FINAL PERFORMANCE REPORT

Federal Aid Grant No. F17AF01216 (T-98-R-1)

Surveys for Wintering Yellow Rails in Oklahoma

Oklahoma Department of Wildlife Conservation

Report Period: October 1, 2017 - June 30, 2019

Grant Period: October 1, 2017 – June 30, 2019

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Grant Program: State Wildlife Grants

Grant Title: Surveys for Wintering Yellow Rails in Oklahoma

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Abstract

Yellow Rail are considered a "species of greatest conservation need" in Oklahoma, but very little habitat management has been undertaken due to the lack of information about their distribution or habitat needs. The northwestern most known wintering population of Yellow Rail was discovered in Red Slough WMA in Oklahoma in 2008. Although the density of this species in Oklahoma was previously reported to be similar to the core of the winter range in Texas, the numbers of wintering Yellow Rails at Red Slough appear to have declined since 2011, with only a handful of detections in subsequent years. During the winters of 2017-18 and 2018-19, surveys were carried out at Sequoyah National Wildlife Refuge (NWR), Hugo Wildlife Management Area (WMA), and Red Slough WMA to relate their presence to habitat variables. We engaged in monthly rope-drags, recording whether Yellow Rails were present at that location. Yellow Rails were routinely encountered at Red Slough WMA, encountered during migration at Sequoyah NWR, and were not encountered at Hugo WMA. We then quantified vegetative characteristics of locations where Yellow Rails were found and used occupancy modeling to relate habitat measurements to occupancy. We also examined vegetative characteristics in 23 sites spanning the winter range from Oklahoma to Texas and east to Florida, repeating measurements in locations where Yellow Rails were found as well as in damp, grassy areas where Yellow Rails were not found. Occupancy across all fields was 64.7% ± 11.3% but detectability was quite low, averaging only 25.4% ± 0.01%. Within the state of Oklahoma, occupancy was greatest in areas with 1-3 cm of water, was positively associated with the amount of grass cover, and was negatively associated with the amount of shrub and marsh vegetation. Overall numbers of Yellow Rails banded in Oklahoma also exhibit a moderate correlation with rainfall during September and October. Vegetative characteristics across the winter range demonstrate a moderate positive correlation between the number of stems at 10 cm, 20 cm, and 30 cm in height, as well as a moderate positive correlation with the amount of green cover. In order to maintain wintering Yellow Rails in the state of Oklahoma, it is recommended that mowing of potentially suitable habitat occur during June, and/or that periodic burns be employed when possible. In addition, the planting of trees in damp grassy fields in southeastern Oklahoma will quickly render this habitat unsuitable for Yellow Rails, and it is recommended that an effort should be made to retain the limited amount of suitable habitat in an early successional stage.

OBJECTIVES

1) To estimate the distribution and abundance of Yellow Rails in Oklahoma by surveys. The locations and numbers of Yellow Rails that are recorded during the project will be provided in each Performance Report.

2) To quantify the habitat associations of wintering Yellow Rails using occupancy modeling combined with vegetation measurements.

Introduction

In North America, wetlands have long declined in quality and quantity due to drainage, filling, and overall impairment (Mora 2011). Approximately 221 million acres of wetland existed prior to European settlement in the area that would become the continental United States (Dahl 1996). Societal priorities, technological advances, and historical events have largely degraded wetlands in the country, with more than half of the country's wetlands destroyed by 1980 (Dahl 1996). Public perception on the value and necessity of wetlands has changed dramatically in the last half century, and due to recent federal regulations and mitigation efforts, the total acreage within the United States has stabilized (Dahl 2006, Mora 2011). In recent years, efforts to create or restore wetlands have increased in the United States (Mora 2011). The capability of created or restored wetlands to support their targeted communities, including non-game species, varies from case to case, and landscape attributes such as road density, anthropogenic development, fragmentation, and isolation cause decreasing diversity trends in bird communities (Martin 1997, Mora 2011).

Wetlands have many taxa listed as species of concern but are typically managed to maintain waterfowl populations and associated biotic and abiotic communities, and so may not meet the needs of other waterbirds such as Rallidae (Sterling 2008, Mora 2011, Fournier 2017a). The avian family Rallidae is one of the most widespread avian families of the world, with genera on every habitable continent and several of the Pacific islands (Garcia-R. 2014). While extremely diverse in their habits and distribution, their affinity for wetland habitats is nearly universal and is the ancestral habitat for the family (Sibley 2001, Garcia-R. 2014). The breeding strategies of Rallids are diverse; while most Rallids are monogamous, others practice polygyny, polyandry, promiscuity, cooperative breeding, or intraspecific brood parasitism (Sibley 2001, Winkler 2015). With these various approaches, Rallidae tend to have abnormally large clutch sizes and semiprecocial chicks. These life-history strategies may have evolved as a response to habitat vulnerability, and allow for rapid reproduction rates (Feduccia 1996, Sibley 2001, Winkler 2015).

