Pika-Yak Interaction: Plant Cover

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| Figure 1 |

# 1. Methods

## 1.1 Statistical analyses

All data were analyzed using linear models, generalized linear mixed models, or generalized additive models, with the choice of model and statistical family guided by the structure and distribution of the data. Posthoc comparisons were conducted only when the pika × S. chamaejasme interaction term was significant. For the 2021 field surveys, we fit generalized linear mixed models with plot and month as random effects. We then used generalized additive mixed models for S. chamaejasme cover and active pika burrow density, with plot as a random effect, and linear regression models for dung density and S. chamaejasme cover. For the field manipulation experiments in 2022 and 2023, we constructed generalized linear mixed models with the dependent variables (e.g., grass bites per step, sedge total bites, weight gain) regressed against the interactive effect of pika and S. chamaejasme treatments, while including block, year, and month as random effects to capture the hierarchical structure of the data. Models assumed gaussian, beta (for proportions), or tweedie (for non-normal data) distributions, selected based on data type and model fit. A significance threshold of P = 0.05 was applied, with TukeyHSD or Sidak posthoc tests used where appropriate. All data management, modeling, and visualization were carried out in R, with dependencies managed using *renv*. The main modeling packages were *glmmTMB* and *mgcv*, with *DHARMa* used for model diagnostics. Data management relied on the *tidyverse* suite of packages. A complete record of package versions is available in the renv.lock file in the repository: <https://github.com/ddlawton/pika_yak_interactions>.

# 2. Results and Discussion

First, we carried out a set of field observational experiments to investigate diet selection by pika and yak, as well as the associations among pika abundance, S. chamaejasme abundance, and yak activity under natural field conditions. Consistent with previous studies5,11,24–25, we found that pika and yak have distinct diet preferences: yaks preferred grasses and sedges, while pika preferred the poisonous S. chamaejasme ([Figure 2](#fig-diet-selection) A,B, [Supplementary Table 1](#supptbl-pika-yak-feeding-model-summary), [Supplementary Table 2](#supptbl-pika-yak-feeding-model-contrast)). We also found that S. chamaejasme abundance was negatively associated with active pika burrow abundance ([Figure 2](#fig-diet-selection) C) and with yak foraging activity, as indicated by dung density ([Figure 2](#fig-diet-selection) D).

Building on these results, we conducted an in-situ manipulative field experiment using fenced enclosures to test the interactive effects of pika and S. chamaejasme on yak weight gain, foraging quantity and quality, and grazing behavior. For weight gain, yaks gained less in poison-plant plots than in non-poison plots, and there was a significant interaction between pika and S. chamaejasme treatments ([Supplementary Table 3](#supptbl-yak-performance-model-summary)). When pika were present, yaks showed higher weight gain ([Supplementary Table 4](#supptbl-yak-performance-model-contrast)). This effect was driven by pika feeding on S. chamaejasme ([Figure 2](#fig-diet-selection) B, [Supplementary Table 3](#supptbl-yak-performance-model-summary), [Supplementary Table 4](#supptbl-yak-performance-model-contrast)), which increased grass cover ([Figure 2](#fig-diet-selection) C, [Supplementary Table 3](#supptbl-yak-performance-model-summary), [Supplementary Table 4](#supptbl-yak-performance-model-contrast)) compared to plots with S. chamaejasme but no pika.

