

First record of the leafhopper *Nealiturus grandidentis* Gnezdilov (Auchenorrhyncha: Cicadellidae) in Israel

GUY SINAIKO^{1*} & CHRISTOPHER H. DIETRICH²

¹*School of Zoology, Tel Aviv University, Tel Aviv 6997801, Israel*

²*Illinois Natural History Survey, Prairie Research Institute, University of Illinois, Champaign, IL 61820, USA*

*Corresponding author: guysinaiko@gmail.com

ABSTRACT

Leafhopper *Nealiturus grandidentis* Gnezdilov, 2022 is reported from Israel for the first time. A recording of the male call of this species is provided; the syllable of *N. grandidentis* is longer by a magnitude compared to published male calls produced by several other *Nealiturus* species. The hitherto unknown female of *N. grandidentis* is described.

KEYWORDS: Auchenorrhyncha, Cicadellidae, leafhoppers, male calls, vibrational signals, vocal communication, Levant, Middle East.

INTRODUCTION

Leafhoppers (Cicadellidae) are one of the largest families of insects and are among the most abundant herbivores in terrestrial habitats that support vascular plants. The leafhopper fauna of Israel had been reviewed by Linnavuori (1962), who documented 114 species, but very little subsequent research focused on this family in Israel. A recent survey for leafhoppers in various locations in Israel was conducted as part of the senior author's PhD project between March 2018 and August 2022. Here we report the presence of previously unknown from Israel *Nealiturus grandidentis*. Gnezdilov (2022) described this species based on two males from Abu Dhabi and Sharjah in the United Arab Emirates. Its diagnostic feature is the large, flat, fin-like lobe at each side of the preapical area of its aedeagal shaft. The female of this species was unknown at the time of its original description.

While Linnavuori (1962) reported seven *Nealiturus* species in Israel, and three variants of known *Nealiturus* species were recorded by Klein & Raccach (1991) and Klein *et al.* (1982), none of those taxa fits the description of *Nealiturus grandidentis*.

MATERIALS AND METHODS

Specimens of *Nealiturus grandidentis* were collected in southern Israel at Nahal Shitta (30.144°N 35.129°E) and Yotvata (29.912°N 35.064°E), by sweeping in both localities and by light trapping in Yotvata. A few additional specimens were spotted

during light trapping at Hazeva Field School (30.783°N 35.250°E). The examined material is deposited in the Auchenorrhyncha collection of the Steinhardt Museum of Natural History, Tel Aviv University, Israel (SMNH-TAU-I.).

The body length of adults was measured from the anterior tip of the vertex to the posterior tip of the forewings. Abdomens of specimens were cleared using a 10 % KOH solution in order to reveal their genitalia and prepare them for morphological analyses. Morphological terminology follows Zahniser and Dietrich (2008).

Photographs of the habitus and diagnostic morphological structures, including male and female genitalia, were taken using a Dino-Lite camera mounted on a Leica 165M stereo microscope and on an Olympus CX33 compound microscope. Focus stacks were combined using the PMax method implemented in Zerene Stacker (V1.04). The photograph and the video of a live specimen were taken using a TOMLOV DM4S USB Digital Microscope.

The male calls (vibrational signals transmitted through the plant) of two specimens were recorded in the field at 28 °C using the pickup cartridge method described by Tishechkin (2022), with a EQ-7545R Preamplifier. Oscillograms and a spectrogram of the male call were prepared using the 'spectro' function implemented in the R package Seewave (Sueur *et al.* 2008). RX 9 Audio Editor v. 9.3.0.1435 was used to reduce background noise; its screen recording via Free Cam v. 8 was used to create the dynamic oscillogram and spectrogram. Terminology of vocal calls follows Bluemel *et al.* (2014) and Tishechkin (2021).

TAXONOMY

Family Cicadellidae Latreille, 1825
Subfamily Deltocephalinae Dallas, 1870
Tribe Opsiini Emeljanov, 1962
Subtribe Circuliferina Emeljanov, 1962
Genus *Neotaliturus* Distant, 1918
Neotaliturus grandidentis Gnezdilov, 2022

(Figs 1–3)

Neotaliturus grandidentis Gnezdilov, 2022: 752, figs 11–17.

