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AUTUMN SANDHILL CRANE MIGRATION IN SOUTHEASTERN OREGON

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Abstract: Each autumn, from 2,000 to 3,000 greater sandhill cranes (*Grus canadensis tabida*) of the Central Valley Population congregate on Malheur National Wildlife Refuge. Migratory behavior, flock sizes and arrivals and departures from this important autumn use area were observed for 13 years (1970-1986). Average size of flocks arriving from the north was 15.7, with those arriving from the southwest averaging 7.4. Flocks departing for California wintering areas averaged 9.2, but as smaller groups merged, flock sizes increased to 24.8 (35 km southwest from the departure area). Most flights were at speeds ranging from 56 to 88 kmh⁻¹, at altitudes ranging from 150 to 900 m. If favorable habitat and weather conditions occurred in September and October, *en masse* migrations generally did not occur until November. Most southward departures occurred when winds aloft were from a northerly quadrant but wind direction was less important for birds arriving onto the refuge.

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Malheur National Wildlife Refuge (NWR), Harney County, Oregon is the most important autumn use area for the Central Valley Population of greater sandhill cranes. In July and August, cranes begin congregating on refuge grain fields and by mid-October, 2,000 to 3,000 are often present (Littlefield 1986). Depending on food supplies, roost site availability, weather conditions and human disturbance, cranes have lingered into mid-November and on rare occasions into December. If inclement weather "grounds" cranes for periods in late October or early November, a spectacular migration frequently occurs once favorable migratory conditions return. On days after these periods, a major percentage of these birds often migrate *en masse* for their California wintering areas.

Williams (1970) and Nesbitt (1975) reported on the spring departures of sandhill cranes in Florida, while Walkinshaw (1960), DeVore (1972) and Patterson (1978) discussed spring and autumn flock sizes in the midwest and eastern United States. But little information has been available on migratory behavior, flock size and arrivals and departures of sandhill cranes from autumn staging and traditional use areas.

The U.S. Fish and Wildlife Service has provided financial support for sandhill crane studies on Malheur NWR for the past 21 years, and I am extremely grateful. In addition, staff and students at Malheur Field Station helped in various ways during the study. I would like to express my appre-

ciation to these, in particular Gaylin Holloway and Susan Lindstedt.

STUDY AREA

The primary study area was in the Blitzen Valley, which extends 60 km southward from refuge headquarters. Within the narrow valley occur numerous marshes and meadows, interspersed with shrub-grass uplands. Normally about 325 ha of cereal grains are planted annually, and cranes congregate on these grain fields in autumn, and at least 80% of the Central Valley Population spend some time on the refuge before migrating.

The climate on the refuge is semi-arid with most precipitation occurring November through January, and May and June. Average annual precipitation is 23 cm. Summer temperatures seldom exceed 35°C. The hottest, driest months are normally July and August, with cooler temperatures and increased precipitation beginning in September. By December, all waters, except those fed by springs, become ice covered. The last sandhill cranes usually migrate southward as soon as ice begins forming on roost sites.

Adjacent to the Blitzen Valley on the west, Jackass Mountain rises to 1,648 m over which cranes must fly to reach Catlow Valley. Catlow Valley has mostly level terrain, sloping upward to Hart Mountain, Lake County, on the west. In the south-central portion of the valley, Beattys Butte, Harney

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County, provides a prominent landmark and cranes migrate between the butte and Hart Mountain.

METHODS

Since 1970, data have been collected on autumn crane use at Malheur NWR, with extensive observations in 1970 and 1982. Little information was collected in 1971, 1972, 1973, 1976 and 1986.

During the study, observations were confined to an area from Malheur NWR Headquarters (ca. 30 km south of Burns, Oregon), south to Catlow Valley (ca. 70 km south of refuge headquarters). The area within these limits included both arrival and departure corridors, major feeding areas and most roost sites.

Observations were primarily with 7 X 35 binoculars. When weather conditions were conducive for migrating, cranes were examined for migratory activity at their concentration areas. If cranes initiated soaring, an observation point was established south of the area and flock sizes were recorded. On occasion, flocks were followed by vehicle to Catlow Valley. Observations were terminated in north Catlow Valley because of inaccessibility. All times were recorded as Pacific Standard Time (PST).

Weather data were obtained from the NOAA Station in Burns, Oregon and personnel observations.

RESULTS

Movement Onto Staging Area

Sandhill cranes have been observed flying toward Malheur NWR autumn use areas as early as 5 August (1977), when 8 birds were observed flying southward 13 km west of headquarters. Several hundred cranes frequently congregate in this region before moving onto the primary staging area. Drought conditions, accompanied by poor cereal grain production, persisted through the 1977 growing season and this likely contributed to this early flight.

