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Abstract: Greater sandhill cranes *(Grus canadensis tabida)* and foster-reared whooping cranes *(G. americana)* were monitored on a 345 km migration between their traditional stopover in southcentral Colorado and their winter grounds in central New Mexico during 4 autumns (1984-87) and 1 spring (1985). Autumn sandhill crane counts totaled 17,363 in 1984, 9,317 in 1985, 29,053 in 1986, and 26,552 in 1987. Peak flights of over 7,000 cranes in 1 day were recorded in both 1986 and 1987. More than 50% of the cranes were counted on just 4 days in 1984, 1986 and 1987. At least 27% of the sandhill cranes counted stopped overnight in 1984, 58% stopped in 1986, and 46% in 1987. Most completed 225 to 280 km of the journey and roosted on rivers and mesas north of Albuquerque. Stopover rates were affected by wind speed/direction and solar radiation, but were most highly correlated with frontal movements. During the 1985 spring migration 25,890 cranes were counted. Aided by southerly winds, over 95% apparently completed the northward journey in 1 day.

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Greater sandhill crane migration has been extensively studied during the last 2 decades. Through the use of colormarkers and radiotelemetry, migration routes have been delineated for major populations in the Rocky Mountains (Drewien & Bizeau 1974, 1981) and the Great Lakes (Toepler & Crete 1979), as well as for several smaller populations (Drewien et al. 1976, Littlefield & Thompson 1979). Migration ecology of sandhill cranes has also been described (Melvin & Temple 1982). However, the dynamics of the movement of an entire population along a portion of its migration route has not been extensively studied.

This report details the 1984-87 autumn and 1985 spring migrations of the Rocky Mountain greater sandhill crane population between their traditional autumn/spring stopover in the San Luis Valley, Colorado, and their major wintering grounds in the Central Rio Grande Valley of New Mexico (Fig. 1). The presence of whooping cranes, cross-fostered by sandhill crane parents *(Drewien & Bizeau 1981)*, in this population increased the importance of understanding their migration patterns.

ACKNOWLEDGMENTS

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STUDY AREA AND METHODS

Rocky Mountain cranes spend from 4-8 weeks each spring and autumn at a traditional migration stopover in the San Luis Valley, Colorado. Their principal wintering grounds are in the Rio Grande Valley of central New Mexico (Drewien & Bizeau 1974). The minimum distance between the two areas is 345 km. Bosque del Apache National Wildlife Refuge (NWR), New Mexico is 460 km south of Monte Vista NWR, Colorado; the 2 refuges are important use areas for these cranes.

The direct route between these areas crosses uplands of pinyon juniper woodland and sagebrush grassland. Wetland habitat, preferred by cranes for roosting, is virtually nonexistent between the Colorado-New Mexico border and the Rio Chama, 190 km south of Monte Vista NWR. The Rio Chama, the Jemez River (280 km south of Monte Vista), and portions of the Rio Grande between these 2 major tributaries are potential aquatic overnight roost sites for migrant cranes (Fig. 1). My study area was

this 90 km segment of the crane migration corridor.

Crane migration was monitored from a series of observation points between Espanola and Bernalillo, New Mexico. I conducted autumn 1984 and spring 1985 counts near White Rock and Espanola and 1985-87 autumn counts near Bernalillo. I concentrated my counting efforts between 25 October and 20 November during autumn and between 12 February and 5 March in spring. Counts by others from White Rock and Albuquerque supplemented my data. Autumn migrants had completed 61% of their minimum journey at Espanola, 68% at White Rock, and 85% at Bernalillo. White Rock was also the midpoint of the 90 km long study area.

Several hilltops were used to observe cranes in the Espanola-White Rock area. Cranes were counted near Bernalillo as they (1) passed over the area during mid- to late afternoon and continued on to the wintering grounds, (2) arrived at the Jemez Roost in late afternoon and evening, and (3) departed the study area the following morning from roosts other than the Jemez Roost. I could move along State Highway 44, an east-west roadway, and remain near the cranes' flight line under most conditions.

Migrating cranes were found by listening for their distinctive call, then finding them with binoculars. Even when cranes could not be heard, the sky to the north (autumn) and south (spring) was scanned at regular intervals. Sandhill cranes were counted, whooping cranes were noted, and the time and direction of flight of each flock were recorded. When cranes were migrating in large numbers, flock sizes were estimated. To get a correction, the number of cranes in passing flocks was estimated, then counted during lighter periods of migration, and estimated and actual numbers compared with a x^2 test. Estimating was greatly curtailed in 1987, resulting in more conservative counts but less potential for estimation error.

During 1984 and 1985 the frequencies of radio transmitters attached to whooping and sandhill cranes (Drewien & Bizeau 1981) were monitored with a scanning receiver. This allowed documentation of the passage of individual birds and, more importantly, the movement of cranes even when flocks were not sighted. Finally, early morning helicopter flights were used 9-11 November 1984 and 9 February 1988 to locate major crane roosts.

Weather data for the autumns of 1984-87 were taken from monthly summaries for National Weather Service stations at Alamosa, Colorado and Albuquerque, New Mexico and for a Los Alamos National Laboratory station at White Rock, New Mexico. The effect of weather on cranes choosing to either stopover within or overfly the study area was tested using stepwise regression. Factors tested included wind speed and direction at 1100 (Alamosa), 1400 (White Rock), and 1700 (Albuquerque) hours, percent cloudcover (and thus thermal activity) in the morning (Alamosa) and afternoon (Albuquerque-White Rock mean), and the position of cold fronts in relation to the study area. The sample was stratified over several levels of migration intensity. A variable had to have a 0.15 significance level for entry into the model.

RESULTS

Autumn Migration – Autumn counts of migrating sandhill cranes totaled 17,363 in 1984, 9,317 in 1985, 29,053 in 1986, and 26,552 in 1987 (Figs. 2-5). Eighteen whooping cranes were documented in 1984, 8 in 1985, 15 in 1986, and 9 in 1987. The Rocky Mountain greater sandhill crane population was estimated at 17,000 to 20,000 while the western whooping crane population declined from 32 to 22 over the same period (R. Drewien pers. comm.).

