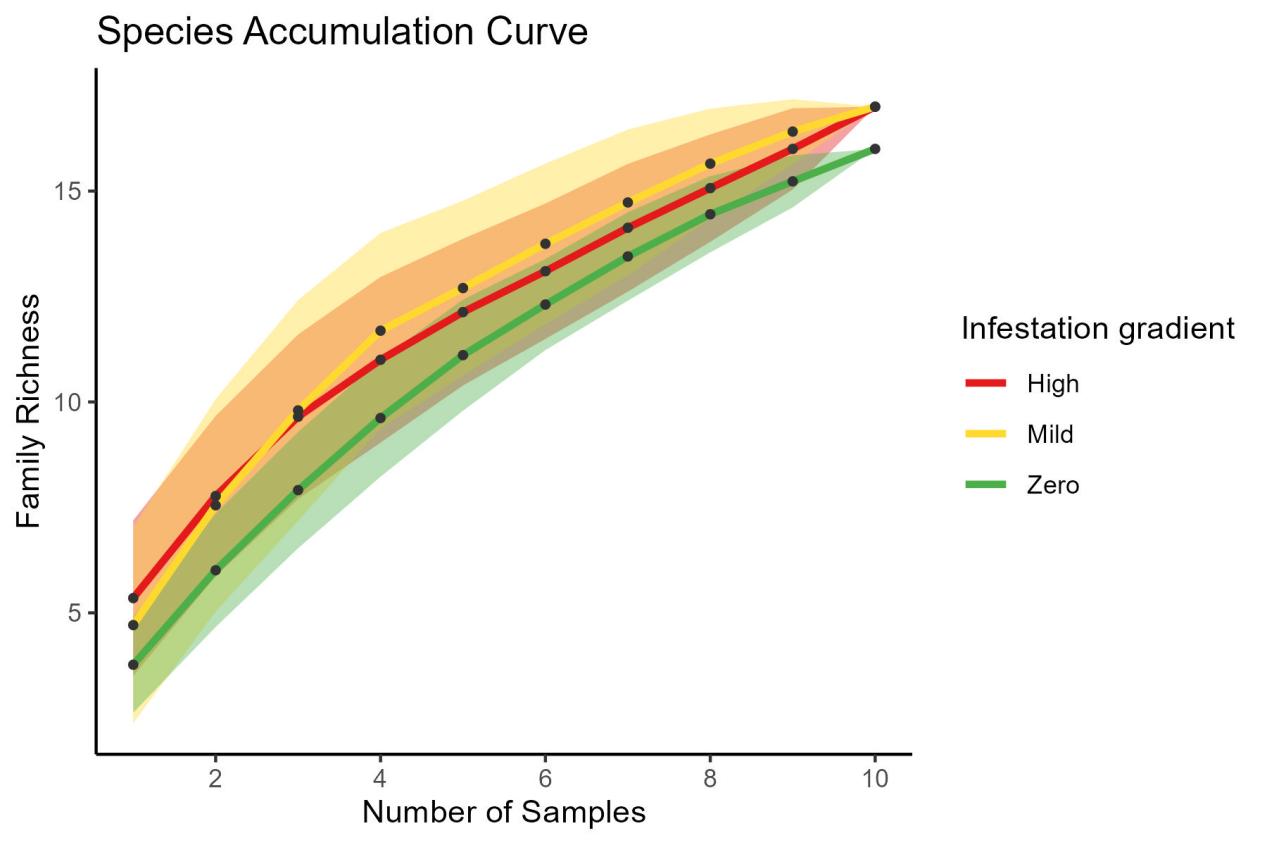
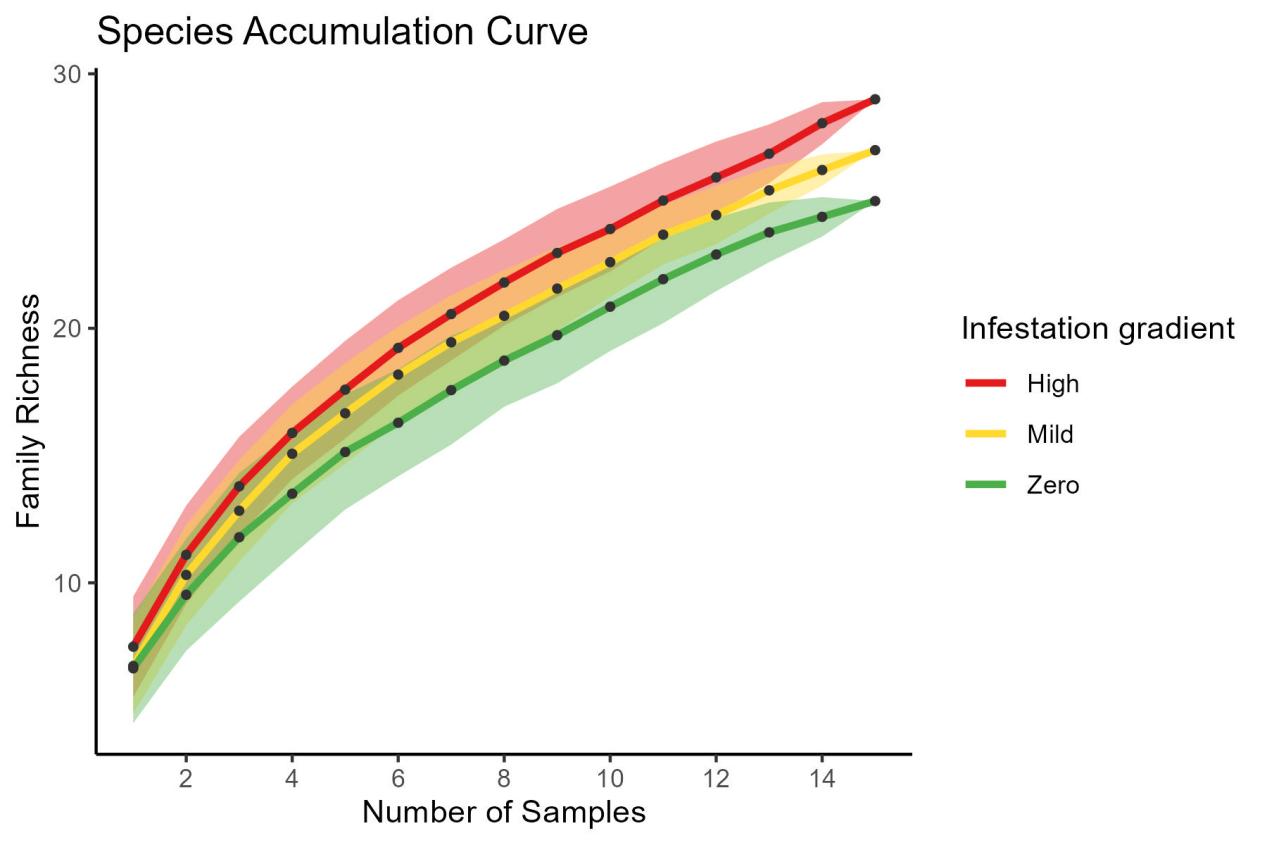


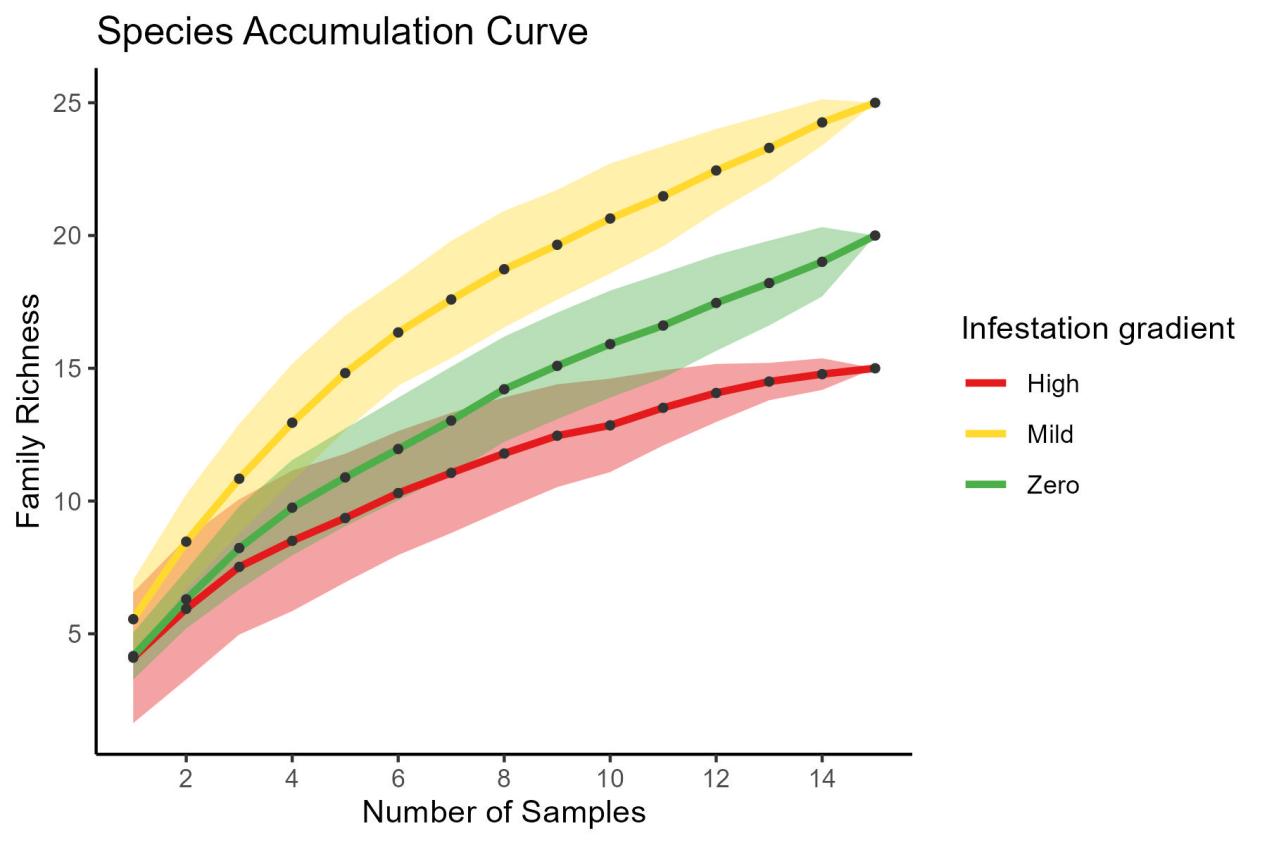
Figure \_: Family accumulation curve for Iguovbiovo for beating tray collections in the wet season.



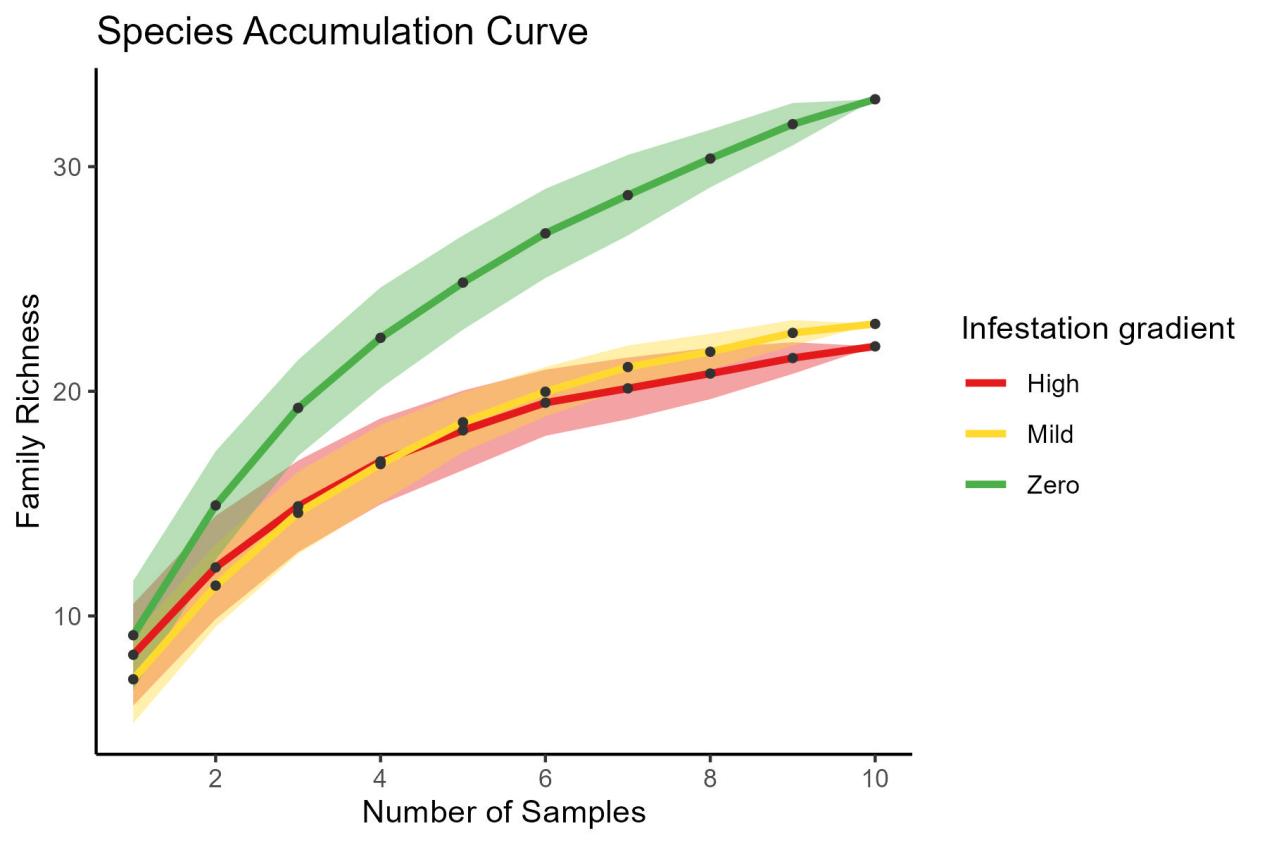
Figure\_: Family accumulation curve for Iguovbiovo for beating tray collections in the dry season.



