Flowering Phenology and Anthophilous Insect Community in a Grassland Ecosystem at Mt. Yufu, Western Japan

YAMAZAKI, Kyoko; KATO, Makoto

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Flowering Phenology and Anthophilous Insect Community
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Kyoko YAMAZAKI and Makoto KATO
Graduate School of Human and Environmental Studies, Kyoto University,
Yoshida-Nihonmatsu-cho, Sakyo-ku, Kyoto, 606-8501 Japan

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 myphily (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).

Fig. 1. The location of Mt. Yufu in Kyusyu district in Japan (left) and a topographical map of the study area (right). The sampling route is shown by a solid line. Grasslands are shown by pale areas.

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>
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<th>Code</th>
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<th>No. of flowering plant species</th>
<th>No. of collected insects</th>
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<td>14-16 Oct. 2001</td>
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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 phoenicosaurus, 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. corniculatus 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 asclepiadea] 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].
Table 2. A list of plants studied for phenology and flower-visitors, with blooming month (MB), growth habitat (GH), nativity (N), breeding system (BS), flower color (FC), flower symmetry (FS), flower morphology (FM), rank in Red Data Book (RD), the number of observed insects on flowers (NV), cluster detected by analysis on flower visitor spectra (CL), and pollination agent determined (PA).

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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).

![Graphs showing seasonal changes in the number of flowering plant species at Mt. Yufu.](image)

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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<tr>
<th>Order</th>
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<th>Larval feeding habit*</th>
<th>Adult feeding habit*</th>
<th>Species</th>
<th>Individual</th>
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<td>4</td>
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<td>-</td>
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</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
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>
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<td>Colletes</td>
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<td>2</td>
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<td>Halictinae</td>
<td>Lasio glossum</td>
<td>s</td>
<td>underground</td>
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<td>15</td>
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<td>4</td>
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<td>18</td>
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<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>
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</table>

Total: 54 species, 375 individuals

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

Nine eusocial bee species were found: *Lasio glossum apristum*, *L. sibiriacum*, *L. baleicum* (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\%), and Tipulidae (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.

![Graph showing seasonal changes in insect numbers](image)

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.

Fig. 6. Seasonal changes in the number of bee genera observed on flowers at each sampling data.
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.

![Graphs 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 components (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 (C1) 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 suffluitum* (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.
diversus (2.6%). 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., 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, 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: Hamakoshimizu (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. (Matsuura et al., 1972), Kochi (Ikudome, 1978), Shiroyanma 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 Shiroyanma.
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.

![Diagram showing 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).]

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


Plant-pollinator interactions at Mt. Yufu

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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 parallem* (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);

*Drusophila* 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 occidentis* (Hal: Hy) 26-29 May (1); *Lasioglossum* (carinaless *Evylaeus*) sp.2 (Hal: Hy) 11-16 May (3), 26-29 May (1); *Lasioglossum* (carinaless *Evylaeus*) 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 *Evylaeus*) 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); *Cteniopus 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

Mordellistena sp. 1 (Mor: Co) 10-16 Jul. (1); Lasioglossum (carinaless Evylaeus) sp.5 (Hal: Hy) 10-16 Jul. (2); Lasioglossum (carinaless Evylaeus) 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)

Moehringia lateriflora

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

Pseudostellaria heterantha

Oedemeronia lucidicollis (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 sibiriacum (Hal: Hy) 24-26 Aug. (1); Apis cerana (Api: Hy) 24-26 Aug. (4); Apis mellifera (Api: Hy) 24-26 Aug. (3); sp.1 (Cul: Di) 24-26 Aug. (1); sp.1 (Cec: Di) 24-26 Aug. (1); Eristalis tenax (Syr: Di) 24-26 Aug. (1); Eristalis 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 obsoleta (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 grypocreras

Euosphalerium parallelym (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 mutsensis (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); Bombylus 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

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

Viola orientalis

Oedemeronia lucidicollis (Oed: Co) 16-18 Apr. (4); Chrysomela vigintipunctata (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); Tetralonia nipponensis (Ant: Hy) 16-18 Apr. (1); Cheilosia sp.4 (Syr: Di) 11-16 May (1); Platycerthus urakawensis (Syr: Di) 16-18 Apr. (1); Scirpophaga sp.1 (Thy: Le) 16-18 Apr. (1)

