

**LANDSCAPE FRAGMENTATION AS A RESULT OF URBANIZATION IN POLAND
[PL]: PRESJA FRAGMENTACJI KRAJOBRAZU W WYNIKU URBANIZACJI W POLSCE**

The article presents an assessment of changes in land use in Poland in 1980-2018 and fragmentation of individual arable lands using basic landscape statistics and CLC 2000-2018 data. In Poland, areas with medium pressure of fragmentation prevail, but almost 24% surface is under high or very high pressure. Certainly with the development of housing estates, expressways and the development of other roads, this value will be much higher.

Keywords: fragmentation, landscape, land use changes, Poland

Introduction

Poland belongs to one of the richest in nature areas of European countries. According to habitat classification of the European Nature Information System (EUNIS), developed for the European Environment Agency (EEA) and the European Environmental Information Observation Network (EIONET), there are 25 types of ecosystems in Poland out of 57 identified in Europe at level 2 (EUNIS L2 ecosystem typology by EEA). In order to preserve its natural values, for many years Poland has been developing various forms of legal protection of areas and facilities, which together cover almost 45% of its area, which counts our country among the leaders in the EU (Zbierska 2016). Within the network of Natura 2000 areas, 81 types of natural habitats occurring in the country are protected, including 18 priority habitats, i.e. those for which the European Union Member States have a special responsibility and 40 species of plants, including 10 species of priority importance for the Community (Pietrzak 2011).

Unfortunately, in many cases these ecosystems are isolated with small areas that do not fully fulfill their function or are under strong investment pressure (Zydroń i in., 2015; EEA / FOEN, 2016). Landscapes change constantly but in recent decades humans have often shaped them with little thought to the cumulative impacts and at a pace that is unprecedented. The value of landscapes is not yet fully reflected in decision-making on transport infrastructure and urban development. Considerations such as biodiversity and landscape quality are often marginalised. Although Poland ratified the European Landscape Convention in 2004, the legal definition of the landscape to Polish regulations was introduced only on April 24, 2015 in the "Act amending certain laws in connection with the enhancement of landscape protection tools", colloquially called the "landscape law" (Zbierska 2016). Poland, like most countries in Europe, are now emphasising the need to preserve biodiversity and ensure connectivity between the remaining natural areas for the movement of animals, including migration and dispersal, for access to different types of habitats and other resources, for recolonisation of empty habitats and for genetic exchange between populations (Jaeger 2011). One of the most important issues is fragmentation of landscapes by human activities and infrastructure — a major cause of the alarming decrease in many European wildlife populations (Damarad, Bekker 2003). Fragmentation results in collisions with vehicles, prevents access to resources, facilitates the spread of invasive species, reduces habitat area and quality, and subdivides and isolates animal populations into smaller and more vulnerable fractions. Noise and pollution from traffic also threaten human and environmental well-being, and impair the scenic and recreational qualities of the landscape.

Aim, scope and methodology

The aim of the article is to analyze changes in land use in the Polish landscape. In particular, the evaluation of the fragmentation of particular types of natural and semi-natural land cover as a result of housing development and the development of roads and railway lines. Landscape fragmentation caused by transportation infrastructure and built-up areas has a number of ecological effects (increasing endangerment loss of wildlife populations for example through the dissection and isolation of populations, and affects the water regime and the recreational quality of landscapes). In spite of the planning concept of preserving large unfragmented areas, fragmentation has continued to increase during the last 30 years, and many more new transportation infrastructure projects are planned, which will further increase the level of landscape fragmentation significantly.

The statistical data from 1980-2018 and Corine Land Cover 2000, 2018¹ (based on a visual interpretation of satellite images in scale 1: 100,000 with a minimum mapping unit of 25 ha) were used for the analysis. Basic landscape statistics were calculated: Number of Patches (NumP), Mean Patch Size (MeanAREA), Median Patch Size (MedianAREA), Maximum Patch Size (MaxAREA), Perimeter of patches. As a measure of the degree of isolation and fragmentation Mean Nearest Neighbor and Mean Proximity Index (MPI) were used.

