Final Report to:

Texas Comptroller

Texas Species Research
IAC # 15-5545RR
Black Rail
(*Laterallus jamaicensis*)

Photo: Black Rail at San Bernard NWR, 2017
(Credit: A. A. Moore)

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ABSTRACT

The enigmatic Black Rail (*Laterallus jamaicensis*) is often regarded as the most secretive marsh bird in North America. The Eastern Black Rail *(L. j. jamaicensis*) may be the most endangered bird species along the Atlantic and Gulf coasts of North America, as it is listed as endangered in six eastern states and is a candidate for federal listing. Texas represents a knowledge gap critical to the development of the species status assessment (SSA) needed for the proposed listing rule in the Federal Register (to be published September 2018). Determining the status of a species or its populations is an arduous task but there are some principles that can help inform conservation efforts: resiliency and redundancy. The objective of this research is to assess the current status of the Eastern Black Rail in coastal Texas, specifically in terms of resiliency and redundancy of rail populations. In 2015 and 2016, we conducted the first large scale study of Black Rail occupancy and abundance in Texas. Six-minute call-playback surveys were conducted to detect rails acoustically. We fit 19 occupancy and 19 abundance models while accounting for imperfect detection and used the top occupancy model to estimate the required survey effort to precisely estimate black rail occupancy. We found that detection increased with moon phase and temperature but decreased with wind speed and ambient noise. Occupancy and abundance increased with *Spartina* spp. and intermediate marsh cover. Estimates of mean occupancy (0.27 and 0.27) and abundance (1.08 and 1.00 rails/point) were similar between years. Estimated survey effort under mean and good environmental conditions was less for detection correction methods than for non-correction methods. In the winter and spring of 2017, we conducted a radio telemetry study to obtain home range information on Black Rails in Texas. Preliminary telemetry results show average home ranges to be ~0.67 ha (95% MCP, n=7). We also conducted a mark-recapture study with Black Rails and Yellow Rails in six habitat plots that differed in number of years since last burned. Preliminary results show that there may be differences in burn regime preference between the two species. These studies will be replicated in 2018. We hope to better understand Black Rail habitat requirements in coastal Texas by examining home range size, movements, and habitat selection through the use of radio telemetry, and use occupancy-detection data

obtained from standardized surveys to develop species distribution models for the Black Rail along the Texas coast.

ACKNOWLEDGEMENTS

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INTRODUCTION

The enigmatic Black Rail (*Laterallus jamaicensis*) is often regarded as the most secretive marsh bird in North America. According to the Eastern Black Rail Conservation & Management Working Group, the Eastern Black Rail *(L. j. jamaicensis*) may be "the most endangered bird species along the Atlantic and Gulf coasts of North America". Some estimates indicate a 75% or greater decline in population sizes over the past 10-20 years (Watts 2016). The Eastern Black Rail is listed as endangered in six eastern states and is a candidate for federal listing. In Texas, there have not been any published studies on the species conducted in the state even though Black Rails were first documented in Texas as far back as 1879 (Cooke 1914). Furthermore, based on the amount of marsh habitat in the state, Texas may have an abundance of Eastern Black Rails. Thus, Texas represents a knowledge gap critical to the development of the species status assessment (SSA) needed for the proposed listing rule in the Federal Register (to be published September 2018).

Determining the status of a species or its populations is an arduous task but there are some principles that can help inform conservation efforts: resiliency and redundancy. In simple terms, we can think of population size as a measure of resiliency and the number of populations as a measure of redundancy. The objective of this research is to assess the current status of the Eastern Black Rail in coastal Texas, specifically in terms of resiliency and redundancy of rail populations.

In 2015 and 2016 we conducted repeated call-playback surveys at 5 study sites along the Texas coast and measured covariates of Black Rail detection, occupancy, and abundance. The specific objectives for these surveys were to: (1) determine covariates relating to Black Rail detection, occupancy, and abundance; (2) estimate Black Rail occupancy and abundance along the Texas coast; and (3) estimate the required survey effort to precisely estimate Black Rail occupancy with and without correcting for detection.

In 2017 the first season of two other studies were conducted: a radio telemetry study and a burn regime study. These studies are ongoing and will be repeated it 2018. The objectives for the radio telemetry study are to: (1) estimate the home range size for Black Rails at San Bernard National Wildlife Refuge (NWR) in Texas; and (2) examine habitat selection within home ranges. The purpose of this study is to better understand Black Rail habitat requirements in Texas by examining home range size, movements, and habitat selection through the use of radio telemetry.

The objectives of the burn regime selection study are to obtain and compare abundances of wintering Black Rails and Yellow Rails (*Coturnicops noveboracensis*) in study plots differing in time since burned at San Bernard NWR in Texas to examine interspecific abundance relationships and which burn regimes contain the highest/lowest numbers of rails. In Texas, Black Rail and Yellow Rail wintering habitat overlaps. Ecological theory predicts that two or more species rarely coexist in the same niche but instead one species will displace the other (Gause 1934, Volterra 1926). Since Yellow Rails and Black Rails are known to share some of the same wintering grounds in Texas, it is possible that interspecific competition is occurring in one form or another. The two species have similar diets (aquatic and terrestrial invertebrates and seeds) and since Yellow Rails are larger, they may displace the resident Black Rails from their home ranges. We will also examine age and sex ratios of each species. We predict the responses of Yellow Rails and Black Rails to wintering habitat burning will be similar to one another. Effects of controlled burns on Black Rails in Texas are unknown but could be substantial, given the apparent effects on Yellow Rails detailed in other studies (Austin and Buhl 2013, Burkman 1993, Morris *et al.* 2017).

METHODS

STUDY AREA

The 6 sites where call-playback surveys were conducted include Anahuac National Wildlife Refuge (NWR; 13,759 ha) in Chambers County, Brazoria NWR (17,973 ha) in Brazoria County, San Bernard NWR (21,853 ha) in Brazoria and Matagorda Counties, Mad Island Wildlife Management Area (2,913 ha), Clive Runnells Family Mad Island Marsh Preserve (2,858 ha) in Matagorda County, and Powderhorn Ranch (6,981 ha) in Calhoun County (Fig. 1). These sites represent a gradient of climatic conditions as they occur along an annual precipitation gradient with the highest precipitation (~145 cm/year) at Anahuac NWR and lowest (~106 cm/year) at Powderhorn Ranch (Baker *et al*. 1994). Additionally, temperatures along the Texas coast increase from northeast (32˚C max and 5˚C min) to southwest (33˚C max and 7˚C min; Baker et al. 1994). The burn regime (Fig. 2) and radio telemetry (Fig. 3) studies were conducted solely at San Bernard NWR.

