

THE FIRST RECORDS AND THE PRESENT DISTRIBUTION OF THE GRASS SNAKE, *NATRIX NATRIX* (SQAMATA: SERPENTES: COLUBRIDAE), IN THE SOUTHERN POINT OF LATVIA (DAUGAVPILS DISTRICT, SOUTH-EASTERN LATVIA) AS THE PROBABLE EFFECT OF THE CLIMATE CHANGE IN THE REGION

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The research of the *Natrix natrix* distribution in the Daugavpils district is being carried out since 1985. The methods of the study were the visual inspection, recording on the roads, interviewing of the local population and a visual inspection of the reported points. As a result of the conducted research, *Natrix natrix* was for the first time registered in nature in the Daugavpils district, south-eastern Latvia in 2002. During the research, we totally registered 22 points of finding *N. natrix* in this territory, also very close to the borders with Lithuania and Belarus. *N. natrix* was found here in a variety of the habitats: on mixed forests, near the water basins, in the meadows, in the gardens, in the settlements. It is difficult to state the real reasons for the emergence and rapid spread of *N. natrix* in the surveyed region. However, because of the insignificant changes in the ecosystems in the protected Silene Nature Park, one can assume that the main factor contributing to the progressive spread of *N. natrix* in the Daugavpils region and in the South-Eastern part of Latvia, is the climate warming in the region.

Key words: Colubridae, *Natrix natrix*, distribution, climate change, Latvia, population

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INTRODUCTION

The spread of the poikilothermic species in the northern part of their area of distribution depends on various factors, but, above all, it depends on the climate conditions. The species of herpetofauna inhabiting Latvia, belong to such animals. The influence of the cold climate on reptiles, in

comparison with the central regions of their habitat, is manifested here both directly: a longer incubation period of eggs (Mitrus & Zemanek 1998); longer development of juveniles; later attainment of puberty (Meeske 2006, Meeske et al. 2006) increased overwintering mortality; and through influencing the ecosystem on the whole: other species constituting the ecosystem – other

kinds of feed, other predators, competitors and parasites.

The land relief, affecting the local microclimate optimality, leads to the disruptiveness and to the mosaic structures of the area of distribution of the species of herpetofauna in the north (Pupins & Pupina 2008a, 2008b).

The Grass Snake *Natrix natrix* (Linnaeus, 1758) inhabits Latvia in the northern part of its European area of distribution (Terentyev & Chernov 1949, Bannikov et al. 1977). The population of *Natrix natrix* in Latvia belongs probably to 8 mitochondrial lineage of *Natrix natrix* in the Baltic region, and its putative immigration routes are leading here from more southern territories of modern Belarus and Ukraine (Kindler et al. 2014).

Despite the fact that its area of distribution includes the whole territory of Latvia (Terentyev & Chernov 1949, Bannikov et al. 1977, Caune 1992), *Natrix natrix* is unevenly distributed here having not been registered approximately on

third part of the area of Latvia (Fig. 1) (Čeirāns 2006). Despite the historical facts on its most presence in south of Latvia (Silins & Lamsters 1934) *Natrix natrix* was not registered in the very south of Latvia – in its south-eastern part – in the south of the Daugavpils district. The reason for this is the fact that the regional abundance of *Natrix natrix* in Latvia is mostly determined by the climate factor; the species is common here only in the lowlands, where winters are milder (Čeirāns 2006).

The research on long-term changes in the distribution of reptiles in the north of their European habitat may be useful both for a better understanding of the peculiarities of the ecology and evolution of the reptiles on the northern border of its distribution and the influence of the climate change (Henle et al. 2008) in the Baltic region on native ecosystems, and for the protection of the reptiles in the Baltic region. But the distribution maps are ephemeral products in constant need for updating (Sillero et al. 2014). It is known, that “...the principle response of

