Fens, Fire, and Forest Management: Effects of the Dixie Fire on Sierra Nevada fens

Carina Bilodeau[1], Esther Adelstein[1], Megan Keever[1], Karley Rodriguez[1], Nicole Jurjavcic[1], Nate Butler[1]
[1]Stillwater Sciences, cbilodeau@stillwatersci.com

Stillwater Sciences

Aquilegia formosa
Red columbine

Background

High severity wildfires threaten fens by decreasing biodiversity, providing a pathway for introduction of invasive species, and increasing instability of the ecosystem. However, managed wildfire can increase downstream water availability, which may result in expansion of a fen over time. On the other hand, fire suppression may enable woody plant invasion and desiccation of meadow margins through evapotranspiration. Despite this, **few studies have measured available groundwater in fens following watershed-level fires**, and in situ data is lacking to concretely link evapotranspiration, groundwater availability, and fen condition.

In 2015, Stillwater conducted botanical surveys of fens in the Plumas National Forest in two locations: on the northern shore of Bucks Lake and at Grassy Lakes. In 2021, the Dixie Fire burned 963,309 acres across the Plumas and Lassen National Forests, including in and around the fens studied during 2015. On the southern edge of the fire perimeter, the road near the Bucks Lake fens became a control line for the fire as it burned from the dry conifer forest into these fens. **In 2022, Stillwater was able to return to the area using internal grant funding aimed at bolstering scientific studies to get a first look at the post-fire condition of the fens.** We conducted vegetation surveys and placed piezometers in three fens, yielding 4 study sites.

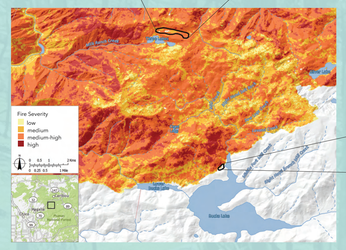
Our study will set a baseline for future post-fire recovery studies in the area, and results may help guide management of fire and woody plant invasion in fen ecosystems.

Waggletail Fen: highest severity upslope burn

Grassy Lakes North: medium-high severity upslope burn

Grassy Lakes South: medium severity upslope burn

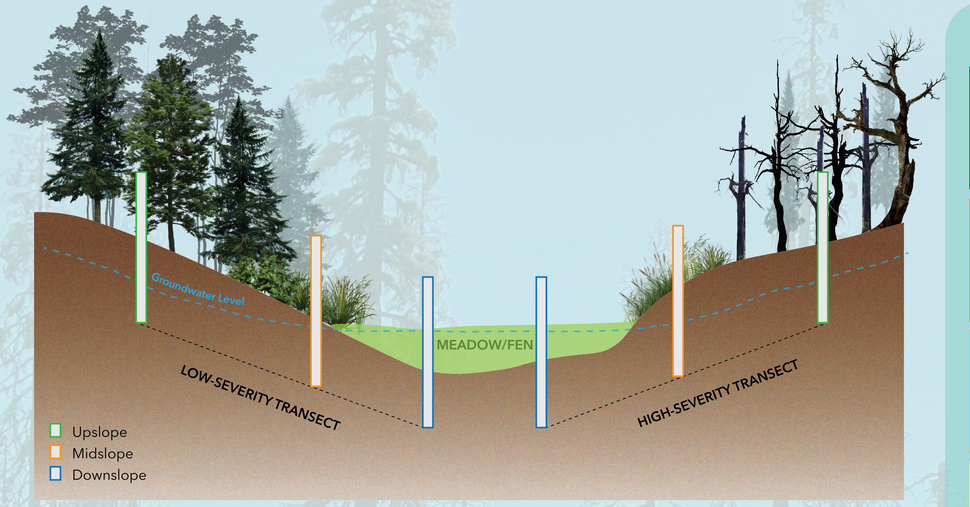
Huckleberry Fen: lowest severity upslope burn



