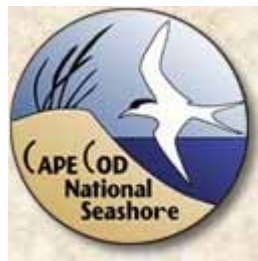


# Managing Fuels in Northeastern Barrens v-2.0

Second printing, August 31, 2004



The Village of Lake Pleasant, Massachusetts following the disastrous Montague Plains fire of 1907  
(courtesy Jonathan Parrott)



**A Field Tour Sponsored by  
The Joint Fires Sciences Program  
June 14-18, 2004**

**In cooperation with:**

**The University of Massachusetts/Amherst  
Cape Cod National Seashore  
The Massachusetts Division of Fisheries and Wildlife –  
Ecological Restoration Program  
The Massachusetts Department of Conservation and  
Recreation – Bureau of Forestry**

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S. Wellfleet, MA

## **Day-by-Day Schedule of Activities**

### **Monday, June 14, 2004**

Afternoon—Travel to Howard Johnson in Hadley (east on Rt. 9 from Exit 19 off I-91N) (phone: 413 586-0114). Dinner on your own

Parking for the week will be available at the Howard Johnson, upon signing a waiver

7:30pm—Check-in/Tour Orientation in the lobby of the Howard Johnson [Bill Patterson/Kim Iwamoto]

### **Tuesday, June 15, 2004 (Montague Plains Wildlife Management Area - Montague)**

7:00am-8:00am: Continental breakfast at the Howard Johnson

8:00am: Leave Howard Johnson, drive to Montague Sand Plains

8:30am: Montague Sand Plains [Tim Simmons/Glenn Motzkin]

9:30am: Predicting Crown Fire Hazard in Pitch Pine [Matt Duveneck]

10:30am: Canopy Fuels Treatments in Pitch Pine [Bill Patterson/Tim Simmons]

noonish: Lunch at the Country Creemee at an appropriate time

1:00pm: Scrub Oak Fuels and Biodiversity Management [Bill Patterson/Tim Simmons]

3:00pm: Leave Montague, drive to Buzzard's Bay/Bourne.

6:30pm: Overnight at the Eastern Inn (phone: 508 759-2711)

7:00pm: Dinner at Sandy's Restaurant.

### **Wednesday, June 16, 2004 (M.F. Correllus State Forest - Martha's Vineyard)**

7:00am: Coffee and muffins at the Eastern Inn

8:00am: Leave Eastern Inn, drive to Woods Hole

9:30am: Ferry departs Woods Hole for Martha's Vineyard

10:15am: Ferry arrives at Oak Bluffs

10:45am: Gate 18. Overview and history of Manual F. Correllus State Forest [John Varkonda/Tim Simmons/Glenn Motzkin]; Mechanical, Biological and Prescribed Fire Treatments in Scrub Oak and Pitch Pine [Bill Patterson/Dave Crary/Gretel Clarke]

1:00pm: Fire Station. Picnic Lunch (from Biga's or bring your own) on the ball field.

1:30pm: Walk to Oak Woodland/Scrub Oak and Pitch Pine plots

4:00pm: Load bus, travel to Vineyard Haven

5:00pm: Ferry departs Vineyard Haven

5:45pm: Ferry arrives at Woods Hole. Travel to Hyannis

Dinner in Hyannis, Overnight at the Day's Inn (phone: 508 771-6100)

### **Thursday, June 17, 2004 (Cape Cod National Seashore)**

7:00am-8:00am: Continental breakfast at the Day's Inn

8:00am: Leave Day's Inn, drive to Cape Cod National Seashore

9:00am: Marconi Atlantic White Cedar Swamp. Prehistoric and Historic Role of Fire in the Outer Cape Landscape [Glenn Motzkin and Bill Patterson]

10:30am: Travel to Truro

11am-4pm: Lombard/Paradise Fire Management and Research Study Area. 18-years of Prescribed Fire Research in Oak-Pine Woodlands [Bill Patterson/Dave Crary/John Norton-Jensen] Picnic Lunch (from Box Lunch)

4-6 pm: Cape Cod National Seashore conference room. Discussion, wrap-up, looking ahead.  
 6:00 pm : Travel to North Eastham, Overnight at Blue Dolphin Inn (phone: 508 255-1159)/Dinner

**Friday, June 18, 2004**

7:30am: Breakfast buffet at Laura and Tony's Kitchen, adjacent to the Blue Dolphin Inn  
 8:30am: Load bus and depart for Hadley  
 12:00pm: Return to the Howard Johnson, Hadley. Pick up cars/Travel home – Have a Safe Trip!

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## **PROBLEM STATEMENT AND PROJECT GOALS**

Fire-dependent barrens of the Northeast are an important habitat for a variety of rare, threatened, and endangered plant and insect species. They also represent the most dangerous wildland fuel complex in the region. Fire behavior in barrens vegetation is comparable to southern rough of the Southeast and chaparral of the West. Many barrens occur in densely populated areas such as Cape Cod, Long Island and within the city limits of Albany, NY where they pose a significant wildland-urban interface risk.

We have developed fuels management demonstration sites at Montague (Montague Plain Wildlife Management Area), on Martha's Vineyard (Manual F. Correllus State Forest), and Cape Cod National Seashore. Barrens fuel types/plant communities include dense scrub oak thickets and closed-canopy pitch pine forests at Montague and Martha's Vineyard, and mixed pitch pine-oak woodlands at Martha's Vineyard and Cape Cod National Seashore. Our applied research documents the effects of treatments on rare species habitat, and the effects of treatments on fuel loads and fire behavior characteristics with the goal of modeling fire behavior in treated pine barrens fuels. Treatments include mechanical manipulation of shrubs, grazing by sheep to minimize grass and shrub fuels recovery, and thinning of pitch pine canopies to reduce the threat of crown fire. Prescribed fire is being used to manage fine fuels and to evaluate the effectiveness of mechanical and grazing treatments.

Information transfer is an important part of our project and this field tour is a primary means by which we hope to initiate that process.

## **ACKNOWLEDGMENTS**

Our work is supported by grants and contracts from the Joint Fire Sciences Program (to WA Patterson and DW Crary), the Massachusetts Department of Conservation and Recreation Bureau of Forestry (to WA Patterson and PR Sievert, and the Massachusetts Division of Fisheries and Wildlife Ecological Restoration Program (to WA Patterson) in cooperation with the University of Massachusetts/Amherst, Cape Cod National Seashore, The Massachusetts Bureau of Forest Fire Control, and the Massachusetts Chapter of The Nature Conservancy. JFSP, MDCR and MDF&W funding has supported the graduate education and research of Gretel Clarke, Matthew Duveneck, Sarah Haggerty and John Norton-Jensen. We would like to thank, in particular, Bob Clark of the JFSP, Bill Rivers and Jim DiMaio of MADCR-BF, Mike Tirrell of MABFFC, Tim Simmons of MADF&W, John Varkonda of MFCFSF, and Joel Carlson of MATNC) for funding and/or facilitating our work.

## PROJECT SCHEDULE

1985-2006	Establish and maintain prescribed fire and mowing treatments at CCNS.
2000	Initiate fuels management in Scrub Oak at MPWLMA.
2002	Establish and sample plots prior to treatments, initiate thinning, brushing, grazing treatments at MFCSF.
2003	Establish mowing + burning treatments at CCNS, pretreatment sampling. Post-treatment sampling at MFCSF.
2004	Thin pitch pine at Montague. Burn mechanically treated plots at Montague Continue treatments and monitor at CCNS. Burn treatment plots at MFCSF. Field tour for area fire managers to all three sites.
2005 & 2006	Technology transfer/training at CCNS, MFCSF & satellite sites.

## VIDEO REFERENCE PAGE

**Video Outline** 1:21 total ( Video produced by Matthew Duveneck and Michael Ohman)

**Martha's  
Vineyard**

<b><i>Scrub oak Plot 5 Control</i></b>		
	<u>Date</u>	<u>Start time</u>
1 <sup>st</sup> strip head fire	7-May	11:54:13 AM
2 <sup>nd</sup> strip head fire	7-May	12:07:28 PM
Fire behavior results of above	7-May	12:19:00 PM
<b><i>Scrub oak Plot 6 Mow</i></b>		
1 <sup>st</sup> strip head fire	6-May	4:04:50 PM
2 <sup>nd</sup> strip head fire	6-May	4:14:55 PM
Fire behavior results of above	6-May	4:19:40 PM
<b><i>Scrub oak Plot 2 Mow/graze</i></b>		
1 <sup>st</sup> strip head fire	6-May	2:49:08 PM
2 <sup>nd</sup> strip head fire	6-May	2:55:51 PM
Fire behavior results of above	6-May	3:01:21 PM
<b><i>Pitch pine Plot 1 Control</i></b>		
1 <sup>st</sup> strip head fire	30-Apr	3:27:32 PM
Fire behavior results of above	30-Apr	3:30:10 PM
2nd strip head fire	30-Apr	3:43:05 PM
Fire behavior results of above	30-Apr	3:44:44 PM
Burn out operation at the southwest corner	30-Apr	4:08:59 PM
<b><i>Pitch pine Plot 7 Thin/mow</i></b>		
1st strip head fire	5-May	3:11:53 PM
2nd strip head fire	5-May	3:18:57 PM
Fire behavior results of above	5-May	3:23:53 PM
<b><i>Pitch pine Plot 3 Thin/mow</i></b>		
1st strip head fire	7-May	1:55:40 PM
Fire behavior results of above	7-May	2:02:35 PM
2nd strip head fire	7-May	2:05:13 PM
3rd strip head fire	7-May	2:10:35 PM
Fire behavior results of above	7-May	2:14:24 PM

