Reptiles and amphibians of the Gauja National Park, Latvia

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Abstract
An inventory of the herpetofauna of the Gauja National Park, located in the north-central part of Latvia, was carried out in 1999-2000. Its objectives were to determine species composition, status, and habitat preferences. The main attention was focussed on reptiles. Data were collected along transects located throughout the territory of the Park. The total length of transects was 166.2 km, and numerous separate observations of various species were also recorded. Common and widespread species were Lacerta vivipara, Bufo bufo, Rana temporaria, and Rana synklepton esculenta. Anguis fragilis was found mostly in a dry pine, pine-spruce forest on the terrace of the ancient valley of Gauja River. A large population of Natrix natrix was found in the southern part of the Park in deciduous and coniferous forests. A few populations of Lacerta agilis were found in dry pine forests, and on the banks of the Gauja River. Rana arvalia was a rare species, more frequently found in high moors. There were also several records of Triturus cristatus and T. vulgaris in the Gauja National Park. The required conservation activities are discussed.

Key words: reptiles, amphibians, habitats, Gauja National Park, Latvia

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INTRODUCTION

Gauja National Park is located in the north-central part of Latvia, about 35 km north-west of Rîga. The Park was established in 1973, and it was then the second National Park in the territory of the former USSR. The area of the Park is 91,745 ha; forest occupies 48,592 ha (Pilâts 2000). The area is dissected by the ancient valley of the Gauja River, together with valleys of its numerous tributaries and side ravines. Gauja National Park is one of the florally richest regions in Latvia, with a high diversity of forests. The largest proportion of old broad-leaved forests in Latvia is found near the town of Sigulda (Pilâts 2000). However, boreal coniferous forests dominate the Park. The largest high moor is Sudas-Zviedru mire (2575 ha), found in the southern part of Gauja National Park. There are also several smaller mires in the central and northern parts of the Park. Agricultural landscapes, although occupying a large part of the Park, are fragmented by many forest stands, shrubs, and fallow lands that serve as refuges for wild animals. Gauja National Park also includes many historically significant objects and popular tourist sites.

The present survey is part of a large-scale inventory of flora, fauna and habitats of Gauja National Park carried out in 1999 and 2000. The aim of the inventory of herpetofauna was to determine the species composition and status of reptile and amphibian species, and to describe their habitats in the Park. The main attention was focussed on reptiles, because studies of these animals in Latvia have been very few and since information on their preferred habitats is limited.

METHODS

Data was collected mainly on transects in the field seasons of 1999 (from 06.08. to 08.09.) and 2000 (from 17.04. to 14.07). The total length of transects was 166.2 km. Censuses were carried out in all of the main habitat groups of the Park (Table 1). The type of habitat was determined from short descriptions made in the field. This information was supplemented by data from forest plans of the State Forest Service. The syntaxonomical classification of Latvian forests has not yet been fully developed (Priedîtis 1999), and is therefore supplemented (Table 1) by the forest stand classification applied in the forestry industry (Bu_s 1997). The transects were evenly distributed throughout the area. Therefore, the transect length for a particular habitat is roughly proportional to the area that the habitat occupies in the Park. An exception was agricultural landscapes, which were considerably less represented in transects (31.0 % of total transect length in comparison to 45 % coverage in the Park).

The routes were carried out in warm and dry weather, as the main attention was focussed on reptiles. Each observation of a reptile or amphibian was mapped at a 1:50.000 scale. For every reptile specimen observed, a brief description of the site was made, and in most cases it was supplemented later with information from the data base of the State Forest Service. Transects were located mostly along sites with potentially highest reptile density (roadsides, fringes, cuttings, clearings etc.), and extrapolation of this data to the whole habitat could provide misleading results. Densities were used only for *Anguis fragilis* and *Lacerta vivipara* for comparing various habitats. To describe the occurrence of the Common Lizard *Lacerta vivipara* in habitats, two parameters were used: the number of the individuals and the number of records. As the movement range for *Lacerta vivipara* is up to 80 m (Zamolodchikov, Avilova 1989), two records were considered to be separate if

Table 1: Transect length of different habitats of the Gauja National Park
Plant communities after Priedîtis 1999* and Kabucis 2000**, forest types after Buđs 1997.

