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Poecilimon mytilenensis Werner, a polytypic phaneropterid bushcricket from the Aegean island of Lesbos (Orthoptera, Tettigonioidea), differing in male mating structures

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Abstract

Description of a new subspecies of *Poecilimon mytilenensis* Werner 1932. Both the new and the nominate subspecies occur on the island of Lesbos, Greece. Both subspecies differ mainly in the length of the tip of male subgenital plate. In addition to morphological data and a detailed distribution map, descriptions and oscillograms of male song of both subspecies, female song of the nominate subspecies and some data on the unusual mating behavior (ampulla mass 15 % of male body mass) are provided.

Key words

Poecilimon, Greece, Turkey, Lesbos, new subspecies, song, bioacoustics, spermatophore, ampulla

Introduction

The genus *Poecilimon* is the most species-rich bushcricket genus of southeast Europe and Anatolia. A few species range widely, but most are restricted to a small area. Many of its species are well defined by specific characters of the male subgenital plate and cerci (see Ramme 1933b, Bei-Bienko 1954). In some groups (*e.g.*, *Poecilimon affinis* / *ornatus*), however, these characters are quite similar, even when occurring sympatrically (Willemse 1984, 1985a). Another most helpful character in identification is the male calling song. This may differ considerably between morphologically closely related species (*e.g.*, Heller & Reinhold 1992). The characters of most species are stable throughout their range and if intraspecific variation is noteworthy, it is observed commonly in species with a wide range (*e.g.*, *Poecilimon jonicus* group). In this paper, however, we describe a species which, notwithstanding its small range, occurs in 2 forms.

Poecilimon mytilenensis was known by a very few specimens from the Greek Aegean island of Lesbos. On account of fresh material the species was redescribed in Willemse & Heller (1992). In that study it became apparent that on the island of Lesbos (=Lesvos), 2 forms occur, quite distinct in length of subgenital plate (Figs 21, 22 in Willemse & Heller 1992). The available data were not sufficient to make more decisive conclusions. Therefore 2 further excursions to Lesbos were made (May 1993 by Heller, April 2001 by Luc Willemse). Meanwhile the species was found also in the adjacent Turkish Aegean island of Alibey. The results of these studies are presented in this paper.

Material and methods

Depositories of material are abbreviated as follows: CH *Collectio* Heller, Magdeburg; CW *Collectio* Willemse, Naturalis, Leiden; HUZOM (Hacettepe University, Zoology Museum); ITZA, Instituut voor Taxonomische Zoologie, Amsterdam; MNHB Museum fur Naturkunde der Humboldt-Universität, Berlin; MZAA Michigan University Museum of Zoology, Ann Arbor; NMW Naturhistorisches Museum, Vienna.

For sound recording in the field a Uher tape recorder 4200 IC was used with a microphone Uher M 645 (frequency response flat up to 20 kHz); in the laboratory we used a Racal store-4-D tape recorder with microphones Brüel & Kjaer 4133 and 4135 (frequency response flat up to 40 and 70 kHz resp.). The Turkish animals were recorded in the laboratory using a Sony WM-GX688 Walkman and a stereo microphone (50 Hz to 18000 Hz) at 22°C (distance to microphone about 5-10 cm). After digitizing the songs on a PC or an Apple computer, oscillograms (after filtering) and sound analyses were made, using a PC and the programs Turbolab, Amadeus (Apple) and CoolEdit. Wing movements were registered by an opto-electronic device (Helversen & Elsner 1977, modified as in Heller 1988). Due to the heating effect of the registration lamps, only a lower limit for the body temperature can be given (see Heller 1988). The actual body temperature may be up to 4 degrees higher than the ambient air temperature (measurements marked by ">").

The maps were produced using the programs Versamap (localities; 'http://www.versamap.com') and DG Terrain Viewer (relief; 'http://www.dgadv.com/dgtv') using elevation data from 'ftp://e0dps01u.ecs.nasa.gov/srtm/srtm30'.

To obtain the mass data, animals, complete spermatophores and ampullae were weighed to the nearest mg (balance Mettler PM 640).

Song terminology.— Calling song: song produced by an isolated male. Syllable: the sound produced by one complete up (opening) and down (closing) stroke of the wing. Impulse: a simple, undivided, transient train of sound waves (here: the highly damped sound impulse arising as the impact of 1 tooth of the stridulatory file).

At 'http://www.dorsa.de' the localities of the specimens in *Collectio* Heller can be visualized on a map by a web-based GIS mapping tool. The sound data are available at the taxonomic database Systax 'www.biologie.uni-ulm.de/systax/index-e.html'.

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Taxonomic part

Poecilimon mytilenensis Werner, 1932

Taxonomic history.—Some previous data on the type material of *P. mytilenensis* and its synonym *brevicauda* need to be rectified. Unlike the assumption in Harz (1969) and Otte (1997) that the male holotype of *P. mytilenensis* is traceless, it is deposited in MZAA (Naskrecki & Otte 1999, Naskrecki 2003). The same can be said about the female holotype of *brevicauda*, assumed to be lost (Ramme 1933b) but now reported also from MZAA (discussed below). Naskrecki (2003) made the situation even more complicated. In addition to the photographs of the male holotype from MZAA he figured a male from MNHB as holotype of *P. mytilenensis*. This specimen, however, is labeled "Paratypus" (Ohl, MNHB, personal communication). Werner (1932) described *P. mytilenensis* after one male. In his redescription of the species, Werner (1933b) mentioned a second male paratype, apparently the same specimen (MNHB) studied by Ramme (1933b). This second male, however, though collected together with the holotype, can only be considered a topotype according to the International Code of Zoological Nomenclature. Another error slipped in: Naskrecki (2003) mentioning a female (MNHB) as allotype of *P. mytilenensis*. Though the specimen is labeled "Allotypus" (Ohl, MNHB, personal communication) it doubtless represents Ramme's specimen of *P. brevicauda* "das mir vorliegende paratypische Weibchen [of *brevicauda*] von Mytilene", which Ramme in the same paragraph synonymized with *P. mytilenensis* (Ramme 1933b: 537).

The status of the species *Poecilimon brevicauda* Werner 1932 appears now almost completely resolved. This taxon was described from 2 females, one from the island of Limnos (= Lemnos) (holotype), the other from the island of Lesbos (= Mytilini = Mitilini = Mytilene) (paratype). According to Werner (in Ramme 1933b: 537) both females of *P. brevicauda* agreed quite well with each other and were confidently considered conspecific. Ramme (1933b) could not trace Werner's holotype in NMW because Werner, to endow his travels, had already sold/sent his types [out of his private collection, 1940 granted to NMW (Wettstein *et al.* 1941)] to MZAA and thus the type of *brevicauda* was no longer present in NMW (we assume that Ramme was not aware of this circumstance). Though *P. brevicauda*'s holotype was not available, Ramme (1933b) synonymized this taxon as the unknown female of *mytilenensis*. The female "allotype" of *P. brevicauda* from MZAA figured in Naskrecki & Otte (1999) and Naskrecki (2003) may thus actually be the holotype of *P. brevicauda*, assumed by Ramme (1933b) to be lost.

