

**MORPHOMETRICS OF NESTING PROTHONOTARY WARBLERS AT TISHOMINGO
NATIONAL WILDLIFE REFUGE, OKLAHOMA**

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Abstract—We measured morphometric data of adult female and male Prothonotary Warblers (*Protonotaria citrea*) from 2008-2011 at the Tishomingo National Wildlife Refuge in south-central Oklahoma. Males had longer wing and tail lengths; however, females had greater body mass. Adult warblers (± 2 years old) tended to have longer wing and tail lengths than second year warblers (< 2 years old). Although most statistical tests were not significant, significant results should be interpreted with caution due to small sample sizes. No differences were found among age classes for body mass. Morphometric results correspond to previously published ranges for Prothonotary Warblers across the species' range.

The Prothonotary Warbler (*Protonotaria citrea*) is a secondary cavity nesting Nearctic-Neotropical migrant bird species that occurs in Oklahoma (Petit 1999). Wood (2007) documented morphometric relationships of Prothonotary Warblers from 2003-2006 at the Tishomingo National Wildlife Refuge in south-central Oklahoma. In that study, male Prothonotary Warblers had significantly greater wing and tail length than female Prothonotary Warblers; however, female Prothonotary Warblers had greater body mass than male Prothonotary Warblers. No differences among age classes were detected, although sample sizes were relatively small. Wood (2007) also documented that Prothonotary Warblers appeared to follow Bergmann's Rule which states that individuals in the northern latitudes of the species' range have greater body mass than conspecifics in the southern portions of the species' range. No relationship was detected for Allen's Rule which states that animals exhibit shorter appendage length in the northern portion of the species' range compared to conspecifics in the southern portion of the species range (Wood 2007).

After a significant flood event in 2007 at the Tishomingo National Wildlife Refuge, which inundated Wood's Prothonotary Warbler study sites, research resumed from 2008 to 2011 (Diggs 2009, Newman *in prep*). Our objective was to contribute additional Prothonotary Warbler morphometric data to the literature and make comparisons to previous studies.

METHODS

From 2008-2011, we collected Prothonotary Warbler morphometric data at the Tishomingo National Wildlife Refuge (34° 11'N, 96° 38'W) in Johnston County, Oklahoma. Adult female warblers were target captured from nest boxes during incubation using the hat trick method (Wood and Reasor 2006). This ensured that only nesting female warblers were captured. Male warblers were opportunistically captured using mist nets while holding territory (i.e., displaying or singing within 10 m of active nest box) or feeding nestlings, although sample sizes were not large. We measured un-flattened wing cord length and tail length with a standard wing rule (Pyle 1997). Body mass was weighed using a 50-g Pesola spring scale (Wood 2007). We rounded morphometric measurements to the nearest 1 mm or 1 g in the field. Warblers were aged as either After Second Year (ASY) or Second Year (SY) based on criteria in Pyle (1997).

Due to small sample sizes and lack of normality in the data, non-parametric Wilcoxon tests were used to compare mean wing length, tail length, and body mass among age classes and sexes of Prothonotary Warblers. All tests used an *a priori* alpha level of 0.05 for significance. Statistical tests were conducted using SPSS® software.

RESULTS

From 2008-2011, we captured 89 female and 9 male Prothonotary Warblers that had not previously been captured at the Tishomingo National Wildlife Refuge. We combined data from different years to facilitate morphometric comparisons among measurements, ages, and sexes. Due to small sample sizes, significant results from non-parametric tests should be interpreted with caution.

Wing length

ASY females ($n = 69$) had longer wing length than SY females ($n = 20$; difference = 0.1 mm), but not statistically significantly different ($Z = 0.23$, $P = 0.82$; Table 1). Similarly, ASY males ($n = 5$) had longer wing length than SY males ($n = 4$; difference = 1.1 mm); however, they were not significantly different ($Z = 0.82$, $P = 0.41$; Table 1). Overall, males ($n = 9$) had statistically longer wing length (difference = 3.9 mm) than females ($n = 89$, $Z = 2.57$, $P = 0.01$; Table 1).