Habitat	Plant community	Forest type	Transect length, km (%)
Dry pine forests on poor sandy soil	Cladonio-Pinetum,Vaccinio vitis-idaeae-Pinetum*	Cladinoso-callunosa, Vaccinosa	2.8 (1.7)
Dry mesotrophic pine and pine-spruce forests	Vaccinio myrtilli-Pinetum, several types not classified yet*	Myrtillosa, Hylocomiosa	78.1 (47.0)
Dry mesotrophic spruce forests	Oxalido-Piceetum excelsae*	Oxalidosa	9.3 (5.6)
Moist eutrophic broad-leaved forests	Querco-Tilietum*	Aegopodiosa	2.3 (1.4)
High moors with pine and pine forests on wet peat	Sphagnion magellanici**,Vaccinio uliginosi-Pinetum*	moor, Sphagnosa, Caricoso-phragmitosa	8.4 (5.1)
Degraded high moors and pine forests on drained peat	not classified yet*	Callunosa turf. mel., Vaccinosa turf. mel.	1.7 (1.0)
Other wet forest types		Myrtilloso-sphagnosa, Dryopterioso-caricosa	1.1 (0.7)
Edges of dry pine, pine-spruce forests		Myrtillosa, Hylocomiosa	7.5 (4.5)
Edges of dry spruce and leaf tree forests		Oxalidosa, Aegopodiosa	3.4 (2.0)
Agricultural landscapes, meadows and shrubs			51.6 (31.0)
Total			166.2 (100.0)

the distance between individuals was more than 100 meters. This served to reduce the effect of occasional observations of a large number of individuals at the same site due to higher activity in optimal weather conditions or better visibility for the observer. Juveniles were excluded from these data. In the analysis of dominant tree species in habitats, data acquired from transect censuses were supplemented with descriptions of twelve locations where the tree species were observed outside transects.

For amphibians, the type of habitat was determined later from State Forest Service forest plans and its data base. Amphibians along transects were not counted, and densities were not calculated in cases when numerous individuals were observed. The transect method was not applied for the recording of newts, and information on these animals was collected occasionally.

Species distribution maps were prepared using the Baltic Co-ordinate System, Transverse Mercator Projection (TM-1993). The number of 1x1 km squares of this Co-ordinate System, in which species were observed, was used to estimate the occurrence of various species in the Gauja National Park. A total of 269 or 27.5 % of all 1x1 km squares of the Park were visited in the survey. The number of the squares is not necessary identical to the number of locations indicated for species in the results, as several locations in the same square are possible.

RESULTS

Six reptile and five amphibian species were found during the survey. At least one species was observed in 201 or 74.7 % of the visited 1x1 km squares. Observation frequency for the various species is shown in Table 2.

Reptiles

The Sand Lizard *Lacerta agilis* was found in 2 areas: dry pine *Pinus sylvestris* forest

Table 2: Occurrence of reptiles and amphibians in 1x1 km squares of the Baltic Co-ordinate System that were crossed by transects in the Gauja National Park

Species	No. of squares	% of visited squares
Reptiles		
Lacerta agilis	6	2.2
Lacerta vivipara	59	21.9
Anguis fragilis	8	3.0
Natrix natrix	9	3.3
Vipera berus	1	0.4
Amphibians		
Triturus cristatus	1	0.4
Triturus vulgaris	1	0.4
Bufo bufo	91	33.8
Rana arvalis	8	3.0
Rana temporaria	133	49.4
Rana synklepton *esculenta*	40	14.9

in the south-western part of the Park (2 locations), and banks and terraces of the river Gauja and smaller tributaries in the central part of the Park (5 locations).

