FAUNA OVERWINTERING IN OR ON STEMS OF WISCONSIN PRAIRIE FORBS

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Abstract: This is a report of on-going research into the fauna overwintering in or on stems of Wisconsin prairie forbs. Two of 20 plant species studied to date produced no fauna, but the 18 others produced 9 to 31 taxa. The average among these 20 plant species was 15 arthropod taxa. The discovery of this diverse stem-fauna, comprised of herbivores, detritivores, predators and parasitoids, of immatures as well as adults, prompts reconsideration of how prairies are currently managed for biodiversity. Management implications are discussed.

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For many years, conservationists have urged us to leave dead wood in our woodlands because a diversity of wildlife uses it. Invertebrates comprise the vast majority of this wildlife. An analogous situation exists in prairie: many invertebrates live over the winter in or on the dead stems of prairie plants. The following is a preliminary report of an on-going study of this fauna.

The discovery of this diverse stem-fauna, comprised of herbivores, detritivores, predators and parasitoids, of immatures as well as adults, prompts reconsideration of how prairies are currently managed for biodiversity.

MATERIALS AND METHODS

All plant specimens were collected at Thomas Wet Prairie, owned by The Prairie Enthusiasts - Southwest Chapter, in Grant County, Wisconsin. This site has a history of grazing and has been partially burned twice in the last decade, over which period it has not been grazed. Abutting land is still pastured. Herbaceous wetlands, low pastures, row crops, overgrown oak savanna and oak woods, and overgrazed, limy hill prairies characterize this hilly agrarian landscape.

Prairie plant species with larger diameter stems were chosen, and stems with galls were preferentially collected. In late September, stems of each species were placed into their own sterile container over freshly sterilized soil. Stems were cut into lengths approximating the width of the container and were jumbled together loosely to allow animals to extricate themselves from the stems and to move about freely and, with luck, toward the light and so into the trap. The containers were tall kitchen trash cans with slits cut in their bottoms for drainage.

Queen-sized panty hose was stretched over the open top of each container to keep fauna from entering or exiting, and these were left outdoors on a second story, open porch over the winter.

The containers were brought indoors and tightly caged in March, sheathed in black plastic bags and provided with a zippered plastic bag over a clear plastic collar. The black plastic bags were lawn and leaf bags, the zippered plastic bags were the 1-gallon size (zippers on larger bags quickly deteriorate), and the clear plastic collars were the tubular midsection of 2-L soda bottles. Both clear plastic packing tape and fiber reinforced packing tape were used to hold these components together and to effect a complete seal of the bagged container.

The clear plastic collar was taped into 1 corner of the top of the container, angling outward. The container was set into a black plastic bag that was drawn up and tightly taped around the container just below its lip, to deter animals from wandering down between the black bag and the container. The black bag was then drawn across the container's open top. This involved cutting away part of the bag and using packing tape to seal the cut edges together. The black plastic was funneled into the clear plastic collar, cut off and taped to the collar, leaving as much of the collar free of this black plastic as possible.

The top of the container was then covered with supplemental layers of black plastic to further occlude light, so that the only light entering the container was that entering at the clear plastic collar. A zippered plastic bag was taped to the distal end of the collar and positioned so the collar penetrated the base of the zippered bag and so the zippered end was farthest from the container. One's sole access to the fauna was through the zippered bag.

Containers were placed on lab tables so their zippered bags were at about face-height to facilitate checking for animals. By reaching into the container through the plastic collar, some stems were piled up and spilled over into the plastic collar to facilitate movement of wingless animals into the zippered bag.

Excessive condensation inside the zippered bags was a problem with this design, though high humidity in the containers is desirable. The containers were checked and any condensation in the zippered plastic bags or in the clear plastic collars was removed with paper towels 2 or 3 times daily. Paper towels were reused but each container had its own supply of paper towels so that accidental introduction of fauna originating in one container to a second container could not occur. A blank sheet of white paper held up behind the zippered bag as one peered through it made the tiny animals easier to see.

After about a week of apparent inactivity, small animals began to appear in the zippered plastic bags. These were caught, usually with an aspirator, the animals killed in 80% EtOH, and sorted under a microscope into vials containing 80% EtOH. The aspirator was cleaned after each use, so that accidental introduction of fauna originating in one container to a second container could not occur.

