

## SPECIES DIVERSITY AND ECOLOGY OF AMPHIBIANS AND REPTILES IN URBANIZED LANDSCAPES OF THE CITY OF MINSK

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The results of ecological and faunistic studies of amphibians and reptiles in urbanized landscapes of Minsk are submitted. Minsk is the largest city in Belarus, which urbanized areas include vast areas of housing development zones, industrial enterprises, developed infrastructure of roads. According to data received, at present the fauna of the city is represented by 11 species of amphibians and 5 species of reptiles, which are characterized by different occurrence, number of population and conservation status. The most adapted to the urban environmental conditions are three species of water frogs (*Pelophylax esculentus* complex), the green toad (*Bufo viridis*), the moor frog (*Rana arvalis*), the sand lizard (*Lacerta agilis*) and the viviparous lizard (*Zootoca vivipara*). In the habitats structure two main groups are distinguished relatively weakly transformed natural (urban reserves) and artificial (urban habitats). First group includes forest areas (forest park zones, forest belts, city parks), aquatic habitats (various ponds and watercourses) and fragments of open landscapes (unploughed meadows, wastelands, farmland). Urban habitats are represented by zones of small house suburbs, summer cottages, roadsides, railroad slopes and industrial zones. Populations of different species are sporadically distributed because of mosaics of urbanized landscapes and preserved habitats. In most cases, the number of local population groups is low and does not exceed several tens to hundreds of individuals. The smallest number of species was recorded in the central most urbanized part of the city, the maximum in the peripheral areas. The main limiting factor that determines the species diversity and abundance of amphibians is the sufficiency and diversity of water bodies in which conditions favorable for reproduction have been preserved. The state of reptiles is determined largely by the preservation of large forests.

Key words: Amphibians, reptiles, herpetofauna, species diversity, Minsk city, urbanization, anthropogenic factors.

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## **INTRODUCTION**

Urbanization is one of the most significant factors of anthropogenic transformation of natural ecosystems, which poses a significant threat to the biological diversity. Currently conservation of the fauna is one of the most pressing problems in large cities. Urbanization has a complex effect on the animal world, it causes habitats destruction and fragmentation, pollutes the environment with toxins. The vehicles, recreational stress, direct destruction by humans, the press of synanthropic predators negatively influence on fauna (Vershinin 1995, 1997). The intense impact of various forms of anthropogenic activities on the biota entails irreversible changes in populations, biological communities and ecosystems generally.

A wide range of occupied habitats, high numbers and productivity of populations characterizes amphibians and reptiles. Thanks to these features, they play an important role in the structural and functional organization of natural ecosystems. Amphibians have amphibiotic habit of life, permeable skin, high sensitivity to pollutants due to this they are considered to be most sensitive biological indicators of the state of the environment including ecosystems of urban territories (Bolshakov et al. 2001, Hamer & McDonnell 2008, Hocking & Babbith 2014). Because of special conditions and a narrow range of suitable habitats the cities fauna is presented by specific species composition of amphibians and reptiles (Lebedinskij 1983, Kuzmin 1985, Vershynin 1995, 1997, Bobrov et al. 1995, Semenov et al. 2000, Bakiev et al. 2003, Bobrov & Semenov 2013).

Minsk is the largest city in Belarus, with a high number and density of people population, developed industry, intensive construction of buildings, dense road network and heavy traffic. Herpetofauna of the city has practically not been studied and there is the limited number of publications on this subject (Pikulik 1993, Mishkovez 1994, Drobenkov et al. 2006, Drobenkov 2018). From a dozen largest industrialized cities in Belarus the state of the herpetofauna and the key regularities of its

transformation during urbanization has been studied only for Grodno city (Yanchurevich 2001, 2002). Information on the current state and dynamics of herpetofauna on the territory of Minsk is very limited, making it difficult to make solution according of many environmental problems, develop of special long-term programs for maintaining the diversity and monitoring of amphibians and reptiles in urban areas.