Salicaceae

Salix sieboldiana

Athousius sp.1 (Elu: Co) 11-16 May (1); Themis midas (Can: Co) 11-16 May (1); Mikadosanthis japonica (Can: Co) 11-16 May (1); Anthemus magnus (Can: Co) 11-16 May (1); Podabrus malthinoides (Can: Co) 11-16 May (1); Oedemeronia lucidicollis (Oed: Co) 11-16 May (1); Dinoptera minuta (Cer: Co) 11-16 May (1); Tenthredo fusakii (Ten: Hy) 11-16 May (1); Rhogogaster varipes (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);
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sp.4 (Bra: Hy) 11-16 May (1); sp.5 (Bra: Hy) 11-16 May (1); sp.6 (Bra: Hy) 11-16 May (1); sp.9 (Bra: Hy) 11-16 May (2); sp.10 (Bra: Hy) 11-16 May (1); Ichneumon sp.2 (Ich: Hy) 11-16 May (1); sp.3 (Ich: Hy) 11-16 May (1); sp.4 (Ich: Hy) 11-16 May (1); sp.6 (Ich: Hy) 11-16 May (1); sp.1 (Per: Hy) 11-16 May (1); sp.1 (Per: Hy) 11-16 May (1); Andrena mikado (And: Hy) 11-16 May (2); Andrena longitibiaalis (And: Hy) 11-16 May (1); Andrena benedica (And: Hy) 11-16 May (3); sp.2 (Tip: Di) 11-16 May (1); sp.5 (Tip: Di) 11-16 May (1); sp.2 (Cer: Di) 11-16 May (1); Bibio sp.1 (Bib: Di) 11-16 May (3); Bibio simulans (Bib: Di) 11-16 May (1); Bibio sp.4 (Bib: Di) 11-16 May (1); Bibio gracilipalpus (Bib: Di) 11-16 May (28); sp.2 (Myco: Di) 11-16 May (1); sp.5 (Myco: Di) 11-16 May (1); sp.8 (Emp: Di) 11-16 May (1); Syrphus vitripennis (Syr: Di) 11-16 May (1); Homoneura sp. (Lau: Di) 11-16 May (2); sp.1 (Chl: Di) 11-16 May (1); Hylomyia sp.1 (Ant: Di) 11-16 May (2); Delta sp.1 (Ant: Di) 11-16 May (1); Delta sp.2 (Ant: Di) 11-16 May (1); sp.1 (Tor: Le) 11-16 May (1)

Salix vulpina

Eusphalerum 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); Lasionomma sp.1 (Ant: Di) 16-18 Apr. (23); Hydrophoria sp.1 (Ant: Di) 16-18 Apr. (5)

Brassicaceae

Arabis glabra

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

Clethraceae

Clethra barvinervis

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

Eusphalerum parallelym (Sta: Co) 16-18 Apr. (27); Eucetonida pilifera (Sca: Co) 16-18 Apr. (1); Podabris malthinoides (Can: Co) 16-18 Apr. (1); Meligethes sp.1 (Nit: Co) 16-18 Apr. (2); sp.1 (Cry: Co) 16-18 Apr. (1); Byturus sp.1 (Byt: Co) 16-18 Apr. (1); Vibidia dudoeicunguttata (Coc: Co) 16-18 Apr. (1); Nonarthra cyanae (Chr: Co) 16-18 Apr. (3); Himatium sp.1 (Curt: Co) 16-18 Apr. (1); Andrena okabei sapporenis (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 dierviltae (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 anuuretus (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); Copromyza sp.1 (Sph: Di) 16-18 Apr. (1); Delta sp.3 (Ant: Di) 16-18 Apr. (1)

Rhododendron kiusuamum

Pidonia pipizoi (Cer: Co) 26-29 May (1); Andrena mikado (And: Hy) 26-29 May (2); Andrena longitibiaalis (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); sp.4 (Cer: 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 pisizoi (Cer: Co) 11-16 May (1); sp.1 (Ich: Hy) 11-16 May (1); Andrena mikado (And: Hy) 11-
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* *(Scz: Co) 10-16 Jul. (1); *Mordellistena* sp.1 *(Mor: Co) 10-16 Jul. (2); *Hippuriphipha* sp.1 *(Chz: Co) 10-16 Jul. (1); sp.5 *(Ich: Hy) 10-16 Jul. (1); *Slenodynerus* tokyaonos *tokyayuno* *(Eum: Hy) 10-16 Jul. (1); *Lasioiglossum* (carinaless *Erythaeus*) sp.5 *(Hal: Hy) 10-16 Jul. (2); *Sphaerophoria philantus* *(Syr: Di) 10-16 Jul. (1); *Campiglossa* *hirayamae* *(Tep: Di) 10-16 Jul. (1); *Peribaeas* sp.1 *(Tac: Di) 10-16 Jul. (1); *Siphoza* sp.1 *(Tac: Di) 10-16 Jul. (3); *Polytreneis* *pellucida* *pellucida* *(Hes: Le) 10-16 Jul. (1); *Lycen* *phlaeas* *daimio* *(Lyc: Le) 10-16 Jul. (4); *Fabriciana* *adippe pallecens* *(Nym: Le) 10-16 Jul. (2); *Fabriciana* *nerippe* *(Nym: Le) 10-16 Jul. (1)

Hydrangeaceae

*Hydrangea lateo-venosa*

*Andrena* *longitibialis* *(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* *scatare* *(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 paniculata*

