Scientific Reports in Life Sciences 4 (1): 1-7

DOI: http://doi.org/10.5281/zenodo.7632690

Golestan national park's ecosystem services, a case with brown bears habitat suitability

Reyhaneh Farahani[*1], Afsaneh Asgharzadeh[2]

*[*1]Department of Environment, Faculty of Agriculture and Environment, Arak University, Arak, Iran*

[2]Department of Environment, Tehran, Iran

[*]Email: reyhaneh.faraahani@gmail.com

Received: 15 November 2022 / Revised: 30 December 2022 / Accepted: 29 January 2023/ Published online: 05 February 2023.

How to cite: Farahani, R., Asgharzadeh, A. (2023). Golestan national park's ecosystem services, a case with brown bears habitat suitability. Scientific Reports in Life Sciences, 4(1), 1-7**. DOI:** https://doi.org/10.5281/zenodo.7632690

Abstract

Ecosystem services are the benefits that people gain directly or indirectly from the ecosystems. Golestan National Park as one of the world's biosphere reserves and one of the best habitats of brown bears (*Ursus arctos*) as the biggest carnivore in the country, has been truly important. The brown bear has been considered a model species in this research due to its high ecological value. Assessment models of habitat and ecosystem services can be used as a suitable tool for conservation, planning, and management purposes. Ecosystem service indicators were determined through the Co$ting Nature web model and based on the results, the entire region had the highest priority for protection. The index of region future threats showed the average threat (0.55) in 77% of the national park area. However, the potential ecosystem services index showed that 50.9% of the park has a high potential for ecosystem services. Mainly, Golestan National Park has a suitable quality brown bear habitat and it has relatively appropriate conditions in terms of ecosystem services. However, it is necessary to adopt strategies to protect the region and improve the conditions, especially in the area of the Tehran-Mashhad Road in Golestan national park.

Keywords: Ecosystem services, Golestan national park, *Ursus arctos*, Co$ting nature

Introduction

Biodiversity loss, habitat destruction, and lower quality of life are one of the most critical consequences of human activities like land use, land cover change, and some events like global climate change (Perrings et al., 2010). Because of such activities and events, ecosystem services may also be disrupted and may not be given full support for all aspects of life. One of the most vital functions of ecosystems and provisioning services is providing habitats for various species. Large carnivores are one of the most important taxa in each ecosystem as they have some special

ecological roles like being apex predators, umbrella species, bioindicators, and keystone species. Regarding the specific ecological roles, habitat requirements, and biology, bears are an ideal target species to be focused on and investigate some aspects like ecosystem health, ecosystem services, habitat connectivity, and gene flow (Mohammadi et al., 2021).

In this study, the ecosystem services provided by the study biosphere reserve (Golestan National Park) have been explored by Co$tingNature, a sophisticated web-based spatial policy support system for natural capital accounting and analyzing the natural environments. identifying the beneficiaries of these services and assessing the impacts of human interventions. This PSS is a testbed for the development and implementation of conservation strategies focused on sustaining and improving ecosystem services. It also focused on enabling the intended and unintended consequences of development actions on ecosystem service provision to be tested in silico before they are tested in vivo. The PSS incorporates detailed spatial datasets at 1-square km and 1-hectare resolution for the entire World, spatial models for biophysical and socioeconomic processes along with scenarios for climate and land use. The PSS calculates a baseline for current ecosystem service provision and allows a series of interventions (policy options) or scenarios of change to be used to understand their impact on ecosystem service delivery. We do not focus on valuing nature (how much someone is willing to pay for it) but rather on costing it (understanding the resource e.g. land area and the opportunity cost of nature being protected to produce the ecosystem services that we need and value).

Material and methods

Study area

Golestan biosphere reserve can be regarded as one of the most important protected areas of Iran and it has a long history of more than six decades as a national park (Darvishsefat, 2006). This forested and mountainous area is located in the northeastern parts of Iran and covers more than 91895 ha of the Alborz mountains slopes, Hyrcanian lowland forests, and steps there (Majnoonian et al., 1998). A variety of local climates from dry, semi-dry, and semi-humid provided an excellent opportunity for species to occupy different niches (Mirkarimi, 2007). Hyrcanian forests in the western part and Irano-Turani vegetation in the eastern parts are the dominant plant communities of the national park. Based on recent assessments, more than half of the country's mammalian species, one-third of birds, and more than 1400 plant species have been recorded in this area which indicates its considerable biodiversity and species richness. Red deer (*Cervus elaphus*), Persian leopard (*Panthera pardus*), Brown bears (*Ursus arctos*), Follow deer (*Cervus dama mesopotamica*), Jungle cat (*Felis chaus*), Grey wolves (*Canis lupus*), Wild boars (*Sus scrofa*) are some of the most abundant mammals from this park. From major trees, chestnut-leaved oak

