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AN EXPERIMENTAL RELEASE OF WHOOPING CRANES IN FLORIDA - THE FIRST THREE YEARS

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Abstract: Fifty-two juvenile whooping cranes (*Grus americana*) were soft-released in Florida from February 1993 to April 1995. The birds were released in groups ranging in size from 5 to 14 individuals. The first-year survival rate was 0.42 for all years combined. First-year rates for each year were 0.36 for 1993, 0.32 for 1994, and 0.47 for 1995. Most mortality (62%) occurred during the first 3 months following release. The survival rate of 0.81 the second year after release was similar to that of Florida sandhill cranes (*G. canadensis pratensis*) (0.87). Predation by bobcats (*Lynx rufus*) was the only known source of mortality. We attempted to modify the roosting behavior and habitat use of released birds. Before and immediately after release, efforts were made to condition birds to roost in water and avoid rank, overgrown habitat. Most dispersal distances were similar to those of local populations of sandhill cranes, but there were 2 episodes that exceeded the normal range of local cranes. Four pairs have formed among birds that survived for greater than 1 year. Two pairs defended territories in spring 1995, and 1 completed a nest platform within the defended territory.

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Key words: captive-rearing, cranes, Florida, *Grus americana*, soft-release, whooping crane.

The minimal criteria for downlisting the whooping crane from endangered to threatened status are (1) 2 self-sustaining wild populations, additional to the Wood Buffalo-Aransas population (AWBP), that (2) must be reproducing at an acceptable rate for 10 years (U.S. Fish and Wildlife Service 1994). Feasibility studies of establishing a population of whooping cranes in Florida in order to downlist the species began in 1980 (Nesbitt and Carpenter 1993), and the first experimental release of whooping cranes occurred in 1993. Florida offers a unique opportunity to establish a nonmigratory population of whooping cranes similar to the population that occurred in Louisiana until the late 1940's (Lowery 1974, Gomez 1992). The Florida peninsula provides extensive areas of suitable crane habitat that supports a stable population of 4,000 to 6,000 Florida sandhill cranes (Nesbitt 1996).

The goal of the Florida release is to establish a population of ≥25 breeding pairs by the year 2020 (U.S. Fish and Wildlife Service 1994). Techniques for raising birds and introducing them into the wild were developed with sandhill cranes and have been used successfully to release Mississippi sandhill cranes (*G. c. pulla*) (Ellis et al. 1992).

Previous studies of sandhill cranes in Florida (Nesbitt and Carpenter 1993) and Mississippi (Ellis et al. 1992) indicated that initial mortality might be high, 40 to 60% during the first year after release, and that predation would be a major factor. Because there had been mortality at Patuxent Wildlife Research Center (Patuxent) due to eastern equine encephalitis (EEE) (Carpenter and Dein 1987), we were also concerned about the birds' reaction to this or other diseases in the wild.

It was presumed, when the idea for establishing whooping cranes in Florida was initially discussed in the late 1970's, that cross-fostering of whooping crane eggs into sandhill crane nests would be the preferred method of introduction. This technique successfully produced wild, migratory cranes in Idaho (Drewien and Bizeau 1978). However, by 1984 there was no evidence of pair bonds developing among the Idaho birds, and doubts about the behavioral consequences of foster rearing by non-conspecifics began to arise (Drewien et al. 1989, Mahan and Simmers 1992, U.S. Fish and Wildlife Service 1994). Because of these behavioral concerns, we decided that soft-release (Ellis et al. 1992) of captive-reared birds would be the primary method of introduction. Whooping cranes for release originated from 2 captive flocks. One flock was located at the Patuxent Wildlife Research Center (formerly U.S. Fish and Wildlife Service), National Biological Service, Laurel, Maryland. The other, at the International Crane Foundation (ICF), Baraboo, Wisconsin, is maintained under direction of the U.S. Fish and Wildlife Service.

This establishment effort is cooperatively funded by the

Florida Game and Fresh Water Fish Commission and Regions 2 and 4 of the U.S. Fish and Wildlife Service. Administration of the project is covered by a memorandum of understanding between the 2 agencies. We wish to thank A. Adams, R. Overstreet, and R. Gerali for maintaining their property in a condition that the cranes have found so attractive and for allowing us access to their property. Transportation of some of the whooping cranes from Maryland and Wisconsin to Florida was provided by Windway Capitol Corporation. Their generosity has been of great benefit to this project. B. Wagner has assisted with soft-release and monitoring the cranes from 1993 to 1995. M. Nagendran assisted with releases in 1995 and provided several helpful suggestions.