Although some migration occurred in October of each year, the majority of the cranes migrated during the first 3 weeks of November. In fact a large proportion of the birds migrated in only a few days. A flight of 7,557 cranes on 9 November 1986 was 26% of the 1986 total count while 7,395 cranes on 8 November 1987 was 29% of that autumn's total count. During 1986 and 1987, when coverage was most complete, 71% and 77%, respectively, of the cranes were counted in just 4 days (Figs. 4 & 5). In 1984 the highest 4 days accounted for 50% of the total count (Fig. 2).

An important aspect of this study was the documentation of preferred overnight roost sites along this migration corridor. In the northern half of the study area the Rio Chama and Rio Grande are relatively narrow (< 75 m) and cottonwoods *(Populus fremontii)* line channels in most areas. Where viewing distances were acceptable, however, cranes did stop over . Between 29 October and 13 November 1984, 765 sandhill cranes and 2 whooping cranes were documented roosting on the two rivers. Another 220 sandhill cranes and 1 whooping crane were found roosting on the open mesas to the west of the Rio Grande. Upland roosting by both species had been previously documented (Drewien & Bizeau 1981; Ward & Anderson 1987).

Roost sites north of White Rock were not monitored after 1984. Some cranes were counted at White Rock in the mornings during both 1985 and 1986 (Figs. 3 & 4), further documenting crane use of northern roosts. On the morning of 10 November 1986 approximately 1,500 of the previous day's flight of 7,557 sandhill cranes were counted at White Rock.

Over one-half (53%) of the cranes counted in 1984 passed White Rock after 1530h, or within 2h of sunset (Fig 6). Since sandhill cranes migrate at 35-55 km/hr and usually discontinue migration before sunset (Melvin & Temple 1982), it seemed likely that a major overnight roosting area existed in the southern half of the study area. On early morning helicopter flights on 10-12 November, we located several roosting areas between Cochiti Reservoir and Bernalillo (Fig. 7). Sandhill crane use of these southern roosts during the autumns of 1984-87 is depicted in Figs. 2-5. Four whooping cranes also roosted there in late 1984, 4 more in 1985, 9 in 1986 and 2 in 1987.

The most heavily used of these southern roosts was the Jemez River above Jemez Reservoir (Fig. 7). Over 21,000 sandhill cranes, 54% of those documented roosting overnight, stopped there during the 4 autumns. The river has a wide (250-350 m) sandy channel. It also carries a shallow, narrow, but meandering stream during autumn. The channel is lined with tamarack *(Tamarix cninensis)*. Cranes also used a sandbar at the head of the reservoir, especially in 1987. Conversely, the Rio Grande exiting Cochiti Reservoir is confined to a relatively narrow (50-100 m), sometimes braided, channel for most of its 30 km run to Bernalillo. Tall cottonwoods line both banks. On the 1984 helicopter flights, 467 cranes were found roosting in the wider sections of the Rio Grande.

A minimum of 2,200 cranes roosted on the Santa Fe River portion of Cochiti Reservoir during 4 autumns. The peak count there was 600 sandhill cranes on 27 October 1987. This roost was not regularly censused during the study. We also counted 158 cranes roosting on mesas between Cochiti and Jemez reservoirs during the 1984 helicopter surveys. It was not possible to regularly count cranes roosting on mesas during the remainder of the study, but on several mornings we counted cranes flying over Jemez Dam that had roosted on mesas to the north; i.e., 130 sandhill cranes on 10 November 1986.

On 4 November 1987, 275 sandhill cranes were found roosting in the Rio Grande within the city of Albuquerque. This river section was not a part of the study area and was not regularly monitored. The river channel south of Bernalillo is broad (>200 m) and the gallery forest of cottonwoods provides some protection from the noise and human activity of Albuquerque and nearby communities.

A major portion of the sandhill cranes counted each autumn roosted overnight in the study area. In 1984, 27% of the 17 thousand cranes counted were documented in overnight roosts. Moreover, 53% of the cranes counted passed White Rock after 1530 MST in 1984, and most probably stopped in the southern roosts.

The 1985 crane count was incomplete. During the final two years of the study, when coverage was most complete, 59% (1986) and 46% (1987) of the cranes counted stopped overnight within the study area.

Weather influences crane decisions of whether to complete this 345 km journey in 1 or 2 days. On 49 days, I recorded crane flights of more than 100 birds; 32 days with flights of more than 500 cranes and a summary of weather conditions on those dates are in Table 1. A series of stepwise regressions were run at 4 levels of migration intensity utilizing direct counts and the stopover/overflight ratio (Table 2). Frontal position (approaching or past) contributed to 11 of 12 models and was largest in 10 models. It was most important for flights of >1,000 cranes where the majority overflew the study area (r^2 = 40.3) and for the stopover/overflight ratio (r^2 = 64.4) on flights of >1,000 cranes. In the model for a >2,000 crane stopover in the study area, winds at 1400h and afternoon sunshine had a combined r^2 of 51% while for a >2,000 crane overflight, morning winds contributed an r^2 of 56.6% to the model.

Reverse migration was documented during the autumns of 1986 and 1987. During the week of 27-31 October 1986, 497 sandhill cranes were counted migrating northward over White Rock. A flock of 29 cranes flew northward over White Rock on 29 October 1987, and 145 northbound cranes were observed at Bernalillo and Albuquerque between 28 October and 15 November 1987.

Spring Migration – A total of 25,890 sandhill cranes and 14 whooping cranes were counted in the spring of 1985. Cranes were first observed migrating northward over the study area on 7 February 1985 (Fig 8). The major movement of cranes occurred between 20 and 25 February. During 5 of 6 days, southerly winds dominated and 18,489 cranes were counted (3,698/day). Mean wind speed and direction at 1100h at Albuquerque for

those 5 days was 5 m/s at 202°. The flow of cranes ceased only on 23 February when 10-15 cm of snow fell during the passage of a cold front.