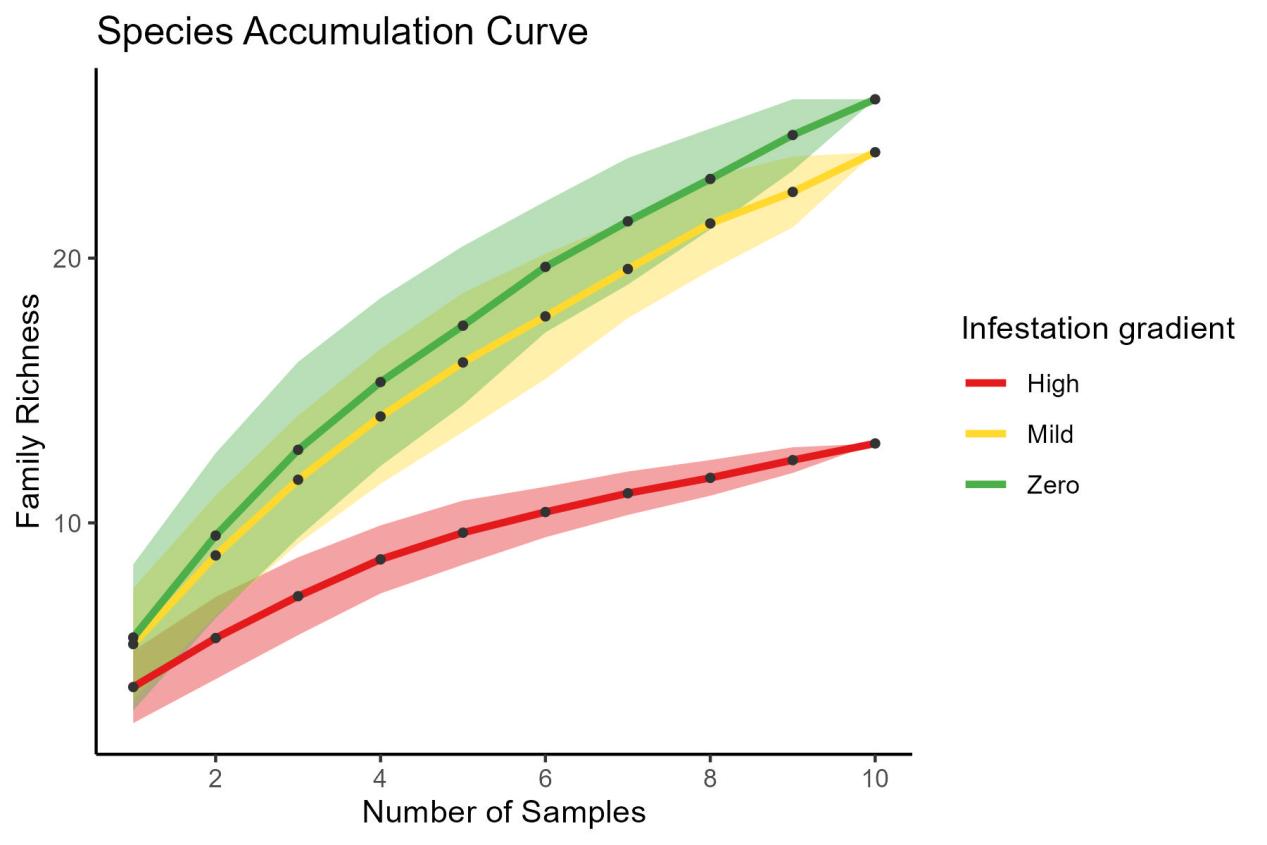
Figure\_: Family accumulation curve for Ahor urokosa for pitfall collections in the wet season.



Figure\_: Family accumulation curve for Ahor urokosa pitfall collections in the dry season.



Figure\_: Family accumulation curve for Ahor urokosa beating tray collections in the wet season.



Figure\_: Family accumulation curve for Ahor urokosa beating tray collections in the dry season.

**Diversity indices across villages, seasons, and levels of *Chromolaena* invasion**

Diversity indices varied across villages, seasons, and levels of Chromolaena invasion. In general, species diversity (Shannon and Simpson indices) was lowest under high invasion during the dry season, while sites with little or no invasion consistently supported higher diversity. For example, in Ahor-Urokosa and Iguegosagie, Shannon values increased from high invasion to zero invasion during the dry season, with Simpson’s index showing a similar trend.

Across all villages, wet-season communities exhibited higher diversity than their dry-season counterparts. In Iguegosagie, for instance, Shannon values during the wet season reached 2.95 under zero invasion compared with only 0.79 under high invasion in the dry season. Similarly, in Ogua, wet-season sites under high invasion recorded Shannon values above 2.8 compared with less than 1.0 during the dry season.

Species richness and Margalef’s index also followed these patterns, with higher richness recorded in the wet season across most sites. Notably, Iguovbiobo and Iguegosagie recorded the highest richness values (47–50 species) in the wet season under low or no invasion. Conversely, abundance tended to peak under high invasion during the dry season—for example, Iguovbiobo recorded over 1400 individuals under zero invasion, and Ogua recorded more than 1200 under high invasion, despite lower diversity.

Evenness varied across villages, seasons, and levels of Chromolaena invasion, with the lowest values generally recorded under high invasion during the dry season. In contrast, sites with mild or no invasion supported higher evenness. Seasonal effects were also evident, as wet-season communities consistently exhibited greater evenness than their dry-season counterparts. While Ahor-Urokosa and Iguovbiobo showed clear increases in evenness from high to zero invasion, Ogua presented some exceptions, with relatively high evenness even under high invasion in the wet season.

Table\_: Biodiversity levels of the sites for each village and Chromoleana infestation levels at dry and wet seasons

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Village** | **Season** | **Infestation gradient** | **Shannon** | **Simpson** | **Margalef** | **Richness** | **Abundance** |
| Ahor-Urokosa | Dry | High | 0.6514 | 0.2131 | 3.2216 | 23 | 924 |
| Ahor-Urokosa | Dry | Mild | 1.4892 | 0.49503 | 5.56345 | 37 | 646 |
| Ahor-Urokosa | Dry | Zero | 1.87281 | 0.61638 | 6.8485 | 41 | 344 |
| Ahor-Urokosa | Wet | High | 2.1575267 | 0.7481184 | 6.271139 | 41 | 589 |
| Ahor-Urokosa | Wet | Mild | 2.6888726 | 0.8699131 | 6.952506 | 42 | 364 |
| Ahor-Urokosa | Wet | Zero | 2.3432148 | 0.7814845 | 7.247074 | 47 | 571 |
| Iguegosagie | Dry | High | 0.7884749 | 0.2541578 | 4.211169 | 29 | 772 |
| Iguegosagie | Dry | Mild | 1.2304508 | 0.4241651 | 4.068887 | 26 | 466 |
| Iguegosagie | Dry | Zero | 1.1388937 | 0.3810675 | 5.443507 | 37 | 745 |
| Iguegosagie | Wet | High | 2.8684601 | 0.8983082 | 8.118656 | 50 | 418 |
| Iguegosagie | Wet | Mild | 2.7632834 | 0.882069 | 7.054822 | 41 | 290 |
| Iguegosagie | Wet | Zero | 2.9508221 | 0.8995199 | 8.476418 | 50 | 324 |
| Iguovbiobo | Dry | High | 2.0478795 | 0.7007276 | 5.05788 | 32 | 459 |
| Iguovbiobo | Dry | Mild | 2.0097956 | 0.7557791 | 4.616605 | 31 | 664 |
| Iguovbiobo | Dry | Zero | 1.0765387 | 0.3594848 | 5.484187 | 41 | 1471 |
| Iguovbiobo | Wet | High | 2.485551 | 0.8338076 | 7.411494 | 47 | 496 |
| Iguovbiobo | Wet | Mild | 2.7264254 | 0.8680183 | 7.83363 | 47 | 355 |
| Iguovbiobo | Wet | Zero | 2.6250437 | 0.8585281 | 7.298933 | 45 | 415 |
| Ogua | Dry | High | 0.9352578 | 0.5345337 | 3.353381 | 25 | 1283 |
| Ogua | Dry | Mild | 1.0573671 | 0.3368169 | 5.850415 | 39 | 662 |
| Ogua | Dry | Zero | 1.8584905 | 0.7632317 | 3.993184 | 23 | 247 |
| Ogua | Wet | High | 2.8428775 | 0.8932125 | 6.882644 | 40 | 289 |
| Ogua | Wet | Mild | 2.545517 | 0.8230327 | 6.769844 | 39 | 274 |
| Ogua | Wet | Zero | 1.7251049 | 0.6152828 | 5.463176 | 30 | 202 |

**Effect of *Chromoleana* invasion gradient on arthropod diversity**

**Arthropod Abundance**

A generalized linear model (GLM) with a Poisson error distribution and a log link function was fitted to examine the effects of season and infestation gradient on arthropod abundance. The model revealed significant effects of both predictors on abundance.

The results indicate that arthropod abundance varies both seasonally and across infestation gradients. Specifically, season had a strong effect, with abundance significantly lower in the wet season compared to the dry season (β = −0.638, SE = 0.018, p < 0.001). Regarding the infestation gradient, plots with mild infestation had slightly lower abundance relative to the baseline (β = −0.149, SE = 0.022, p < 0.001), whereas plots with high infestation showed significantly higher abundance (β = 0.191, SE = 0.021, p < 0.001).

**Family richness**

A generalized linear model (GLM) with a Poisson error distribution and a log link was fitted to assess the effects of season and infestation gradient on arthropod family richness. The model shows a significant effect of season but no significant effect of infestation gradient. Specifically, family richness was significantly higher in the wet season compared to the dry season (β = 0.301, SE = 0.067, p < 0.001). In contrast, neither mild (β = −0.039, SE = 0.081, p = 0.63) nor high infestation (β = −0.090, SE = 0.082, p = 0.27) significantly affected family richness relative to the no infestation sites. This indicate that seasonal variation is a stronger driver of arthropod family richness than infestation intensity.

**Shannon diversity index**

Shannon diversity was strongly influenced by season but not by infestation gradient. Diversity was significantly higher in the wet season compared to the dry season (β = 1.21 ± 0.18 SE, p < 0.001). In contrast, neither mild (β = 0.12 ± 0.22 SE, p = 0.60) nor high infestation (β = –0.10 ± 0.22 SE, p = 0.65) differed significantly from the baseline infestation level.

Overall, Shannon diversity was consistently elevated during the wet season, whereas infestation gradient showed no statistically significant relationship with diversity.

**Simpson diversity**

Simpson diversity was significantly affected by season but not by infestation gradient (Table X). Diversity was higher in the wet season compared to the dry season (β = 0.34 ± 0.06 SE, p < 0.001). Neither mild (β = 0.02 ± 0.08 SE, t = 0.30, p = 0.77) nor high infestation (β = –0.02 ± 0.08 SE, p = 0.75) differed significantly from the baseline infestation level.

**Margalef index**

The Gamma regression model revealed that Season had a significant effect on Margalef’s diversity index, while Infestation gradient did not show strong evidence of an effect (Table X). Specifically, Margalef’s diversity was significantly higher during the wet season compared to the dry season (β = 0.41, SE = 0.07, t = 5.71, p < 0.001). In contrast, sites with mild (p = 0.65) or high infestation levels (p = 0.09) did not differ significantly from sites with low infestation.

**Comparing Community composition of arthropods at the sites**

**Igueosagie NMDS**

**Pitfall trap collections:**

Non-metric multidimensional scaling (NMDS) ordination based on Bray–Curtis dissimilarity revealed clear patterns of variation in arthropod community composition across Chromolaena infestation gradients and between seasons in Iguegosagie village. Arthropod assemblages varied markedly in response to both seasonality and infestation intensity, with the strongest dissimilarities observed between plots experiencing high Chromolaena infestation and those with low or no infestation.

The analysis of multivariate dispersion (PERMDISP) indicated significant differences in within-group variation among the combined season–infestation treatments (F = 7.37, p < 0.001), indicating heterogeneity in community dispersion across treatments.

The PERMANOVA further confirmed these patterns, showing that season and infestation jointly explained a substantial proportion of the variation in community composition (R² = 0.486, F = 15.88, p = 0.0001). Pairwise comparisons provided additional resolution of these differences. Arthropod communities in plots with high Chromolaena infestation during the dry season were consistently distinct from most other groups, particularly from plots with high infestation in the wet season (F = 30.08, R² = 0.518, p.adjusted = 0.015), mild infestation in the wet season (F = 14.95, R² = 0.348, p.adjusted = 0.015), zero infestation in the dry season (F = 3.50, R² = 0.111, p.adjusted = 0.045), and zero infestation in the wet season (F = 19.79, R² = 0.414, p.adjusted = 0.015).

Similarly, arthropod assemblages in plots with high Chromolaena infestation during the wet season differed significantly from nearly all other treatments. These differences were especially pronounced when compared with mild infestation in the dry season (F = 23.68, R² = 0.458, p.adjusted = 0.015), mild infestation in the wet season (F = 5.65, R² = 0.168, p.adjusted = 0.015), no infestation in the dry season (F = 24.88, R² = 0.471, p.adjusted = 0.015), and no infestation in the wet season (F = 9.82, R² = 0.260, p.adjusted = 0.015).

Comparisons among low- and mild-infestation plots showed more subtle differences. For instance, arthropod communities in mildly infested plots during the dry season were not significantly different from those in uninfested plots during the dry season (p.adjusted = 0.660). However, they were distinct from communities in mildly infested plots during the wet season (F = 12.18, R² = 0.303, p.adjusted = 0.015) and from those in uninfested wet-season plots (F = 14.16, R² = 0.336, p.adjusted = 0.015). Likewise, arthropod assemblages in mildly infested wet-season plots were significantly different from those in uninfested wet-season plots (F = 10.08, R² = 0.265, p.adjusted = 0.015).

Taken together, these results demonstrate that both seasonality and Chromolaena infestation strongly shape arthropod community composition, with the most pronounced differences observed under conditions of high infestation.

