The Cultural Importance, Ecology, and Status of Giizhik (Northern White Cedar) in the Ceded Territories

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Administrative Report 02-06
April 2002

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Giizhik - Ojibwemowin
Northern White Cedar, Eastern White Cedar, Arborvitae, Swamp Cedar - English
Thuja occidentalis L. - Scientific Latin

Introduction

Respected for its sacred qualities, giizhik (northern white cedar, *Thuja occidentalis*) plays a meaningful role in the Anishinaabe[1] spiritual and material world. Giizhik misan (wood), nagek (bark), waatigwaanan (boughs), and aniibiishan (leaves) all impart significant contributions to the Anishinaabe lifeway. They provide needed medicines, ceremonial articles, food, and utility items (Joseph J. Chosa, traditional ecological knowledge interview (TEK int.), 2002; Art Tainter, TEK int., 2002).

Many Anishinaabeg gather giizhik both on and off their reservation lands. These tribal members retain rights to hunt, fish, and gather on lands their ancestors ceded to the United States government in the Treaties of 1836, 1837, 1842, and 1854. To assist with the protection and implementation of these treaty rights, some of the treaty signatory tribes together established the Great Lakes Indian Fish and Wildlife Commission (GLIFWC). Member tribes currently include the Bay Mills Community, Bad River Band, Fond du Lac Band, Keweenaw Bay Community, Lac Courte Oreilles Band, Lac du Flambeau Band, Lac Vieux Desert Band, Sokaogon Band [2], Mille Lacs Band, Red Cliff Band, and St. Croix Band (Fig. 1). Representatives from each member tribe help direct the mission, focus, and activities of GLIFWC.

Recently, some of these tribal representatives voiced concerns about the continued availability of giizhik for harvest purposes. Tribal elders have noticed fewer trees and the loss of entire stands. (Elmer J. LeBlanc, TEK int., 2000; Constance T. Lang, TEK int., 2001; Corrine E. Wick, TEK int., 2001; Joe M. Rose, TEK int., 2002). In addition, an apparent decline in smaller and younger trees has spurred a series of scientific studies on the regeneration requirements of giizhik (Algren and Algren 1983, Chimmer and Hart 1996, Heitzman et al. 1999, Cornett et al. 2000a).

This report compiles basic information about giizhik including its non-medicinal uses by the Anishinaabe, its ecology, its past and present status, potential threats to its abundance, management recommendations and future research needs. It is hoped that this report will provide needed information to assist tribal and public land resource managers and decision-makers with the establishment and implementation of policies and practices that ensure the long-term health of giizhik.

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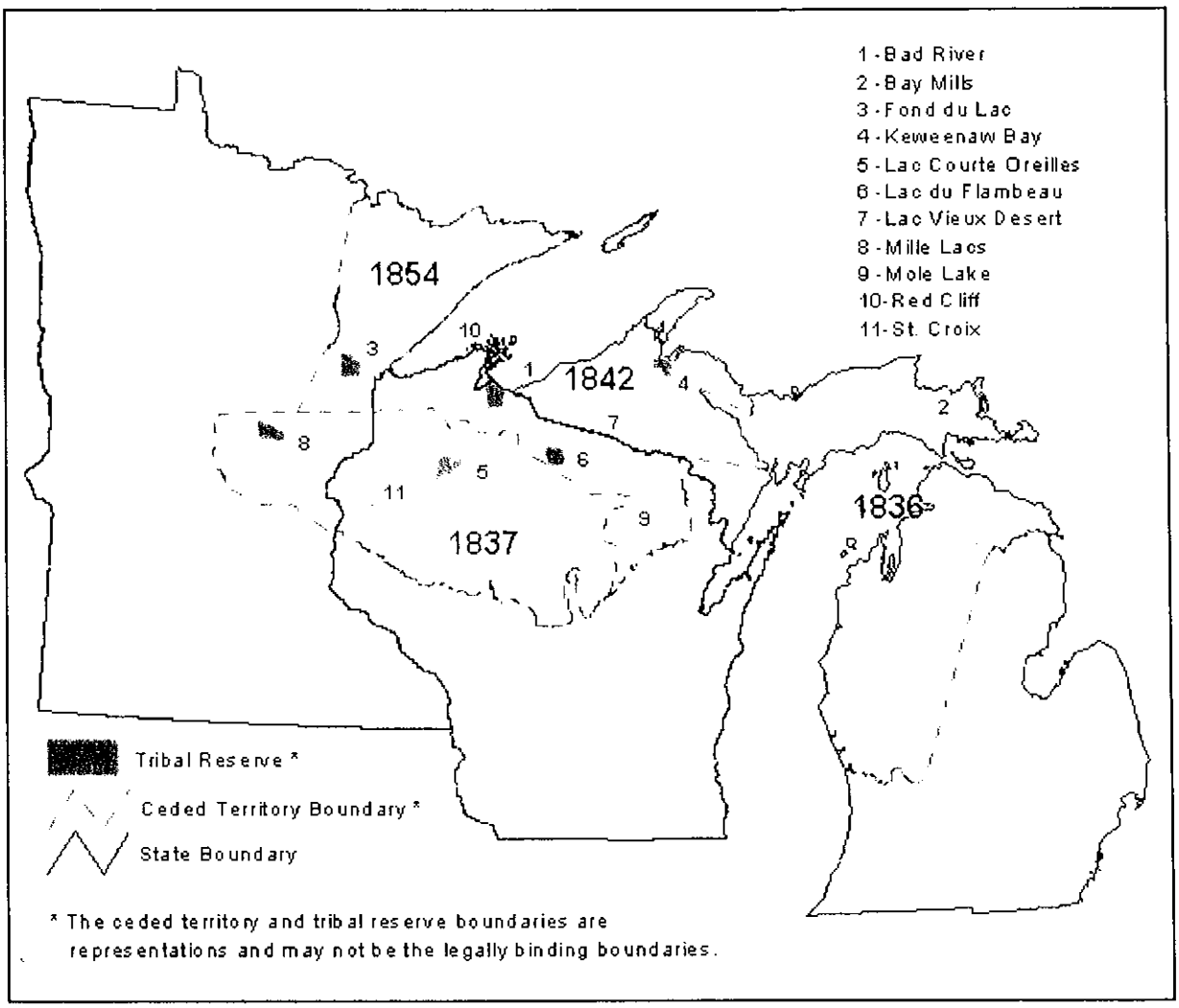
[1]Also referred to as Ojibwe or Chippewa.

[2]Also referred to as the Mole Lake Band.

Figure 1: Location of the Great Lakes Indian Fish and Wildlife Commission member tribes and boundaries of the ceded territories.



Anishinaabe Uses of Giizhik

The Anishinaabe use giizhik for many purposes. Interviews of tribal elders by Great Lakes Indian Fish and Wildlife Commission (GLIFWC) staff between 2000 and 2002 reveal the great diversity of uses. The interviews were held on the reservations of the eleven GLIFWC member tribes located in northern Michigan, Minnesota, and Wisconsin.

Funding for the interviews came from a two year grant beginning in 2000 and received by GLIFWC through the Administration for Native Americans (Grant # 90NA7252). The project consisted of gathering traditional ecological knowledge (TEK) on non-medicinal uses of plants from tribal elders and integrating this information with western scientific knowledge. TEK has been defined by Berkes (1999) as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans with one another and with their environment." TEK does not remain stagnant, but rather, without disregarding past wisdom, continues to transform through time (Danielsen and Gilbert 2002).

The TEK interviews proceeded with abiding respect for the elders providing information. The interviews were audio- and video-taped only with permission of all the elders present. If no taping occurred, documentation proceeded through note-taking. The elders retained the final approval for release of the acquired TEK to tribal and non-tribal communities. Credit for the acquired TEK was solidly linked to the elders, not the interviewers. Consequently, any future use of the acquired TEK must reference the appropriate elder(s).

Some of the uses of giizhik, as noted by the elders during these TEK interviews, include steeping the leaves in boiling water as an air freshener and to make tea, cleansing solutions, and hair rinse. The leaves may also be burned for ceremonial smudging, incense, and as an insect repellent. Fresh leaves and boughs may be used as bedding and floor covering, placed in living spaces as talismans, and hung over maple sap cooking kettles to prevent boil-overs.

Giizhik wood may be used for building dugout canoes, flat bottom ricing boats, and frames for birch bark canoes. In addition, the wood may be used to make baskets and basket frames, or burned as kindling and to smoke hides. The male flower may be burned as an insect repellant (Roger A. McGeshick, TEK int., 2001). All parts of the tree may be used to make medicines. The following tables (1-3) detail the non-medicinal uses of giizhik as described by tribal elders during the 2000 to 2002 interviews.