Tail length

ASY females had significantly longer tail length (difference = 0.4 mm) than SY females ($Z = 2.2$, $P = 0.03$; Table 1). ASY males had longer mean tail length than SY males (difference = 1.5 mm), but were not significantly different ($Z = 1.3$, $P = 0.20$; Table 1). Overall, males had statistically longer tails (difference = 1.3 mm) than females ($Z = 2.1$, $P = 0.04$; Table 1).

Body mass

ASY females and SY females had nearly identical mean body masses (difference = 0.1 mm) that were not significantly different ($Z = 0.41$, $P = 0.68$; Table 1). Similarly, ASY males and SY males (difference = 0.3 mm) had similar body masses ($Z = 0.82$, $P = 0.41$; Table 1). Females weighed significantly more (difference = 1.0 g) than males ($Z = 2.4$, $P = 0.02$; Table 1).

DISCUSSION

At Tishomingo National Wildlife Refuge, mean female Prothonotary Warbler wing length (67.0 mm) fell within the range (63-72 mm) published in the literature (Walkinshaw 1941, Kowalski 1986, Petit and Petit 1996, Pyle 1997). Mean female tail length (43.0 mm) also fell within ranges (41-49 mm) published by Kowalski (1986), Pyle (1997), and Petit (1999). Mean female body mass (15.4 g) fell within published ranges (14-16 g; Petit 1999). Male mean wing length (70.9 mm) fell within published ranges (66-76 mm), as did mean tail length (44.3 mm) compared to published ranges (43-50mm) in Pyle (1997). Male mean body mass (14.4 g) also fell within the 14-16 g range published in the literature (Walkinshaw 1941, Kowalski 1986, Pyle 1997, Petit 1999).

We also compared morphometric results with Wood (2007) from the same study site. Prothonotary Warblers demonstrated similar morphometric measurements with few exceptions. SY females had slightly smaller wing and tail lengths (difference <0.6 mm), although they weighed 0.9 g more on average than SY females in Wood (2007). ASY females had slightly smaller wing lengths (difference < 0.6 mm) and identical tail lengths compared to Wood (2007). Body mass only varied by 0.4 g between female age classes (Wood 2007).

From 2008-2011, SY male warblers had slightly shorter wings; however, tail length was 1.6 mm shorter than in Wood (2007). ASY male warblers had virtually identical wing lengths (difference = 0.1 mm) compared to Wood (2007); however, tail length was 1.0 mm shorter than (Wood 2007). Body mass was 0.6 g less than in Wood (2007).

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Table 1. Female and male Prothonotary Warbler morphometric measurements from the Tishomingo National Wildlife Refuge from 2008-2011. Values are mean \pm SD, range.

Sex	Age (n)	Wing (mm)	Tail (mm)	Mass (g)
Female	SY (20)	66.9 \pm 1.5, 64-69	42.9 \pm 1.5, 38-46	15.5 \pm 1.0, 13-17
	ASY (69)	67.0 \pm 1.8, 61-70	43.3 \pm 1.9, 42-50	15.4 \pm 1.2, 13-20
	Combined (89)	67.0 \pm 1.8, 61-70	43.0 \pm 1.6, 38-50	15.4 \pm 1.2, 13-20
Male	SY (4)	70.3 \pm 2.5, 67-73	43.5 \pm 1.7, 42-46	14.3 \pm 0.5, 14-15
	ASY (5)	71.4 \pm 1.1, 70-73	45.0 \pm 0.7, 44-46	14.6 \pm 1.1, 13-16
	Combined (9)	70.9 \pm 1.8, 67-73	44.3 \pm 1.4, 42-46	14.4 \pm 0.9, 13-16

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ERRATUM. In my article *First Swainson's Warbler nest documented in Oklahoma since 1917* (Revels, M. R. 2003. Bulletin of the Oklahoma Ornithological Society, 36[1-2]:1-3) the first sentence should be changed to: Swainson's Warbler (*Limnothlypis swainsonii*) was first documented breeding in Oklahoma in 1914 in Washington County by Albert J. B. Kirn (Nice 1931).

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