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BIOMETRICS OF NON-BREEDING IMMATURE MALLARDS (*Anas platyrhynchos*) IN NORTH-EASTERN POLAND

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ABSTRACT

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Non-breeding immature Mallards from north-eastern Poland (Północnopodlaska Lowland) were captured and measured (altogether 182 individuals in their 1st year of life). Immature males were significantly larger than females according to all analysed parameters. The length of bill and wing were the most sexually dimorphic traits and the least dimorphic were the total length of bill with head and tarsus length. The results of the present analysis and other studies in different regions of Europe suggest that wing size of Mallards follows Bergmann's rule, while a bill size – Allen's rule. Mallards from north-eastern Poland are larger than those from western Europe. We hypothesize that the reason for this is the fact that main population of non-breeding Mallards originates from the larger eastern European population, which is confirmed by some ringing data.

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Key words: Mallard, *Anas platyrhynchos*, non-breeding, biometrics, Bergmann's rule, Allen's rule.

INTRODUCTION

The Mallard is a common breeding species in Europe (Hagemeijer and Blair 1997, BirdLife International 2009) and one of the most common wintering bird in the Western Palearctic (Pihl *et al*. 1995, Avilova 2008) as well as in Poland (Tomiałojć and Stawarczyk 2003, Piotrowska 2003, Meissner and Rydzkowski 2007, Ławicki *et al*. 2008). The Mallard is a numerous wintering and regular breeding species in Białystok (NE Poland). A great proportion of individuals observed there are non-breeding

birds from Północnopodlaska Lowland (Mazurek and Polakowski 2002, Świętochowski 2007, Polakowski *et al*. 2010). The species shows sexual dimorphism, *i.e.* males are bigger and more coloured than females (Cramp and Simmons 1977, Owen and Cook 1977). The feathers stop growing once the immature individuals are fully grown (Panek and Majewski 1990).

The variation of morphological parameters can indicate intra-species variability and therefore the analysis of these parameters can be useful for describing different populations. According to the fact that the morphometric variability is lower within a population than within a species, after statistical analysis, it is possible to show the population differentiation of a species (Busse 1974, Busse and Maksalon 1986). Such biometric studies on the Mallard based on the analysis of basic morphological parameters have not been carried out in Poland, opposite to those in western Europe (Schiøler 1925, Cramp and Simmons 1977, Owen and Montgomery 1978).

The aim of this paper is to: (1) analyse the morphological variability of immature Mallards in relation to their sex, (2) determine the origin of non-breeding Mallards in north-eastern Poland.

MATERIAL AND METHODS

The study was carried out in the town of Białystok (NE Poland: 53°08'N, 23°10'E), which is situated in the coldest region in Poland. The data were collected in 2003-2009, particularly during September-March. The measurements were taken mainly from wintering individuals. Studies were conducted at 27 wintering sites of Mallards, particularly on the small rivers Biała and Dolistówka (Polakowski *et al*. 2010) in the administrative limits of the town.

We measured a total of 182 immature individuals (*i.e.* in their 1st year of life). Ducks were baited into the loop-trap (Polakowski *et al*. 2010) with a few trapped in hands. Captured Mallards were ringed and measured according to standard methods (Cramp and Simmons 1977, Baker 1993). The measurements taken were: length of bill, total length of head with bill, lengths of tarsus and wing. The bill was measured from its tip to the distal corner of the nostril, the total length of head with bill was measured from the tip of the bill to the back of the head (occiput), according to Green (1980), and the tarsus was measured from the notch at the back of the intertarsal joint to the distal edge of the last large complete scale at the front of the foot (before the toes diverge). The wing was measured as a maximum chord according to Cramp and Simmons (1977). In some birds it was impossible to take all parameters described above. The results we compared with measurements from literature, which were taken by the same methods and based on immature and adult individuals together. According to Cramp and Simmons (1977) there are no significant differences between those age classes.

The Storer's index (Storer 1966) was used to calculate the sexual dimorphism according to the formula:

$$DI = 100 \times (f - m) / 0.5 \times (f + m)$$

where:
f – the mean value of female parameter,
m – the mean value of male parameter.

Not all data met the assumption of normality and homogeneity of variance, therefore to test the differences between the parameters, a nonparametric Mann-Whitney *U*-test was used. The coefficient of Pearson's linear correlation was calculated to analyse relationships in different measurements. All tests were two-tailed and $p < 0.05$ was considered as significant. STATISTICA 8.0 (StatSoft Inc. 2007) program was used for statistical analyses.

