First report of *Cheiloneurus exitiosus* (Perkins, 1906) and *Helegonatopus dimorphus* (Hoffer, 1954) (Hymenoptera: Encyrtidae) from Japan, with remarks on their abundance in rice paddies

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Academic editor: Donat Agosti

Received: 16 May 2016 | Accepted: 24 Aug 2016 | Published: 29 Aug 2016

Citation: Mita T, Handa H, Higashiura Y, Japoshvili G (2016) First report of *Cheiloneurus exitiosus* (Perkins, 1906) and *Helegonatopus dimorphus* (Hoffer, 1954) (Hymenoptera: Encyrtidae) from Japan, with remarks on their abundance in rice paddies. Biodiversity Data Journal 4:e9230. doi: [10.3897/BDJ.4.e9230](https://doi.org/10.3897/BDJ.4.e9230)

Abstract

Background

Encyrtid secondary parasitoids of Delphacidae have not been recorded in Japan. However, they may play an important role in the rice ecosystem because they can reduce the number of Dryinidae, the natural enemies of rice planthoppers.

New information

We found two encyrtid species, *Cheiloneurus exitiosus* (Perkins, 1906) and *Helegonatopus dimorphus* (Hoffer, 1954), from rice paddies and the surrounding environment. *Haplogonatopus oratorius* (Westwood, 1833) and *Anteon* sp. were newly recognized as...
hosts of *He. dimorphus*. Parasitism of *C. exitiosus* was rare, but *He. dimorphus* was common in Kumamoto Prefecture. The sex ratio (male proportion) and clutch size of *He. dimorphus* was estimated as 0.19 and 4.95, respectively.

**Keywords**

Distribution, *Haplogonatopus oratorius*, host record, *Laodelphax striatellus*, parasitoid wasp

**Introduction**

Some encyrtid wasps are known as parasitoids of Dryinidae (Guerrieri and Viggiani 2005, Olmi and Xu 2015 and Xu et al. 2013). There are two genera of encyrtids reported as parasitoids of Dryinidae, namely, *Cheiloneurus* Westwood and *Helegonatopus* Perkins. Hitherto, *Helegonatopus* is considered the specialist of Dryinidae. Among these, *H. dimorphus* (Hoffer, 1954) has been widely recorded from Europe to Sakhalin (Noyes 2016). This species exhibits a peculiar sexual dimorphism. The head of the male is compressed laterally, whereas that of the female is unmodified. As for *Cheiloneurus, C. exitiosus* (Perkins, 1906) is recorded widely from South Asia to Oceania (Xu et al. 2013). As is often the case with small parasitoid wasps, a substantial number of Encyrtidae show a cosmopolitan distribution. Furthermore, some of their primary hosts such as rice planthoppers are known as long-distance migrants (Otuka 2013), and dryinid larvae can also be transported (Mita et al. 2013). It is possible that those primary hosts carry not only dryinid larvae, but also their hyperparasitoids. In East Asian countries, the secondary parasitoid of rice planthoppers has seldom been investigated. However, a consideration of their distribution range and the host's dispersal ability suggests they should be found widely in East Asian countries including Japan, and they may play an indispensable role in the rice ecosystem. We herein report the occurrence of these encyrtid wasps in Japan, and present results of a preliminary survey of their field abundance.

**Materials and methods**

Materials used in the study are preserved in 99.5% ethanol. They were mounted on pieces of cardboard or glass slides when necessary. Original pictures were taken by a digital camera (Olympus E-5) attached to an Olympus SZX10 stereomicroscope. Photo images were processed using image-stacking software (Combine ZP). Materials are deposited in the Entomological Laboratory, Faculty of Agriculture, Kyushu University (ELKU). Distribution and host records were obtained from Guerrieri and Viggiani (2005), Xu et al. (2013) and Olmi and Xu (2015).

