STATUS ASSESSMENT and CONSERVATION GUIDELINES

Poweshiek Skipperling
Oarisma poweshiek (Parker)
(Lepidoptera: Hesperiidae)

Illinois, Indiana, Iowa, Michigan, Minnesota
North Dakota, South Dakota, Wisconsin

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For

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Disclaimer

This document is a compilation of biological data and a description of past, present, and likely future threats to Poweshiek skipperling (*Oarisma poweshiek*). It does not represent a decision by the U.S. Fish and Wildlife Service (Service) on whether this taxon should be designated as a candidate species for listing as threatened or endangered under the Federal Endangered Species Act. That decision will be made by the Service after reviewing this document; other relevant biological and threat data not included herein; and all relevant laws, regulations, and policies. The result of the decision will be posted on the Service's Region 3 Web site (refer to: http://www.fws.gov/midwest/endangered/lists/concern.html). If designated as a candidate species, the taxon will subsequently be added to the Service's candidate species list that is periodically published in the Federal Register and posted on the World Wide Web (refer to: http://endangered.fws.gov/wildlife.html). Even if the taxon does not warrant candidate status it should benefit from the conservation recommendations that are contained in this document.

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Cover Photo

Poweshiek skipperling perched on large Indian breadroot (*Pediomelum esculentum*) at Prairie Coteau SNA, Pipestone County, Minnesota. ©Gerald Selby.

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Part One: Status Assessment

I. Introduction

This status report provides a comprehensive review of species information (Part One), and conservation/management issues (Part Two) for the Poweshiek skipperling (*Oarisma poweshiek*). Part One provides an overview of species information including classification and nomenclature, general and technical descriptions of the adult and immature life stages, and summaries of habitat requirements, biology and ecology. It also includes a review of the best available information on the historic and current distribution and status of the species in Illinois, Indiana, Iowa, Minnesota, Michigan, North Dakota, South Dakota, Wisconsin and Manitoba. Part Two provides an overview of conservation recommendations for the species including site protection, management, recovery, and research, survey and monitoring priorities.

This assessment was based on a comprehensive review of publications and unpublished reports, consultation with experts (including State Natural Heritage Programs personnel) in each state, and personal knowledge and experience. Documents that provided an initial overview and starting point for the review process included the conservation assessment for the Poweshiek skipperling in North and South Dakota by Royer and Marrone (1992), the status assessment for the Poweshiek skipperling in Canada (COSEWIC 2003), and the comprehensive species report by NatureServe (2005). Documents that provided critical information on the distribution and status in each state included survey reports for Iowa (Reiser 1997; Saunders 1995; Selby 2000, 2004a), Manitoba (Catling and Lafontaine 1986; Webster 2003), Michigan (Bess 1988; Holzman 1972; Shuey 1985; Summerville and Clampitt 1999), Minnesota (Cuthrell 1991; Dana 1989, 1991; Reiser 1997; Schlicht 1997a, 1997b, 2001; Schlicht and Saunders 1995; Selby 1991, 2003b, 2004b; Selby and Glenn-Lewin 1989, 1990; Skadsen 1999c, 2001a, 2001b), North Dakota (Orwig 1995, 1996, 1997; Reiser 1997; Spomer 2001, 2002), South Dakota (Reiser 1997; Skadsen 1997, 1998, 2002, 2003, 2004), and Wisconsin (Borkin 1994, 1995, 1996, 2000a). Key resources for the conservation and management portion of the report include the management guidebook by Moffat and McPhillips (1993), and the extensive publications and reports by Ann and Scott Swengel, and Ron Panzer. These sources are cited in the text and listed in the References section.

II. Species Information

A. Classification and Nomenclature

Class:	Insecta (Insects)
Order:	Lepidoptera (Butterflies and Moths)
Superfamily	Hesperioidea (Skippers)
Family:	Hesperiidae (Skippers)
Subfamily:	Hesperiinae (Grass or Branded skippers)
Genus:	*Oarisma* Scudder, 1872
Specific Name:	*poweshiek* (Parker), 1870
Scientific Name:	***Oarisma poweshiek***
Common Name:	**Poweshiek skipperling**

Controversial or Unresolved Taxonomy: NONE

1. Common Name (and other common names)

Poweshiek skipperling

This is the common name proposed by both Miller (1992) and NABA (2001) in recent independent efforts to establish standardized butterfly common names.

Miller (1992) also summarizes the common names that have been used historically, and the authorities that have used them. She does not, however, distinguish between the different spellings (e.g. Powesheik vs. Poweshiek) for the species name that have been carried over to the common names. Names listed by Miller (1992) plus the alternate spellings used by various authorities are summarized below:

Poweshiek skipperling	Brock & Kaufman (2003); Glassberg (1999); Layberry et al. (1998) Miller (1992); NABA (2001); Opler et al. (1995)
Powesheik skipperling	Holland (1931); Opler (1992); Opler & Malikul (1992); Pyle (1981)
Powesheik skipper	Klots (1951); Miller (1991); Opler & Krizek (1984) Tilden & Smith (1986)
Eastern skipperling	Scott (1986)
Parker's broad wing	(no references listed in Miller 1992)
Iowa dunn	(no references listed in Miller 1992)

2. Scientific Name (and other scientific names)

Oarisma poweshiek (Parker, 1870)

The Poweshiek skipperling was first described by Parker (1870) from specimens collected at Grinnell, Iowa on June 21, 1870. It was named for the county in which it was found (Poweshiek County), but it was misspelled, *powesheik*, in the original description. This spelling was retained by most early authorities (Holland 1905 & 1931; Lindsey 1922). Miller and Brown (1981) used the corrected spelling, *poweshiek*, but then Ferris (1989) changed it back in his supplement to their catalogue/checklist. Current usage is mixed, with many authorities retaining the original spelling (Beccaloni et al. 2003; Miller 1992; NatureServe 2005; Pavulaan 2004), while others have opted for the corrected spelling (Brock & Kaufman 2003; Glassberg 1999; Layberry et al.

1998; NABA 2001; Opler et al. 1995; Opler & Warren 2003). Layberry et al. (1998) state ". . . since it is a clear case of an original incorrect spelling it can be corrected [rule 32(c)ii of the International Code of Zoological Nomenclature]."

3. Controversial or unsettled taxonomic issues

There are no current or unsettled taxonomic issues.

Scott (1986) raised the possibility that *O. poweshiek* could be a subspecies of *O. garita* (Garita skipperling) based on the apparent overlap of their range in southeastern North Dakota, but no unequivocal proposals have been made to establish their conspecificity (Royer and Marrone 1992; R. Royer, Minot State University, pers. comm. 2004). This possibility has been rejected based on differences in habitat preference, phenology and genitalia (McCabe and Post 1977) and differences in flight characteristics (Royer and Marrone 1992). *O. poweshiek* is considered to be a valid species by most authorities (R. Royer, pers. comm. 2004).

B. Description of the Species

1. General Description

Poweshiek skipperlings are small and slender-bodied, with a wingspan ranging from 2.3 to 3.0 cm (Royer and Marrone 1992). The upper wing surface is dark brown with a band of orange along the leading edge of the forewing. Ground color of the lower surface is also dark brown, but the veins of all but the anal third of the hindwing are outlined in hoary white, giving an overall white appearance to the undersurface.

The Poweshiek skipperling is most easily confused with the Garita skipperling. Garitas can be distinguished by their smaller size, quicker flight and overall golden-bronze color (Royer and Marrone 1992). A diagnostic distinguishing feature is the color of the anal area of the ventral hindwing (orange in Garita; dark brown in Poweshiek). Unfortunately, this is not always visible in the field.

2. Technical Description

Parker (1870) provided the original description of this species from his type series collected near Grinnell, Iowa. It is difficult to improve on his thorough technical description of the adults, and the publication containing the description is not readily available, so it merits reproduction in its entirety here:

> Expands 1.16-1.26. Primaries trigonal, the edges nearly straight, angles but slight rounded, and the length of the costal border to the internal as 68 to 40. Secondaries more rounded. Ground color of both wings, above and beneath, silky dark brown, with purplish gloss. Primaries are ochre between the costal edge and subcostal nerve, the color narrowing and shading off near the apex, where it appears mostly, if at all, on the nervules. . . . Sometimes the yellow scales encroach on the interspaces. . . .
>
> The underside of the primaries has the costal color somewhat narrower and paler, and the color is still paler as it is carried around the apex, whence it extends, most often narrowly, two-thirds the length of the external edge, shading into the ground color towards the disk; and there is a similar

but lighter color on the branches of the subcostal and median nerves, sometimes almost gray. The underside of the secondaries is occupied by ochrey hairs and scales between the costal edge and the costal nerve, and has a thick sprinkling of either pale yellow or hoary white (variable) in all the interspaces except a segment between the internal nerve and the second nervure therefrom, widening of course from the base to the exterior edge, where it occupies one-third of the marginal length; this space is wholly dark brown. All the other nervures are conspicuous with hoary white, and the internal border likewise. At a little distance, the surface generally seems to be nearly white.

The body, of the same length as the secondaries, is of the ground color above, with profuse yellow hairs on the sides of the thorax and top of the head, and is white and hairy beneath. The hairy palpi, the antennae and the legs simply *correspond* in all particulars with the coloring of the body, above, laterally and beneath, with the exemption that the legs have not a dark shade of brown, and the antennae, which are clubbed only, show mostly the yellow, and are not annulated. On the posterior legs are two pairs of short spurs, the lower equal, the upper differing in length by one-fourth. White encircles the eyes, obscurely so above.

The ♀ differs from the males in a larger proportion of light color in the fringe, above and beneath. In both, on the inferior surface, the basal half of the fringe is ashy white, then nearly black, and barely tipped with yellowish white. The ♀ antennae show annulations.

The size of Poweshiek skipperlings appears to vary somewhat across their range. Royer and Marrone (1992) give a general range for the wingspan of 2.3 to 3.0 cm for the species. They state that North and South Dakota specimens tend to be slightly smaller than the 2.9 to 3.2 cm range given by Parker (1870) for the type series from Grinnell, IA. A sample of Richland County, North Dakota specimens from Royer's collection had an average wingspan of 2.8 cm for males and 3.0 cm for females. South Dakota specimens in Marrone's collection had an average wingspan of 2.6 cm for males and 2.7 cm for females.

McAlpine (1972) described the various life history stages based on observations made in 1944-1945 of individuals from the Lamberton Lake and Button Lake populations in Kent County, Michigan. The eggs are described as pale yellowish green, mushroom shaped with a flattened bottom and slightly depressed micropyle (pore in the egg's membrane through which the sperm enter), and with a smooth surface. They were 0.8 mm long, 0.7 mm wide and 0.5 mm high. The overall color of the head and body of the larvae is pale grass green, with a distinctive darker green mid-dorsal stripe and seven cream colored stripes on each side. First instars were 1.8 mm at hatching, and the lone 7^{th} instar survivor was 23.6 mm near the end of that stage. Unfortunately, McAlpine's records were incomplete and no further data were available. He assumed that there should be one or two additional instars.

C. Summary of Habitat, Biology, and Ecology

1. Biology and natural history

Poweshiek skipperlings are univoltine (having a single flight per year), with an adult flight from about the middle of June through the end of July. The actual flight period varies somewhat across their range and can also vary significantly from year-to-year depending on weather patterns. Females emerge slightly later than males. In Iowa and Minnesota their emergence

appears to be closely synchronous with the Dakota skipper (*Hesperia dacotae*), regal fritillary (*Speyeria idalia*), and wood nymph (*Cercyonis pegala*) at sites where they occur together. The Michigan fen populations co-occur with Mitchell's satyr (*Neonympha mitchelli*) and swamp metalmark (*Calephelis muticum*), which emerge slightly before and after, respectively, the Poweshiek (D. Cuthrell, Michigan Natural Features Inventory, pers. comm. 2005).

Description of life history stages

McAlpine (1972) described the various life history stages based on observations made in 1944-1945 of individuals from the Lamberton Lake and Button Lake populations in Kent County, Michigan. Eggs from captive females were hatched, and then the larvae were reared on what he referred to as lawn grass, probably a *Poa* sp. Most of the larvae refused to eat the lawn grass, but a few did and he was able to follow two of them through most of the developmental stages. Unfortunately, his records were incomplete, and he did not have any observations past the 7th instar. He believes there should have been one or two additional instars, followed by the chrysalis and then the imago (adult) stages. His physical descriptions of the eggs and larvae were included in the technical description above. His observations on the developmental chronology follow:

Eggs laid: 4-5 July 1944
Egg stage: about 9 days
Larval stages (based on observations of two larvae)
1st Instar: 1.8 – 4.0 mm; 11 days
2nd Instar: 4.0 – 7.0 mm; 9 days
3rd Instar: 6.5 – 8.8 & 9.3 mm; 16 days
4th Instar: 8.8 – 10.0 mm & 9.3 – 11.5 mm; about 25 days
5th Instar: 10.0 mm & 11.5 mm
Diapause initiated latter part of September
Feeding initiated again 29 March – 1 April
Fifth molt 12 & 16 April
6th Instar: 16 mm & 19 mm; 32 or 28 days (records incomplete)
Sixth molt 14 May for one (other larva died)
7th Instar: 19 mm on 14 May; 23.6 mm on 30 May (possibly near end of 7th instar)
(no additional data – records lost or misplaced)
Should have one or two additional instars, followed by chrysalis and imago stages

Principal nectar plants

Preferred nectar plants vary across the geographic range of Poweshiek skipperlings. Yellow ox-eye (*Heliopsis helianthoides*) and purple coneflower (*Echinacea angustifolia*) were the favorite nectar plants during surveys conducted in Iowa, Minnesota and North Dakota from 1990-1997 (Swengel and Swengel 1999). Other species used, in descending order of number of observations, were tickseed (*Coreopsis palmata*), black-eyed susan (*Rudbeckia hirta*), and pale-spike lobelia (*Lobelia spicata*) (Swengel and Swengel 1999). On drier prairie habitats where I have worked in Iowa and Minnesota, purple coneflower is used almost exclusively of other species and the emergence of the adults corresponds closely to the early maturity of this species' disk florets. On the wetter prairie habitats of Canada and the fen habitats of Michigan, favorite nectar plants are black-eyed susan and pale-spike lobelia (Bess 1988; Catling and Lafontaine

1986; COSEWIC 2003; Holzman 1972; Nielsen 1970; Summerville and Clampitt 1999). Additional preferred nectar plants on the Michigan fens include sticky tofieldia (*Tofieldia glutinosa*) (Bess 1988) and shrubby cinquefoil (*Pentaphylloides floribunda*) (Summerville and Clampitt 1999).

Larval food plants

A careful study of larval food plants has not been done for the Poweshiek skipperling. Royer and Marrone (1992) identified this as a top research priority in their status assessment for the species in North and South Dakota and it still remains a top priority. Until recently, the larval food plants have been presumed to be spike-rush (*Eleocharis elliptica*) or sedges, but this was based on limited observations, mostly from the disjunct and somewhat anomalous Michigan populations. More recent observations have suggested that for some populations the preferred larval food plants are prairie dropseed (*Sporobolus heterolepis*) or little bluestem (*Schizachyrium scoparium*). More research is needed to determine whether these apparent differences in larval food plant preference are real or simply based on erroneous or incomplete data. This research needs to be top priority, because knowing which species is the preferred larval food plant is essential to defining essential habitat for the highly vulnerable larval stages.

