W·O·R·K·S·H·O·P P·R·O·C·E·E·D·I·N·G·S

Northern White-Cedar in Michigan

February 21-22, 1990

Ramada Inn
Sault Ste. Marie, Michigan

Edited by:
Douglas O. Lantagne
Department of Forestry
Michigan State University

Agricultural Experiment Station
March 1991 • Research Report 512

Workshop Proceedings for the

Northern White-Cedar in Michigan

February 21-22, 1990
Ramada Inn
Sault Ste. Marie, Michigan

Edited by:
Douglas O. Lantagne
Department of Forestry
Michigan State University
East Lansing, MI 48824

Sponsored by
MSU Cooperative Extension Service
Michigan Department of Natural Resources
Hiawatha National Forest
MSU Department of Forestry

Acknowledgments

I have many people to thank for their effort in planning and managing the Northern White Cedar Workshop. Specifically, I wish to thank the members of the Planning committee: Ed Langenau, Bill Botti, Mike Zuidema, Don Elsing, Mike Lanasa, Ray Miller and Mark Ash. They were extremely hardworking, cooperative and committed to the Workshop's success. I think they succeeded.

Many others worked hard to make this meeting a success, the speakers, you the participants and the group leaders. Slyvia Taylor, David Brownlie, Robert Heyd, Robert Panek, Robert Ojala, Ronald Balcerak, Gary Benes, Eunice Padley, Michael Mang, Russell Kidd, Alan Ettenhofer and Daniel Keathley all volunteered to be facilitators. Little did they realize the tremendous amount of responsibility they were to have in recording and organizing your comments. They worked extremely hard and it is only through their hard work that the conference was successful in combining so many users of the cedar resource into a coherent and forceful voice. Everyone owes these individuals a big thank you for their fine work.

Douglas O. Lantagne
Planning Committee Chairperson

OLE PETE BATEESE

Ole Pete Bateese got chase one night
By wolf up by de Soo.
Dese wolf dey t'ree--four in de pack
And dey scare him tru and tru.

Pretty soon ole Pete climb up a tree;
He t'ink he stay awhile
Dese wolf dey sit down in de snow
And lick dere chops and smile.

Pretty quick two wolf go trot away;
Pete t'ink de rest soon go.
Pretty quick dese wolf come right straight back;
Pete's spirits dey sink low.

For w'at you t'ink dese wolf dey got?
Big beavers---one? No---two:
Dey set dem down beside dat tree
And say, "By gar, now chew "

Dose beavers start in chew dat tree;
Dey chew like beat de band.
Pete t'ink he soon be on de groun'
Unless he take a hand.

So Pete pull out his one-quart hooch
And let it run out slow.
It trickle down de trunk to where
Dose beaver chew below.

Dose beaver dey got drunk, by gar,
Dey don't see none too good.
Dey make mistake and chew de wolf
Instead of chew de wood,

Dose wolf run 'way, and Pete climb down
And sit down in de snow,
And cry and cry to t'ink for where
His one-quart hooch she go.

De moral of thees stori?
The next time you up by de Soo,
And de wolf chase you.
Take two quarts t'at way you drink one
While you cry about de ut'er.

Table of Contents

Northern white-cedar Workshop: Introduction and Goals

Douglas O. Lantagne
Department of Forestry
Michigan State University
East Lansing, MI 48824

Welcome to the Northern White-cedar Management Workshop. In order for this workshop to be successful, your participation will be required; be prepared to work. The presentations will provide background information, but it will be your identification of northern white-cedar management problems and solutions that will be the major outcome of this meeting.

As a reminder I will reiterate the objectives of the workshop. The first is to focus attention on the potential for cooperative management of the northern white-cedar resource by the many different user groups interested in this important resource. Second, provide the forum for discussions on the management of the northern white-cedar resource by you, the representatives of the user groups. A forum and your willingness to discuss the aspects of northern white-cedar management will determine the outcome of this workshop. Your participation is the key to the success of this meeting. Third, investigate and evaluate the options for integrated management of the northern white-cedar resource and lastly, produce a list of management recommendations and research needs. The group must be willing to listen to each other and critically evaluate what is needed to insure the long-term availability of the northern white-cedar resource at some level for all users.

The objectives of this meeting are rather large. However, through the use of small groups we may be able to accomplish our task. The speakers that follow will provide you a set of facts, so that in the small groups we can discuss issues, not debate perceptions. The one thing I and the committee stress and believe is the need to work as a multi-disciplinary group in order to solve the social and biological problems associated with the management of northern white-cedar in Michigan. I must stress to those from out-state and Canada that this meeting will be oriented towards Michigan. We are not looking for specific answers to northern white-cedar regeneration problems because otherwise we would have entitled this work shop "northern white-cedar regeneration in Michigan". As a group we should map out a path which a smaller steering committee is able to follow to begin addressing northern white-cedar regeneration problems in this state.

The committee appreciates the interest that has been shown in this topic. It is something that the committee has talked about for two years and has been planning for a year. The speakers this afternoon will present information that will help us better understand how to think about the northern white-cedar resource. It is not a matter of saying we are here to talk about northern white-cedar, but which northern white-cedar? Upland northern white-cedar? Lowland northern white-cedar? Are we here to talk about the importance of northern white-cedar to water, fiber industries, wildlife habitat, conservations and/or preservation groups? What are the conditions of these northern white-cedar stands. Are they in prime condition for use as saw timber, northern white-cedar logs, wildlife habitat, water filtration? Are they in a condition where they can fully meet the needs of our society? Or are they in a deteriorating condition? Can we see a time in the future when this resource has become degraded more than it is now? These are questions which our speakers will address. We as individuals must remember these questions when we are in our discussion groups. The final speaker will discuss management options for northern white-cedar. The authors of this paper may be wrong, but at least they are have put forth their ideas on management options for this resource.

The speakers will give us a good jumping off point for our specialty discussion groups. As groups of forest managers, silviculturists, researchers, wildlife biologists, industrial foresters and conservationists you will answer three specific questions: Why is the northern white-cedar resource important to our specialty group? How does my specialty group help manage the northern white-cedar resource? What are the biggest obstacles to our group managing this resource for our needs? I encourage every member of each

group to air their ideas so that a groups answers and comments can be carried forward. These comments will be the jumping off point for tomorrow morning. Specialists groups will be disbanded and individuals assigned to a multi-disciplinary group. The multi-disciplinary groups will work as a unit using specialist group input to develop strategies for pursuing the needs in northern white-cedar management.

We have a lot to accomplish within a 24 hour span. We only have a short intense period of time to think, breath, smell and discuss northern white-cedar. Make use of the different backgrounds, and the different viewpoints represented in this group. I would suggest that the most productive way you can spend this time is by actively participating in your working groups, actively participating by asking questions and actively getting your thoughts down on paper. The proceeding will try to capture your ideas. Lets move forward as multiple professions in a multi-disciplinary mode to tackle the issue of northern white cedar management in Michigan. Again, I say "Welcome". Let's move on with the conference. Thank you.

The Importance of Cedar in Michigan's Forest History

Wendell Hoover
Park Naturalist
Hartwick Pines State Park
Grayling, MI 49738

What species and the distribution thereof made up the pre-settlement forest of this state may be open to debate, but there is no question that it was an extensive forest or the land surveyors of the 1830's and 40's would not have made mention of it so frequently in their notes. The old surveyors were gone long before my time, but I had the privilege of conversing with men who had been in that forest and helped cut it down. One conversation comes to mind with an Old Timer from the Gladwin area, who in his search for employment walked a trail from Meridith to Prudenville, a distance crowding eighteen miles, and stated he could not see the sky or the horizon due to the thickness of the forest. He was only one of several who made similar comments about the forest as it once was. One old time shanty boy wrote that "if we had only been a bit more careful, a bit more slow, we would still be logging".

Estimates of the amount of land on which marketable pine timber was found in Michigan varies from as little as 13 million acres to as many as 18 million acres. Considering that this state has a land area of 37,258,240 acres, nearly half was covered with white and red pine. It ranged in diameter from a meager eight inches to as much as ten and twelve feet. Some of those trees scrapped the sky at 220 feet in height.

Rolland Maybee, in his book Michigan's White Pine Era, wrote that in the period from 1840 to 1900 161 billion board feet of pine was cut. During those years, he estimated that a billion sawlogs were reduced to lumber, starting with 435 sawmills in 1837 to well over 1600 mills counted in the state census of 1873. For those sixty years, the average price of a thousand board feet of pine lumber was $13.00. It varied from a ridiculous $6.00 per thousand to an outrageous $26.00 per thousand.

Keep in mind the waste from the woods to the sawdust pile. In the early days, if a pine wasn't exactly straight, leave it. There was a better one next to it. Consider the fires that have been estimated to have destroyed three out of five trees. Also consider the vast number of logs lost in the rivers when they were pushed over the banks or into the bottom by the shear volume of logs being transported by water. And finally consider the volume of fine lumber consumed by the kerf of the insatiable circular saws.

Not all of the logs cut by men in the woods or milled into lumber or other products was pine. During that same 60 year period, Maybee stated that about 50 billion board feet of northern white-cedar, hemlock and a variety of hardwoods was also cut. It is interesting to speculate on the width of the plank sidewalk you could have built across this nation with the 211 billion board feet of lumber sawed in those 60 years.

In 1869 there were 6000 men working in the forests of Michigan with another 3000 in the mills of just the Saginaw Valley alone and by 1884 there were 40,000 men working in the logging camps of Michigan, not to mention those working in the mills. There are very few or perhaps none of those men left; even those who got in on the tag end of the cut are few in number. When I first started working at the Hartwick Pines State Park, those silver haired old timers were still able to visit the park. Memories were sharp and the gestures of work gnarled hands were expressive. What impressed me most besides the memories translated into stories, was the look on those men's eyes. While somewhat bored relatives stood by, those old men let me know what they missed most. I don't believe it was the food, the spring sprees in town or the camaraderie of the bunkhouse; it was the forest they missed and remembered most. I've seen the wonder in a child's eyes as he gazes up at a stately tree, but the most heart rending thing has been the tears in the eyes of an Old Timer as he remembered the forest of his youth.

Not all of the trees cut were pine or hardwood. A major portion of the cut was northern white-cedar which records and remembrances indicate was included in the pine cut. In the early days northern white-cedar

was used primarily for shingles, poles and mine timbers. Those needs and usage haven't changed a great deal even today.

It is interesting to note that northern white-cedar was the wood of choice for the early survey stakes. Its durability assured that the meets and bounds of the pine lands would be identifiable for many years to come. The Tree of Life, as it was called by an early French king when he was informed that his explorers had been cured of scurvy with a drink made from the tip ends of the leaves, has thus served mankind for a very long time.

The durability of northern white-cedar made it an excellent choice where contact with the soil was necessary. Northern white-cedar was used primarily for lagging in the mines. Mining companies often had their own logging operations to supply their need for timbers of various kinds. Northern white-cedar was cut into six foot lengths in the woods before transporting it to the mines.

The demand for railroad ties was great when one considers the increase in just railroads used for logging in a seven year period. In 1882 there were 32 railroads used primarily for logging in Michigan, but by 1889 there were over 90 such railroads in operation.

A mile of main line used 3200 eight foot ties while a mile of spur line used only 2600 ties. At one point during the mid 1880's there was an estimated 450 miles of main line logging railroad in this state which equates out to 1,440,000 ties. In addition, consider the needs of the telegraph and the later telephone companies who used 40 poles per mile or the farmer who needs 640 to 700 posts to fence a mile.

While tie or post camps may not have been as numerous, nor as large as the pine camps, the volume required for various needs made it a certainty that where northern white-cedar was abundant there were men to cut it. A tie or post camp usually was comprised of twenty-five to seventy-five men. Most northern white-cedar was cut during the winter and hauled to a yard adjacent to a railroad where it was peeled and sorted. The men who worked in such camps were piece workers, but there wasn't much piece work done before the late 1890's or 1900.

The tasks performed by a tie maker, for example, were as demanding physically and nearly as dangerous as working in big timber. Most tie makers felled, hewed, cut and piled their own ties and a good one could make up to fifty a day. First of all, the tree had to be cut fairly low but it wasn't cut cleanly off. The trunk was left attached to the stump and then trimmed, all except for some of the branches which would hold the trunk above the snow while the hewer scored and hewed the trunk so that it had two flat sides. Once this had been done the tree trunk was cut into lengths and piled along the hauling road. A tie maker was paid about ten cents per tie.

Keep in mind that in the 1920's piece workers were paid seventy five cents a day for their meals and wouldn't stop much for lunch because the price per piece had dropped to about four cents. By the time I got to the woods and was doing piece work in the early 1950's, the woods worker had got a heck of a raise. We were paid six cents per piece. It is no wonder that during the depression of the thirties, men were known to work for just bed and board.

The men who did piece work were just as unique as other woods workers of the day. Many chose piece work, simply because they did not work well with a partner or because they wanted more control of what they did and how it was done.

That they were characters has been borne out by the stories that have come down to us. A park visitor told me about a relative of his who sought work wherever he could and one season he was bookkeeping in a camp where posts, ties and poles were being cut. When the swamps got too soft to work in some of the crew turned to cutting and peeling hemlock. My informant explained that when the men got to town they avoided fights with the bark peelers. When I asked why, he explained, "that as the weather warmed up, the mosquitoes and blackflies became a plague on the land". To keep them at bay the men resorted to bear

grease and pine tar which became liberally mixed with the red pitch of the hemlock. He went on to say that not only did the bear grease get rancid and smelled terrible, but that the pitch was so damned sticky you couldn't let go of the man once you got a hold on him.

A piece maker generally carried his own tools from camp to camp. The tools included a broadax, ax and saw. For many years there have been what we called Swede Saws, used in the cutting of ties, posts, poles and pulpwood.

The first saws used for piece work were the wood framed bucksaws, which had a blade some two inches wide and only two feet or so long. This blade had straight teeth without rakers. Needless to say, it wasn't the most efficient cutting tool, but then someone discovered by leaving two teeth, then removing two, that the bucksaw cut a lot faster. Then the next thing was a saw with raker teeth and that was still faster. According to one source, it was the Finns who helped make the bucksaw the standard saw for piece work. They would make blades from phonograph springs by unwinding and filing small teeth on it, they made an excellent saw for frozen wood. In the 1930's the once familiar steel-frame pulp saw became common. Perhaps the saw should have been called the Finn Saw, but because large quantities came from a factory in Sweden, it became known as the Swede Saw instead. Even with a good saw it took a healthy young man two months to learn the knack of cutting two cords a day. If you couldn't cut two cords a day you were done.

To keep any crew of men healthy took good food and lots of it. The first question a man often asked was "Who's the boss?" and his next was "Who's cooking?" In the early years camp food was limited pretty much to salt pork, hardtack, dried peas, dried apples and molasses. Some of the early camps were so remote it was difficult to get provisions in and when the diet got too monotonous, the crew would go out on Sunday to hunt or fish. Some camps located in areas where wild game was available would purchase wild game from market hunters. Venison or beaver sold for two cents a pound. While there wasn't often a lot of such game to be had it did provide welcome variety. In one camp, members of the crew took over for the cook on Sunday so he could indulge in his favorite pastime, which was hunting rabbits, which in turn supplemented the men's diet.

It wasn't until cook stoves were introduced into the cook shanties that the quality and quantity of the food improved. A hundred-man camp with twenty horses consumed 1700 pounds of food and fodder a day -- seventy-five to a hundred pounds of beef a day, a bushel of cookies, three bushels of potatoes, thirty pies - apple, mince, cherry, raisin, lemon and prune, twenty one-pound cans of condensed milk, two gallons of canned apples, thirty-six to forty loaves of bread, two hundred doughnuts, ten yeast cakes, forty pounds of sausage, twenty-five pounds of liver, two gallons of molasses plus cabbage in the fall and turnips in the winter. It probably isn't necessary to mention tea, coffee, oatmeal, beans and prunes.

Cooks, no matter what type of camp, were autocrats and often ruled the cook shack with an acid tongue and a rolling pin. While highly paid, he or she worked hard for those wages. The day often started about 3 a.m. and the cook would still be working at 8 p.m.

In the early camps the cooking was done on a raised platform of sand held in place by a framework of logs under a smoke-hole in the roof. Such a cook-sleeping shanty was called a cambuse. At such a camp the men got to teasing the cook about how good he was at flipping pancakes in the air with his pan and then catching them. The cook bragged that he could throw a pancake out of the smoke-hole in the roof and catch it outside the building as it came down. Of course, such a bet and brag couldn't be left alone and in due course a great spreading batch of batter was poured into the frying pan. While the griddle cake browned, the track to the door was cleared and the crisis came. The cook estimated the distance to the hole overhead and the door, calculated the time that would be required for the cake to descend, braced himself and sent the steaming flapjack on its way. He turned and rushed for the door, but struck his head on the low lintel and went out like a stunned ox. While not seriously injured he had to endure a lot of bad jokes about his flapjacks for the rest of the season.

There have been and there will continue to be stories told wherever men gather about working in the woods. There will never be another log drive in this state, or a brag load hauled with two horses. There will never be a saloon full of ham fisted shanty boys blowin'er in, but if we are careful with our resource there will be stories of feats performed with chain saw and skidders.

LITERATURE USED

Bacig, T. and Thompson, F. 1982. Tall Timber: a pictorial history of logging in the Upper Midwest. Voyageur Press, Bloomington, MN. 152p.

Holbrook, S. 1971. Hold Old Mackinaw: a natural history of the American lumberjack. Ballantine Books, Comstock edition, New York, NY. 274p.

Mackay, D. 1978. The Lumberjacks. McGraw-Hill Ryerson, New York, NY. 319p.

Maybee, R.H. 1960. Michigan's White Pine Era 1840-1900. Michigan Historical Commison, Lansing, MI. 55p.

Pike, R.E. 1967. Tall Trees, Tough Men. W.W. Norton, New York, NY. 288p.

Ryan, J.C. Early Loggers in Minnesota, Vols. 1, 2, 3. Minnesota Timber Producers Association, 200 Christie Building, Duluth, MN.

Wells, R.W. 1978. Daylight in the Swamp. Doubleday, Garden City, NY. 240p.

The Ecology of Northern White-Cedar

Kurt S. Pregitzer
Department of Forestry
Michigan State University
East Lansing, Michigan 48824

Northern white-cedar (*Thuja occidentalis* Linnaeus) is a small to medium sized tree typical of northern conifer-hardwood swamps. Individual trees rarely exceed 25 m in height and 80 cm in diameter. Heights of 10 to 15 m and diameters of 30 to 60 cm are more typical of mature second-growth forests. Northern white-cedar (cedar) is considered shade-tolerant and individuals have the potential to live more than 500 years. Cedar often dominates the lower portion of the canopy of a swamp forest with other hardwood and conifer species dominating the upper canopy. Trunks are highly tapered and sometimes divided into two or more secondary stems. Because of the poor aeration of swamp soil, root systems are shallow and spreading, and large structural roots protrude above the ground. Windthrow is common in cedar swamps. Windthrow in combination with the ability to reproduce vegetatively results in trees of unusual form; highly curved and peculiar trunk shapes are common.

The cedar swamp association has been considered to be the final stage of plant succession on alkaline organic soil (Gates 1942). But cedar swamps are not regenerating naturally like late-successional upland forests. Why are these supposedly tolerant trees not reproducing? The objective of this paper is to review the ecological and life-history attributes of northern white-cedar. In doing so, I hope that others will be able to tackle the practical question of cedar regeneration with a better appreciation of the ecology of this important and interesting species.

LANDFORM, SOIL AND STAND COMPOSITION

Lowlands

Cedar dominated lowland swamps are critical winter habitat for the white-tailed deer *(Odocoileus virginianus borealis* Miller) in northern Michigan (Nelson 1951). They are important in terms of both thermal cover and forage. The composition of lowland cedar swamps is highly variable and cedar rarely occurs in extensive pure stands.

Depressions in glacial terrain where ground water is at or near the surface are characteristically dominated by cedar and other lowland species. These lowland habitats can occur in a variety of landscape positions: in former glacial drainways, on outwash plains, in a band around the perimeter of a kettle hole, between glacial drumlins, or along the margin of contemporary lakes and streams.

Since the close of the Pleistocene, these poorly-drained topographic depressions have filled with organic matter commonly known as peat. The ground surface is hummocky due to continual windthrow with poorly drained pits and organic mounds. Such microrelief results in substantial variability in pH and substrate composition. The result is tremendous micro-diversity in both habitat and species composition; cedar swamps can be some of the most diverse plant communities in the Lake States.

Poorly-drained organic soils vary widely in terms of pH, dissolved oxygen, nutrient content, and degree of organic matter decomposition. The literature clearly indicates that cedar prefers organic matter where the pH is neutral to basic (pH 6.0-8.0) and where rates of organic matter decomposition are relatively rapid (Curtis 1946, Nelson 1951, Habeck 1958, Heinselman 1970, Schwintzer 1981). Schwintzer (1981) suggests that conifer swamps are related developmentally to water flow and chemistry. His data agree with my own personal observations. Cedar dominated forests develop where the ground water contains relatively high concentrations of oxygen and essential nutrients and where it moves laterally through the soil. These conditions result in finely decomposed organic matter and a high pH, characteristics of a good

cedar soil easily identified in the field. Lateral movement of oxygen and nutrient laden water through the soil may be why cedar swamps typically occur as bands in wetlands and along lakes and streams. As soon as the hydraulic gradient lowers and water stagnates, soils become highly acidic. Acidic organic deposits are often dominated by bog vegetation, e.g. black spruce (*Picea mariana* (Miller) BSP).

The composition of cedar swamps is highly variable and these forests are some of the most diverse in Michigan. Cedar rarely forms pure stands over extensive lowland areas. Typically cedar is found growing in association with other lowland hardwood and conifer tree species. Tamarack (*Larix laricina* (Du Roi) K. Koch), balsam fir (*Abies balsamea* (Linnaeus) Miller), white spruce (*Picea glauca* (Moench) A. Voss), black spruce (*Picea mariana* (Miller) BSP), and hemlock, (*Tsuga canadensis* (Linnaeus) Carriere) are common evergreen associates. Several lowland hardwoods are commonly found in cedar swamps: black ash (*Fraxinus nigra* Marshall), red maple (*Acer rubrum* Linnaeus), yellow birch (*Betula alleghaniensis* Britton), balsam poplar (*Populus balsamifera* Linnaeus) and speckled alder (*Alnus rugosa* (Du Roi) Sprengel). In addition, many upland hardwoods and conifers can be found growing well in cedar swamps; basswood (*Tilia americana* Linnaeus), sugar maple (*Acer saccharum* Marshall), trembling aspen (*Populus tremuloides* Michaux), paper birch (*Betula papyrifera* Marshall) and white pine *(Pinus strobus* Linnaeus) are good examples.

Cedar, because it grows slowly and rarely reaches 20 m in height, often is found in a subordinate canopy position. Although cedar may dominate in terms of basal area, tamarack, balsam poplar, trembling aspen and paper birch often tower 5 to 10 meters above the slow growing cedar. Thus, the cedar swamp commonly exhibits a two-storied stand structure. Black ash, red maple, yellow birch and sugar maple are usually found in the lower third of the stand diameter distribution, although large-diameter individuals do occur. White spruce, balsam fir and hardwoods occur on low ridges or elevated microsites. Alder is confined to flooded areas.

The mosaic of dominant vegetation in the cedar swamp is quite interesting. Cedar itself is typically found in small, relatively pure patches. These seem to occur in areas where the water table is at or very near the surface and is moving, such as the edge of a low ridge or along a small stream. The pure patches of cedar will give way over short horizontal distances to tamarack, spruce, and fir or patches of lowland hardwoods such as black ash, balsam poplar, and trembling aspen. This vegetation mosaic is continually changing in both time and space – the result of microrelief, a constantly changing water regime and windthrow. Low sandy ridges dominated by upland vegetation are very typical linear features in a cedar swamp. A change in elevation of just a meter or two can result in a completely different forest community.

The lowland cedar swamp is highly variable and discrete patches of vegetation dominated by one or more species are the exception rather than the rule. Nonetheless, large areas of wetland in Michigan are dominated by what might be best termed a "conifer-hardwood swamp on neutral to basic peat." Cedar is often a dominant or co-dominant member of this common lowland forest.

Uplands

Upland or "old-field" stands of cedar have been reported for many years (Potzger 1941, Curtis 1946, Nelson 1951, Habeck 1958, and Musselman et al. 1975). Upland cedar forests are found growing on the following substrates: sand dunes, limestone bedrock and shallow soil overlying limestone, and rich, basic mineral soil (pH 7.0). The common denominator in all of these upland habitats is soil with a high pH. Cedar forests are more or less confined in the uplands to soils with free calcium carbonate close to the surface.

Another common observation is that upland cedar forests invade open areas: old fields, clearcuts, sand dunes, and limestone bluffs. These situations are, in fact, the only ones where seedling establishment and recruitment are clearly the mechanism of stand regeneration. Second-growth upland cedar forest can range from relatively pure stands of cedar, to cedar mixed with virtually the entire complement of upland tree species.

Potzger (1941) suggested that cedar in northern Michigan possessed ecotypes because of its presence in upland and lowland habitats on Mackinac Island. Both Habeck (1958) and Musselman et al. (1975) further investigated the concept of localized ecotypes of cedar. Each concluded that there was evidence of genetic differentiation between upland and lowland populations. In programs of artificial regeneration, consideration should be given to the fact that local ecotypes could exist. Lowland vs. upland seed should be used to reforest the appropriate habitat.

NATURAL REPRODUCTION

Northern white-cedar is a dependable seed producer. It bears good seed crops every 3 to 5 years, with light to medium crops in the intervening years (Johnson 1977). Seed production *per se* does not appear to limit natural regeneration. Although seed viability is low, production is abundant and, compared with other tree species, relatively consistent year to year. Seed dispersal by wind starts in September with the majority of seed falling during autumn. Some seed is dispersed during winter. Most seed is dispersed within 50 meters of the mother tree. Many experts have recommended small block or strip clearcuts for this reason (Verme 1965).

Abundant seedling establishment occurs naturally on a variety of substrates (Nelson 1951, Scott 1984). Seedlings can establish on bare organic and mineral substrates, moss mats, and down logs in various stages of decay (Nelson 1951, Curtis 1956, Scott 1984, Verme and Johnson 1986). Both Nelson (1951) and Scott (1984) report that seedling establishment is numerically greatest on logs, but Scott (1984) correctly points out that numbers of seedlings are not necessarily related to recruitment success. It is unclear if seedling establishment on logs was common in old-growth cedar forests before European settlement. It seems doubtful because “stilt rooted” individuals are uncommon and because down logs are still frequent due to blowdown (although today’s seedlings may not recruit because of browsing).

In the field, light in the forest understory is not a factor regulating seedling establishment (Nelson 1951). Seedling establishment is positively related to soil pH (Nelson 1951, Scott 1984). Verme and Johnson (1986) report the highest level of seedling establishment on sites that were burned. It is important to understand that seedling establishment is abundant under a wide variety of ecological conditions. Seedling establishment is not limiting cedar reproduction.

Recruitment of seedlings into the sapling, pole and mature tree size classes appears to be the primary factor limiting natural cedar reproduction. Scott (1984) estimated that 99% of the initial seedling cohort had died by year 13. As I examined the literature I could find no clearly documented cases where lowland cedar had been successfully regenerated through seedling establishment and recruitment. In fact, except for small seedlings that are covered by the annual snowpack, there are very few reports of any large, advanced cedar reproduction. The virtual lack of larger seedlings and saplings in lowlands is probably due to browsing by the white-tailed deer. Small cedar die when more than 15 to 20% of the foliage is removed annually (Aldous 1952). Seedlings often grow very slowly; it can take 20 years for a seedling to reach 1 meter in height (Nelson 1951). Because cedar grows slowly, seedlings are exposed to browsing pressure for a relatively long time. The only successful reports of sexual reproduction comes from the uplands, exclosures, and lowlands that are not utilized by the deer for thermal reasons (Verme 1965). Interestingly, there were many references to advance cedar reproduction in the original land surveyor notes (see below).

Cedar can and often does reproduce by layering or tree tipping. Nelson (1951) reports that branch layering (where a branch of the parent stem transforms into a stem) is the predominant type of vegetative reproduction. The presence of a thick sphagnum moss mat facilitates the formation of adventitous roots and branch layering (Nelson 1951). Trees also can be blown over and the lateral branches then become main stems. When several small stems are found in a perfect row this is undoubtedly the mode of vegetative reproduction.

Vegetative reproduction via layering and blowdown appears to be a major pathway for successful regeneration in the lowlands. Reports of vegetative reproduction are abundant in the literature. Old photographs depicting advanced regeneration (e.g. Nelson, 1951) and personal observations lead me to believe that many of today's "seedlings" and sapling are the result of vegetative reproduction, not seedling establishment and recruitment. It might well be that cedar, once established, is able to perpetuate itself on a site by vegetative reproduction. Perhaps seedling reproduction followed large-scale blowdown or fire in the primeval forest and persistence occurred through layering and tree tipping.

The notion that "cedar typically occurs in the understory and eventually replaces the overtopping associated species" is a myth that should be eliminated. Cedar almost never "overtops" any other tree simply because it grows so slowly and rarely reaches even 20 meters in height.

Cedar is long-lived and very capable of persisting in a stand. It may simply outlive most associated species. It's occurrence in the lower portion of the canopy and ability to persist have led to the idea that cedar is very tolerant and a late successional species. In 1946 Curtis (1946) wrote:

"Evidence supports the belief that cedar is not so tolerant as formerly believed. This fact is emphasized by the scarcity of advance reproduction, especially seedlings, over one foot in height in all stands containing cedar."

In fact, the only places seedling recruitment occurs are sand dunes, old-fields, clearcuts and burns. Perhaps cedar is a slow growing, shade tolerant, long-lived **pioneer species** capable of persisting by means of vegetative reproduction. Demographic studies of existing stand structure might help us understand how and when cedar established relative to its associates. Are many second-growth stands even aged? Did they establish following major disturbance at the turn of the century?

SUCCESSION

Presettlement Vegetation

Due to deforestation at the turn of the century, continued forest management and artificially high white-tailed deer populations, it is conceivable that the composition of cedar swamps today is different than those of presettlement time. To examine this possibility, I reviewed some of the original land survey records from the Upper Peninsula of Michigan. Maps published in 1977 by the Michigan Department of Natural Resources identify "core deer yards". The original surveyor records from three of these core deer yards were examined (Table 1).

Although no quantitative study was made of the presettlement vegetation compared to the composition of present cedar swamps, it is clear that the general composition of today's forest is very similar to the cedar swamps of presettlement time. All of the three areas examined (Arnold, Danforth, and Whitefish River) were dominated by cedar, tamarack, fir, and spruce over 150 years ago before any timber harvesting. In fact, the surveyor notes convey a picture of forest composition that is remarkably similar to contemporary cedar swamps. The original forest was a mosaic of conifer swamp and upland hardwood-conifer ridges. Cedar was a commonly recorded line tree as the surveyors established section boundaries in the lowlands (Table 1). Spruce, fir, tamarack, balsam poplar, alder, and aspen were all mentioned along with cedar as the surveyors traversed the swamps. Occasionally, cedar was recorded in the uplands. One notable difference occurs between present and presettlement forests: cedar and ground hemlock (*Taxus canadensis* Marshall) "undergrowth" were frequently mentioned in the original land surveyor notes. Such "undergrowth" is notably absent from today's forest, almost surely due to over browsing by the white-tailed deer.

Algernon Merryweather, a Deputy Land Surveyor, recorded the following general comments as he finished surveying the boundaries of Township 42 North, Range 21 West (Whitefish River deer yard north of Rapid River, Michigan) on the 9th day of September, 1842:

"The greater part of this township lies in the valley of White Fish and Rapid Rivers, which valley is enclosed by a bluff in the East from 70 to 100 feet high and on the west side from 40 to 50 feet. The first of these bluffs is very springy and generally runs into cedar swamp extending to the river. The land rises higher in the middle of the Valley where are some fine ridges of sugar, elm, and basswood ... but the larger portion of the valley is hemlock, cedar, tamarack, spruce, birch and polar ."

Both the detailed line transects and general comments suggest that today's cedar swamp is very similar to those that existed in the same locations more than 150 years ago, except for today's lack of cedar and ground hemlock understory.

Windthrow

Blowdown is extremely common in cedar swamps and is a major form of natural disturbance. Completely and partially uprooted trees abound. When trees tip only partially, lateral branches assume dominance and the resulting trees are unusually shaped. Gaps range in size from an individual tree to relatively large areas. It is possible for very large areas to blow down during severe thunderstorms and as the result of occasional tornadoes.

Gap formation in the presettlement cedar swamp probably encouraged the release of vegetative reproduction (individuals that established by layering) and perhaps, when gaps were large enough, even resulted in seedling establishment and recruitment. Today, most blowdowns simply release advance spruce, fir, and hardwood regeneration, or the gaps are colonized by intolerant hardwoods and conifers like trembling aspen, paper birch, balsam poplar and tamarack. Some cedar reproduction still occurs in gaps, especially when trees are only partially uprooted and lateral branches remain beyond the reach of deer. But because there is little chance for natural reproduction to grow above the browse line, cedar does not generally regenerate in areas that are disturbed by wind. Thus, one of the primary modes of natural regeneration has been eliminated by the white-tailed deer.

Fire

The role of wildfire in cedar swamps is not well understood. Where individual investigators have attempted to burn swamps, seedling establishment has been promoted (Verme and Johnson 1986). There seems to be little doubt that cedar swamps burned naturally during exceptionally dry years. I have often noticed evidence of wildfire in the swamp; charred stumps are not unusual, especially along the edges of the low ridges that typically occur in the swamp mosaic. However, historical studies documenting the frequency of fire in cedar swamps have, to my knowledge, not been attempted.

Assuming that swamp forests did burn during exceptional years, it is likely that such fire promoted cedar establishment. We know that successful seedling regeneration today only occurs in open areas, and wildfire would have reduced competition and created an open environment. It is my suspicion that many of today's second growth cedar forest established following logging and wildfire. The second growth forests of today established before the first explosion of the white-tailed deer population and, therefore, were not subject to such intense browsing pressure.

Detailed studies of the age of individual tree populations and the structure of today's second growth forest might help us understand how cedar regenerates naturally following logging and in the absence of intense browsing pressure. Prescribed fire is a management tool that deserves additional investigation in the cedar swamp. But any practical attempt to study silvicultural systems in cedar forests is bound to be totally confounded unless the influence of deer is factored out. It is my belief that deer are the primary force inhibiting natural cedar regeneration and their influence is so pervasive as to render more field experiments totally useless unless deer are excluded from the experimental or trial area. The effect of white-tailed deer on cedar regeneration should be our number-one silvicultural priority.

LITERATURE CITED

Aldous, S.E. 1952. Deer browse clipping study in the Lake States region. J. Wild. Manag. 16:401-409.

Curtis, J.D. 1946. Preliminary observations on northern white-cedar in Maine. Ecol. 27:23-36.

Gates, F.C. 1942. The bogs of northern lower Michigan. Ecol. Monogr. 12:213-254.

Habeck, J.R. 1958. White cedar ecotypes in Wisconsin. Ecol. 39:457-463.

Heinselman, M.L. 1970. Landscape evolution and peatland types, and the environment in the Lake Agassiz Peatlands Natural Area. Ecol. Monogr. 40:235-261.

Johnson, W.F. 1977. Manager's handbook for northern white-cedar in the north central states. USDA For. Ser. Gen. Tech. Report NC-35.

Musselman, R.C., D.T. Lester, and M.S. Adams. 1975. Localized ecotypes of *Thuja occidentalis* L. in Wisconsin. Ecol. 56:647-655.

Nelson, T.C. 1951. A reproduction study of northern white-cedar. Game Division, Dept. Conservation, State of Michigan. 100 p.

Potzger, J.E. 1941. Vegetation of Mackinac Island. Amer. Midland Naturalist 25:298-323.

Schwintzer, C.R. 1981. Vegetation and nutrient status of northern Michigan bogs and conifer swamps with comparison to fens. Can. J. Bot. 59:842-853.

