Distribution of King and Clapper Rails in Managed Impoundments and Tidal Marshes of South Carolina

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Introduction

King (*Rallus elegans*) and Clapper (*R. longirostris*) Rails are marsh-dwelling birds present in South Carolina's fresh to saline coastal habitats. King Rails in the South Atlantic Coastal Zone (SACZ) are considered the only non-migratory King Rails in the U.S. (Meanley 1992). Thirteen states, comprising most of the migratory range of the King Rail, list the King Rail as threatened or endangered (Cooper 2006). Eight subspecies of the Clapper Rail occur within marshes of the Atlantic (Cumbee 2003) and Gulf Coasts, as well as California's coastal marshes (Zembel et al. 1989, Eddleman and Conway 1994). One subspecies of Clapper Rail occurs in Arizona's freshwater marsh. All subspecies, except the Northern Clapper Rail (*R. l. crepitans*), are non-migratory (Eddleman and Conway 1994).

King Rails are associated with freshwater and brackish marshes, while Clapper Rails use brackish and saline marshes (Meanley 1992; Eddleman and Conway 1998). Because of their exclusive use of marshes and selection of invertebrate prey, rails are good indicators of marsh health (Gaines et al. 2003). Regrettably, the marsh habitat upon which rails rely has been lost or degraded by direct and indirect factors. Only 12% of the area of the United States remains in wetlands (Zedler and Kercher 2005). The estimated wetland loss between 1986 and 1997 averaged 23,674 ha annually; 5848 ha of this annual loss were estuarine, emergent wetlands (Dahl 2000). Rail populations appear to be suffering as a consequence of wetland loss and degradation (Eddleman et al. 1988; Eddleman and Conway 1998).

In South Carolina, approximately 28,522 ha of coastal wetlands are managed as impoundments (Gordon et al. 1989). These impoundments were created during the eighteenth and nineteenth centuries for rice and indigo production (Epstein and Joyner 1988). Wooden water control structures called ricefield trunks were used to manage the hydrology of coastal impoundments by controlling flooding and drying cycles, and water movement within impoundments (Morgan et al. 1975). South Carolina's rice production decreased significantly during the late 1800s after the Civil War and loss of slave labor, increased competition from Louisiana and Texas rice production, and a series of damaging hurricanes (Morgan et al. 1975). Subsequently, many rice plantations were managed by new owners for wintering waterfowl to enhance hunting and other recreational activities (Epstein and Joyner 1988).

These managed wetlands of the SACZ may provide important habitat for King and Clapper Rails; however, the primary focus of management is to provide habitat for migrating and wintering waterfowl (Epstein and Joyner 1988). We do not know to what extent rails use these marshes because few studies (Rundle and Fredrickson 1981; Epstein and Joyner 1988; Tori et al. 2002) have examined the effects of waterfowl management strategies on rail use of these wetlands (Dodd et al. 1999). With the loss of natural wetlands, however, managed marshes may provide additional habitat for rails and other marsh-dwelling species.

Few habitat selection and movement studies have been conducted on King Rails, and many such studies on Clapper Rails focused on the endangered subspecies (Conway 1990; Hinojosa et al. 2002) in the western United States. We examined habitat selection and movement, and estimated home range sizes, of King and Clapper Rails relative to managed impoundments and tidal marshes using radio-telemetry during the breeding season. We suspected habitat selection and movements of King and Clapper Rails would be restricted to tidal marshes. Furthermore, we expected that King Rails would use fresh to brackish marshes and Clapper Rails would use brackish to saline marshes. This work addressed gaps in data concerning rail ecology and biology in the SACZ and assessed the feasibility of trapping and radio-marking rails in the South Atlantic coastal marsh.

Study Area

We conducted our study within two managed properties, the Ernest F. Hollings Ashepoo-Combahee-Edisto (ACE) Basin National Wildlife Refuge (Refuge) and Nemours Plantation (Nemours) in Beaufort County, South Carolina. The 4781-ha Refuge includes 1598 ha of tidal marsh and 1214 ha of managed wetland impoundments. It is divided into the Edisto River Unit and Combahee River Unit. We selected the 1847-ha Combahee River Unit because of its proximity to Nemours and because both it and Nemours are within the Combahee River watershed.