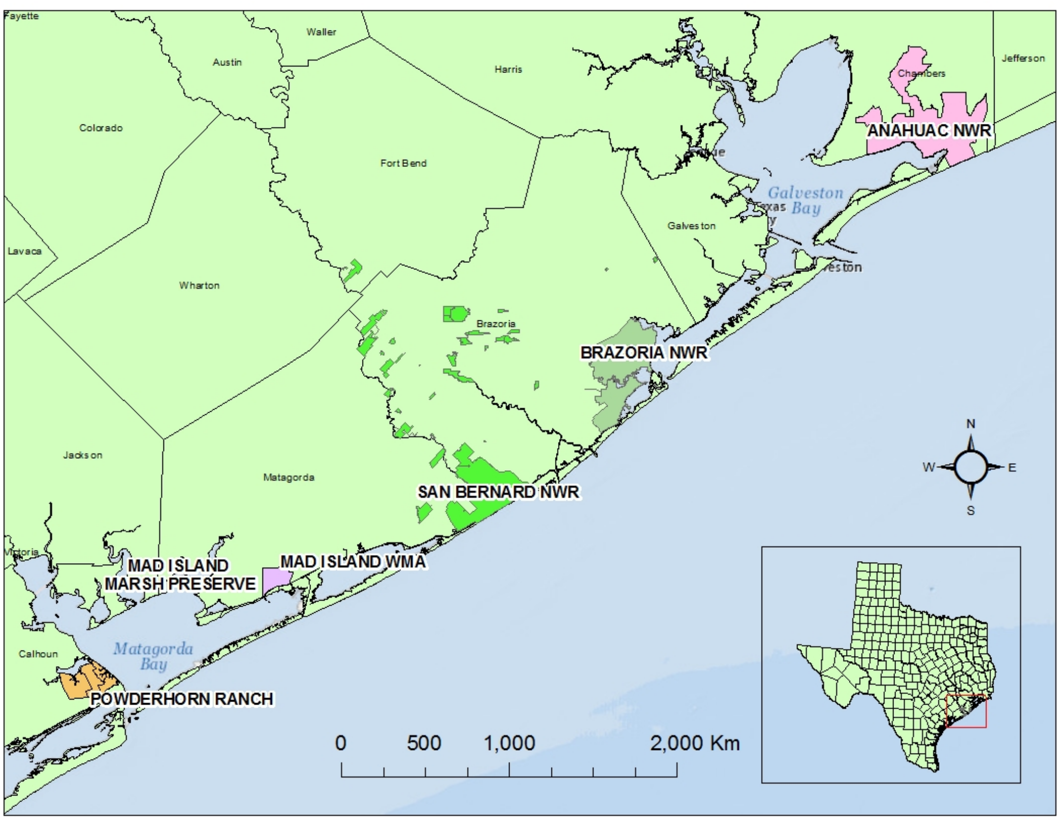

Figure 1: Location of 6 study sites along the Texas coast where Black Rail call-playback surveys were conducted in 2015 and 2016.

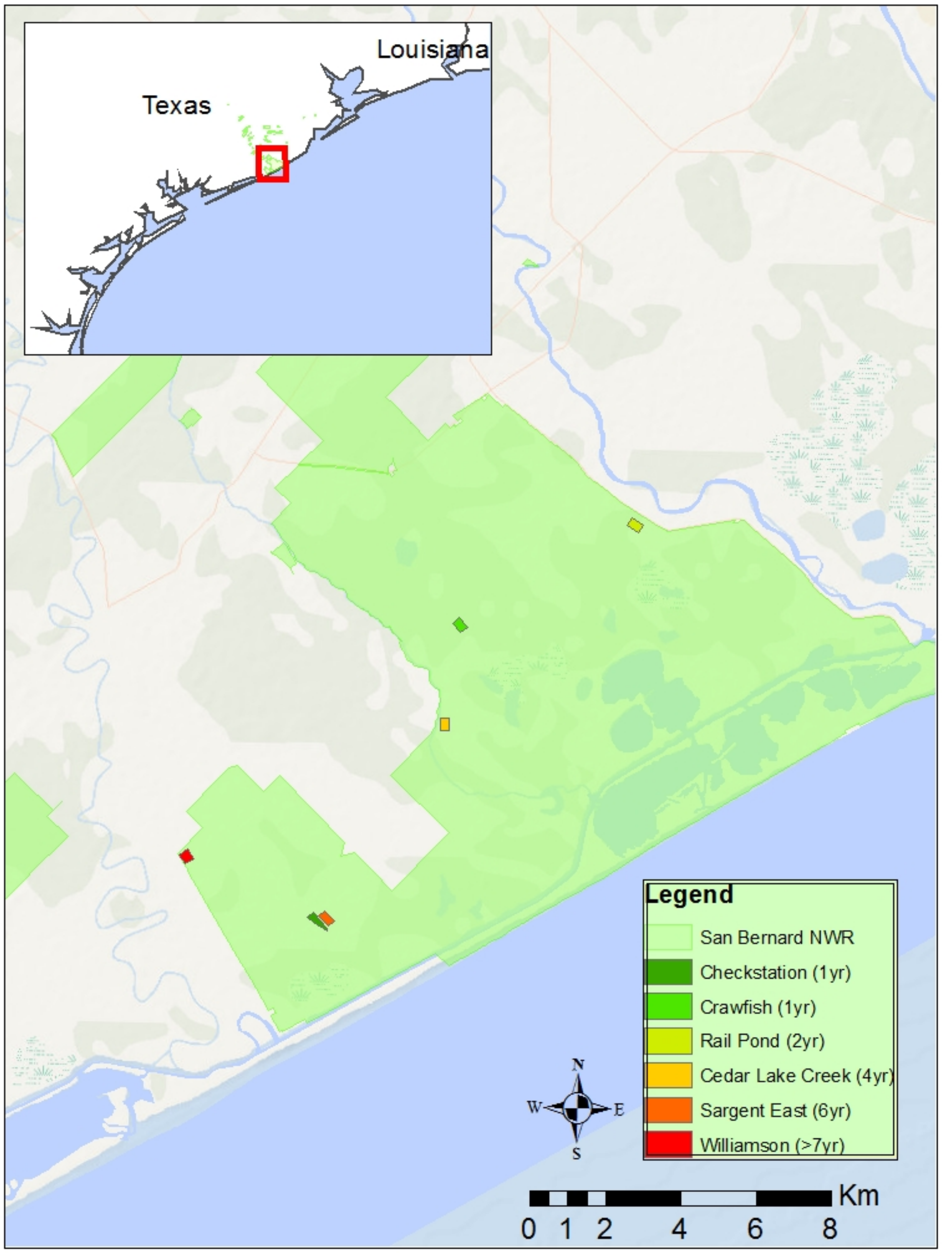

Figure 2. Location of burn plots at San Bernard NWR, Texas, where Black Rails and Yellow Rails are being captured and banded (2017-18).

