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LESSONS FROM THE MOTORIZED MIGRATIONS

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LESSONS FROM THE MOTORIZED MIGRATIONS

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Abstract: Ten experiments have been conducted to determine if cranes can be led on migration and if those so trained will repeat migrations on their own. Results have been mixed as we have experienced the mishaps common to pilot studies. Nevertheless, we have learned many valuable lessons. Chief among these are that cranes can be led long distances behind motorized craft (air and ground), and those led over most or the entire route will return north come spring and south in fall to and from the general area of training. However, they will follow their own route. Groups transported south and flown at intervals along the route will migrate but often miss target termini. If certain protocol restrictions are followed, it is possible to make the trained cranes wild, however, the most practical way of so doing is to introduce them into a flock of wild cranes. We project that it is possible to create or restore wild migratory flocks of cranes by first leading small groups from chosen northern to southern termini.

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Key words: crane, migration, ultralight aircraft.

Early efforts to fly with birds were summarized in an earlier paper (Ellis et al. 1997). This paper provides a brief listing of the number of birds involved in each migration experiment from 1993 onward and an overview of the lessons and generalizations stemming from these pioneering experiments. The first motorized migration (led by Operation Migration, Lishman et al. 1997) was with Canada geese (*Branta canadensis*) in 1993 (Fig. 1). The first motorized crane migrations were in 1995 (a truck-led experiment led by Patuxent [Ellis et al. 1997] and an ultralight-led experiment led by Kent Clegg [Clegg et al. 1997]). The first motorized migration involving endangered cranes (whooping cranes; *Grus americana*) was in 1997 (Clegg and Lewis 2001). See Table 1 for a brief summary of the crane migrations. In addition to the goose migrations, trumpeter swans (*Cygnus buccinator*) have also been led in 3 experiments. The non-crane experiments are summarized in Table 2. Details of the methods and results of each experiment are best presented separately by the several teams (this volume).

MAJOR LESSONS

Among the most important results of these motorized migrations is the knowledge that juvenile cranes can be led south for hundreds of kilometers by motorized craft (ultralight aircraft or truck) and that it is possible to travel 75 or more km in a single flight. Further, after only 1 motorized migration south, most juveniles will return north the following spring (Clegg and Lewis 2001, Duff et al. 2001*a*, Ellis et al. 2001*a*). This is not to say that all cranes will return, but enough will return (Table 1) that the techniques are proven. This was demonstrated not only for the sandhill cranes (*G.*

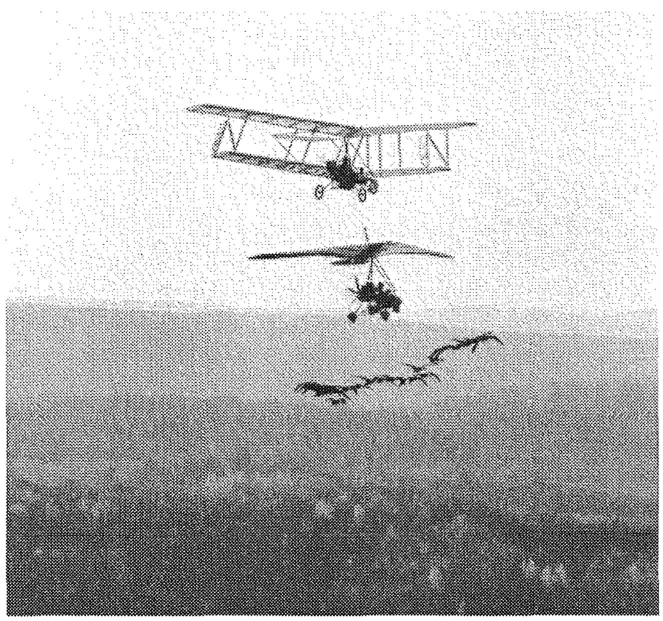

Fig. 1. The first motorized migration was with Canada geese. (Photo by Joseph W. Duff.)