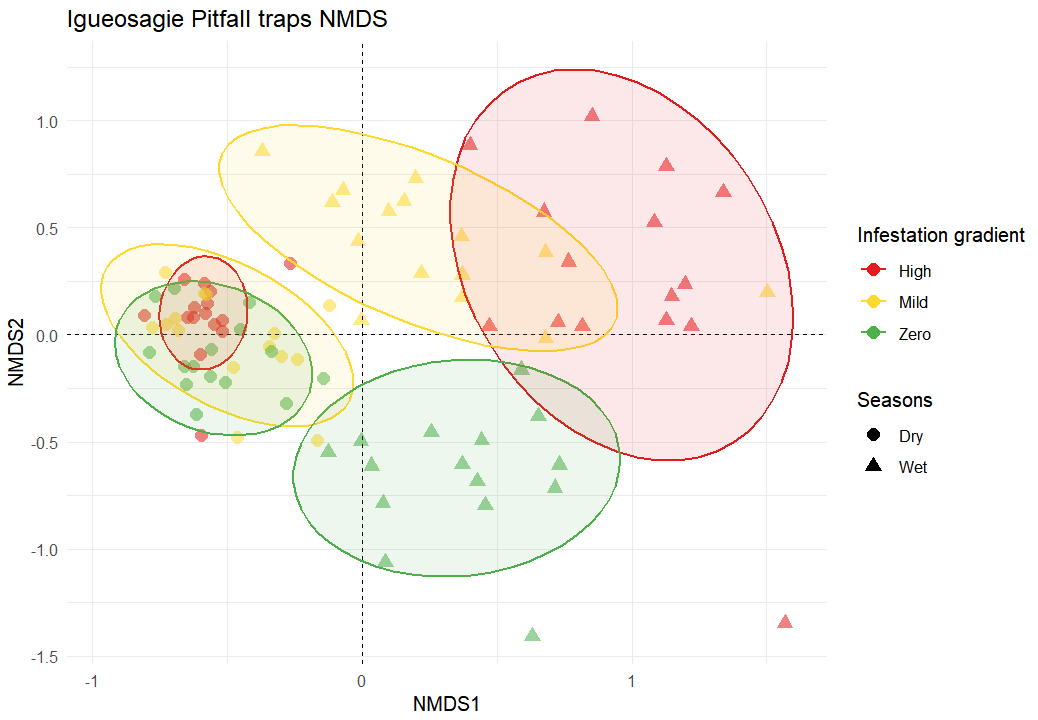


Figure \_: NMDS ordination plot (Stress = 0.16449) showing the community compositional differences in arthropods across seasons and Chromoleana infestation gradients in Igueosagie, surveyed using pitfall traps. *Each scatter point reprent a sampling point, and eclipse is made from 95% confidence interval from the center of each group. Colors and shape are used to distinguish the Chromoleana infestation levels and survey seasons.*

**Beating Tray Collections:**

**# Results and analysis for beating tray collection should not be trusted.**

Analysis of arthropods collected via beating trays showed that community composition varied across season and *Chromolaena* infestation intensity. The results suggest that arthropod assemblages collected via beating trays are strongly influenced by both seasonality and Chromolaena infestation intensity, with the most pronounced compositional differences occurring under high infestation, particularly when contrasting dry- and wet-season conditions.Examination of multivariate dispersion (PERMDISP) indicated no significant differences in within-group variability among the combined season–infestation treatments (F = 0.84, p = 0.53), suggesting that the spread of community data within each treatment was relatively homogeneous.

Despite the lack of dispersion differences, PERMANOVA revealed a significant effect of season and infestation on arthropod assemblages, with the model explaining approximately 24% of the observed variation in community structure (R² = 0.238, F = 3.38, p = 0.0001). This indicates that arthropod communities were structured by both seasonal changes and the level of Chromolaena infestation.

Pairwise comparisons highlighted which treatments were most distinct. Communities in plots with high Chromolaena infestation during the dry season differed significantly from those in high infestation during the wet season (F = 5.52, R² = 0.235, p.adjusted = 0.015), mild infestation during the wet season (F = 7.07, R² = 0.282, p.adjusted = 0.015), and no infestation during the wet season (F = 9.03, R² = 0.334, p.adjusted = 0.015). Similarly, high infestation in the wet season plots were distinct from communities in mildly infested dry-season plots (F = 4.17, R² = 0.188, p.adjusted = 0.015), mildly infested wet-season plots (F = 3.15, R² = 0.149, p.adjusted = 0.030), and plots with no infestation during the wet season (F = 5.36, R² = 0.230, p.adjusted = 0.015).

More subtle differences were observed among low- and mild-infestation plots. For example, mild infestation in the dry season was not significantly different from uninfested dry-season plots (p.adjusted = 1.0), but differed from uninfested wet-season plots (F = 8.13, R² = 0.311, p.adjusted = 0.015). Likewise, mild infestation in the wet season differed from uninfested dry-season plots (F = 4.51, R² = 0.200, p.adjusted = 0.015), though differences between mild and uninfested wet-season plots were not significant (p.adjusted = 0.242).

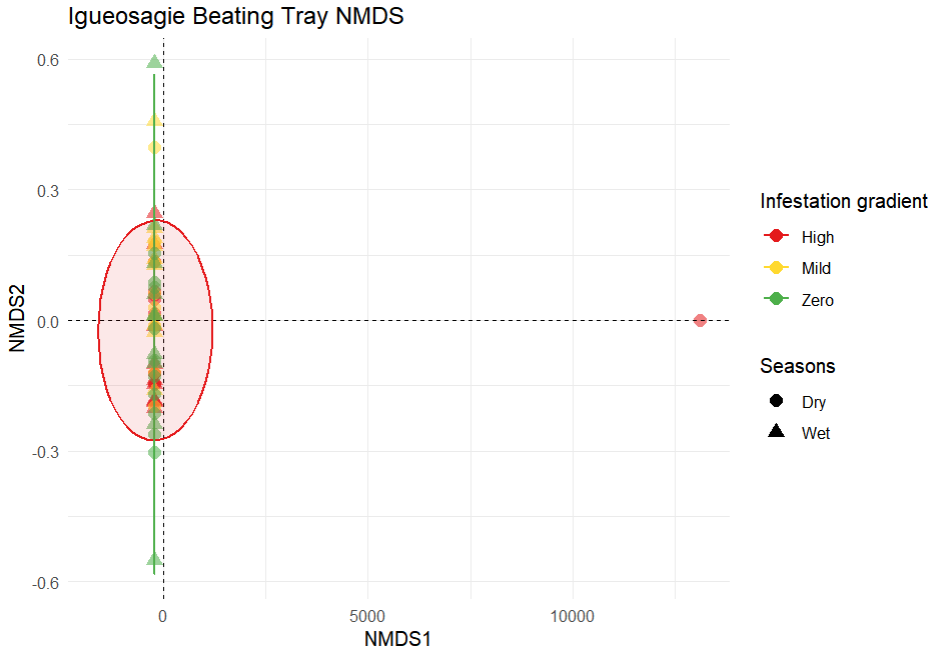


Figure \_: NMDS ordination plot (Stress = 0.000069) showing the community compositional differences in arthropods across seasons and Chromoleana infestation gradients in Igueosagie, surveyed using beating trays. *Each scatter point reprent a sampling point, and eclipse is made from 95% confidence interval from the center of each group. Colors and shape are used to distinguish the Chromoleana infestation levels and survey seasons.*

**Ogua NMDS**

**Pitfall trap collections:**

**# Results and analysis for pitfall trap collection should not be trusted.**

Pitfall trap collections in Ogua village revealed significant variation in arthropod community composition in response to season and Chromolaena infestation intensity. Analysis of multivariate dispersion (PERMDISP) indicated that within-group variability differed significantly among the combined season–infestation treatments (F = 3.56, p = 0.006), suggesting heterogeneity in community spread across treatments.

PERMANOVA confirmed that both season and infestation significantly influenced pitfall-trap arthropod assemblages, explaining approximately 28% of the variation in community composition (R² = 0.284, F = 6.65, p < 0.001). This demonstrates that arthropod communities are structured by both seasonal dynamics and the level of *Chromolaena* infestation.

Pairwise comparisons provided more detailed insight. Communities in plots with high *Chromolaena* infestation during the dry season were significantly distinct from high infestation in the wet season (F = 18.94, R² = 0.403, p.adjusted = 0.015), mild infestation in the wet season (F = 10.67, R² = 0.276, p.adjusted = 0.015), and uninfested wet-season plots (F = 8.73, R² = 0.238, p.adjusted = 0.015). In contrast, high infestation in the wet season was also distinct from dry mild (F = 18.72, R² = 0.401, p.adjusted = 0.015), wet mild (F = 5.19, R² = 0.156, p.adjusted = 0.015), dry zero (F = 8.42, R² = 0.231, p.adjusted = 0.015), and wet zero plots (F = 9.47, R² = 0.253, p.adjusted = 0.015).

Communities in mild- or zero-infestation plots showed more subtle differences. For instance, dry mild plots differed significantly from wet mild (F = 10.39, R² = 0.271, p.adjusted = 0.015) and wet zero (F = 8.08, R² = 0.224, p.adjusted = 0.015), whereas comparisons such as dry mild vs dry zero were not significant (p.adjusted = 0.120). Overall, these results indicate that high Chromolaena infestation during the dry season drives the largest compositional differences, while mild or no infestation generally results in more similar arthropod assemblages.

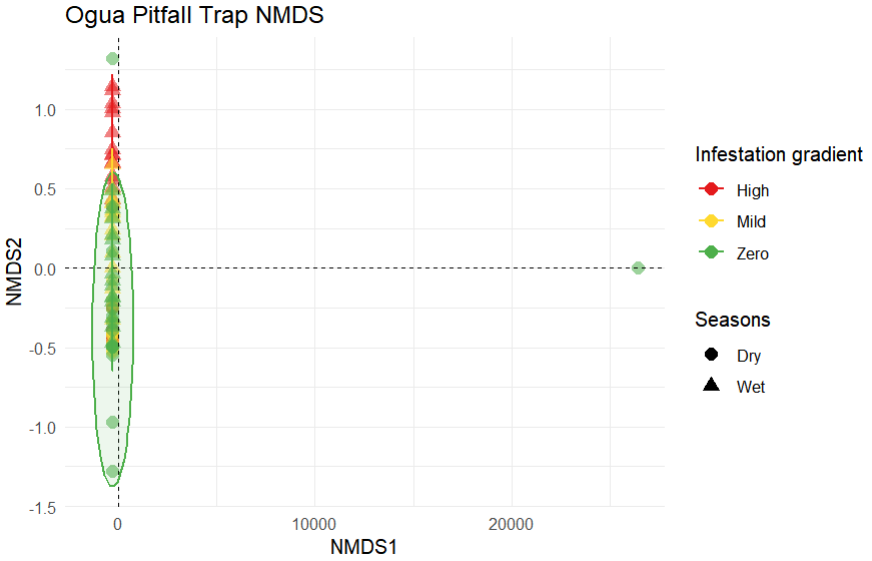


Figure \_: NMDS ordination plot (Stress = 0.000063) showing the community compositional differences in arthropods across seasons and Chromoleana infestation gradients in Ogua, surveyed using pitfall traps. *Each scatter point reprent a sampling point, and eclipse is made from 95% confidence interval from the center of each group. Colors and shape are used to distinguish the Chromoleana infestation levels and survey seasons.*

**Beating tray collections:**

Arthropod communities sampled using beating trays in Ogua village showed significant variation across season and Chromolaena infestation intensity. The results demonstrate that arthropod assemblages collected by beating trays are strongly influenced by the interaction of seasonality and Chromolaena infestation intensity, with the greatest divergence observed under high infestation in the dry season.

The analysis of multivariate dispersion (PERMDISP) indicated that within-group variability differed significantly among the combined season–infestation treatments (F = 4.37, p = 0.002), suggesting heterogeneity in the spread of community data across treatments.

PERMANOVA confirmed that both season and infestation significantly influenced arthropod assemblages, explaining approximately 27% of the total variation in community composition (R² = 0.270, F = 3.85, p = 0.0001). This indicates that beating-tray-collected arthropod communities were structured by both seasonal dynamics and the level of Chromolaena infestation.

Pairwise comparisons further clarified these patterns. Communities in plots with high Chromolaena infestation during the dry season were significantly distinct from those with high infestation during the wet season (F = 18.62, R² = 0.509, p.adjusted = 0.015), mild infestation in the dry season (F = 6.87, R² = 0.276, p.adjusted = 0.030), mild infestation in the wet season (F = 18.49, R² = 0.507, p.adjusted = 0.015), uninfested dry-season plots (F = 16.12, R² = 0.502, p.adjusted = 0.015), and uninfested wet-season plots (F = 34.79, R² = 0.659, p.adjusted = 0.015).

In contrast, communities in high infestation wet-season plots were generally not significantly different from mildly infested or uninfested plots within the same season (p.adjusted > 0.3), indicating that the combination of high infestation and dry-season conditions drove the largest compositional differences. Comparisons among low- and mild-infestation plots showed smaller and mostly non-significant differences, suggesting that pitfall-trap communities were more resilient to mild infestation or seasonal changes alone.

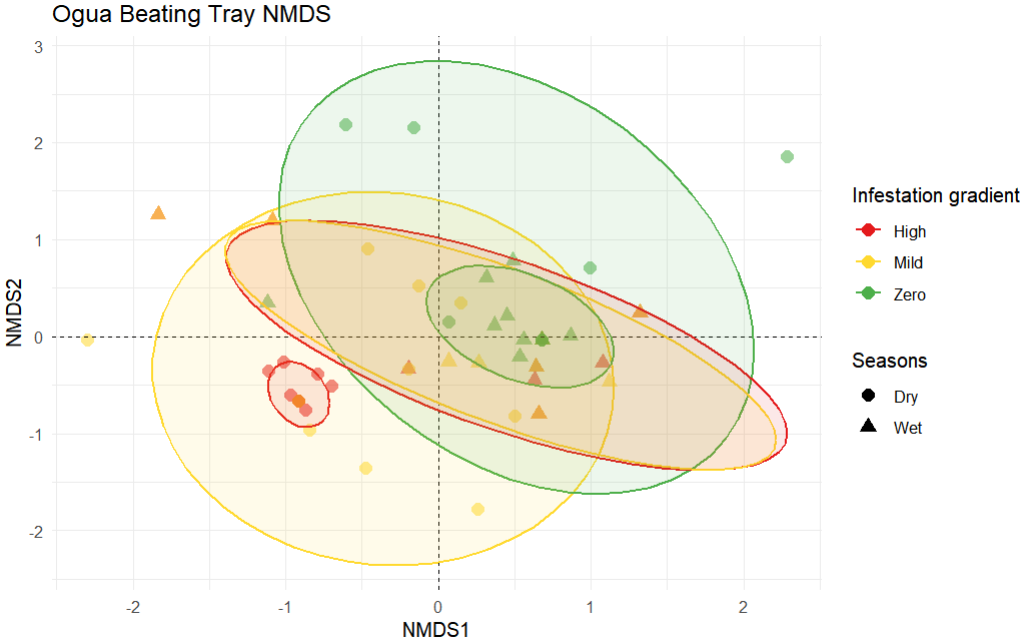


Figure \_: NMDS ordination plot (Stress = 0.10019) showing the community compositional differences in arthropods across seasons and Chromoleana infestation gradients in Ogua, surveyed using beating tray. *Each scatter point reprent a sampling point, and eclipse is made from 95% confidence interval from the center of each group. Colors and shape are used to distinguish the Chromoleana infestation levels and survey seasons.*

**Iguovbiobo NMDS**

**Pitfall trap collection:**

Pitfall trap collections in Iguovbiobo village indicated significant variation in arthropod community composition across both season and Chromolaena infestation intensity. The findings indicate that high Chromolaena infestation in both dry and wet seasons drives the greatest compositional differences in pitfall-trap arthropod communities, whereas mild or absent infestation results in more similar assemblages. Analysis of multivariate dispersion (PERMDISP) revealed significant differences in within-group variability among the combined season–infestation treatments (F = 3.12, p = 0.012), suggesting heterogeneous community dispersion across treatments.