Most Rallids are opportunistic omnivores, with a varying diet that includes plant material, invertebrates, fish, amphibians, other birds, and small mammals (Sibley 2001, Ciach 2007, Lardjane-Hamiti 2015, Winkler 2015). The foraging time and food abundance varies largely depending on the time of year and seasonal availabilities, with a tendency towards animal matter during the breeding season and plant matter during the colder months (Sibley 2001). While some Rallids are active in daylight, the majority of the family are mostly nocturnal or crepuscular (Sibley 2001). The primary communication method between individuals is auditory rather than visual, as heavy marsh vegetation and their preference for low-light-levels hamper visual displays (Sibley 2001).

Rallids' affinity for colonizing islands and insular or flightless speciation has led to a number of unique, endemic populations worldwide (Garcia-R. 2014). Any population that exists solely on an island is particularly susceptible to impacts from outside sources. Coupled with habitat loss and human impacts on populations not confined to islands, an estimated 37% of extant Rallid species are ecologically at risk of extinction due to habitat destruction and fragmentation or from the introduction of exotic species (Feduccia 1996, Garcia-R. 2014, Winkler 2015).

One species of conservation concern is the Yellow Rail (*Coturnicops noveboracensis*), a small, nocturnal, marsh-dwelling Rallid which breeds across Nova Scotia west to Montana, Alberta, and British Columbia (Phinney 2015, Fournier 2017b) **(**Figure 1**)**. A small isolated population of Yellow Rails breeds and winters in parts of California and Oregon (Miller et al. 2012). It is a species of special concern in Canada and in most of the states where breeding populations exist. This is due to its relatively small population size (only 17,500 individuals), small wintering range, and ongoing threats to breeding and wintering wetland habitats (Sibley 2001, Butcher 2007, Phinney 2015, Birdlife International 2016). Due to the primary vocalization period being at night, Yellow Rails are rarely encountered during North American breeding bird surveys (Bookhout and Stenzel 1987, Martin 2011). Early morning or evening surveys for marsh birds occasionally record Yellow Rails, but these numbers do not provide an adequate population estimate as they are not gathered during the primary vocalization period (Alvo 1999, Martin 2011). Yellow Rails are a migratory species, spending their winters in the coastal regions of the United States from Texas to North Carolina (Butler et al. 2010, Phinney 2015, Fournier 2017b). In recent years, it was discovered that Yellow Rail have overwintering territories in the southeastern corner of Oklahoma in the Red Slough Wildlife Management Area (WMA; Butler 2010, Butler 2011).