STUDY AREA

Previous studies identified the Kissimmee Prairie area of Florida as the area with the best potential to support a new nonmigratory population of whooping cranes (Bishop 1988). The Kissimmee Prairie consists of some 500,000 ha of freshwater marsh and open grasslands in Osceola and Polk Counties (Fig. 1) associated with the floodplain of the Kissimmee River. Marshes were dominated by pickerelweed (*Pontederia cordata*) and maidencane (*Panicum hemitomon*). Most grasslands were in improved pasture used for livestock grazing or sod production; some were allowed to revert to native prairie. Most areas preferred by the local crane population were managed for grazing. Releases were centered at the Three Lakes Wildlife Management Area (TLWMA) in south-central Osceola County (Fig. 1).

METHODS

Whooping cranes were hatched the spring prior to release at the captive-rearing facilities and were reared especially for release with established methods (Wellington et al. 1996). They were flown to Florida in groups of 5 to 14 birds on commercial carriers or on private aircraft from November to April. Shipments were scheduled so the birds would be introduced into the acclimation/release pen after dark to reduce stress and aid in acclimation to the new environment. Birds were examined for transportation injuries and banded with numbered aluminum USFWS bands and a unique series of colored plastic leg bands before being introduced to the pen. They were also fitted with leg-band-mounted radio transmitters (Melvin et al. 1983). Each radio transmitter (Advanced Telemetry Systems, Isanti, Minn.) had a mortality indicator switch, battery life of 24 months, and weighed approximately 65 g. One wing was brailed (Ellis and Dein 1991) to preclude flying during the 2- to 4-week acclimation phase. Brails were changed to the alternate wing after 2 weeks unless release was to occur before 4 weeks of acclimation. Capturing the bird for brail change or removal was accomplished after dark with lights and long-handled nets. Birds were returned to the pen after brail removal and were then free to leave.

The primary release enclosure was built in 1992 on the Sunset Ranch unit of the Three Lakes Wildlife Management Area and was similar to those used for the release of Mississippi sandhill cranes (Ellis et al. 1992). It was constructed of galvanized chainlink fence, 30 × 120 m and 3 m high. Temporary (portable) satellite release pens were used during the third year. These pens were 15 × 18 m, and 2.5 m high, and made of welded wire supported by PVC posts; each could be erected on site in ≤40 man-hours. A metal detector was used in and around the perimeter of the pens to remove any metal construction waste.

A quarantine protocol, developed by representatives from the National Wildlife Health Center, Madison, Wisconsin, Patuxent, ICF, and University of Florida School of Veterinary Medicine, required that the birds be quarantined for 60 days before shipment to Florida. They were also quarantined after they arrived in Florida for 2–4 weeks during their acclimation period.

We cleared and mowed 10–20 ha around the release pen to reduce stalking opportunity for bobcats and reduce post-release predation. We also attempted to capture and relocate bobcats from the release vicinity.

Each bird was checked daily for the first year post-release. Monitoring was reduced to ≥twice per week after the first year. Birds that dispersed (movement ≥10 km) from the release area were monitored from fixed-wing aircraft. Necropsies of dead birds were conducted by wildlife pathologists of the University of Florida School of Veterinary Medicine or at the National Wildlife Health Center. First-year post-released survival was based on the percent of birds that survived for the 12 months following the date of brail removal for each release group. We used the staggered entry design, a modified Kaplan-Meier procedure (Pollock et al. 1989), to estimate survival after the first year to compare results with estimates for the Florida crane population studied earlier (Nesbitt 1992). This is a simple nonparametric method for deriving a running survival rate that can accommodate individuals being added to or lost from the study population. Survival results are preliminary at this time, and an in-depth analysis or comparisons of rearing and release techniques would be premature.

The whooping cranes released in Florida were designated as "experimental nonessential" (Lewis and Finger 1993) and thus not subject to several aspects of the Endangered Species Act. This designation increased management flexibility.

