

## First Observations of Mormon Metalmark (*Apodemia mormo*) Oviposition Behaviour in Canada

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We present new information on oviposition behaviour in the Mormon Metalmark, *Apodemia mormo* Felder and Felder, 1859, documented in Grasslands National Park of Canada, Saskatchewan, in August 2011. The Mormon Metalmark is found throughout the U.S. southwest; little is known about its life history in the northern populations found in Canada. We provide photographic documentation of the butterfly laying single eggs directly on soil or rocks. These observations differ from those recorded in the southern part of its range, where it lays eggs in groups of 2–4 on various locations of the host plant, Branched Umbrella-Plant, *Eriogonum pauciflorum* Pursh. This is the first published account of oviposition behaviour of this species in Canada in the most northern part of its range.

**Key Words:** Mormon Metalmark, *Apodemia mormo*, Grasslands National Park of Canada, Saskatchewan, Lepidoptera, oviposition, eggs.

The Mormon Metalmark, *Apodemia mormo* Felder and Felder, 1859, is a butterfly of the primarily neotropical family Riodinidae. Its range extends from northwestern Mexico through much of the western United States, but its distribution becomes patchy in the northwestern U.S. and southern Canada (Scott 1986; Layberry et al. 1998). The Canadian prairie populations of the Mormon Metalmark comprise the most northerly documented extent of the species' range.

The species was first observed in Canada in August 1974, when lepidopterist Ronald Hooper documented the Mormon Metalmark in what is now the east block of Grasslands National Park of Canada (GNP) in southern Saskatchewan (Hooper 2002\*). Surveys were sporadic, but in 1983 search efforts yielded two new colonies, in the west block of Grasslands National Park. In 2002, six additional colonies were discovered (Hooper 2002\*). The species was assessed as threatened in Saskatchewan (Hooper 2002\*), and the Prairie population of the Mormon Metalmark was assessed as threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (COSEWIC 2003\*). With these assessments, increased search efforts have led to the documentation of 40 colonies in GNP, as well as the federal Val Marie Community Pasture managed by Agriculture and Agri-Food Canada, which is located northwest of the park.

There is a second population in Canada located in the Similkameen River valley in southern British Columbia (the Southern Mountain population); this population was assessed as endangered by COSEWIC (COSEWIC 2003\*). Both populations are on the List of Wildlife Species at Risk of the federal Species at Risk Act, the Prairie population as threatened and the Southern Mountain population as endangered.

Recent work on the population genetics of the Mormon Metalmark in the northern part of its range has reinforced the listings of endangered and threatened under the Species at Risk Act and has uncovered new information that the British Columbia and Saskatchewan populations are only distantly related (Proshek et al. 2012). This suggests that further research should investigate whether these populations may warrant a separate taxonomic status (Proshek et al. 2012). Little is known about the biology and population dynamics of the northern prairie populations, and much of the information currently available refers to observations in the U.S. southwest.

Mormon Metalmark larvae in Saskatchewan are known to feed on the Branched Umbrella-Plant (also known as Few-flowered Buckwheat) (*Eriogonum pauciflorum* Pursh), which grows almost exclusively on eroded or heavy clay soils, found on hillsides, slopes, and embankments (COSEWIC 2003\*). The Branched Umbrella-Plant is common under these conditions in badlands habitat, of which there are roughly 290 km<sup>2</sup> within the current and proposed boundaries of Grasslands National Park (Pruss et al. 2008\*). Rubber Rabbitbrush, *Ericameria nauseosa* (Pall. ex Pursh) G. L. Nesom & Baird, is also used by Mormon Metalmark adults, which feed on the nectar and perch on the plants. In 2010, the first observations of Mormon Metalmark caterpillars in Grasslands National Park provided valuable information about the early life history of this butterfly in Canada (Peterson et al. 2010). However, there was no documented evidence of oviposition behavior of the Mormon Metalmark in Canada. Given the importance of Grasslands National Park in this species' Canadian range and the lack of biological information specific to northern populations, further



FIGURE 1. Female Mormon Metalmark, *Apodemia mormo*, ovipositing in cracks in the soil in Timmons coulee, Grasslands National Park of Canada (west block), near Val Marie on August 21, 2011. Photo: Johane Janelle.

understanding of the life history and behaviour of this species is vital for effective conservation planning.

