2004

Duck Nesting on Rotational and Continuous Grazed Pastures in North Dakota

Robert K. Murphy
Des Lacs National Wildlife Refuge Complex

Darrell J. Schindler
University of North Dakota

Richard D. Crawford
University of North Dakota

Published in THE PRAIRIE NATURALIST 36(2): June 2004
Published by the North Dakota Natural Science Society.

Duck Nesting on Rotational and Continuous Grazed Pastures in North Dakota

ROBERT K. MURPHY[1], DARRELL J. SCHINDLER[2], and RICHARD D. CRAWFORD

U.S. Fish and Wildlife Service-Des Lacs National Wildlife Refuge Complex,
8315 Highway 8, Kenmare, ND 58746 (RKM)
Department of Biology, University of North Dakota,
Grand Forks, ND 58202 (DJS, RDC)

ABSTRACT -- To improve the economic viability of grazed prairie and thus conserve it as wildlife habitat, the Prairie Pothole Joint Venture (PPJV) cost-shares establishment of rotational cattle grazing on privately owned, native rangeland. During 1996 and 1997 we evaluated duck nest density, nest success, and nesting habitat on six PPJV rotational grazed pastures on the Missouri Coteau landform in central and northwestern North Dakota. Each rotational pasture was paired with a traditional, continuous grazed pasture for comparison. We located 444 nests of eight duck species. We detected no differences ($P > 0.1$) between rotational and continuous grazed pastures in apparent nest density of ducks ($\bar{x} \pm$ SD nests/ha, all species combined, 1996: 0.26 ± 0.09 and 0.31 ± 0.12; 1997: 0.38 ± 0.14 and 0.25 ± 0.12), although a grazing type x year interaction suggested rotational pastures might be more attractive to ducks in a dry spring (1997). No differences in duck nest success were detected between rotational and continuous pastures (% Mayfield estimate, 1996: 27.2 ± 12.6 and 15.5 ± 11.0; 1997: 21.6 ± 10.0 and 16.7 ± 13.7), but varied occurrence of canid species could have obscured differences. We detected no differences in vegetation height-density indices as measured by visual obstruction readings (VORs) between rotational and continuous pastures in 1996. VORs were greater on rotational pastures, however, in the relatively dry spring of 1997. Our findings suggested that rotational grazing systems can serve as a prairie

[1]E-mail address: Bob_Murphy@fws.gov
[2]Current address: Red Lake Department of Natural Resources, P. O. Box 279, Red Lake, MN 56671.

conservation tool on private rangelands without altering habitat values for nesting ducks, and in relatively dry springs might provide more attractive nesting cover for ducks than prairie under continuous grazing.

Key words: Anatidae, habitat conservation, mixed-grass prairie, nesting, North Dakota, Prairie Pothole Region, rangelands, rotational grazing.

Rotational grazing systems can enhance livestock forage production on northern prairies (Sedivec and Barker 1991) and thus might improve the economic viability of privately owned native prairie and avert its conversion to other land uses, especially cultivation. In the Dakotas, specific rotational grazing prescriptions on private lands are promoted through the Prairie Pothole Joint Venture (PPJV) of the North American Waterfowl Management Plan, mainly by cost-sharing of fence and water source development. In return, ranchers follow a specific grazing prescription for 10 years, which includes delayed turnout dates and grazing periods of 2 to 3 weeks in pasture paddocks (i.e., cells). During 1987 to 2002 the PPJV spent more than $750,000 to initiate 140 rotational grazing systems on private lands in North Dakota (Kevin Willis, U.S. Fish and Wildlife Service, Bismarck, North Dakota, personal communication). However, there are no published reports of the abundance and productivity of nesting ducks on these pastures. Ignatiuk and Duncan (2001) recently reported on duck nesting on rest- or deferred-rotational grazing systems in Saskatchewan. Sedivec et al. (1990) studied gamebird nesting on a twice-over rotational grazing system at a university experiment station in south central North Dakota. The goal of our study was to sample duck nesting on representative PPJV grazing systems, and on nearby prairie tracts under traditional, continuous (i.e., season-long) grazing that resembled grazing approaches replaced by the rotational systems. We questioned whether rotational grazing by cattle (*Bos taurus*) could be implemented on privately owned rangelands without altering the quality or availability of nesting habitat for ducks. Specific objectives were (1) to compare nest density and nest success of upland nesting ducks between rotational and continuous grazed pastures, and (2) to assess vegetative cover availability and its use by upland nesting ducks on the two grazing regimes.

