

Section 5 – Monitoring, Reporting, Review and Revision

Introduction

Michigan has committed to sustainable forest management using an ecosystem-based approach. One of the key elements of this approach is an effectiveness monitoring component. Without effectiveness monitoring the desire to integrate continuous improvement into the DNR management approach and overall monitoring plan, is severely compromised at best, as is the ability to integrate the results of research.

Despite the intuitive value of effectiveness monitoring there are very few examples of well-designed and integrated programs outside the realm of research. Operational effectiveness monitoring remains an indisputable challenge (Lee and Bradshaw, 2004). An effectiveness monitoring program is something that will take a considerable effort to develop and will be based very much on many aspects of this plan. Consequently, the monitoring plan will necessarily be developed after this plan is approved. The approved plan will guide the development of the monitoring plan, but there also may be reasons to revise the plan to ensure better integration with the monitoring plan.

The absence of a monitoring plan does not mean that there are currently no monitoring activities currently being undertaken. This section describes the various types of monitoring, provides a description of monitoring directives, describes current monitoring activities, outlines the potential reporting framework and discusses the review and revision process for the management plan. The monitoring plan will revise and refine this current work.

Concepts of Monitoring

Monitoring is a rather generic term that is used to loosely describe any of the basic components of monitoring. Use of the generic term has done a disservice to monitoring in general as its most common use has really been related to surveillance monitoring (see description below). The greatest need for the results of monitoring is in the process of judging management success. Surveillance monitoring is unsuited for this purpose. The results of surveillance monitoring cannot be linked to decision making and as a result monitoring has received a bad reputation and is most often the first casualty of budget reductions.

Monitoring is intended to determine whether or not the condition of a current resource matches the expected condition or whether or not it is within some acceptable range around that outcome (Mulder et al., 1999). It can also be used to determine progress towards achieving the desired outcome. The expected outcomes are often described in terms of objectives which are a necessary prerequisite for designing a monitoring program. Monitoring also serves to increase our knowledge and improve our plans (Ringold et al., 1999). Monitoring serves to detect conditions that allow for timely corrective action, allow the scientific community to provide insight into ecosystem functions and demonstrate active attention being given to forest management (Lee and Bradshaw, 2004).

Monitoring works to its greatest advantage in three basic ways (Lee and Bradshaw, 2004):

1. Monitoring provides an accurate assessment of the status of the resource being managed;
2. It validates that management decisions are correctly interpreted and implemented and that such decisions achieve desired results; and
3. It provides insight into how systems operate.

Based on this description, it is easy to understand the role that is played by each of five basic components of an effectiveness monitoring program. These components are described below.

1. **Baseline Monitoring - Inventory:** A basic inventory is the creation of a list of elements of interest on a given site or landscape, for example birds, butterflies, trees and other vascular plants, or aquatic species. An inventory can represent what is known to be present at a given point in time or it can take the form of a continuous inventory where newly found or identified species are added to the list as they are found. Basic inventory data essentially indicate presence or absence, and nothing specific can be inferred about abundance. However, a systematic inventory which is based on a rigorous sample design can, produce estimates of abundance.
2. **Baseline Monitoring - Surveillance:** Surveillance is essentially a repeated inventory done to common and in many cases, rigorous standards and can be conducted annually, periodically or intermittently. It is probably the most common form of 'monitoring.' Surveillance is used to most commonly track presence/absence or population abundance over time. Its strength is in its ability to detect change over time; however, surveillance is not designed to suggest reasons or causes for the observed change. Surveillance does not establish whether or not objectives, targets or standards have been met unless the presence or absence is the objective. Examples of this type of monitoring are the Breeding Bird Survey, pellet group surveys for white-tailed deer, moose aerial inventory and many forms of forest inventory (i.e., the repeated measurements of the forest inventory and assessment plots by the U.S. Forest Service and the DNR state forest inventory process).

