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Body Weight and Some Biometrical Traits of Ring-necked Pheasants (*Phasianus colchicus*) at Different Ages

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Although the growth of pheasants is an important issue, there are few publications providing information on body weight and morphometrics of pheasants at different ages. The aim of this study was to investigate body weight, tarsus length, wing length and wingspan in farmed pheasants aged 3-16 weeks. The study was carried out on 50 pheasants (31 females and 19 males). All one-day old birds were marked and kept until the 16^{th} week of life. In the 3^{rd}, 8^{th}, 12^{th} and 16^{th} weeks of life all pheasants were weighted and tarsus length, wing length and wingspan were measured. Male chicks appeared to be significantly heavier than females ($P \leq 0.01$) already in the third week of life. Also their wings were longer and their wingspan attained higher values ($P \leq 0.05$). Absolute gains of the majority of traits also differed between sexes (being larger in males) in all studied periods. Values of body weight, tarsus length and wingspan noted in the third week of life were significantly correlated with all later measurements. Thus body weight and some biometrical traits of pheasant chicks measured already at the 3^{rd} week of life could be applied as predictors of future body weight and size.

Key words: Pheasant, body weight, body weight gain, tarsus length, wing length, wingspan, Galliformes

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The ring-necked (or common) pheasant (*Phasianus colchicus*) is a species naturally inhabiting vast areas in Asia and Eastern Europe. However, this bird was also introduced to other areas including Central Europe (MRÓZ 2003), and is currently still expanding both its geographical as well as habitat distribution, which sometimes may be a problem for local birds (eg. SKÓRKA *et al.* 2010). Pheasants are sexually dimorphic. Adult males are adorned with ornaments and possess armaments that are absent in females. They are also heavier and have brighter plumage (MCGOWAN 1994). Pheasants were kept for meat already centuries ago and presently they are usually kept in large, industrial farms. Many investigations were conducted to determine the influence of environmental conditions, nutrition and diet components or internal traits of eggs and incubation parameters on pheasant reproduction and chick quality (CAIN *et al.* 1984; JAMROZ *et al.* 1985; KJÆR 1997; KRYSTIANIAK *et al.* 2005; NOWACZEWSKI & KONTECKA 2005; KOŻUSZEK *et al.* 2009). The growth of young birds is an issue important both in nature (RICKLEFS 1968) and in farm conditions, thus it has received some interest (e.g. WOODARD *et al.* 1979; KJÆR 1997; TUCAK & KLAIC 1997; KRYSTIANIAK & TORGOWSKI 1998). However, there are few publications providing information on body weight and morphometric measurements of pheasants at different ages (e.g. KU NIACKA & ADAMSKI 2010; KOKOSZYŃSKI *et al.* 2011).

The aim of this study was to investigate body weight, tarsus length, wing length and wingspan in farmed pheasants aged 3-16 weeks.

Material and Methods

The study was carried out at the experimental farm belonging to Poznań University of Life Sciences on 50 pheasants (31 females and 19 males) from one hatch. All one-day old birds were marked individually (on wing) and kept until the 16^{th} week of life. Based on plumage colour the gender was determined during the 8th week of life. Until the 4th week of life they were kept in a closed building on a litter under optimal environmental conditions according to the standards of the farm. Beginning from the 4th week of life, the birds had access to a small outdoor enclosure overgrown with Jerusalem artichoke *(Helianthus tuberosus)*. They were fed *ad libitum* with a complete diet containing 11.5, 11.02, 11.32 and 11.43 MJ/kg of metabolizable energy and 28.1, 24.0, 20.6 and 18.2 % of crude proteins depending on age, i.e. for periods of 0-3, 4-6, 7-12 and 13-16 weeks of life, respectively. In the 3rd, 8th, 12th and 16th weeks of life all pheasants were weighted and tarsus length, wing length and wingspan were measured according to the methods of BAKER (1993). Birds were weighted (with 0.1 g accuracy) for the first time in the 3rd week of life. Tarsus length is defined as the distance between the recess on the back of the metatarsus and the last complete horny scutellum before the toes disperse. This measurement was performed using an electronic slide calliper with 0.1 mm accuracy. Wing length was measured from carpal joint (the wing should be closed) to the tip of the longest primary remige. Wingspan is defined as the distance between the tips of the right and left wings, where the line runs along the dorsal side of bird. Both wing length and wingspan were measured using a ruler with stop at zero (accuracy 0.1 mm). Total gains of body weight, tarsus length, wing length and wingspan were calculated for three periods (weeks 3-8, 8-12 and 12-16).

