Natural Resource Network

Connecting Research, Teaching and Outreach

Extent of Prescribed Fire Use in New Hampshire

UNH Cooperative Extension
131 Main Street, 214 Nesmith Hall, Durham, NH 03824

Extent of Prescribed Fire Use in New Hampshire

Authors

Benjamin T. Kaufhold, University of New Hampshire

Andrew J. Fast, University of New Hampshire Cooperative Extension, andrew.fast@unh.edu

Mark J. Ducey, Department of Natural Resources & the Environment, University of New Hampshire mark.ducey@unh.edu

Acknowledgments

We appreciate the valuable assistance of:

- Steve Sherman, N.H. Division of Forests and Lands
- Bryan Nowell, N.H. Division of Forests and Lands
- Lisa Landry, N.H. Department of Environmental Services
- Jennifer Little, N.H. Division of Forests and Lands
- Meredith Lund, N.H. Department of Safety
- John Neely, U.S. Forest Service
- Wendy Weisiger, Society for the Protection of N.H. Forests
- Zachary Boyajian, N.H. Adjutant General's Department
- Heidi Holman, N.H. Fish and Game
- Jeff Lougee, The Nature Conservancy
- Stephan Najjar, U.S. Air Force.

Karen P. Bennett, UNH Cooperative Extension Forestry Professor and Specialist reviewed and edited this manuscript.

A project of the New Hampshire Prescribed Fire Council, the University of New Hampshire and the University of New Hampshire Cooperative Extension.

Suggested form of attribution:

Kaufhold, B.T., A.J. Fast, and M. Ducey. 2017. Extent of Prescribed Fire Use in New Hampshire. University of New Hampshire Cooperative Extension, Durham, N.H.

Introduction

Prescribed fire is used for public safety (firefighter training and fuels reduction), agriculture, enhancing biodiversity, and forest and wildlife management in New Hampshire. Annual prescribed fire statistics (acreage, types of fuels, frequency, etc.) are not collected systematically and are largely unknown for the state. UNH Cooperative Extension, in partnership with UNH faculty and the N. H. Prescribed Fire Council, compiled state prescribed fire s for 2014 and 2015. In addition to identifying the frequency of prescribed fire use, this research identifies who uses prescribed fire (public entities, private organizations, and individuals) and why they use it (e.g. wildlife, silviculture, etc.).

The collected data provide a baseline to analyze long-term prescribed fire trends; improve air quality emissions modeling; inform state prescribed fire policy; show the spatial distribution of prescribed fire use in New Hampshire; and generate recommendations for prescribed fire record-keeping and use.

Methods

During the fall of 2016, government agencies, municipal fire departments, and private organizations and individuals participating in prescribed burning were asked to contribute prescribed fire information to develop a dataset that included:

1) Year of the burn (2014 and 2015)
2) Town where the fire occurred
3) Agency, organization, or individual responsible for the burning
4) Acres burned
5) Primary and secondary fuels, if present, categorized broadly as grass, shrub, timber[1], or slash (Anderson 1982)
6) Burn objective
7) Date of the burn

The following methods were used to account for every prescribed burn[2] in the state:

1) Reviewed 100% of the category IV fire permits[3] through meetings with N.H. Division of Forests and Lands Forest Rangers[4].

[1] This is typically surface litter fuels, such as small twigs, needles and leaves, and described as timber litter throughout the document.
[2] Prescribed burns included broadcast burns only, not pile burns or residential burns, i.e. residential burn permits.
[3] A category IV permit is for a controlled fire greater than 2 feet in diameter. It may be kindled during the day between 9am-5pm. A permittee must comply with additional, special provisions to qualify for a category IV permit, and a category IV permit is issued jointly between a N.H. Forest Ranger and N.H. Forest Fire Warden.
[4] N.H. Forest Rangers work for the N.H. Department of Resources and Economic Development. They oversee the state wildland fire control program, and enforce state timber harvesting laws.

