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ZEUNERIANA MARMORATA (FIEBER):
AN ENDEMIC BUSHCRICKET FROM THE COAST
OF THE NORTHERN ADRIATIC SEA
(*Insecta Orthoptera Tettigoniidae*)

ABSTRACT - KLEUKERS R., FONTANA P. & ODÉ, B., 1997 - *Zeuneriana marmorata* (Fieber): an endemic bushcricket from the coast of the northern Adriatic Sea (*Insecta Orthoptera Tettigoniidae*).

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In this paper data on biology, song and distribution of *Zeuneriana marmorata* are summarized. There has been some confusion on the exact distribution, but the species seems to be restricted to the coastal area of northern Italy. We have found data from six exact localities only. The species was thought to be extinct, but after 50 years it is now rediscovered near Monfalcone. Information on the song is published for the first time.

KEY WORDS - *Orthoptera*, Italy, Chorology, Song, Protection.

RIASSUNTO - KLEUKERS R., FONTANA P. & ODÉ, B. - *Zeuneriana marmorata* (Fieber): una specie endemica della costa dell'Adriatico settentrionale (*Insecta Orthoptera Tettigoniidae*).

Vengono esposti i dati relativi alla biologia, al canto ed alla geonomia di *Zeuneriana marmorata* (Fieber). La distribuzione di questa specie sembra essere limitata a sei sole località certe. La specie era ritenuta estinta, ma dopo 50 anni è stata ora riscoperta vicino a Monfalcone. Le informazioni relative al canto di *Zeuneriana marmorata* (Fieber) vengono pubblicate per la prima volta.

PAROLE CHIAVE - *Orthoptera*, Italia, Corologia, Canto, Protezione.

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INTRODUCTION

The genus *Zeuneriana* has been erected by RAMME (1951), who included *marmorata* (type-species) and the closely related *amplipennis* (Brunner von Wattenwyl, 1882). Later *abbreviata* (Serville, 1839) and *burriana* (Uvarov, 1935) have been added by HARZ (1966, 1969). PFAU (1986) suggests, using song characters, that *Zeuneriana* could form a monophyletic group with some *Metrioptera* species. Although *Zeuneriana* is now being considered as a subgenus of *Metrioptera* by some authors (HELLER, 1988; RAGGE, 1990), we follow the recent checklist of Italian Orthoptera (FAILLA *et al.*, 1994), in which *Zeuneriana* is treated at generic level.

In this paper the records on the recent and present distribution of *Z. marmorata* are reviewed and some morphological characters, its habitat and its previously unknown song are described. We hope the information presented in this paper will show the urgent need to save this interesting, rare and most vulnerable species from ultimate extinction.

***Zeuneriana marmorata* (Fieber, 1853)**

Platycleis marmorata Fieber, 1853: 259 (female holotype; Illyrien); Fieber, 1854: 76; Krauss, 1878: 526 (*partim*); Brunner v. Wattenwyl, 1882: 361; Redtenbacher, 1900: 124 (*partim*); Padewieth, 1900: 24 (*partim*); Yacobson & Bianchi, 1905: 415 (*partim?*).

Chelidoptera marmorata : Kirby, 1906: 212.

Metrioptera marmorata : Caudell, 1908: 32; Ramme, 1939: 109, fig. 36-37.

Sphagniana marmorata : Zeuner, 1940: 44; Giordani Soika, 1949: 66.

Zeuneriana marmorata : Ramme, 1951: 256, fig. 62, 70; Beier, 1955: 248, fig. 10; Nadig, 1961: 292; Harz, 1966: 29; Us, 1967: 20 (*partim*); Harz, 1969: 318, fig. 647, 650, 990, 993-995; Nadig, 1987: 301; La Greca, 1993: 21, 43; Failla *et al.*, 1994: 9.

Metrioptera (Zeuneriana) marmorata : Heller, 1988: 118.

DISTRIBUTION

Material examined - Bistrigna, Schatzm., 3 females and 2 males, Coll. Mus. Civ. St. Nat. Trieste; 1 female, Coll. La Greca; Monfalcone, Friuli, 24.VII.38, Marcuzzi, 3 females and 3 males, Coll. Mus. Civ. St. Nat. Trieste; 1 male, Coll. La Greca; Bonifiche Aquileia Terzo, VII.1932, 1 male, Coll. Mus. Civ. St. Nat. Trieste; Foci dell'Adige, 1 female, Coll. La Greca; Lisert, 2 km south-east of Monfalcone, 16.VII.1996 leg R.



Fig. 1 - Male of *Zeuneriana marmorata* (Fieber) in its natural habitat. Lisert, 2 km South of Monfalcone (Friuli-Venezia Giulia). Photo Roy Kleukers, 16-VII-1996.



