

Metric characteristics and sexual dimorphism of the postcranial skeleton of wild cat *Felis silvestris* in Bulgaria

Ivan PETROV

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The measurements of *scapula*, *pelvis*, *humerus*, *ulna*, *radius*, *tibia*, *femur*, and the first three *vertebrae* of the adult wild cat *Felis silvestris* Schreber, 1777 from Bulgaria were used in this study. Considerable differences between the sexes were revealed at three levels of significance in most of the sizes of *scapula*, *pelvis*, and *vertebrae*. The males were bigger than the females. No significant differences were found in the limb bones, except in the length of the *humerus*. Widening of the female *pelvis* was not observed. The variability of the skeletal parts examined was found to be comparatively low for most of them.

Forest Research Institute, 132 Kl. Ohridski str., 1756 Sofia, Bulgaria

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Introduction

Studies of the postcranial skeleton of wild cat *Felis silvestris* Schreber, 1777 had been made by Cantuel (1955). The author compared atlases, axes, spatulae, humeruses, pelvises, and femurs of the wild cat and of the domestic cat *F. catus* L., 1758. He found that the bones of the wild cat were bigger. Kratochvíl (1976) studied material of 31 skeletons of wild cat and 76 skeletons of domestic cat of either sex. He examined the possibility of separating these two species in a visual way, and by measuring and statistically evaluating 73 measurements and 5 indices. This author concluded that the postcranial skeleton of the wild cat shows little or no sexual dimorphism, and he considered visual diagnostics unsuitable.

Kratochvíl (1977a) studied the correlations within the postcranial skeleton of the wild cat and of the domestic cat. Kratochvíl (1977b) examined the correlation between characters of the postcranial skeleton of 19 adult wild cats and 65 adult domestic cats. In addition, he used 12 subadult specimens of the wild cat, 11 subadult domestic cats, three specimens of Persian (*F. lybica f. persica*) and six of Siamese cats (*F. l. f. siamica*). The author paid attention to characters which showed strong and medium correlation. He found the most important and significant difference, based on the correlation of two characters, in the zeugopodium and the stylopodium in which the values for the two species did not overlap. The values of width of long bone diaphyses appeared of interior value, particularly in

form of indexes. He concluded that the characters examined in all three forms of domestic cat formed an identical variation field, which tended to evidence their belonging to one and the same species. Schauenberg (1980) published results from measurements on 9 bones of the wild cat: *scapula*, *tibia*, *radius*, *ulna*, *humerus*, *femur*, *ilium*, *sacrum*, *atlas* and *axis*. He found the correlation between body length and the sum of the lengths of *tibia* and *femur*. The results of the study of a series of skeletons of wild cat show that this species does not vary significantly over the entire geographical range of the species. Arrighi and Salotti (1988) published data about the sizes of *femur*, *tibia*, *ilium*, *humerus*, *ulna*, *radius* and *scapula* of one male and one female wild cat from Corsica.

There are no published works on the postcranial skeleton of the wild cat from Bulgaria. The purpose of this paper, therefore, is to fill up this gap.

Material and methods

Bones of 23 male and 15 female adult wild cats from Bulgaria were used for the study of the postcranial skeleton. The features providing information on the form of *scapula* (V1, V2, V3, V4, V5), *pelvis* (V11, V12, V13, V14), length of *humerus* (V6), *ulna* (V7), *radius* (V8), *tibia* (V9), and *femur* (V10), as well as the size of the first three *vertebrae*: *atlas* (V15, V16, V17), *epistropheus* (V18, V19, V20) and *vertebra cervicalis* III (V21, V22, V23), were measured (Table 1, Fig. 1). The measurements were taken with a vernier calliper, with precision of 0.1 mm.

Table 1. List of the measurements taken on the postcranial skeleton of wild cat *Felis silvestris* from Bulgaria.

