Predicting the Future of Wildfire in the Southern Appalachian Region

Throughout the Appalachian region, fire exclusion has altered the landscape. There could be shifts in the wildfire regime as climate change is predicted to increase the frequency and severity of droughts, and as the Wildland Urban Interface (WUI) expands in some areas. A new paper in the journal *Fire Ecology* authored by Zachary Robbins et al., **"Fire regimes of the Southern Appalachians may radically shift under climate change"**, models potential changes in wildfire and forest composition from now to 2100.

The authors tested 3 hypotheses for four different climate predictions:

1. Increasing drought over time will increase the total area burned, through greater fuel drying.
2. More variation in drought within decades will increase the total area burned, as more extended droughts (like 2016) may occur.
3. If the models predict increases in the area burned, fire-adapted oaks may benefit but the well-established mesic species (e.g., red maple, yellow-poplar) will persist.

Methods and Study Area:

- The study area was the Blue Ridge Ecoregion of Tennessee, Georgia, North Carolina, and South Carolina, consisting of oak forest.
- To test their hypotheses, the authors used the LANDIS-II model, which can forecast changes in forest composition, disturbances, and their interactions across the landscape, while also incorporating climate change.
- They used climate and area burned by wildfire from 1972 – 2018 (historic) data to predict future area burned by decade (2020-2100) under four different climate projections (minimal to maximum change).
- They also modeled forest composition change in response to predicted wildfire trends, and incorporated the effects (ignitions and suppression) of predicted WUI expansion on wildfire trends.

Key Findings:
Predicted area burned by wildfire from minimal to maximal change.

- **Low T/Low V**: minimal drought trend increase with low variation within decades.
  Approximately 5.5 °F average temperature increase by 2100.
  The total area burned by wildfire 2020-2100 was predicted to be **similar** to burning at the current (1972-2018) rate. The average fire return interval (FRI) for the landscape was **314 years**.
- **Low T/High V:** minimal drought trend increase with high variation within decades.
  Approximately 9°F average temperature increase by 2100.
  The total area burned was predicted to be **42% higher**. The average FRI was **200** years.

- **High T/ Low V**: maximal drought trend increase with low variation within decades.
  Approximately 11°F average temperature increase by 2100.
  The total area burned was predicted to be **104% higher**. The average FRI was **139** years

- **High T/ High V**: maximal drought trend increase with high variation within decades.
  Approximately 13°F average temperature increase by 2100.
  The total area burned was predicted to be **485% higher**. The average FRI was **48** years.

Vegetation

- Oak-dominance in the overstory will continue under all climate and wildfire scenarios as mature oaks are long-lived and fire-resistant.
- Under the **maximal wildfire prediction**, white and chestnut oak biomass are predicted to increase moderately, with black and scarlet oak exhibiting little change; red maple biomass is predicted to decline by 50% but other mesic hardwoods, including yellow-poplar, are predicted to change less. Yellow pines are predicted to decline.

Take-Home Points:

- All three hypotheses were supported by the model predictions: as droughts increase in intensity and become more variable (more extended droughts), the area burned by wildfire will increase due to greater fuel drying. Also, oak-dominance will continue but the increasing area burned by wildfire will not be enough to greatly reduce the mesophytic species that are now well-established in the landscape.
- While a previous study had predicted little change in wildfire for the Southern Appalachians due to climate change, the authors were unable to include the 2016 wildfire season in the analysis of drought effects on area burned. This new paper highlights the potential for more extended droughts like 2016 in the future which could lead to large increases in acres burned by wildfire in the decades to come.

Zachary Robbins is a scientist at the Los Alamos National Lab in New Mexico. His research focuses on forest modeling, landscape scale interactions, and insect disturbance. For additional information on the study, see this article from North Carolina State University's website.

Links to paper: Robbins, Z.J., Loudermilk, E.L., Mozelewski, T.G. et al. Fire regimes of the Southern Appalachians may radically shift under climate change. fire ecol 20, 2 (2024). https://doi.org/10.1186/s42408-023-00231-1
https://www.appalachianfire.org/_files/ugd/696505_c6f8e2ed234e4d0da249a3cb54524444.pdf

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