

# Survey of environmental protection methods in process of motorway planning and project making in Croatia

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**Abstract.** Croatia is a country of great biodiversity, rich in endemics and unique karstic phenomena. It is also a region in which numerous communication routes of European significance intersect. Against a background of those natural values, the work presents main stages of a development of environmental impact assessments. A special attention has been paid to their connection with spatial planning. On the basis of a critical analysis of previous experiences, the directions for the future progress of environmental impact assessments have been proposed.

**Key words:** biodiversity, environmental planning, environmental protection, Environmental Impact Assessment, karstic phenomena, Croatia

## 1. Introduction

Presently, traffic activities in general and traffic infrastructure construction are one of the most important and recognizable space consumers and users. After the Croatian war and certain economic stabilization in 1997, motorway construction becomes the priority in the country. Approximately 900 km of motorway and two-lane roads have been built so far. The planned length of the motorway network is about 1500 km.

Environmental Planning Strategy of the Republic of Croatia (1997) and Environmental Planning Program (1999) define the disposition of the motorway network on the territory of the country. These documents are unique and adopted by the Croatian Parliament. They are considered to be the top documents for physical planning in Croatia. The documents define two basic ideas: (i) the development of traffic infrastructure from the point of significance and progress of the country in Europe (connecting Croatia with the countries of Central Europe and Danube region, Adriatic Sea and Mediterranean) and (ii) efficient traffic connection of all the areas, centers of development and other important parts within the country [1].

Traffic Development Strategy of the Republic of Croatia (1999) is the first long-term development document proposed after the independent and sovereign Republic of Croatia was established. The planned road network is to connect the following European, Trans-European and state corridors (Fig. 1):

- direction Ljubljana, Maribor-Zagreb and further to Sava Region corridor towards east to connect West Europe and the East;
- direction (Trieste) Rijeka (and/or Istria Y)-Gospić-Zadar-Šibenik-Split-Dubrovnik further toward Albania and Greece to connect West and South Eastern Europe;
- direction (Hungary)-Goričan-Zagreb-Rijeka through Bosiljevo entering Adriatic bypass route (Lika Y) to connect Central Europe and Mediterranean [1].

The 2005 year is a very important for Croatia. The project of connecting Croatian north and south (Zagreb-Split Motorway) (Fig. 1.) was completed in that year. Construction of that route is considered one of the largest investments and construction project ever in the country. The motorway is extremely complex and expensive construction due to its characteristics and the specificities of the ground where it spreads. There are about 26000000 m<sup>3</sup> of hollowed material on the 380 km route. 292 transport structures have been built (tunnels, bridges, viaducts, overpasses, underpasses, passes, green bridges). The calculation says that 18.6% of the route goes to the various transport structures which is a high percentage by comparison to the other motorways [2].



**Fig. 1.** European framework – Strategic and traffic – related position of the Republic of Croatia; Eurostat and Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC), Department for Physical Planning. Explanation in the tekst. (Source: Report on the State of the Environment in the Republic of Croatia 2003)

In the assessment process of opportune road setting into the certain space along with the above mentioned factors – the basic ‘initiators’ of motorway construction process [3], the factor of protection is an indispensable element. It acts as a ‘reflex’ for possible negative consequences of the motorway in the space.

It is very hard to perform an optimal setting of contemporary traffic routes, especially motorways, in the area without negative influence on the environment. The main reasons are traffic- technical and construction demands (wide roadways and separation track, large radius of ground-plan distortion, service road facilities etc.).

By expanding into area, contemporary traffic routes take large areas, cause conversion of the ground use, destroy and fragment habitats and cause pollution of terrestrial and water ecosystems.

The aim of this article is to present the historical frame of the aspects of protection implementation as a consequence of the planning and traffic routes construction in Croatia, the way the aspects formally function, and mechanisms which are to become reality and not only theory.

## **2. Principle discussion: biological diversity in Croatia**

Specific geographic location on the intersection of few biogeography regions, characteristic ecological, climatic and geomorphology conditions make Croatia one of the richest countries in Europe from the point of view of biological diversity. A large diversity of terrestrial and underground habitats resulted in numerous species and subspecies as well as a large number of endemic species.

There are 37 000 known species in Croatia, but it is assumed that the real number is much higher – 50 000 to even 100 000 species. That is an extremely large number for a country with such a small territory. One of the reasons for numerous endemic species in Croatia (especially tertiary relicts) is the fact that a glaciation had not affected these areas [4].