Food quantity and quality are key drivers of individual performance and population dynamics in large herbivores30–32. In the presence of *S. chamaejasme* forbs, pika doubled the cover of yak’s most preferred grasses ([Figure 2](#fig-diet-selection) C, [Supplementary Table 3](#supptbl-yak-performance-model-summary), [Supplementary Table 4](#supptbl-yak-performance-model-contrast)) and increased the crude protein content of total forage by approximately 16% ([Figure 3](#fig-yak-performance) D, [Supplementary Table 3](#supptbl-yak-performance-model-summary), [Supplementary Table 4](#supptbl-yak-performance-model-contrast)), suggesting that pika facilitate yak by enhancing both the quantity and quality of forage. Acid detergent fibre (6%) was higher in pika plots, while ether extract also differed significantly between treatments ([Figure 3](#fig-yak-performance) E,F, [Supplementary Table 3](#supptbl-yak-performance-model-summary), [Supplementary Table 4](#supptbl-yak-performance-model-contrast)). These increases in grass abundance and forage quality were likely driven by the decline in poisonous plants induced by pika ([Figure 3](#fig-yak-performance) B), which reduced interspecific competition for shared resources (e.g., light, soil moisture, nutrients) and allowed grasses to expand27–28. In the absence of S. chamaejasme forbs, however, the positive effects of pika on food resources and yak weight gain disappeared ([Figure 3](#fig-yak-performance) A,C,D). Pika and poisonous plants influenced sedge cover in a similar way as grass cover ([Supplementary Figure 1](#suppfig-other-figs) A), while interactions with forb cover were more complex ([Supplementary Figure 1](#suppfig-other-figs) B). There was no impact of pika or poisonous plants on neutral detergent fibre ([Supplementary Figure 1](#suppfig-other-figs) C).

Pika-yak facilitation was also linked to improved foraging efficiency in yak when grazing alongside pika. Optimal foraging theory predicts that animals minimize energy costs to exploit high-quality food items and maximize intake of digestible nutrients, thereby improving performance33. In ruminants, bite rate, step rate, and bites per step are key predictors of foraging efficiency34 and, ultimately, animal performance35. In the presence of *S. chamaejasme* forbs, yak total, sedge, and grass bite rates increased by roughly 35% ([Figure 4](#fig-yak-foraging-efficiency) A), 48% ([Figure 4](#fig-yak-foraging-efficiency) B), and 41% ([Figure 4](#fig-yak-foraging-efficiency) C), respectively, in the treatment where they coexisted with pika ([Supplementary Table 5](#supptbl-yak-foraging-efficiency-summary), [Supplementary Table 6](#supptbl-yak-foraging-efficiency-contrast)). Yak stepped more often in the presence of *S. chamaejasme* forbs without pika, which meant they consumed more grasses and sedges per step in plots where pika were present.

Yak total steps were also higher in the presence of *S. chamaejasme* forbs when pika were absent ([Figure 4](#fig-yak-foraging-efficiency) D). In contrast, sedge bites per step and grass bites per step increased significantly by r {sedge\_bite\_steps}% ([Figure 4](#fig-yak-foraging-efficiency) E) and 41% ([Figure 3](#fig-yak-performance) F) in plots with pika. These gains in foraging efficiency can be attributed to the decline in *S. chamaejasme* forbs ([Figure 3](#fig-yak-performance) B), which improved access to palatable grasses and sedges. In this system, increased food availability ([Figure 3](#fig-yak-performance) C,D) and enhanced foraging efficiency ([Figure 3](#fig-yak-performance)) likely work together to shape the facilitative effects of pika on yak performance ([Figure 3](#fig-yak-performance) A).

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| Figure 2: Diet selection of pika and yak and their potential interactions mediated by poisonous plants in the field surveys in July 2021. (a) Feeding and clipping frequency of pika, and (b) grazing frequency of yak on the S. chamaejasme, sedges, grasses, and forbs in the 10 2 m × 2 m plots and the 10 250 m transects, respectively. (c) The relationship between active pika burrow density and S. chamaejasme cover, and (d) the relationship between S. chamaejasme cover and yak grazing activity in the 30 10 m × 10 m plots. (e) Two yak were grazing around the poisonous S. chamaejasme during its flowering season (i.e., May to June) in the study site. Different letters above the bars indicate significant differences at P < 0.05. |