Figure 1. Adult Yellow Rail in Typical Habitat

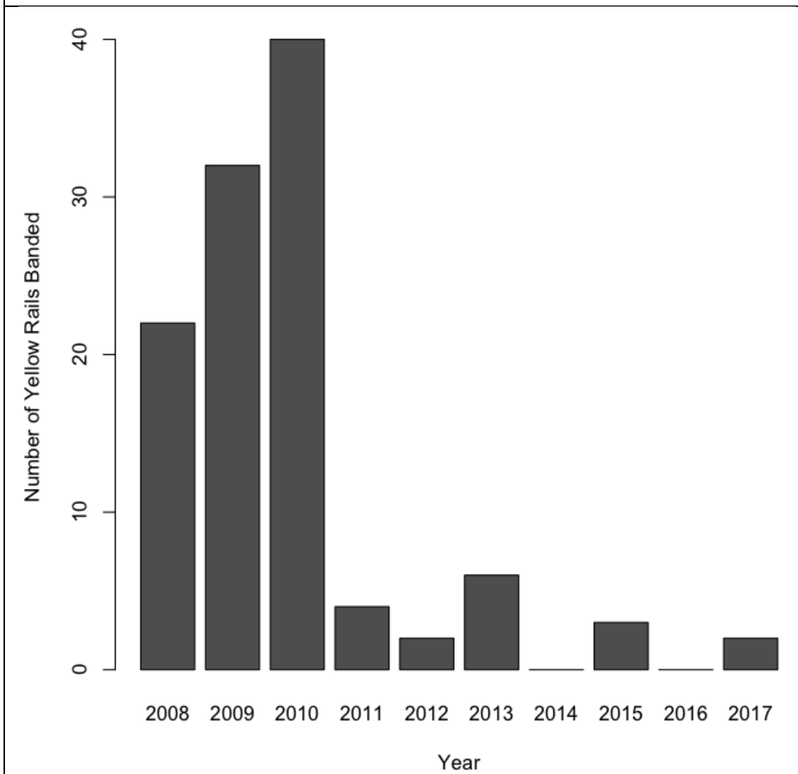
The habitat requirements of Yellow Rails during the breeding season are well understood, with this species requiring shallow marshes dominated by sedges (Stenzel 1982, Bookhout and Stenzel 1987, Gibbs 1991, Robert and Laporte 1999, Luterbach 2000, Popper and Stern 2000, Martin 2011). Higher preference is given to sites that flood in spring but markedly drier at the end of summer (Stenzel 1982, Bookhout and Stenzel 1987, Popper and Stern 2000). The influence of other vegetation types, water depth, and overall size of habitat is not well studied (Martin 2011). During their breeding season, annual fluctuations of water level in marshes greatly influence Yellow Rail habitat selection (Phinney 2015). Large marsh patches tend to hold larger numbers, as the potential for individuals to shift territories and respond to current conditions makes this habitat type most suitable (Phinney 2015). During migration, they select habitat based on water conditions and vegetation cover, with a preference for shallowly flooded wetlands or prairies with dense vegetation (Fournier 2017b).

In contrast, there are relatively few studies that examine the habitat preference of this species in winter. For example, Butler et al. (2010) found Yellow Rails in damp, grassy fields dominated by perennial grasses (*Sporobolus* spp.), while Morris et al. (2017) found that fire was important in maintaining suitable habitat in Mississippi. Details about required minimum patch size, vegetative structure, and hydrology are not reported in the literature.

Yellow Rail are considered a "species of greatest conservation need" in Oklahoma (Donnell et al. 2015) but the status of Yellow Rails in Oklahoma is not well understood. Annual attempts to flush Yellow Rails at Red Slough WMA began in the early 2000s and individuals were documented at Red Slough WMA during the autumnal migratory period (Heck and Arbor 2008).

Targeted surveys for wintering Yellow Rails (from December to March) were initiated in 2008 and twenty-five individuals were banded during the two-year study period (Butler et al. 2010). During the 2009/10 field season, the density of Yellow Rails overwintering at Red Slough was comparable to the density along the Texas Gulf Coast, with approximately 5.3 birds per ha (Butler et al. 2016). However, as Figure 2 shows, in 2011 the wintering population crashed, and has yet to recover.

Figure 2. Number of Yellow Rails banded at Red Slough WMA from 2008-2017



The causes for the decline in wintering Yellow Rails at Red Slough are unclear, but we hypothesize successional change in habitat is the primary reason. A multi-year drought leading to water shortages may have accelerated succession at the sites where Yellow Rails were consistently found previously. Yellow Rails were captured in areas where the vegetation averaged 44.1 ± 4.6 cm in height with small amounts of woody vegetation. Presently the sites at Red Slough that have previously held Yellow Rails appear to be overgrown with an abundance of aggressive moist-soil forbs and grasses such as sumpweed (*Iva annua),* broomsedge bluestem (*Andropogon virginicus*), and saltmarsh aster (*Symphyotrichum divaricatum*). The goals of this project were to estimate the distribution and abundance of Yellow Rails in Oklahoma by surveys, and to quantify the habitat associations of wintering Yellow Rails.

Approach

Study Areas

The study areas included two state-managed Wildlife Management Areas and one federally-managed National Wildlife Refuge: Red Slough WMA (McCurtain County), Hugo WMA (Choctaw County) and Sequoyah NWR (Sequoyah County). We surveyed three units at Red Slough, three sites at Hugo WMA and three sites at Sequoyah NWR.