2) Surveyed 100% of the Federal agencies conducting prescribed fire in the state using a combination of a written survey and personal communication. Federal agencies are not required to file burn permits.
3) Surveyed 100% of the town fire wardens using a combination of a written survey and personal communication and received an 89% response rate. Fire wardens are not required to file burn permits.

If a single burn was reported by more than one entity, only a single entry was made in the data-set. Included in the data-set is "reported redundancy," to track instances when more than one entity reported a single burn.

Respondents were grouped in affiliations that included "federal agency," "state agency," "municipal fire department" and "other." The "other" affiliation represents anyone that is not a municipal fire department, state or federal agency. Respondents in this category included private landowners and private nonprofit organizations. When multiple entities collaborated on a burn, the burn was attributed to the lead entity.

There were numerous cases where a municipal fire department may have been involved in a burn on private land. If a category IV fire permit was filled out, the burn was considered an "other" (private landowner) burn; if no fire permit was filled out, the burn was considered a municipal fire department burn. Despite occurring on private land, the fire warden was present and not requiring the landowner to fill out a permit. As such, it was assumed that the fire department was the lead entity for the prescribed fire.

Thirty-two prescribed fires were conducted to meet multiple objectives (e.g. silviculture and public safety). When analyzing prescribed fire objectives, burns with multiple objectives are accounted for twice (i.e. Table 2 accounts for a fires meeting multiple objective). Similarly, if multiple fuels were identified at a prescribed burn, they were represented (counted) in each fuel group.

Results and Discussions

Prescribed fire can provide agriculture, wildlife, forestry, biodiversity and public safety benefits; however, there is no historical record of the frequency of prescribed fire, prescribed fire characteristics and why prescribed fire is being used in the state.

Table 1 provides a summary of prescribed fires occurring in New Hampshire in 2014 and 2015. Prescribed fire occurred in approximately 15 to 20% of New Hampshire towns in each year and took place on a greater geographical scale than the relatively small burn acreage might imply—350 to 500 acres in each year.

There was a large reduction in the total number of acres burned from 2014 to 2015. This may indicate high year-to-year variability in prescribed fire use. Many survey respondents indicated

that dry conditions in 2015 led to burns being canceled or delayed. Regional wildfire demands in 2015 may have limited the availability of people and equipment to execute prescribed fire. Natural resource professionals involved with prescribed fire indicated that 2014 and 2015 are not representative of "typical" prescribed fire seasons due to the drought and associated reduction in burn acreage (J. Neely, personal communication, December 7, 2016). With this study's limited sample size, it is difficult to draw conclusions about the degree to which drought years affect burn acreage relative to normal years.

Municipal fire departments conducted close to half of the prescribed fires in 2014 and 2015, followed by state agencies, (i.e. N.H. Fish and Game, N.H. Division of Forest and Lands and the N.H. Department of Safety), federal agencies (i.e. U.S. Forest Service, U.S. Air Force, U.S. Army National Guard, U.S. National Park Service, and U.S. Fish and Wildlife Service) then private entities (i.e. nonprofit organizations and private landowners). Private entities accounted for only 7% of the prescribed fires over the two-year period despite individuals and families owning 68% of the state's forestland (NEFA 2013).

Prescribed fire requires significant resources and planning to be carried out safely. Ninety-four percent (129 of 135 prescribed burns) of prescribed fires over the two-year period were conducted by a public or private entity with an established fire program (i.e. they have the established training, personnel, and equipment to execute prescribed fire). The data suggest that private entities without established fire programs do very little burning in the state. Potential barriers to executing prescribed fire include short burn windows, wildland-urban interface challenges (i.e. smoke management, operational challenges, etc.), a lack of prescribed fire culture in the region, strict liability law, high costs to implement prescribed fire, few prescribed fire contractors and minimal technical education.

