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Beneficial insects associated with stinging nettle, *Urtica dioica* Linnaeus, in central Washington State

David G. James*, Gerry Lauby, Lorraine Seymour and Katie Buckley
Department of Entomology, Washington State University, Irrigated Agriculture Research and Extension Center, 24106 North Bunn Road, Prosser, Washington 99350, U.S.A.
*Corresponding author. E-mail: david_james@wsu.edu

Abstract. Beneficial insects (predators, parasitoids, pollinators) associated with stinging nettles, *Urtica dioica* Linnaeus (Urticaceae), were sampled at three sites in central Washington during spring–summer 2011–2013 using transparent sticky traps attached to upper portions of plants. Large numbers (200–400/trap) of beneficial insects were trapped particularly in June and early July, gradually decreasing thereafter. Phytophagous insects (aphids and leafhoppers) were trapped in much lower numbers (< 20/trap). Predatory bugs, carnivorous flies, parasitic wasps (Pteromalidae, Eulophidae, Trichogrammatidae, Scelionidae) and native bees dominated the trap catches. Predatory bugs were the most abundant beneficial insects trapped in 2 years (2011, 2013) with parasitic wasps dominant in 2012. Minute pirate bugs, *Orius* spp. (Anthocoridae) were dominant, accounting for > 95% of predatory bugs, peaking in abundance in June or July. Predacious flies were dominated by species of Empididae and Dolichopodidae. Native bees were commonly trapped, especially in 2011 and 2012. The data presented here indicate that stinging nettles in the Yakima Valley of eastern Washington may provide an important habitat for beneficial insects and may have a role to play in enhancing conservation biological control in agricultural crops.

Key Words. Predators, parasitoids, pollinators, conservation biological control, Yakima Valley

Introduction

In Europe, the common stinging nettle *Urtica dioica* Linnaeus ssp. *dioica* (Urticaceae), a perennial and weedy plant, is well known for harboring a diversity of phytophagous and predaceous insects and mites (Davis 1973, 1975, 1989; Stiling 1980, Sommagio et al. 1995, Alhmedi et al. 2007, 2009; Perrin 1975). Perrin (1975) showed *U. dioica* in England to be a 'reservoir' of natural enemies, while Alhmedi et al. (2007, 2009, 2011) provided evidence suggesting that nettles enhance the density of aphidophagous insects to the degree necessary for biological control of aphids in adjacent field crops. Nettles also support breeding populations of at least four nymphalid butterflies in Europe (Bryant et al. 1997).

Two native subspecies of *U. dioica* occur in the Pacific Northwest: *U. dioica* ssp. *gracilis* (Aiton) Selander and *U. dioica* ssp. *holosericea* (Nutt.) Thorne (Woodland 1982), most commonly in wetter coastal areas. However, in irrigated agricultural areas of eastern and central Washington, *U. dioca* is frequently found near watercourses, seeps and along irrigation canals. No studies on the phytophagous and predaceous arthropods associated with nettles in the Pacific Northwest have been published. However, Pacific Northwest nettles support breeding populations of five nymphalid butterflies (James & Nunnallee 2011) and are therefore important in butterfly conservation. If nettles in central Washington harbor communities of arthropod natural enemies similar to Europe, the value of this plant to conservation biological control of agricultural pests could be important. Here we

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present data on beneficial insects attracted to nettles in central Washington during three seasons.

