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ASSESSMENT OF LANDSCAPE CONFLICTS IN MOTORWAY PLANNING, NE HUNGARY

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Abstract

Field surveys are essential in the Hungarian motorway planning process so that it would be possible to assess their impacts on the landscape, since the available databases are insufficient in respect of listing all the valuable elements of the landscape. The aims of the research are to analyse the impacts of the planned M30 Motorway (located in north-eastern Hungary) on the landscape, to enumerate the cultural and natural valuable elements of the landscape near and within the area to be expropriated, to explore the possibilities of their protection and to outline the possible land use conflicts likely to arise after the implementation of the motorway. The main sources used for the research were: landscape, green space management and environmental protection studies made for the modification of the affected settlements' urban plans, field surveys alongside the entire track, and existing environmental databases. In the case of M30 motorway, the chosen corridor was mostly acceptable in the sections where the motorway track leads along the track of the existing Main Road 3, because it is fitted to an existing linear artificial landscape element, it is basically on the border of two natural micro-regions and can also fit into the existing land use structure. Nevertheless, it is not considered to be the best choice in places where it separates vineyards from vine cellars, where it is located within 50 meters from residential areas or where it passes through small plot vineyards or horticultural areas instead of the arable lands of the nearby plain.

Keywords: European Landscape Convention, landscape protection, land use conflicts, planned motorway, ecological barriers

INTRODUCTION

In accordance with the European Landscape Convention – ratified by Hungary in 2007 – the landscape "is an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors". The preamble states that the landscape "contributes to the formation of local cultures and that it is a basic component of the European natural and cultural heritage", it is "an important part of the quality of life for people everywhere" and "landscape is a key element of individual and social well-being and that its protection, management and planning entail rights and responsibilities for everyone". Thus, as a result of the above mentioned citations, landscape policy has to be integrated into any other policies – like transport planning – directly or indirectly impacting the landscape.

Road development has been a necessary task all through mankind's history (Rostovtzeff, 1926), but nowadays these road development demands have increased due to the rapid progress of motorization (Jones, 2008). The establishment of transport connections and the provision of the existing connections' usability are in the whole society's interest, since road transportation has a lot of positive socio-economic effects as well, like increasing employment (by mobilizing manpower), aiding underdeveloped areas to catch up, strengthening urban-rural links (Merriman, 2012). Besides these aspects, road projects also have several negative environmental impacts on the landscape, which are highlighted in the research.

Nowadays technical limitations of road constructions have almost disappeared; roads can be led along completely new tracks almost everywhere in the landscape, without being adapted to the terrain or the hydrographic conditions. Due to the rise of speed limit and increase of traffic, the geometry of the road must be adapted to strict technical standards in order to ensure road safety (Gulyas, 2006; Aarts and Schagen, 2006) resulting in a greater intervention in the landscape: e.g. a 13 m wide two-lane road is less safe than a 16 m wide road (2+1 lanes) with a road separation cable barrier in the case of huge traffic load (Bergh et al., 2016). Moreover, in the case of a motorway the crown width is much wider (even 26.6 m as in the case of the M30 Motorway) and road safety depends e.g. on the width of the emergency lanes or the central median barrier (Bergh et al., 2016; Bramaister, 1999) making the motorway wider. So the environmental impacts of road development can be more significant because of the greater intervention in the landscape than they were before the construction of motorways.

A new road line and its connecting facilities (e.g. drainage ditch, petrol station, rainwater reservoir, new utility lines or just a temporary land use change which can be caused by the construction works) result in direct land use changes and land use structure changes; nevertheless, indirect land use changes often also occur as a result of better regional accessibility after the development of the transport links (Eiter and Potthoff, 2016; Yuchu et al.,

2016). In addition to the direct land use changes, the related land uses are limited by the buffer areas of the roads. (Possible uses are regulated by Gov. Decree No. 253 of 1997 in Hungary. It is forbidden to plan built-up areas except for industrial areas along the motorways in a 250 m wide area each side.) Roads not only ensure good accessibility and connection between settlements, but can also be functional barriers for local people (Hawbaker et al., 2006). Furthermore, land use changes can result from the modified hydrological (or other abiotic) conditions which might be caused by the construction of road subgrade – e.g. disappearance of edaphic forest communities, like marshland forests (Fi, 2000). Besides, valuable land use can be endangered by road projects too, like historical land use structure (Ihse, 1995), traditional land uses (Antrop, 2005), unique landscape elements, characteristic plantings – like a line of trees with a special silhouette or a striking visual appearance, and a clump of trees, which can act as landmarks – alongside the road or forests (Liu et al., 2014; Gurrutxaga et al., 2011).

The visibility of the roads and their connecting facilities mainly depends on the category of the road (need of earthworks), the relief, the vegetation and the surrounding buildings, but the perception of visual quality is an interaction between people and their environment (Transportation Research Board of the National Academies, 2013). Visual impacts cannot be defined without interviewing the stakeholders (or without determining frequented viewpoints). Visual changes occur due to the appearance of huge road embankments, bridges, noise walls; or the changes of the vegetation (e.g. disappearing of characteristic alleys). Hungarian planning practice lacks methodology for quantifying or qualifying these visual impacts, but there are some good international examples to be adopted (The Landscape Institute with the Institute of Environmental Management and Assessment, 2002; Transportation Research Board of the National Academies, 2013). The landscape character assessment could also be a great basis for the road projects' visual impact assessments (Boromisza et al., 2011), as in Scotland (Kabai, 2010), where recommendations are offered based on the landscape character assessment concerning various types of interventions in the landscape (like a motorway or other roads) in order to minimize (or avoid) negative visual impacts. However, in Hungary the realization of a landscape character based landscape classification system is currently in progress, and the recommendations are not yet known.

There are also negative impacts on the ecosystem, among which the most important ones are fragmentation and habitat loss (Forman and Alexander, 1998; Trombulak and Frissel, 2000; Bata and Mezősi, 2013). Fragmentation means that the roads are ecological barriers or filters for animal movement, subdivide populations and reduce the size of habitats. One of the results of fragmentation is animal mortality due to collision with vehicles, but the genetic consequences are more significant and dangerous (Forman and Alexander, 1998; Trombulak and Frissel, 2000). Critical habitat reduction occurs when the habitat of insects falls below 1 ha, the habitat of small mammals falls below 10 ha or the habitat of birds falls below 100 ha (Blake and Karr, 1987; Lord and Norton, 1990). The landscape ecological research on the fragmentation of Hungarian natural micro-regions made it clear that the most important ecological barriers are to be found in valleys, in small mountain pools, near Lake Balaton and near Budapest (Csorba, 2005). Another negative ecological impact can be the rapid spread of invasive plant species in the disturbed surfaces – which endangers the naturalness of valuable habitats (Hulme, 2009). Moreover, negative ecological impacts can be caused by the disruption of local hydrological conditions, pollution of local watercourses by road run off, effects of road lightning or noise, effects of air pollution from vehicle emissions or disturbance during construction (Byron et al., 2000). In spite of the numerous negative impacts, areas along the road track are habitats too, where protected species can subsist, e.g. orchids in the roadside or amphibians in drainage facilities (Puky, 1999).

