University of Northern Iowa
UNI ScholarWorks

Undergraduate Student Work

2014

Grassland Bird Nest Survival in Perennial Agroenergy Crops

Libby Torresani

Stephanie Paape

Mark C. Myers

Let us know how access to this document benefits you

Copyright ©2014 Libby Torresani, Stephanie Paape, Dr. Mark Myers

Follow this and additional works at: https://scholarworks.uni.edu/ugswork

Offensive Materials Statement: Materials located in UNI ScholarWorks come from a broad range of sources and time periods. Some of these materials may contain offensive stereotypes, ideas, visuals, or language.

Grassland Bird Nest Survival in Perennial Agroenergy Crops

Libby Torresani, Stephanie Paape, and Mark Myers

University of Northern Iowa

Abstract

Previous research had been done in 2011 and 2012 regarding bird nest survival rates in the Cedar River Natural Resource Area in Washburn, IA. Further analysis of bird nest survival rates was done in this study to research how nest age, calendar date, soil type, and vegetation type influence the success or failure of these nests. New nests were identified in the prairie plots of the Cedar River Natural Resource Area and added to the previous sample size from the original study. A sample size of 97 bird nests total and 67 Dickcissel nests –SPAM (*Spiza Americana)* were used. The new nests were checked every 3-4 days and a fail or success was noted. The data was then analyzed using R statistical analysis to calculate correct logistic exposure models. The results for all nests showed that success was influenced by the nest age. A new nest had a 10% lower chance of success than an older nest. For all nests, the calendar date with which the nest was laid also influenced the successfulness. Nests laid in early may had a higher chance of surviving than nests laid in late season. Soil type and vegetation effects differed from all nests and the Dickcissel nest samples. However, for both sample sizes there was a much higher chance of success in 2011 than 2012 with the nests in the biomass vegetation mix having a better chance of survival than only grass.

Introduction

Native grasslands, including tallgrass prairies, continue to be destroyed to make room for monoculture crops such as corn (*Zea mays)* and soybeans (*Glycine max)* grown for food and agrofuel production. These monoculture fields are not ideal habitats for native grassland birds due to their low plant diversity and structural homogeneity. Because of this, grassland bird populations are declining.

In 2009, The University of Northern Iowa's Tallgrass Prairie Center initiated a research project that converted seven agricultural fields managed for corn and soybean production to four experimental agroenergy crops comprised of native tallgrass prairie species. The four crops are: Switchgrass (a switchgrass monoculture), Grasses (5 grass speices), Biomass (16 species of grasses and forbs), and Prairie (32 species of grasses and forbs). Each crop type was replicated four times on each of three soil types (sandy loam, loam, and clay loam) found within the study area. Since 2009, the site has been managed for biomass production and bird use and nesting activity in the plots has been intensively monitored.

In 2011-2012, former UNI graduate student Jarrett Pfrimmer studied grassland birds in the agroenergy crop plots. Part of his research involved locating and monitoring passerine songbird nests to assess nest success rates; however, the analyses he employed assume constant daily survival rates and did not permit a detailed assessment of factors influencing nest survival. We reanalyzed the 2011-2012 nest data using logistic exposure models of nest survival. We sought to answer the following questions:

1) Does daily nest survival rate vary as a function of nest age and/or calendar date?
2) Do daily nest survival rates vary between years?
3) Do daily nest survival rates vary among soil type or agroenergy crop types?

Materials and Methods

The research site is located at the Cedar River Natural Resource Area in Black Hawk County, Iowa. In 2011-2012, each of the 48 research plots (0.30 to 0.56 ha) was thoroughly searched for nests at weekly intervals from May 15 to July 30 by dragging a rope across the top of the grasses between two moving vehicles. When a bird flushed, a nest was searched for. Once a nest was found its location was noted and its contents were monitored every 3-4 days until the nestlings fledged or the nest failed. A total of 97 nests (61 Dickcissels, 22 Lark Sparrows, 6 Indigo Buntings, 5 Common Yellowthroats, 2 Grasshopper Sparrows, and 1 Song Sparrow) were monitored.