In Croatia one can find a considerable number of endangered species in European frames. They can be found on large, preserved areas, on a characteristic habitat for those species. Spacious woods of beech and fir-tree are habitats of population of three wild animal species: bear, wolf and lynx. Wetland areas and flooded woods are important areas where European wading birds and other birds living near wetland, nest, winter and migrate. Considerable biological diversity of the sea, islands and rocks hides a large number of endemic species. That makes Croatian coast interesting on international level. Destruction and loss of habitat, as well as transformation of natural habitats into construction sites or agricultural areas, are the biggest threat for wild life in the country. Habitat fragmentation occurs in the process of traffic construction [5-7].

According to the Nature Protection Law [8], there are 9 categories of the protected areas in Croatia. At the moment, there are 444 protected areas taking 5124,80 km<sup>2</sup>, which is 9,05% of total Croatian territory (size of the country is 87609 km<sup>2</sup> – 56 542 km<sup>2</sup> is land and 31 067 km<sup>2</sup> sea). The largest part of the protected areas goes to the categories of nature parks or national parks. There are 2 nature reserves, 8 national parks, 10 nature parks with Lastovo archipelago in the process of becoming the 11<sup>th</sup> nature park. There are also some other areas in the process of preserved areas pronouncement.

Three out of eight national parks (Brijuni, Kornati, Mljet) are islands. Their main characteristic is a rich sea world life. National parks Sjeverni Velebit, Risnjak and Paklenica are mountain areas. Numerous limestone rocks, slides, high mountain meadows and vast wood areas are characteristic relief in the national parks mentioned above. Habitat diversity and geographic isolation made the development of specific vegetation and numerous endemic species possible.

Plitvice lakes – the oldest Croatian national park, and Krka river are proud of their unique karst morphology and hydrology, calcareous travertine barriers and cascades. Six out of ten nature parks are situated in mountain areas – Medvednica, Žumberak – Samoborsko gorje, Učka, Biokovo, Velebit and Papuk. Nature parks Kopački rit and Lonsko polje are large flooded areas of Pannonia valley with ornithology reserves included in both of them. Rivers surrounding and flooding these areas are responsible for habitat diversity and life diversity, especially bird life. Vransko Lake is a nature park on the coast, near Zadar. It is the largest natural lake in Croatia and it is very important for bird nesting and wintering.

On behalf of their biological and landscape diversity some protected areas in Croatia earned status of international protection as the extremely valuable locations. Plitvice lakes is included in UNESCO's world heritage area. Velebit – nature park plus national parks Paklenica nad North Velebit – is UNESCO's biosphere reserve. Nature parks Kopački rit, Lonjsko polje, River Neretva

delta and special ornithology reserve Crna Mlaka are included in the list of internationally important wetland areas according to Ramsar Convention.

There are types of habitats specific for Croatia – subterranean karst habitats. Karst area takes 54% of Croatian territory. It is relief specificity which cannot be found anywhere else in Europe. It spreads along the whole Adriatic coast and in the continental part of the country. Those dimensions make karst in Croatia ‘locus typicus’ of exceptional geological structure and hydro geological characteristics. These characteristics reflect not only on surface morphology, but also on the subterranean crack system arrangement with permanent or temporary subterranean water strains. Rich diversity of subterranean fauna with a large number of endemic species is strong dependence with the karst relief. Karst is a habitat sensitive to environment influences. Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC) and World Bank made a project KEC (Karst Ecosystems Conservation Project). It is implemented on the basis of National strategy and biology diversity protection action plan (NSAP) [9]. The strategic objective of NSAP is to preserve existing values of biological and landscape diversity in the karst areas valuable on global level in the way to protect karst and subterranean ecosystems. It should also ensure harmonic management of all natural goods in this area. The estimated project time is 2002-2007.

Besides karst habitats, there are other numerous endangered habitats in Croatia. The preservation is defined according to the ecology network made by overlapping species distribution map and protected areas and habitat map. The areas with the largest density of priority species and habitat types give the most endangered areas. The habitat types in Croatia are described in CORINE – (COoRdination of INformation on the Environment) (2002-2005). Like other countries, Croatia also developed its National habitat classification (NHC), to point out the diversity on its territory and specificities in the sea world, subterranean areas and karst areas. There is a key for conversion of one habitat classification type into another. It is used for conversion of the national classification into any other European standard [10-11]. Croatian Environment Agency (AZO) uses and services the base on the national level.

