# Survival Rates and Mortality Factors of Florida Sandhill Cranes in Georgia

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**Abstract**

Survival rates and mortality factors of Florida Sandhill Cranes *(Grus canadensis pratensis)* were studied in the Okefenokee Swamp, Georgia, during 1986-1988. Mean annual survival was 0.89 and varied from 0.82 for adult males to 0.94 for subadults (sexes combined). In spring, adult males exhibited the lowest seasonal survival rate among sex and age classes (0.80, $P<0.05$): survival was 1.00 in winter. Bobcats *(Felis rufus)* were responsible for 5 of 7 deaths attributed to predation.

There are no published studies on survival rates of migratory or nonmigratory Sandhill Cranes. Annual survival of Whooping Cranes *(G. americana)* has averaged 0.89, 1939-85 (Boyce 1985), but in recent years, 1978-88, has ranged from 0.91 to 0.94 (Doughty 1989). The status of migratory Sandhill Crane populations is currently based upon surveys of adult-juvenile ratios in fall (Lovvorn and Kirkpatrick 1982, Tacha and Vohs 1984), and population surveys on breeding and staging areas (Benning and Johnson 1987, Harris and Knoop 1987). However, these techniques require long-term monitoring and are of limited effectiveness on nonmigratory populations that inhabit remote wetlands or are difficult to survey.

We used radio telemetry (Trent and Rongstad 1974) to estimate survival rates of Florida Sandhill Cranes in the Okefenokee Swamp, Georgia. Our objectives were to estimate seasonal and annual survival rates among age and sex classes and to identify the causes and timing of mortality.

## METHODS

This study was conducted in the Okefenokee Swamp, southeastern Georgia. We captured 45 Sandhill Cranes by rocket netting (Wheeler and Lewis 1972), aged them by wing molt pattern (Nesbitt 1987), and classified each as subadult (1-3 year) or adult (> 3 year). We determined the sex of adult cranes by behavior and unison calls (Archibald 1975); sex of subadults was not determined. All cranes were banded with size 9 U.S. Fish and Wildlife Service aluminum leg bands and instrumented with leg band radio transmitter packages as described by Melvin et al. (1983). Radio-tagged cranes were located from boats and aircraft a minimum of 3 days/week. One crane that died $\leq$ 7 days post-instrumentation, considered an adjustment period, was not included in survival calculations. Causes of death were determined by examining carcass remains and kill sites.

We used the Kaplan-Meyer (KM) method of analysis of failure times (Kaplan and Meyer 1958) to estimate survival curves. This method calculates changing mortality risk of the population over time and allows for the inclusion of observation from animals whose ultimate fate is unknown. Six cranes whose transmitters prematurely failed were considered as censored observations. Estimates of seasonal and annual survival were obtained from the KM estimate and standard errors computed.

For all calculations, the biological year began on 1 March and survival was assumed to be constant within a given season (Spring = Mar-May; Summer = Jun-Aug; Fall = Sep-Nov; Winter = Dec-Feb). When the exact date of death was unknown, the mid-point from the last known survival date to the date of death confirmation was used as the date of death. Because sample sizes are small, survival estimates should be interpreted cautiously.

## RESULTS

***Seasonal and Annual Survival Rates.*** Eight of 44 cranes monitored from 1 March 1986 to 1 March 1988 died. Death occurred 252 ± 61 days after capture and tagging (Table 1). Analysis of data for 28 adult Sandhill Cranes (15 males, 13 females) and 16 subadults indicated variation in spring survival rates. Adult males exhibited the lowest (0.80, $P < 0.05$) survival rate in spring (Table 2). Two males died during the incubation period and a third

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during brood rearing. Survival rates among sex and age classes did not significantly differ ($\underline{P} > 0.05$) during summer and fall. No deaths occurred during winter.

Although differences in annual survival rates among age and sex classes approached significance ($\underline{P} = 0.12$), our sample size would make it difficult to detect any real difference in survival rates. Subadults exhibited the highest annual survival rates 0.94 (CI = 0.89 to 0.99) and adult males the lowest 0.82 (CI = 0.77 to 0.94). Mean annual survival for all cranes was 0.89 (CI = 0.82 to 0.98).

***Causes of Death.*** Predation was the major source of mortality among radio-tagged cranes (Table 1) although loss to other factors, subsequently attributed to predation, may have occurred. Bobcats were believed responsible for 5 of 7 predator-related deaths including 3 adult males and 1 adult female killed in spring. Evidence at kill site suggested that these cranes were attacked along marsh-shrub ecotones and dragged into wooded cover where they were consumed. No kills occurred at nests, although one crane was killed 50 m from a clutch of eggs that it was incubating. A fifth crane was killed by a bobcat during early fall. On two occasions we observed bobcats stalking pairs of cranes that were feeding along marsh edges.

American Alligators *(Alligator mississippiensis)* killed one subadult crane during summer. The carcass was decapitated but not consumed by the alligator. We concluded that this crane was killed at night while roosing in shallow water. An alligator also killed a pre-fledged chick that was not among the radio-tagged sample. This 50-day-old chick was under observation when it was killed. An alligator seized the chick and pulled it under water as it and its sibling swam across a boat trail. Predators responsible for the death of two radio-tagged cranes could not be determined.

