Supplementary Material

**Figure S1.** Changes in accumulated average daily temperatures exceeding 0°C from Kangerlussuaq and Zackenberg, Greenland. Hourly temperature data from Zackenberg were downloaded from Climate Basis for the period 1 January 1996 – 31 December 2017. We calculated average daily temperature as the average of the 24 hourly measurements. At Kangerlussuaq, we used data from the Danish Meteorological Institute (Technical report 14‐08, 18‐08; <http://research.dmi.dk/data/>) that were available through 2013. The dataset contained daily minimum and maximum temperatures. We first modeled hourly temperatures based on these minimums and maximums as described in Cesaraccio et al. (2001) and Finger Higgens et al. (2019) and then took the average of the 24 hourly temperatures for each day. For both locations, we determined if average daily temperature exceeded 0°C. If so, we considered the accumulated degree days for that day to be: average daily temperature – 0. We then summed the degree days (DD) for each year and fit simple linear regression lines to describe trends over time (1996-2013 for Kangerlussuaq and 1996-2017 for Zackenberg).

**Table S1** Start and end dates of the pitfall sampling periods in each of the three habitat types from Zackenberg, Greenland. Each plot contained 4-8 pitfall traps, depending on the year. Habitat and plot-level descriptions are provided in more detail in (Høye and Forchhammer, 2008; Jensen et al., 2013; Koltz et al., 2018).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Year | Plot | Habitat type | Sampling Dates | Total # Trap Days |
| 1996 | 2 | Wet fen | 6/3 - 9/2 | 361 |
| 1996 | 3 | Mesic heath | 6/3 - 9/2 | 280 |
| 1996 | 4 | Mesic heath | 6/4 - 9/2 | 280 |
| 1996 | 5 | Arid heath | 6/4 - 9/2 | 336 |
| 1997 | 2 | Wet fen | 5/27 - 8/27 | 702 |
| 1997 | 3 | Mesic heath | 5/27 - 8/27 | 519 |
| 1997 | 4 | Mesic heath | 5/27 - 8/27 | 484 |
| 1997 | 5 | Arid heath | 5/29 - 8/27 | 706 |
| 1998 | 2 | Wet fen | 5/27 - 8/26 | 707 |
| 1998 | 3 | Mesic heath | 5/27 - 8/26 | 482 |
| 1998 | 4 | Mesic heath | 5/27 - 8/26 | 490 |
| 1998 | 5 | Arid heath | 5/27 - 8/26 | 638 |
| 1999 | 2 | Wet fen | 6/3 - 8/26 | 304 |
| 1999 | 3 | Mesic heath | 6/3 - 8/26 | 224 |
| 1999 | 4 | Mesic heath | 6/3 - 8/26 | 203 |
| 1999 | 5 | Arid heath | 6/3 - 8/26 | 287 |
| 1999 | 7 | Arid heath | 6/3 - 8/26 | 336 |
| 2000 | 2 | Wet fen | 6/4 - 8/26 | 332 |
| 2000 | 3 | Mesic heath | 6/4 - 8/26 | 301 |
| 2000 | 4 | Mesic heath | 6/4 - 8/26 | 308 |
| 2000 | 5 | Arid heath | 6/4 - 8/26 | 332 |
