COMMONWEALTH OF
MASSACHUSETTS

Comprehensive Wildlife Conservation Strategy

Produced by the

Massachusetts Division of Fisheries & Wildlife
Department of Fish and Game
Executive Office of Environmental Affairs

Revised September, 2006

Executive Summary

The goal of the Comprehensive Wildlife Conservation Strategy (CWCS) is to conserve the wildlife biodiversity of Massachusetts. The CWCS must address eight required elements described by the U. S. Congress and must be approved by the Director of the U.S. Fish and Wildlife Service for this agency to receive funds through the State Wildlife Grant Program. These eight elements, and a brief description of how the Massachusetts Division of Fisheries and Wildlife (MDFW) has addressed each, are included at the end of this executive summary.

In the Comprehensive Wildlife Conservation Strategy, we describe a brief history of the MDFW and its past successful efforts to conserve the biodiversity of the Commonwealth. A review of the landscape changes which have affected wildlife populations sets the stage for problems we see facing these species today. We note the process used to identify the habitats and species in the greatest need of conservation. We list the primary strategies we plan to employ to conserve these species and their habitats, and we end by explaining the processes used to gain input to the CWCS from outside the MDFW and how the CWCS will be reviewed periodically.

We organized the CWCS around 22 habitat types ranging from large-scale habitats such as Large Unfragmented Landscape Mosaics; to medium-scale habitats like the state's Large- and Mid-sized Rivers; to small-scale habitats such as Vernal Pools. Information for each habitat type includes a description of the habitat; the suite of species in greatest need of conservation which is associated with that habitat; a map showing the distribution of the habitat type across the state, where available; a description of the problems and threats facing the habitat and the species in it; a listing of the conservation strategies needed to conserve the habitat; and the monitoring requirements that will ensure the success of the conservation strategies.

We identified 257 animal Species in Greatest Need of Conservation for the CWCS. These 257 species are assigned to one or more of the 22 habitats, if the habitat was essential to the survival of the species. Our list of Species in Greatest Need of Conservation includes all of the federally listed animal species in the state; all of our state Special Concern, Threatened, and Endangered animal species; globally rare species; animal species which are listed as being of regional concern by the Northeastern Association of Fish and Wildlife Agencies; and other species which are of conservation concern within the Commonwealth. A species summary is provided for each of the Species in Greatest Need of Conservation. This summary includes our most recent distribution information in map form, where this information is available, along with a life history narrative and a listing of key threats facing the species.

The strategies identified in the CWCS to ensure the conservation of populations of Species in Greatest Need of Conservation fall into six broad categories: habitat protection, surveys and inventories of the CWCS species and habitats, conservation planning, environmental regulation, habitat restoration and management, and education. We expect to accomplish these through coordination and partnerships with many governmental and non-governmental agencies and organizations.

Where the Eight Required Elements can be Found

In order to receive funds through the State Wildlife Grant Program, each state must complete a Comprehensive Wildlife Comprehensive Strategy (CWCS) which will address the species the state fish and wildlife agency deems "in greatest need of conservation", while addressing the full array of wildlife and wildlife–related issues. The CWCS must also address all of the eight elements required by the Congress. The eight elements are:

1. Information on the distribution and abundance of species in greatest need of conservation, low and declining populations as the State Fish and Wildlife Agency deems appropriate, that are indicative of the diversity and health of State's Wildlife.

This information can be found in the 257 Species Summaries in Chapter 10, which includes a narrative of the life history, key threats, and a statewide distribution map. The species are also listed in the Table of Species in Greatest Need of Conservation, Chapter 6A.

2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of those species identified in item 1.

This information is listed for each of 22 habitat types in Chapter 9, Conservation Strategies by Habitat. This section includes a narrative describing each habitat, a list of Species in Greatest Need of Conservation in that habitat, a narrative linking the species to how they use the habitat, and, in most cases, a statewide distribution map of the habitat.

3. Description of problems which may adversely affect species identified in item 1 or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and their habitats.

An overview of the large-scale problems affecting biodiversity in the Commonwealth is addressed in Chapter 3. Habitat-specific information is found in Chapter 9, Conservation Strategies by Habitat, which includes a narrative of the threats facing the habitat and species and a listing of the proposed conservation strategies, including research needs and monitoring plans.

4. Description of conservation actions proposed to conserve the identified species and habitats and priorities for implementing such actions.

In Chapter 7, Overview of Conservation Strategies, we describe and summarize the range of conservation strategies proposed for the CWCS species and habitats. Chapter 9, Conservation Strategies by Habitat, lists the specific conservation strategies for each of the 22 habitats and their associated species.

5. Proposed plans for monitoring species identified in item 1 and their habitats, for monitoring the effectiveness of the conservation actions proposed in item 4, and for adapting these conservation actions to respond appropriately to new information or changing conditions.

The proposed monitoring plans are described within Chapter 9, Conservation Strategies by Habitat, for each of the 22 habitat types and their associated species.

6. Description of procedures to review the strategy at intervals not to exceed ten years.

This information is found in Chapter 11, Schedule of CWCS Review and Revision.

