Description and photographs of cricket parental care in the wild

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Academic editor: Kevin Judge | Received 14 March 2020 | Accepted 12 June 2020 | Published 23 March 2021

http://zoobank.org/C99D80AF-2002-464F-B990-17BC9ED30C32

Citation: McNeil DJ, Erregger B (2021) Description and photographs of cricket parental care in the wild. Journal of Orthoptera Research 30(1): 27–30. https://doi.org/10.3897/jor.30.52079

Abstract

Although certain forms of parental care are relatively widespread phenomena among insects, within Orthoptera, parental care is rare. Short-tailed burrowing crickets (*Anurogryllus* spp.) are among the few members of this order for which extensive parental care has been documented. However, accounts of parental care in *Anurogryllus* have been largely under laboratory conditions, and observations of this behavior in the wild are rare. Herein we present photographic observations from a mountain slope in Honduras where we discovered an active *Anurogryllus* brood chamber where an adult female was tending her brood. We present these results in the context of parental care in insects and compare our observations with those reported in past literature published on *Anurogryllus* crickets' parental behavior.

Keywords

behavior, eggs, Honduras, nymphs, Orthoptera, short-tailed cricket

Introduction

Parental care, though widespread and important across many vertebrate taxa (Balshine 2012), is broadly rare among invertebrates (Trumbo 2012). In insects, parental care has evolved independently several times (e.g., in Hymenoptera, Coleoptera, Blattodea, Dermaptera) but is thought to be largely absent from other insect orders. In Orthoptera, parental investment takes one of two main forms: pre-mating and post-mating (Gwynne 1983). Pre-mating parental investment is common in Orthoptera (especially Ensifera; Gwynne 1983) whereby males provide their mates with a nutrient-rich spermatophylax, which is an appendage of spermatophores often containing a high proportion of protein. Post-mating parental investment (i.e., parental care), on the other hand, is much less common in Orthoptera and varies from digging burrows to protect nymphs from predators (e.g., Gryllotalpidae, Phaneropterinae: Gwynne 1983) to the protection of eggs (e.g., *Neotridactylus apicialis* (Say, 1825): Gwynne 1983) to maternal care for their young (e.g., *Anurogryllus muticus* (De Geer, 1773): West and Alexander 1963, Lee and Loher 1995; *Hemiandrus* spp.: Gwynne 2004). Despite being uncommon in Orthoptera, post-mating parental care occurs more commonly in a variety of related insect orders as a means to maximize juvenile survival (e.g., Blattodea: Nalepa 1988; Dermaptera: Kölliker 2007). For example, the wood roach *Cryptocercus punctulatus* Scudder, 1862 provides biparental care to nymphs for as long as three years (Nalepa 1988).

Among Orthoptera, crickets in the genus *Anurogryllus* Saussure, 1877 provide exceptional parental care to their young, with care frequently lasting for several weeks (West and Alexander 1963, Weaver and Sommers 1969). As first detailed by West and Alexander (1963) and Weaver and Sommers (1969), *Anurogryllus muticus* females extensively clean their eggs, provision nymphs with forage collected outside the burrow and trophic eggs, and vigorously defend young from males and other intruders to their burrow (West and Alexander 1963). Although parental care in *Anurogryllus* spp. is well described in captivity, few accounts of parental care in this unique orthopteran genus exist from the wild, and no published photographs exist of natural *Anurogryllus* brood chambers where this rare example of orthopteran parental care is known to occur. This is an important gap in the literature as species behaviors in the wild may differ drastically from those observed in captivity (Alvarez and Nicieza 2003, Tenger-Trolander et al. 2019). For the first time herein, we provide photographs of the natural brood chamber of an *Anurogryllus* cricket observed in a mountain rain forest in northern Honduras.

Materials and methods

Our observations were made on 1 February 2017 at Rio Santiago Nature Reserve in San Francisco, Atlántida, Honduras (15.592223°N, -87.062514°E; 150 m) at 20:55 (Fig. 1). This region is heavily forested and dominated by contiguous broadleaf

evergreen forest. On the evening when our observations were made, the temperature was approximately 19 °C and the sky was overcast with light rain. Our observation occurred during a reptile/amphibian survey through the nature reserve during which we rolled stones and other objects to document resident wildlife. During this survey, we rolled a small stone with dimensions approximately 7.5 × 13 cm. This stone, which was sitting atop the soil within the forest path, was covering the brood chamber of an *Anurogryllus* cricket (Fig. 1). Female *Anurogryllus* are readily identified by their habitus in general (e.g., wing structure), but especially by their greatly reduced ovipositor, consistent with their common name: the short-tailed cricket (Weaver and Sommers 1969). They are also the only known Gryllids that exhibit parental care of nymphs (West and Alexander 1963, Weaver and Sommers 1969), making brooding females very easy to identify. With that in mind, and because detailed descriptions of *Anurogryllus* species present in Honduras are lacking, we did not attempt to identify the crickets observed at species level. Four photographs were taken to document the observation. The record was also posted to the citizen science platform iNaturalist (https://www.inaturalist.org/observations/5089680).

