Differentiating between the role of intrinsic and extrinsic factors dictating field sparrow (*Spizella pusilla*) nesting success

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ABSTRACT

Altering breeding behavior with age may help birds reduce breeding costs and enhance reproductive success in more experienced breeders. However, age-related trends appear to be inconsistent, which may be due in part to the logistical difficulties of studying free-ranging populations of identified and known-aged individuals. To further examine how age may influence reproductive behaviors, we examined nest construction, location, and fate in a population of well characterized, known-aged field sparrows (*Spizella pusilla*). In our population, older parents appeared to have greater overall nest success. Characteristics of the nest itself also influenced whether a nest failed or produced fledglings. These findings suggest that field sparrow breeding success may be influenced by factors attributed to the nest microhabitat and surrounding environment as a whole and also the intrinsic factors attributed to the parents themselves.

INTRODUCTION

- Experience may result in lower reproductive costs and greater breeding success due **changes in parental behavior** with age (Curio 1983)
  - Greater offspring provisioning rates (Daunt et al. 2007)
  - Higher-quality food to offspring (Limmer & Becker 2009)

- Age may also influence **nesting characteristics**
  - Access to more favorable territories (Norris et al. 2003)
  - Greater nest concealment (Marzluff 1988)

- Previous studies in birds provide **conflicting and inconsistent results** with respect to the effect of age on breeding behavior/success
  - Ex: age does not influence field sparrow provisioning rates (Carr et al. *in press*)

- Inconsistent findings may be due to **interactions** between individual, nest, and environmental factors and/or difficulty in monitoring known-aged adult birds

- Banding of our field sparrow population began in Summer 2014 **with nearly all birds of known age and identity**

QUESTION

To what extent do intrinsic (e.g., pair- or nest-specific) and extrinsic (e.g., environmental) factors influence field sparrow nesting success?

PREDICTIONS

1. *Older pairs have greater reproductive success*
2. *Nests further from edge habitats have greater success due to greater predation risk near forested areas*
3. *Nests in dense vegetation with more coverage are more successful*

Selected references

- Carr, J.M., M.E. Gimpel, D.M. Small. 2019. Northeastern Naturalist.
- Curio, E. 1983. Ibis.
- Daunt, F., S. Wanless, M.P. Harris, L. Money, and P. Monaghan. 2007. Functional Ecology.
- Limmer, B., and P.H. Becker. 2009. Animal Behaviour.
- Marzluff, J.M. 1988. Animal Behaviour.
- Norris, D.R., P.P. Marra, T.K. Kyser, T.W. Sherry, and L.M. Ratcliffe. 2003. Proceedings of the Royal Society B.
- Pyle, P. 1997. Identification guide to North American Birds, Part I.
- Shaffer, T.L. 2004. The Auk.

METHODS

STUDY LOCATION

- Observation period: Summer 2017 – present; banding began in 2013
- Chester River Field Research Station, Queen Anne's County, Maryland
- 91.7 ha CRP warm-season grassland (**Fig. 1**)

Figure 1. Chester River Field Research Station in Chestertown, Maryland, a subdivision of Washington College's River and Field Campus. (A) Location within the Mid-Atlantic region and (B) aerial view of the warm season grasslands (Source: GoogleMaps)

BANDING

- Unbanded birds were target-banded with mist nets using audio lures (males) or a flush from the nest (females)
- Birds were assigned a minimum age using molt patterns (Pyle 1997) or by referring to their age when first captured if previously banded
- All adult birds were assigned a combination of three unique color bands to identify individuals using field optics. The color band on the left leg (above the aluminum federal band) indicated sex

NEST SEARCHING & MONITORING

- GPS points were taken for male singing points to map territory boundaries
- Nests were located by observing parental behavior, including agitated "chip" calls, carrying food to offspring, or flushed from the nest
- Nests marked by pink flagging ~1m north of nest
- Monitored every 2-3 days to determine nest fate
  - *Fail* = predation, mechanical failure, exposure
  - *Success* = at least one FISP fledgling
- Chicks banded 6 days post-hatching (PH-6; **Fig. 2**)

Figure 2. Field sparrow developmental stages (A) eggs, (B) PH-2, (C) PH-6, (D) fledging, PH-9

VEGETATION SURVEYS

- **NEST VEG:** Vegetation type and density in 1m^2 centered around nest
  - % vegetation type
    - forb, warm-/cool-season grass, bare, duff, woody plants
  - Tallest plant
  - Measure of visual obstruction using Robel pole method
    - Height of pole visible from height of 1m at four cardinal directions 4m away from nest

- **NEST CHARACTERISTICS:**
  - Height of nest
  - % nest visible from above
  - Distance to woodline or road/path

- **RANDOM VEG:** Same measures as nest vegetation taken at a random direction and distance from nest location

PRELIMINARY ANALYSIS

- Number of nests: N_{2017} = 97; N_{2018} = 91

- Nest outcomes: N_{fail} = 125; $N_{success}$ = 63
  - 33% nest success
  - 60% of nest failures attributed to predation

- Vegetation at nest location varies considerably from surrounding habitat (**Table 1**)

Vegetation criteria	Avg. nest	Avg. random	*P*
Average Robel	**57.8 cm**	**48.3 cm**	**< 0.001**
Tallest plant	**127.7 cm**	**117.0 cm**	**0.002**
% bare ground	**2.3%**	**5.7%**	**< 0.001**
% duff	**9.3%**	**13.4%**	**< 0.001**
% cold season grass	**0.57%**	**1.82%**	**0.024**
% warm season grass	19.6%	18.7%	0.612
% forb	50.0%	45.3%	0.072
% woody plant	15.3%	13.2%	0.231
% standing dead veg	3.14%	2.09%	0.085

Table 1. Vegetation comparison within 1m^2 centered at the nest and at a corresponding random point for all 188 nests. Average Robel height visible calculated by averaging values at each cardinal direction for each nest. Criteria significant at α = 0.05 after paired *t*-test shown in bold.

- In the preliminary logistic-exposure model, the following factors (**Table 2**) significantly influenced nest outcome.

	Log odds	SE	*Z*	*P*	*Trends (successful nests)*
Sum parent ages	0.076	0.036	2.111	0.035	Older parents
% duff	-0.070	0.025	-2.818	0.005	Less duff
% warm season grass	-0.072	0.024	-2.994	0.003	Less WS grass
% forb	-0.068	0.024	-2.455	0.014	More forbs
% woody plant	-0.051	0.023	-2.210	0.027	More woody veg
Average Robel	0.013	0.005	2.771	0.006	Denser, taller veg

Table 2. Results of a preliminary logistic-exposure model. Only those factors that significantly influenced nest outcome (success/fail) at α = 0.05 are presented here. Trends associated with successful nests are included in the last column.

FUTURE DIRECTIONS

- Continuation and conclusion of project at end of Summer 2021 field season

- Full analysis of factors affecting nest success using logistic-exposure method for all five study years (Shaffer 2004)

- Consider landscape-level trends in nest outcome

ADDITIONAL QUESTIONS

1. *Does a greater distance between active nests reduce predation risk?*
2. *Does the species of plant where the nest is constructed influence success?*
3. *Does dense vegetation enhance success via greater protection from predators, extreme weather, or fluctuations in nest microclimate?*
4. *Do birds move their nests farther away from the location of a previous failed nest?*

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