

INTRODUCTION

➤ Eastern bluebird (*Sialia sialis*) populations suffered regional declines for two decades beginning in the late '50s, with a reduction to 17% of previous numbers in the early '60s

➤ This led researchers to investigate the causes of decline and to define characteristics of preferred nest sites. Professional organizations (e.g. NABS, Audubon Society, The Birdhouse Network) suggest nestbox-building specifications and nest site criteria to promote bluebird populations, however there has been limited empirical studies of how nestbox and local environmental factors influence nesting success.

GOAL OF STUDY

We performed an empirical study to examine the influence of nestbox and local environmental variables on breeding success of Eastern bluebirds, with the goal of improving guidelines for nest box design and conservation efforts.

METHODS

➤ We monitored nesting activity in 404 nestboxes from May to July 2003 (277 pre-existing at golf courses, 127 newly constructed and erected at similar habitats). All boxes were located within 10 miles of Williamsburg, VA.

➤ Each week, we recorded nest building, clutch size, chick numbers, and fledging success at every nestbox

➤ We quantified 36 factors (summarized in Table 1) relating to nestbox design and the local environment of each box

➤ We tested whether environmental and nestbox factors influenced whether a box successfully fledged offspring or not (i.e. 'fledge' vs. 'no fledge') by a binary logistic regression and how many offspring fledged by a multiple regression.



Variables with Fitness

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Table 1. Nestbox factors and local environmental variables

Variable	Mean	SD	Range	% Yes
Nest cup depth (cm)	15.6	1.8	2.8 to 25	
Hole diameter (mm)	36.7	7.6	17 to 77.5	
Nestbox volume (cu.cm)	67844	24768	19887 to 130865	
Roof overhang (cm)	5.2	2.7	0 to 18	
Height of nesthole from ground (m)	1.5	0.3	0.92 to 4.47	
Distance to nearest box (m)	97.8	54.1	3.7 to 424.6	
Density of nestboxes at site	48672554	48044452	174288 to 124151349	
Mean sq. distance to boxes on site	48550060	56844208	87192 to 275046298	
Distance to nearest road/path (m)	14.4	14.3	1 to 50	
Distance to nearest building (m)	33.8	19.7	1 to 51	
No. of buildings within 50m	0.9	1.3	1 to 8	
Distance to water (m)	360.1	166.0	8.3 to > 500	
2m % mowed grass	19.7	30.4	0 to 100	
2m % bare	21.9	28.9	0 to 100	
2m % non-woody vegetation	20.4	31.8	0 to 100	
2m % shrubs	7.3	18.2	0 to 100	
2m % trees	29.2	38.0	0 to 100	
25m % mowed grass	27.0	25.8	0 to 100	
25m % bare	18.9	19.4	0 to 100	
25m % non-woody vegetation	14.1	21.5	0 to 100	
25m % shrubs	6.3	13.4	0 to 100	
25m % trees	31.5	26.1	0 to 100	
25m % permanent water	0.2	2.5	0 to 100	
50m % mowed grass	30.7	24.1	0 to 100	
50m % bare	16.2	16.4	0 to 100	
50m % non-woody vegetation	12.7	19.3	0 to 100	
50m % shrubs	5.1	10.0	0 to 100	
50m % trees	33.3	20.4	0 to 100	
50m % permanent water	0.377	2.506	0 to 100	
Nestbox rotted?				8.6
Nestbox painted?				44.3
Climbable (box mounting)				46.1
Predator guard on pole or box?				61.4
Overhanging branches within 2m?				20.7
View other boxes from this box?				40.1
Electrical power line over head?				3.9

RESULTS

A forward binary logistic regression identified 5 variables that significantly and independently contributed to the breeding success of bluebirds (fledged):

1. Whether mounting pole had climbable attributes
2. Diameter of entrance hole
3. % of mowed grass within a 2m circumference of the box
4. Distance to road or path
5. Distance to water source

Variable	B	S.E.	Sig.	Exp(B)
Climbable	1.295	0.274	0.000	3.651
Hole diam	-0.074	0.021	0.000	0.929
2m % grass	0.012	0.004	0.006	1.012
Dist to road	-0.008	0.004	0.020	0.992
Dist to water	-0.002	0.001	0.041	0.998

Summary table of 6th step of a binary logistic regression with 'fledge' as the dependent variable. B indicates the correlation of the variable with fledging success of the box.

A multiple regression analysis with "number of fledglings" as the dependent variable returned 3 predictors. Beta shown below is for standardized coefficients, and indicates the degree to which the variable correlates with more fledglings reared.

Variables	Beta	t	Sig.
Climbable	-0.261	-4.792	0.000
Nestbox volume	-0.237	-4.279	0.000
2m % grass	0.171	3.197	0.002

DISCUSSION

➤ Existing guidelines emphasize anti-predation aspects of box-building. Although we found that fledging success was not correlated with the presence of predator guards, the first 3 significant variables all relate to predation risk.

➤ Many expected local environmental (e.g. large areas of lawn) and nestbox characteristics (e.g. predator guards) did not influence their occupants' reproductive fitness. This does not support most recommendations. Somewhat surprisingly, nests slightly closer to roads/paths did better, as did nests slightly closer to large bodies of water.

➤ Two factors that correlated with reproductive success also contribute to the degree of success

➤ Future studies could include more diverse habitats to better understand the effects of environmental variation

➤ Overall, our boxes had relatively high (71%) success. Thus we recommend following the current guidelines, but also avoiding predator-friendly mounting and nearby vegetation, having slightly smaller entrances, and perhaps placing boxes near water. Light traffic areas should not be avoided.

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■	Unsuccessful nestboxes
■	Successful nestboxes

Mean (±s.d., where appropriate) values of the 5 variables explaining differences between unsuccessful (blue) and successful (red) nestboxes. N (unsuccessful) = 200, N (successful) = 141.

