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Insect galls found on Ohshima, Kozushima and Niijima Islands, the Izu Islands, Tokyo, Japan

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Abstract. Galls induced by cecidomyiids and other insects were surveyed from 2009 to 2012 on Ohshima, Niijima, and Kozushima Islands, the Izu Islands, Tokyo, Japan. As a result, 13, 16 and 14 sorts of cecidomyiid galls were found on Ohshima, Niijima, and Kozushima, respectively. Among them, the following five are new to the Izu Islands: a fruit gall induced by *Asphondylia* sp. on *Ardisia japonica* (Myrsinaceae), a bud gall induced by an unidentified cecidomyiid on *Styrax japonica* var. *kotoensis* (Styracaceae), a stem gall induced by *Rhopalomyia struma* on *Artemisia indica* var. *maximowiczii* (Asteraceae), a stem gall induced by *Rhopalomyia giraldii* on *A. indica* var. *maximowiczii*, and a leaf gall induced by *Rhopalomyia* sp. on *A. indica* var. *maximowiczii*. Of that number, five, nine, and seven sorts of cecidomyiid galls are newly recorded from Ohshima, Niijima, Kozushima, respectively. A terminal or axillary bud gall on *Chrysanthemum pacificum* is newly recorded from Honshu through an additional field survey. The following four sorts of other insect galls are newly recorded from the Izu Islands: a stem gall induced by *Tetrastichus ardisiae* (Hymenoptera: Eulophidae) on *A. japonica*, a bud gall induced by *Ceratovacuna nekoashi* (Hemiptera: Aphididae) on *S. japonica* var. *kotoensis*, and stem galls induced by *Eucosma metzneriana* (Lepidoptera: Tortricidae) and *Oedaspis japonica* (Diptera: Tephritidae) on *A. indica* var. *maximowiczii*.

Key Words: biogeography, Cecidomyiidae, gall midge, host plant, new distribution record.

Introduction

Island biota is interesting in terms of biogeography and evolutionary ecology because it often exhibits somewhat unique community structures and insular populations show different ecological traits from mainland populations (e.g. MacArthur & Wilson 1967; Thornton 1996; Stuessy & Ono 1998; Thornton *et al.* 2002).

The Izu Islands consist of several volcanic islands located south of Honshu, Japan, extending for about 230 km from north to south (Fig. 1). The Islands have a unique biota of insects (Kurosawa 1978; Inoue & Amano 1986; Takaoka & Saito 2005), terrestrial reptiles (e.g. Hasegawa 2003), and plants (Inoue 1988; Oiki *et al.* 2001; Miyake & Inoue 2003).

In recent years, we have been paying special attention to clarify cecidomyiid (Diptera) fauna of the Izu Islands (Tokuda *et al.* 2012a,b), because gall inducers are one of the most suitable organisms for biogeographic studies. Galls are generally specific in shape and structure to gall inducers and remain on plants for a long period. These features enable us to identify gall inducers without dissection of galls, estimate the population density, develop the life table of inducers, and investigate local gall-inducer fauna during the short period of surveys (Partomihardjo *et al.* 2011; Tokuda *et al.* 2012b; Yukawa *et al.* 2012). Moreover, various organisms such as predators, parasitoids, inquiline, cecidophages, and successors are known to be associated with galls and gall inducers (Mani 1964; Yukawa 1983; Tokuda 2012). Gall inducers can be regarded as keystone taxa in the terrestrial ecosystem, because they affect not only associated organisms but also other herbivores through manipulation of host characteristics (Ohgushi 2005).

Because gall inducers generally have high host specificity and the induction of galls is essential for their survival in most cases, colonization of oceanic islands by them is premised on the existence of their host plants. Particularly, gall midges have weak flight and dispersal abilities due to degenerated wing veins and very short adult life span (Gagné 1989, 1994; Yukawa & Masuda 1996; Yukawa & Rohfrisch 2005; Tokuda 2012). Therefore, they are considered to disperse passively with wind (Yukawa & Partomihardjo 1997; Partomihardjo *et al.* 2011).

In this paper we report insect galls found on northern parts of the Izu Islands: Ohshima, Niijima and Kozushima Islands. On these islands, several species of gall midges (Diptera: Cecidomyiidae) are already known to occur: Ishizawa (1942) reported *Asteralobia sasakii* (Monzen) inducing axillary bud galls on *Ilex crenata* Thunb. var. *hachijoensis* Nakai (Aquifoliaceae) from Ohshima. Sunose (1981) later reported *A. sasakii* from Kozushima; two more species from Ohshima: *Asphondylia aucubae* Yukawa et Ohsaki inducing fruit galls on *Aucuba japonica* Thunb. var. *japonica* (Aucubaceae) and *Rhopalomyia yomogicola* (Matsumura) inducing leaf galls on *Artemisia indica* Willd. var. *maximowiczii* (Nakai) H. Hara (Asteraceae); and four species from all three islands: *Asphondylia sphaera* Monzen inducing fruit galls on *Ligustrum ovalifolium* Hassk. var. *pacificum* (Nakai) M. Mizush. (Oleaceae), *Daphnephila machilicola* Yukawa inducing leaf galls on *Machilus thunbergii* Sieb. et Zucc. (Lauraceae), *Pseudasphondylia neolitseae* Yukawa inducing leaf galls on *Neolitsea sericea* (Bl.) Koidz. (Lauraceae), and *Lasioptera camelliae* Ohno et Yukawa inducing leaf galls on *Camellia japonica* L. (Theaceae).

