PROGRESS IN PROTECTING WILDLIFE FROM TRANSPORTATION IMPACTS IN HUNGARY AND OTHER EUROPEAN COUNTRIES

Ágnes Simonyi
Technical and Informational Services on National Roads
Budapest, Hungary

Miklós Puky
Institute of Ecology and Botany, Hungarian Academy of Sciences
Göd, Budapest

Tibor Tóth
Research Institute for Soil Science
Budapest, Hungary

László Pásztor
Research Institute for Soil Science
Budapest, Hungary

Botond Bakó
University of Agricultural Sciences
GödöllÅ, Hungary

Zsolt Molnár
Institute of Ecology and Botany, Hungarian Academy of Sciences
Vácrátót, Hungary

Abstract

Infra Eco Network Europe B IENE

19 European countries form an international network for knowledge and experience transfer in the field of habitat fragmentation and infrastructure. The network was initiated, financially supported and co-ordinated by the Road and Hydraulic Engineering Division in the Netherlands. In July 1998 the co-ordination of IENE was taken over by the Swedish National Road Administration. Five international IENE meetings has been arranged since 1996 giving good opportunity for the dissemination of various research results and practical solutions. In a new action of the COST program of the European Community, a State of the Art Report on habitat fragmentation at European level (June 2000), a European Handbook on Defragmentation (autumn 2002) and an on-line database (autumn 2002) will be produced by 11 participating countries. The usefulness of co-operation is illustrated with the summaries of two presentations from the 5th IENE meeting.

Progress in protecting wildlife from transportation impacts in Hungary

Hungary is located in the Eastern part of Central Europe. Two-third of its territory is plain along two main rivers, the Danube and the Tisza, one third is hilly. The geographical location and the historical pattern of the existing transportation networks determine the considerable EastBWest and NorthBSouth transit traffic. In Hungary 9 national parks encompass most of the country's natural heritage. During the last decade wildlife protection has become an important issue in Hungary and habitat fragmentation due to transportation is taken into consideration. Measures have already been taken: amphibian tunnels were built under existing roads, and there are new game tunnels and two green bridges.

Knowledge transfer is essential on different fields of transport related environmental protection, therefore Hungary takes part in IENE and COST 341. International co-operation stimulates research activity, for example there is a new program of amphibian road kill survey, several case studies are under work in addition to the National State of the Art Report from which we present here the mapping of fragmentation.

Introduction

This paper is about two main topics:

- A European initiative (Infra Eco Netwok Europe) and efforts on the field of habitat fragmentation due to transportation
- Progress in protecting wildlife from transportation impacts in Hungary

Infra Eco Network Europe (IENE) http//iene.vv.se

The establishment of IENE is an initiative of the Road and Hydraulic Engineering Division of the Dutch Ministry of Transport, Public Works and Water Management. In this network policy-makers, planners, implementors and researchers are involved whose work is connected with habitat fragmentation and infrastructure.

The network was financially supported and co-ordinated by the Road and Hydraulic Engineering Division in the Netherlands until June 1998. In July 1998 the co-ordination of IENE was taken over by the Swedish National Road Administration.

Participating countries in IENE

19 European countries form the network: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Romania, Russia, Slovenia, Spain, Sweden, Switzerland, United Kingdom. These countries are represented by a national coordinator, whose tasks are:

- to build up and to maintain a national Infra Eco Network
- to organize IENE meetings in his/her land
- to make information flow within the network

Five international IENE meetings have been arranged since 1996.
1st IENE meeting in Danube Delta, Romania, 9B11 October 1996.
2nd IENE meeting in Hoga Kusten, Sweden, 9B13 April 1997.
3rd IENE meeting in Vladimir, Russia, 28 SeptemberB2 October 1997.
4th IENE meeting in Brig, Switzerland, 22B26 April 1998.
5th IENE meeting in Budapest, Hungary, 14B17 April 1999.

Goals of IENE

IENE is involved in the phenomena of habitat fragmentation caused by the development and use of main networks of infrastructure (roads, waterways, railways). IENE promotes co-operation and exchange of knowledge between the sectors of environment and infrastructure both on national and European levels. The general goal of IENE is to promote a safe and sustainable pan-European transport infrastructure through recommending measures and planning procedures to conserve biodiversity and reduce vehicular accidents and fauna casualties. The negative impacts on biodiversity caused by the networks of motorways, railways and waterways are: loss of habitats, fauna casualties, barrier effect, disturbance (noise and light) and local pollution. IENE disseminates the results of various researches and gives practical solutions to reduce impacts during the construction, use and maintenance of linear transportation infrastructure. Furthermore, new directions for research will be drawn according to the actual and future needs.

COST 341 `Habitat fragmentation due to transportation infrastructure@

IENE promotes international and multidisciplinary research in the field of transportation infrastructure and nature. In this context, a new action in the framework of the COST (Co-operation in the field of Scientific and Technical research) program of the European Community has been proposed. The initiator of the proposal was the Road and Hydraulic Engineering Division of the Dutch Ministry of Transportation, Public Works and Water Management in early 1997. The products of this new COST Action are:

? State of the Art Report on habitat fragmentation at European level (June 2000)
? European Handbook on Defragmentation (autumn 2002)
? on-line database (autumn 2002)
? a final report should be available in spring 2003.