Fig. 2 - Female of *Zeuneriana marmorata* (Fieber). Lisert, 2 km South of Monfalcone (Friuli-Venezia Giulia). Photo Paolo Fontana, 16-VII-1996.



Fig. 3 - Habitat of *Zeuneriana marmorata* (Fieber). Reed-land at Lisert, 2 km South of Monfalcone (Friuli-Venezia Giulia). Photo Paolo Fontana, 16-VII-1996.

Kleukers & P. Fontana, 3 males, Coll. F. Willemse, 1 female and 2 males, Coll. P. Fontana; Lisert, 2 km south-east of Monfalcone, 21.VII.1996 leg. R. Kleukers, 1 male, Coll. F. Willemse; Lisert, 2 km south-east of Monfalcone, 25.VII.1996 leg. P. Fontana, A. Galvagni, R. Kleukers, 1 female and 1 male, Coll. F. Willemse, 2 female and 1 male, Coll. A. Galvagni, 2 males, Coll. P. Fontana.

Literature - Fieber's original record and type-locality reads «Illyrien», a Roman name used for an area reaching from northern Croatia through Bosnia-Herzegovina and Dalmatia to northern Albania. The second record of *Z. marmorata* was given by KRAUSS (1878) referring to material collected in Semlin (= Zemun, near Beograd), present in the 'kais. Museum' (now: Naturhistorisches Museum Wien). At the same time he mentions that Brunner von Wattenwyl collected the species in «Chioggia (Venezia)» (in the 1860's and deposited in Brunner's collection, now also at the Naturhistorisches Museum Wien). Furthermore Krauss indicates that the species might be found in Istria. BRUNNER VON WATTENWYL (1882) acknowledges that the specimens from Chioggia belong to *marmorata*, at the same time describing the specimens from Semlin as *amplipennis* sp.n. Since Brunner's publication distribution data on *marmorata* have been quite confusing. Repeatedly Istria and Semlin or its wider area Vojvodina (Beograd) have been named as localities of *marmorata* (e.g. PADEWIETH, 1900; REDTENBACHER, 1900; Us, 1967), apparently referring to Krauss's data. HARZ (1969) even mentions Sardinia, referring to COSTA (1882). However COSTA A. (1882: 7, 22) mentions *Porthetis marmorata* Burm. and *Porthetis (Pamphagus) marmorata* Burm. (1883: 53) and not Zeuner's *Platycleis marmorata* (Fieber).

Finally NADIG (1987), quoting GIORDANI SOIKA (1949), states that the species was found near Chioggia by Gridelli. However, Giordani Soika remarked that Chioggia is the type-locality of *marmorata* and Gridelli found the species near Aquileia.

Another question is the localisation of the type-locality. Fieber's «Illyrien» refers to a large area of former Yugoslavia, west of and excluding the area of Beograd from where *amplipennis* is known. Most authors consider Chioggia to be the type-locality, but this area is not covered by Illyrien and is thus incorrect. Chioggia is no more than the first precise locality where *marmorata* has been found, and from which the first male has been described (BRUNNER VON WATTENWYL, 1882).

Present distribution - From the scarce data from entomological collections and literature it is evident that *Z. marmorata* has always been an

extremely local and rare species. The last record in literature dates back to GIORDANI SOIKA (1949) and the species was thought to be extinct (NADIG, 1987). However, in 1996 we discovered a large population in the wetland of Lisert (Gorizia, Friuli-Venezia Giulia, Italy), 2 km south-east of Monfalcone (25 km northwest of Trieste). We guess that on the circa 2 km² large area more than a thousand individuals were present.

Conclusion - From the available data we conclude that *Z. marmorata* is indeed an endemic species in the coastal part of northeastern Italy, in agreement with NADIG (1987) and FAILLA *et al.* (1994). As the presence of *marmorata* in «Illyrien» has never been confirmed, we tentatively exclude this area from the range of *marmorata*. The range covers six localities in the area from the Adige river in the south to Lisert in the north (fig. 4). It is possible that the old records from Monfalcone coincide with the recent records from Lisert, in which case the total number of localities is reduced to five.

MORPHOLOGY

Habitus of male and female as in fig. 1 and 2. As several authors (RAMME, 1939, 1951; BEIER, 1955; HARZ, 1969) have given detailed information on the morphology of *Z. marmorata*, we abstain from a formal description. Here we concentrate on the male cercus, titilator and stridulatory file which have as yet been insufficiently described.

Male cercus remarkably short, inflated, largely covered by last tergite, with a relatively wide base that broadly projects medially; extending and narrowing medio-dorsally into a flap which is recurved and terminates into a strong, hook-shaped tooth. Apex of cercus finger-like, slender, cylindrical as long as main body of the cercus, slightly excurved, pointing latero-distally with smoothly rounded tip (fig. 5 A-D).