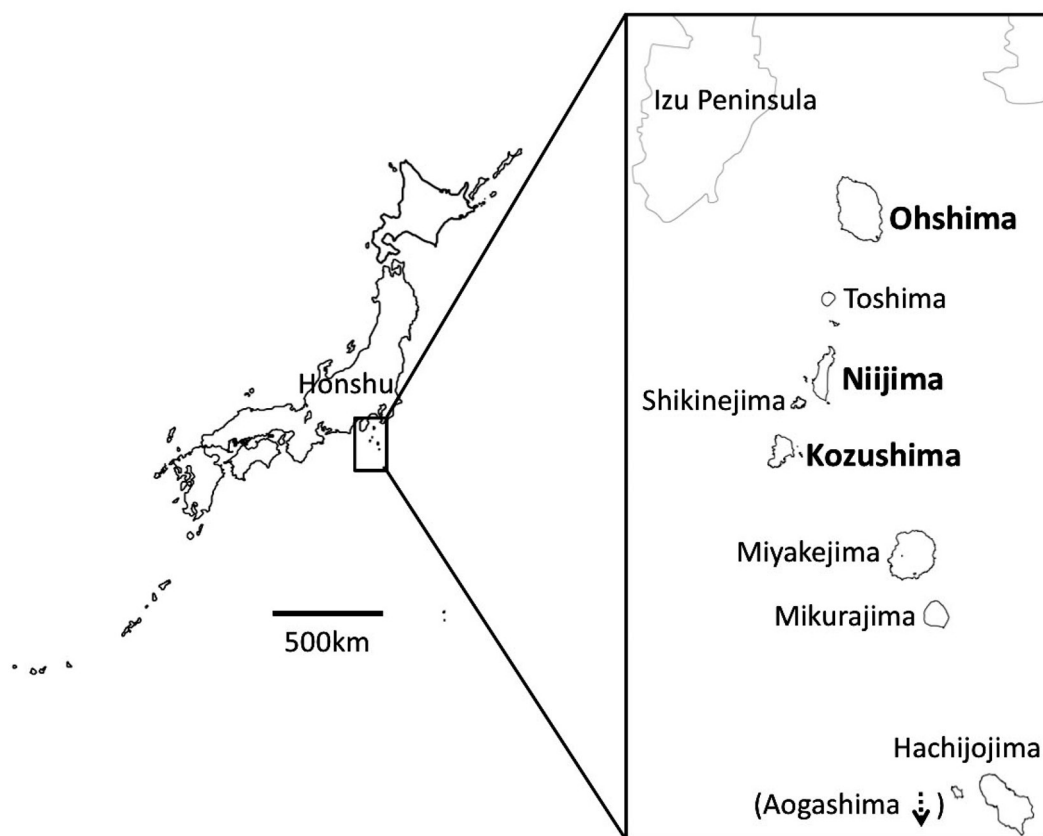


Figure 1. Map of Japan and the Izu Islands.

Methods

Insect galls were surveyed on Ohshima (17–18 Apr. 2009 by MT, KM, & KK; 14–15 Apr. 2010 by MT & KM; 20 Apr. 2011 by MT; 13 Dec. 201 by MT), Kozushima (18–19 Apr. 2009 by MT, KM, & KK; 15–16 Apr. 2010 by MT & KM; 14 Dec. 2011 by MT) and Niijima (19–20 Apr. 2009 by MT, KM, & KK; 12–13 May 2010 by MT; 23–24 Nov. 2012 by MT & K. Kawauchi). Detailed methods of field survey followed Tokuda *et al.* (2012b). Terminal or axillary bud galls induced by *Rhopalomyia* sp. on *Chrysanthemum pacificum* Nakai (Asteraceae) collected from Manazuru, Honshu by MT, KM and JY through an additional survey on 23 Apr. 2009 are also included in the results.

Collecting record of each gall consists of latitude, longitude, altitude, and collection date. Galls induced by cecidomyiids are first listed according to the order in Yukawa and Masuda (1996) and then followed by those induced by other insects. Gall numbers designated by Yukawa and Masuda (1996) are shown in brackets for each gall. Known distributional information of galls newly recorded in this study from northern parts of Izu Islands is mentioned in remarks, but not of other galls whose distributions were already summarized by Tokuda *et al.* (2012a,b). Absence records of galls for those surveyed on ten or more host trees on an island were also included in the results.

The family name of host plants follows the Angiosperm Phylogeny Group (APG) system of plant classification (Stevens, 2008). Plant and insect specimens collected

during the course of this study are kept in the Laboratory of System Ecology, Faculty of Agriculture, Saga University, Japan or in the Entomological Laboratory, Faculty of Agriculture, Kyushu University, Japan.

Results

Galls induced by cecidomyiids

FAGACEAE

1. Inflorescence gall induced by an unidentified cecidomyiid on *Castanopsis sieboldii* (Makino) Hatus. ex T. Yamaz. et Mashiba [C-163] (New distribution record from Kozushima)

Japanese name: ‘Sudajii-hanaeda-fukure-fushi’(newly proposed name)

[Kozushima] N34°13'E139°08', Alt. 101 m, 14 Dec. 2011; N34°13'E139°08', Alt. 141 m, 14 Dec. 2011; N34°14'E139°09', Alt. 221 m, 14 Dec. 2011; N34°13'E139°09', Alt. 108 m, 14 Dec. 2011; N34°12'E139°08', Alt. 62 m, 14 Dec. 2011; N34°12'E139°08', Alt. 192 m, 14 Dec. 2011.

Remarks: This gall was previously recognized as a stem gall and recorded from Miyakejima, Mikurajima, and Hachijojima on the Izu Islands (Tokuda *et al.* 2012a), Kobayashi, Miyazaki Prefecture, Kyushu (Nagai 2010), and Okinawa Island (Yamauchi *et al.* 1982). Because recent observations (Tokuda *et al.* unpublished) revealed that the gall is induced on the host's female inflorescence, we propose the new Japanese name for this gall.

