Can desert ants take the heat?

OCTOBER 2, 2020 / MADISON SANKOVITZ

by Sean O'Donnell

Based on research for the paper "O'Donnell, S., S. Bulova, V. Caponera, K. Oxman, & I. Giladi. *In press*. Species differ in worker body size effects on critical thermal limits in seed-harvesting desert ants (*Messor ebeninus* and *M. arenarius*). Insectes Sociaux."

A key puzzle in understanding animal biodiversity is how species with similar ecological needs, sometimes even closely related species, can coexist in a habitat. Why doesn't competition for shared resources lead to some of the competing species going extinct? If we can understand how species manage to partition their environments, we may gain insights into how high species diversity is maintained.

In the deserts of the Mediterranean and Middle East, seed-harvesting ants of the genus *Messor* provide a great study case of this conundrum. Several *Messor* species often co-occur and all harvest the seeds of desert plants for food. Within nests, *Messor* ant workers differ widely in body size, and species can further differ in average worker body sizes. Body size affects seed choice, but *Messor* species still overlap widely on the types of seeds they harvest. Do other factors help reduce interspecific competition?

Deserts are challenging to animal life in many ways, including their famously extreme temperatures. Many deserts, including the Negev, swing from being exceptionally hot to very cold. Small-bodied animals like ants, unable to thermoregulate when working outside their nests, are especially vulnerable to local temperature extremes.

My lab's earlier work on army ants (Baudier et al. 2015, 2018) showed that worker body size differences within and among species were associated with the ants' abilities to withstand temperature extremes. Smaller workers are generally more vulnerable to extremely high temperatures. We hypothesized that *Messor* species differences in thermal sensitivity, perhaps associated with body size variation, could affect their ability to function in extreme desert temperatures. Differences in thermal biology could influence the species' relative abilities to harvest seeds under different temperature conditions. A first step in exploring this possibility was to test whether worker ant thermal physiology was related to body size with and between species. We chose two *Messor* species that co-occur in the northern Negev desert in Israel as research subjects: *M. ebeninus* and *M. arenarius*. *Messor ebeninus* workers range smaller,

Search … SEARCH

RECENT POSTS

Just when you thought it was safe to go back near the water… army ant predation on river turtle nests

Interview with a Social Insect Scientist: Ajay Kumar Harit

Interview with a Social Insect Scientist: Joe Velenovsky

Interview with a Social Insect Scientist: Inácio Teles e Gomes

Going, going, gone – The remarkable Cerrado biome in Southern Brazil

RECENT COMMENTS

Honey bees can't pra… on Honey Bee Immunity: More Speci…

Lessons learned from… on Interview with a social insect…

Lessons learned from… on Interview with a social insect…

Lessons learned from… on Interview with a social insect…

Lessons learned from… on Science in the time of CO…

ARCHIVES

July 2021

April 2021

March 2021

and *M. arenarius* workers range larger, but there is some species overlap in worker body sizes.

Ein Avdat National Park provides a stunning setting for the Ben Gurion University Desert Research Center

We collected workers from several nests of each species. Then we brought them to Itamar Giladi's lab at the Desert Research Center of Ben Gurion University for physiological analysis. We placed single workers in vials in either a digitally-controlled heating or cooling device. By slowly ramping the temperatures up or down and watching for cessation of the ants' behavioral responses, we determined the maximum or minimum critical temperature for each worker. After the thermal physiology trials, we measured each worker's head width as an indicator of body size variation. We asked whether worker body size was associated with critical thermal maxima and minima both within and between the species.

The research crew hiking in Ein Avdat Park (left to right: PhD student Karmi Oxman, co-PI Itamar Giladi, research associate Susan Bulova, PhD student Virginia Caponera)

We found that body size was related to maximum thermal tolerance in complex ways. In the larger species, *M. arenarius*, workers of all sizes were similarly tolerant of high-temperature extremes. In contrast, body size was strongly related to maximum tolerated temperature in *M. ebeninus*: smaller workers were more thermally sensitive and could not function at temperatures as high as their larger nestmates; larger *M. ebeninus* overlapped in size with smaller *M. arenarius* and were similarly thermally tolerant. Worker size showed no relationships with low-temperature tolerance in either species.

