A Study to Determine the Preference of Nesting Box Entrance Hole Size of *Sialia sialis* (Eastern Bluebird)

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Nesting boxes with large entrance holes were paired with boxes with the traditional entrance hole size at the Powell River Education Center to test whether the Eastern Bluebird (*Sialia sialis*) would utilize the boxes with the larger opening. During the 2010 nesting season (mid-April to mid-August), nesting activity was observed in both box types. Bluebirds, tree swallow and chickadees were active in field 1. Bluebirds and tree swallows successfully fledged young. One chickadee nest was lost due to predation, but at the time of the writing of this report, a chickadee nest in a large entrance hole box was active with chicks. Bluebirds and chickadees were active in field 2, however both nest failed in fledging young and all nesting activity ended in the field by mid-June when the grass in the field grew tall. During 2010 nesting season, a total of 15 bluebirds fledged and possibly 3 chickadees will fledge; the one successful tree swallow nest fledged 5 chicks. Student volunteers from the Mountain Empire Community College assisted in the removal of open-topped boxes from the previous study, modification and installation of new boxes and the monitoring of nesting activity.

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Introduction

During the fourth year of the project along the bluebird trail established at the Powell River Education Center, open-topped boxes were removed and replaced with closed topped boxes with enlarged entrance holes in order to test whether Eastern Bluebirds, when given a choice, had a preference in entrance hole size. The round hole diameter specified by the North American Bluebird Society, and used in most commercially produced bluebird boxes, is 1.5 inches (www.nabluebirdsociety.org/nestboxspecs.htm). Bermudez (2002) published a study in which he presented data demonstrating that Eastern Bluebirds would utilize and successfully fledge young from boxes with entrance holes enlarged to a diameter of 2.75 inches. Competitors such as European Starlings and House Sparrows have been found to avoided boxes with large entrance holes (McGilvrey and Uhler, 1971; Heusmann et. al., 1977).

Student volunteers from Mountain Empire Community College assisted in trail maintenance, the removal of open-topped boxes from the previous study, the installation of new boxes and the monitoring of nesting activity. B. Wells modified the boxes.

Methods

Entrance hole preference- Nesting boxes of the Bermudez design were paired with boxes with the traditional entrance hole diameter along the Bluebird trail established at the Powell River Education Center (figure 1a, b). The standard bluebird box has an entrance hole 1.5 inches in diameter (Figure 2a), while the Bermudez box has a hole diameter of 2.75 (Figure 2b). Nesting boxes were monitored for activity on a weekly basis beginning April 13 through the submission date of this report. Monitoring activity followed the protocols established by the North American Bluebird Society (Fact Sheet: Monitoring Bluebird Nest Boxes, 2002) and the Virginia Bluebird Society (Virginia Bluebird Trail Monitoring Information, 2004). Data was recorded on forms provided on the Virginia Bluebird Society website.

