As a line officer, it is my responsibility to recommend a mix of treatments to National Forest Land that, best meets the needs of the public, are economically sound, provide for long term benefits, enhance resources, protect existing resources and even protect resources that we're not even sure exist. While doing the above I am also directed to manage the public lands within the framework of numerous laws Congress has set forth to be followed.

More frequently than not, the district's recommended approach to management through Environmental Analysis has been disapproved based upon a specialists' review of the proposed action. In most cases, the specialist feels his or her particular area of concern isn't getting a fair shake in reference to a particular law or management principle. You may say the obvious answer to this problem is get earlier specialists input. This does not solve the problem. The decision on the "mix" is made by the Line Officer, whereby it is again reviewed by the specialists to see how well his input was followed. This is getting to be a time consuming and expensive procedure.

At present we on the Tawas District are having problems in satisfactorily establishing this suitable "mix" in implementing the Threatened and Endangered Species Act (Kirtland Warbler to be specific) on the district. This need not be frustrating or exceedingly complex if a few things regarding T & E species management were out in the open. Some are:

1. The KW recovery plan (of which we have a preliminary draft dated 1976), calls for certain land treatments specifically designed to encourage the preservation and reproduction of the Kirtland Warbler. These treatments will encompass 55,000 acres on the Huron Forest now or in the future.
Some of these treatments have not been analyzed as they do impact other resources both present and future. I feel that considering the magnitude and importance of the Recovery Plan that an objective environmental assessment is way over due.

For example, one hard and fast treatment for Kirtland Warbler is the necessity of prescribed burning as a preparatory measure to habitat development. Some of my questions are do we know what we are doing with the fire? What are we attempting to accomplish? What are the effects of fire on Grayling sand soils? What effect does fire have on long term site productivity? Is a fire history really necessary for Kirtland Warbler occupancy?

Another management axiom for KW management is to convert to large, (preferably 300 acres or more) jack pine mono types. This is contrary to many other guidelines and laws. Have the trade-offs been evaluated in respect to the effects this direction could have on I & DC problems, losses in utilizing the land for more productive species, losses in terms of species diversity related to "other" wildlife on the forest?

Several hundred acres of public lands are "closed" to use each year. When ever the public loses the use of "their" land some analysis must surely be made evaluating the action.

Other optimum management principles designed to enhance KW call for planting opposed to other more economical methods of reforestation. Where is the economic rationale for this? Where is the "best mix" that the Recovery Team is willing to accept?

As you see, the concerns above would have been evaluated in an Environmental Assessment of the KW Recovery Plan had that step been taken. I feel the lack of this has been contributory to most of our problems.

I propose we sit down in your office on March 15th, along with Horace, Bill and Dave Sorenson to determine:

1. The potential for getting the KW Recovery Plan and it's management principles objectively analyzed.

2. Produce interim direction to the field until such time the appropriate line and staff officers
"sign off" on an Environmental Assessment.

3. Look to the future as to how we will approach The Endangered Plants Act.

If this date is not satisfactory, give me a ring. I plan to invite a representative from Mio and Harrisville since we all share some potential habitat.

CALVIN NORTON
District Ranger
March 12, 1979

Mr. John Byelich, Chairman
P.O. Box 306
Mio, MI 48647

Dear Mr. Byelich:

Please review this proposal and make your comments and return it in the enclosed envelope. I would like to have your reply by April 10.

Sincerely,

[Signature]

Richard Winters

cc: Kirtland's Warbler Recovery Team Members
TO: Assistant Area Manager Winters, Fish and Wildlife Service, East Lansing, Area Office

FROM: District Supervisor DeCapita, Fish and Wildlife Service, ADC, Lansing

DATE: February 25, 1979

SUBJECT: Proposal to terminate operation of cowbird banding traps near Kirtland's Warbler breeding areas in Michigan

A critical review should be made of the operation of banding traps. Banding traps have been operated in an effort to obtain information on cowbird movements which would improve the operation of kill traps in Kirtland's Warbler nesting areas.

