6. Annual growth and removals of forest products

6.1 Net growth and removals

This indicator compares net growth with wood harvest (removals) for products on timberland. This is a frequently-used method of assessing whether or not wood harvesting is reducing the total volume of trees on forest available for wood production. Net growth is defined as the net annual increase in the volume of growing stock between FIA inventories after accounting for effects of mortality, but before accounting for the effects of harvest. Removals are a measure of the average annual volume of growing stock trees harvested between inventories. Timberland is assumed to be the subset of forest land on which some level of wood harvesting is potentially allowed. So long as growth (net of mortality) exceeds removals, the volume of trees on timberland is considered sustainable. This measure, however, conveys no information about quality, biodiversity, other attributes of ecology, or management objectives, and so it should be considered in conjunction with other indicators.

Net growth exceeded removals by 30% or more on Wisconsin timberlands from 1983 to 2007, and the area of timberland increased. The result has been a substantial increase in the volume of growing stock on Wisconsin timberlands. A removals to net growth ratio of 100% means that removals are equal to net growth. A removals to net growth ratio over 100% indicates that more wood volume is being removed each year than grows in to replace it. Conversely, a removals to net growth ratio less than 100% indicates that more wood volume is growing in to the forest than is being removed. The removals/net growth ratio increased from 48% to 59% between 1983 and 2007. Between 1996 and 2007, net annual growth increased by 102 million cubic feet, while annual removals increased by only 17 million cubic feet (Figure 6.a).

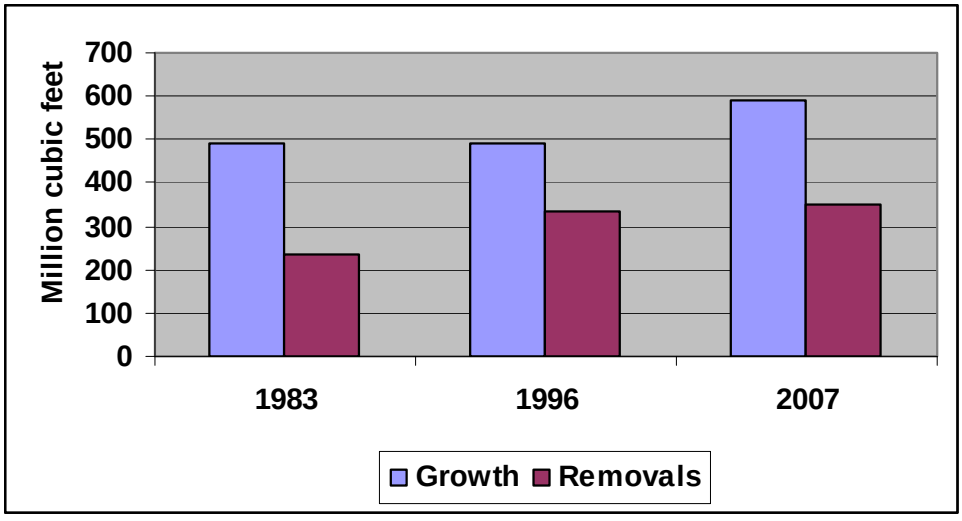

Figure 6.a: Net annual growth and removals of growing stock on timberland in Wisconsin
Source: FIA, 2007

Five of the 55 commercial species in Wisconsin have a removals/net growth ratio higher than 100% and also showed a significant decline in growing stock volume between 1996 and 2007 at

the 68% confidence level. Softwood species included in this group are jack pine and balsam fir. Hardwood species included paper birch, American beech, and balsam poplar.

Four of the five species (except American beech) also have higher mortality rates than the average for all species in Wisconsin. This effects net growth volume negatively since net growth equals gross (or total) growth minus mortality. American beech may actually have a higher than average mortality rate as well since the data showed zero mortality, which is obviously questionable. However, four of the five species (except balsam fir) have higher removals to gross growth ratios than the average so they do have high real removal rates as well as relative to mortality. Balsam fir has a very high (75%) mortality to gross growth ratio. It appears that as a result of high expected mortality among these species that the older and larger trees are being utilized to salvage the value of the timber before they pass from natural causes.

The jack pine trend is of particular concern. It was severely hit by jack pine bud worm (see Criterion 3, Indicator 7). As a result, a larger proportion of the jack pine forest type currently is in the youngest age class and smallest stand size class as it regenerates. This helps to explain some of the decline in growing stock volume but more importantly, over one-half of jack pine forest type acres have converted to other forest types since 1983 (see Criterion 1, Indicator 2).

