Black Terns Benefit from Cattail Management in the Northern Great Plains

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Abstract.—In the northern Great Plains, cattails (*Typha* spp.) have overgrown many wetlands, contributing to a decline in numbers of Black Terns (*Chlidonias niger*). Since 1991, wildlife agencies have applied glyphosate-based herbicide to cattail-dominated wetlands with the objectives of increasing duck (Anatinae) abundance and reducing crop-depredating blackbird (Icterinae) populations. In 1990 and 1991, we aerially applied glyphosate-based herbicide to cattail-dominated wetlands in North Dakota to assess the influence of habitat changes on birds. Numbers of Black Terns and selected ducks species were positively correlated with open water and dead cattails (r_{17} range: 0.77-0.46); whereas, blackbird numbers were positively related with live cattails (r_{17} range: 0.52-0.48). Black Tern numbers were positively related (r_{17} range: 0.76-0.49) to numbers of Mallards (*Anas platyrhynchos*), Blue-winged Teal (*A. discolor*), Redheads (*Aythya americana*), and Yellow-headed Blackbirds (*Xanthocephalus xanthocephalus*), suggesting some common habitat requirements among these species. Cattail management programs designed specifically to enhance duck use and decrease Red-winged Blackbird (*Agelaius phoeniceus*) numbers probably benefit Black Terns.

Key words.—Anatidae, blackbirds, black tern, cattails, ducks, *Chlidonias niger*, glyphosate, Icterinae, *Typha*, wetlands.

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Cattails (*Typha* spp.) have dispersed across the northern Great Plains in the last 70 years, forming dense monotypic stands that eliminate open water in many semipermanent wetlands (Kantrud 1986). The loss and degradation of wetlands that feature stands of emergent vegetation interspersed with open water probably contributed to a decline of the Black Tern (*Chlidonias niger*) in North Dakota during the 1970s and 1980s (Dunn and Agro 1995, Igl and Johnson 1997). Wetlands, managed to provide an interspersion of open water, live emergent vegetation and floating mats of dead vegetation, are ideal for Black Terns because of increased availability of invertebrates (Murkin *et al.* 1982, Overland 1994) and nest sites (Linz *et al.* 1994).

Since 1991, wildlife agencies in North Dakota and South Dakota have aerially-applied glyphosate-based herbicide to 9,800 ha of cattail-dominated wetlands (Bergman *et al.* In press). Their primary objectives are to increase duck (Anatinae) numbers (Solberg and Higgins 1993, Linz *et al.* 1996a) and reduce crop depredating blackbird (Icterinae) populations (Linz *et al.* 1995, Bergman *et al.* In press). Data documenting the effects of herbicide applications on local populations of Black Terns (Linz *et al.* 1994), ducks (Solberg and Higgins 1993, Linz *et al.* 1996a), and blackbirds (Linz *et al.* 1996b) have been published. Nevertheless, these data have not been integrated and generalized for use by wetland managers charged with planning systematic wetland habitat manipulations.

In this paper, we (1) examine the relationship between various wetland parameters and numbers of Black Terns, seven species of ducks, and two species of blackbirds and (2) describe the relationship between Black Tern abundance and numbers of ducks and blackbirds. Further, we discuss the cost of applying glyphosate-based herbicide and suggest approaches for managing wetland vegetation to meet multiple management objectives.

STUDY AREA AND METHODS

The study area and methods were described by Linz *et al.* (1996a). The study area was near Lakota, North Dakota (48°03'N, 98°21'W) in northeastern North Dakota.

In 1990 and 1991, we randomly designated a pool of 24 cattail-dominated wetlands, as either reference or treated at 50%, 70% or 90% spray coverages with aerially-applied glyphosate (N-phosphonomethyl-glycine), formulated under the tradename RODEO® (Monsanto Company, St. Louis, Missouri). RODEO® is a nonselective, nonresidual, postemergence aquatic herbicide registered in the United States by the Environmental Protection Agency (EPA Reg. No. 524-343) but unregistered in Canada.