STUDY AREA AND METHODS

We studied duck nesting on PPJV grazing systems on the Missouri Coteau landform, a hilly moraine consisting of gravely clay soils interspersed with numerous wetlands (Bluemle 1991). Three study sites were located in each of Stutsman and Mountrail counties, in central and northwestern North Dakota (47°10' N, 99°20' W and 48°20' N, 102°20' W). Pastures were northern mixed-grass prairie (*Stipa-Agropyron* association invaded by Kentucky bluegrass [*Poa pratensis*] and with scattered low brush, mainly western snowberry [*Symphoricarpos occidentalis*]). Climate was continental, with a short (110-day) growing season. Annual precipitation during the first year of our study (1996) was above long-term averages of 45 and 38 cm for Stutsman and Mountrail counties, but spring precipitation the second year (1997) was below normal, especially in Mountrail County (National Oceanic and Atmospheric Administration 1997).

We selected PPJV rotational grazing systems that had been in place for at least 4 years. We studied five rotational pastures in 1996. We studied the same five pastures again in 1997 plus added a sixth (size range of pastures, 260 to 520 ha). Twice-over rotations were used, with 14- to 21-day grazing periods and 45 to 60 days of rest between grazing periods, as described by Sedivec and Barker (1991); however, one pasture was grazed once-over in 1997. Stocking rates ranged from 1.2 to 2.2 Animal Unit Months/ha, based on standard guidelines (U.S. Soil Conservation Service 1975). The grazing season began in early June and ended in October. Prior to PPJV cost-share agreements, rotational pastures had been under continuous grazing without restrictions on turnout dates or stocking rates. Therefore, every rotational grazed pasture was paired with a nearby (5 to 10 km away), continuous grazed pasture (130 to 324 ha) with roughly similar range site makeup, wetland composition, and surrounding land use (i.e., idle and annually grazed native prairie, dryland cropland annually tilled for small grains, and tame grass-legume plantings on hayland and Conservation Reserve Program lands). Each continuous pasture was grazed annually for an average of about 3 months (range, 2 to 6 months) at the landowner's discretion. Stocking rates were similar to those on rotational pastures. Turnout dates for continuous pastures ranged from early May to early June.

We sampled duck nesting on randomly selected, 16-ha plots, one from each paddock of each rotational pasture (total, four to eight plots/pasture) and four (total) from each continuous pasture. We systematically searched plots for nests of upland nesting ducks by pulling a 30-m long chain between two all-terrain vehicles (Klett et al. 1986). Two-person teams searched for nests during 0700 to 1400 hrs CST. Each plot was searched three times during the nesting season: early May, late May to early June, and late June to early July. Nests were marked in the field by placing a 1-m tall fiberglass stake 4 m north. We revisited nests at 10-day intervals until they were successful (at least one egg hatched), destroyed, or abandoned. Nesting data were recorded and analyzed according to Klett et al. (1986).