The information obtained through cowbird banding has not resulted in significant changes in the cowbird trapping program. Cowbird trapping as currently conducted has succeeded in reducing cowbird parasitism on Kirtland's Warbler nests to practically nothing. The cowbird banding program is not properly designed to yield worthwhile information on cowbird movements in Kirtland's nesting areas. Thus, continued operation of banding traps does not seem justifiable. If more information is desired on cowbird behavior in Kirtland's nesting areas, a proper study, probably involving radio tracking, should be designed and implemented.

MED: lak

Dick - I feel that Mike has made a good case for discontinuing the banding traps. I think it should be discontinued unless a strong case can be made (i.e., some reason that is directly related to K. Warbler survival) to redesign the study.

Bill

3/14/79

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan
May 8, 1979

Kirtland's Warbler Habitat Management Plans
(Ref. Yr. 4/24 Ltr.)

TO: Forest Supervisor, Huron-Manistee

We are pleased that the draft management plan for the Kirtland's Warbler has been completed. It will provide a basis for discussions with the State and Fish and Wildlife Service concerning the implementation of the Kirtland's Warbler Recovery Plan.

Our comments refer to the questions you raised in your letter of April 24. Since this may be one of the first plans completed under the revised Endangered Species Act, it will be used to clarify the issues you raise. We have discussed these issues with the FWS (Jim Engle) and WD.

1. The FWS is responsible for preparing the NEPA documents on the Recovery Plan. Input to this document should be provided by the FS. The FS can concur with the FWS if our input has been direct and incorporated into the EA (or EIS). We should prepare a separate EA if FS input has not been direct. This EA would be used as a basis for recommended input into the EA or EIS prepared by the FWS.

We believe a joint FS-State-FWS EA should be prepared covering the Recovery Plan and FS-State Management Plans. Since these Plans will only recommend "essential" habitat, the EA would not require the detailed economic/analysis for establishment of critical habitat as required in the Act. This detailed economic analysis will be prepared by the FWS prior to designation of critical habitat by the Sec. of Interior.

2. The Endangered Species Act requires public notification, and a public hearing prior to designation of critical habitat. This is the responsibility of the FWS. Jim Engle (FWS) feels that designation of critical habitat should be considered a separate action, apart from the Recovery Plan. A detailed economic assessment is required for the establishment of critical habitat, and the FWS is unclear at this time on how best to accomplish this. This issue is currently undergoing review by the Director, FWS. Jim Engle stated that it may be some time before this issue is resolved.
3. Approval of the FS (habitat) Management Plan will be by the Regional Forester. This Plan will be incorporated into the Forest Land Management Plan. The Sec. 6 Regs. will require specific reference to habitat needs of endangered species.

4. The Chief will recommend essential habitat to the Director, FWS. The Recovery Team may also recommend essential habitat to the Regional Director, FWS. We would hope that these recommendations concur. The Kirtland's Warbler Recovery Plan and our Management Plan are the result of close coordination between the State, FS and FWS. However, there may be times when the FS and FWS recommendations may not be in agreement.

Secretary Cutler has requested that the FS provide recommendations concerning essential habitat for all endangered species, (ref. our 2630 letter of 10/26/77) to meet the intent of the Act. Enclosed is a copy of a WO letter expanding on critical habitat designations. You will note in the Chief's letter that descriptions of essential habitat may be reviewed with the FWS (Regional Director) prior to transmittal of a formal proposal by the Chief. This review should be made through the Regional Forester.

The enclosed exhibit may help to clarify input and responsibilities relating to consultation and establishment of critical habitat. Only the Secretary of the Interior has authority to establish critical habitat.

