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HISTORY OF BREEDING PAIRS AND NESTING SITES OF THE MISSISSIPPI SANDHILL CRANE

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Abstract: Thirty-four Composite Nesting Areas (CNA’s) of endangered Mississippi sandhill cranes (Grus canadensis pulla) within the current breeding range in Jackson County, Mississippi, were located from 1965 to 1996, primarily by ground searching. Of those 34 CNA’s located, 28 were on 1 of the 3 refuge units and 6 were off but adjacent to the refuge’s Ocean Springs Unit. Five of the CNA’s had 2–3 distinct smaller core nesting areas within. Two CNA’s had active nests in more than 20 years, and those nests accounted for 11% of the total. Nine CNA’s accounted for 130 (63%) of the nests. Eleven CNA’s were used in only 1 year. The first marked cranes nested in 1985; by 1996, 34 marked cranes had nested. The mean distance between different CNA’s used by same individual(s) in different years was 2.0 km. The shortest distance between active nests in a year was 0.8 km. The mean distance from release pen to CNA for 32 released cranes was 2.9 km; only 4 cranes used CNA’s in different units from their release pens.

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Key words: Grus canadensis pulla, Mississippi, nesting, sandhill crane, territory.

The endangered Mississippi sandhill crane is a non-migratory subspecies found in the wild only on and adjacent to the Mississippi Sandhill Crane National Wildlife Refuge (NWR) in extreme southeastern Mississippi. Earlier studies have described nesting habitats (Valentine and Noble 1970), nesting ecology (Valentine 1982, 1992), captive release efforts (Zwank and Derrickson 1982, Zwank and Dewhurst 1992, Mitchell and Zwank 1987, Wilson 1987, Valentine and Logan 1991), changes in habitat (Smith and Valentine 1987), and status and management (U.S. Fish and Wildlife Service [USFWS] 1991; Valentine 1979, 1981, 1987; Valentine and Noble 1976). This paper is a historical record of the breeding pairs and nest area occupancy during 32 years.

We acknowledge and thank past and present employees of the Mississippi Sandhill Crane NWR, Louisiana State University students, State of Mississippi biologists, Student Conservation Association Resource Assistants, refuge volunteers, interns, Mississippi Gulf Coast Audubon Society members, contract helicopter pilots, and numerous others for participating in nest searching efforts over the years. International Paper Company, DeSoto National Forest, Jackson County, Mississippi, Mississippi Gulf Coast Wastewater Authority, State of Mississippi, N. Jordan, E. Huger, and others allowed nest searches access to their lands. We gratefully acknowledge J. R. Twiss for preparing the figure.

STUDY AREA AND METHODS

This study was conducted on the 7,770-ha Mississippi Sandhill Crane NWR and adjacent lands in Jackson County east of the Pascagoula River in southeastern Mississippi (Fig. 1) between April 1965 and June 1996. The study area has been described elsewhere (Valentine and Noble 1970, Smith and Valentine 1987). There are 3 units, Gautier, Ocean Springs, and Fontainebleau, each with an enclave of cranes. Although units are only 3.0 km apart, cranes rarely go into the neighboring units during summer, but they may use the same feeding grounds in winter. Cranes also have nested outside the refuge’s Ocean Springs Unit on adjacent private and public lands.

Habitat management for breeding sites has included clearing of pine trees by hand, bulldozing, commercial harvest, and prescribed burning. Shallow impoundments were created by raising culvert elevations on roads and with other water-control structures.

Nests were found during 32 annual searches (1965–96) mostly on foot, but also by airplane, helicopter, horse, and radiotelemetry. Nest site locations were plotted on USGS topographic maps. Beginning in the early 1980’s, nest sites were permanently marked with a metal stake and tag. Composite Nesting Areas or CNA’s (Kuyt 1981) were used to identify the site where cranes habitually nested. Nesting areas were designated only after evidence of an active nest was discovered. Generally, CNA’s were designated with unique numbers. Some CNA’s consisted of 2–3 smaller nesting areas used by the same pair. A single CNA was used by but 1 pair in a given year.

RESULTS

The crane breeding population was small (Table 1); nesting habitats were widely separated. Three secluded territories, 0.8 km apart, along Ben Williams Swamp (Fig. 1) contained more than 90% of the breeding population.
Fig. 1. Locations of Mississippi sandhill crane Composite Nesting Areas (CNA's), Jackson County, Mississippi.

