Radiotracking Mormon crickets

Gregory A. Sword[1], Patrick D. Lorch[2] & Darryl T. Gwynne[3]

[1]Northern Plains Agricultural Research Laboratory, USDA-ARS, 1500 N. Central Ave., Sidney, MT 59270 USA (gsword@sidney.ars.usda.gov); [2]Department of Biological Sciences, Kent State University, Kent, OH USA 44242; [3]Biology Department, University of Toronto at Mississauga, Mississauga, ON L5L 1C6 Canada

Overview

Insect outbreaks can have devastating effects on natural and agricultural ecosystems. Little is known about the causes of these outbreaks, not to mention the causes of *en masse* migrations during outbreaks. Our work focuses on flightless Mormon crickets (*Anabrus simplex* (Tettigoniidae)), a katydid species that forms large, mobile groups called migratory bands during outbreaks in the western United States.

We utilized radiotelemetry, GPS, and GIS to test hypotheses about the proximate and ultimate mechanisms underlying migratory band formation and movement. Here, we provide a summary of our main findings to date.

Why do migratory bands form?

Migratory bands form because they provide substantial protection from predators.

We performed a replicated mark-recapture experiment in which the survival of individual Mormon crickets within a band was compared with that of individuals removed from the band and transplanted to a site lacking Mormon crickets. Insects removed from the band suffered 50-60% predation over just 2 days (Figure 1).

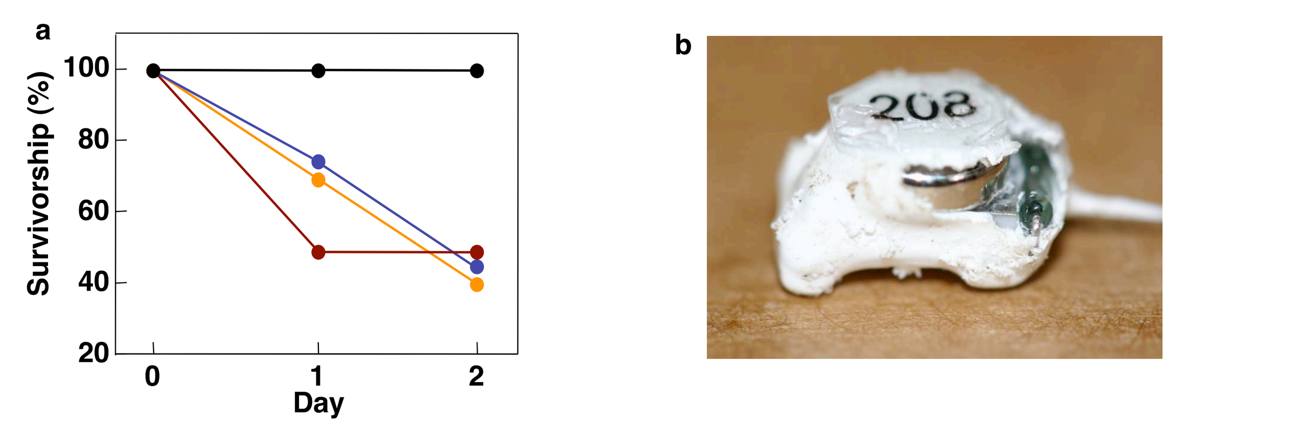


Figure 1. (a) Survivorship of Mormon crickets in a migratory band (black, n=10 all replicates) compared with transplanted conspecifics in three replicate experiments (red (n=10), blue (n=20), and orange (n=20)). (b) Example of recovered radiotransmitter with signs of predation. Radiotransmitters (0.4 g) were often recovered partially chewed as above, in trees, and underground in burrows. Data are from Sword, Lorch & Gwynne (2005).

Movement differs between outbreak and non-outbreak populations.

We compared the daily movement patterns of radiotracked Mormon crickets in migratory band-forming, outbreak populations versus those in non-outbreak populations. Insects in outbreak populations exhibited collective movement patterns and traveled much farther than those in non-outbreak populations. Insects in migratory bands can travel up to 2 km/day while insects in non-outbreak populations often move less than 1 m/day (Figure 2).