The name and number of the plant were marked on tape on the outside of the container, on the zippered bag, and also on an aluminized paper tag that was tied to one of the topmost stems inside the container: e.g. swamp lousewort 4701. As different animals appeared in that container, they were given numbers (4701.1, 4701.2, etc.) and stored in vials in a rack. Having all the vials for swamp lousewort together made it easy to slip that plant's vials under the microscope to see if newly caught animals were something new. When more individuals of animal 4701.2 appeared over ensuing days, these were simply added to the same vial in the rack. As time passed, there were more and more vials in the rack. Some larger animals were killed in a killing jar, point-mounted, and provided with numbered tags on their pins.

The containers were maintained until the eruption of fauna subsided or the arrival of new taxa slowed to a standstill. This was 50 days in spring 1997, but it was 88 days in spring 1998. These data were put into a database with my other prairie insect data, and the specimens themselves were deposited in the Insect Research Collection at University of Wisconsin—Madison.

At the end of this process, the animals of each sort were counted, with 2 exceptions. Flies and fly larvae (Diptera) and springtails (Collembola) were often common and no effort to collect them all was made.

RESULTS

To date, 20 species of prairie forbs have been studied. Two of these species produced no fauna, but the 18 others produced between 9 and 31 taxa (Table 1). The average among these 20 plant species was 15.5 arthropod taxa.

A list of the taxa produced with the number of each taxon that appeared is provided for 5 plant species: spotted joe-pye-weed (Table 2), gayfeather (Table 3), green-eyed susan (Table 4), swamp lousewort (Table 5) and bottle gentian (Table 6).

As more specimens are identified in the future, these lists will probably change, and the total numbers of taxa for a plant may go up or down a bit as a result. The scale of diversity will not change, however, and this is the factor that these tabular results show.

These taxa include animals that overwintered as eggs or early instars, emerging into the light traps as immatures, and others that overwintered as larvae, pupae or adults, emerging as adults. These include herbivores, detritivores, predators and many different parasitoids, tiny wasps that develop within the bodies of other insects. Some of these taxa will never be identified to species, but with the help of experts, I expect to identify them to family and perhaps to genus. Some may be new to science. Most of these animals are tiny in contrast to the charismatic megafauna that get the bulk of conservationists attention: "gigantic" animals such as the Karner blue butterfly.

It is possible that some of these animals might have left the stems and overwintered in the sterile soil provided in each container. However, I think that would be true for only a few of these taxa, based on what is known of the life histories of these animals, many of which are wasps and beetles. The soil serves primarily as a sponge to maintain humid conditions inside the container.

DISCUSSION

The technique used here reveals only those fauna that use a particular part of these particular plants, growing on a single site. Furthermore, the use is only at a particular time of year. Surely the stem-fauna differs over the growing season, among yet other plants, and from place to place. And surely many other animals use these few plants in other ways.

Table 1: Plant species studied and the number of arthropod species produced from the stems of each, in ascending order of biodiversity.

Common Name	Plant Species	Arthropods
swamp milkweed	*Asclepias incarnata*	0
blue vervain	*Verbena hastata*	0
sawtooth sunflower	*Helianthus grosseserratus*	9
great St. John's-wort	*Hypericum pyramidatum*	10
late goldenrod	*Solidago gigantea*	10
tuberous sunflower	*Helianthus tuberosus*	12
smooth ironweed	*Vernonia fasciculata*	13
New England aster	*Aster novae-angliae*	14
white wild indigo	*Baptisia lactea*	14
ox-eye	*Heliopsis helianthoides*	16
spotted joe-pye-weed	*Eupatorium maculatum*	17
boneset	*Eupatorium perfoliatum*	17
swamp lousewort	*Pedicularis lanceolata*	18
Culver's-root	*Veronicastrum virginicum*	18
gayfeather	*Liatris pycnostachya*	20
Canada goldenrod	*Solidago canadensis*	20
bottle gentian	*Gentiana andrewsii*	21
cup plant	*Silphium perfoliatum*	23
common sneezeweed	*Helenium autumnale*	27
green-eyed susan	*Rudbeckia laciniata*	31

Table 2: These are the 17 taxa produced by spotted joe-pye-weed 3638, in the order in their appearance.