Table 1: Non-medicinal Uses of Giizhik Aniibiishan (Leaves) and Waatigwaan (Boughs)

USES OF GIIZHIK ANIIBIISHAN AND WAATIGWAAN	TRIBAL ELDER	INTERVIEW LOCATION	INTERVIEW DATE
Tea	Rebecca Munz	Bay Mills	12/21/00
	Sylvia Cloud-Parisien	Bad River	12/13/00
	Joe M. Rose	Bad River	4/16/00
	Ruth Wise Baker	Fond du Lac	3/26/00
	Deanne Baker	Fond du Lac	7/25/00
	James White	Mille Lacs	2/23/01
	Frank Montano	Red Cliff	2/5/01
Bedding and floor covering	Elder	Fond du Lac	1/24/01
	Elder	Lac du Flambeau	12/4/00
	Ruth J. Antone	Lac Vieux Desert	10/4/00
	Helen Smith	Lac Vieux Desert	10/4/00
Hair rinse	Margaret Ojibway	Fond du Lac	1/24/01
	Elder	Mille Lacs	2/23/01
	Elder	St. Croix	3/6/01
Smudge	Robert Powless Sr.	Bad River	12/13/00
	Myrtle Soukkala	Fond du Lac	3/26/01
	Marylyn Carpenter	Fond du Lac	1/24/01
	Corrine E. Wick	Fond du Lac	1/24/01
	Geraldine Defoe	Fond du Lac	1/24/01
	Carl Ambromowski	Fond du Lac	1/24/01
	Frank Montano	Red Cliff	2/5/01
	Elder	Sokaogon	1/9/01
	Myra J. Pitts	Sokaogon	2/12/01
	Elder	St. Croix	3/6/01
Incense	Joe M. Rose	Bad River	4/16/01
	Dorothy Polar	Sokaogon	2/12/01
	Frank Montano	Red Cliff	2/5/01
Medicine lodge covering	Helen Smith	Lac Vieux Desert	10/4/00
	Ruth J. Antone	Lac Vieux Desert	10/4/01
Talisman	Elmer J. LeBlanc	Bay Mills	8/4/00
	Frank Montano	Red Cliff	2/5/01

USES OF GIIZHIK ANIIBIISHAN AND WAATIGWAAN	TRIBAL ELDER	INTERVIEW LOCATION	INTERVIEW DATE
Insect repellent	Elder	Bad River	1/29/01
	Corrine E. Wick	Fond du Lac	1/24/01
	Ruth J. Antone	Lac Vieux Desert	10/4/00
	Charles Ackley	Sokaogon	1/9/01
Washing body and household objects	Linda Houle	Fond du Lac	1/25/01
	Betty M. Torgerud	St. Croix	3/6/01
Air freshener	John Wood	Fond du Lac	1/25/01
	Frank Montano	Red Cliff	2/5/01
Prevent maple sap boil over	Elder	Fond du Lac	1/24/01
	Ferdinand Martineau	Fond du Lac	1/25/01
	Linda Houle	Fond du Lac	1/25/01
Courting	Elder	Sokaogon	1/9/01
Wreaths and other decorations	Marylyn Carpenter	Fond du Lac	1/24/01
	Norma Graves	Fond du Lac	1/25/01
	Leroy Defoe	Fond du Lac	1/25/01
	Elder	Sokaogon	1/9/01
	Dorothy Polar	Sokaogon	2/12/01
Cash crop	Elder	Bad River	1/29/00
	Linda Houle	Fond du Lac	1/25/01
	Betty Kegg	Fond du Lac	3/22/01

Table 2: Uses of Giizhik Nagek (Bark)

USES OF GIIZHIK NAGEK	TRIBAL ELDER	INTERVIEW LOCATION	INTERVIEW DATE
Lodge covering	Joe M. Rose	Bad River	12/13/00
	Robert VanZile	Sokaogon	2/12/01
	Elder	Mille Lacs	1/9/01
Insect Repellant Bedding	Harold Crowe	Bad River	1/29/01

Table 3: Uses of Giizhik Misan (Wood)

USES OF GIIZHIK MISAN	TRIBAL ELDER	INTERVIEW LOCATION	INTERVIEW DATE
Canoes or boats	Harold Crowe	Bad River	1/29/01
	Joe M. Rose	Bad River	4/16/01
	Helen Smith	Lac Vieux Desert	10/4/00
	Elder	Mille Lacs	2/23/01
Canoe or boat paddles	Clarence Crowe	Bad River	12/13/00
	Melvin L. Defoe	Fond du Lac	1/24/01
	Elder	Lac du Flambeau	11/27/00
	Helen Smith	Lac Vieux Desert	10/4/00
	Charles Peter McGeshick	Sokaogon	2/12/01
	Myra J. Pitts	Sokaogon	2/12/00
	Elder	Sokaogon	1/9/01
	Joseph Duffy	Red Cliff	1/4/01
Ricing knockers (sticks)	Joe M. Rose	Bad River	12/13/00
	Harold Crowe	Bad River	12/13/00
	Daryorld Blanketter	Fond du Lac	1/24/01
	Marylyn Carpenter	Fond du Lac	1/24/01
	William Houle	Fond du Lac	1/26/01
	Mary E. Davis	Fond du Lac	1/25/01
	John Dupruis Sr.	Fond du Lac	1/25/01
	Dorothy Yadon	Fond du Lac	1/25/01
	Ferdinand Martineau	Fond du Lac	1/25/01
	Jim Northrup	Fond du Lac	1/24/01
	George W. Brown	Lac du Flambeau	7/24/00
	Joseph J. Chosa	Lac du Flambeau	7/24/00
	May Jameson	Lac Vieux Desert	9/13/00
	Raymond Smith Jr.	Lac Vieux Desert	10/4/00
	Charles Peter McGeshick	Sokaogon	2/12/01
	Robert VanZile	Sokaogon	2/12/01
	Myra J. Pitts	Sokaogon	2/12/01
	Elder	Mille Lacs	2/23/01
	Elder	Red Cliff	1/4/01
	Ruth Holmes	St. Croix	3/6/01
Ricing push poles	Dorothy Yadon	Fond du Lac	1/25/01
	John Dupruis Sr.	Fond du Lac	1/25/01
	Daryorld Blanketter	Fond du Lac	1/24/01
	Elder	Mille Lacs	2/23/01

USES OF GIIZHIK MISAN	TRIBAL ELDER	INTERVIEW LOCATION	INTERVIEW DATE
Spigots for maple tapping	Les Northrup	Fond du Lac	1/25/01
	Lucy Dewing	Fond du Lac	1/26/01
	Carl Abromowski	Fond du Lac	1/24/01
	Geraldine L. Defoe	Fond du Lac	1/24/01
	David White	Fond du Lac	1/26/01
	Elder	Lac Courte Oreilles	11/28/00
	Elder	Lac du Flambeau	11/27/00
	Elder	Lac du Flambeau	12/4/00
	Charles Ackley	Sokaogon	1/9/01
	Delores M. Bainbridge	Red Cliff	1/4/01
	Joseph Duffy	Red Cliff	1/4/01
	Elder	St. Croix	3/6/01
Paddles for stirring maple sap	Harold Crowe	Bad River	12/13/00
	Ferdinand Martineau	Fond du Lac	1/25/01
	Phyllis Stott	Fond du Lac	1/24/01
	Elder	Red Cliff	1/4/01
Cradle boards	Alvina Tiessen	Fond du Lac	1/24/01
	Elder	Lac Courte Oreilles	11/28/00
	May Jameson	Lac Vieux Desert	10/4/00
	Myra J. Pitts	Sokaogon	2/12/01
Drums	Elder	Lac du Flambeau	11/27/00
	Elder	Mille Lacs	2/23/01
Toboggans and sleds	Elder	Fond du Lac	1/25/01
	Elder	Mille Lacs	2/23/01
Snowshoe frames	John Dupruis Sr.	Fond du Lac	1/25/01
	Elder	Lac du Flambeau	11/27/00
	Elder	Lac du Flambeau	12/4/00
Snow boards	Elder	Sokaogon	1/9/01
Baskets	George W. Brown Jr.	Lac du Flambeau	12/4/00
	Dorothy Polar	Sokaogon	2/12/01
	Elder	Mille Lacs	2/23/01
Fish decoys and other carvings	Joe M. Rose	Bad River	4/16/01
	Elder	Fond du Lac	1/25/01
	Elder	Lac du Flambeau	12/4/00
	Helen Smith	Lac Vieux Desert	10/4/00
	Ruth J. Antone	Lac Vieux Desert	10/4/00
Poles to set fish nets under ice	Joseph Duffy	Red Cliff	2/5/01

USES OF GIIZHIK MISAN	TRIBAL ELDER	INTERVIEW LOCATION	INTERVIEW DATE
Tools and frames for stretching and tanning hides	Sylvia Cloud-Parisien Elder	Bad River Sokaogon	12/13/00 1/9/01
Smoking hides	William Houle Ruth J. Anotone Madeline Shreyer	Fond du Lac Lac Vieux Desert Red Cliff	1/26/01 10/4/00 1/4/01
Eating utensils	George W. Brown	Lac du Flambeau	7/24/00
Arrows	Elder	Sokaogon	1/9/01
Flutes and whistles	Elder Frank Montano Elder	Sokaogon Red Cliff St. Croix	1/9/01 2/5/01 3/6/01
Furniture	Myrtle Soukkala	Fond du Lac	3/26/01
Tip-ups	Helen Smith Charles Peter McGeshick	Lac Vieux Desert Sokaogon	10/4/00 2/12/01
Yokes	Harold Crowe Clarence Crowe	Bad River Bad River	12/13/00 12/13/00
Kindling	Elder Ruth J. Antone Charles Peter McGeshick	Lac du Flambeau Lac Vieux Desert Sokaogon	12/4/00 10/4/00 2/12/01
Fence posts	Elder	Bad River	1/29/01

The Ecology of Giizhik

Considered to be a slow-growing small to medium-sized tree, giizhik rarely exceeds 15 m (45 ft) in height, even at its average maximum age of 400 years. It's reddish-brown bark may be distinguished by its long shedding strips. The flat and scalelike leaves, though yellowish green most of the year, often turn brown for a short period of time in the winter (Barnes and Wagner Jr. 1981). When crushed or burned, the leaves release a strong fragrance (Frank Montano, TEK int., 2001; Barnes and Wagner Jr. 1981).