Surveys

Surveys took place monthly from October through April during 2017-18 and again during 2018-19. During the winter, three approaches were used to band birds. First, we used the procedure outlined by Butler et al. (2010) to catch Yellow Rails, as well as incidental Le Conte's Sparrows and Sedge Wrens. We dragged a 12 m rope weighted with bottles (filled with rocks) through each field at night and birds were captured using handheld nets. Two people held the ends of the rope, while the remainder spaced themselves evenly behind the rope, maintaining a distance of 2-4 m from the rope. We used adjacent transects to sample for birds covering the fields from edge to edge. Lanterns were placed on opposite ends of the field in order to ensure that transects were straight. Sampling times began one hour after sunset and continued until the entire study site had been covered by the bottle line (Butler et al. 2010, Morris et al. 2017). Where possible, we also captured Yellow Rails, which we banded and aged according to Pyle (2008).

Vegetation Measurements

We measured vegetation at wintering sites during November and December. Quantification of habitat covariates followed the BBIRD Grassland Protocol (Martin et al. 1997). Vegetation variables were measured at one, three, and five meter intervals in four cardinal directions from a central point. We averaged the vegetation variables for the four cardinal directions to a single value for the site. We assessed coverage within the 10 m diameter circle by estimating the percentages of each cover type. We initially assessed cover types as vegetation, water, and bare ground. After this initial assessment, we quantified different vegetation cover types within the vegetation cover1 m^2 at the center of the plot to determine percent cover by grasses, forbs, succulents, etc. within a 1 m x 1 m square. Variables measured included: vegetation height, litter depth, water depth, stem density, canopy height, and species composition. Table 1 provides a summary of all measured variables. We also included habitat measurements from 16 additional sites from Florida to Texas, which we surveyed for Yellow Rails during 2013-2019. These sites were surveyed during other projects separate from this grant, but they were similar in vegetation structure and their data were included in the analysis to strengthen the habitat characterization.

Statistical Analysis

We used occupancy modeling to estimate the probabilities of detection and the proportion of sites used by wintering Yellow Rails, as well as explore the effects of habitat covariates. Covariates were normalized and scaled, and we utilized the program PRESENCE to estimate occupancy (Mackenzie et al. 2006). Occupancy models using multiple vegetation and land use variables were created in program PRESENCE. Models were evaluated using Akaike's Information Criterion (AIC) scores (Akaike 1983). Models of occupancy (ψ) were then created using all possible combinations of uncorrelated (i.e., $p > 0.05$ for each correlation) site-specific variables We also used a Spearman's rank correlation to examine whether fall precipitation was linked to the number of Yellow Rails detected, as well as to examine whether vegetation measurements from 23 sites (seven in Oklahoma, 16 across the Gulf Coast) correlated with the presence of Yellow Rails. Finally, we obtained location data of wintering Yellow Rails from museums, eBird, and Christmas Bird Counts and used Maxent to model the projected distribution of Yellow Rails during winter Oklahoma in response to 19 bioclimatic variables and elevation at a resolution of 2.5 arc-minutes (Table 2). We used all Worldclim data layers as our predictors, since our goal was to create a model with the greatest predictive power, not one which would allow for inference about environmental drivers (Beaumont et al. 2005, Hijmans et al. 2005, Porfiro et al. 2014). We eliminated duplicates and resampled the observations to no more than one locality observation per 2.5 arc-minutes. We then quantified suitability for locations where Yellow Rails have been documented overwintering in Oklahoma, including Hugo WMA and Red Slough WMA (Butler et al. 2010, 2011), and created a map showing potentially suitable areas for wintering Yellow Rails in Oklahoma.

Table 1. Descriptions of site-specific variables included in the analysis of Yellow Rail occupancy.

Variable	**Description**
BareAvg	Average % of all four quadrants covered by bare ground
ForAvg	Average % of all four quadrants covered by forbs
GrassAvg	Average % of all four quadrants covered by grasses
GreenAvg	Average % of green cover in the center $1m^2$
MarAvg	Average % of all four quadrants covered by marsh vegetation (primarily cattails, *Typha* sp.)
Robel	Average Robel pole vegetation density measured at 5 m, 3 m, and 1 m for the four cardinal directions
SedAvg	Average % of all four quadrants covered by sedges
ShrAvg	Average % of all four quadrants covered by shrubs
VegAvg	Average % of all four quadrants covered by vegetation
Veg_height	Average vegetation height (in cm) measured at 5 m, 3 m, and 1 m for the four cardinal directions
WatAvg	Average % of all four quadrants covered by water
Water_depth	Average water depth (in cm) measured at 5 m, 3 m, and 1 m for the four cardinal directions
0to10	Average number of stems at 0-10 cm height at 5 m, 3 m, and 1 m for the four cardinal directions
10to20	Average number of stems at 10-10 cm height at 5 m, 3 m, and 1 m for the four cardinal directions
20to30	Average number of stems at 20-30 cm height at 5 m, 3 m, and 1 m for the four cardinal directions
30to40	Average number of stems at 30-40 cm height at 5 m, 3 m, and 1 m for the four cardinal directions

Table 2. Summary of bioclimatic variables used in creating the wintering Yellow Rail species distribution model.

