3 - Current Forest Conditions and Trends

3.1 - Introduction

The state forest satisfies many uses for the people of Michigan that can be divided into ecological, social and economic categories. Ecological uses or services include conservation of genetic diversity and wildlife habitat, regulation of water flow and quality, protection of soil quality and protection from erosion, air quality, climate modification and carbon sequestration. Social used include a feeling of spirituality or well-being associated forests, consumptive uses such as hunting, fishing, gathering and harvesting of forest products; and non-consumptive uses including nature appreciation, camping and trail related activities (hiking, bicycles, off-road vehicles and horseback riding). Economic uses range from local community support through tourism and forest harvesting to oil and natural gas production and mining.

3.2 – Climate Change Impacts

Climate is as fundamental to forest communities as soil or hydrology. Since the 1980s, the climate has been changing faster than it has in recorded history. The best available climate science indicates that past trends will continue. In that context, some impacts of these trends are very likely or virtually certain (Handler et al., In Press):

- Ecosystems will change across the landscape – this may include changes in location and/or changes in composition;
- Boreal and sub-boreal species are likely to be extirpated or increasingly isolated in cool lake-effect microclimates;
- Forest succession will likely change, making future trajectories increasingly unclear;
- Forest productivity will change, driven by changes in CO_2 fertilization, water and nutrient availability, local disturbances and species migration;
- Seasonal distribution of keystone species such as deer and wolves will change with decreasing snow fall and increased midwinter snow melt events;
- Exacerbation of existing threats and new interactions between threats are likely to be the most obvious effects of climate change; and
- Many current management objectives and practices will face substantial challenges.

Current (Observed) Climate Trends

Throughout the Midwest, average annual temperature has been increasing. The rate of that change has doubled since 1950 (Andresen et al., 2012). Winter and spring are warming faster than summer and fall and nighttime temperatures are warming faster than daytime temperatures (Andresen et al., 2012). Extreme heat events are more common (Andresen et al., 2012), but some regions of the Midwest, such as northern Wisconsin, have not seen a change in the number of really hot days (Swanston, 2011). The western Upper Peninsula, from a climatic perspective, is much more like the continental U.S. (e.g., northern Wisconsin) than the rest of Michigan.

Precipitation has also increased. The increase in recent years (1981-2010) has included a greater increase in winter and spring precipitation than summer and fall precipitation decreased. Both the frequencies of extreme precipitation events as well as the number of merely wet days have increased (Andresen et al., 2012).

The growing season has lengthened by about a week since the 1930s and the duration and amount of ice cover have decreased (Andresen et al., 2012). In Michigan, snowfall patterns have been different in lake-effect and non-lake-effect zones. Snowfall has increased in lake effect zones as lake ice has decreased. Outside lake-effect zones snowfall has decreased. Regional differences in snowfall within the state also have corresponded with changes in annual number of soil frost days, with fewer annual soil frost days in areas that have greater snowfall (Handler et al., In Press). However, across Michigan and Wisconsin, the loss of a persistent blanket of snow has resulted in decreased winter soil temperatures and more soil freeze-thaw cycles per winter (Handler et al., In Press).

Predicted Climate Trends

There have been consistent projections for an increase in mean annual temperature and an increase in extreme heat events for the Midwest as a whole. Seasonal temperature projections are less consistent (Winkler et al., 2012). For northern Wisconsin and the western Upper Peninsula, the projections suggest a greater increase in summer than winter (Forest Ecosystem Vulnerability Assessment for Synthesis for northern Wisconsin and the western Upper Peninsula, under development); however, overall temperature increases will likely be moderated by proximity to a Great Lake (Swanston, 2011).

The Forest Ecosystem Vulnerability Assessment and Synthesis for northern Wisconsin and the western Upper Peninsula (under development) projects an increase in mean annual precipitation for the western Upper Peninsula regardless of the emission scenario used. Throughout Michigan the most consistent precipitation projections are for more winter precipitation, more rain instead of snow and more heavy precipitation events in every season (Winkler et al., 2012). The Forest Ecosystem Vulnerability Assessment and Synthesis for northern Wisconsin and the western Upper Peninsula (under development) predicts an increase in precipitation for winter and spring, but changes in the summer and fall depend upon the emission scenario used. Projections for northern Wisconsin and the western Upper Peninsula also indicate a likely increase in periodic drought and an increase in heavy precipitation, particularly in lake-effect areas (due to an increasing lack of lake ice). In the short-term this lake-effect increase in precipitation may mean more snow, but in the long-term it will likely be more rain (Swanston, 2011). Due to changes in the timing and volume of precipitation, all regions of Michigan will likely see significant changes in hydrologic regimes.

Potential Impacts to Forest Communities

Potential Impacts can be broken into categories, including 'direct impacts' (where change in a climatic variable has a direct effect on a species or ecosystem), 'indirect impacts' (where change in a climatic variable has an effect on some other factors that affects a species or ecosystem, typically by altering a disturbance regime) and 'combined impacts' (where changes in climatic variables cause complex interactions between factors that are already threats to the species or ecosystem).

Potential Direct Impacts:

- Increased temperatures resulting in reduced growth for some species and increased growth for others (Vose et al., 2012); for those with potential to increase growth, this gain may be off-set by negative effects resulting from lack of synchronicity with other ecosystem or climatic variables (Swanston, 2011);
- Low soil moisture resulting in stress/mortality and affecting regeneration of trees and wetland wildlife (Vose et al., 2012);
- Extreme weather events resulting in stress/mortality, including longer dry seasons and more extreme floods (Vose et al., 2012);
- Increased atmospheric carbon dioxide and nitrogen deposition resulting in altered physiological function; much variation between species in response is expected (Vose et al., 2012);
- Changes in seasonal climatic factors resulting in longer growing seasons (Vose et al., 2012);
- Changes in multiple climatic factors resulting in reduced suitable habitat (spatial extent and/or quality) for some species; particularly for species associated with boreal forest systems, including quaking aspen, paper birch, tamarack, jack pine and black spruce (Handler et al., In Press); and
- Changes in multiple climatic factors resulting in increased suitable habitat (spatial extent and/or quality) for some species; particularly for species with ranges that currently extend to the south, including American basswood, black cherry and white oak (Handler et al., In Press).

Potential Indirect Impacts:

- Pests, Disease and Invasive Species
    - Increased temperatures causing some pests and diseases to become more active; examples include beech bard disease, white pine blister rust, spruce budworm, tamarack sawfly, jack pine budworm, *Scleroderis*, white pine shoot weevil and red pine shoot blight (Handler et al., In Press);
    - Changes in multiple climatic factors causing some pests to expand in to new areas, particularly into areas with increased disturbance and dry forest ecosystems (Vose et al., 2012); examples include Asian longhorn beetle and western bark beetle (Handler et al., In Press); and
    - Changes in multiple climatic factors causing some invasive plants to increase and/or expand into new areas, with impacts particularly on regeneration; examples include buckthorn, honeysuckle, garlic mustard, reed canary grass, Japanese barberry, leafy spurge, spotted knapweed and St. John's wort (Handler et al., In Press).
- Moisture, Drought and Wildfire
    - Decreased snow cover causing even lower soil moisture (Vose et al., 2012);
    - Changes in multiple climatic factors causing increased drought and moisture stress, particularly late in the growing season (Handler et al., In Press and Swanston et al., 2011);
    - Changes in multiple climatic factors causing increased drought and wildfire, resulting in overall changes to structure and function of forest ecosystems (Vose et al., 2012);

- Shifts in winter precipitation and temperature causing an advance in the timing of snowmelt runoff, resulting in changes to seasonal soil moisture and potentially increasing fire risk, depending on infiltration rates and soil frost (Handler et al., In Press); and
    - Increased temperatures causing accelerated decomposition of litter layers, resulting in lower water-holding capacity and greater moisture stress; this could prompt a move to barrens in some systems (Handler et al., In Press).

- Snowfall and Soil Frost
    - Changes in snowfall causing changes in soil frost that in turn affect water infiltration rates, nutrient cycling and tree growth (Handler et al., In Press); while short-term increases in soil frost depth due to decreases in snowfall may occur, long-term predictions suggest air temperatures will ultimately increase enough to off-set decreased snowfall and cause a decrease in soil frost depth; and
    - More variable winter weather causing an increase in the number of freeze/thaw cycles per year, resulting in increased root damage of frost-intolerant tree species and affecting the timing of nutrient release in forest soils; northern hardwood species (like sugar maple) are most likely to be negatively affected by this kind of root damage (Handler et al., In Press).

- Growing Season and Productivity
    - Longer growing season and warmer temps will result in increases in productivity for deciduous forest types (Handler et al., In Press), as long as there are enough water and nutrients available (Swanston, 2011).
- Species and Habitat
    - Increased temperatures causing increased deer populations, resulting in increased herbivory and/or competitive advantage for those species not eaten (Handler et al., In Press);
    - Changes in multiple climatic factors causing drying of ephemeral ponds, resulting in increased stress on dependent species (Swanston, 2011); and
    - Changes in multiple climatic factors causing changes in hydrology of lowland systems, resulting in increased stress on dependent species (Handler et al., In Press).

Potential Combined Impacts:

- Increased invasive species and pest stress exacerbating existing stress complexes, including current land use activities (Vose et al., 2012);
- Increased drought exacerbating existing stress complexes, resulting in higher tree mortality, slow regeneration in some species and altered species assemblages (Vose et al., 2012);
- Decreased snow cover, causing even more reduced soil moisture, resulting in decreased tree vigor and increased forest susceptibility to insects and pathogens that will likely be increased due to climatic factors alone (Vose et al., 2012);
- Increased disturbance causing even greater fragmentation in landscapes that are already highly fragmented, resulting in even more decreased habitat connectivity and corridors for species movement (Vose et al., 2012);
- Decreased moisture and increased temperatures causing weakened trees (from moisture and heat stress), resulting in even greater damage from pests and diseases; examples include hypoxylon canker, forest tent caterpillar, gypsy moth, oak wilt and oak decline (Handler et al., In Press);
- Earthworm activity causing forest stands to have increased susceptibility to drought, resulting in drought-stressed trees that are even more susceptible to pests and disease that will likely be increased due to climatic factors alone (Handler et al., In Press); and
- Increased pests and diseases and increased extreme weather events causing increased mortality, resulting in increased fuel loads and even greater wildfire risk that will likely be heightened due to climatic changes alone (Handler et al., In Press).

The ability of a forest community to cope with potential impacts will also be affected by many additional factors. For example, communities with greater species diversity and structural complexity and those that are more tolerant of disturbance will tend to be better able to adapt to climatic changes. Whereas, forest communities within highly fragmented landscapes or that are very limited to certain spatial areas due to specific abiotic requirements will tend to be less able to adapt. A document for Northern Wisconsin (and the western Upper Peninsula) similar to the Michigan Forest Ecosystem

Vulnerability Assessment and Synthesis for the northern Lower Peninsula and eastern Upper Peninsula (Handler et al., In Press), detailing forest type adaptive capacity, is currently being developed.

Potential Impacts to Forest Management Activities (Handler et al., In Press)

- Increased occurrence of intense precipitation events causing increased soil erosion and potential effects on forest infrastructure, affecting access to forests for management activities; roads and bridges are of particular concern;
- Increased disturbance events causing increased tree mortality, resulting in increased salvage cuts;
- Changes to and greater variability in winter weather (increased freeze/thaw cycles, increased air temperatures, increased rainfall, fewer days of soil frost in the long-term, less snow to protect soils), resulting in more limited access to stands for management activities and increased soil erosion and sedimentation from use by trucks; and
- Decreased soil moisture (particularly later in the growing season and during prolonged droughts), resulting in increased access to stands in typically wetter areas for management activities in summer.

Key Vulnerabilities [to the Forestry Sector] across the Midwest Region (Handler et al., 2012)

- Climate change will amplify many **existing stressors** to forest ecosystems, such as invasive species, insect pests and pathogens and disturbance regimes (very likely);
- Climate change will result in **ecosystem shifts and conversions** (likely);
- Many tree species will have **insufficient migration** rates to keep pace with climate change (likely);
- Climate change will amplify existing stressors to **urban forests** (very likely);
- Forests will be less able to provide a consistent supply of some **forest products** (likely);
- Climate change impacts on forests will impair the ability of many forested watersheds to produce reliable supplies of **clean water** (possible);
- Climate change will result in a widespread decline in **carbon storage** in forest ecosystems across the region (very unlikely);
- Many contemporary and iconic forms of **recreation** within forest ecosystems will change in extent and timing due to climate change (very likely); and
- Climate change will alter many traditional and modern **cultural connections** to forest ecosystems (likely).

Regional Differences that May Affect Forest Community Response to Climate Change

- This region has more of a continental climate (not including the Keweenaw Peninsula and some Great Lakes shoreline areas): Climatic changes and response to changes by forest communities will likely be different than the rest of Michigan;
- This region has less fragmentation than some other regions of Michigan: Application of climate change adaptation strategies across landscapes may be easier; migration may be easier for species;
- This region has more moraines and exposed bedrock than other regions of Michigan: Natural communities that are adapted to these more extreme/harsh conditions may be better able to adapt to climatic changes; existing communities may face less additional stress as new species may be less competitive in these conditions;
- This region has more rare species than some other regions of Michigan: Rare species will likely be very vulnerable to climatic changes, as these become additive stresses on top of those already making the species rare;
- This region is less reliant on planting for regeneration of forest communities than some other regions of Michigan, natural regeneration generally works well: Fewer opportunities for assisted migration may occur; species may experience less stress from climatic changes that affect regeneration;
- This region has more hardwood forest communities than other regions of Michigan: Hardwood forest communities may experience increased productivity due to longer growing seasons; hardwood forest communities may be more vulnerable to stress complexes including earthworm activity, drought stress, pests/disease and climatic changes;
- This region has a greater proportion of aspen than other regions of Michigan: Aspen is likely more vulnerable to climate change than many other species;

- This region has more potential ‘reference areas’ or ‘refugia’ (particularly for boreal forest communities) than some other regions of Michigan: Refugia are likely to be less affected by climatic changes than other places on the landscape and may provide safe harbor for vulnerable species and communities; boreal forests are likely more vulnerable to climate change than many other forest communities;
- This region has a lower wildfire risk than other regions of Michigan: Migration may be easier for species due to less potential for increased fragmentation; forest communities may be at reduced risk for structural and functional changes, including conversion to barrens or grasslands; and
- This region has greater exposure to species invasions and new migrants (through Wisconsin) than some other regions of Michigan: New invasive species and competition from new migrants may exacerbate existing stresses and increase forest community vulnerability to climatic changes.

