Shorebird Nesting Success Report
Bear River Migratory Bird Refuge
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INTRODUCTION

PROJECT SUMMARY

Human population growth affects the earth's ecosystems in a variety of ways. One of the most striking and persistent is through habitat fragmentation where once large continuous tracts of native vegetation are converted to other vegetation types and land uses. Habitat fragmentation is thought to negatively affect bird populations through increased rates of nest predation. This is of particular importance for shorebirds breeding in northern Utah because 1) many species of shorebirds have been declining precipitously and 2) much of the habitat required for breeding and foraging along the Wasatch Front has been fragmented due to urbanization. This project will investigate the effects of habitat fragmentation and urbanization on the reproductive success of shorebirds in an attempt to provide critical information for their conservation.

BACKGROUND AND OBJECTIVES OF RESEARCH/PROJECT.

The Wasatch Front is defined as the five Utah counties concentrated between the valley of the Wasatch Mountains and the Great Salt Lake. The population of this region (1.3 million) contains slightly more than half the state's 2.2 million people. Because of the state's unique demographics; the youngest population in the country with the highest fertility rate and the second lowest death rate, population projections indicate that the Wasatch Front will contain 2.3 million people by the year 2030. This rapid growth and associated urbanization has created a number of ecological problems. One such problem is habitat fragmentation.

Habitat fragmentation occurs when large, continuous tracts of native vegetation are converted to other vegetation types or land uses so that only a few scattered fragments of original vegetation remain (Faaborg et al.1995). Fragmentation is a characteristic feature of most human dominated landscapes and is particularly evident along the Wasatch Front. Many studies have shown that habitat fragmentation can change the abundance and diversity of avian communities (Emlen 1974, Blair 1996). A number of mechanisms might underlie these changes. For example, fragmented habitats may have a higher proportion of nest predators or a different suite of predators relative to unfragmented sites (Haskell et al. 2001). This change in nest predator abundance and diversity may increase the rates of predation on eggs and young (Wilcove 1999, Cavitt and Martin 2002). For the past several decades considerable attention has been given to the effects of forest fragmentation on avian populations within North America because of widespread population declines (Cavitt and Martin 2002 and references therein). However, the effects of habitat fragmentation on wetland breeding species are largely unknown.

Because of habitat loss and alteration, populations of many shorebird species are in severe decline (Oring et al. 2003a). For example, a 1995 summary indicated that more than half the shorebird species evaluated were declining (Brown et al. 2001). A reversal of these declines requires an understanding of the population dynamics (factors affecting productivity and survival) of shorebird species. Unfortunately, we currently lack a sound knowledge of many aspects of their basic biology. This knowledge is essential for the successful conservation and management of these populations.

This preliminary study was initiated to establish a baseline of nesting success for one of the most important breeding sites of shorebirds within the Greater Salt Lake Ecosystem, the Bear River Migratory Bird Refuge.

This project is part of a longterm study that will allow: 1) identification of species' breeding habitat requirements, 2) assessment of current population health based on breeding productivity, and 3) projection of species vulnerability to habitat disturbance and land management.

PROCEDURES AND METHODS.

This preliminary study was conducted from late April to late July of 2003 on the Bear River Migratory Bird Refuge. Four study plots were located and monitored throughout the breeding season (Unit 2B, 2C, 3E and the dikes surrounding 3E). Each plot was searched twice weekly for the presence of shorebird nests. Because flagging or other visible markers can increase the risk of predation (Picozzi 1975), nest locations were determined by GPS, plotted on aerial photographs of the study site and the precise location described using compass bearings and distance estimates (paces) from obvious landmarks. Nests were checked every three to four days to determine nest status (Martin and Geupel 1993). To minimize the probability of nest predators locating nests, 1) nests were checked from as great a distance as possible, 2) adults and nests were disturbed as little as possible and different routes were taken within each site to avoid making trails, and 3) visits to nests were quick, minimizing the amount of time spent at the nest. Nests were classified as failed if they disappeared prior to the expected date of hatching and the eggshell evidence was consistent with a failed nest (see Mabee 1997 for techniques used to classify the fates of shorebird nests).

The daily survival rate (DSR) of nests and their associated standard errors were estimated using the Mayfield (1961, 1975) method as modified by Johnson (1979) and Hensler and Nichols (1981). We calculated the DSR for nests of each species as one minus the total number of failures divided by the total number of days nests were observed. Mayfield estimates of nesting success are also provided (Mayfield 1961, 1975).

Nest density and intra-nest distances were regressed on Mayfield estimates to better understand how each relates to nesting success. ANOVAs were used to test for differences in nest initiation date and colony size.

The primary species of study for this report are American Avocets (*Recurvirostra americana*), Black-necked Stilts (*Himantopus mexicanus*), Killdeer (*Charadrius vociferous*), and Snowy Plover (*Charadrius alexandrinus*). Because stilts and avocets nest in similar locations, I pooled the data for these species.

PRELIMINARY RESULTS

A total of 202 nests were located and monitored on the Bear River Migratory Bird Refuge during the 2003 breeding season. The number of nests monitored, their associated DSR, and nesting success estimates for each species and plot are given in Table 1.

