**Supporting Information**. Drees, T.H. and K. Shea, 2023. “Climate warming increases insect-driven seed removal of two elaiosome-bearing invasive thistle species”. *Ecology*.

**Appendix S1.** Parametric survival models methods and results, as well as qualitative comparison to GLMs for seed removal.

**Survival Analyses**

To qualitatively compare our results derived from GLMs to those from a more standard survival analysis, we fit parametric survival models for each species. Before fitting the survival models, the data were re-structured as single-seed entries with time of removal (if removed) rather than per-depot counts at various time points. Models were then fit using the **survreg** function from the package **survival** version 3.4-0 (Therneau 2022), with time to seed removal as a response; elaiosome and warming treatments, as well as their interaction, were encoded as fixed effects. Unfortunately, at the moment, this package (like many similar survival model packages) does not fully support random effects for the parametric survival models, so we have encoded block as a fixed effect instead. This encoding still allows us to account for spatial variation in seed removal rates within the experiment, but does not extend estimation of spatial variation outside the context of this experiment. These models were fit testing two parameterizations of the survival and hazard functions: an exponential distribution with a constant hazard and a Weibull distribution with a time-varying hazard, similar to the exploratory survival analyses in Jones *et al*. (2023).

Comparing the Weibull and exponential distributions for the survival and hazard functions, the Weibull distribution had a lower AIC in both *C. nutans* (6911 versus 6947) and *C. acanthoides* (7019 versus 7271), and thus seemed to be a better candidate for the underlying survival and hazard functions, suggesting that the hazard varied through time. For each species, the model fit with a Weibull distribution had a scale parameter less than 1: 0.84 in *C. nutans* (*n* = 1000, *z* = -6.418, *p* < 0.001) and 0.62 in *C. acanthoides* (*n* = 975, *z* = -17.534, *p* < 0.001). This indicates that the risk of removal decreases over time.

As can be seen in Table S1, the same general trends seen in the GLM results were also seen in the Weibull survival models. For both species, significant negative coefficients on warming and elaiosome treatments indicate that elaiosome presence and increased growing temperatures each decreased the average time it takes for a seed to be removed. Note that while they convey the same trend, the treatment coefficients have opposite signs when compared between Table 1 (main text) and Table S1 since the model for the former examines proportion of seeds *removed* as the response, while the model for the latter examines how long seeds *remain* before being removed.

**References**

Therneau, T.M. (2022). Package ‘survival’, version 3.4-0. https://cran.r-project.org/web/pac- kages/survival/index.html

Jones, E., Harden, S., & Crawley, M.J. (2023). The R Book (3rd ed.). John Wiley and Sons.

**Table S1.** Estimates (1 standard error), -scores, and -values for the coefficients of the parametric survival models fit with Weibull survival/hazard functions. The intercept (baseline) represents seeds from unwarmed maternal plants and without elaiosomes in the first experimental block. Estimates must be exponentiated to yield mean time to removal for seeds that were removed.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | ***C. nutans* (*n* = 1000)** | | |  | ***C. acanthoides* (*n* = 975)** | | |
|  |  |  |  |  |  |  |  |
|  | **Estimate** | ***z*** | ***p*** |  | **Estimate** | ***z*** | ***p*** |
| Intercept | 2.745 0.094 | 29.346 | <0.001 |  | 2.651 0.068 | 38.984 | <0.001 |
| Warming | -0.518 0.090 | -5.782 | <0.001 |  | -0.741 0.065 | -11.422 | <0.001 |
| Elaiosome | -0.966 0.084 | -11.514 | <0.001 |  | -0.649 0.060 | -10.778 | <0.001 |
| Warming:Elaiosome | -0.172 0.118 | -1.461 | 0.140 |  | 0.858 0.086 | 10.022 | <0.001 |
| Block |  |  |  |  |  |  |  |
| 2 | 0.080 0.123 | 0.654 | 0.513 |  | 0.106 0.088 | 1.196 | 0.232 |
| 3 | 0.651 0.129 | 5.057 | <0.001 |  | 0.796 0.093 | 8.606 | <0.001 |
| 4 | 1.043 0.126 | 8.259 | <0.001 |  | 1.054 0.093 | 11.321 | <0.001 |
| 5 | 1.525 0.130 | 11.709 | <0.001 |  | 0.805 0.101 | 7.991 | <0.001 |
| 6 | 0.586 0.130 | 4.524 | <0.001 |  | 1.038 0.092 | 11.329 | <0.001 |
| 7 | 1.100 0.128 | 8.588 | <0.001 |  | 0.907 0.093 | 9.746 | <0.001 |
| 8 | 1.475 0.129 | 11.431 | <0.001 |  | 0.910 0.095 | 9.591 | <0.001 |
| 9 | 1.194 0.127 | 9.373 | <0.001 |  | 1.543 0.098 | 15.734 | <0.001 |
| 10 | 0.781 0.123 | 6.378 | <0.001 |  | 1.025 0.092 | 11.168 | <0.001 |