## DISCUSSION

Lower adult survival rates of cranes in spring may result from a combination of crane behavior and vegetation density that influences predator success. In the Okefenokee Swamp, cranes normally nest close to wooded cover in small (< 0.5 ha) shrub-scrub marsh openings (Bennett 1990). This habitat is rarely used in other seasons. Except for brief periods each day when they exchange incubation duties, pair members are alone throughout incubation (Walkinshaw 1973). Single cranes are often easy targets for predators (Bizeau et al. 1987) and may be very vulnerable to ambush in wooded habitats. Males are more likely to encounter predators because they normally contribute only 30% to total inclubation time (Nesbitt 1988) and are active in territory defense during the nesting season (Walkinshaw 1973). Bobcats may be least effective at hunting cranes in winter when leaf cover is absent and cranes, especially subadults, assemble in larger groups.

Documented causes of non-hunting mortality to adult cranes are largely from disease and human-related causes (Windingstad 1988). Mammals are known to prey on pre-fledged chicks as identified by Drewien (1973), Littlefield (1976), and Drieslein and Bennett (1979), but there are few published accounts of mammalian predation on adult cranes. Golden Eagles *(Aquila chrysaetos)* are considered the most frequent predators on Sandhill Cranes in some western areas (Drewien 1973, Perkins and Brown 1981). Bobcats have killed captive-reared subadult Sandhill Cranes that were experimentally released in Mississippi and Florida (T. Logan and S.A. Nesbitt, pers. comm.). Although bobcats occur throughout much of the breeding and winter range of Sandhill Cranes in North America (McCord and Cardoza 1982), they may be of greatest significance to southern nonmigratory subspecies that inhabit swamp-marsh habitats.

Alligators primarily hunt small prey (Wolfe et al. 1987), but they are large and powerful predators easily capable of killing adult cranes. However, in the Okefenokee Swamp, crane-alligator encounters are uncommon because alligators primarily frequent lakes, watercourses, and deeper marshes, whereas cranes prefer shallow herbaceous marsh (Bennett 1990). We believe alligators prey upon adult cranes infrequently--when high water levels provide access to crane habitat.

This crane population does not disperse from the Okefenokee Swamp (Bennett 1989) and is not subjected to human-related mortality common in migratory populations. This population numbers 400 birds and has a mean annual recruitment of 9.4% (1985-87) Bennett and Bennett (1990). Our results suggest that this crane population is limited by predators. Due to the late age of sexual maturity and low fecundity of cranes (Walkinshaw 1973), small fluctuations in recruitment or survival can produce major changes in a population this size. Ideally, estimates of mortality as well as productivity should be obtained to assess and manage Sandhill Crane populations.

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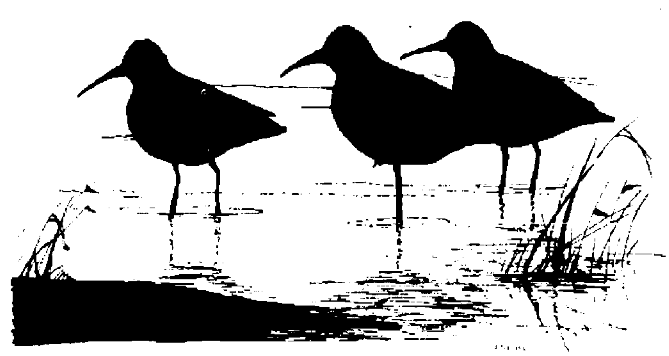

Table 1. Survival time and cause of death among radio-tagged Florida Sandhill Cranes in Georgia, 1986-88.

| Age and Sex | Days Survived After Tagging | Cause of Death |
|---|---|---|
| Adult Male | 21 | Predation by bobcat. |
| Adult Male | 116 | Predation by bobcat. |
| Adult Male | 286 | Predation by bobcat. |
| Adult Male | 681 | Predation by bobcat. |
| Adult Female | 204 | Predation |
| Adult Female | 482 | Predation by bobcat. |
| Subadult (sex unk.) | 43 | Predation by alligator. |
| Subadult (sex unk.) | 182 | Unknown |

Table 2. Age, sex, and season specific survival rates of radio-tagged adult (> 3 years old) and subadult (1-3 years old) Florida Sandhill Cranes in Georgia, 1986-88.

| Age/Sex | N Cranes | Spring (Mar-May) | Summer (Jun-Aug) | Fall (Sep-Nov) | Winter (Dec-Feb) | Annual (95% CI) |
|---|---|---|---|---|---|---|
| AM | 15 | 0.804 | 1.000 | 0.956 | 1.000 | 0.821 (0.776-0.941) |
| AF | 13 | 0.938 | 0.938 | 1.000 | 1.000 | 0.922 (0.860-0.983) |
| SA M&F | 16 | 1.000 | 0.936 | 1.000 | 1.000 | 0.936 (0.897-0.990) |
| ALL | 44 | 0.871 | 0.948 | 0.964 | 1.000 | 0.894 (0.824-0.978) |

A = adult; SA = subadult; M = male; F = female.