Flowering Phenology and Anthophilous Insect Community

in a Grassland Ecosystem at Mt. Yufu, Western Japan

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ABSTRACT The hillsides of Mt. Yufu, located in Kyusyu, Japan, is a dormant volcano, are covered with natural and semi-natural grasslands; the latter of which are maintained by traditional mowing and burning. Both the natural and semi-natural grasslands are inhabited by many grassland-specific plant species, some of which are now endangered in Japan. To understand pollination mutualisms in the grassland ecosystem, we investigated the flowering phenology and anthophilous insect communities on 149 plant species from 49 different plant families, from April to October 2001. In total, 1192 individuals from 308 species, 83 families and 10 orders of Insecta were observed on flowers of 101 plant species. The most abundant insect order was Hymenoptera (37.8% of individuals), followed by Diptera (32.5%), Coleoptera (22.7%) and Lepidoptera (6.2%). The proportions of Coleoptera and Lepidoptera were respectively smaller and greater than in forested habitats, suggesting that many anthophilous beetles depend on woody plants during their larval stages and that anthophilous butterflies (especially Nymphalidae) are associated with grassland-specific perennials (especially Viola spp.) in their larval stages. The bee fauna consisted of 54 species, from 10 genera and 6 families; the bee community was characterized by an absence of cavity-nesting Hylaeus and Xylocopa and by the predominance of long-tongued Tetralonia in the early spring. The bumblebee community was characterized by the predominance of a short-haired Bombus ignitus, uncommon in forested habitats. The dominant pollination syndrome, among 70 plant species for which pollinators were inferred, was melittophily (82%), followed by myophily (14%), psychophily (1.4%), phalaenophily (1.4%) and anemophily (1.4%). Among the melittophilous species, small-bee-pollinated species (45%) dominated, followed by Bombus- (36%), Apis- (8.6%), Tetralonia- (6.9%), megachilid- (1.7%) and wasp- (1.7%) pollinated species. These data on community-level plant-pollinator interactions at Mt. Yufu will contribute to the conservation of endangered grassland ecosystems.

KEY WORDS flowering phenology / anthophilous insect community / bumblebee / grassland ecosystem / traditional grassland management

Introduction

Community-level plant-pollinator interactions are founded on mutualisms between plants and their pollinators, as well as on competition between plants for pollinators, and competition between pollinators for floral resources (Waser and Real, 1979; Kevan and Baker, 1983; Feinsinger, 1987). Thus, the study of both flowering phenology and the community structure of flower-visiting insects on individual flower species forms the foundation for studying mutual interactions and competition in terrestrial ecosystems (Sakagami and Fukuda, 1973).

Ecological studies of anthophilous bee communities have been conducted in various

These studies have demonstrated that, in Japan, anthophilous bee/insect assemblages vary greatly among plant species, and that anthophilous bee/insect communities vary among vegetation types. For example, it has been reported that bumblebees dominate the bee community in cool-temperate subalpine forests and meadows was dominated by bumblebees (Kato et al. 1993), while that in subtropical forests on Amami Islands were reported to be dominated by solitary bees (Kato, 2000). These studies on anthophilous insect communities have been conducted, primarily, in forest vegetation, with the exception of studies undertaken in cool-temperate meadows at Hamakoshimizu (Fukuda et al., 1973) and Mt. Kushigata (Kato et al. 1993), and the lowland marshes at Nakaikemi (Kato and Miura, 1996). Anthophilous insect communities in warm, temperate zone, grassland ecosystems have not yet been studied.

Most grasslands in Japan are intermediate successional stages, since both temperature and rainfall are favorable for climax forests. Accordingly, natural grasslands are rare; they are found only around active volcanoes, which cause grassland-maintaining. In addition to its natural grasslands, Japan also has semi-natural grasslands, which are maintained by traditional mowing methods, as a source of thatch and fodder (Kato, 2000). Both the grasslands are inhabited by many grassland-specific plant species that colonized Western Japan from the Asian continent during the last glacial epoch (Murata, 1977). Traditionally managed semi-natural grasslands have become less common over the last 40 years due to post industrial revolution innovations with respect to agriculture and economic systems.

The hillsides of Mt. Yufu, a dormant but geologically active, volcano located in Kyusyu, Japan, are covered with natural and semi-natural grasslands (Sumata, 1989). Both the grassland types are inhabited by many grassland-specific plant species, some of which are endangered in Japan (Environment agency of Japan, 2000). To conserve these endangered plant species, it is indispensable that we know the native pollinators and understand community-level plant-pollinator interactions in the grasslands.

This study describes flowering phenology and the composition of flower-visiting insect communities, especially the anthophilous bee community, as well as the phenology of these flower-visitors and the anthophilous insect assemblages of certain plant species in the grassland ecosystem. Secondly, pollination syndromes of certain plant species are inferred by examining their respective anthophilous insect communities and the contributions to pollination made by members of these communities. Finally, the anthophilous insect communities and pollination systems at Mt. Yufu are compared to those of other localities. Biodiversity conservation strategies and plant-pollinator interactions in the grassland ecosystem are discussed.
Study Site

Mt. Yufu, altitude 1583 m, is a dormant, but geologically active, volcano located in Oita Prefecture, Kyushu, Japan (33° 24' N, 131° 30' E, Fig. 1). The volcano was vigorously active 50,000 to 20,000 years ago (Yoshida and Moriyama, 1974).

The climate at Mt. Yufu is strongly affected by cold Siberian winds in the winter season. The mean temperature in 2001 at Yufuin (2 km southwest of Mt. Yufu, 435 m above sea level) was 13.4°C, the monthly minimum temperature was below 0°C from November to April, and total rainfall for the year was 1858 mm (Fig. 2). Rainfall is heavy in June and July. The peak of Mt. Yufu is often snow covered during the winter.

The vegetation of Mt. Yufu is typically semi-natural/natural volcanic grasslands (Plate 4A). The semi-natural grasslands, altitude 760–800 m, are maintained by traditional annual mowing and harvesting of grass (*Miscanthus sinensis*), and controlled burning. The natural grasslands are formed on upper mountain slopes (altitude 1,100–1,300 m) where the soil is thin (Plate 5A). Both grasslands contain various perennial plant species, e.g., *Miscanthus*...
sinensis, Arundinella hirta, Pleioblastus chino var. viridis, Themeda japonica, Calamagrostis arundinacea var. brachytricha, and Pennisetum alopecuroides (Arakane et al., 1974). The grassland flora is also characterized by many herbaceous species which colonized to western Japan from the Asian continent during the last glacial epoch (Murata, 1977): Iris rossi (Plate 4D), Allium thunbergii, Chionographis japonica, Aconitum japonicum ssp. Napifarm, Corydalis heterocarpa, Viola orientalis (Plate 4E), Echinops setifer (Plate 5D), Saussurea gracilis, Cephalanthera falcata, Angelica cartilaginomarginata and Atractylodes japonica (Sumata, 1989). The grasslands are also inhabited by some plant species endemic in Kyushu district, e.g., Salix sieboldiana, and Achillea alpina var. brevidens. Other grassland-specific species, e.g., Sophora flavescens (Plate 5E), Hemerocallis vespertina (Plate 5B), Dianthus superbus var. longicalycinus, are also present.

Fig. 2. Seasonal changes in the maximum (open rectangle) and the minimum (solid rectangle) temperature (upper) and monthly rainfall at Yufuin in 2001 (lower) (after Japan Meteorological Agency, 2002).
In some places, former grasslands now support pine forests, dominated by *Pinus densiflora* and *P. thunbergii*, and deciduous forests with *Weigela japonica* and *Hydrangea luteo-venosa*.

While the climate could otherwise support temperate forest growth at the top of the mountain, recent volcanic activity and the dominant northwest winter wind result in scrub vegetation dominated by *Rhododendron kiusuanum* (Sumata, 1989).

**Methods**

Surveys of flowering phenology and flower visitors were made at three-week intervals from mid April to mid October 2001. In total, 9 surveys were conducted, each lasting 2–3 days. Surveys were conducted from 0830 to 1600–1700, along a fixed route, which went upwards through semi–natural grasslands (alt. 760–800 m, Plate 4C), temperate deciduous forest (alt. 800–1,000 m), natural grasslands (alt. 1100–1300 m, Plate 4B) and the summit scrub (alt. 1300–1583 m).

**Table 1. Observation dates and the numbers of flowering plant species and collected insects.**

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When flowering plants were encountered, flower visitors were netted for about 8 minutes per site. The flowers were then swept with the net for 2 minutes to collect all visitors remaining on the flowers. If no visitors were collected during this 10-minute period, the observation time was prolonged.

All collected insect specimens were pinned and labeled by date, site, and flower species visited. The specimens were then sorted and identified to the species level, with some exceptions that were identified only to family or genus level. Thus, a data set of all insect visits to flowers was created. All specimens were put into storage at Kyoto University.

Using the data set, the faunal makeup of flower visitors, phenological patterns, and the
floral hosts for each insect group (order, family, genus, or species) were investigated. Principal component analysis and cluster analysis were performed on the data set to detect patterns of anthophilous insect communities on different plant species. In these analyses, plant species visited by fewer than 3 insects were excluded. For the 10 plant species visited by less than 4 visitors each (Aconitum japonicum ssp. napiform, Corydalis lineariloba, Rubus phoenicosilasi, Sanguisorba officinalis, Polygala japonica, Codonopsis lanceolata, Paederia scandens, Synurus excelsus, Aletris luteoviridis, Lilium leichtlinii var. maximowiczii), additional records of flower-visits from subsequent observations were added. Thus, 70 plant species were included in the analysis. Anthophilous insects were grouped into 15 functional/taxonomical groups: Bombus, Apis, small bees, Megachilidae, Tetralonia (long-tongued anthophorine bees), wasps (Vespoidea, Pompiloidea, and Sphecoidea sensu stricto), Scoliidae, other Hymenoptera, Syrphidae, Calyptrata, other Diptera, butterflies, moths, Coleoptera, and other miscellaneous insects. Statistical analyses were made using SAS, in the Data Processing Center at Kyoto University.

Results

1. Flora

Flowering of 149 plant species, from 49 families, was observed, including 12 annuals, 101 perennials, 3 climbing perennials, 22 shrubs, 10 trees, and 1 liana (Table 2). Anthophilous insects were observed visiting 101 plant species.

Asteraceae was the most represented plant family (with 29 species), followed by Rosaceae (10 sp.), Liliaceae (8 sp.), Ranunculaceae (5 sp.), Caprifoliaceae (5 sp.), Violaceae (5 sp.), Saxifragaceae (5 sp.), and Gentianaceae (5 sp.). The only non-native plant species were Lotus corniculatus var. corniculata and Erigeron annuus.

The flora included 9 species from the Red Data Book (Environment Agency of Japan, 2000): 2 endangered species [Echinops setifer (Plate 5D), Dioscorea asclepiadeal] and 7 vulnerable species [Viola orientalis (Plate 4E–F), Euphorbia adenochlora, Swertia pseudochinensis, Achillea alpina var. brevidens, Ligularia fisherii var. takeyuki (Plate 5C), Saussurea pulchella, Cephalanthera falcata].
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**Fabales**

| Fab3   | Lespedeza bicolor | Marubahagi | VIII-IX | p   | n | h | v | z | p | -  | 41  | C3   | Bombus  |
|--------|-------------------|-------------|----------|-----|----|----|----|----|----|-----|------|---------|
| Fab4   | Lotus corniculatus var. corniculatus | Seiyoumiyakogusa | VI-VIII | p   | a | h | y | z | p | -   | -    | ?       |
| Fab1   | Sophora flavescens | Kurara    | VI-VII  | p   | n | h | c | z | p | 18  | C4   | Bombus  |
| Fab2   | Vicia unijuga     | Nantenhagi | VI      | p   | n | h | v | z | p | 3   | C4   | Bombus  |

**Haloragales**

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1. MB, month when a plant blooming
2. GH, growing habitat: a, annual; c, climbing perennial; p, perennial; l, liana; s, shrub; t, tree
3. N, nativity: a, alien; c, cultivated; n, native
4. BS, breeding system: d, dioecious; h, hermaphrodite; m, monoecious
5. FC, flower color: b, blue; br, brown; c, cream; g, green; o, orange; p, pink; rv, reddish violet; v, violet; w, white; y, yellow; w/y, white and yellow; w→p, white turn pink
6. FS, flower / inflorescence symmetry: a, actinomorphic; z, zygomorphic
7. FM, flower morphology: a, apetalous; b, brush; c, cup/bell-shaped; ct, catkins; f, funnelform; h, head; o, open regular; p, papilionaceous; s, spikelet; sp, long-spurred; sx, spadix; t, tubular
8. RD, IUCN Red Data Book Category: EN, Endangered; VU, Vulnerable (Environment agency of Japan, 2000)
9. NV, number of flower visitors
10. CL, cluster detected by an analysis of flower visitor spectra (see Fig. 10)
11. PA, pollination agents
2. Flowering phenology

Flowering was observed from April to October. The number of plant species in flower remained between 23 and 28 from May to September, with no clear peak flowering period (Fig. 3). The number of flowering perennial species remained higher than 12, except for October, and was higher in the fall than in the spring. Flowering shrubs and trees began in the spring, peaked in June, and decreased suddenly in July. Spectacular mass-flowering was observed in *Viola orientalis* in April (Plate 4C), in *Hemerocallis vespertina* (Plate 5B) and *Echinops septifer* in August (Plate 5D).

Fig. 3. Seasonal changes in the number of flowering plant species at each sampling date at Mt. Yufu. Plant species are sorted by their habits: annual, perennial, climbing perennial, liana, shrub and tree.
3. The Flower-visiting insect community

3.1 Fauna

A total of 1192 individuals from 308 species, 83 families, and 10 orders were observed on the flowers of 101 plant species (Table 3, Appendix 1). The most represented order (in numbers of individuals) was Hymenoptera (37.8% of individuals), followed by Diptera (32.5%), Coleoptera (22.7%), Lepidoptera (6.2%), and others (Fig. 4). The order represented by the greatest number of species was Diptera (40.3%), followed by Hymenoptera (31.8%), Coleoptera (16.2%), and Lepidoptera (8.4%).

![Fig. 4. The percentages of insect species and individuals in orders.](image)

3.2 Hymenoptera

A total of 18 families, 98 species, and 450 individuals were recorded. The most abundant Hymenoptera superfamily was Apoidea sensu stricto (85.3%), followed by Vespoidea (7.1%), Ichneumonoidea (4.9%), Tenthredinoidea (1.3%), and Chalcidoidea (1.3%). In Apoidea, 7 families, 56 species, and 384 individuals were recorded.

The most abundant family in Apoidea was Apidae (40.8% of individuals), followed by Anthophoridae (22.1%), Andrenidae (18.9%), Halictidae (16.3%), Megachilidae (1.3%), and Colletidae (0.5%). The family with the greatest number of species was Halictidae (18 sp.), followed by Andrenidae (15 sp.), Anthophoridae (11 sp.), Apidae (5 sp.), Megachilidae (4 sp.), and Colletidae (1 sp.).

The most abundant genus of Apoidea was Bombus (30.7% of individuals), followed by Andrena (18.9%), Lasioglossum (16.3%), Ceratina (15.7%), Apis (10.1%), and Tetralonia (4.8%) (Table 4). Excluding cleptoparasitic species, 267 and 101 individual underground-nesting and cavity-nesting bees were found, belonging to 38 and 9 species, respectively.
Table 3. A list of insect families collected or observed on flowers at Mt. Yufu, with their larval/adult feeding habits, numbers and percentages of species and individuals.

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<td>0.08</td>
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</tr>
</tbody>
</table>

Total 308 100.00 1192 100.00

* aq, aquatic scavenger/predator; b, blood-sucker; m, mycophagous; n, nectarivorous; o, omnivorous; p, pollenivorous; ph, phytophagous; pr, predatory; ps, parasitic; s, saprophagous; x, xylophagous
Plant-pollinator interactions at Mt. Yufu

Table 4. A list of bee genera recorded at Mt. Yufu, with their size class, nest site and relative abundance.