The article applies also the method of 'effective mesh density' which quantifies the degree to which the possibilities for movement of wildlife in the landscape are interrupted by barriers. This method was used in joint EEA-FOEN² report No 2/2011 "Landscape fragmentation in Europe" therefore the results for Poland could be compared with the data for 28 countries in Europe.

¹ „Corine Land Cover 2018 project in Poland was implemented by the Institute of Geodesy and Cartography and financed from the European Union funds. The project results were obtained from the website Głównego Inspektoratu Ochrony Środowiska clc.gios.gov.pl.”

² Swiss Federal Office for the Environment (FOEN) and the European Environment Agency (EEA).

Results and conclusions. The analysis of land and building register and changes in the directions of utilization of space in Poland in 1980-2018 indicate three basic directions of changes in land use: development of housing estates, increase of forest area and decrease of arable land area (Table 1). The key change in land use in the last dozen or so years has been the development of urban areas and the development of the road network in Poland (Fig. 1). In the years 2000-2018, the largest area loss was recorded for arable land and heterogeneous agricultural areas (Table 2). At the same time, the number of patches (Patch) increased significantly for arable land. This indicates a significant fragmentation of these areas, which is confirmed by a clear decrease in the Mean Proximity Index. Lowering the Proximity Index (MPI) value applies to the majority of analyzed land uses, which indicates that these areas are more isolated. Almost 24% of Poland's surface is under high or very high pressure of fragmentation (Fig.2). These are mainly areas in the area of developing cities and main communication routes in the southern and central parts of Poland. In comparison with other EEA countries, Poland is characterized by a medium threat of fragmentation, however, it is already known today that with the development of housing estates, expressways and the development of other roads (Program...), this volume will be much higher.

Table 1. Changes in land use structure in Poland [in percent]

	Grand total	Agri-cultural land	Forests and woody land	Lands under water	Buil-up and urbanised areas	Other
1980	100,0	61,1	28,0	2,6	5,9	2,4
1985	100,0	60,5	28,3	2,6	6,1	2,5
1991	100,0	60,0	28,4	2,6	6,4	2,5
2000	100,0	59,0	29,3	2,7	6,5	2,5
2010	100,0	58,2	30,5	2,7	6,7	2,0
2018	100,0	56,9	31,2	2,8	7,2	1,9

Source: Central Statistical Office (GUS 2019)

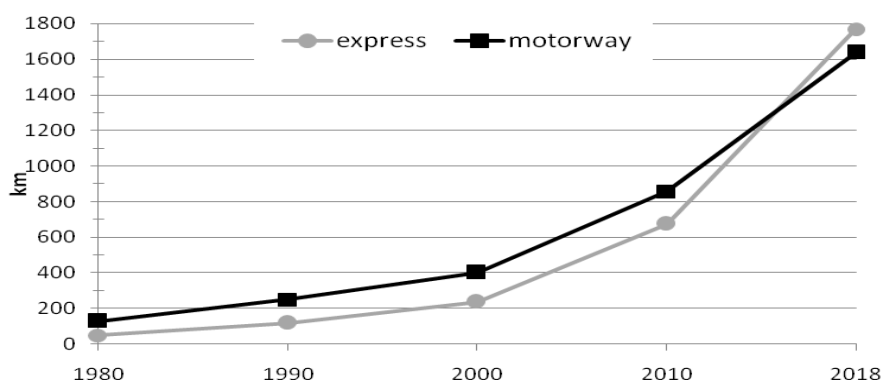


Fig. 1. Motorway and express roads length in Poland

source: Regional statistical data (BDR) and General Director of National Roads and Motorways (GDDKiA)

Table 2. Changes in landscape statistics for particular types of land cover 2000-2018

