The Kirtland's Warbler: Interagency and International Cooperation works

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Introduction

Protection of migratory species requires understanding the ecology and demography of a species throughout its life cycle. This requires evaluating ecological requirements and survivorship during the breeding and wintering seasons as well as the migratory period. Obtaining these data is exceedingly difficult due to methodological limitations associated with (1) tracking individual birds throughout their life cycle and (2) being able to assess population changes during each part of the life cycle (Sillett and Holmes 2002, Webster and Marra 2005). Equally challenging is the ability to coordinate conservation work across jurisdictional boundaries, especially international boundaries where different legal, cultural and socioeconomic factors must be integrated to ensure that effective conservation programs can be sustained. This paper focuses on recent efforts in the Bahamian wintering grounds of the Kirtland's Warbler (*Dendroica kirtlandii*), a federally listed species in the United States and Canada, to fill gaps needed to develop a comprehensive range wide conservation program for this species.

The Kirtland's Warbler, North America's rarest songbird, has one of the most limited ranges of any landbird on the continent and breeds almost exclusively in Michigan, though some breeding occurs in Wisconsin and Ontario, in early succession jack pine (*Pinus banksiana*) stands. It winters in short, dense scrub in The Bahamas and Turks and Caicos Islands. The rarity of the Kirtland's Warblers coupled with its highly specific habitat requirements has required intensive research to identify appropriate management strategies to ensure survival of this conservation-reliant species. Research on the breeding grounds has guided development of two principal management activities which have successfully improved habitat and habitat conditions: (1) management of jack pine forests to ensure there are relatively large patches of early successional jack pine forest and (2) population control of a nest parasite, the Brown-headed Cowbird (*Molothrus ater*). Approximately 87,200 ha are dedicated to Kirtland's Warbler management in Michigan. About 1,400 hectares are planted with jack pine annually to ensure there is sufficient habitat for the species to maintain the recovery goal of a minimum of 1,000 pairs. Response of Kirtland's Warblers to these treatments has been evaluated through demographic studies (Bocetti 1994; Sarah Rockwell, personal communication, 2009), annual censuses conducted since 1971 (Mayfield 1992), monitoring productivity of parasitized versus nonparasitized nests (Bocetti 1994), and many other studies. This work has been coordinated through

This photo is of the 2009 Kirtland's Warbler Research and Training Project taken at Tarpum Bay, Eleuthera, Bahamas. From left to right (back row): Dave Ewert, Joe Wunderle. From left to right (front row): Elise Corliss, Jennifer Thieme, Scott Johnson, Jennifer White.

the Kirtland's Warbler Recovery Team (KWRT), a consortium of agency biologists and managers responsible for management of the species, including a representative from the Bahamas National Trust, which has overseen the recovery of the species from an estimated 167 singing males in Michigan's lower peninsula in 1987 to approximately 1,813 singing males in both the lower and upper peninsulas of Michigan, Wisconsin and Ontario in 2009.

Recently there has been increased emphasis on the study and conservation of the Kirtland's Warbler during migration and on the wintering grounds. All known locations of Kirtland's Warblers found during migration have been compiled by Petrucha and Huber (unpublished data) and priority areas for protection of landbird stopover sites have been compiled in the western Lake Erie basin of Ohio and Michigan, where Kirtland's Warblers are reported relatively frequently during migration (Ewert et al. 2006). This paper focuses primarily on ongoing studies of wintering Kirtland's Warblers in The Bahamas, primarily through the Kirtland's Warbler Research and Training Project and related work, including locating Bahamas-banded birds on the Michigan breeding grounds. We briefly describe results from the work to date and emphasize how collaboration has furthered our goal of contributing to a comprehensive, range-wide approach to conservation of this highly endangered species.

The Kirtland's Warbler Research and Training Project: a focus on the wintering grounds

The Kirtland's Warbler Recovery Plan lists activities to ensure survival of the Kirtland's Warbler on the wintering

grounds – identification of habitat used by Kirtland's Warblers, management activities needed to create this habitat, and increasing conservation capacity to ensure habitat availability on The Bahamas (Kirtland's Warbler Recovery Team 1985). In response to these needs, we initiated the Kirtland's Warbler Research and Training Project in 2002, with four principal objectives: (1) to provide a description of the ecology of wintering Kirtland's Warblers and associated resident and migratory species on the Bahamian wintering grounds, (2) to examine connectivity between the wintering and breeding grounds, (3) to convert research findings to management guidelines and other outreach activities for the Kirtland's Warblers on the wintering grounds, and (4) to increase conservation capacity in The Bahamas. These objectives were formulated based on needs articulated by the Kirtland's Warbler Recovery Team and subsequent discussions between Bahamian and United States conservationists, biologists, and others responsible for protection of the Kirtland's Warbler. Objectives for the wintering grounds coincided with Bahamian conservation needs as expressed by a past president of the Bahamas National Trust who stated "…Our [Bahamas] greatest needs are massive public and decision-maker education and intensified scientific research." (in Raffaele et al. 1998). These conservation approaches are needed to implement habitat restoration and increase quality of human life and thus compensate for past land-use practices that have degraded the biodiversity of The Bahamas