The purpose our study is to assess the species diversity and ecology features of amphibians and reptiles in the transformed landscapes of the Minsk city.

## **MATERIAL AND METHODS**

Ecological and faunistic studies of amphibians and reptiles in the territory of Minsk were carried out in 1980-2020. Study areas include urban landscapes within the Minsk Beltway and some large areas that are part of the administrative districts, which are located outside the outer boundaries of the Minsk Beltway (Shabany district and others). The main attention in the research was paid to areas with preserved woodlands and water bodies. Most of the information about amphibians was received in spring and early summer (during the breeding season, embryonic and larval development periods). Some data was received by examining soil shelters, as well as by studying the circumstances of the death of animals on the roads.

The estimation of the relative abundance (density) of populations was carried out by route censuses method with a fixed width of transect. The area of the registration sites was at least 300-400 m<sup>2</sup>. In addition to field research, to assess the species composition, territorial distribution and temporal dynamics of herpetofauna, we used data obtained from respondents (usually from professional biologists). Collection funds of museums of Scientific and Practical Center for Bioresources (formerly the Institute of Zoology) of the National Academy of Sciences of Belarus and Belarusian State University were used.

On the base study results, the distribution map of reptile and amphibian habitats on the territory of the city was created (Fig. 1). The species were ranked according to the number of sightings recorded over the past 10 years (2011-2020). During all study period (from 1980-s up to present time) 279 habitats of different species have been first recorded or confirmed within the city. The locations of the largest stable populations currently existing in the city of Minsk (46 marked sites) are shown in Fig. 1.

## RESULTS AND DISCUSSION

### Species composition of urban herpetofauna

According to data received, the herpetofauna of the Minsk city currently includes 11 species of amphibians and 5 species of reptiles: smooth newt – *Lissotriton vulgaris* (Linnaeus, 1758), crested newt – *Triturus cristatus* (Laurenti,

1768), fire-bellied toad – *Bombina bombina* (Linnaeus, 1761), common spadefoot – *Pelobates fuscus* (Laurenti, 1768), common toad – *Bufo bufo* (Linnaeus, 1758), green toad – *Bufo viridis* (Laurenti, 1768), common frog – *Rana temporaria* (Linnaeus, 1758), moor frog – *Rana arvalis* (Nilsson, 1842), marsh frog – *Pelophylax ridibundus* (Pallas, 1771), pool frog – *Pelophylax lessonae* (Camerano, 1882), edible frog – *Pelophylax esculentus* (Linnaeus, 1758), slow worm – *Anguis fragilis* (Linnaeus, 1758), sand lizard – *Lacerta agilis* (Linnaeus, 1758), viviparous lizard – *Zootoca vivipara* (Jacquin, 1787), grass snake – *Natrix natrix* (Linnaeus, 1758), and common adder – *Vipera berus* (Linnaeus, 1758) (Table 1).

In the last decade in the city were not observed natterjack toad – *Epidalea calamita* (Laurenti, 1768), European tree frog – *Hyla arborea* (Linnaeus, 1758), European pond turtle – *Emys orbicularis* (Linnaeus, 1758) and smooth snake