Scott, M.L. 1984. Growth dynamics and successional trends in an old-growth, cedar-hardwood dune forest. Ph.D. dissertation, Mich. State Univ., East Lansing, MI 122 p.

Verme, L.J. 1965. Swamp conifer deeryards in northern Michigan: Their ecology and management. J. For. 63:523-529.

Verme, L.J. and W.F. Johnson. 1986. Regeneration of northern white-cedar deeryards in Upper Michigan. J. Wild. Manag. 50:307-313.

Wildlife Values Of Northern White-Cedar

Robert V. Doepker
Wildlife Division
Department of Natural Resources
Norway, MI 49870

John J. Ozoga
This paper is a contribution from Federal Aid Wildlife Restoration Project W-127-R Michigan, and the Cusino Wildlife Research Station.
Wildlife Division
Department of Natural Resources
Shingleton, MI 49884

The northern white-cedar (*Thuja occidentalis*) forest community occupies approximately 2 million acres in the northern Lake States (Johnston 1977). Of the 1.2 million acres found in Michigan, 69% occur in the Upper Peninsula and 31% in the northern Lower Peninsula (Raile and Smith 1983). The annual timber harvest in Michigan is projected to increase 137% between 1976 and the year 2000 (MDNR 1983), the harvest of northern white-cedar is likely to escalate, thereby yielding certain short- and long-term biological, ecological, economic and social impacts.

Wildlife use of forested habitats is influenced by vegetation characteristics (James 1971, Holmes and Robinson 1981, Thompson and Capen 1988, Morris 1984). Silvicultural practices modify vegetation by altering tree and shrub species, diversity, density, age, and other within- and between-stand (spatial) attributes. Intensive forest management that shortens rotation schedules may alter the composition, structure and spatial arrangement of forested communities. This can have profound effects upon the abundance and distribution of wildlife species (Dickson et al. 1983, Harris 1984, Helle and Jarvinen 1986).

Obviously, those wildlife species that use the northern white-cedar community in northern Michigan will be affected by future cedar management. The objectives of this paper are: (1) identify wildlife species groups associated with developmental stages of northern white-cedar in northern Michigan, and (2) evaluate the probable impact of past, present, and future cedar management practices on wildlife within this northern region. In addition, the blackburnian warbler (*Dendrocia fusca*) was used to demonstrate the significance of within-stand vegetation composition and structure; and the white-tailed deer (*Odocoileus virginianus*) as an indicator of the importance of landscape vegetation patterns and processes.

METHODS

Forest inventory and wildlife survey information from the Escanaba River State Forest (ERSF) and Hiawatha National Forest (HNF) was used to determine wildlife use of developmental stages of northern white cedar in Michigan's east-central Upper Peninsula. For this assessment, the northern white-cedar community includes varying amounts of common associates such as white spruce (*Picea glauca*), black spruce (*P. mariana*), balsam fir (*Abies balsamea*) and tamarack (*Larix laricina*).

Four developmental stages of the northern white-cedar community (regenerating, young, mature, and old) were defined using stand age (Table 1). Wildlife species were assigned to one or more stages employing techniques similar to Niemi and Pfannmuller (1979) and Niemi et al. (1979) based largely upon published material for the Great Lakes region. However, information from other sources, including observations of experienced field personnel, were also considered. A species assignment to a particular developmental stage indicates the animal uses that stage to meet some portion of its basic biological needs. It does not imply all of its requirements for survival and reproduction can be obtained solely from that developmental stage.

Table 1: Wildlife species associated with developmental stages of the northern white-cedar community, according to season of use and special habitat features, in northern Michigan.

SPECIES	Northern White - Cedar Developmental Stages[a]				Season[b]	Special Habitat Features[c]
	Regenerating	Young	Mature	Old		
Birds						
Osprey (Pandion haliaetus)			x	x	S	S.R.
Green Heron (Butorides striatus)			x	x	S	S.R.
Spruce Grouse (Dendragapus canadensis)	x			x	P	E
Ruffed Grouse (Bonasa umbellus)	x			x	P	E
Long-eared Owl (Asio otus)	x				S	S,E,R
Great-gray Owl (Strix nebulosa)			x	x	P	E
Northern Saw-when Owl (Aegolius acadicus)	x	x	x	x	P	S
Pileated Woodpecker (Dryocopus pileatus)			x	x	P	S,R,D
Olive-sided Flycatcher (Contopus borealis)		x	x	x	S	E
Yellow-bellied Flycatcher (Empidonax flaviventris)		x	x	x	S	
Blue Jay (Cyanocitta cristata)	x	x	x	x	P	M
Gray Jay (Perisoreus canadensis)		x	x	x	P	M
Common Raven (Corvus corax)_	x	x	x	x	P	S
American Crow (Corvus brachyrhynchos)	x	x	x	x	P	
Black-capped Chickadee (Parus atricapillus)		x	x	x	P	S,D
Boreal Chickadee (Parus hudsonicus)			x	x	P	S
White-breasted Nuthatch (Sitta carolinensis)		x	x	x	P	S,D
Red-breasted Nuthatch (Sitta canadensis)			x	x	P	S,D
Brown Creeper (Certhia americana)		x	x	x	P	S,D
Winter Wren (Troglodytes troglodytes)		x	x	x	S	S,D
Golden-crowned Kinglet (Regulus satrapa)		x	x	x	S	
Ruby-crowned Kinglet (Regulus calendula)		x	x	x	S	
Swainson's Thrush (Catharus ustulatus)			x	x	S	M
Tennessee Warbler (Vermivora peregrina)	x	x	x		S	E
Nashville Warbler (Vermivora ruficapilla)	x	x			S	
Northern Parula Warbler (Parula americana)			x	x	S	
Yellow Warbler (Dendroica petechia)	x				S	E,R
Magnolia Warbler (Dendroica magnolia)				x	S	E
Cape May Warbler (Dendroica tigrina)			x	x	S	E
Yellow-Rumped Warbler (Dendroica coronata)		x	x	x	S	E
Blackburnian Warbler (Dendroica fusca)			x	x	S	
Black-throated Green Warbler (Dendroica virens)			x	x	S	
Chestnut-sided Warbler (Dendroica pensylvanica)	x				S	E
Bay-breasted Warbler (Dendroica castanea)		x	x	x	S	E
Palm Warbler (Dendroica palmarum)	x				S	
Northern Waterthrush (Seiurus noveboracensis)		x	x	x	S	R,D
Connecticut Warbler (Oporonis agillis)		x	x		S	E
Wilson's Warbler (Wilsonia pusilla)	x				M	R
Canada Warbler (Wilsonia canadensis)		x	x		S	
American Tree Sparrow (Spizella arborea)	x	x			M	E
Chipping Sparrow (Spizella passerina)	x	x			S	E
White-throated Sparrow (Zonotrichia albicollis)	x	x			S	E
Lincoln's Sparrow (Melospiza lincolnii)	x				S	E,R
Pine Grosbeak (Pinicola enucleator)		x	x	x	W	E,M
Pine Siskin (Carduelis pinus)	x	x	x	x	S	M
Red Crossbill (Loxia curvirostra)			x	x	P	M
White-winged Crossbill (Loxia leucoptera)		x	x	x	P	M

a Regenerating – (0-19 years old), Young – (20-99 years old), Mature – (100-149 years old), Old – (150 + years old).

b Season of Occurence: S = Summer, P = Permanent, M = Migrant, W = Winter.

c Habitat Features: B = Banks, D = Dead and Down, E = Edge, K = Rock, M = Mast, R = Riparian, S = Snag, C = Man-made structures

Table 1: (Continued) Wildlife species associated with developmental stages of the northern white-cedar community, according to season of use and special habitat features, in northern Michigan.

SPECIES	Northern White - Cedar Developmental Stages[a]				Season[b]	Special Habitat Features[c]
	Regenerating	Young	Mature	Old		
Mammals						
Arctic Shrew (Sorex arcticus)	x	x	x	x	P	
Masked Shrew (Sorex cinereus)	x	x	x	x	P	D
Pygmy Shrew (Sorex hoyi)	x	x			P	
Water Shrew (Sorex palustris)		x	x	x	P	R
Short-tailed Shrew (Blarina brevicauda)	x	x	x	x	P	D
Star-nosed Mole (Condylura cristata)			x	x	P	D
Keen's Bat (Myotis keenii)			x	x	P	S,E,K,R
Little Brown Bat (Myotis lucifugus)			x	x	P	D,E,S,R
Silver-haired Bat (Lasionycteris noctivagans)			x	x	S	C,E,S
Big Brown Bat (Eptesicus fuscus)	x	x	x	x	P	S,R,C
Hoary Bat (Lasiurus cinereus)			x	x	S	E,R
Eastern cottontail (Sylviiagus floridanus)	x				P	C,E
Snowshoe Hare (Lepus americanus)	x			x	P	E
Least Chipmunk (Eutamias minimus)	x			x	P	D,E,M
Red Squirrel (Tamiasciurus hudsonicus)			x	x	P	D,S,M
Northern Flying Squirrel (Glaucomys sabrinus)			x	x	P	D,S,M
Deer Mouse (Peromyscus maniculatus)	x	x	x	x	P	S,E,D,M
Southern Red-backed Vole (Clethrionomys gapperi)	x	x	x	x	P	E,D
Meadow Mole (Microtus pennsylvanicus)		x	x		P	E
Southern Bog Lemming (Synaptomys cooperi)	x	x	x	x	P	R
Meadow Jumping Mouse (Zapus hudsonius)	x				P	E,D
Woodland Jumping Mouse (Napaeozapus insignis)			x	x	P	R,D
Porcupine (Erethizon dorsatum)		x	x	x	P	S,D
Coyote (Canis latrans)	x	x	x	x	P	M,B,E
Gray Wolf (Canis lupus)	x	x	x	x	P	E,B
Red Fox (Vulpes vulpes)	x				P	M,B
Black Bear (Ursus americanus)			x	x	P	B,D,E,M
Marten (Martes americana)		x	x	x	P	D,S
Fisher (martes pennanti)			x	x	P	S,D
Ermine (Mustela erminae)	x	x			P	R
Long-tailed Weasel (Mustela frenata)	x	x			P	R,S,D
Bobcat (Felis rufus)	x	x	x	x	P	K,D
Moose (Alces alces)	x	x	x	x	P	R,E
Herpetiles						
Wood Frog (Rana sylvatica)			x	x	P	R,D
Blue-spotted Salamander (Ambystoma laterale)			x	x	P	D
Wood Turtle (Clemmys insculpta)			x	x	P	B,D,R

a Regenerating – (0-19 years old), Young – (20-99 years old), Mature – (100-149 years old), Old – (150 + years old).

b Season of Occurence: S = Summer, P = Permanent, M = Migrant, W = Winter.

c Habitat Features: B = Banks, D = Dead and Down, E = Edge, K = Rock, M = Mast, R = Riparian, S = Snag, C = Man-made structures

The blackburnian warbler, a summer resident of Michigan, was selected as an indicator species of mature, coniferous forest habitat conditions for the ERSF management plan. Ecological Management Unit 30 (EMU-30) was surveyed for blackburnian warblers during summer, 1989, as a preliminary step in verifying the blackburnian warbler habitat model (Leefers et al. 1988). Ecological Management Units were delineated by visually comparing the relative abundance and spatial arrangement of different land uses and forest communities, then aggregating areas exhibiting similar landscape vegetation patterns (MDNR 1989).

Twenty-four transects were randomly located within EMU-30 using techniques similar to those of Hill (1986). A transect consisted of eight 2-minute listening stops, at 5-chain intervals, then offset 12-chains perpendicular to the first leg of the transect, and eight stops parallel to the first eight stops, for a total of 16 stops per transect. The initial listening stop was located randomly 1 - 5 chains from the starting point. Vegetation data was collected from 10 sites where singing blackburnian warbler males were located in the survey, and an additional 10 sites where singing males were located incidental to other activities.

Differences in landscape vegetation patterns result from differences in landforms, weather patterns, soils and disturbance history (Forman and Godron 1981, Albert et al. 1986). These variables are important considerations in the management of some wide-ranging wildlife species, and species whose habitat requirements vary by sex, age, or season. The white-tailed deer was used to demonstrate the importance of landscape vegetation patterns and processes when assessing the value of the cedar community to wildlife.

Seasonal movements of white-tailed deer were examined in south-central Upper Michigan during the winters of 1962 - 1969 and 1984 - 1987. Deer were tagged with self-attaching collars (Verme 1962) in a northern Menominee County deer wintering complex. Another 50 deer were live-trapped, ear-tagged and released in the same area in 1989, employing techniques comparable to those of Ozoga and Verme (1984). Subsequent recovery information from tagged animals was determined to the center of the specific square mile, and plotted on a base map to compute the straight-line distance and direction of movement from the wintering area to where deer spent the summer.

SYMAP, a raster (cell) based spatial analysis program (Dougenik and Sheehan 1979), identified core and secondary deer wintering concentrations in the aforementioned deer wintering complex by using 19 years of deer pellet survey data collected over a 23-year (1965-87) period[1] . The peripheral area, which exhibited more limited deer use in winter, was delineated by visually linking areas of similar vegetation patterns, based upon presence, abundance, interspersion, and juxtaposition of land use-forest cover types. The principal summer range of the deer herd was determined by circumscribing an area to encompass the majority of all marked deer recoveries.

WILDLIFE COMMUNITIES

Information on wildlife-habitat relationships was similar for the HNF and ERSF (Figure 1), and therefore the ERSF results were used in this report. There are 286 wildlife species occurring in the central Upper Peninsula; 206 birds, 52 mammals and 28 herpetiles. Of these, 133 (47%) are summer residents (i.e., breeding season only), 103 (36%) are permanent residents; 45 (15%) occur only during migration (in spring and fall) and 5 (2%) migrate to the area in winter (USDA 1986, MDNR 1989). Forested communities were used by 208 (73%) species.

Eighty-four wildlife species (47 birds, 34 mammals and 3 herpetiles) were identified as using developmental stages of the northern white cedar community (Table 1). Fifty-one species were classified as permanent residents, 30 were summer residents, 2 occurred only as migrants, and 1 was present only during the winter. Thirty-nine species used regenerating, 45 young, 62 mature and 64 old developmental stages of northern white-cedar. More permanent residents were associated with mature and old stages (40 and 44 species, respectively) than with the regenerating or young stages (27 and 28 species, respectively).

[1] Northern Michigan University, unpublished data.

The number of wildlife species using cedar in winter declines because 30 of the summer breeding species have emigrated. However, certain species, such as snowshoe hare (*Lepus americanus*), bobcat (*Felis rufus*), and white-tailed deer, intensify their use of cedar with the onset of winter.

Birds

The number of bird species using the northern white-cedar community increases to 47 with the arrival of 28 migrant breeding species in spring. The wood warblers (subfamily *Parulinae*) are an especially abundant and diverse group of summer breeding species that use the cedar community. Fifteen of 22 (68%) wood warblers found breeding in the east-central upper peninsula use cedar. In addition, the Wilson's Warbler (*Wilsonia Pusilla*) and American Tree Sparrow (*Spizella arborea*) are migrants, whereas the Pine Grosbeak (*Pinicoola enucleator*) only winters in this region.

Mature and old developmental stages of the northern white-cedar community support more potential bird species (referred to as species richness) than younger stages. Sixteen of 26 (62%) permanent bird species found in the east-central Upper Peninsula used cedar habitats. More permanent bird species used mature and old developmental stages (14 and 16 species, respectively), compared to regenerating and young stages (6 and 9 species, respectively).

Five of 16 (31%) permanent bird species were associated with all four cedar developmental stages. These included the northern saw-whet owl (*Aegolius acadicus*), blue jay (*Cyancitta cristata*), common raven (*Corvus corax*), American crow (*C. brachyrynchos*) and the pine siskin (*Corduelis pinus*).

Among the eight special habitat features considered in the analysis (Table 1), "edge effect" and presence of standing snags stood-out as major accessory factors influencing bird use of cedar developmental stages. Summer bird species (13 of 28) were especially responsive to edge effects, whereas permanent bird species (8 of 16) were influenced most profoundly by the presence of standing snags. The influence of edge may be over emphasized, however, because several of the species use forested habitats exhibiting the structural and compositional characteristics of regenerating conifer over-topped by more mature conifers. This same type of habitat condition develops where regenerating conifer adjoins more mature conifer habitats. Riparian features, dead and downed woody material, and mast crops were less important, but banks, rocks, and man-made structures had no discernible impact upon bird use of cedar.

Within Stand Features and the Blackburnian Warbler. Cedar was present at 10 of 20 blackburnian warbler singing locations. Cedar basal area averaged 41 sq. ft. (range 2.6 - 114.5 sq. ft.) at these sites. Cedar was the dominant tree species, based on basal area, at four of the 20 sites. These four stands occurred on upland or transition sites, and cedar basal area averaged 75.8 sq. ft. (range 61.9 - 114.5 sq. ft.). Stand age averaged 100 years (range 90 - 112 years). Basal area at the 20 singing locations averaged 99.1 square feet and 32.8 sq. ft. of coniferous and deciduous trees, respectively. Tree canopy closure averaged 77% and understory canopy coverage, 17.6%. Canopy height averaged 53.4 ft and singing trees averaged 57.3 ft in height.

Habitat at male blackburnian warbler singing locations can be generalized as tall, mature, well-stocked, conifer-dominated stands, where males usually sang from near the top of the tallest conifers in the stand. These results are similar to those reported by Titterington et al. (1979), Collins et al. (1982), and Collins (1983).

Bird Species Richness. Findings indicate the potential number of bird species (species richness) is greater in older developmental stages of northern white-cedar. Given the heterogeneous canopy and understory which characterizes older stands, horizontal and vertical vegetation complexity increases the number of niches available for birds. The presence of larger snags in older seral stages provides additional habitat diversity. Conversely, in younger developmental stages of cedar, where vertical and horizontal vegetation structure is simpler and more homogeneous, bird species richness was lower.

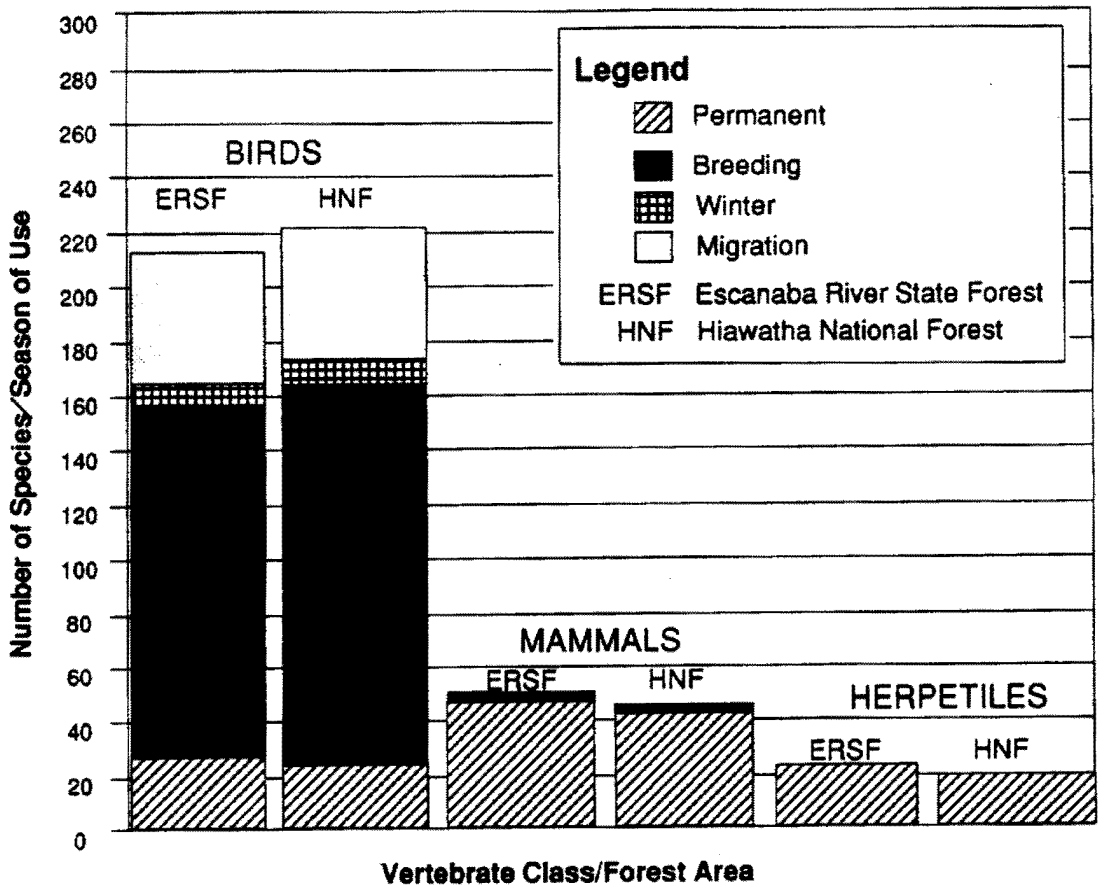


Figure 1: Comparison of data base results, by vertebrate class, and season of use, for the Escanaba River State Forest and Hiawatha National Forest, Michigan

The results support Martin (1960), James (1971), and Titterington et al. (1979) who identified groups of bird species associated with different forest cover types and/or stages of forest development. The positive relationship of potential bird species richness with vegetation complexity and within-stand features such as snags, agrees with Webb et al. (1977) and Niemi and Hanowski (1986). In addition, it supports Roth's (1976) view that bird species richness may be estimated from the horizontal and vertical structure of the vegetation.

Mammals

Thirty-four of 52 (65%) mammal species on the ERSF use the northern white-cedar community. Twenty-one mammals use the regenerating stage, 19 the young, 25 the mature and 27 the old developmental stages. Of the 34 mammals using the cedar community, only the silver-haired bat (*Lasioncyteris noctivaganus*) and hoary bat (*Lasiurus cinereus*) emigrate in late summer to wintering areas in milder climates.

Five species, including the Keen's bat (*Myotis keeni*), little brown bat (*Myotis lucifugus*), big brown *bat (Eptesicus fuscus*), least chipmunk (*Eutamias minimus*), and black bear (*Ursus americanus*) typically enter various stages of torpor during winter in this region.

Unlike birds, the 27 mammalian species classified as permanent non-torpor residents of the cedar community exhibited rather uniform potential species richness among the four developmental stages of the cedar community. Nineteen species use the regenerating stage, 18 the young, 19 the mature, and 20 the old stage. Eleven species (41%) were associated with all four developmental stages of the northern white-cedar community (Table 1).

Special habitat features of particular importance to mammals using northern white-cedar were dead and fallen woody materials, edge, and standing snags (which influenced the distribution of 17, 16, and 11 species, respectively). Less influential factors, in decreasing order of importance, were riparian features, mast crops, man-made structures, banks, and rock.

Small mammals. The most common small mammals found in cedar dominated habitats include the masked shrew (*Sorex cinereus*), red-backed vole (*Clethrionomys gapper*i), deer mouse (*Peromyscus maniculatus*), short-tailed shrew (*Blarina brevicauda*), least chipmunk, northern flying squirrel (*Glaucomys sabrinus*), meadow vole (*Microtus pennsylvanicus*), arctic shrew (*Sorex arcticus*), and red squirrel (*Tamiasciurus hudsonicus*), in declining order of abundance (Ozoga and Verme 1968). The relative abundance of small mammals changed dramatically from year to year, and species richness varied widely among the lowland conifer communities studied, being greatest in diversified stands and least in the young developmental stage.

Verme and Ozoga (1981) reported strip-cutting in upper Michigan lowland conifers increased the relative abundance of small mammals; particularly deer mice, least chipmunks, and meadow voles. Likewise, broadcast burning of slash resulted in a greater population of shrews (especially masked) and deer mice. Despite the natural increase of seed eaters like the deer mouse and least chipmunk, as well as plant eaters such as meadow and red-backed voles, they concluded that small rodents had minimal impact upon regeneration of northern white-cedar.

Predator-prey Relationships. Several small mammal species fluctuate dramatically in abundance from year to year (Bookhout 1965, Ozoga and Verme 1968). Such abrupt changes in the prey base is likely to impact the distribution and abundance of some carnivores, causing considerable annual variation in mammal species richness among lowland conifer habitats. For example the weasels' exorbitant energy and heat production demands, and their dependence upon mice, voles, and shrews for food (Simms 1979) would intuitively link the ermine (*Mustela erminea*) and long-tailed weasel (*M. frenata*) with the regenerating and old stage of cedar, where preferred small mammal prey tend to be most abundant.

Baker (1983) reports marten (*Martes americanus*) and fisher (*M. pennanti*) prefer mature forests, with a substrate well-strewn with windfalls and other forest debris. Within the mature and old developmental stages of the cedar community, deer mice, red-backed voles, red squirrels, northern flying squirrel, and snowshoe hare are important food items for marten and fisher. Fisher also prey on porcupines (*Erethizon dorsatum*) a frequent resident of older stands of conifer and hardwoods (Powell and Brander 1977).

Although the bobcat feeds upon a variety of small mammals, its primary food in northern Michigan is the snowshoe hare (Erickson 1955), which occurs most abundantly in regenerating and old lowland conifer stands (Bookhout 1965). Erickson (1955) found bobcats in Michigan uplands primarily in warmer seasons and in lowland conifer communities in winter. Presumably, bobcats avoid leafless deciduous areas in winter because of heavy snow accumulations, increased wind, and low night temperatures in this exposed environment, as compared with well-canopied, coniferous areas (McCord 1974). Lowland conifers, especially northern white-cedar stands (Fuller et al. 1985), were important habitats for bobcats in Minnesota (Berg 1979).

The gray wolf (*Canis lupus*) is the most efficient predator of deer in the northern Great Lakes region (Mech 1984), where the deer is considered to be the wolves' most important year round food source (Van Ballenberge et al. 1975, Nelson and Mech 1981). The few gray wolves that currently inhabit the Upper Michigan mainland rely almost exclusively on deer for sustenance in winter.

Nearly all carnivores feed upon deer carrion when available (Mech 1984). During late winter and early spring, in particular, numerous dead deer in northern Michigan cedar habitat provide an important (if not life-sustaining) food source for wolves, coyotes (*Canis latrans*), red foxes (*Vulpes vulpes*), bobcats, fishers, martens, and weasels. Also, birds such as ravens, crows, blue jays and, no doubt, other smaller “suet-eaters” scavenge deer carcasses. Even bald eagles (*Haliaeetus leucocephalus*), not normally associated with the northern white-cedar community, feed upon such carrion, as do black bears (*Ursus americanus*) when emerging from winter torpor.

Habitat Spatial Relationships and the White-tailed Deer. In the central Upper Michigan study area, deer exhibited a pronounced seasonal drift northwest from preferred winter habitat to summer range (Figure 2) of 72,000 animals in May 1987 (Wood 1987). The core area of 117 square miles (Figure 3) exhibited deer pellet group densities 2-3 times greater than the other zones (Table 2). The mean linear distance between point of marking to reporting site (i.e., winter to summer range) was 10.1 (+1.1SE) miles range 1 to 50 miles) for 66 marked deer, or considerably greater than the 7.5 (+0.6 SE) miles Verne (1973) reported for deer in the western upper peninsula.
These data indicate that deer traditionally leave areas of deep snow cover in northern Dickinson and southern Marquette Counties, and migrate (south) to reach areas that receive consistently less snowfall (Figure 4). Hence, differences in ground level snow cover appear to be a factor influencing winter deer distribution in this mid-peninsula area.

The 360 square mile deer wintering complex identified in this study is dominated by drumlin landforms (Figure 5). These long, low ridges formed by glacial drift are ½ to 2 miles long, ¼ to ½ mile wide, and 20 to 60 feet in height. Individual drumlins, separated by areas of lowland conifers generally ¼ to ½ mile in width, are oriented northeast to southwest, or perpendicular to the majority of winter weather systems which normally approach from the northwest. In addition, that portion of the area (217 square miles) having the greatest winter deer concentrations (Zones 1 and 2) is characterized as having as having a higher proportion of thermal cover conifer species, most notably northern white-cedar, as compared to the surrounding area (Table 2).

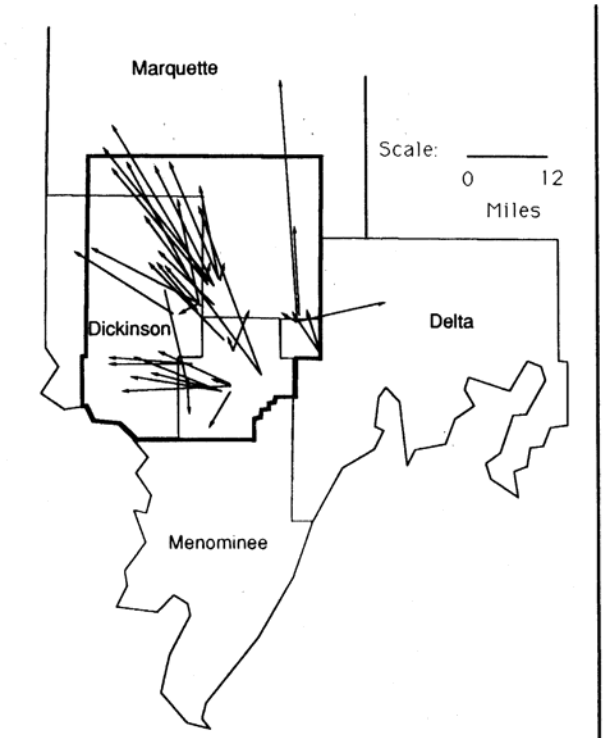


Figure 2: Dispersal pattern of white-tailed deer from a winter yarding complex in northern Menominee County, Michigan, 1962-1989.

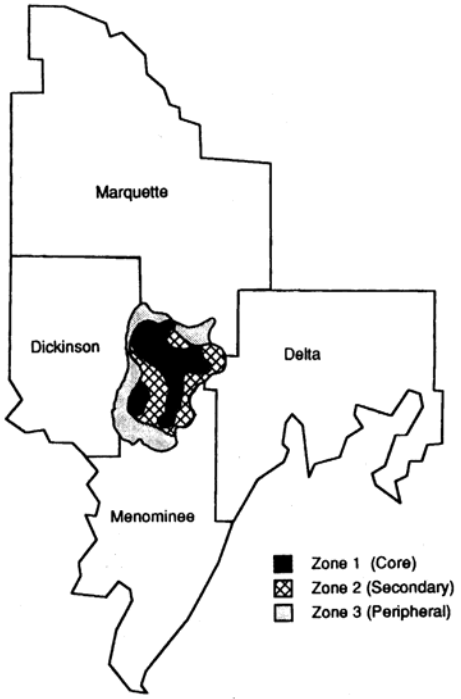


Figure 3: Winter deer concentrations in a deer wintering complex in northern Menominee County, Michigan, as determined from deer pellet survey data and landscape vegetation features.

Table 2: Level of deer use associated with thermal cover in four zones of the winter deeryard

	Total Area					Deer Pellet Survey		
	No. Square	% Thermal	% Non-Thermal	Thermal Cover		No.		
Zone	Miles	Cover	Cover	% Cedar	% Other	Courses	Mead	S.D.
1	117	49	51	58	42	68	63.5	39.5
2	100	39	61	58	42	66	30.9	23.9
3	143	31	69	47	53	60	22.2	19.1
4	1040	25	75	45	55	411	19.8	20.5

1. Data taken from USFS (1986) for Dickinson County and from ERSF management Plant
2. Includes northern white-cedar, white and black spruce, balsam fir, and hemlock
3. Includes all other deciduous and coniferous forest cover types.
4. Includes white and black spruce, balsam fir, and hemlock.

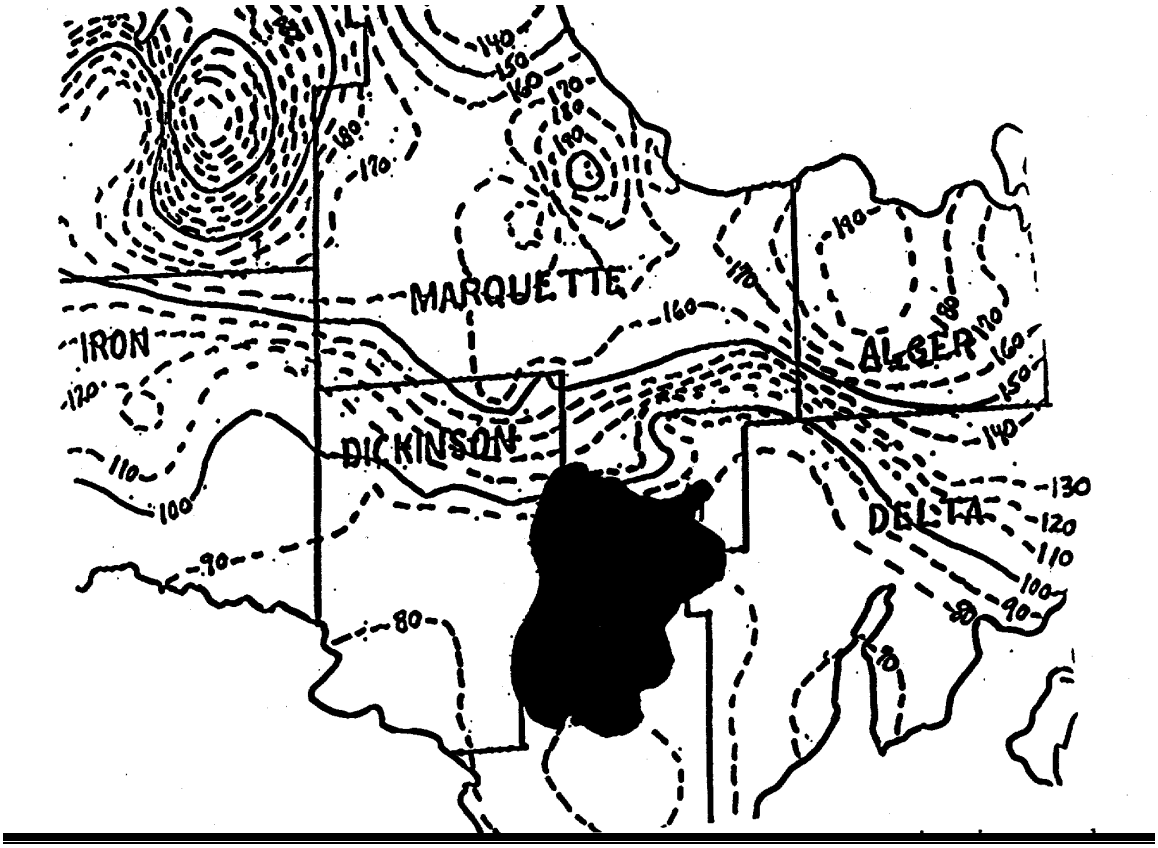


Figure 4: Location of the northern Menominee County, Michigan, deer wintering complex with respect to total snowfall patterns recorded during the 1985-86 winter (modified from Wood 1987).

Normally, low temperatures and wind (the principal factors causing high rates of radiant and connective body heat loss) in combination, prompt deer to shift from scattered distribution on summer range to concentrate on sheltered winter range (Verne and Ozoga 1971), even with minimal (9 inches) snow cover (Ozoga and Gysel 1972). Snow conditions (i.e. depth and support quality) are more instrumental in
governing freedom of travel once deer are in the wintering area (Verne 1968). This "yarding" behavior presumably (evolved as an energy-conserving and predator-defense adaptation for winter survival (Marchinton and Hirth 1984).