Clearly, on a statewide basis, there is capacity to sustain, and in some cases increase, present levels of timber harvest from a purely wood volume standpoint at current growth, mortality and removals rates. However, there are many reasons why potential increase in harvests may not be achieved. The main reason is that the diverse objectives of the many different owners of Wisconsin's timberlands may not have the maximization of wood fiber production as their primary objective.

6.2. Type of removals

FIA defines average annual removals to include: (1) net growing-stock volume harvested or killed in logging, (2) cultural operations (such as timber stand improvement) or land clearing, and (3) the net growing-stock volume not harvested but growing on land that was reclassified from timberland to non-commercial forest land or non-forest land during the period between FIA inventories. This volume is divided by the number of growing seasons to produce average annual removals.

The smaller component of removals other than harvests is defined as "other removals." This includes the volume lost from the resource through land use change and conversion to a reserved status. Forest land that is cleared for roads, industrial expansion, home construction, and development of rights-of-way all contribute to other removals.

Removals for harvest accounted for 88% of all growing stock removals in Wisconsin in 2007. Removals due to land change accounted for 12% of all growing stock removals during the same time period (Figure 6.b). Other removals from past forest inventories are erratic and show no defined trend. Since 2005 the rate of other removals has been consistent. Other removals may affect future harvest volumes if the forest land base has been reduced. These losses to forest land could be short or long term depending on future land use changes.

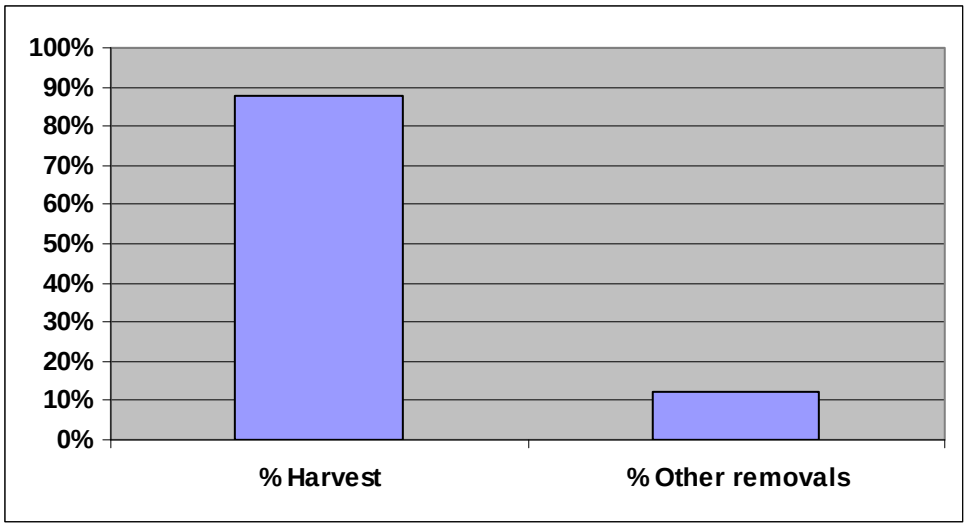

Figure 6.b: Type of growing stock removals on timberland in Wisconsin, 2007
(Sampling errors for harvest removals is 11% and for other removals 29%.)
Source: FIA, 2007

6.3. Total growing stock and tree grade of both merchantable timber and non-merchantable tree species on forest land available for timber production

Growing stock is a fundamental element in determining the productive capacity of the area identified as forest land available for wood production. Knowledge of growing stock and how it changes over time in both quantity and quality is central to considerations of a sustainable supply of wood for products. Growing stock is the volume, in cubic feet, of growing-stock trees 5.0 inches dbh and larger. Quality of growing stock is measured in grades 1, 2, 3 or greater than 3 with 1 being the best (see Glossary for complete description). Small diameter trees, called poletimber (conifers under 9-inch dbh and hardwoods under 11-inch dbh), are too small to be graded. Larger diameter trees, called sawtimber (conifers at least 9-inches dbh and hardwoods 11-inches dbh), can be graded.