We obtained visual obstruction readings (VORs) as an index of vegetation height and density at each nest by using a pole read in 0.25-dm increments for the first dm and 0.5-dm increments otherwise (Robel et al. 1970). VORs were placed into four classes (0.0-0.49, 0.5-0.99, 1.0-1.49, and $\geq$ 1.5 dm). Use of these classes by each common nesting species of duck was compared to availability, which was based on VORs recorded along a transect across each plot during late April to early May and again during early June, as per Kruse and Bowen (1996). Transects began at a randomly chosen corner of each plot, with the transect direction oriented through the plot along a random compass bearing. Each transect included 12 VORs spaced about 15 m apart. Thus, a minimum of 48 VORs (12/plot) was collected from each pasture. The second (June) set of VORs was repeated on the same respective transects. VORs from early transects were compared to nest site VORs of early nesting species (mallard [*Anas platyrhynchos*] and northern pintail [*A. acuta*]), while VORs from late transects were compared to nest sites of late-nesting species (blue-winged teal [*A. discors*] and gadwall [*A. strepera*]) as per Kruse and Bowen (1996).

Canid community makeup can influence significantly duck nest success (Sovada et al. 1995) and might confound habitat treatment effects. We conducted systematic track surveys for red fox (*Vulpes vulpes*), coyote (*Canis latrans*), and other mammalian predators during late April, early May, and early June, as an index to predator community makeup. The perimeter of each pasture was divided into 200 x 200-m grids, modified from Sargeant et al. (1993), which were searched on foot. We searched track-holding areas such as wetland edges and cattle wallows and trails, at least 2 days after a rain or frost event to allow time for tracks to be made. Additionally, at the end of every day in the field each crewmember independently recorded the number of places each predator species was observed directly. A place was defined as any 150-m diameter area (Sargeant et al. 1993). This helped uncover species missed by track surveys, such as the Franklin's ground squirrel (*Spermophilus franklinii*). We classified each rotational pasture and each continuous pasture as visited by red fox, coyote, or mixed fox-coyote (Sovada et al. 1995).

Daily survival rates (DSRs) of nests were estimated by using a modified Mayfield method (Johnson 1979). We used Least Square Means ANOVA in PROC GLM (SAS Institute, Inc. 1992), weighted by exposure days, to test for main effects of grazing type (rotational versus continuous grazing), year, canid, and interactions on DSRs. For convenient interpretation, DSRs were converted to percentage nest success by raising DSRs to the power represented by the mean age of clutches at hatching (e.g., 35 days for mallard; Klett et al. 1986). We considered our sample of pastures to be reasonably independent between years, mainly because the species makeup of local predators, especially canids, changed between years on several pastures (Table 1). We also used ANOVA to test effects of grazing type, year, and grazing type by year interaction on nest density. VORs of available cover were compared between grazing regime types with paired t-tests. Differenced were considered significant at $P < 0.1$.

Table 1. Mean nest success of ducks (all species) and canid community class (F = red fox, C = coyote, M = mixed fox and coyote) on rotational and continuous grazed pastures in central and northwestern North Dakota.

	1996						1997					
	Rotational			Continuous			Rotational			Continuous		
Site	Success (%)[a]	n[b]	Canid class	Success (%)	n	Canid class	Success (%)	n	Canid class	Success (%)	n	Canid class
A	20.5	18	M	14.5	21	M	39.3	21	M	9.7	18	F
B	17.7	27	M	3.9	20	F	12.7	49	M	5.2	12	M
C	21.8	22	M	33.4	19	F	14.3	46	M	7.8	14	F
D	48.8	10	C	--[c]	7	F	17.8	12	M	18.2	21	F
E	--	5	C	10.3	12	M	14.3	15	C	--	2	M
F	[d]						31.1	20	C	42.6	20	C
$\bar{x}$	27.2			15.5			21.6			16.7		
SD	12.6			11.0			10.0			13.7		

[a]Mayfield estimator (Johnson 1979).
[b]Number of nests.
[c]Nest success not calculated where n less than 10.
[d]Site F not examined in 1996.

RESULTS

We found 187 nests in 1996 and 257 nests in 1997, representing eight duck species. Blue-winged teal was the most common nesting species on both rotational and continuous pastures (n = 250 nests total), followed by mallard (n = 68), gadwall (n = 42), and northern pintail (n = 35). Less common were northern shoveler (*A. clypeata*; n = 29 nests), American wigeon (*A. americana*; n = 8), green-winged teal (*A. crecca*; n = 6), and lesser scaup (*Aythya affinis*; n = 6).