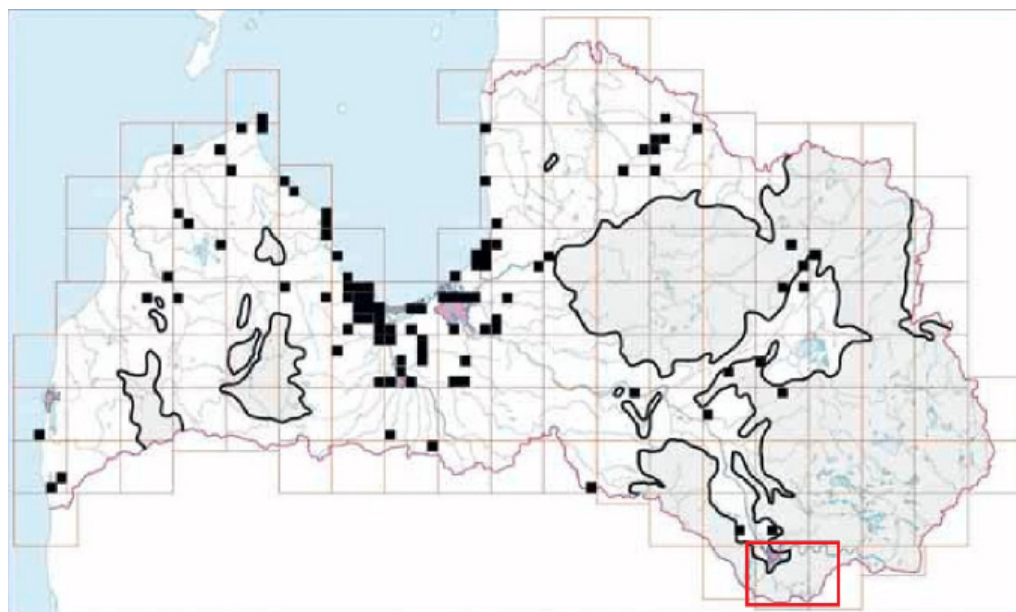


Fig. 1. The distribution of *Natrix natrix* in 1990 – 2004 (solid squares), and the area above 100 m isobar (pale). (Čeirāns 2006). The region examined in our research is in the red frame – *Natrix natrix* has not been registered here.

species to climate change is a spatial response. Their geographical range changes as the area shifts in which their climatic tolerances and/or requirements are met” (Walther et al. 2002, cited in Henle et al. 2008).

It makes the research on the changes in the distribution of *Natrix natrix* in the extreme southern point of Latvia, namely, in the south of the Daugavpils district, current.

MATERIAL AND METHODS

The registration of findings and the research on the distribution of *Natrix natrix* in south-eastern Latvia were carried out as part of the examination and monitoring of the ecosystem of our target species *Bombina bombina* and *Emys orbicularis*. We have started to examine the occurrence of *Natrix natrix* in the Daugavpils district since 1983 when we noted the absence of *Natrix natrix* in the Silene Nature Park. The South of Daugavpils district, including the territory of Daugavpils city, is the territory examined during the present research. Daugavpils city and the Daugavpils district: Dēmenes parish, Kalkūnes parish, Medumu parish, Skrudalienas parish, Sventes parish were thoroughly examined in field expeditions as the territories of the target species *Bombina bombina* and *Emys orbicularis*. A part of the research was carried out during the monitoring of the results of the project LIFE-HerpetoLatvia. The monitoring is still ongoing.

In field studies, having caught and registered the first *Natrix natrix*, any further target catching was stooped. In some cases, a specimen and biotope were photodocumented. *Natrix natrix* which had been caught at the request of residents in their homes and gardens were kept in a terrarium for 2-3 days at the temperature of 25-27°C, feeding them with live fish kept in aquaculture; subsequently, *Natrix natrix* were released into the sites wherein they had been previously registered.

