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Cattail Distribution and Abundance in North Dakota

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ABSTRACT

Wetlands in the Prairie Pothole Region (PPR) of North Dakota provide important habitats for a plethora of invertebrate and vertebrate animals. Since 1991, glyphosate-based (N-phosphonomethyl-glycine) herbicides have been used to manage dense cattail (*Typha* spp. L.) stands on 29,522 ha of wetlands in the PPR to disperse blackbird roosts. Limited information exists on the abundance and distribution of this important habitat. We took aerial photographs and used geospatial analysis tools to identify wetland basins and cattail coverage on randomly selected sample sites within the PPR. We found that average wetland density and size were 13 wetlands/km^2 and 1.1 ha, respectively. Average wetland size was 1.1 ha; whereas, wetlands with cattails averaged 2.4 ha. Cattail was most commonly found in palustrine systems, semi-permanent wetlands, and wetlands with surface water throughout the growing season. Our data showed that current cattail management activities annually impact <1% of the total wetland acreage. The affects of these management actions on wildlife populations, however, are largely unknown.

Key words: Cattail, Geospatial, North Dakota, Prairie Pothole Region, *Typha*, Wetlands.

INTRODUCTION

The hybrid cattail (*Typha glauca*), a cross of the native broad-leafed cattail (*Typha latifolia*) and the invasive narrow-leafed cattail (*Typha angustifolia*), is ideally suited for the shallow wetlands commonly found in the Prairie Pothole Region (PPR) of the northern Great Plains (Kantrud 1986). Frequent disturbance by tillage and elevated salinity conditions contribute to the success of hybrid cattail. As a result, cattail can take over a wetland and become a monotypic stand, which can have negative effects on wildlife use (Weller 1975, Kantrud 1986). For example, waterfowl prefer open water interspersed with emergent vegetation (Kaminski and Prince 1984, Solberg and Higgens 1993) and over-water nesting birds use wetlands with exposed mudflats and floating mats of dead cattail (Linz and Blixt 1997). On the other hand, deer, gallinaceous birds, and passerines use dense cattail stands as an important source of shelter and protection during the harsh winters of the northern Great Plains (Kantrud et al. 1989).

Dense cattail stands can, however, harbor large roosting aggregations of blackbirds that sometimes damage agricultural crops, especially sunflower (Linz and Hanzel 1997). Since 1991, natural resource agencies have managed about 29,522 ha of wetlands with aerially-applied glyphosate-based herbicide (N-phosphonomethyl-glycine) to disperse blackbird roosts (USDA 2006). Prior to that time, other aquatic herbicides (Comes and Kelley 1989) were tested on cattails on an experimental basis. Generally, the wetlands are altered to achieve an open water-emergent vegetation ratio of about 70:30 (USDA 2006). The aim of this study was to quantify the distribution and abundance of cattails in the PPR in North Dakota. These data can be used to help guide resource managers charged with managing wetlands on a landscape scale.

STUDY AREA AND METHODS

Our study area was the PPR (95,200 km^2) in North Dakota (Figure 1). The topography of the PPR consists of undrained depressions, known as potholes and sloughs, which were formed during the Pleistocene Epoch (Kantrud et al. 1989). Large moraines accumulated along the edges of the region, which formed low rolling hills such as those in the Missouri Coteau.

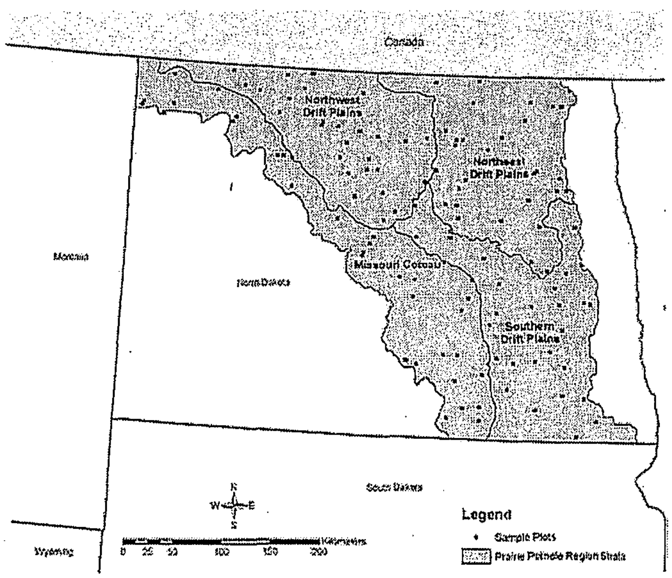

Figure 1. Sample sites in the stratified Prairie Pothole Region of North Dakota.