Participating countries in COST 341

11 European countries participate in the COST action: Austria, Belgium, Czech Republic, Denmark, Hungary, Netherlands, Romania, Spain, Sweden, Switzerland, United Kingdom.

COST 341 and IENE

The differences between COST 341 and IENE are as follows:

? IENE is a network in Europe for exchanging information (results of research, experiences, raising new ideas) about habitat fragmentation due to transport infrastructure.
? The new COST action aims at the production of a State of the Art Report on habitat fragmentation at European level, a European Handbook on Defragmentation and a database.

5th meeting of IENE

The 5th meeting of IENE took place in Hungary between the 14th and the 17th of April 1999 and was organized and supported financially by the Swedish National Road Administration and the Hungarian Technical and Information Service on National Roads. The opportunity to exchange information were positively exploited during the meeting. To demonstrate the progress in protecting wildlife in several European countries here follows two abstracts from the several presentations.

The use of wildlife overpasses by mammals: results from infra-red video surveys in Switzerland, Germany, France and the Netherlands (Keller. 1999)

Wildlife passages link habitats which are divided by linear transportation infrastructure. Several bridges mainly across motorways have been constructed in Europe in the last decades. The aim of the project led by the Swiss Ornithological Institute was to study the effectiveness of wildlife overpasses or "Grünbrücken" from an ecological point of view. 21 wildlife overpasses in Germany (8), Switzerland (6), France (4) and the Netherlands (3) were included in the study. The three most frequent species, roe deer (*Capreolus capreolus),* fox *(Vulpes vulpes)* and brown hare *(Lepus europaeus)* occurred in all study areas, while red deer *(Cervus elaphus)* and wild boar *(Sus scrofa)* were absent from some regions, and badger *(Meles meles)* and (pine or stone) marten *(Martes sp.)* occurred irregularly.

On broad bridges animals showed significantly higher rates of >normal= behaviour. Results confirm previous recommendations of a width of at least 50B60 m for wildlife overpasses for large mammals.

Large carnivores (bear, wolf, lynx), moose and trunk roads in Austria (Zedrosser and Völk. 1999)

Large mammals, especially large carnivores, are of major importance in habitat and wildlife conservation. Due to their relative rarity, large home ranges and great mobility population of large carnivores can never be protected and managed by just one country, but must always be seen in connection with the adjacent countries, and international co-operation is needed from several countries to ensure the long term survival of these species in Europe. The cited presentation shows the situation of the brown bear *(Ursus arctos),* lynx *(Lynx lynx),* wolf *(Canis lupus)* and moose *(Alces alces)* in Austria.

The data of migration routes of these animals in Austria and CentralBEurope was registered on a map of the existing trunk road system in Austria. Thus conflict areas could be identified where current and potential migration routes intersect trunk roads.

Planning on a large geographical scale is crucial for the future of large carnivores in Europe. Because populations of large carnivores are usually shared by different states, national and international considerations have to be taken into account when constructing roads. To maintain the connection between populations and to encourage natural expansion of existing populations international co-operation and information exchange is necessary.

Progress in protecting wildlife from transportation impacts in Hungary

Geographical location

Hungary is situated in the Eastern part of Central-Europe on a 93000 square kilometre territory. (Population: 10,2 million, GDP: 4370 USD/person) One third of the country is mountainous, the highest mountain peak reaches 1000 m above sea level, the rest of the country is a fertile plain crossed by two main rivers, the Danube and the Tisza. The capital, Budapest, has 2 million inhabitants and it is located on both banks of the river Danube.

The geographical location and the pattern of the existing transportation networks determine the considerable EastBWest and NorthBSouth transit traffic.

Conditions

Although a few results have been achieved in some areas (urban mass transport, civil aviation), today Hungary must face the task of resolving a series of accumulated and often contradictory problems of a transportation system under stress. While the density of Hungary's railroad network, even when compared with Western Europe is high, its technical conditions are inadequate. The motorway network's length and capacity ranks below the average of developed countries, for example the density of limited access roads is about 4,1 km per thousand square km.

The obvious insufficiency of the road network means that an intensive road building program has to be implemented. Some proposed and existing elements of the Hungarian national road network are in conflict with the ecological network. 9 national parks emcompass most of the country's natural heritage.Hungary has a wide range of natural habitats, the level of biodiversity is high, 3000 plant and 40000 animal species are known. During the last decade wildlife protection has become an important issue in Hungary and habitat fragmentation due to transportation is taken into consideration.

Conflicting areas

The most obvious issues to be presented here in details are related with amphibians and game. Measures to protect these groups have already been taken: amphibian tunnels were built under existing roads, and the M1 Motorway is the first road project with game tunnels and two green bridges.

