Weights and Measurements of Prothonotary Warblers from Southern Indiana, with a Method of Aging Males.

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The Prothonotary Warbler (*Protonotaria citrea*) is a common breeding bird throughout much of the eastern United States. However, since Walkinshaw's early studies (1941, 1953) the species has received little attention from researchers. In this paper I summarize weight and measurement data obtained from Prothonotaries during a 3 year study of the species in southern Indiana, and suggest a method for separating first year from older males.

Study Area and Methods

Field work was done on the North Fork of Salt Creek, located in eastern Monroe Co., IN from 25 April to 1 Sept in 1983 and 1984, and 20 April to 5 Aug in 1985. In 1983 the study area consisted of 4.0 km of stream, and in 1984 and 1985 this was increased to 12.7 km. Male Prothonotaries were captured by the use of song playback and females were captured at the nest while incubating. Wing lengths were taken from the flattened wing, tail lengths were taken by inserting a straightedge between the middle 2 retrices, and weights were taken with an Ohaus triple-beam balance.

A total of 89 males and 23 females were banded during the study, with 7 males and 4 females in 1983, 41 males and 14 females in 1984, and 41 males and 5 females in 1985. For the following analysis weights and measurements taken from birds returning from previous years are counted as additional samples.

Results and Discussion

Overall comparisons. Table 1 compares the weight and measurement data for the Prothonotaries banded during the study. Males were found to have significantly longer wings and tails than females, while females were on average heavier. In both Michigan and Tennessee Walkinshaw (1941) also found that males averaged longer wings and were lighter. This weight difference is interesting given the smaller size of females. During this study females were captured while incubating, suggesting that the observed weight difference did not result from the presence of unlaid eggs.

Table 1. Comparison of wing length, tail length, and body weight of Prothonotary Warblers banded from 1983 to 1985.[1]

	MALES	FEMALES	SIGNIFICANCE[2]
Wing	72.90±.18 (68-78) n = 111	68.96±.36 (66-73) n = 24	p << .001
Tail	47.10±.17 (44-55) n = 110	45.38±.34 (43-49) n = 24	p < .001
	15.49±.11 (12.8-17.7) n = 112	16.09±.34 (13.4-19.6) n = 23	p < .05

[1]Values reported: $\bar{X}$ ±SE, range, sample size. Lengths in mm, weights in g.
[2]Student's t-Test.

Walkinshaw (1941) found that Prothonotaries from his Calhoun Co., MI study area were larger than those from his Reelfoot Lake, TN site. My study area is nearly equidistant from these 2 locales, being approximately 359 km SW of the Michigan site and 320 km NE of the Tennessee site. With regards to males, the available data only allow a comparison of my birds with Walkinshaw's Michigan males. These 2 groups do not differ significantly in wing length or weight. Table 2 compares the wing length and weight data for female Prothonotaries from these 3 areas. Both wing lengths and weights increase from Tennessee to Michigan, and the variation in these data is significant. The pair-wise comparison of locales (Newman-Keuls multiple range test) shows that both Michigan and Indiana females have longer wings than those from Tennessee (MI vs TN: $q = 3.84$, $p < .025$. IN vs TN: $q = 3.61$, $p < .05$), but Indiana and Michigan females do not differ in wing length ($q = 1.26$). However, both Tennessee and Indiana females are significantly lighter than Michigan females (TN vs MI: $q = 4.20$, $p < .025$. IN vs MI: $q = 3.62$, $p < .025$), with Indiana and Tennessee females not differing in weight ($q = .71$).

Table 2. Comparison of wing lengths and weights of female Prothonotary Warblers from Reelfoot Lake, TN, Monroe Co., IN, and Calhoun Co., MI.[1]

	TENNESSEE[2]	INDIANA	MICHIGAN[2]	SIGNIFICANCE[3]
Wing	67.67±.27 (66-70) n = 21	68.96±.36 (66-73) n = 24	69.40±.43 (65-72) n = 20	$p < .005$
Weight	15.85±.32 (12.1-18.7) n = 21	16.09±.34 (13.4-19.6) n = 23	17.32±.38 (13.4-19.8) n = 20	$p < .02$

[1]Values reported: $\bar{X}$ ±SE, range, sample size. Lengths in mm, weights in g.
[2]Data supplied by L. H. Walkinshaw.
[3]Single Factor ANOVA.