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Table 1. Summary of motorized crane migrations, 1995–99.

Year	Lead team	Method	Species	No. Chicks[a]	No. Start South[b]	No. Finish[c]	Origin (North)	Terminus (South)	Route Length (km)	Spring Results Alive/Return North
1995	Patuxent	Truck	SH crane	13/10	10	7/2	northern Ariz.	southern Ariz.	622	9/0 (1996), 4/4 (1997)
1995	Clegg	Ultralight	SH crane	19/13	11	6/2	Id.	N.M.	1204	4/3
1996	Patuxent	Truck	SH crane	17/14	12	9/1	northern Ariz.	southern Ariz.	622	11/4 of 4
1996	Clegg	Ultralight	SH crane	23/13	8	8	Id.	N.M.	1204	4/4
1997	Operation Migration	Ultralight	SH crane	12/8	8	7	Ont.	Va.	790	7/6
1997	Operation Migration	Stage-by-stage	SH crane	6/6	6	6	Ont.	Va.	790	6/0
1997	Clegg	Ultralight	SH crane + WC	11/9 7/7	8 4	7 3/1	Id.	N.M.	1204	6/6 2/2
1998	Operation Migration	Partial ultralight	SH crane	16/16	15	12	Ont.	S.C.	1312	Complicated[d]
1998	Patuxent	Stage-by-stage	SH crane	24/14	12	6/1	central Ut.	central Ariz.	1290	Complicated[e]
1999	Patuxent	Stage-by-stage	SH crane	23/14	14	12/2	central Ut.	central Ariz.	1290	Complicated[f]

[a] Number of Chicks. The number of chicks that began experiment/number chosen for flight school.
[b] Number Start South. Number of the survivors of rearing/training process that began migration.
[c] Number Finish. Number that flew or were released along all or nearly all of the route/additional birds still alive and that participated in some of the route but were injured or sick or lost or uncooperative and were transported in a vehicle to terminus.
[d] Spring survivors (these birds flew only the southern-most 108 km of the route from Ontario, then in spring moved north but only about 300 km).
[e] All 7 survivors began northward, spring migration independent of the wild flock but then returned south past the wintering area after 1 week, then continued south into Mexico and disappeared.
[f] Spring survivors flew north with the wild flock, and all but 2 separated from the wild flock when the routes divided. These returned to the wintering ground in April (not October), then 7 were captured and transported north, but later that spring at least 2 of the 3 left on the wintering grounds flew north unassisted. None of this group of 10, although found on our chosen summering area in 2000, arrived at our chosen wintering area autumn/winter 2000–1.

canadensis) and whooping cranes released on the wintering grounds in New Mexico (1995–97) with many thousands of other cranes that could lead them north along their same migration route, but also it proved generally true for the 1996 trucking cranes that were released with wild sandhill cranes but followed a route far divergent from the wild sandhill cranes (Mummert et al. 2001*a*). It also proved true for the sandhill cranes led in 1997 from Ontario to Virginia and released far from any wild cranes (Duff et al. 2001*a*). Come spring, birds in all of these groups traveled north to the region where they had been trained the previous summer.

To successfully lead cranes, motorized craft must travel 45–55 km/hr air speed (faster if cranes have a tail wind or are flying downhill) to control the flock. With reasonable caution, mortality during migration can be minimized. However, in the western United States, golden eagle (*Aquila chrysaetos*) attacks were a major problem (Ellis et al. 1999) both for ultralight-led and for truck-led migrations. Fifteen attacks were documented, with 4 cranes killed, another injured, and flocks frequently scattered. The partial solution was for ultralight missions to fly higher and use an interceptor (faster aircraft firing shell crackers). For trucking missions, a partial solution is to have a lead vehicle precede the flock and fire shell crackers in canyons. Also, it is important to be prepared to deter approaching eagles at all times by being ready to fire shell crackers. To prevent eagle attacks at roosts, we either camped near the cranes or placed a costumed dummy in the marsh as a "scare eagle." If intending the latter, crane chicks should be trained from hatching to accept the dummy.

