

LJUBLJANA, DECEMBER 2005

Vol. 13, št. 2: 81–92

## THE FINDING OF *ZEUNERIANA MARMORATA* (FIEBER, 1853) IN SLOVENIA (ORTHOPTERA: TETTIGONIIDAE)

Stanislav GOMBOC<sup>1</sup>, Blaž ŠEGULA<sup>2</sup>

<sup>1</sup>Šiškovsko naselje 19, SI - 4000 Kranj, e-mail: stanislav.gomboc@bf.uni-lj.si

<sup>2</sup>Lepi pot 4, SI – 1000 Ljubljana

**Abstract** In central Slovenia, on Ljubljansko Barje, the species *Zeuneriana marmorata* (Fieber, 1853) (Orthoptera: Tettigoniidae) was found unexpectedly in September 2004. So far, the occurrence of this species has not been known in Slovenia. The genus *Zeuneriana* is represented by four species in Europe, which are distributed in relatively small areas. Closest to Slovenia are the findings of *Z. marmorata* in Italy, in the regions Friuli-Venezia Giulia and Veneto. A second species, *Z. amplipennis*, is reported from Vojvodina and the surroundings of Belgrade in Serbia, and two other species in the mountains of Spain, France and Western Italy. The morphological characteristics and the analysis of sounds of the recorded Slovenian specimens with some basic characteristics of the locality are discussed in the article. When analysing the song the minor differences between the Italian and Slovenian specimens were established. The morphological characters comply with the description of the species as provided by Ramme (1939) and Harz (1969).

**KEY WORDS:** *Zeuneriana marmorata*, Orthoptera, Tettigoniidae, new records, fauna, Slovenia

### **Izvleček - NAJDBA VRSTE *ZEUNERIANA MARMORATA* (FIEBER, 1853) V SLOVENIJI (ORTHOPTERA: TETTIGONIIDAE)**

V osrednji Sloveniji, na Ljubljanskem barju, smo septembra 2004 nepričakovano odkrili vrsto *Zeuneriana marmorata* (Fieber, 1853) (Orthoptera: Tettigoniidae). Vrsta doslej iz Slovenije ni bila poznana. Rod *Zeuneriana* je v Evropi zastopan s štirimi vrstami, ki so razširjene na sorazmerno majhnih območjih. Sloveniji najbližje so najdbe vrste *Z. marmorata* v Italiji, v deželah Furlanija Julijska krajina in Veneto. Druga vrsta je razširjena v Vojvodini in okolici Beograda v Srbiji, ostali dve vrsti pa v gorah Španije, Francije in zahodne Italije. Članek obravnava morfološke

značilnosti najdenih primerkov, podaja analizo napevov posnetih primerkov in nekaj osnovnih značilnosti najdišča. Pri analizi napevov smo ugotovili, da se slovenska populacija v napevu nekoliko razlikuje od italijanske. Morfološki znaki so v skladu z opisom vrste, ki sta jo podala Ramme (1939) in Harz (1969).

KLJUČNE BESEDE: *Zeuneriana marmorata*, Orthoptera, Tettigoniidae, nova najdba, favna, Slovenija

## Introduction

The genus *Zeuneriana*, a sister genus to the genus *Metrioptera*, is a typical relict genus with a refugial distribution. In Europe four species of the genus are known. They are all local, mostly endemic, spread in particular in southern Europe (Harz, 1969). The species distributed closest to Slovenia are *Zeuneriana marmorata* (Fieber, 1853) and *Z. amplipennis* (Brunner v. W., 1882). *Z. amplipennis* is spread along the Sava river basin in Vojvodina and in the surroundings of Belgrade. *Z. marmorata* is spread in the regions Friuli-Venezia Giulia and Veneto in Italy. Local populations in northern Italy, which were supposed extinct, were rediscovered in 1996 in marshy areas near the seaside, from the Adige River in the south to Monfalcone in the north (Kleukers *et. al.*, 1997). Here it is known only from 6 localities and is treated as very rare endemic species known only from Italy. *Z. marmorata* lives in marshy habitats along Adriatic coast in associations of the genera *Carex* and *Juncus* (Fontana *et. al.*, 2002). Both species populate wet, periodically flooded meadows. The other two species, *Z. burriana* (Uvarov, 1935) and *Z. abbreviata* (Serville, 1839) are mountain species, locally spread in the mountains of Spain, France and western Italy (Morin, 1994; Harz, 1969). According to Ramme (1951) the species *Z. marmorata* is distinctly stenoeck, related to ditches. Specimens of the species live in reeds above the water surface.

