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Pelvis of the striped field mouse *Apodemus agrarius* (Pallas, 1771): sexual dimorphism and relation to body weight

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Running title: Sexual dimorphism of *Apodemus agrarius*

Abstract

Morphometric investigations of 821 striped field mice (*Apodemus agrarius*) were carried out to identify sexual dimorphism in body size and pelvic bones with regard to age of individual and breeding history of females. It was found that body size differs between juvenile males and females of *A. agrarius*, while subadult and adult individuals of both sexes are of the same size. The length of the pubis is significantly bigger in females, while the width of the pubis is greater in males of all age categories. However, the length of the ischium did not differ in males and females of subadult and adult individuals. The length of the ischium and the length of the pubis differ significantly between nulliparous and gravid, and primiparous and multiparous females. Regression equations were obtained that gave reasonable body weight estimations from the length of the ischium for both male and female *A. agrarius*. We conclude that pelvic measurements and indices may be used in the study of prey-predator ecology of owls and birds of prey, identifying body mass, age and gender of *A. agrarius*.

Keywords: striped field mouse, *Apodemus agrarius*, pelvis morphometry, parousity

Introduction

Despite overlaps between sexes, small mammals are good objects to test sex-related differences in body size (Schulte-Hostedde et al. 2001). The existence of sexual dimorphism is characteristic of some small mammal species, but not all (Brown & Twigg 1969, Bondrup-Nielsen & Ims 1990, Schulte-Hostedde et al. 2001, Velickovic 2006, Balčiauskienė & Balčiauskas 2009). Out of 95 small mammal species, size was insignificantly female-biased in 33 species, and insignificantly male biased in 62 species (Lu et al. 2014). However, data on the sexual dimorphism of the striped field mouse (*Apodemus agrarius*) are inconsistent (Haitlinger 1962, Velickovic 2006, Balčiauskienė 2007, Lu et al. 2014).

The size and shape of the pelvis in mammals is subjected to differences based on gender (Brown & Twigg 1969, Berdnikovs et al. 2006). For the root vole (*Microtus oeconomus*), it was found that the pelvis of adult animals has pronounced differences, the main one being the width of the pubis. In females, the length of the ischium and the greatest pelvis length differed according to parousity (Balčiauskienė & Balčiauskas 2009). Distinguishing between males and females as well as identification parousity of females was conducted on the domestic mouse (*Mus musculus*) on the basis of the size and shape of *os coxae* (Schutz et al. 2009). The ratio “length of pubis / length of ischium” were used to identify the gender of small mammals from their remains in owl prey (Trejo & Guthmann 2003).

According to Brown & Twigg (1969), parousity of females is easily characterised in voles from the pelvis, but is not possible in *Apodemus* mice. However, *A. agrarius* was not included in that study and the sample size for the yellow-necked mouse (*Apodemus flavicollis*) was insufficient.

The idea of extending small mammal morphological studies into the area of the analysis of the diet of birds of prey and owls is not new; it was already mentioned in the pelvis studies of Dunmire (1955) and Brown & Twigg (1969). While body mass and/or age of the prey can be estimated from cranial or mandible measurements (Dickman et al. 1991, Balčiauskas & Balčiauskienė 2014a, b), gender of the prey is identifiable from the pelvic bones only (Brown & Twigg 1969, Dickman et al.1991, Ronayne & Sleeman 2013).

The aim of our study was to analyze sex based dimorphism in *A. agrarius*, and pelvic morphometry in particular. We also aimed to test whether there is a relationship between age (body weight) and pelvic measurements or indices, and if these measures differ according to the age of the mice, the gender and parousity in females.

Material and methods

A. agrarius were snap-trapped in Rusnė flood meadows (SW Lithuania, Nemunas River Delta, 55°20'34" N; 21°18'07"E) in August–October 2008–2012. In total, 827 individuals were trapped (821 examined). Males prevailed in the catch every year, but significant deviations from a 1:1 sex ratio were observed only in 2009 ($\chi^2 = 5.6$, $p < 0.02$) and 2010 ($\chi^2 = 5.2$, $p = 0.02$). Male dominance was most noticeable among subadult (1: 0.42, $\chi^2 = 19.2$, $p < 0.0001$) and juvenile individuals (1: 0.79, $\chi^2 = 3.4$, $p = 0.066$; Table 1).

Body mass (Q, g) and body length (L, mm) were recorded before dissection, and measured to nearest 0.1 g and 0.1 mm respectively. After dissection, *A. agrarius* were sexed and divided into juveniles, subadults and adults, taking into account body weight, presence of *glandula thymus* and the reproductive status of individual (according to Balčiauskienė & Balčiauskas 2009).

