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Determination of sensitive biotopes using GIS: A case study in Mediterranean coastal region

Abstract

Authors Info

A.G. Gürkan^{1*} and S. Kayıççı²

Department of Landscape Architecture, Faculty of Architecture, Mustafa Kemal University, Hatay, 31070, Turkey

²Antakya Nature, Art & Tourism Association, 31070, Turkey*Corresponding Author Email : aaysgmansur@hotmail.com

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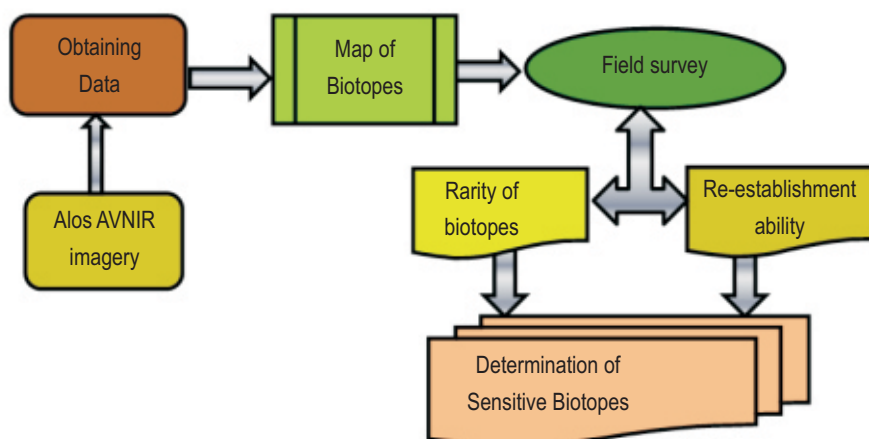
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Aim : The aim of the study was to analyze biotopes sensitivity in Samandağ coastal zone in Mediterranean coastal region of Turkey. The study was carried out to map the biotopes using object-oriented classification and to determine sensitivity of these biotopes using rareness and re-establishment ability.

Methodology : The study was performed with the help of remote sensing and geographic information system in three stages, *i.e.*, obtaining data, creating map of biotopes using object-oriented classification using ALOS AVNIR imagery assisted with field verification and determination of biotope sensitivity to human disturbance. The sensitivity assessment was based on two parameters, *i.e.*, rareness and re-establishment ability of biotopes.

Results : As a result of classification, biotope types were divided as cultural areas and semi-natural areas. Cultural areas; commercial area, settlement (garden houses, multi-story), protected area, agriculture (annual), horticulture, semi-natural areas; forest, bare rock, coastal dunes, dry streambed, river banks, meadow, shrubs, wetland meadow. The results showed that the majority of biotopes in Samandağ coastal zone were either very sensitive or sensitive to human disturbance. Agricultural activities and construction on the coastal zone have threatened the wildlife, especially species of *Caretta caretta* and *Chelonia mydas* and some of the endangered plants.

Interpretation : The wise use of coastal resources and reduction of anthropogenic pressure is possible through planning based on ecological data integrated of social and economic system. only the comprehensive plan of action could help to protect these dunes



Introduction

Human-natural habitat relations underwent a change about 200 years ago. Today, human activities have affected a large part of the World (Curebalet *et al.*, 2014). Natural biotopes replaced human cultural activities. Biotopes are generally described as a part or element of the environment, which create suitable conditions for living organisms to be nourished, to shelter, to protect one another, and to contact with each other, and can be limited according to their functional point of view (Foody, 2002). It is a fundamental variable that impacts, on and links many parts of human and physical environments (Foody, 2002; Güzelmansur and Kılıc, 2013)