(*Quercus castaneifolia* and *Q. macranthera*), Hornbeam (*Carpinus betulus*), zelkova (*Zelkova carpinifolia*), *Populus capsica*, *Acer velutinum*, *Celtis caucasica*, *Parrotia persica* can be mentioned.

Modeling approaches

Co$ting nature is a web-based tool for analyzing ecosystem services and assessing human interventions and threats induced by human activities (Mulligan and Soesbergen, 2017). In this online analysis, habitat data can be combined with human-induced pressures, and future threats like climate change, then the target ecosystems can be evaluated regarding their conservation priority (Mulligan and Soesbergen, 2017; Hemati et al., 2020). In this modeling approach, factors and variables like water quality and quantity, Carbon services, recreations, biological diversity, conservation priorities, threats and pressures, stakeholders, opportunities, costs, and benefits be considered as input items (Mulligan and Soesbergen, 2017). The outputs of this model include a) the Overall priority index for relative total development (Potential or realized services), b) the Overall priority index for nature conservation (Potential or realized services), c) the relative index of biodiversity priority, d) Relative index or Delphic conservation priority, e) Relative pressure and relative threat indices, f) Relative index if accompanying services (Potential and realized), g) The maximum amount of overall realized accompanying services. This study aimed at modeling Golestan national park's ecological services using brown bears as an umbrella and bio-indicator species.

Results

As figure 1 shows, warm colors indicate higher priority in biodiversity conservation. Based on this map, around 75 percent of the area has a high capability to support biodiversity. This output which is based on various data from the IUCN red list, World Wildlife Fund, Important Birds Areas, International conservation of hotspots, and many other related sources, ranges from zero to one, and the more to the one, it indicates higher priority for conservation.

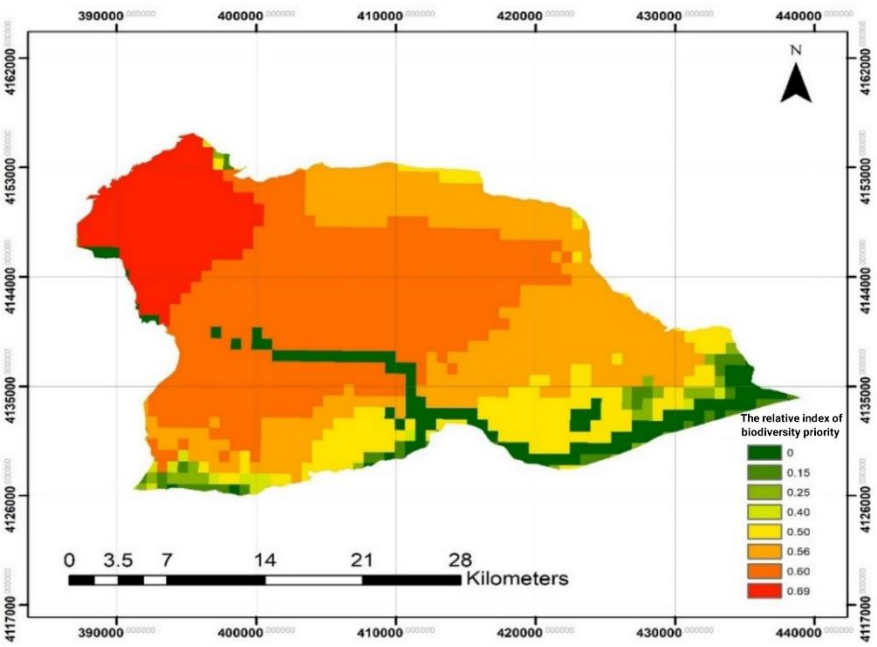

Figure 1. Model output indicating the capability of the area for supporting biodiversity

Figure 2 indicates the relative pressure index which has been calculated based on population pressure, grazing, fire frequency, farming, dams, infrastructures, and human-related facilities. Fortunately, the target area suffers from a very low amount of the mentioned pressures (less than 4 percent) which is mostly induced by the main road that passes through the national park.

