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Abstract

Prescribed fire is an important management tool in select northeastern United States habitats. Accurate and effective prescription parameters are necessary to safely and successfully meet prescribed fire management objectives. This paper presents prescription parameters that are commonly used in northeastern United States fuels (grass, shrub, timber, slash) and habitats. Findings are based on document analysis of prescribed fire burn plans supplied by agencies and organizations using prescribed fire in the region. Natural resources professionals can interpret the presented prescription data as standard practice and use to it to inform their planning.

Index Terms: prescribed fire, fire prescriptions, fire management, prescribed burning, fire fuels

Introduction

In the northeast, government agencies, private non-profit organizations, and private landowners have traditionally used prescribed fire for multiple objectives including silviculture, wildlife management, fuels reduction, vegetation maintenance, forest health and agriculture (Kautz 1987). More recently, there is an increasing focus on using prescribed fire as a tool for restoring natural communities (Patterson and Clarke 2007) and managing invasive species (Richburg et al. 2004).

Burn plans are developed to help land managers implement burns and meet prescribed fire objectives. Burn plan content varies depending on many factors including agency standard operating procedures, the complexity of the burn, the plan preparer's experience and training, and existing burn plan templates. Included in burn plans is a prescription—"a written statement defining the objectives to be attained as well as the conditions of temperature, humidity, wind direction and speed, fuel moisture, and soil moisture under which a fire will be allowed to burn" (Helms 1998).

The preparation of burn plans, including the development of prescriptions to meet specified objectives, often relies on the plan preparer using old plans on record, formulating elements of the document empirically, or relying on consultation from other experienced prescribed fire personnel. In regions where they exist, published prescription guidelines can aid in this process.

Fire managers may use a number of factors as prescription parameters including weather, fuel, fire characteristics, fire application, soil, vegetation, time, or fire danger rating systems (Sando 1969, Martin 1978). Martin and Dell (1978) suggest that one, two, or more parameters may be necessary to meet prescribed burning objectives. Wright and Bailey (1982) note that experienced prescribed fire personnel usually use two to four critical variables when deciding whether to burn, which include wind speed, relative humidity, quantity of fine fuel, fine fuel moisture, duff moisture, fuel load, and ambient temperature.

Published prescription guidelines are available for most regions and habitats of the United States including southern forests (Wright and Bailey 1982, Wade and Lunsford 1989), the northern great plains (Wright and Bailey 1982, Higgins et al. 1989), the inland northwest (Martin and Dell 1978, Wright and Bailey 1982), the intermountain west (Beaufait 1966, Wright and Bailey 1982) and southwest (Allen et al. 1968, Wright and Bailey 1982). With the exception of burning red and white pine (Wright and Bailey 1982, Olson and Weyrick 1987, McRae et al. 1994), few publications provide information on prescription guidelines for northeastern habitats.

Fire planning guidance by region is valuable. Martin (1978) cautions prescriptions may not translate from one area or region of the country to another. It is unclear how safe prescription parameters developed from other regions or climates outside the northeast may translate to similar habitats, habitat structures, or fuel types in the northeast.

This paper is intended to identify common prescription parameters used by agencies and organizations using prescribed fire in northeastern habitats and their associated fuel groups (Anderson 1982, Patterson 2001, Scott and Burgan 2005, Patterson et al. 2005). The results serve to increase the amount of information available to fire managers and act as a resource for others who aren't part of an established fire program.

We don't intend to have the prescription information provided in this document function as boilerplate information to be plugged into burn plans; similarly, the information shouldn't supplant a fire manager's experience or common sense. However, a fire manager may wish to contrast his/her burn plan prescription parameters with the results of this study. If there are significant differences or outliers in the burn plan prescription, the fire manager can think about or justify why those differences exist.

Individuals who aren't fire managers or participating in a prescribed fire program can use the information provided in this document to understand commonly used prescribed fire prescription parameters in the northeast. If the prescriptions in this document are used for prescribed fire plan preparation and implementation, they should be modified to meet prescribed fire objectives (Martin and Dell 1978), and should be based on fuel availability (Martin 1978), as well as local knowledge.