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We stratified the PPR into four strata known as the Missouri Coteau, Northwest Drift Plains, Northeast Drift Plains, and Southern Drift Plains (Stewart and Kantrud 1972). We proportionally allocated 120-3.2 × 3.2 km (1,036 ha) sample plots to the four strata (Johnson et al. 1999). We had aerial color infrared (CIR) photographs taken from mid August to early September 2002 because many agricultural crops were harvested or senescing; whereas, the cattails were still green. These differences in vegetation state provided good spectral contrast in the color infrared photos.

Photographs were taken, on cloudless days, of all four legal quarter sections (1.6 × 1.6 km) within each sample site. Each photo was taken with a large overlap to reduce the distortion caused by the curved outer edge of the camera lens. Kodak Aerochrome II infrared film 2443 was used with a 35mm Nikon F3 camera and a 35mm lens. A Tiffen #15 orange filter was also applied to reduce blue light. The camera was mounted on a fixed wing airplane flown at an altitude of about 3,100 m above ground level. An onboard GPS unit was used in coordination with programmed locations of the sample sites to ensure accuracy of the location. Limitations were placed on the time of the flights (1100 to 1400 h) to reduce shadows caused by sun angles.

We conducted ground surveys on 60 sample sites to reinforce interpretation of aerial CIR images and to check accuracy of problematic photo signatures. We digitized the photographs into a TIFF format and imported them into a Geographic Information Systems (GIS) program (ESRI's ArcInfo 8.x) for analysis. The images were georeferenced using at least four identifiable ground features in the image and with North Dakota Department of Transportation coverage layers. The images were rectified to correct for distortion caused by photo angles. The resulting spatial resolution on the images was 0.75 m × 0.75 m. We analyzed each image separately due to variations among images, such as contrast and light intensity.

CIR film is useful for distinguishing cattail from other vegetation because cattail is tall and has broad leaves that give a distinct red signature compared to most other plant species in wetlands. This difference permitted us to classify the image and separate land cover types based on pixel colors. Other data layers, such as USFWS National Wetland Inventory (NWI) layers and USGS Digital Elevation Models (DEM), also were used to gain remote sensed knowledge of the topology of sites which increased the probability of correctly identifying wetland basin boundaries and cattail within the basin (USDI 2005).

To reduce the variation in the image and lower the error produced by classifying pixels into the wrong class, an analysis mask was used to reclassify only those pixels found within cattail containing polygons designated by the classifier. The image was classified into 10 to 30 groups based on the spectral signature and complexity of the pixels. Once classified, each class was visually evaluated and grouped into either cattail or non-cattail. If the class divisions did not satisfactorily define the image, the classification was rerun with more classes, class breaks were redefined, or the original mask was divided into smaller parts. This process was repeated for all four images in each site, and the cattail raster layers were converted into vector format for finer definition and for extraction of area values.

In situations where the photo-signature was difficult to interpret, ground truthed maps were used as a reference when available. For locations that were not surveyed on the ground, alternative methods of interpretation were used. Similar looking features on a ground truthed map were compared against the feature on the photo in question. National Wetlands Inventory data and USGS DEM also were used to interpret questionable features where topography and proximity to known wetlands were used to form logical rule-based modifiers. Even when there were no questionable features in the photo, classified cattail was still compared against ground-truthed photos when available and also against NWI and DEM data to ensure the greatest possible accuracy.