7. Plans for coordinating the development, implementation, review, and revision of the plan with Federal, State, and local agencies and Indian tribes that manage significant land and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats.

The CWCS was first drafted by MDFW staff and then made available to all our state, federal, local and tribal partners and to the general public for their review and comment (see Chapter 5, p. 89). The CWCS was amended as appropriate based on these comments. We expect the review and revision process to follow roughly the same process (see Chapter 11). One of the primary goals of the CWCS is to provide information and guidance to our partners regarding the conservation of habitats and species identified in the CWCS. Implementation of these conservation strategies by all conservation partners will be encouraged. We have longstanding relationships with these partners, which leads us to believe that these priorities are shared priorities will be implemented as is feasible. The Division of Fisheries and Wildlife operates in the Department of Fish and Game which is part of the Executive Office of Environmental Affairs (EOEA). EOEA is the Secretariat which contains all of the environmental resource agencies of state government and coordinates the overall activities of theses line agencies. EOEA has been aware of the development of the CWCS throughout the process through regular staff briefings and directly from the Fish and Wildlife Board.

8. Congress also affirmed through this legislation that **broad public participation is an essential element of developing and implementing these plans**, the projects that are carried out while these plans are developed, and the Species in Greatest Need of Conservation that Congress has indicated such programs and projects are intended to emphasize.

Public participation in developing the CWCS took many forms. The MDFW operates under the direction of an appointed Fish and Wildlife Board. An appointed Natural Heritage and Endangered Species Advisory Committee advises the MDFW director on rare species issues. The CWCS has been developed with the assistance of this public Board and Committee, along with the public at large and other resource groups and agencies that provided comment during the review process. An overview of the process we used for garnering broad public support for the conservation strategies described in the CWCS is set forth in Chapter 5, Methodology and Approach, starting on page 89.

Table of Contents

Table of Figures

Table of Tables

Acknowledgements

This Comprehensive Wildlife Conservation Strategy for the Commonwealth of Massachusetts is the natural outgrowth of the centuries of attention and care given to the state's biodiversity by innumerable organizations and individuals, including federal, state, and municipal governments, national, state, and local nonprofit conservation groups, land trusts, conservation commissions, scientists, amateur naturalists, and sportsmen. We thank them all for inspiring and contributing to this Strategy. Particular thanks to Karsten Hartel, who kindly granted permission to use information from his book, *Inland Fishes of Massachusetts*, to the staff of MassGIS, who contributed maps, and to the Massachusetts Audubon Society, for permission to quote from their catalogue of the changes in the Massachusetts landscape, *Losing Ground: At What Cost?*.

8. Young Forests and Shrublands

Habitat Description

Collectively, young forests and shrublands are referred to as "thicket" habitats (Litvaitis 2003), and provide important resources for several wildlife species of conservation concern. Young forest habitats are typically dominated by rapidly growing trees and shrubs, and generally occur when a mature forest canopy is disrupted, allowing sunlight to stimulate the growth of herbaceous and woody vegetation on the forest floor. Shrublands are defined here as relatively ephemeral, upland habitats that are dominated by low woody vegetation (generally <3 m tall), with varying amounts of herbaceous vegetation and sparse tree cover. Shrublands primarily include abandoned field sites and power line corridors that would ultimately revert to forest absent some human or natural disturbance (e.g., mowing or burning), and abandoned beaver flowages along forested stream courses, which typically succeed from wet meadow to drier herb/shrub habitat, and eventually revert to forest in the decades following abandonment.

Enduring shrubland habitats also occur, and include both pitch pine-scrub oak communities on relatively dry upland sites, as well as shrub-dominated wetland communities (generally referred to as "shrub swamps"). These enduring shrublands provide unique habitats and support particular wildlife species of conservation concern, and so are treated separately in this report.

While several wildlife species use both young forest and shrubland (Litvaitis 2003), there are important differences in plant species composition and structure (Lorimer 2001) that result in some species of plants (Latham 2003) and animals (Wagner et al. 2003) occurring in one or the other. The woody vegetation in young forest is often dominated by regenerating stands of late successional species that are present as advanced reproduction or seed at the time of a canopy disturbance. Shrublands tend to be dominated by pioneer species whose seed can travel substantial distances (Lorimer 2001). The distinction between young forest habitat dominated by late-successional species and shrublands dominated by pioneer species has received little attention from researchers, but may prove to be a key consideration in regional conservation planning (Askins 2001). Absent disturbance, the thicket habitats discussed here eventually succeed to mature forest.

Preserving biodiversity in temperate forest requires the maintenance of all successional stages (Franklin 1988), and managers should recognize the role of disturbance in maintaining biodiversity (DeGraaf and Miller 1996). Forest managers need to provide a range of habitats at temporal and spatial scales that will support viable populations of all native wildlife species, and this task must be accomplished in a landscape being developed for human use that does not resemble any previous historical condition. While it is instructive to examine the historical range of variability associated with natural disturbance regimes (see Thompson and DeGraaf 2001), managers should not seek to re-establish conditions from a previous time (e.g., prior to European settlement), but rather should seek to secure a range of conditions in today's landscape that will support viable populations of native wildlife species (DeGraaf and Yamasaki 2003).

