

CADWELL FOREST MANAGEMENT PLAN

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Overview

The Department of Natural Resource Conservation at the University of Massachusetts-Amherst owns and manages 1,950 acres in Massachusetts. The primary goals of this ownership are to provide an outdoor laboratory for teaching, research, and demonstration in ecology, forestry, and natural resources management. These forests are located in the central hardwood region of southern New England, but also include eastern hemlock (*Tsuga canadensis*) and eastern white pine (*Pinus strobus*) stands and several conifer plantations. The university forests are working forests, which includes the sale of timber and non-timber forest products from these properties.

Forest History

Cadwell Forest

The Cadwell Forest was established in 1952 through the generosity of Mrs. Frank A. Cadwell. Her donation of 1200 acres was an assemblage of the numerous woodlots her late husband had owned and managed from 1899-1935. As is the case for most areas in southern New England, the current vegetation on the Cadwell Forest has strongly been influenced by past land-use. In 1783, the first settlers moved to the area now occupied by Cadwell Forest. The majority of the land in this area was cleared for pasture and agriculture from the early to mid 1800s. During this time period, ten farms operated on Cadwell Forest, along with a sawmill and small woodworking shop. Stonewalls, rock piles, cellar holes, and old dams still remain in the Forest today as relics of this time period. By 1850, the population of the area was declining rapidly as people moved to the more productive soils in the Ohio River Valley and other parts of the Midwest. By 1900,

the majority of farming on Cadwell Forest had ceased. White pine colonized the abandoned pastures and hardwoods colonized the abandoned crop fields. During the early 1900s many of the white pine stands were cut and hardwoods, primarily oaks, grew in their place. Most of these hardwood stands on the forest were eventually cut in the 1920s and 1930s for timber and cordwood for the Amherst Brick Company. At the time of Mrs. Cadwell’s donation, the forest stands on much of the Cadwell Forest were sapling and pole size due to this previous logging.

After acquiring Cadwell Forest in 1952, the University of Massachusetts began to manage the property primarily for teaching, research, and demonstration. Small amounts of open land were planted with conifers (spruces (*Picea* spp. , pines (*Pinus* spp.), and hemlock). In addition, a variety of research activities were conducted on the forest, including white pine direct seeding experiments and studies examining the relationships between gypsy moths, oak forests, and small mammals. Today, the Cadwell Forest continues to be managed for teaching, research, and demonstration.

Current Forest Conditions

Current vegetation

Cadwell Forest consists primarily of mixed oak and oak-hardwood forests (Table 1). Species in these mixtures include red maple (*Acer rubrum*), red oak (*Quercus rubra*), and scarlet oak (*Quercus coccinea*) (Table 1). In addition, other forest types also occurring in the Cadwell forest include white pine)/Eastern hemlock) and hemlock/hardwood mixtures (Figure 1). The majority of these forests are relatively even-aged but uneven-sized.

Table 1. Major forest types occurring in the Cadwell Memorial forest.

Forest type	Percent of Cadwell Forest
Mixed hardwood	49.3
Mixed oak	23.7
White Pine/Hardwood	12.8
White pine	7.7
Hemlock	3.0
Hemlock/Hardwood	2.5
Plantations (Norway spruce, red pine)	0.8
White pine/Hemlock	0.2



Figure 1. Major vegetation and land cover types in the Cadwell Forest, Pelham, Massachusetts, 2002.

Stand growth

Stand volume (board-foot) estimates for the Cadwell Forest were calculated from the continuous inventory data taken in 1983 and 1993 (Table 2). Merchantable heights of all trees in 1983 and 1993 were estimated using models developed by Ek et al. (1984). For merchantable height predictions, minimum top diameters outside bark of 6 and 8

inches were used for conifer and hardwood species, respectively. Board foot volumes per tree were then estimated using the appropriate volume equation for each species (Scott 1979). A minimum merchantable diameter of 10 and 12 inches was used for conifer and hardwood species, respectively.

Table 2. Cadwell Forest volume and growth estimates--Total Forest Area (1200 acres). Based on the Continuous Forest Inventory System (millions of board feet), Pelham, Massachusetts, 1993.

Cadwell Forest	Standing Volume	Standing Volume	Net increase
Total area	1983	1993	
Oak	2.28	3.03	0.75
Pine	0.84	1.24	0.40
Hemlock	0.29	0.48	0.19
Other hardwood	0.86	1.14	0.28
TOTAL	4.27	5.89	1.62

Hydrologic features

Cadwell Forest lies in two major Massachusetts watersheds – the Chicopee River Watershed and Connecticut River Watershed. In addition, Cadwell Forest is part of three sub-basins that contribute to the Amherst, Ludlow, and Boston water supplies.

