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The occurrence and the characteristics of *Coronella austriaca austriaca* (LAURENTI, 1768) (Serpentes: Colubridae) in western Poland

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Abstract. Populations of *Coronella a. austriaca,* a species which is a rapidly disappearing species in mid-western Poland, have been examined for 16 years. In 13 out of 16 recorded sites 1-2 live or dead individuals were observed. Populations consisting of up to several dozen individuals were observed in the valleys of the Bóbr, Odra, Ilanka and Pliszka rivers. 76% of the observations were conducted on anthropogenic and 24% on primary sites. In total 248 individuals were examined, including 38 (15.3%) males, 36 (14.5%) females, 8 (3.2%) young/subadult individuals and 166 (67%) neonates.

Key words: Reptilia, Serpentes, Colubridae, *Coronella a. austriaca*, smooth snake, population, western Poland.

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I. INTRODUCTION

The smooth snake *Coronella a. austriaca* occurs in the whole of Poland and is subject to legal protection. It is a rare species (PROFUS & SURA 2003) and is classified as endangered with extinction VU (PROFUS & SURA 2001). So far, in this part of Europe, researchers have paid little attention to the species, which was frequently reflected in presenting its distribution on the background of the its total range (e. g. ENGELMANN 1993; STRIJBOSCH 1997; VÖLKL & KÄSEWIETER 2003).

The knowledge of the species' current distribution in Poland, as well as its biology and ecology is unsatisfactory. However, despite this, observations made by zoologists indicate that the smooth snake is rapidly disappearing from sites all over the country. Although there is no complete historical data on its occurrence in Poland, some of the sites considered relatively recently as having many individuals are either devoid of smooth snakes or have only sporadic records. The most striking disappearance was recorded in Silesia (PROFUS & SURA 2003).

Since 1994 three areas of the western part of the country with smooth snake have been found with several dozen individuals of various ages. As far as we know these appear to be the richest sites for the species in Poland.

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II. STUDY AREA

Lubuskie province is located in a narrow part of the European Lowlands in mid-western Poland 51º21'-53º07' N and 14º32'-16º25' E (Fig. 1). Its characteristic features include the occurrence of proglacial river valleys with moraine barriers. It covers an area of 13 989 km^2, 60% of which is located between the altitudes of 50-100 m above the sea level (RÖSLER 2005). 50% of the area occupied is forested, 90% of which is pine wood. The climate is moderate with the prevailing features of an oceanic climate. The average annual temperature is 7.8-8.0ºC, while the average temperature in summer is 14-14.4ºC (ZAJCHOWSKA 1972). The average duration of the thermal winter is approx. 60 days, whereas the summer half year lasts for approx. 90 days (JANISZEWSKI 1973-1978).

