SPECIES MANAGEMENT IN THE IRON GATES NATURAL PARK, ROMANIA: AN OVERVIEW OF ZONATION EFFECTIVENESS

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Key words: conservation, biodiversity, species richness, Hot Spot Analysis, Iron Gates Natural Park, Romania

Abstract. Iron Gates Natural Park is the third largest protected area in Romania and second in terms of number of protected species, including a wide variety of natural and semi-natural habitats and landscapes in various stages of human intervention. Threats to biodiversity are diverse and the management of these threats is a major research direction in the conservation of biological diversity.

In our study, the biodiversity and spatial analysis databases were used to assess the current situation. Even though the issue of distribution data of the species is not solved yet, the spatial distribution of threats to species is even less understood. We mapped the distribution of 59 species of conservation concern (17 mammals and 42 birds) using the geographic ranges of species. The correlation of the obtained data with the internal zonation of the park led to the identification of the “hot spots” in the Iron Gates Natural Park, which require immediate actions. Our study reveals that there are still uncovered and unprotected species of mammals and birds and so we recommend expanding both strictly protected and buffer areas to achieve the maximum level of protection resulting from Hot Spot Analysis.

Introduction

The contribution of the Natura 2000 network to biodiversity conservation has been explored by several works (Dimitrakopoulos et al., 2004; Maiorano et al., 2007; D’Amen et al., 2012) some of them proving that existing reserve networks in general are inherently poor and perform no better than a random choice of areas (Rodrigues, 1999).

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Geographic information system (GIS) provides an unrivaled software platform to support statistical analysis of spatial data (Maguire, 2005). Mapping species distribution is a key issue in ecology and conservation that relies on an accurate knowledge of where species occur (Brotons et al., 2004). To map species distribution, different approaches can be used. Since accurate data on species absence are difficult to obtain, especially for mobile or rare species (Brotons et al., 2004), studies can be made using only presence data or using presence/absence data.

Patterns of biodiversity features distribution represent a critical step in drafting protected areas conservation plans (Rozylowicz et al., 2010). The Romanian protected areas system is struggling to conserve its biodiversity, and is confronted with lack of funding and conflict management objectives (Ioja et al. 2010), threatening to lose the habitat of many species of conservation interest (Cucu et al. 2013).

The goal of this study was to show how a typical analysis of data might be done using Hot Spot Analysis tools and how the results can help us in further research. The study objectives are (1) to assess the spatial distribution of bird and mammal species of conservation concern in the Iron Gates Natural Park and (2) to determine priority areas for conservation using the Hot Spot Analysis Tool.

1. Methods

For this study, we mapped the distribution of 59 species of conservation concern (17 mammals and 42 bird species) in accordance with the EU Habitats and Birds Directives. Habitat affinities for birds and mammals were determined primarily based on literature review and expert opinion. We used Romania’s Fauna series (Murariu 2000; Murariu 2004; Murariu and Munteanu 2005) to determine mammal species presence/absence data on a 4 km² grid (2 x 2 km quadrates). For the bird species, we obtained the information on the presence/absence from Ciochia (1992), Kiss (1999, 2006) and Munteanu al. (2002). We determined the Area of Occupancy (AOO) that represents the area within the extent of occurrence, which is occupied by a taxon, excluding cases of vagrancy (IUCN 2010) in order to see the abundance of each species.

A final list of 59 species was used in our analysis (Annex 1). The species distribution data were used to run the analysis using Hot Spot Analysis Tool for both mammals and birds species in order to obtain species richness maps.

2. Study area

Iron Gates Natural Park is located in the south-west of Romania, at the border with Serbia, covering an area of 1156 km². It is described as a region with a rich biodiversity, covering 27 habitats and 59 species of community interest of
birds and mammals (RNP Romsilva, 2012). The Iron Gates Natural Park is managed as a category V IUCN (protected landscape/seascape), which emphasizes nature conservation and interactions with humans through traditional management practices.

