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ARTHROPODS ASSOCIATED WITH PURPLE LOOSESTRIFE IN ILLINOIS WETLANDS

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ABSTRACT

We estimated and described the arthropod fauna on purple loosestrife (*Lythrum salicaria*) plants in northeastern Illinois wetlands. A total of 1063 individual arthropods were collected—930 insects and 133 arachnids. The average number of arthropods ranged from 19.00 to 86.75 individuals per loosestrife plants of a single root crown. We collected individuals from twenty-five families representing 8 orders of insects. Miridae, Anthocoridae, Lygaeidae, Cicadellidae, and Aphididae were each represented by at least 50 individuals. Three orders and ten families were found that had not been previously reported as occurring on purple loosestrife, but many of these taxa were represented by only a few individuals.

INTRODUCTION

Purple loosestrife (*Lythrum salicaria* L., Lythraceae)—an herbaceous perennial of Eurasian origin—is an invasive weed of North American wetlands that was introduced to the eastern seaboard in the early 1800s (Stuckey 1980). Enhanced by the absence of natural enemies and frequent disturbances of natural systems (Malecki et al. 1993), purple loosestrife rapidly spread across North America during the 20th century, and currently inhabits wetlands throughout the northern half of the United States and southern Canada (Stuckey 1980, Thompson et al. 1987). Commonly considered a serious threat to North American wetlands (Stuckey 1980, Thompson et al. 1987), purple loosestrife has been the target of a biological control program in North America (Blossey et al. 2001), because indigenous arthropods have been unable to control loosestrife populations. Although arthropod species compositions on purple loosestrife have been reported, abundances of those arthropods have not been estimated in North American habitats where purple loosestrife is common. Consequently, our objective was to estimate and describe the arthropod fauna associated with purple loosestrife in Illinois wetlands.

METHODS & MATERIALS

Field studies were conducted in the Lake Calumet Industrial Corridor, Cook County, Illinois. The area contains numerous wetlands of various sizes (5 ha to 120 ha) scattered among the prominent industries that dominate the area. Our study sites were located in two different wetlands: Indian Ridge Marsh (24 ha) and Hyde Lake Marsh (16 ha). Indian Ridge Marsh (N41°40', W87°33') was dominated by purple loosestrife, except for a small patch (≈ 200 m^2) of cattail (*Typha* spp., Typhaceae). Hyde Lake (N41°39', W87°32'), located approximately 1 km east of Indian Ridge Marsh, contained both purple loosestrife and cattail in separate, but generally equal, areas.

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We sampled arthropods on sunny and calm (wind speed less than ≈ 10 kph) days from purple loosestrife at Hyde Lake on 4 Aug 2000 and 29 June 2001, and at Indian Ridge Marsh on 26 July 2000 and 24 July 2001. In areas dominated by purple loosestrife, arthropods were collected via beat-cloth sampling. Purple loosestrife plants are often found clustered on slightly elevated root crowns. Consequently, we randomly chose a single root crown (≈ 0.25 m^2), bent over all the loosestrife stems associated with that root crown, and thoroughly beat them. Dislodged arthropods were collected on a 0.75 m^2 cloth frame, aspirated, and stored in ethanol. This sampling technique likely excluded highly mobile arthropods that could fly or jump away from the cloth frame before we were able to collect them. For each sampling date, four root crowns were sampled; except at Indian Ridge Marsh in 2000 when 5 root crowns were sampled. Insect individuals were identified to order or family. Arachnid individuals were not further identified. We pooled each of the 4 or 5 samples obtained from each site separately by year, resulting in four sampling units. Analysis of variance (ANOVA) was used to determine whether arthropod abundances were significantly different between sites and years. Pairwise comparisons were assessed using Tukey-Kramer HSD. Results were considered significant at $P \leq 0.05$. All arthropods collected during this study have been deposited in the arthropod collection of the Illinois Natural History Survey, Champaign, IL.

RESULTS

Arthropod abundance was highly variable among taxa (Table 1). The average number of arthropods per root crown ranged from 19.00 at Hyde Lake in 2001 to 86.75 at Indian Ridge Marsh in 2001 (Table 1). Arthropod abundances were significantly different among the four sampling dates ($F = 10.78$, df = 3, 13, $P < 0.01$; Fig. 1). Tukey-Kramer HSD test revealed that arthropods were significantly less abundant at Hyde Lake in 2001.

