HERBIVOROUS INSECT FAUNA OF MILE-A-MINUTE WEED, *PERSICARIA PERFOLIATA* (POLYGONACEAE), IN JAPAN

KAZUMI MIURA1,4, HIROYUKI IDA1,2, KENSAKE IMAI3, SUZANNE LYON2, RICHARD REARDON4 AND KENJI FUJISAKI1

1Laboratory of Insect Ecology, Graduate School of Agriculture, Kyoto University, Kyoto, 606-8502, Japan

4Department of Plant, Soil & Insect Sciences, Fernald Hall, University of Massachusetts, Amherst, MA 01003 USA

2Forest Health Technology Enterprise Team, USDA Forest Service, Morgantown, WV 26505 USA

3Current Address: Center for Ecological Research, Kyoto University, Hirano 2, Otsu, Shiga, 520-2113, Japan

1Current Address: National Institute of Vegetable and Tea Science, Mie, 514-2392, Japan

4Current Address: Faculty of Human Sciences, Osaka University of Human Sciences, Settsu, Osaka, 566-8501, Japan

The mile-a-minute weed, *Persicaria perfoliata* (L.) H. Gross (Polygonaceae), was first established in the United States in Pennsylvania and Maryland in the 1930s (Wu et al. 2002), and has been placed on noxious weed lists in several states of the United States because of the damage it causes in infested orchards, nurseries, and horticultural crops (Oliver & Coile 1994; Wu et al. 2002). Because of its rapid growth, the weed readily invades forests or forest edges (Wu et al. 2002). In addition, the weed’s thorny vines impede movement of wildlife and interfere with human activities (Okay 1997). By 2003, the plant was found in 8 states (Delaware, Maryland, New York, Ohio, Pennsylvania, Virginia, West Virginia, and Connecticut) and the District of Columbia (Lamont & Fitzgerald 2000; Price 2001). Fifteen additional states are currently at risk of becoming infested with this weed (Okay 1997). In the southern United States, mile-a-minute weed could behave as a perennial plant (Stevens 1994; Ding et al. 2000). Recently, mile-a-minute weed was targeted for biological control.

Several natural enemies of mile-a-minute weed have been recognized in China (Ding et al. 2004), but little information is available on other potential biological control agents from other regions of the plant’s large native range (Ohwi 1965; Satake et al. 2000). We examined the weed in Japan because parts of Japan are in the native range of mile-a-minute weed (Ohwi 1965) and those areas are a good climatic match to the northeastern United States, where release of natural enemies is intended (Reardon, unpublished data). Here we report the results of a survey made in 2004 and 2005 of the herbivorous insect fauna of mile-a-minute weed of Japan.

We selected our survey locations in Japan using data from the National Census on River Environments (1993–1999). We surveyed 15 sites, mainly in Kinki district (Table 1). Although most sites were sampled only once, in 2004, one site (Yawata city, Kyoto) was sampled several times over the course of the season. In 2005, we surveyed 1 site in Kinki district several times. Sample sites were distributed over 10 Prefectures and samples were collected between Apr and Nov.

For thorny vines of mile-a-minute weed sprawling on other vegetation, sweep net sampling was not feasible. Instead, timed visual searches were used as the sample unit (15 min per sample, 2 to 6 samples per site on a given sample date). Insects detected were captured for identification. Larvae were reared to adults on mile-a-minute weed in the laboratory (25°C, a photoperiod of 16:8 L:D).

We collected 50 herbivorous insect species (Table 2) on mile-a-minute weed: 11 Lepidoptera (22%), 26 Hemiptera (52%), 3 Orthoptera (6%), 9 Coleoptera (18%), and 1 Hymenoptera (2%). Of the total (except 4 species with unknown hosts), 30 species were clearly polyphagous and 10 were specialists on other plant families; these species clearly were not potential biological control agents. Six species appeared to be potential Polygonaceae specialists: (1) Two hemipterans, the bug *Coptosoma parvipictum* Montandon (Pataspidae) (Tomokuni, 1993), found frequently at the Yawata city site, and the aphid *Trichosiphonaphis ishimi-kawae* (Shinji) (Aphididae) (Moritsu 1983), which was found in both years at many sites; (2) two lepidopterans, *Timandra apicirosea* (Prout) (Geometridae) and *Oligonyx vulnerata* (Butler) (Noctuidae) (Inoue et al. 1982), of which *T. apicirosea* was frequently found, whereas *O. vulnerata* was rarely collected; (3) one sawfly, *Allantus luctifer* Smith (Tenthredinidae) (Asahina et al. 1965), found in both years at many sites; and (4) one beetle, *Rhinoconimus latipes* Korotyaev (Curculionidae) (Colpeter et al. 2004a,b) (Table 2).