During the research, we used the following methods of detecting the presence of *Natrix natrix*:

1. A visual registration in natural biotopes. The research was carried out during the spring and summer season, during daylight hours when it was warm and sunny. A researcher moved along the route which had been mapped in accordance with the research objectives to find the places of possible habitat of *Natrix natrix*. A special attention was devoted to the outer woods, southern slopes of hills and ravines, brush piles, driftwood, banks of ponds, headlands. Usually, such a registration was combined with other herpetological studies in target species *Bombina bombina* and *Emys orbicularis*. The researcher registered the encountered specimens of *Natrix natrix* and their discarded skin, as well as searched for traces on the ground whenever possible.

2. The registration on the roads. The researcher drove a car at a speed of 30-40 km per hour on the roads in the places of possible habitat of *Natrix natrix*. We registered both alive and dead specimens found on the roads.

3. The interviewing of local people and subsequent examination. We have been informing the local people for many years about the fact that they may ask us for help if they ever encounter any snake on their land property, in a populated locality or building. Having received such a report, within half an hour we went to the place for an examination, caught a snake and identified to which species it belonged. If it was *Natrix natrix*, the point of finding was being registered.

4. Face-to-face interviewing of biologists. The interviewing was conducted within the period from 1990 to 2015, having met respondents in person. The respondents were asked question regarding the findings of *Natrix natrix* in south-east Latvia. Positive reports were checked in field studies.

While processing the acquired data, we recorded the coordinates of a finding with the help of the Magellan GPS receiver and the Google Earth services. The place of the finding was given a name based on the name of the nearest populated locality or natural object (a pond, wood). The

findings located at a distance of not less than 200 m from each other were usually consider as one point. While drawing a map, a circle 1 km in diameter in the map scale with a center designating the point of the finding was drawn for each finding. It allowed us to take into account the possible migration and settlement of *Natrix natrix* in the area.

RESULTS

The distribution of *Natrix natrix* in the Daugavpils district. While interviewing the biologists who

had been conducting field practice for the students-biologists of Daugavpils University in Ilgas, the Daugavpils district, for many decades, it was confirmed that *Natrix natrix* had previously never been encountered (Ģ.Kasparsons, pers. comm.).

As a result of the conducted research, *Natrix natrix* (Fig. 2) was for the first time registered in nature in the Daugavpils district, south-eastern Latvia in 2002. During the research, we totally registered 22 points of finding *Natrix natrix* in this territory (Tab. 1).



Fig. 2. Adult *Natrix natrix* encountered in Kalkunes parish, Daugavpils district, south-eastern Latvia.

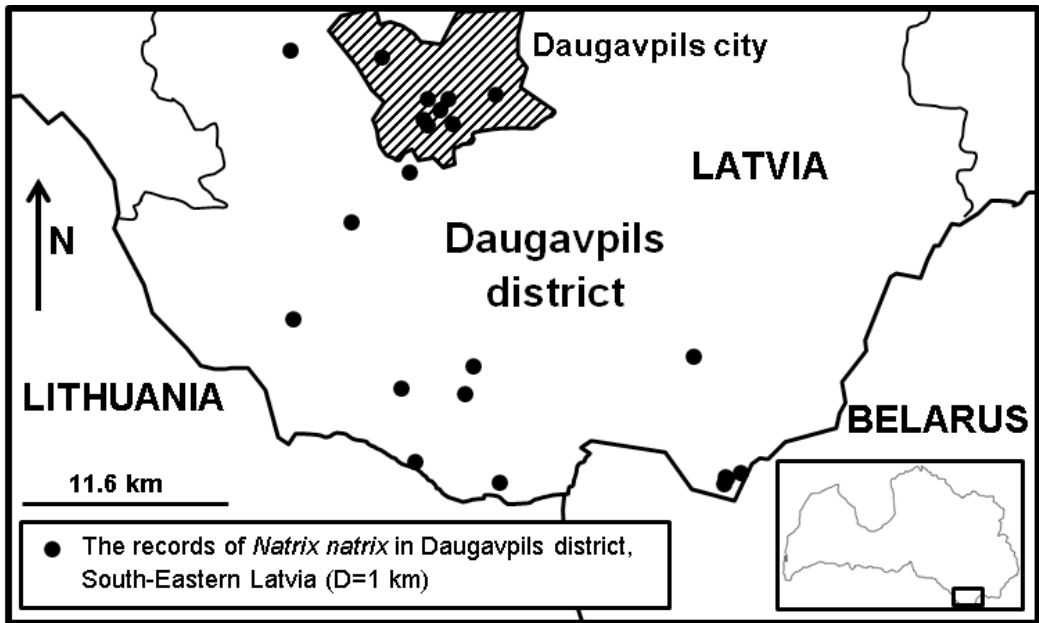


Fig. 3. The distribution of *Natrix natrix* in the Daugavpils district, south-eastern Latvia.