The Forest Ecosystem Vulnerability Assessment and Synthesis for northern Wisconsin and the western Upper Peninsula is under development is using the Tree Atlas and LANDIS-II models to predict future trends in tree species in that region. Early results are indicated below. Detailed information about the models, differences between the models and model results will be available in the final publication. ‘Declining’ or ‘increasing’ refers to the overall general existence and/or health of the species. It is important to note that the models do not account for all factors that may influence tree species and forest communities under a changing climate, including forest management – such as whether artificial regeneration is employed.

RESULTS CONSISTENT BETWEEN MODELS		RESULTS INCONSISTENT BETWEEN MODELS	
Declining Overall, with Greater Declines Under Higher Emission Scenario		**More Declining than Increasing**	
Balsam fir	Quaking aspen	Black ash	Red pine
Black spruce	White spruce	Jack pine	Yellow birch
Paper birch		Northern white cedar	
Stable Under Lower Emission Scenario, Declining Under Higher Emission Scenario		**Mixed Results**	
Eastern white pine	Sugar maple	Balsam poplar	Eastern hemlock
		Big-tooth aspen	Green ash
		Black cherry	Red maple
Increasing Under Both Emission Scenarios		**More Increasing than Declining**	
American beech	Bur oak	American basswood	Northern red oak
Bitternut hickory	White ash	Northern pin oak	
Black oak	White oak		

The Forest Ecosystem Vulnerability Assessment and Synthesis for northern Wisconsin and the WUP (under development) is using modeling results, literature review and expert opinion to assess potential impacts and ability to adapt to climatic changes for forest communities and develop overall assessments of vulnerability to climate change for those forest communities. Early results are included below. Detailed information about the assessment and synthesis process, as well as results, will be available in the final publication.

VULNERABILITY	FOREST SYSTEM
High	**Lowland conifers** **Upland spruce-fir**
High-Moderate	**Aspen-birch** **Lowland-riparian hardwoods** **Red pine-white pine**
Moderate	**Jack pine** **Northern hardwoods**
Low-Moderate	**Oak associations** **White pine**

3.3 – Region Wide Forest Resource Base Conditions and Trends

State forest land in the western Upper Peninsula covers approximately 882,785 acres or about 13% of the region (Table 3.1). This represents approximately 22% of the entire four million acre state forest system. From 1988 to 2005, western Upper Peninsula state forest acres increased by about 3% (26,000 acres). The administration of state forests in the ecoregion falls within four forest management units, ranging in size from about 142,000 acres to over 306,000 acres each. They are the Baraga, Crystal Falls, Escanaba and Gwinn forest management units (Figure 3.1).

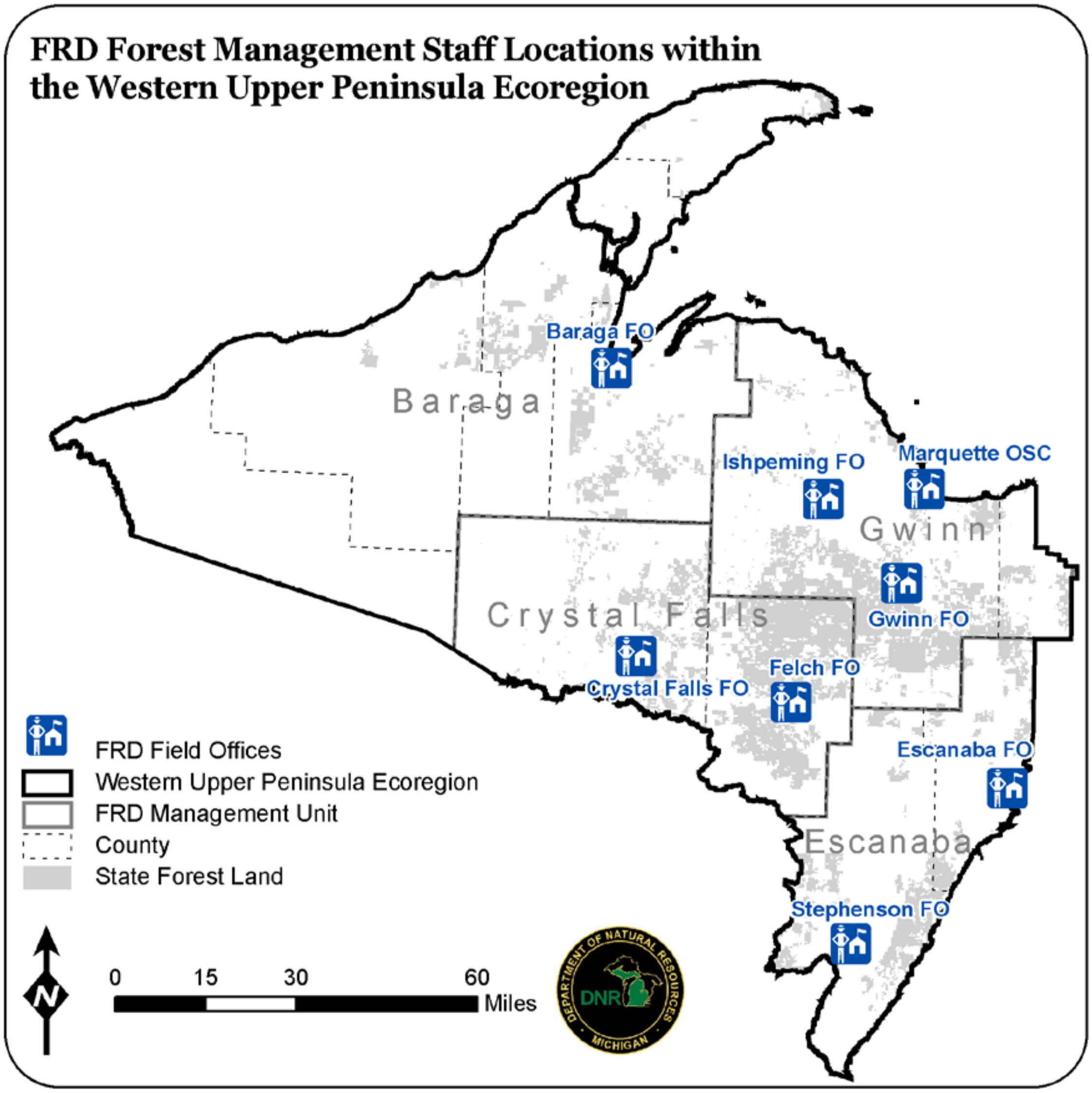

Figure 3.1. Map of the western Upper Peninsula ecoregion showing the forest management units and the state forest land.

State Forest Cover Types

Almost 88% of the state forest is forested, with 12% being non-forest (Table 3.1). Four major cover types account for the majority (about 65%) of forested state forest land in the ecoregion (Table 3.1): Upland aspen (28%); northern hardwoods (18%); cedar (10%); and lowland conifers (9%) (Table 3.1 and Figure 3.2). Lowland shrubs make up 8% of the state forest land (Table 3.1).

Table 3.1. Extent of current cover types for the western Upper Peninsula ecoregion state forest land (2012 Department of Natural Resources inventory data).

Aspen	246,797	28%
Northern Hardwood	162,935	18%
Cedar	83,865	10%
Lowland Conifer	81,308	9%
Lowland Spruce-Fir	29,131	3%
Jack Pine	26,910	3%
Lowland Deciduous	23,876	3%
Red Pine	21,549	2%
Upland Spruce-Fir	21,344	2%
Mixed Upland Deciduous	11,050	1%
White Pine	10,582	1%
Tamarack	9,285	1%
Hemlock	9,163	1%
Oak	8,154	1%
Upland Mixed Forest	8,043	1%
Lowland Aspen-Balsam Poplar	6,882	1%
Paper Birch	5,482	1%
Upland Conifer	4,999	1%
Natural Mixed Pine	3,554	0%
Lowland Mixed Forest	3,202	0%
Planted Mixed Pine	367	0%
Lowland Open/Semi-Open Lands	68,318	8%
Upland Open/Semi-Open Lands	23,674	3%
Other (Water, Local, Urban)	12,315	1%
Total State Forest Area	882,785	100%
Forested Total	778,478	88%
Non-Forest Total	104,307	12%

The forest is dominated by deciduous tree species (54%) and upland site conditions (71%) (Figure 3.3). Deciduous uplands comprise 50% of the forest; upland conifers 21%; lowland conifers 14%; and lowland deciduous tree species comprise four percent of the forest land.

Approximately 38% of the state forest is made up of late successional forest types; about 12% is in mid-successional forest types; and the remainder (38%) is comprised of early successional types (Figure 3.4).

Aspen

The aspen cover type consists of big-tooth and quaking aspen and is the largest state forest cover type in terms of area (246,797 acres (Table 3.1)) in the western Upper Peninsula ecoregion. Big-tooth and quaking aspen largely benefited from the logging and widespread fires of the late 1800s and early 1900s where it proliferated as pioneer species on many sites. Until specific markets developed in the 1950s, aspen was considered a “weed” species. The species were heavily harvested in the 1970s and 1980s as markets developed. As a result, the majority of aspen in the western Upper Peninsula is presently forty years old and younger. The type is widely represented in all management areas of the ecoregion. From 1988 to 2005, aspen type acres increased by about 6% (16,000 acres).

The Ecosystem Vulnerability Assessment and Synthesis (Swanston et al., 2011) for northern Wisconsin (similar climatic conditions to the western Upper Peninsula) summarized potential impacts, vulnerabilities and ability to adapt to projected future climate changes for tree species and forest types. Both species of aspen (trembling and big-tooth) are predicted to decline, particularly under a higher emission future. Overall, the aspen forest type is adapted to disturbance events and exists on a wide range of sites, which could improve its ability to adapt to climatic changes and resulting impacts. However, it has a low species diversity, which may limit options for future trajectories and reduce its ability to adapt to climatic changes. Drought and forest pests are of significant concern for aspen species – both of which are expected to increase over time. In northern Wisconsin, aspen is projected to remain widespread but significantly decline in abundance.

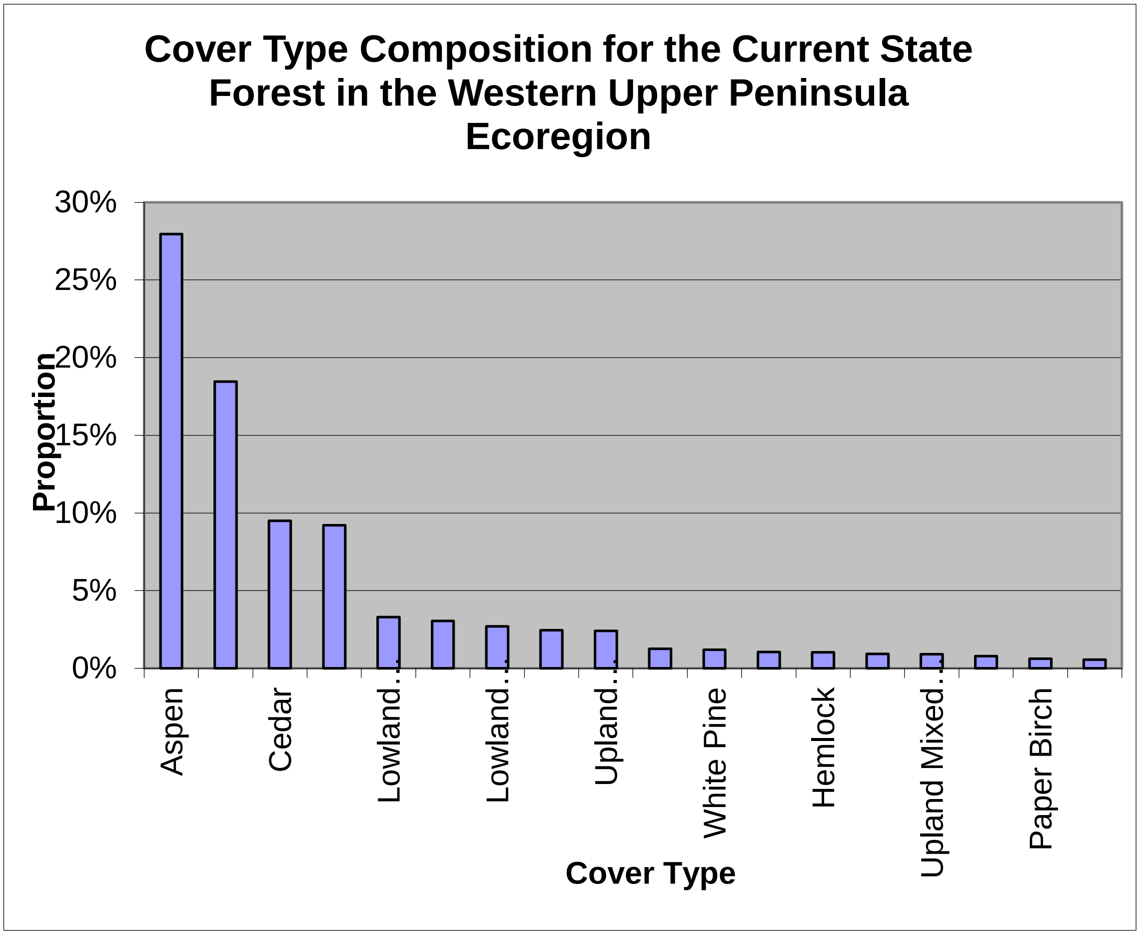

Figure 3.2. Composition of the current state forest for the western Upper Peninsula ecoregion (2012 Department of Natural Resources inventory data).