Permutation-based multivariate analysis of variance (PERMANOVA) confirmed that season and infestation significantly structured pitfall-trap arthropod assemblages, explaining approximately 35% of the variation in community composition (R² = 0.352, F = 9.12, p < 0.001). These results indicate that both the dry and wet seasons, in combination with varying levels of *Chromolaena* infestation, have a strong influence on arthropod assemblages.

Pairwise comparisons provided finer resolution of these patterns. Communities in dry-season plots with high infestation were significantly distinct from wet-season high infestation plots (F = 12.38, R² = 0.307, p.adjusted = 0.015), wet-season mild infestation (F = 7.29, R² = 0.207, p.adjusted = 0.015), dry-season zero infestation (F = 5.91, R² = 0.174, p.adjusted = 0.015), and wet-season zero infestation (F = 7.50, R² = 0.211, p.adjusted = 0.015). Likewise, wet-season high infestation plots differed significantly from dry mild (F = 18.33, R² = 0.396, p.adjusted = 0.015) and dry zero (F = 14.77, R² = 0.345, p.adjusted = 0.015) plots.

Subtle differences were observed among plots with mild or zero infestation. For instance, dry mild plots were distinct from wet mild (F = 12.74, R² = 0.313, p.adjusted = 0.015), dry zero (F = 12.73, R² = 0.312, p.adjusted = 0.015), and wet zero plots (F = 12.33, R² = 0.306, p.adjusted = 0.015). In contrast, wet mild and wet zero plots did not differ significantly (p.adjusted = 1.000).

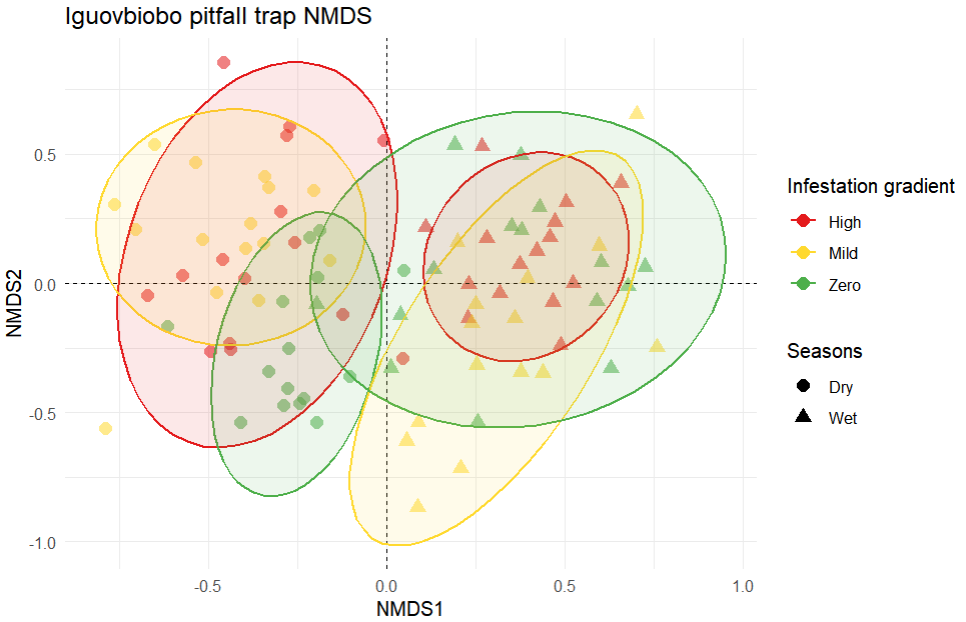


Figure \_: NMDS ordination plot (Stress = 0.2439) showing the community compositional differences in arthropods across seasons and Chromoleana infestation gradients in Iguovbiobo, surveyed using pitfall traps. *Each scatter point reprent a sampling point, and eclipse is made from 95% confidence interval from the center of each group. Colors and shape are used to distinguish the Chromoleana infestation levels and survey seasons.*

**Beating tray collection:**

Beating tray collections in Iguovbiobo village showed significant variation in arthropod community composition across both season and Chromolaena infestation intensity. The results show that high Chromolaena infestation consistently drives the greatest changes in arboreal arthropod community composition in both dry and wet seasons, whereas mild or absent infestation results in more similar assemblages Analysis of multivariate dispersion (PERMDISP) indicated no significant differences in within-group dispersion among the combined season–infestation treatments (F = 1.10, p = 0.373), suggesting that community variability was relatively homogeneous across groups.

Permutation-based multivariate analysis of variance (PERMANOVA) revealed a significant influence of season and infestation on arthropod assemblages, explaining approximately 44% of the total variation in community composition (R² = 0.436, F = 8.36, p < 0.001). This indicates that both seasonal conditions and Chromolaena infestation levels strongly structure the arboreal arthropod communities sampled with beating trays.

Pairwise comparisons highlighted the patterns of community differentiation. Arthropod assemblages in dry-season plots with high infestation were significantly different from wet-season high infestation plots (F = 11.93, R² = 0.399, p.adjusted = 0.015), wet mild infestation (F = 8.06, R² = 0.309, p.adjusted = 0.015), dry zero infestation (F = 3.17, R² = 0.150, p.adjusted = 0.045), and wet zero infestation (F = 16.15, R² = 0.473, p.adjusted = 0.015). Similarly, wet-season high infestation plots differed significantly from dry mild (F = 10.60, R² = 0.371, p.adjusted = 0.015), dry zero (F = 8.55, R² = 0.322, p.adjusted = 0.015), and wet zero plots (F = 19.21, R² = 0.516, p.adjusted = 0.015).

Communities in plots with mild or no infestation also showed distinct patterns. Dry mild plots differed from wet mild (F = 7.58, R² = 0.296, p.adjusted = 0.015) and wet zero plots (F = 21.11, R² = 0.540, p.adjusted = 0.015), while wet mild plots differed from dry zero (F = 7.40, R² = 0.291, p.adjusted = 0.015) and wet zero plots (F = 11.14, R² = 0.382, p.adjusted = 0.015). All other pairwise comparisons, including dry mild vs dry zero, were not statistically significant (p.adjusted > 0.05).

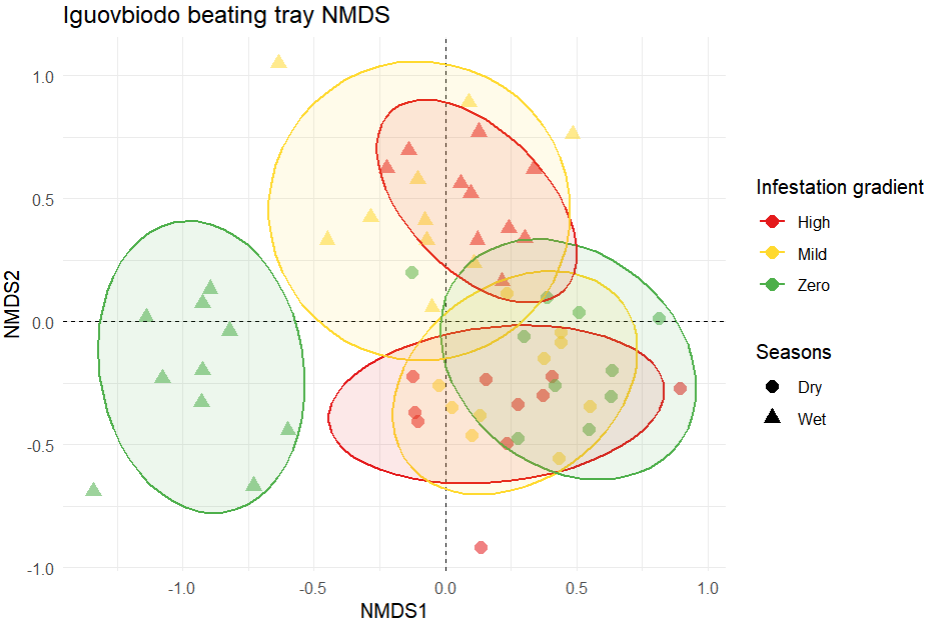


Figure \_: NMDS ordination plot (Stress = 0.17719) showing the community compositional differences in arthropods across seasons and Chromoleana infestation gradients in Iguovbiobo, surveyed using beating trays. *Each scatter point reprent a sampling point, and eclipse is made from 95% confidence interval from the center of each group. Colors and shape are used to distinguish the Chromoleana infestation levels and survey seasons.*

**Ahor Urokosa NMDS**

**Pitfall trap collection:**

Pitfall trap collections in Ahor Urokosa revealed significant variation in arthropod community composition across both season and Chromolaena infestation intensity. Analysis of multivariate dispersion (PERMDISP) indicated significant differences in within-group dispersion among the combined season–infestation groups (F = 5.82, p < 0.001), suggesting heterogeneity in community variability across treatments.

PERMANOVA confirmed that season and infestation had a strong effect on arthropod assemblages, explaining 43% of the observed variation in community structure (R² = 0.431, F = 12.75, p < 0.001). This indicates that both seasonal conditions and infestation intensity significantly structure the ground-dwelling arthropod communities sampled with pitfall traps.

Pairwise comparisons showed that dry-season plots with high infestation were distinct from almost all other groups, including wet high infestation (F = 25.03, R² = 0.472, p.adjusted = 0.015), wet mild (F = 24.83, R² = 0.470, p.adjusted = 0.015), wet zero (F = 24.91, R² = 0.471, p.adjusted = 0.015), dry mild (F = 4.70, R² = 0.144, p.adjusted = 0.015), and dry zero (F = 4.83, R² = 0.147, p.adjusted = 0.015). Similarly, wet high infestation plots differed from dry mild (F = 12.46, R² = 0.308, p.adjusted = 0.015), wet mild (F = 18.84, R² = 0.402, p.adjusted = 0.015), dry zero (F = 12.75, R² = 0.313, p.adjusted = 0.015), and wet zero plots (F = 3.12, R² = 0.100, p.adjusted = 0.030).

Communities in plots with mild or no infestation also differed in some cases. Dry mild plots differed from wet mild (F = 17.71, R² = 0.387, p.adjusted = 0.015) and wet zero plots (F = 11.73, R² = 0.295, p.adjusted = 0.015), while wet mild plots differed from dry zero (F = 13.39, R² = 0.324, p.adjusted = 0.015) and wet zero (F = 21.43, R² = 0.434, p.adjusted = 0.015). The comparison between dry mild and dry zero was not significant (p.adjusted = 1.000).

These results indicate that high Chromolaena infestation consistently drives the largest shifts in ground-dwelling arthropod community composition, while mild or absent infestation results in more similar assemblages. Seasonal differences further modulate these community patterns.

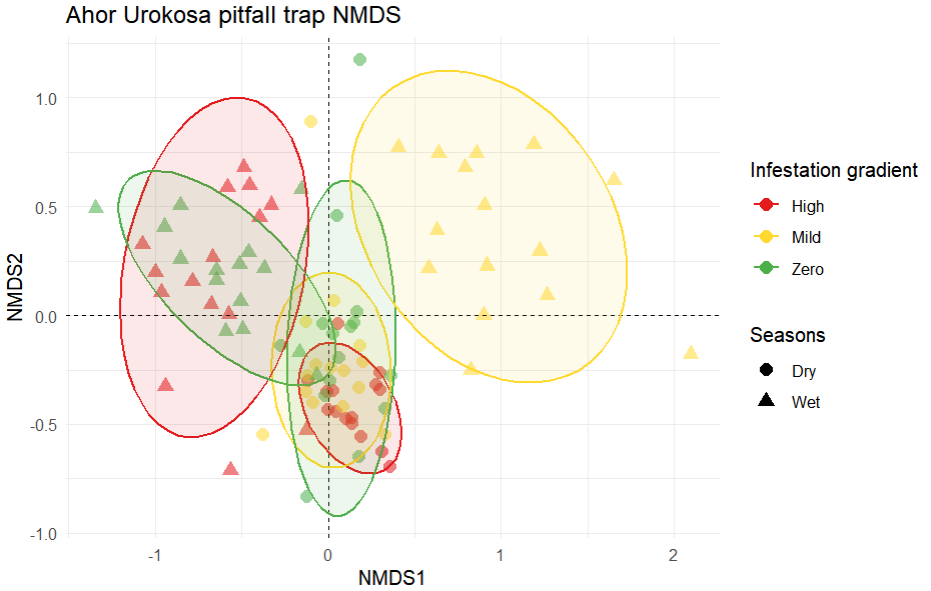


Figure \_: NMDS ordination plot (Stress = 0.17473) showing the community compositional differences in arthropods across seasons and Chromoleana infestation gradients in Ahor Urokosa, surveyed using pitfall traps. *Each scatter point reprent a sampling point, and eclipse is made from 95% confidence interval from the center of each group. Colors and shape are used to distinguish the Chromoleana infestation levels and survey seasons.*

**Beating tray collection:**

Beating tray collections in Ahor Urokosa revealed significant differences in arthropod community composition across season–infestation combinations. The findings suggest that high infestation levels strongly influence the composition of foliage-dwelling arthropod communities, and seasonal effects modulate these patterns. Plots with mild or no infestation generally exhibited more similar communities.

Analysis of multivariate dispersion (PERMDISP) indicated significant heterogeneity among groups (F = 2.98, p = 0.019), suggesting variation in within-group community variability across treatments.

PERMANOVA results confirmed a significant effect of season and infestation on arthropod assemblages, with 29.4% of the variation explained by these factors (R² = 0.294, F = 4.50, p < 0.001).

Pairwise comparisons indicated that dry high infestation plots differed from most other groups, including wet high infestation (F = 19.92, R² = 0.525, p.adjusted = 0.015), wet mild (F = 8.87, R² = 0.330, p.adjusted = 0.015), dry zero (F = 3.15, R² = 0.149, p.adjusted = 0.045), and wet zero (F = 7.36, R² = 0.290, p.adjusted = 0.015).

Other significant pairwise differences included wet high infestation vs dry mild (F = 10.14, R² = 0.360, p.adjusted = 0.015), wet high vs dry zero (F = 9.07, R² = 0.335, p.adjusted = 0.015), and dry mild vs wet mild (F = 4.48, R² = 0.199, p.adjusted = 0.015). Some comparisons, such as dry mild vs dry zero and wet mild vs wet zero, were not significant after adjustment (p.adjusted = 1.000 and 0.069, respectively).