Methods

During the spring and summer of 2008, government agencies and organizations participating in prescribed burning from Maine, New Hampshire, Vermont, Massachusetts, New York, Rhode Island, and Connecticut were asked to contribute prescribed fire burn plans to develop a dataset that included:

- The name of the landowner
- Type of ownership (public, nonprofit, private)
- State where the property resides
- Broad habitat type (grass, grass-shrub, shrub, timber, slash)
- Detailed habitat description
- Associated Anderson (1982), Scott and Bergan (2005) or custom fuel model (Patterson 2001, Northeast Barrens Fuels Demonstration Project 2004, Patterson et al. 2005)
- Average burn unit size
- Maximum and minimum prescription for:
  - 20-foot windspeed
  - midflame windspeed
  - 1-hour fuel moisture
  - 10-hour fuel moisture
  - 100-hour fuel moisture
  - live fuel moisture
  - live herbaceous fuel moisture
  - live woody fuel moisture
  - air temperature
  - relative humidity
  - days since last rain
  - Keetch-Byram drought index (KBDI)
  - head fire rate of spread
  - backing fire rate of spread
  - head fire flame length
  - backing fire flame length
  - probability of ignition (POI).
- Minimum mixing height

If more than one burn plan was provided from an agency, organization or individual that represented the same fuel model and prescription, only a single entry was made in the data set. This was done to avoid bias if a single agency using a specific prescription provided many burn plans.

The information collected in this document represents the current state of practice, i.e. the prescriptions that planners use for their burn plan. There was no attempt to determine the specific conditions when burns were executed, or to determine whether fire managers were successful meeting their objectives when a burn was executed. There are significant financial and research challenges monitoring the efforts of prescribed fire. It can be difficult to replicate studies and fire is dynamic with many factors interacting in complex ways. As such, this study relied on professional judgment (i.e. the prescriptions developed by plan preparers were appropriate for the site and meeting objectives outlined in the respective burn plans) to understand what prescription parameters represent a typical standard of practice for northeastern fuels and habitats.

Each entity that participates in prescribed fire determines what prescription parameters should be incorporated into a burn plan. Some prescription parameters such as live herbaceous fuel moisture and live woody fuel moisture weren't included in most of the burn plans analyzed in this study—as a result, these prescription parameters aren't presented in the results.

Analysis was conducted in R version 2.8.1 (R Development Core Team 2008) and consisted of calculating the median of the maximum and minimum values for each prescription parameter collected (e.g. median of minimum relative humidity and median of maximum relative humidity). Data were grouped and analyzed by fuel groups (Anderson 1982) rather than individual fuel models (Anderson 1982, Patterson 2001, Northeast Barrens Fuels Demonstration Project 2004, Scott and Bergan 2005, Patterson et al. 2005) in order to generate larger sample sizes and mitigate the impact of outliers. Custom fuel models for pitch pine-scrub oak forest, pitch pine-oak thicket, untreated oak woodland, and untreated scrub oak were included in the shrub fuel group. Mowed scrub oak was included in the slash fuel group. A complete list of habitats assigned to each fuel group is shown in Table 1. In some cases, habitats, such as pitch pine-scrub, scrub, or grass, are included in multiple fuel groups.