Description: *Color.* In Israeli population, some males lightly colored (Fig. 1A); others as in original description (Fig. 1B). Females lightly colored (Fig. 2A), otherwise display the same color pattern as males.

Size and shape. Body length of males 3.18–2.58 mm (N=30, \bar{x} =3.33±0.09), of females 3.34–3.8 mm (N=30, \bar{x} =3.59±0.1). General habitus of female elongated and more robust than male's. In lateral view, female face more inflated than in male.

Female genitalia. Sternite 7 rectangular, its posterior margin with 3 shallow triangular emarginations, with 2 dark blotches above mesal emargination (Figs 2B, D). Sculpture of first valvula granulose and submarginal preapically, imbricate near dorsal margin apically (Fig. 2G). Teeth of second valvula non-scalene, obtusely triangular, unevenly spaced (Fig. 2H). Third valvula with large blotch dorsally (Fig. 2F).

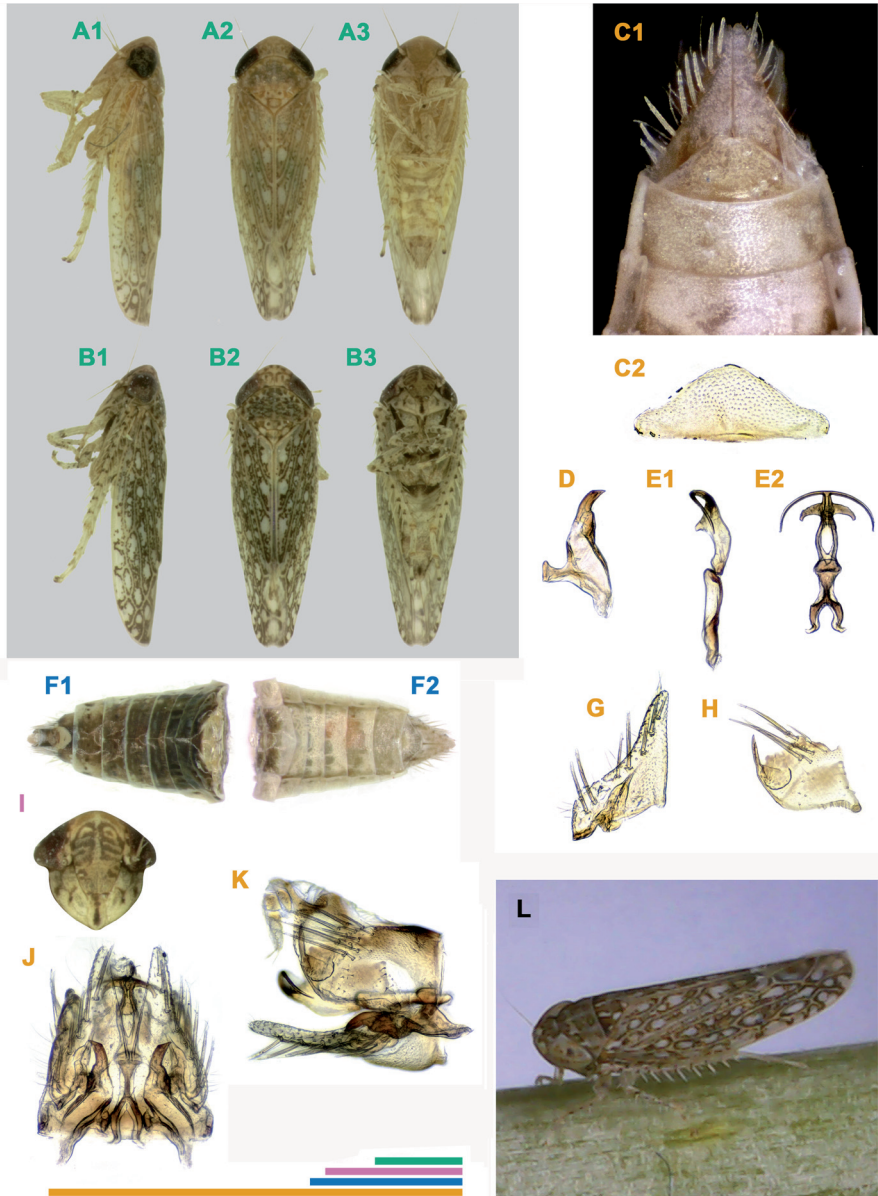


Fig. 1. Morphology of *Neoaliturus grandidentis* male (various specimens): (A, B): habitus (1: lateral, 2: dorsal, 3: ventral); (C1) subgenital plates and valve; (C2) valve; (D) style; (E) aedeagus (1: ventral, 2: dorsal); (F) abdomen (1: dorsal, 2: ventral); (G) subgenital plate; (H) pygofer process; (I) head; (J) genital capsule (cleared, ventral); (K) genital capsule (cleared, lateral); (L) live specimen. Scale bars = 1 mm; scaling is color-coded to the letter near each figure part. Live specimen (L) not scaled.

Material examined: Israel: *Southern Negev*: 2♂ Nahal Shitta, 30.144°N 35.129°E, 30.iv.2022, G. Sinaiko; 15♀ Nahal Shitta, 30.144°N 35.129°E, 8.v.2022, G. Sinaiko; *'Arava Valley*: 28♂ Yotvata, 29.912°N 35.064°E, 23.v.2020, G. Sinaiko; 16♀ Yotvata, 29.912°N 35.064°E, 25.iv.2022, G. Sinaiko.

Biology: *Neoliturus grandidentis* was present in the field from April until July (Fig. 3B). Nymphs of *N. grandidentis* were seen on *Lycium* sp. (Solanaceae), possible host plant of this species. Some of the specimens were parasitized by Dryinidae, as was evident by the presence of a typical thylacium on the leafhopper's body.

Vocal communication: We recorded the male call (term as used by Tishechkin 2021) oscillogram and spectrogram of the *Neoliturus grandidentis* (Fig. 3A, S1) in the field (Fig. 3B, S2).

