Eastern Black Rail Management Guidance

The Center for Conservation Biology

William & Mary

Eastern Black Rail: Management Guidance

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Recommended Citation:

Watts, B. D. 2022. Eastern black rail: Management Guidance. The Center for Conservation Biology Technical Report Series, CCBTR-22-08. William & Mary, Williamsburg, VA. 50 pp.

Project Partners:

United States Department of Agriculture
(Natural Resources Conservation Service)
United States Fish and Wildlife Service
(Atlantic Coast Joint Venture)
The Center for Conservation Biology

Front Cover: Cover art by Anna Stunkel.

The Center for Conservation Biology is an organization dedicated to discovering innovative solutions to environmental problems that are both scientifically sound and practical within today's social context. Our philosophy has been to use a general systems approach to locate critical information needs and to plot a deliberate course of action to reach what we believe are essential information endpoints.

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EXECUTIVE SUMMARY

The eastern black rail (*Laterallus jamaicensis jamaicensis*) has experienced a catastrophic decline including both a 450-kilometer contraction of the northern range limit and a hollowing out of historic strongholds throughout the remaining range. Many local populations have been extirpated. This subspecies is now listed as endangered within six states along the Atlantic Coast and in 2020 was formally listed as *Threatened* under the Endangered Species Act by the U. S. Fish and Wildlife Service. Recognition of this decline has led to the mobilization of biologists throughout the range to clarify current distribution and to investigate basic ecology and habitat requirements.

Over the past five years, a clear call-to-action has been building within the conservation community to deploy the resources needed to halt the ongoing decline of eastern black rails. However, questions about where and how to deploy resources have emerged as barriers to action. This guidance document focuses on removing those barriers to management action so that we may take advantage of conservation opportunities for eastern black rails. This report develops an approach for prioritizing landscapes for management opportunities based on the distribution of extant populations and dispersal distances, develops a strategy for staging activities, compiles a set of management endpoints, reviews techniques that may be useful in moving habitats toward target conditions and links management needs to priority landscapes.

The conservation community focused on the eastern black rail continues to operate within a catch twenty-two. The ongoing pace of decline dictates that we must take action to halt the decline if we want to retain the species within historic landscapes. However, management prescriptions have not been formally tested for eastern black rails, leaving the community without known outcomes for the range of possible actions. We have no alternative but to "learn as we go" and adapt management techniques as new information emerges.

ACKNOWLEDGMENTS

I thank the many biologists from throughout the eastern black rail range who contributed to meetings and calls focused on developing management options over the past five years. Our perspective on black rails within eastern North America and how to manage them has evolved rapidly in recent years. Thanks goes to the eastern black rail core team (group of advisors for the Atlantic Coast Joint Venture recovery effort) for comments on an earlier draft. I thank Kashi Davis, Christy Hand and Joe Smith for updates on rail occurrences. Mo Correll, Woody Woodrow, Craig Faulhaber and Christy Hand provided extensive comments that improved the report. Aimee Weldon provided project oversight from the Atlantic Coast Joint Venture of the U.S. Fish and Wildlife Service. Charlie Rewa provided oversight from the NRCS of the U.S. Department of Agriculture. Erica Lawler provided administrative oversight from William & Mary. Marie Pitts assisted with production of maps and the layout of the report.

INTRODUCTION

Eastern black rails (*Laterallus jamaicensis jamaicensis*) have suffered a catastrophic decline including both a 450-kilometer contraction of the northern range limit along the Atlantic Coast and a hollowing out of historic strongholds within the remaining range (Watts 2016). The human development of the United State' coastal landscape likely destroyed the majority (>90%) of black rail habitat area by the 1970s (Tiner 1984, Dahl and Johnson 1991) converting coastal wetlands to agricultural land and urban spaces and altering the hydrology for mosquito control and infrastructure development. However, in recent decades (1980s to present), black rail declines have occurred within tidal wetlands where the underlying structure and vegetation remains intact (Watts et al. 2021). It seems likely that populations using tidal wetlands have crossed a sea-level-rise demographic threshold where the increasing frequency of higher-than-normal tides and duration of tidal flooding have negatively shifted demographic rates to unsustainable levels. To date, available demographic data on black rails is inadequate to assess this possibility. However, data on other species (e.g., Field et al. 2017) using very similar tidal marsh habitat supports the hypothesis that ongoing sea-level rise has been a leading driver of these declines.

Concern about the status of eastern black rails has been building within the conservation community for more than 30 years (Watts and Beisler 2021). Inclusion of black rails in "Migratory Nongame Birds of Management Concern" by the United States Fish and Wildlife Service (USFWS 1987) consolidated concerns and prompted assessments within two USFWS regions, including the Midwest (Hands et al. 1989) and Northeast (Davidson 1992), as well as three benchmark surveys, including New Jersey (Kerlinger and Sutton 1989), Maryland (Brinker and Therres 1992) and South Carolina (Cely et al. 1993). Although focus waned over the next 15 years, the establishment of The Eastern Black Rail Conservation and Management Working Group in 2009 reignited interest and was followed by several regional meetings and workshops. The year 2016 was a turning point for the working group with the completion a status assessment covering the Atlantic and Gulf Coast states (Watts 2016), the convening of a well-attended symposium focused on eastern black rails during the 40th annual meeting of the Waterbird Society and the adoption of the eastern black rail as one of three flagship priority species by the Atlantic Coast Joint Venture (ACJV) that led to the development of a Species Status Assessment (USFWS 2018) a salt marsh bird conservation plan (ACJV 2019) and a targeted black rail management plan (ACJV 2020).

On November 9, 2020, the eastern black rail was formally listed as *Threatened* under the Endangered Species Act (85 FR 63764 63803) by the US Department of Interior following through on the recommendation of the US Fish and Wildlife Service published on October 9, 2018 (83 FR 50610 50630). In addition to the federal status, eastern black rails are listed as *Endangered* within six eastern states (CT, NY, NJ, DE, MD, VA) and a Species of Greatest Conservation Need in ten eastern states (CT, NY, NJ, DE, MD, VA, NC, SC, GA and FL). Formal designations on both the federal and state levels have already had an impact on engagement and focus by the management community. Efforts are now emerging that will hopefully reverse the decline and restore the species to its historic range (https://ecos.fws.gov/docs/recovery_plan/20210318_EBLRA_Recovery%20Outline_signed%20(1).pdf).

OBJECTIVES

The eastern black rail working group has developed recovery goals focused on two time horizons, including 1) stabilize the population above 300 pairs over the next decade and 2) grow the population to 2,500 pairs over the next five decades. Toward these goals, the overriding objective of this document is to focus where and how we conduct management actions within Atlantic Coast states. Specific objectives include:

1) Develop an approach to prioritizing landscapes for management action.
2) Develop a list of priority landscapes.
3) Develop a strategy for staging management activities.
4) Clarify management endpoints for eastern black rails.
5) Compile a set of habitat management techniques for eastern black rails.
6) Provide a general overview of priority landscapes.

The ongoing pace of eastern black rail decline dictates that we must take action now to retain the species within historical landscapes. However, management strategies have not been robustly tested for eastern black rails, leaving the community with uncertain outcomes for the entire range of possible actions. Adaptive management is necessary to "learn as we go" and update/modify management techniques as new information allows. Although not addressed within this document, an adaptive management program is in place to 1) maximize what we learn from management efforts (https://acjv.org/black-rail-adaptive-management-project/) and 2) use what we learn to constantly improve techniques and associated outcomes.

MANAGEMENT

One of the objectives of habitat management for wildlife species is to improve the compatibility of habitats for species in order to drive population change. The process includes the identification of habitat requirements or management endpoints, an assessment of current conditions relative to endpoints, the development of an action plan to alter the habitat toward desired endpoints, the execution of the action plan and monitoring of a metric of success to inform ongoing management. Throughout this process it is important to note the anticipated costs and benefits of decisions made and recognize there are inherent limits to a species response to management activities.

BLACK RAIL HABITAT

Black rails have never been abundant and widespread throughout North America (Eddleman et al. 1994, Watts 2016). Most researchers believe that their patchy distribution and rare status is due to their dependence on a narrowly defined niche and the restricted distribution of this niche throughout the landscape. Although habitat requirements for this species are not fully understood, two habitat dimensions stand out as requirements, including water depth (e.g., Flores and Eddleman 1995, Legare and Eddleman 2001, Richmond et al. 2010) and dense screening vegetation (e.g., Flores and Eddleman 1995, Spautz and Nur 2002). In addition to these physical requirements, two landscape features or processes, including topographic diversity and periodic disturbance, can serve as ecological modifiers to maintain habitat attributes within the required range. Although the literature has been reviewed with regard to habitat requirements, information on eastern black rails remains very limited.

Because of our limited information, it remains possible that other, less-understood habitat features such as the availability of fresh/brackish water and its influence on prey availability may play important roles in black rail ecology and distribution.

REQUIREMENTS

Habitat requirements are those characteristics or attributes that a species must have to occupy an area. For black rails habitat requirements are known to include specific water conditions, dense concealing vegetation and a close juxtaposition between dry and wet areas.

Water Conditions

Black rails have very specific water requirements and water is the dominant habitat feature that dictates distribution (Eddleman et al. 1994, Richmond et al. 2010, Watts 2016). When compared to other North American rails, eastern black rails occupy the drier end of the water gradient (moist soil to 3 cm depth), avoiding areas with deep water during the breeding season. Avoidance of areas with deep water by black rails may reflect the small stature of the species and the difficulty of broods to move through deeper water. California black rails (L. j. coturniculus) used areas with an average depth of 2.2 cm, which corresponds to an average tarsus length of 2.5 cm (Flores and Eddleman 1995).

Black rails require a specific water depth and select nesting sites in areas that have both shallow water and very low variation in water depth during the breeding season (Legare and Eddleman 2001, Tsao et al. 2009). Pairs within a seepage wetland in Arizona built nests in areas with an annual variation in depth of only 7 cm (Flores and Eddleman 1995). The most consistently used areas throughout the range also appear to deliver the most consistent water depth. Many of the inland records of nesting black rails occur for a single year and authors describe an "unusual water event" during the year of occupancy (e.g., Stevenson and Stupka 1948, Nevius 1964). These episodic events suggest that conditions rarely meet requirements within these landscapes. However, black rails appear to be opportunistic breeders that take advantage of appropriate conditions when they exist (Hand et al. 2021). Within a given location or region, it appears that black rails adjust their nesting phenology to the appropriate window within the hydroperiod. Conditions within some areas seem to promote early breeding while conditions within other areas appear to favor later breeding. Within some landscapes, water conditions may be less predictable and birds may nest opportunistically within a range of dates.

Black rails have been associated with habitats where water slowly flows through the site rather than pooling within the site (Evans et al. 1991, Richmond et al. 2010, Hines et al. 2021). Such flow-through sites have open topographic contours as compared to ponds or bowls that have closed contours. Closed contour features on the landscape tend to accumulate and hold water. Tidal marshes, seep wetlands, slope wetlands, floodplain wetlands and the Everglades are examples of open contour wetlands. The significance of moving water to black rails is not fully understood. It may be that black rails do not prefer stagnant water or that flowing water may support preferred prey populations. It may also be that water depth is more consistently maintained within flow-through sites supported by perennial water sources as compared to closed contour sites. Closed contour sites tend to be more susceptible to flooding during rain events because they accumulate water and so experience greater variation in water depth. If depth requirements are more easily met in landscapes with flowing water compared to standing water, then flow may be an artifact of meeting depth requirements rather than a requirement itself.

Fresh Water

The availability of fresh water (or in some settings brackish water) may be more critical to black rail occupancy during the breeding season than has been widely acknowledged. The need for wet features within breeding territories likely reflects requirements for foraging. During the breeding season, black rails feed primarily on invertebrates (Eddleman and Lagare 1994). From the few diet samples available, prey appears to be dominated by aquatic insects (Weske 1969, Flores and Eddleman 1991, Hall et al. 2020). Presumably insect availability is enhanced by persistent water features. Descriptions of breeding territories, including those in tidal salt marshes and barrier islands, often refer to scattered small ponds (e.g., Harlow 1913, Bailey 1927). Tidal salt marshes receive fresh water from both rain and from ground water discharge from adjacent uplands (Brinson et al. 1995). Mosquito control programs that targeted fresh-water areas on the surface (considered mosquito breeding grounds) through ditching or other techniques impacted available fresh/brackish water and may have impacted prey populations and undermined the viability of black rail territories on a large spatial scale. Sea-level rise has been shown to reduce groundwater exchange with the wetland (Masterson and Garabedian 2007, Fagherazzi et al. 2019). For marshes adjacent to agricultural fields, groundwater withdrawal may also reduce freshwater recharge within tidal marshes (Masterson 2004). Disruption in fresh water may therefore have contributed to the decline of black rails within tidal marshes on a level equal to or greater than the flooding that resulted from tides and rain events.

Vegetation

Dense, herbaceous vegetation is a universal habitat characteristic during all seasons and throughout the entire range of black rails (e.g., Flores and Eddleman 1995, Spautz and Nur. 2002, Richmond et al. 2010, Haverland et al. 2021). Birds are rarely observed away from dense vegetation and when they are it is only for brief periods. Vegetation structure rather than specific species appears to be the key habitat feature. For example, numerous nests have been described in hay fields or row crops within agricultural settings (Brimley and Brimley 1900, Wayne 1905, Walker 1935). The dominant marsh plants that provide dense stands of concealing vegetation vary across the range but are typically narrow-leafed grasses or plants with similar densities. Among others, salt meadow hay (*Spartina patens*), gulf cordgrass (*S. spartinae*), bunch cordgrass (*S. bakeri*), little bluestem (*Schizachyrium scoparium*), marsh fimbry (*Fimbristylis castanea*), needlerush (*Juncus roemerianus*) and sawgrass (*Cladium jamaicensis*) provide the dominant concealing vegetation within black rail territories throughout different parts of their range. Coverage of screening vegetation within occupied sites is typically >70% and mean vegetation height ranges from 0.5 m to more than 1.5 m (Flores and Eddleman 1995, Richmond et al. 2010, Hines et al., unpublished).

Black rails do not appear to prefer areas with dense stands of woody vegetation (Stevens et al. 2022). Because black rails occupy the drier portions of wetlands, encroachment by woody vegetation is an ongoing successional process within most sites (some exceptions do occur where woody encroachment is restricted by a variety of constraints). Woody vegetation represented 10% of occupied home ranges within coastal Texas (Haverland et al. 2021). Woody cover in sites occupied by California black rails averaged less than 4% (Flores and Eddleman 1995). Occupancy within south Florida declined as the number of trees/ha increased (Hines et al., unpublished). Woody encroachment is likely the cause of black rail abandonment within a wetland mitigation site in Virginia (Watts 2016) as well as a driver of site abandonment throughout the range.

Wetland Upland

Black rails have dual requirements including 1) shallow water (wetlands) that are consistently available and 2) dry areas (uplands) that are consistently available (Flores and Eddleman 1995). These two habitat features stand out as requirements throughout their breeding range and appear to be fundamental to occupancy (Neice and McRae 2021). Wet and dry features are typically juxtaposed within home ranges allowing birds to readily move between them. Black rails will only use the upland- wetland complex if both habitats support dense concealing vegetation.

