FIRE MANAGEMENT PLAN

FOR THE MAINE ARMY NATIONAL GUARD HOLLIS TRAINING SITE

YORK COUNTY, MAINE

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EXECUTIVE SUMMARY

The modern fire management era began at the Maine Army National Guard Hollis Training Site in 1995 with initial efforts to characterize fuels and implement a prescribed burning program. The Hollis site is important ecologically because it supports unique Pitch Pine-Scrub Oak barrens vegetation which provides habitat for regionally rare moth, butterfly and plant species. The vegetation is adapted to fire, and fire suppression since the 1950's has resulted in the vegetation becoming overgrown and in many areas dominated by gray birch, which shades out barrens species of lower stature and interferes with mobility during training exercises. Pitch Pine-Scrub Oak fuels are highly flammable, and infrequent fires lead to an increased hazard of catastrophic wildfire occurrence. A fire management plan completed in 1997 identified objectives including the reduction of fire hazard, increased mobility during training exercises, and the restoration and maintenance of pine barrens communities and rare species habitat. This plan provides documentation of the effectiveness of efforts to meet goals established in 1997 and provides guidance for future management activities.

Thirty-two prescribed burns were conducted on 23 different days between June 1995 and August 1999, with a total of 138 acres (58 hectares) burned, including approximately 10 acres (4 ha) which were burned twice. Much of the central and northern portions of the Training Site were burned at least once during the five year period. Areas in the southwestern and western portion of the Site were not burned, because they are inaccessible and there are no firebreaks against adjacent land to the west.

Effectiveness of burns was documented on 12 monitoring plots established in representative cover types, sampled initially in 1995 or 1996 and resampled annually through 1999 and again in 2002. Sampling in 2002 supported this revision of the 1997 FMP.

Burns were originally planned to be conducted either in the spring before leaf-out [Pitch Pine-Scrub Oak (PP-SO)units that had not been invaded by Grey Birch] or during the growing season (Grey Birch invaded PP-SO stands referred to as PP-SO-GB or SO-GB cover types). Although most prescribed burning in New England has been done during the dormant season (particularly in the spring), our rationale for burning during the summer was that growing-season burns might reduce the sprouting of Grey Birch. Because local fire authorities expressed reservations about our burning on days in the spring when we felt conditions were appropriate, we eventually conducted all burns during the summer months.

We found that reburning after two years was possible only where grass fuels were present. Elsewhere, on most units, it was necessary to wait at least three years before litter fuels had accumulated to the point where they allowed reburning. Areas dominated by Scrub Oak before burning contained abundant dead, standing and downed fuels even six years after burning. An initial reburn in Scrub Oak dominated fuels can thus be expected to be nearly as intense as initial burns, if dead fuel moistures are low. Where Blueberry dominates, more time may is required for fine fuels to accumulate unless species other than Blueberry are present.

Grey Birch resprouted vigorously even after summer burns, so we experimented with cutting sprouts with brushcutters one-to-two years after an

initial summer burn. We found that survival of sprouts was dramatically reduced up to four years after treatments, in part because sprouts from the mechanical treatments were heavily browsed by deer, moose and/or rabbits. Our experiments were on a small scale but suggest that some combination of burning and cutting treatments may facilitate browsing that ultimately decreases the vigor of sprouts from stumps.

Burning in the summer effectively regenerates Scrub Oak and Heath species, but no burns were intense enough, even under drought conditions in 1995, to expose mineral soil and allow new Pitch Pine seedlings to establish. Reburning areas of Scrub Oak-Heath opened up areas with effects lasting up to six years. Dense stands of Scrub Oak and Grey Birch, however, closed in rapidly and should be reburned at three-to-four year intervals to maintain access to the interior of these areas for training purposes.

Summer burning requires close attention to the buildup of drought conditions, and the acreage burned should be no more than a crew can effectively mop-up the day of the burn (to prevent air quality problems from smoke settling to the ground at night). A typical 10-person crew could be expected to mop up no more than five acres (2 ha) the day of a burn under moderate drought conditions.

Because burning previously untreated fuels in the spring (when mop-up is of lesser concern) is problematical due to potential control problems, and because the extent of summer burning is often limited by dry conditions, we recommend that mechanical treatments of the more hazardous Scrub Oak and Pitch Pine fuels be considered in advance of prescribed burning previously untreated stands. Work elsewhere in the region has shown that reducing the depth of the fuelbed using Bullhog or DAVCO grinders can be accomplished at $500 to $1200/acre. Slash from these operations can be burned in 3-12 months and burns in slash during the dormant season (when these burns are safer than in untreated fuels) allow rapid reduction of fire hazard and vigorous regrowth. Where suppressing Grey Birch sprouts is a goal, an initial mechanical treatment followed by a spring burn may accomplish some of what burning followed by hand cutting did on our test plots.

An effort will have to be made to open up access corridors to the western part of the Training Site before the dense Scrub Oak stands there can be treated. Denser stands of mature Pitch Pine may need to be thinned to approximately 30% of full stocking to reduce the potential for crown fires. Documentation of the effectiveness of treatments in meeting resource management goals can be accomplished by resampling monitoring plots at approximately five-year intervals.

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SITE

This justification for fire management applies only to the approximately 390 acre (163 hectares) Maine Army National Guard (MANG) Hollis Training Site in an area known locally as the Hollis Barren. The site, in the northern York County town of Hollis and bordered on the northwest by the town of Limington, is owned and used for training by the Maine Army National Guard (see Figure 1). There are currently no buildings or facilities on the property, and no National Guard personnel are stationed at the site. Sections of are heavily disturbed by grading, roads, and off-road vehicle (ORV) use, and there are several sand pits scattered through the property. A seasonally dry pond and extensive wetlands are scattered through the western portions of the site (Figures 2 and 3).

In 1991 the MANG entered into a contractual agreement with the Maine Natural Areas Program (MNAP), Augusta, Maine to inventory the site. When the ecological significance of the site was realized, the MNAP agreed to become involved in the restoration and conservation of the Hollis Barren. Because of the fire adapted nature of barrens communities and species, this lead to the need for fire management activities. Research and management performed by the MNAP on the Hollis Barren was funded by Department of Defense Legacy funds. In 1995 MNAP contracted with the University of Massachusetts to inventory fuels and establish monitoring plots to document the effects of past fire suppression and future fire management activities. Initial prescribed burns were conducted in 1995 under the direction of W. A. Patterson of the University of Massachusetts. The first fire management plan was completed by Patterson in 1997. A total of 32 prescribed burns were conducted during 1995-99. Monitoring of vegetation and fuels continued through 1999.

Revision of the Fire Management Plan was initiated in 2002, with resampling of previously burned sites accomplished in August 2002. This revised plan incorporates recommendations resulting from lessons learned from the prescribed burning conducted between 1995-1999, from the 2002 resampling, and from Nelson’s (2001) work on initial fuel load recovery following prescribed burns.

TARGET OF MANAGEMENT

The purpose for using prescribed fire as a management tool at the Hollis Barrens is to achieve the dual goal of restoring the Pitch Pine-Scrub Oak barren community while simultaneously improving the usefulness of the site as a training facility by reducing the cover of Scrub Oak and especially Grey Birch.

Specifically, MANG's goals are to:

1) reduce the cover of tall shrubs in order to increase mobility during training operations, and

(2) attempt restoration and encourage the expansion of the Pitch Pine-Scrub Oak community through fire and vegetation management activities (including the application of prescribed fire).

The Maine Natural Area Program's goals that lead to its initial involvement in fire management activities at the Hollis Barren were to:

(1) attempt restoration and encourage the expansion of the Pitch Pine-Scrub Oak community through fire and vegetation management activities (including the application of prescribed fire),

(2) create or improve potential habitat on the site for unusual or rare insect and plant species that are associated with pine barren ecosystems, and

(3) encourage more widespread conservation of pine barrens ecosystems in Maine by educating local citizens about this ecosystem and by demonstrating that, when used in a controlled manner, fire is a useful conservation tool.

Ecological Elements

Northeast Pitch Pine-Scrub Oak barrens are increasingly threatened by development and fire suppression. It is widely accepted that pine barrens species require periodic fires to rejuvenate. Although this is best understood in terms of vegetation response, it is likely that fire is a process integral to the functioning of the entire ecosystem.

FIRE HISTORY

Historic Fires

The following wildfire history is drawn from the Annual Reports of the Commissioners of the Maine Forest Service (MFS). These reports were supplemented by on-site inspections conducted in 1994 and updating from MFS reports of wildfires through 2003.

The MFS reports, initiated in 1902, list - by town, date, number of acres, and cause - each wildfire reported in the state through 1956. The reports stopped listing wildfires by town starting in 1957. Although in-the-field reporting by towns undoubtedly continued, wildfire figures by town were not available again until 1969, when the Maine Forest Service started computerizing the information.

With few exceptions, the most specific locations given for fires are the towns in which they burned. Thus, unless additional data are obtained on location, one cannot assume anything about the specific location of a fire within a town. The several exceptions to this include the 1761-62 fire which, according to Wilkins (1978), burned the entire Town of Hollis (and in fact most of southern Maine), and the May, 1938 and October, 1947 fires, for which additional location information was obtained.

Wildfire reporting cannot be assumed to be consistent. It is clear from an examination of the MFS reports that fewer small fires as well as fewer fires

overall were reported before World War II. After WW II, fire reporting became more thorough due to improved fire detection and suppression nation-wide as well as increased awareness of the danger of wildfire hazards after the great Maine fires of 1947 (Patterson, 1994). Butler (1978) notes that "In 1949 the (Maine) Legislature enacted a rash of fire bills. At long last the Forest Commissioner was given ultimate authority at forest fires within the organized territory...This meant every forest fire had to be reported to a State warden as well as the local warden as soon as it was discovered."

The following wildfire history pertains to the Town of Hollis as a whole. For the 88-year period between 1902 and 1990, records of wildfires are available for 77 years (all but 1957 to 1968).