Variable	Definition
BIO 1	Annual mean temperature
BIO 2	Mean diurnal range (Mean of monthly [max temp - min temp])
BIO 3	Isothermality (BIO 2 / BIO 7) * 100
BIO 4	Temperature seasonality (standard deviation * 100)
BIO 5	Max temperature of warmest month
BIO 6	Min temperature of coldest month
BIO 7	Temperature annual range (BIO 5 - BIO 6)
BIO 8	Mean temperature of wettest quarter
BIO 9	Mean temperature of driest quarter
BIO 10	Mean temperature of warmest quarter
BIO 11	Mean temperature of coldest quarter
BIO 12	Annual precipitation
BIO 13	Precipitation of wettest month
BIO 14	Precipitation of driest month
BIO 15	Precipitation seasonality (coefficient of variation)
BIO 16	Precipitation of wettest quarter
BIO 17	Precipitation of driest quarter
BIO 18	Precipitation of warmest quarter
BIO 19	Precipitation of coldest quarter
Elevation	Elevation above sea level

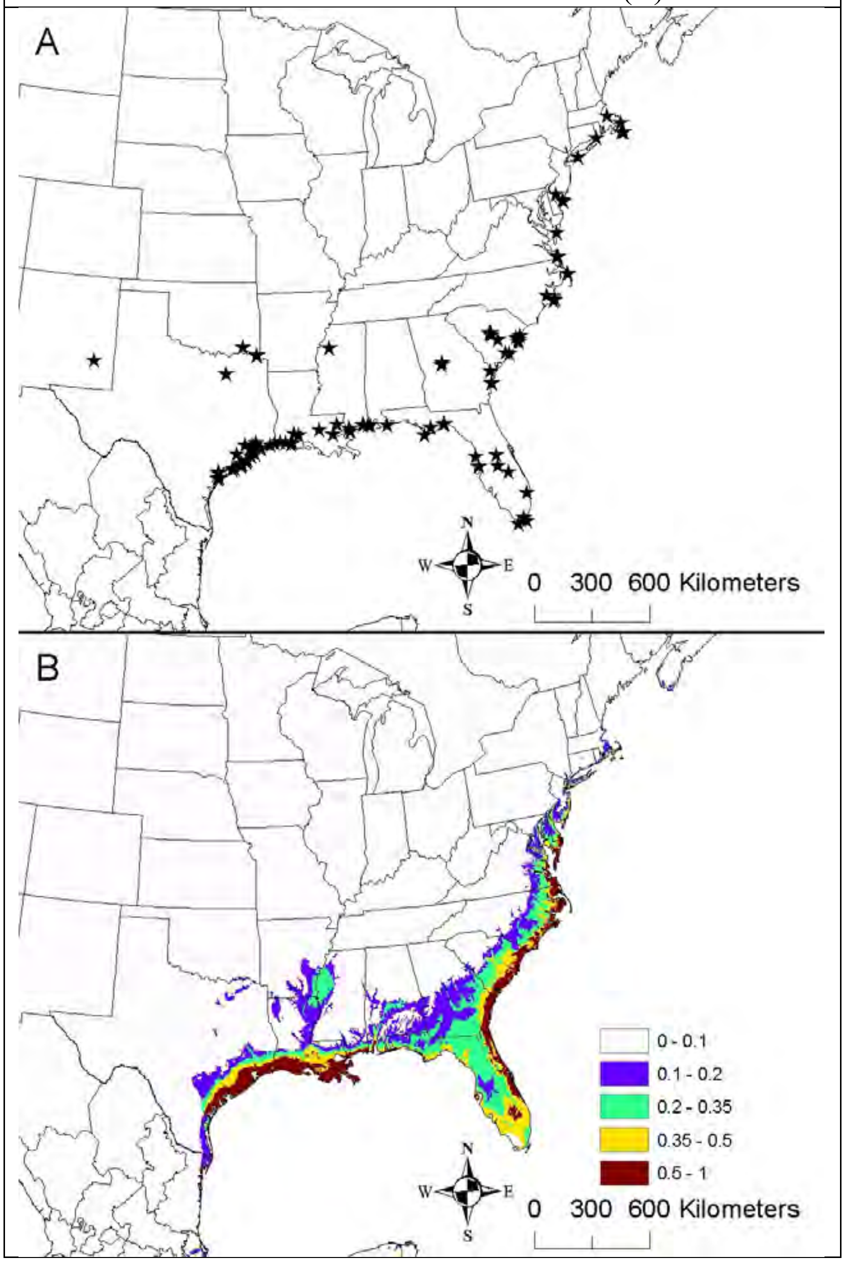
Results and Discussion

The objectives of this study were to estimate the distribution and abundance of Yellow Rails in Oklahoma, and to quantify the habitat associations of wintering Yellow Rails. Both objectives were met as detailed below.

Estimating the distribution and abundance of Yellow Rails in Oklahoma

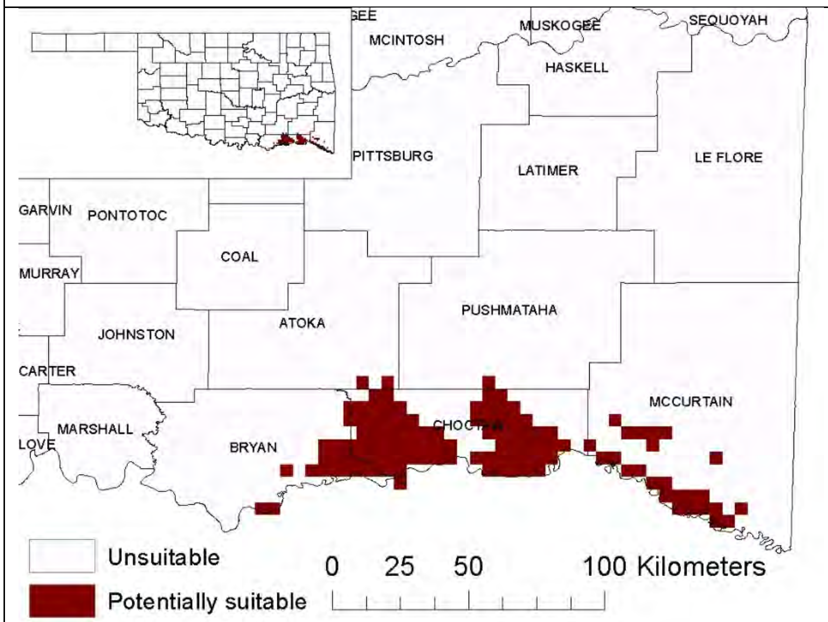
Seven Yellow Rail were found from October to April of 2017-18. Of these, three were successfully captured and banded. Of the total number, six were found at Red Slough WMA, and one was found at Sequoyah NWR. Four Yellow Rail were found during the 2018-19 season, three of which were banded, and all Yellow Rail detections occurred at Red Slough. There were no Yellow Rail found at Hugo WMA for either season.

Figure 3. A total of 296 locations with records of wintering Yellow Rails were used in the model (A). The model suggest that the greatest suitability for Yellow Rails was along the Gulf Coast, from Texas through Alabama, and along the Atlantic Coast from Delaware south to Florida (B).



