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NATIVE PRAIRIE GRAMINOID HOST PLANTS OF MINNESOTA
AND ASSOCIATED LEPIDOPTERA: A LITERATURE REVIEW

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ABSTRACT. Native grasses act as host plants, providing food and shelter, for numerous Lepidoptera species during their larval stage. As grassland habitat decreases because of conversion to agriculture and urban areas, prairie specialist butterflies and moths have also declined. Addition of native species to urban and agriculture landscapes has been shown to benefit Lepidoptera communities in various ways. Native grasses have grown in popularity as a landscaping plant due to their low nutrient requirements, drought tolerance, and soil stabilization properties. However, the benefits of native grasses to Lepidoptera are not well known to many entomologists or horticulturists, let alone the average consumer. We reviewed the literature that identified native prairie graminoids as host plants for native Lepidoptera in Minnesota, especially plants widely available in the horticultural trade that could be planted for restoration or landscaping purposes. The context of the Lepidoptera and host plant associations found in the literature are described. In total, we found 36 Lepidoptera species that used 17 prairie graminoids as host plants cited in the literature. Three native grasses, *Schizachyrium scoparium* (Michx.) Nash, *Andropogon gerardii* Vitman and *Panicum virgatum* L. and were found to be used by the most Lepidoptera species, 11, 9, and 8, respectively. Most likely there are additional moth species that use these grasses as host plants because butterfly species tend to be better documented than moth species. The specific larval habits and host plant species were unknown for many species of moths that feed or are suspected to feed on graminoids, showing the need for further research in this area. This information can assist horticulturalists, ecologists, landscape planners, land managers, and homeowners in their decisions to buy and plant native grass species. In general, this knowledge provides increased awareness about the larval life stage of butterflies and moths to concerned citizens and green industry and further supports the importance of conserving native prairie to support and maintain Lepidoptera species.

Additional key words: Butterflies, moths, larval host plants, pollinators, sustainable landscapes

Lepidoptera go through a complete metamorphosis from larva to pupa to adult during their life cycle (Scott 1986). The larval and adult stages have different food requirements. Adults often feed on flower nectar and other liquid substrates, while almost all lepidopteran larva are phytophagous (Scoble 1992). Lepidoptera evolved with the flowering plants, initially eating plants from the family Fabaceae (Ehrlich & Raven 1964, Scott 1986). Since then, certain families and species have evolved to eat monocotyledons such as grasses and sedges (Ehrlich & Raven 1964, Scott 1986). In North America, these include the butterfly subfamilies Satyrinae and Hesperinae (Scott 1986), and various subfamilies, genera, and species of moths (Powell & Opler 2009, Wagner et al. 2011).

Native grasses provide food sources for numerous species of Lepidoptera (Scott 1986). However, native grassland habitats are some of the most endangered in North America (White et al. 2000). Less than 1% of the original tallgrass prairie remains (Samson & Knopf 1994), putting pressure on prairie endemic species of butterflies and moths. Declining populations of prairie-specialist Lepidoptera have been documented in North

America for several decades and they are continuing to decline even on prairie preserves (Orwig 1990, Schlicht et al. 2009, Swengel et al. 2011, Swengel & Swengel 2015). In Minnesota, of the 19 Lepidoptera species listed as endangered, threatened, or of special concern, nine are prairie dependent, and two are suspected of being prairie dependent (Metzler 2005, MN DNR 2013).

The loss of grasslands in North America is due to conversion to agriculture and urban areas (White et al. 2000), and has significantly altered native habitat, replacing native plant species with non-native species, such as agronomic crops and exotic landscape ornamentals (Burghardt et al. 2008, Tallamy & Shropshire 2009). Host specificity is common in Lepidoptera; non-native species usually support fewer Lepidoptera species as larval hostplants than native species (Tallamy & Shropshire 2009). Planting native species as ornamentals in urban or semi-urban areas has shown to benefit some Lepidoptera (Vickery 1995, Fontaine et al. 2016). Studies in agricultural and urban landscapes have shown that grasslands with higher cover and richness of native species had higher numbers of

uncommon or specialist butterfly species (Collinge et al. 2003) and higher diversity of butterfly and moth larvae (Burghardt et al. 2008).

Native grasses have grown in popularity as landscaping plants due to their low nutrient requirements, drought tolerance, and soil stabilization (Meyer 2012). Although the benefits of native flowers to adult Lepidoptera are well known, the food requirements of the larval forms of these same Lepidoptera are much more obscure and undocumented. Many entomologists and horticulturists know little of the feeding habits or preferences of graminoid-feeding Lepidoptera. The purpose of this review is to compile the information known to date about native graminoids that serve as larval host plants for Lepidoptera in Minnesota.

MATERIALS AND METHODS

The literature was reviewed for Lepidoptera species that use native Minnesota prairie graminoids, especially those widely available in the horticultural trade that could be planted for restoration or landscaping purposes. We included graminoid species from the upland prairie, wet meadow/carr, and wetland prairie system descriptions in the Field Guide to the Native Plant Communities of Minnesota (Minnesota Department of Natural Resources 2005), which listed the dominant, characteristic, and distinguishing graminoids for each community. Nomenclature for plant species followed the PLANTS database (USDA, NRCS, 2017). *Carex pennsylvanica* Lam. ssp. *heliophila* (Mack.) W.A. Weber (Cyperaceae) which was cited in Scott (1992) as a host plant, was updated to its current synonym in the PLANTS database (USDA, NRCS, 2017), *Carex inops* L.H. Bailey ssp. *heliophila* (Mack.) Crins. This sedge is a dry prairie species which differentiates it from *Carex pennsylvanica* Lam., which is primarily a woodland species (Gleason & Cronquist 1963). Only records that identified the host plant by species (not just genus) were included. We included records for Lepidoptera species that occur in Minnesota. If the host plant record was obtained outside of the region, the information was still included in the review. However, host plant records for an adjacent lepidopteran subspecies that did not occur in Minnesota were not included because host plant preferences can differ between adjacent subspecies (MacNeil 1964). Host plant relationships are determined by evidence that feeding has occurred, observations of larvae on a plant, evidence of larval shelters, or oviposition choice of adult butterflies and moths. The validity of host plant relationships can be difficult to determine because some species oviposit indiscriminately. For this reason, the context of the

lepidopteran host plant associations found in the literature were included in the review. Nomenclature for butterflies follows Pelham (2008). Nomenclature for moths follows Hodges et al. (1983), except where modified by Lafontaine and Schmidt (2010), Kaila (1999), Metzler and Brown (2014), and Hodges (1978).

