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## WING TO TAIL LENGTH RATIO IN EUROPEAN BLACKBIRDS (*TURDUS MERULA* L.) OF DIFFERENT AGE

**ABSTRACT:** Urban European Blackbird (*Turdus merula* L.) population was studied in 1997–2004 in two city parks of Szczecin (NW Poland), based on observations of colour-ringed birds. Biometric studies involving numerous bird species showed that the wings of individuals in their second year of life are shorter than those of birds older than two years; the causes of the differences are, however, unclear. The wing length of the individuals observed the year following the ringing was similar to that of the individuals that were not observed that year (probably non-survivors) – 127.2 vs. 127.5 mm for young birds, 129.9 vs. 128.3 mm for old birds, respectively. Therefore, the hypothesis assuming increased mortality of shorter-winged individuals has to be rejected. In opposition to the expected differences between the wing to tail length ratios in the young and older birds (1<sup>st</sup> year – 1.43, 2<sup>nd</sup> year – 1.40, older – 1.39) one has to reject the hypothesis that the young individuals benefit from higher maneuverability of shorter wings. On the other hand, the greater wing length of those individuals captured in their second year of life and recaptured one year later (127.2 vs. 129.7 mm respectively) allows to accept the hypothesis of better nutrition as the cause of longer wings in the older blackbirds.

**KEY WORDS** – wing to tail length ratio, *Turdus merula*, biometry

### 1. INTRODUCTION

Morphology of an individual reflects a compromise between, e.g., sexual selection, predation, foraging manner, and migration behavior, which frequently act in opposite directions (James 1982, Hall *et al.* 2004). Old individuals of many bird species have been found to have longer wings than their young conspecifics (Alatalo *et al.* 1984, Jenni and Winkler 1994, Norman 1997, Figuerola and Gutierrez 2000, Wysocki 2002). The cause of those differences, however, has not been explained so far. By way of explanation, three hypotheses have been offered. One of them assumes that, during the growth of feathers, the young need more food than the adults, hence the wing length is affected by food availability (van Balen 1967, Slagsvold 1982). The hypothesis predicts that the wings grow after the first breeding season and that short- and long-winged individuals do not differ in their survival and site fidelity. However, the wing length (WL) to tail length (TL) ratio should be similar in the young and old individuals ( $WL/TL_{\text{young}} = WL/TL_{\text{old}}$ ). The second hypothesis assumes that young individuals may benefit

from having shorter wings because of their enhanced maneuverability and, thus, a facilitated escape from a predator (Hedenström and Rosen 2001), while longer wings of the adults provide for faster migrations (Alatalo *et al.* 1984, Hedenström and Alerstam 1998). If predation pressure is the major factor affecting the wing and tail lengths in the young birds, they would be expected to have proportionally shorter wings and longer tails (because of their enhanced maneuverability – Norberg 1990, also see Evans *et al.* 2002). The wings should be longer in the old birds, hence  $WL/TL_{\text{young}} < WL/TL_{\text{old}}$ . The third hypothesis, largely unexplored, assumes the young bird's wing length is a result of increased mortality of the short-winged birds (see Figuerola and Gutierrez 2000 for a review).

## 2. MATERIAL AND METHODS

The study was carried out in 1997–2004 in two city parks of Szczecin (NW Poland). The European blackbird (*Turdus merula*) individuals were captured, measured, and color-ringed throughout each year. A total of 310 birds with intact plumage were caught, including 50 individuals in their first year of life whose feathers had completed their length growth (hence the birds were older than 45 days; D. Wysocki unpubl.), 155 in their second year, and 105 older than two years. Owing to the high site fidelity (averaging 70 and 60% in males and females, respectively; Wysocki 2004), some of the birds ringed in one year were recaptured the following year. A total of 30 young individuals (i.e. measured in the second year of life) and 17 old (i.e., measured when older than 2 years) were recaptured.