We calculated apparent, Mayfield, and Logistic Exposure estimates of nest success for Dickcissels (N = 61 nests, 204 exposure intervals) and All Passerine Nests (N = 97 nests, 307 exposure intervals). Apparent nest success is the number of successful nests divided by the total number of nests monitored. Daily survival rates and nest success rates were also calculated using the Mayfield method below based on a nest cycle length of 22 days:

$$DSR = \frac{\text{exposure days} - \text{failed nests}}{\text{Exposure days}}$$

$$DSR\_SPAM = \frac{669-29}{669} = 0.9566$$

$$\text{Mayfield Success\_SPAM} = (0.956652)^{22} = 37.7\%$$

$$DSR \text{ all nests} = \frac{1025-48}{1025} = 0.953171$$

$$\text{Mayfield Success all nests} = (0.95317)^{22} = 34.8\%$$

We developed logistic exposure models in R using a stepwise process to assess the effects of nest age, calendar date, year, and soil and crop type on nest survival. First, we defined a set of candidate models including the the linear, quadratic, and cubic effects of nest age and calendar date on nest survival within the nesting season. We determined the best fitting model using an information theoretic approach. Once the best fitting model was determined for time effects, the effect of year was added to that model. Finally, once the best model from the previous two steps was identified, we defined a set of candidate models including our experimental design variables, which consisted of soil type, vegetation treatment, and soil + vegetation treatment. We used all models that carried any weight to calculate model-averaged parameter estimates for vegetation and soil type variables.

Results

Table 1 below shows the percentage that a given nest will survive the whole nesting period from day 1-22. The apparent success measures the direct observation of whether or not a nest fledged offspring. The Mayfield estimate assumes a constant daily survival rate (DSR) over the entire nesting cycle. For all nests the Mayfield success was 34.8% and for Dickcissels was 37.7%. From the models however, the DSR is not constant over the whole nesting period. The logistic exposure model calculated the DSR as a function of nest age. For all nests the chance of survival was 27.6% with a 95% confidence interval ranging from 13.3%-43.6% and for Dickcissels it was 26.2% with a 95% confidence interval ranging from 6.4%-49.1%

	# nests found	# failed	Apparent successes	Mayfield success	Logistic exposure
All Nests	97	48	50.5%	34.8%	27.6% (CI)
Dickcissels	61	29	52.5%	37.7%	26.2% (CI)

Table 1: Apparent, Mayfield, and Logistic Exposure estimates of passerine bird nest at the Cedar River Natural Resource Area, 2011-2012.

Logistic Exposure: All Nests

The best fitting model for nest survival of all nests included the quadratic effect of nest age, cubic effect of calendar date, year, and soil type (Table 2). Models including the effect of vegetation treatment were also competitive (Table 2). The linear, quadratic, and cubic effects of calendar date were included in the best model of nest survival for all species (**Figure 1).** Nests that were laid around day 140 (the month of May) had daily survival rates around 95%. If the nest was laid towards the end of the nesting period around day 200 or later (mid-July), the daily survival rate dropped in the 80% range.

The linear and quadratic effects of nest age were included in the best model of nest survival for all species (Figure 2.) As soon as the nest is laid the daily survival rate is lowest at approximately 90%. The older the nest gets, the more likely it will survive each day. Toward the end of the nest cycle, the daily probability of survival goes up to a 98%. The results of this graph show that the chance of success increases with each passing day that the nest survives.

Vegetation treatment and soil type also influenced the nest success rate for all bird species. In **Table 1**, each level of vegetation type and soil type were compared that having the lowest rate of nest success (Grasses and Sandy loam). Model coefficients were converted to odds ratios which gives a percent when multiplied by 100% and then subtracting 100. In 2011 the nests had a 77% better chance of success than the year 2012. The nests in Biomass had a 156% better chance of surviving than nests in the Grasses plots. The nests laid in the plots with clay loam soil had a 200% better chance of success than those nests in the sandy loam soil.

All Nest, AICc table	K	AICc	Delta	AICcWt	Cum.Wt
Calendar date+age+year+soil	9	281.25	0.00	0.44	0.44
Calendar date+age+year+soil+treatment	12	282.11	0.86	0.29	0.72
Calendar date+age+ year	7	282.65	1.41	0.22	0.94
Calendar date+age+year+treatment	10	285.3	4.06	0.06	1.00
Intercept only	1	310.94	29.69	0.00	1.00

Table 2: the nest model rankings for all nests. K=the parameter

Parameter (N=61, 204 exposure intervals	Coefficient	SE	Odds ratio	90_LCL	90_UCL
Year (2011 vs. 2012)	1	0.53	2.72	1.14	6.50
Veg1 (Switchgrass vs. Grasses)	0.44	0.73	1.55	0.47	5.16
Veg2 (Biomass vs. Grasses)	0.48	0.58	1.62	0.62	4.12
Veg3 (Prairie vs. Grasses)	0.15	0.54	1.16	0.48	2.82
Soil1(sandy loam vs. loam)	0.13	0.56	1.14	0.45	2.86
Soil2 (sandy loam vs. clay loam)	0.7	0.57	2.01	0.79	5.14

Table 3: the results of the Dickcissel nest successes compared with the year, treatment, and soil types.