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

*Hydrangea serrata*

*Lasiglossum* *sibiriacum* *(Hal: Hy) 10-16 Jul. (1); *Lasiglossum* *baleicum* *(Hal: Hy) 10-16 Jul. (1); *Apis mellifera* *(Api: Hy) 10-16 Jul. (3); *Dela* sp.1 *(Ant: Di) 10-16 Jul. (1)

Saxifragaceae

*Astilbe thumbergii*

*Baris dispitota* *(Cur: Co) 10-16 Jul. (8); *Baccha maculata* *(Syr: Di) 10-16 Jul. (1); *Cheilosia* sp.3 *(Syr: Di) 10-16 Jul. (1); *Sphaerophoria* *philanthus* *(Syr: Di) 10-16 Jul. (1); *Stomorhina* *osbeta* *(Cal: Di) 10-16 Jul. (2); *Peribaeas* sp.1 *(Tac: Di) 10-16 Jul. (2); *Siphoza* sp.1 *(Tac: Di) 10-16 Jul. (2); *Fischeria* sp.1 *(Tac: Di) 10-16 Jul. (1); *Oechloes* *ochraceus* *(Hes: Le) 10-16 Jul. (1)

Deutzia crenata

*Hoplia moerens* *(Scc: 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 *(Scr: Co) 16-17 Jun. (1); *Esosoma* *flaviventre* *(Chr: Co) 16-17 Jun. (1); *Andrena* *knuthi* *(And: Hy) 16-17 Jun. (4); *Andrena* *taraxaci* *chikuzenensis* *(And: Hy) 16-17 Jun. (1); *Andrena* *prostomias* *(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 *(Emp: Di) 16-17 Jun. (2); *Helophillus* *virgatus* *(Syr: Di) 16-17 Jun. (1); *Betasyrphus* *serarius* *(Syr: Di) 16-17 Jun. (1); *Cheilosia* sp.2 *(Syr: Di) 16-17 Jun. (1); *Cheilosia* sp.3 *(Syr: Di) 16-17 Jun. (1); *Sphaerophoria* *philanthus* *(Syr: Di) 16-17 Jun. (1); *Allobaccha* sp.1 *(Syr: Di) 16-17 Jun. (1); *Zodia* *var. Di) 16-17 Jun. (1); *Stomorhina* *osbeta* *(Cal: Di) 16-17 Jun. (1); *Peribaeas* 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*

*Esosoma* *flaviventre* *(Chr: Co) 16-17 Jun. (1); *Prochneumon* sp.1 *(Ich: Hy) 10-16 Jul. (1); *Hoplismen* sp.1 *(Ich: Hy) 10-16 Jul. (1); *Ammophila* *sabulosa* *nipponica* *(Sph: Hy) 16-17 Jun. (2); *Lasiglossum* sp.1 *(Hal: Hy) 16-17 Jun. (1); *Andrena* *knuthi* *(And: Hy) 16-17 Jun. (1); *Andrena* *prostomias* *(And: Hy) 16-17 Jun. (8); *Philopota* *nigroaenea* *(Acr: Di) 16-17 Jun. (1); *Eristalis* *cerealis* *(Syr: Di) 10-16 Jul. (3);
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### Helophitus virgatus
- (Syr: Di) 10-16 Jul. (1)
- (Paragus japonicus) 10-16 Jul. (1)
- Delia sp.1 (Ant: Di) 10-16 Jul. (8)
- Stomorhina obsoleta (Cal: Di) 10-16 Jul. (3)
- Sisyropa sp.1 (Tac: 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 japonicus (Syr: Di) 14-16 Oct. (1)

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

### Rosaceae

#### Potentilla freyniana
- Oedemeronia lucidicollis (Oed: Co) 16-18 Apr. (3)
- Andrena komachi (And: Hy) 11-16 May (1)
- Andrena minuata (And: Hy) 16-18 Apr. (3)
- Bombus diversus diversus (Api: Hy) 11-16 May (1)
- sp.2 (Emp: Di) 11-16 May (1)
- Cheiliosp.5 (Syr: Di) 16-18 Apr. (1)
- Melangyna sp.1 (Syr: Di) 16-18 Apr. (1)
- Parnassia patustris
- Oedemeronia tucidicottis (Oed: Co) 16-18 Apr. (3)
- Andrena komachi (And: Hy) 11-16 May (1)
- Andrena minututa (And: Hy) 16-18 Apr. (3)
- Bombus diversus diversus (Api: Hy) 11-16 May (1)
- sp.2 (Emp: Di) 11-16 May (1)
- Cheiliosp.5 (Syr: Di) 16-18 Apr. (1)
- Metangyna sp.1 (Syr: Di) 16-18 Apr. (1)
- Cheiliosp.1 (Syr: Di) 11-16 May (1)
- Platycheirus urakawensis (Syr: Di) 11-16 May (1)