We obtained 295 locations for wintering Yellow Rails (Figure 3). The species distribution model suggested that the greatest suitability for this species occurs along the Gulf Coast from Texas through Alabama, and along the Atlantic coast from Florida north to Delaware (Figure 3). In Oklahoma, suitability was generally low, and was restricted to extreme southeastern Oklahoma. Suitability for this species in Oklahoma at Red Slough WMA and Hugo WMA, where Yellow Rails had previously been documented overwintering was approximately 8%. A map showing areas of equal or greater suitability shows that bioclimatic conditions are suitable for Yellow Rails to overwinter in McCurtain, Choctaw, and Bryan Counties (Figure 4).

Figure 4. Areas that are potentially suitable for overwintering Yellow Rails are restricted to extreme southeastern Oklahoma from Bryan County east to McCurtain County.



Quantifying the habitat associations of wintering Yellow Rails

Model averaged occupancy modeling suggests that 64.7% ± 11.3% of the surveyed locations were occupied by Yellow Rails. However, note that detectability was low, averaging only 25.4% ± 0.01%. The best model for determining the presence of Yellow Rails was water depth, although there was also support for the amount of shrubs, marsh vegetation, grass, and sedge (Table 3). In general, occupancy was highest where the water depth ranged from 1-3 cm, marsh vegetation was not present, shrubs were not present, the area was at least 60% grass, and some sedges were present (Figure 5). A moderate correlation was found with the combined rainfall for September and October with the number of rails found at Red Slough WMA, but the effect was not significant (Spearman's $\rho = 0.474$, $p = 0.142$). The presence of Yellow Rails across the Gulf Coast and Oklahoma exhibited a moderate positive correlation with the number of stems at 10 cm, the number of stems at 20 cm, the number of stems at 30 cm, and the percent of green vegetation (Table 4).

