Herpetological methods:
I. On the use of the road transect method in surveying amphibians with examples from different zoogeographical regions of Hungary

By

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Abstract. Road transect survey can be a useful method in monitoring amphibians especially when the herpetofauna is poorly known and the available resources and personnel are limited. Besides providing fast data collection over a large area, this method also helps to conserve amphibians along the surveyed route by highlighting the distribution of the most frequent amphibian crossing sections, where mitigation measures should be carried out to lower amphibian road casualties.

The rapid destruction of many ecosystem types and the disappearance or serious decline of many species in the last three decades of the 20th century stresses the importance of environmental investigations. Among other programmes, large-scale zoological research projects are needed to understand, conserve and improve the present diversity of species, the stability and functioning of ecosystems on Earth (Purvis & Hector, 2000). Standardisation together with the testing of new methods to develop better sampling protocols is a key element of the process.

Among animals, freshwater organisms seem to be most threatened (Abramovitz, 1996; IUCN, 1996). Amphibians are among those groups, which need extra attention due to their biphasic life cycle, increased sensitivity and moderate migrating capacity. Their increased vulnerability was recognised early (Wake, 1991; Griffiths & Beebee, 1992) and a standardised protocol was compiled by Heyer *et al.* in 1994, which also included night driving as a supplementary method.

In several countries in Europe and elsewhere, herpetological research projects should include additional tasks for comparison with those countries where amphibians are better studied (Gasc *et al.*, 1997). In some regions basic (e.g. species distribution) data are still missing. Hungary is one of the countries where it is still to be collected (Puky, 2000 a) at the beginning of the

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third millennium. Besides the compilation of reliable information from thepast, further investigations are needed to cover the whole country. Financial resources and personnel are limited for this task, which urges the use of time- effective, low cost methods, which are suitable for surveying large areas fast but do not require a high number of investigators.

The road transect method was tested over three years in four different regions in Hungary. The methodological results of this work are presented and discussed in this paper.

Fig. 1. Location of the investigated areas in Hungary. (Bükk National Park includes the Eastern-Cserhát and the Mátra Landscape Protection Areas, too)

Sites and methods

In 1998 a new herpetological project was launched in Hungary to determine the extent of road casualties on the existing road system and work out appropriate mitigation solutions (Simonyi et al., 1999). The road networks in and around four national parks were studied for at least eighteen months, up to autumn, 2000. The Danube – Ipoly National Park is situated north of Budapest on both sides of the Danube (Fig. 1) mostly including mountains and riverine ecosystems. The Bükk National Park and the Mátra Landscape Protection Area are the highest regions in the country with the highest peak of

1,015 m above sea level. Here the survey area also included the Eastern-Cserhát Landscape Protection Area, a forested mountain range. The northern and central part of the Körös - Maros National Park includes a strikingly different lowland area dominated by rivers and canals of low flowing velocity in the southeastern part of the Great Hungarian Plain. Approximately 250 km of road was investigated in each of these regions.

A fourth protected area; the Balaton Uplands National Park with a 407 km road network was surveyed in 1999–2000. Due to the work of several authors the herpetofauna of the Balaton Uplands National Park is relatively well studied providing an excellent area for comparative studies. To test the effectiveness of the road transect method further, in April, 2000 a 187 km road section from Zalacsány to Veszprém was surveyed in the central part of the region in a single night.

The speed of the investigation was selected to be appropriate for the actual task. It varied from 15–35 km/hr during night driving and reached 50 km/hr during the day. Peak migration sections (i.e. over 50 individuals/km) were covered on foot. Both live and dead amphibians were recorded. Besides the characteristics of the crossing populations and road casualties, the surrounding habitats were described and if necessary mitigation measures were also suggested.

Results and discussion

Figure 2 shows the species composition and number of amphibian populations crossing roads in three protected regions in Hungary. Road casualties reflect well the local amphibian fauna. In the middle mountains *Bufo bufo* and *Rana dalmatina* (at high elevation with *Rana temporaria*, lower with *Hyla arborea*), in the lowlands *Bufo viridis* and *Rana esculenta* „complex" predominate.

Road transects can also be useful if only very limited time and personnel is available in case the survey is carried out under optimal conditions. In April 2000 a high number of amphibians (more than 1,500 individuals) was recorded during a night survey between Zalacsány and Veszprém. The species number of amphibians was strikingly high; altogether nine taxa were recorded. As this single night survey indicated all species (except *Bombina variegata*, which had been known only from one site in the investigated area) in the region (Ilosvay, 1985; Marián, 1988), it proved the usefulness of the method for mapping purposes.