<table>
<thead>
<tr>
<th>Family</th>
<th>Subfamily</th>
<th>Genus</th>
<th>Body Size*</th>
<th>Nest Site</th>
<th>No. of species</th>
<th>No. of individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colletidae</td>
<td>Colletinae</td>
<td>Colletes</td>
<td>s</td>
<td>underground</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Halictidae</td>
<td>Halictinae</td>
<td>Lasio glossum</td>
<td>s</td>
<td>underground</td>
<td>18</td>
<td>61</td>
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<tr>
<td>Andrenidae</td>
<td>Andreninae</td>
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<td>s</td>
<td>underground</td>
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<td>Coelioxys</td>
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<td>cleptoparasitic</td>
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<td>1</td>
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<td></td>
<td></td>
<td>Megachile</td>
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<td>in cavities</td>
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<td>4</td>
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<tr>
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<td>Nomadinae</td>
<td>Nomada</td>
<td>s</td>
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<td></td>
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<td>Xylocopinae</td>
<td>Ceratina</td>
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<td>in cavities</td>
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<td>Apis</td>
<td>m</td>
<td>in tree hollows</td>
<td>2</td>
<td>38</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>54</td>
<td>375</td>
</tr>
</tbody>
</table>

*: l, large; m, middle-sized; s, small.

Nine eusocial bee species were found: Lasio glossum apristum, L. sibiriacum, L. baleicu m (Halictidae), Ceratina iwatai (Anthophoridae), 3 species of Bombus, and 2 species of Apis (Apidae). Long-tongued bees were proportionally more abundant (64.3%) than short-tongued bees (35.7%). The bee fauna was characterized by the absence of wood-boring Xylocopa..

Four species of Ceratina were found. Ceratina japonica and C. megastigmata were common (45.8% and 37.3% of individuals, respectively), while C. flavipes and C. iwatai were uncommon (15.3% and 1.7%, respectively).

The most abundant Bombus species was B. ignitus (48.7% of individuals), followed by B. diversus (29.6%) and B. ardens (21.7%). No queens were collected from these three species. All B. diversus individuals were workers, but males of B. ardens (72%) and B. ignitus (37%) were found. During the field surveys, a living colony of B. ignitus was found at the forest edge, neighboring a grassland.

3.3 Diptera

A total of 387 individuals, of 124 species, and 27 families were recorded (Table 3). The most abundant group was syrphid flies (31.5% of all individuals), followed by Calyptrata flies (30.0%). Dominant families were Syrphidae (31.5%), Bibionidae (14.5%), Anthomyiidae (11.9%), Calliphoridae (9.8%), Tachinidae (7.8%), Acroceridae (4.7%), Empididae (3.9%), Mycetophilidae (3.1%), and Bombyliidae (2.6%).

The most species rich families were Syrphidae (24.2% of species), Tachinidae (10.5%), Empididae (8.9%), Mycetophilidae (8.9%), Anthomyiidae (6.5%), Bibionidae (6.5%), Sciaridae (5.6%), Calliphoridae (4.8%), andTipulidae (4.0%).

3.4 Coleoptera
A total of 270 individuals from 18 families were recorded (Table 3). The most abundant family was Chrysomelidae (22.6% of individuals), followed by Curculionidae (21.1%), Staphylinidae (15.9%), Scarabaeidae (14.1%), Oedemeridae (8.1%), Cantharidae (5.9%), and Mordellidae (3.0%).

3.5 Lepidoptera
A total of 74 individuals from 11 families were recorded (Table 3). The most abundant family was Hesperiidae (32.4% of individuals), followed by Nymphalidae (28.4%), Papilionidae (10.8%), and Lycaenidae (9.5%). Butterflies accounted for 86.5% of all individuals. Sphingidae was the most abundant type of moth.

Fig. 5. Seasonal changes in the number of insects observed on flowers at each sampling data. Insects are sorted by order.

4. Phenology of flower visitors
4.1 Order
The number of Hymenoptera individuals peaked three times, in early May, mid June, and mid September. Numbers of Diptera peaked in May, and then decreased gradually, peaking again, weakly, in September (Fig. 5). The number of Coleoptera individuals peaked in the spring and in June, but the number was low in other months. Lepidoptera numbers showed a clear peak in July.
4.2 Anthophilous bee genera

The three bee genera, *Andrena*, *Nomada*, and *Tetralonia*, appeared almost exclusively from April to June. Other dominant bee genera, *LasioGLOSSUM*, *Ceratina*, *Bombus*, and *Apis*, showed bimodal patterns, peaking in June/July and in September (Fig. 6). The three less abundant genera, *Megachile*, *Coelioxys*, and *Colletes*, peaked in June, July, and August, respectively.

![Graph showing seasonal changes in the number of bee genera observed on flowers at each sampling data.](image-url)
4.3 Bombus species

*Bombus ardens* appeared in May and disappeared before the summer (Fig. 7). *B. diversus* appeared in May and was active until October, peaking in June and September. *B. ignitus* appeared in June and was active until October, with worker peaks in June and August/September, and a male peak in September.

![Graph showing seasonal changes in Bombus species](image)

Fig. 7. Seasonal changes in the number of Bombus individuals observed on flowers at each sampling date. Solid and open circles denote worker and male, respectively.

5. Anthophilous insect communities on individual plant species

5.1 Principal component analysis

The anthophilous insect community per plant species varied greatly. To explain this variance, a principal component analysis was conducted. Insects were classified into 15 groups: *Bombus, Apis, small bees, Megachilidae, Tetralonia, wasps, Scoliidae, other*
Hymenoptera, syrphid flies, Calyptrata flies, other Diptera, butterflies, moths, Coleoptera, and other miscellaneous insects. The percentages of these 15 groups found on each plant species were defined as the flower-visitor spectrum of each plant species.

The flower visitor spectra of 70 plant species were used in the principal component analysis. Eigenvectors of 1st, 2nd, and 3rd principal components for each insect group are shown in Fig. 8. The major trend involved alternation of dominant insect groups between [other Hymenoptera + Calyptrata fly + other Diptera] and [Megachilidae + Bombus + syrphid fly]. The variance of the first principal component, PC1, contributed to 11.2% of the total variance. The second factor corresponded to the dominance of [Bombus + butterfly + moth + others] over the small bee group (PC2, 10.5%). The third factor was primarily related to alternation between [syrphid fly + Calyptrata fly] and [Bombus + Tetralonia + Coleoptera] (PC3, 8.7%). The cumulative percentages of variance of the first three principal components were 30.4%, suggesting that additional factors also contributed to the total variance.

Fig. 8. A result of principal component analysis of flower-visitor spectra of 70 plant species. Eigenvectors of the first three principal components calculated for each visitor group are shown.
Scatter plots of loadings on PC1 and PC2 (Fig. 9) show that most apetalous flowers had positive loadings on PC1, whereas many head, and all papilionaceous, flowers had negative loadings on PC1. Loadings of funnel-form flowers were positive or close to zero on PC2. Loadings of tubular flowers were negative on PC3.

Fig. 9. Scattering graphs obtained by principal component analysis of flower-visitor spectra of 70 plant species. The loadings of the second and the third principal components (PC2 and PC3) are plotted against those of the first principal component (PC1). Plots refer to plant species discriminated by flower shape. Eigenvectors of the axes are shown in Fig. 8.

5.1 Cluster analysis
The flower-visitor spectra were also subjected to cluster analysis. The dendrogram derived from the cluster analysis using Ward’s minimum variance method is shown in Fig. 10. At 20% of objective function, 70 plant species were divided into 12 clusters.

Cluster 1 (Cl) was composed of 10 plant species, which were visited mainly by Coleoptera and, with two exceptions (Lindera sericea and Prunus jamasakura), also by small bees. Most plant species in Cl were visited by various groups of insects, and flower shapes were primarily open or head, with the exceptions of Viola orientalis and Pieris japonica.
Fig. 10. Flower-visitor spectra (sorted by visitor group) of 70 plant species and dendrogram (right) derived from cluster analysis on the flower-visitor spectra. Plant species codes are shown in Table 2.
C2 was composed of 8 plant species, which were visited by miscellaneous insects, including the other Diptera group. Except for Arisaema japonicum, which was visited mainly by other Diptera, the other plant species in C2 were also visited by a few groups of bee species and various other groups of insects. There were three species with funnel-form flowers, two of which, Rhododendron kiusuanum and Rhododendron reticulatum, were predominantly visited by bee groups. Viola grypoceras was visited by long-tongued solitary bees (Tetralonia) and had a long-spurred flower.

C3 was composed of 4 plant species, visited mainly by Apis and the small bee group. Only Lespedeza bicolor, with a papilionaceous flower shape, was visited by Bombus. The other plant species had open or head-shaped flowers.

C4 was composed of 8 plant species, characterized by a predominance of Bombus, Apis and small bee visitors. Five plant species were also visited by butterflies. Weigela decora, with a funnel-form flower shape, was visited by long-tongued solitary bees (Tetralonia).

C5 contained only Codonopsis lanceolata, visited only by vespid wasps.

C6 was composed of 2 species, Corydalis lineariloba and Iris rossii, characterized by the predominance of long-tongued solitary bee visitors (Tetralonia). These two plant species bloomed in early spring and had tubular flowers.

C7 was composed of 5 plant species and was characterized by the predominance of Syrphidae. Except for Valeriana fauriei and Chionographis japonica, the plant species were visited by all groups of bees.

C8 was composed of 8 plant species and was characterized by the predominance of Calyptrata flies. Four plant species had white flowers, 2 species had brown flowers, 1 species had green flowers, and 1 species had pink flowers. Half of the species were visited by bee group(s). Salix vulpina and Chionographis japonica had apetalous flowers and were visited mainly by Calyptrata.

C9 was composed of 6 species and was characterized by the predominance of butterflies. Some of the 6 plant species were also visited by bee groups.

C10 was composed of 10 plant species, which were mainly visited by small bees. Most were also visited by syrphid flies. Many had open or head-shaped flowers. The tubular flowers of Dianthus superbus var. longicalycinus, and the funnel-form flowers of Deutzia crenata, were also visited by long-tongued bees (Megachilidae and Bombus, respectively).

C11 was composed of 4 plant species, predominantly visited by small bees. Flower types were various, such as papilionaceous, cup/bell-shaped, head, and open. Flower colors were white (3 sp.) or violet (1 sp.).

C12 was composed of 4 plant species, which were almost exclusively visited by Bombus. The cluster included three flower types: pendent rotate flowers with abundant pollen and nectar (Styrax japonica and Rubus phoenicolasius), deep flowers with long spurs (Aconitum japonicum ssp. napiform), or deep flowers with floral tubes (Synurus excelsus).
5.2 Pollination guilds
The dominant flower visitor per plant species was not always the pollinator. Actual pollinators were inferred by examination of the flower-visitor communities, behavior of the flower visitors, pollen attachment on visitor's bodies, and floral morphology. Among the flower visitors, the following hierarchy in the contribution to pollination was hypothesized:

(Tetralonia, Bombus) > middle-sized bee > Apis > hawkmoth > small bee > butterfly > Syrphidae > Calyptrata fly > Coleoptera > other Hymenoptera > other groups

Thus, the insects of higher pollination status could be regarded as more effective pollinators than those of lower status, as long as the frequency of flower visitation by the pollination candidate was not too low. For several clusters (i.e., C4, C5, C6, C11, and C12), the dominant visitors were regarded as pollinators. For each plant species in other clusters, an effective pollinator group was determined from the visitor assemblage following the above hierarchy. Using this procedure, 71 plant species were classified into the following pollination guilds: Bombus-, Apis-, small bee (Nomada, Ceratina, Colletes, Lasioglossum, Andrena)-, megachilid-, Tetralonia-, wasp-, syrphid fly-, Calyptrata fly-, other Diptera-, butterfly-, hawkmoth-, and wind-pollinated guilds.

The dominant pollination syndrome was melittophily (i.e., bee-pollination, 57 species, 81%), followed by myophily (i.e., fly-pollination, 10 species, 14%), psychophily (i.e., butterfly-pollinated, 1 species, 1.4%), phalaenophily (i.e., moth-pollinated, 1 species, 1.4%), and anemophily (1 species, 1.4%). Of the melittophilous species, small-bee-pollinated species (45%) dominated, followed by Bombus- (36%), Apis- (8.6%), Tetralonia- (6.9%), Megachilid- (1.7%), and wasp- (1.7%) pollinated species.

6. Floral hosts of anthophilous insects
The plant species most frequently utilized by insects was Cirsium japonicum (8.1% of all visits), followed by Salix sieboldiana (7.4%), Pieris japonica (5.9%), Cirsium suffultum (4.6%), and Lespedeza bicolor (3.4%).

The plant family most frequently visited by bees was Asteraceae (29.6% of individuals), followed by Fabaceae (13.6%), Caprifoliaceae (6.9%), Ericaceae (5.9%), and Saxifragaceae (5.6%).

The host plant species varied greatly among insect families, genera, and species. The plant family most frequently visited by Lasioglossum bees was Asteraceae (36.1% of individuals), followed by Ranunculaceae (13.1%). The plant family most frequently visited by Andrena was Saxifragaceae (25.4%), followed by Ericaceae (19.7%), and Violaceae (8.5%). Ceratina preferred to visit Asteraceae (32.2%), Geraniaceae (22.0%), and Fabaceae (16.9%).

The plant family most frequented by Bombus was Asteraceae (45.2%), followed by Fabaceae (18.3%), Caprifoliaceae (12.2%), and Styracaceae (8.7%). B. diversus (a total of 34 individuals) visited 13 plant species, whereas B. ardens (25 individuals) and B. ignitus (56 individuals) visited 9 and 10 plant species, respectively. The number of individuals per floral host species was highest for B. ignitus (5.6%), followed by B. ardens (2.8%), and B.
A floral host family common to three Bombus species was Rosaceae, whereas floral host families common only to B. diversus and B. ignitus were Fabaceae, Asteraceae, and Liliaceae. Flower colors of Bombus-visited plant species were violet (7 species), white (7 species), pink (5 species), yellow (4 species), red-violet (2 species), brown (1 species), and cream (1 species).

The plant family most frequently visited by Apis was Fabaceae (42.1%), followed by Polygonaceae (18.4%) and Hydrangeaceae (15.8%). Apis cerana (A total of 7 individuals) visited only 2 plant species, both of which were also visited by Apis mellifera (A total of 31 individuals).

**Discussion**

This is the first report on community-level plant-pollinator interactions in a grassland ecosystem in Japan. Characteristics of floral phenology, anthophilous insect community, and plant-pollinator interactions at Mt. Yufu were compared with those from various other climatic regions with different vegetation types.

1. **Flowering phenology**
   At Mt. Yufu, the total number of flowering species did not show a clear decrease from May to September. This contrast with the forested habitats in temperate zones in Japan where the number of blooming plant species decrease during mid-summer (Inoue et al., 1990; Kato et al., 1990; Kato et al., 1993). Generally, the mid-summer decrease of flowers is mainly caused by early finishing of flowering by tree and shrub species. The lack of the mid-summer decrease of flowers at Mt. Yufu is probably due to the low species richness of trees and shrubs and to the high species richness of mid-summer flowering perennials at grassland habitats.

2. **Anthophilous insect community**
   The dominance of Hymenoptera, in terms of the number of individuals, and the dominance of Diptera, in terms of the number of species, in anthophilous insect communities were also seen in forested habitats at Ashu (Kato et al., 1990), Kibune (Inoue et al., 1990), and Mt. Kushigata (Kato et al., 1993). However, in the grasslands, the proportions of Coleoptera were lower, and those of Lepidoptera were higher, than in these forested habitats. This pattern suggests that many anthophilous beetles depend on forests in their larval stages, and that anthophilous butterflies (especially Nymphalidae) are associated with grassland-specific perennials (especially Viola spp.) in their larval stages.

The bee fauna at Mt. Yufu was characterized by the absence of cavity-nesting Hylaeus and Xylocopa, probably due to a scarcity of nest sites and the effects of artificial fires. The bee community at Mt. Yufu was generally similar to that of temperate forests at Ashu, Kibune, Hanayama, and Rifu (Fig. 11). The predominance of Tetralonia in the spring was characteristic at Mt. Yufu, and corresponded to the abundance of plant species pollinated by
Fig. 11. A comparison of relative abundance of bee tribes among 21 localities in Japan. Data source are as follows: Hama-koshimizu (Fukuda et al., 1973), Botanical garden of Hokkaido University in Sapporo (Sakagami and Fukuda, 1973), Rifu and Hanayama in Miyagi Pref. (Go'ukon, 1992), Nikko in Gunma Pref. (Nakamura and Matsumura, 1985), Mt. Kushigata in Yamanashi Pref. (Kato et al., 1993), Ashu (Kato et al., 1990), Kibune (Inoue et al., 1990), Botanical garden of Kyoto University (Kakutani et al., 1990), in Kyoto Pref., Nakaikemi in Fuku Pref. (Kato and Miura, 1996), Kibi in Wakayama Pref. (Matsura et al., 1972), Kochi (Ikudome, 1978), Shiroyama in Kagoshima Pref. (Ikudome, 1992), Yaku Is. (Yumoto, 1994), Amami Islands (Kato, 2000), Hachijo Is. (Takahashi, 1990), Ani Is., Haha's satellite islands, Chichi Is. and Haha Is. (Kato, 1992). Apis was excluded from the analyses at Hamakoshimizu, Hokkaido Univ., Rifu, Hanayama, Nikko, Hachijo, Kibi, Kochi and Shiroyama.
Tetralonia bees.