Variability in the size and quality of trees has considerable bearing on their value in wood products. Generally speaking, about 89% of all live tree volume on timberland in Wisconsin is considered to be growing stock or wood capable of being used for traditional commercial products. The remaining 11% are trees of poor form, small stature, or otherwise unsuited for traditional wood products, but can be harvested for biomass or left in the forest for diverse structure and habitat. Given the minor influence of non-merchantable volume relative to total live volume of timber on forests available for wood production, the remainder of the discussion for this indicator will focus on merchantable or growing stock volume. As biomass/bio-energy markets develop, however, closer analysis of currently non-merchantable volume and net unutilized growth will be of greater future significance.

Overall, growing stock volume (Figure 6.c) increased in Wisconsin between 1983 and 2007. With a stable base of forest land available for timber production or timberland (Indicator 5.1) and a historic pattern of growth exceeding removals (Indicator 6.1), the volume of growing stock in Wisconsin has been rising steadily for more than 50 years. The current total of 20.5 billion cubic

feet of growing stock is 33% higher than the volume in 1983 (15.5 billion cubic feet). Hardwood volume totals about 75% of growing stock volume on Wisconsin timberland.

Growing stock volume has been changing in quality, overall tree size, and quantity. Poletimber volume (which is ungraded) declined from 1983 to 2007. Sawtimber volume increased in all tree grades from 1983 to 2007. The volume of higher grade trees (1 and 2) has increased at a slower rate since 1996 whereas grade 3 and poorer increased at a much faster rate since 1996 (Figure 6.c). Timber grading rules have remained the same from 1983 to the present.

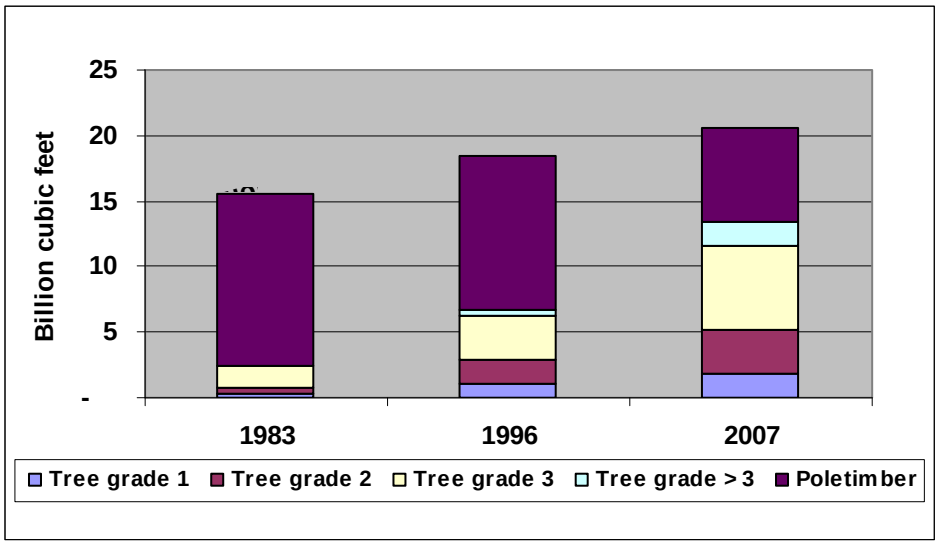

Figure 6.c: Volume of growing stock on timberland by tree grade, 1983-2007
Source: FIA, 2007

The highest growing stock volume species are sugar maple, red maple, northern red oak, red pine, and quaking aspen. All of these species but quaking aspen increased in growing stock volume between 1983 and 2007. Only quaking aspen declined during this period. Northern red oak volume did decline by 2% between 1996 and 2007, however. Thirty-four of the 72 counties in Wisconsin saw a decline in northern red oak growing stock volume from 1996 to 2007.

Four major commercial species have declined significantly in growing stock volume since 1983. These species include: jack pine (45% decline), paper birch (40% decline), balsam fir (27% decline) and quaking aspen (14% decline). All four declined from 1983 to 1996 and again from 1996 to 2007. Bigtooth aspen increased in volume between 1983 and 1996; however, it declined between 1996 and 2007 by 7%.

Two other lower volume commercial species declined significantly in growing stock volume between 1996 and 2007. Butternut and American beech declined by 50% and 34%, respectively.