GRASSY LAKES

WAGGLETAIL

Methods



2015 SURVEYS

- Comprehensive botanical surveys
- Vegetation mapping and classification
- Belt vegetation transects (Waggletail)
- Woody stem density and tree diameter measurements (Waggletail)

2022 SURVEYS

- Line-point intercept transects along piezometer gradient
- Conifer encroachment within 1meter of line-point intercept transect
- Belt vegetation transects at each piezometer and in upslope area
- Fen boundary demarcation

Hypotheses

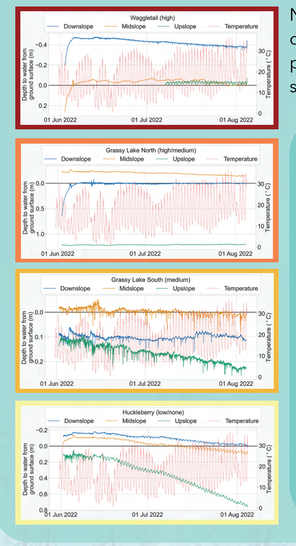
Groundwater in the fen and/or adjacent uplands is positively correlated with the severity of wildfire

Severe wildfire in mid-elevation (5,000–6,500 feet) fens reduces plant diversity and conifer encroachment, and increases abundance of nonnative plants

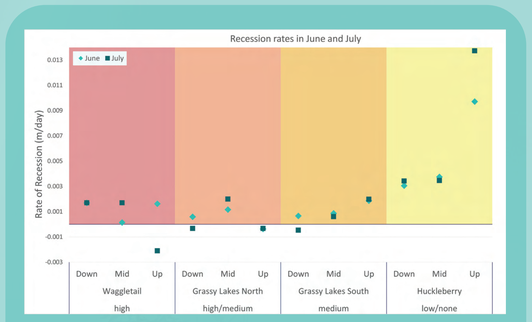
Wildfire improves fen condition and/or size, as evidenced by hydrologic (e.g., depth to water table, evidence of hydrologic alteration), vegetation (e.g., cover of peat-forming and wetland plant species), and soil characteristics (e.g., cover of bare ground, signs of erosion or deposition)

Preliminary Results

GROUNDWATER

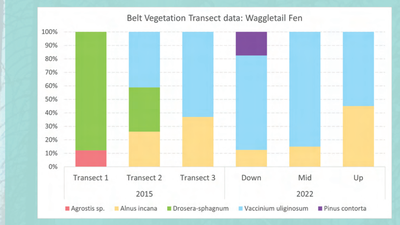


Negative depth to water at the downslope and midslope piezometers in the low + medium severity sites = more standing water



Higher recession rate (rate at which the groundwater is receding) at the low severity site = increased evapotranspiration

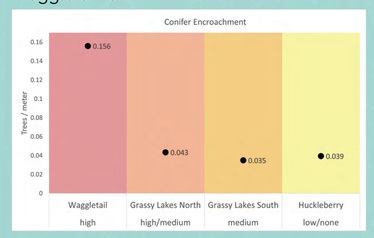
PLANTS



Invasive woolly mullein (*Verbascum thapsus*) was observed on newly deposited silt in Waggletail fen.

2015 versus 2022 = *Pinus contorta* is much more prevalent in 2022 data, though transects are not in exactly the same locations

Species richness is similar across all sites = future study needed to assess trends over time.



Conifer encroachment is highest in the high severity site = no reduction in encroachment due to fire, but could management play a role?

Next Steps for Analysis

- In-depth comparison of 2015 and 2022 data, where available.
- Link groundwater recession rates to evapotranspiration and vegetation transect data to understand linkage between vegetation, burn severity, and available groundwater.
- Future studies? What will species diversity, conifer encroachment, and groundwater availability look like 5 years post-fire? After 10? How can forest management post-Dixie Fire and pre-next season's fire contribute to the preservation of this ecosystem?

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