Cranes moving onto the staging area from the north usually appeared from mid-September through mid-October. Of 145 arriving flocks, 27 (18.6%) were seen in September and 118 (81.4%) in October. In addition, Brad Ehlers (pers. comm.) observed 5 cranes on 5 October 1981 and 2 on 1 October 1983 moving onto the refuge from the east-northeast.

Usually birds arrived from the north over an

extended period with no mass movements onto the staging area. An exception occurred on 28 September 1982, when an estimated 450 passed over Headquarters at 0700 hours, arriving at the staging area at 0745 hours. A frontal system which moved through the area at 0500 hours, accompanied by strong northwesterly winds and cooler temperatures, was believed responsible for this flight. During years when cranes lingered in agricultural regions north of the refuge, a pronounced increase in flocks onto the staging area occurred on opening day of the waterfowl season.

Arriving flocks from the north have been recorded between 0700 and 1740 hours, with the majority between 1200 and 1300 hours (Table 1). Smallest average flock size occurred between 1100 and 1200 hours ($\bar{n}=9$; $N=37$). The average between 1000 and 1100 hours was 13.9 ($N=23$) and between 1200 and 1300 hours 15.2 ($N=52$). There was little difference in average flock sizes in September (15.7) and October (14.4).

Cranes entering the staging area from the southwest arrived earlier in the season than those from the north. Flocks of 2 to 21 individuals ($\bar{x}=7.4$) have been seen arriving at the southern portion of the refuge from 24 August through 13 September. Unlike cranes arriving from the north, these birds did not arrive until mid-afternoon. The earliest arrival was 1500 hours, the latest 1653 hours. These individuals likely had left south Warner Valley, Lake County, Oregon (130 km southwest) in the late morning.

Migration From the Staging Area

The earliest departure from the staging area was noted on 13 September 1970. However, before this study began, cranes had been observed leaving in late August (Littlefield 1986). Of departing flocks, 4.6% left in September, 65.4% in October and 30.0% in November. Although October had a larger number of departing flocks, departing flight sizes increased in November. In September, 174 (3.4%) cranes were observed leaving the staging area, in October 2, 220 (43.6%) and in November 2, 695 (53.0%)

Earliest recorded departure was 0915 hours, while the latest was 1153 hours. Of 1,569 cranes that left, 12.2% departed between 0900 and 1000 hours, 63.7% between 1000 and 1100 hours and 24.0% between 1100 and 1200 hours (Table 2). Percentage of flocks leaving was 4.7% between 0900 and 1000 hours, 75.2% between 1000 and 1100 hours and 20.1% between 1100 and 1200 hours.

Flock sizes increased as distances from the staging area increased. Average flock size of all cranes leaving the area was 9.2 (Table 3), but approximately 35 km southwest of the staging area average flock size increased to 24.8. Combined flock sizes averaged 14.9 birds and totaled 5,275 individuals. DeVore (1972) reported the average flock size for cranes migrating over Tennessee as 26.9 birds, while flocks over Georgia averaged 22.8 (Patterson 1978). Extensive data presented by Walkinshaw (1960) through the eastern United States showed an average flock size of 24.5 birds, very similar to the 24.8 birds recorded southwest of the Malheur NWR staging area.

Migration Behavior

Typical crane behavior on days of migration was similar to that described by Williams (1970) for spring migration from Florida. Cranes left on early morning feeding flights, after which they began spiraling upward, accompanied by calling. Small flocks, family groups, pairs and single birds initiated soaring and as cranes gained altitude smaller groups combined. However, some family groups of 3 or 4 did not join and migrated as a unit. Although surface winds would often be favorable, those aloft were not and when such conditions occurred cranes typically aborted the migration effort and returned to loafing sites. Otherwise, they would form a line or chevron and fly rapidly southward. Periods of soaring continued at points along the route. Little vocalization was noted when birds were in straight flight, but soaring was accompanied by considerable calling.

Soaring was often associated with mountainous regions and was particularly evident as flocks crossed Jackass Mountain before entering Catlow Valley. Northeasterly winds uplifted against the escarpment provided ideal soaring conditions. Most flights through the Blitzen Valley were at altitudes ranging from 150 to 300 m, but once birds migrated into Catlow Valley altitudes increased to 300-900 m. Estimated flight speed ranged from 56 to 88 kmh⁻¹ (clocked by vehicle) depending on wind speed and direction. Flock leaders were usually males.

