Executive Office of Environmental Affairs

Sustainable Forest Management

What are forest reserves?

Forest reserves are portions of state lands where commercial harvesting of wood products is excluded in order to capture elements of biodiversity that can be missing from sustainably harvested sites. Small (patch) reserves will conserve sensitive, localized resources such as steep slopes, fragile soils, and habitat for certain rare species that benefit from intact forest canopies. Large (matrix) reserves will represent the diversity of relatively un-fragmented forest landscapes remaining in Massachusetts today. Matrix reserves will ultimately support a wider diversity of tree sizes and ages than typically occurs on sustainably harvested sites, and will also support structures and processes associated with extensive accumulations of large woody debris that are typically absent from harvested sites.

Matrix reserves will ultimately include a wide range of tree sizes and ages, from large, old trees 200-500 years old, to small, young trees that occur in open gaps where old trees have died or been blown over. Matrix reserves will ultimately feature extensive “pit and mound” micro-topography that occurs when old trees are blown over and their roots are pulled from the ground. Pits are formed when roots of large trees are pulled out of the ground during a natural disturbance like a wind storm. Pits collect moisture, organic matter, and nutrients over time, and provide unique, protected micro-climates for plants and invertebrate wildlife. Over time, the exposed roots of toppled trees degrade and form mounds characterized by extreme soil conditions of low moisture, low organic matter, and low nutrients that are markedly different from, yet in close proximity to pits originally occupied by the roots (Beatty 1984). The trunks and branches of large trees that are toppled during wind storms will accumulate as large woody debris in the forest, and will support decades or even centuries of activity by micro-organisms and invertebrate wildlife that occupy, feed upon, and ultimately break down these massive stores of organic material.

The EOEA agencies responsible for managing state-owned forestlands (DCR Division of State Parks and Recreation, DCR Division of Water Supply Protection, and DFG Division of Fisheries and Wildlife) have proposed nine matrix reserves (***Table 1***) that will represent the diversity of forest ecosystems that occur within the remaining, relatively un-fragmented forest landscapes of Massachusetts.

Table 1. Potential large (matrix) forest reserve sites on state lands.

Site Name	Ecological Type	State Lands	Potential ac State Land
Mt. Greylock	Taconic Mountains ELU group 9	Portions of the Mt. Greylock State Reservation	8,500
Mohawk/Monroe/Savoy	Southern Green Mountains	Portions of the Monroe State Forest	7,100
Chalet	Berkshire/Vermont Upland Ecoregion. ELU group 8	Portions of the Chalet, Stafford Hill, and Eugene Moran Wildlife Management Areas, and portions of the Windsor State Forest.	7,112
Mt. Washington	Taconic Mountains ELU group 9	Portions of the Mt. Washington State Forest, and portions of the Jug End State Reservation & Wildlife Management Area	7,155
Middlefield / Peru	Berkshire/Vermont Upland Ecoregion. ELU group 7a	Portions of the Middlefield State Forest.	2,900
Otis	Berkshire/Vermont Upland ELU group 6b	Portions of the Otis State Forest.	769
East Branch Westfield River	Hudson Highlands Ecoregion ELU group 4a	Portions of the Gill Bliss State Forest, and portions of the Hiram Fox Wildlife Management Area.	2,638
Cunningham Pond	Worcester-Monadnock Plateau Ecoregion	Portions of the Ware River Watershed Forest.	3,029
Myles Standish	Cape Cod/Islands Ecoregion	Portions of the Myles Standish State Forest and portions of the Sly Pond Natural Heritage Area.	11,000

The EOEA agencies have established the following goal, objectives, and benefits for matrix reserves.

Goal: Capture elements of biological diversity that can be missing from harvested sites.

- Objectives:
  - Retain wood fiber that is typically extracted from the forest ecosystem.
  - To the greatest degree possible, allow natural disturbance processes to determine the structure and composition of the forest ecosystem.
  - Facilitate biological monitoring to establish baseline data on the species, natural communities, and ecological processes that occur in forest ecosystems reserved from commercial timber harvesting.
- Benefits:
  - Allow comparison of species, natural communities, and ecological processes on harvested sites with sites reserved from harvest of wood products.
  - Provide late-successional forest habitats for wildlife that represent the diversity of forest ecosystems in Massachusetts.
  - Inform management of harvested sites with knowledge of structural attributes that develop on reserve sites.
  - Provide unique recreational and aesthetic opportunities in biologically mature forest habitats that will develop over time in reserves.

Why are reserves important?