RESULTS

The biometrics of the studied Mallard females and males are given in Table 1. According to the data immature males are significantly larger in all analysed parameters (Table 2). According to the Storer's index, the most sexually dimorphic traits were wing and bill ($DI_{wing} = 7.54$, $DI_{bill} = 7.20$) and the least ones – head with bill and tarsus ($DI_{head\ with\ bill} = 5.68$, $DI_{tarsus} = 6.53$). A significant correlation was found between the length of bill and total length of head with bill in females ($N = 40$, $r = 0.51$, $p < 0.001$) and in males ($N = 45$, $r = 0.37$, $p < 0.001$).

Table 1
Biometrics of the studied females and males of the Mallard.
All values are given in millimetres.

Measurements	N	Mean	Minimum	Maximum	*SD*	*SE*
Females						
Bill	40	51.8	48.2	57.7	1.97	0.31
Head with bill	66	108.7	102.7	117.3	3.19	0.39
Tarsus	40	42.7	40.0	47.7	1.70	0.27
Wing	77	269.6	250.0	286.0	7.72	0.88
Males						
Bill	45	55.2	50.1	59.6	2.05	0.31
Head with bill	79	115.8	107.0	124.7	3.11	0.35
Tarsus	46	45.3	40.9	48.5	1.48	0.22
Wing	98	286.3	267.0	306.0	8.42	0.85

Table 2
Differences in biometric parameters between immature female and male Mallards
(the Mann-Whitney *U*-test)

Measurement	*N* females	*N* males	*Z*	*p*
Bill	40	45	-6.08	<0.0001
Head with bill	66	79	-8.90	<0.0001
Tarsus	40	46	-6.25	<0.0001
Wing	77	98	-9.65	<0.0001

DISCUSSION

There are no data regarding biometric characteristics of the Mallard in Poland and in eastern Europe except those reported by Dementiev and Gladkov (1951). Those authors presented only maximum and minimum length of wing, bill and tarsus, while missed the mean values of these parameters. They also did not describe the origin of those data (countries from the former Soviet Union) and did not give the sample size. Other published data regarding Mallards' biometry come from studies in northern and western Europe: Greenland and Iceland (Schiøler 1925), the Netherlands (Cramp and Simmons 1977) and England (Owen and Montgomery 1978). However, a part of these data was obtained from museum skins, with only small sample sizes being taken. Moreover, such parameters as the total length of head with bill were not included. These data showed a difference between males and females, with regard to the lengths of wing, bill and tarsus, *i.e.* the males tended to be larger. Our study shows that males are significantly larger according to all these parameters (Table 1). The most dimorphic traits are the wing and bill, while the least dimorphic – the head with bill and tarsus lengths. There are two possible hypotheses explaining the size differences of sexes: the intersexual competition and social mating system in which social polygamy provides large size differences (Owens and Hartley 1998). The observed difference in the length of bill could be explained by the first hypothesis. The study on sexual size dimorphism in bill morphology of *Anas spp*. from North America shows that intersexual competition for food favours the size difference of the bill (Nudds and Kaminski 1984). The differences in the wing and tarsus lengths could be associated with a social mating system. We think that the higher dimorphism of wing (as compared to tarsus and head with bill) results from intersexual differences in growth pattern as a consequence of allometry (Teather and Weatherhead 1994). The high correlation between the bill and head with bill lengths can be easily explained by the fact that bill is included in the measurement of "head with bill". In conclusion, this parameter relates to the two hypotheses: bill – to the intersexual competition and wing with tarsus – to social polygamy. The lack of correlation between other parameters most probably results from different selection pressure on each feature.