*Rhinoconimus latipes* was collected in 2004 at the Yawata site from May to Oct, with peak abundance in late-Jun and mid-Sep and was collected at 6 sites (Yawata, Matsuobashi, Ishiyama, Kizu, Sendai, and Sapporo). Larvae of *T. apicirosea* were observed from May to Sep and it was collected at 9 sites (Azuchi, Kizu, Matsuobashi, Taki-
Florida Entomologist 91(2) June 2008

yama, Yawata, Haijima, Kagoshima, Sendai, and Tochigi). The sawfly <i>A. luctifer</i> was collected mainly as eggs or larvae and was observed at 10 sites (Azuchi, Hirakata, Ishiyama, Matsuobashi, Takiyama, Yasu, Yawata, Hachioji, Haijima, and Shizuoka). Eggs of <i>A. luctifer</i> were inserted in or around leaf midrib veins and at the Yawata site peak egg abundance occurred in May and Jul.

Of the 6 specialist herbivores encountered, <i>R. latipes</i> appears to be the most promising agent to control mile-a-minute weed (Colpetzer et al. 2004a, b). Two other species encountered, <i>A. luctifer</i> and <i>T. apicirosea</i>, appear less promising. A congener of <i>T. apicirosea</i>, <i>Timandra griseata</i> Peterson (Lepidoptera: Geometridae) from China, previously has been rejected as a biological control agent because it developed on common buckwheat, <i>Fagopyrum esculentum</i> Moench (Polygonaceae) and tartary buckwheat, <i>Fagopyrum tartaricum</i> Gaertn (Polygonaceae) (Price et al. 2003). The aphid <i>T. ishimikawae</i>, a Polygonaceae specialist, was abundant but switches hosts seasonally, using species of Caprifoliaceae in winter (Moritsu 1983). Therefore, this aphid would only establish where both necessary Polygonaceae and Caprifoliaceae hosts grow near each other. The remaining Polygonaceae specialists, <i>C. parvipictum</i> and <i>O. vulnerata</i>, were not abundant in our samples, and may have limited impact on mile-a-minute weed in Japan. However, it is possible their densities might increase after the introduction to the United States if their own natural enemies limit their Japanese densities.

Two leaf beetle species, <i>Lema diversa</i> Baly and <i>L. concinnipennis</i> Baly, that are oligophagous for Polygonaceae and that are common in China (Ding et al. 2004) have been reported from Japan (Hayashi et al. 1984), but were not collected in this survey. Although seed feeding species are known in China (Ding et al. 2004), none was collected in Japan.

We thank the USDA Forest Service for funding, and Kazuo Yamazaki (Osaka City Institute of Public Health and Environmental Sciences) for identifications of some insects, Yoshitaka Sakamaki (Graduate School of Agriculture, Kagoshima University) for identification of <i>Calybites phasianipennellus</i>, Hiroaki Kojima (The Kyushu University Museum) and Hiraku Yoshitake (Graduate School of Arts and Sciences, University of Tokyo) for identification of <i>Rhinoncomimus latipes</i>, and Yoshihisa Sawada (The Museum of Nature and Human Activities, Hyogo) for identification of some weevils. We thank several colleagues in our laboratory for the identification of some insects and for assistance in field survey, and in particular, Azusa Yamazaki, who surveyed mile-a-minute weed in Kagoshima and Shingo Tanaka, who surveyed in Sapporo.

**SUMMARY**

<i>Persicaria perfoliata</i> is an annual plant of Asian origin, which is a serious invader of native and orchard plant communities in the eastern USA. Based on a 2-year survey of herbivores of

