DUCK NESTING SUCCESS AND SMALL MAMMAL ABUNDANCES ON FISH SPRINGS NATIONAL WILDLIFE REFUGE, JUAB COUNTY, UTAH

A REPORT PREPARED FOR UTAH DWR

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INTRODUCTION

Population growth (λ) is the product of demographic processes such as age- or stage-specific survival rates. These demographic processes, also known as vital rates, vary in time and space and have differing levels of influence on population growth. It is well known that a key aspect of population growth is recruitment, but even within this area of focus several different vital rates—such as female survival during the breeding season or juvenile mortality rate—can affect this dynamic. For example, in ground-nesting birds, nest success has been found to be an important determinant of recruitment and population growth rate (Hoekman et al., 2002). In sensitivity analyses of midcontinental mallards, it was found that perturbations of nest success caused the largest changes to λ when compared to other vital rates (Hoekman et al., 2002).

Understanding not only which factors have the greatest effect on a population, but which factors potentially effect these vital rates can be important for effectively managing a population. In ground-nesting birds, factors such as weather (Harvey 1971), food availability (Gloutney & Clark 1991), and nest parasitism (Lokemoen 1991) have been demonstrated to influence nest success, largely through abandonment. However, the greatest cause of nest failure in ground-nesting birds is nest depredation (Klett et al. 1988). Not only do predators cause nest failure directly by killing nesting individuals or depredating nests, but their presence can indirectly reduce nest success. In a study of several passerine species in Arizona, when predators were being experimentally controlled, parental investment increased in the form of higher rates of nestling feeding, increased egg size, greater clutch mass, and higher rates of males feeding incubating females (Fontaine & Martin 2006). Increased predator pressure may reduce these actions as nesting individuals seek to conserve energy in the event that renesting is required, and as individuals attempt to reduce activity that could draw predator attention to the nest (Fontaine & Martin 2006).

Studies have since been done to assess the effects of predation on nest success. These studies have investigated several aspects of these predator-prey interactions, from the differential effects of particular predators on nest success, to the effects of nesting patch size on the likelihood of predation. However, the majority of nest success studies in the past have been conducted in the Prairie Pothole Region (PPR) of the United States and Canada, North America's most significant waterfowl breeding ground. Exploring nest predation processes in dissimilar or unique nesting habitats can help determine how general the processes are, informing management of important nesting areas outside of the PPR. For example, Fish Springs National Wildlife Refuge (FSNWR) in the West Desert of Utah includes nearly 10,000 acres of wetland habitat inundated by artesian springs. Unlike other waterfowl nesting sites, where human activity has reduced the habitat to fragmented islands in a matrix of agricultural fields, development and livestock pasture, FSNWR is a habitat island in the midst of a salt-desert ecosystem, characterized by salt-tolerant vegetation (*Sarcobatus vermiculatus*, *Spartina gracilis*, *Atriplex confertifolia*). The PPR's matrix of agricultural land use favors a broad variety of generalist mesopredators, likely at elevated densities due to the greater and more persistent food resources associated with anthropogenic development (Fedriani et al. 2001, McKinney 2001). The location of FSNWR in the West Desert results in the surrounding area being relatively inhospitable, limiting the spectrum of mesopredator species capable of surviving here. The suite of mesopredators found at FSNWR includes primarily bobcat, coyote, raven, snakes, and rarely kit fox and badger. This creates a unique situation for waterfowl management and investigations of nest success. In other habitats that are more like the PPR, it has been noted that the variety of predators have made it almost futile to attempt to understand nest site characteristics that increase nest success; there is always some type of predator adapted to counteract any adaptation the waterfowl have developed to select safe nest sites (Jiménez et al. 2007). Perhaps, with the simplified predator base, FSNWR will provide a different picture of nest site selection. This knowledge could potentially allow managers to identify some of the safe nest site characteristics of the refuge, potentially allowing them to implement management practices that could increase nest success at FSNWR.

Alternative prey may play an important role in nest survival by providing prey resources to predators (Ackerman 2002). Increased small mammal abundances have been positively correlated with duck nest success, presumably providing a buffer against depredation as predators forage for small mammals rather than nests (Adkins 2003). Predators have been shown to prey on duck nests opportunistically while foraging for other food sources (Vickery et al. 1992), therefore, small mammal populations may provide enough food sources to satiate the simplified predator base on the refuge, resulting in increased nest survival. Understanding the relationship between small mammals and nest success can help guide future management decisions to help increase waterfowl production on the refuge.