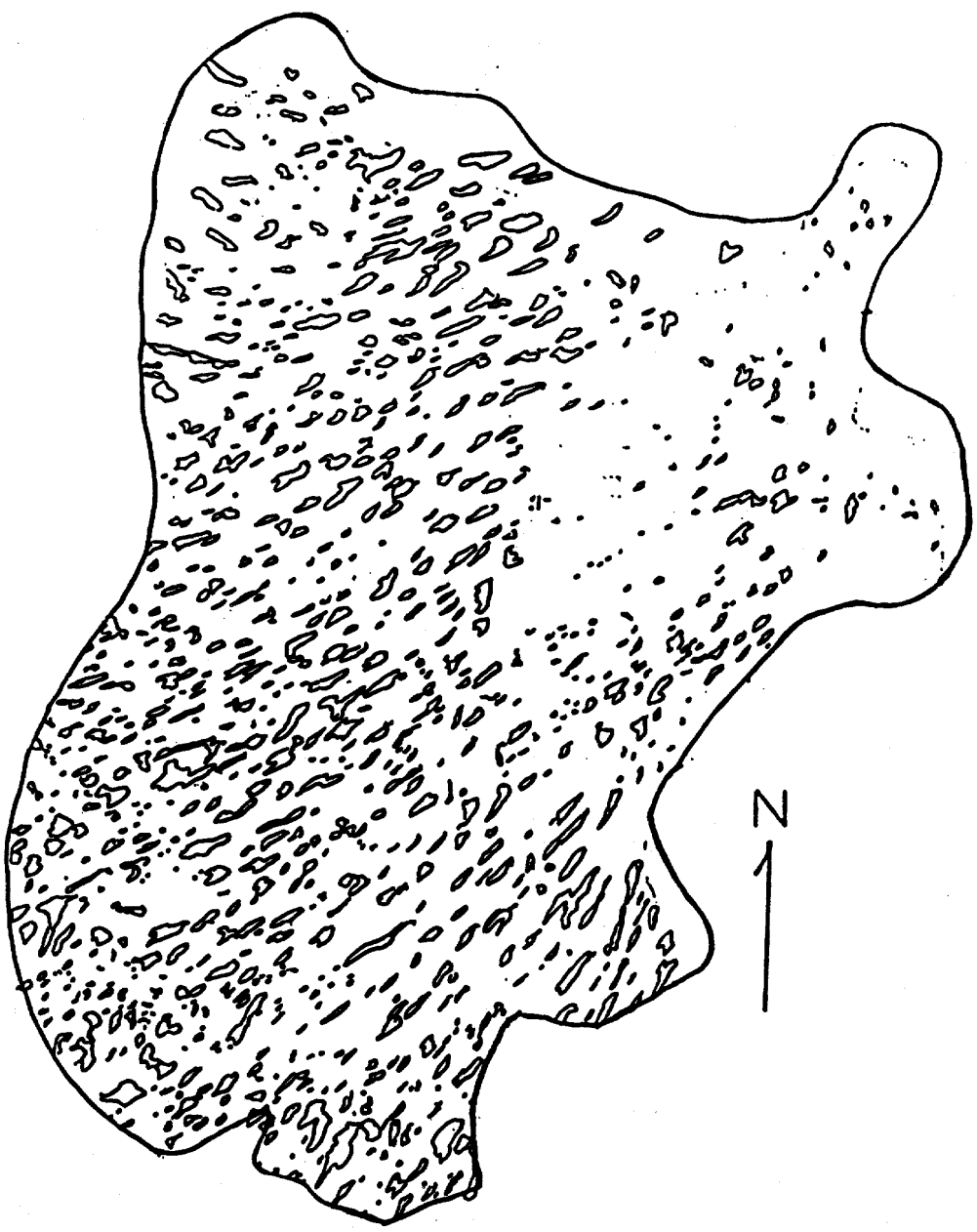


Figure 5: Characteristic drumlin topography within the northern Menominee County, Michigan, deeryard complex (modified from Wood 1987).

Northern white-cedar is a preferred species in deeryards because it provides excellent protection from snow and wind, and is the only browse species that, by itself, will maintain deer over winter in good health

(Verne 1965). While cedar 20-40 years old (depending on site productivity) provides the most abundant supply of browse, studies of microclimate (Verne 1965, Ozoga 1968) showed that dense mature stands exhibited the narrowest thermal ranges, warmest average temperatures, lowest wind flow, and least hazardous snow conditions. Likewise, other studies revealed that a deer's radiant and convective heat loss was minimized under thick conifers (Moen 1976).

High quality deer wintering areas are characterized by having approximately 50% of the landscape in productive, mature or over-mature, well-stocked (100 square feet of basal area) coniferous stands (Weber et al. 1984, Kirchhoff and Schoen 1987, Elliott 1988). Conversely, low productivity cedar sites (i.e., site index 30) produce small, poorly stocked stands with incomplete crown closure and minimal thermal cover value.

Deer in the northern parts of their range have evolved to reduce their food intake and become relatively inactive during mid-winter (Ozoga and Verne 1970, Verne and Ozoga 1971), because of certain physiological adjustments and reduced metabolism (Silver et al. 1969). Therefore, the primary benefit derived from shelter-seeking behavior is to reduce energy loss. The shelter requirements of deer will vary considerably from on area to the next, primarily dependent on the magnitude of winter weather severity, but also according to the quality and quantity of food available. For example, a given cedar stand bordered by a field with available corn may support hundreds of deer in Menominee County, but, in the absence of corn a comparable stand may be totally inadequate as shelter for deer along Lake Superior.

The drumlin landforms in the northern Menominee County study area, being juxtaposed with cedar dominated lowlands, provide deer with a uniquely diversified ecological situation, not normally available to deer wintering in much of the more extensive lowlands characteristic of the eastern upper peninsula (Verne 1965, Verne and Johnston 1986). The upland-lowland transition (ecotone) formed by the abrupt topographic change effectively buffers deer from cold prevailing winds, thereby minimizing convective body heat-loss. The slope of the transition zone, and especially the southeast aspect, provides deer the additional benefit of increased radiant energy (Moen 1976). Also, the extensive edge and favorable juxtaposition of upland and lowland communities provides valuable predator escape cover nearby, more protected nighttime deer bed sites during times of extreme cold, less and more compact snow cover for easier travel, and access to better browse conditions. Such benefits effectively reduce the impact of winter weather and enhance deer survival in this mid-peninsula area during the winter season.

Herpetiles

Few studies of herpetiles have been conducted in cedar habitats. Despite this paucity of information, 3 of 28 herpetiles known to occur in the southcentral Upper Peninsula (wood frog, *Rana sylvatica* , blue spotted salamander, *Ambystoma laterale* and the wood turtle, *Clemmys insculpta*) were reported to use cedar communities. Dead and downed woody material is reported to be an important habitat component for the three herpetiles. The delayed spring phenology may reduce the number of herpetiles using the seasonally flooded cedar habitats. These areas are generally inhospitable in late spring and into early summer, as snow and ice melt slowly beneath the coniferous canopy.

ECOLOGICAL EVALUATION

Northern white-cedar occurs on a variety of upland and lowland sites (Braun 1950, Curtis 1959). In northern Lower Michigan, 66% of the cedar growing stock is in the northern white-cedar type, with lesser amounts in the aspen (14%), elm-ash-soft maple (7%) and maple-birch (6%) forest types. By comparison, 74% of the cedar in eastern Upper Michigan occurs within the northern white-cedar type, with nearly equal amounts (7 and 6%, respectively) in the aspen and maple-birch forest types. Only 48% of the cedar in western Upper Michigan occurs in the northern white-cedar type, with a comparatively high percentage occurring in maple-birch (23%), balsam fir (10%), elm-ash-soft maple (7%) and black spruce (6%) forest types.

Northern white-cedar tends to be a natural pioneer species following catastrophic fire or windfall, but it can also perpetuate itself on fallen decaying woody material in small tree fall gaps in old-aged stands (Verme and Johnston 1986, Scott and Murphy 1987). This trait may explain the presence of advanced northern

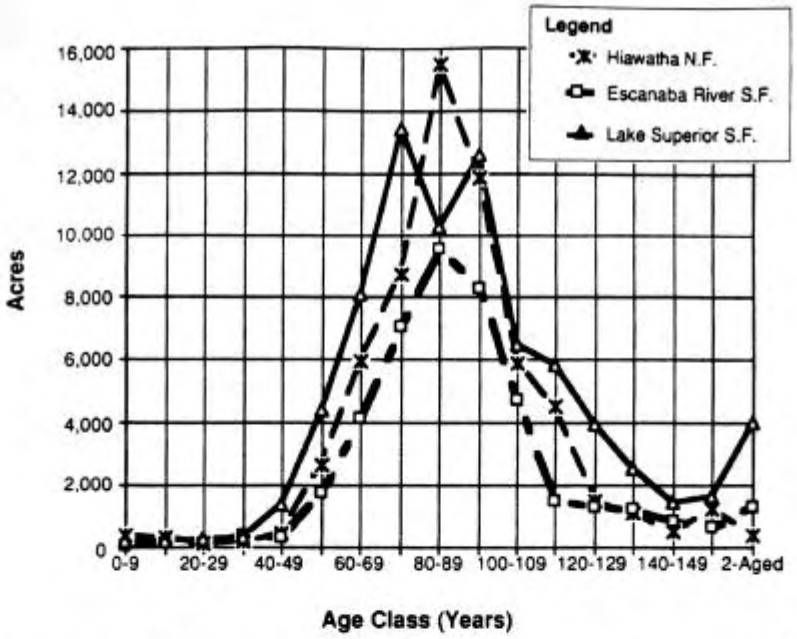


Figure 6: A comparison of northern white-cedar age distribution within the Lake Superior and Escanaba River State Forests, and Hiawatha National Forest.

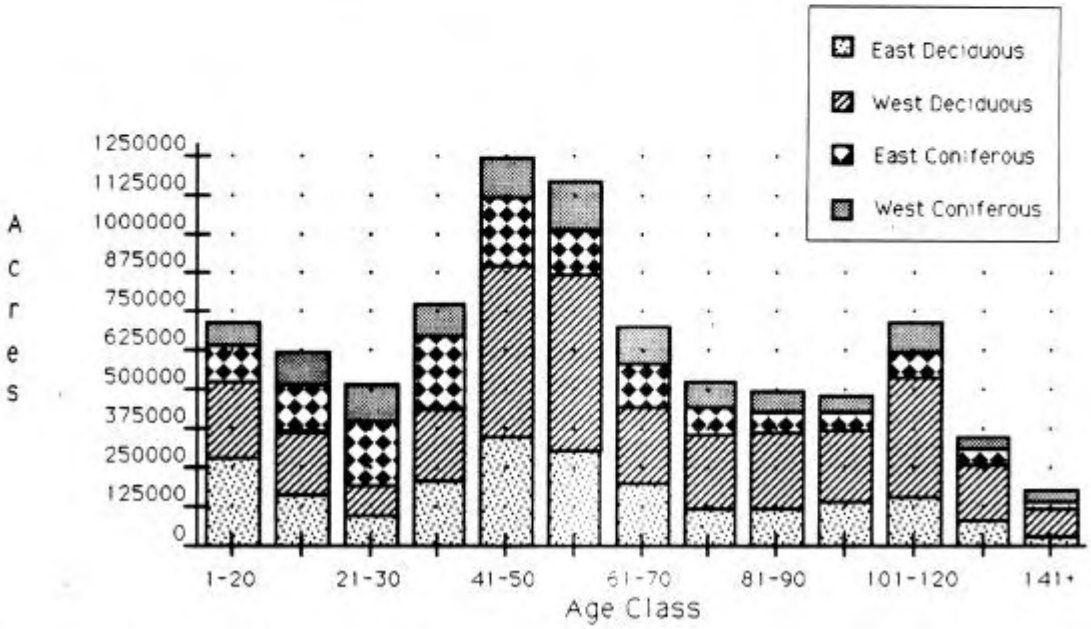


Figure 7: Acreage of deciduous and coniferous forest types in the eastern and western Upper Peninsula of Michigan, 1980.

white-cedar reproduction in some old lowland conifer habitats. The result is an all-aged condition, which suggests that cedar is capable of self-replacement in stands that are allowed to progress past physiological maturity. Gates (1942) indicated that bog and lowland forest communities containing mixtures of black and white spruce, balsam fir, tamarack and northern white-cedar represent seral stages, that given sufficient time would develop into northern white-cedar dominated communities. This suggests that northern white-cedar acreage may increase in the short-term due to the age and species composition of mixed swamp conifer communities (USDA 1986).

While the amount of coniferous habitat in Michigan has declined since European settlement (Braun 1950, Curtis 1959, Bourdo 1983), much of the existing cedar in the Great Lakes region regenerated following wildfires around the turn of the century (Curtis 1959, Verme and Johnson 1986). Cedar stands on the HNF, ERSF and Lake Superior State Forest (LSSF) are relatively young, at least from the standpoint of board foot volume production and capability of providing suitable winter cover for deer (Figure 6). However, due to the overall age of the forest in Upper Michigan (Figure 7), the cedar forest type represents a disproportionate amount of the mature (100+ years old) conifer habitat condition in the western and eastern Upper Peninsula, 49 and 78 percent, respectively. This habitat condition is especially important to species dependent upon snags (permanent birds), dead and downed woody material (permanent mammals) and the structural complexity (summer birds) characteristic of mature and old developmental stages of northern white-cedar.

For the past 60 years, hardwood management and conifer regeneration via red pine (*Pinus resinosa*) and jack pine *(P. banksiana*) plantation management have been emphasized in Michigan. Compared to natural conifer stands, however, conifer plantations are of minimal value to wildlife because they lack horizontal and vertical vegetation complexity. Conifer plantations are also deficient in snags and dead and downed woody material favored by many birds and mammals (Dickson et al. 1983, Szaro and Balda 1986, Cruz 1988, Santillo et al. 1989). These homogeneous stands fail to provide adequate thermal cover, required by many permanent residents to survive the stressful winter conditions normally experienced in this northern environment. Therefore, given current forest management emphasis, and general failure to regenerate lowland conifers, a continued decline in the amount of suitable habitat for conifer associated wildlife species is anticipated (Strong 1977, Erskine 1977, Mooty et al. 1987).

We believe the inability to regenerate northern white-cedar in northern Michigan during the past 60+ years stems chiefly from a general failure to follow proven silvicultural guidelines. Although many northern white-cedar stands have been strip-clearcut, intervening cover strips were often not removed on a timely basis, or clearcut blocks were not burned. Also, many stands were harvested before the recommended entry age, while still others were cut without proper preparatory or intermediate treatments to remove competing hardwoods. Ultimately, these faulty practices have led to a severe reduction, if not complete loss, of the northern white-cedar component in many instances (Johnston 1977). If silvicultural guidelines are not adhered to, northern white-cedar reproduction may be inadequate to maintain or enhance northern white cedar as a stand component, or deer may adversely affect the reproduction (Nelson 1951, Johnston 1977, Verme and Johnson 1986).

In order to simultaneously support wintering herds of white-tailed deer, regenerate northern white-cedar, and successfully manage lowland conifer deeryards, managers must gain a better understanding of deer wintering behavior and learn to manipulate the animals they manage. Wintertime logging of northern white-cedar permits carrying far more deer through winter than the natural habitat could otherwise support. In addition, these deer become highly dependent upon felled browse for sustenance. Therefore, once northern white-cedar management (i.e., cutting) is initiated, cutting must resume every winter and herd size must be closely regulated, preferably via recreational harvesting of anterless deer, if northern white-cedar management is to be successful. Nonetheless, in the absence of careful long-range planning and annual cuts designed to attract, feed, and move deer within a yarding complex, no degree of herd control short of complete annihilation, will assure northern white-cedar regeneration success, because relatively few deer can destroy many acres of valuable northern white-cedar seedlings.

Obviously, successful northern white-cedar management is a complex endeavor. It requires diligent long-range planning, the application of proven silvicultural techniques that consider the deer's behavior, strict herd control, and above all coordination among the private landowners, hunters, and land management agencies involved.

CONCLUSIONS

In Michigan, northern white-cedar communities provide especially valuable breeding habitat for certain birds, especially the wood warblers, and as preferred habitat for permanent residents (birds and mammals) in winter. Considerable species variation exists regarding seasonal use of the various developmental stages of cedar. The presence and abundance of snags and dead and downed woody material, found in greater abundance in more mature stands, are important habitat features influencing wildlife habitat suitability. In addition, the proportion and spatial arrangement of the northern white-cedar community relative to other forest communities (landscape vegetation pattern) also are important. **Clearly, all developmental stages of the northern white-cedar community must be well represented to satisfy the basic needs of all cedar associated wildlife species and to assure perpetuation of the forest community**.

An anticipated increase in timber harvest from Michigan's forests (MDNR 1983) suggests that more emphasis will be placed on harvesting northern white-cedar. In fact, annual cedar harvest volumes have already increased 199% in the western Upper Peninsula, 128% in the eastern Upper Peninsula, and 32% in the northern Lower Michigan since 1977 (R. Berstch, pers. comm.). A long-term decrease in all developmental stages of northern white-cedar habitat is anticipated unless a concerted effort is made to regenerate this type. Northern white-cedar growing on the more productive sites may be in great jeopardy, because of the tendency of these sites to convert to hardwoods following harvest (Thornton 1957, W. Johnston pers. comm.).

There is a definite need for additional research into aspects of northern white-cedar regeneration, particularly as applied to the diversified habitat characteristics of the western U.P. and those areas which receive insufficient snowcover to protect seedlings from excessive deer browsing. Nonetheless, the guidelines provided by Johnston (1977) and Verme and Johnston (1986), are adequate to assure successful regeneration of northern white-cedar in the Lake Superior watershed and other areas of extensive lowland conifer habitat. The most serious deficiencies we see are the current lack of comprehensive long-range planning, and the lack of dedicated commitment to natural conifer regeneration by the biologists and foresters involved.

ACKNOWLEDGMENTS

We thank R. Clute, F. Short, H. Hill, E. Langenau, L. Perry, R. Wood and C. Bennett, Wildlife Division, MDNR; D. Farnsworth and R. Bertsch, Forest Management Division, MDNR; G. Dudderar, Michigan State Univ.; J. Lowe, Cornell Laboratory of Ornithology; Upper Peninsula Whitetails Association; D. Ewert, Michigan Chapter, The Nature Conservency; and E. Olsen, Northland Audubon Society. D. Brownlie, U.S. Forest Service, and R. Earle, Wildlife Division, MDNR, were especially helpful.

LITERATURE CITED

Albert, D.A., S.R. Denton and B.V. Barnes. 1986. Regional landscape ecosystems of Michigan. School of Natural Resources, Univ. of Mich., Ann Arbor, MI. 32 p.

Baker, R.H. 1983. Michigan mammals. Michigan State Univ. Press, East Lansing, MI. 642 p.

Berg, W.E. 1979. Ecology of bobcats in northern Minnesota. Proc. Bobcat Res. Conf., Natl. Wildl. Fed. Sci. and Tech. Serv. 6:55-61.

Bookhout, T.A. 1965. The snowshoe hare in Upper Michigan its biology and feeding coaction with white-tailed deer. Michigan Dept. Conserv., Res. and Dev. Rept. No. 38. Lansing, MI. 191 p.

Bourdo, E.A. 1983. The forest the settlers saw. Pages 3 - 16. in S.L. Flader ed. The Great Lakes forest. An environmental and social history. Univ. of Minn. Press, Minneapolis, MN. 336 p.

Braun, L.E. 1950. Deciduous forests of eastern North America. Blakiston Co., Philadelphia, PA. 596 p.

Collins, S.L. 1983. Geographic variation in habitat structure of wood warblers in Maine and Minnesota. Oecologia 59:246-252.

Collins, S.L., F.C. James, and P.G. Risser. 1982. Habitat relationships of wood warblers (Parulidae) in northern central Minnesota. Oikos 39:50-58.

Cruz, A. 1988. Avian resource use in a Caribbean pine plantation. J. Wildl. Manage. 52:274-279.

Curtis, J.T. 1959. The vegetation of Wisconsin. Madison: University of Wisconsin Press. 657 p.

Dickson, J.G., R.N. Conner, and J.H. Williamson. 1983. Snag retention increases bird use of a clear-cut. J. Wildl. Manage. 47:799-804.

Dougenik, J.A., and D.E. Sheehan. 1979. SYMAP User's Reference Manual. Laboratory for Computer Graphics and Spatial Analysis, Graduate School of Design, Harvard University, Cambridge, MA. 189 p.

Elliott, C.A. 1988. A forester's guide to managing wildlife habitats in Maine. Univ. of Maine, Coop. Exten. Serv., Univ. of Maine, Orono, ME. 46 p.

Erickson, A.W. 1955. An ecological study of the bobcat in Michigan. M.S. Thesis, Mich. State Univ., East Lansing, MI. 133 p.

Erskine, A.J. 1977. Birds in boreal Canada: commumities, densities and adaptaptaions. Canadian Wildlife Serv. Report Series Number 41. Ottawa.

Forman, R.T. and M. Godron. 1981. Patches and structural components for a landscape ecology. BioScience 31:733-740.

Fuller, T.K., W.E. Berg and D.W. Kuehn. 1985. Bobcat home range size and daytime cover-type use in northcentral Minnesota. J. Mammal. 66:568-571.

Gates, F.C. 1942. The bogs of northern lower Michigan. Ecol. Monogr. 12:213-254.

Harris, L.D. 1984. The fragmented forest: island biogeography theory and the preservation of biotic diversity. University of Chicago Press, Chicago. 211 p.

Helle, P. and O. Jarvinen. 1986. Population trends of North Finnish land birds in relation to their habitat selection and changes in forest structure. Oikos 46:107-115.

Hill, H.R. 1986. The 1986 deer pellet group surveys. Wildl. Div. Rept. No. 3055. Mich. Dept. Nat. Res., Lansing, MI.

Holmes, R.T. and S.K. Robinson. 1981. Tree species preferences of foraging insectivorous birds in a northern hardwood forest. Oecologia 48:31-35.

James, F.C. 1971. Ordinations of habitat relationships among breeding birds. Wilson Bull. 83:215-236.

Johnston, W.F. 1977. Manager's handbook for northern white-cedar in the north central States. U.S. For. Serv. Gen. Tech. Rep. NC-35. 18 p.

Kirchhoff, M.D. and J.W. Schoen. 1987. Forest cover and snow: implications for deer habitat in southeast Alaska. J. Wildl. Manage. 51:28-33.

Leefers, L.A., C.W. Ramm and J. Haufler. 1988. Forest level simulation model for the Michigan Department of Natural Resources. Mich. State Univ., East Lansing, MI.

Marchinton, R.L. and D.H. Hirth. 1984. Behavior. Pages 129-168 in L.K. Halls, ed. White-tailed deer. Ecology and management. Stackpole Books, Harrisburg, PA. 870 p.

Martin, N.D. 1960. An analysis of bird populations in relation to forest succession in Algonquin Provincial Parks, Ontario. Ecology 41:126-140.

McCord, C.M. 1974. Selection of winter habitat by bobcats (Lynx rufus) on the Quabbin Reservation, Massachusetts. J. Mammal. 55:2f61-264.

Mech, L.D. 1984. Predators and predation. Pages 189-200 in L.K. Halls, ed. White-tailed deer. Ecology and management. Stackpole Books, Harrisburg, PA. 870 p.

MDNR. 1983. Michigan's forest resources. Direction for the future. A statewide forest resources plan. Mich. Dept. Nat. Res., Lansing, MI. 41 p.

MDNR. 1989. DRAFT-Escanaba River State Forest management plan. Mich. Dept. Nat. Res., Lansing, MI. 259 p.

Moen, A.N. 1976. Energy exchange of white-tailed deer, western Minnesota. Ecology 57:192-198.

Morris, D. 1984. Patterns and scale of habitat use in two temperate-zone small mammal faunas. Can. J. Zool. 62:1540-1547.

Mooty, J.J., P.D. Karns and T.K. Fuller. 1987. Habitat use and seasonal range size of white-tailed deer in northcentral Minnesota. J. Wildl. Manage. 51:644-648.

Nelson, M.E. and L.D. Mech. 1981. Deer social organization and wolf predation in northeastern Minnesota. Wildl. Monogr. 77. 53 p.

Niemi, G.J. and J.M. Hanowski. 1986. Relationships of breeding birds to habitat characteristics in logged areas. J. Wildl. Manage. 48:438-443.

Niemi, G.J., P.B. Hofslund and H.L. Collins. 1979. Wildlife species and their habitat: overview, Ottawa National Forest, Michigan. Report to Ottawa National Forest. University of Minn., Duluth. 28 p.

Niemi G.J. and L.A. Pfanmuller. 1979. Avian communities: approaches to describing their habitat association. Pages 154-178 in R.M. DeGraaf and K.E. Evans, compilers. Management of northcentral and northeastern forests for non-game birds. U.S. For. Serv. Gen. Tech. Rep. NE-51. 268 p.

Ozoga, J.J., and L. Gysel. 1972. Response of white-tailed deer to winter weather. J. Wildl. Manage. 36:892-896.

Ozoga, J.J. 1968. Variations in microclimate in a conifer swamp deeryard in northern Michigan. J. Wildl. Manage. 32:574-585.

Ozoga, J.J. and L.J. Verme. 1968. Small mammals of conifer swamp deeryards in northern Michigan. Papers Mich. Acad. Sci. Arts and Letters 53:37-49.

Ozoga, J.J. and L.J. Verme. 1970. Winter feeding patterns of penned white-tailed deer. J. Wildl. Manage. 34:431-439.

Ozoga, J.J. and L.J. Verme. 1984. Effects of family-bond deprivation on reproductive performance in female white-tailed deer. J. Wildl. Manage. 48:1326-1334.

Powell, R.A. and R.B. Brander. 1977. Adaptations of fishers and porcupines in relation to their predator prey system. Pp. 45-53 in R.L. Phillips, and C.J. Jonkel, eds. Proc. 1975 Predator Symp., Univ. Montana, Montana Forest and Conserv. Exp. Sta., 268 p.

Raile, G. K., and W. B. Smith. 1983. Michigan forest statistics, 1980. Resour. Bull. NC-67. St. Paul, MN: U.S. Dept. Agric. For. Serv. 101p.

Roth, R.R. 1976. Spatial heterogeneity and bird species diversity. Ecology 57:773-782.

Santillo, D.J., P.W. Brown and D.M. Leslie. 1989. Response of songbirds to glyphosate-induced habitat changes on clearcuts. J. Wildl. Manage. 53:64-71.

Scott, M.L. and P.G. Murphy. 1987. Regeneration patterns of northern white cedar, an old growth forest dominant. Amer. Midl. Nat. 117:10-16.

Silver, H., N.F. Colovos, J.B. Holter and H.H. Hayes. 1969. Fasting metabolism of white-tailed deer. J. Wildl. Manage. 33:490-498.

Simms, D.A. 1979. North American weasels: resource utilization and distribution. Canadian J. Zool. 57:824-832.

Strong, K.F. 1977. Evaluative review of deer yard management work in New Hampshire and Maine. New Hampshire Fish and Game Dept., Concord. 117 p.

Szaro, R.C. and R.P. Balda. 1986. Relationships among weather, habitat structure and ponderosa pine forest birds. J. Wildl. Manage. 50:253-260.

Titterington, R.W., H.S. Crawford, and B.N. Burgason. 1979. Songbird responses to commercial clear-cutting in Maine spruce-fir forests. J. Wildl. Manage. 43:602-609.

Thompson, F.R. and D.E. Capen. 1988. Avian assemblages in seral stages of a Vermont forest. J. Wildl. Manage. 52:771-777.

Thornton, P.L. 1957. Problems of managing Upper Michigan's coniferous swamps. J. Forestry 55:192-197.

USDA. 1986. Land and Resource Management Plan, Hiawatha National Forest. Eastern Region. U. S. Dept. Agric., Forest Service, Milwaukee, WI.

Van Ballenberge, V., A.W. Erickson and D. Byman. 1975. Ecology of the timber wolf of northeastern Minnesota. Wildl. Monogr. 43. 43 p.

Verme, L.J. 1962. An automatic tagging device for deer. J. Wildl. Manage. 26:387-392.

Verme, L.J. 1965. Swamp conifer deeryards in northern Michigan: their ecology and management. J. Forestry 63:523-529.

Verme, L.J. 1968. An index of winter weather severity for northern Michigan deer. J. Wildl. Manage. 32:566-574.

Verme, L.J. 1973. Movements of white-tailed deer in Upper Michigan. J. Wildl. Manage. 37:545-552.

Verme, L.J. and W.F. Johnston. 1986. Regeneration of northern white-cedar deeryards in Upper Michigan. J. Wildl. Manage. 50:307-313.

Verme, L.J. and J.J. Ozoga. 1971. Influence of winter weather on white-tailed deer in Upper Michigan. Pages 16-28. In: A. O. Haugen (ed.) Proc. Snow and Ice Symposium, Iowa State Univ.

Verme, L.J. and J.J. Ozoga. 1981. Changes in small mammal population following clear-cutting in Upper Michigan conifer swamps. Canadian Field-Naturalist 95:253-256.

Webb, W.L., D.F. Behrend and B. Saisorn. 1977. Effect of logging on songbird populations in a northern hardwood forest. Wildlife Monograph No. 55. 35 p.

Weber, S.J., W.W. Mautz, J.W. Lanier and J.E. Wiley. 1984. Predictive equations for deeryards in northern New Hampshire. Wildl. Soc. Bull. 14:331-338.

Wood, B. 1987. Resolution of issues between the Department of Natural Resources and Mead Corporation - North Menominee County. Mich. Dept. Nat. Res., Interoffice Communication. 2 November.

Michigan's Cedar Resource: Timber Supply, Value, and Related Employment

Gerald H. Grossman
USDA Forest Service,
North Central Forest Experiment Station
East Lansing, MI 48842

Karen Potter-Witter
Department of Forestry
Michigan State University
East Lansing, MI 48824

INTRODUCTION

The northern white-cedar resource[1] in Michigan represents 23 percent of the softwood growing-stock volume and 7 percent of the total commercial forest area. The resource has grown 2.5 times from 7.3 million cords in 1955 to 19.5 million cords in 1987. Although harvesting has increased in recent years, overall removals are only 25 percent of growth. However, in the eastern Upper Peninsula removals are approaching growth on private lands.

In 1986, $1.4 million of cedar stumpage was harvested representing $6.5 million of delivered sawlogs, pulpwood, posts, and miscellaneous roundwood. This harvesting activity helps support approximately 1,600 jobs concentrated in northern Michigan. Real prices for cedar have increased in the Upper Peninsula since 1979, indicating high demand. The long-term viability of the cedar-using industry depends on maintaining an adequate supply through regeneration activities and public policy decisions about multiple outputs, regulation of private forests, and tax policies.

DEFINING VALUE

The cedar resource has numerous values, many of which are difficult to measure economically or monetarily. Cedar's timber value in the market can be measured as the monetary value of timber products sold, industries supported, and people employed. These values are a direct result of the economic supply of cedar and the demand for it as a forest product. Other less tangible values are also important but are discussed in other conference papers.

Current economic cedar supply depends on physical supply, operability constraints, ownership constraints, and public policy constraints. Standing timber volumes, timber size and quality, growth, regeneration success, and stand age distribution are the basic biological factors that determine physical supply. Operability --how easily the timber can be removed and transported -- physically affects the economic supply. Land ownership objectives and policy constraints that withdraw stands from timber harvesting, or limit harvest levels, further reduce what is physically available to what is economically available.

[1] Northern white-cedar will be referred to as cedar for the remainder of this paper.

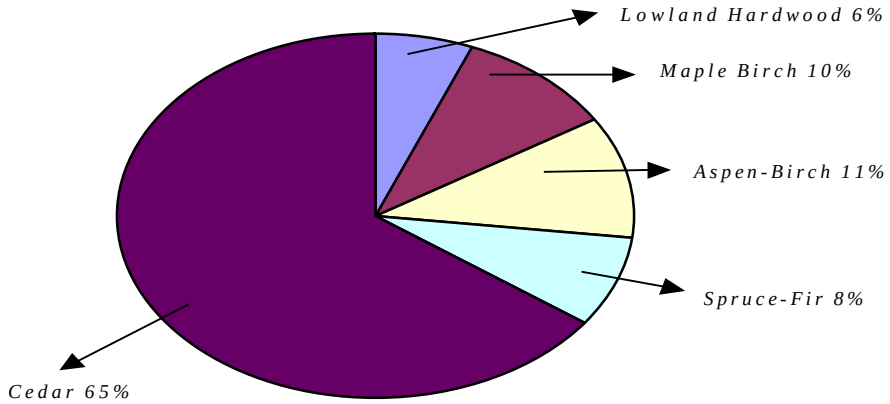
WHITE CEDAR SUPPLY

Diverse Forest Type

Cedar occurs within many forest types in association with numerous other species. Sixty-five percent of the cedar growing-stock occurs in predominantly cedar stands and the remaining volume is distributed among lowland hardwood, maple-birch, aspen-birch, and spruce-fir forest types (Figure 1). Forty percent of the volume within the cedar type is comprised of other associated species (Figure 2).

This diversity makes "cedar stands" hard to define. Spencer and Hahn (1984) define cedar stands as "forests in which swamp conifers comprise a plurality of the stocking with northern white-cedar the most common. (Common associates include tamarack and black spruce.)" In 1980 approximately 1.2 million acres in Michigan met this definition.

Figure 1: Northern white-cedar growing-stock volume by forest type in Michigan, 1980. (Adapted from Spencer and Hahn 1984.)



Growing Stock Volume

One recurrent theme expressed in the proceedings of the 1975 national northern white-cedar conference was the under-utilization of the cedar resource in Michigan. This conclusion was based on an estimated net growing-stock of 12.8 million cords, and an annual harvest of 67 thousand cords. Estimated allowable annual cut from 1975 to 1985 was 461 thousand cords per year (Boelter 1976, Zollner 1976).

Cedar growing-stock increased over 2.5 times from 7.3 million cords in 1955 to 19.5 million cords in 1987 Table 1). [2] The greatest change was between 1955 and 1966 when the annual rate of increase was 5.7 percent. This can be attributed to ingrowth from stands established in the early 1900's. The annual change from 1966 to 1980 was 2.1 percent and the estimated annual change between 1980 and 1987 is 1.2 percent. Between 1984 and 1987 cedar growing-stock removals increased approximately 35 percent to 127 thousand cords (Figure 3).

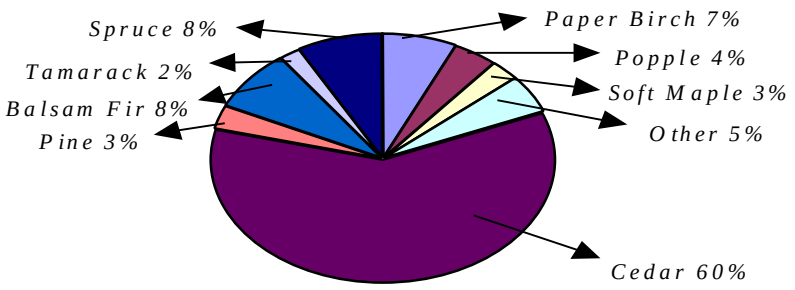
[2] Surveys of the Nation's forest resources are produced periodically by the United States Department of Agriculture, Forest Service. Field surveys were completed for Michigan in 1955, 1966, and 1980. A computerized update was conducted to estimate the resource in 1987. The next field survey for Michigan should be completed by 1993.

Table 1: Net volume of growing stock on commercial forest land by species group[1]

	1955	1966	1980	1987
	(million cords)			
Northern white-cedar	7.28	13.38	17.92	19.52
Total softwood	32.84	50.65	70.56	83.38

[1] Sources: Findell et al. 1960; Spencer and Hahn, 1984; and Smith and Hahn, 1986.

Figure 2: Species composition within the northern white-cedar forest type in Michigan, 1980. (Adapted from Spencer and Hahn 1984.)



Operability

Volume statistics estimate the total resource, but inadequately represent the economically available or operable resource. Hansen and Hahn (1987) published an operability study of Michigan's timber resource and put approximately 53 percent of the cedar volume and acres into the poor operability class. Twenty-eight percent of the area and 39 percent of the volume is in the medium operability class and a negligible amount of the acres and volume is in the good operability class.

If the industry is willing to harvest small stands with poor access, the economically operable resource increases dramatically. Sixty-seven percent of the cedar acres are classified in the medium operability class when these constraints are eliminated. If stand area is the only constraint eliminated, 51 percent of the cedar stands would be in the medium operability class.