Tab. 1. The records of *Natrix natrix* in the Daugavpils district, south-eastern Latvia.

Registration Number	Year of registration	Place	Coordinate N	Coordinate E
1.	2002	Kalkune	55°50'23.08"N	26°29'40.47"E
2.	2006	Medumi	55°45'57.94"N	26°23'32.79"E
3.	2007	Brigene	55°44'35.87"N	26°32'59.91"E
4.	2007	Daugavpils	55°51'46.21"N	26°30'34.25"E
5.	2007	Daugavpils	55°52'32.74"N	26°34'13.48"E
6.	2008	Ilgas	55°41'25.56"N	26°47'14.98"E
7.	2008	Daugavpils	55°52'29.47"N	26°31'39.61"E
8.	2008	Daugavpils	55°51'49.65"N	26°30'31.79"E
9.	2009	Demene	55°43'46.57"N	26°32'37.34"E
10.	2009	Kimbartiske	55°41'43.53"N	26°30'1.60"E
11.	2009	Kuhalski	55°43'53.45"N	26°29'17.79"E
12.	2009	Birkineli	55°48'53.28"N	26°26'31.82"E
13.	2010	Daugavpils	55°52'17.43"N	26°31'21.02"E
14.	2011	Sengeida	55°44'47.55"N	26°44'26.48"E
15.	2011	Daugavpils	55°51'46.67"N	26°32'3.97"E
16.	2011	Svente	55°53'57.17"N	26°23'10.24"E
17.	2012	Skirna	55°41'12.61"N	26°34'21.07"E
18.	2012	Daugavpils	55°53'48.87"N	26°28'10.15"E
19.	2013	Ilgas	55°41'26.45"N	26°47'18.53"E
20.	2013	Daugavpils	55°52'27.50"N	26°30'37.99"E
21.	2014	Ilgas	55°41'8.60"N	26°46'55.95"E
22.	2014	Ilgas	55°41'4.43"N	26°46'18.29"E

The points of finding *Natrix natrix*, registered by us in the Daugavpils district, are mostly located in its central and southern part (Fig. 3). The extreme northern points of finding *Natrix natrix* detected by us in the Daugavpils district are located in the city and not far from it, the extreme southern points are located right on the border with Belarus and Lithuania, and at a distance not farther than 2 km from these borders.

Habitats. In this research, the typical natural habitats of *Natrix natrix* which are explored by it while spreading in the Daugavpils district are wet meadows overgrown by shrubs, the outer woods, banks of ponds overgrown by cane (Fig. 4). The rare and protected species of Latvian

herpetofauna such as *Triturus cristatus*, *Bombina bombina*, *Pelobates fuscus*, *Lacerta agilis*, *Emys orbicularis* already inhabited the same territories in many cases.

Natrix natrix has spread in the protected natural territories Natura 2000 in the Daugavpils district: landscape park "Augszeme", the Silene Nature Park and microreserve "Ilgas", microreserve "Katriniski".

In many cases, *Natrix natrix* was also registered in highly urbanized biotopes such as vegetable gardens, yards, courtyards of the city and even buildings and flats, including on the second floor of a building located in the city centre.

Vitality. All *Natrix natrix*, caught at the request of residents in the urbanized territories and kept in a terrarium for a couple of days, tried to escape by moving quickly; they actively fed on live fish from aquaculture. When released into nature, they quickly concealed in the grass and bushes, thus testifying to their satisfactory vitality.