Maintaining water quality through Best Management Practices (BMPs; Kittredge and Parker 2000) is essential due to the contributions of these streams to local water supplies. Roughly 6.5 miles of streams are present in Cadwell Forest as well as 66 acres of wetlands, including a beaver (*Castor canadensis*) pond-wetland complex and numerous vernal pools (Figure 2).

Wildlife

Past and present land uses in Cadwell Forest have provided a variety of conditions suitable for a wide array of plant and animal species. Cadwell Forest is home to conspicuous species such as beaver), white-tailed deer (*Odocoileus virginianus*), moose (*Alces alces*), black bear (*Ursus americanus*), wild turkey (*Meleagris gallopavo*), and golden-crowned kinglet (*Regulus satrapa*). In addition, several species considered rare in Massachusetts have been found in Cadwell Forest. The BioMap Project produced by the Massachusetts Division of Fisheries and Wildlife’s Natural Heritage and Endangered Species Program has designated approximately three fourths of Cadwell Forest as

‘Supporting Natural Landscape’. Land with this designation includes large, undeveloped patches that buffer and connect core patches for rare plants and animals (NHESP 2001).

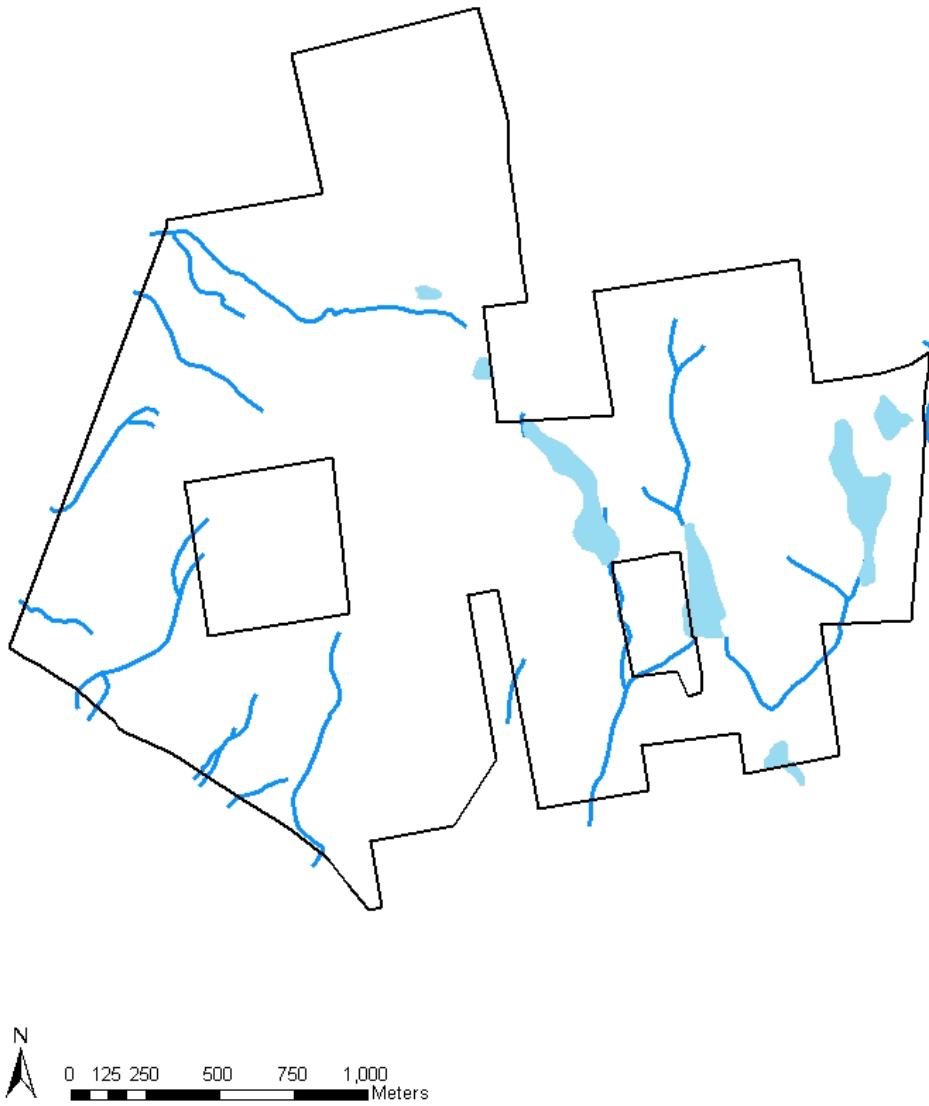


Figure 2. Hydrologic features in Cadwell Forest, Pelham, Massachusetts, 2003.

