

First record of *Urostylis hubeiensis* Ren (Hemiptera, Heteroptera, Urostylididae) from Japan, with an illustrated key to the Japanese urostylidid species

Jun Souma^{‡§}, Yoshiaki Sakai[|], Tadashi Ishikawa[¶]

[‡] Entomological Laboratory, Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Fukuoka, Japan

[§] Research Fellowship for Young Scientists (DC1), Japan Society for the Promotion of Science, Tokyo, Japan
[|] Kuta, Izuhara-machi, Tsushima-shi, Nagasaki-ken, Japan

[¶] Laboratory of Entomology, Faculty of Agriculture, Tokyo University of Agriculture, Atsugi-shi, Kanagawa, Japan

Corresponding author: Jun Souma (kodokusignal@gmail.com)

Academic editor: Chen-Yang Cai

Abstract

Background

Although the Japanese species of Urostylididae are of interest to not only heteropteran taxonomists, but also to the public, an illustrated key for all species of the family from the country is lacking. To date, the urostylidid species *Urostylis hubeiensis* Ren, 1997, has been known to occur in China and Korea, but not in Japan.

New information

Urostylis hubeiensis is recorded from Japan for the first time and represents the easternmost occurrence of this species. In Japan, it inhabits the broad-leaved forest of Tsushima Island and was found on *Quercus acutissima* Carruth. (Fagaceae). An illustrated key to the species of Urostylididae occurring in Japan is provided.

Keywords

Heteroptera, Urostylididae, *Urostylis hubeiensis*, true bug, first record, illustrated key, Japan, Tsushima Island

Introduction

The phytophagous family Urostylididae Dallas, 1851 (Hemiptera, Heteroptera) comprises over 170 species in 11 genera, which are mainly distributed in eastern and southern Asia (Rider 2006, Schuh and Weirauch 2020). In Japan, the fauna of Urostylididae has been known for more than 100 years, with five common species in two genera (*Urochela* Dallas, 1850 and *Urostylis* Westwood, 1837) and well-referenced biological information, such as their host plant affinities; thus, they have long been considered to be fully elucidated. In other words, *Uroc. luteovaria* (Distant, 1881) was described from Japan approximately 140 years ago and feeds on deciduous trees of Rosaceae; *Uroc. quadrinotata* (Reuter, 1881) was recorded from Japan for the first time approximately 110 years ago as *Uroc. jozankeana* Matsumura, 1913 and feeds on deciduous trees of Ulmaceae; and *Uros. annulicornis* Scott, 1874, *Uros. stricornis* Scott, 1874 and *Uros. westwoodii* Scott, 1874 were described from Japan approximately 150 years ago and feed on deciduous trees of *Quercus* spp. (Fagaceae) (cf. Scott 1874, Distant 1881, Matsumura 1913, Yang 1939, Yasunaga et al. 1993, Kanyukova and Marusik 2006, Ishikawa and Miyamoto 2012, Ishikawa 2016). Additionally, *Uroc. luteovaria* is known as a pest of apple, apricot, cherry, pear and sakura and *Uros. stricornis* and *Uros. westwoodii* are known pests of deciduous oaks (Japanese Society of Applied Entomology and Zoology 2006). Moreover, all five species have been frequently recorded in faunistic studies (Nagashima et al. 2015, Ito 2020, Okuda 2020 etc.) and numerous photographs have been posted on the Internet by the public (Wildlife Research Society 2016, Tsukiji 2022, amongst others). In conclusion, the Urostylididae are considered to be attracting attention from not only heteropteran taxonomists, but also by the general public in Japan. However, in previous studies dealing with the Japanese Urostylididae (e.g. Yasunaga et al. 1993, Ishikawa and Miyamoto 2012), no identification key illustrating the diagnostic characteristics of all five species was provided, which may hinder identification by the public. Therefore, the publication of an illustrated key to the urostylidid species from Japan will not only improve the accuracy of many future faunistic studies, but will also help the public accurately recognise these familiar true bugs.

For the past six years, the authors and colleagues have collected an indeterminate species of *Urostylis* from Tsushima Island, Japan. After careful morphological examination, we concluded that it represented the *Uros. hubeiensis* Ren, 1997, known to occur in China and Korea to date (Ren 1997, Kim et al. 2018, Zhou and Rédei 2018). Herein, we record *Uros. hubeiensis* from Japan for the first time, representing the easternmost occurrence of this species. In addition, we provide an illustrated key for the Japanese species of Urostylididae, including *Uros. hubeiensis*.