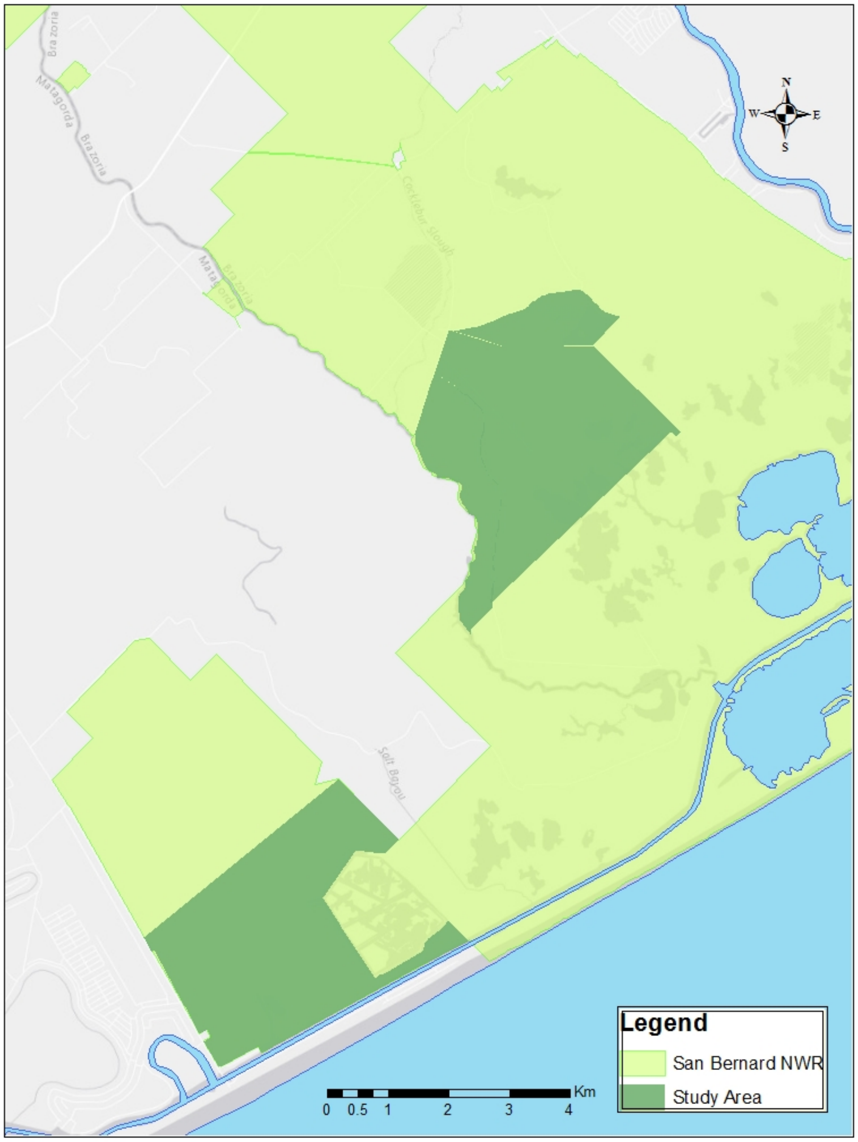

Figure 3. Location of areas at San Bernard NWR, Texas, where Black Rail radio telemetry study is taking place (2017-18).

CALL-PLAYBACK SURVEYS

Survey Protocol

Call play-back surveys were conducted up to 6 times per survey point following the general methodology described by Conway (2011). The survey sequence was slightly modified to as follows: 4 minutes of passive listening followed by 30 seconds of Black Rail calls, then 30 seconds of silence followed by 30 seconds of Clapper Rail (*Rallus* *crepitans*) calls, and then a final 30 seconds of silence. Clapper Rail calls were included since a previous study found an increase in response of some marsh birds with the broadcast of a conspecific's call (Conway and Nadeau 2010). Calls on mp3s were obtained to reflect the regional dialect. Sound pressure in the broadcast speakers was measured at 80-90db and the surveyor stood at least 2m away from the speaker.

Using GIS, transects were established along roads and firebreaks that ran through potential and unsuitable habitat and then a subset was randomly selected. Survey points were spaced 400m apart to avoid risk of double counting individual birds and to increase total area covered by monitoring efforts. Surveys were conducted twice a day: 30min prior to sunrise until 2hrs after sunrise, and 2hrs prior to sunset until 30min after sunset. Observers recorded the number of Black and Clapper Rails to respond, as well as direction of each bird using a compass and an estimate of the distance of each bird within distance bands (0-50m, 50-100m, 100-150m, >100m). Numerous environmental variables were recorded during each survey including weather data, lunar phase, ambient noise level, and disturbance (i.e. cattle grazing or recently burned).

Vegetation and Habitat Assessment

We assessed the relationships of habitat covariates with black rail population states at two spatial scales: the survey point-level and the site-level. The point-level covariates (percent cover of *Spartina* spp., non-*Spartina* herbaceous spp., and woody spp.) were visually estimated in a 50-meter radius at each survey point with Daubenmire coverage classes. To characterize habitat covariates at the site-level, we used a United States Geological Survey raster file (Enwright *et al.* 2015) in ArcGIS to estimate percent cover of intermediate-brackish marsh (intermediate marsh; salinity = 3.4–8.3 ppt) at each study site. We used intermediate-brackish marsh cover because both *Spartina spartinae* and *Spartina patens* dominate this habitat type (Enwright *et al.* 2015), and preliminary observation showed most black rail detections were in this habitat type. Percent cover of these habitat types was used since our study sites varied in size.

Occupancy Modeling

Occupancy models using multiple vegetation and habitat variables were created using package "unmarked" (Fiske and Chandler 2011) in program R (R Version 3.4.2, www.r-project.org, accessed 16 November 2017) to model occupancy and abundance. We used package "AICcmodavg" for our model selection analyses. We estimated individual model fit with Nagelkerke R^2 (Fiske and Chandler 2011). We selected the top occupancy model with AIC_C and the top abundance model with AIC (Akaike 1983).

RADIO TELEMETRY

Capture and Radio Marking

Black Rails will be captured and fitted with 0.9g radio transmitters (model BD-2, Holohil Systems Ltd., Carp, Ontario, Canada). There is no mass data for Black Rails in Texas, however the average mass is 29.3g for the California subspecies (Tsao *et al.* 2009) and 35g for those in Florida (Eddleman *et al.* 1994). Birds will be weighed upon capture to ensure the transmitters do not exceed 3% of the bird's body mass. Transmitters will be glued to the bird's back using Loctite® Epoxy Gel with a 6-minute setting time (Henkel Corporation North America). After the transmitter is in place, the bird will be placed in an observation pen for 5 minutes and then inspected to ensure that the glue is dry and that the bird's wings are free from the glue. Black Rails will be captured and marked under a USGS banding permit (#23546), Texas Parks and Wildlife Scientific Collection Permit (SPR-0106-005) and approved IACUC protocol (IACUC201533955) through Texas State University.

We will capture Black Rails from January to May of 2017 and 2018 using the bottle-line method or an audio-lure method, both of which are conducted 30 min after local sunset. The bottle-line is a 15m length of rope weighted with 5 small paint cans spaced ~1.5m apart along the rope. The cans contain various objects (rocks, jingle bells) that create noise and cause a physical disturbance when dragged through the vegetation. Each crew member will have a headlamp and/or hand-held spot-lights to spot for birds. Two people hold opposite ends of the rope and walk slowly, remaining equidistant to each other while the other two crew members walk ~2m behind the rope. Each person is spaced ~5m from each other. We will use dip-nets to capture any Black Rails that flush. For the audio-lure method, we will carefully walk through Black Rail territories playing various calls on portable speakers in attempt to elicit a response. Once a Black Rail responds, we repeatedly play calls to lure the bird out of the vegetation where we are able to either hand-capture the bird or capture with small (20cm) aquarium fish nets.

Radio Tracking

Radio-tagged Black Rails will be located using the homing method or by triangulation (described by White and Garrott 1990) with hand-held three-element Yagi antennas and receivers (Model R4000, Advanced Telemetry Systems, Inc., Insanti, MN). When homing, observers will approach rails within 5 meters and record a GPS waypoint to estimate its location (Garmin GPS eTrex 20x, WAAS enabled <3m position accuracy, Garmin International, Inc., Olathe, KS). To minimize impact on the sensitive vegetation in the birds' habitat and reduce potential of trampling nests, triangulation will be used as the season nears spring when nesting is possible. Birds will be located 1–4 times daily until the transmitter falls off or battery fails. Bird locations will be obtained ≥1 hr apart to reduce potential autocorrelation among locations (White and Garrott 1990). Tracking sessions will be conducted daily between 30 min prior to sunrise and 30 after sunset and at least once during each hour of the day. Since Black Rails are reportedly inactive at night (Flores and Eddleman 1995), we will not regularly track the birds after sunset.

BURN TREATMENT

Survey Methods

Since rails are typically secretive, most studies rely on vocalizations to estimate population size, however this is not a practical technique since rail vocalizations are rare in winter. Instead, the dragline method will be used to capture and band Black Rails and Yellow Rails from January through March 2017 and 2018. We will begin dragline ~30mins after sunset and end once the entire plot has been systematically covered or until 2.5hrs have passed. We will attempt to dragline each plot four times during each field season with surveys at the same site ~3 weeks apart. We will use dip-nets to capture any Black Rails and Yellow Rails that flush. We will collect a series of metrics from each bird, affix a USGS aluminum band, and take a waypoint for each bird at the point from where it flushed to conduct a habitat and vegetation assessment at each point the next day. Rails will be sexed and aged according to criteria outlined by Pyle (2008) and Dittmann and Cardiff (2013).

