

AN ECONOMIC ANALYSIS OF THE JOINT U. S. FOREST SERVICE,  
MICHIGAN DEPARTMENT OF NATURAL RESOURCES  
MANAGEMENT PLAN FOR LANDS DESIGNATED AS  
KIRTLAND'S WARBLER CRITICAL HABITAT

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## Introduction

The Kirtland's warbler is an endangered songbird that is known to nest only in Michigan's Lower Peninsula. The target of the management plan is to provide suitable nesting habitat for 1,000 mated pairs of warblers. Current census estimates place the population of warblers at 242 mated pairs (Ryel 1980). The management program began on state forest land in 1957 with the dedication of 7,680 acres to Kirtland's warbler management. In 1962, the Lower Michigan National Forest (now the Huron-Manistee) dedicated 4,010 acres to Kirtland's warbler management. Both agencies established these areas not as preserves, but as management units in which multiple use concepts could be applied. This has been a major feature of the warbler management effort.

A significant decline in population of the warbler was observed in 1971 when the third ten-year census was conducted. At that time, 201 singing males were counted, down from 502 in 1961 and 432 in 1951. The most important factor in this decline was thought to be a decline in suitable nesting habitat from 10,000 to 15,000 acres in the 50's and 60's to 5,000 acres in 1976. A second limiting factor in the bird's survival, cowbird parasitism was also cited as a casual factor in the declining population of the warbler. As a result of the serious decline in warbler population observed in 1971, a meeting was held to consider emergency measures to reverse the dwindling population. The U. S. Fish and Wildlife Service agreed to begin trapping cowbirds in the spring of 1972, a program which has continued through the spring of 1980. Annual population census counts were also begun in the spring of 1972. By 1975 it was clear that the cowbird trapping program had succeeded

in its goal to reverse the decline in numbers of warblers, but no real increase in their population had been observed.

A recovery plan was begun in 1975 and published in 1976 by the Kirtland's Warbler Recovery Team, a group of concerned individuals and agencies. The primary objective of the plan was to stabilize the warbler population. The ultimate goal stated by the Team was to increase the population to 1,000 actively nesting pairs, which continues to be the target of the warbler management efforts in Michigan. Jack pine type suitable for nesting habitat, or that is capable of producing suitable nesting habitat in the future, was recommended for inclusion in the Warbler Management Areas on state forest and Forest Service land. A total of 135,000 acres was recommended for inclusion. Management was designed to maintain and develop 36,000 to 40,000 acres of suitable nesting habitat available in any given year. A habitat management plan that would coordinate timber and wildlife treatments within the habitat was called for to achieve the desired nesting habitat objectives stated in the Recovery Plan. This resulted in the Kirtland's Warbler Habitat Management Plan, released jointly by the U. S. Forest Service and the Michigan Department of Natural Resources in 1980. This plan details location and management actions to be taken by the two agencies in order to meet the objective of habitat maintenance and development.

The analysis that follows is intended to provide a measure of the economic impact of the management program put forth. It is assumed at the outset that this impact will be primarily attributable to management actions that are required to implement the warbler program and are different from the program of land management that would be employed if the Kirtland's warbler were not a major management goal. This analysis is not intended to establish a social

value for the Kirtland's warbler. The designation of the warbler as an endangered species under the provisions of the Endangered Species Act establishes the importance of the warbler.




#### Location and Description of Critical Habitat

Specific criteria used in designating critical habitat are as follows:

1. Soil type - Grayling sand.
2. Forest cover type currently jack pine and where management for jack pine is feasible. May contain a limited hardwood (oak) component.
3. Areas currently occupied or previously occupied by the species.
4. Tracts of 320 acres and larger, preferably where five or more of them lie within two miles of each other. Tracts of less than 320 acres and larger than 80 acres, where they occur in close proximity to the larger tracts.
5. Lands preferably in public ownership (state or national forest).
6. Limited development potential, or where development could be controlled.
7. Relatively level topography.

The map on the following page shows the general location of designated critical habitat. The U. S. Forest Service administers 53,537 acres. State forest land comprises 72,536 for total dedicated habitat in public ownership of 126,073 acres. In addition, approximately 7,500 acres of nesting habitat are found on lands owned by the Michigan National Guard, who are cooperating in the management program. The total, 133,578 acres, represents 15 percent of the jack pine cover type in Michigan and approximately 19 percent of the jack pine type that is publicly owned. Most of this is



-  U.S. Forest Service Critical Habitat
-  State Forest Critical Habitat
-  Military Area Habitat

### KIRTLAND'S WARBLER HABITAT IN MICHIGAN

poor-site jack pine, and, across the stands designated critical habitat, the average site index is 45 on a 50-year basis. Range in site quality is from site index 40 to site index 50.

The ten counties in which the critical habitat is located have a year-round resident population of 146,000 (Michigan Statistical Abstracts 1979). In addition to these year-round residences, there are many second homes and seasonal dwellings. Unemployment rates in 1978 averaged 11.2 percent, compared with the statewide average of 6.9 percent. This area has long had higher than average unemployment when compared with the rest of the state. The economic base is also quite different from the state as a whole. Well over 70 percent of the economy of the ten-county area is reliant on nonmanufacturing business sectors, most importantly retail trade and services. This reflects the importance of tourism and outdoor recreation to the area. Statewide, nonmanufacturing industries account for 42.8 percent of total employment. Manufacturing industries, primarily the auto and related industries, account for 27.4 percent of all employment in Michigan. In the ten-county area of concern, manufacturing provides 19.8 percent of all employment. Forest products manufacturing, which accounts for five percent of total state manufacturing, accounts for 18.3 percent of those employed in manufacturing in the critical habitat area.

In general, the area can be characterized as relatively sparsely populated with a large number of second homes and seasonal dwellings. It is a less industrialized area than much of Michigan, with chronically higher than average unemployment. The economic base is more dependent on tourism and outdoor recreation than the state as a whole, and the forest products industry is a significantly more important employer than it is on a statewide basis.

The designation of 133,000 acres of land as warbler habitat could have a significant effect on the economic base of the area to the extent that it increases tourism, timber, and other forest-based outputs. Restrictions could likewise have a negative impact on the economy of the area.

