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Abstract: Two hundred eighty-nine nonmigratory whooping cranes (*Grus americana*) were released in Central Florida from 1993-2005. As of January 2006, we had monitored 50 birds (16 pairs) but suspect 10 others had also survived, for a population estimate of 60 birds. The sex ratio for monitored birds was 1:1. From 47 nest attempts (1999-2005), only 4 chicks have fledged and survived to independence. Efforts are underway to determine why recruitment has been lower than expected. Other challenges for the project have included birds colliding with power lines, dispersing beyond their normal range (beyond Florida), forming pair bonds with Florida sandhill cranes (*Grus canadensis pratensis*), and venturing into urban settings. Birds were translocated in order to help solve the latter 2 problems. Of 9 translocations, 3 resulted in new long-term pair bonds.

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The first attempt at using the soft-release technique for whooping cranes (*Grus americana*) was a nonmigratory reintroduction to central Florida. Soft-release involved holding captive-reared birds in a pen at the release site for a 2 week acclimation period prior to release (Nesbitt et al. 2001). Major challenges were encountered early in the history of the project. Newly released whooping cranes roosted on dry ground, resulting in a high incidence of predation (Nesbitt et al. 1997); however, changes in rearing strategy (providing water in pens for nocturnal roosting) improved post release survival (Gee et al. 2001). Changes in our release methods, such as the use of a portable pen system that could easily be deployed where habitat conditions were optimal, also improved survival (Nesbitt et al. 2001). Another problem in the early years of the program was that birds ingested metal, principally bits of discarded metal from chain link fence construction, and suffered zinc toxicosis (Spalding et al. 1997). The portable release-pen system we developed (mentioned above) was constructed without chain link or other potential sources of metal scrap that cranes could ingest. The flock has, however, sustained mortality from other human-derived sources, such as from colliding with power lines (Folk et al. 2001). The cranes approached breeding age during the worst drought in Florida history (1998-2002), and the resulting low wetland water levels suppressed nesting attempts and success (Folk et al. 2006*a*). Natural reproduction thus far has resulted in 4 chicks fledged into the population. The health of some release birds apparently was compromised by Infectious Bursal Disease (IBD), a viral disease for which little is known in wild populations of birds (see Candelora et al. 2008 for information about on-going research). In this paper we provide an update on the reintroduction and summarize some of the more recent challenges not covered in previous papers.

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METHODS

We soft-released small groups ("cohorts") of whooping cranes (a total of 289 cranes) each winter during 1993-2005 (Fig. 1) into Lake, Osceola, and Polk counties in central Florida (see Fig. 2 in Folk et al. 2006*a*). We monitored the birds (via radio telemetry) daily for the first 3-6 months post release and 2-3 times each week thereafter for the life of the bird.

RESULTS AND DISCUSSION

General

As of January 2006, we had monitored 50 birds (16 pairs) in the population (Fig. 1) and estimated that 10 more birds had survived but are untrackable. Twenty-five were males and 25 were females.

From 47 nests (1999-2005), 4 chicks have fledged and survived to independence. [During the same period, within the Aransas/Wood Buffalo population (AWBP), 374 nests fledged 149 young (B. Johns, Canadian Wildlife Service, personal communication)]. Efforts are underway to determine why recruitment has been lower than expected. Factors that could cause the apparent low fertility rate include environmental conditions, disease, and parental inexperience. Fertility varies between years, but is generally lower than that of whooping

cranes within the AWBP. In addition, there are individual birds that seem incapable of breeding, and vestigial gonads have been observed in some cranes.

We captured 149 free-living whooping cranes for routine replacement of transmitters and health checks. Of 10 capture techniques used (Folk et al. 2006*b*), the "clap trap" (see Parker et al. 2008) became increasingly important because it allowed simultaneous capture of multiple individuals. The only captures dealt with specifically in this paper were associated with translocations (see that section below). The remainder of this paper will focus on other long-term challenges faced by the project.