Table 1: Summary of prescribed burns by group and year

Summary Statistics	**Complete Data**		**Municipal Fire Departments**		**State Agencies**		**Federal Agencies**		**Other**	
Year	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
# of burns	82	53	34	24	24	17	19	7	5	5
Acres burned	513.85	366.11	216.25	113.75	39	31.36	150.1	55	108.5	166
Average Ac / burn	6.27	6.91	6.36	4.74	1.63	1.85	7.9	7.86	21.7	33.2
% of total burns	100%	100%	41.5%	45.3%	29.3%	32.1%	23.5%	13.5%	6.1%	9.4%
# of towns where burns occurred	50	36	19	24	17	10	6	4	4	5
% of towns where burns occurred	21.3%	15.3%	14.1%	10.2%	7%	4%	2.5%	2%	1.7%	2.1%

Fire appears to be an underused tool across all groups. Over the two-year study, state agencies treated 0.03% of their ownership (70 of 201,513 acres) with prescribed fire. Similarly, Federal agencies burned only 0.03% (205 of 798,718 acres).

Future research might examine the types of natural communities where these fires are occurring and provide guidance on how prescribed fire can be applied more effectively to maintain fire-adapted communities. If 0.015% (0.03% over a two-year period) of public land in New Hampshire is burned annually, this indicates average fire-return-intervals are in the thousands of years. Including wildfire acreage, fire-return-intervals would continue to be in the thousands of years. Given the varied geographic distribution of state and federal lands, their diverse natural communities, and goals, there may be additional opportunities to use prescribed fire in a way that is more in-line with historical fire regimes.

Prescribed fires averaged 6 to 7 acres per burn over the two-year period; the "other" (private ownership) category burned at greater scale compared to public entities. While conducting only 5 to 10% of the burns, private entities accounted for 20 to 45% of the burned acreage during any given year. This disparity may relate to the considerable planning and cost of prescribed fires. When private entities burn, they may look to minimize the per acre cost by burning larger areas.

Private entities may look for cost-effective substitute treatments (e.g. mechanical treatment to fields rather than prescribed burning). Private entities seem to use fire when there is no cheaper treatment or when using a cheaper, non-fire treatment is not as effective at achieving their goals. For example, it is necessary for private entities such as The Nature Conservancy to use prescribed fire to maintain fire-adapted ecosystems despite the costs. Blueberry growers often justify the added cost of prescribed fire to prune their crops through increased yields, and reduced insects, weeds, and disease.

The goal for public entities is often not profitability but a public good. As such, the costs and benefits of prescribed fire may be fundamentally different. The costs and benefits are shared more broadly and are often harder to quantify—how does the cost of a 2-acre prescribed fire in a specific town relate to the benefit of having a safer, well-trained volunteer fire department?

Burn Objectives

Survey respondents were asked to identify their prescribed fire objectives within five broad categories; forestry, biodiversity, wildlife, public safety (i.e. fuel-reduction and firefighter training), and agriculture. These categories were identified based on input from a diverse group of prescribed fire practitioners. Some respondents identified multiple objectives for burns. Most prescribed fires meet multiple objectives, though this characteristic may not have been fully captured through the survey process. Figure 1 displays prescribed fire objectives as a percentage of total prescribed fires in 2014 and 2015.