Nemours is south of the Refuge and includes 3881 ha of diverse habitats, including 607 ha of remnant ricefields, now managed for waterfowl, and 115 ha of tidal saline and brackish marshes. Marshes were dominated by *Spartina cynosuroides*, *S. alterniflora*, and *Juncus roemerianus*. The Combahee River flows through the Refuge and Nemours to St. Helena Sound where all three rivers of the ACE Basin meet and converge with the Atlantic Ocean.

We trapped rails in three managed impoundments at the Refuge, and three tidal marshes each at the Refuge and Nemours. We selected trap sites that were large enough for the trap line, and in marshes where we heard or saw rails.

Methods

Trapping procedure. We used a cloverleaf trap design with drift fences and a catch box (Kearns et al. 1998). We set three trap lines consisting of two cloverleaf traps with a 20-m drift fence between them from March through May 2006, in all tidal marshes at the Refuge and Nemours, and in all three managed impoundments at the Refuge. We did not trap in managed impoundments on Nemours because the water depth was too great. Traps were set in the morning and checked twice per day for five days or until we caught two rails at a trap site. We placed a wildlife caller and speakers at each trap line to increase capture probabilities (Kearns et al. 1998). This system broadcasted a 1-min recorded call of the King Rail followed by a 1-min recorded call of the Clapper Rail every 3 min for 6 hrs each day.

Radio attachment and tracking. We marked each captured rail with a radio-transmitter (Model R1-2C, Holohil Systems Ltd., Ontario, Canada; <4% body weight), attached with a leg-loop harness (Rappole and Tipton 1991; Powell et al. 1998). We released each radio-marked rail at its trap site, then began recording radio-locations, 1 day post release. We tracked and located rails three times per day—morning (9:00–11:00 hrs), midday (13:00–15:00 hrs), and evening (18:00–20:00 hrs) periods. Each tracking period was 4 hrs apart and included a low tide and high tide. We tracked each rail 4 days per week (every other day), except when severe thunderstorms occurred. Each location was recorded with a GPS unit, then mapped using GIS.

Home range and movement analysis. To assess home range size and location for each rail, we estimated fixed kernel and minimum convex polygon (MCP) home ranges from ≥30 radio-locations. Kernel home range associates kernel elements with each point within set locations to minimize the probability of overestimating home range size (Seamen and Powell 1996). The MCP home range size was used to compare our estimates with previous home range studies on rails that estimated MCP home ranges. Distances a rail moved as well as average daily movement between each location identified for each rail were obtained from March–July 2006. We used intervals to eliminate bias due to different sample sizes (number of locations) among rails (Conway 1990). We used 14-day intervals for each rail, then calculated average movement (m) within each interval. These 14-day intervals consisted of days during which locations were recorded three times.

Results

We captured and radio-marked five King and six Clapper Rails. Locations were obtained for 10 rails, but we obtained ≥30 locations for only one King and two Clapper Rails; thus, data from these rails were used in home range and movement analyses. Overall, location data from 73% of radio-marked rails were lost due to predation, loss of transmitter, or significant movement out of study area (emigration).

Radio contact with two King Rails was lost before location data could be collected. Of the five King Rails captured on the Refuge, four moved from the refuge to a complex of managed impoundments on private property where we were unable to work. The remaining King Rail, captured in tidal marsh, moved to managed impoundments on the Refuge. All locations (n = 67) were in four drawn-down impoundments, and were obtained from 26 April–27 July 2006. Most locations (n = 55) were in one managed impoundment (95 % kernel home range = 10 ha; Fig. 1). The 95% kernel home range size for this rail was 31.3 ha, and its MCP was 90.5 ha. The distance traveled in one day by the King Rail ranged from 26.3 m to 238 m.