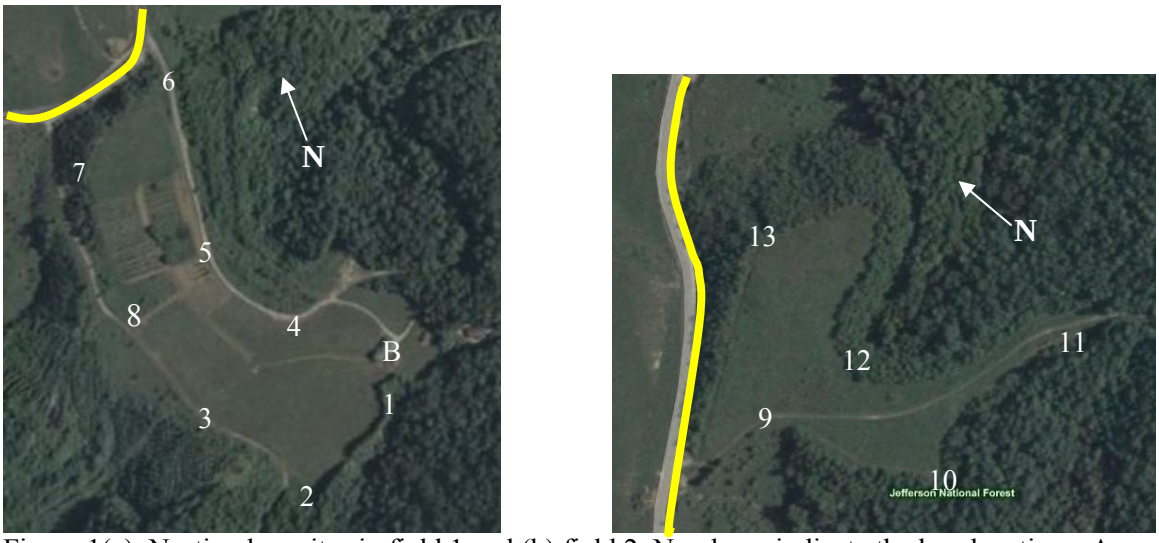

Figure 1(a). Nesting box sites in field 1 and (b) field 2. Numbers indicate the box locations. Arrow indicates north. The B indicates the position of the barn. Yellow lines indicate the location of the main road. (Image from Microsoft Virtual Earth.)

Figure 2. (a) Nesting box with 1.5 inch diameter entrance hole and (b) nesting box with 2.75 inch diameter entrance hole.

Survey of insect and invertebrate populations. During the breeding season, insects and other invertebrates make up approximately 68% of the Eastern Bluebird diet (Fimbel, 2006) and include: grasshoppers, crickets, katydids, beetles, earthworms, spiders, millipedes, sow bugs, and snails [Eastern Bluebird (*Sialia sialis*), 1999]. Insects and other invertebrates were sampled at 4 sites in field 1 only (figure 3), due to the paucity of nesting activity in field 2. Samples were collected using (1) passive pan traps that were in place for seven days and captured both flying insect and organisms that live at ground level (Terrestrial Arthropod Densities, 1994), and (2) insect nets that collected insect by sweeping the grass along a 30 m x 1 m transects (Perry et al, 2001). Pan traps were placed outside the fences in case cattle were moved into the field during the sampling period. Pan traps [13 in x 9 in metal cake pans sprayed yellow (Terrestrial Arthropod Densities, 1994)], were placed flush with the substrate, and filled with a soap and salt solution. The soap and salt solution acted as a trap and as a temporary preservative. Specimens were collected from the traps by pouring the contents though a strainer. The specimens were rinsed and placed in 95% ethanol. Transect sampling took place inside or along the fence lines where the grass was short and bluebirds would most likely hunt. Bluebirds prefer areas where the grass is short and perches are available to spot their prey (www.bluebirdsforever.com/trail.html). Animals collected along transects were also transferred to jars containing 95% ethanol. Specimens were identified and sorted into groups using the National Audubon Society Field Guides to North American Insects and Butterflies.

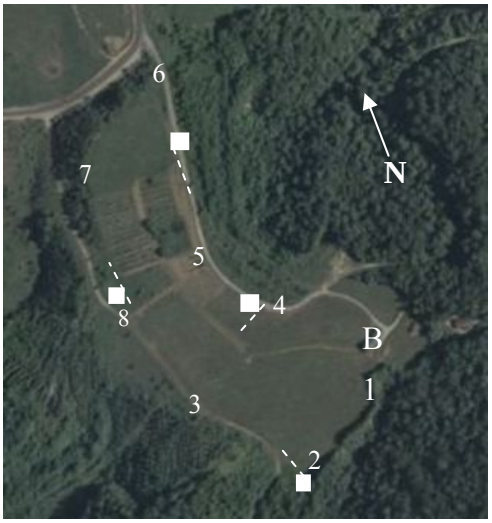

Figure 3. Field 1: Nesting box sites indicated by numbers. Pan sample locations indicated by □'s. Transect locations indicated by dashed lines (----). Arrow indicates north. The B indicates the position of the barn. (Image from Microsoft Virtual Earth.)

