1992

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Abstract: Whooping cranes (*Grus americana*) observed immediately before the initiation of migratory flights exhibited increased alertness, wing ruffling, and head tilting. Seven observations at Aransas National Wildlife Refuge (NWR), Texas, indicate that the departure of 1 group of whooping cranes may influence other nearby cranes to start migration, even though later departing groups may fly separately.

Key Words: behavior, flight initiation, *Grus americana*, migration

PROC. NORTH AM. CRANE WORKSHOP 6:102-105

Only limited information on crane behavior prior to and during migratory flights has been published. A flock of sandhill cranes (*G. canadensis*) initiating migration was joined by smaller groups and single individuals from nearby areas (Williams 1970); Nesbitt (1975) noted that the sight and sound of migrating sandhill cranes seemed to stimulate migration in sandhill cranes on the ground. Both reports came from Paynes Prairie, Florida. Shields and Benham (1968) witnessed the departure of 20 whooping cranes, all members of a group at a supplemental feeding area, from Aransas NWR. Fourteen minutes later, they noted 3 additional whooping cranes initiating migration 2 km north of the feeding area. They postulated that the calls of the 20 departing cranes were audible to the other 3 whooping cranes and precipitated their migration.

The radio-tracking of whooping cranes during migration from 1981 to 1984 (Howe 1989) enabled biologists to regularly observe their behavior prior to the start of migratory flights. In some cases, crane pre-flight behavior enabled observers to predict that the birds would migrate (Stehn 1983, 1984). I recorded additional information on premigratory behavior of whooping cranes on their wintering grounds at Aransas NWR, Texas, between 1985 and 1990. I describe premigratory behavior and report 7 additional cases when migrating whooping cranes apparently influenced others to begin migration.

Most data presented here were gathered incidentally while I was involved in management activities at Aransas NWR. H. E. Hunt and D. H. Ellis graciously provided additional observations. Reviews by C. A. Faanes and D. W. Stahlecker improved the final manuscript.

METHODS

As a ground crew member that tracked migrating whooping cranes radio-marked between 1981 and 1983 (Howe 1989), I had ample opportunity to observe their premigratory behavior. During spring migrations of 1983 and 1984, we followed the same adult pair of whooping cranes, with different radio-tagged young each year, northward from Texas to Saskatchewan, Canada. The family group was at times accompanied by 1–4 other whooping cranes. Observation time of these cranes during 35 days in 1983–84 totalled 158 hours (Stehn 1983, 1984). Between 1985 and 1990, observations were made on crane groups at Aransas NWR on 11 days when those cranes initiated a migratory flight. Because observation periods at Aransas varied from 1 to 120 minutes, only the radio-tracking observations were used to quantify premigratory behavior. Qualitative entries in field notes were summarized for this report.

RESULTS AND DISCUSSION

Pre-flight Behavior

A key behavior predictive of migration was increased alertness among the entire group of birds. For several minutes before flight, 1 or more cranes, including the adult male, would show extended alert behavior. In contrast, members of whooping crane groups on the wintering grounds are rarely all alert unless reacting to a specific disturbance, predator, or other cranes. Prior to short wintering grounds flights, cranes will stop feeding, then fly within seconds with no predictive behavior except flight intention noted.

Another behavior that predicted migratory flight of a family group was head tilting by the adult male. He would tilt his head sideways with the bill slightly above the horizontal, presumably to look up at the sky. Head tilting was noted 84 times on 16 different days and was observed from 1 to 12 times preceding all 7 migratory flights. However, on 9 occasions, occurrences of head tilting were not followed by migration. On 19 days, no head tilting was observed and no migratory flights were initiated (Table 1). Based on 7 observations of premigration behavior, head tilting first occurred an average of 32 minutes (range = 7–83 min) prior to initiation of migration. Head tilting

Table 1. Number of observation days and the relationship of head tilting behavior to initiation of migration in whooping cranes at Aransas National Wildlife Refuge, 1983–84.

	Followed by migration	Not followed by migration
Head tilting observed	7	9
Head tilting not observed	0	19

might always preceed migratory flight but is not always indicative that migration will occur.

