EXPERIMENTAL DEMONSTRATION OF A CAT LOCATING ORTHOPTERAN PREY BY THE PREY'S CALLING SONG

THOMAS J. WALKER
Department of Entomology, University of Florida, Gainesville

Solitary males of most crickets, tettigoniids, and cicadas, and of some short-horned grasshoppers produce intense sounds frequently or continuously for many minutes or hours daily. These sounds function in getting the sexes together—in most species the female goes to the sound. For long-range intraspecific communication sound has important advantages over chemicals (it is easily coded and will carry upwind) and light (it is usable day or night and can pass around barriers). It has the potential disadvantage of advertising the location of the sound-producing male to many predators.

There has been no previous experimental demonstration that a predator uses the acoustic signals of its insect prey in capturing it, but circumstantial evidence for such behavier has been advanced several times. Marler (1955) points out that some vertebrate predators ought to find sound-producing insects especially easy prey. Swearinger and Mohler (1962) suggest that starlings locate singing crickets by sound, but their chief evidence is that "a large proportion of the diet of starlings (almost half) consists of crickets *and other insects*" (italics mine) and that starlings seem to be attracted to taxiing Lockheed Electra airplanes, the engines of which may sound like some unspecified cricket to the starlings. Haskell (1961, p. 174) suggests that small mammals, birds, and perhaps amphibians may use the sounds of insects in capturing them and points out the lack of definite information to this effect.

I have observed two domestic cats apparently locating singing insects by their sounds and have demonstrated that one of the cats was attracted to the electronically reproduced sound of the prey species.

One cat was observed to run toward a coneheaded grasshopper (*Neoconocephalus triops*) when it began to sing and to capture it. The other cat was first observed feeding on short-tailed crickets (*Anurogryllus muticus*), which leave their burrows at dusk and sing from tree trunks and other perches 1 to 8 feet above the ground. One evening as I was watching a cricket singing on a tree trunk, the cat swatted the cricket to the ground, pounced on it, and ate it. Immediately, the cat went toward another cricket singing in a dense hedge about 20 feet away; it stopped at the hedge but did not locate the cricket. It then proceeded directly to a third singing cricket about 40 feet away, knocked the cricket from its perch, and pounced on it. The same cat was observed about a month later feeding on singing males of a roundheaded katydid (*Amblycorypha* near *uhleri*). These katydids fly from perch to perch and sing only a few minutes at each perch. On two occasions, the cat was observed to capture a singing male which had perched nearby. The cat's attention was directed toward the katydid each time only after the katydid had begun to sing.

An experiment was performed the following evening to determine if the sound of a katydid could be the initial stimulus directing the cat to the katydid and if the cat would go toward an unfamiliar insect sound. A speaker (University Model T-202 supertweeter) was hung 4 feet above the ground on a tree trunk. The cat showed no response to the silent speaker. When the cat was 30 feet from the tree, I began playing a recording of the katydid. The cat immediately went toward the speaker. Five feet from the tree the cat came upon the speaker cord, instantly shied away, and ceased responding to the recorded signal. The signal was discontinued after one minute. Two hours later, after the cat had walked across the speaker cord several times, the katydid recording was turned on again. The cat went directly toward the speaker, and the sound was stopped when the cat reached the base of the tree. The cat walked about peering upward and then sat for nearly two minutes looking upward. The cat at no time showed a response to the silent speaker, so the cat must have been attracted to the sound of the katydid during each of the two trials.

To test the specificity of the cat's response, the song of a cricket (*Gryllus assimilis*) which the cat could not have heard before was played. The cat, 20 feet away, showed no response. The recording of *Amblycorypha* nr. *uhleri* was then played for the third time. The cat immediately started toward the speaker but after approaching about 5 feet started chasing a moth that crossed its path. The cat showed no further response to broadcast sounds that evening and no further experiments were attempted.

Discussion

It is evident that domestic cats sometimes use the sounds of singing insects in preying upon them. This use occurs without human intervention and without abnormally high populations of singing insects. Both gryllids and tettigoniids are involved.