*Z. marmorata* was found in Slovenia by Blaž Šegula when he was recording and observing singing grasshoppers and crickets on the Ljubljansko Barje on September 13, 2004. In the time of year when the grasshopper season is slowly diminishing, he was caught by surprise by loud and unfamiliar sounds. It was with great patience that he managed to trace singing males of an unknown species in high grass and bent-grass. He recorded the sounds and also succeeded to catch two singing males for identification.

The status of the genus *Zeuneriana* has not been finally determined yet. Most authors consider it as a subgenus and only the minority as a separate genus. If we take into account the significant morphological differences in genital structures of males, cercus shape and very scattered distribution we could treat it as a separate genus. This is what the authors of this article are following too. However, the rest of the characters speak in favour of classifying *Zeuneriana* as a subgenus of the genus *Metrioptera*. The genus *Metrioptera* is represented in Slovenia by 4 species (Us,

1992), which are widely distributed and rather frequent (*Metrioptera roeselii* (Hagenbach, 1822), *M. bicolor* (Philippi, 1830), *M. brachyptera* (Linnaeus, 1761) and *M. kuntzeni* Ramme, 1931).

## Materials and methods

Singing animals were tracked down and caught with a butterfly net. They could not easily be found in the high grass, since they hide well and jump quickly into the vegetation, when disturbed. We caught only 5 singing males. The males were further observed at home, photographed and additional recordings of their sounds were made. After examination, the males were prepared, including the dissection of the genital structures (titilators and cerci), to ensure the most reliable identification of the species. The species was identified on the basis of morphological characters (Ramme, 1939; Harz, 1969) and by the sound.

Sounds of the species were recorded by DAT recorder SONY DAT TCD D8 and microphone AT 845R/RW with a parabolic disc.

The analysis of the sounds was carried out using the computer program Sound Forge 7 and Cool Edit Pro. The oscillogram and spectrogram were produced with the program Raven 1.2 Cornell Lab.

Dry specimens from the locality are kept in the collection of S. Gomboc in Kranj and original sound recordings by B. Šegula in Ljubljana.

## Results

Considering the morphological characteristics and sounds the species was identified as *Z. marmorata*. The form of cerci, titilator, small teeth at the apical part of the titilator and the size of individuals correspond to descriptions of the species given by Ramme (1939, 1951), Harz (1969) and Kleukers *et al.* (1997). According to Ramme (1939, 1951) the form of cerci, subgenital plate and titilator is rather variable. The size of specimens, which Ramme considered a good character for distinguishing *Z. marmorata* and *Z. amplipennis*, the first one being bigger, was proven to be not so reliable. According to Fontana *et al.* (2002) and Harz (1969) the size may vary significantly within populations. Taking into account the variability and the available morphological descriptions, and after having examined all morphological characters, we identified the species as *Z. marmorata*. The top of titilator of this species is slightly more rounded with less and somewhat bigger teeth, while in *Z. amplipennis* the top of titilator is more pointed with numerous smaller teeth. A somehow unclear description and corresponding pictures are given by Harz for cerci, since great morphological similarity exists between the two species. Our specimens had a thick cylindrical basis with a thin upper outgrowth of 1.5-2 mm in length and thin lower hook-like shaped teeth at the basis of cerci. The cercus is

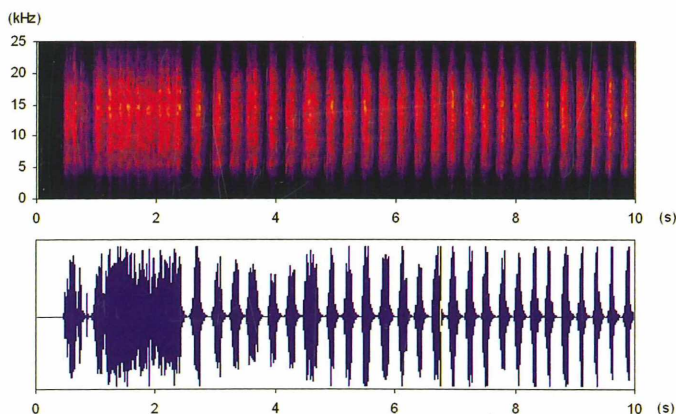
represented in detail in figure 4. Cerci may be visible only if separated from the body since the biggest part is covered with epiproct especially in dried specimens. Other morphological characters of the specimens found are represented on figures 3-7. All morphological characters correspond very well to the figures and description in Kleukers *et. al.* (1997).

