

**Appendices to J Poll Ecol 33(7), Arifin & Okamoto**

[DOI: 10.26786/1920-7603(2023)740](https://doi.org/10.26786/1920-7603%282023%29740)

Article

Floral scent and pollination on the invasive plant *Coreopsis lanceolata* in Japan

Muhammad Arifin 1\* and Tomoko Okamoto 1,2

1 The United Graduate School of Agricultural Sciences, Gifu University, 501-1193, Gifu, Japan.

2 Laboratory of Insect Ecology, Faculty of Applied Biological Sciences, Gifu University, 501-1193, Gifu, Japan.

**\*** **Correspondence**: muh.arifin.1994@gmail.com

|  |
| --- |
|  |

**Appendix 1.** List and distribution of floral visitors of *Coreopsis lanceolata.* “No.” refers to the number of floral visitors collected. “%” refers to the relative abundance of floral visitors. The relative abundance was calculated by dividing the number of floral visitors collected for a specific species by the overall number of floral visitors collected. *N* in parenthesis refers to the total number of floral visitors collected for each population. Abbreviation: Aj = Ajiki; Hi1 = Hirai1; Hi2 = Hirai2; Km = Kami Minami Gata; Kd = Kidaiji, So = Sogaya; Tb = Tsubaki Bora; Yn = Yanagido. “Compiled” refers to the compilation of data of floral visitors collected across all populations.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Order/Family** | **Species** | **Aj (*N* = 97)** | **Hi1 (*N* = 78)** | **Hi2 (*N* = 93)** | **Km (*N* = 59)** | **Kd (*N* = 22)** | **So (*N* = 57)** | **Tb (*N* = 65)** | **Yn (*N* = 5)** | **Compiled (*N* = 476)** |
|  |  | **No.**  | **%**  | **No.**  | **%**  | **No.**  | **%**  | **No.**  | **%**  | **No.**  | **%**  | **No.**  | **%**  | **No.**  | **%**  | **No.**  | **%**  | **No.**  | **%**  |
| **HYMENOPTERA** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Apidae | *Apis mellifera* | 0.00 | 0.00 | 0.00 | 0.00 | 4.00 | 0.04 | 0.00 | 0.00 | 1.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.000 | 0.011 |
|  | *Ceratina* (*Ceratina*) sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | 0.03 | 0.00 | 0.00 | 2.000 | 0.004 |
|  | *Ceratina* (*Ceratinidia*) *flavipes* | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 2.000 | 0.004 |
|  | *Nomada japonica* | 0.00 | 0.00 | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 4.00 | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.000 | 0.011 |
| Halictidae | *Halictus* sp.1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | 0.03 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 3.000 | 0.006 |
|  | *Halictus* sp.2 | 25.00 | 0.26 | 8.00 | 0.10 | 15.00 | 0.16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 16.00 | 0.25 | 1.00 | 0.20 | 65.000 | 0.137 |
|  | *Halictus* sp.3 | 11.00 | 0.11 | 1.00 | 0.01 | 6.00 | 0.06 | 13.00 | 0.22 | 0.00 | 0.00 | 21.00 | 0.37 | 0.00 | 0.00 | 0.00 | 0.00 | 52.000 | 0.109 |
|  | *Halictus* sp.4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.000 | 0.004 |
|  | *Lasioglossum* sp.1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.000 | 0.006 |
|  | *Lasioglossum* sp.2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
|  | *Lasioglossum* sp.3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 5.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 6.000 | 0.013 |
|  | *Lasioglossum* sp.4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.00 | 0.05 | 0.00 | 0.00 | 3.00 | 0.05 | 7.00 | 0.11 | 0.00 | 0.00 | 13.000 | 0.027 |
|  | *Lasioglossum* sp.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