In Hungary, most of the road development projects are financed by the European Union through the Integrated Transport Development Operational Programme in the period between 2014 and 2020. Altogether a HUF 1,040 billion EU fund is allocated, approx. 30.5% of which serves for road development goals (Integrated Transport Development Operational Programme, 2014-2020). One of the road projects to be financed by this Operational Programme is the planned M30 Motorway between Miskolc and Tornyosnémeti, which is our study area. In accordance with Annex 2 of Gov. Decision No. 1247 of 2016 this project is one of the national priority projects. The motorway is currently under construction and is planned to put into operation in 2021 (based on the website of the National Infrastructure Development Corporation). The M30 Motorway is part of the Trans-European Transport Network (TEN-T), namely „Via Carpathia", between Klaipeda–Thessaloniki.

The main aims of the research are to investigate the impacts of the planned M30 Motorway on the landscape, to assess the possible impacts on the valuable cultural and natural elements of the landscape, to explore the possibilities of their protection and to outline the probable land use conflicts that might arise after the implementation of the motorway. Land use conflicts can occur because the proposed developments and land use changes can affect landscape qualities that are valuable for people (Bengston et al., 2004). Land use conflicts are also the result of different perceptions of a group of people about landscapes and their services (Brody et al., 2004). Thus, a land use conflict is a contradiction between two neighbouring land uses – and the groups of people who use the land in different ways: which can cause functional (e.g. disturbance, functional barrier), ecological (e.g. disturbance of valuable habitats, pollution) and visual conflicts.

STUDY AREA

The study area is located in Borsod-Abaúj-Zemplén County, near the north-eastern border of Hungary. The planned motorway is to lead towards Slovakia's second biggest city, Kosice. The examined section is 56 km long and affects 21 settlements (Fig. 1). The study area (see Fig.1) also contains the plots connecting to the expropriation area of the

motorway (the main reason for this is that exactly the same delineation was used in the corroborative examinations carried out for the modification of the affected settlements' urban plans).

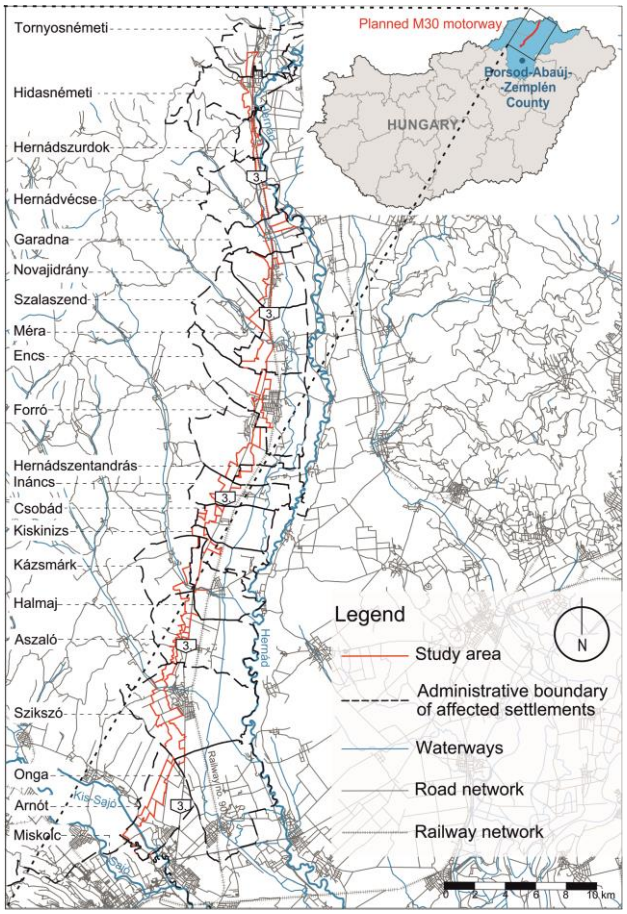

Fig. 1 Location of the study area and the affected settlements

The area studied in details is 3620 ha, of which the territorial distribution per settlement is shown in Fig. 2 (with the length of the planned motorway). Arnót and Szikszó are the two most affected settlements in respect of the territorial distribution and the length of the motorway. The track of the motorway basically leads along the border of Eastern-Cserehát and Hernád-Valley natural micro-regions, and between Arnót and Szikszó the road track affects the Sajó-Hernád plain and the Western-Cserehát natural micro-regions (Marosi and Somogyi, 1990). The elevation is between 110 mBf (near Miskolc) and 200 mBf (near Tornyosnémeti, Aszaló and Szikszó) in the study area. The main soil types on the lower areas are various meadow soils (meadow, meadow chernozem, and meadow alluvial soil). The higher areas are covered by brown forest soils (Ramann's brown forest soil, and chernozem brown forest soil). The climate is moderately warm and dry in the south and moderately cool and dry in the north, meaning that the average annual temperature falls between 9.2-9.6 °C and the annual rainfall is between 540-640 mm. The prevailing wind direction is northern, north-eastern. Its average speed is 2-2.5 m/s.

The determinative linear landscape elements in the examined regions are the watercourses (especially the Hernád and Kis-Sajó rivers), the Main Road 3, and the Railway Line 90, which influenced the planning of the motorway's corridor. In some places the chosen corridor leads along the flood bed of the River Hernád, thus, the motorway's embankment is also to act as the primary flood protection dike in some sections (e.g. between Garadna-Hidasnémeti, Garadna-Forró, Arnót-Miskolc). The track of the planned motorway is almost parallel with the River Hernád, which means it leads along the border of Cserehát Hills and the valley side of the Hernád (Fig. 3).