Titilator with apical parts in posterior view basally separated from each other, distally touching and apically slightly divergent; in lateral view slightly recurved and conical; posterior surface of apical parts smooth, anterior and medial sides spinulose distally, tip rounded with lateral, apical and medial surfaces strongly spinulose (fig. 5 E-F).

Stridulatory file of left male elytron as in fig. 6 A-C, length almost 3 mm, distal end not reaching hind edge of elytron; in proximal 5/6 part 40-50 teeth, roughly regularly spaced 16 teeth per mm, in distal 1/6 teeth gradually decreasing in width and increasingly closer set; file seen in profile almost straight to slightly concave.

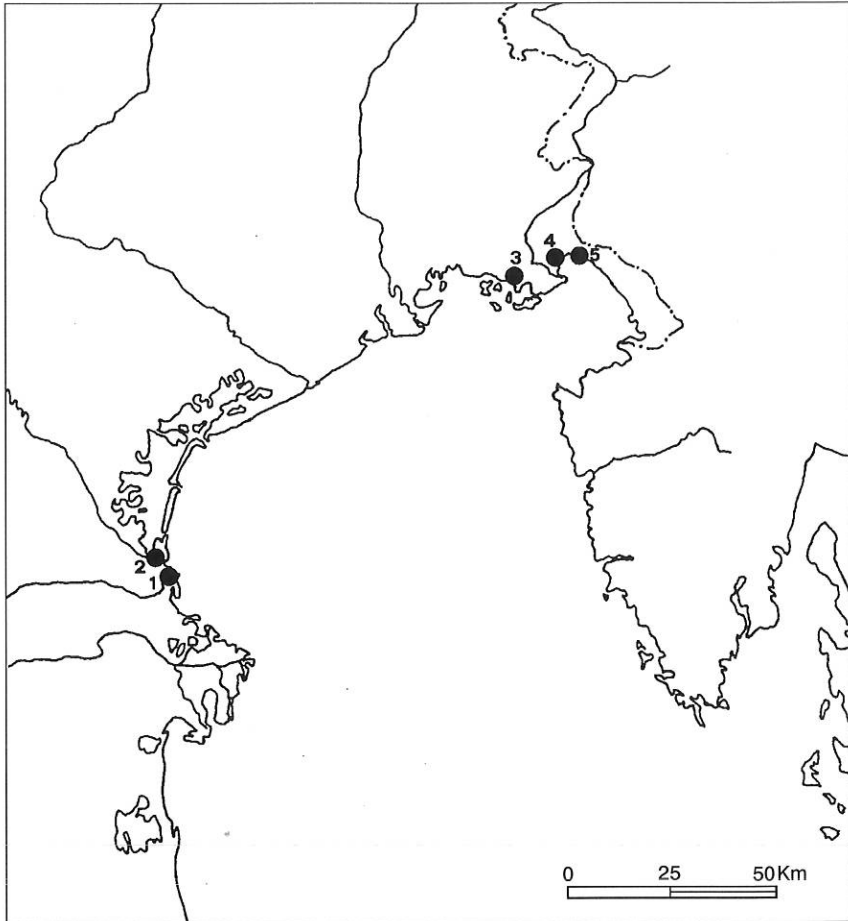


Fig. 4 - Distribution of *Zeuneriana marmorata* (Fieber), based on collection material and literature examined by the authors. 1: Foci dell'Adige (Coll. La Greca); 2: Chioggia (BRUNNER VON WATTENWYL, 1882); 3: Aquileia (GIORDANI SOIKA, 1949), Bonifiche Aquileia Terzo (Coll. Mus. Civ. St. Nat. Trieste); 4: Monfalcone (Coll. Mus. Civ. St. Nat. Trieste); Bistrigna (Coll. Mus. Civ. St. Nat. Trieste); 5: Lisert, 2 km South-East of Monfalcone (Coll. Galvagni, Coll. Fontana and Coll. Willemse).

HABITAT

According to RAMME (1951) both *Z. marmorata* and *Z. amplipennis* occur almost exclusively in very wet habitats, mostly in *Carex* and *Juncus* vegetation near the water's edge. Whereas *Z. amplipennis* was found inland along rivers (ADAMOVIC, 1967), *Z. marmorata* seems to be con-

