

Monarch and Regal Fritillary Behaviors in Grasslands with Restored Fire Regimes

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*We are evaluating the behavior of two butterfly species within a patch-burn grazing framework. Our focal species are monarchs (*Danaus plexippus*) and regal fritillaries (*Speyeria idalia*). The main goals of this study are to describe species' behavior generally and to determine species' use of the landscape. Here we present year one of a two-year study.*

Introduction

Conservation management research typically focuses on species richness and abundance. However, behavior also can be an important component in assessing the efficacy of management for conservation purposes. The way an animal uses the landscape contributes to determining if that landscape is a valuable area for conservation.

Butterflies are a good organism to examine for this purpose. Butterflies often are considered indicators because of their short generation times and wide life history requirements (Samways 2007). Additionally, researchers rarely study butterfly behavior in the field, but this could provide important insight into their use of the landscape (Carleton and Schultz 2013).

We have chosen to monitor the behavior of two species of butterfly: the monarch (*Danaus plexippus*) and the regal fritillary (*Speyeria idalia*). These are species of conservation concern but may differ in their behavior due to differing life histories and habitat requirements. Monarchs are generalist butterflies and may occur in many habitats, while regal fritillaries are grassland specialists, which require grasslands for their entire life cycle.

The main objectives of this study are to quantify butterfly behavior in the field and determine if these behaviors can predict an individual's status as resident or transient.

Procedures

Our research takes place in the Missouri Coteau ecoregion. The region is primarily mixed-grass prairie with a semiarid climate. Specifically, we are using the Central Grasslands Research Extension Center in central North Dakota, which North Dakota State University manages.

The study area is subject to a set of experimental treatments. In one treatment, season-long grazing, the pastures are stocked with cow-calf pairs for the duration of the growing season. In the second treatment, the pastures are similarly stocked, but also have a 40-acre patch burned each spring. The third treatment also has moderately-stocked cow-calf pairs, and has a 20-acre burn each spring, followed by a 20-acre burn each summer.

We conducted time-budget surveys to collect data on butterfly behavior. Whenever an individual of the target species was located, the observer followed it and recorded each behavior as it occurred for up to 15 minutes. Observations were between 10 and 15 minutes in length.

Behaviors include resting, basking, ovipositing, nectaring, mating, patrolling, foraging, chasing, and fleeing (Table 1). We also recorded the plant during events of resting, basking, ovipositing or nectaring, and we recorded the other organism in events of mating, chasing, and fleeing.

Statistics

We calculated total proportions of time spent in each behavior by averaging the time in each behavior across individuals. We categorized groups by species and sex.

We also categorized individuals into groups by philopatry status. Any individual that was mating or ovipositing is considered a resident. Males that chased conspecifics for any length of time are also residents.

Individuals whose full observations consisted of 95 percent or more of flying are considered transient. To determine time spent flying, we added patrolling and foraging together. Any individuals that did not meet any of the above criteria are of unknown philopatry status.

We were limited in our ability to conduct thorough statistical tests due to the small sample size from one year of data. Results are largely presented as anecdotal at this time.

Results

In 2018, we observed 35 monarchs (15 females and 20 males) and 21 regal fritillaries (10 females and 11 males).

Proportion of Time in Behaviors

We were unable to perform statistical tests reliably to indicate any differences due to the small sample size obtained from only one year of data collection. However, proportions of time spent in each of our nine behaviors by males and females of both species are presented in Figure 1.

Philopatry Status

We were able to determine philopatry status for 17 of the total 56 observations. Of these, 15 were residents and 2 were transients. Eight of the residents were monarchs (five males and three females). The remaining seven residents were regal fritillaries (four males and three females). One of the two transients was a male monarch and the other was a female regal fritillary.

Behavior	Description	Citation
Resting	Sitting on vegetation or substrate; wings closed	Clench 1966
Basking	Sitting on vegetation or substrate; wings open	Clench 1966
Foraging flight/ <u>nectaring</u>	Flight above vegetation canopy, occasionally stopping to sit on open flower with proboscis extended	Curtis et al. 2015
Mating	Two butterflies, typically in flight, connected at the abdomen	<u>Rutowski</u> 1982
Ovipositing: monarchs	Female on <u>Asclepias</u> spp., occasionally pausing to flex her abdomen and deposit an egg	Ladner and <u>Altizer</u> 2005
Ovipositing: regal fritillaries	Female in low flight, occasionally dipping below the vegetation canopy, walking through senesced vegetation occasionally flexing her abdomen to deposit an egg	<u>Kopper</u> et al. 2000
Chasing	<u>Flighted</u> pursuit of any organism; will be separated into conspecific, misc. Lepidoptera, other insect, or vertebrate	Kemp 2000
Fleeing	Flight closely followed by any organism; will be separated into conspecific, misc. Lepidoptera, other insect, or vertebrate	Kemp 2000
Patrolling	Flight that appears to follow a pattern and cover a specific area; likely to be broken up by bouts of chasing	<u>Peixoto</u> and Benson 2009
Courtship	Unlikely to be observed, but may consist of male pursuit of female	<u>Pliske</u> 1975
Table 1 shows the behaviors we expect to observe, as well as an explanation of how each behavior <u>will be quantified</u> and at least one source.		

Discussion

With a total of only 56 complete detections, which must be split into four groups for species and sex, making any strong conclusions is difficult. We anticipate that a second year of data collection will help alleviate this issue.

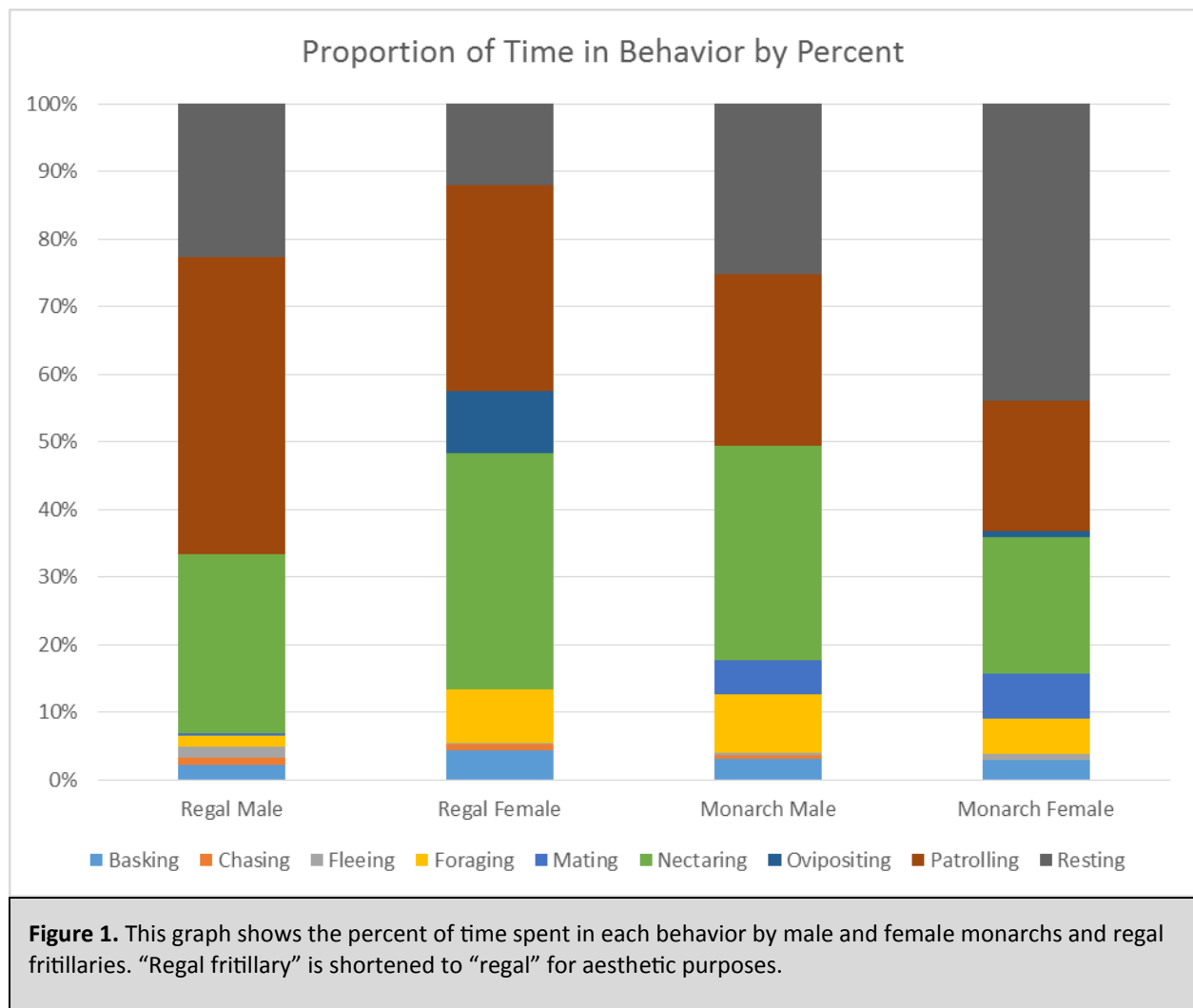
Despite the lack of statistical power currently possible in this study, we still can make observations on the data available. For instance, what is apparent is that female regal fritillaries spend a greater amount of time ovipositing than do female monarchs. This is likely because of their life history traits; monarchs oviposit quickly, almost while in flight, and regal fritillaries land and walk around in senesced vegetation to oviposit (Casagrande and Dacey 2007; Kopper et al. 2000).

We also can see that all four groups spend a lot of time nectaring, but male regal fritillaries spend less time foraging than the other groups. This may be because male regal fritillaries are very territorial (Kopper et al. 2001). Rather than nectaring consistently and briefly taking foraging flights between flowers, as the other groups do, male regal fritillaries appear to stop along their

patrolling flights and nectar for shorter periods of time. This also is reflected in their proportion of time spent patrolling, which appears to be slightly higher than the other three groups.

Determining philopatry status also is largely anecdotal at this point in the study. We are unable to perform tests to see if either species or either sex is more likely to be counted as a resident or transient, and we are unable to compare behaviors in residents and transients. After the second year of data collection, we hope to analyze the influence of vegetation variables on individuals' philopatry status; i.e., are regal fritillaries more likely to be residents in areas with high floral diversity?

Having only one year of data collection, we are unable to present conclusive results. However, we expect that the present trends will continue, and we should be able to present statistical evidence to support these trends after the coming field season. After the completion of the study, we will provide further evidence that behavior should be considered an important part of conservation monitoring.



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