Reserves allow people to experience and to understand how forest ecosystems function when timber and other wood products that are normally extracted for human use remain in place. While it is important to have the great majority of forestland open to the sustainable harvest of wood products in order to support human society, it is equally important to retain portions of our forested landscapes in a condition where all components of the ecosystem remain in place. Forest reserves allow us to more fully assess human impacts on harvested sites, and may provide insights into how extractive management of harvested forestlands can be improved.

Most private forest landowners can ill-afford to forgo harvesting of large sawtimber and to allow sawtimber trees to be blown down and remain in the forest. Revenues generated from harvesting on private lands also make it economically viable to retain private forestland in forest use. State-owned forestlands are generally able to provide more accumulation of large woody debris than private lands, but in order to meet a range of existing goals, the sustainable harvest and commercial sale of renewable wood products is appropriate on most state lands. At the same time, it is also appropriate to establish reserves on state lands that will provide unique environments where all woody biomass remains on site.

Reserves will likely support substantially higher densities of certain species of moss and lichens that typically occur only on older trees (Selva 1996). Feather flat moss (Neckara pennata), lungwort lichen (Lobaria pulmonaria), and shaggy fringe lichen (Anaptychia palmulata) are examples of species that do not typically occur on harvested sites in Massachusetts. Some beetle species which occupy the forest-floor appear to be more abundant in old-growth than in managed forests (Flatebo et al. 1999). Certain forest songbirds (e.g., Blackburnian warbler, Magnolia warbler, and Solitary vireo) occur at substantially higher densities in forest reserves than in harvested forestlands (Haney and Schaadt 1996). Forest reserves provide potential refugia for unique species assemblages, and may provide habitat for invertebrate wildlife and soil micro-organisms that have not been well studied to date. Reserves will provide unique recreational, aesthetic, and educational opportunities for the people of Massachusetts.

Forest reserves provide reference sites for objective assessment of the sustainability of forest management practices (Norton 1999), and are essential for practicing adaptive resource management (Walters and Holling 1990). Reserves create opportunities for connectivity within the landscape, conservation of species and processes, buffering against future uncertainty, and other hard to measure but valuable functions (Hunter 1996). While no forestland in Massachusetts is free of human impact from ubiquitous influences such as air pollution and invasive, exotic organisms introduced by people, forest reserves can still help ensure that representative examples of biodiversity indigenous to an area are more likely to be conserved since wood fiber is not extracted and invasive plant species are less likely to be introduced in reserves.

Natural disturbance processes will, to a large degree, determine the structure and composition of the forest ecosystem in reserves. Reserves will provide valuable late-seral forest habitat for wildlife that may ultimately support species assemblages and abundances that do not occur on the sustainably harvested sites. Long term ecological monitoring (LTEM) is planned on reserve sites to document the composition of plant and animal communities over time. EOEA has contracted with researchers at the University Of Massachusetts Department Of Natural Resource Conservation to design and implement comprehensive LTEM in reserves. The results of LTEM may eventually aid in refining management practices on harvested sites to enhance conservation of biodiversity across all forestlands.

Reserves can be used to conserve small, isolated resources (e.g., rare species habitats or sites with fragile soils), and to establish extensive areas that represent the diversity of forest ecosystems that occur in Massachusetts. A combination of small (patch) reserves and large (matrix) reserves will be created on state lands to insure that all elements of biodiversity are represented across Massachusetts' forestlands. Reserves will be imbedded within the extensive, working forest landscapes of Massachusetts, where the

great majority of land is open to commercial harvesting of renewable wood products. Together, sustainably harvested sites and reserves will provide a range of ecological and recreational opportunities on state-owned forest lands.

What activities will occur in reserves?

Each matrix reserve will have an operational plan established with opportunities for public input to clearly define what activities will and will not occur, and to determine in advance how managers will coordinate with local officials in response to events like wildfires, pest and pathogen outbreaks, extensive blowdowns, and other natural disturbance events. Plans should review all known disturbance events that have occurred in the vicinity of the reserve over the past few hundred years, and should also anticipate both natural and human-caused events that may occur in the future. Biological monitoring of species, communities, and processes will be a fundamental component of planning for all reserves.

The primary difference in activities between reserves and other state-owned forestlands will be the exclusion of commercial timber harvesting. Recreational use of rubber-tired motorized vehicles such as dirt bikes, ATV's, and four-wheel drive trucks are already excluded from the great majority of state lands, and will also be excluded from reserves. Recreational use of snowmobiles during the winter season may continue under existing permits and on designated trails depending on Agency policy. However, snowmobile use during the winter season will not be expanded on any reserve site beyond what is currently allowed. Foot-pedaled mountain biking and horseback riding will be determined on a case by case basis for each reserve according to Agency policy. Camping will typically be restricted to existing recreational sites, and will not be expanded in reserve sites. Activities such as hiking, hunting, fishing, trapping, birding, and other forms of wildlife observation are currently allowed on most state-owned forestlands, and will continue in reserves.