3. **Implementation or Compliance Monitoring:** Essentially, compliance monitoring is the collection of data and/or information to determine if we 'did what we said we would do' in our plan of action or our project/program design. Auditing is the most common example of compliance monitoring. Law enforcement is also compliance monitoring.
4. **Effectiveness Monitoring:** Effectiveness monitoring is the collection of data to determine if what we did had the desired/intended effect. It measures progress towards an objective or target, such as a desired future condition. Effectiveness monitoring investigates or evaluates the relationships between cause and effect and is guided by a specific monitoring question or a series of monitoring questions. It should only be used where a management decision can be influenced.
5. **Validation Monitoring:** Validation monitoring is largely confined to the realm of research and is used to validate or verify the assumptions and causal pathways underlying a conceptual model of how a system works. This is the most expensive and rigorous form of 'monitoring' and is usually done on the limited scale of research projects.

There are two other activities that are integrally associated with monitoring and reporting that should also be discussed: assessment and adaptive management.

Assessment is the data analysis component of each of the various types of monitoring and results in conclusions and recommendations that are usually provided as part of a report documenting the rationale for the project or program, the data collection activity and the data analysis.

Walters (1997) defined adaptive management as a structured process of 'learning by doing' that involves more than simply seeking better ecological monitoring and responding to unexpected management impacts. Adaptive management should begin with a concerted effort to integrate existing interdisciplinary experiences and scientific information into dynamic models that attempt to make predictions about the impacts of alternative policies. Adaptive management is a rigorous systematic approach rather than a random trial-and-error process and it must be designed into the implementation rather than applied retroactively. Inherent to the philosophy of adaptive management is the idea that it is also acceptable to fail, as this can and will contribute to the associated learning process.

Monitoring Directives

Monitoring of plan implementation results from a number of drivers and is an integral component of a responsible management program based on the principles of ecosystem management.

Monitoring, assessment and reporting requirements include the following:

- The DNR budget process
- Special purpose funding such as federal grants
- Compartment review process
- Timber sale preparation and inspection process
- Forest Regeneration Surveying
- Resource Damage Reporting
- Forest Health Monitoring Program
- Wildfire Detection
- Sustainable Forestry Initiative Certification Protocol
- Forest Stewardship Council Certification Protocol
- Public reporting – as required by the certification standards.

Monitoring, assessment and reporting are done at a variety of scales including the state, ecoregion, management area, compartment and project. Data and information are collected and assessed to:

- Identify current conditions or status of forest timber and non-timber values;
- Determine progress towards future forest conditions as described by management goals and objectives; and
- Determine the social, economic and ecological effects of management activities.

A discussion of each of the drivers that will be considered in the development of a monitoring plan is provided below.

The DNR budget process requires fiscal reporting on an annual basis as part of sound fiscal management. Similarly, special purpose funding agents (such as the federal government) require reporting to ensure that special funding was spent responsibly on the intended purpose.

Monitoring data are essential for an objective and accurate assessment of the condition of the state forest and for subsequent implementation of forest treatment prescriptions through the timber sale process and forest regeneration surveys. The annual inventory cycle is accomplished through the compartment review process, and begins with a pre-

inventory meeting at which time results of monitoring, policies and procedures, forest health concerns, wildlife habitat concerns, management area analyses and a review of the management direction from Section 4 are assessed for the compartments in the next year-of-entry.

The compartment review process is a decentralized area-regulation approach to determining harvest levels. Approximately 10% of state forest lands (400,000 acres) are inventoried each year through compartment review, with about 60,000 acres being prescribed and prepared for commercial timber harvest as part of the annual plan of work. When each forest management unit finishes their inventory updates and all quality control checks are completed, the inventory for that forest management unit is combined with the inventories of other forest management units that have completed the process for that year. In this manner, a complete and updated statewide inventory is compiled for what is referred to as an 'entry year.' The timber sale preparation process collects additional volumetric data about current forest stands and the timber sale inspection process ensures that all sale specifications are met. After timber sales have been completed, forest regeneration surveys quantify both natural and artificial (planted) regeneration survival and composition for achievement of the specified management objective. As treatments (or natural disturbances) occur on the landscape, the stand-level inventory is updated to reflect the current condition. These rolling live inventory data constitute a complete and relatively accurate inventory of the state forest at any given time and provides the basis for all tactical and strategic planning efforts, including new analyses and work planning for the next entry year.

Forest health monitoring is conducted through a network of permanent plots and other means (such as aerial surveys and insect traps) and provides the basis for ongoing early detection/rapid response surveys for exotic invasive insects, diseases and plants statewide.