Young Forests

Young forest constitutes the first of four developmental stages of forest growth, and is technically referred to as "stand initiation" (Oliver and Larson 1996). The stand initiation stage is characterized by high stem densities (e.g., 1,000 to >10,000 stems per acre) and is relatively

ephemeral, generally lasting about 10 years or until a young tree canopy is formed, typically causing herbaceous and woody vegetation on the forest floor to die back. The competition for sunlight within a young forest canopy typically results in a rapid decline in stem density during the stem exclusion stage. Canopy gaps form as the result of stem exclusion, which facilitates plant growth on the forest floor during the understory re-initiation stage. Over time, an uneven-aged forest is formed and stands eventually enter the old growth stage (Oliver and Larson 1996).

During the stand initiation stage, the flush of woody and herbaceous vegetation on the forest floor provides food (e.g., berries, browse, and insects) and cover (e.g., shrubs, tree seedlings, and slash) resources for wildlife that is generally lacking in older forest. Wildlife species that prefer early successional habitats have been perceived as habitat generalists (see Foster and Motzkin 2003), but in fact, many wildlife species associated with young forests are habitat specialists with specific vegetation structure or area requirements, such as the New England Cottontail and Chestnut-sided Warbler (DeGraaf and Yamasaki 2003). Relatively large (>25 acre) patches of early successional habitat may be necessary to maintain viable populations of mammals associated with young forest (Litvaitis 2001).

In addition, Hunter et al. (2001) note that early successional habitats are important for wildlife species generally associated with mature forests. Examples include fledgling and molting adult Wood Thrushes (*Hylocichla mustelina*) that move from mature forest to patches of disturbed habitat that may be critical for food and cover resources not typically found near nesting sites.

Young forest established by clearcutting can temporarily reduce amphibian numbers (Pough et al. 1987), including the terrestrial-breeding Redback Salamander (*Plethodon cinereus*) (DeGraaf and Yamasaki 1992 and 2002), the wetland-breeding Wood Frog (*Rana sylvatica*), and mole salamanders (*Ambystoma* spp.) (deMaynadier and Hunter 1998), which require a moist environment and are not especially mobile. However, a shaded canopy is usually restored within 10 years, Redback Salamander numbers typically recover to pre-cut levels within 30 years (DeGraaf and Yamasaki 2002), and there is generally no difference in numbers of salamanders in 60-year-old second-growth forest vs. old-growth forest (Pough et al. 1987). Maintaining sustainable populations of amphibians can be compatible with timber harvesting (deMaynadier and Hunter 1995, Brooks 1999).

Generally, a minority of forest area is in an early successional stage at any given point in time, so the many habitat benefits of young forest can be realized without any substantial threat to populations of mature forest species. Overall, young forests support a great diversity of wildlife species and are a critical component of wildlife habitat at the landscape level (DeGraaf and Yamasaki 2001, 2003).

Mature forest canopies in New England have historically been disrupted by various natural disturbance events, including wind (e.g., down-bursts, tornadoes, or hurricanes), fire (e.g., lightning strikes and intentional spring fires set by native Americans), flooding (e.g., beaver impoundments and spring floods along major rivers and streams), and pathogens (e.g., insect infestations) (see DeGraaf and Miller 1996, pp. 6-10 for review). Wind disturbances have occurred historically throughout Massachusetts, with hurricanes being more prominent in eastern Massachusetts, and down-bursts and tornadoes more prevalent in western Massachusetts. Fire

was historically more common in the eastern part of the state and in the major river valleys. Beaver flooding occurred throughout the state until beaver were extirpated from nearly all of Massachusetts by 1700 (Foster et. al. 2002) (limited beaver flooding occurs today in all but the southeastern part of the state since beaver were re-established during the 20th century). Pathogens most likely had sporadic historical impact throughout the state.

Historical return intervals for canopy-replacing wind and fire disturbance events vary across Massachusetts, and are generally highest in the pitch pine-oak barrens of coastal and eastern Massachusetts (40-150 years between severe fires and/or hurricanes), followed by oak-hickory forests (85-380 years between fires and/or wind events), northern hardwood forest (500-1,500 years between wind events and occasional fires), and spruce-northern hardwood forest (230-545 years between wind, insect, and/or fire events) (Lorimer and White 2003). These disturbance intervals indicate that 10-31% of pitch pine-oak barrens naturally occur in early successional (≤15 year-old) forest, compared to 3-40% of oak forests, 1-3% of northern hardwood forests, and 2-7% of spruce-northern hardwood forest (Lorimer and White 2003).

Patch sizes for individual wind and fire disturbances appear to range between <1 acre to a few thousand acres, with the majority of individual disturbance patches being toward the small end of the range. For example, it has been estimated that the majority of natural disturbance patches in original northeastern forest caused by wind, water, or pathogens commonly occurred in gaps <0.05 ac (Runkle 1982). However, while the great majority of disturbance patches are relatively small, the few large disturbance patches that do occur account for a substantial amount of all young forest (e.g., >40% of total blowdown patch area in northern hardwood forest) and likely provide important habitat for early successional wildlife species that are area-sensitive (Lorimer and White 2003).