Statistical calculations were conducted with the assistance of the SAS® v. 9.1 package. Mean values ($\bar{x}$) as well as coefficients of variance (CV) were calculated for all measured traits. Differences between sexes in each analyzed week, with regard to body weight and biometrical traits, were determined employing Student's *t*-test. Moreover, Pearson correlations between the majority of traits were calculated.

Results

The investigated birds were significantly sexually dimorphic in terms of body weight already in the 3rd week of life (Table 1) and the intersexual differences were also significant in the 8th, 12th and 16th weeks of life. Tarsus lengths of male and female chicks at the age of 3 weeks did not differ significantly (P=0.058), but in all later measurements intersexual differences in this trait were significant. Wing length and wingspan were sexually dimorphic already in the 3rd week of life as well as in all later periods. In general, all studied traits reached higher values in males and the coefficients of variance calculated for older birds were smaller than those calculated for younger ones (Table 1).

Absolute values of body weight gains also differed significantly (P≤0.01) between sexes (being larger in males) in all studied periods (Table 2). The absolute gain of the tarsus length was highly

Table 1

Mean values ($\bar{x}$) and coefficients of variance (CV) of biometrical traits in pheasants

Trait	Week of age	Sex -statistical measures				Significance of differences
		males		females		
		$\bar{x}$	CV	$\bar{x}$	CV	
Body weight [g]	3	146.8	12.8	130.6	11.9	P≤0.01
	8	614.6	13.0	510.2	11.0	P≤0.01
	12	1073.2	8.7	829.3	12.4	P≤0.01
	16	1349.4	7.0	999.8	8.3	P≤0.01
Tarsus length [mm]	3	37.7	5.9	36.5	6.6	insignificant
	8	63.3	6.1	58.1	6.4	P≤0.01
	12	70.9	4.3	62.1	5.7	P≤0.01
	16	70.4	4.6	62.4	4.3	P≤0.01
Wing length [mm]	3	121.8	4.3	118.5	5.04	P≤0.05
	8	207.1	4.5	193.7	4.1	P≤0.01
	12	236.1	3.2	218.9	3.4	P≤0.01
	16	257.3	3.0	231.5	3.4	P≤0.01
Wingspan [mm]	3	404.5	4.8	392.5	4.9	P≤0.05
	8	683.6	4.3	646.4	3.7	P≤0.01
	12	770.0	3.3	720.7	2.8	P≤0.01
	16	826.1	3.9	753.5	2.7	P≤0.01

Table 2

Mean values ($\bar{x}$) and coefficients of variance (CV) of the absolute gains of biometrical traits in pheasants

Trait	Period (weeks of age)	Sex -statistical measures				Significance of differences
		males		females		
		$\bar{x}$	CV	$\bar{x}$	CV	
Absolute gains of body weight [g]	1 (3-8)	468.8	14.5	378.4	12.8	P≤0.01
	2 (8-12)	458.6	7.0	315.75	20.4	P≤0.01
	3 (12-16)	276.2	17.0	173.2	27.0	P≤0.01
Absolute gains of tarsus length [mm]	1 (3-8)	25.6	11.2	21.5	11.9	P≤0.01
	2 (8-12)	7.6	47.3	4.0	41.7	P≤0.01
	3 (12-16)	0.7	114.4	0.85	121.9	insignificant
Absolute gains of wing length [mm]	1 (3-8)	85.4	8.7	75.2	10.0	P≤0.01
	2 (8-12)	29.5	18.1	25.3	21.1	P≤0.05
	3 (12-16)	20.8	17.0	13.0	33.9	P≤0.01
Absolute gains of wingspan [mm]	1 (3-8)	281.7	8.7	252.6	10.1	P≤0.01
	2 (8-12)	86.4	20.7	73.6	19.7	P≤0.01
	3 (12-16)	62.1	24.0	32.6	35.2	P≤0.01

dimorphic in the first and second period (P≤0.01), but this trait was not sexually dimorphic in the last period. The absolute gains of wing length were sexually dimorphic in all studied periods. Intersexual differences in the absolute gains of wingspan were highly significant in all studied periods (P≤0.01; Table 2).

