Planning wildlife habitat's corridors in three adjacent provinces in Iran: Hamedan, Markazi, and Qom

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Abstract

Nowadays, habitat destruction is one of the most important satanic factors which threatens biodiversity throughout the world. Corridors, which connect fragmented habitats, are substantially important in reducing the negative consequences of habitat fragmentation. In this study, using Arc GIS and focusing on large herbivores in the protected areas, I tried to design the most suitable habitat corridors relying on the target model species habitat needs. Totally, 10 protected areas were selected in three adjacent provinces and tried to find the shortest pass ways where cover the most habitat requirements of the species especially structural variables like topography, slope and distal factors.

Keywords: conservation, habitat hotspots, protected areas network, geographic information systems.

Introduction

Biodiversity is rapidly eradicating due to the human activity (Sanaei et al. 2012). Today, the destructions of habitats are the biggest threat to biodiversity in the world, which is occurred subsequently after habitat fragmentation and destruction. Due to the human's unplanned activities, especially in developing countries, many small habitats, which may be less important than non-protected species, are destroyed (Yousefi and Jafari Sayadi 2013). The fragmentation of habitats increases the risk of species extinction as results of increased inbreeding and therefore accidental demographic events (Shabani et al. 2017). The viability of any living organisms is completely dependent to the other living beings (Yousefi and Jafari Sayadi 2013). Infrastructure development can be considered as one of the main threats to the species viability, which lower species abundance and maximize the number of threatened species (Senaei et al. 2012). Traffic roads are on the main infrastructures that cause habitat to be fragmented while increasing negative consequences of the edge effect. Some of isolated populations in the fragmented habitats may pass under from the extinction (Sabzghabaie et al. 2013, Valizadegan and Ramezani 2013). Therefore, carefully and accurately designing and plotting wildlife corridors can reduce the negative and harmful effects of habitat fragmentation (Yousefi and Jafari Sayadi 2013). In some investigations using the GIS, potential corridors were modeled on the regional scale among the potential habitats of the Lynx (Bates and Jones 2007). Bates and Jones (2007) used habitat symmetry analysis to determine the most suitable corridor planning. In this modeling, it has been assumed that the identified dynamic corridors will provide adequate heat and nutritional resources along the way, in addition to providing the habitat and safety necessary for safe travel between the spots of the safe areas. Chetteri et al. (2007) examined the expansion and development of corridors in order to preserve the link between the forests in the eastern Himalayas. They began the overall goal of revitalizing scattered forest resources, which are getting worse, through the developing...
protective corridors and moving conservation actions from a species approach to a landform approach. The results showed that in the new approach to environmental protection, strategic partnership and understanding the importance of the planning process in ecosystem management would be very effective in the implementation. Jantz and Goetz (2008) carried out an assessment of the effect of roads and buffers on main habitat areas and connectivity in these habitats in temperate northeast forests in the United States, using available data. Construction and road development is always a major factor in the fragmentation of the habitat. Roads The obstacles to the wildlife movement are directly linked to the deaths of wildlife and increase the introduction of non-indigenous species, and vice versa, areas without roads have higher levels of native diversity and less invasive species. Ferrari et al. (2012) examined the connection between forest components through corridors. In this survey, the corridor was identified as an important strategy to reverse the negative impacts of forest integration, and using the GIS, possible routes were identified for implementation of wildlife corridors, which facilitated the connection among the remaining patches of forest. Van Looy et al. (2014) carried out a study on the modeling of the structural and functional connection of corridors for the restoration of European marten. Loro et al. (2015) carried out research on ecological connectivity to prevent the fragmentation of the ecosystem by focusing on the Roe deer (Capreolus capreolus). In these studies, to obtain the location of corridors with comparable costs, the development of a network path and a repetitive GIS method were used. Erfanian et al. (2010) carried out studies on the role of overpasses and underpasses in compensating for the negative effects of habitat fragmentation in Golestan National Park. They investigated on a pattern for locating overpasses and underpasses in the park in order to reach short paths, optimized and safe for crossing the Persian leopard from the traffic roads using Niche Factor Analysis and Arc GIS. This study showed that the structure and location of existing underpasses are not standard and in accordance with existing needs. Rouhi (2014) investigated and determined the probable leopard corridors between two habitats of Khosheyeylagh Wildlife Sanctuary and Golestan National Park. In this study, firstly, the desirability of the leopard habitat in two habitats of Khosheyeylagh Wildlife Sanctuary and Golestan National Park was investigated by means of niche factor analysis. The theory of electrical circuits was used to investigate Persian leopard habitat connectivity between the two mentioned habitats. Based on flow maps, the pattern of movement and functional requirements for the target species as well as important step stones were identified. Pourchitsaz (2015) determined the corridors for Asian cheetah between the protected areas of Bafq Mountain, Darreh Anjir and Siahkoh in Yazd province. The results of this study showed that 25% of the study area is suitable for Asian cheetah species. Shabani et al. (2017) determined the priority of the wildlife corridors between the protected areas of East Azarbajian. Based on the results, the need to establish movement corridors between Kayamaki Wildlife Sanctuary and the Markan protected area is at the top of the provincial priorities. A summary of such studies shows that the determination of habitat corridors will have an important role in conservation of the biodiversity and all large animals of the fragile habitat. Connection among the fragmented habitats plays vital role in the species viability. Therefore, I aimed to define best corridors in three adjacent provinces in the central Iran based on Arc GIS algorithms and ecological factors.