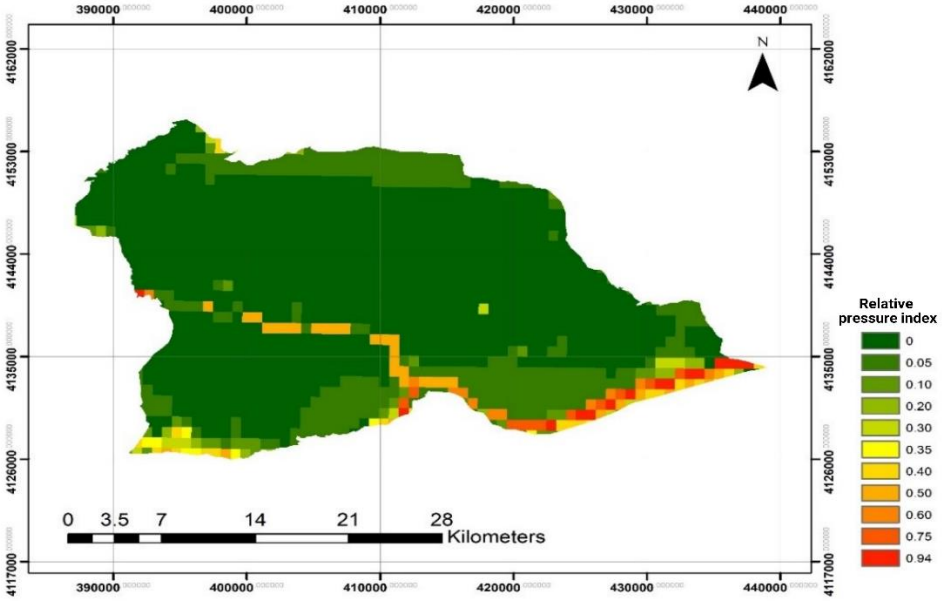

Figure 2. Relative pressure index map. The yellow line corresponds to the road crossing the park

The relative threat index which has been built on recent deforestations, predicted population changes, possible climate change, variation in gross domestic production (GDP), light pollution, and similar threats, indicates that less than one-fourth of the area suffers from low relative threats and around 77 percent of the area face with moderate threats (Fig. 3).

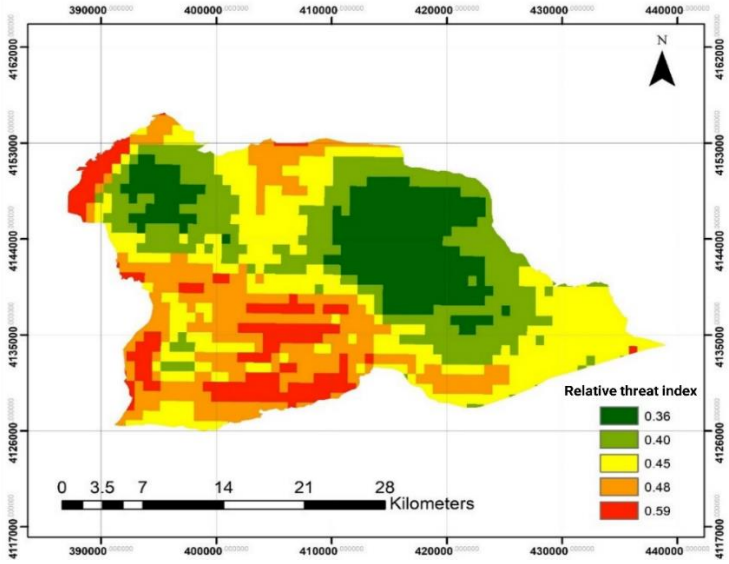

Figure 3. The distribution of the relative threat index

Figure 4 shows the park's relative index of overall potential services, which indicates various potential ecosystem services like hydrology, carbon sequestration, wildlife ecotourism, timber production, nonwoody products, aquaculture, aesthetic values, etc. Based on this index, the closer values to 1, indicate higher potential ecosystem services and as a result, have higher values and priorities. Around half of the park, presents high potential services, 40 percent gives medium levels, and less than 10 percent can be classified as areas with low potential for ecosystem services. The relative total realized bundled services index also has been shown in figure 5. This map shows that around 12, 57, and 30 percent of the area has a high, moderate, and low capability for realized bundled services respectively.