Each refuge within the National Wildlife Refuge System, is expected to create a refuge management plan with the purpose of managing for the conservation of the wildlife, plants and habitats found on the refuge, and to do so in a way that achieves the purposes behind the formation of the refuge and the Refuge System Mission of establishing a network of lands and waters for the management of wildlife resources for future generations. Part of creating these refuge management plans is gathering baseline information on the species within the area, which will be vital in making management decisions in the future. An investigation of nest success and the factors affecting it on FSNWR will not only provide important information to inform future management and create a comprehensive refuge management plan, but it will do so in a way that addresses the motivations behind the formation of the refuge: the protection and support of migratory birds.

Our objective is to quantify duck production on the refuge and understand the factors that may be limiting nest survival, including understanding the interactions between small mammal populations and nest depredation. The information gained from the study will help guide management decisions for the refuge, as well as provide insight on factors affecting nest survival and nest site selection in unique habitats other than the PPR.

SITE DESCRIPTION

FSNWR is located in Juab County of Utah, at the southern end of the Great Salt Lake Desert. It is roughly two hours southwest of Dugway Proving Grounds. The refuge is composed of 17,992 acres, and includes 10,000 acres of spring-fed wetlands. Five main artesian springs at the base of the Fish Springs Range provide water to the refuge, along with several lesser upwellings. Although the springs vary in temperature and salinity, they are all brackish and warm. The dry areas of the refuge are dominated by a salt-desert shrub community, with

Distichlis spicata and *Sporobolus airoides* as common grasses and *Sarcobatus vermiculatus* and *Atriplex canescens* as common shrubs. Wet areas of the refuge support several different types of sedges and rushes. Common vegetation in these areas include *Distichlis spicata*, *Juncus balticus*, *Schoenoplectus acutus,* cattail species (*Typha domingensis* and *T. latifolia*), and *Phragmites australis* (USFWS 2004). On average, the hottest month is July, with January being the coolest month on the refuge. April is the average wettest month (NOAA). On average the refuge receives 8 inches of precipitation, with the majority falling in the spring and fall. Temperatures can range from 109° F during the summer to -19° F in winter, but the springs never freeze over completely (USFWS 2004). Frost-free days generally extend from late April until mid-October (NOAA).

METHODS

Nest Dragging

Nests were located using teams of 2 dragging a 50 m cable-chain behind all-terrain vehicles (Klett et al. 1986). Speeds were kept between 3-8 km/h by keeping ATV's in low gear allowing drivers to stay in a straight line and watch the cable drag (Klett et al. 1986). Dragging at speeds faster than 8 km/h increases the likelihood of the chain passing over a nest without flushing the hen. I searched for nests between 0700 and 1400 to maximize the probability of the hen being on the nest (Gloutney et al. 1993). I performed 2 searches on each plot to try and find nests from early and late nesting species. I marked each nest found with a 1-m wooden lathe painted orange to allow easy visualization in the field by searchers. The wooden lathe was placed 10-m north of the nest and numbered to give each nest its own unique identification. Nests were monitored on 7 day intervals until fate was determined (e.g., successful, depredated, abandoned). Clutch size and incubation status were determined at each visit. Incubation status was determined with a simple field candler (Weller 1956) made from 1 ½ -inch radiator hose. Data recorded at the nest site included: date, plot, species, distance to nearest road, distance to nearest water, and Universal Transverse Mercator coordinates. After each visit, nests were covered using material from the nest and a marker in the form of an X was made out of vegetation and placed on top. If the X was found undisturbed on the next visit, the nest was considered abandoned due to investigator disturbance and censored from survival analysis.

Small Mammal Trapping

Small mammal trapping followed Hadley (2002). I created a web of random points within each plot to determine the placement of traps (Figure 1). Sherman© live traps were laid out in a web pattern, with 2 webs containing 30 traps and 1 web containing 36 traps for a total of 96 traps. To sample small mammal populations throughout the waterfowl nesting period, 3 primary trapping sessions were completed. These primary sessions occurred in consecutive weeks with each primary session having 3 secondary sessions. This gave a total of 864 trap nights. Traps were checked once daily and closed after the daily check, then reopened each evening. Traps were baited with rolled oats and peanut butter and a cotton ball was placed in each trap to reduce small mammal deaths due to hypothermia. Animals were identified to species and on the first capture marked with a numbered ear tag (size 1005-1).