Var. no.	Measurements
V1	Length of <i>scapula</i> (between <i>tuberositas supraglenoidalis</i> and <i>margo vertebralis</i> , external)
V2	Breadth of <i>scapula</i> (between <i>angulus caudalis</i> and <i>angulus cranialis</i>)
V3	Length of <i>spina scapulae</i>
V4	Distance between <i>tuberositas supraglenoidalis</i> and <i>cavitas glenoidalis</i> (external)
V5	Height of <i>proc. suprahamatus</i>
V6	Length of <i>humerus</i> (maximum)
V7	Length of <i>ulna</i> (maximum)
V8	Length of <i>radius</i> (maximum)
V9	Length of <i>tibia</i> (maximum)
V10	Length of <i>femur</i> (maximum)
V11	Length of <i>pelvis</i> (between <i>spina ilica ventralis</i> and <i>tuber ischiadicum</i>)
V12	Breadth of <i>pelvis</i> (between <i>spinae ilicae ventralis</i> , external)
V13	Breadth of <i>pelvis</i> (on <i>tubera ischiadica</i>)
V14	Length of <i>symphysis ossium pubis</i>
V15	Least breadth of <i>atlas</i> (dorsal)
V16	Greatest breadth of <i>atlas</i> (dorsal, between <i>alae atlantis</i>)
V17	Breadth of <i>atlas</i> (lateral)
V18	Breadth of <i>epistropheus</i> (dorsal, between <i>facies articulares craniales</i>)
V19	Distance between <i>apex dentis</i> and <i>processus transversus</i>
V20	Length of spinous process
V21	Breadth of third cervical vertebra (dorsal)
V22	Height of third cervical vertebra
V23	Breadth of third cervical vertebra (lateral)