Recreation

Cadwell Forest is a popular recreation spot for residents of Pelham and the surrounding area. The 13.5 miles of roads and trails in Cadwell Forest are utilized for activities such as hiking, cross-country skiing, and bird watching. A portion of the Metacomet-Monadnock Trail, which stretches from the northern border of Connecticut to Mount Monadnock, New Hampshire, passes through the Cadwell Forest. In addition, there is a self-guided nature trail in the eastern portion of the Forest.

Table 3. Hydrologic, recreational, cultural, and ecological features in Cadwell Forest, Pelham, Massachusetts.

Feature type	Area, distance, or number
Hydrologic	
Streams	6.5 miles
Wetlands	66 acres
Recreational	
Roads	12 miles
Trails	1.5 miles
Cultural	
Cellar Holes	20
Stone Walls	12.5 miles
Stone Piles	54 acres
Ecological	
BioMap Supporting Natural Landscape	876 acres

Forest roads

Roughly 12 miles of roads and 25 culverts exist within the Cadwell Forest. There have not been any major repairs or maintenance of these roads over the past few years, with the exception of the road leading to the tower on Mt Lincoln, which is maintained by the UMass Physical Plant crews on a scheduled basis. Priorities for road repair and maintenance include brush clearing along major forest roads and replacement of culverts

not conforming to BMPs. In order to begin road repairs and maintenance, roads within the forest will be classified into three categories:

1. Temporary roads designed and constructed for short-term use during a specific project such as timber harvesting or research.
2. Permanent seasonal roads that are part of the permanent road system but designed for use only when the ground is frozen or firm.
3. All season roads that are permanent gravel roads for year-round use.

After the roads have been classified, the appropriate repairs and maintenance will be conducted.

Research Activities

Numerous research activities take place in the Cadwell Forest (see: <http://www.umass.edu/forwild/research/>). Early research on the Forest included white pine direct seeding experiments and studies focusing on the relationships between gypsy moths, oak mortality, and small mammals. A phenological study of leaf growth and flowering of 25 tree and shrub species in the Cadwell forest has been ongoing since 1979. Continuous Forest Inventory plots established throughout the Forest have been sampled every 10 years since 1983 allowing long-term monitoring of the Forest's composition and structure. Most recently, several experimental linear gaps were established to study the dynamics of trees growing in gaps (began in 2000). In addition, a series of woodland openings were created and prescribed burns conducted in 2001 to study the efficacy of these management activities in meeting combined wildlife and recreational goals.

Desired Future Conditions

In 2002, several NRC faculty members and graduate students developed a prioritized list of desired future conditions (DFCs) for the Cadwell Forest. The four primary DFC's were 1) increased diversity of stand size and age structures, 2) maintenance and enhancement of native biodiversity, 3) sustainable management of productive areas for timber and teaching, and 4) promotion of research. In addition to these four primary areas of emphasis, other DFC's included control/eradication of

invasive species, water quality protection, and maintenance of current recreational use (see Appendix for complete list).

Management Actions

Management Zones

In order to achieve these desired future conditions for Cadwell Forest, the Forest has been delineated into four main management zones: Research Natural Areas, Mount Lincoln Special Management Area, Active Management Areas, and Wetlands (Figure 3). Research Natural Areas were selected to represent a range of forest types to serve as controls for future research and to allow for the development of old-growth characteristics on the Forest. No timber harvesting will be allowed in these areas. The Mt. Lincoln Special Management Area includes the prescribed burning and thinning experiments and the direct-seeded white pine plantations on the summit of Mt. Lincoln. Active Management Areas constitute 670 acres of the forest and will be sustainably managed for timber production and used for teaching, demonstration, and research. In order to protect wildlife habitat and water quality, all management actions in Wetland Areas of the Forest will meet or exceed the Massachusetts BMPs (cf. Kittredge and Parker 2000).

Forest management guidelines and harvest levels for Active Management Areas

The management guidelines and harvest levels for the active management areas are based on the 10-year standing volume and growth estimates determined for 1983-1993 (Table 4). Based on these estimates, the Annual Allowable Cut (AAC) is 1,080 MBF for a ten-year period. Using these estimates, a harvest schedule was developed to provide for (1) teaching and demonstration needs by having a harvest in the planning or implementation stage at all times and (2) creating a diversity of stand ages, including 5 to 10% in an early successional stage at any time (Table 5). To facilitate future harvest planning, the standing volume for the Active Management Area was projected for years 2003, 2013, 2023, and 2033 using the Land Management System (LMS; Figure 4).