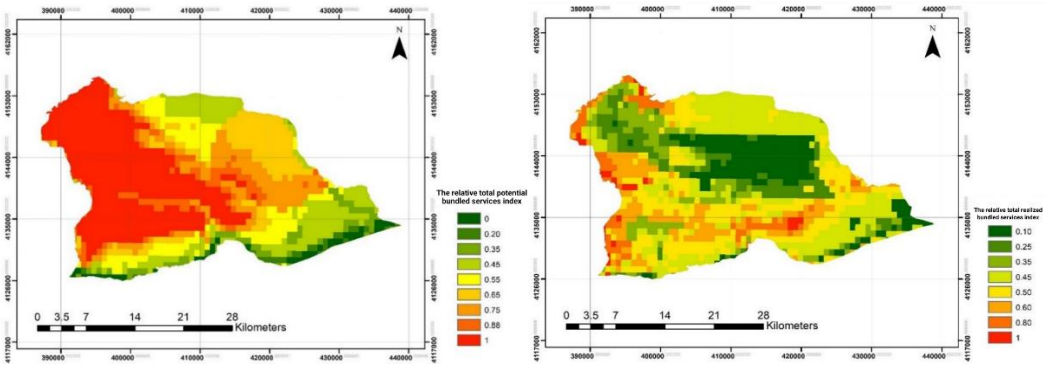

Figure 4. The relative total potential bundled services index

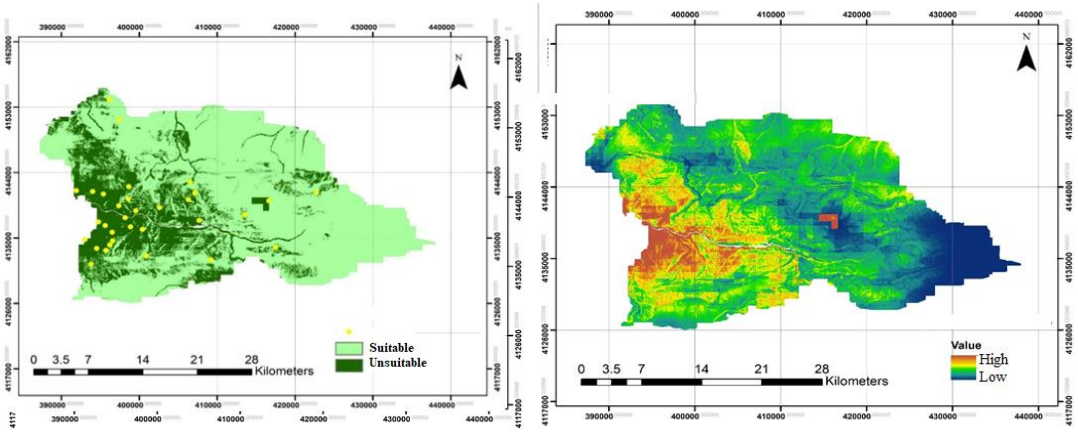

Figure 5. The relative of total realized bundled services index

Brown bears are the largest carnivores throughout the country and have a large distribution occupying most of the suitable habitats along the Alborz and Zagros mountainous ridges (The Atlas of Mammals of Iran, 2017). Based on InvEST modeling approach (Fig. 6), we found that around 70 percent of the Golestan National Park has a high capability for supporting this species' habitat requirements.

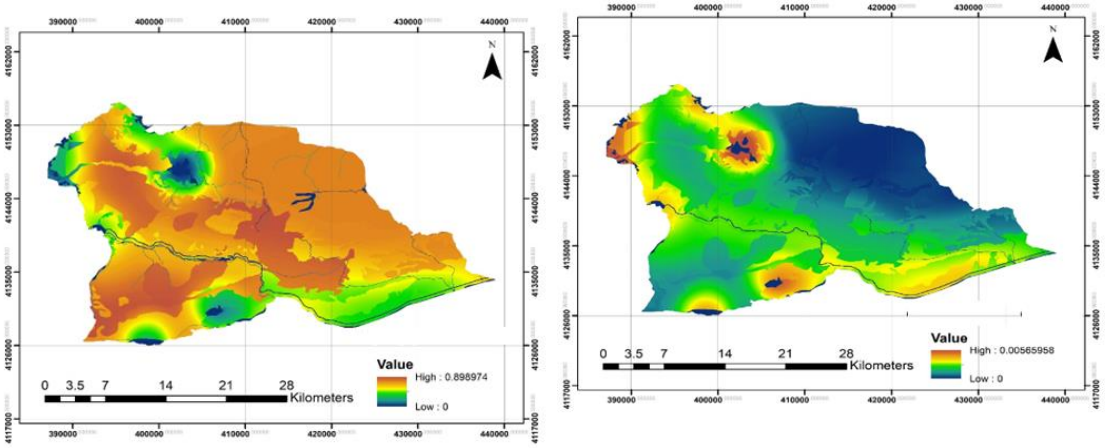

Figure 6. Invest Model of habitat destruction (left) and habitat quality (right)