It is most likely that the paratypic female of *P. brevicauda* from Lesbos (= Mitilini) was collected in the same period and close to the site of *mytilenensis*. Though the holotype of *P. brevicauda* was recorded by Werner from Limnos (almost a week later to his visit to Lesbos), we assume that its locality label had been exchanged erroneously and the specimen was actually collected together with his paratype from Lesbos and probably close to his *mytilenensis* locality in the southeastern part of Lesbos (= Mytilini). A reconstruction of the historical events may be: Werner in southeastern Lesbos actually found 2 males and 2 females of *Poecilimon*; he recognized the males as being new and described them as *mytilenensis*; the identity of the females was obscure because one of them had been labeled (erroneously) from Limnos and thus possibly represented yet another new species which he decided to describe as *brevicauda* (several years after the collection of the specimens); he agreed with Ramme's action to synonymize *brevicauda* with *mytilenensis*. For the time being we consider Werner's record of *P. brevicauda* from Limnos to be erroneous. One of us also failed to rediscover this species during a visit to this island (K.-G.H, 11-16 June 1999), where only *P. brunneri* was found. The occurrence of the latter species indicates at the same time that the fauna of Limnos is allied to continental Thracia rather than to Anatolia, underlined also by our own observations and those in Fattorini (2002). For all these reasons the occurrence of *P. mytilenensis* in Limnos is quite unlikely.

Another rectification of more recent data refers to the identity of a male "holotype" assigned to *P. brevicauda* and figured in 3 photographs in Otte & Naskrecki (1999, under *mytilenensis*, images: habitus II, terminalia II, male wings) and Naskrecki (2003). The holotype of *P. brevicauda* is not male but female and it is evident that the images show an *Isophya* species. The specimen presented is almost certainly the holotype of *Isophya lemnotica*, which was described in the same paper as *P. brevicauda* and *mytilenensis* (Werner 1932).

Systematics

From material available since Willemse & Heller (1992) it became apparent that the length of the male subgenital plate is quite variable, not individually but among different populations. At the same time it became apparent that this variation correlates to its distribution. In the extreme southeastern part of the island of Lesbos occur populations with the longest subgenital plate, while for males of the central and northwestern part of the island plates are increasingly shorter. It also became clear that the mediodorsal part of the second abdominal tergite in the male is somewhat inflated in populations with longer subgenital plates and that this inflation is absent in males with shorter subgenital plates. From these distinct characters and other observations we feel confident describing these forms as intraspecific taxa. The form with the long male subgenital plates, shown by the holotype of *P. mytilenensis*, are assigned to the nominate form, the other is described as *P. m brevissimus* n. subsp.

Key to subspecies (male only)

— Male subgenital plate extending into an upwardly directed apical part, its length more than 0.5 mm (Fig. 1 A, B)); male 2nd abdominal tergite commonly with weak median inflation along anterior edge . . . . . *P. mytilenensis mytilenensis* Werner, 1932

— Male subgenital plate without such remarkably long apical extension (Fig. 1 C); male 2nd abdominal tergite commonly without any indication of an inflation . . . . *P. mytilenensis brevissimus* n. ssp

***P. mytilenensis mytilenensis* Werner, 1932**

Poecilimon mytilenensis mytilenensis — Holotype male, Mytilene 21. v. 1927 (ZMAA).
Poecilimon brevicauda — Holotype female, Lemnos 27. v. 1927 (ZMAA).

Poecilimon mytilenensis: Werner 1932: 297 (preliminary description); Werner 1933a: 404 (additional description), 414 (phenology); 1933b: 203 (checklist); Ramme 1933b: 507 (arrangement), 510 (checklist), 537 (description); Harz 1969: 102 (key), 144 (description); Willemse & Heller 1992: 301 (checklist), 309 (description) (*partim*); Otte 1997: 124 (catalogue); Heller *et al.* 1998: 29 (checklist); Naskrecki & Otte 1999: (catalogue, *partim*); Naskrecki 2003: (*ibid.*).
Poecilimon mytilensis [*sic*]: Willemse 1982: 156(checklist), 188 (ref-

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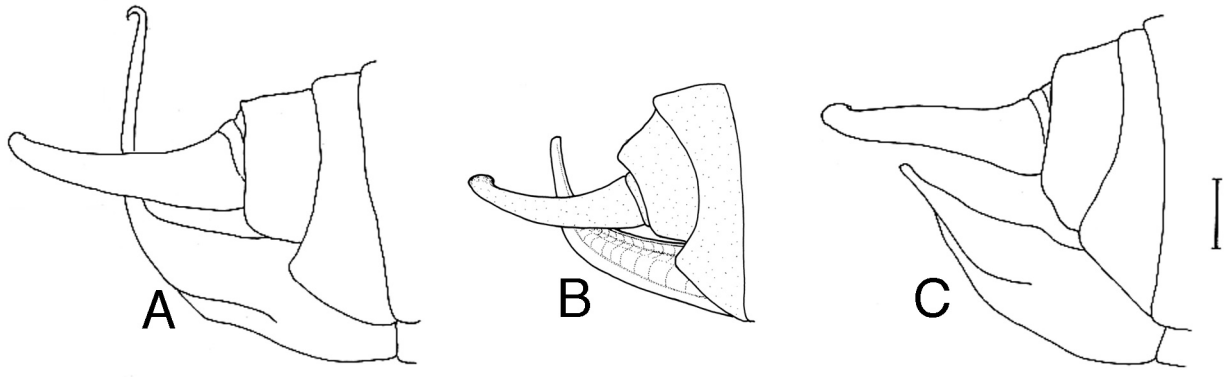

Fig. 1. Male subgenital plate of *P. mytilenensis*, lateral view. A. *P. mytilenensis mytilenensis* (Greece, Lesvos, Ayiassos); B. *P. mytilenensis mytilenensis* Turkey, Alibey island; C. *P. mytilenensis brevissimus* (Greece, Lesvos, 3 km NW Kaloni). Scale bar 1 mm.

erence); 1984: 15 (checklist), 41(reference); 1985b: 43 (key), 266 (checklist)); Heller 1988: 69 (reference).
Poecilimon brevicauda: Werner 1932: 297 (preliminary description); Ramme 1933a: 415 (additional description of *brevicauda* omitted from Werner's paper 1933a); Ramme 1933b: 499 (as synonym), 537 (as synonym); Harz 1969: 144 (*id.*); Willemse 1982: 188 (*ibid.*); Willemse 1984: 41 (*ibid.*); Otte 1997: 124 (*ibid.*); Naskrecki & Otte 1999: (*ibid.*, *partim*); Naskrecki 2003: (*ibid.*, *partim*).