The site with *Z. marmorata* is located in the vicinity of Ljubljana, about 1 km east from the village Ig, along river Iščica on Ljubljansko Barje, at 290 m above sea level. It is indicated on the map of Slovenia in figure 1. The habitat is a peat meadow which is part of the wetlands of the Barje. In autumn and in spring the meadow of 1 ha is usually flooded for at least a short period, so its surface is covered mostly by bent-grass *Carex davalliana* Sm., flying bent (*Molinia coerulea* (L.) Moench.), some other grass species and marsh herbs. A macadam road runs along the western side of the meadow, the gutter is grown over by a narrow strip of willows. It is surrounded by drainage trenches, but is still rather damp because of the high level of ground water and peat. The meadow is extensively exploited and seems to be cut only once a year (usually in June), thus not even every year since hay can only be used for litter. On this meadow we traced most of the singing males. For most of the day it is exposed to the sun,



Fig. 1: Map of Slovenia with the new finding site of *Z. marmorata*. The closest Italian sites are also marked.

Sl. 1: Karta Slovenije z označenim novim najdiščem vrste. Najbližja italijanska najdišča so tudi označena.



**Fig. 2:** Spectrogram and oscillogram of *Z. marmorata* calling song from the locality Ig, Ljubljansko Barje, in the time period of 10 s (temp. 21 °C).

**Sl. 2:** Spektrogram in oscilogram vabitvenega napeva vrste *Z. marmorata* z lokalitete Ig, Ljubljansko barje, v časovnem obdobju 10 s (temp. 21 °C).

however climate conditions indicate that the microclimate of the locality is rather humid and the average temperatures slightly lower than at the edge of Ljubljansko Barje. This may be the reason for the late occurrence of the species, in autumn.

In the field we succeeded to catch 5 specimens and record a few-minute song of two males. The males were recorded on site in the middle of September, on a sunny afternoon. Picture 2 provides a typical song of one syllable.

The calling song of male is loud, clearly audible even from a distance of 30 m and more. Males sing in a standing position at the upper parts of stalks of marsh herbs and grasses. Their continuous singing lasts up to few minutes and is composed of at least 90 songs. It begins with a longer initial phrase of duration up to 2.06 s, which is followed by shorter echemes, in average 26. The duration of intervals between individual echemes is 0.1 s. The duration of each echeme is 0.2 s and consists of 6-7 syllables of 0.01 s. The dominant frequency of the sound is at 14 kHz and significantly higher than at *Z. marmorata* recorded by Odé & Fontana (2002), with the dominant frequency at 11 kHz and a syllable consisting by the rule of 5-7 syllables. More detailed description of the sound and its variation is represented by Kleukers et al. (1997). The sound of Slovenian specimens is in comparison to Italian population almost identical. The stridulatory file of left male elytron is also almost identical to Italian populations, with all together 50-57 teeth (fig. 8). The teeth at the beginning and at the end of stridulatory file are much smaller than in the middle and almost completely pour into the stridulatory vein. At that part they are also very difficult to count.

The specimens are difficult to find, because they hide well in high bent-grass. We were able to hear the singing males without a problem, but the exact localisation in

the vegetation proved to be very difficult. When the singing individuals eventually were traced, we faced the difficulty of catching them in the high vegetation. Catchers were not very useful, because the specimens were warned by vibrations transferred by the stems of grasses and bent-grasses. Because of this only 5 males and no females were caught for morphological studies. Females were even more difficult to locate, since they do not sing. According to the songs, there were dozens of males on the locality, most of them on the meadow overgrown by bent-grass.