The need for high, dry features within breeding territories appears to reflect rail requirements for nesting and brood rearing. Rather than constructing platforms, black rails tend to build nests near the substrate surface. In one Florida study, mean height of nests (N = 17) above the substrate was 6 cm (Legare and Eddleman 2001). Nests are frequently constructed within the uplands surrounding wetland patches or on topographic highs within wetlands (e.g., Brimley and Brimley 1900, Wayne 1905, Legare and Eddleman 2001). High elevations within territories provide rails with places to move to during flooding events. The selection of higher elevations in the post-nesting period also suggests that pairs may move broods to higher ground (Flores and Eddleman 1995).

ECOLOGICAL MODIFIERS

In addition to habitat requirements there are landscape characteristics that serve to constrain the range of conditions within a desired range and facilitate occupancy within a wider range of landscape settings. For example, slope may facilitate a desired water depth across a wide range of hydrologic regimes whereas maintaining a target depth would only be possible for a narrow hydrologic range without slope. For black rails, these landscape characteristics or "ecological modifiers" include topographic diversity and some type of disturbance regime that constrains succession.

Topographic Diversity

Flat or level areas on the landscape are subject to wide fluctuations in water depth as the volume of water supply changes. In order to maintain a specific water depth on flat ground, the water source must be finely calibrated. This calibration and maintenance of water depth is therefore particularly difficult in areas with periodic rains. It is possible to maintain water depth where the water source is highly consistent, however such situations appear to be rare across the landscape. A potential solution to this problem is the incorporation of topographic diversity to modulate or buffer water depth across fluctuations in water sources. Having a diversity of high and low areas on the landscape serves to resist complete dry out since pockets of water will persist longer under dry conditions. Topographic diversity may also provide both high ground (flood refugia) and a range of water depths during flood events which are important during nesting, brooding and flightless molt for black rails (Flores and Eddleman 1995, Legare and Eddleman 2001, Hand et al. 2021).

For sites occupied by black rails, the form and grain of topographic diversity seems to vary site to site and may reflect the underlying fluctuation in the water source. Traditional tidal marshes have an elevation gradient extending from the low marsh to uplands that provide topographic relief from flooding. The mean elevation gradient in black rail home ranges within the salty prairie of coastal Texas was 2.5%, with a mean elevation of 83 cm (Haverland et al. 2021). The mean slope of occupied wetlands within the Sierra Nevada foothills was 3.6% (Richmond et al. 2008). In Florida, black rails were observed to construct nests on high spots within marshes, often surrounded by standing water (Legare and Eddleman 2001). An index of "topographic roughness" was associated with black rail occupancy in south Florida (Hines et al., unpublished). Topographic diversity within south Florida was achieved in several different ways from gentle slope wetlands to more complex topographies including elevation gradients within drainage basins, roadside ditches and areas with mounding that resemble ski moguls (Watts, personal observation) or much larger topographic highs referred to as "hummocks".

Black rail occupancy may require that the range of elevations available matches or exceeds the range of normal water fluctuations. One way to successfully avoid nest flooding is to place nest height above the normal high-water mark. In areas that receive episodic rains or high tides, black rails may only be able to occupy sites that contain areas with elevations that exceed these water events. It is possible that the abandonment of sites or broad-scale declines reflect changes in fluctuations in water sources that have become mismatched to the topographic diversity on the landscape.

Vegetation Disturbance

Black rails appear to have a limit to the level of woody vegetative cover they will tolerate within their habitat. Occupied sites are sometimes abandoned when woody plants become the dominant cover type (Watts 2016). Within most upland areas, ecological succession will result in woody encroachment and woody plants will eventually form a closed canopy that covers the site. In order to maintain occupancy by black rails, succession may need to be periodically set back to prevent woody dominance. Disturbance events include natural forces like fire, flooding, and/or grazing and management techniques such as chemical or mechanical applications. The minimum period between disturbance events required to maintain occupancy may depend on the characteristics of the site and the disturbance used, but in most situations ranges between five and fifteen years (e.g., Miller et al. 1995, Foster and Gross 1995, Wright and Fridley 2010, Abella et al. 2020). Suggested disturbance interval to maintain black rails in Kansas is 2 years (Kane 2011).

MANAGEMENT ENDPOINTS

Based on historical occupancy of black rails and the associated habitat conditions at these sites, there is an emerging set of conditions that can be considered as management end points. These habitat conditions (Table 1) represent end-goal targets for management activities based on our current understanding of black rail needs. This list is subject to expansion and adjustment as our understanding of black rail habitat use and needs improves over time.

Management activities should be designed to deliver 1) shallow water conditions that cover a significant area consistently throughout the breeding season, 2) fresh or brackish water to support prey populations, 3) herbaceous vegetation that covers the majority of the habitat patch while minimizing coverage of woody vegetation and 4) topographic highs that exceed the high water mark within wetlands and/or provide herbaceous vegetation with minimal woody coverage within an adjacent upland buffer. Ideally, management will deliver all of these conditions in order to improve the probability of black rails using the habitat.

Table 1. List of habitat requirements and target conditions for eastern black rails as currently understood. Target conditions are intended to serve as a guide for management planning and may not all be achievable within a particular site.

Requirement	Target Conditions
Water Conditions	
Shallow Water	Moist soil to 3 cm depth
	Cover 50% of patch area, >0.5 ha/territory
Vegetation	
Herbaceous Cover	0.5 to 1.5 m tall
	Cover >70% of patch area
Woody Cover	<20% coverage
Wetland-Upland	
Within Wetland	>5 topographic highs greater than normal high water
Adjacent Upland	Establish 50-100m buffer of dense herbaceous cover
	<20% coverage of woody vegetation
Forest Isolation	Maintain >100-m distance from forest edge

MANAGEMENT STRATEGIES

The decline of the eastern black rail has not been uniform throughout the historic range (Watts 2016). Within some landscapes populations have disappeared entirely, while others have declined, and others appear to be stable. Landscapes also differ in terms of their potential to both recover populations and to sustain recovery. Black rails may have limited dispersal capabilities such that proximity to an extant breeding population likely has an influence on the probability of colonization (Hall et al. 2017, 2018). It is important to consider all factors that influence recruitment and persistence of black rail populations to maximize the likelihood of success of management strategies and invested resources.

TIDAL VS NONTIDAL

Eastern black rails have historically occurred and continue to occur within both tidal and non-tidal wetlands (Eddleman and Legare 1994, Watts 2016). However, the pattern and history of occurrence within these two habitats has been different and the differences are relevant to management decisions. More than 90% of all historic eastern black rail records have come from tidal marshes, and the sites with the most consistent occupation have been within tidal marshes (Watts 2016). However, accelerating sea-level rise coupled with the lack of proven techniques to counter habitat impacts make tidal marshes less attractive as a long-term management option. Although targeted management activities should focus on both tidal and non-tidal wetlands, the reality of sea-level rise has inspired a shift in management priority toward non-tidal habitats where it is possible to more reliably control outcomes (ACJV 2020, McGowan et al. 2020).

Tidal

Tidal populations of black rails along the Atlantic Coast have declined precipitously from historical numbers (Watts 2016, Watts et al. 2021). Because tidal habitats have historically supported the majority of breeding pairs, the declines within these habitats are likely responsible for the collapse in the broader population. One possible explanation is that an increase in the frequency of flooding related to ongoing sea-level rise has driven a transition of previously source populations and habitat into demographic sinks. There is some evidence suggesting that flooding frequency is excluding black rails from traditional sites. Black rails within several well-documented historical sites have moved up slope toward the upland edge and vacated lower areas of the marshes (Kerlinger and Sutton 1989, Watts et al. 2021). One of the most continuously occupied and demographically stable breeding sites has been in continuous use for decades and is located within a series of tidal impoundments where water control structures constrain tidal amplitude (Roach and Barrett 2015, Hand et al. 2021). Other, more intensely studied tidal marsh species (e.g. saltmarsh sparrow) are predicted to collapse due to flooding risk alone (e.g., Field et al. 2017). It is also possible that sea-level rise is fundamentally changing the capacity of the wetland to support black rails in other ways beyond flooding events, for example, changes in the amount of dense herbaceous vegetation, changes in prey availability, etc. that could affect survival of adults or brood chicks.

It is important to preserve residual populations of black rails within tidal settings in order to preserve genetic diversity. Ideally, conservation efforts for these populations should follow a two-pronged approach including 1) mitigating sea-level rise impacts *in situ* and 2) creating non-tidal habitat in close proximity (<10km) to occupied sites in order to maximize the likelihood of colonization (Hall et al. 2017, 2018). The goal of *in situ* mitigation is to push pairs back toward demographic sustainability within the marsh by reducing the impact of tidal flooding. Reducing the impact of flooding requires 1) restoration of the natural hydrology within the marsh and 2) the creation of topographic refugia or the reduction in the reach of the tide. The hydrology within many marshes throughout the range of black rails has been severely altered (USFWS 2018). Management strategies designed to restore hydrology (e.g. ditch remediation, runnel creation) should be used in sites where appropriate (ACJV 2019, 2020).
Topographic refugia can be provided by 1) creating topographic highs within the marsh or 2) facilitating marsh migration and managing adjacent uplands where topography allows. In order to counter increased flooding, management must outpace ongoing sea-level rise.

Non-Tidal

Black rails have been documented within non-tidal wetlands across a wide range of topographic settings, including wet meadows, riparian hay fields, slope wetlands formed from leaky impoundments, outfalls from farm ponds, fringe wetlands around ponds and reservoirs, flooded crops and pastures and the everglades ecosystem (Watts 2016). Most inland records were documented in the late 19th and early 20th century following extensive deforestation after the Civil War (Ramankutty and Foley 1999). Since the 1950s, inland records of black rails within eastern North America have declined dramatically (Watts 2016). Secondary succession along with the intensification of farming practices (including the draining of lands) likely reduced the availability and quality of non-tidal sites that are suitable for black rails. However, there is no indication that non-tidal habitats have accounted for a significant portion of the overall eastern black rail population during any period of time.

Non-tidal black rail sites are notoriously ephemeral. The length of occupation for the majority (>90%) of sites is a single year with nearly all sites being occupied for less than three years (Watts 2016). The episodic pattern of occupancy could be due to the lack of consistency in water supply and/or encroachment by woody vegetation with ongoing succession. Descriptions of site occupation during "unusual water events" by some authors suggest that occupation of many non-tidal sites represent rare points in time when conditions happen to come together and that conditions are not consistently suitable for rails. This pattern also suggests that although the landscape is capable of supporting black rails, normal conditions and the landscape are not matched routinely to allow for it.

Given ongoing sea-level rise one strategy for reversing the broader population decline is to increase the number of suitable non-tidal sites and to improve the consistency of conditions that allow for occupation. Improving consistency will require 1) establishing topographic refugia by creating topographic highs within wetlands and managing the surrounding upland buffer, 2) delivering water conditions within the required range and 3) managing woody vegetation.

POPULATION MANAGEMENT STAGES

Due to the severe decline of eastern black rail populations and the contraction of their distribution, recovery will require targeted efforts that include local enhancement of existing populations and restoration of populations throughout the historic range. The approach to staging management described in this document conforms to a sequence of actions applied with other declining species (Wilcove 2010) including 1) rescue and stabilization, 2) enhancement and expansion and 3) restoration. The relevance of these stages differs according to whether the population is extant (rescue, stabilize, enhance, expand) or has been extirpated (restore). For extant populations, the situation and prospects for recovery within each landscape will dictate what steps will apply. Efforts should first be focused on the rescue and stabilization of existing populations to mitigate the current, severe population decline. Stabilization may be followed by efforts to enhance local populations within non-tidal habitats. Restoration (including re-establishment of populations via translocation and release) efforts should follow after extant populations have been stabilized and are robust enough to be source populations and considered for donor populations for translocation efforts.

Rescue and Stabilize

For populations that are currently on the verge of being lost (all populations north of South Carolina and some in Florida) there is an urgent need to either rescue or stabilize them for additional action. "Rescue" refers to actions intended to protect birds from being lost in the short term. These actions are designed to maintain population size until they can be supported within higher-quality sites for the long term. Black rails currently occupying tidal wetlands are a good example of this scenario. Management for these birds should create 1) topographic refugia within marshes and 2) new non-tidal habitat in the immediate vicinity. "Stabilize" refers to actions intended to stabilize birds within their existing habitat with the intent to grow and expand the population in place. Birds within non-tidal habitats represent examples of this scenario.

Enhance and Expand

For black rail populations that occupy stable habitat patches but are currently diminished compared to historic levels or have the potential to increase, there is a need for enhancement or expansion. "Enhance" refers to actions intended to stabilize and grow the population in the current footprint. Birds currently in non-tidal settings where management actions may improve conditions and facilitate the creation of new occupied territories or improved reproduction are examples of this scenario. "Expand" refers to actions intended to create new or restore historic habitat within the surrounding landscape that may be colonized by black rails and increase the extent of the current population. Occupied habitat patches that are embedded within landscapes that have potential habitat patches that could be improved to encourage black rail occupancy fit into this category..

Restore

The range of eastern black rails has contracted from their historic extent. Because black rails have limited dispersal capacity, restoration of the population to portions of the historic range will likely require a two-step process including 1) creation or restoration of suitable, non-tidal habitat, and 2) translocation and establishment of new populations. Translocation of birds would require existing metapopulations that can withstand the emigration of a number of individuals without negatively affecting the source metapopulation. While further scientific work is required to understand the emigration thresholds, enhancing and expanding current populations is a step toward establishing and developing donor populations. Considerable amount of basic ecological work (e.g., seasonality of translocation, development of release techniques, demography of donor populations) will have to be concluded before we will be able to consider restoration efforts.