The wing length was measured, as the maximum length, on a flattened and straightened wing (Svensson 1992). Statistical treatment was applied to measurements of the right wing. When the right wing primaries were damaged, the wing was assumed to be equal in length to the left wing. When both wings were damaged, measurements were not taken. The tail length was measured in two ways. Tails of the first 110 individuals were measured with a ruler (to

the nearest 1 mm) according to the “to back” method proposed by Busse (1983), whereas tails of the next 200 individuals were measured with a calliper (to the nearest 1 mm) according to the “T[C]” technique (Svensson 1992). Because of different tail positions, the length taken with a ruler was, on average, 17% higher than that measured with a calliper (Wysocki 2002). When calculating the wing length to tail length ratio, the tail length measured using the “T[C]” technique was used. The measurements taken with the “to back” technique were standardised using the formula  $TL_{\text{T[C]}} = TL_{\text{to back}} + 0.17 \times TL_{\text{to back}}$ . The metatarsus length was measured as in Svensson (1992). Statistical treatment was applied to measurements of the right metatarsus.

To check if wing length increases with age, Student's *t* test for paired observations was used; normality of distribution of the differences was tested using the Kolmogorov-Smirnov test. The analysis was applied also to the metatarsus length as it is a good body size descriptor, attains its final length in the initial months of life (Rising and Somers 1989, Gosler *et al.* 1998), and is not directly associated with flying efficiency. Differences in wing length between individuals observed and non-observed in the next years were analysed separately using ANCOVA controlling for metatarsus length. As there were no wing length differences between individual age groups the birds caught in different months ( $F_{11, 332} = 0.64$ ;  $P = 0.78$ ), effects of abrasion of primaries on wing length of individuals caught at different times were ruled out. To compare the wing length (WL) to tail length (TL) ratios in individual age groups, analysis of variance was applied to  $\log_{10}$ -transformed WT/TL ratios.

## 3. RESULTS

Birds in their second year were found to have wings shorter than birds in their third year of life; (mean:  $127.2 \pm 2.8$  mm and  $129.7 \pm 3.5$  mm; Student's *t* test for pairs:  $N = 30$ ;  $t = 6.03$ ;  $0.001 < P < 0.01$ ). The differences were not significant with respect to the birds captured first when older than two years and recaptured (the respective mean lengths:  $129.0 \pm 2.8$  mm and  $129.9 \pm 1.5$  mm; Student's

*t* test for paired observations:  $N = 17$ ;  $t = 1.49$ ;  $P = 0.16$ ).

There was no difference in wing length between young individuals observed in the years following the year of ringing and those that could not be observed then (Table 1). Also the wing length of individuals captured when older than 2 years did not affect the probability of observation in subsequent seasons (Table 1).

No age-dependent change in metatarsus length was detected (birds in their second year:  $33.2 \pm 1.0$  mm, birds in their third year:  $33.3 \pm 1.0$  mm; Student's *t* test for paired observations:  $N = 30$ ,  $t = 1.64$ ,  $P = 0.12$ , birds first captured when older than 2 years:  $33.8 \pm 0.9$  mm; birds recaptured at least a year later:  $33.9 \pm 0.9$  mm; Student's *t* test for paired observations:  $N = 13$ ,  $t = 0.51$ ,  $P = 0.62$ ). No significant differences were found in the metatarsus length between the juveniles observed and not observed in the subsequent years ( $33.6 \pm 1.2$  mm;  $N = 85$

vs.  $33.7 \pm 1.1$  mm,  $N = 70$ , wing length-controlled ANCOVA:  $F_{1,152} = 0.47$ ,  $P = 0.49$ ). Moreover, the metatarsus length of the individuals older than two years did not affect their probability of survival in later seasons ( $34.0 \pm 0.9$  mm;  $N = 61$  vs.  $33.5 \pm 1.0$  mm;  $N = 44$ , wing length-controlled ANCOVA:  $F_{1,102} = 3.25$ ,  $P = 0.07$ ).