Materials and methods

Dried specimens were used to observe the morphological characteristics. To examine the genitalia, the male terminalia were removed from the body after softening the specimens

in hot water. The removed parts were immersed in a hot 15% potassium hydroxide (KOH) solution for 5 min and then soaked in 99% ethanol for further observation. Male genitalia were preserved in small polyethylene vials containing 50% glycerine and mounted on a pin with the respective specimens. Morphological characteristics were observed and measured using a stereoscopic microscope (SZ60; Olympus, Tokyo, Japan), equipped with an ocular grid. The specimens were photographed using a digital microscope (Dino-Lite Premier M; Opto Science, Tokyo, Japan) and a compact digital camera (Tough TG-6; Olympus, Tokyo, Japan) and image stacks were processed using Adobe Photoshop 2021 ver. 22.5.1 (Adobe Inc., California, U.S.A.) when using a digital microscope. Morphological terms were generally assigned in accordance with Zhou and Rédei (2018).

All specimens of *Urostylis hubeiensis* used in the present study were deposited in the Laboratory of Entomology, Faculty of Agriculture, Tokyo University of Agriculture, Kanagawa, Japan (TUA). Specimens of the Japanese Urostylididae that were used for creating the identification key and comparison with *Uros. hubeiensis* were deposited in the Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka, Japan (ELKU) and TUA.

Distribution records of the species were mapped using SimpleMappr software (Shorthouse 2010). Geographical coordinates were obtained using the Google Maps software. The map was edited using Adobe Photoshop 2021 ver.22.5.1. The scientific names of the host plants were assigned in accordance with Yonekura and Kajita (2022).

Taxon treatment

Urostylis hubeiensis Ren, 1997

Nomenclature

Urostylis hubeiensis Ren, 1997 - Ren 1997 [58], new species, description and figures; Rider 2006 [113], catalogue and distribution; Zhou and Rédei 2018: 145, diagnosis, figures and distribution.

Urostylis koreana Kim & Jung, 2018 - Kim et al. 2018 [446], new species, description and figures; Zhou and Rédei 2018: 145, synonymised with *Urostylis hubeiensis*.

Materials

- a. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Toyotama-machi; locality: Nii; decimalLatitude: 34.401000; decimalLongitude: 129.326000; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 22/11/2016; individualCount: 1; sex: male; lifeStage: adult; recordedBy: Yoshiaki Sakai; identifiedBy: Jun Souma; Tadashi

- Ishikawa; dateIdentified: 2022; institutionCode: TUA; basisOfRecord: PreservedSpecimen; occurrenceID: 4A38D4F0-0370-5D65-A352-C24B01F5A2D8
- b. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Toyotama-machi; locality: Nii; decimalLatitude: 34.401000; decimalLongitude: 129.326000; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 22/11/2016; individualCount: 1; sex: female; lifeStage: adult; recordedBy: Yoshiaki Sakai; identifiedBy: Jun Souma; Tadashi Ishikawa; dateIdentified: 2022; institutionCode: TUA; basisOfRecord: PreservedSpecimen; occurrenceID: 688CDBED-78E1-596A-A988-BB15C44D13D4
- c. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Toyotama-machi; locality: Nii, Matsunbara-shizen-kôen; decimalLatitude: 34.404940; decimalLongitude: 129.332420; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 05/09/2017; individualCount: 2; sex: female; lifeStage: adult; recordedBy: Yoshiaki Sakai; identifiedBy: Jun Souma; Tadashi Ishikawa; dateIdentified: 2022; institutionCode: TUA; basisOfRecord: PreservedSpecimen; occurrenceID: E6E4F356-CDD4-5B96-85B4-72A538B83719
- d. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Toyotama-machi; locality: Nii, Matsunbara-shizen-kôen; decimalLatitude: 34.404940; decimalLongitude: 129.332420; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 05/09/2017; individualCount: 2; sex: female; lifeStage: adult; recordedBy: Tadashi Ishikawa; identifiedBy: Jun Souma; Tadashi Ishikawa; dateIdentified: 2022; institutionCode: TUA; basisOfRecord: PreservedSpecimen; occurrenceID: ADD5E451-B95D-5ED3-B589-1BCE9808A729
- e. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Toyotama-machi; locality: Nii, Matsunbara-shizen-kôen; decimalLatitude: 34.404940; decimalLongitude: 129.332420; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 06/09/2017; individualCount: 1; sex: female; lifeStage: adult; recordedBy: Jun Souma ; identifiedBy: Jun Souma; Tadashi Ishikawa; dateIdentified: 2022; institutionCode: TUA; basisOfRecord: PreservedSpecimen; occurrenceID: 46DE05FE-8EC4-5A61-BB4A-6BEF1CA62F32
- f. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Toyotama-machi; locality: Nii, Matsunbara-shizen-kôen; decimalLatitude: 34.404940; decimalLongitude: 129.332420; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 17/11/2017; individualCount: 4; sex: male; lifeStage: adult; recordedBy: Yoshiaki Sakai; identifiedBy: Jun Souma; Tadashi Ishikawa; dateIdentified: 2022; institutionCode: TUA;