The most common cause of nest failure for all species monitored was nest predation. Nest fates for AMAV-BNST are indicated in Figure 1. Flooding accounted for 8% and 9% of nest fates in 2B and 2C respectively.

We also examined the effects of colony size and distribution on nesting success of American Avocets on islands within 3E. Colony sizes ranged from 1 to 37 nests. The mean initiation dates for each colony did not differ significantly ($F=1.427$, $P=0.268$). However, nests that were initiated earlier in the season were more successful than those initiated later (Figure 2). We found no significant difference in the size of islands between colonies ($F=1.712$, $P=0.186$).
There was a significant positive relationship between nest density and nesting success (Figure 3).

DISCUSSION

These results provide an indication of the reproductive success of shorebirds breeding within the Bear River Migratory Bird Refuge. However, this long term study is also investigating nesting success of shorebirds breeding at two other locations within the Greater Salt Lake Ecosystem, Farmington Bay and Layton Marshes. Together, these results will eventually allow me to examine the effects of landscape and land management on the population health of breeding shorebirds.

Daily survival rates were considerably lower for avocets and stilts breeding within 2B and 2C plots. One potential explanation for this difference is that water levels began dropping in these units before nests were completed. This may have allowed mammalian predators greater access to nests. We also noted a higher abundance of California Gulls near these units relative to 3E. In the upcoming breeding seasons we will address these possibilities with measurements of water depth at the time of nest failure and by conducting point counts at each plot.

The overall nesting success of stilts and avocets breeding on the Bear River Migratory Bird Refuge is very comparable to that found on Farmington Bay (Table 2), whereas no successful nests were found at the Layton Marshes. Snowy Plover nesting success estimates were also very similar between the Bear River and Farmington (Table 3) despite the fact that the birds monitored used different substrates. Snowy Plover nests monitored at Bear River were found on dikes but at Layton and Farmington they were located on mudflats. Plover nests monitored at Farmington were actually within 10 – 20m of active avocet colonies and thus may have benefited from the nest defense behavior of avocets.

Future data collected will allow me to examine the effects of nest site selection on nesting success and also examine the effects of landscape features on productivity. We intend to also include an additional species, Long-billed Curlew, in the next and subsequent years.

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Table 1. Daily survival rate (± standard error) estimates, Mayfield nesting success estimate (apparent nesting success) and total nests monitored for shorebirds breeding at the Bear River Migratory Bird Refuge.

Species	**Plot**											
	2B			2C			3E			DIKE		
	DSR ± SE	MAY (APP)	#	DSR ± SE	MAY (APP)	#	DSR ± SE	MAY (APP)	#	DSR ± SE	MAY (APP)	#
AMAV-BNST	0.937 ± 0.02	0.183 (0.42)	12	0.882 ± 0.02	0.04 (0.07)	57	0.977 ± 0.005	0.548 (0.642)	54	0.956 ± 0.01	0.312 (0.50)	36
KILL	-	-	-	-	-	-	-	-	-	0.971 ± 0.01	0.396 (0.632)	19
SNPL	-	-	-	-	-	-	-	-	-	0.980 ± 0.007	0.538 (0.710)	24

Table 2. Overall Mayfield nesting success estimate (apparent nesting success) for American Avocets and Black-necked Stilts breeding at the Bear River Migratory Bird Refuge, Farmington Bay and Layton Marshes.

Site	**# Nests Monitored**	**Mayfield Nest Success (Apparent)**
Bear	169	0.212 (0.361)
Farmington	183	0.209 (0.383)
Layton	49	0
Total	401	

Table 3. Overall Mayfield nesting success estimate (apparent nesting success) for Snowy Plover breeding at the Bear River Migratory Bird Refuge, Farmington Bay and Layton Marshes.

Site	**# Nests Monitored**	**Mayfield Nest Success (Apparent)**
Bear	24	0.538 (0.710)
Farmington	7	0.543 (0.714)
Layton	18	0.247 (0.556)
Total	49	