Of the females, 277 were nulliparous (subadult or juveniles with no visible breeding signs), 23 primigravid with the first litter (irrespective of the embryos age), 36 primiparous (had one litter, i.e., placental scars and/or *corpora lutea* present from one litter only), and two multiparous (had two litters, placental scars from the first litter and embryos from the second or placental scars from two litters present).

For reference material, skeletons were prepared using *Dermestes* beetles. Three measurements were taken for each specimen according to Dunmire (1955) and Brown & Twigg (1969): P1 – length of the ischium (*os ischii*) from the rim of the acetabulum (*margo acetabuli*) to the ischial tuberosity (*tuber ischii*); P2 – greatest length of the pubis from the acetabular rim (*margo acetabuli*), and P3 – width of the pubis (*os pubis*) measured at the thinnest point of *ramus cranialis ossis pubis*. All measurements were taken to the nearest 0.1 mm under a binocular with a measuring scale. Only the right side of the pelvis was measured.

We also calculated three indices: P1/P2, P1/P3 and P2/P3 (according to Balčiauskienė & Balčiauskas 2009).

The standard statistical approach (mean and standard error, range, Student t-test for the comparison of means, correlation matrices) was used. The relationship between body mass and pelvic measurements was described using single predictor based on the best linear models and linear regressions Q = A + Bx (multiple regression was tested using GLM, but did not give any advantage compared to linear regression). Calculations were done with Statistica for Windows ver. 7.0 software (StatSoft 2004).

Results

Analyzing body size, it was found that male body weight ($F = 13.99$, $p = 0.0002$), body length ($F = 8.05$, $p = 0.005$) and tail length ($F = 7.94$; $p = 0.005$) were significantly bigger than the respective measurements of females in juveniles only (Table 2). In other age groups, body weight, body length, tail length, hind foot length and ear length did not differ significantly between the sexes, i.e. sex-based differences in body size of subadult and adult *A. agrarius* were not observed.

In *A. agrarius*, the male pubis is significantly shorter (Table 3) and thicker than in females, with both features obvious in all age groups (Fig. 1). The posterior end of the pelvis in adult and subadult males is convex (Fig. 1D, 1E) or straight in juveniles (Fig. 1F), while in all females the posterior end of the pelvis is concave (Fig.1A-C).

In contrast to body measurements, two out of three pelvic measurements and all three indices are sex-dependent, irrespective of animal age (Table 3). The exception is the length of the ischium, its length did not differ in males and females of subadult and adult *A. agrarius*. The length of the pubis was significantly bigger in females of all age categories, while the width of the pubis was significantly bigger in all age categories of *A. agrarius* males.

Accordingly, the pelvis index P1/P2 was significantly bigger in males, while P1/P3 and P2/P3 were bigger in females of all age categories (Table 3).

We found that a scatter plot of P1/P2 versus P3 was most sex-informative, clearly showing that the pelvis in adult *A. agrarius* is sex-dimorphic (Fig. 2). The cutting lines are P1/P2 = 0.70 and P3 = 0.64. Males in general had P1/P2 > 0.70 (exception – one individual out of 57, Q = 22.1 g, breeding signs), while females had P1/P2 < 0.70. In females, there were three individuals out of 63 with P1/P2 > 0.70: one multiparous female (Q = 31 g and six placental scars from the second litter), one primiparous female (Q = 28 g and five placental scars) and one primigravid female (Q = 28 g and six embryo). Males in general had P3 > 0.64 (exception – one individual, Q = 21 g), with five males out of 57 being on the limit. In females, 10 individuals (15.9% of the sample) also were on the limit, with P3 = 0.64 (five females primigravid, three primiparous and one multiparous). Using both limits, only two individuals out of 120 were misclassified (both females, see Fig. 2).

In subadult *A. agrarius*, sex-dimorphism of the pelvis was less expressed, with cutting lines P1/P2 = 0.70 and P3 = 0.50 (Fig. 2). In females, there were two individuals out of 65 with P1/P2 > 0.70. In males, P1/P2 < 0.70 was observed in 21 individuals out of 155 (13.5%). The limit P3 > 0.50 was not reached by eight males (5.2% from the sample) and P3 < 0.50 was exceeded by eight females (12.3% from the sample). Using both limits, only three individuals out of 220 were misclassified (one female and two males, see Fig. 2).

In juvenile *A. agrarius*, sex-dimorphism of the pelvis was even less expressed than in subadult individuals, using both limits (P1/P2 < 0.70 and P3 < 0.50 for females), 57 individuals out of 481 were misclassified (27 females and 30 males, see Fig. 2).