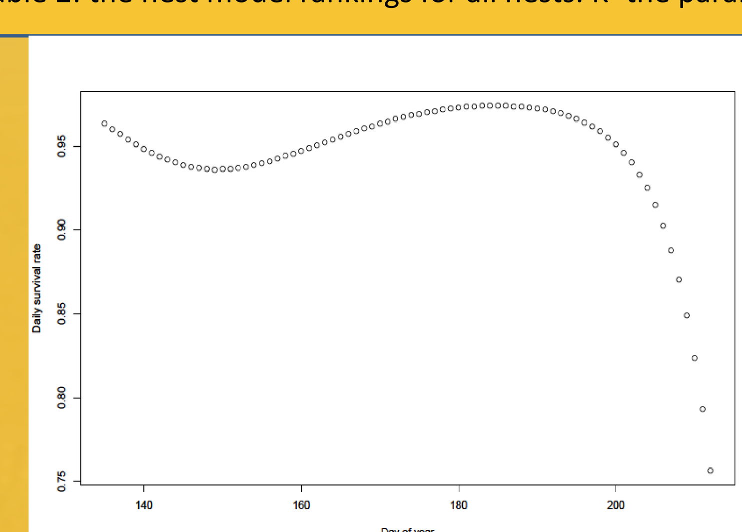

Figure 1: Daily survival rate vs. calendar date for all bird nests

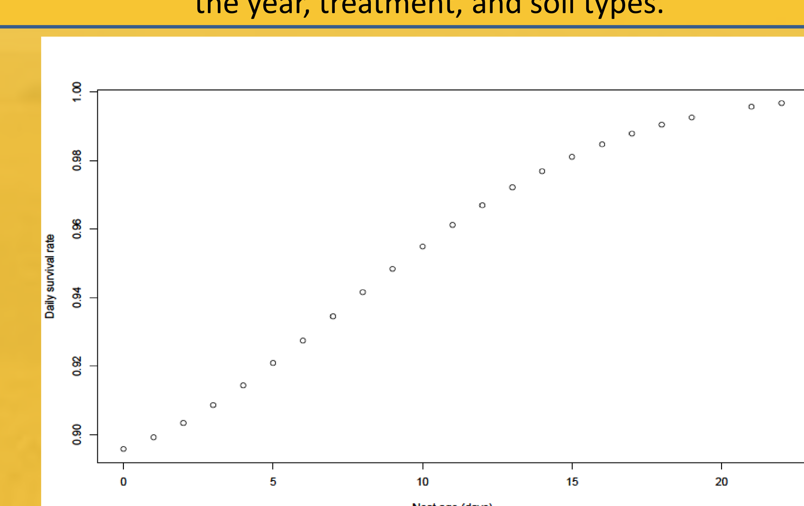

Figure 2: Daily survival rate vs. nest age for all bird nests.

Logistic Exposure: Dickcissel Nests

The best fitting model for Dickcissel nest survival included the cubic effect of nest age and year. Models including soil type were also competitive (Table 2). The results displayed in **Figure 3** show relationship between Dickcissel daily survival rate and nest age. Dickcissels nest survival had a cubic relationship with nest age. The resulting analysis showed that the chance of success decreases from a 90% chance of survival to an 85% chance or survival within the first 3 days during the egg stage. The chance of success then increases once the nest survives past the first 4 days.

In addition to nest age, year was the most important variable influencing Dickcissel nest survival (Tables 4 & 5). The Dickcissel nests in 2011 had a 172% better chance of survival than in 2012 . Vegetation treatment and soil type appeared in some models of Dickcissel nest success, but these models had lower weight and all parameter estimates had confidence intervals that included 1.0. Similarly, the biomass mix had a 65% better chance of survival than the grass. However, the Dickcissel nests seemed to have better success in the Switchgrass than in the prairie mix. Switchgrass had a 55% better chance of surviving whereas the prairie mix only had a 16% better chance than the grasses.

