Northwest Fire Science Consortium
A JFSP FIRE SCIENCE EXCHANGE NETWORK

BURNING FOR BUTTERFLIES

IDENTIFYING WEATHER AND FUEL CONDITIONS THAT PROTECT AND PROMOTE BUTTERFLY HABITAT

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Prescribed burning is a common habitat management tool for fire-adapted grasslands world-wide. However, application of this tool at times of the year that are most effective for fuel reduction and non-native species removal may be detrimental to fire-sensitive organisms like butterflies and other invertebrates. Targeting burn conditions that will meet both ecological objectives for the site and mitigate risk to invertebrates may be necessary, especially when state- or federally-listed species are present.

In the prairies of the South Puget Sound, Washington, the Taylor's checkerspot butterfly (*Euphydras editha taylori*) spends the majority of its life cycle, including the typical prescribed fire season (July to September), just a few centimeters below the soil surface in diapause. Soil has an incredible temperature buffering capacity but it is unknown if it's enough to protect this species through the full range of fire conditions that typically occur throughout fire season. Previous research on thermal tolerance of terrestrial insects has shown that the upper temperature threshold for survival is 43°C and that both temperature and duration of heat (combined into a 'heat dosage' metric) should be considered when evaluating heat effects on insects. Determining weather and fuel conditions that create patchy burns and limit lethal heat dosage belowground may provide managers with guidance on when to burn in areas occupied by rare butterflies.

In this study, researchers measured vegetation structure and fuel moisture (pre-burn), weather conditions, belowground heat dosages, and peak temperatures (during the burn), and burn severities and unburned refugia (post-burn) for paired morning and afternoon prescribed burns at each of ten prairie sites throughout the south Puget Sound in 2014.

KEY FINDINGS

- Peak sub-surface soil temperatures were related to both air temperatures and dead fuel moisture.
- Variation in time of burn within a day (morning vs. afternoon) can produce as much variation as burning in different seasons.
- Dead fuel moisture was the best predictor of whether a lethal heat dosage occurred, and ambient air temperature best predicted the magnitude of lethal heat.
- High fuel moistures alone did not reduce burn continuity enough to reach the target amount of low-severity or unburned refugia for butterflies. A combination of high fuel moisture with small amount of pre-burn bare ground increased burn patchiness.

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RESULTS

All twenty prescribed burns were conducted between July 22, 2014 and September 22, 2014, when air temperatures ranged from 14°C to 32°C, relative humidity ranged from 32% to 88%, and dead fuel moisture ranged from 2.3% to 30.0%. Burning when dead fuel moisture was below 7% increased the likelihood of lethal conditions for the butterfly and burning when air temperature was over 26°C increased the magnitude of the lethal heat dose. Plots burned in the afternoon experienced the majority of these lethal heat dosage conditions. When fuel moistures were below 10%, field-measured fuel moistures were consistently about 1-5% lower than predicted fuel moistures using the NWCG published tables that use weather, time of day and time of year to predict moisture levels. Surprisingly, neither thatch depth nor fuel loading were significantly related to soil temperature, a departure from findings in other ecosystems. In these PNW prairies, the abundance of potential refugia (unburned areas or areas burned at low severity) for the Taylor's checkerspot butterfly was positively related to pre-burn percent cover of open ground and dead fuel moisture.

MANAGEMENT IMPLICATIONS

Target conditions for burning in sensitive butterfly habitat in PNW prairies should include air temperatures of 26°C or less and fine dead fuel moistures of at least 9% (using published tables). These targets are within the typical range of conditions during an average burn season in western Washington, especially earlier in the mornings when cool and moist conditions prevail. However, additional unpublished data from more recent drought years (2015-2017) suggest that, while many of the patterns found here still apply in dry years, severe fire effects could occur even during morning burns, due to prolonged drying of fuels. So, managers should pay particular attention to dry fuel moistures in drier years to inform the go/no-go call in sensitive butterfly habitats.

MORE INFORMATION

This brief is based on the following article:

Hill, K.C., J.D. Bakker, and P.W. Dunwiddie. 2017. Prescribed fire in grassland butterfly habitat: targeting weather and fuel conditions to reduce soil temperatures and burn severity. *Fire Ecology* 13(3): 24-41.

Contact: *nw.fireconsortium@oregonstate.edu*

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