Significant differences in the WL/TL ratio were found between the birds in their first, second, and later years of life (Table 2). Significant differences were found between birds in their first year of life and older individuals (post hoc Turkey's test, birds in their first year of life vs. those in their second year:  $0.01 < P < 0.05$ ; birds in their first year vs. birds older than two years,  $0.001 < P < 0.01$ ). However differences between birds in their second and third year of life are non-significant ( $P = 0.39$ ). None of the age categories showed significant differences in the WL/TL ratio between observed and not observed in the next years individuals (Table 3).

Table 1. Wing length of *Turdus merula* survivors (i.e. observed) and non survivors (i.e. not observed) in seasons following the year of ringing.

Age category	Bird wing length $\pm$ SD		Metatarsus length-controlled ANCOVA
	survivors (N)	non survivors (N)	
Young (2 yr)	$127.2 \pm 3.4$ (81)	$127.5 \pm 3.4$ (74)	$F_{1,152} = 0.09$ , $P = 0.76$
Old (after 2 yr)	$129.9 \pm 4.4$ (61)	$128.3 \pm 3.8$ (44)	$F_{1,102} = 2.29$ , $P = 0.13$

Table 2. The wing length (WL) to tail length (TL) ratios in different age categories.

Age category			ANOVA
1 <sup>st</sup> year	2 <sup>nd</sup> year	Older	
$1.43 \pm 0.01$	$1.40 \pm 0.00$	$1.39 \pm 0.01$	$F_{2,307} = 5.21$
$N = 50$	$N = 155$	$N = 105$	$P < 0.01$

Table 3. The wing length (WL) to tail length (TL) ratios in the individuals – observed (i.e. survivors) (S) and not observed (i.e. not survivors) (NS) in seasons following the year of ringing.

Age category	WL/TL ratio S mean $\pm$ SD	WL/TL ratio NS mean $\pm$ SD	Student's <i>t</i> test
1 <sup>st</sup> year	$1.43 \pm 0.06$ ( $N = 29$ )	$1.42 \pm 0.05$ ( $N = 21$ )	$t = 0.99$ , $P = 0.33$
2 <sup>nd</sup> year	$1.40 \pm 0.06$ ( $N = 85$ )	$1.40 \pm 0.06$ ( $N = 70$ )	$t = 0.25$ , $P = 0.80$
Older	$1.40 \pm 0.06$ ( $N = 61$ )	$1.38 \pm 0.08$ ( $N = 44$ )	$t = 1.10$ , $P = 0.26$

#### 4. DISCUSSION

Because of substantial site fidelity of the population studied (Wysocki 2004), it may be assumed that most of the birds that were not observed in the years following the year of ringing, had perished. Therefore, the lack of differences in wing length between the observed birds and those that did not return to the parks allows to reject the hypothesis of the juvenile bird wing length being controlled by higher mortality of shorter-winged individuals (Figuerola and Gutierrez 2000).

Even small differences in the bird morphology can cause meaningful changes in bird fitness (see Rosen 2003 for wing length, and Grant 1986 for beak) so the differences between the WL/TL ratios in the young and older birds preclude acceptance of the hypothesis put forth by Alatalo *et al.* (1984) that the young individuals benefit from higher maneuverability of shorter wings, while longer wings are better suited for older and more experienced birds by allowing faster migrations. In a population that rarely migrates any considerable distance (Stephan 1985, Wysocki, unpubl.), individuals with enhanced maneuverability, i.e., a low WL/TL, should be selected for. Those birds having a higher WL/TL ratio should be selected against and the selection should operate at its strongest in the first year of life (yearlings are inexperienced, so probability of death is the highest). The lack of differences in WL/TL ratio, particularly in those individuals in their first year of life, between the observed and not observed birds in the breeding seasons following the year of ringing, could have resulted from the sample being too small.

Another explanation of the difference in WL/TL between juvenile and adult birds involved a reduced competition for nutrients during the growth of primaries and rectrices in the juveniles. Most primaries in the birds in their first and second year of life (8 out of 12 cm in the case of the longest primaries; Wysocki unpubl.) grow when the birds are still in the nest, 4 cm only being a primary growth outside of the nest. In contrast, the rectrice gain in length as little as about 2 cm in the nest, the remaining about 7 cm being added outside of the nest. In older birds in which the primaries and rectrices are fre-

quently exchanged simultaneously, more nutrients can be directed to build the primaries, more important for survival. Consequently, the WL/TL ratio of juveniles is higher than that of older birds.