McAlpine (1972) captive reared Michigan larvae in 1944. Although he obtained good data for the various developmental stages, he did not obtain very useful larval food source data. The larvae refused short "marsh grasses" and small "bog plants", and were force-fed "lawn grass", presumably *Poa* sp., which they fed on reluctantly. He presumed that the natural food plants were sedges or marsh grasses. In 1970 Holzman (1972) observed oviposition of a single egg on spike-rush and later located identical eggs on other spike-rushes in the area. In 1971 he also observed two ovipositions on an unidentified sedge. McCabe observed oviposition and subsequent feeding on a sedge (*Carex* sp.) at the McCleod area in North Dakota (McCabe and Post 1977). The sedge was in a clump of fowl bluegrass (*Poa palustris*), which the larvae would not feed on. These observations have led to general acceptance that the preferred larval food plant was spike-rush, or possibly sedges (Holzman 1972; McCabe and Post 1977; COSEWIC 2003). Those conclusions were reinforced by the association of wetland habitats containing spike-rush with many Poweshiek skipperling populations. They did not explain, however, how healthy Poweshiek populations could be supported by some drier prairie remnants that were not associated with such wetland habitats. Where were the larval food plants at these sites? More recent observations of larval food plant preferences may have provided the answer. In studies of Poweshiek populations in Wisconsin, Borkin (1994, 1995, and 1996) has found that the preferred larval food plants are prairie dropseed and little bluestem. Even at sites where spike-rush is present, prairie dropseed is also likely to be found on the drier areas. It is possible that further research will show that prairie dropseed is the preferred larval food plant throughout most of the Poweshiek skipperling's range. Michigan populations are distinctive, though, and further research may confirm that spike-rush is their preferred larval food plant.

Robert Dana also made observations of Poweshiek skipperlings while conducting his dissertation research (Dana 1989) on Dakota and Ottoe skippers in southwestern Minnesota's dry hill prairies (R. Dana, Minnesota Department of Natural Resources, pers. comm. 2005). Those observations included ovipositions on prairie dropseed, little bluestem, big bluestem, porcupine grass (*Stipa spartea*) and a couple unidentified species, and a larva feeding on sideoats grama (*Bouteloua*

curtipendula). Dana noted that larvae and ovipositing females appeared to have a preference for "very fine, threadlike structures". He speculates that the Poweshiek skipperling may not actually be that specific in its host requirements and apparent preferences may simply reflect dominance of acceptable species at a site (Dana, pers. comm. 2005). Additional research needs to be done in a variety of habitats throughout the Poweshiek skipperling's range to help resolve these host plant issues.

2. Habitat requirements

Opler and Krizek (1984) describes the habitat of Poweshiek skipperlings as native tallgrass prairie, but the full range of habitat preferences for this species includes fens, grassy lake and stream margins, moist meadows, and wet-mesic to dry tallgrass prairie. McCabe and Post (1977) describe their habitat in North Dakota as ". . . high dry prairie and low, moist prairie stretches as well as old fields and meadows." Where Garita and Poweshiek skipperlings occur together, Garita is found on the dry knolls and Poweshiek is found in the moister valleys. Although Poweshiek does not compete well with Garita in the dry western prairies, it does well in dry habitats further east where Garita is absent. Royer (2003, 2004) describes the habitat for Poweshieks in North Dakota as "virgin fresh tallgrass meadows". Royer and Marrone (1992) describe their preferred habitat in North and South Dakota as "native, sedge containing tallgrass prairie associations". These wetland habitats form the transition zone between aquatic and upland communities, contain a significant component of plants in the aster family (Asteraceae) that can serve as nectar sources, and usually contain spike-rush, a presumed larval food source (but see discussion above). In Iowa and Minnesota the habitat description of McCabe and Post (1977) seems most appropriate, with good representation of both "high dry" and "low wet" prairie populations throughout both states. The only documented Illinois record (Dodge 1872) was associated with "high rolling prairie" (probably dry to dry-mesic), and the only documented Indiana record was from "marshy lakeshores and wetlands" (Blatchley 1891; Shull 1987).

The disjunct populations of Poweshiek skipperlings in Michigan have more narrowly defined habitat preferences. They are generally considered fen species and their habitat is variously described as wet marshy meadows (Holzman 1972), bog fen meadows or carrs (Shuey 1985), and sedge fens (Bess 1988). At the Liberty Fen site in Jackson County, Bess (1988) found them primarily in the drier portions of the fen dominated by low sedges and an abundance of nectar sources. Summerville and Clampitt (1999) noted that the population was concentrated in areas dominated by spike-rush and that only 10-15% of the fen area was occupied despite the abundance of nectar sources throughout. They are often found in association with Mitchell's satyr and swamp metalmark (D. Cuthrell, pers. comm. 2005).

Poweshiek skipperling populations in Wisconsin are also somewhat disjunct from the core population to the west, but S. Borkin (Milwaukee Public Museum, pers. comm. 2005) is uncertain whether their preferred habitat is more similar to the Michigan or to the western populations. Wisconsin populations tend to be associated with mesic to wet areas, but she also sees them on more dry-mesic habitats where fire is not a factor. She speculates that their apparent preference for wetter habitats is an artifact of their sensitivity to fire. Higher survival in wetter areas, which tend to burn cooler and less completely, coupled with low recolonization rates, could give the false impression that the wet areas were their preferred habitat. She also speculates that their apparent preference for wetter habitats (e.g. fens, lake and stream borders) in

Michigan could also be the result of habitat loss, since in many areas those are the only native habitats left.

Canadian populations of Poweshiek skipperlings are restricted to a single 2,300-hectare area in southeastern Manitoba (COSEWIC 2003). The wet to mesic tallgrass prairie in this area is characterized by low relief (1-2 meters), with alternating lower wetter areas and higher drier prairie; the Poweshieks tend to be concentrated on or near the edge of the higher drier prairie (COSEWIC 2003). Spike-rush is frequent in the wetter areas and prairie dropseed, black-eyed susan, and pale-spike lobelia are frequent in the drier areas (COSEWIC 2003). The distribution of preferred nectar plants helps define the preferred adult habitat, but to define essential habitat for the highly vulnerable larval stages, and perhaps address some of the habitat preference questions raised by Borkin (see above), the preferred larval food plants (e.g. spike-rush vs. prairie dropseed) need to be identified.

Poweshiek skipperlings require relatively pristine native tallgrass prairie habitat for their survival. They do not have the capability to survive in the surrounding altered landscape and have low dispersal capability, so if populations are lost from highly fragmented and isolated prairie remnants it is unlikely that they will be repopulated.

D. Range and Population Trends

1. Current and historical range

The Poweshiek skipperling is found in better-quality native wet-mesic to dry tall-grass prairie from Iowa to Minnesota and the Dakotas, and in more disjunct wet-mesic prairie habitats in Wisconsin and fen habitats in Michigan. It has also been documented more recently in wet-mesic prairie habitats in southeastern Manitoba, Canada (Catling and Fontane 1986). There are limited historic records from Illinois and Indiana, but it is currently listed as possibly extirpated (SH) for both of those states by NatureServe (2005). Some accounts include Montana, Colorado and Nebraska in its range, but they are most likely based on misidentified records of its western congener, the Garita skipperling. The current and historic range of Poweshiek skipperling county records (confirmed and unconfirmed), and the distribution of all documented populations are illustrated in Figure 1. Data sources include the county distribution maps of Opler et al. (1995), Natural Heritage Inventory data, published and unpublished literature, and expert input. Unconfirmed county records include records from dubious sources, and some counties listed by Opler et al. (1995) as confirmed for which no documentation could be found. The distribution data are also summarized as population frequencies per county for all known records (Figure 2), and observed population frequencies per county per time period (Figures 3-8). These observed population frequencies reflection both survey intensity and actual population frequencies, and should therefore be interpreted accordingly. A more detailed discussion of the distribution, abundance, and trends of populations per state and province follows and should help provide a better understanding of the trends suggested by the maps.

Poweshiek skipperlings do not migrate and have very poor dispersal capability. Therefore, if isolated populations in the fragmented prairie landscape are extirpated, it is unlikely that they will be repopulated. The larvae overwinter in the leaf litter as 5th instars (McAlpine 1972) and

are vulnerable to extreme weather conditions, dormant season fire, and other disturbances (e.g., intense cattle grazing).

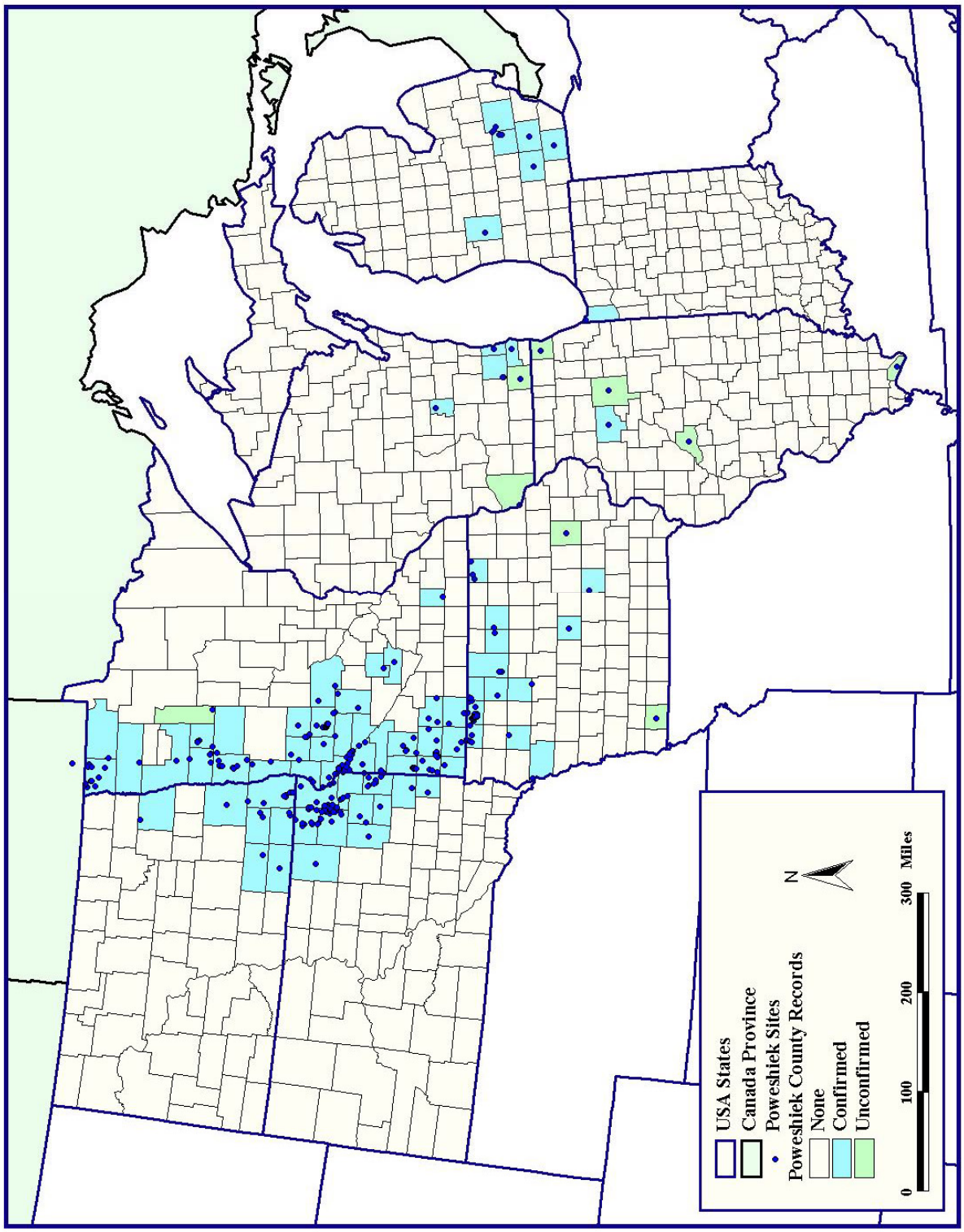

Figure 1. Poweshiek skipperling county distribution map (confirmed and unconfirmed county records).

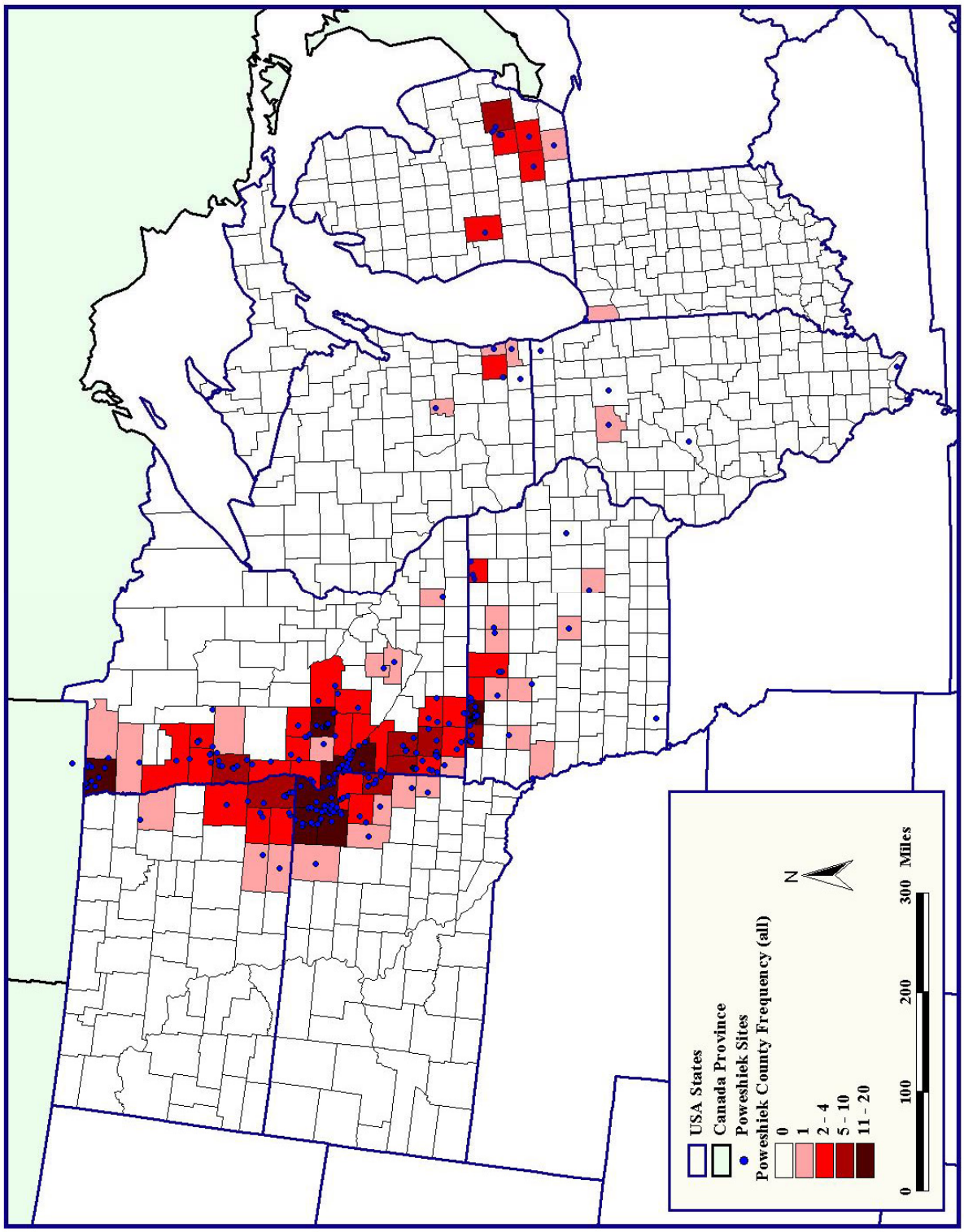

Figure 2. Poweshiek skipperling county frequency map (all records).