Statistical Analysis

I calculated the daily survival rate of nests using the Mayfield method (Mayfield 1975). Due to a small sample size, modeling to determine factors having the most influence on nest success was not possible. I assumed a 35-day exposure period (Klett et al. 1986) to convert DSR to point estimates of nest success. I used the mark recapture data from small mammals to determine the catch per unit effort (CPUE). The CPUE is an indication to the relative abundance of small mammals on each plot. With low sample sizes of nests, we were not able to use the small mammal abundance data in our analysis of nest success.

RESULTS

A total of the 8 nests were found at FSNWR through nest searching efforts including; 2 Mallards, 3 Gadwalls, 1 Northern Shoveler (*Anas clypeata*), 1 Canvasback, and 1 Cinnamon Teal. Of the 8 nests located, 3 successfully hatched, resulting in a daily survival rate of 0.969. The estimated Mayfield nest success rate was 33.61%. Hens nested in similar vegetation, with 4 nesting in baltic rush, 3 nesting in alkali sacaton (*Sporobolus airoides*)/baltic rush, and 1 nesting in saltgrass. Nests were placed, on average, 204.3 m from roads and 94.0 m from water. The average vegetation height for nests was 37.5 cm with an average visual obstruction of 38.3 cm and a litter depth 3.19 cm.

Small mammal trapping efforts resulting in 71 total captures over 860 trap nights. This resulted in a CPUE of 8.25 captures per 100 trap nights. The Avocet trap grid had the highest capture rate at 22.14 captures per 100 trap nights. Pintail and Shoveler trap grids had similar CPUE at 6.97 and 7.80 captures per 100 trap nights, respectively. Of the 71 captures, 65 were Western Harvest mice (*Reithrodontomys megalotis*), 5 were Deer mice (*Peromyscus maniculatus*), and the other was a house mouse (*Mus musculus*).