D. H. Ellis (U.S. Fish and Wildlife Service, pers. commun.) noticed a similar behavior that he termed monocular gazing. This behavior occurs in the captive flock at the Patuxent Wildlife Research Center when the whooping cranes look skyward at birds flying overhead. The function of this head tilting behavior prior to migration is unknown, but it could be used by whooping cranes to assess weather conditions. On the wintering grounds, head tilting is rarely observed if the birds are just making a flight to another nearby location. It has been observed at Aransas primarily when raptors fly near the cranes. Head tilting has been observed in sandhill cranes when other sandhill cranes fly overhead (W. M. Brown, University of Idaho, pers. commun.).

Whooping cranes typically fed intensively for several hours before initiating migratory flights (n = 7). On only 1 occasion did cranes act differently. On 17 April 1983, 4 whooping cranes at the Quivira NWR in Kansas were feeding at 0615 hours when first observed but then loafed for 2.3 hours in an open water marsh before migrating. No food items were found where the cranes had been when the site was visited immediately after their departure (Stehn 1983).

Alertness increased and feeding decreased to occasional pokes at the ground shortly before ($\bar{x}$ = 18 min, n = 5, SE = 5) whooping cranes began migration. Head tilting was occasionally observed, along with an increase in comfort movements (preening, wing stretching, flapping, or ruffling). Drinking was observed on 3 of 7 occasions at an average of 15 minutes before migration. Preening and/or resting were observed immediately before initiation of flight in 1 instance, and increased alert behavior was noted only within the final 10 minutes before migration.

In a family group, the male was usually the first to show increased amounts of alert behavior, followed by the female, and lastly the chick. Most all cranes were alert during the minute prior to flight. Immediately before liftoff, all of the birds were at full alert and grouped into a tightly spaced formation facing into the wind with the adult male in the lead. The male leaned forward (flight intention) and took a few steps as he became airborne along with the other cranes. On 2 occasions, juveniles initially showed flight intention while the family became airborne almost simultaneously.

Heat waves that began to impair vision through a spotting scope usually occurred an average of 14 minutes (n = 4, SE = 4) before the onset of migration. Thermal currents are an integral part of crane spiral migration flight (Melvin and Temple 1982), and the heat waves were an indication that whooping cranes waited until heated air was rising before departing.

Influence Of Migrating Cranes On Other Cranes

Eleven observations of whooping cranes at Aransas indicate that a group of cranes starting migration often influence initiation of migration by other cranes. On 3 April 1985, I observed a widowed male and a widowed female crane, each with their respective juveniles, that had wintered together on the male's territory. The group of 4 cranes was first observed standing alert in a line at 0910 hours. At 0915 the 4 cranes took flight and flew approximately 2 km. After the 4 cranes had passed by, a territorial pair about 1 km away also took flight and joined them. All 6 birds circled for approximately 5 minutes but never gained altitude. The cranes then returned to their respective territories, the pair landing approximately 250 m from the group of 4. Little feeding or movement was subsequently observed except for a limited amount by the 2 juveniles. At 0940 hours, the 4 cranes were once more alert and in line. The neighboring pair was also alert. In the group of 4, the lead crane looked around at full alert. The other adult preened and ruffled its wings. One juvenile, the second in line, went into an exaggerated lean for about 10 seconds. All 4 took flight into the wind, then quickly turned to head north-northwest (335°). This time the neighboring pair took flight immediately and joined the 4. The cranes flew 100-150 m above the ground until they were out of sight. Two different whooping cranes, located approximately 6 km to the northeast, also took off about the same time, circled, and then landed. Ten minutes later, the 2 birds began migration (H. Hunt, Louisiana Tech University, pers. commun.). It is unknown if these 2 cranes had been aware of or influenced by the departure of the other cranes.

On 6 April 1984, 2 whooping cranes departed from the refuge at 0928 hours. The pair vocalized and flew in a large spiral pattern. A radioed family group located approximately 2 km to the southeast took flight at 0930

hours and migrated with the other 2 cranes (H. Hunt, Louisiana Tech University, pers. commun.).

On 8 April 1986, I observed a family group at Aransas starting migration. Three subadult cranes nearby then flew. One returned to the ground while the other 2 birds continued climbing until they were near, but not in formation with, the family in spiral, migratory flight. All 5 cranes headed north-northwest. A neighboring territorial pair remained on the ground. Similarly, on 14 April 1986, 2 family groups from nearby territories on Matagorda Island started migration about 3 minutes apart, spiralling high into the sky.

