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SURVIVAL AND OTHER OBSERVATIONS OF ADULT FEMALE NORTHERN PINTAILS MOLTING IN CALIFORNIA

MICHAEL R. MILLER, JOSEPH P. FLESKES, DENNIS L. ORTHMEYER, AND DAVID S. GILMER

U.S. Fish and Wildlife Service
Northern Prairie Wildlife Research Center
Wildlife Research Field Station
6924 Tremont Road
Dixon, California 95620 USA

Abstract.—Survival rates of nine adult female Northern Pintails (*Anas acuta*) that became flightless after being radio-marked in the Sacramento Valley, California in August 1987–1989 were estimated. Seven of the radio-marked pintails molted in the Sacramento Valley, a nontraditional molting region, and two flew 280 km north to the Klamath Basin to molt. Molting marshes were dominated by emergent vegetation in both locations. Two ducks, while flightless in the Sacramento Valley, were killed by predators. Molting pintails remained sedentary (did not fly) for an average of 36 d, and the daily survival rate during this period was 0.9934. The resulting sedentary-period survival rate was 0.79. Primary feather 9 on two captive ducks grew an average of 4.2 mm per day. Mean body mass of molting ducks that died was lower than that for molting ducks that survived ($P < 0.10$). The number of pintails molting on Sacramento Valley refuges is probably <200.

SOBREVIVENCIA Y OTRAS OBSERVACIONES DE HEMBRAS ADULTAS DE *ANAS ACUTA* MUDANDO EN CALIFORNIA

Sinopsis.—Se estimó la tasa de sobrevivencia de nueve adultos del pato *Anas acuta* que perdieron la capacidad de vuelo durante la muda, luego de haber sido marcadas con radiotransmisores en el Valle de Sacramento, California durante agosto de 1987–1989. Siete de las aves con radiotransmisores mudaron en el valle de Sacramento, una región no-tradicional de muda, mientras que dos volaron 280 km al norte, hasta la Cuenca de Klamath para mudar. Los anegados utilizados para mudar en ambas localidades, estaban dominados por vegetación emergente. Dos de los patos, en Sacramento, fueron eliminados por depredadores durante el período que perdieron la capacidad de vuelo. Durante la muda las aves permanecieron sedentarias (no volaron) por un período de 36 d, y la tasa de sobrevivencia diaria durante este período resultó ser de 0.9934. La tasa de sobrevivencia durante el período sedentario fue de 0.79. La novena primaria de dos patos cautivos creció a un promedio de 4.2 mm por día. El promedio del peso corporal de las aves que murieron durante la muda fue menor que el de aves que sobrevivieron este período ($P < 0.10$). El número de individuos de este tipo de pato que muda en los refugios del Valle de Sacramento es menor a 200.

Northern Pintails (*Anas acuta*) migrate to the Sacramento Valley beginning in early August; most are adult males (Miller 1985) that have shed and regrown flight feathers before arrival. Miller (1987), however, collected a flightless adult female pintail in August 1979 in the Sacramento Valley, and during recent August trapping there, caught additional adult females that had not yet molted (birds had worn flight feathers). The origin of these pintails is unknown, but females tend to molt in the marshes where their broods fledge (Gilmer et al. 1977, Hochbaum 1944, Oring 1964), and virtually no pintails nest in the Sacramento Valley (Anderson 1957).

Pintail populations have declined markedly in North America (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1989), and poor survival during the postbreeding period might have contributed to this decline. We found few data on the survival rates of flightless adult female dabbling ducks, however. Kirby and Cowardin (1986) reported on Mallards (*A. platyrhynchos*) and Ringelman and Longcore (1983) on "post-rearing" American Black Ducks (*A. rubripes*). These reports prompted us to calculate survival rates of adult female pintails that molted after we captured and radio-marked them in the Sacramento Valley of California, traditionally considered to be a wintering area only.

STUDY AREA AND METHODS

We captured pintails at baited trap sites on Sacramento and Delevan National Wildlife Refuges (NWRs) in the Sacramento Valley, California during the last week of August in 1987–1989, and the first week of September 1987. We weighed, radio-marked (≤24-g transmitter) (Dwyer 1972) and released ducks that had badly worn flight feathers when captured, indicating they had not yet molted. We obtained diurnal and nocturnal locations on each bird daily until all birds regained flight or died. We also drive-trapped one permanent wetland on Delevan NWR to determine if other molting hens were present.

We estimated daily survival rates (DSR) and sedentary-period survival rates (SPSR). The sedentary period is the time during which ducks, after a period of normal movement, limited their activities to a confined area and did not fly. This period normally includes: (1) a variable premolt interval, which includes 2 d before feather loss when ducks behave as if flightless (Bowman 1987); (2) a flightless interval, which includes 2 d between loss of feathers and appearance of blood quills (Panek and Majewski 1990); and 3) a variable postflightless interval when ducks remain on molting ponds after regaining flight. We estimated the flightless interval from Sowls (1955) and by measuring ninth primary feather lengths every 3–9 d on two captive molting adult female pintails fed rice and commercial feed (16% protein) *ad libitum*. We computed DSR, SPSR, and 95% confidence intervals (CI) using "Micromort" (Heisey and Fuller 1985), and compared body mass among years with an ANOVA and between survivors and mortalities with a *t*-test (SAS Inst., Inc. 1988).

