

2006-2012 LAND COVER AND USE CHANGES IN ROMANIAN NATURAL PROTECTED AREAS

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Abstract. The literature shows that, despite of the ‘sustainability’ concept, conservation and development are still in a conflicting relationship. In Romania, natural protected areas were declared during the accession to the European Union, but their status was not always enforced. The aim of this study is to look at the spatial distribution of land cover and use changes occurring in Romanian natural protected areas during 2006-2012 in relationship to their underlying transitional dynamic. The methodology consists of geo-spatial analyses of CORINE land cover and use data and data on the Romanian natural protected areas. The results attest the presence of land cover and use changes in the Romanian natural protected areas. Furthermore, nearly 50% of all deforestations occurred within their perimeter. The findings reflect the consequences of an unplanned development, disregarding the long-term consequences for the short-term benefits.

Keywords: sustainability, deforestation, floods, CORINE, conservation.

Rezumat. Modificări în acoperirea și utilizarea terenului din ariile naturale protejate din România în perioada 2006-2012. Literatura de specialitate arată că, în pofida apariției conceptului de „dezvoltare durabilă”, relația dintre conservare și dezvoltare rămâne una conflictuală. În România, ariile naturale protejate au fost declarate în timpul procesului de aderare la Uniunea Europeană, dar statutul lor nu a fost întotdeauna supus controlului implementării legislației. Scopul acestui studiu a fost analiza distribuției modificărilor acoperirii și utilizării terenului din ariile naturale protejate din România în perioada 2006-2012 pe baza dinamicilor de tranziție. Metodologia a constat în analize geo-spațiale pe baza datelor CORINE privind acoperirea și utilizarea terenului și acelor referitoare la ariile naturale protejate. Rezultatele atestă prezența modificărilor acoperirii și utilizării terenului în ariile naturale protejate. Mai mult, 50% din defrișări s-au produs în acest perimetru. Aceste rezultate reflectă consecințele unei dezvoltări neplanificate, ce sacrifică consecințele pe termen lung pentru beneficii imediate.

Cuvinte cheie: dezvoltare durabilă, defrișare, inundații, CORINE, conservare.

INTRODUCTION

The conservation status limits the usage of natural resources (JAMES et al., 2001; CHOMITZ et al., 2005; PETRIȘOR et al., 2016), but results in benefits such as ecosystem services (ADAMS & HUTTON, 2007; TALLIS et al., 2008; ANDAM et al., 2010; BUSCH & GRANTHAM, 2013), tourism revenues (ANDAM et al., 2010; FERRARO et al., 2011) and an improvement of the infrastructure (ANDAM et al., 2010; FERRARO et al., 2011).

In developing countries and/or during economic crises, conservation and socio-economic development develop a confliction relationship (BENNETT et al., 2007; PETRIȘOR et al. 2016); this could be a consequence of the association between the lack of environmental awareness and poverty (REICHEL-DOLMATOFF, 1982; ROZELLE et al., 1997; JEHAN & UMANA, 2003; TALLIS et al., 2008), especially in the developing countries (LEONARD & DAVID, 1981; IANOȘ et al., 2011) which do not use the natural resources to reduce poverty (SAYER et al., 2012).

The potential benefits of conservation are debatable (WILKIE et al., 2006; ANDAM et al., 2010; ANTHONY & SZABO, 2011). Some authors consider conservation a solution for reducing poverty (KUŠOVÁ et al., 2005; KOTHARI, 2006; ADAMS & HUTTON, 2007; TALLIS et al., 2008; ANDAM et al., 2010; FERRARO et al., 2011), whilst others consider it a cause of poverty (DE SHERBININ, 2008), because conservation does not have this aim (ANDAM et al., 2010). The conflict may be rooted in the long-term goals of conservation, which do not account for the present challenges (OHL et al., 2008). Generally, the relationship might differ by scale (UPTON et al., 2008).