|  | *Lasioglossum* sp.6 | 9.00 | 0.09 | 5.00 | 0.06 | 0.00 | 0.00 | 4.00 | 0.07 | 0.00 | 0.00 | 1.00 | 0.02 | 6.00 | 0.09 | 1.00 | 0.20 | 26.000 | 0.055 |
|  | *Lasioglossum* sp.7 | 6.00 | 0.06 | 6.00 | 0.08 | 1.00 | 0.01 | 12.00 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 26.000 | 0.055 |
| Megacilidae | *Megachile* sp.1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
|  | *Megachile* sp.2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.00 | 0.07 | 0.00 | 0.00 | 1.00 | 0.02 | 3.00 | 0.05 | 0.00 | 0.00 | 8.000 | 0.017 |
|  | *Megachile* sp.3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 1.00 | 0.02 | 0.00 | 0.00 | 2.000 | 0.004 |
|  | *Megachile* sp.4 | 7.00 | 0.07 | 11.00 | 0.14 | 18.00 | 0.19 | 1.00 | 0.02 | 2.00 | 0.09 | 0.00 | 0.00 | 4.00 | 0.06 | 0.00 | 0.00 | 43.000 | 0.090 |
|  | *Megachile* sp.5 | 0.00 | 0.00 | 5.00 | 0.06 | 4.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 10.000 | 0.021 |
|  | *Megachile* sp.6 | 0.00 | 0.00 | 1.00 | 0.01 | 1.00 | 0.01 | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.000 | 0.006 |
|  | *Megachile* sp.7 | 0.00 | 0.00 | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
| **Appendix 1.** *Continued* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Order/Family** | **Species** | **Aj (*N* = 97)** | **Hi1 (*N* = 78)** | **Hi2 (*N* = 93)** | **Km (*N* = 59)** | **Kd (*N* = 22)** | **So (*N* = 57)** | **Tb (*N* = 65)** | **Yn (*N* = 5)** | **Compiled (*N* = 476)** |
| **No**  | **%**  | **No**  | **%**  | **No**  | **%**  | **No**  | **%**  | **No**  | **%**  | **No**  | **%**  | **No**  | **%**  | **No**  | **%**  | **No**  | **%**  |
|  | *Megachile* sp.8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.05 | 0.00 | 0.00 | 3.00 | 0.05 | 0.00 | 0.00 | 4.000 | 0.008 |
| Scoliidae | *Campsomeriella* *annulata* | 1.00 | 0.01 | 5.00 | 0.06 | 4.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 10.000 | 0.021 |
| Vespidae | *Ancistrocerus* sp. | 0.00 | 0.00 | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
|  | *Stenodynerus* sp. | 3.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.000 | 0.006 |
| ? | Symphita spp.  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.000 | 0.004 |
| **DIPTERA** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Calliphoridae | *Lucilia* sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
| Rhiniidae | *Stomorhina* sp. | 6.00 | 0.06 | 0.00 | 0.00 | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 8.000 | 0.017 |
| Syrphidae  | Eristalinae spp.1 | 8.00 | 0.08 | 6.00 | 0.08 | 9.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.00 | 0.05 | 0.00 | 0.00 | 26.000 | 0.055 |
|  | Eristalinae spp.2 | 2.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.000 | 0.004 |
|  | *Mesembrius flavipes* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | 0.40 | 3.000 | 0.006 |
|  | Syrphidae spp.1 | 3.00 | 0.03 | 4.00 | 0.05 | 2.00 | 0.02 | 1.00 | 0.02 | 0.00 | 0.00 | 12.00 | 0.21 | 5.00 | 0.08 | 1.00 | 0.20 | 28.000 | 0.059 |
|  | Syrphidae spp.2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 1.00 | 0.02 | 1.00 | 0.02 | 0.00 | 0.00 | 3.000 | 0.006 |
| ? | Diptera spp.1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
|  | Diptera spp.2 | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
|  | Diptera spp.3 | 0.00 | 0.00 | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