5. We believe that consultation should be provided on the habitat management plan. This would involve all activities covered by the Plan. Although we cannot be positive on this point, this was the agreement reached with the FWS concerning consultation on eagle management plans on the Nicolet. Jim Engle stated that the FWS would rather consult on a "program" or plan than on individual actions, so long as these actions are in agreement with approved plans. Activities not covered in the plan involving essential habitat would require further consultation. The Forest Service is still bound by Section 7 of the Act, which prohibits any action that may have an adverse effect on an endangered species.
3.

We concur that a joint effort with the State would be more efficient, and look forward to your Plan.

[Signature]

for STEVE YURICH
Regional Forester

Enclosure
CRITICAL HABITAT DESIGNATION

SECRETARY OF INTERIOR

Designates "Critical" Habitat

DIRECTOR - FWS
1. Recommends Critical Habitat
2. Prepares EA (EIS) & Economic Analysis - Critical Habitat
3. Approves Recovery Plan
4. Establishes Recovery Teams

CHIEF - FS
1. Recommends Essential Habitat - (FS)

REGIONAL DIRECTOR - FWS
1. Consultation
2. Coordination-Recovery Plans
3. Implementation ES
4. Review Recovery Plans
5. Recommend Essential Habitat
6. EA - Recovery Plan

REGIONAL FORESTER
1. Approves FS Mgt Plan (LMP)
2. Recommends Essential Habitat (FS)
3. Requests Consultation

RECOVERY PLAN
1. May include recommendation for Essential Habitat
2. Establishes broad direction for Species Management.
3. Coordinates Agency input

FOREST SUPERVISOR
2. EA (EIS) Management Plan
3. Implements FS role in Recovery Plan.
4. Coordinates w/State
5. Recommends Consultation
6. Develops Essential Habitat recommendation.
REPLY TO: 2630 Habitat

SUBJECT: Criteria for Critical Habitat Recommendations

TO: Forest Supervisors

May 18, 1979

The attached 2630 letter, May 8, 1979 from the Chief is self-explanatory.

The Fish and Wildlife Service relies heavily upon us for furnishing biological information for critical habitat determinations on the National Forests. In our opinion, it is in our best interest to cooperate in data collection and impact analysis.

Specific guidance and criteria will be forthcoming.

H. PETER WINGLE, Director
Recreation, Range, Wildlife
and Landscape Management

Enclosure

Horro H Bill D,

Looks like some of the issues raised by Rangers will need to be evaluated in future regarding the Harbord's Warbler. Let's discuss sometime at your leisure.

WDM
This letter is to let you know, in advance, about possible new impacts in your endangered species program.

The Endangered Species Act Amendments of 1978 changed the manner in which the Fish and Wildlife Service must determine critical habitat for threatened and endangered species. Prior to the Amendments, the determination of critical habitat was purely a biological process, with only the needs of the species being considered. Impacts on other resource management and economics were only considered after critical habitat was finalized.

The Amendments now require that the Fish and Wildlife Service consider the economic impact, and any other relevant impacts caused by specifying any particular area as critical habitat. The Amendments also allow any area to be excluded from the critical habitat if the benefits of exclusion outweigh the benefits of specifying the area as part of the critical habitat, unless the failure to designate such area as critical habitat will result in the extinction of the species.

The Amendments fail to indicate the level of economic or other impact analysis required and fail to provide criteria for determination of when the benefits of excluding an area from critical habitat may outweigh the benefits of inclusion. In fact, the language of the Amendments is so broad that any kind of an analysis from a "quick-and-dirty" approach to an extremely complex professional analysis could be envisioned. This makes it imperative that the Fish and Wildlife Service establish firm criteria which they will use in these determinations.

The Fish and Wildlife Service is currently working on such criteria and the indication is that these analyses will be something more than the "quick-and-dirty" approach.

Although the Amendments place the responsibility on the Secretaries of the Interior and Commerce for considering the economic and other relevant impacts of specifying critical habitat, the Forest Service must remain vitally interested in this process. The Fish and
Wildlife Service has placed much reliance upon us for furnishing biological information for critical habitat determinations on the National Forest System, and we foresee their continued reliance upon us for economic and other relevant impact data.