The geographical range of giizhik extends from southeastern Canada to northeastern United States and west through the Great Lakes States, with additional isolated stands occurring in the Appalachian Mountains (Fig. 2). It often grows in cool, moist swamps carpeted with assaaikamig (moss) on nutrient-rich organic soils. Other tree species at these sites include zhiingob (balsam fir, *Abies balsamea*), gaawaandag (white spruce, *Picea glauca*), mashkiigwaatig (tamarack, *Larix laricina*), aagimaak (black ash, *Fraxinus americana*) and zhiishiigimiiwanzh (red maple, *Acer rubrum*). Occasionally, giizhik grows on drier limestone uplands and old fields with tree species such as wiinizik (yellow birch, *Betula alleghaniensis)*, wiigwaas mitig (paper birch, *B. papyrifera*), zhingwaak (eastern white pine, *Pinus strobus*), kaakaagiwanzh (eastern hemlock, *Tsuga canadensis*), and azaadi (quaking aspen, *Populus tremuloides* and big-tooth aspen, *Populus grandidentata*) (Johnson 1990).

During the 16th century, Europeans imported giizhik from North America for cultivation as an ornamental. Currently, over 120 named cultivars exist, each having various leaf colors, growth forms, and climate adaptations. Landscapers worldwide, including the United States, commonly use the cultivars as hedges or other types of borders and wind blocks (Nesom 2000).

Giizhik reproduces by seed and vegetatively. An individual tree must be generally at least 30 years old (sometimes up to 70 years old) before seed production occurs in large quantities. Seed cones begin developing in July and ripen by August or September. The cones remain relatively small measuring no longer than 1.3 cm (.5 in). Once ripened, the cones almost immediately release their seed. Dependent upon the wind, the seeds, measuring 6 mm (.25 in) long, often travel less than 60 m (200 ft) from the parent tree. On the forest floor, the seeds rarely remain viable for more than one year.

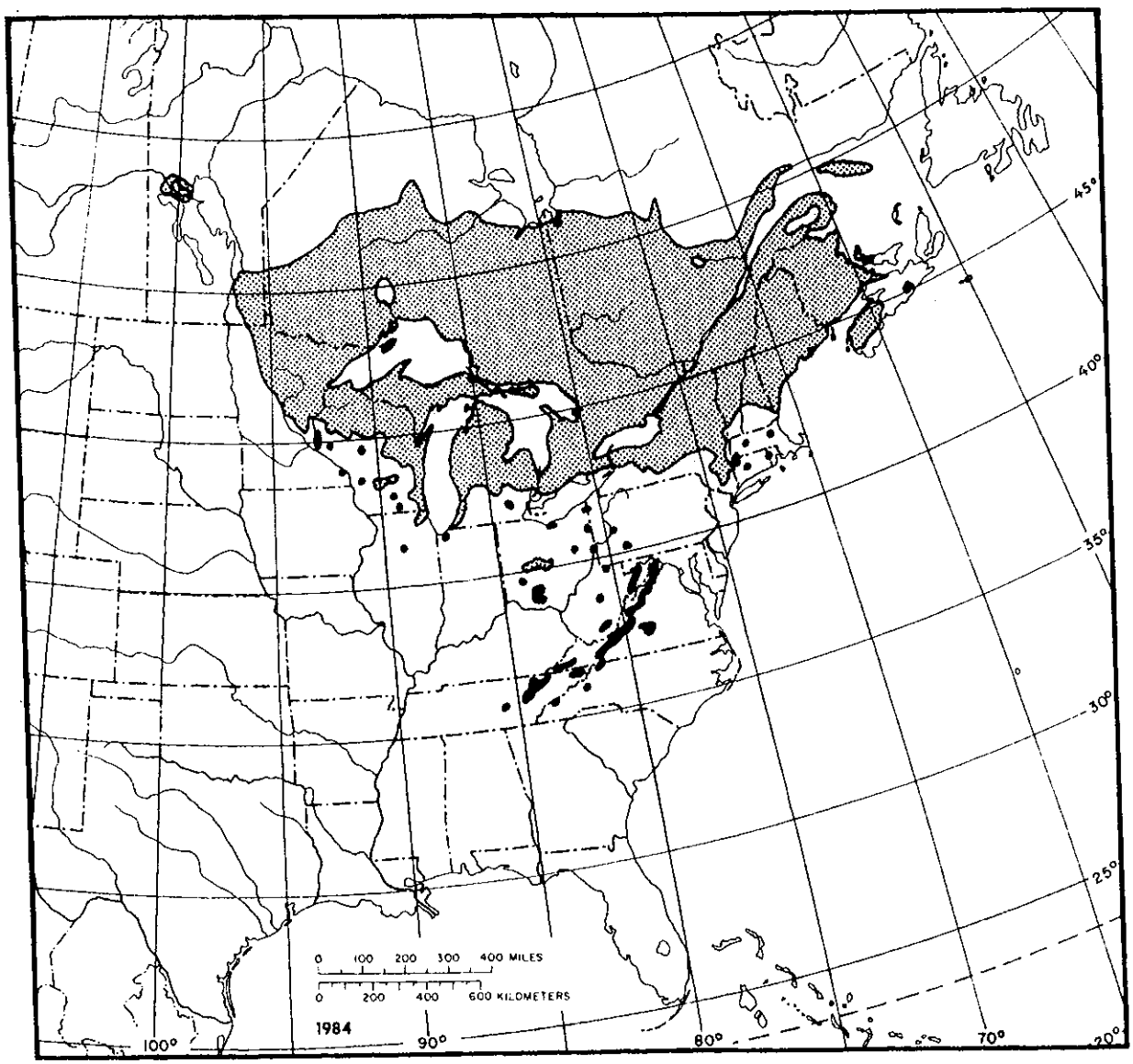
Seedlings develop most often from seed germinating on decaying logs or stumps. Seedlings also develop on burned sites with exposed mineral soil in uplands though colonization may take as long as 50 years (Simard et al. 1998). Seedlings grow slowly, about 8 cm (3 inches) per year, and require consistently moist conditions and generous amounts of sunlight for survival.

Vegetative reproduction, roots developing from the branches or stems of leaning or fallen trees to establish a "new" tree, requires moist conditions. Shade does not limit vegetative

reproduction. Not surprisingly, this form of reproduction occurs most frequently in swamps.

A study on giizhik growth patterns and other characteristics indicated that genetic variances do occur within the species. For example, researchers found that giizhik growing on lowland and upland sites in Wisconsin show some differentiation. However, these differences are not large enough to foster the division of this species into races or varieties. (Johnson 1990).

Figure 2: Distribution of Giizhik (from Johnson 1990).



Past and Current Status of Giizhik

Prior to Euro-American settlement, northern Michigan, Minnesota, and Wisconsin possessed extensive stands of zhingwaak (white pine) and apakwanagemag (red pine, *Pinus resinosa*), acres of kaakaagiwanzh (hemlock) and wiinizik (yellow birch, *Betula lutea*) mixed with ininaatig (sugar maple, *Acer*) and wiigobaatig (basswood, *Tilia americana*); sandy barrens harboring low-growing shrubs and stands of wakikaandag (jack pine, *Pinus banksiana*); swamps and bogs, and other unique plant communities. Beginning with zhingwaak, most of the forests had been clearcut by the early 1900's. Fire ravaged much of the remaining forests.

Though early settlers tended to avoid swamps supporting giizhik, primarily due to their difficult access (Bourdo Jr. 1983), only 5% of the original swamp forest currently remains in the Lake States region (Frehlich 1995). Prized for its decay-resistance, giizhik became the favored wood for fence posts, planking and railroad ties (Sandberg 1983).

Recent population trends for giizhik may be assessed through a program sponsored and implemented by the USDA Forest Service called Forest Inventory and Analysis (FIA). This program entails repeated inventories of the nation's forest through the monitoring of permanent plots. Data gathered includes forest composition (e.g., species present) and structure (e.g., average tree diameter, height, age, and abundance), in addition to information regarding individual trees. In the past, monitoring occurred on a state by state rotation schedule such that the permanent plots were revisited approximately every ten years. Recent policy changes to this state by state rotation schedule now promote five year monitoring intervals.