#### The Warbler Management Program

Kirtland's warbler habitat management is designed to coordinate multiple use management objectives with the warbler's unique requirements for nesting habitat. This effort requires the services of the equivalent of 1.3 full-time habitat biologists to plan, administer, and evaluate field operations, and additional administrative and clerical support. These additional costs<sup>1</sup> (Appendix A) amount to \$74,449 for the Michigan Department of Natural Resources and \$48,300 for the U. S. Forest Service. Cowbird trapping, provided by the U. S. Fish and Wildlife Service, costs \$36,000 annually. These costs are expected to continue at approximately the same level for the next ten years. Total annual direct costs of the program for administration and management as well as parasite control is \$158,749.

Land management will be aimed at developing stands of 1,200 trees per acre that will provide habitat for ten to twelve years. These stands are to be managed on a 50-year rotation resulting in an annual harvest of 2,700 acres when the habitat areas are fully regulated. In 1976, the Recovery Plan called for an emergency regeneration effort of 3,500 acres annually. Since 1976, warbler habitat treatment has totaled 6,600 acres, or 2,200 acres annually. The emergency period program calls for regeneration by prescribed burning and planting. The opposing wave pattern shown in Figure 1 is used in order to create the desired stand density and openings. Anticipated costs for this regeneration program are different between agencies due to organizational and other differences. Costs are shown in Table 1.

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<sup>1</sup>Personal communication with program administrators.

57

~~20 openings/40A.~~  
~~10 Acres Open/40A.~~

~~45.5%~~  
23%

10  
62.5 opening  
10 A. open  
25%

"OPPOSING WAVE" PATTERN

For Kirtland's Warbler Plantings  
Scale: 1" = 100'

Prepared by: D. K. Pavlevich, Wildlife Technician

650-700 acres/yr  
1700 from state DWS

-31263

12

Often open ended

10 Rows Parallel to Road

6 rows - 6'x3' spacing

1 rows - 4'x4' spacing

2 rows - 4'x4' spacing

6'x8' Spacing

10 Rows - 4'x4' spacing

3 Rows - 4'x4' spacing

Two-track (not well traveled)

200'

70'

92'

66'

234'

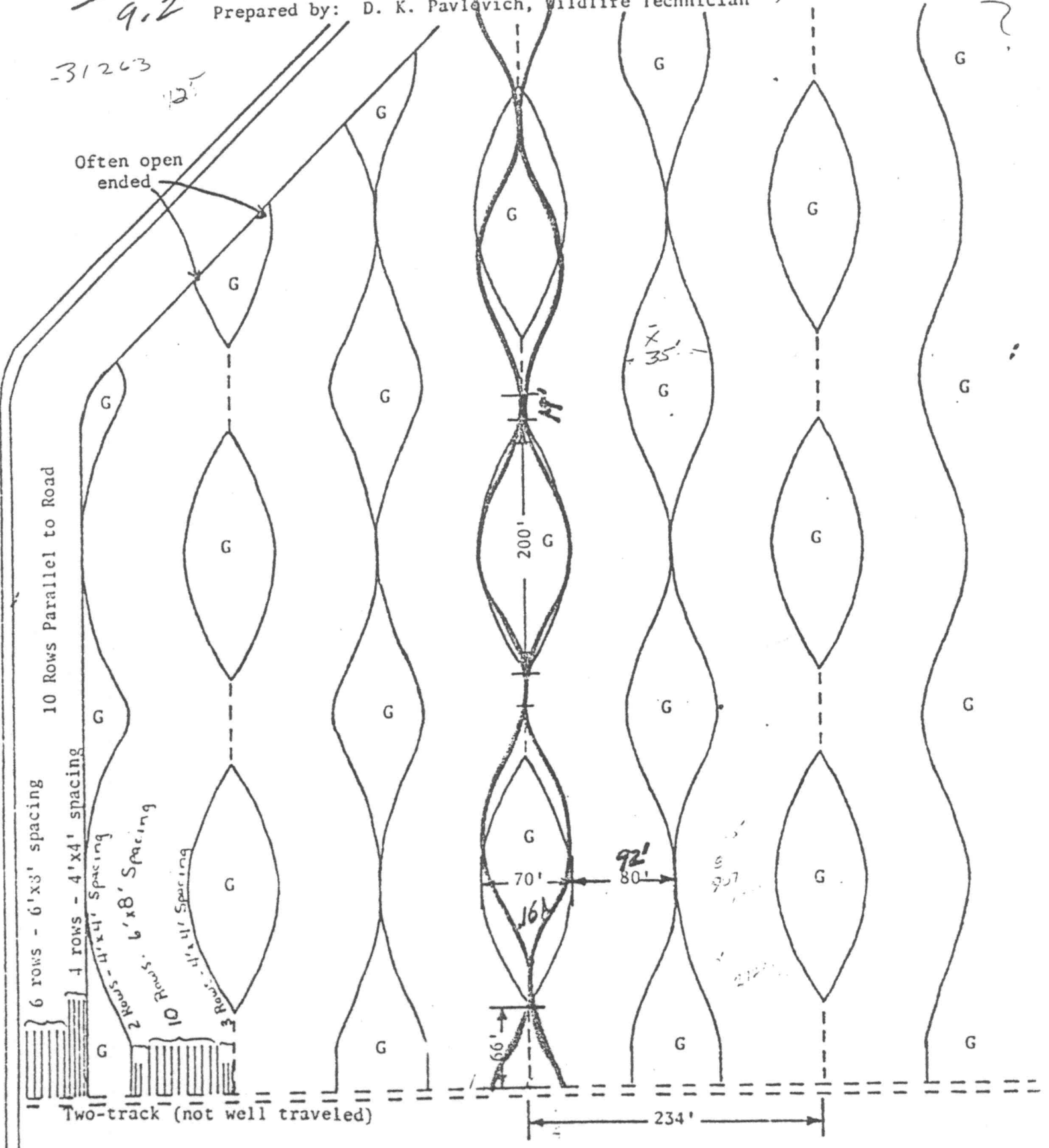




Table 1.

