NORTH DAKOTA GAME AND FISH DEPARTMENT

Final Report

Demographic Performance of Prairie-nesting Shorebirds and Raptors in North Dakota

Project T-8-1

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Demographic Performance of Prairie-nesting Shorebirds and Raptors In North Dakota: Developing Management Tools for Successful Conservation
2006 Final Report

Demographic Performance of Prairie-nesting Shorebirds and Raptors in North Dakota
Final Report for State Wildlife Grant
Year 3 of 3

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Project Summary: Several shorebird species have been identified as Level I priority conservation concerns along with grassland nesting raptors in the Level II priority under the North Dakota Comprehensive Wildlife Conservation Strategy. Unfortunately, little information exists to guide management efforts aimed at maintaining healthy populations of these priority species. As a result, this research was designed to obtain information about how habitat and landscape factors influence reproductive success for shorebirds and raptors in North Dakota. Beginning in 2000, we have collected data on nest survival of willets, marbled godwits, upland sandpipers, Wilson's Phalaropes, Northern Harriers and Short-eared owls. This data was used to develop models of nesting success based on habitat and landscape characteristics. These models were then translated into Geographic Information Systems to develop targeting maps of areas where conservation work will have the greatest impact on population persistence for shorebirds and raptors.

Need:

Successful management strategies for breeding birds must address three key information needs: (1) the distribution and density of the population, (2) the demography of the population across their distribution, and 3) the condition of landscapes that influence both density and demography. Prairie-breeding shorebirds (i.e., Marbled Godwit{*Limosa fedoa*}, Willet{*Catoptrophorus semipalmatus*}, Upland Sandpiper {*Bartramia longicauda*}, and Wilson's Phalarope {*Phalaropus tricolor*}) and raptors (i.e., Northern Harrier {*Circus cyaneus*}and Short-eared Owl {*Asio flammeus*}) are no exception and have been identified as species of concern yet all three critical components for these species are currently inadequately addressed. Almost no information is available beyond general habitat preferences for these species. Thus, for example, although all 4 species of shorebirds require wetlands for foraging and grassland for nesting, the reproductive success of breeding birds is likely affected by many important habitat and landscape factors that have yet to be identified.

From a population perspective, areas where birds breed can be effectively categorized based on how the rate of reproductive success will affect growth of the population. Source populations are those that achieve high reproductive

success and produce more young than is necessary to replace adults lost to mortality. Stable populations are those that are just replacing the adults lost via recruitment of young and sink populations are those that have low reproductive success and do not produce enough young to replace adults lost from mortality sources. Obviously if managers are to be successful in maintaining healthy populations, they need information on the habitat and landscape features that affect reproductive success to ensure a sufficient number of stable and source populations are maintained.

Efforts are underway to survey shorebirds and develop models of shorebird density (Neil Niemuth, personal communication), which will help address information need (1); distribution and density. However, it is well documented that information on only the density of breeding birds can be misleading (Van Horne 1983, Pulliam and Danielson 1991). For example, in many instances sites that have the highest densities of breeding birds may actually be operating as sink populations because they have low reproductive success (Remes 2003). Thus, models that identify the key habitat and landscape characteristics are critical to achieve success with management programs.

Ultimately, identification and protection of sites that are functioning as population sources is paramount to maintaining populations. However, the prairie ecosystems are characterized by extremes in environmental conditions. Nest survival rates for many ground-nesting birds in the prairies fluctuate substantially from year to year in response to the variable environmental conditions. As a result, models developed using nest survival data from multiple years provide the most reliable information and thus, have the greatest utility. Additionally, such models have great utility for management by providing prescriptions for what to alter through management to convert population sink areas into population sources. Thus, although efforts to protect grassland and wetland complexes will be successful in capturing some of the important population source areas, they will undoubtedly be far less efficient at capturing the most critical areas for shorebird and raptor populations than management strategies that utilize models such as those we propose to develop. The management tools we propose to produce with funding from the State Wildlife Grants Program will facilitate the most efficient use of limited resources for maintaining healthy populations of shorebirds and raptors in North Dakota.

Objectives:

1. Locate and monitor nests for prairie-nesting shorebird and raptor species of concern across a gradient of landscapes and habitat types.

2. Develop statistical models using field data on nest survival rates to identify the important landscape and habitat factors that influence nesting-success rates for prairie-breeding shorebirds and raptors and identify management prescriptions based on the results.