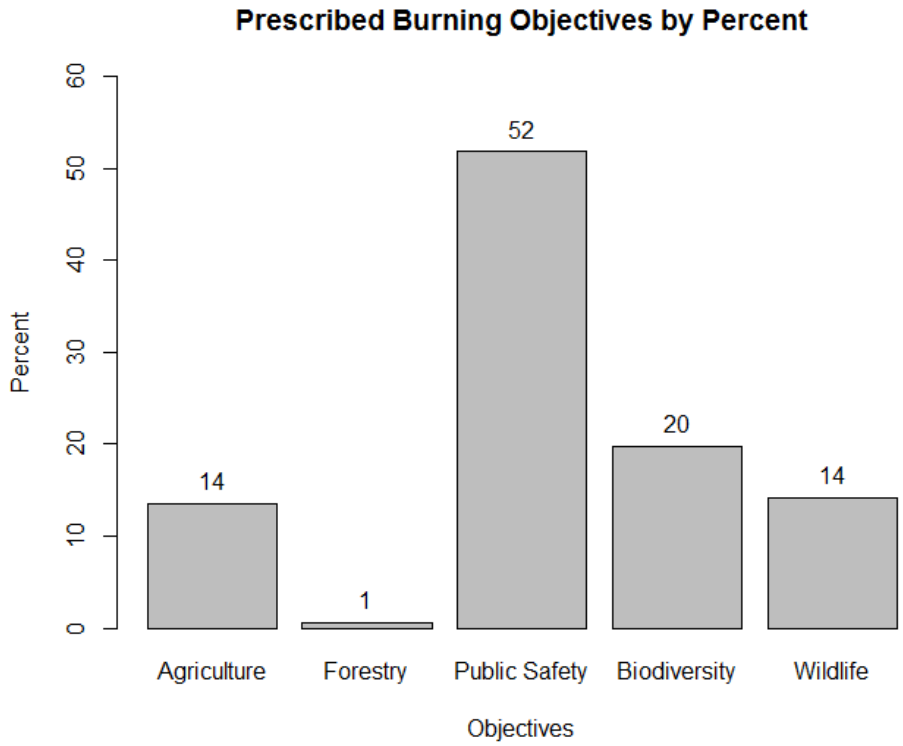

Figure 1: Prescribed fire objectives as a percent of total burns

Table 2 displays burn objectives across the four groups.

Table 2: Burn objectives by group

Objectives	Complete Data	Municipal Fire Departments	State Agencies	Federal Agencies	Other
Agriculture	22	16	0	0	6
Forestry	1	0	0	1	0
Public Safety	84	44	35	1	4
Biodiversity	37	7	4	22	4
Wildlife	23	0	7	16	0

Agriculture

Agricultural prescribed fires were used primarily for low bush blueberry and forage crops (hay fields); agriculture was an objective for 14% of burns. Citing increased development as the cause, some survey respondents noted agricultural burning has decreased since the 1980's.. Challenges burning in the wildland urban interface are well documented (Cohen 2008). Despite the challenges, prescribed fire continues to be a valued and necessary tool for certain agricultural producers in the state.

Forestry
A single, 5-acre silvicultural prescribed fire was recorded over the two-year survey period. Given the role fire can play in site preparation, specifically for oak and pine regeneration, and weeding, it is likely that there are additional silvicultural benefits when burning for other objectives such as for biodiversity and wildlife.

Public Safety
Public safety includes prescribed fire for training or fuels reduction. Approximately 15 to 20% of municipalities conduct training burns annually through the local fire department or the N.H. Fire Academy. This accounts for approximately 95% of the burns where public safety was an objective. There are some excellent examples of municipal fire departments conducting joint training burns with other town fire departments, and with state and federal agencies. Many fire chiefs and fire wardens referenced New Hampshire's strict liability laws as a deterrent to using prescribed fire as a training tool. Some of these fire chiefs and wardens stopped burning in the last decade because of strict liability laws, though some fire departments continue burning because of the training benefits.

Biodiversity
Fire plays an important role in maintaining biodiversity in New Hampshire's fire-adapted natural communities such as pitch pine-scrub oak woodlands. Twenty percent of all burns over the study period were conducted to promote biodiversity. These burns were largely conducted by federal agencies and private organizations or individuals. While burns to increase biodiversity, understandably, tend to focus on fire-adapted communities, there may be an opportunity to use fire as a tool to maintain biodiversity more broadly across the state (e.g. controlling invasives such as multiflora rose through multiple fire treatments) (Zouhar et al. 2008).

Wildlife
Fourteen percent of all burns over the study period were for wildlife objectives. Historically, fire has been a means to maintain shrub, meadow, and grassland habitats. This benefits wildlife species that use early successional habitat, some of which are state-listed rare species such as the New England cottontail, Grasshopper sparrow, and northern harrier. Mowing and clearcutting are popular modes of habitat restoration. Mowing and clearcutting may encourage different conditions than prescribed fire. Fire can be used as another useful tool to mimic natural disturbance regimes, influence species composition or forest structure, alter grass-forb ratios in field and forest openings, or encourage short-term nutrient release in the soil.

