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Spring-migration Ecology of Northern Pintails in South-central Nebraska

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Abstract.—Spring-migration ecology of staging Northern Pintails, *Anas acuta*, was investigated in south-central Nebraska, USA. Habitat associations, local movements, settling patterns, arrival dates, residency times and survival were estimated from 71 radiomarked pintails during spring 2001, 2003 and 2004, and diet determined from 130 females collected during spring 1998 and 1999. Seventy-two percent of pintail diurnal locations were in palustrine wetlands, 7% in riverine wetlands, 3% in lacustrine wetlands, 6% in municipal sewage lagoons and irrigation reuse pits and 10.5% in croplands. Emergent wetlands with hemi-marsh conditions were used diurnally more often than wetlands with either open or closed vegetation structures. Evening foraging flights averaged 4.3 km (SE = 0.6) and 72% were to cornfields. In accord with these findings, 87% of 93 pintails collected during spring 1998 and 1999 returning to evening roosts consumed corn, which represented 84% dry mass of all foods. Pintails collected on non-cropped wetlands ingested invertebrates and seeds from wetland plants more frequently than birds returning to roost. Radiomarked pintails arrived in Nebraska on 7 March 2003 and 18 February 2004; average arrival date was six days earlier during 2004 compared to 2003. Residency time for individuals varied greatly (1-40 days) yet yearly means were similar and averaged 9.5 days within the region. No mortality was detected for 71 birds monitored over 829 exposure days. Conservation planners linking population dynamics and habitat conditions at spring-staging areas need to focus on pintail body condition during spring and its connection with reproductive success and survival during the breeding season. *Received 5 March 2010, accepted 29 April 2010.*

Key words.—*Anas acuta*, diet, habitat use, Nebraska, Northern Pintail, Platte River, Rainwater Basin, spring migration.

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Migratory birds make physiological, nutritional and behavioral preparations for reproduction while traveling between wintering and breeding areas during spring (Webster *et al.* 2002). Conditions at stopover sites may limit populations in certain instances, providing impetus for understanding function of staging areas used during spring migration (Newton 2006). For example, changes in climate have potential to influence timing of migration and disrupt synchronies with food resources (Both *et al.* 2005). For certain Anatids, relatively little information exists regarding their ecology during spring migration, and this information could be useful for science-based habitat conservation (Arzel *et al.* 2006; Bishop and Vrtiska 2008).

The breeding population size of Northern Pintails (*Anas acuta*; hereafter pintails) in North America has been below goals set by the North American Waterfowl Management Plan since the mid-1970s (U.S. Department of the Interior and Environment Canada 1986; U.S. Fish and Wildlife Service 2009). Nutrients obtained during spring migration may influence survival, nesting efforts and breeding success for numerous species of waterfowl, including pintails (Raveling and Heitmeyer 1989; Alisauskas 2002; Blums *et al.* 2005; Devries *et al.* 2008). Therefore, factors potentially influencing population growth include loss of wetland habitats and food resources during winter and early spring (Moon *et al.* 2007; Moon and Haukos 2009). Recent studies of pintail spring migration have provided broad-scale information on migration routes, timing and linkages between wintering and breeding areas for Pacific and midcontinent populations (Miller *et al.* 2005; Clark *et al.* 2006; Haukos *et al.* 2006; Yerkes *et al.* 2008). Integration of these large-scale studies with efforts focused on estimating use of habitats, timing of stopovers and residency times at key spring-staging areas would be useful for conservation planning and management of staging habitats at a regional level. Furthermore, estimation of survival at staging sites may assist managers in evaluating quality of habitats available during spring and determine if management actions are required.