The habitats of Lacerta agilis can be grouped in two types:

1. low and sparse *Pinus sylvestris* growing (sometimes mixed with birch Betula spp. and spruce *Picea abies*) on dry sand, with a tree height of 2-7 m and canopy cover of 10-30 %; herb layer dominated by grasses (*Poa, Festuca, Calamagrostis*) and, in some cases, with horsetail (*Equisetum*); herb cover of 10-50%; habitat found on the banks of the river and in some disturbed habitats (such as old sand quarries) on terrace (5 locations);
2. fringes of dry and tall pine forest (*Vaccinio vitis-idaeae - Pinetum, Vaccinio myrtilli - Pinetum* associations) on sandy soil on terrace (2 locations).

The Common Lizard *Lacerta vivipara* was more or less evenly distributed throughout the territory of the Gauja National Park. This species was observed in most of the habitats, except some types of forest. The highest density was in high moors and wet pine forests on peat, especially in drained sites, and along the fringes of various dry forests (Table 3). The dominant tree species in *Lacerta vivipara* wet forest habitats usually was pine *Pinus sylvestris,* while deciduous trees (*Betula spp., Populus tremula, Quercus robur, Tilia cordata*) were characteristic of open habitats with separate trees or small groups of trees, such as in open agricultural landscapes.

Lacerta vivipara preferred forest habitats, especially mature dry forest, where it was observed exclusively on relatively open sites such as forest clearcuts, grassy roadsides, banks, fringes and sites with large gaps in the forest canopy.

The Slow Worm *Anguis fragilis* was found rarely, in upland pine dominated forest areas in the whole territory, and only in dry forest types. Specimens were usually observed on or near paths. Two

Table 3: Occurrence of Lacerta vivipara on transects in various habitats.
Only the habitats where species were found are included in the list. The first value indicates the number of observations, the second - density of findings. For the transect length in the habitat see Table 1. Separate observations that were made outside the transects are not included.

Habitat	Records	Individuals
Dry mesotrophic pine and pine-spruce forests	12/0.15	15/0.19
High moors with pine and pine forests on wet peat	5/0.60	5/0.60
Degraded high moors and pine forests on drained peat	3/1.79	8/4.71
Fringes of dry pine, pine-spruce forests	5/0.67	5/0.67
Fringes of dry spruce and leaf tree forests	2/0.59	2/0.59
Agricultural landscapes, meadows and shrubs	15/0.29	17/0.33

locations (or 0.71 records/km) were in pine forest on poor sandy soil (association *Vaccinio vitis-idaeae - Pinetum*), and seven locations (0.09 records/km) in pine and pine-spruce forest on mesotrophic soil. *Pinus sylvestris* was the dominant tree species in all locations.
The Grass Snake *Natrix natrix* was regularly observed in the south-western part of the Park, particularly near Sigulda. The species inhabited the following habitats: young and patchy *Alnus incana* and *Betula* stands and meadows with pools located on the bed of the ancient Gauja river valley (5 locations), old broad-leaved forests with *Fraxinus excelsior, Quercus robur,* and *Ulmus glabra* on the slopes of the valley (association *Querco-Tilietum,* 2 locations), and dry mesotrophic pine and pine-spruce forests on terraces of the valley (4 locations). In forest habitats, it was usually found in habitat edges and roadsides.
There were also some records of *Natrix natrix* in 1985-1987 from other parts of the Park, mostly along the Gauja River (Z. Bru_eniece, unpublished Bachelor's thesis).
The Adder *Vipera berus* was found in only two locations during the survey. The first was on the edge of a clay quarry with young and sparse *Betula* and *Picea abies,* with *Calluna vulgaris* in the ground cover. This site was located on a slope with western exposure, within dry mesotrophic pine and spruce forests in the northern part of the Park. The other observation of *Vipera berus* was made about 500 m outside the eastern border of the Park, on the grassy railway embankment near a young *Betula-Salix-Alnus incana* stand in a hilly landscape.
Vipera berus is also present in the north-eastern part of Sudas-Zviedru mire (observed by M. Deičmane); however, the species was not detected there during the transect counts.