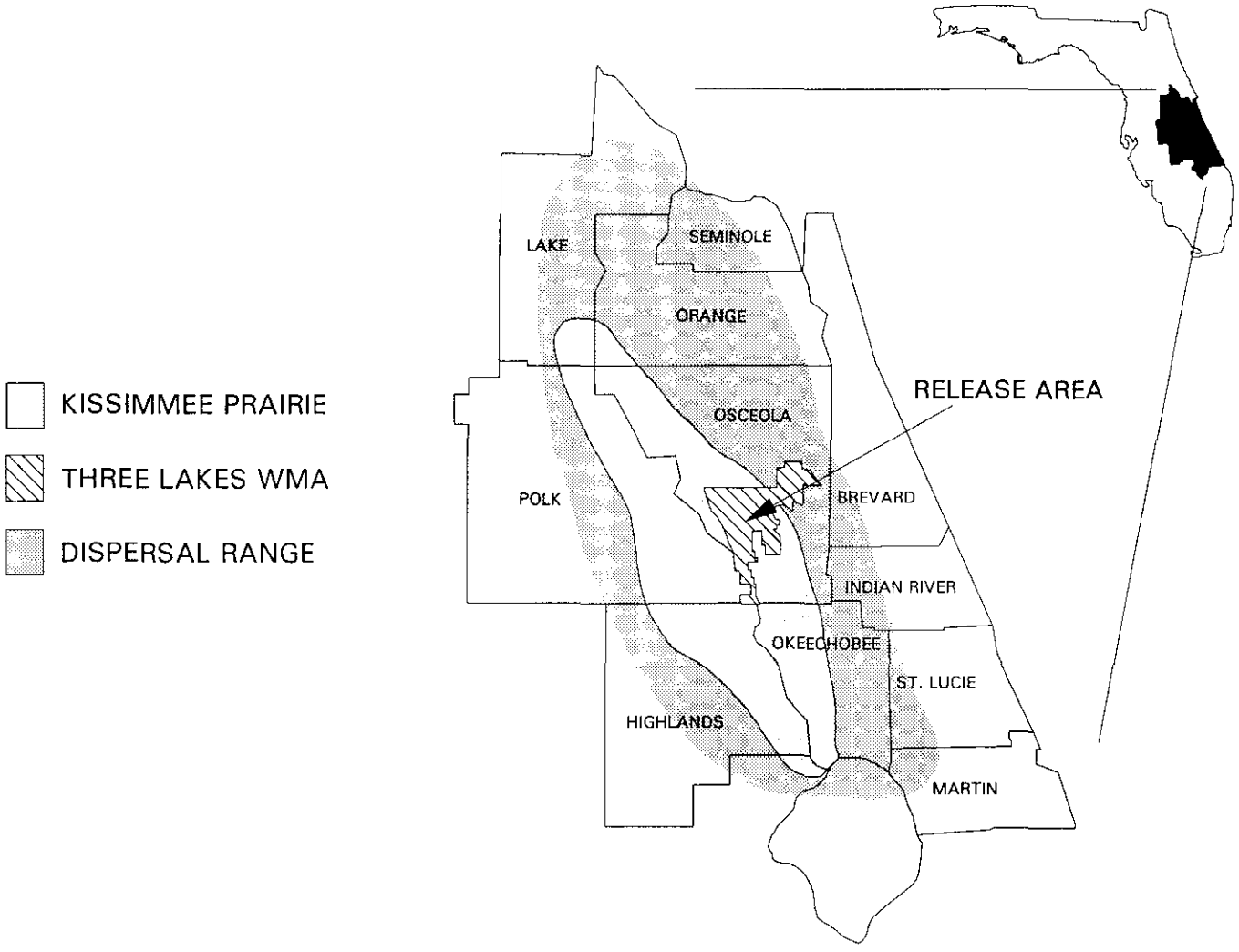

Fig. 1. Kissimmee Prairie, Three Lakes Wildlife Management Area, and release site for whooping cranes introduced in Florida, 1993–95.

Another advantage of this designation was that the owners of the private property that the cranes were likely to frequent would not be constrained in their land use practices due to the presence of the whooping cranes.

RESULTS

Releases and Habitat Management

Birds from the initial releases in 1993 and 1994 tended to roost on dry ground and to use heavily vegetated areas. Birds that did not roost in water or were prone to use overgrown areas were more likely to be killed by bobcats. Efforts were made to modify the release area habitat after these first releases by mechanically removing brush and mowing an additional area of pasture (25–30 ha) around the release pen. Changes were made at the rearing facilities to better prepare the birds for release. Standing water was provided in most rearing pens to encourage the birds to roost in water, and cranes were housed in pens with an open, unobstructed view of the surroundings. Some birds were exposed to food items and feeding sites similar to those they might find in Florida during "marsh walks" with their costumed caretakers. Birds were allowed minimal flight experience in a covered flight pen prior to release. We hoped that limiting flight experience at rearing sites would encourage site loyalty to the Florida release site.