Power Lines

Eighteen birds have died after striking power lines (see Stehn 2008). We assumed, based on recovery of transmitters with broken leg bands under power lines and subsequent observations of the birds that had carried those transmitters, that 5 more birds collided with lines and survived. It is not unusual to see whooping cranes brush power lines or trees with their legs as they pass over them. As the bird brushes the object, the transmitter, which hangs down on the leg, likely strikes the lines hard enough to shatter the plastic band.

Whooping cranes have died after striking high-voltage transmission lines (9 strikes) and lower-voltage lines for local power distribution (9 strikes). Seven deaths took place within a 2-year period (March 2003-March 2005) along an 8-km span of high-voltage lines. The birds were roosting on one side of the line and feeding on the other, necessitating that they fly across the lines at least twice a day. The owner of the lines, Progress Energy, was kept apprised of the situation. In January 2004 they used visibility markers (yellow spiral type) to mark the top "static" lines (smaller-diameter lines that are difficult for birds to see and avoid) in select locations. In June 2005, after we requested that more lines be marked with a potentially more effective marker (Firefly Bird Flapper by PR Technologies, Portland, OR), Progress Energy marked more lines in that problem span.

Dispersals Beyond Florida

During the severe drought of 1998-2002 we documented an unusually high (in numbers of birds and distance traveled)