The harvesting levels outlined in Table 5 will be met by having one regeneration harvest and one thinning every two years, thus having active management going on at all times to use in class and demonstration exercises. In addition, the 50 acres of

shelterwood overstory removal cuts (and perhaps some patch clearcuts) will provide early successional stands on about 7% of the 670 acre Active Management Area. These harvests will provide 300 MBF per 10-year period resulting in a scheduled harvest rate just under 30% of the AAC. Timber harvests will be conducted during 2003-2013 on the areas outline in Figure 5. Within each actively managed area, a representative acre of forest will be left unmanaged for comparison purposes. The projected diameter distribution of harvested and unharvested trees is illustrated in Figure 6.



Figure 3. Proposed management areas along with cultural and hydrologic features in Cadwell Forest, Pelham, Massachusetts, 2003.

Herbicide and Pesticide Use

The use of herbicides for release treatments and the eradication of exotic or invasive species will be allowed in the Active Management and Mt. Lincoln Special Management Areas. Herbicides and pesticides may only be used in the Research Natural Areas for the eradication of exotic and invasive species. Any herbicide use in Wetland Areas must conform to Massachusetts BMPs.

Table 4. Cadwell Forest volume and growth estimates for the Active Management Area (670 acres). Based on the Continuous Forest Inventory System (millions of board feet), 1993, Pelham, Massachusetts.

Cadwell Forest Active mgmt area	Standing Volume 1983	Standing Volume 1993	Net increase
Oak	1.04	1.51	0.47
Pine	0.67	0.97	0.30
Hemlock	0.09	0.19	0.10
Other hardwood	0.51	0.72	0.21
TOTAL	2.31	3.39	1.08

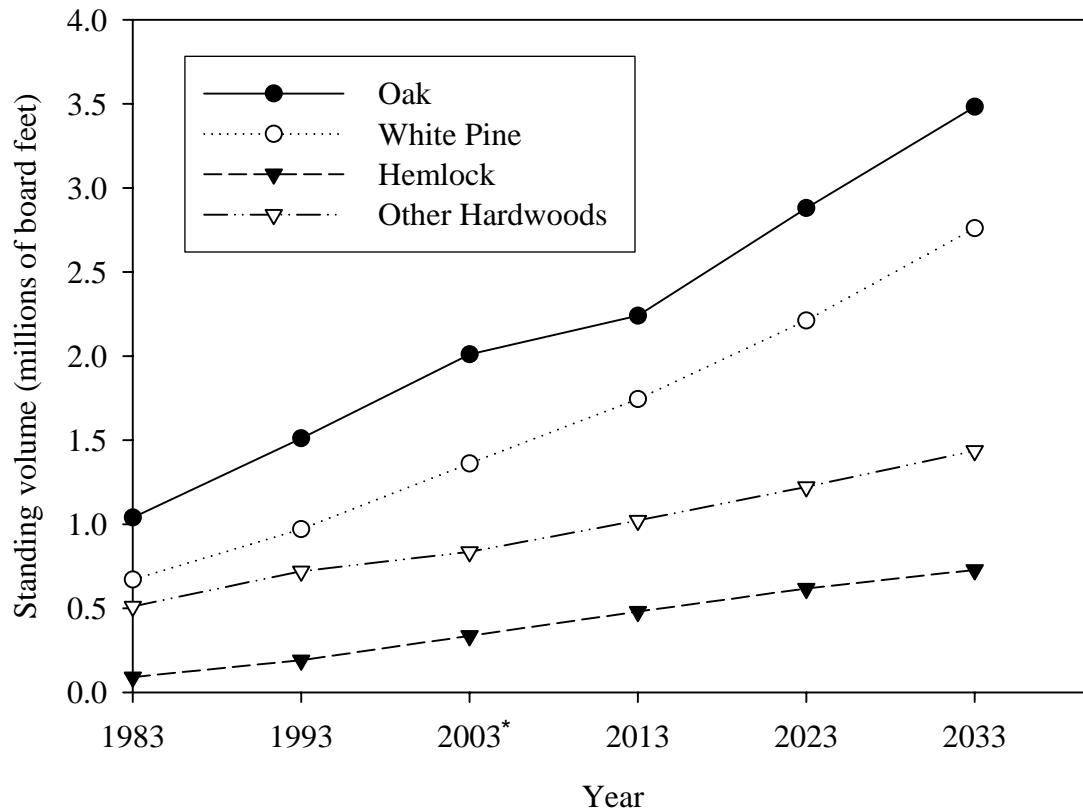


Figure 4. Standing volume estimates for the Active Management Area based on continuous forest inventory data (1983, 1993) and growth projections using the Landscape Management System (2003, 2013, 2023, and 2033), Cadwell Forest, Pelham, Massachusetts. *Does not include volume removed in scheduled timber harvests for 2003-2013.