Table 1. Habitats Associated with Fuel Groups

Grass Fuel Group	Shrub Fuel Group	Timber Fuel Group	Logging Slash Fuel Group
Coastal Dune	Sandplain Heathland	Hardwood	Mowed Scrub Oak
Freshwater Marsh	Open Scrub Oak	Closed Scrub Oak	Soft Break (mowed)
Grassy Openings	Closed Scrub Oak	Surface Fires--All Forest Types	Mixed Hardwood & Softwood Logging Slash
Grass	Old Field	Mixed Timber	Brush-Mowed Brush
Short Grass-Invasive Species	Shrub	Timber-Shrub	Grassy Openings, Scrub Cover, light Logging Slash
Mowed Old Field	Mowed Scrub Oak	Oak Understory	Pitch Pine Scrub or Scrub
Unmowed Old Field	Wetland Shrub	Mixed Hardwood Forest-Low Load Leaf Litter	
Mowed Grass	High Shrub Fuel Load	Pitch Pine-Oak Forest	
Short Grasses	Very High Shrub Fuel Load	Oak Woodland	
Sandplain Grassland-Coastal Heathland	Pitch Pine Scrub Oak Thicket	Red & White Pine	
Mixed Warm & Cool Season Grass	Shrub Wetland	Oak Pitch Pine	
Grassland	Pitch Pine Scrub Oak Woodland	Black Oak Woodland	
Tall Grasses	Ericaceous Shrub Layer	Broadleaf Forest & Seeps	
Humid Climate Grass	Scrub Oak Shrubland	Cut Immature Pitch Pine	
Cool Season Grasses & Forbes	Mixed Coastal Heathland-Maritime Shrubland	Red Pine Stand	
Warm Season Grasses-Old Field	Oak Pitch Pine		
Immature Pitch Pine	Shrublands & Mechanically Treated		
Pitch Pine Scrub or Grass	Pitch Pine-Scrub Oak Community		
Grassy Openings, Scrub Cover, Light Logging Slash	Pitch Pine-Oak Woodland		
Pitch Pine Scrub or Scrub	Pitch Pine-Oak Forest		
	Grass, Low Brush		
	Pitch Pine Scrub or Grass		
	Pitch Pine-White Pine-Scrub Oak		
	Blueberry-Brush-Seedlings-Saplings		

Results and Discussion

Sixteen agencies and organizations from seven different northeastern states (Connecticut, Massachusetts, Maine, New Hampshire, New York, Rhode Island, and Vermont) contributed 31 burn plans (Table 2). Burn plans were written between 2001 and 2008 with the exception of four burn plans which were not dated.

Table 2. Participation and Contributions by Organization Type

Organization type	*n*	*Burn plans contributed*
Non Profit	*4*	*7*
Public		
Federal	4	15
State	5	6
Local	1	1
Other	2	2
Total	16	31

Most of the burn plans included the same prescription parameters for multiple fuel models and their associated habitats, resulting in a total of 81 fuel models with associated prescription parameters. A list of fuel models used in each fuel group is given in Table 3.

Table 3. Fuel Models Associated with Fuel Groups

Grass Fuel Group	Shrub Fuel Group	Timber Fuel Group	Logging Slash Fuel Group
1 Anderson 1982	**4** Anderson 1982	**8** Anderson 1982	**11** Anderson 1982
2 Anderson 1982	**5** Anderson 1982	**9** Anderson 1982	**MV-MSO** Patterson et al. 2005 Northeast Barrens Fuels Demonstration Project 2004
3 Anderson 1982	**6** Anderson 1982	**10** Anderson 1982	
GR3 (103) Scott & Bergan 2005	**7** Anderson 1982	**TU (162)** Scott & Bergan 2005	
GR4 (104) Scott & Bergan 2005	**SH3 (143)** Scott & Bergan 2005	**TL6 (186)** Scott & Bergan 2005	
GR6 (106) Scott & Bergan 2005	**SH6 (146)** Scott & Bergan 2005	**TL8 (188)** Scott & Bergan 2005	
GR7 (107) Scott & Bergan 2005	**SH8 (148)** Scott & Bergan 2005		
	SH9 (149) Scott & Bergan 2005		
	CFM 60 Patterson 2001		
	CFM 61 Patterson 2001		
	CFM 63 Patterson 2001		
	MV-UOW Patterson et al. 2005 Northeast Barrens Fuels Demonstration Project 2004		
	MV-USO Patterson et al. 2005 Northeast Barrens Fuels Demonstration Project 2004		

Note: Custom Fuel Models: Ossipee New Hampshire includes CFM 60 = Hobbs Tract Pitch Pine Scrub Oak Forest, CFM 61 = West Branch Pitch Pine Scrub Oak Forest, CFM 63 = West Branch Pitch Pine Oak Thicket (Patterson 2001); Martha's Vinyard includes MV-UOW = Untreated Oak Woodland, MV-USO = Untreated Scrub Oak, MV-MSO = Mowed Scrub Oak (Northeast Barrens Fuels Demonstration Project 2004, Patterson et al. 2005)

Median minimum and maximum prescription parameters and their frequency are presented in Table 4. Prescription parameters include:

- Median maximum and minimum
  - 20-foot windspeed
  - midflame windspeed
  - 1-hour fuel moisture
  - 10-hour fuel moisture
  - 100-hour fuel moisture
  - live fuel moisture
  - air temperature
  - relative humidity
  - days since last rain,
  - Keetch-Byram drought index
- Median minimum
  - atmospheric mixing height.