Dickcissel Nests, AICc table	K	AICc	Delta AICc	AICcWt	Cum.Wt
Nest age+year	5	179.66	0.00	0.68	.68
Nest age+year+soil	7	181.64	1.99	0.25	.94
Nest age+year+treatment	8	185.20	5.54	0.04	.98
Nest age+year+treatment+soil	10	186.82	7.16	0.02	1.00
Nest age+year	1	203.83	24.17	0.00	1.00

Table 4: the nest model ranking for the Dickcissel nest

All Nests (N=97, 307 Exposure intervals)					
Parameter	Coefficient	SE	Odds ratio	90_LCL	90_UCL
Year (2011 vs. 2012)	0.57	0.41	1.77	0.90	3.47
Veg1 (Switchgrass vs. Grasses)	-0.03	0.54	0.97	0.40	2.36
Veg2 (Biomass vs. Grasses)	0.94	0.47	2.56	1.18	5.55
Veg3 (Prairie vs. Grasses)	0.44	0.43	1.55	0.77	3.15
Soil1(loam vs. sandy loam)	0.62	0.46	1.86	0.87	3.96
Soil2 (clay loam vs. sandy loam)	1.09	0.46	2.97	1.40	6.34

Table 5: the results of the total nest successes compared with the year, treatment, and soil types.

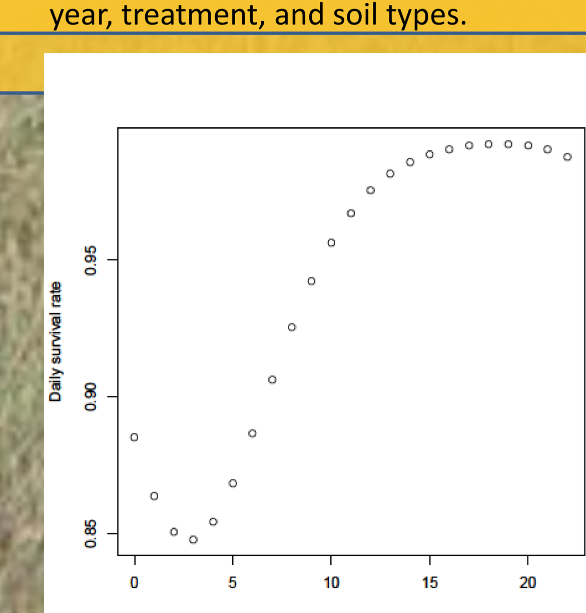

Figure 3: Daily survival rate versus nest age for Dickcissels

Conclusions and Future Work

The results of this study conclude that nest age, calendar date, soil type, and treatment do have an effect on the success of bird nests. The nests which have the best chance of success are the ones laid in the beginning of the season. 2012 was a drought year meaning vegetation was less dense causing nests to be more visible to predators. This could be due to several factors such as an increase in predator abundance and unusual heat indexes in the late summer unbearable for newborn birds. The closer the nest is to fledging, the higher the probability that it will be successful. The biomass mix treatment had the highest success rate of bird nests for both sample sizes. This is most likely because it had the best coverage from predators and disturbances. The logistic exposure model of nest success for Dickcissels was lower than the Mayfield success because the logistic exposure model took into account the function of nest age. Instead of having a constant DSR like the Mayfield model it took into account the lower chance of survival during the first few days of the nest age. The results concluded that about 1 in 4 nests were successful which are compatible with other natural grassland areas and the wild.

The results of this study give insight into steps farmers and conservationists can take to increase the success of nests belonging to grassland bird species which may become endangered if their native prairie habitat continues to be destroyed. If ethanol was produced using native prairie grasses instead of monoculture row crops more habitat would be available for grassland birds. Replacing corn and soybeans with agroenergy crops such as switchgrass and prairie mixes would give nesting birds more coverage and protection which ultimately may help the nest success and the bird population.

University of Northern Iowa

Acknowledgements

I would like to thank the University of Northern Iowa , specifically the biology department, for having an undergraduate research program along the Iowa Power Fund. Also, my mentor Dr. Mark Myers and graduate student Ben Hoksch for guiding me through this research experience. I would be lost and clueless without their broad range of knowledge of bird species, butterfly species, flowers, and prairie plants. Their wide range of knowledge as opened my eyes to the diversity within a prairie ecosystem and how important it is to protect it.