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| Figure 3: Combined effects of 2-yr (2022-2023) pika and poisonous plant removal treatments on yak performance, forage quantity and quality in the field manipulated experiments. (a) yak weight gain, (b) S. chamaejasme cover, (c) grass cover, and (d) crude protein (CP) content of total forage based on dry mass. The average values of each variable in the two years were used for statistical analysis, providing a single data point for each variable in each 150 m × 150 m plot. (e) and (f) Show how S. chamaejasme abundance respond to the absence and presence of pika, respectively. Significant interactions between pika and S. chamaejasme plants were evaluated with post hoc comparisons; means that do not share letters are significantly different. Error bars represent +/- SE. |

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| Figure 4: Combined effects of 2-yr (2022-2023) pika and poisonous plant removal treatments on foraging efficiency of yak in the field manipulated experiments. (a) Total bite rate, (b) sedge bite rate, (c) grass bite rate, (d) total step rate, (e) sedge bites per step, and (f) grass bites per step. The average values of each variable in the two years were used for statistical analysis, providing a single data point for each variable in each 150 m × 150 m plot. Significant interactions between pika and S. chamaejasme plants were evaluated with post hoc comparisons; means that do not share letters are significantly different. Error bars represent +/- SE. |

# 3. Supplementary Figures and Tables

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| Supplementary Figure 1: Sedge cover percent (A), forb cover percent (B), ndf percent, total plant yak bites, and yak plant bite/steps by pika and *S. chamaejasme* treatment. Sedge cover was lower in no pika and *S. chamaejasme* plots than any other treatment level and there was a trending decrease in forb cover as well. in the same plot, but it was not significantly different from no pika, no *S. chamaejasme* plots and pika, *S. chamaejasme* plots. There was no signficant different in the interaction between pika and *S. chamaejasme* treatments for NDF, yak forb bite, and yak forb bite/step. |

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| | effect | term | estimate | std.error | statistic | p.value | | --- | --- | --- | --- | --- | --- | | Pika feeding | | | | | | | fixed | (Intercept) | 36.33 | 3.24 | 11.23 | 0.00 | | fixed | Grasses | -21.67 | 4.39 | -4.94 | 0.00 | | fixed | S. chamaejasme | 23.67 | 4.39 | 5.39 | 0.00 | | fixed | Sedges | -18.67 | 4.39 | -4.25 | 0.00 | | random | plot | 0.00 | NA | NA | NA | | random | month | 1.58 | NA | NA | NA | | random | Residual | 17.00 | NA | NA | NA | | Yak feeding | | | | | | | fixed | (Intercept) | 16.33 | 3.23 | 5.05 | 0.00 | | fixed | Grasses | 58.00 | 4.24 | 13.68 | 0.00 | | fixed | Sedges | 29.00 | 4.24 | 6.84 | 0.00 | | random | transect | 3.83 | NA | NA | NA | | random | month | 0.00 | NA | NA | NA | | random | Residual | 16.42 | NA | NA | NA |   Supplementary Table 1: Model summary for pika and yak feeding. |

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| | contrast | estimate | SE | df | t.ratio | p.value | | --- | --- | --- | --- | --- | --- | | Pika feeding | | | | | | | Forbs - Grasses | 21.67 | 4.39 | 113.00 | 4.94 | 0.00 | | Forbs - S. chamaejasme | -23.67 | 4.39 | 113.00 | -5.39 | 0.00 | | Forbs - Sedges | 18.67 | 4.39 | 113.00 | 4.25 | 0.00 | | Grasses - S. chamaejasme | -45.33 | 4.39 | 113.00 | -10.33 | 0.00 | | Grasses - Sedges | -3.00 | 4.39 | 113.00 | -0.68 | 0.90 | | S. chamaejasme - Sedges | 42.33 | 4.39 | 113.00 | 9.64 | 0.00 | | Yak feeding | | | | | | | Forbs - Grasses | -58.00 | 4.24 | 84.00 | -13.68 | 0.00 | | Forbs - Sedges | -29.00 | 4.24 | 84.00 | -6.84 | 0.00 | | Grasses - Sedges | 29.00 | 4.24 | 84.00 | 6.84 | 0.00 |   Supplementary Table 2: Model contrasts for pika and yak feeding. |