Although spring migrants were counted only 1 season, the 1985 migration was apparently similar to previous spring flights for this population. In 1977, 22,263 sandhill cranes were counted passing White Rock with a peak flight of 4,215 on 3 March (Travis, J. R. 1977. Sandhill crane migration watch, Los Alamos, NM 1974-77. Typescript). Massive departures of cranes from the wintering grounds typically occur in this population (R. Drewien pers. comm.).

Most spring migrants were propelled by favorable southerly winds to Colorado in 1 day. For example, on 20 February 1985, several thousand sandhill cranes left Bosque del Apache NWR at 0930h. Four thousand cranes were counted over White Rock between 1200h and 1400h and many cranes were seen entering the San Luis Valley at 1700h that evening (M. Nail pers. comm.).

Pre-frontal winds, though favorable to northward migration, do push the cranes toward inclement weather. On several occasions in the spring of 1985, I watched crane flocks skirting or flying through snow squalls. On the morning of 8 February 1980, 340 sandhill cranes were counted retreating southward near White Rock after an all-night snowstorm. Over 1,700 northbound cranes had been counted the previous afternoon (T. Johnson pers. comm.).

Poor conditions after a storm can also short-stop cranes on the spring journey. Following the storm of 23 February 1985, snowcover limited thermals and winds were low. One hundred fifty sandhill cranes stopped along the Rio Grande north of Espanola the afternoon of 24 February and about 500 were seen in the sagebrush uplands west of Taos (Fig. 1) the next morning. It is likely that many of the 2,968 cranes counted that day had to stopover short of the San Luis Valley that night.

Some use of the Jemez and Cochiti roosts also occurs in the spring. On a 9 February 1988 helicopter flight, 40 sandhill cranes were observed in the Jemez roost and 150 more were seen at Cochiti Reservoir. There had been no recent storms, so these birds had apparently departed the wintering grounds late in the day and only completed a portion of their journey.

DISCUSSION

Counts – Brown et al. (1987) estimated that there were between 17,000 and 20,000 greater sandhill cranes in the Rocky Mountain population between 1982 and 1984. Systematic aerial counts (Benning & Johnson 1987) in the spring of 1985 in the San Luis Valley resulted in an estimate of 21,800 birds (Benning, D. S. 1986. Spring survey, Rocky Mountain population of greater sandhill cranes. U. S. Fish and Wildlife Service, typescript). The population probably declined to about 17,000 by 1987 due to poor reproduction and higher mortality (W. Brown pers. comm.). The total of 29,053 I recorded in the autumn of 1986 exceeds 21,800 by 33% and 17,000 by 71%. The 1987 count of 26,552 exceeds these population estimates by 22% to 56%.

Prior to late autumn 1986, these differences were not evident. Since crane numbers were often estimated during peak flights, over-estimation could have led to the high 1986 total count. My estimates for 56 flocks at Bernalillo in 1986 were not significantly different from the actual numbers ($c = .001$, $x2 = 38.96$) However, these estimates and comparative counts were conducted mostly on flocks containing fewer than 100 cranes. Only 12 of the 56 flocks had more than 100 and only 1 flock had more than 200 cranes. During some major flights of 1986, when estimates of 300 to 800 cranes were made, I (and cooperating counters) could have been over-impressed by large flocks of cranes, leading to a systematic over-estimation of crane numbers.

To examine this possibility, I separated the cranes I actually counted, 13,391, from the total, leaving 15,662 where some unknown level of estimation error existed. Table 3 presents several potential ranges of estimation error by myself and cooperators, leading to lower population estimates. Only at a 50% error level does the total autumn 1986 count fall below 21,800 cranes and only at 75% error does it approach 17,000. Such error levels seem excessive, and I believe that more than 22,000 cranes migrated through the study area in 1986.

In 1987 I estimated only as a last resort. I decreased the estimation proportion of the total count from 54% in 1986 to 11% (2,750 cranes) in 1987. I was also pointedly conservative in my estimates, counting cranes in groups of 10, 25, and at most 50 when large flocks were overhead. Still there were considerably more cranes migrating along this route than are in the Rocky Mountain population. Rocky Mountain greater sandhill cranes are counted in late March when virtually all of them are in the San Luis Valley (Benning, op. cit.). It is unlikely that there are 5-10 thousand more cranes than the official 1982-87 estimates.

Reverse migration could account for a portion

of the overcount. Nearly 500 sandhill cranes were counted migrating northward over White Rock during the autumn of 1986 and 176 northbound birds were counted, mostly at Bernalillo, in 1987. Even more cranes may have returned to the San Luis Valley, to be recounted on their second journey to New Mexico. However, large northward movements of cranes were not noted during autumn, and this phenomena at the documented level cannot account for the large difference between migration and population estimates.

The most logical reason for the higher counts of migrants is that lesser sandhill cranes (*G. c. canadensis*) are also using this migration corridor. Estimates of lesser sandhill cranes in the San Luis Valley in October were 2.8% in 1989 and 2.1% in 1990 (W. Brown, pers. comm.). Two to 3% of my 1986 and 1987 counts of 26,000-29,000 cranes would only be 500-600 cranes. Therefore, if lesser sandhill cranes are moving through the San Luis Valley, they are not staying long enough to be documented. Further, entry into the San Luis Valley or the Rio Grande drainage north of the study area requires an otherwise unnecessary mountain crossing. It seems more likely that lesser sandhill cranes migrating across the Great Plains turn westward south of Albuquerque and reach the Middle Rio Grande Valley without crossing the Sangre de Cristos, which terminates near Santa Fe (Fig. 1). The large difference between autumn migration counts and systematic spring aerial counts cannot be satisfactorily explained.

The spring 1985 count of 25,890 sandhill cranes was also 19% higher than the 1985 aerial count. Many lesser sandhill cranes that winter along the Rio Grande apparently join in the flight to the San Luis Valley. Though more lesser sandhill are seen there in the spring than in the autumn, usually < 10% of the cranes there in March are lessers (W. Brown pers. comm.). It seems likely, however, that the lessers do not stopover long in the San Luis Valley but quickly move on to the Platte River in Nebraska.