Diagnosis.—A general description of both sexes can be found in Werner (1932), Ramme (1933b), Harz (1969) and Willemse & Heller (1992). As stated above, the nominate form is characterized by the male subgenital plate having a remarkably up-curved apical part; its length ranging from 0.6 to 2.7 mm (at the latter extreme quite > half the length of the remainder of the plate), arising at the distal end of the basal part and from there strongly narrowing, curved and pointing upwardly, in normal position projecting between the cerci, with the tip occasionally even reaching the dorsal plane of the abdomen; ventral side often concave; edge of very tip, particularly if length exceeds 1 mm, often folded downward collar-like, and terminating laterally into a tiny hook (Fig. 1 A, B). An as yet undescribed character, recognizable in the nominate form, is a weak median inflation along the anterior edge of the second abdominal tergite of the male, commonly indicated also as a triangularly shaped black area bordering the hind margin of the paler, more concolorous first tergite.

Song and Behavior.—The calling song of the male consisted of sequences of 25 to 120 syllables with a duration of 10 to 30 s (rarely as short as 6 s; all data for 23.5 to >27°C). At the beginning of each sequence the syllable repetition rate was mostly relatively high (5 to 8 syll./s), but became continuously lower, changing to syllable pairs and ending with separated single syllables (Fig. 3 A-C). Sometimes these single syllables were missing. In a few recordings the initial fast part was missing: the song started with syllable pairs. Each syllable was composed of 2 parts (Fig. 4 A-C), both of which were produced during the closing movement of the tegmina (Fig. 5 A).

The frequency spectrum of the male calling song showed a broad peak around 30 kHz; that of the female was quite similar (Fig. 6).

Courtship behavior.— The females responded acoustically to the male song as in many other *Poecilimon* species (*e.g.*, Heller & Helversen 1986, Heller 1990). For the production of the acoustical signal, the female closed its tegmina rapidly and opened them immedi-

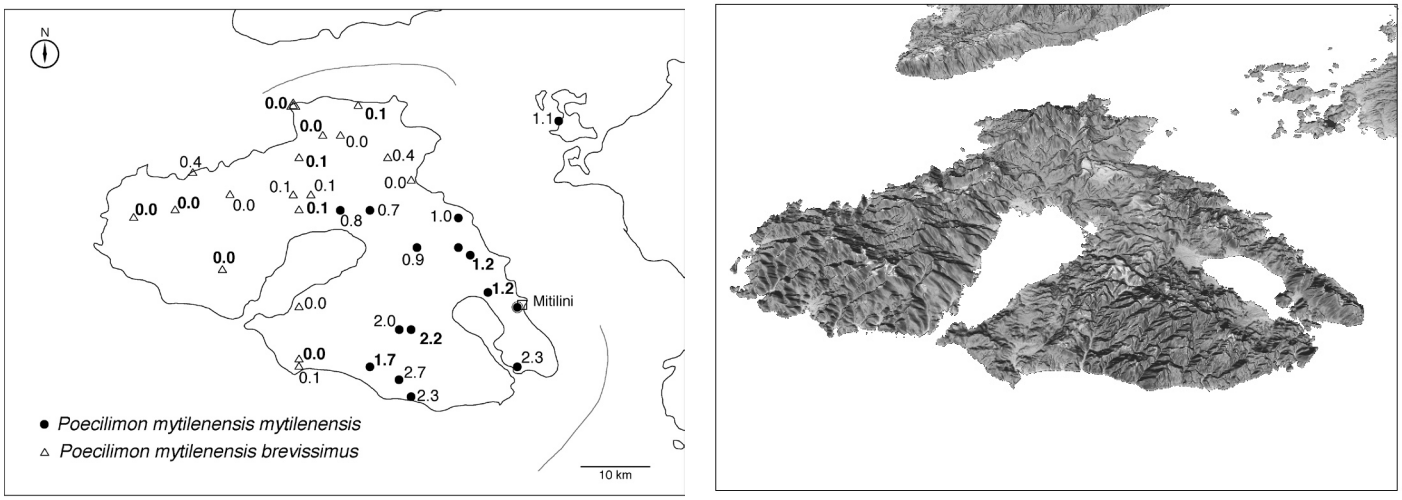

Fig. 2. A. Distribution of *P. mytilenensis* in the islands of Lesvos, Greece and Alibey, Turkey (number beside locality symbol indicates length of tip of subgenital plate; bold numbers indicate mean values (n = 2 - 6); type localities double-marked). B. Relief map of Lesbos (height of mountains 8 times enlarged).

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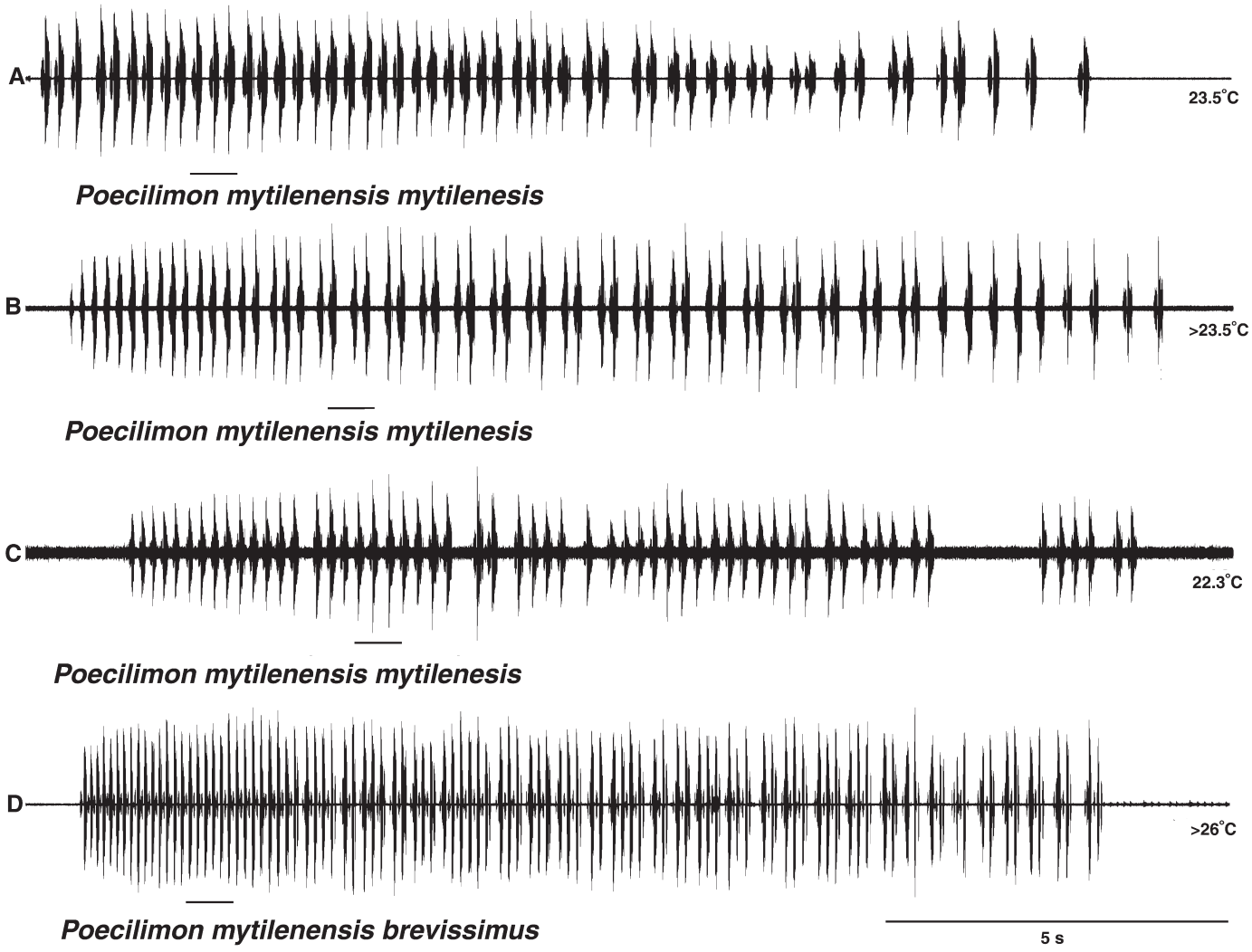