Total growing stock volume has increased over the past 50 years and there is no reason to think this trend will not continue since net annual growth continues to exceed removals by a wide margin (Indicator 6.1). Although all grades of sawtimber have increased, lower quality sawtimber volume has increased at a faster rate than higher quality sawtimber. The larger rate of increase in the lower grade volume is likely due to three factors. First, the large volume of

poletimber that grew into sawtimber size class since 1983 is likely a large percentage of the current grade 3 and poorer. Intermediate and selection harvests in the new sawtimber stands could improve the quality of the residual sawtimber over time. Second, a higher percentage of sawtimber that could be graded at 1 or 2 is of lower quality than previous years. Third, there may be an increase in harvesting higher grade timber rather than lower grade. This is often called high-grading as these types of harvests leave low quality trees and only harvest the highest quality, and the problem merits research to determine the extent to which the practice is occurring. We would expect the total growing stock volume to keep growing even though demand increased in recent years, especially for high quality hardwood sawtimber.

Most of the more important commercial species also increased in growing stock volume over the past 25 years. The exceptions are generally early successional species that are generally replaced by more shade tolerant species or are converted to other species such as red pine. Species that are being replaced or converted include jack pine, paper birch, and quaking aspen that are maturing with high mortality rates (all over 2%) and are heavily utilized (over 100% removals to growth ratio). Balsam fir is not an early successional species but its mortality rate is over 4% and its removals to growth ratio is over 100%. As a result, these species are declining in Wisconsin's forests. The decline in butternut and American beech can be attributed to Butternut Canker mortality and removals to growth ratio over 200%, respectively. These trends are likely to continue.

Northern red oak is an exception to the high mortality rate with a recent decline in growing stock volume. This species had a mortality rate (0.7%) that is less than the 1% average rate for all species in the state. The highest significant northern red oak volume losses at the 68% confidence level were in Burnett, Washburn, Monroe and Jackson counties. Considering the lower than average mortality rate, it appears that the northern red oak decline in these counties is due to high harvest levels relative to the standing volume and/or low in-growth of young stock.

All oak species in Wisconsin, with the exception of northern pin oak (1.4%), have mortality rates that are equal to or less than the 1% average mortality rate for all species combined. All oak species except Northern red oak and swamp white oak increased in growing stock volume statewide between 1996 and 2007. Black oak, northern red oak and white oak had removals to net growth ratios higher than the average for all species (59%). The major oak species, other than Northern red oak, increased in volume and have a lower than average mortality rate on a statewide basis. While the oak species are generally doing well across the state, it does vary by county. This appears to indicate that oak harvest intensity is variable in different areas of the state. The last statewide forest assessment (2000) showed a trend of limited oak regeneration in southern Wisconsin due to aging forests with heavy selection harvests which increase the rate of succession to elm-ash-soft maple and maple-basswood types. Northern red oak is the primary oak species of concern in Wisconsin.

6.4. Annual removal of non-timber forest products (NTFP)

Non-timber forest products (NTFP) include medicinal plants, food and forage, floral and horticultural products, resins and oils, arts and crafts materials, and game animals (National Report 2010). The various types, uses, and growing locations of these products make tracking the amount of removal challenging. Many of these products do not have a commercial market,

but are of greatest importance to specific people for individual use. For instance, Native Americans harvest birch bark and medicinal plants for cultural traditions and applications. Many woodland owners state one of the reasons they own forest is for the enjoyment from non-timber forest products they harvest such as mushrooms, berries, and wild game. Some NTFPs have a commercial market; balsam and pine boughs, sphagnum moss, and princess pine (*Lycopodium*, or club moss, which is fairly common in northern hardwood forests) are typically harvested by the floral industry to use in products. NTFP reflect the biodiversity of forest ecosystems. Many species with commercial value can be culturally and ecologically sensitive.

As demand for these products grows, it becomes increasingly important to monitor the removal of products from forests, and the effects of their removal on the viability of current and future forest ecosystems. Active management for NTFPs on the other hand can potentially maintain ecosystem complexity and play an important role in restoring biodiversity and balance to damaged forests. Furthermore, extraction of a broader range of natural resources other than just timber products can lead to economic diversity and stability for rural forest communities and the state economy in general (IFCAE, 2009). Further research on the population biology, demographics, and eco-physiology of some of these non-timber forest products can provide needed data concerning the sustainability of harvest.