Road mortality. During the research, we have registered *Natrix natrix* mortality on the roads in the Daugavpils district (Fig. 5). Of course, it was very difficult to detect and register the dead specimens of *Natrix natrix* during the present research because they are quickly found and eaten by predators running across the roads.

Interviewing and “snake” folklore. While surveying local people, we found out that *Natrix natrix* had previously never been found in the Daugavpils district which was confirmed by the residents; however, it has appeared here in recent years. Trying to explain such an unexpected appearance of *Natrix natrix*, the local people of village Demene wherein *Natrix natrix* has become numerous in recent years told us a local legend. The legend says that a local farmer made

a favour to a wanderer-sorcerer 50 years ago and asked him to make snakes vanish from Demene. The sorcerer promised that there would not be any snake in Demene. That is why there were never snakes, including *Natrix natrix* in Demene. This period ended in 2000, as a result the snakes made their way to Demene.

A negative attitude and aggression of local people. While conducting interviews and checking reports received from local people, we found out that their attitude towards snakes, including *Natrix natrix* is extremely negative, as well as they do not distinguish this species from the only snake which is dangerous in Latvia, namely, *Vipera berus*.

That is why in most cases known to us, the local people who had found *Natrix natrix* on their land property, in a courtyard, city, garden or flat, killed snakes if they managed to do it. We also found out that the residents always kill a found snake even when they know it is non-venomous *Natrix natrix*. In addition to the above, the people used not only some random tools such as shovels and rakes but they purposefully made deadly traps



Fig. 4. *Natrix natrix* appeared in the biotope of *Castor fiber* in Microreserve Ilgas Natura 2000, Daugavpils district. *Natrix natrix* uses the building of *Castor fiber* for sun-basking, shedding of the skin, and as a shelter. The protected species of herpetofauna such as *Triturus cristatus*, *Bombina bombina*, *Pelobates fuscus*, *Lacerta agilis*, and *Emys orbicularis* (released in wild in 2014 by project LIFE-HerpetoLatvia) live here. The forest seen on the horizon is already located in Belarus.

aimed at killing *Natrix natrix*: pieces of cardboard smeared with glue intended for catching rodents. Not less than 8 snakes have been killed with the help of such a method in the premises of a shop located in Demene during one season (Fig. 6).

DISCUSSION

In this study, the findings of *Natrix natrix* were registered for the first time, as well as the further spread of this species was recorded in the most southern part of Latvia, i.e. in the Daugavpils district, south-eastern Latvia. *Natrix natrix* has not been previously encountered here neither by us nor other biologists or local people for some decades.

What was the reason for the fact that *Natrix natrix* had previously not inhabited this most southern part of Latvia? Is it possible that some kind of barriers did not allow them to spread here from neighbouring territories? Apparently not, because this territory is connected with the surrounding territories by very diverse biotopes, including the ones urbanized to varying degree: mixed woods and pine forests, meadows, shrubbery, swamp lands, a large number of various water bodies, fields and meadows which are suitable for the habitat of *Natrix natrix*. The Daugavpils district is immediately adjacent to the borders with more

southern Belarus and Lithuania wherein *Natrix natrix* is spread and registered nearby (Fig. 7.) (Gasc et al. 1997). The only possible barrier, namely, the large river Daugava could not be the reason for the absence of *Natrix natrix* in the Daugavpils district because they inhabit both its banks in the other territories of Latvia and Belarus.

Therefore, in these circumstances, the most probable reason preventing *Natrix natrix* from the colonization of the south-eastern part of Latvia and its most southern part, namely, the Daugavpils district, is climate patterns which are the result of both its location and relief. Thus, A.Čeirāns (2006) having examined the distribution of *Natrix natrix* states that "... *Natrix natrix*, which is more abundant in areas with mild winters, is restricted in elevation in Latvia to areas below the 100 m isobar (Fig. 1), with only few records at elevations about 120 m a.s.l. This species is relatively common only in areas below 50 m." Indeed, the Daugavpils district is located in the area above 100 m isobar, and *Natrix natrix* have not been encountered here before.