The fire program conducts regular aerial surveys during periods where the danger of wildfire establishment and spread is high, in order to enable quick detection and response to fire outbreaks in accordance with MCL 324.51502 and to minimize the loss of timber and other property values.

The Sustainable Forestry Initiative certification standard for monitoring is largely addressed through the management review system, as described below under Implementation or Compliance Monitoring.

The Forest Stewardship Council certification standard is more specific and detailed in its monitoring, assessment and reporting requirements. Forest Stewardship Council Principle 6 addresses environmental impact and requires forest management activities to conserve biodiversity, water resources, soils, unique and fragile ecosystems and landscapes, and by doing so to maintain ecological function and integrity. The principle requires credible scientific analysis of the best available data appropriate to the scale and management intensity. Potential short- and long-term impacts are to be documented and management approaches and prescriptions are developed and implemented. This plan documents the approaches for management of the state forest.

Forest Stewardship Council Principle 8 speaks more specifically to monitoring and assessment and is concerned with the design and implementation of a monitoring program based on a consistently implemented, comprehensive and replicable written monitoring protocol. The monitoring protocol must be consistent with the scale and intensity of management. Criterion 8.2 provides some minimum requirements related to the following categories:

1. Yield of all forest products harvested. This includes species, volumes, stocking, regeneration, stand and forest composition and structure and timber quality.
2. Growth rates, regeneration and condition of the forest. This includes calculation and documentation of the sustained yield harvest level for each management area and ecoregion as required by Forest Stewardship Council Criterion 5.6. Requirements for documenting the current condition of the forest are described in Forest Stewardship Council Criterion 7.1.c.
3. Composition and observed changes in flora and fauna. This requires data to assess the presence of habitat for rare, threatened and endangered species; common and rare plant communities; presence and abundance of invasive species; condition of protected areas; and high conservation value areas (also addresses Criterion 9.4 as well).
4. Environmental and social impacts of harvesting and other operations. This requires monitoring to ensure site specific plans and operations are properly implemented, environmental impacts of site disturbing operations are minimized and that harvesting prescriptions and guidelines are effective.
5. Cost, productivity and efficiency of forest management. This requires accounting of costs and revenues in order to assess productivity and efficiency.

Forest Stewardship Council Criterion 8.4 requires that the results of monitoring be incorporated into the implementation and revision of the plan and Forest Stewardship Council Criterion 8.5 requires a publically available report summarizing the results of monitoring.

Forest Stewardship Council Principle 9 addresses the maintenance of high conservation value areas and requires an assessment to determine the presence of high conservation value attributes and annual monitoring shall be conducted to assess the effectiveness of measures used to maintain or enhance the conservation value attributes. Although not required by the Forest Stewardship Council principle, ecological reference areas have the same monitoring and assessment requirement per DNR policy.

Resource damage reporting system is required by forest certification standards and is used to report, track and prioritize areas of the state forest which are in non-conformance with soil and water quality best management practices on forest land.

Specific components of DNR's monitoring program for state forest land is described in the following sections.

Baseline Monitoring - Inventory

The DNR state forest inventory database is housed in a GIS-based geographic decision support environment. The Geographic Decision Support Environment contains a variety of baseline data layers that describe important attributes, associated infrastructure, and values known to exist on the forested landscape of the state forest. There are several large inventory and assessment projects that will contribute to the Geographic Decision Support Environment during the 10-year period of this plan.

1. Assessment, selection and approval of a comprehensive network of ecological reference areas for all natural community types, which will provide an opportunity for stewardship for a significant portion of Michigan's native biodiversity.
2. Inventory, assessment and validation of possible Type 1 and Type 2 old growth areas in the state forest, with an objective to identified all such areas by the end of the 10-year planning period.
3. Assessment and validation of a statewide set of deer wintering complexes, which will replace old maps developed between 1977-78 and 2000-2005.
4. Continuous addition and refinement of various Geographic Decision Support Environment baseline data layers, including the incomplete roads layer. The initial objective is to develop a baseline roads layer that can subsequently be maintained through annual deletions and additions.