Fig. 3. Oscillograms of male calling song of *Poecilimon mytilenensis*. Horizontal bars mark the position of the enlarged sections shown in Fig. 4. A. *P. mytilenensis mytilenensis* from Rachidi (CH3016, POMY9325); B. *P. mytilenensis mytilenensis* from Moria (CH3152, POMY9317); C. *P. mytilenensis mytilenensis* from Alibey (HUZOM; P. mytilenensis-22.3 der6.wav); D. *P. mytilenensis brevissimus* from Ovriokastello (CH3000, POMY9328).

ately afterwards. Each of these movements resulted in (a single impulse or) a series of impulses (Fig. 5 B), similar to the case of *Poecilimon laevissimus* (Heller & Helversen 1986). The first answers occurred after the females had heard some syllables of a sequence, but sometimes the females responded then to 2, or rarely 3 syllables, one after another. The abrupt beginning of the second part of the male syllable may act as a trigger for the female response as in other phaneropterid species (Heller 1990, Dobler *et al*. 1994, review Bailey 2003). In this case the delay of the female stridulatory response would be around 60-70 ms at >27°C). After having heard a male song and responded to him, the female did not wait for the male, but oriented towards him and started to approach him phonotactically.

The data presented above for the males refer mainly to recordings made from animals collected in the field in 1993. The acoustic signals recorded from the females are mainly from lab-reared animals, but the sounds from a field-collected female from Rachidi do not differ significantly.

Documentation.—Sound files: male: POMY9324-5 (CH3016 (or CH3017, CH3153)), POMY9301-07 (CH3152 (or CH3151, 2995)), POMY9308-19 (CH3152), POMY9320-23 (CH3151); female: POMY9331-40 (CH3018 (or CH3154)). Possibly subspecies hybrids (see below): male: POMY9401-5 (CH5063), POMY9406-14 (CH3069), POMY9415-20 (CH5058), POMY9421-23 (CH3071); female: POMY9424-26, 33-36 (CH3072), POMY9427-32 (CH3068 or CH5062, CH5064).

Measurements.— Length (taken as usual, in mm): pronotum male 5.0 to 6.0, female 4.8 to 6.5, hind femur male 14.8 to18.0, female 14.3 to 19.0, apical part of male cercus 0.7 to 2.7 mm, see distribution map (Fig. 2); ovipositor 5.5 to 7.0. Body mass (in mg): animals from Rachidi, weighed alive 31 May 1993: male (n=4): 822±71; female (n=4): 1157±94 ($\bar{x} \pm s_{\bar{x}}$),

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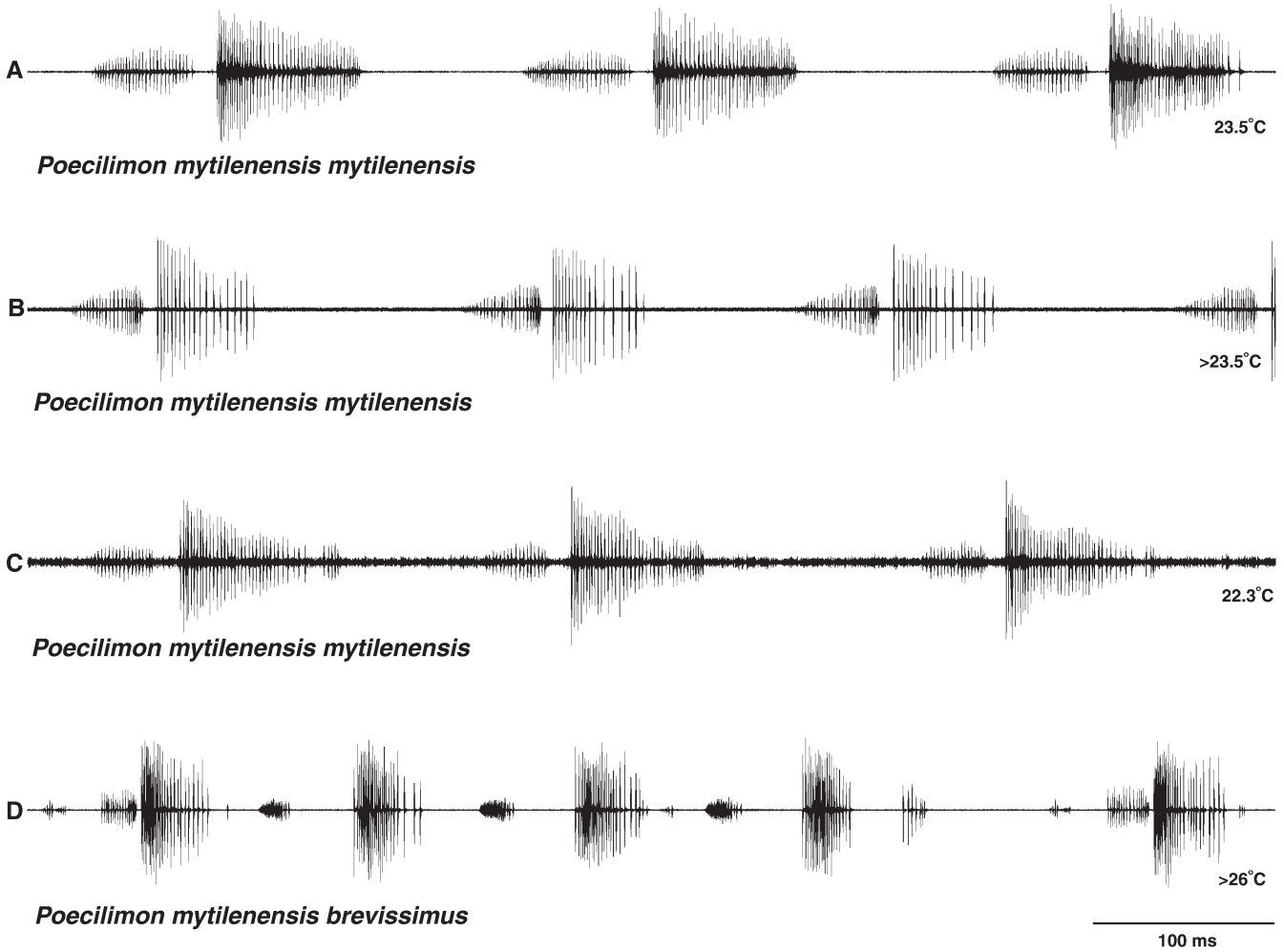

Fig. 4. Oscillograms of male calling song of *P. mytilenensis*. A. *P. mytilenensis mytilenensis* from Rachidi (CH3016, POMY9325); B. *P. mytilenensis mytilenensis* from Moria (CH3152, POMY9317); C. *P. mytilenensis mytilenensis* from Alibey (HUZOM; P. mytilenensis-22.3 der6.wav); D, *P. mytilenensis brevissimus* from Ovriokastello (CH3000, POMY9328).

