Far Eastern Entomologist

Number 487: 21-28 ISSN 1026-051X (print edition) ISSN 2713-2196 (online edition) October 2023

https://doi.org/10.25221/fee.487.2
https://elibrary.ru/smvagp
https://zoobank.org/References/FCD093C7-8788-467B-A783-9C681EDB2EC4

NEW DATA ON DISTRIBUTION OF *DECTICUS NIGRESCENS* TARBINSKY, 1930 (ORTHOPTERA: TETTIGONIIDAE) IN RUSSIA

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Summary. The rare bush-cricket *Decticus nigrescens* Tarbinsky, 1930 is recorded from the Zabaykalsky Krai, Amurskaya Oblast, Jewish Autonomous Oblast, and Primorsky Krai in Russia. The type locality of this species is actually the vicinity of Nagibovo settlement in the Jewish Autonomous Oblast, Russia (47.75°N, 131.54°E). The ecologo-geographic models of the species distribution over the Asian part of Russia are generated by the Maxent and 'ellipsenm' algorithms for the first time as well.

Key words: Decticini, fauna, new record, range, modelling, Siberia, Russian Far East.

М. Г. Сергеев, В. В. Молодцов, С. Ю. Стороженко. Новые данные о распространении *Decticus nigrescens* Tarbinsky, 1930 (Orthoptera: Tettigoniidae) в России // Дальневосточный энтомолог. 2023. N 487. С. 21-27.

Резюме. В России редкий кузнечик *Decticus nigrescens* Tarbinsky, 1930 распространен в Забайкальском крае, Амурской области, Еврейской АО и Приморском крае. Установлено, что типовым местонахождением этого вида фактически являются окрестности с. Нагибово в Еврейской автономной области (47.75°N, 131.54°E). Впервые с использованием алгоритмов Maxent и 'ellipsenm' созданы эколого-географические модели распространения данного кузнечика в азиатской части России.

INTRODUCTION

The blackish bush-cricket *Decticus nigrescens* was described by S.P. Tarbinsky (1930) from the "Nambovo, Primorskaja prov." (actually from the Jewish Autonomous Oblast, Nagibovo on the Amur River – 47.75°N, 131.54°E). This species was recorded from the Russian Far East, East Siberia and adjacent regions of China, commonly without exact geographical coordinates (Furukawa, 1948; Sergeev, 1986, 1993; Stebaev *et al*., 1989; Kang *et al*., 1990; Ma *et a*l., 1991; Storozhenko, 1992, 2004; Karmazina, 2010; Liu *et al*., 2020). There are only a few records of this species from exact localities in the Zabaykalsky Krai

(Dubatolov & Sergeev, 1999), Amurskaya Oblast (Storozhenko, 1980; Lapteva, 2023) and Primorsky Krai (Storozhenko, 2009). Therefore, our knowledge about *D. nigrescens* remains very limited. In the present paper, we try to characterize the actual data on its distribution and to suggest ecologo-geographic models of its possible distribution over this territory.

MATERIAL AND METHODS

The specimens of this large but rare species (Fig. 1) were collected mainly by S.Yu. Storozhenko (SS). We study also material stored in the collections of the Federal Scientific Center of the East Asia Terrestrial Biodiversity (Vladivostok), the Institute of Systematics and Ecology of Animals (Novosibirsk), Novosibirsk State University and the Zoological Institute of the Russian Academy of Sciences (St. Petersburg). Nomenclature is given according to Cigliano *et al*. (2023).