Fuels

Figure 2 shows grass is the most common fuel in New Hampshire prescribed fires, followed by shrubs, timber litter, and slash. Municipal fire departments conduct the most burns and they tend to burn grass fuels. The data does not inform us whether burning grass fuels is meeting a specific goal for fire departments (i.e. the fire departments are deliberately seeking out grass since grass is the most common wildfire fuel, or because grass represent higher risk areas for

fire departments, etc.)—or whether it is opportunistic (i.e. it tends to be low complexity, the field is available, and the landowner wants it burned).

From a public safety, fuel-reduction standpoint, grass is a rapidly available fuel that usually has lighter fuel loads than other fuel categories (Anderson 1982). Traditional fuel-reduction efforts often focus on heavier fuel loads that pose a public risk. There may be opportunities for municipal fire departments and state agencies to shift their trainings burns to heavier fuel loads associated with shrub or slash fuel categories. This may meet their training priority and more aggressively treat heavy fuel loads in high risk areas. When fuel-reduction is not the primary objective for the fire department, there may be opportunities to work with foresters and land managers to implement forestry, wildlife and biodiversity objectives in addition to their primary training objective.

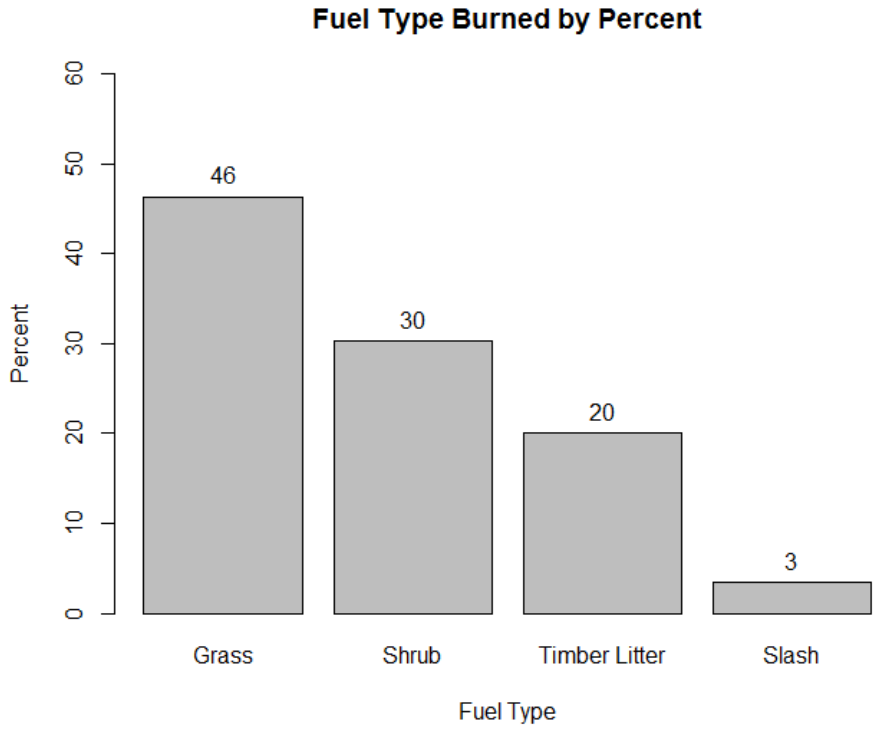

Figure 2: Fuel type burned as a percent-

As seen in Table 3, Grass was the most common fuel when burning for public safety, agriculture or wildlife objectives. Shrubs were also burned regularly for all objectives, including forestry. Grass and shrubs are frequently found simultaneously within fields and meadows and at transition zones between two biological communities.

A number of burns involved timber litter as a fuel. However 83% of burns with timber litter fuel were conducted for a public safety objective. Forestry, biodiversity and wildlife were underrepresented in the timber litter fuel category. This highlights the possibility for agencies

conducting public safety burns to work with foresters and land managers to implement forestry, wildlife and biodiversity objectives.