In both males and females of *A. agrarius*, the length of the ischium was best correlated with body weight and length. In females, the second best correlation with body weight was that of length of the pubis, while in males it was the width of the pubis (Table 4).

In male *A. agrarius*, the dependence between body weight and the length of ischium was totally linear (Fig 3A), while in females several outliers were pregnant individuals (Fig. 3B). For the re-calculation of body weight, the following regressions may be used in *A. agrarius*:

Q = -12.30 + 7.8385 × P1 ($R^2 = 0.64$, $p<0.0001$) for males, and

Q = -20.04 + 10.139 × P1 ($R^2 = 0.63$, $p<0.0001$) for females,

where Q is body weight (g), P1 is length of the ischium (mm).

However, if sex of the individual is not known, then

Q = -16.01 + 8.9205 × P1 (R2 = 0.62, $p<0.0001$) may be used.

Dispersion of the multiple regressions did not yield much gain in the body weight recalculation from the pelvic measures. For males, adding P3 increased the result by 4%, and adding also P2 by another 0.8%. For the females, adding P3 to the regression added 1.7%, and P2 another 1.3%.

Parousity in females is a significant factor, influencing the measurements of pelvic bones (ANOVA, length of the ischium, $F_{3,306} = 144.5$; length of the pubis, $F_{3,241} = 103.2$, width of the pubis, $F_{3,293} = 149.9$; all $p < 0.0001$) and pelvic indices (P1/P2, $F_{3,241} = 5.52$, $p < 0.002$; P1/P3, $F_{3,285} = 7.6$; P2/P3, $F_{3,241} = 10.0$, both $p < 0.0001$) (Table 5).

The most significant differences between nulliparous *A. agrarius* and gravid, primiparous or multiparous individuals are in the length of the ischium and the length of the pubis (Fig. 4A, B). Differences in the width of pubis were less expressed (Fig. 4C).

Growth tendencies in the pelvis of *A. agrarius* males and females, as well as sex-based differences of the weight groups of individuals are presented in the Table 6. Changes in length of the ischium, length of the pubis and width of the pubis in males ($F_{3,437} = 139.9$, $F_{3,337} = 44.8$, $F_{3,425} = 89.1$ accordingly, all $p < 0.0001$) and females ($F_{4,304} = 139.9$, $F_{4,239} = 103.6$, $F_{4,290} = 16.7$ accordingly, all $p < 0.0001$) are highly significant.

The length of the ischium is larger in males only in the group with body weight between 10.1 g and 20.0 g, and did not differ significantly in other body weight categories. The length of the pubis is significantly bigger in females with body weight over 10 g, and the width of pubis is significantly smaller in all females (Table 6).

Discussion

Sex-based differences in mammals are easily observed as body size, but differences caused by reproductive stages also lead to dimorphism of body structures and organ systems that are not easily observed (Schulte-Hostedde et al. 2001). While body size substantially overlaps between the genders in most small mammals (Haitlinger 1962, Brown & Twigg 1969,, Schulte-Hostedde et al. 2001, Balčiauskienė & Balčiauskas 2009), differences in pelvis shape and size are significant (Dunmire 1955, Brown & Twigg 1969, Berdnikovs et al. 2006).

The issue of sexual dimorphism in *A. agrarius* is not fully clear. According to Haitlinger (1962), sexual dimorphism is best expressed in older individuals (where body weight, body length and skull condylobasal length are concerned), with males being bigger. Other features have much less expressed dimorphism (Haitlinger 1962). This is in accordance with data from Serbia and Montenegro – weakly expressed sexual dimorphism was found in the upper diastema only (Velickovic 2006). In Slovakia, however, body weight was found to be bigger in females, specifically 20.2 g versus 19.9 g in males (Morand et al. 2004).

For captive *A. agrarius* in Lithuania, it was found that males are generally larger. This was significantly expressed in body weight, body length and several skull characters, such as coronoid height of mandibula, length of nasalia, breadth of the braincase, zygomatic skull width, length of maxillary tooth row, length of the first upper molar and length of the upper diastema (Balčiauskienė 2007). Length of the upper diastema is significantly bigger in *A. agrarius* males also in Serbia (Velickovic 2006).

In the wild populations of *A. agrarius* in Lithuania, we found sexual dimorphism in body weight, body length and tail length well-expressed only in juveniles (males were larger). In subadult and adult individuals, differences between genders in body dimensions (see Table 2) were not expressed, thus we confirm the absence of sexual dimorphism for these age groups. This is not the case in pelvic dimensions: the length of the pubis was significantly bigger in females of all age categories, while the width of the pubis was significantly bigger in all age categories of males. The length of the ischium did not differ between males and females of subadult and adult *A. agrarius*, while it was significantly bigger amongst males in the juvenile age category (see Table 3).

