An abdominal stridulation organ in *Cyphoderris* (Prophalangopsidae) and concerning the systematic classification of the Ensifera (Saltatoria)

Kjell Ander

Translated by: translated.com, Barbara Sander, Kevin A. Judge

NOTICE: This is a translated version of the following article: Ander, K. (1938) Ein abdominales Stridulationsorgan bei *Cyphoderris* (Prophalangopsidae) und über die systematische Einteilung der Ensiferen (Saltatoria). *Opuscula Entomologica*, *3*, 32-38.

Permanent link to this version http://doi.org/10.31542/r.gm:2687

An abdominal stridulation organ in *Cyphoderris* (Prophalangopsidae) and concerning the systematic classification of the Ensifera (Saltatoria)

by

Kjell Ander

Among the jumping straight-wingers, Saltatoria, sound-producing organs are very common, however, several quite different types exist depending on structure and location. The best known of these can be found in Tettigoniidae and Grylloidea, the crickets, the existing tegminal stridulation or chirping organ and the femoro-tegminal, which is common among field locusts, Acrididae. In the former case, the sound is produced by stroking the tegmina against each other, in the latter by rubbing the rear limb against the tegmina. In both cases there are special features that produce the sound, such as raised ridges, rows of teeth or the like, and others that act as volume amplifiers.

Other types of chirping organs in Saltatoria have been known for a good while. Graber (1876) describes a femoro-abdominal organ in *Gryllacris* and *Hemideina*, and Brunner von Wattenwyl (1888) mentions one such with *Maxentius*, *Sia* and other forms of the family Stenopelmatidae, that are usually included in the family Gryllacrididae today according to Karny's suggestion. Karny (1929) and the author (1933) made further contributions to the knowledge of this chirping organ. As I have found in my comparative studies, this type of sound-producing organ is very widespread among the so-called gryllacridids and occurs in numerous variants, which are to be described elsewhere.

A femoro-abdominal chirping organ is also found in the Acridoidea, namely in the family Pneumoridae and the subfamily Tmethinae (Regen 1903), although it differs in the details from that of the Orthoptera mentioned above. Two completely different types of chirping organ have been found in Tridactyloidea, namely a tegmino-alarian one in *Tridactylus* (Tindale 1928, Carpentier 1936) and a palpo-mandibular one in *Cylindracheta* (Tindale). Another type, a coxo-sternal organ, is found in the Phyllophorinae (Tettigoniidae).

A new, to my knowledge, type of stridulatory organ of importance to Saltatoria is the organ I will describe below. While examining *Cyphoderris monstrosus* Uhler (Canada), I noticed a small area with transverse ridges on the back of the abdomen, and on closer inspection it turned out to be a chirping organ.

The genus *Cyphoderris* belongs to the family Prophalangopsidae (Zeuner 1935) and comprises only two species. In both, the males have shortened forewings with a well-developed tegminal chirping organ, while in the females the forewings are reduced to very small lobes. The discovery of another kind of sound producing organ in this form is therefore of particular interest.

The part of the organ that remains motionless during sound generation is located at the rear edge of the metanotum (Fig. 1). At the lowest part of the same and exactly at the exposed edge there is a simple row of pointed, brown teeth, which are directed diagonally backwards and downwards; their number was at most 14 (female). The largest ones are located in the middle, while the teeth diminish towards the sides. The aforementioned area with chitin ridges is part of the first abdominal segment and is at the same level on the side as the largest teeth at the back edge of the metanotum.

The area is oriented lengthwise and has transverse chitin ridges. These are thin, hard, sharp, brown in color and inclined backwards to an insignificant degree; they stand out clearly in profile. They are longest in the front and middle parts of the section, while the rear ridges are shorter and sometimes interrupted, i.e. divided into shorter ridges that are not arranged in a straight line. In a large female, apparently imago, although the wing rudiments are pointed upward as in the nymphs, the number of ridges was 18-19.

As the abdomen contracts, this ridged area slides forward, just below the row of metanotum teeth, and the sound may be produced both by the contraction of the abdomen and by the subsequent extension. The first movement, which is caused by contraction of the tergal muscles, is potentially the stronger and therefore the most important.

With a nymph of 11 mm length (pronotum 2.8 mm), no trace of this organ was to be seen, while the same was formed with an 18 mm long nymph (pronotum 4.7 mm), although quite weak. In larger nymphs, the organ is approximately as described above according to the already mentioned female. Since I cannot decide whether this specimen is really an imago, I cannot say anything specific about the adult female.

