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Herpetofauna of the Kozubów Landscape Park

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Abstract

The research was conducted in 2016-2017 in the 6,613-ha Kozubów Landscape Park (KLP). It focused on the occurrence and distribution of amphibians and reptiles, the biology and phenology of selected species and the existing threats.

The KLP, established in 1986, is located in the Nida Basin, covering the eastern part of the Wodzisławski Ridge. This area is characterised by diverse landscape features formed on a chalk substrate. A significant part of the KLP (48.8%) is covered by forests growing on the tops and slopes of loess hills intersected by valleys and gorges. Hornbeam forests and fragments of riparian forests have retained a semi-natural character. The steep, non-forested slopes with a southern and south-western exposure are overgrown by thermophilic xerothermic grasslands. Xerothermic plant communities show a relatively low species diversity, because the main type of substrate in this area is loess. Two nature reserves, Polana Polichno and Wroni Dół, are located within the KLP borders.

The following amphibian species were found in the KLP: smooth newt (*Lissotriton vulgaris* L.), great crested newt (*Triturus cristatus* Laur.), European fire-bellied toad (*Bombina bombina* L.), common spadefoot toad (*Pelobates fuscus* Laur.), common toad (*Bufo bufo* L.), European green toad (*Bufotes viridis* Laur.), European tree frog (*Hyla arborea* L.), edible frog (*Pelophylax esculentus* L.), pool frog (*Pelophylax lessonae* Cam.), moor frog (*Rana arvalis* Nilss.) and common frog (*Rana temporaria* L.). Reptiles are represented by the sand lizard (*Lacerta agilis* L.), viviparous lizard (*Zootoca vivipara* Jacquin), slow worm (*Anguis fragilis* L.), grass snake (*Natrix natrix* L.), smooth snake (*Coronella austriaca* Laur.) and common European adder (*Vipera berus* L.). The study also included the phenology and reproductive biology of common toad and common frog.

Major threats to the herpetofauna are posed by grass burning. Unfavourable changes include decreasing water levels and drying out of water bodies.

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1. INTRODUCTION

The Nida Basin is a very specific area regarding the natural environment, since many years raising the interest of numerous scientists. The direct results of their work included attempts for the conservation of this unique area, which resulted in the establishment of three landscape parks (LPs): the large Nida Region LP and two smaller parks – Szaniec LP and Kozubów Landscape Park (KLP). Each park is surrounded by a buffer zone, which is also a legally protected area in the form of a protected landscape area (PLA): Nida, Szaniec and Kozubów Regions. In addition, a total of 12 nature reserves are located within the borders of these parks.

Previous research within the Nida Basin was concentrated mainly on the Nida Region LP and some nature reserves,

whereas much less interest was dedicated on the remaining two LPs. Previous herpetofaunal studies concerned large areas [Juszczyk, 1987; Juszczyk et al., 1988; Wojdan, 1994; Głowaciński and Rafiński, 2003; Bonk and Pabijan, 2006] but unfortunately did not cover legally protected areas. Detailed inventories in the Nida Region LP and Szaniec LP were performed just recently [Ichniowska-Korpula, 2012; Wojdan, 2012a, 2012b, 2015].

So far, only the KLP was not subject to herpetofaunal studies. They are crucial, however, because literature data indicate the need of such studies following the worldwide decline in the occurrence of amphibians [Houlahan et al., 2000; Gardner, 2001; Blaustein and Kiesecker, 2002; Collins and Storfer, 2003; Stuart et al., 2004; Nyström et al., 2007].

In the future, these studies will serve as reference data for comparative studies of species occurring in the study area. Therefore, the aim of this research was to determine the occurrence and distribution of amphibians and reptiles of the KLP. The phenology and reproductive biology of two selected amphibian species was also performed, and the existing threats were determined.

