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RESULTS OF THE FIRST ULTRALIGHT-LED SANDHILL CRANE MIGRATION IN EASTERN NORTH AMERICA

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Abstract: In 1997, we led 8 sandhill cranes (*Grus canadensis*) south from Ontario, Canada by ultralight aircraft to a wintering area near Warrenton, Virginia, an area without a wild population. Six others were transported south in a trailer in hopes they would return north with those that flew. The migration was 863 km long, included 14 stops, and took 21 days to complete. All 13 surviving birds were wintered together. In March 1998, the surviving 7 "aircraft-led" birds departed the wintering site. The following day, 6 of the 7 were reported on the south shore of Lake Ontario. The flock then moved around the western tip of Lake Ontario. On 5 April 1998, we used 2 aircraft to lead the birds 104 km directly east to the rearing area. The flock soon moved off the fledging grounds, continued to associate with people, and was eventually removed from the flyway. Because no wild cranes are known to fly our chosen route, this study demonstrated not only the effectiveness of ultralight aircraft to lead cranes on migration, but it also proved that cranes so led can return from their wintering site to the general vicinity of their fledging area unassisted. The birds did not follow our indirect route south but rather flew north to the latitude of the fledging area, then wandered.

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Beginning in 1993, Operation Migration conducted a series of migration studies with Canada geese (*Branta canadensis*), trumpeter swans (*Cygnus buccinator*), and sandhill cranes. These experiments were designed to encourage precocial birds to follow ultralight aircraft to learn safe migration routes where they were to be reintroduced into the wild. In the previous ultralight-led migration experiments, sandhill cranes were led to a wintering area used by a large wild flock (Clegg et al. 1997). This practice promotes wildness in the study birds, but wild cranes may also assist the ultralight birds in initiating their return migration and leading them along the route. By contrast, a reintroduced population of whooping cranes (*G. americana*) would not have the benefit of wild conspecifics. Because of this situation, in 1997, we conducted a study to determine if sandhill cranes, led south by ultralight aircraft, would winter in an area without wild cranes and initiate their own return migration the following spring. If the test birds remained at the wintering site past the expected migration time, we proposed leading the flock north to determine if the return migration could be human-assisted and if trained birds would

follow an aircraft in their second season. This study is a precursor to an attempt to establish a discrete, migratory population of whooping cranes into eastern North America (Edwards et al. 1994, USFWS 1994).

STUDY AREAS

Rearing and Training Areas

The Patuxent Wildlife Research Center (Patuxent) in Maryland (39°N, 77°W) is part of a 500 ha complex comprising the Patuxent National Research Refuge in a "greenbelt" lying northeast of Washington, D.C. All birds for the project were hatched and reared there.

The training area is located on the southern tip of Lake Scugog (44°N, 79°W) near Port Perry, Ontario. A fallow field adjacent to a 250 ha wetland served as the fledging/training grounds. Within this area, a large pen (ca 200 m²) was constructed of chain-link fence and top netted, then divided into two sections. An electric wire discouraged predators (foxes [*Vulpes vulpes*], coyotes [*Canis latrans*], raccoons [*Procyon lotor*], and feral dogs). Sixty-five percent of the pen's outer perimeter was covered with painted plywood as a visual barrier. Water was provided in shallow plastic wading pools and changed daily. The pen door was

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located ca 150 m from the aircraft runway.

Wintering Area

The birds wintered at the Airlie Center near Warrenton, Virginia (39°N, 78°W). This area was selected by invitation and because of its lack of an existing population of wild cranes. The birds were at first housed on the wintering site in a pen ca 150 m² erected on the edge of a shallow lake, providing both wet and dry areas. An electric fence was used to protect against predators, which included foxes, raccoons, and feral dogs.

Migration Route

The migration route was planned to be directly south over Lake Ontario, through New York state, Pennsylvania, West Virginia, and Virginia, however, we modified the route to avoid overflying the lake late in the season. Instead, we first traveled east around the eastern end of Lake Ontario before heading southwest to Virginia. This indirect extension added 160 km to our route, making the total distance 863 km.

METHODS

Rearing

We selected 18 greater sandhill cranes hatched from captive breeders at Patuxent. Patuxent staff raised the birds using a costume-rearing technique (Horwich 1989) modified from that used in trucking migration experiments conducted in Arizona (Ellis *et al.* 1997) and releases in Mississippi (Ellis *et al.* 1992). In addition, we played a tape recording of aircraft engine noises for the chicks (Lishman *et al.* 1997). Caretakers wore an amorphous gray costume resembling a poncho and extending to the knees. Headgear included a face veil and shroud attached to a red baseball-type cap. Talking was restricted during rearing, but less so thereafter. Handlers used a portable replica of the ultralight with an engine recording to lead the birds from the pen to the aircraft for taxi training. They also used mealworms to encourage the birds to follow. We raised the flock in two separate groups based on hatch dates (Table 1).