Amphibian road kill survey over existing roads in national parks, landscape protection areas and their vicinity

In 1998 a new national project has been launched to survey and solve amphibian road kills in the most valuable natural areas, in national parks and landscape protection areas. In the first stage 250 km road network section was studied in the peak season of amphibian migration (spring and autumn) between sunset and midnight at several times. Data were evaluated and a classification was produced using a colour code system.

Colour code	Number of individuals	Traffic density	Amphibian road kill	Numeric code
red	high	high	great	1.
yellow	high	medium	great	2.
magenta	small	small	small	3.
grey	small	high	small	4.
green	high	small	very small	5.

Species with long migration distances (0,7B2,2 km) were found to be killed most frequently in all investigated areas. The common toad *(Bufo bufo)*, agile frog *(Rana dalmatina)*, common spadefoot *(Pelobates fuscus)* and around villages and towns the green toad *(Bufo viridis)* were the most common amphibians found dead on roads but nearly all amphibians living in the studied areas could be recorded including the European fire salamander *(Salamandra salamandra)*, which has a limited home range. In the case of the first two categories mitigation measures have been proposed.

The results of the first stage of this long term project demonstrated that the methodology is applicable and should be used in survey of other national parks.

Game bridges over the M1 Motorway

The alignment of the motorway runs in the proximity of the FertÅBHanság National Park, near the HungarianBAustrian state border. The park consist of wetlands with peculiar fauna and flora of European importance. The suitable places for the game bridges were chosen after several consultations with hunters about game movements. The shape of the bridge is curved, its minimum width is 20 m.

There is a monitoring program examining the usage of these bridges. After short hesitation several migrating animal use the bridges. 60B70% of the tracks came from wild boar *(Sus scrofa)*, 20B25% from roe deer *(Capreolus capreolus)*, 5B10% from red deer *(Cervus elaphus)* and fox *(Vulpes vulpes)* (Takács and Pellinger. 1999). The animals use the bridges of other unpaved agricultural roads as well. The number of accidents and fauna casualties has declined significantly due to the amendments of the fencing. Unfortunately the number of birds of prey killed is unchanging. The monitoring program is going on using systematic data collection from sand beds.

Hungarian activity in IENE and COST 341 Action

Realising that knowledge transfer is essential on different fields of transport related environmental protection, because countries in transition thus can avoid the unnecessary bypasses in the development using the experiences of other countries, Hungary takes part in IENE from the very beginning and joined in the COST Action as well.

Based on the appointment of the Hungarian Ministry of Transportation, Water Management and Communications the Technical and Informational Services on National Roads became the coordinating centre of IENE and COST 341 activities. The activity is supervised by the Authority for Nature Conservation of the Ministry of Environment.

Financial background is mainly provided by Road Fund (Provision for Road Maintenance and Development), from this year partly by Environmental Provision.

After signing the Memorandum of Understanding of "Habitat fragmentation due to linear infrastructure" the work on the Hungarian National Report has begun. Working groups were formed involving several institutions and universities such as Institute for Nature Reservation, Institute of Environmental Protection, Research Institute for Soil Science, Institute of Ecology and Botany, University of Sopron, National Park Directorates, consultant companies, individual researchers. The first version of the report on Hungarian State of the Art will be ready by the end of 1999.

Hungarian State of the Art C National Report on habitat fragmentation due to transportation

The report summarizes the existing knowledge and gaps on habitat fragmentation due to transportation, describes the Hungarian habitats and qualifies the habitats according to their sensibility. The participation in the international network IENE and COST 341 stimulated the research activity, several case studies have been initiated, whose results will also be summarized in the report.

Here follows a summary of a chapter from the Hungarian State of the Art Report.

Mapping of fragmentation

The aim was to prepare experimental maps on the conflicts of traffic and nature at the scale of 1:100000. These maps can be used for the selection of the viable routes of new roads. Two maps were prepared:

`Habitat value and traffic@ map

`Habitat value and traffic@ map is based on the modelled distribution of reptiles and amphibians. 10H10 km raster-maps on the distribution of these animals were used. Several ecological factors were then considered, such as temperature, soil type, precipitation, solar radiation amount, relief, vegetation, depth of soil. The accuracy of modelling was decided on the cross-table of reported and modelled occurrences of the species. Out of the ten species studied only the following four showed satisfactory accuracy for mapping.

Species	Uncertainty coefficient	Total accuracy (%)	Coverage of reported cases (%)
Amphibians			
Common frog *(Rana temporaria)*	0,28	92	74
Yellow-bellied toad *(Bombina variegata)*	0,21	89	69
Reptiles			
Aesculapian snake *(Elaphe longissima)*	0,12	89	49
Balkan wall lizard *(Podarcis taurica)*	0,11	82	63

The ecological factors for the occurrence of the four selected species were the following.