Determining the appropriate response to wildfires, outbreaks of pests and pathogens, and occurrence of invasive species will be a critical component of reserve planning. One objective established above for matrix reserves was: "To the greatest degree possible, allow natural disturbance processes to determine the structure and composition of the forest ecosystem". Given that humans are part of the natural environment, how do we define a natural disturbance, and how do we constrain a natural disturbance such as a lightning-strike wildfire within a reserve so that it does not threaten human life and property outside the reserve?

For planning purposes, a natural disturbance will be defined as an event that would be expected to occur absent direct human actions on the landscape. Natural disturbances include windstorms, lightning-caused wildfire, and outbreaks of native insect pests such as hemlock looper and forest tent caterpillar that have occurred historically in Massachusetts. For each natural disturbance that occurs within a given reserve, a decision must be made as to whether or not the disturbance can be allowed to proceed to any degree without threatening human life and property outside the reserve. Disturbances such as natural wildfires which can clearly threaten human life and property must either be immediately extinguished within a reserve, or to whatever degree possible, be allowed to "let burn" within portions of the reserve if state and local officials feel this can be done without impairing public health and safety. In a fire-adapted forest ecosystem like the pitch pine/scrub oak type found in southeastern Massachusetts, wildfire can be extremely difficult to contain, and prescribed burning may be appropriate to emulate natural processes while insuring public health and safety.

A similar approach should be taken to new, human-caused introductions of insects and pathogens that threaten the economic value of private and public forests outside reserves. For example, exotic insects like the Asian long-horned beetle and emerald ash borer have recently caused substantial loss of standing timber in parts of the United States. In the event that a species like these is discovered within a reserve, actions should be taken to eliminate or at least control the species within the reserve so that it does not spread into adjacent forestlands open to harvesting.

Response to introduction of invasive plant species into a reserve must also be considered. Invasive plants include species that did not continuously expand their range area into Massachusetts, but rather were transported substantial distances by humans and placed into new environments where no natural controls occur to constrain the introduced species. Invasive plant species multiply rapidly and reduce diversity of native plants (see http://www.mass.gov/dfwele/dfw/nhesp/findingslistapr05.pdf for a listing of invasive species in Massachusetts). Invasive plant species identified in this NHESP publication should be eliminated or controlled within reserves using mechanical procedures whenever possible.

In addition to natural disturbances, which can be allowed in reserves without threatening public health and safety outside reserves, certain human-caused disturbances that have become ubiquitous throughout the landscape will likely be allowed to proceed unabated within reserves. Examples include beech bark disease complex, periodic gypsy moth infestations, and hemlock wooly adelgid.

How big should reserves be?

Patch reserves will typically be relatively small (tens or hundreds of acres) and will be defined by the extent of the unique resources (rare species, steep slopes, etc.) intended for conservation. The goal and objectives established above for matrix reserves infer that reserve size should be based on the expected extent of natural disturbance events. Natural disturbances are common in southern New England forests, and range from frequent, small disturbances (e.g., annual wind events that disrupt <1 acre of forest canopy) to occasional, catastrophic disturbances (e.g. major windstorms that disrupt as much as 5,000 contiguous acres of forest canopy once every few centuries) (***Table 2***). Major wind events like tornadoes and hurricanes often disrupt more than 5,000 total acres across the landscape (hurricanes in particular can impact millions of acres), but disturbance is typically not continuous, and historically the largest individual disturbance patches do not appear to exceed about 5,000 acres in this area. EOEA supports having a limited number of large reserves of 5,000± acres that represent the diversity of forest ecosystems that occur in Massachusetts.

Table 2. Comparison of characteristics among infrequent catastrophic disturbances in the Northern Appalachian Ecoregion (adapted from Foster et al. (1998) by Anderson and Bernstein (2003)).

	Tornado	Hurricane	Down-Bursts	Large Fires	Insect Outbreak	Ice Storms	Flood
Maximum Size of Severe Damage Patch (acres	5,000	803	3,400	57-150	?	<5	?
Return Interval (years)	100-300	60-200	?	400-6,000	10	2	20-100

Where should reserves be located, and how many reserves should there be?