**Cape Cod**

4th strip head fire	7-May	2:16:52 PM
Fire behavior results of above	7-May	2:20:44 PM
<b><i>Pitch pine Plot 2 Thin/mow</i></b>		
1st strip head fire	7-May	2:44:50 PM
Fire behavior results of above	7-May	2:48:49 PM
2nd strip head fire	7-May	2:52:35 PM
Fire behavior results of above	7-May	2:56:37 PM
<b><i>JFSP plot 2 Control</i></b>		
spot fire	12-May	1:49:52 PM
strip head fire	12-May	2:07:00 PM
<b><i>JFSP plot 5 Mow</i></b>		
spot fire	12-May	3:43:00 PM
1st strip head fire	12-May	5:05:57 PM
Fire behavior results of above	12-May	5:12:03 PM



## Tuesday: Montague Plains Wildlife Management Area

**Site Description.** (modified from Clark and Patterson 2002) The Montague Plain Wildlife Management Area (MPWMA) is located in the Connecticut Valley of western Massachusetts in the Franklin County town of Montague (Figure 1). The area lies on the Greenfield, Massachusetts, U.S. Geologic Survey 7.5 minute quadrangle (at approximately 42°34'N latitude and 72°32'W longitude). The MPWMA is owned and managed by the Massachusetts Department of Conservation and Recreation (DCR) Division of Fisheries and Wildlife (DFW) in cooperation with Northeast Utilities (NU). The primary purpose of the site is to protect and preserve an outstanding example of a xeric outwash pitch pine-scrub oak barren natural community, its associated biota, and ecological processes. Pitch pine-scrub oak barrens, also known as "pine plains," "sand plains," "pinelands," and "pine bush," occur throughout the Northeast from New Jersey to Maine (Finton 1998). These barrens are characterized by excessively drained soils and by several plant species which are highly flammable and/or have adaptations to survive or regenerate after fire (Finton 1998, Motzkin *et al.* 1999). Pitch pine-scrub oak barrens are among the rarest and most imperiled natural community types in the United States (Patterson and White 1993, Swain and Kearsley 2001), and they support a number of rare species, especially rare lepidopterons such as Gerhard's underwing moth (*Catacala herodias gerhardi*) and barrens buckmoth (*Hemileuca maia*) (Swain and Kearsley 2001). The MPWMA provides an area for scientific research and limited public recreation, including hunting and wildlife viewing. Additionally, part of the property protects the water supply (groundwater recharge area) for the DF&W's Bitzer Fish Hatchery and the Town of Montague water supply.

**Fire History.** Paleoecological evidence strongly suggests fire was a common occurrence on the Montague Plain from 500 to at least 2,000 years before European settlement (Motzkin *et al.* 1996). Sediment cores from Green Pond, Lake Pleasant, and Dead Frog Pond adjacent to the property showed high charcoal-to-pollen ratios (Motzkin *et al.* 1996). Most pre-historic fires were probably human-caused. Lightning-caused wildfires are rare in New England today, and are assumed to have been rare during recent prehistoric periods (Patterson and Sassaman 1988). Lightning-caused fires may have been more common in southern New England during the mid-Holocene, however, due to warmer and drier conditions (Patterson and Sassaman 1988). Throughout North America, prehistoric Native Americans utilized fire as a landscape management tool to increase browse and mast for game species, drive game, increase production in certain food-bearing plants, ease travel through the wilderness by clearing underbrush, communicate among groups, facilitate effective defense of their communities and territories, and, once agriculture was adopted, to clear and fertilize crop lands (Lewis 1982, Patterson and Sassaman 1988). There are many references to fire-maintained landscapes and the use of fire by Native Americans in southern New England (Patterson and Sassaman 1988, Dunwiddie and Adams 1995, Bromley 1935, Cronon 1983, Day 1953). These general

trends and the paleoecological evidence specific to the Montague Plain suggest that prehistoric Native American burning on the Montague Plain was practiced for a sufficient length of time as to profoundly influence the vegetation.

Fire history of the post-settlement/pre-agricultural period (roughly 1720 to 1850) is not well known. Given that the Plain was utilized mostly for forest resources during this period, it is not unreasonable to conjecture that the pre-settlement fire regime persisted either out of accident or design. During the period from 1850 through 1925, agriculture was widespread on the Plain (Motzkin *et al.* 1996), and fire occurrence is presumed to have been very limited due to a lack of fuels.

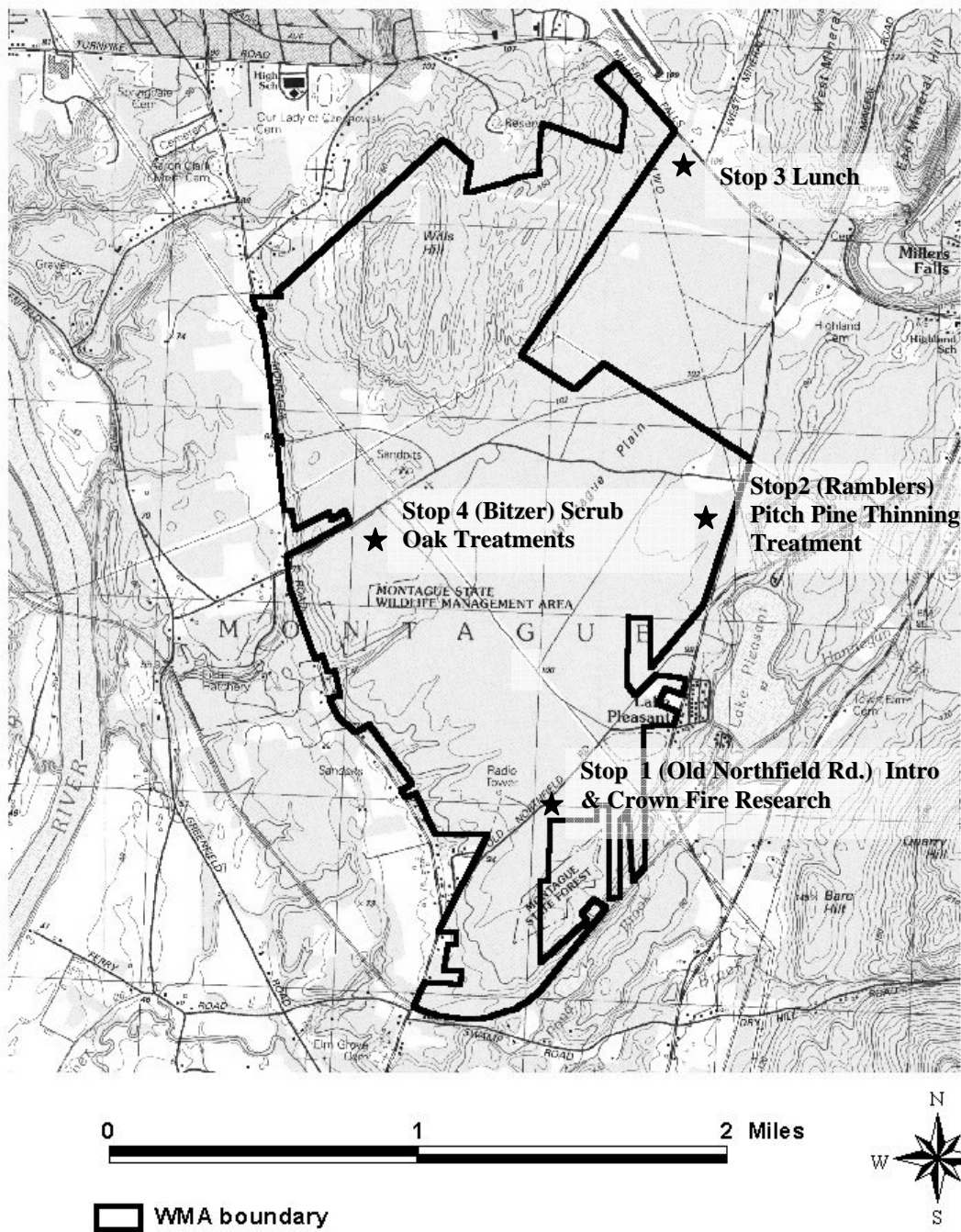
The early 1900's saw the decline of agriculture on the Plain, the regeneration of forest and scrub fuels, and the development of suppression approach to fire management. Historical records indicate that extensive fires (some larger than 1,000 acres) burned through the Plain in the early and middle 20th century followed by numerous smaller fires (less than 5 acres) after about 1950 (Motzkin *et al.* 1996). The last large fire (approximately 460 acres) occurred in 1957. Motzkin *et al.* (1996) note, "A similar pattern of large fires early in [the 20th] century followed by many small fires in recent decades has been noted elsewhere in the northeastern United States, and is interpreted as resulting from improved fire detection and suppression capabilities and an increase in accidental fires." Recreational use of the site appears to have increased dramatically since corporate ownership in the 1960's , and numerous fires have been ignited accidentally (or sometimes intentionally) by people using the area for recreation.

Fires have occurred in every month of the year, but are most frequent in April and May (Motzkin *et al.* 1996). This pattern is consistent with the fact that the lowest average relative humidities in the region occur in April and May, that leaf-out of deciduous species on the Plain has not occurred leading to very low fuel moisture conditions, and that this period corresponds with the Massachusetts legal open burning season.

Starting in 2000, small prescribed burns have been conducted on a portion of the Montague Plain WMA for ecological management and training purposes. There are no records of intentional burning to accomplish resource management objectives prior to 2000. (from Clark and Patterson 2002)

NOTES:

### Figure 2: Montague Plain Wildlife Management Area



## ***Stop M-1: Introduction to the MPWLMA. Pitch Pine Crown Fuels Characterization and Crown Fire Behavior Prediction***

Crown fires represent a unique problem in Pitch Pine barrens of the Northeast. The development and behavior of crown fires are difficult to predict and often erratic. Compared to surface fires, crown fire characteristics are associated with:

- Fires that are more difficult to control (Scott and Reinhardt 2001),
- Higher spread rates (Rothermel 1983),
- Frequent spotting occurring over long distances (Butler and Cohen 1998),
- Spotting and increased radiant heating making structures more difficult to defend (Butler and Cohen 1998),
- Longer flame lengths dictating larger safety zones (Butler and Cohen 1998),
- Ecological effects that are more immediate and long lasting. (Scott & Reinhardt 2001).