Once applied to the foliage, glyphosate is translocated throughout the plant and inhibits protein synthesis by blocking the shikimic acid pathway (Cole 1985), a metabolic pathway missing in animals. Therefore, glyphosate is considered practically nontoxic to aquatic invertebrates, fish (Folmar *et al.* 1979, Buhl and Faerber 1989, Henry *et al.* 1994), algae, and submerged macrophytes (Maule and Wright 1984, Ware 1989). Glyphosate loses its phytoxicity on contact with water and dissipates rapidly by (1) adhering to suspended soil particles and bottom sediment, (2) microbial degradation, and (3) photolysis (Bronstad and Friestad 1985). Glyphosate does not bioaccumulate in fish, but applications in lentic waters where low levels of dissolved oxygen or high temperatures exist could be hazardous to fish fry (Folmar *et al.* 1979).

Wetland area and coverages of open water, live cattails, and dead cattails were determined from color infrared aerial photographs using geospatial processing software (MicroImages, Inc., Lincoln, NE). The wetlands were treated in July at a rate of 5.8 l/ha of glyphosate mixed in an aqueous solution containing surfactant, drift retardant, and water (Linz *et al.* 1994). A fixed-wing spray plane was used to apply 15-m wide parallel strips of herbicide along the long axis of the wetlands. To achieve the 50%, 70%, and 90% treatment levels, the pilot skipped about 15 m, 6 m, or 2 m strips of vegetation, respectively (Linz *et al.* 1996a).

During 2-18 June 1991-1993 wetlands were visited in random order between local sunrise and 5-hr post-sunrise by 2 experienced observers. We established 8 count locations at uniform intervals around the perimeter of each wetland (Linz *et al.* 1996a). The observers recorded any Black Terns, ducks, and blackbirds seen while walking to the count locations. At each count station, we recorded all birds seen or heard in the wetland or leaving the wetland during the next 6 minutes. Censuses were not conducted in steady rain or if the wind velocity exceeded 24 km/hr.

We used Spearman rank correlation analysis (Cody and Smith 1991) to assess the relationship among mean numbers of Black Terns, Northern Shovelers (*Anas discolor*), Gadwalls, (*A. strepera*), Blue-winged Teal (*A. discolor*), Northern Pintails (*A. acuta*), Mallards (*A. platyrhynchos*), Redheads (*Aythya americana*), Ruddy Ducks (*Oxyura jamaicensis*), Red-winged Blackbirds (*Agelaius phoeniceus*), and Yellow-headed Blackbirds (*Xanthocephalus xanthocephalus*) observed in each wetland during the 2 posttreatment years and coverages of open water, live cattails, and dead cattails. Additionally, we investigated the relationship among numbers of Black Terns, ducks, and blackbirds using Spearman rank correlation analysis. Five wetlands featuring >25% open water before treatment and 2 wetlands that were dry were not included in the data set (Linz *et al.* 1996a). We set the significance level at 0.1 (*a priori*) because resources were not sufficient to increase sample sizes, and the consequence of accepting false null hypotheses (Type II error) on populations of wetland-dwelling birds was much greater than if Type I errors (rejecting a true null hypothesis) were made (Tacha *et al.* 1982, Linz *et al.* 1996b, Steidl *et al.* 1997).

RESULTS

The median percent coverages of open water, dead cattails, and live cattails in the 17 test wetlands were 26.5% (range: 5.5-45.5%), 35% (range: 12.1-58.0%) and 40.0% (range: 9.5-82.5%), respectively. Median areal coverages of these attributes were 1.4 ha (range: 0.2-14.1 ha) open water, 2.1 ha (range: 0.7-27.7 ha) dead cattails, and 2.2 ha (range: 1.1-15.1 ha) live cattails.

Black Tern numbers were positively correlated with areal coverage of open water (r_{17} = 0.46, P = 0.06) and dead cattails (r_{17} = 0.47, P = 0.06) (Table 1). Yellow-headed Blackbirds and Red-winged Blackbird numbers were positively related to coverage (r_{17} = 0.48, P = 0.05) and percentage (r_{17} = 0.52, P = 0.03) of live cattails, respectively. Numbers of all 7 duck species were positively related to both coverage and percentage of open water (r_{17} range: -0.68-0.42, P range: <0.001-0.09). Mallards, Blue-winged Teal, Northern Shovelers, Northern Pintails, and Redheads, were positively correlated with areal coverage of dead cattails (r_{17} range: 0.77-0.56, P range: <0.001-0.02); whereas, Blue-winged Teal, Northern Shovelers, and Northern Pintails were positively correlated with percentage of dead cattails (r_{17} range: 0.59-0.48, P range: 0.01-0.05). Finally, Black Terns numbers were positively related (r_{17} range: 0.76-0.49, P range: <0.001-0.04) to numbers of Mallards, Blue-winged Teal, Redheads, and Yellow-headed Blackbirds (Table 2).