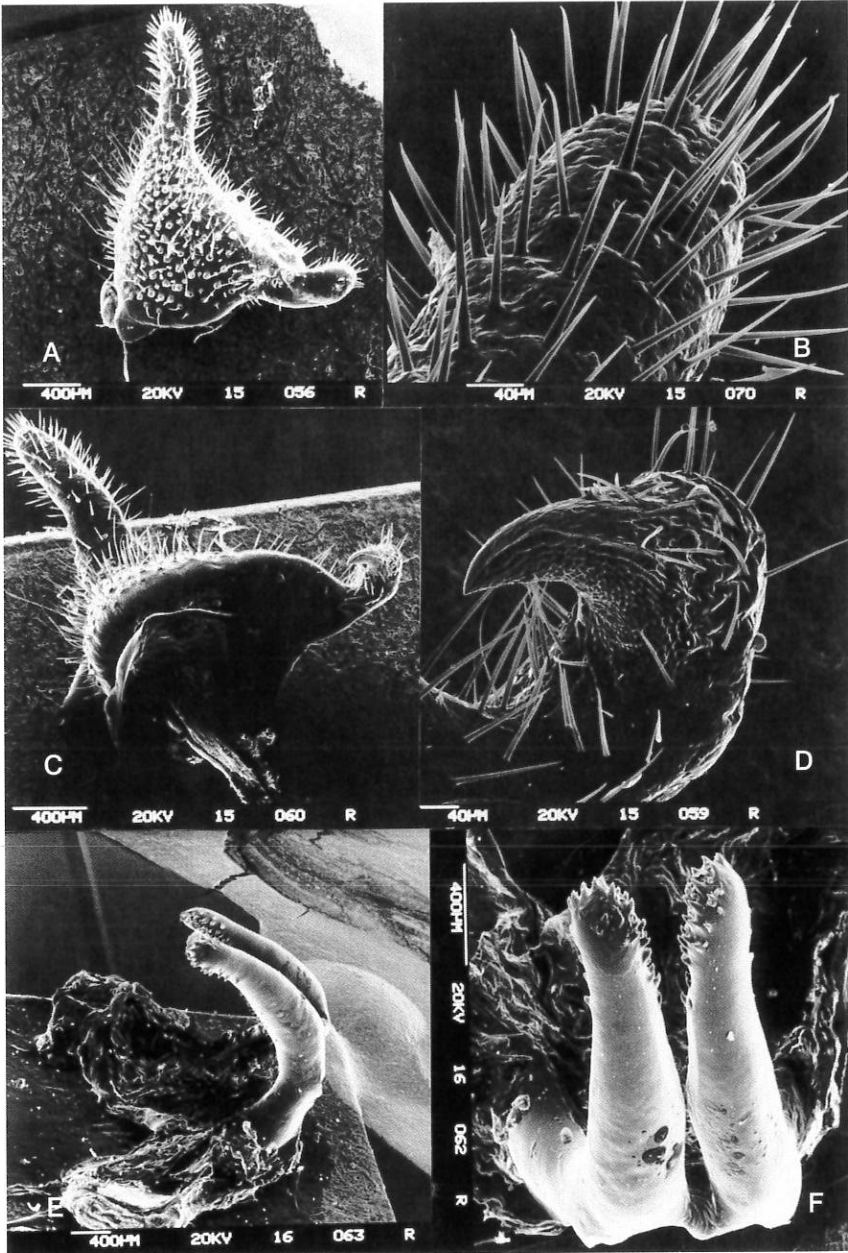


Fig. 5 A-F - male *Zeuneriana marmorata* (Fieber). Lisert (Friuli-Venezia Giulia, Italy); A: right cercus in dorsal view; B: apex of right cercus; C: left cercus in antero-ventral view; D: left cercus, tooth of media-dorsally pointing tooth; E: titilators, latero-dorsal view from the left; F: titilators, posterior view.

Electron microscope (Cambridge Stereoscan 250) photo's by Paolo Fontana.