In 2005 the State Institute for Nature Protection completed the project ‘The National Ecological Network’ LIFE CRO NEN. European Commission LIFE III fond co financed the project with the aim to make the proposal of national ecological network. This proposal is a basis for National Ecological Network decree which must be enacted by the Government. National Ecological Network is a first step in preparation of proposal NATURA 2000 network – the obligation of Croatia in the process of accession to the European Union.

LIFE III CRO NEN analyzed the distribution and representative quantity of every NATURA 2000 habitat type and species. There are 269 species and 65 habitat types. Croatia is the area of distribution of priority species such as wolf, brown bear, monk seal, sea turtle, two types of sturgeon and human fish. The most represented are birds. There are some 130 enumerated in the Appendix 1 of Council Birds Directive in Croatia. The most endangered habitat types in Croatia are: *Posidonia oceanica* meadows, Pannonia dunes, periodical Mediterranean pools, calcareous wells, *Caricion davallianae* bogs, flooded alder woods, etc.

The State Institute for Nature Protection continues to gather and process the data needed for completion of NATURA 2000 network in Croatia. The European Environment Agency and European Council created EMERALD network which, along with PHARE project, are included in the above mentioned activities.

In 1997 the Republic of Croatia made the National Landscape Strategy, prior to ratification of the European Landscape Convention [12]. The basic intention of the Strategy is model structuring for landscape inventory [13]. There are 16 basic landscape units structured according to natural characteristics and based on anthropogenic influence.





**Fig. 2.** Composite map of protected areas in Croatia and interaction with the existing and planned motorway network

The natural resources (natural diversity and relatively high preservation degree of vast Pannonia lowlands, narrow area of the high Dinarides and impressive indented Adriatic coast) are, logically, an imperative in the development process and no matter what it takes it must be kept as a value of prestige on the European level [1]. Accordingly, the motorway route planning and construction has represented a great challenge for professionals and scientists. The example of the adjustment of motorway construction and protection of natural territories is the correlation of Zagreb-Split (A1) motorway section and the areas protected by law (Fig. 2.). The route in a shape of system of viaducts crosses over the protected water area and Gacka valley [14]. The tunnel Mala Kapela makes it possible to preserve valuable animal and plant species. Sveti Rok tunnel passes through Velebit (National Park and UNESCO biosphere reserve). Finally, at the very end of the section, the Krka bridge ‘concurrs’ the canyon situated near the Krka National Park border. The route mainly bypassed the protected areas. However, there are habitats, animal and plant species, valuable landscapes and wood edges which preservation should be integrated into the protection aspect in a better way.

### 3. Results and discussion

This article is about environmental protection in the process of planning, project making and construction of motorway infrastructure. In that context we tried to define the phases of the process, the ratio and representation of those protection factors. Unlike the beginning phase of the protection implementation, these days there are numerous disciplines included in the process. Also, an overall legislation aspect is settled [15-32]. But, formally, it is of high importance to define traffic roads in a planning context from the environment protection point of view. Since the physical planning is the initial phase of decision making about positioning of a certain intervention in space ‘the optimal order for optimal use should be decided on’, because ‘...traffic road construction process does not begin with the cost analysis, construction expenses and technical project, but with planning; the first step is not technical aspect or engineering, but culture and planning’ [33].

When the theoretic and legislative (practical) frame for protection implementation is discussed, Croatia stands next to the countries following world trends. In the sixties, physical planning activities and territory protection come into the light. Environment protection becomes important in the seventies. Consciousness on limited natural resources and need for preserving eco balance grew (at least in theory) with environment protection ideas. Questions of environmental pollution (especially water, air and ground) change the conceptual and politic approach, means of action, social and individual responsibility [34]. Space is seen as a unit of dependable processes. The idea of ‘sustainable development’ gradually took shape.

#### 3.1. The EIA role in route design, project making and motorway construction in Croatia

Before the location and construction permits are issued, EIA (Environmental Impact Assessment) must be implemented. ‘Law on physical planning and space design’ from 1980 requires EIA implementation. The details were defined in ‘Regulations for Drafting Environmental Impact Study (EIS)’ [17]. Not before 1985 did the European Community issue a ‘Directive’ with EIA implementation guidelines for the member states. So, it can be deduced from that fact that Croatia was one of the countries first to introduce EIA into their legislation. It cannot be said that there was no environmental protection in the country before that, but fulfillment of technical and traffic conditions was a primary thing, and then environmental protection was considered, but mainly water protection [35].