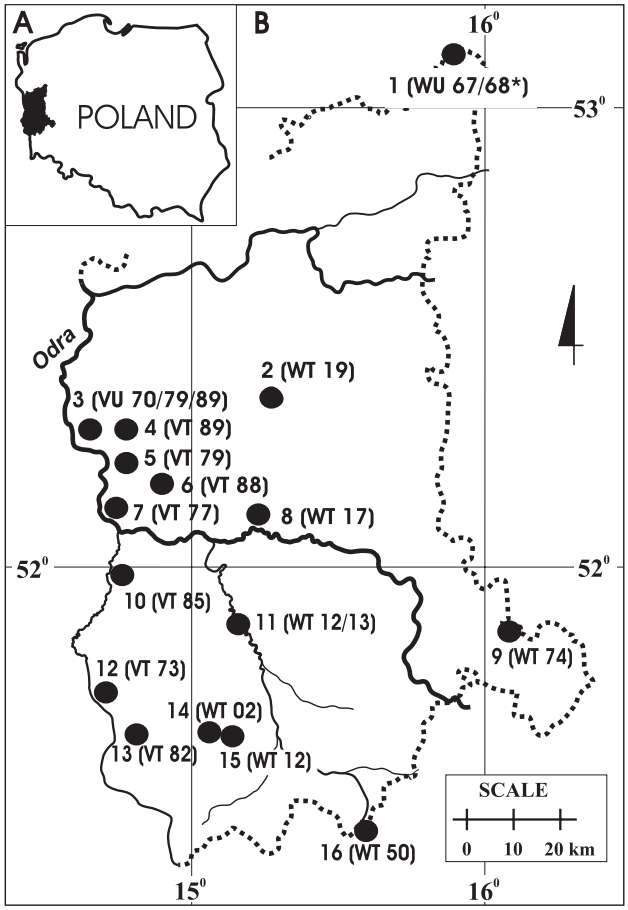

Fig. 1. Study area; A – general location, B – ● sites of *Coronella a. austriaca*; * – Universal Traverse Mercator.

III. THE TIME, MATERIAL AND THE METHODS OF STUDY

The paper presents data for the smooth snake collected between May 1990 and May 2005 in the current administrative area of Lubuskie province. The research was carried over 225 days, with an average of 6-8 hours a day. The snakes were surveyed on those sites where at least one dead or live individual had been observed. The survey included sites which were considered to be natural as well as those which were anthropogenic in origin.

The individual snakes were identified by means of photographing the arrangement of spots on their heads, anomalous shield structure or other variable features. Additionally the snakes were marked by means of the BROWN & PARKER method (1976).

The sex of adult individuals was determined by means of comparing the proportion of the total length to the length of the tail, counting the number of abdominal shields (scuta ventralia) and pairs of subcaudal shields (sc. subcaudalia), as well as analysing the shape and probing the cloaca area. The sex of young/subadult individuals (below 40 cm of length) and neonates was not determined.

Pregnant females injured by people or vehicles were transported to terrariums and kept there until the birth. A number of births were observed in field (NAJBAR 2001). All individuals were released in safe places in the area of their origin as soon as it was possible.

The total length was measured, at an accuracy of 0.5 cm, by means of placing the measure along the snake's body, other measurements were taken by means of a caliper at the accuracy of 0.1 cm. The snakes were weighted at an accuracy of 0.1 g (with Tanita Digital 1212 scale).

The results were analysed by means of Statistica for Windows 5.5 (StatSoft Inc. 2001).

IV. RESULTS

D i s t r i b u t i o n. Smooth snakes were observed at 16 sites (Fig. 1). On 13 of them (81.3%) (Nos 1, 2, 4, 6-10, 12-16) 1-2 live or dead snakes were found, the remaining 3 sites (18.7%) (Nos 3, 5, 11) were inhabited by populations in which, excluding neonates, 10-35 individuals were recorded.

The first populous site was discovered in 1994 in the area of Nowogród Bobrzański in the valley of the Bóbr river (NAJBAR 1997). Further sites were found at the end of the 1990s along the border with Germany, in the valley of the Odra river, in the regions where the Ilanka and Pliszka rivers meet the Odra river (the region of Słubice, Świecko and Urad).

H a b i t a t. The smooth snake inhabits various kinds of environment in the research area. Eco-tonal areas, exposed to the sun e. g. at the edge of forests or bush complexes, in forest clearings, stony areas etc. are considered to be primary habitats. Most of these types of environment, apart from stony areas (of which there are few), occur in the research area and they are relatively easy to penetrate, yet it is not easy to find smooth snakes there. 24% of the observations were made in such areas. 76% of the observation were made in anthropogenic environments, particularly on local village waste dumps, in abandoned buildings, on road shoulders, in ruins and other places (Fig. 2).