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| | effect | term | estimate | std.error | statistic | p.value | | --- | --- | --- | --- | --- | --- | | weight gain | | | | | | | fixed | (Intercept) | 0.32 | 0.03 | 10.80 | 0.00 | | fixed | pika | 0.01 | 0.01 | 0.74 | 0.46 | | fixed | S. chamaejasme | -0.11 | 0.01 | -7.70 | 0.00 | | fixed | pika:S. chamaejasme | 0.13 | 0.02 | 6.63 | 0.00 | | random | block | 0.01 | NA | NA | NA | | random | year | 0.01 | NA | NA | NA | | random | month | 0.05 | NA | NA | NA | | random | Residual | 0.07 | NA | NA | NA | | grass cover | | | | | | | fixed | (Intercept) | -1.11 | 0.10 | -11.58 | 0.00 | | fixed | pika | -0.09 | 0.10 | -0.90 | 0.37 | | fixed | S. chamaejasme | -0.88 | 0.11 | -7.76 | 0.00 | | fixed | pika:S. chamaejasme | 0.90 | 0.15 | 5.97 | 0.00 | | random | block | 0.13 | NA | NA | NA | | random | year | 0.00 | NA | NA | NA | | random | month | 0.02 | NA | NA | NA | | S. chamaejasme | | | | | | | fixed | (Intercept) | -3.44 | 0.26 | -13.39 | 0.00 | | fixed | pika | -0.11 | 0.22 | -0.49 | 0.62 | | fixed | S. chamaejasme | 2.25 | 0.17 | 12.91 | 0.00 | | fixed | pika:S. chamaejasme | -1.15 | 0.25 | -4.58 | 0.00 | | random | block | 0.16 | NA | NA | NA | | random | year | 0.17 | NA | NA | NA | | random | month | 0.24 | NA | NA | NA | | crude protein % | | | | | | | fixed | (Intercept) | -2.39 | 0.02 | -107.03 | 0.00 | | fixed | pika | 0.03 | 0.02 | 1.88 | 0.06 | | fixed | S. chamaejasme | -0.15 | 0.02 | -8.72 | 0.00 | | fixed | pika:S. chamaejasme | 0.13 | 0.02 | 5.45 | 0.00 | | random | block | 0.01 | NA | NA | NA | | random | year | 0.00 | NA | NA | NA | | random | month | 0.03 | NA | NA | NA | | acid detergent fibre % | | | | | | | fixed | (Intercept) | -0.82 | 0.03 | -32.36 | 0.00 | | fixed | pika | 0.01 | 0.02 | 0.46 | 0.65 | | fixed | S. chamaejasme | -0.06 | 0.02 | -3.14 | 0.00 | | fixed | pika:S. chamaejasme | 0.08 | 0.03 | 2.84 | 0.00 | | random | block | 0.03 | NA | NA | NA | | random | year | 0.00 | NA | NA | NA | | random | month | 0.03 | NA | NA | NA | | ether extract % | | | | | | | fixed | (Intercept) | -3.44 | 0.03 | -124.03 | 0.00 | | fixed | pika | -0.05 | 0.02 | -2.19 | 0.03 | | fixed | S. chamaejasme | -0.03 | 0.02 | -1.50 | 0.13 | | fixed | pika:S. chamaejasme | 0.09 | 0.03 | 2.90 | 0.00 | | random | block | 0.00 | NA | NA | NA | | random | year | 0.01 | NA | NA | NA | | random | month | 0.04 | NA | NA | NA |   Supplementary Table 3: Model summary for weight gain, grass cover, S. chamaejasme cover, crude protein %, acid detergent fibre %, and ether extract %. |