Field surveys, categorization of biotopes and evaluation were once the main steps in the mapping process, in which conditions in the environment *e.g.*, land use, flora, *etc.* are evaluated and graded by various ecological values on the map. However, the field surveys have now been largely replaced by more advanced technique of GIS-based interpretation of remote sensing data, characterizing and updating biotope maps (Yılmaz *et al.*, 2010; Gao, 2015). Additionally a GIS can suggest the description of land utilization types needed for land evaluation (Van de Putte, 1989; Bronsveld *et al.*, 1994; Rossiter, 1995; Reis and Yoramlıoğlu, 2006; Adak *et al.*, 2016). The length of sandy coasts accounts for more than 50% of the global coasts (Short and Masselink, 1999; Wang *et al.*, 2016). Samandağ coastal area is one of the most important beaches in the Mediterranean region. It is 16 km long and 500-600 m wide including second largest sand beach in Turkey. It hosts 48 families, 152 genera and 198 species (Kayıkcı, 2006; Atalay and Efe, 2015). Three taxa are VU (vulnerable) and 1 taxon is EN (endangered) according to Red List (Ekim *et al.*, 2000). *Pancretium maritimum* L. is EN whereas *Zygophyllum album* L., *Alhagimannifera* Devs. and *Leucanthemum myconis* (L.) Giraud. belong to VU category. In addition, 54 bird species (9 families) and 10 reptiles (6 families) live in this area. *Chelonia mydas* and *Caretta caretta* are in endangered category according to Red List.

The aim of the study was to map and analyze biotopes sensitivity in Samandağ coastal zone. The study was performed with the help of GIS.

Materials and Methods

Study area, the Samandağ coastal zone, is a region with a typical complex Mediterranean landscape in Hatay province in the southern part of Turkey. Samandağ is a small coastal town of 129,011 people, close to the city of Antakya. The total land area of the study is 4,648 ha (Fig. 1). The study region is demarcated by the Mediterranean Sea on the west, and by Amanos Mountain in the east.

The study comprised of three stages: obtaining data, processing of data and classification and determination of biotope



Fig. 1 : Location of study area

sensitivity to human disturbance. The first stage consisted of literature survey and obtaining spatial and non-spatial data. The second stage consisted of image preprocessing, classification, and accuracy assessment. "Object-based Classification" was performed for classification of the area. The pixel resolution was 10 cm used in the study. The last stage comprised biotope sensitivity analysis *i.e.*, developed by Altan (1997), Güzelmansur (2000) and Mansuroğlu *et al.*, (2006). It is based on two parameters; the rareness of biotopes and re-establishment ability (Table 1). [Rareness; Very rare (VR): Those biotopes standing alone or distributed in a very restricted area, Rare (R): Those biotopes limited in numbers or distributed in a restricted area, Partly present (PP): Those biotopes seen at intervals in large areas, Sufficiently present (SP): Those biotopes regularly seen in large areas].

The following classification was proposed by Kaule and Schober (1985) for re-establishment ability of biotopes (Altan, 1997; Güzelmansur, 2000): Re-establishment impossible (RI): Biotopes need more than 50 years for re-establishment, Re-establishment very difficult (RVD): Biotopes need 25–50 years, Re-establishment partly possible (RPP): Biotopes need 5-25 years, Re-establishment possible (RP): Biotopes need about five years for re-establishment.

Results and Discussion

Based on biotope map, cultural areas have 3007,2 ha and semi natural areas have 1640.8 ha (Table 2) (Fig. 2). As a result of sensitivity analyses 939.4 ha is very sensitive, 174.8 ha area is sensitive, 931.3 less sensitive, and 2,602.5 not sensitive.

Cultural area : Built-up areas consist of settlement, sparse settlement, commercial, protected, agricultural and horticultural. Samandağ small industrial site is the commercial area of Samandag of multi story settlement in the Samandağ Province. Cultural areas nestle almost same cultural plants and ruderal plants. Agriculture and horticulture occupy considerable area.