T h e c h a r a c t e r i s t i c s o f t h e p o p u l a t i o n

M o r p h o m e t r i c f e a t u r e s. 248 smooth snakes were measured. Compared to the description presented e. g. by VÖLKL & KÄSEWIETER (2003), the shield structure of the head of most individuals was typical for the species, except for 12 (4.8%) individuals in which anomalies were observed. In 8 (3.2%) cases 1-2 additional tiny shields along the scuta supralabialia line were observed (the total of 8-9), in the remaining 4 (1.6%) cases 1-2 additional shields (the total of 9-10) were observed along the sc. sublabialia line. Anomalous shield structure tended to occur more frequently in sc. ventralia, and consisted of divided shields or additional smaller shields of various shapes. Such cases were observed in 97 (39.1%) individuals. Anomalies in the subcaudial area (sc. subcaudalia) were observed in 27 (10.9%) individuals. 1 shield sc. analia was observed in 1 (0.4%) individual while 3 shields sc. analia were also observed in 1 (0.4%) individual (Tab. I).

The total length of the males, in cases where unambiguous determination of their sex was possible, ranged between 42.2 and 71.0 cm. In the females, to which the same principle of sex determination was applied, the length ranged between 40.3 and 72.4 cm. In individuals whose length was 30.0-38.0 cm dimorphic features were not explicitly marked. The characteristic features of the smooth snake from the researched area are presented in Table I.

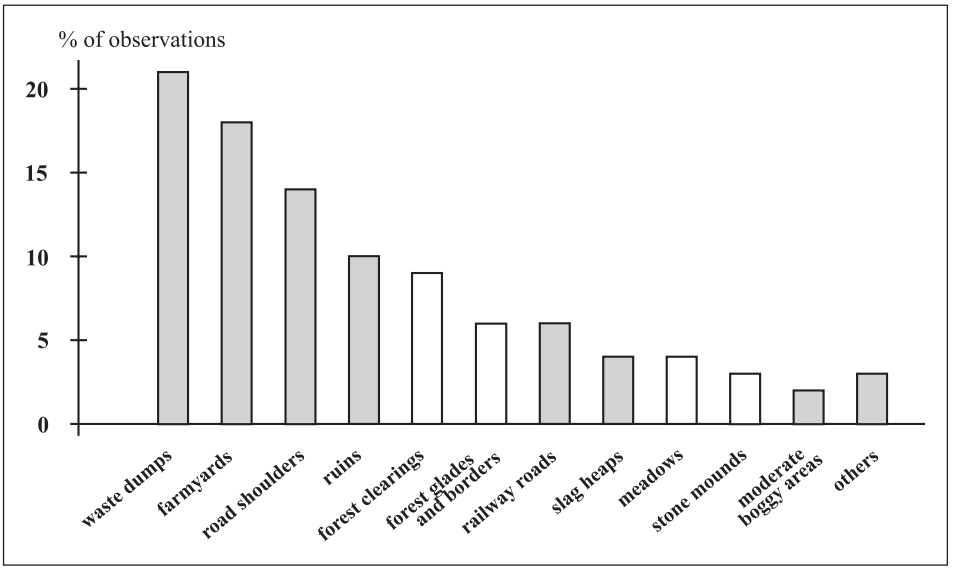

Fig. 2. Type of habitats of *Coronella a. austriaca* in the study area, ▭ – primary habitats, ▬ – secondary habitats.

Table I

The characteristcs of the smooth snake from the study area (n = 248)