The Kirtland's Warbler Research and Training Project requires integration of research, conservation planning, fund raising, education, communication, knowledge of regulations in both The Bahamas and the United States and understanding of Bahamian and upper Midwest cultural and economic issues, all of which require extensive collaboration to achieve our ultimate goal of defining management practices needed to sustain the species in the Bahamas archipelago.

Research

Wintering grounds results. Kirtland's Warblers are difficult to locate on the wintering grounds where they are unevenly distributed across the landscape (Mayfield 1992, Currie et al. 2005). In spite of this challenge, the wintering

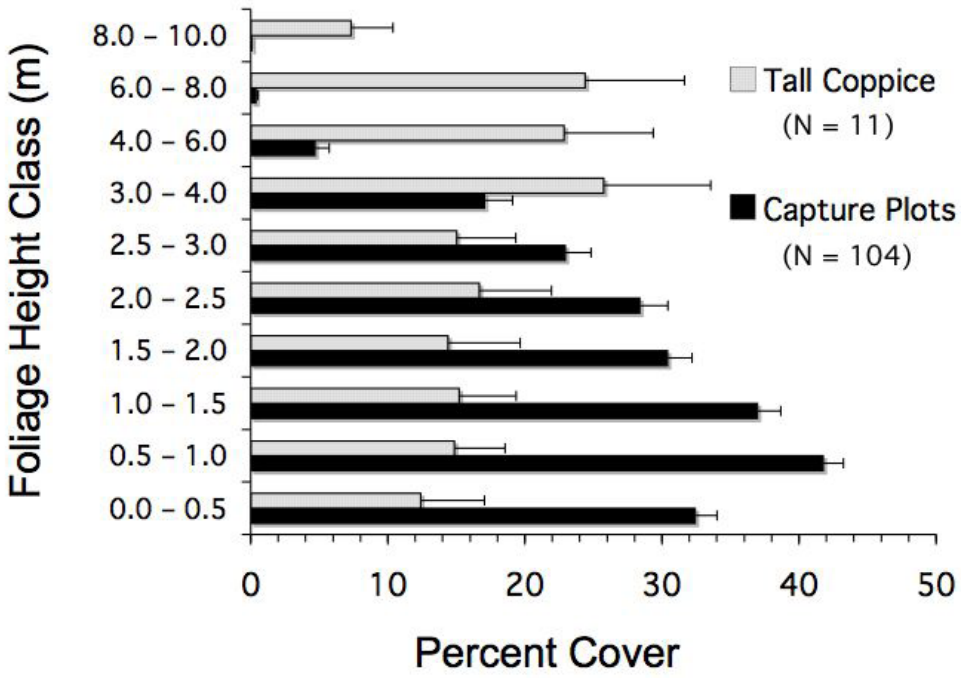

Figure 1:
Foliage height profiles showing percentage cover at various height categories in Kirtland's Warbler capture plots and randomly selected tall coppice plots from Eleuthera, The Bahamas. N indicates the number of plots sampled in capture and tall coppice plots. Foliage profiles indicate Kirtland's Warblers occupy low stature brushy or scrubby sites rather than tall, mature coppice (forest) sites. Figure modified from Wunderle et al. (2010) where methods are described.