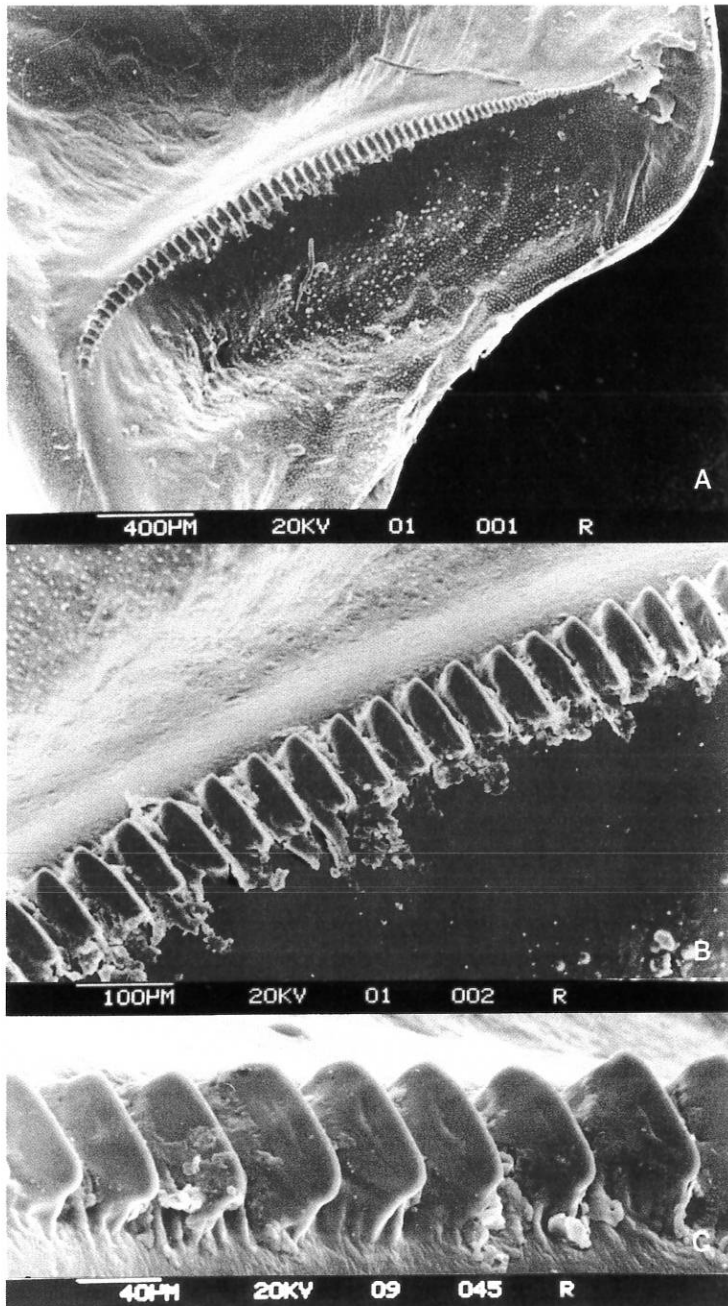


Fig. 6 A-C - stridulatory file of *Zeuneriana marmorata* (Fieber). Lisert (Friuli-Venezia Giulia, Italy); A: overview of file; B: detail of central part of file; C: detail of central part of file. Electron microscope (Cambridge Stereoscan 250) photo's by Paolo Fontana.

found to wet reed-land near the sea. GIORDANI SOIKA (1959) says *Z. marmorata* is a characteristic species of reed-land. This view is confirmed by the newly discovered population south of Monfalcone. The population inhabits wet, open reed-land, bordering the sea. The undergrowth consists mostly of a dense *Juncus* vegetation. In winter the waterlevel is very high and floods most of the plain. We found males especially in places where the reed and also the undergrowth was more dense. The males sat mostly low (< 50 cm) in the vegetation, sometimes higher (up until 2 m).

The species which were found in the same habitat as *Z. marmorata* are mostly typical wetland species (table 1). The occurrence of the very rare *Chrysochraon dispar giganteus* Harz, 1975 is remarkable.

Table. Species found in reed-land habitat of *Z. marmorata* at Lisert

Xiphidion discolor (Thunberg, 1815)
Pteronembius heydeni (Fischer, 1853)
Micropodisma salamandra (Fischer, 1854)
Pezotettix giornae (Rossi, 1794)
Tetrix subulata (Linnaeus, 1758)
Tetrix cf. *ceperoi* (Bolivar, 1887)
Tetrix tenuicornis (Sahlberg, 1893)
Aiolopus thalassinus (Fabricius, 1781)
Parapleurus alliaceus (Germar, 1817)
Chrysochraon dispar giganteus Harz, 1975
Omocestus rufipes (Zetterstedt, 1821)
Chorthippus parallelus (Zetterstedt, 1821)

SONG

Recording and analyses - The song of *Zeuneriana marmorata* has been recorded in the field as well as in the studio, with air temperature between 25 and 30 °C. All 8 recorded specimens are from the population described in this paper. Males were recorded both isolated, as well as close to another male or (once) close to a female. All recordings were made with a DCC-recorder (Philips DCC170 and DCC175) and Shure or Sony condenser microphones. This yielded in recordings with a frequency response of between 20 Hz and 18 kHz.

Analyses have been performed with the computer on sampled (44,1 kHz, 16 bits) fragments from the original recordings. No apparent loss of frequency response is to be expected from this technique.

Song terminology (according to RAGGE, 1990)

Calling song: the song produced by an isolated male.

Syllable: the sound produced by one complete opening and closing movement of the forewings. In *Platycleis* s.l. and *Metrioptera* s.l. two distinct types of syllables may be produced, differing in duration. The longer, more normal ones are termed macrosyllables and the shorter ones, usually lasting less than 10 ms, microsyllables.

Hemisyllable: the sound produced by one unidirectional movement (opening or closing) of the fore wings.

Echeme: a first-order assemblage of syllables.

Song description - The song of *Zeuneriana marmorata* is very loud and can be heard over distances of over 30 meters. In the field individuals were observed singing for long periods (more than 15 minutes) without a break and insects which were kept indoors sang almost continuously, day and night.

