EASTERN BLACK RAIL

CONSERVATION PLAN FOR NORTH CAROLINA

(photo credit: Christy Hand, SCDNR)

NORTH CAROLINA Wildlife RESOURCES COMMISSION

EASTERN BLACK RAIL (*Laterallus jamaicensis jamaicensis*)

EXECUTIVE SUMMARY

The goal of this plan is to provide steps that can increase the abundance and distribution of the Eastern Black Rail (*Laterallus jamaicensis jamaicensis*), a federally and state-listed threatened species, in North Carolina. Actions to conserve, restore, create, and manage Black Rail habitat will benefit many other species that also depend on coastal and freshwater marshes. This plan draws heavily from the Atlantic Coast Joint Venture's (ACJV) Black Rail Conservation Plan (ACJV 2020), the Species Status Assessment Report for the Eastern Black Rail (USFWS 2019), and the Eastern Black Rail Management Guidance document (Watts 2022). Extensive work completed by the Black Rail Conservation Program of the South Carolina Department of Natural Resources also contributes to this plan. The North Carolina Wildlife Resources Commission (NCWRC) will lead and implement management actions on NCWRC managed lands in collaboration with partners and will support conservation of the Black Rail across the state.

The Eastern Black Rail (hereafter, Black Rail) is one of four subspecies of *Laterallus jamaicensis*. Black Rails are the smallest rails in North America, measuring only 10-15 cm (3.94 to 5.90 inches) in length. These secretive "feathered mice" walk and run under dense herbaceous marsh vegetation in preference to flying. As scant research exists about Black Rails, much information on the species comes from field observations. Historically, their range extended from east of the Rocky Mountains to Massachusetts and along the Atlantic and Gulf Coasts.

The Black Rail is a marsh dependent bird that breeds in freshwater marsh and high elevation brackish and saltwater marshes dominated by water depths less than 3 cm (1.18 inch), with dense, grassy vegetative cover and few trees or shrubs. Historically, occasional fires maintained their habitat's dense, grassy structure. Black Rails appear to construct nests close to the ground in regions with low-growing marsh vegetation, such as North Carolina's coastal marshes. The Center for Conservation Biology comprehensively assessed Black Rail status using literature reviews and field survey results from the last 150 years (Watts 2016) and determined 90% of detections were in coastal marshes and 10% of detections were in inland freshwater marshes.

The species' range contraction and population decline have been significant. Since 1990, the northern extent of the range has contracted 450 km (about 280 miles) from New England where they are effectively extirpated, south to New Jersey. Population levels are categorized as effectively zero in the Appalachian Plateau and Central Lowlands North American Physiographic Provinces. The population in Maryland has declined by 90%. Surveys in New Jersey, Delaware, Maryland, and North Carolina in the late 1980s and early 1990s, and repeated in the mid-2010s, showed a 64% decline in occupancy and an 89% decline in birds detected, equating to a 9% annual rate of decline (USFWS 2019). During surveys in North Carolina in the 1970s, more than 80 Black Rails were heard calling in one night at Cedar Island National Wildlife Refuge (NWR, [Watts 2016]), whereas fewer than 10 were heard in the same locations during surveys between 2014 and 2017 (Wilson et al. 2015, Smith et al. 2018). As a result of these findings, Black Rails are listed as threatened under the U.S. Endangered Species Act and in North Carolina (NCAC 10I .0104).

The Species Status Assessment population projection model predicts that the Southeast Coastal Plain Physiographic Province, which had robust available data, and Mid-Atlantic Coastal Plain regions, both of which occur in North Carolina, were projected to have 35 to 50 years to extinction from present (USFWS 2019). Extinction, as predicted by the model, was driven primarily by habitat loss.

Historic declines in Black Rail populations were likely caused by human impacts to marshes from filling and development, ditching and draining for mosquito control, and alterations to hydrology for agriculture, transportation, and flood control (Watts 2016). Causes of the recent dramatic declines in the Black Rail population are attributed, at least in part, to marsh loss from global sea level rise, which has increased about 20-23 cm (7.87 - 9.06 inches) since 1880, with the rate of increase doubling (about an 8-cm rise [3.15 inches]) from 1993 to 2017 (Sweet et al. 2017). To offset coastal marsh loss, the ACJV's Black Rail Conservation Plan (ACJV 2020) focuses on restoring or creating moist-soil, herbaceous marsh habitat in non-tidal areas in addition to conserving high elevation tidal coastal marsh. Since 2016, the ACJV named the Black Rail as one of three focal species and coordinates Black Rail conservation partners on the Atlantic Coast to promote conservation actions for this species. Population losses due to sea level rise will be unsustainable if Black Rail habitat is not created and restored in non-tidal areas (Watts 2022). Significant conservation actions are needed to recover Black Rail populations.

In North Carolina, needed conservation actions mirror those outlined in the ACJV Plan (2020) and include the following:

- Identify areas and initiate projects where non-tidal Black Rail habitat can be created.
- Employ and promote appropriate prescribed fire Best Management Practices (BMPs) to maintain and increase the amount of Black Rail habitat.
- Develop and implement BMPs to facilitate coastal marsh migration with partners.
- Employ land conservation programs including land acquisition, NCWRC's Wildlife Conservation Lands Program, and other incentives to safeguard current and potential Black Rail habitat.
- Assess the potential of existing impoundments to provide Black Rail habitat.
- Offer landowner assurances programs such as Safe Harbor agreements.
- Work with the North Carolina Department of Agriculture and Consumer Services and other partners to develop, employ, and promote beneficial agricultural practices.

BIOLOGICAL INFORMATION

Listing Status

State

- Threatened[1]
- Species of Greatest Conservation Need[2]
- S1, Critically Imperiled[3]

Federal / Global

- Federally listed as Threatened
- IUCN Endangered[4]
- G3T1, Critically Imperiled[5]

Description and Taxonomic Classification

The Eastern Black Rail (*Laterallus jamaicensis jamaicensis*) was described by Browne and Edwards from individuals discovered in Jamaica in 1760 and formally classified by Gmelin in 1789 (*Rallus jamaicensis*; Allen 1900, USFWS 2019). Audubon (1838) described the Eastern Black Rail found in North America from live specimens obtained near Philadelphia, Pennsylvania. The Black Rail is in the family Rallidae and order Gruiformes (American Ornithologists' Union 1998), which contains 34 genera and 134 species. The genus *Laterallus* includes nine species, and the Eastern Black Rail is one of four recognized subspecies. The Eastern Black Rail (hereafter, Black Rail) and California Black Rail (*L. j. coturniculus*) occur in North America, while the other two subspecies of *L. jamaicensis*, *L. j. murivagans and L. j. salinasi,* occur in South America in Peru, Chile, and Argentina (Taylor and van Perlo 1998, USFWS 2019).

The Black Rail is the smallest of the rails in North America with a total length of 10-15 cm (3.94-5.90 inches) and wingspan of 22-28 cm (8.66-11.02 inches). The average weight is approximately 35 g (1.23 oz) and tarsal length is 2.24 cm (0.88 inches) in females, and 2.29 cm (0.90 inch) in males (Eddleman et al. 2020). Overall, males and females are similar in size and appearance. Adults are pale to blackish gray, with a small black bill and bright red eyes. The chin and throat are lighter gray; nape and upper back are chestnut-brown or rufous; and back, remiges, and upper rectrices are dark gray to black with small white spots and sometimes a light amount of chestnut-brown or rufous coloration (Taylor and Van Perlo 1998). Males are typically darker than females, with females having pale gray to white throats (Davidson 1992, Eddleman et al. 2020). Tarsi and toes are brownish gray, or gray to blackish brown (Meanley and Stewart 1960).

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[1] North Carolina Administrative Code. 15A NCAC 10I .0104. (a) 2. A. 2023.

[2] NC Wildlife Resources Commission, NC Wildlife Action Plan, 2015

[3] NC Natural Heritage Program, List of Rare Animal Species of North Carolina, 2024

[4] BirdLife International. 2021. *Laterallus jamaicensis*. *The IUCN Red List of Threatened Species* 2021: e.T22692353A178666347. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22692353A178666347.en. Accessed on 28 February 2024.

[5] NatureServe. 2025. NatureServe Network Biodiversity Location Data accessed through NatureServe Explorer [web application]. NatureServe, Arlington, Virginia. Available https://explorer.natureserve.org/. (Accessed: May 13, 2025).

Juveniles look like adults but have duller plumage and fewer and smaller white spots and flank markings (Bent 1926, Eddleman et al. 2020). Juveniles' eyes are darker and become red at three months (Flores 1991, Eddleman et al. 2020).

Chicks have black down with an "oily greenish sheen" and eyes are dark brownish-olive. The chick's bill is reddish-brown with a small (2-5 mm wide [0.08-0.20 inches wide]) pinkish spot around the nostril (Eddleman et al. 2020).

Black Rail eggs are smooth and buff to pinkish-white, with evenly distributed, fine, brownish or drab spots (Bent 1926, USFWS 2019). Mean dimensions of 157 eggs were 26.0 mm (1.02 inches) in length, ranging from 24.4-28.1 mm (0.96-1.10 inches), by 19.8 mm (0.78 inches) in width ranging from 18.9-20.4 mm (0.74-0.80 inches, [Eddleman et al. 2020]).

Life History

Although we know little about the life history of these diminutive and highly secretive birds, including the age of sexual maturity, this plan summarizes known information from several research studies. Mate selection, breeding, and nesting occur from March through August. Nesting begins in May and continues through mid-August, with the peak in mid-June (Table 1, USFWS 2019, Watts 2020). Egg laying has been documented as early as 19 March in Coastal Texas (Haverland et al. 2021) and mid-April in South Carolina (Hand et al. 2021). Watts (2020) obtained 170 historic and current Black Rail breeding records from 1836 to 2016, which showed that eggs were found between 3 May and 15 August, with 85% of clutches discovered in June and July. He suggests that egg dates do not differ regionally along the Atlantic Coast, though there is uncertainty in breeding phenology in the Everglades Ecosystem of South Florida.

