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<th>Flowering Phenology and Anthophilous Insect Community in a Grassland Ecosystem at Mt. Yufu, Western Japan</th>
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<td>Author(s)</td>
<td>YAMAZAKI, Kyoko; KATO, Makoto</td>
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<td>Citation</td>
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Kyoto University
Flowering Phenology and Anthophilous Insect Community
in a Grassland Ecosystem at Mt. Yufu, Western Japan

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ABSTRACT The hillsides of Mt. Yufu, located in Kyusyu, Japan, is a dormant volcano, are covered with natural and semi-natural grasslands; the latter of which are maintained by traditional mowing and burning. Both the natural and semi-natural grasslands are inhabited by many grassland-specific plant species, some of which are now endangered in Japan. To understand pollination mutualisms in the grassland ecosystem, we investigated the flowering phenology and anthophilous insect communities on 149 plant species from 49 different plant families, from April to October 2001. In total, 1192 individuals from 308 species, 83 families and 10 orders of Insecta were observed on flowers of 101 plant species. The most abundant insect order was Hymenoptera (37.8% of individuals), followed by Diptera (32.5%), Coleoptera (22.7%) and Lepidoptera (6.2%). The proportions of Coleoptera and Lepidoptera were respectively smaller and greater than in forested habitats, suggesting that many anthophilous beetles depend on woody plants during their larval stages and that anthophilous butterflies (especially Nymphalidae) are associated with grassland-specific perennials (especially Viola spp.) in their larval stages. The bee fauna consisted of 54 species, from 10 genera and 6 families; the bee community was characterized by an absence of cavity-nesting Hylaeus and Xylocopa and by the predominance of long-tongued Tetraltion in the early spring. The bumblebee community was characterized by the predominance of a short-haired Bombus ignitus, uncommon in forested habitats. The dominant pollination syndrome, among 70 plant species for which pollinators were inferred, was melittophily (82%), followed by myophily (14%), psychophily (1.4%), phalaenophily (1.4%) and anemophily (1.4%). Among the melittophilous species, small-bee-pollinated species (45%) dominated, followed by Bombus- (36%), Apis- (8.6%), Tetraltion- (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 Kyushu, Japan, are covered with natural and semi-natural grasslands (Sumata, 1989). Both the grassland types are inhabited by many grassland-specific plant species, some of which are endangered in Japan (Environment agency of Japan, 2000). To conserve these endangered plant species, it is indispensable that we know the native pollinators and understand community-level plant-pollinator interactions in the grasslands.

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

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

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

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

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

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

**Methods**

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

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

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<th>Code</th>
<th>Date</th>
<th>No. of flowering plant species</th>
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<td>18</td>
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<td>17-22 Sep. 2001</td>
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<td>142</td>
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<td>9</td>
<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 phoenicosius, Sanguissorba officinalis, Polvga 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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<td>VIII-IX p n h v z p - 41 C3 Bombus</td>
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<td>VI t n h w a o - 14 C8 Bombus</td>
<td>V t n h g a o - - -</td>
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<td>p n h w a o - - - ?</td>
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**Asteridae**

**Gentianales**

**Gentianaceae**

| Gen5 | Gentiana scabra var. buergeri | Rindou   | X p n h v a f - - - ? |
| Gen4 | Gentiana thunbergii           | Harurindou | IV a n h v a f - - - ? |
| Gen3 | Gentiana zollingeri           | Huderindou | IV a n h v a f - l - - ? |
| Gen2 | Swertia japonica              | Senburi   | X a n h w a o - l - - ? |
| Gen1 | Swertia pseudochinensis       | Murasakisenburi | X a n h v a o VU - - - ? |

**Lamiales**

**Lamiaceae**

| Lam1 | Isodon inquisus                | Yamahakka | IX p n h v z t - 1 - ? |
| Lam2 | Isodon longitubus             | Akichouji | IX p n h v z t - - - ? |
| Lam3 | Prunella vulgaris var. lilacina | Utsubogusa | VI-VIII p n h v z t - 23 C9 small bee |
| Lam4 | Isodon trichocarpa            | Hikiokoshi | X p n h v z t - - - ? |

**Scrophulariales**

**Scrophulariaceae**

| Scr1 | Melampyrum roseum var. japonicum | Mamakona | VIII a n h rv z t - - - ? |
| Verona arvensis | Tachinunofuguri | V a a h b z o - - - ? |
| Veronica rotunda var. petiolata | Himerotanoo | VIII p n h v z o - 6 C10 small bee |

**Orobanchaceae**

| Aeginetia sinensis | Oonanbangisuru | VIII a n h rv a f - - - ? |
| Phryma leptostachya var. asiatica | Haedokusou | VII p n h w z o - - - ? |

**Campanulales**

**Campanulaceae**

| Cam1 | Adenophora triphylla          | Saiyoushajin | VIII p n h v a c - 4 C9 Bombus |
| Cam2 | Codonopsis lanceolata         | Tsuruninjin  | IX c n h w/br a c - 1 C5 wasp |
| Cam3 | Campanula punctata            | Hotarubukuro | VII-VIII p n h w a f - - - ? |

