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## Are the Romanian natural protected areas properly covering the wetlands?

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**A**bstract: Wetlands host an important biodiversity, provide important ecosystem services, and are threatened and vulnerable ecosystems, representing a priority for the conservation of biodiversity. Previous studies have attempted to assess the efficiency of conservation in Romania through the natural protected areas. The current study attempts to provide an overall picture, using free available geospatial data on natural protected areas and land cover. The methodology consisted of computations performed using the GIS. The results indicate a very good conservation of wetlands (90% of their area). However, if the Danube Delta Biosphere Reserve is excluded, the percentage drops down to 62%. Wetlands make up an important share of biosphere reserves, world heritage sites, and Ramsar sites. Overall, 11% of the land cover of natural protected areas consists of wetlands. The results indicate that the natural protected areas system accounts for wetlands in particular, but improvements are still possible.

**Keywords:** conservation, geospatial data, geo-statistical methods, biodiversity, land cover

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### INTRODUCTION

In recognition to their importance, wetlands are key points of the environmental conservation agendas. Among the arguments, their high biodiversity, including the presence of rare and endangered species, and importance in global mass and energy flows are the most important (Meiță and Petrișor, 2015). Wetlands rank at the top of the most biologically productive ecosystems in the world (Heinl, 2001). They are important sources of methyl mercury to the boreal forest ecosystem (St. Louis et al., 2004); absorb and slow down floodwaters from coastal storms, hurricanes, filter and degrade toxic substances, reduce flooding and erosion by absorbing storm water and releasing it slowly, and by absorbing overflows from streams and lakes, and help replenishing stream flows during the dry periods, recharging the groundwater, and preserving biodiversity through the provision of habitats for a variety of species (Tyler Miller and Spoolman, 2009), provide valuable feeding sites and migration staging (McCulloch et al., 2003). Moreover, wetlands are home to diverse and unique species assemblages (Russel et al., 2002), and play a crucial role in the dynamics of metapopulations of particular animal species (Gibbs, 1993). Their economic value comes from the fact that many of their functions have proved their utility to humans. Their perceived values come out from functional ecological processes, but are also determined by human perceptions, particular locations, human pressures on them, and extent of the resources (Mitsch and Gosselink, 2000).

In addition to their importance, wetlands are among the most vulnerable and most threatened habitats (Williams and Dodd, 1979; Sbarcea et al. 2019). In addition to human impacts, natural causes affect them too. In summary, the main impacts are due to drainage and filling to provide more agricultural lands and as an anti-malaria measure, building of huge dams to store water for agricultural purposes, straightening and straightening the course of riverbeds with dikes as a flood protection measure, water pollution, overexploitation/ unwise use of wetlands resources, species composition alteration/ damage – removal of plant cover, overgrazing by domestic animals, introduction of non-indigenous (nonnative) species (Williams and Dodd, 1979; Apostolov et al., 2004). Dams, and canals fragment rivers, alter and destroy terrestrial and aquatic habitats by reducing water flows and increasing damage due coastal

storms; flood control levees and dikes disconnect the rivers from their adjacent floodplains, destroy aquatic habitats, and alter or diminish the functions of neighboring wetlands. Most anthropogenic impacts originate in cities and farms, which add pollutants and excess plant nutrients. Finally, many inland wetlands have been drained or filled to grow crops or covered with concrete, asphalt, and buildings (Tyler Miller and Spoolman, 2009). As a consequence of these impacts, wetlands are disappearing globally at an alarming rate (Heinl, 2001).

The ecosystem services constitute an excellent framework for assessing the benefits of wetlands. Starting with the Millennium Ecosystem Approach from the early 2000's, the classical capital-based approach (i.e., environmental goods and services provided by the natural capital to human society) was replaced with the ecosystem services perspective (Petrișor, 2016b). Ecosystem services are the benefits provided by ecosystems to human society, classified as: (1) supply (food, water), (2) regulation (flood and disease control), (3) cultural (spiritual, recreational, and cultural benefits), and (4) support (nutrient cycling) (Zakri and Watson, 2003; Watson and Zakri, 2005). This perspective is related with the previous one, since a normally functioning ecological system has a biological yield, transformed into the goods and services yielded to the human society (Ianoș et al., 2009).