Vegetation Assessment

Habitat variables will be measured in the 50 x 50m area surrounding each location where a Black Rail or Yellow Rail was flushed and captured. Since the habitat within each plot is fairly uniform due to relatively flat topography of the wetlands, separate measurements will not be taken for birds captured within 25m of one another unless an obvious difference in habitat structure is observed (i.e. a stand of *Baccharis*, *Typha*, or a salt pan). Substrate type (dry, moist, muddy) or water depth will be recorded at the center and at 1m in each cardinal direction. Dominant cover types will be recorded for the entire plot and more in-depth measurements will be taken within 6 randomly selected 10m x 10m subplots, including Robel pole readings, tallies of trees species within size classes, presence of a senescent layer, and cover class for a 1m x 1m chosen at random. We will also conduct a count of the invasive Red Imported Fire Ant (*Solenopsis invicta*) mounds with in the 10m plot. This ant may directly affect a species of bird by eating eggs and killing chicks (Mueller *et al.* 1999, Sikes and Arnold 1986), or indirectly by lowering populations of invertebrate species that may be important dietary components (Epperson and Allen 2010, Morrow *et al.* 2015).

RESULTS

CALL-PLAYBACK SURVEYS

We conducted 3,425 call playback and sampled vegetation at 308 points from mid-March to the end of May, 2015 and 2016. There was a mean of 5.6 surveys/year/point. The minimum number of surveys/year/point was 3 and the maximum 8. Over the two years of the study there were a total of 284 individual Black Rail detections during 190 surveys at 92 points. We found that detection of Black Rails increased with moon phase (*i.e.* brighter moon) and temperature but decreased with wind speed and ambient noise.

Multi-season occupancy and open *N*-mixture models were used to estimate Black Rail occupancy and abundance as population states might have changed between 2015 and 2016 (MacKenzie *et al.* 2006, Dail and Madsen 2011, Hostetler and Chandler 2015). We fit 19 occupancy and 19 abundance models while accounting for imperfect detection. The highest Black Rail abundances (> 2.5 rails/point) were associated with survey points having > 90% *Spartina* spp. cover. In addition to being positively related to *Spartina* spp. cover, Black Rail abundance was positively related to herbaceous and woody cover at the point level and open water and intermediate marsh cover at the site level. Mean abundance was similar between 2015 (1.08 rails/point; 95% credible interval [CI] = 0.29 – 3.50) and 2016 (1.00 rails/point; CI = 0.29 – 2.76) (Table 1).

Mean recruitment was 0.19 rails/points (SE = 0.08) in unburned areas but 8.11 rails/point (SE = 3.76) in areas burned between 2015 and 2016. The apparent survival rate was 0.48 rails/point (SE = 0.13). Mean individual detection was 0.06 (SE = 0.02). Though Black Rail population estimates are critical for meeting management and conservation goals, it is difficult to ascertain the accuracy of our total estimates. Thus, mean estimates over time may be more reliable and helpful in population monitoring. We recommend caution when using these techniques to estimate total abundance.

We used the top occupancy model to estimate the required survey effort to precisely estimate black rail occupancy with and without detection correction methods. Assuming optimal survey conditions (detection: wind = 0–5 km/hr, lunar phase = full moon, average survey temperature = 30.92˚C) and that a given survey point was occupied by ≥1 black rail ($\hat{p}$ = 0.44), required survey effort (*i.e.* number of surveys needed to have a 0.95 probability of detecting the species) was ~6 surveys. Under mean survey conditions ($\hat{p}$ = 0.18), survey effort required was ~16 surveys/point and under poor conditions for detection ($\hat{p}$ = 0.01), required survey effort was ~100 surveys/point. Using detection correction methods (i.e. occupancy models), the optimal numbers of surveys to conduct under optimal, mean, and poor conditions are 3 surveys/point, 8 surveys/point, and 158 surveys/point respectively when using a standard design.

Table 1. Estimated abundance for 6 study sites surveyed for Black Rails from mid-March to the end of May (2015 – 2016). Included in the table are the number of points at each field site (*n*), mean abundance of Black Rails at each study site, and total abundance at each study site. Numbers in parentheses are the 95% confidence interval of the estimate. Mad Island Marsh Preserve and Mad Island WMA data were combined since the two preserves share a common border and basically represent the same geographic area.

Study Site	*n*	Mean Abundance (rails/point) 2015	Mean Abundance (rails/point) 2016	Total Abundance (number of rails) 2015	Total Abundance (number of rails) 2016
Anahuac NWR	86	1.78 (0.50 - 5.09)	1.44 (0.43 - 3.67)	787 (186 – 2612)	493 (112 – 1564)
Brazoria NWR	67	1.29 (0.28 - 4.27)	0.73 (0.22 – 2.40)	543 (92 - 2185)	297 (66 - 2197)
San Bernard NWR	63	1.08 (0.27 - 3.77)	1.33 (0.48 - 3.14)	370 (69 - 1619)	583 (161 - 1692)
Mad Island MP & WMA	58	0.41 (0.16 - 1.74)	0.65 (0.17 - 1.96)	37 (9 - 207)	73 (14 - 291)
Powderhorn Ranch	34	0.04 (0.00 - 0.53)	0.44 (0.00 - 1.79)	1 (0 - 28)	24 (0 - 174)
			Total:	1738 (356 - 6651)	1470 (353 - 5918)

At the site-level, Black Rail abundance increased with intermediate-brackish marsh cover which is similar to findings reported for other Black Rail populations, and other Rallid species (Austin and Buhl 2013, Harms and Dinsmore 2013, Roach and Barrett 2015). At the point-level, estimated Black Rail abundance was highest in habitats with high *Spartina* spp. cover. *Spartina* spp. cover consisted of marshhay cordgrass (*S. patens*) and Gulf cordgrass (*S. spartinae*). *Spartina* species have been reported to influence Black Rail occupancy in previous studies (Butler et al. 2015, Roach and Barrett 2015). Radio telemetry studies have suggested that dense habitat is attractive to Black Rails (Flores and Eddleman 1995, Tsao *et al.* 2009) and Butler et al. (2015) suggested that the tendency of Black Rails to occupy *Spartina* dominated habitats is due to the dense cover these grasses provide. The high stem-count of Gulf cordgrass coupled with the rhizomatous growth form and monoculture-forming tendency of marshhay cordgrass epitomizes densely vegetated habitat. *Spartina* cover seems to be important for Black Rail occupancy and abundance, thus conservation of this habitat is vital for the management of the species.

Mapped Locations of Black Rails

During call-playback surveys, surveyors recorded the direction and estimated distance (0–50m, 50–100m, 100–150m, or >150m) from which each bird was detected. The following maps show the plotted locations of each Black Rail (*n*=284) that was detected during the 2015–16 survey seasons as well as the vegetation types present.