Apparent density of duck nests (all species) in both rotational and continuous pastures averaged about 0.3 nests/ha between years (Table 2). Due to small sample sizes per species we could test for treatment differences only when nest data for all species were combined. Nest density did not differ between grazing regime types when tested for effects of grazing type ($F = 0.26$, df = 1, 21, $P = 0.62$) or year ($F = 0.31$, df = 1, 21, $P = 0.58$), but a grazing type by year interaction was weakly suggested ($F = 2.96$, df = 1, 21, $P = 0.10$).

Nest success of ducks (all species) averaged about 24% in rotational pastures and 16% in continuous pastures between years (Table 1). Success varied markedly among individual pastures in each grazing treatment category and between years for some individual pastures, possibly due in part to variable occurrence of predator species. Canid species makeup was dissimilar between a given rotational pasture and the continuous pasture it was paired with in most instances (Table 1). We were unable to include canid class in our nest DSR model, as per Sovada et al. (1995), due to insufficient replication of fox-only areas and coyote-only areas. We were, however, able to test for effects of year, grazing type, and interactions. No differences in nest DSR were detected under the reduced model of grazing type by year ($F = 0.001$, df = 1, 21, $P = 0.99$). Also, no differences were detected for grazing type ($F = 0.20$, df = 1, 21, $P = 0.66$) or year ($F = 0.13$, df = 1, 21, $P = 0.72$) when tested separately. Tests for main effects and interactions combined were not significant ($P > 0.1$). Other nest predator species commonly detected were striped skunk (*Mephitis mephitis*), northern raccoon (*Procyon lotor*), and American badger (*Taxidea taxus*).

We detected no differences in VORs between rotational and continuous pastures in 1996. VORs averaged 0.53 ± 0.05 (SD) and 0.50 ± 0.13 for rotational and continuous pastures on early spring transects (paired $t = 0.80$, df = 4, $P = 0.47$), and 1.17 ± 0.41 and 0.69 ± 0.29 on late spring transects ($t = 1.62$, df = 4, $P = 0.18$). In 1997, however, VORs were greater on rotational pastures in early spring ($\bar{x} = 0.50 \pm 0.10$ dm and 0.35 ± 0.13 dm for rotational and continuous pastures, respectively; paired $t = 2.40$, df = 5, $P = 0.06$) and were not greater on rotational pastures in late spring ($\bar{x} = 1.02 \pm 0.30$ and 0.78 ± 0.34; $t = 1.86$, df = 5, $P = 0.12$).

Table 2. Apparent nest density (nests/100 ha) of common duck species and of all duck species on rotational and continuous grazed pastures on privately owned, native mixed-grass prairie in central and northwestern North Dakota.

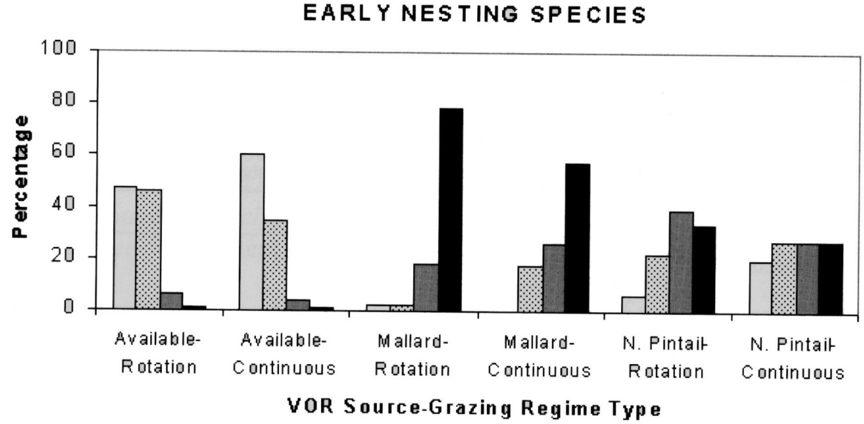
	1996 (n = 5)[a]				1997 (n = 6)			
	Rotational		Continuous		Rotational		Continuous	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Blue-winged teal	17	7	17	7	21	9	13	6
Mallard	2	3	4	2	9	3	3	4
Gadwall	1	1	4	4	4	3	3	1
Northern pintail	2	3	1	1	3	4	3	3
All duck species[b]	26	9	31	12	38	14	25	12