Table 4. Median Prescription Parameters by Fuel Group

Prescription Parameters	Fuel Group															
	Grass				Shrub				Timber				Logging Slash			
	n	Max	*n*	Min	*N*	Max	*n*	Min	*n*	Max	*n*	Min	*n*	Max	*n*	Min
20-foot windspeed (mph)	20	20	20	5	22	20	22	5	9	20	8	4.5	7	20	7	5
Midflame windspeed (mph)	25	10	25	2	31	8	31	1	16	8	15	2	7	10	7	0
1HR Fuel Moisture (%)	25	12	25	6	30	15.5	30	6	14	13	14	6	7	14	7	6
10HR Fuel Moisture (%)	17	18	20	8	17	25	28	8.5	11	20	14	8	6	18	7	8
100HR Fuel Moisture (%)	7	22	12	12	3	28	22	10	7	22	10	12	3	25	6	11.5
Live Fuel Moisture (%)	14	120	16	60	19	300	21	30	5	90	6	30	5	120	6	60
Air Temp. (%)	25	90	26	35	30	90	31	35	14	87.5	17	35	7	79	7	40
RH (%)	24	65	26	26	27	65	31	35	16	67	16	30	7	60	7	30
Days Since Last Rain	16	6.5	18	1	27	5	30	1	9	7	12	1	7	7	7	1
KBDI	13	400	13	0	24	300	24	0	11	299	11	0	4	350	4	0
Atmospheric Mixing Height (feet)	--	--	22	1500	--	--	27	1500	--	--	11	1500	--	--	7	1500

Median minimum and maximum parameters were used to define the limits of the burn window (the conditional limits when it is appropriate to implement prescribed fire). For example, maximum air temperature was recorded for every burn plan (fuel group) that used it as a prescription parameter. The median number was calculated and presented. Table 4 shows maximum air temperature for the grass fuel group (90°F), shrub fuel group (90°F), timber fuel group (87.5°F) and slash fuel group (79°F). Median numbers were calculated and presented to minimize the impact of outliers.

Air temperature is one of the most common prescription parameters contained in the prescribed fire plans, but most plans provided an exceptionally wide prescription window so air temperature may be somewhat ineffective in guiding prescribed fire planning. In the northeast, median air temperatures ranged from slightly above freezing to 80 to 90°F at the high end of the prescription depending on the fuel group (Table 4). The 39 to 55°F temperature range indicates that in most circumstances, fire planners don't want to limit their prescription window through temperature alone.

The results in the northeast are comparable to recommendations for other regions of the country at the high end of the prescription and less than most other regions at the low end. While a study of the northern great plains showed 90 percent of prescribed burns were conducted at temperatures between 41 to 90°F, recommended temperatures were more narrow, 68 to 90°F (Higgins et al. 1989). Ralphs et al. (1976) recommended temperatures greater than 75°F for western rangelands. In southern forests, temperatures above 80°F were recommended for growing season burns while temperatures below 60°F were recommended for winter understory burns (Wade and Lunsford 1989).

Relative humidity is closely related to fine fuel moisture barring the influence of precipitation (Wright and Bailey 1982) and is another common variable in northeastern prescribed fire plans. The median maximum relative humidities for the fuel groups in this study ranged from 60 to 67 percent (Table 4) compared to 60 percent recommended in southern forests (Wade and Lunsford 1989), 50 percent in the intermountain west (Beaufait 1966), and 80 percent in the northern great plains (Higgins et al. 1989).

Median minimum relative humidities for northeastern fuel groups ranged from 26 to 35 percent. Extra caution should be exercised at the lower end of the prescription window. Wade and Lunsford (1989) caution that burning below a relative humidity of 30 percent can be dangerous in southern forests, and Wright and Bailey (1982) suggest that prescribed burns shouldn't be conducted when the relative humidity is below 25 percent. In other regions such as the intermountain west or northern great plains, burning at a relative humidity as low as 20 percent is acceptable (Beaufait 1966, Higgins et al 1989), although burning with higher relative humidity is recommended (Higgins et al. 1989).