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| | contrast | estimate | SE | df | t.ratio | p.value | | --- | --- | --- | --- | --- | --- | | weight gain | | | | | | | no pika No S. chamaejasme - pika No S. chamaejasme | -0.01 | 0.01 | 184.00 | -0.74 | 0.88 | | no pika No S. chamaejasme - no pika S. chamaejasme | 0.11 | 0.01 | 184.00 | 7.70 | 0.00 | | no pika No S. chamaejasme - pika S. chamaejasme | -0.03 | 0.01 | 184.00 | -2.42 | 0.08 | | pika No S. chamaejasme - no pika S. chamaejasme | 0.12 | 0.01 | 184.00 | 8.44 | 0.00 | | pika No S. chamaejasme - pika S. chamaejasme | -0.02 | 0.01 | 184.00 | -1.68 | 0.34 | | no pika S. chamaejasme - pika S. chamaejasme | -0.14 | 0.01 | 184.00 | -10.12 | 0.00 | | grass cover | | | | | | | no pika No S. chamaejasme / pika No S. chamaejasme | NA | 0.11 | Inf | NA | 0.81 | | no pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.27 | Inf | NA | 0.00 | | no pika No S. chamaejasme / pika S. chamaejasme | NA | 0.11 | Inf | NA | 0.90 | | pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.25 | Inf | NA | 0.00 | | pika No S. chamaejasme / pika S. chamaejasme | NA | 0.10 | Inf | NA | 1.00 | | no pika S. chamaejasme / pika S. chamaejasme | NA | 0.05 | Inf | NA | 0.00 | | S. chamaejasme | | | | | | | no pika No S. chamaejasme / pika No S. chamaejasme | NA | 0.24 | Inf | NA | 0.96 | | no pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.00 | | no pika No S. chamaejasme / pika S. chamaejasme | NA | 0.07 | Inf | NA | 0.00 | | pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.00 | | pika No S. chamaejasme / pika S. chamaejasme | NA | 0.06 | Inf | NA | 0.00 | | no pika S. chamaejasme / pika S. chamaejasme | NA | 0.46 | Inf | NA | 0.00 | | crude protein % | | | | | | | no pika No S. chamaejasme / pika No S. chamaejasme | NA | 0.02 | Inf | NA | 0.24 | | no pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.00 | | no pika No S. chamaejasme / pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.91 | | pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.00 | | pika No S. chamaejasme / pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.61 | | no pika S. chamaejasme / pika S. chamaejasme | NA | 0.01 | Inf | NA | 0.00 | | acid detergent fibre % | | | | | | | no pika No S. chamaejasme / pika No S. chamaejasme | NA | 0.02 | Inf | NA | 0.97 | | no pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.01 | | no pika No S. chamaejasme / pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.54 | | pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.00 | | pika No S. chamaejasme / pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.82 | | no pika S. chamaejasme / pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.00 | | ether extract % | | | | | | | no pika No S. chamaejasme / pika No S. chamaejasme | NA | 0.02 | Inf | NA | 0.13 | | no pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.44 | | no pika No S. chamaejasme / pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.98 | | pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.90 | | pika No S. chamaejasme / pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.05 | | no pika S. chamaejasme / pika S. chamaejasme | NA | 0.02 | Inf | NA | 0.22 |   Supplementary Table 4: Model contrasts for weight gain, grass cover, S. chamaejasme cover, crude protein %, acid detergent fibre %, and ether extract %. |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | effect | term | estimate | std.error | statistic | p.value | | --- | --- | --- | --- | --- | --- | | total bites | | | | | | | fixed | (Intercept) | 516.96 | 13.70 | 37.74 | 0.00 | | fixed | pika | 16.73 | 16.58 | 1.01 | 0.31 | | fixed | S. chamaejasme | -130.85 | 16.58 | -7.89 | 0.00 | | fixed | pika:S. chamaejasme | 119.48 | 23.45 | 5.10 | 0.00 | | random | block | 8.62 | NA | NA | NA | | random | year | 7.95 | NA | NA | NA | | random | month | 0.01 | NA | NA | NA | | random | Residual | 81.22 | NA | NA | NA | | total sedge bites | | | | | | | fixed | (Intercept) | 5.65 | 0.04 | 138.78 | 0.00 | | fixed | pika | 0.04 | 0.04 | 0.92 | 0.36 | | fixed | S. chamaejasme | -0.42 | 0.05 | -8.71 | 0.00 | | fixed | pika:S. chamaejasme | 0.35 | 0.06 | 5.51 | 0.00 | | random | block | 0.04 | NA | NA | NA | | random | year | 0.02 | NA | NA | NA | | random | month | 0.03 | NA | NA | NA | | total grass bites | | | | | | | fixed | (Intercept) | 151.72 | 7.49 | 20.25 | 0.00 | | fixed | pika | -0.80 | 8.61 | -0.09 | 0.93 | | fixed | S. chamaejasme | -45.34 | 8.61 | -5.27 | 0.00 | | fixed | pika:S. chamaejasme | 43.95 | 12.17 | 3.61 | 0.00 | | random | block | 4.78 | NA | NA | NA | | random | year | 5.17 | NA | NA | NA | | random | month | 0.00 | NA | NA | NA | | random | Residual | 42.16 | NA | NA | NA | | total steps | | | | | | | fixed | (Intercept) | 583.54 | 15.19 | 38.42 | 0.00 | | fixed | pika | -8.23 | 20.98 | -0.39 | 0.69 | | fixed | S. chamaejasme | 113.06 | 20.98 | 5.39 | 0.00 | | fixed | pika:S. chamaejasme | -136.15 | 29.67 | -4.59 | 0.00 | | random | block | 6.53 | NA | NA | NA | | random | year | 0.00 | NA | NA | NA | | random | month | 0.00 | NA | NA | NA | | random | Residual | 102.78 | NA | NA | NA | | sedges bite steps | | | | | | | fixed | (Intercept) | 0.04 | 0.14 | 0.28 | 0.78 | | fixed | pika | 0.08 | 0.12 | 0.67 | 0.50 | | fixed | S. chamaejasme | -0.95 | 0.12 | -7.61 | 0.00 | | fixed | pika:S. chamaejasme | 1.01 | 0.17 | 5.83 | 0.00 | | random | block | 0.17 | NA | NA | NA | | random | year | 0.08 | NA | NA | NA | | random | month | 0.06 | NA | NA | NA | | grass bite steps | | | | | | | fixed | (Intercept) | -1.01 | 0.08 | -13.16 | 0.00 | | fixed | pika | 0.02 | 0.09 | 0.19 | 0.85 | | fixed | S. chamaejasme | -0.60 | 0.10 | -6.28 | 0.00 | | fixed | pika:S. chamaejasme | 0.67 | 0.13 | 5.15 | 0.00 | | random | block | 0.03 | NA | NA | NA | | random | year | 0.06 | NA | NA | NA | | random | month | 0.00 | NA | NA | NA |   Supplementary Table 5: Model summary for plant bites (total, sedges, and grasses) and the bite to step ratio (sedges, and grasses) as well as total steps. |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | contrast | estimate | SE | df | t.ratio | p.value | | --- | --- | --- | --- | --- | --- | | total bites | | | | | | | no pika No S. chamaejasme - pika No S. chamaejasme | -16.73 | 16.58 | 184.00 | -1.01 | 0.74 | | no pika No S. chamaejasme - no pika S. chamaejasme | 130.85 | 16.58 | 184.00 | 7.89 | 0.00 | | no pika No