**Rubiales**

**Rubiaceae**

| Rub1 | Galium japonicum              | Kurumamugura | V p n h w a o - 1 - ? |
| Rub2 | Galium verum                 | Kibanakawaramatsuba | VII-VIII p n h y a o - 5 C10 small bee |
| Rub3 | Paederia scandens            | Hekusokazura | VIII c n h w a c - 1 C11 small bee |
| Pseudopyxis depressa | Inamorisou | VI p n h p a o - - - ? |

**Dipsacales**

**Caprifoliaceae**

<p>| Cap1 | Abelia serrata                | Kotsukuhaneutsugi | V s n h w a f - 18 C2 Apis |
| Cap2 | Viburnum dilatatum           | Gamanazumi      | VI s n h w a o - 17 C1 small bee |
| Cap3 | Viburnum erosum var. punctatum | Kobanogamazumi | V s n h w a o - 4 C7 small bee |
| Cap4 | Weigela decora               | Nishikiutsugi  | VI s n h w a o - 20 C4 Bombus |</p>
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<td>Shirayamagiku</td>
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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).

![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.](image-url)
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%).

![Graph showing percentages of insect species and individuals in orders.]

Fig. 4. The percentages of insect species and individuals in orders.

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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</tbody>
</table>

* n, nectarivorous; p, pollenivorous; s, saprophagous; aq, aquatic scavenger/predator; b, blood-sucker; m, mycophagous; o, omnivorous; pr, predatory; ps, parasitic; s, 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>
</tr>
</thead>
<tbody>
<tr>
<td>Colletidae</td>
<td>Colletinae</td>
<td>Colletes</td>
<td>s</td>
<td>underground</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Halictidae</td>
<td>Halictinae</td>
<td>Lasio glossum</td>
<td>s</td>
<td>underground</td>
<td>18</td>
<td>61</td>
</tr>
<tr>
<td>Andrenidae</td>
<td>Andreninae</td>
<td>Andrena</td>
<td>s</td>
<td>underground</td>
<td>15</td>
<td>71</td>
</tr>
<tr>
<td>Megachilidae</td>
<td>Megachilinae</td>
<td>Coelioxys</td>
<td>m</td>
<td>cleptoparasitic</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Megachile</td>
<td>m</td>
<td>in cavities</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Anthophoridae</td>
<td>Nomadinae</td>
<td>Nomada</td>
<td>s</td>
<td>cleptoparasitic</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Anthophorinae</td>
<td>Tetralonia</td>
<td>m</td>
<td>underground</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Xylocopinae</td>
<td>Ceratina</td>
<td>s</td>
<td>in cavities</td>
<td>4</td>
<td>59</td>
</tr>
<tr>
<td>Apidae</td>
<td>Bombinae</td>
<td>Bombus</td>
<td>l</td>
<td>underground</td>
<td>3</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>Apinae</td>
<td>Apis</td>
<td>m</td>
<td>in tree hollows</td>
<td>2</td>
<td>38</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>54</td>
<td>375</td>
</tr>
</tbody>
</table>

*: 1, 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 the number of insects observed on flowers at each sampling data. Insects are sorted by order.](image)

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 individuals](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.

![Scatter plots of loadings on PC1 and PC2](image)

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

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

Cluster 1 (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 C1 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 phoenicosius*), 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 sufitum (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 frequently 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., 1990; Kato et al., 1993). Generally, the mid-summer decrease of flowers is mainly caused by early finishing of flowering by tree and shrub species. The lack of the mid-summer decrease of flowers at Mt. Yufu is probably due to the low species richness of trees and shrubs and to the high species richness of mid-summer flowering perennials at grassland habitats.

2. **Anthophilous insect community**

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

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

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

![Comparison of relative abundance of Bombus species among 13 localities in Japan.](image)

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


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*

*Euphalerum parallelym* (Sta: Co) 16-18 Apr. (11); *Anaspis sp.1* (Scr: Co) 16-18 Apr. (2); *Manobidia nipponica* (Chr: Co) 16-18 Apr. (9); *sp.1* (Eul: Hy) 16-18 Apr. (1); *sp.2* (Eul: Hy) 16-18 Apr. (3); *Drosophila sp.2* (Dro: Di) 16-18 Apr. (1)

**Ranunculaceae**

*Aconitum japonicum* ssp. napiform

*Bombus diversus diversus* (Api: Hy) 17-22 Sep. (1)

*Cimicifuga acerina*

*Lasioglossum sp.3* (Hal: Hy) 17-22 Sep. (2); *Apis mellifera* (Api: Hy) 17-22 Sep. (1)

*Ranunculus japonicus*

*Oedemeronia lucidicollis* (Oed: Co) 11-16 May (3); *Zyngia lewisi* (Chr: Co) 11-16 May (1); *Lasioglossum occidens* (Hal: Hy) 26-29 May (1); *Lasioglossum (carinalex Evylaes)* sp.2 (Hal: Hy) 11-16 May (3), 26-29 May (1); *Lasioglossum (carinalex Evylaes)* 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* (Sy: Di) 11-16 May (1); *Cheilosia sp.1* (Sy: Di) 11-16 May (1); *Platyceirus urakawensis* (Sy: Di) 11-16 May (1)