Regional Supply

Michigan's cedar resource is not distributed evenly. Fifty-one percent of the cedar acres and 45 percent of the growing-stock volume are in the eastern Upper Peninsula (EUP), 18 percent of the acres and 26 percent of the growing-stock volume are in the western Upper Peninsula (WUP), and 31 percent of the acres and 33 percent of the growing-stock volume are in the northern Lower Peninsula (NLP) (Smith, 1982; Spencer, 1982; Jakes, 1982).

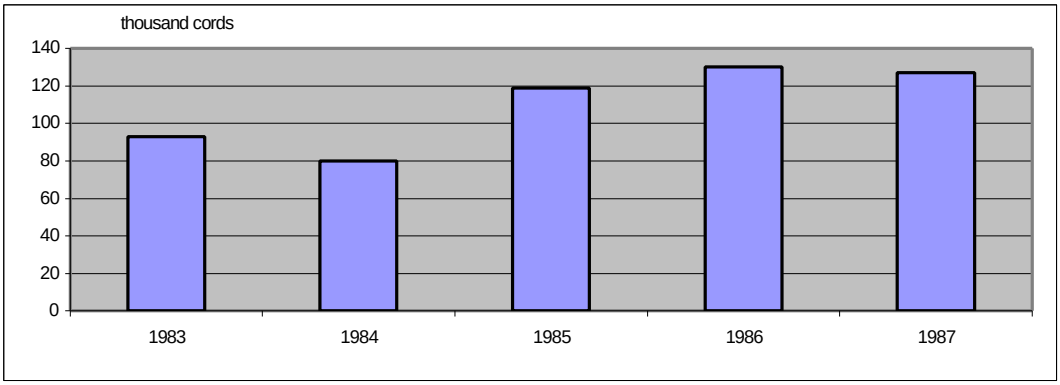


Figure 3: Trends in northern white-cedar growing-stock removals in Michigan, 1983-1987. (Adapted from Smith and Blyth 1989.)

The estimated change in growing-stock (net growth minus total removals) from 1980 to 1987 differed widely between the regions. The average annual increase was 1/4 percent for the EUP, 1/2 percent for the WUP and 3 1/4 percent for the NLP. This was primarily due to the large net growth component in the NLP and the large removal component in the EUP (Table 2). Although the NLP has 28 percent of the 1980 growing-stock volume, it represents 66 percent of the periodic net growth and only 22 percent of the total periodic removals. By contrast the EUP has 22 percent of the periodic net growth and 62 percent of the total periodic removals.

Table 2: Northern white-cedar growing stock volume and periodic growth (in thousands of cords) on timberland in Michigan, 1980-1987[1]

Region	1980 growing stock volume	1980-1987 net growth	1980-1987 total removals	1987 growing stock volume	Removals as percent growth
			(thousand cords)		
Eastern Upper Peninsula	8,101	463	-313	8,252	67
Western Upper Peninsula	4,670	234	-79	4,825	34
Northern Lower Peninsula	5,100	1,392	-113	6,380	8
Southern Lower Peninsula	47	19	0	66	0
Total	17,918	2,108	-505	19,523	24

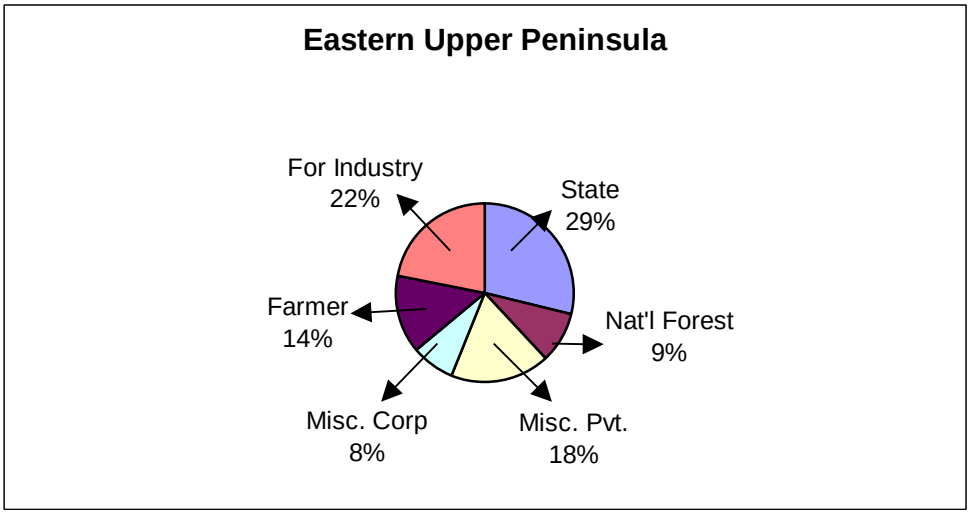
[1] Source: Smith and Hahn, 1986.

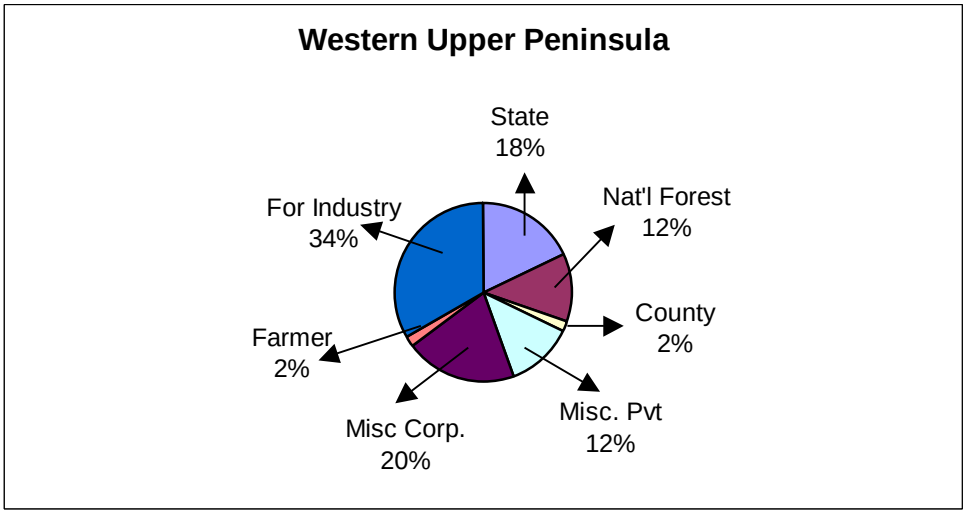
Ownership

Landowner objectives affect the available supply of any forest resource. In general, forest industry and farmers tend to harvest more than other owners (Spencer and Hahn, 1984; Carpenter and Hansen, 1985). Figure 4 illustrates the broad classes that own the cedar in each region. In Michigan the recently increased cedar harvest has been absorbed by the private sector. For example, the State owns approximately 26 percent of the growing-stock yet it contributed 5 percent of the 1987 harvest (Michigan Department of Natural Resources, Forest Management Division, 1989; Smith and Blyth, 1989).

Cedar productivity

Cedar stands in Michigan have low growth potential. In 1979 the average growth per acre was 22 cubic feet, and the maximum potential for most stands is between 20 and 49 cubic feet per acre per year (United States Department of Agriculture, Forest Service, 1989). Only ten percent of the acres in the Upper





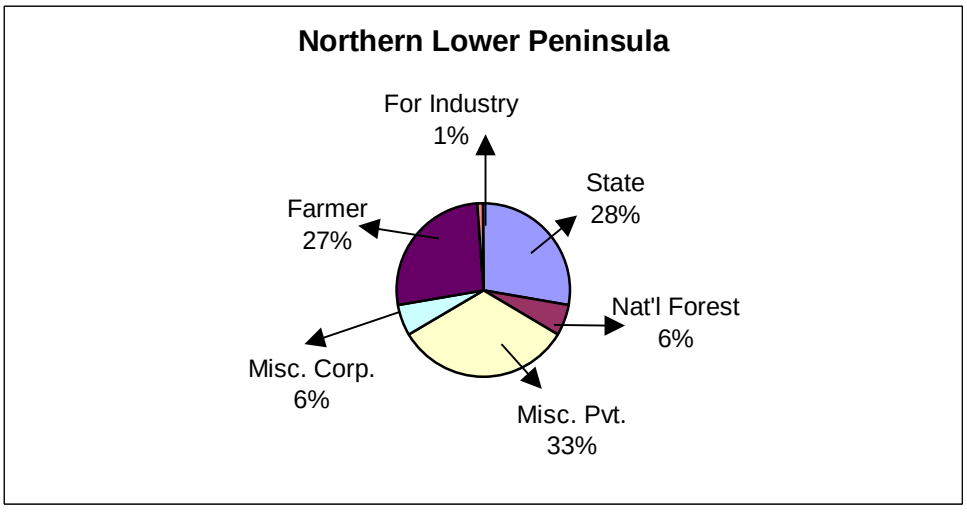


Figure 4: Percent of northern white-cedar growing–stock volume on commercial forest land by ownership and region, 1980. (Adapted from Smith 1982, Spencer 1982 and Jakes 1982, respectively.)

Peninsula (UP) have the potential to grow greater than 50 cubic feet per acre annually. In the NLP 29 percent of the National Forest acres, 11 percent of the other public acres, and 13 percent of the private acres could potentially produce 50-85 cubic feet per acre annually.

Age Class Distribution

In its simplest form a fully regulated forest maintains an even flow of desirable products by ensuring that each age class is adequately represented. In general, cedar acreage in Michigan sharply declines in younger age classes (Figure 5). This decline in young age classes raises concerns about the long-term viability of the cedar-using industry.

Scarcity

One indication of scarcity is rising real prices over time. Real cedar prices from 1979 to 1989 were examined for indications of scarcity (Figure 6)[3]. After adjusting for inflation, prices for sawtimber and pulpwood remained constant from 1979 to 1989 in the NLP. The UP, however, has experienced significant ($p = .05$) annual real price increases of 4.4 percent for pulpwood and 8.0 percent for sawtimber. This increase in the UP indicates that cedar is becoming scarcer in that region.

The Eastern Upper Peninsula

The EUP deserves particular attention in the regional supply picture. Removals as a percent of growth is 67 percent. If State ownership is eliminated, removals as a percent of growth is approximately 87 percent. This level might be sustainable except for the ominous drop in regeneration from 1970 to 1980. Stand establishment decreased from 37,300 acres in 1960 to 13,600 acres in 1970 (Figure 5). If the number of acres established between 1980 and 1990 is also low, the long-term viability of the cedar-using industry in this region could be jeopardized.

DEMAND FOR CEDAR

Cedar is manufactured into many products in Michigan including log homes, shakes, shingles, posts, poles and pilings, and specialty products. Intermediate products are sawlogs, pulpwood, posts, poles, and bolts.

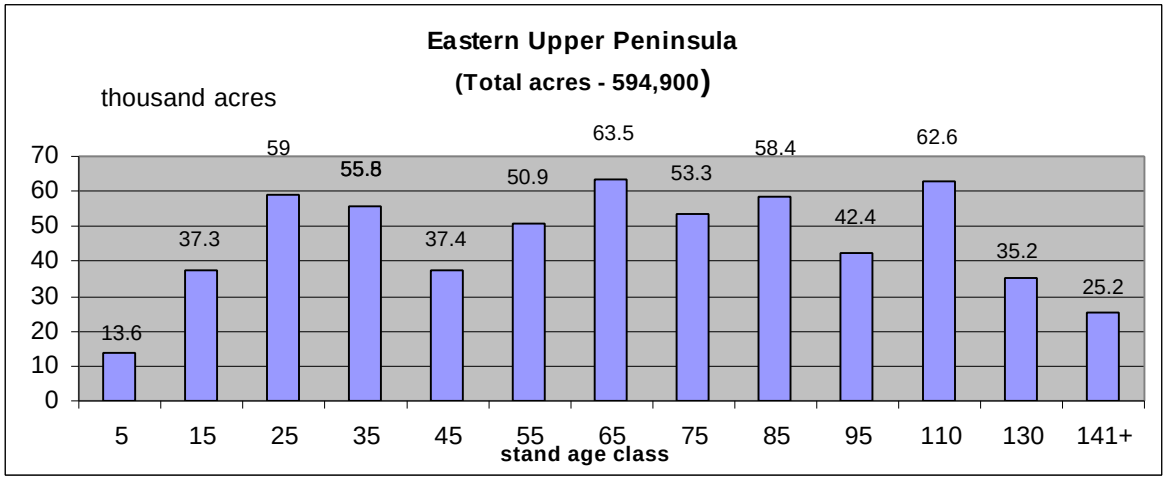
Monetary Values

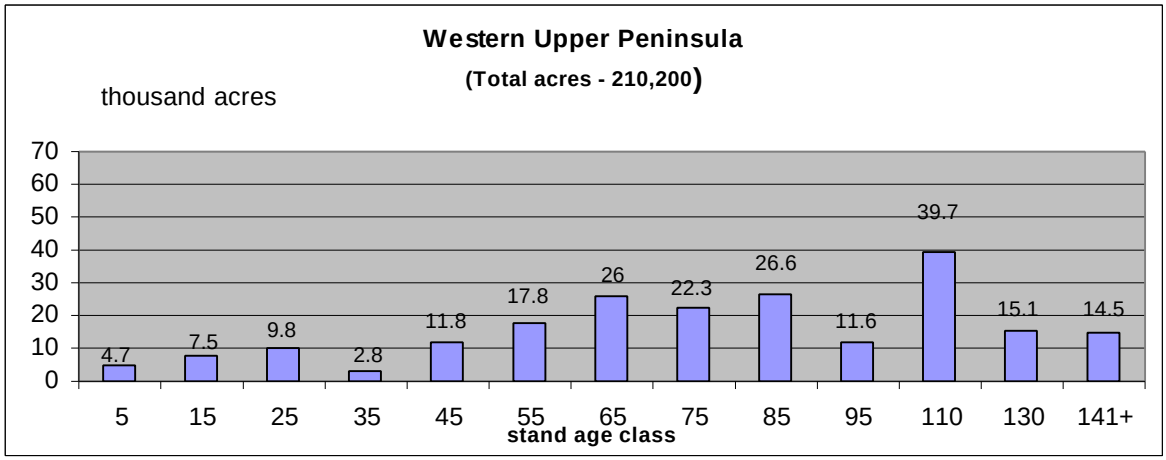
According to the most recent production data, 12,073 MBF of sawlogs, 51,743 cords of pulpwood, 4,000 poles, and 2,902,000 posts of cedar were cut during 1986 in Michigan (Table 3). On a cubic foot basis, pulpwood is the predominant product with 4.1 million cubic feet of the 10.7 million cubic feet of total production. The NLP counts for negligible amounts of the reported production. The EUP, however, produces 51 percent of the sawlogs, 65 percent of the pulpwood, 50 percent of the poles, and 66 percent of the cedar posts.

Based on average reported stumpage prices, the 1986 value of Michigan's cedar stumpage production is estimated at 1.4 million dollars.[4] Delivered values for sawlogs, pulpwood, poles, posts, and miscellaneous roundwood in 1986 are estimated at 6.5 million dollars (Table 4).

[3] Michigan Department of Natural Resources (1989) prices were deflated to common 1982 dollars and plotted by region and product. Regressions were then run using the model: $\ln(P) = Bo + B1*Y$ where P = real price in 1982 dollars and Y = DNR fiscal year. B1 is an estimate of the annual change in price.

[4] Sawtimber stumpage prices and sawtimber, pole, post, and other products delivered prices are from Timber Marts (1986). Pulpwood and post stumpage prices are from the Michigan Department of Natural Resources, Forest Management Division (1989).





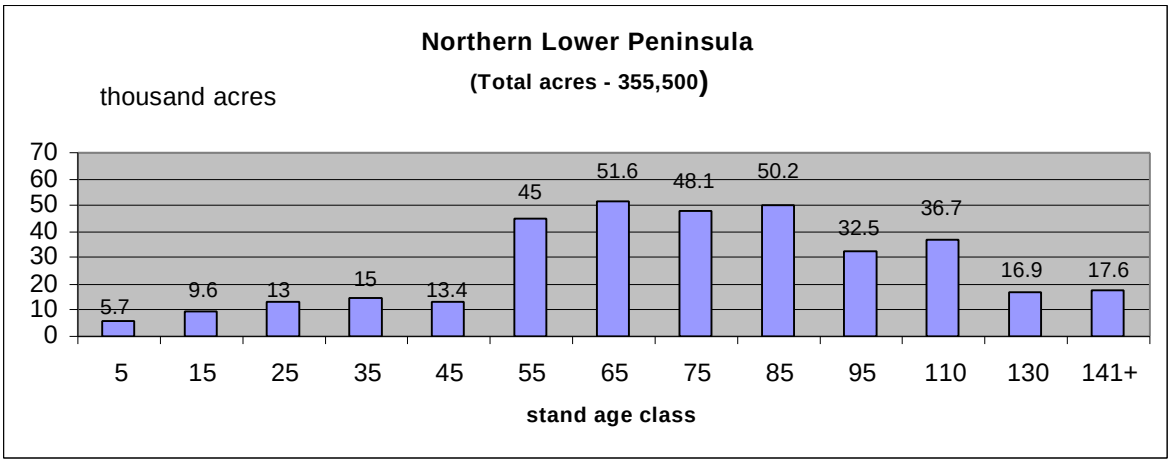


Figure 5: Area of commercial northern white-cedar forest type by stand-age class and region, 1980. (Adapted from Smith 1982, Spencer 1982 and Jakes 1982, respectively).

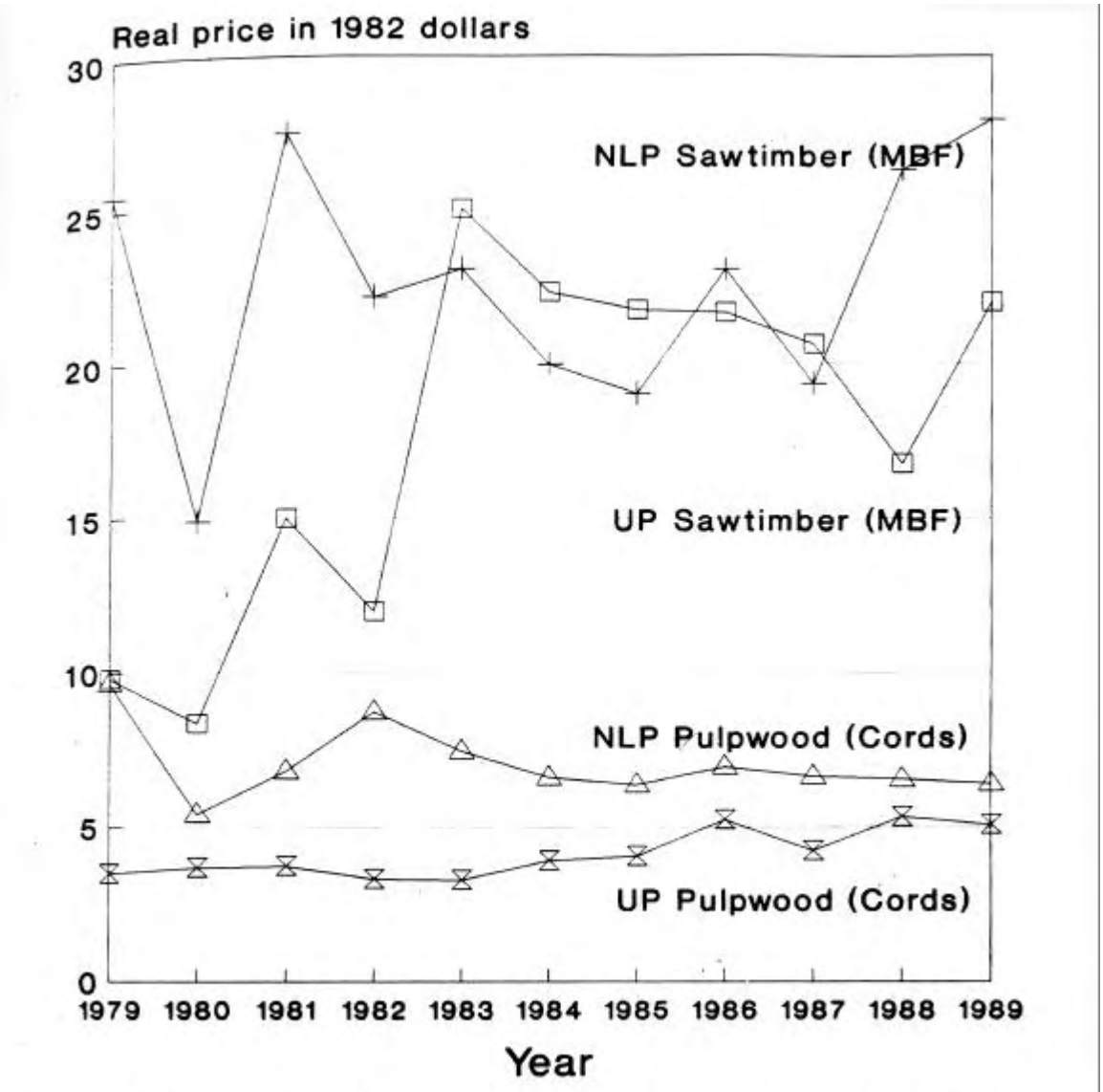


Figure 6: Real stumpage prices for northern white-cedar by region and product, 1979-1989.

The Cedar Industry in Michigan

Cedar production contributes to Michigan's economy through jobs and income in logging, transportation, and primary and secondary processing. Most producers, truckers, sawmills, and manufacturers do not deal exclusively with cedar. It is not possible, therefore, to determine precisely how many jobs and how much income result exclusively from cedar. However, cedar helps support many firms throughout northern Michigan.

There are 82 primary or primary and secondary processors in Michigan and an additional 49 exclusively secondary manufacturers who use cedar (Table 5). Cedar is relatively more important in the EUP, where 48 percent of all reported manufacturers say they use cedar, than the NLP (13 percent) and the SLP (4 percent).

Table 3: Michigan's northern white-cedar harvest, 1986[1]

Region	Sawtimber MBF	Pulpwood cords	Poles M pieces	Posts MCF	Misc.[2] MCF	Total
Eastern Upper Peninsula	6188	33800	2	1917	759	6584
Western Upper Peninsula	4451	17943	2	287	558	3125
Northern Lower Peninsula	1434	0	0	698	23	999
State	12073	51743	4	2902	1340	10708

[1] Source: United States Department of Agriculture, Forest Service 1989.
[2] Includes fuelwood (97% of this category), charcoal wood, cabin logs, and shingle bolts.

Table 4: Northern white-cedar values in Michigan, 1986[1] (in thousands of dollars)

	Sawlogs	Pulpwood	Poles	Posts	Misc. other	All
			Stumpage			
Northern Lower Peninsula	46	0	0	160	2	208
Upper Peninsula	386	192	22	489	62	1,151
State	432	192	22	649	64	1,359
			Delivered Wood			
Northern Lower Peninsula	201	38	0	356	8	603
Upper Peninsula	1,596	2,328	87	1,155	750	5,916
State	1,797	2,366	87	1,511	758	6,519

[1] Volume conversions used to develop the table are from United States Department of Agriculture, Forest Service 1989.

Table 5: Reported northern white-cedar-using manufacturers in Michigan, 1988[1].

Region	Primary Manufacturers	% of all Primary Mfgs. Using Cedar	Secondary Mfgs.
Southern Lower Peninsula	4	4	22
Northern Lower Peninsula	25	13	17
Eastern Lower Peninsula	39	48	6
Western Upper Peninsula	14	30	5
State	82	19	50

[1] Source: Michigan Department of Natural Resources, 1988a.

Employment

Fifty-one percent of the primary manufacturers employ one to five people and 20 percent employ six to fifteen people (Table 6). There are four large firms in the UP and NLP which employ over 50 people each. The firms employing 31 or more people are the major log home producers.

The cedar-using forest products industry is characterized by many small firms. The small firms tend to categorize themselves as sawmills. The medium size firms produce fences and posts and a few are in the log home business. The largest cedar-using firm produces posts in the UP. Seven UP, three NLP, and one SLP primary producers reported using cedar as their only wood raw material.

Secondary manufacturers of cedar in Michigan are varied (Table 7). Of the 50 secondary manufacturers listed who report using cedar, almost half are in the SLP. Most (58 percent) also employ one to five people. These small

shops tend to be specialty manufacturers that produce signs, cabinets, and furniture. Ten percent of the secondary manufacturers employ at least 31 people, and the two largest, with over 50 employees each, are in the UP and SLP.

Based on the midpoint of the employment ranges, direct employment in firms that process cedar is 1,559. Based on the total logging and trucking employment for 1980, and cedar's percentage of the total harvest, logging and trucking firms employ an additional 70 people (James et al., 1982). In the UP where total employment is 122,600, direct employment from cedar harvesting and cedar processing firms represents approximately 0.7 percent of the employment (Michigan Employment Securities Commission, Bureau of Research and Statistics, 1989). Total employment, which includes direct, indirect, and induced employment, is approximately 2.3 times the direct employment (Chappelle et al., 1986).

Table 6: Size of reported northern white-cedar-using primary manufacturers in Michigan, 1988[1]

	Size Class (Number of Employees)					
Region	1-5	6-15	16-30	31-50	51-100	101-200
Southern Lower Peninsula	3	0	0	1	0	0
Northern Lower Peninsula	15	6	3	0	1	0
Eastern Upper Peninsula	22	10	2	2	2	1
Western Upper Peninsula	12	2	1	0	0	0
State	52	18	6	3	3	1

[1] Source: Michigan Department of Natural Resources, 1988a.

Table 7: Size of reported northern white-cedar-using secondary manufacturers in Michigan, 1988[1]

	Size Class (Number of Employees)					
Region	1-5	6-15	16-30	31-50	51-100	101-200
Southern Lower Peninsula	13	5	0	3	1	0
Northern Lower Peninsula	7	7	3	0	0	0
Eastern Upper Peninsula	6	0	0	0	0	0
Western Upper Peninsula	3	0	1	0	1	0
State	29	12	4	3	2	0

[1] Source: Michigan Department of Natural Resources, 1988a.

FUTURE SUPPLY

The future supply in Michigan partially depends on stand establishment, multiple output constraints, and public policy. Forest managers have the opportunity to influence these variables to help ensure a steady supply of cedar in the future.

Stand establishment

Stands of cedar are established through natural succession or management activities (Johnston and Booker, 1983). Cedar will gradually replace other species that are not as shade tolerant or long lived. Thinning activities that favor cedar in established stands and regeneration after clear cutting are management activities that establish "new" cedar stands. Although cedar growth still exceeds removal throughout Michigan, the reduced acreage in young cedar stands is cause for long-term concern. Verme and Johnson (1986) conclude that cedar is not especially difficult to regenerate but is slow growing and subject to high mortality from various environmental and biotic factors. Harvests designed to regenerate cedar must be coordinated with deer herd management to minimize browsing during the first 20 to 40 years of stand development.

Multiple outputs as supply constraints
Management for multiple outputs often affects the timing of timber harvests, constrains harvest levels, and in other ways reduces the supply of cedar timber. Cedar stands provide critical deer habitat, wilderness areas, and old growth habitat in addition to cedar volume for forest products. Often these outputs are the landowner's primary management objective (particularly for public lands).

Management for critical deer habitat provided by even-aged pole and sawtimber stands increases the recommended rotation ages from a minimum of 80 years to a high of 150 years (Smith and Spencer, 1985; United States Department of Agriculture, Forest Service, 1986). The strength of the public interest in deeryard management in Michigan is illustrated by an agreement between the Michigan Department of Natural Resources and a major industrial landowner (Michigan Department of Natural Resources, 1988b).

On the Hiawatha National Forest, cedar stands may attain "old growth condition" when they are 100 years old and average diameter at breast height (dbh) is 14 inches (United States Department of Agriculture, Forest Service, 1986). Maximum longevity is considered 700 years.

Public regulation of private forest practices
Although there is much debate about the desirability and form of forest practices legislation in Michigan, potential legislation will undoubtedly affect the supply of cedar. The following statement is from a Society of American Foresters position paper on the public regulation of private forests (Society of American Foresters, 1989).

Landowners' choices of forest practices depend on the ecological characteristics of their forests, their interests in and capacities for forest management, and the market and policy influences that shape their choices. Forest practice regulations place planning and operational requirements on landowners who conduct certain forest management activities (e.g., timber harvest, forest improvement, road construction). These requirements, and the costs they involve, may modify landowners' choices and actions.

Regulations may have their intended positive effects on forest productivity and environmental quality. They may also have negative effects if they impose a burden that landowners cannot sustain without reducing the quality and productivity of their practices. Regulations that discourage productive timber management practices, for example, may erode the economic viability of forest enterprises sufficiently to promote forest conversion to uses more harmful than timber production to the environmental qualities the regulations are intended to protect. The balance of effects depends on the suitability of a regulatory system to the ecological and human circumstances in which it is applied.

Since regenerating cedar stands often present significant challenges for forest managers, specific regeneration requirements could affect the amount of cedar available for harvest. Recent forestry legislation in Maine includes rules for forest harvesting practices and provides for regeneration requirements within five years of harvest (State of Maine, 1989).

Changes in Michigan's Commercial Forest Act
Michigan's Commercial Forest Act will certainly be revised in the near future, with increased tax rates for enrollees. Since the revisions are not available at this time, the actual effects cannot be predicted. In general, however, higher property taxes are an incentive for landowners to increase harvests to help pay taxes. Thus, current enrollees would tend to increase their harvests. Changes in the provisions of the act may increase or decrease enrollment by non-industrial landowners, thus changing their property taxes and perhaps changing their willingness to sell stumpage. The net effect will depend on the form of the revisions.

CONCLUSION

The cedar resource in Michigan provides numerous benefits. One benefit is the monetary value of timber products sold, industries supported, and people employed. In 1986 the cedar harvest represented $1.4 million in primary products processed and a total of $6.5 million in delivered wood. This harvesting activity helps support approximately 1,600 jobs concentrated in the Upper and the northern Lower Peninsulas.

The resource is located in the Upper and northern Lower Peninsulas and grows in complex associations with other species. It is being harvested at an accelerated rate, and removals are approaching growth on private lands in the eastern Upper Peninsula. Rising real prices for both cedar pulpwood and sawtimber in the Upper Peninsula indicate that cedar is becoming scarcer in this region. If prices continue to rise, some current cedar producers and users may be forced out of the cedar timber market. The long-term viability of the cedar-using industry in Michigan depends on maintaining an adequate supply through regeneration activities and public policy decisions about multiple outputs, regulation of private forests, and tax policies.

LITERATURE CITED

Boelter, A.H. 1976. Michigan Drain Data By-Product. In Proceedings of National white-cedar Conference. Coop. Ext. Serv. Michigan State Univ. Dept. of For. pp. 3-5.

Carpenter, E.M. and M.H. Hansen. 1985. The Private Forest Landowners of Michigan. USDA For. Serv. Res. Bull. NC-93, 55 p.

Chappelle, D.E, S.E. Heinen, L.M. James, K.M. Kittleson and D.D. Olson. 1986. Economic Impacts of Michigan Forest Industries: A Partially Survey-Based Input-Output Study. Michigan State Univ. Agric. Exp. Stn. Res. Rep. 472. 17 p.

Findell, V.E., R.E. Pfeifer, A.G. Horn, C.H. Tubbs, 1960. Michigan's Forest Resources. USDA For. Serv. Stn. Pap. LS-82, 46 p.

Hansen, M.H. and J.T. Hahn. 1987. Operability and Location of Michigan's Timber Resource. USDA For. Serv. Gen. Tech. Rep. NC-116, 41 p.

Jakes, P.J. 1982. Timber Resource of Michigan's Northern Lower Peninsula, 1980. USDA For. Serv. Res. Bull. NC-62, 120 p.

James, L.M., Heinen, D. Olson, D. and Chappelle. 1982. Timber Products Economy of Michigan. Michigan State Univ. Agric. Exp. Stn. Res. Rep. 446. 24 p.

Johnston, W.F. and R.G. Booker. 1983. Northern White-Cedar in Silvicultural Systems for the Major Forest types of the United States. USDA For. Serv. Agric. Handbook 445, 105-108.

Michigan Department of Natural Resources, Forest Management Division. 1988a. Wood Products in Michigan: A Directory of Mills and Manufacturers. 390 p.

Michigan Department of Natural Resources, 1988b. Memorandum of Understanding Between the Michigan Department of Natural Resources and Escanaba Paper Company. September 2, 1988, 7 p.

Michigan Department of Natural Resources, Forest Management Division. 1989. Timber Sale Contract System Reports, 1979-1989. Unpublished. Lansing MI.

Michigan Employment Securities Commission, Bureau of Research and Statistics. 1989. Civilian Labor Force and Employment Estimates, 1988. Lansing, MI.

Smith, B.W. 1982. Timber Resource of Michigan's Eastern Upper Peninsula, 1980. USDA For. Serv. Res. Bull. NC-64, 103 p.

Smith, B.W. and J. Blyth. 1989. Timber Harvesting Trends in the Lake States, 1983-1987. USDA For. Serv. Res. Bull. NC-288.

Smith, B.W. and J.T. Hahn 1986. Michigan's Forest Statistics, 1987: An Inventory Update. USDA For. Serv. Res. Bull. NC-112, 44 p.

Smith, B.W. and J.S. Spencer, Jr. 1985. Forest Management Opportunities for Michigan, 1981-1990. USDA For. Serv. Res. Pap. NC-264, 31 p.

Society of American Foresters. 1989. Public Regulation of Private Forest Practices. J. For. 7(1989):52-54.

Spencer, J.S. 1982. Timber Resource of Michigan's Western Upper Peninsula, 1980. USDA For. Serv. Res. Bull. NC-60, 102 p.

Spencer, J.S. and J.T. Hahn. 1984. Michigan's Fourth Forest Inventory: Timber Volumes and Projections of Timber Supply. USDA For. Serv. Res. Bull. NC-72, 95 p.

State of Maine, 1989. Maine Laws, H.P. 315 L.D. 429, An Act to Implement Sound Forest Practices. 17 p.

Timber Marts. 1986. Timber Mart-North. Michigan Vol. 6 Nos. 1-4. F.W. Norris, Highlands, NC.

United States Department of Agriculture, Forest Service. 1989. Timber Products Output from Roundwood by Species and Product. Table 18. Unpublished Data. USDA For. Serv. North Central For. Exp. Station. St. Paul, MN.

United States Department of Agriculture, Forest Service. 1986. Land and Resource Management Plan, Hiawatha National Forest; GPO 641-110/20070. Washington DC: U.S. Government Printing Office.

Verme, L.J. and W.F. Johnston. 1986. Regeneration of Northern white-cedar Deeryards in Upper Michigan. J. Wildl. Manage. 50(2):307-313.

Zollner, J.A. 1976. The Cedar Resource. in Proceedings of National white-cedar Conference. Coop. Ext. Serv. Michigan State Univ. Dept. of For. pp. 5-7.

Condition of The Northern White Cedar Resource

William Botti
Forest Management Division
Department of Natural Resources
Lansing, MI 48901

When attempts to describe the condition of a forest stand are made, factors that can be measured objectively, such as age, stocking level and grade are used. This paper attempts to describe the condition of northern white-cedar stands using forest survey data (MDNR 1980). No comparable data is available to measure the condition of this resource for wildlife-related factors.

When forest survey figures from 1965 and 1980 are compared, there was only a drop of 14,000 acres of northern white-cedar type, a 1 percent drop (Table 1). However, in comparing size classes, a skewed trend is noted. There is a very small increase in sawtimber acres, more than a 100,000 acre increase in pole stands, but a corresponding 100,000 acre decrease in seedling and sapling acreage. Evidently very little northern white-cedar is regenerating or being cut. As a percent of total acres, 55 percent is in poletimber, 26 percent in sawtimber and 19 percent in seedlings and saplings (Table 1). Michigan's State Forest Operations Inventory showed 78 percent of the cedar type to be well stocked, 17 percent with medium stocking and only 5 percent poorly stocked. However, trees over 100 years old represent 44 percent of the northern white-cedar volume.