It is hard to state how the current level of NTFP harvesting is affecting forest ecosystems without more monitoring. Monitoring of harvested populations will also provide vital information that can direct future management decisions. Measuring harvest levels for a given NTFP can be difficult because, for the majority of products, there are no systems in place to track their removal rate. State and federal laws regulate the harvesting of some NTFP's (e.g. wild rice and ginseng), but because there is little monitoring, the result of the regulation is not know. The National Forest System is beginning to track the removal of more NTFPs and their data on princess pine is provided here. The National Forest System found that specifically for food and forage products, the number of permits increased across the country and the volume harvested grew even more (National Report, page 2-38).

The Great Lakes Indian Fish and Wildlife Commission (GLIFWC) has monitored removals by tribal members on National Forest land for almost the last two decades; the best long term data available in the state (Figure 6.d). GLIFWC assists tribal governments in the protection, preservation, conservation and prudent use and management of tribal fish, wildlife, and plant resources in the Great Lakes area. They have tracked and reported on a number of plant and animal species tribal members harvest off reservation. The off reservation permits for wild plants grew from 1,491 permits in 2000 to 2,063 in the 2007. Tribes can harvest over 300 plants but track the five most collected products (conifer boughs, princess pine, ginseng, birch bark, and firewood). GLFIWC, through its Tribal Commercial Gathering Permits, can gather data on the amount of harvest in specific areas and then respond to the condition of the resource through special regulation.

6. Annual growth and removals of forest products

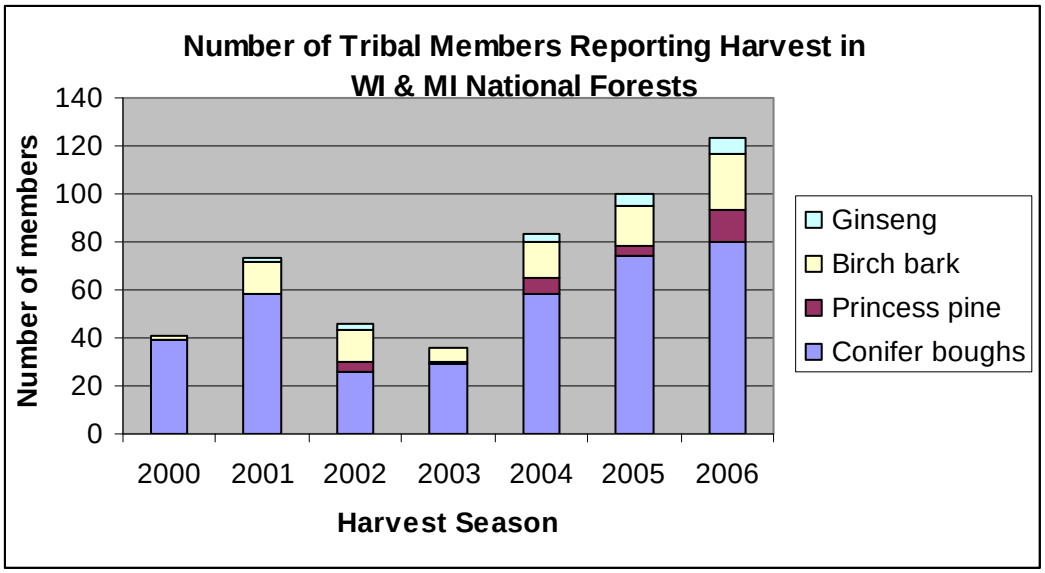

Figure 6.d: Number of tribal members reporting harvest in WI & MI national reports
Source: Danielsen, K. 2008. GLIFWC Administrative Report 08-10

Table 6.a: Amount of forest products harvested by tribal members on WI & MI National Forests

	2000	2001	2002	2003	2004	2005	2006
Conifer boughs (tons)	39	132	40	36	64	80.3	87.3
Princess pine (pounds)	0	0	265	13	263	338	463
Birch bark (trees)	2	24	145	45	148	173	287
Ginseng (pounds)	0	2	0.75	0	0.75	2.75	4

Source: Danielsen, K. 2008. GLIFWC Administrative Report 08-10

Tribal members are from the ten member tribes of the Great Lakes Indian Fish and Wildlife Commission (GLIFWC). These include: Bad River, Lac Courte Oreilles, Lac du Flambeau, Lac Vieux Desert, Mole Lake, Red Ciff, and St. Croix. Three tribes are not located in Wisconsin, (Bay Mills, Keweenaw Bay, Mille Lacs) but are included in the data presented.