When observing singing males we noticed that they were responding to songs of the nearby males. This makes them singing together. As we noticed, males are rather territorial; since they were arranged in rather regular distances of 10 to 30 m. Singing of males was encouraged by the warm autumn sun. When singing, males climbed up to the top of grass vegetation, so as to improve their audibility and also to increase resonance, made by grass stems. Observing them revealed quite a resemblance to *Metrioptera roeselii*. At first threat of danger they descended to the ground and hid in high vegetation, where their brown protective colour made them almost impossible to be found. Also our careful and lengthy examination of the ground under bent-grass did not give any results. This may be the reason why this species has not been found in Slovenia earlier.

## Discussion

The finding of *Z. marmorata* is most surprising. Considering its present distribution its occurrence had not been expected in Slovenia. Local and isolated findings along the northern Italian coast did not show any similarity with the Slovenian locality. All known populations are far distant from here and are not subject to any genetically inter-exchange. Isolated development of the populations had lasted for quite a long period, which may be indicated also by their local adaptations, reflected in particular in their sounds and to a smaller extent also in morphological adaptations. Populations in Italy and the recently discovered population in Slovenia live in rather different climatic conditions. In Italy the species is spread in the Mediterranean climatic zone, however in Slovenia in the continental zone. The lengthy isolation is manifested also in differences in the song morphology of Slovene and Italian populations. Slovenian specimens are also slightly smaller than Italian ones, but with same morphological characteristics. We cannot make a firm conclusion that this long isolation can resolve in a different subspecies or even species, since we do not have an adequate quantity of specimens and comparing material to make the analysis. In the near future we will be aiming at carrying out the additional morphological analysis.

Besides the already stated differences it was a surprise to discover one specimen from among the five collected at the same location, which showed significant morphological deviations in pronotum and cerci in comparison to other four specimens (figures 6 and 7). Due to the lack of material it is not clear whether this is

due to morphological deformations or maybe this is a matter of two sympatrically living species. Such questions also have to be answered in the near future.

The site with *Z. marmorata* is rather small, about 2 ha. Carefully looking for specimens in the close vicinity of the meadow did not give any results. These meadows are subject to more intensive exploitation, at least two cuttings a year and heavy fertilisation. They have different vegetation which probably is not suitable for *Z. marmorata*. The population of *Z. marmorata* is under great pressure in this small area. Any small changes in use of these meadows and even small microclimatic changes, drying of the meadow or any other change can harm this small population. Farmers have already ploughed up and made fields from many such meadows nearby, now grown mostly by corn. The species may be preserved only if its habitat is preserved in present or more optimal state. If the use of the meadow is changed, the population will be facing its disappearance.

We discovered meadows with suitable living conditions for the species in the close vicinity between Ig and Škofljica, however no individuals have been found so far. There is always a possibility to find the species also in some other localities in the Ljubljansko Barje and, hardly likely, in some other places in Slovenia.

The identity of *Z. marmorata* and *Z. amplipennis* raise still some questions. The morphological characters described and illustrated in Harz (1969) show very close similarities between the two species (shape of cerci, titillator) and need to be rechecked. More detail to this question is also discussed in Kleukers *et. al.*, 1997. The other interesting question is the description of *Z. marmorata* by Fieber. As reported in Kleukers *et. al.*, 1997, Fieber described the species after the female holotype with the locality description Illyrien, what represented a very big area at this time. A part of the so-called Illyrian Provinces (during the French rule) and Illyrian Kingdom (after the restored rule by Austria) was also Ljubljana, which was even the capital city of the Illyrian Provinces (Wikipedia, Österreich Lexikon). Famous Slovenian naturalist Ferdinand J. Schmidt lived here, collector of many different insect groups. It is known that Schmidt was a friend of Fieber. He was sending specimens to Fieber and Fieber described a few new species for science from them. Among this materials there were also Orthoptera specimens. Schmidt collection is now deposited in the Slovenian Museum of Natural History in Ljubljana. There are also 9 boxes of Orthoptera, which are poorly labelled, and we could not find any *Z. marmorata* in his collection. It is possible, however, that Fieber described the species after Schmidt's material, collected in the surroundings of Ljubljana. Therefore, Ljubljansko Barje could even be the type locality from which *Z. marmorata* was described; but this is very difficult to check today.

