

NATURAL PROTECTED AREAS IN THE CONTINENTAL BIOGEOGRAPHIC REGION (ROMANIA)

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Abstract. *The continental bioregion covers over a quarter of the territory of the European Union, including in whole or in part, the territory of 13 EU Member States. A comparison of the percentage of coverage for each bioregion in the EU shows that the continental bioregion occupies 29.3% of the EU territory, ranking first among all nine bioregions in the EU Member States. On the Romanian territory there are five biogeographical regions established at European level: continental, alpine, Pannonian, Pontic (Black Sea) and steppe (present only in Romania). The purpose of this paper is to present the number and distribution of protected natural areas, their area and share, in the continental biogeographic region of Romania. For the elaboration of this study there were used: geospatial data, Digital Elevation model with spatial resolution at 25 m and auxiliary geospatial data. The continental bioregion overlaps on large areas in Romania, in the central, southern and northeastern part, on 13,469,987.94 ha, which means 56.5% of Romania's territory. The protected natural areas in the continental biogeographical region were analyzed by categories, in terms of occupied territory, but also in terms of interrelationships between them. On the Romanian territory, from the continental biogeographical region, 3,629,684.90 ha, respectively 26.94%, are included in different categories of protected natural areas, distributed as follows: SPAs = 1,393,100.90 ha (38.38% from the territory) divided into 95 entities; SCIs = 1,390,611.97 ha (38.31% of the territory), divided into 272 entities; RORMS on the surface of 340,770.38 ha (9.39% of the territory), divided into 9 entities; NP on the area of 313,354.78 ha (8.63% of the territory), divided into 11 units; NP on the area of 103,430.19 ha (2.85% of the territory), divided into 7 units; RN on the surface of 88,348.81 ha (2.43% of the territory), divided into 425 entities, RS on the surface of 37.78 ha, with a single entity; MN on the surface of 30.07 ha, with a single entity. Through the data provided in the paper, we wanted to present a detailed situation of protected natural areas in the continental bioregion in Romania, compared to the entire bioregion in the EU.*

Key words: *biogeographical regions, continental bioregion, coverage, protected areas*

INTRODUCTION

Romania is located in Central Europe, at an equal distance between the North Pole and the Equator, as well as between the Atlantic Ocean and the Ural Mountains, in the Danube and Black Sea river basin. With an area of 238,391 km² and a population of 21,584,365, according to data provided by the NIS, it is considered a medium-sized European country and represents 6% of the total area of the European Union and 4% of its population.

The geographical position, the physical-geographical, lithological complexity and the radial distribution of the altitudinal gradients of the relief forms create a great diversity of *mesoclimatic, microclimatic and pedological* conditions. This variability of the composition and structure of the substrate and abiotic conditions determines the richness, distribution and level of representation of the types of ecosystems and natural habitats in Romania (NATIONAL STRATEGY AND ACTION PLAN FOR BIODIVERSITY CONSERVATION 2014 - 2020).

On the Romanian territory there are five biogeographical regions established at European level: continental, alpine, Pannonian, Pontic (Black Sea) and steppe (present only in

Romania). The Black Sea Bioregion includes, in addition to the coastal part, the Romanian territorial waters and the exclusive economic zone, according to the Framework Strategy for the Marine Environment of the European Union (DIRECTIVE 2008/56/EC).

The continental region covers over a quarter of the territory of the European Union and stretches over a wide strip from west to east, starting from the center of France and heading towards the eastern border of Poland in the north and Romania in the south. Outside the EU, it stretches as far as the Ural Mountains, on the border with Asia. In the south, the region is almost divided in two by the high mountain ranges in the alpine area and the steppe areas in the Pannonian Plain. Parts of the Adriatic and Baltic Sea coasts are also included (SUNDSETH, 2010).

In total, the continental region includes, in whole or in part, the territory of 13 EU Member States. It covers large areas of France, Germany, Italy, Poland, the Czech Republic and Bulgaria, as well as significant parts of Denmark, Belgium, Austria, Slovenia and Romania. Luxembourg is the only state that is located entirely in the continental region, while, on the other hand, Sweden has only 3% of the territory in this region (SUNDSETH, KERSTIN, 2010). In 2010, at the Tenth Conference of the Parties (COP) to the Convention on Biological Diversity (CBD), the CBD Parties adopted a revised and updated Strategic Plan for Biodiversity 2011-2020, including five Goals and 20 Aichi Biodiversity Targets (<https://www.cbd.int/decision/cop/?id=12268>).