Value	Length			The width of the head	No of shields			Body mass
	Total	Tail	Head		sc. ventralia	sc. subcaudalia (pairs)	sc. analia	
	[cm]				[no]			[g]
Males (n = 38)								
min.	42.2	7.6	1.4	0.8	162	54	1	14.1
max.	71.0	14.5	2.5	2.0	185	65	3	92.4
mean ± S.D.	59.41 ± 8.1	12.02 ± 1.6	1.91 ± 0.3	1.33 ± 0.3	169.08 ± 4.4	57.81 ± 2.8	2.00 ± 0.2	58.23 ± 23.3
Females (n = 36)								
min.	40.3	6.1	1.2	0.9	176	44	2	12.8
max.	72.4	12.9	1.9	1.6	190	56	2	147.9
mean ± S.D.	59.52 ± 8.3	9.46 ± 2.0	1.60 ± 0.2	1.23 ± 0.2	180.90 ± 3.3	49.10 ± 3.3	2.0 ± 0.0	74.56 ± 32.0
Subadult individuals (n = 8)								
min.	30.0	4.7*	1.2	0.8	173	46*	2	13.3
max.	38.0	8.4	1.5	1.0	185	61	2	30.0
mean ± S.D.	33.35 ± 2.8	5.75 ± 1.4	1.36 ± 0.1	0.89 ± 0.1	178.00 ± 4.3	53.17 ± 6.3	2.00 ± 0.0	20.14 ± 6.8
Neonates (n = 166)								
min.	10.9	1.4	0.7	0.4	158	43	2	0.8
max.	19.1	4.0	1.3	0.8	190	65	2	3.4
mean ± S.D.	16.98 ± 0.8	2.84 ± 0.4	1.02 ± 0.1	0.59 ± 0.1	174.48 ± 7.8	53.10 ± 5.7	2.00 ± 0.0	2.76 ± 0.3

* n = 6

In the population researched the range of the number of abdominal shields ranged between 158 and 190 (Fig. 3) and subcaudal shields (pairs) between 43 and 65 (Fig. 4).

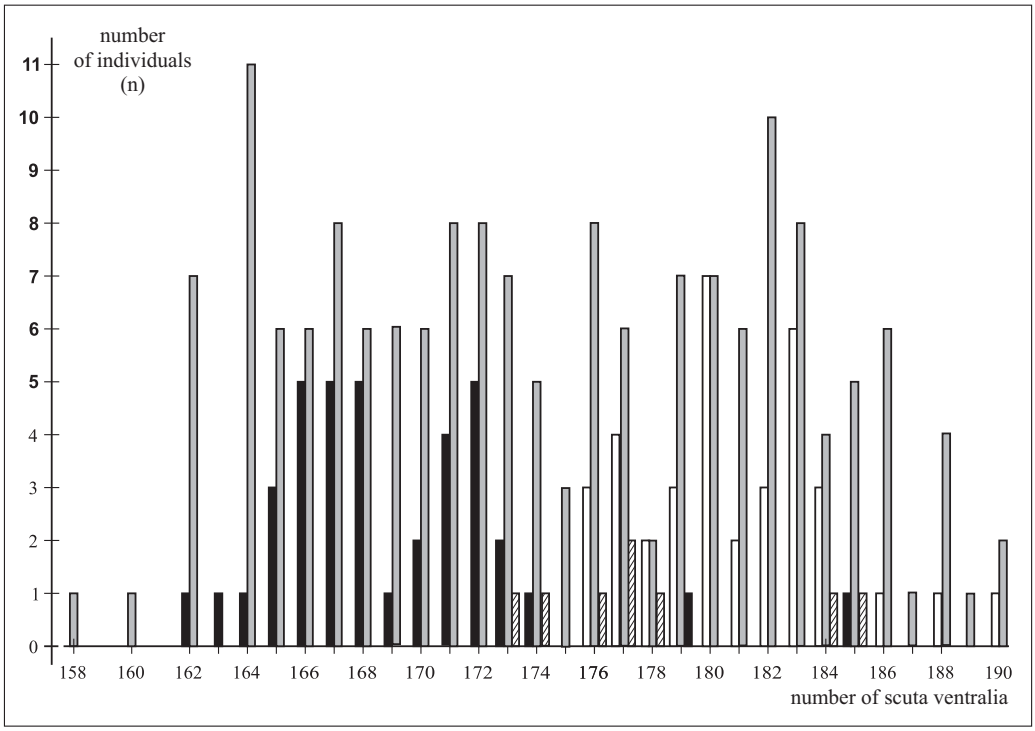

Fig. 3. Number of scuta ventralia of *Coronella a. austriaca* in the study area; ■ – males (n=38), □ – females (n=36), ▨ – subadult individuals (n=8), ▭ – neonates (n=166).