**Berberidaceae**

*Epimedium diphyllum*

*Oedemeronia lucidicollis* (Oed: Co) 11-16 May (2), 26-29 May (1); *Zyngia lewisi* (Chr: Co) 11-16 May (2); *Lasioglossum (carinalex Evylaes)* sp.4 (Hal: Hy) 26-29 May (1)

**Papaveraceae**

*Corydalis lineariloba*

*Tetralonia nipponensis* (Ant: Hy) 16-18 Apr. (1)

**Fagaceae**

*Castanea crenata*

*sp.1* (Del: He) 16-17 Jun. (1); *Cteniopinus hypocrita* (All: Co) 16-17 Jun. (1); *Hesperomorpha hirsuta* (Chr: Co) 16-17 Jun. (1); *Eristalis cerealis* (Syr: Di) 16-17 Jun. (1); *Siphona sp.1* (Tac: Di) 16-17 Jun. (1)
Quercus dentata
Oxycetonia jucunda (Sca: Co) 11-16 May (1); Eucetonia pilifera (Sca: Co) 11-16 May (3); Hoplia moerens (Sca: Co) 11-16 May (14); Camponotus japonicus (For: Hy) 11-16 May (1); Crossocerus sp. (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 sibiricum (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 gryphoceras
Euphlererus pararelym (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 mutesensis (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 gracilipalpis (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); sp.2 (Ten: 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); Platycerithrus urakawensis (Syr: Di) 16-18 Apr. (1); Scirpophaga sp.1 (Thy: Le) 16-18 Apr. (1)

Salicaceae
Salix sieboldiana
Athousius sp.1 (Ela: Co) 11-16 May (1); Themos midas (Can: Co) 11-16 May (1); Mikadocantharis 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 tikai (Ten: Hy) 11-16 May (1); Rhogogaster variipes (Ten: Hy) 11-16 May (1); sp.1 (Ten: Hy) 11-16 May (1); sp.1 (Bra: Hy) 11-16 May (1); sp.2 (Bra: Hy) 11-16 May (1);
Plant-pollinator Interactions at Mt. Yufu

Salix 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 gracilipatpus (Bib: Di) 16-18 Apr. (3); Lasiomma sp.1 (Ant: Di) 16-18 Apr. (23); Hydrophoria sp.1 (Ant: Di) 16-18 Apr. (5)

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

Clethraceae

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)

Eriaceae

Pieris japonica
Eusphalerum parallelym (Sta: Co) 16-18 Apr. (27); Eucetonia 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); Byturis sp.1 (Byt: Co) 16-18 Apr. (1); Vibidia duodecimguttata (Coc: Co) 16-18 Apr. (1); Nonarthra cyanae (Chr: Co) 16-18 Apr. (3); Himatium sp.1 (Cur: Co) 16-18 Apr. (1); Andrena okabei sapporensis (And: Hy) 16-18 Apr. (1); Andrena dentata (And: Hy) 16-18 Apr. (1); Andrena mikado (And: Hy) 16-18 Apr. (1); Andrena watasei (And: Hy) 16-18 Apr. (1); Andrena komachi (And: Hy) 16-18 Apr. (1); Ceratina japonica (Ant: Hy) 16-18 Apr. (1); Nomada 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 aneuretus (Bib: Di) 16-18 Apr. (1); 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); Delia sp.3 (Ant: Di) 16-18 Apr. (1)

Rhododendron kiusuwanum
Pidonia pizili (Cer: Co) 26-29 May (1); Andrena mikado (And: Hy) 26-29 May (2); Andrena longitibialis (And: Hy) 26-29 May (2); Ceratina japonica (Ant: Hy) 26-29 May (2); Nomada asozuana (Ant: Hy) 26-29 May (1); Bombus ardens ardens (Api: Hy) 16-17 Jun. (1), 26-29 May (1); Philopota nigrosaenea (Acr: Di) 26-29 May (4); Bombylus 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 pizili (Cer: Co) 11-16 May (1); sp.1 (Ich: Hy) 11-16 May (1); Andrena mikado (And: Hy) 11-16 May (1);...
16 May (4); *Andrena longitibialis* (And: Hy) 11-16 May (1); *Bombus major* (Bom: Di) 11-16 May (3)