Table 5. Ten-year timber harvest schedule (2003-2013) for Active Management Areas in Cadwell Forest, Pelham, Massachusetts.

Area (acres)	Treatment type	Volume (MBF)
50	Thinning (commercial or precommercial)	50
50	Shelterwood establishment cut; some selection cuts	125
50	Overstory removal cut, patch clearcut	125

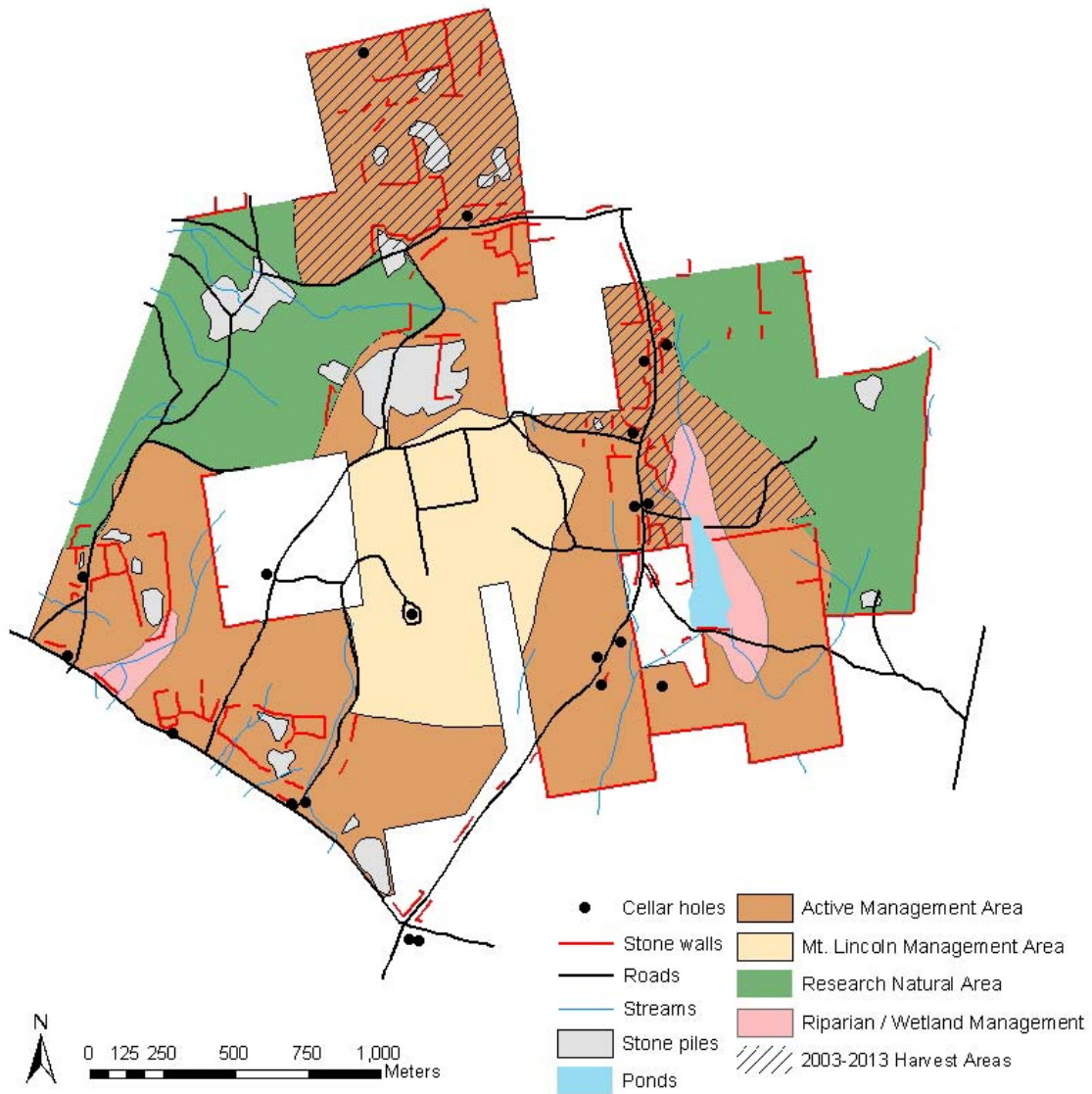


Figure 5. Proposed areas for forest management activities 2003-2013, Cadwell Forest, Pelham, Massachusetts.