[a]Number of pairs of rotational and continuous grazing systems examined.
[b]Other species included northern shoveler, American wigeon, green-winged teal, and lesser scaup.

Within both rotational and continuous pastures, VORs at nest sites of common duck species differed from availability indicated by transects (Fig. 1). Northern pintail was the only species that occasionally nested in the sparse (< 0.5 dm) cover that was widely available on both rotational and continuous pastures especially in early spring. Most nests of northern pintail and blue-winged teal were in 0.5- to 1.5-dm cover, which comprised roughly one-half of the available cover in early and late spring. In contrast, mallard and gadwall nests were mainly in cover greater than 1.5 dm, which occurred on only 1% of both grazing regime types in early spring and on 20 and 15% of rotational and continuous pastures in late spring (Fig. 1).

DISCUSSION

Our mean annual nest density of ducks (0.3 nests/ha, both grazing regime types) was similar to that previously noted on grazed mixed-grass prairie in central North Dakota (Duebbert et al. 1986). We did not detect differences in nest density between rotational grazed pastures and the continuous grazed pastures with which they were paired, which suggests that rotational grazing and continuous grazing might be equally attractive to nesting ducks in northern mixed-grass prairie. A grazing type by year interaction was suggested, however, whereby ducks seemed more attracted to rotational grazed pastures in 1997 as precipitation declined and as



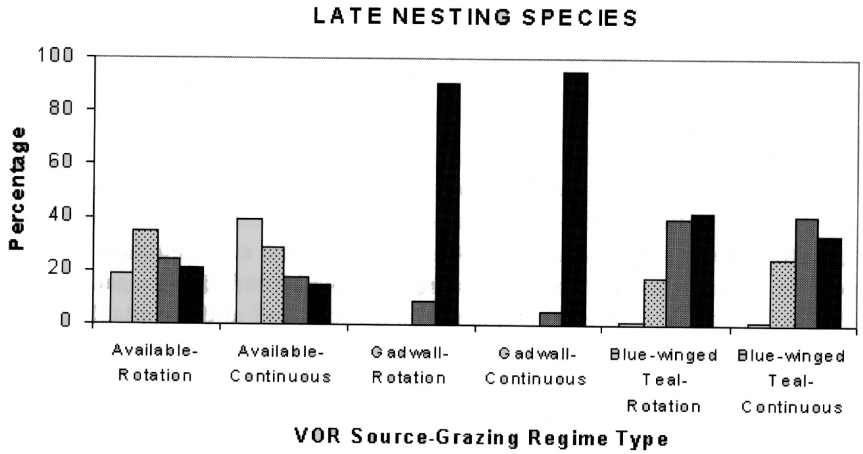


Figure 1. Visual obstruction readings (VORs) as indices of height and density of available vegetation and of vegetation at nest sites of common duck species on PPJV rotational grazed pastures and on nearby, continuous grazed pastures in central and northwestern North Dakota, early and late spring, 1996 and 1997.

VORs increased in rotational pastures compared to continuous pastures. In 1997, passerine abundance and diversity also were greater on rotational pastures than on continuous pastures we studied (Buskness et al. 2001). Perhaps PPJV rotational grazed pastures support greater abundance of nesting grassland birds than continuous pastures during dry years, especially for species that require relatively dense cover such as mallard and bobolink (*Dolichonyx oryzivorus*).