- basisOfRecord: PreservedSpecimen; occurrenceID: AB7949A2-66D5-5BD5-88F8-4E56A4824E1B
- g. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Toyotama-machi; locality: Nii, Matsunbara-shizen-kôen; decimalLatitude: 34.404940; decimalLongitude: 129.332420; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 17/11/2017; individualCount: 2; sex: female; lifeStage: adult; recordedBy: Yoshiaki Sakai; identifiedBy: Jun Souma; Tadashi Ishikawa; dateIdentified: 2022; institutionCode: TUA; basisOfRecord: PreservedSpecimen; occurrenceID: DDF6E651-040F-5288-8828-5E90CFEE98D3
- h. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Mine-machi; locality: Saka; decimalLatitude: 34.464881; decimalLongitude: 129.372242; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 27/05/2018; individualCount: 1; sex: female; lifeStage: adult; recordedBy: Yoshiaki Sakai; identifiedBy: Jun Souma; Tadashi Ishikawa; dateIdentified: 2022; institutionCode: TUA; basisOfRecord: PreservedSpecimen; occurrenceID: 7F917149-7845-584E-85C8-F2AD2D0ECFF9
- i. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Mine-machi; locality: Saka; decimalLatitude: 34.464881; decimalLongitude: 129.372242; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 02/06/2018; individualCount: 2; sex: male; lifeStage: adult; recordedBy: Yoshiaki Sakai; identifiedBy: Jun Souma; Tadashi Ishikawa; dateIdentified: 2022; institutionCode: TUA; basisOfRecord: PreservedSpecimen; occurrenceID: FA955514-4DE5-5771-ACF9-0E5EFBDC95D1
- j. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Mine-machi; locality: Saka; decimalLatitude: 34.464881; decimalLongitude: 129.372242; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 01/06/2019; individualCount: 1; sex: male; lifeStage: adult; recordedBy: Yoshiaki Sakai; identifiedBy: Jun Souma; Tadashi Ishikawa; dateIdentified: 2022; institutionCode: TUA; basisOfRecord: PreservedSpecimen; occurrenceID: 88FF6D61-2CBE-540D-9D22-E2F143AB8FB8
- k. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Toyotama-machi; locality: Nii, Matsunbara Shinrin Koen; decimalLatitude: 34.404940; decimalLongitude: 129.332420; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 08/06/2019; individualCount: 2; sex: male; lifeStage: adult; recordedBy: Shusuke Shimamoto; identifiedBy: Jun Souma; Tadashi Ishikawa; dateIdentified: 2022; institutionCode: TUA; basisOfRecord: PreservedSpecimen; occurrenceID: AC6B71CD-DA92-59B6-BD04-7AD84A8CF855

- l. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Toyotama-machi; locality: Nii, Matsunbara Shinrin Koen; decimalLatitude: 34.404940; decimalLongitude: 129.332420; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 08/06/2019; individualCount: 3 ; sex: female; lifeStage: adult; recordedBy: Shusuke Shimamoto; identifiedBy: Jun Souma; Tadashi Ishikawa; dateIdentified: 2022; institutionCode: TUA; basisOfRecord: PreservedSpecimen; occurrenceID: E43CE918-7590-5E68-A586-69E023220BD9
- m. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Kamitsushima-machi; locality: Kawachi, Yuishiyama Shinrin Koen; decimalLatitude: 34.673087; decimalLongitude: 129.421658; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 13/06/2019; individualCount: 1 ; sex: male; lifeStage: adult; recordedBy: Shusuke Shimamoto; identifiedBy: Jun Souma; Tadashi Ishikawa; dateIdentified: 2022; institutionCode: TUA; basisOfRecord: PreservedSpecimen; occurrenceID: 081C547E-E0BE-5B31-AD08-33B5DC376CE2
- n. scientificName: *Urostylis hubeiensis* Ren, 1997; namePublishedIn: 1997; kingdom: Animalia; phylum: Arthropoda; class: Insecta; order: Hemiptera; family: Urostylididae; genus: *Urostylis*; specificEpithet: *hubeiensis*; scientificNameAuthorship: Ren; island: Tsushima Island; country: Japan; stateProvince: Nagasaki; municipality: Kamitsushima-machi; locality: Kawachi, Yuishiyama Shinrin Koen; decimalLatitude: 34.673087; decimalLongitude: 129.421658; geodeticDatum: WGS84; samplingProtocol: none specified; eventDate: 13/06/2019; individualCount: 1 ; sex: female; lifeStage: adult; recordedBy: Shusuke Shimamoto; identifiedBy: Jun Souma; Tadashi Ishikawa; dateIdentified: 2022; institutionCode: TUA; basisOfRecord: PreservedSpecimen; occurrenceID: 03148DDB-0E00-5CC6-A266-66E2DB5E7091