The examined motorway is planned for a driving speed of 130 km/h, consequently the vertical and the horizontal technical parameters are appropriate for this speed. It is planned to lead partially along a whole new track, and to partially use the track of the existing Main Road 3, with 2+2 physically separated lanes and a 26.60 m wide crown. The crown of the crossing roads is 12.0 m

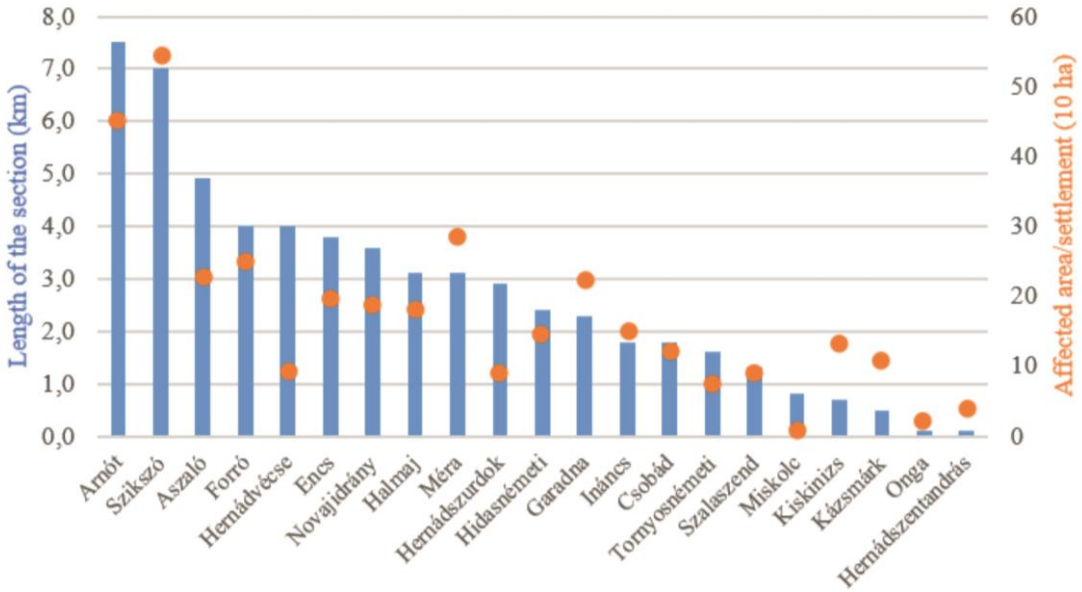

Fig. 2 Affected area of settlements and the length of the motorway section

and the parallel service roads are 7.00 m wide (the above mentioned technical parameters are summarized in the permitting plan: TURA-TERV Ltd. et al., 2016).

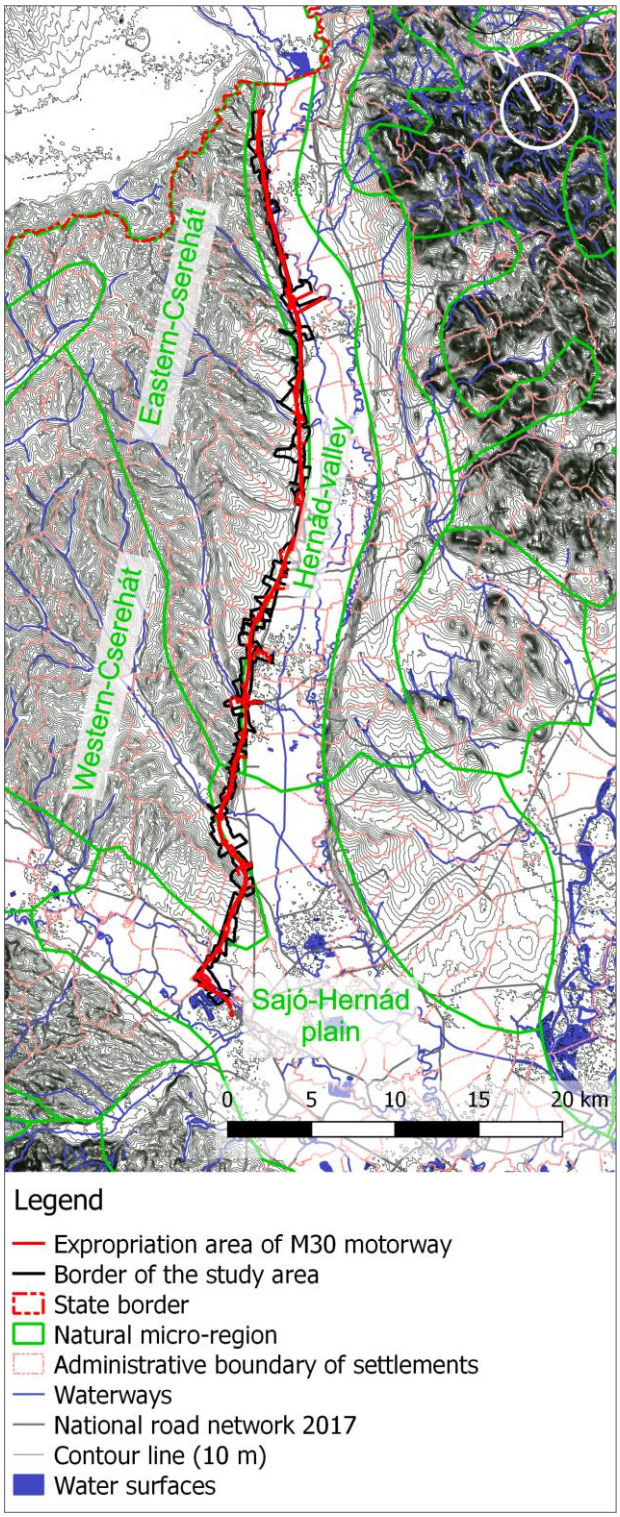

Fig. 3 Hydrological and topographical conditions of the study area

METHODS

The present analysis is a case study about the Hungarian motorway planning practice. According to Flyvbjerg (2006) single case studies can serve as a basis for drawing more general conclusions, provided that the case in question is sufficiently rich and illustrative. The M30 Motorway was considered to be a particularly interesting case due to the diversity of the existing valuable cultural and natural landscape elements in this region, the nearness of the River Hernád and the remaining traditional land uses. Land uses are considered to be traditional, if the land use in question is extensive cultivation at a small-scale existing on the particular site for at least 100-150 years.

