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Additions to the natural history of *Gammarotettix bilobatus* (Orthoptera: Rhaphidophoridae)

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Abstract

The arboreal camel cricket, *Gammarotettix bilobatus* Thomas, is abundant and widespread in California. It emerges in mid to late February, survives into late May and early June, and utilizes 8 host-plant species (coast live oak, barberry, Christmas berry, California lilac, California buckeye, Monterey pine, black locust, and California bay), some of which are toxic. It appears that *G. bilobatus* switches host plants intraseasonally and possibly acts as an inadvertent pollinator of some of its host plants.

Key words

California, *Gammarotettix*, Rhaphidophoridae, host plant

Introduction

Gammarotettix is a genus of 6 species of arboreal camel crickets distributed through California into southern Oregon (Rehn 1941), with one record from Arizona (Rehn 1940). Its distribution parallels that of the grasshopper *Morsea* (Rehn 1940). Though the species of *Gammarotettix* have been relatively well described, little information is available concerning their host plants, habits, and biology. Information about the most widespread species, *Gammarotettix bilobatus*, is anecdotal and appears to have been perpetuated almost solely through the citation of earlier work or unpublished data. My observations of *G. bilobatus* over a few years adds greatly to the natural history of this species.

Seasonal Occurrence

G. bilobatus has only been reported as occurring in the spring (Helfer 1987). The earliest specimens of *G. bilobatus* that I have observed were seen on 27 February (early instars), and the latest on 23 May. This species likely hatches in mid to late February, possibly into early March, and probably survives as adults into early June. *G. bilobatus* becomes adult in early April (earliest adult 4 April). There is heterogeneity in the hatching times of *G. bilobatus* that probably is related to the heterogeneity in plant growth in late winter and early spring. It appears likely that the cricket's emergence from eggs is related more to the opening of leaf buds and inflorescences (*i.e.*, the host plants themselves) than to temperature changes or a decrease in rainfall. It is still unknown when and where eggs are laid. However, eggs likely are laid above ground, in or upon local trees.

Host Plants and Usage

Previously *Ceanothus cuneatus* (California lilac) (Helfer 1987), *Quercus agrifolia* (coast live oak) (Kleintjes & Dahlsten 1994), and *Pinus radiata* (Monterey pine) (Kleintjes & Dahlsten 1994), have been the only host plants reported for *G. bilobatus*. I have collected *G. bilobatus* in northern California (Table 1) on *Quercus agrifolia* (coast live oak), *Aeusculus californicus* (California buckeye), *Heteromeles arbutifolia* (Christmas berry), *Umbellularia californica* (California bay), *Robinia pseudoacacia* (black locust), and *Mahonia* = *Berberis* sp. (barberry). Three of these host plants (black locust, California bay, and California buckeye) are considered toxic (Hickman 1993). *Gammarotettix aesculus* also has been recorded on buckeye (Helfer 1987), and *Gammarotettix genitalis* has been reported on *Quercus agrifolia* and *Rhus laurina* (Rentz & Weissman 1981). Host plants for the other species of *Gammarotettix* have not been reported.

Shortly after emergence from eggs, early instar individuals were collected from the inflorescences of California bay. They are relatively common on this host. I have observed individuals crawling over the flowers and eating parts of the bay flowers. *G. bilobatus* may specialize on pollen, though it need not discriminate while feeding and may include detritus and insect parts in its diet. It is likely that since *G. bilobatus* occupies inflorescences, it serves as an inadvertent pollinator of California bay.

As the bay inflorescences dry up, individuals are no longer found on the bay trees. While bay trees are in bloom, California buckeye leaves are beginning to unfurl from large buds. Early instar individuals commonly are found inside the base of these recently opened buckeye buds. Multiple individuals can occupy the same newly opened bud. Individuals appear to use these roosts for at least several hours, since large numbers of fecal pellets (presumably accumulated over the time spent in the roost) are generally associated with hiding individuals.

G. bilobatus appears to use California buckeye through the spring. Late in spring (especially April and May), they are commonly found at the bases of buckeye leaf blades. In particular, they are found on leaves that are partially folded and around where the leaf clusters (the petioles) meet the bark of the branches. I often found them in groups of 3 to 7 individuals per leaf cluster on buckeye. These clusters of individuals tended to be all, or nearly all, of one sex. Gregarious behavior also has been indicated for *G. genitalis* (Rentz & Weissman 1981).