Larger patch sizes tend to be associated with more frequent disturbance intervals, but a range of patch sizes occur across all four of the general forest types discussed here. Historically, the largest individual wind and fire disturbance patch sizes appear to range from about 700 ha in northern hardwood forest to more than 1,000 ha in pitch pine-oak barrens in the northeast (Lorimer and White 2003). Disturbance patterns are spatially non-random, and are highly influenced by soil and topographic features and human settlement patterns (Lorimer 2001). Natural disturbances often overlap and as a result some trees never fully mature before a subsequent disturbance destroys them, while other trees can attain old-growth status if they escape natural disturbance over two or more centuries.

Young forests were extremely common in Massachusetts during the late nineteenth and early twentieth century as abandoned farmland reverted to forest cover (Figure 32). Today, however, only 5% of forestland in the state occurs in an early successional (seedling/sapling) condition (Alerich 2000) (Figure 32). Early successional habitats are currently less common in southern New England than they were in pre-settlement times (Litvaitis 1993, DeGraaf and Miller 1996). Wind events still provide some young forest in Massachusetts today, but the impact of fire and beaver flooding on the landscape has been curtailed as a result of European settlement and subsequent development (Askins 2001).

Fire has largely been excluded from the Massachusetts landscape. Residential developments are now dispersed throughout the pitch pine-oak barrens and oak forests of eastern Massachusetts where fire historically provided early successional habitat. It is more difficult to appreciate the loss of early successional habitat that resulted from beaver flooding because beaver are active on the Massachusetts landscape today, and continually cause problems for people by plugging road culverts and temporarily flooding well and leach fields in residential areas.

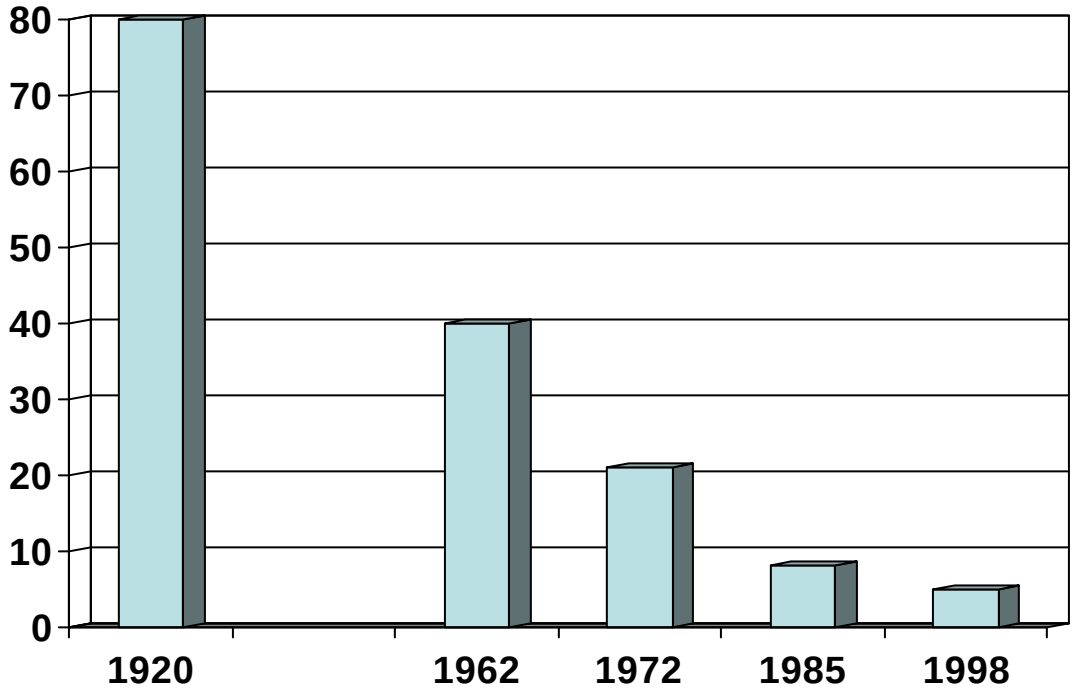

Figure 32: Percent early successional (seedling/sapling) forest in Massachusetts (U.S. Forest Service data).

Given current problems caused by beaver activity, it is difficult to appreciate that beaver flowages likely occupied far greater areas of what is now Massachusetts during pre-settlement times. Beaver activity historically occurred most frequently on lower slopes and along low-gradient streams in Massachusetts (Howard and Larson 1985). These low-lying sites have generally been the focus of human development in Massachusetts, and therefore no longer support extensive beaver activity.

