

Distribution of low frequency vibrational songs in local Heteroptera

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ABSTRACT The basic type of acoustic emission in Geocorisae according to our previous investigations is the low frequency type of song, as described first in some Pentatomoidea. The structure related to the production of such vibrational signals is the tergal plate (fused first two abdominal terga) with the attached muscles, as shown recently by KUŠTOR (1989) and AMON (1990). During last years we have recorded low frequency vibrational songs, alone or in combination with the broad band stridulatory signals in some groups of Heteroptera where this phenomenon was previously not known. We recorded low frequency vibrational songs in local species of Plataspidae (*Coptosoma scutellatum*), Rhopalidae (*Corizus hyoscyami*), Alydidae (*Alydus calcaratus* - together with stridulation) and Coreidae (*Coreus marginatus*).

IZVLEČEK - RAZŠIRJENOST NIZKOFREKVENČNIH VIBRACIJSKIH NAPEVOV PRI DOMAČIH VRSTAH STENIC (HETEROPTERA) - V predhodnih raziskavah smo ugotovili, da je pri skupini Geocorisae osnovni tip vibracijskih napevov nizkofrekvenčni tip, ki je bil najprej opisan pri nekaterih vrstah skupine Pentatomoidea. Struktura, povezana z nastopanjem teh vibracijskih signalov je tergalna plošča (zlita prva dva abdominalna tergita) s pripadajočimi mišicami, kar sta pred kratkim dokazala tudi KUŠTOR (1989) in T. AMON (1990). V zadnjem času smo dokazali obstoj takih nizkofrekvenčnih signalov kot edinega tipa vibracijskih napevov ali v kombinaciji s stridulacijskimi signali še pri nekaterih skupinah stenic, kjer ta fenomen dosedaj še ni bil znan. Tako smo posneli in analizirali nizkofrekvenčne vibracijske napeve pri domačih vrstah družin Plataspidae (*Coptosoma scutellatum*), Rhopalidae (*Corizus hyoscyami*), Alydidae (*Alydus calcaratus* - tudi stridulacijske signale) in Coreidae (*Coreus marginatus*).

Low frequency vibrational songs in terrestrial Heteroptera (Geocorisae) have been detected and recorded in many species and families of bugs (GOGALA, 1984). Such signals were described for the first time for some Pentatomoidea by JORDAN (1958).

The structure related to the production of such vibrational signals is the tergal plate with the attached muscles, as shown by GOGALA (1969, 1985) and recently by KUŠTOR (1989) and AMON (1990). These muscles cause the movements of the tergal plate and the vibration of the whole abdomen as a pendulum. A tymbal mechanism (i.e. a bistable mechanical structure) has been proposed by GOGALA (1984), but questioned recently by NUMATA et al. (1989). The direct proof for a tymbal device is still missing, but there is much indirect evidence, supporting this idea (effects of immobilisation, physical characteristics of signals, activity of muscles etc.).

Similar structures and low frequency vibrational signals were also described in small species of Homoptera Auchenorrhyncha (see review in CLARIDGE, 1985). It was therefore assumed that this type of low frequency vibrational signals is the basic type of acoustic emission in Hemiptera (GOGALA, 1984).

Low frequency vibrational songs have been reported up to now in many species of bugs belonging to the families Lygaeidae, Cydnidae, Thyreocoridae, Scutelleridae, Pentatomidae, Acanthosomatidae, as well as Tingidae, Reduviidae and Phymatidae. In some groups these low frequency signals are combined with stridulatory signals as in the families Cydnidae or Reduviidae, but in others only low frequency signals are present, for example most Pentatomidae and some Lygaeidae (GOGALA 1984, 1985).

During the past years we have recorded low frequency vibrational songs as the only acoustic emission or in combination with the stridulatory songs in some groups of Heteroptera where this phenomenon was previously not known but in some cases expected (e.g. *Coreus marginatus*, GOGALA 1984).

Vibrational signals of these bugs were recorded with a contact dynamic microphone (Electro Acoustic Laboratory, Ljubljana) on a tape or cassette recorder (UHER Report 4200, SONY WM-D6C). Alternatively, we recorded vibrations of a host plant stem with a miniature magnet fixed to the plant and an induction coil, according to the method described by STRÜBING and ROLLENHAGEN (1988). Oscillograms were produced by a special program, written in OMIKRON.BASIC from digitized samples on an ATARI MEGA ST-4 computer using a 16 bit sampler (AS Sound Sampler III, G-Data Bochum) and a laser printer ATARI SLM 804. Sonagrams were made from selected parts of the same samples after transformation to a PC format with the CED WATERFAL program (using a PC-SPEED emulator on the same computer).