| 2000 | 7 | Arid heath | 6/4 - 8/26 | 311 |
| 2001 | 2 | Wet fen | 5/31 - 8/26 | 336 |
| 2001 | 3 | Mesic heath | 6/3 - 8/26 | 252 |
| 2001 | 4 | Mesic heath | 6/3 - 8/26 | 252 |
| 2001 | 5 | Arid heath | 6/3 - 8/26 | 298 |
| 2001 | 7 | Arid heath | 6/3 - 8/26 | 336 |
| 2002 | 2 | Wet fen | 5/31 - 8/26 | 329 |
| 2002 | 3 | Mesic heath | 6/3 - 8/26 | 273 |
| 2002 | 4 | Mesic heath | 6/3 - 8/26 | 252 |
| 2002 | 5 | Arid heath | 6/2 - 8/26 | 336 |
| 2002 | 7 | Arid heath | 6/2 - 8/26 | 336 |
| 2003 | 2 | Wet fen | 6/3 - 8/26 | 336 |
| 2003 | 3 | Mesic heath | 6/3 - 8/26 | 280 |
| 2003 | 4 | Mesic heath | 6/3 - 8/26 | 287 |
| 2003 | 5 | Arid heath | 6/3 - 8/26 | 315 |
| 2003 | 7 | Arid heath | 6/3 - 8/26 | 322 |
| 2004 | 2 | Wet fen | 6/1 - 8/26 | 344 |
| 2004 | 3 | Mesic heath | 6/2 - 8/26 | 316 |
| 2004 | 4 | Mesic heath | 6/2 - 8/26 | 322 |
| 2004 | 5 | Arid heath | 6/1 - 8/26 | 342 |
| 2004 | 7 | Arid heath | 6/1 - 8/26 | 337 |
| 2005 | 2 | Wet fen | 5/20 - 8/26 | 392 |
| 2005 | 3 | Mesic heath | 5/20 - 8/26 | 338 |
| 2005 | 4 | Mesic heath | 5/20 - 8/26 | 326 |
| 2005 | 5 | Arid heath | 5/20 - 8/26 | 392 |
| 2005 | 7 | Arid heath | 5/20 - 8/26 | 392 |
| 2006 | 2 | Wet fen | 5/27 - 8/26 | 354 |
| 2006 | 3 | Mesic heath | 5/26 - 8/26 | 232 |
| 2006 | 4 | Mesic heath | 5/26 - 8/26 | 226 |
| 2006 | 5 | Arid heath | 5/27 - 8/26 | 336 |
| 2006 | 7 | Arid heath | 5/27 - 8/26 | 364 |
| 2007 | 2 | Wet fen | 5/26 - 10/01 | 512 |
| 2007 | 3 | Mesic heath | 5/25 - 9/23 | 426 |
| 2007 | 4 | Mesic heath | 5/25 - 9/23 | 416 |
| 2007 | 5 | Arid heath | 5/26 - 9/23 | 480 |
| 2007 | 7 | Arid heath | 5/26 - 9/23 | 478 |
| 2008 | 2 | Wet fen | 5/10 - 8/25 | 344 |
| 2008 | 3 | Mesic heath | 5/10 - 8/25 | 256 |
| 2008 | 4 | Mesic heath | 5/10 - 8/25 | 252 |
| 2008 | 5 | Arid heath | 5/10 - 8/25 | 342 |
| 2008 | 7 | Arid heath | 5/10 - 8/25 | 329 |
| 2009 | 2 | Wet fen | 5/20 - 9/26 | 484 |
| 2009 | 3 | Mesic heath | 5/27 - 9/23 | 440 |
| 2009 | 4 | Mesic heath | 5/20 - 9/23 | 467 |
| 2009 | 5 | Arid heath | 5/27 - 9/23 | 458 |
| 2009 | 7 | Arid heath | 5/20 - 9/23 | 472 |
| 2011 | 2 | Wet fen | 5/27 - 9/30 | 538 |
| 2011 | 3 | Mesic heath | 6/10 - 9.30 | 448 |
| 2011 | 4 | Mesic heath | 6/10 - 9.30 | 456 |
| 2011 | 5 | Arid heath | 5/27 - 9/30 | 527 |
| 2011 | 7 | Arid heath | 5/27 - 9/30 | 536 |
| 2012 | 2 | Wet fen | 6/10 - 10/07 | 488 |
| 2012 | 3 | Mesic heath | 7/01 - 9/30 | 382 |
| 2012 | 4 | Mesic heath | 7/01 - 9/30 | 379 |
| 2012 | 5 | Arid heath | 6/10 - 9/30 | 480 |
| 2012 | 7 | Arid heath | 6/10 - 9/30 | 480 |