PLANTING COSTS BY AGENCY - 1980

	<u>Michigan DNR (Spring 1980)</u>	<u>U. S. Forest Service</u>
Stock	\$20.00/M	\$ 31.00/M
Storage and Transport	1.35/M	1.35/M
Supervision	5.58/M	5.85/M
Fuel, Maintenance, Etc.	6.26/M	6.50/M
Planting (incl. tractor)	42.03/M	44.09/M
Transportation	1.22/M	1.65/M
Layout	.18/M	.50/M
	<hr/>	<hr/>
TOTAL	\$76.62/M	\$ 90.44/M

Prescribed burning costs are estimated to be \$18 per acre for the DNR and \$31 per acre for the U. S. Forest Service. Release costs would be the same whether or not the area is managed for Kirtland's warbler.

Comparing these costs with those anticipated for nonwarbler populations, there are two primary areas of differences in cost. Nonwarbler jack pine plantations are planted at 800 to 900 trees per acre with uniform spacing. The second difference is that no prescribed burning would be performed. Comparison is shown in Table 2.

Following the emergency habitat creation period, approximately by 1990, the management program will shift from planting to seed tree regeneration. The method favored is to leave 25 trees per acre after final harvest as seed trees. Prescribed burning will be used to prepare a seed bed and release seed from the jack pine cones. Successful stand establishment will result in stands that have an average of 1,000 trees per acre in various densities six years after harvest, or approximately five years after site preparation. It is assumed that 50 percent of the regeneration work using this method will be successful and the rest will require replanting. The anticipated costs are shown in Table 3.

Jack pine managers would not use regeneration methods of this kind if the warbler were not a consideration. Additional costs would also be sustained under this program equivalent to the time cost of postponed timber harvest due to regeneration failure from seed. This cost will be calculated as equal to the difference between the present value of stands harvested at age 50 and stands harvested at age 55 years after harvest.

Existing mature timber stands are to be handled the same under the management plan as they would if warbler management were not a consideration. No reduction in the volume or value of timber harvested is expected from existing

Table 2.

MAJOR DIFFERENCES BETWEEN JACK PINE MANAGEMENT WITH  
AND WITHOUT KIRTLAND'S WARBLER HABITAT OBJECTIVES

Activity		Cost Difference Between Warbler & Nonwarbler Per Acre	
<u>Warbler Program</u>	<u>Timber Management</u>	<u>Michigan DNR</u>	<u>U. S. Forest Service</u>
Plant 1,200 TPA	Plant 800 TPA	+\$30.65	+\$36.38
Prescribed burn	No site preparation	+ 18.00	+ 31.00
Release	Release	--	--
Regen. survey	Regen. survey	--	--
	TOTAL	+\$48.65	+\$67.38

Table 3.

COST OF SEED TREE BURNING PROGRAM  
TO BE IMPLEMENTED IN 1990 BY AGENCY

Activity	Cost Per Acre by Agency	
	Michigan DNR	U. S. Forest Service
Residual stand value not harvested*	\$11.00	\$11.00
Prescribed burning	18.00	31.00
	<hr/>	<hr/>
TOTAL	\$29.00	\$42.00

\* Residual stand value not harvested: This is the assumed stumpage value of the seed trees not harvested. It is equal to the volume per tree multiplied by the number of trees and stumpage price.

$$RSV = (.04 \text{ cords/tree}) (25 \text{ TPA}) (\$11.00/\text{cord})$$

stands. Prescribed burning will affect timber in the understory and losses of future timber volume are expected. This is shown in Table 4. The losses shown in Table 4 represent the opportunity cost of not holding the timber to maturity.

Timber Stand Growth and Yield

The planting pattern shown in Figure 1 results in a partially stocked stand being established. A total of 1,200 to 1,250 trees per acre are planted in this opposing wave pattern. Openings represent 20 percent of the stand. If evenly distributed throughout the stand, yield at harvest would be equal to the yield of a fully stocked stand established at 500 trees per acre. Plantation yield will be assumed equal to that of a stand planted at 1,200 trees per acre. Source yield tables are found in Appendix 1.

The yield of seed origin stands is more difficult to estimate, due to uncertainties regarding initial stand stocking and density, and time between harvest and actual stand establishment. Past experience indicates that stand establishment may take upwards of three years following site preparation and seeding. These factors all have a direct impact on final stand yield. Realistically, the yield of stands of seed origin are likely to tend more towards the yield of existing stands. This will form the basis of assumed yields for natural stands to be established by fire and seed trees during the period 1990 to 2030. The available data regarding yield from such stands indicates that yields may range from eight cords per acre (the average in Michigan) to 15 cords per acre. The influence of site quality, although not known, will be assumed to improve the total yield volume. The following yields will be assumed for 50-year-old seed origin stands:

Site index 40. . . . .	8 cords/acre
Site index 50. . . . .	.12 cords/acre
Site index 60. . . . .	.16 cords/acre

The above yield assumptions are taken from forest survey data and the 1979 state forest allowable cuts.

Table 4.

OPPORTUNITY COSTS ASSOCIATED WITH BURNING STANDING TIMBER IN DOLLARS BY YEAR

Year	Michigan DNR	Huron-Manistee N. F.	Total	PV @ 6-7/8%
2002	\$ 86	\$ 62	\$ 148	\$ 34
2003	3,910	2,825	6,735	1,459
2004	409	295	704	143
2005	592	428	1,020	194
2006	207	149	356	63
2007	N/A	N/A	N/A	N/A
2008	3,888	2,810	6,697	1,041
2009	N/A	N/A	N/A	N/A
2010	293	212	505	69
2011	118	85	203	26
2012	3,536	2,555	6,091	726
2013	7,107	5,136	12,243	1,364
2014	4,125	2,980	7,105	741
2015	8,539	6,170	14,708	1,435
2016	N/A	N/A	N/A	N/A
2017	1,023	739	1,762	150
2018	12,925	9,339	22,264	1,780
2019	14,616	10,562	25,176	1,883
2020	18,186	13,141	31,325	2,192
2021	84	61	145	9
2022	N/A	N/A	N/A	N/A
2023	19,614	14,173	33,787	1,937
2024	N/A	N/A	N/A	N/A
2025	159	115	274	14
2026	196	142	338	16
			TOTAL	\$15,276

## Analysis of Timber Management Investments

Site quality ranges from good to very poor for jack pine. Table 5 displays an assumed distribution of site index which will be used in calculating stand yield. It is derived from the distribution of site class for jack pine in the northern Lower Peninsula found in the 1966 state forest survey.

