

Bagnalliella mojave (Thysanoptera: Phlaeothripidae) thrips inhabit small and isolated *Yucca brevifolia* (Agavaceae) host plants

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Bagnalliella mojave Hood (Thysanoptera: Phlaeothripidae) (Hood 1927) is a wing-dimorphic thrips found only on *Yucca brevifolia* Engelm (Liliales: Agavaceae) (Cott 1956). *Yucca brevifolia*, or Joshua tree, is a large, arborescent monocot endemic to the Mojave Desert in the southwestern U.S. The plant produces 1-3 branching, trunk-like stems that terminate in clusters of rigid, semi-succulent, pointed leaves (Webber 1953). *Bagnalliella mojave* lives between young leaves at the center of leaf clusters.

Joshua trees appear to compete for soil moisture, because plant size increases with increasing spacing from other *Yucca* plants (Yeaton et al. 1985). Availability of soil moisture likely affects the water content, growth, and size of plants. *Bagnalliella mojave* may require plants with high water-contents, because it is more abundant on younger *Y. brevifolia* and on more-succulent leaf-clusters on older plants (Cott 1956). I evaluated the dependence of *B. mojave* on host-plant water-content by examining its presence or absence on different sizes of *Y. brevifolia* growing together with *Yucca schidigera* Roezl ex Ortgies.

The study was conducted at the southern end of the Eldorado Mountains, 5.4 km northeast of Searchlight, Clark County, southern Nevada. The area (35°30'N, 114°53'W; elevation 1,140 m asl) contains outcroppings of weathered granite interlaced with washes. *Yucca brevifolia* at the study area have the short growth-form of *Yucca brevifolia* var. *jaegeriana* McKelvey (Fig. 1a). Rainfall at Searchlight averages 196 mm yearly, mostly during Dec-Mar and Jul-Sep (DRI 2014), and totaled 102 mm in 2011, 184 mm in 2012, and 177 mm in 2013 (CCRFC 2014).

I searched for *B. mojave* during 2011-2013 by examining leaf clusters on differently-sized *Y. brevifolia* and recorded the locations of the 12 plants found to be inhabited. The rare aggregations of the thrips were recognized by the relatively large, apparently-black adults and frequently-present, red immatures. Wing morphs of adults, some treated with NaOH, were mounted on slides and identified as *B. mojave* following Cott (1956). I compared mounted females with those at the Entomology Research Museum, University of California, Riverside, and deposited vouchers (nos. 417188-417192). I photographed life stages under incident light and superimposed images at different focal planes with CombineZP (Hadley 2013). Second-instar larvae and brachypterous (Fig. 1f) and macropterous adults were collected from a single leaf-cluster during Jul 2011. First- and second-instar larvae (Fig. 1c,d), one propupa (Fig. 1e), and brachypterous adults were collected from a second leaf-cluster during Oct 2013. Both larval instars and brachypterous adults were collected from a third leaf-cluster during Jan 2014.

Leaf clusters on *Y. brevifolia* likely support multiple generations of *B. mojave*, because leaf clusters on the first plant (Fig. 1a) found to contain *B. mojave* during Jul 2011 still contained thrips during Dec 2013. The single propupa (third instar) that was found in an aggregation of larvae and brachypterous adults suggests *B. mojave* pupates and completes its life cycle within the same leaf-cluster.

Sizes and spacing of *Y. brevifolia* plants inhabited or not inhabited by *B. mojave* were measured during 2013-2014. Each recorded plant was relocated, and the continued presence of the thrips on at least 1 leaf-cluster was verified with a hand lens. Plant size was measured by counting the number of leaf clusters. Plant spacing was measured as the distance from the inhabited plant to the nearest *Y. schidigera* and *Y. brevifolia* in 4 quarters (compass bearings N-E, E-S, S-W, W-N; point-centered quarter method, Greig-Smith 1964). The four, nearest *Y. brevifolia* were sampled for *B. mojave* by examining all leaf clusters that contained young leaves at or below eye-level (34 plants). Plants with all leaf-clusters above eye-level (14 plants) were not sampled. At each of the nearest *Y. brevifolia* sampled for thrips, I similarly counted the number of leaf clusters and measured the distances to the nearest *Yucca* plants. *Bagnalliella mojave* were found on 2 of the nearest *Y. brevifolia*, producing 14 plants inhabited by *B. mojave* and 32 plants not inhabited by *B. mojave*.

