

Steward's Circle

Response of Regal Fritillary (*Speyeria idalia* Drury) to Spring Burning in an Eastern Nebraska Tallgrass Prairie, USA

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Fire has been a major force in the formation and maintenance of the tallgrass prairie ecosystem in North America (Collins 1990, Bragg 1995, Steinauer and Collins 1996); thus, the role of fire and its effects on tallgrass prairie plant communities have been well studied (e.g., Daubenmire 1968, Vogl 1974, Collins and Gibson 1990, Svejcar 1990). It is generally accepted that prescribed fire, when applied at the appropriate season and frequency, plays an important role in tallgrass prairie management by promoting long-term species diversity in the plant community (Bragg 1991). Furthermore, lack of fire management on prairie remnants may cause herbaceous plant species losses by facilitating woody plant encroachment (Bragg and Hulbert 1976) and also by minimizing the dynamic conditions necessary for persistence of certain plant species (Leach and Givnish 1996).

Prairie management strategies have historically focused on the plant community, but recent attention has been given to animals, particularly invertebrates, the most

diverse biotic group of the tallgrass prairie ecosystem (Opler 1981, Panzer 1988, Arenz and Joern 1996). Among invertebrates, lepidopterans have received particular attention (Opler 1981, Panzer 1988, Moffat and McPhillips 1993). As awareness of the importance of invertebrate populations in tallgrass prairie has increased, so has concern regarding the use of fire as a management tool—especially the effect of extent, frequency, and timing of prescribed burns on invertebrate populations (e.g., Moffat and McPhillips 1993). In general, the response of invertebrates to fire management differs by species, and by fire extent, frequency, and timing (reviewed by Reed 1997).

The regal fritillary butterfly (*Speyeria idalia* Drury) is considered a key indicator species of native tallgrass prairie (Hammond and McCorkle 1983), and has been classified as both a remnant-dependent species (Panzer et al. 1995) and a prairie specialist (Swengel 1996). Because declines in abundance have been noted throughout the species' range (Opler 1981, 1992; Bliss and Schweitzer 1987), specific information about the effects of prairie management on the regal fritillary is valuable. Swengel (1996) reported a negative response to fire by regal fritillary and concluded that habitat maintenance by haying is more favorable than burning where this species is concerned. However, Swengel's (1996) conclusions have been questioned (Schwartz 1998). Schwartz (1998) contended that the issue is not whether prairie butterflies, or other species, are temporarily reduced by fire management, but rather whether fire management alters the ability of populations to persist in a given habitat? We observed the effects of a prescribed spring burn on a regal fritillary population in an eastern Nebraska tallgrass prairie that has been managed since 1979 with spring burns applied every three to four

years. Here we report on the response of that regal fritillary population to a spring burn and comment on the population's persistence under a 20-year burn regime. These data are part of a larger study but are reported here because they provide timely information for the debate on use of fire for invertebrate management in prairies.

Nine-mile Prairie is a 97-ha native tallgrass prairie approximately 14.5 km northwest of Lincoln, Lancaster County, Nebraska, USA (40° 52' N, 96° 49' W). The prairie has been owned by the University of Nebraska Foundation since 1984, but has been studied by university personnel since the early 1900s (Kaul and Rolfsmeier 1987). Three hundred ninety-two vascular plant species have been found on the prairie (Kaul and Rolfsmeier 1987). Over the past century, Nine-mile Prairie was occasionally hayed and lightly grazed, but since a change in ownership in 1979, the prairie has been mostly managed with springtime burning on a 3- to 4-year fire-return interval (Kaul and Rolfsmeier 1987). Over half of the prairie was burned on 15 May 1995, and the portion not burned in 1995 was burned on 23 May 1997. No burns were conducted in 1996. Prescribed fires after the first week in May are considered late in the spring burning season (T.B. Bragg, pers. obs.) and may have severe effects on invertebrates (see Bragg 1995) because most insects have emerged by that time and are in, on, or above the litter that is the fuel for burning.

In 1996 we established a single 4460-m butterfly-survey transect that traversed all major regions of Nine-mile Prairie. Following established procedures (Thomas 1983, Gall 1985, P. Hammond; Oregon State University, Corvallis, pers. com.), surveys consisted of walking the preestablished transect at a steady pace and counting each regal fritillary butterfly seen within an area 5 m in front and 5 m to either side of the survey transect. All surveys were conducted by a single observer to limit variability. Surveys were first conducted in 1996, when the prairie had not been burned, and again in 1997, when approximately one-third of the prairie was burned. Data collected included whether butterfly observations occurred in burned or unburned