Results

The main brood chamber was ~57 mm long by ~23 mm wide (Fig. 2) and included a single entrance (~31 mm in length) facing west that allowed travel between the burrow and the soil surface. This brood chamber contained 1) an adult female *Anurogryllus* cricket, 2) three *Anurogryllus* nymphs (first instar), and 3) three *Anurogryllus* eggs. We did not observe *Anurogryllus* nymphs attached to the underside of the rock and thus believe this was the complete brood (three nymphs, three eggs). During our brief encounter with these crickets, including photographing them from several angles, the female was reluctant to expose the nymphs and made no attempt to abandon the brood. After documenting the event, the stone was carefully replaced, and the crickets were not harmed.

Discussion

Parental care is common in some insect orders (e.g., Hymenoptera) but remarkably rare in others (e.g., Orthoptera: Trumbo 2012). Among the best documented cases of extensive orthopteran maternal care are the ground wētā (*Hemiandrus* spp.) and crickets in the genus *Anurogryllus* (West and Alexander 1963, Smith et al. 2013). We believe our observations constitute the first published photographs of an opened, active *Anurogryllus* cricket brood chamber in the wild. Although *Anurogryllus* crickets are known to become highly abundant in some areas (West and Alexander 1963), nearly all published studies of their breeding behavior have been restricted to captive conditions. This is surprising given that the natural history and ecology of *Anurogryllus* crickets has been studied for over a half century and the species is widespread across many states and countries (West and Alexander 1963, Erregger and Schmidt 2018). Although we expect broad reproductive behaviors to remain largely consistent between captivity and the wild, insect behavior can be impacted by captive conditions in profound ways (Tenger-Trolander et al. 2019), underscoring the importance of such natural history observations.

In many regards, the *Anurogryllus* sp. brood chamber observation was similar to those reported in the literature for *A. muticus*. For example, West and Alexander (1963) observed female *A. muticus* to construct a brood chamber several centimeters deep into loose soil, linked to the surface by a single connecting channel, though these observations all occurred within a captive environment where burrowing depth was constrained. In contrast, Weaver and Sommers (1969) created plastic casts of *A. muticus* burrows in the wild and found them to be multi-chambered and as deep