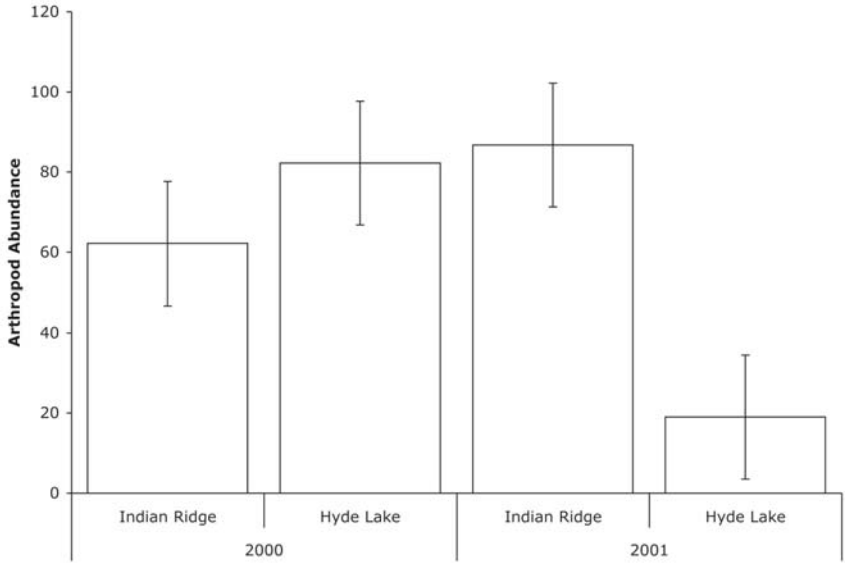

Figure 1. Average number of arthropods (± 1 SE) per root crown of purple loosestrife at Indian Ridge and Hyde Lake in 2000 and 2001.

Table 1. Average number of arthropods per purple loosestrife root crown for each taxon collected at Hyde Lake and Indian Ridge in 2000 and 2001. Taxa stages were classified as adult (A) or immature (I). Taxa not reported by other studies are indicated with an asterisk.

		Indian Ridge		Hyde Lake		
Taxon	**Stage**	**2000**	**2001**	**2000**	**2001**	**Total**
Collembola*		3.00	2.75	0.25	0.00	27
Psocoptera*	I	1.40	0.00	0.00	0.00	7
	A	0.40	0.50	0.00	0.00	4
Thysanoptera						
Thripidae	A	3.20	1.00	1.25	0.00	25
Hemiptera						
Miridae	I	18.00	34.50	14.00	0.75	287
	A	0.00	3.25	0.00	0.00	13
Lygaeidae	I	1.00	0.50	4.00	0.00	23
	A	0.00	14.75	0.25	0.00	60
Anthocoridae	I	1.40	1.50	24.50	0.00	111
	A	2.00	7.50	5.25	0.50	63
Nabidae	A	0.00	0.50	0.00	0.00	2
Pyrrhocoridae*	I	0.00	2.25	0.00	0.50	11
Homoptera						
Cicadellidae	I	9.00	2.25	4.75	0.50	75
Aphididae	I	9.20	0.00	2.00	0.00	54
	A	0.40	0.25	0.00	0.00	3
Neuroptera*						
Chrysopidae	I	0.20	0.75	0.75	0.00	7
Coleoptera						
Chrysomelidae	A	0.00	1.50	0.25	8.00	39
Curculionidae	A	0.00	0.00	0.25	0.50	3
Coccinellidae	I	1.60	0.00	0.50	0.00	10
	A	0.00	0.00	0.50	0.25	3
Staphylinidae	A	0.20	0.00	0.25	0.00	2
Lampyridae*	A	0.20	0.00	0.00	0.00	1
Bruchidae*	A	0.20	2.50	0.00	1.25	16
Cleridae*	A	0.20	0.00	0.25	0.00	2
unknown	A	1.20	0.75	0.50	0.25	12
Lepidoptera						
Geometridae	I	0.60	1.00	10.00	0.00	47
Noctuidae	I	0.80	0.00	0.50	0.50	8
Lymantriidae	I	0.00	0.00	0.00	0.25	1
Arctiidae	I	0.00	0.00	0.50	0.00	2
unknown	I	0.40	0.00	0.50	0.00	4
Diptera*						
Culicidae	A	0.00	0.00	0.00	0.25	1
Cecidomyiidae	A	0.20	0.00	0.00	0.00	1
Stratiomyidae	A	0.00	0.00	0.25	0.00	1
Hymenoptera						
Ichneumonidae*	A	0.00	0.50	0.00	0.00	2
Formicidae*	A	0.20	0.00	0.00	0.00	1
unknown	A	0.20	0.00	0.25	0.00	2
Class Arachnida						
unknown		7.00	8.25	10.75	5.50	133
Totals[a]		311	347	329	76	1063

[a]Note: Each sampling date consisted of 4 samples except for Indian Ridge in 2000 when 5 samples were collected.

We collected a total of 1063 individual arthropods, comprising 930 insects and 133 arachnids. Individuals from twenty-five families representing 10 orders of insects were collected. The 5 most common taxa (in decreasing order) were Hemiptera (570 individuals; comprised 53.6% of all individuals), Arachnida (133; 12.5%), Homoptera (132; 12.5%), Coleoptera (88; 8.3%), and Lepidoptera (62; 5.8%). Specimens of Psocoptera, Neuroptera, Diptera, and Hymenoptera were also collected, but each order totaled fewer than 15 individuals. Frequently encountered insect families (i.e., > 50 individuals) included Miridae, Anthocoridae, Lygaeidae, Cicadellidae, and Aphididae.