Tables 6 and 7 show the planned habitat development work to be carried out between 1980 and 1989 by the Michigan DNR and the U. S. Forest Service. Differences in plan formats do not allow annual reporting of Forest Service treatment plans, consequently, an even annual accomplishment is assumed. The source of the data in Tables 6 and 7 is the individual agency plans, released during 1980.

Additional investment in timber stand establishment required for warbler habitat creation as compared to nonwarbler plantations is shown in Table 8. Marginal investment is defined as the increased investment necessary in order to create the conditions desired for Kirtland's warbler. It is based on Table 2. Total investment discounted at 6-7/8 percent is the present value in 1980, excluding inflation, of the marginal investments required for stand establishment.

Plantations established during the ten years from 1980 to 1989 will be harvested at stand age 50. Timber yield expected from these plantations is shown in Table 9 and compared with the yield expected from plantations that would have been established if warbler habitat were not a goal. Source yield tables are in Appendix 3.

The results of this analysis, shown in Tables 8-9, indicate that the additional investment required to create nesting habitat will result in increased timber yields beginning in 2030. The resulting increased yield over nonwarbler plantations has the effect of increasing stand values per acre an average of \$68 at time of harvest when compared to the nonwarbler plantation.

Table 5.

DISTRIBUTION OF SITE INDEX CLASS  
ON DESIGNATED HABITAT BY OWNER

<u>Site Class</u>	<u>% Land Area in Class</u>	<u>Estimated Acres of Habitat by Owner</u>		
		<u>MI DNR</u>	<u>USFS</u>	<u>Nat. Guard</u>
50-60	38.4%	27,853	20,558	2,880
40-50	54.9	39,822	29,392	4,118
30-40	<u>6.7</u>	<u>4,859</u>	<u>3,587</u>	<u>502</u>
TOTAL	100. %	72,356	53,537	7,500



Table 6. SUMMARY OF HABITAT DEVELOPMENT WORK (IN ACRES) PRESCRIBED ON STATE FORESTS 1980-1989

**Mgmt. Area	1980		1981		1982		← Year of Entry → 1983		1984		1985		1986		1987		1988		1989		Total	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	← Treatment Prescribed* →																					
Leota	0	0	0	0	0	0	213	0	160	0	142	0	0	0	0	0	0	0	0	0	0	0
Lovells	314				305			254				312										1185
No. Branch																						
Pere Cheney													279	250								
Staley Lake	184				320																	
Fletcher Rd.														136								
Manistee R.				246			311				229											
Sharon				263			229		277													
Ogemaw		80		309																		
Big Creek				214											275							
Muskrat Lk.				298																		
Crapo L.				147	63		139	26			109	45				281						
Clear L.							153				352						265					
Damon		594		554			264		200		309											
St. Helens				182	126																	
TOTAL	1092	80	2213	189	1121		1309	26	891		1141	45	765	66	1458		1023	281	2028	113	314	(239)

\*TREATMENT PRESCRIBED: A - Stands designated for harvest and regeneration.  
 B - Stands designated for regeneration only.

\*\*Note - Monument management area not included in this table. No treatments are prescribed during period.

Table 7.

SUMMARY OF HABITAT DEVELOPMENT WORK PRESCRIBED  
ON THE HURON-MANISTEE N. F. 1980-89  
(In Acres)

<u>Management Area</u>	<u>Harvest &amp; Regenerate</u>	<u>Regenerate Only</u>
Big Creek	1,027	229
Eldorado	774	147
Mack Lake	1,365	94
McKinley	964	
Pere Cheney	303	
Pine River	3,301	593
Tawas	534	577
	<hr/>	<hr/>
TOTAL	8,268	1,640

\*NOTE: Due to differences in planning format, National Forest prescriptions can only be given within a 10-year period.

Table 8.

MARGINAL INVESTMENT\* REQUIRED ANNUALLY TO CARRY OUT  
PRESCRIBED HABITAT DEVELOPMENT 1980-89

Year	Michigan DNR		Huron-Manistee N. F.		Total Investment Discounted at 6-7/8%
	Acres	Discounted Investment (\$)	Acres	Discounted Investment (\$)	
1980	1,172	\$ 57,018	991	\$ 66,774	\$ 123,792
1981	2,402	109,340	991	62,479	171,819
1982	1,121	47,746	991	58,459	106,205
1983	1,335	53,203	991	54,699	107,902
1984	891	33,224	991	51,180	84,404
1985	1,186	41,380	991	47,888	89,268
1986	831	27,128	991	44,807	71,935
1987	1,458	44,535	991	41,925	86,460
1988	1,304	34,872	991	39,228	74,100
1989	2,141	53,572	991	36,705	90,277
P. V. Total Marginal Investment					\$1,006,162

\*Marginal Investment: The increased investment required for habitat-required planting as shown in Table 2.

Table 9.

## PRESENT VALUE OF MARGINAL YIELD FROM TIMBER PRODUCED BY WARBLER PLANTATIONS 1980-1989

Year	Michigan DNR			U. S. Forest Service			Total Marginal Return P. V.
	Acres	Marginal Yield	P. V. 1980 @ 6-7/8% Disc.	Acres	Marginal Yield	P. V. 1980 @ 6-7/8% Disc.	
1980	1,172	3,095	\$ 2,849	991	2,617	\$ 2,409	\$ 5,258
1981	2,402	6,344	5,464	991	2,617	2,254	7,718
1982	1,121	2,960	2,386	991	2,617	2,109	4,495
1983	1,335	3,526	2,659	991	2,617	1,974	4,633
1984	891	2,353	1,660	991	2,617	1,847	3,507
1985	1,186	3,132	2,068	991	2,617	1,728	3,796
1986	831	2,195	1,356	991	2,617	1,617	2,973
1987	1,458	3,851	2,226	991	2,617	1,513	3,739
1988	1,304	3,444	1,862	991	2,617	1,415	3,277
1989	2,141	5,654	2,861	991	2,617	1,324	4,185
TOTAL	13,841	36,554	\$25,391	9,910	26,170	\$18,190	\$43,581

The present value of these increased (or marginal) revenues are shown in Table 9. The net present value of these investments, considering only the timber produced, is \$ 962,581. This is equivalent to an increased cost of \$40 per acre in established warbler habitat during this period.