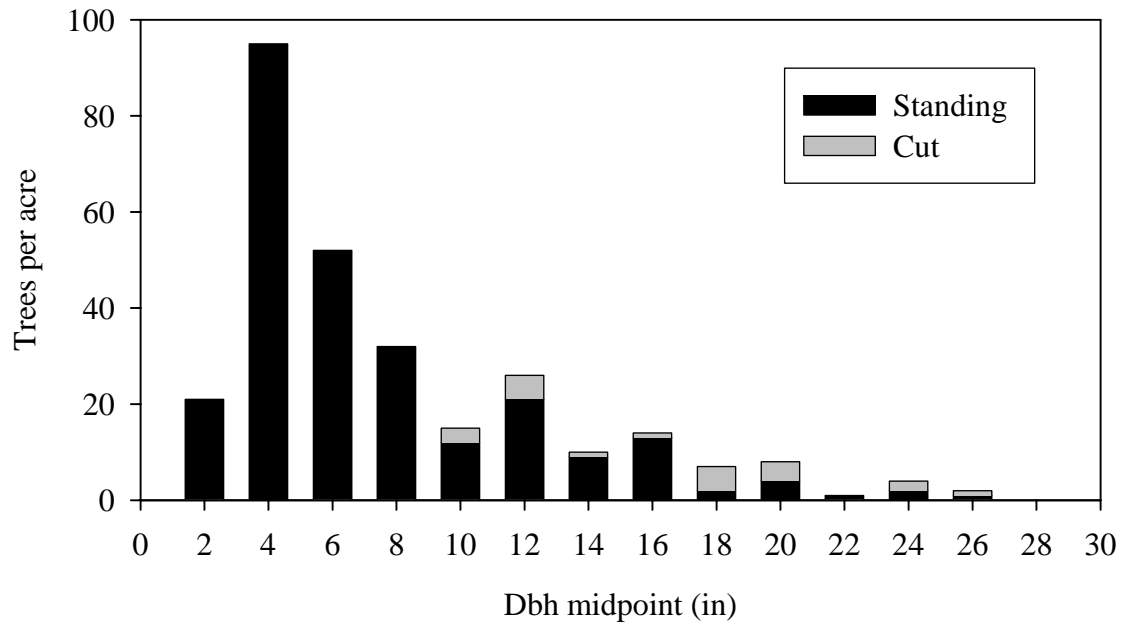


Figure 6. Projected diameter-class distribution of standing and cut trees in areas actively managed during 2003-2013, Cadwell Forest, Pelham, Massachusetts. Distribution based on composite of diameter distributions projected for the actively managed areas using LMS.

Public Participation

A public meeting was held on January 29, 2003 at the Pelham Public Library to present the proposed management plan to the public users of Cadwell Forest. Over 60 residents attended the meeting and provided valuable input on recreational use and potential conflicts. In addition, over 200 surveys pertaining to recreational use of Cadwell Forest were administered to landowners abutting the Forest. A summary of a portion of these surveys is presented in Figures 7 and 8. In general, hiking is the largest recreational use of the forest followed by cross-country skiing and wildlife viewing (Figure 7). Concerns and conflicts regarding recreational use of the Forest include use of the Forest by snowmobiles and trail damage caused by mountain bikes (Figure 8). The public meeting and survey results illustrate the need for a policy on trail use within the Forest and future meetings between recreational groups, such as the Amherst Mountain

Bike Club and Appalachian Mountain Club, are scheduled to address these specific recreational concerns.