#### Prunus japonica
- Euphraterum paralalelym (Sta: Co) 11-16 May (2)
- Dalopius tamui (Ela: Co) 11-16 May (1)
- Mikadoantharis japonica (Can: Co) 11-16 May (3)
- Antheus magnus (Can: Co) 11-16 May (1)
- Meligethes sp.1 (Nit: Co) 11-16 May (1)
- Epuraea bergeri (Nit: Co) 11-16 May (1)
- Byturus sp.2 (Byt: Co) 11-16 May (1)
- Manobidia nipponica (Chr: Co) 11-16 May (3)
- Pachyprostas sp.1 (Ten: Hy) 11-16 May (1)
- sp.2 (Ich: Hy) 11-16 May (1)
- sp.1 (Tis: 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)
- Euthynesia sp.1 (Emp: Di) 11-16 May (1)
- Melanastoma scalare (Syr: Di) 11-16 May (1)
- sp.2 (Chl: Di) 11-16 May (1)
- Hylmyia sp.1 (Ant: Di) 11-16 May (2)

#### Rubus 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)

#### Rubus phoenicolasius
- Bombus ardens ardens (Api: Hy) 26-29 May (1)

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

#### Spiraea japonica
- Anechura japonica (For: De) 10-16 Jul. (1)
- Lasioglossum (Lasioglossum) 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

#### Lespedeza bicolor
- Colletes perforator (Col: Hy) 24-26 Aug. (2)
- Megachile remota sakagamii (Meg: Hy) 4-5 Aug. (1)
- Ceratina japonica (Ant: Hy) 24-26 Aug. (5)
- Ceratina flavipes (Ant: Hy) 24-26 Aug. (2)
- Ceratina megastigmata (Ant: Hy) 24-26 Aug. (1)
- Bombus diversus diversus (Api: Hy) 17-22 Sep. (1)
- Bombus ignitus (Api: Hy) 17-22 Sep. (1)
- Apis cerana (Api: Hy) 17-22 Sep. (2)
- Apis mellifera (Api: Hy) 17-22 Sep. (9)
- Scaeva komabensis (Syr: Di) 24-26 Aug. (1)
- Prosena sp.1 (Tac: Di) 24-26 Aug. (2)

#### Sophora flavescens
- Trypherus niponicus (Can: Co) 16-17 Jun. (2)
- Canpomorus prismaticus (Sco: Co) 16-17 Jun. (1)
- Ammophila sabulosa nipponica (Sph: Hy) 16-17 Jun.
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(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 Evytaeus) 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); Prothenus ciusianus (Can: Co) 16-17 Jun. (1); Andrena taraxaci chikuzenensis (And: Hy) 16-17 Jun. (1); Bombus ardens ardens (Api: Hy) 16-17 Jun. (1); Eristalis tenax (Syr: Di) 16-17 Jun. (1); Epistrophe aino (Syr: Di) 16-17 Jun. (2); Eristalis 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 (Tac: 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 Evytaeus) 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 Evytaeus) 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 (Tac: Di) 24-26 Aug. (1)

Apiaceae

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

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

Hydrocotyle ramiflora
Lasioglossum (carinaless Evytaeus) 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
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Serphulariaceae

Veronica rotunda var. petiolata
Annemphila sabulosa nipponica (Sph: Hy) 4-5 Aug. (1); Lasioglossum (carinaless Evylaeus) sp.1 (Hal: Hy) 4-5 Aug. (1); Lasioglossum (carinaless Evylaeus) sp.4 (Hal: Hy) 4-5 Aug. (2); Sphaerophoria macrogaster (Syr: Di) 4-5 Aug. (1); Sphaerophoria phlanthus (Syr: Di) 4-5 Aug. (1)

Campanulaceae

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

Codonopsis lanceolata

Rubiaceae

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

Galium verum
Metellerista sp.1 (Mor: Co) 10-16 Jul. (1); Lasioglossum (carinaless Evylaeus) sp.5 (Hal: Hy) 10-16 Jul. (1); Lasioglossum (carinaless Evylaeus) sp.6 (Hal: Hy) 10-16 Jul. (1); Paragus quadrtfasciatus (Syr: Di) 10-16 Jul. (2)

Paederia scandens

Caprifoliaceae

Abelia serrata
Macrolagria robusticeps (Lag: Co) 26-29 May (1); Myrmica sp.1 (For: Hy) 26-29 May (1); Lasioglossum (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); Euthyneura 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); Vuiletus 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

Lasioglossum (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)

Weigela decora

Paraserica gricea (Sca: Co) 16-17 Jun. (1); Dalopius tamui (Ela: Co) 16-17 Jun. (1); Anthemus maculileytiris (Can: Co) 16-17 Jun. (1); Prothemerus ciusianus (Can: Co) 16-17 Jun. (2); sp.3 (Bra: Hy) 16-17 Jun. (1); Myrmica sp.1 (For: Hy) 16-17 Jun. (1); Lasioglossum 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 ardens (Api: Hy) 16-17 Jun. (2); Bombus ignitus (Api: Hy) 16-17 Jun. (7); Homoneura sp.2 (Lau: Di)
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16-17 Jun. (1)