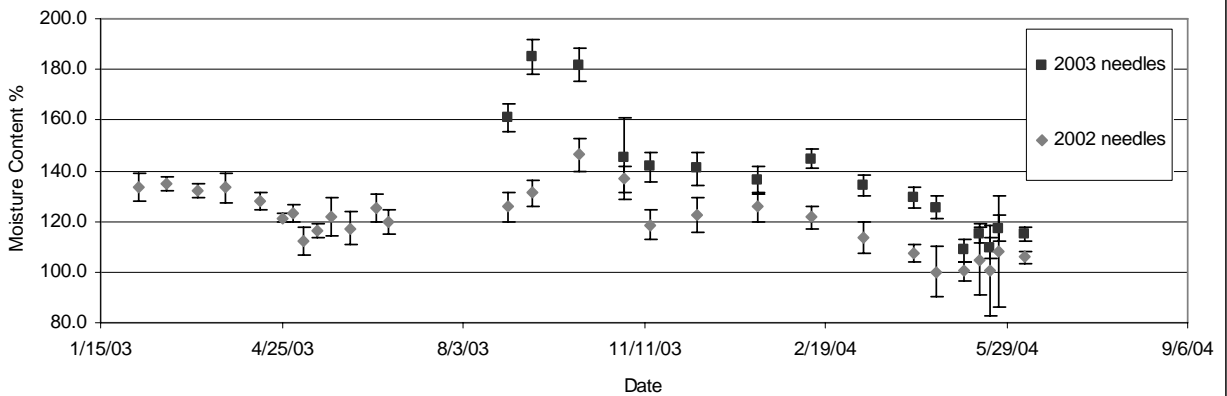
Crown fire models exist to assist fire managers in predicting intensity and rate of spread in many coniferous tree species. Van Wagner (1977) theorized and Rothermel (1991) applied the concept that the density of a crown fuel layer is related to the minimum spread rate of a crown fire. Canopy characteristics, which are inputs to the models, have, until now, never been measured directly for Pitch Pine.

We destructively sampled 31 Pitch Pine stems from three sites and have developed regression models to predict available fuel weight data using tree diameter at breast height. Canopy Bulk Density, or the weight of canopy fuels per volume of canopy, can be used to predict Crowning Index – the wind speed at which active crown fire is possible within a specified fire environment.

With canopy bulk density predictions, we can model crown fire behavior using programs such as FARSITE or the nomogram in the back of this field guide. By understanding the inputs to the crown fire behavior models, we can better apply management decisions to treat Pitch Pine stands prone to crown fire.

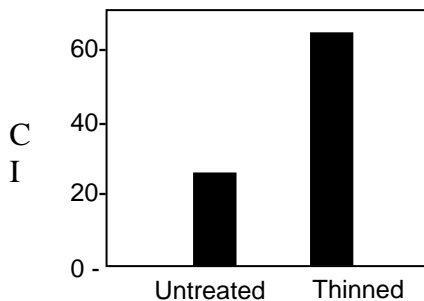
For the past two years, we have monitored live fuel moisture in Pitch Pine needles. The results (graph next page) show a significant decline in moisture content in late spring for both one- and two-year-old needles. This decline in moisture content corresponds with the period in early May when many of the largest fires have burned through barrens in the past. Lower canopy fuels moisture content would facilitate torching that could lead to crown fire development under high wind conditions

Montague pitch pine needle moisture content over one year of measurements starting in February 2003. Error bars represent 95% confidence intervals. The drop in moisture content bottoming out in the beginning of May indicates a seasonal low with implications for increased crown fire hazard. Assuming this trend is annual, crown fire hazard assesment can be modeled using these data.



## Stop M-2: Managing Pitch Pine to Reduce Crown Fire Potential.

During winter 2004 DF&W initiated at the Rambler's site applied research, the goal of which is to demonstrate the potential for reducing the threat of crown fires in mature Pitch pine stands. Closed-canopy Pitch Pine stands at Montague have 100-170 ft<sup>2</sup> of basal area per acre. Stocking in this stand was reduced to approximately 25-30 ft<sup>2</sup>/acre. We estimate that the wind speed that would initiate active crowning increased from less than 30 mph to more than 60 mph as a result of the operation (figure below). Trial FARSITE runs indicate that the operation would substantially reduce the likelihood that a crown fire would continue through the treated area (see FARSITE output on following page). Slash from the operation was ground with a Brontosaurus leaving nearly 24 tons/acre of highly compacted residual material on the ground (table below).



Thinning increased the crowning index from ~ 30 to about 65 mph.

Ramblers pitch pine	control	thin/ground
litter (tons/acre)	4.9	23.7
live shrubs (tons/acre)	0	0.1
fuel bed depth (ft)	0.5	0.3

***What we have learned:***

- A method to predict canopy bulk density in pitch pine using linear regression and the independent variable dbh.
- Thinning pitch pine will reduce canopy bulk density and increase the wind speed needed to sustain an active crown fire (crowning index).
- Disposal of slash remains a challenge

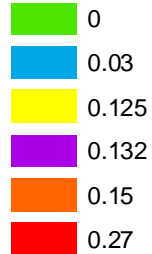
**NOTES:**

## Farsite Simulations at Montague:

25 mph wind @ 270 true for 1.5 hours



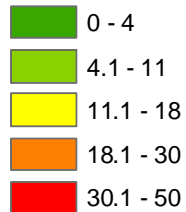
### canopy bulk density (kg/m3)



### fire behavior type



### rate of spread (ft/min)



#### Fuel Parameters:

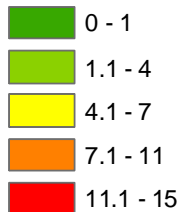
\*Fuel model 6 for pitch pine surface fuels.

\*Fuel moisture conditions:

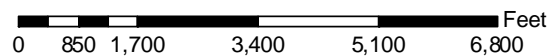
1hr = 9%,  
10hr = 12%,  
100hr = 16 %,  
Foliage = 100%.



### flame length (ft)



FARSITE simulations by Matthew Duveneck



### ***Stop M-3: Lunch at the Country Creemee***

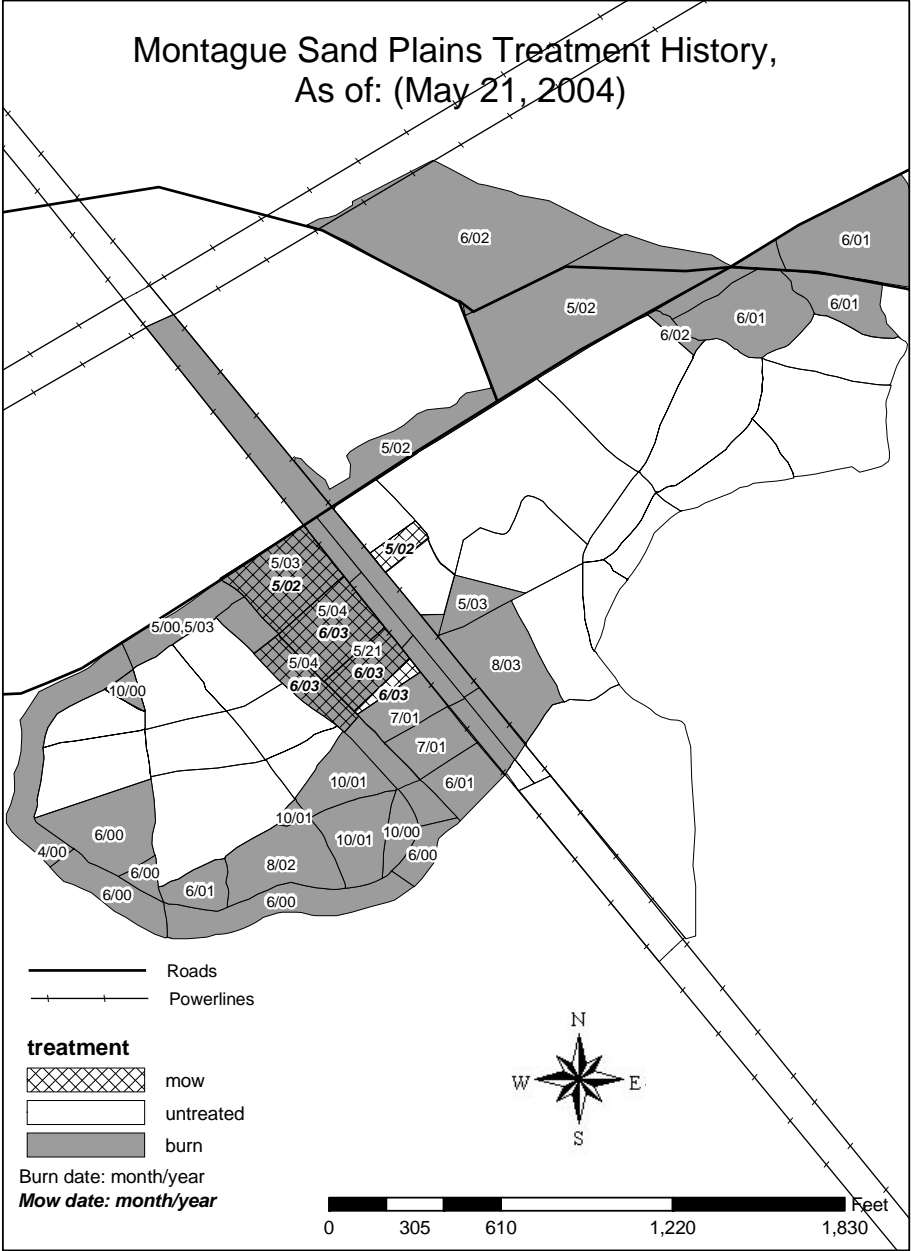
### ***Stop M-4: Scrub Oak Fuels and Biodiversity Management***

