

MODELING ENDANGERED BIRD SPECIES HABITAT WITH REMOTE  
SENSING AND GEOGRAPHIC INFORMATION SYSTEMS

Mark Jakubauskas  
Kansas Applied Remote Sensing (KARS) Program  
2291 Irving Hill Drive  
The University of Kansas  
Lawrence, Kansas 66045

ABSTRACT

The Kirtland's Warbler (*Dendroica kirtlandii*) is an endangered bird species indigenous to northern lower Michigan. For its nesting habitat, the warbler requires stands of jack pine (*Pinus banksiana*) growing on the Grayling soil series, a sandy, well-drained soil of glacial outwash plains. These stands, which must be at least 32.4 hectares in size, are generally between eight and twenty-one years old. Ninety percent of all warbler nests have been found within the watershed of the Au Sable River of Michigan.

This research focused on assessing the potential nesting habitat for the species during 1982-83. Landsat Thematic Mapper data were classified and then analyzed using a geographic information system (GIS). Spatial algorithms within the GIS eliminated jack pine stands outside the specified age range, of insufficient area to support optimal nesting sites, and analyzed the shape of each potential habitat patch. Results indicate that this integrated approach has promise for evaluation of potential habitat for the species.

INTRODUCTION

Remote sensing and geographic information systems have been utilized for habitat assessment for several endangered avian species (Breininger et al., 1991; Hodgson et al., 1988; Miller and Conroy, 1990). Recent research on the information content of multispectral satellite data has indicated that information important for habitat assessment (forest community type, stand age, and stand density) may be derivable from the digital data (Horler and Ahern, 1986; Peterson et al., 1986; Spanner et al., 1989; Leckie, 1990). Digital remotely sensed data are readily integrated with other data (e.g., topography, soils, hydrology, others) in a geographic information system (GIS). Additionally, the use of a GIS facilitates the analysis of multiple large data sets, allowing areas that meet specified criteria to be rapidly evaluated for suitability.

The prime nesting habitat for the Kirtland's Warbler is highly dynamic, as known sites pass out of use within a few years and new potential sites are created through logging, prescribed fire, and wildfire. The population of the Kirtland's Warbler hovers around 400 individuals (based on field censuses of an estimated 200 males), and is highly dependent upon the available nesting area. An example of this sensitivity is the 1980 Mack Lake Fire in Oscoda County, Michigan, which destroyed nearly 25,000 acres of jack pine and mixed pine-hardwood forest. Warblers began nesting in the regenerating burn beginning in 1986, and the population of singing males within the county has doubled, from 80 in 1985 to 166 in 1990 (M. DeCapita, pers. comm.). Since the nesting habitat of the Kirtland's Warbler is constantly changing, an integration of remote sensing and GIS technology is attractive for management of this species. The objectives of this

Ref ID # 5482

project were to identify all present potential nesting habitat for the warbler, and to evaluate the suitability of each potential site in terms of several landscape shape indices.

## BACKGROUND

Mayfield (1960) and Walkinshaw (1983) have described the particular nesting needs of the Kirtland's Warbler in detail. Naturally-regenerated stands of young jack pine (8 - 21 years) growing on the Grayling Sand series of soil are favored by the warbler, with the young jack pine thickets providing shelter and concealment for the nests. Typically, warblers begin to occupy sites when the pine seedlings are 2-3 meters in height, and use declines sharply as tree height approaches 5-6 meters, and the branches closest to the ground die off. Consequently, the total area of potential habitat within this region is constantly changing as sites are created and site conditions change with age. Sites under 32 hectares are not commonly favored by the warbler (Mayfield 1960).

Since the warbler builds its nest on the ground, it is critical that the soil drain rapidly after a precipitation event. The Grayling soil provides favorable conditions for nestbuilding, with a thin to nonexistent humus layer, and perviousness extending to one or more meters below the surface (Oscoda County Soil Survey, 1931). Regeneration of jack pine occurs slowly on this poor soil, providing favorable conditions for the warbler for an extended period of time (Harwood, 1981). The soil occurs predominantly on former glacial outwash plains within the study region.

## STUDY AREA

The study area for this research is located in Crawford and Oscoda Counties, Michigan (Figure 1). Jack pine and red pine (*Pinus resinosa*) are the principal lowland conifers, occupying former glacial outwash plains, while oaks (*Quercus spp.*), paper birch (*Betula papyrifera*), and aspen (*Populus tremuloides*) predominate in the uplands. Other tree species common to the region include tamarack (*Larix laricina*), black spruce (*Picea mariana*), and white cedar (*Thuja occidentalis*). Understory vegetation is typical of a northern pines forest, comprised primarily of blueberry (*Vaccinium spp.*), sedge (*Carex spp.*), and bracken (*Pteridium aquilinum*). Much of the forest in this region was logged and burned during the period 1880 - 1920 (Whitney, 1987).