The Rainwater Basin in south-central Nebraska is an important staging area for migratory birds during spring, and an estimated 30% of the midcontinent pintail population stages in this region (Gersib *et al.* 1992). Over the past century, the Rainwater Basin has lost 90% of its original wetlands, resulting in crowding and reducing wetland-foraging opportunities for migratory birds (Smith and Higgins 1990). Adjacent to the Rainwater Basin, the central Platte River Valley also attracts multiple species of migratory waterbirds during spring migration (U.S. Fish and Wildlife Service 1981). The Platte River has undergone major changes in the 20th Century, including reduction of channel width and encroachment of woody vegetation (Krapu *et al.* 1982; Sidle *et al.* 1989). Habitat alterations in these regions and changes in agricultural practices constitute nutritional and energetic challenges to pintails and other waterbirds during spring staging (Pearse *et al.* 2010). Herein, we provide baseline information on use of the Rainwater Basin and south-central Nebraska as a stopover site during spring to assist in clarifying the role of this area in the annual cycle of pintails and determining habitat goals and objectives to inform conservation and management activities (U.S. Department of the Interior and Environment Canada 1986). Our specific objectives were to: 1) describe pintail spring-staging ecology by investigating habitat associations, local movements, and diet; 2) determine migration patterns including settling patterns, arrival dates, and residency time; and 3) estimate survival of pintails staging in south-central Nebraska during spring.

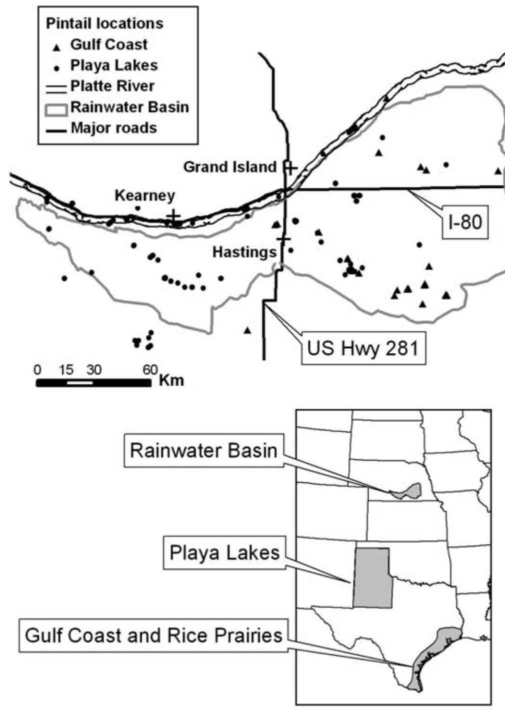

Figure 1. Locations of female Northern Pintails (*Anas acuta*) marked in the Gulf Coast and Rice Prairies regions and Playa Lakes region of Texas and staging in the Rainwater Basin and central Platte River Valley of south-central Nebraska during springs 2003 and 2004.

METHODS

Study Area

The Rainwater Basin is located in south-central Nebraska, south of the Platte River between Lexington and Columbus, Nebraska, encompassing 1.7 million ha (Fig. 1). The region was characterized historically as a mixed-grass prairie with wetlands interspersed throughout (Gersib *et al.* 1992). Waterfowl typically use deeper semipermanent basins as nocturnal roost sites and agricultural fields and shallow portions of basins as feeding sites (Pederson *et al.* 1989). Land use during the study period was dominated by annual crop agriculture (74% of landscape during late 1990s and early 2000s), of which corn represented 75% and soybeans 18% of cultivated lands within counties of the region (i.e. Adams, Clay, Filmore, Gosper, Hamilton, Kearney, Phelps, Polk and York; U.S. Department of Agriculture 2008). The Rainwater Basin was bordered on the north by the central Platte River Valley (Fig. 1), which supported large numbers of Sandhill Cranes (*Grus canadensis*) and arctic-nesting geese during spring migration and has been described by U.S. Fish and Wildlife Service (1981). Land use of the central Platte River Valley also was dominated by row crops during the late 1990s and early 2000s (Pearse *et al.* 2010). Minimum daily temperatures (°C) reported at Hastings, Nebraska during February and March averaged -2.3 and -4.7 during 1998, -3.6 and -2.9 during 1999, -11.1 and -2.8 during 2001, -9.5 and -2.1 during 2003, and -9.8 and -0.3 during 2004 (National Oceanic and Atmospheric Administration 1998-2004). Wetland conditions were above average during springs 1998, 1999 and 2001 (M. Vrtiska, Nebraska Game and Parks Commission, personal communication), whereas fewer wetlands were available during springs 2003 and 2004 due to below-average precipitation (Webb *et al.* 2010).