3. Based on the important factors identified in the statistical models, develop GIS models of predicted nesting success rates for shorebirds and raptors across the Missouri Coteau region of North Dakota and provide priorities for management activities.

Study Area:

This work was conducted across the Missouri Coteau region of North Dakota (Figure 1). Landscapes within the Coteau vary from large tracts of native grassland devoted to cattle production to extensive areas of cropland. This makes the Coteau an ideal area for identifying the important habitat and landscape features that influence nest survival of shorebirds and raptors.

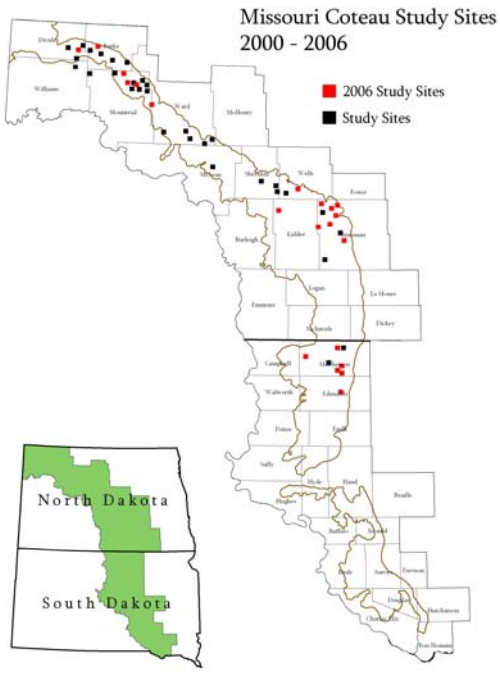

Figure 1. Locations of the 50, four-square-mile study sites in North and South Dakota used to investigate nest survival of shorebirds and raptors during 2000-2006.

2006 Results—Shorebirds

We began searching for nests in early-May. In both crew areas, shallow water in seasonal wetlands was scarce early in the year and wetland conditions overall were poor, which resulted in reduced nesting effort for waterfowl and shorebirds during the early part of the nesting season. However, some rains in May and June provided some much needed water and improved habitat conditions from there forward. The number of nests that we found in 2006 was comparable to other years (Table 1). Across all years and sites, fate was determined for 645 nests: of these, 330 hatched and 315 failed. Of the failed nests, 291 were destroyed by unidentified predators, 22 were abandoned, and 2 did not hatch because of non-viable eggs.

Table 1. Sample Sizes of Shorebird Nests 2000-2006

Year	MAGO	UPSA	WILL	WIPH	Total
2000	4	59	21	13	97
2001	5	60	20	16	101
2002	2	18	19	15	54
2003	3	77	18	34	132
2004	0	38	11	16	65
2005	0	53	22	38	113
2006	7	80	14	26	127
Total	21	385	125	158	689

Although this sample of shorebird and raptor nests is one of the largest ever assembled, the data set is still not sufficient to completely understand nest survival of shorebirds and raptors. These data are the best available, however, and we plan to continue to refine and validate the models developed here with data from additional years.

Modeling Methods and Results

We considered models that included a diversity of habitat and landscape scale factors to identify those that correlated best with nest survival of shorebird and raptor species. Shorebirds and raptors were modeled separately but the landscape and habitat factors considered were the same. In our models, we considered the individual species, the habitat type the nest was contained in, a Robel reading taken at the nest site which characterized the height/density of vegetation at the nest site, and landscape characteristics that included the amount of grassland, amount of edge between grassland and cropland, the total length of roads, the number of wetland basins, and the area encompassed by the wetland basins. The landscape factors considered were measured at 4-mi^2

scales. Once we have updated landcover information, we plan to further explore landscape-level variables at multiple spatial scales.

We constructed a small set of *a priori* models that described multiple hypotheses about landscape and habitat factors that would be related to nest survival of shorebirds and raptors. Based on those results, we then considered a limited set of exploratory models where we added the influence of species, year, and considered different spatial scales for the variables that were included in the best models.

Table 2. Best approximating models of shorebird nest survival 2000-2006 in the Missouri Coteau region.

Variables							K	AICc	AICc	Wi
Year							7	1620	18	0.000
Year	Species						10	1602	0	0.731
Year	Species	Habitat					14	1625	23	0.000
Year	**Species**		**Percent Grass**	**Crop Edge**	**Road Length**	**Wetland Area**	**18**	**1604**	**2**	**0.269**

The best model with habitat variables for shorebirds contained the variables Year, Species, Percent Grassland 4-mi^2 scale, Cropland Edge 4-mi^2 scale, Total Road Length 4-mi^2 scale and Wetland Area 4-mi^2 scale (Table 2). This model was substantially better than the habitat type only model. Willets had the highest nesting success followed by Marbled Godwits, Upland Sandpipers, and Wilson's Phalaropes (Table 3).

