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Research paper

Urban rights-of-way as extensive butterfly habitats: A case study from Winnipeg, Canada

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HIGHLIGHTS

- Butterfly species richness increased with plant species richness at study sites.
- Some species increased with resource plant cover or vegetation density.
- Resources predicted butterfly richness and numbers better than urban land.
- Resources were less abundant in frequently mowed and sprayed rights-of-way.

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ABSTRACT

Urban rights-of-way (ROWs) offer large underused tracts of land that could be managed for plants and butterflies of threatened ecosystems like tall-grass prairies. However, built-up unvegetated urban lands might serve as barriers preventing butterflies and resource plants from settling along ROWs. Further, negative edge effects from surrounding urban lands or frequent mowing and spraying associated with urbanization may prevent butterflies from benefiting from urban ROWs as habitats. However, because ROWs often run for kilometres, they might facilitate movement from other, similar habitats by which they run close. To determine if surrounding built-up lands had a greater effect on butterflies than did the abundance of resource plants along ROWs, we surveyed butterflies and resource plants along transects in 48 transmission lines in or near Winnipeg, Manitoba, 2007–2009. In general, butterfly richness and abundance were better predicted by available resources than by built-up urban lands surrounding ROWs. Butterfly species richness per visit increased by 85% with increases from 10 plant species per site to 80 species of plants per site, while abundance per species per visit increased by 100% with increases from negligible forb cover to 5% forb cover, and by 112% with increases in vegetation height-density from 5 cm to 40 cm high. If appropriate resource plants are reintroduced and managed for along urban ROWs, densities of most butterfly species will increase along these lines despite surrounding built-up urban lands. Thus, urban ROWs present an opportunity for restoring habitats for prairie butterflies.

1. Introduction

Humans need to manage expanding urban landscapes so that they sustain biodiversity and minimize the loss of wildlife habitat (Cadenasso, Pickett, & Schwarz, 2008; Young, 2000). Urban grassy spaces that people rarely use (e.g. transmission line and roadside rights-of-way [ROWs]) could have high conservation value for butterflies, if those spaces serve as alternative habitats for plants that inhabit low-growing, threatened ecosystems like tall-grass prairies (Hoekstra, Boucher, Ricketts, & Roberts, 2005; Samson & Knopf, 1994). Restoring and managing for key resource plant species along ROWs may benefit threatened butterflies like the monarch (*Danaus plexippus*), which depends on milkweeds and dogbanes as larval host plants (Brower et al., 2011; Klassen, Westwood, Preston, & McKillop, 1989); the regal fritillary (*Speyeria idalia*), which depends on violets as host-plants (Klassen et al., 1989), and the Karner blue (*Lycaeides melissa samueli*), which uses lupines as host-plants (Forrester, Leopold, & Hafner, 2005). Combined with prairie restoration along roadsides (Ries, Debinski, & Wieland, 2001), such practices could increase needed habitat for many plants and butterflies.

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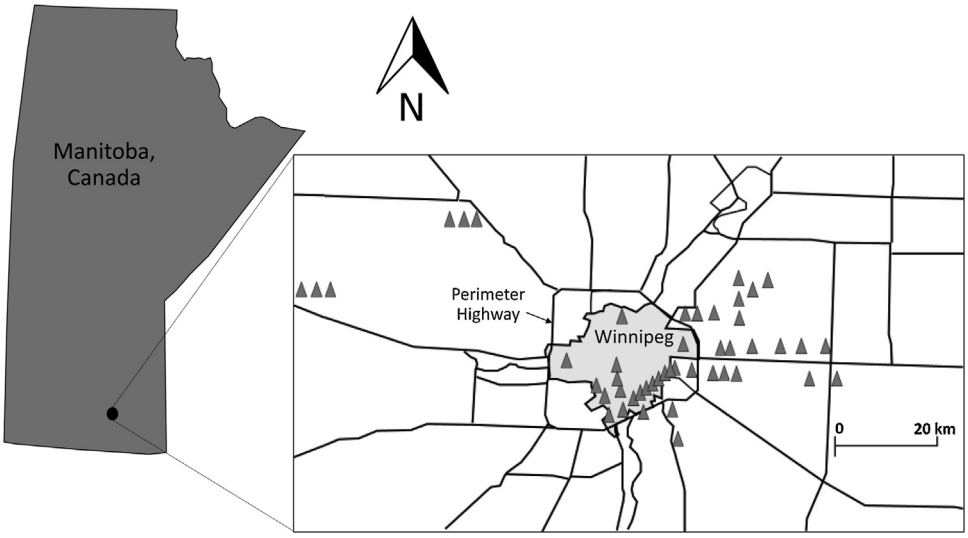

Fig. 1. Locations of butterfly survey sites along 48 transmission lines within 70 km of Winnipeg, Manitoba, 2007–2009. Triangles = study sites.