Table 1: Northern white-cedar Type in Michigan by Forest Survey Years (in thousands of acres)*

			Percent of Total
	1965	1980	1980
Seedlings & Saplings	321.7	227.2	19
Poletimber	535.6	640.6	55
Sawtimber	303.2	305.8	26
Total	1,187.7	1,173.6	100

*Source: Raile and Smith 1980

Table 2: Location of white-cedar Type in Michigan, 1980*

	Thousands of Acres	Percent of Total
Eastern Upper Peninsula	594.6	51
Western Upper Peninsula	210.2	18
Northern Upper Peninsula	355.5	30
Southern Lower Peninsula	13.0	11
Total	1,173.6	100

*Source: Raile and Smith 1980

Just over one-half of northern white-cedar acres are found in the eastern Upper Peninsula (Table 2). The northern Lower Peninsula contains 30 percent of the acreage followed by the western Upper Peninsula with 18 percent. Only 1 percent of the northern white-cedar is located in southern Lower Michigan.

The largest single landowner is the State of Michigan with 28 percent of the northern white-cedar type. The largest percentage (39%) is owned by farmers and miscellaneous private individuals. Forest industry controls only 17 percent and the National Forest only 6 percent. (Table 3)

On the surface, the northern white-cedar resource appears to be in good shape. However, over 10 percent of the volume of northern white cedar growing stock is considered cull (MDNR 1980). This is similar to Scotch pine

stands, and only Austrian pine stands have a higher cull percentage. In addition, 97 percent of northern white-cedar sawtimber is categorized as grade 3 -- the same as for Jack pine sawtimber. Some of the reasons for convening this conference are contained in these dismal numbers.

Table 3: Ownership of white-cedar Type in Michigan*

Owner Class	Thousands of Acres	Percent of Total
National Forest	68.3	6
State Forest	323.7	28
County and Municipal	10.8	1
Forest Industry	205.4	17
Farmer	212.3	18
Misc. Private – corp.	103.9	9
Misc. Private – individual	247.6	21
Total	1,173.6	100

* Source: Raile and Smith 1980

Why are our northern white-cedar stands in such poor condition? No management! Examples of northern white-cedar stand management in Michigan are rare at best. This lack of management impacts both timber quality and wildlife habitat quality. Both should be of concern to all of us attending this conference. This conference is an opportunity to begin laying the foundation for future management of northern white cedar stands.

Northern white-cedar stands are crucial to the health and survival of the white-tail deer herd in Michigan. As a result, we have hesitated as managers to do anything that would jeopardize the habitat of the deer herd. At least, that is the story on State Forest land where very little northern white-cedar type has been cut in the past 15 years. We have been preserving the "Green Barn". With this approach, we have avoided dealing with the northern white-cedar regeneration problem with which we are all familiar.

Are northern white-cedar regeneration problems real or imagined? The forest survey (MDNR 1980) listed an annual northern white-cedar harvest of nearly 80,000 cords. Recognizing that it did not all come from the northern white-cedar type, we could still estimate that several thousand acres of northern white-cedar are harvested each year. For discussion, let us assume that one-half of this annual volume is from the northern white-cedar type and it averaged 7 cords per acre. That would be a harvest of 5,000 acres per year. That is 75,000 acres of northern white-cedar harvested over the 15-year period between forest surveys. The most recent forest survey (MDNR 1980) listed a decline in northern white-cedar type of only 14,000 acres during that time. Can we therefore conclude that the majority of harvested northern white-cedar stands are regenerating?

Maybe and maybe not. I visited some old deer yard areas that were active in the 60's in Marquette and Luce Counties. Everywhere I went, I found blown down northern white-cedar. Why did it happen? Is this a characteristic of all northern white-cedar stands in Michigan? Perhaps it is and perhaps we have enhanced it by cutting strips and patches.

In the old deeryard in Luce County, non-commercial cedar harvests were made to feed a declining deer herd for several successive winters in the 60's. The harvests were not successful in stopping the decline of the deer herd. By the mid-70's the deer herd was gone.

Presently, there is northern white-cedar regeneration in certain places in both of the old deeryards. Some of the regeneration has even reached a point where it could be considered established. Not surprisingly, the northern white-cedar regeneration is in an area where there are now few white-tail deer.

I think this tells us to put our northern white-cedar regeneration efforts where the deer are not. It does not appear to me that deer populations move from one yard to another, rather, they die out of one yard and flourish in another

as individuals stray into new areas with good food and cover conditions. We should therefore be ready to move into a deeryard after a population collapse to encourage northern white-cedar regeneration. Perhaps someday we will be able to "plant" deer in areas with good browse conditions and then eliminate the cover in the old yard when the new one is established.

I know this is somewhat simplistic and that there are some areas without the deep snow needed to keep the deer in one place. However, I do think it would work in most of the Upper Peninsula. The basic principle of successful northern white-cedar regeneration is to keep the deer out until it is established.

Lou Verme's idea of progressively cutting adjacent blocks and thus attracting deer away from regenerating stands has been shown to work, but it takes diligence over many years. Mike Zuidema[1] told of one such area near Escanaba where after more than twenty (20) years of success, one year without cutting allowed the deer to move through and destroy most of the established regeneration.

The condition of our stands says we are running out of time. They are falling down piece by piece and losing their value as "Green Barns". We know the principles of how to regenerate them. Now we need to figure out how to make those principles work. It will take diligence and some money too, but we have to get started.

LITERATURE CITED

Raile, G. K. and W. B. Smith, 1980. Michigan Forest Statistics, USDA Forest Service North Central Expt. Station Resources Bulletin NC-67.

Michigan Department of Natural Resources. 1980. Forest Management Division, Forest Operations Inventory, Box 30028, Lansing, MI 48909.

Verme, Louis. 1963. Guides for Managing Swamp Conifer Deeryards, Michigan Department of Conservation, Cusino Wildlife Experiment Station, Shingleton, MI.

[1] Personal Communication, MI DNR Silviculturist, Escanaba, MI

NORTHERN WHITE-CEDAR:
Stand Assessment and Management Options

Raymond O. Miller
Michigan State University

Donald Elsing
United States Forest Service

Mike Lanasa
United States Forest Service

Mike Zuidema
Michigan Department of Natural Resources

ABSTRACT

This paper summarizes the important factors for assessing northern white-cedar (Thuja occidentalis L.) stands when considering various management objectives. The shortcomings of the system now used to prescribe management are discussed and suggestions are made to refine and improve upon this system. Possible management options are examined and evaluated for effectiveness and feasibility.

INTRODUCTION

The northern white-cedar (Thuja occidentalis L.) resource is a series of paradoxes.

First, a typical commercial forest is productive and a pleasant place to be, but this is generally not the case with cedar. Cedar stands are often low in productivity and the type of place that none of us would choose for a vacation trip.

Second, cedar stands are vital winter habitat for white-tailed deer (Odocoileus virginianus borealis Miller) and snowshoe hare (Lepus americanus), providing both top quality browse and thermal cover. The high palatability of cedar foliage causes extreme browsing pressure on young trees making regeneration difficult. This places their future in jeopardy.

Third, cedar stands are slow growing and inaccessible yet recent trends have made them extremely valuable from a forests products standpoint.

Fourth, even though cedar stands occur over a vast portion of the northern Great Lakes region, the conditions that led to their successful establishment years ago, are now extremely difficult to duplicate.

Fifth, today the need to manage this valuable resource has never been more strongly felt but our failures are as frequent and as poorly understood as they were 40 years ago when Thomas C. Nelson first began systematically defining and studying cedar management in Michigan.

Preceding papers have demonstrated the value and complexity of the cedar resource from a number of different perspectives. One thing that ecologists, hydrologists, economists, timber managers, and wildlife managers can agree to is that healthy cedar stands are an asset to Michigan: The cedar resource should be maintained. Many of these same people also agree that this will be easier said than done.

WHERE ARE WE NOW?

According to the 1980 Forest Inventory of Michigan, northern white-cedar occupies approximately 8% (1.2 million acres) of the commercial forest land in the northern Lower Peninsula and Upper Peninsula. These stands are most often managed following the guidelines established in the Manager's Handbook for Northern White-cedar in the North Central States. Results are unpredictable at best and frequently unacceptable. In fact, both the State and Federal forests in the region have instituted a partial moratorium on cedar harvesting until suitable regeneration systems can be developed.

Harvesting cedar often results in stand type conversion: The stocking of Thuja is frequently inadequate. No one is entirely sure why this happens, but the theories advanced fall into two broad groups: Silvicultural problems and Wildlife problems.

Silvicultural problems may include;

- A poor seed source or lack of advanced regeneration.
- Seeds that fall do not germinate due to moisture or pH problems.
- Seedlings becomes established but desiccate or drown due to fluctuations in the water table.
- Too much competition on the site prevents early seedling development.

Wildlife problems include;

- Newly established seedlings may be eaten by hare and deer.
- Animal populations may fluctuate tremendously during the 20 years that young cedar is vulnerable to over browsing. This almost ensures that a stand will be at high risk during some phase of regeneration.
- Improperly coordinated feeding and cutting practices in adjacent areas can causes deer to concentrate in regenerating stands.

Until recently, it was standard practice for wildlife managers and silviculturists to blame each other for the cedar management problem and leave it at that. Silviculturists would show off a deer exclosure brimming full of cedar and say, "If you just keep the deer out, you get cedar!" Then a wildlife manager would take you to two stands, only a mile apart. One would be full of cedar regeneration and the other -- nothing but tag alder. They would say, "See those foresters just don't know how to treat these stands to get the cedar back!"

WHAT HAPPENS IF WE DO NOTHING?

Predicting the future is always risky, but current trends suggest that if our management of the cedar resources does not change, trouble lies ahead.

- State and Federal forests will continue to be held in reserve but will age and become less well suited for deer yards.
- Financial pressure will continue to grow on the remaining private cedar stand owners to sell, as the market for timber products becomes more competitive.
- Poorly managed cedar stands will regenerate to species such as balsam poplar (Populus balsamifera L.), tag alder (Alnus rugosa (DuRoi) Spreng.), and balsam fir (Abies balsamea (L.) Mill.).
- The deer herd will be forced into smaller and smaller yarding areas and thus make it even more difficult to bring young cedar seedlings to sapling size.
- The deer herd will decline or move south unless massive feeding programs are implemented.
- Northern white-cedar timber products industry will shrink to insignificance as the resource dwindles.

Aspects of this scenario are already occurring, and it may only take another 20 to 50 years before the last of these predictions come true. The undesirable scenario outlined above can only be averted by the combined efforts of all forest user groups. Fortunately, this is already happening -- as demonstrated by this meeting.

Cedar resource management can be improved in two areas: 1) By improving the means of describing a site's suitability or potential for various management alternatives, and 2) by developing or improving management options that better meet the needs of the cedar resource. The remainder of this paper will consider each of these two needs in turn.

STAND ASSESSMENT

Any forest and wildlife management system is made up of a series of cultural treatments applied at various times to different parts of a resource. Developing the correct system requires that the managers choose the appropriate treatment(s) and apply it (them) at the right time to achieve their objectives. This is all rather basic, but it is important to start here to arrive at a solution to the cedar management problem we now face.

It will be necessary for managers to know a great deal about the sites they intend to manage if their efforts are to be successful. This preliminary management phase will be referred to here, as stand assessment.

Cedar stands occur over a range of sites where the physical conditions or management objectives dictate which operations are appropriate and which will succeed. Any stand assessment scheme must address each of these factors.

SILVICULTURAL CHARACTERISTICS

Current management guides for northern white-cedar (and most other species) place a strong emphasis on the analysis of silvicultural stand characteristics. Cultural practices are often prescribed on this basis alone.

Productivity (Site Index): One of the most common methods for measuring a site's potential to respond to cultural treatments is to determine its site index (Site index is a standardized measure of height growth). For cedar, a site index less than 20 feet at 50 years is considered poor and greater than 40 feet at 50 years is considered good. Site indices in excess of 60 are exceptional but are rarely encountered. The most recent forest survey of Michigan found a large portion of the cedar resource occurring on sites with poor growth potential (52% of Michigan's cedar stands have a site index of 30 or lower and only 17% have a site index over 40).

This factor alone may have lead us to the current situation where the resource is poorly managed and little understood. After all, why spend limited research and management time on the least productive forest types when the most productive types (hardwood and pine types) also require attention. Lest this approach be condemned by wildlife managers, remember that the more productive stands provide the summer range for white-tailed deer and thus are of equal importance to the maintenance of the herd.

Stand size: The size of a cedar stand will affect cultural practices for two reasons. First, adequate provision must be made for natural seeding under the present strip or block clearcutting prescriptions. If the stand is too small to accommodate repeated strip or block cuts and still allow for residual seed trees, then a system of shelterwood harvesting is recommended.

A second consequence of stand size involves wildlife use of the area. Without alternative yarding areas, the manager must consider how a small stand will regenerate in the presence of its usual winter deer herd.

Associated species: Winter thermal cover properties and regeneration potential of a stand are effected when cedar occurs together with other species. Stands with a large hardwood or tamarack component will not provide a dense unbroken canopy during the winter and so are poor deeryards. The hardwood component of these stands will give rise to vigorous competition for young cedar following a regeneration cut, which often results in a type conversion.

Species such as balsam fir are more successful than cedar at regenerating on cutover swamps. These stands can provide thermal cover but do not supply winter food to yarding deer.

Stand age: Young stands are made up of small trees that deer can use for food. As the stand ages, its value as thermal cover improves and its potential for producing forest products increases. Old stands are the most valuable for timber products but tend to have lower value as wildlife habitat (poor thermal cover and little browse).

Older stands may have fewer intolerant species present to compete with cedar following a cutting. These older, larger trees may be prone to wind throw however, during strip or shelterwood harvesting.

PHYSICAL CHARACTERISTICS

The factors described above are traditionally used by forest managers to predict a stand's response to treatment. In recent years, however, other site factors have been measured and included in site assessments to better predict how a stand will respond to cultural treatments. Reliance on stand characteristics alone has been shown to be an unreliable way of predicting the results of cedar management systems. It may be necessary to include other site characteristics to improve the accuracy of cedar stand assessments. Many managers are already doing this informally.

Indicator species: Attempts have long been made to link the presence of minor species of plants on a site with the performance of the major species (trees). Rather than directly predicting tree performance, these minor plants are sometimes used as indicators of physical site characteristics that are known to affect the crop. The most recent Ecological Site Classification systems include an examination of non-crop species in models of stand assessment.

Soil mechanical and chemical properties: Soils and climates are the basis for plant growth and can have a deterministic effect on which plants can exist on a site and how well they will regenerate, compete, and grow. Northern white-cedar occurs on thin limestone based soils, deep mineral upland soils, and on both shallow and deep organic soils. The most common site for cedar is in the organic swamps, but its presence on other sites may hold the clues to the difficulty we have managing it.

Soil factors that have been implicated in the regeneration and development of cedar include reactivity (pH), temperature, and of course fertility. Deer exhibit a browsing preference for cedar grown on organic soils over that grown on limestone sites although the nutritive value of the two is the same.

Ground water conditions: A principle cause of mortality for young cedar seedlings has been ascribed to soil moisture conditions in the swamps. Spring water levels are usually excessive and the organic layers become dry during the summer. This fluctuation in water levels creates conditions where small seedlings are either drowned or desiccated over the course of the year.

Another factor which effects the productivity of cedar stands seems to be related to the groundwater flow patterns for the entire area. Excessively flat areas with no appreciable groundwater flow seem to have much lower productivity than sites that have a slow but regular groundwater flow. These latter sites are often located between a ridge or high ground and a river or stream. Groundwater slowly flows from the ridge to the stream, providing a continuous movement of nutrients and ameliorating the effects of decaying organic matter.

EXTERNALLY APPLIED RESTRICTIONS

Many management decisions are based on conditions that are imposed by neither site vegetation nor physical conditions. These include ownership objectives, legal requirements, and adjacent property use. In many cases, these are the determining factors in management plans and in some cases can rule out management altogether.

Ownership objectives: Each piece of ground has a potential to be used for several purposes. The way it is used will depend on the owner's goals for that land. Land owners often value their land for its potential to produce commercial products, wildlife, recreation, or some combination of these three. The methods used to manage these areas will differ with these objectives.

Commercial objectives are best served by the production of forest products such as poles, cabin logs, sawtimber, and foliage. For the most part, this mandates long rotations and medium to low stand densities.

Wildlife habitat objectives will require management systems that favor adequate thermal cover and browse. Adequate thermal cover can be achieved in dense stands of medium-aged conifers. These stands need not be populated exclusively by northern white-cedar. Cedar is essential for winter browse, and stands managed for this objective would be dense and young.

Cedar stands managed for recreation objectives will share some characteristics with the stands described above. The list of possible recreation activities for cedar swamps is short but may include: Hunting, winter sports (snowmobiling, snowshoeing, etc.), or wildlife viewing (probably from a nearby road). If nothing else, recreation objectives may preclude clearcutting and thus complicate normal regeneration operations. Stands near roads that are managed for wildlife viewing may attract tourists as long as the deer stay in the swamps and off the roadways (where they become problems for the auto insurance companies).

Legal requirements: Most cedar stands occur in swamps or wetlands. The size of our nation's wetlands has been reduced over time, by man's activity, and there is increasing concern about this. Legislation may restrict the types of cultural operations that are permitted in wetlands such as the cedar swamps. Policy decisions have already eliminated the possibility of swamp draining as a management tool.

Other policy decisions may also have a bearing on how cedar stands can be managed. The annual allowable harvest of white-tailed deer is one example of the way that policies effect cedar (sometimes indirectly). Another example is the virtual moratorium on cedar harvesting on State and Federal forests in Michigan's Upper Peninsula.

Adjacent property use: Managers must always consider how adjacent tracts are being used and the effect that will have on the stand in which they are working. The reverse is also true: Managers must consider the effects of their treatments on the adjoining property. Developing a deer yard on the outskirts of an airport would certainly be poor planning.

An example of adjacent property management effects on a cedar regeneration area can be found near Rock, Michigan. A large cedar stand there had been under regeneration for 30 years. Strip clearcuts of various ages were regenerating well, and it was an example of how present management practices worked well. The winter of 1988-89 brought disaster for the stand. In addition to a larger-than-normal deer herd, cutting in nearby cedar stands was stopped. This forced the deer that normally used the other areas to seek winter browse in the only possible place; the Rock stand. It will take many years for the stand to recover from the over-browsing that occurred there that winter.

IMPROVED STAND ASSESSMENT SYSTEM

The above list of factors affecting cedar management decisions seems, at first, to be elementary. Those that are not specifically addressed by existing management guides are certainly considered by resource managers. Yet, the failure to consistently regenerate cedar and the arguments over proper corrective measures has continued for 40 years.

It may be that the cedar resource is simply unmanageable, but this is hopefully not the case. A second possibility is that the cultural systems for reliable cedar management are presently unknown. If this is the case then the solution is to develop new methods or adapt methods used on other sites. A third explanation may be that managers are not

integrating what is currently known about the resource into a workable system. This problem could be addressed by revising the management guidelines for cedar to incorporate information learned since the present guidelines were established.

We feel that the real problem is a combination of the last two mentioned above. Management guidelines do not consider all factors known to affect the resource and, in some instances, there is no cultural practice available to solve a specific problem. Cultural practices will be discussed later but first it is important to consider what an updated site assessment system might include.

Detailed examination of site vegetation
- Assessment of stand productivity
- Inventory of crop and non-crop species
- Interpretation of indicator species.
- Assessment of competition effects.
- Seed source evaluations.
- Evaluation of stand size and age.

Characterization of site physical characteristics
- Examination of weather patterns.
- Assessment of micro-site variations.
- Investigation of access problems.

Characterization of soils
- Investigation of surface characteristics as they may effect establishment.
- Investigation of sub-surface characteristics as they effect growth potential.
- Assessment of soil chemistry affects on germination and nutrient cycling.

Characterization of groundwater
- Characterization of seasonal fluctuations in water table levels.
- Topographical drainage pattern assessments.

Assessment of animal pressure on the site
- Current use patterns of the site.
- Changes that might be expected at different times during stand management.
- Effects of activity in adjacent areas on animal use of the managed stand.
- Likely effects of unexpected fluctuations in animal populations.

Assessment of social concerns
- Legal restrictions against certain cultural practices.
- Political pressures that may exist against certain management decisions.

Financial analysis
- Complete accounting of all multiple use values.
- Assessment of the intensity of management system that is warranted based on stand value.

MANAGEMENT OPTIONS

An improved site assessment system might be used to determine the combination of cultural treatments that will achieve a desired ownership objective. Silvicultural and wildlife issues must be addressed jointly to ensure the success of any management plan and also to share the cost of the prescribed operations.

It will probably be necessary for the cedar resource to be subdivided into management units, since it is so varied. Stand management can not be covered by blanket policies but rather needs to be done on a case-by-case basis.

New cultural techniques need to be improved and developed to add to existing ones and so provide an arsenal from which managers can draw. Some of these techniques may be expensive and so it will be important to have a thorough understanding of the value of the stands being managed. This must include an assessment of both the traditional values of forest products as well as the less tangible values of wildlife, recreation, and watershed protection.

The workshops of this conference were designed to provide a forum for those interested in the cedar resource to consider and discuss management options and needs. This paper concludes by offering a list of possible management techniques for the cedar resource to be considered during these workshops.

PRE-HARVEST STAND TREATMENTS

Eliminate undesirable species: Stands that contain species that are known to interfere with the regeneration of cedar (tag alder and balsam poplar for example) could be treated to kill these species prior to harvest. This would effectively prevent them from competing with the regenerating stand. These operations would be expensive and so could only be justified in certain instances.

Encourage advanced regeneration: Cedar is shade tolerant like some of the valuable hardwood species, so it might be possible to establish advanced regeneration prior to harvesting using techniques similar to those now employed in hardwoods. This regeneration may be better able to withstand the competition of undesirable species after harvest and thereby improve the chances of success. These treatments would also be expensive and need to be carefully justified.

HARVESTING AND SLASH HANDLING

Clearcutting: Although it may be possible to manage northern white-cedar using uneven-age management systems, the resulting stands may not provide quality winter deer yards. It is more likely that even-aged management systems will be required. Clearcutting in small strips or blocks is presently prescribed to take advantage of natural seeding from adjacent stands. If artificial regeneration systems are employed, it may be better from an operations standpoint to increase the size of these cuts. Clearcutting is a profitable harvesting technique and creates large areas of cedar in the same stage of development.

Shelterwood: Shelterwood or seed tree regeneration systems can be employed in stands that are too small to accommodate strip or block clearcutting. Both of these harvesting systems leave scattered seed trees throughout the stand. Shelterwood also provides some of the benefits described above for advanced regeneration treatments: The shade of the shelter trees may tend to discourage regeneration of highly competitive hardwoods.

Slash handling: The accumulation of slash following a harvest operation is a problem for several reasons: It makes access to the site for subsequent cultural treatments difficult, it provides shelter for high populations of snowshoe hare, and may even prevent seed from germinating and establishing.

This slash is often the principle source of food for deer that are yarding in cutting areas. The slash acts to lure deer away from the young seedlings in previous year's cuttings. Anything done to eliminate slash must consider these positive effects.

Traditional slash handling techniques include windrowing, piling, or loping and scattering. Slash piles in cedar stand are usually the last areas to regenerate, so scattering slash is preferable. It may be possible to use whole-tree

skidding to remove the slash from the harvested area. The tops of trees could either be fed to deer away from the site or sold for processing into wreaths or chemicals. Burning of slash will be discussed below.

SITE MODIFICATIONS BEFORE REGENERATION

Burning: The vast stands of cedar in Michigan probably arose after extensive fires. The fires may have had several beneficial effects: Reduced slash loading, removed undecomposed mosses on the swamp floor, blackened the surface and thus increased its temperature, and produced quantities of ash to raise the pH. Fire, then, removed competition and improved the seedbed. There are only a few cases where prescribed burning has been conducted in cedar stands, but it is generally thought to be a promising technique.

Cedar managers today have been hoping to use prescribed burning as part of their efforts to regenerate cedar, but have found that safe and effective burns in a swamp are even more difficult than in upland forest types. Burning windows are so narrow that only some stands could be treated this way each year. Without a serious commitment by the agencies that conduct prescribed burns, it is unlikely that burning will be used extensively in cedar management.

Mechanical scarification: The beneficial effects of burning (slash reduction and seedbed improvement) can be duplicated mechanically. Several machines are available commercially that grind woody material and mix the top layers of the swamp floor, like large rototillers or hammer mills. Machines like these are tremendously expensive and so their cost would need to be spread over many sites. In addition they tend to level the site, erasing all micro topography. This effectively places the entire site under water in the spring and makes seed germination difficult at that time of year.

Micro site modifications: As stated earlier, a primary cause of early seedling mortality is the soaking and drying cycles that occur over the year in a swamp. Operations that provide intermediate micro sites are common in the southeastern United States. Bedding, furrowing, and mounding are all examples of this type of treatment and have been used experimentally in this part of the country. These operations are also expensive, but costs vary among them. Mounding is one of the least expensive alternatives and creates a site that is analogous to an established hardwood stand with the typical pit and mound topography.

Drainage: Recent public policy makes the drainage of wetland sites difficult to accomplish. It may be possible to develop a system that alternately drains areas during their regeneration phase and refloods them for the remainder of their life. A 1000-acre management area could be divided into ten 100-acre blocks. Each block might be drained for 10 years and then reflooded for the remaining part of the rotation (say 90 years). This would maintain the majority of the area as a wetland and would increase the health of the whole block.

pH and feld beility adjustments: Soil pH has been implicated in the germination success of cedar seeds. Experiments are underway now to better define these relationships and it may be that lime applications on particularly acid swamp sites may greatly improve regeneration success. The beneficial effect of feltilization is obvious but the cost of this is frequently too high to justify. Quantitative measures of costs and benefits are lacking for cedar stands, however, so it is impossible to make any final determinations now.

REGENERATION METHODS

Regeneration from seed: Regenerating stands by natural or artificial seeding requires no or almost no investment. After harvest, one simply walks away or scatters some seed and waits. These methods have been used exclusively in the cedar resource and although the apparent costs are low, the actual costs may be very high indeed.

Cedar seed does not spread far from a seed tree so the current management system prescribes cutting in small strips or blocks. The distribution of these numerous small areas becomes a problem when the expensive machines,

mentioned above, are used to prepare the site, or when fire lines need to be established around scores of 10-acre blocks. The cost of managing many small units is more than several larger ones.

Cedar plantations: Traditionally, when forest managers encounter problems with natural regeneration systems for important forest species, they establish artificial plantations. Although northern white-cedar is widely planted as an ornamental (arborvitae), plantation management of cedar swamps has not been adopted. Plantation silviculture is more expensive than natural regeneration systems but it is also more controlled.

Layering: Northern white-cedar is notorious for regeneration through layering on swampy sites (Layering is a natural process where live branches take root and form new plants). Trees of layered origin tend to have sweeping stems and are less desirable for posts and timber. Stands that reproduce by layering tend to have scattered, dense clumps of cedar that provide excellent wildlife habitat. The sweeping form of layered trees gives deer access to the foliage of older trees. Layering regeneration systems are as inexpensive as natural or direct seeding systems but may result in stands that are only suitable for wildlife objectives.

Type conversion: In certain instances the best course for management on a particular site may be to abandon the idea of growing cedar entirely. Some species, such as balsam fir, regenerate more easily and could provide some of the same thermal cover benefits to wildlife. This course of events has already taken place, unintentionally, on many sites.

EARLY ESTABLISHMENT AND GROWTH TREATMENTS

Competition control: Weeding operations are standard practice in many forestry operations and can be accomplished mechanically or chemically. The hardwood brush that frequently invades regenerating cedar stands can be controlled with the application of certain herbicides. Glyphosate, a broadleaf weed control chemical, is manufactured in a formulation that can be applied to open water and might be effectively used in swamps. Some mechanical methods for reducing unwanted species have already been discussed but might also include girdling or felling of young unwanted saplings. Weeding operations can be expensive but have been shown in other applications to pay for themselves through improved stocking and growth.

Wildlife population control: Young cedar stands are susceptible to over-browsing by deer and hare. The number of animals using a regenerating stand might be altered in several ways:

- Lure animals away from sensitive areas by feeding them elsewhere. This could be done through harvesting operations in adjacent stands or by direct feeding of agricultural crops in areas remote from managed stands.
- Reduce populations by increased hunting pressure through changes in the length of the season, type of seasons, or increased kill limits.
- Introduction of natural predators.

There is likely to be a great deal of public reluctance to employ the latter two suggestions above, so this must be considered as a cost.

Wildlife behavior modification: It may be possible to reduce the pressure exerted on young cedar stands by large deer and hare populations by changing their browsing preference. This might be accomplished by: Providing an alternate, more desirable food source at the stand; treating the cedar foliage with repellents that discourage browsing; or by breeding cedar that contain natural repellents. Deer have been shown to exhibit preference between cedar grown on different sites, and genetic links for this preference have been demonstrated in Douglas-fir (Pseudotsuga menziesii var. glauca (Beissn.) Franco). This approach to the cedar management problem will require more research and undoubtedly be expensive.

Wildlife exclosures: Excluding deer and hare from regenerating cedar stands has been shown to be an effective way of improving success. Many exclosure fences were erected as part of research projects over the last 30 years

and have yielded dramatic results. Large exclosures have never been used in cedar stands, although they have been used in hardwood stands in Pennsylvania. This may relate back to the growth potential of cedar stands when compared to other forest types; managers may simply not want to spend money on these projects.

An alternative to large area fencing has recently been introduced to the United States from Great Britain and a similar idea has been used in landscaping work for many years. This system involves erecting small, individual tree shelters around selected crop trees. These tubes have two advantages: First, they prevent animals from eating the trees they surround and second, they have been demonstrated to increase the growth rate of some species' seedlings by a factor of 4 or more. Of course, they are not inexpensive.

STAND DEVELOPMENT TREATMENTS

All of the preceding cultural treatments deal with the planning, establishment, and early development phases of cedar stand management. Once stands are established the forest manager's work continues through any number of intermediate treatments. We feel that the real problems with cedar management lie in the time prior to successful stand establishment and that existing intermediate treatment techniques are adequate. For this reason, we choose not to discuss them at length now, but to leave that for another time.

CONCLUSIONS

The preceding discussion is frequently punctuated with phrases that warn that certain information is not yet available or that the effects of various cultural treatments on the cedar resource are not well understood. Another recurring theme is that research or the application of a cultural system will be expensive. The first problem is undoubtedly caused by the second!

The only people seriously researching solutions to the cedar management problem today are doing it in their spare time, so the slow pace of improvement is easily understood. It is clear that if our intention is to prevent the dire prediction made at the beginning of this paper (that the cedar resource is doomed at the hands of the present management system) a serious commitment of time and money must be made.

Beyond the biological importance of the cedar resource lies its poorly defined economic value. Accurately defining this value is essential to obtaining the political commitment necessary to advance our understanding and to improve our management. A thorough financial analysis of cedar in Michigan must precede any attempts to refine present management practices. If nothing else, managers will need to know the value of a particular stand in order to justify expensive management options.

It is also clear that because the wildlife and timber uses of this resource are so intimately united, that the present trend toward cooperative management must continue and strengthen. It is hoped that this meeting will serve to cement these bonds and join us together in a single resolve.

Northern White Cedar Workshop: Closing Comments

Douglas O. Lantagne
Department of Forestry
Michigan State University
East Lansing, MI 48824

We have made it to the end of 24 hours. We as foresters, wildlife biologists, recreational users, industrial users and others have worked together to increase OUR understanding of the importance of the northern white-cedar resource. The discussion of the past several hours should not stop when we leave this room today. The discussion must continue on an individual basis among all the users of the cedar resource. Numerous ideas on how to approach the cedar management problem have been put forward. Now the goal is to pursue some of these ideas.

What do we use as goals for the months and years to come? The ideas of this meeting will be documented in the proceedings. The papers and the individual group reports will be included. So if you forget what we accomplished and what OUR goals are, don't forget to take down the proceedings from the book shelf and refresh your memory. Remember that each of you have a responsibility. Each of you should write an article about the importance of northern white-cedar in your area. If you don't, WHO WILL? In the same vein, contact your local forester, wildlife biologist, local wood using industry or sports club to arrange a visit and learn about their goals for the northern white-cedar resource. It is not enough to depend on meetings such as this workshop to provide the discussion necessary to manage this or any of our other natural resources. We must constantly be talking with other users, whether we agree with them or not!

How have we tried to establish goals for the future? Discussion, compromise and hardwork. We started with individual ideas 24 hours ago, I hope we still have those, but in addition an understanding that everyone here has some common purpose related to cedar management. We all want a healthy and usable northern white-cedar resource.

In the course of the our discussions we have defined some of OUR common ideas for improving cedar management. Based on the work of the multi-disciplinary groups, three major problems were defined. They were:

- A lack of information on correct silvicultural and wildlife management techniques. There is not a clear understanding of the northern white-cedar resource and its general management problems;

- There is a lack of serious commitment or emphasis towards northern white-cedar management by top agency and industry officials, and by the forest managers and wildlife biologists in these same organizations. Coordinated implementation of ongoing activities is also lacking in such areas as deer management, and northern white-cedar regeneration;

- Multiple-use issues have not been resolved. There is a lack of understanding, appreciation and discussion between interest groups and users of the northern white-cedar resource. Some conflicts may be arising from the use of statewide management guidelines which are not considered acceptable management by the public or resource managers in local areas.

A solution suggested by most discussion groups for these and other problems was to form a permanent cedar working group to serve as an information clearing house for all users. The working group would help identify common objectives among interested resource managers. The working group would also help establish task forces to articulate the importance of the cedar resource and research the management problems associated with cedar.

The apparent consensus of all the participants was that the value of the northern white-cedar resource should be expressed to politicians, administrators and the public. The discussion groups almost uniformly indicated that the

northern white-cedar resource must be made a higher priority with public agencies, outside interest groups, legislators, forest industry, Natural Resources Commission and the public.

In response, the workshop planning committee will form a cedar working group of any interested individuals. The working group will begin to develop a support base to accomplish some of the tasks outlined by the discussion groups. Any cedar working group however, will only succeed with the support and activity of all users of the cedar resource.

In closing, I would like to thank all of you for your hardwork, the speakers for their fine presentations, the group leaders for their support and the planning committee for making my job as chairperson easy. Thank you, and keep thinking about cedar.

Appendix A
Specialty Group Reports

Nine committees were formed to discuss the following questions:

- Why is the northern white-cedar resource important to our group?
- What is our groups role in northern white-cedar management?
- What is our groups greatest obstacle in fulfilling our role in northern white-cedar management?

The committees were composed of individuals with similar interests and/or backgrounds. The committees were:

- Conservationists
- Recreational Users
- Planners/Administrators
- Industrial Users
- Forest Managers
- Researchers
- Silviculturists
- Fire Managers
- Wildlife Managers

Each group was provided with a facilitator to record group responses. Responses by question and committee are listed in this appendix.

Why is the northern white cedar resource important to this group?

Conservationist Group

As with other forest types, northern white cedar is important in preserving wildlife diversity and in maintaining water quality and a productive forest industry. It must be managed to maintain a balance of species and habitat types for future generations.

Recreational User Group

It serves as a primary source of vegetation and thermo-cover for whitetail deer and other wildlife including non-game species.
As a recreation resource, these stands are utilized by approximately 750,000 sports persons (hunters) seasonally.

Planner/Administrator Group

Provides various natural outputs.
Output to meet current as well as future demands.
Demands will increase for current products and future products.
Cedar provides special wood products, watershed values (unique).
Cedar important for forest industry.
Other.
Social and economic benefits.
Wildlife benefits and human appreciation.
Good size of the cedar resource (% of acreage).
Must act now - future too late.
Benefits rural traditional jobs.
Now abused, mismanaged or unmanaged at present.