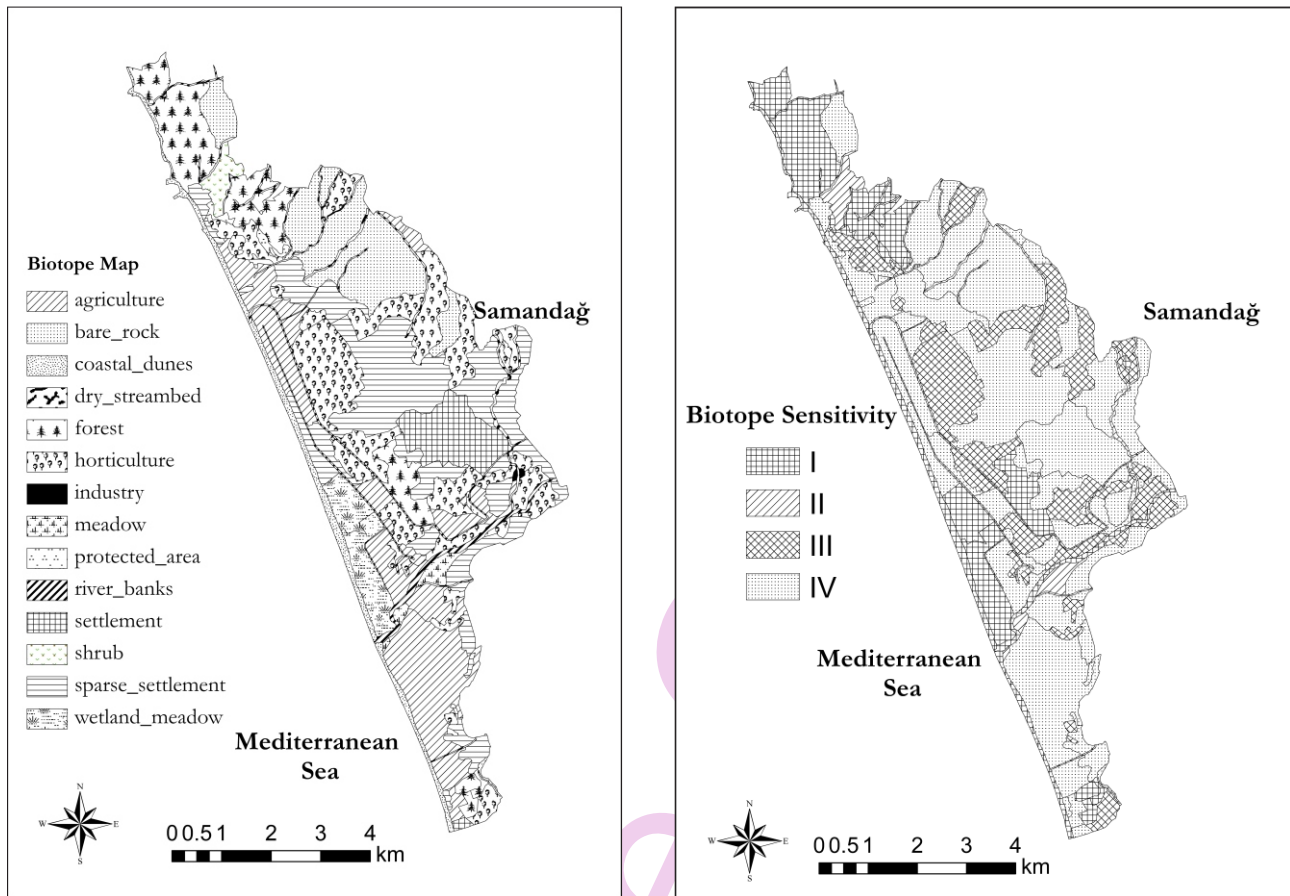


Fig. 2 : Biotope map and sensitivity map of study area

Parsley, peanut, tomato, pepper, eggplant, beans, kidney bean, cucumber, okra are most common products. Citrus species, apricot, plum, fig, olive are also grown in horticultural area. The ancient city of Seleucia Pieria, Cravdle Cave, Dor Temple and Şeyhhıdır Monument comprise protected cultural heritage area in cultural area. Some ruderal plants grow in the places.