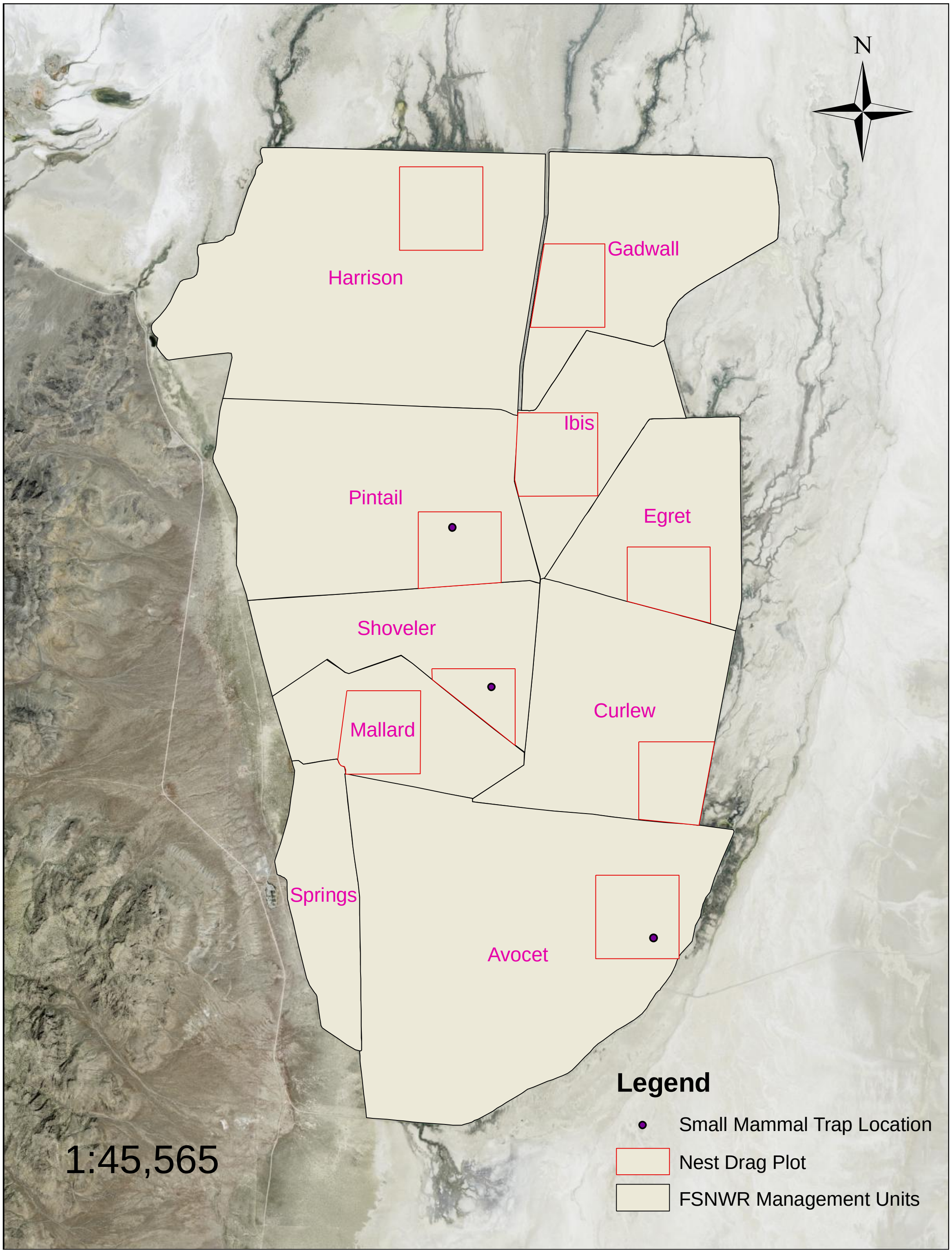
DISCUSSION

Duck production appears to be at an all-time low at FSNWR. Comparisons to the most recent nest production studies (1989-1993) on the refuge indicate nest success has increased on the refuge, however, the low number of nests found does not likely provide an accurate estimate, leaving any inference from the results very weak. Due to the lack of nests found in this study, brood surveys were conducted during bi-weekly avian surveys. These surveys were not meant to serve as a production estimate, rather to try and identify if more hens were nesting on the refuge than implied by nest searching efforts and went undetected. These surveys resulted in a minimum (maximum cannot be determined due to inability to differentiate broods from one survey to the next because no individuals were marked) of 10 broods on the refuge. This is likely an underestimate of broods on the refuge as surveys were conducted from roads while completing other tasks, making it unlikely to census all broods, especially dabbling duck broods which prefer to rest and forage in emergent cover (Ringelman and Flake 1980). Despite the deficiencies in survey methods, the low number of broods observed suggests this study provided a relatively accurate sample of nesting activities on the refuge.

Results from this study showed the highest Mayfield nest success rates recorded on the refuge, however, it also showed the fewest number of nests located on the refuge. The increased success this year may have been a result of fewer hens nesting on the refuge, allowing hens that did nest in the area to select the safest nesting locations available. This should be interpreted with caution, however, as the small sample size likely did not give a good representation of nest success for the refuge.

Due to the small sample size of nests found, I was not able to use the small mammal abundance data to model its effect on nest success. The data collected, however, suggests that areas that are managed for duck nesting are also providing suitable habitat for small mammals, especially western harvest mice. Diversity of small mammals captured during this study was much lower than previous records (FSNWR unpublished data). This was likely due to the habitat where trap occurred, rather than an actual decrease in small mammal diversity on the refuge. Previous trapping efforts on the refuge indicate small mammal diversity is greatest in the the foothills of the mountains, while the marsh/wetland areas, where sampling occurred for this study, have the lowest diversity (Robson and Rickart unpublished report). Robson and Rickart (unpublished data) also indicated a concern over an increased abundance of house mice, an invasive species that may compete for resources with native species. In this study, I only captured 1 house mouse in trapping efforts, whereas this species made up ~10% of all captures in the previous study. The majority of the captures of house mice in the previous study occurred in similar habitat as trapping efforts of this study. This provides evidence, albeit trivial, that house mice populations may be declining and may not be having an impact on native species on the refuge. A more complete sampling effort is needed to determine the status of house mice on the refuge, as well as determine if species richness of small mammals has changed over time.

Figure 1. Map of nest drag plots and small mammal trapping locations within management units at the Fish Springs National Wildlife Refuge (FSNWR), Juab County, Utah.



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