Weigela japonica
Andrena watasei (And: Hy) 26-29 May (1); Andrena haliictoides (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); Philapota nigroaenea (Acr: Di) 26-29 May (2); Dideaides coquilletti (Syr: Di) 26-29 May (1); Alobochca apicalis (Syr: Di) 26-29 May (1)

Valerianaceae

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

Patrinia villosa
Chrysopa sp.1 (Chr: Ne) 24-26 Aug. (1); Lasioglossum (carinaless Evelyaeus) 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 ageratoides ssp. leiophyllus
Lasiohlossum sp.3 (Hal: Hy) 17-22 Sep. (2); Lasiohlossum (carinaless Evelyaeus) sp.3 (Hal: Hy) 17-22 Sep. (1); Ceratina japonica (Ant: Hy) 17-22 Sep. (1); Ceratina megastigmata (Ant: Hy) 17-22 Sep. (3)

Aster scaber
Aulacophora nigripennis (Chr: Co) 17-22 Sep. (1); Lasiohlossum 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 lewissi (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 canthoptera (Ves: Hy) 16-17 Jun. (1); Vespa tropica pulchra (Ves: Hy) 16-17 Jun. (1); Lasiohlossum (carinaless Evelyaeus) 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 jeddarana (Syr: Di) 16-17 Jun. (1); Eristalis cerealis (Syr: Di) 16-17 Jun. (1); Betasyrphus serarías (Syr: Di) 16-17 Jun. (1); Sphaerophoria philantrus (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 paullescens (Nym: Le) 10-16 Jul. (3), 16-17 Jun. (3); Macroglossum stellatarum (Sph: Le) 16-17 Jun. (1)

Cirsium suffultum
Oxyetonia 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); Lasiohlossum (carinaless Evelyaeus) 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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Echinops setifer

Oxyctonia juncunda (Scat: Co) 17-22 Sep. (1), 24-26 Aug. (2); Campsomeriella annulata annulata (Sco: Hy) 24-26 Aug. (1); Vespa simillima xanthoptera (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 gutta 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); Lasiglossum (carinaless Evylaeus) sp.7 (Hal: Hy) 10-16 Jul. (1); Nomada ruinensis (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)

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); Lasiglossum 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)

Iseris dentata

Lasiglossum (carinaless Evylaeus) sp.2 (Hal: Hy) 26-29 May (1); Lasiglossum (carinaless Evylaeus) sp.4 (Hal: Hy) 26-29 May (1); Andrena knuthi (And: Hy) 11-16 May (2); Eristalis tenax (Syr: Di) 26-29 May (1); Sphaerocera macrogastr (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); Platycererus clypeatus (Syr: Di) 26-29 May (1); Peribaea sp.1 (Tac: Di) 11-16 May (1)

Ligularia fisheri 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

Sympetrum 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); Polyrrhina pellucida pellucida (Hes: Le) 10-16 Jul. (1); Parnara gutta guttata (Hes: Le) 24-26 Aug. (1); Papilio bianor dehaanii (Pap: Le) 10-16 Jul. (4); Lycaena phlaeas daimio (Lyc: Le) 10-16 Jul. (1); Argyronome ruslana lysippe (Nym: Le) 10-16 Jul. (1); MacroGLOSSUM bombyleaus (Sph: Le) 10-16 Jul. (1)

Saussurea gracilis

Campsomeris prismatica (Sco: Hy) 24-26 Aug. (1); Lasiglossum 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 pietrotii
SphaeroPHoria philanthus (Syr: Di) 26-29 May (1)

Solidago virga-aurea ssp. Asiatic
Nonarthra cyanea (Chr: Co) 17-22 Sep. (3); Aulacophora nigripes (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 latueviridis
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); Epi Coryphus balteatus (Syr: Di) 17-22 Sep. (2); Scaeva komabensis (Syr: Di) 17-22 Sep. (1)

Asparagus schoberioides
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); Linnaenia sp.1 (Tae: 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 (Tae: Di) 4-5 Aug. (1); Eumea sp.1 (Tae: Di) 4-5 Aug. (1); Eumea sp.2 (Tae: 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); Apoderus 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*

*Syrphetrum frequens*

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

*Tettigoniidae*

*Metrioptera hime*

*Hemerocallis vespertina (lil8) 4-5 Aug. (1)*

**DERMAPTERA**

*Forficulidae*

*Anechura japonica*

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

**HEMIPTERA**

*Ricaniidae*

*sp.1*

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

*Deltocephalidae*

*sp.1*

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

*sp.2*

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

**Tingidae**

*sp.1*

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

**Lygaeidae**

*Pachygonrtha*

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

**Chrysopidae**

*Chrysopa sp.1*

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

**COLEOPTERA**

*Staphylinaidae*

*Eusphalerum parallelym*

*Lindera sericea (lau1) 16-18 Apr. (11); Viola Grypoceras (vio2) 16-18 Apr. (2); Salix vulpina (sai1) 16-18 Apr. (1); Pieris japonica (eri1) 16-18 Apr. (27); Prunus jasamsakura (ros3) 11-16 May (2)
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**Scarabaeidae**