Species #	Order	Family	Name	Arthropods
3638.1	Diptera	Sciaridae		4
3638.2	Hymenoptera	Pteromalidae	*Habrocytus* sp.	2
3638.3	Diptera	Agromyzidae	*Melanagromyza* sp.	10
3638.4	Hymenoptera	Braconidae	*Bracon palliventris*	4
3638.5	Hymenoptera	Ormyridae	*Ormyrus* sp.	2
3638.6	Coleoptera	Cleridae	*Enoclerus rosmarus*	1
3638.7	Diptera		(larvae)	many
3638.8	Acari			many
3638.9	Coleoptera	Languriidae	*Acropteroxys gracilis*	7
3638.11	Hymenoptera			1
3638.12	Coleoptera	Mordellidae		4
3638.13	Coleoptera	Cerambycidae	*Dectes sayi*	1
3638.14	Hymenoptera	Braconidae	*Schizoprymnus* sp.	3
3638.15	Diptera	Cecidomyiidae		2
3638.16	Hymenoptera			13
3638.17	Acari			4
3638.18	Hymenoptera	Braconidae	*Chorebus* sp.	3

Table 3. These are the 20 taxa produced by gayfeather 4685, in the order of their appearance.

Species #	Order	Family	Name	Arthropods
4685.1	Hemiptera	Membracidae	(nymphs)	13
4685.2	Hemiptera	Miridae	(nymphs)	5
4685.3	Acari			many
4685.4	Orthoptera	Tettigoniidae	(nymphs)	5
4685.5	Coleoptera	Cleridae	*Enoclerus rosmarus*	2
4685.6	Diptera	Cecidomyiidae		2
4685.7	Orthoptera	Gryllidae	*Oecanthus* sp. (nymphs)	31
4685.8	Diptera		(larvae)	many
4685.9	Hymenoptera			3
4685.11	Hymenoptera			4
4685.12	Collembola	Sminthuridae		2
4685.13	Collembola	Sminthuridae		many
4685.14	Diptera	Cecidomyiidae	*Heteropeza pygmaea*	many
4685.15	Acari			few
4685.16	Acari			few
4685.17	Acari			few
4685.18	Diptera	Cecidomyiidae		1
4685.19	Collembola	Hypogastruridae		few
4685.21	Hymenoptera			2
4685.22	Diptera	Mycetophilidae	*Leia bivittata*	1

Table 4. These are the 31 taxa produced by green-eyed susan 4696, in the order of their appearance.

Species #	Order	Family	Name	Arthropods
4696.1	Hymenoptera			3
4696.2	Hymenoptera	Braconidae	*Heterospilus* sp.	2
4696.3	Hymenoptera	Braconidae	*Heterospilus* sp.	1
4696.4	Hymenoptera			9
4696.5	Hymenoptera	Braconidae	*Nealionus curculionis*	6
4696.6	Araneae			1
4696.7	Hymenoptera			2
4696.8	Hymenoptera			10
4696.9	Hymenoptera	Braconidae	*Heterospilus* sp.	1
4696.11	Coleoptera	Curculionidae		5
4696.12	Coleoptera	Cleridae	*Enoclerus rosmarus*	1
4696.13	Acari			few
4696.14	Diptera	Cecidomyiidae	(larvae)	some
4696.15	Coleoptera	Mordellidae		6
4696.16	Diptera	Cecidomyiidae		1
4696.17	Hymenoptera	Eurytomidae		1
4696.18	Hymenoptera			2
4696.19	Hymenoptera			1
4696.21	Hymenoptera			1
4696.22	Coleoptera	Staphylinidae		1
4696.23	Orthoptera	Gryllidae	*Oecanthus* sp. (nymphs)	58
4696.24	Acari			few
4696.25	Hymenoptera			1
4696.26	Diptera		(larva)	1
4696.27	Hymenoptera	Ichneumonidae	*Trathala granulata*	2
4696.28	Hymenoptera	Braconidae	*Chorebus* sp.	2
4696.29	Diptera	Agromyzidae	*Melanagromyza* sp.	3
4696.31	Collembola	Sminthuridae		1
4696.32	Acari			1
4696.33	Diptera			1
4696.34	Hymenoptera	Braconidae	*Schizoprymnus* sp.	4

Table 5: These are the 18 taxa produced by swamp lousewort 4701, in the order of their appearance.