RESULTS

Of 199 adult female pintails trapped in 3 yr, we obtained 11 [4(7.6%) in 1987–1988; 4(6.3%) in 1988–1989; 3(3.7%) in 1989–1990] that had badly worn flight feathers when captured. One was injured and the radio failed on another upon release. We report results from the nine remaining females (except we included in body mass calculations the duck whose radio failed).

Seven of the nine ducks remained on Sacramento and Delevan NWRs to molt (Table 1). Two flew 280 km north within a few days of marking to molt in the Klamath Basin (near the Oregon border), and returned to

TABLE 1. Year of capture, molting locations, duration of Sedentary Periods[a] and fates of nine adult female Northern Pintails radio-marked in August in the Sacramento Valley, California.

Year	Molting location	Individual sedentary period	Total days	Fate
1987	Sacramento Valley	25 Aug.–9 Oct.	44	Survived
	Sacramento Valley	28 Aug.–3 Oct.	37	Survived
	Sacramento Valley	2 Sep.–28 Sep.	26	Died
	Klamath Basin	18 Sep.–22 Oct.	35	Survived
1988	Sacramento Valley	5 Sep.–11 Oct.	37	Survived
	Sacramento Valley	6 Sep.–7 Oct.	32	Survived
1989	Sacramento Valley	31 Aug.–25 Sep.	26	Died
	Sacramento Valley	1 Sep.–30 Sep.	30	Survived
	Klamath Basin	8 Oct.–12 Nov.	36	Survived

[a] Sedentary Period = length of time ducks did not fly and includes 2-d preflightless interval, approximate 25-d flightless interval (unless killed), and variable length postflightless interval.

the Sacramento Valley after regaining flight. In both locations, the ducks molted in marshes dominated by tule bulrush (*Scirpus acutus*), cattail (*Typha* spp.) or barnyardgrass (*Echinochloa crusgalli*); in the Valley, the marshes were few and small (<10 ha). We caught five unmarked molting adult female pintails during drive-trapping on Delevan NWR.

Molting ducks remained within individual or adjacent ponds during the sedentary period, which averaged 36 ± 2 (SE) d in length for survivors (Table 1). Sedentary periods for the two ducks in the Klamath Basin began later, but were of similar duration to those in the Sacramento Valley (Table 1).

One radio-marked duck died on Delevan NWR in 1987 and another on Sacramento NWR in 1989, both in late September (Table 1). We found the defleshed carcass of the former floating in water; the radio harness and several bones were broken and chewed, and the primary feathers were incompletely grown (5–8 cm). The other carcass was not found whole, but the harness was broken, and bones and feathers (including nonremige blood quills) were scattered within emergent vegetation. Harness damage indicates that mammalian predators probably caused these deaths. Raccoons (*Procyon lotor*), mink (*Mustela vison*), coyotes (*Canis latrans*) and river otters (*Lutra canadensis*) were present on the refuges. The two deaths yielded a DSR during the 36-d sedentary period of 0.9934 (95% CI = 0.9843–1.0000, exposure days = 303). The corresponding SPSR was 0.79 (95% CI = 0.57–1.00).

Primary feather 9 of captive females grew an average 4.2 ± 0.2 mm (SE) per day (6.3 ± 0.4 mm per day during the first 14 d, 4.8 ± 0.1 mm per day during the next 12 d, and 1.7 ± 0.2 mm per day during the last 15 d). These feathers reached 76% of their ultimate lengths in 25 d.

Mean body mass of captured premolt females did not differ among years ($F_{2,7} = 0.21$, $P = 0.825$); the pooled mean ($n = 10$) was 770 ± 30

g (SE). Body mass did not differ between molting and nonmolting females among years ($\bar{x}$ = 780 ± 5 g) ($F_{5,194}$ = 1.38, P = 0.232). Molting ducks that died while flightless tended to weigh less ($\bar{x}$ = 660 ± 15 g) at capture than those that survived ($\bar{x}$ = 780 ± 25 g) (t = −2.26, 7 df, P = 0.061).

DISCUSSION

Small numbers of migrant adult female pintails and Northern Shovelers (*A. clypeata*) (Smith 1977), Gadwalls (*A. strepera*) (Chabreck 1966, Lebret 1952), Green-winged Teals (*A. carolinensis*) (Rogers 1967), and Eurasian Wigeons (*A. penelope*) (Lebret 1952) have been found molting on fall migration and wintering areas. These early arrivals to the wintering grounds may be late-nesting successful hens (Gilmer et al. 1977; Oring 1964, 1969), which are the last to molt (Leafloor 1989, Oring 1969, Sowls 1955).