Diagnosis

Urostylis hubeiensis can be distinguished from other species of the genus using a combination of the following characteristics (cf. Kim et al. 2018, Zhou and Rédei 2018): dorsum pale, mostly concolorously punctate (Fig. 1D and Fig. 8); scape (antennal segment I) with a black longitudinal fascia on lateral surface (Fig. 2D); scutellum with pale punctures entirely; forewing decorated with large, coarse, scattered black punctures in area enclosed by medial furrow and Cu (cubital) vein (relatively sparse between Cu and R+M (radiomedial) veins, denser between R+M and medial furrow); corium with a series of rather regularly arranged, closely placed black punctures forming a straight line along claval furrow; abdomen with pale spiracles (Fig. 3D); genital capsule of male with a pair of short and blunt dorsolateral processes and a single apically excised ventromedian process (Fig. 4D, Fig. 5D and Fig. 6D); posterior margin of genital capsule below dorsolateral process broadly convex, enclosing a narrow, U-shaped interspace with anterior margin of ventromedian process in lateral view; ventromedian process directed nearly dorsad, with apex approximately reaching level of dorsolateral processes in lateral view, with lateral margins

subparallel-sided or slightly concave in caudal view; ventrite VII of female not protruding posteriad below ovipositor, leaving valvifers VIII fully exposed (Fig. 7D); laterotergite VIII of female reaching a level of laterotergite IX ventrally; laterotergite IX of female longer, distinctly surpassing posterior extremities of valvifers VIII both in ventral, but particularly in posteroventral views; and posteromesal portion of laterotergite IX surpassing its posterolateral portion posteriorly.

Distribution

Japan (Tsushima Island) (Fig. 9), China (Ren 1997, Zhou and Rédei 2018), Korea (Kim et al. 2018, Zhou and Rédei 2018).

The records of *Urostylis hubeiensis* from Tsushima Island represent the easternmost occurrence of this species.

Biology

Urostylis hubeiensis was collected from *Quercus acutissima* Carruth. (Fagaceae) in Japan, suggesting that this deciduous fagaceous tree is a host plant for this species. In other distribution areas, the host plant of this urostylidid species is unknown. *Uros. hubeiensis* is found in broad-leaved forests in Japan. Its habitat is unknown in China, but it is found regularly in forest of *Q. acutissima* in Korea (M. Roca-Cusachs, pers. comm. 2022). In Korea, *Uros. hubeiensis* were attracted to artificial light (Kim et al. 2018).

Adults were collected in May, June, September and November in Japan and from May to September in other distribution areas (Ren 1997, Kim et al. 2018, Zhou and Rédei 2018). The nymph and overwintering stages are unknown both in Japan and in other distribution areas.

Taxon discussion

The above-recorded specimens matched the photographs of the holotype (Zhou and Rédei 2018) and descriptions (Ren 1997, Kim et al. 2018, Zhou and Rédei 2018) of *Urostylis hubeiensis* described from China in terms of their morphological characteristics. Moreover, the Japanese specimens were identified as *Uros. koreana* [= *Uros. hubeiensis*] using a key for the Korean species of *Urostylis* (Kim et al. 2018). In conclusion, we identified the Japanese specimens as *Uros. hubeiensis*.

Checklist of the species of Urostylididae occurring in Japan

Urochela luteovaria (Distant, 1881)

Distribution: China, Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea (Distant 1881, Rider 2006, Ishikawa and Miyamoto 2012, Ishikawa 2016).

***Urochela quadrinotata* (Reuter, 1881)**

Distribution: China, Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, Russia (Matsumura 1913, Yang 1939, Rider 2006, Ishikawa and Miyamoto 2012, Ishikawa 2016).

***Urostylis annulicornis* Scott, 1874**

Distribution: China, Japan (Kunashiri Island, Hokkaido, Honshu, Shikoku, Kyushu), Korea, Russia (Scott 1874, Kanyukova and Marusik 2006, Rider 2006, Ishikawa and Miyamoto 2012, Ishikawa 2016).

***Urostylis hubeiensis* Ren, 1997**

Distribution: China, Japan (Tsushima Island), Korea (Ren 1997, Kim et al. 2018, Zhou and Rédei 2018, present study).

***Urostylis striicornis* Scott, 1874**

Distribution: China, Japan (Hokkaido, Honshu, Sado Island, Shikoku, Kyushu, Tsushima Island), Korea, Russia (Scott 1874, Rider 2006, Ishikawa and Miyamoto 2012, Ishikawa 2016).

***Urostylis westwoodii* Scott, 1874**

Distribution: China, Japan (Honshu, Shikoku, Kyushu, Tsushima Island), Korea (Scott 1874, Rider 2006, Ishikawa and Miyamoto 2012, Ishikawa 2016).