Each syllable of the male call is 13.6–47.6-second-long ($\bar{X}=28.8\pm 11.3$, $N=2$, $n=10$): 18.32, 33.106, 21.614, 42.277, 47.565, 32.213, 15.741, 13.621 (SMNHTAU-I.435471); 32.281, 30.836 (SMNHTAU-I.435472). It comprises three distinct sections (1–3, Fig. 3A). Section 1 is a frequency modulated siren (term as used by Bluemel *et al.* 2014) or indistinguishable pulses (term as used by Tishechkin 2021) with increasing amplitude, which bears harmonics. Peak amplitude is reached near the last third of section A1. Section 2 also has harmonics and is of about the same amplitude as A1, however the peaks are more spaced and this section is shorter in terms of time. Section 3 is a very dense siren, and includes a low frequency section which does not exist in the former sections. It has a broadband frequency without harmonics, and terminates without a decrease in amplitude.

DISCUSSION

We assume that the presence of *N. grandidentis* Gnezdilov, 2022 in Israel remained undetected so far due to two main reasons. The first being that it is only present in the far south of Israel, which might have been studied to a lesser extent than other areas. The second being the fact that the general appearance of *N. grandidentis* is somewhat similar to that of *N. pulcher* (Haupt, 1927) in some aspects. This is evident mainly in the coloration of some specimens of both species, pale brown with white spots.

Moreover, some specimens of *N. pulcher* have a spine located at the preapical area of the aedeagal shaft, which is somewhat similar to the typical lobe of *N. grandidentis*, although this spine is thin and elongated, unlike the flat fin-like lobe of *N. grandidentis*. This might have caused the misidentification of some *N. grandidentis* specimens as belonging to *N. pulcher*.

Compared to published male calls by produced by several other *Neoliturus* species (Tishechkin 2021), the syllable of *N. grandidentis* is longer by a magnitude. The longest published syllable in Tishechkin's (2021) study was a ~0.8-second-long one, belonging to *N. fenestratus* (Herrich-Schäffer 1834) from Greece. However, the shortest recorded syllable of *N. grandidentis* in our study was 13.62-second-long. As Tishechkin (2021) provided oscillograms only, the spectral pattern of calls produced by species from his study cannot be compared with that of *N. grandidentis*.