PRIORITIZING WHERE TO WORK

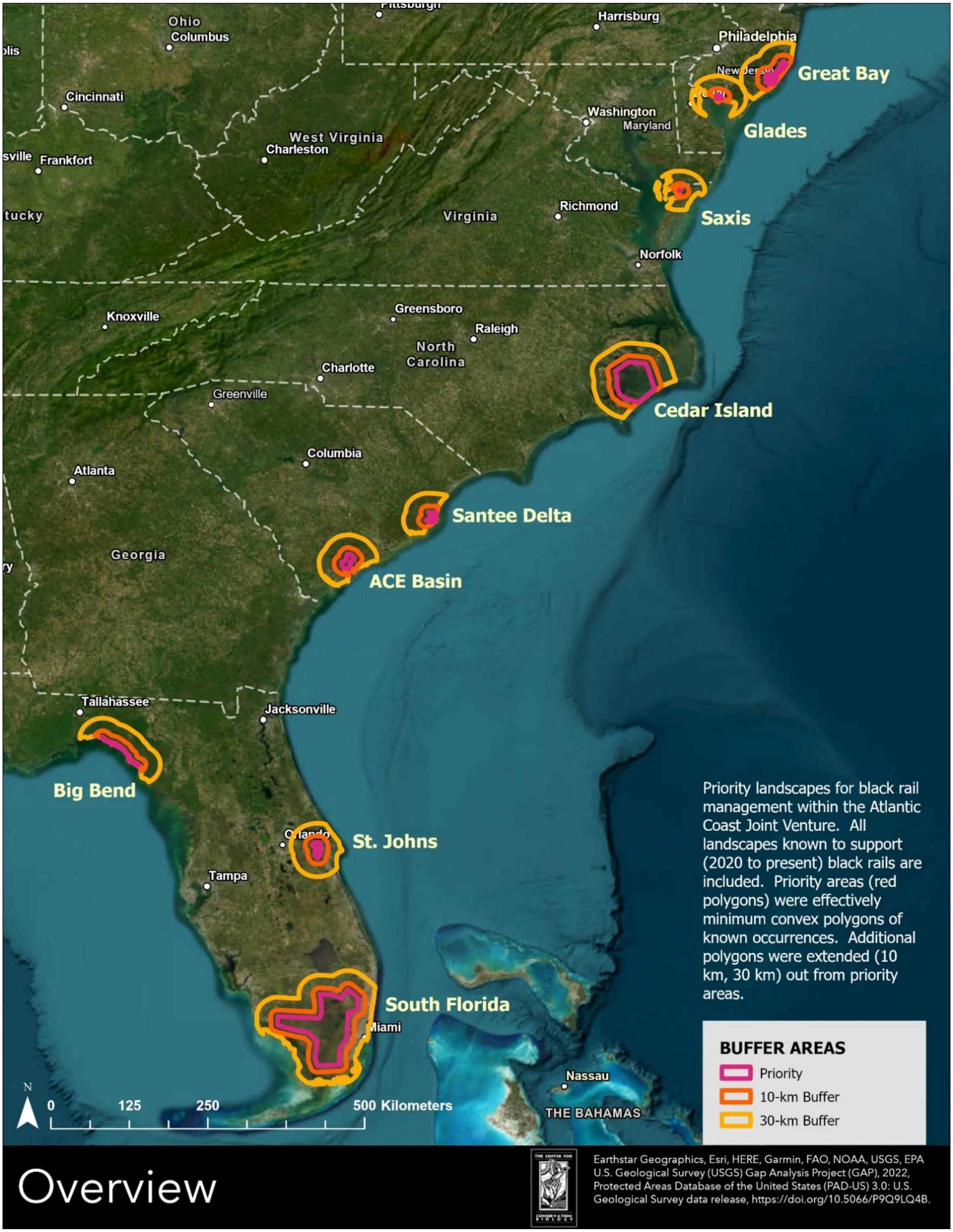
The decline of the eastern black rail population, the urgent need to reverse the decline, the distribution of extant populations, differences between habitats and localities in our ability to execute successful management all suggest that we need to develop an approach for prioritizing where we should allocate resources. The strategy for prioritizing landscapes outlined here is to 1) work within landscapes that currently support birds and 2) work in landscapes that have the highest probability of being colonized by dispersers from current populations. In order to prevent further decline, we should consider prioritizing work designed to stabilize existing populations. This requires that we prioritize landscapes that continue to support black rail populations. Black rails appear to have limited dispersal capabilities (Hall et al. 2017, 2018). When we consider creating new habitats, we should prioritize landscapes where birds have the highest likelihood of finding and colonizing them. Proximity is particularly critical when attempting to recruit birds originating from tidal marshes to non-tidal habitats.

Although our understanding of dispersal in eastern black rails is limited, information from California black rails suggest that mean dispersal distance inferred from incidence functions and from parent-offspring dyads varied between 5 and 8 km (Risk et al. 2011, Hall et al. 2018). These studies also found that wetland connectivity is an important indicator of colonization, suggesting that a single population can occupy a cluster of wetland patches, and wetlands may also serve as "stepping stones" to other wetlands. Although the distribution of dispersal distances was skewed to short (<5 km) values, black rails were found to make longer (30 km) dispersal movements within metapopulations and even longer (100 km) movements between metapopulations, however these longer movements were rare.

This report stratifies the historic range of eastern black rails along the Atlantic Coast into two types of areas including 1) high-priority landscapes and 2) lower-priority landscapes. High-priority landscapes are all areas currently known to support black rails (known occupancy since 2020, personal communication with state, federal and NGO biologists). Clusters of black rail occurrences were used to loosely delineate occupied landscapes. Occurrence clusters that were separated by >30 km were considered independent landscapes based on information on normal dispersal distances (Hall et al. 2018). Management within all high-priority landscapes is urgently needed. Lower priority landscapes include all areas beyond 30 kmfrom currently occupied sites. High-priority landscapes are further stratified according to proximity to areas with current occupation. Occupied areas are considered the highest priority followed by areas with the highest likelihood of receiving dispersers (<10 km from occupied areas) and finally areas with a lower likelihood of receiving dispersers (10-30 km from occupied areas). Priority landscape polygons were delineated based on known occurrences and surrounding areas of like habitat. Buffer areas including <10 km and <30 km were extended out from the priority polygons to delineate management areas with different likelihoods of colonization from occupied sites.

Nine high priority landscapes have been delineated along the Atlantic Coast (see below). These sites represent known areas of current occupation by black rails. Priority landscapes as delineated here differ slightly from those found in the Black Rail Potential Habitat Tool that has been developed in recent years based on occupancy probabilities derived from older survey data (https://acjv.org/). Although the two mapping exercises are in close agreement in terms of geographic focal areas, the priority landscapes used here are more targeted to recent occurrences.

While the landscape prioritization provided here uses dispersal distances and related colonization probabilities to inform the results, opportunistic management investments are also important to pursue; land ownership, available management resources and political climate will likely play a role in identifying these types of management opportunities. Managers within each geographic area will need to decide which mix of metrics should be used to prioritize actions in order to return the highest conservation benefit.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Norfolk
Knoxville
Greensboro
Raleigh
North Carolina
Charlotte
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Cedar Island
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Tallahassee
Jacksonville
Big Bend
St. Johns
Tampa
South Florida
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THE BAHAMAS
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0
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250
500 Kilometers
Priority landscapes for black rail management within the Atlantic Coast Joint Venture. All landscapes known to support (2020 to present) black rails are included. Priority areas (red polygons) were effectively minimum convex polygons of known occurrences. Additional polygons were extended (10 km, 30 km) out from priority areas.
BUFFER AREAS
Priority
10-km Buffer
30-km Buffer
Overview
Earthstar Geographics, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA
U.S. Geological Survey (USGS) Gap Analysis Project (GAP), 2022, Protected Areas Database of the United States (PAD-US) 3.0: U.S. Geological Survey data release, https://doi.org/10.5066/P9Q9LQ4B.

HABITAT MANAGEMENT

WATER MANAGEMENT

Water is both one of the most critical habitat elements for black rails and one of the most difficult elements to get right. Variation in water levels and persistence is likely the primary reason why black rails are so patchily distributed and within some landscapes why occupancy is so ephemeral. We suggest delivering water to provide moist soil to 3 cm depth and to deliver this depth within a portion of the patch consistently through the breeding season. Delivering water within this narrow range may require supplementing water during dry periods and actively controlling water during wet periods. Options for delivering consistent conditions are constrained to a relatively narrow range of parameter combinations based on the multiple considerations of water source, water delivery systems, flood control, topography, etc. Management projects should be adapted to fit local settings rather than trying to achieve an outcome in a setting where it is unlikely to succeed in the short or long term. For example, working within exceptionally dry or wet landscapes may require inappropriately large management investments in order to maintain desired water depths.

Design Considerations

One of the keys to designing a management or mitigation solution capable of consistently delivering the target water depth is understanding the local conditions. Two dimensions of particular interest are water regime and soil. It is important to understand the availability of water (risk of drying out) and peak water events (risk of flooding) during the breeding season. Habitats within landscapes with low water regimes may require water addition (see below) in order to maintain wet areas. Habitats within landscapes that regularly experience large rain events may require drainage systems designed to prevent extensive flooding. Soils play an important role in water retention. For example, clay soils hold more water than loam soils such that landscapes that receive the same water regime but have different soils may have different water retention and drainage patterns.

Water and Slope

Slope has a large influence on the behavior of water on the landscape. Water depth is more easily controlled as slope increases because the water runs down as sheet flow and is less likely to pond and flood. Low-slope surfaces flood more easily because water drains more slowly, and as the input rate exceeds the drainage rate water will pond. However, as slope increases it becomes more difficult to maintain adequate water as the water spreads out and dries more easily. Maintaining moist soil or shallow water on steep slopes requires a higher water volume. Slopes that fall within the range of 1 to 5% (consistent with slopes measured within wetlands occupied by black rails; Richmond et al. 2008, Haverland et al. 2021) represent a useful compromise between flooding, drying and the required water volume in most landscapes.

Depth Control

One of the more challenging management problems in maintaining desired water depth is to control flooding events. Within tidal systems, flooding occurs during extreme tidal and precipitation events. Along many areas of the Atlantic Coast such events are becoming more frequent and of longer duration. Within non-tidal systems, extreme flooding occurs during extreme rain events. These two types of flooding events require different management and mitigation options.

Tidal Systems – Extreme tidal events linked to the lunar cycle or high winds flood natural tidal marshes from the low marsh to the high marsh-upland ecotone and increasingly into the adjacent uplands. Within tidal impoundments rice truck gates, flashboard risers or other devices may be utilized to constrain tidal amplitude and moderate tidal flooding. Within natural open marshes strategies to reduce tidal flooding include raising the elevation of the marsh using strategies that 1) increase accretion rates and/or add sediments via thin-layer deposition of mineral dredge materials, 2) creation of topographic diversity such as adding hummocks or facilitating upslope marsh migration and 3) restore or improve hydrology using techniques such as ditch remediation or runnel creation (see ACJV 2020 and Hartley and Weldon 2020 for broader discussion of saltmarsh management strategies).

Non-tidal Systems – Most non-tidal impoundments and many non-tidal wetlands are subject to flooding during extreme rain events. Flooding is caused by inadequate drainage; water from the rain ponds and inundates the surface. For closed contour wetlands or impoundments, rain events may inundate the entire surface. The only management option for reducing flooding during extreme rain is to increase drainage to move excess water off the site. Removing excess water and preventing ponding is easier on sloped surfaces; flat surfaces such as traditional impoundments are susceptible to ponding and surfaces must be re-contoured in order to improve drainage. Mitigation options include increasing topographic diversity within the marsh or managing adjacent uplands (see below) to provide topographic refugia.

Water Addition

Black rails appear to require a perennial water source (Flores and Eddleman 1995, Spautz and Nur 2002, Richmond et al. 2010). The lack of occupancy for many wetland patches is likely due to sites drying out for all or a portion of the breeding season. One management option to improve occupancy is to supplement water to bridge the habitat over dry periods. In order to be successful, the water source and delivery system must be scaled to the need. Water supplementation has been successfully used to support California black rails within the Sierra Nevada foothills, using water from an irrigation canal run through an elevated PVC pipe (Richmond et al. 2010). Holes were drilled along the length of the PVC so that water was delivered over a broad area and allowed to create a shallow sheet flow. The system was gravity fed from a large irrigation canal and was able to deliver 50-100 gal/min.

Coverage Area – Estimated home range for eastern black rails range from 0.5 to 3.1 ha with a mean of 1 to 1.3 ha in Texas and Florida (Legare and Eddleman 2001, Haverland et al. 2021). This value is generally larger than that reported for California black rails (Flores and Eddleman 1995, Tsao et al. 2009). Available estimates of coverage of moist soil to shallow water include 54% from California (Richmond et al. 2010) and 54% from Florida (Hines et al., unpublished). Taken together, these values suggest that a pair of black rails may require 0.5 to 0.7 ha of wet area within their home range. This corresponds well to the estimated home range core area of 0.4 ha from Texas (Haverland et al. 2021). As a general estimate, eastern black rails appear to require approximately ¾ ha of wet area within their home range and this may represent the core foraging area during the breeding season.

Water Source - An adequate water source may be one of the greatest constraints on water manipulation throughout much of the range. Rainwater alone may not be adequate to prevent draw down and drying in most areas (site-specific rainfall, soils and slope should be examined in the planning process). Typically, a perennial water source is necessary. Water sources such as ponds, impoundments, canals, rivers and ground water (well) must be large enough to supply enough stable water to support the wetland. Soil type, climate, slope, target area and other factors will determine the size of the source required. A simple flow model may provide an example for reference. If we consider a low-slope site with an outflow of 1 meter/hour (everglades flow rate), we can supply a 1-ha wetland to a depth of 0.68 cm (within the target range) with a 3 gal/min pump. Water usage required for this system would be 4,300 gal/day. The amount of water required is influenced by slope, surface condition, soil type and climate. Water demand increases with increasing slope, soil permeability and evaporation rate. Increases in surface roughness will increase water retention on the surface and reduce the water required. For farm ponds, lakes and reservoirs the outfall is balanced with the inflow and provides a good estimate of average availability from the source. For situations with low availability, recycling water by pumping water up grade and allowing water to pass through the wetland and drain back to the source may help to reduce the total draw.

Delivery Systems – Supplemental water may be delivered to wetlands by either directing gravity-fed water or by pumping water to the site. Gravity-fed systems are typically the simplest and least expensive alternative but are only options within specific landscapes.

<u>Gravity-fed -</u> A gravity-fed system requires a source of water that is elevated above the target wetland. This water can be diverted or channeled to the target wetland either by running a hose or pipe or by directing outflow. With adequate water pressure, water may be run through a spreader such as an irrigation device in order to produce a wider flow and cover more area. Using the outflow from a source such as farm pond, reservoir or canal to supplement a down slope wetland is an example of this application. Ground water may also be used as a source of water within a

gravity-fed system by using a ground-water dam or other approach to bring the water to the surface and create a seepage wetland.

Pumping water – Mechanical pumps are typically required to deliver water to target wetlands when the water source is either below or nearly level with the wetland. This is often the case for many sites in the outer Coastal Plain where topographic relief is limited. Water is pumped upslope and run through a spreader to divide the outflow in order to cover the target area. Spreader devices include lengths of perforated hose, a perforated pipe (as used in Sierra foothills example) or aerial sprayer (sprinkler). Several factors should be considered when designing the appropriate pumping system including budget, distance between the water source and wetland, water flow rate required, longevity and maintenance costs.

FRESH WATER MANAGEMENT

Tidal salt marshes have supported a large portion of the eastern black rail population. The loss of black rails within tidal settings has been largely responsible for the broader decline. Although tidal salt marshes receive both freshwater and saltwater inputs, there is some indication that the availability of fresh water on the surface has declined with increasing sea-levels (Masterson 2004). Legare (pers. comm.) has indicated that one of the key determinants of black rail distribution in St. Johns National Wildlife Refuge is the availability of permanent fresh-water ponds. It may be possible to replicate these ponds within high marsh areas of tidal salt marshes to supplement the availability of fresher sources of water.

VEGETATION MANAGEMENT

Beyond water, vegetation structure is the most important habitat dimension that must be managed to support black rails. Black rails require dense herbaceous vegetation during all life stages and will only tolerate moderate coverage of woody vegetation. The management objective is to deliver dense herbaceous vegetation with high (>70%) coverage and to minimize coverage (<20%) of woody cover. Plant species and their response to management varies throughout the range of eastern black rails such that it is important for managers to have a working understanding of the plant species they are attempting to manage.