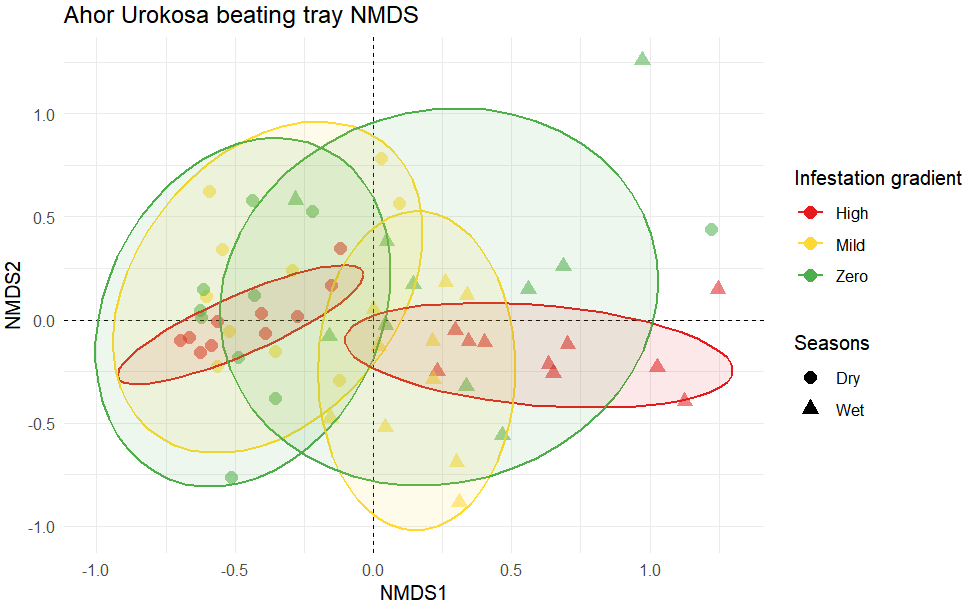


Figure \_: NMDS ordination plot (Stress = 0.20715) showing the community compositional differences in arthropods across seasons and Chromoleana infestation gradients in Ahor Urokosa, surveyed using beating trays. *Each scatter point reprent a sampling point, and eclipse is made from 95% confidence interval from the center of each group. Colors and shape are used to distinguish the Chromoleana infestation levels and survey seasons.*

**Indicator species analysis of sites with varying levels of *Chromoleana* infestation and seasons**

**Igueosgie**

Indicator species analysis identified several arthropod taxa that were significantly associated (Table \_) with specific combinations of season and Chromolaena infestation levels at Igueosagie, with patterns varying between collection methods (beating tray and pitfall trap).

**Beating tray collections**

A total of 11 taxa were significantly associated with distinct season–infestation groups (Table\_). In the wet season with high Chromolaena infestation, Cicadellidae (IndVal = 0.707, p = 0.001) and Coccinellidae (IndVal = 0.637, p = 0.006) were the strongest indicators. Pyrgomorphidae was significantly associated with the dry season under high and mild infestation (IndVal = 0.707, p = 0.001).

Other taxa reflected combinations of wet season and infestation gradients. Spirostreptidae was linked to the dry season with mild infestation and the wet season with high infestation (IndVal = 0.634, p = 0.013), while Lycidae was restricted to the wet season with high infestation and the wet season with zero infestation (IndVal = 0.500, p = 0.045). Several taxa were consistently indicative of the wet season with mild infestation and the wet season with zero infestation, including Forficulidae (IndVal = 0.837, p = 0.001), Tenebrionidae (IndVal = 0.742, p = 0.002), Linyphiidae (IndVal = 0.561, p = 0.017), and Geocoridae (IndVal = 0.500, p = 0.040).

Beyond season-specific associations, some groups occurred across multiple infestation–season categories. Taxa unidentified (“Unknown”) was significantly associated with the dry season with zero infestation, the wet season with high infestation, the wet season with mild infestation, and the wet season with zero infestation (IndVal = 0.776, p = 0.021). Similarly, Formicidae had broad occurrence across the dry season with high infestation, dry season with mild infestation, dry season with zero infestation, wet season with high infestation, and wet season with mild infestation. This arthropod group showed the highest indicator value among beating tray taxa (IndVal = 0.941, p = 0.013).

**Pitfall trap collections**

Patterns from pitfall trapping revealed 17 significant taxa, many of which reflected different seasonal or infestation gradients compared with beating tray collections.

In the dry season with high infestation, Spirostreptidae was significantly associated (IndVal = 0.527, p = 0.005). Derodontidae (IndVal = 0.654, p = 0.001) and Dermestidae (IndVal = 0.616, p = 0.001) were both characteristic of the dry season with zero infestation. Gryllidae was a strong indicator across the dry season with high infestation, the dry season with mild infestation, and the dry season with zero infestation (IndVal = 0.843, p = 0.001).

During the wet season, several families were significant. Segetriidae was linked to the wet season with high infestation (IndVal = 0.683, p = 0.001). Reduviidae (IndVal = 0.881, p = 0.001), Coccinellidae (IndVal = 0.548, p = 0.005), and Meinertellidae (IndVal = 0.516, p = 0.003) were all associated with the wet season with zero infestation. Carabidae (IndVal = 0.919, p = 0.001), Paradoxomatidae (IndVal = 0.632, p = 0.001), Salticidae (IndVal = 0.516, p = 0.004), and Termitidae (IndVal = 0.408, p = 0.047) were linked to the wet season with high infestation and the wet season with mild infestation.

Other groups spanned broader gradients. Muscidae (IndVal = 0.609, p = 0.001) and Tenebrionidae (IndVal = 0.530, p = 0.002) were both characteristic of the wet season with high infestation and the wet season with zero infestation, while an unidentified taxon (“Unknown”) was associated with the wet season with high infestation, wet season with mild infestation, and wet season with zero infestation (IndVal = 0.709, p = 0.010). Scarabaeidae was associated with both dry- and wet-season categories, specifically the dry season with high infestation, dry season with mild infestation, dry season with zero infestation, wet season with high infestation, and wet season with zero infestation (IndVal = 0.678, p = 0.018).

Formicidae again emerged as the strongest indicator group overall. It was associated with the dry season with high infestation, dry season with mild infestation, dry season with zero infestation, wet season with mild infestation, and wet season with zero infestation, showing the highest indicator value in the entire dataset (IndVal = 0.982, p = 0.001).

Table\_: indicator species analysis for sites in **Igueosgie** grouped by seasons and Chromoleana infestation gradient.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Collection Method** | **Group (Combinations)** | **Species** | **Specificity** | **Fidelity** | **IndVal** | **p.value** |
| Beating tray | Wet\_High | Cicadellidae | 1 | 0.5 | 0.707 | 0.001 \*\*\* |
| Beating tray | Wet\_High | Coccinellidae | 0.8125 | 0.5 | 0.637 | 0.006 \*\* |
| Beating tray | Dry\_High+Dry\_Mild | Pyrgomorphidae | 1 | 0.5 | 0.707 | 0.001 \*\*\* |
| Beating tray | Dry\_Mild+Wet\_High | Spirostreptidae | 0.7297 | 0.55 | 0.634 | 0.013 \* |
| Beating tray | Wet\_High+Wet\_Zero | Lycidae | 1 | 0.25 | 0.5 | 0.045 \* |
| Beating tray | Wet\_Mild+Wet\_Zero | Forficulidae | 1 | 0.7 | 0.837 | 0.001 \*\*\* |
| Beating tray | Wet\_Mild+Wet\_Zero | Tenebrionidae | 1 | 0.55 | 0.742 | 0.002 \*\* |
| Beating tray | Wet\_Mild+Wet\_Zero | Linyphiidae | 0.9 | 0.35 | 0.561 | 0.017 \* |
| Beating tray | Wet\_Mild+Wet\_Zero | Geocoridae | 1 | 0.25 | 0.5 | 0.040 \* |
| Beating tray | Dry\_Zero+Wet\_High+Wet\_Mild+Wet\_Zero | Unknown | 0.8923 | 0.675 | 0.776 | 0.021 \* |
| Beating tray | Dry\_High+Dry\_Mild+Dry\_Zero+Wet\_High+Wet\_Mild | Formicidae | 0.9628 | 0.92 | 0.941 | 0.013 \* |
| Pitfall Trap | Dry\_High | Spirostreptidae | 0.8333 | 0.3333 | 0.527 | 0.005 \*\* |
| Pitfall Trap | Dry\_Zero | Derodontidae | 0.9167 | 0.4667 | 0.654 | 0.001 \*\*\* |
| Pitfall Trap | Dry\_Zero | Dermestidae | 0.8125 | 0.4667 | 0.616 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_High | Segetriidae | 1 | 0.4667 | 0.683 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_Zero | Reduviidae | 0.7755 | 1 | 0.881 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_Zero | Coccinellidae | 0.6429 | 0.4667 | 0.548 | 0.005 \*\* |
| Pitfall Trap | Wet\_Zero | Meinertellidae | 1 | 0.2667 | 0.516 | 0.003 \*\* |
| Pitfall Trap | Wet\_High+Wet\_Mild | Carabidae | 0.9394 | 0.9 | 0.919 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_High+Wet\_Mild | Paradoxomatidae | 1 | 0.4 | 0.632 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_High+Wet\_Mild | Salticidae | 0.8 | 0.3333 | 0.516 | 0.004 \*\* |
| Pitfall Trap | Wet\_High+Wet\_Mild | Termitidae | 1 | 0.1667 | 0.408 | 0.047 \* |
| Pitfall Trap | Wet\_High+Wet\_Zero | Muscidae | 0.9286 | 0.4 | 0.609 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_High+Wet\_Zero | Tenebrionidae | 0.9375 | 0.3 | 0.53 | 0.002 \*\* |
| Pitfall Trap | Dry\_High+Dry\_Mild+Dry\_Zero | Gryllidae | 1 | 0.7111 | 0.843 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_High+Wet\_Mild+Wet\_Zero | Unknown | 0.8082 | 0.6222 | 0.709 | 0.010 \*\* |
| Pitfall Trap | Dry\_High+Dry\_Mild+Dry\_Zero+Wet\_High+Wet\_Zero | Scarabaeidae | 0.9865 | 0.4667 | 0.678 | 0.018 \* |
| Pitfall Trap | Dry\_High+Dry\_Mild+Dry\_Zero+Wet\_Mild+Wet\_Zero | Formicidae | 0.9909 | 0.9733 | 0.982 | 0.001 \*\*\* |

**Ogua**

Indicator species analysis at Ogua identified several arthropod taxa significantly associated with distinct combinations of season and Chromolaena infestation level, with differences evident between the two collection methods (beating tray versus pitfall trap).

**Beating tray collections**

Five taxa were significantly associated with dry-season infestation gradients. In the dry season with high infestation, Curculionidae was the strongest indicator (IndVal = 0.983, p = 0.001). Forficulidae was linked to the dry season with mild infestation (IndVal = 0.548, p = 0.020). Two taxa, Sphecidae (IndVal = 0.500, p = 0.020) and Araneae (IndVal = 0.494, p = 0.035), were characteristic of the dry season with zero infestation.

One taxon displayed a broad occurrence across both seasons and infestation levels. Formicidae was associated with the dry season with mild infestation, the dry season with zero infestation, the wet season with high infestation, the wet season with mild infestation, and the wet season with zero infestation. It had a high indicator value (IndVal = 0.846, p = 0.005), confirming its role as a widespread indicator group.

**Pitfall trap collections**

Seventeen taxa were significantly associated with infestation–season categories from pitfall trap samples. In the dry season with mild infestation, Derodontidae was significantly associated (IndVal = 0.447, p = 0.020). Armadillidiidae was characteristic of the dry season with zero infestation and the wet season with high infestation (IndVal = 0.437, p = 0.037). Curculionidae occurred across a wider gradient, including the dry season with high infestation, the dry season with zero infestation, and the wet season with mild infestation (IndVal = 0.572, p = 0.027). Gryllidae was the broadest dry-season indicator, spanning the dry season with high infestation, dry season with mild infestation, dry season with zero infestation, and also the wet season with mild and zero infestation (IndVal = 0.622, p = 0.017).

In the wet season with high infestation, Amplidae (IndVal = 0.816, p = 0.001) and Tiphiidae (IndVal = 0.553, p = 0.001) were strongly associated. Glossinidae (IndVal = 0.592, p = 0.001), Meinertellidae (IndVal = 0.535, p = 0.006), and Mantidae (IndVal = 0.447, p = 0.022) were significant indicators of the wet season with mild infestation. Linyphiidae was shared across the dry season with mild infestation and the wet season with high infestation (IndVal = 0.475, p = 0.025).

Some taxa were consistently associated with combinations of wet season with high infestation and wet season with mild infestation, including Scarabaeidae (IndVal = 0.844, p = 0.001), Evaniidae (IndVal = 0.739, p = 0.001), Thyreocoridae (IndVal = 0.487, p = 0.010), and Tetrigidae (IndVal = 0.478, p = 0.020). Elateridae occurred across the dry season with high infestation, the wet season with high infestation, and the wet season with zero infestation (IndVal = 0.447, p = 0.037).

Two groups were shared across three wet-season infestation gradients. Carabidae was significantly associated with the wet season with high infestation, the wet season with mild infestation, and the wet season with zero infestation (IndVal = 0.844, p = 0.001). Similarly, Reduviidae was linked to the same set of conditions (IndVal = 0.543, p = 0.004).

Table\_: indicator species analysis for sites in **Ogua** grouped by seasons and *Chromoleana* infestation gradient.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Collection Method** | **Group** | **Species** | **Specificity** | **Fidelity** | **IndVal** | **p-value** |
| Beating Tray | Dry\_High | Curculionidae | 0.966 | 1 | 0.983 | 0.001 \*\*\* |
| Beating Tray | Dry\_Mild | Forficulidae | 1 | 0.3 | 0.548 | 0.020 \* |
| Beating Tray | Dry\_Zero | Sphecidae | 1 | 0.25 | 0.5 | 0.020 \* |
| Beating Tray | Dry\_Zero | Araneae | 0.976 | 0.25 | 0.494 | 0.035 \* |
| Beating Tray | Dry\_Mild + Dry\_Zero + Wet\_High + Wet\_Mild + Wet\_Zero | Formicidae | 0.982 | 0.729 | 0.846 | 0.005 \*\* |
| Pitfall Trap | Dry\_Mild | Derodontidae | 1 | 0.2 | 0.447 | 0.02 \* |
| Pitfall Trap | Wet\_High | Amplidae | 1 | 0.667 | 0.816 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_High | Tiphiidae | 0.917 | 0.333 | 0.553 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_Mild | Glossinidae | 0.875 | 0.4 | 0.592 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_Mild | Meinertellidae | 0.857 | 0.333 | 0.535 | 0.006 \*\* |
| Pitfall Trap | Wet\_Mild | Mantidae | 1 | 0.2 | 0.447 | 0.022 \* |
| Pitfall Trap | Dry\_Mild + Wet\_High | Linyphiidae | 0.846 | 0.267 | 0.475 | 0.025 \* |
| Pitfall Trap | Dry\_Zero + Wet\_High | Armadillidiidae | 0.818 | 0.233 | 0.437 | 0.037 \* |
| Pitfall Trap | Wet\_High + Wet\_Mild | Scarabaeidae | 0.93 | 0.767 | 0.844 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_High + Wet\_Mild | Evaniidae | 0.909 | 0.6 | 0.739 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_High + Wet\_Mild | Thyreocoridae | 0.889 | 0.267 | 0.487 | 0.010 \*\* |
| Pitfall Trap | Wet\_High + Wet\_Mild | Tetrigidae | 0.857 | 0.267 | 0.478 | 0.020 \* |
| Pitfall Trap | Dry\_High + Dry\_Zero + Wet\_Mild | Curculionidae | 0.921 | 0.356 | 0.572 | 0.027 \* |
| Pitfall Trap | Dry\_High + Wet\_High + Wet\_Zero | Elateridae | 1 | 0.2 | 0.447 | 0.037 \* |
| Pitfall Trap | Wet\_High + Wet\_Mild + Wet\_Zero | Carabidae | 0.89 | 0.8 | 0.844 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_High + Wet\_Mild + Wet\_Zero | Reduviidae | 0.947 | 0.311 | 0.543 | 0.004 \*\* |
| Pitfall Trap | Dry\_High + Dry\_Mild + Dry\_Zero + Wet\_Mild + Wet\_Zero | Gryllidae | 1 | 0.387 | 0.622 | 0.017 \* |

**Iguovbiobo**

Indicator species analysis identified numerous arthropod taxa as significant indicators of particular season–infestation gradients, with differences between pitfall trap and beating tray collections in Iguovbiobo.

