Małgorzata Łaciak, PhD thesis

„Habitat parameters relevant for the occurrence and reproduction of yellow-bellied toad *Bombina variegata* in river valleys"

SUMMARY

Metapopulation theory is a fundamental concept in contemporary nature conservation. Its application stems from the ever-increasing, human-induced fragmentation of natural habitats. This has given rise to the situation where populations of many species occur in spatially restricted habitats in which their continued existence cannot be guaranteed. Hence, the sole mechanism preventing their extinction is constant dispersal and recolonisation of habitats during which individuals are exchanged between sub-populations, the whole forming a stable system.

Amphibians are those terrestrial vertebrates most vulnerable to extinction, so taking effective conservation action for this group of animals is an urgent necessity. However, in order to be able to effectively protect particular species, highly specific knowledge of the mechanisms underlying their distribution, abundance, dispersal and reproductive decisions is needed. At the forefront is an understanding of how amphibians function under conditions of ongoing habitat loss and fragmentation, and the identification of key habitat features that can guide the animal during its dispersal so that population connectivity is ensured. Because in natural conditions the main factor influencing amphibian populations is reproduction in spatially restricted habitats, these animals are generally assumed to function in a metapopulation system. However, little is known about their breeding potential in habitats, and above all, not much is known about the distribution and movement of amphibians in the matrix separating habitats. These are issues that require in-depth research in relation to individual species.

This PhD thesis is based on two scientific publications and one manuscript submitted for publication. Its aim was to investigate the influence of a set of environmental factors on the occurrence and reproduction of the yellow-bellied toad *Bombina variegata* in the Biała River valley in the Ciężkowice Foothills (Małopolska province, southern Poland). The yellow-bellied toad is a small anuran amphibian, protected by Polish law (strict protection with recommendations for active protection) and also international law (Council Habitats Directive

EEC92/43 − Annexes II and IV, Bern Directive − Annex II). The field research was carried out between 2011 and 2016.

In paper (I), I describe the influence of succession in water bodies on the efficiency of metamorphosis in yellow-bellied toads and present the results of a study investigating the pressure of certain predatory invertebrate species on the survival of the early developmental stages of these toads. The results of the field experiment show clearly that the more advanced the succession in a water body, the less successful is yellow-bellied toad metamorphosis in it. I demonstrate that the principal, though underestimated, factor governing the reproduction of these amphibians is the presence of predatory invertebrates, which cause high mortality of toads in their early life stages. I have also demonstrated experimentally the extent of predation by different invertebrate species.

In article (II), I address the topic of predation on adult yellow-bellied toads. By using telemetric methods, I was able to show that adult toads, contrary to popular opinion regarding their toxicity, are relatively frequent prey for predators, primarily the grass snake *Natrix natrix*. Neither the toad's strong venom nor the bright colouration of its ventral side provide effective defence against the grass snake. This work demonstrates that bright colouration may serve purposes other than defence, which only coincidentally co-occur in a toxic animal.

Paper (III) gives a more extensive description of the spatial functioning of yellow-bellied toad populations in a river valley. The results of the study, based on telemetric data, indicate that the river (and more broadly other aquatic habitats) plays a crucial part as a major landscape feature concentrating the distribution of toads both during and outside the breeding season. Nevertheless, there are highly dispersive individuals in the population that do not exhibit 'anchoring' behaviour in a particular body of water. It is these individuals that ensure the connectivity of the population and the maintenance of the metapopulation.

The results presented in this thesis show that river valleys are an extremely important environmental element in the functioning of yellow-bellied toad populations. If a river is natural, it provides dispersal opportunities for the toads and creates small, temporary and predator-free water bodies, optimal for their breeding. In view of this, conserving river valleys (and rewilding them as far as possible) may also be crucial for the protection of yellow-bellied toads.