G. bilobatus does not appear to be as common on *Heteromeles* and *Berberis* as it is on *Aeusculus*. Most of the host plants are in bloom, about to bloom, or have recently bloomed when *G. bilobatus* occurs

Table 1. Observed *G. bilobatus* host plants by California county.

	Alameda	Colusa	Contra Costa	Napa	Stanislaus	Yolo	Published
Aeusculus	X		X				
Ceanothus							X
Heteromeles			X				
Pinus							X
Quercus	X	X	X		X	X	X
Mahonia			X				
Robinia				X			
Umbellularia	X		X				

on them. Therefore, it seems possible that *G. bilobatus* may serve as an inadvertent pollinator on many, if not all its host plants.

Host plant usage by *G. bilobatus* appears to vary temporally and possibly geographically. In the San Francisco Bay area, the earliest host plants utilized appear to be California bay and California buckeye. By April, it seems that California bay (for the most part) is no longer used. In the later part of the season (as the adult instar), they begin to use oak, Christmas berry, barberry, and continue use of buckeye. There is apparently host plant switching over a given season at a particular locality and over their geographic range. However, to the North of San Francisco Bay, I have so far only found *G. bilobatus* on *Q. agrifolia*,with the exception of a specimen collected on black locust in Napa County.

Other host plants recorded in the bay area occur to the North. While north of the bay California buckeye may be closely associated with oak trees, with trees adjacent to each other and within meters of each other, I have yet to find *G. bilobatus* on non-oak trees north of the bay at any time of year. At one locality, numerous individuals were collected from an oak (with only a few green leaves) about 4 m from a healthy, fully vegetated buckeye with no *Gammarotettix*.

There also appear to be long-term fluctuations in the populations of *G. bilobatus*. While individuals were collected in Colusa and Yolo Counties in 1998 and 2000, sometimes at the same localities and even in the same trees, not a single individual was located in these counties in 1999, despite several collecting trips to the area. However, this variation may relate more to the *el niño/la niña* climatic cycle during those years than any normal interannual fluctuation.

Habits

The number of individuals on each host plant varies widely. I have collected a single male from a 2-m tall California bay tree, alone on a grassy hillside, and observed more than 100 individuals on a single California buckeye tree in a group of trees (with a large number of individuals on adjacent trees). Individuals are difficult to locate visually on host plants. Even when not apparent on a particular plant, they are frequently present, and most easily caught, by beating over a sheet or open ground. In addition, 3 females were collected together from under a piece of bark on a standing dead oak tree (Stanislaus County). When beaten out of a host plant, individuals often remain still and can be caught by hand. Their coloration makes them difficult to find when they drop to open ground. Individuals vary greatly in color from having significant portions of whitish gray to being combinations of green and/or tan. Body color might vary substantially within single individuals over time, but this needs study.

Often individuals are inactive when located on a host plant. When disturbed on the host plant, they readily jump to the ground. Very little disturbance is necessary to elicit this response, which is likely an escape response to avian predation, especially from *Poecile rufescens* (chestnut-backed chickadees) (Klientjes & Dahlsten 1994). Sometimes individuals jump wildly once on the ground, but this is not common. The potential ingestion of toxic chemicals from some host plants included in the cricket's diet (see above) may serve to aid in deterring predators, as it does in other orthopterans (Sword 1999). In addition, it is likely that *G. bilobatus* is active at night like other gryllacridids, thus reducing potential interactions with visual predators.

G. bilobatus may spin silk "cocoons" in the leaves of their host plants. However, I have observed the occurrence of silk spinning only once in an individual that did so after it was collected in the field. This is not an unlikely habit, since other gryllacridids commonly spin silk (Lockwood & Rentz 1996).

Distribution

G. bilobatus may range from Southern Oregon, south to somewhere north of Los Angeles (Rehn 1940, 1941). Its distribution has been listed solely as California by some (Caudell 1916, Helfer 1987), and Essig (1958) reported *G. bilobatus* on the North and Central coast range of California, the Sierra Nevada foothills, and possibly in adjacent southern Oregon. Detailed distribution data have not been presented previously. It remains unknown if *G. bilobatus* is allopatric or partially sympatric with *G. bovis* in the San Francisco Bay area (they occur within at least 30 km of each other) and *G. genitalis* in the Los Angeles area. The southern-most record of *G. bilobatus* is a specimen from Gilroy, Santa Clara County, housed in the United States National Museum. *G. bilobatus* appears to be restricted to the coast ranges from about sea level to over 500 m in elevation. I have not found evidence of *G. bilobatus* in the Sierra Nevada foothills. Their presence there would likely make them sympatric with one of the other species of *Gammarotettix*.

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