

ACKNOWLEDGEMENTS

I would like to thank Nanjing Forestry University and the Ministry of Forestry, The People's Republic of China, who financed my whole education at the University of Michigan. I especially thank Dr. Burton V. Barnes for his guidance and aid in organizing and carrying out the research and for his reviewing and editing my thesis. I am grateful to Dr. Gary W. Fowler for his statistical advice and for editing my thesis. My sincere thanks go to Miss. Corinna Theiss for her assistance in the field and in the data preparation. My special thanks go to Tom Simpson, and Phil Stuart for their initiating the field work and for their consistent encouragement.

I would also like to thank the Huron-Manistee National Forest Office, US Forest Service, the Michigan Department of Natural Resources, and the Kirtland's Warbler Recovery Team for their advices, supports and assistance throughout the field seasons. Special thanks go to Sylvia Tailer and Jerry Weinrich for their generously spending time and giving information.

TABLES OF CONTENTS

ACKNOWLEDGEMENTS.....	ii
LIST OF TABLES.....	v
LIST OF FIGURES.....	vii
LIST OF APPENDICES.....	viii
CHAPTER I. INTRODUCTION.....	1
Background and Problem.....	1
Objectives.....	10
CHAPTER II. STUDY AREA.....	11
Climate.....	11
Topography and Soil.....	15
Vegetation.....	17
Fire History.....	18
Local Landscape Ecosystem Types.....	19
CHAPTER III. METHODS.....	27
Field Sampling.....	27
Sampling of Variables in Landscape Ecosystem Plots....	27
Sampling of Pattern of Jack Pine Occurrence.....	33
Statistical Analysis.....	34
Analysis of Pattern Types.....	35
Multivariate Analysis.....	37
CHAPTER IV. RESULTS AND DISCUSSION.....	39
Patterns of Jack Pine Occurrence in Selected Local Landscape Ecosystem Types.....	39
Patterns of Kirtland's Warbler Occupancy in Local Landscape Ecosystem types.....	44
Analysis of Relationships of Physical and Vegetative Factors to Selected Ecosystem types, Pattern of Jack Pine Occurrence,	

and Occupancy by the Kirtland's Warbler.....	47
Analysis of Variables of Physiography-soil, Tree Species, and Ground-cover Vegetation Selected by Stepwise Discriminant Analysis.....	47
Relationships of Physical and Vegetative Factors to Local Landscape Ecosystem Types.....	53
Relationships of Physical and Vegetative Factors to the Pattern of Jack Pine Occurrence and the Occupancy of the Kirtland's warbler.....	55
Relationships of Canonical Variates to Physical and Vegetative Factors.....	58
 CHAPTER V. SUMMARY AND CONCLUSIONS.....	 66
Background, Hypothesizes, and Objectives.....	66
Methods.....	68
Results and Conclusions.....	69
 LITERATURE CITED.....	 72
 APPENDICES.....	 78

LIST OF TABLES

1.1	Number of male Kirtland's warblers found in censuses from 1971-1987.....	7
2.1	Local landscape ecosystem types of the Mack Lake burn.....	20
2.2	Mean and standard deviation of selected variables of physiography, soil and ground-cover species in ecosystem types of the Mack Lake burn.....	22
3.1	Coverage classes used in determining areal coverage of species in sample plots.....	32
4.1	Pattern of jack pine occurrence for selected ecosystem types of the Mack Lake burn.....	40
4.2	Comparison of patterns of jack pine occurrence between two ecosystem groups (ecosystems 1, 6, 8, and 10--the "contagious" group vs. ecosystems 3, 4, and 9--the "random" group) and among methods (Clark-Evans, Hopkins-skellam, and Pielou-Mountford).....	42
4.3	Distribution in 1987 of 28 male Kirtland's warblers by ecosystem types at the Mack Lake burn.....	45
4.4	Mean and standard deviation of physiographic-soil variables selected by stepwise discriminant analysis.....	48
4.5	Mean and standard deviation of tree species variables selected by stepwise discriminant analysis.....	49
4.6	Mean and standard deviation of variables of ground-cover vegetation selected by stepwise discriminant analysis.....	51
4.7	Variables associated with ecosystem type, jack pine occurrence, and the occupancy of the warbler in 1987 determined by one-way ANOVA and Duncan's multiple range test.....	54
4.8	Eigenvalues, cumulative proportion of explained variance, and	

variance coefficients of the first three canonical variates of an analysis of the first 20 principal components.....	61
4.9 Eigenvalues, cumulative proportion of explained variance, and variable coefficients of 10 selected principal components of an analysis of 56 variables of physiography-soil, tree species, and ground-cover vegetation determined by stepwise discriminant analysis.....	62

LIST OF FIGURES

Fig. 2.1 Location of the Mack Lake fire..... 12

Fig. 2.2 Mean minimum temperature (F°) in July based on the period
1931-52, indicating the extreme temperature in Oscoda
County..... 13

Fig. 2.3 Major landscape forms in the Mack Lake burn, Oscoda County,
Michigan, showing low-level outwash plain and high-level
outwash terraces and ice-contact terrain..... 16

Fig. 3.1 Plot outline used to sample vegetation and patterns of
jack pine occurrence in the Mack Lake burn..... 29