Woody Vegetation/Disturbance

Disturbance is a critical ecosystem process that creates spatial heterogeneity in vegetation types, modulates successional processes and controls transitions between alternate ecosystem states. The question is not just whether or not disturbance to woody vegetation is beneficial or detrimental to black rails, but rather what intensity, duration and timing of disturbance minimizes impacts or maximizes benefits.

Because black rails occupy the driest portions of the marsh and because one strategy to avoid flooding is to provide topographic refugia, within most landscapes (although exceptions do occur within some regions) woody vegetation will colonize marshes through succession and will form a nearly continuous canopy if disturbances do not occur regularly. Management of woody vegetation will therefore require periodic disturbance to set back succession. There are several options for managing woody vegetation including fire, chemical, mechanical, grazing and flooding.

The breeding season in eastern black rails generally coincides with the growing season of plants which spans from April through late August. Breeding stages of concern include courtship, incubation, brood rearing and flightless prebasic molt of adults. Throughout the northern portion of the breeding range, birds begin to arrive and call in mid-April, with egg-laying beginning in May and reaching a peak during the third week of June (Watts 2021). Although we currently lack definitive information, breeding in southern Florida may be earlier compared to other regions and may coincide with the end of the dry period (eggs have been recorded during April in southern Florida). Observations of adults with young reach a peak in late June and early July, but span from early May (southern portion of the range) through late August (Hand et al. 2021, Watts 2021). Most late-season nesting attempts likely represent second attempts, though Hand et al. (2021) and Hand (2020) present evidence of double-brooding in South Carolina. Based on photographic evidence, Hand et al. (2021) estimated that the brood rearing period extends from 19 May through 29 September. Also in South Carolina, adult molt of remiges and rectrices was initiated between 15 August and 20 September, with estimated completion dates ranging from 5 September through 11 October, requiring approximately 21 days for completion. Molting adults are flightless during a portion of the molt cycle and are vulnerable to some habitat management actions.

Seasonality of Treatment – The schedule of woody vegetation management should represent the best tradeoff between when control measures are most effective and when black rails (and other wildlife) are most impacted by disturbance from the treatment. Woody plants utilize stored, below-ground carbohydrate reserves to survive periods of dormancy and disturbance events. These reserves fluctuate throughout the year declining in the spring during elongation of shoots and leaf growth and increase during the growing season when products from photosynthesis exceed demand (Kozlowski 1992, Kozlowski and Pallardy 2002). Treatments to reduce coverage of woody plants are often most effective when carbohydrate reserves reach a low just after leaf-out (Randal 2022). Throughout most areas within the range of eastern black rails, shrubs may be most effectively treated just following the onset of spring growth in April and May. It should be noted that species vary considerably in their adaptation and response to management such that management should be tailored to target species. Although treatment of many woody plants may be most effective in early spring, managers should design treatments to minimize impacts to black rails and other marsh-nesting species, particularly in smaller sites where maintaining a mosaic of habitat conditions is less feasible. The early spring is a sensitive period during the breeding cycle for black rails and other species.

Treatment of Occupied Sites – Treatment of sites currently supporting black rail territories should minimize impacts to the birds and their nesting success. Consideration should be given to targeted techniques where feasible. For broad treatment techniques that impact herbaceous vegetation, managers should design treatments to occur on a rotational basis that ensures availability of suitable habitat conditions for black rails within or among management units. At large sites (i.e., > 640 acres), at least 50 percent of the black rail habitat within a particular management boundary in a given calendar year should be maintained in order to provide the opportunity for reproduction and population maintenance and recruitment. Special care should be taken at small sites with limited available habitat. Timing should also consider the length of time required for herbaceous vegetation to recover for the breeding season. In South Carolina, a burn in February was believed to have delayed breeding for one month as vegetation recovered (Hand et al. 2021). Burns later in the spring may have prevented nesting for the year, underscoring the need to ensure untreated habitat within or among management units. However, recovery of vegetation following a burn varies across regions such that treatments should be customized for a specific landscape.

Treatment of Unoccupied Sites – Sites that do not currently support black rails but have been chosen for treatment to provide habitat for population expansion should be treated during time periods that will yield the best results. For many (target species should be evaluated) woody plants this period would be in early spring but may vary from region to region (Randal 2022). Most sites with well-developed woody vegetation will require multiple follow-up treatments to effectively shift the community. This may include the use of the same technique multiple times in succession or a combination of treatments such as mechanical or fire coupled with herbicide.

Treatment Intervals – In order to sustain black rail habitat, treatment of woody vegetation will require an ongoing management program. Whether applied during the dormant or early growing season, a single treatment is unlikely to deplete the carbohydrate reserves in the roots and so additional treatments may be required to reach target conditions. This is particularly true for unoccupied sites where woody plant densities are very high and the intent is to convert the site for black rails. These sites may require multiple treatments to achieve conversion. Sites that have been converted to satisfy target conditions or occupied sites will need to be treated periodically to avoid excessive woody plant growth. Disturbance intervals for treatment to support black rails may vary site to site based on the plant community and its response to the treatment. Land managers should base their return intervals on the Criteria in Table 1 in order to maintain woody vegetation below a coverage of 20%.

Targeted Treatment – Treatment of individual woody plants (targeted treatment) may be possible using a wide range of equipment to apply herbicide or hand tools for removal. Advantages of using a targeted treatment are 1) woody vegetation may be set back without impacting herbaceous vegetation and 2) treatment may be implemented during any time of the year. Drawbacks to using targeted treatment are 1) the need for intensive manual labor and 2) manual application may limit the size of the site that can be treated.

Broad Treatment – Treatment of a site rather than an individual plant typically involves a blanket technique such as fire, broadcast spraying of herbicide or mechanical removal such as mowing. One of the advantages of using a broad treatment is that a site may be treated more efficiently with much less manual labor. Disadvantages of using a broad treatment are 1) all plants are treated together such that the treatment impacts target and nontarget plants (though targeted herbicides may be used that only affect certain plants, new programmable drones may effectively target specific plant patches and fire may benefit non-target plants) and 2) application may be seasonally limited in order to minimize impacts to other species..

Fire – Historically, fire was an important natural driver of plant composition throughout the range of eastern black rail. Fire suppression over several decades has shifted the plant community toward woody vegetation in areas that historically supported more open habitats. If properly controlled and managed, fire can be a valuable tool to manage the distribution and composition of vegetation and reopen habitats for black rails. Sites that support dense stands of woody trees and shrubs may take several years of treatment with fire alone to convert to open habitat. A more effective approach may be to use a chemical or mechanical preparation to make burning more effective.

Fire has been used to manage marsh habitat to improve wildlife value for more than a century (Mitchell et al. 2006). Periodic fire restricts the ability of woody plants to invade the marsh and has generally been thought to increase the productivity of food plants for waterfowl. Although the specific response to fire varies between herbaceous species, the general pattern is a reduction in dead vegetation and a compensatory increase in above-ground live vegetation following the burn. Most species appear to demonstrate greater vigor of live vegetation in response to the removal of dead vegetation, and some species show greater productivity and stem density. Response of bird species to marsh burns vary according to season of burn, composition of vegetation and target bird species, but general patterns have emerged across studies. The density of marsh birds is suppressed in the first year post burn, presumably due to the loss of cover, but bird numbers increase following the first season as cover returns. Bird densities increase in the following years and then decline as the amount of dead herbaceous vegetation and woody cover increases. Ideal habitat conditions for rails usually occurs from 4 to 8 years post burn depending on the seasonality of burn and local conditions. In general, a wild burn pattern that produces a mosaic of burned and unburned areas is preferable because it reduces the immediate impact of the burn by still providing some cover while also resetting succession through the disturbance of the affected areas.

Although our understanding of the relationship between black rails and fire continues to be fragmented and incomplete (studies are ongoing), it does appear that fire can be an effective tool for controlling woody encroachment to benefit black rails within some settings (see USFWS 2018 for a more complete treatment). Important considerations when planning controlled burns to improve habitat include 1) soil type (organic vs mineral), 2) plant community, 3) seasonality of burn, 4) frequency of burn or fire interval and 5) burn pattern. Depending on moisture levels and other factors, prescribed fire may impact organic soils and their invertebrate communities and/or the associated plant community (see overview in McKee and Grace 2012). Burning during the breeding season risks impacting nests, young or molting adults so seasonality is a large consideration in planning controlled burns. Burning during the late fall and winter allows herbaceous plants within some geographic areas to recover before the nesting season (Kane 2011). The optimal interval between burns depends on the specific plants to be controlled and the site conditions and should be tailored to the specific location. The spatial pattern of burn should be considered carefully when planning controlled burns to limit negative impacts to marsh birds including black rails (Legare et al. 1998, Grace et al. 2005, USFWS 2018). Black rails seek out concealing vegetation and are reluctant to flush making them vulnerable to fast moving fires or patterns that serve to "trap" them in place. Strategic refugia should be part of the design of burns.

Chemical – Herbicides are considered one of the most effective control techniques for shrubs available but are inappropriate for use in watersheds protecting drinking water supplies, areas used by livestock and in natural areas supporting rare plant species that may be adversely impacted by broadcast spraying. Caution should also be used when considering using herbicides within active black rail territories because we do not understand potential impacts. Industry currently offers a wide range of herbicides designed for specific groups of plants and situations. Labeling of herbicides is very specific and off-label applications are illegal and can be subject to severe fines. Many jurisdictions also require certification before applying herbicides. For use in wetland settings, formulations that are short lived in the environment should be favored. Chemical options that protect herbaceous vegetation should be favored except when targeting herbaceous species that are invasive. Many herbicides are designed to operate on rapidly growing plants and are less effective on dormant plants such that the optimum period of application in many areas is early spring (Randal 2022) (this may vary region to region and knowledge of local plant biology and response is important for planning). Herbicides may be used in combination with other techniques to improve effectiveness, such as pre-treating shrubs and trees prior to a fire to improve kill or treating stumps after mechanical operations to prevent re-sprout.

The optimum timing of application for most herbicides coincides with the breeding season of black rails. This conflict favors the use of targeted rather than broad application techniques for sites occupied by black rails (local information should be used to design management). Targeted applications include foliage treatment using a backpack sprayer (spray growing leaves), basal spray (soaking the lower 18 inches of trunk and root crown), cut stump (chemical applied to recently cut stump), frill (chemical placed in frill made by ax cuts on the trunk and hatchet injection (chemical injected into the trunk using hypo hatchet). For sites that are not currently occupied but chosen for future expansion of rail habitat, decisions about the type and timing of application should be made to maximize effectiveness and with considerations of other plant and wildlife species.

No studies relating the use of herbicides for habitat management and black rails have been conducted (one study is ongoing in Florida). However, based on the need for disturbance to maintain habitat, herbicide application is expected to have a positive influence on habitat establishment and maintenance. General guidance should follow that of other disturbance techniques.

Grazing – Studies of the relationship between grazing and black rail habitat are limited. The presence of grazing had little influence on occupancy or abundance of black rails in coastal Texas (Tolliver et al. 2019). Light to moderate grazing had a positive influence on occupancy in California black rails within irrigated wetlands in Nevada and California but had a negative impact on occupancy within non-irrigated sites (Richmond et al. 2012). The study was restricted to sites experiencing light grazing and so could not evaluate the impact of grazing intensity. Irrigation could facilitate plant recovery from grazing; Eddleman et al. (1988) suggested that grazing had a negative impact on black rails during the breeding season. Kane (2011) found that light to moderate disturbance including burning, haying or grazing had a positive influence on habitat structure in Kansas. Despite the fact that our perspective on grazing and black rails is not complete, the influence of grazing on the plant community suggests that grazers can play a role in habitat management. However, high-density grazing for an extended period compacts soil, tramples plants and overgrazes plant communities reducing cover. These impacts both inhibit the recovery of the plant community and do not promote the conditions required by black rails.

Mechanical – Mechanical removal of woody vegetation by mowing, logging, uprooting, cutting and other physical techniques may be an effective tool to manage habitat. The effectiveness and limitations of mechanical removal follow the same pattern as other disturbance techniques. Mechanical removal is most effective in controlling woody vegetation when applied during the spring when carbohydrates have been mobilized. For hardwood species, mechanical removal may be best paired with chemical treatment in order to reduce continued regrowth. The approach and equipment required for mechanical management depends on the size of the site and the current condition of woody vegetation. For small sites with relatively small and sparse woody plants, targeted management using hand tools may be an option. For larger sites with dense canopy cover of woody plants, heavy mowing or logging equipment may be required that will cause damage to herbaceous vegetation and possibly topography. The use of such equipment may be limited to the dry season and may be inappropriate for some sites.

Whether or not the site is occupied by black rails will dictate the approach and equipment used for woody management. For sites that currently do not support black rails and that are intended for restoration to facilitate population expansion the use of heavy equipment may be an effective management option. Caution should be used when using heavy equipment within occupied sites. Consideration should be given to providing adequate refugia and focusing management during the nonbreeding and/or dry period to avoid habitat damage.

No studies relating the use of mechanical techniques for habitat management and black rails have been conducted. However, based on the need for disturbance to maintain habitat, mechanical removal of woody vegetation may have a positive influence on habitat establishment and maintenance within settings where targeted techniques may be used or where the use of heavy equipment may be appropriate.

Flooding – Many woody plant species are sensitive to prolonged flooding (Jones et al. 1994, Toliver et al. 1997). Within landscape settings where water levels can be manipulated, flooding can be used as a management tool to control woody encroachment. Managers in South Carolina have effectively used flooding within impoundments occupied by black rails to control woody cover (Hand and Weitzel 2021). In order to avoid the breeding season, managers waited until 2 November to raise the water level and maintained flood conditions through late February. Flooding included a minimum of 15 cm depth around the bases of groundsel trees (Baccharis sp.). Dieback from flooding was complete resulting in no standing woody vegetation one year after treatment. Overwinter requirements of black rails should be considered when planning offseason flooding.

Wetland-Upland

There are several ways to manage for the mosaic of wetland and upland areas needed by black rails. Topographic highs that represent uplands, like scattered hummocks, can be embedded within wetland patches such that both requirements are contained within the patch. For sites that do not have topographic highs within wetland patches, home ranges typically include both wetlands and adjacent uplands. This configuration is why black rails have often been associated with the marsh edge (Flores and Eddleman 1995), straddling wetland and upland habitats. In such situations, surrounding uplands are part of the required habitat for black rails and must support concealing vegetation with limits on woody encroachment and separation from forest edges.

Topographic Diversity

Creating topographic diversity within a managed area can mitigate the extremes of water depth by reducing the likelihood of both flooding and draw down/dry out. There are several different topographic configurations that can satisfy the need for high and low areas on the landscape. Some options fit specific needs better than others. For example, marsh areas with little topographic relief may benefit from the creation of scattered elevated areas that provide topographic refugia or sites with high slope may benefit from the creation of riffles or pockets along the slope that hold water. From a management perspective, some configurations may be easier to create than others. For example, using a tractor to create furrows or a marsh excavator to create mounds with in-situ material to increase topographic diversity may require much less effort than creating a complex mogul or mounded configuration that may require hand work. Minimizing the establishment of invasive plant species should always be a prominent consideration when planning management activities.