Females lay one egg per day during the laying period. Average clutch size from 49 clutches was 7.6 ± 1.3 eggs, with a range of 4 to 13 eggs. Both the male and female incubate eggs and defend the nest. Adults incubate the clutch for 19 to 20 days in Florida (Legare and Eddleman 2001), and in South Carolina, adults incubated clutches for 26 days (Hand et al. 2021). Double and triple brooding has been recorded in Florida and South Carolina (Flores and Eddleman 1993, Hand et al. 2021). Black Rails can re-nest after nest loss (Legare and Edleman 2001).

Few studies exist of Black Rail population parameters due to their secretive nature, difficulty in accessing marsh nesting habitat, and low numbers of breeding pairs. A study of 17 nests in Florida by Legare and Eddleman (2001) estimated a 43% nest success and 0.968 daily nest survival rate. Flooding after significant rainfall events caused four nest failures and two failures were from predation. Biologists do not know how long Black Rails live and no banding return data exist for the species to date.

Chicks hatch synchronously and remain in the nest for about 24 hours (Davidson 1992a). They are semi-precocial, remain in the nesting territory, and are fed by their parents for the first few days (Taylor and van Perlo 1998, Hand et al. 2021). Hatch dates from 33 nests in South Carolina ranged from 13 May to 20 August (Hand et al. 2021). Adults were observed with 23 different broods of chicks from 11 May to 22 August, with half of the observations occurring before 26 June and the remaining half to 22 August (Watts 2020). Only one study (Hand et al. 2021) has been published on brood size and chick development to date. Mean brood size from 16 broods observed in South Carolina was 3.4 chicks per pair ± 1.8 chicks (Hand et al. 2021).

Chicks obtain their first juvenal feathers at 42 to 45 days; thus, they may become fledglings as early as mid-June and as late as September depending on when eggs are laid (Hand et al. 2021). Fledging can be synchronous or asynchronous, resulting in up to three days' difference in fledging dates in the same brood. Fledglings partially molt after three months and have their first pre-basic plumage by winter (Taylor and van Perlo 1998, Pyle 2008, Hand et al. 2021). Juveniles partially molt during March or early April into their first pre-alternate plumage. Two to three months later, they molt into their alternate plumage.

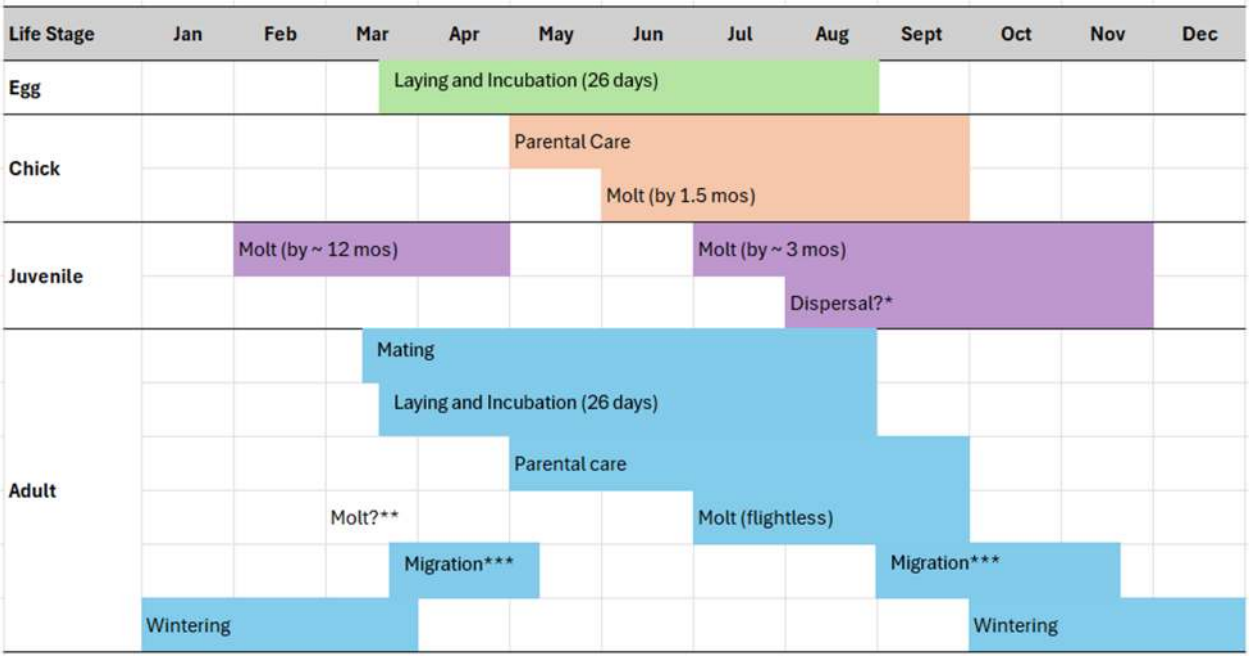
Following the breeding season and on the breeding grounds, there is a period of flightless molt in adults, during which they are extremely vulnerable to predation and environmental perturbations such as fire or flooding. In South Carolina, the flightless molt period was 15 August to 11 October (Hand et al. 2021). During this time, adult Black Rails molt all remiges and rectrices simultaneously, leaving them unable to fly for approximately three weeks (Flores 1991, Pyle 2008, Hand et al. 2021).

It appears that juvenile California Black Rails typically disperse 10 km (6.21 miles) but may disperse up to 28 km (17.40 miles) within their metapopulation and more widely up to 100 km (62.14 miles) between metapopulations (Hall et al. 2018). Therefore, Eastern Black Rails may exhibit similar behavior and be able to colonize new areas with appropriate habitat. Some populations of Black Rails appear to migrate south in the winter and north in the spring. Stable isotope analysis showed that Black Rail populations in Colorado and Kansas likely migrate, wintering in Texas (USFWS 2019). Biologists suspect, based on data from Black Rails killed by collisions with radio and television towers, that northern populations on the Atlantic Coast migrate to the Carolinas and farther south for the winter (Watts 2016). However, birds have been found in New Jersey in winter (Eddleman et al. 2020); thus, not all Black Rails migrate south. Watts (2020) compiled 55 records of Black Rails that indicated migratory behaviors occur from mid-March through early May and from early September to mid-November.

Black Rails vocalize before and during the breeding season and are most vocal when they are not nesting (Weske 1969, Legare et al. 1999). Calling birds tend to group, apparently locating near one another (Kerlinger and Wiedner 1990). Vocalization patterns differ by population and by individual. In Florida, Legare et al. (1999) found that birds call most in July, whereas in New Jersey, calling peaks from April to mid-May (Kerlinger and Wiedner 1990). Additionally, calling peaks at various times in the diel cycle. Some populations vocalize more in the morning, within two hours before and after sunrise, some only vocalize during the two hours before and after sunset, and others only vocalize during night hours (Legare et al. 1999, Bobay et al. 2018, Eddleman et al. 2020, Butler et al. 2023). Biologists usually detect Black Rails using call-response surveys and recorded-call analyses using Autonomous Recording Units (ARUs). ARUs are weatherproof recording devices deployed in habitats to record the vocalizations of any species of interest. Both sexes respond to call-response survey recordings, although males respond more often than females, and response vocalizations differ between the sexes (Legare et al. 1999). In a study done in the Pamlico Sound region of North Carolina, detection by ARUs was highest from midnight to 4 a.m. (Bobay et al. 2018). However, Bobay et al. suggest that this peak detection window for ARUs could reflect a time-period with less background noise from other species that vocalize during daylight hours. Call-response surveys conducted by observers from 30 minutes before sunrise to two hours after sunrise resulted in similar detection probabilities as those of ARUs, and overall detection probability was

increased by using ARUs (Bobay et al. 2018). Call-response surveys done by observers in the morning and evening hours in Florida revealed that detection was highest in the morning within three hours of sunrise (Legare et al. 1999). Detecting breeding birds can be confounded by an overlap in migration and breeding which could occur from March through April. During this period, a small proportion of birds (2.4%) migrates (Watts 2020). However, habitats are generally considered to be occupied if they have multiple detections, so this counting of migrants and breeders is likely a minor issue.

Table 1. The annual life-cycle of the Black Rail across the global range, including all subspecies of *Laterallus jamaicensis.* Dates are likely to vary with latitude (USFWS 2019).



* Specific timing of juvenile dispersal is unknown.

** Ongoing studies indicate flightless molt begins around 1 August and finishes by 31 October in SC (Hand 2023).

*** Not all individuals migrate.

Dietary generalists, Black Rails forage mostly on small animal prey during the growing season and on seeds in the winter (USFWS 2019). A literature review by Ehrlich et al. (1988) notes that Black Rails eat insects, crustaceans, and seeds of aquatic vegetation. Black Rails in South Carolina glean invertebrates including spiders, snails, beetles, katydids, and clams from vegetation and shallow puddles, and appeared to forage on seeds on the soil surface (C. Hand, personal communication, 5 Mar. 2024). The most comprehensive study of the California Black Rail's spring and summer diet to date from 30 birds, documented that birds consume prey in proportion to its presence in marsh habitats. Consistent with other geographic regions, arachnids were the most common prey item followed by amphipods, gastropods, heteroptids, and coleoptids (Hall et al. 2020).

Resource quality, regional conditions, and density-dependent factors likely determine home range size (Table 2). The following information is a summary of the details in Table 2 below. Males in Florida had significantly larger home ranges than females ($p = 0.0024$) during the breeding season (Legare and Eddleman 2001). In Texas (Haverland et al. 2021) and Louisiana (Johnson and Lehman 2021), home

range size before the breeding season did not differ by sex. Legare and Eddleman (2001) suggest that Black Rail home range size may differ by season in regions where water levels fluctuate widely.

