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Maturation and Variation of Head Characteristics in Sandhill Cranes

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ABSTRACT.—We evaluated eye color, bill color, and head plumage characteristics in 836 known-age Sandhill Cranes (*Grus canadensis*) captured in Florida between 1974 and 1995. Eighty-three birds were recaptured 1–16 years later. There were noticeable variations in eye color and head plumage among individuals and between birds 20 months or less of age and those 21 months and older. These variations may be representative of the relatively high genetic diversity in Sandhill Cranes and be criteria for mate selection. *Received 10 August 1997, accepted 29 Oct. 1997.*

Birds that exhibit delayed onset of reproduction may go through a series of plumage changes before attaining their characteristic adult appearance. Sandhill Cranes (*Grus canadensis*) are sexually mature at two to three years, but gross plumage characteristics distinguish juveniles from adults only in their first year (Tacha et al. 1992). Adults are pale mouse gray to ashy slate gray with a gull gray to white cheek, an unfeathered crown of begonia rose, and a pallid to mouse gray nape (Ridgway and Friedmann 1941) that may be darker in some populations. The mikado brown natal plumage is gradually replaced with pale mouse gray plumage through fall and winter of the first year (Tacha and Vohs 1984, Tacha et al. 1992). Iris color at hatching is dark raw umber, changing during the first year to orange (Tacha et al. 1992). The flesh-colored bill of hatchlings changes to a dark drab gray, fading to olive gray in the mid-mandibular area in adults (Tacha et al. 1992).

After January of their first year, juveniles cannot be easily distinguished at a distance from older birds (Lewis 1979). In hand, how-

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ever, individuals can be separated into four year classes: juvenile (3–12 months), first year subadult (12–24 months), second year subadult (24–36 months), and adult (≥ 36 months) based on plumage and molt characteristics (Lewis 1979, Nesbitt 1987).

Adult-plumaged Sandhill Cranes captured in Florida for other studies (Williams and Phillips 1972, Nesbitt and Williams 1990, Nesbitt and Carpenter 1993) showed variations in iris, cheek, bill, and nape coloration. We began recording head characteristics as part of routine handling in 1974 to investigate the possibility that these variations might be useful for aging birds beyond the first year. The opportunity to recapture some of the cranes made it possible to follow the changes in these head characters as individuals aged.

STUDY AREA AND METHODS

Greater Sandhill Cranes (*G. C. tabida*) and nonmigratory Florida Sandhill Cranes (*G. c. pratensis*) were captured on or near Paynes Prairie, Alachua County, Florida using oral tranquilizers applied to whole kernel corn (Williams and Philips 1973, Nesbitt 1984, Bishop 1991). Hatch dates for most eastern Greater and Florida Sandhill Cranes are from early March to late May (Tacha et al. 1992); so, 1 April was assigned as an arbitrary hatch date for all birds. The cranes were segregated into seven age groups (3–6 months, 6–9 months, 9–12 months, 12–18 months, 18–24 months, 2–3 years, > 3 years) based on date of capture or wing molt.

Iris color was compared to a color guide (Smithe 1975–1981) and ranked as amber, buff, buff-yellow, orange-yellow, spectrum orange, chrome orange, or flame scarlet. Clarity of the white cheek patch was ranked as not present (all gray), poorly defined (more gray than white), fairly well-defined (more white than gray), or well-defined (all white). The occipital area of the nape was evaluated for the presence or absence of brown (persistent juvenile plumage) or white feathering. White feathers in the nape were ranked as not present, 1–12 feathers, 12 to 24, > 24, or a more or less complete line.

The birds were individually color marked (Nesbitt et al. 1992) and banded with standard USF&WS numbered leg bands. Cranes were held until they recovered from the tranquilizer and then returned to the area of capture. Subsequent to marking, sex and population of origin were determined based on behavior and resighting location, respectively (Nesbitt et al. 1992).

RESULTS

Between 1974 and 1995, 836 known-age cranes were evaluated. Forty-seven birds first captured as adults were recaptured 1–16 years later [($\bar{x}$ = 3.6 ± 2.8 (SD) years], and 36 birds that were initially captured as juveniles or first-year subadults were recaptured as adults.

The most frequently occurring iris colors among adult cranes were chrome orange, flame scarlet, or spectrum orange, in descending order of frequency (Table 1). Juvenile iris color progressively lightened from amber to buff-yellow then darkened to spectrum orange or chrome orange by the middle of their second year. Two-year-old cranes showed a greater frequency of orange yellow than adults, but, by the third year, iris colors occurred at rates similar to adults. Remnant juvenile brown feathering persisted in some birds beyond the second year, but 83% had no brown feathers after 18 months (Table 1). Forty-three percent of the adult cranes showed some white feathering in the nape, with 7% showing a distinct line of white feathers across the nape. White feathering began appearing as the brown juvenile plumage was replaced, and, by 18 months, the rate of occurrence was similar to that of adults (Table 1). Cheek clarity rankings in 2–3 year olds and adults were similar; most (88 and 85% respectively) were either more white than gray or all white (Table 1). Ranking of juvenile cheek clarity was predominantly (100–66%) not present or mostly gray. Cheek clarity in one- to two-year old cranes approximated that of adults, with 77% ranked as more white than gray or all white.