In spring 2000 we initiated prescribed fire management of Scrub Oak thicket fuels at the Bitzer Fish Hatchery watershed protection area on the west side of the MPWLMA. Initial burns had as their goal the establishment of a fuel break around the core area west of the NU transmission lines (picture below). We have conducted 6-8 burns per year during each of the past four years during all months between March and October. We have burned grassy-heath fuels, Scrub Oak thickets, and closed-canopy Pitch Pine, Oak and aspen stands. Burn units range in size from less than an acre to 5-6 acres (map on following page). Firebreaks and access corridors were initially established by mowing, and in 2002 we began combining mowing and burning treatments on some units. We will examine the effectiveness of several combinations of mowing and/or burning in reestablishing the vigorous, young stands of Scrub Oak believed to be high quality habitat for Lepidoptera. Results of our most recent treatments indicate that we can reduce live plus dead fuel loads in overmature stands of Scrub Oak from 25 tons/acre to 3 tons per acre in 12 months with a combination of mowing and burning (see table below).



<b>Bitzer Scrub oak</b>	control	ground	ground/burned
litter (tons/acre)	13.1	25	2.9
live shrubs (tons/acre)	12.2	0	0
fuel bed depth (ft)	2	0.6	0.13





What we have learned:

- **Mechanical treatments followed by prescribed fire reduce the time required to restore vigorous, young scrub oak stands from 6 years to less than two years.**
- **Prescriptions to effectively reduce slash loads in mowed areas require low 1, 10 and 100-hr fuel moistures but high 1000-hr moistures.**
- **Prescribed fire alone is accompanied by increased risk of escape and/or smoke management problems.**
- **Mechanical treatments cost \$300-\$500/acre using a DAVCO mower.**

NOTES:

## Wednesday: M.F. Correllus State Forest, Martha's Vineyard



Martha's Vineyard Heath Hen Reserve – 1926 (HQ in background, courtesy G. Motzkin)

**Land-Use History.** (*modified from Mouw 2002*) M. F. Correllus State Forest was established in 1908 as a reservation for the last remaining population of the heath hen (*Tympanuchus cupido*), a race of the prairie chicken. The Forest was managed as habitat for heath hens until their extinction in 1932 (DEM, 1994). Through the course of the next 70 years, additional lands were purchased to bring the total area protected to more than 5,000 acres. Beginning in the 1920s and continuing through the early 1990s, approximately 1,700 acres were planted with conifers in an effort to provide timber for island industry. (see 194 vegetation map below) Due to the droughty soils, periodic fires, and insect and disease infestations, many of these plantations failed. The plantations are no longer expected to generate income for the Commonwealth of Massachusetts, are recognized as economic failures (Rivers, 1997) and are being liquidated from the more sensitive rare species habitats.

Historical documentation suggests that by the early 17<sup>th</sup> century there were between 3,000 and 3,500 Native American inhabitants on Martha's Vineyard (Richardson, 1985). Historical and archeological evidence for areas of mainland New England suggests that Martha's Vineyard supported a greater Native American population density than typically occurred on the mainland (Stevens, 1996). In part because of this, fire has been an important factor on Martha's Vineyard since before the time of European settlement. Stevens's (1996) fire history studies show a decrease in charcoal content of sediments for parts of the Island after European settlement. This implies a decrease in

fire occurrence with the arrival of Europeans. Sedimentary analyses are not possible on MFCSF proper, because it lacks permanent water bodies.

European settlers reached the Island in the early 17th-century, and by 1670 there were 180 Europeans living on Martha's Vineyard. By this time Native American populations were in decline due to disease (Foster and Motzkin, 1999). Through the colonial period, agriculture and grazing resulted in the clearing of much of the island's woodlands. Although agriculture was extensive, there was little cultivation on the glacial outwash in the center of the Island that is now MFCSF (Foster and Motzkin, 1999). This area was, however, probably cut repeatedly for fuelwood during the colonial period (Foster and Motzkin, 1999).

Although it is clear that sandplains were used extensively for grazing, timber, and industry (primarily pine tar) once settlement began, the nature of the vegetation of during the early colonial period is less well understood. Some evidence suggests that oak savannas – open woodlands dominated by scattered tree oaks with an understory of grasses and forbs - were present (Stevens, 1996). Although pollen studies of lagoon sediments suggest that grass was important in the near coastal environment, (Stevens, 1996), forest history studies suggest that pitch pine and scrub oak were dominant on the central plains (Foster and Motzkin, 1999). The presence of highly specialized, Scrub Oak dependant, lepidoptera such as the Barrens Buck Moth (*Hemileaca maia*) suggest that the barrens may have existed for millennia in much the same composition as the modern vegetation, although there is little historical data to corroborate this theory. Stevens (1996) concludes that, based on pollen evidence, the "historic landscape of Martha's Vineyard was characteristically forests and woodlands dominated by oak or mixed oak-pine, and occasional pine-dominated stands, interrupted by localized grassy clearings associated with Indian land uses along the shorelines of coastal ponds."

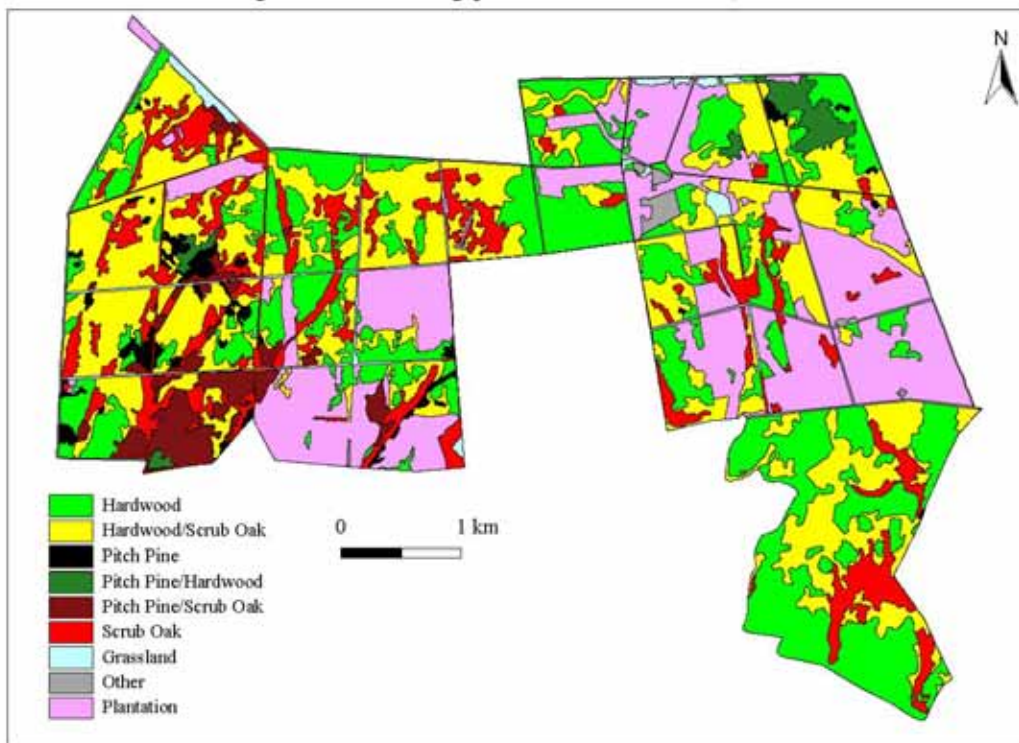
Colonial era land use opened much of the landscape to pasture and shrublands. Agriculture abandonment and a shift to coal rather than wood as the primary fuel source in the middle of the 19<sup>th</sup> century allowed much of Martha's Vineyard to revert to woodland in the early and middle 20<sup>th</sup> century (Dunwiddie, 1994; Foster and Motzkin, 1992). Although MFCSF was still used as a source of firewood, the effects of logging on the Forest were reduced by the early 20<sup>th</sup> century (Foster and Motzkin, 1999). The establishment of the Forest in 1908 prevented fragmentation of the central sandplain, but the development boom of the past 40 years has created a fragmented landscape as well as an overall loss of forested acres elsewhere on the Island (Foster and Motzkin, 1999).

Following establishment of MFCSF, fire was fought vigorously with limited initial success. Fires greater than 1,000 acres in size are recorded as having occurred 16 times from 1867 to 1929 on the Island as a whole (Table 1.1, derived from Foster and Motzkin, 1999). Many of these originated in or burned through the droughty central regions of the Island. Large fires in the 1920s are thought to have been a contributing factor in the extinction of the heath hen (Adams, 1992). Since the last large fire in 1954, improved fire fighting equipment and techniques have limited fire occurrence on MFCSF. The paucity of fire on the Forest in the past 50 years is believed to have allowed standing and downed fuels to build up to levels that would make fighting a fire in the Forest difficult (DEM, 1994).