The calling song consists of long sequences of echemes repeated fairly regularly at the rate of about 2,5-3,5/s (fig. 7 A). Each echeme is composed of about 5-7 (macro)syllables, which become gradually louder during the course of an echeme (fig. 7 D). Usually only the closing hemisyllables are loud (and visible in the oscillograms), opening hemisyllables are quiet or absent. Within audible range the dominant frequencies of the song are between 7 and 15 kHz.

In confrontation with the nearby song of other males the calling song may be changed in one of the two following ways:

- two males start singing alternately (fig. 7 B). This interaction between two individuals has frequently been heard in the field. Although often continuously repeated it marks the transition between the calling song and rivalry song (below). A regular alternating pattern (as shown in fig. 7 B) might be explained by temporary mutual inhibition of singing (JONES, 1966).
- one or more males start producing longer echemes of up to 500 ms (fig. 7 C, E). Often the syllabic structure in these echemes is changed. Part of the syllables is markedly shorter than with the calling song. These may be called microsyllables, although they seem to vary in number and duration. Frequently a prolonged echeme only consists of macrosyllables. The syllable rate remains unaltered in echemes with or without microsyllables. This song type can be referred to as rivalry song.

No distinct courtship or other apparent change in the calling song

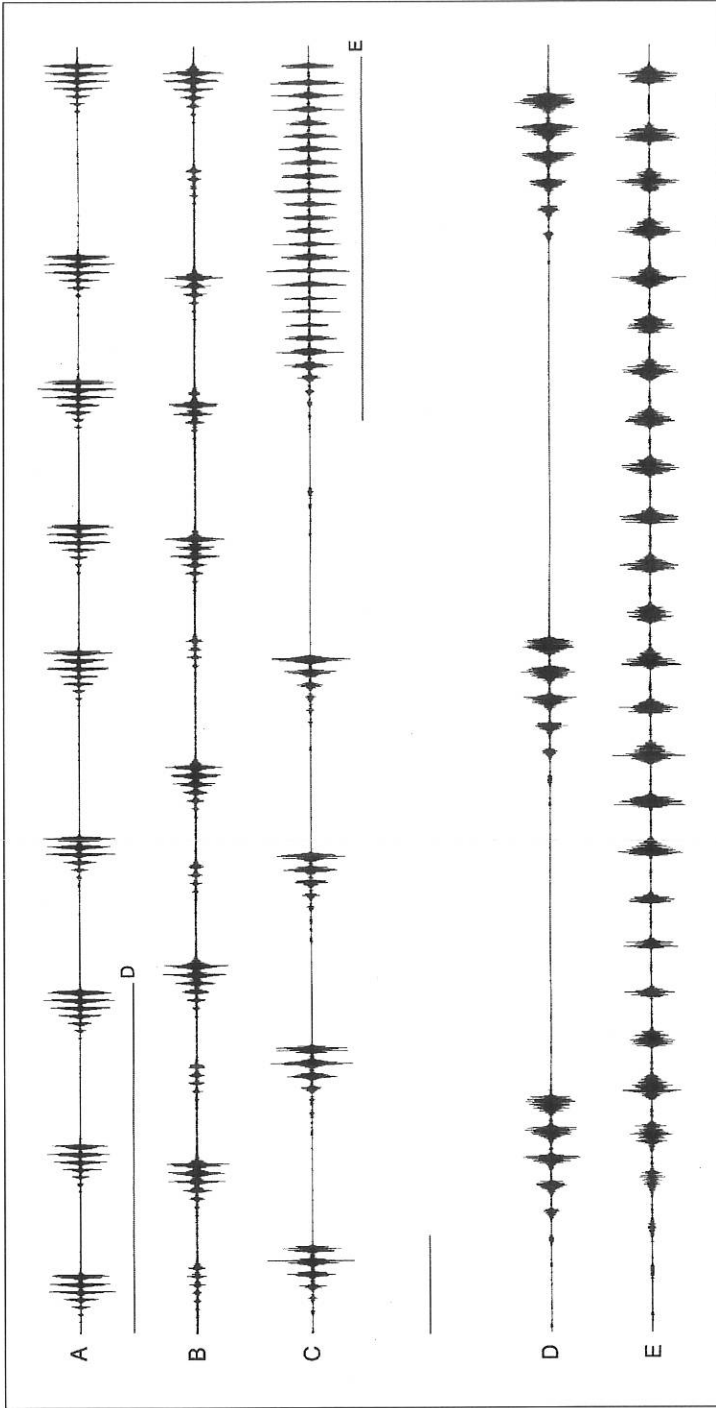


Fig. 7 A-E - oscillograms of song of *Zeuneriana marmorata* (Fieber). Lisert (Friuli-Venezia Giulia, Italy); A: calling song; B: alternating of two males; C: longer echemes during rivalry; D: syllable structure of echeme in calling song (detail of A); E: syllable structure of longer echeme during rivalry (detail of C). Time-scale A-C: 200 ms, D-E: 50 ms; Recordings A, B, D by Roy Kleukers, 16-VII-96, fieldrecording; C, E by Paolo Fontana, 19-VII-1996, studio-recording; Oscillograms by Baudewijn Odé.

was noticed when a male was close to a female. Only some irregularities could be observed, possibly due to disturbance of the male by the presence of the female.