Industrial User Group

Economic contributor to business and state.
Serves as a raw material for wood products.
No substitute available by other tree species.
Wood properties of cedar (durability, odor).
Source of employment in NLP and UP.
Associated species along with cedar are equally important.
Improved markets for loggers.
Better land management through improved utilization and markets for cedar and other species.
(Public) consumer demand for cedar products.
Because the resource is present and should be used.
The recreational demand on both industry-owned and private owned lands is strong and owners must be provided the opportunity for assistance in managing this type.

Forest Management Groups

A.
Value that public places on wildlife (deer yards).
Unique/scarce vegetative type.
Economic value it represents.
Should be "good stewards" (replace what is used).
Large forest type in certain areas but minimal management.

Prefer cedar to tag alder.
Need it to maintain diversity of Forest.
Aesthetic value in a landscape environment.
Unique ecosystem.
Very important part of some local economics.
Very important component of total wetland ecosystem.
Very stable ecosystem.

Harvest pressure may be exceeding growth of larger sizes.
Most in public ownership - public managers must be concerned.

B.

Heavy demand for cedar products.
Large acreage of cedar to manage.
Public demand for cedar products / game & non-game.
Watershed/site protection.
Thermal cover, food, nutrients for deer.
Aesthetic (intrinsic) value of cedar (unique type).
Unique wood species as wood product.
Higher priority on regeneration by planting.
Management has been ignored for years.
Unique habitat type.

Researchers Group

Lack of information on the resource.
Values of the resource are largely unknown - including wildlife, forestry, and others.
Concerned about the environment; want to maintain the resource.
Problems with understanding impacts of harvest practices on cedar.
Don't understand wildlife and cedar regeneration interactions.
To facilitate better management.
To study factors influencing poor regeneration establishment.
Develop computer models.
Resource is diverse - study presents an intellectual challenge.
Silvics of upland cedar are poorly understood.
Need for long-term research.

Fire Group

Tool for regeneration of cedar.
Training opportunity for prescription and wildfire.
Opportunity for interagency cooperation.
Can offer a fuelbreak in the spring.
Opportunity for experimentation and research in fire suppression.

Silviculturist Group

A lot of it!
Many people depend on it.
Economic demand.
Wildlife habitat.
Unique wood properties/values.
Cedar oil.
Multiple-use values (unique).
Visual value.

Ecosystem value (unique).
Michigan has most of U.S. supply (stewardship).
Irreplaceable.
Watershed balance of lowlands.

Wildlife Groups

A.(Voted on importance)
Key ecosystem in the broad spectrum of Michigan Ecosystems (10).
Intrinsic value for a diversity of reasons; botanical,
soil properties, wetlands, aesthetics (8).
In Michigan, Northern White Cedar is a very limited resource (7).
Northern White Cedar provides critical winter deer habitat (6).
Northern white cedar provides food and cover for other wildlife species.

B.
Economic value of sawn wood product.
Habitat component of some forest plan indicator species.
Watershed indicator and special concern as a plant habitat.
Good winter cover in general for deer and other species.
T&E wildlife species habitat.
Habitat for large home range species.
Typically low road densities.
Habitat component for many wildlife species.
Critical cover for deer in winter.
Unique species in and of itself.
Value to wetland management along riparian corridors.
Often an important component of larger wetland systems.
Supports combination of plant communities for winter food and cover for birds, deer and other species, e.g., bobcat, lynx.
Source of water supply for trout and people.
Important value as wood product making management more economical.
Valuable for unknown features - don't know much about it.
Shade on trout streams - use along managed trout streams.
Use for revegetation on some lowland ecological land type phases.
Many current stands already have some old growth community attributes.
Contribution to overall vegetative diversity.

What is our groups role in northern white cedar management?

Conservationist Group

To promote stewardship of the resource, to maintain the balance in the debate so that no special interest group, no one audience is favored.

Recreational User Group

Forest management practices - private lands, industrial lands
Deer population densities (sex and quantities) to levels where the forests are not devastated by harvesting.
Political influence in allocation and budgeting of research funding.
Government and private involvement in land acquisition (properly managed) to ward off elimination (and/or) conversion of cedar stands.

Cooperative efforts and input by public/private sector people (organizations).

Planner/Administrator Group

Set goals, objectives for amount, location, distribution, condition of cedar on State, Federal, private land.
Set policy.
Inventory and assess resource.
Generate resources (financial, personnel, equipment) for appropriate study.
Other.
Separate fact from fiction.
Identify information gaps.
Excite and motivate people to action.
Get known cedar information to the field for management action.
Find and eliminate stumbling blocks in getting information out to land managers.
Lobby for better land tax abatements and other incentives
Anticipate implications of present management.

Industrial User Group

Can't provide management without markets.
More selective harvesting.
Socially responsible to be good stewards of the land.
Manage resource and keep it in a vigorously growing condition.
To motivate private owners to manage.
To provide harvesting and operational aspects (mechanics) to management options.
Help clarify relationship between wildlife and this forest type. Become more active politically, research, etc.
Eliminate waste, improve yields, use other species, stimulate use of better technology to extend resource.
Encourage more funds to be directed towards cedar management research from timber sales, licensing Federal or game management funds.
Create marketing conditions that would promote long-term management.
Advise land owner before harvest to get professional advice.

Forest Management Groups

A.

Provide timber product.
Educate public.
Recommendations on how to manage the resource.
Balance demand for cedar products (game/non-game) with site capacity to produce products.
Protection of cedar and wetlands.
Provide a reasonable acreage of cedar type under sustained yield.
Feed deer.
Identify and quantify demands on the cedar type.
Manage and conserve for a variety of uses.
Make money for budget.
Apply and test research results.
DEMAND research on cedar.

B.

Implement proven silvicultural techniques.
Protect what regeneration presently exists.
Bring wildlife into balance with habitat.
Manage for ownership objectives.
Manage for diversity of age classes - wildlife diversity.
Set example for management to obtain desired results.

Bring wildlife value into balance with timber value.
Disseminating proven technique to private landowners.
Maintain the type.
Public manager's role is to manage based on "social pressure" of the time.
Have obligation to manage on all sites that can support it.
Utilize a valuable resource.

Researchers Group

Provide new information & technology to questions on cedar.
Identify the ecosystem values of cedar.
Document and expand upon previous research.
Provide information to allow management to develop standards and guidelines.
Coordinate various groups working on the problem.
Provide sound research design.

Fire Group

Write fire prescriptions to carry out silvicultural prescriptions.
Protection from wildfire.
Carry out burn.
Collect research data.
Monitoring fire effects.

Silviculturist Group

Silvics/technical answers (regeneration; maintain cedar type; proper management alternatives & techniques; insure problems are recognized and addressed).
Leadership/integrated approach (recognize and set priority; integrate agencies, corporations & public; education & salesmanship; information coordinator & dissemination; **I.D.** & rank research needs).
Protect the resource (deer).
Maintain product availability.

Wildlife Groups

A. (Voted on importance)
We are land managers (8).
Communication of the values of cedar resources to wildlife (7).
Promote research by identifying research needs (5).
Develop and maintain maximum/optimum quantity and quality of cedar habitat (5).
Identify silvicultural options and their relationships to wildlife (3).
Develop a management system for deer to assure cedar regeneration(2).
Manage the size of wildlife populations (2).
Maintain the original range of Michigan's white cedar (beyond present commercial range)(1).
B.
Preserve existence in quantity and quality as wildlife habitat and cedar timber products.
Manage the deer herd to be compatible with cedar regeneration for good of wildlife and timber values within constraints of what hunting public will allow.
Estimate biological, ecological, social, economic impacts both short and long term of various cedar management alternatives and inform users and general public of those impacts.
Determine what is practical and needed, and make sure commitment is long term and properly funded.
State biologists have co-responsibility for managing the resource with foresters at state lands by mandate (commission policy).

Identify all uses of cedar products and find ways of regenerating the type.
Manage the resource in most responsible way possible. In case of NWC and affected wildlife, it is to maintain diversity and viable populations and where possible, for species in most demand by public.
Identify where we believe NWC should be managed.
Managing well, including not cutting where appropriate and act cautiously until we can assure regeneration and recruitment
Educating publics to wildlife species dependencies, watershed qualities, dynamic associated plant species, especially to private landowners.
Provide leadership through research, educate various agencies, industry, and small private forest landowners.
Monitor our cuts and regeneration techniques.
Implement different types of regeneration techniques.
Include protected areas in NWC strategy, e.g., research natural areas, following natural succession uninterrupted by human interference.

What is our groups greatest obstacle in fulfilling our role in northern white cedar management?

Conservationist Group
Failure of society to understand the concept of carrying capacity. To manage northern white cedar we must manage both the deer herd and the production of timber. This is difficult because it involves many special interest groups that have seemingly noble, but conflicting objectives. The problem centers on the issue of the size of the deer herd, which has become so important to the general public that it will be hard to alter the current direction. To achieve conservation of the northern white cedar resource we must get the timber and wildlife interests to work together.

Recreational User Group
Public misperceptions about management needs: Education.
Distrust of goals.
Lack of knowledge on conditions.
Timetables (impact).
Policy involvements.

Planner/Administrator Group
Administrative priorities need to be set.
Lack of successful experience in managing the cedar resource - fear of losing the resource.
Deer.
Other.
Different interest groups want different things from cedar resource.
Professional and public apathy.
Finances.
Too effective fire prevention program--"Smokey".

Industrial User Group
Not the only interest group involved in deciding how cedar resource is managed.
Large size of deer population and its implications.
Clearcutting is perceived as negative practice.
Industry often blamed and identified as the bad guy.
Seasonal harvesting is detrimental to both harvest timing and regenerating the site.
Market conditions.
Wetland regulations.
Media sensationalism.
Management size of the deer herd needs to be clarified and better defined.
Educate the forester, landowner and cutter.

Supply and demand - running out of cedar resource in future.

Forest Management Groups

A.

Lack of sound knowledge concerning cedar in general.
Lack of incentive to manage due to long rotations, low rates of return, high regeneration cost.
Inability to get successful regeneration.
Low priority with limited resources (time & $).
Diverse special interest concerns.
Overabundance of deer due to public pressure.
High financial pressure on private landowners to harvest.
Lack of markets for poor quality cedar.
Site problems (hard to work in).

B.

Regeneration/recruitment
Management on more than local basis (manage on local areas).
Deer numbers - political barriers to control.
Conflicting values.
Finding balance of cedar management.
Deer control.
Past practices that did not work.
Measured values - wood, wildlife, water.
Lack of knowledge or reliable management techniques.

Researchers Group

Not a high priority for funding due to it's relatively minor role as a forest product, and the lack of awareness of its multiple-use potential.
Interested parties have been ineffective in securing funding.
Lack of awareness of the problem from agencies and personnel responsible for funding.
Wetlands are very complex and difficult to study, spatially diverse.
Values of the type are not well defined.
Long rotations make research expensive and difficult to continue over a long time period. Short term studies are currently emphasized.
Environmental factors affecting the type vary with time and location.
Agencies are reluctant to combine efforts.
Difficulties in multidisciplinary research.
Problems associated with technology transfer.

Fire Group

Budgets and old equipment.
Narrow burning window; emerging issues in air quality.
Lack of resources; high cost of prescription in northern cedar type.
Priorities/obstacles.
Lack of understanding between resources.
Political climate (Mack lake/Yellowstone).
Cutting specs and sale design need to reflect needs for prescription burn.
Limited experience in fire managers and timber.
Don't have objective.
Access to prospective site.

Silviculturist Group

(Voted on importance)

Deer (public popularity; ignoring deer problem; an informed public) (9).
Lack of research & knowledge; inconsistent regeneration results. No centralized pool of knowledge (clearinghouse) (7).
Lack of agreement between different disciplines (7).
Low priority work; low economic return; funding; politics with high demand product (5).
Short management tenure; no long-range thinking (4).
Difficult operations in lowlands (2).
Lack of application of known techniques (2).

Wildlife Management Groups
A. (Voted on importance)
There is a lack of priority and direction (10).
There is a lack of time and resources to do the job (9).
We need better coordination among agencies and interests (9).
There is difficulty in fire management (3).
There is a shortage of feasible options and guidelines (1).
We've experienced a lack of regeneration of the type (1).
B.
Bio-political management of the deer herd.
Economic value of the ecosystem.
Rampant ubiquitous ignorance.
Lack of knowledge about communities, ecosystem components/interrelationships.
Lack of coordinated research effort in cedar regeneration.
Adequate long-term financing programs.
Securing peer/co-worker support for cedar regeneration.
General public's lack of understanding of the relationship between deer and its food supply.
Hunting public unwillingness to allow degree of deer herd reduction needed to permit successful cedar regeneration.
Need long-term commitment from higher levels in DNR organization e.g. Director or higher.
Lack of commitment of resources ($, staff power, equipment) and lack of coordination between agencies/organization managing this type.
Poorly defined roles of various professional disciplines charged with managing this type and associated resources.
Major commitment from top organizational leaders.
Funding mechanism (hunting licenses) instead of general fund - special interest based.

Appendix B
Multi-disciplinary Group Reports

Twelve multi-disciplinary groups were formed. They were composed of one or two representatives from each of the specialty groups identified in Appendix A. Before group discussion, individuals were given the opportunity to summarize their thoughts in regards to problems associated with current northern white-cedar management policies. They were also encouraged to provide a solution(s) and the rationale for their statements. The individual responses are listed by group number in this appendix. The ensuing discussions within the multi-disciplinary groups were found to have revolved around three main issues. These are summarized in Appendix C.

Group 1

Problem: Lack of information on the interaction between silvicultural treatments, deer, and cedar growth. **Solution:** Develop replicated silvicultural tests including fire and deer exclosures so that proper management guidelines can be determined. **Rationale:** It is impossible to develop a set of sound management guidelines until the biology of the system is understood.

Problem: Lack of funding for action due to failure of administration to recognize the magnitude of the problem. **Solution:** Publicize the problem and make certain that special interest groups lobby the legislature concerning the importance of this issue. **Rationale:** Funding and effort will not be directed at the problem until it has administrative approval.

Problem: The successful regeneration of the cedar type. **Solution:** To learn more by trying out new and varying techniques. To stop the present cutting practices when they do not produce regeneration of the white-cedar type. **Rationale:** I think in some areas we are simply exploiting the cedar resource without insuring its continuance.

Problem: Winter logging does not offer good ground scarification for seed bed. **Solution:** Try summer logging in cedar stands with various logging mechanisms. **Rationale:** Haven't experimented with new methods.

Problem: Deer and cedar reproduction do not mix or may not co-exist. **Solution:** Reduction of herd to carrying capacity of yarding areas by: 1) hunting regulations as to take and timing; 2) educating hunters and non-hunters; and 3) limiting cedar harvest to non-yarding areas to establish reproduction.

Problem: General public uneducated as to why cedar and other species are harvested and that the aim is to establish reproduction after harvest but it is interdependent with deer herd size. **Solution:** Educate the public by using tours, print media, video and schools at all levels. **Rationale:** A better informed public will support habitat manipulation (cutting).

Problem: Stand recruitment: getting growing stock past the browse pressure of white-tailed deer. **Solution:** Either a reduction in the deer herd or work to establish cedar outside of heavy yarding areas. **Rationale:** Methods of fencing and repellents are costly and not very effective. Attempts on regeneration may be futile without deer population control.

Problem: We don't know enough about regeneration practices for cedar (natural or artificial). **Solution:** Conduct properly designed studies to evaluate various natural/artificial regeneration techniques. These should not preclude the use of mechanical and/or chemical site preparation. Seedling microsite will likely greatly influence success. **Rationale:** In the past we have looked primarily at fire and liming as possible treatments. These may be important, but there are other less costly alternatives. If we can help increase the level of regeneration we are one step closer to an established stand.

Problem: Lack of acceptable management practices for wood and wildlife in the cedar stage of plant succession. **Solution:** Review and research the available information. Select the best known and acceptable and practical. There must be a solution in the bulk of information and experiences available. Doing nothing may be the best practice. **Rationale:** My past experience, especially with the lack of success in cedar regeneration. More and better research information and a better informed public will give forestry and wildlife greater support.

Problem: Need analysis of the total value of this successional stage for wood production and wildlife values. What ratio of the cedar area should be assigned to wood and wildlife? What is the value to wetland? **Solution:** Identify the economic value of cedar and wildlife and set priorities for management. **Rationale:** Lack of acceptable management practices.

Problem: Lack of proven methods to regenerate white-cedar. **Solution:** Research methods on fencing, tree planting, tree shelters, harvest types, and site preparation. **Rationale:** If we have a proven method to regenerate white-cedar, we will better be able to make sound prescriptions.

Problem: Deer browsing. **Solution:** Experiment with exclusion devices, allow some areas for deer while other areas exclude deer. Educate public on carrying capacity for deer and need to reduce herd size in some locations. **Rationale:** Reduce pressure of deer browsing to give white-cedar a chance to regenerate.

Problem: Concentrated large deer herds versus a more dispersed population. **Solution:** More local control of deer herd harvest quotas. Let local biologists and technicians establish quotas. Deer management units need to be smaller to more accurately assess problem areas and concentrate larger harvests in these areas. **Rationale:** We have many areas within the state that support deer herds larger than the carrying capacity of the land. This causes severe problems not only on cedar management, but on forest management in general. This solution will require more funding from Lansing to enable our biologists to become more sophisticated in their management of the herd.

Problem: Lack of a solid research base on cedar management. **Solution:** A lot can be learned from past harvests which resulted in successful cedar regeneration. Funding for research to investigate the conditions that resulted in success might lead to new management prescriptions. **Rationale:** We need a base on which to base our prescriptions now and in the future.

Problem: Proven reproductive methods needed. **Solution:** Literature, personal experience and historical search to find methods which work. **Rationale:** There are a variety of age-classes of white-cedar which had to have some origin.

Problem: How to keep white-cedar predators from inhibiting the growth of white-cedar once reproduction has occurred. **Solution:** Controlling the numbers of predaceous species using white-cedar stands. **Rationale:** Deer damage and rabbit damage are known inhibitors of white-cedar.

Problem: We have very little research or practical information on cedar. **Solution:** We must get an inventory of what has been done. Organize a research committee to review and catalog all research available on cedar or in allied areas. Then decisions may be made for additional research needed. This should not only come from the committee but also from interests of the entire group.

Problem: We have very little research and practical information on cedar. **Solution:** Field trials by foresters and biologists have been carried on for years. These need to be brought together by a committee on a form (See Appendix D). We may be surprised what we can learn from all this. **Rationale:** The information should be split between upper and lower Michigan. The value, amount and use or importance of cedar varies to much between peninsulas.

Problem: Lack of emphasis on swamp management. **Solution:** Institutional consideration of importance (planning process). Highlight the issue (as in this session) widely among resource managers. **Rationale:** Commitment for management where no measurable benefits are demonstrated or accounted for is difficult to obtain. The planning process is most likely to provide the information and direction necessary for agency action.

Problem: Lack of coordination of research and demonstration projects. **Solution:** For entire process: target funding, use cooperative funding, establish coordinated research objectives, determine funding needs, coordinate experimental design and data collection, disseminate findings. **Rationale:** Still a considerable lack of understanding of cedar's silvicultural requirements (how second growth developed, what specific practices and effects of practices are producing success and failure).

Group 2

Problem: Land managers have not maintained or made provisions for the future quantity, quality and health of the northern white cedar ecosystem. **Solution:** Convince administrators of the need for placing a higher priority for management of this ecosystem; and then to follow that up with direction, dollars and other resources as needed. **Rationale:** A unique, limited ecosystem.

Problem: Lack of understanding of the relationships between deer and cedar (i.e. concepts of carrying capacity and "winter kill" are not well understood. Difficult to determine what level of herd reduction (if any) would be required to improve recruitment of cedar. How does deer behavior influence "winter kill" (i.e. can deer behavior be modified to assist in cedar vigor with intercept feeding). Large clear-cuts that remove entire yard should be evaluated with influence on deer movement, causes and rates of deer mortality and cedar vigor. **Solution:** Large scale research study. **Rationale:** IF deer are an important factor in limiting cedar resource the relationship between deer and cedar must be understood to solve problem.

Problem: Lack of priority on the management of cedar resource. **Solution:** Put a higher priority on research and development of management techniques. **Rationale:** There is no real or concrete management technique that will satisfy or allow a cut/regeneration program.

Problem: Funding for research. **Solution:** Present the problem to political officials or people that fund research projects. **Rationale:** Once you identify a problem, then give it a priority in the system. We need funding to do research on the needs of cedar.

Problem: To successfully regenerate and maintain cedar. **Solution:** Close gaps in research for implementation of silvicultural practices. Monitoring and reporting of successful operations. Forest managers and wildlife managers working together.

Problem: To determine a workable balance of users on a sustained yield basis for the cedar resource. **Solution:** 1) Task force of various users; 2) Public education and awareness to show importance of the cedar resource; 3) Management use guidelines for all groups. **Rationale:** No commitment to keep cedar resource. No one use should be permitted that is detrimental to another use or a use that cannot be sustained. Public option drives funding.

Problem: 1) To find a balance of cedar management that will successfully meet the objectives of a variety of clients (e.g. timber, wildlife, recreation, watershed protection). 2) To determine a workable balance of uses for the cedar resource. 3) Poor education and awareness of the ecosystem of the cedar resource. **Solution:** Task force approach to solving problem -- members from various disciplines.

Problem: Lack of agreement among various user groups on management priorities for cedar. **Solution:** Goals/objectives for cedar management needs to be addressed in an organized interdisciplinary framework. **Rationale:** No-one is taking responsibility now.

Problem: Lack of awareness regarding existing knowledge. **Solution:** Greater communication among managers and researchers.

Problem: The cedar resource is fundamental to many user and interest groups. Yet we do not view its well-being, management and use from an integrated approach. Each group looks at its use from their own values or needs. We need a management (stewardship) philosophy which integrates all needs and interests. **Solution:** Develop management and use guidelines for public and private lands which reflect a broader range of values and interests. Extensive information and education efforts among users and interested groups should occur. **Rationale:** Sustaining the resource has to be our first priority. No one use should be permitted if it is destructive to or negatively affects the resource or its ability to sustain itself. Long term needs and values must take priority over short term gains for any interest group.

Problem: Lack of effective regeneration prescriptions (silvicultural treatments) -- even if deer are excluded. **Solution:** Expand research efforts to specifically develop regeneration (recruitment) treatments. **Rationale:** Even if we obtain a consensus understanding of the many uses on the cedar ecosystem, we need effective prescriptions for implementation on public and private lands.

Problem: Present number of deer makes the possibility of successfully regenerating and "recruiting" cedar near impossible. **Solution:** Major reduction in deer numbers. Impacts being felt on not only cedar, but other forest types as well. **Rationale:** Varying degrees of success have been obtained with fire and mechanical treatments after harvesting to obtain cedar regeneration. Eventually, however, this regeneration disappears due to selective browsing and other swamp conifers remain unimpeded.

Problem: Priority is not being given to harvest and regeneration of cedar in areas that are not presently used as deeryards. **Solution:** Establish goals and objectives to accomplish regeneration and obtain or provide adequate funding to accomplish. **Rationale:** There seem to be many stands that are not presently used as deeryards. These stands should be targeted for harvest to satisfy present demand for cedar as an important resource for forest product industry. At the same time begin the process of managing the resource for the future, (i.e., ensure the continuance of the resource, create future deeryards, ensure there is cedar available for the future).

Problem: We (DNR, Forest Service, private and industrial) have not yet made a long term commitment to keep the white-cedar type as a viable community. Apparently have not decided it's that important. **Solution:** In the DNR we need the Natural Resources Commission to make this commitment. Forest Service not sure how they do it, but need the same type of thing. In the case of private land some type of tax incentives may serve this purpose. **Rationale:** Would need a coordinated approach (forestry, wildlife, etc.) to decide how much and where. Every bit of information we now have on the type and how to keep it viable would be used. More research may be needed and would do it if a commitment was made. Public could be elevated to support such action. If deer are a problem they would be reduced.

Problem: Management of cedar type (including all lowland conifers) on non-industrial private land (growth with removals). **Solution:** A. Intensive <u>educational</u> program by MSU, DNR, USFS, RC&D, MFA, and SCD. Identify owners of the resource and use many different methods such as direct visits, exclosures and demonstration plots. B) <u>Regulatory</u> -- recognize swamp conifer/cedar types as "significant open land" under P.A.116 (either at local or state level). **Rationale:** Many landowners just need to be made aware of their resource and how it potentially can meet their objectives. We may not know all of the "right" answers but we do have some of the "wrong" ones that many times get applied on private land.

Problem: Deer appear to be the biggest problem to bringing a new stand to maturity and we (foresters/wildlife managers) don't have the knowledge to solve the problem. **Solution:** Intensified coordinated and integrated research by both disciplines with the objective of raising cedar to the point that they can't be destroyed by deer. **Rationale:** Regeneration, though difficult, can be accomplished. Current winter cutting to feed deer will someday have to come to an end if we can't bring new stands along.

Problem: The public is unaware of the critical nature of the long term problem, but this is probably the most influential factor. **Solution:** Educate/publicize the problems and work on a long-term solution. **Rationale:** Public opinion drives allocation of effort and money.

Group 3

Problem: Lack of understanding by many private landowners on the management of cedar on lands. **Solution:** Increased educational efforts. **Rationale:** Increase understanding.

Problem: Little economic incentive to "manage" cedar on private lands. **Solution:** Possibly tax land according to use. **Rationale:** Provide some incentive to manage cedar.

Problem: Coordination of all interest groups with diverse interests, to arrive at a mutually acceptable management scheme for northern white-cedar. **Solution:** Get representatives from each interest group on a task force to develop mutually acceptable management strategies. **Rationale:** The only way to satisfy most interest groups is to let them have a voice in the development of the management strategies for the white-cedar resource.

Problem: Recognize that an ecosystem has a limited varying capacity for wildlife. The varying capacity for white-cedar is not well defined. This needs to be done in order to develop management strategies for the resource. **Solution:** Develop a task force to define the varying capacity for the resource so management can be developed which will regulate that carrying capacity. **Rationale:** If we don't know what the balance of the components of the ecosystem are then it's difficult to have a management prescription which is suitable for multi-use.

Problem: Research is inadequate to define the working relationships within the white-cedar ecosystem. **Solution:** Accelerate research by dollar input from Federal, State, industrial, private concerns which all have an interest in the white-cedar resource. Research on wildlife, fire and silvics. **Rationale:** Research takes money and all parties with an interest in the resource base need to make a commitment to finding more information about the resource base.

Problem: No real specifics on what kind of a fire it takes to promote cedar regeneration-hot fast surface fire versus slow fire burning 2/3" of duff. **Solution:** More Research/Monitor the results of different burn conditions. **Rationale:** Can save a lot of time and money by concentrating on burning sites that can produce cedar. Scarifying may be better than burning in some cases.

Problem: Lack of pre-planing for burning - areas are cut up by skid trails - slash doesn't provide a continuous fuel or is driven over and packed down. **Solution:** Cutting/skidding specs in sales should be geared to facilitate burning. **Rationale:** There are only a few days a year that are good for burning so anything that will speed up the process and provide better results is going to help.

Problem: Obtaining proper regeneration. (stocking level) **Solution:** A) Site Preparation: creating an ideal site for natural regeneration with lime and the use of mulching equipment and/or fire. B) Replant the cut area at a very close spacing of 3'x3' or 4'x4'. **Rationale:** Since cedar has such a small seed it needs to be established on a mineral soil to be successful. Cedar may have a better chance to succeed from deer browsing if it is growing in thick clumps.

Problem: Deer population. **Solution:** 1) Develop a system to exclude deer for new regeneration (i.e. fencing, deer repellant); 2) Or draw the deer away from new regeneration by artificial feeding. **Rationale:** Deer are feeding on and killing new seedlings. Remove deer and you will have successful regeneration.

Problem: 1) To get advanced regeneration. 2) Silvicultural Practices: Clear-cutting versus shelterwood or selective harvest or pre-stand treatment or weed tree removal. **Solution:** On upland cedar without chance for high windthrow perform a shelterwood harvest - Residual Basal Area of 30-50 sq. ft.? **Rationale:** To provide a tremendous seed source, to shade out aspen, or other regenerating hardwoods. Possibly some layering will result.

Problem: (Silvicultural) Proper size harvest and design. Lack of Research. **Solution:** Research different size or shapes of clear-cuts to determine best regeneration situations.

Problem: A lack of information based on solid research for silvicultural recommendations on cedar management. **Solution:** 1) Education of public, managers, legislators, interest groups and others on importance of the resource; 2) Seek funding from any and all sources based on input from above; 3) Carry out research and publish results; and 4) A statewide clearinghouse is needed for the research. **Rationale:** Before practicing valid management, a tool is needed (research results and recommendations).

Problem: Deer eat cedar reproduction, especially during times of very high populations. Political and biological problem. **Solution:** Reduce the herd by antlerless quotas to a point where carrying capacity meets browse needs without loss of cedar regeneration. Education of public on importance of cedar and relationship to deer numbers. **Rationale:** Reduction of herd will happen naturally if not done artificially. They must be kept in line with available browse.

Problem: High demand for deer by the hunting public creates a conflict between high deer numbers and cedar regeneration. **Solution:** 1) Make the public aware of the problem and encourage the lowering of deer numbers; 2) Wait -- the cedar type will last for many years and the attitudes toward hunting may change. The value and demand for product may also increase and the conflict may resolve itself in time; and 3) Prioritize based on deer numbers and cedar potential. Some swamps can be managed now without lowering numbers. **Rationale:** 1) A better informed public is likely to be more agreeable to changes; and 2) Young peoples attitudes are changing as wood values are increasing.

Problem: 1) Regeneration of cedar without deer may have cost-benefit ratio problems. Regenerating white-cedar with deer numbers reduced may not be cost effective. Logistics and treatments may not justify the return by the product. Can we successfully burn after cuts on public and private? **Solution:** Needs well documented cost-benefit ratio studies indicating practicality of treatments and possibly some additional research.

Problem: Lack of commitment demonstrated by lack of time spent by personnel in cedar regeneration. Priority and budget. **Solution:** Spend available DRIP money on swamp management where appropriate by changing priorities from summer range improvement on state, federal and industrial forest lands. Also look for other sources of funding to support more research and field personnel. **Rationale:** Commercial timber sales provide adequate summer range.

Problem: Lack of knowledge on how to regenerate cedar on different site conditions. **Solution:** More time spent on research and applied research in field and training field personnel to apply research. **Rationale:** To date, knowledge is very general and not site specific.

Problem: Balance deer herd with habitat carrying capacity. **Solution #1**: Educate public, both hunters and nonhunters**. Solution #2**: Put and take deer hunting. Keep deer in pens all year, feed them, let them out day before deer season and give hunters a permit to shoot at specified pens on a certain day. Sort of like hunting over bait. **Rationale:** Many people do not understand how animals impact environment and do not want animals harvested.

Problem: Too many deer? **Solution:** Reduce deer herd to a number compatible with the deer management units as recommended by the DNR biologist. **Rationale:** Reduce deer browse, reduce economics (fencing, etc.) associated with white-cedar regeneration, provide recreation experience opportunities through deer hunting.

Problem: Silvicultural prescription is not carried through or a facet of a prescription is omitted (i.e., site prep.) that leads to assumed failure or a write-off of the project. Lack of monitoring associated with the project. **Solution:** Follow through with project to completion. Develop as complete of a prescription that seems necessary to finish the project. Implement monitoring scheme and document. Don't write-off cedar regeneration attempts within 3-5 years. Commitment! **Rationale:** Many cedar regeneration projects are written-off short-term. Cedar regeneration appears to be more long-term than short-term. Define objectives and goals for cedar regeneration projects, develop a "complete" silvicultural, social, and biological prescription and be committed to the completion of the project.

Problem: Exchange of information! Agency to agency. **Solution:** Increase awareness of cedar silviculture projects that have been attempted. Showcase success stories and failures. **Rationale:** Keep land managers abreast of current white-cedar programs that have been attempted. Provide ideas that can be applied to other areas. Omit reinventing the wheel.

Problem: Deer population too large (resulting in over browsing and lack of regeneration and recruitment). **Solution:** Reduce antlerless deer numbers. **Rationale:** Inform and educate public and hunting public, legislators, conservation leaders about deer habitat relationships.

Problem: Lack of good research information and on-the-ground demonstrations. **Solution:** Place higher priority and adequate time and funds to do this. **Rationale:** Information would help educate and direct professionals. On the ground demonstration would be useful to the nonprofessionals.

Problem: How much cedar do we have to manage? Where is it (Private, state and federal ownership)? Inventory all cedar dominant lands and prioritize their relative value as timberland, critical deeryards, endangered species, wildlife habitat, groundwater/watershed/wetland ecosystem. **Solution:** Prepare maps that have a numbering system on the cedar lands that correspond to an action plan. This action plan is the management plan specific for the identified value. (Prescription?). **Rationale:** This system would fit in with the current soils mapping system, the wetland inventory and could be implemented through these "in place" systems. And in many cases would overlap. The maps and action plan would supply "longevity" to the management of white-cedar. These maps could be produced from data already available, and be supplied to both public and industrial landowners.

Problem: Lack of recognition and understanding that there is a problem in the regeneration of cedar. **Solution:** Produce literature for public distribution that brings the importance of cedar to the forefront. Educate towards low impact management for the private landowner and fund research for industrial management and regeneration studies. **Rationale:** As the public becomes enlightened they will support legislation and lobby groups that will allow research and management to occur.

Problem: High deer populations. **Solution:** 1) Educate the public (coordination of efforts); 2) Define suitable deer populations; 3) Put higher priority on commitment to reduction of deer population; 4) Identify cedar areas which are not deeryards and try to manage and get regeneration; and 5) Explore alternatives to present deeryard areas. **Rationale:** The public wants to see deer yet they are not aware of all the issues of cedar management and high deer populations.

Problem: Lack of research. **Solution:** 1) Need coordinated effort between interest groups (inventory mapping system); 2) Need dollar commitment for research; 3) Explore new areas of research, (i.e. instead of traditional clear-cuts try shelterwoods and other regeneration cuts); 4) Try deterring deer browse by various methods; 5) Spread research throughout the state on a variety of sites; 6) Follow-up and apply present and older research; and 7) Offer scholarships to institutions for research. **Rationale:** Basic research and attendant guidelines for management are the basis for wise management.

Group 4

Problem: Rampant ubiquitous ignorance of components of the white-cedar stands/ecosystem. **Solution:** In-depth inventory including plant and animal species present, predators present, more intensive silvicultural plot data. May need to concentrate on identifying standard species component more carefully. Some folks may be overlooking relatively minor though significant cedar component. **Rationale:** Now can you manage what you know too little about? We can't predict effects of activities until we know what's there to be affected. How can we speak authoritatively to our publics without first-rate knowledge of the resources and areas we're trying to manage.

Problem: Sharing of information with all publics and coordinating agencies. **Solution:** Need to take an advocacy role with school contacts, newspaper articles, publications (including a magazine), public meetings. Address local government at all levels, sportsperson's groups, any and all organizations. Have folks talk and write about what they're doing and why in layperson's terms. **Rationale:** Can't sit and wait to be consulted we must carry the battle to them. Must not ignore published misinformation but should challenge and confront it. Must be well founded in research and in superior knowledge of the subject areas.

Problem: Much information is available, but it is not compiled in a form that is palatable. **Solution:** Have North Central Forestry Experiment Station redo the Northern White Cedar silvicultural guide. The current one must be badly dated in information content. Should be done by interdisciplinary team so all resources are represented. **Rationale:** This would provide up-to-date information to wildlife cedar managers to use to guide their activities and to share with the public.

Problem: There is general consensus among land managers that deer numbers are too high to facilitate regeneration of white-cedar. **Solution:** LEGISLATIVE SOLUTION: Eliminate supplemental feeding of deer through the winter by law. **Rationale:** Supplemental feeding through the winter artificially elevates deer nutritional levels (stops fetus resorption) in harsh winters and supports the population above natural carrying capacity. Excess deer are particularly damaging to white-cedar regeneration.

Problem: Have to stop clear-cutting cedar. **Solution:** Select cut only, pass a law stating this. **Rationale:** Put more doe permits in areas being harvested, also do more rabbit hunting in area. Rabbits destroy as much or more than the deer.