| 2013 | 2 | Wet fen | 5/27 - 9/21 | 500 |
| 2013 | 3 | Mesic heath | 6/03 - 9/21 | 459 |
| 2013 | 4 | Mesic heath | 5/27 - 9/21 | 495 |
| 2013 | 5 | Arid heath | 5/20 - 9/21 | 528 |
| 2013 | 7 | Arid heath | 5/20 - 9/21 | 528 |
| 2014 | 2 | Wet fen | 6/03 - 9/30 | 468 |
| 2014 | 3 | Mesic heath | 6/24 - 9/30 | 401 |
| 2014 | 4 | Mesic heath | 6/24 - 9/30 | 394 |
| 2014 | 5 | Arid heath | 6/24 - 9/30 | 407 |
| 2014 | 7 | Arid heath | 6/3 - 9/30 | 484 |

**Table S2** Site locations and sampling dates from which wolf spider egg sacs were collected from Kangerlussuaq, Greenland in 2010, 2011, and 2012. Each sampling site contained twenty pitfall traps and was located in mixed dwarf shrub / graminoid tundra habitat. In 2011 and 2012, additional sticky traps were deployed within 10 meters from the established pitfall sampling sites. The contents of all traps were collected every 24-48 hours.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Site | Sampling dates (month/day) | Total Duration (Days) | Total # Trap Days | Lat (N) | Long (W) |
|
| 2010 | 1 | 5/30 - 7/21 | 53 | 1060 | 67°06’31.00” | 50°20’26.99” |
| 2010 | 2 | 5/30 - 7/21 | 53 | 1060 | 67°06’29.99” | 50°20’58.99” |
| 2010 | 3 | 5/30 - 7/21 | 53 | 1060 |  67°06’47.99” |  50°20’3.98” |
| 2010 | 4 | 5/30 - 7/21 | 53 | 1060 |  67°06’37.01” |  50°20’35.99” |
| 2010 | 5 | 5/30 - 7/21 | 53 | 1060 |  67°06’33.98” |  50°20’42.00” |
| 2010 | 6 | 5/30 - 7/21 | 53 | 1060 |  67°06’47.99” |  50°20’11.00” |
| 2011 | 1 | 5/30 - 7/21 | 53 | 1060 | 67°06’31.00” | 50°20’26.99” |
| 2011 | 2 | 5/30 - 7/21 | 53 | 1060 | 67°06’29.99” | 50°20’58.99” |
| 2011 | 3 | 5/30 - 7/21 | 53 | 1060 |  67°06’47.99” |  50°20’3.98” |
| 2011 | 4 | 5/30 - 7/21 | 53 | 1060 |  67°06’37.01” |  50°20’5.99” |
| 2011 | 5 | 5/30 - 7/21 | 53 | 1060 |  67°06’33.98” |  50°20’42.00” |
| 2011 | 6 | 5/30 - 7/21 | 53 | 1060 |  67°06’47.99” |  50°20’11.00” |
| 2012 | 1 | 5/30 - 7/21 | 53 | 1060 | 67°06’31.00” | 50°20’26.99” |
| 2012 | 2 | 5/30 - 7/21 | 53 | 1060 | 67°06’29.99” | 50°20’58.99” |
| 2012 | 3 | 5/30 - 7/21 | 53 | 1060 |  67°06’47.99” |  50°20’3.98” |
| 2012 | 4 | 5/30 - 7/21 | 53 | 1060 |  67°06’37.01” |  50°20’35.99” |
| 2012 | 5 | 5/30 - 7/21 | 53 | 1060 |  67°06’33.98” |  50°20’42.00” |
| 2012 | 6 | 5/30 - 7/21 | 53 | 1060 |  67°06’47.99” |  50°20’11.00” |