We tested the effectiveness of sample separation into sexes by means of a scatter plot, where the width of the pubis is plotted against the ratio between the length of the ischium and length of the pubis. Such an approach worked fine for *A. sylvaticus*, *M. minutus* and *M. musculus* (Brown & Twigg 1969), with well separation of sexes. As for *M. musculus*, the same method was employed by Dickman et al. (1991), having <5% classification error. For *A. agrarius*, the misclassification was 1.6% and 1.4% for adult and subadult individuals respectively. However, 11.9% of juvenile individuals were misclassified.

In many representatives of the genus *Apodemus*, males are bigger (Montgomery 1989). However, inconsistencies have been recorded when comparing the sexual dimorphism of wild populations to captive representatives. For example, amongst *A. speciosus* (Ueda & Takatsuki 2005): sexual size dimorphism was present in captive individuals, but not in the wild. This is in accordance with our data on captive-bred and wild *A. agrarius* in Lithuania – the differences in the captive-bred animals were better expressed.

Differences in sexual dimorphism between young and adult individuals, at least in microtine voles, are related to maturity: in both *M. agrestis* and *C. glareolus*, immature males and females did not differ in size, while in adults, females of *C. glareolus* and males of *M. agrestis* are bigger (Bondrup-Nielsen & Ims 1990).

We agree with Brown & Twigg (1969) that sexual differences start to appear already at 17–21 days post partum. In our sample of wild *A. agrarius*, the minimum body weight of adult animals in both sexes was 13.3 g (see Table 2), with the next values being 16.1 and 16.5 g in males and 17.5 and 19.0 g in females. According to captive-breeding data (Balčiauskienė 2007), females can mature in 20–30 days and males near 30 days of age and at this age, pelvic sexual dimorphism is clearly present (see Table 4).

In one of the widest investigations of pelvic bones covering a range of species in genus *Apodemus*, it was shown that the pubis is longer and thinner in females and that the posterior margin is convex in males, but concave in the female individuals. These features establish themselves early in post-natal life (Brown & Twigg 1969). The same authors point out that changes of the pelvic bones in males occur in stages (related to stages of sexual maturity). Parturition in small mammals results in the remoulding of the os coxae, and multiparous females have elongated pubis. It was shown that recognition of non-parous, uniparous and multiparous females is possible in all cricetid voles and mice of genus *Micromys*, but doubtful in genus *Mus* and not possible in genus *Apodemus*, neither in genus *Rattus* (Brown & Twigg 1969), nor in shrews (Brown & Twigg 1970). However, such diagnosis was based on a substantial sample only in the case of *A. sylvaticus*. We show that in *A. agrarius* females, parousity is well-reflected in pelvic indices as well as in measurements (see Table 5 and Fig. 4). Our data thus changes the existing knowledge of sex-based dimorphism in genus *Apodemus*.

Knowledge on the relationship between body weight and measurements of various parts of the body is important, with likely uses in paleoecology (i.e., Toledo et al. 2014), analysis of predator-prey systems and other fields of interest (Lovegrove & Mowoe 2014). In particular, regressions are widely used to obtain the body mass of small mammals or birds preyed upon by owls, as skulls and pelvis bones tend to remain relatively intact in their pellets (Dickman et al. 1991, Doube et al. 2012, Frasier 2014).

While skulls allow the analysis of prey composition in the age aspect (Balčiauskas & Balčiauskienė 2014 a,b), analysis of pelvis remains in owl pellets can be used to determine the gender of the predated individuals and to identify the groups subjected to the highest pressure of predation within common shrews (*Sorex araneus*), short-tailed voles (*Microtus agrestis*), house mice (*Mus domesticus*) and field mice (*A. sylvaticus*) (Brown 1981, Dickman et al. 1991, Kelleher et al. 2010, Ronayne & Sleeman 2013). As for *Sorex* shrews, differences in the pelvic bones (e.g., Brown & Twigg 1970) were used to test museum material. It was found that the sex in nearly 10% of the collection specimens was misidentified or not identified (Carraway 2009).

Thus, our investigation of the pelvis of *A. agrarius* contributes not only to the species biology field, but also to the ecology of birds of prey.