Table 3. Between season comparison of wing length, tail length, and body weight of male Prothonotary Warblers.[1]

	1984	1985	SIGNIFICANCE[2]
Wing	72.59±.31 (70-77) n = 44	73.35±.20 (70-78) n = 60	$p < .05$
Tail	46.98±.26 (44-51) n = 44	47.39±.23 (45-55) n = 59	n.s.
Weight	14.71±.12 (13.1-15.9) n = 44	16.15±.13 (12.8-7.7) n = 61	$p < .001$

[1]Values reported: $\bar{X}$ ±SE, range, sample size. Lengths in mm, weights in g.
[2]Student's t-Test.

Table 4. Between season comparison of wing length, tail length, and body weight of female Prothonotary Warblers.[1]

	1984	1985	SIGNIFICANCE[2]
Wing	68.36±.36 (66-70) n = 14	70.71±.56 (69-73) n = 7	$p < .002$
Tail	45.43±.48 (43-49) n = 14	45.86±.55 (44-48) n = 7	n.s.
Weight	16.03±.36 (14.4-19.2) n = 13	17.03±.92 (13.6-19.6) n = 6	n.s.

[1]Values reported: $\bar{X}$ ±SE, range, sample size. Lengths in mm, weights in g.
[2]Student's t-Test.

Between season comparisons. The comparison of male weights and measurements of 1984 with those of 1985 (Table 3) shows that in 1985 the males on the study averaged longer weings and were heavier. The difference in weight may have resulted from better feeding conditions in 1985, but this is speculative. However, the increase in wing length suggests that the average age of males on Salt Creek in 1985 was greater than that of 1984 (see Table 5), and the correlation of wing length with weight ($r = .68$, $df = 107$, $p < .001$) would account for the concurrent increase in weight. Female wing length showed a similar increase in 1985, but body weight did not increase significantly (Table 4). Female wing length and weight were also significantly correlated ($r = .61$, $df = 20$, $p < .005$), but to a significantly lesser degree than in males ($r_m = .68$, $r_f = .61$, H_o: $r_m = r_f$, $Z = .50$, $p > .50$). This smaller correlation may account for the non-significant increase in female weight in 1985.

Table 5 compares the weights and measurements taken from males in the season they were banded with the same data taken from these males in the next season. Both wing length and weight increased significantly from that of the previous season.

Table 5. Changes in wing length, tail length, and body weight of male Prothonotary Warblers: Birds banded as adults and returning to the study area the next season.[1]

	SEASON BANDED	NEXT SEASON	DIFFERENCE	SIGNIFICANCE[3]
Wing	72.19±.67 (68-77) n = 16	74.00±.40 (71-78) n = 16	1.81±.46	$p < .002$
Tail	47.00±.51 (44-51) n = 16	47.81±.57 (46-55) n = 16	.81±.40	n.s.
Weight	15.02±.20 (13.9-16.0) n = 12	16.35±.27 (13.5-17.6) n = 12	1.34±.27	$p < .001$

[1]Values reported: $\bar{X}$ ±SE, range, sample size. Lengths in mm, weights in g.
[2]Paired-Sample t-Test.

Male age. During the course of this study I began to notice that during the breeding season adult males varied markedly in the amount of greenish-tipped feathers present on the occipital region of the crown, with some males appearing nearly as green as females and others totally lacking greenish on this area. That this character might be an indicator of age is suggested by 4 lines of evidence. Firstly, the male juvenile plumage closely resembles that of the adult female (Chapman 1907). Secondly, adult Prothonotaries undergo but one molt per year, the postnuptial (Bent 1953). Thirdly, during the study 2 birds banded as nestlings on the study area returned as breeding males the following season, and in both cases the occipital region of the crown was very greenish. Fourthly, a male banded as an adult in 1983 returned to the study area both in 1984 and 1985. In 1985 this male did not have any greenish on the crown, and the entire crown was intensely orange-yellow.