We used two quite distinct approaches to model the species distribution over its range, namely the maximum entropy modelling (Maxent 3.4.4) based on the machine-learning technique (Phillips *et al.,* 2006, 2017; Elith *et al*., 2011), and the 'ellipsenm' that generates multidimensional ellipsoid envelopes of ecological niches (Cobos *et al*., 2023). For both models we exploited resources of WorldClim 2 (Fick & Hijmans, 2017; WorldClim, 2022): "Historical climate data" (19 standard annually averaged bioclimatic variables at the 30 arcsecond spatial resolution). To generate the Maxent model we used the full sets of applicable bioclimatic variables and following parameters: features – auto, output format – cloglog (Phillips *et al.*, 2006), regularization multiplier = 1. We estimated accuracy of this model by using the AUC (the area under the receiver operating characteristic curve) values for sets of 25 replicates with cross-validation, and evaluate significance of climatic variables by their predictive contributions and Jackknife tests. To produce the 'ellipsenm' models we selected only 6 variables: annual mean temperature, maximal temperature of warmest month, minimal temperature of coldest month, annual precipitation, precipitation of warmest quarter, and precipitation of coldest quarter, and counted average values for 25 replicates as well. To produce the ellipsoid the 'covmat' method was used. In this case, 1% of the occurrence data is considered as potentially erroneous and, consequently, they are not included in the generated ellipsoid model. Maps of species distribution were produced with MapInfo 15.2.4. A Lambert conformal conic projection was selected as the basic map.

NEW RECORDS

***Decticus nigrescens* Tarbinsky, 1930**
Fig. 1

Decticus nigrescens Tarbinsky, 1930: 181 (holotype: male, Russia: 'Nambovo'; kept in the Zoological Institute, St. Petersburg); Furukawa, 1948: 267; Storozhenko, 1980: 16; Sergeev, 1986: 180; 1992: 46; Otte, 1997: 299; Dubatolov & Sergeev, 1999: 47; Storozhenko, 2004: 136; Karmazina, 2010: 191; Storozhenko, 2009: 47; Liu *et al*., 2020: 575; Lapteva, 2023: 88, 100.

Decticus verrucivorus (nec Linnaeus): Pravdin & Cherniakhovsky, 1975: 362, 367.

TYPE MATERIAL EXAMINED. **Russia**: Jewish Autonomous Oblast, Nagibovo, 47.75°N, 131.54°E, 26.VII 1926, 1♂ (holotype), 1♀ (paratype), leg. Pljater-Plokhotzky.

OTHER MATERIAL EXAMINED. **Russia**: Zabaykalsky Krai: 3 km E Aleksandrovsky Zavod, 50.92°N, 117.97°E, steppe, 18.VII 1977, 5♂, 6♀ (SS); between Budiumkan and Uriyupino border post, 52.67°N, 119.95°E, 31.VII 1997, 1♀ (Dubatolov, Berezina, Kosterin);

Fig. 1. *Decticus nigrescens* female from the Lazovsky Nature Reserve, Primorsky Krai (Photo S. Storozhenko).