*Anomala octiescoctata*
* Dioscorea asclepiadea* (dio1) 26-29 May (1) *Popillia 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)

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

*Eucetonia pilfera*
* 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* (ili6) 16-17 Jun. (1)

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

*Dalopius tamui*
* Prunus jamasakura* (ros3) 11-16 May (1); *Weigela decora* (cap6) 16-17 Jun. (1)

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

**Elateridae**

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

*Mikadochantharis 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 maculilelytris*
* Weigela decora* (cap6) 16-17 Jun. (1)
Prothemen ciusianus
  Benthamidina 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)

Nitidulidae

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

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

Cryptophagidae

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

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

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

Oedemeridae

Oedemeronia lucidicollis
  Ranunculus japonicus (ran1) 11-16 May (3); Epimedium diphylllum (ber1) 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)

Scaptiidae

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

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

Lagriidae

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

*Alleculidae*

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

*Cerambycidae*

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

*pidonia hyllophila hyllophila*
Syrax japonica (sty1) 16-17 Jun. (1)

*pidonia piziloi*
*Rhododendron kiusuanum (eri4) 26-29 May (1); Rhododendron reticulatum (eri3) 11-16 May (1)

*Chrysomelidae*

Nonarthra cyanina
*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 yanagisawae var. nivea (ast17) 17-22 Sep. (1); Solidago virga-aurea ssp. Asiatic (ast18) 17-22 Sep. (3); Allium thunbergii (li1) 17-22 Sep. (1)

Aulacophora nigripennis
Aster scaber (ast19) 12-22 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 (ranl) 11-16 May (1); Epimedium diphylhum (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 jasakura (ros3) 11-16 May (3)

*Atteabidae*

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 fischerii 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)

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

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

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

Braconidae

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

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

   Weigela decora (cap6) 16-17 Jun. (1)

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

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

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

   Salix vulpina (sal1) 16-18 Apr. (1)

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

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

*Hoplistemens* 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 yanagisawai 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 decora (cap6) 16-17 Jun. (1)

Pomilidae

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

Eumenidae

Stenodynerus tokyanus tokyanus
Lysimachia clethroides (pri1) 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

Crosocerus 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 rotund var. petiolata (scr1) 4-5 Aug. (1); Asparagus schoberoides (lil5) 26-29 May (1)

Colletidae

Colletes perforator
Lespedeza bicolor (fab3) 24-26 Aug. (2)

Halictidae

Lasioglossum (Lasioglossum) sp.1
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*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

*Lasioglossum sibiriacum*
*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*
*Aletris luteoviridis* (li9) 10-16 Jul. (1)

*Lasioglossum (carinate Evytaeus) sp.2*
*Viburnum erosum* var. *punctatum* (cap3) 26-29 May (1); *Cirsium suffultum* (ast16) 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 (carinaless Evytaeus) sp.1*
*Spiraea japonica* (ros9) 10-16 Jul. (1); *Veronica rotunda* var. *petiolata* (scr1) 4-5 Aug. (1)

*Lasioglossum (carinaless Evytaeus) sp.2*
*Ranunculus japonicus* (ran1) 11-16 May (3), 26-29 May (1); *Ixeris dentata* (ast1) 26-29 May (1)

*Lasioglossum (carinaless 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 (carinaless Evytaeus) sp.4*
*Ranunculus japonicus* (ran1) 11-16 May (1); *Epimedium diphyllum* (ber1) 26-29 May (1); *Vicia unijuga* (fab2) 16-17 Jun. (1); *Polygala japonica* (pol1) 11-16 May (1); *Hydrocotyle ramosa* (api1) 16-17 Jun. (2); *Veronica rotunda* var. *petiolata* (scr1) 4-5 Aug. (2); *Paederia scandens* (rub3) 4-5 Aug. (1); *Ixeris dentata* (ast1) 26-29 May (1)

*Lasioglossum (carinaless Evytaeus) sp.5*
*Dianthus superbus* var. *longicalyx* (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 (carinaless Evytaeus) sp.6*
*Galium verum* (rub2) 10-16 Jul. (1)

*Lasioglossum (carinaless Evytaeus) sp.7*
Erigeron annuus (ast5) 10-16 Jul. (1)

Lasioglossum (carinaless Evylaeus) sp.8

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

Andrenidae

Audrena okabei sapporenisis

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 barvinervis (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 (sal3) 11-16 May (2); Pieris japonica (eri1) 16-18 Apr. (1); Rhododendron kiusianum (eri4) 26-29 May (2); Rhododendron reticulatum (eri3) 11-16 May (4)