We began considering alternative release locations, mainly on private property, in the fall of 1994. A temporary satellite release pen was constructed on 1 of these locations, but the exact sites for the pens were not selected until just before the birds were to be introduced. This allowed us to

Table 1. Characteristics of 52 whooping cranes released in Florida, 1993–95, and their status on 15 April 1996.

Date of release	Radio band colors[a]	Rearing location[b]	Sex	Hatch year	Rearing method[c]	Cause and date of death
10 Feb 93	[GO]	I	M	92	CT	Unknown Sep 94
	YG	I	M		CT	
	[YW]	I	M		CT	Bobcat 2 Mar 93
	BB	I	M		CT	
	[OB]	I	F		PR	Bobcat 23 Feb 93
	[OW]	I	F		CT	Bobcat 10 May 93
	[GB]	I	F		CT	Bobcat 22 Feb 93
	[SW]	I	F		CT	Bobcat 16 Feb 93
	[RG]	P	M		CT	Bobcat 16 May 95
	[BS]	P	M		CT	Bobcat 4 Jul 93
	[WY]	P	F		CT	Bobcat 22 Feb 93
	[SY]	P	F		PR	Bobcat 3 Jun 93
	[BO]	P	F		CT	Bobcat 20 Jun 93
	SO	P	F		CT	
14 Dec 93	[Bk]	I	M	93	PR	Bobcat 10 Feb 94
	[B]	I	F		PR	Bobcat 25 Dec 93
	[G]	P	M		PR	Bobcat 16 Dec 93
	[W]	P	M		PR	Bobcat 30 Sep 94
	Y	P	F		PR	
15 Feb 94	RG	P	M	93	CT	
	[R]	P	M		CT	Bobcat 28 Mar 94
	[RR]	P	M		CT	Bobcat 17 Feb 94
	[RBk]	P	M		CT	Bobcat 16 Mar 94
	RW	P	F		CT	
	RB	P	F		CT	
20 Apr 94	[YY]	P	M	93	CT	Bobcat 2 Nov 94
	[WYY]	P	M		CT	Bobcat 6 May 94
	[WY]	P	M		CT	Bobcat 6 May 94
	R	P	F		CT	
	BkY	P	F		CT	
	[RY]	P	F		CT	Bobcat 2 Nov 94
	[B]	P	F		CT	Bobcat 6 May 94
	[GY]	P	F		CT	Bobcat 2 Nov 94
23/25 Dec 94	[BkBk]	I	F	94	CT	Bobcat 23 Sep 95
	[RR]	I	M		CT	Bobcat 4 Jan 95
	GYY	I	M		CT	
	[OB]	I	M		PR	Bobcat 21 Feb 95
	OY	I	M		CT	
	BkWW	I	M		CT	
	[BkW]	I	F		CT	Bobcat 4 Jan 95
	GRR	I	F		CT	
12/20 Mar 95	BY	P	M	94	CT	
	[BB]	P	M		CT	Bobcat 22 Oct 95
	BBk	P	M		CT	
	BR	P	M		CT	
	BRR	P	M		CT	
13 Apr 95	[WW]	P	M	94	CT	Bobcat 4 Oct 95
	WY	P	F		CT	
	WB	P	F		CT	
	[WBk]	P	M		CT	Bobcat 10 Jul 95
	[WR]	P	M		CT	Bobcat 4 Oct 95
	WRR	P	F		CT	

[a] G= green, O = orange, Y = yellow, W = white, B = blue, S = silver, R = Red, Bk = black, [Mortalities].
[b] I = ICF, P = Patuxent.
[c] CT = costume-reared, PR = parent-reared.

Table 2. Comparison of survival (%) by sex, rearing method, and release method of whooping cranes released in Florida, 1993–95.

Number of cranes	Sex		Rearing method		Release method	
	Male	Female	Costume	Parent	Soft-release	Satellite
Released	29	23	44	8	36	16
Surviving 3–12 months	62.1	69.6	70.5	37.5	52.8	81.3
Surviving >12 months	37.9	43.5	45.5	25.0	27.8	62.5

respond to any recent changes in water levels, habitat conditions, or local crane use, and select the site that provided optimal crane habitat with lower predator density. Birds were first held in the large acclimation pen; then after brails were removed, they were moved to the satellite release pens at the selected site. They were introduced to these pens after dark and could leave as soon as they were able to fly over the fence. If they did not leave the pen after 3 days, 1 side of the pen was removed.