Material examined.— GREECE - Aegean island of Lesvos: S of Ayiassos (lat 39° 4′ N, long 26° 22′ E), 500 m *Castanea* forest, 21.v. (15 M 11 F, ITZA & CW); Megalokhorion (lat 39° 00′ N, long 26° 35′ E), 550 m, 27.v. (1 M 2F, ITZA & CW); Playia, E of Plomari (lat 38° 98′ N, long 26° 37′ E), 29.v. (1 M 1 F, CW); Thermi, N of Mytilini (lat 39º 17′ N, long 26º 47′ E), 9.vi. (1 M, CW) (all 1988, J.P.Duffels); surr. Mistegna (lat 39º 22′ N, long 26º 45′ E), 50 m, 25.iv.2001, L. Willemse & J. Hilgeman, along Mytilini- Mandamado road on herbs next to the road (1 M, CW); Ag. Ermogenis (lat 39° 1′ N, long 26° 32′ E), 27.v.(1M 1F, CH3011-12); Olympos (below summit) (lat 39° 4′ N, long 26° 21′ E), 23.v., collected as nymphs, (1 M 1F 1M nymph, CH3019-21); near Rachidi (S of Neochori) (lat 39° 1′ N, long 26° 18′ E), 22.v. (3M 2 F, CH3016-18, CH3153-54 & 1F reared 1994, CH5064); near Moria (lat 39° 7′ N, long 26° 30′ E), 27.v. (3M 1F, CH2995 -6, CH3151-2); Halinadou (south east of Ag. Paraskevi) (lat 39° 14′ N, long 26° 18′ E), 25.v. (1M, CH3007); Nees Kidonies (26° 15′ E; 39° 14′ N), 26.v. (1M, CH2987); Komi (lat 39° 11′ N, long 26° 23′ E), 25.v. (1M, CH2988); Thermi (lat 39° 10′ N, long 26° 28′ E), 27.v. (2M, CH2989-9); 4 km west of Thermi (lat 39° 11′ N, long 26° 27′ E), 27.v. (1F, CH2991) (all 1993, all K.-G. Heller); offspring of parents from 2 different localities on Lesvos, reared 1.iii – 31.v.1994: K.-G. Heller, female from Sikaminea (or from Vafios) x male from Rachidi (6M, CH3069-70, CH5058-59, CH5063, CH5059 & from other localities 3M, CH3071, 3156-57) (see below). TURKEY - Balıkesir, Ayvalık, Alibey adası, (lat 39º21′ N, long 26º37′ E), sea level, 6.v. 2001, H. Sevgili, 25 M, 23 F (HUZOM & CH6132-3).

Distribution.— Southeastern part of the Aegean Greek island of Lesbos and the Turkish island of Alibey (see Fig. 2A). The Andhissa specimens collected 1987 (S. Drosopoulos) and arranged under the typical form (Willemse & Heller 1992) are assumed to be erroneously labeled because all additional material from this area and originating with certainty from this site, clearly belongs to *P. mytilenensis brevissimus*.

Type locality.—The label of the type specimen of the nominate subspecies, in agreement with the description, reads "Mytilene" without further specification. This name (also spelled Mytileni,

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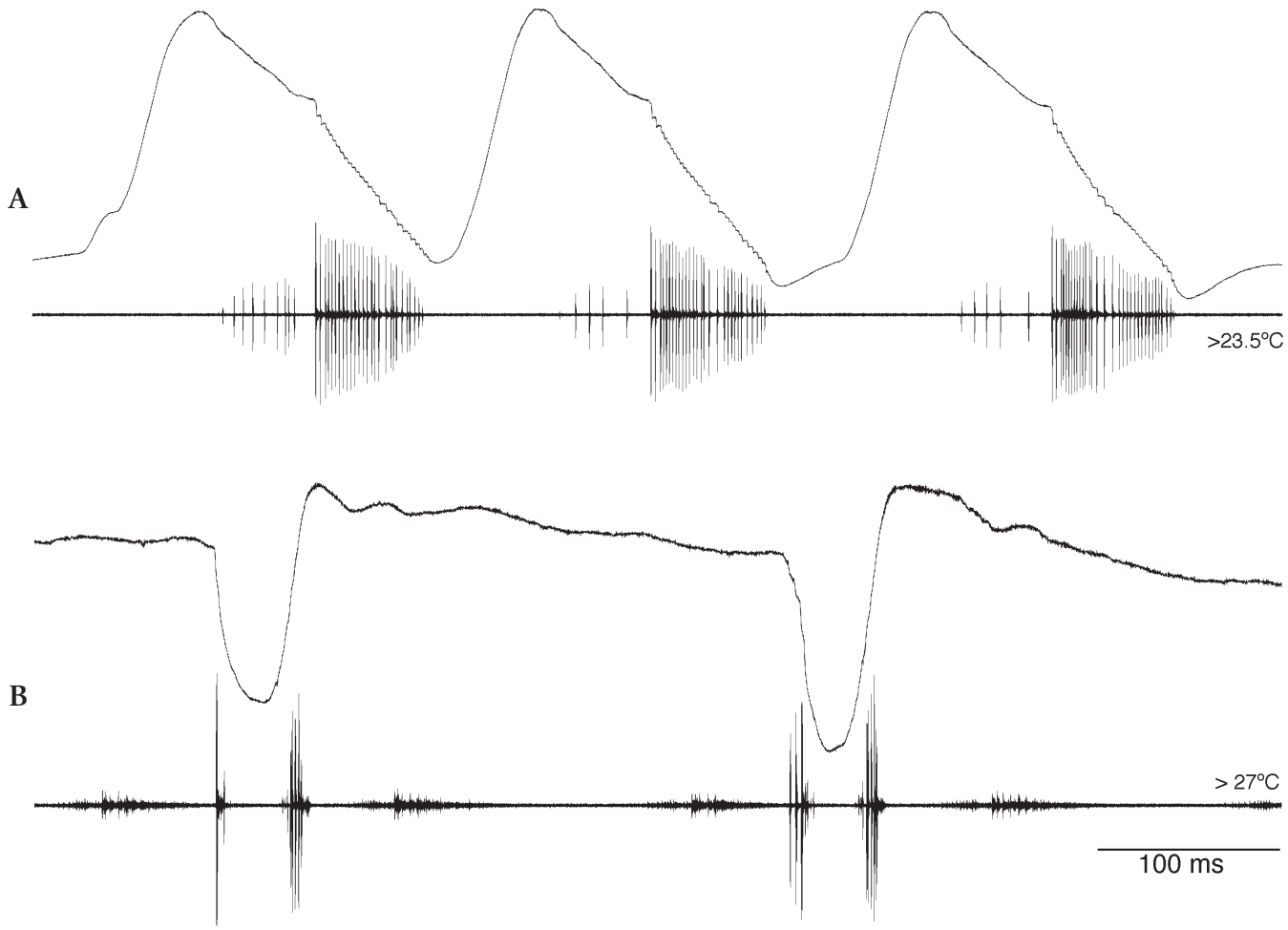