| **LEPIDOPTERA** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Crambidae | *Spoladea recurvalis* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
| Hesperiidae | *Parnara guttata* | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
| Lycaenidae | *Everes argiades* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 1.00 | 0.02 | 0.00 | 0.00 | 2.000 | 0.004 |
|  | *Lycaena phlaeas* | 4.00 | 0.04 | 2.00 | 0.03 | 1.00 | 0.01 | 0.00 | 0.00 | 2.00 | 0.09 | 2.00 | 0.04 | 2.00 | 0.03 | 0.00 | 0.00 | 13.000 | 0.027 |
|  | *Zizeria maha* | 2.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.000 | 0.004 |
| Nymphalidae  | *Argyreus hyperbius* | 0.00 | 0.00 | 1.00 | 0.01 | 0.00 | 0.00 | 2.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.000 | 0.006 |
|  | *Polygonia c-aureum* | 0.00 | 0.00 | 1.00 | 0.01 | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.000 | 0.004 |
|  | *Vanessa cardui* | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
|  | *Ypthima argus* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
| Papilionidae | *Papilio xuthus* | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
| **Appendix 1.** *Continued* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Order/Family** | **Species** | **Aj (*N* = 97)** | **Hi1 (*N* = 78)** | **Hi2 (*N* = 93)** | **Km (*N* = 59)** | **Kd (*N* = 22)** | **So (*N* = 57)** | **Tb (*N* = 65)** | **Yn (*N* = 5)** | **Compiled (*N* = 476)** |
| **No**  | **%**  | **No**  | **%**  | **No**  | **%**  | **No**  | **%**  | **No**  | **%**  | **No**  | **%**  | **No**  | **%**  | **No**  | **%**  | **No**  | **%**  |
| Pieridae | *Colias erate* | 0.00 | 0.00 | 9.00 | 0.12 | 11.00 | 0.12 | 0.00 | 0.00 | 1.00 | 0.05 | 1.00 | 0.02 | 2.00 | 0.03 | 0.00 | 0.00 | 24.000 | 0.050 |
|  | *Pieris rapae* | 0.00 | 0.00 | 4.00 | 0.05 | 4.00 | 0.04 | 1.00 | 0.02 | 4.00 | 0.18 | 1.00 | 0.02 | 3.00 | 0.05 | 0.00 | 0.00 | 17.000 | 0.036 |
| **COLEOPTERA** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Chrysomelidae | Alticini spp. | 5.00 | 0.05 | 1.00 | 0.01 | 2.00 | 0.02 | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9.000 | 0.019 |
| Curculionidae | *Anthonomus bisignifer* | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 2.000 | 0.004 |
| Mordellidae | Mordellidae spp. | 0.00 | 0.00 | 0.00 | 0.00 | 3.00 | 0.03 | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.000 | 0.008 |
| Oedemeridae | *Oedemera lucidicollis* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
| Scarabaeidae | *Cetonia pilifera* | 1.00 | 0.01 | 1.00 | 0.01 | 1.00 | 0.01 | 0.00 | 0.00 | 1.00 | 0.05 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 5.000 | 0.011 |
|  | *Gametis jucunda* | 0.00 | 0.00 | 2.00 | 0.03 | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.000 | 0.006 |
| **ORTHOPTERA** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Tettigoniidae | Tettigoniidae spp.1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
|  | Tettigoniidae spp.2 | 0.00 | 0.00 | 1.00 | 0.01 | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.000 | 0.004 |
|  | Tettigoniidae spp.3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.000 | 0.002 |
| **HEMIPTERA** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lygaeidae | *Nysius* sp. | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.02 | 2.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.000 | 0.008 |
|  | *Tropidothorax sinensis* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.000 | 0.004 |