A total of 79 fires were reported in the 77 years. At least one wildfire occurred in 34 of the 77 years or 44.2% of the years. Records indicate that the single year with the most fires (9) was 1980, although they were all 1 acre (0.4 ha) or less. The most acres burned in one year (not including the 1947 fire for which acres burned were not recorded by town) was 4,700 in the spring of 1938. Roughly 25% of the town burned at that time. Since 1902, five fires of over 1,000 acres have burned, with the last great fire in 1947. Since 1947, no fire larger than 25 acres has been reported.

Based on historical accounts (Butler 1978), the Hollis Barren did not burn in the 1947 fire. A sketch map in Butler's book indicates that the 1947 fire burned about a quarter of the town in the vicinity of West Hollis, south of the Hollis Barren and west of Hollis Center. Butler notes that "At 9 pm Sunday night...flames were within a mile and a half of Hollis Center. But on Monday ... there was no wind to help it...the fire shrank like a cornered beast." If this account is accurate, the last reported large fire that may have burned the Hollis Barrens was an April 23, 1943 fire that burned 2,250 acres (938 ha), although no specific information is available on the location of this fire.

The 1938 fires burned at least part of the Hollis Barren as reported by the Portland Press Herald on May 5 and 6, 1938. There were actually five fires burning over these two days. The Portland Press Herald reported four fires, all of which started in the vicinity of Killick Pond, on May 4th. One burned west toward Bonny Eagle and West Buxton. Another burned east of Killick Pond into the town of Limington. This fire undoubtedly burned some of the larger Killick Pond/Hollis PP-SO ecosystem, although Killick Pond is east of the MANG site and thus the site itself may not have been burned by this fire. Fire suppression efforts were concentrated on the fires that threatened property in Bonny Eagle, West Buxton, and the Old Brick Tavern, while the Limington and Killick Pond fires were allowed to simply burn out. "Most of the area swept (by fire), several 100 acres, consisted of scrub-hardpine." (PPH May 5, 1938) The next day (May 6th) the Herald reported that "More than 3,000 acres were said to have been burned since Wednesday night...so rapidly did the flames travel through the slash and small growth Thursday that between 11 am and mid-afternoon a thousand acres had been covered. At its height that main fire was extremely spectacular, flames leaping from the tops of the taller hard pines and being visible for miles...Four times the wind shifted suddenly, making it more difficult for the firefighters."

These historic accounts are supplemented by on-site observations made in May, 1994. Mature Pitch Pine that we cored at the site date either from the early 1930's and have no evidence of fire scars, or to approximately 1918, with several trees of this apparent age having fire scars that date to the early

1930's. Trees near the rifle range in the north-central portion of the area were burned in a ca. 1985 wildfire that affected most of the surrounding area now typed as Grey Birch (GB). These trees are 70-75 years old and have fire scars clearly dating to the early 1930's. There is some evidence on at least some of these trees of an additional fire or two in the mid-to-late 1930's. A small area southeast of the rifle range (in an area of Grey Birch) burned in the early 1990's. Areas with Pitch Pine dating to the period 1915-1920 have less Scrub Oak and more Grey Birch than areas in the southwestern part of the unit. These oldest Pitch Pine are in a level area and the character and age of the stands suggest that they may have arisen on disturbed land abandoned at about the time of the first World War. The fire that scarred many of these trees in the early 1930's apparently provided seed-bed conditions that facilitated the establishment of the younger cohort of Pitch Pine. It is possible that a fire also preceded the establishment of Pitch Pine in the late-1910's, but we have no direct evidence for this. Aside from the fire in the early 1930's, in ca. 1985 and in the early 1990's, we found no other evidence for 20th century fires on the property, although we were not able to examine some of the less accessible areas in the southwestern portion of the Site.

Although there was no systematic attempt to manage the Barrens with prescribed fire before 1995, Hollis Town Fire Warden Reggie St. Amand told us that it was common practice for local people to light fires in the Barrens to promote the growth of blueberries through the mid-1960’s.

For the period 1994-2002, 16 wildfires burned a total of 6.98 acres (2.9 ha) in the town of Hollis. One fire of unknown cause (on April 30, 1994) burned one acre (0.4 ha) on the MANG Training Site. One fire burned in March, eight (50%) in April, two in May, three in July and one each in August and September. Six were caused by debris burning, and three by incendiary activity. The remainder were caused by a variety of human activities including lighters, campfires and machine use. No lightning-caused fires are recoded

During 1995-99, prescribed fires burned a total 138 acres on 23 separate days, with fires conducted during late May thru early September.

Seasonality

For the 77-year period for which records are available, 44.3% (35 of 79) of the wildfires burning in the Town of Hollis occurred in April. Twenty-five fires (or 31.6% of the total) burned in May. Fires occurring in March, and June through November averaged 3.2 fires per month for a total of 19 fires (24% of all reported). No fires were reported to have burned in December, January or February.

Of the five largest fires (over 1,000 acres), three burned in May and one in April. The 1947 fire burned in October.

Size

With no acreage available for two fires (including the 1947), 79 fires burned 12,081 acres (or about two-thirds of the total area of the town) in the 77-year period. Slightly more than 87% of the fires burned 99 acres or less, with over 75% burning 9 acres or less. During the post-World War II era, only

five of 56 reported fires burned 10 acres or more, but included in this is the 1947 fire.

Causes

Of the 79 wildfires reported to have burned in Hollis since 1902, 20.2% (16 fires) were classified as incendiary, i.e. they were intentionally set. Nineteen percent (15 fires) were caused by children. Cigarette smoking ranked third in number of fires caused (13 fires or 16.5% of the total). Ten (or 12.6%) were of miscellaneous origin. Lightning caused only two of the 79 fires.

Of the five largest fires (1,000 acres or larger), two were of incendiary origin, one was from brush burning, one from smokers, and the cause of the 1947 fire is listed as unknown.

Recent Wildfire Activity

For the period 1994-2002, 16 wildfires burned a total of 6.98 acres (2.9 ha) in the town of Hollis. One fire of unknown cause (on April 30, 1994) burned one acre (0.4 ha) on the MANG Training Site. One fire burned in March, eight (50%) in April, two in May, three in July and one each in August and September. Six were caused by debris burning, and three by incendiary activity. The remainder were caused by a variety of human activities including campfires and machine use. One lightning-caused fire was recorded on May 8, 2002.

FIRE EFFECTS

Species

Plant and animal (including insect) species found in barrens areas are, for the most part, adapted to frequent fire. The effects of fire on vegetation in general have been reviewed by Wade et al. (2000) and on species at Hollis in particular by Gawler (1997) and at the web-based Fire Effects Information System (http://www.fs.fed.us/database/feis/), and information found in these sources will not be repeated here. It is important to note, however, that effects on species depend not only on the intensity and season of occurrence of individual fires, but on the interval between fires and the pattern of burning on the landscape. Most plants of barrens areas are capable of vegetative reproduction following the killing of above ground stems, but resprouting is more vigorous following dormant season burns than following those occurring during the growing season, when root reserves of stored carbohydrates may be depleted. Fires burning during dry periods in late summer and early fall can burn out root systems and further inhibit vegetative resprouting. For species that reproduce chiefly from seed, effects depend upon the timing of fires with respect to seed maturity and upon the pattern of fires on the landscape. Patchy fires that leave islands of unburned vegetation that can reseed burned areas allow for more rapid colonization of burned areas than do extensive, uniformly burned areas.

Timing of fires is particularly important with respect to effects on fauna. Fires burning when young are fledging, or, in the case of insects, when

species are present only as eggs or pupae, can slow population recovery following extensive burns. The interaction between vegetation, fauna, and fires can be important when individual animal species depend upon food sources that are either made available by or depleted by fire. We still have much to learn about the specific habitat requirements and effects of fire intensity and seasonality on many of the rare insect species that occupy barrens areas.

Ecosystem

A conceptual model of pine barrens ecosystem development was completed by participants in a July, 1992 workshop held at Limerick, Maine. Although the model was developed with Waterboro Barrens in mind, it should serve as a basis for evaluating change at Hollis. In the absence of fire, succession of open areas (upland heath and grass-dominated communities) proceeds first to Scrub Oak, then to either Pitch Pine/Scrub Oak or mixed deciduous/conifers (other than PP/SO), and finally to mixed conifer/hardwood (dominated by mesic hardwoods and non-fire tolerant conifers like Hemlock, Spruce and Fir). Fire can arrest or even reverse this succession from barrens to mesic forest. The exact pathway will depend upon the interval between fires and the intensity, severity, and seasonality of individual fires.

An analysis of change during the past half century at the Waterboro Barrens, an area burned in the 1947 fires, shows that hardwoods have increased 144% and Pine/Oak 44%, while Scrub Oak, open pine and grassland/heath have declined in acreage by 74 to 100 percent (Patterson 1994). This is probably a reasonable representation of what happened, during the past 60 years, to areas at Hollis that are now occupied by Scrub Oak and Pitch Pine/Scrub Oak vegetation (i.e. areas on the western and southern portions of the unit). It appears that disturbance of the soil (by military activities) was more important at Hollis than at Waterboro, and this may account for the greater abundance of Grey Birch. Grey Birch is a species that increases in abundance in response to disturbance, and we attempted to determine if there is a disturbance regime that will reduce the abundance of Grey Birch while encouraging the growth of other barrens species. Vegetation of the Site as a whole is depicted on Figure 3 and shows that areas of Grey Birch are concentrated in the central, more heavily used portions of the site.

Components Lost

As detailed in the above section, the Pitch Pine-Scrub Oak barrens were very different a hundred years ago. Their reduction in size during the 20th century has many ramifications. The Hollis Pitch Pine-Scrub Oak barren is now an island, and all the problems associated with isolation exist, including reduced gene flow. Isolation also creates logistical difficulties in the implementation of prescribed burning. Gone is the ability to set "larger" fires that might come closer to approximating natural fires.

Exotic species

Although exotic plant species do not appear to be a particularly serious problem at Hollis, areas under active management should be monitored carefully to ensure that unwanted species do not invade and replace native barrens

species, much as the native, but unwanted, Grey Birch has increased in importance on the area with disturbances associated with military training.