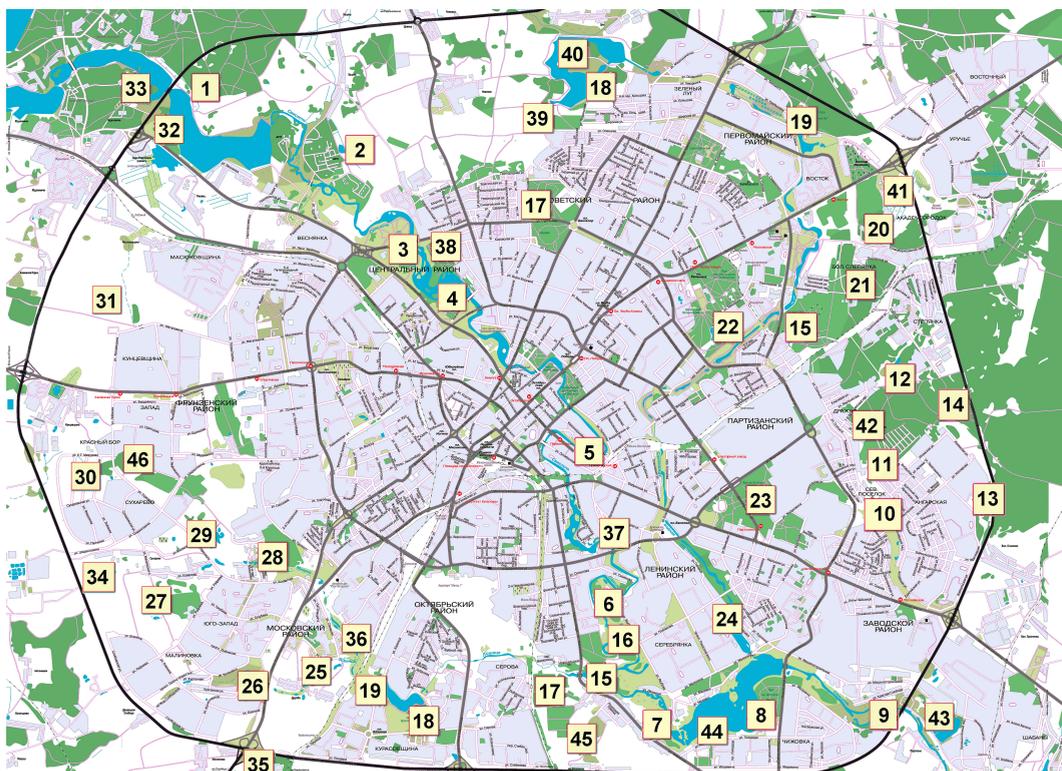


Fig. 1 Location of the largest habitats and stable populations of amphibians and reptiles in the urbanized areas of the Minsk city.

Table 1. Occurrence, population density and conservation status of amphibians and reptiles in the city of Minsk

Species	Habitats, <i>n</i>	Population density, specimen/ ha	Conservation status*
<b>Amphibians (Amphibia)</b>			
Water frogs <i>Pelophylax esculentus</i> complex**	57	2,5-121,5	C
Green toad <i>Bufo viridis</i>	44	5,4-250,8	S
Moor frog <i>Rana arvalis</i>	32	11,6-43,6	C
Common toad <i>Bufo bufo</i>	18	5,4-65,8	C
Common frog <i>Rana temporaria</i>	15	12,3-56,6	C
Smooth newt <i>Lissotriton vulgaris</i>	13	3,1-14,0	R
Common spadefoot <i>Pelobates fuscus</i>	11	6,5-21,6	R
Fire-bellied toad <i>Bombina bombina</i>	6	11,2-15,2	L
Crested newt <i>Triturus cristatus</i>	4	15,5-21,7	L, RB
<b>Reptiles (Reptilia)</b>			
Sand lizard <i>Lacerta agilis</i>	27	3,5-142,8	C
Viviparous lizard <i>Zootoca vivipara</i>	24	6,7-32,8	C
Slow worm <i>Anguis fragilis</i>	11	11,1-33,6	R
Grass snake <i>Natrix natrix</i>	9	7,8-98,7	R
Common adder <i>Vipera berus</i>	8	11,3-45,8	R

\*S - synanthropus, common, in places a mass species, C - widespread, common species, R - sporadically occurring, rare species, L - locally occurring, endangered species, RB - included in the Red Book of the Republic of Belarus

\*\*Water frogs *Pelophylax esculentus* complex: march frog – *Pelophylax ridibundus* (Pallas, 1771), pool frog – *Pelophylax lessonae* (Camerano, 1882), edible frog – *Pelophylax esculentus* (Linnaeus, 1758)

– *Coronella austriaca* (Laurenti, 1768). All this species apart of European tree frog are rare and included in the Red Book of Belarus (Krasnaij kniga Respubliki Belarus 2015).