The most conflicting activities are the economic ones (FRYS & NIENABER, 2011), especially agriculture (ANDAM et al., 2010; ANTHONY & SZABO, 2011; FRYS & NIENABER, 2011). Conflicts are determined by the limited access to resources (BELL et al., 2001; CERNEA & SCHMIDT-SOLTAU, 2003; BROWMAN et al., 2004; ADAMS & HUTTON, 2007; DHAKAL et al., 2007; OHL et al., 2008; ANDAM et al., 2010; IOJĂ et al., 2010; ANTHONY & SZABO, 2011; FERRARO et al., 2011), restrictions to the ownership (CERNEA & SCHMIDT-SOLTAU, 2003; WILKIE et al., 2006; ADAMS & HUTTON, 2007; PETRIȘOR et al., 2016), ignoring the local culture in the management process (WALPOLE & GOODWIN, 2001; CAMPBELL & VAINIO-MATTILA, 2003; KOTHARI, 2006; SINGH et al., 2012, 2014; SUGANDI, 2014) or unfair distribution of revenues (KOTHARI, 2006; WILKIE et al., 2006; OHL et al., 2008). Political causes include the opposition to top-down approaches (ADAMS & HUTTON, 2007; KUŠOVÁ et al., 2008; MACKELWORTH & CARIC, 2010; ANTHONY & SZABO, 2011; GRODZINSKA-JURCZAK & CENT, 2011), especially in an international context (NELSON & VERTINSKY, 2005), but also by low accessibility (ANDAM et al., 2010), lack of funding (SHULTIS, 2005; IOJĂ et al., 2010) of planning (SINGH et al., 2014) and tourism (SHULTIS, 2005).

Land cover and use changes reflect socio-economic issues through their underlying transitional dynamics (PETRIȘOR et al., 2010; 2014). Previous studies (PETRIȘOR, 2015b; 2016) aimed to assess human impacts in the Romanian natural protected areas through the land cover and use changes occurred in the Romanian natural protected areas, but due to the age of the datasets it was hard to assess causality (i.e., whether changes occurred before of after the

acquisition of the protection status). Romanian natural protected areas were declared in relationship with joining the European Union, but their status was not really enforced always, as some missed either a managing authority and a management plan or at least the second. For these reasons, the protection status was questioned, and resulted into Romania being sued by the European Union (COJOCARIU et al., 2010), as: (1) if changes occurred before, the protection status is questionable because the areas were no longer in a pristine state, and (2) if changes occurred after, the efficiency of enforcing the protection status is at stakes.

This study aims at looking at the spatial distribution of land cover and use changes occurred in the Romanian natural protected areas during 2006-2012 in relationship to their underlying transitional dynamic.

DATA AND METHODS

The study used several datasets, freely available from European and international sources, presented in Table 1. Data processing consisted of re-projecting and sub-sampling subsets for Romania, clipping the polygons affected by land cover and use changes by the natural protected areas, and ultimately computing areas using the X-Tools extension of ArcView GIS 3.X. The analyses aimed to assess the distribution of land cover and use changes by the natural protected areas by computing their total areas.

The following transitional dynamics were defined combining the classification schemes used in the previous studies (IANOȘ et al., 2011; PETRIȘOR, 2012a, b, c, 2015a, b, 2016, 2017b, c; PETRIȘOR & PETRIȘOR, 2015, 2017; PETRIȘOR et al., 2010, 2014), based on the occurrence of changes at the first level of classification – C1, corresponding to land cover, or at the third – C3, corresponding to land use (PETRIȘOR et al., 2010):

1. Urbanization – C1 transformation of other classes into ‘urban’ or C3 change indicating that urban development occurred within the city
2. Forestation – C1 transformation of other classes into ‘forest’, including the colonization of abandoned agricultural land into forests (AGNOLETTI et al., 2011; PETRIȘOR et al., 2014), C3 transformation into forest; ‘forest’ corresponds to C3 classes 311 – coniferous forests, 312 – broadleaved forests, 313- mixed forests) (DE LIMA, 2005)
3. Deforestation – C3 transformation of ‘forest’ (see above) into other classes
4. Development of agriculture – C1 transformation of other classes into ‘agricultural’ or C3 transformations indicating the development of agriculture
5. Abandonment of agriculture – C3 transformations indicating the abandonment of agriculture
6. Floods – C1 transformation of other classes into ‘wetlands’ or ‘waters’.