Migrating cranes usually trickled from the staging area in September and October, but there were exceptions. In the late 1960's and early 1970's, cereal grain production was limited and cranes departed earlier. In 1983, dike repairs were being made along the canals that provided water to roosting sites, not only resulting in those drying,

but also excessive disturbance. All roost sites had become mudflats by 10 October. Over 2,100 cranes were using the staging area on the morning of 11 October, but by afternoon, only 446 remained after a mass migration, and none remained after 23 October.

Normally *en masse* migrations did not occur until November. In 1982, cold temperatures, with southerly winds, periods of fog, sleet and snow prevailed 8-12 November. Early on 13 November, northwesterly winds with scattered clouds were recorded, then at 1049 hours winds switched to the northeast and an *en masse* migration ensued. In total, 1,428 cranes were counted in Catlow Valley during a 53 min period, with 98.6% passing over between 1123 and 1155 hours (Table 4). Before this *en masse* exodus, 2,136 cranes were present on the staging areas but by 1200 hours only 179 remained. Such *en masse* November migrations produced large average flock sizes. In October, average size was 15.6 for 31 flocks (N=483 individuals), while in November average size was 28.2 for 80 flocks (N=2,259 individuals).

Migration in Relation to Weather

Sandhill cranes departed from the staging area with winds from the northwest quadrat 56.3% of the time; winds from the northeast quadrat prevailed during 37.5% of the departures. Only 6.3% of observed departures occurred with wind from the southwest quadrat, while no departures were noted with southeast winds. Most *en masse* departures occurred with winds from the northeast.

Wind direction had less influence on arrivals to the staging area, particularly for birds making the short flight from the pre-staging area north of the refuge. Arrivals occurred 45.5% with northwesterly winds, and 27.3% occurred with northeasterly winds. Twenty-two percent occurred against head winds from the southwest, and 4.5% arrived when winds were from the southeast. Birds arriving from the southwest all arrived with northwesterly, southwesterly or westerly winds.

Sky conditions varied, but 39.4% arrived under clear conditions. Cold temperatures had little influence on movements onto the refuge; 46% arrived when temperatures were below normal, while the remainder arrived with normal or above normal temperatures.

Cranes usually left after a frontal passage accompanied by lower temperatures. In September, 75% migrated when early morning temperatures were 1 to 4°C below normal. Only 1 observation

was made of cranes migrating under overcast conditions; 18.8% left when sky conditions were clear, with the remainder leaving under partly cloudy skies.

Departing cranes crossed Catlow Valley through an 11 km corridor, with wind direction determining which portion of that corridor they used. When winds were from the northwest the eastern half was used, while northeasterly winds resulted in birds migrating along the western half. On 31 October 1981, 5 flocks were observed migrating southward with winds from the west-northwest, but were making little forward progress. On other occasions birds migrated west across Catlow Valley after encountering, unfavorable head winds. This behavior frequently occurred when wind direction was from a northerly quadrat at the departure site, but from a southerly quadrat in Catlow Valley.

Under the northerly wind conditions associated with *en masse* migrations, some cranes made non-stop flights to the California Central Valley. Birds that encountered unfavorable migratory conditions after departure usually landed enroute. "Grounded" cranes have been seen in autumn at Catlow Valley, Warner Valley, Modoc NWR and Big Valley, Modoc County, California, and Fall River Valley, Siskiyou County, California. On 31 October 1970, 11 were observed on a grain field at Cowhead Lake, Modoc County, California. Persistent northeasterly winds had occurred on Malheur NWR between 27 and 30 October, but had changed to the southwest on 31 October. The birds probably left Malheur NWR on 30 October, but encountered unfavorable (i.e. southwesterly) winds along the migration route. In addition, south of Ft. Bidwell, Modoc County, a local rancher reported that 30 to 40 cranes had landed on 23 October, again following a period of southwesterly winds. Snow had fallen on Malheur on 20 October and several cranes were seen unsuccessfully attempting to depart. A few cranes did apparently leave at that time but were successful only in traveling the 160 km distance to Ft. Bidwell. Other "grounded" cranes were noted at Modoc NWR (38 individuals) and Davis Creek, Modoc County, California (8 individuals) on 1 November. With 1 exception, cranes have not departed from the staging area during precipitation or fog, that being 21 individuals that left under snowy conditions on 6 October 1970.

Retromigration

Retromigration was noted on 7 occasions, each incident associated with adverse weather condi-

tions. Two were of birds returning shortly after departing from the staging area, once when 50 left at 1050 hours on 14 October 1970 under clear skies and northeasterly winds. At 1100 hours, 7 returned and 15 returned at 1106. Again on 12 November 1982, cranes departed when winds were calm, but 5 km southward the group encountered 30 kmh⁻¹ head winds and landed on a pond 19 km south of the staging area. At 1345 hours, 150 birds left the pond, flew southward briefly, then turned northward, arriving back at the staging area at 1405 hours.