Although, in our opinion, it is the responsibility of the Fish and Wildlife Service to collect necessary data for critical habitat determinations, it is in the best interest of the Forest Service that we cooperate very closely in the collection of this data on the National Forest System and in the analysis of economic and other relevant impacts of specifying critical habitat.

Specific guidance for such cooperation will be furnished once the Fish and Wildlife Service finalizes the criteria which they will use in critical habitat determinations.

J. B. HILMON
Associate Deputy Chief

Limited Distribution
August 16, 1979

Mr. John Byelich
Wildlife Division, Michigan DNR
Mason Building
Lansing, Michigan  48926

Dear John:

I think it's time to give you a final report on our 1979 experience with Kirtland's Warblers in Wisconsin. I received the last chapter just last week from a person we didn't know had contacted the warblers. At any rate, we now have three observations, one by DNR people and two by reputable birdwatchers well-known to us. There's no reason to doubt any of them.

1. On May 26, 1979, Mr. Charles Sindelar of Waukesha, Wisconsin heard and saw an adult singing male in Section 24, T22N, R3W, Black River State Forest, Jackson County. This is the same section in which the two males were found in 1978. Mr. Sindelar heard the bird do much singing in the hour that he was there, and said he got close enough to see that the bird was not banded. He checked this area again on May 27 and May 28, but could not find the bird. This area was checked several times before and after May 26 by various DNR personnel, including Nancy Tilghman, but no warblers were encountered.

2. On June 15, 1979, two DNR wildlife managers, Gene Kohlmeyer and Terry Valen, heard a singing male Kirtland's respond to a recorded song, but they could not get close enough to the bird to see it. They state there was no question about the identity of the singing bird they heard. This location was in the SESE of Section 29, T22N, R2W, Jackson County, about 2 miles southeast of the Sindelar sighting. It also is in the Black River State Forest. Several checks were made after June 15, but the warbler was not relocated.

3. On July 7, 1979 at 2:30 p.m., Mr. Don Follen, Sr. of Arpin, Wisconsin watched a male Kirtland's Warbler for about 15 minutes. It apparently sang briefly. He went to the same area again on July 14, but could not locate the bird. This observation was in Section 6, T22N, R2W, Jackson County, also in the Black River State Forest. The location is approximately 3 miles north of the Sindelar sighting.
107 SEEN AND HEARD 5/26/79;
207 SEEN AND HEARD JUNE, 1978

107 HEARD 6/15/79
Mio Ranger District

5400 Land Ownership Adjustment

Acquisition of R.O.W. surrounded by essential Kirtland's Warbler habitat

Forest Supervisor, Huron-Manistee N.F.'s

August 22, 1979

This memo will serve to (1) document a telephone conversation with Lands Staff Officer - Ed Youngblood and Dave Sorenson (Wildlife Biologist) on July 23, 1979; (2) provide information on the parcel of land in question, and (3) identify short term and long term objectives concerning this tract.

As discussed in our phone conversation, there is a parcel of land in T24N, R6E, Section 1 (Tawas District) that is causing us some management problems. The parcel in question is located within essential Kirtland's Warbler nesting habitat (Pine River Unit IX - Cutting Block I). The tract appears to be an old railroad R.O.W. that was reserved when the rest of Section 1 was purchased from the Michigan Agricultural College in 1927. The parcel is 100' wide (approximately 13.4 acres) and runs diagonally through the section. The R.O.W. was apparently never developed and presently supports a J5 forest type that is economically mature and in need of harvest.

Block I is presently being final harvested under the Bryant's Landing Sale (see attached map). Following the Sale, the Block will be burned and planted with jack pine seedlings for future Kirtland's Warbler habitat. The R.O.W. in question will essentially bisect this developing habitat, undesirable from the standpoint of Warbler habitat management. In addition to making the prescribed burning more difficult, the remnant strip will also break up the continuity of the Block and possibly make it less desirable as Warbler nesting habitat.