For this report, changes in giizhik abundance were summarized and compared using data gathered from the northern counties of Michigan (limited to Upper Peninsula) in 1980 and 1993; the northern counties of Minnesota in 1977, 1990, and 1999; and the northern counties of Wisconsin in 1983 and 1996. The counties selected for these summaries and comparisons occur entirely or partially within the ceded territories (Fig. 3).

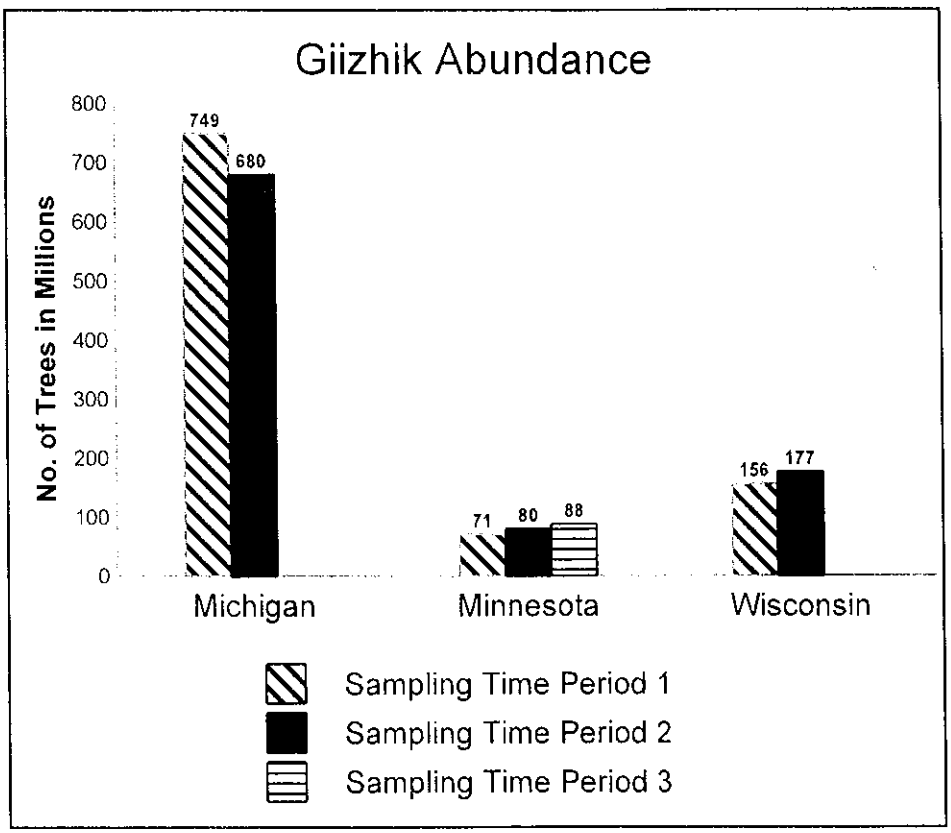
One caveat accompanies the following data summaries with regards to the degree of statistical precision associated with any long-term study of this nature. In this report, confidence intervals and other descriptive statistics based on probabilities do not accompany the data presented. Therefore, interpretations of these data are preliminary and have been judiciously applied to ascertain possible, yet potentially insightful, major population trends in giizhik.

Figure 3: Counties of focus for FIA data analyses

Michigan	**Minnesota**	**Wisconsin**	
Benton	Alger	Ashland	Marathon
Baraga	Carlton	Barron	Marinette
Chippewa	Chisago	Bayfield	Menominee
Delta	Cook	Burnett	Oconto
Dickinson	Isanti	Chippewa	Oneida
Gogebic	Kanabec	Clark	Polk
Houghton	Lake	Douglas	Price
	Mille Lacs	Dunn	Rusk
	Morrison	Florence	Sawyer
	Pine	Forest	Taylor
	St. Louis	Iron	Vilas
		Lincoln	Washburn

FIA data were summarized to ascertain giizhik abundance in Michigan, Minnesota, and Wisconsin for the last two (or three, if available) sampling time periods (Fig. 4). These data illustrate each state's relative overall abundance of giizhik in comparison with one another. In Northern Michigan, favorable growing conditions (soils and climate) make giizhik one of the most abundant trees species (Heitzman et al. 1997). Whereas in Minnesota, less favorable growing conditions cause giizhik to reach it's western-most boundary. These data also indicate that overall giizhik abundance decreased in Michigan and increased in Minnesota and Wisconsin.

Figure 4: Abundance of giizhik measured in millions of trees.

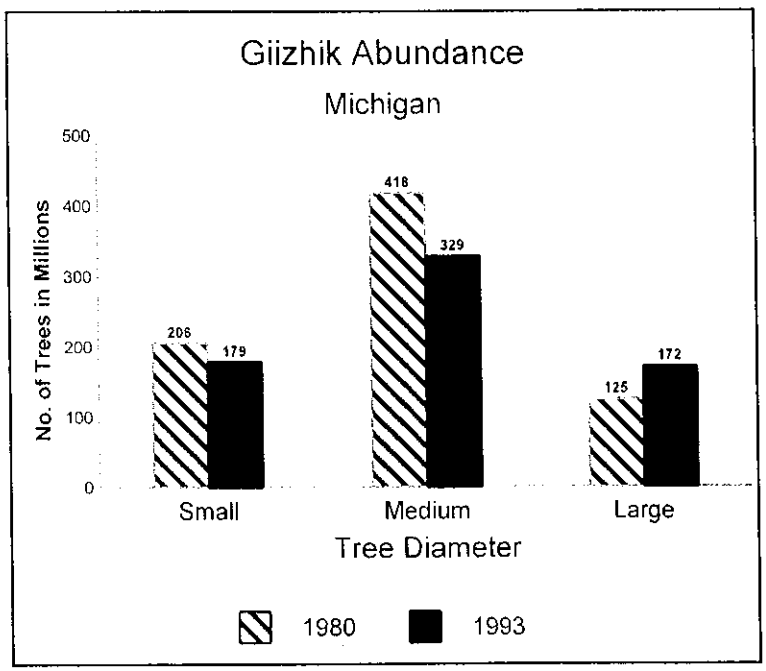


Sampling period 1 occurred for MI in 1980, MN in 1977, and WI in 1983.
Sampling period 2 occurred for MI in 1993, MN in 1990, and WI in 1996.
Sampling period 3 occurred for MN in 1999, no data available for MI or WI.

Further comparisons, using tree diameter size as a variable, provide a more clear understanding of giizhik population dynamics. FIA monitoring categorizes trees into three diameter size classes. For conifers, small trees (seed saplings) measure less than 13 cm (5 in) diameter at breast height (dbh). Medium trees (poletimber) measure between 13 and 23 cm (5 and 9 in) dbh. Large trees (sawtimber) measure over 23 cm (9 in) dbh.

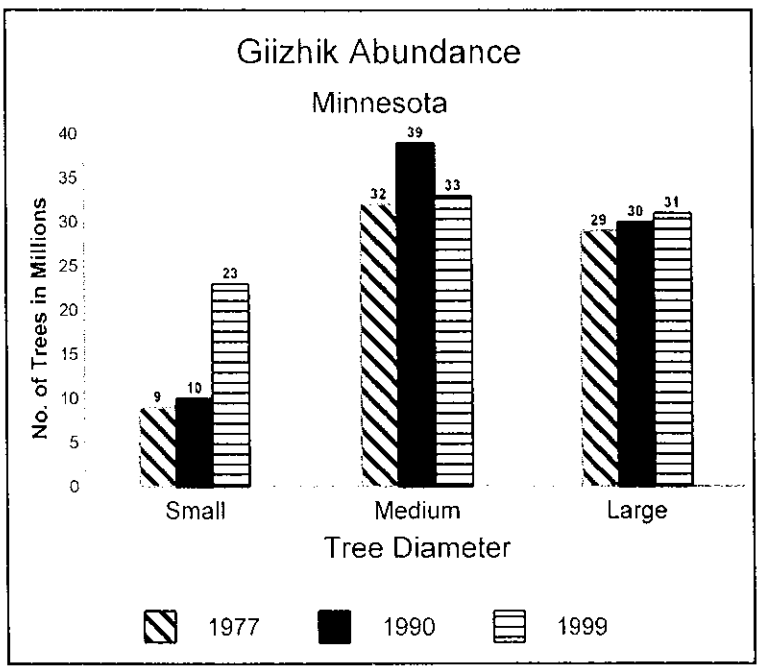
In Michigan, between sampling time periods, the number of small and medium trees decreased while the number of large trees increased (Fig. 5). Most likely, these trends represent a sustained decline in small and medium trees over the last two decades, ultimately resulting in fewer trees to replace older dying trees. Less likely, these trends represent an unusually high survivorship of small and medium trees before 1980, and a return to more typical survivorship rates after 1980.

