

Observations on a sound-producing female of *Orchamus gracilis* (Brunner, 1882) from Cyprus (Caelifera: Pamphagidae)

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Abstract

Mid-November 2012 a female of the endemic *Orchamus gracilis* (Brunner, 1882), sitting on a pine tree on the Troodos Mountains (Cyprus), was captured and held in captivity over 3.5 months, feeding on conifer needles, perhaps the first observation of conifer feeding in Pamphagidae. Rather irregularly, this female stridulated by flapping, moving the short tegmina rapidly over the reduced alae structures. It is the first evidence of sound production in the genus *Orchamus*.

Zusammenfassung

Mitte November 2012 wurde ein Weibchen des endemischen *Orchamus gracilis* (Brunner, 1882), an einer Kiefer sitzend, im Troodos-Gebirge auf Zypern gefangen und über drei Monate in Gefangenschaft gehalten, wo es sich von Koniferennadeln ernährte, der wohl erste Nachweis einer Nadelhölzer fressenden Pamphagide. Das Weibchen stridulierte in sehr unregelmäßigen Abständen in kurzen Pulsen (< 1 sec), erzeugt durch 'flapping', einer schnellen Bewegung der Tegmina über eine stark rückgebildete Alaestruktur. Es ist der erste Nachweis einer Stridulation in der Gattung *Orchamus*.

Introduction

The genus *Orchamus*, distributed from the Eastern Mediterranean to the Middle East, includes five species, with *O. yersini* (Brunner, 1882) and *O. gracilis* (Brunner, 1882), an endemic species, occurring on Cyprus. Hitherto, from *O. gracilis* only few individuals were found, resulting in scarce behavioral and ecological information (HARZ 1975; MASSA 1995, 2009; TUMBRINCK 2006). Therefore it is worth to describe in a short note some observations in an adult female recently found in Western Cyprus.

Locality, habitat and captivity

The female of *O. gracilis* was captured on 10.XI.2012 in the Troodos Mountains north of the locality Troodos at 1.691 m a.s.l (34°56'12" N, 32°53'12" E; leg. E. Friedrich). It was located in the surroundings of a picnic site, in the typical mountain vegetation, an extended light conifer forest dominated by black pine (*Pinus nigra*), mixed with Aleppo pine (*Pinus brutia*). Here the *Orchamus*-♀ (Fig. 1) was sitting on a pine stem (Ø 50-70 cm) in about 2.50 m height, at 13.30 p.m., shortly after a cold front with heavy rain had been passed and the air was still misty, with temperatures around 10 °C.



Fig. 1: Adult female of *Orchamus gracilis*, put on a pine branch distant from its habitat. 10.XI.2012. Photo: E. Friedrich.

After taking photographs, the female was stored in a plastic box over 10 days in refrigerators (4–6 °C), interrupted only by an one day trip per plane and train. On 21.XI. it was put in a small cage (16×16×24 cm) at the SSE-window of my working room (G.K.) at the Institute of Ecology in Jena. According to the sampling circumstances, short spruce twigs, put into a glass with water, were offered as potential food. Additionally, in Mid-February, a box with fine sand for egg-laying was put in the cage. The female survived about three and a half months in captivity and died around the 26.II.2013, without producing an egg-pod.

Characteristics

After the death of the female, an exact determination as *O. gracilis* (in comparison with *O. yersini*) was possible using the keys, descriptions, measures, and figures in HARZ (1975) and MASSA (1995, 2009). In contrast to other species of the genus, *O. gracilis* is distinctly smaller (species name!), but within the species variation the body size of our female is rather large with 42 mm (fastigium – apex of postfemur; MASSA 2009) resp. 55 mm (apex – ovipositor valves; HARZ 1975), whereas other measures stay within the known variation (Table 1). Further characteristics correspond more or less to existing descriptions, available only from a few females (see Table 2). The antennae, about as long as head and pronotum, have each 13(14) flattened segments of different length. The long-elliptical and slightly curved tegmina do not reach the end of the first abdominal segment,

nearly covering the more or less trapezoid tympana. The postfemora are light pink apically, their inner sides show scattered white spots within a yellow/brownish matrix. The posttibiae are also pink apically (extending to the first two tarsal segments), and their inner sides are metallic blue. The overall body color is brownish-grey marbled with spot-like areas and dark broken lines, the tergites are distally red-brown, each with six short dark brown lines on each side. Based on this colouring, both in its habitat and mainly on pine stems, the species (♀) is well camouflaged (Fig. 1 and 2).