LAURACEAE

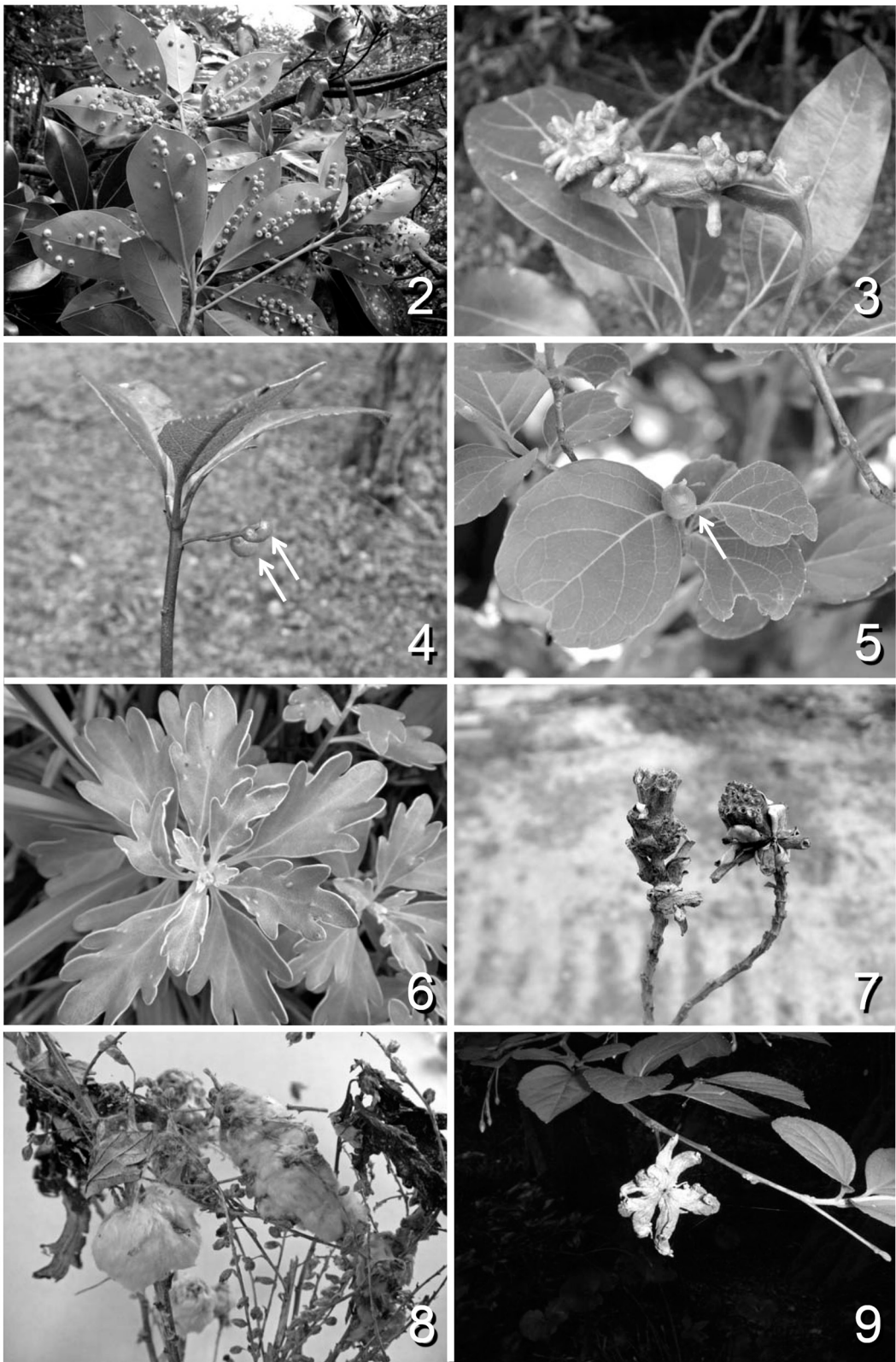
2. Leaf gall induced by *P. neolitseae* on *N. sericea* [C-254] (Fig. 2)

Japanese name: ‘Shirodamo-ha-kobu-fushi’

[Ohshima] N34°45'E139°22', Alt. 122 m, 17 Apr. 2009; N34°45'E139°22', Alt. 254 m, 17 Apr. 2009; N34°45'E139°23', Alt. 353 m, 17 Apr. 2009; N34°44'E139°23', Alt. 544 m, 17 Apr. 2009 (old galls); N34°46'E139°25', Alt. 347 m, 17 Apr. 2009; N34°46'E139°25', Alt. 258 m, 17 Apr. 2009; N34°45'E139°22', Alt. 66 m, 17 Apr. 2009; N34°47'E139°21', Alt. 9 m, 18 Apr. 2009; N34°46'E139°24', Alt. 436 m, 14 Apr. 2010; N34°46'E139°26', Alt. 31 m, 14 Apr. 2010; N34°47'E139°25', Alt. 45 m, 14 Apr. 2010* [*a female was observed ovipositing into a host bud with 30 mm long in the evening]; N34°44'E139°23', Alt. 557 m, 20 Apr. 2011.

[Niijima] N34°24'E139°16', Alt. 393 m, 19 Apr. 2009; N34°23'E139°16', Alt. 364 m, 19 Apr. 2009; N34°23'E139°16', Alt. 208 m, 19 Apr. 2009; N34°22'E139°15', Alt.

Figures 2–9 (right page). Insect galls found on Ohshima, Niijima and Kozushima Islands. 2, leaf galls induced by *Daphnephila machilicola* on *Machilus thunbergii*; 3, leaf galls induced by *Pseudaspiondylia neolitseae* on *Neolitsea sericea*; 4, fruit galls (arrows) induced by *Asphondylia* sp. on *Ardisia japonica*; 5, a bud gall (arrow) induced by an unidentified cecidomyiid on *Styrax japonica* var. *kotoensis*; 6, leaf galls induced by *Rhopalomyia chrysanthemum* on *Chrysanthemum pacificum*; 7, terminal bud galls induced by *Rhopalomyia* sp. on *C. pacificum*; 8, stem galls induced by *Rhopalomyia giraldii* on *Artemisia indica* var. *maximowiczii*; and 9, a bud gall (an old gall) induced by *Ceratovacuna nekoashi* on *S. japonica* var. *kotoensis*.