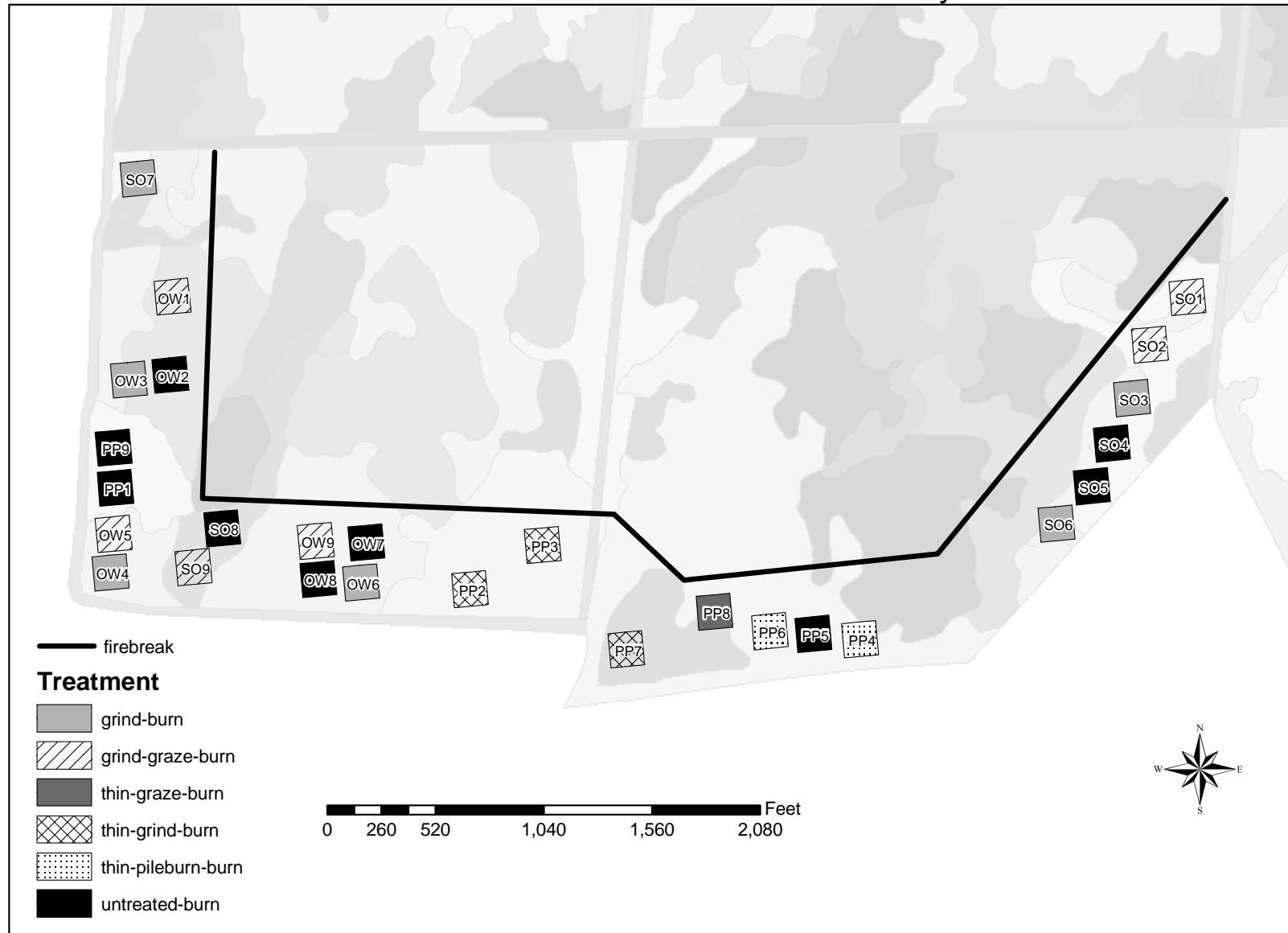
***Landscape/Fire Interactions.*** Topographic variation of the Forest is low, although gullies (bottoms) created by spring-sapping increase the potential for severe fire behavior, primarily due to the mixed scrub oak/grass/forb vegetation they support and their susceptibility to frost during the late spring and summer. Although the gullies can extend for up to one mile in length, their maximum width is considerably less – only a few tens of yards/meters – and they represent less than 1% of the total area of the Forest. The lack of topographic variation on the Forest allows large fires to spread through the broad expanses of scrubby vegetation.

The glacial outwash underlying most of the Forest consists of sand and gravel (Oldale and Barlow, 1986) which favor flammable ericaceous plant species. Coarse soils retain little water and create droughty conditions which facilitate the ignition and spread of fires. Although precipitation is common in all months, the combination of strong winds and droughty soils can result in rapid drying of fuels. Low relative humidity, especially in the spring, facilitates rapid evaporation and drying of fuels.

**Major Stand Types on MFCSF, 1994**

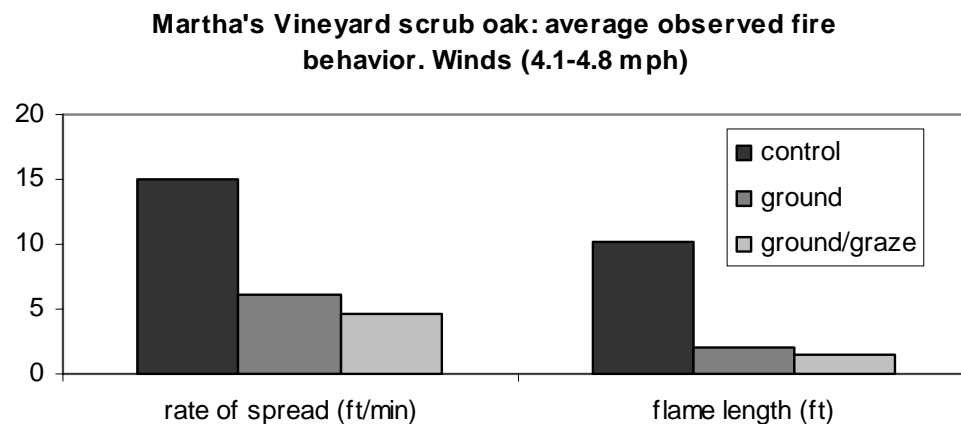


# JFSP Plots at MFCSF on Martha's Vineyard



## ***Stop MV-1: Willow Tree Scrub Oak Bottom along the Edgartown-West Tisbury Rd.***

Since the earliest days of state protection, a network of fire breaks has been maintained with the goal of improving access to the Forest by firefighters. In 2003 we initiated experiments to evaluate the effectiveness of various fuel treatments including thinning of Pitch Pine stands, grinding of shrub understories and grazing of regrowth by sheep. The goal was to determine the effectiveness of fuel-break construction techniques in reducing fire spread and to evaluate the impacts of treatments on rare plant and insect habitats. With a contract with the Department of Conservation and Recreation, we established 27, 0.5-acre plots in Scrub Oak, Pitch Pine and Oak Woodland vegetation. These are contained within a larger 80-acre area which has been developed as a 500-foot-wide fuel break adjacent to roads and residences near the southwest corner of the Forest. Pre- and post-treatment sampling documented rare species habitat variables and the effects of treatments on fuel loads. All 27 plots were burned to evaluate effects of the treatments on fire behavior in April/May 2004. We will examine several of these plots and discuss the project in the context of rare species conservation and wildfire hazard reduction.



### ***What we have learned:***

- **Grinding followed by sheep grazing virtually precludes the need or opportunity for the use of prescribed fire for up to two years.**
- **Mechanical treatments in scrub oak cost approximately \$200/acre using a Bullhog grinder.**
- **Sheep graze all resprouts one year following grinding at a cost of \$900/acre.**

[optional walk to Stop MV-2 past Pitch Pine and Oak Woodland plots]

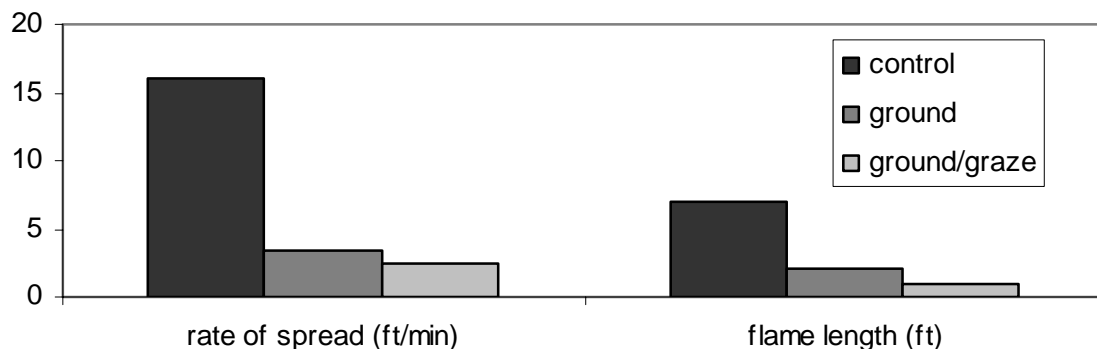
## ***Stop MV-2: Oak Woodlands and Pitch Pine***

About 55% of MFCSF consists of stands of tree oaks (mainly white, black, and post oak) with or without understories of scrub oak. An interesting aspect of these stand types is that many contain groups of oak sprouts in which 5 to 10 stems (or more) have developed in a circle, arising from a single stump. The stems are not particularly large (mainly 3 to 12 inches dbh) but the diameter of the circle of sprouts is often as large as 4 feet. The distinctive aspect of this sprout growth is that the sprouts arise individually from the ground, with no trace of the original stump remaining aboveground.

This growth form likely developed during the 18th and 19th century, when extensive fuelwood cutting and fires occurred. Small stems were cut and subsequent fires consumed the aboveground stump and killed small sprouts, causing new sprouts to develop from very close to the root collar. Whenever sprouts grew large enough to be harvested, the same process would have occurred again, with the circle of sprouts increasing in diameter, but with the 'stump' existing just below the litter layer.