**Material and methods**

**Study area**

The characteristics of protected areas studied are shown in the table 1 and figure 1.
In these areas, wild goats and Armenian sheep occupy the mountainous regions. Wild goat (*Capra aegagrus*) and wild sheep (*Ovis Orientalis*) are one of the most prominent mammals in the mountainous regions of Iran (Sarhangzadeh et al. 2011). For these species, altitude and slope are a limiting factor. For this purpose and for determining the habitat corridors, slope classes and altitude maps were prepared. Then, after classifying the maps, the probable habitat corridors were estimated. Finally, by studying the map of the study area and the map of the corridors, the sensitive and hazardous areas for the animal passage were determined.

**Table 1.** The characteristics of protected areas studied

<table>
<thead>
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<th>Type of protection</th>
<th>Area (ha)</th>
<th>province</th>
<th>Region name</th>
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<tr>
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<td>Lashgardar</td>
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<td>Protected area</td>
<td>31735</td>
<td>Qom</td>
<td>Palang Dare</td>
</tr>
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</table>

**Results and Discussion**

In this study, the most suitable and probable corridors between the protected areas were mapped out (Fig. 3). Connectivity is now a key issue in landform management and wildlife protection especially in the fragmented areas. The study of the assessment of the importance of corridors and the linkage between habitat...
fragments has an important impact on the distribution of wildlife populations in this habitat. Corridors are important for designing conservation in fragmented ecosystems and reducing the harmful consequences of Islanding phenomena. Considering the importance of connecting corridors management methods proportionate to conservation, it is essential to rebuild the connection between fragmented ecosystems in order to better protect the healthy environment and biodiversity. I mapped key habitats and corridors in a regional scale in the central Iran to provide a framework of key fauna habitats and linking habitat corridors.

Key habitat and corridor maps were constructed based on major protected areas and wild sheep's habitat requirements as a model species. This investigation allows interrogating the key habitats and corridors among three central provinces in the country. Wildlife corridors provide a link among wildlife habitat, and joins two or more larger areas of similar wildlife habitat. Such pass ways or connections are play critical role in the maintenance of ecological processes and capable animals to move between the habitats and enable gene reciprocal flow among the populations (Scotts and Drielsma 2003).

Figure 2. Surface cost map shows the lowest cost pass ways
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