As a primary source the findings of the landscape, green space management and environmental protection studies prepared for the modification of the affected settlements' urban plans (Department of Landscape Protection and Reclamation, 2016) were used. All the affected settlements located between Miskolc and Tornyosnémeti were included in the analysis. The studies focus on current land use, valuable cultural and natural landscape elements of the affected area (which must adjust to plot borders because of the plan type), scenery, potential conflicts between the motorway and the surrounding land uses. Proposals are also expected to be formulated for the future land uses (on the level of regulations within the frame of the urban plans). In these studies – made for the urban plan modification – other plans (environmental impact assessment, design plan) and historical maps (18-20th centuries military survey maps of Hungary) were also considered. As a secondary source (besides maps and plans) field surveys were carried out alongside the entire track of the planned motorway. The expected land use conflicts were evaluated based on the field survey and the list of non-protected landscape elements is mainly based on this too (e.g. in the case of unique landscape elements national databases were not available for these settlements). As a tertiary source, the study area was analysed by using existing databases. For the preparation of maps shown in the research, the Open Street Map database, the Hungarian Road Network 2017 (provided by the Hungarian Public Road Non-profit PLC), the protected areas (provided by the Ministry of Agriculture), the expropriation area of the planned M30 Motorway (based on the design plan) and the SRTM terrain model (interpolating 10 m contour lines) were used. For some figures the topographic map was used as a base map. The 'Las Palmas' version of Quantum GIS open source program was used.

Besides the summing up of the plans in connection with the planned motorway, some basic principles were determined based on the above-mentioned environmental impacts of the motorway implementation in connection with physical aspects related to valuable landscape elements and land uses. They are proposed to be considered in a road planning process so that the negative impacts on the landscape could be minimized. These are the followings:

(1) Ensure the continuation of traditional land uses
(2) Protection of valuable natural and cultural landscape elements (independently from the fact whether they are protected or not by law)
(3) Fitting to the current land uses so that the potential conflicts could be minimized between the motorway and the surrounding land uses

(4) Maintaining the ecological and functional connections in the landscape (minimization of fragmentation)
(5) Maintaining the valuable scenery relations and minimization of the negative visual impacts on the landscape.

RESULTS AND DISCUSSION

The directly affected land uses located within the expropriation area – based on the field survey – are mainly arable lands, but orchards, acacia forests and oak forests, small plot vineyards and vine cellars, horticultural area with old walnut trees and wet pastures are also to be found. Both the small plot vineyards and the horticultural areas are traditional land uses in the region: Aszaló and Szikszó are parts of the Vine Region of Bükk. In the case of the section between Miskolc and Aszaló the planned motorway leads across the hilly vineyards and orchards, with a completely new track in the landscape and does not fit to any existing linear landscape elements or the topographical conditions (see the motorway section between Szikszó and Aszaló on Fig.4 where those land uses are shown which are sensitive for the impacts of the planned motorway). An artificial, 100-250 m wide flood control channel of the River Kis-Sajó needs to be modified in Arnót because of the chosen road corridor.

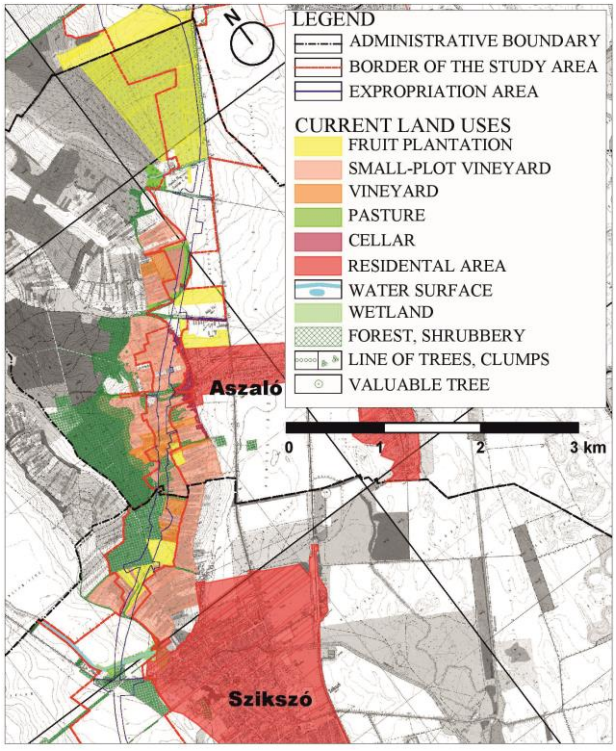

Fig. 4 The section between Szikszó and Aszaló doesn't fit to the topographical conditions and the current land use structure

There are natural values in the study area protected at international (Natura 2000 areas) or national level (ex lege – that is protected by law – protected mottes, elements of the National Ecological Network) or at local level (local Nature Conservation Area). Furthermore, numerous valuable cultural and natural landscape elements are to be found here which are not protected by law, e.g. traditional land uses, unique landscape elements (see the definition below Table 1). Based on the overview map of the national, international natural values (Fig. 5a) it can be stated that the chosen corridor is quite favourable, since it leads along the border of valuable landscape elements and land uses or it bypasses them. The affected valuable landscape elements per settlements are summarized in Table 1, which contains not only the protected areas but also the other non-protected landscape elements. Affectedness was considered as a real area demand, so these valuable elements are within the motorway's expropriation area (they are endangered or would disappear during the construction of the motorway). Over the total length of 56 km, passing through 21 settlements, the corridor affects one Nature Conservation Area protected at local level (in Szikszó, namely "Magyar-hegyi macskaherés"), two Natura 2000 areas (close to their border), 14 ecological corridors and 10 buffer areas of the National Ecological Network. The ecological corridors are mostly waterway crossings (10 out of 14). The planned motorway is also close to an ex lege protected motte (Méra) and a spring (Novajidrány), but they are outside the expropriation area. Besides the mentioned natural values, a lot of non-protected valuable landscape elements are also endangered (see details in Table 1), such as unique landscape elements, lines of trees, small plot vineyards, orchards, horticultural areas with old and characteristic walnut trees.

A length of 9.6 km out of the 56 km (sections between Hernádvécse-Hidasnémeti and Szikszó-Arnót) of the planned motorway (see Table 1) is within the priority area of scenery conservation (defined in Hungary's National Spatial Planning Plan), due to the remaining traditional land use (e.g. near Aszaló), the Valley of the River Hernád, and the traditional settlement structure (Hernádszurdok). The track of the motorway leads along 7-8 km away from the Zempléni Protected Landscape Area between Ináncs and Tornyosnémeti, which is a valuable scenery relation between the protected area and the motorway (providing a "beautiful view" from the motorway). According to the field surveys there are some local valuable scenery elements – e.g. line of trees, shrubberies, waterways and wetlands alongside them, gallery forests – which would disappear as a result of the construction of the road (see Fig. 6 and Table 1).

