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Ecological networks as a new approach for nature conservation in Turkey: A case study of İzmir Province

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ABSTRACT

This paper aims to identify and evaluate a potential ecological network including core areas and large-scale corridors in the İzmir Province and its surrounding areas, Turkey. It is one of the first studies on the connectivity for mammal species and the detection of potential ecological corridors for Turkey. Four wide-ranging species (*Hyaena hyaena*, *Lynx lynx*, *Caracal caracal*, and *Felis chaus*) have been chosen as target species. Existing Key Biodiversity Areas (KBAs) and surrounding lands have been evaluated based on a three criteria: (1) vegetation/habitat types, (2) carrying capacity and (3) road density using simple GIS-based models.

The results are evaluated using the Minimum Viable Metapopulation (MVMP) standards. No KBA in the study region has a Key Population (KP) or Minimum Viable Population (MVP) with the exception of Boz Dağlar. Least cost-path analysis has been applied to identify linkages between KBAs relevant for the four target species. The conclusion is that it is possible to maintain MVPs in the region when the KBAs are linked by ecological corridors.

1. Introduction

Soulé (1986) and Forman (1996) stated that habitat fragmentations and losses have become an important subject of ecological research (Wiegand et al., 2005) as fragmentation is considered to be one of the major threats to biological diversity (Forman, 1998; Cook, 2002; Bouwma et al., 2003; Jongman, 2004).

The planning and establishment of ecological networks as a means of creating spatially integrated landscapes and habitats is being increasingly accepted as an appropriate approach for improving the ecological quality of natural ecosystems and protecting biodiversity (Van Rooij et al., 2003; Verboom and Pouwels, 2004; Smith, 2004). Where fragmentation occurs, establishing or restoring linkages between patches through ecological corridors is essential to facilitate their ecological functions (Cook, 2002). Ecological linkages also provide opportunities for human services such as recreation, education, human benefits both cultural and aesthetic as well as being compatible with the concept of sustainable land use (Ahern, 2002; Cook, 2000).

An ecological network is recognized as a framework of ecological components, e.g. core areas (nodes), corridors (natural and/or artificial linkages) and buffer zones which provide the physical conditions necessary for ecosystems and species populations to survive in a human-dominated landscape (Jongman, 2004). In this context, conservation biology is an integral science for the delineation of ecological networks (Noss, 1993, 1996; Carroll et al., 2003). The planning of ecological networks and greenways largely focuses on the integration and application of landscape ecological principles and conservation biology (Ahern, 2002). These principles have guided nature conservation and landscape planning in recent years throughout the world (Jongman, 2004).

Turkey is a key country in terms of conservation of global biodiversity owing to its location at the junction of three continents as well as Anatolia's complex biogeoclimate regimes and geomorphology. These geographical features account for a high level of biodiversity, especially an exceptionally rich flora (Eken et al., 2004). Biodiversity in Turkey has been seriously threatened by land-use changes in recent decades (Evrendilek and Doygun, 2000; Eken et al., 2006; Yücel, 2005). There are many areas of high biological biodiversity that are not preserved by the existing legal protection system in the country. Nearly 80% of the total surface area of Turkey's known high Key Biodiversity Areas (KBAs) has no protection (Eken et al., 2004; Yücel, 2005).

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Bibby (1998) states that KBAs are places of international importance for the conservation of biodiversity at the global, regional or local levels. This approach to designation of KBAs aims to identify, document and protect networks of such areas by setting objectives and globally applicable criteria. These areas must be large enough to support viable populations of the species for which they are important (Eken et al., 2004). In Turkey, the scientific task involved in designating the KBAs has been carried out by a national Non-Governmental Organisation (NGO) Doğa Derneği, with the support of the British Royal Society for the Protection of Birds (RSPB, Eken et al., 2006). KBAs established in 2003–2004 have the status of at least one of the categories, including Important Plant Areas, Important Bird Areas or Important Mammal Areas (Özhatay et al., 2003; Eken et al., 2006). In Turkey as in most other countries, ecologically valuable areas have been established and managed as isolated units. Haaren and Reich (2006) indicated that the traditional concept of protecting isolated remnants of endangered habitats as nature reserves could not stop the continuing decline of endangered species and the regional losses of biodiversity sufficiently.