Baseline Monitoring - Surveillance

There are a number of surveillance programs that contribute to the management of the state forest land. The DNR data collected as a result of these programs is housed in the Integrated Forest Monitoring Assessment and Prescription system database. The Integrated Forest Monitoring Assessment and Prescription system allows for the integration of inventory data from various efforts to allow for a multi-scaled inventory. Integrated Forest Monitoring Assessment and Prescription system is also a geographic decision support environment that allows for the development of customized tools for data entry, access and analysis. The U.S. Forest Service collects forest data from permanent inventory plots (forest inventory and assessment) and maintains these data in a database that DNR can access. Maintenance of these databases and development of specialized tools will allow for periodic assessment and comparison with criteria for success that will be identified in the monitoring plan. These surveillance and assessment programs include:

1. The DNR Compartment Review Process. The DNR uses a continuous and systematic inventory protocol for the Michigan state forest known as Integrated Forest Monitoring, Assessment and Prescription, which is integrated with the Geographic Decision Support Environment. The compartment review process uses Integrated Forest Monitoring Assessment and Prescription system to collect inventory data and prescribe treatments, for both timber and non-timber forest values on state forest land. The compartment review process systematically collects inventory data on ten percent of the forest each year to provide a picture of the current condition of forest stands within any compartment. Inventory data that is collected includes canopy and sub-canopy tree species composition, age, stand structure and basal area data for stands that are managed by stocking density (northern hardwoods, red and white pine and oak). See Appendix C for a more detailed look at the type of data collected to describe forest cover types. The vegetative management system (which is replacing the older TSALE system), in combination with the Treatment Tracking Module of the Integrated Forest Monitoring Assessment and Prescription system, tracks vegetative changes in land cover brought about by timber sales. Data providing estimates of volume (cords) are collected during timber sale preparation for stands that are prescribed for harvest treatments. Inventory data for non-forested habitat types include management status and priority objectives (such

as regeneration on previously forested sites or maintaining open conditions). Some of these data are shown in Table 5.1. The inventory data are then used with other values to determine potential management prescriptions intended to move the cover type towards the desired future condition; assess the biological, social and economic impacts of proposed management activities; and to make subsequent management decisions. Tracking these data over time will help inform those management decisions when compared to the objectives.

2. U.S. Forest Service Forest Inventory and Assessment Program. The U.S. Forest Service maintains a national permanent sample plot network on forest land. These plots are re-measured on a periodic basis to a rigorous and consistent measurement protocol to provide a continuous statewide assessment of cover type acreage, growth and removals through harvesting and natural mortality. Some of these metrics are shown in Table 5.2. The data can be stratified by Integrated Forest Monitoring Assessment and Prescription system forested cover types and are often used in statewide analyses across all ownerships. Some forest inventory and assessment data are also used to supplement DNR inventory data. This information is of particular importance to growth and yield calculations and determination of sustained harvest levels by cover type. This information also provides critical data for assessment of forest structure (Table 5.1) and carbon sequestration. An assessment of the state's forest-based economy is also conducted.
3. Forest Health Monitoring Program. The forest health monitoring program survey protocol, designed in partnership with the US Forest Service, co-operating state agencies and universities, uses the forest inventory and assessment plot network as the basis for ongoing statewide early detection/rapid response surveys for exotic invasive insects, diseases and plants. Periodic aerial surveys are also conducted to detect outbreaks of forest pests and diseases of highest concern. Data collected as part of these forest health monitoring activities are used to conduct resource risk assessments and to feed a decision-support tool in Integrated Forest Management Monitoring Assessment and Prescription Geographic Decision Support Environment. Timely detection and response of these potentially damaging agents can minimize economic and ecological impacts and reduce the need for costly suppression activities. Data associated with this activity are also shown in Table 5.2.
4. Management Area Analyses. A baseline analysis related to the age-class or basal area distribution and maximum sustained yield calculations by cover type is provided in Section 4 of this plan for each management area on the state forest. These analyses provide the basis for determining annual treatments and contribute to the discussion of desired future condition. Updated management area analyses are conducted at the start of each year's inventory cycle, and are based upon an annually updated inventory database that incorporates changes resulting from field inventory and prescribed treatments in the previous year. This information is used in the compartment review process to help focus treatments toward achieving the desired future conditions.
5. Wildlife Surveillance Programs: Surveys of abundance of game, non-game, common and rare wildlife species are carried out on an annual or periodic basis. These surveys include surveys for many mammal, bird and amphibian species to determine population trends.
6. Fisheries Surveillance Programs: Periodic surveys and assessments are carried out in lacustrine and riverine habitats and include surveys of fish, macro-invertebrates and water quality.
7. Recreation Surveillance Programs: Use trends for state forest land are assessed for camping, off-road vehicle use and snowmobile recreation use through registration and trail permit data. State forest recreation use and revenue trends are reported to the Michigan Legislature and Natural Resource Commission on an annual basis.