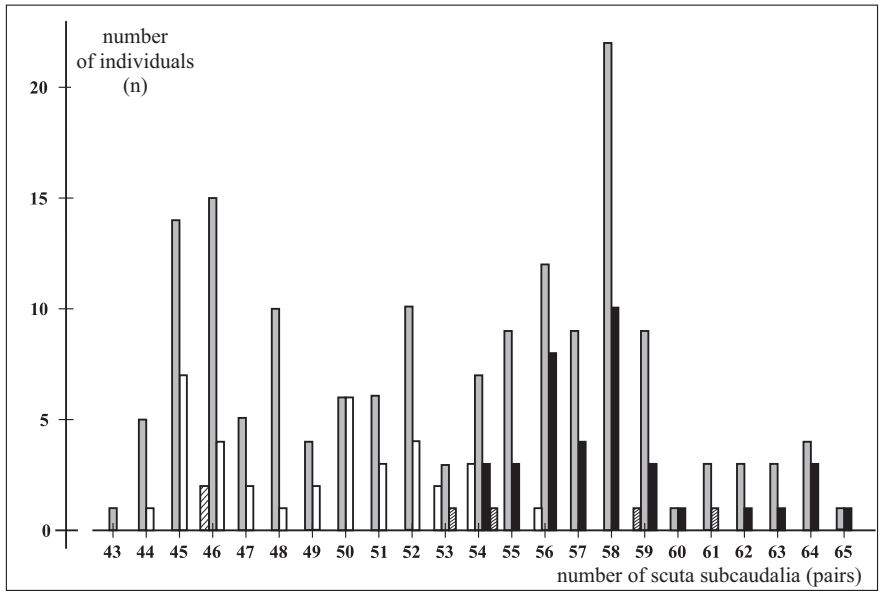

Fig. 4. Number of scuta subcaudalia of *Coronella a. austriaca* in the study area; ■ – males (n=38), □ – females (n=36), ▨ – subadult individuals (n=6), ▭ – neonates (n=166).

All shields of the examined snakes were smooth and the number of dorsal shields, scuta dorsalia, in one row (in the medial part of the body) was 19.

The comparison between the tail length and total length does not allow for unambiguous determination of the sex of immature individuals. In the individuals examined the ratio was 4.25-7.25 (mean 6.14; S.D. 0.9), which indicated that the group consisted of both males and females. The ratio becomes more explicit once the length of approx. 40 cm has been reached (Fig. 5). In the researched population the ratio of the total length to the tail length was 4.32-5.55 (mean 4.94; S.D. 0.3) for adult males and 5.27-7.57 (mean 6.38; S.D. 0.6) for adult females.