1), were closest. Large open savannas were occupied by only 1 pair at a time. There were 34 CNA's found and used during 1965-96. One of these 34 was described prior to the study period (Walkinshaw 1960). A thirty-fifth CNA was described previously (McIlhenny 1938, Gandy and Turcotte 1979) but not actively used during the study period. Five CNA's included 2 or more separate nesting areas. There were 6 CNA's off the refuge and adjacent to the Ocean Springs Unit. There were 28 CNA's on the refuge: 14 on the Gautier Unit, 13 on the Ocean Springs Unit, and 1 on the Fontainebleau Unit. There were 207 active nests including 20 renests. Among the latter, 9 were used only during 1 or 2 years.

The most frequently occupied CNA had active nests in 21 of the 32 years. Eleven CNA's were used only once. Two CNA's had 44 (11%) of the nests, and 9 CNA's accounted for 130 (63%) of the nests. Five CNA's were not used after 1970. Nesting in 7 CNA's was initiated after 1992.

Crane nesting occurred in the Gautier Unit in all 32 years. Nests were found in 26 years in the Ocean Springs Unit, 10 years in the Fontainebleau Unit, and 16 years in off-refuge CNA's. There were 111 (54%) nests in Gautier, 62 (30%) in Ocean Springs, 10 (5%) in Fontainebleau, and 24 (11%) in off-refuge CNA's.

Marked cranes first nested in 1985. By 1991 the majority of nesting cranes were marked. Six (2 female, 4 male) marked wild-hatched cranes and 28 (9 female, 19 male) marked captive-bred and released cranes nested. The CNA use by certain unmarked cranes was determined from their association with marked cranes and the small population size. Some individual breeding cranes or pairs moved between CNA's (Table 2), nesting in different CNA's in different years and occasionally in the same year. Movement between CNA's was always within a refuge unit, but some movements were across paved public roads, including an interstate highway, and nearly all were across unpaved refuge roads.
Table 1. Occupancy of Mississippi sandhill crane Composite Nesting Areas (CNA’s), Jackson County, Mississippi, 1965-96. Number of active nests (first plus renests) is indicated.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. years occupied</th>
<th>No. of nests</th>
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<tbody>
<tr>
<td>1965</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>1966</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>1967</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>1968</td>
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<td>11</td>
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<td>1970</td>
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<td>1995</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1996</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Released cranes tended to use CNA’s near their release pens (Table 3).

Gautier Unit

Brown’s Trail. — Before 1960 the Brown’s Trail savanna was about 1.5 km wide and 3.5 km long. Housing and commercial developments and U.S. I-10 reduced nesting habitat to about 150 ha. There are 2 CNA’s in the Brown’s Trail area. CNA 1 had active nests in 20 years. Two active nests were found (1965–66) in the 23-ha northeastern savanna (CNA 1A), but the pair abandoned the site after a wildfire coursed through in 1967. No nests were found there until 1990, when an unknown pair nested, but none has nested since.

The original CNA 1A pair may have moved after the fire to the large southwestern “Coke Plant” savanna, CNA 1B, in 1978. In summer 1984, wild female (#627) of the CNA 1B pair was alone with her half-grown colt. Released crane #608 became a surrogate parent that summer and helped raise the juvenile. In 1985, eggs were laid but the nest was abandoned because of disturbance; in December #608 died. In late winter, female #627 mated with wild crane #628 and the 2 nested without success in 1986. Although still paired in 1987, they did not nest. No breeding pairs occupied the territory after 1987 until 1996, although nonbreeding
From | To | Male | Female | Distance between CNA's (km)
--- | --- | --- | --- | ---
1980 4 | 1981 2 | UM | UM | 3.0
1981 2 | 1982 4 | UM | UM | 3.0
1982 23 | 1983 14 | UM | UM | 1.2
1982 4 | 1983 6A | UM | UM | 1.8
1983 6A | 1984 6B | UM | UM | 3.0
1987 4 | 1989 6C | UM | UM | 1.5
1988 24 | 1989 25 | UM | UM | 1.8
1988 22 | 1990 24 | UM | UM | 3.3
1988 23 | 1990 25 | UM | UM | 1.6
1989 16 | 1991 22 | UM | UM | 2.1
1991 22 | 1994 27 | UM | UM | 1.3
1993 8C | 1994 14 | UM | UM | 1.2
1995 28 | 1996 29 | UM | UM | 1.1
\bar{x} | | | 2.0
SD | | | 0.77

* Unmarked.

associations of released cranes have occurred there. In 1996 a family (unbanded male, captive-bred #912 female, and chick) appeared on adjacent private lands and presumably the pair nested in this territory.