Smooth newt (*L. vulgaris*). It is a rare species of tailless amphibians on the territory of Minsk. Only several reproductive groups of up to 10-12 adults were recorded in water bodies in the spring during 10 last years. Typical summer habitats for smooth newt are moist, shaded forests having small ponds and swamps suitable for breeding (Table 2). The species occur mainly on the city outskirts. Smooth newt was recorded in the district of Malinovka, Sukharevo, Stepyanka and village of Drazhnya. The corpses of individuals that died under the wheels of cars were met on various roads. Smooth newt habits the Central Botanical Garden where it breeds, apparently, in very small depressions flooded with melt water.

*L. vulgaris* rarely occurs in the city mainly due to the lack of small ponds necessary for breeding. In some parks and wastelands, it successfully spawns even in small ponds. The larvae of this species were found in water bodies that dry up in summer, in this connection we assume that the successful breeding is not annual.

Crested newt (*T. cristatus*). Rare species, just some individuals were found in the last decades in Minsk. Only a few small, relatively stable population groups (places of finds) of crested newt are known. They occur in small bogs located in bushy lowlands (near the Drozdy reservoir, the villages of Drazhnya and Schomyslitsa). According to the results of spring estimating the number of breeding groups does not exceed 5-7 individuals. In the suburban areas this species also occurs extremely rare. The Crested newt is included in the Red Book of Belarus (IV category

Table 2. Amphibians and reptiles habitats structure in urbanized landscapes of the city of Minsk

Habitat	Frequency of species, %													
	<i>L.vulgaris</i>	<i>T.cristatus</i>	<i>B.bombina</i>	<i>P.fuscus</i>	<i>B.bufo</i>	<i>B.vireidis</i>	<i>R.temporaria</i>	<i>R.karvalis</i>	<i>Pelophylax esculentus</i> complex	<i>A.fragilis</i>	<i>L.agilis</i>	<i>Z.vivipara</i>	<i>N.matrix</i>	<i>V.berus</i>
<i>Natural slightly transformed</i>														
<b>Forest park</b>														
City parks and squares	23,1	25,0		27,3	22,2	11,4	20,0	18,7		27,3	11,1	20,8		
Forest parks	15,4			7,7	5,6	6,8	13,3	9,4		27,3	7,4	12,5		50,0
Forest belts				7,7	5,6	2,3		6,2		9,1	14,8	8,3	11,1	25,0
<b>Water</b>														
Riverbed of the Svisloch rive				7,7	5,6		6,7			22,8				
Old courses	15,4	25,0	50,0		11,2	11,4	13,3	9,4		15,8			33,3	
Canals of water system										7,0				
Lakes and reservoirs			33,3			11,4		6,3		12,3			22,2	
Ponds	30,8	25,0	16,7			4,6	6,7	15,6		21,1			22,2	
Water treatment facilities						2,3		3,1		5,3				
Quarries with water	7,7	25,0			11,2	4,6				3,5				
Marsh areas				7,7		6,8	13,3	3,1		5,3			11,1	12,5
Rain puddles						4,6				1,8				
<b>Open areas</b>														
Untilled meadows				15,4	16,7	11,4	6,7	12,5		1,8		4,2		
Wastelands				7,7	11,2	6,8	13,3	3,1			11,1	16,7		
<i>Artificial</i>														
<b>Urban habitats</b>														