Table 2. Home range[1] sizes of the Eastern Black Rail (*Laterallus jamaicensis jamaicensis*) in salt and brackish marsh along the Atlantic and Gulf coasts.

Home Range Size		n[2]	State	Sex	Season	Habitat Type	Reference
Mean (ha)	Range (ha)						
1.3, SD = 0.52	0.82 - 3.1	9	FL	M	Breeding (during egg laying and incubation)	High elevation salt marsh[3], non-tidal relict salt marsh[4]	Legare and Eddleman 2001
0.62, SD = 0.27	0.51 - 0.86	6	FL	F			
0.52, SD = 0.36	0.11 - 1.22	13	TX	No difference by sex	Winter	Salt and brackish high tidal marsh, salty prairie, and Baccharis (spp.) shrubland[5]	Haverland et al. 2021
0.71, SE = 0.13	0.22 - 1.59	13	LA	No difference by sex	Winter and Spring	Saltmeadow Cordgrass (*Sporobolus pumilus*) in high marsh	Johnson and Lehman 2021
3.24	-	1	MD	Unkown	Breeding	Tidal salt marsh	Weske 1969

[1]Mean 95% Minimum Convex Polygon
[2]Number of Black Rails
[3]Dominated by Black Needlerush (*Juncus roemerianus*), Spikegrass/Saltgrass (*Distichlis spicata*), and Silverling (*Baccharis angustifolia*)
[4]Dominated by Cordgrass (*Sporobolus bakeri*), Wax Myrtle (*Morella [Myrica] cerifera*), and Sawgrass (*Cladium jamaicense*)
[5]Dominated by Gulf Cordgrass (*Sporobolus spartinae*), Saltmeadow Cordgrass (*Sporobolus pumilus*), Sea Ox-eye Daisy (*Borrichia frutescens*), Batis (*Batis maritima*), Eastern Baccharis (*Baccharis halimifolia*) and Glassworts (*Salicornia* spp.)

Life history traits that may affect management actions such as timing of prescribed fire, impoundment management, and other habitat management activities are depicted in Table 1 and include:

- Black Rails prefer running and walking over flying.
- Nesting begins in mid-April in SC.
- The range-wide peak clutch period is mid-June.
- Adults incubate eggs for approximately 19 to 26 days.
- February burns in South Carolina delayed hatching by 23 days. Late winter and early growing season prescribed burns may delay nesting enough to subject chicks hatched on those breeding grounds to hurricanes which peak in mid-September.
- Chicks become immatures or fledglings at 40 days post-hatch when the first preformative molt is complete and they can fly.
- The adult flightless molt period lasts for three weeks and may peak in mid-September, coinciding with peak hurricane season.

Habitat

In one of the first modern accounts of the Black Rail, Todd (1977) describes the species as “a bird of wet meadows.” Currently, populations of Black Rails breed in high elevation salt and brackish marsh, which is

the zone of coastal marsh that has infrequent or no tidal influence, or inland freshwater marshes and wet prairies. Ninety percent of Black Rail populations inhabit coastal regions, mostly in high elevation salt and brackish marsh (Watts 2016). Various projects yielded no Black Rail detections even in seemingly suitable habitat, suggesting biologists do not understand all factors influencing habitat selection (Watts 2016, ACJV 2020, Eddleman et al. 2020, Neice and McRae 2021a). Most often, Black Rails inhabit remote locations that are inaccessible to people (ACJV 2020).

In general, Black Rails use higher marsh elevations than other marsh birds. They occur along the gradient from shallow, constantly inundated strata to moist-soil in high marsh where the soil moisture is maintained either by rain or king tides (extreme high and low tides that happen during the full or new moon) in coastal marshes, or rainfall in freshwater marshes (Eddleman et al. 1988, Nadeau and Conway 2015). Three main factors characterize Black Rail habitats: a) moist-soil dominated by variable, gently sloping topography with sheet water flow and/or areas of very shallow surface water (less than 3 cm [1.18 inch]); b) very high-density herbaceous vegetation allowing travel under cover; and c) dense herbaceous cover with relatively high ground for escape from flooding and dense fine-stemmed herbaceous vegetation for nesting. Small size, short tarsus length, and the Black Rail's propensity to run rather than fly determine its habitat needs (Flores and Eddleman 1995, Legare and Eddleman 1995, Legare and Eddleman 2001, ACJV 2020, Eddleman et al. 2020, Haverland et al. 2021, Watts 2022). In an arid Sierra Nevada landscape, irrigated and spring fed wetlands hold significantly higher numbers of Black Rails, underscoring the necessity of a permanent, shallow, and dynamic sheet water source (Richmond et al. 2010).

Gently sloping and variable topography is a necessary component of Black Rail breeding habitat. This feature offers high ground to keep nests dry, and areas for chicks and molting adults to escape flooding from rain or tides (USFWS 2019, Legare and Eddleman 2001, Haverland et al. 2021). Subtle topographic variation provides wet areas during dry periods and higher biodiversity across variable microhabitats for foraging (USFWS 2019, Legare and Eddleman 2001, Haverland et al. 2021, Watts 2022). Black Rails will inhabit tidal or non-tidal impoundments that are actively or passively managed, if sufficient area of the habitat conditions discussed above is present.

In marshes with the conditions described above, dense herbaceous vegetation structure and cover are correlated with Black Rail presence more than vegetative species composition. Because they occupy various inland and coastal marsh types, plant species composition is thought to be less important than structure (USFWS 2019). Vegetation height in Black Rail habitat ranges from ≤1 m (3.2 feet) in coastal areas to taller cattail (*Typha* spp.) and bulrush (*Scirpus* spp.) in freshwater marshes (Davidson 1992, Legare and Eddleman 2001). Across the range, detection increases as vegetation cover and density increase (Flores and Eddleman 1995, Kane 2011, Legare and Eddleman 2011, Tolliver et al. 2019, Butler et al. 2023). In Louisiana, Black Rail occupancy rates were highest with increasing stem density when the number of stems at 0-10 cm (0-3.94 inches) above ground was a count of six or greater stems and had a moderate positive relationship to the number of stems at 20-30 cm (7.87-11.81 inches). Vegetation height above ground and above layers of dead vegetation was also positively correlated with Black Rail presence (Butler et al. 2023). In Kansas, total dead vegetation thatch cover at 10-20 cm (3.94-7.87 inches) above ground was correlated with Black Rail detections (Kane 2011). Vegetation at nest sites was found to be denser than surrounding habitat (Spautz and Nur 2002). Occupied sites are dominated by open, dense grassy marsh and are not typically comprised of more than 20-30% shrubs or trees. The

presence of woody vegetation indicates higher elevation where Black Rails can escape flooding (USFWS 2019, Haverland et al. 2021) which may explain why Black Rail occupancy tends to be higher in herbaceous marsh vegetation near shrubs and trees or upland forest edge (Roach and Barret 2015). However, there is evidence that this proximity may lead to increased predation rates (Watts 2022). Plant species in high elevation brackish and salt marshes occupied by Black Rails in the Carolinas include areas dominated by Saltmeadow Cordgrass (*Sporobolus pumilus*), Sand Cordgrass (*Sporobolus bakeri*, [not native to NC]), Coastal Saltgrass (*Distichlis spicata*), and Black Needlerush (*Juncus roemerianus,* [USFWS 2019]). Hand (2023) has since documented Saltmarsh Bulrush (*Scirpus robustus*) and Marsh Fimbry (*Fimbristylis castanea*) to be characteristic of Black Rail high elevation brackish and salt marsh habitat in South Carolina. High coastal marsh in North Carolina may contain a significant component of Sawgrass (*Cladium jamaicense*)*,* which has been documented in breeding habitat in Florida (Legare and Eddleman 2001). Although vegetation structure (cover and density) has a stronger positive relationship to Black Rail presence than species composition, plant species composition indicates water level and fluctuation. Thus, vegetation types used by Black Rail, especially for breeding, are those that thrive in shallower, more stable water levels (Conway and Sulzman 2007, Tolliver 2019, Butler 2023). *Juncus roemerianus* tolerates a wide variety of water and salinity levels and may not be a reliable indicator of Black Rail breeding habitat, although it may act as breeding habitat where water levels and water level variability are low. Elevation and vegetation alone do not explain Black Rail presence. It is suspected that Black Rails are most abundant in appropriate conditions described here and in areas that have a degree of sheet water flow (Evens et al. 1991, Richmond 2010). It is unknown whether sheet water flow provides higher quality habitat as opposed to a thin layer of surface water that does not flow, or whether it is merely correlated with optimal water depth (Watts 2022).

Nests are bowl-shaped and made of live and dead fine-stemmed emergent grasses, rushes, or other herbaceous plants. Nests often have a canopy and ramp made also of fine-stemmed herbaceous vegetation (Harlow 1913, Flores and Eddleman 1993) and are constructed under dense vegetative cover on or near the ground (Legare and Eddleman 2001). Nests have also been found over very shallow water (<3 cm [1.18 inches]; Flores and Eddleman 1993). The mean nest height above ground from 17 nests was 6 cm ± 2.3 cm (2.36 inches ± 0.91 inches) in Florida (Legare and Eddleman 2001) where the herbaceous vegetation height is similar to conditions found in North Carolina.

Herbaceous emergent wetlands are maintained by disturbance such as fire and changes in water levels. In the coastal context, salinity introduced by tides and storms is an important factor in vegetation composition as it can kill shrubs and trees. The disturbance factors that maintain herbaceous wetlands are therefore required to maintain appropriate Black Rail habitat. Further discussion of habitat disturbance regimes can be found in the Conservation Objectives and Actions sections.

The ACJV defines target Black Rail habitat in the Carolinas as follows (ACJV 2020):

Tidal habitat is comprised of Saltmeadow Cordgrass (*S. pumilus*) and Coastal Saltgrass (*D. spicata*). They define secondary vegetation of tidal habitat in the Carolinas as having a significant component of Eastern Baccharis (*B. halimifolia*) at the highest elevations. Marsh Fimbry *(Fimbristylis castanea*), Chairmaker's Bulrush (*Schoenoplectus americanus*), Sand Cordgrass (*S. bakeri* [not known in NC]), Black Needlerush (*J. roemerianus*), and Sea Ox-eye Daisy (*Borrichia frutescens*) are important components of habitat at elevations just below those where shrubs typically grow (Hand 2018).