Plant size was regressed (Systat version 10.2, Chicago, Illinois) against 4 measurements of plant spacing: (1) the mean distance (across the 4 quarters) to *Y. brevifolia*, (2) the mean distance to *Y. schidigera*, (3) the mean distance to the nearest *Y. brevifolia* or *Y. schidigera* in each quarter, and (4) the mean distance to *Y. brevifolia* and *Y. schidigera* within and across quarters. Numbers of leaf clusters were transformed $\log(N)$, and distances between plants were transformed $\log(m)$, to normalize residuals. Plant size was most related, positively, to mean distance to the nearest *Yucca* of either species in each quarter ($F = 11.6$; $df = 1,44$; $P < 0.001$; $R^2 = 0.21$; Fig. 2).

Mean distance to the nearest *Yucca* did not differ ($t = 0.73$; $df = 44$; $P = 0.47$) between plants inhabited (6.1 m, back-transformed) or not inhabited (6.6 m) by *B. mojave* (Fig. 2). Adding thrips presence or absence as an indicator variable to the regression of plant size against plant spacing significantly decreased the error variance ($F = 70.3$; $df = 1,43$; $P < 0.001$; partial $R^2 = 0.53$; Fig. 2). The 14 inhabited plants supported 2-16 leaf clusters (back-transformed mean = 5.8 clusters), and the 32 uninhabited plants supported 8-146 leaf clusters (33 clusters). Eleven plants, 6 with thrips and 5 without thrips, overlapped with 8-16 leaf clusters.