Table 5.1. Potential sub-elements, indicators and metrics for monitoring state forest land in Michigan.

Sub-Element	Indicator	Metrics
Description of Forest Ecosystems	Floodplain Forest	Area, patch sizes, age-class distribution, stocking by component forest type by ecozone.
	Hardwood-Conifer Forest	Area, patch sizes, age-class distribution, stocking by component forest type by ecozone.
	Northern Hardwood Swamp	Area, patch sizes, age-class distribution, stocking by component forest type by ecozone.
	Poor Conifer Swamp	Area, patch sizes, age-class distribution, stocking by component forest type by ecozone.
	Rich Conifer Swamp	Area, patch sizes, age-class distribution, stocking by component forest type by ecozone.
	Boreal Forest	Area, patch sizes, age-class distribution, stocking by component forest type by ecozone.
	Dry Northern Forest	Area, patch sizes, age-class distribution, stocking by component forest type by ecozone.
	Dry-Mesic Northern Forest	Area, patch sizes, age-class distribution, stocking by component forest type by ecozone.
	Mesic Northern Forest	Area, patch sizes, age-class distribution, stocking by component forest type by ecozone.
Description of Non-Forest Ecosystems	Bog	Area by type by ecozone
	Fen	Area by type by ecozone
	Marsh	Area by type by ecozone
	Prairie	Area by type by ecozone
	Savanna	Area by type by ecozone
	Upland Shrub	Area by type by ecozone
	Lowland Shrub	Area by type by ecozone
	Primary Substratum	Area by type by ecozone
	Ecosystem Landscape Parameters	Fragmentation
Patch Size		Area by age class by cover type by ecozone
Juxtaposition		Actual metrics to be determined
Successional Stage		Area by successional stage by cover type by ecozone
Stand Structure		Metrics by cover type related to tree size, snags, coarse woody debris, large living trees, canopy closure and canopy layers, shrubs, and herbaceous layers.
GAP Land Protection Status	Floodplain Forest	Protected area by designation, ecozone and ownership
	Hardwood-Conifer Forest	Protected area by designation, ecozone and ownership
	Northern Hardwood Swamp	Protected area by designation, ecozone and ownership
	Poor Conifer Swamp	Protected area by designation, ecozone and ownership
	Rich Conifer Swamp	Protected area by designation, ecozone and ownership
	Boreal Forest	Protected area by designation, ecozone and ownership
	Dry Northern Forest	Protected area by designation, ecozone and ownership
	Dry-Mesic Northern Forest	Protected area by designation, ecozone and ownership
	Mesic Northern Forest	Protected area by designation, ecozone and ownership
	Bog	Protected area by designation, ecozone and ownership
	Fen	Protected area by designation, ecozone and ownership
	Marsh	Protected area by designation, ecozone and ownership
	Prairie	Protected area by designation, ecozone and ownership
Savanna	Protected area by designation, ecozone and ownership	
Provenance of Planted Forest Stock	Trees - Oak	Seed source
	Trees - Beech	Seed source
	Trees - Red Pine	Seed source
	Trees - White Pine	Seed source
	Trees - Jack Pine	Seed source
	Trees - Hemlock	Seed source
	Trees - Other	Seed source

Table 5.2. Additional elements, sub-elements, indicators and metrics for monitoring state forest land using forest inventory and assessment data from the U.S. Forest Service plots.