Conclusions

1. Sex-based dimorphism in body size is characteristic to juvenile *A. agrarius* (males are bigger), but with puberty it disappears (subadult and adult animals are of the same size).
2. The length of the pubis (P2) is significantly bigger in females, while the width of the pubis (P3) is greater in males of all age categories. The length of ischium did not differ in males and females of subadult and adult *A. agrarius*. Pelvis indices are all sex-dependent: P1/P2 is significantly bigger in males; P1/P3 and P2/P3 are bigger in females of all age categories.

3. Pelvis measurements in females are dependent on parousity, with the most significant differences being in the length of the ischium and the length of the pubis between nulliparous and gravid, primiparous or multiparous individuals of *A. agrarius*.
4. Using a scatter plot, where the width of the pubis is plotted against the ratio between the length of the ischium and length of the pubis, misclassification of gender identification in adult and subadult *A. agrarius* is less than 2%, while in juveniles it is nearly 12%.
5. Body mass of both genders in *A. agrarius* can be obtained using regression equation based on the length of the ischium.
6. Thus, pelvic measurements and indices are suitable for the identification of body mass, age and gender of *A. agrarius*, with practical employment in the prey-predator ecology of owls and birds of prey.

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Table and Figure captions

Table 1. Sex and age structure of the *A. agrarius* sample from the Rusnė flooded meadows, 2008–2012.

Table 2. Morphometric data of *A. agrarius* according to age and sex.

Table 3. Pelvis measurements (in mm) and indices of *A. agrarius* depending on sex and age (avg±SE, NS – difference between males and females not significant, * – $p < 0.005$, all other male-female differences significant at $p < 0.0001$).

Table 4. Correlation of pelvis measurements and indices with body mass and body length in males and females of *A. agrarius* (* - $p < 0.05$, ** - $p < 0.01$, all other correlation coefficients significant at $p < 0.001$).

Table 5. Pelvis indices of adult *A. agrarius* females depending on parousity.

Table 6. Pelvis measurements (in mm) and indices of *A. agrarius* depending on body mass (g) and sex. Data presented as avg±SE. Male-female differences, based on Student's *t* are: * – $p<0.05$; ** – $p<0.01$; *** – $p<0.001$.

Fig. 1. Pelvis of *A. agrarius* males and females from different age groups: A – adult female (Q – 31.0 g, L – 104.2 mm), B – subadult female (Q – 17.5 g, L – 82.6 mm), C – juvenile female (Q – 15.0 g, L – 79.2 mm), D – adult male (Q – 28.5 g, L – 106.9 mm), E – subadult male (Q – 20.0 g, L – 90.4 mm), E – juvenile male (Q – 17.5 g, L – 79.5 mm). Pelvic measures according to Dunmire (1955) and Brown & Twigg (1969).

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Fig. 2. Scatterplots evaluating sexual dimorphism in A. agrarius age classes by pelvic measurements (P3 – width of the pubis, P1/P2 – ratio of the length of the ischium to greatest length of the pubis).

Fig. 3. Dependence between body weight and pelvis measurements in *A. agrarius*.

Fig. 4. Pelvis measurements of *A. agrarius* depending on parousity.

Table 1.

	Adult	Subadult	Juvenile	Total
Males	57	155	269	481
Females	63	65	212	340
Total	120	220	481	821

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Table 2.

	Total			Males	Females
	N	avg. ±SE	min–max	avg. ±SE	avg. ±SE
Juvenile					
Body weight	477	14.76±0.10	9.0–24.0	14.97±0.14	14.49±0.16
Body length	410	76.06±0.26	59.4–92.1	76.94±0.36	75.00±0.35
Tail length	322	59.63±0.28	46.8–74.3	60.36±0.40	58.77±0.38
Hind foot length	338	17.76±0.04	13.5–20.0	17.87±0.06	17.63±0.05
Ear length	336	10.63±0.06	7.2–13.2	10.73±0.08	10.51±0.08
Subadult					
Body weight	219	17.48±0.16	10.9–28.5	17.38±0.18	17.71±0.34
Body length	186	82.26±0.35	71.0–99.1	82.09±0.42	82.68±0.60
Tail length	151	65.48±0.39	54.3–81.0	65.03±0.42	66.59±0.89
Hind foot length	162	18.37±0.05	16.9–20.4	18.38±0.06	18.33±0.10
Ear length	161	11.15±0.09	8.3–15.2	11.22±0.10	10.98±0.16
Adult					
Body weight	118	26.94±0.59	13.3–49.6	25.77±0.74	26.24±0.90
Body length	114	95.63±0.67	78.8–112.1	95.36±0.99	95.89±0.92
Tail length	97	75.08±0.46	65.5–88.2	74.45±0.58	75.75±0.73
Hind foot length	101	18.74±0.06	17.2–20.5	18.84±0.08	18.63±0.08
Ear length	101	12.03±0.09	9.7–14.1	12.17±0.11	11.87±0.14

Table 3.