Amphibians
Two species were common on transects, and were found in various habitats throughout the entire territory of the Park - the Common Toad *Bufo bufo* and the Common Frog *Rana temporaria. Rana temporaria* was the dominant species in all natural habitats, except for the Sudas-Zviedru high moor and sometimes also the broad-leaved forests on the slopes of the Gauja River valley. *Bufo bufo* were fewer in number than *Rana temporaria* in all dry forest habitats, with the exception of a few cases in broad-leaved forest on valley slopes (association *Querco-Tilietum*). This species was infrequent on high moors and in wet pine forests on peat. Both *Bufo bufo* and *Rana temporaria* were relatively common on agricultural landscapes, especial-

ly *Bufo bufo,* which was a usual inhabitant of the local villages. Both species were absent in the driest fragments of pine forests on sandy soil (association *Cladinio-Pinetum*).

Green frogs Rana synklepton esculenta were common in aquatic and semi-aquatic habitats in forest and agricultural landscapes, especially wet habitats with many pools. Green frogs were usual inhabitants of ponds on agricultural farms. Most of the examined individuals belonged to the Pool Frog *Rana lessonae;* a few specimens of the Green Frog *Rana esculenta* were found in the largest lake of the Park (Ungura Lake, 394 ha).

The Moor Frog *Rana arvalis* was a rare species; a few individuals were occasionally observed in the entire territory of the Park. It was more common in the central parts of the Sudas-Zviedru mire, the largest high moor of the Gauja National Park, and in the surrounding wet forest where it was the dominant amphibian species.

Amphibian roadkills are fairly common in the Gauja National Park, especially of *Bufo bufo.* The number of killed individuals of this species on country roads during spring migration in one case (26.04.2000) reached 43 toads on a 0.025 km long road span, and in two other cases (17.04.2000 and 17.05.2000), there were 11 and 12 killed toads per 0.035 and 1.5 km, respectively. Separate killed individuals of this species were a common sight in or near human settlements. Brown frogs were seldom killed on roads, but on one day (17.05.2000), 11 dead frogs per km were recorded.

Two newt species were found at one location each. A dead specimen of the Great Crested Newt *Triturus cristatus* was found on a road on the outskirts of the town of Cçsis. The road is located between a wet deciduous tree forest area and a garden area. There have been also reports from zoologists (V. Pilâts, A. Minde) about findings in four other locations in ponds near or in human settlements. Larvae of the Smooth Newt *Triturus vulgaris* were found in the central part of the Park in a small forest lake with swampy banks surrounded by wet pine forest. There are two reports (from M. Deičmane, M. Kalniňs) about findings in human settlements.

Comments on some other species

In 1988, a few individuals of the Fire-bellied Toad *Bombina bombina* were observed (by S. Inberga) near Sigulda in a popular tourist area, but the species has not survived in this location. Apparently the observed individuals were released by man. *Bombina bombina* in Latvia is on the periphery of the distribution, and the species inhabits only the southern part of Latvia - Bauska and Daugavpils Districts (unpublished data).

The Natterjack Toad *Bufo calamita* was found (by M. Kalniňs) in the 1990s in two locations within a few kilometres of the southern border of the Gauja National Park, and the presence of this species in the Park is highly possible.

There are records of the European Pond Turtle *Emys orbicularis* in 1914 and 1925 in the territory of the present-day Gauja National Park (Siliňđ, Lamsters 1934). Since then, there have been no new records of this species, in spite of well developed tourism in the Park. In Latvia, there have been rare but regular findings of *Emys orbicularis* in various regions. In most cases, these animals were possibly released by man, but in a few locations in southern Latvia (Daugavpils and Dobele districts) this species is observed regularly (personal communications by E. Tone, M. Pupiňđ) and small populations of this species are expected there.