The study confirms the hypothesis, advanced by van Balen (1967), of food availability during the growth of feathers playing a crucial role for feather length. As demonstrated by Desrochers (1992), the juvenile European blackbirds foraged less efficiently than the experienced individuals; therefore, they should be expected to be in a worse condition when growing feathers and their primaries and rectrices should be expected to be shorter. As shown in an earlier biometric study of the population (Wysocki 2002), this indeed was the case.

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#### 5. REFERENCES

- Alatalo R.V., Gustafsson L., Lundberg A. 1984 – Why do young passerine birds have shorter wings than older birds? – *Ibis*, 126: 410–415.
- Busse P. 1983 – Biometrical standards in the Operation Baltic work – *Ring*, 10: 125–137.
- Desrochers A. 1992 – Age and foraging success in European blackbirds: variation between and within individuals – *Anim. Behav.* 43: 885–894.
- Evans M.R., Rosen M., Park K.J., Hendenström A. 2002 – How do birds' tails work? Delta-wing theory fails to predict tail shape during flight – *Proc. R. Soc. Lond. B*, 269: 1053–1057.
- Figuerola J., Gutierrez R. 2000 – Why do juvenile Moustached Warblers have shorter wings? – *Ornis Fennica*, 77: 183–187.
- Gosler A.G., Greenwood J.J.D., Baker J.K., Davidson N.C. 1998 – The field determination of body size and condition in passerines: a report to the British Ringing Committee – *Bird Study*, 45: 92–103.

- Grant P.R. 1986 – Ecology and evolution of Darwin's Finches. Princeton, University Press.
- Hall K.S.S., Rytman H., Fransson T., Stol B-Ot. 2004 – Stabilising selection on wing length in reed warblers *Acrocephalus scirpaceus* – J. Avian Biol. 35: 7–12.
- Hedenström A., Alerstam T. 1998 – How fast can birds migrate? – J. Avian Biol. 29: 424–432.
- Hedenström A., Rosen M. 2001 – Predator versus prey: on aerial hunting and escape strategies in birds – Behav Ecol. 12: 150–156.
- James F.C. 1982 – The ecological morphology of birds review – Ann. Zool. Fennici, 19:265–275
- Jenni L., Winkler R. 1994 – Moulting and ageing of European passerines – Academic Press, London, UK.
- Norberg U.M. 1990 – Vertebrate flight: mechanics, physiology, morphology, ecology and evolution – Berlin, Springer.
- Norman S.C. 1997 – Juvenile wing shape, wing moult and weight in the family Sylviidae – Ibis, 139: 617–630.
- Rising J.D., Somers K.M. 1989 – The measurement of overall body size in birds – Auk, 106: 666–674.
- Rosen M. 2003 – Birds in the Flow. Flight Mechanics, Wake Dynamics and Flight Performance – Lund University, Sweden.
- Slagsvold T. 1982 – Sex, size and natural selection in the Hooded Crow *Corvus corone cornix* – Ornis Scand. 13: 165–175.
- Stephan B. 1985 – Die Amsel – Neue Brehm-Bucherei 95, Zienssen, Wittenberg Lutherstadt.
- Svensson L. 1992 – Identification Guide to European Passerines – Stockholm.
- Van Balen J.H. 1967 – The significance of variation in body weight and wing length in the Great Tit, *Parus major* – Ardea, 55: 1–59.
- Wysocki D. 2002 – Biometrical analysis of an urban population of the Blackbird (*Turdus merula*) in Szczecin (NW Poland) – Ring, 24: 69–76.
- Wysocki D. 2004 – Age structure of urban population of blackbirds (*Turdus merula*) in Szczecin (NW Poland) – Zoologica Poloniae, 49: 219–227.

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