The natural protected areas considered in this study, based on the availability of data from the Romanian Ministry of the Environment and Sustainable Development, were:

1. National parks and natural parks (IUCN: protected landscapes)
2. Scientific reserves, natural reserves and natural monuments with an area exceeding 10 ha
3. Ramsar Sites (derived by the authors)
4. Reserves of the biosphere (derived by the authors)
5. Natura 2000 SCIs, SPAs and SACs
6. A consolidated dataset, which joined all protected areas, accounting for their overlap (IOJĂ et al., 2010)
7. The Romanian territory of the Carpathian Convention, although not a genuine protected area (simply assumes measures for conserving the biodiversity).

Table 1. Specifications on the data used in the study: dataset, provider, URL, remarks and transformations.

Dataset	Provider	URL	Remarks	Transformation
Land cover and use changes data	Copernicus Land Monitoring Services	http://land.copernicus.eu/pan-european/corine-land-cover/lcc-2006-2012/view	ArcView GIS 3.X	Project into Stereo 1970, sub-sample for Romania
Natural protected areas	Romanian Ministry of the Environment and Sustainable Development	http://www.mmediu.ro/departament_ape/biodiversitate/	ArcView GIS 3.X; only several categories are available	No transformation needed

RESULTS AND DISCUSSION

The analysis aimed to look at the spatial distribution of land cover and use changes by their underlying transitional dynamic in the Romanian natural protected areas. The results are presented for each analysis separately: the overall situation in all natural protected areas (Table 2), in the Carpathian Convention area (Table 3), and in each type of natural protected area (Table 4).

Table 2 compares the distribution of land cover and use changes by their underlying transitional dynamic in all natural protected areas and the overall situation of Romania, looking at the area affected and its share in the total. The results reveal the existence of some differences; deforestation seems to be more prominent (69% compared to 57%); this is due to the fact that a significant number of natural protected areas are situated in the mountain region and include forests. It has to be stressed out that 48% of the areas Romanian affected by deforestation during 2006-2012 are situated in natural protected areas. However, forestations total a lesser share (5% compared to 9%), and only 26% of the total

Romania forested area is situated within the natural protected areas. Also, floods have a higher importance (21% compared to 8%); this is due to the fact that wetlands make up an important share of the natural protected areas, and significant floods occurred during the analyzed period.

Table 2. Land cover and use changes in all Romanian natural protected areas, compared to all changes in Romania.

Transitional dynamic	Area affected per region			
	Romania		All protected areas	
	Area (km ²)	% of the category	Area (km ²)	% of the category
Abandonment of agriculture	30	4	4	1
Deforestation	408	57	196	69
Development of agriculture	26	4	1	0
Floods	60	8	59	21
Forestation	62	9	16	5
Other	6	1	6	2
Urbanization	128	18	3	1

Table 3 compares the area of the Carpathian Convention with the national territory with respect to land cover and use changes by their underlying transitional dynamic. The Convention on the protection and sustainable development of the Carpathians, known as the Carpathian Convention, was signed in Kyiv, Ukraine in 2003 and aims to turn into a policy the special interest paid by the European Union to the mountain regions due to their vulnerability to environmental and special characteristics, such as the inclusion of fragile ecosystems, harsh climate, isolation, political and economic isolation (POPESCU & PETRIȘOR, 2010). The results emphasize the importance of deforestations (89% compared to 57%) – 82% of the whole deforested areas, explained by the fact that most Romanian forests lie within the Carpathians, covered by the Carpathian Convention. However, only 26% of the forested area is situated within this perimeter. Another difference consists in the lesser importance of urbanization (3% compared to 18%), explained through the fact that low accessibility prevented urban development (POPESCU & PETRIȘOR, 2010).

Table 3. Land cover and use changes in the area of the Carpathian Convention, compared to all changes in Romania.