Nerchinsky Zavod, southern vicinities, 51.29°N, 119.61°E, flood plain meadow, 09–14.VIII 1996, 6♂, 8♀; Amurskaya Oblast: Svobodny Trud, 51.93°N, 127.28°E, at forest edge, 12.VIII 1982, 1♂ (SS); Klimoutsy, 51.48°N, 127.64°E, at forest edge and in meadow, 10–11.VIII 1982, 3♂, 5♀ (SS); Glukhari, 51.76°N, 128.09°E, 14–15.VIII 1982, 1♂, 1♀ (SS); 6 km E Saskal, 51.69°N, 126.95°E, meadow, 13.VIII 1982, 1♂ (SS); 40 km S Zavitinsk, Mikhailovka settlement, Zavitaya River, left side, 49.92°N, 128.83°E, 18.VII 1976, 2♂ (Moiseeva); Kulikovka, 49.79°N, 129.28°E, 21-13.VIII 2004, 1♀ (Bezborodov); Jewish Autonomous Oblast: Obluchye, Khingan River, left side, 48.99°N, 131.04°E, low terrace, 6.VII 1976, 1♂, 1♀ (Moiseeva); 6 km NE Pashkovo, 48.93°N, 130.77°E, 20.VIII 1982, 6♂ (SS); Babstovo, 48.08°N, 132.63°E, piedmont plain, sandy stone scare, very dry meadow with grasses and sagebrushes, 6.IX 1977, 1♂ (Murav'eva, Kretova, Ruban); Primorsky Krai: Shiryaevka, 43.97°N, 132.58°E, 17.VII 1971, 1♀ (Kuliev); Kedrovaya Pad Nature Reserve, Kedrovaya River, 43.11°N, 131.60°E, 1974, 2♀ (Cherniakhovsky); Milogradovo, 43.32°N, 134.59°E, dry clearing in forest, 13–14.VII 1982, 2♂, 2♀ (SS); 6 km SW Lyalichi, 44.02°N, 132.29°E, at forest edge and in meadow, 10-13.VII 1984, 9♂, 4♀ (SS); Dmitrievka, 44.39°N, 132.80°E, 15.VII 1988, 1♀ (Arefin); 3 km S Frolovka, 43.17°N, 133.27°E, 20–25.VII 1995, 1♂, 1♀ (SS); Barabash-Levada, 44.75°N, 131.43°E, 6.VIII 1987, 2♂ (SS); Ussuriysk, 43.82°N, 132.03°E, 20.VII 1981, 1♂ (collector unknown); Komissarovo, 44.98°N, 131.77°E, meadow, 13.VII 1980, 3♂ (SS); Lazovsky Nature Reserve, cordon Korpad, 43.29°N, 134.05°E, 25.VIII 2007, 1♀ (SS); Staraya Kamenka, 43.35°N, 134.04°E, 29.VIII 2007, 1♂, 3♀ (SS); Sikhote-Alin Nature Reserve, cordon Zimoveiny, 45.07°N, 136.62°E, 26.VII 1998, 1♀ (Kuznetsov).

REMARKS. This species was described as “one male (type) and one female (paratype) from Nambovo, Primorskaja Prov., collected by Mr. Pljater-Plokhotzky, 26.VII 1926” (Tarbinsky, 1930). The labels of types were incorrectly interpreted by Tarbinsky; really the type material was collected from the territory of the modern Jewish Autonomous Oblast, Nagibovo settlement on the left side of the Amur River (47.75°N, 131.54°E).

DISTRIBUTION. Russia (Zabaykalsky Krai, Amurskaya Oblast, Jewish Autonomous Oblast, Primorsky Krai) (Fig. 2); known also from Inner Mongolia and Heilongjiang in China but records from these regions were given without exact localities (Furukawa, 1948; Kang *et al*., 1990; Ma *et a*l., 1991).

ECOLOGICAL PREFERENCES

Stebaev *et al.* (1989) noted that *Decticus nigrescens* could be included in the ecological group mainly associated with the regions occupied by coniferous forests and forest-steppes, mainly north of the Amur River. However, all set of data on the species preferences show that it can mainly occur in quite different habitats, commonly open and relatively dry, such as some variants of the meadows and clearings in broad-leaved forests, the steppe-like vegetation on stony plots. The abundance of this species is low and varies usually around 1–2 per hour and the maximal density is about 0.01–0.02/m^2.