Once cattail had been extracted, all wetland basins were mapped and classified. All available databases were used to define the boundaries of the wetland basins including the following: 2002 CIR photos, 2003 Farm Service Agency color photos, USGS topology layers, and ground survey maps. Wetland basin boundaries were drawn based on visual cues of vegetation or landscape changes and not based on current water levels due to frequent seasonal and annual fluctuations in hydrology. Linear wetlands, such as ditches or waterways, containing cattail were only outlined to the extent of the cattail vegetation. We classified wetlands based on the Cowardin et al. (1979) wetland system and water regime classifications, using the pre-identified classification designated by the NWI data layer when possible as long as the wetland condition satisfactorily defined the classification. The Cowardin system includes a subsystem of water flow, classes of substrate types, subclasses of vegetation types and dominant species, flooding regimes and salinity levels for each system. All wetlands were designated with a modifier including linear wetlands (roadside or drainage ditch, waterway or trench) or non-linear wetlands (wetland basins that are not in a linear form). Finally, wetlands also were classified based on the presence or absence of visual standing water at the end of the growing season.

RESULTS

Missouri Coteau

The Missouri Coteau is the most western strata in the sampled area (Figure 1). We identified 3,943 wetlands in this stratum, with 23% containing cattail (Table 1). Density of wetlands was 10.7 non-linear wetlands/km^2 and 2.5 cattail wetlands/km^2. Average wetland size was 1.6 ha and 4.3 ha for all wetlands and cattail wetlands, respectively. Areal coverage of cattail averaged 23% in individual cattail wetlands (Table 1) and 68% of the cattail wetlands were in semi-permanent wetlands (Table 2). The majority of cattail was found in palustrine systems, semi-permanent water regimes, and wetlands with surface water.

Northwest Drift Plains

We identified 3,661 wetlands in the Northwest Drift Plains (NDP) strata, with 14% of those containing cattail (Table 1). Density of wetlands was 12.2 non-linear wetlands/km^2 and 1.6 cattail wetlands/km^2. Total wetlands and cattail wetlands averaged 0.9 ha and 2.8 ha, respectively. Areal coverage of

TABLE 1. WETLAND CHARACTERISTICS IN 120 SAMPLE SITES (10.4 KM²) IN FOUR STRATA WITHIN THE NORTH DAKOTA PRAIRIE POTHOLE REGION IN 2002.

	PPR*	MC*	NWDP*	NEDP*	SDP*
Number of samples	120	33	27	28	32
Total wetlands	15,986	3,943	3,661	4,391	3,991
Mean wetland size	1.1 (0.04)	1.6 (0.14)	0.9 (0.07)	0.8 (0.05)	0.8 (0.05)
Mean cattail wetland size	2.4 (0.12)	4.3 (0.46)	2.8 (0.36)	1.7 (0.12)	1.9 (0.16)
% Land area covered by cattail	2.0 (0.3)	1.0 (0.2)	1.0 (0.3)	4.0 (0.3)	3.0 (0.4)
% Cattail coverage/cattail wetland	37.0 (0.3)	23.0 (0.6)	31.0 (1.0)	43.0 (0.5)	49.0 (0.6)

*PPR = Prairie Pothole Region, MC = Missouri Coteau, NWDP-Northwest Drift Plains, NEDP = Northeast Drift Plains, and SDP = Southern Drift Plains.

cattail averaged 31% in individual cattail wetlands. Unlike the other three strata, seasonal wetlands in the NDP had the highest percentage (40%) of cattail (Table 2). The majority of cattail was found in wetlands with surface water.

Northeast Drift Plains

We identified 4,391 wetlands within the Northeast Drift Plains ($n = 28$), with 39% of those wetlands containing cattail (Table 1). Estimated density of non-linear wetlands/km² was 13.8 for all wetlands and 5.2 for cattail wetlands. Areal coverage of cattail averaged 43% in individual cattail wetlands (Table 2). Average wetland size was 0.8 ha and 1.7 ha for all wetlands and cattail wetlands, respectively. We found that about 49% of all cattail was in semi-permanent water regimes, and over 75% of the cattail was in wetlands with surface water.

Southern Drift Plains

The Southern Drift Plains had 3,991 wetlands identified in 32 sample sites and 31% contained cattail (Table 1). Non-linear wetland density/km² was estimated to be 11.1 for all wetlands and 3.2 for cattail wetlands. Average wetland size for all wetlands and cattail wetlands was 0.8 ha and 1.9 ha, respectively. About 49% of an average cattail wetland basin was covered by cattail. The greatest proportion of all cattail in the stratum was in semi-permanent water regimes and in wetlands with surface water (Table 2).