The adjacent narrow 15-ha CNA 2 (7 nests and 1 renest) in the east savanna, east of the swamp, was occupied concurrently with CNA 1A–B, 1.4–2.2 km apart during 1966–74, except for 1971. This CNA was considered one of the most pristine hydric savannas in the area. After 1974 no nests were found in CNA 2 until 1996, except when the CNA 4 pair nested there in 1981. Five potential nesting openings were hand-cleared and burned several times during 1980–93. A hand-reared pair, #02 male and #933 female, nested in 1996. The Gautier release pen is located at the northern end of the CNA 2 savanna.

Ben Williams Swamp.—The swamp is an area of 104 ha of slash pine (Pinus elliottii) and pond cypress (Taxodium ascendens) with wet savanna nesting habitat along the edges. During 1965–74, 4 separate nesting areas (Fig. 1) were found along swamp edges. One nest was found in CNA 3 on the north-central edge in 1965; it appeared to have been occupied for several years. After 30 years without occupancy, in 1995 an unknown pair built several start nests in CNA 3 but no eggs were found.

In 1971–74 there were 3 CNA's (4, 5, 6) about 0.8 km apart along the eastern half of the swamp edge. The territory used most (21 years) in the study period was the hydric 6-ha CNA 4 swamp edge along the eastern edge of the Ben Williams Swamp. In a pre-study period, Walkinshaw (1960) found 2 nests in CNA 4 in 1940 and 1 in 1960. The CNA 4 was found again by Valentine in 1966, with nests in 1969 and 1971–80. After their nesting site was burned, CNA 4 pair moved in 1981 3.0 km north to vacant CNA 2 where they nested but destroyed their only egg. They returned to CNA 4 in 1982. After losing a chick in 1982, they nested nearby without success. In 1983 the pair abandoned their non-viable eggs and renested in vacant CNA 6A where they hatched a chick. In 1984 they nested 2.4 km from CNA 4 in a cleared savanna, CNA 6B, without producing young; no nests were found in 1985 or 1986. One of the pair was thought to have been killed by a coyote (Canis latrans) in 1985.

A newly formed pair (wild male and captive-bred female #634) nested in CNA 4 in 1987. No nests were found in 1988, but #634 and a wild male nested 1.5 km northeast of CNA 4 in 1989 in CNA 6C. In 1990 female #634 acquired a new mate (captive-bred #855). The pair nested and laid eggs in CNA 4 but deserted. In 1991 the same pair nested, but again deserted the nest. No nests were found in 1992. In 1993 the pair produced a fledgling. Male #855 mated with an unbanded female and nested in 1994, but no chicks were seen. Male #855 disappeared in winter and captive-bred #018 replaced him, nesting with the unbanded female in 1995–96.

A minimum of 3 pairs claiming CNA 4 nested there 22 times during 1966–96. A CNA 4 pair (with changes in spouses) has temporarily nested in nearby vacant territory sites. After CNA 4 burned, the pair nested 1 season in CNA 2 (3.2 km) away. In 1983 they renested in CNA 6A (1.8 km away). After a nest failure in CNA 4 (1984), the pair renested in CNA 6B, cleared savanna 2.4 km away, but returned the next year to CNA 4. The pair nested twice in 1989 in CNA 6C.

The <1-ha CNA 5 was a small opening in the southeastern edge of the swamp, just northwest of the release pen and between CNA's 4 and 6A. Active nests were found in 1971, 1973, and 1974, and none thereafter. The opening has since become overgrown with greenbrier (Smilax spp.), and cranes were rarely observed.

There were 5 nests in CNA 6A, an approximately 5-ha, very narrow, hydric area along the south-central edge of the swamp. There were nests in 1971, 1975–76 (CNA 4 pair) but none again until 1996 (probably captive-bred #919 male and #926 female).