Radio Telemetry

During 2001, we captured female pintails using baited swim-in traps and, after capture, birds were placed into crates and transported to indoor facilities for further processing. Males captured in the same trap as females also were kept captive to reduce the chance of breaking pair bonds. We fitted females with either a 21-g, harness-type transmitter (Dwyer 1972) with an expected life of 150 days or a 13-g, prong-and-suture type transmitter (Mauser and Jarvis 1991; Pietz *et al.* 1995) with an expected life of 100 days. All radiotransmitters had mercury-type mortality sensors, which caused the pulse rate to double if transmitters remained motionless for >4 h. We provided captive birds with food and water *ad libitum* during captivity and released them simultaneously with accompanying males during daylight hours at capture sites ≤24 h following capture (Cox and Afton 1998). Capture activities and protocols were conducted under Nebraska Game and Parks Commission scientific collecting permit 142 and with methods approved by the Northern Prairie Wildlife Research Center Animal Care and Use Committee.

Collaborators in the Playa Lakes and Gulf Coast and Rice Prairies Regions of Texas radiomarked 316 female Pintails during winter 2002 (157 in Gulf Coast and Rice Prairies and 159 in Playa Lakes) and 324 during winter 2003 (158 in Gulf Coast and Rice Prairies and 168 in Playa Lakes; Moon 2004; Anderson 2008; Fig. 1). Capture techniques, handling and instrumentation of females were similar to that described above except only 21-g harness transmitters were used.

In Nebraska, we located radiomarked females once each day to monitor habitat use, provided weather permitted use of aircraft. We used standard telemetry techniques to locate marked birds from fixed-wing aircraft (Gilmer *et al.* 1981), and personnel in the aircraft communicated approximate locations to technicians in ground vehicles (Cox and Afton 1997). Technicians located radiomarked females from ground vehicles using 4-element, null-peak antenna systems. Three or more azimuths were acquired for each location and point locations were calculated using laptop computers on-site based on a maximum-likelihood estimator (Lenth 1981) and Location of a Signal software (Ecological Software Solutions 1999). We estimated station locations of ground vehicles using a Global Positioning System (Cox *et al.* 2002) and used an empirically derived bearing standard deviation of three degrees to estimate 95% error ellipses for point estimates of Pintail locations. We continued to record azimuths for individual locations until 95% error ellipses reached ≤20 ha (Cox and Afton 1997).

We assessed habitats used by pintails on site. For locations occurring in noncropped wetlands, we collected wetland type, percent cover of emergent vegetation based on an ocular estimate and ownership (i.e. public or private). We classified wetlands as palustrine, lacustrine, riverine and other (i.e. irrigation water reuse pits and municipal sewage lagoons). We classified cropland habitats used by pintails from residual crop stubble and recorded if birds used sheetwater or dry land.

We monitored daily foraging flights by following radiomarked females selected at random during late afternoon (2 h before sunset to 0.5 h after sunset). We recorded timing, duration and distance of these movements continuously during this time interval using telemetry procedures described earlier. We determined daily status (alive or dead) of radiomarked females from aircraft concurrently with pintail locations.

Food Habit Collections

We collected female pintails during February and March 1998-1999 returning to roost or feeding in noncropped wetlands by shooting (hereafter roosting or wetland-feeding birds) and did not use decoys to avoid potential bias (Sheeley and Smith 1989). We removed each bird's esophagus and proventriculus and stored the organs and contents in an 80% ethanol solution for later analysis. We identified and categorized plant seeds to genera and animal prey to family. After sorting ingested materials, we dried items to a constant mass at 55°C and weighed each item to the nearest 0.0001 g. Food items consumed by pintails were expressed as frequency of occurrence and as a percentage of dry mass averaged across birds (i.e. aggregate percent dry mass) by collection type (Swanson *et al.* 1974). Collections were conducted under Nebraska Game and Parks Commission scientific collecting permits 6, 7, 49 and 50, in concurrence with U.S. Fish and Wildlife Service personnel, and with methods approved by the Northern Prairie Wildlife Research Center Animal Care and Use Committee.