RESULTS

Host plant associations. Seventeen native graminoid species occurring in the upland prairie, wet meadow/carr, and wetland prairie systems of Minnesota were found to serve as food for native Lepidoptera species (Table 1). In total, we found 36 Lepidoptera species cited in the literature that used these native prairie graminoids as host plants in Minnesota (Table 2). *Schizachyrium scoparium* (Michx.) Nash (Poaceae) was found to be used by the most species, 11 (Table 3). *Andropogon gerardii* Vitman (Poaceae) served as a host plant for nine species; *Panicum virgatum* L. (Poaceae) for eight species; *Bouteloua gracilis* Willd. ex Kunth (Poaceae) and *Bouteloua curtipendula* Michx. (Poaceae) served as a host plant for six species; *Carex lacustris* Willd. (Cyperaceae), *Carex stricta* Lam. (Cyperaceae), *Elymus canadensis* L. (Poaceae), and *Sporobolus heterolepis* (A. Gray) A. Gray (Poaceae) for five species; *Koeleria macrantha* (Ledeb.) Schult. (Poaceae) and *Carex inops* subsp. *heliophila* (Cyperaceae) for four species and; *Bouteloua hirsuta* Lag. (Poaceae) and *Elymus trachycaulus* (Link) Gould ex Shinnars (Poaceae) for three species; *Spartina pectinata* Bosc. ex Link (Poaceae), *Sorghastrum nutans* (L.) Nash (Poaceae), and *Hesperostipa spartea* (Trin.) Barkworth (Poaceae) for two species and *Hesperostipa comata* (Trin. & Rupr.) Barkworth (Poaceae) for one species (Table 3).

Oviposition. Many Lepidoptera oviposit on their host plant, presumably to increase the chances that the larvae will encounter their host plant after hatching, increasing survival rates (Ehrlich & Raven 1964, Celik et al. 2015). However, oviposition “mistakes” have been observed when females accidentally oviposit on the wrong plant (Scott 1986, Thompson & Pellmyr 1991). Non-specific oviposition, or ovipositing indiscriminately on plant species, has also been observed. This behavior is common among graminoid-feeders, such as those in the Satyrinae subfamily (Scott 1992, Tiitsaar et al. 2016, Wiklund 1984). It is hypothesized that these species oviposit at random because their food plants grow abundantly, and so they do not need to target as precisely as other species that feed on less abundant plants (Wiklund 1984).

Less has been published about the Hesperinae, the graminoid-feeding subfamily of Hesperidae. Scott

TABLE 1. Graminoids native to the Upland Prairie, Wet Meadow/Carr, and Wetland Prairie systems of Minnesota as defined by Minnesota DNR (Minnesota Department of Natural Resources 2005) that serve as food for Lepidoptera larvae.

Common name	Scientific Name
big bluestem	<i>Andropogon gerardii</i> Vitman
sideoats grama	<i>Bouteloua curtipendula</i> Michx.
blue grama	<i>Bouteloua gracilis</i> Willd. ex Kunth
hairy grama	<i>Bouteloua hirsuta</i> Lag.
sun sedge	<i>Carex inops</i> ssp. <i>heliophila</i> (Mack.) Crins
hairy sedge, lake sedge	<i>Carex lacustris</i> Willd.
tussock sedge, upright sedge	<i>Carex stricta</i> Lam.
Canada wildrye	<i>Elymus canadensis</i> L.
slender wheatgrass	<i>Elymus trachycaulus</i> (Link) Gould ex Shinners
needleandthread	<i>Hesperostipa comata</i> (Trin. & Rupr.) Barkworth
porcupine grass	<i>Hesperostipa spartea</i> (Trin.) Barkworth
Junegrass	<i>Koeleria macrantha</i> (Ledeb.) Schult.
switchgrass	<i>Panicum virgatum</i> L.
little bluestem	<i>Schizachyrium scoparium</i> (Michx.) Nash
Indiangrass	<i>Sorghastrum nutans</i> (L.) Nash
prairie cordgrass	<i>Spartina pectinata</i> Bosc. ex Link
prairie dropseed	<i>Sporobolus heterolepis</i> (A. Gray) A. Gray

(1973) found that *Notamblyscirtes simius* (W. H. Edwards) oviposited only on its host plant, *Bouteloua gracilis*. However, *Hesperia dactyloae* (Skinner) has been observed to oviposit on a variety of plant species (McCabe & Post 1977, Dana 1991).

Shelter building. Some caterpillars construct shelters in which they reside during their larval life stage (Scoble 1992). Various families of Lepidoptera exhibit this behavior, including families with graminoid-feeding species such as Tortricidae, Gelechiidae, Pyralidae, Nymphalidae, and Hesperidae (Greeney & Jones 1998). The moth families, Tortricidae, Gelechiidae, and Pyralidae are leaf rollers, named for the shelters they make by folding or rolling one leaf or multiple leaves together, using silk as a fastener (Lafontaine et al. 2010). While there are nest builders in the Nymphalidae, none

of the graminoid-feeding satyrs in this family exhibit this behavior (Scott 1992). However, almost all species in the Hesperidae family make shelters (Greeney & Jones 1998).

The Hesperidae may contain the largest diversity of shelter types (Greeney & Jones 1998). Shelters are built at various heights, often changing during the life of the larvae, using different techniques and on different grass species and substrates (MacNeill 1964, Dana 1991, Lafontaine et al. 2010). *H. dactyloae* larvae make shelters near the base of bunch grasses, *Schizachyrium scoparium* and *Sporobolus heterolepis*, by weaving together blades of grass and leaf litter (Dana 1991). *Hesperia assinihoia* (Lyman) make nests by rolling or attaching leaves together or sometimes even using dried cattle feces (McCabe & Post 1977, Scott 1986). Early larval instars of *Hesperia ottoe* W. H. Edwards and *Polites origenes* (Fabricius) make aerial nests, by weaving grass leaves together above the soil surface, using bunch grass species *Andropogon gerardii* (Scott 1992) or *Schizachyrium scoparium* (Dana 1991). *Polites themistocles* (Latreille) larvae are suspected of making silk tunnels in the litter and/or soil (Scott 1992). *Amblyscirtes oslari* (Skinner) larvae make conventional rolled leaf tube nests (Scott 1992). The placement of larval nests determines the vulnerability of larval species to different kinds of land management, such as prescribed burning or haying, throughout the year (Dana 1991).