Critical Element	Sub-Element	Indicators	Metrics
Regeneration	Free-To-Grow Status	Regenerating Area	Area of regeneration by forest type
		Herbivory	Area of regeneration by type kept from free-to-grow status by mammalian herbivory
		Insects	Area of regeneration by type kept from free-to-grow status by insect type
		Disease	Area of regeneration by type kept from free-to-grow status by disease type
		Drought	Area of regeneration by type kept from free-to-grow status by drought conditions
Resilience	Growth Rates	Net Annual Growth	Growth rates by forest type
		Insects	Area of forest by type with altered growth rate caused by insects
		Disease	Area of forest by type with altered growth rate caused by disease
		Drought	Area of forest by type with altered growth rate caused by drought
		Ozone	Area of forest by type with altered growth rate caused by ozone
		Pollution	Area of forest by type with altered growth rate caused by pollution
		Partial Harvesting	Area of forest by type with altered growth rate caused by partial harvest/salvaged
		Area of Forest by Successional Stage	Area by type by successional stage
Biomass	Changes in Forest Area	Harvesting	Area by type by stand replacing harvest
		Fire	Area by type burned and/or salvaged
		Blow Down	Area by type blown down and/or salvaged
		Flooding	Area by type lost to flooding and/or salvaged
		Insects	Area by type killed/salvaged causing stand replacement
		Disease	Area by type killed/salvaged causing stand replacement
		Drought	Area by type killed/salvaged causing stand replacement
		Ozone	Area by type killed/salvaged causing stand replacement
		Pollution	Area by type killed/salvaged causing stand replacement
		Conversion to Non-Forest	Area converted to non-forest condition by type
		Area Returned to Forest (Free-To-Grow)	Area returned to productive forest by type - includes afforestation
		Biomass Estimation	Total biomass of vegetation

Implementation or Compliance Monitoring

The DNR conducts compliance monitoring through annual internal audits, annual forest certification surveillance and re-certification audits and a formal management review of audit results. Inspection for compliance with timber sale contract specifications are also conducted for (active) timber sales, which is further described below.

1. **Internal Forest Management Audits:** Internal audits are carried out on an annual basis on three or four forest management units; however, supplemental audits can be requested through the chain of command. The DNR Resource Bureau Management Team will designate which forest management units will be audited each year. Internal audits are conducted by a DNR lead auditor and an audit team of three members. Internal audits must record, evaluate and report non-conformances of field implementation with forest certification standards and related work instructions at all levels of the department.
2. **Annual Forest Certification Surveillance and Re-certification Audits:** These annual audits are carried out by independent third party auditors certified by the Forest Stewardship Council and the Sustainable Forestry Initiative to assess the conformance of DNR management operations with forest certification standards. The title of “surveillance audit” is a misnomer, as it is really compliance monitoring. Re-certification audits are conducted every third year for the Sustainable Forestry Initiative and every five years for the Forest Stewardship Council standards.
3. **Annual Field Management Review:** A review of the results of both internal audits and the annual forest certification surveillance audit are conducted by DNR program and field staff and evaluate field operations and DNR programs on a statewide basis.
4. **Timber Sale Preparation and Inspection Process:** The timber sale preparation process is driven by Forest Certification Work Instruction 7.1 – Timber Sale Preparation and Administration Procedures and other DNR policy and procedures, which requires use of a Timber Sale Proposal Checklist to ensure that the sale specifications match the forest inventory prescriptions. Inspections of active timber sales are conducted to ensure compliance with timber sale contract specifications. The process includes a pre-sale meeting, ongoing inspections during the period in which the sale is active and a final inspection once the sale is completed.
5. **Law Enforcement:** Department conservation officers conduct patrols of state owned lands ensuring compliance with applicable laws, rules and orders, as well as contractual obligations. Conservation Officers carry out their compliance work with clearly identified priorities. These priority areas are supplemented based on the identification of potential violations referred to Law Division by other department employees for investigation. The mere presence of conservation officers provides an immeasurable component to regulatory compliance.

Effectiveness Monitoring

Effectiveness monitoring is carried out in a number of different areas of forest management and is described below. Each of these subject areas will become an integral component of the monitoring plan.