The measures set to stop biodiversity loss are also found in the "7th Environment Action Program (2014-2020)" which will be adopted this year and will contribute to achieving the Europe 2020 goals of sustainable, smart and inclusive growth. (NATIONAL STRATEGY AND ACTION PLAN FOR BIODIVERSITY CONSERVATION 2014 - 2020)

The Strategic Plan for Biodiversity 2011-2020, with the 20 Aichi Biodiversity Objectives and the 2030 Agenda for Sustainable Development are probably two of the most important such commitments reached in the last decade. Strategic Objective C of the Strategic Plan addresses efforts to conserve ecosystems and species in both terrestrial and marine environments. These efforts include ecological cover and representation, ensuring the efficient and equitable management of protected areas, the protection of areas important for biodiversity and the development of well-protected systems of protected areas integrated into the landscape (UNEP-WCMC and IUCN (2016)).

Protected areas offer benefits that extend beyond their borders. They play a key role in (UNEP-WCMC and IUCN (2016) by:

- ensuring health, livelihoods and well-being;
- strengthening ecosystem restoration and resilience (Aichi Biodiversity Targets 14 and 15);
- promoting positive contributions to local economies and reducing poverty (Aichi Biodiversity Target 2).

Protected areas provide natural solutions to many global challenges (LOPOUKHINE et al., 2012; ERVIN et al., 2013; WATSON et al., 2014; DUDLEY et al., 2014; DUDLEY et al., 2015), including carbon storage and sequestration. for climate change mitigation (MELILLO ET AL., 2016; Scharlemann et al., 2010), helping communities and protected area managers cope with the growing risk of natural disasters (DUDLEY et al., 2015).

The World Database on Protected Areas (WDPA) recorded in the Protected Planet Report 2018, a total of 238,563 protected areas, most of them on land, covering 14.9% of the land area and 7.3% of the marine area. Globally, sites important for terrestrial biodiversity are covered by 19.3% protected areas, in the case of freshwater (16.6%), in the marine area (19.3%) and in the mountain area (20%).), (UNEP-WCMC and IUCN 2016).

The EU will also continue to play an active role at an international level, contributing to the fulfillment of global biodiversity commitments adopted at the Conference of the Parties to the Convention on Biological Diversity held in Nagoya, Japan in 2010 (<http://ec.europa.eu/environment/nature/biodiversity/comm2006/2020.htm>).

This responsibility has focused on creating a European ecological network that includes a representative sample of all species and natural habitats of Community interest, in order to adequately protect them and ensure their long - term viability. This network - Natura 2000 - opposes the current trend of fragmentation of natural habitats and is based on the fact that the development of socio-economic systems can be done only on the basis of natural and semi-natural ecological systems. The legal obligations of the Member States in nature protection are included in Directive 79/409/EEC as amended by Directive 2009/147/EEC (Birds Directive) and Directive 92/43/EEC (Habitats Directive).

Transforming Europe into the first climate-neutral continent by 2050 is the greatest challenge and opportunity of our time. To make this happen, the European Commission has presented the European Green Pact, the most ambitious package of measures that should enable European citizens and businesses to benefit from the transition to a green and sustainable economy. The measures are accompanied by an initial roadmap for key policies and range from ambitious emission reductions and investments in cutting-edge research and innovation to the conservation of Europe's natural environment (https://ec.europa.eu/info/strategy/Priorities_2019-2024/European-green-deal_ro).

As a signatory of CBD, Romania has the obligation to apply the provisions of art. 6 stipulating that the Parties shall "develop national strategies, plans and programs for the conservation of biological diversity and the sustainable use of its components, or adapt existing strategies, plans or programs to that end". Romania, as an EU member state, also assumes through transposition into national legislation, the commitments assumed by the EU through international conventions and treaties. Bioregions are an important concept in biogeography, and are key to our understanding of biodiversity patterns across the world (NATHANIEL et al., 2018).

The purpose of this paper is to present the number and distribution of natural areas protected by different categories, but also data on their area, or their share, in the Continental biogeographic region of Romania.

MATERIAL AND METHODS

Location of the study area

The Continental Region overlaps on large areas in Romania, in the central, southern and northeastern part, on 13,469,987.94 ha, which means 56.5% of Romania's territory (Fig. 1).