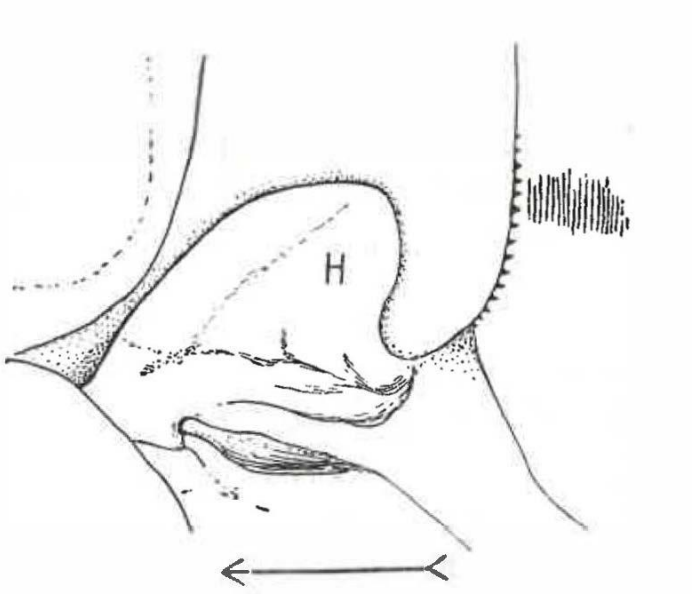

Fig. 1. *Cyphoderris monstrosus*. (Female). The abdominal stridulation organ. H: Hind wings.

The fully developed male, which has a powerful tegminal chirping organ, also possesses the abdominal, although reduced. It is smaller than the female and cannot function because the teeth on the metanotum are aligned straight backwards. Their number is less, only about 6, and they are short. At the area where the row of teeth is located, the edge of the notum is slightly widened and thickened. The abdominal ridges are present, but they are short and lower than in the female examined, numbering about 10.

Due to its two different chirping organs, *Cyphoderris* presents an interesting case not observed in other forms. The tegminal chirping organ is associated with the male imago, while the abdominal chirping organ is associated with the nymphs and perhaps also with the female imago.

The genus *Cyphoderris* is assigned by Zeuner (1935) to the family Prophalangopsidae, which Walker had previously only encompassed in *Prophalangopsis*. He also includes some fossil straight-wingers, mainly *Cyrtophyllites* Oppenh., which until then had been considered a true tettigoniid. The family Prophalangopsidae represents the group of origin for both Grylloidea and Tettigoniidae according to the author (1935). In my anatomical studies of Saltatoria, which extend to most organ systems, I have come to such results that I cannot share Zeuner's view on the relationship and descent of the Ensifera groups in several points. Since my more extensive work on these studies cannot yet be published, I would like to briefly mention here the grouping of the Saltatoria groups to which my research has led me. Since the so-called gryllacridids are regarded by several researchers, among others by Karny and also by Zeuner (1935) as the most primitive Saltatoria, I have devoted special attention to them.

The examination of the internal anatomy and the morphology of the skeleton revealed that the family Gryllacrididae is heterogeneous within the scope of Karny. Several significant features demonstrate this with certainty, such as the musculature, the tracheal system, the genitals, and also certain parts of the skeleton. The family must again be divided into four families, Rhaphidophoridae, Schizodactylidae, Gryllacrididae (s. str.) and Stenopelmatidae; the latter family is the same as Brunner's of the same name, with the exception that Rhaphidophoridae are excluded.

The first of these four families, despite the complete absence of wings and the resulting specialization of the whole thorax, exhibits the most primitive traits not only among these families, but probably also among all ensiferans. Organs exhibiting this are the male and female sex organs, the skeleton of the prothorax, and the tracheal system, among others. The group is very distinct and can easily be distinguished from the others, which has also been observed by earlier systematists.

The Schizodactylidae are very isolated among the bush crickets. These also form a highly specialized group in certain respects (wings, tarsi, reduction of external genitalia). Based on my findings so far, the internal anatomy of this group does not suggest any stronger evidence for their placement. While some organs seem to point to the Gryllacrididae (s. str.), others seem to suggest the impossibility of such a placement. The peculiar, broad, flattened spurs of the posterior tibiae may seem to indicate a relationship with the elcanids, but this fossil family is so similar to the Gryllacrididae (s. str.) that it is probably closely related to them.

The Gryllacrididae s. str. form a group that is unusually homogeneous and species-rich, and which is currently apparently undergoing lively speciation. In connection with the peculiar morphology of the tip of the male hind body, which is observed by the systematists, there is the peculiar, highly specialized construction of the inner parts: the testes are represented by an externally unpaired structure which is located above the rectum in a swelling of the last segments. The tracheal system, the different parts of the ovipositor and the tarsi are some of the features specific to the group.

The Stenopelmatidae family is much more diverse and may include more ancient forms than the previous family. Stenopelmatidae is closely related to *Cyphoderris*, the only species in the Prophalangopsidae family I have studied. A little more distant is the family Tettigoniidae, the most species-rich and multiform of all bush crickets. Due to the presence of a tegminal stridulatory organ and a tibial auditory organ as well as a related specialization of the tracheal support of this sensory

organ, the Prophalangopsidae are well associated with the Tettigoniidae. In most other organ systems, however, the previous family (*Cyphoderris*) refers more strongly to the Stenopelmatidae. For all three of them there are also common characteristics that the abovementioned families do not exhibit, e.g., in the generational organs and the tracheal system. Therefore, I would suggest uniting them under the name Tettigoniaemorpha. Probably the whole group primarily possessed the tibial auditory organ, although it has been reduced in many stenopelmatids. It is possible that the tegminal chirping organ was already formed or in the process of being formed in the ancestors of the group. The similarity of *Cyphoderris* with the stenopelmatids probably supports this.