1. **Management Area Analysis:** Annually updated forest cover type inventory data for each management area is used in the compartment review process to assess progress towards achieving desired future conditions for forest cover types. This information can also be used to generate an annual data summary for each management area. Information that will be useful for assessment and reporting include what is shown in Table 5.1. This is not a complete list, but it does represent best bets prior to the development of the monitoring plan. The list will undoubtedly expand.
2. **Forest Regeneration Surveys:** Forest regeneration surveys have long been an integral part of forest management activities and are required under Forest Certification Work Instruction 2.1 – Reforestation. These surveys quantify both natural and artificial (planted) regeneration survival and composition for achievement of the specified management objective within the requirements required by the Sustainable Forestry Initiative certification standard. Artificially regenerated stands (planted or directly seeded) are surveyed and assessed at one, three and five years (if needed) post-treatment. These surveys follow procedures listed in the Forest Regeneration Survey Manual (IC 4145, June 2009). Forest health surveys in planted stands are simultaneously conducted. The resulting data are recorded in District-level databases. There is an initiative underway to record all forest treatment proposals in a relational database that would include artificial regeneration and forest health plot data. Natural regeneration surveys are conducted and assessed against minimum standards for all stands using a separate inventory protocol (Appendix B of IC 4145). Natural regeneration survey results are documented in a spreadsheet maintained in each forest management unit. A central database for managing these data does not exist and is desirable in order to provide an enhanced linkage to their associated treatments.
3. **Resource Damage Reports:** These reports document, track and prioritize areas of the state forest that are in non-conformance with best management practices.
4. **Pesticide Use Evaluation Report:** These reports provide the basis for a means of assessing how effective the chemical treatment was in obtaining the desired results in the application area.

5. High Conservation Value Areas: Forest Stewardship Council Criterion 9.4 requires annual monitoring to assess the effectiveness of the measures used to maintain or enhance the applicable conservation attributes. All high conservation value areas do not require the same intensity of monitoring and those that are not actively managed or which are inherently stable and relatively resistant to short-term perturbations are monitored once per decade. Those that are actively managed or more susceptible to degradation from causal agents are monitored on a more frequent basis by site-specific high conservation value area assessments. The monitoring and assessment of the quality of ecological reference areas is currently accomplished under contract with staff from the Michigan Natural Features Inventory.

Validation Monitoring

Validation monitoring is not carried out directly by the Forest Resources Division. However, these needs are partially met through partnerships with universities and other public entities that carry out research needed to help validate causal relationships for subjects of interest to the DNR forest management program. Development of an effectiveness monitoring plan will allow for increased relevance of externally produced science and enable more timely integration into DNR management programs.

Research projects that have been or are currently supported by the DNR through Partners in Ecosystem Resource Management with Michigan State University include:

1. Deer and Sedge Impacts on Forested Community Vegetation Dynamics.
2. Forest Dynamics Following Ash and Beech Mortality.
3. Forest Productivity, Site Index, and Habitat Classification.
4. Importance of Coarse Wood for Seedling Establishment.
5. Does Low Seed Limit Regeneration in Northern Hardwood Stands?
6. Adapting Management of Northern Hardwoods in Response to Climate Variability and Related Threats to Sustainability of Multiple Forest Values.

The DNR is also a partner with the Great Lakes Forest Alliance and the U.S. Forest Service Northern Research Station in the Northwoods Climate Change Response Framework project.

Assessment and Reporting

The DNR has established a systematic process of gathering information regarding the state forest and forest management practices as described above. Assessment of the data and reporting on the findings is a key component of improving management of the state forest. The basic reports that are produced on a regular basis are described below. The monitoring plan will refine and add to this list of reports. The monitoring plan will also address the criteria for success associated with management objectives reflected in the monitoring plan.

1. Internal Audit Report (Implementation Monitoring): Internal audit reports are produced by the lead auditor and any non-conformances and/or opportunities for improvement are clearly identified. DNR staffs are responsible for implementing the corrective actions and reporting on pending or continuing non-conformance at the annual management review (see below).
2. Annual Forest Certification Audit Reports (Implementation Monitoring): These annual reports are prepared and submitted by independent auditors. They summarize the results of annual forest certification surveillance audits and assesses conformance with the Forest Stewardship Council and Sustainable Forestry Initiative forest certification standards. The reports include major and/or minor corrective action requests and opportunities for improvements that will need to be addressed by the state.
3. Field Management Review (Implementation Monitoring): This review is summarized in a report entitled 'Annual Report on Compliance with Forest Certification Standards.' The report addresses conformance with the forest certification standards and recommendations for improvement. The report also specifies the actions needed to address audit results and non-conformance issues and reports other significant findings. The final report is submitted to the DNR Resource Bureau Management Team through the Forest Certification Team.
4. Timber Sale Reports (Implementation Monitoring): The TSALE and vegetation management system databases are used to prepare quarterly and annual reports required by annual appropriation legislation and Part 525, Sustainable Forestry on State Forestlands, of the Natural Resources and Environmental Protection Act, 1994 PA 41, as amended.
5. Timber Harvest Trends Report (Baseline Monitoring): This report describes the level of available timber sale acres from the state forest and the factors that influence this level of availability. Unless there is a compelling reason to update the numbers, this report is produced every five years.