If urban ROWs are to serve as habitats for butterflies, planners must first determine if surrounding lands will prevent butterflies from reaching and benefiting from these new habitats. Frequent mowing and spraying along urban ROWs helps to control weeds and create tidy homogeneous green spaces as a symbol of order and prosperity (Byrne, 2005), but may degrade butterflies and their habitat through mortality of insects (Munguira & Thomas, 1992), removal of taller vegetation that is shelter habitat for butterflies and their caterpillars (Collinge, Prudic, & Oliver, 2003; Dover, 1996; Kruess & Tscharntke, 2002), and reduction in diversity of resource plants (Munguira & Thomas, 1992; Öckinger, Dannestam, & Smith, 2009; Parr & Way, 1988; Valtonen, Saarinen, & Jantunen, 2007). Reducing resource plant diversity may have larger adverse effects on specialist butterflies with larvae that only feed on few species of plants (Clark, Reed, & Chew, 2007; Kitahara, Sei, & Fujui, 2000). Butterflies may also decline as built-up, unvegetated land increases around sites with many resources for butterflies (Bergerot, Fontaine, Renard, Cadi, & Julliard, 2010), perhaps because habitat conversion reduces the mean size of urban wildlife areas while increasing their physical isolation by large expanses of sub-optimal habitats or hostile non-habitats (McDonald, Kareiva, & Forman, 2008). High densities of urban roads may be barriers or sources of mortality for butterflies moving between habitats (Ries et al., 2001), preventing sedentary butterfly species from colonizing isolated urban habitats (Hill, Thomas, & Lewis, 1996; Polus, Vandewoestijne, Choutt, & Baguette, 2007; Sutcliffe, Thomas, & Moss, 1996), and preventing smaller urban habitats from supporting specialist butterfly species (Hill et al., 1996; Kraus, Steffan-Dewenter, & Tscharntke, 2003; Polus et al., 2007).

In this study, we explored whether built-up urban lands prevented transmission lines with large amounts of resources from serving as attractive habitats for butterflies. Unlike patchy butterfly habitats such as domestic gardens and abandoned lots (Bergerot et al., 2010), urban ROWs provide many hectares of potential habitat for butterflies and resource plants (Morgan, Collicut, & Thompson, 1995). Butterflies might also increase in urban landscapes if they are able to feed on exotic plants (Graves & Shapiro, 2003; Tooker, Reagel, & Hanks, 2002). We predicted that butterfly species richness and abundance would increase along transmission lines with greater plant species richness, dense vegetation, greater cover of nectar-plants for adult butterflies, and more larval host-plants. If surrounding urban lands prevented butterflies from using transmission lines, we predicted that butterfly species richness and abundance would decline as the amount of built-up urban lands surrounding transmission lines increased, regardless of available resource plants for butterflies along urban transmission lines.

2. Methods

2.1. Study area

We conducted surveys in a study area that was historically occupied by tall-grass prairie, which is a critically endangered ecosystem in North America (Hoekstra et al., 2005). Study sites were along 48 power transmission line sections with grassy ROWs that were at least 30 m wide and 500 m long (mean width = 50.36 m, SD = 19.35 m), in or near Winnipeg, Manitoba (49.90°N, 97.14°W) (Fig. 1). Although these lines had low levels of native prairie plant cover, native tall-grass prairie plant species naturally colonized these lines (Leston & Koper, 2016).

2.2. Butterfly surveys along transmission lines

To measure butterfly diversity, we counted individuals of all species detected within 5 m of a straight 500-m transect line at each of the 48 transmission lines. We only surveyed butterflies in conditions when butterflies were more likely to be actively flying and detected, from 10:30 to 1:30 on warm days (>13 °C) without strong wind (≥15 km/h) or precipitation (Pollard, 1977). There were 3–11 butterfly surveys per site from June to August of 2007–2009, with up to four surveys per site in a given year. There were 7 surveyors across 3 years. We spent approximately 30 min per transect. Where possible, we captured butterflies that could not be identified on the wing and examined them in the hand prior to release, or collected them as voucher specimens. While we tentatively identified crescent butterflies on the surveys as northern pearl crescents (*Phyciodes morpheus*) based on the voucher specimens, some individual crescents during the surveys could have been similar-looking pearl crescents (*P. tharos*). We deposited voucher specimens at the J.B. Wallis/R.E. Roughley Museum of Entomology, Department of Entomology, University of Manitoba.

Study sites occurred along an urbanization gradient, as measured by the proportion of built-up lands (roads, railways, homes and gardens, other buildings) within 100 m of the transmission line's 500-m transect line for butterfly surveys. The most distant sites were ~70 km from Winnipeg's city limits, where 20 urban sites