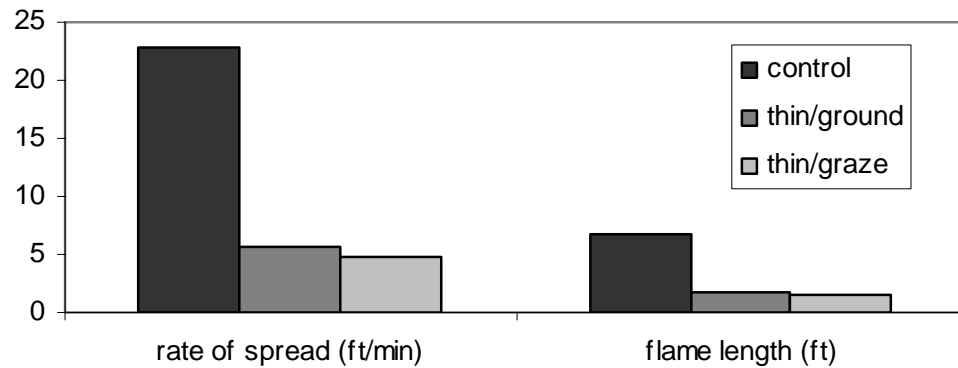
The most likely method of maintaining this growth form would be to replicate this historic pattern of cutting followed by burning. It is not known when this treatment would be needed, relative to the age of the stems. Sprout vigor declines with age, but the details of this relationship are not known for these species with the slow growth rates that occur on the dry sandy soils of MFCSF. Cutting alone would not maintain the growth form because aboveground stumps would persist (it would be impractical to cut stems at the soil surface), and stems growing from aboveground stumps may have shorter lifespans due to stem rot moving from decaying stumps into the sprout stems.

**Martha's Vineyard oak woodlands: average observed fire behavior. Winds (2.8-4.3 mph)**





**Martha's Vineyard pitch pine: average observed fire behavior. Winds (2.7-3.4 mph)**



***What we have learned:***

- Because local markets for poles and saw logs are lacking on Martha's Vineyard, the state must pay loggers to thin pitch pine stands. Elsewhere it should be possible to sell products resulting from thinning.
- Thinning pitch pine to a residual stand of 30 ft<sup>2</sup>/acre dramatically reduces the predicted risk of crown fire. Burning slash in piles reduces the intensity of surface fires at a cost of \$200/acre.

## Thursday: Cape Cod National Seashore

(*modified from Clark 2002*) Cape Cod National Seashore encompasses 43,570 acres of land and is located in the northeastern corner of the United States on the southeastern shore of the Commonwealth of Massachusetts. Cape Cod, a peninsula of glacially deposited material, extends eastward from the mainland and turns sharply northward. Cape Cod National Seashore is located on the portion of the peninsula known as the Outer or Lower Cape. The Seashore is entirely within Barnstable County and occupies parts of six towns: Chatham, Orleans, Eastham, Wellfleet, Truro, and Provincetown. Seashore headquarters is located in South Wellfleet, Massachusetts at approximately 41° 54' 12" N latitude and 69° 58' 42" W longitude.

**Historic Role of Fire.** Fire has been an important influencing factor on the landscape of southern New England and of Cape Cod in particular for millennia. In modern times, fire continues to influence the vegetation of the Cape to the extent that fire-adapted natural communities predominate over most of the Seashore. Paleocological evidence exists suggesting that pre-historic fire was a prominent process on much of the landscape of North America, including southern New England (Patterson and Sassaman 1988). Winkler (1982) found abundant charcoal throughout the stratigraphic column dating back 12,000 years from Duck Pond on Cape Cod suggesting that fire has played an important role in maintaining pine-oak forests on the Cape throughout the Holocene. Backman (1984) found a similar pattern of charcoal from a different core in the same pond dating back 4,800 years. Patterson and Sassaman (1988) cite numerous other studies that document high charcoal amounts in pre-Colonial pond sediments, although the records do not extend as far back in the past as Winkler (1982). A study of the Pamet Bog in North Truro shows that major fires burned about 2000 and 7000 years ago there (Patterson and O'Keefe 1979). A significant charcoal layer dating to approximately 1,000 years ago was found in sediments of the Marconi Atlantic white cedar swamp indicating a large fire and/or series of fires in that area (Patterson 1987). Motzkin et al. (1990) found evidence that large-scale fires burned through the Marconi area every 50 to 200 years prior to European settlement. Studies on nearby Martha's Vineyard yield similar results with high charcoal values in the paleocological record for at least the last 1,000 to 2,000 years (Stevens 1996).

Ignition of pre-historic fires was probably mostly human-caused. Lightning-caused ignitions of wildland fires are rare in New England, and are assumed to have been rare during prehistoric periods (Patterson and Sassaman 1988). Lightning-caused fires may have been more common in southern New England during the mid-Holocene, however, due to warmer and drier conditions (Patterson and Sassaman 1988). Pre-historic Native Americans utilized fire as a landscape management tool to increase browse for game species, drive game, increase production in certain food-bearing plants, ease travel through the wilderness by clearing underbrush, communicate among groups, facilitate effective defense of their communities and territories, and, once agriculture was adopted, to clear and fertilize crop lands (Lewis 1982, Patterson and Sassaman 1988). There are many references to fire-maintained landscapes and the

use of fire by Native Americans in accounts by early European explorers and settlers (Patterson and Sassaman 1988, Dunwiddie and Adams 1995). All evidence indicates that Native American burning on the Cape was practiced for a sufficient length of time as to profoundly influence the vegetation and act as an evolutionary force on the biota.

Dunwiddie and Adams (1995) provide a thorough assessment of fire history and vegetation on the Outer Cape from the time of European settlement through modern times. At the time of European-Native American contact, the upland vegetation of the Outer Cape probably consisted of a mosaic of forests and fire-maintained open woodlands comprised of oak, pitch pine, and other deciduous hardwoods with limited grasslands and heathlands. In areas of frequent and intense fires, scrub oak barrens may have been sustained. During the early settlement period (1600 - 1700), pioneers harvested much timber for use as lumber and fuelwood, and to open areas for crops and grazing. Settlers probably imitated Native Americans in their use of fire to clear land for agriculture. From 1700 to about 1840, grazing became an increasingly widespread and influential land use on the Cape. Deforestation of the Cape continued to the point that fuelwood became scarce. Colonists may have continued to use fire for agricultural purposes. By the end of this period tree-cutting, fire, and grazing had converted many formerly forested areas of the Cape to grasslands and heaths. From 1840 to 1910, agriculture, particularly grazing, began to decline. Trees, especially pitch pine, began to re-colonize abandoned pastures and fields. The arrival of railroads contributed a new ignition source and wildland fire frequencies increased. The lack of large human-made barriers to fire, limited resources at risk from fire (due to the small population and rural character), and relatively ineffective suppression technology resulted in a period of large wildland fires on the Cape. From 1910 until 1960, decline of agriculture and re-growth of forests continued. Tourism and population growth led to a proliferation of roads and development. The roads act as barriers to the spread of large-scale fires, and the development was put at risk from fires. Improved fire detection and firefighting technology and techniques evolved, and the Cape became a fire-suppressed landscape (Dunwiddie and Adams 1995). The central sand plain of Martha's Vineyard has similar soils to the Outer Cape, but lacks the historical conversion to agricultural use. That area has remained in oak woodland or scrubland for 1,000 to 2,000 years during which time fire was a common occurrence (Foster and Motkin 1999).

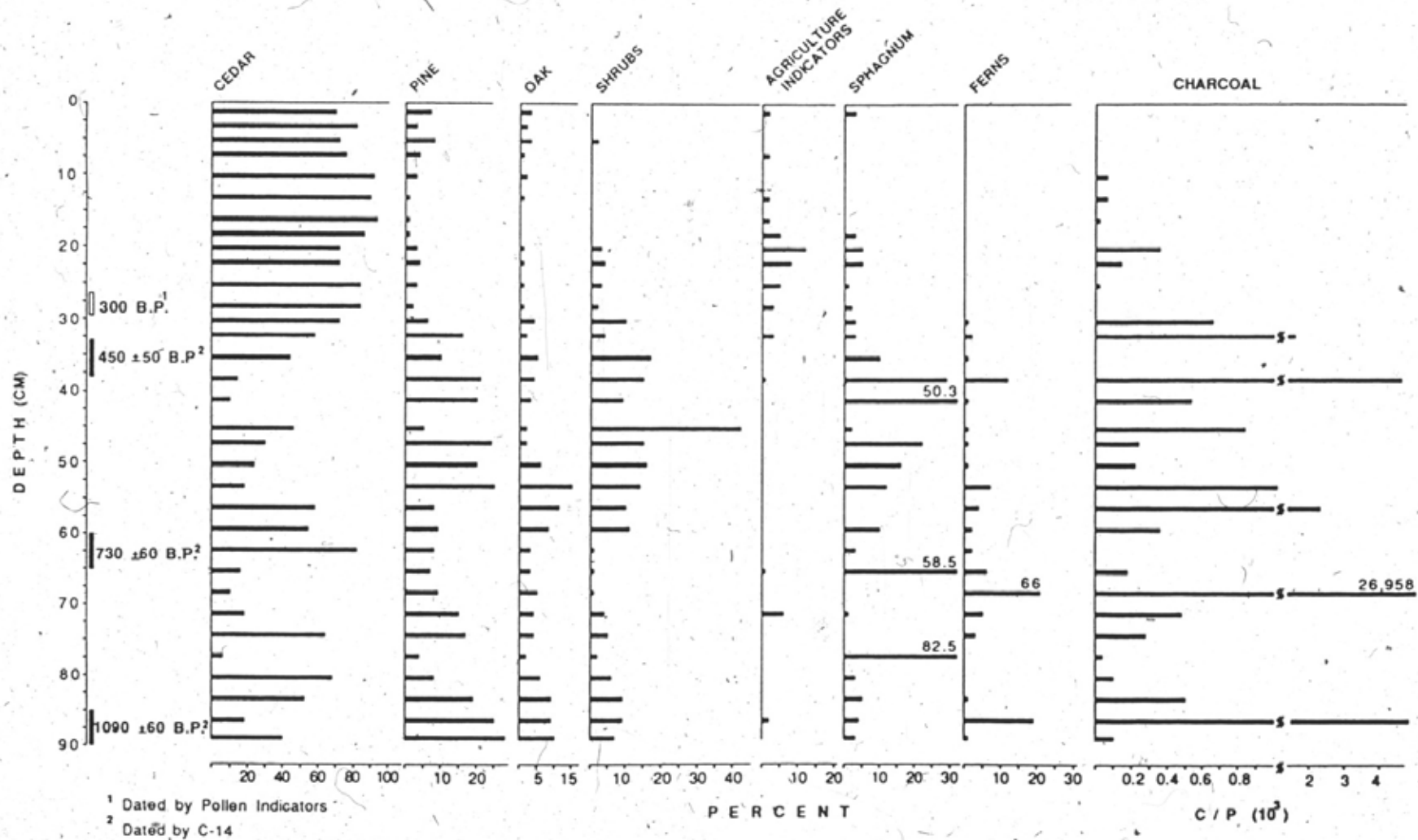
Cape Cod National Seashore was authorized in 1961, and written fire records date to 1974. A total of 290 wildland fires were recorded on the Seashore for the period from 1974 through 2000 with an average number of fires per year of 10.7. The greatest number of fires per year was 20 in 1977, and 15 or more fires occurred during seven of the 27 years in the record. Thirty-five prescribed burns were also conducted from 1992 through 2000. Most wildland fires (76%) were size class A (0.2 acres or less), 23% were class B (0.3 - 9.9 acres), and 1% was class C (10 - 99.9 acres). The largest wildland fire on record on the Seashore since it was established was 26 acres. Just over 90% of wildland fires occurred from April through October, and July and August have the highest numbers of wildland fires at 22% of the total each. Causes of wildland fires were mostly unknown/miscellaneous (38%) or campfires (33%). None were caused by lightning. (from Clark, 2003)