We recorded for the first time low frequency vibrational songs in local species of Plataspidae (*Coptosoma scutellatum*), Rhopalidae (*Corizus hyoscyami*), Alydidae (*Alydus calcaratus* together with stridulations) and Coreidae (*Coreus marginatus*).

In *Coptosoma* such signals were recorded from specimens placed directly on a contact dynamic microphone or alternatively by an electromagnetic transducer detecting the vibration of the host plant stem on which the bugs were feeding and courting. The physical characteristics of the courtship song of the male are evident from the fig. 1.

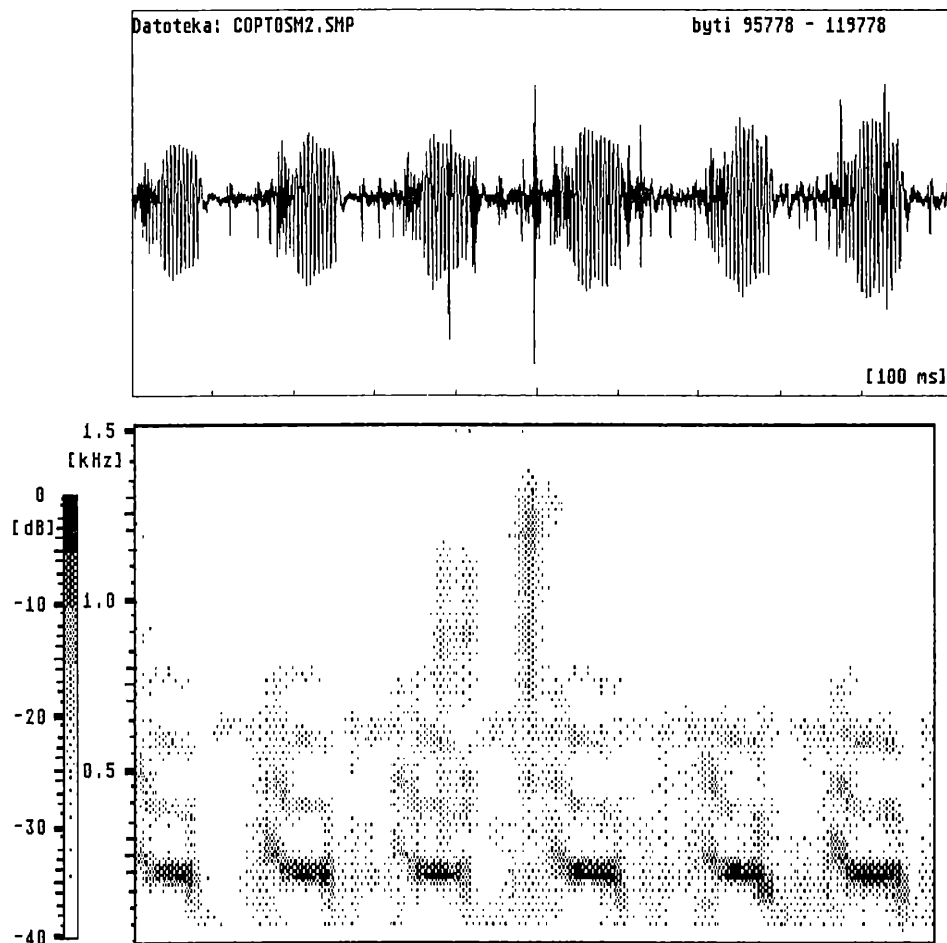


Fig. 1. *Coptosoma scutellatum* (Geoffroy) (Plataspidae) Oscillogram (above) and sonagram of the male courtship song, recorded with a contact microphone. The basic frequency is about 200 Hz.

In Coreidae previously detected signals in *Enoplops scapha* and *Coreus marginatus* were quite different from the typical low frequency songs of many other bugs (GOGALA, 1984). Nevertheless, typical low frequency songs were recently detected also in *Coreus marginatus*, as was expected from the shape of the first two terga. Oscillogram and sonagram of this vibrational song are shown in fig. 2.