Andrena longitibialis

Salix sieboldiana (sal3) 11-16 May (11); Rhododendron kiusianum (eri4) 26-29 May (2); Rhododendron reticulatum (eri3) 11-16 May (1); Hydrangea luteo-venosa (hyd1) 26-29 May (1)

Andrena watasei

Viola grapeceras (vio2) 16-18 Apr. (2); Viola orientalis (viol) 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 (sal3) 11-16 May (3)

Andrena hikosana

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

Andrena komachi

Ranunculus japonicus (ran1) 11-16 May (1); Pieris japonica (eri1) 16-18 Apr. (1); Potentilla freyniana (ros1) 11-16 May (1)

Andrena kaguya

Ranunculus japonicus (ran1) 11-16 May (1); Viola orientalis (viol) 16-18 Apr. (1)

Andrena minutula

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

Andrena sp.1
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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. lilacina (lam1) 10-16 Jul. (2), 16-17 Jun. (1); Abeliserrata (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. lilacina (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. lilacina (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 mutsuensis
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 suffruticosum (ast16) 17-22 Sep. (2); Ligularia japonica (ast6) 10-16 Jul. (3); Symurus excelsus (ast25) 14-16 Oct. (3); Hemerocallis vespertina (lil18) 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); Styrrax japonica (sty1) 16-17 Jun. (10); Deutzia crenata (sax2) 16-17 Jun. (2); Rubus parvifolius (ros8) 16-17 Jun. (1); Rubus phoenicolasius (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 suffruticosum (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 (lil13) 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
Cimicifuga 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 yanaquisawa var. nivea (ast17) 17-22 Sep. (1); Allium thunbergii (lil13) 17-22 Sep. (1); Hemerocallis vespertina (lil8) 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)

sp.5

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

**Culicidae**

sp.1

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

**Chironomidae**

sp.1

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

**Ceratopogonidae**

sp.1

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

sp.2

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

sp.3

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

sp.4

*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**

sp.1

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

sp.1
Arisaema japonicum (ara1) 26-29 May (2)

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

sp.3
Arisaema japonicum (ara1) 26-29 May (1)

sp.4
Prunus masasakura (ros3) 11-16 May (1)

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

sp.6
Prunus masasakura (ros3) 11-16 May (1)

sp.7
Arisaema japonicum (ara1) 26-29 May (1)

sp.8
Arisaema japonicum (ara1) 16-17 Jun. (1)

sp.9
Arisaema japonicum (ara1) 26-29 May (1)

sp.10
Arisaema japonicum (ara1) 16-18 Apr. (1)

sp.11
Arisaema japonicum (ara1) 26-29 May (1)

Sciariidae

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

sp.2
Arisaema japonicum (ara1) 16-18 Apr. (1)

sp.3
Pieris japonica (erl1) 16-18 Apr. (1)

sp.4
Arisaema japonicum (ara1) 16-18 Apr. (1)

sp.5
Pieris japonica (erl1) 16-18 Apr. (1)

sp.6
Arisaema japonicum (ara1) 16-18 Apr. (1)

sp.7
Plant-pollinator Interactions at Mt. Yufu

_Arisaema japonicum_ (ara1) 26-29 May (1)

**Aceridae**

_Philopta nigroaenea_

_Rhododendron kiusuwanum_ (eri4) 26-29 May (4); _Hydrangea luteo-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)

**Bombyliiidae**

_Bombylus major_

_Viola grypoceras_ (vio2) 16-18 Apr. (4); _Viola hondoensis_ (vio3) 16-18 Apr. (1); _Rhododendron kiusuwanum_ (eri4) 26-29 May (2); _Rhododendron reticulatum_ (eri3) 11-16 May (3)

**Asilidae**

_Neaitamus angusticornis_

_Hydrangea luteo-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_

_Prúnus 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); _Prúnus 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 bumalda_ (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 fauriei (val1) 16-17 Jun. (2), 26-29 May (2); Anaphalis margaritacea var. angus (ast13) 24-26 Aug. (1); Cirsium japonicum (ast3) 16-17 Jun. (1); Eupatorium chinense (ast9) 4-5 Aug. (1); Helichrysum vulgare var. lilacina (lam1) 10-16 Jul. (3); 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)

Dioeaides coquillettii

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

Volucella jodon

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

Syrphus torvus

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

Epistrophe 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)

Helophorus 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)

Epiyrhus balteatus

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

Baccha maculata

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

Aliocacca acapalis

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

Meliscoeae cinctella
Galium japonicum (rub1) 11-16 May (1)

Sphaerophoria macrogaster
Dianthus superbus var. longicalyc (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 (ril6) 16-17 Jun. (3), 26-29 May (1)

Paragus quadrifasciatus
Hydrocotyle ramiflora (apil1) 16-17 Jun. (1); Galium verum (rub2) 10-16 Jul. (2)