Identification keys

Key to the species of Urostylididae occurring in Japan		
1	Dorsum brown or reddish-brown (Fig. 1A and B); scape (antennal segment I) shorter, less than 2.0 times as long as head (Fig. 2A and B); laterotergites III–VII with a single black spot (Fig. 3A, B and Fig. 7A and B)	2
–	Dorsum pale or green (Fig. 1C–F and Fig. 8); scape longer, more than 2.0 times as long as head (Fig. 2C–F); laterotergites III–VII without black spot (Fig. 3C–F and Fig. 7C–F)	3

2	Corium of forewing without black spot (Fig. 1A); dorsolateral and ventromedian processes of genital capsule well-developed (Fig. 4 A, Fig. 5A and Fig. 6A)	<i>Urochela luteovaria</i> (Distant, 1881)
–	Corium of forewing with two black spots (Fig. 1B); dorsolateral and ventromedian processes of genital capsule undeveloped (Fig. 4B, Fig. 5B and Fig. 6B)	<i>Urochela quadrinotata</i> (Reuter, 1881)
3	Abdomen with black spiracles (Fig. 3F and Fig. 7F); ventromedian process of genital capsule narrowed apically (Fig. 4F, Fig. 5F and Fig. 6F)	<i>Urostylis westwoodii</i> Scott, 1874
–	Abdomen with pale spiracles (Fig. 3C–E and Fig. 7C–E); ventromedian process of genital capsule not narrowed apically (Fig. 4C–E, Fig. 5C–E and Fig. 6C–E)	4
4	Dorsum pale (Fig. 1D and Fig. 8); scutellum with pale punctures entirely; corium of forewing with black punctures partly	<i>Urostylis hubeiensis</i> Ren, 1997
–	Dorsum green (Fig. 1C and E); scutellum with black punctures entirely; corium of forewing with black punctures entirely	5
5	Ventromedian process of genital capsule not widened apically (Fig. 4C, Fig. 5C and 6C); laterotergite IX not elongated, not protruding posteriad (Fig. 7C)	<i>Urostylis annulicornis</i> Scott, 1874
–	Ventromedian process of genital capsule widened apically (Fig. 4 E, Fig. 5E and Fig. 6E); laterotergite IX elongated, protruding posteriad (Fig. 7E)	<i>Urostylis striicornis</i> Scott, 1874

Acknowledgements

We express our sincere thanks to Chen-Yang Cai (Chinese Academy of Sciences, Nanjing, China) and Marcos Roca-Cusachs (Universitat de Barcelona, Barcelona, Spain) for their critical comments on the manuscript. We are grateful to Shusuke Shimamoto (TUA) for kindly providing valuable material and information on the collection sites. This work was partially supported by a Grant-in-Aid for JSPS Fellows (JP20J20483) to the first author from the Japan Society for the Promotion of Science, Tokyo, Japan. We would like to thank Editage (<https://www.editage.jp>) for the English language editing.

References

- Distant WL (1881) Notes on a small collection of from Tokei, Japan. *Annals and Magazine of Natural History* 5: 27-29. <https://doi.org/10.1080/00222938109459836>