S. chamaejasme - pika S. chamaejasme | -5.36 | 16.58 | 184.00 | -0.32 | 0.99 | | pika No S. chamaejasme - no pika S. chamaejasme | 147.58 | 16.58 | 184.00 | 8.90 | 0.00 | | pika No S. chamaejasme - pika S. chamaejasme | 11.37 | 16.58 | 184.00 | 0.69 | 0.90 | | no pika S. chamaejasme - pika S. chamaejasme | -136.21 | 16.58 | 184.00 | -8.22 | 0.00 | | total sedge bites | | | | | | | no pika No S. chamaejasme / pika No S. chamaejasme | NA | 0.04 | Inf | NA | 0.80 | | no pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.07 | Inf | NA | 0.00 | | no pika No S. chamaejasme / pika S. chamaejasme | NA | 0.04 | Inf | NA | 0.94 | | pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.08 | Inf | NA | 0.00 | | pika No S. chamaejasme / pika S. chamaejasme | NA | 0.05 | Inf | NA | 0.45 | | no pika S. chamaejasme / pika S. chamaejasme | NA | 0.03 | Inf | NA | 0.00 | | total grass bites | | | | | | | no pika No S. chamaejasme - pika No S. chamaejasme | 0.80 | 8.61 | 184.00 | 0.09 | 1.00 | | no pika No S. chamaejasme - no pika S. chamaejasme | 45.34 | 8.61 | 184.00 | 5.27 | 0.00 | | no pika No S. chamaejasme - pika S. chamaejasme | 2.19 | 8.61 | 184.00 | 0.25 | 0.99 | | pika No S. chamaejasme - no pika S. chamaejasme | 44.54 | 8.61 | 184.00 | 5.18 | 0.00 | | pika No S. chamaejasme - pika S. chamaejasme | 1.39 | 8.61 | 184.00 | 0.16 | 1.00 | | no pika S. chamaejasme - pika S. chamaejasme | -43.15 | 8.61 | 184.00 | -5.01 | 0.00 | | total steps | | | | | | | no pika No S. chamaejasme - pika No S. chamaejasme | 8.23 | 20.98 | 184.00 | 0.39 | 0.98 | | no pika No S. chamaejasme - no pika S. chamaejasme | -113.06 | 20.98 | 184.00 | -5.39 | 0.00 | | no pika No S. chamaejasme - pika S. chamaejasme | 31.31 | 20.98 | 184.00 | 1.49 | 0.44 | | pika No S. chamaejasme - no pika S. chamaejasme | -121.29 | 20.98 | 184.00 | -5.78 | 0.00 | | pika No S. chamaejasme - pika S. chamaejasme | 23.08 | 20.98 | 184.00 | 1.10 | 0.69 | | no pika S. chamaejasme - pika S. chamaejasme | 144.37 | 20.98 | 184.00 | 6.88 | 0.00 | | sedges bite steps | | | | | | | no pika No S. chamaejasme / pika No S. chamaejasme | NA | 0.11 | Inf | NA | 0.91 | | no pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.32 | Inf | NA | 0.00 | | no pika No S. chamaejasme / pika S. chamaejasme | NA | 0.10 | Inf | NA | 0.66 | | pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.35 | Inf | NA | 0.00 | | pika No S. chamaejasme / pika S. chamaejasme | NA | 0.11 | Inf | NA | 0.96 | | no pika S. chamaejasme / pika S. chamaejasme | NA | 0.04 | Inf | NA | 0.00 | | grass bite steps | | | | | | | no pika No S. chamaejasme / pika No S. chamaejasme | NA | 0.09 | Inf | NA | 1.00 | | no pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.17 | Inf | NA | 0.00 | | no pika No S. chamaejasme / pika S. chamaejasme | NA | 0.08 | Inf | NA | 0.79 | | pika No S. chamaejasme / no pika S. chamaejasme | NA | 0.18 | Inf | NA | 0.00 | | pika No S. chamaejasme / pika S. chamaejasme | NA | 0.08 | Inf | NA | 0.88 | | no pika S. chamaejasme / pika S. chamaejasme | NA | 0.05 | Inf | NA | 0.00 |   Supplementary Table 6: Model contrasts for plant bites (total, sedges, and grasses) and the bite to step ratio (sedges, and grasses) as well as total steps. |