- 37 m, 19 Apr. 2009; N34°21'E139°15', Alt. 224 m, 20 Apr. 2009; N34°21'E139°16', Alt. 289 m, 20 Apr. 2009.
- [Kozushima] N34°13'E139°09', Alt. 405 m, 18 Apr. 2009; N34°13'E139°09', Alt. 388 m, 18 Apr. 2009; N34°14'E139°09', Alt. 329 m, 18 Apr. 2009; N34°14'E139°09', Alt. 248 m, 18 Apr. 2009; N34°14'E139°09', Alt. 164 m, 18 Apr. 2009; N34°14'E139°09', Alt. 168 m, 19 Apr. 2009; N34°13'E139°08', Alt. 25 m, 19 Apr. 2009; N34°14'E139°09', Alt. 232 m, 15 Apr. 2010; N34°12'E139°08', Alt. 62 m, 17 Apr. 2010.
3. Barrel-shaped leaf gall induced by *D. machilicola* on *M. thunbergii* [C-256] (Fig. 3)
 Japanese name: 'Tabunoki-haura-usu-fushi'
 [Ohshima] N34°45'E139°22', Alt. 66 m, 17 Apr. 2009; N34°46'E139°26', Alt. 31 m, 20 Apr. 2011.
 [Niiijima] N34°24'E139°16', Alt. 393 m, 19 Apr. 2009; N34°23'E139°16', Alt. 364 m, 19 Apr. 2009; N34°23'E139°16', Alt. 147 m, 19 Apr. 2009; N34°23'E139°16', Alt. 208 m, 12 May 2010; N34°21'E139°16', Alt. 234 m, 13 May 2010; N34°21'E139°15', Alt. 224 m, 13 May 2010; N34°22'E139°16', Alt. 5 m, 24 Nov. 2012.
 [Kozushima] N34°14'E139°09', Alt. 180 m, 18 Apr. 2009 (old galls); N34°14'E139°09', Alt. 172 m, 19 Apr. 2009; N34°14'E139°09', Alt. 168 m, 19 Apr. 2009; N34°12'E139°08', Alt. 13 m, 19 Apr. 2009; N34°14'E139°09', Alt. 164 m, 15 Apr. 2010 (old galls); N34°12'E139°08', Alt. 58 m, 16 Apr. 2010; N34°12'E139°08', Alt. 192 m, 14 Dec. 2011.
4. Leaf gall induced by an unidentified cecidomyiid on *M. thunbergii* [C-262] (New distribution records from Niiijima and Kozushima)
 Japanese name: 'Tabunoki-ha-fukure-fushi'
 [Niiijima] N34°24'E139°16', Alt. 393 m, 19 Apr. 2009 (old galls); N34°23'E139°16', Alt. 364 m, 19 Apr. 2009 (old galls); N34°23'E139°16', Alt. 147 m, 19 Apr. 2009 (old galls); N34°21'E139°15', Alt. 224 m, 20 Apr. 2009 (old galls).
 [Kozushima] N34°14'E139°09', Alt. 248 m, 18 Apr. 2009 (old galls); N34°14'E139°09', Alt. 172 m, 19 Apr. 2009 (old galls); N34°14'E139°09', Alt. 164 m, 15 Apr. 2010 (old galls); N34°14'E139°09', Alt. 290 m, 15 Apr. 2010 (old galls).
 Remarks: On the Izu Island, the gall was previously recorded from Miyakejima, Mikurajima, Hachijojima, and Aogashima (Tokuda *et al.* 2012a,b).

THEACEAE

5. Leaf-vein gall induced by *L. camelliae* on *C. japonica* [C-280]
 Japanese name: 'Yabutsubaki-hamyaku-fukure-fushi'
 [Ohshima] N34°46'E139°25', Alt. 347 m, 17 Apr. 2009.
 [Niiijima] N34°23'E139°16', Alt. 208 m, 19 Apr. 2009; N34°22'E139°15', Alt. 37 m, 19 Apr. 2009; N34°22'E139°16', Alt. 5 m, 24 Nov. 2012.
 [Kozushima] N34°14'E139°09', Alt. 329 m, 18 Apr. 2009; N34°14'E139°09', Alt. 168 m, 19 Apr. 2009; N34°13'E139°08', Alt. 25 m, 19 Apr. 2009; N34°14'E139°08', Alt. 172 m, 16 Apr. 2010; N34°12'E139°08', Alt. 62 m, 17 Apr. 2010.

AQUIFOLIACEAE

6. Bud gall induced by *A. sasakii* on *I. crenata* var. *hachijoensis* [C-373]
Japanese name: 'Hachijoinutsuge-me-tama-fushi'
[Ohshima] N34°45'E139°22', Alt. 254 m, 17 Apr. 2009; N34°45'E139°23', Alt. 353 m, 17 Apr. 2009; N34°44'E139°23', Alt. 544 m, 17 Apr. 2009; N34°46'E139°26', Alt. 140 m, 17 Apr. 2009; N34°45'E139°22', Alt. 66 m, 17 Apr. 2009; N34°48'E139°22', Alt. 27 m, 18 Apr. 2009; N34°44'E139°23', Alt. 557 m, 14 Apr. 2010; N34°47'E139°21', Alt. 9 m, 15 Apr. 2010.
[Kozushima] N34°13'E139°09', Alt. 468 m, 18 Apr. 2009 (old galls); N34°13'E139°09', Alt. 388 m, 15 Apr. 2010.

AUCUBACEAE

7. Fruit gall induced by *A. aucubae* on *Au. japonica* var. *japonica* [C-413]
Japanese name: 'Aoki-mi-midori-fushi'
[Ohshima] N34°45'E139°22', Alt. 122 m, 17 Apr. 2009.

