

DISTRIBUTION, ECOLOGICAL TRAITS AND CONSERVATION OF THE SMOOTH SNAKE (*CORONELLA AUSTRICA*) IN BELARUS

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Geographical distribution, habitats, prey items and other aspects of the life history of the Smooth snake (*Coronella austriaca*) in Belarus are analyzed. The main human factors of threat for regional population were defined. The current conservation status of this colubrid species in is estimated and sustainable preservation measures are proposed.

Key words: Smooth snake, *Coronella austriaca*, distribution, habitat, diet, conservation, Belarus.

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INTRODUCTION

The smooth snake (*Coronella austriaca* Laur., 1768) is widespread colubrid species in Central and East Europe. However, mozaic distribution, very low abundance of the populations and increased susceptibility to human factors makes it rare and endangered species. By this reason the life history of the smooth snake attract permanent interest of herpetologists and conservationists (Bannikov et al. 1977, Sczcerbak & Sczcerban 1980, Pikulik et al. 1988, Glandt 1972, Juszczyk 1974, Spellerberg & Phelps 1977, Andren & Nilson 1979, Goddart & Spellerberg 1980, Volkl & Meier 1988, Zimmermann 1988, Larsson 1995, Bakiev et al. 2004). In Belarus, as in the most other European countries, this reptile's sporadically distributed and included in the List of endangered species (Fig. 1). Knowledge of geographical distribution, population structure, behavior, food preferences, and reproduction are the basis for its sustainable and long-term conservation.

MATERIAL AND METHODS

The materials presented in the work is obtained in 1979-2014 in Belarus located in the north-eastern part of species distribution range. As a result of the field research 28 localities were found and the sample of 123 specimens for population structure analysis was collected. Diet was studied using intravital approach. In general 38 prey specimens of *Coronella austriaca* were detected and identified. Seasonal activity, spatial movements, and other aspects of natural history studied in 3 areas in the southern and central part of the country. Some of the results and research methods were published in our earlier articles (Drobenkov 1995, 2000, 2004).

RESULTS AND DISCUSSION

Distribution and number

As the analysis of our data and literature



Fig. 1. Typical morphotype of the Smooth snake in Belarus (adult female).

information (Sapozhenkov 1961, Rodionenko 1962, Pikulik et al. 1988) has shown, in the last fifty years in the territory of Belarus the smooth snake characterized by a wide distribution but very low number. In the southern part of the republic in Brest and Gomel regions findings of the species were more often than in the central provinces. Most of the localities were recorded in Lelchitsy, Stolin and Malorita districts near the border with Ukraine (Gomel and Brest regions). Records of this snake in the northern part of Belarus in the Vitebsk region were very rare. The clear tendency of population changing in the latitudinal direction indicates important role of climatic and geographic factors in its distribution in the periphery of the range. The relative contribution of the species currently in the Belarussian herpetofauna does not exceed 0,7% in the southern regions, and 3,7% for Belarus as a whole.

The spatial structure of the population was represented by the sparse, considerably separated populations with the extremely low size (3-8,

very rarely up to 15-20 individuals). Two-three snakes usually occupy territory of 0,08-0,3 ha, and the population density varies from 3,3 to 25,0 specimens per ha (mean $14,6 \pm 2,6$). Many local groups of the smooth snake could be the offsprings generated by one of several females (dem or micropopulation).

The habitats of the smooth snake in Belarus are associated with forest landscapes, mainly forest ecotones and dry sites of mosaic weakly hilled terrain (Fig. 2). The snake inhabited forest landscapes, it is most often recorded in low hill areas. It lives in different habitats including sides of earth roads (37,5%), edging of forest (25%), sparse growth of trees (18,8%), cuttings in a forest (12,5%) and strips along the embankment of railways (6,2%) (Drobenkov 2000). Most of the modern habitats has appeared or modified as a result of the human activity. This makes difficult the determination of the primary natural habitats, from which the species was distributed. It could be supposed that primary habitats were represented by forest-meadow ecotones.