Northern Hardwoods

The northern hardwood cover type is also extensive in the state forest of the western Upper Peninsula ecoregion (162,935 acres (Table 3.1)). They are largely uneven-aged and most stands tend to have a simple, less diverse structure lacking the mesic conifer and dead wood components that existed in the pre-settlement forests. Northern hardwood distribution in the ecoregion is highly correlated to the high quality soils of moraine ridges and areas of glacial till. The northern hardwood type increased 2.5% (4,400 acres) from 1988 to 2005.

The Ecosystem Vulnerability Assessment and Synthesis (Swanston et. al. 2011) for northern Wisconsin (similar climatic conditions to the WUP) summarized potential impacts, vulnerabilities and ability to adapt to projected future climate changes for tree species and forest types. This forest type has diverse tree species and can exist on a range of soil types and landforms, so there are many potential future trajectories, although they may include a different mix of species than is currently characteristic for northern hardwoods. Sugar maple is currently a key tree species in Michigan's northern hardwoods – unfortunately, model results have been mixed for this species and it is difficult to predict any future trends at this time. This species is shade tolerant and has fewer disease and insect pests relative to other species, so it may be able to adapt to climatic changes and continue to persist in many areas where it currently exists. However, sugar maple is also often limited to soils rich in nutrients like calcium, which may limit its future habitat opportunities. Overall, the northern hardwoods type is less adapted to widespread, more frequent disturbance events than others, which could limit its ability to adapt to climatic changes and resulting impacts. It is intolerant of frequent soil freeze/thaw cycles, which are predicted to increase. It could also potentially lose the ephemeral pond component of the ecosystem. Northern hardwoods may not do as well where it occurs in simplified stands with low species diversity.

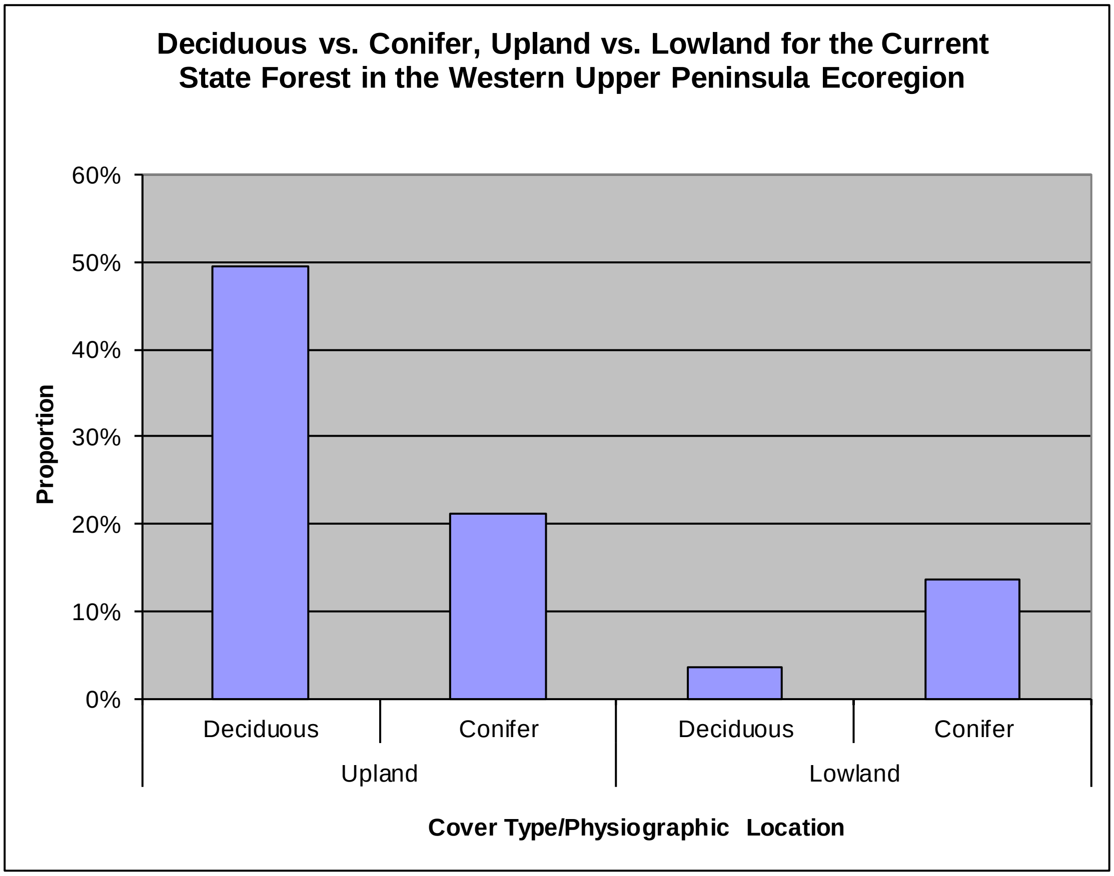

Figure 3.3. Upland and lowland cover types in the state forest in the western Upper Peninsula ecoregion (2012 Department of Natural Resources inventory data).

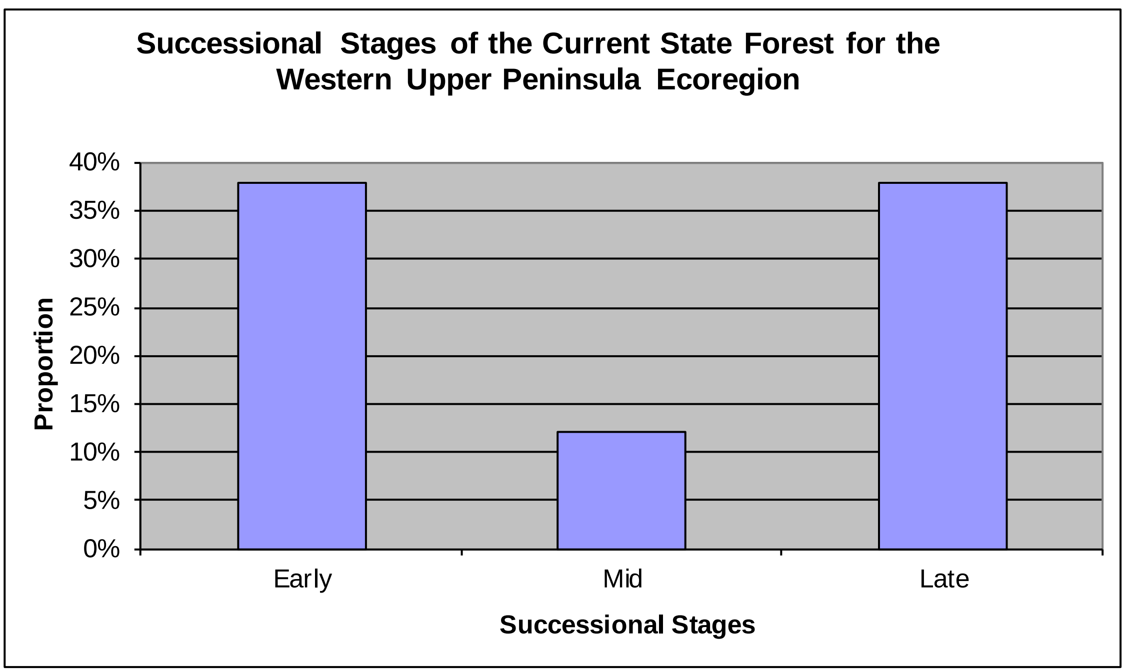

Figure 3.4. Successional stages for the state forest in the western Upper Peninsula ecoregion (2012 Department of Natural Resources inventory data).

Cedar

Much of the 83,865 acres (Table 3.1) of cedar in the western Upper Peninsula occurs in even-aged stands is a result of the widespread fires of the 18th and early 19th century. These stands provide excellent thermal cover for the white-tailed deer of the western Upper Peninsula. Cedar is also a favored browse for deer and has made the regeneration of these stands very challenging in areas of high deer numbers. Most of the cedar cover type has been protected from harvest. Limited attempts at strip cutting have largely failed to provide adequate regeneration. The cedar type has increased 22% (13,000 acres) from 1988 to 2005.

The Ecosystem Vulnerability Assessment and Synthesis (Swanston et al., 2011) for northern Wisconsin (similar climatic conditions to the western Upper Peninsula) summarized potential impacts, vulnerabilities and ability to adapt to projected future climate changes. Northern white cedar is a key species in lowland coniferous forests and is predicted to decline under all future emission scenarios. Increases in pests and deer herbivory are of particular concern. The lowland coniferous forest type has a limited tolerance for changes in water table, which may make it more vulnerable to climatic changes. It is also closely associated with sphagnum moss, which will likely be limited by future increases in temperature.

Lowland Conifer

Lowland conifers are widespread across the state forest in the western Upper Peninsula ecoregion consisting of 81,308 acres (Table 3.1). Tree species commonly found in this type include balsam fir, black spruce, tamarack, birch and red maple. Cedar is frequently a component of these stands and also occurs as separate stands closely associated with lowland conifer types. The lowland conifer type has increased 3% (3,300 acres) from 1988 to 2005.

Jack Pine

There are 26,910 acres (Table 3.1) of jack pine in the state forest of the western Upper Peninsula ecoregion, with extensive areas being located in the Baraga Plains and Yellow Dog Plains management areas. The jack pine in the Baraga Plains exhibits very high growth and form.

The Ecosystem Vulnerability Assessment and Synthesis (Swanston et al., 2011) for northern Wisconsin (similar climatic conditions to the western Upper Peninsula) summarized potential impacts, vulnerabilities and ability to adapt to projected future climate changes for tree species and forest types. Jack pine is predicted to decline under all future emission climate scenarios. In northern Wisconsin, a decline in abundance is predicted, even though there may be some expansion of spatial distribution (limited by soils). The jack pine forest type has a low species diversity which may limit options for future trajectories and could potentially limit the ability of this forest type to adapt to climatic changes and resulting impacts. However, it is also disturbance adapted and could expand with increased widespread disturbance, or it could convert to barrens, if disturbance is too great. Jack pine may face increased competition from hardwoods and greater pest and disease threats and may also be physiologically limited by increased temperatures.

Upland Spruce/Fir

The upland spruce-fir cover type is evenly spread across the ecoregion and consists of 21,344 acres (Table 3.1). Tree species commonly found in this type are balsam fir, black spruce and white spruce. The upland spruce-fir type has decreased 34% (10,000 acres) from 1988 to 2005.

Lowland Brush

Lowland brush is the most common non-forested cover type on state forest land in the western Upper Peninsula ecoregion covering 68,227 acres (Table 3.1). This type primarily occurs on the fringe of major streams and watercourses. Little or no management of these areas has been attempted. The most common species in this type is alder. Lowland brush is uniformly spread across the ecoregion. The lowland brush type has decreased 7% (3,000 acres) from 1988 to 2005.

Restrictions on Timber Harvesting

Any discussion of forest cover types and the availability of timber for harvest must consider that basis of forest land that is actually suitable for timber production. There are five categories of state forest acres which are mostly unavailable for timber harvests:

- Forest land that is leased to other governmental agencies or private corporations for other uses;
- Non-forested lands (bogs, grasslands, sand dunes, water, etc.);
- Forest land that is withdrawn from timber production (with a legal basis) for ecological purposed (high conservation value areas and ecological reference areas);
- Forest land that is not physically suited for timber production (many lowland forests and physically inaccessible lands); and
- Forest land that is not appropriate for timber production (administratively removed lands that are used for other purposes, such as roads and campgrounds).

These categories can overlap each other on any given acre of the state forest, so this analysis accounts for overlap to provide an accurate estimate of forestland that is suitable for timber production. This analysis also accounts for many factors that constrain or limit the prescription of stands that meet a silvicultural criterion and are otherwise ready for harvest. Treatment limiting factors are used to record constraints on the availability of a stand for harvest. There currently are five categories of limiting factors (Appendix C): (1) Administrative and legal factors; (2) Accessibility factors; (3) Special management or use designation; (4) Markets and industrial factors; and (5) Technological/ecological factors. These limiting factors are used to identify reasons that harvest cannot occur.

The accounting framework for a current estimate of state forest land that is suitable for timber production starts with the approximately 886,000 acres of state forest in the western Upper Peninsula ecoregion (Table 3.2). Of this total there are 3,380 acres that are leased for mineral production. An additional 101,043 acres are non-forested, which include rock, water, marshes, grassland and brush. These lands provide wildlife habitat and are important recreational and biological components of the landscape but they are not part of a working timber base. After accounting for leased and non-forested lands, the estimate of actual forest land in the ecoregion is about 782,000 acres (Figure 3.2).