Prairie Pothole Region

Across the PPR of North Dakota, we identified 15,986 wetlands in the 120 sample sites, with 4,494 wetlands containing cattails (Table 1). Average wetland size was 1.1 ha and 2.4 ha for all wetlands and for cattail wetlands, respectively. We estimated that areal coverage of cattail was 2% (221,509 ha) of the land surface. Cattail wetlands represented 28% of all sampled wetlands and averaged 3.1 non-linear wetlands/km². Areal coverage of cattail averaged 37% in individual cattail wetlands. A great majority of cattail wetlands were found in a palustrine system (Table 2). Semi-permanent wetlands contained over 50% of the cattails across the PPR.

DISCUSSION

We found that most cattails are in wetlands that contained water in late summer, which is typical of semi-permanent wetlands. This observation collaborates other investigators contention that cattail thrives in wetlands with shallow surface

TABLE 2. MEAN (S.E.) PERCENTAGE OF TOTAL ESTIMATED CATTAIL DISTRIBUTED AMONG WETLAND CLASSIFICATIONS IN FOUR STRATA WITHIN THE NORTH DAKOTA PRAIRIE POTHOLE REGION IN 2002.

	PPR*	MC*	NWDP*	NEDP*	SDP*
Wetland system					
Palustrine	96 (11.4)	87 (12.5)	91 (22.1)	97 (20.4)	100 (16.7)
Lacustrine	4 (1.4)	13 (6.9)	8 (6.2)	3 (1.5)	<1 (0.3)
Water regime					
Temporary	13 (1.6)	6 (1.4)	18 (4.5)	12 (2.1	15 (3.2)
Seasonal	30 (4.4)	17 (4.0)	40 (11.8)	37 (7.9)	24 (5.8)
Semi-permanent	54 (7.5)	68 (10.1)	34 (9.8)	49 (13.4)	61 (12.6)
Intermittently exposed	4 (1.3)	9 (6.2)	8 (6.2)	3 (1.5)	<1 (0.3)
Hydrology					
Surface water	74 (9.8)	79 (11.9)	66 (18.3)	77 (18.3)	69 (13.6)
No Surface water	26 (2.6)	21 (3.6)	34 (7.1)	23 (3.5)	31 (5.2)
Wetland modifier					
Linear wetland	6 (1.0)	2 (0.5)	7 (1.6)	4 (0.9)	10 (2.8)
Non-linear wetland	94 (11.2)	98 (12.7)	93 (22.6)	96 (20.2)	90 (16.0)

*PPR = Prairie Pothole Region, MC = Missouri Coteau, NWDP-Northwest Drift Plains, NEDP = Northeast Drift Plains, and SDP = Southern Drift Plains water (Waters and Shay 1992). Wetland basins with little or no water allow farmers to plow, burn, and use ground applicators to apply glyphosate herbicide; whereas, deep water (>1 m) wetlands tend to contain thin stands of cattail.

We found that the Northeast Drift Plains had the highest density of wetlands and highest areal coverage of cattail. This area also is known for an abundance of wetland-dependent birds, especially breeding and migrating waterfowl and blackbirds. Waterfowl are generally considered to be of economic value; whereas, high blackbird populations can cause significant sunflower damage in local areas (Hothem et al. 1988). On the other hand, the Northwest Drift Plains had the second highest density of wetlands but the lowest areal coverage of cattail. This stratum has relatively few problems with roosting blackbirds but does support a large population of waterfowl.

The Missouri Coteau features a high percentage of land area covered by wetlands compared to other strata, and has a relatively high percentage of wetlands with surface water. Even so, the Missouri Coteau has a relatively low abundance of cattail. The stratum probably has fewer cattails because its wetlands are comparatively large and deep, consequently cattail can only grow on the outer shallow edges of the basin.

The Northeast Drift Plains and Southern Drift Plains have a good balance of wetland distribution among wetland categories. These wetland conditions provide good seasonal fluctuations in water levels, which allow enough moisture to support cattail growth without surpassing its' survivable water depth (>1.0 m). These shallow basins also frequently develop exposed mudflats later in the growing season, providing suitable conditions for new seed germination. Total precipitation for the Northeast Drift Plains and Southern Drift Plains is greater than the other parts of the PPR which may also contribute to greater amounts of cattail.

