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June 15, 1992

TO: Dale Henry
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FROM: Karen A. Smith
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SUBJECT: Manuscript entitled "Habitat and predator management for nesting piping plovers on Lostwood National Wildlife Refuge, North Dakota"

Enclosed please find a copy of a manuscript entitled "Habitat and predator management for nesting piping plovers on Lostwood National Wildlife Refuge, North Dakota," authored by myself and Robert K. Murphy. We hope to submit the ms soon for publication in The Prairie Naturalist, and seek USFWS approval for publication.

Thank you.

HABITAT AND PREDATOR MANAGEMENT FOR NESTING PIPING PLOVERS AT LOSTWOOD NATIONAL WILDLIFE REFUGE, NORTH DAKOTA

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ABSTRACT -- Population levels, nesting effort, and pair success of piping plovers (Charadrius melodus) were monitored in northwestern North Dakota in years before and during attempts to improve breeding habitat. An increase in the plover breeding population appeared unrelated to management efforts, but pair success on sites prescribe-burned (n = 15 pairs) and on sites burned and protected by predator exclosure fences (n = 15 pairs) was greater than expected based on unmanaged sites (n = 24 pairs; both $P < 0.001$). Attempts to create new breeding habitat by adding gravel to unused beach areas had limited success (one of five sites used one year), mainly due to vegetation encroachment within a year. Nesting sites on one area were avoided by plovers during three consecutive years of grazing by cattle during the nesting season, but pair numbers exceeded pregrazing levels in years following grazing.

Key Words: Piping plover, Charadrius melodus, endangered species, habitat, nesting, prescribed burning, grazing, predator control, northern Great Plains

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Piping plovers (Charadrius melodus; hereafter, plover) that nest in the northern Great Plains are considered Threatened in the U.S. (USFWS 1985) due to declining numbers. Causes of this decline include diminished breeding habitat quality and quantity, and low reproductive success due to predation on nests or chicks (Prindiville Gaines and Ryan 1989, Root et al. 1992). Population recovery will require strategies to reverse these trends (Root et al. 1992); e.g., nesting beaches can be fenced to reduce predation (Mayer and Ryan 1991). Reproductive success is tied closely to habitat quality, key features of which include unobstructed views and homogeneous gravel substrates along wetland beaches (Cairns 1982, Whyte 1985, Prindiville Gaines and Ryan 1988). Although potential avenues for plover habitat improvement have been suggested (Prindiville Gaines and Ryan 1988), no large-scale attempts to enhance habitat have been reported from the northern Great Plains, nor have approaches that integrate habitat and predation management. Herein we describe an array of such methods employed on a National Wildlife Refuge in North Dakota. Because plover recruitment may be higher from sparsely vegetated beaches, we tried to reduce live and residual vegetation by using prescribed burning, grazing, or salt applications (Kotliar and Burger 1986). In addition, we used predator exclusion fences, and attempted to create new plover breeding sites by modifying beaches that appeared potentially similar to known sites but had no records of territorial plovers.

STUDY AREA AND METHODS

Lostwood National Wildlife Refuge (LNWR) encompasses 105 km^2 of rolling mixed-grass prairie in Mountrail and Burke counties, North Dakota (48°35'N;