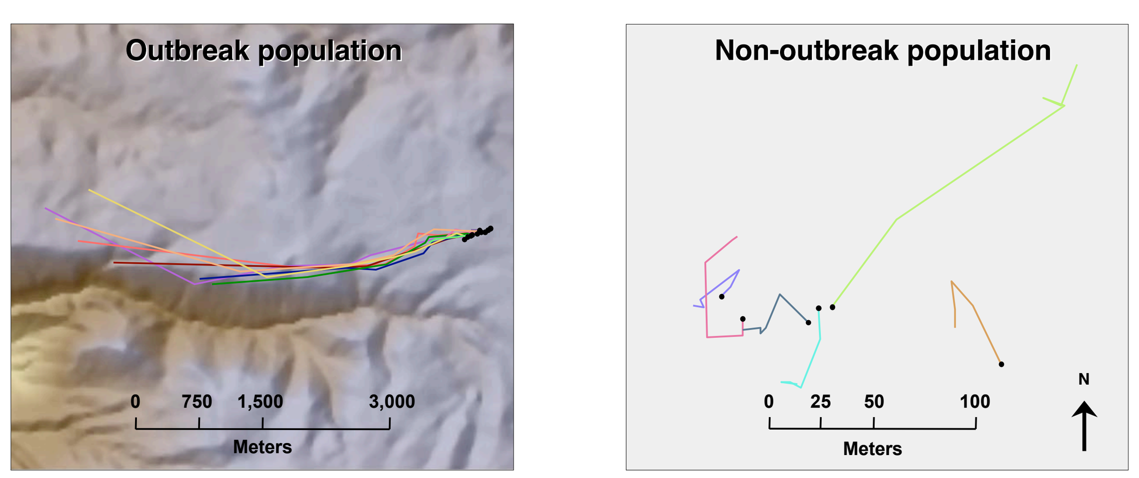
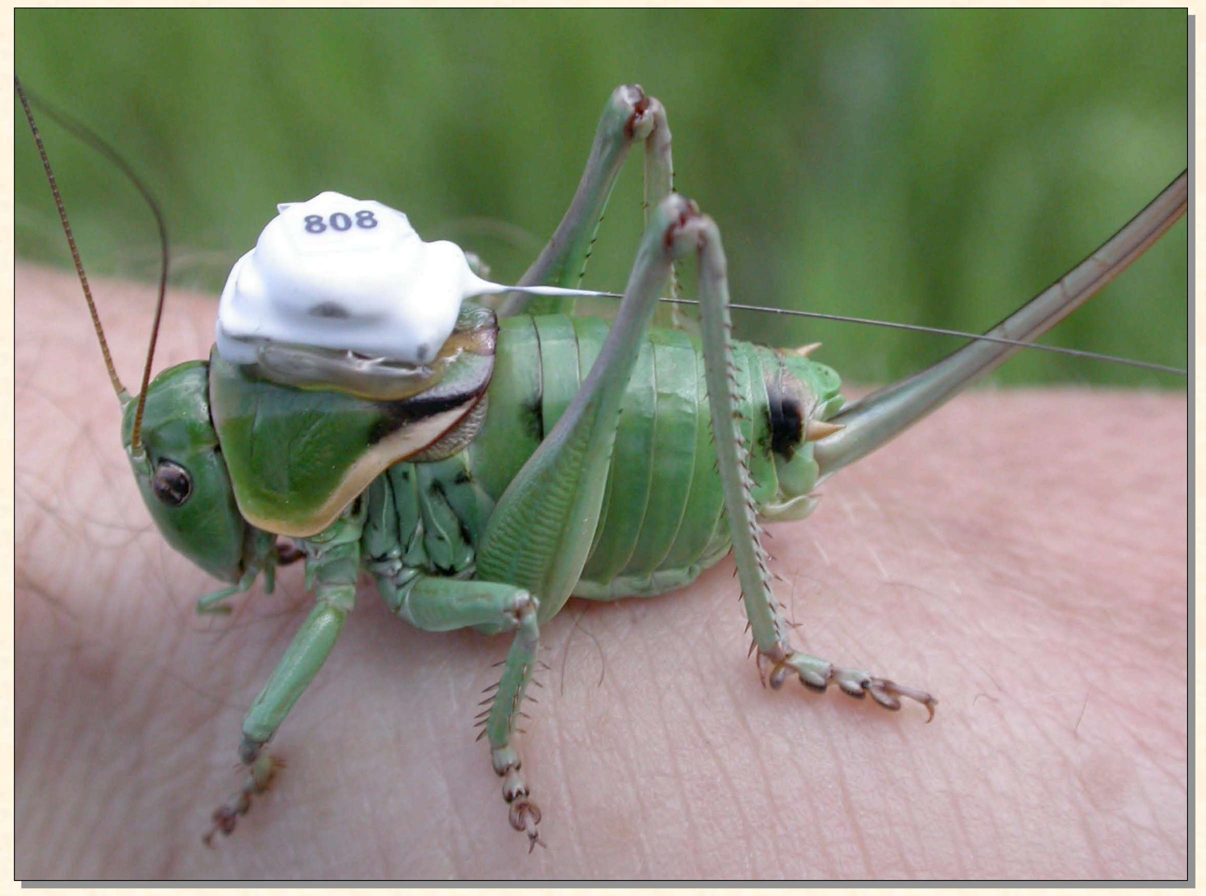