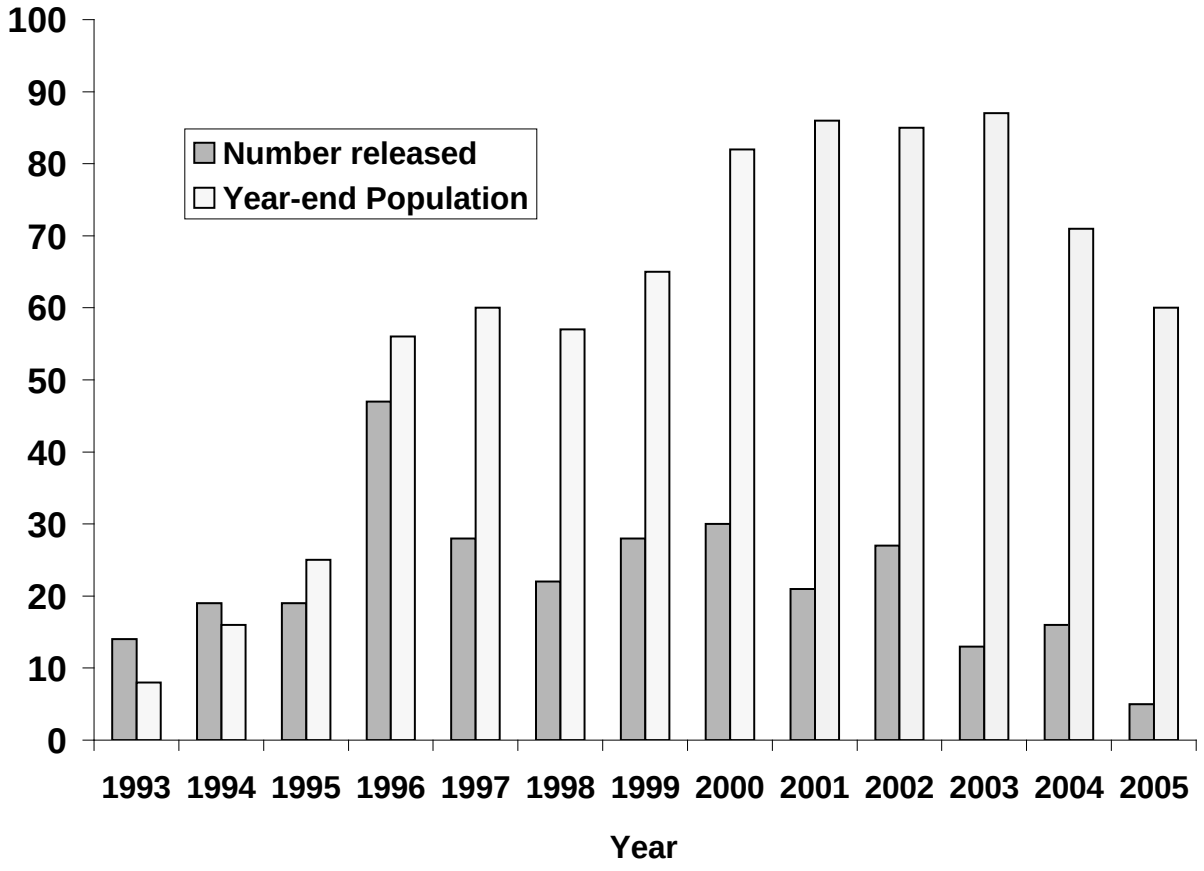

Figure 1. Number released and year-end population size of the nonmigratory flock of whooping cranes in central Florida.

Table 1. Dispersals of 16 nonmigratory whooping cranes beyond Florida during 2000-2005.

Bird ID	Date	Age of birds	Dispersal to	Outcome
Pair 653, 512	Last seen in Fla. 8 Apr 2000; Sighted in Ill. 11 May 2000; Sighted in Mich. 15 May 2000.	Male: 4 years Female: 5 years	Spent the summer and fall in east central Mich.	Began trip back to Fla. 21 Nov 2000; Male disappeared over Lake Erie; female returned to central Fla.
918, 919, 920, 921	26 Jul 2000	1 year	Last seen flying into Ga.	Never seen again
910, 911, 913, 915	26 Jul 2000	1 year	Last seen flying into Ga.	All return to central Fla. by 17 Jan 2001
787	Early May 2001	4 year	Western Va.	Returned to its usual group in Fla. 27 Jun 2001
1306, 1338, 1340, 1349, 1350	Between 5 May 2005 and 9 May 2005	2 years	Coastal S.C.	1340 returned to Fla. in early September 2005; other 4 still missing

dispersal of cranes, undoubtedly related to drying wetlands. We saw movements within the state but also, for the first time, substantial movements beyond Florida. Sixteen nonmigratory whooping cranes have been documented in 5 states other than Florida (Table 1). Nine of those birds have not been seen since they left Florida.

Relationships with Sandhill Cranes

Soft-released whooping cranes spent time with Florida sandhill cranes (*Grus canadensis pratensis*) and no doubt benefited by learning about foraging and roosting sites. The 2 species appear to "speak the same language" in that they effectively communicate with each other through calls, postures, and actions. As expected, on a given social level, the larger whooping crane dominated the smaller sandhill cranes. Whooping cranes and sandhill cranes commonly shared habitats; however, some whooping cranes consistently spent more time with sandhill cranes than with conspecifics. Fifteen whooping cranes have shown varying degrees of affinity for sandhill cranes, ranging from simply spending all their time with them to actually attempting to mate and nest with them. We describe these birds in chronological order of release.

Male 284 was one of the very first birds released. Throughout the years it spent time with both sandhill cranes and whooping cranes. It was observed soliciting for copulation from sandhill cranes and on one occasion showed "adoptive" behavior by feeding a sandhill crane chick. Bird 284 paired with several whooping cranes for short periods of time but never nested with them. In early 2002 we saw an encouraging relationship between 284 (he was approaching 10 years old) and the younger whooping crane female 512 (approaching 7 years of age). However, on 4 April 2002, bird 284 was found with a sandhill crane female and her chick (we don't know what became of the sandhill male). Bird 284 consistently chased off his whooping crane "mate" and adopted the sandhill crane female and chick, feeding the sandhill chick as if it were his. From 4 to 26 April 2002, the male whooper was always seen with his adopted sandhill family but he was not seen thereafter.

Female 394 dispersed from its release site on 1 April 1994 and began living with sandhill cranes. During numerous opportunities for interaction with whooping cranes throughout the years, bird 394 showed little interest in them. In 1995, a pair of sandhill cranes building a nest tolerated the presence of this single whooping crane within the nest marsh. In March, bird 394 was observed performing a precopulatory display for a couple of sandhill cranes. Later in the spring, bird 394 was spending time with a sandhill crane family. In 1996, bird 394 again was with a sandhill crane family. The bird continued to live with sandhill cranes until last seen 11 February 1999.

