



Intercontinental Geoinformation Days

igd.mersin.edu.tr



Comparative analysis of forest change by type of natural park using CLEAR CUTS method

Eun Ha Park¹, Ji Young Kim², Jin Won Kim², Byeong-Hyeok Yu^{*3}

¹National Institute of Ecology, Seocheon, Korea

²Korea National Park Research Institute, Korea National Park Service, Wonju, Korea

³Social Value & Innovation Office, Korea National Park Service, Wonju, Korea

Keywords

Remote Sensing
NDVI
Protected Area
Buffer Zone
Zoning District

ABSTRACT

A natural park is a system in which protected areas are designated and managed for the conservation and sustainable use of natural ecosystems. In Korea, the management provisions for natural parks are equally applied to all four types (national parks, provincial parks, county parks, and geoparks), but the actual management is not applied equally, as the management authority differs depending on the type. Therefore, this study confirmed the effect of natural park types on forest changes in Korea by observing clear-cut land using satellite images and comparing it according to the type of natural park. The analysis showed that the proportion of severely damaged grade 3 clear-cut land was higher in provincial parks than in national parks. And marginal deforestation areas, which could not be seen inside the national park boundary, were found inside the provincial park boundary. To minimize forest changes in natural parks in the future, additional research is needed to derive the minimum buffer zone needed to perform its original function to supplement the provincial park management system and prevent the determination of development-friendly use districts.

1. Introduction

A natural park is a system in which protected areas are designated and managed for the conservation and sustainable use of natural ecosystems. Even after designation, protected areas are threatened by various influences (Cho & Lee 2010). Therefore, to properly conserve a protected area, it is necessary to manage it effectively after designation.

Protected areas of natural parks in Korea are managed by researching natural resources, establishing park plans, determining use districts, and designating prohibited acts for each use district. This applies equally to all four types of natural parks (national parks, provincial parks, county parks, and geoparks), but the management authority differs depending on the type of park. National parks are designated and managed by the central government, while provincial parks are designated and managed by local governments. Considering that forests often span multiple

administrative districts, provincial parks that require consultation among various management entities have limitations in systematic management compared to national parks.

Therefore, this study confirmed the effect of natural park type on forest changes by observing clear-cut land using satellite images and comparing it according to the type of natural park.

2. Method

2.1. Site status

To compare forest changes according to the type of natural park, national and provincial parks with approximately the same distance from the city and city size were selected as target sites. In consideration of the size of the city, the analysis was conducted for a total of four natural parks, two each in metropolitan areas and non-metropolitan areas (Table 1).

* Corresponding Author

(paoseeh@gmail.com) ORCID ID 0000-0002-7797-0449
(kjiy2050@knps.or.kr) ORCID ID 0000-0001-7460-6353
(whales9208@knps.or.kr) ORCID ID 0000-0002-9329-9608
(bhyu@knps.or.kr) ORCID ID 0000-0001-5396-7969

Cite this study

Park E H, Kim J Y, Kim J W & Yu B-H (2021). Comparative analysis of forest change by type of natural park using CLEAR CUTS method. 3rd Intercontinental Geoinformation Days (IGD), 143-145, Mersin, Turkey

Table 1. Site status

	Site	Area (km ²)
Metropolitan area	Bukhansan National Park	76.922
	Namhansanseong Provincial Park	36.400
Non-metropolitan area	Gyeryongsan National Park	65.335
	Daedunsan County Park	62.640

2.2. Clear-cuts

The clear-cuts detection method (Ose et al. 2016) was used to identify forest changes, and the details of the data used for the analysis are as follows.