Lands that are withdrawn from timber production for ecological purposes (high conservation value areas and ecological reference areas) total 5,423 acres of state forest in the ecoregion. Lands which are not physically suited for timber production (due to wetness, with water quality concerns, physical inaccessibility or steep slopes) total 38,795 acres. After accounting for these two categories, there are an estimated 738,000 acres of state forest land that is tentatively suitable for timber production (Table 3.2).

There are 51,047 acres of lands that have been administratively removed from timber production for other purposes and uses (including recreational uses, non-dedicated natural areas, Type 1 and 2 old growth, deer winter habitat and forest roads). Accounting for these areas yields an estimated 687,000 acres of state forest land that is suitable for timber production in the ecoregion (Table 3.2).

This analysis does not account for temporary treatment limiting factors that can also constrain or limit the prescription of stands that meet a silvicultural criterion and are otherwise ready for harvest. Stands with temporary limiting factors will be harvested once the factors have been satisfied (longer rotation age) or are eliminated (need for a bridge).

Table 3.2 State forest lands suitable for timber production for the western Upper Peninsula ecoregion. (2013 Department of Natural Resources inventory data).

Major Categories	Acres [1]	Acres	Definitions
		886,396	**Total DNR State Forest Land**
Leased Lands	-3,380		This category includes lands that are leased to the Department of Military Affairs, Luce County, and to corporations for mineral, oil and gas extraction facilities.
Non-forest Land	-101,043		This category is comprised of non-stocked acres: bogs, muskeg, grasslands, rock, lowland and upland brush, marsh, sand dunes, and water.
		781,973	**= Forest Land**
Forest Land Withdrawn from Timber Production	-5,423		This category is comprised of areas that are legally or otherwise dedicated to other uses that preclude timber production: Dedicated Natural Areas, Natural River Buffers, Ecological Reference Areas, Critical Dunes, Designated Critical Habitat (Piping Plover), and Coastal Environmental Areas.
Forest Land not Physically Suited for Timber Production	-38,795		This category is comprised of areas that have site conditions where timber production would cause resource damage to soils, productivity, or watershed conditions: being too steep (Code 2F), too wet (Code 2G), blocked by physical obstacle (Code 2H), Influence Zones (Code 3G), and water quality/BMPs (Code 3J).
		737,755	**= Forest Land Tentatively Suitable for Timber Production**
Forest Land not Appropriate for Timber Production	-51,047		This category is comprised of areas that are administratively removed for other resource values and management uses: Recreation Areas (SF Campgrounds, Motorized Trails, and Scramble Areas), Scenic Values (Code 3D), Proposed and Nominated Natural Areas, Possible and Verified Type 1 and 2 Old Growth Areas, Potential Old Growth (Code 3A), Deer Wintering Areas (Code 3H), TE&SC Species (Code 3B), other wildlife concerns (Code 3L), Archeological Sites (Code 3I), Rare Landforms (Code 3K), Non-Military Easements (Code 3E), Forest Roads, and Other Administrative/Legal Factors (Codes 1A, 1B, 1C, and 1D).
		686,708	**= Forest Land Suitable for Timber Production**

[1] Acres have been adjusted to eliminate duplicate accounting where multiple designations occur for any given area. Absolute acres are higher for any given category.

3.4 Forest Health Conditions and Trends

The western Upper Peninsula faces several major forest health concerns. The introduction of non-native plants, insects and diseases are a serious threat to the health and plant species composition of the state's forest ecosystems, although population cycles of endemic native insects also cause periodic disturbance and can have a significant impact at a localized level.

Native insects and diseases periodically kill weakened and/or older trees. While outbreaks of some native insects and diseases periodically cause unacceptable growth loss and tree mortality, they also contribute to the process of forest regeneration, growth and renewal. Areas with large outbreaks, anticipated or on-going, often have timber harvest operations to salvage the usable fiber.

Unlike native insects and diseases, non-native species have not evolved with and are not integral parts of our forest ecosystems. These organisms cause new and sometimes devastating effects that disrupt natural functions and processes and have major consequences on the vegetative composition, structure, productivity and health of native forests.

Due to a continually emerging global economy, there is an ever-present threat of the introduction of new non-native invasive plants, insects and diseases. Recently introduced non-native species include the emerald ash borer, beech bark disease and the hemlock woolly adelgid. Introduced pests pose a major threat to U.S. forests, as well as those in Michigan. Some of these pests are transported inadvertently by movement of firewood, wood products and nursery stock. Quarantines and other types of restrictions try to curb the movement and introduction into other parts of the state and neighboring states.

The long-term ecological consequences of threats to forest health may not be fully apparent or immediately understood. To address this, Michigan participates in the national Forest Health Monitoring program to evaluate the extent, severity and causes of changes in forest health. There is also ongoing research by various agencies including the DNR.

A number of forest insects and diseases are present or may threaten forest health conditions in the western Upper Peninsula ecoregion (Table 3.3). The most significant insects are emerald ash borer, beech scale, spruce budworm, jack pine budworm, eastern larch beetle, hemlock looper and hemlock woolly adelgid. All of these pests are present in Michigan now although the hemlock woolly adelgid has only been found and eradicated in a few very isolated spots on ornamental trees in the Lower Peninsula. Beech bark disease has a significant impact on beech, but beech is not a predominant species in the western Upper Peninsula. Table 3.4 shows the major forest pests and diseases by management area for the ecoregion. All of these pests pose a very serious threat to our forests. As such, their presence needs to be recorded and reported when detected.

Other observed forest health issues, particularly to aspen include *Armillaria* root rot, the bronze poplar borer (*Agrilus lirgus*) and *Septoria* leaf spot (*Septoria musiva*). Mortality of larger aspen is often associated with *Hypoxylon* canker. Significant periodic defoliation by the forest tent caterpillar, gypsy moth and the large aspen tortrix in the last decade has also contributed to a decline in aspen vigor and overall health. The aspen leaf blotch miner (*Phyllonorycter apparella*) and *Septoria* leaf spot discolored aspen canopies in many parts of the state in 2011.

Several different tree declines are being observed in the western Upper Peninsula. Tree decline refers to a gradual loss of tree growth and vigor. Declining trees often have some combination of off-color leaves, early leaf drop, poor growth and dieback of twigs and branches. This condition usually progresses slowly over several years. During this time trees may be susceptible to some combination of insect attacks, diseases and adverse weather conditions like drought and late frosts. These stressors can further reduce growth and may increase the likelihood of tree death.

Drought is one of several triggers that can cause declines in tree canopy health. Hardest hit trees in drought situations are those that grow in light, sandy soils or on lowlands exposed to significant water table fluctuations. Drought stressed trees are susceptible to a host of insect pests and diseases. Oak is affected by the two-lined chestnut borer (*Agrilus bilineatus*); paper birch is affected by the bronze birch borer (*Agrilus anxius*); larch is affected by the eastern larch beetle (*Dendroctonus simplex*); and jack and red pine saplings are affected by *Diplodia* and *Armillaria.*

There are declines specific to tree species including aspen, black ash, bitternut hickory, oak and maple.

Table 3.3. Forest pests, host species, origin, threat severity, incidence and trends for the western Upper Peninsula ecoregion.

Pest	Host Species	Origin	Severity of Threat	Incidence In NLP	Trend
Emerald Ash Borer	Ash	Non-Native	High/Extreme	High, Extensive	Increasing
Hemlock Woolly Adelgid	Hemlock	Non-Native	High/Extreme	Not Found	Increasing
Hypoxylon Canker	Aspen	Native	Medium	High, Extensive	Stable
White Trunk Rot	Aspen	Native	Medium	High, Extensive	Stable
Oak Wilt	Oak	Non-Native	Medium	Low	Increasing
Eastern Larch Beetle	Larch, Tamarack	Native	Low	Low	Stable
Larch Casebearer	Larch, Tamarack	Native	Low	Low	Stable
Diplodia Shoot Blight	Red and Jack Pine	Native	Low	Medium	Stable
Jack Pine Budworm	Jack Pine	Native	Medium	Medium	Stable
Spruce Budworm	Balsam Fir, White Spruce	Native	Medium	High	Periodic
Two-Lined Chestnut Borer	Northern Pin Oak	Native	Medium	Medium	Periodic
Hemlock Looper	Eastern Hemlock	Native	Medium	Low	Periodic
Beech Bark Disease	American Beech	Exotic	High	High	Increasing

Table 3.4. Forest pests by management area for the western Upper Peninsula ecoregion

Management Area		Pest Occurrence Within a Management Area													
		Emerald Ash Borer	Hemlock Wooly Adelgid	Hypoxylon Canker	White Trunk Rot	Oak Wilt	Eastern Larch Beetle	Larch Casebearer	Diplodial Shoot Blight	Scleroderris Canker	Jack Pine Budworm	Spruce Budworm	Two-Lined Chestnut Borer	Sirococcus Shoot Blight	Total
MA-1	Amasa Plains	X		X	X							X			4
MA-2	Baraga Plains			X	X	X			X		X			X	6
MA-3	Brampton Lake Plain			X	X				X					X	4
MA-4	Brule/Iron River	X		X	X							X			4
MA-5	Cassidy Creek	X		X	X							X			4
MA-6	Central Houghton	X		X	X							X			4
MA-7	Central Keweenaw											X			1
MA-8	Chain Lake Moraine			X	X				X		X	X		X	6
MA-9	Chatham/AuTrain	X		X	X							X			4
MA-10	Covington/Ned Lake	X										X			2
MA-11	Cyr Swamp						X	X				X			3
MA-12	Dead Horse Moraines	X		X	X							X			4
MA-13	Floodwood Plains			X	X							X			3
MA-14	Fourteen Mile Point Lake Plain	X	X												2
MA-15	Green Bay Lake Plain	X		X	X							X			4
MA-16	Groveland	X		X	X							X			4
MA-17	Huron Mountains	X	X	X	X										4
MA-18	Keweenaw Tip	X		X	X							X			4
MA-19	Menge Creek	X		X	X										3
MA-20	Menominee End Moraine			X	X	X							X		4
MA-21	Michigamme Reservoir	X		X	X							X			4
MA-22	Nathan/Banat Moraines	X		X	X										3
MA-23	Net River	X		X	X							X			4
MA-24	North Menominee Moraines	X		X	X							X			4
MA-25	Norwick Plains	X		X	X										3
MA-26	Palmer Moriaine			X	X				X		X			X	5
MA-27	Panola Plains			X	X				X		X			X	5
MA-28	Peavy End Moraine	X		X	X	X							X		5
MA-29	Peshekee Highlands	X										X			2
MA-30	Ralph Ground Moraine	X		X	X							X			4
MA-31	Sand River Lake Plain	X	X	X	X										4
MA-32	Sands Plains			X	X				X		X			X	5
MA-33	Sturgeon Sloughs	X					X	X				X			4
MA-34	Voelker Plains			X	X				X		X	X		X	6
MA-35	Yellow Dog Plains								X	X	X			X	4
	Total	24	3	28	28	3	2	2	8	1	7	21	2	8	

Invasive Plant Species

Invasive species are a serious threat to biodiversity and ecosystem function. Invasive species are those that are non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (National Invasive Species Council, 1999). Invasive species disrupt complex interactions among native species and hence ecosystem functions. Invasive species may displace native species, disrupt critical components of food chains (particularly invertebrates), be unpalatable or toxic, disrupt mutualistic relationships and/or diminish recreational opportunities (Higman and Campbell, 2009).

The potential threat of an invasive species is based on how fast it spreads, how quickly it will displace native vegetation and how difficult it is to control. There are several invasive species that present the highest threat to the forest systems that are not yet well established and for which local control and eradication is possible (Table 3.5). Tables 3.5 and 3.6 represent the best of our knowledge about invasive plant species; however, the database is incomplete – occurrences are more widespread than we know. These data can be supplemented by continuing to map the presence of invasive plant species as part of the compartment review process. This list, in conjunction with an early detection and rapid response system, will be used to help focus and prioritize prevention for monitoring and for control activities.

The most commonly found invasive plants on management areas are Japanese knotweed (23); Japanese barberry (14); spotted knapweed (14); glossy buckthorn (13); common buckthorn (12); tartarian buckthorn (12); and wild parsnip (11). Some eradication efforts have started on invasive species. Scots pine (*Pinus sylvestris*) is systematically being removed from state forest lands. Common (*Rhamnus cathartica*) and glossy buckthorn (*Rhamnus frangula)* plagues many areas of the state and are being removed as opportunities occur. Garlic mustard (*Alliaria petiolata*) monitoring, management and eradication projects are gaining momentum in Michigan; and public and private organizations are cooperating in efforts to remove and keep garlic mustard from establishing in new areas of the western Upper Peninsula. Purple loosestrife (*Lythrum salicaria*) has been reduced to isolated areas by an introduced exotic leaf beetle (*Galareucella sp*.). There are also several other invasive plants of concern which have been detected. Invasive plant management is a new arena and training sessions for DNR personnel that include plant identification, reporting protocols and management strategies were conducted and will be repeated periodically.

Table 3.5. Non-established invasive plants for western Upper Peninsula ecoregion state forest lands.

Common Name	Scientific Name(s)	Wetland/Riparian	Forest Understory/Edge	Open/Grassland
Black and Pale Swallow-worts	*Cunanchum louiseae, syn. - Vincetaoxicum nigrum and C. rossicum, syn. - V. rossicum*	X	X	X
Common Buckthorn	*Rhamnus cathartica*		X	X
Garlic Mustard	*Alliaria petiolata*	X	X	X
Glossy Buckthorn	*Rhamnus frangula*	X	X	X
Japanese and Giant Knotweeds	*Fallopia japonica and F. sachalinensis*	X	X	X
Japanese Barberry	*Berberis thinbergii*		X	
Leafy Spurge	*Euphorbia esula*			X
Phragmites	*Phragmites australis*	X		
Oriental Bittersweet	*Celastrus orbiculatus*		X	
Narrow-leaf Cat-tail	*Typha angustifolia*	X		
Amur Honeysuckle	*Lonicera maackii*		X	X
Tartarian Honeysuckle	*Lonicera tatarica*		X	X
Spotted Knapweed	*Centaurea stoebe and C. maculosa*			X
Wild Parsnip	*Pastinaca sativa*			X
Reed Canary Grass	*Phalaris arundinacea*	X		
Purple Loosestrife	*Lythrum salicaria*	X		

Table 3.6. Invasive plant occurrences by management area for the western Upper Peninsula ecoregion.