Yellow-bellied toad	Common frog	Aesculapian snake	Balkan wall lizard
yearly average precipitation:>650mm yearly average temperature:< 10,5°C forest, relative relief: 50B150m/km.	yearly average precipitation:<650mm yearly average temperature:< 9,5°C forest, relative relief: <50m/km.	yearly average precipitation:>50mm yearly average temperature:< 10°C forest, relative relief: 50B150m/km.	yearly average precipitation: 550B650mm sand

The road density data were weighted with the traffic data. The resulting measure shows how many cars pass through one km long segment of road inside a raster cell of 1 km^2 (the dimension is: $carHday^{-1}HkmHkm^{-2}$.)

The map showed that the approach was useful and that it could be applied immediately in the planning if enough data on a certain number of species had been available. Therefore the ecological modelling of the species must be improved as well as the survey of the occurrence of amphibians and reptiles.

`Habitat fragmentation sensitivity@ map

The basic maps were the CORINE Land Cover database, the AGROTOPO soil database and the maps of road and traffic. First an experimental map called the `Actual vegetation types of Hungary@ was prepared mainly on the basis of CORINE Land Cover at the scale of 1:100000. The forest patches were identified using of the forestry maps. The grassland patches were classified with the joint use of CORINE Land Cover and AGROTOPO soil database. To transform this map into the sensitivity map, its different categories were classified into sensitivity categories. For example the oak forests were classified having intermediate sensitivity, or the swamps having high sensitivity in terms of the fragmentation effect of roads. The data on traffic were treated as on the other map.

The map of Hungary shows the distribution of sensitive vegetation patches.

The detailed map of the `Kis-Balaton@ swampy region shows that the GIS database at the original scale of 1:100000 can be used in the evaluation of planned routes of new roads.

Conclusions

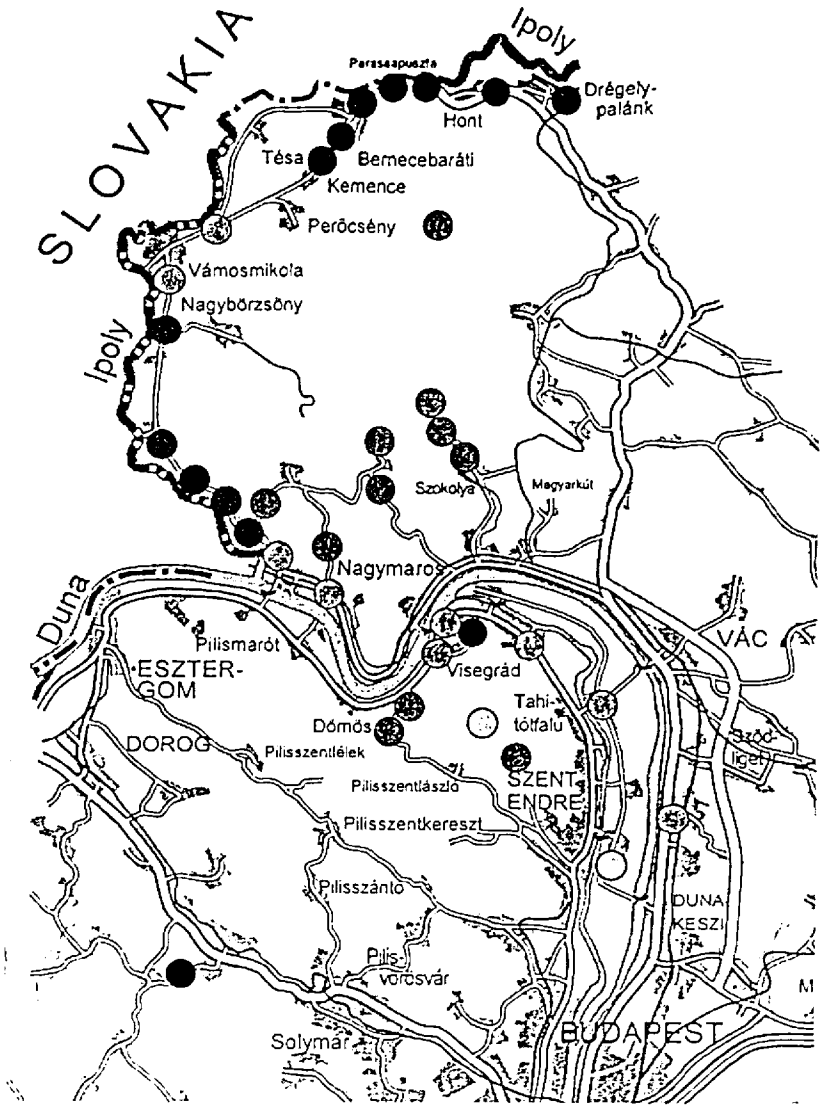
Knowledge transfer is essential on different fields of transport related environmental protection. International co-operation stimulates research activity and the participating countries can avoid the unnecessary bypasses in the development using the experiences of other countries.

References cited

Keller, V. 1999. The use of wildlife overpasses by mammals: results form infra-red video surveys in Switzerland, Germany, France and the Netherlands. In: 5th IENE meeting Budapest, Hungary, Report of the meeting. 27B28.

