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Using Geographic Information System (GIS) Software to Predict Blackbird Roosting Locations in North Dakota

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ABSTRACT: Cattail stands provide roosting and staging areas for large congregations of blackbirds in North Dakota in late summer and early fall. Since 1991, the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) program has conducted a cattail management program in North Dakota to alleviate blackbird damage to ripening sunflower. To extend the capabilities of the program, a geographical information system (GIS) will be incorporated to help WS personnel find blackbird roosts more effectively. We will use the GIS to construct field maps showing the association between areas of moderate to high sunflower damage (>5%) and cattail-dominated wetland basins >2 ha. Buffer distances comparable to the distances blackbirds typically travel to forage will be placed around sunflower planting areas susceptible to high damage. This will help WS personnel focus their efforts on locating cattail-dominated wetlands that should be enrolled in the management program and improving current and future blackbird damage management programs.

KEY WORDS: bird damage control, blackbirds, cattails, GIS, North Dakota, sunflowers, *Typha* spp., wetlands

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INTRODUCTION

Wetlands are a common feature on the North Dakota landscape with an estimated 15 wetland basins per square ha encompassing nearly 1.4 million ha across the state (Reynolds et al. 1997). Many of these wetlands are classified as temporary, seasonal, and semi-permanent, which are shallow and dominated by emergent vegetation (Stewart and Kantrud 1971, Cowardin et al. 1979, Kantrud 1983). These emergent wetlands comprise nearly 975,000 ha in North Dakota (Reynolds et al. 1997) and are most commonly found in the Prairie Pothole physiographical region (PPR) of North Dakota (Stewart and Kantrud 1973, Stewart 1975, Kantrud 1983).

Historically, the emergent vegetation species characteristic of these wetlands were sparse stands of bulrush (*Scirpus* spp.) and common cattail (*Typha latifolia*) (Kantrud 1992). In the early 1940s, the exotic narrow-leaved cattail (*T. angustifolia*) was reported in the state (Stevens 1963). During the 1970s, the narrow-leaved cattail had spread throughout the region and hybridized with the native common cattail to form *T.* × *glauca* Godron. This hybrid is a robust, quickly-growing cattail that forms dense homogonous stands and can tolerate seasonal inundation and draw-downs (Weller 1975, Davis and van der Valk 1978). Steenis et al. (1959) reported that *T. latifolia* could be controlled when immersed in 64 cm of water, while Grace and Wetzel (1982) reported control of *T. angustifolia* at water depths of 100 cm for a year. Given the intermediate morphological characteristics between the parent species displayed by *T.* x *glauca* (Smith 1967), a maximum water depth that would prevent growth is most likely intermediary of the two parent species.

Water depths fluctuate annually in these shallow, emergent wetlands based on spring snow melt and annual rainfall (Stewart and Kantrud 1971, Cowardin et al. 1979, Kantrud 1983). These fluctuating water depths are found throughout the PPR and often provide ideal growing conditions for cattails. In 2002, Ralston et al. (2004) estimated cattails covered 225,000 ha in the PPR of North Dakota. These dense stands of cattails provide ideal roosting and loafing areas for large congregation of blackbirds that form each fall before migration occurs.

The PPR covers 50.9% of North Dakota (Stewart 1975) and is the primary sunflower growing area in the state (NDASS 2003). Reports of conflicts between blackbirds (Icteridae) and sunflower producers were reported as early as the 1960s as commercial sunflower production expanded into North Dakota (Linz and Hanzel 1997). Annual sunflower losses across North Dakota are relatively low but can be locally severe where major blackbird roosts occur. Sunflower damage is closely associated with cattail-dominated wetlands that act as blackbird roosts (Otis and Kilburn 1988, Linz et al. 1993). Linz et al. (1995) found a positive relationship between the hectares of living cattails, the number of blackbirds, and sunflower loss.

An estimated 75 million blackbirds migrate through the sunflower growing areas of North Dakota each fall causing $5.4 million in sunflower losses annually (Peer et al. 2003). The blackbirds of major concern to lost sunflower production are the red-winged blackbird (*Agelaius phoeniceus*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), and common grackle (*Quiscalus quiscula*). Of these three blackbird species, red-winged blackbirds account for 52% of the annual sunflower loss (Peer et al. 2003).

