Productivity of Prothonotary Warblers in the Cache River Bioreserve

Final Report

by

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BACKGROUND AND METHODS

This project, funded in part by the Illinois Wildlife Preservation Fund, investigated the productivity of Prothonotary Warblers (Protonotaria citrea) in the Cache River Bioreserve during the 1996 breeding season and was the third year of ongoing research studying the breeding ecology of Prothonotary Warblers. The Cache River Wetlands (CRW) project is a joint venture with the ultimate goal being large-scale ecosystem restoration and land acquisition in the Cache River watershed in southern Illinois. One of the main objectives of the CRW project is to improve conditions for songbirds by restoring thousands of acres of bottomland forest habitat. The Prothonotary Warbler is common throughout the many swamp and wet-bottomland forests. Because Prothonotary Warblers are common in a variety of wet forested habitats in the CRW, and it preferentially uses nest boxes rather than natural cavities, we were able to obtain a large amount of detailed reproductive information from several areas in the project area. The success of this research has allowed us to document the current conditions for Prothonotary Warblers in the CRW project area (levels of abundance, nesting success, nest predation, and brood parasitism) and forms a basis against which to compare future conditions to determine the success of the restoration effort.

During the summer of 1996, we maintained 690 nest boxes (made from 1.9-liter milk and juice cartons) among 6 sites within the CRW. Nest boxes were also present on these sites in 1994 and 1995. We captured adult Prothonotary Warblers and placed a unique band combination (color bands and USFWS aluminum band) on their legs. We monitored each nest box every three days from 10 April (arrival of first males) until nesting ceased in August. We documented the fate of each nesting attempt and determined the productivity on each of the study sites and the costs associated with brood parasitism. We compared the return of color-marked individual adult warblers to their nesting success the previous year (1995). We conducted standardized censuses on all of the study sites to

determine the abundance of all avian species and particularly for comparison with the 3 years of abundance data already obtained on each of the study sites (1993-1995).

RESULTS AND DISCUSSION

During the 1996 field season, we monitored a total of 366 nesting attempts (all in nest boxes) by Prothonotary Warblers. Where nest boxes were present, the warblers did not use natural cavities, so we are confident that for a given site we were able to monitor all nesting attempts. We captured 274 adult warblers, consisting of 110 males and 164 females. Of these totals, 28 males and 49 females were captured as breeding adults on the study sites in 1995. Each pair typically made 2-3 nesting attempts during the breeding season. We were also able to put aluminum USFWS bands on 173 Prothonotary Warbler young.

The range of values for the productivity (number of Prothonotary Warbler young produced per color-marked female) on the 6 study sites was 0.00-3.82. Between years, females returned at a slightly higher rate (49%) than did males (41%). There was a pronounced tendency for females that raised 2 broods in 1995 to return between years at a significantly higher rate than for females that raised 1 or no broods (Table 1). The males followed a similar pattern of higher returns with increasing numbers of broods fledged the previous year, but it was not significant (Table 1). These trends were similar to those found in the 1994-1995 field seasons (Table 2). The return rate between years for both males and females was not influenced significantly by the absolute number of predation events experienced the previous year or by the number of times an adult warbler raised a brood containing a cowbird the previous year.

The range of values for the severity of brood parasitism by Brown-headed Cowbirds (Molothrus ater) (number of cowbird eggs per Prothonotary Warbler nest) was 0.9-2.96. Abandonment of nests was not different between parasitized and unparasitized nests in 1995. In 1996, however, abandonment was significantly more frequent for

parasitized nests than for unparasitized nests (16 % vs. 4.5 %, respectively, $X^2 = 13.9$, $P < 0.01$). A majority of these abandonments of parasitized nests (17 out of 26) occurred following a cowbird laying an in egg in a nest before completion of the nest, or prior to the onset of egg laying by the host. There was significant ($P < 0.05$) reduction in clutch size (egg removal) for first and second clutches (reduction = 0.8 and 0.4 eggs, respectively), but not for third clutches. For those nests escaping predation up to the hatching stage, hatching success was significantly lower for parasitized nests than for unparasitized (Table 3). When nestlings were 4-5 days old, the interval of food delivery to the nest by adults was significantly less (food brought more frequently) for parasitized nests than for unparasitized and was lowest for broods containing 2-4 cowbird young (Table 4).

With the potential for increased predation at nests due to the greater number of trips being made to the nest by adults, we compared the predation rates during the nestling period for nests that contained cowbird young to those that did not. Predation was not significantly different between nests with parasitized and unparasitized broods (20 % vs. 23%, respectively, $X^2 = 0.25$, $P > 0.25$). However, the fledging success for those nests that escaped predation during the nestling stage was significantly lower for parasitized nests than for unparasitized (Table 3). Another cost of brood parasitism was that the mass of 8-day-old host young was significantly lower ($P < 0.05$) in a parasitized brood than in an unparasitized one (in a parasitized brood, a warbler young weighed approximately 0.83 that of a warbler young in an unparasitized brood). Lastly, there was no apparent cost to the adult females in terms of a between-nest interval, as these intervals were not different following the successful fledging of a parasitized or an unparasitized brood.

With this research we have documented the following in the CRW:

- Prothonotary Warblers will readily use nest boxes instead of natural cavities when given the choice, and have shifted entirely to nest boxes where nest boxes are available.