MYRSINACEAE

8. Fruit gall induced by *Asphondylia* sp. on *Ardisia japonica* (Thunb.) Bl. (New distribution record from the Izu Islands) (Fig. 4)
Japanese name: 'Yabukouji-mi-fukure-fushi'
[Niiijima] N34°21'E139°16', Alt. 289 m, 20 Apr. 2009.
[Kozushima] N34°14'E139°09', Alt. 168 m, 19 Apr. 2009.
Remarks: This gall was previously recorded from Honshu and Kyushu (Uechi *et al.* 2002, 2005).

STYRACACEAE

9. Bud gall induced by an unidentified cecidomyiid on *S. japonica* var. *kotoensis* [D-011] (New distribution record from the Izu Islands) (Fig. 5)
Japanese name: 'Ohbaegonoki-me-fukure-fushi'
[Niiijima] N34°21'E139°15', Alt. 224 m, 13 May 2010.
Remarks: This gall was previously recorded from Honshu, Kyushu, and Tanegashima Island (Yukawa & Masuda 1996).
10. Ovate leaf gall induced by *Oxycephalomyia styraci* (Shinji) on *S. japonica* var. *kotoensis* [D-015] (New distribution record from Kozushima)
Japanese name: 'Ohbaegonoki-ha-tsubo-fushi'
[Kozushima] N34°14'E139°09', Alt. 290 m, 15 Apr. 2010.
Remarks: On the Izu Islands, this gall was recorded from Miyakejima and Hachijojima (Tokuda *et al.* 2012a).
11. Leaf gall induced by an unidentified cecidomyiid on *S. japonica* var. *kotoensis* (new distribution records from Niiijima and Kozushima)
Japanese name: 'Ohbaegonoki-haura-midoritama-fushi'
[Niiijima] N34°21'E139°15', Alt. 224 m, 12 May 2010.
[Kozushima] N34°14'E139°09', Alt. 290 m, 15 Apr. 2010.

Remarks: This gall was discovered by Tokuda *et al.* (2012a) on Miyakejima.

OLEACEAE

12. Fruit gall induced by *A. sphaera* on *L. ovalifolium* var. *pacificum* [D-027]

Japanese name: 'Hachijoibota-mi-midori-fushi'

[Ohshima] N34°47'E139°25', Alt. 45 m, 17 Apr. 2009; N34°47'E139°24', Alt. 23 m, 14 Apr. 2010; N34°47'E139°21', Alt. 9 m, 15 Apr. 2010.

[Niijima] N34°23'E139°15', Alt. 14 m, 20 Apr. 2009.

[Kozushima] N34°13'E139°08', Alt. 25 m, 19 Apr. 2009; N34°13'E139°08', Alt. 45 m, 15 Apr. 2010.

APOCYNACEAE

13. Root gall induced by *Ametrodiplosis* sp. on *Trachelospermum asiaticum* (Sieb. et Zucc.) Nakai by *Ametrodiplosis* sp. [D-032] (New distribution record from Niijima)

Japanese name: 'Teikakazura-ne-kobu-fushi'

[Niijima] N34°23'E139°16', Alt. 364 m, 19 Apr. 2009; N34°22'E139°16', Alt. 5 m, 24 Nov. 2012.

Remarks: On the Izu Islands, this gall was recorded from Hachijojima (Tokuda *et al.* 2012a).

14. Fruit gall induced by *Asteralobia* sp. on *T. asiaticum* [D-033] (New distribution records from Ohshima and Niijima)

Japanese name: 'Teikakazura-misaki-fukure-fushi'

[Ohshima] N34°45'E139°23', Alt. 353 m, 17 Apr. 2009 (old galls); N34°46'E139°25', Alt. 258 m, 17 Apr. 2009 (old galls).

[Niijima] N34°23'E139°16', Alt. 208 m, 19 Apr. 2009 (old galls).

Remarks: On the Izu Islands, this gall was recorded from Miyakejima and Hachijojima (Tokuda *et al.* 2012a).

CAPRIFOLIACEAE

15. Bud gall induced by *Asphondylia baca* Monzen on *Weigela coraeensis* var. *fragrans* (Ohwi) H. Hara [D-061] (New distribution records from Ohshima and Niijima)

Japanese name: 'Nioiutsugi-me-tama-fushi'

[Ohshima] N34°45'E139°22', Alt. 122 m, 20 Apr. 2011.

[Niijima] N34°23'E139°16', Alt. 364 m, 12 May 2010; N34°21'E139°16', Alt. 234 m, 13 May 2010.

Remarks: On the Izu Islands, this gall was reported from Mikurajima (Tokuda *et al.* 2012b) and Hachijojima (Hachijojima Interpretation Association 2007).

ASTERACEAE

16. Leaf gall induced by *Rhopalomyia chrysanthemum* Monzen on *Chrysanthemum pacificum* Nakai [D-075] (New distribution records from Ohshima, Niijima and Kozushima) (Fig. 6)

Japanese name: 'Isogiku-ha-ibo-fushi'

[Ohshima] N34°46'E139°26', Alt. 31 m, 14 Apr. 2010.