In the case of the M30 Motorway the main expected land use conflicts per settlements are summarized in Table 2. The most common conflicts which occur: potential pollution from rainwater drainage into living water (2), disturbance of residential areas and recreational facilities (3), and unfavourable changes in the local road transport because of the disappearance of an existing main road (6). In connection with the last mentioned conflict the main problem is that motorways are toll roads in Hungary, while the use of the main roads is free of charge, so probably the traffic will flow back to the settlements. In the case of Aszaló the motorway would be a significant functional barrier, because it separates the vineyards from the vine cellars, so these will be difficult to approach.

Table 1 Affected landscape values per settlements

Settlement	Natura 2000 area SPA/SCI	Nature Conservation Area protected on the local level	National Ecological Network		Unique landscape values and valuable scenery relations		Traditional land use/valuable landscape elements
			ecological corridor (pcs)	buffer area (pcs)	priority area for scenery conser-vation[1]	characteristic elements/ unique values[2]	
Miskolc	-	-	1	-	-	-	-
Arnót	-	-	2	-	affected	viewpoint	vineyard with small plots
Szikszó	-	"Magyar-hegyi macskaherés" Nature Conservation Area	2	-	affected	viewpoint, line of trees	traditionally cultivated hilly area: small plot vineyards, shrubberies
Onga	-	-	-	-	-	viewpoint	horticultural area with old walnut trees
Aszaló	-	-	-	-	affected	wine cellars, onetime farm of the landed gentry, line of trees	traditionally cultivated hilly area: small plot vineyards and vine cellars, orchards
Halmaj	-	-	-	-	-	-	horticultural area with old walnut trees, local ecological corridor
Kiskinizs	-	-	-	-	-	-	local ecological corridor
Kázsmárk	-	-	1	-	-	roadside crucifix	orchards, old poplar trees
Ináncs	-	-	1	-	-	-	-
Csobád	-	-	1	-	-	line of trees	local ecological corridor
Hernádszentandrás	-	-	1	-	-	-	not protected spring and wetland around it
Forró	-	-	2	-	-	onetime mill, roadside crucifix (3 pcs)	-
Encs	-	-	-		-	sun-dial, 1956 Memorial Tree	the gate of the settlement (with unique values)
Méra	-	-	2	3	-	line of trees (nearby an ex lege protected motte)	vineyards and orchards
Szalaszend	-	-	-	1	-	line of trees	-
Novajidrány	HUBN10007	-	1	1	affected	viewpoint, cemetery, funeral home, spring, onetime hunter mansion (nearby an ex lege protected spring)	small plot vineyards and orchards
Garadna	HUBN10007/ HUAN20004	-	2	2	-	roadside crucifix, line of trees	sports ground with old trees
Hernádvécse	HUBN10007/ HUAN20004	-	4	1	affected	-	-
Hernádszurdok	HUBN10007/ HUAN20004	-	1	1	affected	-	traditional settlement structure
Hidasnémeti	-	-	4	-	affected	roadside crucifix, line of trees	old elm tree
Tornyosnémeti	-	-	-	1	-	line of trees	-

[1] According to the National Spatial Planning Plan of Hungary.

[2] Unique landscape values are artificial or natural landscape values that have significance for the society from a natural, historical, cultural, scientific or aesthetic point of view (according to the Hungarian nature conservational act).

HUBN10007: „Zempléni-hegység a Szerencsi-dombsággal és a Hernád-völggyel" SPA area