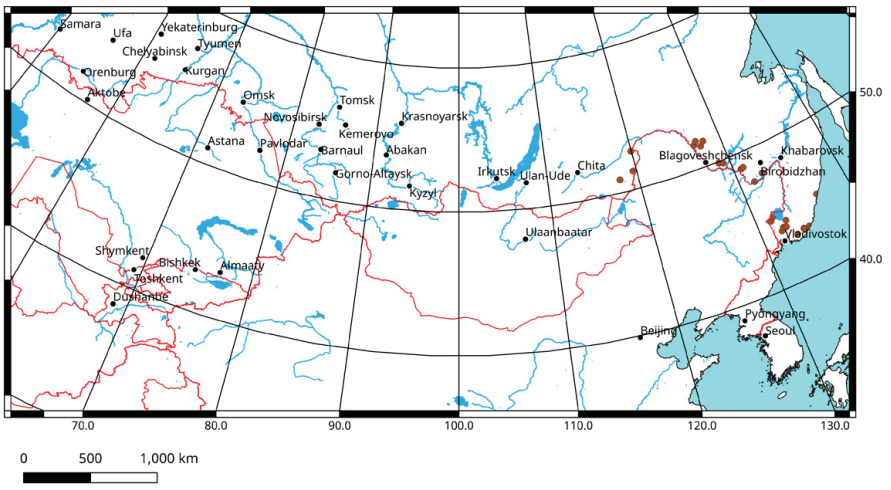
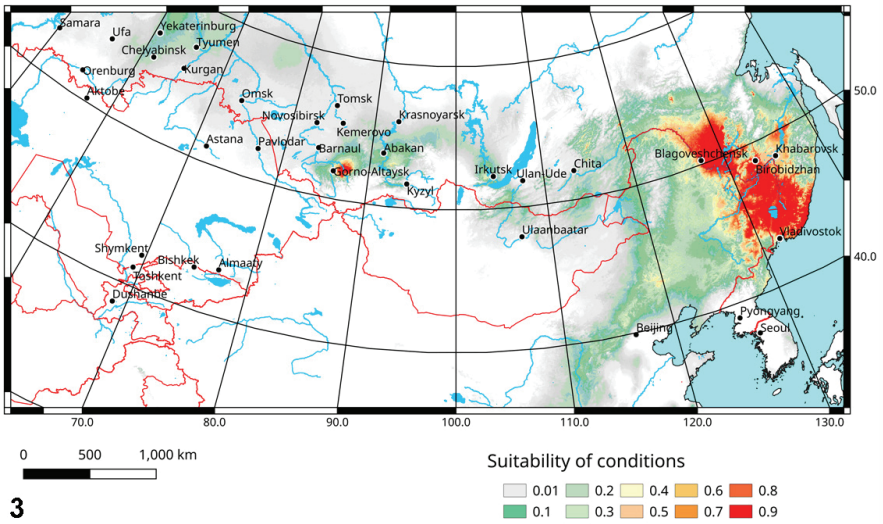


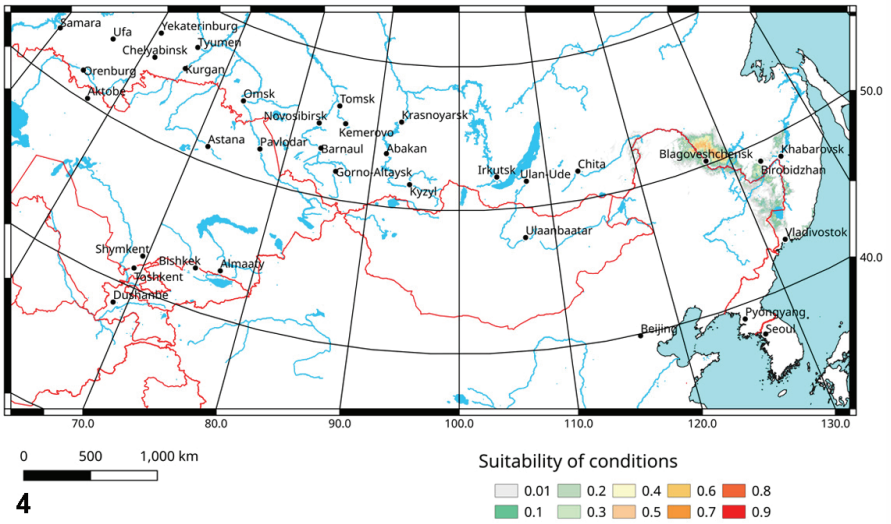
Fig. 2. *Decticus nigrescens* known localities.