Our requests concerning this tract can be broken down into short term and long term objectives:

(1) **Short term objective** - We would like to determine ownership of the parcel in question and establish an agreement to harvest the existing timber (paying present stumpage rates). The timber on this tract has already been cruised and the volumes determined. Perhaps the operator of the Bryant's Landing Sale would be interested in bidding on the additional volume - if the owner of the tract was in agreement.
According to the Iosco County records, there have been no taxes paid on this parcel. We suspect that it may be owned by the State of Michigan.

(2) Long term objective - Our long term objective would be to acquire this land either through purchase or exchange. Through an oversight, this parcel was not included on our list of potential acquisition sites in Kirtland's Warbler habitat. Acquisition, however, should be considered high priority.

We would appreciate your assistance in expediting this matter. We have an ideal opportunity to achieve our short term objective while the adjacent Bryant's Landing Sale is still active.

David J. Sorenson
DAVID J. SORENSON
Wildlife Biologist

DJS/dla
Enclosure
cc: Bill Irvine
    Tawas District
October 17, 1979

TO: Nels I. Johnson, Regional Wildlife Biologist
FROM: Jerry Weinrich, Endangered Species/Wild Turkey Biologist
SUBJECT: Speculation on Kirtland's Warbler Habitat Prior to 1850 A.D.

The following are some thoughts and speculations on Kirtland's Warbler habitat before and after logging and settlement of northern Michigan. I would appreciate your comments and criticism of these thoughts and speculations.

Using the following assumptions:

1. Before the development and settling of northern Michigan (1850 onward) by the white man, wildfires were probably less frequent but of larger scale than in the past 100 years.

2. This would have resulted in a larger number of jack pine stands reaching maturity and over-maturity.

3. These older stands probably contained a significant component of hardwood seedlings, especially oak, since these older stands would have been more conducive to their establishment and growth (more moist).

4. The older the mature and over-mature stands became, the better established the hardwood seedlings would have become.

5. The better established the hardwoods became, the more resistant they became to elimination when the stands burned.

6. Even though severe drought might adversely affect oak distribution, losses would probably have been greatest in recently burned, even-aged stands rather than in stands where seedlings were partially shaded.

Therefore: If a hardwood component was more common, and fires were less frequent, it is likely that a high proportion of the "occupiable-aged" jack pine stands for warblers before 1850 had significant components of hardwoods, especially oak; and for the Kirtland's to persist, they would have had to be adapted to utilizing stands with significant hardwood components.

I believe our concept of good Kirtland's habitat is probably not of the type of habitat which the warbler used much of the time prior to 1850. We have observed warblers in habitat which has been much more drastically influenced by human activities than what was available before 1850. Fires in the late 1800s and early 1900s were much more frequent (and some were probably more intense—logged areas with heavier ground fuel loads) than previously. These repeated fires
would tend to discourage hardwoods and create more open grassland areas and more pure jack pine stands. Similarly, agricultural attempts in the early 1900s yielded large areas which reverted first to open grassland. Succession on these dry open grasslands resulted in many nearly pure jack pine stands since oak is not as well adapted to these droughty conditions as is jack pine. For these reasons, more of the warbler habitat available since 1900 has been pure or nearly pure jack pine. Our impression of good warbler habitat is therefore of pure or nearly pure jack pine on poor sites since this type of habitat has been most often what has been available to and used by warblers since we have studied them.

If the hypothesis that warblers more often used stands with a significant hardwood component prior to 1900 is correct, then it seems unlikely that habitat of pure jack pine is really best for the Kirtlands. If the warbler used mixed stands for most of the thousands of years of its existence, it is probably best adapted for utilization of this type of habitat and less successful in different types of habitat. It is possible (but I think unlikely) though that the pure jack pine stands present a "super habitat" for the warbler.