Sunflower loss caused by blackbirds continues to be a major concern of producers and the sunflower industry despite continued use of many dispersal and harassment techniques. Current methods of alleviating blackbird damage to sunflower have limited effectiveness and are often costly (Linz and Hanzel 1997). Propane cannons, shotguns, rifles, and aerially applied repellents are the most common harassment and dispersal methods used today.

Since 1991, the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) has utilized an aquatic glyphosate (N-phosphonomethyl glycine) herbicide to reduce blackbird roosting habitat in North and South Dakota. Applications are conducted aerially (usually by helicopter) in linear strips approximately 15 meters wide with a 6 meter buffer of untreated cattails between treatment lanes in areas of the wetland dominated by cattails. Only wetlands with continuous cattails >4 ha are treated, and only 70% of the total cattail hectares are removed from each wetland. This application design was shown to disperse blackbirds from roosting locations and provide benefits to other wildlife (Linz et al. 1992, Linz et al. 1995, Linz et al. 1996). In 2002, WS treated 1,728 ha of cattails, which represent less than 1% of the total cattails hectares in the PPR of North Dakota (Ralston et al. 2004).

In 1993 and 1995, Linz et al. found that reliance on an unsystematic approach to selecting and treating cattail-dominated wetlands without information on blackbird roost size or their feeding patterns would not be cost-effective. WS currently relies on passive participation from interested sunflower producers experiencing sunflower damage. This type of participation can be effective on a small scale but often leaves potential roost sites untreated on adjacent or nearby properties. The optimum method of cattail management would be to aggregate wetland treatments in those wetlands that meet the requirements for the cattail management program in association with an aggregated pattern of sunflower damage. For those wetlands that do not meet the requirements for the cattail management or are located on lands where cattail management is unwanted or undesirable, effective blackbird damage management strategies can be formulated using other damage abatement techniques. Geographic Information System (GIS) software allows this level of landscape patterning using layers of geographical, biological, and tabular datasets.

The ability to predict blackbird roosting locations associated with high sunflower damage areas and high wetland densities, would allow for better implementation of existing and future damage abatement programs. Our objectives in this project were 1) to create a GIS database of current and historical sunflower damage surveys, 2) to develop GIS classification methods to predict cattail dominated wetlands and possible blackbird roosting locations for use in the cattail management program, and 3) to incorporate the GIS database into current and future blackbird damage management tools.

STUDY AREA AND METHODS

As part of an initial investigation into the feasibility of identifying blackbird roosting habitat using GIS software, 6 counties were selected in east central North Dakota for analysis. Nearly 25% of the 2001 sunflower crop in North Dakota was harvested in Stutsman, Barnes, Eddy, Foster, Griggs, and Wells Counties (NDASS 2003). These 6 counties encompass on area approximately 18,460 km^2 within the PPR of North Dakota. Wetland basins cover 164,000 ha with an average of 94 wetland basins/km^2 in these 6 counties (Reynolds et al. 1997).

A multilayered geographical database was created for the 6 target counties in this initial investigation. Data layers were displayed and analyzed using ArcGIS™ 8.3 (Environmental System Research Institute [ESRI], Redlands, CA). Spectral signatures were analyzed through supervised reclassifications using Image Analysis™ (Leica Geosystems, Atlanta, GA). All spatial data were projected in Universal Transverse Mercator Zone 14, North American Datum 1983.

The initial base layer consisted of polygon boundaries of North Dakota counties registered in the Public Land Survey System (PLSS) displayed as vector data (North Dakota Department of Transportation, Bismarck, ND, 1999). The initial base layer served as a foundation for projecting additional vector and raster layers. The PLSS layer consisted of rectangular land survey boundaries divided into 93-km^2 townships. These townships were further sub-divided into thirty-six 2.59-km^2 sections.

To begin the basic process of identifying areas of high sunflower production within each target county, sunflower plantings were identified using Cropland Data Layer (CDL) sets (National Agricultural Statistics Service [NASS], Fargo, ND, 1997-2002). The CDL is a thematic raster produced from LANDSAT 5 and LANDSAT 7 satellite imagery. Using spectral analysis, the CDL is categorized into several cropland and non-cropland classes, including sunflower. The CDL data sets were reclassified removing all crop and non-crop categories except sunflower. This information was then used to confirm the presence of sunflower over several recent growing seasons.