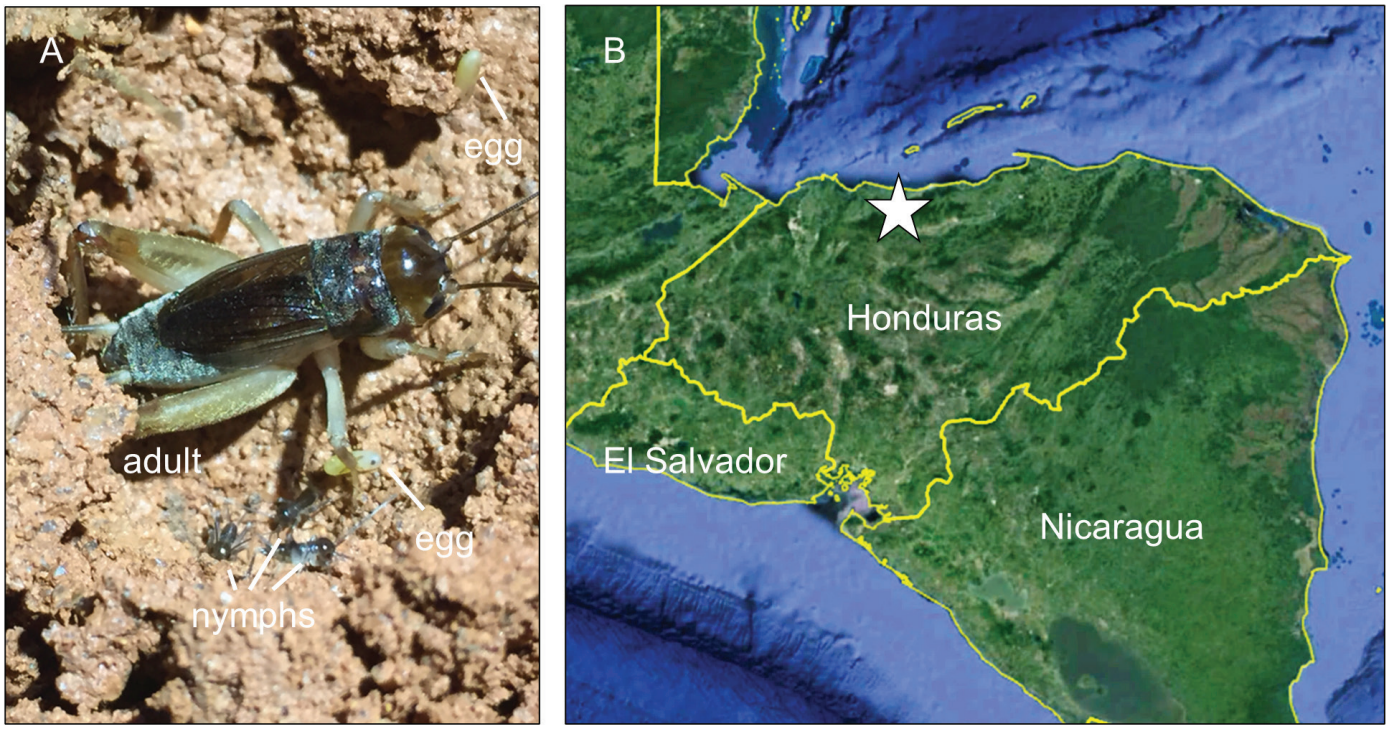

Fig. 1. A. Female *Anurogryllus* cricket with eggs and nymphs observed in northern Honduras; **B.** Map of northern Honduras; star represents observation location.