Fig. 5. A dead adult *Natrix natrix* on a low-traffic road in Medumi, Daugavpils district.



Fig. 6. A deadly trap purposefully made for *Natrix natrix* by Latvian inhabitants. This is a dead young adult of *Natrix natrix* glued to a piece of cardboard purposefully smeared with rodent-catching glue for killing *Natrix natrix*. The premises of the shop located in Demene, Daugavpils district.

Along with this, A.Čeirāns (2006) further notes that what concerns *Natrix natrix*, "... Hence, local factors such as prey abundance, presence of suitable egg-laying and wintering sites, opography, etc. could be more important than broad habitat types like in the present [Čeirāns 2006] survey."

However, despite the fact that there was a decline in agricultural production and significant reduction of the area of the land under cultivation which have turned into meadows overgrown by shrubs in the Daugavpils district after the collapse of the Soviet Union and can make the habitats more optimal for *Natrix natrix* (Ceirans 2007), these changes were insignificant in the Silene Nature Park having been a protected territory since 1977 and bordering directly with more southern Belarus.

Along with this, the average annual air temperature and the amount of precipitation have been exhibiting a strongly pronounced

upward trend in Latvia (Fig. 8), including in the Daugavpils district since the 1950s (Latvijas...).

Henle et al. (2008) rightly claims that the "climate change factors may include micro-climatic effects: though the 'gross climate' changes will affect the 'climate space', impacts may largely occur at the micro-climate level".

Thus, based on the above-mentioned, we suppose that the main factor having influenced the occurrence and further spread of *Natrix natrix* in the most southern part of Latvia, namely, the Daugavpils district, is the climate change in the region.

Proposed recommended actions for conservation of reptiles and amphibians in a climate change conditions are facilitate in-situ adaptation and natural range shifts by redoubling efforts to maintain or restore large intact habitats and large-scale connectivity (Henle et al. 2008).