Statistical Analyses

We estimated habitat use, characteristics of wetlands used, and distance and time of foraging flights from multiple observations of individual birds. To account for lack of independence among observations of the same individual, we constructed a dataset by averaging observations by bird and derived final estimates weighted by the number of observations collected for each bird. We derived estimates of habitat use, distance and time of daily foraging flights, and survival by pooling across years due to small yearly sample sizes. We did not detect any mortality events during our tracking of pintails in south-central Nebraska; therefore, we could not estimate a conventional variance estimate of survival. We estimated a lower confidence interval from the binomial distribution directly as described by Dugger *et al.* (1994). We estimated mean and median arrival date of Texas radiomarked pintails by year in springs 2003 and 2004. Arrival date was defined as the first day a radiomarked bird was detected in the study region. We also estimated residency time by determining the number of days each radiomarked bird resided in the region during 2003 and 2004. Finally, we determined geographic area used during springs 2003 and 2004 by comparing easting and northing of locations for birds from Gulf Coast and Rice Prairies and Playa Lakes wintering sites based on Universal Transverse Mercator zone 14 coordinates.

RESULTS

We captured 31 female pintails in the Rainwater Basin of Nebraska during 10-19 March 2001 (18 harness-type and 13 prong-and-suture transmitters). During spring 2003, we detected seven birds marked in the Gulf Coast and Rice Prairies Regions and 20 birds in the Playa Lakes Region in the study region. We detected three birds from the Gulf Coast and Rice Prairies Regions and ten birds from the Playa Lakes Region during spring 2004. We recorded 416 diurnal locations from 68 birds over the three years of study. Seventy-nine percent of locations were acquired before 12.00 h (average time of location acquisition = 10.30 h).

Pintails used palustrine wetlands more often than other habitat types (72%, SE = 4). Eighty-five percent of palustrine wetlands used by pintails were classified as emergent and 15% as aquatic bed. Thirty-one percent of pintail locations in palustrine emergent wetlands occurred in wetlands with <25% emergent vegetation, 57% in hemi-marsh wetlands (25-75% emergent vegetation), and 12% in wetlands with >75% emergent vegetation. Other wetland use by pintails included lacustrine (3%, SE = 1), riverine (7%, SE = 2), and municipal sewage lagoons and irrigation reuse pits (6%, SE = 2). Pintails were found in croplands and uplands infrequently (soybean = 5%, corn = 4%, grain sorghum = 1.5%, grasslands = 1.5%), and 77% of use of croplands was associated with presence of sheetwater.

We observed 136 local evening flights by 53 birds initiated within two hours before sunset. Pintails flew 4.3 km (SE = 0.6, range = 0.02-29.4) on average between roost and evening foraging sites, and average time spent in flight was 14 min (SE = 2). Pintails initiated flights from wetland habitats and destinations included croplands (75%) and other wetlands (25%). The most common flight destination was to cornfields, which occurred in 72% of flights.

Pintails marked at wintering areas in the Gulf Coast and Rice Prairies Regions used portions of the Rainwater Basin further east than those marked in the Playa Lakes Region ($\bar{x}_{diff}$ = 89.8 km, 95% CI, 61.3-118.3 km; Fig 1). We did not detect a difference in northing of bird locations from different wintering regions ($\bar{x}_{diff}$ = -15.5 km, 95% CI, -35.0-3.9 km). During springs 2003 and 2004, radiomarked pintails entered the study area initially on 7 March 2003 and 18 February