**Styracaceae**

*Styrax japonica*

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

**Primulaceae**

*Lysimachia clethroides*

*Popilia japonica* (Sca: Co) 10-16 Jul. (1); *Mordellistena* sp.1 (Mor: Co) 10-16 Jul. (2); *Hippuriphipha*

sp.1 (Chr: Hy) 10-16 Jul. (1); *Stenodynerus tokuyanu tokuyanu* (Eum: Hy) 10-16 Jul. (1); *Lasioglossum (carinaless Euryaeus)* sp.5 (Hal: Hy) 10-16 Jul. (2); *Sphaerophoria philanthus* (Syr: Di) 10-16 Jul. (1); *Cingoglopha hirayamae* (Tep: Di) 10-16 Jul. (1); *Peribaea* sp.1 (Tac: Di) 10-16 Jul. (1); *Siphona* sp.1 (Tac: Di) 10-16 Jul. (3); *Polytemes pellucida pellucida* (Hes: Le) 10-16 Jul. (1); *Lycena phlaeas daimio* (Lyc: Le) 10-16 Jul. (4); *Fabriciana adipe pallescens* (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 scalare* (Syr: Di) 26-29 May (1); *Sphaerophoria philanthus* (Syr: Di) 26-29 May (1); *Humerus sp.1* (Syr: Di) 26-29 May (1); *sper.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); *Lasioglossum apristum* (Hal: Hy) 4-5 Aug. (1); *Andrena dentata* (And: Hy) 4-5 Aug. (1); *Apis mellifera* (Api: Hy) 4-5 Aug. (3); *Stomorhina obsoleta* (Cal: Di) 4-5 Aug. (1)

*Hydrangea serrata*


**Saxifragaceae**

*Astilbe thunbergii*

*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 obsoleta* (Cal: Di) 10-16 Jul. (2); *Peribaea* sp.1 (Tac: Di) 10-16 Jul. (2); *Siphona* sp.1 (Tac: Di) 10-16 Jul. (2); *Fischeria* sp.1 (Tac: Di) 10-16 Jul. (1); *Ochloides ochraceus* (Hes: Le) 10-16 Jul. (1)

*Deutzia crenata*

*Hoplia moerens* (Sca: Co) 16-17 Jun. (2); *Trachys sunderi* (Bup: Co) 16-17 Jun. (1); *Mordellina* sp.1 (Mor: Co) 16-17 Jun. (1); *Anaspis sp.2* (Scr: Co) 16-17 Jun. (1); *Exosoma 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); *sper.1* (Emp: Di) 16-17 Jun. (2); *Helophilus 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); *Zodion* sp.1 (Con: Di) 16-17 Jun. (1); *Stomorhina obsoleta* (Cal: Di) 16-17 Jun. (1); *Peribaea* sp.1 (Tac: Di) 16-17 Jun. (1); *Nemophora umbrilennis* (Inc: Le) 16-17 Jun. (1); *Pieris melete melete* (We: Le) 16-17 Jun. (1)

*Deutzia crenata* var. *floribunda*

*Exosoma flaviventre* (Chr: Co) 16-17 Jun. (1); *Proctochneumon sp.1* (Ich: Hy) 10-16 Jul. (1); *Hoplisthenes sp.1* (Ich: Hy) 10-16 Jul. (1); *Ammophilia sabulosa nipponica* (Sph: Hy) 16-17 Jun. (2); *Lasioglossum 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);
Helophilus virgatus (Syr: Di) 10-16 Jul. (1); Paragus jozanus (Syr: Di) 10-16 Jul. (1); Delia sp.1 (Ant: Di) 10-16 Jul. (8); Stomorhina obsoleta (Cal: Di) 10-16 Jul. (3); Sisyropia 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 jozanus (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 minuta (And: Hy) 16-18 Apr. (3); Bombus diversus diversus (Api: Hy) 11-16 May (1); sp.2 (Emp: Di) 11-16 May (1); Cheilosis sp.5 (Syr: Di) 16-18 Apr. (1); Melangyna sp.1 (Syr: Di) 16-18 Apr. (1); Cheilosis sp.1 (Syr: Di) 11-16 May (1); Platycheirus urakawensis (Syr: Di) 11-16 May (1)

Punus jamaakura  
Eusphaterium paralellym (Sta: Co) 11-16 May (2); Dalopius tamui (Ela: Co) 11-16 May (1); Mikadoantharis japonica (Can: Co) 11-16 May (3); Anthemus magnus (Can: Co) 11-16 May (1); Meligethes sp.1 (Nitt: Co) 11-16 May (1); Epuraea bergeri (Nitt: Co) 11-16 May (1); Byturus sp.2 (Byt: Co) 11-16 May (1); Manobidia nipponica (Chr: Co) 11-16 May (3); Pachyprota (Syr: Hy) 11-16 May (1); sp.2 (Ich: Hy) 11-16 May (1); sp.1 (Tip: Di) 11-16 May (1); sp.3 (Cer: Di) 11-16 May (1); Bibio sp.5 (Bib: Di) 11-16 May (1); sp.4 (Myc: Di) 11-16 May (1); sp.6 (Myc: Di) 11-16 May (1); sp.5 (Emp: Di) 11-16 May (1); Euthyneura sp.1 (Emp: Di) 11-16 May (1); Melanastoma scalare (Syr: Di) 11-16 May (1); sp.2 (Chl: Di) 11-16 May (1); Hylomyia 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  
Eustytheta sp.1 (Cal: Di) 17-22 Sep. (1)