Training

All 18 birds were transported in closed containers (*i.e.*, shipping crates) to Ontario on 31 July 1997, prior to fledging. Flight training began on 5 August and continued every day, weather permitting. Although the birds flew with the aircraft many times, the first flight when the pilot had consistent con-

Table 1. Chronology of events for 18 sandhill cranes involved in the 1997 ultralight migration from Ontario.

ID ^a	Hatch Date	Date First Aircraft Exposure	Fate
201 ^{UL}	15 May 97	17 May 97	returned to Canada 30 Mar 98
202 ^{UL}	17 May 97	18 May 97	returned to Canada 30 Mar 98
203 ^{UL}	14 May 97	17 May 97	returned to Canada 30 Mar 98
204 ^{UL}	17 May 97	21 May 97	returned to Canada 30 Mar 98
205 ^{UL}	20 May 97	22 May 97	killed on route south, 28 Oct 97
206 ^{UL}	19 May 97	21 May 97	returned to Canada 30 Mar 98
207 ^{UL}	18 May 97	21 May 97	returned to Canada 30 Mar 98
208 ^{UL}	19 May 97	21 May 97	removed from study 9 Oct 97
209 ^{UL}	19 May 97	21 May 97	lost on return migration; recovered in Ohio
210	10 Jun 97	13 Jun 97	removed from study 9 Oct 97
211 ^T	11 Jun 97	13 Jun 97	removed from study Mar 98
212 ^T	11 Jun 97	13 Jun 97	injured, euthanized
213 ^T	10 Jun 97	13 Jun 97	removed from study Mar 98
214 ^T	10 Jun 97	10 Jun 97	removed from study Mar 98
215 ^T	7 Jun 97	10 Jun 97	removed from study Mar 98
216 ^T	10 Jun 97	13 Jun 97	removed from study Mar 98
217 ^T	7 Jun 97	10 Jun 97	died from septicemia 3 Aug 97
218 ^T	9 Jun 97	10 Jun 97	injured (aggression): euthanized 31 Jul 97

^a Cranes led south by aircraft have a superscript UL, those in trailer a T.

trol over direction, duration, and destination did not occur until 7 October.

Migration

By late fall, 14 birds remained in good condition and were prepared for migration. On 24 October 1997, we began the migration (Table 1) with 8 birds following the aircraft and 6 birds being occasionally flown but mostly trailered along with the migration. We flew east around Lake Ontario, avoiding the urban area to the west, then continued southwest to Virginia (Fig. 1). Frequent delays due to rain and wind resulted in the entire migration occupying 21 days. Seven birds completed the trip following the aircraft and 6 were transported in a trailer. Birds in the latter group were allowed to fly free at 7 of the 14 stopover points. After flying the 863 km route, we arrived at the wintering site at Airlie Center, Virginia on 13 November. All birds were equipped with conventional radio tracking devices and 2 wore satellite transmitters.

Overwintering

Once at the wintering grounds, the birds were penned together for a few days, then released during the day to forage on their own but penned nightly. They were led on local flights to familiarize them with the area. The top net and side panels of the pen were removed on 10 February 1998 and the birds were allowed their freedom. We used a continuous supply of pelletized food and a costumed dummy in the pen area to keep the birds in the vicinity. Birds were visited daily by a costumed caretaker.

Equipment

Four aircraft were used in this study. One was a Maxair Drifter, 3 axis control, "tail dragger" ultralight powered by a Rotax 503, 50 hp engine and a 3-blade propeller. This aircraft was introduced during early flight training, but it was eventually used only as a "chase" plane. The wing was modified for slow flight and a bird guard was added to shield the propeller area.

Two Cosmos, Phase II "weight-shift" controlled ultralights known as "trikes" and powered by Rotax 503, 50 hp engines with 4 to 1 reduction drives and 6-blade propellers (to reduce noise emissions) were used as lead planes. This aircraft was selected because of its maneuverability, short field landing and take-off capabilities, and ease of transport. Several wing sizes are available for this trike to control airspeed, and they can be changed by 2 persons in 20 min. Initial training with the birds was conducted using an Atlas 21-m² wing with a speed range of 40–98 km/hr. For higher speeds, an Echo 12-m² wing with a speed range 56–128 km/hr was used. Both aircraft were fitted with bird guards,

radios, and GPS navigation units.