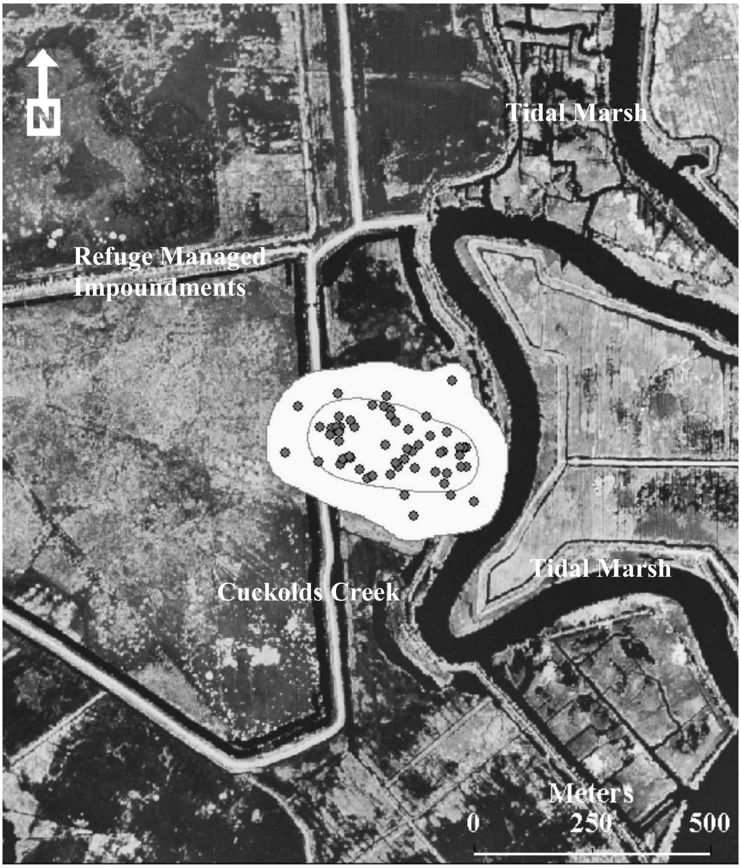

Figure 1. Aerial photograph (1999) of a 95% (31.3 ha) and 50% kernel home range size (10 ha) of a King Rail's locations (n = 55) within two managed impoundments of the Ernest F. Hollings ACE Basin National Wildlife Refuge's managed impoundment complex, Beaufort County, S.C. The King Rail was radio-tracked from May–July 2006.

One Clapper Rail was killed by a mink (*Mustela vison*), deduced from teeth marks on the radio-transmitter. Two Clapper Rails each slipped out of their radio-harness and radio contact was lost for one Clapper Rail before data could be collected. For our analyses, we used data from one Clapper Rail before contact was lost and data from another Clapper Rail before it died.

All six Clapper Rails were using tidal marshes before contact was lost or they died. Kernel home range sizes for the two Clapper Rails were 3.6 ha (*n* = 34 locations) and 0.7 ha (*n* = 38 locations), respectively. The MCP home ranges for the two Clapper Rails were 7.3 ha and 0.4 ha, respectively. Locations of the two Clapper Rails were within narrow tidal marshes on the Combahee River (Figs. 2 and 3).