Semi natural areas : Semi-natural areas consist of forest, bare rocks, river bank, dry stream bed, meadow, coastal dunes, wetland meadows, shrubs. Coastal dunes in Turkey are rich in floristic diversity (Uslu 1974; Byfield and Özhatay 1996). Characteristics of vegetation on fixed dunes are different. On Mediterranean coasts, the forest is mostly composed of *Pinus brutia* Tenore. On Mediterranean coastal fixed dunes, the shrub formation is mostly maquis species (Atalay and Efe, 2015).

Coastal dunes, *Pancratium maritimum* L., *Zygophyllum album* L., *Inulacrith moides* L., *Eryngium maritimum* L., *Euphorbia paralias* L., *Cakile maritima* Scop., *Sporobolus virginicus* (L.) Kunth, *Otanthus maritimus* (L.) Hoffmanns. Ex Link, *Medicago marina* L., *Limonium angustifolium* (Tausch) Turill, *Ipomea stolonifera* (Cyr.) J. F. Gmelin, *Maresia nana* (DC.)

Batt., *Polygonum maritimum* L., *Juncus acutus* L., *Verbascum sinuatum* L., *Echium angustifolium* Miller., *Elymus farctus* are characteristic coastal dunes species. Interior parts of coastal zone which sand dunes generally host *Verbascum sinuatum* L., *Echium angustifolium* Miller., *Medicago marina* L., *Otanthus maritimus* (L.) Hoffmanns. Ex Link, *Ipomea stolonifera* (Cyr.) J. F. Gmelin, *Pancratium maritimum* L., *Eryngium maritimum* L., *Alhagi mannifera* Desv. and *Euphorbia paralias* L. Milleyha aquatic ecosystem lies within the coastal dunes in the borders of Asi Delta in East Mediterranean Region. Milleyha aquatic ecosystem together with the Asi River Delta possesses the lowest elevations from its surrounding (Korkmaz et al., 2012). In addition, *Phragmites australis* (Cav.) Trin. ex Steudel, *Arthrocnemum macrostachyum* (Moric.) C. Koch, *Cakile maritima* Scop, *Halimione portulacoides* (L.) Aellen, *Bolboschoenus maritimus* var. *maritimus* (L.) Palla, *Salicornia* sp., *Tamarix myrnenensis* Bunge, *Melilotus messanensis* (L.), *Plantago maritima* L., *Hordeum marinum* Huds, *Juncus acutus* L. and *Juncus maritimus* Lam. are dominant species in wetland meadow and shrubs. *Salicornia palasiana* subsp. *palestina* is endemic species in Turkey. *Pancratium maritimum* L. (EN), *Salicornia pallasiana*

Table 1 : Sensitivity matrix (Altan, 1997; Güzelmansur 2000)

Rareness	Re-establishment			
	Impossible (RI)	Very difficult (RVD)	Partly possible (RPP)	Possible (RP)
Very rare	I	I	II	II
Rare	I	I	II	II
Partly present	I	II	II	III
Sufficiently present	II	II	III	IV

Table 2 : Biotopes and Sensitivity of biotopes of study area

	Biotopes	Area		Sensitivity		
		ha	%	Rareness degree	Re-establishment	Sensitivity degree
Cultural Biotopes	Commercial area	3,6	0,1	SP	RP	IV
	Settlement (garden houses)	993,5	21,4	SP	RP	IV
	Settlement (multi story)	227,0	4,9	SP	RP	IV
	Protected area	23,4	0,5	VR	VRD	I
	Agriculture (annual)	827,8	17,8	SP	RP	IV
	Horticulture	931,3	20,0	SP	RPP	III
Semi natural Biotopes	Forest	484,6	10,4	PP	RI	I
	Bare rock	550,1	11,8	SP	RP	IV
	Coastal dunes	151,8	3,3	VR	RI	I
	Dry streambed	78,9	1,7	PP	RVD	II
	River banks	99,8	2,1	R	RI	I
	Meadow	45,5	1,0	PP	VRD	II
	Shrubs	50,4	1,1	PP	VRD	II
	Wetland meadow	179,8	3,9	VR	VRD	I
Total	4648,0	100,00				

(VU), *Diploxiserucoides* (L.) DC, (VU) *Zygophyllum album* L. (VU), *Alhagimannifera* Desv (VU) and *Coleostephus myconis* (L.) Cass (VU) are in Red List (Ekim *et al.*, 2000).