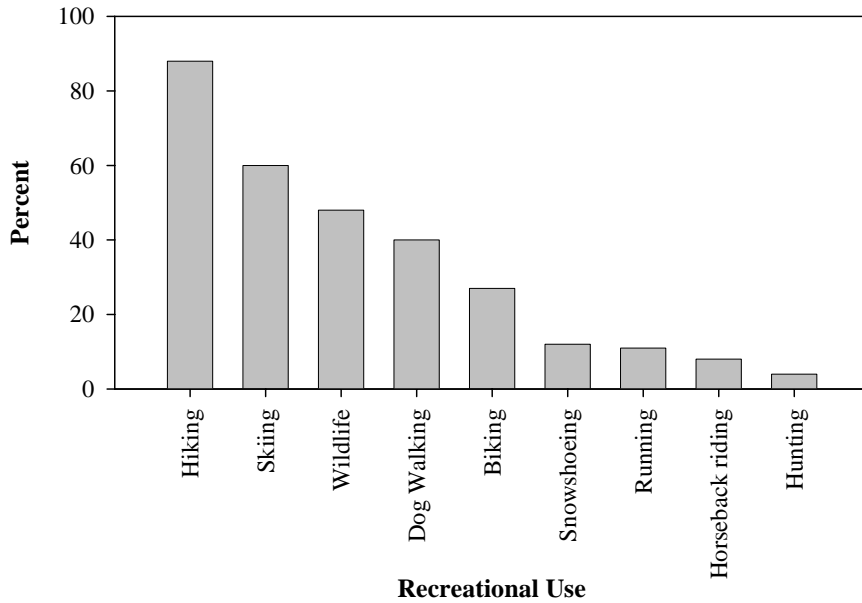


Figure 7. Summary of recreational survey (as of January 30, 2003) administered to users of Cadwell Forest, Pelham, Massachusetts, 2002 (n=75).

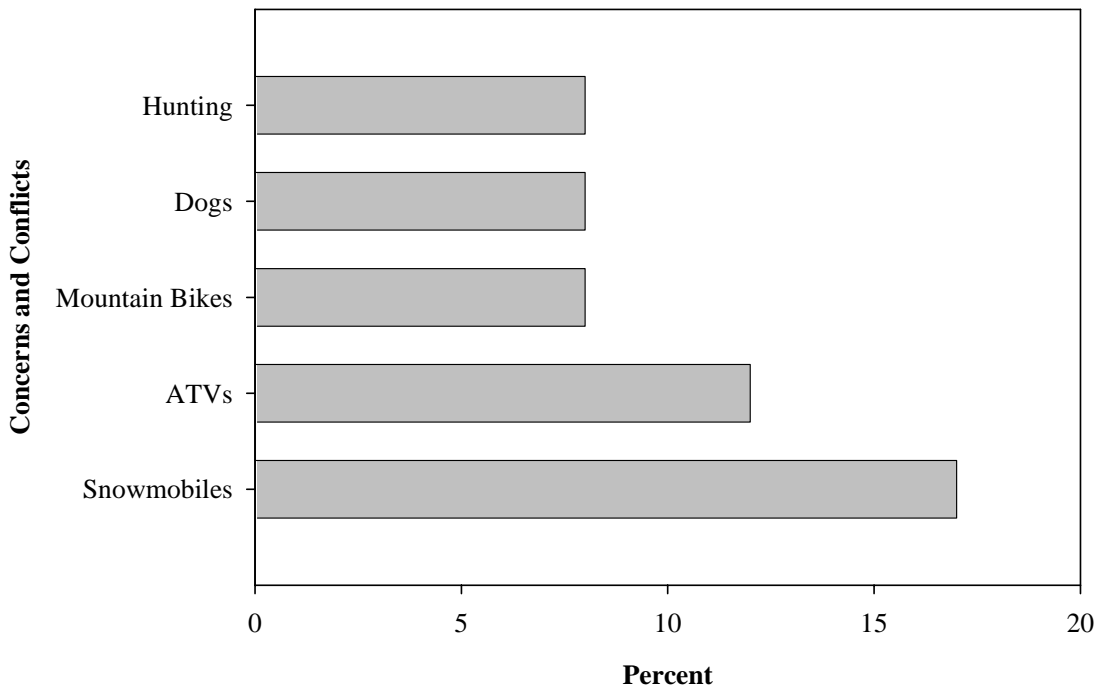


Figure 8. Concerns and conflicts expressed by recreational users of Cadwell Forest,

Pelham, Massachusetts, 2002 (n=40 documented conflicts or concerns out of 75 total respondents).

Monitoring Plans

Inspections of Forest infrastructure, including culverts, gates, creek crossings, and road grades, will be conducted annually. Forest boundaries will be inspected and remarked where needed on a ten-year basis. Continuous Forest Inventory plots will continue to be measured every ten years, with the next measurement occurring in the summer 2003. Implementation of the proposed harvests for 2003-2013 will be monitored by a consulting forester. Data collected as part of research projects and as well as class labs in the Forest will be used to document species presence on the Forest. A research coordinator and database manager will be appointed to maintain an active database of ongoing research and will update the Department of Natural Resource Conservation's research archives (<http://www.umass.edu/forwild/research/>) on a yearly basis.