The Romanian system of protected areas was designed in line with the guidelines of the International Union for the Conservation of Nature, with some variations (Munteanu and Seviănu, 2014). However, the process of declaring new areas in relationship to the accession of Romania to the European Union, was not easy (Vanonckelen and Van Rompaey, 2015), and its consequence is the overlapping of different categories (Iojă et al., 2010), generating a lawsuit from the European Union (Cojocariu et al., 2010). Current natural protected areas cover some 18% of the national territory (Stăncioiu et al., 2010), similar to other European countries (Kati et al., 2014).

Previous studies were carried out in Romania to look at the efficiency natural protected areas in terms of the overlapping of different categories (Iojă et al., 2010), biogeographical coverage (Petrișor, 2008) coverage of priority habitats (Petrișor, 2016a) or wetland habitats (Petrișor, 2010), diversity of landforms (Petrișor, 2009), and deforestations (Petrișor, 2018b) or all land cover and use changes occurred within (Petrișor, 2018a). Most studies used the Geographical Information Systems (GIS) and spatial indicators (Pătroescu et al., 2007).

The present study attempts to assess the efficiency of conserving the biological diversity of wetlands by the current national protected areas system based on the spatial correlation of land cover data and the presence of protected areas. The difference between the previous aforementioned research carried out for wetlands (Petrișor, 2010) is that the current one has a global approach, while the previous one was focused on the habitats only.

## **MATERIALS AND METHODS**

The research used spatial data on the Romanian Natural Protected areas, freely available from the Romanian Ministry of the environment (<http://www.mmediu.ro/beta/domenii/protectia-naturii-2/arii-naturale-protejate/>), and 2012 data on land cover and use, freely offered by the European Union Copernicus Land Monitoring Service (<http://land.copernicus.eu/pan-european/corine-land-cover/lcc-2006-2012/view>) in a shape file format.

The software used to analyze the spatial data based on overlying and clipping the different datasets was ArcView 3.X, in conjunction with its X-Tools extension, used for computations of areas.