River banks Asi (Orontes) River reaches the Mediterranean sea through the Samandağ coastal area. So Asi River is the largest river and several small rivers are present in the study area. River banks are generally covered with wattles. *Phragmites australis* (Cav.) Trin. ex Steudel is the dominant species on river banks. Some other plants are; *Typha latifolia* L., *Cakile maritima* Scop, *Alhagi mannifera* Desv, *Xanthium strumarium* L., *Salsola kali* (L.), *Tamarix myrmensis* Bunge, *Polygonum equisetiforme* Sibth. Et Sm., *Limonium angustifolium* (Tausch) Turrill., *Imperata cylindrical* (L.) Raeusheland *Vitexagnus-castus* L. Water hyacinth (*Eichhorniacrassipes*) is an invasive plant in the Asi River. *Amaranthus retroflexus* L., *Chenopodium murale* L., *Solanum nigrum* L., *Portulaca oleracea* L., *Conyza canadensis* (L.) Cronquist, *Xanthium spinosum* L., *Ecballium elaterium* (L.) A.Rich, *Cynodon dactylon* (L.) are some other ruderal plants in the coastal area.

After making biotope type evaluation map, the results were confirmed with field check. To perform sensitivity

assessment two parameters were used: rarity and re-establishment ability (Altan, 1997; Güzelmansur, 2000). The sensitivity assessment method of Altan (1997), explained in the Method section, was applied to the biotopes of Samandağ coastal zone and the results are given in Table 2. According to the results of the assessment, 24% of the Samandağ coastal area was found as very sensitive or sensitive, 17.8 % of land as very sensitive, 6.2% of land sensitive, 20 % less sensitive and 56 % of land in sensitive. Wetland meadows, forests, coastal dunes, river banks, and protected areas were found to be very sensitive biotope, which implies that their protection should be of primary concern. Dry stream bed, meadow, shrubs were found sensitive biotopes. On the other hand horticultural area was found as less sensitive, while commercial area, settlement (both garden houses and multi-story), agricultural areas and bare rocks were found as in sensitive.

Using GIS in biotope mapping gives some advantages; it helps to create all maps in a short time, so it gives us an opportunity to complete study in restricted time. The other advantage is that, it can be modified easily, according to new development. It gives opportunity to monitor the changes about land uses in coastal area. The other advantage is that it helps to

provide an ecological basis for coastal management activities. Some disadvantages of using GIS in determining sensitivity are high price of digital imagery, requirement of qualified labor about GIS and challenge of finding appropriate equipment.

The results revealed that the majority of biotopes in Samandağ coastal zone are either very sensitive or sensitive to human disturbance. This leads to the fact that the biotopes of the coastal zone need to be protected. Special protection should be provided to the coastal dunes, wetland, river banks and forest biotopes which also host endangered and endemic plant and animal species. Actually, there is an intensive human impact on the biotopes of coastal dunes. Construction on the coastal dunes threatening the wildlife, especially on turtle species of *Caretta caretta* and *Chelonia mydas*, and for endangered plants. Sensitivity analysis using re-establishment ability and rareness gives advantages to maintain sustainability. But the most difficult issue is to predict about re-establishment ability and rareness as it is sometimes effected by user.

The study shows that sensitivity analysis using GIS provides numerous advantages, hence GIS is a useful tool for sustainable planning.