**Table S3** Site locations and sampling dates from which wolf spider egg sacs were collected from Kangerlussuaq, Greenland in 2016 and 2017. Traps were distributed among four tundra habitat types and were collected every 4-5 days in both years. Sampling periods are indicated by the month/day, with the number of trapping days in parentheses. Asterisks indicate the subset of 2017 samples that were collected between June 27/28 – July 9 only.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Year | Site | # Pitfall traps per habitat type | Sampling Dates |   |   | Lat (N) | Long (W) |
| Bare | Shrub | Grass | Wet Grass | Total Duration (Days)  | Total # Trap Days |
| 2016 | 1 | 12 | 12 | - | - | 6/30 - 7/16 (16) | 16 | 384 | 67°00’45.84” | 50°45’31.49” |
| 2016 | 2 | 12 | 12 | - | - | 6/30 - 7/16 (16) | 16 | 384 | 67°05’18.35” | 50°17’54.91” |
| 2016 | 3 | 12 | 12 | - | - | 6/30 - 7/16 (16) | 16 | 384 | 67°09’07.70” | 50°04’56.99” |
| 2017 | 1 | 9 | 9 | 9 | - | 7/10 - 7/24 (14) | 14 | 378 | 67°00’45.84” | 50°45’31.49” |
| 2017 | 2 | 9 | 9 | 9 | - | 7/10 - 7/25 (15) | 15 | 405 | 67°05’18.35” | 50°17’54.91” |
| 2017 | 3 | 9 | 9 | 9 | 9 | 7/10 - 7/25 (15) | 15 | 540 | 67°09’07.70” | 50°04’56.99” |
| 2017 | 4 | - | - | 6\* | 6 | 5/19 - 7/9 (51), \*6/28-7/9 (11) | 51 | 372 | 67°00’21.81” | 50°47’06.16” |
| 2017 | 5 | - | - | 6\* | 6 | 5/18 - 7/9 (52), \*6/28-7/9 (11) | 52 | 378 | 67°01’05.99” | 50°43’13.40” |
| 2017 | 6 | - | - | 6\* | 6 | 5/20 - 7/9 (50), \*6/27-7/9 (12) | 50 | 372 | 67°05’09.18” | 50°17’55.98” |
| 2017 | 7 | - | - | - | 6 | 5/20 - 7/9 (50) | 50 | 300 | 67°05’12.66” | 50°17’39.48” |
| 2017 | 8 | - | - | 6\* | 6 | 5/20 - 7/9 (50), \*6/27-7/9 (12) | 50 | 372 | 67°05’15.54” | 50°17’14.82” |

**Table S4** Dates, trapping method, and habitats of individual egg sac parasitism events recorded at Kangerlussuaq, Greenland. Each line is a single parasitized egg sac. We also list the number of parasitoid eggs or immature parasitoids contained within each egg sac.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Year | Habitat tundra type | Trap type | Collection date (month/day) | # Parasitoid eggs | # Parasitoid immatures |
| 2011 | Dwarf shrub/graminoid | Sticky trap | 7/1 | 3 | 0 |
| 2011 | Dwarf shrub/graminoid | Sticky trap | 7/1 | 0 | 5 |
| 2011 | Dwarf shrub/graminoid | Sticky trap | 7/1 | 0 | 5 |
| 2011 | Dwarf shrub/graminoid | Pitfall | 7/3 | 0 | 4 |
| 2011 | Dwarf shrub/graminoid | Pitfall | 7/6 | 0 | 2 |
| 2011 | Dwarf shrub/graminoid | Sticky trap | 7/6 | 0 | 4 |
| 2011 | Dwarf shrub/graminoid | Pitfall | 7/8 | 0 | 4 |
| 2016 | Dwarf shrub | Pitfall | 7/9 | 0 | 5 |
| 2016 | Dwarf shrub | Pitfall | 7/9 | 0 | 6 |
| 2016 | Dwarf shrub | Pitfall | 7/9 | 0 | 3 |
| 2016 | Dwarf shrub | Pitfall | 7/16 | 0 | 2 |
| 2017 | Wet graminoid | Pitfall | 6/21 | 1 | 0 |