Feeding behavior. Caterpillars feed on grasses using various techniques. Some caterpillars feed in the open, exposed on the plant on which they are feeding (Scoble 1992), while others are concealed feeders, feeding internally in the plant or hiding themselves in shelters (Lafontaine et al. 2010). Shelter-builders often feed from inside or near their shelter. Dana (1991) observed larvae of *H. dactyloae* leaving shelters to forage, cutting off blades of grass, and then returning to their shelter with the blade to eat it. Species that do not build shelters, like those in the Satyrinae, protect themselves by camouflage or hiding at the base of plants during the day and then feeding at night (Scott 1992).

Graminoid-feeding moths exhibit multiple concealed feeding behaviors. Many fall into the borer category. Borers drill into either the stem or roots of plants using specialized mouth parts (Wagner et al. 2011). Graminoid-feeders in the moth family Elachistidae are leaf miners, eating the chlorophyll between the outer layers of the leaf (Braun 1948). Graminoid-feeding moths from the Gelechiidae family are leaf-rollers, feeding from the inside of their shelter (Lafontaine et al. 2010). Like butterflies, moths that are exposed feeders employ camouflage and nocturnal eating behaviors to

TABLE 2. Lepidoptera recorded to use the native prairie graminoids in Table 1, and their native ranges in the Upper Midwest (Minnesota, South Dakota, North Dakota, Iowa, Illinois, Wisconsin, Michigan). Ranges are not listed for some subspecies.

Lepidoptera Species	MN	SD	ND	IA	IL	WI	MI	Reference
<i>Aethes spartinana</i> (Barnes & McDunnough, 1916)	x	x	x	x	x	x		Ainslie 1917; Prasifika 2012
<i>Amblyscirtes hegon</i> (Scudder 1863)	x			x	x	x	x	Scott 1986
<i>Amblyscirtes vialis</i> (W. H. Edwards 1862)	x	x	x	x	x	x	x	Scott 1986
<i>Anatrytone logan</i> (W. H. Edwards, 1863)	x	x	x	x	x	x	x	Scott 1986
<i>Anatrytone logan logan</i> (W. H. Edwards, 1863)								-
<i>Anicla tenuescens</i> (Smith, 1890)	x	x	x	x		x		Lafontaine 2004
<i>Atrytone arogos</i> (Boisduval & Leconte, [1837])	x	x	x	x	x	x		Scott 1986
<i>Atrytone arogos iowa</i> (Scudder, 1868)								-
<i>Atrytonopsis hianna</i> (Scudder, 1868)	x	x	x	x	x	x	x	Scott 1986
<i>Atrytonopsis hianna hianna</i> (Scudder, 1868)								-
<i>Blastobasis repartella</i> (Dietz, 1910)	x	x	x	x	x	x	x	Adamski et al. 2010
<i>Cercyonis pegala</i> (Fabricius, 1775)	x	x	x	x	x	x	x	Scott 1986
<i>Cercyonis pegala nephele</i> (W. Kirby, 1837)								-
<i>Deltote bellicula</i> (Hübner, 1818)	x	x	x	x	x	x	x	Beadle & Leckie 2012
<i>Euphyes conspicua</i> (W. H. Edwards, 1863)	x			x	x	x	x	-
<i>Euphyes dion</i> (W. H. Edwards, 1879)	x	x	x	x	x	x	x	Scott 1986
<i>Euphyes vestris</i> (Boisduval 1852)	x	x	x	x	x	x	x	Scott 1986
<i>Faronta diffusa</i> (Walker, 1856)	x	x	x	x	x	x	x	Beadle & Leckie 2012
<i>Faronta rubripennis</i> (Grote & Robinson, 1870)	x	x		x	x	x	x	Beadle & Leckie 2012
<i>Hesperia assiniboia</i> (Lyman, 1892)	x	x	x					Dana & Huber 1988
<i>Hesperia comma</i> (Linnaeus, 1758)	x	x	x			x	x	Scott 1986
<i>Hesperia dacotae</i> (Skinner, 1911)	x	x	x					Scott 1986
<i>Hesperia leonardus</i> T. Harris, 1862	x	x	x	x	x	x	x	Scott 1986
<i>Hesperia leonardus leonardus</i> T. Harris, 1862	x				x	x	x	Scott 1986
<i>Hesperia leonardus pawnee</i> Dodge, 1874	x	x	x	x				Scott 1986; Metzler et al. 2005
<i>Hesperia metea</i> Scudder, 1863	x			x	x	x	x	Scott 1986
<i>Hesperia ottoe</i> W. H. Edwards, 1866	x	x	x	x	x	x	x	Scott 1986
<i>Hesperia sassacus</i> T. Harris, 1862	x				x	x	x	Scott 1986
<i>Hesperia uncas</i> W. H. Edwards, 1863	x	x	x	x				Scott 1986
<i>Hesperia uncas uncas</i> W. H. Edwards, 1863								-
<i>Lethe appalachia</i> R. Chermock, 1947	x	x		x	x	x	x	Scott 1986
<i>Lethe eurydice</i> (Linnaeus, 1763)	x	x	x	x	x	x	x	Scott 1986
<i>Meropleon ambifusca</i> (Newman, 1948)	x	x	x	x	x	x	x	Wagner et al. 2011; Beadle 2012
<i>Mocis texana</i> (Morrison, 1875)	x			x	x	x	x	Wagner et al. 2011
<i>Oarisma garita</i> (Reakirt, 1866)	x	x	x					Scott 1986
<i>Oarisma poweshiek</i> (Parker, 1870)	x	x	x			x	x	Scott 1986
<i>Papaipema cataphracta</i> (Grote, 1864)	x			x	x	x	x	Wagner et al. 2011
<i>Papaipema nebris</i> (Guenee, 1852)	x	x		x	x	x	x	Beadle & Leckie 2012
<i>Poanes massoit</i> (Scudder, 1863)	x	x	x	x	x	x	x	Scott 1986
<i>Poanes viator</i> (W. H. Edwards, 1865)	x	x	x	x	x	x	x	Scott 1986
<i>Poanes viator viator</i> (W. H. Edwards, 1865)								-
<i>Polites origenes</i> (Fabricius, 1793)	x	x	x	x	x	x	x	Scott 1986
<i>Polites themistocles</i> (Latreille, [1824])	x	x	x	x	x	x	x	Scott 1986
" <i>Resapamea</i> " <i>stipata</i> (Morrison, 1875)	x	x	x	x	x	x	x	Metzler et al. 2005

avoid predators (Lafontaine et al. 2010). Other tactics include physical defenses, like spines, and coloration warning of toxicity (Lafontaine et al. 2010).