Management Area		Phragmites		Norway Maple		Common Buckthorn		Garlic Mustard		Glossy Buckthorn		Japanese/Giant Knotweeds		Japanese Barberry		Leafy Spurge		Black Locust		Narrow-leaf Cattail		Spotted Knapweed		Wild Parsnip		Purple Loosestrife		Reed Canary Grass	
		MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer
MA-1	Amasa Plains					1						1																	
MA-2	Baraga Plains					1				1				1								1						1	
MA-3	Brampton Lake Plain	1						1		1		1																	
MA-4	Brule/Iron River	1						1				1		1						1		1				1		1	
MA-5	Cassidy Creek	1				1		1		1		1																	
MA-6	Central Houghton	1										1		1		1						1		1		1		1	
MA-7	Central Keweenaw					1		1		1		1		1								1				1		1	
MA-8	Chain Lake Moraine																												
MA-9	Chatham/AuTrain							1																					
MA-10	Covington/Ned Lake					1																1				1		1	
MA-11	Cyr Swamp																												
MA-12	Dead Horse Moraines	1								1		1																	
MA-13	Floodwood Plains											1																	
MA-14	Fourteen Mile Point Lake Plain																												
MA-15	Green Bay Lake Plain									1		1		1															
MA-16	Groveland					1		1		1		1		1															
MA-17	Huron Mountains							1		1		1		1				1				1				1			
MA-18	Keweenaw Tip											1																	
MA-19	Menge Creek									1		1		1								1				1			
MA-20	Menominee End Moraine																												
MA-21	Michigamme Reservoir					1						1		1															
MA-22	Nathan/Banat Moraines																												
MA-23	Net River	1				1						1		1						1		1				1		1	
MA-24	North Menominee Moraines																												
MA-25	Norwick Plains	1		1		1				1		1		1				1		1		1		1		1			
MA-26	Palmer Moraine																												
MA-27	Panola Plains					1						1		1								1				1			
MA-28	Peavy End Moraine					1		1		1		1		1															
MA-29	Peshekee Highlands					1						1										1						1	
MA-30	Ralph Ground Moraine											1																	
MA-31	Sand River Lake Plain			1				1		1		1		1				1				1				1		1	
MA-32	Sands Plains							1				1																	
MA-33	Sturgeon Sloughs									1		1										1				1		1	
MA-34	Voelker Plains																												
MA-35	Yellow Dog Plains																					1							
	Total	7	0	2	0	12	0	10	0	13	0	23	0	14	0	1	0	3	0	3	0	14	0	2	0	11	0	9	0

Management Area		Tartarian Honeysuckle		Japanese Honeysuckle		Bell's Honeysuckle		Birdsfoot Trefoil		Dane's Rocket		European Swamp Thistle		Morrow's Honeysuckle		Multiflora Rose		Canada Thistle		Common St. John's Wort		Crack Willow		Scot's Pine		Totals	
		MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer	MA	Buffer
MA-1	Amasa Plains	1				1		1		1		1														7	0
MA-2	Baraga Plains	1				1						1		1		1										10	0
MA-3	Brampton Lake Plain																									4	0
MA-4	Brule/Iron River	1				1						1						1		1		1		1		15	0
MA-5	Cassidy Creek																									5	0
MA-6	Central Houghton	1		1		1						1						1				1				14	0
MA-7	Central Keweenaw																	1								9	0
MA-8	Chain Lake Moraine																									0	0
MA-9	Chatham/AuTrain																									1	0
MA-10	Covington/Ned Lake	1				1						1		1		1				1						10	0
MA-11	Cyr Swamp																									0	0
MA-12	Dead Horse Moraines																									3	0
MA-13	Floodwood Plains																									1	0
MA-14	Fourteen Mile Point Lake Plain																									0	0
MA-15	Green Bay Lake Plain																									3	0
MA-16	Groveland																									5	0
MA-17	Huron Mountains	1																								8	0
MA-18	Keweenaw Tip																									1	0
MA-19	Menge Creek	1				1						1														8	0
MA-20	Menominee End Moraine																									0	0
MA-21	Michigamme Reservoir																									3	0
MA-22	Nathan/Banat Moraines																									0	0
MA-23	Net River	1				1						1		1				1		1						14	0
MA-24	North Menominee Moraines																									0	0
MA-25	Norwick Plains	1				1						1		1								1		1		17	0
MA-26	Palmer Moraine																									0	0
MA-27	Panola Plains																									5	0
MA-28	Peavy End Moraine																									5	0
MA-29	Peshekee Highlands	1										1				1				1						8	0
MA-30	Ralph Ground Moraine																									1	0
MA-31	Sand River Lake Plain	1																								10	0
MA-32	Sands Plains																									2	0
MA-33	Sturgeon Sloughs	1																1								7	0
MA-34	Voelker Plains																									0	0
MA-35	Yellow Dog Plains											1								1						3	0
	Total	12	0	1	0	8	0	1	0	1	0	10	0	4	0	2	0	5	0	5	0	3	0	2	0	179	0

Occurrences of Invasive Species Within the Managagment Area or Five Mile Buffer

3.5 - Wildlife Habitat Conditions and Trends

The DNR Wildlife Division has a public trust responsibility for the restoration, conservation, management and enhancement of wildlife and the provisions for the public use of these resources. This responsibility is codified in Public Act 451 of 1994 and reinforced in the division's mission statement and strategic plan. In practice, this responsibility is carried out by: 1) Managing/co-managing state-administered land; 2) Advocating/facilitating wildlife-appropriate management on other lands; and 3) Informing decisions on the regulations that affect the method and manner of take of game species. Goals for land management that affect wildlife distribution and abundance focus on providing sufficient habitat to maintain viable wildlife populations. Additional goals include providing sufficient recreational opportunities for viewing, hunting and trapping. Recognizing that resources are limited and often restricted to types of use, Wildlife Division has employed a featured species approach to prioritize land management actions.

Featured species include highly valued game species, threatened and endangered, species of greatest conservation need and umbrella wildlife species with an identified habitat requirement and for which a practical habitat-related solution exists. Table 3.7 lists the featured wildlife species by management area for the western Upper Peninsula ecoregion. This plan addresses those featured species for which state forest provides a significant opportunity to address these habitat conditions. Within the context of ecoregional state forest planning, featured species will:

- Help to identify and focus the discussion regarding current habitat conditions and threats within the ecoregion;
- Help to more effectively prioritize and articulate a desired future condition for state forest lands within and across the ecoregions during this planning cycle and into the future; and
- Provide life requisites for a larger assemblage of species when the habitat requirements of the featured species are successfully met.

There are approximately 291 wildlife species (205 birds, 53 mammals and 33 reptiles and amphibians) that commonly inhabit the western Upper Peninsula. Of these, 22 "featured species" were selected to better focus our limited resources. Featured species were selected using a multi-step process which was informed by U.S. Fish and Wildlife Service Strategic Habitat Conservation (http://www.fws.gov/landscape-conservation/). Species were initially nominated by Wildlife Division staff and vetted through a public review process and through individuals and teams within the Wildlife Division and the department. Habitat Guidance for each species was developed by the Wildlife Division staff with species-specific knowledge.

The featured species concept does not preclude the management for other wildlife species within a particular management area, rather it is simply intended to be as a tool to help prioritize or focus habitat management.

For lands purchased with Pittman–Robertson Act or Game and Fish funds, the primary objective of vegetative management must be wildlife restoration.

Many existing departmental guidance documents are adequate for addressing wildlife habitat needs and will be used as appropriate. Where these documents do not adequately provide for the habitat needs of featured species, more specific direction is provided in Section 4. In addition to the featured species guidance included in this plan, numerous Wildlife Division strategic management plans exist (e.g., deer, wolves, elk and bear) that help guide the population management of these species, yet do not provide habitat direction at a finer scale (e.g., management areas) or direction on timber management or timber management mitigation for a given species.

Featured Species Summaries

This section contains information on each of the western Upper Peninsula featured species including: special listings, conservation history, habitat need and threats, as well as the specific wildlife management issue that will be addressed with this plan. Refer to the Desired Future Condition by cover type and management area in Section 4 of this document for specific detail regarding goals and recommended practices for featured species within the species' priority landscape.

Table 3.7. Featured wildlife species by management area for the western Upper Peninsula ecoregion.

WUP Management Area	American Marten	American Woodcock	Beaver	Black Bear	Blackburnian Warbler	Bobolink	Canada Goose	Eastern Bluebird	Gray Jay	Kirtland's Warbler	Moose	Pileated Woodpecker	Northern Goshawk	Red Crossbill	Red-shouldered Hawk	Ruffed Grouse	Sharp-tailed Grouse	Snowshoe Hare	Spruce Grouse	Upland Sandpiper	White-tailed Deer	Wild Turkey	Wood Duck
MA 1 Amasa Plains		X		X								X				X					X		
MA 2 Baraga Plains				X			X	X		X									X				
MA 3 Brampton Lake Plain		X			X											X						X	
MA 4 Brule/Iron River	X			X									X								X		X
MA 5 Cassidy Creek		X			X								X								X		X
MA 6 Central Houghton				X	X							X	X			X							
MA 7 Central Keweenaw				X									X								X		
MA 8 Chain Lakes Moraine		X		X					X			X	X	X		X							
MA 9 Chatham/Autrain Moraines				X		X	X						X				X						
MA 10 Covington/Ned Lake	X			X					X		X		X										
MA 11 Cyr Swamp															X				X		X		X
MA 12 Dead Horse Moraines				X								X				X					X		
MA 13 Floodwood Plains		X		X												X				X	X		
MA 14 Fourteen Mile Point Lake Plain	X											X									X		
MA 15 Green Bay Lake Plain					X										X	X					X	X	X
MA 16 Groveland				X	X								X								X		
MA 17 Huron Mountains	X				X																X		
MA 18 Keweenaw Tip				X	X							X		X									
MA 19 Menge Creek	X			X																	X		
MA 20 Menominee End Moraine				X				X								X							
MA 21 Michigamme Reservoir		X		X								X	X			X					X		
MA 22 Nathan/Banat Moraines													X			X						X	
MA 23 Net River	X	X		X							X										X		X
MA 24 North Menominee																		X			X		
MA 25 Norwich Tract		X		X																	X		
MA 26 Palmer Moraine		X		X								X		X									
MA 27 Panola Plains		X		X				X		X						X					X		
MA 28 Peavy End Moraine		X		X				X													X		X
MA 29 Peshekee Highlands	X				X				X		X	X	X										
MA 30 Ralph Ground Moraine		X		X									X			X					X		
MA 31 Sand River Lake Plain	X				X										X						X		
MA 32 Sands Plains										X									X	X			
MA 33 Sturgeon Sloughs		X		X			X	X															
MA 34 Voelker Plains		X	X	X						X													
MA 35 Yellowdog Plains				X						X									X	X			
Totals	8	14	1	24	9	1	3	5	3	5	3	9	12	3	3	12	1	1	4	3	20	3	6

American Marten

The American marten was eliminated from much of Michigan in the early 1900s as a result of removal of large tracts of mature conifer forest and unregulated marten harvest. Recovery efforts since that time have been successful in relatively unfragmented landscapes where reintroductions have occurred and restoration of this species in the Upper Peninsula has been successful to allow a sustainable harvest. Mature conifer stands provide the structure sought by marten which are rarely found outside the forest canopy and avoid stands with less than 30% canopy cover. Marten depend on live den-trees, snags and coarse woody debris for resting and denning sites. Dead and declining trees play an important role in marten reproduction and in the habitat requirements of their prey. The role of coarse woody debris in almost all aspects of marten ecology warrants special consideration of this element in management practices. In addition, marten need habitat connectivity (corridors) between populations in order to maintain population vigor. The American marten has been identified in Michigan as a species of greatest conservation need.

American marten is moderately vulnerable to climate change in Michigan and future populations will depend on both climate shifts and forest habitat (Hoving et al., 2013).

American Woodcock

The American woodcock is a valued game bird with a strong contingent of stakeholders. For example, in 2010, 36,000 hunters spent 213,000 days pursuing American woodcock in Michigan. The American woodcock is listed as both a species of greatest conservation need and a U.S. Fish and Wildlife Service, Upper Mississippi and Great Lakes Region Joint Venture focal species. Michigan is among the top woodcock producing states, but since the late 1960s, woodcock numbers have declined by 2-3% each year. Woodcock populations across time will benefit from a balanced aspen age-class distribution and provision of display, feeding, nesting and brood-rearing habitat via upland brush, opening and poorly stocked stand management.

American woodcock is likely to Increase due to climate change in Michigan and future populations are likely to respond positively to forest habitat management (Hoving et al., 2013).

Beaver

Beaver is a valued furbearer species and in 2010, 1,300 trappers spent nearly 30,000 days afield trapping Michigan beaver. Beavers modify their environment, creating a unique and important disturbance regime. Beaver ponds and abandoned pond meadows provide essential conditions for many wildlife species including waterfowl, otters, warblers, and woodcock. Beaver activity also promotes the maintenance of diverse wetland and riparian communities. Beavers prefer relatively narrow, low gradient streams of less that 15% slope with emergent vegetation and abundant alder, aspen, birch, maple or willow. Reduction in beaver abundance can result in a decrease in this disturbance regime and a suite of associated wildlife. The beaver population in the western Upper Peninsula appears to be healthy and timber management specifically designed to benefit beaver does not appear necessary in most places. Beaver prefer to forage within 100 feet of streams.

The population of beaver is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Black Bear

The black bear is a highly valued big game species throughout northern Michigan. In 2010, 37,000 hunters applied for 12,000 available bear licenses and hunters spent more than 55,000 days afield hunting. There are at least seven well-established stakeholder groups supporting bear management. In addition, viewing bears is valued by hunters and non-hunters alike. In 2011, the department recommended increasing the bear population in the western Upper Peninsula by 25% over four years. Hard and soft mast are critical resources for bears during the fall months to achieve adequate weight gains before denning, black bear also benefit from small forest clearings and maintaining an oak component in stands.

The population of black bear is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Blackburnian Warbler

The blackburnian warbler is listed as both a species of greatest conservation need and a Partners in Flight stewardship species. Blackburnian warbler abundance declines when forests become fragmented. Blackburnian warblers build nests almost exclusively in conifers (hemlock, white pine, white spruce, balsam fir or natural stands of red pine) and nest densities increase with increased percentage of conifers and are most abundant in mature forests. Thus, the primary habitat concern is the continuing decline in the percentage of conifers in the region and the continuing decline in the amount of mature conifers. Blackburnian warblers prefer diverse, unfragmented stands of mature forest with a conifer component.

Blackburnian warbler is moderately vulnerable to climate change in Michigan and future populations will depend on both climate shifts and forest habitat (Hoving et al., 2013).

Bobolink

The bobolink is a species of greatest conservation need and Breeding Bird Survey data indicates an average annual decline of 3.9% per year over the past 41 years in Michigan. Recent declines are thought to result from habitat fragmentation, conversion of grassland to other cover types and changes in grassland agricultural practices. Declines have been correlated to declines in acres of alfalfa, oats and pasture. Bobolink prefers fields with a minimum size of 75 acres and is highly sensitive to disturbance (e.g., mowing, burning or haying) during their breeding season (mid-May-August).

Bobolink is likely to increase due to climate change in Michigan and future populations are likely to respond positively to forest habitat management (Hoving et al., 2013

Canada Goose

The Canada goose is a valued game bird in Michigan. In 2010, nearly 35,000 goose hunters spent over 250,000 days afield. Geese are not habitat-limited in Michigan; they have adapted well to agricultural, suburban and urban areas and there is currently little concern about the sustainability of the resident breeding population. Water features and fields are important landscape features to attract migrating geese in the western Upper Peninsula and provide hunting opportunity.

Canada goose is moderately vulnerable to climate change in Michigan and future populations will depend on both climate shifts and forest habitat (Hoving et al., 2013).

Eastern Bluebird

The eastern bluebird is one of the western Upper Peninsula's most easily recognized and valued songbirds. Although Michigan's bluebirds have been generally increasing at an average rate of 5.9 % per year between 1966 and 2007, bluebird abundance in the western Upper Peninsula has been declining at an average rate of greater than 1.5 % per year over the same period. Declines are thought to result from changes in land-use practices including open lands reverting back to forest and forest practices that do not favor the production of snags.

The population of eastern bluebird is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Gray Jay

The gray jay is listed as a species of greatest conservation need and this species is at the southern edge of its range in the Upper Peninsula where it is considered an uncommon to locally common resident of conifer dominated habitats, particularly those containing spruce. Evidence suggests that abundance is declining at the southern edge of their range (including the Upper Peninsula), possibly in response to climate change and the resulting degradation of the perishable food stores used for late-winter nesting. Winter habitat needs (especially old black spruce) may be critical to persistence of local populations. Gray jays also serve as an umbrella species for other wildlife using boreal forest cover types (e.g., white spruce, balsam fir, tamarack, white cedar, white birch and aspen). Gray jays benefit from older age classes of boreal forest and retention of spruce and fir and scattered individual trees for food caching.

The population of gray jay is presumed stable (elsewhere) due to climate change, but the population is likely to shift out of Michigan. Future populations of gray jay are more likely to respond to climate trends rather than forest habitat management (Hoving et al., 2013).

Kirtland's Warbler

Kirtland's warbler, the rarest neotropical migrant in North America, is a federal and state listed endangered species, a species of greatest conservation need and a Joint Venture land bird species. It is considered a conservation-reliant species meaning that managing jack pine in large patches with relatively high stem densities is necessary to sustain a viable population. Since the early 1990's, Kirtland's warbler has been found in suitable Upper Peninsula jack pine habitat as the species expands beyond the core northern Lower Peninsula range. Primary or core nesting habitat may expand and or shift northward as a result of future climate change especially with the provision of suitable habitat (e.g., large blocks of 300-500 acres with appropriate structural and compositional diversity).

Kirtland's warbler is likely to increase due to climate change in Michigan and future populations are likely to respond positively to forest habitat management (Hoving et al., 2013).

Moose

Moose are highly valued by Michigan's citizens, wildlife enthusiasts and hunters. Recently the legislature passed a bill to allow moose hunting in Michigan, yet at the time this was written, the Natural Resources Commission has not taken action to implement a season. The western Upper Peninsula moose population continues to grow at a slow rate. The reasons for the slow population growth are unclear and may be related to habitat limitations and increasing temperatures making the animals less fit. Moose in the Upper Peninsula are at the southern edge of their range, are easily heat stressed and climate change projections suggest conditions in Michigan may be unsuitable for moose by the end of this century.

The two most important habitat issues for moose in the western Upper Peninsula are the reduction in mesic conifer (thermal cover) and the skewed age-class distribution of aspen (forage). Moose require wetlands, particularly those interspersed with forested uplands, to provide submerged aquatic plants and to stay cool in the summer months; mesic conifers (including white pine, spruce and hemlock – the most important) to provide shelter in winter and shade in summer; and early successional aspen and birch stands for forage. Willow is an important browse species, as are submergent and emergent aquatic vegetation associated with summer feeding areas. Buffers along riparian and wetland edges would provide thermal and escape cover adjacent to the feeding areas.

Moose is highly vulnerable to climate change in Michigan. The long-term sustainability moose will depend on more on climate shifts than on forest habitat (Hoving et al., 2013).

Northern Goshawk

The northern goshawk is a U.S. Forest Service regional forest sensitive species, a species of greatest conservation need and is impacted by alteration of forest structure required for both nesting and post-fledging use. These same alterations also influence the abundance and vulnerability of northern goshawk prey species and can enhance populations of goshawk predators and competitors. Some forest treatments have resulted in reduced proportions of mature upland hardwoods that contain large diameter trees, standing dead and down trees, cull trees, multiple vegetation layers and high tree species diversity, including conifers. A goshawk will occupy a nesting area for one-to-eight years, with an average of 3.8 years.

In addition to following the *Interim Management Guidance for Red-Shouldered Hawks and Northern Goshawk on State Forest Lands*, goshawk benefit from: large (300-600 acre) blocks of unfragmented mature hardwood or mixed forest (single or multiple stands in close proximity); large populations of snowshoe hare, ruffed grouse and other small prey that are dependent upon coarse woody debris; and in addition, aspen stands in the 60-69 year-old age class with large diameter trees (> 18 inches in diameter at breast height) trees for nesting especially multi-crotched trees high in the canopy are important habitat features for northern goshawk.

The population of northern goshawk is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Pileated Woodpecker

The pileated woodpecker creates large cavities for nesting. They do not reuse nest sites, so the cavities become available for other cavity-dependent animals which cannot excavate their own cavities (secondary cavity nesters). There is strong competition both within and between species of secondary cavity nesters for the limited supply of pileated woodpecker nests, including wood duck, common goldeneye, bufflehead, hooded merganser, common merganser, merlin, kestrel, screech-owl, saw-wet owl, barred owl, fisher and American marten. Only large-diameter trees have sufficient girth for nest and roost cavities. Thus, there is concern for populations of this woodpecker and species dependent upon it when late-successional forests are converted to younger habitat conditions or younger stands are not allowed to mature. Mature forest including large diameter living and dead standing trees (for cavities) are important habitat requirements for this species.

The population of pileated woodpecker is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Red Crossbill

The red crossbill is a species of greatest conservation need and has a nearly exclusive diet of conifer seeds which influences its seasonal distribution and habitat selection. Red crossbills are an umbrella species for other species dependent upon mature hemlock, white spruce and red and white pine forests. Declines in red crossbills have been associated with declines in the availability of conifer seeds (Table 3.8); mostly a result of decreases in conifer across the landscape and a shortening of rotation periods for remaining conifer stands relative to when seed is produced and the mean pathological age (Table 3.8) (Benkman, 1993). This species is closely associated with conifer forests throughout the year. In Michigan, savannah-like stands of mature red pine are preferred cover types (Evers, 2011). The provision of older age classes of conifer cover types in appropriate cover types and stands within select landscapes is necessary to meet red crossbill life requisites.

The population of red crossbill is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Table 3.8. Comparison of Department of Natural Resources suggested rotations ages with mean pathological age, maximum known age and minimum seed bearing age (Bonner and Karrfalt, 2008).

	Minimum seed bearing age	DNR 'Generic Silvicultural Criteria'	Mean Pathological Age	Maximum Known Age
Eastern Hemlock	20-30 years	150	400	988
Red Pine	20-25 years	80	150	360
White Pine	5-10 years	100	160	460
White Spruce	30 years	54	160	637

Red-shouldered Hawk

The red-shouldered hawk is a U.S. Forest Service regional forest sensitive species, a state-threatened species and a species of greatest conservation need. Additionally, it is a U.S. Fish and Wildlife Service, Region 3, conservation priority as a rare/declining species. In the early 1900's, red-shouldered hawk numbers decreased along with declines in mature lowland deciduous forests habitat. Although Michigan red-shouldered hawk populations are currently believed to be stable, they are sensitive to decreases in suitable forest cover and preferred nest trees and increased forest fragmentation. Red-shouldered hawk prefer hardwood forest stands greater than 385 acres in size with some large diameter trees.

The population of red-shouldered hawk is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Ruffed grouse

The ruffed grouse is an important game bird in Michigan with approximately 85,000 hunters spending 616,000 days hunting grouse in 2010. Michigan and the western Upper Peninsula are both nationally recognized for grouse production and hunting opportunity. The western Upper Peninsula state forest contains higher proportions of aspen cover types (30% of all cover types and 44% of the upland cover types) than any other ecoregion and almost three times the percent of aspen as in the eastern Upper Peninsula ecoregion state forest. Although ruffed grouse use many different cover types, aspen support the highest densities of grouse. Optimum habitat includes young (6-15 years old), even-aged deciduous stands that typically support 8-10,000 woody stems per acre. A balanced aspen age-class distribution and provision of soft browse should contribute to the provision of long-term sustainable ruffed grouse populations.

The population of ruffed grouse is presumed stable (elsewhere) due to climate change, but the population is likely to shift out of Michigan. Future populations of ruffed grouse are more likely to respond to climate trends rather than forest habitat management (Hoving et al., 2013).

Sharp-tailed Grouse

Sharp-tailed grouse historically were widely distributed in the Upper Peninsula and northern Lower Peninsula during the 1950s, but their range has since declined, primarily due to changes in open land cover types. The sharp-tailed grouse is listed as a species of greatest conservation need. There is a desire for increased recreational opportunities associated with hunting and viewing and a limited hunting season was reopened in 2010 in the eastern Upper Peninsula after being closed since 1997. Distribution and abundance of sharp-tailed grouse is tied to their habitat needs including relatively large blocks of herbaceous open lands, including upland herbaceous openings, sedge meadows, other herbaceous wetland types and upland pine barrens.

The population of sharp-tailed grouse is presumed stable (elsewhere) due to climate change, but the population is likely to shift out of Michigan. Future populations of sharp-tailed grouse are more likely to respond to climate trends rather than forest habitat management (Hoving et al., 2013).

Snowshoe Hare

The snowshoe hare is a valued game species across the northern part of the state and during 2010 15,000 hunters spent about 103,000 days in the field hunting this species. Snowshoe hare are an important prey species for many western Upper Peninsula furbearers including marten, fisher, bobcat and other medium size carnivores. Today there is a low relative abundance of hare throughout the southern extent of its range which includes northern lower and upper Michigan. Declines likely result from a reduction in habitat quality (young forest with regenerating mesic conifer); however, climate change may also play a role. Hare populations do best in areas of dense, young forest and shrub communities; alder and coniferous swamps are preferred. Dense understory cover is the primary limiting factor; escape and thermal cover is more important than food availability. Priority habitat needs include maintaining early successional forest (jack pine, mixed swamp conifer, tag alder and aspen), especially in areas adjacent to lowlands, promotion of retaining and restoring the mesic conifer component within stands and maintenance or enhancement of leaving coarse woody debris following harvest.

Snowshoe hare is highly vulnerable to climate change in Michigan. The long-term sustainability of snowshoe hare will depend on more on climate shifts than on forest habitat (Hoving et al., 2013).