grounds research on the island of Eleuthera has been successful in characterizing the winter habitat (Wunderle et al., 2010) and has demonstrated that Kirtland's Warblers use anthropogenically disturbed early successional habitats that range in age from 3 to 28 years following disturbance. Warblers occurred in sites that had been disturbed by clearing for construction, agriculture, goat farming and fire. Sites where the warblers were captured had canopies of lower stature (mean 1.8 m) and had more foliage near the ground (Figure 1) than late successional tall coppice sites (mean 6.3 m). These sites typically had lower canopies (mean 1.8 m) than randomly selected sites (mean 2.7 m). Although the seven study sites were heterogeneous in terms of time since last disturbance, most foliage height categories, canopy height, stem density and five ground cover traits (e.g., leaf litter, grass, wood, rock, bare ground), the density of vegetation at 0.5-1 m was consistent among study sites sampled. Kirtland's Warbler frequently foraged on small fruits on shrubs, especially those on wild sage (*Lantana involucrata*), black torch (*Erithalis fruticosa*), and snowberry (*Chiococca alba*); these species occurred at higher frequency on plots where Kirtland's Warblers were found compared to random plots (Wunderle et al. 2010). At both site and landscape levels, fruiting of these three shrubs can vary considerably between the times Kirtland's Warblers arrive in The Bahamas in the fall until they depart in April. Kirtland's Warblers appear to track fruit abundance as some individuals moved up to several kilometers from fruit-poor to fruit-rich sites during the winter. These results suggest that a landscape approach will be essential to ensure availability of high quality habitat across time and space for this species. Research collaborators include Dr. Peter Marra (Smithsonian Institution) and Ph.D. student Sarah Rockwell, Dr.

Eileen Helmer (International Institute of Tropical Forestry, U.S. Forest Service, Rio Piedras, Puerto Rico), Dr. Charles Kwit (University of Tennessee), Dr. Bernard Parresol (Southern Research Station, U.S. Forest Service, Asheville, North Carolina), Dr. Joseph O'Brien (Southern Research Station, U.S. Forest Service, Athens, Georgia), and Dr. Kimberly Hall (The Nature Conservancy).

Connectivity results. Two approaches are being applied to evaluate connectivity between wintering sites on Eleuthera, The Bahamas, and the breeding grounds: (1) observations of color-banded birds seen in both The Bahamas and the breeding grounds and (2) isotope signatures. Of the approximately 50 color-banded individuals found on the breeding grounds that were banded in The Bahamas, most were found widely scattered in Michigan's Lower Peninsula but some were also found in Wisconsin, Michigan's Upper Peninsula, and Ontario (Ewert et al., unpublished data). These observations suggest that Kirtland's Warblers wintering at one site widely disperse across the breeding range and further emphasizes the need for a landscape approach to habitat protection in The Bahamas. Collection and analysis of isotope data, based on collections of feathers and other tissues in both The Bahamas and Michigan are underway. These data will be used to better delineate connectivity between breeding and wintering areas, establish relationships between arrival times on the breeding grounds and environmental conditions on The Bahamas, and evaluate diet of overwintering Kirtland's Warblers.

Outreach and management

Outreach results and projected activities. Outreach has been achieved through extensive collaboration with local schools in southern Eleuthera, the Bahamas National Trust, Kirtland Community College, The Nature Conservancy, and the U.S. Forest Service in Michigan. In The Bahamas, student project participants give presentations on the Kirtland's Warbler and associated flora and fauna to primary and secondary students. In addition, the Bahamian student project participants coordinate local elementary school participation in Kirtland's Warbler artwork contributed to the annual Kirtland's Warbler calendar contest sponsored by Kirtland Community College. These activities generate local interest for the project, facilitate access to potential study sites and set the stage for potential management work with local landowners. In addition, presentations on the project have been made to the public, at science conferences, and to government officials in the Bahamas. Project brochures and posters have been produced and distributed throughout much of the Bahamas. Increased outreach activities are planned including distribution of posters on the project at public centers around the country. Other presentations have been made on the project at meetings and conferences throughout the United States, the Caribbean, Mexico, and Germany to increase support for conservation of the Kirtland's Warbler. Presentations are given annually at the Kirtland's Warbler Festival sponsored by Kirtland Community College, Roscommon, Michigan.

Proposed management results activities. Experimental management activities are now being initiated and require testing before encouraging implementation of these techniques. Our research indicates that re-occurring habitat disturbance will be required to produce early successional habitats with key fruiting species needed by wintering Kirtland's Warblers. We are focusing potential management on activities that produce, enhance, or maintain wintering Kirtland's Warbler habitat that will

be cost-effective, practical and sustainable over the long-term; it is unlikely there will be extensive management solely for the Kirtland's Warbler at a large scale in the Bahamas archipelago. Thus a key to success will be identifying those re-occurring natural and anthropogenic disturbance types which can be harnessed in a cost effective manner to facilitate production and maintenance of the warbler's winter habitat. To increase the likelihood of success we are initiating trial conservation programs in The Bahamas with diverse groups from the public and private sectors including: (1) working with resorts and botanical gardens where the presence of Kirtland's Warblers could enhance ecotourism, (2) working with utility companies to manage rights-of-ways that will create or maintain Kirtland's Warbler habitat by retarding vegetative succession, (3) working with goat farmers to encourage goat management practices (goats avoid foraging on two shrub species, wild sage and black torch, favored by Kirtland's Warblers) that retain the fruiting shrubs used extensively by Kirtland's Warblers, (4) evaluating the planting of firebreaks with shrubs used by Kirtland's Warblers and (5) working with local schools to encourage the planting of wild sage, black torch and snowberry. On the northern pine islands of The Bahamas (especially Andros, Grand Bahamas and Abaco) it may be possible to develop fire management approaches to create early successional habitat which benefit Kirtland's Warblers if Bahamian legislation permitting prescribed fires is adopted.