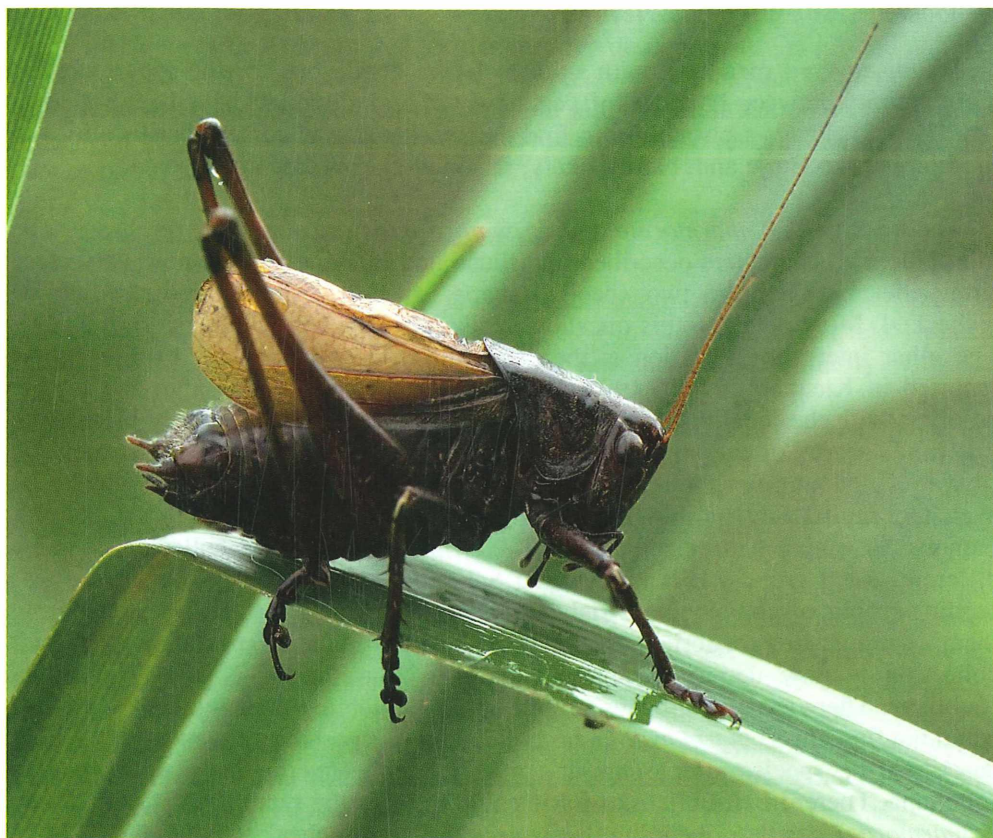
The present finding, as well as other findings of species which were new to the grasshopper fauna of Slovenia in 2004, when we discovered 4 new species, indicates the insufficient knowledge of the fauna of grasshoppers in Slovenia. The new



findings indicate that we could still expect new discoveries by careful work and a combination of knowledge of ecology and biology of species living also outside Slovene borders. Among a combination of contemporary methods for observing species, the recording of the sounds proved as very successful.

### Acknowledgments

We would like to thank our colleagues for helping us with the literature, suggestions and discussions on the identification of the species: Klaus-Gerhard Heller, Gerlind and Arne Lehman, Paolo Fontana and Roy Kleukers. For the informations on Ferdinand Schmidt and photos of his collection we would like to thank our colleagues from the Slovenian Museum of Natural History: Andrej Gogala, Tomi Trilar and Ignac Sivec.



**Fig. 3:** Adult male *Z. marmorata* from the locality Ig, Ljubljansko Barje, photography taken in the field. Photo: B. Šegula.

**Sl. 3:** Odrasli samček vrste *Z. marmorata* z lokalitete Ig, Ljubljansko barje, fotografiran na terenu. Foto: B. Šegula.





**Fig. 4:** Cercus of a male of the population from Ljubljansko Barje.

Photo: S. Gomboc.

**Sl. 4:** Izgled cerka pri samčku pri populaciji z Ljubljanskega barja. Foto: S. Gomboc.



**Fig. 5:** Shape of titilator of specimens from Ljubljansko Barje, from various views. Photo: S. Gomboc.

**Sl. 5:** Oblika titilatorja pri primerkih z Ljubljanskega barja, iz različnih zornih kotov. Foto: S. Gomboc.





**Fig. 6:** Shape of pronotum and stridulatory organ of specimens from Ljubljansko Barje. Left pronotum of 4 »typical specimens«, right form of pronotum of atypical specimen from the same location. Photo: S. Gomboc.