Some encyrtid wasps collected before 2014 could not be separated into each host individual. To confirm the number of encyrtid wasps per dryinid larva, the parasitism ratio, and the sex ratio of encyrtid hyperparasitoids, specimens of *Laodelphax striatellus* (Fallén,
1826) parasitized by Dryinidae and dryinid cocoons on leaves were collected from rice paddies in Kumamoto and Kagoshima prefectures on Kyushu Island during September 17–28, 2014 (Table 1). Two other species of rice planthoppers, *Nilaparvata lugens* (Stål, 1854) and *Sogatella furcifera* (Horváth, 1899), were seldom collected during the survey. Cocoons were additionally collected at Suya from September to October 2014. Parasitized planthoppers were reared separately in small glass tubes plugged by cotton with a stem of rice. Field cocoons were similarly treated, but a stem was not inserted. They were kept in an incubator (25°C, 16L/8D) or the laboratory at room temperature. When no parasitoid emerged, the cocoon was dissected and any dead wasps were identified.

| Prefecture | Site name | Locality | Latitude | Longitude | Date |
|------------|-----------|----------|----------|-----------|------|
| Kumamoto   | Shisui    | Shisui-machi, Kikuchi-Shi | 32.927N | 130.766E | 21. IX. 2014 |
| Kumamoto   | Suya      | NARO Kyushu Okinawa Agricultural Research Center, Suya, Koshi-Shi | 32.876N | 130.738E | 17. IX. 2014 |
| Kumamoto   | Hida      | Hida, Kita-ku, Kumamoto-Shi | 32.849N | 130.720E | 18, 20. IX. 2014 |
| Kagoshima  | Kimpo     | Kagoshima Prefectural Institute for Agricultural Development, Kimpo-cho, Minamisatsuma-Shi | 31.482N | 130.343E | 26-28. IX. 2014 |

Table 1.
Collection sites of field survey in 2014.

**Taxon treatments**

*Cheiloneurus exitiosus* (Perkins, 1906)

**Materials**

a. country: Japan; stateProvince: Kumamoto; locality: rice paddy, Hida, Kita-ku, Kumamoto, Japan; decimalLatitude: 32.849; decimalLongitude: 130.720; samplingProtocol: collecting cocoon of *Haplogonatopus oratorius*; eventDate: 2014-09-20/2014-10; individualCount: 5; sex: 1 male, 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-05; institutionID: ELKU

b. country: Japan; stateProvince: Nagasaki; locality: rice paddy, Nagasaki Plant Protection Office, Kobunakoshi-machi, Nagasaki, Japan; decimalLatitude: 32.837; decimalLongitude: 31.024; samplingProtocol: sweeping of parasitised *Sogatella furcifera* by *Haplogonatopus apicalis* and rearing of adult wasps; eventDate: 2009-08-26/2009-09; individualCount: 5; sex: 1 male 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-05; institutionID: ELKU
c. country: Japan; stateProvince: Nagasaki; locality: rice paddy, Nagasaki Plant Protection Office, Kobunakoshi-machi, Nagasaki, Japan; decimalLatitude: 32.837; decimalLongitude: 130.024; samplingProtocol: sweeping of parasitised Sogatella furcifera by Haplogonatopus apicalis and rearing of adult wasp; eventDate: 2009-08-26/2009-09; individualCount: 1; sex: 1 male; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

Distribution

American Samoa, Australia, China, Fiji, Guam, India, Malaysia, Philippines, Western Samoa (Noyes 2016), Japan, new record: Kyushu (Figs 1, 2).

![Figure 1. Dorsal habitus of Cheiloneurus excitiosus. Scale bar: 0.5mm.](image)

- a: Female.
- b: Male.

Host: Palaearctic Region: Gonatopus camelinus Kieffer, 1904 (Spain). Oriental Region: Haplogonatopus apicalis Perkins, 1905 (Malaya; Japan); H. oratorius (Westwood, 1833) (China; Japan); G. flavifemur (Esaki & Hashimoto, 1932) (Philippines); G. nigricans (Perkins, 1905) (Malaya); G. nudus (Perkins, 1912) (India).