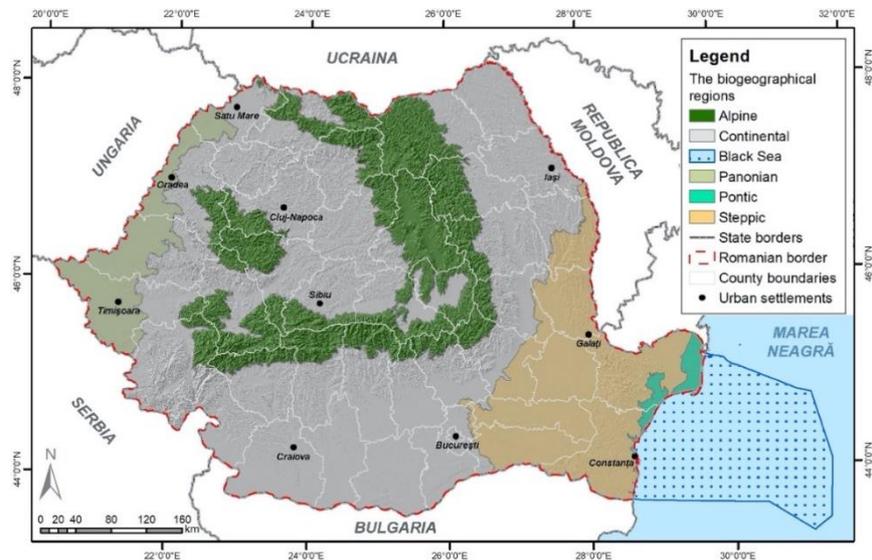


Figure.1. Location of the study area and distribution of biogeographical regions at a national level

From a physical-geographical point of view, the Continental biogeographical region includes territories with high amplitude of relief, with altitudes from below 10 m, to over 1800 m, which suggests a great variety of environmental conditions.

Used materials

For the elaboration of this study there were used:

- geospatial data taken from the website of the Ministry of Environment, respectively the limits of bioregions on the Romanian territory and the limits of protected natural areas (<http://www.mmediu.ro/articol/date-gis/434>)
- Digital Elevation Model with spatial resolution at 25 m, taken from the European Environment Agency website (<https://www.eea.europa.eu/data-and-maps/data/eu-dem>)
- auxiliary geospatial data (county boundaries, Romanian borders, borders of European states, Romanian localities), taken from specialized sites (http://geoportal.gov.ro/Geoportal_INIS/, <http://www.geospatial.org/download> / [romania-seturivectoriale](http://romania-seturivectoriale.com); <https://ec.europa.eu/eurostat/web/gisco/geodata/referencedata/administrative-units-statistical-units/countries>).

Research methodology

The first stage in the elaboration of the study was the spatial analysis in the GIS environment. From the map of bioregions in Romania, the Continental bioregion and the protected natural areas that overlap on this territory were extracted.

The protected natural areas in the Continental biogeographical region were analyzed by categories, in terms of occupied territory, but also in terms of the interrelationships between them (case study).

RESULTS AND DISCUSSIONS

Globally there are 8 biogeographic terrestrial realms and 14 biomes that together contain 827 ecoregions (OLSON et al., 2001), 43.2% of all terrestrial ecoregions (excluding Antarctica, rock and ice) have at least 17% of their surface. Included in protected areas, 5.6% of ecoregions have less than 1% protected or not at all protected area (PROTECTED PLANET REPORT 2018).

A comparison of the coverage percentage for each bioregion in the EU shows that the continental bioregion occupies 29.3% of the EU territory, ranking first among all 9 bioregions in the EU Member States (Table 1).

Table 1

Distribution of biogeographical regions across the EU

The region	The countries involved	% of EU territory
Atlantic	Belgium, Germany, Denmark, Spain, France, Ireland, Portugal, Netherlands, United Kingdom	18,4
Boreal	Estonia, Finland, Latvia, Lithuania, Sweden	18,8
Continental	Austria, Belgium, Bulgaria, Czech Republic, Germany, Denmark, France, Italy, Luxembourg, Poland, Romania, Sweden, Slovenia	29,3
Alpine	Austria, Bulgaria, Germany, Spain, Finland, France, Italy, Poland, Romania, Sweden, Slovenia, Slovakia	8,6
Pannonian	Czech Republic, Hungary, Romania, Slovakia	3,0
Steppic	Romania	0,9
Black Sea	Bulgaria, Romania	0,3
Mediterranean	Cyprus, Spain, France, Greece, Italy, Malta, Portugal	20,6
Macaronesia	Spain, Portugal	0,2