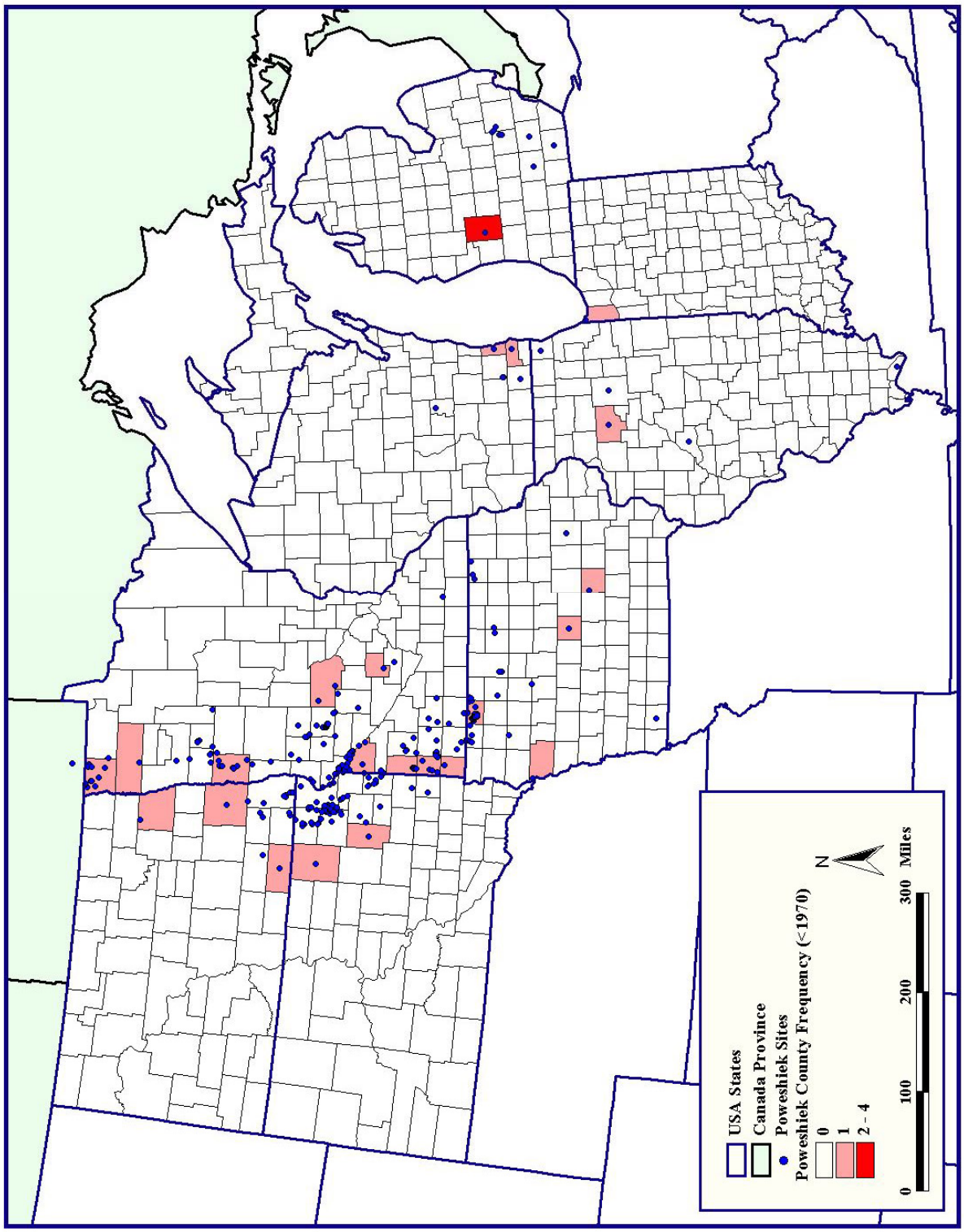

Figure 3. Poweshiek skipperling county frequency map (<1970 records).

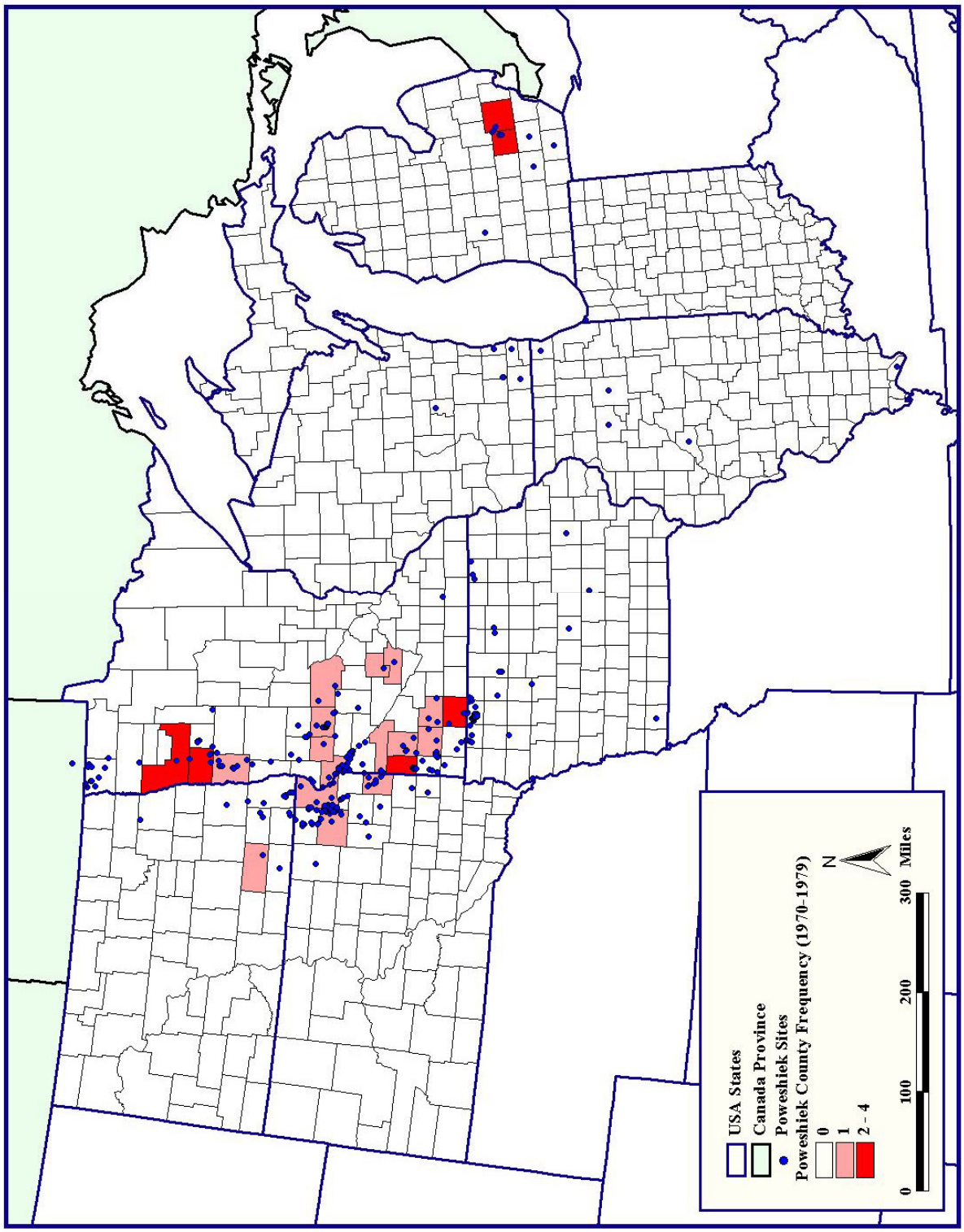

Figure 4. Poweshiek skipperling county frequency map (1970-1979 records).

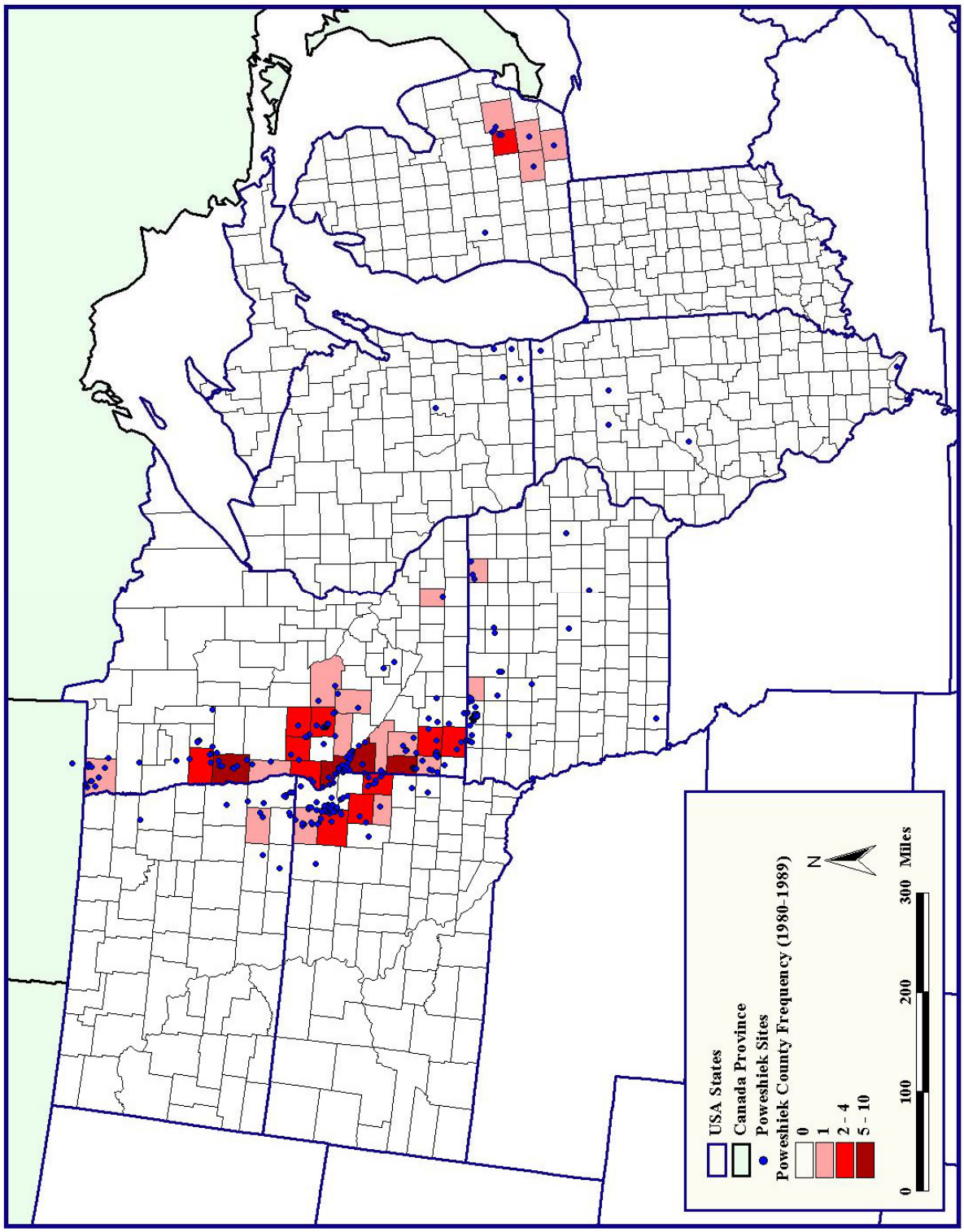

Figure 5. Poweshiek skipperling county frequency map (1980-1989 records).

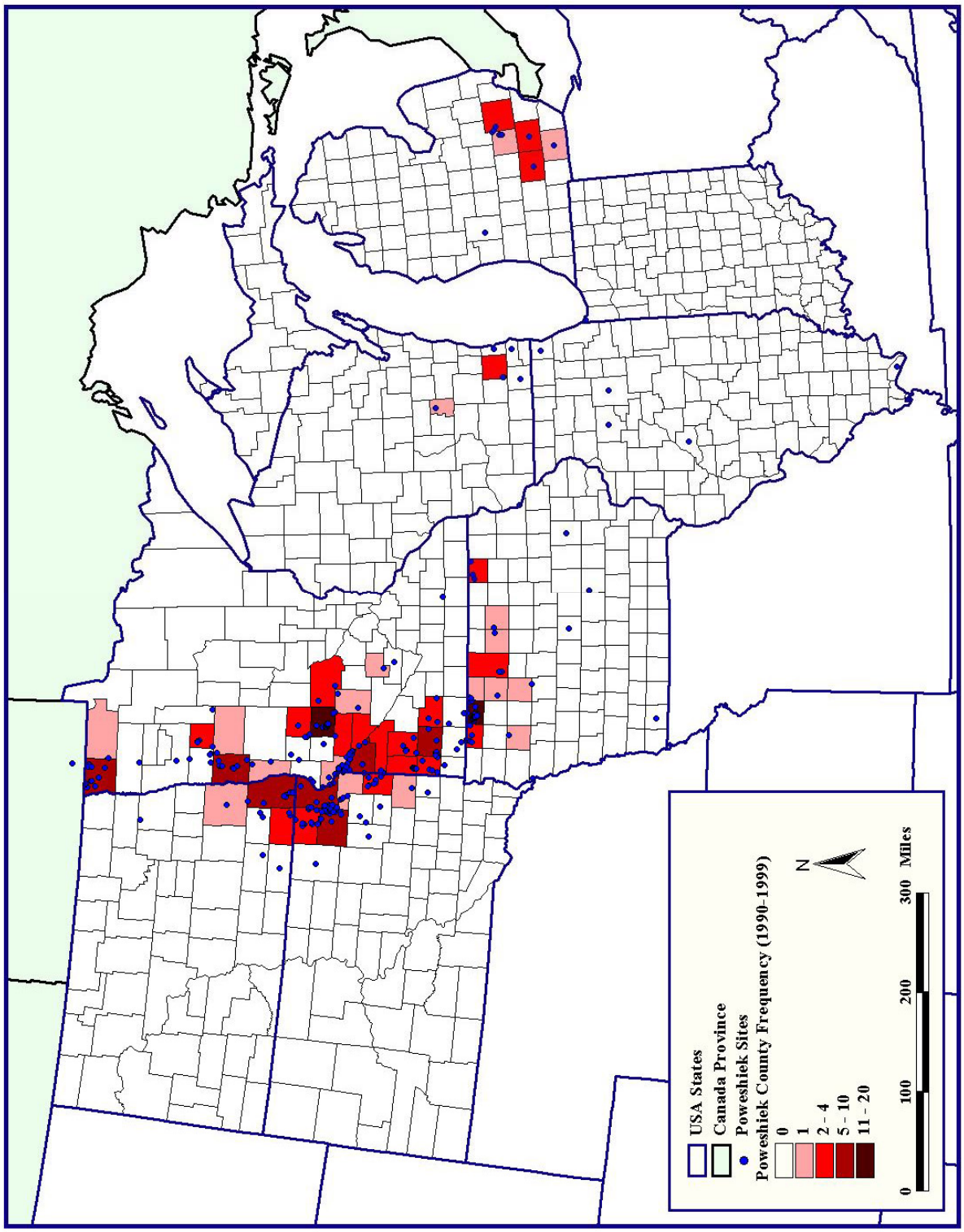

Figure 6. Poweshiek skipperling county frequency map (1990-1999 records).