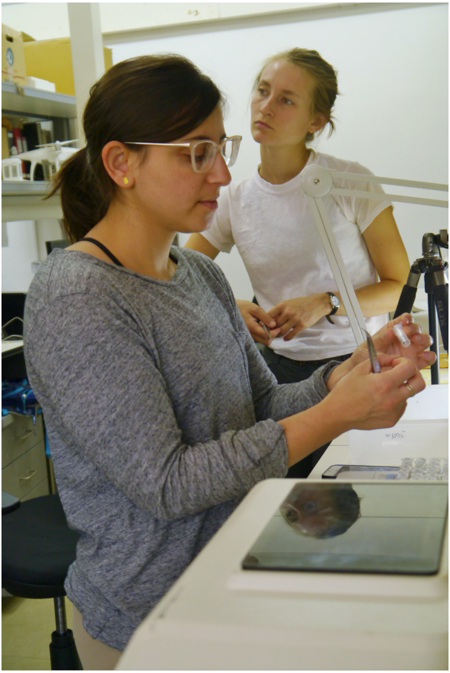
February 2021
January 2021
December 2020
November 2020
October 2020
September 2020
July 2020
June 2020
May 2020
April 2020
March 2020
February 2020
January 2020
December 2019
November 2019
October 2019
September 2019
August 2019
July 2019
June 2019
May 2019
March 2019
February 2019
January 2019
December 2018
November 2018
October 2018
September 2018
August 2018
July 2018
June 2018
May 2018

Messor ebeninus ant workers returning to their nest from foraging

These results suggest extreme high desert temperatures could differentially affect these two *Messor* species and their abilities to forage for seeds. We expect smaller *M. ebeninus* workers to be restricted to foraging at cooler temperatures. Whether the smaller workers only, or the entire foraging force, drop out at higher temperatures remains to be tested (Baudier & O'Donnell 2017). But our results do suggest that temperature effects differ between ant species that share the same habitat and food resource. Species differences in thermal physiology may promote species coexistence.

April 2018
March 2018
February 2018
January 2018
December 2017
November 2017
October 2017
September 2017
August 2017
July 2017
June 2017
May 2017
April 2017
March 2017
February 2017
January 2017
December 2016
November 2016
October 2016
September 2016
August 2016
July 2016
June 2016
May 2016
April 2016
March 2016
February 2016
January 2016
December 2015
November 2015
October 2015
September 2015

PI Sean O'Donnell collecting workers from a nest of the ant Messor arenarius



PhD students Karmi Oxman (l) and Virginia Caponera running thermal tolerance trials on Messor ant workers in Itamar Giladi's lab

References

Baudier KM, D'Amelio CL, Malhotra R, O'Connor MP, O'Donnell S. 2018. Extreme insolation: climatic variation shapes the evolution of thermal tolerance at different scales. American Naturalist 192: 347-359.

Baudier KM, Mudd AE, Erickson SC, O'Donnell S. 2015. Microhabitat and body size effects on heat tolerance: implications for responses to climate change (army ants: Formicidae, Ecitoninae). Journal of Animal Ecology 84: 1322-1330.

Baudier KM, O'Donnell S. 2017. Weak links: How colonies counter the social costs of individual variation in thermal physiology. Current Opinion in Insect Science 22: 85-91.

All images taken by the author.

Share this:

August 2015

June 2015

May 2015

April 2015

January 2015

CATEGORIES

Uncategorized

META

Register

Log in

Entries feed

Comments feed

WordPress.com

Related

Just when you thought it was safe to go back near the water… army ant predation on river turtle nests
July 26, 2021

Why are wee wasps big-headed?
July 4, 2019

Montane ants use their bodies to make warm homes for themselves (and others)
July 1, 2016

Uncategorized

← Interview with a social insect scientist: Robin Southon

Interview with a social insect scientist: Katja Kwaku →

Leave a Reply

Enter your comment here...

Search …

SEARCH

RECENT POSTS

Just when you thought it was safe to go back near the water… army ant predation on river turtle nests

Interview with a Social Insect Scientist: Ajay Kumar Harit

Interview with a Social Insect Scientist: Joe Velenovsky

Interview with a Social Insect Scientist: Inácio Teles e Gomes

Going, going, gone – The remarkable Cerrado biome in Southern Brazil

RECENT COMMENTS

Honey bees can't pra… on Honey Bee Immunity: More Speci…

Lessons learned from… on Interview with a social insect…

Lessons learned from… on Interview with a social insect…

Lessons learned from… on Interview with a social insect…

Lessons learned from… on Science in the time of CO…

ARCHIVES

- July 2021
- April 2021
- March 2021
- February 2021
- January 2021
- December 2020
- November 2020
- October 2020
- September 2020
- July 2020
- June 2020
- May 2020
- April 2020
- March 2020
- February 2020
- January 2020
- December 2019
- November 2019
- October 2019
- September 2019
- August 2019
- July 2019
- June 2019
- May 2019
- March 2019
- February 2019
- January 2019
- December 2018
- November 2018
- October 2018
- September 2018

August 2018

July 2018

June 2018

May 2018

April 2018

March 2018

February 2018

January 2018

December 2017

November 2017

October 2017

September 2017

August 2017

July 2017

June 2017

May 2017

April 2017

March 2017

February 2017

January 2017

December 2016

November 2016

October 2016

September 2016

August 2016

July 2016

June 2016

May 2016

April 2016

March 2016

February 2016

January 2016

December 2015

CATEGORIES

META