Road transect is an effective method if environmental conditions are optimal, when, as the above described investigation proved, even a single night survey can provide reliable data on the presence of species. On the basis of a 120 day survey over a seven year period, rainy or very humid (over 95%) conditions with no or little wind are necessary (Schád *et al.*, 1999) during the migration period to get the best results. Besides the breeding migration in spring, the summer migration of juveniles, or to a lesser extent autumn

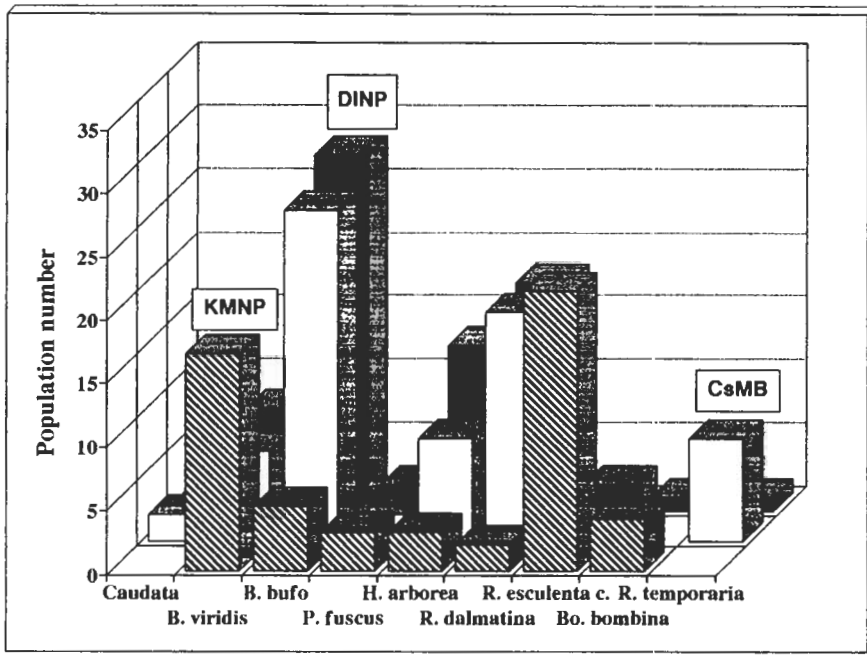

Fig. 2. Number of amphibian populations migrating over roads in three Hungarian national parks. (DINP = Danube - Ipoly National Park; CSMB = Eastern-Cserhát and Mátra Landscape Protection Areas, Bükk National Park; KMNP = Körös - Maros National Park)

migrations can also be effectively studied. The survey should be started after sunset and continued while amphibians are active, i.e. usually until midnight but on rainy nights it can last till nearly sunrise.

The road transect method has several limitations, which should be taken into consideration when the results are evaluated. Small animals (e.g. *Triturus vulgaris*) are often difficult to see especially when they are hit by the wheels and their presence can be underestimated. As a consequence, individual numbers recorded with this method are biased toward large animals and also toward species with longer migration routes. Amphibians with a short migration radius (e.g. *Rana arvalis*) are found on roads less frequently than their close relatives (e.g. *Rana dalmatina*) which cover longer distances. Local conditions are also crucial. If the road network is not developed, breeding sites are far from roads or most individuals hibernate near the breeding sites, certain species might not be detected or their relative individual number underestimated. In those cases other methods should also be used. Traffic intensity greatly affects the number of killed amphibians. However, as

amphibians tend to stay on the surface of roads longer due to its special microclimatic conditions or even for foraging, the presence of live specimens on roads can be an important indicator when gathering information on the local amphibian fauna (Puky, 2000 b).

Safety regulations are especially important to follow when the road transect method is carried out. For safety reasons it should not be applied if the traffic is too busy (at around 75 cars/hr and above) over the period of the investigation, when observations are also very difficult to make. Sudden stops should be avoided and the actual investigation of the animals should be done with extra care. At least two investigators should join for night transects but the ideal team is made of three people. Light reflecting clothes are advisable to wear by those who check amphibians out on the road to reduce the risk of accidents.

Road transect is an optimal method for making preliminary surveys for amphibians, covering relatively long distances in previously poorly studied areas. As at the moment basic herpetological information is missing from many areas in Hungary and in neighbouring countries, road transects can effectively be used in collecting such information in these regions. It is suggested that it be used extensively in the production of general, 10 km × 10 km UTM species distribution maps as the road network of the country is developed enough for this task.

As all amphibians are protected by law in Hungary, this method can also support other research projects e.g. by providing an opportunity to supply tissue samples for genetical studies without harming live individuals. Besides a fast data collection over a large area, this method also helps to conserve amphibians along the surveyed route by highlighting the distribution of the most frequent amphibian crossing sections, where mitigation measures should be carried out to lower amphibian road casualties.

Summary

1. Basic herpetological data (e.g. on species distribution at a national level) are still missing in Hungary.

2. Besides the compilation of reliable information from the past, further investigations are needed to complete this data collection.

3. Due to limited financial resources and personnel, the use of time-effective, low cost methods is highly recommended.

4. The road transect method was applied along a 1,160 km road network in and around four national parks.

5. Road transect limitations include a biased result toward large amphibians with long migration routes, which should be taken into consideration when the results are evaluated.

6. Safety regulations are important to follow to avoid accidents during fieldwork.

7. Road transect proved to be an effective survey method and it is suggested to use it extensively in the production of general, 10 km × 10 km UTM species distribution maps.

8. The application of this methodology can also support other amphibian projects by the collection of specimens and the conservation of the group by highlighting the distribution of the most frequent amphibian crossing sections.

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