The stridulatory apparatus was described previously in some species of Alydidae (SCHAEFER and PUPEDIS, 1981). We have recorded in *Alydus calcaratus* both stridulatory as well as low frequency signals. Recently, NUMATA et al. (1989) also reported in *Riptortus clavatus* four types of

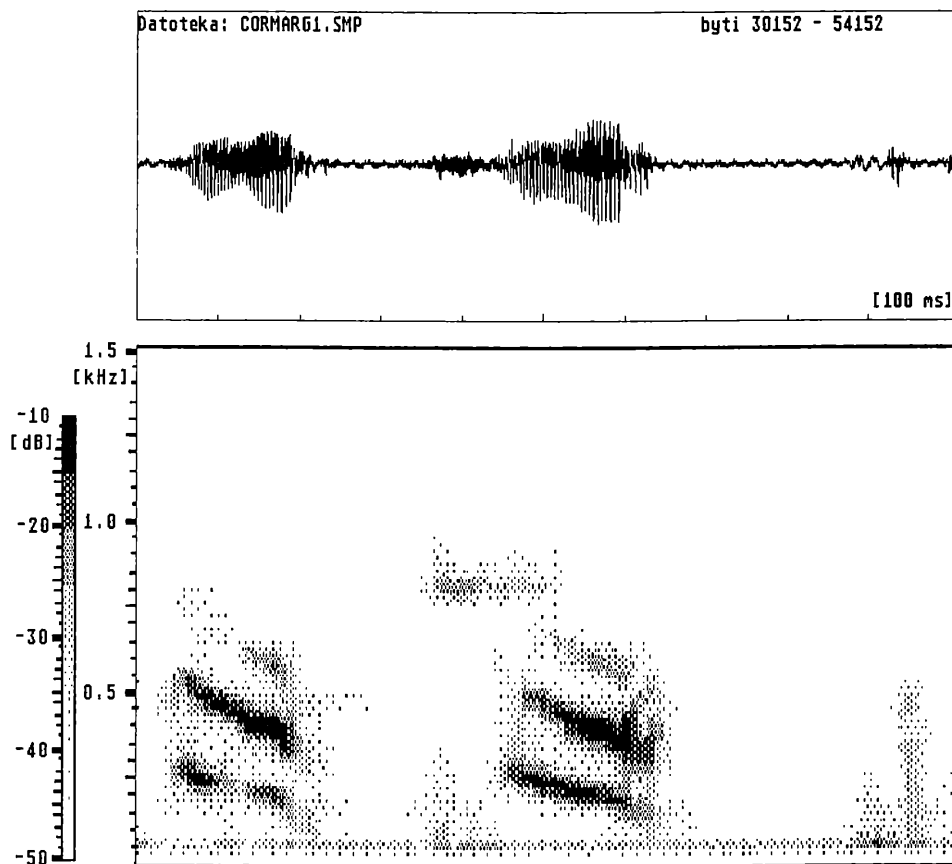


Fig. 2. *Coreus marginatus* (L.) (Coreidae) low frequency signal of a male, recorded on a contact microphone. Note frequency sweeps typical for many vibrational songs of bugs.

songs with fundamental frequencies in the range of 80-250 Hz. *Riptortus* according to these authors does not have any stridulatory apparatus. Two types of signals, recorded in our species *Alydus calcaratus* are shown in figs. 3 and 4.

To my knowledge there are no previous reports on acoustic behaviour of Rhopalidae. Nevertheless, we succeeded in recording low frequency song in males of *Corizus hyoscyami*. These signals, representing a series of highly damped transients, are also similar to other low frequency songs of Heteroptera, with a basic frequency of the vibrational signal of around 80 Hz (recorded as a velocity parameter by a contact dynamic microphone - Fig. 5).