#### Habitat Development 1990-2030

At the end of the emergency period, regeneration methods will be seed tree harvesting and prescribed burning. The stands successfully established in this manner will provide the best habitat conditions. However, regeneration success from seed is unpredictable. Forest Management Division, Michigan DNR, success rates over the last ten years averaged 25 percent. This analysis will assume a 50 percent success rate due to improved understanding of jack pine regeneration requirements expected to develop over the next ten years, and improved seed bed conditions resulting from the use of prescribed fire. The 50 percent of the acres assumed to fail are to be replanted five years after initial regeneration attempt. Yield of planted stands will be assumed equal to the yield of warbler plantations as determined earlier. The yield of seed origin stands will be assumed equal to yield estimates presented in the discussion of timber stand growth and yield. The Habitat Management Plans prescribe the habitat development work shown in Table 10 by agency and period.

Under the assumptions about growth, yield, and investment, it is possible to evaluate the habitat development work remaining after 1990. Site distribution will be assumed to follow the same proportions as given in Table 5. It is also assumed that the habitat development work will total the following annual acreage:

1990 - 1999:	2,680.5 acres
2000 - 2009:	2,528.1 acres
2010 - 2019:	2,262.3 acres
2020 - 2029:	1,746.9 acres

This assumption is made primarily for the sake of simplicity, but it also recognizes the potential need to change certain specific prescriptions in the future. Tables 11 through 14 show the net present worth of this program in comparison to the nonwarbler management prescription of planting 800 trees per acre and managing on a 50-year rotation.

The marginal investment required for regeneration during the period 1990 to 2030 is significantly less than that required during the first ten-year period. Assuming 50 percent success, the DNR's marginal investment at time of stand establishment is \$0.70 per acre higher than the cost of the alternative plantation established at 800 trees per acre. The Forest Service realizes a net savings in comparison to the alternative, due to the higher cost of Forest Service plantations. Yields are significantly lower than those expected from plantations. Marginal yields are expected to be 3.3 cords per acre lower across the range of sites. Present value of yields consequently are \$4.70 per acre less than the nonwarbler plantation, across the assumed range in sites. The result over the remaining period of the habitat program is that if the assumed 50 percent regeneration success holds true, returns from timber harvested will yield \$123,620 net of stand establishment cost when compared to the same sites and total acreage planted at 800 trees per acre. The net present value of marginal returns on DNR lands are \$49,100 and the marginal returns on Forest Service lands are \$172,722.

#### Summary of Timber Analysis

Over the 50-year period 1980-2030, Kirtland's warbler habitat will be harvested and regenerated to establish a fully regulated jack pine forest. Land designated as Kirtland's warbler habitat on Michigan National Guard lands was not included in this analysis. A total of 115,929 acres is scheduled for harvest and regeneration in the plans published by both agencies. The remaining 9,571 acres that are part of the habitat and not in military

ownership are not in need of treatment during this period. The first ten years of the habitat program require the heaviest investment. The remaining forty years will require less intensive regeneration investment.

The marginal net present value of this regeneration program was determined by comparing the yield of plantations established at 800 trees per acre to the regeneration systems employed under the warbler program. The total net present value of -\$ 838,969 represents a net additional expense of \$6.28 per acre regenerated over the life of the program. In addition, the present value of immature timber scheduled for burning adds \$15,280, or \$.13 per acre to the total net cost of the program, attributable to timber. The additional \$6.41 per acre then, represents the opportunity cost in timber values foregone in order to have suitable habitat for the warbler.

Table 11.

NET PRESENT VALUE OF MARGINAL NET RETURNS OF SEED ORIGIN  
WARBLER STANDS COMPARED WITH NONWARBLER PLANTATIONS 1990 - 1999

Year	Michigan DNR			U. S. Forest Service			Total		
	Acres	Marginal Yield	NPV Returns From Timber in 1980	Acres	Marginal Yield	NPV Returns From Timber in 1980	Acres	Marginal Yield	1980 NPV Marginal Return
1990	1,375.6	- 4,539	- \$ 3,118	1,304.9	- 4,358	+\$ 13,931	2,680.5	- 11,057	+\$10,813
1991	1,375.6	- 4,539	- 2,917	1,304.9	- 4,358	13,035	2,680.5	- 11,057	10,118
1992	1,375.6	- 4,539	- 2,730	1,304.9	- 4,358	12,197	2,680.5	- 11,057	9,467
1993	1,375.6	- 4,539	- 2,554	1,304.9	- 4,358	11,412	2,680.5	- 11,057	8,858
1994	1,375.6	- 4,539	- 2,390	1,304.9	- 4,358	10,678	2,680.5	- 11,057	8,288
1995	1,375.6	- 4,539	- 2,236	1,304.9	- 4,358	9,991	2,680.5	- 11,057	7,755
1996	1,375.6	- 4,539	- 2,092	1,304.9	- 4,358	9,348	2,680.5	- 11,057	7,256
1997	1,375.6	- 4,539	- 1,958	1,304.9	- 4,358	8,747	2,680.5	- 11,057	6,789
1998	1,375.6	- 4,539	- 1,832	1,304.9	- 4,358	8,184	2,680.5	- 11,057	6,352
1999	1,375.6	- 4,539	- 1,714	1,304.9	- 4,358	7,658	2,680.5	- 11,057	5,944
TOTAL	13,756	-45,390	-\$23,541	13,049	-43,580	+\$105,181	26,805	-110,570	\$81,640

$$\text{Marg. NPV} = \frac{[(\Delta \text{ yield}) (\text{Price Function}) (\Delta \text{ Cost})]}{1/(1+i)^N}$$

$$\Delta \text{ Cost} = (\text{Planting Cost}) - (\text{Seeding Cost} + \text{Repainting Cost})$$

$$\text{Price} = 6.45 + (.39 * \text{VOL})$$



Table 12.