The CNA 6B (Fig. 1) is a cleared mesic to xeric savanna north of the Applewhite Dump. There was only 1 nest there, in 1984, when the CNA 4 pair temporarily relocated there.

Also used only 1 year was the narrow 7-ha CNA 6C (Fig. 1), north of the refuge 1-10 Crop Unit. The CNA 4 pair nested there in 1989. A renest was not found but was...
assumed because the pair and a juvenile were seen during the October 1989 census.

Vickers.—The Vickers CNA (15) is located in the southeast part of the unit in a 48-ha mesic savanna (Fig 1). A swamp pond is on the north end, and a narrow marsh runs from the pond southwest through the savanna. Six nests were found in the marsh and 1 in dry wiregrass (Aristida spp.) during 1975-84. In 1984 the Vickers pair raised a subadult (#624) and spent the summer and fall 8.0 km north of Vickers. The male appeared to neglect his family and, in winter 1984-85, the female and #624 roosted together in the Bluff Creek Marsh. Telemetry and sightings indicated that #624 and a wild crane (possibly his mother), spent most of March-May 1985 in Vickers. In 1985, 2 large nests were found in the swamp pond, but no eggs were laid.

After a CNA vacancy of 8 years, in 1993 a new pair (released male #922 and wild female) nested through a rare snowfall, then renested in the pond edge and produced a fledgling. The Vickers pair nested again in the pond in 1994, but no chick fledged. In 1995-96, the Vickers pair nested in the swamp edge immediate to the site where in past years 4 nests had been found. During years when no cranes nested, the mesic savanna was hand-cleared and burned several times; the swamp pond was hand-cleared in 1993, just months before the new pair began nesting.

Valentine Savanna.—Two CNA’s were defined along the Valentine Road, a pine plantation converted to mesic savannas. Two ponds in wooded drains were created by raising the elevation of culverts in Valentine Road. The 52-ha Valentine North CNA (21A) was discovered in May 1983 when a pair and 2 chicks were seen along Valentine Road. A large nest, apparently used in 1984, contained eggs in 1985. In 1986 a nest with eggs was found 1.0 km south of the 1985 nest. This CNA was the third most frequently used. Between 1983 and 1996, the CNA had active nests every year but 1984 and 1988.

In 1987 a newly formed pair (captive-bred male #623 and wild female) nested near the site of first pair’s 1984-85 nests in 21A. No nests were found in 1988, but in 1989 the pair nested in the 5-ha north pond along Valentine Road.

In 1994 the Valentine North pair nested in the savanna about 200 m south of Brown’s Trail. The original pair nested 3 times in the savanna. The second pair (#623 and wild female) nested 3 times in the savanna and 3 times in the pond. On 11 November 1994, #623 was killed by a car on the Gautier-Vancleave Road. During the winter the wild female stayed on territory, accepted #883, and the pair nested in the savanna in 1995-96.

The Valentine South CNA (21B) is located farther south along Valentine Road (Fig. 1). In 1987 a pair (captive-bred #636 male and wild female) occupied the small 3.5-ha impoundment south of the Valentine Crop Unit. The CNA has had active nests every year since, totaling 10 nesting attempts. The male #636 died in late 1995. The unbanded female held the territory, mated with captive-bred #214, and nested in 1996. All CNA 21B nests were in the pond along Valentine Road.

Firetower.—Firetower CNA (28), a 1.0-ha wetland cleared of pond cypress in winter of 1993 and adjacent to a 23-ha mesic savanna, is located 1.5 km east of Ben Williams Swamp and 1.6 km northwest of CNA 15 (Fig. 1). Firetower Road was impassable during winter-spring of 1994, which limited human disturbance. In 1994 a nest was found. Both captive-bred #871 male and #136 female were first-time nesters. A pair, presumably the same, nested unsuccessfully in 1995. A new but unknown female nested there in 1996.

Beasley Pond.—The Beasley Pond CNA (29) was used for the first time in 1996 by captive-bred #218 male and #136 female. The nest was in a hydric strand just west of the 1.5-ha Beasley Pond. The female had been mated with #871 in the Firetower CNA 28.

Ricky.—The Ricky CNA (30) was converted back to a 33-ha open savanna in 1989. The mesic savanna borders the Gautier-Vancleave road to the west. A new but unknown banded pair nested in a shallow 0.1-ha pool in 1996, only 0.8 km from the Valentine South CNA (21B).