Median minimum **1-hour fine fuel moisture** was 6 percent for all fuel groups in this study (Table 4), which is lower than the 7 to 8 percent threshold Wright and Bailey (1982) cite when firebrands may be problematic in grass fuels, but greater than the 5 percent threshold Wright and Bailey (1982) identify when spot fires are a certainty. In southern forests, Wade and Lunsford (1989) recommend minimum fine fuel moisture of 10 percent for understory burns. In northeastern fuels, exercise caution as fine fuel moisture decreases and evaluate this parameter in terms of interactions with other prescription parameters (e.g. windspeed).

At the high end of the prescription, spot fires are rare as fine fuel moisture exceeds 11 percent (Wright and Bailey 1982). The 12 to 15.5 percent median maximum 1-hour fuel moisture found in this study (Table 4) is less than the recommended maximum fine fuel moistures recommended for understory burns in southern forests, which is 20 percent (Wade and Lunsford 1989).

Results showed median minimum **10-hour fuel moisture** was 8 to 8.5 percent on the low end of the prescription window depending on the fuel group. Wright and Bailey (1982) recommended minimum 10-hour fuel moistures of 7 percent. In southern forests, the recommendations are slightly higher when burning slash—10 percent in open areas and 15 percent in the forested units (Wade and Lunsford 1989). Recommended minimum 10-hour fuel moisture for burning slash in the intermountain west was 6 percent, but 8 percent in forested units (Beaufait 1966). The 8 percent median minimum 10-hour fuel moisture for burning the slash fuel group in this study is close to recommendations in many other regions.

On the high end of the prescription, median maximum 10-hour fuel moisture ranged from 18 to 25 percent (Table 4). These values are slightly higher than other regions. The recommended maximum 10-hour fuel moisture for burning slash in the intermountain west was 15 percent in the open and 25 percent in forested units (Beaufait 1966). Wright and Bailey (1982) recommend slash burns when 10-hour fuel moisture doesn't exceed 12 percent.

Windspeed is an important contributor to fuel combustion (Davis 1959). Median midflame windspeeds in this study ranged from 0 to 2 miles per hour (mph) depending on the fuel group at the low end of the prescription through 8 to 10 miles mph at the high end of the prescription (Table 4). These results are similar to the recommendations in southern forests (Wade and Lunsford 1989) and the intermountain west (Beaufait 1966). Wade and Lunsford (1989) encouraged burning with midflame windspeeds of 1 to 3 mph and up to 10 mph if appropriate firing techniques are used. The majority of fire specialists in the intermountain west prefer to burn with minimal wind and don't burn with winds exceeding 10 mph (Beaufait 1966).

Recommended optimal windspeeds for the northern great plains range from 5 to 18 mph (Higgins et al. 1989). Wright (1974) recommends midflame windspeeds of 8 to 15 mph and these numbers are similar to Ralphs et al.'s (1976) preferred windspeeds in western rangelands. Although there is considerable variation in fuel models used for some northeastern habitats, windspeed often trumps local variability in fuels for predicting fire behavior under common conditions (Ducey 2003).

Some fire modeling programs, such as BehavePlus, require 20-foot windspeed as an input. Most prescribed burning guidelines predate BehavePlus' inception and don't address 20-foot windspeed. An exception is the 6 to 20 mph recommended 20-foot windspeeds for conducting underburns in southern forests (Wade and Lunsford 1989). Those recommendations are consistent with the results found in this study (Table 4).

KBDI is a measure of drought (Keetch and Byram 1968). As such, it is useful strategically when deciding whether to conduct a burn, but some other prescription parameters have a more defined impact on fire behavior (e.g. 1-hour fuels, relative humidity, midflame windspeed). Melton (1996) outlines expected fire effects when burning at different KBDI levels. 200 to 400 is an acceptable range to carry fire through most fuel types in southern forests. KBDI from 400 to 600 represents the high end of the prescription in southern fuels and will result in more extreme fire behavior (Melton 1996). The results provided in Table 4 are compatible with Melton's (1996) findings and only reach a KBDI value of 400 in the grass fuel group. One-hour and 10-hour fuels carry a fire—consequently, a successful burn may be completed shortly after a rain despite a high KBDI level (Melton 1996).