Fig. 5. Oscillograms of stridulatory movements and song of *P. mytilenensis mytilenensis* [synchronous registration of left tegmen movement (upward deflection represents opening, downward closing) and sound]. A. Male from Moria (CH3151, POMY9323); B. Female (CH3068, POMY9432)

Mytiline, Mitilini) is the old name used for both the island and its capital. Presently the island is named Lesbos (or Lesvos) and its capital still Mitilini. As Werner (1928) spent only 2 days on the island and his types agree fully and only with specimens from the area near its capital Mitilini, we assume that they originate from a spot not far from the town of Mitilini.

Also the type locality of *P. brevicauda* is assumed to be in this area (see discussion above). As there are no further arguments to cast doubt on Ramme's opinion that *P. brevicauda* represents the female of *mytilenensis*, we agree with his opinion.

Subgenital plate variation.—Morphological variation among males of a single population is very slight, but between different populations noteworthy. Males from extreme southeastern Lesbos present the longest subgenital plates, the apical part measuring 2.0 mm or more and, when flexed and in normal position, the tip reaching the upper level of the abdomen. More to the north and west, however, the apices are increasingly shorter, down to 1.0 or even 0.7 mm, but still always as a readily recognizable produced apical part, more or less distinctly bent upward. Still more to the north and west the apical part is commonly very short, not curved upwardly or commonly virtually absent. These gradients made it necessary to make an arbitrary choice for a classification according to the length of the male subgenital plate: length > 1.0 mm in typical *P. mytilenensis*, 1.0 to 0.6 mm in intermediate forms of the latter and < 0.5 mm in *P. m. brevissimus* (Fig. 2). Intermediate forms were only observed in the zones of contact with *P. m. brevissimus*, mainly near the narrowest part of the horseshoe-shaped island of Lesbos. The population of the Turkish island of Alibey agrees with the typical form of *P. mytilenensis*.

This arrangement is underlined by particulars of the 2nd male tergite. The mediodorsal inflated area as described above is well recognizable in males of nominate *P. mytilenensis* and absent or sometimes weak in *P. m. brevissimus*. This inflated area is situated in a place, which is regularly intensively touched by the female with her mouthparts before copulation. Some other *Poecilimon* species (and other Barbitistinae/-ini) have large glands in that area (*e.g.*, *erimanthos* Willemse & Heller, 1992; *ampliatus* Brunner von Wattenwyl, 1878; see Heller & Lehmann (2004) for comments).

Poecilimon mytilenensis brevissimus n. ssp.

Holotype male.—labeled: "Greece Lesbos/Mytilini//Mithymna Molivos)//26.v.1993//leg. K.-G. Heller & M. Volleth" [Mithymna

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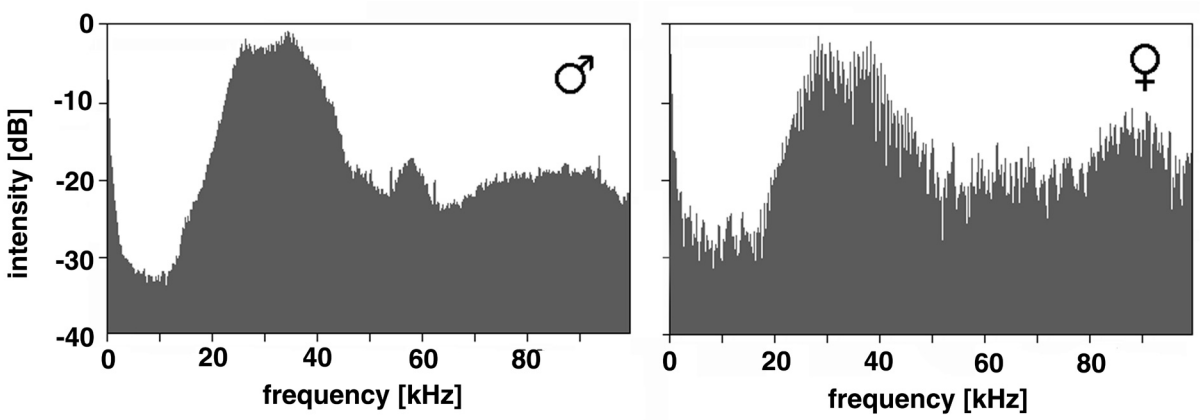

Fig. 6. Frequency spectra of male calling song (POMY9423) and female response (POMY9424) in *Poecilimon m. mytilenensis*.

(Molivos) on the north coast of Lesvos (lat 39° 22′ N, long 26° 10′ E), near to the castle] (CH, 3008, in alcohol).

P. mytilenensis: Werner 1934: 324; Willemse & Heller 1992: 311 (*partim*, as aberrant form from N of Kaloni & 3km NW of Kaloni & Sikaminea; not Andhissa material).
P. mytilensis [*sic*]: Willemse 1982: (*partim*); 1984: 41 (*partim*).

Diagnosis. — The subspecies differs morphologically from the nominate subspecies in a much shorter male subgenital plate, resulting from a reduced apical part: lateral edges shortly tapering towards a transverse truncate or slightly emarginate hind margin, pointing in almost the same direction as the basal part of the plate and typically not bent upward, the edges of the tip never collar-like folded backwards (Fig. 1C). The 2nd male abdominal tergite presents no inflation. Female as nominate subspecies.

Song.—The song is quite similar to that of the nominate subspecies. The calling song of the male consisted of sequences of 75 to 105 syllables with duration of 10 to 15 s. At the beginning of each sequence the syllable repetition rate is mostly relatively high (8 to 10 syllables/s at >26°C), but becomes continuously lower, ending in syllable pairs and separated single syllables (Fig. 3 D). The distinctly higher syllable repetition rate of the recorded animal compared to that of *P. m. mytilenensis* is certainly due to the much higher body temperature. The animal was recorded in the field singing in the bright sun, while the other recordings were made in the laboratory. In one of the recorded animals (Fig. 4 D) the structure of the syllables differs a little bit from the nominate subspecies. Here the syllables are composed of 2 to 3 parts (Fig. 4 D). In the 3-part syllables, the 2 last parts correspond to that found in the other animals. The first part of the 3-part syllables, however, is similar in structure and time relationship to the first part of the 2 part syllables. Here it is separated from the last part by a larger gap than the first part in the nominate subspecies. It may be produced during the opening of the forewings. Sometimes a series of impulses follows after the last part (also observed in the nominate subspecies). In other recorded animals the same syllable structure as in the nominate subspecies was observed. In all animals, however, the duration of the second (last) part of the syllable was quite variable (30 to 60 ms). Mostly the last syllable before a short interval was longer than the 2 to 3 previous ones. In one animal isolated impulses at the time of the female response could be found (about the function of these elements see Stumpner & Meyer 2001, Hammond & Bailey 2003).