Although most Lepidoptera specialize in feeding on just one or few species, others are generalist feeders (Scott 1992, New 1997). Graminoid-feeding butterflies are suspected of being able to eat numerous species of grass, making them graminoid specialists (Scott 1992). The grass skippers (Hesperiinae) range from preferring a certain species, growth-form, or genus of grass to eating grass and sedge species (Scott 1986, Scott 1992). Their limitations to certain species are suspected to be determined by their preference for shelter building and not necessarily nutrition requirements (MacNeil 1964). Butterflies in the Satyrinae subfamily, which do not build above-ground shelters, are polyphagous, feeding on a variety of grass species and sometimes grass and sedge species (Scott 1992). Moth species range from very host-specific, eating only one or two species of grass, to extremely polyphagous, feeding on species from multiple families (Wagner et al. 2011).

DISCUSSION

Additional grass skipper species that feed on native Minnesota grasses were not included here because either their host plants were listed only to genus, or were not listed in the plant community reference that defined the scope of our study. Further research on grass skippers may reveal additional species that feed on the native grasses listed.

In general, butterfly species are better documented than moth species because they are larger, showier, and fly during the day, making them easier to study (Thompson & Pellmyr 1991). Although many moth species are known to eat grass, the specific larval habits and host plants of individual species are often unknown. Forty-six additional native moth species that occur in Minnesota were suspected or confirmed to feed on grasses or sedges but could not be added to the list because their larval food preferences were unknown (Hodges 1978, Lafontaine & Poole 1991, Landry 1995, Lafontaine 2004, Metzler et al. 2005, Mikkola et al. 2009). This large number demonstrates the need for further research and documentation of larval moth habits and host plants.

The host plants and larval habits of some moth species have been documented in detail because they are considered as pests. These tend to be polyphagous species that in addition to eating the native grasses on our list, feed on many additional graminoid, forb, shrub species, and/or cultivated grass species such as corn, wheat, and barley (Decker 1930, Decker 1931, Reddy & Antwi 2016). *Papaipema nebris* (Guenee) (Noctuidae),

Papaipema cataphracta (Grote) (Noctuidae), *Faronta diffusa* (Walker) (Noctuidae), and “*Resapamea*” *stipata* (Morrison) (Noctuidae) are all native moth species included in this review that have been documented as occasional pests of agricultural crops (Decker 1930, Decker 1931, Solomon 1995, Reddy & Antwi 2016). *P. nebris* has also been documented as an occasional pest of gardens (Decker 1931).

The information in this review can assist horticulturalists, ecologists, landscape planners, land managers, and homeowners in their decisions to buy and plant native grass species to benefit Lepidoptera. This important attribute of native grasses can be used in garden center promotion and to educate the general public. In general, this knowledge provides increased awareness about the larval life stage of butterflies and moths for both concerned citizens and horticultural and ecological businesses and further supports the importance of conserving native prairie to maintain these Lepidoptera.

As Lepidoptera populations decline, it is important to maximize the ecological benefits of anthropogenic landscapes that are replacing their native habitat. However, native grass use in landscaping should not detract from the importance of conserving native habitat. Rather, the purpose of this literature review is to provide information on the values of native grasses to Lepidoptera.

Additional research is needed to fully understand the benefits of native landscaping in suburban and urban areas to Lepidoptera communities and rare species. While the addition of native nectar flowers into human dominated landscapes has shown to be successful in providing nectar to butterflies (Vickery 1995), there is debate surrounding the efficacy of butterfly gardens as breeding habitat (Di Mauro et al. 2007; Cutting & Tallamy 2015). The main benefit of residential butterfly gardens may be as stepping stones between larger natural areas, where Lepidoptera can obtain nectar before continuing on to permanent habitat (Vickery 1995; Di Mauro et al. 2007). Studies differ in their findings on the influence of patch characteristics, such as habitat quality, versus landscape characteristics, such as surrounding matrix, on butterfly diversity (Collinge et al. 2003; Di Mauro et al. 2007; Olivier et al. 2016). The influence of these factors also differs for individual species due to species-specific traits such as habitat preference and mobility (Olivier et al. 2016). Olivier et al. (2016) found a stronger negative correlation between urbanization and habitat specialists than between urbanization and habitat generalists. Considering this information, further research is needed to understand how much the landscape context influences the

TABLE 3. List of native graminoids species and associated Lepidoptera, references for individual associations, and the context of the host plant record in the literature. No notes were added if the species was listed as a host plant or food plant with no additional context.

Larval Plants	Lepidoptera	References	Notes
<i>Andropogon gerardii</i>	<i>Anatrytone logan</i>	Layberry et al. 1998; Scott 1986	-
	<i>Anatrytone logan logan</i>	McCabe & Post 1977	-
	<i>Atrytone arogos</i>	Scott 1992	Field observations of shelters in Colorado
		Metzler et al. 2005	Field observations of feeding
		Opler & Krizek 1984	Listed as host plant in Missouri
		Scott 1986; Opler & Malikul 1992	-
		Pyle 1981	Listed as a species used for oviposition
	<i>Atrytone arogos iowa</i>	McCabe & Post 1977	-
	<i>Atrytonopsis hianna</i>	Layberry et al. 1998; Scott 1986; Opler & Krizek 1984	-
	<i>Atrytonopsis hianna hianna</i>	McCabe & Post 1977	-
	<i>Faronta diffusa</i>	Godfrey 1972	Larvae collected from this plant species in the field
		Wagner et al. 2011	Field observation of oviposition
	<i>Hesperia dacotae</i>	Dana 1991	Field observations of feeding
		McCabe 1981	Accepted by confined first instar larvae
		Scott 1986	Listed as a species used for oviposition
<i>Hesperia metea</i>	Scott 1986; Opler & Krizek 1984	-	
<i>Hesperia ottoe</i>	Scott 1992	Field observations of shelters and oviposition in Colorado	
	Dana 1991	Accepted grass during no choice experiment; field observations of shelters	
	Scott 1986; Metzler et al. 2005	-	
<i>Hesperia sassacus</i>	Opler & Malikul 1992	-	
<i>Meropleon ambifusca</i>	Wagner et al. 2011	Field observations of feeding	
<i>Bouteloua curtipendula</i>	<i>Atrytone arogos</i>	Scott 1992	Field observations of shelters and oviposition in Colorado
	<i>Hesperia assiniboia</i>	Scott 1992	Field observations of oviposition in Colorado
	<i>Hesperia dacotae</i>	Dana 1991	Field observations of feeding
	<i>Hesperia leonardus pawnee</i>	Scott 1986	-
	<i>Hesperia ottoe</i>	Scott 1986	-
		Dana 1991	Accepted during a no choice experiment; field observations of shelters in MN
	<i>Oarisma poweshiek</i>	Selby 2005	Field observations of feeding
<i>Bouteloua gracilis</i>	<i>Hesperia assiniboia</i>	Layberry et al. 1998	-
		Scott 1992	Field observations of oviposition in Colorado
	<i>Hesperia comma</i>	Scott 1986	-
	<i>Hesperia leonardus</i>	Layberry et al. 1998; Opler & Malikul 1992	-
	<i>Hesperia leonardus pawnee</i>	Scott 1992	Field observations of oviposition in Colorado
	<i>Hesperia ottoe</i>	Scott 1986	-

continued on next page

TABLE 3. (Continued) List of native graminoids species and associated Lepidoptera, references for individual associations, and the context of the host plant record in the literature. No notes were added if the species was listed as a host plant or food plant with no additional context.