ECOLOGO-GEOGRAPGICAL MODEL OF DISTRIBUTION

Almost all known localities of the species are situated in either the southern parts of the Russian Far East or the easternmost areas of the Transbaikal region. The Maxent ecologo-geographic model shows that the most optimal habitats for this bush-cricket are distributed across the southern parts of the Amurskaya Oblast, almost all territory of the Jewish Autonomous Oblast, and the Primorsky Krai, except its north-eastern areas (Fig. 3). However, some adjacent areas are very suitable for *Decticus nigrescens* as well. Among them are the southern parts of the Khabarovsky Krai, especially along the Amur River, and the north-eastern parts of Heilongjiang, NE China. Surprisingly, the north-eastern area of the Altai Mts

looks like one of the most appropriate territory for the species. Certainly, finding of *Decticus nigrescens* in the Altai Mts is unlikely, but this area may be used for the species introduction if that will be needed in the future, e.g., for species conservation. The modest levels of suitability (about 0.4–0.5) are forecasted for wide areas of NE China, N Korea, some parts of the Stanovoy (Outer Khingan) Range and the West Sayan Mts in S Siberia. The ellipsoid model shows the similar distribution patterns (Fig. 4), but its predictions look like very





Figs 3–4. Predicted probabilities of suitable conditions for *Decticus nigrescens*. 3 – according the Maxent model (all distribution data and bioclimatic variables for 1970–2000; point-wise mean for 25 replicates); 4 – according the ellipsoid envelope model (all distribution data and selected bioclimatic variables for 1970–2000; means for 25 replicates).

moderate. Perhaps these differences are determined by the limited set of variables included in the analysis.

The Maxent model performance is almost perfect (especially taking into account a few samples), because the AUC value for 25 replicates equals 0.979 (Fig. 5). According the Maxent model, the precipitation of wettest month is the most important factor (contribution – 36.6%), the precipitation of warmest quarter (22.4), the annual mean temperature (11.7), and the mean temperatures of wettest quarter (10.2) are also significant. The Jackknife test allows to add the precipitation of wettest quarter as well. This means that precipitation levels of warm seasons are very essential for this bush-cricket.

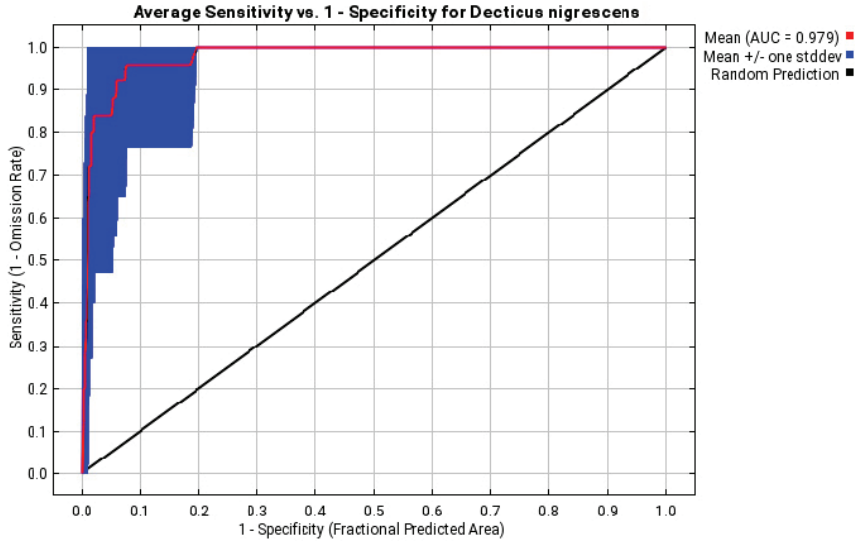


Fig. 5. Reliability test for the *Decticus nigrescens* Maxent distribution model (bioclimatic variables for 1970–2000; 25 replicates with cross-validation).