Materials and Methods

Beneficial insect populations were monitored in nettle (*U. dioica* ssp. *holosericea*) patches at three locations in the Yakima Valley in central Washington using sticky traps during spring–autumn over three years (2011–2013). In 2011, nettles at sites near Yakima (46.32 ºN, 120.90 ºW) and Horn Rapids near Benton City (46.22 ºN, 119.26 ºW) were surveyed. In 2012 and 2013, the Horn Rapids site was used as well as a site near Prosser (46.14 ºN, 119.42 ºW). Nettles at the Yakima site occupied an area of ~100 m^2. Nettles at the Prosser and Horn Rapids sites occupied ~200 and 100 m^2, respectively. Transparent sticky traps (WindowBugCatcher, large 40.6 × 12.1 cm, Alpha Scents Inc., Portland, Oregon) were used, avoiding trap color as a potential influence on insect attraction. Traps were attached to the upper 30 cm of nettle plants from late June to mid September in 2011, early June to mid September in 2012, and mid May to early September in 2013. At each site, three traps were placed singly on nettle plants separated by at least 5 m. Traps were left in place for 12–14 days before removal and replacement. Traps collected from the field were transported to the laboratory and stored at -30 ºC until examined under a stereomicroscope. All insects were identified to family or species when possible and counted. The incidence and abundance of 34 species, genera or groups of winged beneficial insects were recorded (Table 1). Numbers of aphids and leafhoppers were also recorded in 2012 and 2013. Beneficial insects were condensed into 10 categories: Lacewings (Chrysopidae, Hemerobiidae), ladybird beetles (Coccinellidae), predatory true bugs (Miridae, Anthocoridae, Nabidae), predatory thrips (Aeolothripidae), predaceous flies (Syrphidae, Empididae, Dolichopodidae, Tachinidae), ichneumonid and braconid wasps (Ichneumonidae, Braconidae), *Anagrus* spp. wasps (Mymaridae), *Coccophagus* spp. and *Metaphycus* spp. wasps (Aphelinidae, Encyrtidae), other parasitic wasps (Pteromalidae, Eulophidae, Trichogrammatidae, Scelionidae) and bees (Apoidea). Bumblebees and larger wasps such as yellow jackets and hornets were often able to extricate themselves from the sticky material and were rarely trapped. Trapping data were log (log x) transformed prior to analyses to improve normality of variances and then back-transformed for reporting. Repeated measures ANOVA with means separated using the Holm-Sidak method was used for analyses (SigmaStat Version 3.0., SPSS Inc.).

Results

Large numbers (200–400/trap) of beneficial insects were trapped at all three nettle sites in all years and data were combined for sites within each year. Numbers of beneficial insects trapped in 2012 were significantly greater than the other years ($F = 15.69$; df = 2, 57; $P < 0.001$; Fig. 1). In each year, greatest numbers of beneficial insects were trapped in June and early July, gradually declining thereafter (Figs. 2, 3). Aphids and leafhoppers occurred in much lower numbers (< 20/trap) and declined similarly (Fig. 4).

Predatory bugs and predaceous flies, parasitic wasps (Pteromalidae, Eulophidae, Trichogrammatidae, Scelionidae) and native bees dominated the trapped beneficial insect fauna in 2011 ($F = 15.8$, df = 9, 13, $P < 0.001$; Fig 5). In 2012 and 2013, significantly greater numbers of predatory bugs and predaceous flies and parasitic wasps were trapped than other groups ($F = 9.78$, df = 9, 13, $P < 0.001$:2013:

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Table 1. Categories of beneficial insects identified and recorded in this study, along with species, genera and families within each category.

Beneficial insect categories	Species, genera or family included
Neuroptera (lacewings)	*Chrysoperla plorabunda* (Fitch, 1855)
	Chrysopa nigricornis Burmeister, 1839
	Chrysopa coloradensis Banks, 1895
	Chrysopa oculata Say, 1839
	Eremochrysa spp.
	Hemerobius spp.
	Micromus spp.
Coccinellidae (ladybird beetles)	*Harmonia axyridis* (Pallas, 1773)
	Coccinella septempunctata Linnaeus, 1758
	Coccinella transversogutatta Faldermann, 1835
	Hippodamia convergens Guerin-Meneville, 1842
	Psyllobora vigintimaculata (Say, 1824)
	Stethorus punctum picipes Casey, 1899
	Stethorus punctillum (Weise, 1891)
	Scymnus spp.
	Other ladybird beetles
Heteroptera (predatory bugs)	*Deraeocoris brevis* (Uhler, 1904)
	Geocoris pallens Stal, 1854
	Orius spp.
	Nabidae
Aeolothripidae (predatory thrips)	*Franklinothrips* spp.
	Aeolothrips spp.
Diptera (predatory and parasitic flies)	Empididae
	Syrphidae
	Dolichopodidae
	Sarcophagidae
	Tachinidae
Icheumonidae and Braconidae (ichneumonid and braconid wasps)	
Mymaridae (fairy wasps)	*Anagrus* spp
Encyrtidae and Aphelinidae	*Coccophagus* spp.
	Metaphycus spp.
Other parasitic wasps	Pteromalidae, Eulophidae, Trichogrammatidae, Scelionidae
Apoidea (bees)	Andrenidae, Halictidae, Megachilidae, Apidae, Colletidae

$F = 16.3$, df = 9, 13, $P < 0.001$, Fig. 5). Predatory bugs was the most abundant category of beneficial insects trapped in 2 years (2011, 2013) with parasitic wasps dominant in 2012. Minute pirate bugs, *Orius* spp. (Anthocoridae) were the dominant predatory bugs accounting for > 95% of trapped bugs, and peaked in abundance in June or July (Figs. 6, 7). Predaceous flies were dominated by species of Empididae and Dolichopodidae. Native bees were commonly trapped especially in 2011 and 2012. In contrast very few honeybees were trapped.