Fig. 2. Xerophilous preferred habitat of *Coronella austriaca* in south part of the country.

According to analysis of the habitats, at present time this snake occupies very narrow spectrum of plant communities. The main forest complexes preferred by this species include heather (37,5%) and adder-spit-sphagnum pine forests (18,8%), and also mixed small-leaved forests (31,3%). Some extension of the habitats range as a result of occupation of sandy uplands among the marshes and distinct sites of dry meadows is observed in southern regions of the Republic (Polesye region).

For comparison, the other sympatric species, *Vipera berus* and *Natrix natrix* use more broad spectrum of habitats, mainly by occupation of overwet and shore sites. The biotope choice by the smooth snake is clearly demonstrated by preference of xerophilous habitats, although some of these biotopes in several cases are adjacent with over-humid biocenoses (river flood-plains, forest marshes).

The area of activity of the majority animals in the summer is limited by small territory near 0,1-0,3 ha. Individual sites have elongated shape,

usually overlapping with each other. Special summer feeding and winter sites, typical for two other species of snakes (*Vipera berus* and *Natrix natrix*), as well as regular seasonal migrations were not observed in the smooth snake. The same shelter (a bush hole or a butt of a tree) is used during 2-3 seasons.

Feeding

In Belarus, as well as in the other parts of the range, the smooth snake is a specialized saurophagous predator (Table 1). As shown by the analysis of the stomach content, the main role in its diet is played by viviparous lizard (*Zootoca vivipara*), less significant are sand lizard (*L. agilis*) and slow worm (*Anguis fragilis*). Small mammals (*Microtus arvalis* and other) sometimes present in the stomachs of large specimens. Recently we have noted a European mole (*Talpa europaea*) in food (Fig. 3).

It is necessary to note a rather high role of cannibalism (9,1 %) in the feeding of the smooth snake in Belarus. Viviparous lizard dominates in



Fig. 3. Newborn of the European mole (*Talpa europaea*) from the stomach of the Smooth snake.

the diet in the central part of the country (about 85%), whereas the three lizard species were equally represented in the diet (15-20% each) in the southern part of the Republic. Obviously, such differences in the diet are explained by the structural peculiarities of herpetofauna in the different parts of Belarus.

All sites of the smooth snake, examined by us, were characterized by high local abundance of its main prey - lizards. The total density of the lizard population in the typical sites was about 90-160 individuals per ha. The smooth snake is the most thermophilous species among snakes inhabiting Belarus. This feature determines the main characteristics of its stations, short period of seasonal (average from April 10 to September 15-20, i.e., 155-165 days) and diurnal activity (from 9 – 10 a.m. to 7 p.m.). The smooth snake seems to be more active than common adder and grass snake in day time, that is explained by differences in their thermal preference and by difference in daily activity of their preys (anurans, lizards, and mice).

Population structure and reproduction

Judging from the structure of samples collected in Belarus (n=123) the size-age group may be distinguished in the population of the smooth snake: juveniles (juv.), length (L+L.cd) up to 200 mm; yearlings (juv.+), 200-280 mm; 3) subadults, 280-440 mm; and adults, males >440 mm, females >510 mm (Table 2). The juveniles form a rather high part of the population (12,7%). Their number is strongly increased at the end of summer as the result of annual brood. At the end of active period and after the first hibernation, in particular, the number of juveniles is quickly reduced. According to the differences between the spring and autumn records mortality of the juveniles is the highest in the whole population (>80%). This fact is reflected the relatively low percent of presentation of an average age group (juv.+ , subadults). Because of the decreased growth rate of snakes, we estimate that at least 5 – 12-year-old individuals enter the adult group and form the main part of the population (75%). The most essential feature of the structure of the population of the smooth snake in Belarus is the