The mean age after which no further changes in iris color were seen was 19.0 (± 4.1 SD, range 12–24) months for birds banded as juvenile or first year subadults and recaptured as adults. Cheek clarity became stable at 16.7 (± 4.4 SD, range 9–24) months. Brown feathers were no longer present in the nape at a mean age of 19.6 (± 3.8 SD, range 10–24) months. White feathering in the nape became fixed after a mean age of 16.5 (± 4.6 SD, range 10–24) months. Too little variation in bill color was noticed for it to be a useful characteristic.

Cranes initially banded as adults and recaptured one year or more later showed little change in any characters evaluated. Iris color and cheek clarity ranked the same in 97.9% of the recaptures; white feathering in the nape was the same in all recaptured cranes. The only case of iris color change (interval six years) was from chrome orange to flame scar-

TABLE 1. Occurrence (%) of head characteristics in Sandhill Cranes from Florida, 1974–1995.

Months of age (n)	Iris color[a]							Cheek clarity[b]				Nape									
												% Brown					# White				
	AMB	BUF	BUF YEL	ORG YEL	SPE ORG	CHR ORG	FL SCAR	NP	PD	FWD	WD	NP	10	11–30	31–50	>50	NP	1–12	13–24	>24	Line
3–6 (30)	20	37	32	10	10	00	00	60	40	00	00	04	04	07	14	72	45	35	14	07	00
6–9 (84)	08	14	46	08	21	01	00	21	68	10	01	02	09	18	23	48	14	51	15	21	00
9–12 (104)	04	11	38	13	16	16	02	21	45	28	06	04	17	25	28	27	21	40	18	19	03
12–18 (99)	01	02	13	18	36	27	02	00	21	45	34	55	29	15	01	00	43	32	01	09	14
18–24 (127)	00	00	08	21	20	40	10	00	26	45	29	83	16	02	00	00	52	35	08	02	04
24–36 (92)	00	00	04	08	24	48	16	01	14	53	33	92	08	00	00	00	61	25	07	01	06
>36 (300)	00	00	01	04	16	53	26	00	15	44	41	100	00	00	00	00	57	25	06	01	07

[a] Iris colors are AMB, amber; BUF, buff; BUF YEL, buff-yellow; ORG YEL, orange-yellow; SPE ORG, spectrum orange; CHR ORG, chrome orange; FL SCAR, flame scarlet.
[b] Cheek clarity: NP, not present, all gray; PD, poorly defined, more gray than white; FWD, fairly well defined, more white than gray; WD, well defined, all white.

let. The only case of change in cheek clarity was in a bird ranked as more white than gray initially, then mostly gray when recaptured one year later. These two changes in ranking, out of 47 recaptured adults were both near enough to their initial rank to suggest that the change may have been due to ranking error rather than to any actual change in the characters as a consequence of aging.

There were no significant differences between iris color ($P > 0.05$, $\chi^2_3 = 0.604$), white feathering of the nape ($P > 0.05$, $\chi^2_3 = 1.523$), or cheek clarity ($P > 0.05$, $\chi^2_3 = 3.976$) between Greater ($n = 35$) and Florida Sandhill Cranes ($n = 44$). Variation in iris color was not influenced by gender [$P > 0.05$ $\chi^2_2 = 1.569$ ($n = 53$ ♂, 51 ♀)]. White feathering in the nape and cheek clarity were also not affected by gender ($P > 0.05$, $\chi^2_3 = 2.608$, and $\chi^2_2 = 1.189$, respectively).

DISCUSSION

The four head characters we evaluated became fixed at 16 to 20 months and did not change further as the birds aged. The variations found in iris color, nape, and cheek characters were not associated with population or gender. These variations may be a sign of comparatively high genetic diversity within the populations of Sandhill Crane we evaluated. Genetic diversity indices for Florida and Greater Sandhill Cranes are high (heterozygosity 0.125 and 0.067 respectively) when compared with other crane species or to other populations of Sandhill Cranes (Dessauer et al. 1992).

Tacha (1988) found that cheek clarity affected social status in juveniles. Juveniles still in family groups during winter and spring had gray cheeks, while juveniles that were alone had white flecks in the cheek patch. He also found a lower than expected occurrence of completely gray cheeks in paired or parent cranes suggesting that the absence of white in the cheek may be a disadvantage for pair formation in adults.

Cheek patch color may function as a signal of social status in juveniles or as a sign of fitness in older birds as Tacha suggested. But, if greater variability of cheek patch color and other head characters within populations reflect greater overall heterozygosity, then these characters could also be important criteria for

mate selection. A mate choice system that favors increased heterozygosity may increase resistance to disease (Jarvi et al. 1995). A mating system that tends to maximize genetic heterozygosity could also facilitate the ability of a species to adapt to a changing environment and have other advantages.

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