Transitional dynamic	Area affected per region			
	Romania		Carpathian Convention area	
	Area (km ²)	% of the category	Area (km ²)	% of the category
Abandonment of agriculture	30	4	2	0
Deforestation	408	57	335	89
Development of agriculture	26	4		
Floods	60	8	1	0
Forestation	62	9	25	7
Other	6	1		
Urbanization	128	18	12	3

Table 4. Land cover and use changes in different types of natural protected areas, compared to all changes in Romania and in all the natural protected areas.

Transitional dynamic	Area affected per region																								
	Romania		All protected areas		Parks (1)			Ramsar			Reserves of the biosphere			Reserves (2)			SCIs			SPAs			SACs		
	Area	% (3)	Area	% (3)	Area	% (3)	% (4)	Area	% (3)	% (4)	Area	% (3)	% (4)	Area	% (3)	% (4)	Area	% (3)	% (4)	Area	% (3)	% (4)	Area	% (3)	% (4)
Abandonment of agriculture	30	4	4	1							12	18	4	0	2	0	1	0	0	3	2	1			
Deforestation	408	57	196	69	62	53	22	13	19	5				8	90	3	176	69	62	122	60	43	4	100	2
Development of agriculture	26	4	1	0	0									1	7	0	1	0	0	1	0	0			
Floods	60	8	59	21	54	46	19	54	80	19	54	82	19				59	23	21	58	29	20			
Forestation	62	9	16	5	2	1	1	1	1	0				0	0	0	12	5	4	12	6	4			
Other	6	1	6	2													6	2	2	6	3	2			
Urbanization	128	18	3	1	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	2	1	1			

1 – includes national parks, natural parks (IUCN: protected landscapes); 2 – includes scientific reserves, natural reserves and natural monuments; 3 – percentage from the total area affected per category; 4 – percentage from the total area affected by changes in all natural protected areas

Table 4 compares the different types of Romanian natural protected areas with respect to land cover and use changes by their underlying transitional dynamic. Comparisons are carried out between the different types of natural protected areas, but also between them and the national situation or all protected areas together, accounting for their overlap (IOJĂ et al., 2010). The results vary across the different natural protected areas and transitional dynamics. The abandonment of agriculture is important only in Ramsar sites, but their large share is explained by the fact that other changes are not present. More exactly, since the Ramsar sites are wetlands, the share of forests is reduced within their perimeter, and deforestations and forestations are missing; also, they include lesser human settlements, and urbanization is not important. However, they are affected by floods to a greater extent. Deforestations affect all natural protected areas, and especially the Special Areas of

Conservation (SACs), where they are the only driver of change. The development of agriculture, urbanization and other causes are misrepresented; this is because most protected areas include natural ecosystems, and to a lesser extent man-dominated ecosystems, and, therefore, the transitional dynamics characteristic to socio-economic systems are less important, and host lesser human communities, reducing the impacts resulting from demographic factors (population and density), such as urbanization (PETRIȘOR, 2017a, b), extensive agriculture or deforestations. Floods are prominent in many categories, especially the Ramsar sites discussed above, but also the biosphere reserves; this is due to the share of the area of the Danube Delta Biosphere Reserve in the category of biosphere reserve.

The study is subject to limitations characteristic to CORINE data, including misclassification of satellite data, as well as different classification schemes and resolutions from one period to another (JANSEN, 2007; PELOROSSO et al., 2011; VERBURG et al., 2011; PETRIȘOR et al., 2010, 2014).

CONCLUSION

This study aimed to look at the relationship between conservation and development by analyzing the land cover and use changes occurred in Romania during 2006-2012 based on their transitional dynamics, which are conditioned by socio-economic factors. One of the most important factors is that changes occurred within these areas despite their protection status. Furthermore, nearly 50% of all deforestations occurred within this perimeter, but they were not compensated by forestation to a similar extent. Overall, the findings reflect the consequences of an unplanned development, where the protection status was not enforced, disregarding the long-term consequences for the short-term benefits.

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Received: January 12, 2018
Accepted: July 31, 2018