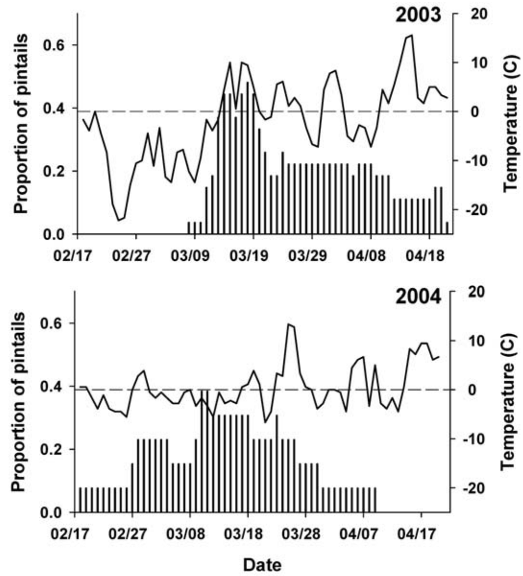

Figure 2. Daily proportions of female Northern Pintails (*Anas acuta*) present in south-central Nebraska in relation to all pintails observed using the region during springs 2003 (N = 27) and 2004 (N = 13). Solid line depicts minimum daily temperature (°C) reported at Hastings, Nebraska, and the dashed line references 0°C.

2004 (Fig. 2). We estimated a mean arrival date of 18 March (median = 15 March) for the 27 pintails arriving during spring 2003. Average arrival date for 13 pintails during spring 2004 was 12 March (median = 10 March). Peak numbers of marked pintails occurred on 18 March 2003 and 10 March 2004 (Fig. 2). During 2003, pintails occupied south-central Nebraska for 1-40 days ($\bar{x}$ = 9.6, SE = 1.9, median = 7). Residency time during spring 2004 was similar and varied between one and 28 days ($\bar{x}$ = 9.3, SE = 2.2, median = 6). Overall, we estimated an average residency time of 9.5 days for birds across the entire study area (SE = 1.4, median = 6.5, mode = 1, N = 40). Pintails spent an average of 6.8 days within the boundaries of the Rainwater Basin (SE = 1.1, median = 6, N = 30; Fig. 1).

We did not detect any mortality events during monitoring of 71 pintails for 829 total exposure days in springs 2001, 2003, and 2004. Therefore, we estimated a daily survival rate of 1.0 for pintails during spring stopover in south-central Nebraska (95% CI: 0.9964-1.0000).

We collected 77 female pintails between 13 February and 31 March 1998 and 79 birds between 7 February and 27 March 1999. Of the 130 birds containing food contents, we collected 37 feeding on noncropped wetlands throughout the day (median collection time = 14.45 h) and 93 birds returning to roosting wetlands, primarily in the evening (median collection time = 18.00 h). Pintails returning to roost wetlands contained corn kernels most frequently, consisting of 84% of total dry mass of foods consumed (Table 1). Wetland-feeding pintails contained seeds of *Polygonum* most frequently (78%), followed by corn kernels (57%) and *Echinochloa* (54%). Chironomidae was the most common animal food item for pintails collected while feeding in wetlands (24%) and returning to roost sites (8%). Gastropods were consumed by 11% of wetland-feeding and 10% of roosting birds.

DISCUSSION

Pintails primarily used palustrine emergent wetlands while staging in south-central Nebraska. Also, extensive use of emergent wetlands by pintails has been observed in Louisiana, Texas and California during fall and winter (Cox and Afton 1997; Fleskes *et al.* 2005; Anderson 2008; Moon and Haukos 2008) as well as for Mallards (*Anas platyrhynchos*) during fall and spring in Illinois (Stafford *et al.* 2007). Wetlands with a 1:1 ratio of interspersed emergent vegetation and open water (i.e. hemi-marsh) have been found to attract greater densities of waterfowl species during breeding and nonbreeding periods (Weller and Spatcher 1965; Weller and Fredrickson 1974; Kaminski and Prince 1981; Smith *et al.* 2004). Pintails used wetlands during spring staging in Nebraska with a variety of vegetation structure, yet over

Table 1. Percentage occurrence and aggregate dry mass of contents ingested by female Northern Pintails (*Anas acuta*) collected at wetlands during foraging bouts (wetland feeding; N = 37) or returning to roosting wetlands (roosting; N = 93) during spring migration in south-central Nebraska, 1998-1999.