- [Niijima] N34°24'E139°16', Alt. 393 m, 19 Apr. 2009; N34°22'E139°15', Alt. 21 m, 20 Apr. 2009.
- [Kozushima] N34°14'E139°08', Alt. 13 m, 19 Apr. 2009; N34°14'E139°09', Alt. 6 m, 15 Apr. 2010; N34°11'E139°07', Alt. 62 m, 15 Apr. 2010.
- Remarks: On the Izu Islands, this gall was recorded from Miyakejima, Mikurajima and Hachijojima (Tokuda *et al.* 2012a,b).
17. Terminal or axillary bud gall induced by *Rhopalomyia* sp. on *C. pacificum* [D-087] (New distribution records from Honshu, Ohshima and Niijima) (Fig. 7)
Japanese name: 'Isogiku-me-nagatsubo-fushi'
[Honshu] N35°09'E139°09' (Manazuru, Kanagawa Prefecture, Honshu), Alt. 40m, 23 Apr. 2009.
[Ohshima] N34°46'E139°26', Alt. 31 m, 14 Apr. 2010; N34°47'E139°21', Alt. 9 m, 14 Apr. 2010.
[Niijima] N34°24'E139°16', Alt. 393 m, 19 Apr. 2009.
Remarks: This gall was discovered by Tokuda *et al.* (2012b) from Mikurajima and recorded also from Miyakejima (Tokuda *et al.* 2012a). In Honshu and Kyushu, similar bud galls were also reported on several species of *Chrysanthemum* (Yukawa & Masuda 1996; Tokuda *et al.* 2012a). Further studies are needed to confirm whether these galls are induced by the same gall midge species.
18. Stem gall induced by *Rhopalomyia struma* Monzen on *Artemisia indica* Willd. var. *maximowiczii* (Nakai) H. Hara [D-102] (New distribution record from the Izu Islands)
Japanese name: 'Yomogi-kuki-kobu-fushi'
[Ohshima] N34°47'E139°21', Alt. 9 m, 14 Apr. 2010.
Remarks: This gall was previously recorded from Honshu to Yakushima Island (Yukawa & Masuda 1996).
19. Stem gall induced by *Rhopalomyia giralddii* Kieffer et Trotter on *A. indica* var. *maximowiczii* [D-107] (New distribution record from the Izu Islands) (Fig. 8)
Japanese name: 'Yomogi-kuki-wata-fushi'
[Niijima] N34°22'E139°15', Alt. 21 m, 20 Apr. 2009.
Remarks: This gall was previously recorded from Honshu to Tanegashima Island (Yukawa & Masuda 1996).
20. Stem gall induced by *Rhopalomyia* sp. on *A. indica* var. *maximowiczii* (New distribution record from Kozushima)
Japanese name: 'Yomogi-negiwakuki-kobu-fushi'
[Kozushima] N34°14'E139°09', Alt. 172 m, 19 Apr. 2009; N34°12'E139°08', Alt. 13 m, 19 Apr. 2009.
Remarks: This gall was discovered by Tokuda *et al.* (2012a) on Miyakejima and Hachijojima.
21. Leaf gall induced by *Rhopalomyia yomogicola* (Matsumura) on *A. indica* var. *maximowiczii* [D-112] (New distribution records from Niijima and Kozushima)
Japanese name: 'Yomogi-ha-eboshi-fushi'

[Ohshima] N34°47'E139°21', Alt. 9 m, 18 Apr. 2009.

[Niijima] N34°22'E139°15', Alt. 21 m, 20 Apr. 2009.

[Kozushima] N34°14'E139°09', Alt. 172 m, 19 Apr. 2009.

Remarks: As mentioned earlier, Sunose (1981) recorded this gall from Ohshima.

22. Leaf gall induced by *Rhopalomyia cinerarius* Monzen on *A. indica* var. *maximowiczii* [D-113] (New distribution records from Ohshima and Niijima)

Japanese name: 'Yomogi-ha-shiroketama-fushi'

[Ohshima] N34°47'E139°24', Alt. 72 m, 13 Dec. 2012.

[Niijima] N34°22'E139°15', Alt. 97 m, 23 Nov. 2012; N34°22'E139°15', Alt. 222 m, 23 Nov. 2012.

Remarks: On the Izu Islands, this gall was previously recorded from Miyakejima and Hachijojima (Tokuda et al. 2012b).

23. Leaf gall induced by *Rhopalomyia* sp. on *A. indica* var. *maximowiczii* [D-114] (New distribution record from the Izu Islands)

Japanese name: 'Yomogi-ha-hime-eboshi-fushi'

[Kozushima] N34°14'E139°09', Alt. 172 m, 19 Apr. 2009; N34°12'E139°08', Alt. 62 m, 17 Apr. 2010.

Remarks: This gall was previously recorded from Honshu to the Ryukyu Islands (Yukawa & Masuda 1996).

Galls induced by insects other than Cecidomyiidae

24. Leaf-vein gall induced by *Trioza cinnamomi* (Boselli) (Hemiptera: Psylloidea) on *Cinnamomum tenuifolium* (Makino) Sugim. ex. H. Hara (Lauraceae) [C-263] (New distribution records from Ohshima and Kozushima)

Japanese name: 'Yabunikkei-hamyaku-ibo-fushi'

[Ohshima] N34°45'E139°22', Alt. 122 m, 17 Apr. 2009; N34°45'E139°22', Alt. 254 m, 17 Apr. 2009; N34°45'E139°23', Alt. 353 m, 17 Apr. 2009; N34°44'E139°23', Alt. 544 m, 17 Apr. 2009; N34°45'E139°25', Alt. 258 m, 17 Apr. 2009; N34°47'E139°25', Alt. 45 m, 17 Apr. 2009; N34°45'E139°22', Alt. 66 m, 17 Apr. 2009; N34°47'E139°24', Alt. 23 m, 14 Apr. 2010.

[Kozushima] N34°22'E139°16', Alt. 208 m, 19 Apr. 2009.

Remarks: On the Izu Islands, this gall was recorded from Miyakejima, Mikurajima, Hachijojima, and Aogashima (Miyatake 1966; Tokuda et al. 2012a,b).

25. Leaf gall induced by *Liothrips kuwanai* (Moulton) (Thysanoptera: Phlaeothripidae) on *Piper kadsura* (Choisy) Ohwi (Piperaceae) [C-269] (New distribution records from Ohshima and Kozushima)

Japanese name: 'Futoukazura-ha-chijimi-fushi'

[Ohshima] N34°47'E139°24', Alt. 23 m, 14 Apr. 2010.