CONCLUSION

The blackish bush-cricket *Decticus nigrescens* is one of the rarest orthopteran species in the temperate Asia. Less than 90 specimens were collected since 1926 up to the present time. Its known range does not overlap the range of the wart-biter (*Decticus verrucivorus*) (Kang *et al*., 1990; Ma *et a*l., 1991; Lapteva, 2023). However, because the last species is widely distributed over the southern parts of the forest life zones, the forest-steppes and steppes in the western parts of its range (Europe and south Siberia) and often occupies the similar habitats, we can use some published data concerning the wart-biter to estimate possible statuses of *Decticus nigrescens* colonies. In the European forest life zones, the wart-biter populations are usually insular and occupy open or semi-open habitats (Cherrill & Brown, 1990; Weidemann *et al*., 1990), they are also characterized by low densities compared with estimations for *Decticus nigrescens*. Possible migrations of the wart-biter are limited. The maximal walking distance is about 1 km (Schuhmacher & Fartmann, 2003) and average dispersal distances are low (about 40 m) (Hjermann & Ims, 1996; Schuhmacher & Fartmann, 2003). One can presume that dispersal abilities of *Decticus nigrescens* are also very limited.

The whole range of *Decticus nigrescens* occupies about 1,300,000 km^2 (Fig. 1). Taking into account relatively low mobility of this insect, the number of its local insular populations can be estimated at least 25–35. However, we have only some very restricted data on the species abundance. This is why the species may be characterized as Data Deficient (DD) [IUCN, 2001]. Now it is not included in the Federal and regional Red Books, but the species occurs in several State Nature Reserves (Kedrovaya Pad, Lazovsky and Sikhote-Alin).

ACKNOWLEDGEMENTS

This study was financially supported by the grant of the Russian Science Foundation No. 22-66-00031.

REFERENCES

Cherrill, A.J. & Brown, V.K. 1990. The life cycle and distribution of the wart-biter *Decticus verrucivorus* (L.) (Orthoptera: Tettigoniidae) in a chalk grasslnad in Southern England. *Biological Conservation*, 53: 125–143.

Cigliano, M.M., Braun, H., Eades, D.C., & Otte, D. 2023. *Orthoptera Species File Online. Version 5.0/5.0*. Available from: http://Orthoptera.SpeciesFile.org. (accessed 30 September 2023)

Cobos, M. E., Osorio-Olvera, L., Soberón, J., Peterson, A. T., Barve, V., & Barve N. 2023. *ellipsenm: An R package for ecological niche's characterization using ellipsoids*. Available from: https://github.com/marlonecobos/ellipsenm#ellipsenm-an-r-package-for-ecological-niches-characterization-usingellipsoids (accessed 10 August 2023)

Dubatolov, V.V. & Sergeev, M.G. 1999. Orthoptera of the Dahurskii State Biosphere Nature Reserve and adjacent territories. P. 44–56. In: *Insects of Dahuria and adjacent territories. Proceedings of the Dahurskii State Biosphere Nature Reserve, Vol. 2*. Novosibirsk. [In Russian]

Fick, S.E. & Hijmans, R.J. 2017. WorldClim 2: New 1 km spatial resolution climate surfaces for global land areas. *International Journal of Climatology*, 37: 4302–4315. DOI: 10.1002/joc.5086

Furukawa, H. 1948. Notulae Orthopterologicae, No 1. *Shin-Konchu*, 1: 266–269. [In Japanese]

Hjermann, D.Ø. & Ims, R.A. 1996. Landscape ecology of the wart-biter *Decticus verrucivorus* in a patchy landscape. *Journal of Animal Ecology*, 65: 768–780.

IUCN. 2001. *IUCN Red List Categories and Criteria: Version 3.1.* IUCN Species Survival Commission, Gland and Cambridge, UK, 30 pp.