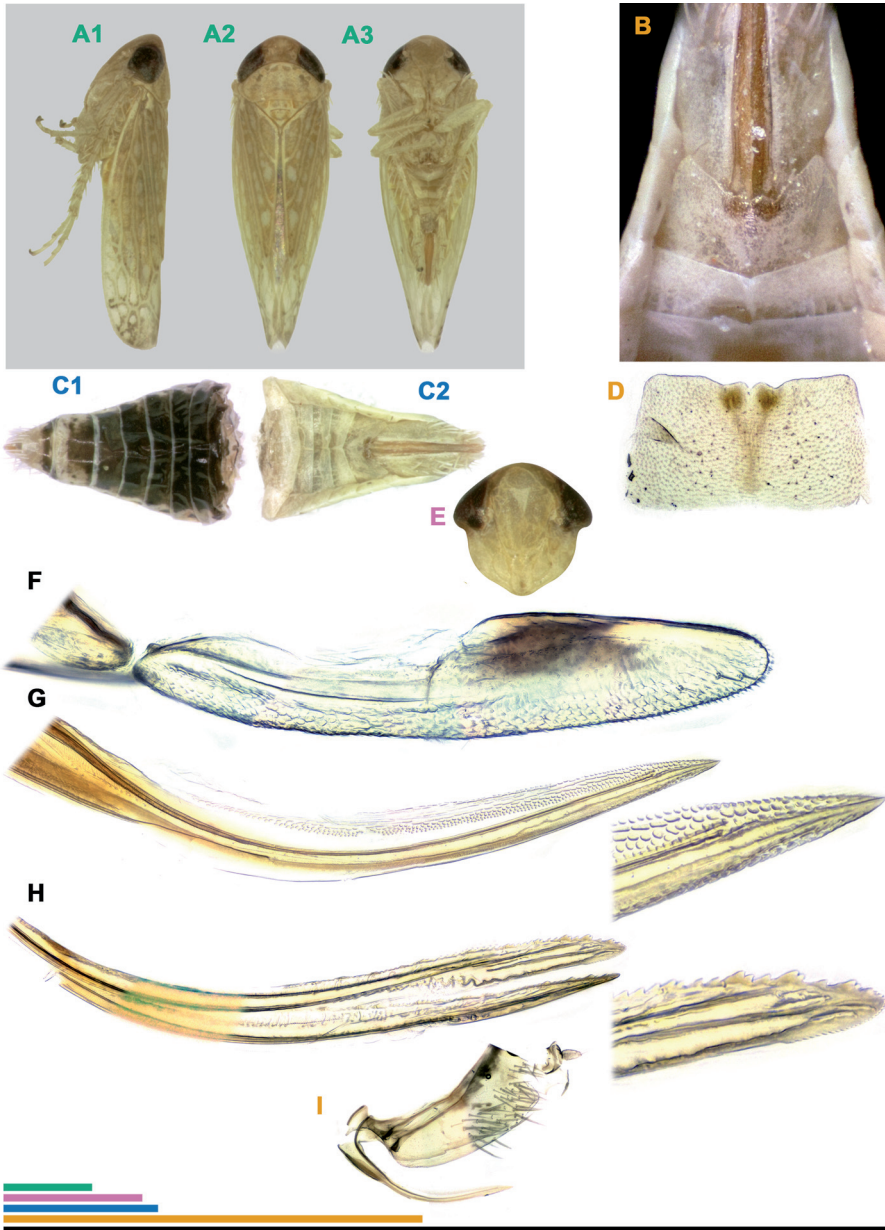


Fig. 2. Morphology of *Neoliturus grandidentis* female. SMNHNTAU-I.434777, habitus (A); SMNHNTAU-I.434789, all other figures: (A) habitus (1: lateral, 2: dorsal, 3: ventral); (B) 7th sternite; (C) abdomen (1: dorsal, 2: ventral); (D) 7th sternite (cleared); (E) head; (F) 3rd valvula; (G) 1st valvula; (H) 2nd valvula; (I) pygofer (cleared, lateral). Scale bars = 1 mm; scaling is color-coded to the letter near each figure part.