We found no differences in duck nest success between rotational grazed pastures and continuous grazed pastures. However, our statistical power was low due to small sample sizes; we probably could detect a contrast in nest success only if it was quite large (i.e., > 22%). Thus, nest success probably does not differ markedly, if at all, between PPJV rotational grazed pastures and the traditional, continuous grazed pastures they replace. The only other published, replicated comparison of duck nest success between rotational grazing systems and traditional livestock grazing regimes in northern mixed grass prairie is Ignatiuk and Duncan (2001), who also detected no difference in nest success between grazing regime types. Nest success of ducks on rotational grazing systems in our study (24%) approximated that of ducks on deferred-rotational pastures in southern Saskatchewan (20%; Ignatiuk and Duncan 2001). Evaluations of duck nest success can be confounded by the makeup of local predator communities, although this seldom is documented in nesting studies. Sovada et al. (1995) recorded greater duck nest success in areas dominated by coyote than in areas dominated by red fox. Our examination of the influence of grazing system type on duck nest success might have been obscured partly by the inconsistent canid makeup we documented between several rotational pastures and respective, nearby continuous pastures. Striped skunk, northern raccoon, and American badger also were common on most pastures. Regardless, the mean nest success of ducks in rotational grazed pastures in our study exceeded a 15 to 20% minimum necessary for population maintenance (Cowardin et al. 1985).

We detected no differences in VORs between rotational and continuous pastures in 1996, and noted only slight differences in 1997. VORs on rotational pastures were derived from several paddocks, each with a different vegetation structure due to the grazing schedule. Paddocks with abundant residual cover might be more attractive to nesting ducks than paddocks that have been more recently grazed and have limited cover. Increased use of one paddock within a rotational pasture might have been offset by decreased use of another paddock that recently had been grazed and provided less residual cover. However, our goal was to evaluate overall nesting habitat for ducks on rotational grazed pastures and not to assess variability among or within paddocks.

We compared use of classes of VORs among common nesting species. Mallards and gadwalls nested in the tallest, densest vegetation available, which typically was dominated by brush, similar to findings on grazed, burned, and idle prairie in northwestern North Dakota (Kruse and Bowen 1996) and for grazed prairie in central North Dakota (Duebbert et al. 1986). Northern pintail was the only common duck species in our study that occasionally nested in cover less than 0.5 dm, a cover class that comprised about one-half of the available vegetation prior to green-up and 20 to 40% of available cover during the mid-growing season. On both rotational and continuous pastures, northern pintail and blue-winged teal nested in most cover structure types in proportion to their availability.

Our findings suggest that nesting habitat quality for ducks on PPJV rotational grazed pastures probably differs little from that on traditional, continuous grazed pastures. Relatively small differences might exist that could be shown with dozens of replications of treatment and control pairs, but this would be very costly; a better approach might be to change treatments among sites over relatively long time periods (Ignatiuk and Duncan 2001). Most extant native prairie in the U.S. Prairie Pothole Region is owned privately and is being used intensively for livestock grazing (e.g., Higgins et al. 2002). Rotational grazing systems can be used to help conserve these increasingly uncommon habitats especially when other tools such as long-term conservation easements seem unworkable, and in some cases eventually might lead to easements by helping build relationships with landowners (Higgins et al. 2002). Although PPJV rotational systems are only 10-year agreements, improved range condition and livestock carrying capacity afforded by such grazing systems (Sedivec et al. 1990, Sedivec and Barker 1991) likely extend beyond the agreement to enhance the economic viability, stewardship, and appreciation of native prairie resources.

ACKNOWLEDGMENTS

We are indebted to the U.S. Geological Survey-Northern Prairie Wildlife Research Center, especially M. Sovada, for technical advice. The U.S. Fish and Wildlife Service's (FWS) Chase Lake Prairie Project and Des Lacs National Wildlife Refuge Complex provided logistic support, and the FWS-Habitat and Population Evaluation Team supplied equipment and helpful counsel. Ducks Unlimited and the FWS-Wetland Habitat Office also helped facilitate our field study. Funding mainly was from the Prairie Pothole Joint Venture, with help from the North Dakota Game and Fish Department and the College of Natural Resources at the University of Wisconsin-Stevens Point. Our field assistants were H. Duchscherer, N. Finke, B. Klemek, K. MacDonald, and D. Puetz. Landowners M. Bieri, B. Davis, D. Farhart, J. Goettle, J. Hertel, L. Hesch, A. Ostdahl, G. Roise, J. VanRay, R. Wirtz, and R. Zink graciously allowed access to their properties. We thank D. Duncan, K. Higgins, S. Kelsch, R. Seabloom, S. Stephens, and an anonymous reviewer for many helpful comments that improved drafts of the manuscript.

