A Note on Overwintering of Polites Mardon (Hesperiinae) in the Wild

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Polites mardon W.H. Edwards (Washington State endangered) is a grass skipper endemic to the Pacific Northwest of the United States. Currently *P. mardon* occurs in four disjunct populations from northern California to the Puget lowland of Washington (Fig. 1, Mattoon et al. 1998). The butterfly's historic distribution in each geographic region is unknown but has likely contracted over the last 100 years along with the loss of grassland and montane meadow habitats due to development, forest succession, fire suppression, and spread of invasive species (Potter et al. 1999). Because little habitat remains throughout the butterfly's range, active habitat restoration and management such as prescribed burning, invasive species control, and conifer removal is ongoing (Beyer & Schultz 2010, Henry & Schultz 2013). Until recently, much of this management occurred with very little knowledge of the habitat requirements and life history of the butterfly.

Early knowledge of the life history of *P. mardon* is based on captive rearing work by Newcomer (1966). He found the larval period of captive individuals to last approximately three months and diapause to occur in the pupal stage. More recently, James and Nunnallee (2011) also found captive individuals to overwinter as pupae. Our field observations of wild populations contradict these observations of captive individuals and provide insights into the biology of the butterfly that can inform conservation and habitat restoration planning. In this note we document *P. mardon* overwintering as larvae in the wild and describe larval shelters observed in the field. The data presented herein were collected as part of larger studies of the oviposition habitat requirements of *P. mardon* in Washington State (Beyer & Schultz 2010, Henry & Schultz 2013).

To determine the overwintering stage of *P. mardon* in the wild, we followed larval development in two disjunct areas of the butterfly's range in Washington State. In 2006/2007, we worked in the Bunny Hill Meadow, a 164 m^2 alpine meadow (1097m elevation) on the Gifford Pinchot National Forest, Cascade Mountains, hereafter referred to as the Cascades (Beyer & Black 2006). In 2009/2010 our focus was Scatter Creek Wildlife Area (60m elevation), a remnant glacial outwash prairie in the south Puget Lowland containing 250 hectares of prairie, hereafter referred to as Puget prairie (Henry & Schultz 2013).

In the wild, female *P. mardon* lay eggs singly in the grass without affixing them to the hostplant (unlike in captivity where James and Nunallee (2011) observed females lightly gluing eggs to hosts). Therefore, to establish egg locations, we performed extensive oviposition surveys in the Cascade Mountains and the Puget prairie during the 2006 and 2009 flight seasons, respectively (see Beyer & Schultz 2010 and Henry & Schultz 2013 for detailed methods). We marked all observed oviposition locations with a wooden skewer as close to the egg as possible and re-visited egg locations every few weeks to determine developmental stages of butterfly larvae.

FIG. 1. *P. mardon* range. Stars indicate locations of known extant *P. mardon* populations, each of which consists of multiple occupied sites. **1**) Puget Lowland, **2**) Southern Washington Cascade mountains, **3**) Southern Oregon Cascade mountains, **4**) Del Norte, California.

In 2006 we documented *P. mardon* larvae in the wild for the first time during surveys in the Cascades. During the summer and fall of 2006 we searched 32 oviposition locations on 6 days (July 31, August 14, August 26, September 9, September 30, and October 21), locating a total of seven individual larvae. We located the first larva on July 31st in its second instar (instar stages determined from descriptions in James & Nunnallee 2011; Fig 2). Three individuals were located more than once over consecutive survey efforts, four individuals were located only once. On October 21, two days prior to the first snow of the season, we located two fourth instar larvae; one of which we found on our previous visit, the other we discovered for the first time on this visit.

Larvae observed in summer and early fall were actively feeding from vertical larval shelters with their heads upward. These larvae responded to disturbance by becoming still or crawling away from their shelters. By the last week of October, larvae were sedentary, curled up in sealed larval shelters, and frass was absent or old suggesting that larvae were no longer feeding. During these final observations, larvae became active only after they were physically removed from their larval shelters, indicating they were partially dormant. It is possible that disturbing larvae and shelters during our previous observations may have slowed their development. However, given that both larvae observed on October 21 were fourth instars and neither larva showed any signs of pupation, including the individual that had not been previously disturbed, we do not think our work had negative impacts on development rates. These observations strongly suggest that the *P. mardon* populations in the Cascades overwinter as larvae. When we returned to egg locations post-snowmelt the following spring we were unable to find evidence of either larvae or pupae.

