Calling Crickets (*Anurogryllus arboreus*) over Pitfalls: Females, Males, and Predators[1]

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ABSTRACT

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Males of *Anurogryllus arboreus* Walker call in season for ca. an hour each warm evening, generally from perches 0.1–2 m up. Animals attracted to the calls were studied in 1977 and 1978 by installing pitfall traps in the midst of a population of *A. arboreus*. Above each pitfall was a cage containing (1) a normal male, (2) a muted male, or (3) nothing. Caged normal males called no less than free males. In 1978, but not in 1977, competing free males (n = 169) were removed from the vicinity of the pitfalls. In 1977, 3 females were caught beneath normal males (0.029 females/normal-male-night). In 1978, 2 were caught (0.014 females/normal-male-night). No females were caught beneath muted males or empty cages. Other animals showed no significant bias as to which pitfalls they fell into. For example, of the 50 wolf spiders caught during the calling period, 15 were beneath normal males; all spadefoot toads caught were beneath normal males, but n=3 ($P=0.11$).

Male crickets generally spend 1–9 h of every 24 making themselves acoustically conspicuous (Loher 1972, Walker 1979). A variety of animals may use the song to approach the cricket: (1) conspecific females—to find a mate (e.g., Popov and Shuvalov 1977) or to end a long flight at a suitable habitat (Ulagaraj and Walker 1973); (2) conspecific males—to attack a competitor (Cade 1979), to become a silent satellite intercepting approaching conspecific females (Cade 1979), or to end a long flight at a habitat likely to have conspecific females; (3) predators—to eat the cricket (Walker 1964); (4) parasitoids—to deposit eggs or larvae on the cricket (Cade 1975). (5) Some animals may be attracted to cricket calls without benefit—because the calls resemble sounds that are beneficially approached. For example, crickets are attracted to heterospecific songs similar to their own (Hill et al 1972, Ulagaraj and Walker 1973, Mangold 1978), and flies that feed on frog blood are attracted to mole cricket calls (Mangold 1978). Since only mate-ready, conspecific females are likely to enhance the reproduction of the calling male and the others are likely to reduce or curtail reproduction, the amount, timing, and quality of a cricket's song should depend in part on the particular animals that were attracted to similar songs in previous generations.

Few attempts have been made to determine what animals come to cricket songs in the field. Cade (1975, 1979) played taped songs of *Gryllus integer* Scudder and collected males and mated and unmated females of *G. integer* and females of *Euphasiopteryx ochracea* (Bigot), a fly that parasitizes *G. integer*. Ulagaraj and Walker (1973), Ulagaraj (1975), and Mangold (1978) studied insects that flew to electronic reproductions of mole cricket songs (*Scapterisius vicinus* Scudder and *S. acletus* Rehn and Hebard). In addition to male and female (mated and unmated) mole crickets, they collected males and females of 5 other species of crickets and females of *E. ochracea* and of *Corethrella wirthi* Stone, a fly that feeds on the blood of tree frogs. Earlier, Walker (1964) reported a domestic cat finding short-tailed crickets, *Anurogryllus arboreus* Walker, by their songs.

I here report a 2-yr study of animals caught in pitfalls beneath caged calling males of *A. arboreus*.

Methods

A. arboreus is a flightless, subsocial, burrowing cricket that occurs in dense, stable populations. In Alachua Co., Fla., calling and mating occur only in Apr., May, and June. Males call during a 2-h period beginning at sunset, generally from perches 0.1–2.0 m above the ground. The call is a continuous series of 5.0–5.5 kHz pulses at a rate of 70–80/sec. The cricket briefly breaks his call when he changes orientation or position. Females are occasionally seen running toward calling males, and mating occurs quickly after contact (Walker 1973, 1979).