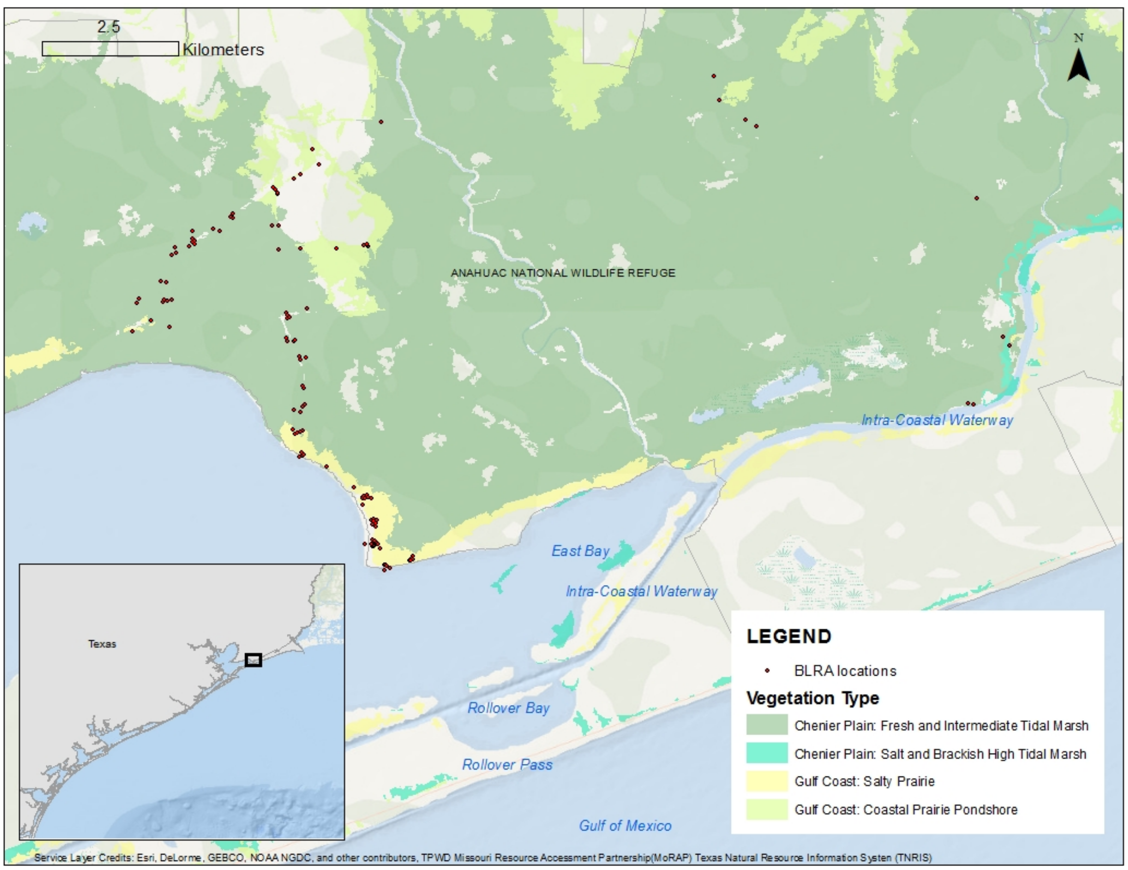

Figure 4. Mapped locations of 137 Black Rails detected at Anahuac NWR, March–May, 2015 and 2016.

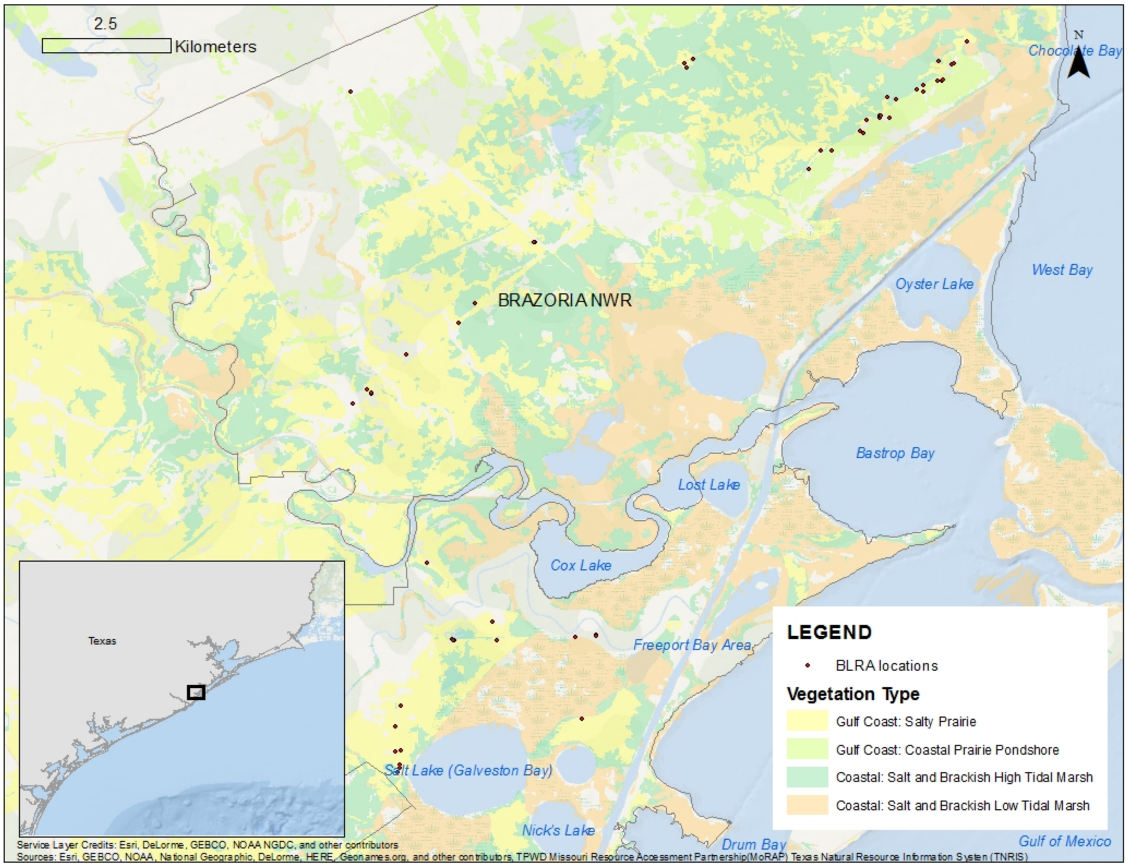

Figure 5. Mapped locations of 54 Black Rails detected at Brazoria NWR, March–May, 2015 and 2016.

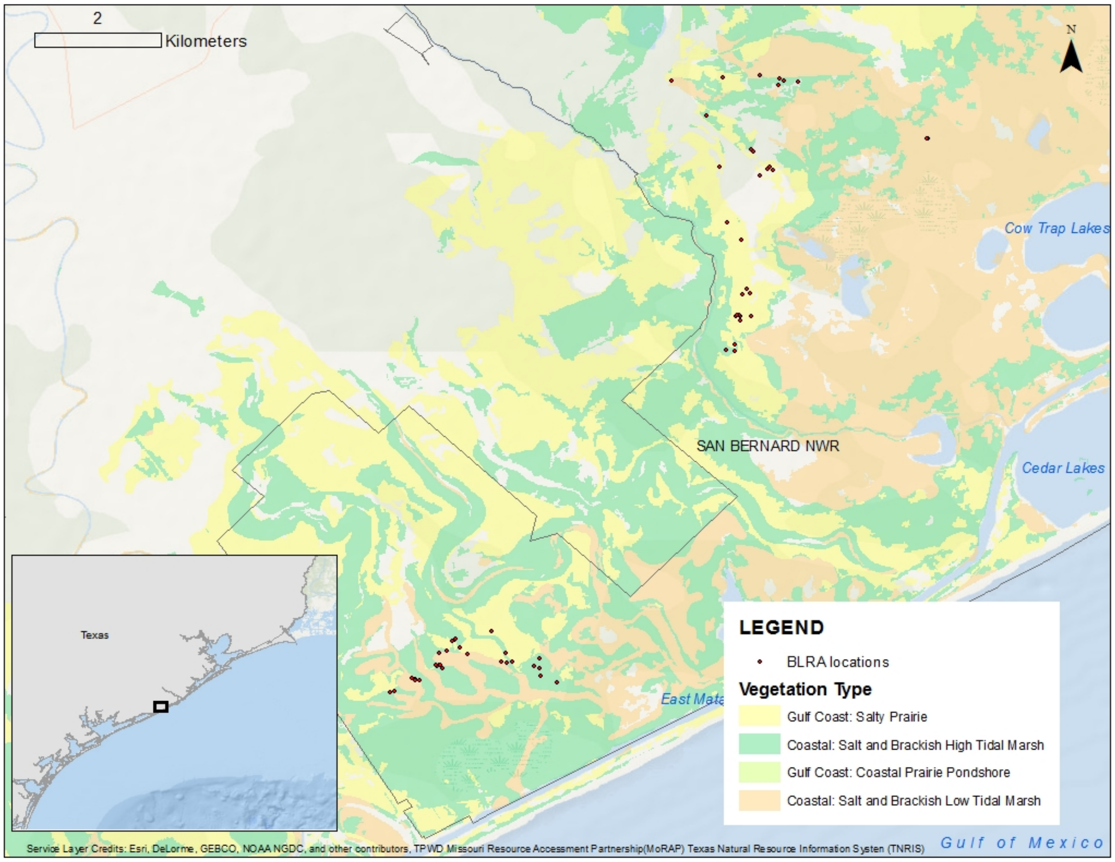

Figure 6. Mapped locations of 64 Black Rails detected at San Bernard NWR, March–May, 2015 and 2016.