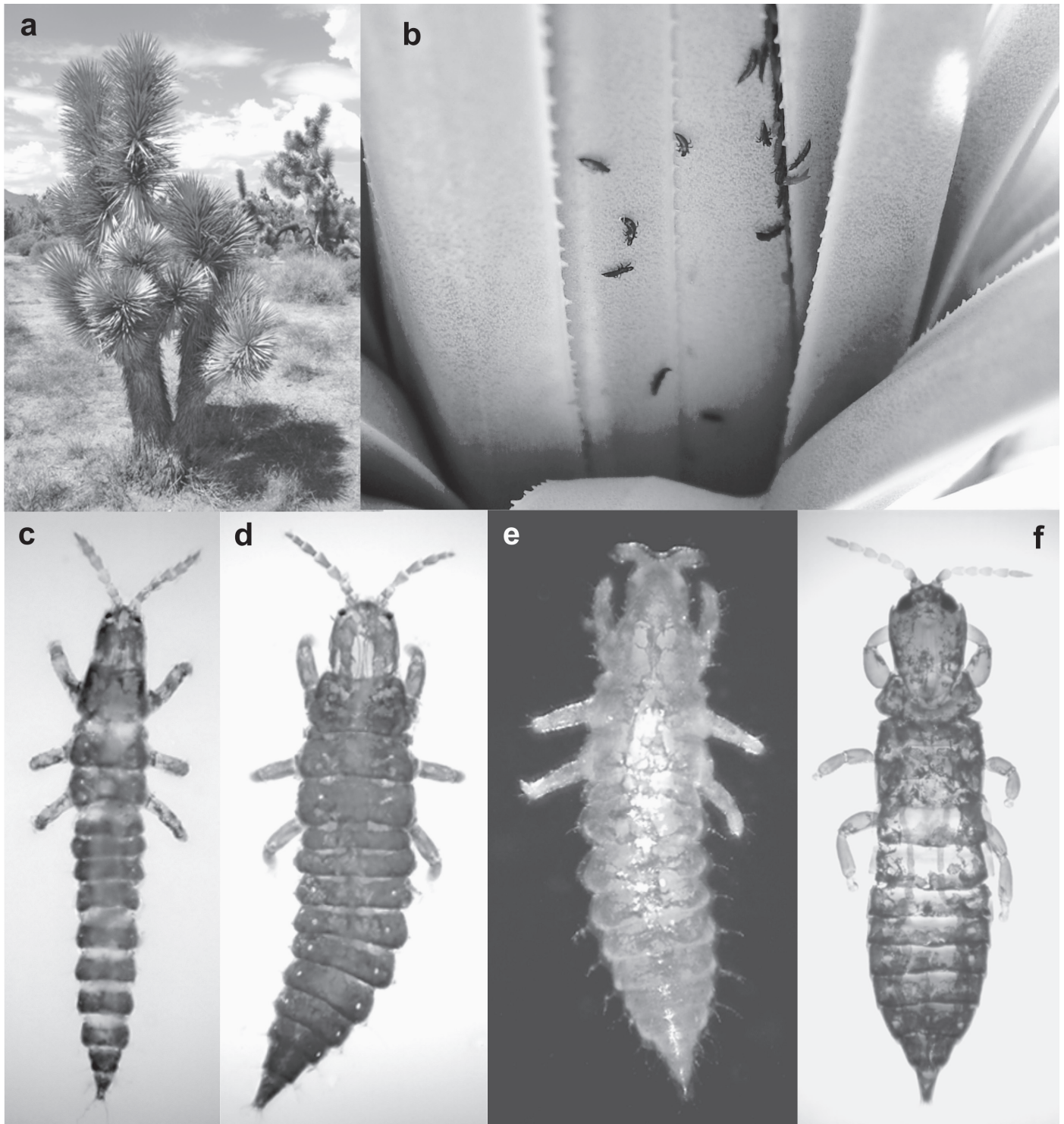


Fig. 1. a. *Yucca brevifolia* supporting 13 leaf clusters and inhabited by *Bagnalliella mojavae*. b. *B. mojavae* adults and immatures on bases of young leaves at center of leaf cluster. c-f. Dorsal aspect of life stages illuminated from above: c, First-instar larva; d, Second-instar larva; e, Third instar (propupa); f, Brachypterous female mounted in euparal on slide.

Yucca brevifolia plants inhabited by *B. mojavae* are smaller than expected based on their spacing from other *Yucca* plants and likely compete less for soil moisture. This agrees with Cott's (1956) observation that the thrips occurs mostly on younger plants. Absence of *B. mojavae*

in more-succulent leaf-clusters on older, larger plants, as described by Cott (1956), may have been due to lower than average rainfall. *Bagnalliella mojavae* appears to be a rare phytophagous thrips mostly limited to small, isolated Joshua trees with high leaf water-contents.

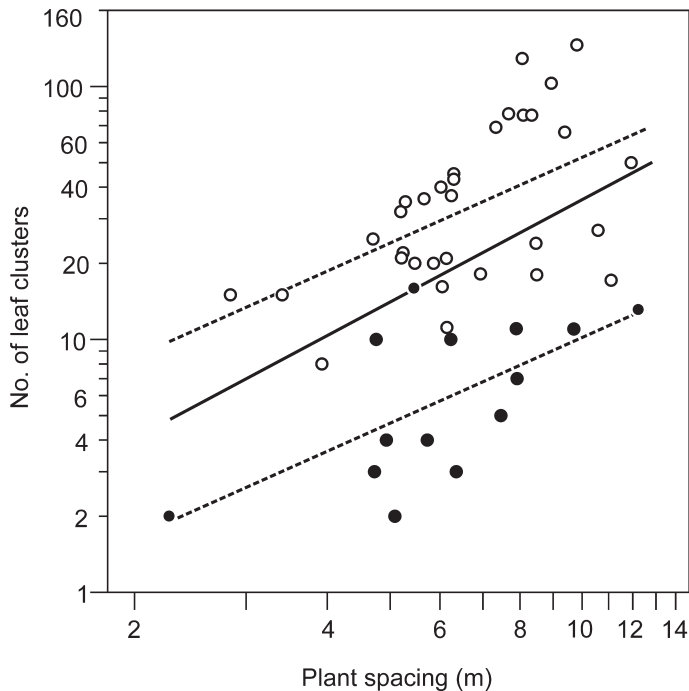


Fig. 2. Number of leaf clusters on *Yucca brevifolia* vs. mean distance from plant to nearest *Yucca schidigera* or *Y. brevifolia* in 4 quarters. *Yucca brevifolia* plants are inhabited (closed circles) or uninhabited (open circles) by *Bagnalliella mojavae*. Axes are log scales. Solid line is Y regressed on X . Dashed lines are the same regression with thrips presence or absence added as an indicator variable.

Summary

I found *Bagnalliella mojavae* Hood (Thysanoptera: Phlaeothripidae) restricted to small, isolated *Yucca brevifolia* Engelm (Liliales: Aga-

vaceae) that likely compete less for soil moisture and have high leaf water-contents.

Key Words: Joshua tree, leaf water-contents, Mojave Desert, wing-dimorphic thrips

Sumario

Se encontro el trips *Bagnalliella mojavae* Hood (Thysanoptera: Phlaeothripidae) limitado a plantas pequeñas y aisladas de *Yucca brevifolia* Engelm (Liliales: Agavaceae) que probablemente compiten menos por la humedad del suelo y tienen un alto contenido de agua en las hojas.

Palabras Clave: árbol de Joshua, contenido de agua foliar, desierto de Mojave, trips de ala dimorfica

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