NET PRESENT VALUE OF MARGINAL NET RETURNS FROM SEED ORIGIN  
WARBLER STANDS COMPARED WITH NONWARBLER PLANTATIONS 2000 - 2009

Year	Michigan DNR				U. S. Forest Service				Total	
	Acres	Marginal Yield	1980 NPV Marginal Return	Acres	Marginal Yield	1980 NPV Marginal Return	Acres	Marginal Yield	1980 NPV Marginal Return	1980 NPV Marginal Return
2000	1,496.5	- 4,938.4	-\$ 2,004	1,031.6	- 3,404	\$ 5,676	2,528.1	- 8,342	\$ 3,672	
2001	1,496.5	- 4,938.4	- 1,875	1,031.6	- 3,404	5,311	2,528.1	- 8,342	3,436	
2002	1,496.5	- 4,938.4	- 1,754	1,031.6	- 3,404	4,969	2,528.1	- 8,342	3,215	
2003	1,496.5	- 4,938.4	- 1,641	1,031.6	- 3,404	4,650	2,528.1	- 8,342	3,009	
2004	1,496.5	- 4,938.4	- 1,536	1,031.6	- 3,404	4,351	2,528.1	- 8,342	2,815	
2005	1,496.5	- 4,938.4	- 1,437	1,031.6	- 3,404	4,071	2,528.1	- 8,342	2,634	
2006	1,496.5	- 4,938.4	- 1,345	1,031.6	- 3,404	3,809	2,528.1	- 8,342	2,464	
2007	1,496.5	- 4,938.4	- 1,258	1,031.6	- 3,404	3,564	2,528.1	- 8,342	2,306	
2008	1,496.5	- 4,938.4	- 1,177	1,031.6	- 3,404	3,334	2,528.1	- 8,342	2,157	
2009	1,496.5	- 4,938.4	- 1,102	1,031.6	- 3,404	3,120	2,528.1	- 8,342	2,018	
TOTAL	14,965	-49,384	-\$15,128	10,316	-34,040	\$42,855	25,281	-83,420	\$27,727	

Table 13.

NET PRESENT VALUE OF MARGINAL NET RETURNS FROM SEED ORIGIN  
WARBLER STANDS COMPARED WITH NONWARBLER PLANTATIONS 2010 - 2019

Year	Michigan DNR			U. S. Forest Service			Total		
	Acres	Marginal Yield	1980 NPV Marginal Return	Acres	Marginal Yield	1980 NPV Marginal Return	Acres	Marginal Yield	1980 NPV Marginal Return
2010	1,518.8	- 5,012	-\$1,046	743.5	- 2,454	\$ 2,104	2,262.3	- 7,465	\$1,058
2011	1,518.8	- 5,012	- 979	743.5	- 2,454	1,969	2,262.3	- 7,465	990
2012	1,518.8	- 5,012	- 916	743.5	- 2,454	1,842	2,262.3	- 7,465	926
2013	1,518.8	- 5,012	- 857	743.5	- 2,454	1,724	2,262.3	- 7,465	867
2014	1,518.8	- 5,012	- 802	743.5	- 2,454	1,613	2,262.3	- 7,465	811
2015	1,518.8	- 5,012	- 750	743.5	- 2,454	1,509	2,262.3	- 7,465	759
2016	1,518.8	- 5,012	- 702	743.5	- 2,454	1,412	2,262.3	- 7,465	710
2017	1,518.8	- 5,012	- 657	743.5	- 2,454	1,321	2,262.3	- 7,465	664
2018	1,518.8	- 5,012	- 614	743.5	- 2,454	1,236	2,262.3	- 7,465	622
2019	<u>1,518.8</u>	<u>- 5,012</u>	<u>- 575</u>	<u>743.5</u>	<u>- 2,454</u>	<u>1,156</u>	<u>2,262.3</u>	<u>- 7,465</u>	<u>581</u>
TOTAL	15,188	-50,120	-\$7,898	7,435	-24,540	\$15,886	22,623	-74,650	\$7,988

Table 14.

NET PRESENT VALUE OF MARGINAL NET RETURNS FROM SEED ORIGIN  
WARBLER STANDS COMPARED WITH NONWARBLER PLANTATIONS 2020 - 2029

Year	Michigan DNR				U. S. Forest Service				Total	
	Acres	Marginal Yield	1980 NPV Marginal Return	Acres	Marginal Yield	1980 NPV Marginal Return	Acres	Marginal Yield	1980 NPV Marginal Return	1980 NPV Marginal Return
2020	947.1	- 3,125	-\$ 335	799.8	- 2,639	\$1,164	1,746.9	- 5,765	\$ 829	\$ 829
2021	947.1	- 3,125	- 314	799.8	- 2,639	1,089	1,746.9	- 5,765	775	775
2022	947.1	- 3,125	- 294	799.8	- 2,639	1,019	1,746.9	- 5,765	725	725
2023	947.1	- 3,125	- 275	799.8	- 2,639	954	1,746.9	- 5,765	679	679
2024	947.1	- 3,125	- 257	799.8	- 2,639	892	1,746.9	- 5,765	635	635
2025	947.1	- 3,125	- 240	799.8	- 2,639	835	1,746.9	- 5,765	595	595
2026	947.1	- 3,125	- 225	799.8	- 2,639	781	1,746.9	- 5,765	556	556
2027	947.1	- 3,125	- 211	799.8	- 2,639	731	1,746.9	- 5,765	520	520
2028	947.1	- 3,125	- 197	799.8	- 2,639	684	1,746.9	- 5,765	487	487
2029	947.1	- 3,125	- 184	799.8	- 2,639	640	1,746.9	- 5,765	456	456
TOTAL	9,471	-31,250	-\$2,532	7,998	-26,390	\$8,789	17,469	-57,650	\$6,257	\$6,257

## Impact on Recreation, Wildlife, and Other Nonmarket Values

The concept of multiple-use is adhered to under the Kirtland's warbler program. Other resource values including recreation, mining, game and nongame wildlife, and fishing are allowed and encouraged within the designated warbler habitat. The only exception is during the spring and summer months when warbler areas are occupied by nesting birds. These closures affect trail users primarily. This includes trail bike riders and hikers. Existing trails through designated habitat are scheduled for relocation to reduce conflict. There are 14 miles of such trail and the cost of relocation will be \$5,600. Additional signing and enforcement costs to exclude visitors from closed areas amount to \$5,000 per season.

The closure of certain sites during the spring and summer will continue until such time as a stable population is reached. This analysis will assume that the stable population will be reached in 50 years. Total direct cost present value is \$75,710, the equivalent of \$0.57 per acre. Direct benefits of the program are an increase in visitor days attributable to habitat tours. An estimated 1,500 user days per season are accounted for by these tours. Assuming a recreation visitor day value of \$15.00 a day (U. S. Forest Service 1978), the present value equivalent of this over ten years at 6-7/8 percent is \$158,950, or \$1.20 per acre.