**Appendix 2. List of previous studies recording floral visitors of the genus *Coreopsis***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Species** | **Visitors** | **Locality** | **Note** | **References** |
| *Coreopsis lanceolata* | **Bees (long-tongued)**Apidae (Apini): *Apis mellifera* Apidae (Bombini): *Bombus impatiens,* *Psithyrus citrinus* Anthophoridae (Ceratinini): *Ceratina calcarata*, *Ceratina dupla*, *Ceratina mikmaqi*, *Ceratina strenua* Anthophoridae (Epeolini): *Triepeolus subnitens* Anthophoridae (Nomadini): *Nomada australis*, *Nomada fervida*, *Nomada lepida*, *Nomada maculata*, *Nomada rubicunda*Megachilidae (Anthidiini): *Dianthidium simile*Megachilidae (Megachilini): *Megachile brevis*, *Megachile mendica*, *Megachile pugnata* Megachilidae (Osmiini): *Osmia georgica* Megachilidae (Stelidini): *Stelis lateralis***Bees (short-tongued)**Halictidae (Halictinae): *Agapostemon splendens*, *Agapostemon texanus*, *Agapostemon virescens*, *Augochlora pura*, *Augochlorella aurata*, *Augochlorella persimilis*, *Augochloropsis metallica metallica*, *Augochloropsis sumptuosa*, *Halictus confusus*, *Halictus ligatus, Lasioglossum floridanum*, *Lasioglossum fuscipenne*, *Lasioglossum leucocomum*, *Lasioglossum paraforbesii*, *Lasioglossum pectorale*, *Lasioglossum perpunctatum*, *Lasioglossum pilosum, Lasioglossum vierecki* Halictidae (Sphecodini): *Sphecodes pimpinellae*Andrenidae (Andreninae): *Andrena rudbeckiae* Andrenidae (Panurginae): *Perdita bequaerti* | Illinois, USA (Native range) | Data was compiled from various literatures without mentioning the important of each visitorMost of Bees were reported to suck nectarLycaeides melissa samuelis as frequent floral visitor that sucks nectar | (Hilty 2020) |
| **Appendix 2.** *Continued* |  |  |  |
| **Species** | **Visitors** | **Locality** | **Note** | **References** |
|  | **Wasps**Scoliidae: *Campsomeris plumipes* **Ants (however mostly show non-pollinating impact)** Formicidae (Dolichoderinae): *Forelius pruinosus* Formicidae (Formicinae): *Formica dolosa*, *Formica incerta*, *Formica subsericea*, *Lasius neoniger*Formicidae (Myrmicinae): *Crematogaster cerasi*, *Myrmica* a*f-eva*, *Myrmica americana***Flies**Syrphidae: *Eristalis stipator*, *Eristalis tenax*, *Eristalis transversa,* *Toxomerus marginatus* Conopidae: *Physocephala texana*, *Zodion fulvifrons*, *Zodion intermedium*, *Zodion obliquefasciatum* **Butterflies**Nymphalidae: *Chlosyne nycteis*, *Phyciodes tharos*, *Vanessa virginiensis* Lycaenidae: *Lycaeides melissa samuelis* Pieridae: *Colias philodice***Beetles**Buprestidae: *Acmaeodera neglecta*, *Acmaeodera ornata*, *Acmaeodera pulchella*Cantharidae: *Chauliognathus pennsylvanicus* Cerambycidae: *Pseudostrangalia cruenta* Chrysomelidae: *Acanthoscelides calvus*  |  |  |  |
| **Appendix 2.** *Continued* |  |  |  |
| **Species** | **Visitors** | **Locality** | **Note** | **References** |
|  | Cleridae: *Trichodes nuttalli*Dermestidae: *Cryptorhopalum triste*Meloidae: *Nemognatha nemorensis* Melyridae: *Collops quadrimaculatus*, *Collops vicarius* Mordellidae: *Mordellistena aspersa*, *Mordellistena cervicalis*, *Mordellistena rubrilabris* Scarabaeidae: *Trichiotinus viridans* **Others**Coreidae: *Merocoris distinctus* Lygaeidae: *Lygaeus kalmii* Miridae: *Lygocoris quercalbae* Pachygronthidae: *Phlegyas abbreviatus* Rhopalidae: *Harmostes reflexulus* |  |  |  |
| *Coreopsis lanceolata* | **Bee**Apidae: *Apis cerana***Flies**Syrphidae: *Eristalis cerealis,* *Phytomia zonata,* *Asarkina porcina, Chrysomyia megacephala***Butterflies**Danaidae: *Euploea mulciber*Lycaenidae: Lycaenidae spp.Nymphalidae: *Argyreus hyperbius, Polygonia c-aureum, Neptis sappho* | Jiangxi Province, China (Introduced range) | *Apis cerana* was the most predominant floral visitor (approximately 45%) | (Zeng et al. 2021) |
| **Appendix 2.** *Continued* |  |  |  |
| **Species** | **Visitors** | **Locality** | **Note** | **References** |
|  | Pieridae: *Pieris rapae*, *Pieris canidi***Hemiptera**Reduviidae: *Aspongopus chinensis, Halyomorpha halys, Lineifer* spp.**Beetle**Coccinellidae: *Coccinella septempunctata* |  |  |  |
| *Coreopsis* spp. | **Bee**Apidae: *Bombus edwurhii*  | California, USA(Native range) | 6 males recorded on flowers | (Thorp et al. 1983) |
| *Coreopsis basalis* | Primarily by bees | Central Texas, USA(Native range) | Bees are native to central Texas but there is no detail about the species of bees | (Simpson & Neff 1987) |
| *Coreopsis palmata* | **Bee** Halictidae: *Agapostemon texanus* **Wasp**Crabronidae: *Bembix spinolae*Sphecidae: *Cerceris* sp.**Syrphid fly**Syrphidae: *Toxomerus marginatus* | Crow Hassan ParkReserve, EasternMinnesota, USA(Native range) | It is unusual to find an insect visitor on this plant (3 collections; 5 individuals; 4 species) | (Reed 1993) |
| *Coreopsis atkinsonia*  | **Bee**Colletidae: *Colletes kincaidii* | Utah, USA(Native range) | The flower is planted in greenhouse. Both sexes were observed collecting nectar from all of the available flowers throughout the following week | (Torchio et al. 1988) |