We simply do not know the extent of these historic beaver-influenced habitats. However, we do know that the Massachusetts Bay Colony in what is now southeastern Massachusetts reported shipments of over six tons of beaver pelts to Britain in the 1620's (Foster et al. 2002). While these shipments likely included some pelts trapped from inland areas, it is still sobering to consider that few or no beaver occur today in many portions of southeastern Massachusetts. Likewise, we know that during the five-year period from 1652 to 1657, fur trader John Pynchon shipped 8,992 beaver pelts from Springfield, Massachusetts in the Connecticut River drainage (Judd 1857 in DeGraaf and Miller 1996). In contrast, approximately 6,500 beaver pelts were

tagged by all licensed trappers in the entire state of Massachusetts during the five-year periods from 1985-1990 and 1990-1995 (MassWildlife unpublished data). In pre-colonial New York state, beaver-created floodplains occurred on about one million acres, or 3.5% of the state. The extent of these floodplains is now reduced by 65% (Gotie and Jenks 1982 in Hunter et al. 2001).

Historically, as dams were abandoned after beaver food resources (primarily tree bark and twigs) became depleted, the impoundments slowly drained, and succeeded first to wet meadow, and then to shrubland and young forest as former impoundments dried more completely. After adequate woody growth become re-established, beaver typically re-occupied these low-lying sites, built new dams, and began the dynamic process of habitat modification all over again. Because human development in Massachusetts is concentrated in low-lying areas along rivers and streams where beaver activity is largely excluded, an important source of young forest habitat formerly associated with these sites has been substantially diminished.

Shrublands

Common upland shrubs within ephemeral shrublands in the northeastern United States include blackberry and raspberry (*Rubus* spp.), and blueberry (*Vaccinium* spp.) (Latham 2003, Wagner et al. 2003). Rare species associated with shrublands in the northeastern U.S. tend to occur in enduring shrub habitats as opposed to ephemeral shrub habitats (Latham 2003), and this may be especially true for Lepidoptera (Wagner et al. 2003). Recent work in Massachusetts indicates that shrublands along power line corridors and at reclaimed abandoned field sites support a diverse assemblage of Lepidoptera, but do not typically support rare species of butterflies and moths (King and Collins 2005). Overall, shrublands are the most important natural community type for rare and endangered Lepidoptera in Massachusetts (Wagner et al. 2003).

Species of Greatest Conservation Need in Young Forests and Shrublands

State Listing Status	Taxon Grouping	Scientific Name	Common Name	State Status
State-listed	Reptiles	*Elaphe obsoleta*	Eastern Ratsnake	E
	Birds	*Vermivora chrysoptera*	Golden-Winged Warbler	E
		Oporornis philadelphia	Mourning Warbler	SC
	Mammals	*Synaptomys cooperi*	Southern Bog Lemming	SC
Not Listed	Reptiles	*Coluber constrictor*	Black Racer	--
		Heterodon platirhinos	Eastern Hognose Snake	--
	Birds	*Bonasa umbellus*	Ruffed Grouse	--
		Buteo platypterus	Broad-Winged Hawk	--
		Caprimulgus vociferus	Whip-poor-will	--
		Colinus virginianus	Northern Bobwhite	--
		Dendroica discolor	Prairie Warbler	--
		Empidonax traillii	Willow Flycatcher	--
		Falco sparverius	American Kestrel	--
		Pipilo erythrophthalmus	Eastern Towhee	--
		Scolopax minor	American Woodcock	--
		Spizella pusilla	Field Sparrow	--
		Toxostoma rufum	Brown Thrasher	--
		Vermivora pinus	Blue-winged Warbler	--
		Zonotrichia albicollis	White-throated Sparrow	--
	Mammals	*Sylvilagus transitionalis*	New England Cottontail	--
	Lepidoptera	*Hadena ectypa*	A Noctuid Moth	--

Among vertebrate wildlife species in New England, 13% (3 of 13) of amphibians, 62% (16 of 26) of reptiles, 37% (79 of 214) of birds, and 72% (46 of 64) of mammals utilize shrub/old field habitats (DeGraff and Yamasaki 2001). Some vertebrate species demonstrate preferred use of shrub/old field sites, including reptiles like the Eastern Ratsnake, Eastern Hognose Snake, and Spotted Turtle, birds such as the Willow Flycatcher, Blue-winged Warbler, and Song Sparrow, and mammals like the New England Cottontail, white-footed mouse, and ermine (DeGraff and Yamasaki 2001). Lagomorphs can be considered obligate users of shrubland habitats, and species such as Bobcat that prey on lagomorphs will certainly use shrubland habitat, but may use other habitat types as well to secure alternative prey sources (Fuller and DeStefano 2003).

Threats to Young Forests

Development and forest cutting practices are likely the two biggest threats to young forest habitat. Despite the fact that Massachusetts was the only state in the nation in which the U.S. Census reported a decline in 2004 in its human population, development continues to convert forest and agricultural sites to residential and suburban developments. More than 157,000 acres of land were developed in Massachusetts between 1985 and 1999 (an annual average of about 11,200 acres/year), and virtually all of this land was previously forested habitat (Breunig 2003). Of the approximately 132 million board feet of timber cut annually in Massachusetts (Alerich 2000), only 45% (about 60 million board feet) can be accounted for from cutting that occurs on land that remains in forest use (Dept. of Conservation and Recreation 2005). The remaining 55% (about 72 million board feet) is apparently harvested from land as it is converted to non-forest use. This estimate can be verified using forest inventory analysis (FIA) data from the U.S. Forest Service, and land use data from the Massachusetts Audubon Society. With an average of about 6,300 board feet per acre of Massachusetts forestland (Alerich 2000), and an average of 11,200 acres of forestland developed annually throughout the state, approximately 71 million board feet of timber is generated annually from forested land converted to development.