Managed tidal impoundments are comprised of Sand Cordgrass (*S. bakeri* [not known in NC]); Chairmaker's Bulrush (*S. americanus*); Saltmeadow Cordgrass (*S. pumilus*); Coastal Saltgrass (*D. spicata*); Sturdy Bulrush (*Bolboschoenus robustus*); and Cattails (*Typha* spp. [Roach and Barrett 2015, Hand 2018]). Tidal impoundments are not likely to be a long-term habitat option for Black Rails in North Carolina, however, due to the increased rate of sea level rise, and availability of better habitat restoration and creation options.

Managed non-tidal impoundments, wet meadows, and freshwater marshes are dominated by native bulrush, sedge, and spikerush species, and/or cattails, and have a secondary component of dense overhead grassy vegetation of any native species.

Black Rail habitat features described above are summarized as follows.

- Water and pools less than 3 cm (1.18 inches) in depth.
- Grass-dominated high elevation coastal marshes or freshwater marshes with less than 20% shrub or tree cover, naturally maintained by occasional fire and hydrology.
- Dense herbaceous vegetative cover.
- Moist-soil.
- Gently sloping and variable topography.
- Fine-stemmed dense herbaceous vegetation for nesting above water level.

Distribution and Population Status

Black Rail populations may have always been low in abundance and patchily distributed due to their specific habitat niche requirements (Watts 2022). A recent assessment of the status of Black Rails in the Atlantic and Gulf states by Watts (2016) and Watts et al. (2017) reviewed 150 years of literature and records for the species. Historically, the Black Rail ranged from Massachusetts to Florida along the Atlantic Coast, Florida to Texas on the Gulf Coast, and into the interior of the United States to Colorado (Watts 2016, Watts et al. 2017, USFWS 2019, Figure 1). The geographic range has contracted recently by 450 km (about 280 miles) along the Atlantic Coast, limiting it to disjunct marshes from New Jersey, south to Florida, and to marshes in Texas (Watts et al. 2016) and Louisiana (Butler et al. 2023). Breeding populations also remain in Colorado and Kansas (USFWS 2019). Historically, 90% of Black Rail detections have been in salt or brackish coastal marsh and the remainder in freshwater inland sites (Watts et al. 2017). Overall, records of birds from the interior have always been uncommon; however, inland areas are under-sampled (Watts 2016). In North Carolina, data from hundreds of call-response surveys from 2014 to 2018 have documented the Black Rail in a handful of coastal marshes, but not elsewhere (Wilson et al. 2015, Smith et al. 2018, Neice and McRae 2021a).

These studies reveal that the Black Rail population in North Carolina has declined significantly. Most historic records actually came from the Mountains and Piedmont where they were found in wet meadows and hayfields, which replaced cleared forests (Watts 2016). However, there have been no records outside the Coastal Plain since 2005 (Watts 2016). Extensive breeding season surveys for Black Rails on the Coastal Plain of North Carolina were conducted by the Center for Conservation Biology (CCB) in 2014, 2015, 2017, and 2018 (Wilson et al. 2015, Smith et al. 2018). These data and those from other studies (e.g., Watts 2016, Bobay et al. 2018, Neice and McRae 2021a) indicate the current presence of the Black Rail in only a few areas on the mid-coast of North Carolina including Swanquarter and Cedar Island National Wildlife Refuges (NWR),

Piney Island, and five other locations. In 1973, there were more than 80 Black Rails calling within accessible areas of Cedar Island NWR on one night (Watts 2016). Davis et al. (1988) heard 96 calls of the Black Rail in Cedar Island NWR during transect surveys. In the 1980s, approximately 74 Black Rails were detected from the bridge across Cedar Island NWR (J. Fussell, personal communication, 23 Sept. 2023). During surveys of Piney Island in 1992, 19 birds were detected (Watts 2016). There have since been five surveys at Piney Island from 2011 to 2022 and detections ranged from 6 in 2014 to 42 in 2018 (USMCAS unpublished data). In 2014 and 2015, the CCB detected 22 individual Black Rails at Swanquarter NWR, Cedar Island NWR, and five other locations, including two sites in Northeast North Carolina. Surveys in 2017 by the CCB of the same areas surveyed in 2014 and 2015 resulted in the detection of only 9 individuals at Cedar Island NWR (Smith et al. 2018). No Black Rails were detected during CCB surveys in 2018, which focused on inner Coastal Plain potential Black Rail habitat, sites where Black Rails were previously detected along the coast and transects within Cedar Island NWR.

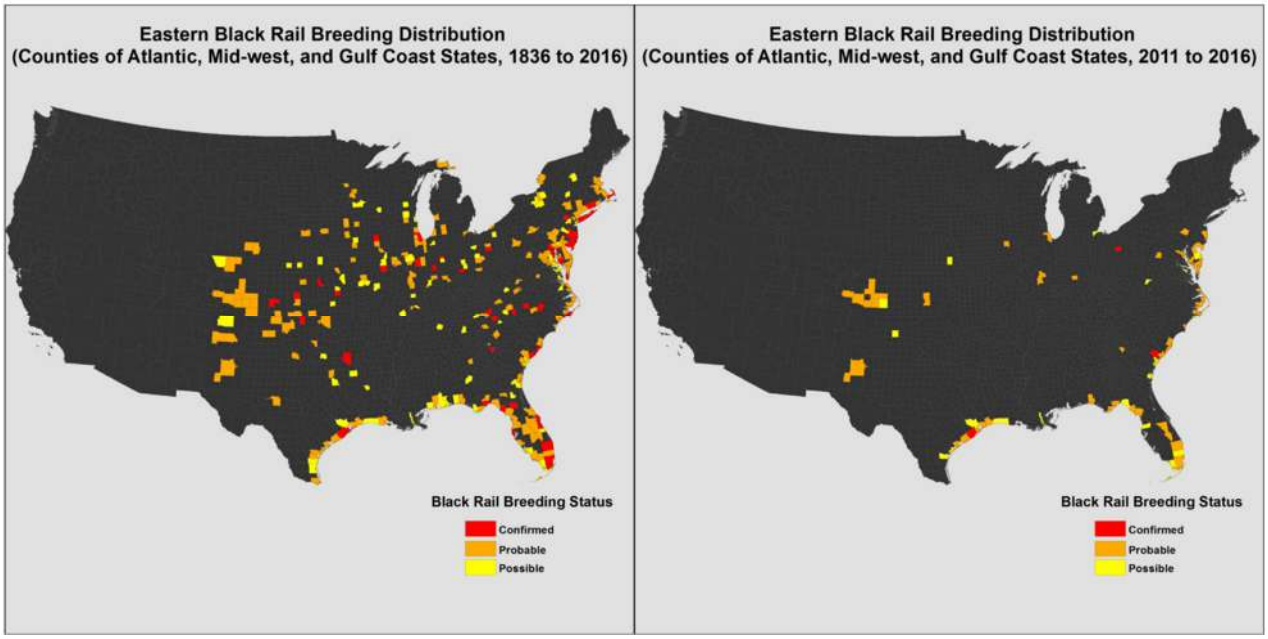


Figure 1. Historic and current breeding distribution of the Eastern Black Rail (USFWS 2019).

THREAT ASSESSMENT

Reason for Listing

Black Rails are listed as threatened under the U.S. Endangered Species Act. Current estimates of breeding pairs for each Atlantic and Gulf state are: 0 pairs from Massachusetts to New York, and 0 pairs in West Virginia, District of Columbia, Tennessee, Alabama, and Mississippi; 40-60 pairs in North Carolina; 40-60 pairs in New Jersey; 15-30 pairs in Maryland; 0-10 pairs in each of Delaware, Virginia, and Louisiana; 50-100 pairs in South Carolina; 100-500 pairs in Texas; and 200-500 pairs in Florida. Populations have experienced an average annual decline of 9% since the 1990s (Watts 2016).

The Species Status Assessment projection model consisted of 5,000 simulations of model replicates for various habitat condition scenarios and found that all populations are projected to go extinct by 2100 if no action is taken. The Southeast Coastal Plain Physiographic Province, which had robust available data, and Mid-Atlantic Coastal Plain regions, both of which North Carolina is a part, were projected to have 35 to 50 years to extinction from present conditions in these scenarios. Extinction was driven by habitat loss (USFWS 2019).

Sea level rise is likely causing coastal Black Rail declines, and Black Rails using high elevation brackish and salt marsh may have reproductive rates that are too low to sustain populations due to higher-than-normal flooding (Watts 2022). Given the steep decline in numbers of Black Rails in North Carolina and the rates of sea level rise and coastal development, it is likely that the subspecies will continue to decline in North Carolina if no actions are taken to conserve, restore, and create habitat. In fact, increased sea level coupled with more frequent and extreme flooding from tropical storm systems have likely contributed to the significant fall in Black Rail numbers (Watts 2022).