*Helegoantopus dimorphus* (Hoffer, 1954)

Materials

a. country: Japan; stateProvince: Kumamoto; locality: rice paddy, Shisui-machi, Kikuchi-shi, Kumamoto, Japan; decimalLatitude: 32.927; decimalLongitude: 130.766; samplingProtocol: collecting cocoon of Haplogonatopus oratorius and rearing of adult wasp; eventDate: 2014-09-21/2014-10-05; individualCount: 5; sex: 1 male, 4 females; lifeStage: adult; recordedBy: Hironobu Handa; identifiedBy: Hironobu Handa; dateIdentified: 2014; modified: 2015-12-05; institutionID: ELKU
Figure 2.
Head of *Cheiloneurus exitiosus* in dorsal view. Scale bar: 0.25mm.
a: Female.
b: Male.
country: Japan; stateProvince: Kumamoto; locality: rice paddy, Hida, Kita-ku, Kumamoto, Japan; decimalLatitude: 32.849; decimalLongitude: 130.720; samplingProtocol: collecting cocoon of *Haplogonatopus oratorius* and rearing of adult wasp; eventDate: 2014-09-20/2014-09-30; individualCount: 4; sex: 1 male, 3 females; lifeStage: adult; recordedBy: Hironobu Handa; identifiedBy: Hironobu Handa; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, Hida, Kita-ku, Kumamoto, Japan; decimalLatitude: 32.849; decimalLongitude: 130.720; samplingProtocol: collecting cocoon of *Haplogonatopus oratorius* and rearing of adult wasp; eventDate: 2014-09-20/2014-09-27; individualCount: 3; sex: 3 females; lifeStage: adult; recordedBy: Hironobu Handa; identifiedBy: Hironobu Handa; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, Hida, Kita-ku, Kumamoto, Japan; decimalLatitude: 32.849; decimalLongitude: 130.720; samplingProtocol: collecting cocoon of *Haplogonatopus oratorius* and rearing of adult wasp; eventDate: 2014-09-20/2014-10-05; individualCount: 5; sex: 1 male, 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.720; samplingProtocol: adult wasp emerged from cocoon of *Haplogonatopus oratorius*; eventDate: 2014-08-30/2014-09-04; individualCount: 6; sex: 1 male, 5 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.720; samplingProtocol: adult wasp emerged from cocoon of *Haplogonatopus oratorius*; eventDate: 2014-08-30/2014-09-04; individualCount: 6; sex: 1 male, 3 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.720; samplingProtocol: adult wasp emerged from cocoon of *Haplogonatopus oratorius*; eventDate: 2014-08-30/2014-09-04; individualCount: 4; sex: 1 male, 3 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.720; samplingProtocol: adult wasp emerged from cocoon of *Haplogonatopus oratorius*; eventDate: 2014-08-30/2014-09-07; individualCount: 4; sex: 1 male, 3 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.720; samplingProtocol: adult wasp emerged from cocoon of *Haplogonatopus oratorius*; eventDate: 2014-08-30/2014-09-08; individualCount: 3; sex: 1 male, 2 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876;
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decimallongitude: 130.738; samplingProtocol: adult wasp emerged from coccoon of Haplogonatopus oratorius; eventDate: 2014-08-31/2014-09-11; individualCount: 5; sex: 1 male, 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU
country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimallongitude: 130.738; samplingProtocol: adult wasp emerged from coccoon of Haplogonatopus oratorius; eventDate: 2014-08-31/2014-09-11; individualCount: 4; sex: 1 male, 3 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimallongitude: 130.738; samplingProtocol: adult wasp emerged from coccoon of Haplogonatopus oratorius; eventDate: 2014-08-31/2014-09-11; individualCount: 2 males, 6 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimallongitude: 130.738; samplingProtocol: adult wasp emerged from coccoon of Haplogonatopus oratorius; eventDate: 2014-08-31/2014-09-11; individualCount: 6; sex: 1 male, 5 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimallongitude: 130.738; samplingProtocol: adult wasp emerged from coccoon of Haplogonatopus oratorius; eventDate: 2014-08-31/2014-09-11; individualCount: 5; sex: 1 male, 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimallongitude: 130.738; samplingProtocol: adult wasp emerged from coccoon of Haplogonatopus oratorius; eventDate: 2014-09-01/2014-09-12; individualCount: 9; sex: 3 males, 6 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimallongitude: 130.738; samplingProtocol: adult wasp emerged from coccoon of Haplogonatopus oratorius; eventDate: 2014-09-01/2014-09-12; individualCount: 7; sex: 3 males, 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimallongitude: 130.738; samplingProtocol: adult wasp emerged from coccoon of Haplogonatopus oratorius; eventDate: 2014-09-01/2014-09-12; individualCount: 4; sex: 1
male, 3 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

x. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLongitude: 130.738; samplingProtocol: adult wasp emerged from cocoon of Haplogonatopus oratorius; eventDate: 2014-09/2014-09-17; individualCount: 5; sex: 1 male, 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

y. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLongitude: 130.738; samplingProtocol: adult wasp emerged from cocoon of Haplogonatopus oratorius; eventDate: 2014-09/2014-09-17; individualCount: 6; sex: 1 male, 5 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

z. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLongitude: 130.738; samplingProtocol: adult wasp emerged from cocoon of Haplogonatopus oratorius; eventDate: 2014-09/2014-09-20; individualCount: 5; sex: 1 male, 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

aa. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLongitude: 130.738; samplingProtocol: adult wasp emerged from cocoon of Haplogonatopus oratorius; eventDate: 2014-09/2014-09-26; individualCount: 6; sex: 1 male, 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

ab. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLongitude: 130.738; samplingProtocol: adult wasp emerged from cocoon of Haplogonatopus oratorius; eventDate: 2014-09/2014-09-20; individualCount: 6; sex: 1 male, 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

ac. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLongitude: 130.738; samplingProtocol: adult wasp emerged from cocoon of Haplogonatopus oratorius; eventDate: 2014-09/2014-09-26; individualCount: 5; sex: 1 male, 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

ad. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLongitude: 130.738; samplingProtocol: adult wasp emerged from cocoon of Haplogonatopus oratorius; eventDate: 2014-09/2014-10-10; individualCount: 6; sex: 1 male, 5 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

ae. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLongitude: 130.738; samplingProtocol: adult wasp emerged from cocoon of Haplogonatopus oratorius; eventDate: 2014-09/2014-09-10; individualCount: 5; sex: 5 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU
First report of Cheiloneurus exitiosus (Perkins, 1906) and Helegonatopus ...

af. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.738; samplingProtocol: adult wasp emerged from cocoon of Haplogonatopus oratorius; eventDate: 2014-09/2014-09-10; individualCount: 5; sex: 5 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

tag. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.738; samplingProtocol: adult wasp emerged from cocoon of Haplogonatopus oratorius; eventDate: 2014-09/2014-09-12; individualCount: 4; sex: 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

ah. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.738; samplingProtocol: adult wasp emerged from cocoon of Haplogonatopus oratorius; eventDate: 2014-09/2014-09-17; individualCount: 5; sex: 5 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

ai. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.738; samplingProtocol: adult wasp emerged from cocoon of Haplogonatopus oratorius; eventDate: 2014-09/2014-09-12; individualCount: 3; sex: 3 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

aj. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.738; samplingProtocol: adult wasp emerged from cocoon of Haplogonatopus oratorius; eventDate: 2014-09/2014-09-17; individualCount: 3; sex: 3 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

ak. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.738; samplingProtocol: collecting coccoon of Haplogonatopus oratorius and examined dead adult wasp; eventDate: 2014-09-20/2014-10; individualCount: 7; sex: 3 males, 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

al. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.738; samplingProtocol: collecting coccoon of Haplogonatopus oratorius and examined dead adult wasp; eventDate: 2014-10-02; individualCount: 1; sex: 1 male; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU
an. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.738; samplingProtocol: collecting cocoon of Haplogonatopus oratorius and examined dead adult wasp; eventDate: 2014-10-02; individualCount: 1; sex: 1 male; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

ao. country: Japan; stateProvince: Kumamoto; locality: rice paddy, NARO Kyushu Okinawa Agricultural Research Center, Koshi, Kumamoto, Japan; decimalLatitude: 32.876; decimalLongitude: 130.738; samplingProtocol: collecting cocoon of Haplogonatopus oratorius and examined dead adult wasp; eventDate: 2014-10-02; individualCount: 1; sex: 1 male; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

ap. country: Japan; stateProvince: Kumamoto; locality: rice paddy, Kamo-cho, Yamaga-shi, Kumamoto, Japan; samplingProtocol: collecting cocoon of rice planthopper and rearing of adult wasps; eventDate: 2008-09-19/2009-08; individualCount: 4; sex: 4 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