Melanastoma scalar
Ranunculus japonicus (ran1) 11-16 May (1); Moehringia lateriflora (car2) 26-29 May (2); Hydrangea luteo-venosa (hyd1) 26-29 May (1); Prunus jasakura (ros3) 11-16 May (1); Prunella vulgaris var. fililacina (lam1) 10-16 Jul. (1); Ixeris dentata (ast1) 26-29 May (1)

Paragus jozanus
Deutzia crenata var. floribunda (sax6) 10-16 Jul. (1); Parnassia palustris (sax8) 14-16 Oct. (1); Hydrocotyle ramiflora (apil1) 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 kiusuanum (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 unjiuga (fab2) 16-17 Jun. (1); Angelica cartilagino-marginata (apil3) 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 kiusuanum (eri4) 26-29 May (1); Ixeris dentata (ast1) 26-29 May (1)

Eumerus sp.1
Hydrangea luteo-venosa (hyd1) 26-29 May (1)

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

Cheilosia sp.4
Viola orientalis (vio1) 11-16 May (1)
Platycheirus urakawensis
   Ranunculus japonicus (ran1) 11-16 May (1); Viola orientalis (viol) 16-18 Apr. (1); Potentilla freyniana (ros1) 11-16 May (1)

Conopidae

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

Tephritidae

Urophora sachalinensis
   Erigeron annuus (ast5) 16-17 Jun. (1); Erigeron philadelphicus (ast4) 16-17 Jun. (1)

Campiglossa hirayamae
   Lysimachia clethroides (pri1) 10-16 Jul. (1)

Sepsidae

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

Lauxaniidae

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

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

Agromyzidae

Liriomyza sp.1
   Lyonia ovalifolia var. elliptica (eri6) 16-17 Jun. (1)

Chloropidae

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

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

Drosophilidae

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

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

Sphaeroceridae

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

Anthomyiidae

Lasiomma sp.1
   Salix vulpina (sal1) 16-18 Apr. (23)

Hydrophoria sp.1
   Salix vulpina (sal1) 16-18 Apr. (5)
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*Hyemyia* sp. 1
*Salix sieboldiana* (sal3) 11-16 May (2); *Prunus jasasakura* (ros3) 11-16 May (2)

*Delia* sp. 1
*Salix sieboldiana* (sal3) 11-16 May (1); *Hydrangea serrata* (hyd2) 10-16 Jul. (1); *Deutzia crenata* var. *floribunda* (sax6) 10-16 Jul. (8)

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

*Delia* sp. 3
*Pieris japonica* (eri1) 16-18 Apr. (1)

*Delia* sp. 4
*Cephalanthera falcata* (orc1) 11-16 May (1)

*Delia* sp. 5
*Rhododendron kiusuanum* (eri4) 16-17 Jun. (1)

**Muscidae**

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

**Calliphoridae**

*Stomorhina obsolata*
*Polygonum cuspidatum* (pol3) 24-26 Aug. (18); *Clethra barwinervis* (cle1) 4-5 Aug. (3); *Hydrangea paniculata* (hyd3) 4-5 Aug. (1); *Astilbe thunbergii* (sax5) 10-16 Jul. (2); *Deutzia crenata* (sax2) 16-17 Jun. (1); *Deutzia crenata* var. *floribunda* (sax6) 10-16 Jul. (3); *Patrinia scabinosafolia* (val3) 17-22 Sep. (1)

sp. 1
*Hypericum pseudopetiolatum* (clu1) 17-22 Sep. (1)

sp. 2
*Quercus dentata* (fag1) 11-16 May (1); *Polygonum cuspidatum* (pol3) 24-26 Aug. (3)

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

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

sp. 3
*Hydrangea luteo-venosa* (hyd1) 26-29 May (1)

**Sarcophagidae**

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

**Tachinidae**

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

*Tachina* sp. 1
*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)

Phebebia 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)

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

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

Peribaea sp.1  
*Lysimachia clethroides* (pri1) 10-16 Jul. (1); *Astillbe 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); *Astillbe thunbergii* (sax5) 10-16 Jul. (2)

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

**LEPIDOPTERA**

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

**Incurvariidae**

*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)
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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 suffultum (ast16) 17-22 Sep. (1); Echinops setifer (ast15) 24-26 Aug. (1); Ligularia japonica (ast6) 24-26 Aug. (1); Hemerocallis vespertina (li1) 4-5 Aug. (1)

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

Papilionidae

Papilio machaon hippocrates
Cirsium suffultum (ast16) 17-22 Sep. (1); Echinops setifer (ast15) 24-26 Aug. (1); Inula japonica (ast14) 24-26 Aug. (1); Lilium leichtlinii var. maximowic (li12) 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 triphylla (cam1) 4-5 Aug. (2)

Lycaena phlaeas damia
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 suffultum (ast16) 17-22 Sep. (1)

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

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

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

Sphingidae
Ampelophaga rubiginosa
Hemerocallis vespertina (li18) 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 sufflultum (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.