- Ishikawa T, Miyamoto S (2012) Family Urostylididae. In: Ishikawa T, Takai M, Yasunaga T (Eds) A field guide to Japanese bugs. Terrestrial heteropterans III. Zenkoku Noson Kyoiku Kyokai, Publishing Co., Ltd., Tokyo, 101 pl., 436–438 pp. [In Japanese]. [ISBN 978-4-88137-168-8].
- Ishikawa T (2016) Family Urostylididae. In: Hayashi M, Tomokuni M, Yoshizawa K, Ishikawa T (Eds) Catalogue of the insects of Japan Volume 4 Paraneoptera. Touka-shobo, Fukuoka, 486 pp. [In Japanese].
- Ito R (2020) [Urostylididae, Plataspidae, Cydnidae, Scutelleridae, Dinidoridae, and Acanthosomatidae from Oita-ken, Kyushu, Japan (Heteroptera)]. Niho-no-Mushi 58: 17-24. [In Japanese].
- Japanese Society of Applied Entomology and Zoology (Ed.) (2006) Major insect and other pests of economic plants in Japan (Revised edition). Japan Plant Protection Association, Tokyo, 387 pp. [In Japanese]. [ISBN 4-9980853-1-X]
- Kanyukova EV, Marusik YM (2006) A check-list of Heteroptera of the Kuril Islands and brief zoogeographical survey of the fauna. Biodiversity and Biogeography of the Kuril Islands and Sakhalin 2: 161-174.
- Kim J, Roca-Cusachs M, Jung S (2018) Taxonomic review of the genus *Urostylis* (Hemiptera: Heteroptera: Urostylididae) from the Korean Peninsula, with description of a new species. Zootaxa 4433 (3): 445-456. <https://doi.org/10.11646/zootaxa.4433.3.3>
- Matsumura S (1913) Thousand insects of Japan. Additamenta 1. Keiseisha, Tokyo, 15 pls., 184 pp. [In Japanese].
- Nagashima S, Ishikawa T, Suzuki K, Sato H, Ono K (2015) A preliminary checklist of heteropteran insects of Kuzumaki Town, Iwate Prefecture, Japan. Bulletin of the Itami City Museum of Insects 3: 37-44. [In Japanese].
- Okuda K (2020) Heteroptera (Insecta: Hemiptera) from Midori-Ku, Saitama City, Saitama Prefecture, Japan. Bulletin of the Saitama Museum of Natural History, New Series 14: 43-52. [In Japanese].
- Ren SZ (1997) New species of *Urolabida* Westwood and *Urostylis* Westwood from China (Heteroptera: Urostylidae). Acta Scientiarum Naturalium Universitatis Nankaiensis 30: 57-65. [In Chinese, with English summary].
- Rider DA (2006) Family Urostylididae Dallas, 1851. In: Aukema B, Rieger C (Eds) Catalogue of the Heteroptera of the Palaearctic Region. Vol. 5. Pentatomomorpha II. The Netherlands Entomological Society, Amsterdam, 102–116 pp. [ISBN 90-71912-28-0].
- Schuh RT, Weirauch C (2020) True bugs of the World (Hemiptera: Heteroptera). Classification and natural history (Second Edition). Siri Scientific Press, Manchester, 32 pls., 768 pp. [ISBN 978-0-9957496-9-6]
- Scott J (1874) On a collection of Hemiptera Heteroptera from Japan. Descriptions of various new genera and species. Annals and Magazine of Natural History 4: 289–304, 360–365, 426–452.
- Shorthouse DP (2010) SimpleMappr, an online tool to produce publication-quality point maps. <http://www.simplemappr.net>. Accessed on: 2022-2-13.
- Tsukiji T (2022) *Urostylis annulicornis*. https://mushinavi.com/navi-insect/data-kame_kunugi_hera.htm. Accessed on: 2022-2-12.
- Wildlife Research Society (2016) [*Urostylis striicornis*]. <https://www.wildlife.or.jp/single-post/%E3%82%B5%E3%82%B8%E3%82%AF%E3%83%8C%E3%82%AE%E3%82%AB%E3%83%A1%E>. Accessed on: 2022-2-12.

- Yang WI (1939) A revision of Chinese urostylid insects (Heteroptera). Bulletin of the Fan Memorial Institute of Biology, Zoology 9: 5-66.
- Yasunaga T, Takai M, Yamashita I, Kawamura M, Kawasaki T (1993) A field guide to Japanese bugs. Terrestrial heteropterans. Zenkoku Noson Kyoiku Kyokai, Publishing Co., Ltd., Tokyo, 380 pp. [In Japanese]. [ISBN 4-88137-052-9]
- Yonekura K, Kajita T (2022) BG Plants Wamei-Gakumei Index (YList). <http://ylist.info>. Accessed on: 2022-2-15.
- Zhou YY, Rédei D (2018) A new synonymy in East Asian Urostylididae (Hemiptera: Heteroptera). Zootaxa 4504 (1): 145-150. <https://doi.org/10.11646/zootaxa.4504.1.10>

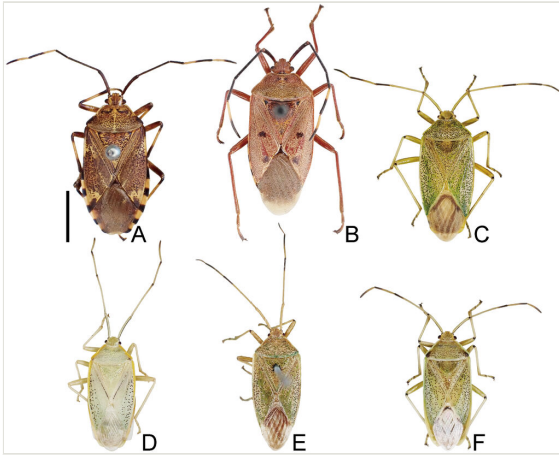


Figure 1.

Dorsal habitus of six species of Urostylididae from Japan. Scale bar: 5.0 mm. **A** *Urochela luteovaria*; **B** *Urochela quadrinotata*; **C** *Urostylis annulicornis*; **D** *Urostylis hubeiensis*; **E** *Urostylis striicornis*; **F** *Urostylis westwoodii*.