Female 590 (released late 1995) spent all its time with sandhill cranes but never paired. In November 2002, it was brought into captivity because of an infection of aspergillosis. The bird could not be re-released.

Female 598 (released in early 1996) wandered considerably and spent much of its time with sandhill cranes. It was last seen in April 1999.

One whooping crane actually nested with a sandhill crane. In November 2003, a landowner reported a hybrid pair of a male whooping crane with a female sandhill crane. He said the pair had been on his property for several years. Male 641 had been "missing" for several years so we didn't know the history of the pairing, but the landowner reported that the pair

nested (unsuccessfully) in 2003. In an effort to pair it with a conspecific, we captured and translocated the whooping crane 16 km to be near 9 other whooping cranes, including 2 eligible females. It spent several days around the release site but then returned to its sandhill crane mate and territory. The hybrid pair was discovered nesting on 11 March 2004. They incubated for 84 days, but the nest failed to hatch. He died after colliding with a power line in April 2005.

Male 655 (released early 1997) began spending time with sandhill cranes in February 1999. It had a long history of association with sandhill cranes until its death (collision with power lines) in January 2001.

Male 901 (released late 1999) is one of the rare exceptions to the rule that once a whooping crane goes off with sandhill cranes, it never returns to whooping cranes. Bird 901 lived in a housing subdivision with sandhill cranes before returning to its release site and getting back together with whooping cranes, even taking a whooping crane mate. However, for its first nest attempt, male 901 chose to nest with a female sandhill crane.

Female 913 (released early 2000) joined sandhill cranes on a golf course in Lakeland. We made plans to capture and translocate it to a more rural habitat, but at the time of capture in April 2002, we found that the bird had sustained a broken leg (reportedly from a golf-ball strike). It died while under anesthesia during treatment of the leg.

Male 926 (released early 2000) was also spending time with sandhill cranes on a golf course. We captured the bird in April 2003 and translocated it to a remote site with eligible whooping cranes. This male immediately showed interest in the whooping cranes and began pairing with one at that time. In 2006 it successfully raised a chick to fledging.

Since its release in late 2000, Female 1003 had lived its life alone or with sandhill cranes. Male 1006, released at the same time as female 1003, joined sandhill cranes and began visiting a subdivision and its associated golf course. The bird sustained a broken leg and was then killed by a bobcat. Female 1007 (released in late 2000) dispersed from the release site to live with sandhill cranes and is a candidate for future translocation. Male 1010 lived with sandhill cranes after its dispersal from its release area. It died after colliding with a power line.

Female 1178 (released early 2002) preferred the company of sandhill cranes and lived in a densely populated suburban area (Brandon, FL). We captured it there and translocated it to rural Polk County to be near other whooping cranes. It showed little interest in the whoopers and soon moved to another suburban area (Lakeland, FL), where it lived near sandhill cranes on a golf course. In spring 2005, it was seen in a marsh with a pair of nesting sandhill cranes. It died of unknown causes in May 2005.

The latest bird to show affinity for sandhill cranes was male 1408, released in late 2004. This bird dispersed with its cohort 18 km, but when the cohort returned to the release site, it remained and began spending time alone or with sandhill cranes.

We looked at variables pertaining to these 15 cranes that might be associated with this behavior. We saw no evidence of a pattern in gender, rearing site, rearing method, release site, or release year. Individuals from hatch-years 1992-2004 have shown this behavior. It does not appear to be a function of small population size or availability of potential mates, because the birds had conspecifics available to them. It may be an artifact of captive rearing, despite the use of mitigating techniques (costume or parent rearing).