Table 3. Nest survival probability of shorebirds 2000-2006 in the Missouri Coteau region.

Species	Nest Survival Probability	Standard Error
UPSA	0.349	0.038
MAGO	0.388	0.118
WILL	0.468	0.056
WIPH	0.181	0.035

Relationships between some of the important habitat variables and shorebird nest survival are shown in Figures 2-3. Landscapes that yielded the highest reproductive success for shorebirds were those with high amounts of grassland (Fig 2), low levels of edge between cropland and grassland (Fig. 3), high road length and a large amount of wetland area. The amount of grassland

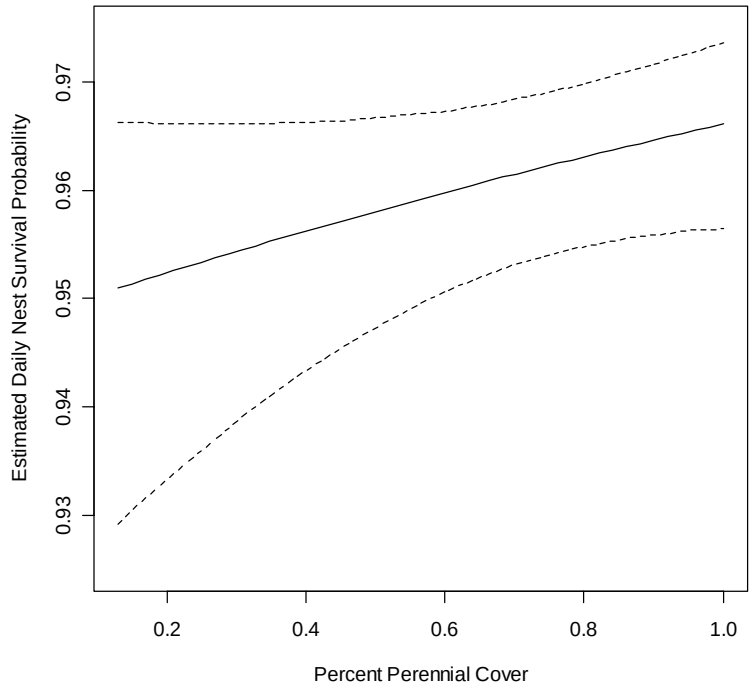

Figure 2. Estimated relationship between daily nest survival for shorebirds and percent grassland measured at a 4-mi^2 scale.

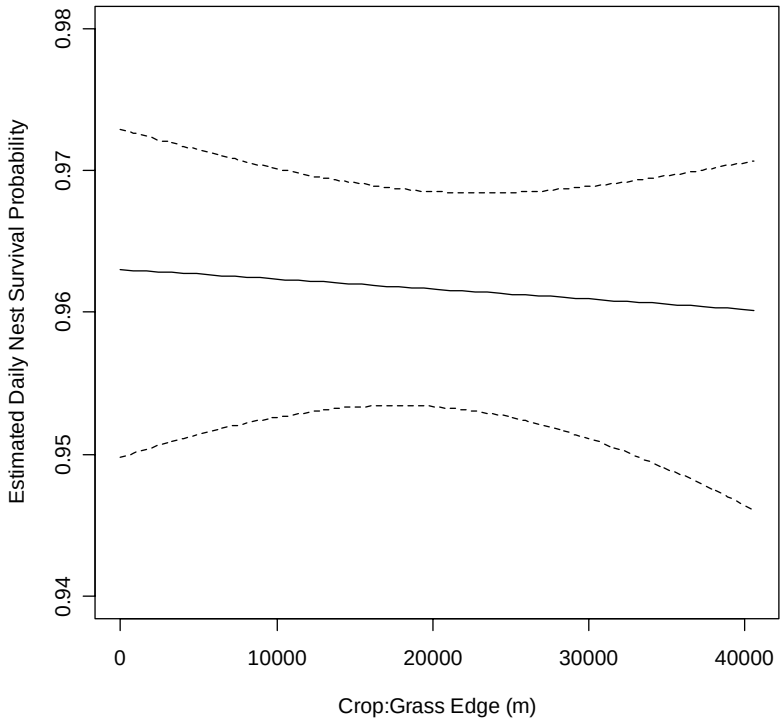

Figure 3. Estimated relationship between daily nest survival for shorebirds and the edge between cropland and grassland measured at a 4-mi^2 scale.