Source: European Biodiversity Center (European Environment Agency) <http://biodiversity.eionet.europa.eu>

On the Romanian territory, the Continental biogeographical region has the surface of 13,469,987.94 ha, of which 3,629,684.90 ha, almost 26.94%, are included in different categories of protected natural areas (Fig.2), Compared to the Pannonian region for example, which occupies (according to Bostan et al., 2017) an area of 1400132.21 ha, 6% of the national territory, and the protected areas amount to 217409.01 ha (15.52%) from the region.

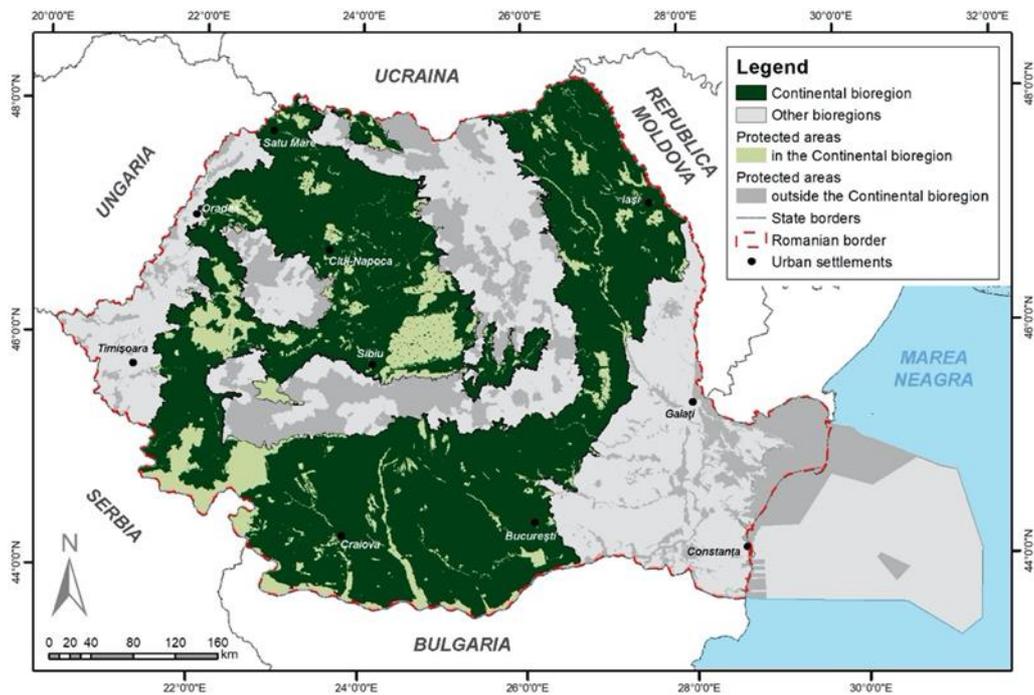
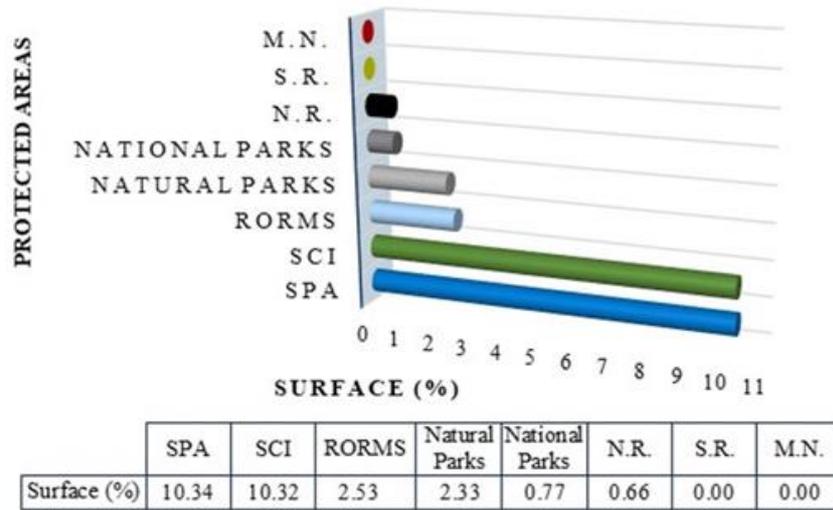