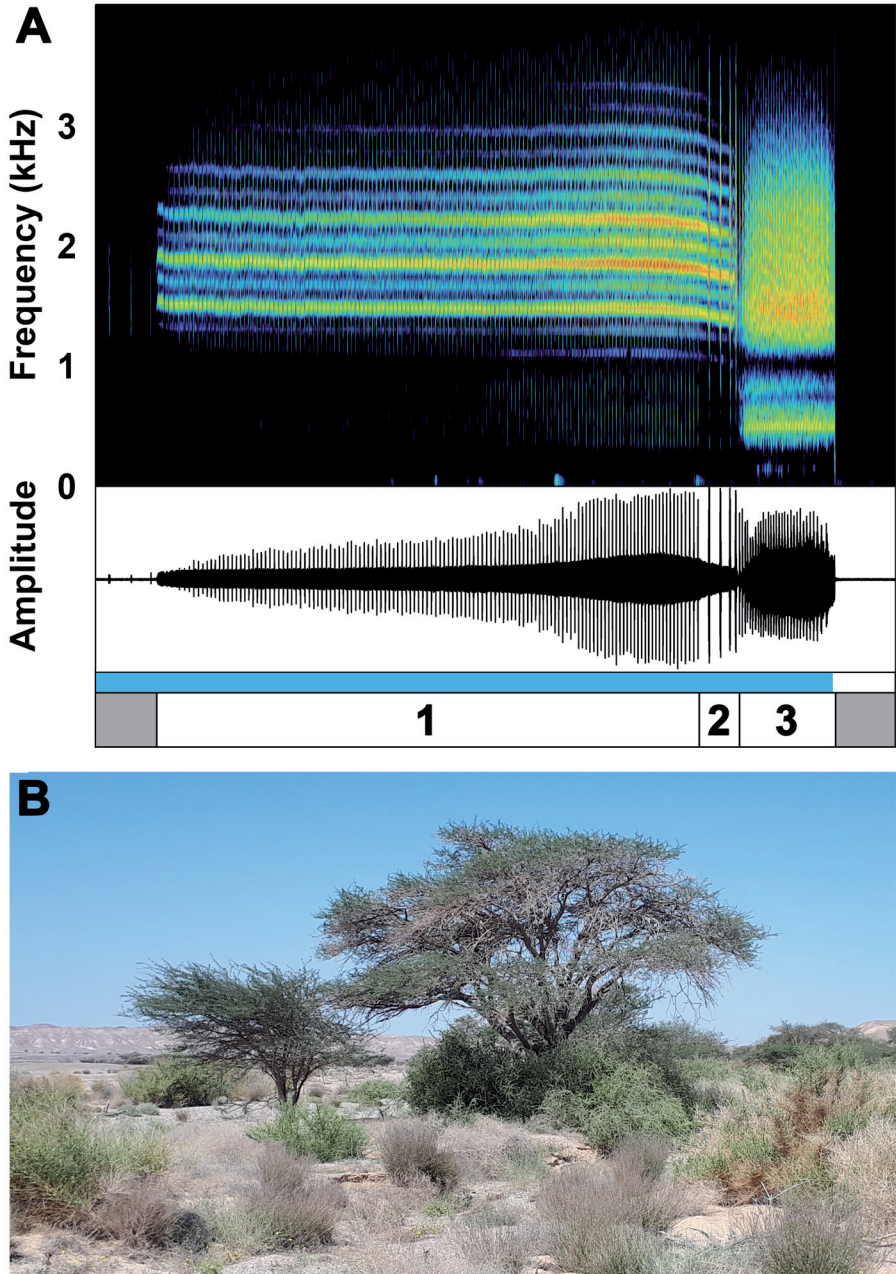


Fig. 3. (A) Spectrogram, oscillogram and partition scheme of *Neoliturus grandidentis* male call; blue scale bar = 35 s; (B) habitat of *N. grandidentis* at Nahal Shitta (30.144°N 35.129°E).

ACKNOWLEDGEMENTS

The authors would like to cordially thank Shai Meiri for providing supervision and study facilities to G. Sinaiko, and Dmitri Tishechkin and Reginald Cocroft for their guidance in regard to recording vibrational signals produced by the leafhoppers. We also thank two anonymous reviewers for improving our manuscript by providing helpful remarks. Collecting by sweeping and light trapping in nature reserves was conducted under Israel National Parks Authority permits nos. 2018/42016, 2019/42292, 2020/42569, 2021/42840 and 2022/43097. This research was funded in part by a grant from the US National Science Foundation (DEB-1639601).

