**Supporting Information**. Drees, T.H. and K. Shea, 2023. *Elevated temperatures shift flower head height distributions and seed dispersal patterns in two invasive thistle species*. Ecology.

**Appendix S1.** Alternative representation of Figure 1 with superimposed data, and tables with select statistics comparing dispersal simulations between both warmed/unwarmed treatments and maximum/distributed flower head height.



**Figure S1.** Distribution of flower head heights for *C. nutans* and *C. acanthoides* under the control and warming treatments. Solid lines indicate bootstrapped mean probability density for a given height, and bars indicate observed frequencies of flower head heights.

**Table S1**. Dispersal statistics from the first set of simulations comparing warmed and unwarmed treatments for *C. nutans* (CN) and *C. acanthoides* (CA). Values are given for the mean and lower/upper values of the 95% bootstrap interval (BI).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | **95% BI Lower** | **Mean** | **95% BI Upper** |
| **Mean dispersal distance (m)** | |  |  |  |
| CN | Unwarmed | 2.84 | 3.05 | 3.27 |
|  | Warmed | 3.45 | 3.70 | 3.96 |
| CA | Unwarmed | 2.28 | 2.46 | 2.63 |
|  | Warmed | 3.19 | 3.39 | 3.62 |
|  | | | | |
| **95th percentile dispersal distance (m)** | |  |  |  |
| CN | Unwarmed | 9.77 | 10.53 | 11.43 |
|  | Warmed | 11.84 | 12.76 | 13.77 |
| CA | Unwarmed | 7.80 | 8.48 | 9.13 |
|  | Warmed | 10.88 | 11.69 | 12.54 |
|  | | | | |
| **99th percentile dispersal distance (m)** | |  |  |  |
| CN | Unwarmed | 22.55 | 25.15 | 28.07 |
|  | Warmed | 27.39 | 30.37 | 33.80 |
| CA | Unwarmed | 17.89 | 19.97 | 22.32 |
|  | Warmed | 24.91 | 27.58 | 30.72 |
|  | | | | |
| **10-m warmed/unwarmed risk ratio** | |  |  |  |
| CN |  | 1.15 | 1.36 | 1.59 |
| CA |  | 1.44 | 1.71 | 2.04 |
|  | | | | |
| **50-m warmed/unwarmed risk ratio** | |  |  |  |
| CN |  | 0.91 | 1.66 | 2.86 |
| CA |  | 1.15 | 2.44 | 4.83 |

**Table S2**. Dispersal statistics from the second set of simulations comparing warmed and unwarmed treatments, paired with either the distribution of all flower head heights or the mean maximum flower head height as a point source, for *C. nutans* (CN) and *C. acanthoides* (CA). Values are given for the mean and lower/upper values of the 95% bootstrap interval (BI).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | | **95% BI Lower** | **Mean** | **95% BI Upper** |
| **Mean dispersal distance (m)** | | |  |  |  |
| CN | Height Dist. | Unwarmed | 2.84 | 3.05 | 3.27 |
|  |  | Warmed | 3.45 | 3.70 | 3.96 |
|  | Max. Height | Unwarmed | 3.18 | 3.54 | 3.92 |
|  |  | Warmed | 3.82 | 4.22 | 4.61 |
| CA | Height Dist. | Unwarmed | 2.31 | 2.47 | 2.62 |
|  |  | Warmed | 3.18 | 3.39 | 3.61 |
|  | Max. Height | Unwarmed | 2.49 | 2.75 | 3.05 |
|  |  | Warmed | 3.79 | 4.24 | 4.70 |
|  | | | | | |
| **95th percentile dispersal distance (m)** | | |  |  |  |
| CN | Height Dist. | Unwarmed | 9.77 | 10.53 | 11.43 |
|  |  | Warmed | 11.84 | 12.79 | 13.83 |
|  | Max. Height | Unwarmed | 11.32 | 12.60 | 13.95 |
|  |  | Warmed | 13.57 | 15.03 | 16.51 |
| CA | Height Dist. | Unwarmed | 7.89 | 8.50 | 9.13 |
|  |  | Warmed | 10.90 | 11.67 | 12.56 |
|  | Max. Height | Unwarmed | 8.72 | 9.81 | 11.00 |
|  |  | Warmed | 13.64 | 15.14 | 16.85 |
|  | | | | | |
| **99th percentile dispersal distance (m)** | | |  |  |  |
| CN | Height Dist. | Unwarmed | 22.55 | 25.15 | 28.07 |
|  |  | Warmed | 27.26 | 30.34 | 33.80 |
|  | Max. Height | Unwarmed | 26.91 | 30.85 | 35.24 |
|  |  | Warmed | 32.24 | 36.71 | 41.62 |
| CA | Height Dist. | Unwarmed | 18.02 | 20.00 | 22.33 |
|  |  | Warmed | 24.93 | 27.55 | 30.43 |
|  | Max. Height | Unwarmed | 20.81 | 23.93 | 27.22 |
|  |  | Warmed | 32.29 | 36.86 | 41.72 |
|  | | | | | |
| **10-m maximum/distribution risk ratio** | | |  |  |  |
| CN |  | Unwarmed | 1.04 | 1.26 | 1.51 |
|  |  | Warmed | 1.08 | 1.31 | 1.59 |
| CA |  | Unwarmed | 1.20 | 1.45 | 1.74 |
|  |  | Warmed | 1.03 | 1.30 | 1.61 |
|  | | | | | |
| **50-m maximum/distribution risk ratio** | | | | | |
| CN |  | Unwarmed | 0.98 | 1.64 | 2.68 |
|  |  | Warmed | 0.91 | 1.77 | 3.05 |
| CA |  | Unwarmed | 1.20 | 2.10 | 3.43 |
|  |  | Warmed | 0.80 | 1.90 | 3.99 |