**Pitfall trap collections**

Several taxa were significantly associated with the dry season, for pitfall trap surveys. In the dry season with mild infestation, Coccinellidae was a strong indicator (IndVal = 0.811, p = 0.001). Nitidulidae (IndVal = 0.553, p = 0.002), Muscidae (IndVal = 0.455, p = 0.028), and Derodontidae (IndVal = 0.447, p = 0.023) were all characteristic of the dry season with zero infestation. Elateridae (IndVal = 0.857, p = 0.001) and Titanoecidae (IndVal = 0.721, p = 0.001) were significantly associated with the dry season with high infestation and dry season with mild infestation. Spirostreptidae (IndVal = 0.621, p = 0.001) was characteristic of the dry season with high infestation and dry season with zero infestation, while Scarabaeidae (IndVal = 0.802, p = 0.001) was linked to the dry season with mild infestation and dry season with zero infestation.

Armadillidiidae was shared across seasons, being significantly associated with the dry season with zero infestation and the wet season with high infestation (IndVal = 0.680, p = 0.009).

In the wet season, Reduviidae was an indicator of the wet season with high infestation (IndVal = 0.527, p = 0.004). Nabidae (IndVal = 0.447, p = 0.028) was associated with the wet season with zero infestation. Tettigoniidae (IndVal = 0.455, p = 0.025) and Oniscidae (IndVal = 0.447, p = 0.015) were both indicators of the wet season with high infestation and wet season with zero infestation. Forficulidae was linked to the wet season with mild infestation and wet season with zero infestation (IndVal = 0.408, p = 0.049).

Carabidae was a strong indicator of a broader wet-season gradient, occurring in the wet season with high infestation, the wet season with mild infestation, and the wet season with zero infestation (IndVal = 0.714, p = 0.001). Finally, the unidentified taxon/taxa was significantly associated with a very wide gradient, spanning the dry season with mild infestation, the dry season with zero infestation, the wet season with high infestation, the wet season with mild infestation, and the wet season with zero infestation (IndVal = 0.764, p = 0.020).

**Beating tray collections**

Beating tray collections had another set of significant indicators. In the wet season with high infestation, Nabidae (IndVal = 0.645, p = 0.004) and Spirostreptidae (IndVal = 0.616, p = 0.020) were notably identified. Carabidae (IndVal = 0.906, p = 0.001) and Coccinellidae (IndVal = 0.548, p = 0.026) were strongly associated with the wet season with zero infestation.

Several taxa were shared across infestation gradients. Curculionidae was significantly associated with the dry season with high infestation and dry season with mild infestation (IndVal = 0.714, p = 0.005). Plataspidae was linked to the dry season with high infestation and the wet season with zero infestation (IndVal = 0.610, p = 0.007). Cerambycidae (IndVal = 0.663, p = 0.004), Ectobiidae (IndVal = 0.652, p = 0.006), and Membracidae (IndVal = 0.500, p = 0.042) were all characteristic of the wet season with high infestation and wet season with mild infestation. Dinidoridae was significantly associated with the wet season with mild infestation and wet season with zero infestation (IndVal = 0.553, p = 0.029).

Broader associations were also identified. Chrysomelidae was linked to the dry season with high infestation, dry season with mild infestation, and wet season with zero infestation (IndVal = 0.668, p = 0.007). Tenebrionidae was strongly associated with the wet season with high infestation, wet season with mild infestation, and wet season with zero infestation (IndVal = 0.922, p = 0.001). Pyrgomorphidae occurred across the dry season with high infestation, dry season with mild infestation, dry season with zero infestation, and wet season with mild infestation (IndVal = 0.632, p = 0.006).

Finally, Formicidae was the broadest and most consistent taxon, occurring across nearly all infestation and seasonal categories, including the dry season with high infestation, dry season with mild infestation, dry season with zero infestation, the wet season with high infestation, and the wet season with mild infestation (IndVal = 0.987, p = 0.001).

Table\_: indicator species analysis for sites in **Iguovbiobo** grouped by seasons and *Chromoleana* infestation gradient.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Collection Method** | **Group** | **Species** | **Specificity** | **Fidelity** | **IndVal** | **p-value** |
| Pitfall Trap | Dry\_Mild | Coccinellidae | 0.704 | 0.933 | 0.811 | 0.001 \*\*\* |
| Pitfall Trap | Dry\_Zero | Nitidulidae | 0.765 | 0.4 | 0.553 | 0.002 \*\* |
| Pitfall Trap | Dry\_Zero | Muscidae | 0.778 | 0.267 | 0.455 | 0.028 \* |
| Pitfall Trap | Dry\_Zero | Derodontidae | 1 | 0.2 | 0.447 | 0.023 \* |
| Pitfall Trap | Wet\_High | Reduviidae | 0.833 | 0.333 | 0.527 | 0.004 \*\* |
| Pitfall Trap | Wet\_Zero | Nabidae | 1 | 0.2 | 0.447 | 0.028 \* |
| Pitfall Trap | Dry\_High + Dry\_Mild | Elateridae | 0.847 | 0.867 | 0.857 | 0.001 \*\*\* |
| Pitfall Trap | Dry\_High + Dry\_Mild | Titanoecidae | 0.917 | 0.567 | 0.721 | 0.001 \*\*\* |
| Pitfall Trap | Dry\_High + Dry\_Zero | Spirostreptidae | 0.771 | 0.5 | 0.621 | 0.001 \*\*\* |
| Pitfall Trap | Dry\_Mild + Dry\_Zero | Scarabaeidae | 0.877 | 0.733 | 0.802 | 0.001 \*\*\* |
| Pitfall Trap | Dry\_Zero + Wet\_High | Armadillidiidae | 0.631 | 0.733 | 0.68 | 0.009 \*\* |
| Pitfall Trap | Wet\_High + Wet\_Zero | Tettigoniidae | 0.889 | 0.233 | 0.455 | 0.025 \* |
| Pitfall Trap | Wet\_High + Wet\_Zero | Oniscidae | 1 | 0.2 | 0.447 | 0.015 \* |
| Pitfall Trap | Wet\_Mild + Wet\_Zero | Forficulidae | 1 | 0.167 | 0.408 | 0.049 \* |
| Pitfall Trap | Wet\_High + Wet\_Mild + Wet\_Zero | Carabidae | 0.818 | 0.622 | 0.714 | 0.001 \*\*\* |
| Pitfall Trap | Dry\_Mild + Dry\_Zero + Wet\_High + Wet\_Mild + Wet\_Zero | Unknown | 0.952 | 0.613 | 0.764 | 0.020 \* |
| Beating Tray | Wet\_High | Nabidae | 0.833 | 0.5 | 0.645 | 0.004 \*\* |
| Beating Tray | Wet\_High | Spirostreptidae | 0.633 | 0.6 | 0.616 | 0.020 \* |
| Beating Tray | Wet\_Zero | Carabidae | 0.821 | 1 | 0.906 | 0.001 \*\*\* |
| Beating Tray | Wet\_Zero | Coccinellidae | 0.75 | 0.4 | 0.548 | 0.026 \* |
| Beating Tray | Dry\_High + Dry\_Mild | Curculionidae | 0.784 | 0.65 | 0.714 | 0.005 \*\* |
| Beating Tray | Dry\_High + Wet\_Zero | Plataspidae | 0.826 | 0.45 | 0.61 | 0.007 \*\* |
| Beating Tray | Wet\_High + Wet\_Mild | Cerambycidae | 0.976 | 0.45 | 0.663 | 0.004 \*\* |
| Beating Tray | Wet\_High + Wet\_Mild | Ectobiidae | 0.773 | 0.55 | 0.652 | 0.006 \*\* |
| Beating Tray | Wet\_High + Wet\_Mild | Membracidae | 1 | 0.25 | 0.5 | 0.042 \* |
| Beating Tray | Wet\_Mild + Wet\_Zero | Dinidoridae | 0.875 | 0.35 | 0.553 | 0.029 \* |
| Beating Tray | Dry\_High + Dry\_Mild + Wet\_Zero | Chrysomelidae | 0.893 | 0.5 | 0.668 | 0.007 \*\* |
| Beating Tray | Wet\_High + Wet\_Mild + Wet\_Zero | Tenebrionidae | 0.944 | 0.9 | 0.922 | 0.001 \*\*\* |
| Beating Tray | Dry\_High + Dry\_Mild + Dry\_Zero + Wet\_Mild | Pyrgomorphidae | 1 | 0.4 | 0.632 | 0.006 \*\* |
| Beating Tray | Dry\_High + Dry\_Mild + Dry\_Zero + Wet\_High + Wet\_Mild | Formicidae | 0.995 | 0.98 | 0.987 | 0.001 \*\*\* |

**Ahor Urokosa**

Indicator species analysis revealed distinct patterns of arthropod associations with Chromolaena infestation gradients and seasonality in Ahor Urokosa village. Results differed between pitfall trap and beating tray collections, but both methods highlighted several strong indicator taxa (Table \_).

**Pitfall trap collections**

In the dry season, Coccinellidae was a significant indicator of the dry season with high infestation (IndVal = 0.661, p = 0.001). Elateridae was characteristic of the dry season with mild infestation (IndVal = 0.440, p = 0.028). Scolopendridae was associated with the dry season with mild infestation and dry season with zero infestation (IndVal = 0.408, p = 0.043). Broader associations were also evident: Tenebrionidae was characteristic of the dry season with high infestation, dry season with zero infestation, and wet season with mild infestation (IndVal = 0.550, p = 0.010), while Scarabaeidae was associated with the dry season with mild infestation, dry season with zero infestation, and wet season with mild infestation (IndVal = 0.557, p = 0.041). Ctenidae was linked to the dry season with high infestation, dry season with zero infestation, wet season with high infestation, and wet season with zero infestation (IndVal = 0.500, p = 0.040). Gryllidae was highly significant across an even broader gradient, spanning the dry season with high infestation, dry season with mild infestation, dry season with zero infestation, wet season with high infestation, and wet season with zero infestation (IndVal = 0.909, p = 0.001).

In the wet season, Spirostreptidae (IndVal = 0.658, p = 0.001) and Andrognathidae (IndVal = 0.488, p = 0.007) were significant indicators of the wet season with high infestation, alongside Blaberidae (IndVal = 0.447, p = 0.027) and Euzetidae (IndVal = 0.447, p = 0.022). Amplidae (IndVal = 0.894, p = 0.001), Salticidae (IndVal = 0.689, p = 0.001), Reduviidae (IndVal = 0.661, p = 0.001), Rhopalidae (IndVal = 0.632, p = 0.001), and Cerambycidae (IndVal = 0.447, p = 0.032) were all associated with the wet season with mild infestation. Carabidae (IndVal = 0.645, p = 0.001) and Cydnidae (IndVal = 0.577, p = 0.001) were characteristic of the wet season with zero infestation.

Several taxa were shared across wet-season gradients. Paradoxomatidae was associated with the dry season with mild infestation and wet season with high infestation (IndVal = 0.586, p = 0.001). Armadillidiidae (IndVal = 0.960, p = 0.001) and Oniscidae (IndVal = 0.577, p = 0.001) were both indicators of the wet season with high infestation and wet season with zero infestation.

**Beating tray collections**

In the dry season, Lygaeidae was characteristic of the dry season with high infestation (IndVal = 0.548, p = 0.018), while Pyrgomorphidae was associated with the dry season with mild infestation (IndVal = 0.598, p = 0.009).

In the wet season, Gryllidae was linked to the wet season with high infestation (IndVal = 0.507, p = 0.040), Nymphalidae to the wet season with mild infestation (IndVal = 0.548, p = 0.020), and both Cymidae (IndVal = 0.548, p = 0.025) and Geocoridae (IndVal = 0.548, p = 0.034) to the wet season with zero infestation.

Several taxa were shared across multiple gradients. Rhopalidae was significantly associated with the dry season with mild infestation and wet season with zero infestation (IndVal = 0.520, p = 0.045). Forficulidae (IndVal = 0.707, p = 0.002) and Andrognathidae (IndVal = 0.632, p = 0.002) were strongly linked to the wet season with high infestation and wet season with zero infestation. Coreidae (IndVal = 0.592, p = 0.008) and Rhyparochromidae (IndVal = 0.500, p = 0.044) were both indicators of the wet season with mild infestation and wet season with zero infestation.

Armadillidiidae (IndVal = 0.928, p = 0.001) and Salticidae (IndVal = 0.585, p = 0.026) were significantly associated with the wet season with high infestation, wet season with mild infestation, and wet season with zero infestation. An unidentified taxon was strongly linked to the dry season with high infestation, wet season with high infestation, wet season with mild infestation, and wet season with zero infestation (IndVal = 0.822, p = 0.018).