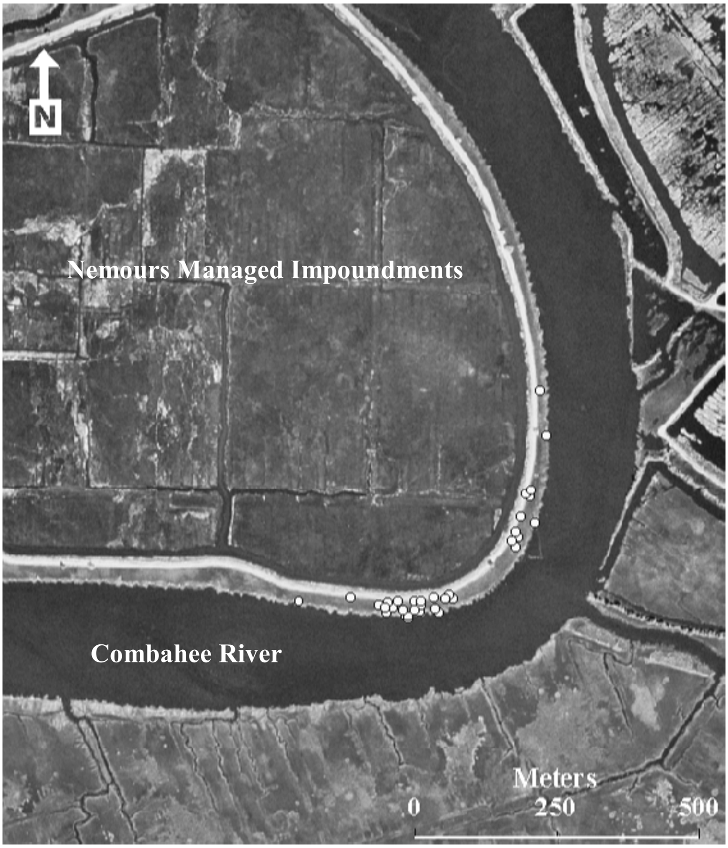

Figure 2. Aerial photograph (1999) of Clapper Rail locations (n = 34) located within tidal marsh along the Combahee River and adjacent to managed impoundments during April–June 2006, Nemours Plantation, Beaufort County, S.C. No locations were located across the Combahee River or within Nemours Plantation's managed impoundments.

Figure 3. Aerial photograph (1999) of Clapper Rail locations (n = 37) within a tidal marsh along the Combahee River and adjacent to managed impoundments on Nemours Plantation, Beaufort County, S.C. Locations were taken April–June 2006. This Clapper Rail's locations were north of those in Figure 2.

Average daily movement for each Clapper Rail was measured over three 14-day intervals (Fig. 5). Maximum distances traveled in one day by the two Clapper Rails were 394.9 m (n = 34) and 162.2 m (n = 37), respectively. The mean minimum distances by the two Clapper Rails were 9.9 m (n = 34) and 11.0 m (n = 37), respectively.

Discussion

Marshes in our study area have been manipulated by people since the late 1600s; hence, what remains is a complex of managed impoundments and remnant tidal marshes. We replicated trapping methods used elsewhere (Kearns et al. 1998) in managed and tidal marshes, yet captured only 14 rails after many hours of effort. Rather than infer that rails are rare in our study area, we concluded the trapping method was not effective because our study sites included much unconsolidated soil difficult to walk through and tidal ranges that reduced availability of trap sites.

Information obtained from radio-marked rails demonstrated the instability of the marsh system. Data were lost to predation of at least one rail, to emigration, and to harness failure. Yet, predation events and emigration would be unknown if telemetry had not been used.

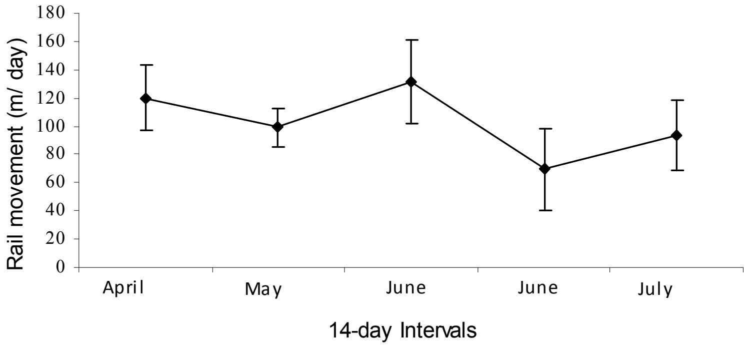

Figure 4. Daily average movements of a King Rail from April–July 2006 at Ernest F. Hollings ACE Basin National Wildlife Refuge, Beaufort County, S.C. Daily averages were estimated in each 14-day interval. Error bars represent 95% confidence limits of daily averages for each 14-day interval.