	Wetland feeding		Roosting	
Food item	Occurrence	Aggregate dry mass	Occurrence	Aggregate dry mass
Animal material[a]				
Insecta	29.7	2.1	18.3	1.3
Chironomidae	24.3	1.8	7.5	0.2
Hydrophilidae	5.4	tr[b]	3.2	tr
Gastropoda	10.8	0.1	9.7	0.8
Planorbidae	8.1	tr	5.4	0.1
Lymnaeidae	5.4	tr	4.3	tr
Clitellata	2.7	0.2	5.4	tr
Plant material[c]				
Corn kernel	56.8	54.1	87.1	84.1
Polygonum	78.4	22.5	50.5	5.2
Echinochloa	54.1	12.2	29.0	4.1
Amaranthus	16.2	2.8	10.8	tr
Ambrosia	10.8	0.2	1.1	tr
Leersia	10.8	0.2	5.4	tr
Helianthus	8.1	0.2	0.0	0.0
Phalaris	5.4	0.2	0.0	0.0
Panicum	2.7	0.2	5.4	0.1
Unidentified seed	8.2	2.2	3.2	0.6
Unidentified plant part	8.1	tr	3.2	0.1

[a]Other animal material recovered with <5% occurrence: Physidae, Sphaeriidae, Calliphoridae, Carabaeidae, Corixidae, Dytiscidae, Pyralidae, Scarabaediae, Stratiomayidae, Tabanidae, Tipulidae.

[b]trace amounts (<0.1%).

[c]Other plant material recovered with <5% occurrence: *Brassica*, *Carex*, *Festuca*, *Grindelia*, *Heteranthera*, *Hordeum*, *Potamogeton*, *Setaria*, Sorghum, *Thlaspi*.

half of emergent wetland locations occurred in hemi-marsh wetlands. Therefore, our results coupled with recent studies suggest the hemi-marsh concept may be relevant during spring staging and useful as a management guideline for Rainwater Basin wetlands to increase waterbird use and diversity (Webb *et al.* 2010). We collected only diurnal locations; patterns of habitat use may differ nocturnally and providing this information would present a more complete representation of habitats used by migrating ducks (e.g. Cox and Afton 1997; Davis *et al.* 2009).

Pintails made evening foraging flights to wetlands and agricultural fields averaging 4.3 km from initial locations. Flight distances were comparable to the 2.2-20 km estimated for wintering pintails in Texas (Moon 2004; Anderson 2008) and Mallards wintering in Nebraska (Jorde *et al.* 1983) yet less than distances reported in Louisiana (Cox and Afton 1996). Foraging-flight distances, which can be site-specific and potentially influenced by distribution of food resources (Legagneux *et al.* 2009), may be useful for directing conservation planning of wetland complexes within this agricultural landscape during spring staging.

The most common destination of evening flights was to cornfields, which corresponded with diet analyses. High-energy foods made up a major component of spring-staging pintail diet, as they do for many other species of waterfowl during nonbreeding periods (Jorde *et al.* 1983; Miller 1987). Seeds and invertebrates also were consumed by some roosting birds and, similarly, we found 25% of pintails moved to wetlands during evening flights where they presumably consume these foods. Based on occurrence of food items, pintails consumed a variety of animal and plant foods, similar to diet of female Mallards during spring migration in Iowa (LaGrange 1985). Waste corn and moist-soil plant seeds from two genera dominated diet composition (89-93% aggregate dry mass). In contrast, a small portion of pintail diet consisted of invertebrates (2% aggregate dry mass). Chironomids represented the principal macro-invertebrates in the diet and presumably were consumed primarily to meet protein and calcium needs (Krapu and Swanson 1975). Therefore, female pintails staging in south-central Nebraska consumed primarily high-energy waste corn to meet energetic demands but also consumed seeds and invertebrates from wetlands to meet nutritional requirements deficient in waste grain (Krapu and Swanson 1975; Haukos and Smith 1995).

During spring migration, pintails from different wintering regions used distinct portions of south-central Nebraska. Birds wintering in the Gulf Coast and Rice Prairies regions of Texas used areas in the eastern part of the study area, whereas birds wintering in the Playa Lakes region of Texas used central and western portions of the study area. Haukos *et al.* (2006) reported a similar east-west pattern based on pintails marked with platform-transmitting terminals (PTT). Segregation of birds on wintering grounds and spring-stopover sites suggests potential opportunities for spatially explicit management of migrating pintails. Improving wetland conditions on staging areas could provide resources pintails need to acquire nutrient reserves for migration and reproduction during years of poor wetland conditions on wintering grounds (Moon and Haukos 2009).