Table\_: indicator species analysis for sites in **Ahor Urokosa** grouped by seasons and *Chromoleana* infestation gradient.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Collection Method** | **Group** | **Species** | **Specificity** | **Fidelity** | **IndVal** | **p-value** |
| Pitfall Trap | Dry\_High | Coccinellidae | 0.818 | 0.533 | 0.661 | 0.001 \*\*\* |
| Pitfall Trap | Dry\_Mild | Elateridae | 0.727 | 0.267 | 0.44 | 0.028 \* |
| Pitfall Trap | Wet\_High | Spirostreptidae | 0.722 | 0.6 | 0.658 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_High | Andrognathidae | 0.714 | 0.333 | 0.488 | 0.007 \*\* |
| Pitfall Trap | Wet\_High | Blaberidae | 1 | 0.2 | 0.447 | 0.027 \* |
| Pitfall Trap | Wet\_High | Euzetidae | 1 | 0.2 | 0.447 | 0.022 \* |
| Pitfall Trap | Wet\_Mild | Amplidae | 1 | 0.8 | 0.894 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_Mild | Salticidae | 0.889 | 0.533 | 0.689 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_Mild | Reduviidae | 0.818 | 0.533 | 0.661 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_Mild | Rhopalidae | 1 | 0.4 | 0.632 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_Mild | Cerambycidae | 1 | 0.2 | 0.447 | 0.032 \* |
| Pitfall Trap | Wet\_Zero | Carabidae | 0.692 | 0.6 | 0.645 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_Zero | Cydnidae | 1 | 0.333 | 0.577 | 0.001 \*\*\* |
| Pitfall Trap | Dry\_Mild + Dry\_Zero | Scolopendridae | 1 | 0.167 | 0.408 | 0.043 \* |
| Pitfall Trap | Dry\_Mild + Wet\_High | Paradoxomatidae | 0.857 | 0.4 | 0.586 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_High + Wet\_Zero | Armadillidiidae | 0.953 | 0.967 | 0.96 | 0.001 \*\*\* |
| Pitfall Trap | Wet\_High + Wet\_Zero | Oniscidae | 1 | 0.333 | 0.577 | 0.001 \*\*\* |
| Pitfall Trap | Dry\_High + Dry\_Zero + Wet\_Mild | Tenebrionidae | 0.909 | 0.333 | 0.55 | 0.010 \*\* |
| Pitfall Trap | Dry\_Mild + Dry\_Zero + Wet\_Mild | Scarabaeidae | 0.872 | 0.356 | 0.557 | 0.041 \* |
| Pitfall Trap | Dry\_High + Dry\_Zero + Wet\_High + Wet\_Zero | Ctenidae | 1 | 0.25 | 0.5 | 0.040 \* |
| Pitfall Trap | Dry\_High + Dry\_Mild + Dry\_Zero + Wet\_High + Wet\_Zero | Gryllidae | 1 | 0.827 | 0.909 | 0.001 \*\*\* |
| Beating Tray | Dry\_High | Lygaeidae | 1 | 0.3 | 0.548 | 0.018 \* |
| Beating Tray | Dry\_Mild | Pyrgomorphidae | 0.714 | 0.5 | 0.598 | 0.009 \*\* |
| Beating Tray | Wet\_High | Gryllidae | 0.857 | 0.3 | 0.507 | 0.040 \* |
| Beating Tray | Wet\_Mild | Nymphalidae | 1 | 0.3 | 0.548 | 0.020 \* |
| Beating Tray | Wet\_Zero | Cymidae | 1 | 0.3 | 0.548 | 0.025 \* |
| Beating Tray | Wet\_Zero | Geocoridae | 0.75 | 0.4 | 0.548 | 0.034 \* |
| Beating Tray | Dry\_Mild + Wet\_Zero | Rhopalidae | 0.9 | 0.3 | 0.52 | 0.045 \* |
| Beating Tray | Wet\_High + Wet\_Zero | Forficulidae | 1 | 0.5 | 0.707 | 0.002 \*\* |
| Beating Tray | Wet\_High + Wet\_Zero | Andrognathidae | 1 | 0.4 | 0.632 | 0.002 \*\* |
| Beating Tray | Wet\_Mild + Wet\_Zero | Coreidae | 1 | 0.35 | 0.592 | 0.008 \*\* |
| Beating Tray | Wet\_Mild + Wet\_Zero | Rhyparochromidae | 1 | 0.25 | 0.5 | 0.044 \* |
| Beating Tray | Wet\_High + Wet\_Mild + Wet\_Zero | Armadillidiidae | 0.993 | 0.867 | 0.928 | 0.001 \*\*\* |
| Beating Tray | Wet\_High + Wet\_Mild + Wet\_Zero | Salticidae | 0.933 | 0.367 | 0.585 | 0.026 \* |
| Beating Tray | Dry\_High + Wet\_High + Wet\_Mild + Wet\_Zero | Unknown | 0.872 | 0.775 | 0.822 | 0.018 \* |