Discussion

The data presented here indicate that stinging nettles in the Yakima Valley of central Washington may provide an important habitat for beneficial insects particularly

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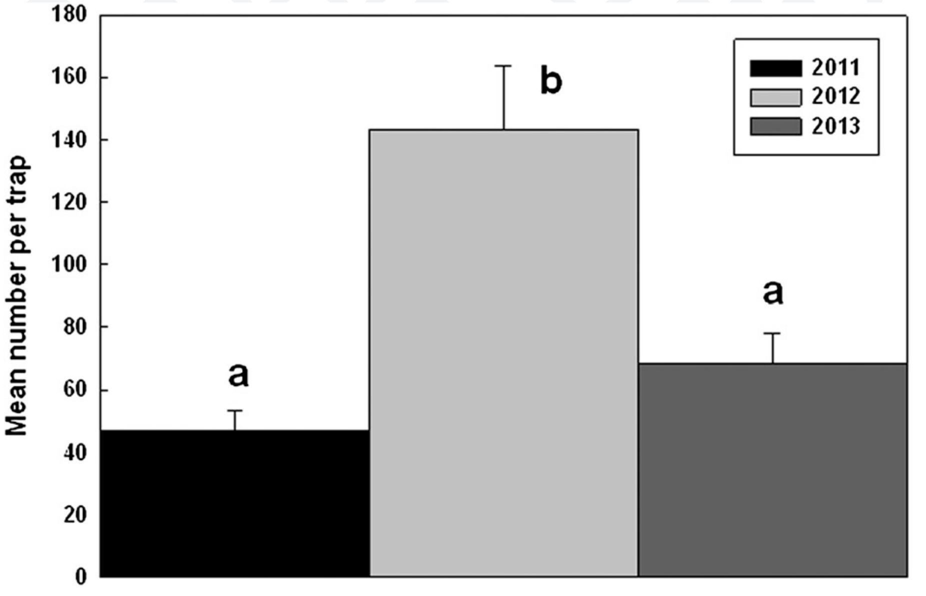

Figure 1. Beneficial insects (all groups) trapped in patches of *Urtica dioica* in the Yakima Valley during 2011–2013. Significant difference denoted by different letter above column (P < 0.001).

predatory bugs, predaceous flies and parasitic wasps in the families Pteromalidae, Eulophidae, Trichogrammatidae and Scelionidae. Although some pestiferous insects (aphids and leafhoppers) also use nettles as a resource, populations during this study