Figure 2. Examples of individual Mormon cricket movement patterns in band-forming outbreak (n=10) and non-outbreak (n=6) populations across five days. Line colors represent different individuals. Each line segment depicts one day of movement. Black dots indicate the initial release points. Data are from Lorch, Sword, Gwynne & Anderson (in press).



Wind direction does not affect band movement direction.

To test for an effect of wind direction on band movement direction, we simultaneously radiotracked insects in bands at three spatially-distinct, but nearby sites. Local weather conditions were monitored at each site and were very similar. Despite the similarity in weather, including wind directions, the three bands exhibited markedly different movement patterns. One traveled west, one east, and the other was observed to bifurcate during the tracking period (Figure 3).

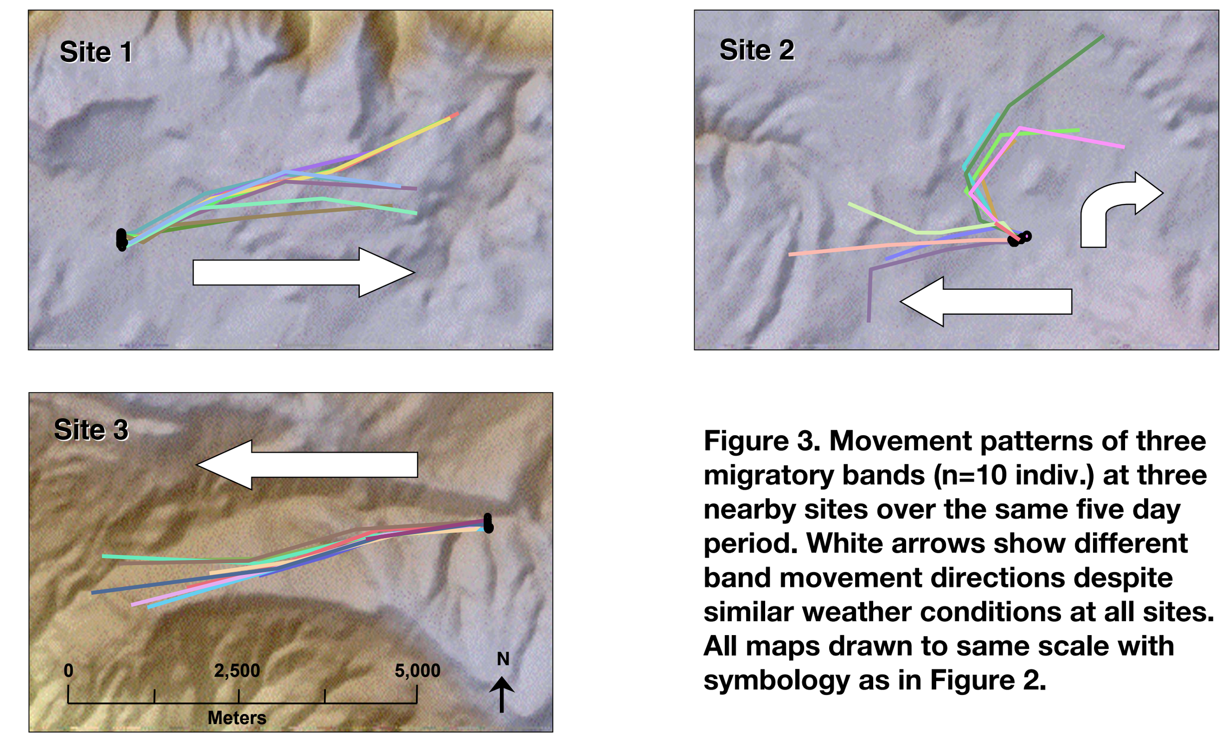


Figure 3. Movement patterns of three migratory bands (n=10 indiv.) at three nearby sites over the same five day period. White arrows show different band movement directions despite similar weather conditions at all sites. All maps drawn to same scale with symbology as in Figure 2.

Social interactions influence band distance and direction.

Mormon cricket movement in the lab is induced simply by short-term, inter-individual interactions (Sword 2005). We were able to test for the effects of social environment on movement in the field using the same experimental design employed in our predation-transplant experiment (see Figure 1). Insects deprived of social interactions by being removed from the band traveled shorter distances and failed to move in a consistent direction (Figure 4).