Zedrosser, A. and Völk, F. 1999. Large carnivores (bear, wolf, lynx) moose and trunk roads in Austria. In: 5th IENE meeting Budapest, Hungary, Report of the meeting. 24B27.

Takács, A. and Pellinger, A. 1999. Case study, evaluation of the use of game bridges, (in prep.)


SLOVAKIA
Ipoly
Parasapuszta
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Tésa
Bemecebaráti
Kemence
Perőcsény
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Nagybörzsöny
Ipoly
Szokolya
Magyarkút
Nagymaros
Duna
Pilismarót
ESZTER-GOM
Visegrád
VÁC
Tahi-tótfalu
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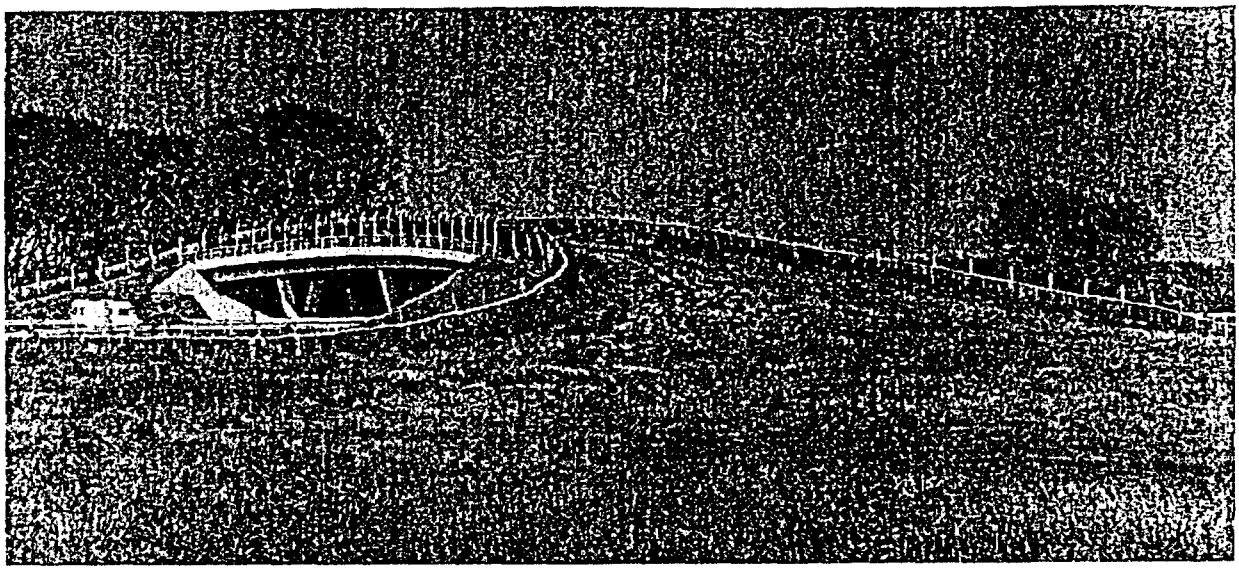
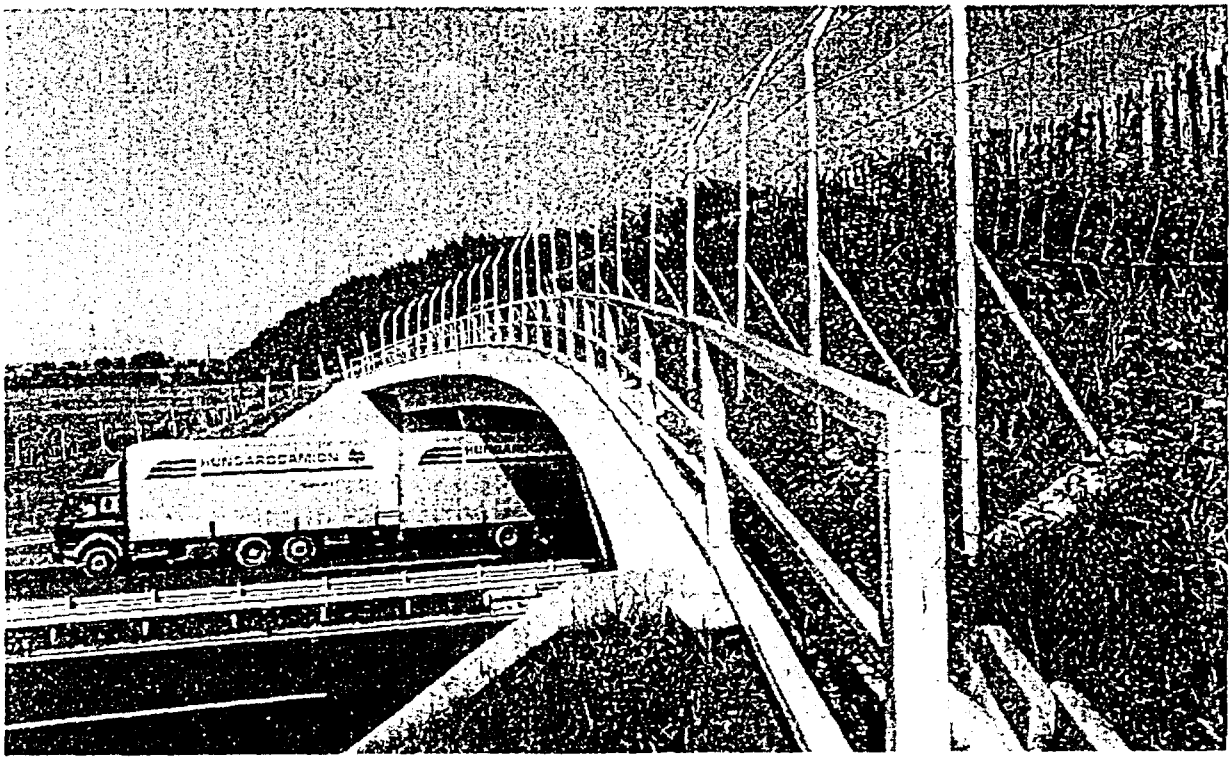
Solymár
BUDAPEST