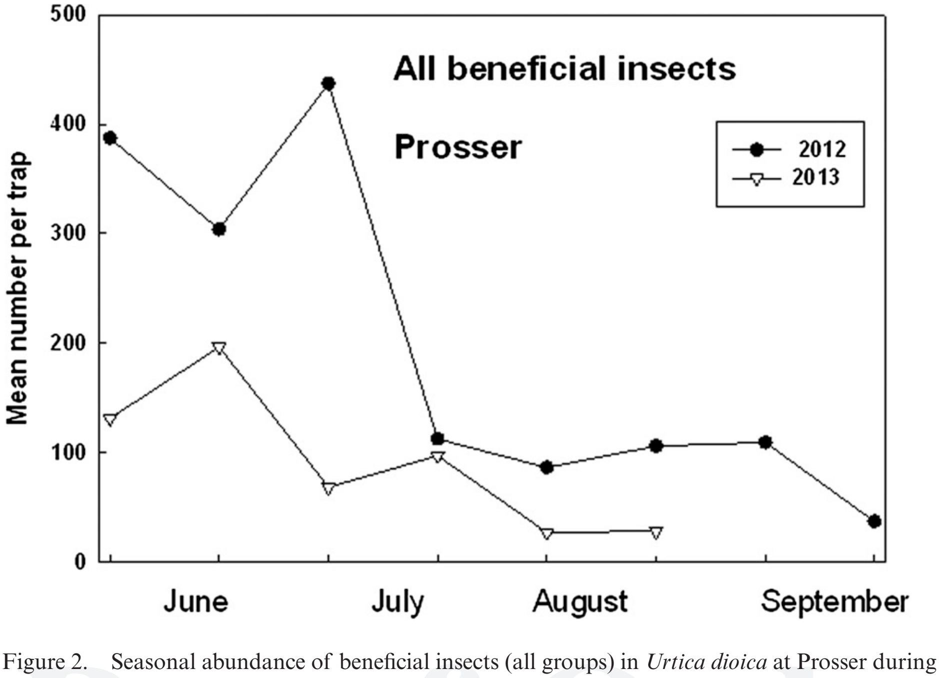

Figure 2. Seasonal abundance of beneficial insects (all groups) in *Urtica dioica* at Prosser during 2012-–2013 as indicated by sticky trap catches.

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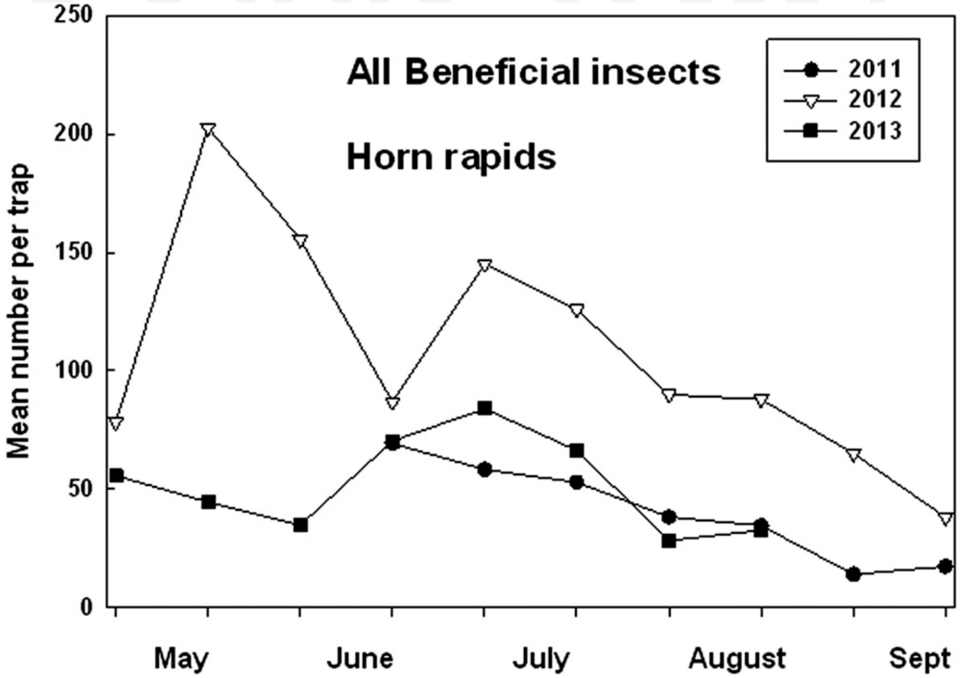

Figure 3. Seasonal abundance of beneficial insects (all groups) in *Urtica dioica* at Horn rapids during 2011-–2013 as indicated by sticky trap catches.

were low as indicated by trap counts. Occasional examination of leaves in the field or under a microscope also showed few herbivores on sampled nettle plants. In England, the aphid *Microlophium carnosum* (Bukton, 1876) occurs at high densities on nettles (Perrin 1976), which Perrin (1975) concluded mediated the abundance of natural enemies. Although beneficial and phytophagous insects in our study showed similar trends in abundance during the season, it seems unlikely that all of the predators and parasitoids were preying on the limited numbers of aphids and leafhoppers. Some of the natural enemies trapped are not known predators or parasitoids of aphids and leafhoppers. Blooming of *U. dioica* in central Washington occurs from early June to early August, and many of the attracted beneficial insects may have been seeking nectar and/or pollen from nettle flowers.