Habitat	Frequency of species, %													
	<i>L.vulgaris</i>	<i>T.cristatus</i>	<i>B.bombina</i>	<i>P.fuscus</i>	<i>B.bufo</i>	<i>B.vitidis</i>	<i>R.tempora-ria</i>	<i>R.arvalis</i>	<i>Pelophylax esculentus</i> complex	<i>A.fragilis</i>	<i>L.agilis</i>	<i>Z.vivipara</i>	<i>N.natrix</i>	<i>V.berus</i>
Zones with detached houses and summer cottages	7,7				5,6	9,1	6,7	6,3	1,8	9,1	3,7	4,2		
Road sides						2,3		3,1		18,2	29,6	16,7		12,5
Railroad embankments										9,1	14,8	12,5		
Industrial plants area					5,6	4,6		3,1	1,8		3,7	4,2		
<b>Total</b>	<b>13</b>	<b>4</b>	<b>6</b>	<b>11</b>	<b>18</b>	<b>44</b>	<b>15</b>	<b>32</b>	<b>57</b>	<b>11</b>	<b>27</b>	<b>24</b>	<b>9</b>	<b>8</b>

of protection) (Krasnaja kniha Respubliki Belarus 2015). The abundance of *T. cristatus* has been decreasing everywhere in Belarus in recent decades (Drobenkov 2018).

Fire-bellied toad (*B. bombina*) Northeastern border of this species range passes through the territory of Minsk. Only 6 sites of fire-bellied toad have been recorded in the city over the last 10 years. It inhabits small stagnant bodies of water. In spring-summer period males make mating calls, which can be used to search habitats and to estimate the number of individuals in the population. *B. bombina* occur in different districts of the city, but mostly on the city outskirts (districts of Chizhovka, Shabany, village of Drazhnyja). According to our data since 1980 year till now, the number of fire-bellied toad has been decreasing. The reason of the population reduction is destruction and changes of water bodies (transformation into recreational areas). Until present, it had been occurred in the floodplain zone of the Svisloch River near the Minsk Zoo.

Common spadefoot (*P. fuscus*). It is a rare species of urban fauna. Common spadefoot (as well as water frogs) breeds in deeper water than other amphibians. In summer, it occurs on dry sandy soils in open habitats on wastelands, dry meadows or in agrocoenosis. Some individuals of common spadefoot were found in industrial zones, on the territories of factories, warehouses, heat power stations where small bodies of water are located. The corpses of the *P. fuscus* were spotted on the roads in various parts of the city during all season of activity. Common spadefoot can reproduce both in large reservoirs (Drozdy and Chizhovskoe) and in small ponds (Drazhnyja village, Malinovka, Slepjanka and Novinki districts). Small reproductive group was recorded near the coastal area of the lake in the Central Botanical Garden. During the spawning period *P. fuscus* can be well identified due to mating calls of males. Groups of young individuals were recorded in some districts of Minsk without permanent water bodies, which indicates the possibility of successful reproduction of this species in deep rain puddles.

Common toad (*B. bufo*). Widespread and relatively common species of urban herpetofauna. It is found mainly on the outskirts of the city and more often near large water bodies (Chizhovskoe reservoir, Drozdy reservoir, Cnyanskoe reservoir, Komsomolskoe Lake). In new districts of the city common toad often breeding in construction excavations filled with water. In spring, solitary individuals, amplexus pairs and small breeding aggregations were observed in the channel of the Slep'yanskaya Water System. During the first years of life growing individuals are settled far from water bodies, therefore this species is often found in parks and forest parks.

Common toad recorded in the detached houses area of Drazhnya village, Severny district, Novinki district. It often occurs in the courtyards, gardens and on the streets under streetlights. In water bodies with favorable conditions during the breeding season, small reproductive groups (numbering dozens of individuals) were observed, and later there were massive communities of larvae. The best-preserved terrestrial habitats are floodplain meadows, forest parks and lowlands overgrown with shrubs.