Factors considered as causes for Black Rail declines:

- Global sea level has increased 20-23 cm (7.87-9.06 inches) since 1880 at a rate of 0.114-0.14 cm (0.045-0.055 inches) of rise per year to 1993. From 1993 to 2016, the rate of rise doubled to 0.28 cm (0.11 inches) per year, equating to an 8-cm (3.15-inch) rise (Sweet et al. 2017).
- Sea level rise along the North Carolina coast is effectively three to four times the global rate due to the Atlantic Meridional Overturning Current along the northeast Atlantic Coast. The associated low-pressure conditions of this current result in increased sea level (Sallenger et al. 2012).
- Ninety percent of Black Rail breeding season records are from coastal high marsh habitat and the species is sensitive to extremely small, centimeter-level changes in water depth.
- Population declines became evident in the 1990s about the same time as the rate of sea level rise started increasing. Most populations could be extirpated by sea level rise if habitat is not created and restored (USFWS 2019, ACJV 2020, Watts 2022).
- It is evident from historical and current breeding records that Black Rails declined significantly before the 1990s due to filling of high marsh areas and development for housing and transportation, marsh draining and ditching for mosquito control, and hydrological manipulation for agriculture and flood control (Watts 2016). More than 90% of native grasslands and their associated wetlands in the eastern United States have been lost due to agricultural expansion (Sampson and Knopf 1994) and 50% of wetlands in the conterminous United States have been converted to agriculture and other uses (Dahl 1990).
- Much coastal marsh habitat in North Carolina has been altered by agricultural and other development practices, decreasing its function as Black Rail habitat. Activities that alter habitat function include draining by ditching, planting row crops or pine trees, development (residential, business, industrial), road construction, and modification of hydrology (channelization of streams and creeks, drainage ditches, dredging channels).
- In the last nationwide reporting period (2004 to 2009), salt marsh losses were three times greater than losses recorded from 1999 to 2004. Eighty-three percent of these declines were related to sea level rise (Dahl 2011).
- Because coastal marsh elevation changes are minute and elevation conditions of adjacent uplands are relatively unknown, it is highly uncertain whether Black Rail coastal marsh habitat conditions will migrate inland as sea levels rise.

Present and Anticipated Threats

Conservation partners conducted a rigorous Black Rail threats analysis in 2018 which culminated in the Black Rail Conservation Plan (ACJV 2020) and determination that sea level rise is the greatest threat to Black Rails currently and in the future. The latest Sea Level Rise Technical Report (NOAA 2022) projects a 0.6- to 2.2-m (1.97- to 7.21-foot) sea level rise for the U.S. (above 2000 levels) by 2100, with east coast levels being 0-5 cm (0-1.97 inches) above the U.S. average. In the U.S., moderate, typically damaging flooding (0.85 m [2.79 feet] above mean higher high water [MHHW]) is expected to increase from 0.3 events per year to four events per year by 2050. Major flooding (1.2 m [3.94 feet] above MHHW) is expected to increase to 0.2 events per year from the current 0.04 events per year.

Residential development is the second highest threat to Black Rails because brackish and saltmarshes in many areas cannot migrate inland due to hardened shorelines, roads, and development activities. Increased temperatures and drought further threaten Black Rails because warming temperatures and changing precipitation patterns will affect habitat parameters Black Rails are dependent on, including availability of a constant source of shallow water. Increased temperatures not only lead to drying of soils but are related to reduced precipitation and extreme storms. This boom-and-bust pattern of precipitation could easily extirpate Black Rails, especially from lower quality habitats. Additionally, Red Imported Fire Ants (*Solenopsis invicta*), prevalent in North Carolina, can kill chicks (Legare and Eddleman 2001) and are an additional source of mortality.

The Black Rail relies on open, grassy, and wet early successional habitat, which requires regular disturbance to limit growth of shrubs and trees. Because population levels of the Black Rail are low, habitat management activities intended to mimic the disturbance needed to maintain appropriate habitat can pose a significant threat of direct and indirect mortality from which populations may not recover. Poorly timed prescribed fire poses a threat to Black Rail populations if the fire return interval is too brief and if fire occurs shortly before or during peak nesting season or during the adult flightless molt period. The species appears to nest in a clumped, semi-colonial distribution and nests are likely placed at relatively higher elevations. As a result, groups of nests have been destroyed during fires (Legare and Eddleman 2001). Flightless young and adults may not be able to escape rapidly moving, unbroken fire. Prescribed burns conducted during dry conditions could reduce marsh elevation by burning through soil and the root systems of vegetation. In addition, if prescribed fire is conducted shortly before the nesting season reproductive success and survival could be reduced because vegetation cover will be inadequate (USFWS 2020). The subsequent summary of threats lists additional threats from high to lower risk.

Summary of Threats

Summary of threats in North Carolina identified in Black Rail Conservation Plan (ACJV 2020):

- Sea level rise:
    - Loss of nests, hatchlings, and fledglings from an increase in tidal flood days and flooding during extreme storm events.
    - Habitat loss from conversion of high elevation brackish and saltmarsh to low salt marsh or open water.
- Increased temperatures, drought, and extreme rain events will both dry and flood habitats.

- Land use practices and shoreline hardening that preclude coastal marsh migration, especially residential, transportation, and other development of or near high marsh habitat. These practices effect "coastal squeeze" such that high marsh areas are confined between hardened shorelines and migrating low marsh, resulting in decreased total area of high marsh habitat and decreased capacity for high marsh migration toward the uplands.
- Agricultural practices that result in loss of wet meadows and other nontidal herbaceous wetlands.
- Prescribed fire practices conducted during the nesting, chick-rearing, and flightless adult molt periods, and that do not leave sufficient areas of refugia, or use ignition tactics that create large, fast-moving fires with few escape routes for Black Rails.
- Shrub encroachment into herbaceous marshes due to a lack of prescribed fire.
- Disease (e.g., West Nile Virus [Beissinger et al. 2022], highly pathogenic avian influenza).
- Harassment of Black Rails by people (e.g., using call-back audio lures, presence in nesting habitat, and flushing birds).
- Increased abundance of invasive animal and plant species in marsh habitats.

Historic and Ongoing Conservation Efforts

A thorough source of information on historic conservation efforts can be found in Watts (2021), which was used as a reference for the information in this section. Virtually no information was collected about the Black Rail until 100 years after its species description. Work to assess the status of the Black Rail was not initiated until the late 1980s after most habitat destruction had already occurred. This first attempt at assessment consisted of a report titled, "Migratory Nongame Birds of Management Concern" (USFWS 1987), after which three baseline surveys were completed by the early 1990s in New Jersey, Maryland, and South Carolina. During the subsequent 15 years, while the rate of sea level rise was increasing, very little work was done on Black Rails in the eastern United States. The Maryland Department of Natural Resources conducted Black Rail surveys in 2007, which showed a dramatic decline in detections and led the Center for Conservation Biology at the College of William and Mary to form the Eastern Black Rail Conservation and Management Working Group in 2009. The Atlantic Coast Joint Venture (ACJV) chose the Black Rail as one of three focal species for conservation action and assumed coordination of the Black Rail Working Group in 2016, which led to the Black Rail Conservation Plan (ACJV 2020). Surveys and research conducted by the ACJV partners and the Center for Conservation Biology informed the Federal Species Status Assessment (SSA) published in 2019 and the Federal listing in 2020. This conservation plan draws from all documents produced by the historic conservation efforts, and the North Carolina state listing was changed in 2022 to mirror the federal listing. The U.S. Fish and Wildlife Service (USFWS) is currently updating the SSA and may reconsider whether to list the species as federally endangered.

There were no systematic surveys for the Black Rail in North Carolina before the 2000s and the most comprehensive surveys began in 2014. Five years of extensive surveys for the Black Rail were conducted by the Center for Conservation Biology (Wilson et al. 2015, Smith et al. 2018, Paxton 2023) in the coastal region of North Carolina.

To date, there has been limited habitat management and no population manipulation directly intended to enhance the population of the Black Rail in North Carolina. However, staff working on NCWRC game lands report that prescribed fire on one game land may have facilitated migration of the high elevation

brackish marsh more than 91 m (100 yards) in some areas where marsh-edge forested wetlands were burned. There have been efforts by NCWRC to acquire land for Black Rail habitat, with hundreds of acres of brackish marsh acquired in the Cedar Island area. Other land acquisition projects are being pursued near other core Black Rail population areas.

CONSERVATION GOAL AND OBJECTIVES

Conservation Goal

The conservation goal and objectives of this plan mirror those of the Atlantic Coast Joint Venture's Black Rail Conservation Plan (BRCP [ACJV 2020]). The goal over the species' range is to prevent further decline in Black Rail population levels and to increase the population three to seven times above current levels by 2056. The BRCP states that North Carolina, South Carolina, and Georgia should collectively aim for a minimum of 625 pairs by 2056, with half occurring in non-tidal areas and half in tidal areas. These areas correspond to a total habitat acreage among these states of 728 hectares (1,800 acres) of non-tidal habitat and 728 hectares (1,800 acres) of tidal habitat. For North Carolina, assuming the current population is 40 breeding pairs, this would equate to a goal of increasing the number of breeding pairs to 167 by 2056; an increase of 5.5 breeding pairs per year on average in North Carolina.

In terms of additional habitat acreage goals of the BRCP, North Carolina must restore or create about 16 hectares (39 acres) per year; a total of 243 hectares (600 acres) of non-tidal and 243 hectares (600 acres) of tidal habitat by 2056. These habitat targets are based on a conservative estimate of home range size (Table 2). However, conserved habitats must be embedded in a significantly larger landscape of suitable wetland habitats. Large areas of habitat should be prioritized for conservation actions over small patches of apparently suitable habitat. However, small habitat patches that occur adjacent to large areas of potentially suitable habitat are likely important to manage and conserve.

Conservation Objectives

Objectives needed to achieve these goals are derived from the Black Rail Conservation Plan (ACJV 2020). Specific North Carolina objectives for Black Rail conservation are:

1. Implement and promote prescribed fire BMPs that are beneficial to Black Rails, their habitat, and prey resources.
2. Protect high elevation coastal marsh from effects of sea level rise to the maximum extent possible. Contribute to the development and implementation of BMPs to facilitate coastal marsh migration.
3. Restore or create shallow water herbaceous wetlands in non-tidal and inland areas near Black Rail detections.
4. Conduct and promote targeted impoundment management.
5. Contribute to the development and implementation of compatible agricultural BMPs.
6. Conserve lands with existing or potential Black Rail habitat.

7. Conduct surveys and research to identify breeding habitat, breeding phenology, prey resources, and the adult flightless molt period, to inform timing of habitat restoration and management actions.
8. Engage and collaborate with conservation partners and private landowners in Black Rail surveys and habitat creation, restoration, and management.

