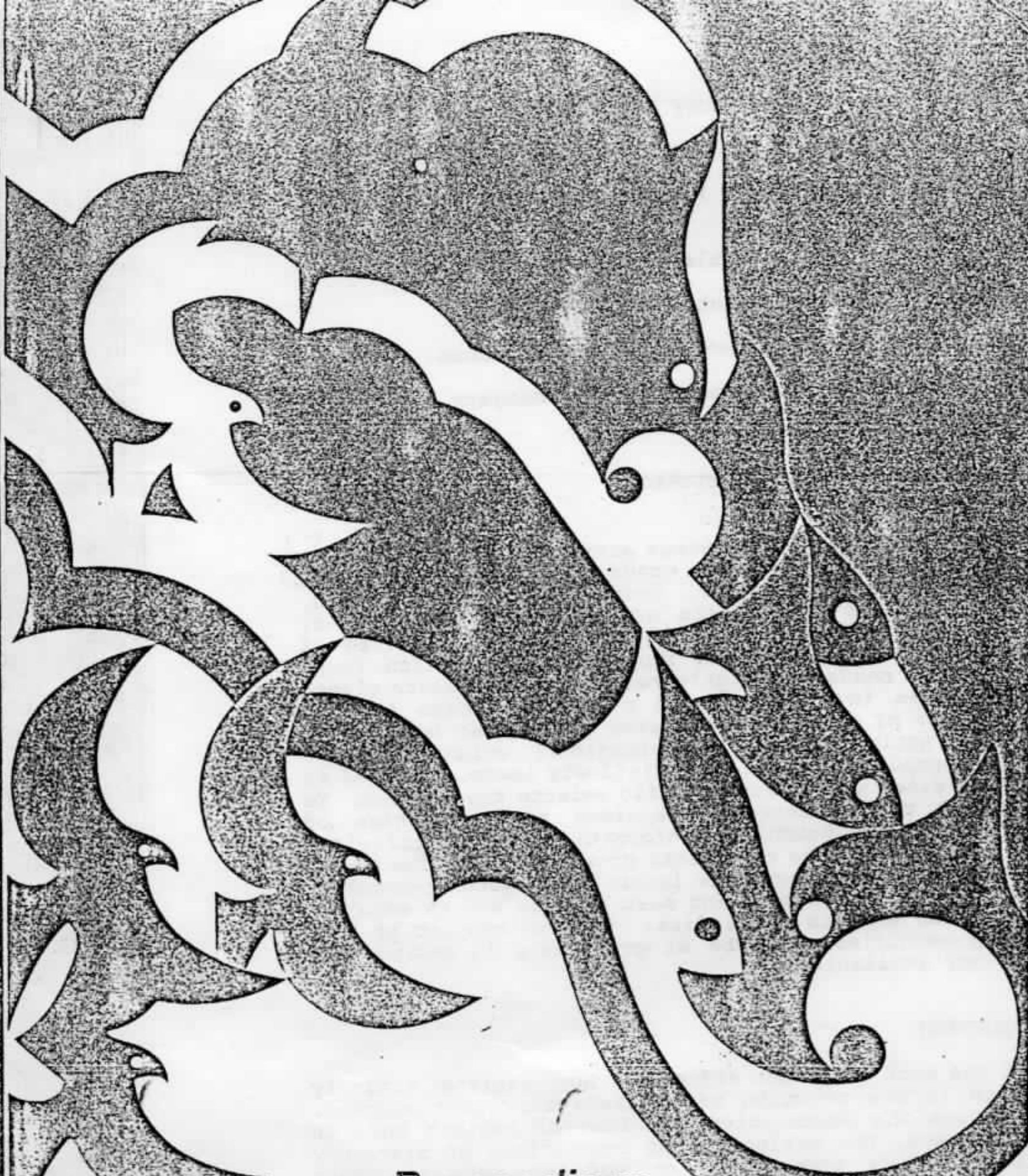

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THE ROLE OF TECHNOLOGY IN SOLVING A MAN-MADE BARRIER-CORRIDOR PROBLEM IN HUNGARY'S PARKS AND RESERVES: THE CONFLICT BETWEEN ROADS AND AMPHIBIANS

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ABSTRACT

By dividing otherwise continuous areas of distribution into artificial subcomponents, roads represent significant barriers for certain species. Constructing road corridors, which can reduce the numbers of individuals in an area, potentially causing serious problems for the survival of affected populations, is an important conservation task. The effect of roads on a highly vulnerable vertebrate class, Amphibia, was investigated and a general scheme for the organization of a corridor-building project was improved by the Toad Action Group, a professional voluntary body. Effective population size was relatively lower, compared to a control site, where heavy traffic selects the animals. To understand this phenomenon requires the collection of geographical and botanical information. In particular, local features must be taken into consideration. The use of remote sensing and geographic information system technology would provide the fastest and most precise way to acquire, process, and analyze these data. Western support of East European countries could be of great help in making this technology available.