Pintails arrived in Nebraska earlier during spring 2004 than 2003, and the majority of arrivals occurred over four days during mid-March 2003, compared to a more extended arrival period during 2004. Observed differences may have been related to varying temperature patterns and habitat conditions at wintering and staging sites between springs. In Nebraska, late February and early March 2003 were colder compared to the same period in 2004 (Fig. 2). Environmental conditions can influence migratory behavior of birds (Both *et al.* 2005; Bauer *et al.* 2008), especially when those conditions relate to habitat availability (e.g. spring thawing of playa wetlands).

Gersib *et al.* (1989) suspected high turnover rates during migration based on changes in relative proportions of duck species present during spring. We found that residency time varied considerably among individual birds, yet yearly averages during springs 2003 and 2004 were consistent. Although based on a small sample size, the pooled estimates of residency time in the Rainwater Basin and in south-central Nebraska may be useful parameters for estimating energetic carrying capacity (Bishop and Vrtiska 2008). Midcontinent pintails wintering in Texas completed spring migration in 17 days (Haukos *et al.* 2006); residency time in Nebraska represented 56% of spring migration, constituting a substantial percentage of time during spring migration for birds staging in the region.

We detected relatively few of the birds marked in Texas migrating through Nebraska during springs 2003 and 2004, although some loss occurred due to radiotransmitter failure and winter mortality (Moon and Haukos 2006; Anderson 2008). Haukos *et al.* (2006) reported a dispersed distribution of PTT-marked pintails during spring migration from Texas wintering grounds with limited use of specific staging sites like the Rainwater Basin. We detected radio signals of marked birds west and north of our study area during reconnaissance flights, indicating that some birds followed migration pathways that bypassed the Rainwater Basin in favor of staging sites in the sandhills of Nebraska and the Prairie Pothole region in South Dakota. These results were inconsistent with observations of large numbers of pintails using the Rainwater Basin as a traditional staging site during spring (Pederson *et al.* 1989). As with most marking techniques, potential exists for transmitters to influence behavior of individuals (Paquette *et al.* 1997), especially during an energetically intensive migration period. Although we could not wholly dismiss potential biases induced by marking, we speculate that pintails from wintering regions not included in marked samples may stage in south-central Nebraska during spring. For example, large numbers of pintails use central Texas and portions of Mexico as wintering grounds (Saunders and Saunders 1981; Austin and Miller 1995), a subset of the midcontinent population not marked as part of this study or by Haukos *et al.* (2006).

Pintails survived at a high rate while staging in Nebraska during spring. Dugger *et al.* (1994) also observed no mortalities of Mallards after hunting season closure during late winter in Missouri. In contrast, Mallards and pintails experienced nonhunting mortality while wintering in Texas, potentially related to wetland conditions (Bergan and Smith 1993; Moon and Haukos 2006; Anderson 2008). We conducted this study during a time of low incidence of avian cholera (*Pasteurlla multocida*), which has been identified as a mortality factor for migratory waterfowl including pintails in the Rainwater Basin (Blanchong *et al.* 2006). We suspect that survival rates of pintails and other migrating dabbling ducks during spring staging in Nebraska may vary annually, with lower survival rates during years of avian cholera outbreaks and higher survival when incidence of avian cholera is low. Due to the potential for high survival rates of pintails in Nebraska, management and conservation strategies targeting survival may not be necessary excluding those conducted specifically to reduce impacts of avian cholera outbreaks. Pintails are among the earliest nesting ducks and may rely on stored nutrients for reproduction to a greater degree than other species of ducks (Esler and Grand 1994; Krapu 2000). Therefore, conservation planners interested in linking population dynamics and available spring habitat for this and potentially other staging areas may need to focus efforts on determining cross-seasonal effects of spring body condition on breeding-season survival and reproductive success (Webster *et al.* 2002).

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