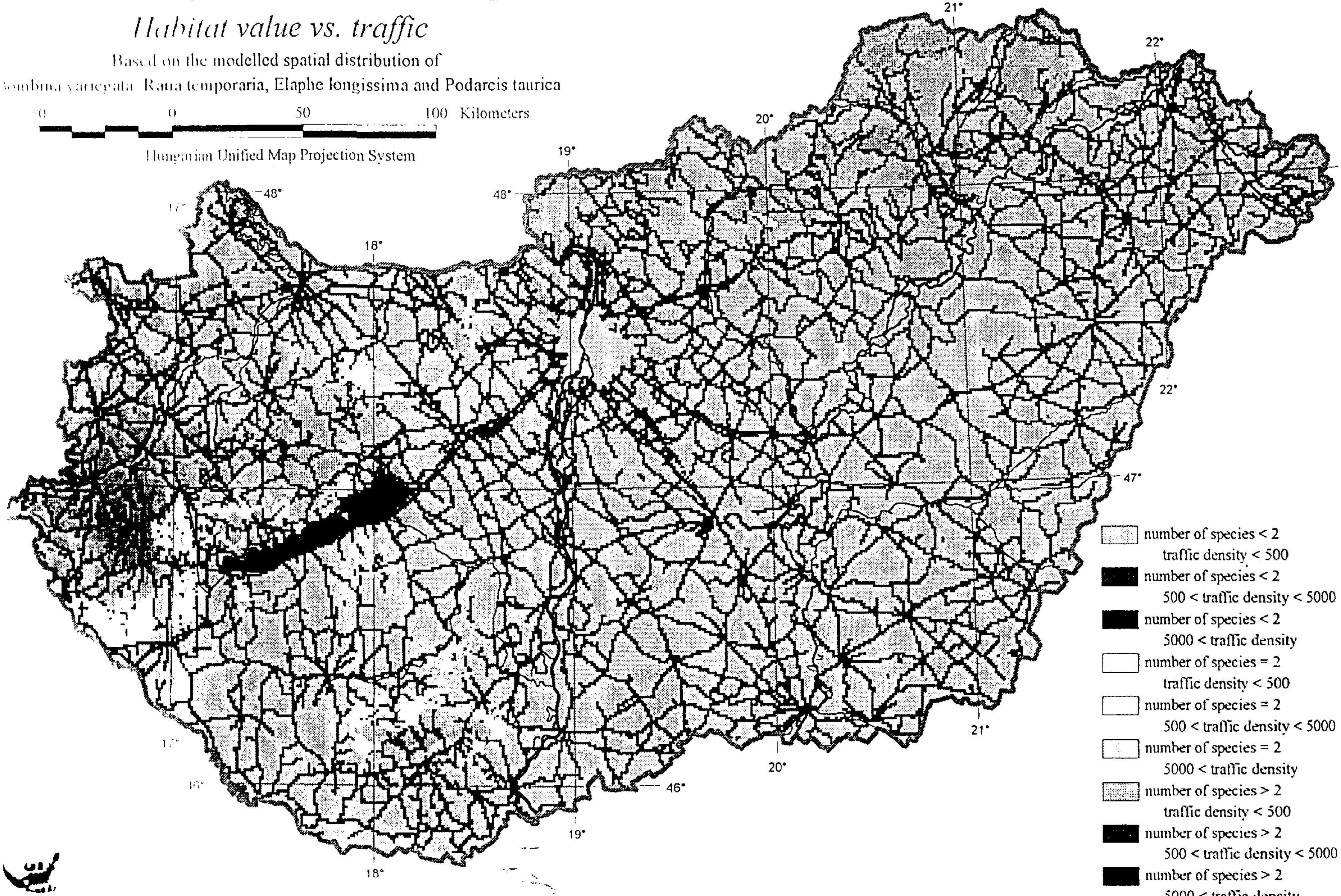



HUNGARCAMION

Habitat Fragmentation Conflict Maps

Habitat value vs. traffic

Based on the modelled spatial distribution of
Bombina variegata, Rana temporaria, Elaphe longissima and Podarcis taurica