aq. country: Japan; stateProvince: Kanagawa; locality: rice paddy, Funako, Atsugi-shi, Kanagawa, Japan; decimalLatitude: 35.434; decimalLongitude: 139.351; samplingProtocol: sweeping of parasitised host planthopper (Laodelphax striatellus) and rearing of adult wasps; eventDate: 2010-09-17/2010-10; individualCount: 3; sex: 3 females; lifeStage: adult; recordedBy: Atsuhito Sakai; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

ar. country: Japan; stateProvince: Kanagawa; locality: rice paddy, Funako, Atsugi-shi, Kanagawa, Japan; decimalLatitude: 35.434; decimalLongitude: 139.351; samplingProtocol: sweeping of parasitised host planthopper (Laodelphax striatellus) and rearing of adult wasps; eventDate: 2010-09-15/2010-10; individualCount: 5; sex: 2 males, 3 females; lifeStage: adult; recordedBy: Atsuhito Sakai; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

as. country: Japan; stateProvince: Nagasaki; locality: rice paddy, Nagasaki Plant Protection Office, Kobunakoshi-machi, Nagasaki, Japan; decimalLatitude: 32.837; decimalLongitude: 130.024; samplingProtocol: sweeping of parasitised Sogatella furcifera by Haplogonatopus apicalis and rearing of adult wasp, multiple individuals of hosts kept in same tube; eventDate: 2009-08-26/2009-09; individualCount: 42; sex: 11 males, 31 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

at. country: Japan; stateProvince: Saitama; locality: grassland, Ooasou-kouen, Kumagaya-shi, Saitama, Japan; decimalLatitude: 36.143; decimalLongitude: 139.348; samplingProtocol: sweeping of parasitised Hecalus sp. by Anteon sp. and rearing adult wasp; eventDate: 2008-10-20/2008-11; individualCount: 4; sex: 3 males, 1 female; lifeStage: adult; recordedBy: Naomichi Ohara; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU

au. country: Japan; stateProvince: Fukuoka; locality: fallow field, Sasaguri-machi, Fukuoka, Japan; samplingProtocol: collecting of cocoon of Haplogonatopus sp. and rearing of adult wasp; eventDate: 2009-08-11/2009-08; individualCount: 2; sex: 2 females; lifeStage: adult; recordedBy: Toshiharu Mita; identifiedBy: Toshiharu Mita; dateIdentified: 2014; modified: 2015-12-25; institutionID: ELKU
Distribution

Widely distributed from western Palaearctic countries to Mongolia (Noyes 2016), Japan, **new record**: Honshu, Kyushu (Figs 3, 4).

Figure 3.
Dorsal habitus of *Helegonatopus dimorphus*. Scale bar: 0.5 mm
- a: Female.
- b: Male.

Figure 4.
Head of *Helegonatopus dimorphus* in dorsal view. Scale bar: 0.25mm.
- a: Female.
- b: Male.
**Host:** Palaearctic Region: *Anteon* sp., **new record** (Japan); *Haplogonatopus oratorius* (Westwood, 1833), **new record** (Japan); *Gonatopus clavipes* (Thunberg, 1827) (Italy); *G. solidus* (Haupt, 1938) (Italy); *G. formicicolus* (Richards, 1939) (Italy); *G. pallidus* (Ceballos, 1927) (Sweden); *G. rosellae* (Currado & Olmi, 1974) (Italy).

**Discussion**

**Dryinidae and Encyrtidae collected by field survey in 2014**

Through our survey in 2014, two dryinids, *Gonatopus nigricans* (Perkins) and *Haplogonatopus oratorius* (Westwood), emerged from *Laodelphax striatellus* (Fallén) and dryinid cocoons collected from the field. All hyperparasitoids were identified as *Helegonatopus dimorphus*, but a cocoon collected at Hida was parasitized by *Cheiloneurus exitiosus*. We found two other examples of *C. exitiosus* emergence from *Ha. apicalis* parasitizing *Sogatella furcifera* in Saga Prefecture. This species seems to be rare in Japan, or they simply might not prefer *L. striatellus*. On the other hand, *He. dimorphus* was widely found from central Honshu (Saitama and Kanagawa) to Kyushu (Fukuoka, Kumamoto). The rearing of parasitized planthoppers revealed that two dryinid larvae were parasitized by Encyrtidae in Hida (Table 2). The proportion of parasitized field cocoons differed greatly and depended on the site of collection (Table 3). The highest score of 87.9% was recorded in Suya. Since the proportion of *G. nigricans* in Kumamoto was very low (2.1%, compared to 50.0% in Kagoshima), dryinids attacked by encyrtids were regarded as *Ha. oratorius*. No hyperparasitoid was found in Kagoshima.