The Role of Fire in Black Rail Habitat

Black Rail habitat has suffered from fire suppression and subsequent encroachment of woody vegetation into herbaceous wetlands. Prescribed fire is an important tool used to manage and restore habitat (USFWS 2020). However, little is currently known about the effects of prescribed fire on Black Rail habitat and populations. Because Black Rail habitat likely benefits from fire, but species populations are dangerously low and relatively large groups of birds can be killed, directly or indirectly, by poorly timed fire, adhering to BMPs in the 4(d) rule (USFWS 2020) and researching prescribed fire regimes and Black Rail response is extremely important. The relationship of fire to Black Rail occupancy and optimal habitat conditions is an active topic of adaptive management research.

Historically, Black Rail habitats would have burned periodically during lightning strikes and growth of shrubs was suppressed (Nyman and Chabreck 1995, Grace et al. 2005). Black Rails have been found to display a clumped spatial distribution (Taylor and Van Perlo 1998, Watts 2016, USFWS 2019), so burns covering large areas without wet escape habitat with dense cover may kill entire groups of birds (Legare et al. 1998). The need to maintain or enhance marsh elevations relative to sea level rise conditions further complicates the use of prescribed fire. Improperly timed fires that occur in dry conditions or when marshes are not flooded can destroy marsh soils and plant root systems, leading to elevation decrease. Fires in peat soils that lack sufficient moisture can result in wetland conversion to open water. Too frequent or improperly timed burns can decimate prey resources by preventing prey recolonization (Nyman and Chabreck 1995). Fire lines placed in Black Rail habitat can also lead to unintended habitat damage. If prescribed fire can be planned to avoid or sufficiently minimize Black Rail mortality and negative breeding habitat impacts while producing the prey source, vegetation, and elevation conditions necessary for Black Rail population growth, then prescribed fire will be beneficial to the Black Rail.

The best available information currently suggests Black Rail abundance may not be negatively impacted by properly timed fire and that fire is necessary in Black Rail habitat to maintain dense herbaceous vegetation with a low proportion of shrubs (Legare et al. 1998, Conway et al. 2010, Tolliver et al. 2019, Haverland et al. 2021, Butler et al. 2023). Due to the threat of direct mortality, it is essential to implement slow-moving, patchy burns that result in sufficiently large, unburned areas within a management boundary at the minimum frequency required to reduce shrubs to less than 20% coverage of the high marsh. Fires should be conducted at times when marshes are flooded or soils are wet, when dense herbaceous vegetation regrowth would occur most quickly, and when shrubs would be killed (USFWS 2020). Regardless of the Black Rail's ability to fly, it favors running and rarely takes flight, so special care to allow escape by foot is important. It is essential to avoid fire practices that would directly kill significant numbers of Black Rails such as ring fires or complete burns over large areas (Legare et al. 1998, Grace et al. 2005). Fire prescriptions that leave some areas of dense vegetation (escape cover)

unburned are also important to reduce predation. One study found that Black Rails were depredated by multiple bird species when vegetation was made sparse (Evens and Page 1986). Patchy burns that occur during the growing season may also be used to achieve the desired prescribed fire outcomes. A slow-moving prescribed burn in Florida during August, under proper soil and weather conditions, resulted in a burn that left 0.04- to 0.81-hectare (0.1- to-2.0-acre) habitat patches intact and resulted in no observed Black Rail mortality (Legare et al. 1998). Conway et al. (2010) recommend that less than 15% of marsh habitat be burned at any one time. The USFWS 4(d) Rule (USFWS 2020) states that for tracts greater than 259 hectares (640 acres), 50% of Black Rail habitat on the tract should be maintained as unburned in any given calendar year. The USFWS 4(d) Rule further states that within each burn unit, 10% of the burn unit should be left as unburned, dispersed patches of habitat that should be no smaller than 9.29 square meters (100 square feet) in size.

Early growing season burns will likely limit shrub encroachment most effectively (Streng et al. 1993, Drewa et al. 2002, Barlow et al. 2015). However, if fires are conducted too close to the peak of nesting, Black Rail populations could experience reduced productivity for that season. Early growing season burns should result in a mosaic of small, burned areas interspersed with appropriate habitat for renesting (USFWS 2019). Prescribed fire early in the growing season likely causes delay in nesting. Burns conducted in February in South Carolina resulted in a later mean hatch date from nine nests of 18 July ± 28.1 days, compared to areas that were not burned where the mean hatch date from 24 nests was 25 June ± 30.8 days (Hand et al. 2021). Moreover, this timing may result in more flightless young at risk of flooding during peak hurricane season in September. Once the response of Black Rails to prescribed fire is better understood in North Carolina, changes to management actions can be made in an adaptive management framework.

Objectives of Prescribed Fire in Black Rail Habitat Management

Objectives include the following:

- During fire line creation, avoid placing fire lines in Black Rail breeding habitat (herbaceous wetlands adjacent to the tree line or areas not dominated by *J. roemerianus*) and avoid lowering the elevation of high marsh soils during fire line creation.
- Minimize mortality at all life stages.
- Reduce shrub coverage to 20% or less and prevent succession to shrubland.
- Promote rapid regrowth of dense herbaceous cover by the time of nesting.
- Increase plant diversity, especially in areas dominated by *S. pumilus* and *D. spicata.*
- Maintain or increase marsh surface elevation.
- Conduct prescribed fire when wetlands and wetland vegetation are wet enough to result in a patchy burn.
- Maintain or increase Black Rail prey.
- Aid coastal marsh migration.

CONSERVATION ACTIONS

1. Habitat Management

A. Prescribed Fire

Guidance in the USFWS 4(d) Rule will be followed (USFWS 2020) for conservation actions that call for prescribed fire. The following includes the 4(d) Rule guidance regarding using caution when implementing prescribed fire and other fire management activities in high marsh habitats, especially in or near breeding habitat.

1) To the maximum extent possible, avoid placing fire lines in Black Rail high marsh breeding habitat or potential breeding habitat. Avoid creating fire lines in areas with herbaceous marsh grasses not dominated by Black Needlerush (*Juncus roemerianus*) or areas adjacent to the tree line. If impacts are unavoidable, only cross habitat in a perpendicular manner in the narrowest band of habitat when machinery cannot go around potential breeding habitat.
2) Maintain a fire return frequency at a rate necessary only to limit shrub cover to less than 20% in the high marsh.
3) Conduct prescribed fire in winter or as early in the growing season as possible to reduce woody vegetation cover to less than 20% of the high marsh and to minimize the loss of eggs and chicks.
4) Apply prescribed fire in weather conditions that will result in very slow moving, patchy burns with broken fire boundaries.
5) Use tactics that provide unburned refugia and avoid complete burns.
6) Avoid fires with long, unbroken boundaries and fires that come together in a short period of time (e.g., ring fires).
7) When using aerial ignition, avoid large, fast-moving fires.
8) Ignition tactics, flame lengths, and rate of spread should avoid trapping Black Rails by allowing escape routes.
9) Aim to achieve patchy fires with unburned refugia, including approximately 10% of the burn unit with dispersed patches of unburned area at least 9.29 square meters (100 square feet) in size.
10) For tracts greater than 259 hectares (640 acres), follow all guidance above and conduct burns such that less than 50% of habitat and breeding habitat is burned in any calendar year.
11) For smaller tracts, follow all guidance in i to viii above, but such that at least 10% of the burn unit is unburned and can serve as escape habitat for Black Rail.

B. Marsh Migration

1) Once effectiveness of coastal marsh migration techniques is better understood, facilitate coastal marsh migration through methods deemed appropriate, which may include prescribed fire, terracing and contouring slopes on degraded lands adjacent to high elevation coastal marsh, and other techniques.

2) Facilitate state and federal permitting for coastal marsh protection by:
    a. Working with regulatory agencies, the ACJV, and the NCWRC Habitat Conservation Division to reduce federal and state regulatory barriers to coastal

marsh management techniques such as, but not limited to, thin layer sediment placement and runneling.

b. Once a state regulatory framework is in place, employ methods to protect high elevation coastal marsh from sea level rise in Black Rail breeding habitats.

c. Partner with and provide Black Rail technical guidance to entities that are employing thin layer sediment placement and other coastal marsh protection techniques.

C. Marsh Restoration and Creation

Shallow-water herbaceous marsh habitat should be restored and created to replace Black Rail habitat losses due to flooding. In and near lands where Black Rails occur, appropriate inland non-tidal areas should be modified to act as wet meadow-like marsh breeding habitat.

Black Rails use habitats with a degree of sheet water flow. Therefore, establishing or restoring sources of sheet water flow is necessary when creating inland habitat. Sheet water flow offers a constant source of moist-soil and shallow pools. Any seeps and springs should be identified for habitat restoration or creation that results in large areas of open herbaceous cover. Drained wetlands should be restored as herbaceous wetlands. Grasslands, pastures, old pine plantations, and old agricultural lands with hydric soils and appropriate hydrology can be converted to herbaceous freshwater marsh. In some areas, irrigation has been used successfully for inland habitat creation in areas with insufficient wetland soils. The South Carolina Department of Natural Resources is testing a solar powered fallow field irrigation system to provide inland habitat. The system is affordable and consists of a solar powered pump connected to a water source, with irrigation tubes dispersed through the field. Constant low volume irrigation creates sheet water flow and should allow dense herbaceous wetland vegetation to dominate the field.

1) Restore non-tidal herbaceous marsh habitat.

   a. Restore shallow herbaceous wetlands in pastures or other agricultural fields.
   b. Use prescribed fire to reduce and limit shrub coverage, and dead trees (snags).