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

Fabaceae

Lespedeza bicolor  

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

Vicia unijuga
Lasioglossum (carinaless Eveylaeus) 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); Prothemenis 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 (Tae: Di) 16-17 Jun. (1); sp.2 (Tor: Le) 16-17 Jun. (1); Ivela auripes (Lym: Le) 16-17 Jun. (1)

Polygalaceae

Polygala japonica
Lasioglossum (carinaless Eveylaeus) 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 Eveylaeus) 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: Mc) 4-5 Aug. (1); Prosena siberita (Tae: Di) 24-26 Aug. (1)

Apiaceae

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

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

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

Gentianaceae

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

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

Lamiaceae

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

Prunella vulgaris var. lilacina

Scrophulariaceae

Veronica rotunda var. petiolaris

Anchusa salicaria (Sph: Hy) 4-5 Aug. (1); Lasioglossum (carinata Evytaeus) sp.3 (Hal: Hy) 4-5 Aug. (1); Lasioglossum (carinata Evytaeus) sp.4 (Hal: Hy) 4-5 Aug. (2); Sphaerophoria macrogaster (Syr: Di) 4-5 Aug. (1); Sphaerophoria philanthus (Syr: Di) 4-5 Aug. (1)

Campanulaceae

Adenophora triphylla

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

Codonopsis lanceolata

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

Rubiaceae

Galium japonicum

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

Galium verum

Mordellistena sp.1 (Mor: Co) 10-16 Jul. (1); Lasioglossum (carinata Evytaeus) sp.5 (Hal: Hy) 10-16 Jul. (1); Lasioglossum (carinata Evytaeus) sp.6 (Hal: Hy) 10-16 Jul. (1); Paragus quadrifasciatus (Syr: Di) 10-16 Jul. (2)

Paederia scandens

Lasioglossum (carinata Evytaeus) sp.4 (Hal: Hy) 4-5 Aug. (1)

Caprifoliaceae

Abelia serrata

Macrolagria robusticeps (Lag: Co) 26-29 May (1); Myrmica sp.1 (For: Hy) 26-29 May (1); Lasioglossum (carinata Evytaeus) 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); Vuilletus viridis (Ela: Co) 16-17 Jun. (1); Oedemeronia lucidicollis (Oed: Co) 16-17 Jun. (4); Andrena knuthi (And: Hy) 16-17 Jun. (1); sp.4 (Emp: Di) 16-17 Jun. (1); sp.6 (Emp: Di) 16-17 Jun. (1); Eristalis tenax (Syr: Di) 16-17 Jun. (1); Periboea sp.1 (Tae: Di) 16-17 Jun. (1)

Viburnum erosum var. punctatum

Lasioglossum (carinata Evytaeus) 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 maculelytris (Can: Co) 16-17 Jun. (1); Prothemos 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)
Weigela japonica

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

Valerianaceae

*Patrinia scabiosaefolia*

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

*Patrinia villosa*

*Chrysopa sp.* (Chr: Ne) 24-26 Aug. (1); *Lasiosglossum* (carinaless *Eveles*) sp.3 (Hal: Hy) 24-26 Aug. (1)

*Valeriana fauriei*

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

Asteraceae

*Anaphalis margaritacea* var. *angus*

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

*Aster scaber*

*Aulacophora nigripennis* (Chr: Co) 17-22 Sep. (1); *Lasiosglossum* sp.3 (Hal: Hy) 17-22 Sep. (1); *Ceratina japonica* (Ant: Hy) 17-22 Sep. (1); *Ceratina flavipes* (Ant: Hy) 17-22 Sep. (1)

*Cirsium japonicum*


**Plant-pollinator Interactions at Mt. Yufu**

sp.1 (Sph: Le) 17-22 Sep. (1)

**Echinops setifer**

Oxyctonia jucunda (Sca: Co) 17-22 Sep. (1), 24-26 Aug. (2); Campsomeriella annulata annulata (Sco: Hy) 24-26 Aug. (1); Vespa simililina 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 guttata guttata (Hes: Le) 24-26 Aug. (1); Papilio machaon hippocrates (Pap: Le) 24-26 Aug. (1)

**Erigeron annuus**

Baris dispilota (Cur: Co) 16-17 Jun. (8); Lasiglossum (carinaless Evti. euen) 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 (Tae: Di) 16-17 Jun. (1); Balataeae gracilis (Zyg: Le) 16-17 Jun. (1)

**Erigeron philadelphicus**

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

**Eupatorium chinense**

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

**Heteropappus hispidus**

Campsomeris prismatica (Sco: Hy) 17-22 Sep. (1); Lasiglossum sp.3 (Hal: Hy) 17-22 Sep. (5); Eristalis cerealis (Syr: Di) 17-22 Sep. (1); Paragus haemorrhois (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 Evti. euen) sp.2 (Hal: Hy) 26-29 May (1); Lasiglossum (carinaless Evti. euen) sp.4 (Hal: Hy) 26-29 May (1); Andrena knuthi (And: Hy) 11-16 May (2); Eristalis tenax (Syr: Di) 26-29 May (1); Sphaerophoria macrogaster (Syr: Di) 11-16 May (3), 26-29 May (2); Melanastoma scalare (Syr: Di) 26-29 May (1); Sphaerophoria philanthus (Syr: Di) 11-16 May (1), 26-29 May (4); Platycheirus clypeatus (Syr: Di) 26-29 May (1); Peribaea sp.1 (Tae: Di) 11-16 May (1)

