NORTHERN WHITE-CEDAR:
Stand Assessment and Management Options

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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.

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- 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 deer yards. 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 rether example is 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.

AN 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 seed bed. 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 alternatingly 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 fertility 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 fertilization 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 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.