Is probably related to the composition of the predator community; higher grassland landscapes are probably dominated by predators such as coyotes and badgers that have larger home ranges. Therefore, nest survival is higher in these landscapes than in landscapes with lower levels of grassland, because low-grass landscapes probably have predator communities composed of smaller-bodied nest predators with smaller home ranges (like fox, skunks and raccoons). Edge between cropland and grassland might relate to the foraging efficiency of the predator species present with nests being easier to discover in more fragmented landscapes with high amounts of edge. The positive relationship between road length and nest survival is opposite our prediction. We currently think that road length might be capturing variation is some other important unidentified variable. More investigation of this variable is warranted to understand what is driving this relationship. We also observed a positive relationship between wetland area and nest survival. A possible explanation for this relationship is that landscapes with high wetland area also attract high nesting densities of other wetland-dependent birds, such as ducks, which could buffer predation impacts on nesting shorebirds. Perhaps there are advantages for shorebirds nesting in areas of high waterfowl nesting densities which would have important conservation implications for protection efforts designed for both avian guilds. Across the Coteau region, the areas with high predicted nest survival for shorebirds are shown in green in Figure 4. Ideally, this information should be combined with models of shorebird density to produce more refined conservation targeting tools of the most critical areas for shorebird conservation efforts to be focused.