Fifty-two whooping cranes were soft-released between 10 February 1993 and 13 April 1995 (Table 1). Forty-one cranes were released in 5 cohorts (14, 5, 6, 8, and 8 birds) from the large acclimation pen on TLWMA and 11 were released in 3 cohorts (2, 3, and 6 birds) from a satellite pen. The time of day following brail removal when the first bird from each of the first 3 release groups left the release pen ranged from 0732 to 1600 hours on the following day. Among the group released in April 1994, the first bird did not leave the pen until 1200 hours 3 days after brail removal. Only 1 of the birds released from the satellite pen departed prior to the pen being opened, 3 days after they were moved to the pen.

Mortality and Survival

Thirty-five of the released cranes survived for ≥3 months after release. The first-year survival of 52 cranes released was 38.2%. Survival rate by release year was 35.7% (1993), 31.6% (1994), and 47.4% (1995). There were no major differences in first-year survival when results of releases were compared for sex or rearing method (Table 2). There was improved survival for birds released from satellite pens. First-year survival was 30.6% for birds released by the standard soft-release method and 50.0% for releases by the satellite method. All mortality during the first year post-release was the result of bobcat predation. Disturbance from private airboat use near the release site may have contributed to at least 1 mortality event. Most (62%) of the first-year mortality occurred within 3 months of release (Fig. 2). One bird that was found caught in a barbed-wire fence in December 1994 was rehabilitated and returned to the wild.

The survival rate during the second year after release improved to 0.81, similar to that for a normal Florida sandhill crane population in north-central Florida (0.87, Nesbitt 1992).

Use of metal detectors prior to arrival of the first cranes did not avoid ingestion of metal pen construction scraps. Six birds from the initial group of 14 ingested metal scraps and 2 exhibited lethargy and weight loss (Spalding et al. 1997). These birds were captured and the metal surgically removed. They recovered from the surgery in a few days and were released, but both birds were eventually killed by predators. Subsequent release groups were checked before and after arrival in Florida for ingested metal. Birds that were discovered to have ingested metal at the rearing facilities were not shipped for release unless the metal was removed or judged not to be a threat.

Dispersal and Movements

The mean time between leaving the release pen to initial dispersal from the release area for the birds released in 1993 and 1994 was 89.75 days (range 43–163 days). Five of 18 birds that survived more than 89 days never dispersed, but

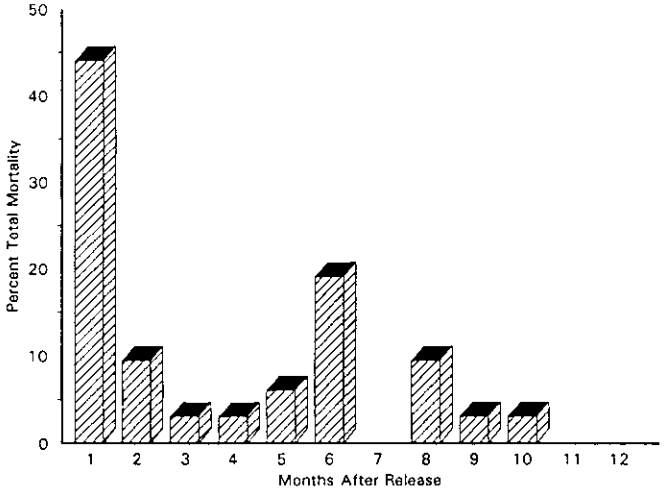

Fig. 2. Distribution of mortality by month after release for 32 of 52 whooping cranes released in Florida, 1993–95.

only 1 of these survived >1 year.

Three from the first release group left the release area on 16 May 1993, initially flying south-southeast and then north, covering a large part of central Florida during a period of 2 weeks (Fig. 1). Subsequent dispersing birds have traveled no farther from the release area than this first group and have, in some instances, followed the same general route. In all cases, dispersing birds have selected habitat that supported Florida sandhill cranes. We never saw whooping cranes flying with sandhill cranes, but they could have followed cranes we did not see or simply selected habitat that was used by sandhill cranes. There have been 4 dispersal events during the first 3 release years. Birds left the release area in groups of 2–5. Only 1 group failed to return to the release area within 5 months. The exception was the pair color-marked RG/RB, which left the release area 30 March 1994, traveled north to Lake County, and joined 3 older birds, color-marked YG, SO, OG, that had been there for several weeks. Although the 3 older birds returned to the release area, the pair (RG/RB) has remained (as of November 1995) in Lake County.