Consistent Use Of Nontraditional Stopovers – Despite unexplained population differences, the most important result of this study is the documentation of heavy use of overnight roosts within the study area. Melvin and Temple (1982) defined such roosts as nontraditional stopovers. They recognized that favorable roosts were consistently used each year, although not by all cranes or even the same cranes each year. They hypothesized that favorable roosts along migration routes are known by older cranes and sought out near the end of the day.

Cranes often approached the Jemez Roost by angling across the mesa from the northeast even before the river was in sight. An even stronger indication of the attraction of this roost to the cranes was encountered on some evenings with strong northwest winds. On 10 November 1986, strong northwest winds helped 2,782 cranes (Fig. 4) overfly the study area, although all were blown well to the east of the Rio Grande. At about lh before sunset, crane flocks began to break from the eastern flight line and angle to the west. Nearly 1,800 cranes entered the Jemez Roost that evening, flying more than 12 km into a strong northwest headwind (Fig. 7). On 6 other occasions between 1985 and 1987, smaller numbers of cranes (r = 19-150) were observed approaching the Jemez Roost under similar conditions.

Part of the attraction of the Jemez and Cochiti roosts may be the absence of human activity there. Public access to Jemez Reservoir is limited to an observation point near the dam, 3 km from the roost. A paved road passes about 0.8 km from the principal roost, while the sparsely inhabited old pueblo of Santa Ana is 1.2 km upstream. The road is only lightly traveled. At Cochiti Lake public access is also limited to the dam and a paved road; both are at least 400 m from areas where cranes have roosted.

Despite the presence of these "popular" roosts, cranes apparently regularly roost in uplands. One flock of 110 sandhill cranes and 1 whooping crane roosted on a mesa 5 km west of Espanola on 7 November 1984, even though the Rio Grande was clearly visible to the flying birds. Documented upland roosts were generally far (>0.5 km) from traveled roads or occupied houses.

Roosting on the Rio Grande within the Albuquerque metropolitan area was documented late in this study. Unconfirmed reports of cranes roosting in this area had been received previously and late birds counted as 1 day migrants might well have roosted south of Bernalillo but north of the wintering grounds. The gallery forest along the river provides some protection from the noise and human activity of the city. Both documented roosts were more than 0.8 km from streets or houses.

Weather and Autumn Crane Migration– Another important result of this study was the analysis of the impacts of weather on migration. A combination of factors influence the speed and timing of crane migration in northcentral New Mexico.

Season is an important factor; most cranes remain in Colorado through October even if favorable conditions for migration occur. About 75% of the cranes migrate after November 1 (Figs. 2-5).

Departure time from the San Luis Valley is also important, but could not be quantified in this study. Flocks departing late in the morning would travel less in a day and therefore be more likely to stop overnight during the journey. Favorable morning winds (r^2 = 56.6) were associated with large numbers of cranes (>2,000/day) overflying the study area (Table 2).

Weather impacts migration once the cranes are underway. Winds and, to a lesser extent, thermal activity (sunshine) affect the distance cranes travel after they leave Colorado. Unfavorable southerly winds generally force cranes to stop overnight in the study area. Favorable northerly winds push them over the area in 1 day. The effects of thermal activity are less apparent, but spiraling, then gliding is an integral part of crane migration (Melvin & Temple 1982).

Cold fronts are important because they directly affect wind speed and direction and thermal activity. Winds ahead of a front blow perpendicular to it, causing unfavorable southwesterly winds in the study area. Cranes that leave Colorado ahead of a front, although they avoid bad weather there, must fly into headwinds and are forced to stopover 1 night enroute. Birds that wait until after a front passes ride northwesterly tailwinds to the wintering grounds in 1 day, even though these winds push them well to the east of the direct line route over the study area (Fig. 7).

Reverse Migration - Autumn – On the evening of 25 October 1986, an estimated 3,600 sandhill cranes (Fig. 4) flew over the study area and arrived on the wintering grounds. That evening and the following day, a Sunday, were part of the first legal sandhill crane hunt in the Middle Rio Grande Valley in 70 years. About 300 hunters were licensed for that portion of the hunt and many were afield that weekend. During the following week, 497 sandhill cranes were counted migrating northward over White Rock. It is likely that, having flown this far north, these cranes were returning to the San Luis Valley. It would seem that a major disturbance, probably the hunt, caused the cranes to return to Colorado. This caused these cranes to make 3 autumn trips instead of the usual.

The experimental crane hunt continued in October 1987, but there was no regular observer at White Rock. A flock of 31 cranes flew northward over White Rock on 29 October, and 145 northbound cranes were observed at Bernalillo or Albuquerque between 28 October and 15 November. Some local movement of wintering birds may have been involved, but these limited observations indicate that reverse migration continued to occur in 1987.

RECOMMENDATIONS

Melvin and Temple (1982) discouraged the acquisition and management of migration stopover refuges because the distances cranes travel in a day can vary greatly. Although not as important as traditional stopovers, consistently used overnight roosts such as the Jemez River should be protected and managed to benefit migrant cranes. The presence of the foster flock of whooping cranes at this and other roosts in northcentral New Mexico heightens the importance of these areas.

Most overnight roosting areas documented herein are on Indian reservations and are relatively isolated from human disturbance. However, the growing population of Albuquerque places greater economic incentives on these pueblos to provide a variety of recreational opportunities. Illegal crane hunting was observed on several reservations during this study. Education and better law enforcement are needed to curb this activity. It is important that state and federal agencies work with tribal officials so that these stopover roosts will continue to be available to migrant cranes.

Although these roosts are on Indian lands, water management is the responsibility of the U. S. Army Corps of Engineers (COE). Both the Jemez and Cochiti roosts are within the floodpools of COE reservoirs and water management can directly affect their quality. Consideration of crane roosting habitat should be a part of all water management decisions made by COE and the New Mexico State Engineer.