Ecosystem Recovery Period

Plant communities are typically much more resilient than animal communities. Most plants can persist for several years or decades with a large decrease in or complete cessation of successful reproduction due to fire suppression. Most Lepidoptera will be eliminated by one season without successful reproduction (Schweitzer & Rawinski, 1988).

Minimum suitable habitat for Lepidoptera should be regarded as the minimum area capable of supporting a viable population in the worst possible year. For fire sensitive species, the worst possible year might well be the year of a major burn, but assuming the population is not eradicated it might well reach its maximum size a few years after such burns. While many vertebrate populations can recover from one or a few years of reproductive failure, it is unlikely that they are as resilient as plants (Schweitzer & Rawinski, 1988).

Thus, in most cases, one or a few hot fires will restore a reasonable facsimile of a Pitch Pine/Scrub Oak barren plant community, but not necessarily the animal community. Whether even the plant community can be restored after extensive land clearing is unclear, but if so, the process could take several decades. Some portions of the Albany Pine Bush, NY and the Montague Plains, MA were farmed over 100 years ago. Pitch Pine re-establish rapidly on these sites, but some associated species are still reinvading disturbed sites. Recovery potential is probably highest in the more northern, species-poor sites (ME & NH), since there are few ecologically fragile, regionally uncommon plant species while known important Lepidoptera microhabitats are either absent or abundant (Schweitzer & Rawinski, 1988).

Animal species, especially Lepidoptera, and certain plant species may have little or no recovery potential following catastrophic disturbances including extended fire suppression. Recovery potential for Lepidoptera should be extremely high, however, if remnant populations still persist, due to their high fecundity and at least moderate dispersal ability. Recolonization of Lepidoptera on sites from which they have been completely eradicated will be largely a function of distance to the nearest source of colonizers, the size of the source population and the size of the barren to be potentially recolonized.

Unnatural or Detrimental Fire Effects

Because there is still much unknown about the Pitch Pine-Scrub Oak barrens and their associated rare species, there is a possibility of unwanted fire effects. The most often stated are the effects of seasonality of fire on rare and disjunct invertebrates. This concern is exacerbated by the above-mentioned island effects. A large fire burning a substantial portion of the Hollis Barrens could adversely affect some species which might be vulnerable as young or in exposed resting stages depending on the season of the fire. We have learned elsewhere (e.g. the Montague, AM Barrens) that it is better to burn small areas of a few hectares in several burns at different times from spring through autumn than to burn large areas at one time. A goal of burning no more than 10-20% of the area each year, in several fires during different

seasons is preferable and is more likely to preserve rare species about which we still have much to learn with respect to their natural history and seasons of susceptibility to fire.

Unnatural disturbance associated with prescribed burning (fire breaks and trampling) can also cause problems, especially in damaging rare plant populations and in encouraging invasion by exotic plants. The utmost care should be taken to minimize these disturbances.

PRIORITIES

Fire Management

Fire management at the Hollis Barren should continue with high priority. Efforts during 1995 and 1996 cleared the initial hurdles to establishing an ecological fire management program and have provided the foundation necessary for continuing and expanding a successful program. Crucial logistical procedures were outlined and implemented, important local and regional contacts established, and support from a variety of agencies and local residents gained. Prescribed fire was successfully implemented between 1995 and 1999 at the Site. No prescribed fire has been implemented since then. Fire management and associated mechanical fuel management activities should continue in order to build upon earlier achievements and to work towards the ecological and management goals for the site. Fire management at the Hollis Barren will contribute to the MANG and MNAP goals of rehabilitating a globally rare natural community and its component species as well as contributing to the understanding the pine barren ecosystem, its component species and the role of fire in this ecosystem region-wide.

Research and Monitoring

Research and monitoring has been the primary responsibility of the Maine Natural Area Program and has been supplemented with regards to fire effects on fuels and vegetation by the University of Massachusetts. A Monitoring Plan for the Hollis Barren (Gawler and Albright 1993) details monitoring methods and analysis procedures. The following are the goals as outlined in that plan:

Vegetation Monitoring Goals

1. Measure response of Grey Birch to burning and determine optimal timing and frequency of burns for its reduction;

2. Measure effect of burning on other tree species, in terms of both existing individuals and regeneration;

3. Measure effect of burning on Scrub Oak density;

4. Monitor ground layer vegetation for response to burning in terms of changes in species composition and species cover;

5. Monitor overall trends in community composition/structure as related to burn and cover type.

6. Continue monitoring the rare plant populations and general species composition of the outwash plain pond shore.

7. Continue to search for the presence (including re-establishment) of rare plant species on the premises.

8. Encourage the regeneration and spread of Pitch Pine on the barren.

Invertebrate Monitoring Goals

1. Refine the data for presence/absence and general distribution of target species within the Hollis site.

2. Monitor immigration, recolonization, and/or relative abundance, over time, of target species/groups in patches recolonized after fire.

3. Monitor overall abundance trends over time of target species/groups on the site overall.

SITE FIRE MANAGEMENT GOALS

Programmatic

1. Continue to build a strong programmatic relationship between MANG and MNAP and/or The Nature Conservancy focusing on research and restoration of the Hollis Barren.

2. As fire management is continued at the Hollis Barren, continue to build rapport with adjacent landowners, local town people, town fire department personnel, and local/state foresters about the ecology of pine barrens and the importance of fire management to them.

Ecological

1. Continue prescribed burning as a management practice at Hollis, with the goal being to reestablish and/or maintain barrens plant and animal communities, especially those rare in the State of Maine.

2. Restore (re-establish) rare species of the pine barrens system.

Research

1. Continue long-term research and monitoring at the Hollis Barren in order to measure effects of fire management on rare insect populations.

2. Further evaluate the effectiveness of growing season burns combined with mechanical treatments on reducing the cover of Grey Birch while at the same time encouraging other, desired barrens species.

3. Continue the evaluation of fire behavior and the ability of existing fire behavior models to predict intensity and rate of spread of dormant and growing season burns.

PRESCRIBED FIRE PROGRAM

Approximately 27 fire management units ranging from 1-2 acres (0.4-0.8 ha) to a few tens of acres in size were established for the Hollis Barren (Figure 5). Units are coded as priority I, II, or III; with priority I units being those with a substantial component of Grey Birch. These units were brought under fire management first, with a goal being to reduce the cover of Grey Birch.

Justification for Unit Delineations

We initially recommended growing season burns for priority I units, under the assumption that summer burns would select against Grey Birch (Popp, 1987) and due to the fire behavior observed in these areas during initial test burns in 1995 and 1996. Burning these areas during the dormant season is not recommended.

Priority II units are currently higher quality Pitch Pine - Scrub Oak or Scrub Oak areas which, although they have not burned for as much as 60 years, are less threatened by invasion by Grey Birch. Most of these units are in the western and southern portion of the training facility where burning is more difficult due to a lack of well-maintained boundaries both between units and at the edge of the National Guard property. These areas can be effectively burned during the dormant or summer seasons once fuel breaks are created and crews are trained to deal with the higher intensity fires which are to be expected in these fuels. Four, better-protected units (II-E, F, G and H) in the east-central and northeast portions of the property provide an opportunity for dormant season burns in priority II areas. Units II-E and half of II-H were burned during the summer of 1996.

The area of mixed conifer hardwoods east of the small pond in the west-central portion of the property probably exists as a result of historic protection from wildfires which ran from west to east across the area. Periodic, low intensity fires at long intervals could be applied to maintain this area in mature oaks with a herbaceous/grass understory.

Prescribed Fire Results (since 1995)

Approximately 138 acres were burned on nearly 23 separate dates between 1995 and 1999 (see Figure 4, Table 1). A variety of agencies and individuals assisted on these burns resulting in additional training in conducting burns in the Scrub Oak/Pitch Pine barrens system. Several important lessons were learned from these prescribed fires.

Summer Burning and Drought For burning during the growing season (summer), only a day or two of drying is necessary, although the Keetch-Byram Drought Index (the KBDI - available from the Maine Forest Service) should be carefully monitored in order to avoid problems with post burn mop-up. Once the KBDI reach 250-300, ground fires are likely to occur and cause mop-up and residual smoke problems. Fires in duff under mature Pitch Pines, and in organic material in bull-dozed berms ignite most readily and are the hardest to extinguish. Summer burns require higher wind speeds than dormant season burns in order to carry the fire through fuels protected by shrub and tree canopies. When KBDI values are less than 100, more drying time is required since rain and lower humidities are necessary to ensure fires carry through areas with high-moisture-content sedge or herbaceous cover.

On-shore Winds Although the Hollis site is inland, it is close enough to the coast to experience sea breezes, though not consistently. These sea breezes affect wind speed and direction and contribute to lower temperatures and higher humidities. We found that predicted south or southwest winds often shifted, periodically during the course of the day, to southeast (and then back to south or southwest) reflecting this weak on-shore breeze effect.

Fire Behavior Research during 1995 and 1996 (Woodall 1998) indicates that fire behavior prediction models tend to under predict fire behavior during the growing season in this fuel type. Fireline intensities (i.e. flame lengths) are substantially greater than expected, although rates of spread of head fires are similar to expected values. The green leaves of Scrub Oak burn readily, however, and contribute to very active fire behavior including crowning in the shrub canopy. New fuel models for the barrens fuels have been created based on fuel and fire behavior sampling in 1995 and 1996 (Woodall 1998). Nelson (2001) provides additional custom fuel models for areas being burned for a second time as well as detailed documentation of sampling procedures and methods for developing fuel models.

Dormant season burning at this site is possible, although the risk of escape fires is higher than during the summer. The potential for spotting and torching of mature Pitch Pines is higher during the dormant season. Dormant season burning should not be conducted in areas with abundant Grey Birch, because they will only result in vigorous resprouting from dormant buds at the root collar.