2) Create non-tidal herbaceous marsh habitat.

   a. Convert lands, including pine plantations, with hydric soils near Black Rail breeding habitat to herbaceous marsh.
   b. Where it is possible to closely manage water levels, convert significant areas of impoundments to moist-soil, herbaceous high marsh.
   c. Create, gently sloping herbaceous wetlands via topographic modification, with or without supplemental irrigation.
   d. Convert pastures or grasslands without sufficient hydric soils to wet meadows through irrigation.
   e. Use prescribed fire to reduce and limit shrub coverage, and dead trees (snags).

2. Habitat Conservation and Protection

A. Conserve unprotected lands with suitable or potentially suitable Black Rail habitat. Prioritize protection of high elevation coastal marsh breeding habitat, areas with potential for coastal

marsh migration, and lands near Black Rail detections that can be converted to non-tidal, herbaceous marsh or wet meadow.

1) Focus land conservation, including conservation easements, incentives, and acquisition, in areas with Black Rail detections or potential Black Rail habitat within a reasonable dispersal distance of Black Rail detections (e.g., within buffers in the ACJV Black Rail Habitat Tool [ACJV 2022]).
2) Conserve high elevation coastal marsh or land that will convert to it, and adjacent undeveloped lands through acquisition and conservation easements.
3) Purchase lands (pasture, grassland, pine plantations, and agriculture) and conservation easements from willing landowners, adjacent to or near existing Black Rail habitat. Preference should be given to lands with wetlands and hydric soils. These lands may be converted to breeding habitat and/or will convert to high elevation coastal marsh as sea level rises.

3. Habitat Management, Restoration, and Creation on NCWRC Game Lands

The NCWRC owns or manages hundreds of acres of potentially suitable Black Rail habitat consisting of high elevation coastal marsh, impoundments, and areas that could be converted to larger freshwater wetlands. Black Rail habitat should be created, restored, and managed in as many suitable areas on game lands as possible, in areas with or near Black Rail detections. NCWRC should consider acquiring lands with hydric soils and appropriate hydrology near occupied Black Rail habitat from willing landowners, including pine plantations, pastures, and old agricultural fields. NCWRC could convert all or part of these lands to herbaceous marsh Black Rail breeding habitat that will not be affected by storm surge or flooding.

Black Rails have been detected on or near several NCWRC game lands. The game lands with Black Rail habitat, impoundments, or potential habitat are Alligator River, Buckridge, Carteret County, Goose Creek, Gull Rock, Neuse River, and North River game lands. The game lands that are near core Black Rail populations and include potentially suitable Black Rail habitat or impoundments are Croatan (impoundments near Catfish Lake), Dare, J. Morgan Futch, Northwest River Marsh, Pungo River, and Texas Plantation game lands. Voice of America Site A should be surveyed for Black Rails and managed for them if they are detected. The NCWRC Wildlife Diversity Program should coordinate often with the Land and Water Access Division's game land managers to implement Black Rail conservation measures outlined herein on game lands or portions of game lands where NC Natural Heritage Program Dedicated Nature Preserves agreements allow.[6]

[6] The NC Natural Heritage Program is a state entity that works with partners to conserve North Carolina's significant natural areas through conservation planning, land management assistance, and conservation agreements such as Dedicated Nature Preserve agreements. These agreements define land management activities that are allowed or are prohibited to conserve the ecosystems they protect.

4. Incentives

The following incentive programs and other wetlands related programs through the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service and United States Farm Bill, may benefit landowners who are willing to conserve and/or manage for the Black Rail:

- The Wildlife Conservation Lands Program of the North Carolina Wildlife Resources Commission,
- Partners for Fish and Wildlife and Safe Harbor programs of the USFWS,
- USDA Wetland Reserve Easements,
- Other conservation easements offered by the North Carolina Coastal Land Trust or other land trusts, Ducks Unlimited, and The Nature Conservancy, which may provide incentives for the landowner to offset changes in use that may result when protecting and/or enhancing land for the Black Rail.

These incentive programs are likely advantageous to private landowners of existing and future brackish and saltmarsh, because coastal marsh is not typically used for grazing in North Carolina. It would be beneficial to work with private landowners willing to implement occasional prescribed fire.

In areas with potential habitat identified in the Atlantic Coast Joint Venture Black Rail Habitat Tool (ACJV 2022):

A. NCWRC should market the Wildlife Conservation Lands Program (WCLP) directly to private landowners of high elevation coastal marsh, through mailings and phone calls. The WCLP will likely benefit landowners by reducing their tax burden on this land type.

B. Market all other incentive programs directly to private landowners of high elevation coastal marsh. Other financial incentive programs can also be employed. The benefits are additive for landowners who receive a property tax reduction through the WCLP and then receive habitat management cost-share through other incentive programs.

C. Work with appropriate landowners to create and restore wet hay fields and marshy meadows.

5. Monitoring and Research

A. Better understand and identify likely breeding habitat on game lands and other lands to inform population status and habitat conservation, management, and restoration decisions.
    1) Prioritize areas for surveys near or at sites where Black Rails have been detected.
    2) Employ call back surveys, Autonomous Recording Units, and other techniques to identify areas where Black Rails are likely breeding.
    3) Establish water level monitoring arrays to better understand Black Rail occupancy and necessary habitat factors.
    4) Evaluate elevation and topographic characteristics of occupied and unoccupied sites.
    5) Monitor changes in vegetation, topography, and hydrology from habitat management activities such as prescribed fire.

B. Collect and share data with the USFWS regarding the population status of Black Rails.
    1) Follow the USFWS Black Rail monitoring protocol to estimate relative Black Rail abundance and occupancy over time.

C. Quantify the response of Black Rails to prescribed fire, creation of wet meadows, and other habitat management and restoration activities.
    1) Conduct Black Rail occupancy surveys before and after habitat restoration and management activities.
    2) During the Black Rail breeding season or the adult flightless molt period, walk transects immediately after conducting a prescribed fire or after wildfires to document any Black Rail mortality.

D. Gather information on the life history and productivity of Black Rails in North Carolina to inform population and habitat management decisions.
    1) Employ camera traps and other techniques in Black Rail breeding habitat to document breeding phenology, productivity, and the adult flightless molt period.
    2) Once and if population levels are sufficient to trap and band birds, conduct banding and radiotelemetry to find and monitor nests, and estimate population parameters.

E. Employ Unoccupied Aerial Systems (UAS) to improve management of high elevation coastal marsh habitat where appropriate.
    1) Use vegetation-penetrating Lidar-equipped UAS to assess and map fine-scale marsh topography of coastal marshes to better understand Black Rail occupancy and prioritize habitat protection and management activities.
    2) Use Lidar data to avoid placing fire lines at higher elevations in high marsh where Black Rails could breed.
    3) Evaluate use of Lidar and multispectral imaging cameras to monitor vegetation changes in response to prescribed fire and other habitat management actions.

F. Evaluate Unoccupied Aerial Systems (UAS or drones) as a means to survey for Black Rails and their nests and to gather habitat data. UAS equipped with super high-resolution thermal cameras have identified Black Rails to species on the Gulf Coast (Olsen et al. 2023). A test of this technique conducted by NCWRC identified Black Rail and a nest of a different marsh bird species in high brackish marsh.

G. Collect eDNA samples in areas with apparently suitable habitat where Black Rail presence is uncertain to evaluate Black Rail presence in previously unknown sites.

H. Collaborate and share information with all partners conducting Black Rail monitoring and research efforts in the state.

6. Education and Outreach

A. Inform and support NCWRC, conservation partners, and private landowners regarding Black Rail habitat restoration and management.

1) Refer these entities to this conservation plan, the resources referenced in this plan, and the South Carolina Department of Natural Resources Black Rail website.
2) Support the North Carolina Black Rail Working Group and ensure its membership includes habitat managers and the appropriate private landowners.
3) Provide technical guidance and assistance to NCWRC, conservation partners, and private landowners to help them survey for and create, restore, and manage breeding habitat.
    a. Share locations of likely Black Rail habitat with these groups to facilitate habitat conservation.

B. Support and work with the range-wide Black Rail Working Group coordinated by the ACJV to provide information for decisionmakers and the public to better inform them about the Black Rail and its conservation needs. Outreach information on the Black Rail exists on websites (e.g., Center for Conservation Biology, William & Mary / Virginia Commonwealth University), and additional articles are planned.
C. Publish posts on social media to inform stakeholder groups about the ecology and conservation needs of the Black Rail.
D. Engage the local media to inform them about Black Rails and related conservation activities.

7. Regulations

The Eastern Black Rail (*Laterallus jamaicensis jamaicensis*) was listed as Threatened under the U.S. Endangered Species Act in 2020. The species is federally regulated under a 4(d) Rule, which outlines prohibitions, best management practices, and exemptions (USFWS 2020). The species is also protected by the Migratory Bird Treaty Act administered by the USFWS. In North Carolina, it is classified as a nongame species and State Threatened. The NCWRC lists the Black Rail as a Species of Greatest Conservation Need; thus, conservation for and research on it is supported by the North Carolina Wildlife Action Plan and State Wildlife Grant program (NCWRC 2015).

8. Population Management

Actions such as translocation and captive breeding and release have not been recommended yet by Black Rail experts, the Black Rail Working Group, or other entities and do not appear in management or species assessment plans. If such efforts are determined to be effective and necessary in the future, the NCWRC will work with USFWS and the Black Rail Working Group to consider population management options in North Carolina.