Fontainebleau Unit

Mary Bourne CNA (12), 130 ha of savanna and pine in the southeast part of the Unit, is located 4.4 km south of CNA 6A, its nearest neighbor. A pair nested each year for 10 years (1968-77). In May 1978 a crane, probably the male, was killed by a vehicle or airplane near the territory. No active nests were found after 1977. A pair was observed in the area until late 1988 after which a single female was seen sporadically until 1993. In late summer 1994 several large areas were cleared, a release pen was built in the autumn, and in March 1995, 12 juveniles were released in the hope of eventually establishing a use area on and adjacent to the Unit for 10-12 cranes, including 2-3 nesting pairs.

<table>
<thead>
<tr>
<th>Pen</th>
<th>n</th>
<th>x</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gautier</td>
<td>8</td>
<td>2.1</td>
<td>1.43</td>
<td>0.5</td>
<td>3.7</td>
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<tr>
<td>Ocean Spring</td>
<td>17</td>
<td>3.6</td>
<td>4.50</td>
<td>0.2</td>
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<tr>
<td>Ben Williams</td>
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<td>2.2</td>
<td>1.29</td>
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<tr>
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<td>32</td>
<td>2.9</td>
<td>3.46</td>
<td>0.2</td>
<td>14.0</td>
</tr>
</tbody>
</table>

Table 3. Mean distance (km) from Mississippi sandhill crane release pens to Composite Nesting Areas (CNA’s) used by released cranes in Jackson County, Mississippi, 1980-96.
Ocean Springs Unit

Perigal Swamp.—The Perigal Swamp area, a region of swamp, wooded creeks, pine plantation, and savanna, was improved for nesting and feeding through bulldozing, timber cutting, hand-clearing, and water control.

The 16-ha CNA 7 is located around the intersection of West Cottonmouth and East Perigal roads. A nest was found in 1966 just west of East Perigal Road next to the swamp (7A); another nest was found in 1967 but none in 1968. In 1969 and 1971, the pair nested about 0.6 km south in a small opening among pines (7B) and returned to nest in CNA 7A in 1970.

Nesting habitats in Perigal Swamp became overgrown with pine trees and shrubs. In the early 1990’s, hand-clearing improved nesting habitats on both sides of East Perigal Road. After a 21-year vacancy, a nest was found 50 m east of the road (CNA 7C) in 1993, but the pair abandoned the site. A renest containing 1 egg was found on the west side in CNA 7B. No nests were found in 1994–96.

A pair nested for 2 years (1966–68) in Blue Hole CNA (8A) located north of Glendale Road, 0.6 km west of Old Fort Bayou Road, but left in 1969 when the Interstate Highway 10 right-of-way was cleared. A borrow pit (Blue Hole), excavated for fill, now occupies part of the former nesting site. CNA 7A pair was nearest neighbor (1.8 km apart) to CNA 8A when they nested concurrently during 1966–69. No nests were found in 1969–71, but during 1972–73, 3 nests were found 0.8 km northeast in a small wet marsh (CNA 8B).

In 1993, after a 20-year vacancy, a new pair, a wild male and an unknown banded female, nested in CNA 8B; no nest was found in 1994. After hand-clearing of pines, a nest was found in 1995 in CNA 8A, just north of the Blue Hole. Captive-bred #032 and an unbanded female used the same nest in 1996.

A first-time pair, captive-bred #038 male and #031 female, nested in 1993 at Gwendale CNA (8C), 0.4 km southwest of Bluehole CNA (8A), concurrently with the pair at CNA 8B, in an open, dry pine plantation (Fig. 1). The nest was abandoned after a mock-up TV camera was set up. No nesting has occurred since 1993 after which the pair moved to CNA 14.

The CNA 14 or Utah savanna is the westernmost CNA on the Ocean Springs Unit (Fig. 1). It was the third most used CNA and the most on the Ocean Springs Unit. The 28-ha CNA 14A east of the crop unit was hand-cleared in 1980–81. An old nest was found in 1980. The Cottonmouth (CNA 23) pair moved there to nest in 1983. There were active nests in CNA 14 in all years since except 1991–92 and 1996. Most of the nests in 14A were in a 3-ha core area, circumscribed by a firebreak. The pair moved 0.8 km east/southeast in 1984 and nested in a 28-ha mesic savanna (CNA 14B) restored by bulldozing. The pair nested in CNA 14A during 1985–86 and in 14B in 1987. The male was caught in 1987 and marked as #629. He and an unbanded female were the nesting pair until 1990–91 when captive-bred #642 replaced him. After a 2-year hiatus, captive #038 male and #031 female nested in 1994, after moving from CNA 8C. The 1995 pair was unknown. Although the savanna was frequently used, no fledglings were produced by the Utah pairs.

