Short term effects of a prescribed burn on the fuel loads in pine barrens ecosystem at Brookhaven National Laboratory

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2017 summer prescribed burn

Prescribed burn in June of 2017

Abstract

Fire is an essential aspect of many ecosystems, particularly Atlantic coastal pine barrens, which require fire to maintain a healthy forest. Burning, whether by prescription or wildfire, has often been suppressed in recent decades despite fire's importance in reducing built-up fuel loads and supporting fire-adapted species. This study was conducted to better understand fuel load dynamics after prescribed burns in the northeastern corner of Brookhaven National Laboratory (BNL) and to determine which objectives of the burn were met. Stand D was burned in June of 2017. Pre-burn fuels surveys were conducted in 2016, and these surveys were repeated post-burn to determine the amount and types of fuels consumed. In both cases, modified Brown's transects, variable radius plots, and biomass plots were used to ascertain fuel loading and a Composite Burn Index assessment was conducted to determine burn severity. A comparison of these data were used to determine if the following objectives of the prescribed burn were met: (1) reduce existing litter, i.e. 1- and 10-hour fuels, by 50-90%, (2) top kill 30 - 90% of the shrub component of the understory, and (3) expose 20 - 50% of bare mineral soil sites over the unit area. Stand D experienced a 63.2% reduction in existing litter and a 100% reduction of live woody shrubs. The CBI determined there was no change in soil and rock cover. Therefore, objectives (1) and (2) were met and objective (3) was not. The results of this burn demonstrate the benefits of incorporating regular prescribed burns into the natural resource management strategies of the Lab. Future monitoring is needed to determine how long the immediate impacts of a prescribed burn last, if the objectives of the burn plans are attainable or should be revised, and how often future treatments will be needed to maintain lower fuel loads

Modified Brown's transects set up in plot

A pre- and post-burn comparison

Flyover shot of the 2017 prescribed burn taken by the U.S. Forest Service.

Introduction

Recurring wildfire has the potential to maintain and even restore the environments that are adapted to it. In the absence of this disturbance over several years, fire-dependent communities, such as Atlantic coastal pine barrens, are often replaced by fire-sensitive and shade-tolerant competitors in a process termed "mesophication".[1] This creates a positive feedback loop, in which the suppression of fire encourages further fire resistance. To disturb this cycle, fire is needed. This study will focus on the first-order fire effects (effects that occur during and immediately after a fire) of a prescribed burn on Brookhaven National Laboratory. By comparing the fuel loads of stand D on BNL before and after a prescribed burn and determining which of the objectives of the burn were met, we will have a better understanding of the land management practices that work best on the lab.

Burn Objectives: 1. Reduce existing litter, i.e. 1 and 10 hour fuels, by 50-90%,
2. Top kill 30 - 90% of the shrub component of the understory, and
3. Expose 20 - 50% of bare mineral soil sites over the unit area.

Methods

Study Site: Stand D in the northeastern corner of Brookhaven National Laboratory, Long Island, New York (Figure 1).

Sampling:

- 5 pre-established plot points
- At each point a modified Brown's transect was used to inventory downed woody fuels, a variable radius plot was used to assess the basal area at each plot, and a 40 cm x 40 cm harvest plot was used to sample 1- and 10-hour fuels.[2-4] A Composite Burn Index (CBI) assessment was also conducted to determine the severity (the extent of environmental change) of the burn.[5]

Analysis:

- The data for stand D from 2016 and 2017 was compiled and compared within Microsoft Excel® (2010) macro-enabled spreadsheets to determine changes in fuel loading in tonne/ha.[3]

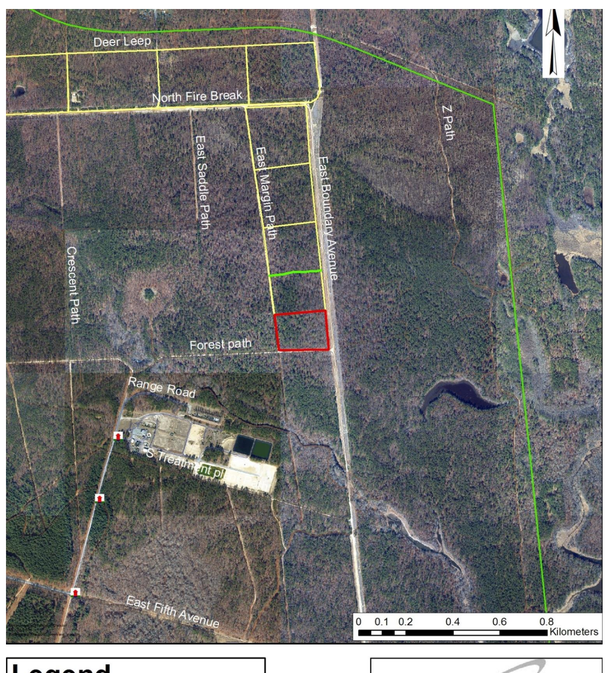

Figure 1: Map of the northeast corner of Brookhaven National Laboratory, Upton, NY.