### Observations

On several occasions in August 2011, we observed Mormon Metalmark females ovipositing in Timmons coulee in the west block of Grasslands National Park, near the town of Val Marie. On August 21, between noon and 5:00 P.M., we followed several females that would find an area of exposed soil or rock within the host plant's habitat. One in particular began curling her abdomen underneath her and walking forward until she located a suitable spot under a rock (Figure 1). All the individuals we observed laid a single amber-coloured egg approximately the size of a pinhead, either in cracks in the soil or under small rocks. In the instances where the eggs were laid in soil cracks, more than one egg may have been laid, but we did not observe this. While these locations were all near (<2 m) Branched Umbrella-Plants, we did not observe any eggs being laid on the lower leaves of the host plant in groups of 2–4, as previously described (Arnold and Powell 1983; Scott 1986; Pyle 2002). The entire oviposition process took anywhere from 5 to 30 seconds.

### Discussion

Evidence that this oviposition behaviour differs from that which has been documented in the southern portion of the species' range suggests that different eco-

logical adaptations may be at work at the northern periphery of its range. These adaptations may be the result of alternate reproductive strategies. The physiology of ectotherms such as butterflies and other arthropods is largely dependent on optimal temperature ranges, and natural and experimental manipulations reveal that these organisms are capable of phenotypic plasticity in response to temperature differences (Fischer et al. 2003a, 2003b, 2004; Steigenga and Fischer 2007; Berger et al. 2008). Specifically, in certain species of butterfly, females raised in cooler temperatures tend to produce a smaller number of larger eggs than conspecifics raised under warmer conditions (Fischer et al. 2003b; Geister et al. 2009).

Atypical Mormon Metalmark egg deposition numbers and sites may also reflect the colder temperatures found in northern parts of its range. In studying other butterfly species, Berger et al. (2008) suggest that both egg placement and maturation are limited by temperature; egg development times are also influenced by direct solar radiation (Bryant et al. 2002). Eggs laid in open habitat developed more quickly (Bryant et al. 2002), and those eggs with an orientation to morning sun had higher survivorship in the coldest years (Bonebrake et al. 2010). In cooler climates, where development time is limited, the position of an egg can have a profound influence on survival and maturation (Bonebrake et al. 2010).

Experiments with other butterfly species also indicate significant temperature effects on egg and larval development as well as on mortality rates (Fischer et al. 2004; Koda and Nakamura 2010). Thus, Mormon Metalmark eggs laid in the ground and covered with snow may be subject to more moderate temperature ranges as well as lower rates of desiccation than eggs laid above ground on the host plant. However, at this point, it is unclear whether eggs or early instar caterpillars overwinter in the Saskatchewan population.

Other studies have shown that eggs placed away from the host plant on alternate substrates may also benefit from decreased predation. For example, in a study of the neotropical butterfly *Oleria onega*, significant increases in survival were found when the eggs were transferred to alternate substrates (De-Silva et al. 2011). However, De-Silva et al. (2011) state that this anti-predation strategy must outweigh the cost to the larvae of finding the host plant. Additionally, the Mormon Metalmark may not suffer from extremely high predation from ants, as it does in the southern parts of its range, such as California, where the endangered subspecies Lange's Metalmark (*Apodemia mormo langei*) resides (Johnson et al. 2011\*).

The differences in oviposition behaviour reported here add important biological information for this species of conservation concern and may affect the residence description under the Species at Risk Act and the way in which critical habitat is designated and protected under that legislation. This reproductive strategy diverges from what we currently know about the species in other parts of its range. Further investigation will elucidate the mechanisms driving this behavioral difference across the species' range.

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