Burn Schedule Litter reaccumulates slowly after initial burns (Figure 7). We burned Units I-A, I-I, I-J, and the northwest portion of I-J after two years and found that results were mixed. Fire behavior was adequate to carry the fire across the units only where in clumps of Scrub Oak where fine (litter) fuel accumulations were greatest. Standing dead and downed woody fuel generated by top-killing Scrub Oak (Figure 8) contributes to intense burning, however, when woody fuel moistures are low. Thus, for priority I and II units, it will be necessary to initially reburn them after 3 to 4 years (when litter accumulations should be adequate to sustain fires) in order to remove the larger woody fuels created by the initial burn. This may best be accomplished by burning in the late spring or early summer. Once the fuels in the units are primarily litter and smaller woody fuels, the units can be burned 5-7 years – before litter accumulations are again sufficient to contribute to intense fires. Burning 30-40 acres per year could result in an area equivalent to the size of the MANG property being burned approximately every 10 years.

Access Additional firebreaks and/or access routes will be needed if fire management is to continue into the southern and western portions of the Site. These areas cannot currently be burned due to their large size and inaccessibility. Opening the western portion of the site will increase access by the general public, however, and this could expose these areas to an increased threat of unauthorized ignitions leading to wildfires.

Control of Grey Birch By 2002, more than 90 percent of Grey Birch stems larger than two inches prior to burning had died in monitoring plots we sampled in burned units (Figure 9). Most large Grey Birch were in clumps of 3-9 stems arising from a single stump, and all stumps resprouted vigorously. We tallied as many as 100-200 stems per stump one year after burning the 11-acre (4.6 ha) Unit I-D. Recognizing this propensity for vigorous sprouting, even after growing season burns, we established an experiment in this Unit in 1998. We selected 15 stumps with vigorous sprouts averaging 3-4 feet in height and cut back the sprouts in June, July, or August (five stumps during each month), with new sprouts from stumps cut in June cut again in August. In August, 2002 we resampled these stumps and found that of the five cut in June and again in August, 1998, there were no live sprouts (i.e. the plants were completely dead). There were an average of only 2 live sprouts on plants cut in July, 1998, and an average of 4.2 sprouts on the five plants cut only in August, 1998. Average height of the sprouts on the July and August-cut plants was 1.2 meters. Sprouts from five untreated stumps that we examined in 2002 had an average of 24 sprouts, with the five tallest sprouts per plant averaging 3.7 meters in height. We observed in 1998 and 1999 that sprouts arising from summer cuttings were heavily browsed by moose, deer and/or rabbits, and this browsing undoubtedly contributed to the decline in sprouting ability of plants. It is unclear to us why these sprouts were browsed when sprouts arising following the initial burn in June, 1997 were not obviously browsed, but when we applied a similar burn/cut treatment to a portion of Unit II-H in 1996/1998, we found that the sprouts arising following cutting were less vigorous as well, again in part due to heavy post-cutting browsing. The results of this experiment suggest that burning alone, even in the growing season, will not reduce sprouting, but that a combination of burning one year followed by cutting during the early summer and again in mid-August of one of the next two years will, if browsers are present, kill Grey Birch completely. We do not know if application of this technique to larger acreages would overwhelm the browsing population resulting in reduced effectiveness or not. It would be necessary to repeat the experiment using exclosures to eliminate browsing in to determine if burning and cutting without browsing would have the same effect. We suspect that mortality of Grey Birch would be reduced without browsing, although sprout vigor would still be reduced.

SITE SPECIFIC FIRE OPERATIONS

Smoke Management

Smoke sensitive areas are housing developments to the southwest and southeast of the training site (Figure 6). Prescribed burns will most likely be conducted with winds from the west or southwest, so smoke management should not cause serious problems. Burning should be done on days when the atmosphere

is unstable (Haines index of 3 or 4) and the mixing height is at least 1,000 feet. Local dispatch agencies should be notified of the fire activities and updated periodically during the day depending on conditions (smoldering for longer than expected). Residual smoke from ground fires may cause a longer lasting problem and should be addressed in communications with residents and local fire officials. If there is a potential for smoke impacting traffic on Hardscrabble Road, at least one person should be stationed along the road for smoke observation and traffic control. Continued development on the outskirts of the property (especially to the southwest, south and east across Killick Pond) may lead to additional smoke management concerns. For some of the southern-most burn units, it may be beneficial to notify adjacent property owners by mail or in person prior to burning.

Prolonged burning of duff during dry periods can cause smoke to accumulate in low areas and should be avoided. If unpreventable, the Hollis-Buxton dispatch should be notified and at least one burn crew member should remain on site until fires are completely extinguished.

Legal Restrictions

The Maine Forest Service has ultimate authority over open burning in Maine, and a burn permit must be obtained from the Hollis Fire Department. Normal burning guidelines call for prescribed burning only after 4 pm, although a variance of this requirement can be obtained by request. A burn prescription, using a standard, two-page form available from MFS, must be filed and approved in advance.

Hazards

Although there are no structures on the property, burn personnel should be cautious in the vicinity of areas used for military training. Barbed wire, trash and other remnants of previous uses including concrete pads and pits are found scattered throughout the property. Most of the areas actively used for military training in the past contain unexploded small arms shells, but, based on our experience with their discharging during controlled burns, all appear to be blanks. There are several sand pits on the property, and although these make good safety zones in event of an escaped fire situation, soft sand could mire vehicles not equipped with balloon tires. Potential for damage (or removal) of unattended fire equipment has also been a problem.

A housing development begun in the early 1990's has resulted in the construction of several single-family dwellings adjacent to the southwest corner of the property. Single-family dwellings also exist along Hardscrabble Road near the southeast corner of the property. Much of the area directly west and northeast of the property is undeveloped land, and given that prescribed burns would probably be conducted with winds from the southwest to northwest, smoke dispersal through residential areas should not be a problem. Smoke dispersal should be closely monitored to avoid impacting the recently constructed Poland Springs bottling plant to the east. The plant is only ¼ to ½ mile (0.4-0.8 km) east of the northeastern-most burn units on the Training Site.

Public Relations

Local officials should be notified of any plans to conduct prescribed burns. The village of Hollis Center is six miles southeast of the property.

Minimum Personnel/Equipment (for a burn of moderate-to-low complexity)

1	Fire Leader (burn boss) qualified to standards of The Nature Conservancy
5-7	trained prescribed fire personnel equipped with appropriate personal protective equipment (hard hats, leather gloves, NOMEX and appropriate foot gear)
4-6	portable radios
1	pumper on site (2 preferred)
1	pumper on call
4-6	fire (Council) rakes
6	back-pack pumps
5	shovels
2-4	drip torches with extra fuel
2	first aid kits
1	belt weather kit (including anemometer and fuel moisture meter)
1	folding tank (when ponds are low or water is inaccessible)
2	Homelite pumps and hose for backup water supply (as needed)
-	burn unit maps

Fire Weather Monitoring

Fire danger indices and fuel moisture estimates (available from the Maine Forest Service district office in Bolton Hill) should be monitored for two weeks prior to burning. Keetch-Byram Drought Index values - available from the Maine Forest Service - should be used as a guide for determining prescription conditions for growing-season burns. Local weather should be monitored one week prior to burn days using a NOAA weather radio (162.55 mhz)and regional fire weather forecasts (http://www.srh.noaa.gov/data/GYX/FWFPWM). Spot weather forecasts are available to federal agencies from the National Weather Service.

A class day designation for the site can be calculated by Bolton Hill MFS personnel based on reported on-site weather conditions. This calculation has often resulted in a lower class day than the regional class day. The Hollis Fire Department has been willing to consider issuing permits on predicted class III days when local conditions appear less threatening than the regional estimates would suggest.

Communications

All burn crew members should be given a thorough briefing prior to lighting a test fire including a walk around all units. Maps of the facility and burn units should be distributed to all crew. At a minimum, radios should be located with pumper trucks, the burn boss, and one member of each holding crew. Cellular phones should be used to notify local authorities of the

initiation and completion of burns and in case of emergency. Phone numbers are listed burn plans, a copy of which should be available to the burn boss at all times during the burn.

Contingencies

If the weather conditions exceed either wind speed, direction or minimum humidity, fires should be suppressed immediately.

Secondary fire breaks at the site include the air strip and access roads within the property, Hardscrabble Road along the entire east and northeast boundary of the property, and the Killick Pond/wetland complex east of Hardscrabble Road. All spots should be contained immediately with hand tools and the pumper truck. If this fails, the holding boss should ask the burn boss to reallocate personnel from the burn to assist in containment and/or request assistance through local dispatch. If an escaped fire situation develops beyond the control of the prescribed fire personnel, incident command will be transferred from the burn boss to the Hollis Fire Department.

Mop Up

The fire will be permitted to burn until flaming combustion subsides. It may be deemed necessary to mop up to avoid prolonged smoke production. A pumper and/or back-pack pumps will be used to immediately extinguish heavier fuels including duff smoldering within 15 feet of the burn unit perimeter. Smoldering within the interior of units should then be extinguished. Extended periods of burning should be avoided by scheduling fires when drought indices are low. Burning snags near the perimeter will be extinguished or felled into the unit and allowed to burn out unless smoke constraints call for extinguishing them immediately. Unless an extended period of rain occurs overnight, the site should be checked the following day, with mop-up personnel kept on site until all smoldering fuels are extinguished. Fires can be considered out when no burning is observed following thorough check for two consecutive days.

WILDFIRE PLAN

In order to be prepared for a wildfire and minimize damage due to suppression efforts, the following procedure will be followed:

1. A copy of this plan will be given to the local office of the Maine Forest Service, the Hollis Fire Department, and the Maine Natural Areas Program (MNAP) and Maine Army National Guard (MANG) all of whom are familiar with the site.

2. Included will be maps of the existing fire lines and sensitive areas.

3. If a wildfire occurs, MNAP and MANG will be notified immediately and, if possible, personnel from these agencies will go to the site.

4. The fire will be contained using existing fire lines if possible; secondary contingency lines of containment include Hardscrabble Road and the Killick Pond Drainage.

5. All possible effort should be made to minimize disturbance (especially from dozers) to sensitive areas. If this is unavoidable, driving across vegetated areas in trucks is acceptable.