DISCUSSION

A survey using methods similar to those of the present study was carried out in 1994-1997 in the Ķemeri National Park (Čeirâns, in press). That National Park is located in the central part of Latvia, but only 15 % of its territory is covered by agricultural land and human settlements (compared to 45 % in the Gauja National Park). The frequency of records (% of visited 1x1 km squares where species was found) for *Lacerta vivipara, L. agilis* and *Vipera berus* was about the same in both Parks. The frequency for *Anguis fragilis* and *Natrix natrix* records was respectively about 3 and 5 times higher in the Ķemeri National Park. For the latter species, this difference is probably associated with climatic differences.

The large proportion of agricultural landscapes in the Gauja National Park affects to a great extent the status of species. Four species of reptiles and amphibians (*Lacerta vivipara, Bufo bufo, Rana temporaria,* and *Rana synklepton esculenta*) are common and widespread in the whole territory. All of these species are typical of agricultural landscapes of the Park, where farming methods are not as intensive as in Western Europe or in some other Latvian regions. The remaining species are not adapted to these landscapes (*Anguis fragilis, Vipera berus, Triturus vulgaris, Triturus cristatus*) or (and) are near the limits of their climatic tolerance (*Lacerta agilis, Natrix natrix*), which are the reasons for their rarity.

Rana arvalis was found in the same habitats as *Rana temporaria,* but usually in considerably lower numbers (excepting for some high moor areas). Among frogs killed on roads in spring 1999-2000 in the southern part of the Gauja National Park, not far from the Sudas-Zviedru high moor (I. Va_ikova, unpublished Bachelor's thesis), *Rana arvalis* and *R. temporaria* individuals were found in proportions from 1:5 to 1:10.

The adder *Vipera berus* population is probably declining in the Gauja National Park. In a survey carried out in 1985-1987, and based on verified reports from local residents, (Z. Bruņeniece, unpublished Bachelor's thesis), records of *Anguis fragilis, Natrix natrix,* and *Vipera berus* were present in a proportion 1:0.9:0.6, compared to a proportion of 0.6:1:0.05 in the present survey (1999-2000) based on transect routes. As the total number of findings of these three species was considerably higher in the former survey, a decrease of all three species is possible. Populations of *Anguis fragilis, Natrix natrix,* and *Vipera berus* show long-term declining trends in Finland (Terhivuo 1993), and decline of *Vipera berus* is recorded for North European Russia (Orlov, Ananjeva 1995). Long-term declining trends for these species in Latvia is also possible.

Lacerta vivipara inhabits diverse habitats in both forest and open landscapes of the Park. For this species, a change of dominant tree species depending on humidity and canopy closure in the habitat was observed. There was a correlation between the occurrence of *Lacerta vivipara* and that of pine in wet and closed habitats, and that of deciduous trees in dry open habitats. The latter possibly reflects the dominance of deciduous trees in open landscapes of the Park, and not that deciduous trees were preferred by *Lacerta vivipara.* However, these shifts can reflect the microclimatic preferences of the species. Pine stands are usually well lit, and in the case of wet stands (such as in high moor or forest on wet peat), fairly open. Deciduous tree stands in wet sites are usually shaded and may be too cool for *Lacerta vivipara.* In the open landscapes, summer temperatures can be considerably higher than in the forest sites. Sparse, dry and relatively open pine stands may be too dry and hot for *Lacerta vivipara,* and suitable rather to *Lacerta agilis* which inhabits such sites on the

banks of the Gauja River.

In high moors of the Moscow region of Russia, the most favourable habitat for *Lacerta vivipara* was observed to be wet sites with sparse low pine stands and *Myrica gale, Ledum palustre, Eriophorum vaginatum,* and *Sphagnum* in the herb and moss layer (Zamolodchikov & Avilova 1989). In high moors of the Gauja National Park, *Lacerta vivipara* preferred sites with a stable water regime, such as sparse low pine-birch stands near old harvested peat areas or in partially drained moor areas, with characteristic swards of *Calluna vulgaris* and grasses (*Molinia caerulea* etc.) in the herb layer.