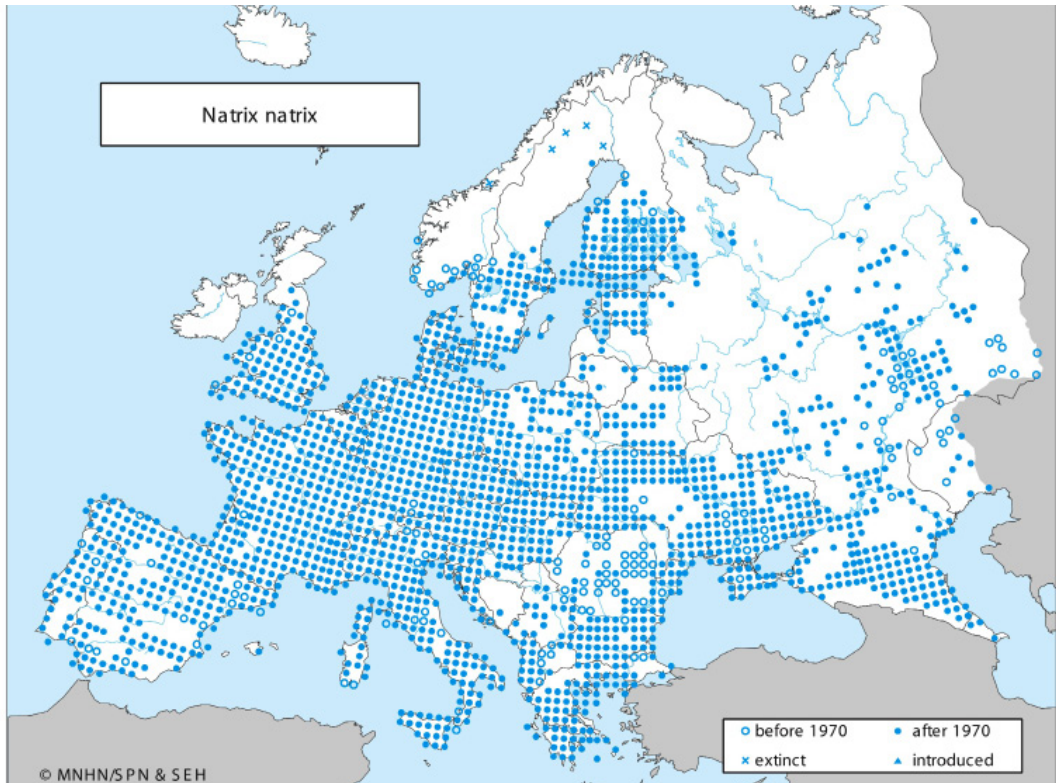


Fig. 7. The distribution of *Natrix natrix* in Europe (Gasc et al. 1997).

CONCLUSIONS

In this research, *Natrix natrix* was for the first time registered in the most southern part of Latvia, namely, the Daugavpils district, and its further spread was stated here. From our point of view, the most likely reason for this is the climate change in the region.

In the region, the climate warming may positively influence the spread of *Natrix natrix* and increase in the number of its population, as well as lead to the defragmentation of the range on the thermally determined borders of the distribution of *Natrix natrix* in Latvia in the north of its distribution.

Natrix natrix is capable of existing in urbanized territories, inhabiting headlands, urban wastelands, yards and vegetable gardens in the south of Latvia.

In the Daugavpils district, herpetofauna of the protected territories Nature 2000 such as "Augszeme", Silene Nature Park, Microreserve "Ilgas", Microreserve "Katrīniski", and probably "Augsdaugava" (the closest finding of *Natrix natrix* is located at a distance of 4 km from the border of this protected territory) now includes

a new species, namely, *Natrix natrix* in these territories.

Due to the fact that the rare and protected species of herpetofauna such as *Triturus cristatus*, *Bombina bombina*, *Pelobates fuscus*, *Lacerta agilis*, and *Emys orbicularis* inhabit these protected territories, it is necessary to research *Natrix natrix* role as a new predator, food competitor and possible vector of the transfer of parasites in the ecosystems of these protected territories, especially those ones which have been created for the purpose of preservation of the species of herpetofauna.

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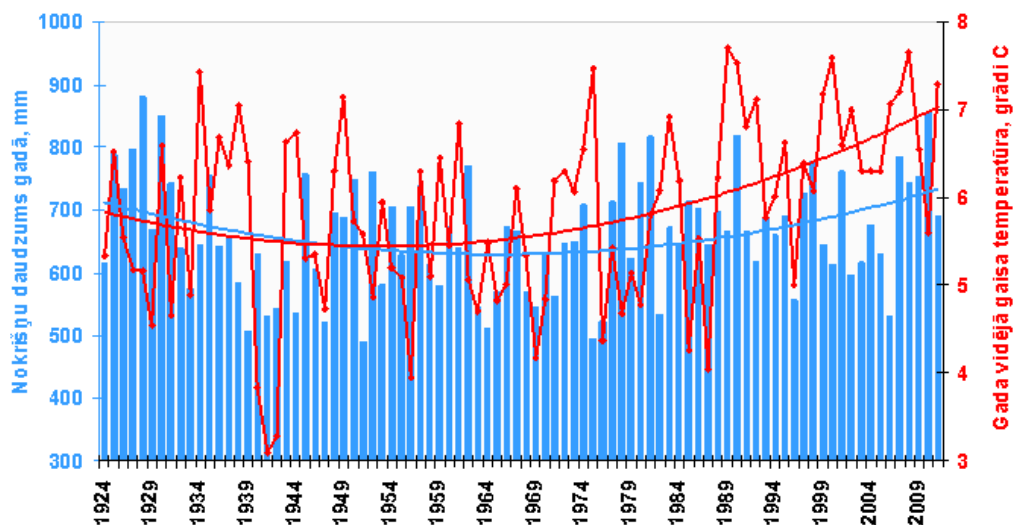


Fig. 8. The changes in the average annual air temperature (in red) and the amount of precipitation (in blue) in Latvia (Latvijas...).

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