On 7 April 1988, a family group of cranes started migration from Rattlesnake Island on Aransas. They were observed walking and standing, feeding little, for about 25 minutes near a freshwater source. They initiated migration at 1035 hours, flying close to a family group and a pair on the edge of Sundown Bay. At 1100 hours, the Sundown Bay pair started migration. The family on Sundown Bay unison-called shortly after the pair left but remained on the ground. Fifty minutes later, a single crane was observed initiating migration about 4 km away from the Sundown Bay family group.

On 13 April 1988, 1 family group and 7 subadult whooping cranes were observed along South Sundown Bay at Aransas. For 42 minutes, the cranes stood and/or preened, with only the juvenile walking and feeding. The simultaneous lack of activity by 3 different crane groups was unusual and suggested migration was impending. At 0957 hours, the family group initiated migration. One minute later, 1 of 3 subadults that had been closest to the family followed and joined the family. One minute later the group of 4 subadults also flew and began to spiral under the other 4. The single subadult dropped back and joined the other 4 subadults. Eight minutes later, the 5 subadults returned to South Sunday Bay while the family apparently continued migration. Two of the group of 5 started migration within the next 30 minutes.

At 0830 hours on 14 April 1988, a family group (3 birds) and a group of 5 subadult whooping cranes were closely associated at Mustang Lake. At 0915 hours, the family ceased feeding and loafed and preened, although occasional wing flapping was observed. The subadult group continued to feed until 0947 hours. All cranes were alert much of the next 15 minutes. At 1002 hours, the family group started migration, flying over the subadults. Two of the 5 subadults followed and joined the family. One of the 3 subadults that stayed behind, female B-o/y (1986), had a 100% frequency of association during the 1987–88 winter with male W-RwR (1985), who migrated. These 2 birds have subsequently mated with others.

At 0936 hours on 12 April 1990, 4 of 7 cranes (presumably subadults) on the edge of Sundown Bay, took flight apparently because my boat had drifted too close. The 4 cranes headed north-northwest, and while in spiral flight, were joined by a fifth whooper that had not been sighted previously. By 1002 hours, the 5 migrating cranes were out of sight. The 3 remaining cranes stayed on the edge of Sundown Bay until 0946 hours and then flew 2 km and landed. At 1013 hours, a family group that had been 2 km from the original group of 7, approached and landed 100 m from the 3 subadults. After 5 minutes during which all 6 cranes were alert, the family took flight at 1018 hours and were followed 30 seconds later by the 3 subadults. The family group spiralled high while the 3 subadults stayed lower. At 1025 hours, 1 subadult apparently returned to the refuge while the other 2 continued spiraling and were lost from sight at 1028 hours.

On 17 April 1990, a family group (Y-BWsp [1984] and WbW-WbW [1985]) started migration from the Boat Ramp Marsh. No other cranes were in the vicinity on that day. During the final 48 minutes before flight, the birds stood and preened. Wing ruffling and flapping were observed. Both adults drank 24 minutes before flight, and the male head tilted once 20 minutes before migration. After takeoff, the cranes flew in straight flapping flight for 4 minutes, then spiraled until lost from sight. At 0820 hours on 18 April the family was back near the Boat Ramp. A similar "false start" was documented by radiotelemetry in April 1984 when the Egg Point family group flew north-northwest 35 km and then returned to the refuge (Stehn 1992). On the second morning the Boat Ramp family group alternated feeding and loafing/preening until 1005 hours. The group stopped feeding and alternated between alert, loafing, or preening behaviors for 19 minutes. Head tilting was observed 6 times 5–9 minutes before migration. The group departed at 1026 hours. After 2 minutes of straight flight, the cranes spiraled until out of sight.

CONCLUSIONS

Behaviors used to predict an impending migratory flight include increased amounts of alert behavior, wing comfort movements, and head tilting. On the wintering grounds, the departure of a group of cranes may influence other nearby cranes to start migration. However, these groups may fly separately. Whooping cranes in migration are almost never found in large groups (U.S. Fish and Wildlife Service 1986).

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