The *Bombus* fauna at Mt. Yufu was characterized by the predominance of *B. ignitus*, rare in forested habitats, and by the absence of *B. hypocrita* and *B. honshuensis*, abundant in forested habitats (Fig. 12). *B. ignitus* has short, velvet-like hairs, and is probably adapted to flight in sunny habitats, such as grasslands. Since the proboscis length of *B. ignitus* is similar to that of *B. hypocrita*, but much shorter than *B. diversus* (Inoue and Kato, 1992), competition between the former two short-tongued bumblebee species would have resulted in the absence of *H. hypocrita* at Mt. Yufu.

Fig. 12. A comparison of relative abundance of *Bombus* species among 13 localities in Japan. Localities are arranged according to a climatic cline. Data source are as follows: Hama-koshimizu (Fukuda et al., 1973), Mt. Moiwa (Sakagami et al., 1974), Hanayama (Go'ukon, 1992), Nikko (Nakamura and Matsumura, 1985), Mt. Kushigata (Kato et al., 1993), Ashu (Kato et al., 1990), Kibune (Inoue et al., 1990), Botanical garden of Kyoto University (Kakutani et al., 1990), Nakaikemi (Kato and Miura, 1996), Kibi (Matsuura et al., 1972), Kochi (Ikudome, 1978) and Yaku Is. (Yumoto, 1994).

3. Plant-pollinator interaction

A cluster analysis on flower-visitor spectra of 70 plant species detected 12 clusters (Fig. 10). Two plant species, *Corydalis lineariloba* and *Iris rossii* (Plate 4D), were almost exclusively visited by long-tongued Tetralonia bees. These plants had long-spurred or deep tubular flowers and bloomed in early spring, before bumblebees became abundant. The flower of *Iris rossii* is much smaller than those of other Japanese *Iris* species, which are pollinated by long-tongued bumblebees (i.e., *B. diversus, B. consobrinus, B. ussurensis*, and *B. yezoensis*). Mt. Yufu has an abundance of nest sites for Tetralonia bees, as they nest in sand in sunny habitats, such as riverbanks, seashores, and grasslands.
Scoliid wasps were frequent visitors to flowers of some asteraceous, such as *Saussurea gracilis, Heteropappus hispidus* and *Echinops septtfer* (Plate 5G). As their body is covered with long hairs, scoliid wasps are potential pollinators of these flowers. The larvae of scoliid wasps are parasitoids of scarabaeid larvae, which infest roots of perennials; thus, scoliid wasps are abundant at seashores and grasslands, where scarabaeid larvae are abundant.

The pollination system of *Codonopsis lanceolata* was unique; only vespid wasps visited flowers of this species.

Flowers of 6 plant species were predominantly visited by butterfly. The percentage of butterfly-visited plant species (8.6%) was higher at Mt. Yufu than in any forested habitat. The dominant anthophilous butterflies were species of *Fabriciana* (Plate 5C) and *Argyronome* (Nymphalidae), whose larval host plants are grassland-specific *Viola* spp.

4. Conservation

Large areas of the Mt. Yufu grasslands are maintained by controlled burning in March. In these semi-natural grasslands, early flowering species, such as *Viola orientalis* (Plate 4E–F) and *Iris rossii* (Plate 4D) can get a lot of sunlight because the fire burns back the tall grasses and bamboo. Burning is advantageous to grassland-specific perennials because it excludes the competitively superior bamboo, shrubs and trees, and it offers sunny nest sites for some grassland-specific pollinators such as *Tetralonia*.

In the grasslands, there are mowed areas of exceptionally rich flora. Prior to burning, in September, the local people mow grasses along the forest edge, to prevent the fire from burning the neighboring forests. The growth of grasses in the mowed area is more restrained than in the areas where only controlled burning occurs. The mowed, unburned, areas are refuges for fire-intolerant plants and herbivores. The unburned grass shoots could be refuges for cavity-nesting bees. Thus, the balance between burning and mowing, and the mosaic of burned and unburned areas, could be important factors affecting the diversity of grassland plants and pollinators.

The grassland ecosystem at Mt. Yufu is a sanctuary for grassland-specific plants and insects. In the current surveys, an endangered butterfly, *Fabriciana nerippe*, was observed on the flower of *Lysimachia clethroides*. The life of this butterfly is tightly connected to grasslands, because its larval host plants are grassland-specific *Viola* spp., and the adult butterfly sucks nectar from *Cirsium* flowers, and probably pollinates them. The community-level plant-pollinator interactions recorded at Mt. Yufu will contribute to the conservation of natural grassland ecosystems.

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References


_______. 1992. The environment and wild bee fauna of natural park in a city, with the result taken at Shiroyama Park in Kagoshima City, Japan, and with the appendix of a revised bee list recorded from the mainland of Kagoshima Prefecture (Hymenoptera, Apoidea). *Bull. Kagoshima Women’s Junior College* 27: 99–135. (in Japanese)


Plant-pollinator interactions at Mt. Yufu


Appendix 1.


Insect-visit records for each plant species are listed as follows: insect species, (family code: order code), date, and (number of individuals collected or observed). Plant taxa and insect taxa are arranged following the natural systems of Cronquist (1981) and Hirashima (1989), respectively. Insect order and family codes are abbreviated as two and three head characters of each order and family name, respectively.

Lauraceae

Lindera sericea

_Eusphalerum parallelum_ (Sta: Co) 16-18 Apr. (11); _Anaspis_ sp.1 (Scr: Co) 16-18 Apr. (2); _Manobidia nipponica_ (Chr: Co) 16-18 Apr. (9); _sp.1_ (Eul: Hy) 16-18 Apr. (1); _sp.2_ (Eul: Hy) 16-18 Apr. (3); _Drosophila_ sp.2 (Dro: Di) 16-18 Apr. (1)

Ranunculaceae

_Aconitum japonicum_ ssp. napiform

_Bombus diversus diversus_ (Api: Hy) 17-22 Sep. (1)

_Cimicifuga acerina_

_Lasioglossum_ sp.3 (Hal: Hy) 17-22 Sep. (2); _Apis mellifera_ (Api: Hy) 17-22 Sep. (1)

Ranunculus japonicus

_Oedemeronia lucidicollis_ (Oed: Co) 11-16 May (3); _Zypangia lewisi_ (Chr: Co) 11-16 May (1); _Lasioglossum occidens_ (Hal: Hy) 26-29 May (1); _Lasioglossum_ (carinaless _Evytaeus_) sp.2 (Hal: Hy) 11-16 May (3), 26-29 May (1); _Lasioglossum_ (carinaless _Evytaeus_) sp.4 (Hal: Hy) 11-16 May (1); _Andrena komachi_ (And: Hy) 11-16 May (1); _Andrena kaguya_ (And: Hy) 11-16 May (1); _Ceratina japonica_ (Ant: Hy) 11-16 May (1); _Ceratina flavipes_ (Ant: Hy) 26-29 May (1); _Bombus diversus diversus_ (Api: Hy) 11-16 May (1); _Euthyneura_ sp.1 (Emp: Di) 11-16 May (1); _Eristalis tenax_ (Syr: Di) 26-29 May (1); _Melanastoma scalare_ (Syr: Di) 11-16 May (1); _Cheilosia_ sp.1 (Syr: Di) 11-16 May (1); _Platycheirus urakawensis_ (Syr: Di) 11-16 May (1)

Berberidaceae

_Epimedium diphyllum_

_Oedemeronia lucidicollis_ (Oed: Co) 11-16 May (2), 26-29 May (1); _Zypangia lewisi_ (Chr: Co) 11-16 May (2); _Lasioglossum_ (carinaless _Evytaeus_) sp.4 (Hal: Hy) 26-29 May (1)

Papaveraceae

_Corydalis lineariloba_

_Tetralonia nipponensis_ (Ant: Hy) 16-18 Apr. (1)

Fagaceae

_Castanea crenata_

_sp.1_ (Del: He) 16-17 Jun. (1); _Cteniopinus hypocrita_ (All: Co) 16-17 Jun. (1); _Hesperomorpha hirsuta_ (Chr: Co) 16-17 Jun. (1); _Eristalis cerealis_ (Syr: Di) 16-17 Jun. (1); _Siphona_ sp.1 (Tac: Di) 16-17 Jun. (1)
Quercus dentata

Oxycetonia jucunda (Sca: Co) 11-16 May (1); Eucetonia pilifera (Sca: Co) 11-16 May (3); Hoplia moerens (Sca: Co) 11-16 May (14); Camponotus japonicus (For: Hy) 11-16 May (1); Crossocerus sp. 1 (Sph: Hy) 11-16 May (4); Syrphus torvus (Syr: Di) 11-16 May (2); sp.2 (Cal: Di) 11-16 May (1); Neope niphonica niphonica (Nym: Le) 11-16 May (1)

Caryophyllaceae

Dianthus superbus var. longicalyx

Mordellista sp. 1 (Mor: Co) 10-16 Jul. (1); Lasioglossum (carinless Evytaeus) sp.5 (Hal: Hy) 10-16 Jul. (2); Lasioglossum (carinless Evytaeus) sp.8 (Hal: Hy) 10-16 Jul. (1); Coelioxys sp.1 (Meg: Hy) 10-16 Jul. (1); Sphaerophoria macrogaster (Syr: Di) 10-16 Jul. (1)

Poehlingia lateriflora

Melanastoma scalare (Syr: Di) 26-29 May (2)

Pseudostellaria heterantha

Oedemeronia lucidicolliis (Oed: Co) 11-16 May (2); Sphaerophoria philanthus (Syr: Di) 11-16 May (1)

Polygonaceae

Polygonum cuspidatum

Oxycetonia jucunda (Sca: Co) 24-26 Aug. (1); Camponotus japonicus (For: Hy) 24-26 Aug. (2); Lasioglossum sibiriucum (Hal: Hy) 24-26 Aug. (1); Apis cerana (Ap: Hy) 24-26 Aug. (4); Apis mellifera (Ap: Hy) 24-26 Aug. (3); sp.1 (Cul: Di) 24-26 Aug. (1); sp.1 (Cec: Di) 24-26 Aug. (1); Erystalis tenax (Syr: Di) 24-26 Aug. (1); Erystalis cerealis (Syr: Di) 24-26 Aug. (1); Sphaerophoria philanthus (Syr: Di) 24-26 Aug. (1); Drosophila sp.1 (Dro: Di) 24-26 Aug. (1); Stomorhina obsoteta (Cal: Di) 24-26 Aug. (18); sp.2 (Cal: Di) 24-26 Aug. (3)

Clusiaceae

Hypericum pseudopetiolatum

Oxycetonia jucunda (Sca: Co) 17-22 Sep. (1); sp.1 (Cal: Di) 17-22 Sep. (1)

Violaceae

Viola gryphoceras

Euphalaria paralelym (Sta: Co) 16-18 Apr. (2); sp.2 (Ten: Hy) 16-18 Apr. (1); Andrena watasei (And: Hy) 16-18 Apr. (2); Ceratina japonica (Ant: Hy) 16-18 Apr. (1); Nomada mutsuensis (Ant: Hy) 16-18 Apr. (1); Tetralonia nipponensis (Ant: Hy) 16-18 Apr. (2); sp.1 (Chi: Di) 16-18 Apr. (1); Bibio sp.1 (Bib: Di) 16-18 Apr. (1); Bibio gracilipalpus (Bib: Di) 16-18 Apr. (1); Bombus major (Bom: Di) 16-18 Apr. (4); sp.3 (Emp: Di) 16-18 Apr. (1); Tachina sp.1 (Tac: Di) 16-18 Apr. (1)

Viola hondoensis

Bombus major (Bom: Di) 16-18 Apr. (1)

Viola orientalis

Oedemerona lucidicolliis (Oed: Co) 16-18 Apr. (4); Chrysomela vignipunctata (Chr: Co) 16-18 Apr. (1); sp.3 (Ten: Hy) 16-18 Apr. (1); Andrena watasei (And: Hy) 16-18 Apr. (2); Andrena kaguya (And: Hy) 16-18 Apr. (1); Andrena minutula (And: Hy) 16-18 Apr. (1); sp.1 (Thy: Le) 16-18 Apr. (1); Chetoliasia c.4 (Syr: Di) 11-16 May (1); Platycerus urakawensis (Syr: Di) 11-16 Apr. (1); Scirpophaga sp.1 (Thy: Le) 16-18 Apr. (1)

Salicaceae

Salix sieboldiana

Athousius sp.1 (Ela: Co) 11-16 May (1); Themes midas (Can: Co) 11-16 May (1); Mikadocantharis japonica (Can: Co) 11-16 May (1); Anthemas magnius (Can: Co) 11-16 May (1); Podabris malthinoides (Can: Co) 11-16 May (1); Oedemerona lucidicolliis (Oed: Co) 11-16 May (1); Dinoptera minuta (Cer: Co) 11-16 May (1); Tenetredo fukaii (Ten: Hy) 11-16 May (1); Rhogogaster variipes (Ten: Hy) 11-16 May (1); sp.1 (Ten: Hy) 11-16 May (1); sp.1 (Bra: Hy) 11-16 May (1); sp.2 (Bra: Hy) 11-16 May (1);
Plant-pollinator Interactions at Mt. Yufu

Salix pulvinaria

*Euphaslervum parallelym* (Sta: Co) 16-18 Apr. (1); *Manobidia nipponica* (Chr: Co) 16-18 Apr. (4); sp.7 (Bra: Hy) 16-18 Apr. (1); sp.8 (Bra: Hy) 16-18 Apr. (1); *Bibio gracilipalpus* (Bib: Di) 16-18 Apr. (1); *Lasiomma sp.1* (Ant: Di) 16-18 Apr. (23); *Hydrophoria sp.1* (Ant: Di) 16-18 Apr. (5)

**Brassicaceae**

*Arabia glabra*

*Sphaerophoria philanthus* (Syr: Di) 16-17 Jun. (1)

**Clethraceae**

*Clethra barbinervis*

*Lasioglossum apristum* (Hal: Hy) 4-5 Aug. (1); *Andrena dentata* (And: Hy) 4-5 Aug. (2); *Stomorhina obsoleta* (Cal: Di) 4-5 Aug. (3); *Meigenia sp.2* (Tac: Di) 4-5 Aug. (1)

**Ericaceae**

*Lyonia ovalifolia var. elliptica*

*Bombus ardens ardens* (Api: Hy) 16-17 Jun. (1); *Bibio sp.2* (Bib: Di) 16-17 Jun. (2); *Liriomyza sp.1* (Agr: Di) 16-17 Jun. (1)

**Ericaceae**

*Pieris japonica*

*Euphaslervum parallelym* (Sta: Co) 16-18 Apr. (27); *Eucetonia pitifera* (Sca: Co) 16-18 Apr. (1); *Podabris malthinoides* (Can: Co) 16-18 Apr. (1); *Meligethes sp.1* (Ntt: Co) 16-18 Apr. (2); sp.1 (Cry: Co) 16-18 Apr. (1); *Byturus sp.1* (Byt: Co) 16-18 Apr. (1); *Vibidia duodecimguttata* (Cc: Co) 16-18 Apr. (1); *Nonarthra cyanea* (Chr: Co) 16-18 Apr. (3); *Himatium sp.1* (Cur: Co) 16-18 Apr. (1); *Andrena okabei sapporensis* (And: Hy) 16-18 Apr. (1); *Andrena dentata* (And: Hy) 16-18 Apr. (1); *Andrena mikado* (And: Hy) 16-18 Apr. (1); *Andrena watasei* (And: Hy) 16-18 Apr. (1); *Andrena komachi* (And: Hy) 16-18 Apr. (1); *Ceratina japonica* (Ant: Hy) 16-18 Apr. (1); *Nomada diervillae* (Ant: Hy) 16-18 Apr. (1); sp.4 (Cer: Di) 16-18 Apr. (3); *Bibio sp.1* (Bib: Di) 16-18 Apr. (3); *Bibio sp.3* (Bib: Di) 16-18 Apr. (1); *Bibio gracilipalpus* (Bib: Di) 16-18 Apr. (2); *Bibio aneuretus* (Bib: Di) 16-18 Apr. (11); sp.3 (Sci: Di) 16-18 Apr. (1); sp.5 (Sci: Di) 16-18 Apr. (1); *Helophilus virgatus* (Syr: Di) 16-18 Apr. (1); *Cromyza sp.1* (Sph: Di) 16-18 Apr. (1); *Delia sp.3* (Ant: Di) 16-18 Apr. (1)