0 50 100 Kilometers
Hungarian Unified Map Projection System
17°
18°
19°
20°
21°
22°
46°
47°
48°
number of species < 2
traffic density < 500
number of species < 2
500 < traffic density < 5000
number of species < 2
5000 < traffic density
number of species = 2
traffic density < 500
number of species = 2
500 < traffic density < 5000
number of species = 2
5000 < traffic density
number of species > 2
traffic density < 500
number of species > 2
500 < traffic density < 5000
number of species > 2
5000 < traffic density
[traffic density] = vehicle * day^{-1} * km * km

… in the frame of Habitat Fragmentation Mapping project
… databases, data of ÁKMI kht. and models of B. Bakó

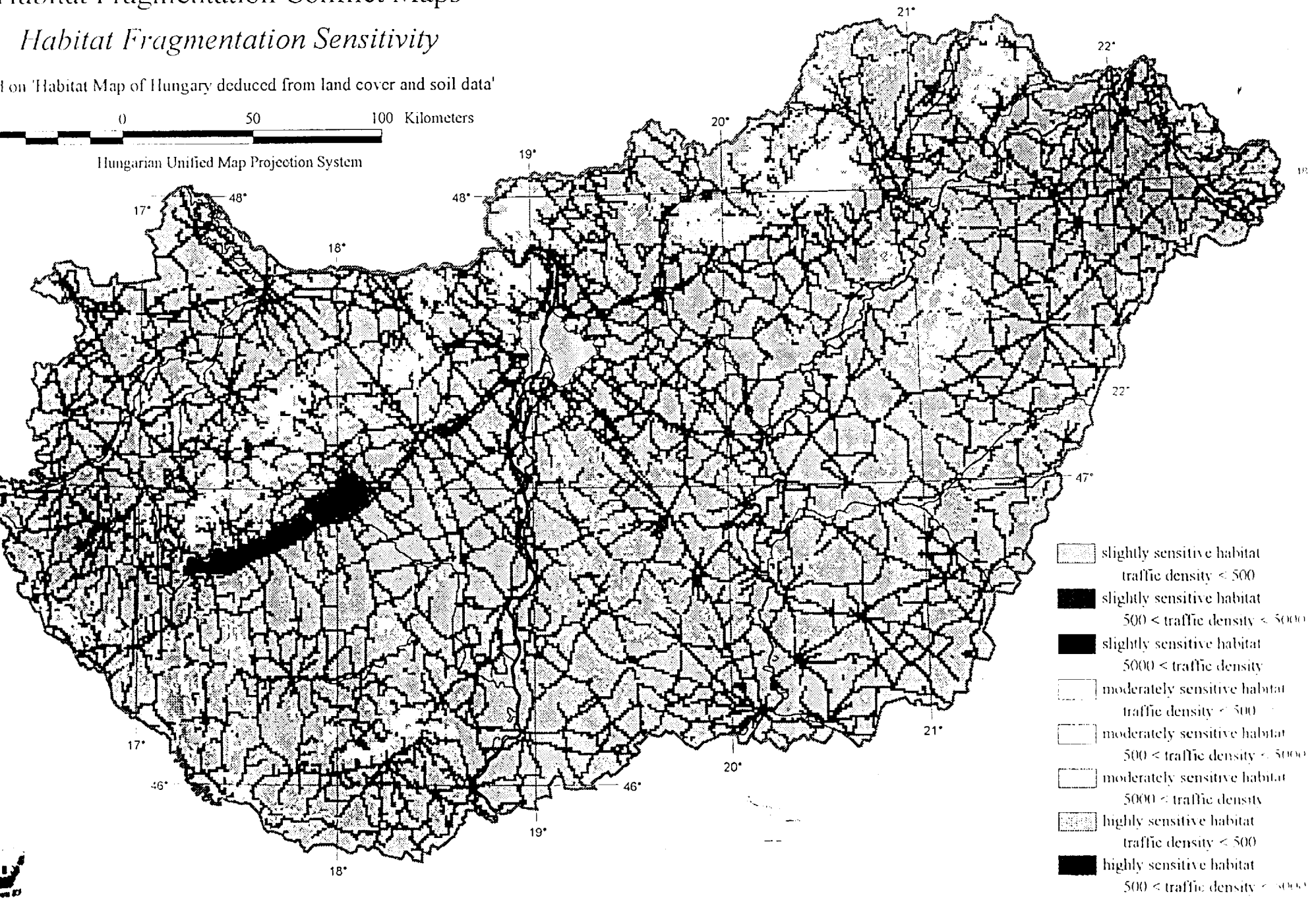
Habitat Fragmentation Conflict Maps

Habitat Fragmentation Sensitivity

d on 'Habitat Map of Hungary deduced from land cover and soil data'