REFERENCES

- BLUEMEL, J.K., DERLINK, M., PAVLOVICIC, P., RUSSO, I.R.M., KING, R.A., CORBETT, E., SHERRARD-SMITH, E., BLEJEC, A., WILSON, M.R., STEWART, A.J.A., SYMONDSON, W.O.C. & VIRANT-DOBERLET, M. 2014. Integrating vibrational signals, mitochondrial DNA and morphology for species determination in the genus *Aphrodes* (Hemiptera: Cicadellidae). *Systematic entomology* **39** (2): 304–324.
<https://resjournals.onlinelibrary.wiley.com/doi/10.1111/syen.12056>
- DISTANT, W.L. 1918. *Rhynchotha. VII. Homoptera: appendix. Heteroptera: addenda. The fauna of British India, including Ceylon and Burma*. Taylor & Francis, London, 210 pp.
- GNEZDILOV, V.M. 2022. Leafhoppers (Hemiptera: Auchenorrhyncha: Cicadellidae) of the United Arab Emirates: Checklist, new records, and a new Species. *Proceedings of the Entomological Society of Washington* **123** (4): 745–758. <https://doi.org/10.4289/0013-8797.123.4.745>
- HAUPT, H. 1927. Homoptera Palestinae I. *Bulletin, The Zionist Organisation. Institute of Agriculture and Natural History, Agricultural Experiment Station Tel-Aviv, Palestine* **8**: 5–43.
- HERRICH-SCHÄFFER, G.A.W. 1834. *Jassus punctifrons, Jassus rostratus, Jassus histrionicus, Jassus strigipes, Jassus 4-notatus, Jassus 6-notatus, Jassus striola, Jassus fenestratus, Jassus punctatus. Deutschlands Insecten* **122**: 1–6.
<https://www.biodiversitylibrary.org/item/256875#page/97>
- KLEIN, M., RACCAH, B. & OMAN, P.W. 1982. The occurrence of a member of the *Circulifer tenellus* species complex (Homoptera: Cicadellidae: Euscelini) in Israel. *Phytoparasitica* **10** (4): 237–240. <https://doi.org/10.1007/BF03023964>
- KLEIN, M. & RACCAH, B. 1991. Morphological characterization of two populations of *Circulifer* (Homoptera: Cicadellidae) from Israel. *Israel Journal of Entomology* **25**: 97–103.
https://ij-entomology.online/ojs/public/journals/1/archives/IJE-1991-2.Klein_-OCR.pdf
- LINNAVUORI, R. 1962 Hemiptera of Israel III. *Annales Zoologici Societatis Zoologicae Botanicae Fennicae 'Vanamo'* **24**: 1–108.
- SUEUR, J., AUBIN, T. & SIMONIS, C. 2008. Seewave, a free modular tool for sound analysis and synthesis. *Bioacoustics* **18** (2): 213–226. <https://doi.org/10.1080/09524622.2008.9753600>
- TISHECHKIN, D.Y. 2021. Review of the *Neoliturus fenestratus* (Herrich-Schffer, 1834) species group (Homoptera: Auchenorrhyncha: Cicadellidae: Deltocephalinae: Opsiini) from Russia, Kazakhstan, and Central Asia. *Zootaxa* **5039** (2): 201–221.
<https://doi.org/10.11646/zootaxa.5039.2.3>
- TISHECHKIN, D.Y. 2022. Vibrational communication in insects. *Entomological Review* **102** (6): 737–768.
<https://doi.org/10.1134/S001387382206001X>
- ZAHNISER, J.N. & DIETRICH, C.H. 2008. Phylogeny of the leafhopper subfamily Deltocephalinae (Insecta: Auchenorrhyncha: Cicadellidae) and related subfamilies based on morphology. *Systematics and Biodiversity* **6** (1): 1–24.
<https://doi.org/10.1017/S1477200007002617>

Supplementary data

S1: Oscillogram and spectrogram of *Neoliturus grandidentis* male:
<https://doi.org/10.5281/zenodo.10561268>

S2: A live leafhopper *Neoliturus grandidentis*
<https://doi.org/10.5281/zenodo.10562103>