Species #	Order	Family	Name	Arthropods
4701.1	Hymenoptera	Eurytomidae		21
4701.2	Hymenoptera	Braconidae	*Bracon palliventris*	23
4701.3	Hymenoptera	Eupelmidae	*Macroneura vesicularis*	5
4701.4	Hymenoptera	Braconidae	*Chorebus* sp.	36
4701.5	Diptera			2
4701.6	Hymenoptera			4
4701.7	Coleoptera	Cleridae	*Enoclerus rosmarus*	2
4701.8	Hymenoptera			24
4701.9	Acari			some
4701.11	Hymenoptera			82
4701.12	Diptera			9
4701.13	Hymenoptera			2
4701.14	Orthoptera	Gryllidae	*Oecanthus* sp. (nymphs)	18
4701.15	Hymenoptera			1
4701.16	Diptera	Cecidomyiidae		2
4701.17	Acari			some
4701.18	Hymenoptera			2
4701.19	Diptera	Cecidomyiidae	*Heteropeza pygmaea*	14

Table 6: These are the 21 taxa produced by bottle gentian 4705, in the order of their appearance.

Species #	Order	Family	Name	Arthropods
4705.1	Diptera	Agromyzidae	*Melanagromyza* sp.	12
4705.2	Hymenoptera	Braconidae	*Bracon palliventris*	47
4705.3	Hymenoptera	Braconidae	*Heterospilus* sp.	7
4705.4	Hymenoptera	Braconidae	*Heterospilus* sp.	6
4705.5	Hymenoptera	Pteromalidae	*Habrocytus* sp.	3
4705.6	Hymenoptera	Eupelmidae	*Macroneura vesicularis*	4
4705.7	Hymenoptera			5
4705.8	Coleoptera	Mordellidae		75
4705.9	Hymenoptera	Braconidae	*Schizoprymnus* sp.	19
4705.11	Lepidoptera			1
4705.12	Hymenoptera			219
4705.13	Hymenoptera			3
4705.14	Acari			some
4705.15	Diptera	Cecidomyiidae	(larvae)	many
4705.16	Hymenoptera			28
4705.17	Diptera	Cecidomyiidae	*Heteropeza pygmaea*	many
4705.18	Acari			some
4705.19	Coleoptera	Mordellidae		1
4701.21	Collembola	Sminthuridae		many
4701.22	Diptera	Phoridae		1
4701.23	Diptera	Sciaridae		40

This novel technique shows that a great diversity of fauna live inside or attached to the outside of herbaceous plant stems over the winter. It also shows that different life stages overwinter on plant stems. These taxa include an array of parasitoids as well as herbivores, detritivores and predators lower on the trophic pyramid. Many parasitoids are very specific in their use of hosts. Thus, we can assume that some of the animals I reared out use particular species among those that have appeared as adults in my containers. Some of these parasitoids probably parasitize other parasitoids in these samples. Some of the herbivores are very choosy about the food plant in which they develop. These first experiments have given but a glimpse of what occurs in or on the stems of various prairie plants.

A frequent prairie management technique is the burning of prairies (or preferably the burning of parts of each prairie) in fall, winter, or spring—just the period over which these taxa are living in or on the stems that would probably be consumed or overheated by the fire. A less frequent prairie management technique is mowing in the fall, winter, or spring, when the flora is inactive, but when these animals may be vulnerable. Many prairies are grazed so hard that much of this stem-fauna may be extirpated through eradication of some plant species from the pasture or through suppression of some plants to the extent that stem development is inadequate to support some of these fauna. Mowing or haying during the summer can have these same effects.

Vigorous application of any of the tools of prairie management must be detrimental to some fauna, probably especially so to those parasitoids that depend on certain herbivores that, in turn, depend on certain plants. These most highly specialized fauna are at risk of eradication from prairie remnants as a result of our management practices, yet most prairie managers have essentially no knowledge of these animals. Indeed, many entomologists have essentially no knowledge of these fauna. That is the state of our common knowledge, given the economic orientation that pervades professional entomology.

Because we know so little about the invertebrate fauna native to our prairies, it seems wise to hedge our bets in the course of designing and implementing management activities so that we lessen the risk of eradicating the very fauna that define a site as native grassland: the specialist fauna that depend on particular plants and/or animals found in that habitat.

In responsible and effective land management, one should consider what is known: in this case, we know at least something about how many prairie plants respond to fire, grazing or mowing. But one must also consider what is not known: in this case, we know almost nothing about what specialist fauna are present and how our management activities affect their populations. Prudence requires that we moderate our management activities accordingly.

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