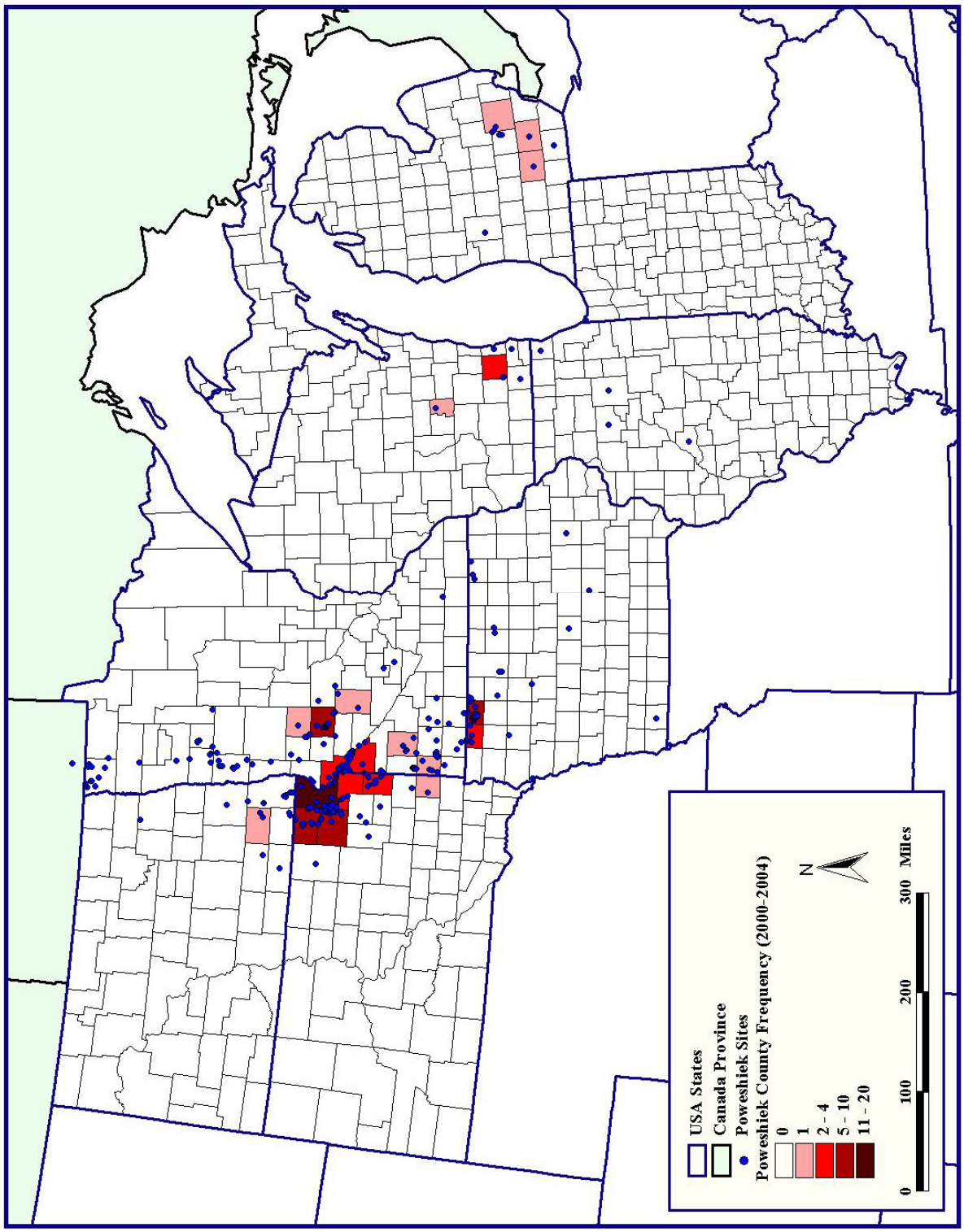

Figure 7. Poweshiek skipperling county frequency map (2000-2004 records).

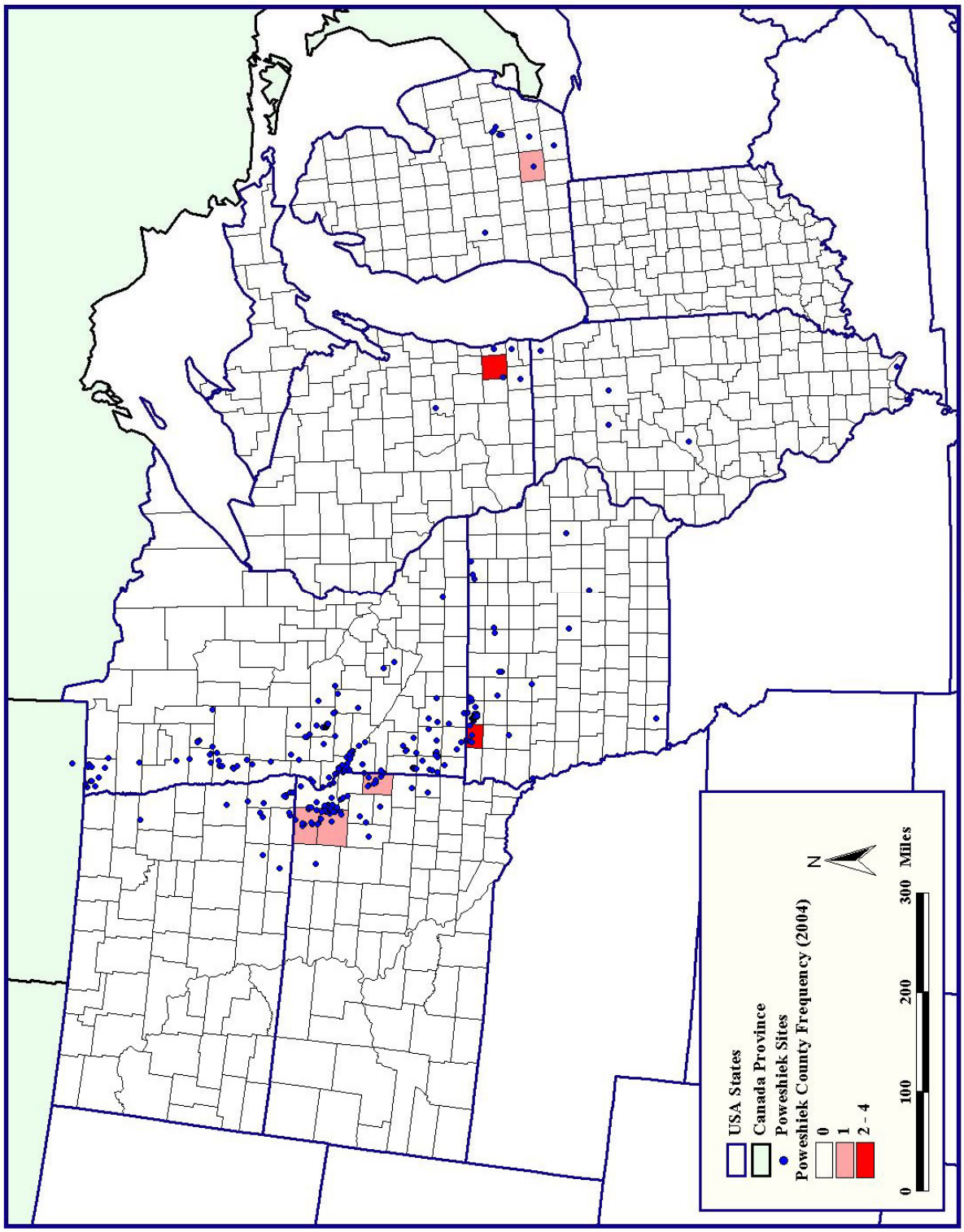

Figure 8. Poweshiek skipperling county frequency map (2004 records).

2. Current and historical population and productivity estimates & trends, broken out by state and province, and for individual local populations, if possible.

United States of America

Illinois (SH)[1]. Dodge (1872) reported seeing an abundance of Poweshiek skipperlings on the slopes of prairie hills forming the divide between the Illinois and Rock Rivers in Bureau County. Irwin and Downey (1973) state that this is the only evidence for the Poweshiek occurring in Illinois. The Butterflies of North America web site (Opler et al. 1995) shows confirmed records for Bureau, Lake and Mason Counties, and unconfirmed records for La Salle and Massac Counties. Doug Taron (Chicago Academy of Sciences, pers. comm. 2005), Illinois state butterfly coordinator for the web site, did not have access to data for the additional records. He stated that there are no recent Poweshiek records and it is most likely extirpated from the state. NatureServe (2005) supports this conclusion in their comprehensive report for the Poweshiek skipperling (reviewed January 31, 2005). Their Illinois status rank for the species is SH (possibly extirpated) and no heritage records are listed.

Indiana (SH). The Poweshiek skipperling is only known from a single historical record near Lake Michigan in northwest Indiana. Blatchley (1891) reported small numbers occurring about Whiting in Lake County, stating "It is a western species not before recorded east of Illinois." Shull (1987) and J. Shuey (The Nature Conservancy in Indiana, pers. comm. 2004) both express confidence that this record is authentic. The habitat included marshy lakeshores and wetlands, and Shull (1987) suggests that drainage of prairie wetlands is likely responsible for its rarity.

Iowa (S1). Iowa populations of Poweshiek skipperlings have been recorded from **38 sites** in **15 counties**. The original description for the Poweshiek skipperling was based on specimens collected June 21, 1870 at Grinnell, Iowa in Poweshiek County (Parker 1870). Parker stated that they were abundant on a prairie slope. Berry (1914) described the Poweshiek as very common in Linn County, but some of his data have been questioned (D. Schlicht, Iowa Lepidoptera Project, pers. comm. 2004), and there are no other documented Linn County records. Lindsey (1917, 1920) described the Poweshiek as rare, with records from Story, Dickinson, Poweshiek, and Woodbury Counties. Opler et al. (1995) shows a confirmed county record for Page County in southwestern Iowa, but I have not found additional documentation for this record and do not know how recent it is or if it is credible.

All recent documentation for Poweshiek skipperlings in Iowa has been from the northern two or three tiers of counties. By the 1980's there were twelve known extant sites in six counties. Saunders (1995) documented populations of Poweshiek skipperlings at 26 sites in seven counties during extensive surveys he conducted in 1993 and 1994, and three additional county records were documented during that time period. Unfortunately, very few of those sites have received follow-up surveys. In 2004 and 2005, thorough surveys were conducted at two sites that had supported healthy populations at least as late as 2000, and no Poweshieks were found (Selby 2004a). They were also absent from several other sites where they were reportedly observed by Saunders (1995) (Selby 2004a; F. Olsen, Iowa lepidopterist, pers. comm. 2004). Follow-up surveys need to be conducted at a representative sample of sites, including those surveyed in

[1] See Table 1 for explanations of status abbreviations.

2004, to obtain an up-to-date status assessment of the Poweshiek skipperling in Iowa. Many of the Iowa sites are owned by state, county, or private conservation agencies/organizations, but the recent declines of some the best populations on lands protected from conversion emphasize the tenuous nature of their long-term survival. Events beyond the control of land managers (e.g. extreme weather patterns) that cause the kind of widespread decline observed recently, habitat degradation, and imprudent applications of fire management are all serious threats to remnant populations.

Michigan (S1S2/T). Michigan populations of Poweshiek skipperlings have been documented from **16 sites** in **six counties**, and are thought to be recently extant at **eleven sites** in **five counties**. The first population was recorded in 1893 by Wolcott at Lamberton Lake near Grand Rapids in Kent County (Wolcott 1893; Holzman 1972), and a second colony was discovered at nearby Button Lake in 1944 (McAlpine 1972). These were the only known Michigan populations until 1970. They persisted until 1968 [documentation by Newcomb in 1930; McAlpine (1972) in 1937, 1938, 1939, 1944, 1948 and 1950; Nielsen (1970) in 1963 and 1964; Warczynski in 1968], but were not found in 1969, 1970, and 1971 surveys (Holzman 1972). The Michigan Natural Features Inventory (MNFI) also failed to find any Poweshieks at Lamberton Lake in surveys conducted in 1986, 1989, and 2004 (D. Cuthrell, pers. comm. 2005). Undisturbed habitat in this area has been reduced by urbanization (Holzman 1972; Bess 1988) and encroachment by woody species such as the exotic glossy buckthorn (*Frangula alnus* = *Rhamnus frangula*) (D. Cuthrell, pers. comm. 2005) and it is unlikely that these populations are extant.

Fortunately, new populations have been discovered much further east in Michigan. Two new populations were discovered in 1970. Nielson discovered a population in Hartland Township, Livingston County, and Holzman discovered a population in Rose Township, Oakland County (Holzman 1972). In 1971 Holzman discovered one additional Livingston County population, and two additional Oakland County populations. One population was discovered 1.5 miles south of the first Livingston County population and two populations were discovered two and seven miles southeast of the first Oakland County population (Holzman 1972). As of 1971 these five populations were the only known extant Michigan populations (Holzman 1972). Since that time, nine new populations have been found in four counties (Jackson = 2; Lenawee = 1; Oakland = 4; Washtenaw = 2), but three populations in two counties (Livingston = 1; Oakland = 2) may no longer be extant (no documented observations since 1980), bringing the current number of extant populations to eleven in five counties.