## METHODOLOGY

### Data Description

Thematic Mapper (TM) data acquired by Landsat 4 on October 27, 1982 (scene number 4010-15494) were chosen for assessment of potential warbler nesting habitat. The Landsat TM acquires spectral data in six reflective bands and one thermal band, with a spatial resolution of 30 meters in the reflective bands. The thermal band was not used in this study due to its low spatial resolution (120 meters) and poor contrast in forested areas (Horler and Ahern, 1986). Bands 1 and 2 (blue-green and green reflectance) exhibited a high degree of noise, and were also not used in this analysis. However, previous research has indicated that bands 3,4,5, and 7 provide the most information of the TM bands for forest cover mapping and analysis (Horler and Ahern, 1986; Leckie, 1990; Spanner et al.,1989). Ground reference information for this study includes detailed cover maps listing type, species, and density of the forest, produced by the

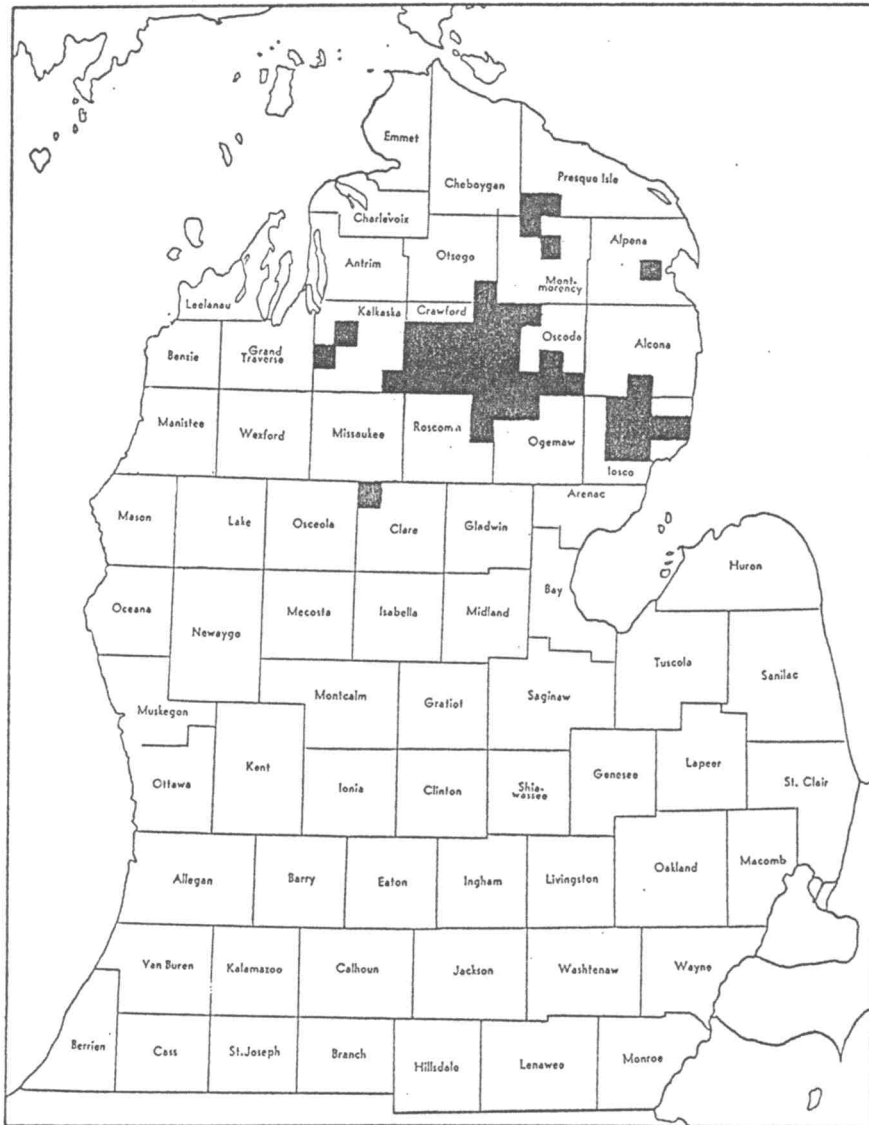


Fig. 1. Historic nesting range of the Kirtland's Warbler in northern lower Michigan during the 20th century.