Design Considerations – There are several elements that should be considered when designing for topographic diversity. One of the key issues is to understand the range of local hydrology. What are the normal peak water events, the extent of normal dry periods and how do these relate to the elevation range within the managed site? Topographic highs should be designed to exceed normal high water and topographic lows should be set below normal water levels. The grain (range between highest and lowest elevations) of the topography should be made with the range of water levels in mind. Matching topographic grain to the water range will ensure that high ground is available and that the site is resistant to dry out. Topography should be designed such that across the site, 50% of the area supports shallow water or moist soil (>0.5 ha/pair) during low water periods and >20% of the area supports uplands during high water events. (Table 1).

Simple Slopes – Simple gradients provide rails with the opportunity to move upslope as waters rise. Historically, this appears to be the dominant topographic configuration for most occupied tidal and non-tidal sites. Within flat landscapes or flat-bottomed impoundments, topographic gradients can be created to provide refugia. The primary design consideration is the normal range of water levels on the site which dictates the target range in elevation. Once this range is known, a decision must be made about the percent grade. High gradient slopes require less space but also provide less area in the target depth range.

Riffles and Furrows – Riffles and furrows are slopes that contain a series of soil folds. As used here, riffles are folds or benches that run perpendicular to the flow of water. Riffles or benches may be used on steep slopes to slow the flow of water, increase ponding and prevent rapid dry out. Design considerations include the percent slope and flow rate from the water source. Shallow riffles constructed close together may accommodate high flow situations where deeper riffles spaced farther apart may be required in lower flow situations. As used here, furrows are folds or ditches that run parallel to the flow of water. Furrows may be used within flat landscapes to increase drainage to provide interspersed uplands and to concentrate ponding to slow dry out. Design considerations include the spacing, depth and diameter of furrows. Sites with low variation in water levels may meet water targets using shallow furrows that are closely spaced. Sites with high variation in water levels will require deeper furrows that are more widely spaced to meet targets.

Moguls – Moguls (termed moguls common in ski resorts) are a series of irregular mounds that produce a complex topographic surface. The surface is more complex than the saltmarsh sparrow hummocks recently used in Connecticut (https://ct.audubon.org/news/creating-saltmarsh-sparrow-nesting-habitat-great-meadows-marsh-stratford) because in addition to topographic refugia the moguls should also retain water. One of the advantages of this configuration is that wet and dry areas are closely interspersed. Water drains from the moguls and is held in the nooks and crannies of the interstitial spaces. These structures may be used within flat landscapes to increase topographic diversity. Design considerations include the height and breadth of mounds and the depth of interstitial spaces. These should be made to match or exceed the range in water level. Possibly one of the greatest advantages of this topographic configuration is that in situations where little is known about the range of water levels, it is possible to vary the height of mounds and the depth of valleys such that it may accommodate a wide range of water conditions (one size fits all configuration). Consideration of woody plant colonization should be made in the design since periodic management will be required to control woody plants once moguls have been established. The size and spacing of moguls should be designed according to the hydrologic regime and the size of the marsh patch. Hummocks as those employed for saltmarsh sparrows provide less complex topographies but may also be beneficial to black rails.

Upland Buffer

Wetlands do not exist in isolation. Much of what goes on in the surrounding landscape has an influence on marsh function and its habitat value. The historic range of the eastern black rail supports hundreds of thousands of non-tidal wetlands. One likely reason for the lack of occupancy of these wetlands is not conditions within the wetland itself but within the surrounding uplands. The majority of isolated wetlands are embedded within uplands such as agricultural fields that have no concealing vegetation. As indicated above, black rails require dense herbaceous vegetation within the adjacent uplands. Upland buffers appear to play an important role during high water events and for portions of the black rail life cycle such as brood rearing.

Design Considerations – Upland buffers surrounding managed black rail wetlands should be a minimum of 50 m wide and preferably 100 m wide or more to allow black rails enough vegetation for cover from predators. Black rails have been documented to use upland buffers composed of row crops, hay, grass buffers around airport runways and mixed forbs and grasses in fallow fields (Watts 2016). As within high marshes, coverage of woody vegetation should be managed to less than 20%.

Management – Management of upland buffer vegetation generally follows the guidance provided above. Woody vegetation may be set back periodically using a combination of fire, chemical, grazing and mechanical. Depending on site conditions, herbaceous cover may require periodic renewal or re-establishment using disking, burning or replanting.

Marsh Migration

Most tidal marsh lands along the Atlantic Coast are shrinking or disappearing entirely due to the disparity between the rate of vertical accretion and the rate of local sea-level rise. One way of counteracting the conversion of marsh to open water is to allow marshes to migrate upslope and convert adjacent uplands to wetlands. Marsh migration is a natural process where marsh vegetation invades uplands as the tidal regime within these areas change. As long as the slope of surrounding uplands is low, there is potential for marsh migration to make up for the accelerated marsh loss along the coast. However, the characteristics of the surrounding landscape can limit the rate of marsh migration or halt it altogether. Marsh migration into uplands with higher slopes will proceed more slowly than those with lesser slopes and structures such as roadways and other infrastructure as well as some plant communities (e.g. maritime forest) may serve as barriers to marsh migration.

Implementing strategic marsh migration is needed to sustain tidal habitat for eastern black rails and other marsh species. This involves the removal of barriers to marsh migration in locations where slope and ownership will allow rapid migration into the uplands. Removal of vegetated barriers such as forests where appropriate to proactively prepare adjacent uplands for colonization as inundation allows should be encouraged.

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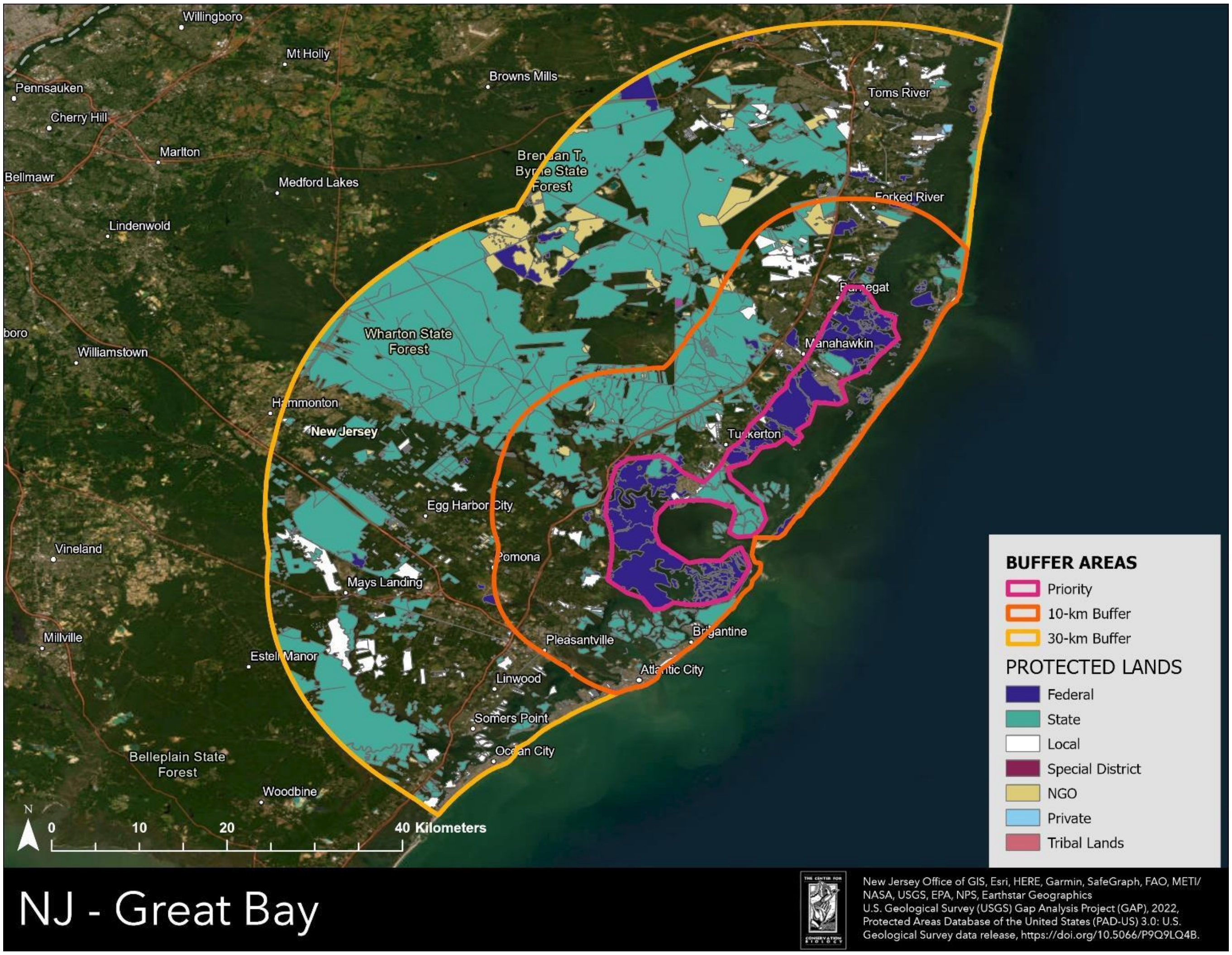
APPENDIX I: PRIORITY LANDSCAPES

GREAT BAY-LITTLE EGG HARBOR, NJ



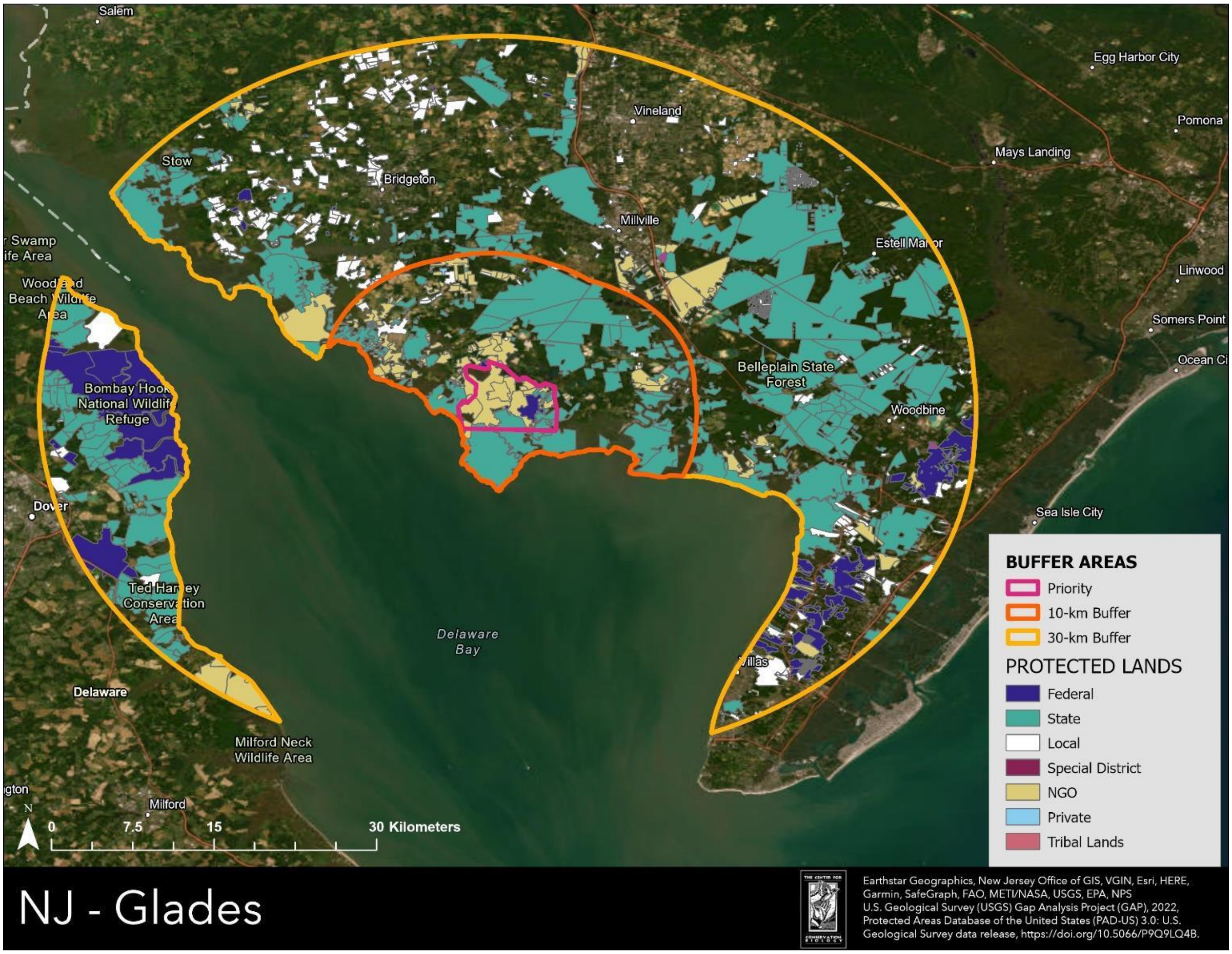
Eastern black rails currently occur within the extensive tidal marshes on the lower Mullica River around Great Bay and within the tidal marshes around Little Egg Harbor. This portion of New Jersey and the nearby barrier islands once supported the highest concentration of black rails in the region, likely including 100+ pairs (Watts 2016). Marshes on the landward side of barrier islands including Long Beach, Beach Haven and Holgate supported high concentrations of nests but were lost to coastal development. The Tuckerton Marshes along the mainland also historically supported high densities of rails. These marshes were extensively grid ditched for mosquito control which greatly reduced rail number, however the southern marshes around Great Bay were not ditched and hold a wilderness designation. The current population of black rails appears to be less than 10% of historic numbers (Smith, unpublished). Occupied habitat is characterized by high marsh dominated by saltmeadow hay and saltgrass. The bulk of this habitat is consolidated within the Edwin B. Forsythe National Wildlife Refuge and the Great Bay Boulevard Wildlife Management Area. The southern portion of Great Bay supports 350+ ha of impoundments managed as fresh water and moist soil units. The outer impoundment is tidal with restricted amplitude due to culvert configuration. The impoundment supports approximately 60 ha of flood-protected high marsh habitat.

Management Opportunities

Rescue and Stabilize – Management of black rails remaining within both the Great Bay and Tuckerton marshes is urgent. Maintaining birds within these sites will require immediate action. Restoration of ditched and impounded marshes by restoring natural drainage networks and increasing elevation can provide topographic diversity and other habitat features required by black rail. Opportunities for marsh migration are limited over much of the area due to existing infrastructure. However, opportunities for facilitated marsh migration should still be explored. A plan should be developed to create non-tidal habitats within the adjacent uplands to assist with the transition of these birds out of tidal territories. An initial phase should identify opportunities within the highest priority buffer (<10 km) followed by the secondary buffer. Management techniques to create new wetlands to recruit new populations of rails should focus on delivering water and vegetation conditions required by black rails. Likely the greatest short-term opportunity is the use of fresh water and moist soil impoundments for nesting black rails. The current management of these units should be examined for opportunities to make management adjustments to support black rails.