Table 2. Summary of motorized migrations of non-cranes, 1993-1998.

Year	Lead team	Method	Species	No. Chicks[a]	No. Start South[b]	No. Finish[c]	Origin (North)	Terminus (South)	Route Length (km)	Spring Results Alive/Return North
1993	Operation Migration	Ultralight	Canada goose	29	18	18	Ont.	Va.	680	16/13
1993	Operation Migration	Stage-by-stage	Canada goose	5	5	5	Ont.	Va.	680	5/0
1994	Operation Migration	Ultralight	Canada goose	38	38	35	Ont.	S.C.	1320	35/33
1995	Operation Migration	Ultralight	Canada goose	38	32	29	N.Y.	S.C.	ca 1320	29/16
1995	Operation Migration	Ultralight	Canada goose	ND	31	31	Va.	S.C.	672	23/16
1995	Operation Migration	Stage-by-stage	Canada goose	16	16	16	Ont.	Va.	680	14/0
1995	Operation Migration	Stage-by-stage	Canada goose	1	1	1	Va.	S.C.	672	ND/0
1997	Airlie	Ultralight	Trumpeter swan	ND	3 (E to W)	3	Va.	Chesapeake Bay	170	3/2
1997	Airlie	Stage-by-stage	Trumpeter swan	ND	2 (E to W)	2	Va.	Chesapeake Bay	170	2/0
1998	Airlie	Stage-by-stage	Trumpeter swan	20/18	18	16	N.Y.	Chesapeake Bay	530	13/0
1998	Bezner-Kerr	Ultralight	Trumpeter swan	ND	5	4	Ont.	Ind.	1250	4/2

[a] Number of Chicks. The number of chicks that began experiment/number chosen for flight school. ND = no data.
[b] Number Start South. Number of the survivors of rearing/training process that began migration.
[c] Number Finish. Number that flew all or nearly all of the route.

A major problem in the trucking migrations was collisions with powerlines: 3 cranes died and ca 15 non-lethal collisions were observed. This was such a serious problem during our sandhill crane surrogate migrations, because we, in fact, chose our route to provide hundreds of powerline crossings (i.e., an average of 1 set of powerlines every 5 km) to see if a problem existed (Ellis et al. 1997, Ellis et al. 2001*a*). When flying endangered cranes, we would, of course, minimize the number of powerline crossings and call cranes down as they approached wires when the cranes' altitude was near the level of wires.

Another major lesson was that chicks do not need to be reared from hatching at the intended northern terminus to migrate appropriately. For our trucking experiments, the trained cranes were transported from Patuxent to the training site when they neared fledging age (i.e., ca 65–88 days of age) (Ellis et al. 1997, Ellis et al. 2001*a*). The stage-by-stage cranes were transported west when over 100 days of age (Ellis et al. 2001*b*). From all of our experiments, we learned that trained juveniles will home to the general area (i.e., most birds will summer within 75 km and nearly all birds within 150 km) of fledging and flight-training sites (e.g., Ontario [Operation Migration ultralight birds], northern Arizona [Patuxent trucking experiments], and southern Idaho [Kent Clegg's ultralight birds]). Trained birds did not home on Patuxent where they hatched and where most were reared to fledging, but rather they did return to the general area where they were flown free and began their migration.

Not only will most trained juveniles return north the following spring, but most can also be expected to return to the same (or nearby) wintering area the following autumn. Our 1996 trucking birds traveled unaided and (with no other cranes to follow) to their Gila River wintering site in 2 subsequent years. Most survivors of the western ultralight migrations (sandhill cranes and whooping cranes) traveled to the chosen wintering site without human assistance (but within a well-established sandhill crane migration corridor). Some birds (especially if they had wild flockmates that went to vastly different areas) did follow the wild flock far from their training route.