Figure 2. Protected natural areas in the Continental biogeographical region (Romania)

On the EU territory, the Continental biogeographical region contains a number of 7475 SCIs, with a total area of 150014 km², the covered land area being 135120 km², the percentage of the total land area being 10.8%. The spas total is 1478 sites, with a total area of 147559 km², the covered land area being 128432 km², the percentage of the total land area being 12.4% (EUROPEAN THEMATIC CENTER FOR BIODIVERSITY (EUROPEAN ENVIRONMENT AGENCY - <http://biodiversity.eionet.europa.eu>))

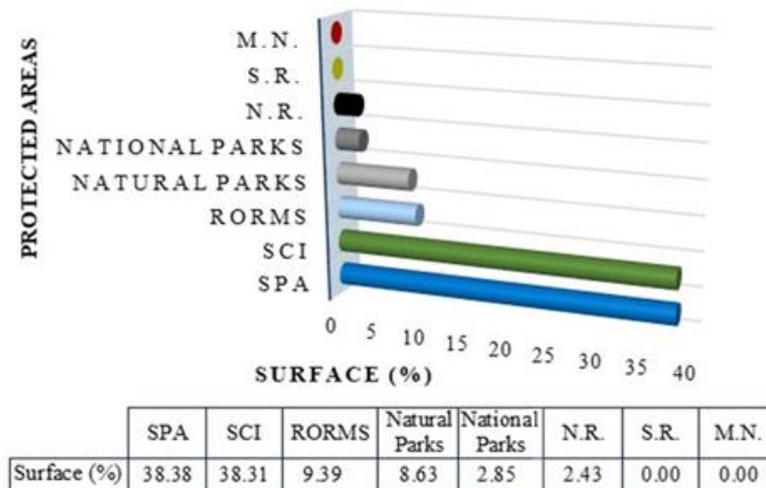
According to the geospatial data published on the website of the Ministry of Environment, Waters and Forests, the protected natural areas in the Continental biogeographical region of Romania are classified into categories in:

- SPAs occupying an area of 10.34% of the biogeographical region;
- SCIs occupying an area of 10.32% of the biogeographical region;
- Wetlands of international importance (RORMS) occupying an area of 2.53%;
- Natural Parks occupying an area of 2.33% of the biogeographical region;
- National Parks covering an area of 0.77% of the biogeographical region,
- Nature reserves occupying an area of 0.66% of the biogeographical region and
- Scientific reservations and Natural Monuments with a percentage below 0% (fig.3).



SCI-Sites of Community Importance, SPA-Special Protection Areas, MN-Monuments of Nature, NR-Natural Reserves from IUCN IV Category, SR-Scientific Reserves, RORMS-Wetland of International Importance
 * data extracted from the geospatial database published on the website of the Ministry of Environment

Figure 3. Categories of protected areas in the Continental bioregion, Romania



SCI-Sites of Community Importance, SPA-Special Protection Areas, MN-Monuments of Nature, NR-Natural Reserves from IUCN IV Category, SR-Scientific Reserves, RORMS-Wetland of International Importance
 * data extracted from the geospatial database published on the website of the Ministry of Environment

Figure 4. Share of area types (of total protected areas)

At the level of the Continental bioregion in Romania, included totally or partially, were identified (Fig.4):

- Areas of special avifauna protection (SPA), on the area of 1,393,100.90 ha (38.38% of the territory) divided into 95 entities, of which the largest area being in the case of ROSPA0099 Hârtibaciului Plateau (237779.77 ha) ;
- Sites of Community Importance (SCI), on the area of 1,390,611.97 ha (38.31% of the territory), divided into 272 entities, of which the largest area being in the case of ROSCI0227 Sighișoara-Târnava Mare (89264.88 Ha);
- Wetlands of international importance (RORMS) on the area of 340,770.38 ha (9.39% of the territory), divided into 9 entities;
- Natural Parks (NP) on the area of 313,354.78 ha (8.63% of the territory), divided into 11 units, of which the largest area being in the case of the Iron Gates Natural Park (128101.71 ha);
- National Parks (NP) on the area of 103,430.19 ha (2.85% of the territory), divided into 7 units, Cheile Nerei Beușnița National Park (36811.52 ha);
- Nature reserves (RN), on the area of 88,348.81 ha (2.43% of the territory), divided into 425 entities, of which the largest area being in the case of RONPA0942 Cama-Dinu-Păsărică (2362.45 ha);
- Scientific reserves (SR), on an area of 37.78 ha, with a single entity and a percentage below 0%, compared to the entire biogeographical region.
- Monuments of nature (MN) on the area of 30.07 ha, with a single entity and a percentage below 0%, compared to the entire biogeographical region.