| 2017 | Wet graminoid | Pitfall | 6/27 | 0 | 5 |
| 2017 | Wet graminoid | Pitfall | 6/27 | 5 | 0 |
| 2017 | Wet graminoid | Pitfall | 6/27 | 0 | 2 |
| 2017 | Wet graminoid | Pitfall | 6/27 | 0 | 6 |
| 2017 | Wet graminoid | Pitfall | 6/27 | 5 | 0 |
| 2017 | Wet graminoid | Pitfall | 6/27 | 5 | 0 |
| 2017 | Wet graminoid | Pitfall | 6/27 | 5 | 0 |
| 2017 | Wet graminoid | Pitfall | 7/4 | 6 | 0 |
| 2017 | Wet graminoid | Pitfall | 7/4 | 0 | 6 |
| 2017 | Wet graminoid | Pitfall | 7/4 | 0 | 10 |
| 2017 | Dry graminoid | Pitfall | 7/9 | 8 | 0 |
| 2017 | Wet graminoid | Pitfall | 7/9 | 6 | 0 |
| 2017 | Wet graminoid | Pitfall | 7/9 | 6 | 0 |
| 2017 | Wet graminoid | Pitfall | 7/9 | 6 | 0 |
| 2017 | Wet graminoid | Pitfall | 7/9 | 6 | 0 |
| 2017 | Wet graminoid | Pitfall | 7/9 | 7 | 0 |
| 2017 | Wet graminoid | Pitfall | 7/9 | 0 | 5 |
| 2017 | Dry graminoid | Pitfall | 7/9 | 0 | 6 |
| 2017 | Wet graminoid | Pitfall | 7/9 | 0 | 5 |
| 2017 | Wet graminoid | Pitfall | 7/9 | 0 | 1 |
| 2017 | Dry graminoid | Pitfall | 7/14 | 0 | 6 |
| 2017 | Dry graminoid | Pitfall | 7/14 | 0 | 4 |
| 2017 | Wet graminoid | Pitfall | 7/14 | 4 | 0 |
| 2017 | Wet graminoid | Pitfall | 7/14 | 0 | 2 |
| 2017 | Wet graminoid | Pitfall | 7/14 | 0 | 3 |
| 2017 | Wet graminoid | Pitfall | 7/14 | 0 | 2 |
| 2017 | Wet graminoid | Pitfall | 7/14 | 0 | 1 |
| 2017 | Wet graminoid | Pitfall | 7/14 | 0 | 5 |
| 2017 | Wet graminoid | Pitfall | 7/19 | 6 | 0 |
| 2017 | Wet graminoid | Pitfall | 7/19 | 0 | 6 |
| 2017 | Dwarf shrub | Pitfall | 7/25 | 0 | 5 |
| 2017 | Wet graminoid | Pitfall | 7/25 | 0 | 4 |
| 2017 | Wet graminoid | Pitfall | 7/25 | 0 | 6 |
| 2017 | Wet graminoid | Pitfall | 7/25 | 0 | 3 |

**Table S5** Results of binary logistic regression model testing whether egg sacs of larger wolf spider females have higher probability of being parasitized. Sampling year for which body size data were available (2010, 2011, 2012) and date of sampling (DOY: Day of year) were also included in the model. Body sizes were estimated by measuring carapace width from any females carrying egg sacs during the summers of 2010-2012 from the Kangerlussuaq, Greenland site (N = 203).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Response** | **Fixed effects terms** | **Estimate** | **SE** | **z** | ***p*-value** |
| Parasitism | Intercept | 5533.56 | 5433.74 | 1.02 | 0.31 |
|  | Body size | -0.07 | 2.33 | -0.03 | 0.98 |
|  | DOY | 0.20 | 0.11 | 1.71 | 0.09 |
|   | Year | -2.77 | 2.71 | -1.02 | 0.31 |

**References**

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