Another lesson, extremely important to future whooping crane reintroductions, is that trained juvenile sandhill cranes do not follow their training route on subsequent migrations. They arrive at northern and southern termini as hoped, but they follow their own, more direct route. This was true for birds in the east, west, and Arizona. There is limited evidence that whooping cranes may more closely follow the training route (Clegg and Lewis 2001).

One result of our efforts to retrieve scattered cranes in the summer is the observation that if you are able to gather the birds as yearlings and subadults to your chosen summering area, they will eventually remain, and males especially are likely to home on that area in subsequent migrations (R. C. Drewien, Hornocker Wildlife Institute, personal communication; Mummert et al. 2001*a*). On this subject, a few lesser lessons also are clear. First, all birds need not follow the entire route south to return north (Clegg and Lewis 2001, Mummert et al. 2001*a*). Non-flying individuals that are closely associated (i.e., in same social group on the wintering grounds) with a flock that flew the route south are likely to go north with that group. However, if a social unit does not fly much of the route, the group will not return north (Duff et al. 2001*a*, Duff et al. 2001*b*, Ellis et al. 2001*b*).

We have several stage-by-stage experiments now behind us (Tables 1 and 2), so it seems clear that for geese, cranes, and swans, it is normally not enough to release birds at intervals along a route during their first fall. They will not go north come spring unless they are closely associated with a social unit that lures them north. From the 1997 ultralight migration from Ontario (Duff et al. 2001*a*), stage-by-stage cranes did not go north even though they wintered with a social unit that went north. For crane stage-by-stage migrations in the west, the 1998 group that separated itself from the wild flock in spring wandered widely but eventually returned south. However, the 1999 group that followed the wild flock did go north and half way along the route, 9 of 12 cranes separated from the wild flock and followed their own route (Ellis et al. 2001*b*). A few of these birds did complete the northward migration without wild birds to guide them. So, we do have some evidence that stage-by-stage cranes will return north to the general vicinity of their training area even if they winter with wild cranes that go to a different summering area.

PROTOCOL LESSONS

Having discussed the general conclusions from our experiments, we should also list a series of technique-related observations. These points should not be considered less important, but rather the means whereby the training techniques will be made successful.

First, the close human involvement required to train cranes results in their being prone to excessive tameness following release. And even if cranes are costume reared according to a rigorous protocol, they very quickly learn to approach uncostumed humans unless human-avoidance conditioned (i.e., unless subjected to mock human attacks) and/or released with wary cranes. A corollary lesson is that the most efficient way to make trained cranes wild (i.e., not approach humans) is to release them (after migration) with wild cranes (Clegg et al. 1997, Ellis et al. 2001*c*). Although most releases in recent decades involve a month or more of acclimation before final release (Nagendran et al. 1996, Ellis et al. 2000, Ellis et al. 2001*d*), we found that abruptly releasing cranes on the wintering grounds following completion of their training migration can be easily conducted and with excellent survival by releasing 1 or 2 experimental birds at a time (Ellis et al. 2001*c*) into a wild flock. All 1996 trucking cranes (12 birds), the 1998 and 1999 stage-by-stage cranes (18 birds with live radios), and a few other cranes all survived the winter when released 1 or 2 at a time (Ellis et al. 2001*c*). Releasing the whole group at once into a large wild flock also resulted in wildness, but some initial mortality accompanied group releases (Clegg et al. 1997, Clegg and Lewis 2001). One-by-one releases on the summering grounds have had mixed success. In 1 study (Mummert et al. 2001*b*), release birds segregated from wild birds and did not migrate with the wild flock. In another study (R. P. Urbanek, U.S. Fish and Wildlife Service, personal communication; Ellis et al. 2001*c*), all birds migrated with the wild flock and all returned north, come spring.