Documentation. — Sound files: male POMY9326-30 (CH3000 and other animals from this population).

Etymology.—Named according to the very short male subgenital plate; adjective.

Measurements.— (Length in mm): Male (holotype): pronotum 6.4, hind femur 16.8. Other material: pronotum male 5.3 to 6.5, female 5.7 to 6.9, hind femur male 14.5 to18.0, female 15.5 to 18.5, apical part of male cercus 0.0 to 0.4 mm, see distribution map (Fig. 2); ovipositor 6.0 to 7.0

Distribution.—Northern and western part of the Greek Aegean island of Lesvos (see map, Fig. 2). If *P. m. brevissimus* should also be discovered on Limnos (but see above), the name *P. m. brevicauda* Werner, 1932 would have priority.

Material examined. — GREECE - Aegean island of Lesvos: Sikaminea (lat 39° 37′ N, long 26° 28′ E), 16.vi.1987, S. Drosopoulos (3 M, CW); 3 km NW Kaloni (lat 39° 23′ N, long 26° 18′ E) 1.vi, (33 M 27 F, ITZA & CW); N of Kaloni (lat 39° 25′N, long 26° 20′ E) 4.iv (1 M, CW); (all J.P.Duffels, 1988); surr. Petri (lat 39° 30′ N, long 26° 18′ E), 300 m, 26. iv, along dirty road on low herbs and shrubs, e.g., thistles, common, partly juvenile (4 M, CW); Lepetimnos Mts above Molyvos (lat 39° 33′ N, long 26° 25′ E), 150 m, 27.iv, on rocky mountain slopes covered with low thorny shrubs, very abundant, mostly adult (1 M 1 F, CW); Polichnitos (lat 39° 10′ N, long 26° 18′ E), thermic springs 100 m, 23.iv, in bull rush along streamlets or in thorny bushes on stony hill side grounds (1 M 1 F, CW) (all L. Willemse & J.Hilgeman, 2001); Mithymna (Molyvos) (lat 39° 37′ N, long 26° 17′ E), 50 m, 21.iv N edge of town along path, on herbs esp. *Chrysanthemum segetum* (2 M 2 F paratypes, CW); *ca* 2 km W of Andissa (lat 39° 23′ N, long 25° 97′ E) 300 m, 22.iv on hill slopes with thorny bushes and patches of grasses and herbs, next to the road Andissa-Eressos (3 M 1 F, CW); 2 km N of Skalochori 300 m (lat 39° 15′ N, long 26° 03′ E), 20.iv, on bare rocky hill slope, in small thorny bushes, almost all juveniles (1 M, CW); (all L. Willemse, 2001); Mithymna (Molivos) (lat 39° 22′ N, long 26° 10′ E), 26.v., (2 M paratypes, CH3009-10); Agra (lat 39° 9′ N, long 26° 3′ E), 24.v., (2 M, CH3003-4); Aspropota-

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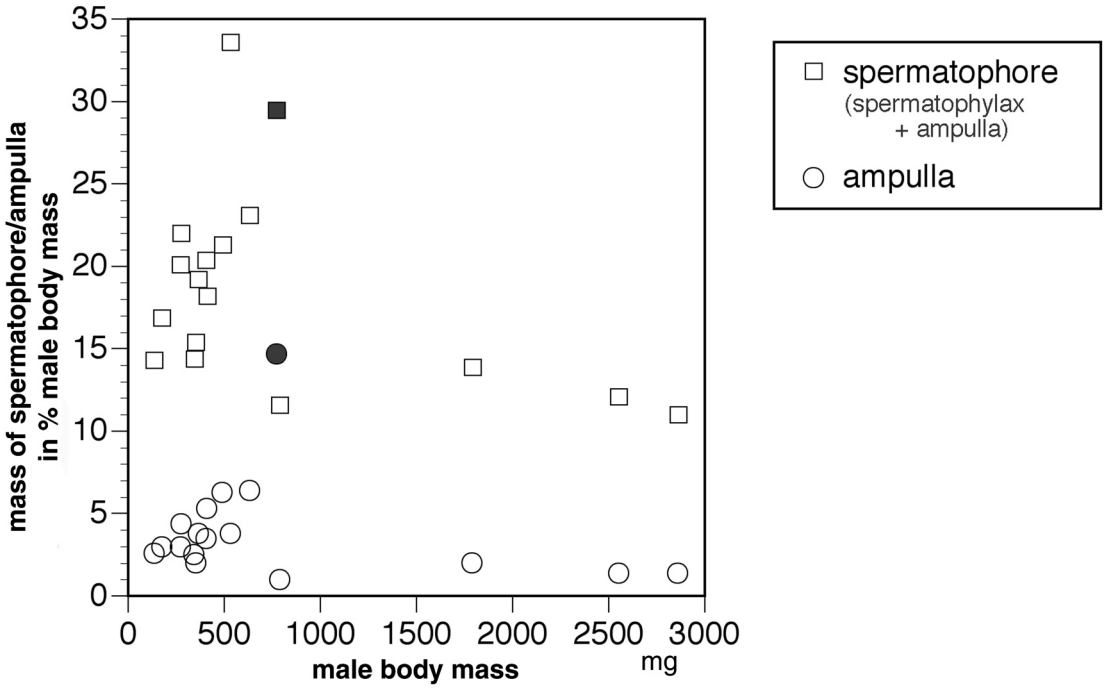

Fig. 7. Mass of spermatophore and ampulla in *P. mytilenensis* (solid symbols) and other *Poecilimon* species (open symbols: *P. elegans, fussi, werneri, jonicus, unispinosus, laevissimus, nobilis, obesus, ornatus, hoelzeli, pergamicus, amissus, marmaraensis, veluchianus minor, propinquus, turcicus*; data from McCartney & Heller, in prep.).

mos (SE of Mandamandos) (lat 39° 16′ N, long 26° 22′ E), 26.v., (1 M, CH3002); Mandamandos (lat 39° 18′ N, long 26° 20′ E), 26.v., (1 M, CH3001); Moni Limonos (lat 39° 15′ N, long 26° 10′ E), 24.v., (1 M, 1 F, CH3013-4,); Ovriokastello (lat 39° 17′ N, long 26° 0′ E), 24.v., (1 M, CH3000); Sigri (petrified forest) (lat 39° 13′ N, long 25° 54′ E), 24.v., (2 M, 1 F, CH2997-9); Vrissa, near ruins of Bycantinian tower (lat 39° 2′ N, long 26° 11′ E), 23.v., (3 M, 5 F, CH2979-86, and 2 M, CH5060-1, reared 1994); Vafios (near Mithymna) (lat 39° 20′ N, long 26° 13′ E), 26.v., (2 M, CH3025-26); Vatera (near beach) (lat 39° 1′ N, long 26° 11′ E), 23.v., (1 M, CH3015); Sikaminea (lat 39° 22′ N, long 26° 17′ E), 26.v., (2 F, CH2992, CH3155, and 2 F, CH2993-4, (or possibly from Vafios)); Klopedi (N of Kaloni) (lat 39° 15′ N, long 26° 12′ E), 25 - 27.v., (1 M, CH3005); (all K.-G. Heller, 1993);

Discussion.— *P. m. brevissimus* is easily distinguished in the male sex from the nominate form by its short and simple subgenital plate in combination with a normal 2nd abdominal tergite. Its range covers all the northern half of Lesbos, north of its isthmus and it occurs also in the extreme western part of the southern half of the island. While individual variation of the male subgenital plate among each population is rather slight, some variation may occur locally, *e.g.*, in Mandamandos, where the apical part may reach a length of 0.4 mm (Fig. 2).