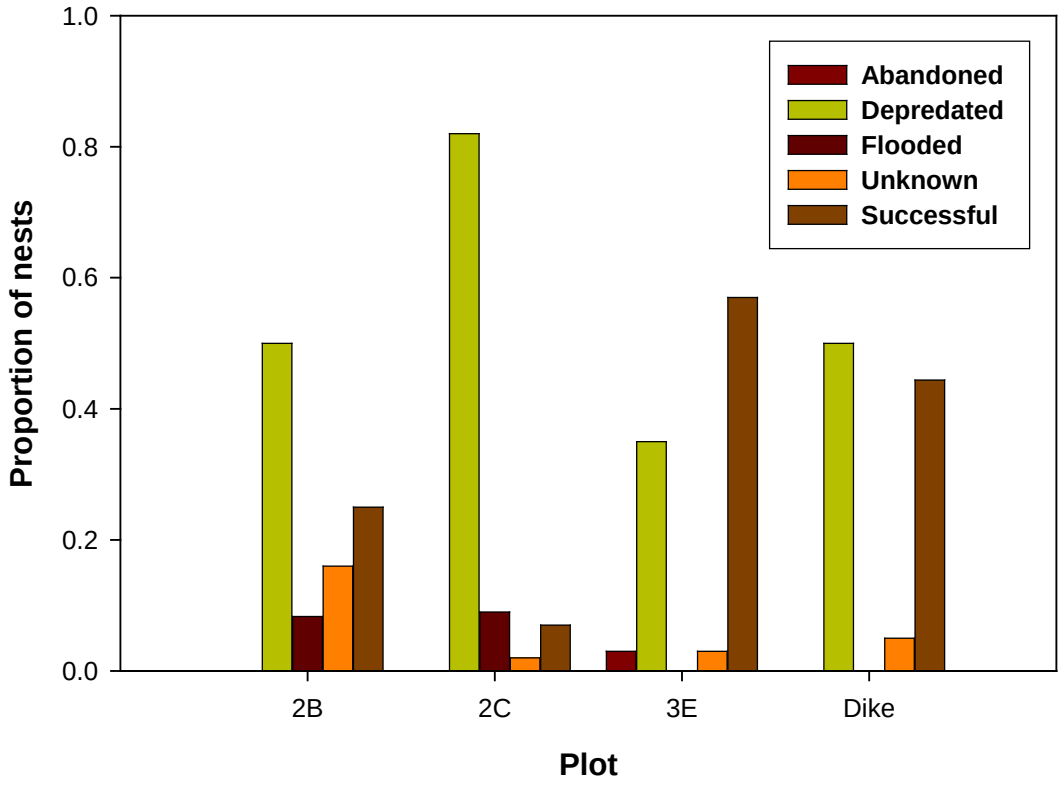

Figure 1. Fates of AMAV-BNST nests within each study plot.

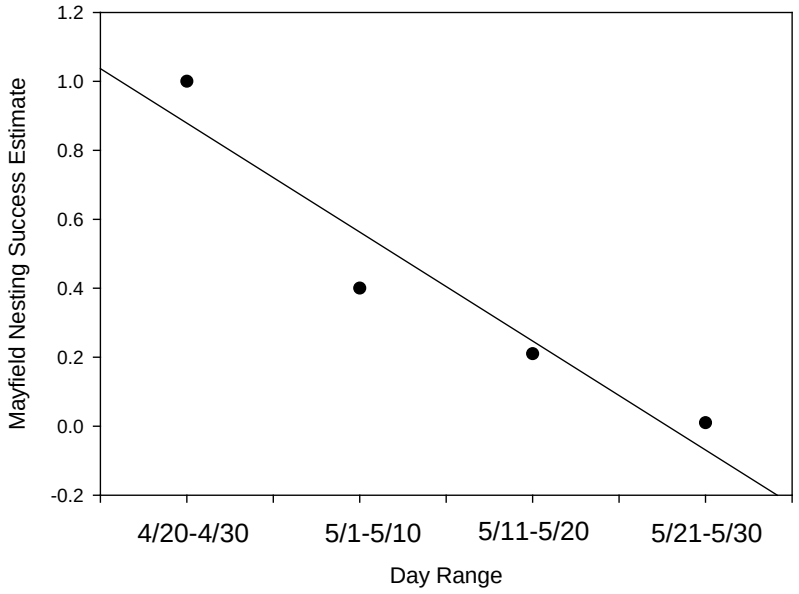

Figure 2. Relationship between nest initiation date and nesting success (F=20.849, P=0.045).

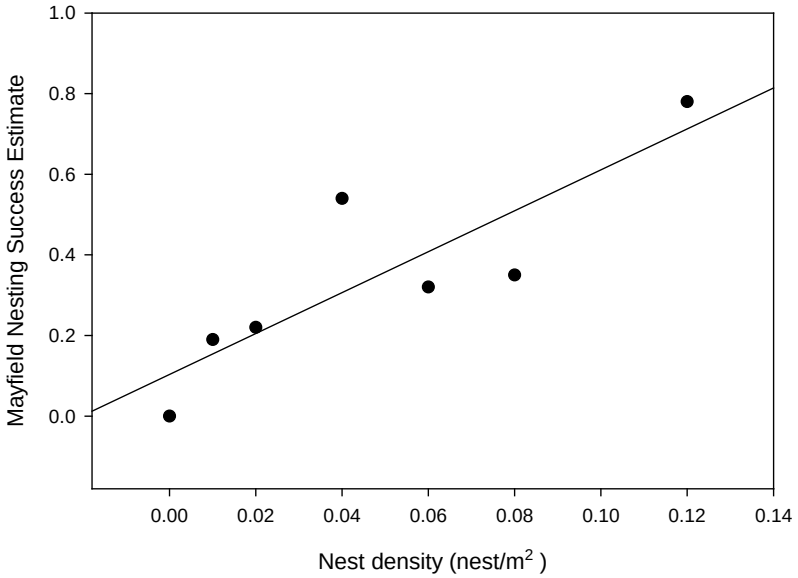

Figure 3. Relationship between density and nesting success (F=9.349, P=0.028).