To implement these conservation approaches and activities the Kirtland's Warbler Research and Training Project will continue to build on our established working relationships with owners or managers of private or community lands and government officials. Thus far, many collaborators, such as the following, have actively participated with this aspect of the work or expressed interest in considering potential management activities: Bahamas National Trust, Bahamian government, Friends of the Environment (Abaco), Bahamas Electricity Corporation, The Nature Conservancy, the U.S. Forest Service, Leon Levy Native Plant Preserve, Cape Eleuthera Development Corporation, goat farmers on Eleuthera, community organizations (commonage and generational land committees) on Eleuthera and others.

Increasing conservation capacity

Results. The project has successfully provided rigorous field training for nine Bahamian students. The project also provided each student an opportunity to spend one summer in Michigan to become acquainted with the Kirtland's Warbler on the breeding grounds, learn complementary skills to those acquired during the winter project and to establish working relationships with United States conservationists. The Huron-Manistee National Forests and Kirtland Community College were instrumental among the collaborators who facilitated this aspect of the training program.

Seven of the students have gone on to attend universities in the United States (Cornell University, University of Minnesota, Northern Michigan University, University of Maryland-Eastern Shore, State University of New York at Buffalo). Each of these universities provided funding to help support education of these students in addition to funding provided by private donors and foundations through The Nature Conservancy. So far, four of these students have graduated with a B.S. degree in Biology or natural resource management from United States universities and one graduated from the College of the Bahamas. Two of these Bahamian students continued their studies in the United States and have obtained M.S.

degrees in ecology. Thus far, two students have returned to The Bahamas and taken conservation positions, one with The Nature Conservancy and one with the Bahamas Environment, Science and Technology Commission. Their work in The Bahamas includes analysis of environmental impact statements, conservation planning for marine and terrestrial parks and outreach activities.

Projected activities. We will continue to work with the College of the Bahamas, the Bahamas National Trust and the Northern Caribbean program of The Nature Conservancy to build educational and conservation capacity by encouraging student participation in the project and encouraging students to consider research and conservation internships with these organizations. The ultimate goal of the project is to have Bahamians assume management of the project and become conservation custodians for the Kirtland's Warblers throughout the country.

Summary

As habitat continues to be lost to development in The Bahamas, the two main challenges facing implementation of conservation programs for the Kirtland's Warbler are: (1) the lack of protected areas, which means that much Kirtland's Warbler habitat conservation must occur on private or community lands and (2) the need for re-occurring habitat disturbance to produce the early successional habitats with key fruiting plant species required by the warbler. These two challenges could prove prohibitively expensive for Kirtland's Warbler conservation on the wintering grounds and therefore it is essential to identify the most cost effective and sustainable means for habitat conservation. Ideally, we wish to identify management strategies that pay their way to ensure sustainability, although we recognize that the economic viability of any management strategy will vary over time. Consequently, we propose several conservation approaches, which will allow an assessment of the most effective and sustainable model(s) for Kirtland's Warbler habitat conservation. Conditions require that we must be opportunistic in our selection of conservation approaches and sites and work with a diversity of coopera-

tors on an array of Kirtland's Warbler management sites scattered across the Eleuthera landscape and elsewhere in The Bahamas.

The Kirtland's Warbler is particularly amenable to range wide conservation approaches due to its limited range and the highly effective, multinational KWRT which promotes collaborative work in the four countries inhabited by this species, the United States, Canada, The Bahamas and Turks and Caicos Islands. These countries are strongly linked economically and share many cultural and legal frameworks due to their history and proximity. These linkages facilitate establishing collaborative programs, such as the Kirtland's Warbler Research and Training Project, which is focused on the ecology and management of this species on the Bahamian archipelago wintering grounds. The collective work of many institutions and individuals, including the Kirtland's Warbler Research and Training Project, is furthering range-wide conservation of the Kirtland's Warblers on the breeding and wintering grounds and along the migration route.

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