Table 1: Female body measures (mm) of the two *Orchamus* species occurring on Cyprus (MASSA 2009) completed by the female from the Troodos Mountains, leg. E. Friedrich. Note: total length = fastigium up to the apex of the postfemur.

Species	Total length	Pronotum		Postfemur	
		length	height	length	height
<i>O. yersini</i> (29 ♀♀)	51.4±4.0	11.7±0.8	12.4±1.0	23.9±2.3	5.4±0.5
<i>O. gracilis</i> (4 ♀♀)	40.0±1.5	7.8±0.3	9.0±0.4	18.5±0.9	4.1±0.04
<i>O. gracilis</i> (1 ♀) of Troodos Mts.	42.0	7.6	8.3	18.5	4.4

Feeding

In accordance with the sampling locality, the caged female was provided with conifer twigs as food, taken from a bunch of Advent (*Abies nordmanniana*), from Christmas tree (*Picea pungens*), and from an Institute's tree (*Picea abies*). Within the first weeks, it did not feed and produced no faeces. Only during December, the first needles were bitten off and dry faeces were found in the cage, and after that the pamphagid fed in irregular intervals, sometimes all the needles of a small twig were removed. But in detail, the needle was bitten off from its base and partly eaten, whereas many needles dropped down. During day time longer feeding was never observed, suggesting that feeding occurred mainly during the night. The opened crop of the dead female contained a brown mass of small pieces of needle tissue and few dark pieces of bud scales. The same plant material (short tissue pieces of 0.5–1.5 mm) occurred in the faeces, dried green-grey sticks of 11–13 mm length and 2.5–3 mm in diameter, most of them with six dark lines around (Fig. 3).

The ovariole number, difficult to establish, was about 25 (12+13), with one well, 14 weakly, and 10 not developed terminal oocytes, what agrees with the missing egg-pod production during captivity.

Tegmino-alar stridulation

After two and a half month in captivity, on 31.I.2013 at 15.15 p.m. I noticed (G.K.) for the first time a sudden rustling sound from the female's cage in about three meters of distance, resembling to a flapping insect within a narrow container. One sound lasted < 1 sec and was composed of rapid and somewhat metallic beats. One week later on 05.II., the female stridulated over the day, beginning in the late morning during sunshine up to the early evening both in the sun and in

the beginning darkness. The short sounds followed in very irregular intervals from few minutes to several hours (and days), and it was very difficult to wait and observe. Only once the rapid and powerful up and down beat of the forewings could be seen, accompanied by a slightly moving abdomen, but without moving the legs. The female stridulated with both closed and spread legs, but mostly sitting vertically at the gauze of the cage. During the following darker days (with snow), the stridulation occurred still few times and ended in Mid-February, after a "singing" period of about 2–3 weeks.

After the death of the female the sound producing structures could be detected, finding a tegmino-alar mechanism. In more detail, a basally thickened vein on the ventral side of the tegmen (7.7 mm long, 1.9 mm high) functioning as a scraper, is rubbing over a chitinous ear-like bump (1.8 mm long; a modified ala) on the metanotum functioning as stridulatory file (Fig. 4 and 5). The different length of the scraper on the left (3.3 mm) and right side (2.4 mm) was striking.



Fig. 2: Adult female of *Orchamus gracilis* near Troodos (Cyprus), camouflaged on black pine, 10.XI.2012. Photo: E. Friedrich.



Fig. 3: Faeces of *Orchamus gracilis* (♀) after foraging on spruce. Photo: G. Köhler.



Fig. 4: Stridulation structures of *Orchamus gracilis* (♀). Note the thickened vein on the basis of the folded up right tegmen and the ear-like reduced ala on the metanotum. Using stereomicroscope 31x, Photo: G. Köhler.



Fig. 5: Thorax of *Orchamus gracilis* (♀) from the left. Note the folded down tegmen, the reduced ala, and the trapezoidal tympanum. Using stereomicroscope 25x, Photo: G. Köhler.

As summarized for the Pamphagidae by MASSA (2012), the *Orchamus*-♀ has a well developed Krauss's plate on both sides of the second tergite, an elliptical area of 3.5 mm height and with about 50 washboard-like horizontal ribs, but without specialized hind femora. Maybe, that this structure can also be used for stridulation (by rubbing the base of the inner hind femur on it), as confirmed in females of *Ocnerosthenus simulans* and *Acinipe calabra* (MASSA 2012).