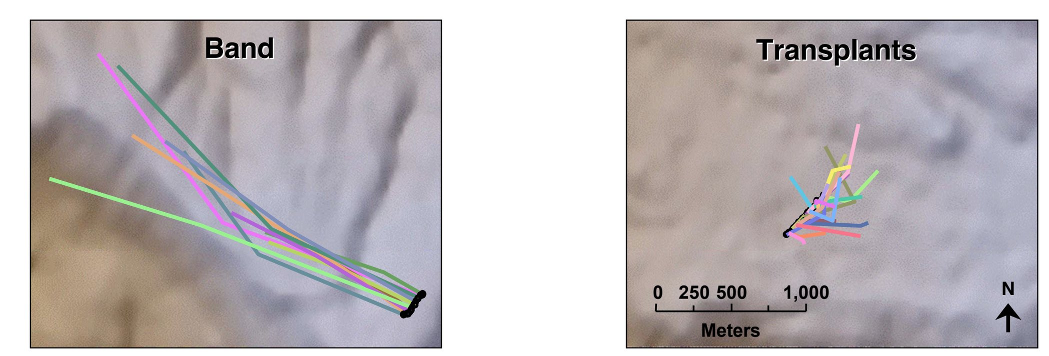


Figure 4. Example of one trial of the social interactions experiment. The movement of insects in a migratory band was compared to that of insects removed from the band and transplanted to a nearby site lacking Mormon crickets (Band, n=10; Transplants, n=20). Maps drawn to same scale with symbology as in Figure 2.

Future directions

Ongoing research focuses on how locally-expressed individual behaviors result in the collective movement patterns of migratory bands at the landscape scale. Our ultimate goal is to develop predictive models of migratory band movement.

Publications

Gwynne, D.T. (2001) *Katydids and Bush-Crickets: Reproductive Behavior and the Evolution of the Tettigoniidae.* Cornell Univ. Press, Ithaca, New York.

Lorch, P.D., Sword, G.A., Gwynne, D.T. & Anderson, G.A. (in press) Radiotelemetry reveals differences in individual movement patterns between outbreak and non-outbreak Mormon cricket populations. *Ecological Entomology*.

Lorch, P.D. & Gwynne, D.T. (2000) Radio-telemetric evidence of migration in the gregarious but not the solitary morph of the Mormon cricket (*Anabrus simplex*: Orthoptera: Tettigoniidae). *Naturwissenschaften* 87:370-372.

Sword, G.A. (2005) Local population density and the activation of movement in migratory band-forming Mormon crickets. *Animal Behaviour* 69:437-444.

Sword, G.A., Lorch, P.D. & Gwynne, D.T. (2005) Migratory bands give crickets protection. *Nature* 433:703.