The site of this study was a mesic woods in Alachua Co. (NW 1/4, sec 31, tp T9S, R19E). During the calling season males of *A. arboreus* reached densities of 100–200/ha. Pitfalls, consisting of 4-liter cans buried flush with the soil surface, were installed in blocks of 3 with the individual traps no closer than 2 m. (Fig 1). A 10×10×10-cm cage with screen sides and bottom was suspended ca. 9 cm above each pitfall. A funnel in the mouth of each pitfall prevented captured animals from escaping. In 1977 and 1978 respectively, 7 and 8 blocks (21 and 24 traps), separated by at least 10 m, were used. In each block each evening one cage contained a normal male, one contained a male muted by amputation of the right tegmen, and one was empty. The cages were rotated every evening (1977) or every 1–4 evenings (1978), resulting in every pitfall having every treatment ca. the same number of evenings. The traps were checked and emptied shortly before sunset and 2 h later—i.e., shortly before and after the calling period each evening. Caged males generally sang as long as or longer than wild males. Fewer than 10% of caged normal males failed to call on the average evening that the traps were run. Caged males were replaced when they sickened or died. In 1977, 105 "block-days" (no. blocks × no. days) were logged May 13–31; in 1978, 142 were logged May 20–June 13. The midpoint of the calling season was ca. a week later in 1978 than in 1977 (Walker 1979).

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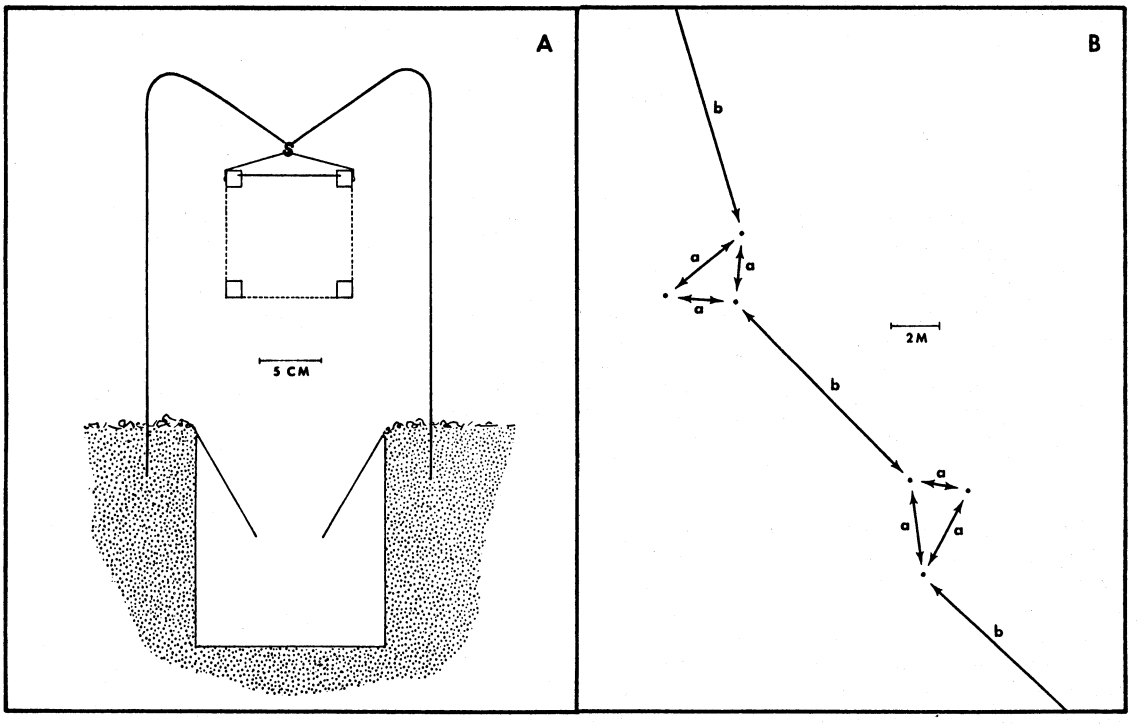

FIG. 1.—Experimental layout for studying animals attracted to calling males of *A. arboreus*. A. Section through pitfall trap and screen cage suspended above. B. Two blocks of the experiment. Distance between pitfalls (a) no less than 2 m. Distance between blocks (b) no less than 10 m.

In 1977, males to be caged were collected outside the study area, and an effect of the experiment was to increase the density of calling males in the study area. In 1978, wild males were systematically removed from the study area in an effort to increase the catch beneath the caged males. Approximately 80% of wild males calling were caught each evening: 79 were removed the 1st week; 83, the 2nd; and 7, the 3rd.