Larval Plants	Lepidoptera	References	Notes
<i>Bouteloua gracilis</i> (continued)	<i>Hesperia uncas</i>	Scott 1992	Field observations of oviposition in Colorado
		Scott 1986; Opler & Krizek 1984; Layberry et al. 1998	-
	<i>Hesperia uncas uncas</i>	McCabe & Post 1977	Listed as a food plant, but only observed oviposition
	<i>Oarisma garita</i>	Scott 1992	Field observations of oviposition in Colorado
<i>Bouteloua hirsuta</i>	<i>Hesperia uncas</i>	Scott 1986	-
		Dana & Huber 1988	Listed as a host plant in Minnesota
	<i>Hesperia ottoe</i>	Dana 1991	Field observations of shelters
	<i>Hesperia leonardus pawnee</i>	Scott 1986	-
<i>Carex inops</i> ssp. <i>heliophila</i>	<i>Hesperia dacotae</i>	Dana 1991	Field observations of feeding
	<i>Euphyes vestris</i>	Scott 1986; Layberry et al. 1998	Listed as host plant with no additional context
		Pyle 1981	Listed as a host plant in Colorado
	<i>Hesperia assiniboia</i>	Scott 1992	Field observations of oviposition in Colorado
<i>Carex lacustris</i>	<i>Oarisma garita</i>	Scott 1992	Field observation of oviposition in Colorado; larvae readily accepted in lab
	<i>Euphyes dion</i>	Scott 1986; McCabe & Post 1977	-
	<i>Euphyes vestris</i>	Scott 1986	-
	<i>Lethe eurydice</i>	Scott 1986	-
	<i>Lethe appalachia</i>	Scott 1986	-
	<i>Poanes viator</i>	Scott 1986	-
	<i>Poanes viator viator</i>	McCabe & Post 1977	-
<i>Carex stricta</i>	<i>Deltote bellicula</i>	Wagner et al. 2011	Raised on plant in lab
	<i>Euphyes conspicua</i>	Scott 1986	-
	<i>Lethe appalachia</i>	Scott 1986	-
	<i>Lethe eurydice</i>	Scott 1986	-
	<i>Poanes masasoit</i>	Scott 1986	-
<i>Elymus canadensis</i>	<i>Amblyscirtes vialis</i>	Scott 1992	Field observations of larval shelters in Colorado
	<i>Faronta diffusa</i>	Godfrey 1972	Eggs were found on the plant
	" <i>Resapamea</i> " <i>stipata</i>	Tietz 1972	-
	<i>Papaipema cataphracta</i>	Tietz 1972	-
	<i>Poanes zabulon taxiles</i>	Scott 1986	-
<i>Elymus trachycaulus</i>	<i>Amblyscirtes vialis</i>	Scott 1992	Field observations of larval shelters in Colorado
	<i>Poanes zabulon taxiles</i>	Scott 1986	Listed as host plant for this subspecies
	<i>Faronta diffusa</i>	Tietz 1972	-

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TABLE 3. (Continued) List of native graminoids species and associated Lepidoptera, references for individual associations, and the context of the host plant record in the literature. No notes were added if the species was listed as a host plant or food plant with no additional context.

Larval Plants	Lepidoptera	References	Notes
<i>Hesperostipa spartea</i>	<i>Hesperia dacotae</i>	McCabe 1981	Accepted by confined larvae
		Dana 1991	Feeding observed in the field, but only by older larvae. Early instars did not feed on this species under captive feeding situations.
	<i>Cercyonis pegala</i>	Scott 1986	-
<i>Hesperostipa comata</i>	<i>Hesperia leonardus pawnee</i>	McCabe & Post 1977	-
<i>Koeleria macrantha</i>	<i>Polites themistocles</i>	Scott 1992	Field observations of oviposition
	<i>Hesperia assiniiboia</i>	Layberry et al. 1998	-
	<i>Hesperia dacotae</i>	McCabe 1981	Accepted by confined larvae. Dana (1991) found that confined early instar larvae did not accept
	<i>Oarisma garita</i>	Scott 1992	Field observations of oviposition in Colorado
<i>Panicum virgatum</i>	<i>Aethes spartinana</i>	Adamski et al. 2010	Larvae were collected from the plant in the field
	<i>Anatrytone logan</i>	Layberry et al. 1998; Scott 1986; Opler & Krizek 1984	-
	<i>Anatrytone logan logan</i>	McCabe and Post 1977	Field observations of oviposition
	<i>Blastobasis repartella</i>	Adamski et al. 2010	Field observations of feeding
	<i>Faronta rubripennis</i>	Metzler et al. 2005	Field observations of feeding
		Wagner et al. 2011	Listed as a host plant in New Jersey
	<i>Hesperia leonardus</i>	Layberry et al. 1998; Opler & Krizek 1984	-
	<i>Hesperia leonardus leonardus</i>	Scott 1986	-
	<i>Mocis texana</i>	Wagner et al. 2011	Listed as a host plant in New Jersey
	<i>Papaipema nebris</i>	Prasifika et al. 2011	Field observations of feeding within stem
<i>Schizachyrium scoparium</i>	<i>Atrytone arogos</i>	Scott 1986	-
		Scott 1992	Field observations of oviposition; Listed as a popular host in Kansas and E. US
	<i>Atrytonopsis hianna</i>	Layberry et al. 1998; Scott 1986; Opler & Krizek 1984; Opler & Malikul 1992	-
	<i>Cercyonis pegala nephele</i>	Scott 1992	Field observations of oviposition; considered rare host plant in Colorado
	<i>Hesperia comma assiniiboia</i>	Scott 1992	Field observations of oviposition in Colorado

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TABLE 3. (Continued) List of native graminoids species and associated Lepidoptera, references for individual associations, and the context of the host plant record in the literature. No notes were added if the species was listed as a host plant or food plant with no additional context.