The studies in other parts of Europe (Schiøler 1925, Cramp and Simmons 1977, Owen and Montgomery 1978) demonstrated that wing length could be arranged in descending order from cooler to warmer regions, with the coolest being Greenland and the warmest being western Europe. This correlation is related to Bergmann's rule, which states that mammals and birds residing in cooler regions are larger (Ashton 2002). Wing lengths of Mallards studied in this paper are larger than those in western Europe, with both males' and females' patterns being rather consistent with Bergmann's rule (Table 3). The bill length shows the reverse arrangement, consistent with Allen's rule, which states that the body apendages of endothermic species are smaller in cooler regions, in order to prevent heat loss (Symond and Tattersall 2010). Mallards in warmer parts of Europe have larger bills than Mallards in cooler regions, such as Iceland and Greenland. The larger bill allows them to lose heat easily (Midtgard 1984). However, a survey from North America has shown a trend in bill mor-

phology, consistent with Bergmann's rule (DuBowy 2000). It is unclear why Mallards from Iceland are consistent with Allen's and not Bergmann's rule. The consistency of surveyed group in north-eastern Poland with Bergmann's and Allen's rule could be explained also by heterogeneity of this group. We hypothesized that a part of wintering population could be of local, while another one of more north-eastern European origin, so being originated from cooler areas than Poland.

Table 3
Comparison of the wing and bill lengths of Mallards in Europe*.
All values are given in millimetres

Wing					
Females	Greenland	**NE Poland**	Netherlands	Iceland	England
	272	269.6	265/257	263	258.6
Males	Greenland	**NE Poland**	Iceland	Netherlands	England
	292	286.3	282	279/272	274.8
Bill					
Females	Netherlands	**NE Poland**	England	Iceland	Greenland
	51.8	51.8	51.3	50.8	48.1
Males	Netherlands	**NE Poland**	England	Iceland	Greenland
	55.4	55.2	54.6	53.4	46.6

* Note, however, that samples contain only adults – Greenland, Iceland (Schiøler 1925); only immatures – this study; adults and immatures together – England (Owen and Montgomery 1978); or for the Netherlands: wing – adults/immatures, bill – adults and immatures together (Cramp and Simmons 1977).

During winter, breeding Mallards migrate from eastern Europe to south-western Europe, particularly to the Mediterranean Sea (Euring 2009). Some authors (Veen *et al.* 2005) have shown that some Mallards migrate from north Europe to winter in central Europe. In Sweden Mallards move south-west to wintering grounds in western Europe, with some also travelling to northern Poland (Fransson and Pettersson 2001). Population from Białystok is, however, somewhat different to that of Scandinavia. The results of the present study show that average wing lengths of the analysed Mallards are larger compared to the data reported from other parts of Europe. Therefore, we suggest that the population of Mallards from Białystok comprises a proportion of birds migrating here from eastern Europe during winter. This can be also confirmed by recoveries of two immature females ringed in Białystok and reported heading east during the spring season, at sites that were probably close to their breeding grounds. The first bird, which was ringed in Białystok on 24 January 2007, was shot on 20 May 2008 in Russia (Proletariy, Novogorod, 58°25'N, 31°42'E). Another Mallard, which was ringed on 9 February 2007, was found freshly dead on 26 March 2010 in Belorussia (Gorki, Mogilev, 54°16'N, 30°58'E), but it was earlier reported from Białystok until 24 December 2009.

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REFERENCES

Ashton G.K. 2002. *Patterns of within-species body size variation of birds: strong evidence for Bergmann's rule*. Global Ecol. Biogeogr. 11: 505-523.

Avilova K.V. 2008. *Number of waterfowl wintering in Moscow (1985-2004): dependence on climate conditions*. Revista Catalana d'Ornitologia 24: 71-78.

Baker K. 1993. *Identification Guide to European Non-Passerines*. BTO, Thetford.

BirdLife International. 2009. *Species factsheet: Anas platyrhynchos*. http://www.birdlife.org

Busse P. 1974. *Biometrical methods*. Not. Orn. 15, 3-4: 114-126.

Busse P., Maksalon L. 1986. *Biometrical variability of Song Thrushes migrating along Polish Baltic coast*. Not. Orn. 27, 3-4: 105-127.

Cramp S., Simmons K.E.L. (Eds). 1977. *Handbook of the Birds of Europe, the Middle East and North Africa. The Birds of the Western Palearctic*. vol. 1. Oxford Univ. Press, Oxford.

Dementiev G.P., Gladkov N.A. (Eds). 1951. [*The birds of the USSR*.]. vol 4. Sovetskaya Nauka, Moscow. (In Russian).

DuBowy P.J. 2000. *Morphological correlates of community structure in north American waterfowl*. Community Ecol. 1: 147-156.

Euring (The European Union for Bird Ringing). 2009. *Migration Mapping Tool: Mallard (Anas platyrhynchos)*. http://blx1.bto.org/ai-eu/

Fransson T., Pettersson J. 2001. *Swedish bird ringing atlas*. vol. 1. Utgivningsår, Stockholm: pp. 96-101.