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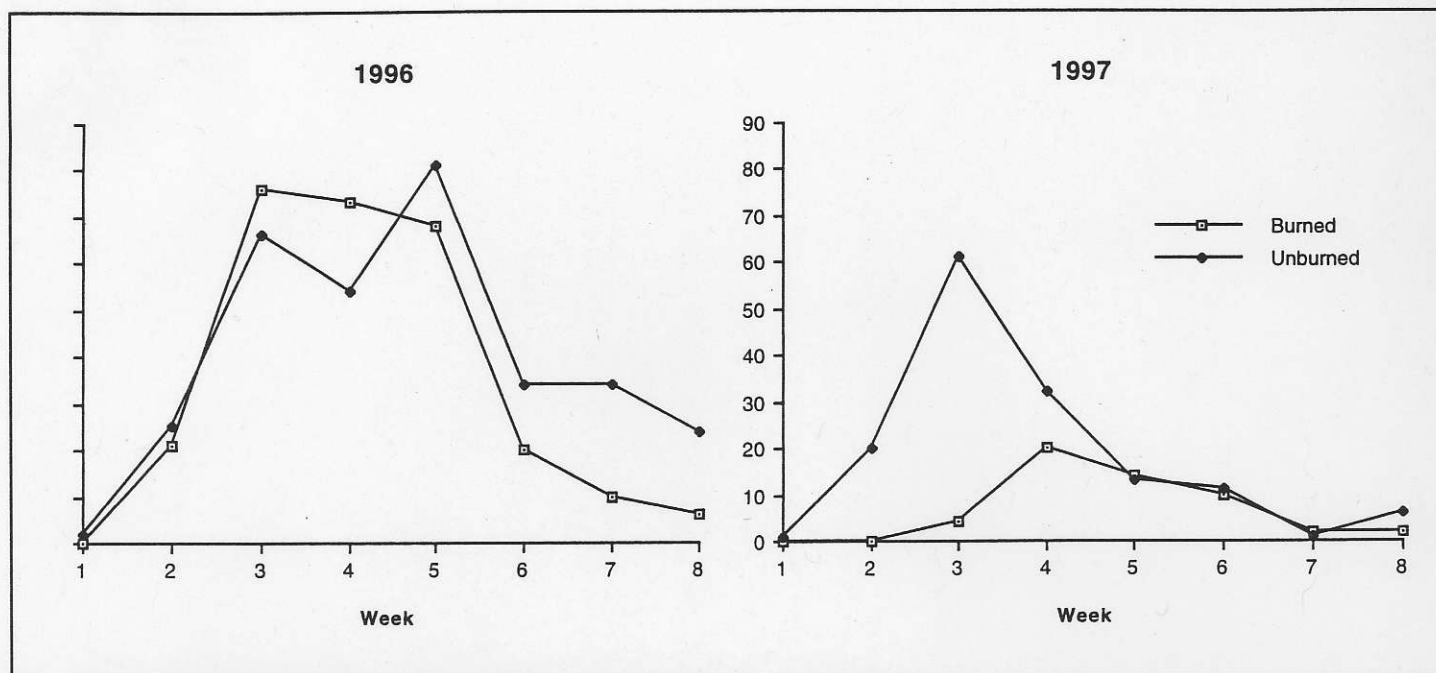


Figure 1. Regal fritillary butterfly counts before (1996) and after burning (1997) by week.

areas. Surveys for regal fritillary were conducted approximately weekly for a total of eight weeks beginning after butterflies were first observed in the region. In 1996 the first and last survey dates were 19 June and 12 August; in 1997 they were 21 June and 20 August.

Surveys were generally conducted from 1000 to 1530 h on sunny (less than 50% cloud cover) days, with temperatures above 21° C. However, when temperatures exceeded 27° C, surveys were conducted with a cloud cover of up to 75%, or surveying time was extended (0930–1600 h), providing that cloud cover remained less than 50%. Surveying criteria were based on Gall (1985).

Regal fritillary butterflies were observed throughout Nine-mile Prairie in 1996. Late-spring burning in 1997, however, had a noticeable impact on regal fritillary distribution and abundance. No butterflies were detected in the burned portion of the prairie in 1997 during the first two weeks of surveys, in contrast to the 21 counted in the unburned portion during that time (Figure 1). By the third survey week, the difference between the burned and unburned areas was the greatest for the year with 4

individuals counted on the burned portion and 61 counted on the unburned portion. After week four, however, the two populations were similar in size and remained so for the rest of the surveying period, suggesting dispersal of regal fritillary from the unburned portion of the prairie to the burned area.

The short-term response of regal fritillary to prescribed fire at Nine-mile Prairie was not surprising. Larvae almost certainly suffered direct mortality in the burned portion of the prairie in 1997 because they were presumably above ground feeding on violets (*Viola L. spp.*), their larval host plants (Opler and Krizek 1984, Bliss and Schweitzer 1987, Opler 1992) at the time of the fire in mid-May. Violets are available to regal fritillary larvae on Nine-mile Prairie throughout May (Huebschman 1998). Subsequent dispersal of adult regal fritillary from the unburned prairie to burned areas is also not surprising because these butterflies are strong dispersers (Bliss and Schweitzer 1987), and, when dispersal occurred by mid-July, the burned prairie was lush with vegetative regrowth (J.J. Huebschman, pers. obs.). Successful dispersal and recolonization of regal fritillary following a burn presumably occurs at

Nine-mile Prairie: regal fritillary butterflies were observed throughout the prairie in 1996, when approximately half of the prairie was burned in mid-May in 1995.

The regal fritillary population at Nine-mile Prairie reflects the net effect of past management, which has included spring burning since 1979. The persistence of regal fritillary at this site suggests that burning at a 3- to 4-year frequency, while leaving adjacent areas unburned, is a realistic long-term management plan for this species at Nine-mile Prairie and, presumably, at similar prairie sites in eastern Nebraska. Successful dispersal of regal fritillary throughout the prairie, following prairie regrowth and recovery from burn treatment, is probably a key factor contributing to the long-term persistence of this species at Nine-mile Prairie under the current fire management regime.

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