102°25'W). About 4100 wetlands occur on LNWR, but only seven have suitable plover habitat: Upper Lostwood Lake (ULL, 224 ha), Lower Lostwood Lake (LLL, 189 ha), School Section Lake (SSL, 58 ha), Piping Plover Wetland (PPW, 6 ha), Salt Wetland (SW, 14 ha), Phalarope Wetland (PW, 30 ha), and Thompson Lake (TL, 175 ha). These brackish and subsaline, permanent and semi-permanent wetlands (classification according to Stewart and Kantrud 1971) provide potential plover breeding habitat that, because of changes in groundwater discharge, varies annually in quantity and quality. Conductivity, alkalinity, dissolved oxygen, and pH collected from these wetlands near plover breeding sites (no data from TL) in 1987-88 averaged 20,973 micromhos/cm^2 (SD $\pm$11,542), 2571 mg/l (SD $\pm$1442), 8.04 mg/l (SD $\pm$0.91), and 9.61 (SD $\pm$0.16). Average annual precipitation of 41.9 cm at LNWR falls mostly during spring and summer. During May-July when plovers breed on LNWR, average monthly precipitation (1936-80) and temperatures (1930-60) are 5.1, 8.4, and 6.0 cm, and 11.1, 16.4, and 20.3°C respectively. Severe drought plagued LNWR in 1987-88 (annual precipitation 30.9 and 33.5 cm respectively), causing water-level drawdown and exposing more potential plover nesting habitat at ULL, LLL, SSL, and TL, but desiccating SW (dry June 1987, dry 1988-89), PW (nearly dry 1987-88, dry 1989), and PPW (dry 1988).

We searched potential nesting habitat at each plover wetland, using two walking census types: 1) a "general" census done once annually during 6-18 June 1984-89, to record locations and numbers of adults and pairs and 2) an "intensive" census done biweekly during late May to mid-July, 1987-88 and every 2-3 weeks in 1989, to monitor numbers of adults, pairs, and nests, and nest success. SSL, however, was censused under the intensive protocol during 1980-89. We identified pairs via behavior (Cairns 1982) or by nest or chick

presence. We considered any scrape with at least one egg to be a nest, and recorded nesting pairs as successful if we observed chicks, persistent distraction displays by the pair, or yolk-free shell fragments (1-3 mm) in respective nest bowls. Stage of incubation was not determined. Plover territories or "sites" were defined as the beach areas defended by territorial birds or pairs (Cairns 1982, Whyte 1985), typically about 100-150 m in length.

Selection of sites for management treatments was non-random. Logistics, safety (i.e., for prescribed burning), and a desire to maximize plover production influenced our assignment of treatments to a given site. We prescribe-burned, one to three times, three sites used previously by nesting plovers: 1) "ULL-East Bay" burned three times (10 August 1982, 15 August 1985, and 25 May 1988), 2) "ULL-West Bay" and "ULL-Points 1, 2, & 3" burned twice (24 April 1987 and 2 May 1989), and 3) "SSL-Points" burned once (16 May 1988). Sites were burned by setting headfires from uplands towards shore, under 10-30 km/h winds, 25-50% relative humidity, and 10-27°C temperatures. Virtually all vegetative litter and above-ground growth were removed by the burns. Sweet clover (Melilotus spp.) stalks remaining after one burn were pulled by hand.

Coyote (Canis latrans), striped skunk (Mephitis mephitis), and raccoon (Procyon lotor) are suspected plover nest and chick predators at LNWR. Six 2-m high galvanized fences, mesh size 4 x 7 cm, were erected on five points to protect plover sites from these mammals. Three of the fences were placed at "ULL-West Bay" (May 1987), one at "ULL-Point 2" (April 1988), and two at "SSL-Points" (April 1988). Fence ends extended 3-8 m into the water and then curved to divert swimming predators away from plover sites. About 0.5 m of fence bottoms were bent (90°) towards the mainland and were flattened on the ground to deter burrowing under fences. All sites fenced also were prescribed

burned.

We monitored plover response to cattle grazing of known sites on one wetland having a firm gravel substrate. SSL-Points were grazed by cattle annually at 0.4 ha per Animal Unit Month (AUM), 1 May-15 June 1982-1984. These points were then rested the following three years before fences and burning were employed as described above.