Bess (1988) states that Liberty Fen in Jackson County is probably the largest undisturbed fen complex in Michigan – it probably has the largest Poweshiek population in the state. Shuey (1985) conducted surveys at Liberty Fen as part of a study of wetland butterfly habitat associations conducted from 1982-84 and discovered the Poweshiek population in 1983. He found that they were associated with the bog fen meadow and carr habitats at the site. Bess (1988) found isolated pockets of Poweshieks throughout the site in 1988. He saw about 200 Poweshieks from 5-12 July, and had a peak count of over 75 on 7 July. Summerville and Clampitt (1999) surveyed the site in 1997. They found that the Poweshieks were restricted to areas dominated by spike-rush, and estimated that the population was over 100 individuals. Most of this site is owned by The Nature Conservancy, which is applying a cautious burn

program to maintain the habitat while minimizing negative impacts on the sensitive Poweshiek skipperling and Mitchell's satyr populations (D. Cuthrell, pers. comm. 2005).

Poweshiek skipperling populations are generally still doing well in the fens of the southern Lower Peninsula (J. Shuey, pers. comm. 2004). Potential threats include loss of habitat to woody vegetation such as glossy buckthorn (D. Cuthrell, pers. comm. 2005), confounded by the potential threat of prescribed fire if it is applied too aggressively in an attempt to control the buckthorn. There is a need for systematic surveys focused on Poweshieks to get a better assessment of their status in the state. Most Poweshiek skipperling observations have been incidental to surveys for Mitchell's satyr and there are numerous fen sites with suitable habitat where surveys have not targeted Poweshiek (D. Cuthrell, pers. comm. 2005).

Minnesota (S3/SC). Robert Dana (pers. comm. 2004) describes the Poweshiek skipper as Minnesota's ". . . most frequently encountered prairie-obligate skipper." It has been recorded from a total of **135 sites** in **32 counties**, plus one additional dubious county record. The number of known Poweshiek sites has dramatically increased over the past few decades as a result of an aggressive survey program. During the 1980s, the number of known sites increased from 24 sites in 19 counties to 71 sites in 28 counties. During the 1990s and early 2000s, surveys by Cuthrell (1991), Reiser (1997), (Schlicht (1997a, 1997b, 2001), Schlicht and Saunders (1993, 1995), Selby (1991), Selby & Glenn-Lewin (1989, 1990), Skadsen (1999c, 2001a, 2001b), Swengel (1992b), and Swengel and Swengel (1999) greatly increased the knowledge base for Minnesota Poweshiek skipperling populations, adding 64 new sites and four new county records.

The relative abundance of sites occupied by Poweshiek skipperling in Minnesota could lead to a false sense of its long-term security. The Glacial Lakes State Park area in Pope County has one of the highest concentrations of Poweshiek populations in the state, but recently those populations experienced a dramatic decline. Ninety-five Poweshieks were observed during four days of surveying in the park in 2001 (Skadsen 2001b). In 2003, however, only four individuals were observed during 30 days of surveys throughout the flight both in the park and on surrounding properties (Selby 2003b). No Poweshieks were seen in the same area during 23 days of surveys in 2004 (Selby 2004b) and seven days of surveys by in 2005 (G. Selby, pers. obs. 2005). Declines during this time period were also reported from Iowa (Selby 2004a), North Dakota (Spomer 2002; S. Spomer, University of Nebraska, pers. comm. 2005), South Dakota (D. Skadsen, Natural History Investigations, pers. comm. 2004), Wisconsin (S. Borkin, pers. comm. 2004), and Canada (COSEWIC 2003). Almost half of all recorded Poweshiek skipperling populations are in Minnesota, so the status of the Minnesota populations is critical to the long-term survival of the species. Therefore, it is important to determine just how widespread the observed population declines are in Minnesota. A small sample of historic populations was surveyed by the author in 2005. Populations were still extant at sites in Lincoln, Murray, and Pipestone Counties, but no Poweshiek skipperlings were observed at sites in Chippewa, Swift, Pope, and Clay Counties. Surveys need to be done at a representative sample of Poweshiek skipperling sites throughout the state to obtain a complete picture of their current status in Minnesota.

North Dakota (SNR). Poweshiek skipperlings have been documented from a total of **16 sites** in **seven North Dakota counties**. Six of the counties are concentrated in the southeastern corner of the state, and the seventh is further north along the eastern border. Unfortunately, they appear to have been extirpated from most of the sites and may be extirpated from the state.

Royer and Marrone (1992) listed **seven sites** in **six counties**. Four of the sites, including the only known records for Dickey, Grand Forks, and La Moure counties, are old records with incomplete or ambiguous locality data. Two of the three remaining sites had historically high numbers, but appeared to have disappeared by 1991. McCabe and Post (1977) described an abundance of Poweshieks at McLeod Prairie in Ransom County, but the area was converted to a cattle-loading area and no Poweshieks were observed in six years of monitoring by Royer from 1986-1991. Observations at West Prairie Church in Cass/Richland Counties went from hundreds in 1986 to four in 1990 to absent in 1991. The third site, McCleod East in Richland County, had a single record from 1991. Ronald Royer (pers. comm. 2004) has not seen Poweshieks in the state in over a decade and all recent observations are from new populations discovered by Orwig in 1995-1997, Swengel in 1996, and Spomer in 2001. Orwig discovered three new populations in Richland (6) and Sargent (2) Counties during three years of surveys in southeast North Dakota; in 1997, however, he only found Poweshieks at one new and one previous site in Richland County (Orwig 1995, 1996, 1997). In 2001 a new population was discovered in Ransom County (Spomer 2001), but no Poweshieks were found at that site in 2002 or 2003 (Spomer 2002; S. Spomer, pers. comm. 2005). Spomer also mentioned that Ann and Scott Swengel discovered a new population in Richland County in 1996. These recent discoveries of new populations and the presence of populations in all counties bordering the state in Minnesota, suggest the possibility that more populations could be discovered in North Dakota, but these surveys also illustrate the precarious state of the North Dakota populations. Thorough surveys need to be conducted at each of the known locations for the Poweshiek skipperling in North Dakota to confirm its current status at those sites. Additional suitable habitat in eastern North Dakota should also be targeted for surveys.

South Dakota (S2). South Dakota has the second highest concentration of Poweshiek skipperlings. The number of Counties and sites where it is known to occur has increased dramatically in recent years as a result of extensive surveys by Dennis Skadsen for the South Dakota Department of Game, Fish and Parks (Skadsen 1997, 1998, 1999a, 2002, 2003, 2004). Royer and Marrone (1992) listed a total of **19 sites** in **eight counties**. These included **14 sites** in **seven counties** with extant populations, and **five sites** in **five counties** with incomplete or ambiguous locality data. An additional **44 sites** in **eight counties** (including **three county records)** have been documented since then, bringing the total number of documented populations to **64 sites** in **eleven counties**. More recent surveys have documented population declines similar to those observed elsewhere (D. Skadsen, pers. comm. 2004) and further monitoring is needed to determine the current status of the Poweshiek skipperling in South Dakota.

Wisconsin (S1/E). According to Susan Borkin (2000a; pers. comm. 2004) there are only three extant populations of the Poweshiek skipperling in Wisconsin. Two of these are within about two km of each other in Waukesha County. The third population is about 100 km northwest in Green Lake County.

Hoy (1883) described the Garita skipperling, probably confused for Poweshiek, as common on the prairies near Racine (Racine County), and Rauterberg (1900) described the Poweshiek skipperling as common in the Milwaukee vicinity (Milwaukee County). Unfortunately, the only documentation for these observations is a 1900 specimen in the Milwaukee Public Museum with incomplete data (Ebner 1970). The Butterflies of North America web site (Opler et al. 1995) shows a confirmed Walworth County record, but no additional documentation was found for this record. The only other historic record is an unconfirmed 1991 Grant County observation (Borkin 2000a).

The Poweshiek skipperling has legal protection in Wisconsin as the state's first endangered insect – all three extant populations are protected in State Natural Areas, but its long-term survival in the state is still tenuous. No Poweshieks were seen at the Green Lake County site during 2004 surveys, but the flight was delayed and the surveys might have been conducted too early (S. Borkin, pers. comm. 2004). A preliminary assessment of 2004 data for the Waukesha County sites suggests that population numbers are low (S. Borkin, pers. comm. 2004). Inherent population fluctuations, potential habitat degradation resulting from woody invasion or other exotic species, and management intended to prevent further habitat degradation (e.g. prescribed fire), all place the few remaining Wisconsin populations at risk. This risk should be mitigated by expanding the areas protected for each population where possible, using caution in managing the areas (e.g. conservative burn management) and possibly augmenting existing populations or reestablishing populations in suitable habitat (Borkin 2000b). Existing populations should be monitored closely.

Canada

Manitoba (S2/T). Poweshiek skipperlings were first recorded in Canada near Vita, Manitoba in 1985 (Catling and LaFontaine 1986). They were found at each of seven prairies surveyed in the area and the populations were described as abundant but tending to be local. Earlier reports of Canadian occurrences (Gregory 1983; Klots 1951; Masters 1973) were based on misidentified Garita skipperlings (Catling and LaFontaine 1986; Layberry and Lafontaine 1998).

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recently completed an assessment and status report for the Poweshiek skipperling in Canada (COSEWIC 2003; author Webster, R.P.). Poweshiek skipperlings do not have national or provincial legal protection in Canada, but they were given a "Threatened" status designation in November 2003 by COSEWIC based on the status report.

III. Population Assessment

A. Summary of Status and Threats (organized by the five Endangered Species Act listing factors)

1. The present or threatened destruction, modification, or curtailment of its habitat or range.

Past Habitat Loss and Fragmentation

Habitat loss and fragmentation have been the greatest historical factors contributing to the decline and tenuous long-term survival of many prairie species, including the Poweshiek skipperling. The historical range of the Poweshiek skipperling is concentrated in the tallgrass prairie portions of northern Iowa, western Minnesota, and eastern North and South Dakota. It also extends eastward to tallgrass prairie portions of Illinois, Indiana, Michigan and Wisconsin, and northward into southern Manitoba. They are also sometimes associated with habitats within the tallgrass prairie landscape where the taller grasses [e.g., indiangrass (*Sorghastrum nutans*) and big bluestem (*Andropogon gerardii*)] are absent or less abundant than shorter grasses (e.g., prairie dropseed and little bluestem). The dramatic losses of native prairie are summarized by Samson and Knopf (1994), and the statistics for those losses in seven of the states (no data were presented for Michigan) and Manitoba where Poweshiek skipperlings have been documented are summarized below in Table 1. The current status of Poweshieks in each state/province is highly correlated with those losses, and the amount of tallgrass prairie remaining in each state (see Table 1). In Illinois and Indiana 99.99% of the tallgrass prairie has been lost, and the Poweshiek skipperling is presumed extirpated in both of these states. Overall tallgrass prairie losses across the range of the Poweshiek skipperling are almost 99.9%.

Table 1. Tallgrass Prairie loss in seven U.S. states (adapted from Samson and Knopf 1994) and one Canadian province (adapted from COWESIC 2003) from which the Poweshiek skipperling has been documented. Data for Michigan were not available. E = listed by state as Endangered; T = listed by state or province as Threatened; SC = listed by state as Special Concern.

State/Province	Historical (ha)	Current (ha)	Decline (%)	Poweshiek Status
Indiana	2,800,000	404	99.99	Possibly extirpated (SH)
Illinois	8,900,000	930	99.99	Possibly extirpated (SH)
North Dakota	1,200,000	1,200	99.90	Not ranked (SNR)
Wisconsin	971,000	4,000	99.59	Critically imperiled (S1/E)
Manitoba	600,000	5,000	99.17	Critically imperiled (S1/T)
Iowa	12,500,000	12,140	99.90	Critically imperiled (S1)
Minnesota	7,300,000	30,350	99.58	Vulnerable (S3/SC)
South Dakota	3,000,000	449,000	85.03	Imperiled (S2)
Total	**37,271,000**	**503,024**	**98.65**	

Future habitat loss (conversion to non-grassland)

Conversion to row crop agricultural

Most prairie remnants occur on marginal land that is not well suited for row crop agriculture, but some remnants were preserved as a result of traditional uses such as prairie hay that might be

abandoned in favor of row-crop agriculture. Prairies that are relatively flat and free of rocks at or near the surface may be the only sites where conversion to intensive agriculture is a threat.

Development and Housing Construction
Development and housing construction are continual threats to some prairie remnants. This is especially true near metropolitan areas where there is a high demand for industrial development of undeveloped areas within the city limits and residential development of surrounding country landscapes.

Road construction and maintenance
Road construction can threaten prairies indirectly by increasing the demand for gravel (see below) and directly as a result of routine maintenance (e.g. broadcast herbicide applications and cleaning out ditches), improvements (e.g. widening roads or converting two-lane highways to four-lane highways), or new construction. Roadside prairie remnants can support populations of Poweshiek skipperlings and serve as dispersal corridors between larger remnants, so these prairie losses could be significant.

Gravel mining
Many prairie remnants with Poweshiek skipperling populations are associated with gravelly glacial till soils where gravel mining is a threat.

Wind generators
Wind energy production in the range of Poweshiek skipperling is increasing. In northwest Iowa and southwest Minnesota "wind farms" are often associated with areas that also have some of the best prairie remnants (e.g. Little Sioux River valley in Iowa; Hole-in-the-Mountain Prairie and Prairie Coteau in Minnesota). In most cases the windmills are located on flat uplands that have already been converted to row crop agriculture. However, if they are placed on or near remnant prairie, access roads and the "footprint" for each wind generator could result in significant prairie loss.

Woody encroachment & exotic species
In the absence of any management, most prairie remnants will eventually be lost to woody succession or invasion by exotic species. The immediate impact is habitat degradation, but the long-term result will be total habitat loss (see management description below).

Degradation of habitat quality

Grazing
Light grazing is not generally considered a threat to the long-term survival of Poweshiek skipperlings if there is some contiguous ungrazed habitat, but heavy grazing is a threat (Royer and Marrone 1992). Dana (1997) stated that overgrazing is a threat, but suggests that the complete absence of grazing may lead to unfavorable habitat conditions and that there may be unique impacts of grazing on community structure that might not be replicated by other management methods.

Exotic species
Prairie remnants survive in the context of a hostile environment. They are often surrounded by row crop agriculture and a constant influx of eroded soil complete with annual weed seeds. Cool season exotics [e.g. smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*)] have been introduced into many prairie pastures and grazing practices often favor these species. Other threats include aggressive perennial species such as purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), and leafy spurge (*Euphorbia esula*) that replace the diverse native communities with dense monocultures of these species. Woody invasion by native and exotic species is also a threat. Prairie must be actively managed to maintain or enhance their quality. If succession has progressed too far, established shrubs or trees should be removed.

Pesticide use
Indiscriminant use of insecticides for pest control on rangeland or adjacent cropland can be a major threat to the species. Royer and Marrone (1992) cite the combination of drought and grasshopper control programs along the Red River Valley as having serious impacts on the species. Broadcast spraying of herbicides, which usually targets dicots, can also affect Poweshiek populations indirectly by eliminating important nectar sources.

2. Overutilization for commercial, recreational, scientific, or educational purposes.

This is not generally a problem for species such as the Poweshiek skipperling. Royer and Marrone (1992) state that no such threats are known or likely, and COSEWIC (2003) states that collecting of specimens is not currently a threat. Scientific Collectors Permits are required in states where they have legal protection, and permission is often required to do collecting on protected areas.