[Kozushima] N34°14'E139°09', Alt. 172 m, 19 Apr. 2009; N34°22'E139°16', Alt. 208 m, 19 Apr. 2009.

Remarks: On the Izu Islands, this gall was recorded from Miyakejima, Mikurajima, Hachijojima, and Aogashima (Okajima 2006; Tokuda et al. 2012a,b).

26. Stem gall induced by *Tetrastichus ardisiae* Ishii (Hymenoptera: Eulophidae) on *A. japonica* (Myrsinaceae) [D-005] (New distribution record from the Izu Islands)
Japanese name: 'Yabukouji-kuki-kobu-fushi'
[Niijima] N34°21'E139°16', Alt. 289 m, 20 Apr. 2009.
Remarks: This gall was previously recorded from Honshu, Shikoku, and Kyushu (Yukawa & Masuda 1996).
27. Bud gall induced by *Ceratovacuna nekoashi* (Sasaki) (Hemiptera: Aphididae) on *S. japonica* var. *kotoensis* [D-012] (New distribution record from the Izu Islands) (Fig. 9)
Japanese name: 'Ego-no-nekoashi'
[Ohshima] N34°46'E139°26', Alt. 140 m, 17 Apr. 2009 (old galls).
Remarks: This gall was previously recorded from Hokkaido to Kyushu (Yukawa & Masuda 1996).
28. Leaf gall induced by *Trioza nigra* Kuwayama (Hemiptera: Psylloidea) on *S. japonica* var. *kotoensis* [D-014] (New distribution record from Ohshima)
Japanese name: 'Egonoki-ha-kubomi-fushi'
[Ohshima] N34°46'E139°26', Alt. 140 m, 17 Apr. 2009.
Remarks: On the Izu Islands, this gall was recorded from Miyakejima and Hachijojima (Miyatake 1966; Tokuda *et al.* 2012b).
29. Petiole gall induced by *Paratephritis fukaii* Shiraki (Diptera: Tephritidae) on *Farfugium hiberniflorum* (Makino) Kitam. (Asteraceae) [D-085] (New distribution records from Ohshima, Kozushima and Niijima)
Japanese name: 'Tsuwabuki-haguki-hukure-fushi'
[Ohshima] N34°45'E139°22', Alt. 254 m, 17 Apr. 2009; N34°46'E139°26', Alt. 140 m, 17 Apr. 2009; N34°47'E139°25', Alt. 45 m, 17 Apr. 2009; N34°46'E139°26', Alt. 31 m, 14 Apr. 2010.
[Kozushima] N34°13'E139°08', Alt. 25 m, 19 Apr. 2009; N34°14'E139°08', Alt. 13 m, 19 Apr. 2009.
[Niijima] N34°21'E139°16', Alt. 289 m, 12 May 2010.
Remarks: On the Izu Islands, this gall was recorded from Miyakejima, Mikurajima, Hachijojima and Aogashima (Tokuda *et al.* 2012a,b).
30. Stem gall induced by *Eucosma metzneriana* (Treitschkë) (Lepidoptera: Tortricidae) on *A. indica* var. *maximowiczii* [D-104] (New distribution record from the Izu Islands)
Japanese name: 'Yomogi-kuki-tsuto-fushi'
[Ohshima] N34°44'E139°23', Alt. 544 m, 14 Apr. 2010.
[Kozushima] N34°14'E139°09', Alt. 172 m, 18 Apr. 2009.
Remarks: This gall was previously recorded from Hokkaido, Honshu, Shikoku and Kyushu (Yukawa & Masuda 1996).
31. Stem gall induced by *Oedaspis japonica* Shiraki (Diptera: Tephritidae) on *A. indica* var. *maximowiczii* [D-106] (New distribution record from the Izu Islands)
Japanese name: 'Yomogi-kuki-maruzui-fushi'
[Kozushima] N34°14'E139°09', Alt. 172 m, 15 Apr. 2010.

Remarks: This gall was previously recorded from Honshu and Kyushu (Yukawa & Masuda 1996).

Table 1. Distribution of Asphondyliini (Cecidomyiidae: Cecidomyiinae: Cecidomyiidi), Lasiopteridi (Cecidomyiidae: Cecidomyiinae) associated with evergreen trees or *Chrysanthemum pacificum* (Asteraceae), and of a gall-inducing tephritid *P. fukaii* on the Izu Islands and in a part of Honshu near the islands. Based on Sunose (1981), Yukawa & Masuda (1996), Tokuda *et al.* (2012a,b) and present data.

| Gall inducer | Honshu | OH | NJ | KZ | MY | MK | HC | AG |
|------------------------------------|--------|----|----|----|----|----|----|----|
| Asphondyliini | | | | | | | | |
| <i>Asphondylia aucubae</i> | + | + | / | / | + | + | + | / |
| <i>Asphondylia baca</i> | + | + | / | / | / | + | + | / |
| <i>Asphondylia sphaera</i> | + | + | + | + | + | + | + | – |
| <i>Asphondylia</i> sp. 1* | + | / | / | / | / | – | + | – |
| <i>Asphondylia</i> sp. 2* | + | / | + | + | / | / | / | / |
| <i>Asphondylia</i> sp. 3* | + | / | / | / | / | – | / | / |
| <i>Asteralobia sasakii</i> | + | + | / | + | + | + | + | / |
| <i>Asteralobia soyogo</i> | + | / | / | / | / | + | + | + |
| <i>Asteralobia</i> sp.* | + | + | + | / | + | / | + | / |
| <i>Daphnephila machilicola</i> | + | + | + | + | + | + | + | + |
| <i>Illiciomyia yukawai</i> | + | – | / | – | / | – | / | / |
| <i>Oxycephalomyia styraci</i> | + | / | / | + | + | + | / | / |
| <i>Pseudasphondylia elaeocarpi</i> | + | / | / | / | / | / | – | – |
| <i>Pseudasphondylia neolitseae</i> | + | + | + | + | + | + | + | / |
| Lasiopteridi | | | | | | | | |
| <i>Lasioptera camelliae</i> | + | + | + | + | + | + | – | – |
| <i>Masakimya pustulae</i> | + | – | – | – | – | – | – | – |
| <i>Rhopalomyia chrysanthemum</i> | + | + | + | + | + | + | + | / |
| <i>Rhopalomyia</i> sp.* | + | + | + | / | + | + | – | / |
| Tephritidae | | | | | | | | |
| <i>Paratephritis fukaii</i> | + | + | / | + | + | + | + | + |