Results

Nesting activity: Species active along the trail during the 2010 season included bluebirds, tree swallows and black-capped chickadees (Table 1). The first eggs were found on April 13 in boxes with the small entrance at sites 3, 7 and 12 (5, 2 and 5 eggs respectively). Nest building activity was also noted in box 5 A (small entrance hole) on that date. One addition egg had been laid in box 7A, while 3 additional eggs were laid in box 12A by the following week. By April 30, 3 of the 5 eggs had hatched in box 3A, 4 eggs had hatched in box 7A as well as 12A. By May 13, the 6 chicks in box 7A were close to fledging, while the chicks in boxes 3A and 12A had disappeared. The chicks in those two nests were too young to fledge and were assumed lost to predation. Additional activity was detected in box 12A on June 2; a chickadee nest had been constructed on top of the bluebird nest. No eggs were ever laid in the nest, and by the following week, the nest was infested with black ants and removed. No further activity was found in any of the boxes in field 2.

The first nesting activity in box 6A was found on May 13; however, the top had been knocked off the box and no eggs were found in the nest. On the same date, a nest with 4 bluebird eggs was found in box 6B, the box with the large entrance hole, but by the following week the eggs were gone. No further activity occurred in either box for the remainder of the breeding season. Three and five eggs, respectively, were found in boxes 4A and 5A on May 21. The bluebird in box 4A eventually fledged 5 chicks, while the tree swallows in box 5A also fledged 5 chicks. Bluebirds were again active in box 7A on June 18, chicks were in the nest by July 7, but were gone by the following week and assumed lost to predation. Five tree swallow eggs were found in box 3A on June 2, but the eggs were lost to predation.

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Box	Species	Nest building	# of Eggs	# of Hatchlings	# Fledged
1 A	CH	Yes	0	0	0
1 B	---	No	0	0	0
2 A	---	No	0	0	0
2 B	---	No	0	0	0
3 A	BB;TS	Yes	5; 5	3; 0	0
3 B	---	No	0	0	0
4 A	BB	Yes	5	5	5
4 B	---	No	0	0	0
5 A	BB; TS	Yes	9; 5	9; 5	9; 5
5 B	---	No	0	0	0
6 A	?	Yes	0	0	0
6 B	BB	Yes	4	0	0
7 A	BB; TS	Yes	10; 0	6; 0	6; 0
7 B	CH	Yes	3?	3?	Box still active
8 A	---	No	0	0	0
8B	---	No	0	0	0
9 A	---	No	0	0	0
9 B	---	No	0	0	0
10 A	CH	Yes	5	5	0
10 B	---	No	0	0	0
11 A	---	No	0	0	0
11 B	---	No	0	0	0
12 A	BB	Yes	5	4	0
12 B	---	No	0	0	0
13 A	---	No	0	0	0
13 B	---	No	0	0	0

Table1. Nesting results for the 2010 nesting season. (A: small box hole; B: large box hole; BB: bluebirds; CH chickadees; TS tree swallows).

Nesting activity was again observed in box 5A on July 7, and 4 bluebird eggs were found in the nest on July19. Three of the 4 eggs hatched by July 26, while the remaining chick hatched by the next week and all 4 chicks fledged by August 9. Also on July 7, nesting activity was detected in box 7B. By July 19, 3 chickadee eggs were found in this large entrance box. The 3 chicks hatched by August 2, and were still in the nest at the writing of this report.

Insect and invertebrate survey: Insects and other invertebrates were sampled at four sites by insect net [July 26 (Table 2)] and by pan traps [July 19-26 (Table 3)]. A total of 3301 specimens were identified in these samples. The largest numbers of specimens were collected by the pan traps. Specimens were identified and placed into one of twenty-five invertebrate groups using Milne et al. (2005).