**Table S3**. Dispersal statistics from the third set of simulations comparing warmed and unwarmed treatments, paired with either the distribution of all flower head heights or the distribution of maximum flower head heights, for *C. nutans* (CN) and *C. acanthoides* (CA). Values are given for the mean and lower/upper values of the 95% bootstrap interval (BI).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | | **95% BI Lower** | **Mean** | **95% BI Upper** |
| **Mean dispersal distance (m)** | | |  |  |  |
| CN | Height Dist. | Unwarmed | 2.84 | 3.05 | 3.27 |
|  |  | Warmed | 3.45 | 3.70 | 3.96 |
|  | Max. Height | Unwarmed | 3.23 | 3.44 | 3.66 |
|  |  | Warmed | 3.86 | 4.12 | 4.39 |
| CA | Height Dist. | Unwarmed | 2.29 | 2.46 | 2.64 |
|  |  | Warmed | 3.17 | 3.39 | 3.61 |
|  | Max. Height | Unwarmed | 2.48 | 2.67 | 2.86 |
|  |  | Warmed | 3.91 | 4.12 | 4.34 |
|  | | | | | |
| **95th percentile dispersal distance (m)** | | |  |  |  |
| CN | Height Dist. | Unwarmed | 9.77 | 10.53 | 11.43 |
|  |  | Warmed | 11.81 | 12.75 | 13.72 |
|  | Max. Height | Unwarmed | 11.03 | 11.85 | 12.72 |
|  |  | Warmed | 13.24 | 14.21 | 15.20 |
| CA | Height Dist. | Unwarmed | 7.82 | 8.47 | 9.11 |
|  |  | Warmed | 10.86 | 11.68 | 12.61 |
|  | Max. Height | Unwarmed | 8.52 | 9.25 | 9.97 |
|  |  | Warmed | 13.18 | 14.06 | 14.98 |
|  | | | | | |
| **99th percentile dispersal distance (m)** | | |  |  |  |
| CN | Height Dist. | Unwarmed | 22.55 | 25.15 | 28.07 |
|  |  | Warmed | 27.23 | 30.31 | 33.72 |
|  | Max. Height | Unwarmed | 25.24 | 28.11 | 31.36 |
|  |  | Warmed | 30.18 | 33.65 | 37.46 |
| CA | Height Dist. | Unwarmed | 17.82 | 19.96 | 22.37 |
|  |  | Warmed | 24.77 | 27.54 | 30.64 |
|  | Max. Height | Unwarmed | 19.68 | 21.87 | 24.28 |
|  |  | Warmed | 29.79 | 33.01 | 36.77 |
|  | | | | | |
| **10-m maximum/distribution risk ratio** | | |  |  |  |
| CN |  | Unwarmed | 1.02 | 1.18 | 1.36 |
|  |  | Warmed | 1.04 | 1.21 | 1.41 |
| CA |  | Unwarmed | 1.16 | 1.34 | 1.55 |
|  |  | Warmed | 0.95 | 1.16 | 1.44 |
|  | | | | | |
| **50-m maximum/distribution risk ratio** | | | | | |
| CN |  | Unwarmed | 0.79 | 1.31 | 2.08 |
|  |  | Warmed | 0.74 | 1.34 | 2.26 |
| CA |  | Unwarmed | 0.94 | 1.59 | 2.64 |
|  |  | Warmed | 0.58 | 1.39 | 2.96 |