6. Proceed with mop up operations as specified in this plan.

7. Note weather and fire behavior, if possible.

8. Report wildfire to local and state authorities and compile all pertinent information in a report.

REFERENCES

S-390 Fire Behavior Field Guide (1981) prepared by the National Wildfire Coordinating Group, Boise Interagency Fire Center, Boise, ID.

BEHAVE, developed by Fire Behavior Research Work Unit of the Noah Fire Science Lab and Systems for Environmental Management, Missoula, MT.

Butler, J. 1978. Wildfire Loose, The Week Maine Burned. Durrell Publications, Inc. Brattleboro, VT.

Copenheaver, C.A., A.S. White and W.A. Patterson III. 2000. Determinants of vegetation development within a southern Maine Pitch Pine-Scrub Oak ecosystem. Journal of the Torrey Botanical Society 127(1):19-23.

Gawler, S.C., and J.J. Albright. 1993. Monitoring Plan for Vegetation and Invertebrates of a Northeastern Pitch Pine-Scrub Oak Barrens Ecosystem at the Maine Army National Guard Training Site, Hollis Maine. Maine Natural Areas Program, Augusta, Maine.

Gawler, S.C. 1997. Management Plan for the Maine Army National Guard Training Facility, Hollis, Maine. Maine Natural Areas Program, Augusta, Maine.

Maine Forest Service. 1902-1957. Annual Forest Commissioners Report. Maine Forest Service, Augusta, ME.

Maine Natural Areas Program (MNAP). 1996. Draft Management Plan for the Maine Army National Guard Training Facility, Hollis, Maine. Maine Natural Areas Program, Augusta, Maine.

Motzkin, G., D.R. Foster, A. Allen, J. Harrod, and R. Boone. 1996. Controlling site to evaluate history: vegetation patterns of a New England sand plain. Ecological Monographs, 66(3):345-365.

Motzkin, G., W.A. Patterson III, and D.R. Foster. 1999. A regional-historical perspective on uncommon plant communities: Pitch Pine-Scrub Oak in the Connecticut Valley, Massachusetts. Ecosystems 2:255-273.

Nelson, K.E. 2001. Determining the optimal prescribed burn frequency for ecological restoration in the Pitch Pine-Scrub Oak barrens of Hollis, Maine. Non-thesis masters project, University of Massachusetts, Amherst. 24 pp. + appendices.

Olsvig, L.S. 1980. A comparative study of northeastern pine barrens vegetation. PhD Thesis, Cornell University. 479 p.

Olsvig, L.S., Cryan, J.F., and R.H. Whittaker. 1979. Vegetational gradients of the pine plains and barrens of Long Island, New York. In: Pine Barrens--Ecosystem and Landscape. (R.T.T. Forman, ed.). Academic Press, New York, pp. 265-282.

Patterson, W.A. 1994. The Waterboro Barrens: Fire and Vegetation History as a Basis for Ecological Management of Maine's Unique Scrub Oak-Pitch Pine Barrens Ecosystem. University of Massachusetts, Amherst, MA.

Patterson, W.A. and A.E. Backman. 1988. Fire and disease history of forests. In: Vegetation history. (B. Huntley and T. Webb III, eds). Kluwer Academic Publishers, Boston, pp. 603-632.

Popp, H.G. 1987. Effects of repeated summer burns on a Pitch Pine - Scrub Oak forest in Carroll County, New Hampshire. M.S. Thesis, University of New Hampshire. 85 pp.

Portland Press Herald. May 5-6, 1938. Portland, ME.

Schweitzer, D.F. and T.J. Rawinski. 1988. Element Stewardship Abstract for Northeastern Pitch Pine/Scrub Oak Barrens. The Nature Conservancy, Boston, MA.

Wade, D.D, B.L. Brock, P.H. Brose, J.B Grace, G.H. Hock, and W.A. Patterson III. 2000. Chapter 4. Fire in Eastern Ecosystems. pp. 53-96 in J.K. Brown and J.K. Smith (eds.) Wildland Fire in Ecosystems: Effects of Fire on Flora. USDA Forest Service General Technical Report RMRS-GTR-42-Vol. 2. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. 257 pp.

Widoff, L. 1987. Pitch Pine/Scrub Oak barrens in Maine. Critical Areas Program Planning Report No. 86. Augusta, ME 103 p.

Wilkins, A.H. 1978. Ten Million Acres of Timber, The Remarkable Story of Forest Protection in the Maine Forestry District (1909-1972). TBW Books, Woolwich, ME.

Woodall, C. 1998. Prescribed fire behavior and custom fuel modeling in the pitch pine-scrub oak barrens and pine-oak forests of New England. Non-thesis masters project, University of Massachusetts, Amherst. 33 pp.

FIGURES AND TABLES

Figure 1: Location of The Maine Army National Guard Hollis training site in northern York County, southwestern Maine