30 m Transects

Group	**Sample Location** (between boxes)			
Sample	**2-3**	**4-5**	**5-6**	**7-8**
Ants	1	1	1	1
Aphids	0	1	0	0
Bees	6	20	56	31
Beetles	8	12	10	8
Butterflies	0	0	0	0
Caterpillars	0	0	0	2
Centipedes	0	0	0	0
Crickets	4	3	7	1
Dragonflies	0	0	0	0
Earwigs	0	0	0	0
Flies	4	28	51	11
Grasshoppers	1	3	12	2
Lacewing	0	0	0	0
Leafhoppers	58	132	142	46
Long-necked seed bug	0	4	6	1
Mosquitoes	0	2	4	4
Moths	0	0	0	0
Roach	0	0	0	0
Sawflies	0	1	1	0
Slugs	0	0	0	0
Snails	0	0	0	0
Spiders	17	16	10	28
Ticks	0	0	0	0
Wasps	2	0	0	6
Weevils	2	0	0	2

Table 2. Results of insect and invertebrate transect surveys conducted July 26, 2010.

Pan Traps

Group / **Sample**	**Sample Location** (between boxes) **2-3**	**4-5**	**5-6**	**7-8**
Ants	5	43	17	10
Aphids	0	0	0	1
Bees	31	247	175	55
Beetles	16	30	30	29
Butterflies	2	9	8	0
Caterpillars	4	1	1	0
Centipedes	0	0	3	1
Crickets	2	7	15	9
Dragonflies	1	1	0	0
Earwigs	4	10	14	15
Flies	18	100	191	40
Grasshoppers	5	12	20	26
Leafhoppers	124	332	317	133
Long-necked seed bugs	0	12	4	0
Mosquitoes	2	5	3	1
Moths	21	72	28	5
Plant hopper	1	0	3	0
Roach	0	0	0	1
Sawflies	8	22	20	3
Slugs	0	0	0	2
Spiders	12	35	24	26
Stink bugs	0	2	3	0
Ticks	3	20	5	0
Wasps	1	12	17	21
Weevils	1	5	3	2
Yellowjacket	1	13	0	0

Table 3. Results of insect and invertebrate pan surveys conducted between July 19 and July 26, 2010.

Discussion

Bermudez (2002) found that bluebirds would utilize nesting boxes with entrance holes enlarged from a diameter of 1.5 inches to 2.75 inches. The objective of this study during the 2010 season and during the 2011 season, is to test whether bluebirds will show a preference for one of the two entrance hole sizes when presented with both. During the course of the 2010 season, nesting activity was observed in two of the large entrance boxes. Bluebirds built a nest and produced 4 eggs in box 6B; however, it is possible that they would not have used this box if box 6A had not lost its top exposing the nest. Chickadees built a nest in box 7B late in the season, and unlike the bluebirds have to this point avoided predation. This box is within a few feet of the tree line and shaded by an over hanging evergreen branch. The location of the

box may have obscured the box from predators and kept the box cool in the high summer temperatures [+90^{o} F (personal observation)]. This study will be continued in the 2011 season, to determine if birds continue to utilize these boxes.

The composition of the insect populations changed from the previous season. The preferred food items for bluebirds [beetles, butterflies, crickets, grasshoppers, leafhoppers moths and spiders (All About Birds- Eastern Bluebird, 2003)] during the 2009 season ranged from 49.9% to 57.3% of the groups present in the combined tallies at each sampling site. During the 2010 season, the preferred food species increased to 75.4% of the identified specimens, ranging from 71.1% to 84.3% in the combined tallies at each sampling site

The bluebird trail at the Powell River Educational Center successfully supported the reproductive efforts of Eastern Bluebirds, chickadees and tree swallows. Both bluebirds and chickadees were found to utilize the Bermudez boxes. In the 2011 season, it will be interesting to determine if the birds will continue to utilize the Bermudez boxes or whether the two cases form this season were isolated incidences.

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