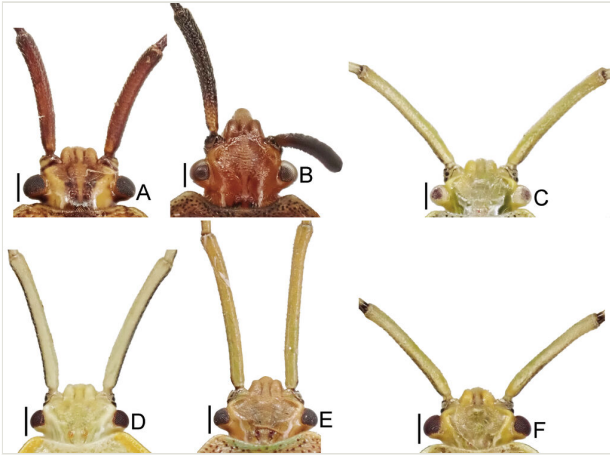


Figure 2.

Head and scape of six species of Urostylidae from Japan, dorsal view. Scale bars: 0.5 mm. **A** *Urochela luteovaria*; **B** *Urochela quadrinotata*; **C** *Urostylis annulicornis*; **D** *Urostylis hubeiensis*; **E** *Urostylis striicornis*; **F** *Urostylis westwoodii*.

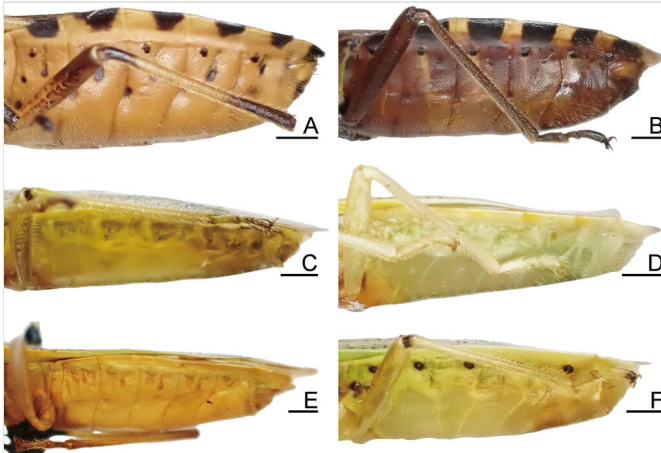


Figure 3.

Female abdomen of six species of Urostylidae from Japan, lateral view. Scale bars: 1.0 mm.

A *Urochela luteovaria*; **B** *Urochela quadrinotata*; **C** *Urostylis annulicornis*; **D** *Urostylis hubeiensis*; **E** *Urostylis striicornis*; **F** *Urostylis westwoodii*.

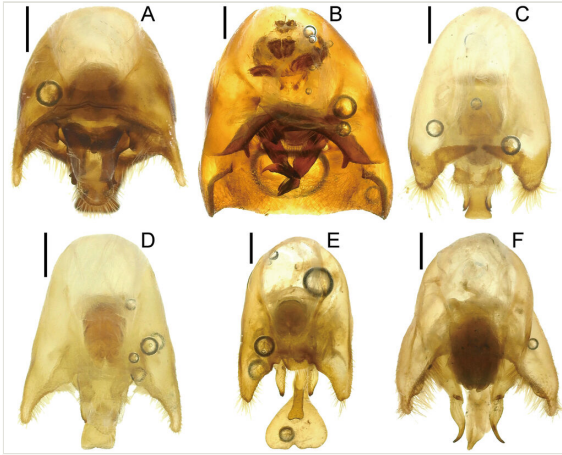


Figure 4.

Genital capsule of six species of Urostylididae from Japan, dorsal view. Scale bars: 0.5 mm. **A** *Urochela luteovaria*; **B** *Urochela quadrinotata*; **C** *Urostylis annulicornis*; **D** *Urostylis hubeiensis*; **E** *Urostylis striicornis*; **F** *Urostylis westwoodii*.

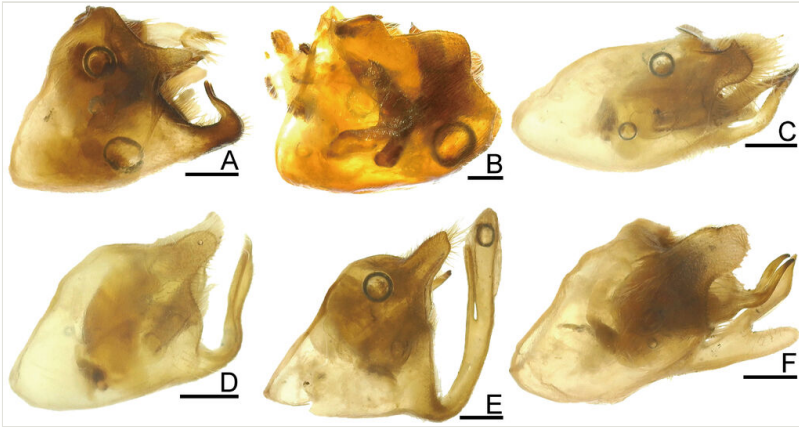


Figure 5.