Spruce Grouse

Spruce grouse is a U.S. Forest Service regional forest sensitive species, a species of greatest conservation need and a permanent resident that provides recreation for birdwatchers and photographers throughout the year. This species is characteristic of mature stands of short-needled conifers (e.g., jack pine, black and white spruce and tamarack) interspersed with small openings. Ideal habitat in Michigan occurs where black spruce and jack pine mix with scattered small openings amongst decaying logs and stumps. Since this bird does not disperse long distances, forest treatments that create large open clear-cuts and subsequent single species plantations (e.g., red/ jack pine plantations with little understory), reduces populations locally and often eliminates them entirely. Populations appear to fluctuate over time, primarily in response to the degree of maturation of post fire re-growth and secondarily to predation pressure. Management in the western Upper Peninsula will focus on early successional forest (jack pine, mixed swamp conifer, tag alder and aspen), maintaining adequate coarse woody debris and encouraging conifer (e.g., jack pine, mixed swamp conifer) understory component.

Spruce grouse is moderately vulnerable to climate change in Michigan and future populations will depend on both climate shifts and forest habitat (Hoving et al., 2013).

Upland Sandpiper

The upland sandpiper is listed as a species of greatest conservation need in Michigan and a U.S. Fish and Wildlife Service, Upper Mississippi and Great Lakes Region Joint Venture focal species. This bird relies on relatively large (greater than 125 acres) contiguous and sparsely vegetated opening complexes. Abundance has declined statewide on average 1.6% per year between 1966 and 2007. These declines are likely the result of forest encroachment on openings, decreases in patch size and decreases in the size of timber harvests and increased fire suppression. Priority habitat issues for this species will focus on maintaining large opening complexes and scheduling jack-pine harvests associated with permanent openings on a sustainable rotation and harvests adjacent to burns or similarly-aged jack-pine treatments in close proximity to one another.

Upland sandpiper is likely to increase due to climate change in Michigan and future populations are likely to respond positively to forest habitat management (Hoving et al., 2013).

White-tailed Deer

White-tailed deer are the most highly valued game species in the state and deer hunting contributes significantly to local economies. Deer are a keystone species and can have significant impacts (positive and negative) on vegetative communities. In 2010, 656,500 hunters spent 9.6 million days afield in Michigan hunting deer with the largest number of participants and stakeholder groups of any game species.

In the Upper Peninsula the strongest limiting factor is overwinter survival and mortality has exceeded 30% of the population in severe winters. A high proportion of the population (60-90%) migrates from summer range to wintering complexes; most of these areas are conifer-dominated stands with >50% canopy closure, adjacent to hardwood browse. Nutritious spring forage, particularly adjacent to wintering complexes, is critical to recovery from winter stress.

White-tailed deer statewide are not likely to increase or decrease due to climate change. However, the patterns of habitat use by white-tailed deer in northern Michigan are likely to shift as snowfall patterns change. Snowfall is a major driver of deer migratory behavior and their restriction to wintering complexes of mature conifers. Current trends toward more winter precipitation and less lake ice have resulted in significant increases in snowfall over the past 30 years, even as temperatures have increased. Thus, deer wintering complexes of mature conifers remain important. At some point, increasing temperatures will cause more snow to fall as rain, winter severity will decrease and the importance of deer wintering complexes will decrease. When deer become less restricted to wintering complexes, the spatial impact of deer browse will change. The timing of this shift is highly uncertain (Hoving et al., 2013).

Wild Turkey

The wild turkey is a highly valued game bird. During the 2009 spring season, 120,000 hunters spent 450,000 days afield in Michigan pursuing turkeys. As a result of successful introduction efforts and winter feeding programs over the past half-century, turkeys are now present in most western Upper Peninsula counties. Provision of natural winter food, maintaining and regenerating the oak component within stands and maintaining brood-rearing openings will improve turkey brood-production and winter survival.

Wild turkey is likely to increase due to climate change in Michigan and future populations of are likely to respond positively to forest habitat management (Hoving et al., 2013).

Wood Duck

The wood duck is a valued game species and is listed as Upper Mississippi River and Great Lakes Joint Venture focal species. Recent regional population estimates were 17% below goals established by the Joint Venture. Wood ducks use a wide range of wetland habitat types throughout the year including riparian areas, wooded swamps, marshes, bottomlands and beaver ponds. Areas with open water and approximately 50–75% cover are preferred. Cavity trees, herbaceous emergent plants, flooded shrubs and downed timber providing cover are also important habitat features. Maintaining forest wetland, riparian corridors with suitable habitat is important for wood ducks.

The population of wood duck is presumed stable due to climate change and large changes positive or negative impacts due to climate change are not expected (Hoving et al., 2013).

Table 3.9. Major western Upper Peninsula ecoregion priority wildlife habitat elements for each featured species.

WUP Featured Species	Major WUP Priority Wildlife Habitat Elements							
	Coarse Woody Debris	Early Successional Forest	Habitat Fragmentation	Large Openland Complexes	Large Living and Dead Standing Trees	Late Successional Forest	Mast	Mesic Conifer
American Marten	√		√		√	√		√
American Woodcock		√						
Beaver		√						
Black Bear		√	√				√	
Blackburnian Warbler			√			√		√
Bobolink			√					
Canada Goose								
Eastern Bluebird				√				
Gray Jay						√		√
Kirtland's Warbler		√	√					
Moose		√						√
Northern Goshawk	√		√			√		
Pileated Woodpecker					√	√		
Red Crossbill						√		√
Red-shouldered Hawk			√			√		
Ruffed grouse		√					√	
Snowshoe Hare	√	√						√
Spruce Grouse	√					√		
Upland Sandpiper			√	√				
White-tailed Deer		√				√		√
Wild Turkey							√	
Wood Duck					√	√	√	

Summary of Priority Habitat Elements

Table 3.9 summarizes the relationship of featured species to habitat need categories. Table 3.10 shows the distribution and abundance trends for selected featured species in the western Upper Peninsula ecoregion.

As the summaries above indicate, there is a high degree of overlap in the conservation/habitat needs of many of the featured species. These needs can be categorized into broad categories that include:

- Coarse woody debris: Maintain and encourage coarse woody debris in harvested stands for wildlife species dependent upon such conditions.
- Early successional forest: Maintain aspen, balsam poplar, jack pine, upland brush and openings in appropriate locations, and strive to balance aspen acreage. Increase species diversity in harvested stands by retaining a variety of tree species and legacy patches.
- Habitat fragmentation: Provide wildlife movement corridors across the landscape, especially along riparian systems or where habitat fragmentation is a problem. This is the second most common habitat issue shared amongst the selected western Upper Peninsula featured species (Table 3.9).
- Large open land complexes: Create and maintain large openings and savanna in appropriate areas.
- Large living and dead standing trees: Maintain and encourage large living and dead trees in harvested stands for wildlife species dependent upon such conditions.
- Late successional forest: Provide mature forest for species that require this habitat condition, particularly in areas subject to intensive timber management. This is habitat issue is shared with more western Upper Peninsula featured species (Table 3.9) than any other.

- Mast: Maintain and expand mast-producing species such as red oak, beech and fruit-bearing shrubs, focusing on areas where disease is threatening sustainability of these resources.
- Mesic conifer: Encourage expansion of natural stands of white pine, white spruce, balsam fir and hemlock and components of these species in other forest types. This is the third most common habitat issue shared amongst the selected western Upper Peninsula featured species (Table 3.9).

Table 3.10. Selected featured species abundance and distribution trends across time.

	Relative Abundance in WUP Ecoregion				Distribution in WUP Ecoregion			
Species	Mid-1800s	Early-1900s	Mid-1900s	Present	Mid-1800s	Early-1900s	Mid-1900s	Present
American Marten	Abundant	Rare/Eliminated	Eliminated	Common	Continuous	Isolated	Eliminated	Isolated
American Woodcock	Low	Common	Abundant	Common	Clumped	Clumped	Continuous	Clumped
Backburnian Warbler & Forest Interior Species	Abundant	Rare	Rare	Common	Common	Continuous	Clumped	Continuous
Bobolink & Grasland Birds	Rare	Common	Common	Rare	Isolated	Continuous	Clumped	Isolated
Kirtland's Warbler	Abundant	Common	Common	Rare	Clumped	Clumped	Clumped	Clumped
Northern Goshawk	Abundant	Low	Low	Common	Common	Clumped	Clumped	Clumped
Ruffed Grouse	Low	Common	Abundant	Common	Clumped	Continuous	Continuous	Continuous
Snowshoe Hare	Low	Common	Abundant	Low	Clumped	Continuous	Continuous	Continuous
White-tailed Deer	Low	Low	Abundant	Abundant	Clumped	Clumped	Continuous	Continuous
Wild Turkey	Absent	Absent	Absent	Common	Absent	Absent	Absent	Clumped
Young Forest Species	Rare	Common	Common	Common	Isolated	Continuous	Continuous	Continuous

3.6 Water Quality and Fisheries

Most of Michigan's watersheds were historically forested. Most watersheds in the western Upper Peninsula have low levels of deforestation. Most deforestation has resulted from human development for agriculture, residential and urban use. Watershed scale deforestation in lower Michigan has been shown to affect the hydrology of streams and lakes, changing flow patterns, channel characteristics and various habitat components including water quality (Wang et al., 2008). Fisheries Division studies have found that the level of forest cover shading the stream channel is one of three important factors influencing water temperatures in Michigan streams, the other two being channel morphology and ground water inputs (Wehrly et al., 1998). More current research has suggested a more complex picture suggesting that stream temperatures are influenced by a much broader suite of factors (Wehrly et al., 2006). Regardless, maintaining and restoring riparian forests are important components of maintaining stream temperatures and hence stream biota (Wehrly et al., 1998).

The relationship between the proportion of a watershed that is harvested (temporary deforestation), as part of forest management operations and when stream temperatures begin to rise is complex and has not been well documented. Also, there has been little work in the area of determining resilience – how long is the period of time that it takes for stream temperature to return to normal levels as the harvested forest regenerates or what is the proportion of the watershed that can be maintained in a deforested state without impacting stream temperature (recognizing that the spatial distribution of temporarily deforested harvest areas move around the landscape). As a result there are no guidelines for use in forest management planning or implementation that relate to the proportion of a watershed that can be harvested without having a negative impact on stream temperature. It is known that stream temperature, stream flow and water quality can be impacted by forest operations within what is called a riparian or riparian management zone adjacent to the stream channel.

Riparian areas of lakes and streams provide critical benefits for aquatic resources, including:
- Protection from sunlight and cold that helps maintain natural water temperatures during winter and summer;
- Maintaining natural cycles of water infiltration and evapotranspiration;
- Natural shoreline vegetation for stabilizing stream banks and lake shorelines against unnatural erosion, critical amphibian and reptile habitat and provision of terrestrial litter and insects into surface waters for direct food sources and aquatic food webs; and
- Attenuating floods and runoff to help maintain water quality.

The DNR uses riparian cover management guidelines, often referred to a best management practices, as described in IC4011 *Sustainable Soil and Water Quality Management Practices on Forest Land* (DNR and DEQ, 2009) to protect riparian management zones on lakes and streams. The riparian management zone is a strip on each side of perennial or intermittent streams or around the perimeter of water bodies (e.g., open water wetlands, ponds and lakes). The riparian management zone is not a "no cut buffer;" it is a zone where extra precaution will be used in harvesting timber or where such related activities as log landings, road construction, stream crossings or site preparation are not permitted or minimized.

Status and Trends of Inland Streams

Historically, many western Upper Peninsula streams have been altered by the effects of logging and road crossings. The removal of timber, the increased erosion (and subsequent deposition of sediments), the use of check dams and the resultant channel changing flow surges, has impacted nearly all rivers in the region. Compared to the Lower Peninsula, most of the area affected by historic logging operations has recovered and additionally, few artificial impoundments exist within the western Upper Peninsula. Most dams are located in the areas of highest gradient, impounding the best spawning areas for many species, making them unavailable to migrating fish species. Though dams inhibit reproduction of desirable species, they also limit the range and production of invasive exotic species such as sea lamprey. Streams with good spawning habitat not blocked by dams, such as the Ford and Chocolay rivers, are chemically treated for sea lamprey ammocetes or have had electrical lamprey barriers installed to prevent lamprey from accessing the most suitable spawning habitat.

Dams (including those constructed by beaver) can also affect the temperature and flow regime of a stream, often to the point of where they impact the downstream aquatic community and stream's ability to sustain an acceptable natural trout population. Dams also affect stream ecology by interrupting the transport of sediments and large woody material.

DNR Policy and Procedure 39.21-20 – Beaver Management addresses high priority trout streams (Appendix F) where beaver have the potential to cause unacceptable degradation of cold water stream quality.

Trout require clean, cold, well-oxygenated water that flows over gravel in order to spawn successfully. Trout are migratory in terms of spawning behavior and seasonally seek thermal refuge (cold water); thus, they require unobstructed passage to headwater areas. The best trout producing streams have cold summer temperatures with sufficient gravel or cobble for spawning. Many stream miles are located within the state forest, providing ample public access to top quality streams and affording significant protection from human alterations within riparian zones. Generally, waters in the western Upper Peninsula support diverse aquatic communities and are commonly found to have good-to-excellent water quality (Wolf and Wuycheck, 2004).

Most streams in the western Upper Peninsula are small, with many small headwater streams draining coarse glacial outwash are cold and relatively stable trout waters. Cold summer temperatures with sufficient gravel or cobble for spawning substrate make those streams good trout producers. Other streams, including the lower sections of some of the better trout streams, provide for coolwater angling opportunities for species such as walleye, smallmouth bass and northern pike. The Escanaba River is primarily a trout river while the lower Menominee River regularly produces 12 different species of fish.

Potential Impacts of Climate Change on Aquatic Ecosystems

Given that the impacts on stream temperature from changes in land cover and land use will be of similar or greater magnitude as from increasing air temperature (Wehrly et al., 2006), global warming has the potential for widespread impact on aquatic ecosystems and biota. There may be a shift of some cold water streams to cool water conditions and cool water systems to warm water systems with a corresponding change in biotic communities.