On 30 October 1970, 51 cranes migrated over Jackass Mountain at 1056 hours, but at 1113 hours the entire flock returned to the staging area. Other retromigration observations have been similar; birds migrated into Catlow Valley, encountered head winds and returned to the refuge. An unusual incident occurred in 1977 when cranes migrated *en masse* ahead of an approaching low pressure system on 19 November. By 21 November, 27.5 cm of snow had fallen, and only 1 crane was present on the staging area. All snow had melted by 30 November and 2 cranes were present, but on 3 December, 57 cranes had returned. The last 4 of this group finally migrated on 15 December. Over 1,000 cranes had migrated on 19 November, but apparently a few birds became "grounded" southwest of the refuge and returned with improved weather conditions. No cranes were present north of the staging area at that time and the lateness of the season would eliminate the possibility that these 57 birds were new arrivals to the refuge. Retromigration has otherwise rarely been recorded in southeast Oregon.

Melvin and Temple (1983) reported on a radio-tagged juvenile sandhill crane that had migrated from its fledging area and was located on 3 September in North Dakota. On 17 September, it had returned to southern Manitoba. This reverse migration was believed related to hunting pressure in North Dakota.

CONCLUSIONS

Sandhill cranes using Malheur NWR apparently move onto the area from a wide geographical region, the extent of which is presently unknown. Formerly it was believed congregations were from throughout the population's nesting range (Littlefield & Thompson 1979). Recent information, however, suggest cranes nesting in the western and southern portions of their range do not use the refuge. Preliminary information does indicate that

many birds using Malheur in autumn nest in south-central British Columbia, and as long as grain production, favorable roosting and loafing sites, and limited human disturbance exist on the refuge, it will likely continue to be an important autumn use area for the central valley population.

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Table 1. Time, individual numbers and flock numbers of sandhill cranes arriving on Malheur NWR, Oregon.

Hour (PST)	No. of Individuals	Flock No. in Parentheses	Flock \bar{x}	Percent Total Flocks	Percent Total Individ.
0700-0800	50	(2)	25.0	1.4	2.6
0800-0900	27	(1)	27.0	0.7	1.4
0900-1000	50	(4)	12.5	2.9	2.6
1000-1100	320	(23)	13.9	16.7	16.9
1100-1200	349	(37)	9.4	26.8	18.4
1200-1300	789	(52)	15.2	37.7	41.6
1300-1400	156	(9)	17.3	6.5	8.2
1400-1500	65	(3)	21.7	2.2	3.4
1500-1600	30	(3)	10.0	2.2	1.6
1600-1700	42	(2)	21.0	1.4	2.2
1700-1800	20	(2)	10.0	1.4	1.1
Total	1,898	(138)	13.8	99.9	100.0

Table 2. Time, individual numbers and flock numbers of sandhill cranes migrating from the Malheur NWR, Oregon staging area.

Hour (PST)	No. of Individuals		Flock \bar{x}	Percent Total Flocks	Percent Total Individ.
	Flock No. in Parenthesis				
0900-1000	192	(7)	27.4	4.7	12.2
1000-1100	1,000	(112)	8.9	75.2	63.7
1100-1200	377	(30)	12.6	20.1	24.0
Total	1,569	(149)	10.5	100.0	99.9

Table 3. Number of birds and flocks from the staging area south to Catlow Valley, Oregon.

Year	S. Blitzen Valley 21 km S. of Departure Area		N. Catlow Valley 35 km SSW of Departure Area			
	Bird No.	Flock No.	Bird No.	Flock No.		
1970	685	100	100	6	305	17
1974	139	9	172	4	-	-
1975	67	6	7	1	-	-
1977	-	-	14	1	322	10
1978	149	3	-	-	-	-
1979	-	-	26	1	117	9
1981	-	-	47	9	146	9
1982	203	15	255	14	1,857	66
1983	643	72	21	3	-	-
Total	1,886	205	642	39	2,747	111

Table 4. Sandhill cranes recorded in Catlow Valley, Oregon during an *en masse* migration from Malheur NWR, Oregon on 13 November 1982.

Hour (PST)	Number	Hour (PST)	Number
1123	81	1138	96
1124	89	1140	159
1125	98	1141	113
1127	20	1142	75
1128	28	1147	84
1129	62	1149	20
1130	111	1151	52
1131	10	1154	38
1133	67	1155	15
1134	48	1201	4
1135	142	1215	16
Total			1,428