In 1985 a simple method of scoring Prothonotary crown plumage was devised (Fig. 1). Males banded during this season were scored, as were returning males. Figure 2 compares the distribution of scores for new birds banded in 1985 with that of returning males. If the amount of greenish on the crown is an indicator of male age, returning males (2 years or older) should score significantly lower on the 0 to 2 scale than new males (1st year and older males). This was, in fact, the case (Mann-Whitney, $U = 351$, $p < .05$). It should be noted here that scores of .5 and 1.5 represent males whose crown coloration fell between 0 and 1, and 1 and 2, respectively.

Figure 1. Male Prothonotary Warbler crown plumage scores. The drawings represent the relative amounts of greenish-tipped feathers in each category.

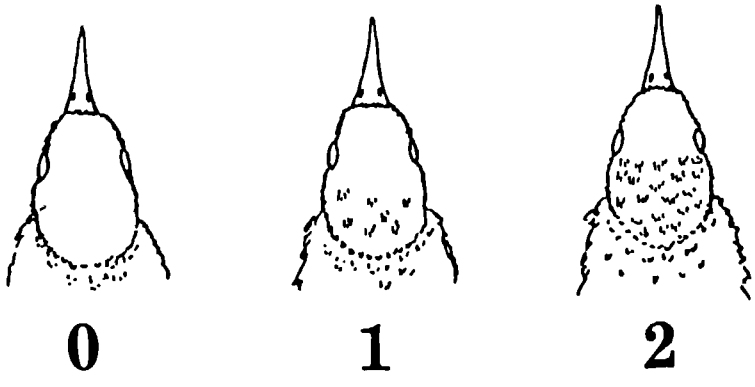
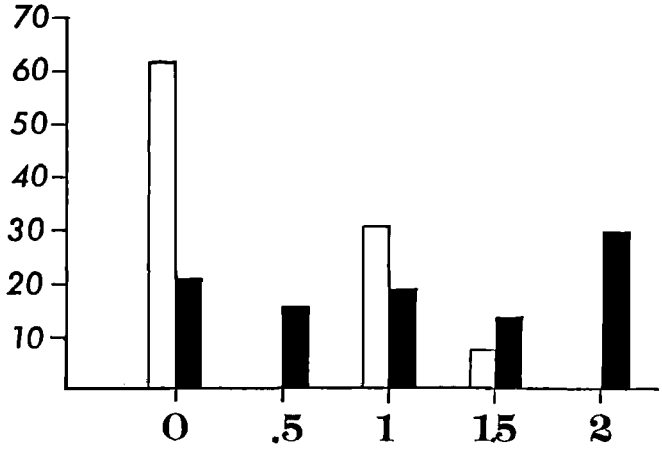


Figure 2. Frequency distribution of crown plumage scores of male Prothonotary Warblers captured in 1985. Black bars represent birds banded in 1985, and white bars represent returns from previous seasons.

X-axis- "Crown Plumage Score"
Y-axis- "Per Cent of Total"



The fact that only 1 (8%) of the 13 males returning to Salt Creek in 1985 scored above 1 for crown coloration supports the idea that the degree of greenish-tipped feathering on the crown is a reliable indicator of age of males in this species. Going on the assumption that males scoring either 0 and 1 were at least 2 years old, the wing lengths of all 1985 birds in these groups were compared with those scoring 1.5 or 2. The mean wing length of males scoring 0 and 1 was 73.94 mm, and those scoring 1.5 and 2 averaged 72.61 mm, a difference that is significant ($t = 3.59$, $df = 53$, $p < .001$). The 95% confidence interval for the range ($\bar{X} \pm 2$ [SD]) of 0 and 1 males is 71.20 mm to 76.68 mm, and 69.59 mm to 75.63 mm for males scoring 1.5 and 2. The areas of non-overlap between these 2 intervals correspond with the wing length data gathered in 1985. All males with a wing length of <71 mm scored 1.5 or 2, and all males with a wing length >76 mm scored 0 or 1 for crown coloration.

Summary

During a 3 year study of the Prothonotary Warbler in southern Indiana, 89 males and 23 females were banded. Males had significantly longer wings and tails than females, while females were heavier. The average wing length and weight of males in 1985 were greater than those in 1984, and in 1985 females averaged longer wings than females in 1984.

The amount of greenish-tipped feathers on the occipital region of the crown appears to be a reliable method for separating first-year from older males. Wing length is a less precise indicator of age, with first-year males having wing lengths of < 71 mm, and older males having wing lengths of > 76 mm.

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(Inland)