Days since last rain is a prescription parameter used in some prescribed fire plans. It is a guidance parameter that can help planners predict when fuels will be ready and safe to burn. The median minimum value for this parameter was one for all fuel groups and the median maximum ranged to five to seven days depending on the fuel group (Table 4).

Good winter burning conditions exist in southern forests for “several days” after ¼ to ¾ inch of rain (Wade and Lunsford 1989). Wright and Bailey (1982) suggest 3 to 4 inches of precipitation prior to most prescribed burns to provide adequate soil moisture. Burns have been conducted less than one day after rains in grasslands of the northern great plains while five days or greater will facilitate more drying and hotter burns (Higgins et al 1989). Melton (1996) recommends burning within two to three days after a rain in the south.

The median minimum **atmospheric mixing height** for a prescribed burn is 1,500 feet in the northeast for all fuel groups (Table 4). Wade and Lunsford (1989) recommend 1,700 feet as a minimum mixing height for underburns in southern forests. Most regional prescribed burning guidelines don’t include mixing heights as a prescription parameter although some recognize atmospheric stability as a consideration in the burn (Beaufait 1966, Higgins et al. 1989).

In the northeast, median maximum mixing heights exceed 1,500 feet throughout most of the year (Holzworth 1964). However, November through February mixing heights are lower than any time of year (Holzworth 1964), and during this time it may be more difficult to conduct a burn. Another consideration is that inversions occur on an almost daily basis throughout most of the country (Holzworth 1964). Starting burns late in the afternoon or leaving fires to smolder to achieve prescribed fires objectives may not be feasible, particularly in the wildland-urban interface.

The objectives and conditions on-site will dictate how prescription parameters should be modified and what the appropriate values should be. In the wildland-urban interface, mixing height may need to be adjusted to a higher altitude than the 1,500 feet identified here. The risks of burning with high fuel moistures, high relative humidity and low temperatures are relatively low, resulting in excess smoke and poor combustion. The risks of burning with low fuel moisture, low relative humidity, and high temperatures carry high risk. The results in this study can provide a framework to begin the planning process.

The list of habitats associated with each **fuel group** (Table 1) and the corresponding list of fuel models (Table 3) can be used to identify the current state of practice, including those cases where practice reflects some uncertainty about the appropriate fuel model to use. In some cases, habitats, such as pitch pine-scrub, scrub, or grass, are included in multiple fuel groups. It appears there aren’t uniform fuel models or fuel groups that fire planners use to model fire behavior for some northeastern habitats. In some cases, fire researchers have responded to this challenge by developing custom fuel models for specific sites (Woodall 1998, Patterson 2001, Dibble et al. 2003, Patterson et al. 2005). Appropriate fuel models and associated prescription parameters may be selected using the results in this study, along with other aids such as technical publications (Anderson 1982, Scott and Bergan 2005, Wright et al. 2006), fuel sampling, and experience.

Analysis was conducted on the four Anderson (1982) fuel groups (grass, shrub, timber, slash). Within each fuel group there is variability between fuel models; for example, fuel model 1 (short grass) responds differently to fire than fuel model 3 (tall grass). This variability within fuel groups was not analyzed because of the sample size and makeup of the data set.

Conclusions

This paper outlines median maximum and minimum prescription parameters for different fuel groups in the northeastern United States. The results of this study may aid in prescription development for different fuel groups or habitats. Specific fire management objectives can be achieved by deviating from the prescription parameters outlined in this document. Those not intimately associated with prescribed fire programs will find general prescription parameters for prescribed fires in the region. Prescription parameters are a useful tool to aid in the prescribed fire planning process. There are many other elements, such as tactics (ignition sequence, firing technique, etc.) that contribute to safe and effective prescribed burning.

The summary of prescriptions outlined in this document are intended to provide baseline information and broadly investigate the question—"Generally, what prescriptions are being used in different northeastern fuels?" It doesn't address how fires behave under specific conditions or link specific weather conditions and fire behavior to fire effects. We hope that this information can aid in the planning process and act as an additional source of information when developing and reviewing burn plans, or when trying to better understand the current state of prescribed fire practice in the northeast.

Ultimately, prescription parameters are one input into the complex process of planning and implementing prescribed burns. The number one goal is always safety; after that, desired fire effects would ideally drive what sort of fire behavior is encouraged and when to burn within the prescription window.

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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.

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