DISCUSSION

The range of *Z. marmorata* is very small, extending over a narrow area of 120 kilometres long, from the Adige river in the south to Monfalcone in the north. Within this area the species is, since its description in 1853, recorded from six localities only. Although the species was thought to be extinct, it was rediscovered in 1996 near Monfalcone. The habitat seems to be confined to wet reed-land near the sea. An extensive search in reed-marshes along the Adriatic coast might bring other remaining populations to light.

Because of its extreme rarity and the vulnerability of its habitat, *Z. marmorata* can be considered to be one of the most threatened insect species of Europe. Therefore the species should be added to the European list of threatened invertebrates (HELSDINGEN *et al.*, 1996) and actively protected.

The song of *Zeuneriana marmorata*, up to now unknown, agrees broadly with that of several species of the *Metrioptera* and *Platycleis* group, although it is comparatively loud. The calling song is particularly similar to that of closely related species, e.g. *Zeuneriana burriana* and *Z. abbreviata*. As with *marmorata* these two species occasionally produce long echemes. In *Z. marmorata* long echemes clearly are not a part of calling song. They are only produced by males influenced by the song of another male. This has also been suggested by RAGGE & REYNOLDS (in press) for *Z. burriana* and *Z. abbreviata*. In many other species (e.g. *Metrioptera saussuriana*) long echemes in male calling song occur even without interaction with conspecific males. RAGGE & REYNOLDS (in press) find clear microsyllables in long echemes of *Z. burriana* and *Z. abbreviata*. By contrast *Z. marmorata* only seems to produce long echemes without clear microsyllables.

PFAU (1986) suggests that the occurrence of prolonged echemes with microsyllables in the song may have a phylogenetic basis. However, song characteristics are often unreliable indicators of phylogenetic affinity. Unrelated species may have a similar song, while closely related species can sing in a very different way (RAGGE, 1986). To clarify the relationships within *Metrioptera* and *Platycleis* a thorough analysis of many characteristics of all species concerned is needed.

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REFERENCES

- ADAMOVIC Z. R., 1967 - *Zeuneriana amplipennis* (Br. W.) endemicni zrikavac u Srbiji (Tettigoniidae, Saltatoria) - *Zastita Prirode*, 34: 139-147, 2 figs.
- BEIER M., 1955 - Die Jugoslawischen Arten der Platycleidini (Orthoptera - Tettigoniidae - Decticinae) - *Razprave*, 2: 211-252, 10 figs.
- BRUNNER VON WATTENWYL C., 1882 - Prodomus der Europäischen Orthopteren - Leipzig, W. Engelmann: XXXII + 446, 11 tavv.
- CAUDEL A. N., 1908 - Orthoptera, fam. Locustidae, subfam. Decticinae - In: P. Wytsman: *Genera Insectorum*: 32.
- COSTA A., 1882 - Notizie ed osservazioni sulla geofauna sarda. Memoria Prima. Risultamento di ricerche fatte in Sardegna nel settembre 1881 - *Atti R. Acc. Sci. fis. mat. Napoli*, 9: 1-42.
- COSTA A., 1883 - Notizie ed osservazioni sulla geofauna sarda. Memoria Seconda. Risultamento di ricerche fatte in Sardegna nella primavera del 1882 - *Atti R. Acc. Sci. fis. mat. Napoli*, Ser. 2°, Vol. 1: 1-110.
- FAILLA M. C., LA GRECA M., LOMBARDO F., MESSINA A., SCALI V., STEFANI R. & VIGNA TAGLIANTI A., 1994 - *Blattaria, Mantodea, Isoptera, Orthoptera, Phasmatodea, Dermaptera, Embioptera* - In: Minelli, A., S. Ruffo & S. La Posta (Eds.) *Checklist delle specie della fauna italiana*, 36: 1-23 - Calderini, Bologna.
- FIEBER F., 1853 - Synopsis der Europäischen Orthopteren, mit besonderer Rücksicht auf die in Böhmen vorkommenden Arten - *Lotos*, 3: 90-104, 115-129, 138-154, 168-176, 184-188, 201-207, 232-238, 252-258, mit Nachtrag.
- FIEBER F., 1854 - Synopsis der Europäischen Orthopteren, mit besonderer Rücksicht auf die in Böhmen vorkommenden Arten - *Lotos*, 3: 1-79. [reprint from *Lotos*, 3, 1853, with new page numbers].
- GIORDANI SOIKA A., 1949 - Studi sulle olocenosi II. Fattori ecologici e fattori geografici nella distribuzione degli Ortoteri nell'estuario Veneto - *Mem. Soc. entomol. Ital.*, 28: 61-72.
- HARZ K., 1966 - Orthopterologische Beiträge VI - *Nachrichtenblatt der Bayerischen Entomologen*, 15: 24-29, 14 figs.
- HARZ K., 1969 - The Orthoptera of Europe, I - *Junk B. V.*, The Hague, Series Entomologica 5: 1-749, 2360 figg.