Genital capsule of six species of Urostylidae from Japan, lateral view. Scale bars: 0.5 mm. **A** *Urochela luteovaria*; **B** *Urochela quadrinotata*; **C** *Urostylis annulicornis*; **D** *Urostylis hubeiensis*; **E** *Urostylis striicornis*; **F** *Urostylis westwoodii*.

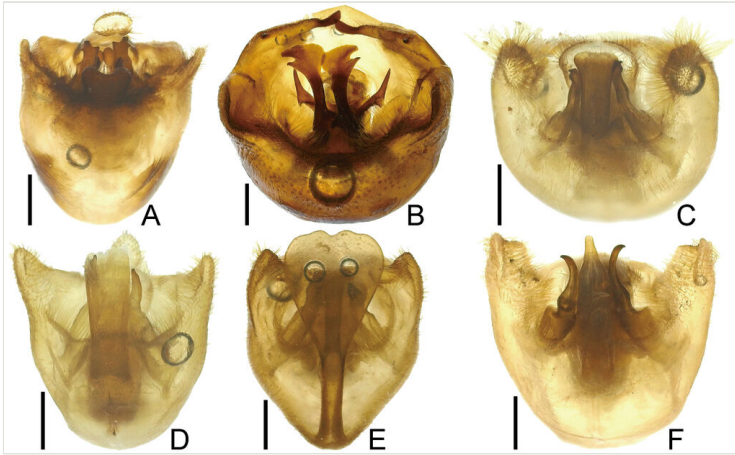


Figure 6.

Genital capsule of six species of Urostylididae from Japan, caudal view. Scale bars: 0.5 mm. **A** *Urochela luteovaria*; **B** *Urochela quadrinotata*; **C** *Urostylis annulicornis*; **D** *Urostylis hubeiensis*; **E** *Urostylis striicornis*; **F** *Urostylis westwoodii*.

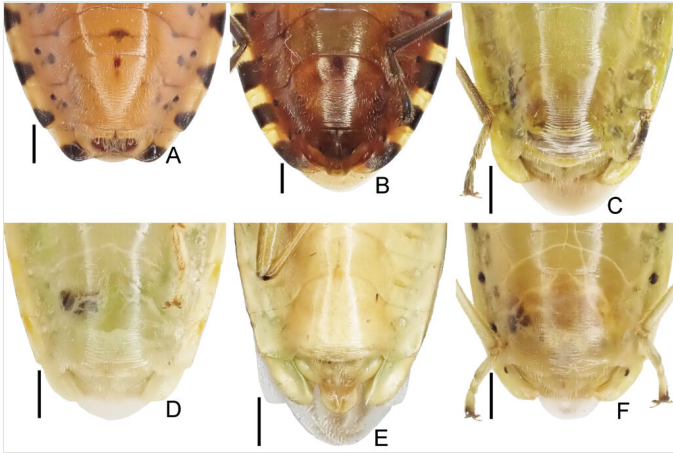


Figure 7.

Female terminalia of six species of Urostylididae from Japan, ventral view. Scale bars: 1.0 mm. **A** *Urochela luteovaria*; **B** *Urochela quadrinotata*; **C** *Urostylis annulicornis*; **D** *Urostylis hubeiensis*; **E** *Urostylis striicornis*; **F** *Urostylis westwoodii*.



Figure 8.
Habitus images of live individuals of *Urostylis hubeiensis* from Tsushima Island, Japan.

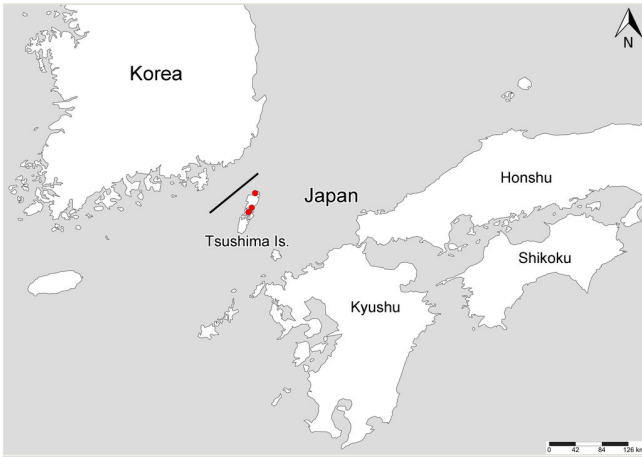


Figure 9.
Collection sites of *Urostylis hubeiensis* from Tsushima Island, Japan.