Kang, L., Ma, Y., Xie, B., Zheng, S., Qiao, F., Pam, J., & Li, K. 1990. Studies of the fauna and zonal distribution of Tettigoniodea (Orthoptera) in Nei Mongol Autonomous Region. *Entomotaxonomia*, 12(3–4): 157–169. [In Chinese]

Karmazina, I.O. 2010. Fauna and ecology of the ortopteran insects in the Khingansky Nature Reserve. *Eurasian Entomological Journal*, 9(2): 187–194.

Lapteva, S.V. 2023. Orthoptera of Amurskaya oblast. P. 84–102. In: *A.I. Kurentzov Annual Memorial Meetings, Issue 34*. PSP95, Vladivostok. [In Russian]

Liu, F., Chen, L. & Liu, C. 2020. Taxonomic studies of the genus *Decticus* Serville, 1831 from China (Orthoptera: Tettigoniidae: Tettigoniinae), based on morphology and songs. *Zootaxa*, 4860(4): 563–576. DOI: 10.11646/zootaxa.4860.4.6

Ma, Y., Li, H., & Kang, L. 1991. *The grassland insects of Inner Mongolia*. Tianze Eldonejo, Beijing. 467 pp. [In Chinese]

Otte, D. 1977. *Orthoptera Species File. 7. Tettigonioidea*. The Orthopterist's Society & the Academy of Natural Sciences of Philadelphia, Philadelphia. 373 pp.

Phillips, S.J., Anderson, R.P. & Schapire, R.E. 2006. Maximum entropy modeling of species geographic distributions. *Ecological Modelling*, 190: 231–259. DOI: 10.1016/j.ecolmodel.2005.03.026

Pravdin, F.N. & Cherniakhovsky, M.E. 1975. Regulatites of the ecological distribution of the orthopteroid insects (Orthopteroidea) in the southern part of the Maritime Territory. *Entomologicheskoe Oboztenie*, 54(2): 360–374. [In Russian]

Schuhmacher, O. & Fartmann, T. 2003. Wie mobil ist der Warzenbeißer? Eine population-sökologische Studie zum Ausbreitungsverhalten von *Decticus verrucivorus*. *Naturschutz und Landschaftsplanung*, 35(1): 20–28.

Sergeev, M.G. 1986. *Distribution patterns of Orthoptera in North Asia.* Nauka Publ., Novosibirsk. 236 pp. [In Russian]

Sergeev, M. G. 1993. The general distribution of Orthoptera in the main zoogeographical regions of North and Central Asia. *Acta zoologica cracoviensia*, 36, 53–76.

Stebaev, I.V., Muraveva, V.M., & Sergeev M.G. 1989. Ecological standards of Orthoptera in herbaceous biotopes in the Far East. *Entomological Review,* 68(2): 1–10.

Storozhenko, S.Yu. 1980. Review of Tettigonioidea (Orthoptera) of the Far East. P. 10–19. In: *Taxonomy of insects of the Far East*. DVNC AN SSSR, Vladivostok. [In Russian]

Storozhenko, S.Yu. 1992. Superorder Orthopteroidea. P. 44–51. In: *Insects of the Khingansky Nature Reserve, Part 1*. Dalnauka, Vladivostok. [In Russian]

Storozhenko, S.Yu. 2004. *Long-horned orthopterans (Orthoptera: Ensifera) of the Asiatic part of Russia*. Dalnauka, Vladivostok. 280 pp. [In Russian]

Storozhenko, S.Yu. 2009. Order Orthoptera. P. 46–50. In: *Insects of Lazovsky Nature Reserve*. Dalnauka, Vladivostok. [In Russian]

Tarbinsky, S.P. 1930. On some new and little-known Orthoptera from Palaearctic Asia. III. *Konowia*, 9(3): 177–190.

Weidemann, S., Stiedl, O. & Kalmring, K. 1990. Distributuion and population density of the bushcricket *Decticus verrucivorus* in a damp-meadow biotope*. Oecologia*, 82: 369–373.

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