Pairing Behavior

Four pairs developed within groups surviving from the 1993 and 1994 releases. Formation of the first pair bond was initiated in December 1993 between YG (♂) and SO (♀), 18 and 20 months old, respectively. A second pair formed in March 1994 and consisted of RG (♂) and RB (♀), 11 and 9 months old, respectively. The third became apparent in October 1994 between BB (♂), 28 months old, and Y (♀), 17 months old. A fourth pair formed between the 2 birds remaining from the April 1994 release (BkY [♀] and R [♀]) perhaps a result of these being the only survivors of a cohort that was unusually cohesive. This pair consisted of 2 females; 1 bird (BkY) exhibited male-like behavior when the pair was displaying dominance and when unison calling. These pairs have remained together (as of November 1995), separated from other whooping cranes in the area. The first pair attempted copulation several times during January and February 1994, constructed a nest platform in a marsh 300 m from the release pen in January 1995, and defended this marsh from local sandhill crane pairs. The third pair (BB and Y) also appeared to be defending a territory during spring 1995.

DISCUSSION

The size of release groups may have had an influence on the post-release behavior of these cranes. Aside from the advantage to us of handling a smaller number of birds for brail changes and release, smaller groups (6–8 birds) seemed to persist as cohesive units longer following release than the initial larger group of 14. Smaller groups remained identifiable in larger flocks where 2 or more release groups were together. Release groups comprised of birds of more than 1 rearing technique were not as cohesive as a group of birds all raised similarly. Therefore, it seems best to assess experiments in rearing strategies with groups of birds all reared under the same conditions. Releasing groups reared under mixed strategies might obscure advantages or disadvantages of techniques unless effects of rearing method were controlled by experimental design.

We noticed little difference in site attachment between birds released from the larger, permanent pens and those released from the satellite pens. It appeared, however, that the satellite release method promoted longer association with the release area, perhaps because the satellite pen was in better habitat. One consideration for pen site selection was use by Florida sandhill cranes and previously-released whooping cranes. Improved habitat with less woody vegetation, more natural foods, more Florida sandhill crane use, and fewer predators may explain why birds released with the satellite method had a higher first-year survival rate. Increased effort to improve conditioning for release at the rearing site also may have contributed to improved survival of the 1995 release group. Our efforts to reduce predation at the TLWMA soft-release site by improving the release habitat (mowing, burning, and predator removal) and to modify the behavior of birds after release (i.e., to roost in water, select appropriate habitat) were not as successful.

Sandhill cranes released without an adequate acclimation period ("abrupt releases") resulted in premature dispersal and lower post-release survival in other trials (Drewien et al. 1982, Ellis et al. 1992). Birds released by the satellite technique did not disperse sooner or farther than those released by the original soft-release method. No birds dispersed until ≥40 days after release by either method. The satellite soft-release method initiated in 1995 has resulted in reduced early mortality (first 3 months) without premature dispersal. Moving birds to a satellite site near the acclimation pen appears to produce a survival-dispersal result similar to the more traditional soft-release method developed in Mississippi (Ellis et al. 1992).

We expected that the whooping cranes released in Florida would remain nonmigratory, as did greater sandhill cranes (*G. c. tabida*) experimentally released in 1986–87 (Nesbitt and Carpenter 1993). We also expected that they would interact with the local Florida sandhill cranes and perhaps adopt their daily and seasonal movements. They have remained nonmigratory, but several weeks elapsed before we noticed any influence on their movements by local sandhill

cranes.

Studies of sandhill cranes have shown that birds socialized for extended periods in the same rearing group were unlikely to pair with members of their release group (Nesbitt and Carpenter 1993). One of 4 pairs of released whooping cranes that have formed consisted of birds from different release years; the others were between members of the same release year. However, the 2 pairs that have shown the greatest inclination to breed consist of members of different rearing groups released together (YG/SO) or birds released in different years (BB/Y). Continuing to release several small groups annually rather than 1 large group may improve pair formation opportunities between birds released in the same year.

We plan to release ≥20 birds annually during the next 10 years and hope to develop a self-sustaining non-migratory population of whooping cranes before 2020. It is our hope that with continued refinement of rearing and release techniques we can increase first-year survival to greater than 60%. The threat of disease, particularly EEE, is still a concern, and we will continue to monitor the health of the experimentally released whooping cranes, as well as that of local Florida sandhill cranes.

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