Figure 5: Giizhik Abundance in Michigan



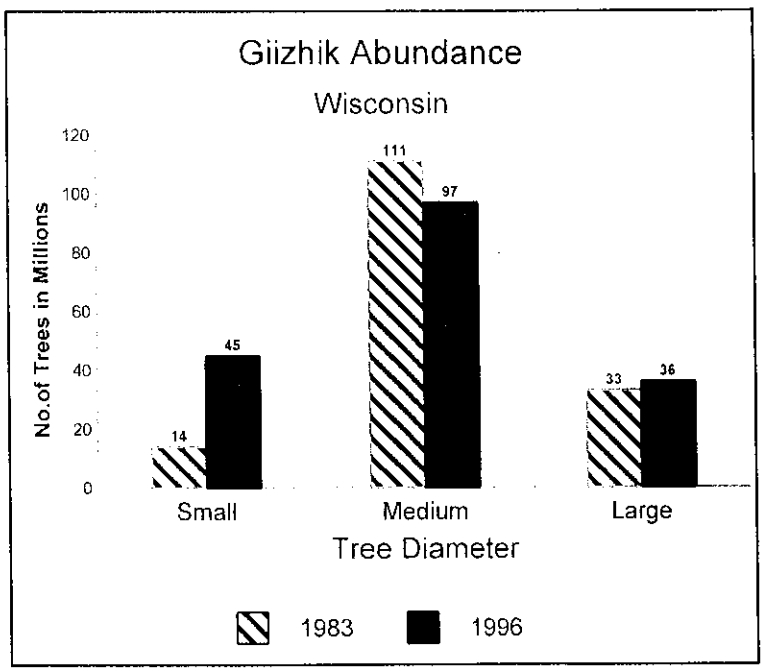
In Minnesota, small and large trees increased in abundance. The abundance of medium trees increased greatly between 1977 and 1990, but declined between 1990 and 1999 (Fig. 6). The cause of this population fluctuation remains unclear, but could have been the result of modifications in environmental conditions or management practices. These data indicate that, with fewer small trees than medium or large trees, replacement rates may not be adequate to sustain overall abundance. The increase of small trees in 1999 looks promising, but may not be enough to ensure giizhik sustainability.

Figure 6: Giizhik Abundance in Minnesota



In Wisconsin, between sampling periods, the abundance of small and large trees increased while medium trees decreased (Fig. 7). This decline in medium trees could have resulted from the rather limited cohort of small trees in 1983 (fewer small trees result in fewer medium trees). Another explanation could be changing environmental conditions that caused an overall high mortality of small trees. In any case, the sustainability of giizhik in Wisconsin remains in question.

Figure 7: Giizhik Abundance in Wisconsin

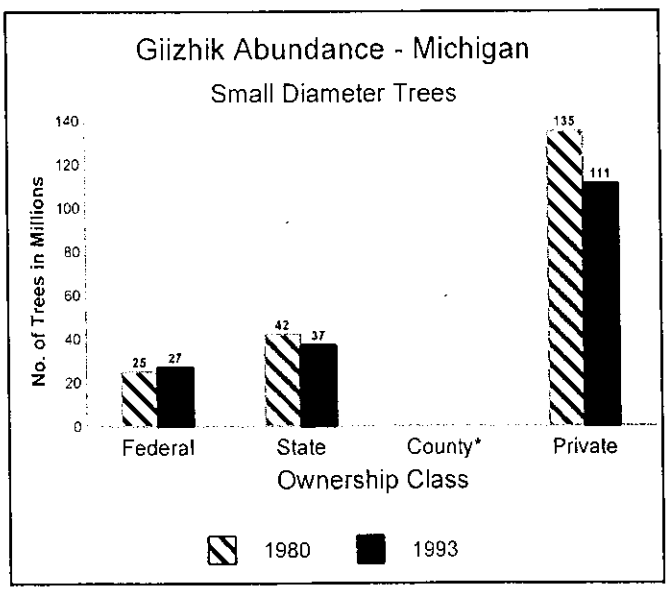


Additional information was uncovered by comparing giizhik population trends between various ownership classes - federal (primarily USDA Forest Service), state, county (and municipal) and private. Each of the owners operates under different regulations and management guidelines which, in theory, could cause different resource impacts or at least varying degrees of the same impacts. Though these data do distinguish some differences in population trends between ownerships, the differences fail to establish clear conclusions. Nonetheless, the data do illustrate some interesting population fluctuations.

The summarized Michigan FIA data reveal that small trees, between sampling periods, decreased on state and private lands, but increased on federal lands. Accurate data for small trees on county lands were unavailable, and therefore, not summarized (Fig. 8). The apparent decline in medium trees was ubiquitous and irrespective of ownership. Large trees increased on all ownerships, except for county lands (Figs. 9 and 10).

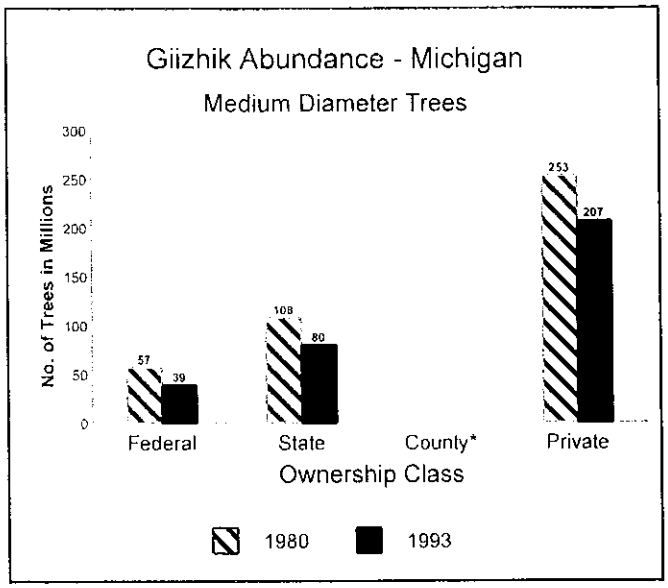
Current management includes only incidental harvest of giizhik on federal lands - consisting of the Hiawatha and Ottawa National Forests (Al Saberniak, pers. comm., 2002; Susan Trull, pers. comm., 2002) and no harvest on state lands except for experimental testing of silvicultural techniques. Giizhik harvest still occurs on private lands, and to a limited extend, on county lands (Ray Miller, pers. comm., 2002).

Figure 8: Giizhik Abundance by Ownership Class - Michigan, Small Diameter Trees



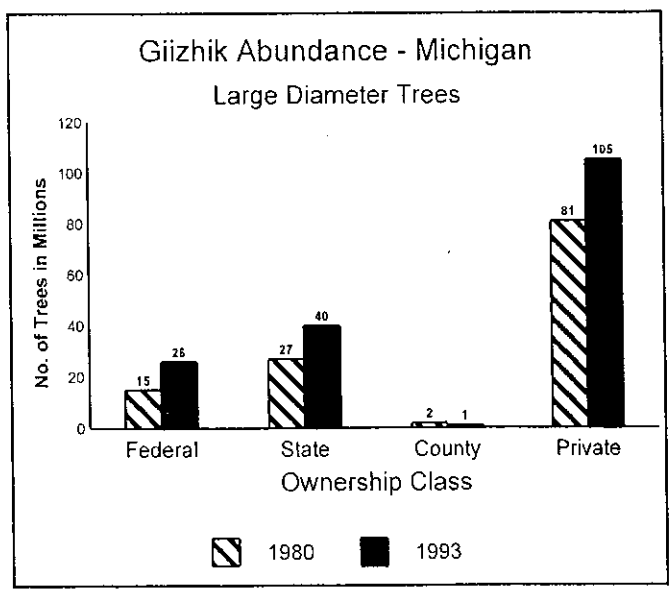
** Accurate data for small diameter trees on county lands were unavailable.*

Figure 9: Giizhik Abundance by Ownership Class - Michigan, Medium Diameter Trees



* *Accurate data for medium diameter trees on county lands were unavailable.*

Figure 10: Giizhik Abundance by Ownership Class - Michigan, Large Diameter Trees



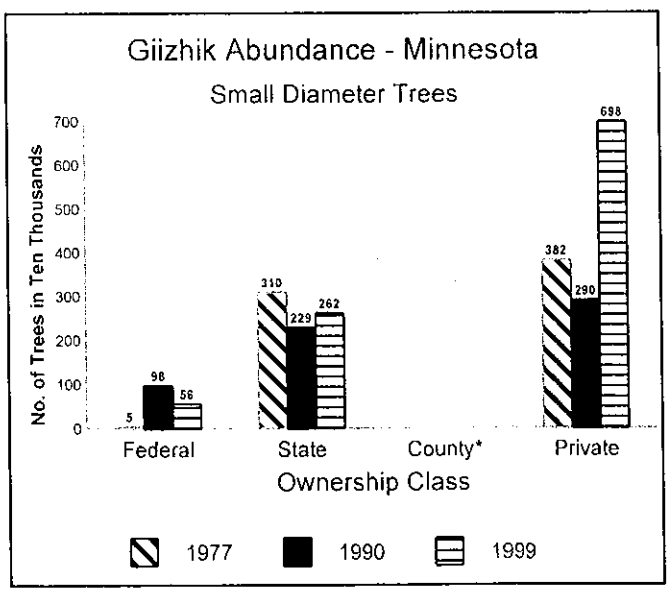
The summarized Minnesota FIA data indicate that the number of small trees fluctuated between sampling periods (Fig. 11). In addition, the data illustrate similar population trends on state and private lands (decrease in 1990, increase in 1999), but opposite trends on federal lands (increase in 1990, decrease in 1999). Accurate data for county lands were unavailable.