2. STUDY AREA

The KLP, established in 1986, is the smallest and westernmost landscape park of the Nida Basin. The KLP is elongated in shape, reaching almost 17 km in length and maximally 7 km in width. Its surface area is 6.046 ha, and the geographic coordinates are 50°21'–50°28'N and 20°23'–20°34'E. It is located in the Świętokrzyskie Voivodeship, within the Pińczów (Pińczów, Michałów, Działoszyce and Złota communes) and Kazimierza Wielka (Czarnocin commune) counties. The park covers the eastern part of the Wodzisławski Ridge mesoregion (Kondracki 2002). Two nature reserves occur within the KLP borders: Polana Polichno (steppe, active protection) and Wroni Dół (forest, active protection) [Płaski, 1998; Cukierska, 1999].

The substrate of the KLP is composed of Upper Cretaceous (opokas and marls) and Miocene deposits, and Pleistocene tills and loesses [Rutkowski, 1986]. Brown soils prevail; fertile black earths and rendzinas also occur [Oczóś and Strzelec, 1986]. The topography of the KLP is a wavy upland with gentle hills. The average elevation is about 270 m a.s.l., with the highest point at 320 m a.s.l. and the lowest at 200 m a.s.l. Quaternary denudation resulted in the erosion of the loess cover, creating numerous ravines, gullies, loess escarpments, dry valleys and diluvial loess fans (Cabaj and Nowak, 1986). The climate in the park is moderately warm (mean annual temperature: +8°C) and typical for the Central Uplands, that is, with large changeability of weather states. A long vegetation period (200–210 days) and slightly higher mean temperatures are characteristic for the KLP, which favours the development of farming [Paszyński and Kluge, 1986; Płaski, 1998].

Large water reservoirs are lacking in the park, the only streams being Mozgawka and a nameless watercourse from Pełczyska [Dynowska, 1986]. The scarcity of surface waters and deep-seated groundwater causes that vast wetlands and peatlands do not occur. A larger complex of wet meadows and swards occurs only along Mozgawka [Dynowska, 1986; Płaski, 1998].

The KLP is the only park of the Nida Region with a considerable contribution of forest habitats. They comprise 48.1% of the surface area; by comparison, the forests contribute to just 10% surface area of the Szaniec LP and 7% surface area of the Nida Region LP. Forests of the KLP occur as dense complexes neighbouring with farmlands. Hornbeam, riparian and mixed forests have retained their natural character within the park. The forest communities include sub-continental oak-hornbeam *Tilio cordata-Carpinetum betuli* (Nida variety), continental mixed forest *Quercus robur-Pinetum* and riparian mixed forest *Fraxino-*

Ulmum minoris [Lesiński and Kobak, 1987]. Non-forested habitats include the most characteristic xerothermic grasslands with *Sisymbrio-Stipetum capillatae*, *Inuletum ensifoliae* and *Thalictrum-Salvietum pratensis*. Xerothermic thicket communities are composed of privet and blackthorn *Pruno-Ligustretum* thickets, and *Geranio-Peucedanum carvariae* fringe communities. Diverse communities of field weeds commonly occur on arable fields [Kobak and Koczwańska, 1987].

Existing literature does not supply any monographs on the flora and fauna of the KLP. Thirty-two species of legally protected vascular plants occur in the KLP [Filkowa, 1987; Szwagrzyk, 1987; Łuszczynska, 1998, 2000; Kwietniowska, 2004]. There are no detailed data on the invertebrates; in turn, 7 species of amphibians, 6 species of reptiles, 72 species of birds and 26 species of mammals are observed amongst vertebrate fauna [Ćmak, 1998; Płaski, 1998; Zając K. and Zając T., 1999].

Culture habitats (villages and farmlands) cover mainly the eastern part of the park. The largest five villages within the KLP are rather small – Kozubów has 451 inhabitants, Zagorzyce – 223, Sadek has 207, Zawarża has 126 and Kołków has only 101.

3. METHODS

The study was performed in 2016–2017 in the KLP. Observation and trapping sites were installed for the observation of herpetofauna (Fig. 1); they were controlled thrice a month between March and June and twice a month between July and September.

In the case of amphibians, the observation sites included only breeding reservoirs because of easy observation and key significance of these water bodies for batrachofauna preservation. In the study area they included small usually temporary basins with variable surface areas (rarely exceeding 100 m²) and depths (usually 1–2 m), such as ponds, pools and ditches filled with water. Generally, these reservoirs were surrounded by forest communities.

In the case of reptiles, the sites were installed in places where numerous representatives of particular species were observed. They usually represented mid-forest clearings and surroundings of roads and pathways.

The abundance of herpetofauna was not counted, because this would require the application of invasive methods based on complete trapping or tagging. Only the approximate number of the observed individuals was determined (this referred to adult and juvenile individuals, amphibian larvae were not counted). The trapped animals were released in the trapping site after counting. Mating calls of adult male amphibians were surveyed during the night. Atmospheric and water temperatures at the depth of 30 cm were measured during studies of phenology and reproductive cycles of the amphibians. Two most abundant species were selected for phenological analysis – common toad and common frog.

Table 1. Amphibian sites in the Kozubów Landscape Park

Species	Sites (numbers according to Fig. 1)									
	1	2	3	4	5	6	7	8	9	10
<i>Lissotriton vulgaris</i>	+	–	+	–	–	–	+	+	+	+
<i>Triturus cristatus</i>	–	–	+	–	–	–	+	–	–	–
<i>Bombina bombina</i>	–	–	–	–	–	–	+	–	–	–
<i>Pelobates fuscus</i>	–	–	–	–	–	–	–	–	–	+
<i>Bufo bufo</i>	+	+	+	+	–	+	+	–	–	+
<i>Bufotes viridis</i>	+	–	–	–	–	+	+	–	–	+
<i>Hyla arborea</i>	–	–	+	+	–	–	+	–	–	+
<i>Pelophylax esculentus</i>	–	–	–	–	–	–	+	–	–	–
<i>Pelophylax lessonae</i>	–	–	+	–	–	–	+	–	–	–
<i>Rana arvalis</i>	+	–	+	+	–	–	+	–	–	–
<i>Rana temporaria</i>	+	+	+	+	+	+	+	+	–	+

4. RESULTS

The following species were observed in 10 selected sites enclosing batrachofauna reproduction reservoirs (Fig. 1, Table 1): smooth newt (*Lissotriton vulgaris* L.), great crested newt (*Triturus cristatus* Laur.), European fire-bellied toad (*Bombina bombina* L.), common spadefoot toad (*Pelobates fuscus* Laur.), common toad (*Bufo bufo* L.), European green toad *Bufotes viridis* Laur., European tree frog *Hyla arborea* L., pool frog *Pelophylax lessonae* Cam., edible frog *Pelophylax esculentus* L., moor frog *Rana arvalis* Nilss. and common frog *Rana temporaria* L. (Fig. 2). The sites were numbered as follows (the type of reservoir is given in parentheses): 1, Wroni Dół nature reserve and its neighbourhood (infilled ditches with water and mid-forest pond); 2, Sadek (mid-forest pond); 3, Orkanów (ditches and two mid-forest ponds); 4, Marianów (ditches and mid-forest pond); 5, Kozubów (Mozgawka pools); 6, Kołków (mid-forest pond); 7, Zagaje Stradowskie (ditches and 2 mid-forest ponds); 8, Wola Chroberska (ditches); 9, Złota (ditches); and 10, Bugaj (ditches, mid-forest pond) (Fig. 1; Table 1).

The study area was inhabited by 11 amphibian species (Fig. 2; Table 1). Smooth newt occurred in six reproductive sites, with several to several tens of individuals observed during each survey. Great crested newt resided in only two reproductive sites. Over a dozen individuals were observed in each site. Only seven individuals of European fire-bellied toad were observed in only one pond near Wola Stradowska. Common spadefoot toad was also observed in only one site, a mid-forest pond near Bugaj. Only one individual was observed there, but mating calls of a few other individuals were also surveyed. European tree frog was observed in 4 reproductive sites, with several to more than 10 individuals observed during each survey. Common toad occurred frequently, being observed in

seven sites. In 2 of them, more than 100 individuals were observed during each survey. European green toad was less abundant and occurred in only four sites. Several to more than 20 individuals were observed in these sites during the survey. Only three individuals of edible frog were observed in only one mid-forest reservoir to the north of Zagaje Stradowskie. Pool frog was much more abundant (up to several tens of individuals) but occurred in only two sites. Moor frog was observed in four sites. From more than 10 to several tens of individuals were observed during a single survey. Common frog occurred in almost all sites (9 of 10). Even several hundred sexually mature individuals were observed in single reservoirs (Fig. 2; Table 1).

Breeding biology and phenology were studied in 2016 in two amphibian species: common toad and common frog (Fig. 3). In common toad, individuals in amplexus were observed from 27.03 (atmospheric temperature: 8°C; water temperature: 5°C) till 8.04. Spawn was observed in 4-15.04 and tadpoles in 16.04-22.06. Metamorphosis took place in 16-28.06 (Fig. 3). In common frog, the stages of breeding phenology observed were amplexus from 17.03 (atmospheric temperature: 8°C; water temperature: 4°C) till 29.03, spawn was present in water in 23.03-6.04, tadpoles in 29.03-18.06 and metamorphosis in 13.06-23.06 (Fig. 3). Reptile observation was performed in 13 sites (Fig. 1; Table 2). The sites were numbered as follows (the type of reservoir is given in parentheses): 1, Wroni Dół nature reserve and its neighbourhood (oak-hornbeam forest); 2, Polana Polichno nature reserve and its neighbourhood (xerothermic grasslands and oak-hornbeam forest); 3, Sadek (mixed forest); 4, Zagórzycze (mixed forest); 5, Orkanów (mixed forest); 6, Marianów (mixed forest); 7, Kołków (oak-hornbeam forest and riparian forest); 8, Zagaje Stradowskie (mixed forest and oak-hornbeam forest); 9, Góry (oak-hornbeam forest); 10, Wola Chroberska

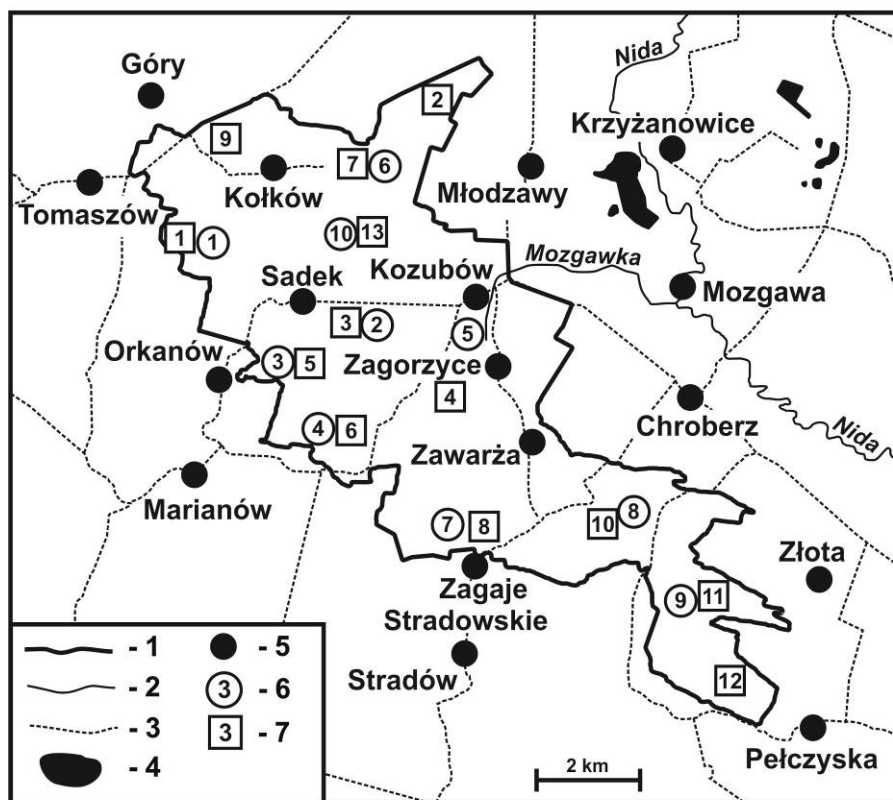


Figure 1. Distribution of amphibian and reptile sites in the Kozubów Landscape Park. (1) KLP limits, (2) rivers, (3) roads, (4) water reservoirs, (5) villages, (6) amphibian sites, (7) reptile sites.

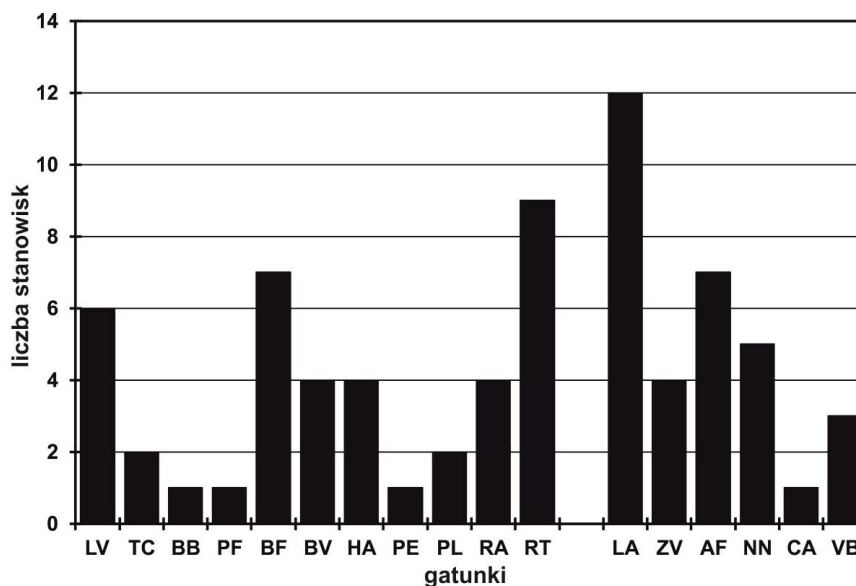


Figure 2. Number of amphibians and reptiles observed in the sites of the Kozubów Landscape Park. Amphibians: LV, *Lissotriton vulgaris*; TC, *Triturus cristatus*; BB, *Bombina bombina*; PF, *Pelobates fuscus*; HA, *Hyla arborea*; BF, *Bufo bufo*; BV, *Bufo viridis*; PE, *Pelophylax esculentus*; PL, *Pelophylax lessonae*; RA, *Rana arvalis*; RT, *Rana temporaria*. Reptiles: LA, *Lacerta agilis*; ZV, *Zootoca vivipara*; AF, *Anguis fragilis*; NN, *Natrix natrix*; CA, *Coronella austriaca*; VB, *Vipera berus*.

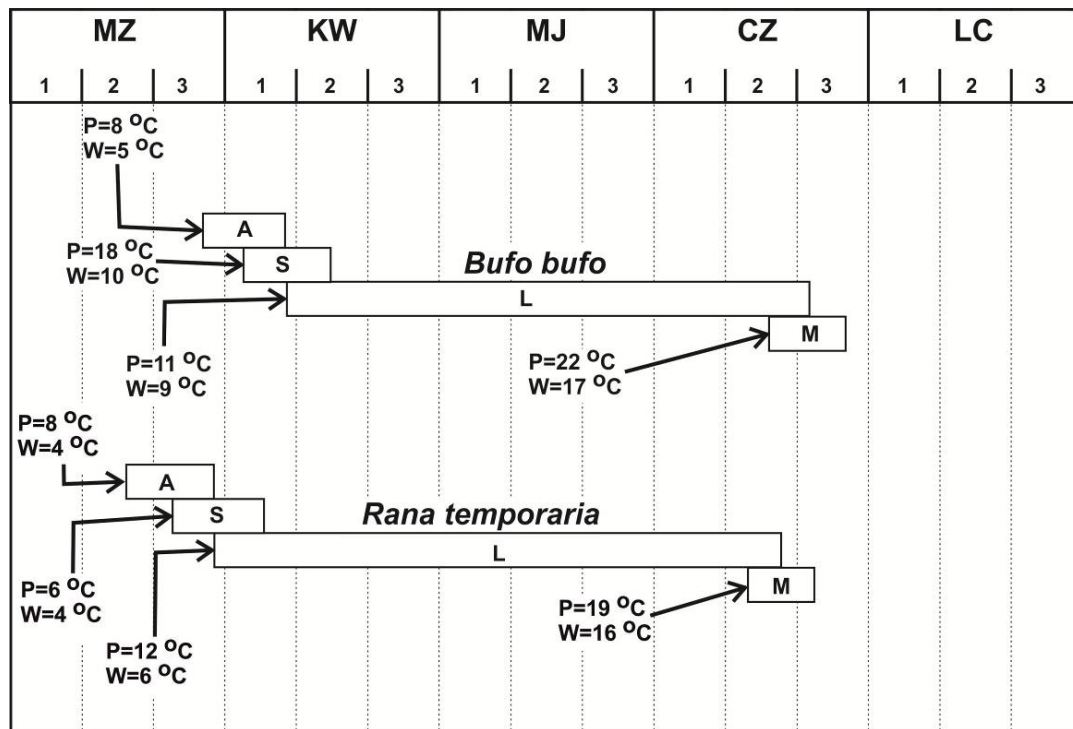


Figure 3. Breeding phenology of common toad and common frog in the Kozubów Landscape Park in 2016. MZ, March; KW, April; MJ, May; CZ, June; LC, July; 1-3, decades; A, amplexus; S, spawn; L, larvae (tadpoles); M, metamorphosis; P, atmospheric temperature; W, water temperature.

Table 2. Reptile sites in the Kozubów Landscape Park

Species	Sites (numbers according to Fig. 1)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
<i>Lacerta agilis</i>	+	+	+	+	+	+	+	+	+	+	+	+	–
<i>Zootoca vivipara</i>	–	–	–	–	–	–	+	+	–	+	–	–	+
<i>Anguis fragilis</i>	+	+	–	–	–	+	–	+	+	–	+	–	+
<i>Natrix natrix</i>	–	+	–	–	–	–	+	+	–	+	–	–	+
<i>Coronella austriaca</i>	–	–	–	–	–	–	–	+	–	–	–	–	–
<i>Vipera berus</i>	–	+	–	–	–	+	–	+	–	–	–	–	–

(oak-hornbeam forest and riparian forest); 11, Złota (mixed forest); 12, Pełczyska (xerothermic grasslands); and 13, Bugaj (riparian forest) (Fig. 1; Table 2).

The reptile fauna of the KLP was represented by six species (Fig. 2, Table 2). They included the populations of sand lizard (*Lacerta agilis* L.), viviparous lizard (*Zootoca vivipara* Jacquin), slow worm (*Anguis fragilis* L.), grass snake (*Natrix natrix* L.), smooth snake (*Coronella austriaca* Laur.) and common European adder (*Vipera berus* L.) (Fig. 2; Table 2). Sand lizard was observed in 12 of 13 sites studied. Several to several tens of individuals were observed in each of them. The species was distinctly less numerous in wetland areas, particularly in alder forests. Viviparous lizard was

observed in four sites. It was more numerous in oak-hornbeam forests, particularly in humid alder forests, where more than 10 individuals were observed during each survey. Slow worm was observed in seven sites, but only single individuals were observed. Grass snake was observed in five sites, usually close to water reservoirs. Several individuals were observed in each of the sites. Smooth snake was observed only in Zagaje Stradowskie. A single individual was found to be basking in the sun along a forest road (oak-hornbeam forest). Common European adder was observed in three sites – in the oak-hornbeam forest and in mixed forest. Only single individuals were observed (Fig. 2; Table 2).

The observed threats included common penetration of the entire area of the landscape park (including both nature reserves), which causes littering and destruction of undergrowth, and particularly extermination of some reptiles. Single killed slow worms and snakes have been observed during the survey. Drying up of ephemeral reservoirs already in May and June was particularly dangerous for amphibian populations (in some cases, larvae were exterminated in the reservoirs), whereas the entire fauna was endangered by grass burning in spring. Mass killings of migrating amphibians on communication routes have not been observed.

5. DISCUSSION

The state of knowledge on herpetofauna of the Kozubów Landscape Park is very scarce, which hampers the possibility of comparing the results obtained with previous data. In the case of scientific reports, the only reference to the KLP was made in the publication of Juszczuk et al. (1988). These authors mentioned only one site from this area – forest areas in Zagaje Stradowskie. Juszczuk et al. [1988] observed an abundant and diverse herpetofauna, including 16 species (10 amphibians and 6 reptiles). The results of the presented research performed in forests neighbouring with Zagaje indicated the presence of the same species. With regard to the quality, this is the richest site in the KLP, which is the result of diverse ecosystems and the presence of mid-forest water reservoirs. The only species observed presently in the KLP, which was not noted by Juszczuk et al. [1988] in Zagaje, was common spadefoot toad. The amphibian was present in only one site, in a mid-forest pond near Bugaj (Table 1).

Płoski [1988] mentioned herpetofauna species but did not provide data on their distribution. Amongst amphibians, Płoski [1988] observed smooth newt, northern crested newt, common toad, European green toad, European tree frog, moor frog and common frog. His report did not indicate rare species of the KLP, which presently include European fire-bellied toad (one site), common spadefoot toad (one site), edible frog (one site) and pool frog (two sites). In the case of European fire-bellied road and common spadefoot toad, these single sites may be explained by the rather rare occurrence of these species in Poland [Głowaciński and Rafiński, 2003]. A different case occurs with 'green frogs', because both edible frog and pool frog are rather common species in Poland. Most surveyed reservoirs represent small, often ephemeral basins, frequently drying up already in spring or summer. In turn, all 'green frogs' require permanent, larger reservoirs. This particularly refers to the largest species – marsh frog *Pelophylax ridibundus* Pall., which was not observed at all in the KLP.

All six reptile species observed during the present survey were mentioned by Juszczuk et al. [1988] and Płoski [1988]. These reports did not supply, however, any data on the distribution and abundance of these species. At present, it is commonly known that only viviparous lizard and slow

worm frequently occur in the KLP, whereas the remaining species are rare (particularly smooth snake) (Table 2).

The phenology of two amphibians studied in 2016 (common frog and common toad) was similar to that in neighbouring areas, that is, the Nida Region LP [Wojdan, 2012a, 2015] and the Szaniec LP [Wojdan, 2012b]. In the KLP, both species begin their mating season quite early (common frog in the second decade of March and common toad in the third decade of March). However, this is not caused by local climate, because early warming in early spring and fast thawing of the snow cover took place in 2016. Similar data on the mating season (common frog, second decade of March; common toad, first decade of April) were observed in 2011 for the Pieczyska Nature Reserve in the Nida Region LP [Wojdan, 2012a].

Several serious hazards posed to herpetofauna have been observed in the KLP. The most severe ones include grass burning and drying up of small water reservoirs. The park's area is penetrated by the local population, which causes littering, collection of undergrowth and killing of some reptile species. An important hazard in the KLP is fragmentation of natural habitats, particularly forests, because of urbanisation and increasing road traffic. These are common and often described problems worldwide [Vos and Chardon, 1998; Kolozsvary and Swihart, 1999; Lehtinen et al., 1999; Andersen et al., 2004; Ficetola and De Bernardi, 2004; Weyrauch and Grubb, 2004; Noël et al., 2007].

6. CONCLUSIONS

In the area of the KLP, 11 species of amphibians and 6 species of reptiles were found. Rare species in the KLP were common spadefoot toad of amphibians and smooth snake of reptiles. The common amphibian species were great crested newt, European fire-bellied toad, common toad, European green toad, European tree frog, edible frog, pool frog, moor frog and common frog. All the listed species were found in more than three breeding localities (in water bodies). Unfortunately, most of these water bodies were threatened by drying out. The present state of chosen water bodies can be improved by protecting them as places of ecological uses.

The common reptiles were sand lizard, viviparous lizard, slow worm, grass snake and common European adder. The main treats include human presence, what results in littering and fire setting.

Comparison of data from the KLP with those for entire Poland [Głowaciński and Rafiński, 2003] shows that the study area has a rather numerous and diverse reptile fauna, but much less diverse batrachofauna, which results from its specific character. The occurrence of amphibians is hampered by the lack of water reservoirs, whereas the occurrence of herpetofauna is favoured by numerous forests in the study area. Therefore, the reptile fauna of the KLP is the same as in other LPs of the Nida Region [Ichniowska-Korpula, 2014; Wojdan, 2012b, 2015], whereas the amphibian fauna is much less diverse.

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