**Ligularia fischerii 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 (Tae: Di) 10-16 Jul. (1); Polystemis pellucida pellucida (Hes: Le) 10-16 Jul. (1); Parnara guttata 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 rutilana lysippe (Nym: Le) 10-16 Jul. (1); Macroglossum bombylaus (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 pierotii
SphaeroPHORIA philanthus (Syr: Di) 26-29 May (1)

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

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

Araceae

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

Juncaceae

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

Lilaceae

Aletris luteoviridis
LasioGLOSSUM (carinate Evylaeus) sp.1 (Hal: Hy) 10-16 Jul. (1)

AIlium thunbergii
Nonarthra cyanea (Chr: Co) 17-22 Sep. (1); Bombus ignitus (Api: Hy) 17-22 Sep. (1); Apis mellifera (Api: Hy) 17-22 Sep. (1); Epiyorphus 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. (1); Linnaena sp.1 (Tact: Di) 16-17 Jul. (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. maximowific
Papilio machaon hippocrates (Pap: Le) 24-26 Aug. (1)

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

Iridaceae

Iris rossii
*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*

*Sympetrum 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*

*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**

*Pachyrhynchus*

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

**Chrysopidae**

*Chrysopa sp.1*

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

**COLEOPTERA**

*Staphylinidae*

*Euphasalerum parallelym*

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

**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)

*Parasericia gricea*

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

**Oxyctonia jucunda**

*Quercus dentata* (fag1) 11-16 May (1); *Polygonum cuspidatum* (pol3) 24-26 Aug. (1); *Hypericum pseudopetiolatum* (clu1) 17-22 Sep. (1); *Cirsium sufflum* (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.*

*Chionographis japonica* (ili6) 16-17 Jun. (1)

*Anthousius sp.*

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

**Elateridae**

*Dalopius tamui*

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

*Vuilletus viridis*

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

**Cantharidae**

*Themus midas*

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

*Mikadocontharis 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)
Prothemerus ciusianus  
Benthamidia japonica (cor2) 16-17 Jun. (1); Weigela decora (cap6) 16-17 Jun. (2)

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

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

Nitrilulidae

Meligethes 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

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

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

Oedemeridae

Oedemeronia lucidicollis  
Ranunculus japonicus (ran1) 11-16 May (3); Epimedium diphyllum (ber1) 11-16 May (2), 26-29 May (1);  
Pseudostellaria heterantha (car1) 11-16 May (2); Viola orientalis (vio1) 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)

Lagridae

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

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

Cerambycidae

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

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

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

Chrysolomelidae

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

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

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

Zypangia lewisi
Ranunculus japonicus (ran1) 11-16 May (1); Epimedium diphyllum (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)

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

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

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

Attelabidae

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

Curculionidae

Baris dispilota
Hydrangea paniculata (hyd3) 24-26 Aug. (1); Astilbe thunbergii (sax5) 10-16 Jul. (8); Rubus parvifolius (ros8) 16-17 Jun. (1); Anaphalis maritima 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)

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

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

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

**Braconidae**

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

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

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

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

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

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

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

sp. 8  
Salix vulpina (sal1) 16-18 Apr. (1)
Plant-pollinator Interactions at Mt. Yufu

**Ichneumonidae**

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

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

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

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

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

*Pteromalidae*

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

*Perilampidae*

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

*Scoliidae*

*Ichneumon* sp. 1
*Lindera sericea* (laul) 16-18 Apr. (1)

*Ichneumon* sp. 2
*Lindera sericea* (laul) 16-18 Apr. (3)

*Eulophidae*

*Ichneumon* sp. 1
*Lindera sericea* (laul) 16-18 Apr. (1)

*Ichneumon* sp. 2
*Lindera sericea* (laul) 16-18 Apr. (3)
Campsomeris prismatica
   Sophora flavescens (fabl) 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 (litl6) 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
   Abelia serrata (cap1) 26-29 May (1); Weigela decora (cap6) 16-17 Jun. (1)

Pompilidae

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

Eumenidae

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

Vespidae

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

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

Sphecidae

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

Ammophila sabulosa nipponica
   Deutzia crenata var. floribunda (sax6) 16-17 Jun. (2); Sophora flavescens (fab1) 16-17 Jun. (1); Veronica rotunda var. petirolata (scr1) 4-5 Aug. (1); Asparagus schoberioides (litl5) 26-29 May (1)

Colletidae

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

Halictidae

Lasioglossum (Lasioglossum) sp.1
Plant-pollinator Interactions at Mt. Yufu

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

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

Lasioglossum occidentis
Ranunculus japonicus (ran1) 26-29 May (1)