**Rhododendron kiusianum**

*Pidonia piziloi* (Cer: Co) 26-29 May (1); *Andrena mikado* (And: Hy) 26-29 May (2); *Andrena longitibialis* (And: Hy) 26-29 May (2); *Ceratina japonica* (Ant: Hy) 26-29 May (2); *Nomada asozuana* (Ant: Hy) 26-29 May (1); *Bombus ardens ardens* (Api: Hy) 16-17 Jun. (1), 26-29 May (1); *Philoptera nigrosaenea* (Acr: Di) 26-29 May (4); *Bombus major* (Bom: Di) 26-29 May (2); *Eristalis tenax* (Syr: Di) 26-29 May (1); *Sphaerophoria philanthus* (Syr: Di) 26-29 May (1); *Platycheirus clypeatus* (Syr: Di) 26-29 May (1); *Delia sp.5* (Ant: Di) 16-17 Jun. (1)

**Rhododendron reticulatum**

*Pidonia piziloi* (Cer: Co) 11-16 May (1); sp.1 (Ich: Hy) 11-16 May (1); *Andrena mikado* (And: Hy) 11-16 May (1)
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16 May (4); Andrena longitibialis (And: Hy) 11-16 May (1); Bombus major (Bom: Di) 11-16 May (3)

**Styracaceae**

**Styrax japonica**

*Pidonia hylophila hylophila* (Cer: Co) 16-17 Jun. (1); *Bombus ardens ardens* (Api: Hy) 16-17 Jun. (1)

**Primulaceae**

**Lysimachia clethroides**

*Popilia japonica* (Sca: Co) 10-16 Jul. (1); *Mordellistena* sp.1 (Morr: Co) 10-16 Jul. (2); *Hippuriphila* sp.1 (Chrr: Co) 10-16 Jul. (1); sp.5 (Ich: Hy) 10-16 Jul. (1); *Stenodynerus tokyanus tokyanus* (Eum: Hy) 10-16 Jul. (1); *Lasiosglossum carinaless Erytlaeus* sp.5 (Hal: Hy) 10-16 Jul. (2); *Sphaerophoria philanthus* (Syr: Di) 10-16 Jul. (1); *Campiglossa hirayamae* (Tep: Di) 10-16 Jul. (1); *Peribaea* sp.1 (Tac: Di) 10-16 Jul. (1); *Siphona* sp.1 (Tac: Di) 10-16 Jul. (3); *Polysten pellucida pellucida* (Hes: Le) 10-16 Jul. (1); *Lycanha phlaeas daimio* (Lyc: Le) 10-16 Jul. (4); *Fabriciana adippe pallescens* (Nym: Le) 10-16 Jul. (2); *Fabriciana nerippe* (Nym: Le) 10-16 Jul. (1)

**Hydrangeaceae**

**Hydrangea paniculata**

*Andrena* tongitibialis (And: Hy) 26-29 May (1); *Ceratina japonica* (Ant: Hy) 26-29 May (1); *Philopota nigroaenea* (Acr: Di) 26-29 May (1); *Neaitamus angusticornis* (Asi: Di) 26-29 May (2); *Metanastoma scalare* (Syr: Di) 26-29 May (1); *Sphaerophoria* philanthus (Syr: Di) 26-29 May (1); *Eumerus* sp.1 (Syr: Di) 26-29 May (1); sp.3 (Cal: Di) 26-29 May (1)

**Hydrangea serrata**


**Saxifragaceae**

**Astilbe thunbergii**

*Baris dispitota* (Cur: Co) 24-26 Aug. (1); *Priocnemis cyphonota* (Pom: Hy) 4-5 Aug. (1); *Lasiosglossum apristum* (Hal: Hy) 4-5 Aug. (1); *Andrena dentata* (And: Hy) 4-5 Aug. (1); *Apis mellifera* (Api: Hy) 4-5 Aug. (3); *Stomorhina obsoleta* (Cal: Di) 4-5 Aug. (1)

**Deutzia crenata**

*Hoplia moerens* (Sca: Co) 16-17 Jun. (2); *Trachys saundersi* (Bup: Co) 16-17 Jun. (1); *Mordellina* sp.1 (Mor: Co) 16-17 Jun. (1); *Anaspis* sp.2 (Srr: Co) 16-17 Jun. (1); *Exosoma flaviventre* (Chrr: Co) 16-17 Jun. (1); *Andrena knuthi* (And: Hy) 16-17 Jun. (4); *Andrena taraxaci chinouenensis* (And: Hy) 16-17 Jun. (1); *Andrena protestias* (And: Hy) 16-17 Jun. (3); *Andrena hikosana* (And: Hy) 16-17 Jun. (1); *Bombus ardens ardens* (Api: Hy) 16-17 Jun. (2); *Philopota nigroaenea* (Acr: Di) 16-17 Jun. (2); sp.1 (Empi: Di) 16-17 Jun. (2); *Helophilus virgatus* (Syr: Di) 16-17 Jun. (1); *Betasyrphus serarius* (Syr: Di) 16-17 Jun. (1); *Cheilosia* sp.2 (Syrr: Di) 16-17 Jun. (1); *Cheilosia* sp.3 (Syr: Di) 16-17 Jun. (1); *Sphaerophoria philanthus* (Syr: Di) 16-17 Jun. (1); *Allodacca* sp.1 (Syr: Di) 16-17 Jun. (1); *Zodion* sp.1 (Con: Di) 16-17 Jun. (1); *Stomorhina obsoleta* (Cal: Di) 16-17 Jun. (1); *Peribaea* sp.1 (Tac: Di) 16-17 Jun. (1); *Nemophora umbripennis* (Inc: Le) 16-17 Jun. (1); *Pieris melete melete* (Wei: Le) 16-17 Jun. (1)

**Deutzia crenata var. floribunda**

*Exosoma flaviventre* (Chrr: Co) 16-17 Jun. (1); *Protichneumon* sp.1 (Ich: Hy) 10-16 Jul. (1); *Hoplismenis* sp.1 (Ich: Hy) 10-16 Jul. (1); *Anampila sabulosa nipponica* (Sph: Hy) 16-17 Jun. (2); *Lasiosglossum* sp.1 (Hal: Hy) 16-17 Jun. (1); *Andrena knuthi* (And: Hy) 16-17 Jun. (1); *Andrena protestias* (And: Hy) 16-17 Jun. (1); *Philopota nigroaenea* (Acr: Di) 16-17 Jun. (1); *Eristalis cerealis* (Syr: Di) 10-16 Jul. (3);
Helophilus virgatus (Syr: Di) 10-16 Jul. (1); Paragus jozanus (Syr: Di) 10-16 Jul. (1); Delia sp.1 (Ant: Di) 10-16 Jul. (8); Stomorhina obsoleta (Cal: Di) 10-16 Jul. (3); Sisyrosp sp.1 (Tacr: Di) 10-16 Jul. (1)

Parnassia palustris
Pachygrontha sp.1 (Lyg: He) 14-16 Oct. (1); Formica japonica (For: Hy) 14-16 Oct. (1); Paragus jozanus (Syr: Di) 14-16 Oct. (1)

Schizophragma hydrangeoides
sp.1 (Emp: Di) 16-17 Jun. (1)

Potentilla freyniana
Oedemeronia lucidicollis (Oed: Co) 16-18 Apr. (3); Andrena komachi (And: Hy) 11-16 May (1); Andrena minuta (And: Hy) 16-18 Apr. (3); Bombus diversus diversus (Api: Hy) 11-16 May (1); sp.2 (Emp: Di) 11-16 May (1); Cheilosis sp.5 (Syr: Di) 11-16 May (1); Melangyna sp.1 (Syr: Di) 16-18 Apr. (1); Cheilosis sp.1 (Syr: Di) 11-16 May (1); Platycheirus urakawensis (Syr: Di) 11-16 May (1)

Prunus jamasakura
Eusphaterum parallelym (Sta: Co) 11-16 May (2); Dalopius tamui (Ela: Co) 11-16 May (1); Mikadoanthis japonica (Can: Co) 11-16 May (3); Anthemus magnus (Can: Co) 11-16 May (1); Meligethes sp.1 (Nitt: Co) 11-16 May (1); Epuraea bergeri (Nitt: Co) 11-16 May (1); Byturus sp.2 (Byt: Co) 11-16 May (1); Manobidia niponica (Chr: Co) 11-16 May (3); Pachyprotasis sp.1 (Ten: Hy) 11-16 May (1); sp.2 (Ich: Hy) 11-16 May (1); sp.1 (Tip: Di) 11-16 May (1); sp.3 (Cer: Di) 11-16 May (1); Bibio sp.5 (Bib: Di) 11-16 May (1); sp.4 (Myc: Di) 11-16 May (1); sp.6 (Myc: Di) 11-16 May (1); sp.5 (Emp: Di) 11-16 May (1); Euthyneura sp.1 (Emp: Di) 11-16 May (1); Melanastoma scalare (Syr: Di) 11-16 May (1); sp.2 (Chl: Di) 11-16 May (1); Hylymia sp.1 (Ant: Di) 11-16 May (2)

Rabus parvifolius
Byturus sp.1 (Byt: Co) 16-17 Jun. (1); Baris dispilota (Cur: Co) 16-17 Jun. (1); Phytopius sp.1 (Cur: Co) 16-17 Jun. (1); Ceratina japonica (Ant: Hy) 16-17 Jun. (1); Bombus ardens ardens (Api: Hy) 16-17 Jun. (1); Sepsis sp.1 (Sept: Di) 16-17 Jun. (1)

Rabus phoenicosius
Bombus ardens ardens (Api: Hy) 26-29 May (1)

Sanguisorba officinalis
Eurychaeta sp.1 (Cal: Di) 17-22 Sep. (1)

Spiraea japonica
Anechura japonica (For: De) 10-16 Jul. (1); Lasiosglossum (carinaless Evylaeus) sp.1 (Hal: Hy) 10-16 Jul. (1); Bombus diversus diversus (Api: Hy) 4-5 Aug. (1); Bombus ignitus (Api: Hy) 4-5 Aug. (1); Eristalis tenax (Syr: Di) 4-5 Aug. (1); Fabriciana adippe pallescens (Nym: Le) 10-16 Jul. (1)

Fabaceae

Sophora flavescens
Trypherus niponicus (Can: Co) 16-17 Jun. (2); Campsomeris prismaticaca (Sco: Co) 16-17 Jun. (1); Camponotus japonicus (For: Hy) 16-17 Jun. (1); Ammophila sabulosa nipponica (Sph: Hy) 16-17 Jun.
(1); Ceratina japonica (Ant: Hy) 16-17 Jun. (2); Bombus diversus diversus (Api: Hy) 10-16 Jul. (1), 16-17 Jun. (7); Bombus ignitus (Api: Hy) 16-17 Jun. (1); Sphaerophoria philanthus (Syr: Di) 16-17 Jun. (1); Neptis sappho intermedia (Nym: Le) 16-17 Jun. (1)

Vicia unijuga
Lasioglossum (carinaless Evylaeus) sp.4 (Hal: Hy) 16-17 Jun. (1); Bombus diversus diversus (Api: Hy) 16-17 Jun. (1); Sphaerophoria philanthus (Syr: Di) 16-17 Jun. (1)

Cornaceae

Benthamidia japonica
Themus midas (Can: Co) 16-17 Jun. (1); Protemus ciusianus (Can: Co) 16-17 Jun. (1); Andrena tarasacci chikuzenensis (And: Hy) 16-17 Jun. (1); Bombus ardens ardens (Api: Hy) 16-17 Jun. (1); Ernistis tenax (Syr: Di) 16-17 Jun. (1); Epistrophoe aino (Syr: Di) 16-17 Jun. (2); Ernistis cerealis (Syr: Di) 16-17 Jun. (1); Aldrichina grahami (Cal: Di) 16-17 Jun. (2); Ravinia sp.1 (Sar: Di) 16-17 Jun. (1); Phebellia sp.1 (Tae: Di) 16-17 Jun. (1); sp.2 (Tor: Le) 16-17 Jun. (1); Ivela auripes (Lym: Le) 16-17 Jun. (1)

Polygalaceae

Polygala japonica
Lasioglossum (carinaless Evylaeus) sp.4 (Hal: Hy) 11-16 May (1)

Staphyleaceae

Staphylea bumalda
Pipunculus sp.1 (Pip: Di) 11-16 May (1)

Geraniaceae

Geranium shikokianum
sp.1 (Ric: He) 24-26 Aug. (1); Nonarthra cyanea (Chr: Co) 24-26 Aug. (7); Rhinoncomimus sp.1 (Cur: Co) 24-26 Aug. (1); Lasioglossum sp.3 (Hal: Hy) 17-22 Sep. (2); Lasioglossum (carinaless Evylaeus) sp.3 (Hal: Hy) 4-5 Aug. (1); Ceratina japonica (Ant: Hy) 17-22 Sep. (3); Ceratina flavipes (Ant: Hy) 4-5 Aug. (1); Ceratina megastigmata (Ant: Hy) 17-22 Sep. (9); Bombus diversus diversus (Api: Hy) 17-22 Sep. (1); Panorpa trizonata (Pan: Me) 4-5 Aug. (1); Prosena siberita (Tae: Di) 24-26 Aug. (1)

Apiceae

Angelica cartilagino-marginata
Sphaerophoria philanthus (Syr: Di) 24-26 Aug. (1)

Angelica longera radiata
Panorpa trizonata (Pan: Me) 24-26 Aug. (1)

Hydrocotyle ramiflora
Lasioglossum (carinaless Evylaeus) sp.4 (Hal: Hy) 16-17 Jun. (2); Paragus quadrifasciatus (Syr: Di) 16-17 Jun. (1); Paragus jozanus (Syr: Di) 16-17 Jun. (1)

Gentianaceae

Gentiana zollingeri
Andrena sp.1 (And: Hy) 16-18 Apr. (1)

Swertia japonica
Formica japonica (For: Hy) 14-16 Oct. (1)

Lamiaceae

Isodon inflexus
Apis mellifera (Api: Hy) 17-22 Sep. (1)

Prunella vulgaris var. lilacina

**Scrophulariaceae**

Veronica rotunda var. petiolaris

- Anaphila sabulosa nipponica (Sph: Hy) 4-5 Aug. (1); Lasiosglossum (carinaless Evylaeus) sp.1 (Hal: Hy) 4-5 Aug. (1); Lasiosglossum (carinaless Evylaeus) sp.4 (Hal: Hy) 4-5 Aug. (2); Sphaerophoria macrogaster (Syr: Di) 4-5 Aug. (1); Sphaerophoria philantus (Syr: Di) 4-5 Aug. (1)

**Campanulaceae**

Adenophora triphylla

- Bombus ignitus (Api: Hy) 4-5 Aug. (1); Maculinea teleius kazamato (Lyc: Le) 4-5 Aug. (2); Minois dryas bipunctata (Nym: Le) 4-5 Aug. (1)

Codonopsis lanceolata

- Vespa simillima xanthoptera (Ves: Hy) 17-22 Sep. (1)

**Rubiaceae**

Galium japonicum

- Meliscaeva cinctella (Syr: Di) 11-16 May (1)

Galium verum

- Mordellistena sp.1 (Mor: Co) 10-16 Jul. (1); Lasiosglossum (carinaless Evylaeus) sp.5 (Hal: Hy) 10-16 Jul. (1); Lasiosglossum (carinaless Evylaeus) sp.6 (Hal: Hy) 10-16 Jul. (1); Paragus quadrifasciatus (Syr: Di) 10-16 Jul. (2)

Paederia scandens

- Lasiosglossum (carinaless Evylaeus) sp.4 (Hal: Hy) 4-5 Aug. (1)

**Caprifoliaceae**

Abelia serrata

- Macrotragia robusticeps (Lag: Co) 26-29 May (1); Myrmica sp.1 (For: Hy) 26-29 May (1); Lasiosglossum (carinaless Evylaeus) sp.3 (Hal: Hy) 26-29 May (1); Ceratina japonica (Ant: Hy) 26-29 May (1); Apis mellifera (Api: Hy) 26-29 May (1); sp.3 (Tip: Di) 11-16 May (1); Philopota nigroaenea (Acr: Di) 11-16 May (1), 26-29 May (7); sp.9 (Emp: Di) 11-16 May (1); Euthynura sp.1 (Emp: Di) 11-16 May (1); sp.10 (Emp: Di) 11-16 May (1); Helophilus virgatus (Syr: Di) 26-29 May (1)