CLC classes name	Code CLC	NumP change	Perimeter change	Area change	Maximum Area	MPI change
			thou. km	thou. ha	ha	
Arable land	21	596	-16,67	-569,96	-226775,35	↓
Permanent crops	22	-1	1,36	44,20	6535,55	↓↑
Pastures	23	742	4,31	130,33	-18633,74	↓
Heterogeneous agricultural areas	24	-9524	-65,86	-826,09	-4208,21	↓
Forests	31	2110	21,02	402,06	-98175,31	↓
Shrub and herbaceous vegetation	32	3998	20,25	273,55	-3876,14	↓↑
Open spaces	33	-60	-0,34	-4,34	72,26	↑
Inland wetlands	41	148	0,61	5,97	373,02	↓
Inland waters	51	267	0,99	-9,32	-6222,77	↓↑

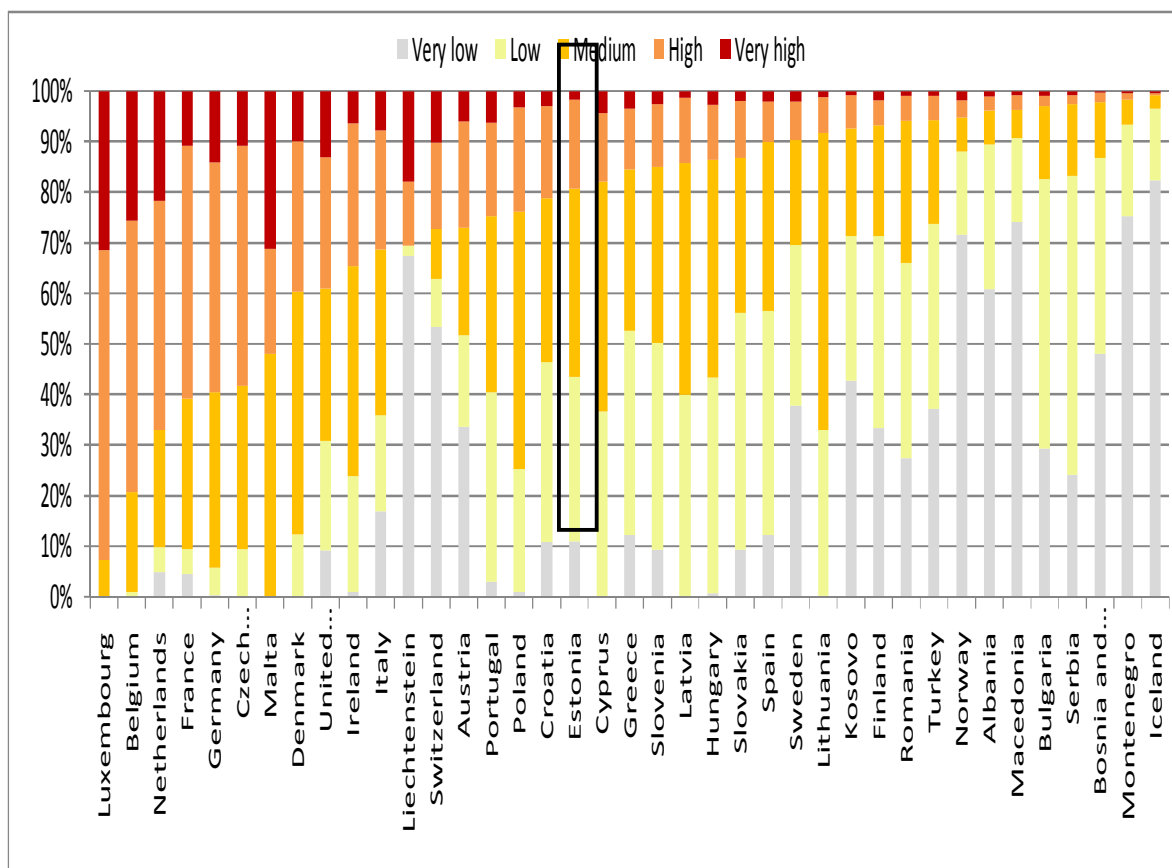


Fig. 2. Fragmentation pressure in Poland compared to EEA member countries³
source: own elaboration based on EEA / FOEN, 2011. Landscape fragmentation in Europe

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³ The thresholds for the fragmentation classes are [number of meshes per 1000 km²]:
Very low (0 – 1.5]; Low (1.5 – 10], Medium (10 – 50]; High (50 – 250], Very high > 250