Other changes in recreational use are less direct and more difficult to measure. In general terms, the habitat management program is expected to improve habitat for most species of both game and nongame wildlife. Game and nongame recreational visitor days may increase as a result of the habitat program to the extent that improved habitat results in greater density and

diversity of wildlife in the area which in turn may attract some level of increased use. There is no data available to document these effects, however. A corollary increase in wild berry production, particularly blueberries, is expected to result from the use of prescribed fire in the program. Conditions will also improve for certain species of native plants in the area. Direct increase in user days and hence user-day values are not estimated, given lack of data upon which to base estimates of increased use. A more detailed discussion of the response of wildlife to the warbler habitat program is contained in Appendix 3.

Summary of Direct Costs and Returns

The present value of marginal costs and returns attributable to the program are as follows:

Management and administration . . . . .	-\$ 867,140	Aug / yr 17,343
Cowbird trapping . . . . .	- 254,320	5,086
Marginal net present value of timber . . . . .	- 838,969	16,780
Cost of trail relocation . . . . .	- 5,600	112
Cost of closure . . . . .	- 75,710	1,514
Recreation benefits provided . . . . .	+ <u>158,950</u>	<u>3,179</u>
TOTAL . . . . .	-\$1,882,789	<u>-37,655.</u> per yr.

Total increased net investment required to carry out the habitat management plans as written amount to \$16.55 per acre in present dollars. Much of that increased cost is attributable to the planting program required during the first ten-year period of the program. The other major cost element is management and administration. This is also incurred in the first ten years of this program, and then dropped out after the initial ten-year period.

X 40%  
15,062  
for NF

Direct and indirect economic impact on the region's economic base should be minor. Some increase in tourism is anticipated which would provide stimulus for the wholesale and retail trade sectors of the economy. Timber volumes are not expected to decline relative to their current levels, making the impact on forestry and forest products sectors negligible. Future timber production will be increased relative to the existing stands as the new plantations reach their rotation age and are harvestable. The increased harvest volumes should provide some improvement in employment and regional income, assuming that demand for jack pine pulpwood can handle the increased volumes available.

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APPENDIX 1  
Source Yield Tables



YIELD OF PLANTATIONS INITIAL STOCKING OF 800 TREES PER ACRE

Site Index 40

<u>Stand Age</u>	<u>Basal Area</u>	<u>Volume</u>	<u>Stumpage Price</u>
20	26.38	1.91	\$ 7.19
25	37.32	3.37	7.77
30	46.61	4.98	8.39
35	54.47	6.63	9.03
40	61.16	8.26	9.67
45	66.94	9.86	10.29
50	71.99	11.40	10.90
55	76.46	12.87	11.47
60	80.47	14.28	12.02
65	84.10	15.61	12.54
70	87.41	16.88	13.03

Site Index 50

<u>Stand Age</u>	<u>Basal Area</u>	<u>Volume</u>	<u>Stumpage Price</u>
20	41.34	3.74	\$ 7.91
25	56.39	6.37	8.94
30	68.65	9.16	10.02
35	78.56	11.94	11.11
40	86.65	14.63	12.16
45	93.37	17.19	13.15
50	99.04	19.60	14.09
55	103.90	21.87	14.98
60	108.13	23.98	15.80
65	111.84	25.96	16.57
70	115.15	27.80	17.29

Site Index 60

<u>Stand Age</u>	<u>Basal Area</u>	<u>Volume</u>	<u>Stumpage Price</u>
20	57.26	6.22	\$ 8.87
25	75.76	10.28	10.46
30	89.95	14.41	12.07
35	100.78	18.39	13.62
40	109.18	22.12	15.08
45	115.85	25.59	16.43
50	121.26	28.80	17.68
55	125.75	31.75	18.83
60	129.52	34.47	19.89
65	132.75	36.97	20.87
70	135.56	39.27	21.77

APPENDIX 2

Calculation of Net Present Values

### Calculation of Net Present Value

$$1. \text{ NPV} = \sum \frac{R_N}{(1+i)^N} - \sum \frac{C_N}{(1+i)^N}$$

Where:  $i$  = discount rate

$N$  = number of years

$C_N$  = cost in year  $N$

$R_N$  = return in year  $N$

NPV = net present value

2. Present value of annual payment:

$$\text{PV} = (\text{payment}) \left( \frac{(1+i)^N - 1}{(1+i)^N} \right)$$

3. Stumpage price calculation:

$$\text{Price} = 6.45 + (.39 * \text{stand volume})$$

$$-R^2 = .66$$

APPENDIX 3

Wildlife Response to Treatment

## APPENDIX 3

### Wildlife Values

An economic analysis of the impact of managing for Kirtland's warbler recovery would not be complete without consideration of impacts on other animal species. It can be difficult, however, to blend forest management and wildlife values in such an analysis.

At the start, a wildlife manager often interprets a joint plan with different assumptions and with emphasis on different outcomes than his forest management partner. This situation is exemplified by the response of five wildlife biologists: Jerry Weinrich, Ed Langenau, Larry Ryel, Richard Moran, and Larry Visser to the foregoing analysis.

In their October 30, 1980 memo, the following observations were made:

"When considering the response of Wildlife to Forest Management as outlined in the Kirtland's Warbler Habitat Plan, one must consider what would have otherwise occurred under "non-warbler" key value designation. In making this comparison we used the Mang-Mahalak-LaBumbard 'best estimate' of the non-warbler prescription but with some degree of mis-giving. Our reservations were a result of the following concerns: (1) there is no mention of regeneration techniques other than planting and natural regeneration without fire; (2) because of a number of factors it seems highly unlikely to us that jack pine would be the favored species on all the acreage under consideration; (3) removal of overtopping trees would probably not be restricted to hardwoods only; (4) rotation age for red pine on these sites would likely be more than 80 years; (5) the matter of stand size is not addressed (average stand size would be smaller under normal timber management practices); and (6) there is no mention of the type or amount of recreational use or development which might be expected in the non-warbler prescription. Some of the above could result in benefits to wildlife other than the Kirtland's warbler and some could be detrimental."

Weinrich et al. reviewed the management plan's impact to wildlife on a species by species basis. Some species, particularly hunted species, have known economic values based upon dollars spent to pursue recreational activities. Other species such as Cirsium hillii are protected by law but have unknown economic value. No acceptable method was found to translate overall wildlife values into numerical values usable in this analysis based on readily available information.

