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Evolution of acoustic behavior and diversification within the Jerusalem crickets (Orthoptera Stenopelmatidae)

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Jerusalem crickets (Orthoptera Stenopelmatidae) are one of the most conspicuous and awe inspiring insect families found throughout western North and Central America. Stenopelmatids are reportedly the insects most often brought to entomologists for identification. Despite this public notoriety, they have received surprisingly little taxonomic attention. For example, in the genus *Stenopelmatus*, only 16 species have been described from North America. Recent work on the acoustic mating calls (produced by abdominal drumming) has revealed substantial cryptic diversity within *Stenopelmatus*, with as many as 70-80 morphological-song species determined to date. Here we examine the evolutionary pattern of acoustic signaling within the context of a molecular phylogeny for the North American stenopelmatids. Over the past 30 years, live specimens were collected from throughout North and Central America. Individuals were raised to adulthood, their calling songs were recorded and karyotypes were determined from male specimens. DNA was extracted from 112 recorded individuals representing 66 song species in the genera *Stenopelmatus* and *Ammopelmatus* and from 2 individuals from the genus *Stenopelmatopterus* (collected from Central America) which were used as an outgroup. Approximately 1200 bases of the mitochondrial DNA Cytochrome Oxidase I (CO I) gene was amplified from each. A molecular phylogeny was generated using maximum likelihood and Bayesian search methods. Mating song characteristics were then mapped onto the resulting phylogenic hypothesis. Each song species for which multiple haplotypes were amplified forms a highly supported monophyletic clade. Moreover, the mtDNA phylogeny is highly concordant with major song characteristics and geographic regions. Species producing single drums group in a well supported monophyletic clade as do those producing a trilled drum in northern California and those with a sexually dimorphic drum found in southern California and northern Baja California. A male karyotype of 2N=25 is most common, and based on a CO I phylogeny, we find at least 5 independent fusion events leading to loss of chromosomes (2N=23, 2N=19) and potentially 1 fission event (2N=19 to 2N=21) scattered throughout the gene tree. Representatives of *Ammopelmatus*, a genus described as sand dune specialists, do not appear to form a monophyletic group and are instead scattered within the single drum clade of *Stenopelmatus*. Finally, a specimen representing a new species collected from Nuevo Leon, Mexico, falls outside and basal to *Stenopelmatus*. Although this species does not have wings (as in *Stenopelmatopterus*), it exhibits behavior found in other members of the latter genus and unknown in any *Stenopelmatus* species. Overall, our results suggest that both shifts in calling song and geographic barriers have had an important role in the diversification of this group.