APPENDIX

Full result of all pairwise NMDS pairwise comparisions using PERMANOVA

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| pairs | Df | SumsOfSqs | F.Model | R2 | p.value | p.adjusted | sig | survey |  |
| Dry\_High vs Wet\_High | 1.00 | 4.04088878160881 | 30.0792371424209 | 0.517900003897453 | 0.00 | 0.02 | . | Iguegosagie.p.pairwise |  |
| Dry\_High vs Dry\_Mild | 1.00 | 0.22447908919446 | 2.59626928241743 | 0.0848557469034113 | 0.02 | 0.30 |  | Iguegosagie.p.pairwise |  |
| Dry\_High vs Wet\_Mild | 1.00 | 1.79905914385574 | 14.9499868251934 | 0.348078961840893 | 0.00 | 0.02 | . | Iguegosagie.p.pairwise |  |
| Dry\_High vs Dry\_Zero | 1.00 | 0.283365470021013 | 3.50436283437516 | 0.111234207553992 | 0.00 | 0.03 | . | Iguegosagie.p.pairwise |  |
| Dry\_High vs Wet\_Zero | 1.00 | 2.49786109365557 | 19.7890493377267 | 0.414091713728744 | 0.00 | 0.02 | . | Iguegosagie.p.pairwise |  |
| Wet\_High vs Dry\_Mild | 1.00 | 3.49448923724734 | 23.6800228881134 | 0.45820457431647 | 0.00 | 0.02 | . | Iguegosagie.p.pairwise |  |
| Wet\_High vs Wet\_Mild | 1.00 | 1.02571827324088 | 5.65297461378458 | 0.167978452979579 | 0.00 | 0.02 | . | Iguegosagie.p.pairwise |  |
| Wet\_High vs Dry\_Zero | 1.00 | 3.53219467791325 | 24.8799041673249 | 0.4704982839719 | 0.00 | 0.02 | . | Iguegosagie.p.pairwise |  |
| Wet\_High vs Wet\_Zero | 1.00 | 1.83946815443608 | 9.81922000012668 | 0.259635709041429 | 0.00 | 0.02 | . | Iguegosagie.p.pairwise |  |
| Dry\_Mild vs Wet\_Mild | 1.00 | 1.62685612311514 | 12.1799623762362 | 0.303135235971247 | 0.00 | 0.02 | . | Iguegosagie.p.pairwise |  |
| Dry\_Mild vs Dry\_Zero | 1.00 | 0.197734192378815 | 2.10153203426416 | 0.0698147865654153 | 0.05 | 0.78 |  | Iguegosagie.p.pairwise |  |
| Dry\_Mild vs Wet\_Zero | 1.00 | 1.97412298989724 | 14.1560730985852 | 0.335801512286975 | 0.00 | 0.02 | . | Iguegosagie.p.pairwise |  |
| Wet\_Mild vs Dry\_Zero | 1.00 | 1.94244375770369 | 15.1792752225877 | 0.351540759874709 | 0.00 | 0.02 | . | Iguegosagie.p.pairwise |  |
| Wet\_Mild vs Wet\_Zero | 1.00 | 1.74732400009485 | 10.080881647956 | 0.264722905870461 | 0.00 | 0.02 | . | Iguegosagie.p.pairwise |  |
| Dry\_Zero vs Wet\_Zero | 1.00 | 2.11164036932353 | 15.7758480862536 | 0.360377897309259 | 0.00 | 0.02 | . | Iguegosagie.p.pairwise |  |
| Dry\_High vs Wet\_High | 1.00 | 0.956501034876166 | 5.52024739390369 | 0.234701927299222 | 0.00 | 0.02 | . | Iguegosagie.b.pairwise |  |
| Dry\_High vs Dry\_Mild | 1.00 | 0.261621119929616 | 1.79314931970806 | 0.0905944420841922 | 0.08 | 1.00 |  | Iguegosagie.b.pairwise |  |
| Dry\_High vs Wet\_Mild | 1.00 | 1.25808288576702 | 7.07399417868006 | 0.282124743599683 | 0.00 | 0.02 | . | Iguegosagie.b.pairwise |  |
| Dry\_High vs Dry\_Zero | 1.00 | 0.341447422494464 | 1.90424827934586 | 0.0956704444508888 | 0.10 | 1.00 |  | Iguegosagie.b.pairwise |  |
| Dry\_High vs Wet\_Zero | 1.00 | 1.84043802517861 | 9.03358030977452 | 0.334161446847211 | 0.00 | 0.02 | . | Iguegosagie.b.pairwise |  |
| Wet\_High vs Dry\_Mild | 1.00 | 0.697746376656704 | 4.17035367170718 | 0.188104968168785 | 0.00 | 0.02 | . | Iguegosagie.b.pairwise |  |
| Wet\_High vs Wet\_Mild | 1.00 | 0.626980521637289 | 3.14659358028191 | 0.148799075763008 | 0.00 | 0.06 |  | Iguegosagie.b.pairwise |  |
| Wet\_High vs Dry\_Zero | 1.00 | 0.615461482769588 | 3.06628451695425 | 0.145554120589537 | 0.01 | 0.18 |  | Iguegosagie.b.pairwise |  |
| Wet\_High vs Wet\_Zero | 1.00 | 1.20784601262716 | 5.36477860315239 | 0.229609648534336 | 0.00 | 0.02 | . | Iguegosagie.b.pairwise |  |
| Dry\_Mild vs Wet\_Mild | 1.00 | 0.915619640411607 | 5.32690499854315 | 0.228358841384052 | 0.00 | 0.02 | . | Iguegosagie.b.pairwise |  |
| Dry\_Mild vs Dry\_Zero | 1.00 | 0.400027611826262 | 2.30765740188962 | 0.113634840110849 | 0.04 | 0.63 |  | Iguegosagie.b.pairwise |  |
| Dry\_Mild vs Wet\_Zero | 1.00 | 1.6087739384691 | 8.13446200758483 | 0.311254236081998 | 0.00 | 0.02 | . | Iguegosagie.b.pairwise |  |
| Wet\_Mild vs Dry\_Zero | 1.00 | 0.925740586537982 | 4.50934611006719 | 0.200332168158826 | 0.00 | 0.05 | . | Iguegosagie.b.pairwise |  |
| Wet\_Mild vs Wet\_Zero | 1.00 | 0.293712703546975 | 1.27857683418276 | 0.0663211213763311 | 0.25 | 1.00 |  | Iguegosagie.b.pairwise |  |
| Dry\_Zero vs Wet\_Zero | 1.00 | 1.39414165448196 | 6.03053247677383 | 0.250952927597526 | 0.00 | 0.03 | . | Iguegosagie.b.pairwise |  |
| Dry\_High vs Wet\_High | 1.00 | 2.85931310875259 | 18.6236697922328 | 0.508514572621625 | 0.00 | 0.02 | . | Ogua.b.pairwise |  |
| Dry\_High vs Dry\_Mild | 1.00 | 1.24521952332756 | 6.86763971041674 | 0.276167734066855 | 0.00 | 0.02 | . | Ogua.b.pairwise |  |
| Dry\_High vs Wet\_Mild | 1.00 | 2.75811237839013 | 18.4885334537867 | 0.506694342133611 | 0.00 | 0.02 | . | Ogua.b.pairwise |  |
| Dry\_High vs Dry\_Zero | 1.00 | 2.65404390545983 | 16.1179158709568 | 0.501835671271924 | 0.00 | 0.02 | . | Ogua.b.pairwise |  |
| Dry\_High vs Wet\_Zero | 1.00 | 3.52419053855181 | 34.794163252652 | 0.659053219314054 | 0.00 | 0.02 | . | Ogua.b.pairwise |  |
| Wet\_High vs Dry\_Mild | 1.00 | 0.816399139151691 | 2.71008517183697 | 0.130858234012593 | 0.01 | 0.21 |  | Ogua.b.pairwise |  |
| Wet\_High vs Wet\_Mild | 1.00 | (0.01) | (0.03) | (0.00) | 1.00 | 1.00 |  | Ogua.b.pairwise |  |
| Wet\_High vs Dry\_Zero | 1.00 | 0.336878223668253 | 1.12449020237765 | 0.0656656162658506 | 0.30 | 1.00 |  | Ogua.b.pairwise |  |
| Wet\_High vs Wet\_Zero | 1.00 | 0.223707126716532 | 1.01126699001345 | 0.0531930349799759 | 0.38 | 1.00 |  | Ogua.b.pairwise |  |
| Dry\_Mild vs Wet\_Mild | 1.00 | 0.777442799201713 | 2.61859315242818 | 0.127001543367657 | 0.02 | 0.23 |  | Ogua.b.pairwise |  |
| Dry\_Mild vs Dry\_Zero | 1.00 | 0.770452381533058 | 2.32876148230291 | 0.127055037764085 | 0.03 | 0.41 |  | Ogua.b.pairwise |  |
| Dry\_Mild vs Wet\_Zero | 1.00 | 1.22553904504255 | 4.92183315500898 | 0.214722492818313 | 0.00 | 0.02 | . | Ogua.b.pairwise |  |
| Wet\_Mild vs Dry\_Zero | 1.00 | 0.341445412582203 | 1.1586690292827 | 0.0675267427389231 | 0.28 | 1.00 |  | Ogua.b.pairwise |  |
| Wet\_Mild vs Wet\_Zero | 1.00 | 0.19695048895529 | 0.908178511786914 | 0.0480309888771558 | 0.48 | 1.00 |  | Ogua.b.pairwise |  |
| Dry\_Zero vs Wet\_Zero | 1.00 | 0.485037065222626 | 2.01420469942466 | 0.11181202462349 | 0.06 | 0.96 |  | Ogua.b.pairwise |  |
| Dry\_High vs Wet\_High | 1.00 | 2.80258867447746 | 18.9372755031541 | 0.403459197410841 | 0.00 | 0.02 | . | Ogua.p.pairwise |  |
| Dry\_High vs Dry\_Mild | 1.00 | 0.31260390183885 | 2.58796630157335 | 0.0846073346641629 | 0.01 | 0.14 |  | Ogua.p.pairwise |  |
| Dry\_High vs Wet\_Mild | 1.00 | 1.58261769198771 | 10.6749750164491 | 0.276017631864245 | 0.00 | 0.02 | . | Ogua.p.pairwise |  |
| Dry\_High vs Dry\_Zero | 1.00 | 0.632038578900373 | 2.84270505641787 | 0.092167825462065 | 0.02 | 0.23 |  | Ogua.p.pairwise |  |
| Dry\_High vs Wet\_Zero | 1.00 | 1.06771493914197 | 8.73131783146732 | 0.23770772046701 | 0.00 | 0.02 | . | Ogua.p.pairwise |  |
| Wet\_High vs Dry\_Mild | 1.00 | 2.63246132766218 | 18.7235956973188 | 0.400731052862724 | 0.00 | 0.02 | . | Ogua.p.pairwise |  |
| Wet\_High vs Wet\_Mild | 1.00 | 0.872684096720662 | 5.19270829031988 | 0.156441235373199 | 0.00 | 0.02 | . | Ogua.p.pairwise |  |
| Wet\_High vs Dry\_Zero | 1.00 | 2.03991661338809 | 8.42447751622272 | 0.231286159491804 | 0.00 | 0.02 | . | Ogua.p.pairwise |  |
| Wet\_High vs Wet\_Zero | 1.00 | 1.34563361133717 | 9.47027394328066 | 0.2527409849636 | 0.00 | 0.02 | . | Ogua.p.pairwise |  |
| Dry\_Mild vs Wet\_Mild | 1.00 | 1.46322799962591 | 10.3879928416957 | 0.270605261508037 | 0.00 | 0.02 | . | Ogua.p.pairwise |  |
| Dry\_Mild vs Dry\_Zero | 1.00 | 0.565040654016439 | 2.62883316521842 | 0.0858287075788338 | 0.01 | 0.15 |  | Ogua.p.pairwise |  |
| Dry\_Mild vs Wet\_Zero | 1.00 | 0.928573604989826 | 8.08 | 0.223998403928345 | 0.00 | 0.02 | . | Ogua.p.pairwise |  |
| Wet\_Mild vs Dry\_Zero | 1.00 | 1.20913218747203 | 4.98810089978101 | 0.151209095514017 | 0.00 | 0.02 | . | Ogua.p.pairwise |  |
| Wet\_Mild vs Wet\_Zero | 1.00 | 0.862137776828145 | 6.05638200219496 | 0.17783398136081 | 0.00 | 0.02 | . | Ogua.p.pairwise |  |
| Dry\_Zero vs Wet\_Zero | 1.00 | 0.766679070484821 | 3.54232205413862 | 0.112303781822361 | 0.00 | 0.03 | . | Ogua.p.pairwise |  |
| Dry\_High vs Wet\_High | 1.00 | 1.53462283621298 | 12.3811681583062 | 0.306607478757632 | 0.00 | 0.02 | . | Iguovbiobo.p.pairwise |  |
| Dry\_High vs Dry\_Mild | 1.00 | 0.357538210653532 | 2.85440173809842 | 0.0925119781069637 | 0.01 | 0.14 |  | Iguovbiobo.p.pairwise |  |
| Dry\_High vs Wet\_Mild | 1.00 | 1.13650626209373 | 7.29143123531644 | 0.206606277503981 | 0.00 | 0.02 | . | Iguovbiobo.p.pairwise |  |
| Dry\_High vs Dry\_Zero | 1.00 | 0.708958233702252 | 5.91002709798847 | 0.174285531560046 | 0.00 | 0.02 | . | Iguovbiobo.p.pairwise |  |
| Dry\_High vs Wet\_Zero | 1.00 | 1.10491304146574 | 7.50055034163754 | 0.211279832832348 | 0.00 | 0.02 | . | Iguovbiobo.p.pairwise |  |
| Wet\_High vs Dry\_Mild | 1.00 | 1.92357382350357 | 18.333075069253 | 0.395680084731069 | 0.00 | 0.02 | . | Iguovbiobo.p.pairwise |  |
| Wet\_High vs Wet\_Mild | 1.00 | 0.428864674064731 | 3.16426154143388 | 0.101534943711947 | 0.00 | 0.05 | . | Iguovbiobo.p.pairwise |  |
| Wet\_High vs Dry\_Zero | 1.00 | 1.47095985634211 | 14.7651623989337 | 0.345261459811547 | 0.00 | 0.02 | . | Iguovbiobo.p.pairwise |  |
| Wet\_High vs Wet\_Zero | 1.00 | 0.333834808088038 | 2.62911592273283 | 0.0858371468953013 | 0.01 | 0.08 |  | Iguovbiobo.p.pairwise |  |
| Dry\_Mild vs Wet\_Mild | 1.00 | 1.74335418553271 | 12.739692632201 | 0.312709591287673 | 0.00 | 0.02 | . | Iguovbiobo.p.pairwise |  |
| Dry\_Mild vs Dry\_Zero | 1.00 | 1.28454074354475 | 12.726531098653 | 0.312487480650516 | 0.00 | 0.02 | . | Iguovbiobo.p.pairwise |  |
| Dry\_Mild vs Wet\_Zero | 1.00 | 1.58220549921771 | 12.3333777690183 | 0.305785888790401 | 0.00 | 0.02 | . | Iguovbiobo.p.pairwise |  |
| Wet\_Mild vs Dry\_Zero | 1.00 | 1.24480156871937 | 9.46298474753089 | 0.252595590322113 | 0.00 | 0.02 | . | Iguovbiobo.p.pairwise |  |
| Wet\_Mild vs Wet\_Zero | 1.00 | 0.207176146813088 | 1.30384194249593 | 0.0444938907688114 | 0.21 | 1.00 |  | Iguovbiobo.p.pairwise |  |
| Dry\_Zero vs Wet\_Zero | 1.00 | 1.32983198493081 | 10.8128318812649 | 0.27858909945925 | 0.00 | 0.02 | . | Iguovbiobo.p.pairwise |  |
| Dry\_High vs Wet\_High | 1.00 | 1.29984975083768 | 11.9292623806052 | 0.398581903853923 | 0.00 | 0.02 | . | Iguovbiobo.b.pairwise |  |
| Dry\_High vs Dry\_Mild | 1.00 | 0.182188865065109 | 1.70648351236523 | 0.086595029057034 | 0.12 | 1.00 |  | Iguovbiobo.b.pairwise |  |
| Dry\_High vs Wet\_Mild | 1.00 | 1.15013052227779 | 8.06035308938759 | 0.309295620889725 | 0.00 | 0.02 | . | Iguovbiobo.b.pairwise |  |
| Dry\_High vs Dry\_Zero | 1.00 | 0.369471923775493 | 3.1674741401429 | 0.149638739094334 | 0.00 | 0.06 |  | Iguovbiobo.b.pairwise |  |
| Dry\_High vs Wet\_Zero | 1.00 | 1.93727364290887 | 16.1465778327596 | 0.472860791843945 | 0.00 | 0.02 | . | Iguovbiobo.b.pairwise |  |
| Wet\_High vs Dry\_Mild | 1.00 | 1.06695181329744 | 10.6002904690212 | 0.370635762615875 | 0.00 | 0.02 | . | Iguovbiobo.b.pairwise |  |
| Wet\_High vs Wet\_Mild | 1.00 | 0.23513570188832 | 1.72159472003238 | 0.0872949041125795 | 0.05 | 0.77 |  | Iguovbiobo.b.pairwise |  |
| Wet\_High vs Dry\_Zero | 1.00 | 0.945061799621243 | 8.54981555188594 | 0.322029188307435 | 0.00 | 0.02 | . | Iguovbiobo.b.pairwise |  |
| Wet\_High vs Wet\_Zero | 1.00 | 2.18689130599573 | 19.2050268528083 | 0.51619440912616 | 0.00 | 0.02 | . | Iguovbiobo.b.pairwise |  |
| Dry\_Mild vs Wet\_Mild | 1.00 | 1.01883639949638 | 7.58176815131635 | 0.296373890439087 | 0.00 | 0.02 | . | Iguovbiobo.b.pairwise |  |
| Dry\_Mild vs Dry\_Zero | 1.00 | 0.169345249157117 | 1.56315499746063 | 0.079903011434686 | 0.15 | 1.00 |  | Iguovbiobo.b.pairwise |  |
| Dry\_Mild vs Wet\_Zero | 1.00 | 2.35721065799106 | 21.1086448283109 | 0.539743704262293 | 0.00 | 0.02 | . | Iguovbiobo.b.pairwise |  |
| Wet\_Mild vs Dry\_Zero | 1.00 | 1.06792726315974 | 7.4026597424506 | 0.291412781870237 | 0.00 | 0.02 | . | Iguovbiobo.b.pairwise |  |
| Wet\_Mild vs Wet\_Zero | 1.00 | 1.64387670060064 | 11.1375653570246 | 0.382240767907519 | 0.00 | 0.02 | . | Iguovbiobo.b.pairwise |  |
| Dry\_Zero vs Wet\_Zero | 1.00 | 2.62368172530871 | 21.5846287260621 | 0.545278038994238 | 0.00 | 0.02 | . | Iguovbiobo.b.pairwise |  |
| Dry\_High vs Wet\_High | 1.00 | 2.33948005051057 | 25.0261003828451 | 0.471958152724002 | 0.00 | 0.02 | . | Ahor\_Urokosa.p.pairwise |  |
| Dry\_High vs Dry\_Mild | 1.00 | 0.359214835035871 | 4.6959630798178 | 0.143625164622127 | 0.00 | 0.02 | . | Ahor\_Urokosa.p.pairwise |  |
| Dry\_High vs Wet\_Mild | 1.00 | 2.81012878059931 | 24.8325847298019 | 0.470024036431333 | 0.00 | 0.02 | . | Ahor\_Urokosa.p.pairwise |  |
| Dry\_High vs Dry\_Zero | 1.00 | 0.432388397952405 | 4.83 | 0.147099770062044 | 0.00 | 0.05 | . | Ahor\_Urokosa.p.pairwise |  |
| Dry\_High vs Wet\_Zero | 1.00 | 2.08163290874186 | 24.9104996793873 | 0.470804468495538 | 0.00 | 0.02 | . | Ahor\_Urokosa.p.pairwise |  |
| Wet\_High vs Dry\_Mild | 1.00 | 1.49102952091369 | 12.460473867215 | 0.307966582598818 | 0.00 | 0.02 | . | Ahor\_Urokosa.p.pairwise |  |
| Wet\_High vs Wet\_Mild | 1.00 | 2.9453735017565 | 18.8408272905381 | 0.402230882338493 | 0.00 | 0.02 | . | Ahor\_Urokosa.p.pairwise |  |
| Wet\_High vs Dry\_Zero | 1.00 | 1.69253034009489 | 12.7542457908403 | 0.312955019614347 | 0.00 | 0.02 | . | Ahor\_Urokosa.p.pairwise |  |
| Wet\_High vs Wet\_Zero | 1.00 | 0.395800025823455 | 3.12315507199469 | 0.100348279754098 | 0.00 | 0.06 |  | Ahor\_Urokosa.p.pairwise |  |
| Dry\_Mild vs Wet\_Mild | 1.00 | 2.46772921590677 | 17.709861778469 | 0.387440720435759 | 0.00 | 0.02 | . | Ahor\_Urokosa.p.pairwise |  |
| Dry\_Mild vs Dry\_Zero | 1.00 | 0.147994901261663 | 1.27894853880226 | 0.0436815050618132 | 0.24 | 1.00 |  | Ahor\_Urokosa.p.pairwise |  |
| Dry\_Mild vs Wet\_Zero | 1.00 | 1.28750279758035 | 11.7319156106864 | 0.295276868239672 | 0.00 | 0.02 | . | Ahor\_Urokosa.p.pairwise |  |
| Wet\_Mild vs Dry\_Zero | 1.00 | 2.04090797997265 | 13.3931344375502 | 0.323559320151423 | 0.00 | 0.02 | . | Ahor\_Urokosa.p.pairwise |  |
| Wet\_Mild vs Wet\_Zero | 1.00 | 3.13802293072934 | 21.432799581916 | 0.433574463983156 | 0.00 | 0.02 | . | Ahor\_Urokosa.p.pairwise |  |
| Dry\_Zero vs Wet\_Zero | 1.00 | 1.24968612026201 | 10.177744180552 | 0.266588411625867 | 0.00 | 0.02 | . | Ahor\_Urokosa.p.pairwise |  |
| Dry\_High vs Wet\_High | 1.00 | 2.05743230367892 | 19.9209041853363 | 0.525327774041831 | 0.00 | 0.02 | . | Ahor\_Urokosa.b.pairwise |  |
| Dry\_High vs Dry\_Mild | 1.00 | 0.399411312950931 | 3.36551193874834 | 0.157520772186351 | 0.01 | 0.09 |  | Ahor\_Urokosa.b.pairwise |  |
| Dry\_High vs Wet\_Mild | 1.00 | 1.00814859125754 | 8.8686601265571 | 0.330074521199934 | 0.00 | 0.02 | . | Ahor\_Urokosa.b.pairwise |  |
| Dry\_High vs Dry\_Zero | 1.00 | 0.434856603718856 | 3.14755201601569 | 0.148837653343136 | 0.01 | 0.09 |  | Ahor\_Urokosa.b.pairwise |  |
| Dry\_High vs Wet\_Zero | 1.00 | 1.03063442826289 | 7.35791851313977 | 0.290162558465794 | 0.00 | 0.02 | . | Ahor\_Urokosa.b.pairwise |  |
| Wet\_High vs Dry\_Mild | 1.00 | 1.51915759786535 | 10.1435395953428 | 0.360421600878567 | 0.00 | 0.02 | . | Ahor\_Urokosa.b.pairwise |  |
| Wet\_High vs Wet\_Mild | 1.00 | 0.529323602528699 | 3.6564661984635 | 0.16883946646489 | 0.00 | 0.02 | . | Ahor\_Urokosa.b.pairwise |  |
| Wet\_High vs Dry\_Zero | 1.00 | 1.53493414011544 | 9.06928246403088 | 0.335039633063121 | 0.00 | 0.02 | . | Ahor\_Urokosa.b.pairwise |  |
| Wet\_High vs Wet\_Zero | 1.00 | 0.62624090628189 | 3.6588091893979 | 0.168929379145595 | 0.00 | 0.02 | . | Ahor\_Urokosa.b.pairwise |  |
| Dry\_Mild vs Wet\_Mild | 1.00 | 0.716829673266077 | 4.47567146862517 | 0.199134049226203 | 0.00 | 0.02 | . | Ahor\_Urokosa.b.pairwise |  |
| Dry\_Mild vs Dry\_Zero | 1.00 | 0.194869079941713 | 1.05538274960644 | 0.0553850197329803 | 0.41 | 1.00 |  | Ahor\_Urokosa.b.pairwise |  |
| Dry\_Mild vs Wet\_Zero | 1.00 | 0.71740537710228 | 3.84549359509158 | 0.176031435424083 | 0.00 | 0.02 | . | Ahor\_Urokosa.b.pairwise |  |
| Wet\_Mild vs Dry\_Zero | 1.00 | 0.668648786701757 | 3.72214480771261 | 0.171352545554849 | 0.00 | 0.02 | . | Ahor\_Urokosa.b.pairwise |  |
| Wet\_Mild vs Wet\_Zero | 1.00 | 0.304589694385785 | 1.67767076531485 | 0.0852575889353746 | 0.07 | 0.99 |  | Ahor\_Urokosa.b.pairwise |  |
| Dry\_Zero vs Wet\_Zero | 1.00 | 0.726300738587802 | 3.52510240233552 | 0.163767044469579 | 0.00 | 0.03 | . | Ahor\_Urokosa.b.pairwise |  |