Budget

The budget for managing and maintaining Cadwell Forest, Pelham, Massachusetts, is outlined in Table 6. Projected harvest revenues are based on current, median stumpage values (Kittredge 2002). Additional revenue from state funding is pending.

Table 6. Projected budget for managing and maintaining Cadwell Forest, Pelham, Massachusetts, for 2003-2013.

Item	Cost
Infrastructure	
• Roads	\$11,700
• Culverts	\$ 5,000
Salaries	
• Forest Inventory	\$10,000
• Boundary Marking/surveying	\$ 5,000
• Research Archives	\$20,000
FSC Certification	\$ 5,000
	Projected Revenue^a
Timber sales	
• Oak (151 MBF at \$305/MBF)	\$46,055
• White pine (86 MBF at \$90/MBF)	\$ 7,740
• Other hardwoods ^b (63 MBF at \$60/MBF)	\$ 3,780
Total Revenue	\$57,575
Total Cost	\$56,700

^a Based on stumpage prices for 2002.

^b Based on stumpage prices for birch (*Betula* spp.).

Literature cited

Ek, A.R., Birdsall, E.T., and Spears, R.J. (1984) A simple model for estimating total and merchantable tree heights. Research Note NC-309, USFS, North Central Experiment Station, 4pp.

Kittredge, D.B. 2002. Southern New England stumpage price survey results-fourth quarter-2002. <http://forest.fnr.umass.edu/snespsr/reports/STUMPREP42002.htm>

Kittredge, D.B., and M. Parker. 2000. *Massachusetts forestry best management practices*. Massachusetts Department of Environmental Protection. 56 pp.

Scott, C.T. (1979) Northeastern forest survey board-foot volume equations. Research Note NE-271, USFS, Northeastern Experiment Station, 4pp.

Natural Heritage & Endangered Species Program, 2001. BioMap Technical Report: A supplement to *BioMap: Guiding Land Conservation for Biodiversity in Massachusetts*. Massachusetts Division of Fisheries and Wildlife, Westborough, Massachusetts.

APPENDIX

Goals and Objectives statements used to develop the Desired Future Condition for Cadwell Forest, Pelham, Massachusetts, 2002 by faculty and students, Department of Natural Resources Conservation, University of Massachusetts-Amherst.

NOTE: the number in parentheses is the number of votes received out of the total possible votes.

1. Diversify tree ages and sizes (9).
 - Increase early and late seral conditions to complement surrounding landscape.
 - Have > 5% of forest in the seedling stage at all times.
 - Identify one or more research natural areas (200-300 acres?) for old-growth development and retention
2. Maintain and enhance native biodiversity (9).
 - Management techniques with special attention given to uncommon species (e.g., white oak)
 - Maintain habitat conditions for a diversity of wildlife.
 - Set aside research natural areas to protect unique/sensitive vegetation communities
 - Set aside research natural areas for development into old-growth
3. Sustainably manage most productive stands for timber (9)
 - Thinning
 - Provide income for management and research
 - Manage to promote teaching, demonstration, and research
 - Living classroom -- students engage in management
 - Plantation management
4. Promote research (9)
 - Interdisciplinary
 - Allow for doing something 'bad' in order to study impacts
 - University properties committee should review proposals
 - Develop a research coordinator and/or database.
5. Control/eradicate invasives (5)
 - Provisions for chemical control will be needed
6. Protect water quality wetlands and riparian zones (4)
 - Buffers for beaver pond, vernal pools, streams
 - Follow chapter 132 regulations
 - Roads and culverts conforming to BMPs
7. Maintain current recreational use (3)
 - Signage with information, nature trail information, rules
8. Preserve, enhance, maintain cultural resources (2)
 - Historic landscape, stone walls, farm fields etc. (acreage?)
9. Increase acreage or consolidate holding through land swaps (0)
10. Zoning to accommodate various goals (0)
11. Plan for response to hemlock wooly adelgid mortality (0)
12. Collaboration/cooperation with neighboring landowners

GIS data layers for Cadwell Forest (A CD with these data will be placed in the research archives web page.

Projection and datum: Massachusetts State Plane NAD 1983

Cadwell Forest Boundary
Cellar Holes
Fences
Stone Piles
Streams
Ponds
Roads
Soils
Powerlines
Stands
Vegetation
M&M Trail
DEM Contours
Watersheds
Sub-basins
NHESP Surrounding Natural Landscape
NHESP Core Habitat
NHESP Potential vernal pools

Buffers of cellar holes, stone piles, fences, streams, roads, pond, M&M trail