3.7 Socioeconomic Context

Concurrently with the U.S. Department of Agriculture Forest Service, the DNR held a series of 53 focus group meetings in 1996 for the purpose of gaining information about the public's views, visions and concerns regarding the management of public lands in the northern Lower Peninsula ecoregion. Participants in these meetings identified the following values and uses as being important for the ecoregion (Tessa Systems, LLC, 2006):

- Low population, less traffic and absence of urban characteristics;
- Slower, friendlier lifestyle;
- Small town environment;
- Beauty and solitude of lakes, rivers and the natural environment;
- Nearness to public lands;
- Clean air, open spaces, the four seasons and the pristine environment;
- Hunting, fishing, viewing wildlife and other recreational activities; and
- Raw materials for manufacturing and good transportation networks.

These uses and values are also likely applicable to the western Upper Peninsula ecoregion, and state forest lands in this ecoregion contribute to these values and uses by providing many human uses and ecosystem services, including biodiversity conservation; timber production; recreational activities; oil, gas and mineral production; public education; and research. Sustainable forest management is greatly influenced by the demands of each of these uses which shape the management direction of the state forest. The importance of the beauty and solitude of the lakes, rivers and the natural environment, particularly on public land will also continue to grow and demand for available outdoor recreational opportunities will continue to put pressure on the ability of the system to meet demand.

3.7.1 – Timber Production - State Forest Timber Harvest Trends

Timber sale records from the mid-1980s to present indicate a dynamic period of harvesting on state land in the western Upper Peninsula which has gradually declined since then. Several important factors contributed to this trend. In the mid- to late-1980's new hardwood and aspen markets emerged for western Upper Peninsula landowners. At that time aspen was the single most common cover type on state forestlands (32%) with northern hardwood second (23%). The majority of the aspen was mature or over mature, 57% over age 50. In response to the new market and the mature condition of the resource, aspen harvests increased dramatically. When markets for dense hardwood developed in the mid-1980s management attention gradually shifted toward northern hardwood stand improvement. Harvest volumes declined as thinning and selection cuts in hardwood stands produced less volume on an acreage basis than clearcut aspen harvests (Figure 3.4). This is an oversimplified analysis, but serves to highlight the principal factors effecting harvest levels on state forest lands in the western Upper Peninsula.

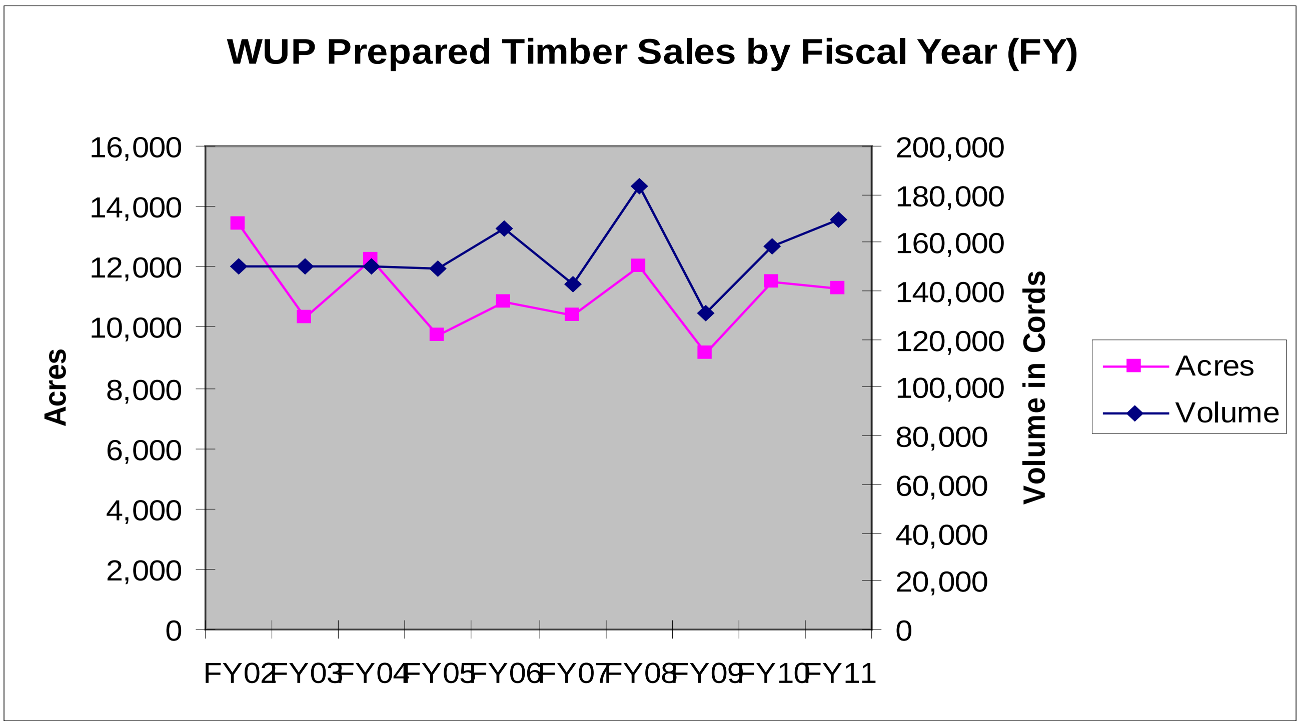

Figure 3.4. Acreage and volume of state forest timber sales in the western Upper Peninsula ecoregion (2012 unpublished Department of Natural Resources timber sale data).

3.7.2 – Oil, Gas and Mineral Production

Mining is a very important land use in Michigan with mineral occurrences located throughout the state. There are 850 producing mineral occurrences in the state with more than 80% of these being sand and gravel operations. Historically, mining operations for metallic ores, such as iron, copper and other metals have been concentrated in the western Upper Peninsula, as well as numerous undeveloped mineral occurrences. There is current interest in expanding exploration activities for metallic minerals in the ecoregion. There were 53,661 acres under 228 state metallic minerals leases at the end of 2007 resulting in revenue totaling $396,901, which was related to bonus, rentals and minimum royalties. Mining for metals in Michigan in 2007 resulted in the production of iron ore along with a very small amount of copper and silver, all on private lands. Today, exploration efforts continue on the state-owned lands under lease, while applications for new leases are being received on a regular basis.

Many nonmetallic mineral operations, especially sand and gravel, are located in Michigan, most in the Lower Peninsula. Special leases were developed for construction sand, gravel, cobbles, boulders and clay as well as for limestone, dolomite and salt. There were 3,527 acres under 45 state nonmetallic minerals leases at the end of fiscal year 2007, which resulted in $451,526 total revenue, all from royalty payments. Of these, six leases covering 994 acres are located in the western Upper Peninsula. The production of non-metallic minerals from state-owned land continues to be an important source of locally used materials for road and other construction purposes.

Significant opportunities exist for further mineral exploration and development on state-owned lands, but there are potential conflicts with other land uses. Given the recent escalation of energy and metal prices on world markets, it is reasonable to expect that future mineral activity and the related revenues will remain high and that there will be greater interest in seeking increased production from state-owned lands in the future.

3.7.3 – Forest Recreation and Tourism

Public lands in Michigan are a very important resource for many types of recreational pursuits. State lands comprise 4.7 million acres of Michigan's total of 36.4 million acres. The state lands account for over 13% of Michigan lands. The state of Michigan has the largest landholdings, including state forests, state park and recreation areas, state wildlife refuges and state game areas These lands in the western Upper Peninsula consists of culturally and ecologically significant sites like the Porcupine Mountains State Park.

Wilderness and natural areas provide unique opportunities for dispersed recreation and solitude. These areas have restrictive management standards and guidelines with a clear purpose of preserving natural ecological and social values. The western Upper Peninsula contains four of these wilderness areas: Huron Islands, McCormick, Sturgeon River Gorge and Sylvania.

Privately owned lands provide another major setting for recreation. Commercial forest lands, through the Commercial Forest Act passed in 1925, also provide a major setting for outdoor recreation on private lands through the provision of access. The program encourages retention of timber-growing land by reducing the owners' taxes and requires access to these lands by citizens for hunting and fishing. A majority of these lands are located in the WUP.

Designated Trails and Natural Beauty/Heritage Routes

Trails are managed by the DNR and other providers, such as the U.S. Department of Agriculture Forest Service and county/local units of government. Snowmobiling, off-road vehicle/all-terrain vehicle riding, hiking, cross country skiing, mountain biking and horseback riding are common uses of designated trails. There were 124,723 Michigan DNR-licensed off-road vehicles for the 1998-99 license years. Nearly 2,000 miles of trails are maintained in the western Upper Peninsula for snowmobiles on state lands alone. Communities are linked through the trail system to allow riders to enjoy lodging, restaurants and other amenities.

Travel to and from recreational settings has long been recognized as an important part of the recreational experience. Natural beauty roads and heritage routes are identified by the state as a way to identify and preserve transportation routes associated with recreation. There are currently 12.5 miles of such routes identified in the western Upper Peninsula. Scenic routes include an 18-mile stretch of U.S.-41 in Keweenaw County near Copper Harbor. Additionally there is a 16-mile section of U.S.-2 that has been identified as the Iron County Heritage Trail. The federal government has a program similar to the Heritage Routes; it identifies National Scenic Byways. The Black River Harbor National Scenic Byway is an 11-mile stretch of Highway 513, north of Bessemer, which parallels the Black River as it flows north to Lake Superior.

Campgrounds

Camping continues to be a popular recreational activity across the state. Private commercial campsites exceed all other campground sources and account for 46% of the campsites within northern Michigan. The western Upper Peninsula differs in this respect, where the number of state park campsites exceeds the number from private commercial locations. Commercial sites also are typically the highest developed, with sewer and electric hookups for large recreational vehicles. In the northern ecoregions, state forests and counties each provide an additional six percent of campsites in the area. State forest campgrounds are concentrated in the northern Lower Peninsula, followed by the eastern Upper Peninsula and western Upper Peninsula, respectively. These sites are the least developed of the campground providers. Most are located near lakes or rivers, an additional draw for other outdoor recreation pursuits.

3.7.4 Hunting, Trapping, and Fishing

The U.S. Fish and Wildlife Service, in collaboration with the Bureau of Census, conducts a periodic national survey of fishing, hunting and wildlife-related recreation and Michigan-specific reports were developed for the 1996, 2001, and 2006 surveys (U.S. Department of the Interior Fish and Wildlife Service and U.S. Department of Commerce Bureau of the Census, 1998, 2003, 2008). In September of 2012, preliminary results from the 2011 survey were released. The surveys compile data on hunter and angler characteristics, participation and expenditures. Over 1.7 million residents and non-residents hunted, trapped or fished in Michigan based on the 2006 results. Economic activity related to these recreational pursuits represents a significant revenue source for the state and local economies. For 2006, it is estimated that total expenditures were over $900 million for hunting and trapping and over $1.6 billion fishing. In addition, state forests provide opportunities for wildlife-watching and these activities contribute another $1.6 billion dollars in annual economic activity.

The Wildlife and Fisheries divisions conduct regular surveys of hunters, trappers and anglers to estimate levels of effort and harvest success. Based on 2011 data, there are nearly 700,000 deer hunters; over 100,000 turkey hunters; over 250,000 small game hunters; and over 1.2 million anglers. These are statewide values and include activities on all lands, yet the state forest system with nearly four million acres open to hunting, trapping and fishing represents a significant proportion of the land open to recreation in the state.

Dispersed Recreation

In studies conducted to examine dispersed recreation activities on forest land in the western Upper Peninsula, researchers surveyed two different forest user groups: people who drove to the forest and residents who live adjacent to the public forest land. Picking berries/mushrooms, fishing, deer hunting, grouse/woodcock hunting and other hunting were the top five activities for vehicle-based visitors. The most important activities for adjacent landowners were deer hunting, hiking/walking, snowmobiling, fishing and nature observation.

In the western Upper Peninsula, households were asked to identify their three favorite outdoor activities in which they or some member of the household participated. Most households participated in many outdoor activities including: wildlife viewing (85%); flower gardening (67%); wild berry picking (64%); wildlife feeding (60%); fishing (71%); swimming (66%); boating (65%); hunting (57%); and camping (48%). Skating/sledding (42%); snowmobiling (40%); cross-country skiing (32%); and downhill skiing (14%) were popular winter activities.

3.7.5 Public Research and Education

The DNR supports a variety of ongoing forestry, wildlife and fisheries research projects that are designed to increase knowledge and to improve methods of sustainable management of Michigan's public lands. Many of these research projects are accomplished in cooperation with state universities through formal agreements and on an as needed call for proposals for subjects of interest. An example of a formal research agreement is Partnership for Ecosystem Research and Management between Michigan State University and the DNR.

The Michigan DNR's Forest Certification Work Instruction 5.1, Coordinated Natural Resource Management Research, describes the procedures to report research performed by each division. The research coordinators from each division or bureau must compile a list of research projects, a list of on-line links or contact persons for research projects completed during the previous fiscal year and a summary of internal and external research expenditures during the previous year. This information will be used to prepare an annual research summary to be published by March 1 of each year and for preparation of the Sustainable Forestry Initiative Annual Report. These report summaries can be found on the DNR forest certification website.

Products of research often include educational materials that serve to convey research findings to the public. Since almost 63% of timberland in the state is in private ownership, public education programs are a critical part of encouraging sustainable natural resource management throughout the state. Several examples of educational opportunities offered by the department include: fire prevention programs, hunter safety, off-road vehicle safety education, snowmobile safety education and boating safety courses programs on fisheries, wildlife and forestry are offered to sportsmen's groups, school districts and other organizations.