Cranes Venturing into Urban Habitats

Whooping cranes learned from Florida sandhill cranes and sometimes traveled with them. Some whooping cranes (subadults especially) followed sandhill cranes into urban areas (several cases were mentioned in the previous section). Florida sandhill cranes are present in every housing subdivision within the core of the population, probably in part due to the rapid development of their native habitat by humans. Cranes are probably attracted by the open setting (mowed grass) and availability of some foods (acorns, earthworms, turf grubs). In addition, humans provide feed, thereby enticing cranes to urban areas. In 2002, the Florida Fish and Wildlife Conservation Commission made it illegal to feed sandhill cranes (Florida Fish and Wildlife Code 68A-4.00(3)). Despite the law, cranes still inhabit urban areas, perhaps because of the attractions mentioned above (open habitat and "natural" food like acorns) and the fact that even though bird feeders are elevated above the reach of the cranes, the feed is often spilled by other animals onto the ground below. In addition, some people continue to deliberately feed sandhill cranes.

Cranes in urban areas are probably more prone to problems associated with human structures, automobiles, and debris (Folk et al. 2001). Several whooping cranes may have died as a result of frequenting urban settings: bird 1006 died from a broken leg and subsequent bobcat predation, bird 655 from a collision with a power line, and bird 913 from being struck by a golf ball.

Some urban areas were considered less threatening to cranes than others. Low-density urban settings where the ratio of green space to human structures is higher, generally provided fewer obstacles to cranes. If automobile traffic (a major concern) was not an issue, we often opted not to intervene with the cranes' behavior. In situations where there appeared to be an elevated threat to the birds, we had several options for action, beginning with public education. Fliers were handed out, and in some instances, we talked to people to encourage them to stop feeding cranes. When these approaches

did not ameliorate the problem, we attempted to capture the bird(s) for routine health checks and replacement of the radio transmitter, knowing that the capture experience might haze the group from that setting. In some instances, we translocated birds after capture, with varying degrees of success. Several returned to urban settings after a few days. One very successful translocation was when bird 926 (living in a golf-course community with sandhill cranes) was caught and moved to a rural setting with many other whooping cranes. It immediately began pairing up with whooping cranes and only briefly visited an urban setting before returning to appropriate rural habitats.

Translocations

We made 149 captures of free-living whooping cranes, principally for replacement of radio transmitters and routine health checks. Nine cranes were moved to new locations after capture (Table 2). Seven of these moves were, at least in part, to promote the formation of pairs. Three translocations were successful, resulting in long-term pair bonds. Moving birds during the breeding season appeared to increase the chances of success.

MANAGEMENT IMPLICATIONS

Many challenges have arisen during this first attempt at reintroduction of whooping cranes by means of the soft-release method. Some problems have been resolved, and the knowledge derived has resulted in dramatic improvements in the way cranes are raised in captivity for release into the wild. These improvements in husbandry have benefited the second, on-going whooping crane reintroduction effort to return migratory whooping cranes to the eastern U.S., which began in 2001.

We are still trying to understand some challenges facing the nonmigratory flock, such as why productivity has been so low. The future of this flock is uncertain; our goal now is to achieve a better understanding of the limitations to this flock.

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Table 2. Translocations of whooping cranes in central Florida.

Bird	Date	From	To	Distance	Reason[a]	Outcome
588	10 Dec 1997	Escape Ranch	Moss Park	45 km	a	Bird returned to capture site after 1 week
787	15 May 1998	Smith Ranch	Escape Ranch	29 km	c	Bird stayed where desired
475	15 Nov 2001	Crooked Lake	Lake Kissimmee	41 km	a, b	Bird returned to capture site after 1 month
926	11 Apr 2003	Inverness	Okahumpka	37 km	a, b	Bird stayed where desired and paired
641	7 Nov 2003	Holopaw	Lake Kissimmee	16 km	a	Bird returned to sandhill crane mate after 2 days
1178	13 Nov 2003	Brandon	Lake Gordon	70 km	b	Bird moved to a new urban setting
513	13 Jan 2005	Escape Ranch	Lake Kissimmee	27 km	a	Bird returned to Escape Ranch after 2 days
512	8 Feb 2005	Lake Kissimmee	St. Johns Marsh	55 km	a	Bird stayed where desired and paired
477	2 Apr 2005	Lake Kissimmee	Escape Ranch	27 km	a	Bird stayed where desired and paired

[a] a: Promote pair bond, b: Remove from urban setting, c: Move to new site for health reasons.

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