3. Disease or predation.

Diseases or predators that are specific to the Poweshiek skipperling are not known (Royer and Marrone 1992), but some parasitism or predation likely occurs during each of the life stages. Borkin (1995) tagged 130 eggs for field observation in a 1994 study of a Wisconsin population. Ten of those eggs appeared to have suffered from predation or parasitism. Some were punctured and had the contents sucked out and others turned black and dried up. In his study of Dakota and Ottoe skippers, Dana (1989, 1991) documented some parasitism of their eggs and larvae by various wasp and ant species and predation by various insect taxa. Mortality of Dakota and Ottoe skipper (*Hesperia ottoe*) larvae in his plots was approximately 50-60%. Potential predators on adults include crab spiders, ambush bugs, stink bugs, robber flies, and birds, but they are not generally thought to have a significant impact on healthy butterfly populations (Royer and Marrone 1992; Dana 1989, 1991).

Disease and predation are not generally considered a major threat to Poweshiek skipperling populations, but under certain conditions they might become a factor. If Poweshiek numbers are already depressed or suffering from relatively high rates of disease, parasitoids, or predators, their impact might be significant. Steve Spomer (pers. comm. 2005) cites dramatic declines for the yucca giant-skipper (*Megathymus yuccae coloradensis*) and the Nevada buckmoth (*Hemileuca nevadensis*) due to parasitoids.

4. The inadequacy of existing regulatory mechanisms.

There is currently no federal protection for the Poweshiek skipperling in the United States. It has state protection in Iowa (T), Michigan (T) and Wisconsin (E). It is listed as special concern (SC) in Minnesota, but this conveys no prohibitions against take of the species. South Dakota has an Endangered Species Act, but no invertebrates are currently listed. The Poweshiek skipperling was placed on South Dakota's Species of Greatest Conservation Concern List in the Statewide Wildlife Conservation Plan. This qualifies the species for funding from State Wildlife Grants for surveys, monitoring, and habitat acquisition and management, but it does not confer legal protection. North Dakota does not have a mechanism for conferring protection to threatened or endangered species at the state level.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recently completed an assessment of the Poweshiek skipperling in Canada (COSEWIC 2003) and designated it as threatened. Canada does not have a legal mechanism for protecting species at the national level, but the province of Manitoba does have an Endangered Species Act. The Poweshiek skipperling does not have legal protection in Manitoba yet, but most of its habitat in Canada is protected through the Critical Wildlife Habitat Program in the 2,200-hectare Tallgrass Prairie Preserve.

5. Other natural or manmade factors affecting its continued existence.

Interspecific competition

Interspecific competitive interactions and their impacts on Poweshiek skipperling population dynamics are poorly understood and require further study. They do not appear to limit Poweshiek skipperling populations.

Extreme weather patterns or events

Extreme weather patterns or severe weather events have the potential to have a significant impact on Poweshiek skipperling populations because they can occur across a large geographic area. These events can include extremely harsh winters, late hard frosts following a spring thaw, severe storms, or cool damp conditions. Global climate change predictions include an increase in the variability of weather patterns and frequency of extreme weather events and gradual warming. If these predictions are realized, direct mortality from the weather extremes, or indirect threats from shifts in plant community composition could pose a significant threat.

Prescribed burning and wildfires

Prescribed burning is a valuable prairie management tool, but overly aggressive prescribed burning programs are a threat to Poweshiek skipperling populations in the fragmented prairie landscape (see discussion under management section). Wildfires are also a constant potential threat because they may burn much larger areas than would likely be burnt during a single prescribed burn.

B. Current Protective Status Under State/Provincial/Tribal/Federal Laws and Regulations

1. The World Conservation Union (IUCN 2004) Global Classification

Global Classification: No listing found
Note: IUCN (2004) did not have any records for Poweshiek skipperling, but COSEWIC (2003) lists the IUCN classification as "vulnerable".

2. NatureServe (2005) Global and National Status Ranks

Global Status: Imperiled/Vulnerable (G2G3) (30 Nov 2002)
Rounded Global Status: Imperiled (G2)
National Rank
Unites States: Imperiled/Vulnerable (N2N3) (30 Nov 2002)
Canada: Critically Imperiled (N1)

3. National Protection Status

United States
Legal protection = None
Canada:
Legal protection = None
COSEWIC Status Designation = Threatened (November 2003)

An aggressive survey program in Iowa, Minnesota, and South Dakota during the 1990s and early 2000s dramatically increased the number of sites from which it was known. At those sites where regular surveys were conducted, the populations appeared to be fairly secure. Even in North Dakota, where Poweshieks were assumed to be on the verge of extinction, and in Michigan, where the only known populations had disappeared by 1969, surveys of new areas led to the discovery of new populations. These populations are, however, prone to dramatic fluctuations that place small, isolated populations at risk. Recently, a dramatic population crash appears to have occurred across a large portion of the Poweshiek's range, including what had been considered some of the healthiest populations. If this crash is as widespread as it appears and if there is not a significant recovery, then the Poweshiek may be at risk throughout its range. A comprehensive assessment of a representative set of populations throughout the Poweshiek's range needs to be done over the next couple years to clearly establish the status of the species.

The Canadian populations are all restricted to a single 2,300-hectare area, and COSEWIC (2003) has given the Poweshiek skipperling a designation of threatened. This designation does not, however, confer legal protection at the national level, because Canada does not have a national law analogous to the U.S. Endangered Species Act.

4. State/Province: NatureServe Status Ranks and Protection Status (USA & Canada)

State/Province	Status Rank	Protection Status
USA		
Illinois	SH	--
Indiana	SH	--
Iowa	S1	T
Michigan	S1S2	T
Minnesota	S3	SC
North Dakota	SNR	--
South Dakota	S2	--
Wisconsin	S1	E
Canada		
Manitoba	S2	--

Status Rank Definitions

S1 = Critically imperiled
S2 = Imperiled
S3 = Vulnerable
SH = Possibly extirpated
SNR = Not ranked

Protection Status Definitions

E = Endangered
T = Threatened
SC = Special Concern

Reassessment of current state/province protection levels may be warranted based on the information presented in this status assessment and the outcome of the population assessments proposed above.

5. Tribal Protection Status

No tribes have conferred any special status on Poweshiek skipperling.

C. Summary of Land Ownership and Protection

Data summarizing site information for individual populations and summary statistics for each county are on file at the Twin Cities Field Office, U.S. Fish and Wildlife Service, Bloomington, Minnesota. Site information includes legal descriptions, land ownership (e.g. private, state (conservation vs. recreation), federal, tribal, Nature Conservancy, Manitoba Naturalists Society, county, unknown), survey summary data (e.g. first year observed, peak year and numbers observed, last year observed, peak abundance per year surveyed) and data sources. County data summaries include confirmed vs. unconfirmed county records, observed population frequencies per county per time period, and data sources).

The ownership of sites known or assumed to be inhabited by Poweshiek skipperling is about equally divided between private owners and a variety of governmental agencies (Table 2). (We assumed that Poweshiek skipperling still inhabits sites where the species has been observed at least once since 1965 and where its extirpation has not been confirmed. See below). The Sisseton-Wahpeton Sioux Tribe owns ten sites (Table 2). The Nature Conservancy owns 25 of the privately owned sites. Non-private entities known to own one or more sites are Iowa Department of Natural Resources, Michigan Natural Areas Association, Michigan Department of Natural Resources, U.S. Fish and Wildlife Service, Minnesota Department of Natural Resources, the Minnesota Counties of Clay, Lincoln, and Pope, U.S. Forest Service, South Dakota Department of Game, Fish, and Parks, Sisseton-Wahpeton Sioux Tribe, Wisconsin Department of Natural Resources, and the County Conservation Boards of Cherokee, Kossuth, Osceola, and Palo Alto Counties in Iowa.

Table 2. Summary of land ownership of 260 sites where Poweshiek skipperling has been recorded since 1965 and where its extirpation is not confirmed. The Nature Conservancy owns 25 of the privately owned sites.

Ownership	Total	Percentage of Total
Unknown	16	6
Federal	31	12
Local Government	6	2
Private	122	47
State	75	29
Tribal	10	4
Grand Total	260	

Of the 260 sites at which we assumed Poweshiek skipperling to be present, most have had at least one positive observation of the species since 1990 (Fig. 9). At 31 of these sites, however, biologists did not observe Poweshiek skipperling during the most recent survey. Most of the negative surveys (19) were conducted in 2003 or later. Although the species may be extirpated from some sites where the species has not been observed for several years (Fig. 9) or where the most recent surveys were negative, we will assume that the species is extant at all of these sites until their absence is confirmed (e.g., through additional negative surveys and/or habitat assessments).

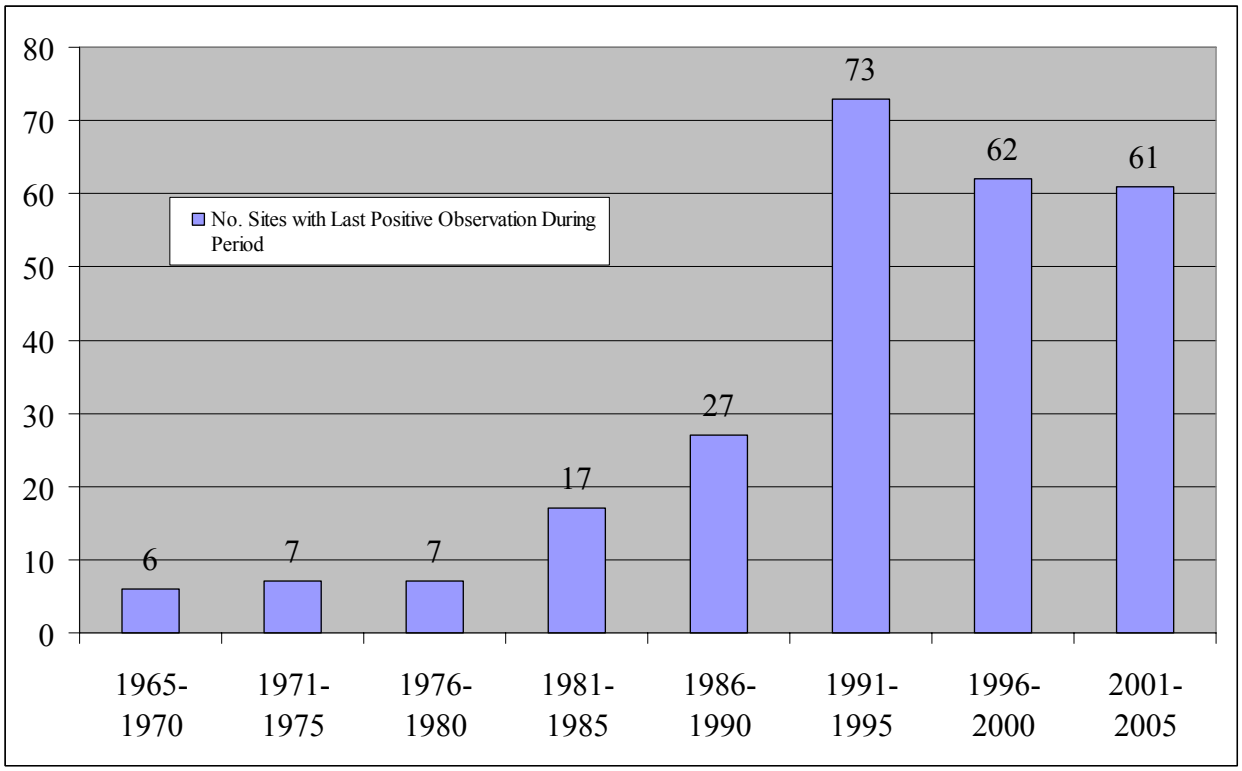

Figure 9. Times of last positive observations of Poweshiek skipperling at sites where USFWS currently assumes the species to be extant.

D. Past, Current and Anticipated Conservation Activities to Benefit Species

In the past, funding for conservation of rare species was primarily directed toward federally listed or candidate species, so while the Poweshiek skipperling has benefited indirectly from conservation activities focused on species such as the Dakota skipper, it has not generally been the primary focus of those activities. As a result, survey data and incidental life history observations have been accumulated as a part of projects focused on other species, but surveys were not necessarily focused on Poweshiek sites and detailed life history data have not been collected.

Cochrane and Delphey (2002) summarize various conservation activities directed at the Dakota skipper, and since they also indirectly benefit the Poweshiek skipperling, they are summarized here.

Meetings & workshops

1980 – workshop to initiate studies of the Dakota skipper & other prairie butterflies
1995 – U.S. FWS sponsored experts meeting to ". . . outline tasks needed to preserve enough viable populations to ensure long-term security for the species." Plan developed by group included:
    1) surveying populations and characterizing site/habitats at priority areas;
    2) identifying and recommending management needs, both generally and in more detail at a subset of important sites;
    3) monitoring: and
    4) outreach and education.
1999 – Dakota skipper recovery strategy meeting in South Dakota (Skadsen 1999b)
    State, federal, and non-governmental biologist

Management assistance (US FWS endangered species program funding)
1) Big Stone National Wildlife Refuge, MN – Dakota skipper population & habitat management planning (Olson 2000)
2) South Dakota – landowner contacts and conservation practice education (Skadsen 1999b)
3) Chippewa Prairie (2000) and Twin Valley Prairie SNA (2001) – prairie vegetation restoration

Easements (US FWS purchases) – prevent conversion of prairie to agriculture
FWS cost-share to encourage proper management (e.g. rotational grazing)
Partners for Fish and Wildlife Program

Nature Conservancy Conservation Planning
1) Prairie Coteau Coordinated Conservation Planning Effort and Plan (Miller 1999; Skadsen 1999b)
2) Ecoregional planning – included Poweshiek as a target in the planning process

Past research and surveys (see earlier descriptions) have been very valuable for determining the conservation status of the Poweshiek skipperling, identifying conservation strategies and setting conservation priorities. These need to be continued at representative sites so that the efficacy of the conservation strategies can be assessed. More data are needed on the impacts of different grazing regimes and grazing intensities. A study has been initiated that is focused on the Dakota skipper, but also includes collection of adult Poweshiek skipperling data (Selby 2003a, 2003b, 2004b). Unfortunately, skipper numbers have been too low to collect data that can be used to test hypotheses.

The designation of Dakota skipper as a candidate in 2002 for listing under the ESA markedly increased the amount of interagency cooperation to avoid or minimize adverse impacts due to government agency actions, especially among federal agencies. The National Wildlife Refuge System in North Dakota and South Dakota, for example, has formally implemented the Conservation Strategy & Guidelines for Dakota Skippers on Service Lands in the Dakotas."

A status assessment and threatened designation have been completed for the Canada populations (COSEWIC 2003) that will provide a good framework for conservation efforts there.

Part Two: Conservation Recommendations
Management Actions (Species, Habitat, or People Management) Needed

I. To Preclude the Need for Listing as Endangered or Threatened

A. Maintain the extent and quality of existing habitat

This will require protection of sites (see site protection below) to prevent intentional conversion of additional habitat and proper management of those sites to prevent unintentional loss of habitat to exotics or succession by woody species (see prairie management below).