6. Forest Inventory and Assessment Report for Michigan (Baseline Monitoring): The U.S. Forest Service analyses and reports on data from its permanent sample plot network in Michigan every five years. The most current report is entitled "Michigan's Forests 2009" which is available on the DNR website. The report assesses cover type growth, removals through harvesting and natural mortality and an assessment of the state's forest based economy.
7. Annual Data Summary Report (Baseline Monitoring): As directed by Forest Stewardship Council Criterion 8.5, the most recent monitoring information is made available to the public on the DNR website. This report will be the annual data summary for each management area by ecoregion (there will be three reports).

Currently there is no effectiveness monitoring report. However, this report will be required by the monitoring plan with a periodicity set at five and/or ten-year intervals.

Validation monitoring is currently reported by project and has little if any impact on management in the short-term. This situation will be greatly improved with the development and implementation of an effectiveness monitoring plan.

Review and Revision of the Regional State Forest Management Plan

Management processes need to be adjusted or changed when results of implementation and effectiveness monitoring indicate that the management direction or desired future conditions are no longer valid or have been reached for a specific ecological, social or economic value. Required changes in management processes shall be incorporated into the revision and implementation of subsequent revisions of statewide and regional state forest management plans.

When monitoring suggests the need for a change in one or more objectives or a change in the way management is implemented, a revision to the appropriate sections of the statewide plan and/or the regional state forest management plans will be initiated. Depending upon the ramifications of the proposed change, a public review of the appropriate sections may be initiated and notifications will be sent out as appropriate. Changes that are really refinements in the process based on new data will be considered as normal business and adjustments will be made without public review.

As a normal part of doing business, the regional state forest management plans will be reviewed, revised or updated on a ten-year cycle. Plan revision will be initiated by the DNR and the public will be engaged in the revision process as they were in the development of these plans.

There are known deficiencies in the regional state forest management plans where data or other information for some uses and values which should or are desired to be included in the plans, but for various reasons (such as incomplete data sets or lack of other information or incompatible timelines for data acquisition) are excluded from the plan content until such time that they are available for inclusion. These gaps will need to be addressed by Forest Resources and Wildlife division staffs in the future revisions to the plans and include:

- A scientifically-based, deliberate and quantifiable vision of the forest type composition of the future state forest (next 30 years), incorporating data and accounting for probable social, economic and ecological trends and impacts related to climate change over the next century.
- Completion of a landscape level analysis of forested land in Michigan (state, ecoregion and management areas) for use in determining the contributions being made by non-state forest land and helping to inform the definition of the desired future conditions and related management objectives on state forest lands for cover type and wildlife habitat;
- Identification and incorporation of areas (ecological reference areas) that fully meet the Forest Stewardship Council and Sustainable Forestry Initiative certification standard requirements of the conservation of biodiversity and rare natural community types;
- Incorporation of obligate and conditional deer winter ranges into the plan based on the newly approved management guidelines – approval came too late to incorporate into this version of the plan;
- More comprehensive identification and incorporation of high threat invasive plant species;
- Completion of the conversion to the Integrated Forest Monitoring Assessment and Prescription inventory system and integration of subsequent inventory assessments into the management area objectives;
- Analysis of complete inventory site condition data to quantify "manageable acres" and to enable better estimations of allowable harvest and to more accurately evaluate opportunities for harvest prescriptions in lowland forest and conifer cover types;
- Develop a better understanding of the implications of climate change on forest associated values and how we can revise our management and monitoring systems to better account for anticipated changes including cover type-specific and wildlife habitat specific adaptive management strategies and approaches;

- Development and integration of wildlife habitat objectives into management area direction;
- Expand implementation monitoring (compliance) to include assessments of the implementation of wildlife habitat prescriptions; and
- Development of robust, effective and practical protocols (monitoring plan) for baseline monitoring (inventory and surveillance), effectiveness monitoring, validation monitoring and assessment and reporting that address the criteria and indicators of forest sustainability, including wildlife habitat.