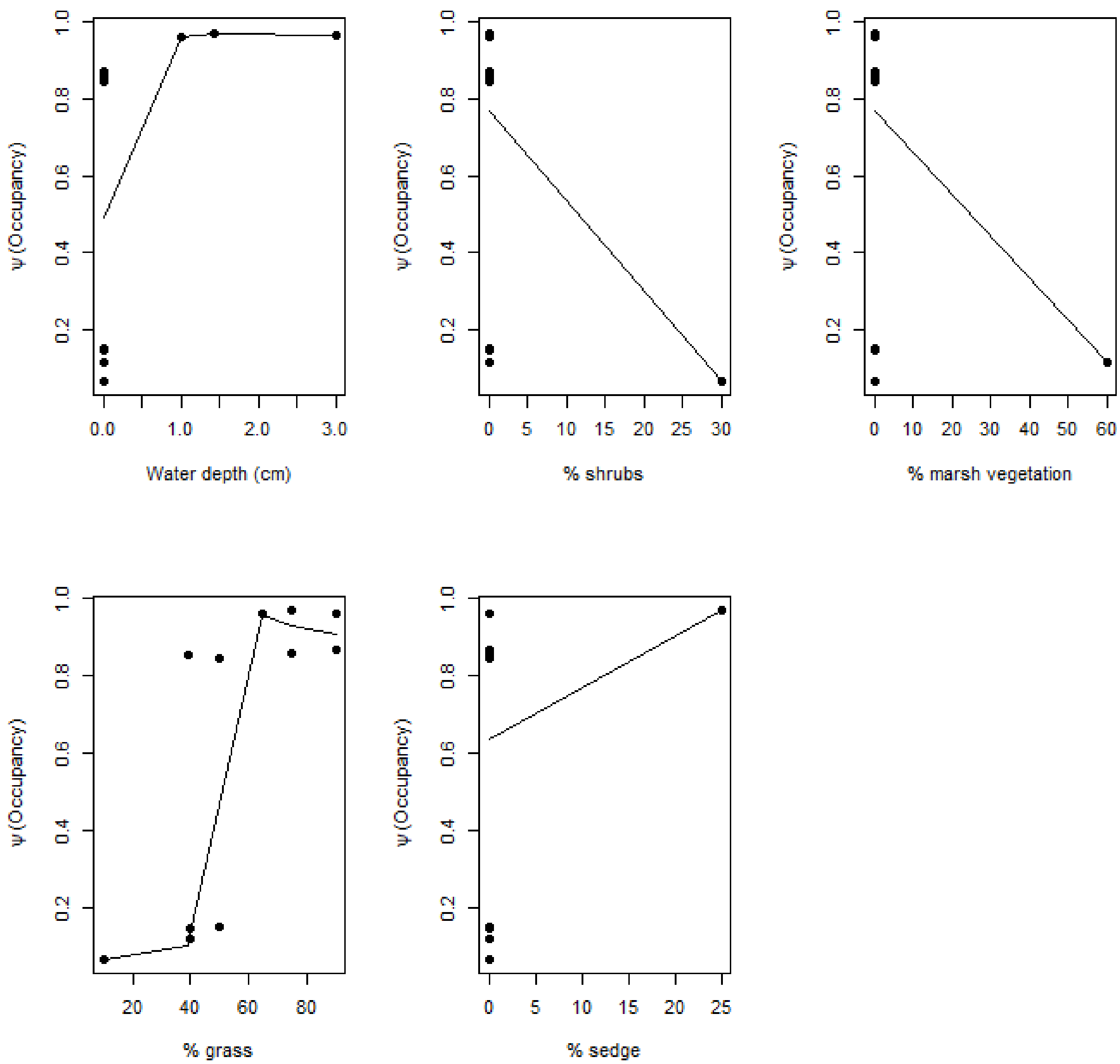
Table 3. The top 10 models for occupancy. Water depth, as well as by the presence of shrubs, grass, and marsh vegetation, are the primary variables that affect occupancy.