A nest was found in a 9-ha St. Regis Company clear-cut (Cottonmouth CNA 23) in 1982. The clear-cut became the site of the Ocean Springs release pen and adjacent nesting savanna. The pair moved 1.2 km west in 1983 to Utah CNA (14A). Two captive-bred cranes from the same release cohort, #644 male and #643 female, nested within 100 m of the Ocean Springs pen in 1987. In 1988, a nest was found near the same site. No nests were found near the pen site after 1988, but in 1989 another pair, captive-bred #641 male and a wild female, behaved as though they had a chick near the same area.

Simms Road.—Simms Road area, a 600-ha tract of pine interspersed with savanna openings, is bounded on 3 sides by roads, including Interstate Highway 10 on the south. Two territories, CNA 9 and CNA 10 (Fig. 1), with active nests were found 1.0 km apart in 1967; only 1 (CNA 9) was active in 1968–69. For several nesting seasons, 1 crane, apparently without a mate, was seen.

Eglin Road.—Eglin Road CNA (13), located south of 1-10 and Simms Road area, consists of 300 ha of large savannas separated by pine forest. During 1969 both CNA 9 and CNA 13 held nests 2.8 km apart. Nests were found in CNA 13 during 1969–72; then 4 years passed without nests. Nests were found in 1977–78 and a nest and renest in 1981. In spring 1983, CNA 13 was burned by a wildfire, but the pair nested in a small unburned section. Altogether, 8 nests and 1 renest were found in CNA 13 (1969–83). Two cranes (#604 and #619), released from the Gautier pen, and a wild crane spent spring and summer 1986 in CNA 13. A nest start was found, but a permanent pair was not established. A young pair, wild W-1 female and captive-bred #913 male, was observed there in 1991. No more cranes were documented there until 1995 when a savanna bird census team saw a pair. A start nest was found the next spring, possibly from captive-bred #245 male and #W-3 female, the latter hatched at North Valentine, 9 km to the east/northeast.

St. Regis.—St. Regis CNA (16) consists of 2 small wet savannas about 400 m apart, separated by a firebreak. The first nest was found in 1975 in the northwestern savanna (CNA 16A). Two small “start” nests were found in 1976 and
The savanna was burned by a wildfire during the 1977-78 dormant season. The next nest in CNA 16A was found in 1981. In 1985 and 1987, a pair nested in the southeastern savanna (CNA 16B). After the 1987 season a prescribed fire burned the area and no cranes nested in 1988. Mystery Chick (see below) and his mate nested in CNA 16B in 1989; they moved to his natal home (CNA 22) in 1990. No nests were found in CNA 16 after 1989. Costapia CNA (24), located 2.4 km away, was the nearest occupied territory in 1987.

Mystery.—Three wetlands were constructed to collect drain-water from a wastewater treatment facility’s spray fields. During 4 of 7 years (1985-87, 1990), a chick or fledgling with its parents were seen, but no nests were found. One chick (“Mystery Chick”) was caught in 1986 and radio-tagged (male #631). CNA 22 was not found until 1991 when an active nest was found in Wetland Cell #2. An old nest probably used in 1990 was found nearby.

In 1989 Mystery Chick #631 male and a wild female nested in CNA 16. During the same season, his putative parents nested in CNA 22. However, in 1990, a 14-day-old chick, found north of Wetland Cell #2, was confirmed as the offspring of #631 and the wild female; the chick later fledged. In 1991 their nest was discovered in Wetland Cell #2. In 1992 the pond was dry and the surrounding lands had been burned and no nests were found. The Mystery Chick pair eluded searchers until 1994 when they nested at “Sawdust Savanna” CNA 27, 1.4 km northwest of Wetland Cell #2.

Dubletree.—Doubletree CNA (25) was found when an unbanded male and captive-bred #640 female nested in 1989 in a 27-ha reclaimed savanna located west of Wet Cell #3. Later the same season the male was replaced by #644, a release cohort-mate of #640, and that pair nested in 1990. No nests were found after 1990.