Till 1980, the period before EIA, there was a small number of constructed motorways, fortunately. At the time when ‘regulation’ was issued, preparations for construction of those types of roads began. During the EIA implementation process the new propositions and demands occurred. Those are the demands of the commission in charge of EIS assessment and are directed to make the traffic roads embed properly in the environment. For example, there were additional demands for better animal protection on the Zagreb-Rijeka route. For brown bear (*Ursus Arctos* L.) protection, instead of 330 m long notch ‘Dedin’ the green bridge was constructed. It is 100 m wide [36]. On the area where 30 m high and very long ‘Gložac’ notch was planned, the 1080 m long tunnel is built to preserve a natural habitat of already endangered wolf (*Canis Lupus* L.) [37]. The demands for ‘Kamačnik’ canyon protection were created [37]. Viaducts on high columns were planned for construction, but the foundations would ruin natural configuration, ground and vegetation. It was decided on the much better solution – the road bridge can ‘concur’ the canyon with less landscape violation.

The additional conditions of technical nature, occurring during the EIA process, can be included in the project and documentation. However, so far there were mostly demands for altering traffic routes to adjust route to the specific characteristics and values of the area or already existing content in the area. Those changes are not easy to make. The question of the relationship of the route and other contents is solved by deciding upon route position in physical plan. Sometimes, though, EIA

has better solutions for route positioning than those in physical plans. In that case physical plans change in favor of EIA.

When the route is established and charted in the physical plan, by legislative, EIA must be made for traffic road structures (National Physical Plan, County Physical Plan, General town planning scheme). During the years of EIA for traffic roads implementation, it has become clear that the results outgrew the objectives set by the legislation. The main role of EIA was finding preventive solutions and ways of environmental protection prior to road route construction. But spontaneously, it started to analyze more convenient route positioning, which means that EIA intruded into physical planning [38]. For example, on Zagreb – Maribor motorway, there were three solutions for Krapina – Macelj route in the physical plan. EIA estimated that not one of the three suggested routes is acceptable. Further investigation brought to the new route and the altering in the district physical plan [39]. There were changes on four locations on Zagreb – Varaždin – Goričan motorway compared to the physical plan. That was the time when EIA for motorways hardly existed, so there were no alterations in the physical plan. The reason is the new generation of physical planning which started at about the same time of development of motorway construction projects. In that context EIS was a planning tool. Since 2004 only interventions defined by physical planning (not taking into consideration alternative solutions) can be assessed.

Presently, the environment impact assessment process does not influence possible strategic decisions on an optimal route corridor. All the mentioned above brings us to conclusion that, in the sequence of legislative duties, EIA is included too late in the physical planning process. To avoid damaging consequences, EIA should definitely come before final route positioning in the physical plan. That can be at the same time or before physical plan construction process, but it must be the part of strategic environment impact assessment domain. So far EIA proved to be an efficient tool for preventive environmental protection. The results were always positive, no matter lacks in the legislative regulations. The development of the EIA should be continued and new ways of organizing, cooperation and use within legislation should be found; especially in relation to physical planning. The main objective is better environmental protection.

CARDS 2003 ‘Environmental Impact Assessment (EIA) – Guidelines and training project’ will contribute to it. The objective of the project is to support the Croatian Government’s objective of the EU accession by increasing the environmental sustainability of development projects in line with the EU standards [40]. The project’s objective is also enhancement of screening process, scoping and revision of the previous EIA, enhancement of assessment tools (cost benefit analysis, etc.) and transparent EIA process for all the included parties. Positive international experiences show that EIA should be implemented in the earliest preparatory phase – when the Physical Planning Strategy and Program are being drafted. In that phase it is possible to consider complex economic, energetic, infrastructure, physical and other problematic in the context of environmental protection.

We hope that strategic environmental impact assessment will help to solve the above mentioned problematic. CARD 200 ‘Strategic Environmental Assessment (SEA)’/2006-2007/ will contribute to it with its objective to enclose the Directive 2001/42/EC into the legislation, to adopt complete methodology and form administrative capacities for SEA implementation in Croatia.

### **3.2. Project making and environmental protection implementation mechanisms due to traffic infrastructure construction in Croatia**

Figure 3 shows the sequence of certain phases of documentation preparation. It also shows the ratio and phases in which protection aspect is represented.