Lasioglossum (Lasioglossum) sp.3
Cimicifuga acerina (ran2) 17-22 Sep. (2); Geranium shikokianum (ger1) 17-22 Sep. (2); Aster ageratoides ssp. leiophyllus (ast21) 17-22 Sep. (2); Aster scaber (ast19) 17-22 Sep. (1); Heteropappus hispidus (ast22) 17-22 Sep. (5); Saussurea gracilis (ast12) 17-22 Sep. (2); Saussurea yanagisawae var. nivea (ast17) 17-22 Sep. (3); Solidago virga-aurica ssp. Asiatic (ast18) 17-22 Sep. (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 Evyllaeus) sp.1
Aleuris luteoviridis (li19) 10-16 Jul. (1)

Lasioglossum (carinate Evyllaeus) sp.2
Viburnum erosum var. punctatum (cap3) 26-29 May (1); Cirsium suffultum (ast16) 17-22 Sep. (1)

Lasioglossum (carinate Evyllaeus) sp.3
Abelia serrata (cap1) 26-29 May (1)

Lasioglossum apristum
Clethra barbinervis (cle1) 4-5 Aug. (1); Hydrangea paniculata (hyd3) 4-5 Aug. (1)

Lasioglossum (carinaless Evyllaeus) sp.1
Spiraea japonica (ros9) 10-16 Jul. (1); Veronica rotunda var. petiolata (scr1) 4-5 Aug. (1)

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

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

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

Lasioglossum (carinaless Evyllaeus) sp.6
Galium verum (rub2) 10-16 Jul. (1)

Lasioglossum (carinaless Evyllaeus) 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 sapporensis
       Pieris japonica (eri1) 16-18 Apr. (1)

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

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

Andrena dentata
       Clethra 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 kiusuanum (eri4) 26-29 May (2); Rhododendron reticulatum (eri3) 11-16 May (4)

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

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

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

Andrena benefica
       Salix sieboldiana (sal3) 11-16 May (3)

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

Andrena komachi
       Ranunculus japonicus (mn1) 11-16 May (1); Pieris japonica (eri1) 16-18 Apr. (1); Potentilla freyniana (ros1) 11-16 May (1)

Andrena kaguya
       Ranunculus japonicus (mn1) 11-16 May (1); Viola orientalis (viol1) 16-18 Apr. (1)

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

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

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

**Megachilidae**

Coelioxys sp.1
Dianthus superbus var. longicalyx (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); Abelia serrata (cap1) 26-29 May (1); Weigela japonica (cap2) 26-29 May (1); Aster ageratoides ssp. leiophyllus (ast21) 17-22 Sep. (1); Cirsium japonicum (ast3) 16-17 Jun. (3); Cirsium suffultum (ast16) 17-22 Sep. (1)

Ceratina flavipes
Ranunculus japonicus (ran1) 26-29 May (1); Lespedeza bicolor (fab3) 24-26 Aug. (2); Geranium shikokianum (ger1) 4-5 Aug. (1); Prunella vulgaris var. 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 decor (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 suffultum (ast16) 17-22 Sep. (2); Ligularia japonica (ast6) 10-16 Jul. (3); Symurus excelsus (ast25) 14-16 Oct. (3); Hemerocallis vespertina (ili8) 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); Stryx japonica (sax1) 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 decor (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 decor (cap6) 16-17 Jun. (7); Cirsium japonicum (ast3) 16-17 Jun. (2); Cirsium suffultum (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 (ili13) 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
Cimiciuga 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 yanagisawai var. nivea (ast17) 17-22 Sep. (1); Allium thunbergii (ili13) 17-22 Sep. (1); Hemerocallis vespertina (ili8) 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
Arisaema japonicum (ara1) 26-29 May (1)

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

Culicidae

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

Chironomidae

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

Ceratopagonidae

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

sp.1

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

sp.2

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

sp.3

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

Bibionidae

Bibio sp.1

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

Bibio sp.2

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

Bibio simulans

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

Bibio sp.3

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

Bibio sp.4

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

Bibio gracilipalpus

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

Bibio anuretus

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 jamasakura_ (ros3) 11-16 May (1)  

sp.5  
_Salix sieboldiana_ (sal3) 11-16 May (1)  

sp.6  
_Prunus jamasakura_ (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_ (cri1) 16-18 Apr. (1)  

sp.4  
_Arisaema japonicum_ (ara1) 16-18 Apr. (1)  

sp.5  
_Pieris japonica_ (cri1) 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)

**Acroceridae**

Philopota nigroaenea

*Rhododendron kiusuanum* (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)

**Bombyliidae**

Bombylus major

*Viola grypoceras* (vio2) 16-18 Apr. (4); *Viola hondoensis* (vio3) 16-18 Apr. (1); *Rhododendron kiusuanum* (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 dilatum* (cap5) 16-17 Jun. (1)

sp.5

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

sp.6

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

sp.7

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

sp.8

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

sp.9

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

Euthyneura sp.1

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

sp.10

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

**Pipunculidae**

Pipunculus sp.1

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

Eristalis tenax

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

*Dideides coquilletti*

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

*Volucella jeddona*

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

*Syrphus torvus*

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

*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)