INTRODUCTION

One of the most important effects of Homo sapiens' activity on earth is the creation of barriers for other species. This causes the degradation and loss of habitat and, in certain cases, the extinction of populations of migratory species. As a consequence one of the most important contemporary tasks for conservationists is to provide corridors for migrating animals through man-made barriers to reestablish areas of continuous distribution.

The Most Common Corridors. The most common corridors are roads. They have direct effects on wildlife -- one million vertebrates are killed daily on the roads of the United States (Pierson, 1987). Roads also cut the original vertebrate habitats into smaller and smaller segments, increasing the probability of destabilization of different populations (e.g., through inbreeding).

Protected Areas in Hungary. Hungary contains four national parks and five biosphere reserves (Fig. 1, Table 1). In addition to these highly protected areas there are several hundred protected sites all over the country. Altogether 5.5 per cent of the country is protected.

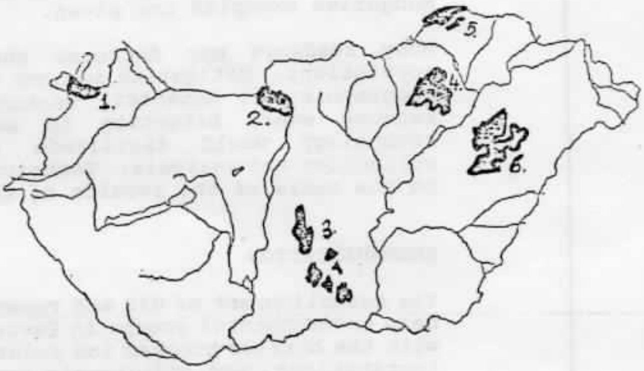

Fig. 1. Hungarian National Parks and Biosphere Reserves. 1 = Fertó, 2 = Pilis, 3 = Kiskunság, 4 = Bükk, 5 = Aggtelek, 6 = Hortobágy.

The Most Endangered Vertebrate Class. On the basis of a World Wildlife Fund survey in Austria, which borders Hungary (Waringer, Löschenkohl, Hiller, 1988) and a Hungarian census (Fenyves, 1989), of all the vertebrates Amphibia are threatened the most by roads in central Europe. The reason for this is that most temperate-zone species migrate considerable distances to breeding ponds and summer habitats, crossing roads in the process.

Table 1. Hungarian National Parks (NP) and Biosphere Reserves (BR).

NAME	AREA (Hectares)	PROTECTED FEATURES	CATEGORY
Fertó	12,500	Large saline lake	BR
Pilis	23,300	Forest Mountains	BR
Kiskunság	30,600	Sand dunes, saline lakes	NP, BR
Bükk	38,800	Densely forested plateau	NP
Aggtelek	19,600	Cave system	NP
Hortobágy	52,000	Loess "puszta"	NP, BR

To investigate the effect of roads as artificial selective factors on amphibians and to find a solution to the problem of road kill, a voluntary professional body, the Toad Action Group (TAG) (Puky, 1989a) was founded four years ago. The potential role of technology in solving road accidents is explored in this paper through two TAG projects: in the Börzsöny Mountains and along the corridor of a proposed roadway, MO.

SITES AND METHODS

Börzsöny Mountains. Two sites were selected for amphibian research and rescue in the Börzsöny Mountains in northern Hungary. Parassapuszta is a border station on an international road between Czechoslovakia and Hungary. In 1986 measures were taken to mitigate the problem caused by animal migration. Királyrét, some 20 km distant and without overlap or disturbance, served as an ideal control site. TAG tested the hypothesis that busy roads can variously effect different dynamic population parameters. The effects of a constructed ditch-culvert systems were also investigated.

Mo. The MO motorway is a beltway of at least 85 km under construction around Budapest. The Hungarian Ministry for the Environment contracted with TAG to investigate the construction and to recommend modifications, if required. TAG subsequently revised a standard questionnaire, to be used at other localities, too.

RESULTS

Population dynamics. Comparisons were made between the *Bufo bufo* populations of Parassapuszta and Királyrét. In a test both males and females of Parassapuszta turned out to be significantly longer (P = 5%) than those of the control area. This is clearly a multi-factor dependent characteristic (e.g., food), so I cannot say more except that it is in agreement with the tested hypothesis: that animals are shorter where road creases selected them (Csapó *et al.*, 1989; Puky *et al.*, 1990).

Another parameter studied was the effective population size. It is the average number of individuals in a population that were assumed to contribute genes equally to the succeeding generation (Nei, 1987). This is an important concept in the conservation of unisexual animals, because it takes into account the sex ratio and the number of offspring per individual. A striking difference was found between the sites, making the effective population sizes of different amphibian species relatively much lower at Parassapuszta than at Királyréti. This meant lower viability of the populations. There is a critical effective population size below which the number of individuals must not sink, especially if barriers, such as roads, are causing isolation. High levels of genetic distancing due to population decrease cannot be adequately compensated by immigrating individuals (Reh, 1989).