Problem: Chipping for power plants, they do this usually when they only have a few logs. Long as there is a demand for it or any wood they shouldn't do this. **Solution:** Find them. People should have the option to buy the logs. **Rationale:** Chipping should only be done on junk wood. Branches, stumps, tops of trees should be left spread out. Branches are mother hen wings protecting the seedlings, stumps are to stop snowmobiles and quad runners and tops are seed and feed, while sawdust provides nutrients for seedlings.

Problem: Educate the landowner that cutting his timber is just like cutting a farm crop. **Solution:** So more timber will be available. **Rationale:** If they don't and the timber is being destroyed rotting or blowing over. He or she should be fined.

Problem: Lack of administrative direction/priority. **Solution:** 1) "Market" conference proceedings to money holders; 2) Reallocate dollars to cedar management; and 3) "Market" cedar management as pilot program for interdisciplinary AND inter-organization AND multi-interest group project. **Rationale:** Without support from all levels (especially $) individuals will not have incentive to tackle difficult problem.

Problem: Values are not defined. We are talking about reallocating dollars, manpower and equipment away from other areas. Is cedar management truly more important than other areas? **Solution:** Research dollars to help establish "value". Develop the relationship between cedar and hunting, cedar and fishing, cedar and non-game wildlife, and cedar and water quality. **Rationale:** Need specific value figures to reallocate scarce management and research funds to cedar management.

Problem: White cedar management is a low priority (relative to easier types) at high levels within our organization (MDNR). **Solution:** We need commitment at top of Forest Management Division and W. C. Division to develop plan for white-cedar management and to complete plan. **Rationale:** Field managers will not establish white-cedar management as a high priority on their own because: 1) They have other existing higher priorities; 2) They understand that white-cedar management requires coordination between divisions and both large scale and small scale planning; 3) They lack the resources (time, budget) to manage; and 4) Any management undertaken is subject to abandonment because of personnel changes.

Problem: White cedar management must be suited to the particular geography of different areas of the state. **Solution:** Goals, commitment, resources should come from upper level management. The particular plans for management of white-cedar must be developed to suit each area. **Rationale:** Severity of winters, deer populations, and deeryarding habits vary greatly within Michigan. Solutions suitable for the Lake Superior watershed would not work in Northern Lower Michigan.

Problem: Lack of information on the "ecology" of the northern white-cedar type. How white-cedar affects streams, how many deer and other wildlife types white-cedar will support. **Solution:** Research - Fence off a large area

(square miles) and control the balance of herbivores to learn about the effects of wildlife on white cedar. **Rationale:** By understanding how the white-cedar type functions we will be better able to manage, protect, and use the white-cedar type.

Problem: Education - Managers and users of white-cedar need information about the white-cedar type. **Solution:** Workshops, field trips and bulletins on the white-cedar type need to be published. Also college education could include some instruction on the white cedar and other wetland forest types. **Rationale:** By understanding the white-cedar type managers and users will be able to "better" protect, conserve, and protect the white-cedar resource.

Problem: Lack of specific regeneration treatments. Results of any regeneration attempt(s) will vary by site and from one geographic area to another. **Solution:** A coordinated research effort needs to be made over a range of sites throughout the natural range of cedar. Some organization needs to organize, coordinate, interpret, and summarize the results of trials. **Rationale:** It is a long-term problem and will not be solved by short-term "trial and error" administrative studies of limited duration and publication.

Problem: Deer browsing. **Solution:** Fencing of areas where the reestablishment of cedar is high priority from a multiple-use (interdisciplinary) point of view. **Rationale:** Long-term protection is required because of the long establishment period, the preferred status of cedar as browse, and the political realities of deer herd management.

Problem: Fencing and site preparation are not economically justifiable over large areas of low sites. **Solution:** Long-term control of the deer herd plus extensive use of prescribed fire (ecosystem management). **Rationale:** On a large scale (large acreages) only comprehensive ecosystem management will (economically) preserve the status quo, assuming the status quo is worth preserving (which should be debated).

Problem: Deer - too many. **Solution:** Deer exclosures in some areas until regeneration is established. Volunteer help for fencing? **Rationale:** Unless deer herd is at a low enough level for regeneration to become established, exclosures are needed. The older stands will cease to provide thermal cover.

Problem: Local markets. Small cedar mills may have problem getting cedar from private land if the state is not cutting. No management is not management. **Solution:** New practices must be tried on state land to provide for local markets. Deer exclosures? Doe season with a buck bonus tag? (To lower deer herd.). **Rationale:** The older cedar stands won't last forever. More cutting must be done to keep local mills alive and the resource alive.

Problem: Recognize that current cedar management presents a problem to both deer and timber. It seems to be a "non-issue" and as such does not get funded. **Solution:** Develop information packages (video tapes, news media, handouts) that clearly state problem and offer possible direction for research and management. **Rationale:** Need to identify problems and provide a "focal" point around which the many interest groups can rally. Can't wait for problems to happen.

Problem: Lack of long-term commitment for staff and funds. **Solution:** Develop standards and guidelines that clearly provide both direction and continuity during rotation period. **Rationale:** Cedar is a slow growing species. When staff retire, projects often die for lack of interest and support. Rotation periods of 90-140 years extend well beyond several lifetimes. Experiments may be tried and forgotten, only to be duplicated elsewhere at a different time and place. Another problem is a lack of communication.

Problem: Cedar on private non-industrial lands. Regulation of the resource through clear-cutting and profit motive. **Solution:** Incentives provided by the Public: Taxation to maintain a property in cedar and to develop and manage the resource. Management plans and assistance provided for setting up sales and reforestation.

Problem: Management of the number of deer. **Solution:** Eliminate baiting. Invest dollars in regeneration of cedar yards. Intensified management is needed. "Stewardship Ethics" for deer and cedar stands are needed. **Rationale:** Encourage and maintain the natural balance of Michigan deer herd.

Group 5

Problem: Public Land: White-cedar management has been a patchwork affair. To a large degree the management has received a low priority from all concerned except, wildlife biologist and then we have not prioritized the time properly to examine and promote the best solutions. Private Land: White-cedar in most cases is in even poorer shape here due to lack of understanding and deer feeding programs. In the past more urgent items needed attention, (i.e., aspen, pines) and since cedar was long lived and young at the time the emphasis went to those needing help first. **Solution:** Better coordinate swamp activities:
1)Plan and make goals for future; 2) Promote and educate successful management techniques; 3) Execute and continue to executive management; 4) Follow-up review of practices; 5) Continue to strive to maintain deer herd at proper level to satisfy hunter, research and range capacity; and 6) Promote pluses of white-cedar to private landowners and avail ourselves to them for management expertise. Probably need to do some ecosystem and watershed management and planning and look at total area not just public land. **Rationale:** white-cedar is important now. It will continue to be important. It is a renewable resource. We have to point out it's importance so it will be given the priority it deserves.

Problem: Due to the multiple demand on the white-cedar resources a number of interested groups exist. Up to now each of these groups have been acting independently in regard to how white-cedar should be managed if at all. Very little progress is evident. **Solution:** A first step would be to form a multidisciplinary task force to plan and lay out a long-term management program with short-term milestones or goals. The task force management plan should include research needs. **Rationale:** Obviously, there exist no quick solutions to this problem. Only by sitting down with all interested parties represented can the job get done. This first step will help get the political, social, technical support needed in the long run.

Problem: There is a general lack of incentives and techniques for proper management of the northern white-cedar resource. A lack of funding for research to develop the information needed. **Solution #1**: Northern white-cedar management problem has to be identified by administrative management staffs of Michigan DNR and U.S. Forest Service and other agencies as a top priority management problem. **Solution #2**: Develop Information Management System (Database) for northern white-cedar to replace northern white-cedar management handbook. Use artificial intelligence (expert systems) methods. **Rationale:** Only by getting the support of the top management in natural resource agencies will the funding and incentives be initiated to begin proper management and make research dollars available.

Problem: Regeneration: Getting the seedling through the critical recruitment stage where "browse" doesn't destroy it. **Solution:** 1) Public awareness; 2) Seedling protection; 3) Moving herds; 4) Herd reduction; and 5) Alternate sites. **Rationale:** By getting the stand through this stage we'll have a stand established.

Problem: Lack of application of the available management information (e.g. USFS handbook) for managing white-cedar in north central states. **Solution:** Better methods for facilitating and disseminating the knowledge. Better interagency cooperation to get the job accomplished (i.e. FIRE-FORESTRY-WILDLIFE DIVISIONS). **Rationale:** Management thus far has seemed to be a miscellaneous collection of practices in more of a "lets try this and see if it works" approach.

Problem: Lack of commitment on the part of resource managers to implement a white-cedar management program (i.e. inadequate planning, funding). **Solution:** Give white-cedar management top priority. This may require more innovative methods to regenerate the type; managing deer herds on a more local basis. **Rationale:** It appears that for too long there has been a lack of direction, a frustration by managers, an attitude of "what if we cut all the cedar and it never comes back?" Administrators seem to have ignored the problems associated with white-cedar management.

Problem: Lack of cooperation between various owners of the cedar resource as to harvesting, management and regeneration. Undue pressure on the cedar resource in certain sectors because of lack of harvesting and management in other sectors. **Solution:** Ownership sectors should be making available the cedar resource as to their share of ownership percent. **Rationale:** If state land, for example, is not allowing harvesting of the cedar resource, this creates undue pressure on private land to provide this resource which in some cases are more important for wildlife cover for the region.

Problem: Carrying capacity of a deeryard should be in balance with deer numbers to prevent undue stress on that cedar deeryard. **Solution:** Research is needed to determine this carrying capacity. Then deer numbers need to be reduced and/or moved to unused cedar areas to reduce the stress on the cedar resource. **Rationale:** With high deer numbers in particular areas, regeneration of this type will be impossible without fencing. At some point in time this type will have to be renewed.

Problem: 1) Lack of administrative priority; and 2) Lack of knowledge and experience in management of the resource. **Solution:** One part of the solution is to form an interdisciplinary working group to review what is known both here and in other areas. It should involve other states and provinces within the range of white-cedar. **Rationale:** Don't reinvent the wheel; different agencies can coordinate budgets and resources for different aspects of management. Avoid duplication but try different regeneration methods, planting stock types, different administrative solutions, deer management policies and interdepartmental cooperation.

Problem: Lot of work and time involved. Fire is a tool to work with. How do we use it? Lack of information for regeneration as there is no burn prescription based on past burns (i.e, how hot, how deep of a burn on organic soil, harvest with burn in mind). **Solution:** Check with other states and agencies to see if information is available and work with other agencies on burns to share experience and results. **Rationale:** Obtain more information from others or do small scale trial burns.

Problem: Priority has to come from up the ladder. **Solution:** Get more support and direction from division.

Problem: There is not enough knowledge available at present for resource managers to apply in order to perpetuate white-cedar. Large scale research conducted in different regions where white-cedar occurs as well as research that encompasses all factors affecting resource regeneration must be considered but is lacking. **Solution:** Coordinate research between different disciplines, in different regions. At the same time these research efforts must consider the many factors that could be affecting regeneration and must be long-term since the resource is a long lived species. **Rationale:** A long-term, all encompassing research effort will provide managers with solutions or at least documentation for which applications work and which don't so there won't be any replications of failures.

Problem: Research available is fragmented and bits and pieces are found in different disciplines. Need to compile and analyze information that is already known. **Solution #1:** People from different disciplines should get together and compile and analyze all the research that is already available and publish a summary of project knowledge**.** **Solution #2:** Information sharing between field personnel. Document the coordination and applications on cedar management with a newsletter or some other way so that information gets from one district to another and from one agency to another. (For people working with cedar). **Rationale:** Such coordination will help direct future research and pinpoint areas that researchers need to concentrate on. It will help eliminate duplication of studies and provide better use of limited funding.

Group 6

Problem: Lack of understanding of the cedar ecosystem and lack of commitment to managing the resource. **Solution:** Need a definitive short and long-term commitment by all interested parties to: 1) Define the "cedar" ecosystems, including values, functions, and demand; 2) Commit manpower and financial resources now; and 3) Make the public aware of cedar issues, including wildlife relationships. **Rationale:** Break the cycle. Currently, "cut for products, cut for deer, can't recruit because of deer, can't regenerate, don't know enough to manage, no money,

no long-term commitment." By making commitments, the knowledge of values and functions will allow for a variety of demands and continuation of the cedar type.

Problem: Lack of priority includes several subproblem areas: 1) Economics: regeneration costs are high and unknown. Extremely low rate of return due to length of investment; 2) Location: limited access and equipment limitations; 3) Interest group conflicts: wildlife, timber; 4) Public knowledge: most of general public do not frequent the swamps. **Solution:** 1)Public awareness that this is a unique and vital ecosystem for water, wildlife, timber, etc.; 2) Greater emphasis on interdisciplinary interaction; 3) Political pressure should evolve from public interest and pressure; and 4) Present as an ecosystem problem not as a timber and "game animal" problem. Promote the swamp. **Rationale:** The only method for overcoming ecosystem adversity is public and political pressure to force the issue. Public opinion/sentiment/pressure has proved to be effective in forcing changes in priorities from economic potential. Examples: recreation initiatives, wilderness.

Problem: Lack clear understanding of relationship between the "cedar forest type" and the various demands placed on the resource. **Solution:** 1) Get accurate inventory of resource (include distribution, subtypes, and wildlife inventory); and 2) Research: baseline information on values and functions of the forest type (includes everything from water quality, forest products, wildlife, and recreation). **Rationale:** Can't begin to set policy or make recommendations without better understanding of the resource.

Problem: Lack clear statement of management objectives. Includes everything from timber supply to recreation needs, wildlife needs and others. **Solution:** Develop a clear statement of management objectives. **Rationale:** Then reconvene to set goals; distribute information; educate public; and lobby for funding and commitment

Problem: Deer population out of balance with carrying capacity of the land. **Solution:** Reduce deer numbers to the point where we can reproduce cedar. **Rationale:** If we don't do this, there is no point in doing anything else.

Problem: Simulate the conditions by which our current cedar stands were established. **Solution:** 1) Fewer deer; 2) Site preparation (extra fine): prepare seedbed and reduce competition; and 3) Place large areas in reproductive stage. Overwhelm deer with feed and less thermal cover in immediate vicinity during critical establishment period.

Problem: Bio-Political -- Deer +Politicians + Professionals = trouble! The fact that regeneration and final use spans a time greater than any one political life! **Rationale:** Do not have a solution! Perhaps education!

Problem: Lack of long-term commitment to manage (regenerate) cedar which involves funding and support for research and lack of actual regenerative techniques (especially prescribed burning). **Solution:** Agencies must recognize need for managing the cedar resource and make financial ($, manpower) commitments appropriate to the need. Commitment of investment must be made to research for regeneration techniques before wholesale harvest is begun, and later for effective silvicultural practices. **Rationale:** There is at present no consensus on the best way(s) to regenerate most cedar stands (with fire, without fire, with or without scarification) while protecting the associated resource values-watershed values, endangered / threatened species. Research is needed and must be directed at management for more than the commercial timber product.

Problem: Deer are perceived as being one of, if not the most important factors limiting cedar regeneration. It must be recognized that at least in many parts of cedar's range that deer numbers will not be reduced to the point where cedar will consistently reproduce. **Solution:** Deer are not the only problem in regenerating cedar. Snowshoe hares are another problem. The need for prescribed burning is probably another important factor. In many parts of the state a deer herd reduction to low levels needed is not realistic and alternative regenerative measures will be needed. **Rationale:** The general public and many private landowners will not tolerate deer numbers so low as to allow widespread cedar regeneration. More intensive management (and probably more expensive) techniques will be required.

Problem: Because of public demand for an increase in the size of Michigan's deer herd and resource professionals lack of knowledge in the silviculture of cedar and it's management (and the management of deeryards) has been

given it a low priority when compared to other species. **Solution:** Two steps: 1) Education of the public in regards to what the enormous size of the deer herd is doing to their thermal cover; and 2) Coordinate research between agencies and universities so that efforts are not duplicated. **Rationale:** Public fails to understand that with a large deer herd there is a large pressure on forest types that carry them. In the summer range, deer use a wider area for habitat and the herd can be maintained. In the winter, deer use one habitat - cedar and this habitat is dwindling because we cannot regenerate it. Eventually the deer herd populations will crash. Also, because of limited personnel resources, agencies must work together to prevent duplication of efforts. In addition to personnel, money is another constraint. Cooperators would alleviate these problems and also help from an education or knowledge base.

Problem: Lack of long-term commitment and low priority for management. Biggest economic benefit often goes to people who have no costs involved in management. Bars, gas stations, retail stores get large windfall from hunters who spend millions of dollars to hunt deer. Almost none of these people have any cost involved in management of cedar or wildlife. Costs to landowners are usually not covered by products and management is a financially losing situation. Larger benefits usually go to those who have no direct involvement. Timber value alone doesn't justify cost of management (below cost timber). **Solution:** Integrate wildlife, timber and other sources of funding (labor) to provide long-term management. **Rationale:** Cedar (lowland conifer) type has many varied values to numerous groups, none of which are willing to "foot the bill" for the whole process.

Problem: Excessive deer population. **Solution:** Liberalize antlerless hunting by local unit: 1) Antlerless only tags; 2) Limit kill to one buck on bow/gun, excess tags for antlerless; and 3) Permit muzzle loader to take antlerless or regular tag similar to bow license. **Rationale:** Too many deer. Not enough antlerless deer being taken. Too many bucks shot. Herd management now done mostly on portion of herd that is in shortest supply.

Problem: This timber type, although abundant in some areas, is a small component of many forests and is not given a high priority. This has led to a lack of understanding as to what is the best way to regenerate the stand, where should the stand be regenerated versus converted, and wildlife management problems. **Solution:** 1) Impress upon those people in a position to set policy and allocate funds of the importance of the species for all the reasons we have discussed; 2) Allocate the funds necessary to carry out long range research into cedar regeneration and improvement; and 3) Assign people to commit to the problem full time, as "cedar specialists" who work closely with all the disciplines and supervise the management activities and research (coordination). **Rationale:** Only by taking the resource more "seriously," not only for regeneration but for improving the stands (thinning to increase rate of return, increase quality, value, demand) will it increase in importance to all.

Problem: The problem seems to be the need to create new healthy deeryards, while at the same time maintain a healthy viable deer herd which requires adequate thermo cover and food. **Solution:** 1) Determine how to do this successfully; 2) Commitment to cedar stands with deer as primary output and timber as a secondary output; and 3) Long rotation ages and long deer-less reestablishment periods (20-30 years) (200 + years). **Rationale:** You need clear objectives and commitment to outline a long-range series of decisions that are necessary to create a good healthy deeryard with both thermo cover and food.

Problem: Recognize and manage the better upland cedar stands and the cedar component of other upland types. How to secure regeneration or reestablishment of these areas. **Solution:** Knowledge of the various characteristics of the species which are necessary for it to adapt and thrive on various locations. Deer proof a few seedlings or isolated clumps to assure a seed source in these diverse, scattered situations. **Rationale:** A serious timber resource can only be produced on a good site. High quality, harvestable stands can better be produced on the upland in association with hardwoods and hemlock. Recognizing cedar on these sites recognizes its value as a high quality, unique, valuable wood product.

Problem: Lack of known reliable harvest/regeneration/recruitment methods on a site-specific basis. **Solution:** Commitment by federal, state, and industry with white-cedar land base to establish "research plots" based on various silvicultural methods by site. Methods and site types should be determined and agreed upon as a group (federal, state, industry) with land managers, foresters, and wildlife biologist representation from each of three

"agencies." Then these methods should be carried out on each of the three "agencies" land base, with documented methods and results including periodic data recording. Periodically, three groups gather to compare and combine results. Develop cedar task group of federal, state and industry. **Rationale:** White-cedar management will be improved when a specific site-type and wildlife impact type can be categorized and specific silvicultural methods can be reliably selected based upon site and wildlife impacts. Study potential and feasibility of using artificial regeneration (planting, direct seeding) for supplemental stocking and/or site conversions.

Problem: There is a lack of priority within the agency as to the importance of this resource. This is reflected by the lack of budget and time committed to management of cedar. **Solution:** Make lowland conifer management a department priority and commit resources (financial and manpower) to renewal and maintenance of this resource. **Rationale:** Cedar is a part of the forested wetlands complex of Michigan that is threatened because of lack of priority within management agencies. To fulfill our charges as resource managers we need to commit reserves to the solution of this current management shortfall.

Problem: There exists no direction that is coordinated within the department (let alone between agencies) that would allow us as resource managers to approach management of this resource in a similar fashion. Lack of interagency coordinated approach to management. Different silvicultural needs. **Solution:** Establish an interagency group including private forest sector to develop or endorse lowland conifer management guidelines. The group could also assist in putting to practical use these guidelines of management. They would include prioritizing work and silvicultural treatment options and evaluation procedures. **Rationale:** Even when the option to manage this resource exists, managers often don't know how to approach regeneration attempts. In many cases they only need direction and encouragement.

Group 7

Problem: Rising pressure of preservationist type attitude regarding cedar management. **Solution:** Proper management would seem to be a concerted effort to research and develop a means of regeneration which can only take place if the mature stand is removed. **Rationale:** If cedar stands are preserved for too long of a period the resource is lost from an industrial standpoint which in effect would eradicate the cedar industry thereby depriving forest managers an important tool in the management of wildlife and of the ecosystem as a whole.

Problem: A reluctance on the part of the public to have a deer population in proper numbers to coincide with habitat. This may not necessarily be wrong if they are willing to bear the cost. The problem is also one of determining what is the carrying capacity. **Solution:** There has to be a meeting of the minds between the forest managers and the sporting public. Forest managers are in part funded by these people and their concerns MUST be addressed. The sporting public must also realize that there are limits that for the good of the ecosystem that MUST be realized. **Rationale:** Without this meeting of minds, funding for management could be curtailed and politics will dictate even more than it does now and this could only prove to be detrimental.

Problem: How to regenerate cedar using fire as a site preparation tool. **Solution:** Using a multi-agency concept, use the manpower, equipment, and expertise to set up a prescribed burning team. This would be similar to a fire overhead team. **Rationale:** By involving the different agencies, you draw on the special skills and equipment of each agency. This results in a more safe and cost efficient effort.

Problem: Trying to burn a cedar clear-cut, that has numerous doglegs, uneven fuel, and cut trees laying in adjacent stands. **Solution:** When the presale forester is laying out a sale, they should anticipate if the area will be burned during the regeneration process. If a burn is the best process then the unit should be free of sharp doglegs, the logger required to keep all the slash in the unit, and spread out uniformly. **Rationale:** The regeneration process is a complex step and should be thought out well in advance.

Problem: Long-term commitment to regenerate cedar. **Solution:** Legislative or at minimum a department mandate to accomplish preset goals. **Rationale:** Without an incentive to regenerate (dollars) the forestry diversion is not

going to put manpower and money into a project. Wildlife will commit until funds are short or manpower is needed in other areas or programs. This cannot be a decision made at the division level. The western 1/3 of the U.P. did not even send a representative to this conference.

Problem: Deer are perceived to be a larger problem by most at this conference than a real commitment to manage cedar. **Solution:** We have the knowledge and information to cut and regenerate a large swamp complex if we are willing to expend the time, manpower and resources. **Rationale:** Probably 50% of the U.P. currently has no deer wintering in it. We are regenerating about as much cedar there as where deer are wintering. The problem is a mandate to do it and the resources to back up the mandate.

Problem: No real commitment to regenerating cedar. **Solution:** Direction must come from the highest levels of the various interest groups involved, so that cedar management becomes a priority. **Rationale:** Cedar management will require tremendous commitment from many groups working together for the wise use of the resource: foresters, wildlife biologists, sportsmen.

Problem: Many managers simply blame deer for the lack of cedar regeneration, although many other factors are involved. **Solution:** Better education of those involved in cedar management. **Rationale:** Deer obviously eat cedar, but we can work around that fact. Don't attempt to regenerate in existing deeryards. The public will have to accept and promote better deer management through increased antlerless harvest. First priority for regeneration should be historic deeryards no longer in use. Site preparation needs more consideration and should include the use of fire.

Problem: What is going on with the resource? If upland sites are showing an increase and total acres is staying the same then are we losing lowland sites? **Solution:** Check inventory data. Might need to do a supplementary survey. **Rationale:** We need to know the extent of the problem.

Problem: Silvics. **Solution:** Look at past successes and failures collectively and look for common denominator. **Rationale:** We collectively know more than we think we know.

Problem: Silvics: Can we wait for research to do a formal study? **Solution:** In the area close to Lake Superior there may be opportunities to try small scale deforestation trial (5-20 acres) blocks in an area relatively free of deer. **Rationale:** It may be years before research can start working in an area free of deer. Would take away one of the major variables.

Problem: Understanding the ecosystem. **Solution:** Systematic study starting with soils and ground vegetation. **Rationale:** We need to define the types of cedar areas. There may be a number of ecological cedar types, maybe some may be worked in, others maybe not.

Problem: Equipment to work in wetland without causing damage. **Solution:** Specialized equipment exists but in general is not purchased by ordinary logger. More agencies (USFS and DNR) need to purchase equipment that has low impact on the swamps. **Rationale:** Lower environmental impact is to everyone's advantage.

Problem: Communication and teaching. **Solution:** Once ecosystem and silvicultural solutions have been achieved then we will have to sell these solutions to other managers and public. **Rationale:** We need public consent to carry out other programs, especially of those necessary to cut down on the number of deer.

Problem: Long-term silvicultural research. **Solution:** Money and cooperative support from USFS, MDNR, MUCC, and Timber Association. There are established research institutes that could do this given the finding and the policy direction. **Rationale:** Cedar is a long lived species with long-term problems. If there isn't long-term, established, continuing research, we'll never understand the cedar resource.

Problem: Coordinated management of the cedar resource over its range. **Solution:** An advisory board in Michigan, Lake States, U.S., Canada-America involved in regional planning for cedar. Help coordinate cedar activities in research, management and deer. **Rationale:** Because of the deer and other interrelated, multiresource values of

cedar, any agency or individual can't manage their resource without affecting or being affected by the other landowners in the region.

Problem: Lack of known method to adequately regenerate cedar in a timely manner. **Solution:** Secure funding and designate an agency to develop and experiment with different methods. A fund sharing project among all groups would provide a better monetary base to work with. **Rationale:** Different agencies have approached the problem on their own. Little if any coordination has taken place.

Problem: Northern white-cedar is not of national importance, it is a regional problem and therefore the local agencies have not placed a high significance to the problems associated with its regeneration. **Solution:** Place more pressure on the National Forest Research group to look for and develop methods for field managers to use for regenerating this species. **Rationale:** This is a very complex problem and will probably take a long time to develop adequate answers.

Problem: A Concern: Loss of a native natural resource for all-time, possible extinction. Convince industry to take lower dollar returns now, in favor of a stable, long-term return after. **Solution:** 1) Industry must create marketing conditions that favor long-term sustained yield; and 2) Set aside certain acreages to be protected from harvest for all time. This is a safeguard for the failure of Solution #1. **Rationale:** Limiting the available supply of cedar will initially drive up the price. In the long run, this will force the consumers to seek alternatives to cedar. As alternative products begin to emerge, they will compete with cedar and the pricing should begin to fall, and hopefully assume long-term stability.

Group 8

Problem: Management of the cedar resource is done on too local a scale. **Solution:** Develop a comprehensive plan with objectives that crosses agency and private boundaries as well as administrative boundaries. **Rationale:** State(s), federal, and private agencies develop a state or regional wide plan that encompasses the total resource. By doing this, it gives many more options at the local level of management, insures commitment to multiresource management of the resource and is more likely to generate more dollars for projects, research and education than one group or agency working alone can generate in a vacuum.

Problem: Not willing to try available technologies on limited basis. **Solution:** Convince line officer to commit (priority) to do something (small-scale) with technology available today.

Problem: Obtaining and recruiting natural regeneration, particularly on lowland sites. **Solution:** Experimentation and long-term monitoring of results to find effective cutting methods and site preparation. Should include such variations as exclosures to determine impact of animal browsing on survival of regeneration. **Rationale:** Right now, we don't know what works. Experimenting is probably the fastest way to find something that does work.

Problem: Lack of long-term commitment to finding solutions. Lack of funding and people committed. Federal budgets are short-term and subject to politics. **Solution:** Need to educate and convince those who control our budgets (whether the Congress or the state legislature or the industrial landowners) that this problem deserves long-term financing and staffing. **Rationale:** If we don't monitor the long-term results of our experimental trials, we'll never learn from them.

Problem: Seedling establishment. **Solution:** Direct application of lime on harvested sites. **Rationale:** Neutral or alkaline site required for best germination. Fire is often difficult and expensive. Scarification may be difficult and expensive. Application of lime on the snowpack might be cheaper and effective.

Problem: Seedling survival. **Solution:** Fence regenerating stands to protect from deer. **Rationale:** Protection necessary if fully stocked stand to result. Investment in seedlings and growing years on the site. Deer herd control

is unpredictable and may be unacceptable to the public. Only the most important and best sites qualify because of the period of fence maintenance required and cost.

Problem: Difficulty in regenerating cedar (or lack of knowledge about). **Solution:** Study how existing second growth stands come to be. How did the cedar get there? **Rationale:** Maybe by knowing how the cedar got there, we can duplicate the conditions and successfully regenerate the stands.

Problem: Lack of knowledge of cultural treatments for immature stands. **Solution:** Need research to determine what, if any, treatments should be done in immature cedar stands to better manage the resource. **Rationale:** No work has been done in this area. We assume that once established, the cedar stands will do the rest on their own. Maybe we can improve the value and quality by applying intermediate treatments.

Problem: Seedling establishment and recruitment is poorly understood. **Solution:** Outline research needs and develop studies to address this issue. **Rationale:** There are methods to obtain seedling establishment, but success is not always guaranteed. When there is success in getting seedlings to germinate; ten years later stocking is almost always poor (inadequate).

Problem: Poor economic return-no incentive to manage or reestablish-who should pay for it? **Solution:** Land Acquisition!!! By state

Problem: 1) Lack of knowledge of white-cedar because of low priority in upper level management on many fronts: a) ecology; b) multiple use; and c) regeneration. 2) Caused by a lack of awareness of the problem and priority. **Solution:** We as a group realize the **Problem**. Must get public and upper level support to back research. **Rationale:** If nothing is done the resource will diminish to unknown amounts.

Problem: We can't regenerate cedar successfully. **Solution:** Review literature, view past research plots and trials by managers, identify research needed, establish studies. **Rationale:** If we could regenerate cedar it wouldn't be a problem.

Problem: The economics involved with any of the tools we choose to use to try to regenerate white-cedar. **Solution:** The agencies and industries have to forget about budget restrictions if we are to accomplish the task. **Rationale:** At the present we all have identified the problem but no one is able to take the first step to the solution.

Problem: Inadequate funding is available at the university level to attract scientists to initiate good research. **Solution:** A priority has to be set by private, industry and government groups to get the legislature and industry to fund research. **Rationale:** Many opinions exist, a lot of questions have been raised that need to be answered before a plan of action can be taken.

Problem: Harvest rate of cedar on private lands in the east U.P. is alarming. **Solution:** 1) Acquisitions of private lands with good cedar to protect them; and 2) Work with industry to point out their impact on the cedar resource. **Rationale:** Cedar is extremely important for deeryarding in the eastern U.P.; carrying capacity will diminish as more cedar is cut.

Problem: Lack of a well defined state policy on management of cedar on state lands, especially between land management divisions. **Solution:** Develop operating policy for cedar management that clearly states goals and objectives, as well as techniques. **Rationale:** Lack of a well defined policy for coordination between land management division.

Problem: Recruitment of white-cedar, and lack of age class diversity in small stands in northern lower Michigan under the current or the publicly acceptable deer population levels.

Problem: Assessment of the loss of white cedar types in lowland areas due to habitat flooding and harvesting. **Solution:** Coordinate an evaluation of this forest type by site lands for a historical period. Define an effected area for evaluation by regional area. Describe past, present, and projected potential affects.

Group 9

Problem: Lack of comprehensive state program that actively manages the northern white-cedar resource in a manner which encompasses its various uses. (Both private and public land). **Solution:** Establish statewide task force made up of the multidisciplinary interest groups to establish program policy.

Problem: White-tail deer herd population and management. Stand management and research on regeneration.

Problem: Lack of commitment and funding in the management of the northern white-cedar resource. **Solution:** Need legislative support in managing the resource. **Rationale:** The "Lawmakers" determine funding and will provide the "political support."

Problem: Lack of knowledge of the northern white-cedar resource. **Solution:** Provide funding for research. **Rationale:** Need to first consolidate existing knowledge and then do the needed research.

Problem: Knowledge limited or lack of application of what knowledge exists on regeneration. We know it is a dynamic ecosystem and its components are complex. **Solution:** Review past management strategies. Thoroughly observe what has been successful and what hasn't. Set up permanent observation points and follow through. **Rationale:** Several techniques have been attempted but not well documented. Some information is available but lack of commitment or communication is apparent.

Problem: Education: A variety of special interests on this unique resource and not just the publics, but our own resource specialist should be included. **Solution:** Show what we know, inform the groups on special fauna and flora. Evaluate cedar management impact to publics. **Rationale:** Everyone has a special interest, but all of us need quality drinking water.

Problem: Recognize the white-cedar resource as a unique and important component of the ecosystem. **Solution:** Education of citizens of the state to promote the importance and role of white cedar through a public information campaign. Research all aspects of cedar ecosystem. **Rationale:** Proper evaluation will promote awareness of the resource and the ecosystem, which improves our understanding.

Problem: Failure to achieve acceptable levels of white-cedar regeneration. **Solution:** 1) Analyze history; 2) Improved methods of regeneration techniques which will reduce wildlife impacts; 3) Reduce deer herds in identified critical areas; 4) Research in aspects of deer behavior in yards; and 5) Educate citizens on why deer need to be reduced. **Rationale:** Coordinated effort among disciples is needed to solve problems.

Problem: Deer herd sizes that inhibit the "recruitment" of white cedar seedlings into a larger size class. **Solution:** We need to work with special interest groups, strive for public enlightenment and on the biological control of white-tail deer. Before we can begin to have reasonable success we must deal with the deer problem. **Rationale:** I believe we could regenerate cedar and develop sustained industries through silviculture if we did not have the continual removal of our regeneration. In order to solve this problem, we must develop more realistic deer management strategies.

Problem: The second major problem we have in dealing with the cedar resource is a lack of a real clear understanding of the silvics of cedar, its role as a portion of our ecosystem and an idea of its intrinsic values. **Solution:** Much can be learned from further research on this resource. I think we should pursue this, but research on regeneration techniques should not be pursued until they address the deer population problems.

Problem: Determining management strategy to satisfy all (or most) interests. Solution**:** 1) Determine interests; 2) Determine strategies; and 3) Determine conflict areas. In other words, plan management jointly with interests represented. **Rationale:** If planning does not occur, NO activity may occur due to special interests halting all activity.

Problem: Regenerating cedar stands. **Solution:** 1) Support research on various regeneration strategies; and 2) Proceed carefully with methods which have previously been unsuccessful during the RECRUITMENT stage. **Rationale:** If successful regeneration methods are not identified, a trial and error approach will necessarily be used. Undoubtedly, areas WILL fail.

Problem: Failure to establish white-cedar following harvest. **Solution:** Follow tested silvicultural guidelines. Verme and Johnston 1986, Nelson 1951, Johnston, 1977. **Rationale:** Regeneration and development of seedling white-cedar requires the development of a long-term plan for each white-cedar community and then strict adherence to that plan.

Problem: Failure to follow tested and proven silvicultural guidelines for regenerating white-cedar (Johnston 1977, Verme and Johnston 1986). **Solution:** Need a long-term commitment to silvicultural.

Group 10

Problem: Value of cedar ecosystem and the common basis by region for: a) Timber; b) Wildlife; c) Recreation; and d) Aesthetics. **Solution:** A multi-agency economic study. **Rationale:** Individual special interest groups need a common basis to make decision on how resource will be used and managed.