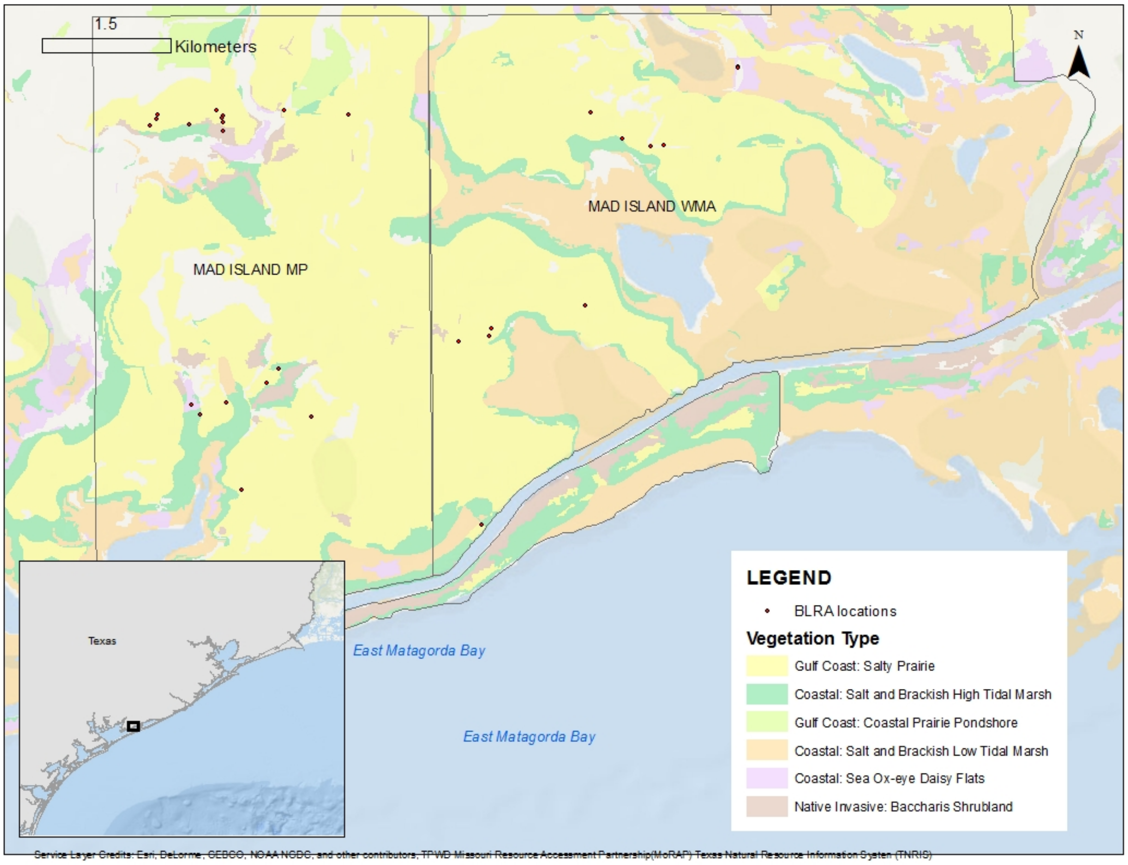

Figure 7. Mapped locations of 29 Black Rails detected at Mad Island Marsh Preserve and Mad Island WMA, March–May, 2015 and 2016.

Vegetation and Habitat Assessment

Using the Ecological Mapping Systems of Texas, which is a land cover classification map for the Texas Gulf Coast (10m resolution, created by The Texas Parks and Wildlife Department in cooperation with Missouri Resource Assessment Partnership and Texas Natural Resource Information System), we examined habitat and vegetation types within 100 meter buffers of 284 Black Rail locations. The mapping system divides the coast into 9 ecological sub-regions and further into 398 vegetation structure and composition types (see Elliott 2014 for descriptions). Black Rail location buffers were primarily composed of "Salty Prairie" (35%), "Fresh and Intermediate Tidal Marsh" (23%), and "Salt and Brackish High Tide Marsh" (14%).

Table 2. Percentages of each vegetation type with >2% representation within 100m buffers of 284 Black Rail locations detected in March–May, 2015 and 2016.

VEGETATION TYPE	% of total buffered area
Gulf Coast: Salty Prairie	35%
Chenier Plain: Fresh and Intermediate Tidal Marsh	23%
Coastal: Salt and Brackish High Tidal Marsh	14%
Gulf Coast: Coastal Prairie Pondshore	8%
Coastal: Salt and Brackish Low Tidal Marsh	5%

RADIO TELEMETRY – SEASON ONE

We captured 9 birds from February – May 2017. Home range was analyzed for birds with at least 10 relocations (n=7). The average 95% minimum convex polygon (MCP) home range was 0.67 hectares. For comparison, the only other home range study on Eastern Black Rails conducted in Florida (Legare and Eddleman 2001) found males to use twice the size. Only one female was tracked during season one and removal of data for that bird did not significantly change the estimated home range size.

The Ecological Mapping Systems of Texas was used to examine habitat types within Black Rail home ranges. Black Rails captured in season one were all within the Mid-coast Barrier Islands and Coastal Marshes ecological sub-region. According to the mapping system, the 3 vegetation categories found within Black Rail home ranges were all within the “Coastal Salt and Brackish Tidal Marsh” (which contains 6 vegetation types total). The largest amount (3.08ha) of Black Rail home range area was in the “High Tidal Marsh” vegetation type (Table 2). The “Low Tidal Marsh” (see Table 3 below for vegetation type description) comprised the 2nd highest area (0.91ha) within home ranges which we find somewhat questionable since *S. alterniflora* was never observed in home ranges and thus is not a plant species we would associate with Black Rail locations. Furthermore, we would not associate frequent tidal inundation with Black Rails at these sites. A very small amount (0.01ha) of the “High Tidal Shrub Wetland” vegetation type fell into some of the home ranges. Due to the disparity between the description of the “Low Tidal Marsh” and the observed lack of usage of this type of habitat, as well as the low amount of “High Tidal Shrub Wetland” included in home ranges, we suggest “High Tidal Marsh” as the main focus of management and conservation efforts.

Table 3. Vegetation types within home range MCPs of seven Black Rails in 2017 at San Bernard NWR.

VEGETATION TYPE	Area in home range (ha)
Coastal: Salt and Brackish High Tidal Marsh	3.08
Coastal: Salt and Brackish Low Tidal Marsh	0.91
Coastal: Salt and Brackish High Tidal Shrub Wetland	0.01

Table 4. Descriptions from Elliott (2014) of vegetation types found within home range MCPs of seven Black Rails in 2017 at San Bernard NRW.