Discussion

Origin, distribution, and phenology. Hypothetically, the endemism of this flightless *Orchamus* species could originate in the Late Miocene, when the Mediterranean Sea during the Messenian salinity crisis completely dried out (between 6.5 and 6 million years B.P.), because after that, the island of Cyprus was separated from the Southern Anatolian mainland (HOFRICHTER 2003).

As published records, about 12 individuals (5 females, 4 males, 1 larva/nymph, 2 others) of the endemic *O. gracilis* from 9 localities are known, with five of them from the Troodos Mountains (Table 2). They occurred in altitudes from 100-1700 m, and were found as adults from Mid-April to the beginning of May and from the end of September to Mid-November (Table 1). Considering that our female survived the winter months, probably the adults hibernate, start with mating in February (when the female attracts the male by stridulating) and with egg-laying in March/April. This also explains the only juvenile found at the beginning of July (TUMBRINCK 2006, according to a letter by Szijj – assuming it was correctly identified).

Table 2: Documented localities of *Orchamus gracilis* in Cyprus (in chronological order), summarized by TUMBRINCK (2006) and MASSA (2009), completed by geographical details. ¹ Given as Livadia (Troodos) in MASSA (2009); there are two other 'Livadia' on Cyprus.

Ind.	Date	Locality	Region	Altitude (a.s.l.)
2 ♂	---	Zypern	---	---
2 ♀	---	Nikosia	Central, Mesaoria Plain	170 m
?	---	Halevga	N, Kyrenia chain, Pentadactylos Mts.	630 m
?	---	Mesa Potamos	W, Troodos Mts.	1100 m
♀	18.IV.1939	Livadia ¹	W, Troodos Mts.	~ 1000 m
L	VII.1992	Akamas	NW, Peninsula / Cape	up to 400 m
♂	27.IV.1997	Kandou	SW, Coastal Plain	~ 100m
♂	5.V.2002	Stavrovouni monastir	S, E Troodos Mts.	500-600 m
♀	30.IX.2005	Stavros tis Psokas	W, Troodos Mts.	900 m
♀	10.XI.2012	Troodos	W, Troodos Mts.	1690 m

Feeding. Generally, in Acridoidea conifer feeding is very rare, occasionally mentioned from a few African and North American species (UVAROV 1977). From Europe there is an old observation from 1838 that the Oedipodine *Psophus stridulus* fed on pine seedlings in Liegnitz / Upper Silesia (ZACHER 1917, after Ratzeburg). And the highly polyphagous Gomphocerine *Dociostaurus maroccanus* was reported to feed on pine and juniper (summarized by LATCHININSKY 1998).

From Pamphagides, there is only a notice in UVAROV (1977): "There is a suspicion that some pamphagides found on pines may also use them as food; an Anatolian species of *Acinipe* occurs in such conditions (BURR 1948)". Following this, our female could be the first Pamphagidae to be observed, successfully feeding on conifer needles (but without any food choice). Unfortunately, there is still a lack of evidence that the species also feeds on pine needles in nature.

Flapping. In Pamphagidae, three main stridulation techniques are known (rubbing, tabbing, flapping), based on at least six different mechanisms, as femuro-abdominal, tibio-alar, tibio-tegmina, alar-notal, tegmino-tibial, and tegmino-alar combinations (JOHNSON 1972, LÓPEZ et al. 2008). A hitherto rare case is the tegmino-alar flapping, where a sound is produced by moving a thickened vein on the inner side of the tegmen over the rudimental ala, grown together with the metanotum, hitherto described in females of the African *Glauia durieui* and *Acinipe crassicornis* by JOHNSON (1972, first description of flapping), and in the Iberian *Eumigus punctatus punctatus* (PRESA et al. 2000). According to this, flapping in *Orchamus gracilis* is the fourth observation of a species using this technique. A similar tegmino-alar mechanism, but with movable alae, was described in *Pamphagus tunetanus* by INGRISCH (1983; *P. sardus* with the same structure). In the few species studied, females began to stridulate a few weeks after the moult to adult and only in the absence of males (they stopped after contact with males), indicating it to be an attracting behavior (INGRISCH 1983, GARCIA & PRESA 1985, LÓPEZ et al. 2008).

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