Green G.H. 1980. *Total head length*. Wader Study Group Bull. 29: 18.

Hagemeijer E.J.M., Blair M.J. (Eds). 1997. *The EBCC Atlas of European Breeding Birds: Their Distribution and Abundance*. T & A D Poyser, London.

Ławicki Ł., Czeraszkiewicz R., Guentzel S., Jasiński M., Kajzer Z., Kaliciuk J., Oleksiak A. 2008. *Wintering of waterbirds in Western Pomerania in 2002-2008*. Not. Orn. 49, 4: 235-244.

Mazurek Ł., Polakowski M. 2002. *Liczenie Ptaków Zimujących na Nizinie Północnopodlaskiej w sezonie 2001/2002. Materiały VI Ogólnopolskiego Przeglądu Działalności Kół Naukowych Przyrodników*. Wydawnictwo Akademii Pedagogicznej, Kraków: pp. 105-110. (In Polish).

Meissner W., Rydzkowski P. 2007. *Wintering of waterfowl on the Bay of Gdańsk in the season 2005/2006*. Not. Orn. 48, 2: 143-147.

Midtgard U. 1984. *Blood vessels and the occurrence of arteriovenous anastomoses in cephalic heat loss areas of mallards, Anas platyrhynchos (Aves)*. Zoomorphology 104: 323-335.

Nudds T.D., Kaminski R.M. 1984. *Sexual size dimorphism in relation to resource partitioning in North American dabbling ducks*. Can. J. Zool. 62: 2009-2012.

Owen M., Cook W.A. 1977. *Variations in body weight, wing length and condition of Mallard Anas platyrhynchos platyrhynchos and their relationship to environmental changes*. J. Zool. Lond. 183: 377-395.

Owen M., Montgomery S. 1978. *Body measurements of Mallard caught in Britain*. Wildfowl 29: 123-134.

Owens I.P.F., Hartley I.R. 1998. *Sexual dimorphism in birds: why are there so many forms of dimorphism?* Proc. R. Soc. Lond. B 265: 397-407.

Panek M., Majewski P. 1990. *Remex growth and body mass of mallards during wing molt*. Auk 107: 255-259.

Pihl S., Durinck J., Skov H. 1995. *Waterbirds in the Baltic Sea, Winter 1993*. Natl. Environ. Res. Inst. Tech. Rep. 145: 66 pp.

Piotrowska M. 2003. *Wintering of waterfowl on the middle Vistula in 1985-2000*. Not. Orn. 44, 2: 138-146.

Polakowski M., Skierczyński M., Broniszewska M. 2010. *Effect of urbanization and feeding intensity on the distribution of wintering Mallards in NE Poland*. Ornis Svec. 20: 76-80.

Schiøler E.L. 1922. *Nogle tilføjelser og bemerkninger til listen over Danmarks fugle*. Dansk Orn. Foren. Tidsskr. 16: 1-55. (In Danish).

StatSoft, Inc. 2007. *STATISTICA (data analysis software system), version 8.0*. Tulusa. www.statsoft.com.

Storer R.W. 1966. *Sexual dimorphism and food habits in tree North American accipiters*. Auk 83: 423-436.

Symonds M.R.E., Tattersall G.J. 2010. *Geographical variation in bill size across bird species provides evidence for Allen's rule*. Am. Nat. 176: 188-197.

Świętochowski P. 2007. *Liczenie ptaków zimujących w dorzeczu Narwi*. In: Krupa M., Kleinschmidt L., Krupa R. (Eds). *XXXVI Międzynarodowe Seminarium Kół naukowych. Olsztyn, 10-11 maja*. Wyd. Uniwersytetu Warmińsko-Mazurskiego, Olsztyn: 173-174. (In Polish).

Teather K.L., Weatherhead P.J. 1994. *Allometry, Adaptation, and the Growth and Development of Sexually Dimorphic Birds*. Oikos. 71: 515-525.

Tomiałojć L., Stawarczyk T. 2003. *Avifauna of Poland*. PTPP pro Natura, Wroclaw.

Veen J., Yurlov A.K., Delany S.N., Mihantiev A.I., Selivanova M.A., Boere G.C. 2005. *An atlas of movements of Southwest Siberian waterbirds*. Wetl. Int., Wageningen, the Netherlands.