Three orders—Collembola, Psocoptera, and Neuroptera—and 10 families—Pyrrhocoridae, Chrysopidae, Lampyridae, Bruchidae, Cleridae, Culicidae, Cecidomyiidae, Stratiomyidae, Ichneumonidae, and Formicidae—had not been previously reported on purple loosestrife in the literature (Table 1). Many of these taxa, however, were represented by only one or two individuals.

DISCUSSION

A diversity of native arthropods was found on purple loosestrife in Illinois, though few were herbivores. Of the 10 most numerous taxa (nine insect families and the class Arachnida) found on purple loosestrife plants, the Anthocoridae and Arachnida are predaceous and the Miridae are facultatively predaceous (Alomar and Wiedenmann 1996). Although many other taxa collected were herbivores, those summed to fewer than 70 individuals per root crown of several large loosestrife plants. Further, 27% of all individual arthropods collected were minute (< 10 mm) mirids which although herbivorous, were neither numerous enough nor significant enough to affect loosestrife plants. Where releases of *Galerucella* spp. (Chrysomelidae) have impacted the fitness of purple loosestrife, feeding by a minimum of several hundred to thousands of beetles per plant was needed before an impact on the plant was observed (R.N. Wiedenmann, *personal observation*). Thus, the densities of native herbivores we observed are most likely insufficient to affect purple loosestrife populations.

Abundances of arthropods were significantly lower at Hyde Lake in 2001 than other sampling dates, though those difference were likely not a result of floral diversity. A prescribed burn was conducted at Hyde Lake prior to the 2001 field season, which almost completely burned cattail, whereas purple loosestrife only partially burned. This disturbance likely accounted for the reduced arthropod abundances in Hyde Lake during 2001. Temporal variation could also have explained this difference, because samples in 2001 were collected at Hyde Lake a month earlier than at Indian Ridge.

Observations of the diversity of arthropods on purple loosestrife in its native Europe revealed 120 species (67 families and 10 orders) of herbivorous insects associated with purple loosestrife (Batra et al. 1986), as compared to the 25 families in 10 orders collected from two sites in our study. A similar study in North America (Hight 1990) found 60 phytophagous insect species representing 5 orders, 22 families, and 55 genera on purple loosestrife in New York, Maryland, and Massachusetts, which is comparable to what we found. Diehl et al. (1997) collected 63 genera (38 families, seven orders, and approximately 80 species) of insect herbivores in purple loosestrife habitats in southern Manitoba, Canada; one genus was that of the two introduced biocontrol agents, *Galerucella pusilla* Duft and *G. calmariensis* L.

Additionally, there are several anecdotal reports of arthropods feeding on purple loosestrife. In the Hudson River Valley, New York, native Lepidoptera (Saturniidae) larvae of *Hyalophora cecropia* (L.), *Antheraea polyphemus* (Cram.), and *Automeris io* (F.) were found on purple loosestrife; and 4th and 5th instar *H. cecropia* and *A. polyphemus* preferred purple loosestrife over gray dogwood (*Cornus racemosa (*Lam.), Cornaceae), a native woody host in wet meadows (Barbour and

Kiviat 1997). Finally, the introduced *Lymantria dispar* L. (Lymantriidae) has been observed feeding on purple loosestrife in Michigan, and 2nd and 3rd instars of *L. dispar* have been successfully reared on purple loosestrife in the laboratory (Sebolt and Landis 1999).

The numbers of arthropods seen on purple loosestrife in our study may have been limited by the presence and abundance of congeneric plants from which native arthropods might have originated. Herbivorous insects associated with introduced *Quercus* spp. (Fagaceae) exhibited higher abundances in habitats that contained native *Quercus* spp. than did habitats without related species (Connor et al. 1980). Seven species of native Lythraceae occur in Illinois: *Decodon verticillatus* (L.) Ell., *Cuphea petiolata* (L.) Koehne, *Lythrum alatum* Pursh, *Peplis diandra* (Nutt. ex DC.) Wood, *Rotala ramosior* (L.) Koehne, *Ammannia coccinea* Rottb., and *A. auriculata* Willd. (Heineke 1977). *L. alatum*, the only native *Lythrum* spp. in Illinois, is relatively uncommon, and we are not aware of studies of the native arthropod fauna associated with *L. alatum*. Purple loosestrife may significantly reduce *L. alatum* populations through displacement and/or pollinator competition (Brown and Mitchell 2001) which may even result in local extirpation of *L. alatum*. Thus, there are few congeners from which native arthropods might move. The other species of Lythraceae also are not common in the wetlands containing purple loosestrife; hence, it seems unlikely in Illinois that there are sufficient arthropods on related plants to add purple loosestrife to their host range. Still the dearth in numbers and small sizes of most arthropods collected suggest that purple loosestrife does not support sufficient levels of arthropod biomass to control loosestrife populations.

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