Referring only to Natura 2000 sites, out of a total of 435 SCIs at a national level, which occupy a total area of 4,031,000.0 ha (Pascu et al., 2018), and 171 SPAs that occupy an area of 3,875,297.71 ha (GIS database <http://www.mmediu.ro/articol/date-gis/434>), in the continental biogeographical region are distributed 272 SCIs, with a total area of 1,390 .611.97 ha and 95 SPAs with a an area of 1,393,100.90 ha.

In terms of flora and fauna species, in Romania the continental biogeographical region is home to 184 species of animals and 102 species of rare plants included in the Habitats Directive, as well as over a third of the bird species listed in Annex I to the Birds Directive (CENTER EUROPEAN BIODIVERSITY THEME - EUROPEAN ENVIRONMENT AGENCY (<http://biodiversity.eionet.europa.eu>)).

Many of the species are associated with beech, oak and hornbeam forests, typical of this region. The continental biogeographical region also contains 159 habitat types listed in Annex I to the Habitats Directive (DIRECTIVE 92/43/EEC), EUROPEAN THEMATIC CENTER FOR BIODIVERSITY - EUROPEAN ENVIRONMENT AGENCY. <http://biodiversity.eionet.europa. I>

Regarding the types of habitats mentioned in Annex I of the Habitats Directive for the conservation of which it is necessary to designate Special Areas of Conservation (SAC), in the continental bioregion of Romania there are four types of dune habitats, one of which is a priority, eight types of freshwater habitats, 13 types of meadow and shrub habitats of which seven priority. Also, seven types of peatland and swamp habitats, of which three priority, six types of rock and cave habitats, of which one priority, 20 types of forest habitats, of which six priority (CATALOG OF HABITATS, SPECIES AND NATURA 2000 SITES IN ROMANIA).

CONCLUSIONS

On the Romanian territory, in the continental biogeographical region out of the total area of 13,469,987.94 ha, 3,629,684.90 ha (26.94%) are included in different categories of protected natural areas.

The largest area in the bioregion is occupied by special avifauna protection areas (38.38% of the territory), followed in descending order by sites of Community importance (38.31% of the territory), wetlands of international importance (9, 39% of the territory), natural parks (8.63% of the territory), national parks (2.85% of the territory); nature reserves (2.43% of the territory), scientific reserves and nature monuments, both with a coverage of less than 0%. Within the Natura 2000 Network, Natura 2000 sites are represented in the continental biogeographical region on the territory of Romania by 272 SCIs and 95 SPAs.

The biodiversity of the continental bioregion in Romania, contains 184 species of animals and 102 species of rare plants included in the Habitats Directive, as well as over a third of the bird species mentioned in Annex I to the Birds Directive, but also 159 habitat types listed in the annex I to the Habitats Directive.