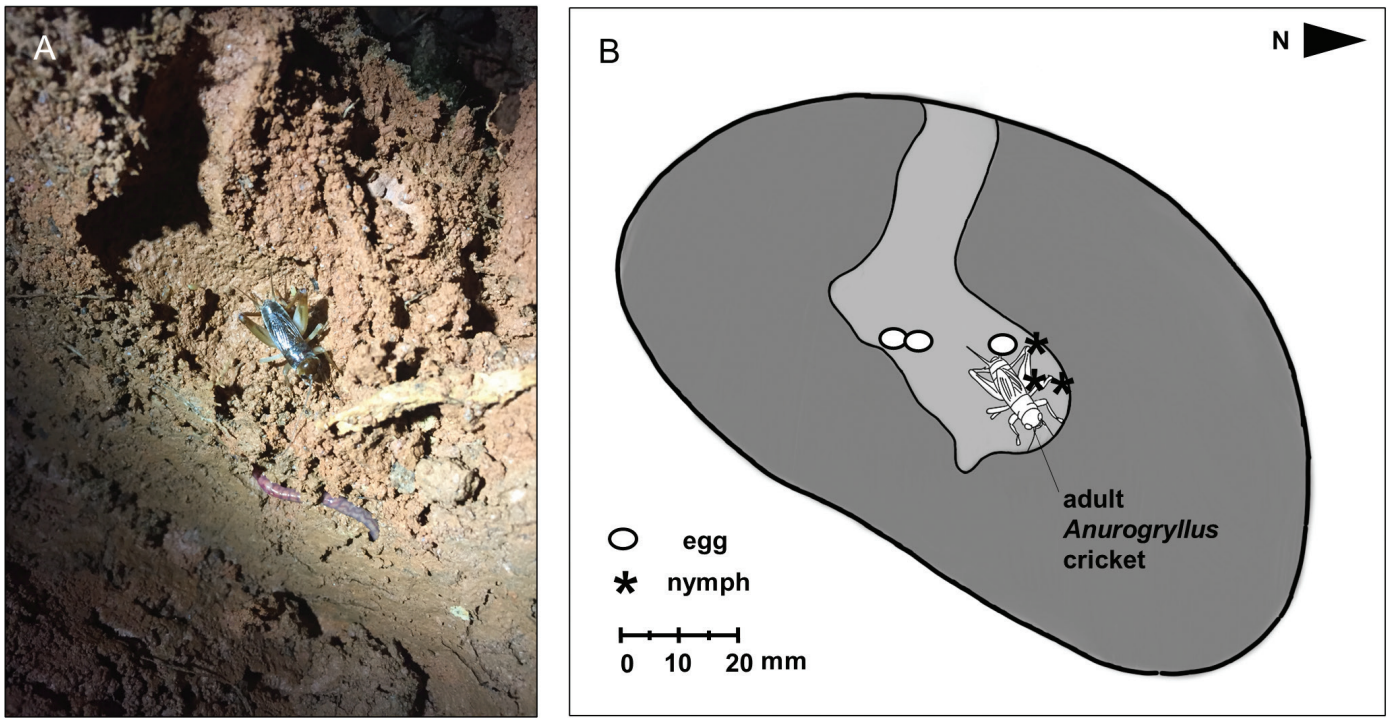

Fig. 2. A. Photo of a female *Anurogryllus* cricket in a brood chamber beneath a stone on a forest path in Honduras; **B.** Drawing simplifying the structure of the brood chamber (scale bar approximated from cricket body size. The brood chamber, shown in light gray, was beneath the footprint of a small stone that was largely in direct contact with the soil (dark gray). The chamber contained an adult female *Anurogryllus* cricket as well as three eggs (open circles) and three first-instar nymphs (asterisks). Map data 2019 (c) Google.

as 50 cm into the soil. In this way, the burrow we observed at Rio Santiago was more similar to those reported by West and Alexander (1963) from the lab than those by Weaver and Sommers (1969) in Louisiana, US. Although we did not measure the burrow's depth at Rio Santiago, we can safely conclude that it was <5 cm deep and contained only an "upper chamber" (*sensu* Weaver and Sommers 1969) with no lower chambers (Fig. 2). Our observation that eggs and nymphs co-occuring is also consistent with past literature suggesting that adults lay eggs successionally (i.e., each individually over the course of several days), sometimes even with nymphs in their burrows (Lee and Loher 1995, Erregger personal observation).

The *Anurogryllus* from Honduras was unique from those previously reported for *Anurogryllus* in several ways: the Rio Santiago brood chamber contained far fewer nymphs (n = 3) and eggs (n = 3; Fig. 2) than those reported by others (up to 129 eggs or 89 nymphs/burrow; Weaver and Sommers 1969). One possible explanation for fewer nymphs and eggs (as compared to previous reports by e.g., Weaver and Sommers 1969) might be the habitat context of the brood chamber. *Anurogryllus* cricket burrows are best known from grassland habitats (Erregger, personal observation), whereas the burrow described here was deep within a closed-canopy forest. Although *Anurogryllus* crickets are foraging generalists, 'typical' food sources (e.g., seeds, flowers, leaves) may have been limited within the forest, thus limiting reproductive output. This observation is potentially supported by our idea of no vegetative provisions within the burrow (Fig. 2). Indeed, *A. muticus* are known to conspicuously provision their young nymphs with vegetation gathered outside the burrow when food is abundant. Vegetational structures are also used to insulate the chamber from intruders during the day and when the female leaves the burrow (Erregger, personal observation from Panama). Thus, other factors, such as predation pressure, also have an impact on their survival rate (Erregger and Schmidt 2018). Furthermore, the geographic location (i.e., elevation level) and the soil characteristics (e.g., for digging) might be restricting factors, reducing survival success. The differences we report here for an *Anurogryllus* brood chamber in the wild as compared to those studied in captivity highlight the importance of wild observation, as natural conditions and ecological context clearly drive at least some variation in life history for short-tailed crickets.

Our observations of an *Anurogryllus* brood chamber provide interesting insights into the parental care behaviors present within Orthoptera. Although some aspects of *Anurogryllus* breeding behavior were confirmed in the wild by our record, others (e.g., brood size, provisioning behavior, etc.) appear to vary among regions, species, and/or study context (e.g., lab vs. field). Given this, several important limitations of our observation should be kept in mind. First, the brood chamber we observed represents a single observation; how typical any components of this observation are in the broader context of the life history of *Anurogryllus* would require a much more thorough examination. Moreover, the species identity of the *Anurogryllus* brood we observed here remains unknown—species-specific life history differences may explain some of the differences we report here as compared to laboratory observations. Still, the different life history pattern we observed in Honduras in contrast to those observed in the lab highlights the need to assess species behavior across multiple contexts, including both in a lab setting and the wild.

Acknowledgements

We are grateful to L. Symes (Cornell Lab of Ornithology) for helpful edits on early drafts of this manuscript. We appreciate the field support in Honduras from M. L. Kazour (Utica College) and

R. E. Bennett (Cornell University). Our manuscript was substantially improved by the comments of K. Judge and one anonymous reviewer. We also thank the Cornell Lab of Ornithology and the Ivy Fellowship for supporting our expedition to Honduras during which these observations were serendipitously made.

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