The number of premolt females present on Sacramento Valley NWRs, including those that ultimately flew north to the Klamath Basin, is probably small. For example, if the total number of pintails counted on the refuges during the trapping period was about 50,000 (U.S. Fish and Wildlife Service, NWR Narrative Reports, Willows, California), 6% were females (Miller 1985), few young pintails were present (Miller 1986), and 5.5% of adults were premolters (this study), then only 165 premolt adult females would have been present. This value might be low because females that were flightless during trapping, or had already flown to the Klamath Basin, would not have been available for capture on the open dikes where we trapped. Observability of molting Pintails was poor. We saw none of the five molting ducks we captured until they surfaced in the drive-trap, and a radio-marked female in the pond eluded capture, and we never saw her. The limited permanent marsh in the Sacramento Valley may limit numbers molting there.

The DSR for female pintails during the sedentary period (0.9934) is similar to values reported for molting female Mallards in Minnesota (0.9979; 95% CI = 0.9950–1.0000, n = 50) (Kirby and Cowardin 1986) and for female Black Ducks during their post-rearing period in Maine (0.9954; 95% CI = 0.9890–1.0000, n = 19) (Ringelman and Longcore 1983). We caution, however, that our small sample precludes broad application of our results. We did not statistically compare our survival rates against published values because of our small sample; all confidence intervals overlapped and period lengths differed among studies.

Length of remige blood quills (up to 8 cm) of the duck that died on Delevan NWR, indicated that growth was occurring for about 13 d (4.2 mm per day). Adding 2 d for premolt and 2 d with no feather growth, the bird should theoretically have been sedentary for 17 d instead of the 26 d that we documented. Thus, the premolt period may have been longer than the sum of the 2-d period of behavioral flightlessness and the 2 d of no quill growth after old remiges are shed; feather growth in the wild may have been slower than in our captive ducks (Pehrsson 1987), the radio-marked duck could have died earlier than we estimated from carcass

condition (our radios did not have mortality sensors), or the duck may have extended its sedentary period as part of behavioral adjustments to the radio package (Gilmer et al. 1973).

Studies of wintering ducks reveal a direct correlation between body mass at time of capture and subsequent survival (Conroy et al. 1989, Haramis et al. 1986). Molting pintails in our study showed a similar trend. Small sample size complicates this interpretation (results marginally nonsignificant), however, and survival rates of molting pintails in the Sacramento Valley may differ from those in more traditional areas (Fuller 1953, Oring 1964, Sterling 1966), including the Klamath Basin. Molting pintails used typical habitats with dense concealing emergent vegetation (Gilmer et al. 1977; Oring 1964, 1969). The few small marshes in the Sacramento Valley perhaps concentrated molting birds, however. Body parts of ducks were common surrounding ponds suggesting intensive predator activity.

Early, rapid feather growth, in contrast to a uniform growth rate, shortens the time to attain flight, which normally occurs before quills have reached full length (Leafloor 1989). This growth pattern and low body mass (Miller 1986) may be anti-predator adaptations (Pehrsson 1987, Sjoberg 1988). The attainment of 76% of ultimate primary length allows flight in Eurasian Teals (*A. crecca*) (Sjoberg 1988), Mallards (Owen and King 1979, Panek and Majewski 1990), and presumably pintails. Sowls (1955) reported that five of seven captive molting Northern Pintails flew out of an open-topped pen on the 27th day after becoming flightless (includes the 2 d of no quill growth). Average growth rate of primary feathers in our pintails was similar to that reported for some Mallards (Owen and King 1979, but see Panek and Majewski 1990, Pehrsson 1987) and Eurasian Teals (Sjoberg 1988). Growth was also more rapid early in the flightless period as shown for American Black Ducks (Bowman 1987) and teals (Sjoberg 1988).

The estimated 25-d flightless period for pintails was between the 21-d period reported for Eurasian and Blue-winged (*A. discors*) Teals (Oring 1964, Sjoberg 1988) and the 29–32-d periods for Black Ducks and Mallards (Bowman 1987, Owen and King 1979, Panek and Majewski 1990, Pehrsson 1987). Thus, flightless period lengths may roughly correlate with body size and affect species survival probabilities during molt.

The origin of Northern Pintails molting in the Sacramento Valley should be determined; the location at which hens molt may reflect the chronology and success of individual nesting seasons (Leafloor 1989, Sterling 1966), as well as tradition (Hochbaum 1955) and, perhaps, habitat quality over broad regions. For example, one female that molted in the Sacramento Valley had been leg banded as an adult during molt in late August the previous year in the Northwest Territories, Canada.

Additional field work with larger samples of pintails is necessary to derive more precise, and perhaps more accurate, estimates of survival during wing molt. Information on the length of premolt and postflightless intervals, feather growth rates and the effect of body mass on survival is

urgently needed. This work should be concentrated in traditional regions where large numbers of molters are present.

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ASSOCIATION OF FIELD ORNITHOLOGISTS AMERICAN BIRDING ASSOCIATION JOINT MEETING

The Association of Field Ornithologists and the American Birding Association will hold a joint meeting at Connecticut College, New London, Connecticut on October 2–4, 1992. The program will include a symposium on conservation of neotropical migrants and workshops on field techniques. One and two-day field trips will follow the meeting. For information write Robert Askins, Box 5461, Department of Zoology, 270 Mohegan Avenue, Connecticut College, New London, CT 06320.