Abbreviations and symbols: OH, Ohshima; NJ, Nijima; KZ, Kozushima; MY, Miyakejima; MK, Mikurajima; HC, Hachijojima; AG, Aogashima; +, both host plant and gall inducer were recorded; –, host plant was surveyed but gall inducer was not found; and /, host plant is not distributed or has not yet been intensively surveyed.

**Asphondylia* sp.1 induces fruit galls on *Hedera rhombea* (Miq.) Bean (Araliaceae), *Asphondylia* sp. 2 induces fruit galls on *Ardisia japonica* (Myrsinaceae), *Asphondylia* sp. 3 induces fruit galls on *Alpinia intermedia* Gagnep. (Zingiberaceae), *Asteralobia* sp. induces fruit galls on *Trachelospermum asiaticum* (Apocynaceae), and *Rhopalomyia* sp. induces bud galls on *C. pacificum*.

Absence records of gall

About 20, 10, and 15 trees of *Euonymus japonicus* Thunb. (Celastraceae) were surveyed on Ohshima, Nijima, Kozushima, respectively, but leaf galls induced by *Masakimya pustulae* Yukawa et Sunose (Diptera: Cecidomyiidae) were not found. About 20 trees of *Illicium anisatum* L. (Illiciaceae) were surveyed both on Ohshima and Kozushima, but leaf galls induced by *Illiciomyia yukawai* Tokuda were not found.

Discussion

Through the field surveys from 2009 to 2012, 13, 16 and 14 sorts of cecidomyiid gall were found on Ohshima, Nijima and Kozushima, respectively. Among them, the fruit gall on *Ar. japonica*, the bud gall on *S. japonica* var. *kotoensis*, the stem galls induced by *R. struma* and *R. giraldii* and the leaf gall induced by *Rhopalomyia* sp. on *A. indica* var. *maximowiczii* were newly recorded from the Izu Islands. Of those galls, five, nine, and seven sorts of cecidomyiid gall were new to Ohshima, Nijima and Kozushima, respectively.

Most cecidomyiid galls found on these islands are common to Honshu, but the inflorescence gall on *C. sieboldii* was previously reported only from Okinawa Island (Yamauchi *et al.* 1982), southern Kyushu (Nagai 2010), and southern parts of the Izu Islands (Tokuda *et al.* 2012a). The leaf gall on *S. japonica* var. *kotoensis*, the bud gall on *C. pacificum* and the stem gall induced by *Rhopalomyia* sp. on *A. indica* var. *maximowiczii* are known to occur only from the Izu Islands (Tokuda *et al.* 2012a). In contrast, the leaf gall induced by *M. pustulae* on *E. japonicus* and that induced by *I. yukawai* on *I. anisatum* have never been found on the Izu Islands (Sunose 1981; Tokuda *et al.* 2012a, b), suggesting that these gall midges have not yet colonized the Izu Islands.

Up to the present, gall midges belonging to the tribe Asphondyliini (Cecidomyiinae: Cecidomyiidi) and the supertribe Lasiopteridi (Cecidomyiinae) associated with evergreen trees or *C. pacificum* have been rather intensively surveyed on the Izu Islands (Sunose 1981; Tokuda *et al.* 2012a,b; present data) and their distributional information has been accumulated as summarized in Table 1. *Asphondylia* species are basically distributed from Ohshima to Hachijojima, but not on Aogashima. *Pseudasphondylia elaeocarpi* has not yet been found on the Izu Islands. *Lasioptera camelliae* and *Rhopalomyia* sp. inducing terminal and axillary bud galls on *C. pacificum* was not found on Hachijojima and Aogashima. Further studies of these gall midges and intensive surveys for other cecidomyiids on the Izu Islands will provide us useful information on the biogeographic aspects of these islands.

Trioza cinnamomi was revealed to occur on all main islands of the Izu Islands, from Ohshima to Aogashima, which contrasts with the fact that a congener, *Trioza machilicola* Miyatake, inducing leaf-vein galls on *M. thunbergii* has never been reported from these islands (Tokuda *et al.* 2012a,b). The stem gall induced by *T. ardisiae* on *Ar. japonica* and the bud gall induced by *C. nekoashi* on *S. japonica* var. *kotoensis* were newly recorded in this study from the Izu Islands. As shown in Table 1, *P. fukaii* has been found on all islands except Nijima.

Although further intensive surveys are needed to discuss biogeographic aspects of gall-inducer fauna of the Izu Islands, it should be noted that no species of gall

wasp (Hymenoptera: Cynipidae) has ever been recorded from these islands (Yukawa & Masuda 1996; Tokuda *et al.* 2012a,b; present data). The family Cynipidae is the second largest group among gall-inducers, next to Cecidomyiidae, and accounts for approximately 13% of gall-inducing arthropods in Japan (Yukawa & Masuda 1996). The absence is largely attributable to the lack of natural vegetation of *Quercus* species (Fagaceae) on the Izu Islands (e.g. Kamijo 1996; Ohshima-shizen-aikokai 2008), particularly evergreen species of *Quercus* that are the main host plants of Cynipidae in the warm temperate zone in Asia (Abe *et al.* 2007; Ide *et al.* 2010).

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