	Adult		Subadult		Juvenile	
	Males	Females	Males	Females	Males	Females
P1	4.54±0.06^{NS}	4.54±0.05	3.76±0.02 ^{NS}	3.79±0.04	3.57±0.02	3.46±0.02
P2	5.80±0.06	7.32±0.11	5.11±0.04	6.03±0.09	4.93±0.04	5.37±0.04
P3	0.86±0.02	0.52±0.01	0.62±0.01	0.45±0.01	0.58±0.01	0.45±0.00
P1/P2	0.78±0.01	0.62±0.01	0.74±0.01	0.63±0.01	0.73±0.01	0.65±0.004
P1/P3	5.37±0.11	8.93±0.20	6.19±0.07	8.50±0.18	6.28±0.09	7.78±0.09
P2/P3	6.79±0.14	14.55±0.39	8.42±0.15	13.62±0.36	8.83±0.18*	12.19±0.17

Table 4.

	P1	P2	P3	P1/P2	P1/P3	P2/P3
Males (N=341–441)						
Q	0.80	0.58	0.64	0.27	-0.13**	-0.20
L	0.80	0.61	0.62	0.25	-0.12*	-0.19**
Females (N=220–309)						
Q	0.80	0.76	0.41	-0.22	0.27	0.31
L	0.87	0.86	0.37	-0.32	0.39	0.45

Table 5.

	Nulliparous	Primigravid	Primiparous	Multiparous
P1/P2	0.64±0.003	0.64±0.01	0.61±0.01	0.66±0.05
P1/P3	7.96±0.06	8.63±0.37	9.02±0.23	8.47±1.19
P2/P3	12.58±0.16	13.81±0.79	14.97±0.46	12.83±0.83

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Table 6.

Body mass, g	P1		P2		P3	
	Male	Female	Male	Female	Male	Female
Up to10.0	3.04±0.09^{NS}	3.10±0.13	3.96^{NS}	4.37±0.32	0.60±0.05*	0.46
10.1–20.0	3.64±0.02***	3.53±0.02	4.98±0.03***	5.53±0.04	0.60±0.00***	0.45±0.00
20.1–30.0	4.39±0.06 ^{NS}	4.40±0.06	5.79±0.07***	7.22±0.14	0.78±0.02***	0.50±0.01
30.1–40.0	5.02±0.10 ^{NS}	4.84±0.07	6.18±0.07***	7.73±0.12	1.00±0.04***	0.57±0.02

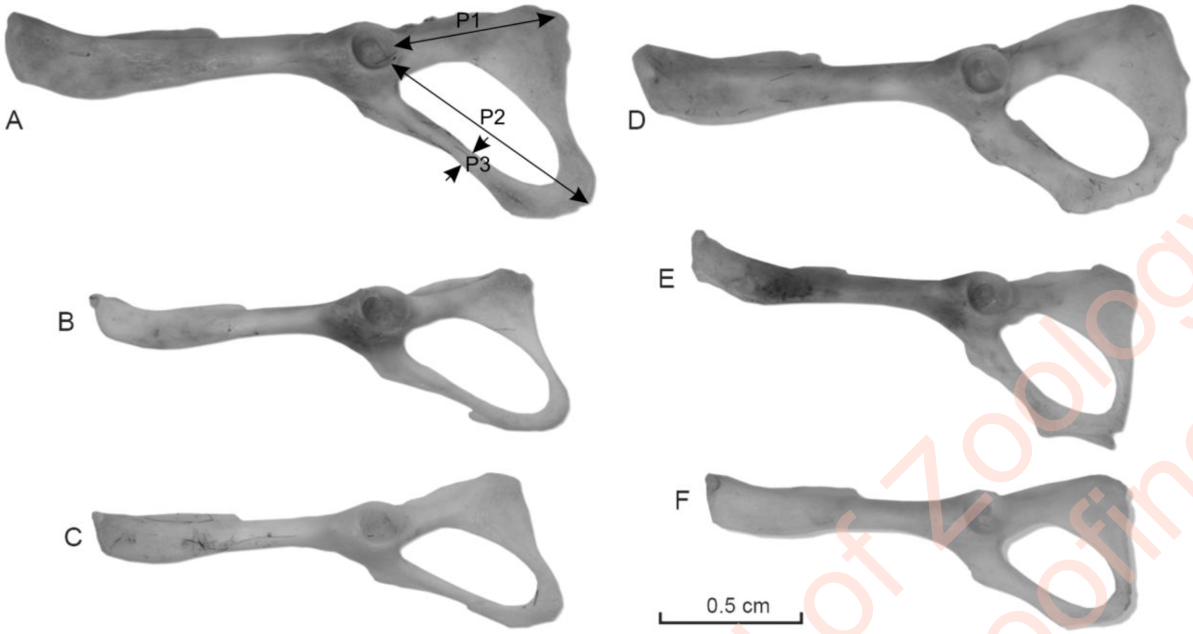

Fig. 1.