Green toad (*B. viridis*). It is the most adapted to urban conditions amphibians species. As well as water frogs, it is the most common species of urban herpetofauna. Green toad is synanthropic species, its abundance in urban landscapes often is higher than in natural landscapes. It inhabits a wide range of habitats, occurs not only in the peripheral and middle parts but also in some parks in the central part of the city. Small groups and single individuals were observed in zone of the detached houses, on vacant lots, in areas of the new estate and on the territory of industrial enterprises. In summer, at night, like common toads, they concentrate under streetlight, where hunt insects and other invertebrates. Several large groups of green toad were noted in the southwestern part of the city on vast areas of agro ecosystems. In such groups, there are more than several hundred individuals. One of such populations has survived in the Suharevo district in the Medvezhino forest park and in the nearest territory.

The adaptations of this species to the urban environment are based on a number of features – the ability to reproduce even in the smallest, ephemeral ponds, the shortest period of embryonic and larval development among amphibians, night activity, toxicity, etc. The population has been relatively stable over the past decades. The disappearance of some reproductive water bodies is compensated by the appearance of new ones, as well as the ability of the species to successfully reproduce in temporary ponds (rain puddles).

Natterjack toad (*E. calamita*). This species in the last decade has not been observed on the territory of Minsk. At the end of the last century natterjack toads was recorded in the northern part of the city, near Uruchie district, and in the Drazhnya village and district. There is data on surviving small populations of the species outside the Minsk Beltway in the area of the former military training ground in Kolodischi village and in the Shabany district. It allows to suggest that small groups of *E. calamita* can exist in the city as well. Natterjack toad is distributed in the southwestern part of the country, the border of area of species runs northeast to Minsk. The species included in the Red Book of Belarus in III category of protection (Krasnaja kniga Respubliki Belarus 2015).

Common frog (*R. temporaria*). Relatively usual species of urban herpetofauna. Common frog is less common than moor frog. *R. temporaria* inhabits mainly least urbanized peripheral zone of the city, the areas of new estate bordering with the green zone, as well as the forest parks and parks. It can breed successfully even in small bodies of water if the strong anthropogenic pressure is absent. Small groups of 5-12 pairs of spawning individuals are regularly found in different places of the Chizhovskoye and Drozdy reservoirs, in small ponds of the Slep'yanka district and other areas of the city. Common frog hibernates in weakly flowing or stagnant water bodies therefore it is less resistant to urbanization than the moor frog.

Moor frog (*R. arvalis*). The species is quite common amphibian in urban landscapes. It

occurs more often than common frog. Moor frog hibernates in terrestrial habitats, which gives to this species of amphibians some advantages in urban landscapes. It often lives together with ecologically similar species - *R. temporaria*. This species can inhabit city parks, forest parks, in the in the zone of the detached houses, on vacant lots, in farmland. Moor frog breeds in different water bodies, which are often very small (up to 15-20 m<sup>2</sup>).

Water frogs (*Pelophylax esculentus* complex). According to our data, water frogs are the most common amphibians in the city. There are three species of water frogs in the territory of the city: pool frog (*Pelophylax lessonae*), edible frog (*Pelophylax esculentus*) and marsh frog (*Pelophylax ridibundus*). Water frogs were found in Minsk in different types of water bodies, standing stagnant and flowing, large and very small. They were observed the Svisloch River (in its preserved floodplain ponds), in the canal of the Slepjanskaj Water system, in the reservoirs of Drozdy, Cnyanskoe, Chizhovskoe, in the ponds in the Loshitca Park. Water frogs also inhabit cooling ponds of thermal power plants and ponds of treatment facilities, in water bodies near industrial facilities. Because of their aquatic lifestyle, behavioral characteristics and tolerance to many pollutants water frogs are well adopted to urban conditions.