Given the ongoing process of land-use changes, preservation of key areas and connectivity through spatially connected landscapes and habitats are now becoming very important in Turkey. The present paper depicts the identification and discussion of an ecological network at a large scale for one region in Turkey, the İzmir Province. The project is a pilot research for Turkey using four wide-ranging mammals as target species (Padoa-Schioppa et al., 2006; Beier, 1993; Klaver, 2003; Bruinderink et al., 2003; Somma, 2006; Wikramanayake et al., 2003). Large carnivores mostly in danger of extinction or seriously threatened in Turkey (Can, 2004) have been included. The four selected target species (*Hyaena hyaena*, *Lynx lynx*, *Caracal caracal*, and *Felis chaus*) are included in both "2007 IUCN Red List" and "National/Regional Red List" species (Eken et al., 2006). The ultimate aims of this study were (1) to assess the habitat suitability of KBAs in the study region for the targeted mammalian carnivores and (2) to analyze and to identify the ecological networks by offering spatial linkages between KBAs by using GIS-based models.

2. The study region

The İzmir Province and its surrounding areas have been chosen for this study (Fig. 1). İzmir is the third largest province in Turkey with nearly 2.5 million inhabitants and situated in the coastline of the Ege (Aegean) region. Coastal areas are densely populated and extensively used for a range of objectives. The landscape in the region is dominated by fertile arable land and Mediterranean forest and scrub with affinities with both maquis and phrygana. Arable land is mostly located in the fertile lowlands between the mountain ranges generally situated perpendicular to the Aegean coastline. These agriculturally valuable lowlands also have a variety of other land uses, e.g. intensive urban agglomerations, small settlements containing holiday accommodation, major transportation routes, and intensive industrial facilities. The region has many different protected areas, such as national parks, spatially protected areas and natural sites. Fortunately, the region has still relatively well-connected natural landscapes due to its geomorphological character.

The core areas in this study are pre-existing KBAs. The total study region including 4.740 km^2 of KBAs (Eken et al., 2006) is approximately 18.905 km^2. The study area is mainly composed of arable land (40%), urban areas (5%), maquis-phrygana vegetation (35%), and forest (12%). The region is confined by the Dilek Peninsula in the south, the Manisa and Aydın provinces in the east and northeast, and the Çandarlı Bay in the north. Fig. 2 gives an overview of their locations in the study region.

3. Methods

According to Bischoff and Jongman (1993), an ecological network is composed of core areas usually protected by buffers and connected through ecological linkages or corridors. Core areas have, in most cases, been identified and safeguarded by a traditional nature conservation strategy through the establishment of protected areas (Jongman, 2004). The main pillars in the present methodology focus on (1) core areas and (2) ecological linkages or corridors as the basic elements of an ecological network. Buffer areas are not considered within the scope of this study due to difficulties with the identification of buffer zones as they are site-dependent. Fig. 3 provides a flowchart of the methodology followed.

3.1. Collection and analysis of data

The main input in this study is a land cover map. Previously, there was no such map relevant with the scope and the scale of the study; therefore, one has been produced and converted into grid map with a grid size of 0.01 km^2 for use in analyses during this study. For determination of land cover types, Landsat-TM (2000) satellite images and some topographical maps were uti-

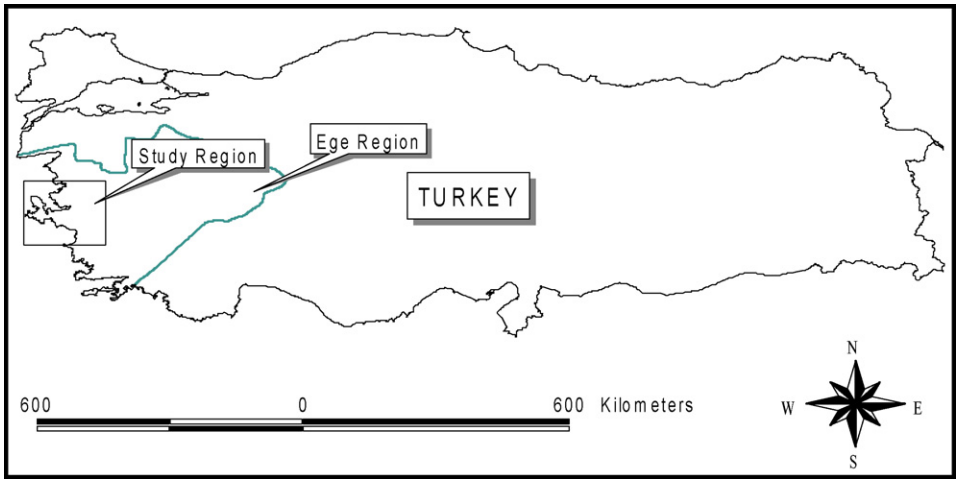

Fig. 1. The location of the study region.