References

- Adak, S., K. Adhikari and K. Brahmachari: GIS based evaluation of crop suitability for agricultural sustain ability around Kolaghat thermal power plant, India. *J. Environ. Biol.*, **37**, 905 (2016).
- Altan, T.: Participation ecological plan to zoning plans and importance of biotope mapping. II. Coastal problems and environment Symposium, Kuşadası, Turkey, pp. 1–16. (1997).
- Atalay, I. and R. Efe: Biogeography of Turkey (Türkiye Biyocoğrafyası) Meta Press, p. 530, Izmir, Turkey
- Bronsveld, K., H. Huizing and M. Omakupt: Improving land evaluation and land use planning. *ITC J.*, **4**, 359-365 (1994)
- Byfield, A.J. and N. Ozhatay: Towards the conservation of Turkey's northern dunes. *Plant Life in Southwest and Central Asia*, pp. 631-641 (1996).
- Byfield, A., S. Atay and N. Özhatay: Important plant areas in Turkey: 122 Key Turkish Botanical Sites, WWF Turkey, Istanbul, p. 464 (2010).
- Curebal, I., R. Efe, A. Soykan and S. Sonmez: Impacts of anthropogenic factors on landdegradation during the anthropocene in Turkey. *J. Environ. Biol.*, **36**, 51 (2015).
- Ekim, T., M. Koyuncu, M. Vural, H. Duman, Z. Aytaç and N. Adıgüzel: Red book of Turkey. Turkey's Nature Protection Association, Ankara, p. 246 (2000).
- Foody, G.M.: Status of land cover classification accuracy assessment. *Rem. Sens. Environ.*, **80**, 185-201 (2002).
- Gao, T.: Biotope and biodiversity mapping in forest and urban green space, No. **41**, (2015).
- Guzelmansur, A.: Analysis of coast land use and alternative landuse proposals for ErzinSarımazı-Burnaz beaches and some holiday housing on coastal zone in Erzin town. Çukurova University, Institute of Science and Technology, Adana, p. 158 (2000).
- Güzelmansur, A. and Ş. Kılıç: Land-cover classification using advanced land observation satellite image: A case study of the peri-urban region of Antakya. *J. Food Agr. Agr. Environ.*, **11**, 1178-1181 (2013).
- Kaule, G. and M. Schober : Ausgleichbarkeit von Eingriffen in Natur und Landschaft. *Schriftenreihe Des Bundesministers Fuer Ernaehrung, Landwirtschaft Und Forsten*, (314) (1985)
- Korkmaz, H., B. Cetin, V. Kuscü, I. Ege, A. Bom, E. Ozsahin and A. Karatas: Temporal change of land use on the Asi River Delta. *J. Environ. Biol.*, **33**, 463-473 (2012).
- Mansuroglu, S., V. Ortacesme and O. Karaguzel: Biotope mapping in an urban environment and its implications for urban management in Turkey. *J. Environ. Manag.*, **81**, 175-187. (2006).
- Reis, S. and T. Yomralioğlu: Detection of current and potential hazelnut plantation areas in Trabzon, North East Turkey using GIS and RS. *J. Environ. Biol.*, **27**, 653-659, (2006).
- Rossiter, D.G.: Economic land evaluation: Why and how? *Soil Use Manag.*, **11**, 132-140 (1995).
- Short, A. D. and G. Masselink: Embayed and structurally controlled beaches. *Handbook of Beach and Shoreface Morphodynamics*. Wiley, New York, pp. 230-249 (1999).
- Wang, Q.S. Zhong, X. Li, C. Zhan, X. Wang and P.Liu: Supratidal land use change and its morphodynamic effects along the eastern coast of laizhou bay during the recent 50 years. *J. Coast Res.*, **74**, 83-94 (2016).
- Van de Putte, R.: Land evaluation and project planning. *ITC J.*, **2**, 139-143 (1989)
- Yılmaz, B., S. Gülez and L.G. Kaya.: Mapping of biotopes in urban areas: A case study of the city of Bartın and its environs, Turkey. *Scient. Res. Essay*, **5**, 352-365 (2010).
- Zhou, W.Q. and A. Troy: An object-oriented approach for analysing and characterizing urban landscape at the parcel level. *Int. J. Rem. Sens.*, **29**, 3119–3135 (2008).