Sawdust.—The Sawdust CNA (27) is a 26-ha mesic treeless savanna cleared in the late 1980’s and an adjacent (south) 42-ha hydric savanna with slash pines. Crane #631 and an unbanded mate nested there in 1994 on the south edge of the open savanna; the pair was observed with a fledgling well into the spring 1995. No nest was found in 1995-96, but a start nest was found in 1996 in the southern part of the hydric section.

Sullivan.—A pair with twins was observed in the Greenpond Crop Unit in 1996. The Sullivan CNA (31), formerly Central Greenpond Savanna, was a 22-ha mesic savanna with a 1.5-ha pond along the north edge. A pair was flushed from the area during the 1996 nesting season, but no nest was found. Later, an unbanded male, a banded but unknown female, and 2 young were observed repeatedly at the Greenpond Crop Unit, 0.8 km east of the middle of the savanna. The pair returned to that savanna when flushed.

Off-refuge

Fort Bayou Church.—Fort Bayou CNA (11) was a small wet savanna. An old nest was found in 1967 and active nests in 1968-69. After 1969 human disturbance caused the cranes to abandon the area. Several years later the savanna was plowed and destroyed as nesting habitat.

Bear Pond.—This historical CNA (17) has not been used for nesting since 1963, before the start of this study. It was a 15-ha wet savanna (Fig. 1) northwest of the intersections of Highways 57 and 90. Nests were found in 1938 (McIlhenny 1938), 1939, 1941, and 1963 (Gandy and Turcotte 1970). Valentine flushed a single crane from the south edge in the 1960’s. No cranes have been noted there since.

Dummystone.—The Dummystone CNA (18) was a small (<1 ha) opening in the flatwoods just south of the upper drain of the west Costapia River (Fig. 1). This CNA was discovered when a chick was seen by a St. Regis Company employee in 1965. It is 5.5 km north of the Ocean Springs Unit, 5 km south-southeast of CNA 19, and 3 km northeast of CNA 26. There was no known nesting after 1965, although a pair was seen in the area from a helicopter in 1967. A set of tracks was seen in 1974 along John Smith Road just east of the CNA. Without management, the small opening has long since become overgrown with pines and gallberry (Ilex spp).

Weber.—The Weber CNA (19), on International Paper Co. and DeSoto National Forest lands, is 10 km north of nearest neighbor (Costapia CNA 24). The International Paper nesting sites are in 2 separated ponded areas (CNA 19A); the DeSoto site (CNA 19B) is wet savanna. An active nest was found during 1977-78 in CNA 19A. No nests were found in the next 6 years (1979-84).

In 1985 International Paper disked and furrowed CNA 19A, but despite habitat loss, a wild pair nested in 1985 in the pond. Considering the nesting hiatus, we assume the pair was new. In 1986 the pair moved 0.6 km to DeSoto National Forest (19B) but returned to CNA 19A where they produced eggs in 1987-90 (including 2 renests) in the south pond but no chicks fledged. The pair disappeared in the winter of 1990-91, except for a sighting on the January 1993 census at the pond.

Mallette.—The Mallette CNA (20), in Section 16, owned by the State of Mississippi, is 2.8 km southwest of Fort Bayou CNA 11. The nesting habitat, a narrow seep bog situated between low pine-covered hills, was kept relatively open by wildfires. Cranes frequented the area in the late 1960’s but no nests were found until 1978-79, then none was seen after. In April 1982 a crane carcass, slightly scavenged,
was found; cause of death not determined.

In 1982 released #602 and a wild mate frequented the area. Two small start nests were found in 1983. In August 1983, #602 was shot and killed adjacent to the territory. The school section was leased in 1990 to a hunting club, fenced, and closed.

Costapia.—Soon after female crane #640 was released, she began an association with a wild crane that lasted from early 1985 to spring 1987 in Costapia CNA (24). CNA 24 is a 50-ha savanna and dense swamp, an eastern part now leased to USFWS by Mississippi Gulf Coast Regional Waste Water Authority and a western part owned by Jackson County. In spring 1987 a new pair, female #640 and wild #632 male, nested in a pine plantation west of a treatment lagoon and south of the gas line right-of-way. In 1988, #632 was replaced by an unbanded male. The 1988 nest was in a swamp 400 m west of the sewage lagoons, in an area owned by Jackson County. No eggs were laid in 1989, and in 1990, #640 was replaced by #643. The pair nested in 1991, but no chick was seen. Crane #643 died in September 1992 and was replaced by an unbanded female, and that pair nested in 1995–96.