Larval Plants	Lepidoptera	References	Notes
<i>Schizachyrium scoparium</i> (continued)	<i>Hesperia dacotae</i>	Opler & Krizek 1984; Opler & Malikul 1992; Pyle 1981	-
		Scott 1986	Field observations of larvae on the plant
		Dana 1991	Field observations of feeding
		Layberry et al. 1998	Field observations of larvae on the plant
	<i>Hesperia leonardus</i>	Opler & Krizek 1984	Associated with stands of little bluestem
		Layberry et al. 1998; Opler & Malikul 1992	-
	<i>Hesperia leonardus pawnee</i>	Scott 1986	-
	<i>Hesperia metea</i>	Scott 1986; Opler & Krizek 1984	-
	<i>Hesperia ottoe</i>	Dana 1991	Accepted during no-choice experiment; Field observations of shelters
		Opler & Malikul 1992; Scott 1986	-
		Layberry et al. 1998; Opler & Krizek 1984	Listed as a species used for oviposition
		McGuire 1982	Field observations of oviposition
	<i>Hesperia sassacus</i>	Layberry et al. 1998; Scott 1986	-
		Scott 1986	-
<i>Oarisma poweshiek</i>	Metzler et al. 2005; Swengel & Swengel 1999	-	
	Selby 2005	Field observations of oviposition	
<i>Polites origenes</i>	Scott 1986; Robinson et al. 2002; Layberry et al. 1998	-	
<i>Sorghastrum nutans</i>	<i>Amblyscirtes hegon</i>	Opler & Krizek 1984; Scott 1986; Layberry et al. 1998; McCabe & Post 1977	-
		Godfrey 1972; Robinson et al. 2002	Larvae of the species were collected from the plant
<i>Spartina pectinata</i>	<i>Aethes spartinana</i>	Barnes & McDunnough 1916; Ainslie 1917; Prasifka et al. 2012.	Field observations of feeding
		Metzler et al. 2005	Listed as a host plant in Ohio
	"Resapamea" <i>stipata</i>	Decker 1930	Field observations of larvae on the plant
		Crumb 1956; Tietz 1972	-
<i>Sporobolus heterolepis</i>	<i>Anicla tenuescens</i>	Metzler et al. 2005	Field observations of larvae on the plant
		Lafontaine 2004; Metzler et al. 2005	Field observations of feeding
	<i>Hesperia dacotae</i>	Dana 1991	Field observations of feeding
	<i>Hesperia leonardus pawnee</i>	Scott 1986	-
	<i>Hesperia ottoe</i>	Dana 1991	Accepted in a no choice experiment
	<i>Oarisma poweshiek</i>	Metzler et al. 2005; Swengel & Swengel 1999	-
		Selby 2005	Field observations of oviposition

effectiveness of native plantings in attracting and benefiting specialist species with low mobility such as prairie skippers. General recommendations to maximize the benefits native plantings provide to Lepidoptera include increasing the size of the planting, increasing the number of blooming nectar plants, and strategically positioning the planting to better connect corridors or areas of suitable habitat (Di Mauro et al. 2007).