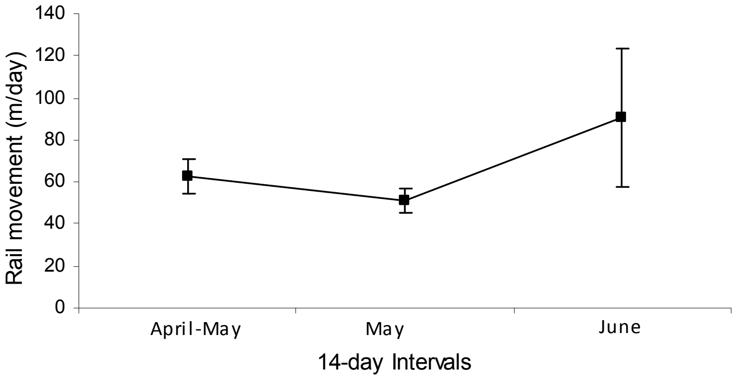

Figure 5. Daily average movements of two Clapper Rails from April–June 2006 at Nemours Plantation, Beaufort County, S.C. Daily averages were taken for each 14-day interval for Clapper Rails. Error bars represent 95% confidence limits of daily averages for each 14-day interval.

We obtained sufficient radio-locations ($n \geq 30$) to estimate home range sizes and movement behavior of only one King Rail and two Clapper Rails because 73% of radio-marked rails were lost. The large percentage of rails lost during this study may not be unusual in the SACZ, as 72% of Clapper Rails in a Georgia study were lost due to predation or loss of transmitters (Cumbee 2003).

The radio-marked King Rail was caught in tidal marsh, but all subsequent locations were in managed impoundments on the Combahee Fields Unit of the Refuge. These brackish (4 to 5 ppt salinity; McGregor 2007) marshes were characterized by tall emergent vegetation interspersed with mudflats; they contained water in canals and ditches, but none on the marsh bed. Contrary to our expectations, this King Rail selected brackish, managed impoundments. Along the Gulf Coast, King Rails use inland fresh to brackish wetlands during the breeding season (Meanley 1992). Managed impoundments in the SACZ may provide flood-free nesting habitat, especially during spring high tides, if water is drawn down in early spring (March) and kept shallow or below bed level through mid-summer (July).

The average daily movement of the King Rail ranged from 65 to 140 m, and it used one impoundment for most of the breeding season. Because the MCP home range size of the King Rail on the Refuge was large and no nests were located in the managed impoundments, this individual may have been a male and/or a juvenile (Zembel et al. 1989).

Clapper Rails were captured only on Nemours, and the two from which radio-locations were obtained were found only in tidal marsh. Likely, impoundments were not used because they were flooded through the breeding season and did not provide mudflats for foraging or tall vegetation needed for nest sites (Lewis and Garrison 1983; Gaines et al. 2003). Tidal marshes were brackish to saline (~17 ppt salinity); hence, our hypothesis that Clapper Rails would use marshes with greater salinity was supported.

One of the two MCP home ranges of Clapper Rails in this study (7.3 ha) was larger than the average MCP home range reported in other studies (0.4 to 1.8 ha; Eddleman and Conway 1998; Cumbee 2003). Possibly, the larger home range resulted from the rail losing its nest during severe weather, then re-nesting at a second location (Cumbee 2003).

Clapper Rail daily movements were within narrow, tidal marsh bordering the Combahee River. None of the rails crossed the river (Figs. 2, 3). Average daily movement (66.8 m, SE = 13 m; $n = 2$ rails) was less than that reported in studies of Clapper Rails occupying different habitat types in western North America (263 m; Zembal et al. 1989; Conway 1990).

Our preliminary data suggest both that fresh to brackish, managed impoundments and tidal marshes in the ACE Basin provide habitat for King Rails, and that Clapper Rails use only brackish to saline tidal marshes. Thus, this initial study suggests King and Clapper Rails partition habitat by the interacting factors of location and salinity range. However, the ranges of both rails may overlap in lower-salinity, brackish marshes (Graves 2001). Longer studies with larger sample sizes will provide greater understanding of rail species distribution, habitat use, movement behavior, and causes of mortality.

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