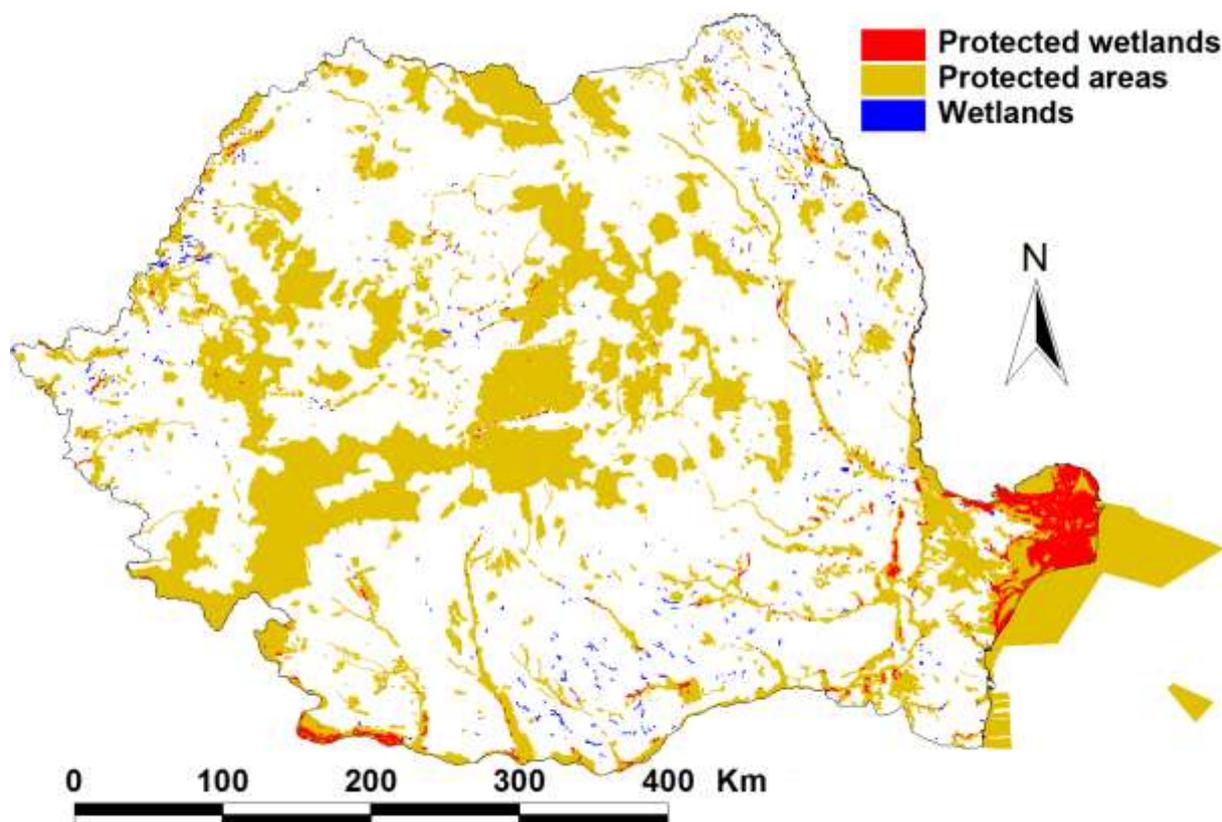
## **RESULTS AND DISCUSSION**

Fig. 1 displays an “overall picture” of the Romanian natural protected areas (all categories), wetland, and wetlands included within the perimeter of natural protected areas. As it can be seen, the most important natural protected area, the Danube Delta Biosphere Reserve, is essentially a wetland; the other wetlands have a very little surface, and the area included in natural protected areas seems to be slightly larger than the one situated outside of them.

A detailed outline of the status of the main categories is displayed in Table 1. As expected, wetlands make up most of the RAMSAR sites (since there are designed to protect aquatic birds). The large share in the case of biosphere reserves and UNESCO natural sites is due to the fact that the Danube Delta

and parts of the Black Sea are included in this category. The area of Danube Delta Biosphere Reserve (DDBR), consisting of wetlands only (according to the computations, 2387.88 km<sup>2</sup>) is protected entirely.

In order to elaborate more, Table 2 provides an overall view on the effectiveness of the protection of wetlands. If DDBR is included, 90% of wetlands are protected. Its exclusion drops down the percentage to 62%, which is consistent with the visual estimation based on Fig. 1: roughly a little bit more than half of their surface is included in natural protected areas.



**Fig. 1.** Overlapped distribution of the land used by humans (built up or agriculture) and the ranges of birds, other protected species and habitats within the administrative limits of Danube Delta Biosphere Reserve. Source: map created by the authors using data from Copernicus Land Monitoring Service and the Romanian Ministry of the Environment.

**Table 1.** Presence of wetlands within the Romanian natural protected areas, by type.

Type of protected area	Total area	Wetland area	%
Biosphere reserve	6619.40	2387.88	36.07
UNESCO natural world heritage site	3119.16	1790.04	57.39
RAMSAR site	10966.40	2660.67	24.26
Site of Community Importance	46508.19	2756.50	5.93
Special Protected Area	38752.98	2797.89	7.22
National park	3174.19	0.00	0.00
Protected landscape	7700.27	84.78	1.10
Natural reserve	409.22	14.26	3.48
Natural monument	0.76	0.00	0.00
Scientific reserve	5.11	0.01	0.16
Other	2758.79	371.30	13.46
Total	120014.47	12864.35	10.72

**Table 2.** Effectiveness of the protection of wetlands in Romania.

	<b>Wetlands</b>	<b>Protected wetlands</b>	<b>%</b>
All	3215.49	2904.82	90.34
Excluding DDBR	827.61	516.93	62.46

In order to address the efficiency of protection, two figures are important. Table 1 shows that wetlands make up 10.72% of the land cover of natural protected areas, while their share of the national territory is 1.35%; this indicates that the Romanian natural protected areas attempt to cover the wetlands more than other categories, accounting for their particular importance. However, the fact that 62% of the wetlands are protected leaves room for improvement.

## CONCLUSION

The main findings of the study indicate that, although the natural protected areas include, in terms of land cover, more wetlands than the national share of the territory, only 62% of the wetlands (except for the DDBR) are protected, leaving room for improvements.

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