This indicator measures harvest levels of non-wood forest products where data exists, when known, describes trends in specific product removals, and discusses efforts to track removals in the future. Even with this monitoring, we still lack the ability to determine the level of harvest that could be considered sustainable. A discussion on the value of these products is in Criterion 6, Indicator 13.5.

Data for NTFPs typically exists for commercial products and those that are harvested by permit on national and state forests. Often, county and state forests issue free permits for harvesting NTFPs; because there is no charge for these, the current data collection system does not include free sales. Currently, there is no way to track harvesting of NTFP on privately owned land unless the product is sold. Christmas trees are occasionally considered NTFPs. In Wisconsin, Christmas

tree farms are regulated by the Department of Trade, Consumer Protection and Agriculture. The federal economic census categorizes Christmas tree farms as crop production (US Census, 2009). The major NTFPs of commercial value in Wisconsin are maple syrup, balsam boughs, moss, princess pine, and ginseng. Culturally and ecologically important non-commercial species are mushrooms, birch bark, and berries. Figure 6.e shows the volume of three tree species that provide valuable NTFPs. The decline of paper birch and balsam fir is of concern.

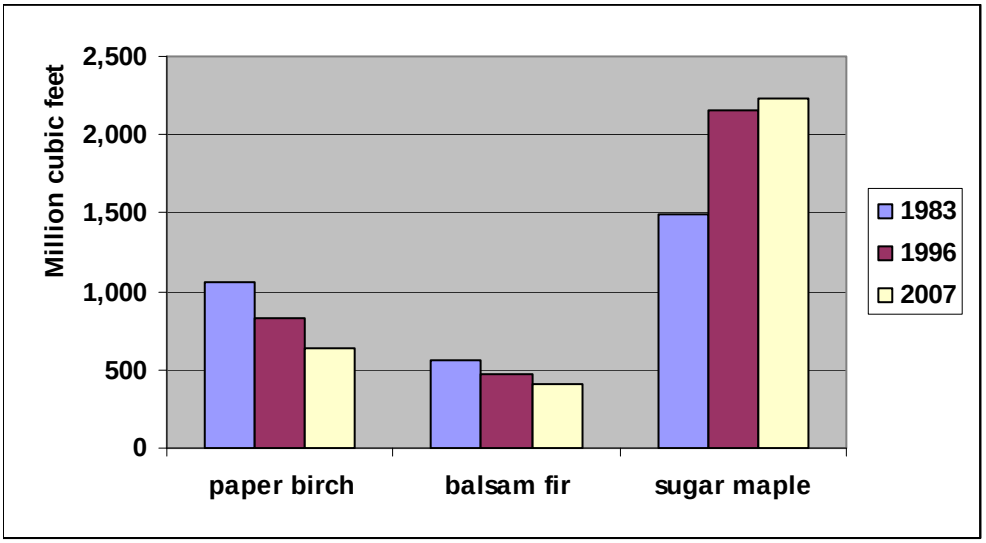

Figure 6.e: Paper birch, balsam fir, and sugar maple cubic feet 1983, 1996, 2007
Source: FIA, 2007

Maple Syrup

Wisconsin's maple syrup production, jumped from 75,000 gallons in 2007 to 130,000 gallons in 2008, an increase of 73% Figure 6.f). Sugar content of the sap decreased, requiring 37 gallons of sap to produce one gallon of maple syrup. In 2007 and 2008, Wisconsin was one of the top five producers of maple syrup in the nation (USDA, NASS, 2008).

Boughs

Balsam and pine boughs are harvested mainly for use in decorations during the winter holidays. The general public or companies can purchase a permit to harvest boughs on county, state, and national forests. On county and state forests, 50 units (a tree sheared for balsam boughs) were purchased by permit in 2007-2008 (DNR, 2009). On National Forests, boughs may be collected with a permit. In 2008, a total of 147 permits were sold for 269 tons of boughs (CNNF, 2009). To understand the magnitude of harvesting in Wisconsin without a complete dataset, it is useful to compare with Minnesota which may be similar. They estimate their bough industry at greater than $20 million per year (http://www.extension.umn.edu/specializations/environment/ntfp.html).

Birch Bark

There were no recorded birch bark sales on county and state lands in 2007 (DNR, 2009). FIA has begun collecting data on birch bark in several northeastern area states. The first report should be available in a few years and will provide the best data to date on the amount of birch bark harvested across the state. GLIFWC tribal members are harvesting more birch bark in the Great

Lakes region; only two trees were reported harvested in the 2000 season compared with 287 in the 2006 season.