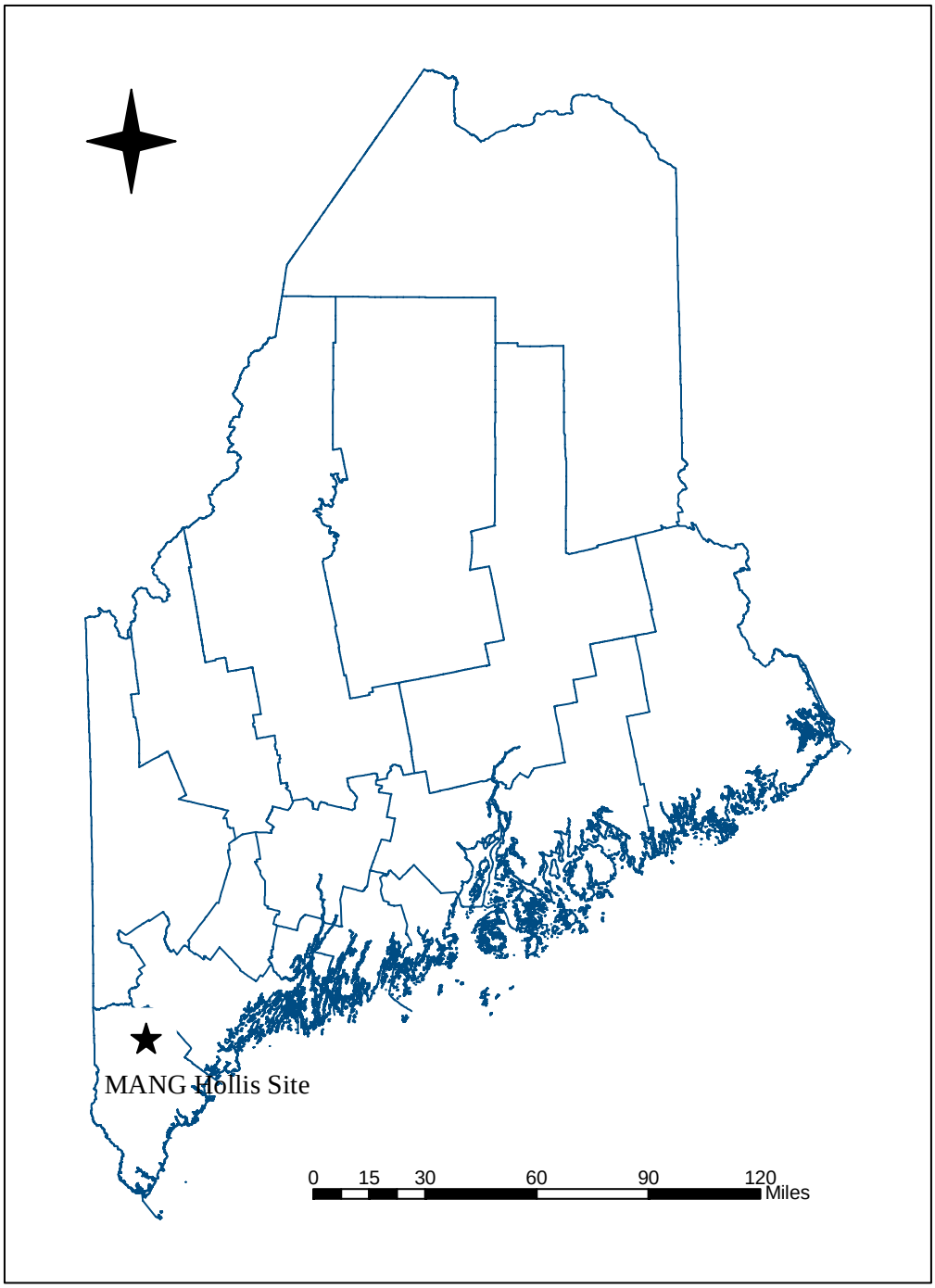


Figure 2: Hollis MANG training site boundaries, roads, and water resources

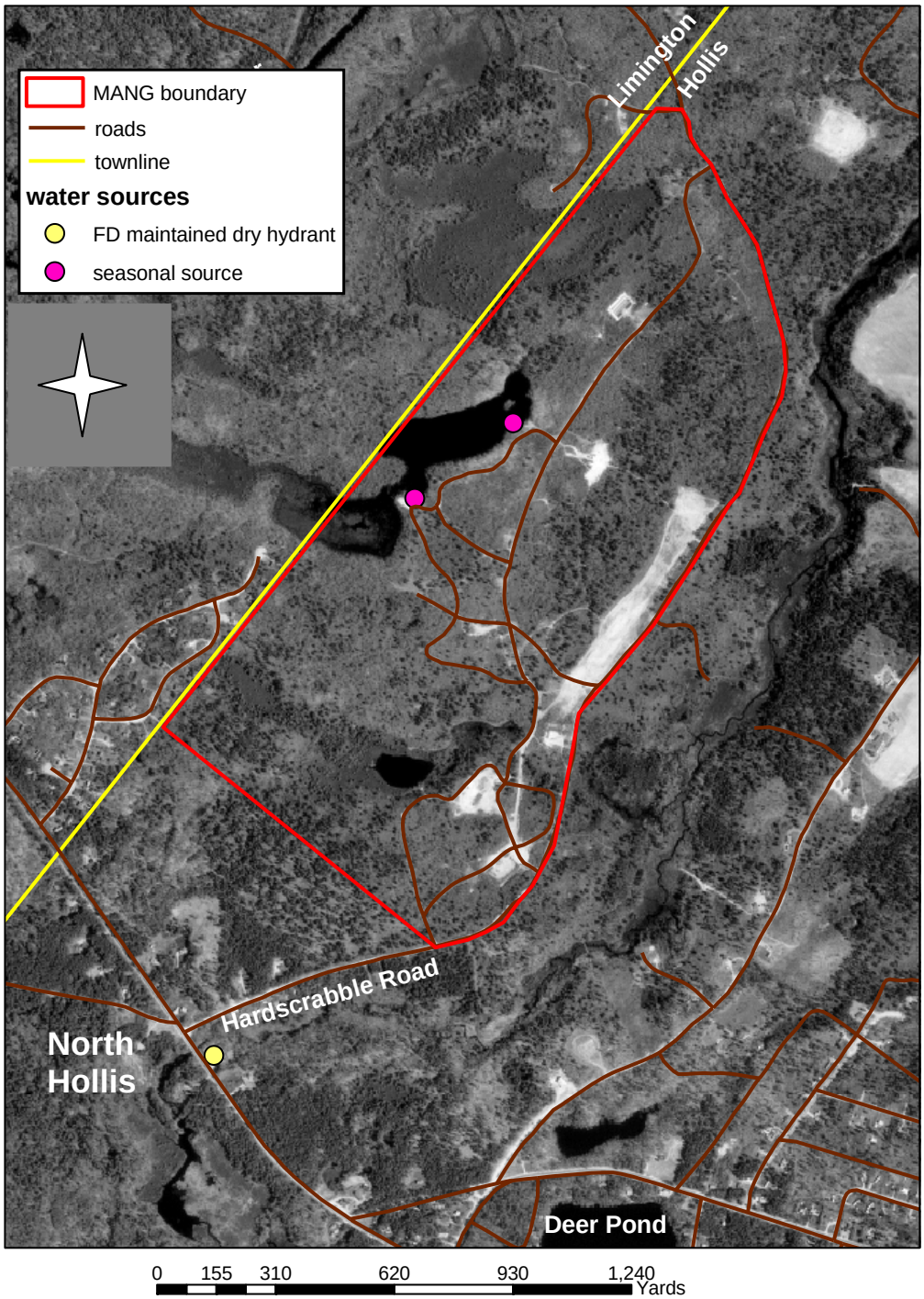


Figure 3: Vegetative cover types within the boundaries of the MANG Hollis training site