Viburnum dilatatum

- Ectinohoptia obducta (Sca: Co) 16-17 Jun. (7); Vuilletus viridis (Ela: Co) 16-17 Jun. (1); Oedemeronia lucidicollis (Oed: Co) 16-17 Jun. (4); Andrena knuthi (And: Hy) 16-17 Jun. (1); sp.4 (Emp: Di) 16-17 Jun. (1); sp.6 (Emp: Di) 16-17 Jun. (1); Eristalis tenax (Syr: Di) 16-17 Jun. (1); Peribaea sp.1 (Tae: Di) 16-17 Jun. (1)

Viburnum erosum var. punctatum

- Lasiosglossum (carinaless Evylaeus) sp.2 (Hal: Hy) 26-29 May (1); Eristalis tenax (Syr: Di) 26-29 May (1); Helophilus virgatus (Syr: Di) 26-29 May (1); Betasyrphus serarius (Syr: Di) 26-29 May (1)

Weigela decora

- Paraserica gricea (Sca: Co) 16-17 Jun. (1); Dalopius tamui (Ela: Co) 16-17 Jun. (1); Anthemus macuilliyris (Can: Co) 16-17 Jun. (1); Prothemenius ciusianicus (Can: Co) 16-17 Jun. (2); sp.3 (Bra: Hy) 16-17 Jun. (1); Myrmica sp.1 (For: Hy) 16-17 Jun. (1); Lasiosglossum sp.2 (Hal: Hy) 16-17 Jun. (1); Ceratina flavipes (Ant: Hy) 16-17 Jun. (1); Tetralonia nipponensis (Ant: Hy) 16-17 Jun. (1); Bombus ardens (Api: Hy) 16-17 Jun. (2); Bombus ignitus (Api: Hy) 16-17 Jun. (7); Homoneura sp.2 (Lau: Di)
Weigela japonica

Andrena watasei (And: Hy) 26-29 May (1); Andrena halictoides (And: Hy) 26-29 May (1); Ceratina japonica (Ant: Hy) 26-29 May (1); Ceratina megastigmata (Ant: Hy) 26-29 May (1); Bombus ardens ardens (Api: Hy) 26-29 May (5); Philatopa nigroaenea (Acr: Di) 26-29 May (2); Dideaides coquillettii (Syr: Di) 26-29 May (1); Allobaccha apicalis (Syr: Di) 26-29 May (1)

Valerianaceae

Patrinia scabiosaefolia

Stomorhina obsoleta (Cal: Di) 17-22 Sep. (1)

Patrinia villosa

Chrysopa sp. (Chr: Ne) 24-26 Aug. (1); Lasioglossum (carinaless Eevylaeus) sp.3 (Hal: Hy) 24-26 Aug. (1)

Valeriana fauriei

Eristalis tenax (Syr: Di) 16-17 Jun. (2), 26-29 May (2); Peribaea sp.1 (Tac: Di) 16-17 Jun. (1)

Asteraceae

Anaphalis margaritacea var. angus

Baris dispilota (Cur: Co) 24-26 Aug. (1); Eristalis tenax (Syr: Di) 24-26 Aug. (1); sp.1 (Mus: Di) 24-26 Aug. (1)

Aster scaber

Ausacophora nigripennis (Chr: Co) 17-22 Sep. (1); Lasioglossum sp.3 (Hal: Hy) 17-22 Sep. (1); Ceratina megastigmata (Ant: Hy) 17-22 Sep. (1)

Cirsium japonicum

sp.2 (Del: He) 16-17 Jun. (1); Mordellista sp.1 (Mor: Co) 16-17 Jun. (3); Nonarthra cyanea (Chr: Co) 16-17 Jun. (2); Zypangia lewisi (Chr: Co) 16-17 Jun. (5); Baris dispilota (Cur: Co) 16-17 Jun. (33); Megacampsomeris grossa matsumurai (Sco: Hy) 16-17 Jun. (1); Vespa simillima xanthoptera (Ves: Hy) 16-17 Jun. (1); Vespa tropica pulchra (Ves: Hy) 16-17 Jun. (1); Lasioglossum (carinaless Eevylaeus) sp.5 (Hal: Hy) 16-17 Jun. (1); Megachile tsurugensis (Meg: Hy) 16-17 Jun. (1); Megachile japonica (Meg: Hy) 16-17 Jun. (1); Ceratina japonica (Ant: Hy) 16-17 Jun. (3); Ceratina flavipes (Ant: Hy) 16-17 Jun. (2); Nomada japonica (Ant: Hy) 16-17 Jun. (1); Tetralonia nipponensis (Ant: Hy) 16-17 Jun. (6); Bombus diversus diversus (Api: Hy) 10-16 Jul. (2), 16-17 Jun. (6); Bombus ignitus (Api: Hy) 16-17 Jun. (2); Eristalis tenax (Syr: Di) 16-17 Jun. (5); Volucella jellodana (Syr: Di) 16-17 Jun. (1); Eristalis cerealis (Syr: Di) 16-17 Jun. (1); Betasyrphus serarius (Syr: Di) 16-17 Jun. (1); Sphaerophoria philantus (Syr: Di) 16-17 Jun. (3); Thoressa varia (Hes: Le) 16-17 Jun. (1); Parnara guttata guttata (Hes: Le) 10-16 Jul. (2); Ochloides ochraceus (Hes: Le) 10-16 Jul. (1); Pieris melete melete (Pie: Le) 10-16 Jul. (1), 16-17 Jun. (2); Fabriciana adippe pallescens (Nym: Le) 10-16 Jul. (3), 16-17 Jun. (3); Macroglossum stellatarum (Sph: Le) 16-17 Jun. (1)

Cirsium suffultum

Oxyctonia jucunda (Sca: Co) 17-22 Sep. (1); Nonarthra cyanea (Chr: Co) 17-22 Sep. (6); Campsomeris prismatica (Sco: Hy) 17-22 Sep. (2); Megacampsomeris grossa matsumurai (Sco: Hy) 17-22 Sep. (1); Lasioglossum (carinaless Eevylaeus) sp.2 (Hal: Hy) 17-22 Sep. (1); Megachile tsurugensis (Meg: Hy) 17-22 Sep. (1); Ceratina japonica (Ant: Hy) 17-22 Sep. (1); Ceratina megastigmata (Ant: Hy) 17-22 Sep. (6); Bombus diversus diversus (Api: Hy) 17-22 Sep. (2); Bombus ignitus (Api: Hy) 14-16 Oct. (2), 17-22 Sep. (26); Prosena sp.1 (Tac: Di) 17-22 Sep. (2); Parnara guttata guttata (Hes: Le) 17-22 Sep. (1); Papilio machaon hippocrates (Pap: Le) 17-22 Sep. (1); Vanessa indica (Nym: Le) 17-22 Sep. (1); Macroglossum
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sp.1 (Sph: Le) 17-22 Sep. (1)

Echinops setifer
Eryctenion jucunda (Sca: Co) 17-22 Sep. (1), 24-26 Aug. (2); Campsomeriella annulata annulata (Sco: Hy) 24-26 Aug. (1); Vespa similina xanathoptera (Ves: Hy) 24-26 Aug. (1); Bombus ignitus (Api: Hy) 24-26 Aug. (5); Apis mellifera (Api: Hy) 24-26 Aug. (3); Prosena sp.1 (Tac: Di) 24-26 Aug. (1); Parnara guttata guttata (Hes: Le) 24-26 Aug. (1); Papilio machaon hippocrates (Pap: Le) 24-26 Aug. (1)

Erigeron annuus
Baris dispilota (Cur: Co) 16-17 Jun. (8); Lasioglossum (carinaless Erylæus) sp.7 (Hal: Hy) 10-16 Jul. (1); Nomada muinensis (Ant: Hy) 16-17 Jun. (1); Nomada sp.1 (Ant: Hy) 16-17 Jun. (1); Sphaerophoria philanthus (Syr: Di) 16-17 Jun. (1); Urophora sachalinensis (Tep: Di) 16-17 Jun. (1); Peribaea sp.1 (Tac: Di) 16-17 Jun. (1); Balataeæ gracilis (Zyg: Le) 16-17 Jun. (1)

Erigeron philadelphicus
Urophora sachalinensis (Tep: Di) 16-17 Jun. (1)

Eupatorium chinense
Baris dispilota (Cur: Co) 4-5 Aug. (1); Betasyrphus serarius (Syr: Di) 4-5 Aug. (1)

Heteropappus hispidus
Campsomeris prismatica (Sco: Hy) 17-22 Sep. (1); Lasioglossum sp.3 (Hal: Hy) 17-22 Sep. (5); Eristalis cerealis (Syr: Di) 17-22 Sep. (1); Paragus haemorrhous (Syr: Di) 17-22 Sep. (1)

Inula japonica
Ceratina flavipes (Ant: Hy) 24-26 Aug. (1); Papilio machaon hippocrates (Pap: Le) 24-26 Aug. (1)

Inula salicina var. asiatica
Ceratina megastigmata (Ant: Hy) 17-22 Sep. (1)

Ixeris dentata
Lasioglossum (carinaless Erylæus) sp.2 (Hal: Hy) 26-29 May (1); Lasioglossum (carinaless Erylæus) sp.4 (Hal: Hy) 26-29 May (1); Andrena knuthi (And: Hy) 11-16 May (2); Eristalis tenax (Syr: Di) 26-29 May (1); Sphaerophoria macrogaster (Syr: Di) 11-16 May (3), 26-29 May (2); Melanastoma scalare (Syr: Di) 26-29 May (1); Sphaerophoria philanthus (Syr: Di) 11-16 May (1), 26-29 May (4); Platycerius clypeatus (Syr: Di) 26-29 May (1); Peribaea sp.1 (Tac: Di) 11-16 May (1)

Ligularia fischeri var. takeyuki
Baris dispilota (Cur: Co) 10-16 Jul. (1); Eristalis tenax (Syr: Di) 10-16 Jul. (2); 4-5 Aug. (1); Fabriciana adippe pallescens (Nym: Le) 10-16 Jul. (5)

Ligularia japonica
Symptetrum frequens (Lib: Od) 10-16 Jul. (1); Bombus diversus diversus (Api: Hy) 10-16 Jul. (3); Bombus ignitus (Api: Hy) 10-16 Jul. (1); Eristalis tenax (Syr: Di) 10-16 Jul. (2); Peribaea sp.1 (Tac: Di) 10-16 Jul. (1); Polysternis pellucida pellucida (Hes: Le) 10-16 Jul. (1); Parnara guttata guttata (Hes: Le) 24-26 Aug. (1); Papilio bianor dehaenii (Pap: Le) 10-16 Jul. (4); Lycaena phlaeus daimio (Lyc: Le) 10-16 Jul. (1); Argyronome rutila lymphe (Nym: Le) 10-16 Jul. (1); Macroglossum bombylaus (Sph: Le) 10-16 Jul. (1)

Saussurea gracilis
Campsomeris prismatica (Sco: Hy) 24-26 Aug. (1); Lasioglossum sp.3 (Hal: Hy) 17-22 Sep. (2); Eristalis tenax (Syr: Di) 24-26 Aug. (1)

Saussurea yanagisawae var. nivea
Nonarthra cyanea (Chr: Co) 17-22 Sep. (1); Campsomeris prismatica (Sco: Hy) 17-22 Sep. (8); Lasioglossum sp.3 (Hal: Hy) 17-22 Sep. (3); Apis mellifera (Api: Hy) 17-22 Sep. (1)

Senecio pierotii
Sphaerophoria philanthus (Syr: Di) 26-29 May (1)

Solidago virga-aurea ssp. Asiatic
Nonarthra cyanea (Chr: Co) 17-22 Sep. (3); Aulacophora nigripennis (Chr: Co) 17-22 Sep. (4); Lasioglossum sp.3 (Hal: Hy) 17-22 Sep. (3)

Symurus excelsus
Bombus diversus diversus (Api: Hy) 14-16 Oct. (3)

Araceae

Arisaema japonicum
sp.1 (Tin: He) 26-29 May (1); Tapinoma sp.1 (For: Hy) 26-29 May (1); sp.4 (Tip: Di) 26-29 May (1); sp.1 (Myc: Di) 26-29 May (2); sp.3 (Myc: Di) 26-29 May (1); sp.7 (Myc: Di) 26-29 May (1); sp.8 (Myc: Di) 16-17 Jun. (1); sp.9 (Myc: Di) 26-29 May (1); sp.10 (Myc: Di) 16-18 Apr. (1); sp.11 (Myc: Di) 26-29 May (1); sp.1 (Sci: Di) 26-29 May (1); sp.2 (Sci: Di) 16-18 Apr. (1); sp.4 (Sci: Di) 16-18 Apr. (1); sp.6 (Sci: Di) 16-18 Apr. (1); sp.7 (Sci: Di) 26-29 May (1); sp.7 (Emp: Di) 26-29 May (1)

Juncaceae

Luzula capitata
Phyllopertha diversa (Sca: Co) 26-29 May (1)

Liliaceae

Aleuris luteoviridis
Lasioglossum (carinate Evylaeus) sp.1 (Hal: Hy) 10-16 Jul. (1)

Allium thunbergii
Nonarthra cyanea (Chr: Co) 17-22 Sep. (1); Bombus ignitus (Api: Hy) 17-22 Sep. (1); Apis mellifera (Api: Hy) 17-22 Sep. (1); Epiyorphus baleatus (Syr: Di) 17-22 Sep. (2); Scaeva komabensis (Syr: Di) 17-22 Sep. (1)

Asparagus schoberoides
Ammophila sabulosa nipponica (Sph: Hy) 26-29 May (1)

Chionographis japonica
Gambrinus sp.1 (Elat: Co) 16-17 Jun. (1); Camponotus japonicus (For: Hy) 16-17 Jun. (1); Sphaerophoria macrogaster (Syr: Di) 16-17 Jun. (3), 26-29 May (1); Linnaenya sp.1 (Tac: Di) 16-17 Jun. (1)

Hemerocallis vespertina
Metrioptera hime (Tet: Or) 4-5 Aug. (1); Bombus diversus diversus (Api: Hy) 10-16 Jul. (1), 4-5 Aug. (1); Apis mellifera (Api: Hy) 4-5 Aug. (1); Eristalis tenax (Syr: Di) 4-5 Aug. (2); Parnara guttata guttata (Hes: Le) 4-5 Aug. (1); Ampelophaga rubiginosa (Sph: Le) 4-5 Aug. (1)

Lilium leichtlinii var. maximowic
Papilio machaon hippocrates (Pap: Le) 24-26 Aug. (1)

Veratrum maackii var. maackii
Ichneumon sp.1 (Ich: Hy) 4-5 Aug. (1); Ichneumon sp.3 (Ich: Hy) 4-5 Aug. (1); Meigenia sp.1 (Tac: Di) 4-5 Aug. (1); Eumea sp.1 (Tac: Di) 4-5 Aug. (1); Eumea sp.2 (Tac: Di) 4-5 Aug. (1)

Iridaceae

Iris rossii
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*Oedemeronia lucidicollis* (Oed: Co) 11-16 May (2); *Tetralonia nipponensis* (Ant: Hy) 11-16 May (1), 16-18 Apr. (6)

Dioscoreaceae

*Dioscorea asclepiadea*

*Anomala octiescoctata* (Sca: Co) 26-29 May (1)

Orchidaceae

*Cephalanthera falcata*

*Zypangia lewisi* (Chr: Co) 11-16 May (4); *Apodorus erythrogaster* (Att: Co) 11-16 May (1); sp.1 (Cer: Di) 11-16 May (1); *Delia* sp.4 (Ant: Di) 11-16 May (1)
Appendix 2

A List of Floral Host Species for Each Anthophilous Insect Species
Recorded at Mt. Yufu in 2001

Flower-visit records of each insect species are arranged in the following sequence: plant species, (plant species code), date and (number of individuals collected or observed). Insect taxa and plant taxa are arranged following the natural systems of Hirashima (1989) and Cronquist (1981).