Problem: Inventory and classification of cedar resource. **Solution:** Ecological classification system: 1) identify rare and endangered species; 2) identify different management, harvest, reestablishment situations based on site type (soils, etc.); 3) Estimate values in common units/based on demand for wildlife, forest products, aesthetics, and water; and 4) Public education. **Rationale:** Diverse resource.

Problem: 1) Stand maintenance/improvement/size; 2) Difficult regeneration; 3)Deer kill and over browsing; 4) Stand matures and deer feed decreases. **Solution:** 1) Reduce size of deer herd; 2) Try several methods of regeneration (i.e. planting of seedlings, artificial tipping); and 3) Communicate present body of knowledge. **Rationale:** Manage stand in a way that will prevent elimination of cedar and changes to other tree types.

Problem: Lack of commitment. **Solution:** 1) Document values of cedar lowlands; 2) Communicate values and present body of knowledge to management, users, public; 3) Research failure to maintain cedar stand and protection from deer; 4) Document and agree on values of cedar timber and swampland environment (i.e., wood products, jobs, economy, wildlife, water quality); 5) Accumulate research (existing/new) to perpetuate cedar type and swamp conifer management units; 6) Implement BMPs for public and private land goals, wildlife (deer/rabbits) populations, and silviculture; and 7) Identify task force to carry message from the conference. The CEDAR FOCUS GROUP should be appointed by the state and have 50% of its membership being land managers. The land managers should come from: MSU forestry and wildlife departments; DNR forestry and wildlife divisions; DNR wetlands; USFS silviculturist; industrial users; MUECUR sportsmen groups; and preservationist groups. The group should have 8 to 12 people meeting 2 to 4 times annually to carry forth the conference agenda.

Problem: Need to document, establish, and agree on values for swampland as sources for wood, water, wildlife for general public understanding and setting agency research/management priorities. **Solution:** Coordinate effort to assemble common values for swamplands and terminology. **Rationale:** Bases understanding and making for new priority with existing budgets in water for wildlife research and management to expanded support for finding answers to best management practices for desired goals.

Problem: Private land (60% cedar) open for over harvest and lack of best management practices available today or tomorrow. **Solution:** Promote information and education to private landowners and wood buying industry. **Rationale:** Perpetuate a valuable and desired resource for land, resource and economy.

Problem: Lack of commitment from top management to manage the cedar resource. **Solution:** Provide funds to manage cedar. Make cedar management a high work priority.

Problem: Lack of cedar management research. **Solution:** Provide funding through hunting license monies. **Rationale:** Research has been limited. Only one swamp soil, carbondale muck, has been burned and studied.

Problem: Too many deer to grow cedar. **Solution:** Herd manipulation and possible funding for exclosures such as the State of Pennsylvania has done with their hardwoods. DNR releasing DRIP funds which would help USFS, private, state swamp management plans.

Problem: The lack of attention given to the problem of regenerating a difficult extremely important species by the Forest Management Division and Wildlife Division of DNR. **Solution:** The two divisions redirecting some time, finances and personnel to work jointly on efforts to regenerate a limited and highly valuable species. **Rationale:** In Region 2 little area cut has regenerated.

Problem: There seems to be a total lack of a specific management plan to allow an adequate harvest for the consumers demand while preserving the resource. **Solution:** Direct state and federal agencies to adapt and implement a harvesting program that is vigorous enough for demand while at the same time expanding the planting program. **Rationale:** State and federal agencies have the knowledge and capital needed. Capital generated from license fees and timber sales could be used.

Problem: State, federal and private landowners problem. **Solution:** Regenerate in areas where deer are not abundant. Educate state and federal agencies as to the value of cutting cedar. Realize the demand? Emphasize what the problem is.

Problem: Loss of quality cedar habitat and timber by the over cutting of private lands due to non-management of public lands. **Solution:** Manage public lands more intensively to help meet market demand for cedar products using currently accepted or established silvicultural techniques. **Rationale:** The private lands that are being cut are being cut on a cut and get out basis. Provisions are not being made for regeneration and in many cases quality cedar type is being converted to less desirable types both for wildlife and wood products.

Problem: The high cost of managing cedar swamps with little direct or immediate results. **Solution:** Expend more dollars. **Rationale:** If type is as important as people here say it is then there should not be any reluctance to commit resources.

Problem: Regeneration of cedar seedlings after some types of regeneration cuts. Some types of cutting will lead to cedar regeneration. **Solution:** Institute numerous types of cuttings (thinning from below, strip cuts of various widths). Have a central database where results can be reported; otherwise, what good is the research? **Rationale:** From all of this activity, we can at least determine under what conditions cedar will most likely regenerate.

Problem: Large deer herd in Wisconsin/U.P. **Solution:** 1) Educate public on how these herds need to be reduced through doe permits; 2) Need to improve values of public; and 3) Illustrate need for research. **Rationale:** When public realizes how a lower deer herd number will save managers a lot of headaches, we can then start dealing more specifically with our research.

Problem: Deer browsing on seedlings and saplings. **Solution:** Manage deer populations at levels which are low enough to keep browse damage to an acceptable level. **Rationale:** High deer populations now may be highly desirable from social and economic standpoints (i.e. hunters and dollars), however in the long term, the carrying capacity of the deeryards will diminish and the resource will degrade.

Problem: Getting adequate regeneration and recruitment on a regular basis (i.e. more consistently). Lack of top management commitment. **Solution:** 1) Educate the public to bring pressure to bear from the top down; and 2) Point out "values" associated with cedar type.

Problem: Too many deer and a lack of control on deer numbers. **Solution:** Develop a plan for coordinating control of deer numbers with a habitat maintenance and regeneration program. Need support and cooperation for research. **Rationale:** Deer are destroying their critical habitat by being in excess to the habitat capacity; therefore we need to reduce or restrict them from the area for an extended period (20-30 years).

Problem: Lack of understanding by the public of wildlife habitat relationships. **Solution:** 1) Initiate an intensive program of public education to give public support for drastically reducing deer numbers in specified deer areas; 2) Get top management commitment; 3) Help the public to better understand the habit-deer relationships; 4) Seek public support for managing the problem; and 5) Seek funding to deal with the problem. **Rationale:** The effort above will need public and interagency support in order to realize its goal.

Problem: Research cause of regeneration and recruitment failures. **Solution:** Series of research areas with exclosures to control browse by deer and hare. **Rationale:** Must define overall problem before proceeding with other actions.

Problem: Deer browsing. **Solution:** Evaluate Cost/Benefit Ratio of known control techniques including fencing, chemicals, and hunting. **Rationale:** Although not the entire solution, it is an obvious major factor from which other solutions can be formulated if no realistic solution to deer browsing is found. This may be a futile effort.

Group 11

Problem: An overabundance of deer which is affecting the quality of the existing yards and regeneration and recruitment of new stands of cedar. **Solution:** To bring the deer populations more in line with the carrying capacity of their yarding areas. How: 1) Deer registration (mandatory) to get an accurate picture of the size and health of our present population; 2) Hunter education, to begin to instill an understanding of deer harvests and the need for doe harvests; 3) Begin to teach a hunting ethic to cull out poor deer, not just big bucks; 4) All-doe harvest in areas which are critically overpopulated; 5) Identification of and analysis of carrying capacity of existing deeryards; and 6) Bring the governor, DNR director and commissioners up here to look over the areas where populations are high so that more resources will be allocated to combating the problem. **Rationale:** I think the bulk of the problem is political and social. Biologically, we have the skills to better manage the herds and the forests. Therefore, I feel efforts should be directed at educating the users and influencing policy makers, to get a grip on the problem.

Problem: Cedar regeneration by natural means: 1) Aspen; 2) Deer eat young seedling; 3) Land too low quality for silviculture. **Solution:** Through silviculture: 1) Plant on high ground with good pH soil only bordering cedar swamps; and 2) Fence planted commercial areas from deer herds. **Rationale:** This means of reforestation is the least expensive to accomplish and fencing would guarantee cedar growth and development of quality cedar stands.

Problem: Cedar management is not a priority for land management agencies. No funding is allocated, no people assigned to it. **Solution:** Bring proceedings and conclusions of this conference to policy-making people in state government (i.e., DNR, Director of Chiefs of Wildlife and Forest Management). **Rationale:** No significant change in commitment or priority can take place at operations level. Division offices can allocate funds and human resources needed to address these cedar-related problems.

Problem: An overall problem set aside that now has to be confronted. Set aside due to complexity, money, deer, manpower and need of all specialists to work together to tackle the problem. **Solution:** Get commitment from the different specialists to work on their end of problem (e.g. wildlife: lower deer numbers through doe seasons not two bucks, foresters: start cedar stands where deer don't winter). Also get financial support for the specialists so they

can do their part. **Rationale:** Being a recreational user with no specialty, this is my observation standing on the outside trying to look at what is happening.

Problem: Funding and/or manpower to regenerate cedar following a commercial cut using fire and deer exclosures. Also funding for research. **Solution:** Special funding via legislative appropriation and/or authorization (i.e., use of sale revenues, fish and game fund). **Rationale:** Unable at present time to justify high per acre expenditures with current budget situation which would allow a long-term effort to establish and protect cedar.

Problem: Commitment from "On High" that cedar is a high priority for management. **Solution:** Pressure from outside the organization from interest groups, legislators, commissions, and the general public. **Rationale:** Has never been a commitment from policy and decision makers in Lansing to place a priority on cedar. It has taken a back seat to upland, easier managed species.

Problem: Lack of adequate regeneration in cedar stands after the stand is harvested because of high numbers of deer. **Solution:** Reduce the size of the deer herd. **Rationale:** Because the size of the deer herd is the biggest portion of the total problem, we would obtain our biggest gains in attempting to solve the problem by concentrating our efforts on reducing the size of the herd.

Problem: Priority and commitment to long-range study of the complexity of the issue. An ecosystem study on deer management in relation to cedar management. **Solution:** Identify the value of cedar and market that value through education and the political arena. Creative funding sources and fund the work. Develop coordinated long-term plans. **Rationale:** Cedar is a special and unique resource/ecosystem, reflecting diverse and potentially conflicting values (timber and wildlife are just two, existence or old growth are others). There is need to bring together interested parties and develop commitment to long-range plans and goals. Reeducating all those parties (from administrators and politicians to private organizations) will work towards this end. Specific activities include review of past research, implementation of some conclusions, development of silvicultural guidelines, active management of deer herd in relation to cedar "recruitment."

Problem: Our cedar stands are getting older with each decade and we cannot successfully reproduce cedar in most parts of Michigan due to deer overbrowsing. **Solution:** 1)Reduce deer herd; 2) Fence out deer; 3) Education; and 4) Research.

Group 12

Problem: Preservation efforts are sorely lagging in comparison to harvest use. **Solution:** 1) Public awareness to this issue via schools, media and organizations; 2)Increased responsibility of owners/users to replace (put back the resource); 3) Diversion of source revenues towards management practice; and 4) Continuity in centralizing data and coordination of effort in management. **Rationale:** Too often energy policy and management of resources are from reaction to loss versus proportionate replacement (action), like those users, white-cedar and wildlife users. While action now is somewhat late, education about long-term needs for resource preservation will provide long-term control. Industry has spent multi-millions of dollars on harvest technique (equipment technology). Users (landowners) who receive C.F.A. breaks should be responsible to the general public for management in lieu of the discounts. Small landowners/uses don't feel they play an important role in the big picture. Wetlands policy governs all users. There are allowances, but not without guidance.

Problem: Silvicultural challenge of cedar regeneration (independent of deer browsing pressure). **Solution:** More research, and methodological innovations by cedar managers. Comprehensive documentation of conditions and results is necessary. **Rationale:** Recruitment of cedar depends on initial regeneration.

Problem: Protection of regenerating cedar from overbrowsing by deer. **Solution:** Research into deer behavior (i.e., how to move deer within or between deeryards). **Rationale:** Moving deer to where cedar is being cut will reduce exploitation of seedlings in regeneration portions of the yard.

Problem: Convincing hunters and nonhunting public of the necessity of deer population reduction to protect regenerating cedar in some areas. **Solution:** Survey deer managers who have successfully reinstituted antlerless hunting to determine their public relations strategies. **Rationale:** Hunters are best way of achieving population reduction.

Problem: Lack of sound knowledge. **Solution:** 1) Summarize and report regeneration results of recent harvesting practices; and 2) Conduct field experiments in many locations to find successful methods and new ideas. **Rationale:** 1) Where are the successes? 2)Determine generality of successful methods.

Problem: Lack of incentive for private landowners to manage due to long rotations and consequently low rate of return. **Solution:** 1) Develop graphic scenarios of long-term trends in various values of cedar stands by various management options; and 2) Develop markets for mid-rotation "products" and methods of harvest. Programs like FIP thinning cost share. **Rationale:** Help landowners visualize the implications of their actions.

Problem: Lack of a serious commitment to cedar management. **Solution:** Need long-term research and long-term funding, also a joint effort between foresters and wildlife to work toward a solution.

Problem: Why is there a great deal of variation in cedar regeneration success? **Solution:** Identify common features between successfully regenerated stands. Is fire a factor, is site preparation a factor? **Rationale:** Finding a common thread is a start to understanding the problem.

Problem: Deer and cedar appear to be noncompatible. **Solution:** Decide and find where you will grow deer and where you will grow cedar. **Rationale:** This long term "zoning" may be solution to problem.

Problem: Regeneration of cedar through recruitment stage (long-range). Lack thoroughly developed problem solving or promising research. **Solution:** 1) Establish a research priority; and 2) Coordinate work regionally (northeast states, Lake States, Canada), and within state (NCSFRS, state agencies, universities-all disciplines). **Rationale:** Michigan's problem is not unique. Other geographical areas (Pennsylvania, Wisconsin, Minnesota) are having same experiences with deer populations to 60/sq. mi. Research must be gathered and directed. Mobilized for results. (Technology transfer)

Problem: Seek immediate relief from deer herd (short-term). **Solution:** 1) Maintain high levels of deer harvest in forest as well as agriculturally important areas; and 2) Intensively manage deeryard timber types. Implement fencing (wire, plastics, electric) on 20 yr. plus rotations to insure regeneration development. **Rationale:** Action needed now. Focus needed.

Problem: Management of white-cedar involves a complex set of interacting variables. The problem is often approached from too simplistic a viewpoint. Try to focus on just one or two variables. **Solution:** More information is needed on the interaction of variables and this information communicated to managers. **Rationale:** Only when all managers are aware of the complexity of the problem and work for a mutual understanding of the complexity can progress be achieved.

Problem: Regeneration of cedar. There is not enough known about silvicultural methods (size of cuts?), deer interactions (size of cuts, leaving slash) and climatic and temporal influences. **Solution:** Initiate a series of replicated planned experiments to provide information. **Rationale:** Additional research and information is needed to address the problem.

Problem: Lack of funding for research and management. **Solution:** Make cedar research and management a higher priority. Strive for interagency cooperation. **Rationale:** Too many diverse problems, situations and regional differences for one group or agency to provide all needed information.

Problem: Need to assess total value of ecosystem. **Solution:** Research on all components. **Rationale:** We need to know importance of all ages of cedar to all aspects.

Problem: Lack of long range deeryard/cedar plans. **Solution:** Develop integrated (silvics, soils, hydrologic, wildlife) plans (50 yrs.). Designated old growth areas, wetlands, fire, timber sales, deer herds, soils and water movement/table maps. **Rationale:** Plan will have all the needed input and up-to-date technology that is needed. Get public input especially from other agencies and local landowners.

Problem: Lack of centralized clearinghouse for information exchange or input. **Solution:** Designate an agency or school to act as clearinghouse. **Rationale:** Will have one area to go for latest data or information. All individuals or agencies should send in silvics techniques tried either successfully or not.(See Appendix D)

Problem: Lack of site specific information on cedar areas. **Solution:** Fund students in different fields (i.e. silvics, soils, hydro) to collect data, pH, water tables, movements, and site index information. **Rationale:** Need to collect and document.

Problem: Perceived lack of successful experience in managing the cedar resource. **Solution:** Determine what has been tried under controlled conditions. Analyze as to what works where. Apply to field, strictly monitor. Agency or organization must be willing to accept or bear the risk. **Rationale:** Question whether all management research has been gathered in one place?

Problem: Administrative priorities need to be set. **Solution:** Send a clear message to Lansing, D.C., Milwaukee, Escanaba that cedar resource management or research must be a priority in agency organization with both short and long-range plans. **Rationale:** Sufficient resources will only be brought to bear if our "bosses," administrators make it so that we can provide appropriate rewards. Need slack resources for special projects.

Problem: Different interest groups with different demands. **Solution:** Multi-ownership assessment, planning, coordination. **Rationale:** It's a trap to just react to this year's problem. Need to determine organizational goals, targets for meeting demands.

Problem: There are multiple demands on the resource. **Solution:** Determine the balance of meeting demands for the best long and short-term public benefit. **Rationale:** All participants must start by giving up single resource management positions.

Problem: Over exploitation by deer. **Solution:** Determine carrying capacity of individual yards and regulate deer herd accordingly. **Rationale:** We use large deer management units, but could fine-tune regulations to smaller areas.

Problem: Lack of reliable management techniques. **Solution:** Test known techniques and develop new ones. **Rationale:** New equipment and methods have come into use since anyone really worked on cedar. Old methods were not sufficiently replicated or recorded.

Problem: Lack of understanding of the resource. **Solution:** Develop summary information on present knowledge. Managers and researches to develop research direction. **Rationale:** Advance of knowledge is as much a function of organizing existing information and asking the right questions as of proceeding with research.

Problem: The statewide range of white-cedar is declining. **Solution:** Treat the plant community as rare, or special concern on fringe of range. **Rationale:** The commercial heart of the range would be protected. Aesthetic and scientific values would be conserved.

Problem: Browsing. **Solution:** Fencing or feeding program; hunting. **Rationale:** Hunting--doe license; drawing for buck license. Fencing--Enclosing cedar regeneration areas. Migratory fencing to force deer to certain areas. Feeding -- feeding in areas of high deer population where cedar is wanted.

Problem: Cost of regeneration technology and size of private landowner--small tractor. **Solution:** Cost sharing programs through ASCS. **Rationale:** Site preparation; actual growing period until above browse line--fencing; Small private landowner cannot afford cost.

Appendix C
Summary of Multi-disciplinary Group Reports

The problems identified by the 12 multi-disciplinary groups for the final vote were summarized into the three general problem statements listed below. The solutions, with the number of votes indicated in parentheses, were also summarized. Details are found in Appendix B.

Problem #1:
There is a lack of information on correct silvicultural and wildlife management techniques. Overall there is no clear understanding of the northern white-cedar resource and its general management problems.

Solutions:
(130) Establish a committee to serve as an information clearing house for all users. The committee should study the history of existing stands to identify factors that allowed them to be established and to act as a coordinator of research activities. The committee should also maintain an informational database on all aspects of the northern white-cedar resource.

(112) Conduct a systematic survey of overstory, ground vegetation and soils to identify stocking levels and wildlife carrying capacities. Identify common objectives among interested resource managers. The survey should quantify the value of all components of the northern white cedar resource.

(48) Compile information from current and past research work, and agency applied field studies. Current knowledge should be implemented until new research indicates other appropriate management techniques.

(9) Identify needed silvicultural research and promising new technologies and develop a standard research approach.

Rationale: Some types of northern white-cedar ecosystems may be manageable and others may not. An advance in knowledge related to northern white-cedar is probably as much a function of organizing existing information, and asking the right questions as proceeding with new research. Therefore, a scientific data base for northern white cedar should be established and provide the basis for more focused management of northern white-cedar. It will be impossible to develop sound management guidelines without baseline information.

Problem #2:
There is a lack of serious commitment or emphasis towards northern white-cedar management by top agency and industry officials, and by the forest managers and wildlife biologists in these same organizations. Coordinated implementation of ongoing activities is lacking in such areas as deer management, and cedar regeneration.

Solutions:
(87) A northern white-cedar working group should articulate the management problems associated with the northern white-cedar resource and the importance of maintaining this cover type. The full value of northern white-cedar resource should be expressed to politicians, administrators and the public. The northern white-cedar resource must be made a higher priority with public agencies, outside interest groups, legislators, forest industry, Natural Resources Commission and the public.

(58) Funding and cooperative efforts should be pursued. Funds may be available from charging user fees on licenses, and timber receipts, or using wildlife habitat funds on winter range improvements. Public agencies must commit manpower and financial resources to help set and follow through on priorities. Private landowner incentives may be required to encourage northern white-cedar management on private land.

(39) Form task forces or zone teams of forest and wildlife mangers and other user groups to work together to influence the politics and priorities of northern white-cedar management. At all levels, managers and users must work towards solutions in the management of the northern white-cedar resource.

Rationale: There is always plenty to do, but this resource is important to wildlife, forest and conservation interests. It is imperative that priorities are identified. It is important to define and implement best management practices for cedar type. To accomplish this goal, long-term commitment from the public, the agencies, the industry and interest groups is required. The cedar resource benefits many different publics but any emphasis must be supported from the top in terms of time and money.

Problem #3: Multiple-use issues have not been resolved. There is a lack of understanding, appreciation and discussion between interest groups and users of the northern white-cedar resource. Some conflicts may be arising from the use of statewide management guidelines which are not considered acceptable management by the public or resource managers in local areas.

Solutions:
(61) Develop new hunting regulations and/or deer management units to help relieve pressure on the northern white-cedar resource. Work on developing new deer yards and/or consider elimination of artificial feeding of deer. Define suitable population levels and reduce the deer herd if necessary.

(24) Continue to develop a forum or process for the interest groups and users to communicate and interact.

(18) Do not place all the emphasis on deer management in an effort to regenerate northern white-cedar.

(10) Identify the interest groups and users of the northern white-cedar resource.

(5) More local control of northern white-cedar and deer management.

Appendix D
Northern White-cedar Silvicultural Demonstration and Trial Areas Reporting Form

NORTHERN WHITE-CEDAR
REPORTING FORM FOR
SILVICULTURAL DEMONSTRATION & TRIAL AREAS

Forest Area or Owner: _____

County: _____

Compartment: _____

Legal Description: _____

Person(s) Originating Study: _____

Contact Person: _____

Forest Type: _____

Size of Study Area: _____ Acres: _____ Plots: _____

Starting Date of Project: _____

Narrative of Silviculture Objective (attach maps and other pages as necessary):

Review Interval:

Narrative of Reviews:

Send to: C.E.D.A.R., c/o MSU-UPTIC, 6005 J Road, Escanaba, MI 49829.

Appendix E
List of Workshop Participants

Robert W. Aho
Box 440
Baraga, MI 49908
DNR

Roger E. Aldrich
P.O. Box 287
Naubinway, MI 49762
DNR

Herbert Ames
P.O. Box 798
Sault Ste. Marie, MI 49783

Dick Arps
10031 W. Cadillac Rd.
Cadillac, MI 49870
DNR

Bob Aschbacher
P.O. Box 1008
Escanaba, MI 49829
Mead Paper

Mark Ash
139 Arlington St.
Sault Ste. Marie, MI 49783
CES

Ron Balcerak
P.O. Box 495
Escanaba, MI 49829
DNR

Bryan R. Barnett
499 E. Lake Shore Dr.
Manistique, MI 49854
Forest Service

Chuck Becker
P.O. Box 1008
Escanaba, MI 49829
Mead Paper

Gary L. Benes
8181 Highway 2
Rapid River, MI 49878
Forest Service

Jim Bielecki
P.O. Box 667
Gaylord, MI 49735
DNR

John H. Blum
899 E. Lake St.,
P.O. Box 51
Baldwin, MI 49304
Forest Service

Edward L. Borczon
10670 Yange St. North
Richmond Hill, Ont. L4C 3 C9
Ont. Min. of Nat. Res.

Bill Botti
Forest Management Division
P.O. Box 30028
Lansing, MI 48909
DNR

Stephen Brown
P.O. Box 330
Conway, MI 49722
Tip of the Mitt Watershed Council

Dan Brown
3695 Maiden
Waterford, MI 48095
Forest Industry

David J. Brownlie
804 S. 18th St.
Escanaba, MI 49829
Forest Service

Larry K. Bulock
5700 Orchard Hwy.
Manistee, MI 49660
MichiTree

Chris Burnett
550 Karen Rd.
Marquette, MI 49855
Big Creek Associates

Paul D. Busch
801 Adams St.
Iron River, MI 49935
Forest Service

John Byelich
Box 306, 605 E. 12th St.
Mio, MI 48647
Self employed

George Byelich
County Bldg.
Harrisville, MI 48740
CES

Paul Call
P.O. Box 425,
416 Ford Ave.
Alpena, MI 49707
Abitibi Price Corp.

Rick Campa
Dept. Fisheries and Wildlife
Michigan State University
East Lansing, MI 48824

Tom Carlson
Rt. 1, Box 68
Hillman, MI 49746
DNR

Elaine Carlson
Rt. 1, Box 68
Hillman, MI 49746
DNR

Mike Castle
4111 E. Four Mile Rd.
Grayling, MI 49738
Weyerhaeuser Co.

Dave J. Chapeskie
RR# 4
Spencerville, Ont. KOE 1XO
Ont. Min. of Nat. Res.

Ralph Colegrove
1498 West US2
St. Ignace, MI 49781
Forest Service

Cole Couvillion
Marinette Co. For. Dept.
Court House,
Marinette, WI 54143

Philip S. Dakin
Rm. 101,
1405 S. Harrison Rd.
East Lansing, MI 48823
SCS

Pete Davis
P.O. Box 182
Chatham, MI 49816
DNR

Robert DeVillez
309 W. McMillan
Newberry, MI 49868
DNR

Bob Doepker
P.O. Box 126
Norway, MI 49870
DNR

Kevin Doran
400 E. Munising Ave.
Munising, MI 49862
Forest Service

Joan Duncan
Land and Water
Management
District 4
Newberry, MI 49868
DNR

Lee Ekstrom
P.O. Box 258
Boyne City, MI 49712
Private consultant

Donald M. Elsing
P.O. Box 316
Escanaba, MI 49829
Forest Service

Ken Ennis
8369 Valley Forge Dr.
Cadillac, MI 49601

Alan Ettenhofer
4332 M. Road
Escanaba, MI 49829
U.P. Whitetail Assoc. Inc.

James Evers
1498 West US 2
St. Ignace, MI 49781
Forest Service

Dan Farnsworth
307 W. Helen
Newberry, MI 49868
DNR

Paul E. Gaberdiel
RR# 3, Box 2604
McMillan, MI 49853
DNR

Dayle Garlock
Rt. 1, Box 30
Atlanta, MI 49709
DNR

Gerald H. Grossman
1407 S. Harrison Rd.
East Lansing, MI 48823
Forest Service

Charlie Gunther
P.O. Box 61
Grayling, MI 49738
MUCC

Pat Hallfrisch
P.O. Box 798
Sault Ste. Marie, MI 49783

Maya A. Hamady
8181 Highway 2
Rapid River, MI 49878
Forest Service

Jim Hammill
P.O. Box 300
Crystal Falls, MI 49920
DNR

Ronald B. Hansen
8181 Highway 2
Rapid River, MI 49878
Forest Service

Brian Harrison
1015 Mackinaw Trail
Rudyard, MI 49780
Tri-County Wildlife
Unlimited

John Haulfer
Dept. Fisheries and Wildlife
Michigan State University
East Lansing, MI 48824

Donald Hennig
Rt. 3, Box 206
Kalkaska, MI 49646
DNR

Alfred Hershman
1498 West US2
St. Ignace, MI 49781
Forest Service

Bob Heyd
1990 US 41 South
Marquette, MI 49855
DNR

Douglas C. Heym
4000 I-75 Business Spur
Sault Ste. Marie, MI 49783
Forest Service

Wendell Hoover
P.O. Box 3840
R#3, M-93
Grayling, MI 49738
DNR

Bernard S. Hubbard
309 W. McMillan
Newberry, MI 49868
DNR

Walter G. Huber
21 Ct. of Greenway
Northbrook, IL 60062

Deborah Huff
P.O. Box 428
Newberry, MI 49868
DNR

Pete Jandro
9498 Co. 513 T. Road
Rapid River, MI 49878
U.P. Whitetail Assoc. Inc.

Joe Jarecki
P.O. Box 297
Naubinway, MI 49762
DNR

Roger L. Jewell
4000 I-75 Business Spur.
Sault Ste. Marie, MI 49783
Forest Service

John R. Johnson
P.O. Box 1008
Escanaba, MI 49829
Mead Paper
Richard A. Johnson
Route 2, Box 2004
Manistique, MI 49854
DNR

Barb Jones
Toumey Nursery,
P.O. Box 445
Watersmeet, MI 49969
Forest Service

James K. Jordan
825 E. Margaret
Ironwood, MI 49938
Forest Service

Daniel E. Keathley
126 Natural Resources Bldg.
Michigan State University
East Lansing, MI 48824-1222

Randy Klevickes
Tree Research Center
3091 E. Jolly Road
Lansing, MI 48910

Russell Kidd
P.O. Box 507, County Bldg.
Roscommon, MI 48653
CES

Tim Kobasic
9498 Co. 513 T. Road
Rapid River, MI 49878
U.P. Whitetails Assoc.

Melvin Koelling
Department of Forestry
Michigan State University
East Lansing, MI 48824

Deb Korich
Toumey Nursery,
P.O. Box 445
Watersmeet, MI 49969
Forest Service

Norman D. Korte
6833 US 2 & 41
Gladstone, MI 49837
DNR

Michael Koss
P.O. Box 800
Gwinn, MI 49841
DNR

Louis T. Kurtis
Kurtis Road
Barbeau, MI 49710
Barbeau Farms

Eric Lamfers
803 E. Grand River
East Lansing, MI 48823

Mike Lanasa
7609 S. Lake Bl. 0.5 Dr.
Gladstone, MI 49837
Forest Service

Ed Langenau
P.O. Box 30028
Lansing, MI 48909
DNR

Douglas Lantagne
126 Natural Resources Bldg.
Michigan State Univeristy
East Lansing, MI 48824

Richard LaValley
Room 221, Courthouse,
300 Walnut St.
Manistique, MI 49854
SCD

Wayne Lintack
Midhearst, Ont.

David Litner
P.O. Box 211, Highway US 2
Norway, MI 49829-0211
Champion International

John Maciok
1498 West US 2
St. Ignace, MI 49781
Forest Service

Bill Mahalak
P.O. Box 128
Roscommon, MI 48653
DNR

Ivan Malnar
Box 8
Rapid River, MI 49878
Rapid River Rustic, Inc.

Michael T. Mang
P.O. Box 667
Gaylord, MI 49735
DNR

Glen Matthews
6984 Wilson, P.O. Box 10
Indian River, MI 49749
DNR

Rory Mattson
2805 N. Lincoln Rd., Box 680
Escanaba, MI 49829
SCD

Jack Maurer
5148 Sharkey 19.9 Ln.
Gladstone, MI 49837

Eric McCumber
605 N. Birch St., Box 78
Kalkaska, MI 49646
Water Cons. Dist.

George E. McLaughlin
P.O. Box 316
Escanaba, MI 49829
Forest Service

Quentin J. McNichols
499 E. Lake Shore Dr.
Manistique, MI 49854
Forest Service

Larry Mellstrom
P.O. Box 198
Kenton, MI 49943
Forest Service

Dennis M. Merkel
LSSU, Biology/Chemistry Dept.
Sault Ste. Marie, MI 49783
Lake Superior State Univ.

Donald D. Mikel
4000 I-75 Business Spur
Sault Ste. Marie, MI 49783
Forest Service

Ray Miller
UPTIC
6005 J Road
Escanaba, MI 49829

Keith Milner
1055 Baraga
Marquette, MI 49855
SCD

Roger Misiak
P.O. Box 425, 416 Ford Ave.
Alpena, MI 49707
Abitibi Price Corp.

Dennis Neitzke
1498 West US 2
St. Ignace, MI 49781
Forest Service

Gary Nielsen
c/o Ministry of Natural Resources
10 Findlay Ave.,
Carlton Place, Ont K7C 3Z6
Ont. Min. of Nat. Res.

Bob Odom
3176 Crestview
Traverse City, MI 49684

Robert F. Ojala
P.O. Box 69
Mio, MI 48647
CES

Anne E. Okonek
8181 Highway 2
Rapid River, MI 49878
Forest Service

Eunice A. Padley
P.O. Box 316
Escanaba, MI 49829
Forest Service

Charles M. Palo
6833 Hwys US2 & 41-M35
Gladstone, MI 49837
DNR

Mike Paluda
1990 US 41 South
Marquette, MI 49855
DNR

Robert E. Panek
499 E. Lake Shore Dr.
Manistique, Mi 49854
Forest Service

Raymond Perez
309 W. McMillan
Newberry, MI 49868
DNR

Jean Perkins
Rapid River, MI 49878
Forest Manager

Terry T. Popour
3 Midway Dr.
Negaunee, MI 49866
DNR

Karen Potter-Witter
126 Natural Resources
Michigan State University
East Lansing, MI 48824

Kurt Pregitzer
126 Natural Resources
Michigan State University
East Lansing, MI 48824

Chad Radka
240 W. Erie Ave.
Rogers City, MI 49779
SCD

Dean I. Reid
P.O. Box 137
Naubinway, MI 49762
DNR

Ray Reilly
PSR Box 122A
Sault Ste. Marie, MI 49783

Kenneth Salo
Rt. 1, Box 338
Republic, MI 49879

Lynn Sampson
Rm 101
1405 S. Harrison Rd.
East Lansing, MI 48823
SCS

Pat Schepke
5760 Batz Rd.
Hubbard Lake, MI 49747
Better Best Cedar Fence Co.

Tom Schrot
Rt. 1, Box 31B
Stephenson, MI 49887
DNR

John Scott
Marinette Co. For. Dept.
Court House,
Marinette, WI 54143

Peter C. Smith
P.O. Box 5000
Maple, Ontario L6A 1S9
Ont. Min. of Nat. Res.

Jay Snyder
5700 Orchard Hwy.
Manistee, MI 49660
Forest Wildlife Project

Ewald Sommerfield
7028 Beaver Lake Rd.
Hubbard Lake, MI 49747
Sommerfield Sawing and Dry Kiln

Jeff Stampfly
P.O. Box 34
Seney, MI 49883
DNR

Mark Stormzand
P.O. Box 425, 416 Ford Ave.
Alpena, MI 49707
Abitibi Price Corp.

Terry Strong
U.S. Forest Service
Rhinelander, WI 54501
USFS

John A. Sturos
U.S. Forest Service
Houghton, MI 49931

Bill Tarr
R# 2, Box 2758
Grayling, MI 49738
DNR

Sylvia Taylor
10353 Judd Rd.
Willis, MI 48191
DNR

Larry J. Throop
1800 W-M55
Cadillac, MI 49601
Forest Service

Larry Visser
240 Sabina
McBain, MI 49657
DNR

Douglas C. Wagner
P.O. Box 300
Crystal Falls, MI 49920
DNR

John Walbridge
P.O. Box 291, Bayview Location
Escanaba, MI 49829
Northern Land and Lumber Co.

Howard C. Walker
P.O. Box 1606
Traverse City, MI 49685-1606
Forest Industry

Jerry Weinrich
413 Fairview
West Branch, MI 48661
DNR

Ed Wenger
Rt. 1, Box 161
Florence, WI 54121
Forest Service

Jim Wethy
Seney N.W.R.
Seney, MI 49883
Fish & Wildlife Service

Douglas A. Whitcomb
16752 Trowbridge Rd.
Wolverine, MI 49799
DNR

Thone Whitscell
5760 Batz Rd.
Hubbard Lake, MI 49747
Better Best Cedar Fence Co.

William H. Wilson
P.O. Box 503
Harbor Springs, MI 49740
Forest Industry

Robert Wood
1990 US41 South
Marquette, MI 49855
DNR

David Worel
400 E. Munising Ave.
Munising, MI 49862
Forest Service

Robert Ziel
P.O. Box 190
Marquette, MI 49855
DNR

Mike Zuidema
Box 495
Escanaba, MI 49829
DNR