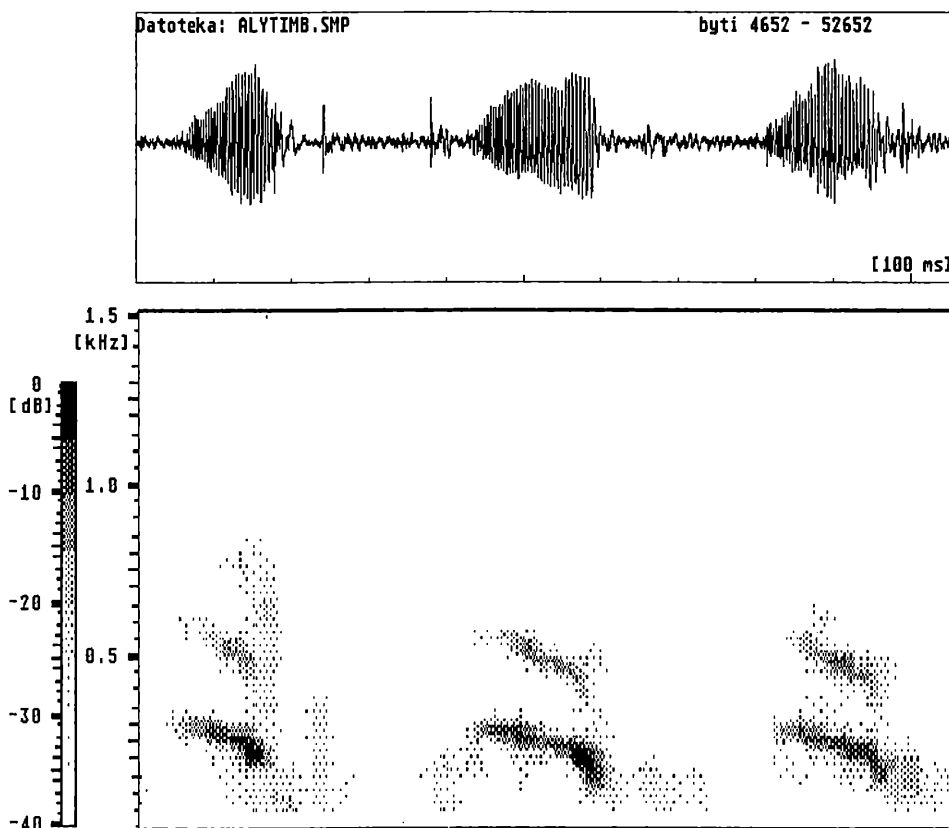


Fig. 3. *Alydus calcaratus* (L.) (Alydidae) a low frequency "tymbal" type vibrational signal of a male with similar frequency modulation as in fig. 3. Recording with a contact microphone.

With these data my assumption is supported of the origin and occurrence of low frequency vibrational songs as a widely spread phenomenon in Heteroptera and an old acquisition in the phylogeny of Hemiptera (GOGALA, 1984). In this paper we do not analyse the details of the acoustic repertoire of the bug species mentioned above. We would only like to emphasize in this preliminary report the ubiquity and universality of the presence of low frequency songs in terrestrial Heteroptera. It should be mentioned that in all these cases the structure of the first two terga is

