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SPECIATION IN OLIARUS (FULGOROIDEA CIXIIDAE) FROM HAWAIIAN LAVATUBES[1]

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ABSTRACT

Profound morphological differences between cave-dwelling *Oliarus* populations from different lavaflows on Hawaii Island are considered to be due to two independant invasions: the population from Hualalai lavaflow displays remnants of eyes and relatively long wings, and the populations from Kilauea-, Mauna Loa- and Mauna Kea lavaflows, previously known as *Oliarus polyphemus* Fennah, are entirely blind and brachypterous. For the first time intraspecific communication in cave-dwelling insects could be studied by recording vibrational signals which revealed significant differences not only between the two different invasions, but also between *O. polyphemus* populations of different lavaflows.

KEY WORDS

Intraspecific communication, substrate-borne vibrational signals.

Within the genus *Oliarus* with 80 named Hawaiian taxa obligate cave species have evolved separately on Molokai, Maui and Hawaii islands. These species are blind, flightless and uncapable of epigean dispersal. On Hawaii Island two separate lines have invaded caves: the population from Hualalai lavaflow displaying remnants of eyes and comparatively long wings, belongs to a yet undescribed species, and the populations from Kilauea-, Mauna Loa- and Mauna Kea lavaflows, being entirely blind and brachypterous, were previously known as *Oliarus polyphemus* Fennah.
By the morphology of the male genitalia *O. polyphemus* seems to be closely related to *O. inaequalis* Giffard, an epigean species living in rainforest on Hawaii Island. *O. polyphemus* feeds on roots of a native Hawaiian tree, *Metrosideros poly-*

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morpha, which is dominant in rainforests and also a major pioneer on young lavaflows where its roots penetrate cracks and voids in the rock to reach the watertable. These roots dangling into the lavatubes provide an enormous food ressource, and the exploitation of this food ressource might have been the driving force for the adaptation and evolution of cave species. A model of parapatric speciation of *O. polyphemus* from an *inaequalis*-like ancestor has been proposed (Howarth, 1986). Mating behaviour could be an important isolating mechanism between diverging surface and underground populations.
Hardly anything is known about mating behaviour in Cixiidae. Since Ossiannilsson's pioneering study (Ossiannilsson, 1949) it is known that Cixiids "sing" resp. communicate by substrate-borne vibrational signals. Comparison of songs among cave and surface populations may not only complement the morphological studies but provide additional data to enlighten the processes which have led to the evolution of troglobites.

Adult males and females were collected from 3 caves on Hawaii Island: Kaumana cave (in a lavaflow from the Northeast Rift of Mauna Loa), Pahoa cave (in a lavaflow from the East Rift of Kilauea) and Ana Lima Kipo cave (in a lavaflow from Hualalai). The populations from Kaumana and Pahoa caves were previously known as *O. polyphemus;* the population from Hualalai belongs to a yet unnamed species. The sexes were kept in separate vials, together with roots of their hostplants, within an "artificial cave" (Howarth, 1979). Recordings were made with the test insects held in a small balsa wood cage which was attached to a particle displacement microphone (Bennet-Clark, 1984). During the recording sessions the ambient temperature was 20° C which is close to the mean temperatures (19-23° C) in the three caves.

RESULTS

1. Both males and females may initiate calling, and after each call, individuals wait for a variable amount of time unless answered.
2. The two populations known as *O. polyphemus* have distinctly differnt calls; the differences concern the pulse form as well as the pulse repetition frequency.
3. Both males and females answered only the playback calls of individuals from their own cave, leading to the conclusion that they are cryptic acoustic species. These data were confirmed by subsequent dissection of the male genitalia which revealed small but consistent differences in the shape of the aedeagus.
4. The call of individuals from Ana Lima Kipo cave was conspicuously different from the others. Here, too, males responded only to playback calls from individuals from the same cave.

Although the full meaning of the recorded signals in their biological context could not yet be assessed, these preliminary findings open new fields of research. This is the first record of intraspecific communication by substrate-borne si-

gnals by an obligate cave species. Except for echolocating vertebrates (bats, birds) which are mostly restricted to larger cave passages, sound production is virtually unknown in troglobitic species. This is not surprising because airborne sound is not transmitted well in caves. Substrate-borne sounds, however, may be efficiently transmitted in subterranean habitats and may carry considerable information, especially along roots and other plant material, and for distances up to a few metres (Michelsen et al., 1982). Therefore, intraspecific communication by substrate-borne vibrations may be widespread among cave animals.

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