Conservation Partners and Ongoing Work - Conservation partners within this landscape include the U.S. Fish and Wildlife Service, the New Jersey Division of Fish and Wildlife, the New Jersey Forest Service, New Jersey State Park Service, New Jersey Office of Natural Lands Management, Conserve Wildlife Foundation of New Jersey, The Nature Conservancy and New Jersey Audubon Society.

CUMBERLAND MARSHES, NJ



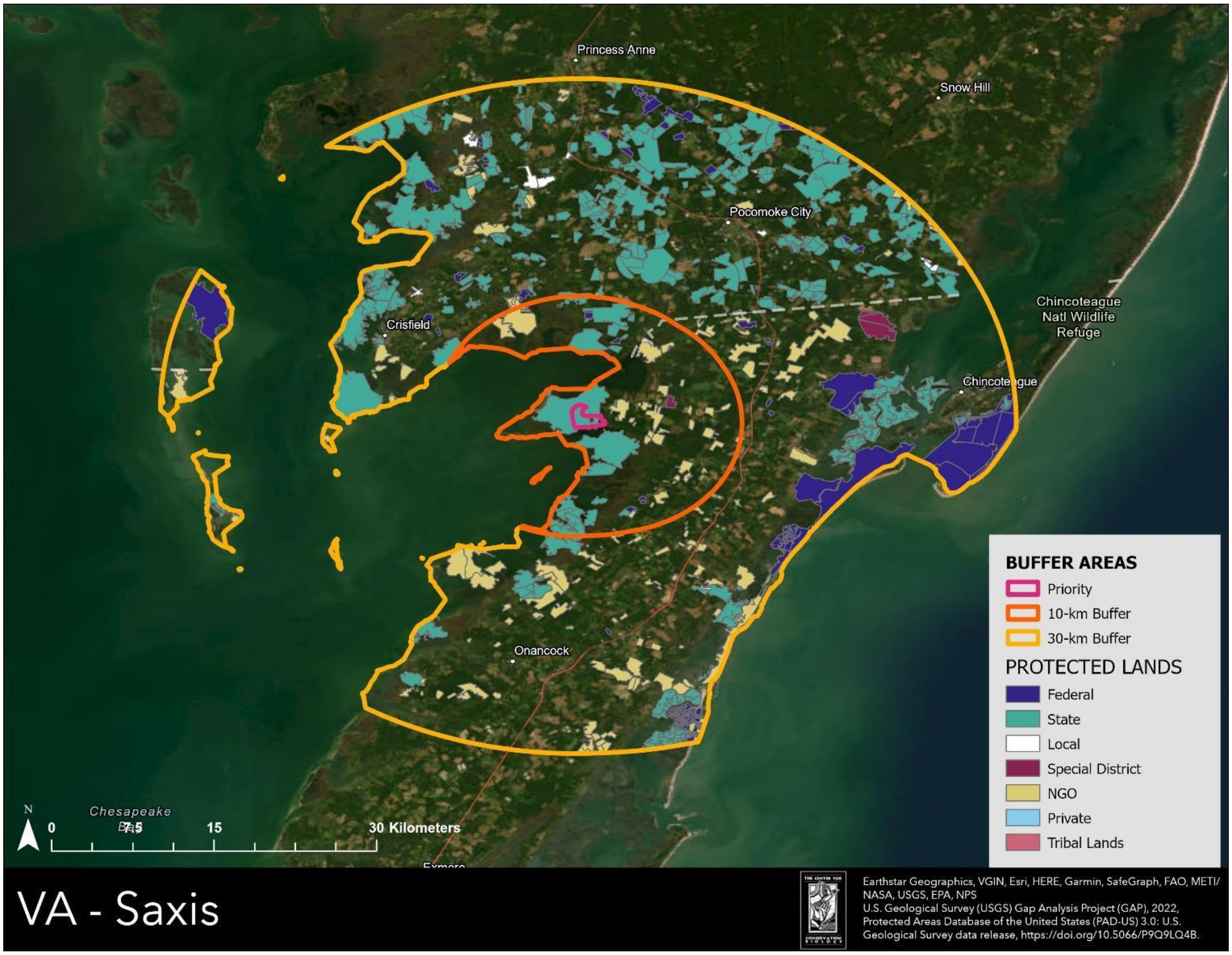
Eastern black rails have likely always been part of the Cumberland Marshes and have been documented along the Delaware Bay marshes from Cape May west to Salem. Birds have been widespread and our understanding of population size has been limited but almost certainly exceeded several dozen pairs (Watts 2016). The current population is less than 10% of this size (Davidson, unpublished). The center of activity historically has been the Turkey Point area and the general area continues to support birds. Black rails are restricted to the high marsh zone dominated by saltmeadow hay, salt grass and saltbush/groundsel trees. Birds historically reached the highest densities along the marsh-upland ecotone and within salt hay farms that have been managed using a system of dykes. Salt hay farms have been abandoned and recent detections of birds have been compressed to the uplands.

Management Opportunities

Rescue and Stabilize – Conservation Management of black rails remaining within the Cumberland Marshes is urgent because high marsh habitat is declining and being compressed by the bounding upland habitats. Maintaining birds within this site will require immediate action to maintain the high marsh including restoring marshes where possible and facilitating marsh migration into a buffer around occupied territories. Restoring the existing marsh in this landscape will be challenging because the elevation deficits caused by marsh farming are on the order of feet rather than inches and the vast dredging resources of the Delaware River and bay have not as of yet been directed to this region. There are opportunities to create habitat by facilitating marsh migration in agricultural areas that are experiencing saltwater intrusion. Activities to facilitate marsh migration should include the removal of barriers including Phragmites and maritime forest. A plan should be developed to create non-tidal habitats within the adjacent uplands to assist with the transition of these birds out of tidal territories. An initial phase should identify opportunities within the highest priority buffer (<10 km) followed by the secondary buffer. Management techniques to create new wetlands and recruit rails should focus on delivering water and vegetation conditions required by black rails.

Conservation Partners and Ongoing Work - Conservation partners within this landscape include the U.S. Fish and Wildlife Service, the New Jersey Division of Fish and Wildlife, the Delaware Department of Natural Resources, the New Jersey Forest Service, New Jersey State Park Service, New Jersey Office of Natural Lands Management, The Nature Conservancy, New Jersey Audubon Society.

ACCOMACK, VA



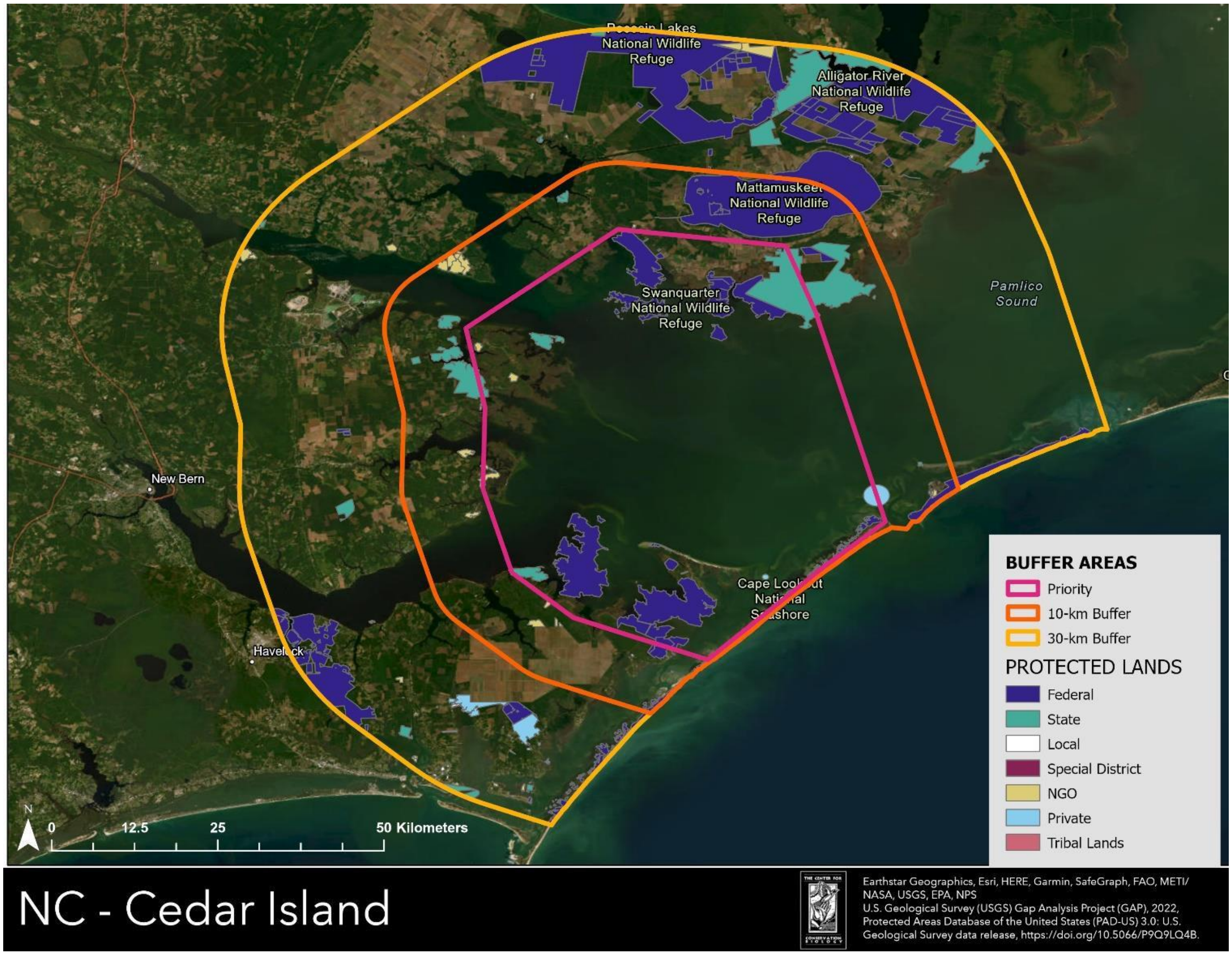
Eastern black rails currently occur within extensive tidal marshes along the Chesapeake Bay side of Accomack County in Virginia. Free School Marsh (part of Saxis, WMA) supported 25 breeding pairs as recently as the early 2000s but is now believed to support 10% of this number (Watts 2016). Historically, pairs also occupied other extensive patches to the south within this marsh complex. No pairs are known to remain. Black rails occupy high marsh within these tidal marshes characterized by saltmeadow hay, salt grass, scattered patches of black needlerush and a low density of salt bush or groundsel tree. High marsh is progressively being replaced by low marsh dominated by smooth cordgrass and black needlerush. The integrity of the remaining high marsh is breaking down. *Phragmites* has replaced switch grass along most of the marsh-upland ecotone over the past 25 years (Watts, personal observation). The marsh has roadways bisecting portions of the marsh with associated drainage ditches, however the site has not been ditched or manipulated for mosquito control. The marsh is bounded along the upland side by maritime forest that has experienced progressive die back with ongoing sea-level rise. Marsh plants are continuing to invade and replace upland forests along the downslope edge.

Management Opportunities

Rescue and Stabilize – Management of black rails remaining within Free School Marsh is urgent because high marsh habitat is declining and crumbling apart from increased inundation. Maintaining birds within this site will require immediate action to maintain the high marsh including facilitating marsh migration into a buffer around occupied territories. Activities to facilitate marsh migration should include the removal of barriers including P*hragmites,* ghost forests and aging infrastructure exposed to frequent flooding. The removal of maritime forests should be limited to those that are in immediate danger of being lost to SLR using selective cutting practices to ensure a more gradual transition from forest to marsh. The availability of fresh water along the upland edge of these territories should be evaluated and improved if necessary. A plan should be developed to create non-tidal habitats within the adjacent uplands to assist with the transition of these birds out of tidal territories. An initial phase should identify opportunities within the highest priority buffer (<10 km) followed by the secondary buffer. Management techniques to create new wetlands and recruit rails should focus on delivering water and vegetation conditions required to support black rails.

Conservation Partners and Ongoing Work - Conservation partners within this landscape include the Virginia Department of Wildlife Resources, the U.S. Fish and Wildlife Service, the National Aeronautics and Space Administration, the U.S. Department of Defense, The Nature Conservancy, Maryland Department of Natural Resources, Maryland Ornithological Society and the Chesapeake Bay Foundation. Several management projects are ongoing or planned within the landscape. Chincoteague National Wildlife Refuge has initiated three major marsh restoration projects focused on restoring hydrology that will increase the availability of high marsh habitat. The Virginia Department of Wildlife Resources will improve high marsh habitat within Saxis, WMA by initiating a burn program and plan to improve hydrology and vegetation management within one of the tidal impoundments within Doe Creek, WMA. There are opportunities to facilitate marsh migration within newly acquired Virginia Department of Wildlife Resource properties along the bayside of Accomack County.

CEDAR ISLAND, NC



Eastern black rails currently occur on Cedar Island National Wildlife Refuge, Piney Island (part of Cherry Point Military Reservation) and Portsmouth Island (part of Cape Lookout National Seashore) in Carteret County and in marshes around Swanquarter National Wildlife Refuge in Hyde County. Historically, this area likely supported 150+ pairs of black rails with the population centered on Cedar and Piney Islands (Watts 2016). The current population is likely around 5% of this size (The Center for Conservation Biology, unpublished data, Fussell, pers. comm.). Black rails occupy high marsh within these tidal marshes characterized by saltmeadow hay, salt grass, scattered patches of black needlerush and a low density of salt bush or groundsel tree. Within Cedar Island and around Swanquarter birds have increasingly contracted from the open marsh to the marsh-upland ecotone suggesting that they are being pushed upslope. Piney Island is a military bombing range and crater ponds may play a role in black rail use.