To gain a spatial understanding of sunflower damage in the target counties, a vector layer was created using historical and current sunflower damage survey locations and sunflower damage data (G. Linz, USDA APHIS WS-NWRC, Bismarck, ND, pers. commun., 2004). Sunflower damage for each location was then categorized and projected as three sunflower damage levels as follows; 0 - 2% (minor), 2 - 5% (moderate), and >5% (high). Those townships containing multiple high damage level points (>5% damage) were then isolated.

Once townships with high sunflower damage were isolated, a Digital Ortho MrSID mosaic (USDA-FSA-APFO, Salt Lake City, UT, 1988 - 2004) was added to the PLSS base layer. The MrSID mosaics were added to aid in navigation, wetland location, and served as a background for additional layers. Damage points with high sunflower damage were assigned 8-km buffers from the survey point. Besser et al. (1981) found that blackbirds leaving roosts in North Dakota limited their foraging radii to <10 km. Wetlands inside these buffers were identified for analysis for cattail habitat.

To identify wetlands within the buffer, a National Wetlands Inventory (NWI) vector dataset was added (U.S. Fish and Wildlife Service, Bismarck, ND 2003). An attribute selection was performed on these data, which selected only those wetland basins with an area >2 ha. A second sorting was performed to remove all wetlands classified as uplands, lakes, and rivers. A new layer was then created from the selection, which included those wetlands >2 ha in size and classified as temporary, seasonal, and semi-permanent under the NWI wetland classification system.

To facilitate habitat analysis and identification of cattails, we georeferenced and overlaid multiple color infrared (CIR) aerial images taken in 2001 of quarter sections containing known cattail-dominated wetlands (Wimberly et al. 2002). Regional LANDSAT 5 satellite imagery was viewed in conjunction with CIR images of known cattail-dominated wetlands to verify cattail spectral signatures on the satellite imagery. Using Image Analysis™, we selected pixels of known spectral signatures for cattails from the satellite imagery that were determined to be within a wetland and likely to be cattail at a township level. A supervised classification produced an output grid of potential cattail pixels within the LANDSAT 5 image. We compared the wetland layer from NWI with the cattail grid produced from the supervised classification of the LANDSAT 5 image. Pixels classified as cattails that did not occur within or adjacent to wetland features were discarded and considered to be upland vegetation or shelterbelts. Remaining pixels contained within NWI wetlands estimated to be >2 ha in size were designated for future ground truthing to verify the presence of cattails.

RESULTS AND DISCUSSION

Initial stages of this project focused on predicting the presence or absence of cattails based on wetland classifications. The wetland classifications that have shallow water depths that are conducive to cattail growth are temporary, seasonal, and semi-permanent wetlands. Using the NWI datasets, ground truthing of wetlands >2 ha designated as seasonal, temporary, and semi-permanent provided no predictability for the presence of cattail based on these wetland classifications. The large number of wetlands in the target area with these classifications made ground truthing for the presence of cattails a time-consuming process that was not cost-effective.

A way to eliminate wetlands without cattails from ground truthing was needed. The LANDSAT 5 satellite imagery provided a means of predicting the presence and location of cattails within wetland basins in the target area. Using the spectral signature of cattail from the LANDSAT 5 imagery that was verified from CIR images of known cattail-dominated wetlands, a classification of cattails across a large geographical area was possible. LANDSAT 5 imagery is made available annually allowing for analysis and applications to occur in subsequent years. Thus, the LANDSAT 5 dataset in the GIS database will be update yearly so changes in cattails across the PPR can be monitored and analyzed.

This level of predictability allowed for the elimination of those wetland basins that did not indicate the presence of cattails or that indicated the presence of cattail but in insufficient densities to be major blackbird roosts. Focus can then place on those wetlands where cattails were indicated to be in sufficient quantities that would warrant ground truthing to verify the presence of cattails in the spring and later as a roost location in the fall. Ground truthing of cattails in wetlands will begin during spring 2004.

Ground truthing for the presence of cattails will provide information on actual water and vegetation conditions within wetland basins and will provide feedback on the accuracy of the cattail classifications. As information becomes available from ground truthing, the GIS database will be refined with variables added or removed providing more accurate estimation of cattails on the landscape.

The final objective is to implement this GIS database into existing and future blackbird damage management tools. The ability to identify cattails on the landscape on a real-time basis will greatly enhance the WS cattail management program. Identifying potential blackbird roost locations within wetland aggregations will greatly improve the cost effectiveness and benefits of cattail management and will provide the foundation for any future blackbird damage management tools.

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