Starting with 2007, 2 SPAs (Special Protected Areas) were declared here: ROSPA0026 The Danube course - Bazias – Iron Gates (10124.4 ha), ROSPA0080 Amlaj – Locvei Mountains (118141.6ha) and one SAC (Special Area of Conservation): ROSCI0206 Iron Gates (124293.0ha), all being integrated in Natura 2000 network of protected areas (RNP Romsilva, 2012) (Fig. 1).

![Fig. 1 Natura 2000 sites in the Iron Gates Natural Park and location within Europe](image)

3. Data analysis

Independent maps of distribution were developed for all species of conservation concern and also maps with the total richness for both mammals and bird species, based on presence/absence data on a 4 km² grid (2 x 2 km quadrates).

The analyses were performed using ArcGIS 9.3 and Hot Spot Analysis (Getis-Ord Gi*), which compares local averages to global averages (identifies if the local pattern is different of what is generally observed across the whole study area (Chainey, 2005; Eck et al., 2005). The Gi* statistic is applied to a grid cell output from which local associations are compared against the global average. We can test if the clusters that we see are statistically significant and worth investigating further. With this tool we can test to see if there are hot spots of species richness with high species rates that are surrounded of high species rates or low rates that are surrounded of low rates.
The input parameters for running the analysis were: the layer containing the species distribution on the grid (Input Feature Class), the column containing the number of species in each grid (Input Field), the new layer, which will record the results of the analysis (Output Feature Class), conceptualization of spatial relationships that is based on expertise and familiarity with the dataset and analysed area taking into account the interaction between grids (Conceptualization of Spatial Relationships) and the distance used in the analysis according to the scale of analysis, which will have a significant impact on the results because of its subjectivity (Distance Band or Threshold Distance). As a general rule, all analyzed grid must have at least 8 neighbors. (Fig. 2)
After running the analysis, we will have two more columns in the attribute table. The **P Value** shows the probability that the hot spot or cold spot is just random (a P value below 0.1 = less than 1% the hot spot occurred randomly = statistically significant hot spot). The **Z score** is used in determining confidence thresholds and in assessing statistical significance (hot spots = statistically significant clusters of high values = high positive Z score; cold spots = statistically significant clusters of low values = high negative Z score) (Chainey, 2005) (Fig. 3).

4. Results and discussions

Mammals and birds species richness was calculated as the sum of all taxa occurring in each cell (Dimitrakopoulos et al., 2004). We found that approximately 7% of mammals and 37% of bird species overlap the areas of maximum richness of species (Fig.4; Fig.5). If we sum up the total amount of species, the percentage of maximum potential richness will reach 25%.

The **Gi*Z Score** values greater than -1.96 and less than +1.96 are statistically insignificant and for that they are symbolized with a neutral colour.

The values that are less than -1.96 are statistically significant cold spots, and the values above +1.96 are statistically significant hot spots. These values are also comparable, meaning that the lower the value below the limit, the colder the cold spot, and the higher the value above the limit the hotter the hot spot. For the Classification, class limits were inserted at ± 1.96 and at ± 2.72 (1/2 of a standard deviation) allowing the significant Z Scores to be symbolized to show where the
hottest and coldest spots are located. The range data allow us to use another class limit for the hot and cold spots at ± 3.48 using the same interval (0.76).

Fig. 5 Richness of bird species

In order to determine the percentage of maximum species richness that coincides with the strictly protected areas, we used the internal zonation map of the park that includes:

- **Core areas** (non-invasive activities: scientific research, controlled tourism, environment education) whose surface is about 13951.5 ha, representing 10.9% of the total area of the park;
- **Buffer zones** (extensive agriculture activities, wood selective extraction, other natural resources exploitation, controlled fishing) whose surface is of about 84975.38 ha, representing 66.3% of the total area of the park;
- **Transition areas** (preponderant forest utilization, agriculture lands, extractive economical activities, uncontrolled constructions on Danube shore, uncontrolled waste deposits) whose surface is about 29269.01 ha, representing 22.8% of the total area of the park (Fig. 6).