Table 3: Fuels associated with burn objectives

Objectives/Fuels	Grass	Shrub	Timber Litter	Slash
Agriculture	17	13	0	0
Forestry	0	1	0	1
Public Safety	47	33	35	0
Biodiversity	22	24	6	8
Wildlife	19	8	1	2

Recommendations and Considerations

Improve Future Data Collection and Reporting

1) Collect additional prescribed fire data. A two-year sample of prescribed fire in the state limits the ability to develop accurate models and make concrete conclusions about long-term prescribed fire trends. Additional data collection annually, or intermittently, as resources permit, and in a way consistent with this study, will help refine our understanding of prescribed fire activity in the state.

   If future data collection takes place, the N.H. Division of Forests and Lands may want to revisit how they collect, record, and file their burn permits. Additional outreach to fire wardens and federal agencies about prescribed fire and the need for record-keeping may improve the process and response rate.

2) Develop a system to improve fire records between appropriate groups statewide, regionally, and nationally. The National Interagency Fire Center (NIFC) annually releases *The National Report of Wildland Fires and Acres Burned by State.* This reports contains the number of prescribed fires and wildfires with associated total acreage burned. The numbers released by the NIFC for New Hampshire were 134 acres burned in 13 fires in 2014 and 55 acres burned in six fires in 2015. These numbers grossly underrepresent the amount of prescribed fire being used in the state.

Improve Availability and Impact of Prescribed Fire

3) Using the N.H. Forest Resources Plan, N.H. Wildlife Action Plan and other documents, evaluate how current prescribed fire activity is meeting statewide public safety, biodiversity, wildlife, forestry and agriculture goals.
   a. Develop outreach to increase awareness of how prescribed fires can better meet statewide goals (e.g. increase “multiple objective” burns).
   b. Consider if public entities increasing average burn unit size can more effectively meet local, regional, and statewide natural resources and public safety goals.

c. Agencies conducting training burns can explore joint training with new partners (i.e. other fire departments, state or federal agencies) to increase on-site resources and expertise, as well as promote peer-to-peer learning.
d. Agencies conducting training burns may consider examining if they are deliberately burning in certain fuel types. If burning in a specific fuel is not deliberate, they might consider rotating among fuels, or how deliberately burning in specific fuel types can promote statewide prescribed fire goals.
e. Increased cooperation can result in more firefighters trained to wildland firefighter standards, and increased prescribed fire capacity in the state.

4) Examine the barriers for private entities to conduct prescribed fire (7% of the burns; 68% of the land). Work toward bridging the public-private prescribed fire use gap.

Geographic Representation—GIS .

5) Geographically represent these data as a publicly accessible shapefile on Granit (www.granit.unh.edu/).
6) Add wildland fire statistics to the existing dataset years (2014 and 2015) and/or future datasets. This can lead to more refined analysis and recommendations of geographic patterns and temporal trends in state fire data (e.g. Are there annual wildfire patterns that relate to New Hampshire geography? If so, can prescribed fires be used to mitigate risk while meeting other prescribed fire objectives?).

National Emissions Inventory

7) This dataset will be compatible with national emissions inventory (NEI) state submission standards (i.e. minimum required state prescribed fire information from the NEI).
8) Data can be used to meet of State Implementation Plan (SIP) requirements. SIPs are required National Ambient Air Quality Standard (NAAQS) implementation rules and the Clean Air Act (CAA) (L. Landry, personal communication, December 1, 2016).

Conclusions

This paper is a first step in identifying the extent of prescribed fire use in New Hampshire—how much burning is occurring, who is burning and why. Results show that little burning is occurring as a percentage of total land area in the state, and most of the burns are not recorded in an accessible manner. Additional research and outreach should take place to explore how more deliberate use of prescribed fire can meet multiple objectives in multiple fuel types throughout the state. The data collected in this study can be used as a foundation to build upon. We provide a list of recommendations for local, state, federal, and private prescribed fire partners to consider and work towards if practical. Lastly, a list of research needs identified by the N.H. Prescribed Fire Council as a result of this project is identified in Appendix A.