The number of medium trees between sampling periods steadily increased on state lands, but decreased on county and private lands (Fig. 12). On federal lands, the number of medium trees fluctuated in a pattern similar to that observed for small trees.

The number of large trees between sampling periods increased on county lands (Fig. 13). Yet, on federal lands, the number fluctuated with a decrease after the first sampling period and an increase after the second sampling period. On state lands, the number remained relatively stable between the first two sampling periods and then increased. On private lands, the number also remained relatively stable between the first two sampling periods, but then decreased considerably.

Current management in Minnesota includes essentially no giizhik harvest on federal (Superior and Chippewa National Forests) or state lands (Jack Greenlee, pers. comm., 2002; Rick Klevorn, pers. comm., 2002). More harvest occurs on county and private lands, but remains fairly limited (Tom Martinson, pers. comm., 2002).

Figure 11: Giizhik Abundance by Ownership Class -Minnesota, Small Diameter Trees



** Accurate data for small diameter trees on county lands were unavailable.*

Figure 12: Giizhik Abundance by Ownership Class - Minnesota, Medium Diameter Trees

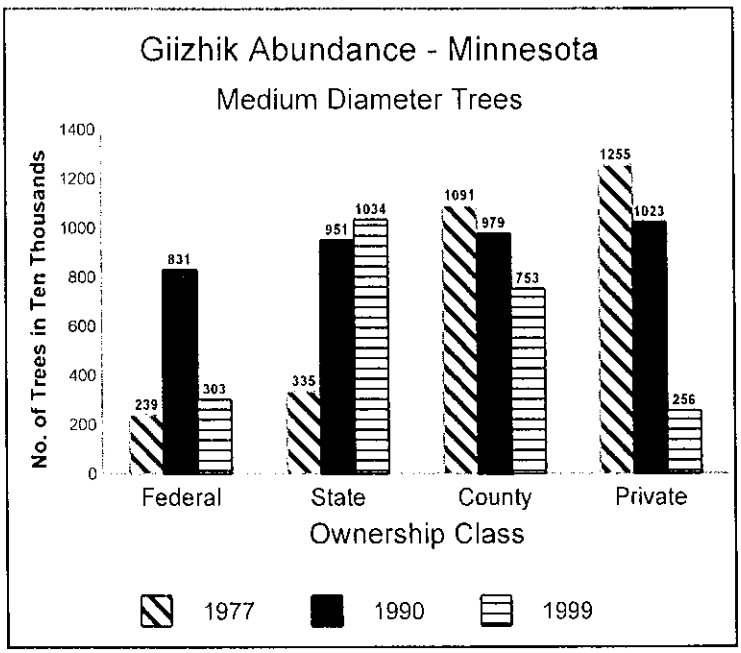
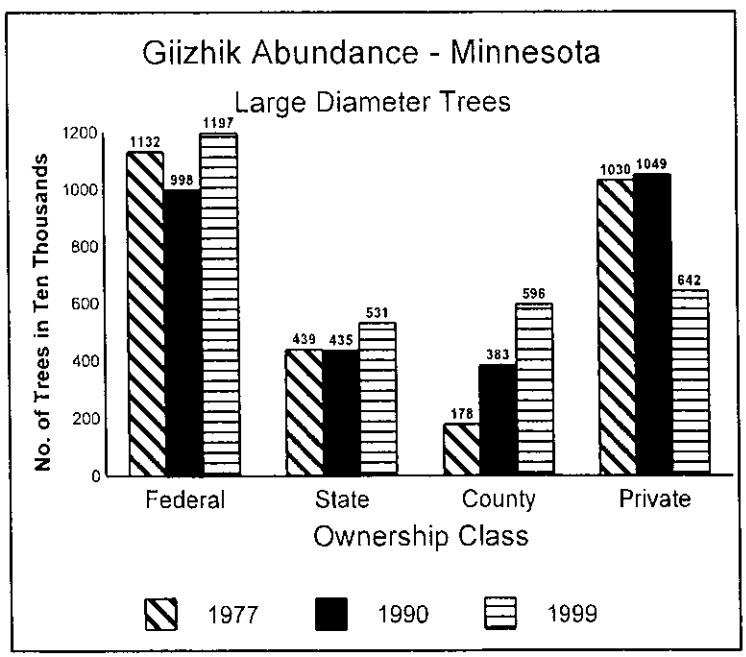


Figure 13: Giizhik Abundance by Ownership Class - Minnesota, Large Diameter Trees



The summarized Wisconsin FIA data illustrate that the number of small trees increased on all ownerships except county lands (Fig. 14). The number of medium trees decreased on all ownerships (Fig. 15), while the number of large trees increased on all ownerships except private lands (Fig. 16). These data suggest that differences in management practices may affect the small and large trees, but not necessarily the medium trees.

Federal lands in Wisconsin consist primarily of the Chequamegon-Nicolet National Forest, where generally, no giizhik harvest occurs (Mark Theisen, pers. comm., 2002). Harvest rarely occurs on state lands also (Steve Peterson, pers. comm., 2002; Jeff Olson, pers. comm., 2002). Though more harvesting occurs on county and private lands, the amount remains limited and is usually discouraged by governmental and consulting silviculturalists (Joe Schmidt, pers. comm., 2002; Tom Piikkila, pers. comm., 2002).

Figure 14: Giizhik Abundance by Ownership Class - Wisconsin, Small Diameter Trees

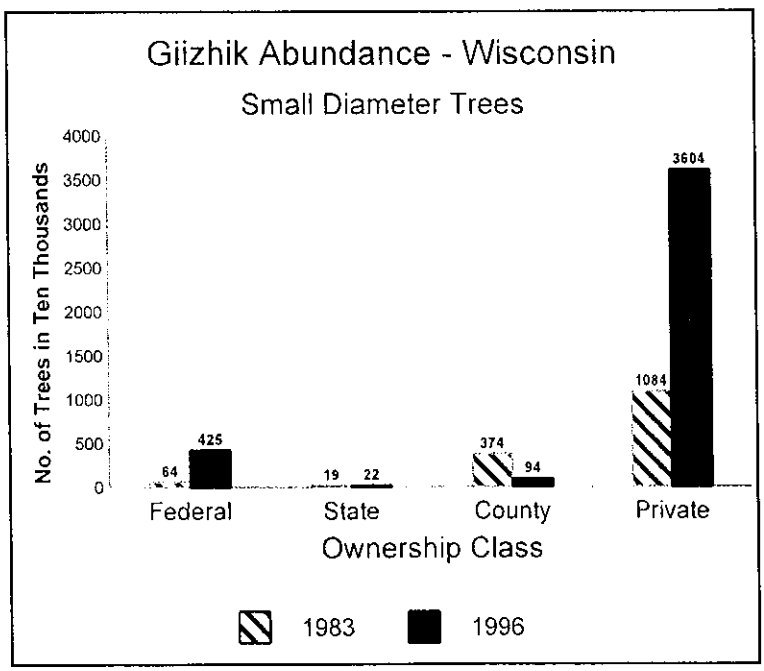


Figure 15: Giizhik Abundance by Ownership Class - Wisconsin, Medium Diameter Trees