We followed *P. mardon* development again over the winter of 2009/2010, but this time worked in the Puget prairies where the sites remain snow-free all winter. On September 11, 2009, we searched 88 known oviposition locations and located six third instar larvae (8–10 mm, all instar classifications based on data from James & Nunnallee 2011; Fig 3). We returned to all six larval locations on October 5 and December 23 2009, and February 21, March 24, April 8, and April 19 2010 to document development through the year. On October 5 and December 23 we detected all six larvae in their shelters but did not disturb them. On February 21 we found four of the six initial larvae, thus establishing that wild *P. mardon* populations overwinter as larvae in the Puget prairies. These larvae were fourth instar larvae (12–13mm; Fig 4). On March 24 we were still able to locate one full-grown fifth instar larva (24mm; Fig 5). We located, but did not disturb this larva again on April 8. On our next visit, April 19, the larva could not be found. Although this was the only larva we were able to find in late March and early April, this observation suggests that *P. mardon* do not pupate until late spring, 4-6 weeks before the adult flight season (mid-May–mid-June).

In both the Cascades and the Puget prairies, when we initially found larvae, they were actively feeding and occupied tubular larval shelters made of grass blades and/or litter fragments stitched together with silk. Larval shelters were nearly vertical, surrounded by frass, and located at the base of the grass just above the soil (Fig. 2 & 3). All larvae were found in the initial egg location, adjacent to the wooden skewer marker. In the fall of 2006, larvae were disturbed every 2–3 weeks. When removed from their shelters they would rebuild shelters by the next visit, moving no more than three inches from the initial egg location. This behavior suggests *P. mardon* are highly sedentary in their larval state, likely only moving in response to disturbance or potentially when they have outgrown shelters or exhausted local food resources as observed in other Hesperiinae species (MacNeill 1964, Dana 1991). During all winter visits (late October–late February; including October visit in Cascades) the larval shelters consisted of silk lined chambers of dry grass blades, moss, litter, and dried up frass perfectly camouflaging with the detritus within the grass tufts (Fig 4). These chambers were horizontal in the vegetation, and located at the base of the grass, near the soil surface. Inside these shelters, larvae rested curled in a U-shape with their back toward the shelter opening, if present. The shelter of the fifth instar larva we found on March 24, 2010 was a horizontal tunnel made of dried grass blades (Fig 5).

While little is known about the larval habits of most Hesperiinae species, our findings of *P. mardon* overwintering as larvae are consistent with previous ideas about the general habits of the Hesperiinae subfamily (Scott 1986, 1992). Other Hesperiinae species known to overwinter as larvae in the wild include *Atalopedes campestris* (Crozier 2003, 2004), *Hesperia dacotae* (Dana 1991), *H. ottoe* (Dana 1991), and a number of other western *Hesperia* species (MacNeill 1964). Additionally, our observations of the larval shelters of *P. mardon* are comparable to detailed observations of the larval shelters of Hesperiinae skippers made by Dana (1991), MacNeill (1964), and James and Nunnallee (2011).

Understanding the basic biology of rare species is fundamental to their successful conservation. For

FIGS. 2–5. Examples of *P. mardon* larvae and their corresponding grass shelters. **2)** 2nd instar larva at Bunny Hill meadow on 26 August 2006, **3)** 3rd instar larva at Scatter Creek on 11 September 2009, **4)** 4th instar larva at Scatter Creek on 21 February 2010, **5)** 5th instar larva at Scatter Creek on 24 March 2010. Larvae and shelter locations are circled.

species whose persistence depends on habitat management and/or restoration, such as *P. mardon*, this is especially important. Individual insect species may respond differently to management treatments based on their life histories (Stark et al. 2004). Knowledge of the timing of a rare butterfly's life cycle allows land managers to time events such as prescribed burning, mowing or herbicide application when they are likely to have minimal impacts on butterfly species of concern (Dana 1991, Konvicka et al. 2008, Johst et al. 2006). Captive rearing and reintroduction are suggested conservation strategies for many rare butterflies (Schultz et al. 2008) and have been suggested for *P. mardon* (A. Potter, pers. com.). In the context of reintroduction, knowledge of the timing of the species' life cycle is of utmost importance to ensure that the life stage and timing of release are matched appropriately.

By determining that *P. mardon* overwinters as a mid-late instar larva, we have added to the body of knowledge of an understudied butterfly family as well as provided new life history information important for conservation of this rare and threatened butterfly.

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