We attempted to improve plover breeding habitat on five unoccupied beaches by adding 5-cm deep, pea-size (0.5-0.9 mm diameter) gravel over about 8 x 25 m in 1987. A year later, we deposited 0.1-0.2 kg/m^2 of 2 x 3-cm rock salt after the nesting season to inhibit vegetation encroaching on two of these graveled beach areas (Prindiville Gaines and Ryan 1988, Kress 1989). We also irrigated two of the gravelled sites (one with rock salt and one without) with lawn sprinklers, using water pumped from nearby saline wetlands (ca. 5-10 1/m^2/d for 1-3 d). With the exception of cattle grazing of SSL-Points and initial burning of ULL-East Bay, all management treatments were applied after 1986.

RESULTS AND DISCUSSION

Numbers of plover adults and pairs detected in 1987 and 1988 general and intensive censuses were similar, except that general censuses consistently overlooked 8% $\pm$ 3% of adults and pairs (Table 1). Thus, we assumed that we similarly missed an average of 8% of the adults and pairs in 1984-86 when only general censuses were conducted, and added 8% to general censuses in these years for our analyses. Also, we likely missed an unknown but probably small number of plovers in 1989 when intensive censuses were conducted less frequently than in previous years, at a time when plover numbers at LNWR were

higher than ever observed.

Plovers on LNWR increased from averages of 21.6 (SD = 3.2) total adults and 9.0 (1.0) pairs observed annually in the 1984-86 "pre-treatment" period, to 41.0 (16.4) and 18.0 (7.0) observed annually during 1987-89 when nearly all treatments were applied. Some increase in plover numbers could be attributed to drought. We did not measure changes in beach area available each year, but steady increases due to drought clearly attracted more plovers during 1987-89. We could, however, expect changes in pair numbers and success between 1984-86 and 1987-89 to be proportional between managed and unmanaged sites. This was true for pair numbers that increased from three-year totals of 16 to 36 on managed sites and from 11 to 18 on unmanaged sites ($\underline{X}^2 = 0.93$, $\underline{P} = 0.335$). Pair success, however, appeared higher on managed than unmanaged sites (69% versus 28%; $\underline{X}^2 = 28.65$, $\underline{P} < 0.001$).

Enhanced success of plover pairs on managed sites was associated with prescribed burning. We also noticed increased plover nesting effort and pair success under combinations of burning and predator exclusion fences. On sites burned but not fenced, the proportion of pairs that nested did not differ from what we expected based on other sites, excluding burn-fence treatments (80% versus 67%, $\underline{n} = 15$ and 24 pairs; $\underline{X}^2 = 2.15$, $\underline{P} = 0.143$). Pair success, however, was elevated on burn sites (67% versus 25%; $\underline{X}^2 = 11.76$, $\underline{P} < 0.001$). Where prescribed burning and predator fences were combined, proportions of pairs with nests and with successful nests (100% and 93%, $\underline{n} = 15$ pairs) were higher than expected on the basis of other sites, excluding burn only sites ($\underline{X}^2 = 9.21$ and 33.8, $\underline{P} < 0.01$ and < 0.001). We acknowledge that disparity in nesting effort could be partly influenced by increased probability of detecting successful nests (Mayfield 1961).

Plovers appeared to avoid cattle grazing at SSL-Points, but pair numbers after grazing exceeded those in pre-grazing years. Prior to grazing, a site on SSL-Points was occupied by a plover pair one year during 1980-81, and it produced a successful nest. While cattle were present from 1982-84, no plovers were seen. But we observed averages of 2.3 pairs and 1.3 successful pairs per year (SD = 0.6 and 1.1) during three years after grazing and before prescribed burns or fencing. Cattle hoof prints may remain indefinitely in soft substrates (e.g., sand, clay) and can reduce plover success (Prindiville Gaines and Ryan 1988). Cattle hoof prints, however, were not left on SSL-Point's firm, gravelly beaches. In lieu of previous authors' concerns over potential damage to plover nest habitat by cattle, we posit that livestock grazing may be judiciously employed on nesting beaches with firm substrate, to reduce vegetation when other techniques (e.g., prescribed burning) are not feasible. Such grazing could be accomplished after the plover nesting season to circumvent the apparent avoidance of cattle by plovers that we observed.