Citations

Anderson, H.E. 1982. *Aids to determining fuel models for estimating fire behavior.* USDA For. Serv. Gen. Tech. Rep. INT-122., Intermt. For. and Range Exp. Stn., Ogden, UT. 22p.

Cohen, J. 2008. The Wildland-Urban Interface Fire Problem. *Fire History Today.* Fall: 20-26.

[NEFA] North East State Forester's Association. 2013. *The Economic Importance of New Hampshire's Forest*. www.nefainfo.org.

Zouhar, K., J.K. Smith, S. Sutherland and M.L. Brooks. 2008. *Wildland fire in ecosystems: fire and nonnative invasive plants.* USDA For. Serv. Gen. Tech. Rep. RMRS-GTR 42., Rocky Mountain For. and Range Exp. Stn., Fort Collins, CO. 355p.

Appendix A

N.H. Prescribed Fire Council research needs identified by this project

1) Refine understanding of the types of natural communities being burned (e.g. percentage of fire-adapted communities rather than raw acreages); what are the fire return intervals for these communities, etc.
2) Develop a better understanding of the lands under state and federal ownership, the need for prescribed fire on those lands, and how much of the need is being met?
3) Strict liability laws—how has the introduction of strict liability laws impacted the use of prescribed fire in the state.
4) Explore prescribed burning costs and efficiency. Why is burning so expensive? How to reduce the per unit cost of treatment?
5) How do municipalities plan and implement their burns (e.g. do they follow the Incident Command System [ICS])?
6) How do different entities (i.e. municipal fire departments, state and federal agencies, non-profits and private landowners monitor effects and benefits of their burns?
7) Are there other nongovernmental organizations (NGOs) and/or private landowners that want to burn in New Hampshire and are not because of constraints? If so, are they responsible for lands that need prescribed fire?

Appendix B

Baseline Prescribed Fire Activity in New Hampshire

SURVEY

Contact Category:

Forest Ranger Warden Training Officer Federal Partner Other

Affiliation (i.e. Forest Service, Town, etc.):

Contact Name: **Contact Phone # (optional)**

Year: 2014 2015

Are you aware of or have you been involved in any broadcast (non brush pile) prescribed burning: Yes No

If yes, supply the following information:

Date:

Location:

- Town
- Latitude (best information available):
- Longitude (best information available):

Primary purpose: agriculture wildlife forestry public safety biodiversity other unknown

Acres burned:

Primary Fuel: grass shrub timber litter slash unknown

Secondary Fuels (all that apply): grass shrubtimber litter slash unknown

Additional comments:

The Natural Resource Network Reports

The Natural Resource Network presents this material as a part of series of research reports and publications of interest to educators, resource professionals, landowners and the public. Additional copies are available from the University of New Hampshire Cooperative Extension Forestry Information Center, 131 Main Street, Nesmith Hall, Durham, NH 03824, or at our website extension.unh.edu.

The University of New Hampshire Cooperative Extension provides New Hampshire citizens with research-based education and information, enhancing their ability to make informed decisions that strengthen youth and families, sustain natural resources, and improve the economy. We work with an extensive network of partners within the natural resources community.

The mission of the Natural Resources Network is to enhance interaction among the natural resource research, teaching, and outreach communities in New Hampshire by providing an ongoing mechanism for identifying, addressing and communicating natural resource issues.

Natural resource professionals are working toward improved ways to conserve and use the natural resources of New Hampshire. The Natural Resource Network was formed to improve the interaction among researchers and those who provide outreach education in many kinds of programs. Teachers, outreach professionals and resource managers can bring research-based education to diverse audiences. At the same time, those audiences, or consumers, identify issues and needs for educational programs which can be addressed by controlled research. Well informed and knowledgeable professionals, free-flowing exchange of information, an advantageous and gratifying professional environment, and natural resource planning are goals of the Natural Resource Network.