Jordan.—Jordan CNA (26), a 0.5-ha former fish pond vegetated with Gulf Coast spike rush (Eleocharis cellulosa), is located northwest of the refuge (Fig. 1). The pond has been a crane roost site for many years. A nest was found in 1994, but a chick did not survive. In 1995 the same nest was flooded before eggs were laid. Jordan’s farm is managed under a “Partners for Wildlife” agreement.

DISCUSSION

We inferred that a territory with interrupted use lost the original pair and that later occupancy was by a new pair. Territories may be inherited by the surviving mate and a new spouse and passed on from 1 generation to the next. Walkinshaw (1960) found 2 nests in CNA 4 in 1940 and 1 in 1960. During 53 years pairs have nested there occasionally, certainly not the same individuals and probably not of the same lineage. Nine CNA’s were recolonized with active nests after at least 5 years vacancy. Seven of the recolonizations were with different pairs. The reuse of CNA 19 probably involved at least 1 member of the original pair. The unbanded female in the reuse of CNA 15 may have been the same from the original pair. CNA’s 7 and 8 were reused after being vacant for more than 20 years. Five CNA’s (2, 6A, 7, 8, 15) were recolonized after recent hand-clearing. Three new CNA’s (27, 28, 30) were first colonized after recent hand- or machine-clearing of savannas.

By 1996, 13 former CNA’s had been vacant for at least the past 5 years, 10 of those for more than 10 years. A fourteenth, pre-study CNA 17, was vacant throughout the study period. The initial cause of abandonment was in many cases the death of one of the spouses. The nesting habitats of 4 CNA’s (off refuge) were destroyed; 9 other refuge CNA’s, with habitat maintenance, were in good condition. Habitat maintenance on 3 refuge CNA’s (5, 9, 10) was difficult due to their location in very wet areas. Crane use of CNA’s 9 and 10 has been very limited over the last 25 years. Six CNA’s were on the fringe of the nesting range and/or refuge where the pairs may have been killed or where disturbance was greater. Roads running through or on edges may invite trespass and shooting. Off-refuge CNA 24 was used recently but was rapidly deteriorating without habitat restoration. CNA 19, not used the last 6 years because of the disappearance of the nesting pair, was in good condition, but unused, probably because the distance from the Ocean Springs Unit limited recolonization. However, start nests were found in CNA’s 3 and 18 in 1995–96. CNA 12 was not used after 1977, but reuse looked possible with the building of an acclimation pen and captive releases beginning in 1995.

At least 7 females (#627 in CNA 1B, #634 in CNA 4, #640 in CNA 24, and unmarked females in CNA’s 4, 14, 21A, 21B, 24) retained their territories after the male spouse died. We know that males held territory after their mate’s death in CNA 4 (#855) and CNA 24 (unmarked), and unmarked males probably held onto CNA’s 4 and 24.

When a population is expanding, newly formed pairs usually occupy vacant territories. During the 1960’s to 1980’s, the Mississippi sandhill crane nesting population was stable. The nesting population did not increase until released cranes began breeding. Among 12 new territories established after 1984, 11 were taken by pairs with at least 1 released crane spouse.

Released birds tended to nest within a few kilometers of their release sites. The exceptions to the small distance between release pen and subsequent CNA were movements by 4 cranes released at Ocean Springs that later nested in the Gautier Unit. This was probably due to better habitat conditions in the Gautier Unit; habitat restoration on the Ocean Springs with wetter soil conditions and thicker undergrowth has been more difficult. The number and rate of release of cranes in the Ocean Springs Unit will need to be adjusted to fit the success of habitat restoration there. As the cranes released in the much smaller Fontainebleau Unit age, increased movement by these cranes to locate suitable nesting areas in other refuge units may occur.

Pens will need to be built to facilitate colonization of areas not presently occupied. With the large release cohorts of December 1989–92 coming into breeding age preparing new nesting sites and improving vacant sites will have high priority.
LITERATURE CITED