During the survey, large numbers of killed amphibians on roads were observed in relatively few cases, mostly regarding *Bufo bufo.* There are data from the southern part of the Park, near Lîgatne (I.Va_ikova, unpublished Bachelors thesis), where amphibians killed on roads were counted during the spawning period (April - first 10 days of May) for two seasons (1999-2000). The maximum numbers of kills were 212 *Rana temporaria,* 35 *Bufo bufo,* and 14 *Rana arvalis* in one spring per 1 km of road. In one case, about 15 km outside the border of the Gauja National Park, 382 killed *Rana temporaria* and 70 *Bufo bufo* per km were counted. This indicates that the number of killed brown frogs recorded in the Park in the present survey - maximum 11 frogs/km - is an underestimate, probably due to the timing of field work after the end of the amphibian spawning season.

The following conservation and research activities are recommended for the Gauja National Park:

- Creating a data base of records at least for rare species (*Lacerta agilis, Anguis fragilis, Natrix natrix, Vipera berus, Triturus vulgaris, T. cristatus, Rana arvalis*) using the 1999-2000 inventory project as a base;
- More research on ecology of all species is needed to encourage the development of a management plan for reptiles and amphibians in the Gauja National Park;
- Development of a network of protected microreserves for *Triturus cristatus.* The species is included in Appendices II of both the Bern Convention (Anonymous 1992a) and EU Directive 92/43EEC (Anonymous 1992b), and in the 2nd category (vulnerable species) of the Red Data Book of Latvia (Ingelög et. al. 1993);
- Measures should be made to avoid amphibian road kills. In cases of mass road kills, conservation activities such as construction of roadside fences and underground passages should be planned;
- Increasing public awareness of reptile and amphibian conservation in the Park. Further tourism development could have a negative effect on some species, particularly snakes.

REFERENCES

ANONYMOUS 1992a: Appendix II, Strictly Protected Fauna Species to the Convention on the Conservation of European Wildlife and Natural Habitats, Bern, 1979. Directorate of Environment and Local Authorities, Strasbourg.

ANONYMOUS 1992b: EU Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Fauna and Flora, Brussels.

BUŠS, K. 1997: Forest ecosystem classification in Latvia. Proceedings of the Latvian Academy of Sciences. Section B 51: 204-218.

ČEIRANS, A. In press: Reptiles and anurans of the Kemeri National Park, Latvia. In: Heikkilä, R. & Lindholm, T. (eds.). Biodiversity and conservation of the boreal

nature. Proceedings of the 10 years anniversary symposium of the Nature Reserve Friendship. The Finnish Environment 485.
INGELOG, T., ANDERSSON, R. & TJERNBERG, M. (eds.) 1993: Red Data Book of the Baltic Region. Part 1. Lists of Threatened Vascular Plants and Vertebrates. Swedish Threatened Species Unit, Uppsala.
KABUCIS, I. (ed.) 2000: Biotopu rokasgramata. Eiropas Savien_bas aizsargajamie biotopi Latvija [Handbook of habitats. Protected habitats by European Union in Latvia]. Latvijas dabas fonds, Riga (in Latvian).
ORLOV, N.L. & ANANJEVA, N.B. 1995: Distribution of amphibians and reptiles and their relict populations in the Gulf of Finland and Lake Ladoga. Memoranda Societatis pro Fauna et Flora Fennica 71: 109-112.
PILATS, V. 2000: Emeralds of Latvia. Opportunities for nature tourism. Ministry of Environmental Protection and Regional Development, Riga.
PRIEDITIS, N. 1999: Latvian forest: nature and diversity. WWF, Riga.
SILIND, J. & LAMSTERS, V. 1934: Latvijas râpu_i un abinieki [Reptiles and amphibians of Latvia]. Valters un Rapa, Riga (in Latvian).
TERHIVUO, J. 1993: Provisional atlas and status of populations for the herpetofauna of Finland in 1980-92. Annales Zoologici Fennici 30: 55-69.
ZAMOLODCHIKOV, D.G. & AVILOVA, K.V. 1989: Materials on biology of the Common Lizard, *Lacerta vivipara,* in a high moor in Western Moscow region. In: Amphibians and reptiles of Moscow Region. Nauka, Moscow: 147-152 (in Russian).