This study has documented the importance of consistently-used overnight roosts to this population. Similar use of certain stopover sites by Rocky Mountain cranes between the San Luis Valley and the summering areas has also been found (H. Heusser & R. Drewien pers. comm.). Important stopover roosts on the migration routes of other sandhill and whooping crane populations should also be located. Lingle (1987) contended that suitable nontraditional stopover roosts might be a limiting factor on the Wood Buffalo-Aransas whooping crane population. The results of this study are

most applicable to those crane populations that migrate short distances (<500 km) between traditional stopovers and wintering or summering areas. As the distance migrated increases, cranes can be expected to spread out and be less likely to concentrate at particular intermediate stopovers. The use of known overnight stopover roosts by migrating cranes should be included in the management decisions at those sites on public lands. Cooperative agreements should be pursued at sites on private land.

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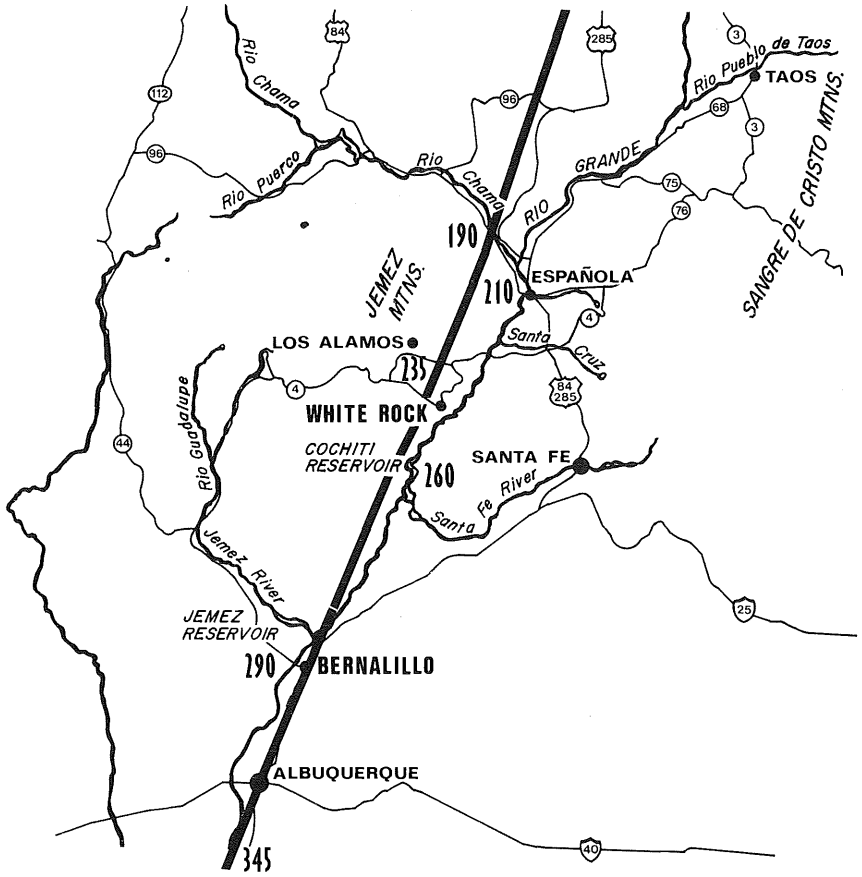

Figure 1. The migration route of greater sandhill and whooping cranes through northcentral New Mexico. Numbers indicate km from Monte Vista NWR, Colorado.

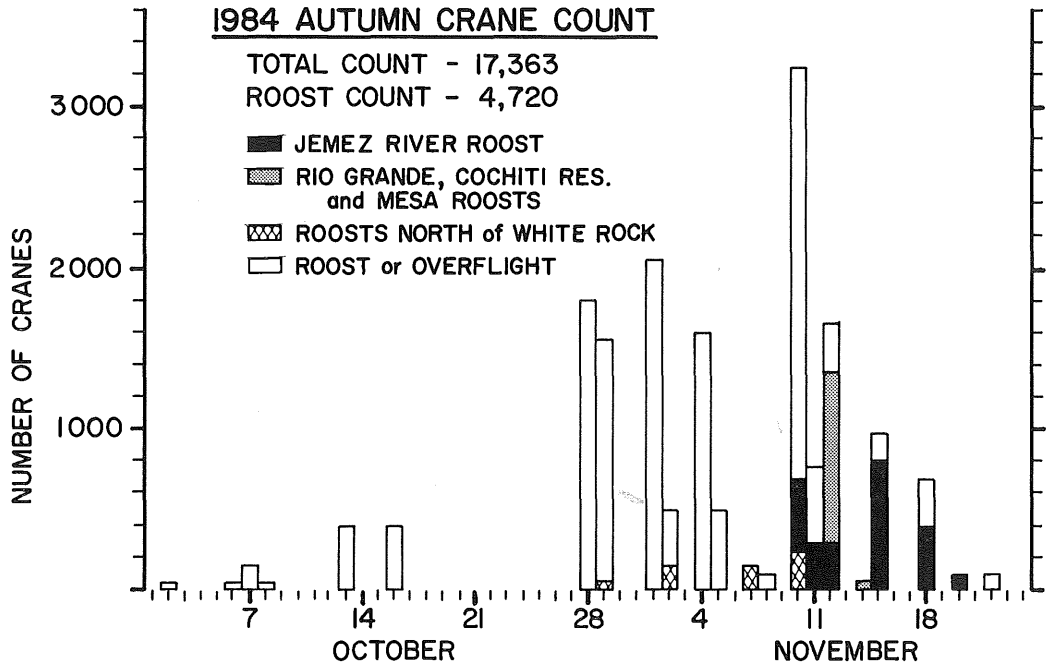

Figure 2. The 1984 autumn sandhill crane count conducted at White Rock, New Mexico.