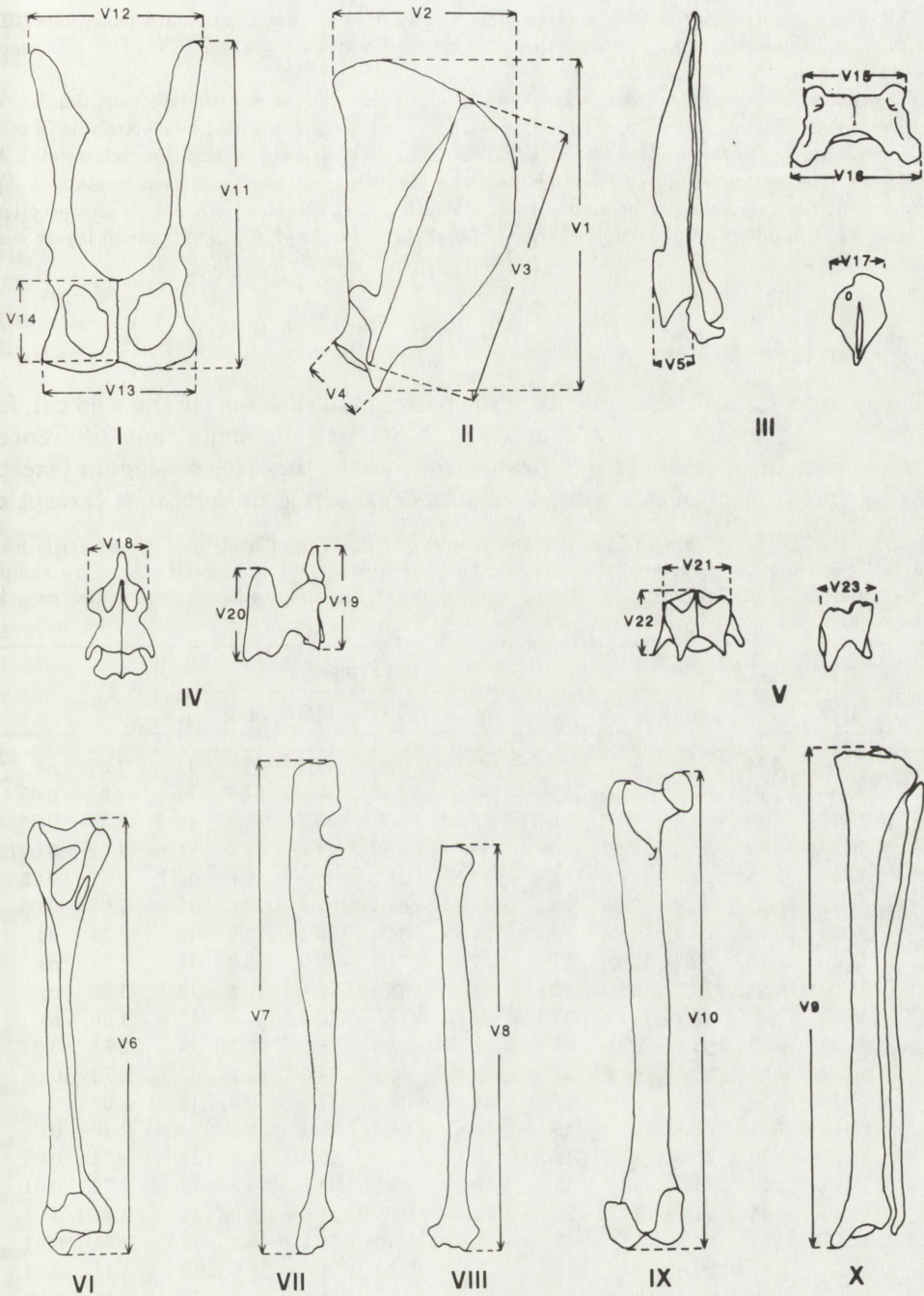


Fig. 1. Scheme of the measurements of the postcranial skeleton of wild cat *Felis silvestris* from Bulgaria. I - pelvis, II - scapula, III - atlas, IV - epistropheus, V - vertebra cervicalis III, VI - humerus, VII - ulna, VIII - radius, IX - femur, X - tibia + fibula.

The absolute variability in the measurements was expressed through standard deviations (SD). The relative variability was expressed through the coefficient of variation (CV). The differences between sexes were tested by Student's *t*-test.

The age of the specimens was determined by analyzing annual growth layers in dentine on cross-sections of C₁ root, below the edge of alveola. The teeth were decalcified by electrolysis in 6.5% HNO₃ solution. Each cross-section was 10 μm thick. Four sections were taken from each animal. All these were fixed on cover glasses for microscope slides. One of them was used unstained. For improving the contrast between the annual rings in dentine, each one of the other three cross-sections were stained with either of Mayer's, Earlich's, or Delafield's hematoxylin. Annual growth layers were counted under a microscope. The wild cats used were from 1 + to 7 years old.

Results

The results of the measurements of the postcranial skeletons of the wild cat, for each of the sexes, are presented in Table 2. Statistically significant differences were found at three levels of significance, for most of the sizes of *scapula* (except of V1), *pelvis* (except of V13), *atlas*, *epistropheus*, *vertebrae cervicales* (except of

Table 2. Arithmetic mean measurements of the postcranial skeleton of wild cat *Felis silvestris* from Bulgaria. VNo – number of variable; SD – standard deviation; Min, Max – observed ranges; n – sample size; *t* – Student's *t*-test values; *p* – level of significance of the differences between sexes; ns – no significant difference.

