

# Experimental control of spotted knapweed (*Centaurea stoebe*) within critical habitat of the endangered half-moon hairstreak (*Satyrus semiluna*) butterfly

## A pilot study of Blakiston fan, Waterton Lakes National Park, Alberta

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### Abstract

Spotted knapweed (*Centaurea stoebe*) is a non-native invasive plant found throughout North America that suppresses native vegetation and reduces biodiversity. The designation of Blakiston fan (Waterton Lakes National Park, Alberta) as critical habitat for the endangered half-moon hairstreak (*Satyrus semiluna*) butterfly has brought forward concerns of the effect of knapweed management practices on native larval and nectar host plants. This pilot study used a randomized complete block design to examine the within season change of spotted knapweed and silky lupine (*Lupinus sericeus*) in response to herbicide application and two timings of manual removal. No significant differences were detected amongst the response of both species to treatments. This study also examined changes in the vegetation community across the fan and the relative abundance of the hairstreak. Survey results in combination with a comprehensive literature review were used to provide recommendations for the management of Blakiston fan.

### Hypotheses of Decline

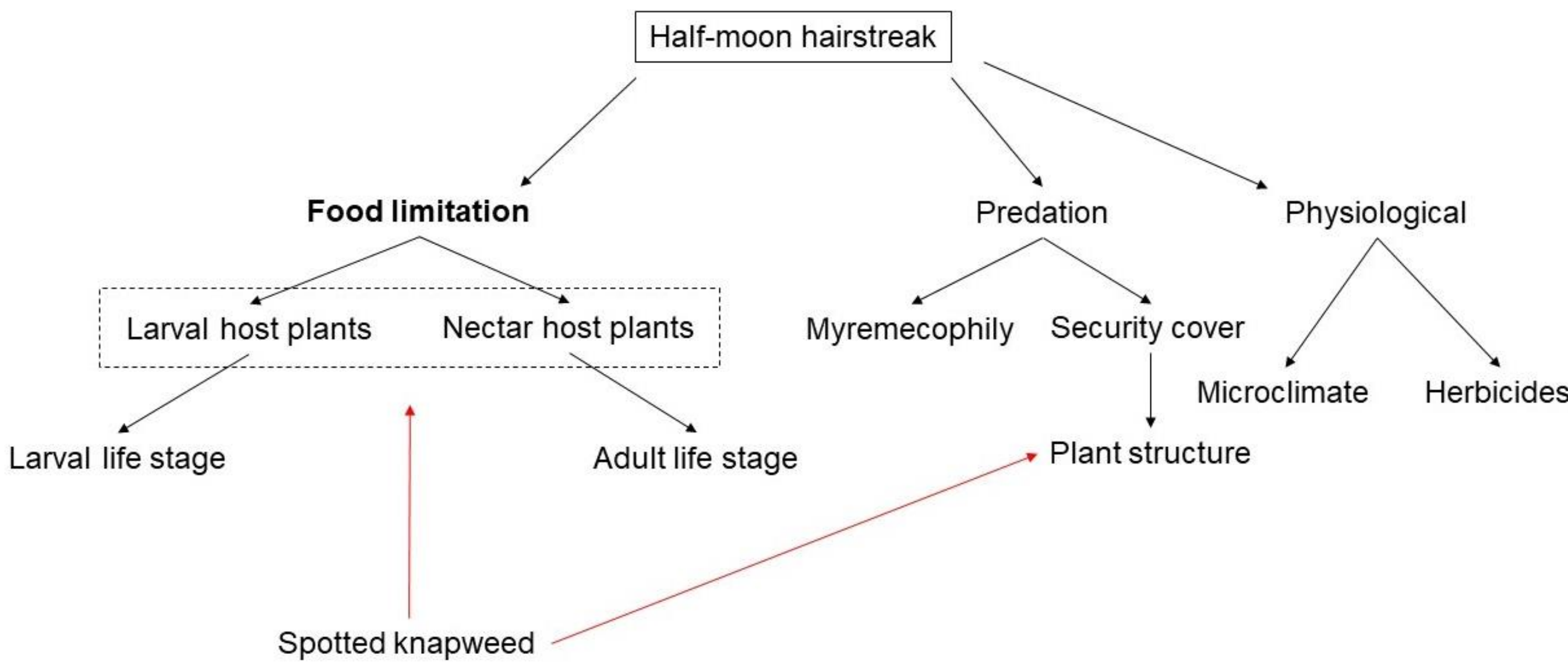


Figure 1. Food limitation, predation, and physiological response are the three hypothesized mechanisms responsible for the decline of the half-moon hairstreak. Synthesis of literature indicates that food limitation is the most likely cause of the decline.