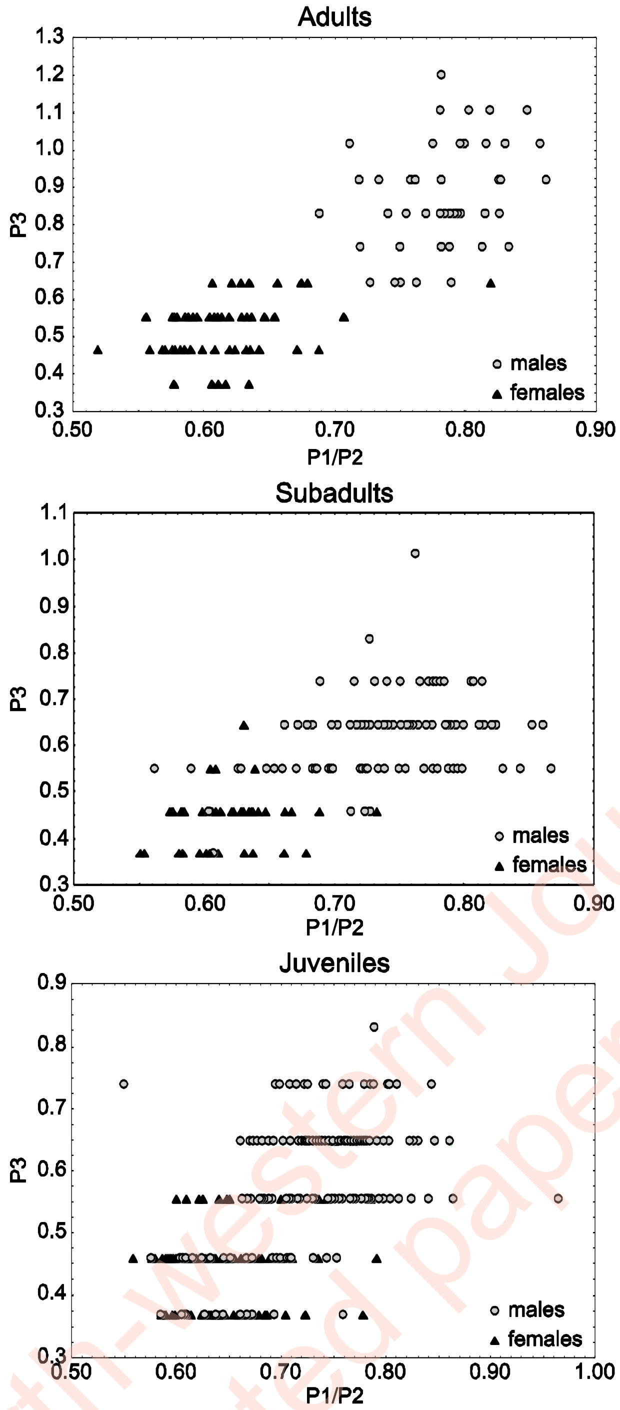
Adults
P3
P1/P2
males
females
Subadults
P3
P1/P2
males
females
Juveniles
P3
P1/P2
males
females

Fig. 2.