Table 1. Food ration of the Smooth snake in Belarus

Nutrition components	Share	
	n	%
Viviparous lizard (<i>Zootoca vivipara</i>)	24	43,6
Sand lizard (<i>Lacerta agilis</i>)	9	16,4
Smooth snake (<i>Coronella austriaca</i>)	5	9,1
Common vole (<i>Microtus arvalis</i>)	5	9,1
Slow worm (<i>Anguis fragilis</i>)	4	7,3
Common Shrew (<i>Sorex araneus</i>)	2	3,6
European mole (<i>Talpa europaea</i>)	3	5,5
Striped field mouse (<i>Apodemus agrarius</i>)	3	5,5

Table 2. Composition of the collected samples in belarussian population of the Smooth Snake

Size-age class, length range	Share	
	n	%
Juv. (juveniles, <200 mm)	7	5,7
Juv.+ (yearlings, 200-280 mm)	12	9,8
Sub.ad. (immature, 280-440 mm)	21	17,1
Ad. (mature males, >440 mm)	61	49,6
Ad. (mature females, >510 mm)	22	17,9

significant dominance of females above males, in the ratio of 2,8:1. The reasons for such situation are need to be studied. It is worthy noting however, that relatively low percent of males does not influence to the reproductive cycle of females, of which about 95% successfully participate in the reproduction each year.

The fecundity of females (n = 19) is rather low, about 4-13 juveniles (7,3±0,8) annually. The females become mature at the age approximately of 5,5 years (after the 5-th hibernation). Therefore if duration of life is estimated to be 12 years, the life cycle includes up to 8 broods. A coupling in the southern part of the study area take place in the first decade of May, the young was born at the beginning of August, and, therefore, the gestation period is about 85-95 days.

The population of the smooth snake demonstrates high reproductive potential, which, obviously, ensures preservation of the species under modern conditions, compensating high natural mortality and supporting stable structure and population number. The density of the population is increased approximately in 2,7 times as a result of the appearance of a new generation, and is again stabilized to the initial level by the following spring-summer period.

Threats and Conservation

Long-term observation of several micro populations of the smooth snake in the different areas Belarus is testified to their rather stable state. Nevertheless, some forms of the human activity, such as logging, cutting, urbanization, car traffic have a negative effect on the state of the population. It should be noted that some forms may produce both a negative and a positive influence on its number.

To the reduction of the range of distribution and number of the smooth snakes usually lead radical modification of natural habitats such as cutting down of woods and heavy road construction. No less than 45% of the inspected settlements of the smooth snake are placed close to roads, therefore death on the roads is one of the major observable factors of mortality of this species. The relative number of perished snakes on separate sites of subsoil roads observed during 7-10 days in the summer is 0,4-0,9 specimens per 1 km of road. The mosaic of landscapes and road construction contribute to expansion of this species.

Main state reserve of the smooth snake preservation is the «Pripyatsky» National Park located in the southern part of the Republic.

According to our evaluation the size of population there is about 100-150 individuals. The main part of the population is concentrated in the southern part of the reserve, which is covered with dry pine-forest and mixed forest.

The broad expansion of the smooth snake is restricted by stenotopic pattern of this species. In Europe this species occupies heathland in the pine and mixed forests (Phelps 1978, Happ 1985, Edelsman 1995). Among three snake species widely distributed in Eastern Europe (smooth snake, common adder and grass snake) the smooth snake is distinguished by low spectrum of feeding and dietary habits (Drobenkov 1995).

Trophic specialization of the mentioned snake species is known also for other regions of Europe (Phelps 1978, Garanin 1983). The highest density of the smooth snake is known in mountain, rocky ravine places and stony grounds (Bannikov et al. 1977, Tertyshnikov 1977). As was shown the smooth snake is characterized by combination of the wide geographic distribution with narrow ecological specialization.

The current number of the smooth snake population in Belarus is relatively stable, however, to sustainable long-term conservation of the species very necessary preventive measures, which should include:

- 1) Reservation of new habitats where big populations are served (several tens of individuals);
- 2) Reduction of economic activity and the car traffic on the roads (as main human threat) in the some of the most important, but unprotected habitats (near the villages, for example);
- 3) Educational activities (distribution information about snakes) among the local people.

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