During migration, a fourth aircraft, a Bellanca Scout was used to check weather ahead as well as search for possible landing sites and to communicate with the ground crew and air traffic control.

RESULTS AND DISCUSSION

Shortly after arriving in Canada, one bird (Table 1) was found dead in the pen. Necropsy indicated septicemia. A second bird (Table 1) was injured in the pen and euthanized. One dominant bird would not follow the aircraft, was disruptive to the flight order, and was removed from the study. We discovered that another bird was missing its tongue. This may have been the result of a pen injury, however, the removal was very clean and scar tissue was inconspicuous. Although the bird was unimpaired in flight, we decided that it could not survive in the wild and removed it from the study.

To encourage the birds to return to Canada, we felt that it was important to fly for the first time in Ontario rather than at their natal area in Maryland. We shipped all birds to Ontario when the youngest birds were 40 days old. The older group (which had nearly reached flight age, oldest chick was 60 days) was not allowed to fly at Patuxent with the aircraft, while they waited for the younger group to mature enough to transport. This 2-week delay in the training came at a critical juncture and required substantial time to correct.

During the pre-fledging training at Patuxent, the birds were often led by costumed staff a distance of ca 200 m to the aircraft for taxi training. Caretakers would also run beside the aircraft in an effort to protect the chicks from the wheels and propeller. By this means, we inadvertently conditioned the birds to follow the handlers and not the aircraft.

Further, an unusually inclement summer in Ontario restricted our flight training. This, combined with the delay in shipment and the large number of birds in each group, resulted in the flock's reluctance to follow the aircraft. Also, shortly after the birds arrived in Ontario, the senior author was injured in a crash while attempting to free a bird that became entangled in his aircraft's guy wires. For a period of 7 days, we did not conduct flight training. We made several attempts to change the group size and adjust the dominance structure, but with continued bad weather, progress was slow. Because of these problems, it was not until 7 October that we experienced the first flight in which the pilot had clear control of the flock. Eventually, the older group learned to follow the aircraft, but the younger group would only follow for a short distance before turning back. This problem was never corrected, and we began the migration on 24 October 1997 leading 8 birds with the aircraft and transporting 6 in a trailer.



Figure 1. Routes of ultralight-led southward migration (points 1-15) and spring return (points 15-21). Locations are (1) Scugog Island, Ontario (fledging grounds), (2) Orono, Ontario, (3) Baltimore, Ontario, (4) Picton, Ontario, (5) Loughborough Lake, Ontario, (6) Watertown, New York, (7) Mexico, New York, (8) Ithaca, New York, (9) Sayre, Pennsylvania, (10) Gover, Pennsylvania, (11) Trout Run, Pennsylvania, (12) Shermans Dale, Pennsylvania, (13) Carlisle, Pennsylvania, (14) Gettysburg, Pennsylvania, (15) Warrenton, Virginia (wintering grounds), (16) Youngstown, New York, (17) St. Catharines, Ontario, (18) Stoney Creek, Ontario, (19) Holland Marsh, Ontario, (20) Listowel, Ontario, (21) Orangeville, Ontario, (22) Patuxent.

Migration

The original plan was to cross into the U.S. over Lake Ontario. However, the dangers of flying over open water late in the season, led us to fly instead around the lake. We chose flying east to avoid the urban area to the west. This extension added ca 160 km to the route. Rain, snow, and high winds slowed our progress, and it took 21 days to cover the 863 km to Airlie Center, Virginia. In total, we made 14 stops, 2 of which were unscheduled. At 7 of these stops, the 6 "trailed" birds were integrated with the rest of the flock, and we encouraged all to fly together. All efforts to lead the 6 failed, and eventually, the younger birds were transported

by trailer the remaining distance to Airlie. During one of these attempts, one bird was struck by an aircraft propeller and killed instantly, leaving only 7 birds to follow the aircraft.

During migration, the cruise speed of the birds varied from 48-64 km/hr (mean 51.2 km/h) and the altitude ranged from 30-250 m. Flight duration was often dictated by weather. The longest flight lasted 2 hr 20 min and covered 124 km in headwinds. No signs of fatigue were noted in the birds during any of the flights. In most cases, the birds soared on the vortices created by the aircraft. They normally only left the aircraft when it was forced to increase speed to climb over mountains or to penetrate rough air. During the entire migration, the birds left the aircraft only once to take advan-

tage of rising thermals. The distance of the lead bird from the aircraft was normally less than 1 m.