The protection aspect representation mostly depends on project documentation preparation after the route is defined in physical planning documentation. The EIS is drafted at the same time of concept design. The assessment process is applied based on concept solutions (usually M 1:5000). After the Study is drafted and the route adopted, the following environmental protection projects





Landscape planning projects for motorway routes are very important [41-45], even though wider landscapes of the route are not properly protected due to the width of the zone bought over. The projects tend to include the following protection categories: crown notch bio reparation, slope bank landscape reparation, tunnel portal reparation, erosion prevention reparation, wood edge bio reparation, green bridges and passes landscape planning, visual adaptation of noise protection barriers, material repository reparation, reparation of devastated manipulative areas and especially service facilities (platforms for rest) accommodation according to natural and cultural characteristics of the area.

In Croatia the monitoring phase (the last phase of the process – included in the construction and maintenance phase) is still at its beginning. We consider the results and concepts of regular ground, water, air and wild life monitoring should serve to planning phase, physical-technical studies, EIAs for new motorway sections, and setting standards in the project planning phase.

The question of adequacy and sufficiency of protection aspect in planning and traffic infrastructure construction and planning in general is recently very popular in Croatia. The reasons are complex and multiple. The rapidity of traffic roads construction in few last years is positive from the development point of view, but it restricted certain research, some protection disciplines and implementation of proper protection. For example, according to the time plan, the estimated time period for preparation of total project documentation with all the permits in case of the route Josipdol – Mala Kapela tunnel (the longest tunnel in Croatia, 5730 m long) on ‘Dalmatina’ (Zagreb – Split motorway) was 14 months (June 1999 – September 2000). For the Study itself with research projects two months were planned. This demanding route was opened to traffic in 2005.

From the ecologic point of view, digging a tunnel on Kapela mountain massif preserved valuable wood associations, habitats of numerous species (brown bear *Ursus Arctos* L., wolf *Canis Lupus* L., rich bird life), hydrologic values – stream flows, quality drinking water. The fact is that lots of objects were built on the sections because of the relief diversity of the area. Those object, certainly, preserved the areas where the rout runs. However, we must conclude that the research for certain planned routes are insufficient. The reasons are mostly, the rapidity of construction, the fact that motorways are the important infrastructure, which make a network in the area in linear and continual way due to geographic reality and influence the elements of the area. There are special categories which are not adequately integrated in the planning and project making system: valuable landscape, habitats, certain plant and animal species. The landscape elements quality assessment is introduced to the practice of traffic road project making in the second half of the 20<sup>th</sup> century. But, in the project making phase, the landscape elements are put to the physical minimum defined by expropriation area width (approximately 2,5 m from the final construction intervention line). As it is obvious, we cannot mention the motorway landscape protection and planning in the process of project making. Unfortunately, not even on the level of planning is it not clear that the landscape (the sum of natural space characteristics and human artifacts with specific quality over the time) is a value which must be protected. More important, the new traffic road construction is a challenge in the process of the existing landscape values protection and their possible enrichment.

## 4. Conclusion

In short, the protection aspect should be adequately integrated in the planning, project making and road construction system. The existing flaws should be avoided:

1. Physical planning level
  - The environmental protection profession underrepresented
  - Bases for studies which are responsible for charting the road corridors are mostly technical and of traffic character

- Relatively slow drawing up of plans and the possibility to modify them
- Insufficient definition of certain protection segments.

## 2. Legislation

### Laws

- Laws concerning construction, especially road construction, hardly include the protection aspect
- The array of the protection laws with no coordination and practical use
- Signed conventions and laws are not coordinated with Croatian legislative – the procedure is pending.

### Environmental Impact Studies

- Studies are drawn up based on the given solution – no possibility to influence the solution
- Question of scale (construction project scale vs. needed protection aspect scale) and influence definition
- Insufficient exploration of certain areas, question of data and their accessibility
- Partial evaluation of impact – Study is just a legal frame
- The study results are not used in further phases of planning and project making – not tested.

## 3. Project implementation level

- Non-transparent protection measures implementation, unknown research results (the reason can be partly the short period of implementation)
- Various protection implementation corridors, measures of protection defined in documentation and the study – impossible to perform (private ownership problem)
- Changes in social system, complex relations, ‘collective property’ and ‘collective interest’ do not exist any more, market battle in the physical planning and EIS drawing up – more challenges for profession protection.

The mapped valuable locations, habitats, karst areas, categories which are about to be mapped, as well as diverse values of the areas must be taken into consideration. That makes the overlapping and interdisciplinary evaluation of the areas necessary, due to traffic infrastructure construction.

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