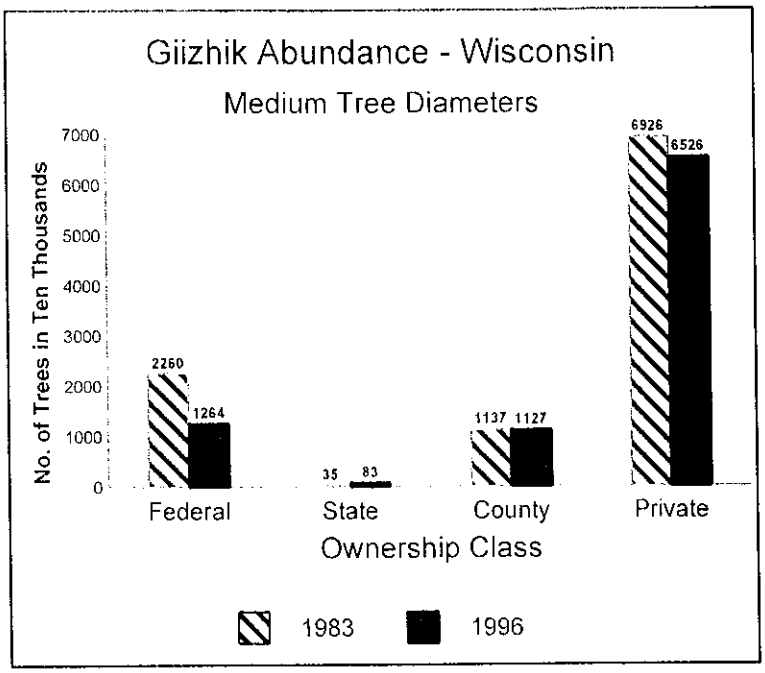
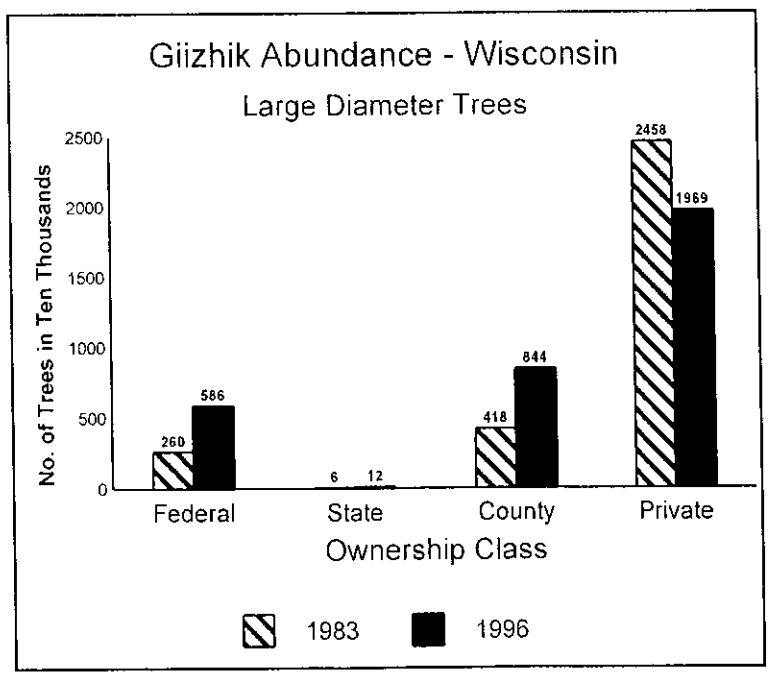


Figure 16: Giizhik Abundance by Ownership Class - Wisconsin, Large Diameter Trees



One final comparison included a review of giizhik population trends on tribal lands (Figs. 17, 18, and 19). The 1999 Minnesota sampling period was not summarized due to the unavailability of accurate data. For Michigan and Minnesota, the number of small trees increased on tribal lands. However, in Michigan, the difference in abundance between the small and medium size classes indicates a high mortality of smaller trees. In Wisconsin, accurate data for small trees were not available. In all three states, the number of medium trees increased. The number of large trees increased in Michigan, but decreased in Minnesota and Wisconsin.

When the U.S. Bureau of Indian Affairs (BIA) took over forestry management responsibilities on the tribal reservations, giizhik began to be cut in larger quantities. Prior to that, tribal chiefs directed the cutting of aspen only (Joe M. Rose, TEK int., 2002; Peter McGeshick Jr., TEK int., 2002). In Minnesota and Wisconsin, the apparent decline in larger trees might be indicative of BIA forestry practices. Recently, the tribes have begun reclaiming responsibility for timber harvest on tribal lands.

Figure 17: Giizhik Abundance on Tribal Lands - Michigan

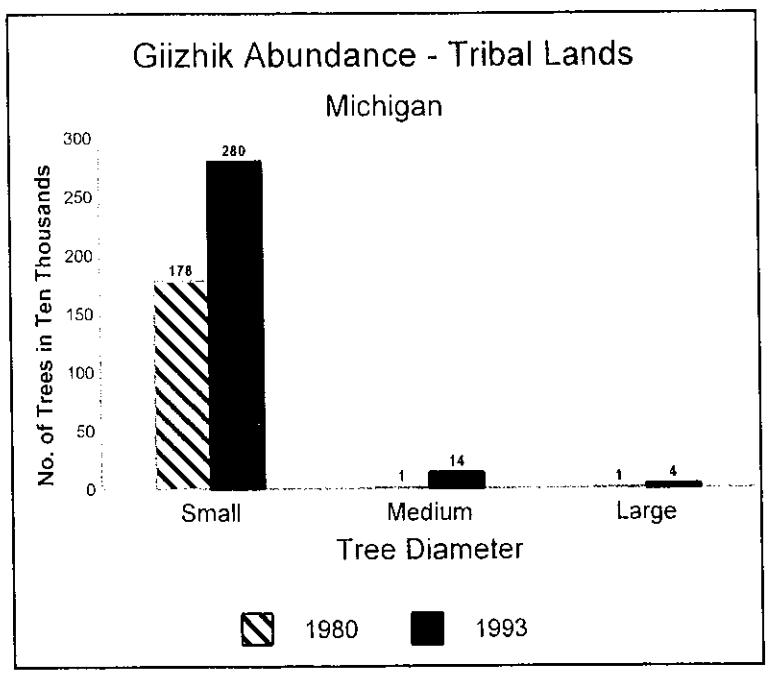


Figure 18: Giizhik Abundance on Tribal Lands - Minnesota

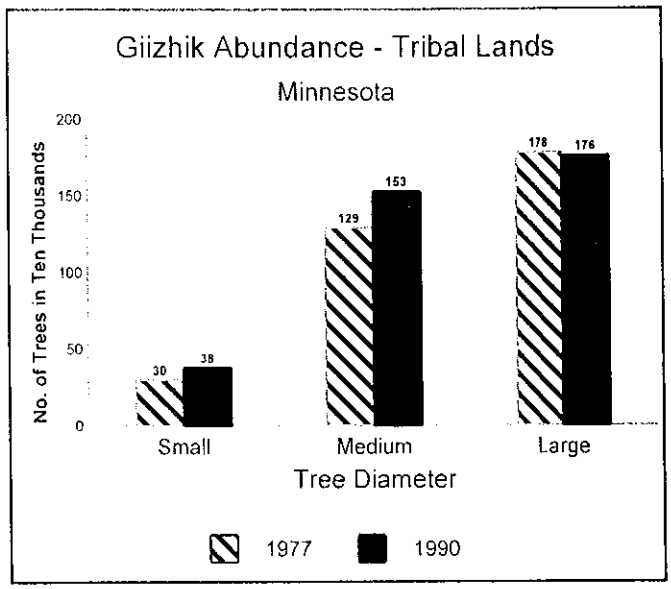
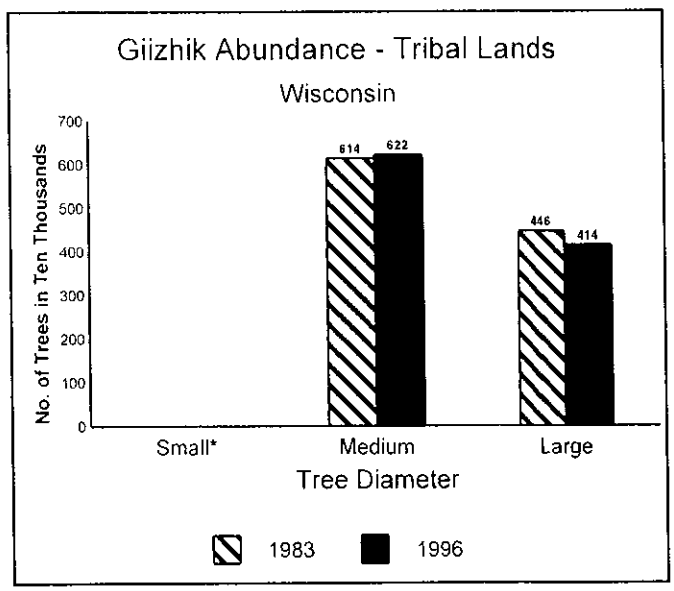


Figure 19: Giizhik Abundance on Tribal Lands - Wisconsin



** Accurate data for small trees in Wisconsin were unavailable.*

Potential Threats to Giizhik Abundance

Tribal elders commonly labeled clearcutting as the biggest threat to giizhik (Elmer J. LeBlanc, TEK int., 2000; Jim Northrup, TEK int., 2001; Margaret Ojibway, TEK int., 2001; Loretta Dietzler, TEK int., 2001; Myra J. Pitts, TEK int., 2001; Betty Kegg, TEK int., 2001; Leonard Sam, TEK int., 2001; Corrine E. Wick, TEK int., 2001; Constance T. Lang, TEK int., 2001). Russell Boyd (TEK int., 2000), claimed that loggers clearcut giizhik and other trees around Mille Lacs in Minnesota over 50 years ago. Now, only azaadii (aspen) grows in its place. Joe M. Rose (TEK int., 2000) stated that clearcutting near swamps has also impacted giizhik.

Tribal elders spoke of another threat as being the lack of gathering and using giizhik in a respectful way. Many elders mentioned the importance of gathering only what is needed. They emphasized the need for gatherers (including loggers) to recognize giizhik as being a gift to be used, but not to be exploited. In either case, not used or exploited, giizhik will go away (Sylvia Cloud-Parisien, TEK int., 2000; Roger A. McGeshick, TEK int., 2001; Art Tainter, TEK int., 2002; Olaf Johnson, TEK int., 2002). Wayne Valliere (TEK int., 2002) mentioned that traditional management included the gathering of giizhik misan (wood) mainly from dead trees.