Human activity, primarily forest cutting practices, can potentially offset some negative impacts on the creation of young forest habitat that result from loss of beaver floodlands, fire, and other natural disturbances. However, harvesting on land that remains in forest use tends to occur as partial cuts that remove about one-third of the standing volume, and thus do not produce young forest habitat. Of the average 6.3 mbf per acre standing in Massachusetts forestlands today (Alreich 2000), an average 2.1-2.2 mbf per acre is reportedly cut during timber sale operations (DCR 2005). Despite the fact that about 60 million board feet of timber are cut annually in Massachusetts from land that remains in forest use (DCR 2005), the availability of young forest habitat continues to decline (Figure 32).

Many private landowners report aesthetic concerns about even-aged cutting practices (especially clearcutting) that provide young forest habitat. In addition to aesthetic concerns, diverse landowner objectives, declining average size of land holdings, and frequent turnover of private forestlands present major challenges to managing forest habitats to benefit wildlife (Brooks and Birch 1988). As a result, the availability of young forest habitat continues to decline in Massachusetts.

Further, pre-settlement forests that formerly occupied what is now developed land likely experienced more frequent natural disturbance than other lands remaining in forest use today. Development following European settlement was focused in low-lying areas along rivers and streams because waterways provided the primary means of transporting goods, and because existing Native American clearings could be readily occupied by European settlers. Forests along waterways were formerly subjected not only to periodic wind, fire, and pathogen events that also impact forests at higher elevations, but also to repeated cycles of ice-scouring and spring flooding (along rivers), or beaver flooding and abandonment (along low-gradient streams). The disproportionate abundance of early successional habitats that likely occurred in forested sites that are now developed for human use must be replaced today in somewhat higher elevation forests, and even-aged silvicultural practices can provide ecologically and economically sustainable early successional habitats for wildlife.

Finally, beaver impacts on forests are reduced not only within developed portions of the landscape (e.g., within cities and towns), but also adjacent to infrastructure such as roads that support development. Beaver activity is understandably restricted by humans wherever a road crosses a stream, in order to avoid damage to the road. Beaver activity is typically constrained along a reach of stream above and below the road crossing, and the potential for beaver-generated young forest is correspondingly reduced, regardless of whether or not areas up-stream and down-stream of the crossing are developed.

Threats to Shrublands

Development of abandoned agricultural sites is probably the single biggest threat to ephemeral shrublands. More agricultural land was converted to development throughout Massachusetts between 1985 and 1999 than remains in agricultural use today; more than 500,000 acres of agricultural land was converted to development between 1985 and 1999 (Breunig 2003), and only about 314,000 acres remains in agricultural use today (MassGIS 2003). Only 6% (313,884 of 5,173,947 acres) of Massachusetts is active farmland at present, and only 3.3% (170,729 of 5,173,947 acres) of all lands in the state are classified as “open land”, which consists primarily of abandoned agricultural sites, power lines, and areas of no vegetation (MassGIS 2003).

Wagner et al. (2003) note that an overlooked threat to butterflies and moths (Lepidoptera) that occupy shrublands is overgrazing of larval host plants by dense populations of white-tailed deer. Deer population levels in eastern Massachusetts are generally above target levels, and are rising (Woytek, personal communication). Therefore, keeping shrublands open to public hunting and maintaining adequate hunting pressure to control deer numbers will likely benefit wildlife species of conservation concern in Massachusetts that occupy shrubland habitats.

Conservation Actions

While about 79% of forestland in Massachusetts is privately owned (Alerich 2000), the best opportunities in the near future for creating high-quality young forest habitat are likely to occur on public lands. Modified even-aged silvicultural practices that address both aesthetic concerns and habitat requirements have been applied on some state lands, and can serve as a model for private lands. Most state lands in Massachusetts, including state forest lands, state wildlife lands, and state watershed lands have been “Green Certified” to the Forest Stewardship Council (FSC) standard for sustainable forest management. Young forest habitat that results from silvicultural

practices on these state lands meets specific criteria for ecological, economic and social sustainability (Seymour et al. 2004).

In particular, landscape composition goals for state wildlife lands call for 15-20% young forest, as well as 10-15% late-successional forest. Young forest habitat is established on state wildlife lands using modified even-aged silvicultural practices. Aggregate retention cuts remove 75-85% of the overstory at one time, and retain 15-25% of the overstory in clusters of mature trees. Shelterwood retention cuts remove up to 90% of the overstory in two cuts over a period of 5-10 years, and retain at least 10% of the original overstory in both individual trees and clusters of trees. Retention of mature trees provides structural diversity as well as relatively cool, moist micro-sites. These attributes should reduce the amount of time needed for some wildlife species to re-occupy harvested sites compared to the time needed following traditional clearcutting practices. DFW may be able to encourage private forest landowners who report that wildlife habitat is an important objective to adopt these practices.