Biology of *P. m. mytilenensis* and *P. m. brevissimus*

The species, especially *P. m. brevissimus*, was very common locally on the island of Lesbos. At Sigri it occurred in large numbers together with *Dociostaurus maroccanus*, and below Agra and near Molivos we observed huge numbers on the road, apparently hungry and consuming even our bread. It would be no surprise if this insect were sometimes considered a pest.

The animals were mainly active (singing, mating) during the daytime, at night moderate singing was observed. The nominate subspecies was found quite often on *Cistus* sp. but lives also on a variety of other low herbs (*e.g., Chrysanthemum segetum*), thistles, thorny bushes (*e.g., Rubus* sp.) but also on bullrush near streamlets. Adult animals were observed between 20th April and 16th June. By the end of May 1993 most animals were adult and females with spermatophores could be observed. The species was found from sea level up to the top of the highest mountains of the island. Its development at higher altitudes was somewhat later (nymphs at Mt. Olympos), but this later appearance occurred locally in the lowlands as well (Vafios, Sikaminea). All specimens from the Turkish island of Alibey were collected under low herbs on a rainy day.

Three other members of the genus occur in Lesbos, *P. pergamicus* Brunner von Wattenwyl, 1891 ("Mytilene", 3 F, Werner 1933b; Moria [near Roman aqueduct], lat 39° 07′ N, long 26° 30′ E, 28. May 1993, K.-G. Heller), *turcicus* Karabag, 1950, new to the fauna of Greece (near Larissos [Kolpos Geras], lat 39° 04′ N, long 26° 26′ E, 28. May 1993, K.-G. Heller) and *amissus* Brunner von Wattenwyl, 1878 (Heller & Lehmann 2004). The nominate form was never observed syntopic with other members of the genus, but *P. m. brevissimus* was found at Vrissa together with *P. amissus*.

Mating behavior and reproduction

The length of the male subgenital plate may be important when mating. Therefore we made a few mating and cross-mating tests with animals collected in 1993 and with their offspring in 1994. In cages each containing one male and one female of different

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subspecies or populations, the animals mated without any obvious problems *(e.g.,* female Sikaminea x male Rachidi, female Rachidi x male Moria). In a previous copulation attempt between a male from Rachidi and this same female from Rachidi, spermatophore transfer was unsuccessful (spermatophore falling off). So from these very limited data there is no evidence for reproductive isolation between the different subspecies.

After the mating tests we kept males and females from different subspecies together for some weeks and collected the eggs laid during that period (females from Sikaminea and Vafios together with males from Rachidi). We also collected the eggs from isolated females. From the eggs of a female from Vrissa (*P. m. brevissimus*) we obtained 2 males of *P. m. brevissimus*; from that of a female from Rachidi we obtained one female, probably of *P. m. mytilenensis*. From the cage with *P. m. mytilenensis* and *P. m. brevissimus* animals, however, we obtained males with subgenital plates typical for *P. m. mytilenensis*, but with distinctly shorter tips of the subgenital plate than males from the parent population (tip length 0.5 to 1.1 mm compared to 1.6 to 1.8 mm). Although there are no data for matings, the most likely explanation is that these animals were hybrids between the 2 subspecies. The *P. m. mytilenensis* female from Rachidi mated later with 2 of the hybrid males without problems. From all these data there is no evidence for a strong or even any pre- or postzygotic reproductive isolation within the species.

We did not find any effects of variability in the shape of the subgenital plate on mating behavior. However, when analyzing the mating behavior we discovered one unusual character. As in all *Poecilimon* species examined until now, the spermatophore consisted of 2 parts: the spermatophylax containing water and proteins (Heller *et al.* 1998a) and the ampulla containing the sperm. The size of the complete spermatophore in *P. mytilenensis* was 29.3 ± 2.9 % male body mass (mean ± $s_{\bar{x}}$; n = 6; data from both subspecies). This is high for bush-crickets in general (compare Vahed, 1993), and also at the upper edge of the published data of the genus *Poecilimon* (compare 24 - 26 % in *Poecilimon veluchianus*; Heller & Helversen 1991, Reinhold & Heller 1994). Very unusual, however, was the size of the ampulla. With 14.7 ± 2.5 % male body mass ($\bar{x}$ ± $s_{\bar{x}}$; n = 5) it was more than double the size observed in any other bush-cricket (see Vahed, 1993) including other *Poecilimon* species (see Fig. 7), and was equal in mass to the spermatophylax. Possibly the transfer of this unusual spermatophore requires a specifically shaped male subgenital plate. The function of the large ampulla is far from understood; the number of sperm inside was high, but quite variable (6.3, 9.2 and 15.8 Mio; n=3) and not as large as could be expected from its size compared to other *Poecilimon* species (*P. veluchianus* 10.5 Mio sperm ($\bar{x}$) in a much smaller ampulla (Reinhold 1994). In one sperm-count preparation an unusually high number of small droplets was observed, possibly an indication of another function in sexual selection.

Conclusion

The here-described taxa occur allopatrically and are, at least morphologically, readily recognizable. However, they are bridged by intermediate forms occurring in a comparatively narrow parapatric zone. From preliminary observations no evidence of any kind of reproductive isolation could be found. These data may suggest that we are dealing with clinal variation between 2 closely allied forms. For the time being, both forms are given subspecific status. Further analysis of their morphological diversity and degree of isolation both genetically and biogeographically would be most useful for a better understanding of this complex.

The evolutionary history of both subspecies of *P. mytilenensis* can only be guessed at. The present day distribution presents no clear evidence of isolation by natural barriers. Further data on geographic isolation by climatic changes or other geological events in the past are insufficiently known. However, it is noteworthy that the ranges of both subspecies contain mountains of about equal height and of sufficient altitude to have served as temporary refugia (900 to 1000m above sea level: Mt. Olympos and Mt. Lepetimnos, respectively) (Fig. 2B). The zone of intermediate forms covers mainly the isthmus, a narrow and lower part connecting the northern and southern half of this horseshoe-shaped island. An obvious possibility is that in the past there has been a (ecological) fragmentation of Lesbos into 2 or more isolated areas, but the idea remains speculative. The specimens from Alibey Island, isolated from Lesbos for at least 18000 y, belong to the nominate subspecies although morphologically not to the most extreme form. This could mean that in geologically recent times the species was introduced in Alibey island or rather that in Lesbos both subspecies arose from an ancient stock, apparently much older than the last interglacial.

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