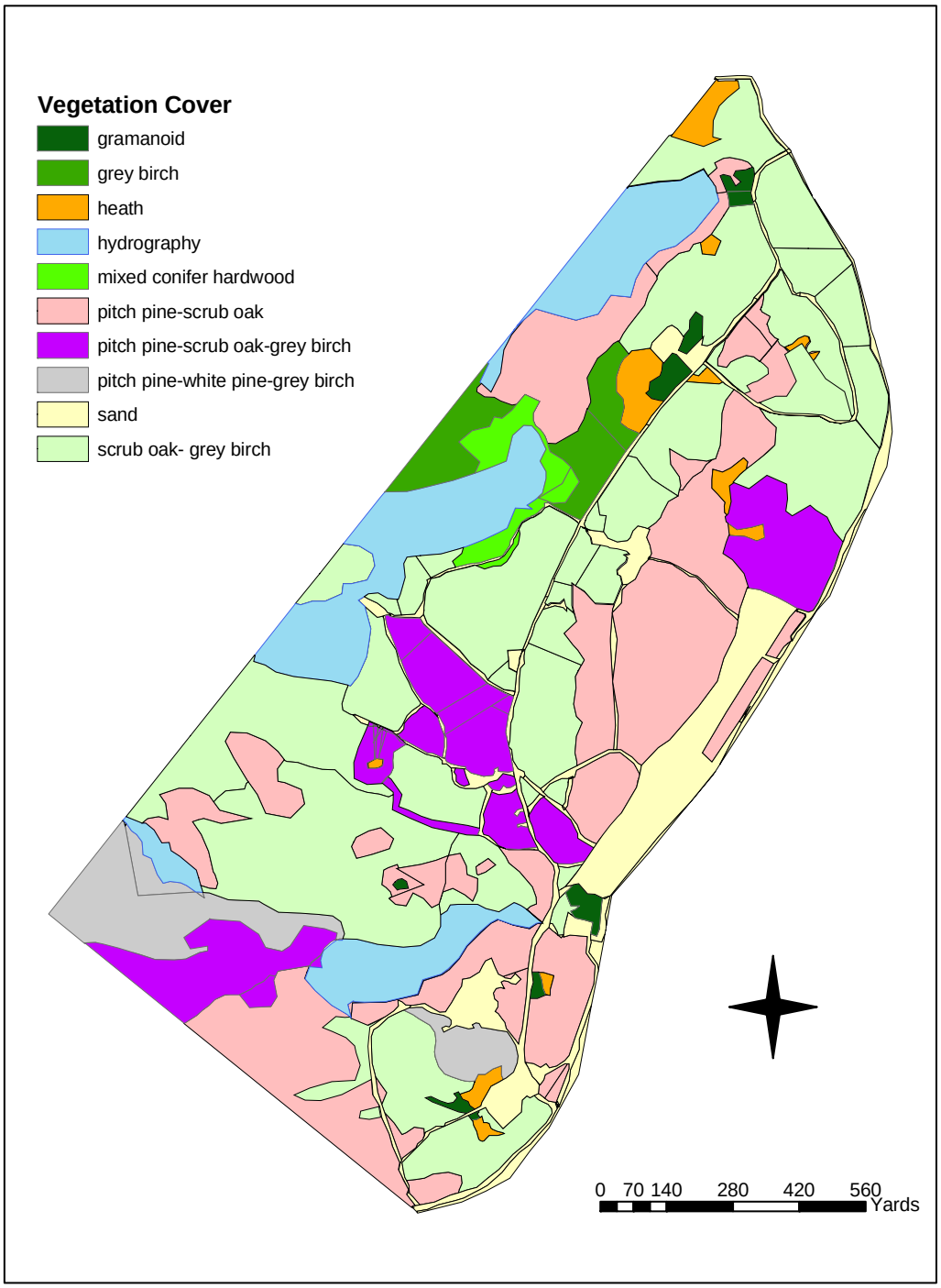


Figure 4: Prescribed burn history, 1995-1999; MANG Hollis training site

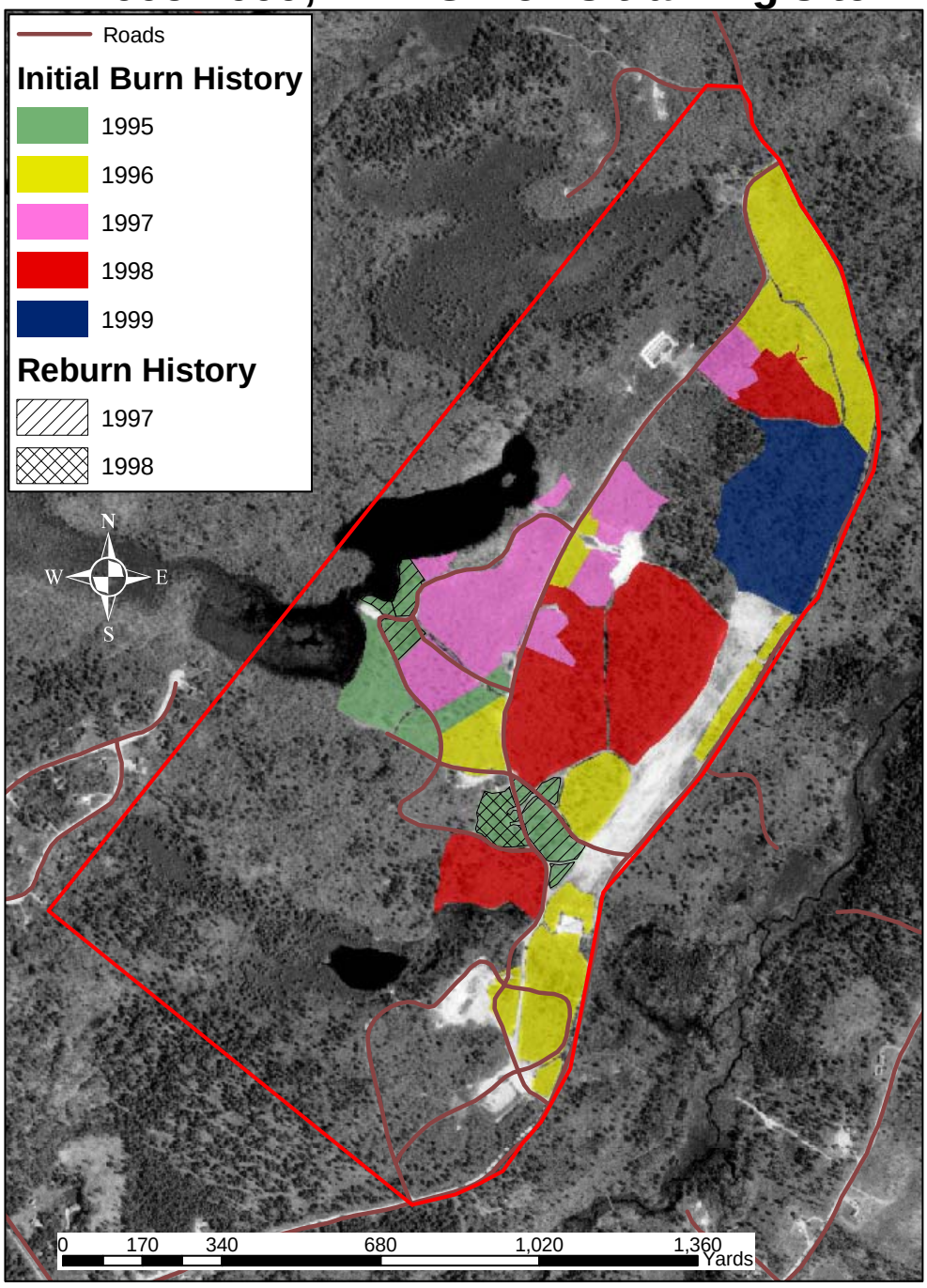


Figure 5: Burn units and 10 X 10 plots

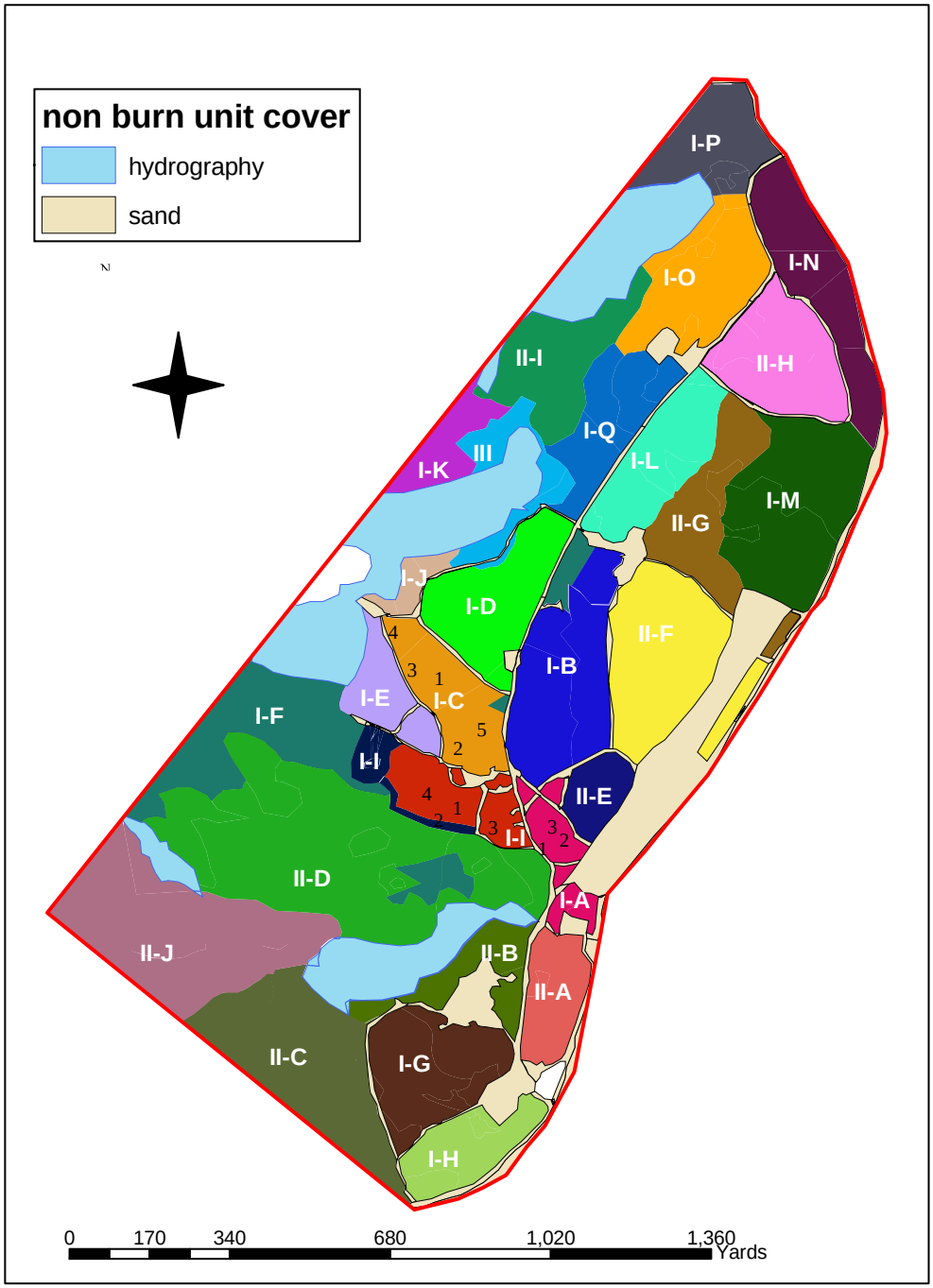
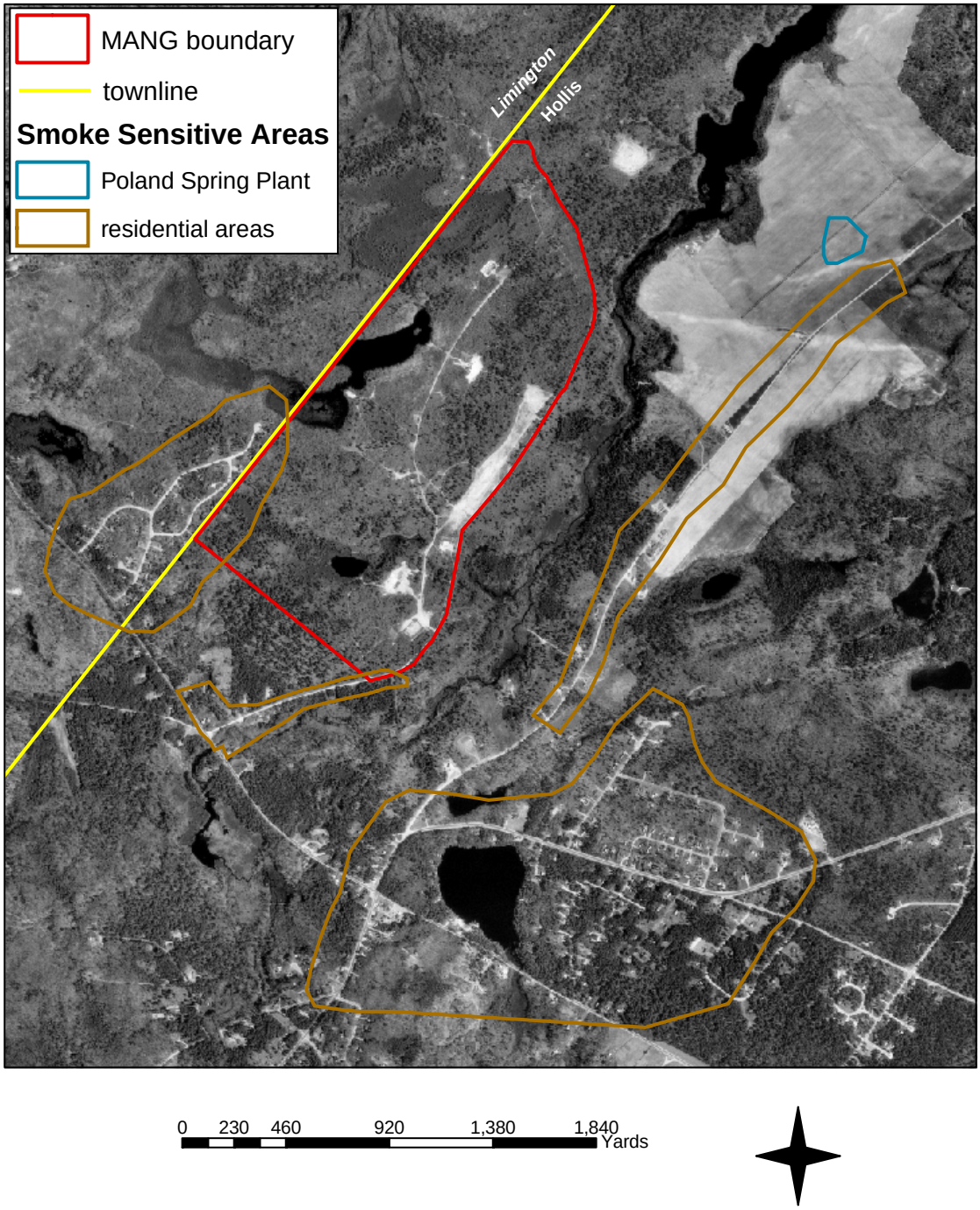