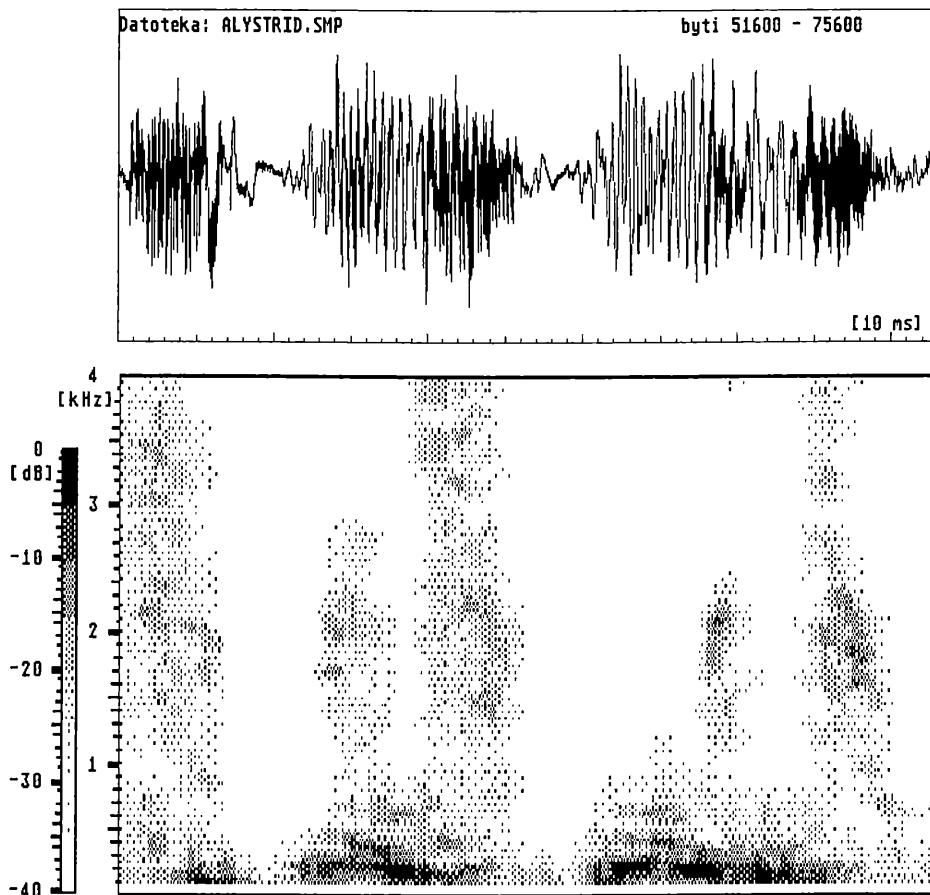


Fig. 4. *Alydus calcaratus* (L.) (Alydidae) stridulatory signal, produced by rubbing the hind femora against a pars stridens on the edges of hemelytrae. In addition, a strong low frequency component is evident in a sonagram.

similar. Since we know that the muscles attached to these structures are responsible for the production of low frequency songs, at least in *Nezara viridula* (Pentatomidae) (KUŠTOR 1989, AMON 1990). This fact still supports the idea, that the tergal plate is the structure involved in vibrations production.

It is interesting that we found a very similar shape of the first two tergites in some Hydrocorisae also, but here the low frequency songs are not known as yet.

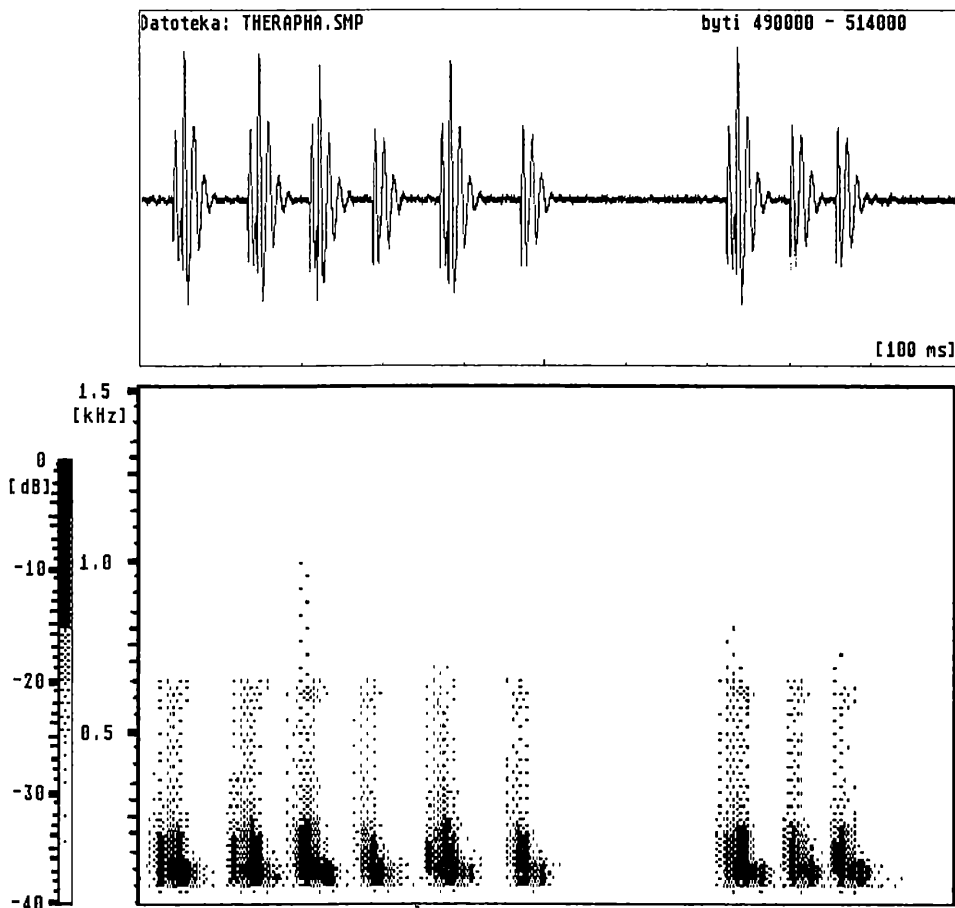


Fig. 5. *Corizus hyoscyami* (L.) (Rhopalidae) series of low frequency transients produced by a male during courtship. The basic frequency of these signals, recorded with a contact microphone, is about 80 Hz.

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