### Objectives

- Assess the hypotheses of half-moon hairstreak decline through a comprehensive literature review.
- Assess the effect of knapweed management prescriptions on within season growth of spotted knapweed and native host plants in critical habitat.
- Assess the changes in the vegetation community and the relative abundance of the half-moon hairstreak on Blakiston fan.
- Develop recommendations for post-fire integrated pest management.

### Methods

- Randomized complete block design implemented with five blocks across the fan, each containing one replicate of four treatments: herbicide, two timings of manual removal, and a control. Blocking based on groundcover, substrate type, and predominant native vegetation. Two-way ANOVA used to assess significant differences.
- Systematic vegetation survey to assess percent cover of invasive and native host plants within 25-m radius polygons. Survey points and cover class system repeated based on Tannas surveys (2008 and 2013).
- Standard Pollard walks used to assess the relative abundance of hairstreaks on Blakiston fan. Meandering surveys used to supplement Pollard walks due to low detection.

Figure 2. Change in average percent cover of spotted knapweed from 2013 to 2017

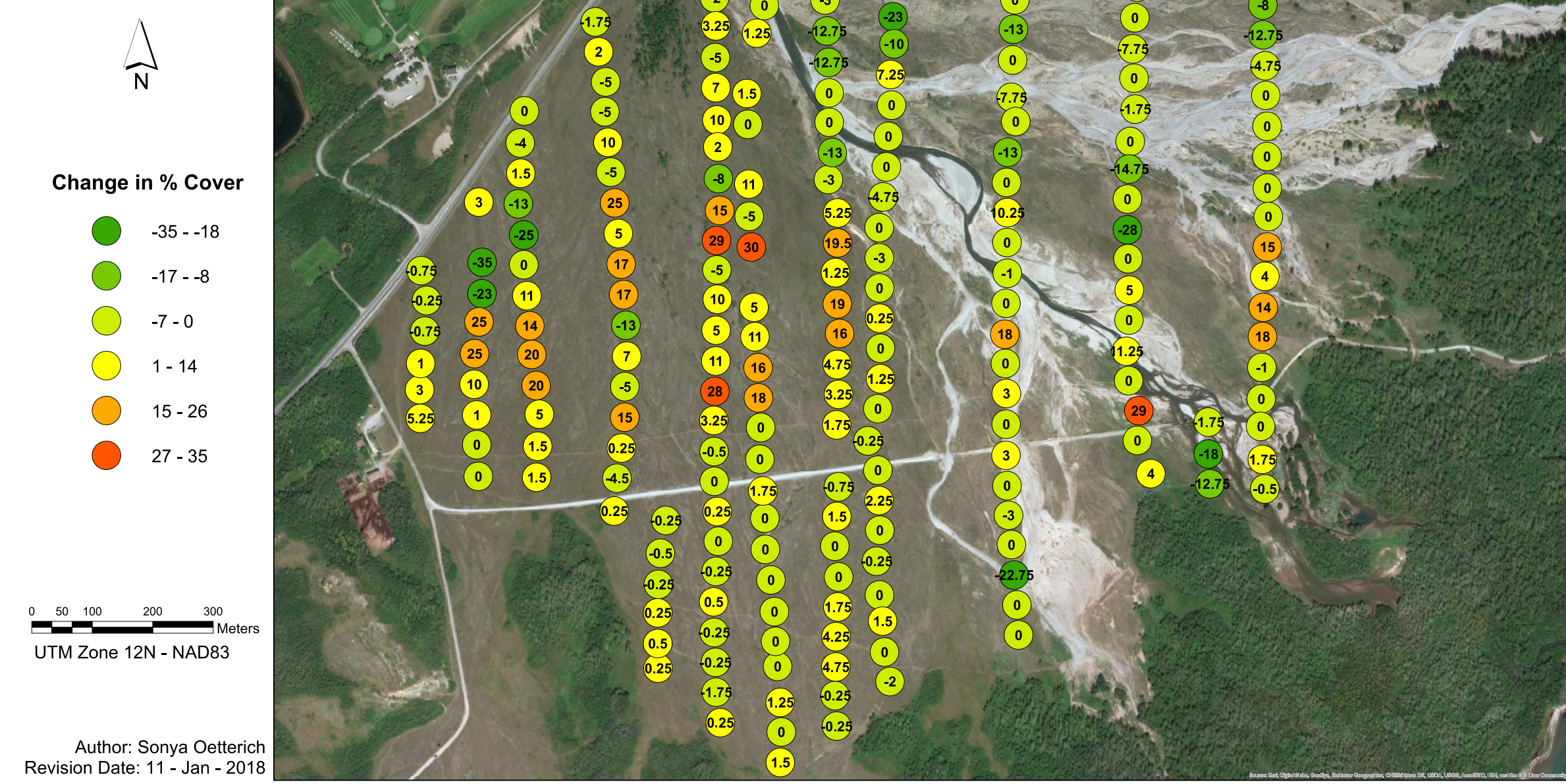


Figure 3. 2017 Knapweed percent cover

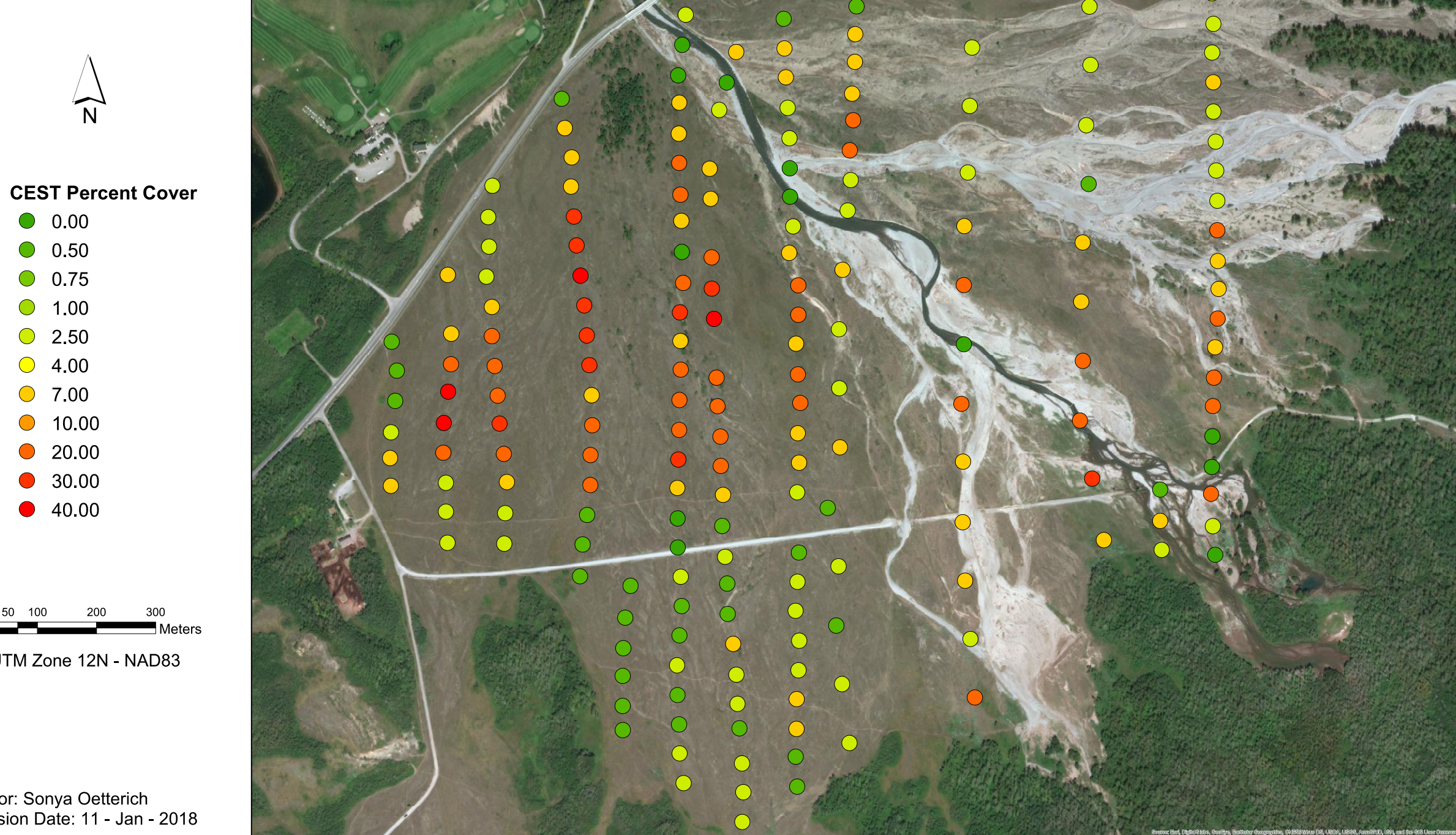
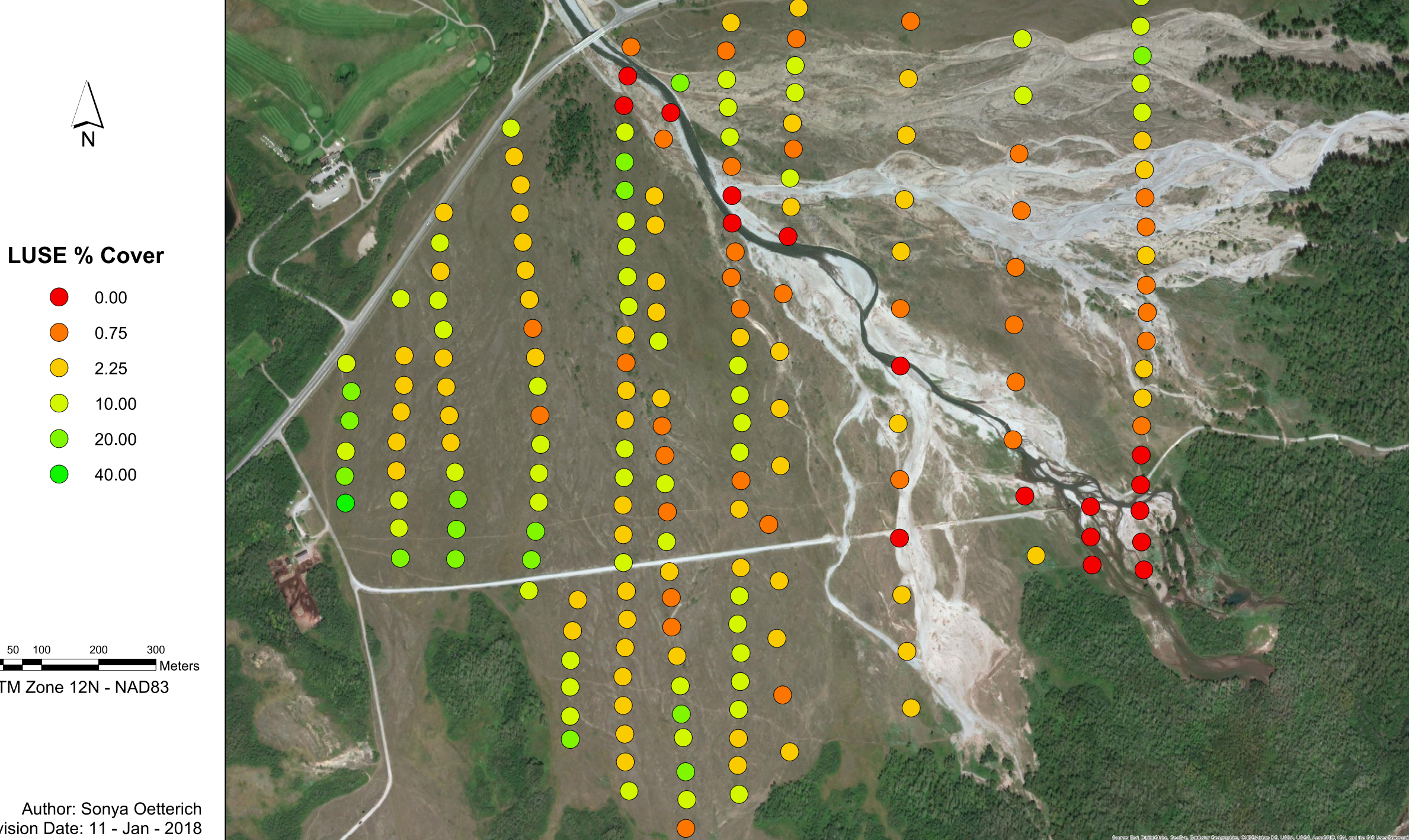