European pond turtle (*E. orbicularis*). Over the past decade, single findings of this species have been noted in the city. It was clearly animals that lived in captivity and then were released into environment. The modern distribution range of the European pond turtle covers the southern and southwestern part of Belarus and is located about 150-200 km from the Minsk city borders. Some individuals were found in certain reservoirs and canals of the Stepianskaja Water System, on the lake of the Central Botanical Garden, in the Chizhovskoe and Drozdy reservoirs. There is information about encounters of turtles far away from water bodies in yards, city parks. According to the external features (light color of the shell and skin), some of individuals were brought from other (southern) areas of the range. European

pond turtle is included in the Red Book of the Republic of Belarus (III category of protection) (Krasnaja kniga Respubliki Belarus, 2015).

Slow worm (*A. fragilis*). It is a rare species of herpetofauna of the city. Single individuals were registered in parks and forest parks, most of them located in the peripheral zone of the city. Slow worm was noted in forest parks of the Drazhnya district and village, the Severny district, in the Park Pobedy, in the forest park in the Stepianka district, in the Park «50-letija Oktjabria». About half of registered observations of *A. fragilis* are animals that died under wheels of vehicles. The only find in the central part of the city (in Gorky Park) is apparently explained by the release of lizards kept at a home terrarium.

Sand lizard (*L. agilis*). It is the most common species of the reptiles in the city. Sand lizards occurs on forest edges, meadow, under electric power lines in large city parks and forest parks, along roadsides and railroad slopes, on wastelands and farmlands. The largest number of these reptiles were registered in the southwestern and western parts of the city. Almost all of findings were in peripheral, least transformed part of the urban area. One of the most stable groups exists along the open strip of the Minsk Beltway. The number of lizards in local populations are usually up to 7-15 individuals.

Viviparous lizard (*Z. vivipara*). It is relatively common species of urban fauna. *Z. vivipara* occurs not so often as the sand lizard because it has less migration ability and specific ecological preferences. In comparison with *L. agilis*, it inhabits more shaded and humid habitats. Viviparous lizard was registered mostly in the territory of parks and forest park zones.

Grass snake (*N. natrix*). It regularly meets on the territory of Minsk. Recorded during last decade habitats of grass snake are located mainly near large water bodies. Some of the animals that were found in the city previously kept in captivity. Stable groups inhabit the coastal zone of the Drozdy, Cnyanskoe and Chizhovskoe reservoirs.

Smooth snake (*C. austriaca*). The species has not been registered in Minsk recently. The notes about registration of smooth snake are erroneous. The finds, judging by the photographs sent by the respondents, belong to the brown individuals of the common adder. *C. austriaca* is a rare species included in the Red Book of Belarus (category III), the distribution area covers the whole of Belarus (Krasnaja kniga Respubliki Belarus 2015).

Common adder (*V. berus*). Single individuals (both adults and young samples) were found in the forested area of the city that border on natural ecosystems of suburban areas. Common adder was sometimes observed in parks in the central part of the city and even in courtyards. This fact can be explained by the release of captive snakes.

### **Basic patterns of variability of urban herpetofauna**

The results of the study showed that amphibians and reptiles are quite rare animals in Minsk and are poorly adapted to conditions of drastically changed urban landscapes. The spatial distribution of herpetofauna in urban landscapes is characterized by extreme unevenness, owing to many reasons: preservation of natural or existence of transformed habitats, location of large industrial zones and districts with high-rise apartment building that are completely unsuitable for life, a dense network of roads and high traffic intensity, radical reconstruction of the water systems, and many other reasons.

Two main groups of urban habitats of amphibians and reptiles can be distinguished. The first one is weakly transformed natural habitats representing urban reserves for many species. The second group is artificial habitats which have completely different conditions and replace natural habitats during urbanization. The first group includes woodlands (forest-park zones, forest belts, and city parks), aquatic habitats (various water bodies and watercourses) and fragments of open landscapes (meadows, wastelands, agricultural fields). The second group consists of artificially created habitats and includes zones with detached

houses and summer cottages, strips along roadsides and railroad embankments, as well as the territory of industrial areas. The smallest number of species was noted in the central, most urbanized part of the city. The highest species diversity occurs in the peripheral landscape-recreational zone, adjacent to the green and suburban area.