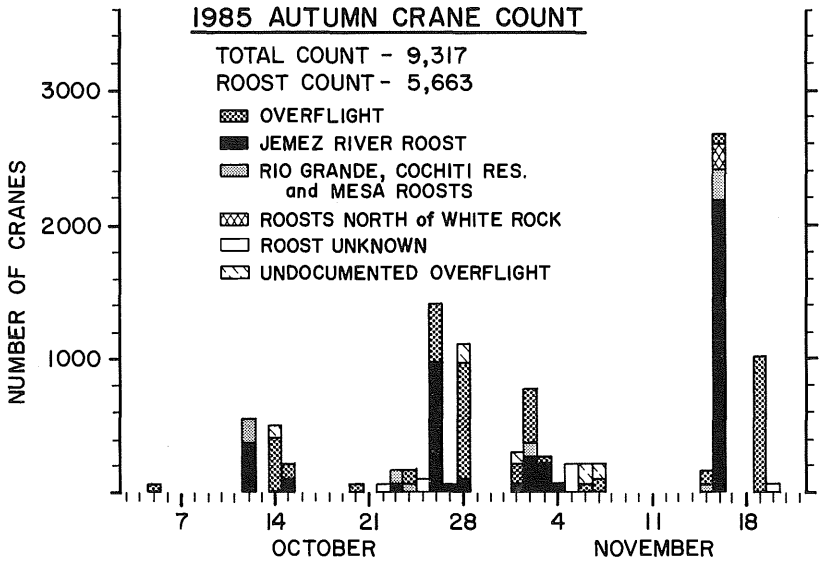

Figure 3. The 1985 autumn sandhill crane count conducted at Bernalillo, New Mexico.

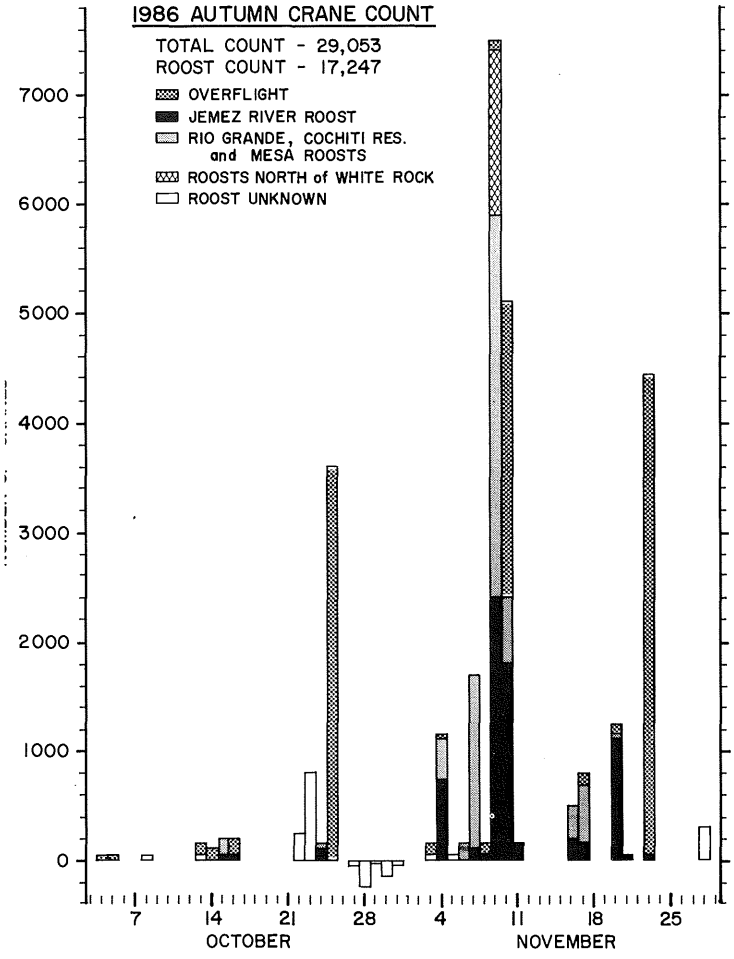

Figure 4. The 1986 autumn sandhill crane count conducted at Bernalillo, New Mexico.

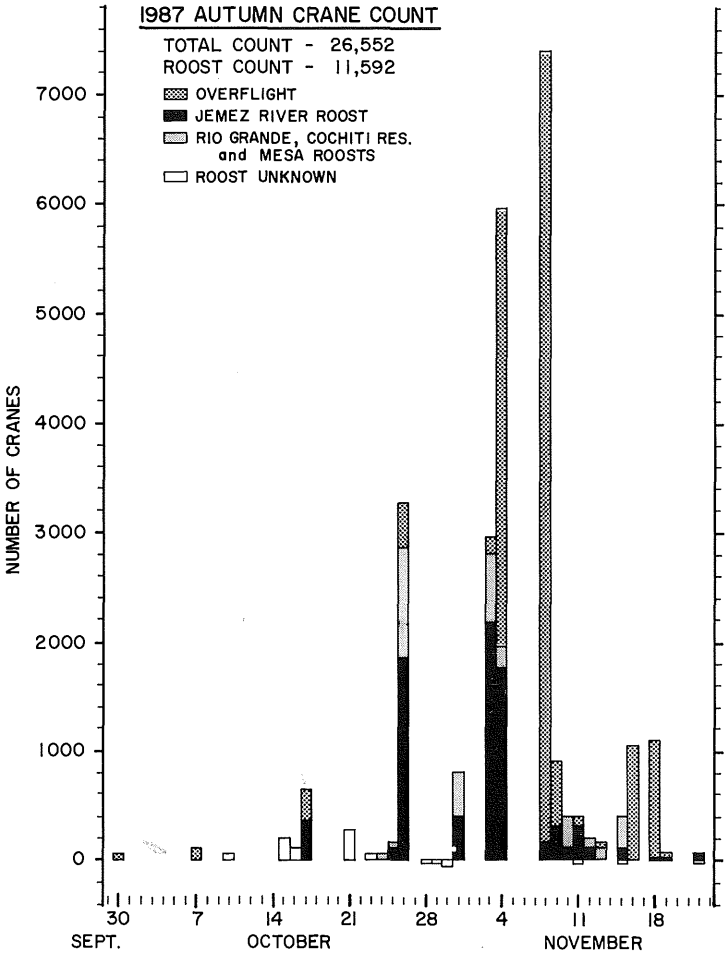

Figure 5. The 1987 autumn sandhill crane count conducted at Bernalillo, New Mexico.