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LITERATURE CITED

- ADAMSKI, D., P. J. JOHNSON, A. A. BOE, J. BRADSHAW, & A. PULTYNIEWICZ. 2010. Descriptions of life-stages of *Blastobasis repartella* (Lepidoptera: Gelechioidea: Coleophoridae: Blastobasinae) and observations on its biology in switchgrass. *Zootaxa* 2656: 41–54.
- AINSLIE, C. N. 1917. A few notes on the life history of *Phalonia spartanana*. *Canad. Entomol.* 49: 93–96.
- BARNES, W. M. & J. MCDUNNOUGH. 1916. An Apparently New Species of *Phalonia*. *The Canad. Entomol.* 48: 144–144.
- BEADLE, D. & S. LECKIE. 2012. Peterson Field Guide to Moths of Northeastern North America. Houghton Mifflin Harcourt, New York, New York. ix + 611.
- BRAUN, A. F. 1948. Elachistidae of North America. *Mem. Am. Entomol. Soc. No. 13.* 110 pp.
- BURGHARDT, K. T., D. W. TALLAMY & W. G. SHRIVER. 2008. Impact of Native Plants on Bird and Butterfly Biodiversity in Suburban Landscapes. *Cons. Biol.* 23:219–224.
- CELIK, T., M. BRÄU, S. BONELLI, C. CERRATO, B. VRES, E. BALLETO, C. STETTNER & M. DOLEK. 2015. Winter-green host-plants, litter quantity and vegetation structure are key determinants of habitat quality for *Coenonympha oedippus* in Europe. *J. Insect Conserv.* 19:359–375.
- COLLINGE, S. K., K. L. PRUDIC & J. C. OLIVER. 2003. Effects of Local Habitat Characteristics and Landscape Context on Grassland Butterfly Diversity. *Conserv. Biol.* 17:178–187.
- CRUMB, S. E. 1956. The Larvae of the Phalaenidae. Technical Bulletin No. 1135. United States Department of Agriculture, Washington, D. C.
- CUTTING, B. T. & D. W. TALLAMY. 2016. An Evaluation of Butterfly Gardens for Restoring Habitat for the Monarch Butterfly (Lepidoptera: Danaidae). *Environ Entomol* 44:1328–1335.
- DANA, R. P. 1991. Conservation management of the prairie skippers *Hesperia dacotae* and *Hesperia ottoe*. University of Minnesota Ag. Exp. Stat. Bull. 594–91.
- DANA, R. P. & R. L. HUBER. 1988. Butterflies. p. 379–395 In Coffin, B. & L. Pfannmuller (ed) Minnesota's Endangered Flora and Fauna. University of Minnesota Press, Minneapolis, Minnesota.
- DECKER, G. C. 1930. The Biology of the Four-Lined Borer *Luperina stipata* (Morr.). *Ag. Exp. Stat. Iowa State College of Agriculture and Mechanic Arts. Res. Bull.* 125. 164 pp.
- . 1931. The Biology of the Stalk Borer *Papaipema nebris* (Gn.). *Exp. Stat. Iowa State College of Agriculture and Mechanic Arts. Res. Bull.* 143. 351 pp.
- DI MAURO, D., T. DIETZ & L. ROCKWOOD. 2007. Determining the effect of urbanization on generalist butterfly species diversity in butterfly gardens. *Urban Ecosyst.* 10:427–439.
- EHRlich, P. R. & P. H. RAVEN. 1964. Butterflies and Plants: A Study in Coevolution. *Evolution.* 18:586–608.
- FONTAINE, B., B. BERGEROT, I. LE VIOL & R. JULLIARD. 2016. Impact of urbanization and gardening practices on common butterfly communities in France. *Ecol. Evol.* 6:8174–8180.
- GLEASON, H. A. & A. CRONQUIST. 1963. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. D. Van Nostrand Company, New York. li + 810 pp.
- GODFREY, G. L. 1972. A Review and Reclassification of Larvae of the Subfamily Hadeninae (Lepidoptera, Noctuidae) of America North of Mexico. *Ag. Res. Service Tech. Bull. No. 1450.* U. S. Department of Agriculture, Washington D. C. 265 pp.
- GREENEY, H. F. & M. T. JONES. 1998. Shelter building in the Hesperidae: A classification scheme for larval shelters. *J. Res. Lepid.* 37:27–36.
- HODGES, R. W. 1978. The moths of North America north of Mexico, fasc. 6.1., Gelechioidea (in part): Cosmopterigidae. In Dominick, R. B. et al. (ed.) *E. W. Classey Ltd. and Wedge Entomol. Res. Found., London.* 166 pp.
- HODGES, R. W., T. DOMINICK, D. R. DAVIS, D. C. FERGUSON, J. G. FRANCLEMONT, E. G. MUNROE, & J. A. POWELL. 1983. Check List of the Lepidoptera of America North of Mexico Including Greenland. *E. W. Classey Ltd. and the Wedge Entomological Research Foundation. London, England.* 284 pp.
- KAILA, L. 1999. Phylogeny and classification of the Elachistidae s. s. (Lepidoptera: Gelechioidea). *System. Entomol.* 24:139–169.
- LAFONTAINE, J. D. 2004. The moths of North America north of Mexico, including Greenland, fasc. 27.1., Noctuoidea: Noctuidae (part) Noctuidae, Agrotini. In Hodges, R. W. (ed.) *Wedge Entomol. Res. Found., Washington, D.C.* 385 pp.
- LAFONTAINE, J. D. & R. W. POOLE. 1991. The Moths of America North of Mexico, fasc. 25.1, Noctuoidea, Noctuidae (part) In Dominick, R. B., (ed.) *Wedge Entomol. Res. Found., Washington, D.C.,* 182 pp.
- LAFONTAINE, J. D. & B. C. SCHMIDT. 2010. Annotated check list of the Noctuoidea (Insecta, Lepidoptera) of North America north of Mexico. *ZooKeys* 40:1–239.
- LAFONTAINE, J. D., J. T. TROUBRIDGE, & A. W. THOMAS. 2010. Moths and butterflies (Lepidoptera) of the Atlantic Maritime Ecozone, p. 489–537. In *Assessment of Species Diversity in the Atlantic Maritime Ecozone.* McAlpine, D. F. & I. M. Smith. (ed.), NRC Research Press, Ottawa, Canada.
- LANDRY, B. 1995. A Phylogenetic Analysis of the Major Lineages of the Crambinae and of the Genera of Crambini of North America (Lepidoptera: Pyralidae). Associated Publishers, Gainesville, Florida. 124 pp.
- LAYBERRY, R.A., P. W. HALL, & J. D. LAFONTAINE. 1998. The butterflies of Canada. University of Toronto Press, Toronto, Canada. 280 pp.
- MACNEILL, C. D. 1964. The skippers of the genus *Hesperia* in western North America, with special reference to California (Lepidoptera: Hesperidae). *Univ. Calif. Publ. Entomol., University of California Press, Berkeley* 35:1–230.
- MCCABE, T. L. 1981. The Dakota Skipper, *Hesperia dacotae* (Skinner): Range and Biology, with Special Reference to North Dakota. *J. Lepid. Soc.* 35:179–193.
- MCCABE, T. L., & R. L. POST. 1977. Skippers (Hesperioidea) of North Dakota: With Additional Records of North Dakota Butterflies and a Butterfly Calendar. *North Dakota Insects, Schaefer-Post Series Publ. No. 11, N.D. Agric. Exp. Stn. Publ. No. 714.* Department of Entomology and Agricultural Experiment Station, North Dakota State University, Fargo, ND. 70 p.
- MCGUIRE, W. W. 1982. New Oviposition and Larval Hostplant Records for North American *Hesperia* (Rhopalocera: Hesperidae). *Bull. Allyn Mus. No. 72.* 6 pp.
- METZLER, E. H. & J. W. BROWN. 2014. An updated check list of the *Cochylina* (Tortricidae, tortricinae, eulini) of North America North of Mexico including Greenland, with comments on classification and identification. *J. Lepid. Soc.* 68:274–282.

