**Form of presentation** *(assign one „x“):*

Oral presentation [X] Poster [ ]

**Main theme** *(assign one „x“):*

Abiotic Environment [ ] Biodiversity and ecosystems [X] Human Dimensions [ ]

Indicative assignment to the **Data-Knowledge-Action cycle** *(assign one or more „x“ marks):*

Data ----- to --- Knowledge -- to ---- Action --- to Research Planning

[ ] [ ] [ ] [ ] [ ] [X]

# Ecological Connectivity in the Carpathians

***GIS model to detect the permeability of the Carpathians for particular "Umbrella Species"***

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Habitat loss and landscape fragmentation due to the extension of roads and human-related facilities are the main issues of biodiversity loss. Sustaining well-connected networks of large natural areas where ecological and evolutionary processes operate over large spatial and temporal scales could mitigate these threats and help to maintain the population of large predators, gene flow, dispersal area, inter-specific competition and mutualism. Corridors allow ecosystems to recover from natural disturbances as fire and to respond to human-caused disturbance as development of human habitats and invasions of exotic species (Beier et al., 2008). The Carpathian countries are on the way to meliorate and modernize their infrastructures since the end of Communism. Romania as an example for an unprecedented socioeconomic transition process had to face a rapid change from a centrally planned to a liberal market economy which led to profound land use change with inevitable environmental impacts (Turnock 1998). Thus the maintenance of ecological connectivity in a steadily stronger fragmented landscape is crucial for the survival of wildlife populations. Although ecological networks in the Carpathians are still well preserved. Many natural areas became isolated and are hence limited for the migration of large carnivores (Maanen et al., 2006). Regarding new phenomena as climate change in connection with decreasing connectivity and a consequently decreasing biodiversity, initiatives dealing with enhancing connectivity increase (e.g., Van der Grift et al., 2008; Kohler et al., 2009).

Bioregio, a project launched in European Territorial Cooperation South East Europe, is to study and enhance biodiversity in the Carpathians. EURAC aims to highlight ecological connectivity within the Carpathians and in selected pilot areas located at the borders between Serbia-Romania, Romania-Ukraine, and Hungary-Czech Republic.

In the two-step model approach the amount and distribution of potentially suitable habitat for umbrella species and the permeability between suitable habitats is considered. The expected objective of that analysis is to enhance and sustain the Carpathians ecological network. A web-GIS application will visualize the determined physical barriers hindering free movement and genetic exchange of umbrella species like the lynx, the bear or the wolf. Due to their large habitat requirements they react sensitively to landscape fragmentation (Witkovski et al., 2003). Hence these umbrella species are appropriate for designing a habitat suitability model in GIS that covers their ecological requirements and habitat distribution which is representative for many other Carpathian species. Applying a minimum cost analysis in a second step enables the identification of migration paths (permeability) between high natural patterns that take less energy effort (costs) even if the land cover matrix in between is not favorable (Fleury and Brown, 1997). This enables the detection of primary ecological corridors and of the hot spots for intervention (Beier et al., 2008).

These suitability models assess the quality of habitats for each umbrella species and provide the basic information for the least-cost analysis to derive the primary ecological corridors. In GIS the habitat suitability models are related to raster- and vector-based layers and consider indicators as land cover, elevation, topography as well as human impact factors.

Every indicator is separated in categories like elevation ranges or altitudinal classes. The habitat preferences of umbrella species are described in a rule-based model considering the spatial structure and the availability of preferred land cover patches relevant for the species considered. The optimal corridors are modeled and visualized in GIS using a minimum cost-path analysis based on the likeliness that the considered species is crossing particular land cover patches. The probability a species uses a patch for migrating depends on its suitability value (0-100%) which is the geometric mean calculated from the defined indicators and their biological weights. The geometric mean has the advantage that if only one weighted indicator is zero, the whole patch is zero and not permeable anymore (Beier et al., 2008). Both – the appropriateness of the indicator and the biological weight for each species – to calculate a suitability value were derived from published ecological profiles and habitat model results (Glenz et al., 2001; Kramer-Schadt et al., 2004; Zajec et al., 2005; Beier et al., 2008; La Morgia et al., 2008; Loy et al., 2009).

For creating a Carpathian wide map to visualize the permeability of landscape and virtual corridors appropriately, neighbor relations, distances among suitable landscape patches (nodes) and potential movement paths (links) are considered in the model. Therefrom potential core areas, stepping stones and corridors across the Carpathians can be identified. Real wildlife observation and presence data are then used to identify the primary ecological corridors for each umbrella species. The overlapping of each umbrella species' map and of road and infrastructure data will define the whole Carpathians ecological network in which physical barriers hindering migration and wildlife genetic exchange are pointed out.

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