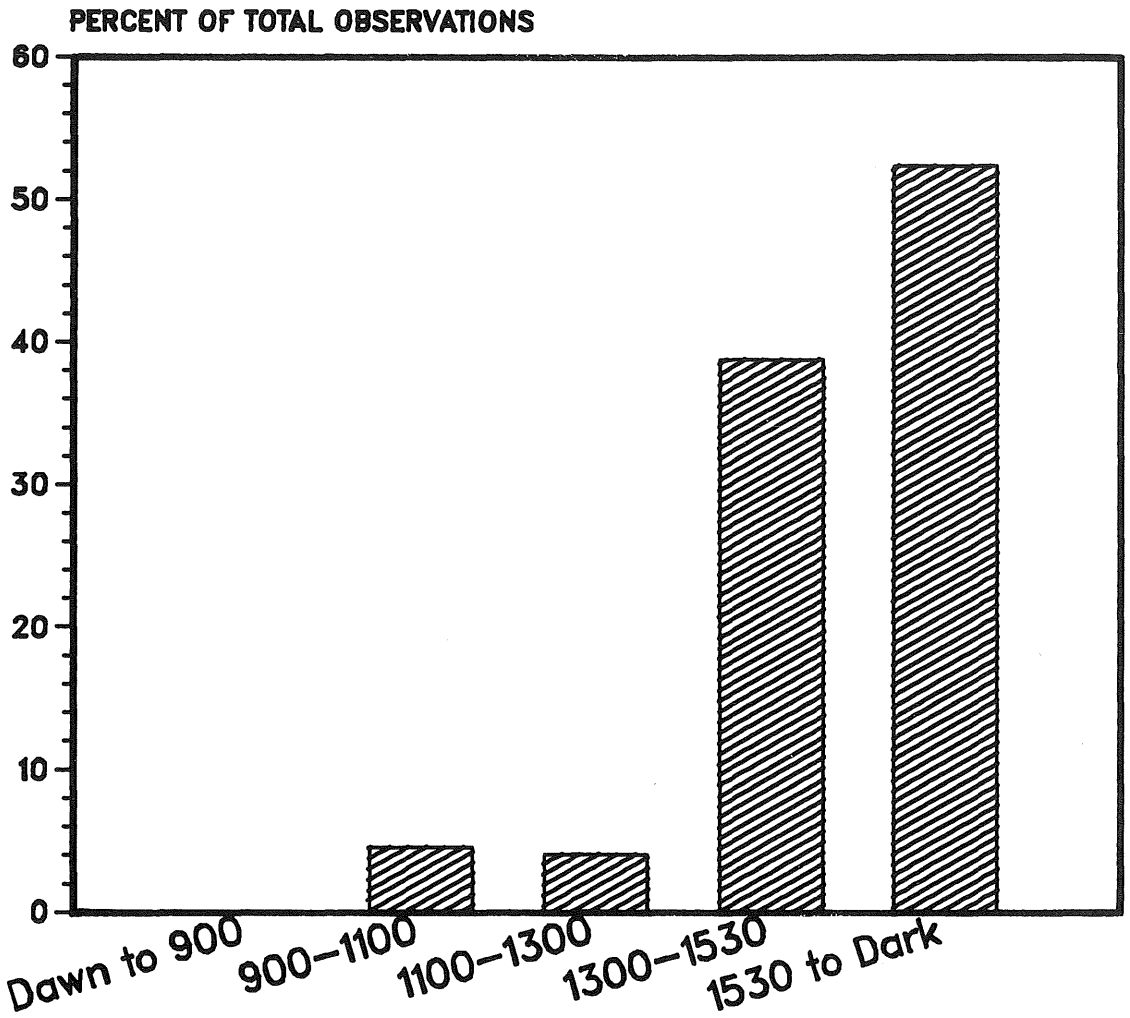

Figure 6. The distribution of the fall 1984 sandhill crane count at White Rock, New Mexico by time of day.