- METZLER, E. H., J. A. SHUEY, L. A. FERRE, R. A. HENDERSON, & P. Z. GOLDSTEIN. 2005. Contributions to the Understanding of Tall-grass Prairie-Dependent Butterflies and Moths (Lepidoptera) and their Biogeography in the United States. *Ohio Biol. Surv. Bull.* 15:1–143.
- MEYER, M. H. 2012. Ornamental Grasses in the United States. *Hort. Rev.* 39:121–152.
- MIKKOLA, K., J. D. LAFONTAINE, & J. D. GILL. 2009. The Moths of North America North of Mexico, fasc. 26.9, Noctuoidea, Noctuidae (part) Xyleninae (part): Apameini (part)—*Apamea* group of genera) *In* Hodges, R. W., et. al., (ed.) *Wedge Entomol. Res. Found.*, Washington, D.C.
- MINNESOTA DEPARTMENT OF NATURAL RESOURCES. 2005. Field Guide to the Native Plant communities of Minnesota: The Prairie Parkland and Tallgrass Aspen Parklands Provinces. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. MNDNR St. Paul, MN.
- (2013) Minnesota's list of Endangered, Threatened, and Special Concern Species. Minnesota Department of Natural Resources. 18 pp. Available from: <http://www.dnr.state.mn.us/ets/index.html> (March 23rd 2016).
- NEW, T. R. 1997. *Butterfly Conservation*. 2nd ed. Oxford University Press, Melbourne, Australia. xii + 248 pp.
- OLIVIER, T., R. SCHMUCKI, B. FONTAINE, A. VILLEMEX, & F. ARCHAUX. 2016. Butterfly assemblages in residential gardens are driven by species' habitat preference and mobility. *Landscape Ecol.* 31:865–876.
- OPLER, P. A. & G. O. KRIZEK. 1984. *Butterflies east of the Great Plains: an illustrated natural history*. Johns Hopkins University Press, Baltimore, Maryland. 295 pp.
- OPLER, P. A. & V. MALIKUL. 1992. *A Field Guide to Eastern Butterflies*. Houghton Mifflin Company, New York, New York. xvii + 396 pp.
- ORWIG, T. T. 1990. Loess hills Prairies as Butterfly Survival: Opportunities and Challenges. pp 131–136 *In* D. D. Smith & C. A. Jacobs (ed.) *Proceedings of the Twelfth North American Prairie Conference*. University of Northern Iowa, Cedar Falls, Iowa.
- PELHAM, J. P. 2008. A catalogue of the butterflies of the United States and Canada: with a complete bibliography of the descriptive and systematic literature. *J. Res. Lepid.* 40:1–658.
- POWELL, J. A. & P. A. OPLER. 2009. *Moths of Western North America*. University of California Press, Berkeley and Los Angeles. xiii + 369 pp.
- PRASIFKA, J. R., J. E. BUHAY, T. W. SAPPINGTON, E. A. HEATON, J. D. BRADSHAW, & M. E. GRAY. 2011. Stem-Boring Caterpillars of Switchgrass in the Midwestern United States. *Entomol. Soc. Am.* 104:507–514.
- PRASIFKA, J. R., D. K. LEE, J. D. BRADSHAW, A. S. PARRISH, & M. E. GRAY. 2012. Seed reduction in prairie cordgrass, *Spartina pectinata* Link., by the floret-feeding caterpillar *Aethes spartinana* (Barnes and McDunnough). *Bioenergy Res.* 5: 189–196.
- PYLE, R. M. 1981. *The Audubon Society Field Guide to North American Butterflies*. Alfred A. Knopf, Inc. New York, New York. 916 pp.
- REDDY, G. V. P. & F. B. ANTWI. 2016. Toxicity of natural insecticides on the larvae of wheat head armyworm, *Dargida diffusa* (Lepidoptera: Noctuidae). *Env. Toxic. Pharm.* 42:156–162.
- ROBINSON, G. S., P. R. ACKERY, I. J. KITCHING, G. W. BECCALONI, & L. M. HERNANDEZ. 2002. *Hostplants of the Moth and Butterfly Caterpillars of America North of Mexico*. The American Entomological Institute, Gainesville, Florida. 824 pp.
- SAMSON, F. B. & F. L. KNOPF. 1994. *Prairie Conservation*. Bioscience 44:418–421.
- SCHLICHT, D., A. SWENGEL, & S. SWENGEL. 2009. Meta-analysis of survey data to assess trends of prairie butterflies in Minnesota, USA during 1979–2005. *Jour. of Insect Conserv.* 13:429–447.
- SCOBLE, M. J. 1992. *The Lepidoptera Form, Function and Diversity*. Oxford University Press, Oxford. 404 pp.
- SCOTT, J. A. 1973. Convergence of Population Biology and Adult Behaviour in Two Sympatric Butterflies, *Neominois ridingsii* (Papilionoidea: Nymphalidae) and *Amblyscirtes simius* (Hesperioidea: Hesperioidea). *J. Animal Ecol.* 42:663–672.
- SCOTT, J. A. 1986. *The Butterflies of North America*. Stanford University Press, Stanford, California. 583 pp.
- 1992. Hostplant records for butterflies and skippers (mostly from Colorado) 1959–1991, with new life histories and notes on oviposition, immatures, and ecology. *Papilio New Series* 6:1–170.
- SELBY, G. 2005. Status assessment and conservation guidelines: Poweshiek Skipperling (*Oarisma poweshiek* (Parker) (Lepidoptera: Hesperioidea). Prepared for Twin Cities Field Office, U.S. Fish and Wildlife Service, Bloomington, Minnesota. 53 pp.
- SOLOMON, J. D. 1995. *Guide to Insect Borers in North American Broadleaf Trees and Shrubs*. Agriculture Handbook 706. Washington, DC. United States Department of Agriculture, Forest Service. 735 p.
- SWENGEL, S. R., D. SCHLICHT, F. OLSEN, & A. B. SWENGEL. 2011. Declines of prairie butterflies in the Midwestern USA. *J. Insect Conserv.* 15:327–339.
- SWENGEL, A. B. & S. R. SWENGEL. 1999. Observations of Prairie Skippers (*Oarisma poweshiek*, *Hesperia dactota*, *H. ottoe*, *H. leonardus pawnee*, and *Atrytone arogos iowa*) (Lepidoptera: Hesperioidea) in Iowa, Minnesota, and North Dakota during 1988–1997. *Great Lakes Entomol.* 32:267–292.
- 2015. Grass-skipper (Hesperioidea) trends in Midwestern USA grasslands during 1988–2013. *J. Insect Conserv.* 19:279–292.
- TALLAMY, D. W. & K. J. SHROPSHIRE. 2009. Ranking Lepidoptera Use of Native versus Introduced Plants. *Conserv. Biol.* 23:941–947.
- THOMPSON, J. N. & O. PELLMYR. 1991. Evolution of Oviposition Behavior and Host Preference in Lepidoptera. *Ann. Rev. Entomol.* 36:65–89.
- TIETZ, H. M. 1972. An index to the described life histories, early stages and hosts of the Macrolepidoptera of the continental United States and Canada. A. C. Allyn, Sarasota, Florida. 1041 pp.
- TIITSAAR, A., A. KAASIK, L. LINDMAN, T. STANEVITS, & T. TAMMARU. 2016. Host associations of *Coenonympha hero* (Lepidoptera: Nymphalidae) in northern Europe: SSmicrohabitat rather than plant species. *J. Insect Conserv.* 20:265–275.
- USDA, NRCS. 2017. The PLANTS Database (<http://plants.usda.gov>, 12 April 2017). National Plant Data Team, Greensboro, NC 27401–4901 USA.
- VICKERY, M. L. 1995. Gardens: the neglected habitat. pp 123–134. *In* *Ecology and Conservation of Butterflies*. Chapman and Hill, London, England.
- WAGNER, D. L., D. F. SCHWEITZER, J. B. SULLIVAN, & R. C. REARDON. 2011. *Owlet caterpillars of eastern North America*. Princeton University Press, Princeton, New Jersey. 576 pp.
- WHITE, R., S. MURRAY, & M. ROHWEDER. 2000. *Pilot Analysis of Global Ecosystems Grassland Ecosystems*. World Resources Institute, Washington, D.C.
- WIKLUND, C. 1984. Egg-laying patterns in butterflies in relation to their phenology and the visual apparency and abundance of their host plants. *Oecologia* 63:23–29

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