HUAN20004: „Hernád-völgy és Sajóládi-erdő" SCI area

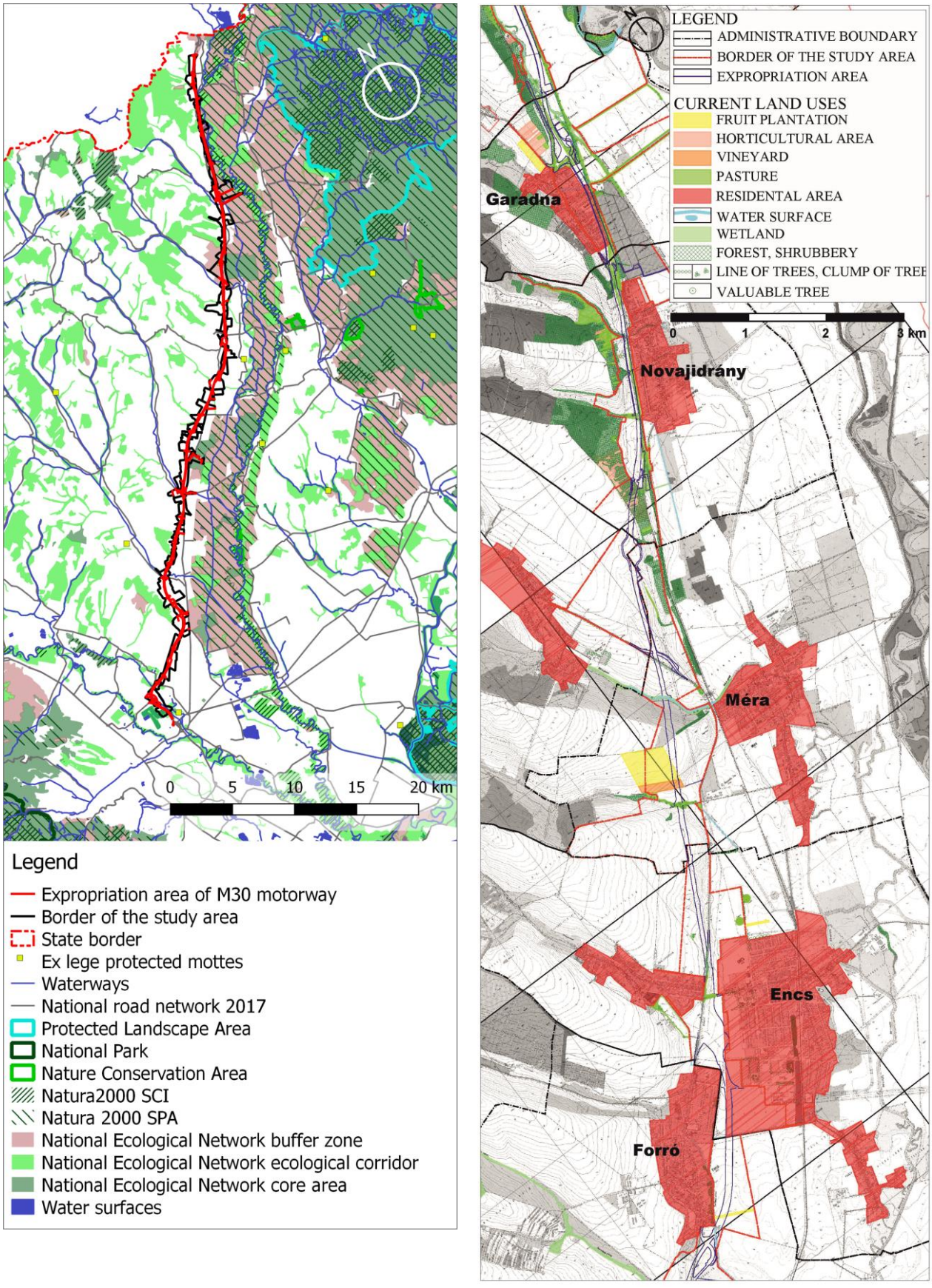

Fig. 5 a) Overview map of the national, international natural values (nature conservation by law); b) The section between Forró and Garadna doesn't fit to the settlement structure and the new motorway causes many land use conflicts

Each mentioned conflict is a long-lasting and irreversible one (if a land use termination/changing is not considered as a "resolution" of the conflict). The main conflict in the case of the section between Forró and Garadna is the closeness of residential areas (on average within 250 m, in some cases within 50 m), which is shown in Fig. 5b. The visual conflicts are considered to be significant when a minimum of 4 m high fill or 4 m deep cut is needed as an earthwork or there is a huge connecting facility (e.g. resting area, junction) and the residential areas are within 1 km off the planned motorway and there is no visual barrier (e.g. forest) (see conflict 7 in Table 2).

The possibilities of landscape protection related to motorway planning – considering both natural and cultural aspects – are basically determined by the corridor and the exact road track within the corridor. In this case – during the preparation of landscape studies made for the modification of the affected settlements' urban plans – we proposed some track modifications in the phase of the design plan, because of the endangered valuable landscape elements (e.g. in order to protect lines of trees, unique landscape elements, and fitting into historical land use structure). But only one proposed modification was accepted in the case of Novajirány, where the original track affected an ex lege protected spring's source area (with old maple trees, willows). In the other cases (see the affected valuable landscape elements in Table 1) most of the valuable elements will perish or if it is possible they will be relocated (e.g. roadside crucifixes). The affected valuable landscape elements are mostly of local significance (and not protected by law). Compensatory measures are planned for the forests (it is regulated by law in Hungary) and due to local demands (in the case of Garadna, where a sports ground would be cut across by the motorway or in the case of Novajidrány, where a funeral home would be destroyed). The mitigation measures for the possible land use conflicts can be plantations alongside the motorway or noise walls. In order to ensure the ecological connections, four ecological bypasses and five eco tunnels are planned along the 56 km long section (if the other waterway crossings are disregarded, which need to be built and also provide ecological connections: 10 of them are suitable for smaller mammals and two of them are suitable for big mammals). The number of the separate ecological bypasses is exactly the same as the number of the locations where the planned motorway cuts forests. It is important to note that the significant big mammal (boar, roe and red deer) migration corridors cover long sections according to the EIA (TURA-TERV Ltd. et al., 2016), and in the planning phase of the EIA there were seven planned ecological bypasses for big mammals originally (four separate and three combined with a waterway). So all in all there are some facilities which are planned to ensure ecological

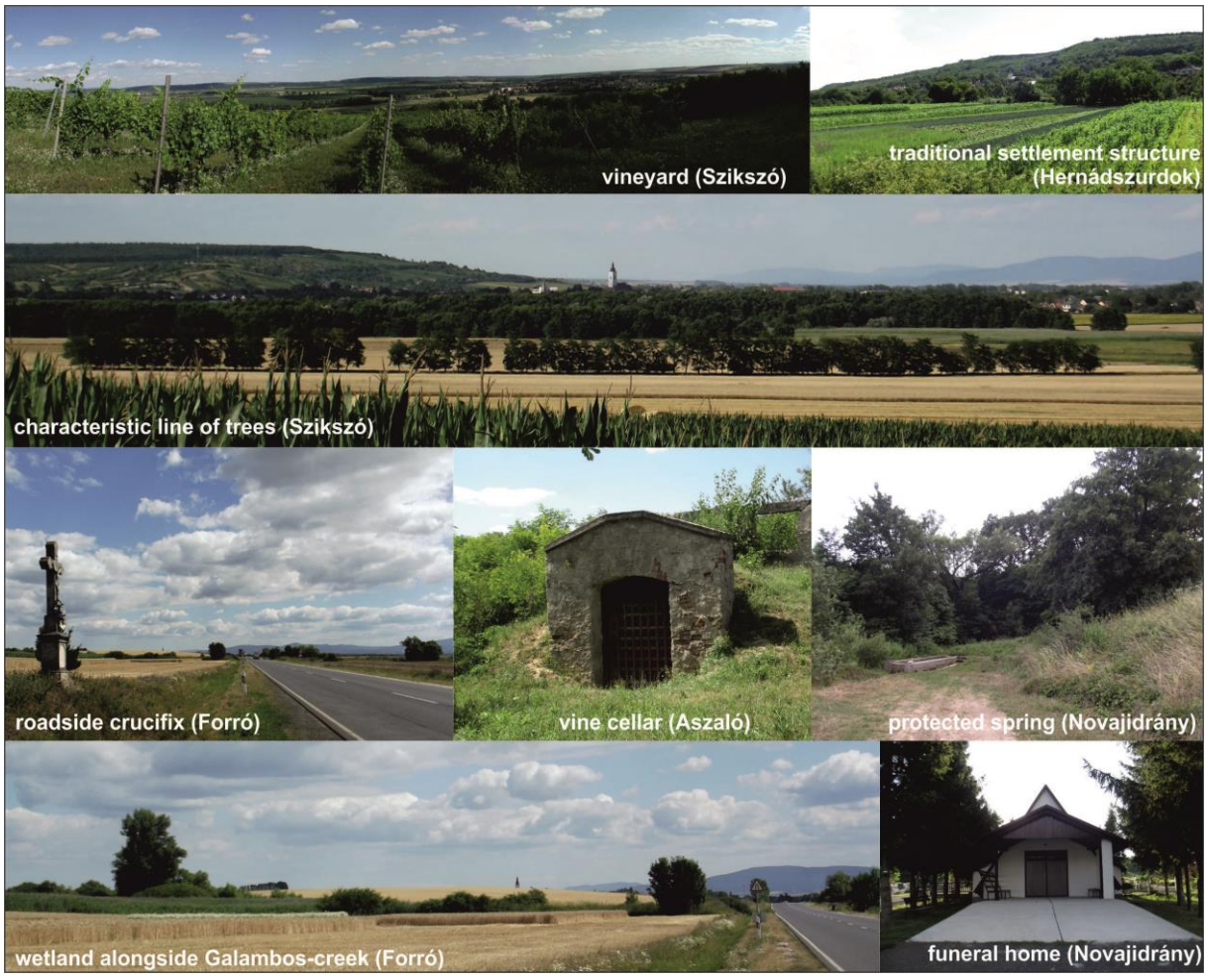

Fig. 6 Some examples for the disappearing/endangered valuable landscape elements because of the motorway