---

| Site (Prefecture) | Survey period | River or lake near the site |
|------------------|---------------|-----------------------------|
| **Within Kinki district** |
| Azuchi (Shiga) | Aug | Aug | Biwa Lake |
| Hirakata (Osaka) | — | Apr-Sep | Yodo river |
| Ishiyama (Shiga) | Oct | Jun-Oct | Daido river |
| Kizu (Kyoto) | May | May-Sep | Kizu river |
| Matsuobashi (Kyoto) | Jul | Apr-Aug | Katsura river |
| Takiyama (Hyogo) | Sep | Jun-Oct | Ina river |
| Yasu (Shiga) | — | Sep-Nov | Yasu river |
| Yawata (Kyoto) | May-Oct | May-Oct | Uji river (the junction of Uji, Kizu, and Katsura river) |
| **Outside of Kinki district** |
| Hachioji (Tokyo)* | Sep | Aug | Aki river |
| Haijima (Tokyo)* | — | Aug | Tama river |
| Kagoshima (Kagoshima) | Oct | Jun-Oct | Usogi river and Kenkou river |
| Sapporo (Hokkaido)* | — | Aug | Yubari river |
| Sendai (Miyagi)* | — | Aug | Natori river |
| Shizuoka (Shizuoka)* | Sep | Aug | Abe river |
| Tochigi (Tochigi)* | Sep | Aug | Kinu river |

*Surveyed once a year.
Table 2. Herbivorous insects associated with *P. perfoliata* in Japan.

| Order/Family | Species                                      | Number of sites | 2004 | 2005 | Host range |
|--------------|---------------------------------------------|-----------------|------|------|------------|
|              |                                             |                 | Y\(^1\) | OY | K | OK |
| Orthoptera   |                                             |                 | ------ |    |   |    |
| Pygromorphidae | *Atractomorpha lata* (Motschulsky) | 2               | 3      | 0  | 0 | G\(^2\) |
| Acridida     | *Acrida cinerea* (Thunberg)                | 1               | 0      | 0  | 0 | OS |
| Patanga japonica (Bolivar) |                                      | 1               | 0      | 0  | 0 | G |
| Hemiptera-Heteroptera |                                      |                 | ------ |    |   |    |
| Tingidae     | *Corythucha marmorata* (Uhler)            | 3               | 1      | 4  | 0 | OS |
| Coreidae     | *Cletus rusticus* Sàtl                   | 2               | 0      | 1  | 0 | OS |
| *Homoeocerus unipunctatus* (Thunberg) |                                      | 2               | 0      | 1  | 0 | OS |
| *Hygia (Colpura) lativentris* (Motschulsky) |                                      | 0               | 0      | 1  | 0 | G |
| *H. (Hygia) opaca* (Uhler) |                                      | 2               | 0      | 0  | 0 | G |
| *Riptortus clavatus* (Thunberg) |                                      | 0               | 0      | 1  | 0 | G |
| Lygaeidae    | *Tropicidothorax cruciger* (Motschulsky) | 0               | 1      | 0  | 0 | ? |
|              | *T. belogolowi* (Jakovlev)                | 0               | 1      | 0  | 0 | ? |
|              | *Nysius plebeius* (Distant)               | 0               | 0      | 1  | 0 | G |
|              | *Togo hemipterus* (Scott)                 | 1               | 0      | 0  | 0 | G |
| Malcidae     | *Chauliops fallax* Scott                  | 3               | 0      | 0  | 0 | OS |
| Miridae      | *Adelphocoris triannulatus* (Sàtl)         | 0               | 0      | 1  | 0 | G |
|              | *Charagochilus angusticollis* (Fallén)     | 2               | 0      | 0  | 0 | G |
|              | *Eurystylus coelestialium* (Kirkaldy)     | 0               | 0      | 1  | 0 | G |
| Pataspidae   | *Coptosoma parvipictum* Montando          | 8               | 0      | 1  | 0 | PS |
|              | *Megacopta punctatissima* (Montandon)     | 0               | 0      | 1  | 0 | OS |
| Pentatomidae | *Carbula humerigera* (Uhler)              | 0               | 0      | 0  | 1 | G |
|              | *Dolycoris baccalum* (Linnaeus)           | 0               | 0      | 2  | 0 | G |
|              | *Eysarcoris lewisi* (Distant)             | 0               | 0      | 0  | 1 | G |
| Hemiptera-Homoptera |                                      |                 | ------ |    |   |    |
| Aphididae    | *Trichosiphonaphis ishimikawai* (Shinji)  | 12              | 6      | 8  | 4 | PS |
| Aphrophoridae | *Aphrophora maritima* Matsumura           | 1               | 1      | 0  | 0 | OS? |
|              | *Gargara genistae* Fabricius              | 0               | 1      | 0  | 0 | G? |
| Deltoccephalidae | *Nephotettix cincticeps* Uhler       | 0               | 1      | 0  | 0 | OS? |
|              | *Phlogotettix cyclops* Mulsant et Rey     | 1               | 0      | 0  | 0 | ? |
| Penthimiidae | *Penthimia nitida* Lethierry              | 1               | 0      | 0  | 0 | G |
| Riciinidae   | *Orosaria japonicus* Melichar             | 0               | 0      | 0  | 1 | G |
| Lepidoptera  |                                            |                 | ------ |    |   |    |
| Arctidae     | *Hyphantria cunea* Drury                  | 0               | 0      | 0  | 1 | G |
| Geometridae  | *Timandra apiceirosea* (Prout)            | 9               | 5      | 5  | 4 | PS |
| Gracillariida | *Calybes phasianipennella* Hübner         | 3               | 0      | 3  | 3 | G |
| Lymantriidae | *Cifuna locuples confuse* (Bremer)        | 0               | 1      | 0  | 0 | G |
|              | *Orgyia thyellina* Butler                | 0               | 0      | 0  | 2 | G |
| Noctuidae    | *Helicoverpa armigera* (Hübner)           | 0               | 0      | 2  | 0 | G |
|              | *Herminia innocens* Butler                | 0               | 0      | 1  | 0 | G |
|              | *Oligonyx vulnerata* (Butler)             | 0               | 0      | 1  | 0 | PS |
| Tortricidae  | *Trachea atriplis gnama* Butler           | 1               | 0      | 1  | 1 | G |
|              | *Viminia rumicis* (Linnaeus)              | 1               | 1      | 1  | 0 | G |
| Hymenoptera  |                                            |                 | ------ |    |   |    |
| Pamphiliidae | *Allantus lucifer* Smith                  | 7               | 4      | 7  | 3 | PS |