The number of animals in local population groups of almost all species is extremely low and does not exceed several tens to hundreds of individuals. At the same time, the relative abundance (density) of populations of some species in favorable habitats can reach values that close to abundance in natural habitats. Populations of the green toad are characterized by the highest values of density, up to 250.8 specimens/ha, the water frogs up to 121.5 specimens/ha, and the sand lizard up to 142.8 specimens/ha. These species form very dense populations in some optimal places.

Water bodies required for the reproduction play the most important role for the existence of amphibians. Ecological features of the ponds (area, depth, flow rate, coastal structure, coastal vegetation as well as intensity of recreational use) have a significant impact on the reproductive success of amphibians. Structure of coastal zones determines not only conditions and efficiency of reproduction, but also hibernation conditions for species hibernating in water (*B. bombina*, *R. temporaria*, *P. ridibundus*, *P. lessonae*, *P. esculentus*). The largest number of co-breeding species (3-5) was noted in floodplain water bodies and artificial ponds.

Water bodies and woodland are the main reserves of amphibians and reptiles in the city, which allow them successfully survive in urban landscapes.

Several groups of species can be distinguished according to the reactions of amphibians and reptiles to the impact of different factors of urbanization: 1. synanthropic (common, in places numerous species, well adapted to urban conditions), 2. widespread, relatively common species, 3. sporadically occurring rare species with medium resistance to negative factors, 4.

locally occurring, with low tolerance, declining species.

The main factors limiting the distribution and number of amphibians in urban conditions are the lack of water bodies suitable for breeding, drainage and destruction of wet habitats, extermination by vehicles and people. For reptiles the main reasons for population decline are the destruction or gradual degradation of woodland habitats and extermination by people and domestic animals (mainly dogs).

The populations of amphibians and reptiles that have survived on the territory of Minsk exist just due to self-reproduction. The Minsk Beltway is characterized by heavy traffic and design features (highway embankment, 6-lane expressway) that prevents amphibians and reptile migration from neighboring suburban areas to the city. It is considered, that amphibians and reptiles belong to the assimilated species (Gladkov, Rustamov, 1975), which have lived on this territory before urbanization. A small number of individuals of some species can migrate to Minsk (sand and viviparous lizards) only along the railways.

The results of long-term observations of the state of the herpetofauna in the urbanized landscapes of Minsk indicate a gradual steady decline in the distribution and population size of almost all species of amphibians and reptiles. According to our data all reptiles, as well as the crested newt and the red-bellied toad suffer from anthropogenic pressure most of all. The urban populations of the green toad and water frogs (marsh frog, pool frog and edible frog) are fairly stable.

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## CONCLUSIONS

1. According to the data obtained the herpetofauna

of the Minsk city includes 11 species of amphibians and 5 species of reptiles. Various species are characterized by different occurrence, territorial distribution, abundance and conservation status. The most adapted to conditions of the urban environment are three species of water frogs *P. esculentus* complex, green toad (*B. viridis*), moor frog (*R. arvalis*), sand lizard (*L. agilis*) and the viviparous lizard (*Z. vivipara*).

2. There two main groups are distinguished among urban habitats - slightly changed natural (city reserves) and artificial (urban habitats). The first group consists of woodland habitats (forest park zones, forest belts, and city parks), aquatic habitats (different water bodies and watercourses) and fragments of open landscapes (meadows, wastelands, farmland). Urban habitats are formed in zones of detached houses and summer cottages, along railroad embankments and roads, in industrial zones.

3. The main limiting factor that determines the species diversity and abundance of amphibians in the city is the sufficiency and diversity of water bodies, where the conditions for reproduction have been preserved. The state of reptile populations is determined mainly by the preservation of large poorly transformed forest areas. The analysis of changes in the herpetofauna in the urbanized landscapes of Minsk over several decades detected a gradual decline in distribution and size of populations almost all species of amphibians and reptiles.

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