Table 2 Probable main land use conflicts after the implementation of the motorway

Settle-ments / Land use conflicts*	Miskolc	Arnót	Szikszó	Onga	Aszaló	Halmaj	Kiskinizs	Kázsmárk	Ináncs	Csobád	Hernádszentandrás	Forró	Encs	Méra	Szalaszend	Novajidrány	Garadna	Hernádvécse	Hernádszurdok	Hidasnémeti	Tornyosnémeti
1		X																			
2		X	X					X		X	X			X			X	X			
3		X										X	X			X	X		X	X	
4			X		X																
5			X																		
6											X	X	X			X	X	X	X	X	X
7	X	X	X		X							X	X	X	X	X	X		X	X	

*1: Wastewater treatment plant near the resting area (smell)
*2: Rainwater drainage into living water (potential pollution)
*3: Recreational facilities/residential area near (within 250 m) the motorway (disturbance, air pollution)
*4: Makes difficult to cultivate the vineyards, orchards (functional barrier to continue the traditional cultivating)
*5: The location of ecological bypass is not compatible with the future land use (e.g. industrial area)
*6: Makes more difficult the local road transport (the current main road No. 3. can't be used furthermore as a main road)
*7: Visual conflicts because of the motorway technical parameters (unfavourable visual element)

connections, but after the construction of the motorway migration of the wildlife will be much less possible than before.

As much as the basic principles set out based on the potential impacts on the landscapes are concerned, it is not a black and white issue. Since a motorway is a significant intervention in any landscape, it is impossible to construct a motorway without losses. The question is only the degree of the loss. In the case of the M30 Motorway, the chosen corridor was mostly acceptable in the sections where the motorway track leads along the track of the existing Main Road 3, because it is fitted to an existing linear artificial landscape element, it is basically on the border of two natural micro-regions and can also fit into the existing land use structure. Nevertheless, it is not considered to be the best choice in places where it separates vineyards from vine cellars, where it is located within 50 meters from residential areas or where it passes through small vineyards or gardens instead of the arable lands of the nearby plain.

CONCLUSIONS

Field surveys are indispensable in the Hungarian motorway planning practice in order to list all the valuable cultural and natural landscape elements, since the available databases are insufficient for this purpose (e.g. unique landscape elements, local ecological corridors). After listing the valuable landscape elements, the determination of the valuable land uses and the analysis of the probable land use conflicts, the probable negative impacts of the motorway can be minimized by technical solutions (e.g. noise wall, ecological bypass), by plantations (alongside the road and also with future forests included in urban plans), or by relocating the unique landscape elements (e.g. roadside crucifixes). In the case of the M30 Motorway compensatory measures are also planned (because of the forests and some local demands, that is a sports ground and a funeral home).

The implementation of a motorway is always a national or at least regional interest of the society, however, the directly affected settlements and their habitants' life does not necessarily become simpler in respect of land use (more difficult accessibility because of the disappearance of a lot of local transport connections), and the motorway also can also be a direct disturbance factor in the locals' everyday life too. If an existing main road track is partially used to satisfy the planned motorway's space demand, the local transport will necessarily flow back to the settlements and their main streets, which leads to growing traffic in residential areas. As for the unfavourable impacts made on the landscape, a motorway can obstruct the continuation of traditional land uses, it always changes the land use structure to a certain degree, and always is a functional and ecological barrier in the landscape. During the construction works several valuable cultural and natural landscape elements can be damaged or can perish, independently from the fact whether they are protected or not protected by law. The potential land use conflicts after the construction can arise directly between the motorway and the existing residential areas, the recreational facilities and also the cultivated lands, and finally it is also expected to lead to changes in land use in the long term.

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References

Aarts, L., Schagen, I. 2006. Driving speed and the risk of road crashes, A review. *Accident Analysis and Prevention* 38, 215–224. DOI: 10.1016/j.aap.2005.07.004

Antrop, M. 2005. Why landscapes of the past are important for the future. *Landscape and Urban Planning* 70, 21-34. DOI: 10.1016/j.landurbplan.2003.10.002

Bata, T., Mezősi, G. 2013. Assessing landscape sensitivity based on fragmentation caused by the artificial barriers in Hungary. *Journal of Environmental Geography* 6 (1-2), 37–47. DOI: 10.2478/v10326-012-0005-1

Bengston, D.N., Fletcher, J.O., Nelson, K.C. 2004. Public policies for managing urban growth and protecting open space: policy instruments and lessons learned in the United States. *Landscape and Urban Planning* 69 (2), 271–286. DOI: 10.1016/j.landurbplan.2003.08.007

Bergh, T., Remgard, M., Carlsson, A., Olstam, J., Strömgren, P. 2016. 2+1-roads Recent Swedish Capacity and Level-of Service Experience. *Transportation Research Procedia* 15, 331–345. DOI: 10.1016/j.trpro.2016.06.028

Blake, J. G., Karr, J. R. 1987. Breeding birds of isolated woodlot: area and habitat relationships. *Ecology* 68(6), 1724–1734. DOI: 10.2307/1939864

Boromisza, Zs., Csima, P., Dublinszki-Boda, B., Módosné Bugyi, I. 2011. Landscape character assessment methodology applied for specific landscape types in Hungary. *Problems of Landscape Ecology* 30, 233–240.

Bramaister, L. 1999. Specific safety measures for emergency lanes and shoulders of motorways. Proposal for motorways' authorities in the framework of the European research project SAFESTAR, Workpackage 1.1. SWOV Institute for Road Safety Research. The Netherlands. Leidschendam.