Figure 6: Smoke sensitive areas around MANG



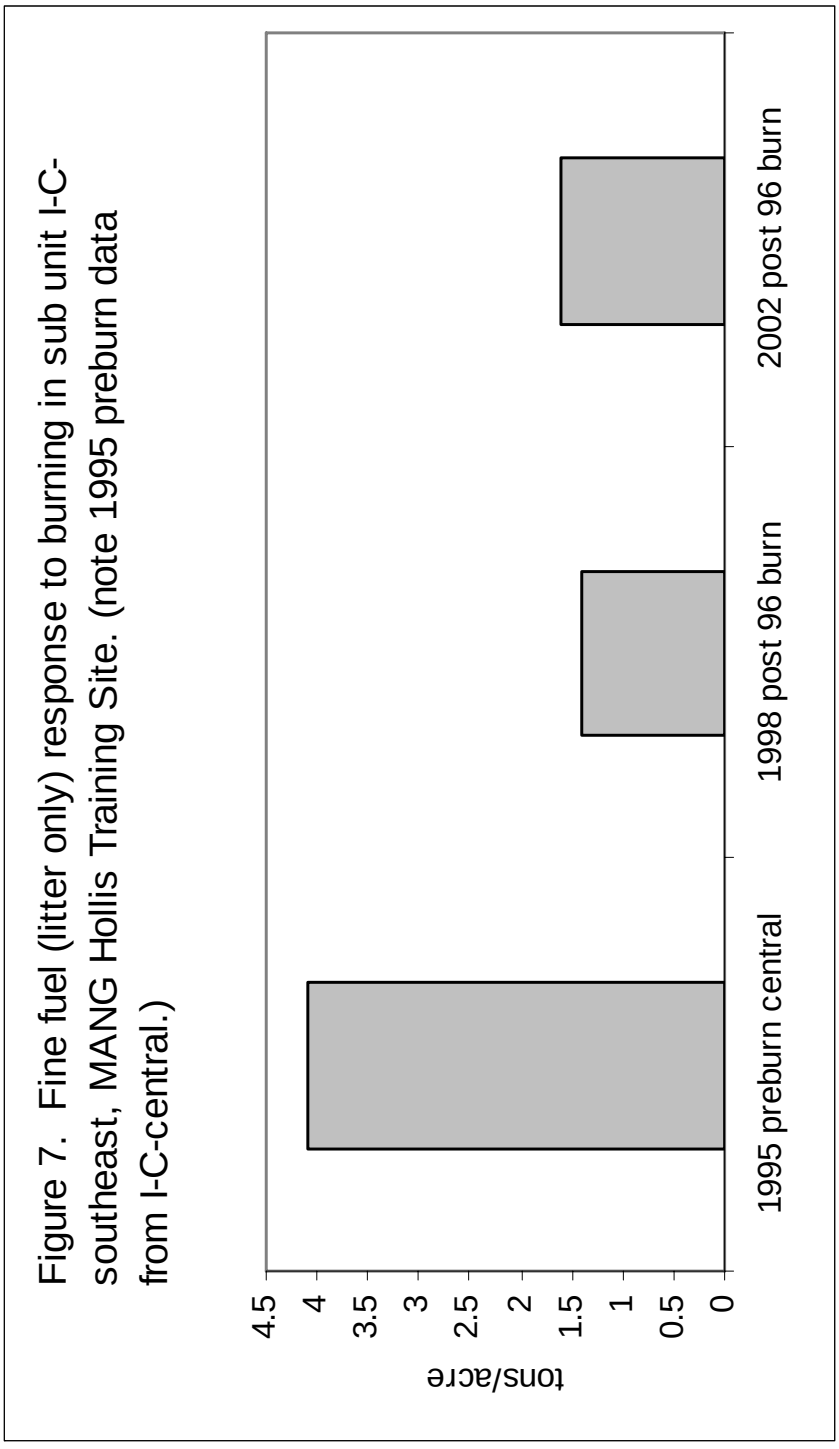


Figure 7. Fine fuel (litter only) response to burning in sub unit I-C-southeast, MANG Hollis Training Site. (note 1995 preburn data from I-C-central.)

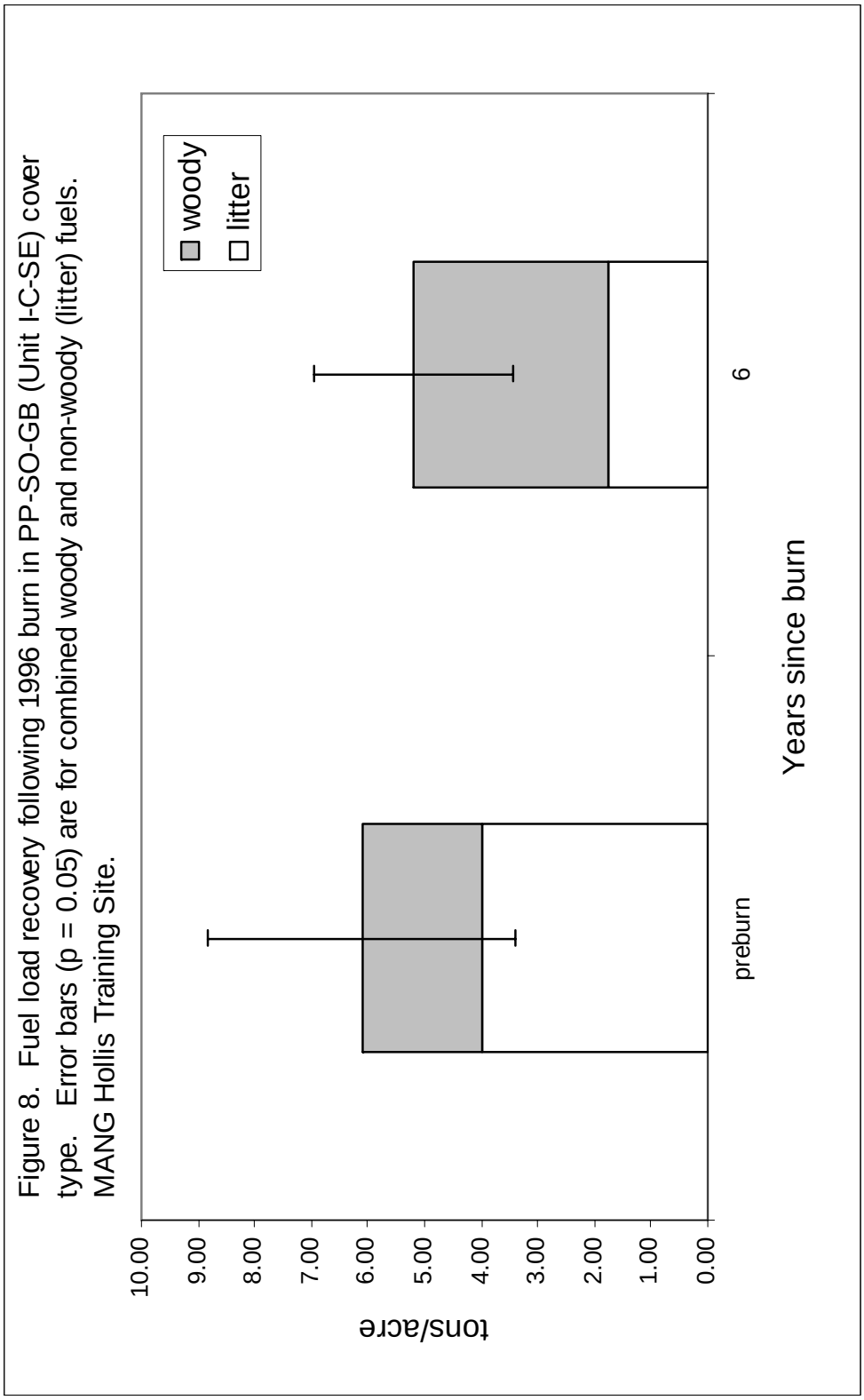
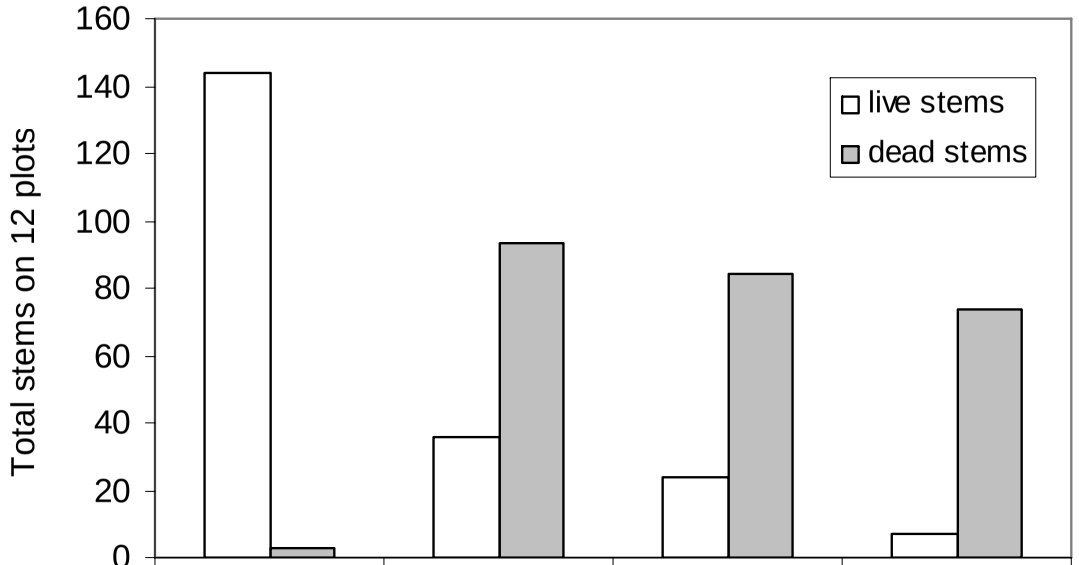


Figure 8. Fuel load recovery following 1996 burn in PP-SO-GB (Unit I-C-SE) cover type. Error bars (p = 0.05) are for combined woody and non-woody (litter) fuels. MANG Hollis Training Site.

Figure 9. Mortality of grey birch stems >5cm DBH in 12, 10X10m plots in PP-GB-SO cover type at Hollis MANG.



	1995	1997	1999	2002
live stems	144	36	24	7
dead stems	3	93	84	74

Table 1. Burn unit designation, area and prescribed burn history, MANG Hollis Training Site. –- indicates not burned.

Burn Unit	Area (acres)	Date Burned
I-A+	2.5	6/23/95*,7/31/95,6/5/97(reburn)
I-B+	15.7	8/8/96* (0.3 acres),7/23/97 (6 acres),6/11/98 (9 acres)
I-C+	8.8	8/17/95*, 6/18/96 (6.3 acres total), 6/5/97 (4 acres + 2 acres reburn of NW section)
I-D+	11.2	8/16/95 (0.8 acres), 6/28/97 (11 acres)
I-E+	5.6	6/18/96
I-F	17.2	--
I-G+	13.8	--
I-H+	6.5	--
I-I+	6.3	6/24/95*, 7/31/95*, 8/1/95*, 7/16/98(reburn)
I-J+	2.2	7/31/95* (1.3 acres),6/6/97 (2.2 acres – reburn 1.3 acres)
I-K	5.2	--
I-L+	4.0	8/17/96 (0.2 acres), 7/23/97 (3 acres)
I-M	16.3	8/25/99 (10 acres)
I-N+	12.4	8/8/96, 8/20/96
I-O	13.5	--
I-P	11.5	--
I-Q	8.8	--
II-A+	7.1	6/19/96, 8/7/96
II-B+	4.9	6/18/96 (0.5 acres)
II-C	20.6	--
II-D	39.0	9/2/98 (7 acres)
II-E+	4.4	7/12/96*
II-F+	15.3	6/11/98 (15 acres)
II-G	4.5	--
II-H+	11.1	8/20/96 (3.5 acres), 7/24/97 (3 acres), 7/15/98 (5 acres),
II-I	13.3	--
II-J	15.2	--
III	8.0	--

+ indicates units with completed fire prescription (see Appendix A for example)
* indicates detailed fire behavior measurements obtained.

APPENDIX