ORTHOPTERA
Libellulidae

*Sympetrum frequens*
   *Ligularia japonica* (ast6) 10-16 Jul. (1)

Tettigoniidae

*Metrioptera hime*
   *Hemerocallis vespertina* (li8) 4-5 Aug. (1)

DERMAPTERA
Forficulidae

*Anechura japonica*
   *Spiraea japonica* (ros9) 10-16 Jul. (1)

HEMIPTERA
Ricaniidae

*Geranium shikokianum* (ger1) 24-26 Aug. (1)

Deltocephalidae

*Castanea crenata* (fag2) 16-17 Jun. (1)

sp.1
*Castanea crenata* (fag2) 16-17 Jun. (1)

Tingidae

*Euphorbia amygdaloides* (ara1) 26-29 May (1)

Lygaeidae

*Pachygrontha*
   *Parnassia palustris* (sax8) 14-16 Oct. (1)

Chrysopidae

*Chrysopa sp.*
   *Patrinia villosa* (val2) 24-26 Aug. (1)

COLEOPTERA
Staphylinidae

*Euphorbia amygdaloides* (ara1) 26-29 May (1)

Lindera sericea (lau1) 16-18 Apr. (11); Viola grypoceras (vio2) 16-18 Apr. (2); Salix vulpina (sal1) 16-18 Apr. (1); *Pieris japonica* (er1) 16-18 Apr. (27); *Prunus jamasakura* (ros3) 11-16 May (2)
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Scarabaeidae

Anomala octiescoctata  
*Dioscorea asclepiadea* (dio1) 26-29 May (1)  
*Popilia japonica*  
*Lysimachia clethroides* (pri1) 10-16 Jul. (1)

Phyllopertha diversa  
*Luzula capitata* (jun1) 26-29 May (1)

*Paraserica gricea*  
*Weigela decora* (cap6) 16-17 Jun. (1)

Oxyctonia jucunda  
*Quercus dentata* (fag1) 11-16 May (1);  
*Polygonum cuspidatum* (pol3) 24-26 Aug. (1);  
*Hypericum pseudopetiolatum* (clu1) 17-22 Sep. (1);  
*Cirsium sufflittum* (ast16) 17-22 Sep. (1);  
*Echinops setifer* (ast15) 17-22 Sep. (1), 24-26 Aug. (2)

Eucetonia pilifera  
*Quercus dentata* (fag1) 11-16 May (3);  
*Pieris japonica* (eri1) 16-18 Apr. (1)

Ectinohoplia obducta  
*Viburnum dilatatum* (cap5) 16-17 Jun. (7)

*Hoplia moerens*  
*Quercus dentata* (fag1) 11-16 May (14);  
*Deutzia crenata* (sax2) 16-17 Jun. (2)

Buprestidae

*Gambrinus sp.* 1  
*Chionographis japonica* (hil6) 16-17 Jun. (1)

Elateridae

*Arhousius sp.* 1  
*Salix sieboldiana* (sal3) 11-16 May (1)

Cantharidae

*Themus midas*  
*Salix sieboldiana* (sal3) 11-16 May (1);  
*Benthamidia japonica* (cor2) 16-17 Jun. (1)

*Mikadoanthuris japonica*  
*Salix sieboldiana* (sal3) 11-16 May (1);  
*Prunus jamasakura* (ros3) 11-16 May (3)

*Anthemus magnius*  
*Salix sieboldiana* (sal3) 11-16 May (1);  
*Prunus jamasakura* (ros3) 11-16 May (1)

*Anthemus maculihlytris*  
*Weigela decora* (cap6) 16-17 Jun. (1)
**Prothema ciusianus**  
*Benthamidia japonica* (cor2) 16-17 Jun. (1); *Weigela decora* (cap6) 16-17 Jun. (2)

**Trypherus niponicus**  
*Sophora flavescens* (fab1) 16-17 Jun. (2)

**Podabrus malthinoides**  
*Salix sieboldiana* (sal3) 11-16 May (1); *Pieris japonica* (eri1) 16-18 Apr. (1)

**Ntrolulidae**

**Meligethes sp.1**  
*Pieris japonica* (eri1) 16-18 Apr. (2); *Prunus jamasakura* (ros3) 11-16 May (1)

**Euphrasia bergeri**  
*Prunus jamasakura* (ros3) 11-16 May (1)

**Cryptophagidae**

**Byturidae**

**Byturus sp.1**  
*Pieris japonica* (eri1) 16-18 Apr. (1); *Rubus parvifolius* (ros8) 16-17 Jun. (1)

**Byturus sp.2**  
*Prunus jamasakura* (ros3) 11-16 May (1)

**Coccinellidae**

**Vibidia duodecimguttata**  
*Pieris japonica* (eri1) 16-18 Apr. (1)

**Mordellidae**

**Mordellistena sp.1**  
*Dianthus superbus* var. longicalyc (car3) 10-16 Jul. (1); *Lysimachia clethroides* (pri1) 10-16 Jul. (2);  
*Galium verum* (rub2) 10-16 Jul. (1); *Cirsium japonicum* (ast3) 16-17 Jun. (3)

**Mordellina sp.1**  
*Deutzia crenata* (sax2) 16-17 Jun. (1)

**Oedemeridae**

**Oedemeronia lucidicollis**  
*Ranunculus japonicus* (ran1) 11-16 May (3); *Epimedium diphylum* (bor1) 11-16 May (2), 26-29 May (1);  
*Pseudostellaria heterantha* (car1) 11-16 May (2); *Viola orientalis* (viol1) 16-18 Apr. (4); *Salix sieboldiana* (sal3) 11-16 May (1); *Potentilla freyniana* (ros1) 16-18 Apr. (3); *Viburnum dilatatum* (cap5) 16-17 Jun. (4); *Iris rossii* (iri1) 11-16 May (2)

**Scraptiidae**

**Anaspis sp.1**  
*Lindera sericea* (lau1) 16-18 Apr. (2)

**Anaspis sp.2**  
*Deutzia crenata* (sax2) 16-17 Jun. (1)

**Lagriidae**

**Macrolagria robusticeps**
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Abelia serrata (cap1) 26-29 May (1)

Cteniopinus hypocrita
Castanea crenata (fag2) 16-17 Jun. (1)

Cerambycidae

Dinoptera minuta
Salix sieboldiana (sal3) 11-16 May (1)

Pidonia hylophila hylophila
Styrax japonica (sty1) 16-17 Jun. (1)

P. piziloi
Rhododendron kiusianum (eri4) 26-29 May (1); Rhododendron reticulatum (eri3) 11-16 May (1)

Chrysomelidae

Nonarthra cyanea
Pieris japonica (eri1) 16-18 Apr. (3); Geranium shikokianum (ger1) 24-26 Aug. (7); Cirsium japonicum (ast3) 16-17 Jun. (2); Cirsium suffultum (ast16) 17-22 Sep. (6); Saussurea yanagisawai var. nivea (ast17) 17-22 Sep. (1); Solidago virga-aurea ssp. Asiatic (ast18) 17-22 Sep. (3); Allium thunbergii (lil13) 17-22 Sep. (1)

Aulacophora nigripennis
Aster scaber (ast19) 17-22 Sep. (1); Solidago virga-aurea ssp. Asiatic (ast18) 17-22 Sep. (4)

Exosoma flaviventre
Deutzia crenata (sax2) 16-17 Jun. (1); Deutzia crenata var. floribunda (sax6) 16-17 Jun. (1)

Zypangia lewisi
Ranunculus japonicus (ran1) 11-16 May (1); Epimedium diphyllyum (ber1) 11-16 May (2); Cirsium japonicum (ast3) 16-17 Jun. (5); Cephalanthera falcata (orc1) 11-16 May (4)

Hippuriphila sp. 1
Lysimachia clethroides (pri1) 10-16 Jul. (1)

Hesperomorpha hirsuta
Castanea crenata (fag2) 16-17 Jun. (1)

Chrysomela vigintipunctata
Viola orientalis (vio1) 16-18 Apr. (1)

Manobidia nipponica
Lindera sericea (lau1) 16-18 Apr. (9); Salix vulpina (sal1) 16-18 Apr. (4); Prunus jamasakura (ros3) 11-16 May (3)

Attelabidae

Apoderus erythrogaster
Cephalanthera falcata (orc1) 11-16 May (1)

Curculionidae

Baris dispilota
Hydrangea paniculata (hyd3) 24-26 Aug. (1); Astilbe thunbergii (sax5) 10-16 Jul. (8); Rubus parvifolius (ros8) 16-17 Jun. (1); Anaphalis margaritacea var. angus (ast13) 24-26 Aug. (1); Cirsium japonicum (ast3) 16-17 Jun. (33); Eupatorium chinense (ast9) 4-5 Aug. (1); Erigeron annuus (ast5) 16-17 Jun. (8); Ligularia fischeri var. takeyuki (ast8) 10-16 Jul. (1)
Himatium sp. 1
   *Pieris japonica* (eri1) 16-18 Apr. (1)

Rhinoncomimus sp. 1
   *Geranium shikokianum* (ger1) 24-26 Aug. (1)

*Phytobius* sp. 1
   *Rubus parvifolius* (ros8) 16-17 Jun. (1)

**HYMENOPTERA**

**Tenthredinidae**

*Tenthredo fukaii*
   *Salix sieboldiana* (sal3) 11-16 May (1)

*Rhogogaster varipes*
   *Salix sieboldiana* (sal3) 11-16 May (1)

*Pachyprotasis* sp. 1
   *Prunus jamasakura* (ros3) 11-16 May (1)

sp. 1
   *Salix sieboldiana* (sal3) 11-16 May (1)

sp. 2
   *Viola grypoceras* (vio2) 16-18 Apr. (1)

sp. 3
   *Viola orientalis* (vio1) 16-18 Apr. (1)

**Braconidae**

sp. 1
   *Salix sieboldiana* (sal3) 11-16 May (1)

sp. 2
   *Salix sieboldiana* (sal3) 11-16 May (1)

sp. 3
   *Weigela decora* (cap6) 16-17 Jun. (1)

sp. 4
   *Salix sieboldiana* (sal3) 11-16 May (1)

sp. 5
   *Salix sieboldiana* (sal3) 11-16 May (1)

sp. 6
   *Salix sieboldiana* (sal3) 11-16 May (1)

sp. 7
   *Salix vulpina* (sal1) 16-18 Apr. (1)

sp. 8
   *Salix vulpina* (sal1) 16-18 Apr. (1)
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Ichneumonidae

Protichneumon sp. 1
Deutzia crenata var. floribunda (sax6) 10-16 Jul. (1)

Hoplistemenus sp. 1
Deutzia crenata var. floribunda (sax6) 10-16 Jul. (1)

Ichneumon sp. 1
Veratrum maackii var. maackii (lil10) 4-5 Aug. (1)

Ichneumon sp. 2
Salix sieboldiana (sal3) 11-16 May (1)

Ichneumon sp. 3
Veratrum maackii var. maackii (lil10) 4-5 Aug. (1)

sp. 1
Rhododendron reticulatum (eri3) 11-16 May (1)

sp. 2
Prunus jamasakura (ros3) 11-16 May (1)

sp. 3
Salix sieboldiana (sal3) 11-16 May (1)

sp. 4
Salix sieboldiana (sal3) 11-16 May (1)

sp. 5
Lysimachia clethroides (pri1) 10-16 Jul. (1)

sp. 6
Salix sieboldiana (sal3) 11-16 May (1)

Pteromalidae

sp. 1
Salix sieboldiana (sal3) 11-16 May (1)

Perilampidae

sp. 1
Salix sieboldiana (sal3) 11-16 May (1)

Eulophidae

sp. 1
Lindera sericea (lau1) 16-18 Apr. (1)

sp. 2
Lindera sericea (lau1) 16-18 Apr. (3)

Scoliidae
Campsomeris prismatica
Sophora flavescens (fab1) 16-17 Jun. (1); Cirsium suffultum (ast16) 17-22 Sep. (2); Heteropappus hispidus (ast22) 17-22 Sep. (1); Saussurea gracilis (ast12) 24-26 Aug. (1); Saussurea yanagisawae var. nivea (ast17) 17-22 Sep. (8)

Campsomeriella annulata annulata
Echinops setifer (ast15) 24-26 Aug. (1)

Megacampsomeris grossa matsumurai
Cirsium japonicum (ast3) 16-17 Jun. (1); Cirsium suffultum (ast16) 17-22 Sep. (1)

Formicidae

Camponotus japonicus
Quercus dentata (fag1) 11-16 May (1); Polygonum cuspidatum (pol3) 24-26 Aug. (2); Sophora flavescens (fab1) 16-17 Jun. (1); Chionographis japonica (lil6) 16-17 Jun. (1)

Formica japonica
Parnassia palustris (sax8) 14-16 Oct. (1); Swertia japonica (gen4) 14-16 Oct. (1)

Tapinoma sp.1
Arisaema japonicum (ara1) 26-29 May (1)

Myrmica sp.1
Abeila serrata (cap1) 26-29 May (1); Weigela decorca (cap6) 16-17 Jun. (1)

Pompilidae

Priocnemis cyphonota
Hydrangea paniculata (hyd3) 4-5 Aug. (1)

Eumenidae

Stenodynerus tokyanus tokyanus
Lyssimachia clethroides (pril) 10-16 Jul. (1)

Vespidae

Vespa simillima xanthoptera
Codonopsis lanceolata (cam3) 17-22 Sep. (1); Cirsium japonicum (ast3) 16-17 Jun. (1); Echinops setifer (ast15) 24-26 Aug. (1)

Vespa tropica pulchra
Cirsium japonicum (ast3) 16-17 Jun. (1)

Sphecidae

Crossecerus sp.1
Quercus dentata (fag1) 11-16 May (4)

Ammophila sabulosa nipponica
Deutzia crenata var. floribunda (sax6) 16-17 Jun. (2); Sophora flavescens (fab1) 16-17 Jun. (1); Veronica rotunda var. petiolaris (scrl) 4-5 Aug. (1); Asparagus schoberoides (lil5) 26-29 May (1)

Colletidae

Colletes perforator
Lespea bicolour (fab3) 24-26 Aug. (2)

Halictidae

Lasioglossum (Lasioglossum) sp.1
Deutzia crenata var. floribunda (sax6) 16-17 Jun. (1)

*LasioGLOSSUM (LasioGLOSSUM) sp.2
Weigela decora (cap6) 16-17 Jun. (1)

LasioGLOSSUM occidens
Ranunculus japonicus (ran1) 26-29 May (1)

LasioGLOSSUM (LasioGLOSSUM) sp.3
Cimicifuga acerina (ran2) 17-22 Sep. (2); Geranium shikokianum (ger1) 17-22 Sep. (2); Aster ageratoides ssp. leiophyllus (ast21) 17-22 Sep. (2); Aster scaber (ast19) 17-22 Sep. (1); Heteropappus hispidus (ast22) 17-22 Sep. (5); Saussurea gracilis (ast12) 17-22 Sep. (2); Saussurea yanagisawae var. nivea (ast17) 17-22 Sep. (3); Solidago virga-aurea ssp. Asiatic (ast18) 17-22 Sep. (3)

LasioGLOSSUM sibiricum
Polygonum cuspidatum (pol3) 24-26 Aug. (1); Hydrangea serrata (hyd2) 10-16 Jul. (1)

LasioGLOSSUM baleicum
Hydrangea serrata (hyd2) 10-16 Jul. (1)

LasioGLOSSUM (carinate Evytaeus) sp.1
Aleuris luteoviridis (lil9) 10-16 Jul. (1)

LasioGLOSSUM (carinate Evytaeus) sp.2
Viburnum erosum var. punctatum (cap3) 26-29 May (1); Cirsium suX7itltum (astl 6) 17-22 Sep. (1)

LasioGLOSSUM (carinate Evytaeus) sp.3
Abelia serrata (cap1) 26-29 May (1)

LasioGLOSSUM apristum
Clethra barvinervis (cle1) 4-5 Aug. (1); Hydrangea paniculata (hyd3) 4-5 Aug. (1)

LasioGLOSSUM (carinaireless Evytaeus) sp.1
Spiraea japonica (ros9) 10-16 Jul. (1); Veronica rotundata var. petiolata (scr1) 4-5 Aug. (1)

LasioGLOSSUM (carinaireless Evytaeus) sp.2
Ranunculus japonicus (ran1) 11-16 May (3), 26-29 May (1); Ixeris dentata (astl) 26-29 May (1)

LasioGLOSSUM (carinaireless Evytaeus) sp.3
Geranium shikokianum (ger1) 4-5 Aug. (1); Patrinia villosa (val2) 24-26 Aug. (1); Aster ageratoides ssp. leiophyllus (ast21) 17-22 Sep. (1)

LasioGLOSSUM (carinaireless Evytaeus) sp.4
Ranunculus japonicus (ran1) 11-16 May (1); Epimedum diphyllum (ber1) 26-29 May (1); Vicia unijuga (fab2) 16-17 Jun. (1); Polygala japonica (pol1) 11-16 May (1); Hydrocotyle ramiflora (api1) 16-17 Jun. (2); Veronica rotundata var. petiolata (scr1) 4-5 Aug. (2); Paederia scandens (rub3) 4-5 Aug. (1); Ixeris dentata (ast1) 26-29 May (1)