Brody, S.D., Highfield, W., Arlikatti, S., Bierling, D.H., Ismailova, R.M., Lee, L., Butzler, R. 2004. Conflict on the coast: using geographic information systems to map potential environmental disputes in Matagorda Bay, Texas. *Environmental Management* 34 (1), 11–25. DOI: 10.1007/s00267-004-0256-x

Byron, H.J., Treweek, J.R., Sheate, W. R., Thompson, S. 2000. Road deveopments in the UK: An analysis of ecological assessment in environmental impact statements produced between 1993 and 1997. *Journal of Environmental Planning and Management* 43(1), 71–97. DOI: 10.1080/09640560010775

Csorba, P. 2005. Fragmentation effect of Hungarian road and railway network. *ÖKO – Ökológia, környezetgazdálkodás, társadalom* 13(3-4), 102–112. (in Hungarian)

Department of Landscape Protection and Reclamation, Szent István University (dr. Illyés, Zs., Mészáros, Sz., Gergely, A., Módosné Bugyi, I.). 2016. Landscape, green space management and environmental protection studies made for the modification of affected settlements' urban plans for the planned motorway No. M30 in the section between Miskolc and Tornyosnémeti. (For each affected 21 settlements, which are mentioned in the paper.) (in Hungarian)

Eiter, S., Potthoff, K. 2016. Landscape changes in Norwegian mountains, Increased and decreased accessibility, and their driving forces. *Land Use Policy* 54, 235–245. DOI: 10.1016/j.landusepol.2016.02.017

European Landscape Convention (Act CXI. 2007 in Hungary)

Fi, I. 2000. Minimization of negative environmental impacts to ecosystem. In Fi, I. (ed.) Utak és környezetük tervezése. Budapest. 286–295. (in Hungarian)

Flyvbjerg, B. 2006. Five misunderstandings about case-study research. *Qualitative Inquiry* 12(2), 219–245. DOI: 10.1177/1077800405284363

Forman, R. T. T., Alexander, L. U. 1998. Roads and their major ecological effects. *Annual Review of Ecology and Systematics* 29, 207–231. DOI: 10.1146/annurev.ecolsys.29.1.207

Gulyas, A. 2006. Research for technical standardisation in Hungary. TRA – Transport research Arena Europe 2006: Goteborg, Sweden, June 12th-15th 2006: Greener, Safer and Smarter Road Transport for Europe. Proceedings. Swedish Road Administration.

Gurrutxaga, M., Rubio, L., Saura, S. 2011. Key connectors in protected forest area networks and the impact of highways, A transnational case study from the Cantabrian Range to the Western Alps (SW Europe). *Landscape and Urban Planning* 101, 310–320. DOI: 10.1016/j.landurbplan.2011.02.036

Hawbaker, T. J., Radeloff, V. C., Clayton., M. K., Hammer., R. B., Gonzalez-Abraham, C. E. 2006. Road development, housing growth, and landscape fragmentation in Northern Wisconsin: 1937-1999. *Ecological Applications* 16(3), 1222–1273. DOI: 10.1890/1051-0761(2006)016[1222:rdhgal]2.0.co;2

Hulme, P. E. 2009. Trade, transport and trouble: managing invasive species pathways in an era of globalization. *Journal of Applied Ecology* 46, 10–18. DOI: 10.1111/j.1365-2664.2008.01600.x

Ihse, M. 1995. Swedish agricultural landscapes – patterns and changes during the last 50 years, studied by aerial photos. *Landscape and Urban Planning* 31, 21–37. DOI: 10.1016/0169-2046(94)01033-5

Jones, D. W. 2008. Mass Motorization + Mass Transit. An American History and Policy Analysis. Indiana University Press, Bloomington, United States.

Kabai, R. 2010. The Scottish National Programme of Landscape Character Assessment and the application of the results. *Tájökológiai Lapok* 8 (1), 97–109.

Liu, S., Dong, Y., Deng, L., Liu, Q., Zhao, H., Dong, S. 2014. Forest fragmentation and landscape connectivity change associated with road network extension and city expansion: A case study in the Lancang River Valley. *Ecological Indicators* 36, 160–168. DOI: 10.1016/j.ecolind.2013.07.018

Lord, J. M., Norton, D. A. 1990. Scale and spatial concept of the fragmentation. *Conservation Biology* 4(2), 197–202. DOI: 10.1111/j.1523-1739.1990.tb00109.x

Marosi, S., Somogyi, S. (ed.) 1990. Survey on the natural micro-regions of Hungary I-II. Institute of Geography of the Hungarian Academy of Sciences, Budapest, (in Hungarian)

Merriman, P. 2012. Enfolding and Gathering the Landscape: A Geography of England's M1 Corridor. In: Hvattum, M., Larsen, J. K (ed.) Routes, Roads and Landscapes. University of Oslo, Norway. 213–226.

Ministry of National Development of Hungary. 2014-2020. Integrated Operational Programme for Transport Development.

Puky, M. 1999. The role of road network in ecosystem. *Közút* 8(9), 18–19. (in Hungarian)

Rostovtzeff, M. I. 1926. The Social & Economic History of the Roman Empire. Biblo & Tannen Publishers. Cheshire, United States.

The Landscape Institute with the Institute of Environmental Management and Assessment. 2002. Guidelines for Landscape and Visual Impact Assessment. London and New York.

TURA-TERV Ltd., RODEN Ltd., ÚT-TESZT Ltd. 2016. Environmental Impact Assessment for the planned motorway No. M30 in the section between Miskolc and Tornyosnémeti. (in Hungarian)

TURA-TERV Ltd., RODEN Ltd., UTIBER Ltd. 2016. Permitting Plan for the planned motorway No. M30 in the section between Miskolc and Tornyosnémeti. (in Hungarian)

Transportation Research Board of the National Academies. 2013. Evaluation of Methodologies for Visual Impact Assessments. NCHRP Report 741. Washington, D.C.

Trombulak, S. C., Frissel, C. A. 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. *Conservation Biology* 14(1), 18–30. DOI: 10.1046/j.1523-1739.2000.99084.x

Yuchu, X., Ji,e G., Peng, S., Xiaohua, G., Yaowen, X. 2016. Impacts of major vehicular roads on urban landscape and urban growth in an arid region, A case study of Jiuquan city in Gansu Province, China. *Journal of Arid Environments* 127, 235–244. DOI: 10.1016/j.jaridenv.2015.12.002

253/1997. (XII. 20.) Gov. Decree of Hungary on national requirements of urban plans and construction. (in Hungarian)

1247/2016. (V. 18.) Gov. Decision of Hungary on the annual frame of Integrated Operational Programme for Transport Development. (in Hungarian)

345/2012. (XII. 6.) Gov. Decree of Hungary on declaring certain transport development projects as matters of national interests. (in Hungarian)