During 2004, forest managers from the EOEA agencies worked to identify potential matrix reserve sites that would represent the diversity of forest ecosystems occurring within the relatively un-fragmented forest landscapes remaining in Massachusetts. The EOEA effort is based on a fundamental assumption that matrix

reserves should occur in relatively un-fragmented forest landscapes where they can be buffered from impacts of human development by working forestlands outside the reserve.

The EOEA agencies worked with The Nature Conservancy (TNC) to evaluate relatively un-fragmented forest blocks that had previously been identified in Massachusetts by TNC. A geographical information systems (GIS) analysis was conducted to identify the portion of each matrix block that contained the largest patches of interior forest habitat and that contained the lowest density of roads and transmission lines. This analysis identified 23 sites representing eight different types of forest ecosystems. Each of the 23 sites was ranked according to 11 ecological criteria that were weighted by an expert panel established by EOEA (***Figs. 1 and 2***). Eight of the highest ranked sites were selected to represent ecoregions and ecological land units (ELUs) occurring in Massachusetts (ELUs capture diversity of elevation, geology, and landform).

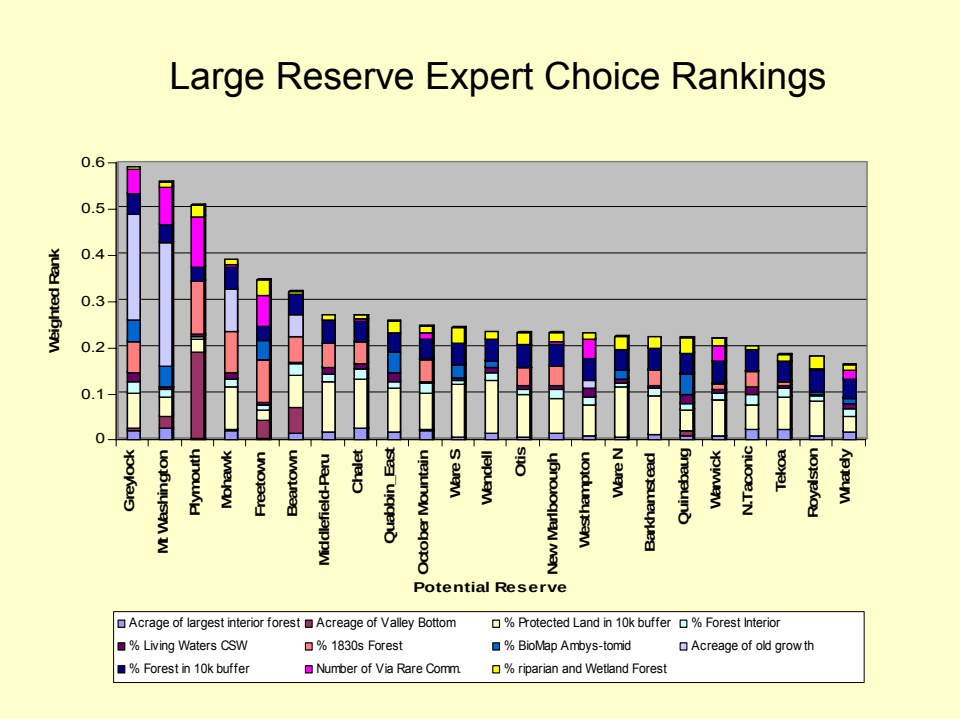
Figure 1.

Biodiversity Value: Forest Reserve Evaluation Criteria

Experts including: UMass, NEFF, DCR Service & Management Foresters, USFS Wildlife Biologist, DFW Forester, Private Forester, MAS, TNC

Criteria	Weight
• Acreage of Old Growth	.268
• Acreage of Valley Bottom Land	.188
• % Protected Land in Surrounding area	.115
• % 1830s Forest	.114
• Number of Viable Rare Communities	.108
• % Forest Cover in Surrounding	.051
• % BioMap Ambystomid Habitat	.047
• % Riparian and Wetland Forest	.035
• % Forest Interior	.025
• Acreage of Largest Interior Forest	.025
• % Living Waters Critical Supporting Watershed	.023

Figure 2.



Does the general public support reserves?

EOEA conducted four public meetings throughout the state in 2005 to obtain public comments on reserves. There was overwhelming public support for a balance of reserves and sustainably harvested sites on state-owned lands. For example, of the approximate 300 letters received after the meetings, more than 250 voiced support for the eight proposed large forest reserves and "Green Certified" forest management. Other letters expressed support for the large forest reserves at Middlefield and the Westfield River, support for adding the Jug End property to the proposed Mount Washington forest reserve, support for an added reserve at Mohawk-Monroe-Savoy State Forests, and support for no new snowmobile trails or communication towers in the Mount Washington reserve.

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