Greatest numbers of beneficial insects occurred during June–July, declining thereafter. A similar trend was described for the abundance of Coccinellidae, Miridae and Anthocoridae on nettles in the United Kingdom (Perrin 1975). Minute pirate bugs (Anthocoridae) are an important group of predators found on stinging nettles in the United Kingdom and continental Europe (Davis 1973, 1989; Perrin 1975) and are similarly abundant on Washington nettles. Davis (1973) showed that anthocorids were the first colonizers of isolated nettle plants in the United Kingdom, even before phytophagous insects like aphids and psyllids arrived. Dwumfour (1992), in a laboratory study, showed that *Anthocoris nemorum* (Linnaeus, 1761) was highly attracted to chemical cues emitted by *U. dioica* leaves. A number of studies have shown anthocorids to feed on pollen increasing fitness and abundance (Wong & Frank 2013 and references therein). During June–July at the Prosser site, anthocorids (*Orius* spp.)

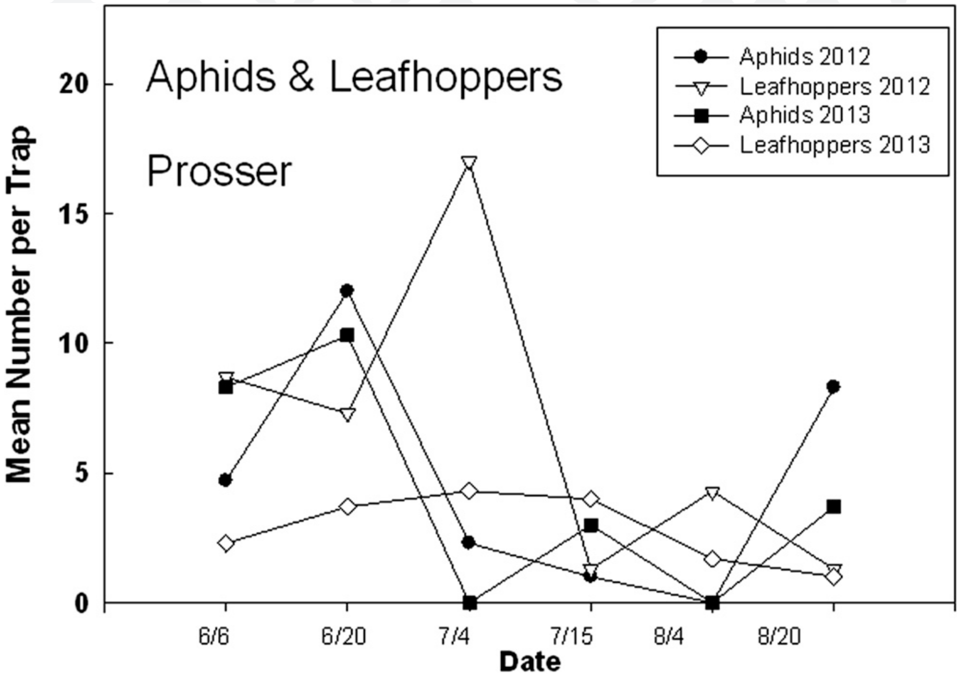

Figure 4. Seasonal abundance of aphids and leafhoppers in *Urtica dioica* at Prosser during 2012-–2013 as indicated by sticky trap catches.

were trapped in large numbers (means of up to 200 per trap). Numbers of aphids and leafhoppers trapped at this time were relatively low (< 15/trap) and may have been suppressed on nettles by the anthocorids. However, the relationship between *Orius* spp. and nettles deserves further study because it appears likely that these insects are attracted to volatiles emitted by *U. dioica* regardless of the presence of herbivores. Predatory flies primarily Empididae (dance flies) and Dolichopodidae (long-legged flies) were also trapped in large numbers around nettles in our study. Empidids both as adults and larvae are predatory on a wide range of arthropods (Cumming & Cooper 1993) as are dolichopodids (Coulibaly 1993). Parasitic wasps in the families Pteromalidae, Eulophidae, Trichogrammatidae and Scelionidae were also trapped in large numbers. Further work is needed to determine which wasps within this arbitrary grouping predominate and whether attraction is mediated by herbivorous hosts. In 2011 and 2012, we trapped significant numbers of native bees (means of 7–10 bees/trap), which were presumably seeking nectar from nettle flowers. However, they were also trapped during non-blooming periods particularly in August and September after flowering had finished.