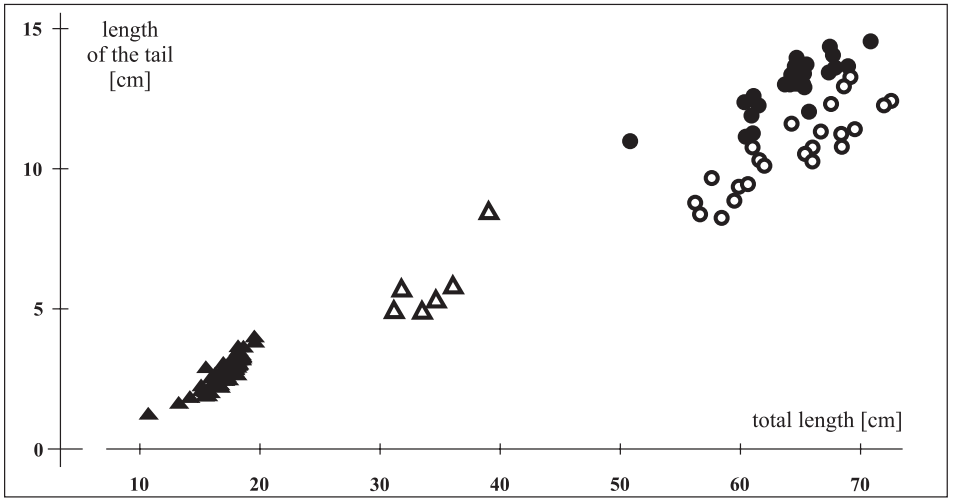

Fig. 5. The length of the tail of *Coronella a. austriaca* relative to its total length; ● – males (n=38), ○ – females (n=36), △ – subadult individuals (n=6), ▲ – neonates (n=166).

In the study area females of the smooth snake reach greater body mass (Mann-Whitney U-test, $U = 451$, $p = 0.012$, $n_{males} = 38$, $n_{females} = 36$), but there were no differences between males and females in length (Mann-Whitney U-test, $U = 667.5$, $p = 0.86$; $n_{males} = 38$, $n_{females} = 36$).

The distribution of the body mass of neonates was similar, yet in other age groups it was strongly diversified, which applied in particular to pregnant females (Fig. 6).

C o l o u r a t i o n. The colouration of the smooth snake from the researched population was variable. The top and sides of the bodies of the youngest individuals were usually light gray or gray. The surface of the abdominal part of the body was brick red yet the intensity of the colour diminishes with age. Next to the typical arrangement of spots on the head and the narrowing of the neck, other emerging patterns included two rows of dark spots located along the body and numerous, dispersed and irregular black spots and dots. Adult females usually had the darkest colouration. Their top and side parts of the body were grey, dark grey or steel grey, the abdominal part of the body was dark grey or sometimes almost black. The sub-faucal section of the body was the lightest and colouration ranged between white-beige and light grey with numerous tiny dark or black spots. As far as males are concerned, the basic colour was brown, clay-like (in various shades), less often light or dark gray. The abdominal part of the body was copper-brown, red-brown, red-yellow, brick-grey or gray, with the central part of the abdominal part being the darkest.

V. DISCUSSION

Considering the morphometrics and colouration of *Coronella a. austriaca* from the research area, it can be observed that the population is comparable with other populations of the species spar-