| Cocoon | *Haplogonatopus oratorius* | *Gonatopus nigricans* | *Helegonatopus dimorphus* | *Cheiloneurus exitiosus* |
|--------|---------------------------|----------------------|---------------------------|--------------------------|
| Suya   | 3                         | 3                    | 0                         | 0                        |
| Shisui | 30                        | 30                   | 0                         | 0                        |
| Hida   | 73                        | 70                   | 1                         | 2                        |
| Kimpo  | 54                        | 28                   | 26                        | 0                        |

**Table 2.**
Parasitized *Laodelphax striatellus* and emerged parasitoids collected by field survey in 2014.

| Cocoon | *Haplogonatopus oratorius* | *Gonatopus nigricans* | *Helegonatopus dimorphus* | *Cheiloneurus exitiosus* |
|--------|---------------------------|----------------------|---------------------------|--------------------------|
| Suya   | 33                        | 4                    | 0                         | 29                       |
| Shisui | 26                        | 24                   | 0                         | 2                        |

**Table 3.**
Field cocoons and emerged parasitoids collected by field survey in 2014.
Clutch size and sex ratio of *Helegonatopus dimorphus*

Olmi and Xu (2015) reported that 10–12 individuals of *He. dimorphus* emerged from a cocoon of *G. rosellae* (Currado & Olmi, 1974), while 7 individuals were recorded as having emerged from *G. solidus* (Haupt, 1938) in Italy. According to our field survey, 3–8 (mean 4.95±1.40SD) individuals emerged from *Ha. oratorius*. The average male proportion is 0.19 (Table 4), and represents 0.95 per clutch. The smaller number relative to the other two dryinid species may be due to the smaller body size (2.0–3.1 mm for the females of *Ha. oratorius*, compared to 3.0–3.4 mm in *G. solidus* and 3.5–3.8 mm in *G. rosellae*). This number is similar to that of *He. pseudophanes* (Perkins, 1906) in Argentina where they attack *Gonatopus bonaerensis* Virla, 1997 (2.4–3.2 mm) and *G. desantisi* Olmi & Virla, 1992 (2.9–3.2 mm), and exhibit a clutch size of 6 and male proportion of 0.32 (De Santis and Virla 1991).

| Clutch number | Emerged number | Sex ratio (male proportion) |
|---------------|----------------|----------------------------|
| *Helegonatopus dimorphus* | 38 | 188 | 0.19 |
| *Cheiloneulus exitiosus* | 1 | 5 | 0.20 |

### Host stage

As for *C. exitiosus*, they attack the "later instar" larva of *G. nudus* (Perkins, 1912) (as *Pseudogonatopus nudus*) (Manickavasagam et al. 2009). According to the observations of De Santis and Virla (1991), both genera may have the ability to begin attacking from the larval-sac stage on the primary host to the pupa in the cocoon. In the present study, we confirmed that *He. dimorphus* can attack the larval sac, but the proportion of this parasitism is much smaller than that of the cocoon. The higher proportion of parasitism can be at least partially explained by the difference in developmental period. The developmental period of the larval sac of *Ha. oratorius* (as *Ha. atratus*, 4.5 days at 25°C) is shorter than the period from removal from the host planthopper to adult emergence (11.2 days) (Kitamura 1983). Our results indicate that *L. striatellus* possibly transports its primary and secondary parasitoid together, but the amount of secondary parasitoid should be very limited not only because of their scarcity. Host stage preference should be investigated to understand the effect on host-parasitoid dispersal dynamics.
Acknowledgements

We are grateful to Masaya Matsumura, Reiko Otsu, Naomichi Ohara, Akihito Sakai, and Ken Teramoto for their help in field surveys, and the various land owners for allowing us to collect samples. This study was partly supported by the Grant-in-Aid for JSPS Fellows (26-3756) and KAKENHI (26850032).

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