- Abundances of Prothonotary Warblers have not increased significantly on study sites where nest boxes have been placed. This indicates that something other than cavity availability is limiting their abundance/density.
- Productivity of Prothonotary Warblers varies greatly between sites, between years, and in some instances within sites between years. Predation is the primary factor limiting productivity and is related to water-level fluctuations and erratic hydrologic patterns that exist on the different sites.
- Between-year return rates for Prothonotary Warblers tend to increase with an increase in the number of successful nesting attempts during the previous breeding season. This is especially true for females that are successful 2 times. This suggests that the warblers may be using "decision rules" to govern their dispersal between years. This demonstrates the need for predictably productive sites so that individuals returning to a site following success the previous year would be likely to experience success again. These productive areas would increase the lifetime productivity for individuals and may serve as "source" habitat for the region.
- Brood parasitism of Prothonotary Warblers in the CRW is the highest ever documented for the species. Brown-headed cowbirds are presently incurring several costs on Prothonotary Warblers. For parasitized nests, there are reductions in clutch size (egg removal), hatching success, and fledging success. Adults deliver food more frequently to young when feeding a brood containing a cowbird. Host young weigh significantly less when in a brood with a cowbird sibling.
- Even with all of these costs associated with brood parasitism, Prothonotary Warblers do not appear to employ any potential defenses to reduce the level of parasitism, with the exception of abandoning a nest if a cowbird egg is laid prior to the onset of the warbler's egg laying.

As the acquisition, restoration, and management of land in the CRW project area progress, we will be able to document any immediate and long-term changes in the avifauna by continuing to study this system of Prothonotary Warblers (abundance, productivity, nest predation, and brood parasitism). The results of this research are invaluable because they form the basis for future comparisons that will allow us to determine the success of the ongoing restoration efforts in the CRW area.

Table 1. Return rates (to study sites) for female and male Prothonotary Warblers in 1996 that were successful 0, 1, or 2 times during the 1995 breeding season.

	% Frequency (n) of adults exhibiting study site fidelity				
	No. of successful[1] nesting attempts in 1995				
Sex	0	1	2	X^2	P
Female	41 (39)	34 (73)	73 (11)	7.04	<0.05
Male	33 (21)	44 (39)	50 (8)	0.93	>0.10

[1] Successful nests were those that had at least one nestling fledge from them.

Table 2. Return rates (to study sites) for female and male Prothonotary Warblers in 1995 that were successful 0, 1, or 2 times during the 1994 breeding season.

	% Frequency (n) of adults exhibiting study site fidelity				
	No. of successful[1] nesting attempts in 1994				
Sex	0	1	2	X^2	P
Female	36 (14)	27 (33)	62 (21)	6.55	<0.05
Male	7 (14)	21 (29)	33 (18)	3.05	>0.10

[1] Successful nests were those that had at least one nestling fledge from them.

Table 3. Comparison between parasitized and unparisitized natural cavities and nest boxes for nesting parameters of Prothonotary Warblers in southern Illinois, 1993-1996.

	Proportion (n) of nests with 100% hatching or nestling success			
	Natural cavities[1]		Nest boxes[1]	
Parameter	Unparasitized	Parasitized	Unparasitized	Parasitized
Hatching success[2]	0.67 (27)[a]	0.13 (15)[b]	0.76 (215)[a]	0.25 (122)[b]
Nestling success[3]	0.93 (28)[a]	0.53 (15)[b]	0.96 (162)[a]	0.70 (71)[b]

[1] Data for natural cavities were obtained during 1993-1994, and for nest boxes from 1994-1996.
[2] Only nests that were successful through the incubation and hatching period were used in this comparison.
[3] Only nests that were successful through the nestling period were used in this comparison.
[a,b] Within rows, values with dofferent letters are significantly different ($P<0.05$) using chi-square tests of independence.

Table 4. Feeding intervals for adult Prothonotary Warblers bringing food to broods of 4-5 day-old nestlings in southern Illinois, 1996.

Brood Composition PROW - BHCO	$\bar{x} \pm 1$ SE (n) feeding interval (min.)
2 - 0	11.72 ± 0.89 (2)
3 - 0	5.43 (1)
4 - 0	5.92 ± 0.53 (11)
5 - 0	6.14 ± 0.31 (15)
6 - 0	4.50 ± 0.44 (2)
All unparasitized	6.29 ± 0.27 (31)[a]
1 - 1	5.59 ± 1.71 (2)
2 - 1	5.97 (1)
3 - 1	4.15 (1)
4 - 1	4.74 ± 0.42 (4)
All with 1 BHCO	5.03 ± 0.22 (8)[b]
0 - 2	3.71 (1)
1 - 2	3.66 ± 0.20 (3)
2 - 2	3.90 ± 0.55 (4)
3 - 2	2.57 ± 0.19 (2)
All with 2 BHCO	3.54 ± 0.16 (10)[c]
0 - 3	4.75 ± 0.92 (2)
2 - 3	2.69 (1)
0 - 4	3.49 ± 0.85 (3)
All with ≥ 3 BHCO	3.78 ± 0.36 (6)[c]

[a,b,c] Means that have different letters are significantly different ($P>0.05$) from each other.