B. Widespread application of "Poweshiek friendly" management practices

Widespread habitat loss and fragmentation have placed the Poweshiek skipperling at risk, but imprudent applications of certain types of management (e.g. prescribed fire) can threaten remaining populations. Habitat must be maintained or improved, while at the same time maintaining healthy populations of sensitive animal species (e.g. Poweshiek skipperlings).

C. Provide incentives for ranchers to "moderate" grazing practices

Government programs can be used to promote conservation practices by ranchers that might also benefit the overall prairie community. Rotational grazing is currently being promoted. More research is needed to determine the "best practices" for maintaining healthy populations of Poweshiek skipperlings.

D. Expand existing habitat and increase connectivity of fragmented habitats through reconstruction

Extinction probabilities can be mitigated by increasing the size and connectivity of prairie remnants. Strict guidelines should be followed to make sure the integrity of the existing remnants is not compromised by the inappropriate selection of species mixes or genotypes. When possible, local seed sources should be used.

E. Augment depressed populations where the potential for recovery is high

Borkin (2000b) is testing the efficacy of augmenting depressed populations with Poweshieks from healthy populations. Her work needs to be followed to determine whether it will lead to methods that may contribute to the conservation of this species.

F. Reintroduce populations to historic sites with adequate quality habitat to support healthy populations

Probabilities are high that isolated local populations will become extinct over time. To enhance the long-term survival of Poweshieks across their range, it may be necessary to reintroduce them to some of these sites. These sites should have the capacity to support healthy populations and source populations should be healthy and as close to the reintroduction site as possible. Methodology would need to be developed and tested and the efficacy of captive propagation would need to be evaluated.

II. Actions To Bring About Recovery if Listed

A. Site Protection

1. Site protection through fee title acquisition by conservation agencies and organizations.

2. Site protection through conservation easements by conservation agencies and organizations.

3. Site protection through management agreements or incentive programs to encourage land-use practices that are "Poweshiek skipperling friendly" (e.g. modified grazing and haying practices). This may also include a management assistance program (e.g. woody vegetation removal, exotic species control, and fire management).

4. Work with the Sisseton Wahpeton Sioux Tribe to encourage continued land use policies that are favorable to Poweshieks and other prairie skippers.

B. Prairie Management

Moffat and McPhillips (1993) provide a good overview of prairie management guidelines for prairie butterflies, and Swengel (2001) provides a review of literature dealing with prairie insect management issues. Opler (1981) and Panzer (1988) were some of the earlier papers to focus attention on managing prairies for insect conservation. Opler (1981) identified three key component of insect conservation: (1) survey and monitoring; (2) habitat conservation; and (3) management (including research). Initial surveys provide vital information needed for conservation planning and provides information needed to assess the success of the conservation actions. Habitat conservation should include enough area to protect viable populations [Opler (1981) recommended a 1000-acre minimum to conserve prairie butterflies at a site] and the variety of habitats present at a site and to protect dispersal opportunities, where they exist. Management (e.g. mowing or burning) is necessary for the maintenance of the prairie vegetation, but burning can destroy the prairie insects. Therefore, he recommended mowing or burning only one third of a preserve each year and making sure that the habitat types were divided among the units. He also recommended reintroducing nectar plants, if necessary. Spomer (2004) has also more recently recommended the reintroduction of nectar species at sites in the Sheyenne National Grasslands where impacts of past management may have reduced the density of these plants.

Panzer (1988) noted that fluctuating population densities (order of magnitude fluctuations are not unusual), poor dispersal ability, and patchy distributions (e.g. restricted to a small area within a much larger preserve), all contribute to high extinction rates in some prairie-restricted insects. Larger preserves are likely to have lower extinction probabilities, but many restricted species are able to survive on much smaller areas than earlier assumed by Opler (see above). Panzer (1988) notes that two-hectare preserves are likely to support a few restricted species and 15-hectare preserves are likely to support several restricted species. Preserves 50-60 hectares can be expected to support sizable prairie insect communities of over 3,000 species, including some rare ones. Poweshiek skipperling are likely to be most secure on larger diverse preserves, but healthy populations have survived on small preserves (e.g. < 10 hectares of suitable habitat) and roadside

prairies. To preserve these small isolated populations it is not enough to simply try to replicate historic processes – site-specific conservation and management strategies need to mitigate the high extinction probabilities. Panzer (1988) recommends several general management guidelines to minimize extinction probabilities. They include:

1) Eliminate unnatural landscape features (e.g., trees). These features are strongholds for non-prairie species, and contribute to excessive predation by birds and mammals and excessive competition from non-prairie invertebrates.
2) Restore habitat diversity. Ecological heterogeneity contributes to invertebrate abundance and some insects have complex habitat requirements. Heterogeneous habitats also allow species to adjust to variable conditions.
3) Burn with restraint – "Small remnant insect populations, beleaguered by encroaching exotic and ecotonal animals, diminishing water tables, and insecticides, are much more susceptible to environmental stresses such as fires than were massive presettlement populations." (Panzer 1988, p. 87)
4) Preserve a minimum number of populations per state [or region] and, if necessary, consider reintroducing species to suitable habitat.

1. Prescribed Burning

Prescribed fires benefit prairie specialist butterflies, such as the Poweshiek skipperling, by helping to control habitat loss to cool season exotics and woody vegetation, increasing the vigor of native species (including larval food plants), and increasing flowering rates of important nectar sources. To reap these benefits at a site, however, the butterflies must either survive the fire in numbers sufficient to recover from any mortality caused by the fire or recolonize the area from a nearby population. In addition, the return interval of fires should be infrequent enough to allow for full recovery of the population between burns. Negative impacts of fire can include direct mortality of larvae in or near the litter layer during dormant season burns (Dana 1985, 1989, 1991), exposure to extreme winter conditions as a result of removing the insulating litter layer in fall burns, and temporarily limiting the availability of critical resources (e.g. larval food plants or nectar sources) immediately following the burn or as a result of altering the phenology (e.g. delayed blooming as a result of a late burn). The interactions between positive and negative impacts of fire and their combined impact on long-term survival must be understood to develop appropriate plans to manage prairies for insect conservation. The combined results from the comprehensive study conducted by Panzer (1998, 2002) and the extensive long-term studies by Swengel (Swengel 1996, 1998b) and Swengel and Swengel (1999, 2001a) provide guidelines that can be applied to management for Poweshiek skipperlings.

Panzer (1998, 2002) conducted a comprehensive study of fire impacts on insects in prairie reserves in Illinois, northwest Indiana, and southwest Wisconsin. His study included 151 species, 33 families and 7 orders. He found that 93% of the species responded consistently to fire (e.g. positive = 26%; neutral = 27%; negative = 40%). Among native species the overall percent of negative responses was also 40%, but the percent of negative responses was much larger for remnant-dependent native species (54%) than for remnant-independent native species (27%). Remnant-independent species also use non-native habitats, such as weedy roadsides and fields. Panzer monitored post-fire recovery rates and found that for 66 species in 163 populations tracked to recovery, 68% recovered within one year, and 100% had recovered within

two years. Thirty-seven species' populations were not tracked all the way to recovery. Recovery rates were at least 1 year for 16 of those populations, and at least three years for three species in three populations. These results clearly demonstrated that many species are negatively impacted by fire, but they also suggested that some can recover quickly if there are adjacent recolonization sources. Panzer concluded that "few (if any) species" are likely to be threatened by the *judicious* use of prescribed burning, and that three-year burn rotations are appropriate for insect conservation. He went on to suggest that four-year rotations are very conservative for insect conservation. It should be noted that Poweshiek skipperling was not included in this study.

From 1990-1997, the Swengels conducted surveys at 106 tallgrass prairie sites in six states and have analyzed the resulting data in various ways to examine management impacts on prairie specialist butterflies (Swengel 1996, 1998b; Swengel and Swengel 1999, 2001a). Swengel (1996) compared the relative magnitudes of butterfly observations among several burn age classes (e.g., 0, 1, 2, 3, 4+ years since last burn). She also examined results from paired adjacent units with similar vegetation and topography, but contrasting burn histories. She found that measures for all prairie specialist butterflies in her study pointed to strong and significant adverse effects of the fire management used at those sites. Swengel (1996) noted that the most fire-negative species included the Poweshiek skipperling, Iowa skipper (*Atrytone arogos iowa*), Dakota skipper, Ottoe skipper and regal fritillary, and that these negative effects often persisted for three to five years or more. The Poweshiek skipperlings had the most negative initial response to fire (-96.6% deviation from expected random distribution in the first year of the burned). However, recovery appeared to be more rapid than the three to five years noted for the group of "most fire-negative species". Numbers were still lower than expected one year post-fire (-27.0%), but exceeded expectations after two years (177.8%), declined slightly after three years (91.0%) and after four or more years were almost as low as the year of the burn (-85.0%) (Swengel 1996). Based on the overall responses of fire-negative species to fire, Swengel (1996) recommended that no more than 20% of the habitat be burned in any year and that burn rotations should be five or more years. These management recommendations are more conservative than those recommended by Panzer (see above), but it should be noted that his study did not include any of her "most fire negative species." The recovery rates he observed might not apply to those species. In later analyses, Swengel (1998b) and Swengel and Swengel (2001a) examined various pairs of management classes (e.g. more vs. less recent burning; burning vs. idling; burning vs. haying/mowing; management type vs. age class) and found that rotational burning was generally less favorable than other management types. Webster (2003) also observed evidence of significant negative impacts of burning on Poweshieks at the Tallgrass Prairie Reserve in Manitoba, Canada. The average number per site for sites burned in 2001 (2 sites) and 2002 (8 sites) was 0.8 (SE = 0.3), and the average number per site for seven unburned sites was 15.9 (SE = 2.5).

Panzer (1998, 2002) identified four life history traits of duff-dwelling insects that were good predictors of a negative response to fire. They included: (1) remnant dependence (occurring as small, isolated populations); (2) upland inhabitance (dry uplands burn more thoroughly than wetter habitats); (3) nonvagility (low recolonization rate); and (4) univoltine (slower recovery rates for one generation per year). He stated that special concern species exhibiting all four traits should be presumed to be hypersensitive. Poweshiek skipperlings fit all those criteria and also

have additional life history traits that help explain their hypersensitivity to fire. Their eggs are laid near the tips of leaf blades and they overwinter as larvae on the host plants (Borkin 2000b; R. Dana, pers. comm. 2005). Unlike Dakota and Ottoe skipper larvae, which overwinter below ground in shelters (Dana 1989, 1991), Poweshiek larvae are exposed on the host plant or in the duff. If the host plants are prairie dropseed and little bluestem, which occur in dry prairie, rather than spike-rush or sedges, then the larvae are even more vulnerable. They are also notably weak fliers and are therefore likely to recolonize more slowly and across shorter distances than other more vagile skippers and butterflies.

Considering the apparent hypersensitivity of Poweshiek skipperlings to fire and the recent dramatic population declines they have experienced, it may be best to err on the side of caution and follow the management guidelines proposed by Swengel (1996) at this time. More data are needed on the responses of "hypersensitive" species such as the Poweshiek skipperling to prescribed burning and their recovery rates following the burns. These data, coupled with monitoring of the populations, can enable managers to adapt their management to ensure the long-term survival of those species.

2. Haying

Many prairie remnants would no longer exist if it were not for the tradition of cutting prairie hay. This practice has not only provided an alternative to land uses that would require plowing, but has also helped to maintain their quality by preventing excessive litter accumulation and succession to woody species. Dakota skippers have survived on sites with long histories of haying and McCabe (1981) feels that appropriately timed mowing (e.g. after adult flight) is more compatible with the indefinite persistence of the Dakotas than burning. Swengel (1996) found that prairie specialist numbers were higher in hayed than burned prairies and also favors mowing over burning. As with any management practice, timing, frequency and intensity are important. If haying is done during the adult flight period, it will have a negative effect by eliminating nectar sources. Late season haying, after the Poweshieks are done flying, is preferable, but even that might impact other species with a later flight negatively. Just as with burning, only a portion of a site (e.g. no more than one-third to one-half) should be hayed in a given year.

Late summer (e.g. August-September) haying or mowing can be more effective at reducing or controlling woody vegetation than most burning for several reasons. It is done at a time when the woody vegetation is already stressed and when most of the plants' resources are above ground. By contrast, spring and fall burns occur when the woody plants' resources are stored below ground, so they will produce more vigorous suckers following the burn. Late summer burns can be used, but it is difficult to get them to burn hot enough to be effective against established woody vegetation. Mowing can also be focused on the problem area, whereas prescribed fires usually burn best in the open prairie and worst where woody vegetation is a problem.

3. Grazing

Peer-reviewed research examining grazing impacts on prairie butterflies has not been published and most references to grazing impacts are based on ancillary observations made during research focused on other management impacts (e.g. fire). A study examining grazing impacts on Dakota skippers was initiated in 2003 in the Glacial Lakes State Park area, Pope County, MN (Selby

2003a, 2003b, 2004b). The study was focused on all life stages of the Dakota skipper, but also included data collection for the adult stage of other prairie specialist butterflies, including the Poweshiek skipperling. Unfortunately, the study coincided with a dramatic population crash for the Dakota skipper and Poweshiek skipperling; both species were too scarce to collect data adequate to test hypotheses. Initial observations based on two years (2003, 2004) of general and quantitative surveys throughout the Dakota skipper flight period suggest that numbers in the light to moderate grazed pasture are similar to those in the best portions of the ungrazed park and adjacent private property (46 vs. 49 total observations respectively). Table 3 compares peak numbers from 2004 quantitative transect data. The numbers are too small to form strong conclusions, but the data suggest general trends. Differences in habitat quality (e.g. extent of cool-season grasses and brush), land use history, and management history (e.g. different burn regimes) might account for some of the observed differences in abundance within the ungrazed portions of the study area. Combined numbers in the grazed study area were similar to those for the ungrazed transect (Transect 3) with the highest numbers (1.21/km vs. 1.35/km respectively). Within the grazed study area, numbers declined with increasing grazing intensity, and were absent from the most heavily grazed areas. Heavy cattle grazing eliminates almost all vegetative cover and all but a few weedy nectar plants. There were dramatic differences between heavily grazed areas (almost no butterflies) and lightly grazed or ungrazed adjacent areas within the same pasture (numerous butterflies including regal fritillaries and wood nymphs).

Table 3. Peak Dakota skipper numbers from 2004 quantitative transect surveys. A comparison of grazed vs. ungrazed, and different grazing intensities. General trends among transects are apparent, but the numbers are too low to form strong conclusions. Ungrazed areas also include varied applications of management by fire.