Results and Discussion

The only animals caught in significantly greater numbers beneath cages of a particular content were *A. arboreus* females beneath normal males during the 2-h calling period; none was caught in other traps or during the 22 h between calling periods. The females trapped evidentally were attracted to the calls of the males. Males of *A. arboreus* were also collected from the pitfalls but 17 of 21 were captured during the non-calling period (Table 1). These results are compatible with the conclusion that most males wander each evening after they finish calling (Walker 1979).

The only potential predators of *A. arboreus* commonly caught in the pitfalls were wolf-spiders (*Lycosa lenta* Hentz). I once observed another lycosid (*L. ammophila* Wallace) capture a wandering male *A. arboreus*, and the remains of a male were found in a pitfall with a *L. lenta*. However, the number of *L. lenta* beneath normal males was no greater than beneath empty cages (Table 1).

Table 1.—Catches in pitfalls beneath suspended cages, some containing calling males of *Anurogryllus arboreus*, in mesic woods, Alachua Co., Fla.

	2-h calling period						Other 22 h	
	1977			1978			1977	1978
	Normal Male	Mute Male	Empty	Normal Male	Mute Male	Empty	(all)	(all)
traps × days	105	105	105	142	142	142	315	426
A. arboreus females[a]	3	0	0	2	0	0	0	0
A. arboreus males[b]	2	0	1	0	0	1	11	6
Lycosa lenta[b]	6	8	15	9	3	9	61	—[c]
Atlanticus gibbosus	0	2	1	0	0	0	0	0
Scaphiopus holbrooki	0	0	0	3	0	0	0	0

[a] Probability that the 5 caught would by chance be caught under cages with the same content is $(1/3)^4 = 0.01$
[b] Distribution of catches does not differ significantly from that expected if cage contents were of no effect ($P > 0.05$, chi-square test).
[c] Not counted.

Three individuals each were captured of 2 predators that belong to groups known to orient acoustically to their own signals: a shield-back katydid, *Atlanticus gibbosus* Scudder, and a spadefoot toad, *Scaphiopus holbrooki* (Harlan). Caged individuals of the katydid will attack and devour ground crickets (*Pictonemobius* spp.), but none was caught beneath a cage containing a normal male. All of the spadefoots were beneath normal males ($P=0.11$) and were caught during the calling period (Table 1).

The number of females trapped per normal-male-night was surprisingly low: 0.029 in 1977 and 0.014 in 1978. Removing competing males (in 1978) did not increase the catch of females. During the 2 yr an avg of at least 49 evenings of calling was required to attract each female! Periodically checking free males that were calling gave a higher estimate of success rate: 8/88 = .091; one female/11 nights. Nonetheless resightings of marked males indicate that few males call as many as 11 nights, and the avg number of nights of calling may be no more than 3 (Walker 1979). Making the discrepancy still greater is the fact that at least some females mate more than once. Four of the pitfall-trapped females were dissected, and 3 proved to have sperm in the spermatheca.

A heavily male-biased sex ratio could explain the paucity of females captured, but Weaver and Summers (1969) and my rearing data indicate a 1:1 ratio. Either or both of the following explanations may be valid: (1) Most mating occurs in the female's burrow as a result of silent searching by the male (Walker 1979). (2) Most females attracted to the caged calling males were not captured—because they escaped (unlikely), because they were repelled by some aspect of the pitfall, or because there was no silhouette of a stem to lead them into the pitfall. Under natural circumstances males calling from above the ground are on tree trunks or smaller vegetation and to reach the male the female must find the correct stem and ascend. That the stem itself is important is clear from 2 occasions when I saw a female climbing the wrong stem. In one case the female fruitlessly searched the surface of a 0.5 m diam tree trunk spending 11 min going up and down between 0.3 and 1.0 m. All the while the male was calling 0.4 m away, opposite the area searched, on a 4 cm diam sapling.

In summary, calling by males of *A. arboreus* may be less profitable but safer than previously surmised.

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