LasioGLOSSUM (carinaireless Evytaeus) sp.5
Dianthus superbus var. longicalyc (car3) 10-16 Jul. (2); Lysimachia clethroides (pri1) 10-16 Jul. (2); Galium verum (rub2) 10-16 Jul. (1); Cirsium japonicum (ast3) 16-17 Jun. (1)

LasioGLOSSUM (carinaireless Evytaeus) sp.6
Galium verum (rub2) 10-16 Jul. (1)

LasioGLOSSUM (carinaireless Evytaeus) sp.7
Erigeron annuus (ast5) 10-16 Jul. (1)

Lasioglossum (carinalless Evylaeus) sp.8

Dianthus superbus var. longicaule (car3) 10-16 Jul. (1)

Andrenidae

Audrena okabei sapporensis

Pieris japonica (eri1) 16-18 Apr. (1)

Andrena knuthi

Deutzia crenata (sax2) 16-17 Jun. (4); Deutzia crenata var. floribunda (sax6) 16-17 Jun. (1); Viburnum dilatatum (cap5) 16-17 Jun. (1); Ixeris dentata (ast1) 11-16 May (2)

Andrena taraxaci chikuzenensis

Deutzia crenata (sax2) 16-17 Jun. (1); Benthamidia japonica (cor2) 16-17 Jun. (1)

Andrena dentata

Clethra barwinervis (cle1) 4-5 Aug. (2); Pieris japonica (eri1) 16-18 Apr. (1); Hydrangea paniculata (hyd3) 4-5 Aug. (1)

Andrena prostomias

Deutzia crenata (sax2) 16-17 Jun. (3); Deutzia crenata var. floribunda (sax6) 16-17 Jun. (8)

Andrena mikado

Salix sieboldiana (sax3) 11-16 May (2); Pieris japonica (eri1) 16-18 Apr. (1); Rhododendron kiusuanum (eri4) 26-29 May (2); Rhododendron reticulatum (eri3) 11-16 May (4)

Andrena longitibialis

Salix sieboldiana (sax3) 11-16 May (11); Rhododendron kiusuanum (eri4) 26-29 May (2); Rhododendron reticulatum (eri3) 11-16 May (1); Hydrangea luteo-venosa (hyd1) 26-29 May (1)

Andrena watasei

Viola grypoceras (vio2) 16-18 Apr. (2); Viola orientalis (viol1) 16-18 Apr. (2); Pieris japonica (eri1) 16-18 Apr. (1); Weigela japonica (cap2) 26-29 May (1)

Andrena halictoides

Weigela japonica (cap2) 26-29 May (1)

Andrena benefica

Salix sieboldiana (sax3) 11-16 May (3)

Andrena hikosana

Deutzia crenata (sax2) 16-17 Jun. (1)

Andrena komachi

Ranunculus japonicus (man1) 11-16 May (1); Pieris japonica (eri1) 16-18 Apr. (1); Potentilla freyniana (ros1) 11-16 May (1)

Andrena kaguya

Ranunculus japonicus (man1) 11-16 May (1); Viola orientalis (viol1) 16-18 Apr. (1)

Andrena minutula

Viola orientalis (viol1) 16-18 Apr. (1); Potentilla freyniana (ros1) 16-18 Apr. (3)

Andrena sp.1
Plant-pollinator Interactions at Mt. Yufu

Gentiana zollingeri (gen5) 16-18 Apr. (1)

**Megachilidae**

Coelioxys sp.1  
*Dianthus superbus* var. *longicalyc* (car3) 10-16 Jul. (1)

Megachile tsurugensis  
*Cirsium japonicum* (ast3) 16-17 Jun. (1); *Cirsium suffultum* (ast16) 17-22 Sep. (1)

Megachile japonica  
*Cirsium japonicum* (ast3) 16-17 Jun. (1)

Megachile remota sakagamii  
*Lespedeza bicolor* (fab3) 4-5 Aug. (1)

**Anthophoridae**

Ceratina japonica  
*Ranunculus japonicus* (ran1) 11-16 May (1); *Viola grypoceras* (vio2) 16-18 Apr. (1); *Pieris japonica* (eri1) 16-18 Apr. (1); *Rhododendron kiusianum* (eri4) 26-29 May (2); *Hydrangea luteo-venosa* (hyd1) 26-29 May (1); *Rubus parvifolius* (ros8) 16-17 Jun. (1); *Lespedeza bicolor* (fab3) 24-26 Aug. (5);  
*Sophora flavescens* (fab1) 16-17 Jun. (2); *Geranium shikokianum* (ger1) 17-22 Sep. (3); *Prunella vulgaris* var. *ilacina* (lam1) 10-16 Jul. (2), 16-17 Jun. (1); *Abelia serrata* (cap1) 26-29 May (1); *Weigela japonica* (cap2) 26-29 May (1); *Aster ageratoides* ssp. *leiophyllus* (ast21) 17-22 Sep. (1); *Cirsium japonicum* (ast3) 16-17 Jun. (3); *Cirsium suffultum* (ast16) 17-22 Sep. (1)

Ceratina flavipes  
*Ranunculus japonicus* (ran1) 26-29 May (1); *Lespedeza bicolor* (fab3) 24-26 Aug. (2); *Geranium shikokianum* (ger1) 4-5 Aug. (1); *Prunella vulgaris* var. *ilacina* (lam1) 10-16 Jul. (1); *Weigela decora* (cap6) 16-17 Jun. (1); *Cirsium japonicum* (ast3) 16-17 Jun. (2); *Inula japonica* (ast14) 24-26 Aug. (1)

Ceratina megastigmata  
*Lespedeza bicolor* (fab3) 24-26 Aug. (1); *Geranium shikokianum* (ger1) 17-22 Sep. (9); *Weigela japonica* (cap2) 26-29 May (1); *Aster ageratoides* ssp. *leiophyllus* (ast21) 17-22 Sep. (3); *Aster scaber* (ast19) 17-22 Sep. (1); *Cirsium suffultum* (ast16) 17-22 Sep. (6); *Inula salicina* var. *asiatica* (ast20) 17-22 Sep. (1)

Ceratina iwatai  
*Prunella vulgaris* var. *ilacina* (lam1) 10-16 Jul. (1)

Nomada diervillae  
*Pieris japonica* (eri1) 16-18 Apr. (1)

Nomada japonica  
*Cirsium japonicum* (ast3) 16-17 Jun. (1)

Nomada asozuana  
*Rhododendron kiusianum* (eri4) 26-29 May (1)

Nomada mutsueonisi  
*Viola grypoceras* (vio2) 16-18 Apr. (1)

Nomada muinensis  
*Erigeron annuus* (ast5) 16-17 Jun. (1)

Nomada sp.1  
*Erigeron annuus* (ast5) 16-17 Jun. (1)
**Tetralonia nipponensis**
*Corydalis lineariloba* (pap1) 16-18 Apr. (1); *Viola grypoceras* (vio2) 16-18 Apr. (2); *Viola orientalis* (vio1) 16-18 Apr. (1); *Weigela decora* (cap6) 16-17 Jun. (1); *Cirsium japonicum* (ast3) 16-17 Jun. (6); *Iris rossii* (iri1) 11-16 May (1), 16-18 Apr. (6)

**Apidae**

**Bombus diversus diversus**
*Aconitum japonicum* ssp. *napiform* (ran3) 17-22 Sep. (1); *Ranunculus japonicus* (ran1) 11-16 May (1); *Potentilla freyniana* (ros1) 11-16 May (1); *Spiraea japonica* (ros9) 4-5 Aug. (1); *Lespedeza bicolor* (fab3) 17-22 Sep. (1), 24-26 Aug. (1); *Sophora flavescens* (fab1) 10-16 Jul. (1), 16-17 Jun. (7); *Vicia unijuga* (fab2) 16-17 Jun. (1); *Geranium shikokianum* (ger1) 17-22 Sep. (1); *Cirsium japonicum* (ast3) 10-16 Jul. (2), 16-17 Jun. (6); *Cirsium suffulatum* (ast16) 17-22 Sep. (2); *Ligularia japonica* (ast6) 10-16 Jul. (3); *Symurus excelsus* (ast25) 14-16 Oct. (3); *Hemerocallis vespertina* (li18) 10-16 Jul. (1), 4-5 Aug. (1)

**Bombus ardens ardens**
*Lyonia ovalifolia* var. *elliptica* (eri6) 16-17 Jun. (1); *Rhododendron kiusianum* (eri4) 16-17 Jun. (1), 26-29 May (1); *Styrax japonica* (sty1) 16-17 Jun. (10); *Deutzia crenata* (sax2) 16-17 Jun. (2); *Rubus parvifolius* (ros8) 16-17 Jun. (1); *Rubus phoenicosius* (ros6) 26-29 May (1); *Benthamidia japonica* (cor2) 16-17 Jun. (1); *Weigela decora* (cap6) 16-17 Jun. (2); *Weigela japonica* (cap2) 26-29 May (5)

**Bombus ignitus**
*Spiraea japonica* (ros9) 4-5 Aug. (1); *Lespedeza bicolor* (fab3) 17-22 Sep. (1), 24-26 Aug. (8); *Sophora flavescens* (fab1) 16-17 Jun. (1); *Adenophora triphylla* (cam1) 4-5 Aug. (1); *Weigela decora* (cap6) 16-17 Jun. (7); *Cirsium japonicum* (ast3) 16-17 Jun. (2); *Cirsium suffulatum* (ast16) 14-16 Oct. (2), 17-22 Sep. (26); *Echinops setifer* (ast15) 24-26 Aug. (5); *Ligularia japonica* (ast6) 10-16 Jul. (1); *Allium thunbergii* (li13) 17-22 Sep. (1)

**Apis cerana**
*Polygonum cuspidatum* (pol3) 24-26 Aug. (4); *Lespedeza bicolor* (fab3) 17-22 Sep. (2), 24-26 Aug. (1)

**Apis mellifera**
*Cimiciuta acerina* (ran2) 17-22 Sep. (1); *Polygonum cuspidatum* (pol3) 24-26 Aug. (3); *Hydrangea paniculata* (hyd3) 4-5 Aug. (3); *Hydrangea serrata* (hyd2) 10-16 Jul. (3); *Lespedeza bicolor* (fab3) 17-22 Sep. (9), 24-26 Aug. (4); *Isodon inflexus* (lam2) 17-22 Sep. (1); *Abelia serrata* (cap1) 26-29 May (1); *Echinops setifer* (ast15) 24-26 Aug. (3); *Saussurea yanagisawae* var. *nivea* (ast17) 17-22 Sep. (1); *Allium thunbergii* (li13) 17-22 Sep. (1); *Hemerocallis vespertina* (li18) 4-5 Aug. (1)

**MECOPTERA**

**Panorpidae**
*Geranium shikokianum* (ger1) 4-5 Aug. (1); *Angelica longeradiata* (api2) 24-26 Aug. (1)

**DIPTERA**

**Tipulidae**

sp.1
*Prunus jamasakura* (ros3) 11-16 May (1)

sp.2
*Salix sieboldiana* (sal3) 11-16 May (1)

sp.3
*Abelia serrata* (cap1) 11-16 May (1)

sp.4
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Arisaema japonicum (ara1) 26-29 May (1)

Salix sieboldiana (sal3) 11-16 May (1)

Culicidae

Polygonum filiforme (pol2) 24-26 Aug. (1)

Chironomidae

Viola grypoceras (vio2) 16-18 Apr. (1)

Ceratopagonidae

Cephalanthera falcata (orc1) 11-16 May (1)

sp.1

Salix sieboldiana (sal3) 11-16 May (1)

sp.2

Prunus jamasakura (ros3) 11-16 May (1)

sp.3

Pieris japonica (eri1) 16-18 Apr. (3)

Bibionidae

Bibio sp.1

Viola grypoceras (vio2) 16-18 Apr. (1); Salix sieboldiana (sal3) 11-16 May (3); Pieris japonica (eri1) 16-18 Apr. (3)

Bibio sp.2

Lyonia ovalifolia var. elliptica (eri6) 16-17 Jun. (2)

Bibio simulans

Salix sieboldiana (sal3) 11-16 May (1)

Bibio sp.3

Pieris japonica (eri1) 16-18 Apr. (1)

Bibio sp.4

Salix sieboldiana (sal3) 11-16 May (1)

Bibio gracilipalpus

Viola grypoceras (vio2) 16-18 Apr. (1); Salix sieboldiana (sal3) 11-16 May (28); Salix vulpina (sal1) 16-18 Apr. (1); Pieris japonica (eri1) 16-18 Apr. (2)

Bibio aneuretus

Pieris japonica (eri1) 16-18 Apr. (11)

Bibio sp.5

Prunus jamasakura (ros3) 11-16 May (1)

Cecidomyiidae

Polygono mfiliforme (pol2) 24-26 Aug. (1)
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<td>Salix sieboldiana (sal3) 11-16 May (1)</td>
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<td>Arisaema japonicum (aral) 26-29 May (1)</td>
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<td>Prunus masakura (ros3) 11-16 May (1)</td>
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<td>Salix sieboldiana (sal3) 11-16 May (1)</td>
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<td>sp.6</td>
<td>Prunus masakura (ros3) 11-16 May (1)</td>
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<td>Arisaema japonicum (aral) 26-29 May (1)</td>
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Plant-pollinator Interactions at Mt. Yufu

**Arisaema japonicum** (ara1) 26-29 May (1)

**Acroceridae**

**Philopota nigroaenea**

*Rhododendron kiusu-num (eri4) 26-29 May (4); Hydrangea iuteo-venosa (hyd1) 26-29 May (1); Deutzia crenata (sax2) 16-17 Jun. (2); Deutzia crenata var. floribunda (sax6) 16-17 Jun. (1); Abelia serrata (cap1) 11-16 May (1), 26-29 May (7); Weigela japonica (cap2) 26-29 May (2)

**Bombyliidae**

**Bombylus major**

*Viola grypoceras (vio2) 16-18 Apr. (4); Viola hondoensis (vio3) 16-18 Apr. (1); Rhododendron kiusu-num (eri4) 26-29 May (2); Rhododendron reticulatum (eri3) 11-16 May (3)

**Asilidae**

**Neaitamus angusticornis**

*Hydrangea iuteo-venosa (hyd1) 26-29 May (2)

**Empididae**

sp.1

*Deutzia crenata (sax2) 16-17 Jun. (2); Schizophragma hydrangeoides (sax7) 16-17 Jun. (1)

sp.2

*Potentilla freyniana (ros1) 11-16 May (1)

sp.3

*Viola grypoceras (vio2) 16-18 Apr. (1)

sp.4

*Viburnum dilatatum (cap5) 16-17 Jun. (1)

sp.5

*Prunus jamasakura (ros3) 11-16 May (1)

sp.6

*Viburnum dilatatum (cap5) 16-17 Jun. (1)

sp.7

*Arisaema japonicum* (ara1) 26-29 May (1)

sp.8

*Salix sieboldiana (sal3) 11-16 May (1)

sp.9

*Abelia serrata (cap1) 11-16 May (1)

**Euthyneura sp.1**

*Ranunculus japonicus (ran1) 11-16 May (1); Prunus jamasakura (ros3) 11-16 May (1); Abelia serrata (cap1) 11-16 May (1)

sp.10

*Abelia serrata (cap1) 11-16 May (1)

**Pipunculidae**

**Pipunculus sp.1**

*Staphylea buma1da (sta1) 11-16 May (1)
Syrphidae

Eristalis tenax

*Ranunculus japonicus* (ran1) 26-29 May (1); *Polygonum cuspidatum* (pol3) 24-26 Aug. (1); *Rhododendron kiusianum* (eri4) 26-29 May (1); *Spiraea japonica* (ros9) 4-5 Aug. (1); *Benthamidia japonica* (cor2) 16-17 Jun. (1); *Viburnum dilatatum* (cap5) 16-17 Jun. (1); *Viburnum erosum var. punctatum* (cap3) 26-29 May (1); *Valeriana flauriei* (val1) 16-17 Jun. (2), 26-29 May (2); *Anaphalis margaritacea var. angus* (ast13) 24-26 Aug. (1); *Cirsium japonicum* (ast3) 16-17 Jun. (5); *Ixeris dentata* (ast1) 26-29 May (1); *Ligularia fischerii var. takeyuki* (ast8) 10-16 Jul. (2), 4-5 Aug. (1); *Ligularia japonica* (ast6) 10-16 Jul. (2); *Saussurea gracilis* (ast12) 24-26 Aug. (1); *Hemerocallis vespertina* (lil8) 4-5 Aug. (2)