## ***Stop CCNS-1: Marconi Atlantic White Cedar Swamp***

Motzkin (1990) describes the modern vegetation of the swamp and Motzkin et al. (1991) the fire and vegetation history for the past 1,000 years. The site is interesting to us not only as an outstanding example of a mature Atlantic White Cedar swamp, but also because it provides evidence for the prehistoric role of fire in the Seashore's vegetation. The pollen and charcoal diagram (following page) show that the modern, closed-canopy stand was duplicated for only brief periods prior to the arrival of Europeans. Fires, which must have swept through pine-dominated forests on the upland, carried through the canopies of Cedar in the swamp creating a wetland vegetation that was, for a period, dominated by shrubby and herbaceous vegetation. Once Cedar filled in to form a closed canopy, fires again swept from the upland into the swamp at approximately 100-150 year intervals. The results suggest that high intensity fires burned through the uplands at least once every 100 years or so. These were no doubt complimented by surface fires that rarely entered the swamp, at least when it contained mature Cedar.

NOTES:

MARCONI ATLANTIC WHITE CEDAR SWAMP  
 CAPE COD NATIONAL SEASHORE  
 SOUTH WELL FLEET, MA.  
 ANAL: N.E.R. DRAKE



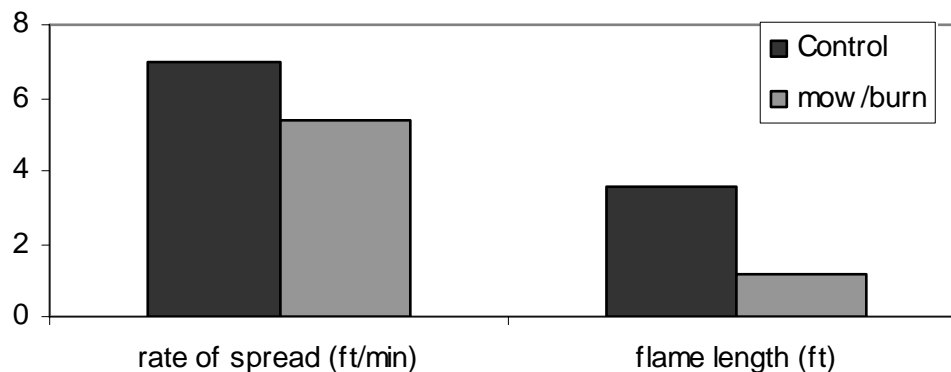
## ***Stop CCNS-2: Lombard/Paradise Fire Management Research Area.***

Beginning in 1986, we have conducted applied research on the effectiveness of varying season and frequency of treatments on plant community composition and fuel loading and fire behavior at a 17-acre site in south Truro (yellow oval on next map). We have treated shrub understories either by brush cutting or prescribed burning in wither the dormant or growing season on 60, 0.1-acre plots. All treatments are replicated three times, with treatments applied at 1-, 2-, 3- or 4-year intervals. This year plots treated at 1-, 2- and 3-year intervals are being burned or cut for the 18<sup>th</sup>, 10<sup>th</sup> and 7<sup>th</sup> times respectively.

In 1995 we began burning larger plots to compensate for the limitations inherent in using small plots. These plots have been burned primarily in the summer and we have developed higher intensity fires with effects that are more readily observed than on the smaller plots.

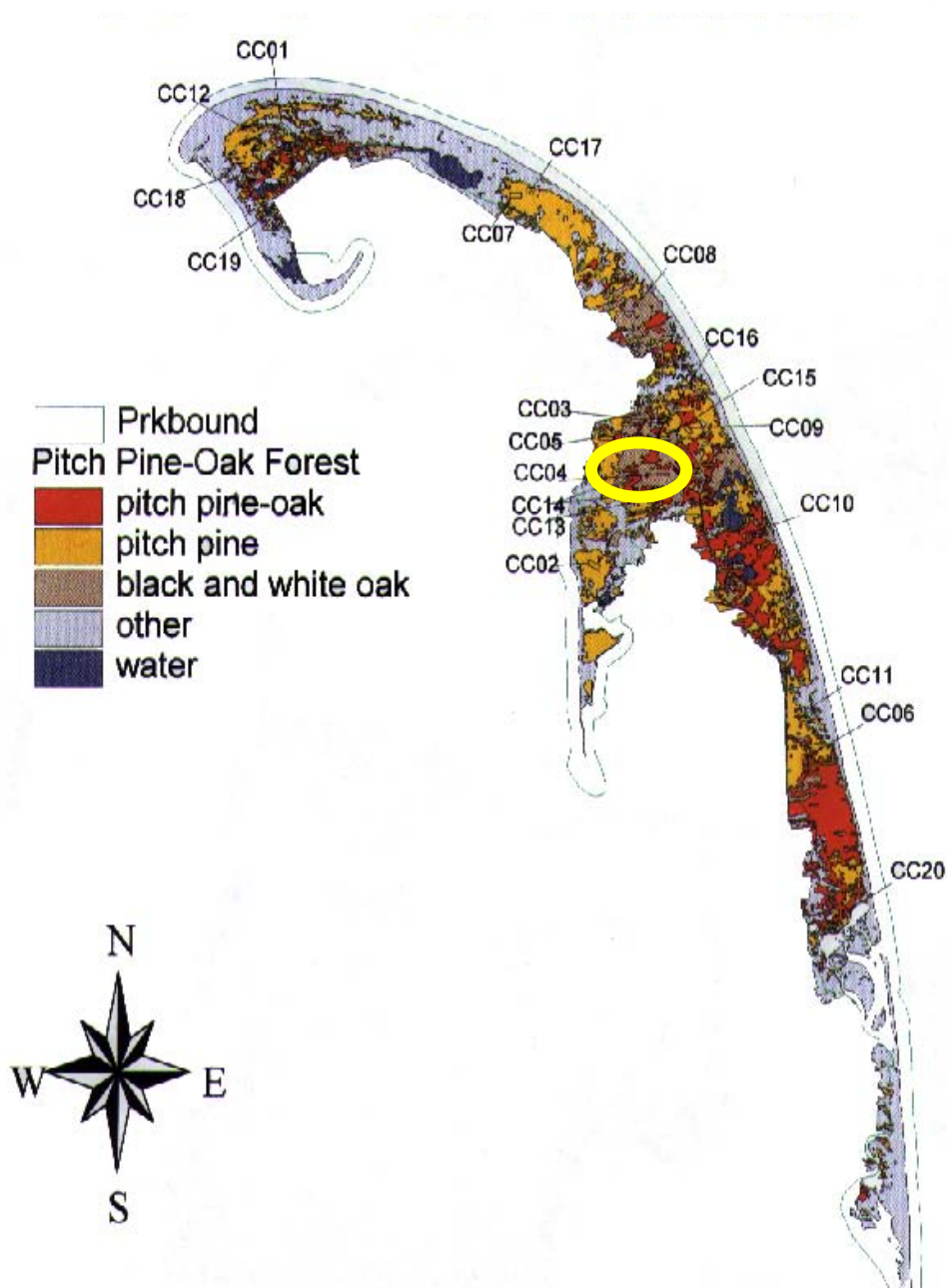
In 2003 we established six additional 0.5-acre plots, three of which were first brush cut in early July and then burned in early August. All six plots were reburned to evaluate effects of the treatments on fire behavior in May, 2004.