Unit D test fire.

Unit D immediately post-burn.

Results

- From 2016 until immediately after the 2017 prescribed burn, in stand D:
  - 1-hour fuels reduced 73.1%, 10-hour fuels increased 52.0%, and 100-hour fuels increased 54.5% (Figure 2)
  - 1- and 10-hour fuels combined, i.e. total litter load, reduced 63.2%:
  - live woody fuels reduced 100%
  - total fuel load was reduced by 68.7%
  - overall fuel bed depth reduced 91.4% (Figure 3)
- The CBI values for the burn on stand D were:
  - Average overall – 1.5, or moderate severity
  - Ground fuels & substrate – 0.6, or low severity
    - Litter – 1.1, ~50% was consumed
    - Soil and rock cover – 0.0, no change
  - Vegetation <1 m in height – 2.6, or high severity
  - Vegetation 1-5 m in height – 2.2, or moderate severity
- Objectives 1 and 2 were met by the prescribed burn, but objective 3 was not.

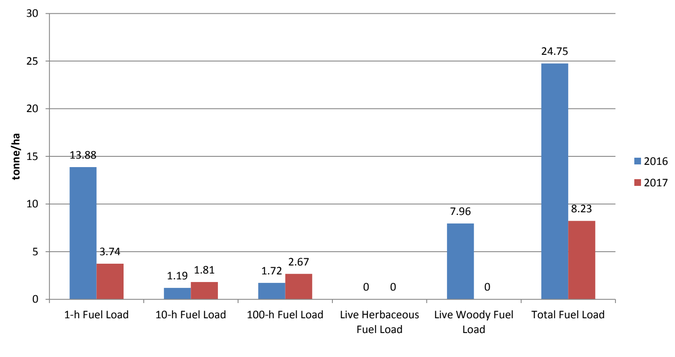

Figure 2: Bar graph representing fuel loading (tonne/ha) by fuel type for stand D in 2016 and 2017 in the east complex units of Brookhaven National Laboratory, Upton, NY.

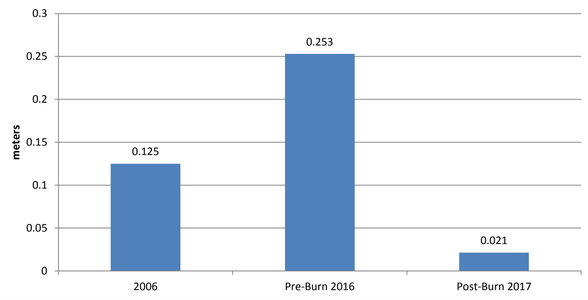

Figure 3: Bar graph representing the average fuel bed depth (meters) of stand D in the east complex units of Brookhaven National Laboratory, Upton, NY.

Discussion

- For fire-dependent communities, prolonged fire suppression has the potential to change the ecosystem to a point of no return,[1] but we believe that the pine barrens ecosystem at BNL is in need and capable of restoration.
- The burn did not consume enough organic matter to expose the mineral soil, but this should not be expected with only one burn after years of fire suppression.
- Management questions requiring further investigation:
  - What fire return interval length is best during restoration?
  - Will different fuel management objectives require different fire return intervals?
  - What basal area is ideal and will this differ based on management objectives?
  - Should mechanical treatment be combined with prescribed burning?
- What we can learn from these efforts will continuously reduce the amount of uncertainty in making informed, adaptive management decisions in the future.[6]

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References

[1] Nowacki, G.J., and M.D. Abrams. 2008. The demise of fire and "mesophication" of forests in the eastern United States. BioScience 58(2):123-138.
[2] Brown, J. K. (1974). Handbook for Inventorying Downed Woody Material. General Technical Report INT-16. Ogden, UT: USDA Forest Service, Intermountain Forest & Range Experiment Station.
[3] Iwamoto, K. (2005) Sampling Methods. Managing Fuels in Northeastern Barrens. Retrieved from http://www.umass.edu/nebarrensfuels/methods/index.html. Accessed July 18, 2016.
[4] Packard, K. C. & Radtke, P. J. (2007). Forest sampling combining fixed- and variable- radius sample plots. Canadian Journal of Forest Research, 37(8), 1460-1471.
[5] Key, C. H. & Benson, N. C. (2006). Landscape Assessment (LA): Samplings and Analysis Methods. USDA Forest Service Gen. Tech. 1-51.
[6] Willians, B. K. & Brown, E. D. (2012). Adaptive Management: The U.S. Department of the Interior Applications Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC.