



Amphibians of Poland's urban areas. Preface

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Abstract: For many reasons urban environment cannot affect positively on amphibian fauna, thus the most of amphibian species decrease in their abundance, become endangered or simply extinct in such areas. Scattered, inconsistent, sometimes simply not available data on amphibian fauna in towns do not facilitate action to protect the species. Therefore the collecting and compiling of the studies on amphibian fauna of different towns of Poland is important for the further research to reveal general rules in changes connected with urbanization. In sum, in 9 Polish towns 13 amphibian species plus one natural hybrid – the edible frog *Rana kl. esculenta* Linnaeus, 1758 were recorded. Eight to thirteen taxa were found in a town and it may be assumed that lack of other species occurring in Poland is connected only with their limited ranges. The current knowledge presented in the collected articles can become the starting point for the further studies on amphibian occurrence in urban environment and for appropriate protective measures in towns.

Key words: Amphibia, anthropopressure, urbanization, urban fauna, habitat changes, frog, toad, newt

Urban ecology appeared as a separate branch of ecology more or less at the beginning of the 1970's (the first issue of the journal "Urban Ecology" was published in 1975). It was initially concerned with climate, soil, and air as well as the occurrence of various organisms in cities. In the 1990's more and more weight was attached to nature conservation in such areas. The first step flora and fauna preserve was the listing of detailed information on distribution and overall condition of populations. In many cities, atlas studies or other investigations took place, e.g. in Germany the inventories of biotopes in 223 cities and towns were carried out (Marzluff et al. 2008).

The most frequently studied animals in urban anthropogenic habitats are birds and mammals (Pickett et al. 2001). In the case of these two groups of vertebrates, a decrease in the total number of species with increasing urbanization is observed (e.g. McKinney 2008). However, at the same time, a much higher population density of particular species that are able to survive in such human modified habitats has been noted (e.g. Luniak 2004). Luniak (1998) presents a few specific urban features, that positively influences the condition of bird and mammal populations living in cities. These features are: weaker pressure of natural predators, easy access to anthropogenic food, large quantities of available nest sites, warmer microclimates that facilitate both winter survival as well as longer breeding season, and a usually welcoming attitude of humans towards many birds and mammals living in cities.

However, those features, which aid the life of birds and mammals in cities, do not apply to amphibians. People are not positively inclined towards frogs and toads, sometimes even killing them. The warmer city microclimate with higher yearly temperatures may severely influence duration and depth of hibernation in amphibians. Consequently, the physical condition and even survival of many amphibians may be negatively affected in temperate regions (e.g. Reading 2007). Amphibians also do not have a diet of an anthropogenic origin. They forage mostly on live invertebrates, which are much more numerous in non-urban, more natural areas (Pickett et al. 2001). All the above reasons lead to the conclusion that amphibians appear to be especially sensitive to urbanization.

Scientists have focused their attention on the sudden decline in amphibians during the last few decades. It is estimated that over one-third of known amphibian species are on the endangered or critically endangered list. The status of the next 23% is unknown (Baillie et al. after Hamer & McDonnell 2008). Amphibian decline is not related to one particular reason, but rather several different causes may be responsible (Nystrom et al. 2007). Nonetheless, the reasons are still unknown for the decline of 48% of the endangered amphibian populations (Stuart et al. after Nyström et al. 2007). Thus, it is impossible to take any effective action connected with prevention or conservation. In some areas amphibian populations are decimated by: over-harvesting (e.g. for consumption), infectious diseases, pollution by chemical compounds, UV-B radiation, climate changes, introduction of exotic animals, as well as the changes, isolation and disappearance of suitable habitats (Ficetola & De Bernardi 2004, Nyström et al. 2007, Brito 2008, Hamer & McDonnell 2008, Maes et al. 2008). Among the several known threats to amphibians, many scientists have highlighted those related to increasing urbanization. It is expected that urban development will continue. By 2030, cities and towns will be inhabited by over 5 billion people (United Nations Human Settlements Programme after Hamer & McDonnell 2008). Overpopulated urban areas will affect urban inhabiting vertebrate populations. Amphibians are the vertebrates in urban areas which have been studied the least.

The majority of amphibian species living in the temperate climates of Central Europe needs two different habitats. A water body is necessary for breeding, spawning, and egg and then tadpole development until metamorphosis take place. After breeding many species spend the rest of their life cycle on land. In various terrestrial habitats they find food and shelter, both for daily as well as winter hibernation. To meet their specific requirements, seasonal migrations take place where individuals may travel large distances. The common toad *Bufo bufo* was observed migrating from 55 to 1600 meters (Sinsch 1988). Water frogs *Rana kl. esculenta* travelled as far as 2.5 km (Juszczak 1987) from their breeding ponds. In cities, suitable habitats for amphibians are much more fragmented and isolated from each other than in natural areas. Various urban architectural barriers as well as dense road networks reduce migration possibilities. A decrease in genetic diversity and extinction of particular, local populations (Hitchings & Beebee 1998) may take place, with little possibility for recolonization of such sites.

A noticeable rapid increase of interest in urbanization pressure on amphibian populations started in the 1990's both in Poland (Pawłowski 1993) and in the rest of the

world (e.g. Vershinin 1990, see also Hamer & McDonnell 2008). Before 1990, only a few articles were published on this topic (e.g. Kral 1983). Juszczuk (1989) described the occurrence of amphibians in Kraków, and the data were gathered between 1922 and 1979. However, this paper, published after the author's death, was not very thorough and lacked detailed ecological conclusions.

It seems that studies on amphibians in urban habitats started later compared to other vertebrates. For this reason, we still have only basic information available on the subject. Especially lacking are data on the long-term changes in species composition in particular areas in relation to increasing urbanization.

A simple and commonly used method of amphibian studies in urban habitats is to describe the occurrence of breeding individuals of particular species in city water bodies in relation to the level of human modifications done to the banks and close surroundings of water bodies. Such research has allowed for some conclusions to be drawn about amphibian reaction to urbanization pressure. It became possible to reveal which species are sensitive to urbanization, which species withdraw from cities as well as species that are rather resistant (Mazgajska 1996, Hamer & McDonnell 2008). Most studies, though, point out the negative influence of urbanization on the number of amphibian species and describe an amphibian decrease as the urbanization gradient increases (Mazgajska 1996, Siwak & Chętnicki 2000, Hamer & McDonnell 2008).

According to Hamer & McDonnell (2008), urbanization and the related changes in habitats, are now and will be in the future the main threats for amphibians worldwide. Taken into consideration amphibian habitat requirements, urban areas are frequently characterized by: degradation and vanishing of optimal terrestrial habitats, large spatial isolation of suitable habitats – architectural barriers and road networks prevent amphibians from moving to or from breeding water bodies, smaller number of suitable water bodies, changes in water bodies (both physical as well as water chemistry and pollution), high penetration of banks by human (and dogs), higher impact of exotic species (e.g. fish and plants), higher average yearly temperatures and lower humidity (Hamer & McDonnell 2008). To prevent amphibian decline related to urbanization, detailed, large-scale studies are necessary. Such studies must concern occurrence, abundance, and requirements of amphibian species, so that it will be possible to recognize ecological mechanisms that link urbanization and this specific group of vertebrates.

This special issue is a response to international as well as Polish interest in the study of amphibians in urban areas. When we started with this thematic issue, there were at least 23 different papers that dealt with batrachofauna in Polish cities. As far as we know, amphibians living in the following cities have been studied: Kraków (Guzik et al. 1996), Wrocław (Mrowiec 1999, Kierzkowski & Ogińska 2001, Ogińska 2000), Wałbrzych (Bałuka 2000, Tomalka-Sadownik 2008), Warszawa (Mazgajska 1996, 1998, 2008, 2009, Derecka 2005, Żebrowski 2007), Lublin (Chobotow & Czarniawski 1999), Białystok (Siwak et al. 2000), Olawa (Majtyka 2006), Olsztyn (Majewski & Nowakowski 2001, Nowakowski et al. 2008), Poznań (Pawłowski 1993), Chorzów (Sołtysiak 2004), Łódź (Stopczyński 1998, Stopczyński et al. 2004), Słupsk (Hetmański et al. 2008), Szczecin (Pilecka-Rapacz et al. 2003), Gniezno (Adamiak 2008), Toruń

(Przystalski et al. 2007) and Zielona Góra (Najbar et al. 2005). Despite our efforts some written materials may not be listed here. Some of the above mentioned studies were already published, but mostly in local scientific journals in Polish, others are included as abstracts or short papers to conference materials, and a few are unpublished thesis available only in university libraries. As a result, those materials are difficult to obtain, and results of the studies are not widespread in Poland or abroad. There were other problems with those studies/publications. The data presentation usually made wider comparisons between cities impossible, due to e.g. lack of comparable methods used during fieldwork, incomplete description of study sites (water bodies) etc. Thus, despite the many studies, it was hard to make a good review or meta-analysis of results obtained so far. It was difficult to draw any general conclusions concerning factors related with urbanization and their influence on particular amphibian species.

In this issue we trying to encourage scientists who work on the subject of amphibians in urban areas to present their results (including those already partially published) in a uniform, standardized way. Such a homogeneous presentation of results would allow for comparison of data about different-sized cities, structure, and geographic location. Generalizations concerning ecology of particular amphibian species in relation to urbanization, may then be made. It is also important to document the population status of amphibians in particular periods of time. Documentation is important for monitoring purposes



Fig. 1. Location of nine Polish cities for which data are presented in this issue.

as well as to convince governing bodies in cities about the importance of particular areas. Information gained about the requirements of amphibians living in cities could be used e.g. in pond reconstruction or general habitat restoration. Up till now, many reconstruction or restoration projects had been improperly carried out, which in many cases made things worse for amphibians (see e.g. Ogielska & Kierzkowski paper in this issue). We also hope the suggested way of data collection, analysis and presentation will stimulate others to carry out investigations in cities which have not yet been studied.

In this issue, data from nine Polish cities (Fig. 1), from different areas of the country are presented. Due to various reasons, data from a few other cities were not included. For Warszawa, for instance, already published results (in Polish – Mazgajska 1998) were given in a similar way as the results for the other cities in this issue so we decided not to include those data.

Due to specific biology of amphibians, fieldworks carried out so far were concentrated around water bodies in which amphibians spawn. Also in similar way data presented in this issue were gathered. However, in our invitation to authors we made a condition that only papers from cities with at least 25 water bodies studied will be included, and those water bodies had to be controlled at least three times during the breeding season of the studied amphibians. Our stipulations mean the results are representative for particular cities, and the probability of a species omitting (so called "false zero") is sufficiently reduced.

All studies presented in this special issue were carried out from 1997 to 2009. The average duration of study in those nine cities was ca 3.6 years. The results were standardized for comparisons between cities. This was done in all nine papers by presenting data such as species composition and frequency of occurrence (calculated for all water bodies studied, including those without amphibians), in a similar way. We also suggested that authors use a similar classification of individual abundances in particular water bodies (according to Mazgajska 1996). The majority of authors accepted our suggestion and followed through. All studied water bodies in all cities were described in as similar a way as possible. We required detailed descriptions of water bodies, with the GPS position. This information was needed for the standardization necessary for another analysis. The information was also needed for monitoring purposes, to find those water bodies out during future fieldwork. Water bodies used by amphibians for breeding are necessary for this group of vertebrates. The water bodies, though, are quite frequently modified by people. There is even the possibility that after the study those water bodies may be lost, due to human activity. Detailed descriptions required from the authors could help analyze such temporal changes in water bodies subjected to urbanization. For the sake of clarity, we decided to include the water body descriptions as appendixes at the end of each paper.

The results obtained so far, indicate that 13 amphibian species (plus one natural hybrid – the edible frog *Rana kl. esculenta* Linnaeus, 1758) live in Polish cities: the crested newt *Triturus cristatus* (Laurenti, 1768), the common newt *Triturus vulgaris* (Linnaeus, 1758), the alpine newt *Triturus alpestris* (Laurenti, 1768), the fire-bellied toad *Bombina bombina* (Linnaeus, 1761), the common spadefoot *Pelobates fuscus* (Laurenti, 1768), the common toad *Bufo bufo* (Linnaeus, 1758), the green toad *Bufo viridis* Laurenti, 1768,

the natterjack toad *Bufo calamita* (Laurenti, 1768), the tree frog *Hyla arborea* (Linnaeus, 1758), the common frog *Rana temporaria* Linnaeus, 1758, the moor frog *Rana arvalis* Nilsson, 1842, the pool frog *Rana lessonae* Camerano, 1882, and, the marsh frog *Rana ridibunda* Pallas, 1771. The average number of species noted in the 9 investigated cities was 10.6 species; the range was 8–13 species. In the cities studied so far, there were four species of amphibians which occur in Poland but were not observed here: fire salamander *Salamandra salamandra* (Linnaeus, 1758), montandon's newt *Triturus montandoni* (Boulenger, 1880), yellow-bellied toad *Bombina variegata* (Linnaeus, 1758) and the agile frog *Rana dalmatina* Bonaparte, 1840. It may be assumed that lack of those species in urban areas is related to their quite limited ranges. The fire salamander, montandon's newt, and yellow-bellied toad live in mountainous areas of Poland. The agile frog has only been found in a few locations (Głowaciński & Rafiński 2003).

To help make the use of this monograph easier for scientists unfamiliar with all the recent changes of amphibian taxonomy, and because of a lack of worldwide agreement on some of the new scientific names, we decided to use older genus names instead of the newer ones.

We would like to thank all the authors for their time and patience with our editorial suggestions and changes. We would also like to thank the editors and publisher of "Fragmenta Faunistica" for making such a special thematic issue possible. We are planning a detailed analysis using data presented from all the contributing papers. The analysis will be published in other journal(s), as the subject of such paper(s) is far beyond the scope of "Fragmenta Faunistica". We hope the presented results as well as all generalizations concerning those findings will stimulate future studies and especially help in conservation of this specific group of vertebrates in towns and cities.

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STRESZCZENIE

[Płazy polskich miast – aktualny stan badań]

Z wielu powodów urbanizacja działa niekorzystnie za płazy. Dlatego też zwierzęta te wycofują się ze środowiska miejskiego, zmniejszając tu swoją liczebność lub wręcz całkowicie zanikając. Dane dotyczące batrachofauny zamieszkującej miasta są niewystarczające, co uniemożliwia podjęcie skutecznych działań ochronnych wobec tej grupy zwierząt. Dlatego też tak istotne dla określenia mechanizmów zanikania płazów na terenach zurbanizowanych było zebranie i usystematyzowanie według spójnej metodyki wyników badań płazów z 9 polskich miast (Białystok, Gniezno, Lublin, Olsztyn, Oława, Słupsk, Wałbrzych, Wrocław i Zielona Góra). Na terenach badań stwierdzono w sumie 13 gatunków płazów plus mieszańca hybrydogenetycznego – żabę wodną *Rana* kl. *esculenta* Linnaeus, 1758. W poszczególnych miastach stwierdzano od 9 do 13 taksonów. Brak pozostałych gatunków płazów wschodzących w skład polskiej batrachofauny związany jest najprawdopodobniej wyłącznie z przebiegiem ich zasięgów geograficznych.

Zebrane w monografii publikacje mogą stanowić punkt wyjścia do szerzej zakrojonych badań płazów na terenach polskich miast oraz do podjęcia właściwych działań ochronnych, które pozwolą na zachowanie ich populacji w tym nieprzyjawnym dla nich środowisku.

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