**CCNS pine oak: average observed fire behavior. Winds (1.2-2.0 mph)**



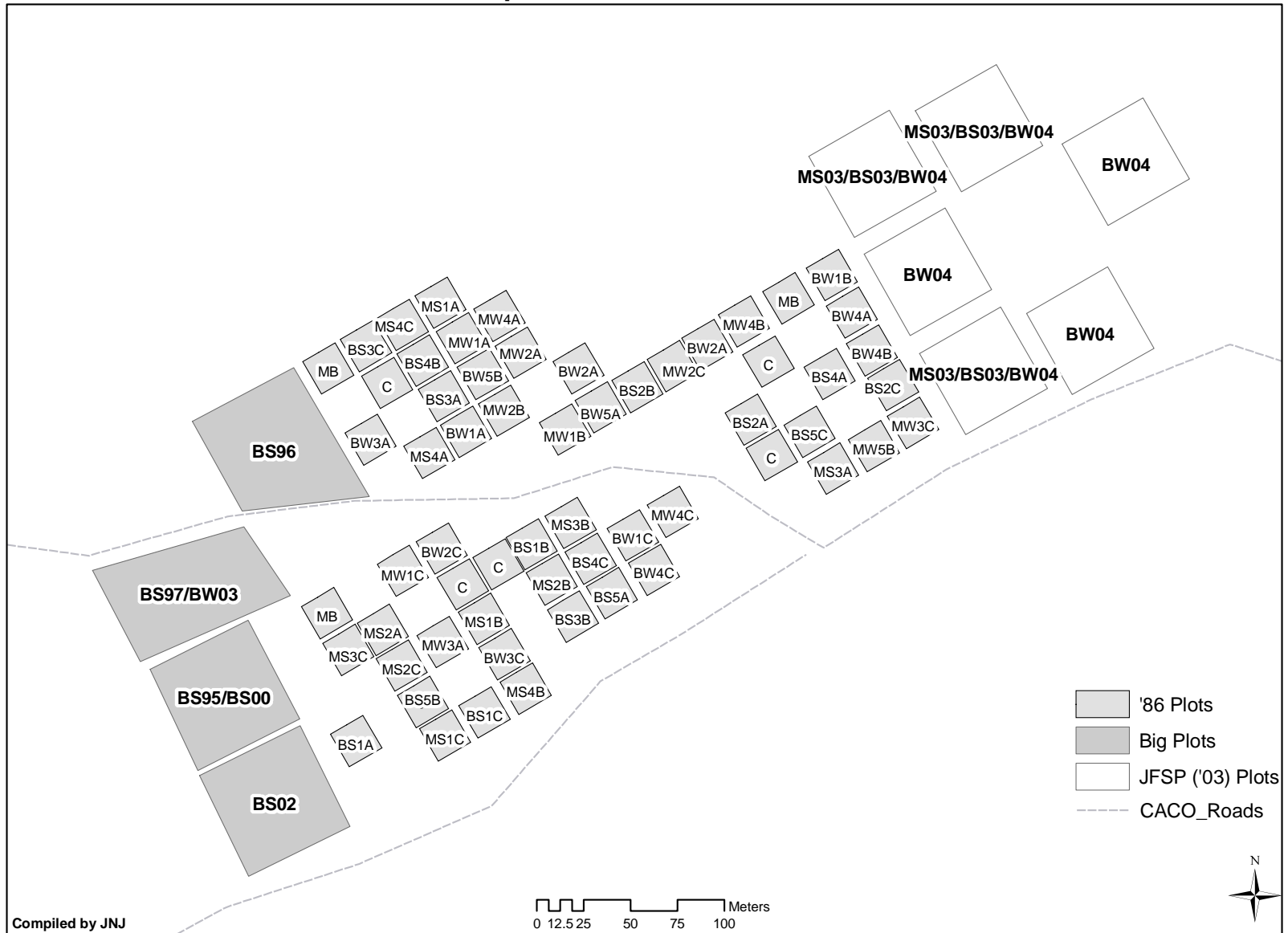
### ***What we have learned:***

- **Growing season treatments – whether cutting or burning – are more effective in reducing the vigor of resprouts than are dormant season treatments.**
- **Drought (documented with the Keetch-Byram Drought Index) limits the size of summer burns due to mop-up constraints.**
- **Thinning overstories is not an option on National Park Service administered lands. Mowing shrub understories with hand-held brush cutters costs approximately \$225/acre.**
- **Brushcutting reduces predicted intensity of surface fires by 60%.**



**Plot locations within Cape Cod National Seashore**

# Lombard-Paradise Hollow Research Area Cape Cod National Seashore





NOTES:

## **CONCLUSIONS**

- During spring, 2004 we documented the effects of treatments on fire behavior observed on prescribed burns. Preliminary results indicate that fuel treatments result in substantial reductions in rates of spread and/or flame lengths. We will continue to refine custom fuel models to better predict observed fire behavior.
- Fuel treatment costs (understory fuels) range from \$200 to \$1100/acre and decrease fuel depths 35% and 80%. The greatest reduction in predicted fire behavior (90%) resulted after the mowing treatment in Montague scrub oak. Brush cutting at CCNS, at \$225/acre, was the most economical and resulted in a 70% decrease in predicted flame length.
- Continued monitoring will evaluate treatment effects on flora and fauna.

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# Appendices

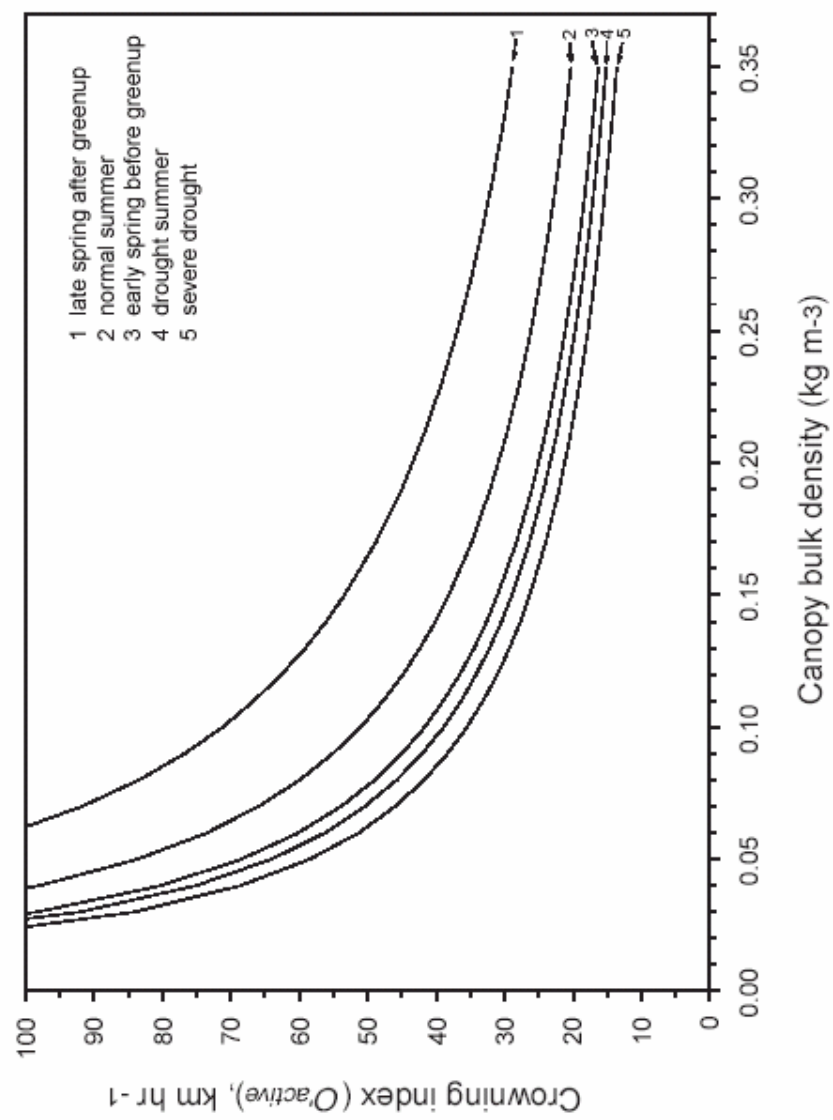


Figure D-1—Chart for determining Crowning Index from canopy bulk density and stylized surface fuel moisture. Level ground is assumed. Fuel moisture conditions are described in table 4.

Nomagram showing the crowning index defined as the windspeed needed to sustain an active crown fire.

(from Scott and Reinhardt 2001)

### **Agencies Represented by Field Trip Participants**

Camp Edwards (Massachusetts Army National Guard)
Chilmark Vol. Fire Department
Harvard Forest (Harvard University)
Massachusetts Department of Conservation Resources-Forest Fire Control
Massachusetts Department of Conservation Resources- Forestry
Massachusetts Natural Heritage and Endangered Species Program
Nantucket Conservation Foundation
National Park Service
New York Dept. of Environmental Conservation
The Nature Conservancy-Massachusetts
The Nature Conservancy-New Hampshire
The Nature Conservancy-New York
University of Florida
University of Massachusetts
US Fish and Wildlife Service
US Forest Service
US Geological Survey

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**Tour Evaluation**  
**Northeast Barrens Fuels Management Tour**  
**June 14-18, 2004**

Please evaluate the tour by filling in comments below. Specific answers will focus future fire management research activities in the northeast. We will discuss the following items during the close out session on Thursday, June 17 at Cape Cod National Seashore headquarters beginning about 1600 hrs.

**What was learned this week?**

**Day 1:**                Montague pine barrens

**Day 2:**                Manuel Correlus State Forest

**Day 3:**                Atlantic White Cedar Swamp and Lombard / Paradise Research area

**What are the fuels management technology transfer needs of Northeastern U.S. land and fire managers?**

**What can you contribute? What type of fuels management demonstration projects can be conducted in the future? Where can these demonstration projects be conducted?**

**Do you have suggestions for satellite fuels management demonstration projects (e.g. Investigate methods for disposal of conifer slash) and proposed locations (e.g. Long Island, Myles Standish State Forest, etc)?**

**How can we most efficiently communicate with one another (e.g. tours, web sites, publications, etc)?**

**Additional Comments:**