The nettle patches used in this study, although relatively large, were isolated and separated from other nettle patches by at least 1–2 km. Zabel & Tscharntke (1998) showed that the diversity and abundance of predatory insects was reduced in isolated nettle patches in Germany. Thus, the abundance and diversity of beneficial insects in central Washington nettle patches may potentially be greater if patches are part of a mosaic with relatively small distances separating them. The potential of nettle patches for attracting and harboring predatory and parasitic insects that could be

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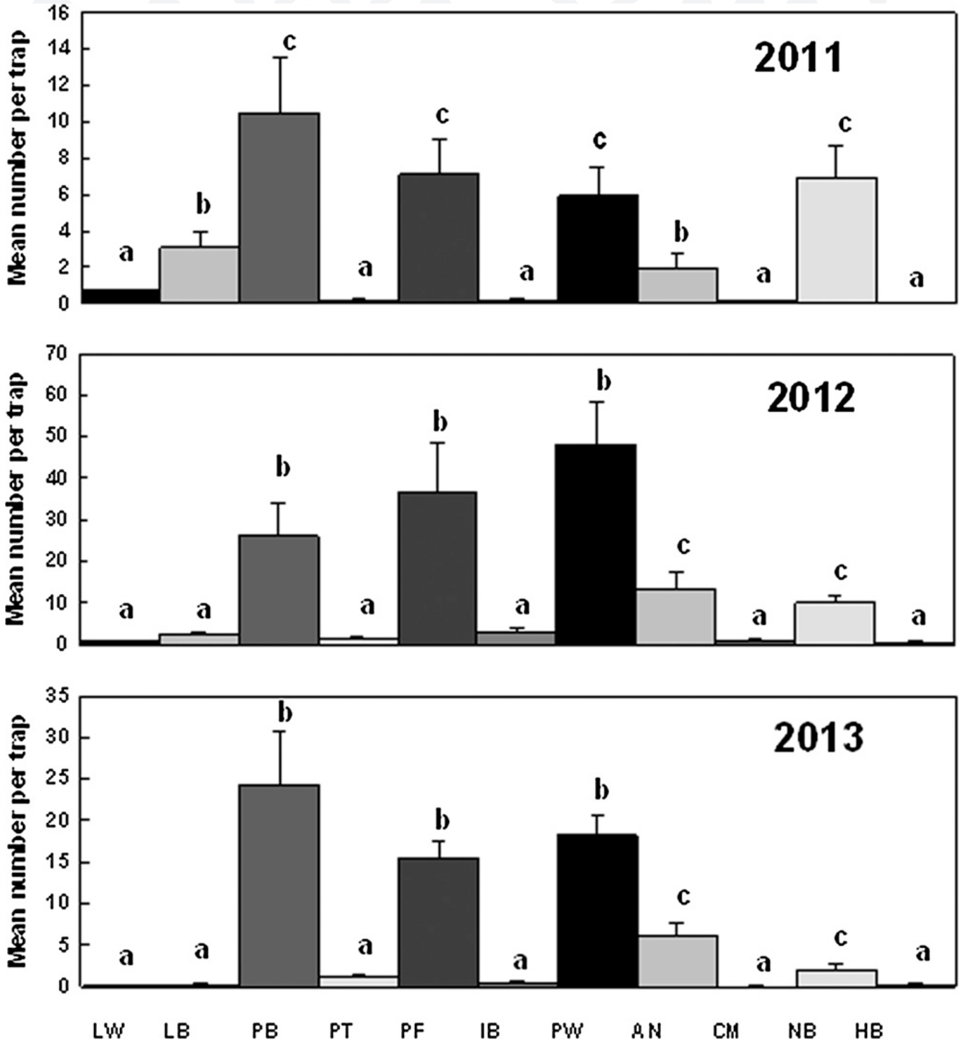

Figure 5. Relative abundance of different categories of beneficial insects in *Urtica dioica* patches in the Yakima Valley during 2011-–2013 as indicated by sticky trap catches. Significant differences denoted by different letters above columns ($P < 0.001$). LW = Lacewings, LB = ladybird beetles, PB = predatory bugs, PT = predatory thrips, PF = predaceous flies, IB = Ichneumonidae-Braconidae, PW = other parasitic wasps, AN = *Anagrus* spp., CM = *Coccophagus-Metaphycus* spp., NB = native bees, HN = honey bees.

exploited for biological control of insect and mite pests in Washington croplands is clear and should be investigated. In a Belgian study, Alhmedi et al. (2011) concluded that stinging nettle habitats are likely to play a key role in conservation biological control. In central Washington, arthropod pest management in viticulture is based on conservation biological control that is progressively being enhanced by habitat restoration focused on native plants that attract and harbor predators and parasitoids (James et al. 2014). Based on the evidence provided in this study, *U. dioica* appears to be a good candidate for inclusion in vineyard habitat restoration aimed at improving