Figure 4. 2017 Silky lupine percent cover



### Results

- Percent cover of spotted knapweed was not significantly different from pre-treatment cover across all treatments; the same was detected for silky lupine (Fig. 5).
- The greatest increases in knapweed cover were observed in the central fan (Fig. 2). Knapweed cover was relatively low on the south fan where lupine cover was relatively high (Fig 3. and 4). Lupine cover was lowest in the north fan with variable knapweed cover.
- Pollard walks (5) and meandering surveys (18) detected a total of 23 adult half-moon hairstreak butterflies on Blakiston fan (Fig. 6).

Figure 5. Actual difference in percent cover of spotted knapweed (CEST) and silky lupine (LUSE) across treatments.

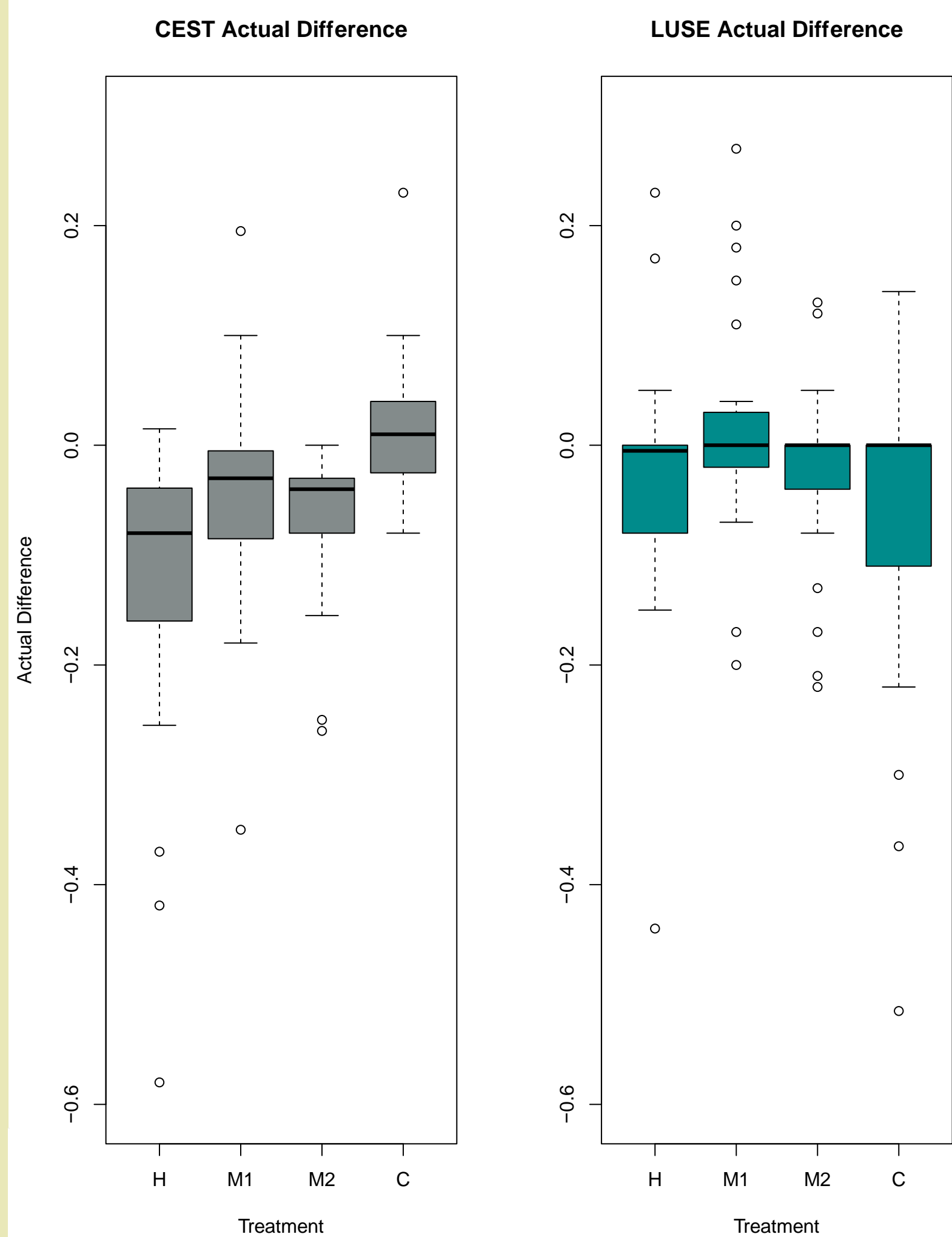


Figure 6. The half-moon hairstreak (*Satyrus semiluna*) perched on its nectar host plant, yellow buckwheat (*Eriogonum flavum*).

### Recommendations

- Post-fire monitoring of vegetation regeneration across Blakiston fan.
- Continue biological control releases for long-term management of spotted knapweed.
- Selective herbicide application in areas of low native vegetation cover.
- Prioritize the south fan for knapweed control due to a high proportion of suitable habitat and a low proportion of burned area.
- Experimental planting of native larval and nectar host plants.
- Long-term tracking of the phenology of native larval and nectar host plants and the emergence of half-moon hairstreak adults.