Texas Coast Salt and Brackish Tidal Marsh vegetation type	Description
High Tidal Marsh	Irregularly flooded marsh dominated by graminoids such as *Spartina patens* (marshhay cordgrass), *Distichlis spicata* (saltgrass), and *Schoenoplectus* spp. (bulrushes).
Low Tidal Marsh	Marshes frequently inundated by tides and often dominated by *Spartina alterniflora* (smooth cordgrass).

High Tidal Shrub Wetland	These sites may be dominated by species such as *Iva frutescens* (shrubby sumpweed) or *Baccharis halimifolia* (eastern baccharis).

BURN TREATMENT – SEASON ONE

Between January 23 and March 27 we captured and banded 10 Black Rails and 48 Yellow Rails. We recaptured 7 of the Yellow Rails and 1 Black Rail resulting in similar recapture rates (Black Rail: 10%; Yellow Rail: 15%). We captured the most Black Rails (6) in the 4-years-post-burn plot and the most Yellow Rails (16) in one of the 1-year-post-burn plots, however, we captured a fairly high number of Yellow Rails in the 6-year-post-burn plot as well (Fig. 8).

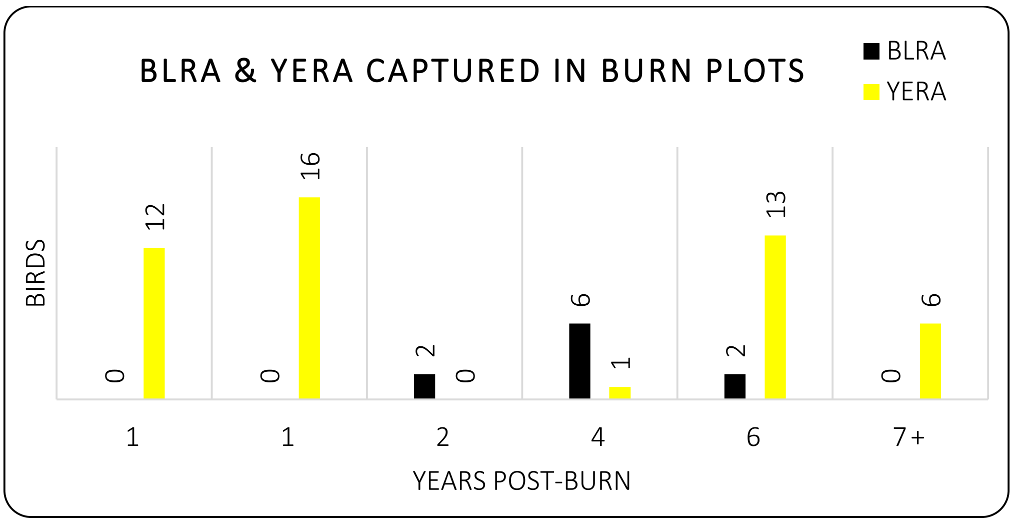

Figure 8. Black Rails and Yellow Rails captured in 6 plots that differed in number of years since last burned (note: there are two 1-year post burn plots)

Vegetation Assessment

Gulf cordgrass (*S. spartinae*) was the dominant plant species in each plot, and sea-oxeye daisy (*Borrichia frutescens*) was the second in 3 plots. Eastern baccharis (*Baccharis halimifolia*) and marshhay cordgrass (*S. patens*) were the second dominant plants in one plot each. The 7+ year plot consisted of a mix of grasses and forbs and there was no second dominant plant species (Table 5). Overhead cover, which we rated on a scale of 1 to 10 was similar across plots: between 9 and 10, or 75% - 100% in each plot (Fig. 9).

Table 5. Dominant plant species in burn plots where Black Rails and Yellow Rails were captured in 2017.

Burn plot	Dominant species 1	Dominant species 2
1-year	*S. spartinae*	*B. halimifolia*
1-year	*S. spartinae*	*B. frutescens*
2-years	*S. spartinae*	*B. frutescens*
4-years	*S. spartinae*	*S. patens*
6-years	*S. spartinae*	*B. frutescens*
7+ years	*S. spartinae*	none

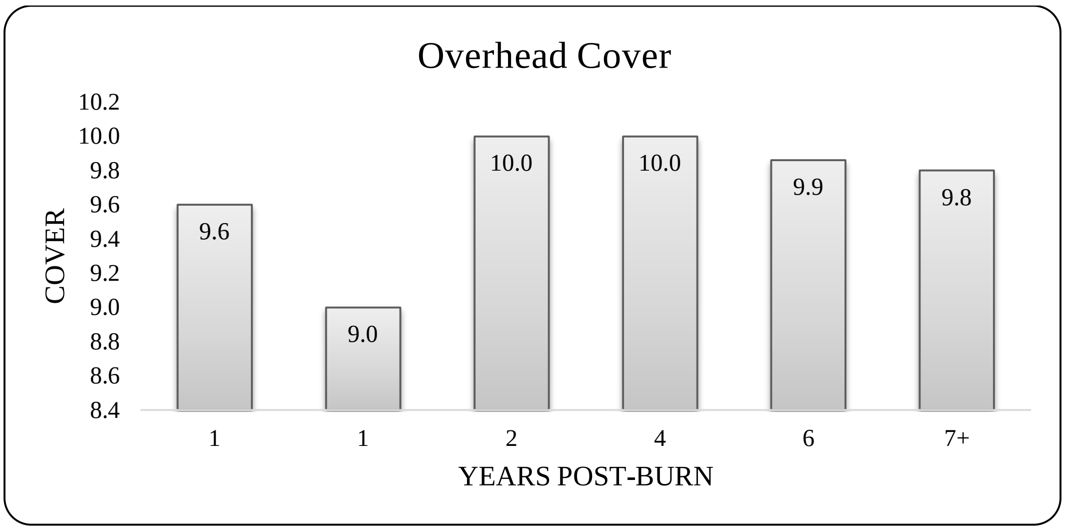

Figure 9. Overhead cover measured in burn plots at locations were Black Rails and Yellow Rails were captured in 2017. Cover was rated using categories: 1 = trace, 2 = 0-1%, 3 = 1-2%, 4 = 2-5%, 5= 5-10%, 6 = 10-25%, 7 = 25-50%, 8 = 50-75%, 9 = 75-95%, 10 = >95%

We also used a Robel pole, which is a visual obstruction measurement used to evaluate the height and vertical density of vegetation. Density and height did not ostensibly increase linearly with the increase in years post-burn: the 2-year plot was denser than the 4, 6, & 7 year plots (Fig. 10). Preliminary finding indicate that vegetation growth rates vary even within the same refuge, exemplifying the need for habitat assessment prior to a scheduled controlled burn in order to achieve management goals. We speculate that the difference in vegetation density can provide an explanation as to the differences in species and abundances across the plots.

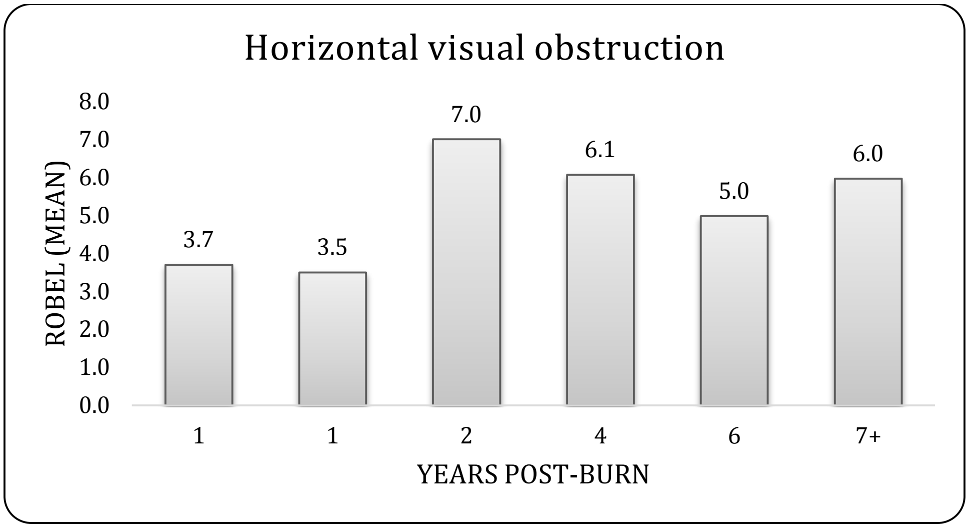

Figure 10: Robel pole mean values measured in burn plots at locations where Black Rails and Yellow Rails were captured in 2017.