The primary limitation of costume-rearing (i.e., unduly taming birds so they approach uncostumed humans) can be lessened if costumes cover to below the knees. Faces, of course, must always be covered. Hands should be routinely covered. It is important to use a crane puppet head when interacting with chicks, and cranes should not hear human voices (Urbanek and Bookhout 1992, Duff et al. 2001*b*, Horwich 2001). Having listed these points, we must state that, if cranes are field-reared and destined to be introduced into a conspecific wild flock, it is possible to hand-rear them without costumes and still train them to avoid humans (Clegg et al. 1997, Clegg and Lewis 2001). Whooping cranes so reared in that study and released with sandhill cranes did not approach uncostumed humans after release but were less wary than wild whooping cranes.

To promote wildness (i.e., avoidance of uncostumed humans during costume-rearing and avoidance of all humans after release), it will often be useful to conduct at least a few bouts of human-avoidance training and predator-avoidance training (Ellis 2001). We have used dogs and/or the skin of a large predator to terrify and flush cranes. We have also employed scare tactics (to be used by attacking humans) such as screaming charges with an alarming device such as a jacket swung overhead, an umbrella rapidly opened and closed, or a shiny balloon. Firing shell crackers during a charge is also helpful. Less than helpful has been our few attempts to use chemical mace, an electrical cattle prod, pepper spray, and lemon oil spray to promote wildness.

Another technique, we call abandonment training. Using this, it is sometimes possible to turn uncooperative cranes into good followers by temporarily abandoning them in a safe, but solo situation, for a few hours (Ellis 2001). Here again, no controlled experiments have been conducted, but initial tests (some accidental) with about a dozen birds proved promising.

An important lesson from the ultralight training program in Idaho was the discovery that sandhill cranes and whooping cranes can be reared in small groups with only intermittent supervision (see Clegg and Lewis 2001). Formerly, aggression was thought to be so severe as to disallow group rearing.

A major development in the safety and handling of cranes during field training and while migrating was the use of crane "magnets" to hold cranes at roost sites before and during migration and at the release site after migration (Urbanek and Bookhout 1992, Ellis 2001). By rearing young chicks next to a plastic crane decoy and/or near a "scare eagle" (human costume draped over a frame), we were able to not only control the roost location of our cranes after release (and thereby keep them at water depths sufficient to keep them from mammalian predators), but using these decoys, we could attract our birds back from exploratory flights. The "scare eagle" is sometimes used in preference to, or supplemental to, the plastic decoy because it apparently fulfilled its namesake purpose and thereby allowed us to camp hundreds of meters from our cranes and out of costume with little fear of eagle attacks. The plastic decoy was also used to anchor our cranes to the release site until they mingled with and left with wild cranes (Ellis et al. 2001*c*).

We also used another device to lure back adventuresome cranes during training. We learned to pen 1 or more stay-at-home or sickly cranes in view of the wayward birds: this practice encouraged free flying flockmates to not stray too far.

It is extremely important in motorized migrations to remove unmanageable birds when time for migration comes. In our experience about 1 in 10 birds will be unmanageable. Such birds can be sent separately to the winter terminus and released with their social unit, but should not be included in flights during migration least they disrupt the flight by leading their group astray. However, it is best to not remove unmanageable birds at the training stage. Experiences during training so alter the behavior of young cranes that their future level of cooperation at time of migration cannot be safely predicted even a week or 2 in advance. On a positive note, an uncooperative bird that missed the migration may fly north in the spring with flockmates if it winters in close association with birds that flew the route.

If a training group exceeds ca 10 birds, sometimes some birds will form a separate subgroup that may withdraw from the migration (i.e., prove uncooperative in following). One technique we used to fly a flock of 12 south (Ellis et al. 2001*a*) was to train birds in subgroups of 5–8 and begin the migration by flying each subgroup separately for the first day, then pool subgroups. Thereafter, "fear of being left behind" keeps less cooperative birds following. However, the opposite conclusion was made from some of the ultralight-led migrations; it is important to form all the cranes into 1 cohort before you exit south or birds will be fighting for the lead (or most favorable) positions while flying. Once again, for all migrations, it is important to form strong social units so that non-fliers (sick, injured, or uncooperative birds) will stay with their social unit (and migrate north) after they are released with the group on the wintering grounds.

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