\(^1\)Y: Yawata, OY: Outside of Yawata, K: Kinki district, OK: Outside of Kinki district.
\(^2\)G: Generalist, PS: Poligonaceae specialist, OS: Other plant family specialist, ?: unknown.

In 2004, we assessed mile-a-minute weed in Yawata 12 times and at 9 sites outside of Yawata. In 2005, we assessed mile-a-minute weed at 8 sites within Kinki district and at 7 sites outside of Kinki district. Insects collected were identified and their host ranges checked with Orthopterological Society of Japan (2006), Tomokuni (1993), Asahina et al. (1965), Hayashi et al. (1984), Uéno et al. (1985), Inoue et al. (1982), and Moritsu (1983).
TABLE 2. (CONTINUED) HERBIVOROUS INSECTS ASSOCIATED WITH *P. PERFOLIATA* IN JAPAN.

| Order/Family | Species | 2004 | 2005 |
|--------------|---------|------|------|
| Coleoptera   |         |      |      |
| Attelabidae  | *Euops splendidus* Voss | 1 | 0 |
| Chrysomelidae| *Aulacophora nigripennis* Motschulsky | 1 | 0 |
| Curculionidae| *Rhinoncomimus niger* Korotyaev | 12 | 3 |
| Scarabaeidae | *Anomala rufecuprea* Motschulsky | 1 | 0 |
|              | *Mimela splendens* Gyllenhal | 0 | 0 |
|              | *Popillia japonica* Newman | 7 | 1 |

1Y: Yawata, OY: Outside of Yawata, K: Kinki district, OK: Outside of Kinki district.
2G: Generalist, PS: Polygonaceae specialist, OS: Other plant family specialist, ?: unknown.

In 2004, we assessed mile-a-minute weed in Yawata 12 times and at 9 sites outside of Yawata. In 2005, we assessed mile-a-minute weed at 8 sites within Kinki district and at 7 sites outside of Kinki district. Insects collected were identified and their host ranges checked with Orthopterological Society of Japan (2006), Tomokuni (1993), Asahina et al. (1965), Hayashi et al. (1984), Uéno et al. (1985), Inoue et al. (1982), and Moritsu (1983).

this plant in Japan, a suite of herbivorous insects were collected. Six species, including 1 bug, 1 aphid, 2 moths, 1 sawfly, and 1 beetle, are considered as specialists on Polygonaceae.

REFERENCES CITED

ASAHINA, S., T. ISHIHARA, AND K. YASUMATSU. 1965. Iconographia Insectorum Japonicorum Colore Naturali. Vol. 3. Hokuryu-Kan Publishing Co., Ltd., Tokyo, Japan (in Japanese).