Technical Solutions. In 1986 a ditch-culvert system was constructed at Parassapuszta. Ditches, which should have directed the animals, were paved with concrete panels containing acute angles between 57 and 74 degrees (Csincsa, 1986). The ditches were neglected, however, and subsequently filled with branches, leaves, and rubbish. TAG cleaned them to test whether they worked. Unfortunately, this failed, because all species in the area, including the common newt, Triturus vulgaris, and the fire-bellied toad, Bombina bombina, can climb up to the road. There is no one solution. However, if the panels had been fixed in greater angles they could have prevented amphibians climbing up to the road, although they would not have stopped the European tree frog, Hyla arborea. On the other hand, special toad or salamander tunnels have also been constructed that have been successful at preventing amphibians from going onto roads (e.g., Amherst, Massachusetts, and Henley-on-Thames [Jackson, Tyning, 1989; Langton, 1989]). These systems, planned specifically for the needs of the local fauna and the features of the area, work better than modifications like the systems at Parassapuszta.

MO. To collect data on amphibians surrounding a beltway under construction around Budapest, MO, in 1988 the Ministry for the Environment and TAG entered into a three-year contract to find best long-term solutions (the road will not be finished until after the year 2000). In the first year (1988)eight sites were selected for more detailed study in two subsequent years. Throughout 1990 the sites with the largest populations were also examined quantitatively (Puky, 1989b). During the study, an existing questionnaire was revised. The data collected related to either geographical or botanical features associated with either the construction of the road or the biology of the organisms. The questionnaire contained the date and the place of the survey, the name, area, depth, and type (e.g., swamp) of the water body, its distance from the planned road, the estimated areas in each water body covered by shrubs, the number and species of amphibians, the type of developmental stage observed, and other remarks of importance. The annual fluctuation of characteristics such as water depth can be interesting as well, so we estimated some of them.

Potential Use of GIS and Remote Sensing. Such a type of data collection is time-consuming, difficult, and could be partly replaced by faster, more precise, and, potentially, more effective GIS and remote sensing techniques. The required data depend on the species and the actual construction project. Data could be obtained from standard field techniques, but changes occurring in the area could be recorded using remote sensing methods. This would guarantee an up-to-date information system. Implementing and using such a system is a real need and can be one important kind of help that Western countries can provide to Eastern Europe.

SUMMARY

One of the most important contemporary conservation tasks is the creation of corridors for migrating species through man-made barriers. Technology is seen as having a potential role in helping to provide corridors through roadways for the most threatened vertebrate classes, the Amphibia. Two Hungarian examples are given.

Busy roadways may decrease the viability of amphibian populations. Mitigating actions should include the study of geographic and botanical features in the affected area, because every situation is unique. The use of GIS technology would facilitate rapid and precise data collection and analysis. Technical fixes should be proposed on the basis of the results of the preliminary studies.

RECOMMENDATION

The establishment of GIS and remote sensing technology would help environmental groups in Eastern European countries deal with the barrier problem and related problems. Governments, institutions, and individuals are encouraged to contribute to this goal.

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AN INTEGRATED DATA MANAGEMENT SYSTEM FOR ECOLOGICAL MONITORING AND RESOURCE MANAGEMENT IN CHANNEL ISLANDS NATIONAL PARK

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ABSTRACT

An integrated data management system for ecological monitoring and resource management has been implemented at Channel Islands National Park Headquarters, Ventura, California. For over ten years, a long-term ecological monitoring program has been in place at Channel Islands National Park, which now includes Anacapa, Santa Barbara, San Miguel and Santa Rosa Islands, and part of Santa Cruz. Data have been collected for terrestrial and marine flora and fauna, along with records of weather and ocean conditions. The datasets are used both for scientific research and for resource management. To make these data more accessible and useful for statistical and spatial analyses, an integrated natural resources data management system has been implemented which incorporates database management, statistical analysis, and GIS/IP (geographic information system/image processing) on a LAN (local area network).

The GIS database now under development will enhance the Park's ability to display and analyze spatial data for scientific research and resource management . Planned GIS thematic data layers are vegetation, soils, topography, bathymetry, hydrology and distributions of species and communities which are the focus of the Inventory and Monitoring Program, including pinnipeds, seabirds, rocky intertidal communities, kelp forests, terrestrial vertebrates, land birds and fisheries. The integrated database management system affords more rapid access to data and more easily interpretable representations of spatial data for Park Scientists and Resource Managers. This system also provides the basis for GIS modeling of resource management alternatives and natural phenomena in the years to come.

INTRODUCTION

The Channel Islands National Park was established to protect the natural resources of the Channel Islands of California. The enabling legislation for the Park stipulated the development of "an inventory of all terrestrial and marine species, indicating their population dynamics, and probable trends as to future numbers and welfare" (16 USC 410ff). Effective management of the Park's natural resources is made more difficult by the current lack of adequate information on the long-term dynamics of the resources. Consequently, the Channel Islands National Park has designed and partially implemented a long-term ecological monitoring program of the population dynamics of selected taxa within the Park. The monitoring program is designed to provide data necessary for the Park to achieve its stated objectives of protecting Park resources and developing a deeper ecological understanding of the Park ecosystems upon which future management decisions could be based (Davis 1983, Davis and Ehorn 1986).