The relative values of body weight gains were significantly sexually dimorphic in all studied periods and higher in males (Fig. 1). In the case of relative values of tarsus length gains, intersexual differences appeared to be statistically different in the first (weeks 3-8) and second periods (weeks 8-12), whereas they did not differ statistically in the last (weeks 12-16) studied period (Fig. 2). The relative gains of wing length were significantly higher in males in the first and third period, but they did not differ in the second period (Fig. 3). The relative values of wingspan gains differed between sexes only in the first period and they were again higher in males (Fig. 4).

The correlations between all measurements of body weight were strong and significant (r>0.6, P≤0.01). Also absolute body weight gains were positively correlated (P≤0.01) and correlation coefficients ranged from 0.43-0.67. All measurements of tarsus length were correlated (P≤0.01, r=0.44-0.93). The length of the wing in the third

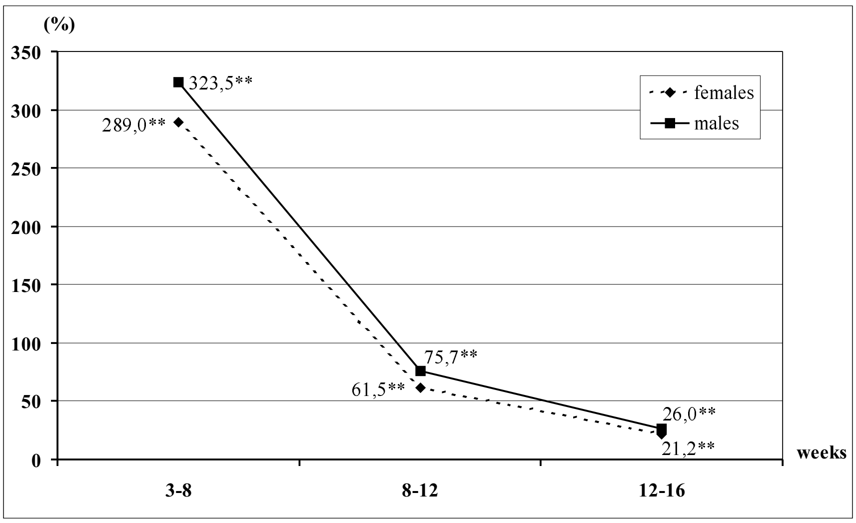

Fig. 1. Relative value of body weight gain in pheasants at different ages.
** Means, within period, differ significantly at level P≤0.01.

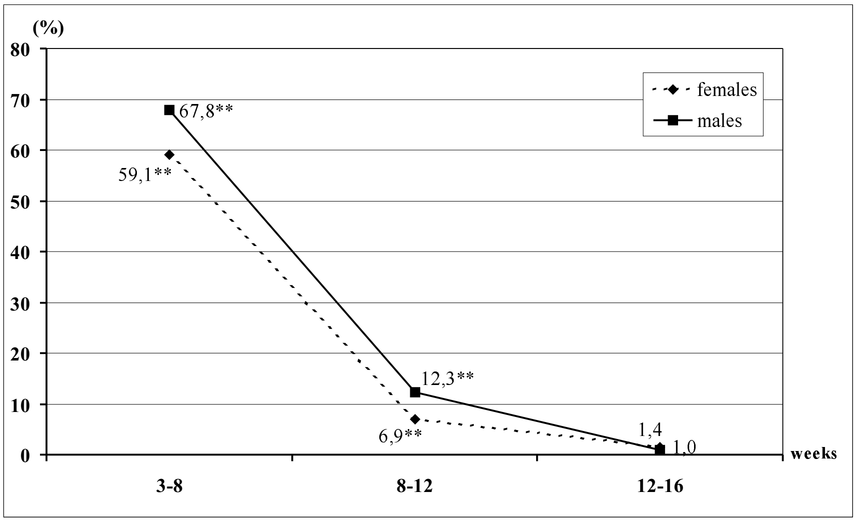

Fig. 2. Relative value of tarsus length gain in pheasants at different ages.
** Means, within period, differ significantly at level P≤0.01.