- HELLER K.-G., 1988 - Bioakustik der europäischen Laubheuschrecken - Ökologie in Forschung und Anwendung 1: 1-358.
- HELSDINGEN P. J. VAN, L. WILLEMSE & M. C. D. SPEIGHT, 1996 - Background information on invertebrates of the Habitats Directive and the Bern Convention. Nature and Environment no. 79: I-XIII, 1-217, no. 80: 218-398, no. 81: 399-529. Strasbourg Cedex, Council of Europe Publishing.
- JACOBSON G. G. & W. L. BIANCHI, 1905 - Orthoptera and 'false Neuroptera' of the Russian empire and bordering countries. St. Petersburg: X + 952 p. [in Russian]
- JONES M. D. R., 1966 - The acoustic behaviour of the bush cricket Pholidoptera griseoaptera: 1. alternation, synchronism and rivalry between males - *Journal of Experimental Biology* 45: 15-30.
- KIRBY W. F., 1906 - A synonymic catalogue of Orthoptera, Vol. II Orthoptera Saltatoria, part I. (Achetidae et Phasgonuridae) - *British Museum (Natural History)*, London: 1-562
- KRAUSS H., 1878 - Die Orthopteren-Fauna Istriens - *SB. Ak. Wiss., math. naturw. Kl.*, (I) 78: 451-544, 28 figs.
- LA GRECA M., 1993 (1996) - Storia biogeografica degli ortotteri d'Italia: origine e distribuzione (*Insecta, Orthoptera*) - *Boll. Mus. civ. St. nat. Verona* 20: 1-46.
- NADIG A., 1961 - Beiträge zur Kenntnis der Orthopteren der Schweiz und angrenzender Gebiete: II. Neue und wenig bekannte Formen aus der insubrischen Region - *Mitt. Schweiz. Ent. Ges.* 34: 271-300, 12 figs.
- NADIG A., 1987 - Saltatoria (*Insecta*) der Süd- und Südostabdachung der Alpen zwischen der Provence im W, dem pannonischen Raum im NE und Istrien im SE (mit Verzeichnissen der Fundorte und Tiere meiner Sammlung) - *Revue Suisse Zool.* 94: 257-356.
- PADEWIETH M., 1900 - Orthoptera genuina des kroat. Littorale und der Umgebung Fiumes - *Glasnika Hrv. Naravoslovnog Društva* 11: 1-26.
- PFAU H. K., 1986 - Morphologie und Stridulation von *Metrioptera ambigua* nov. spec. aus Nordwestspanien, im Vergleich zu nahestehenden Arten (*Insecta: Ensifera*) - *Stuttgarter Beitr. Naturk.* Ser. A 389: 1-10, 9 figs.
- RAGGE D. R., 1987 - The songs of the western European grasshoppers of the genus *Omocestus* in relation to their taxonomy (*Orthoptera: Acrididae*) - *Bull. Br. Mus. nat. Hist. (Ent.)* 53: 213-249
- RAGGE D. R., 1990 - The songs of the western European bush-crickets of the genus *Platycleis* in relation to their taxonomy (*Orthoptera: Tettigoniidae*) - *Bull. Br. Mus. nat. Hist. (Ent.)* 59: 1-35.
- RAGGE, D. R. & W. J. REYNOLDS, in press. The songs of the grasshoppers and crickets of western Europe - *Harley Books*.
- RAMME W., 1939 - Beiträge zur Kenntnis der palaearktischen Orthopterenfauna (Tettig. u. Acrid.) III - *Mitt. Zool. Mus. Berlin*, 24: 43-150 + 3 tables, 36 figs.
- RAMME W., 1951 - Zur Systematik, Faunistik und Biologie der Orthopteren von Südost-Europa und Vorderasien - *Mitt. Zool. Mus. Berlin*, 27: 1-431.
- REDTENBACHER J., 1900 - Dermapteren und Orthopteren (Ohrwürmer und Geradflügler) von Österreich-Ungarn und Deutschland - *Carl Gerold's Sohn*, Wien: 148 p., 32 figs.

US P., 1967 - Orthopteroidea - *Catalogus Faunae Jugoslaviae* III/6: 1-47.

ZEUNER F. E., 1940 - The classification of the Decticinae hitherto included in *Platycleis* Fieb. or *Metrioptera* Wesm. (Orthoptera, Saltatoria) - *Transactions Royal Entomological Society of London* 91: 1-50, 45 figs.

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