Applications of gravel to beaches that appeared otherwise suitable for nesting plovers yielded only a short-term gain. One of five graveled sites was used by a pair and was used only the first year available; the pair was successful. We believe graveled sites were underused mainly due to rapid vegetation encroachment that our salt applications failed to hinder. Rock salt was not applied densely enough because salt residue was evident on only about 30% of the treated area where plant growth was hindered, occurring only within about five cm of each salt rock that had been left. Kress (1988) inhibited vegetation invading a common tern (Sterna hirundo) colony by spreading 2.2 kg/m^2 of rock salt, > 10 X what we applied, but his treatment was effective only four months. The salt water we added may have washed away

the rock salt and diluted natural salts.

A note of caution must be added about graveling beaches. We hauled and spread gravel from a 5-ton truck over winter months when beaches were frozen. On sites having firm, rocky base substrates, no vehicle tracks were evident in spring, but on two sites where substrates were softer, 8-15 cm deep ruts from vehicle tracks developed during the spring thaw and defied our attempts to correct them. These deep ruts likely made the new beaches less attractive to plovers by disrupting homogeneous substrates.

Our observations suggest that at LNWR (1) prescribed burning increases plover pair success, (2) burning combined with predator exclusion fences increase plover nesting effort and pair success, and (3) grazing by cattle during the nesting season may discourage plover use, but enhance plover habitat for a few years following grazing. We urge other resource managers to carefully evaluate these techniques elsewhere in the Great Plains.

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LITERATURE CITED

Cairns, W. E. 1982. Biology and behavior of breeding piping plovers. Wilson Bull. 94:531-545.

Kress, S.W. 1989. The use of rock salt for managing common tern nesting habitat. Colonial Waterbird Soc. Newsletter. 13:19.

Kotliar, N. B. and J. Burger. 1986. Colony site selection and abandonment by least terns Sterna antillarum in New Jersey, USA. Biol. Conserv. 37:1-21.

Mayfield, H. 1961. Nesting success calculated from exposure. Wilson Bull. 73:255-261.

Mayer, P. M. and M. R. Ryan. 1991. Electric fences reduce mammalian predation on piping plover nests and chicks. Wildl. Soc. Bull. 19:59-63.

Prindiville Gaines, E. and M. R. Ryan. 1988. Piping plover habitat use and reproductive success in North Dakota. J. Wildl. Manage. 52:266-273.

Root, B. G., M. R. Ryan and P. M. Mayer. 1992. Piping plover survival in the Great Plains. J. Field Ornithol. 63:10-15.

Stewart, R. E. and H. A. Kantrud. 1971. Classification of natural ponds and lakes in the glaciated prairie region. U.S. Fish and Wildl. Serv. Resour. Publ. No. 92. 57pp.

U.S. Fish and Wildlife Service. 1985. Endangered and threatened wildlife and plants: final rule. Federal Register 50:50726-50734.

Whyte, A. J. 1985. Breeding ecology of the piping plover (Charadrius melodus) in central Saskatchewan. M.S. Thesis, Univ. Saskatchewan-Saskatoon. 126pp.

Table 1. Numbers of piping plover adults and pairs as determined by general and intensive censuses on Lostwood National Wildlife Refuge, northwestern North Dakota. Adult and pair numbers for 1984-86 intensive censues (numbers in parentheses) were projected estimates based on 8% ± 3% adults and pairs overlooked by 1987-88 general censuses[a].

	General census		Intensive census	
Year	No. of adults	No. of pairs	No. of adults	No. of pairs
1984	21	9	(23)	(10)
1985	17	7	(18)	(8)
1986	22	8	(24)	(9)
1987	22	10	23	11
1988	40	16	45	18
1989	42	18	55	25

[a] The 1989 census was not used to estimate total plover adults and pairs for 1984-87 because it was conducted less frequently than in 1987-88.