993 **SUMMARY OF ACTIONS NEEDED**
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ACTION	OBJECTIVES	PARTNERS / FUNDING*	DESIRED OUTCOMES
Mimic habitat disturbance using techniques such as prescribed fire and other methods to clear shrubs and trees.	Follow BMPs to minimize Black Rail mortality and reduce shrubs and trees to less than 20%. Significant acreage of *Sporobolus pumilus* and *Distichlis spicata.*	Partners: Universities, colleges, research institutes, TNC, USFWS, DOD, State Parks, private landowners. Funding: Pittman-Robertson (PR) and State Wildlife Grant (SWG) funds administered by the USFWS and grant sources such as America the Beautiful, NFWF, NRCS.	High quality Black Rail habitat and insignificant Black Rail mortality. Four-hundred and eighty-seven ha (1,200 ac) of additional Black Rail habitat from 2024 to 2056, with half in tidal areas and half in non-tidal areas.
Pursue land acquisition and conservation easements.	Conserve appropriate lands with or near Black Rail detections.	Partners: NC Coastal Land Trust, TNC, Ducks Unlimited, State Parks. Funding: NAWCA, NCLWF, USFWS Cooperative Endangered Species Fund Grants, Open Space Institute, National Coastal Wetland Conservation Grants, NRCS, USFWS Recovery Land Acquisition, DOD REPI Challenge.	Four-hundred and eighty-seven ha (1,200 ac) of additional Black Rail habitat from 2024 to 2056.
Respond to sea level rise.	Facilitate coastal marsh migration into uplands with appropriate topography, using prescribed fire. Support efforts to increase the elevation of coastal marshes where Black Rails are breeding.	Partners: TNC, USFWS, DOD, State Parks, NCDEQ, private landowners, NC Coastal Federation, ACJV, USACE. Funding: NFWF, federal funds from agencies such as NOAA and USACE.	A significant portion of the 243 ha (600 ac) of additional tidal habitats are protected from 2024 to 2056.
Respond to sea level rise.	Work with partners toward a national and state regulatory framework for saltmarsh restoration.	Partners: ACJV, universities, NC Coastal Federation, TNC, USACE, NCDEQ. Funding: See funding sources for SLR response above.	A functioning regulatory framework for saltmarsh restoration techniques.
Evaluate or use specialized cameras on UAS to evaluate topography and vegetation and to conduct Black Rail surveys.	Reasonable cost, practical application of UAS to improve understanding of Black Rail habitat conditions, abundance, and nesting.	Partners: NCDOT Aviation Division, UAS Section, entities that can share UAS, universities, State Parks. Funding: Section 6, SWG, PR, USGS SSP, CSWG.	More accurate data on Black Rail relative abundance and nest locations related to topography and vegetation.
Measure hydrology at occupied and unoccupied sites in tidal and non-tidal habitats, and in high coastal marsh upland migration zones.	Work with partners to gather hydrology data during the breeding season, at occupied and unoccupied sites.	Partners: Universities, colleges, research institutes, DOD, State Parks, private landowners. Funding: PR funds administered by the USFWS and grant sources such as America the Beautiful, NFWF, NRCS.	Understand the hydrology of Black Rail breeding habitat in tidal, non-tidal areas, and coastal marsh migration zones.

SUMMARY OF ACTIONS NEEDED (continued)

ACTION	OBJECTIVES	PARTNERS / FUNDING*	DESIRED OUTCOMES
Manage impoundments as Black Rail breeding habitat in non-tidal areas.	Increase the amount of non-tidal Black Rail breeding habitat.	Partners: USFWS, private landowners, USFS. Funding: See funding sources for habitat restoration above.	Impoundments that are not needed or are not completely needed for waterfowl act as Black Rail breeding habitat.
Create wet meadows in non-tidal areas.	Increase appropriate Black Rail habitat inland away from the threats of SLR.	Partners: USFWS, TNC, private landowners. Funding: See funding sources for habitat restoration above.	Pastures and other lands near high coastal marsh act as Black Rail wet meadow breeding habitat.
Black Rail habitat creation, restoration, and management on NCWRC game lands.	Increase the amount of tidal and non-tidal Black Rail breeding habitat.	Partners: TNC, Ducks Unlimited. Funding: NCWRC federal funds sources for habitat restoration above.	Significant progress toward the goal of 487 ha (1200 ac) of additional Black Rail habitat from 2024 to 2056.
Market habitat conservation and management incentive programs directly to private landowners.	Increase the amount of tidal and non-tidal Black Rail breeding habitat.	Partners: Habitat cost-share incentive programs listed in this plan's text.	Hundreds of acres of additional Black Rail habitat receive some form of protection and / or management to reduce shrub and tree cover and to create and restore habitat.
Conduct monitoring and research.	Inform Black Rail conservation and management decisions.	Partners: USFWS, TNC, NPS, universities, ACJV, DOD.	An adaptive management framework that increases Black Rail abundance and distribution in North Carolina.
Provide education and outreach.	Increase awareness of the need to conserve Black Rails among partners and private landowners.	Partners: ACJV, North Carolina Black Rail Working Group, social media and media outlets.	Partners and landowners are working to conserve Black Rails.

* The ACJV can ghost write grants and apply for funding to subcontract to NC conservation partners for Black Rail conservation.

GLOSSARY

Autonomous Recording Unit (ARU) - ARUs are weatherproof recording devices deployed in habitats to record the vocalizations of any species of interest.

Brackish Marsh – A marsh that is fed by a mix of fresh and salt water (brackish water). Lower elevations of the brackish marsh are inundated by brackish water for longer periods and are dominated by Black Needlerush (*Juncus roemerianus*). High elevation brackish marsh is dominated by moist-soil, experiences infrequent inundation or tidal influence, is mainly rainwater fed, and has a higher diversity of plant species. When inundation or fire are too infrequent, shrubs can dominate high brackish marsh.

Breeding Habitat – Breeding habitat includes freshwater herbaceous marshes or high elevation salt or brackish marsh with shallow water (moist-soil to 3 cm [1.18 inches] deep). Habitat has dense herbaceous cover, limited woody cover, and topographic variation (gentle slope or topographic highs/lows) that provides refugia when conditions are too wet, and moist areas for foraging when conditions are dry. Currently in North Carolina, Black Rails are found in high elevation brackish and saltmarshes dominated by Saltmeadow Cordgrass (*Sporobolus pumilus*) and Coastal Saltgrass (*Distichlis spicata*). However, Black Rails also may breed in Sawgrass (*Cladium jamaicense*), other grasses and herbaceaous vegetation, and Black Needlerush (*Juncus roemerianus*) in North Carolina, provided water is shallow enough.

Breeding Phenology – Timing of breeding related cyclical or seasonal events.

Call-response Survey – A survey done with an audio player and speaker where a species' vocalizations are played to elicit a response from the species of interest in a potential habitat area.

Clutch Period – A period when eggs are in the nest.

Coastal / Salt Marsh Migration – A process during which sea level rise causes salt intolerant vegetation to die, allowing salt-tolerant marsh plants to move inland and up the elevation gradient.

Conservation Easement – A voluntary agreement by a landowner to restrict specific uses of a property for a specified amount of time. The easement is either voluntarily donated or sold by the landowner to an entity that is legally responsible to enforce the easement, usually a type of land trust. Financial incentives are usually received by landowners that donate conservation easements.

eDNA – Environmental DNA is the DNA in cellular material shed by organisms (via skin, excrement, etc.) into aquatic or terrestrial environments that can be sampled from environmental materials (e.g., soil, water) and identified to the originating species.

Extirpation – Local extinction that occurs when a species ceases to exist in a defined geographic area, though it still exists elsewhere.

Fire Line – A line of varying width that is cleared of vegetation to remove combustible materials down to mineral soil to prevent fire from passing through it.

Ghost Forest – Areas of dead trees killed by saltwater intrusion into soils and/or increased water levels.

High Marsh / High Coastal Marsh – High elevation zones in herbaceous marshes near or adjacent to the coast or an estuary. A marsh zone situated above the mean high water level, inundated only during rain events, extreme high tide (such as spring and king tides), and storm surge produced by coastal storms.

Inland Habitat – Habitat that is not affected by any tides or storm surge, but which serves as Black Rail habitat.

Landowner Assurance Program – A voluntary agreement between a landowner and the U.S. Fish and Wildlife Service or other authorized wildlife agency, whereby the landowner agrees to certain conservation practices that will benefit a species, in exchange for limited liability for the fate of the species that occupies their land.

Lidar (Light Detection and Range) – A laser-based remote sensing method that can be used to plot or map three-dimensional topographic or vegetative characteristics on the ground.

(MCP) Minimum Convex Polygon – One of many ways to measure or map the area an animal uses (e.g., its home range) throughout a defined period of time. It reflects the smallest polygon that encloses a set of points; in this case, multiple known locations of a single animal.

Microhabitat – Small scale characteristics or properties within an area used by a species to secure resources for their survival over a period of time.

Prescribed Fire – An intentionally set fire or "controlled burn" that is planned with specific vegetation management objectives, conducted during safe weather conditions by highly trained personnel.

Runneling – A marsh restoration process in which shallow channels are created in the marsh to drain pools of water, promote revegetation, and restore tidal hydrology.

Sheet Water – A thin layer of surface water that forms large areas of shallow (no more than 1 inch) inundation.

Sheet Water Flow – Water that flows over land in a thin sheet.

Shoreline Hardening – Construction of artificial structures such as seawalls, revetments, riprap, and bulkheads designed to block or inhibit landward movement of a shoreline, typically used to protect structures and infrastructure from erosion and coastal hazards.

Subspecies – A population of a species in which individuals do not interbreed due to geographical separation or by habitat use. Sometimes subspecies have genetic differences to other populations of the same species.

Vegetation Composition – The variety and relative proportions of plant species found in an area.

LIST OF ACRONYMS

Atlantic Coast Joint Venture (ACJV)

Autonomous Recording Unit (ARU)
Best Management Practice (BMP)
Department of Defense (DOD)
National Fish and Wildlife Foundation (NFWF)
National Oceanic and Atmospheric Administration (NOAA)
National Park Service (NPS)
National Wildlife Refuge (NWR)
North American Wetlands Conservation Act (NAWCA)
North Carolina Department of Environmental Quality (NCDEQ)
North Carolina Land and Water Fund (NCLWF)
Pittman-Robertson (PR)
Sea Level Rise (SLR)
The Nature Conservancy (TNC)
U.S. Army Corps of Engineers (USACE)
Unoccupied Aerial Systems (UAS)
U.S. Department of Agriculture (USDA)
U.S. Fish &Wildlife Service (USFWS)

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