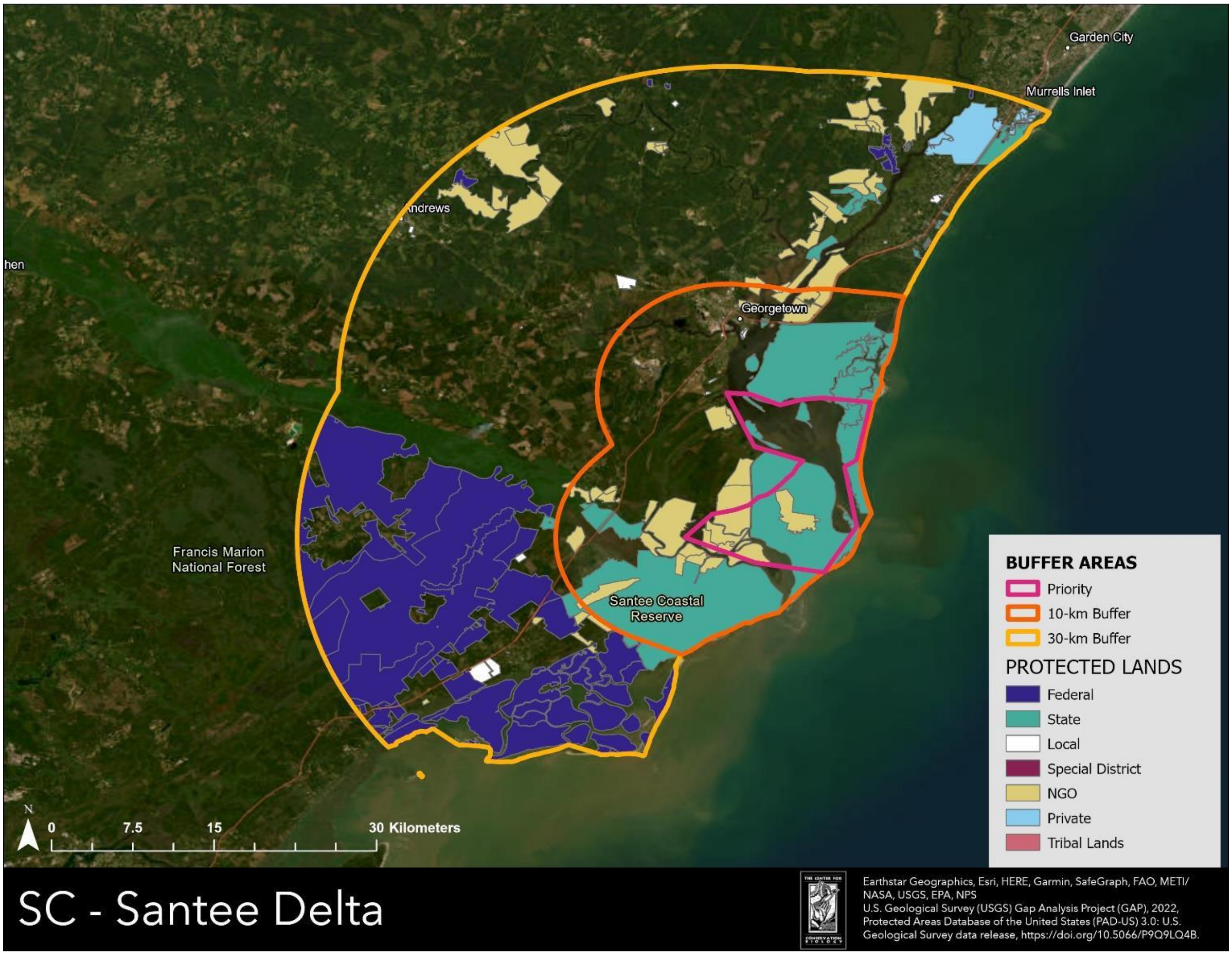
Management Opportunities

Rescue and Stabilize – Management of black rails remaining within this marsh complex is urgent because high marsh habitat is being overrun by sea-level rise. Maintaining birds within this site will require immediate action to facilitate marsh migration into a buffer around occupied territories where possible. Activities to facilitate marsh migration should include the removal of barriers including P*hragmites* and maritime forest.

Facilitation of marsh migration into adjacent uplands may be possible within Cedar Island and around Swanquarter. Habitat on Portsmouth Island is the back-dune marsh on a natural barrier island. P*hragmites* does occupy a portion of the high marsh within this landscape and the National Park Service would consider possible management strategies for this species. Piney Island is a bombing range and there is no practical opportunity for management due to its current use. However, black rails also occur on private lands along the mainland margin of marshes near Piney Island and facilitated marsh migration should be explored. Black rails occur in marshes around Swanquarterbehind the prior tree line and there is opportunity for facilitation of ongoing marsh migration in order to improve these habitat conditions. A plan should be developed to create non-tidal habitats within the adjacent uplands to assist with the transition of these birds out of tidal territories. An initial phase should identify opportunities within the highest priority buffer (<10 km) followed by the secondary buffer. Management techniques to create new wetlands and recruit rails should focus on delivering water and vegetation conditions required to support black rails. One of the highest priorities to explore is Goose Creek Game Lands; this area includes both impoundments and upland areas. Salter's Creek Game Lands immediately adjacent to Cedar Island NWR is now being managed by NCWRC and has saltmarsh and upland habitats.

Conservation Partners and Ongoing Work – Conservation partners within this landscape include the U.S. Fish and Wildlife Service, the National Park Service, the U.S. Department of Defense, North Carolina Wildlife Resources Commission, The Nature Conservancy and the North Carolina Coastal Federation.

SANTEE DELTA, SC



Eastern black rails currently occupy managed tidal impoundments and adjacent wet pastures within the Santee Delta area. Most activity is concentrated on the Tom Yawkey Wildlife Center (owned and managed by the South Carolina Department of Natural Resources) in Georgetown County. The time frame of black rail establishment within this site and the historical population size is not known but they were present in unimpounded high marsh habitat during the1940s (Nicholson 1951) and in both unimpounded and impounded marsh in the early 1990s (Cely et al. 1993). During the 1980s and surveys in 2016, they were also found on a small marsh island in Winyah Bay, but increasingly high tides may be eliminating this habitat. The Tom Yawkey Wildlife Center currently supports a couple of territories. The site includes a complex of tidal impoundments with tide control structures. Black rails occupy the drier portions of the few impoundments with suitable hydrology (constructed during the 20th century) and also have been found in wet field/meadow habitat adjacent to the saltmarsh. Targeted water level management within suitable impoundments and irrigation using solar-powered water pumps has improved water management.

Mowing and fire have been used to control woody vegetation. Dominant plant species included marsh fimbry, saltmeadow cordgrass, saltgrass, saltmarsh bulrush, and black needlerush (Hand et al. 2020).

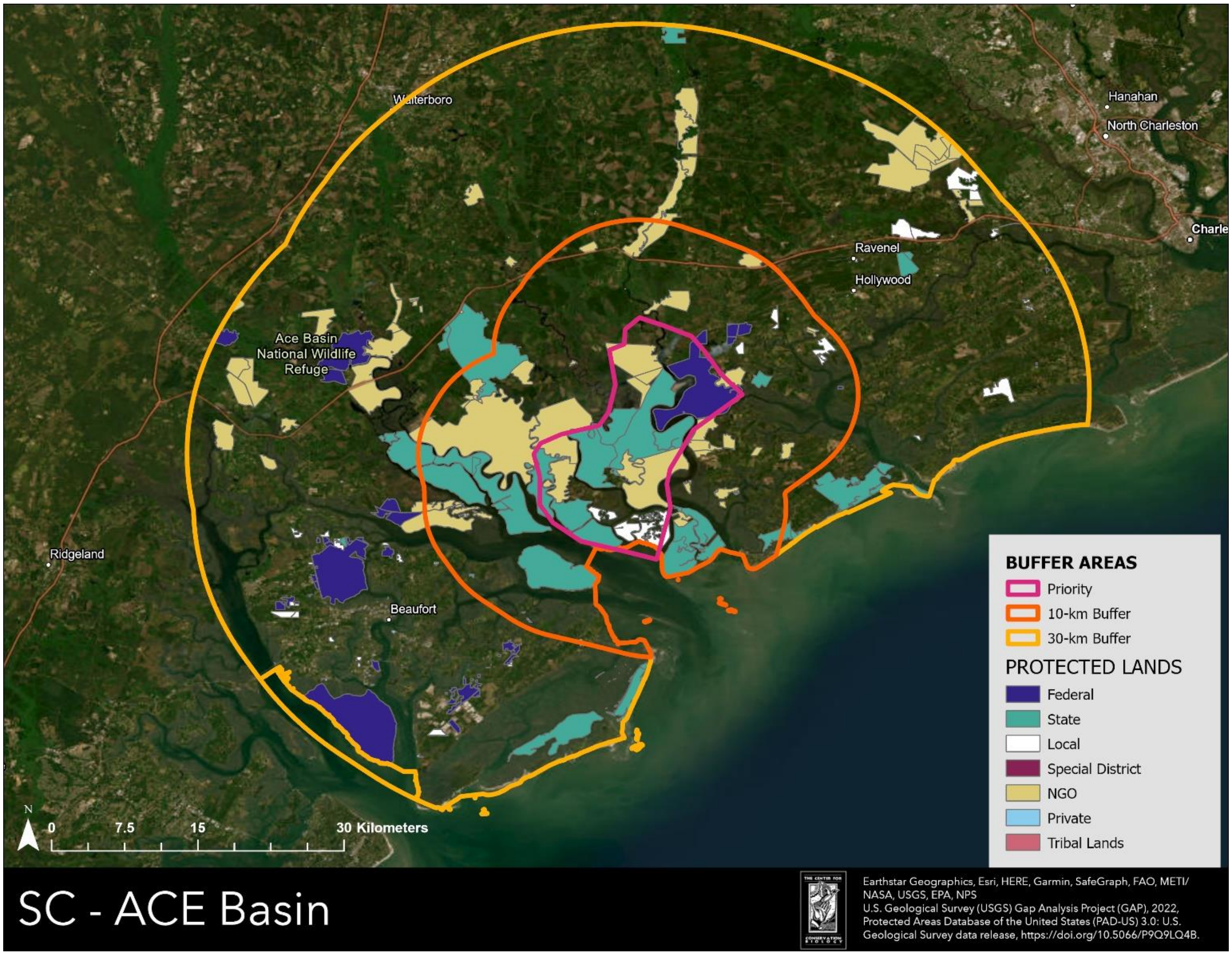
Management Opportunities

Stabilize and Expand – Management of black rails remaining within this landscape is urgent because high marsh habitat in Winyah Bay is being overrun by sea-level rise and maintaining shallow water levels in managed tidal impoundments is becoming increasingly difficult due to higher tidal water levels. The focus of management should be on enhancing or increasing the number of pairs supported within the current footprint and expanding the footprint to include other areas. Efforts should focus on delivering target water levels through irrigation and intensive management of the few impoundments with suitable hydrology on the Tom Yawkey Wildlife Center.

Additional wet pastures and suitable impoundments on other properties within the landscape should also be considered and managed if appropriate. Vegetation management should focus on control of encroachment by woody vegetation and prevention of Phragmites establishment. Deep flooding during the nonbreeding season is an effective method of controlling shrubs within impoundments where the infrastructure is sufficient to hold water for several months. In wet pastures, mowing and other approaches can be used for vegetation management.

Conservation Partners and Ongoing Work – Conservation partners within this landscape include the U.S. Fish and Wildlife Service, South Carolina Department of Natural Resources, U.S. Forest Service, South Carolina State Parks, the Yawkey Foundation, Ducks Unlimited and Brook Green Garden. Recent management projects include an upgrade to the water control structures within two impoundments on the Tom Yawkey Wildlife Center. In 2023, a solar-powered irrigation pump will be installed within wet meadow habitat.

ACE BASIN, SC



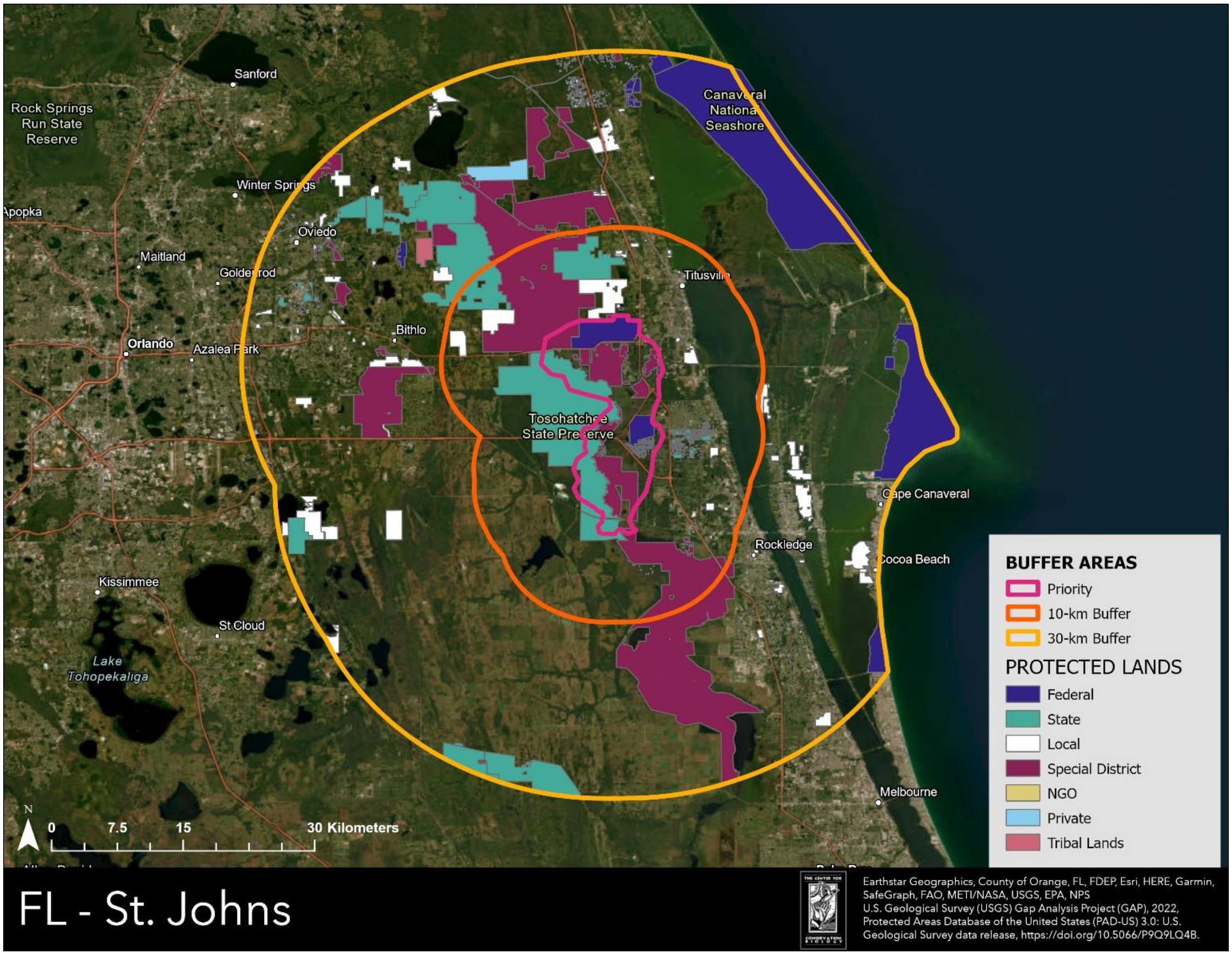
Eastern black rails currently occupy managed tidal impoundments within areas of the lower Ace Basin. Most activity has been focused on Bear Island Wildlife Management Area (owned and managed by the South Carolina Department of Natural Resources) with lower levels of activity on Ace Basin National Wildlife Refuge and private properties. The time frame of black rail establishment within the impoundment network and the historic population size is not known but they were present during the early 1990s (Cely et al. 1993) and have been reliably detected during subsequent years. The basin includes extensive complexes of tidal and non-tidal historic rice fields (Folk et al. 2016) as well as wetlands that were impounded during the 20th century and used for cattle grazing and waterfowl management. With rare exceptions, black rails have been found in the latter type of impoundments, which offer more suitable topography. Black rails occupy the drier portions of impoundments. Recent work has focused on targeted water level and vegetation management to better support breeding by black rails. The use of solar-powered irrigation to maintain suitable water level conditions is also being explored. Dominant plant species included clump cordgrass, saltmarsh bulrush, saltmeadow cordgrass, saltgrass, black needlerush and narrowleaf cattail.