*Dideaides coquilletti*

*Weigela japonica* (cap2) 26-29 May (1)

*Volucella jeddona*

*Cirsium japonicum* (ast3) 16-17 Jun. (1)

*Syrphus torvus*

*Quercus dentata* (fag1) 11-16 May (2)

*Epistrophne aino*

*Benthamidia japonica* (cor2) 16-17 Jun. (2)

*Syrphus vitripennis*

*Salix sieboldiana* (sal3) 11-16 May (1)

*Eristalis cerealis*

*Castanea crenata* (fag2) 16-17 Jun. (1); *Polygonum cuspidatum* (pol3) 24-26 Aug. (1); *Deutzia crenata var. floribunda* (sax6) 10-16 Jul. (3); *Benthamidia japonica* (cor2) 16-17 Jun. (1); *Cirsium japonicum* (ast3) 16-17 Jun. (1); *Heteropappus hispidus* (ast22) 17-22 Sep. (1)

*Helophitus virgatus*

*Pieris japonica* (eri1) 16-18 Apr. (1); *Deutzia crenata* (sax2) 16-17 Jun. (1); *Deutzia crenata var. floribunda* (sax6) 10-16 Jul. (1); *Abelia serrata* (cap1) 26-29 May (1); *Viburnum erosum var. punctatum* (cap3) 26-29 May (1)

*Epipyrhus balteatus*

*Allium thunbergii* (lil13) 17-22 Sep. (2)

*Baccha maculata*

*Astilbe thunbergii* (sax5) 10-16 Jul. (1)

*Allobaccha apicalis*

*Weigela japonica* (cap2) 26-29 May (1)

*Betasyrphus serarius*

*Deutzia crenata* (sax2) 16-17 Jun. (1); *Prunella vulgaris var. lilacina* (lam1) 10-16 Jul. (3); *Viburnum erosum var. punctatum* (cap3) 26-29 May (1); *Cirsium japonicum* (ast3) 16-17 Jun. (1); *Eupatorium chinense* (ast9) 4-5 Aug. (1)

*Scaeva komabensis*

*Lespedeza bicolor* (fab3) 24-26 Aug. (1); *Allium thunbergii* (lil13) 17-22 Sep. (1)

*Cheilostia sp.5*

*Potentilla freyniana* (ros1) 16-18 Apr. (1)
Melangyna sp.1
_Potentilla freyniana_ (ros1) 16-18 Apr. (1)

**Melisoea cinctella**
_Galium japonicum_ (rub1) 11-16 May (1)

_Sphaerophoria macrogaster_
_Dianthus superbus_ var. _longicalyx_ (car3) 10-16 Jul. (1); _Veronica rotunda_ var. _petiolata_ (scr1) 4-5 Aug. (1); _Ixeris dentata_ (ast1) 11-16 May (3), 26-29 May (2); _Chionographis japonica_ (ll6) 16-17 Jun. (3), 26-29 May (1)

**Paragus quadrifasciatus**
_Hydrocotyle ramiflora_ (api1) 16-17 Jun. (1); _Galium verum_ (rub2) 10-16 Jul. (2)

_Melanastoma scalaris_
_Ranunculus japonicus_ (ran1) 11-16 May (1); _Moehringia lateriflora_ (car2) 26-29 May (2); _Hydrangea luteo-venosa_ (hyd1) 26-29 May (1); _Prunus jamasakura_ (ros3) 11-16 May (1); _Prunella vulgaris_ var. _filicina_ (lam1) 10-16 Jul. (1); _Ixeris dentata_ (ast1) 26-29 May (1)

**Paragus jozanus**
_Deutzia crenata_ var. _floribunda_ (sax6) 10-16 Jul. (1); _Parnassia palastris_ (sax8) 14-16 Oct. (1); _Hydrocotyle ramiflora_ (api1) 16-17 Jun. (1)

_Cheilosia sp.1_
_Ranunculus japonicus_ (ran1) 11-16 May (1); _Potentilla freyniana_ (ros1) 11-16 May (1)

_Cheilosia sp.2_
_Deutzia crenata_ (sax2) 16-17 Jun. (1)

_Cheilosia sp.3_
_Astilbe thunbergii_ (sax5) 10-16 Jul. (1); _Deutzia crenata_ (sax2) 16-17 Jun. (1)

_Sphaerophoria philanthus_
_Pseudostellaria heterantha_ (car1) 11-16 May (1); _Polygonum cuspidatum_ (pol3) 24-26 Aug. (1); _Arabis glabra_ (bral) 16-17 Jun. (1); _Rhododendron kiusianum_ (eri4) 26-29 May (1); _Lysimachia clethroides_ (pri1) 10-16 Jul. (1); _Hydrangea luteo-venosa_ (hyd1) 26-29 May (1); _Astilbe thunbergii_ (sax5) 10-16 Jul. (1); _Deutzia crenata_ (sax2) 16-17 Jun. (1); _Sophora flavescens_ (fab1) 16-17 Jun. (1); _Vicia unijuga_ (fab2) 16-17 Jun. (1); _Angelica cartilagino-marginata_ (api3) 24-26 Aug. (1); _Veronica rotunda_ var. _petiolata_ (scr1) 4-5 Aug. (1); _Cirsium japonicum_ (ast3) 16-17 Jun. (3); _Erigeron annuus_ (ast5) 16-17 Jun. (1); _Ixeris dentata_ (ast1) 11-16 May (1), 26-29 May (4); _Senecio pierotii_ (ast2) 26-29 May (1)

**Paragus haemorrhous**
_Heteropappus hispidus_ (ast22) 17-22 Sep. (1)

_Platycheirus clypeatus_
_Rhododendron kiusianum_ (eri4) 26-29 May (1); _Ixeris dentata_ (ast1) 26-29 May (1)

_Eumerus sp.1_
_Hydrangea luteo-venosa_ (hyd1) 26-29 May (1)

_Altobaccha sp.1_
_Deutzia crenata_ (sax2) 16-17 Jun. (1)

_Cheilosia sp.4_
_Viola orientalis_ (vio1) 11-16 May (1)
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<td>Conopidae</td>
<td>Zodion sp.1</td>
<td>Deutzia crenata (sax2)</td>
<td>16-17 Jun. (1)</td>
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<tr>
<td>Tephritidae</td>
<td>Urophora sachalinensis</td>
<td>Erigeron annuus (ast5)</td>
<td>16-17 Jun. (1)</td>
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<td></td>
<td>Erigeron philadelphicus (ast4)</td>
<td>16-17 Jun. (1)</td>
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<tr>
<td>Sepsidae</td>
<td>Sepsis sp.1</td>
<td>Rubus parvifolius (ros8)</td>
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<td>Lauxaniidae</td>
<td>Homoneura sp.1</td>
<td>Salix sieboldiana (sal3)</td>
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<td>Weigela decora (cap6)</td>
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<td>Agromyzidae</td>
<td>Liriomyza sp.1</td>
<td>Lyonia ovalifolia var. elliptica (eri6)</td>
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<tr>
<td>Chloropidae</td>
<td>sp.1</td>
<td>Salix sieboldiana (sal3)</td>
<td>11-16 May (1)</td>
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<td>sp.2</td>
<td>Prunus jamasakura (ros3)</td>
<td>11-16 May (1)</td>
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<td>Drosophila sp.1</td>
<td>Polygonum filiforme (pol2)</td>
<td>24-26 Aug. (1)</td>
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<td>Lindera sericea (lau1)</td>
<td>16-18 Apr. (1)</td>
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<td>Sphaeroceridae</td>
<td>Copromyza sp.1</td>
<td>Pieris japonica (eri1)</td>
<td>16-18 Apr. (1)</td>
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<td>Anthomyiidae</td>
<td>Lasiomma sp.1</td>
<td>Salix vulpina (sal1)</td>
<td>16-18 Apr. (23)</td>
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<td></td>
<td>Hydorphoria sp.1</td>
<td>Salix vulpina (sal1)</td>
<td>16-18 Apr. (5)</td>
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**Plant-pollinator Interactions at Mt. Yufu**

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<th>Date Range</th>
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<td><em>Prunus jamasakura</em> (ros3)</td>
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<td><em>Delia sp.</em></td>
<td><em>Salix sieboldiana</em> (sal3)</td>
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<td><em>Hydrangea serrata</em> (hyd2)</td>
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<td><em>Deutzia crenata var. floribunda</em> (sax6)</td>
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<td><em>Delia sp.</em></td>
<td><em>Salix sieboldiana</em> (sal3)</td>
<td>11-16 May (1)</td>
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<td><em>Pieris japonica</em> (eri1)</td>
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<tr>
<td><em>Delia sp.</em></td>
<td><em>Cephalanthera falcata</em> (orc1)</td>
<td>11-16 May (1)</td>
</tr>
<tr>
<td><em>Rhododendron kiusuanum</em> (eri4)</td>
<td>16-17 Jun. (1)</td>
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</tbody>
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### Muscidae

*Anaphalis margaritacea var. angus* (ast13) 24-26 Aug. (1)

### Calliphoridae

*Polygonum cuspidatum* (pol3) 24-26 Aug. (18); *Clethra barwinervis* (cle1) 4-5 Aug. (3); *Hydrangea paniculata* (hyd3) 4-5 Aug. (1); *Astillbe thunbergii* (sax5) 10-16 Jul. (2); *Deutzia crenata* (sax2) 16-17 Jun. (1); *Patrinia scabiosaefolia* (sax6) 10-16 Jul. (3); *Hypericum pseudopetiolatum* (clu1) 17-22 Sep. (1)

*Quercus dentata* (fagl) 11-16 May (1); *Polygonum cuspidatum* (pol3) 24-26 Aug. (3)

### Aldrichina grahemi

*Benthamidia japonica* (cor2) 16-17 Jun. (2)

### Eurychaeta sp.

*Sanguisorba officinalis* (ros11) 17-22 Sep. (1)

*Hydrangea luteo-venosa* (hyd1) 26-29 May (1)

### Sarcophagidae

*Linnaenya sp.*

*Chionographis japonica* (lil6) 16-17 Jun. (1)

### Tachinidae

*Viola grypoceras* (vio2) 16-18 Apr. (1)
Sisyropa sp.1
Deutzia crenata var. floribunda (sax6) 10-16 Jul. (1)

Meigenia sp.1
Veratrum maackii var. maackii (lil10) 4-5 Aug. (1)

Meigenia sp.2
Clethra barvinervis (cle1) 4-5 Aug. (1)

Phebetlia sp.1
Benthamidia japonica (cor2) 16-17 Jun. (1)

Eumea sp.1
Veratrum maackii var. maackii (lil10) 4-5 Aug. (1)

Eumea sp.2
Veratrum maackii var. maackii (lil10) 4-5 Aug. (1)

Prosena siberita
Geranium shikokianum (ger1) 24-26 Aug. (1)

Prosena sp.1
Lespedeza bicolor (fab3) 24-26 Aug. (2); Cirsium suffutum (ast16) 17-22 Sep. (2); Echinops setifer (ast15) 24-26 Aug. (1)

Peribaea sp.1
Lysimachia clethroides (pri1) 10-16 Jul. (1); Astilbe thunbergii (sax5) 10-16 Jul. (2); Deutzia crenata (sax2) 16-17 Jun. (1); Viburnum dilatatum (cap5) 16-17 Jun. (1); Valeriana fauriei (val1) 16-17 Jun. (1); Erigeron annuus (ast5) 16-17 Jun. (1); Ixeris dentata (ast1) 11-16 May (1); Ligularia japonica (ast6) 10-16 Jul. (1)

Siphona sp.1
Castanea crenata (fag2) 16-17 Jun. (1); Lysimachia clethroides (pri1) 10-16 Jul. (3); Astilbe thunbergii (sax5) 10-16 Jul. (2)

Fischeria sp.1
Astilbe thunbergii (sax5) 10-16 Jul. (1)

**LEPIDOPTERA**

Incurvariidae

Nemophora umbripennis
Deutzia crenata (sax2) 16-17 Jun. (1)

Tortricidae

sp.1
Salix sieboldiana (sal3) 11-16 May (1)

sp.2
Benthamidia japonica (cor2) 16-17 Jun. (1)

Zygaenidae

Balataea gracilis
Erigeron annuus (ast5) 16-17 Jun. (1)
Plant-pollinator Interactions at Mt. Yufu

Thyrididae

Scirpophaga sp.1
Viola orientalis (viol) 16-18 Apr. (1)

Hesperiidae

Thoressa varia
Cirsium japonicum (ast3) 16-17 Jun. (1)

Polytremis pellucida pellucida
Lysimachia clethroides (pri1) 10-16 Jul. (1); Ligularia japonica (ast6) 10-16 Jul. (1)

Parnara guttata guttata
Cirsium japonicum (ast3) 10-16 Jul. (2); Cirsium suffutum (ast16) 17-22 Sep. (1); Echinops setifer (ast15) 24-26 Aug. (1); Ligularia japonica (ast6) 24-26 Aug. (1); Hemerocallis vespertina (li18) 4-5 Aug. (1)

Ochloides ochraceus
Astitbe thunbergii (sax5) 10-16 Jun. (1); Prunella vulgaris var. lilacina (lam1) 10-16 Jul. (13); Cirsium japonicum (ast3) 10-16 Jul. (1)

Papilionidae

Papilio machaon hippocrates
Cirsium suffutum (ast16) 17-22 Sep. (1); Echinops setifer (ast15) 24-26 Aug. (1); Inula japonica (ast4) 24-26 Aug. (1); Lilium leichtlinii var. maximowic (lil12) 24-26 Aug. (1)

Papilio bianor dehaanii
Ligularia japonica (ast6) 10-16 Jul. (4)

Pieridae

Pieris melete melete
Deutzia crenata (sax2) 16-17 Jun. (1); Cirsium japonicum (ast3) 10-16 Jul. (1), 16-17 Jun. (2)

Lycaenidae

Maculinea teleius kazamoto
Adenophora tripbylla (cam1) 4-5 Aug. (2)

Lycaena phlaeas daimio
Lysimachia clethroides (pri1) 10-16 Jul. (4); Ligularia japonica (ast6) 10-16 Jul. (1)

Nymphalidae

Fabriciana adippe pallescens
Lysimachia clethroides (pri1) 10-16 Jul. (2); Spiraea japonica (ros9) 10-16 Jul. (1); Prunella vulgaris var. lilacina (lam1) 10-16 Jul. (1); Cirsium japonicum (ast3) 10-16 Jul. (3), 16-17 Jun. (3); Ligularia fischerii var. takeyuki (ast8) 10-16 Jul. (5)

Fabriciana nerippe
Lysimachia clethroides (pri1) 10-16 Jul. (1)

Vanessa indica
Cirsium suffutum (ast16) 17-22 Sep. (1)

Neptis sappho intermedia
Sophora flavescens (fab1) 16-17 Jun. (1)

Argyronome ruslana lysippe
Ligularia japonica (ast6) 10-16 Jul. (1)
Neope niphonica niphonica
  Quercus dentata (fag1) 11-16 May (1)

Minois dryas bipunctata
  Adenophora triphylla (cam1) 4-5 Aug. (1)

Sphingidae

Ampelophaga rubiginosa
  Hemerocallis vespertina (lii8) 4-5 Aug. (1)

Macroglossum bombylaus
  Ligularia japonica (ast6) 10-16 Jul. (1)

Macroglossum stellatarum
  Cirsium japonicum (ast3) 16-17 Jun. (1)

Macroglossum sp.1
  Cirsium suffutum (ast16) 17-22 Sep. (1)

Lymantriidae

Ivela auripes
  Benthamidia japonica (cor2) 16-17 Jun. (1)

Plate 4. Landscapes and flowers in April at Mt. Yufu
A, Mt Yufu viewed from the base, showing an extensive semi-natural grassland at the foot and a
hillside natural grassland halfway up the mountain (left side); B, field survey at the natural
grassland; C, a traditionally managed grassland after burning in March, with many Viola orientalis
flowers blooming; D, an Iris rossii flower; E, Viola orientalis flowers visited by oedemerid beetles;
F, a Viola orientalis flower visited by a syrphid fly.

Plate 5. Grasslands and flowers in August at Mt Yufu
A, a hillside grassland dominated by Miscanthus sinensis; B, a semi-natural grassland blooming
with Hemerocallis vespertina; C, Ligularia fischerii var. takeuki flowers visited by a nymphalid
butterfly, Fabriciana adippe pallescens; D, a Sophora flavescens plant in a semi-natural grassland;
E, Echinops septifer stands against the background of Mt. Yufu; F, G, Echinops septifer flowers
respectively visited by a Bombus ignitus worker and a scoliid wasp, Campsomeriella annulata
annulata.