Model	AIC	ΔAIC	Occupancy	Model weight
Ψ(water_depth)	72.73	0	1.00	0.15
Ψ(water_depth and shrubs)	73.56	0.83	0.27	0.10
Ψ(water_depth and marsh vegetation)	74.38	1.65	0.27	0.07
Ψ(water_depth and grass)	74.71	1.98	0.27	0.06
Ψ(water_depth and sedge)	74.73	2	0.27	0.05
Ψ(water_depth, marsh vegetation, grass)	75.55	2.82	0.27	0.04
Ψ(water_depth, marsh vegetation, sedge)	75.56	2.83	0.27	0.04
Ψ(grass)	76.04	3.31	0.50	0.03
Ψ(water_depth, marsh vegetation, grass)	76.36	3.63	0.27	0.02
Ψ(water_depth, marsh vegetation, sedge)	76.38	3.65	0.27	0.02

Table 4. Correlations of measured vegetative characteristics with the presence of Yellow Rails across 23 sites, from Florida to Texas and north to Oklahoma. Only the top 10 correlations are shown.

Variable	**Spearman's p**
0to10	0.41
10to20	0.40
GreenAvg	0.36
20to30	0.34
MarAvg	-0.28
SucAvg	-0.28
Litter	-0.28
ShrAvg	-0.25
SedAvg	0.20
Veg_height	0.19

Figure 5. Occupancy for Yellow Rails was positively associated with water depth, amount of grass, and amount of sedge and was negatively associated with the amount of marsh vegetation and the amount of shrubs



Recommendations

Yellow Rails overwintering in Oklahoma are at the very northwestern edge of their range with documented overwintering birds restricted to McCurtain and Choctaw Counties (Butler et al. 2010, 2011). Although the density of Yellow Rails had previously been documented to be comparable to the core winter range in Texas, the population crashed in 2011 and has not yet recovered. Based on the results of this study, it appears that the persistence of Yellow Rails in Oklahoma depends upon a combination of precipitation and management practices. The precipitous decline in numbers banded at Red Slough after 2011 appears to be due to invasion by sumpweed, broomsedge, and saltmarsh aster, as well as a change in the mowing schedule.

To maintain a population of Yellow Rails in Oklahoma, a biannual or triannual controlled burning plan at each site would be helpful. Morris et al. (2017) found substantially higher numbers of wintering Yellow Rails at sites that had been burned 1- 2 years prior. Considering the time and resources required to perform a prescribed burn, annual mowing during the month of June is a potentially more cost and time effective alternative. Many of the invasive grass species present in these sites flower earlier in the summer, so mowing or burning before seed development should help reduce their abundance (Wilson and Clark 2001, Prevéy et al 2014). In addition, early summer treatment will allow the vegetation to reach a suitable height for wintering Yellow Rails by the end of the growing season.

Although Yellow Rails had previously been documenting overwintering at Hugo WMA (Butler et al. 2011), we were unable to locate any birds there over the course of this study. In part, this may be due to the timing of mowing of these areas. For example, during 2018, the fields were mowed shortly before the start of the field season, resulting in vegetation that appeared to be too short to support wintering Yellow Rails. Shifting the mowing schedule to early June would improve habitat at this location.

Another management regime that would be beneficial to the presence of Yellow Rails is to limit the planting of trees in damp grassy areas. These birds depend upon early successional habitat, and conversion of damp grassy fields to lowland forest means that Yellow Rails will cease to use these sites. For example, the recently acquired expansion for Grassy Slough WMA looks potentially suitable for Yellow Rails, but it appears that there has been widespread planting of trees at this location, which will quickly turn the site unsuitable for Yellow Rails.

Finally, it may be worthwhile reaching out to local landowners within McCurtain, Choctaw, and Bryan counties to see whether these sites may have Yellow Rails during migration or winter. There is a very successful "Yellow Rails and Rice" festival that is held in southwestern Louisiana each year, where numerous participants come to see Yellow Rails that are flushed from fields as local landowners harvest rice. While rice farming is quite limited in Oklahoma, there may be opportunities to work with local landowners who are harvesting hayfields in these counties, which may potentially flush Yellow Rails. Additionally, it may be possible to enroll some landowners in these counties in the OLAP program, which could result in additional incentive to maintain suitable habitat for this rare and local species in Oklahoma.

Significant Deviations: None

Equipment: No equipment was purchased

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Date: 22 August 2019

Approved By:

Wildlife Division Administration
Oklahoma Department of Wildlife Conservation

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