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BIBLIOGRAPHY

- DUDLEY N, ALLEN D, CAMPBELL K. Natural Solutions: Protected areas are vital for human health and well-being. The Natural Solutions Series. 2015.
- DUDLEY N, BUYCK C, FURUTA N, PEDROT C, RENAUD F, SUDMEIER-RIEUX K. Protected Areas as Tools for Disaster Risk Reduction. A handbook for practitioners. Tokyo and Gland: Ministry of Environment, Japan and IUCN, Gland, Switzerland; 2015.
- DUDLEY N, MACKINNON K, STOLTON S. The role of protected areas in supplying ten critical ecosystem services in drylands: a review. *Biodiversity*. 2014;15: 178–184.
- ERVIN J. The three new's for protected areas : repurpose, reposition and reinvest. *Parks*. 2013;19.2: 75–84.
- LOPOUKHINE N, CRAWHALL N, DUDLEY N, FIGGIS P, KARIBUHOYE C, LAFFOLEY D. Protected areas: providing natural solutions to 21st Century challenges. *SAPIENS*. 2012;5: 1–16.
- MĂNOIU TIBERIU, BRĂNZAN TUDOR - Catalogul habitatelor, speciilor și siturilor Natura 2000 în România. ed.: Fundația Centrul Național pentru Dezvoltare Durabilă. - București: Exclus Prod, 2013.
- MELILLO JM, LU X, KICKLIGHTER DW, REILLY JM, CAI Y, SOKOLOV AP. Protected areas' role in climate-change mitigation. *Ambio*. 2016;45: 133–145.
- NATHANIEL J. BLOOMFIELD, NUNZIO KNERR AND FRANCISCO ENCINAS-VISO, A comparison of network and clustering methods to detect biogeographical regions, *Ecography* 41: 1–10, 2018.
- OLSON DM, DINERSTEIN E, WIKRAMANAYAKE ED, BURGESS ND, POWELL GVN, UNDERWOOD EC. Terrestrial ecoregions of the world: A new map of life on earth. *Bioscience*. 2001; 51: 933–938.
- PASCU M.S., MAGYAROSI EVA, SIMON D.C., PRUNAR F.V., ARSENE G.G., 2018 - Specific biodiversity of the community importance sites from the Pannonian Bioregion of Arad County – inventory & conservation issues. Proceedings of the International Conference on Life Science. First edition.
- SCHARLEMANN JPW, KAPOS V, CAMPBELL A, LYSENKO I, BURGESS ND, HANSEN MC. Securing tropical forest carbon: the contribution of protected areas to REDD. *Oryx*. 2010; 44: 352–357.
- SUNDSETH, KERSTIN – Natura 2000 in the Continental Region. Luxemburg: Oficiul pentru Publicații al Uniunii Europene, 2010.
- WATSON JEM, DUDLEY N, SEGAN DB, HOCKINGS M. The performance and potential of protected areas. *Nature*. 2014;515: 67–73.
- BOSTAN C., COPĂCEAN LOREDANA, HORABLAGA ADINA, BĂNĂȚEAN DUNEA I., PASCU M.S., COJOCARIU LUMINIȚA, 2018. Natural protected areas from the panonic biogeographic region,

- Romania. Lucrări științifice, vol. 61, nr. 2, pp: 341-347. Seria horticultură. Iași. Romania.
- ***https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_ro.
- ***Directiva 92/43/CEE a Consiliului din 21 mai 1992 privind conservarea habitatelor naturale și a speciilor de faună și floră sălbatică.
- ***Centrul tematic european pentru biodiversitate (Agenția Europeană de Mediu) <http://biodiversity.eionet.europa.eu>.
- ***Convention on Biological Diversity. Decision X/2. The Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets. 2010. Available: <https://www.cbd.int/decision/cop/?id=12268>.
- ***UNEP-WCMC and IUCN (2016). Protected Planet Report 2016. UNEP-WCMC and IUCN: Cambridge UK and Gland, Switzerland.
- ***UNEP-WCMC, IUCN and NGS (2018). Protected Planet Report 2018. UNEP-WCMC, IUCN and NGS: Cambridge UK; Gland, Switzerland; and Washington, D.C., USA.
- ***National Strategy and Action Plan for biodiversity conservation 2014 – 2020.
- ***Directive 2008/56/EC.
- ***<https://www.cbd.int/decision/cop/?id=12268>.
- ***<http://www.mmediu.ro/articol/date-gis/434>.
- ***<https://www.eea.europa.eu/data-and-maps/data/eu-dem>.
- ***http://geoportal.gov.ro/Geoportal_INIS/, <http://www.geospatial.org/download/romaniaseturivectoriale>.
- ***<https://ec.europa.eu/eurostat/web/gisco/geodata/referencedata/administrative-units-statistical-units/countries>.
- ***Protected Planet Report 2018.
- ***European Biodiversity Center (European Environment Agency). <http://biodiversity.eionet.europa.eu>.
- ***<http://ec.europa.eu/environment/nature/biodiversity/comm2006/2020.htm>.
- European Environment Agency - <http://biodiversity.eionet.europa.eu>.
- ***Directive 92/43/EEC), European Thematic Center for Biodiversity - European Environment. Agency. <http://biodiversity.eionet.europa.eu>.
- ***Catalog of habitats, species and Natura 2000 sites in Romania.