Management Opportunities

Enhance and Expand – Compared with other coastal sites where eastern black rails occupy tidal high marsh, this population appears to be sustained by the use of control structures that limit tidal amplitude except during extreme storms. The focus of management should be on enhancing or increasing the number of pairs supported within the current footprint and expanding the footprint to include additional impoundments and nontidal habitats within other ownerships in the basin. Efforts should focus on delivering target water levels through irrigation and intensive management of the few impoundments with suitable hydrology and vegetation. Vegetation management should focus on control of encroachment by woody vegetation. Deep flooding is an effective method of controlling shrubs within impoundments where the infrastructure is sufficient to hold water for several months (Hand et al. 2020).

Conservation Partners and Ongoing Work – Conservation partners within this landscape include the U.S. Fish and Wildlife Service, South Carolina Department of Natural Resources, Nemours Wildlife Foundation, the ACE Basin Task Force, South Carolina State Parks, local land trusts, and Ducks Unlimited. A large amount of work has been ongoing for several years within this landscape by the South Carolina Department of Natural Resources and partners that has improved our understanding of black rail ecology and management. Work has included investigations of methods to survey black rails and monitor reproductive rates, investigations of breeding phenology, breeding ecology and water levels, prey availability, methods of water delivery, and methods to control woody vegetation including Chinese Tallow. Management has included upgrades to water control structures within Bear Island WMA and Ace Basin NWR and woody vegetation control using fire and deep flooding.

ST. JOHNS, FL



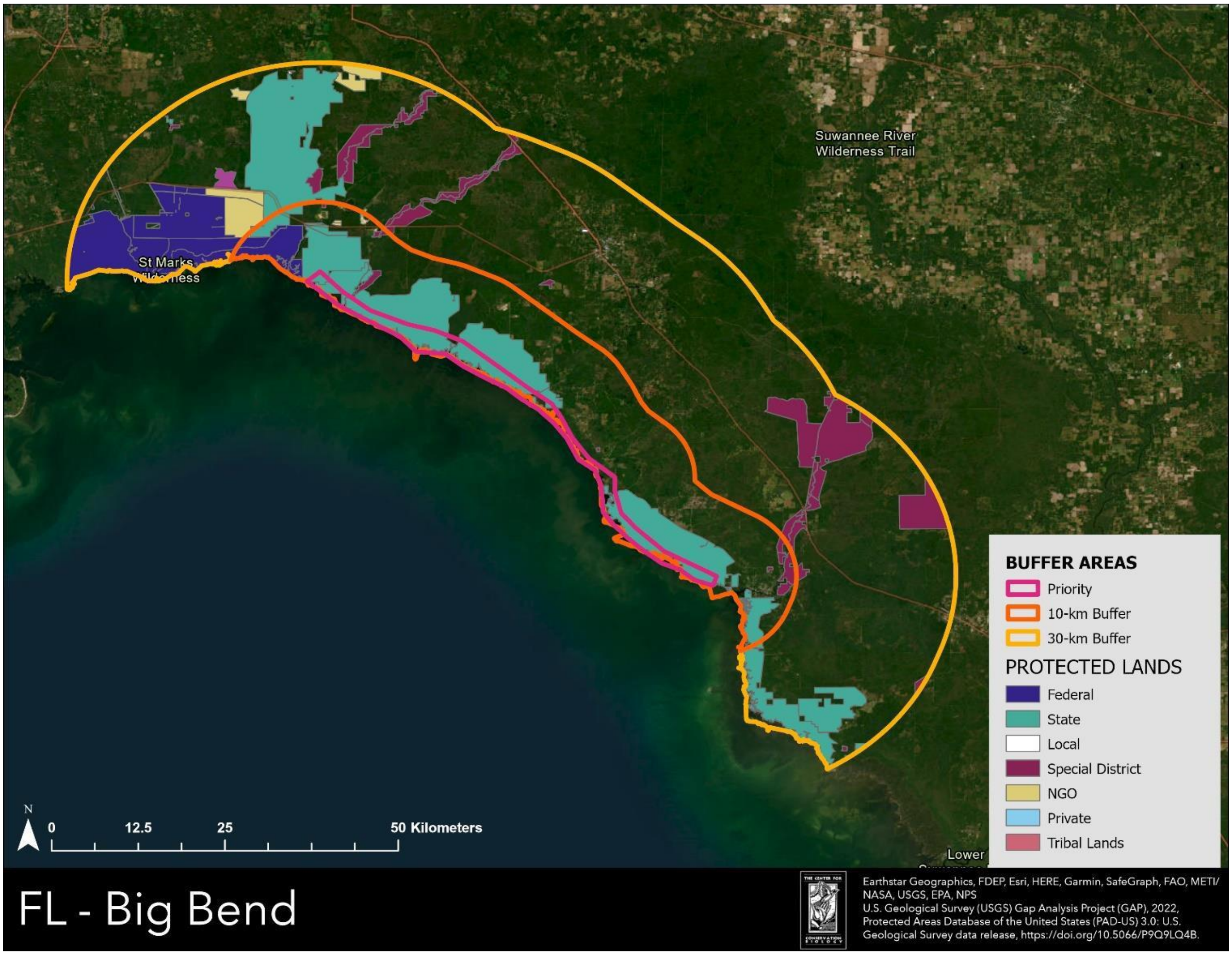
Black rails occupy relict emergent marshes of the upper St. Johns River including habitats on the St. Johns National Wildlife Refuge, Canaveral Marshes Conservation Area and Seminole Ranch. Nesting black rails are known to have occupied the area since the early 1900s and numbers have likely fluctuated over the decades along with shifts in land use. The current population size is not known. The St. Johns National Wildlife Refuge is a relict salt marsh that borders an extreme upper reach of the St. Johns River. The property has a complicated history that includes ditching and draining for mosquito control, cattle grazing and habitat management for the dusky seaside sparrow. Current habitat is dominated by sand cordgrass, sawgrass and wax myrtle. The site also includes scattered freshwater ponds that support cattail and salt pans that support glasswort. Freshwater ponds appear to be important for the distribution of black rails and saltpans have been documented as significant nesting sites (Legare and Eddleman 2001). Black rails occupy portions of the property that are periodically maintained by prescribed fire to set back encroachment by woody vegetation. Canaveral Marshes include a large landscape focused on conservation and protecting the upper St. Johns watershed. Seminole Ranch is a large landscape focused on conservation and cattle production. Collectively the complex of lands on the upper St. Johns may represent one of the best opportunities throughout the range to proactively manage for eastern black rails and increase the range-wide population.

Management Opportunities

Enhance and Expand – The focus of management should be on enhancing or increasing the number of pairs supported within the current footprint and expanding the footprint to include additional management units by increasing the burn program and improving/restoring hydrology. Efforts should be focused on delivering appropriate vegetation conditions and increasing the availability of appropriate water conditions. Management activities should be expanded throughout this extensive complex including on government, tribal and private lands that have the potential to support black rails. A plan should be developed to expand the footprint of habitat suitable for black rails.

Conservation Partners and Ongoing Work – Conservation partners within this landscape include the U.S. Fish and Wildlife Service, Saint Johns River Water Management District, National Aeronautics and Space Administration, Florida Fish and Wildlife Conservation Commission, Florida State Parks and Florida Forest Service. Several projects are ongoing within this landscape to improve habitat for black rails including the restoration of tidal hydrology and marshes within Merritt Island, NWR and expansion of controlled burns within St. Johns, NWR.

BIG BEND, FL



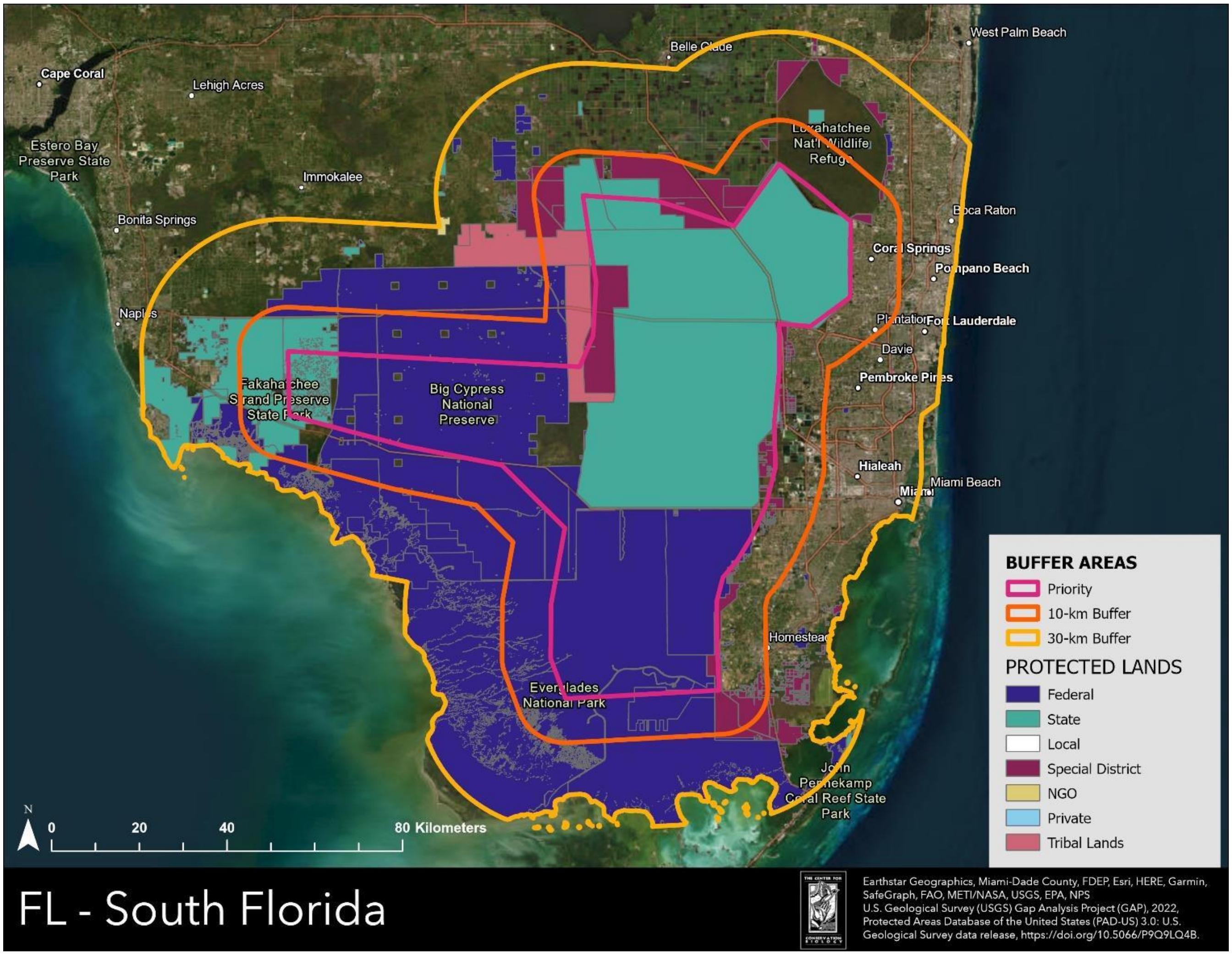
Eastern black rails have been documented within two management units of Big Bend Wildlife Management Area including Hickory Mound and Jena since the 1980s. Much of the habitat within this property is not easily accessible so no estimates of the historical or current populations are available. Black rails that have been detected occurred in the high marsh dominated by saltmeadow hay, saltgrass, gulf cordgrass, black needlerush, sand cordgrass, saw grass and groundsel tree. Numerous locations within this area appear to have good sources of fresh water including ponds, shallow ground water and streams. Most of the coastal salt marsh is bounded on the upland side by expansive maritime forests (hydric hammocks).

Management Opportunities

Rescue and Stabilize – Given ongoing sea-level rise it is likely that maintaining birds within marshes along the Gulf fringe of Big Bend Wildlife Management Area will require action to both facilitate marsh migration and improve topographic diversity. Given the extensive forest habitat along the upland edge of this habitat and the limited access, the practicality of these efforts may be limited. However, all options to manage birds within this habitat should be assessed and pursued. A plan should be developed to create non-tidal habitats within the closest available uplands to assist with the transition of these birds out of tidal territories. An initial phase should identify opportunities within the highest priority buffer (<10 km) followed by the secondary buffer. Management techniques to create new wetlands and recruit rails should focus on delivering water and vegetation endpoints.

Conservation Partners and Ongoing Work – Conservation partners within this landscape include the U.S. Fish and Wildlife Service and Florida Fish and Wildlife Conservation Commission.

SOUTH FLORIDA, FL



Eastern black rails have been documented within south Florida since the 1960s but the occurrence record has been very limited, erratic and widespread. Given the vast area covered by the freshwater system in south Florida it seems likely that this area may support the largest population remaining within the Atlantic Coast range. Black rails have been detected in recent years in several government properties including Big Cypress Preserve, Everglades National Park, Arthur R. Marshall Loxahatchee National Wildlife Refuge, Fakahatchee Strand Preserve State Park and the Southern Glades portion of the South Florida Water Management District. Most occupied sites are some form of marl prairie dominated by sawgrass, muhly grass or sand cordgrass. Dense vegetation providing significant cover is widespread throughout this region, spreading across hundreds of thousands of hectares. Topographic diversity within this area seems to be a strong determinant of whether an area will be occupied by rails. Variation in rainfall between years also appears to contribute to spatial variation in occupancy. Encroachment by woody vegetation appears to limit distribution in certain areas over time.

Management Opportunities

Enhance and Expand – The focus of management should be on enhancing or increasing the number of pairs supported within the current footprint and expanding the footprint to include additional areas. South Florida appears to have tremendous capacity to support black rails if management endpoints can be delivered consistently. Fire is being used extensively to manage for Cape Sable seaside sparrows and other species. This management has also benefited black rails in all areas where they have been observed and a focused effort is needed to identify areas where the introduction of a burn program may increase black rail occupation. Occupancy of some locations has varied with rainfall suggesting that water management/addition may provide more consistency in use and promote use of additional dry sites. This is particularly true in areas away from the primary aquifers that have good topographic diversity and vegetation cover but inadequate water. Areas closer to primary aquifers may benefit from water management/ topographic diversity to promote use of additional wet sites.

Conservation Partners and Ongoing Work - Conservation partners within this landscape include the U.S. Fish and Wildlife Service, National Park Service, Florida Fish and Wildlife Conservation Commission, Florida State Parks, Florida Forest Service, South Florida Water Management District and Miccusukee Tribe. Several projects are ongoing within this landscape that are improving habitat for black rails including burn programs within Everglades National Park, Big Cypress National Preserve and lands managed by the South Florida Water Management District.