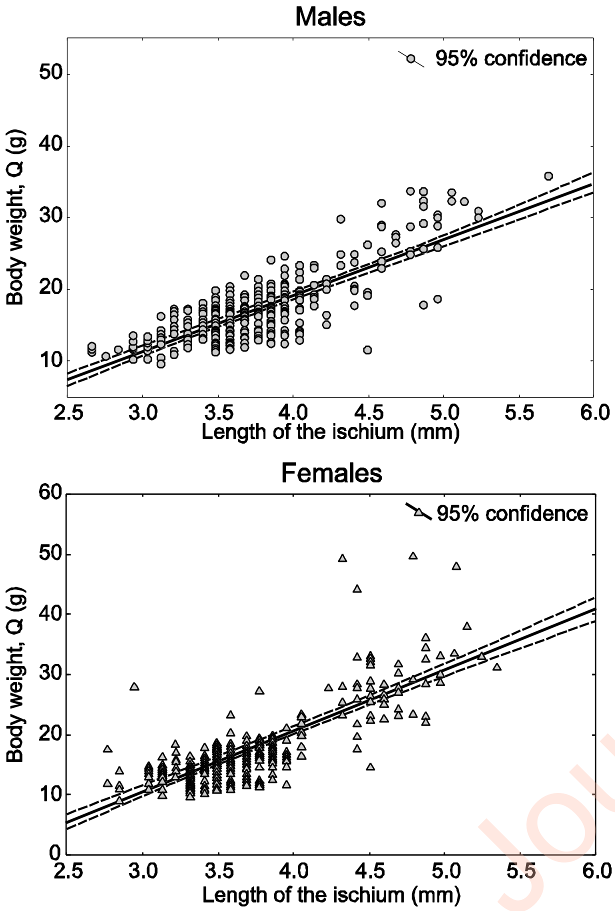
Males
95% confidence
Body weight, Q (g)
Length of the ischium (mm)
Females
95% confidence
Body weight, Q (g)
Length of the ischium (mm)

Fig. 3.

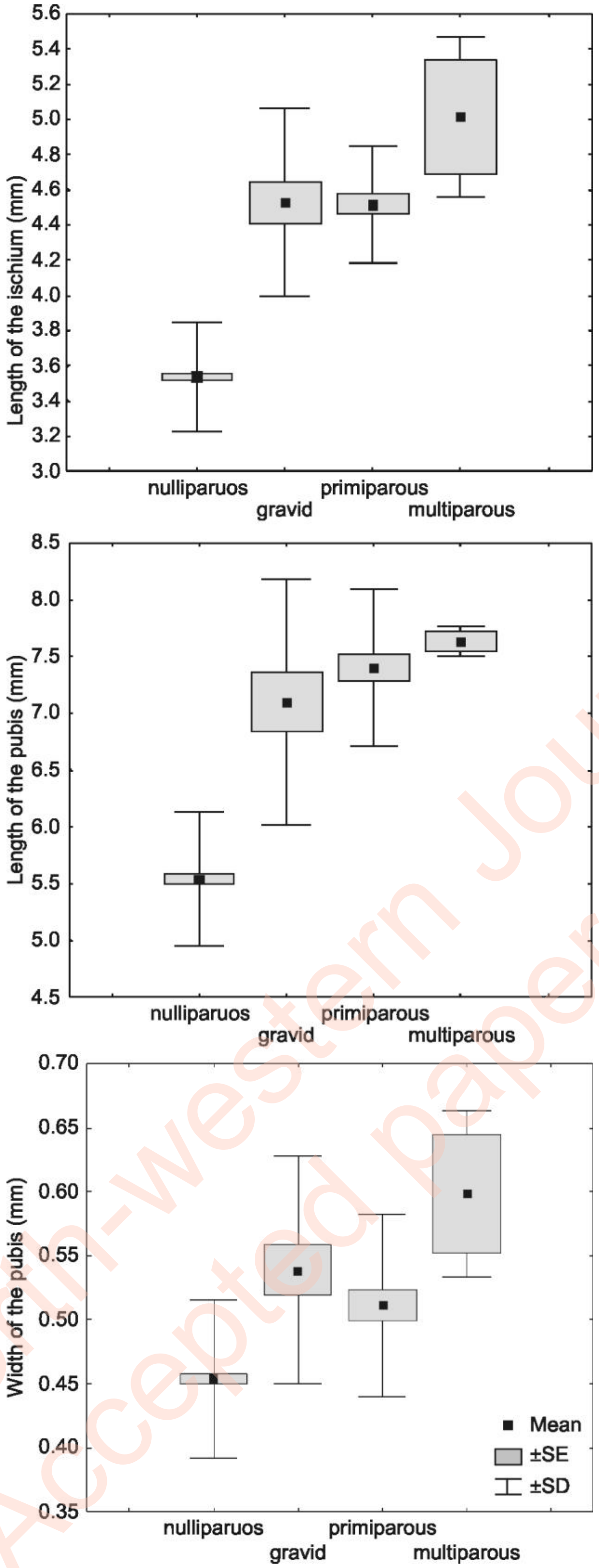
Length of the ischium (mm)
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
nulliparuos
gravid
primiparous
multiparous
Length of the pubis (mm)
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
nulliparuos
gravid
primiparous
multiparous
Width of the pubis (mm)
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
Mean
±SE
±SD
nulliparuos
gravid
primiparous
multiparous

Fig. 4.