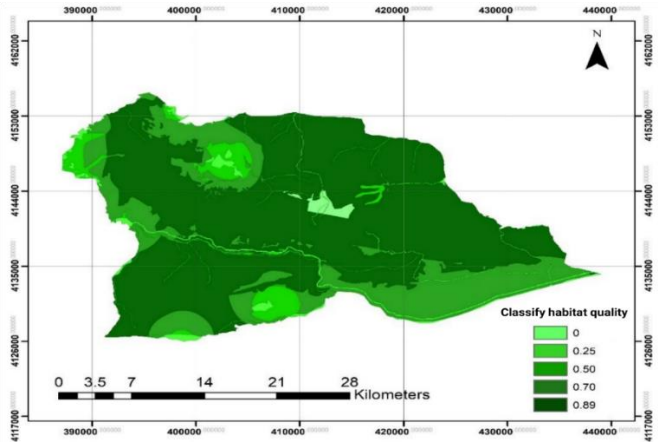

Figure 7. The final habitat quality map from the integration of three approaches

We also modeled the species habitat suitability using the MaxEnt modeling approach which indicates lower parts of the area as a suitable habitat that can be originated from weak spatial coverage of the presence data adopted in this study. This approach indicated that around one-third of the area has high suitability for brown bears. MaxEnt modeling approach showed that slope has a critical role in the species' habitat suitability across the national park, which has already been confirmed by similar studies (Nezami and Farhadinia, 2011; Kouchali, 2018; Mohammadi et al., 2021). This research showed that a combination of three approaches, including InvEST, Costing Nature, and MaxEnt can achieve a robust and reliable spatial output and can be used in conservation programs. A single threat like a road crossing the park may not reflect the effect of the human-induced variables in reducing habitat quality or disturbing ecosystem services, but an integration of various modeling approaches can reflect these impacts and can help better figure out the conservation needs.

References

Darvishsefat A (2006). Atlas of Protected Areas of Iran. University of Tehran, Tehran. (In Persian)

Hemati T, Pourebrahim Sh, Monavari M and Baghvand A (2020). Species-specific nature conservation prioritization (a combination of MaxEnt, Co$ting Nature and DINAMICA EGO modeling approaches). Ecological Modelling, 429: 109093.

Karami M, Ghadirian T and Faizolahi K (2017). The Atlas of Mammals of Iran. Iran Department of the Environment, Tehran.

Kouchali F (2018). Habitat Suitability Evaluation of Brown bear (Ursus arctos) in Hyrcanian forests (Case study: Golestan, Gilan, and Mazandaran provinces). M.Sc. Thesis, Department of the Environment. (In Persian)

Majnoonian H, Zehzad B, Kiabi B, Farhang Darehshouri B and Gashtasb Meygooni H (1998). Golestan National Park (Biosphere reserves). Iran Department of Environment, Tehran. (In Persian)

Mirkarimi H (2007). Landscape ecological planning for protected areas, Using spatial and temporal metrics. Ph.D. Thesis. RMIT University of Melbourne Victoria.

Mohammadi A, Almasieh K, Nayeri D, Ataei F, Khani A, López-Bao J. V, ... and Cushman S. A (2021). Identifying priority core habitats and corridors for effective conservation of brown bears in Iran. Scientific reports, 11(1): 1-13.

Mulligan M and Soesbergen A (2017). Mapping ecosystem services in the Volta basin using Co$ting Nature ES assessment model.

Nezami B and Farhadinia, M (2011). Status and Ecology of Brown Bear (*Ursus arctos)* in Iran. Wildlife Middle East.

Perrings C, Naeem S, Ahrestani F, Bunker D.E, Burkill P, Canziani G, Elmqvist T, Ferrati R, Fuhrman J and Jaksic F (2010). Ecosystem services for 2020. Science, 330(6002): 323-324.