Aspen-birch represents about 20% of all forest land in the state. Total acreage has slowly and steadily declined since the 1980's (see Criterion 1, Indicator 2). It is uncertain whether this decline is of concern because the demand for harvesting birch bark statewide is unknown. If harvests are very small, this may not be a current issue but one to investigate further. Harvesting birch bark requires medium to large diameter trees. Even though the cover type is in decline, a greater percentage of trees have moved into the medium and large diameter size classes.

Moss

Sheet moss and sphagnum moss may be harvested by permit on county, state, and national forest. In the last decade, there have been very few harvests on state property.

Princess Pine

Sheet moss and princess pine (*Lycopodium* spp.) are gathered by Native Americans, hobbyists or to be sold commercially. From a 1995 study, approximately 170,500 pounds per year of princess pine (85.25 tons) were collected annually from just two buyers in Wisconsin and the Upper Peninsula of Michigan (Matula, 1995). Ground pines are considered to be a mid-seral species, occurring in forest stands 10 to 30 years in age and will decline in very old stands. In general, if temperatures become warmer and the forest becomes drier, these species would be expected to decrease (http://www.extension.umn.edu/specializations/environment/components/lycopodium1.html).

Princess pine is monitored on national forests. An individual is allowed to harvest up to 400 lbs. of either princess pine or sheet moss per year and a fee is charged based upon the amount they wish to collect. Starting in 2007, permit holders were given information about princess pine and sheet moss. This included a species identification guide for princess pine, harvesting guidelines, and a voluntary harvest survey to be filled out and mailed back to the Chequamegon-Nicolet National Forest (CNNF). The survey collects information on gathering locations, quantity harvested, and number of harvesting trips made. The information collected from permit holders will allow managers to better understand the pressure harvesting has upon the resource, and enable sustainable management. New requirements for gathering sheet moss and princess pine on the CNNF took effect January 1, 2008. Permittees will now be required to return monitoring forms before receiving another permit.

Table 6.b: Amount (lbs.) of special forest products permitted for harvest on the CNNF from 2004-2007

Year	Sheet Moss (lbs.)	Princess Pine (lbs.)
2004	5,500	600
2005	4,900	200
2006	6,100	400
2007	4,800	504

Source: CNNF, 2009

The number of sheet moss collection permits issued from 2004-2007 have allowed an annual average harvest of up to 5,200 lbs. of sheet moss forest wide (Table 6.b). Not all permittees were likely to maximize their harvest, so the actual harvest could be lower. With the new monitoring methods, the harvest data will be more accurate.

The number of princess pine permits issued (and the amount harvested) each year varied considerably (Table 6.b). GLIFWC member tribes' harvest greatly increased over the last several years although the total amount of all tribal members is a small proportion of what is allowed for harvest on the CNNF. The amount harvested and the locations of the harvest will continue to be monitored to determine if the forest can sustain the desire for princess pine.

Ginseng *(Panax quinquefolius)*

Ginseng is probably the best known example of a NTFP population that changed as a result of harvesting. Recognizing that commercial demands may cause over harvesting of ginseng, Wisconsin law regulates the harvest, sale, and purchase of wild ginseng in the state. In order to promote the most sustainable harvesting practices, international trade agreements permit U.S. export of wild ginseng only from those states that can annually show that harvest and export are not harming the wild ginseng resource (see s. 29.611Wisconsin Statutes and Administrative Rules and chapter 28).

Mineral Collection

The Chequamegon-Nicolet National Forest authorizes recreational mineral collecting, such as panning for gold or rock collecting, without the need for a permit. Gold panning is only allowed with the use of small hand tools (pan, small shovel, and hand pick). Occasional recreation panning for an individual or group is limited to extremely small areas of stream disturbance: A few scattered areas of less than 1 square foot and totaling less than 40 square feet within a 500 foot segment of a stream and that occur less than 5 days per year. Gold panning is not permitted in classified trout water before April 15th and after September 15th. You must also avoid disturbing fish spawning nests. The Wisconsin Department of Natural Resources has the responsibility and jurisdiction concerning water quality. Because this is not a permitted activity, the CNNF maintains no formal data regarding recreational mineral collection.