The following narrative by Weinrich et al. explains, in general terms, impacts of the Kirtland's Warbler Management Plan on other wildlife. There is clearly considerable economic benefit involved. These benefits, however, cannot presently be quantified.

Expanded use of prescribed burning will favor nearly all wildlife species. The improved vigor, nutritional quality, fruit/seed production, and species diversity of post-fire vegetation will be of definite benefit to species such as white-tailed deer, snowshoe hare, black bear, elk (Montmorency County primarily), small mammals such as thirteen-lined ground squirrels, deer mice, etc., and many species of insects. Many other species of birds will also find improved habitat in recently burned areas--upland sandpipers, clay-colored sparrows, vesper sparrows, horned larks, snow buntings, and others. The increased populations of small mammals, small birds, and insects will also be beneficial to predatory birds such as red-tailed hawks, goshawks, kestrels, nighthawks, and others; to gallinaceous birds such as turkeys, spruce grouse, and ruffed grouse; to mammalian predators such as coyotes, badgers, bears, and bobcats; and to some reptiles and amphibians.

With improved food conditions (resultant from burning) and retention and provision of older live trees and dead snags as called for in the Warbler Habitat Plan (especially when jack pine regeneration through seed tree burning becomes better accepted), habitat for many cavity nesting birds (eastern bluebird, yellow-shafted flicker, black-capped chickadee, downy woodpecker, hairy woodpecker, kestrel) and mammals (flying squirrels, red squirrels, fox squirrels) will be provided. Species such as red-tailed hawks, pine warblers, rose-breasted grosbeaks, cuckoos, and others will also find desirable nesting habitat in these areas. Ruffed grouse, white-tailed deer, porcupines, squirrels, turkeys, black bears, and others will also be benefited by retention of some older live trees, both hardwoods and conifers. The nonwarbler prescription would not provide cavity nesting habitat and removal of "overtopping" hardwoods would be detrimental to ruffed grouse, deer, porcupines, squirrels, turkeys, bears, and others.

The warbler population calls for retention of scattered openings throughout the jack pine stands--the timber management prescription does not. These openings are absolutely necessary for some wildlife species such as the upland sandpiper, wild turkey, clay-colored sparrow, and vesper sparrow; and they are very heavily used by certain other species such as white-tailed deer, elk, spruce grouse, nighthawks, and coyotes. They also provide habitat for significant populations of small mammals and insects and thereby provide mammalian predators. Nearly all wildlife benefits, accruing from retention of these openings, would be lost under the timber management prescription.

The warbler prescription calls for management with cutting blocks which will generally be larger than would result from the timber management prescription. Several species which require relatively large acreages of habitat (such as upland sandpipers and horned larks) will be benefited by this condition. The timber management prescription would result in fewer areas of acceptable habitat for these species.

At least three species of plants listed as threatened in Michigan, pale agoseris Agoseris glauca, Hill's thistle Cirsium hillii, and rough fescue Festuca scabrella, are found on designated critical habitat for the Kirtland's warbler. These prairie species, plus a number of nonlisted prairie species such as blazing star (Liatris sp.), bird's foot violet (Viola sp.), and big blue-stem (Andropogon scoparius) will be assured perpetuation under the warbler habitat

plan. A drastic decrease in their distribution could result from the timber management prescription.

Under the warbler prescription, some species can be expected to experience rather drastic short-term population reductions on specific cutting blocks. Porcupines, snakes, ground squirrels, and others could be eliminated from a cutting block for a few years after the fire. Similar population reductions will often also occur under the timber management prescription due to clearcutting and planting or degradation of habitat. Habitat for these species following regeneration will, however, be of higher quality under the timber management prescription.

Nearly all forms of human recreation common to these areas would be significantly improved under the warbler prescription due to higher populations and greater diversity of wildlife and plant species. Opportunities for all wildlife-related recreation pursuits would be improved. These include hunting, bird watching, hiking, nature study, "leisure driving," and deer watching. Due to the increased abundance and diversity of wildlife and improved potential for sustaining this larger and more diverse wildlife component, certain changes in these recreational activities are expected. In general, many of these recreational pursuits will result in longer average duration of visits to these areas and to increase return of recreationists to these areas from one year to the next. Expected increases in costs for travel will probably result in even greater demands for recreation on these lands due to their geographical locations, and improved diversity and abundance of wildlife will make these areas more attractive to these people.

Trail bikers, berry pickers, bird watchers, and hikers will experience limited seasonal restrictions due to area closures of nesting habitat, but these restrictions are expected to lessen as the warbler population increases. Except for trail bikers, these other recreational pursuits will, on the whole, be benefited due to increased availability and diversity of wildlife and improved blueberry production. Under the warbler prescription there might also be some limitation as to the number and location of future recreational developments, such as campgrounds and ORV rally areas.

Persons wishing to gather firewood in the warbler areas will also encounter some restrictions but these too can be expected to decrease as the warbler population increases. It is likely that an improved permit system for firewood collection can alleviate any hardships caused by restrictions imposed for the welfare of the Kirtland's warbler and other wildlife.

Most of the expected changes in abundance and diversity of wildlife and recreational activities under the Kirtland's Warbler Habitat Management Plan cannot be quantified at this time. It should be noted, however, that even very conservative estimates of the recreational value resultant from wildlife on these lands far exceeds the value realized from harvest of timber on either

Jeff Olson

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October 29, 1980

an annual or cumulative basis. Value of the expected increases in these wildlife-dependent recreational activities will undoubtedly far overshadow any loss of revenue from timber harvests resulting from implementation of this plan as compared to the timber management prescription.

JW:mh

cc Boushelle



Table 10.

HABITAT DEVELOPMENT PROGRAM BY AGENCY  
FOR THE PERIOD 1990 - 2030

<u>Period</u>	<u>Agency</u>		<u>Total</u>
	<u>Michigan DNR</u>	<u>U. S. Forest Service</u>	
1990 - 1999	13,756	13,049	26,805
2000 - 2009	14,965	10,316	25,281
2010 - 2019	15,188	7,435	22,623
2020 - 2029	<u>9,471</u>	<u>7,998</u>	<u>17,469</u>
TOTAL	53,380	38,798	92,178