COLPETZER, K., J. HOUGH-GOLDSTEIN, J. DING, AND W. FU. 2004a. Host specificity of the Asian weevil, *Rhinoncomimus latipes* Korotyaev (Coleoptera: Curculionidae), a potential biological control agent of mile-a-minute weed, *Polygonum perfoliatum* L. (Polygonales: Polygonaceae). Biol. Cont. 30: 511-522.

COLPETZER, K., J. HOUGH-GOLDSTEIN, K. HARKINS, AND M. SMITH. 2004b. Feeding and oviposition behavior of *Rhinoncomimus latipes* Korotyaev (Coleoptera: Curculionidae) and its predicted effectiveness as a biological control agent for *Polygonum perfoliatum* L. (Polygonales: Polygonaceae). Environ. Entomol. 33: 990-996.

DING, J., W. FU, Y. WU, AND R. REARDON. 2000. Insects associated with mile-a-minute weed, *Polygonum perfoliatum* in China: a three-year-survey report, pp. 225-231 In N. Spencer [ed.], Proceedings of X International Symposium on Biological Control of Weeds, July 4-14, 1999, Bozeman, Montana.

DING, J., W. FU, R. REARDON, Y. WU, AND G. ZHANG. 2004. Exploratory survey in China for potential insect biocontrol agents of mile-a-minute weed, *Polygonum perfoliatum* L., in eastern USA. Biol. Cont. 20: 487-495.

HAYASHI, M., K. MORIMOTO, AND S. KIMOTO. 1984. The Coleoptera of Japan in Color. Vol. IV. Hoikusha Publishing Co., Ltd. Osaka, Japan (in Japanese).

INOUE, H., S. SUGI, H. KUROKO, S. MORIUTI, AND A. KAWABE. 1982. Moths of Japan. Vol. 1. Kodansha Co., Ltd., Tokyo, Japan (in Japanese).

LAMONT, E. E., AND J. M. FITZGERALD. 2000. Noteworthy plants reported from the Torrey Range-2000. J. Torrey Bot. Soc. 128: 409-414.

MORITSU, M. 1983. Aphids of Japan in Colors. Zenkoku Nison Kyoiku Kyokai, Publishing Co., Ltd., Tokyo, Japan (in Japanese).

NATIONAL CENSUS ON RIVER ENVIRONMENTS. 1993-1999. Foundation for Riverfront Improvement and Restoration. Yankaido, Tokyo, Japan (in Japanese).

OHWI, J. A. 1965. Flora of Japan. Smithsonian Institute, Washington, DC.

OKAY, J. A. 1997. *Polygonon perfoliatum*: A Study of Biological Features Leading to the Formation of a Management Policy. Ph.D. Dissertation. George Mason University, Fairfax, VA.

OLIVER, J. D., AND N. C. COILE. 1994. *Polygonon perfoliatum* L. (Polygonaceae), the Mile-a-minute Weed. Botany Circular No. 29, Florida Department of Agriculture and Consumer Services, Division of plant Industry, Gainesville.

ORTHOPTEROLOGICAL SOCIETY OF JAPAN. 2006. Orthoptera of the Japanese Archipelago in Color. Hokkaido University Press Sapporo, Japan (in Japanese).

PRICE, D. L., AND M. T. SMITH. 2003. Biology, rearing, and preliminary evaluation of host range of two potential biological control agents for mile-a-minute weed, *Polygonum perfoliatum* L. Environ. Entomol. 32: 229-236.
STEVENS, K. W. 1994. Invading weed makes a bid to become the new kudzu. The New York Times, the Environment, Tuesday, August 16, 1994.

TOMOKUNI, M. 1993. A Field Guide to Japanese Bugs—Terrestrial Heteropterans-. Zenkoku Noson Kyoiku Kyokai, Publishing Co., Ltd., Tokyo, Japan (in Japanese).

UÉNO, S., Y. KUROSAWA, AND M. SATÔ. 1985. The Coleoptera of Japan in Color. Vol. II. Hoikusha Publishing Co., Ltd., Osaka, Japan (in Japanese).

WU, Y., R. C. REARDON, AND J. DING. 2002. Mile-a-minute weed, pp. 331-342 In R. G. Van Driesche, B. Blossey, M. Hoddle, S. Lyon, and R. C. Reardon [eds.]. Biological Control of Invasive Plants in the Eastern United States. Forest Health Technology Enterprise Team FHTET-2002-04, Morgantown, WV.