I have not yet touched on the "crucial point" in ensiferan systematics, namely the relationship of the above-mentioned families to the crickets, Grylloidea. Karny includes the family Gryllacrididae which he has broadened, of which the Prophalangopsidae were also a part, as Grylloidea, while earlier researchers such as Handlirch had sharply distinguished all bush crickets from the grylloids, and Zeuner (1935) derives both Grylloidea and Tettigoniidae from the Prophalangopsidae. I have paid particular attention to this question and my research has led me to the following view. I consider the lineage of the tettigoniids from the Prophalangopsidae (s. l.) probable, but I would like to regard the stenopelmatids as descendants of (still unknown) forms, which either could be assigned to the prophalangopsids or were very close to this family. The Grylloidea differ in so many anatomically significant characteristics that it is impossible to derive them from the Prophalangopsidae or any other of the families mentioned here. These can all be grouped into a superfamily, Tettigonioidea, which is equal to the superfamily Grylloidea (Gryllotalpidae [s. str.] and Gryllidae); both together form the suborder Ensifera. The two superfamilies differ in the construction of the skeletal, muscular, tracheal and nervous systems, the digestive and generational organs. In other words, the Grylloidea have primitive anatomical characteristics that are not found elsewhere in the Ensifera. That the tibial tympanal (auditory) organs of the Tettigoniidae and the Gryllidae are to be regarded as analogous has already been emphasized by Schwabe, and Karny expressed the same opinion with regard to the tegminal chirping organs.

Of the two fossil families Elcanidae and Locustopsidae the former seems to belong to the Ensifera and is probably very close to the Gryllacrididae (s. str.). Whether the latter are also ensiferans is still a little uncertain, but the general habitus of the species speaks strongly for it. Both the Elcanidae and the Locustopsidae cannot possibly be considered as parent groups for Acridoidea.

The order Saltatoria includes the Ensifera and the superfamilies Tridactyloidea and Acridoidea. Recent investigations (Carpentier 1933, 1936, 1937, Ander 1934) have demonstrated that the Cylindrachetidae are close to the family Tridactylidae and must be counted as Tridactyloidea. Furthermore, it has been shown that the Tridactyloidea is close to the Acridoidea, and due to certain traits of their anatomy, both superfamilies are in a contrasting relationship to the Ensifera. I have proposed the name Caelifera (1936) for the suborder that must be created for these two superfamilies. It features among other things short antennae, peculiarities in the muscles of the thorax, in the form of the sternum, the ovipositor, the intestinal canal, etc. Please see F. Carpentier (1936, 1937). The anatomy of caeliferans does not support the assumption of a branching from a recent or fossil ensiferan group. Both Caelifera and Ensifera are more likely to originate from different protorthopteran groups.

References

Ander, K. Über Anisoura nicobarica m., eine bemerkenswerte Laubheuschrecke aus der Familie Gryllacrididae (Orth. Saltatoria). Konowia XII, 1933.

Ander, K. Über die Gattung Cylindracheta und ihre systematische Stellung (Orthoptera Saltatoria). Ark. f. Zool. 26, Stockholm 1934.

Ander, K. Orthoptera Saltatorias fylogeni pä grundval av jämförande anatomiska studier. Autoreferat in N. A. Kemner: Det femte nordiska entomologmötet i Lund 3—6 augusti 1936. Opusc. Entom. I, Lund 1936.

Brunner von Wattenwyl, C. Monographie der Stenopelmatiden und Gryllacriden Verhandl. kk. Zool.-bot. Ges. Wien 28, 1888.

Carpentier, F. Sur quelques particularités du tliorax et des pattes de Cylindroryctes spegazzinii Giglio-Tos. V. congrès international d'entomologie, Paris 1933.

Carpentier, F. Le thorax et ses appendices chez les vrais et chez les faux gryllotalpides. Mem. Mus. Roy. Hist. Nat. de Belgique. ser. 2, fasc. 4, Bruxelles 1936.

Carpentier, F. Sur le tube digestif des Tridactyloides. Bull, et Ann Soc. ent. de Belgique, T. 77, 1937.

Graber, V. Über den Bau und die Entstehung einiger noch wenig bekannten Stridulationsorgane der Heuschrecken und Spinnen. Mittheil. d. naturwiss. Ver. f. Steiermark. Jahrg. 1874. Graz.

Karny, H. H. A revision of the South African Gryllacrididae (Orthoptera Saltatoria) Ann. South African Mus. 29, 1929.

Regen, J. Neue Beobachtungen über die Stridulationsorgane der saltatoren Orthopteren. Arb. Zool. Instit. Univ. Wien T. 14, 1903.

Tindale, N. B. Australasian mole-crickets of the Family Gryllotalpidae. Rec. South. Australian Mus. Vol. 4: 1, 1928.

Zeuner, F. The recent and fossil Prophalangopsidae (Saltatoria). Stylops Vol. 4: 5. London 1935.