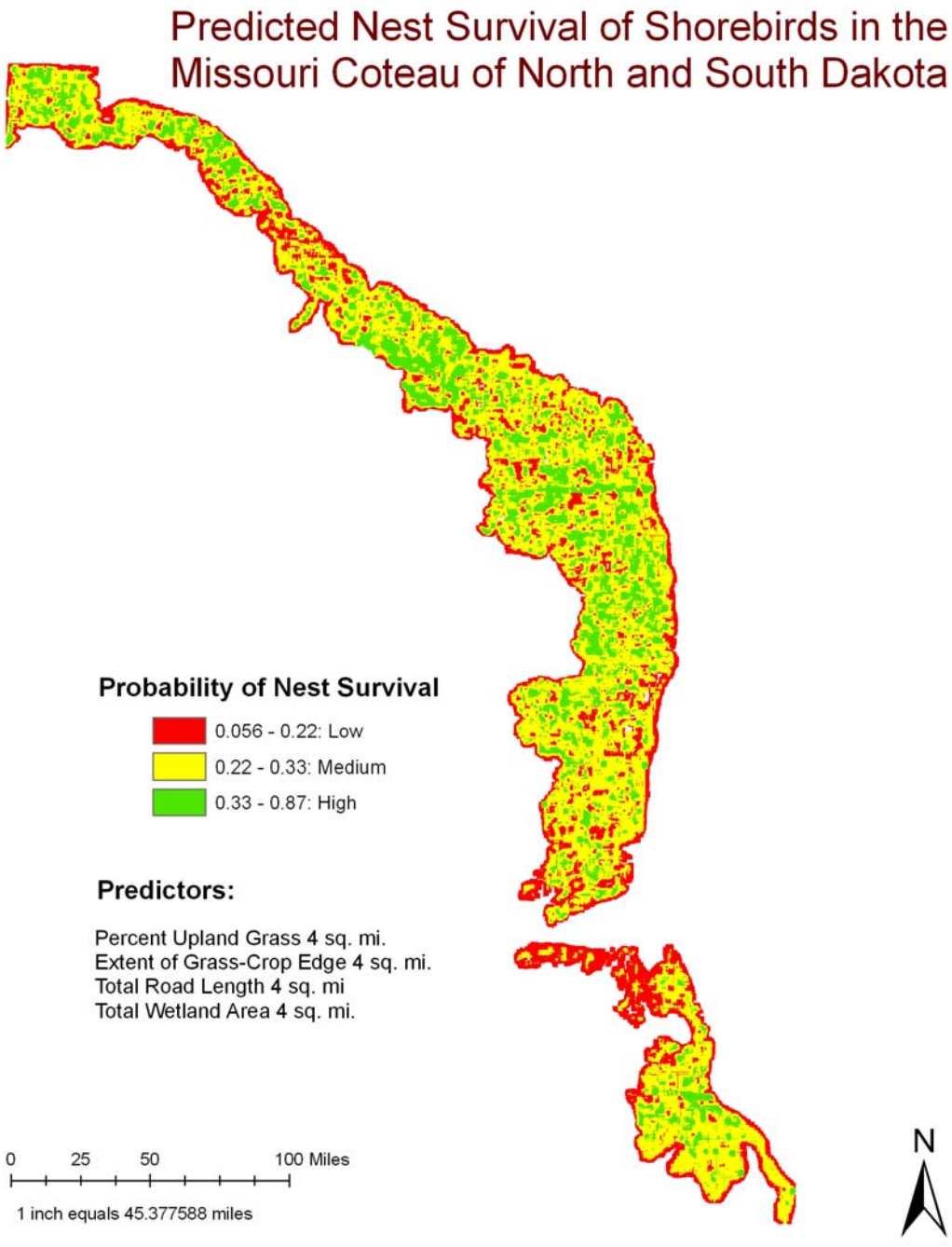

Figure 4. Predicted shorebird nest survival across the Missouri Coteau region based on the best approximating model.

Results—Raptors

We located and monitor 229 raptor nests from 2000 – 2006 (Table 4). Across years and sites, fate was determined for 210 nests: of these, 117 hatched and 93 failed. Of the failed nests, 68 were destroyed by unidentified predators, and 25 were abandoned.

Table 4. Sample Sizes of Raptor Nests 2000-2006.

Year	NOHA	SEOW	Total
2000	30	16	46
2001	20	0	20
2002	8	1	9
2003	29	1	30
2004	39	16	55
2005	25	7	32
2006	37	0	37
Total	188	41	229

The best model for raptors contained the variables Habitat Type, Nest Robel and Wetland Area 4-mi^2 scale (Table 5). Northern harriers and short-eared owls had similar nest survival rates which did not warrant consideration of each species separately.

Table 5. Best approximating models of raptor nest survival 2000-2006 in the Missouri Coteau region.

Variables						K	AICc	AICc	Wi
Habitat						5	574.0	1.1	0.160
Habitat	Nest Robel					6	575.6	2.7	0.072
Habitat	Nest Robel	Date				7	573.6	0.7	0.195
Habitat	Nest Robel	Date	Crop Edge			8	574.7	1.8	0.112
Habitat	Nest Robel	Date		Percent Grass		8	574.9	2	0.102
Habitat	Nest Robel	Date			Road Length	8	575.3	2.4	0.083
Habitat	**Nest Robel**	**Date**			**Wetland Area**	**8**	**572.9**	**0**	**0.277**

Habitat type was related to nest survival rates for raptors. Nest survival varied among habitats (Table 6). Of the two habitat types where most of the nests occurred, nest survival was higher in native grassland than in planted cover such as CRP fields. Nest survival of the few nests that occurred in hayland was very low. The highest nest survival occurred in dry wetlands or wetland fringe but only a small proportion of the nests were located in this habitat type.

Table 6. Variation in nest survival of raptors among habitat types in the Missouri Coteau 2000-2005.

Habitat	Nest Survival Probability	Standard Error
Planted Cover	0.308	0.134
Native Grass	0.318	0.150
Hayland	0.022	0.059
Wetland	0.455	0.187
Other	0.670	0.333

The relationships between the important landscape variable and raptor nest survival is shown in Figure 5. Landscapes that yield the highest reproductive success for raptors will be those with large amount of wetland area (Fig. 5) and native grassland and wetland nesting habitat that have dense grassland cover. We observed a positive relationship between wetland area and nest survival for raptors. One possible explanation for this is that areas with high wetland area also attracting high nesting densities of other wetland dependent birds, such as ducks, which may buffer predation impacts on raptors. Thus, perhaps there are advantages for raptors nesting in areas of high waterfowl nesting densities which would have important conservation implications for protection efforts designed for both avian guilds. Ideally, this information should be combined with models of raptor density to produce more refined conservation targeting tools of the most critical areas for raptor conservation efforts to be focused.