**Sl. 6:** Oblika pronotuma in cvrčalnega aparata pri primerkih z Ljubljanskega barja. Levo pronotum pri 4 »običajnih primerkih«, desno oblika pronotuma pri netipičnem primerku z iste lokacije. Foto: S. Gomboc.

## References

- Fontana, P., Buzzetti, F.M., Cogo, A., Odé, B., 2002:** Guida al riconoscimento e allo studio di Cavallette, Grilli, mantidi e Insetti affini del Veneto. Blattaria, Mantodea, Isoptera, Orthoptera, Phasmatodea, Dermaptera, Embiidina. Museo Naturalistico Archeologico di Vicenza Ed., Vicenza, 592 p.
- Harz, K., 1969:** Die Orthopteren Europas I. Series Entomologica 5. Dr. W. Junk B.V. The Hague: 749 p.
- Heller, K.-G., Korsunovskaya, O., Ragge, D.R., Vedenina, V., Willemse, F., Zhantiev, R.D. & Frantsevich, L., 1998:** Check-List of European Orthoptera. Articulata, Beiheft 7: 1-61.
- Kleukers, R., Fontana, P. & Odé, B., 1997:** Zeuneriana marmorata (Fieber): an endemic bushcricket from the coast of the northern Adriatic sea. *Atti Acc. Rov. Agiati*, a. 247, ser. VII, vol. VII, B: 63-79.
- Morin, D., 1994:** Contribution au catalogue des insectes orthopteres de la Gironde. *Bull. Soc. Linn. Bordeaux*, 22: 77-95.





**Fig. 7:** Shape of subgenital plate of specimens from Ljubljansko Barje. Left subgenital plate of 4 »typical specimens«, right subgenital plate of atypical specimen from the same location. Photo: S. Gomboc.

**Sl. 7:** Oblika subgenitalne plošče pri primerkih z Ljubljanskega barja. Levo subgenitalna plošča pri 4 »običajnih primerkih«, desno subgenitalna plošča pri netipičnem primerku z iste lokacije. Foto: S. Gomboc.



**Fig. 8:** Stridulatory file of a specimen from Ljubljansko Barje.

**Sl. 8:** Cvrčalna žila z značilnimi zobčki pri primerku z Ljubljanskega barja.

- Odé, B. & Fontana, P.**, 2002: Cavallette e Grilli del Veneto. Guida sonora. CD audio. Museo Naturalistico Archeologico di Vicenza Ed., Vicenza.
- Ramme, W.**, 1939: Beiträge zur Kenntnis der palaearktischen Orthopteren-fauna (Tettig. U. Acrid.). III. *Mitt. zool. Mus. Berl.* 24: 41-150.
- Ramme, W.**, 1951: Zur Systematik, Faunistik und Biologie der Orthopteren von Südost-Europa und Vorderasien. *Mitt. zool. Mus. Berlin*, 27: 1-431.
- Österreich Lexikon**, 15.11.2005:  
<http://www.aeiou.at/aeiou.encyclop.i/i209677.htm>.
- Us, P.**, 1967: Orthopteroidea in Catalogus Faunae Jugoslaviae III/6. Academia scientiarum et artium Slovenica, Ljubljana, 47 p.
- Us, P.**, 1992: Favna ortofteroidnih insektov Slovenije. Slovenska akademija znanosti in umetnosti, Razred za prirodoslovne vede, Ljubljana, (32)12, 314 p.
- Wikipedia**, 15.11.2005: <http://de.wikipedia.org/wiki/Illyrien>.

*Received / Prejeto:* 9. 6. 2005

# ZOBODAT - [www.zobodat.at](http://www.zobodat.at)

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Acta Entomologica Slovenica](#)

Jahr/Year: 2005

Band/Volume: [13](#)

Autor(en)/Author(s): Gomboc Stanislav, Segula Blaz

Artikel/Article: [The finding of \*Zeuneriana marmorata\* \(Fieber, 1853\) in Slovenia \(Orthoptera: Tettigoniidae\) Najdba vrste \*Zeuneriana marmorata\* \(Fieber, 1853\) v Sloveniji \(Orthoptera: Tettigoniidae\) 81-92](#)