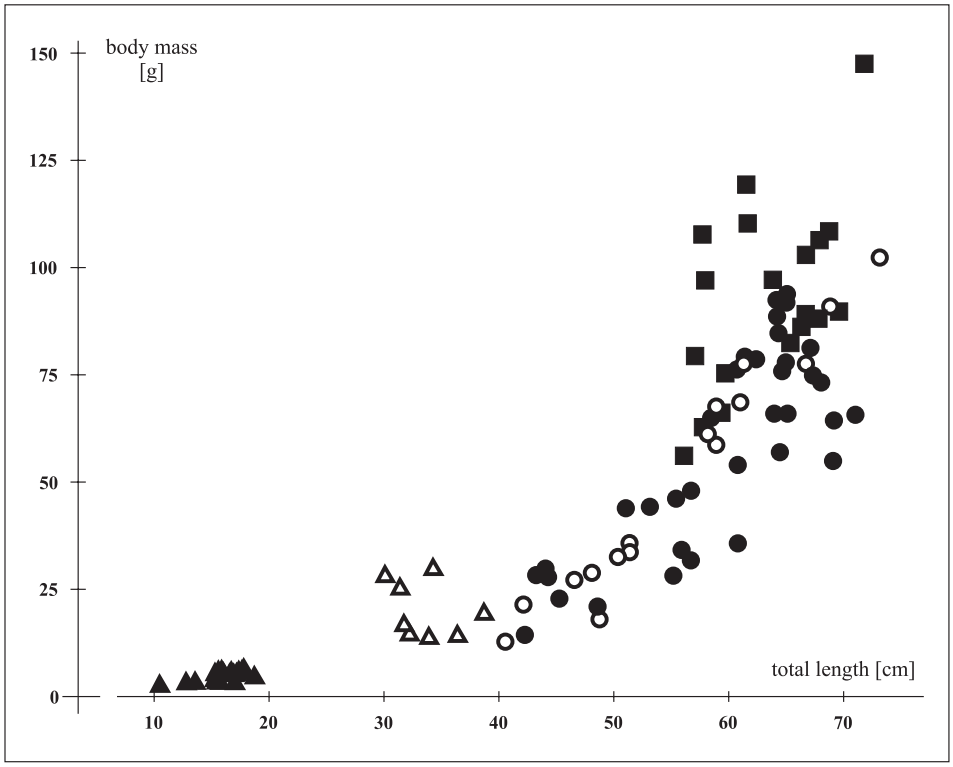

Fig. 6. The body mass of *Coronella a. austriaca* relative to its total length; ● – males (n=38), ○ – females (n=16), ■ – pregnant females (n=20), △ – subadult individuals (n=8), ▲ – neonates (n=166).

ingly inhabiting the area of Poland (JUSZCZYK 1987; ZIELIŃSKI et al. 2001), as well as with other populations located in the nearby regions of Europe (e. g. STRIJBOSCH & VAN GELDER 1993; GÜNTHER & VÖLKL 1996; VÖLKL & KÄSEWIETER 2003).

The smallest new born individual observed significantly diverged from the average of other neonates (16.98 cm) and measured only 10.9 cm. It was weak and died soon afterwards. The longest individuals were 71.0-72.4 cm long. The average and the maximum body weight of adult females was bigger than the mass of adult males. This is the case even when the total lengths of the body were comparable, yet strong variability is possible too (Fig. 6) as pregnant females are the heaviest, particularly those which are also the longest. The latter has been stressed by authors researching other populations of the species (e. g. JUSZCZYK 1987; MONNEY et al. 1995; LUISELLI et al. 1996). The heaviest female observed was from the region of Nowogród Bobrzański (72.4 cm long) and weighed 147.9 g prior to the birth of 14 neonates (NAJBAR 2001). Bigger individuals have also been observed. JUSZCZYK (1987) recorded a pregnant female (also from Poland) which was 87.0 cm long and weighted 185.0 g.

In cases of individuals from the research area, whose length was smaller than 40 cm, dimorphic features such as shape of the cloaca area were unambiguously marked.

As seen above, the tail of the adult males examined was clearly longer than that of adult females, which is typical for populations of the species inhabiting various parts of Europe (VÖLKL & KÄSEWIETER 2003). JUSZCZYK (1987) observed that for individuals coming from various regions of Poland the ratio of the length of the tail to the total length varied in males between 15.5 and 22.0% (mean approx. 20%), and in females between 11.5 and 18.6% (mean approx. 16%), which corresponds well with the data presented in this paper (expressed as a percentage the ratio ranged between 11.5 and 18.6% (mean approx. 16%) for adult males and between 13.2 and 19.0% (mean 15.80%) for adult females).

The smooth snake in the research area inhabits diversified habitats, most populous are the sites which are exposed to the sun and are located in the valleys of the Odra, Pliszka i Ilanka rivers situated along the border with Brandenburg (Germany) i. e. areas where human activity was limited, where human populations are relatively small and where some of the areas were prevented from being overgrown as they were used as runways. There was also no harmful industry in the area. It could be argued that appropriate environment conditions as well as the above mentioned factors enabled the survival of the species on this area.

In order to maintain the population of *Coronella a. austriaca*, apart from eliminating both existing and potential threats, it is vital to protect the widespread and diversified existing sites, yet unfortunately the areas inhabited by the most numerous populations in western Poland are gradually being taken over by the mining industry (NAJBAR 2000).

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