Some shrubland birds may be better suited to successfully exploit relatively small habitat patches (1-10 ha) within or adjacent to suburban landscapes than other wildlife species that require more extensive grassland or forest patches (Dettmers 2003). Therefore, successful wildlife conservation at a landscape scale may be facilitated by focusing forest conservation efforts in relatively un-fragmented parts of the state, and by conserving viable shrubland habitats even in developed parts of Massachusetts.

Finally, it is critical to maintain and manage ephemeral shrublands such as abandoned field sites through periodic mowing and/or burning, and through public and private non-profit land acquisition.

In addition to forest management actions, other proposed actions aimed at conserving young forest and shrubland animals in the future include, assuming adequate funding:

- Determining site-specific Species Habitat Polygons for each current occurrence of a state-listed young forest and shrubland animal, to inform land protection and regulatory priorities and actions;
- Intensive and continued surveying for young forest and shrubland birds, as these species are relatively easy to survey and can serve as indicators of the quality and stage of these habitats;
- Protecting young forests and shrublands supporting populations of rare and uncommon animals;
- Establishing, restoring, and managing these ephemeral habitats through methods other than forestry, such as prescribed fire and targeted removal of invasive plant species;
- Regulating and limiting the impacts of development on young forests and shrublands used by state-listed animals; and
- Educating/informing the public about the values of young forests and shrublands and the issues related to their conservation, through agency publications and other forms of public outreach, in order to instill public appreciation and understanding.

Monitoring Conservation Action Effectiveness

The effects of proposed conservation actions will be evaluated by monitoring the diversity and abundance of plant and animal species across a range of sites on state wildlife lands where even-aged silviculture is applied. Monitoring occurs both before and after forest cutting practices are carried out. While the majority of plant species (including both herbaceous and woody plants) can be monitored effectively, it is not feasible to monitor all animal species. In general, forest songbirds are used as a surrogate indicator of wildlife community response, although butterflies and moths, and/or salamanders can also provide good insight into the sustainability of even-aged forest cutting practices.

In addition, current monitoring efforts by DFW's Upland Habitat Management Program will continue. These including studies of songbird nesting success and Lepidoptera use of forest clearcuts, abandoned field sites, and powerline rights of way, conducted through a collaborative effort with the U.S. Forest Service Northeast Experiment Station and the Massachusetts Audubon Society.

The effectiveness of these proposed conservation actions will be monitored by assessing the:

- Number and percentage of the Species Habitat Polygon delineations used in regulatory reviews and land protection planning;
- Number of surveys completed for young forest and shrubland animals;
- Acreage of young forests and shrublands protected, through fee acquisition or conservation restriction, supporting rare and uncommon animals;
- Number of management efforts of all types, aimed at establishing, restoring, or continuing these ephemeral habitats, and acreage affected by these management efforts;
- Number of proposed alterations to young forests and shrublands reviewed and regulated by DFW each year;
- Number of conservation management permits (part of regulation of proposed developments) monitored, when those permits were issued by DFW for these species; and
- Number of conservation actions modified and adapted, using the results of monitoring.

References

Alerich, C.L. 2000. Forest statistics for Massachusetts: 1985 and 1998. Resour. Bull. NE-148. Newton Square, PA: U.S. Dept. of Agriculture, Forest Service, Northeastern Research Station. 104 p.

Askins, R.A. 2001. Sustaining biological diversity in early successional communities: the challenge of managing unpopular habitats. *Wildlife Society Bulle*tin 29(2): 407-412.

Breunig, K. 2003. Losing ground: at what cost? Changes in land use and their impact on habitat, biodiversity, and ecosystem services in Massachusetts. Massachusetts Audubon Society. 24 p.

Brooks, R.T. 1999. Residual effects of thinning and high white-tailed deer densities on northern redback salamanders in southern New England oak forests. *J. Wildl. Manage*.63: 1172-1180.

Brooks, R.T., and T.W. Birch. 1988. Changes in New England forests and forest owners: implications for wildlife habitat resources and management. *Transactions of the North American Wildlife and Natural Resources Conference* 53:78-87.

DeGraaf, R.M., and R.I. Miller. 1996. The importance of disturbance and land-use history in New England: implications for forested landscapes and wildlife conservation. In: DeGraaf, R.M., and R.I. Miller (eds.), *Conservation of Faunal Diversity in Forested Landscapes*. Chapman and Hall, London, pp. 3-35.

DeGraaf, R.M., and M.Yamasaki. 1992. A nondestructive technique to monitor the relative abundance of terrestrial salamanders. *Wildl. Soc. Bull*. 20: 260-264.

DeGraaf, R.M., and M.Yamasaki. 2001. *New England Wildlife: Habitat, Natural History, and Distribution*. University Press of New England, Hanover, New Hampshire.

DeGraaf, R.M., and M.Yamasaki. 2002. Effects of edge contrast on redback salamander distribution in even-aged northern hardwoods. *Forest Science* 48(2): 351-363.