The overlap of both maps, hot spots/cold spots distribution and internal zonation of the park, coincides within 20%. We can see an obvious overlap between cold spots and strictly protected areas and a less evident one between hot spots and strictly protected areas.

Looking at the significance level of the Gi*Z score, the “hot spots” cover between 77-96% of all analyzed species. We can see a gap between the eastern and western half of the protected area. Most groups of polygons that fall into one of the two categories are situated in the eastern half, while the other half is very poorly represented.
Spatial analysis of hot spots. The maximum concentration points (Gi*Z > 3.48) are situated within the area of Eibenthal and Dubova, average concentration (Gi*Z > 2.72) within the area of Berzeasca, Orșova, Bahna and low concentration (Gi*Z > 1.96) for Liubcova, Cozla, Ilovita.

![Fig. 6 Hot spots/cold spots of birds and mammals richness in the Iron Gates Natural Park](image)

Spatial analysis of cold spots. The maximum concentration points (Gi*Z < -3.48) are situated within the area of Coronini and Gura Văii, average concentration (Gi*Z < -2.72) within the area of Moldova Noua, and low concentration (Gi*Z < -1.96) for Moldova Veche, Pojejena, Belobresca, Divici.

We can determine the differences in the same group of hot spots or cold spots by comparing the number of species present in each cell. The hot spots and the cold spots cover a percentage ranging between 38 and 96% of the total of 59 species. In the first case, our results cover between 4-13 species of mammals from a total of 17 and for the species of birds the results cover 16-37 from a total of 42 (Table 1).

The changes between 2008 and 2012, in the internal zonation of the Iron Gates Natural Park transformed many areas of sustainable development in to sustainable development areas and many strictly protected areas became the limit of the ones designated for sustainable development. The most visible changes can be seen in the expansion of sustainable development areas, especially in the administrative units like Pojejena, Moldova Noua, Gârnic, Coronini, Sicevița,
Berzeasca ( Caraș-Severin County) and Șvinița, Eșelnita, Orșova, Ilovița (Mehedinți County). This dynamics imposed mainly by the changes in the economic activities and investments will have direct projection in multiplying the threats for species and habitat of community interest.

Table 1 Mammals and birds covered in the hot spots/cold spots analysis

<table>
<thead>
<tr>
<th>Grid colour</th>
<th>No. mammals</th>
<th>No. birds</th>
<th>Total species (%)</th>
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Conclusions

The results show that the priority areas for conservation are situated mostly in the S and SE areas of the park. If we compare the internal zonation of the park with the Hot Spot Analysis results, few areas designated as strictly protected overlap with the hot spots. Although species distribution maps for mammals and birds show a great richness all over the protected area, the park zonation should be revised in order to overlap the hot spots, and thus to avoid the habitat degradation in these areas.

From a total of 59 analysed species, after identifying the hot spots/cold spots, we can still see areas that do not fully achieve the maximum protection. Even if the future management plan will take into account the new zonation resulted from the identification of the hot spots/cold spots, there will still remain uncovered and unprotected species of mammals and birds. We recommend expanding both strictly protected and buffer areas, to achieve the maximum level of protection resulting from our Hot Spot Analysis.

We acknowledge the limitation in our study regarding the ecology of some species. We can’t really determine any cause of biodiversity loss using this technique, but it can be used in basic exploratory data analysis, which may lead to the next steps. This approach plainly served to generate a new network that could be highly effective when we are dealing with a great richness of species and a small amount of funds designated for the protection of biodiversity.
Acknowledgements
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**Annex 1 Species of Community Interest in the Iron Gates Natural Park**

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Species management in the Iron Gates Natural Park, Romania

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*Source for the IUCN status: The IUCN Red List of Threatened Species*