If these assumptions and hypotheses are correct, the major implication to management is that creation or perpetuation of jack pine stands with a hardwood component should be encouraged and creation or perpetuation of pure jack pine stands should be discouraged.

Following logic similar to the preceding, it is also possible that the warbler is capable of utilizing habitat on better sites (better soils) than what we commonly assume. Lower frequency of fires prior to 1850 would have increased the likelihood that for some periods all or most of the occupiable-aged jack pine was on better sites, i.e. soils less sterile than Grayling sand. Also, because of the repeated and often intense fires around 1900 and because of the attempts at agriculture in the early 1900s, much of the soil now typed as Grayling sand might really have been somewhat more fertile prior to 1850.

The generally restricted use of Grayling sand sites by the warbler which we have observed might be masking the actual adaptability of this species because of changes in types of habitat available since 1850 (especially since 1900).

I doubt though that the habitat on the better sites is what the warbler is best adapted to. Over the course of the Kirtland's evaluation, habitat on the poorer sites was probably available more often than on better sites. Jack pine on the poorer sites was probably more susceptible to disease and insects, and these infected stands would have been more likely to burn than healthy stands on better sites. Jack pine stands on poorer sites are probably more susceptible to wildfire than stands on better sites even without the influence of insects and disease. (The drier the site the sooner the habitat attains the state of combustibility necessary to carry a fire in drought periods, and the longer the drought lasts, the higher the combustibility becomes).

The implications of this hypothesis to management of the warbler would be that we may have been more restrictive than necessary in selecting critical habitat (although by being so restrictive, the best areas might well have been selected); and, it is likely that warblers will at times occupy habitat on soils better than
Grayling sand on public lands not designated as critical habitat. It also suggests that some of the areas with the poorest soils (which we might consider to be some of the best warbler areas) might actually be less productive for warblers than sites on somewhat less sterile soils.

The following is speculation on an even broader and grander scale:

There is some reason to suspect that at some time in the not too distant past, a major catastrophe (or a series of catastrophes within a relative short period of time) affected a large portion of Michigan's Lower Peninsula, including probably all of the AuSable River watershed. Evidence of this (these) catastrophe(s) is inferred from the types of vegetation present when the white man arrived, i.e. very large acreages dominated by red and white pine.

Since red and white pine are mid-tolerant to shade, the presence of large areas of intolerant tree species would probably have been necessary for the pines to have become so well established. And, for the intolerants to have become so widely established, something major must have created large areas without shade. Knowledge of the average age of the pine stands present in this part of the state when the white man arrived would allow approximation of when this catastrophe probably occurred. I suspect that the average age might have been between 200 to 300 years (conversion to northern hardwoods would probably have occurred had they been much older). Adding another 100 to 200 years (maybe more if the catastrophe(s) was(were) severe enough to eliminate nearly all vegetation) for the establishment and passage of the intolerants, the approximate date(s) of occurrence of the catastrophe(s) would have been between 1400 and 1600 A.D. The nature of the catastrophe(s) is difficult to guess, but fire seems to be a good possibility. (A tribe of Indians called by the Hurons the "Asistagueronon" - translated as "Fire Nation" or "Fire People" - was reported to have lived in northern Lower Michigan in the early 1600s. This tribe actually consisted of five separate tribes known as the Mascouten, Fox, Sauk, Potawatomi and Nasauakaton. The name "Potawatomi" is derived from the Chippewa word "Potowatamink" which means "people of the place of fire").

Whatever the nature and date(s) of the catastrophe(s), the area affected was very large. It seems likely that on much of this area jack pine was the dominant intolerant tree species following the catastrophe(s). If so, it is likely that large numbers of acres of occupiable-aged jack pine were found some distance removed from the AuSable watershed, and it seems likely that they were used by warblers. In fact, it is possible that warblers were forced to use these outlying areas during this period if the catastrophe(s) was(were) so severe as to eliminate or drastically reduce jack pine on the poorer sites. (This might possibly have occurred if extremely severe and prolonged drought were the agent, or if drought were accompanied by repeated fires for a number of years - again assuming that fires would be more frequent on the drier sites). It also seems possible that the Kirtland's might have attained its maximum population size shortly after this(these) catastrophe(s), depending upon timing and duration of the catastrophic occurrences, degree of utilization of areas away from previously occupied areas and amount of loss (if any) of habitat within the traditional range.