**References from Appendix 2**

Hilty J (2020) Flower-visiting insect of sand *Coreopsis*. Illinois wildflowers [online] URL: http://w.illinoiswildflowers.info/flower\_insects/plants/sand\_coreopsis.htm (accessed 19 May 2022).

Reed C (1993) Reconstruction of pollinator communities on restored prairies in Eastern Minnesota. MN USA.

Simpson BB, Neff JL (1987) Pollination ecology in the Southwest. Aliso: A Journal of Systematic and Evolutionary Botany 11:417–440.

Thorp RW, Horning Jr. DS, Dunning LL (1983) Bumble bees and cuckoo bumble bees of California (Hymenoptera: Apidae). University of California Press, Berkeley and Los Angeles.

Torchio PF, Trostle GE, Burdick DJ (1988) The nesting biology of *Colletes kincaidii* Cockerell (Hymenoptera: Colletidae) and development of its immature forms. Annals of the Entomological Society of America 81:605–625.

Zeng J-J, Zhou B, Wang N (2021) Comparing the reproductive biological characteristics of the alien invasive *Coreopsis lanceolata* to those of the non-invasive alien congener *Coreopsis tinctoria*. Plant Species Biology 36:379–389.

**Appendix 3. A comparison of floral morphology between the Tsubaki Bora population in Japan during the 2021 flowering season (*N* = 22) and the Jiangxi population in China during the 2018 flowering season (*N* = 30). The table provides data on various floral characteristics and allows for a comparison of the morphological differences between the two populations.**

|  |  |  |
| --- | --- | --- |
| **Indicator** | **Tsubaki Bora population (Japan)** | **Jiangxi population (China)**# |
| **Mean ± SD**  | **Range (Min-Max)** | **Mean ± SD**  |
| Number of bract | 8.4 ± 0.4 | 8.0–10.0 | NA |
| Number of phyllary | 8.3 ± 0.5 | 8.0–10.0 | NA |
| Number of ray floret | 9.2 ± 2.4 | 8.0–17.0 | NA |
| Number of disk floret | 192.5 ± 44.0 | 113.0–299.0 | NA |
| Corolla diameter (mm) | 54.3 ± 5.1 | 46.5­­­–62.8 | 52.2 ± 4.4 |
| Tubular flower diameter (mm) | 10.6 ± 1.6 | 6.6–14.9  | 11.4 ± 0.9 |
| Length of ray floret (mm) | 25.6 ± 2.9 | 19.1–31.2 | NA |
| Width of ray floret (mm) | 16.7 ± 2.9 | 10.2–23.6 | NA |
| Length of disk floret (mm) | 8.5 ± 2.9 | 6.4–10.7 | 8.9 ± 0.7 |
| Width of disk floret (mm) | 1.1 ± 0.2 | 0.6–2.0 | NA |

# Zeng J-J, Zhou B, Wang N (2021) Comparing the reproductive biological characteristics of the alien invasive *Coreopsis lanceolata* to those of the non-invasive alien congener *Coreopsis tinctoria*. Plant Species Biology 36:379–389.



**Appendix 4. Composition of floral visitors of *Verbena brassiliensis* (*N* = 26, *N* refers to the total number of collected specimens) and *Erigeron annuus* (*N* = 30), the co-flowering species nearby *Coreopsis lanceolata* in Kami Minami Gata population. The observation of floral visitors was conducted for 1 hour each.**



**Appendix 5. *Apis mellifera* visited the co-flowering species nearby *Coreopsis lanceolata* such as (A) *Verbena brassiliensis*; (B) *Erigeron annuus*; (C) *Trifolium repens.***