SPECIES MANAGEMENT

We found that Black Rail occupancy and abundance increased with *Spartina* and intermediate marsh cover. Additionally, the "Gulf Coast: Salty Prairie" encompassed the majority of the habitat type within Black Rail detected location 100m buffers. This system is in part described as having sites that are "…nearly monotypic stands of *Spartina spartinae"* (Elliott 2014). Furthermore, the majority of Black Rail home ranges were in the "Coastal: Salt and Brackish High Tidal Marsh" which is described as "Irregularly flooded marsh dominated by graminoids such as *Spartina patens*…" (Elliott 2014). The focus of Black Rail habitat management in Texas should be on the enhancement and proliferation of coastal marshes containing *Spartina spartinae* (Gulf cordgrass) and *Spartina patens* (marshhay cordgrass). With Black Rail population states tied to these *Spartina* species and intermediate marsh cover, the species is likely susceptible to impacts from controlled burning and proper management of habitat may limit those impacts.

LITERATURE CITED

Akaike, H. 1983. Information measures and model selection. International Statistical Institute 22:277-291.

Austin, J. E., and D. A. Buhl. 2013. Relating Yellow Rail (*Coturnicops noveboracensis*) occupancy to habitat and landscape features in the context of fire. Waterbirds 36:199-213.

Baker, C. B., J. K. Eischeid, T. E. Karl, and H. F. & Diaz, G. C. P. System, editor. 1994. The quality control of long-term climatological data using objective data analysis. Preprints of AMS Ninth Conference on Applied Climatology. Dallas, TX.

Burkman, M. A. 1993. The use of fire to manage breeding habitat for Yellow Rails. M.S. Thesis, Northern Michigan University, Marquette.

Butler, C. J., J. B. Tibbits, J. K. Wilson. 2015. Assessing Black Rail occupancy and vocalizations along the Texas Gulf Coast. Final Report to: United States Fish & Wildlife Service and Texas Parks and Wildlife Department.

Conway, C. J., C. P. Nadeau, and L. Piest. 2010. Fire helps restore natural disturbance regime to benefit rare and endangered marsh birds endemic to the Colorado River. Ecological Applications 20:2024-2035.

Cooke, W. W. 1914. Distribution and Migration of North American Rails and their Allies. Bulletin of the U.S. Department of Agriculture no. 128.

Dail, D., and L. Madsen. 2011. Models for estimating abundance from repeated counts of an open population. Biometrics 67:577–587.

Dittmann, D. L. and S. W. Cardiff. 2013. Notes on mold and plumages of Yellow Rail (*Coturnicops noveboracensis*). Presentation. In Symposium: Ecology and conservation of the Yellow Rail (*Coturnicops noveboracensis*). Session II.

Eddleman, W. R., R. E. Flores and M. Legare. 1994. Black Rail (*Laterallus jamaicensis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/123.

Elliott, L. F. 2014. Descriptions of Systems, Mapping Subsystems, and Vegetation Types for Texas. Texas Parks & Wildlife Department, Austin, Texas.

Enwright, N. M., S. R. Hartley, B. R. Couvillion, M. G. Brasher, J. M. Visser, M. K. Mitchell, B. M. Ballard, M. W. Parr, and B. C. Wilson. 2015. Delineation of marsh types from Corpus Christi Bay, Texas, to Perdido Bay, Alabama, in 2010. Geological Survey, Scientific Investigations Map 3336, Lafayette, Louisiana, USA. http://dx.doi.org/10.3133/sim3336.

Epperson, D. M., and C. R. Allen. 2010. Red imported fire ant impacts on upland arthropods in southern Mississippi. The American Midland Naturalist 163:54-63.

Fiske, I., and R. Chandler. 2011. Unmarked: an R package for fitting hierarchical models of wildlife occurrence and abundance. Journal of Statistical Software 43:1–23.

Flores, R. E. and W. R. Eddleman. 1995. California Black Rail use of habitat in southwestern Arizona. The Journal of Wildlife Management 59:357-363.

Hostetler, J. A., and R. B. Chandler. 2015. Improved state-space models for inference about spatial and temporal variation in abundance from count data. Ecology 96:1713–1723.

Kane, S. A. 2011. Breeding habitat structure and use by Kansas-occurring Black Rail. M.Sc. Thesis, Fort Hays State University.

MacKenzie, D. I., J. D. Nichols, J. A. Royle, K. Pollock, L. L. Baily, and J. E. Hines. 2006. Occupancy estimation and modeling, inferring patterns and dynamics of species occurrence. First Edition. Academic Press an imprint of Elsevier, Burlington, Massachusetts, USA.

Morris, K. M., M. S. Woodrey, S. G. Hereford, E. C. Soehren, T. J. Conkling, and S. A. Rush. 2017. Yellow rail (*Coturnicops noveboracensis*) occupancy in the context of fire in Mississippi and Alabama, USA. Waterbirds 40:95-104.

Morrow, M. E., R. E. Chester, S. E. Lehnen, B. M. Drees, and J. E. Toepfer. 2015. Indirect effects of red imported fire ants on Attwater's prairie-chicken brood survival. The Journal of Wildlife Management 79:898-906.

Mueller, J. M., C. B. Dabbert, S. Demarais, and A. R. Forbes. 1999. Northern Bobwhite Chick Mortality Caused by Red Imported Fire Ants. The Journal of Wildlife Management 63:1291-1298.

Pyle, P. 2008. Identification guide to North American birds. Part II: Anatidae to Alcidae. Slate Creek Press, Point Reyes, California.

Richmond, O. M. W., J. E. Hines, and S. R. Beissinger. 2010. Two-species occupancy models: a new parameterization applied to co-occurrence of secretive rails. Ecological Applications 20:2036-2046.

Roach, N. S., and K. Barrett. 2015. Managed habitats increase occupancy of Black Rails (*Laterallus jamaicensis*) and may buffer impacts from sea level rise. Wetlands 35:1065-1076.

Sikes, P. J., and K. A. Arnold. 1986. Red Imported Fire Ant (*Solenopsis invicta*) Predation on Cliff Swallow (*Hirundo pyrrhonota)* Nestlings in East-Central Texas. The Southwestern Naturalist 31:105-106.

Tsao, D. C., J. Y. Takekawa, I. Woo, Yee Julie L., and J. G. Evens. 2009. Home range, habitat selection, and movements of California Black Rails at tidal marshes at San Francisco Bay, California. The Condor 111:599-610.

Watts, B. D. 2016. Status and distribution of the eastern black rail along the Atlantic and Gulf Coasts of North America. The Center for Conservation Biology Technical Report Series, CCBTR-16-09. College of William and Mary/Virginia Commonwealth University, Williamsburg, VA. 148 pp.

White, G. C., and R. A. Garrott. 1990. Analysis of wildlife radio-tracking data. Academic Press, San Diego.

Volterra, V. 1926. Variazioni e fluttuazioni del numero d’individui in specie animali conviventi. Memoria della Reale Accademia Nazionale dei Lince, Roma 2:31–113.