DISCUSSION

Our data suggest that Black Terns and ducks share similar habitat requirements, at least on a macro-scale. These requirements include the availability of open water and mats of dead cattails, which enhance wetland productivity (Voights 1976, Overland 1994) and provide nest substrate (Arnold *et al.* 1993, Dunn and Agro 1995, Maxson and Riggs 1996). For maximum diversity, areas of

Table 1. Spearman rank correlations (r) describing the relationship between the number of birds found in 17 wetlands during June in northeastern North Dakota 1 and 2 years posttreatment (averaged) and coverages of 3 wetland habitat variables. Wetlands were aerially sprayed with glyphosate-based herbicide in July 1990 and 1991.

	Habitat Variable					
	Open Water		Live Cattails		Dead Cattails	
Species	Percentage	Number of hectares	Percentage	Number of hectares	Percentage	Number of hectares
Black Tern	0.24	0.46*	-0.28	0.30	0.09	0.47*
Mallard	0.57*	0.71*	-0.53*	0.23	0.28	0.77*
Blue-winged Teal	0.66*	0.78*	-0.68*	0.01	0.48*	0.72*
Northern Shoveler	0.51*	0.68*	-0.66*	-0.14	0.50*	0.58*
Gadwall	0.47*	0.46*	-0.42*	-0.03	0.27	0.33
Northern Pintail	0.55*	0.72*	-0.66*	-0.02	0.59*	0.71*
Redhead	0.51*	0.62*	-0.47*	0.11	0.22	0.56*
Ruddy Duck	0.59*	0.59*	-0.53*	-0.19	0.34	0.40
Yellow-headed Blackbird	-0.06	0.25	0.001	0.48*	-0.20	0.24
Red-winged Blackbird	-0.23	-0.28	0.52*	0.40	-0.62*	-0.19

*Statistically significant ($P \leq 0.10$).

live cattails are also needed as nest substrate for blackbirds and other birds (Linz *et al.* 1996b), protection against waves and predators, and concealment for the young (Cuthbert 1954). Breeding Red-winged Blackbirds, which nest on the wetland perimeter in the northern Great Plains, were negatively influenced by cattail reduction (Linz *et al.* 1996b). However, these birds are likely to maintain their population by nesting in other less desirable wetlands and uplands (Igl and Johnson 1997). Our data supports the contention of others that wetlands with a good interspersion of open water and emergent vegetation is a critical first-step towards increasing duck (Weller and Spatcher 1965, Murkin *et al.* 1982) and Black Tern (Dunn and Agro 1995) numbers.

The habitat analysis suggested that Yellow-headed Blackbirds and Black Terns do not share similar habitat requirements. However, their population numbers were positively related, showing that these birds do share wetlands with similar habitat features. Open water and availability of suitable nest substrate are attractive habitat features for nesting Black Terns (Linz *et al.* 1994); whereas, Yellow-headed Blackbirds seek only intact emergent vegetation for nesting with surface water under the nest (Linz *et al.* 1996b). We speculate that their common habitat requirement may be related to depth of water in the wetland, a parameter we did not measure.

Table 2. Spearman rank correlations (r) describing the relationship between median numbers of Black Terns and selected species of ducks and blackbirds 1 and 2 years posttreatment (averaged) in 17 wetlands in northeastern North Dakota. Treated wetlands were aerially sprayed with glyphosate-based herbicide in July 1990 and 1991.

Species	Median	Range	r	P
Black Tern	3.0	0.0 - 35.5	—	—
Mallard	3.0	0.5 - 16.0	0.58	0.01
Blue-winged Teal	5.5	0.0 - 30.0	0.49	0.04
Northern Shoveler	1.5	0.0 - 9.5	0.28	0.27
Gadwall	2.5	0.0 - 10.5	0.14	0.60
Northern Pintail	1.0	0.0 - 5.5	0.33	0.19
Redhead	3.0	0.0 - 15.0	0.76	<0.001
Ruddy Duck	1.0	1.0 - 14.4	0.36	0.15
Yellow-headed Blackbird	15.0	1.5 - 53.5	0.75	<0.001
Red-winged Blackbird	5.0	0.5 - 38.0	0.05	0.85

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