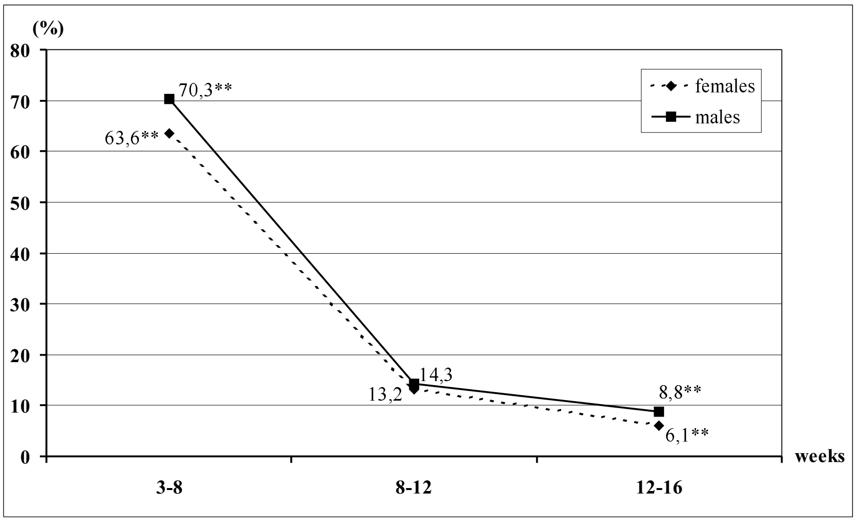

Fig. 3. Relative value of wing length gain in pheasants at different ages.
** Means, within period, differ significantly at level P≤0.01.

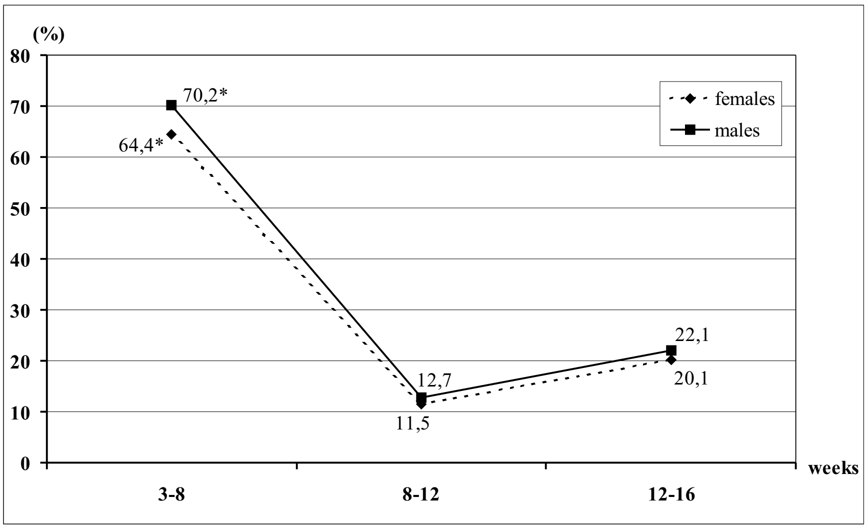

Fig. 4. Relative value of wingspan gain in pheasants at different ages.
* Means, within period, differ significantly at level P≤0.01.

week was not significantly correlated (P>0.05) with any later measurements of this trait, whereas all later measurements were strongly correlated with each other ($r>0.8$, $P \leq 0.01$). The wingspan in the third week of life was correlated with all later measurements of the trait, but correlations were medium ($r=0.35$-0.44, $P \leq 0.05$). All later measurements of the wingspan were strongly correlated with each other ($r>0.75$, $P \leq 0.01$).