MANAGEMENT IMPLICATIONS

From 1991 to 2005, natural resource agencies have managed cattails on 29,522 ha of wetlands in the PPR to disperse blackbird roosts. Except for one year, the annual acreage managed was <1% of the total available cattail (USDA 2006). Cattails have a great capacity to reinfest a wetland over several years. Thus, we speculate that annually spraying <1% of available cattail is unlikely to severely impact wetland-dependent wildlife. To lessen the impact of management activities, however, managers could treat 70% of a wetland basin and stagger treatments within and among wetlands so that successional stages of emergent vegetation are present (Linz et al. 1997). This strategy should lead to increased biodiversity within these wetlands. We suggest a study similar to ours is needed to determine the distribution and abundance of cattails in the PPR in South Dakota. Additionally, a quantitative assessment is needed on the effects of active cattail management on resident and migratory animals.

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LITERATURE CITED

Comes, R. D. and A. D. Kelley. 1989. Control of common cattail with postemergence herbicides. J. Aquat. Plant Manage. 27:20-23.

Cowardin, L. M., V. Carter, F. C. Golet and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish Wildl. Serv., Office of Biological Serv., Washington, DC, USA. FWS/OBS-79/31.

Hothem, R. L., R. W. DeHaven and S. D. Fairaizl. 1988. Bird damage to sunflower in North Dakota, South Dakota, and Minnesota, 1979-1981. U.S. Fish Wildl. Serv., Washington, DC, USA. Technical Report 15.

Johnson, R. R., K. F. Higgins, D. E. Naugle and J. A. Jenks. 1999. A comparison of sampling techniques to estimate number of wetlands. Wildlife Soc. Bull. 27:187-194.

Kaminski, R. M. and H. H. Prince. 1984. Dabbling duck habitat associations during spring in Delta Marsh, Manitoba. J. Wildl. Manage. 48:37-50.

Kantrud, H. A. 1986. Effects of vegetation manipulation on breeding waterfowl in prairie wetlands—a literature review. U.S. Fish Wildl. Serv., Washington, DC, USA. Tech. Report 3.

Kantrud, H. A., G. L. Krapu and G. A. Swanson. 1989. Prairie basin wetlands of the Dakotas: A community profile. U.S. Fish Wildl. Serv., Washington, DC, USA. Biological Report 85.

Linz, G. M., D. L. Bergman, D. C. Blixt and C. McMurl. 1997. Response of American Coots and Soras to herbicide-induced vegetation changes in wetlands. J. Field Ornithology 68:450-457.

Linz, G. M. and D. C. Blixt. 1997. Black terns benefit from cattail management in the Northern Great Plains. Colonial Waterbirds 20:617-621.

Linz, G. M. and J. J. Hanzel. 1997. Birds and sunflower, pp. 381-394. *In:* A. A. Schneiter (ed.). Sunflower Technology and Production, Agronomy Monograph No. 35. American Soc. Agronomy, Inc., Madison, WI.

Solberg, K. L. and K. F. Higgins. 1993. Effects of glyphosate herbicide on cattail, invertebrates, and waterfowl in South Dakota wetlands. Wildl. Soc. Bull. 21:229-307.

Stewart, R. E. and H. A. Kantrud. 1971. Classification of natural ponds and lakes in the glaciated prairie region. U.S. Fish Wildl. Serv., Washington, DC, USA. Resourc. Publ. 92.

Stewart, R. E. and H. A. Kantrud. 1972. Population estimates of breeding birds in North Dakota. The Auk 89:766-788.

USDI (U.S. Fish and Wildlife Service). 2005. National Wetlands Inventory Metadata. http://www.mass.gov/mgis/nwi_meta.txt http://wetlandsfws.er.usgs.gov/data-uses.html

USDA (U.S. Department of Agriculture). 2006. Management of blackbird species to reduce damage to sunflower, corn and other small grain crops in the Prairie Pothole Region of North Dakota and South Dakota. Monitoring Rep. Amendment Environ. Assess., U.S. Depart. Agric., Animal Plant Health Inspect. Serv., Wildl. Serv. Bismarck, ND. 36 pp.

Waters, I. and J. M. Shay. 1992. Effect of water depth on population parameters of a *Typha glauca* stand. Canadian J. Botany 70:349-351.

Weller, M. W. 1975. Studies of cattail in relation to management for marsh wildlife. Iowa State J. Res. 49:483-412.