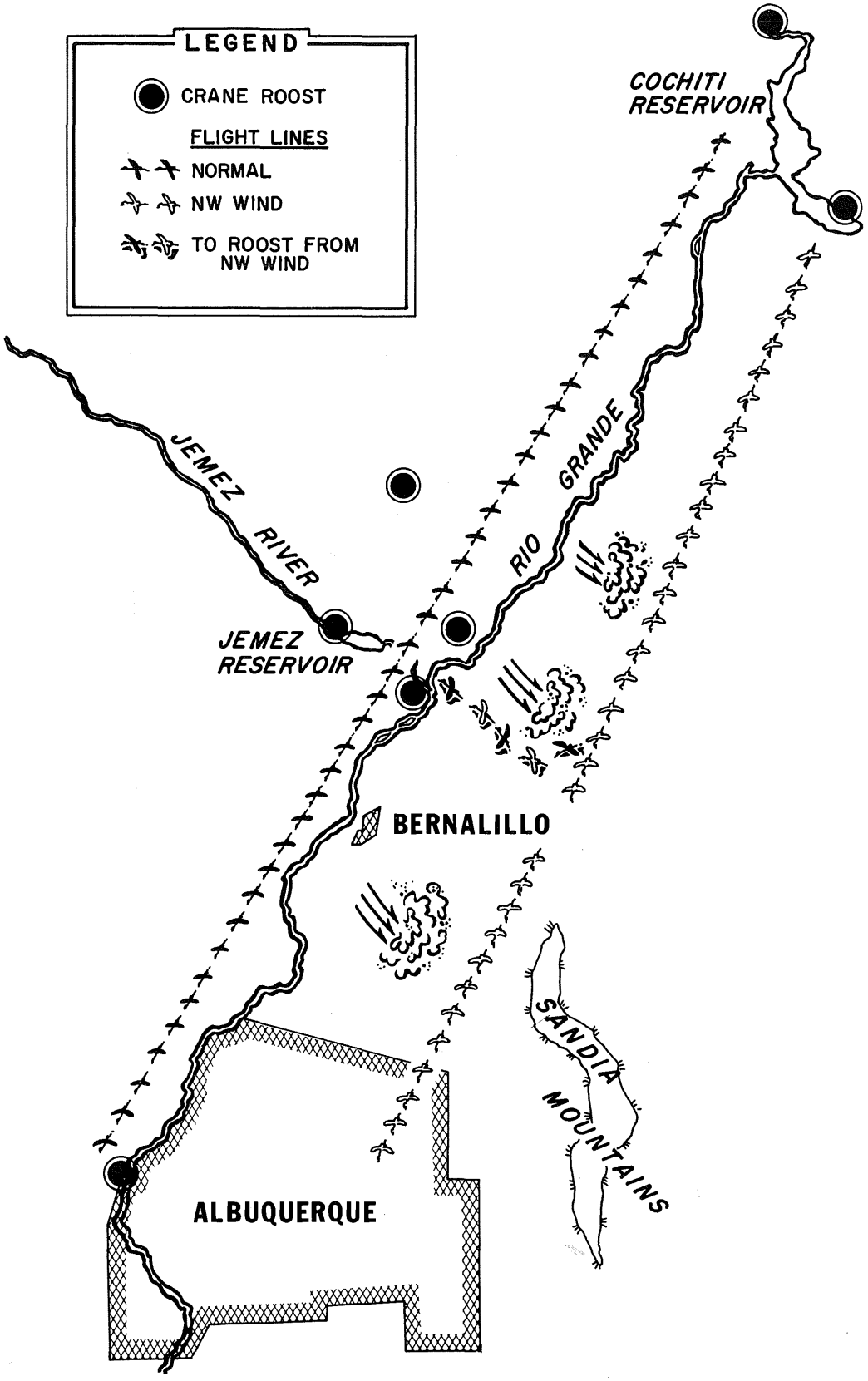

Figure 7. Documented overnight roosts and flight routes of sandhill cranes in northcentral New Mexico.

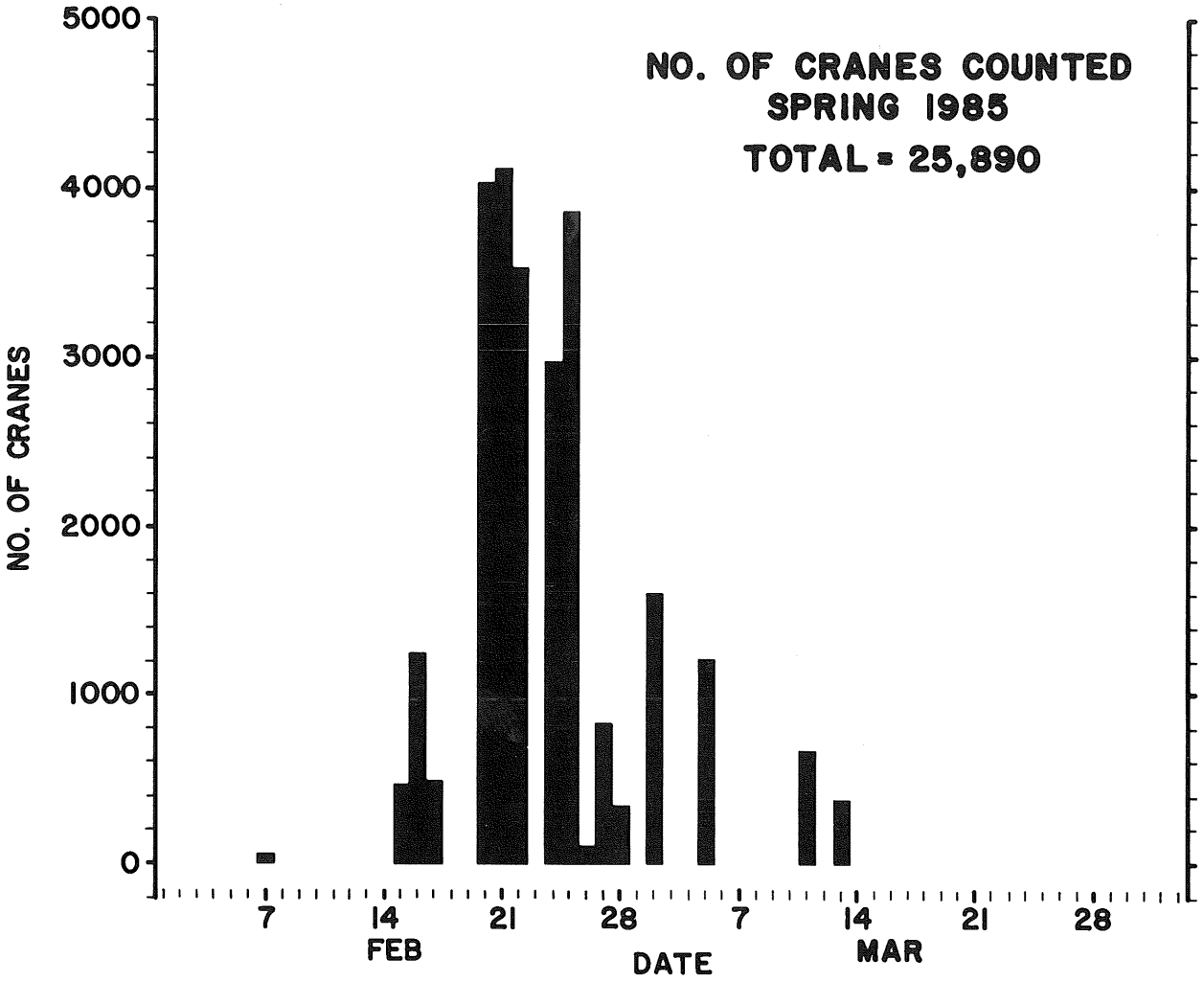

Figure 8. The 1985 spring sandhill crane count conducted at White Rock, New Mexico.