Please let me know what you think of all this.

JW: leg
cc/Beylich, Irvine
Taylor, Perez, Carlson
November 16, 1979

TO: Nels I. Johnson, Regional Wildlife Biologist

FROM: Jerry Weinrich, Endangered Species/Wild Turkey Biologist

SUBJECT: Leasing Program for Kirtland's Warbler Habitat on Private Lands

Even though our Department and the U.S. Fish and Wildlife Service are now involved in a land acquisition program for protecting and supplementing habitat critical to the survival of the warbler, I believe we need to explore further another means to this end.

There are two major reasons for the acquisition of these parcels: 1) to prevent undesirable subdivision and residential development (which usually lead to less effective management on adjacent state-owned lands), and 2) to protect the individuals of the species currently occupying usable habitat - and the habitat itself - on these parcels. A third, but probably less significant, reason is the additional land base to be made available for management for provision of usable habitat through acquisition.

Both of the two major reasons would appear compatible with some type(s) of leasing arrangement - especially the second one. Considering the probable difference in costs between acquisition and leasing, the apparent availability of funds, and the probably lowered potential for actual acquisition due to recent developments in both agencies, I suggest that we now take a much closer look at the possibilities for various leasing arrangements with the landowners concerned.

JW:leg
cc/Taylor
   Byelich
   Irvine
   Perez
November 16, 1979

TO: Sylvia Taylor, Endangered Species Coordinator - Wildlife Division
FROM: Jerry Weinrich, Endangered Species/Wild Turkey Biologist - Region II
SUBJECT: Kirtland's Warbler Habitat Management - Research Needs

Recently I wrote to you on this subject and gave my opinion in a general way. I will try to be more specific now.

It is apparent that we, as land managers, sorely need more and better information on methods for intentional regeneration of jack pine as it has been regenerated through its evolution as a species - as a fire species. I believe the following aspects of this problem deserve immediate study:

1) Amount of seed source needed. (Number of seed trees, degree of serotining of cones, number of cones per tree, etc.)

2) Seed dispersal. (What patterns for leaving seed trees will maximize distribution of adequate numbers of seeds but still minimize loss of seed trees to windthrow, etc.)

3) Germination requirements. (What combination of moisture and temperature regimes are needed or tolerable, results of seed dormancy if present, effect of shade, etc.)

4) Seedbed requirements. (Is exposure of mineral soil necessary if moisture is adequate, etc.)

5) Seedling survival. (Effect of shade from snags of seed trees and other sources such as stumps and associated vegetation, timing of burning relative to major frontal systems, temperature and moisture regimes, loss of invertebrate and vertebrate consumers, competition from other plants, etc.)

6) Economic feasibility. (I think there is a better than even chance that regenerating jack pine by burning seed trees will prove economically advantageous over planting.)

The preceeding applies mainly to regeneration by seed tree burning but further experimentation is also definitely needed with artificial seeding on dry sites. I think that much more emphasis should be given to the importance of shade from dead trees (or shade from any source) on these sites.

It is very important that any study on this problem include an analysis of economical feasibility. Obviously, the experimental design should attempt to facilitate
and maximize commercial harvest while still providing conditions most conclusive to establishment of the new stand.

Many previous efforts at timber regeneration on these poor sand soils have proved to be either failures or economic embarrassments; and, very little reputable research has been done on this problem. Besides providing us with information on how to regenerate more productive Kirtland's Warbler habitat more economically, I think information from this research will also be helpful to those concerned solely with the commercial value of the timber resource.

JW:leg
cc/N.Johnson
  Byelich
  Irvine