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Tremulation of Firebags *Pyrrhocoris apterus* L. (Heteroptera, Pyrrhocoridae)

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Abstract—Tremulatory signals of firebugs *Pyrrhocoris apterus* L. are described. The oscillogram of the tremulatory signals is given.

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Along with chemical, visual, and acoustic communication, many representatives of true insects or bugs (Heteroptera) have a vibrational communication system. According to the latest evidence (Virant-Doberlet and Čokl, 2004), vibrosignaling was recorded in representatives of 18 out of approximately 50 bug families known in the world. The modes and mechanisms used for emitting vibrosignals are diverse. First, being relatives of cycadas (Homoptera), many Heteroptera have a cymbal apparatus. Second, vibrosignals may be produced thanks to the work of wing muscles during the unfolding and folding of the wings. Third, different rubbing parts of the body, limbs, and wings may be involved in vibration production. Fourth, vibrations may be caused by mere trembling (tremulation) of the whole body or a part of it.

However, for several families of bugs, reports of the presence of acoustic communication have been lacking so far. To silent Heteroptera, in which neither acoustic nor vibrational signals have been found, the representatives of the family of Pyrrhocoridae are also assigned. This family includes *Pyrrhocoris apterus* L., which is known for its numerous red-black colonies on the stems of trees, stumps, and fences. This species has been long used as a model one for many scientific studies related to biogeography, embryology, development and reproductive biology, endocrinology, biochemistry, cytogenetics, genetics, ethology, and other trends in biology (Socha, 1993). It is successfully cultivated in laboratories, is widespread in nature, and is not rare; however, the capacity for emitting vibrosignals has not been recorded in it as yet. We detected a well-pronounced tremulation in both sexes and larvae of this species, which is described below.

MATERIAL AND METHODS

Vibrations were recorded using standard methods, which were previously published (Benediktov, 2001). The temperature during the recording was 26–28°C.

We observed tremulation in young, completely pigmented males and females, as well as in the last larval instar of *P. apterus* from the following geographical points of Russia: Kaluga oblast, Obninsk, July 17, 2004, two males and one female *forma brachyptera* (greater Obninsk region), signals were recorded and studied; Moscow, Vorob'evy gory, August 2, 2005, male *forma brachyptera* and two larvae of the last instar (greater Moscow region), visual observations; Moscow oblast, Volokolamskii raion, village of Kurbatovo, August 11, 2006, three females and two males *forma brachyptera*, male *forma macroptera* (greater Kurbatovo region), visual observations; and Voronezh oblast, Usman pinewood, Venevitinovo Biological Educational-Scientific Center, VGU, June 29, 2006, two males and three females *forma brachyptera* (greater Venevitinovo region), video records were made.

RESULTS AND DISCUSSION

After a male and a female were placed on the cardboard plate of the device for recording vibrational signals, they adapted to the new conditions for some time: intensively moved trying to find an exit from the closed space. During this movement, the insects easily contacted with each other, climbed on the back of the partner, or pushed it in the side; however, we recorded no signals detected in similar situations for other bugs or generally for insects emitting vibrations. If one of the individuals turned out to be on the top, the individual below it threw it off from its back by a jerk, after which movement over the substrate resumed. Some time after, there came a period of rest: the bugs either cleaned their legs, antennas, or proboscis or sat immovably. This state could last from several to tens of minutes. At this time, a female (Fig. 1a) or a male (Fig. 1b) sometimes shook its whole body, emitting a vibrational impulse with a duration of 0.8–1.3 s with an unclear inner structure. The vibrational impulses were always single, and the intervals between them comprised an indefinitely long time.

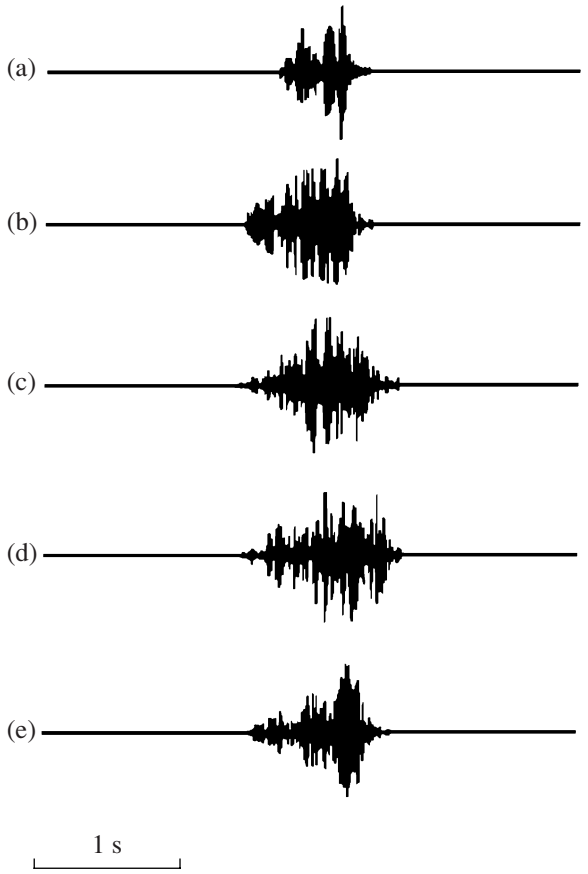

Fig. 1 Vibromessages of *Pyrrhocoris apterus* L. (Obninsk): (a) the female near the male; (b) the male near the female; (c) solitary female; (d) solitary male; (e) the male near the second male.

The isolated female (Fig. 1c) or male (Fig. 1d) also shook its whole body and emitted a similar vibrational impulse during the intervals between activity. Seldom, during the vibration, if an individual could touch the substrate with the bottom side of its abdomen, the signal became clearer. The maximum intervals between the messages could comprise 30–60 min or more and the minimal, about 5–15 min.

We recorded neither signals nor male courtship of the female prior to copulation or visible female responses to them. Crawling to the female, the male rapidly fell on it, seized it by his legs, shook its whole body, and began copulation (we observed a similar behavior of young males from Venevitinovo with respect not only to females but also to other males and even to larvae). In copula, the male and female could tremble without stopping the mating process even during movement. After separation of the copulating pair, the male could for some time move near the female; then, often it again seized her with its legs, shivered, and copulated repeatedly.

Two males placed together quite peacefully neighbored with each other. The second male did not respond to the vibrational impulses of the other (Fig. 1e). Moreover, at that moment, the silent male exhibited neither fear nor vigilance: if the signal was produced during cleaning of antennas and legs of the silent male, it, as if nothing were the matter, continued to be engaged in the mentioned action.

In bugs from other sites (Kurbatovo, Venevitinovo), we observed a similar picture: tremulation was typical of both solitary males and females and insects in groups including individuals in copula that could be short–winged, full-winged forms, or larvae of the last instar. We once observed tremulation of larvae of the last stage in individuals from Moscow; it visually did not differ from that of the imago.

Note that the same individuals of *P. apterus* L. not always vibrated with their body. We failed to relate the cause of it to any external factors (illumination, temperature, humidity). We observed vibrations in nature in the direct sun on hot days and in cloudy weather on a comparatively cool morning (temperature about 22°C). Thus, the issue concerning the role of tremulation for *P. apterus* remains open.

Vibrational signals transformed into sound, as well as photographic and video materials, are available on the internet on the Entomology Info site (http://entomology.ru/heteroptera/).

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