All correlations of four traits (body weight, tarsus length, wing length and wingspan) collected during the same period were strong and significant ($r>0.8$, $P \leq 0.01$) for the 8^{th}, 12^{th} and 16^{th} week of life, but not for the 3^{rd} one. In the 3^{rd} week of life only body weight and wingspan were strongly correlated ($r=0.8$, $P \leq 0.01$). Body weight was highly correlated with tarsus length ($r=0.57$, $P \leq 0.01$). For other pairs of traits the calculated correlation coefficients ranged from 0.24-0.33 and were either significant ($P \leq 0.05$: tarsus length/wingspan and body weight/wing length) or insignificant (P>0.05: tarsus length/wing length and wing length/wingspan).

Discussion

We found that pheasants were sexually dimorphic already in their 3^{rd} week of life. Male chicks were significantly heavier than female chicks; values of their wing length and their wingspan were significantly higher. These traits were sexually dimorphic also in all later periods of data collection. In the case of tarsus length, significant sexual dimorphism appeared at a later time.

RIZZI *et al.* (1994) have found that the average weight of female pheasant chicks aged 28 days was 161 g, whereas those of male chicks – 174 g. ADAMSKI and KU NIACKA (2006) reported pheasant cocks to be significantly heavier than hens in the 12^{th}, 16^{th} and 20^{th} weeks of life. In a recent report, KU NIACKA and ADAMSKI (2010) observed that male pheasants attained significantly higher body weight than females in the 8^{th}, 12^{th}, 16^{th}, 20^{th} and 24^{th} weeks of life, but not in the 3^{rd} one. These authors also have shown that shank length was not sexually dimorphic in weeks 3-24 and forearm length was sexually dimorphic only in weeks 16^{th} and 20^{th}. In the case of other traits (trunk length, breast bone length, chest circumference, chest depth and shank thickness), significant sexual dimorphism was recorded in the 12^{th} or 16^{th} week of life and later periods of measurement (i.e. 20^{th} and 24^{th} week of life).

KOKOSZYŃSKI *et al.* (2011) who weighted and measured marked pheasants at the end of 4,8,12 and 20 weeks found higher body weights and daily gains in males than in females until 20 weeks of age. Males were also characterized by a significantly longer keel from 4 weeks, longer lower thighs and shanks from 8 weeks, and longer trunk with and without neck and greater chest circumference from 12 weeks of age (KOKOSZYŃSKI *et al.* 2011). These authors also reported that daily body weight gains differed significantly between sexes in all studied periods. These results are consistent with ours.

The correlations of body weight and measurements collected in the third week of life with those collected later suggest that body weight and dimensions of the chicks aged 3 weeks can be a predictor of their future body weight and measurements. Moreover, body weight gains in the first period were significantly correlated with later ones. LAITNEROVÁ and MACKOVÁ (1978) proposed that "the growth of pheasant hybrids up to 70^{th} day of age forms two phases, the turning point being between the first and the second phase in 21-23 days of age". Thus, the results of measuring chickens at the age of 8 weeks are even better predictors, especially in the case of length of wing.

Interestingly, we observed that all traits (body weight, tarsus length, wing length and wingspan) were strongly correlated in the 8^{th} week of life and later, but not in the 3^{rd} week of life. For example, in the 3^{rd} week of life wingspan was not correlated with wing length. We suggest that this is due to differences in plumage development and different rates of growth of body parts in chicks aged 3 weeks. BEKLOVÁ *et al.* (1988) has shown that body weight of cocks aged up to 1 year was significantly ($P \leq 0.01$) correlated with their tarsus length ($r=0.34$ in one of the investigated groups and 0.32 in the second group) and spur length ($r=0.13$ and 0.18). Spur length is the most important factor for pheasant cock reproductive success under natural conditions. Their survival is also connected with spur length (WITTZELL 1991). Thus it is possible that male chicks heavier than others in the 8^{th} (or even 3^{rd}) week of life will be the most viable adult birds and the best sires.

In conclusion, we have found that sexual dimorphism in size appeared in ring-necked pheasants already in the third week of life and that body weight in this age was a predictor of values of this trait in later ontogeny until the 16^{th} week of life.

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