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## The secret stridulatory file under the right tegmen in katydids (Orthoptera, Ensifera, Tettigoniodea)

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Males of most species of crickets and katydids produce species-specific calling songs to attract conspecific females. The typical stridulatory apparatus of the Ensifera consists of a file-and-scraper system in the basal dorsal region of the forewings (tegmina): the file on the underside of the cubital vein of one tegmen is composed of a series of lamelliform teeth and is run against the sclerotized scraper at the edge of the other tegmen. The region directly distal of the cubital vein is often thin and glassy and serves to amplify and spread the sound. In stridulating crickets the tegmina are quite symmetrical with both the left and the right one containing a file, which is considered the ancestral condition (Béthoux 2012). Most of these crickets adopted a right-over-left wing overlap and use only the right file. The few extant species of the ancient group Hagloidea have bilaterally symmetrical tegmina, both with functional files, and individual males can change the overlap (Morris & Gwynne 1978). Katydids are distinguished by a left-over-right wing overlap, with a stridulatory file on the underside of the left tegmen, and a scraper on the right one, which usually is also equipped with a mirror as resonating structure.

During taxonomic studies in Brazilian Agraeciini (JCR & CLA) and the study of the peculiar stridulatory apparatus of *Xiphelimum amplipennis* found at the Argentine side of the Iguazú Falls (Cataratas do Iguazu) (HB & co-authors), we were surprised to find fairly well-developed files also on the underside of the stridulatory area of the right tegmen. We then examined more specimens from Colombia and Brazil (verified or collected by JCR) as well as from Ecuador and Argentina (collection HB), and noticed that a file on the ventral side of the right tegmen is more common than we expected.

While the first draft of our paper had in the title “the untold history of the stridulatory files in katydids”, we found several studies documenting files on the right tegmen. In the apparently first correct description of the mechanism of sound production in Ensifera (Landois 1867) are already mentioned two species of Tettigoniidae with right files of somewhat fewer teeth than in the functional left one. A study on the stridulatory apparatus of katydids (Graber 1872) reports right files for one species of each Conocephalinae and Bradyporinae (or Ephippigerinae depending on classification), three species of Phaneropterinae, and two additional species of Tettigoniinae. And for still another species of Tettigoniinae is reported a right file (Petrunkevitch & Guaita 1901). Another study reports a right file for two additional species of Phaneropterinae with fewer and smaller teeth than on the functional file, and also includes illustrations of the non-functional file and individual teeth (Regen 1903). That male katydids have a rudimentary file on the right tegmen is actually considered as normal condition (Roy-Noel 1954). Measurements on numerous specimens of ten species show that the right file is always shorter than the left one, is always composed of fewer teeth, and that the tooth density is about equal, with sometimes being a little lower or even a little higher (Stärk 1958). For one male of Pseudophyllinae was also found a right file (Klee 1961). However, in another species of that subfamily the right file is totally absent, while a right file is also found in one species of Phlugidini (Meconematinae) (Leroy 1969). Among 27 species of Phaneropterinae are reported two species without right file: *Phaneroptera sparsa* and *Zeuneria melanopeza* from Africa (Leroy 1970). Of another species of this subfamily, *Ectomoptera nepicauda*, was recently described the extraordinarily derived and completely asymmetrical stridulatory apparatus of the male, where the stridulatory area of the left tegmen is

**TABLE 1.** (Continued)

Subfamily	Tribe	Species	Country
		<i>Gongrocnemis</i> sp. nov.**	Ecuador
		Gen. et sp. nov. *	Ecuador
	Pterochrozini	<i>Porphyromma</i> sp. nov.	Brazil
		<i>Typophyllum egregium</i>	Ecuador
		<i>Typophyllum inflatum</i>	Argentina
		<i>Typophyllum</i> sp. nov.	Ecuador
	Teleutiini	<i>Pemba cochleata</i> **	Ecuador
Tettigoniinae	Nedubini	<i>Platydecticus</i> cf. <i>angustifrons</i>	Argentina

Among the Pseudophyllinae we found files on the right tegmina in six species out of 14 (Table 1). Only in the four species of the Pterochrozini it is equally well developed as in members of the other subfamilies, but this tribe should probably be separated from the Pseudophyllinae, because it seems to be a sister lineage of all other Tettigoniidae (Mugleston *et al.* 2013). In one species of *Schedocentrus* the right tegmen has on the basal portion of the cubital vein 16 very small teeth (corresponding to the basal end of the left file with altogether more than 100 teeth), the remainder of the vein being completely smooth. A very curious male, which seems to represent an undescribed genus of Pleminiini, also shows a peculiar condition of the right tegmen: It is lacking the typical mirror and there are 25 teeth on the basal half of the cubital vein, only 10 of them relatively well-developed. For the Brazilian *Thliboscelus hypericifolius* (Pterophyllini) is reported a right file with 46 teeth in contrast to 78 on the functional file (Klee 1961, as *Th. camellifolius*, *sensu* Serville). The African *Pantecphyllus helleri* (Pantecphyllini) has a right file on the distal portion of the cubital vein that is much shorter than the left file, while several Phylloimini do not have any traces of a right file (K.-G. Heller, personal communication, 2014). This is also the case for the remaining species we examined: the ventral surface of the cubital vein of the right tegmen is perfectly smooth (Fig. 4B). So the common condition in Pseudophyllinae seems to be the complete reduction of the right file.

The aim of this note is to provide some new qualitative data for several subfamilies (detailed measurements can be found in Stärk 1958, Klee 1961, Leroy 1969 & 1970), and in particular highlight the frequency of a vestigial or not-so-vestigial right file among male katydids, which seems to be largely overlooked in recent literature. It might be a useful character to include in morphological and phylogenetic studies in katydids, and perhaps the mechanisms that lead to the observed variety in development of the right file could be elucidated. It might be worthwhile to look under the right tegmen, which in pinned male specimens is rarely extended, and document the development or absence of stridulatory teeth.

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