DeGraaf, R.M., and M.Yamasaki. 2003. Options for managing young forest and shrubland bird habitats in the northeastern United States. *Forest Ecology and Management* 185(2003): 179-191.

deMaynadier, P.G., and M.L. Hunter, Jr. 1995. The relationship between forest management and amphibian ecology: a review of the North American literature. *Environ. Rev*. 3: 230-261.

deMaynadier, P.G., and M.L. Hunter, Jr. 1998. Effects of silvicultural edges on the distribution and abundance of amphibians in Maine. *Conserv. Biol.* 12: 340-352.

Department of Conservation and Recreation. 2005. Bureau of Forestry, Chapter 132 Database Summary, Amherst, Massachusetts.

Dettmers, R. 2003. Status and conservation of shrubland birds in the northeastern U.S. *Forest Ecology and Management* 185(2003): 81-93.

Foster, D.R., and G. Motzkin. 2003. Interpreting and conserving the openland habitats of coastal New England: insights from landscape history. *Forest Ecology and Management* 185 (2003) 127-150.

Foster, D.R., G. Motzkin, D. Bernardos, and J. Cardoza. 2002. Wildlife dynamics in the changing New England landscape. *Journal of Biogeography* 29: 1337-1357.

Fuller, T.K., and S. DeStefano. 2003. Relative importance of young forests and shrubland habitats to mammals in the northeastern United States. *Forest Ecology and Management* 185(2003): 75-79.

Franklin, J.F. 1988. Structural and functional diversity in temperate forests. Pages 166-175 in: E.O. Wilson (ed.), *Biodiversity*. National Academy Press, Washington, D.C.

Gotie, R., and Jenks, D. 1982. Assessment of the use of wetlands inventory maps for determining potential beaver habitat. *New York State Fish and Game Journal* 31(1): 55-62.

Howard, R.J., and J.S. Larson. 1985. A stream habitat classification system for beaver. *J. Wildl. Manage.* 49: 19-25.

Hunter, W.C., D.A. Buehler, R.A. Canterbury, J.L. Confer, and P.B. Hamel. 2001. Conservation of disturbance-dependent birds in eastern North America. *Wildlife Society Bulletin* 29(2): 440-455.

Judd, S. 1857. The fur trade on Connecticut River in the seventeenth century. *New England Historical General Register N.S.*1: 217-219.

King, D.I., and J. Collins. 2005. Study of biodiversity in Massachusetts wildlife openings and clearcuts. Interim Report to the Massachusetts Division of Fisheries and Wildlife, Westborough, Massachusetts.

Latham, R.E. 2003. Shrubland longevity and rare plant species in the northeastern United States. *Forest Ecology and Management* 185(2003): 41-64.

Litvaitis, J.A. 1993. Response of early-successional vertebrates to historic changes in land use. *Conser. Biol.* 7: 866-873.

Litvaitis, J.A. 2001. Importance of early successional habitats to mammals in eastern forests. *Wildlife Society Bulletin* 29(2): 466-473.

Litvaitis, J.A. 2003. Shrublands and young forests: critical habitats dependent on disturbance in the northeastern United States. *Forest Ecology and Management* 185 (2003): 1-4.

Lorimer, C.G. 2001. Historical and ecological roles of disturbance in eastern North American forests: 9000 years of change. *Wildlife Society Bulletin* 29: 425-439.

Lorimer, C.G., and A.S. White. 2003. Scale and frequency of natural disturbances in the northeastern U.S.: implications for young forest habitats and regional age distributions. *Forest Ecology and Management* 185(2003): 41-64.

Massachusetts Geographic Information System. 2003. Landuse summary statistics. http://www.mass.gov/mgis/landuse_stats.htm.

Oliver, C.D., and B. Larson. 1996. *Forest stand dynamics*. Second edition. Wiley and Sons, New York, New York.

Patterson, W.A., III, and K.E. Sassman. 1988. Indian fires in the prehistory of New England. In: Nicholas, G.P.(ed.), *Holocene Human Ecology in Northeastern North America*. Plenum Press, New York, pp. 107-135.

Pough, F.H., E.M. Smith, D.H. Rhodes, and A. Collazo. 1987. The abundance of salamanders in forest stands with different histories of disturbance. *Forest Ecology and Management* 20:1-9.

Runkle, J.R. 1982. Patterns of disturbance in some old-growth mesic forests of eastern North America. *Ecology* 63:1533-1546.

Seymour, R., D. Capen, J. Furnish, and D. Wager. 2004. Certification evaluation report for the natural forests managed by the Commonwealth of Massachusetts, Executive Office of Environmental Affairs. Scientific Certification Systems, Emeryville, CA. 174 p.

Thompson, F.R., and R.M. DeGraaf. 2001. Conservation approaches for woody, early successional communities in the eastern United States. *Wildlife Society Bulletin* 29(2): 483-494.

Wagner, D.L., M.W. Nelson, and D.F. Schweitzer. 2003. Shrubland Lepidoptera of southern New England and southeastern New York: ecology, conservation, and management. *Forest Ecology and Management* 185(2003): 95-112.