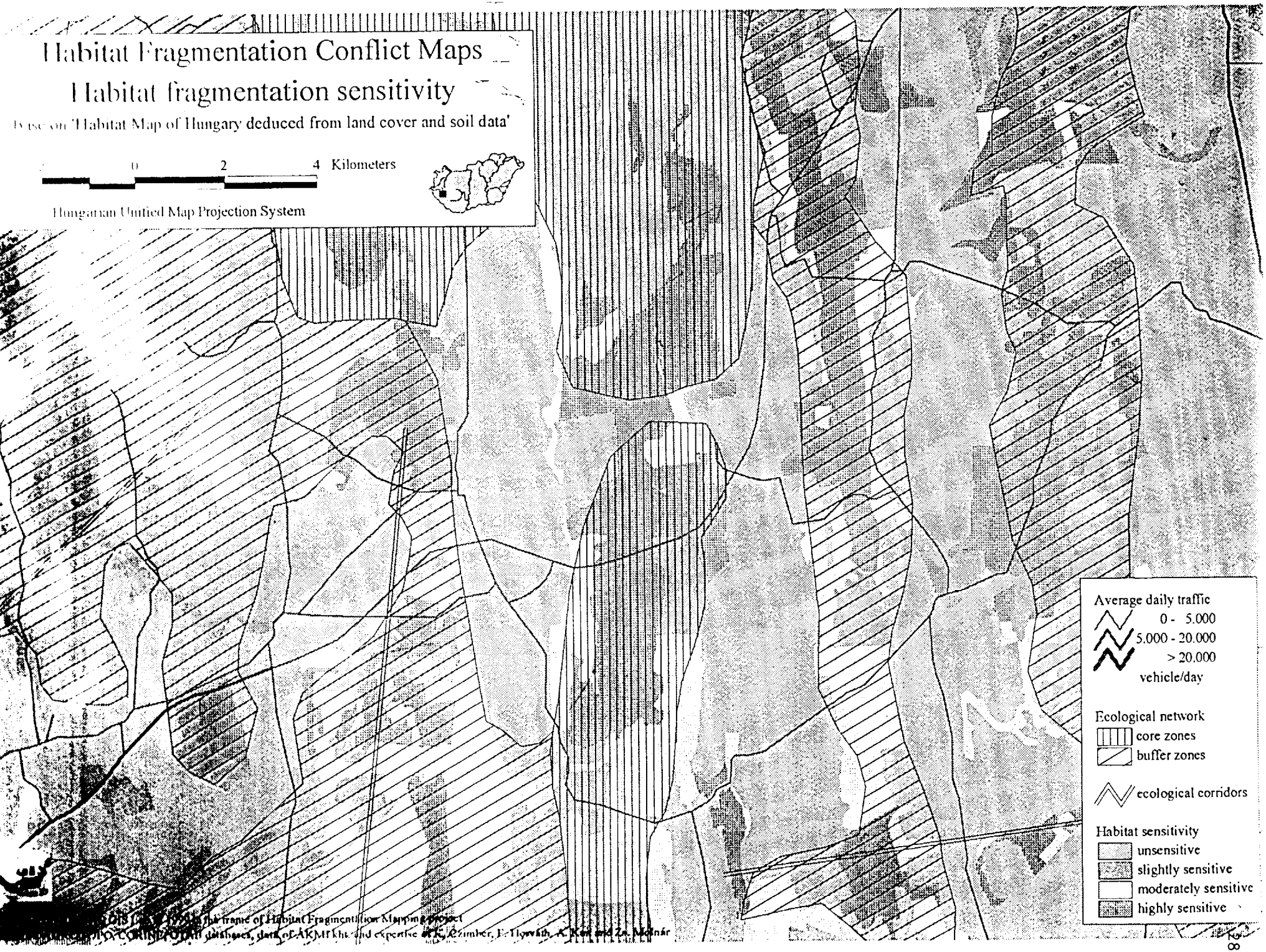
0 50 100 Kilometers

Hungarian Unified Map Projection System



led in RISSAC GIS Lab in 1999 in the frame of Habitat Fragmentation Mapping project
on AGROTOPO, CORINE, OTAB databases, data of ÁKMI kht. and expertise of K. Czimber, F. Horváth, A. Kun and Zs. Molnár

[traffic density] = vehicle * day^{-1} * km * km^{-2}


Habitat Fragmentation Conflict Maps
Habitat fragmentation sensitivity
Based on 'Habitat Map of Hungary deduced from land cover and soil data'
0
2
4 Kilometers
Hungarian Unified Map Projection System
Average daily traffic
0 - 5.000
5.000 - 20.000
> 20.000
vehicle/day
Ecological network
core zones
buffer zones
ecological corridors
Habitat sensitivity
unsensitive
slightly sensitive
moderately sensitive
highly sensitive