VNo	Males					Females					<i>t</i>	<i>p</i>
	Mean	SD	Min	Max	n	Mean	SD	Min	Max	n		
V1	86.64	5.84	74.5	97.1	23	83.09	4.02	77.3	94.6	14	1.99	ns
V2	46.48	3.73	40.8	52.5	23	43.65	3.24	37.0	51.8	14	2.35	0.05
V3	79.49	5.70	67.0	90.6	23	75.46	3.77	69.5	86.1	14	2.34	0.05
V4	16.53	0.83	15.1	18.1	23	15.41	0.77	14.5	17.3	14	4.12	0.001
V5	14.11	1.55	11.5	17.9	23	12.86	1.22	10.2	14.6	14	2.57	0.05
V6	116.11	5.87	101.0	126.3	23	111.44	4.04	107.0	123.6	15	2.69	0.05
V7	126.68	10.75	108.3	144.8	22	122.47	6.94	108.9	135.9	15	1.34	ns
V8	111.46	10.28	92.3	138.0	21	107.71	3.98	98.9	116.3	15	1.34	ns
V9	135.70	8.31	116.0	148.6	22	131.07	5.76	119.4	142.5	15	1.86	ns
V10	128.30	9.09	102.9	144.9	17	124.06	4.60	115.4	134.3	15	1.66	ns
V11	91.34	3.95	82.0	97.5	17	86.10	4.25	78.8	95.3	14	3.55	0.01
V12	45.87	2.57	39.5	49.6	17	42.99	3.24	37.5	47.2	13	2.72	0.05
V13	46.52	3.17	41.1	51.8	17	44.08	3.40	38.0	50.9	13	2.02	ns
V14	32.03	2.71	27.1	37.2	18	29.81	2.66	25.2	35.3	14	2.29	0.05
V15	27.09	0.99	25.9	29.6	18	26.16	0.99	25.0	28.2	12	2.52	0.05
V16	38.74	2.40	34.0	42.7	18	36.29	2.31	33.2	40.9	12	2.78	0.01
V17	15.39	0.54	14.1	16.1	18	14.85	0.51	14.0	15.9	12	2.74	0.05
V18	17.78	0.74	16.1	19.0	17	17.01	0.70	16.1	18.3	12	2.85	0.01
V19	27.98	1.97	25.0	31.3	17	26.04	1.03	24.9	28.0	12	3.11	0.01
V20	27.85	2.07	24.3	30.8	11	25.81	2.70	23.0	32.4	12	2.19	0.05
V21	19.01	1.81	16.8	22.4	11	17.49	1.52	16.3	21.1	9	2.00	ns
V22	16.41	0.85	14.3	17.2	11	15.00	0.69	14.1	16.0	9	4.01	0.001
V23	15.78	1.37	13.9	18.5	11	14.00	0.54	13.1	15.1	9	3.68	0.001

V21), and the length of *humerus*. The parameters of males were higher than those of the females. No significant differences in the length of the limb bones (*ulna*, *radius*, *tibia*) were found. The *humerus* was longer in males than in females at 5% level of significance.

The absolute variability in the measurements was greater for males, than for females, except for measurements V11, V12, V13, and V20, while for measurements V4, V14, V15, V16, V17, and V18 the values were almost equal. The relative variability was very small – less than 10%, except for measurements V5 (CV = 11.09%) for males and V20 (CV = 10.44%) for females. The relative variation was higher for males than for females, except for the same measurements, indicated with the analysis of absolute variation.

Discussion

The comparison between skeletons of the two sexes indicated that the males had more developed bones than females. This was probably due to the reproductive behaviour of the wild cat. Males fight for their females and bigger body, i.e. the more bulky skeleton, is the most important feature deciding the issues of such fights. The bones of the limbs whose development was determined by motions shared by both sexes (i.e. walking, hunting, sneaking, and climbing), did not demonstrate very significant differences. No enlargement of the pelvises of females, as a result of pregnancy, was observed.

Measurements of the selected elements of the postcranial skeleton of the wild cats from Bulgaria were compared with those from Czechoslovakia (Kratochvíl 1976), Switzerland (Schauenberg 1980) and Corsica (Arrighi and Salotti 1988). Only a few of the measurements appeared to be significantly different, when compared by Student *t*-test, at $p = 0.05$. In most cases, however, the differences were not significant. This shows that geographic variation of the wild cat postcranial skeleton throughout its European range is comparatively small.

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