Ungrazed	km	#	#/km	Grazed*	km	#	#/km
Transect 1	3.321	0	0.00	L to M	2.801	5	1.78
Transect 2	3.971	0	0.00	M-H to H	6.675	8	1.20
Transect 3	5.864	8	1.36	H-S to S	1.252	0	0.00
Transect 4	5.291	2	0.38	**Combined**	**10.728**	**13**	**1.21**
Combined	**18.447**	**10**	**0.54**				

* Grazing Intensity: L = Light; M = Moderate; H = Heavy; S = Severe

Royer and Marrone (1992) state that heavy grazing is a threat to Poweshiek skipperlings, but that light grazing is not a long-term threat if there is contiguous ungrazed habitat. Swengel and Swengel (1999) noted that at the Sheyenne National Grassland in North Dakota, grazing appeared to be unfavorable for Poweshiek skipperlings, but that other habitat factors (e.g. lower quality; drier prairie) could also be responsible for the low numbers of Poweshieks. Abundance of Dakota skippers may be reduced in direct proportion to grazing intensity (Dana 1997). Reduced availability of nectar resources may be the primary factor, but vegetation structure changes may also be involved. Dana also suggested that some grazing may actually help maintain habitat structure suitable for prairie skippers and the complete absence of grazing in some areas may have a negative impact by leading to unfavorable habitat conditions. Properly managed grazing can be an alternative to other forms of management (Royer and Marrone 1992).

Bison (*Bos bison*) grazing may be preferable to cattle (*B. taurus*) grazing, but should be implemented with the same caution as other disturbances (e.g. fire). For example, cattle diets

have a lower percentage of graminoids and a higher browse/forb component than bison diets and the abundances of some plant species respond in opposite ways to cattle vs. bison grazing (Damhoureyeh and Hartnett 1997; Knapp et al. 1999; Plumb and Dodd 1993). Bison often leave forbs "conspicuously ungrazed" (Knapp et al. 1999). Various grazing regimes (e.g. season-long vs. rotational) may also have significantly different impacts. The nature of grazing management on a site is likely more important to Dakota skippers than selection of either cattle or bison as grazers. Knapp et al. (1999) state, "… it is likely that because bison and cattle are functionally similar as large grass-feeding herbivores, management strategies (stocking intensity and duration) will have a greater influence … than inherent differences in these ungulates."

Before human actions fragmented the prairie, grazing by wide-ranging herds of bison, in addition to fire, was likely one of the most significant impacts to the habitat of Poweshieks, especially in the western portion of its range. Current grazing in the range of Poweshieks, however, is drastically different than the grazing under which the species evolved – grazers, typically cattle, are fenced into what are relatively tiny fragments of the original prairie, all of which are vulnerable to invasion by exotic invasive species, such as smooth brome, Kentucky bluegrass, or leafy spurge. Therefore, grazing may now only be favorable to the conservation of Poweshieks and other sensitive prairie invertebrates where it is light relative to typical grazing intensity or where managers adjust grazing prescriptions according to their effects on essential features of the prairie ecosystem (e.g., adaptive management).

4. Brush control

Various tools, or combinations of tools, can be used for brush control. Once brush is established, mechanical removal is generally more effective in removing it than prescribed burning. Cedars and other conifers do not generally resprout, so they can simply be cut and removed. Deciduous species are notorious for suckering, so when they are cut it is best to kill them with a local application of a systemic herbicide to the stumps. Aspen can be killed first by girdling and then cut after they are dead (at least one growing season) to avoid suckering. As mentioned earlier, woody vegetation is more stressed and has most of its resources above ground during late summer (e.g. most of August in northern Iowa and southern Minnesota), so cutting at this time can be the most effective. Brush control is generally most effective if it is coordinated with the burn program, focusing cutting in areas that are scheduled to be burned. It is also important not to clear areas with woody vegetation faster than they can be restored, or they may simply turn into weed patches.

5. Exotic species control

Cool-season exotic grasses (e.g. smooth brome, Kentucky bluegrass) are generally controlled by late spring burns, but these can be the most harmful to butterfly larvae in the litter layer. Short-term intensive cattle grazing in the spring can also be effective in shifting the balance toward warm-season grasses. Where dense patches of exotic grasses are established, it may be best to use a radical approach, killing it with a non-persistent herbicide such as Round-up and seeding the area to native vegetation. Very late season applications of Round-up can be effective in killing the cool-season grasses without impacting native species that might be mixed in with them. As with the clearing of brush, if the area is not restored immediately (e.g., via seeding with native species), it will simply turn into a weed patch.

Leafy spurge is a highly invasive deep-rooted perennial that can form dense patches that eventually crowd out native prairie plants. It is a major threat to prairies with Poweshiek skipperlings in Iowa, Minnesota, North Dakota and South Dakota. Chemical control has been used historically, but it can also damage native species and is not very effective. Biological control is becoming the preferred treatment, and is generally thought to be "safe" for native species.

Purple loosestrife (*Lythrum salicaria*) is a threat to Poweshiek skipperlings where they are more closely associated with wet prairie or fens. It is a serious problem in Michigan, Wisconsin, and Minnesota, and is becoming a problem in South Dakota (Royer and Marrone 1992). It is also a major potential threat to the wet tallgrass prairie habitats for the Poweshiek in Canada (COSEWIC 2003). It can be treated with glyphosphate herbicides approved for use in wetland habitats, but the best solution for this species will probably also be biological control, which is underway.

Glossy buckthorn is a major threat to the fen habitats for the Poweshiek skipperling in Michigan (D. Cuthrell, pers. comm. 2005). Prescribed fire is used to control it, but it is unlikely that a cautious "Poweshiek friendly" application of fire will be effective against it. Primary control will need to be achieved by other means (e.g. cutting and treating) and then fire can be effective in maintaining the habitat.

Sweet clover (*Melilotus* spp.) is an aggressive biennial. It can be controlled with careful applications of prescribed fire, but it can also be enhanced by fire. Early spring burns facilitate seedling establishment during the year of the burn (Year 1). If nothing is done to control these seedlings, the second-year plants can form dense patches that choke out the native vegetation and produce another crop of seeds. If problems areas are identified in Year 1, they can be targeted for a late-season burn in Year 2, which will kill the second-year plants before they can go to seed. Burns in consecutive years, however, should not be done if they will impact a significant portion of the Poweshiek skipperling population at a site. Sweet clover can also be controlled by pulling or mowing, but the pulling is labor intensive and disturbs the soil and mowing does not always prevent it from producing another crop of seed.

C. Management of "Extirpated" Sites

Sites from which Poweshiek skipperling have been extirpated should be managed as if the species is still there if the essential features of the species' habitat are intact or restorable. Small and overlooked remnant populations may exist at some of these sites or natural reintroduction may occur if there are nearby extant populations. Intentional reintroduction may also be an option for restoring the species to some of these sites.

D. Research, Surveys and Monitoring

To complete the status assessment and allow for an informed listing decision

1. Assessing the status of existing populations

Recent widespread conspicuous declines of what had appeared to be healthy populations of Poweshiek skipperlings in Iowa and Minnesota (Selby 2003b, 2004a & 2004b) illustrate the tenuous existence of the remnant populations. Surveys need to be conducted throughout its range to determine how pervasive these declines are and whether the populations will recover. Priorities for conducting those surveys and the resources needed or already available are summarized below for each state. The efforts will need to be coordinated and the results from current and past surveys will need to be compiled and provided for analysis with data from other states to examine overall population trends.

Iowa. Saunders (1995) documented populations of Poweshiek skipperlings at 26 sites in 7 Iowa Counties during extensive surveys in 1993 and 1994. Unfortunately, very few of those sites have received follow-up surveys. In 2004 and 2005, thorough surveys were conducted at two sites that had supported healthy populations at least as late as 2000 (Selby 2000) and no Poweshieks were found (Selby 2004b). They were also absent from several other sites where Saunders (1995) had found them (Selby 2004a; F. Olsen, pers. comm. 2004). Follow-up surveys need to be conducted at a representative sample of sites, including those surveyed in 2004 and 2005, to obtain an up-to-date status assessment of the Poweshiek skipperling in Iowa.

Michigan. David Cuthrell (pers. comm. 2005) indicated that most Poweshiek skipperling observations have been incidental to surveys for Mitchell's satyr and that there is a need for systematic surveys focused on Poweshieks. There are numerous fen sites with suitable habitat that have not received such surveys. The first priority should be surveying all known sites where they have not been confirmed as extirpated and the second priority should be a targeted search for new populations at selected additional sites with suitable habitat.

Minnesota. Surveys by Cuthrell (1991), Reiser (1997), (Schlicht (1997a, 1997b, 2001), Schlicht and Saunders (1993, 1995), Selby (1991), Selby & Glenn-Lewin (1989, 1990), Skadsen (1999c, 2001a, 2001b), Swengel (1992b), and Swengel and Swengel (1999) greatly increased the knowledge base for Minnesota Poweshiek skipperling populations. Recently, the population in the Glacial Lakes State Park area in Pope County experienced a catastrophic decline from 2001 to 2003; in 2004 and 2005 no Poweshiek skipperlings were observed in this same area during extensive surveys (Skadsen 2001b; Selby 2003b, 2004b). Almost half of all the Poweshiek skipperling populations are in Minnesota, so the status of the Minnesota populations is critical to the long-term survival of the species. Therefore, it is important to determine just how widespread the observed population declines are in Minnesota and whether populations will recover. Surveys of several key sites by the author in 2005 helped provide an initial assessment of some additional populations. More resources will need to be devoted to this effort, however, to get a complete picture of the status of Poweshieks in Minnesota.

North Dakota. Ronald Royer (pers. comm. 2004) has not seen Poweshieks in North Dakota in over a decade at historic sites. Orwig (1995, 1996 & 1997) discovered eight new populations in Richland and Sargent Counties during three years of surveys in southeast North Dakota; in 1997,

however, he only found Poweshieks at one new and one previous site in Richland County. In 2001 a new population was discovered in Ransom County (Spomer 2001), but they were not found at that site in 2002 or 2003 (Spomer 2002; S. Spomer, pers. comm. 2005). These surveys illustrate the value of conducting surveys – i.e., new sites found – but also illustrate the precarious state of these populations. The discovery of these new populations by Orwig and Spomer and the presence of populations in all counties bordering the state in Minnesota, suggest the possibility that more populations could be discovered. Thorough surveys should be done at all historic sites where evidence for the extirpation of the species is not strong and additional suitable habitat in eastern North Dakota should also be targeted for surveys.

South Dakota. Skadsen (1997, 1998, 1999a, 2002, 2003, 2004) has been very active in northeast South Dakota. His work has resulted in the discovery of many new sites, but he has also reported a decline in numbers in recent years. His work should be continued at or above the current levels, with a focus on evaluating population trends at a representative set of sites.

Wisconsin. Borkin (1994, 1995, 1996, 2000a, 2000b; pers. comm. 2004) has been conducting life history studies, monitoring extant populations regularly, conducting surveys for new populations, and testing methodology for augmenting populations in Wisconsin. If her work continues at or above the current levels, that should provide adequate information to monitor the status of the Wisconsin populations.

Canada. All the populations are localized in Tallgrass Prairie Preserve in Manitoba, so it should be quite practical to continue monitoring them. Long-term monitoring data are needed for this area.

2. Life history studies

Comprehensive life history studies have not been completed throughout the range of the Poweshiek skipperling. The limited studies that have been done have focused on eastern populations and may not be representative of the more western populations in the Dakotas, Minnesota, and Iowa. Observations of Michigan populations by McAlpine (1972) and Holzman (1972) suggested that the larval foodplants were sedges or spike-rush. McCabe and Post (1977) also report seeing oviposition and subsequent feeding on *Carex* sp. in a North Dakota population. More recent work by Borkin (1994, 1995, 1996) on Wisconsin populations, however, suggests that the larval foodplants are prairie dropseed and little bluestem. These results are supported by numerous incidental observations by R. Dana (pers. comm. 2005; unpublished data) while conducting research focused on other species and would actually fit better with the observed habitats for many of the western populations. A better understanding of the life history requirements for each developmental stage is needed to adequately protect and manage Poweshiek skipperling habitat. New studies need to be done on representative western populations, and should be coordinated with work done on eastern populations (e.g. Borkin 1994, 1995, 1996).

3. Factors influencing population fluctuations

Poweshiek skipperling populations are characterized by dramatic population fluctuations. Therefore, understanding the factors that influence these fluctuations should be a top research priority (Royer and Marrone 1992). Understanding the interaction between external environmental factors (e.g. extreme weather patterns or events), habitat quality, and heterogeneity and management activities could provide essential input for conservation planning. Predicting fluctuations resulting from environmental factors could enable managers to avoid activities that put the population at risk during years when the populations are likely to be low. There is a need to compile historic data across a wide geographic area and examine population fluctuations in relation to various environmental parameters (e.g. an unusually cold winter and/or lack of snow cover, a late frost (post-diapause), a cool wet spring and/or summer, etc.). It is also important to examine those populations where the negative impacts are not as pronounced and try to determine what factors might be mitigating the environmental impacts.

To bring about recovery, if listed

1. Develop and Implement a Comprehensive Protection Strategy

Identify an adequate number and configuration of populations to ensure long-term survival throughout its range and develop a strategy to protect them. This strategy should include fee title ownership by conservation agencies/organizations, conservation easements, incentives to modify land use practices (e.g. grazing and haying) to minimize negative impacts, and targeted management assistance.

2. Develop and Implement Appropriate Management Guidelines

Establish management guidelines that maintain or enhance habitat, while minimizing direct negative impacts of the management on the population. Degradation or loss of quality habitat in protected sites is a long-term threat, but the application of fire management that does not ensure the conservation of Poweshiek skipperlings is probably the biggest short-term threat to their populations. Healthy populations need to be maintained while retaining, restoring, or expanding the habitat they need for long-term survival. This needs to be coupled with an aggressive education program. Many managers still need to be convinced that prescribed fire can pose a threat to invertebrate populations and that the inconvenience associated with accommodating these concerns is justified. Managers also need to learn how to use fire more judiciously and effectively in concert with a full suite of other management tools. Agencies and organizations that have oversight for management activities need to follow through to ensure implementation of the guidelines that are established. It is critically important to provide adequate funds for training and management – it takes properly trained and equipped management crews to implement proper management.

3. Develop an Ongoing Monitoring Program

Regular monitoring is needed to constantly assess the efficacy of the protection and management strategies. These programs should be implemented at a representative subset of sites throughout the Poweshiek skipperling's range and the monitoring results should help drive protection and management decisions.

4. Augment and/or reestablish populations

It is always best to focus conservation efforts on preserving and managing extant populations, but there may be circumstances where recovery might require augmenting severely depressed populations or reestablishing populations at historic sites with suitable habitat. If significant gaps are identified in the current Poweshiek skipperling distribution, or a geographic area is represented by only a few isolated populations, reestablishing populations in historic sites with suitable habitat might help mitigate the likelihood of the species being lost from the area.

The Wisconsin populations definitely meet these criteria and methodology for augmenting depressed populations is being tested (Borkin 2000b). The Poweshiek skipperling is only known from one site in Green Lake County and two sites within 2 km of each other in Waukesha County (Borkin 2000a). There is a healthy population at one of the Waukesha County sites, but the population at the other site is much lower despite the fact that it has three to four times as much suitable habitat (Borkin 2000b). Captive reared larvae from the larger population are being used to augment the smaller population, but the project has not been successful yet (S. Borkin, pers. comm. 2004). This project should be followed closely to evaluate the efficacy of the methodology and testing of similar or alternate methodologies should be considered for other areas (e.g. southeast North Dakota). Any such attempts should follow strict guidelines to avoid placing existing populations at risk and to avoid inappropriate choice of reestablishment sites or source populations.

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