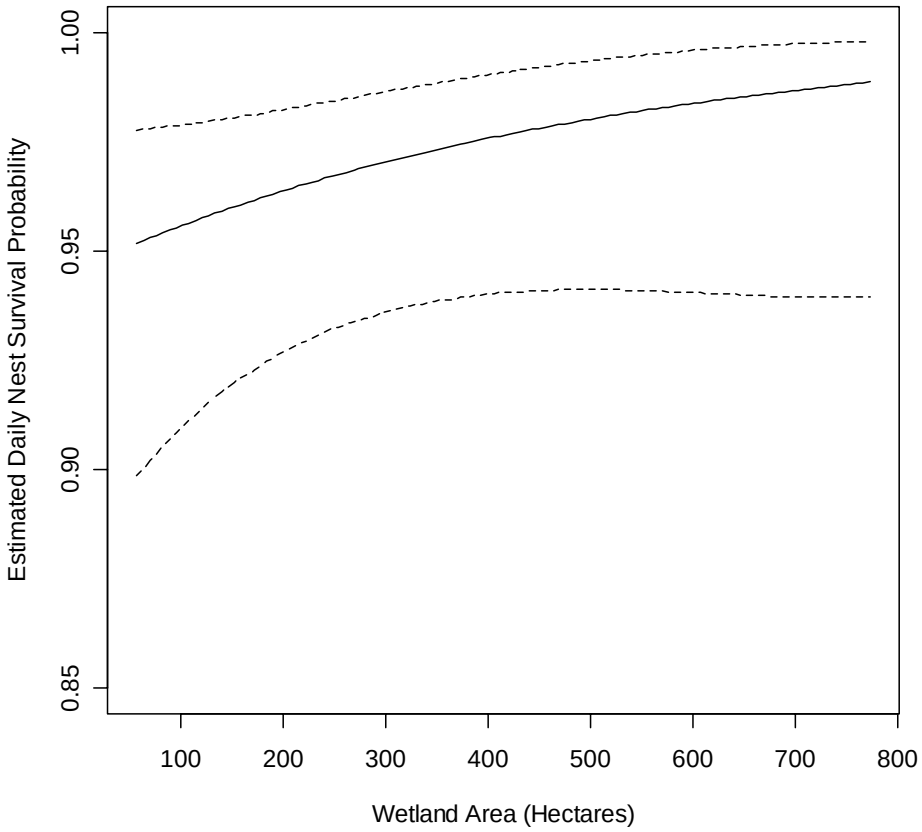

Figure 5. Estimated relationship between daily nest survival for raptors and the wetland area measured at a 4-mi^2 scale.

Key sources of mortality: For both shorebirds and raptors, nearly all of the nest loss could be attributed to predation. However, identification of the species of predator responsible is challenging and could not be rigorously done with the data we had. Nevertheless, predation is the primary cause of nest loss for both shorebirds and raptors. Based on our modeling results, landscapes with large blocks of intact grassland and with large areas of wetlands seem to mitigate predation effects on the shorebird and grassland habitats are important for raptor species that we studied.

Threats to Shorebird and Raptor Populations: Based on our modeling of reproductive success it seems clear that both shorebirds and raptors achieve highest reproductive success in landscapes with abundant grassland and abundant wetlands. However, ongoing grassland loss via conversion of native grassland to agriculture and potential loss of millions of CRP acres suggests that shorebird and raptor populations may decline if these trends continue. Additionally, when the grassland is lost, the wetlands also become at much higher risk of being drained or detrimentally altered because they are a liability to crop production instead of an asset to the rancher when in grassland based agriculture.

Management Implications: Our modeling effort identified some important factors that correlate with nesting success for both shorebirds and raptors nesting in the Missouri Coteau of North Dakota. Some common themes have continued to emerge for all the grassland nesting species of birds where nesting success has been studied to date (i.e., ducks, shorebirds, raptors). Reproductive success is highest where complexes of high density wetlands and large blocks of intact grasslands exist. This is not too surprising given the fact that these are exactly the habitat conditions in which all these species evolved. Thus, protection of intact grassland/wetland landscapes seems like the best strategy to safeguard healthy populations of raptors and shorebirds in North Dakota. We believe the GIS planning tools developed here provide a starting point for identifying those areas most important to shorebirds and raptors.

Future plans: Although our models currently provide useful guidance for managing shorebirds and raptors, reducing the uncertainty in our models will be important. For example, the conflicting relationships between nest survival and road length for raptors and shorebirds should be investigated further. This modeling effort is the first in which we included the variable road length. However, the other landscape variables identified in these models have been identified previously in models of nest survival of ground-nesting ducks, shorebirds and raptors. Validation and refinement of the current models will be important to ensure that we have rigorous scientific information on which to base decisions. We plan to develop a manuscript based on this research during the winter/spring 2007/2008 that will be submitted to a peer-reviewed journal.

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