LITERATURE CITED

Bluemle, J. P. 1991. The face of North Dakota. North Dakota Geologic Survey Educational Series Number 21.

Buskness, N. A., R. K. Murphy, K. F. Higgins, and J. Jenks. 2001. Breeding bird abundance and habitat on two livestock grazing regimes in North Dakota. South Dakota Academy of Science 80:247-258.

Cowardin, L. M., D. S. Gilmer, and C. W. Shaiffer. 1985. Mallard recruitment in the agricultural environment of North Dakota. Wildlife Monographs 92:1-37.

Duebbert, H. F., J. T. Lokemoen, and D. E. Sharp. 1986. Nest sites of ducks in grazed mixed-grass prairie in North Dakota. Prairie Naturalist 18:99-108.

Higgins, K. F., D. E. Naugle, and K. J. Forman. 2002. A case study of changing land use practices in the northern Great Plains, U.S.A.: an uncertain future for waterbird conservation. Waterbirds 25:42-50.

Ignatiuk, J. B., and D. C. Duncan. 2001. Nest success of ducks on rotational and season-long grazing systems in Saskatchewan. Wildlife Society Bulletin 29:211-217.

Johnson, D. H. 1979. Estimating nest success: the Mayfield method and an alternative. Auk 96:651-661.

Klett, A. T., H. F. Duebbert, C. A. Faanes, and K. F. Higgins. 1986. Techniques for studying nest success of ducks in upland nesting habitats in the prairie pothole region. U.S. Fish and Wildlife Service Resource Publication 58.

Kruse, A.D., and B. S. Bowen. 1996. Effects of grazing and burning on densities and habitats of breeding ducks in North Dakota. Journal of Wildlife Management 60:233-246.

National Oceanic and Atmospheric Administration. 1997. Climatological data: North Dakota. U.S. Department of Commerce, National Oceanic and Atmospheric Administration Volume 105. Washington, D.C.

Robel, R. J., J. N. Briggs, A. D. Dayton, and L. C. Hulbert. 1970. Relationship between visual obstruction measurements and weight of grassland vegetation. Journal of Range Management 23:295-297.

Sargeant, A. B., R. J. Greenwood, M. A. Sovada, and T. L. Shaffer. 1993. Distribution and abundance of predators that affect duck production: prairie pothole region. U.S. Fish and Wildlife Resource Publication 194.

SAS Institute. 1992. SAS/STAT user's guide, version 6.07. SAS Institute, Inc., Cary, North Carolina.

Sedivec, K. K., and W. T. Barker. 1991. Design and characteristics of the twice-over rotation grazing system. North Dakota State University Extension Service Publication No. R1006.

Sedivec, K. K., T. A. Messmer, W. T. Barker, K. F. Higgins, and D. R. Hertel. 1990. Nesting success of upland-nesting waterfowl and sharp-tailed grouse in specialized grazing systems in south central North Dakota. U.S. Forest Service General Technical Report RM-194:71-92.

Sovada, M. A., A. B. Sargeant, and J. W. Grier. 1995. Differential effects of coyotes and red foxes on duck nest success. Journal of Wildlife Management 59:1-9.

U.S. Soil Conservation Service. 1975. Field technical guide: Coteau vegetative zone. U.S. Department of Agriculture, Soil Conservation Service, Bismarck, North Dakota.

Received: 31 January 2003 *Accepted: 18 February 2004*