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# Preliminary observations on sound production in South African hawk moths (Lepidoptera: Sphingidae)

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Sound production in sphingid moths is a widespread phenomenon, but has never been investigated in the African members of the family. Two ways of producing sound are known in hawk moths: pharyngeal and genital. Pharyngeal sound is generated by an airstream forced through the pharyngeal tract (Prell 1920; Busnel & Dumortier 1959) and thus far only known in the genus *Acherontia* (subfamily Sphinginae), of which adults of both sexes are capable of producing a loud squeaking noise when in distress. Genital sound is produced by stridulatory movements of the valves of the male genitalia (van Doesburg 1966 [review]; Lloyd 1974; Nässig & Lüttgen 1988). This kind of sound production is far more widespread in the family and, being restricted to the male sex, perhaps of significance in mating behaviour, although it has so far also only been observed under conditions of distress.

During various collecting trips in South Africa since January 1989 we were able to check numerous species of hawk moths arriving at collecting lights for their ability to produce sound audible to the human ear. Often such moths produced intermittent noises as they hit the screen of the light trap and flew around it for a while before settling, but for proof of their sound-producing abilities they were gripped firmly on the thorax with the wings folded upwards, and kept close to the ear for some time. When irritated in this way, generally all hawk moths capable of that behaviour do emit sound, especially if slightly squeezed. However, we did not examine the species for possible production of ultrasonic sound.

We were able to detect sound production in *Batocnema africana* (Distant), *Macropoliana natalensis* (Butler), *M. ohefferani* (Gess), *Pseudoclanis molitor* (Jordan) and *P. postica* (Walker) of the subfamily Sphinginae, and *Daphnis nerii* (Linnaeus) of Macroglossinae, but not in *Afroclanis calcarea* (Rothschild & Jordan), *Agrius convolvuli* (Linnaeus), *Coelonia mauritii* (Butler), *Hoplistopus penricei* Rothschild & Jordan, *Lophostethus dumolinii* (Angas), *Oligographa juniperi* (Boisduval), *Platysphinx piabilis* (Distant), *Polyptychoides grayii* (Walker), *Rufoclanis jansei* (Vári) and *Rufoclanis numosae* (Wallengren) of Sphinginae and *Euchloron megaera* (Linnaeus), *Hippotion balsaminae* (Walker), *H. celerio* (Linnaeus), *H. eson* (Cramer), *H. roseipennis* (Butler), *Nephele accentifera* (Palisot de Beauvois), *N. argentifera* (Walker), *N. bipartita* Butler, *N. comma* Hopffer, *N. funebris* (Fabricius), *N. peneus* (Cramer), *Temnora marginata* (Walker), *T. murina* (Walker), *T. natalis* Walker, *T. plagiata* Walker, *T. pylades* Rothschild & Jordan and *Theretra capensis* (Linnaeus) of Macroglossinae.

Of the species testing positive for sound production, all except the *Pseudoclanis* did so by male genital stridulation (their females being silent) by means of fast lateral movements of the genital valves against the underside of the eighth tergite. These valves carry dorsally some special stridulatory scales, which are rubbed against a file on the tergite to produce the noise. The sound is emitted immediately upon disturbance of the moth and will persist for a short time even after injection of a killing liquid (solution of ammonia and nicotine in water) into the thorax, until the nicotine reaches the abdominal tip. The sound is, especially in *B. africana*, much weaker than in some South-East Asian species (Nässig & Lüttgen 1988), but still well perceptible. *Agrius convolvuli* was not found to produce any sound, even when strongly squeezed, although it has been reported to do so elsewhere (van Doesburg 1966 and references) and does possess similar modified scales on its valves, as already reported by Carcasson (1968).

The most surprising discovery in this regard, however, was that the mulberry hawk moth *Pseudoclanis postica* and its congener *P. molitor* are able of producing a true squeaking sound in both sexes. Preliminary studies indicate that this sound is produced by an airstream in the pharyngeal tract like in *Acherontia*, but probably with a slightly different apparatus, as we did not find such a strongly sclerotized epipharynx as is present in *Acherontia*. Injection of killing liquid into the thorax generally stops the production of this sound at once. The sound emitted by these two species differs clearly in loudness, frequency and pitch. This is the first time that a true squeaking sound is reported in a sphingid genus other than *Acherontia*, and it may have taxonomic significance as it appears to confirm Carcasson's (1968) removal of *molitor* from *Polyptychus* and its inclusion in *Pseudoclanis*. Other *Pseudoclanis* species are therefore also expected to possess this squeaking ability.

All South African species we found to be capable of producing sound belong to the subfamily Sphinginae, with the single exception of the oleander hawk *Daphnis nerii*, which is also a genital stridulator and appears to be the only African species of Macroglossinae known thus far to generate an audible sound. Macroglossinae seem to produce audible sound not as commonly as Sphinginae, only a few other species having recently become known to do so (Nässig 1991). This lack of audible genital stridulation in Macroglossinae is surprising in view of the fact that many macroglossine genera, e.g. *Celerio*, *Basiothia*, *Hippotion*, *Nephele*, *Temnora* and *Theretra* (several of which tested negative in our experiments), have very similar modified friction scales on their genital valves (see also Carcasson 1968). Since such scales are used for sound production in Sphinginae and in *Daphnis* and thus likely to have the same function in other Macroglossinae, we suspect

that in these genera, as perhaps in *Agrilus convolvuli*, the friction scales may produce ultrasonic sound not detectable by the human ear.

The function of these sounds in Sphingidae remains unclear. The fact that in most Sphingidae the sound-producing organs are found only in the male sex and located on the male genitalia suggests that the sound may have arisen from sexual stimulation during mating behaviour and may still play a role in courtship. However, it seems very likely that it has an additional (if not primary) function in deterring enemies or possibly interfering with the echo-location system of bats, as the ultrasonic sounds of other species suggest (Spangler 1988). Roeder & Treat (1970) have shown that several Macroglossinae can not only detect ultrasonic sound by means of an acoustic receptor on the labial palps, but also that they make violent evasive movements when exposed to ultrasound while hovering in front of flowers. However, the function of low-frequency, audible genital sounds in Sphinginae, in which no acoustic receptors have yet been found, neither by ourselves nor any other author, is still to be explained. The pharyngeal squeaking sound in *Acherontia* and *Pseudoclanis* obviously evolved independently from the genital stridulation and probably also serves mainly as a deterrent.

Detailed studies of the sound-producing structures in South African Sphingidae are in preparation.

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