Other threats identified by tribal elders include urban development (Elmer J. LeBlanc, TEK int., 2000), disease (Leonard Sam, TEK int., 2000), and lack of regeneration (Joseph Duffy, TEK int., 2000). Hildreth Thomas (TEK int., 2002) blamed acid rain and pollution. Ruth M. Holmes (TEK int., 2002) cited changes in waterways due to road construction and similar disturbances. Either excessive flooding or draining of swamps can result in losses of giizhik.

Western scientists have identified similar threats including the past harvest of mature stands and an apparent lack of regeneration (Kneeshaw and Bergeron 1996, Cornett et al. 2001). Calculations comparing vegetation maps using current data (e.g., FIA and natural heritage programs) and past data (General Land Office land surveys) reveal that only 4% of the primary (that which existed prior to Euro-American settlement) conifer swamp remains in the upper Midwest. Nevertheless, of the existing primary forest, 50% is old-growth conifer swamp (Frelich 1995).

Giizhik regeneration from seed appears to be limited by herbivory from waawaashkeshi (white-tailed deer, *Odocoileus virginianus*) and habitat changes which, given the loss of mature stands, could be detrimental to the species (Cornett et al. 2000a) . Prior to Euro-American settlement, forests in the upper Midwest provided marginal habitat for waawaashkeshi. After the early 1900's, waawaashkeshi increased in response to the new forage and habitat resulting from clearcutting and declining predator numbers (Alverson et al. 1988, Anderson and Katz 1993, Van Deelen 1996). Biologists estimate that, in this region, waawaashkeshi numbers have doubled since Euro-American settlement, and consequently, have dramatically increased browsing pressure. Exclosure experiments have demonstrated that giizhik, a preferred shelter

and forage during winter, has been particularly impacted by waawaashkeshi (Alverson et al. 1988, Cornett et al. 2000a). The slow growth rate of giizhik seedlings and saplings keep it susceptible to browsing for up to 20 to 40 years (Heitzman et al. 1999).

Giizhik also requires a narrow range of conditions for seed germination. Most seedlings germinate on decaying, moss covered logs. The logs retain the necessary moisture needed for the survival of these seedlings which cannot survive extended drought conditions (Simard et al. 1998, Cornett et al. 2000b). Furthermore, hummocks in swamps provide good habitat for seedling survivorship by providing an undulating micro-topography for the formation and retention of pools of water (Chimner and Hart 1996). These requirements indicate that timber harvest techniques that remove large woody debris and minimize or obliterate micro-topography (both characteristics of clearcutting) have been harmful for the regeneration of giizhik (Simard et al. 1998, Heitzman et al. 1999).

Higher light-levels increase giizhik seedling growth. Consequently, Cornett et al. (2000a) found that seedlings growing in stands of wiigwaas (paper birch), which have greater light penetration, could recover from browsing events more quickly than seedlings growing in the low-light levels of established giizhik stands. However, wiigwaas stands have fewer sites appropriate for giizhik seedling establishment (seedbeds). In addition, attempts to create seedbeds in wiigwaas provided mixed results.

During the 1960's land managers began implementing a new silvicultural technique designed to enhance giizhik regeneration. This technique entailed clearcutting in narrow strips of land such that adjacent uncut trees could provide a seed source. Once seedlings became established in the cut areas, the remaining trees would be harvested. Unfortunately, by the 1980's, evidence abounded that this technique failed to consistently produce the expected seedling and sapling survivorship. Apparently only under certain conditions does this technique result in successful giizhik regeneration (Heitzman et al. 1999). These conditions include a continued and prolific seed source (e.g., not cut remaining trees), reduced competition from hardwood seedlings and saplings, and reduced numbers of deer.

Vegetative reproduction, which occurs frequently in swamps, provides as much as 50 percent of giizhik new growth (Johnson 1990). However, browsing also impacts this new growth. Van Deelen et al. (1996) observed defoliation of new growth up to the height of waawaashkeshi, thereby favoring less preferred species (Cornett et al 2000a) such as zhiingob (balsam fir) and aninaatig (sugar maple, *Acer saccharum*). Thus, vegetative reproduction cannot guarantee giizhik survival.

Management Recommendations

Tribal elders suggested that giizhik should continue to be gathered in a respectful and sustainable way. They expressed concerns that non-use or overuse of giizhik could lead to its eventual decline. The use of giizhik must be responsible. They mentioned that any continued harvest of giizhik for timber should be carefully considered, given the past exploitive harvesting practices.

FIA data supports the elders concerns regarding an over harvest of giizhik. These data indicate declining numbers of small and medium sized trees in Michigan and medium sized trees in Minnesota and Wisconsin. It seems imprudent to harvest many large trees without the assurance of an equal replacement of smaller trees.

Several researchers have proposed various management recommendations to enhance giizhik regeneration. Some continue to support the strip cut harvest technique under the conditions identified by Heitzman et al. (1999) - a prolific seed source, reduced hardwood competition, and reduced herbivory (Ray Miller, pers. comm. 2002, Mike Paluda 2002). Other researchers emphasize the need to conserve more old growth stands which retain adequate micro-topography and produce large woody debris as substrates for giizhik seedling establishment and growth (Chimner and Hart 1996, Simard et al 1998, Cornett et al. 2001). Heitzmann et al. (1999) call for land managers to practice long-range, resource-wide management which would require creativity, new thinking, and cooperation to overcome some of the expected obstacles such as changing ownerships, short tenures for land managers, and shifting politics.

To protect giizhik from browsing, some land managers have already constructed exclosures (since the 1940's) or used netting and other materials to wrap around individual seedlings. As long as maintenance remains diligent, these methods can be very effective. Unfortunately, these methods also prove to be labor intensive, expensive and not very practical for large scale giizhik regeneration needs (Alverson et al. 1988).

Another option to protect giizhik may include modifying browse preferences either by providing an alternative desirable food, treating giizhik with commercial browse repellents, or breeding and growing giizhik that appear to contain natural repellents (those trees in which the foliage receives minimal browsing) (Miller et al. 1991). Alverson et al. (1988) provide another suggestion that could lower waawaashkeshi in certain key areas by establishing reserves of contiguous habitat where timber harvest would be excluded. These reserves would initially measure approximately 200 to 400 km^2 (50,000 to 100,000 acres). With increasing canopy cover, forage opportunities would decline and eventually encourage the movement of waawaashkeshi to other areas.

Interestingly, tribal elders never raised concerns about browsing by waawaashkeshi. This lack of

concern might stem from the fact that tribal hunting regulations tend to lower the number of waawaashkeshi on tribal reservations, which apparently leads to higher giizhik seed sapling survivorship. The FIA data for Minnesota and Wisconsin tribal lands seem to support this conclusion. Furthermore, on the Menominee Reservation, year-round hunting has maintained low numbers of waawaashkeshi, which seems to have sustained the healthy regeneration of another browse sensitive plant species, bagandag (Canada yew, *Taxus canadensis*) (Alverson et al. 1988). Thus, lower numbers of waawaashkeshi would not only benefit giizhik, but additional species equally impacted by browsing such as kaakaagiwanzh (eastern hemlock) and bagandag (Canada yew, *Taxus canadensis*). Some researchers assert that reducing the overall numbers of waawaashkeshi through increased hunting pressure either by humans or other natural predators is likely to be the most effective solution for ensuring adequate giizhik regeneration (Alverson et al. 1988, Anderson and Katz 1993, Heitzman et al. 1997 Cornett et al. 2000).

Further Research Needs

Identifying giizhik population trends could be studied to a greater extend. The FIA data summarized in this report were those accessed online through the USDA Forest Service computer website. Additional data dating back to the 1940's could be acquired directly from the North Central Research Station, a branch of the USDA Forest Service. Furthermore, these data could be statistically analyzed to develop more definitive and detailed conclusions regarding giizhik population trends.

Research should continue on the identified threats including the impacts of timber harvest within and adjacent to giizhik stands, acid rain and pollution, and disease. Though research has documented little damage to giizhik by fungi and other diseases (Johnson 1990), stress from browsing or unfavorable habitat conditions might increase vulnerabilities. Heitzman et al (1997) recommend the study of changing groundwater levels, as Chimmer and Hart (1996) note could have a large impact on microhabitats. Chimner and Hart (1996) further suggest studying other characteristics of microhabitat conditions including soils and associated vegetation. Since giizhik has colonized burned sites in the past, some scientists recommend further study of the role of fire on giizhik regeneration (Heitzman et al. 1997, Simard et al. 1998).

Any attempted giizhik management should be carefully monitored for many years. Initial trials of strip cut harvest techniques in the 1950's and 60's demonstrated successful seedling establishment. However, by the 1980's, it became apparent that many of the seedlings failed to survive. Yet, by that time, many land managers had already incorporated strip cuts into their harvest plans. Consequently, management techniques should continue to be monitored to document significant long-term consequences.

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