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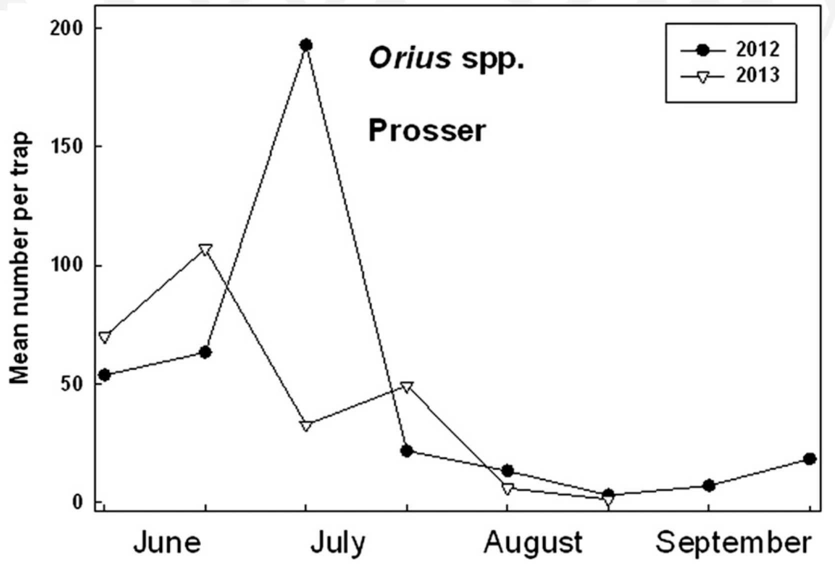

Figure 6. Seasonal abundance of *Orius* spp. (Anthocoridae) in *Urtica dioica* at Prosser during 2011–2013 as indicated by sticky trap catches.

conservation biological control of grape pests. An additional aspect of habitat restoration in central Washington vineyards is the provision of plants and habitat to aid conservation of butterfly species (DGJ, unpublished data). Clearly, *U. dioica* as

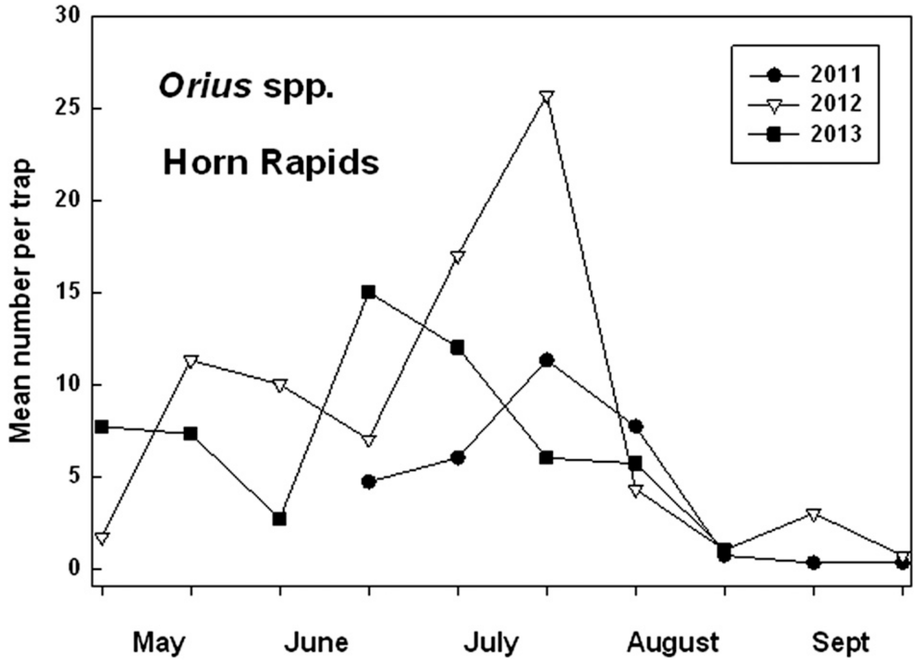

Figure 7. Seasonal abundance of *Orius* spp. (Anthocoridae) in *Urtica dioica* at Horn Rapids during 2011-–2013 as indicated by sticky trap catches.

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a component of vineyard habitat restoration and as a host to five butterfly species in central Washington (James & Nunnallee 2011) would be extremely beneficial to butterfly conservation.

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