Many important questions remain to be answered concerning the use by predators of the sounds of the prey in locating sound-producing insects. One such question is what predators other than domestic cats are involved. Three groups of predators not mentioned in the literature reviewed above may prove to be important sound-using predators of sound-producing insects: (1) Insect-eating owls, such as the burrowing owl, may locate stridulating insects by sound. Payne (1962) proved that the barn owl can capture mice in complete darkness using for orientation only the sounds made by the prey incidental to the prey's movement. The sounds produced by stridulating insects should be adequate stimuli for prey localization by owls. (2) Lizards of the family Gekkonidae eat insects (including crickets), have keen hearing, and feed while moving about at night (personal communications, A. F. Carr, C. J. Goin). Such a combination of characters suggests sound-aided predation. (3) Some sound-producing insects are predaceous (e.g. the tettigoniid genus *Rehnia*) and might locate prey by the prey's acoustical signals.

Another important question concerning the use of the prey's sound by predators of sound-producing insects is the extent such predation has influenced the evolution of long-range acoustical communication in insects. The abundance of species with such communication is convincing evidence that increased susceptibility to predation has often been offset by increased likelihood of reproductive success. Nevertheless predation by acoustically alerted or oriented predators constitutes a significant selective force in the evolution of at least eight features of the production of calling or "spontaneous" songs by crickets, tettigoniids, short-horned grasshoppers, and cicadas: (1) Males produce the calling songs. Females usually produce no sounds or produce sounds only in response to those of the males. (2) Calling males frequently cease singing at the slightest visual, acoustical, or mechanical disturbance. This behavior is especially pronounced in large species producing intense sounds, and the disturbed male frequently drops to the ground or flies. (3) The calling songs may be produced at certain times of day, at certain seasons of the year, or even in certain years. For example, the majority of species which sing from trees do not produce sounds during the day, when most birds feed. Another example concerns three species of 17-year cicadas which in any one locality mature the same year (or years, if more than one brood occurs) (Alexander and Moore 1962). The resulting super-abundance of cicadas increases the individual's probability of escaping predation. (4) The duration of singing may be brief. Some sound-producing insects sing for only a brief period each day (e.g. evening twilight), and many are highly restricted in their season of singing. For instance, *Neoconocephalus triops* becomes adult in the fall, but the males do not sing until the following spring. Most females are probably inseminated during the first few evenings of singing. (5) The place of singing may be restricted and may change according to the time of day. *Gryllus fultoni* sings very little during the day, but when it does, it sings from the ground (relatively safe from diurnal predators). At night, on the other hand, *G. fultoni* often sings from trees, perhaps out of reach of some small nocturnal mammals. (6) The song may be of high frequency or include gradual changes in intensity. Marler (1955, 1961) discusses the significance of these features in making a sound difficult for some vertebrates to localize. (7) Groups of males may synchronize their singing. Synchronous singing makes it more difficult for a predator to locate a particular individual since the sound is continuous even though the individual a predator is stalking drops out of the chorus. (8) The calling songs may be produced at infrequent and irregular intervals during the period of singing.

Although predation probably played some part in the evolution of each of these eight features, in features (3)-(7) other selective forces must in many cases have been of greater significance. Two such selective forces are especially important: The enhancement of the intra-specific communication and the elimination of interference from all other concurrent environmental sounds, especially those of other sound-producing species.

Literature Cited

Alexander, R. D., and *T. E. Moore*. 1962. The evolutionary relationships of 17-year and 13-year cicadas, and three new species (Homoptera, Cicadidae, *Magicicada*). Misc. Publ. Mus. Zool. Univ. Mich. 121: 1-59.

Marler, Peter. 1955. Characteristics of some animal calls. Nature 176 (4470): 6-8.

Marler, Peter. 1961. The evolution of visual communication. *in* Vertebrate speciation (W. F. Blair, editor). Univ. Texas Press, Austin. p. 96-121.

Payne, Roger S. 1962. How the barn owl locates prey by hearing. *in* The living bird. 1st Annual, Cornell Lab. of Ornithology. p. 151-159.

Swearingen, John J., and *Stanley R. Mohler*. 1962. Sonotropic effects of commercial air transport sound on birds. Federal Aviation Agency, Oklahoma City, Okla. 5 p.