Wintering

After 10 February 1998 when the pen was opened and the top net was removed, the flock established a routine, foraging in nearby upland fields during the day and roosting in or near the pen at night. No birds were lost to predation and all appeared healthy when examined by the Patuxent staff in late February. The exception was number 209: this crane was often observed alone or at a distance from the main flock: it otherwise appeared healthy. The two groups (7 aircraft-led and 6 trailered birds) integrated and were seen flying together as a cohesive flock. We decided to leave them together to determine if one group would lead the other north.

Spring Migration

On 13 March, all 13 birds left Airlie on what proved to be a pre-migration exploration flight. The next day, most of the 6 trailered birds, landed in an urban area near Baltimore, Maryland. Patuxent staff and volunteers collected them from various locations and transported them back to Airlie. The 7 aircraft-led birds returned together to Airlie on their own. There were no reports of their location except a satellite signal received from the eastern shore of the Chesapeake Bay, north of Washington, D.C. Because of tameness, we removed the errant 6 birds (all of those trailered south) from the study and placed them in captivity (i.e., at the Henry Doorly Zoo in Omaha, Nebraska).

On 28 March 1998 in a strong south wind, the remaining 7 birds departed the wintering grounds. The next day Don Glynn reported 6 in Youngstown, New York. The seventh bird, number 209, was eventually sighted by Scott Butterworth, a wildlife officer in Ohio. This bird was placed in captivity.

Our flock did not follow our original route (Fig. 1) around the east end of Lake Ontario but stopped on the southern shore of the lake, 100 km from and directly south of the northern terminus. Next, they moved 50 km west to St. Catharines, Ontario, and then north again around the western tip of the lake. The following day, they were sighted in Holland Landing, 32 km west of their fledging grounds. In strong easterly winds, they moved west to Kitchener and London, Ontario. After several days, they traveled east again to Orangeville, Ontario, only 67 km west of their training area.

At each location, the birds were tame enough that private citizens were able to read the phone number on the radio transmitters and report the whereabouts of the birds to Operation Migration headquarters. These reports also

attracted the attention of the local news media. To avoid further human interactions, we collected the flock, which, by this time, had divided into 3 small groups, and at sunrise on 5 April 1998, we led the 6 east to the fledging/training grounds using two ultralight aircraft. The birds' flight capabilities had developed to such a degree that they broke away several times to ride thermals to higher altitudes. The flight lasted 2 hr 10 min with a peak altitude of 1700 m.

The day after arriving at the fledging grounds, a wild sandhill crane (rare for this area) joined the flock. We hoped this bird would encourage the flock to use the wetland adjacent their pen area. We provided food and a costumed dummy to help keep them in the vicinity. After several days, however, they began to wander, covering distances of 160 km or more at a time. We were forced to collect them from several urban locations where they were approaching humans. We placed 5 of the surviving 6 birds in captivity (i.e., at the Northwoods Animal Center in Seagrave, Ontario).

One bird remained at large. This female was regularly seen in an isolated area near a boat launch on Scugog Island, 10 km north of the fledging grounds. Unfortunately, after ca 2 months, this bird also began to wander and had to be removed from the wild.

CONCLUSIONS

Several conclusions are clear. First, 6 of the 7 birds led south to Virginia, returned to Ontario without aid from humans or wild conspecifics. Second, all 6 cranes boxed and trailered south left with the ultralight-led cranes on a long pre-migration flight. The 6 dropped out of this flight in an urban area and had to be removed from the study, so unfortunately we do not know if 1 or more would have migrated with the ultralight survivors when they left north 2 weeks later. Third, we were able to lead the birds with ultralight aircraft during their second season, suggesting that it may be possible to direct future return migrations. Fourth, although the primary goal of this study was successfully achieved (i.e., the ultralight birds were able to home correctly), minor violations of our rearing protocol (especially talking when near the cranes) resulted in birds that sought association with humans (see Duff *et al.* [2001] for results of an adapted rearing protocol used in 1998). Fifth and most interesting, the birds did not return to Canada using the route south the previous autumn. Rather than following our course around the east end of Lake Ontario, they flew directly north and eventually rounded the lake at its west end. After heading north again, they reached the same latitude as their fledging grounds and began to move both west and east. During their wanderings, they did not venture further north. It appears that landmarks were not used as navigational aids. We speculate that during their stay at the fledging grounds, they acquired knowledge of

that latitude. Return migration then became a process of flying north until they reached the fledging latitude, then moving east and west as if searching for the exact area.

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