*Helophites 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)

*Epiyrphus balteatus*

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

*Baccha maculata*

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

*Allobaccha apicalis*

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

*Betasyrphus serarius*

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

*Scaeva komabensis*

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

*Cheilostia sp.*

- *Potentilla freyniana* (ros1) 16-18 Apr. (1)
Plant-pollinator Interactions at Mt. Yufu

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

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

Sphaerophoria macrogaster
Dianthus superbus var. longicalyc (car3) 10-16 Jul. (1); Veronica rotunda var. petiolaris (scr1) 4-5 Aug. (1); Ixeris dentata (ast1) 11-16 May (3), 26-29 May (2); Chionographis japonica (lil6) 16-17 Jun. (3), 26-29 May (1)

Paragus quadrifasciatus
Hydrocotyle ramiflora (api1) 16-17 Jun. (1); Galium verum (rub2) 10-16 Jul. (2)

Melanostoma scalare
Ranunculus japonicus (ran1) 11-16 May (1); Moehringia lateriflora (car2) 26-29 May (2); Hydrangea luteo-venosa (hyd1) 26-29 May (1); Prunus jamaakensis (ros3) 11-16 May (1); Prunella vulgaris var. lilacina (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 (api1) 16-17 Jun. (1)

Cheilosia sp.1
Ranunculus japonicus (ran1) 11-16 May (1); Potentilla freyniana (ros1) 11-16 May (1)

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

Cheilosia sp.3
Astilbe thunbergii (sax5) 10-16 Jul. (1); Deutzia crenata (sax2) 16-17 Jun. (1)

Sphaerophoria philanthus
Pseudostellaria heterantha (car1) 11-16 May (1); Polygonum cuspidatum (pol3) 24-26 Aug. (1); Arabis glabra (bral) 16-17 Jun. (1); Rhododendron kiusuanum (eri4) 26-29 May (1); Lysimachia clethroides (prl1) 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 (fabl) 16-17 Jun. (1); Vicia unijuga (fab2) 16-17 Jun. (1); Angelica cartilagino-marginata (api3) 24-26 Aug. (1); Veronica rotunda var. petiolaris (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)
Plant-pollinator Interactions at Mt. Yufu

_Hylmyia sp._
_Salix sieboldiana (sal3) 11-16 May (2); Prunus jamasakura (ros3) 11-16 May (2)_

_Delia sp._
_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._
_Salix sieboldiana (sal3) 11-16 May (1)_

_Delia sp._
_Pieris japonica (eri1) 16-18 Apr. (1)_

_Delia sp._
_Cephalanthera falcata (orc1) 11-16 May (1)_

_Delia sp._
_Rhododendron kiusuanum (eri4) 16-17 Jun. (1)_

**Muscidae**

sp.1  
_Anaphalis margaritacea var. angus (ast13) 24-26 Aug. (1)_

**Calliphoridae**

_Stomorhina obsoleta_
_Polygonum cuspidatum (pol3) 24-26 Aug. (18); Clethra barvinervis (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 scabiosaeolia (val3) 17-22 Sep. (1)_

sp.1  
_Hypericum pseudopetiolatum (clu1) 17-22 Sep. (1)_

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

_Aldrichina grahami_
_Benthamidia japonica (cor2) 16-17 Jun. (2)_

_Eurychaeta sp._
_Sanguisorba officinalis (ros11) 17-22 Sep. (1)_

sp.3  
_Hydrangea luteo-venosa (hyd1) 26-29 May (1)_

**Sarcophagidae**

_Ravinia sp._
_Benthamidia japonica (cor2) 16-17 Jun. (1)_

**Tachinidae**

_Linnaenia sp._
_Chionographis japonica (lil6) 16-17 Jun. (1)_

_Tachina sp._
_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)

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

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

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

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

Prosena sp.1  
  *Lespedeza bicolor* (fab3) 24-26 Aug. (2); *Cirsium suffutatum* (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 Jun. (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**

**Incurvariidae**

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

**Tortricidae**

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

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

**Zygaenidae**

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

Thyrididae

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

Hesperiidae

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

Parnara guttata guttata
  Cirsium japonicum (ast3) 10-16 Jul. (2); Cirsium suffutum (ast16) 17-22 Sep. (1); Echinops setifer (ast1.5) 24-26 Aug. (1); Ligularia japonica (ast6) 24-26 Aug. (1); Hemerocallis vespertina (lil8) 4-5 Aug. (1)

Ochlodes ochraceus
  Astilbe 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 suflSfbltum (ast16) 17-22 Sep. (1); Echinops setifer (ast15) 24-26 Aug. (1); Inula japonica (ast14) 24-26 Aug. (1); Lilium leichtlinii var. maximowic (lil12) 24-26 Aug. (1)

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

Pieridae

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

Lycaenidae

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

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

Nymphalidae

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

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

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

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

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

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

*Sphingidae*

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

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

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

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

*Lymantriidae*

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

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**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 hilside 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*. 