Table 2. Data acquisition

Sort	Site	Data Acquisition
Metropolitan area	Bukhansan National Park,	Landsat 8 (2014/5/30, 2018/5/9),
	Namhansanseong Provincial Park	Sub-divided Land Cover Map (2014)
Non-metropolitan area	Gyeryongsan National Park,	Landsat 8 (2015/5/26, 2018/5/21),
	Daedunsan Provincial Park	Sub-divided Land Cover Map(2015)

Changes in the Normalized Difference Vegetation Index (NDVI) for each site five years after the production of the land cover map by the Ministry of Environment were examined, and the grade of clear-cut land was calculated based on the forest area classified at the time of the production of the land cover map (Table 3). For the satellite images used in the NDVI calculation, images with few clouds (<5%) were selected to minimize the analysis error. And among the clear-cut land classified into 3 grades, the objects presumed to be a cloud were manually deleted. To examine changes in the surrounding area outside the boundary of the protected area, the status of the occurrence of clear-cut land in the buffer section, which was 5 km from the boundary, was also analyzed.

Table 3. Grades of clear-cut land (Ose et al. 2016)

Grade	Description
0	Absence of clear-cuts
1	Clear-cuts with a low confidence degree
2	Clear-cuts with a medium confidence degree
3	Clear-cuts with a high confidence degree

3. Results

3.1. Comparison of the ratio of clear-cut land area

The ratio of clear-cut land area to total forest area did not show a significant difference according to the type of natural park (Table 4). Similar results were obtained inside and outside the boundaries of natural parks, and the difference according to the size of the city was not large.

However, within the boundary of natural parks, the ratio of grade 3 clear-cut land to the total area of clear-cut land was larger in provincial parks than in national parks (Table 5). The maximum value of grade 3 clear-cut land was also determined to be larger in provincial

parks than in national parks both inside and outside the boundaries. This means that more heavily damaged clear-cut areas are appearing in provincial parks than in national parks and larger clear-cut areas are occurring in provincial parks.

Table 4. The ratio of the total area of clear-cut land to the total forest area (%)

	Sort	Grade of clear-cut land	Inside the boundary	Outside the boundary
Metro	Bukhansan	No clear-cuts	98.36	91.27
		Clear-cuts(1+2+3)	1.64	8.73
		Clear-cuts(3)	0.05	1.52
	Namhansanseong	No clear-cuts	97.46	93.39
		Clear-cuts(1+2+3)	2.54	6.61
		Clear-cuts(3)	0.44	2.62
Non-metro	Gyeryongsan	No clear-cuts	98.47	94.71
		Clear-cuts(1+2+3)	1.53	5.29
		Clear-cuts(3)	0.07	1.88
	Daedunsan	No clear-cuts	97.85	95.79
		Clear-cuts(1+2+3)	2.15	4.21
		Clear-cuts(3)	0.73	1.54

Table 5. Area ratio and maximum values of grade 3 clear-cut land compared to total clear-cut land

	Sort	Inside the boundary		Outside the boundary	
		Area ratio (%)	Maximum values (m ²)	Area ratio (%)	Maximum values (m ²)
Metro	Bukhansan	3.16	11,700	17.46	118,805
	Namhansanseong	17.32	42,458	39.58	1,161,163
Non-metro	Gyeryongsan	4.31	9,002	35.49	148,519
	Daedunsan	33.83	83,720	36.65	227,759

3.2. Clear-cut land type comparison

In the case of the clear-cut land type, there was a difference according to the type of natural park inside the boundary, whereas a difference according to the size of the city was found in the area around the boundary.

Within the boundary, various types of clear-cut land were analyzed for each target site in the use districts except for the park nature conservation district. In the case of Bukhansan National Park, changes in the area around temples and cultural heritage excavations were analyzed as grade 3 cleared areas, and changes around some highland bedrock areas were analyzed as grades 1 and 2 cleared areas. Gyeryongsan National Park showed changes in the area in which a landslide occurred in 2018 and around residential areas located in the Park Village District and Park Natural Environment District. In Namhansanseong Provincial Park, cleared land due to military facilities and deforested areas in the periphery was found, and in Daedunsan Provincial Park,

deforested areas in the periphery and bare areas around roads were analyzed.

In the case of natural parks located in metropolitan areas, development areas such as apartment complexes, artificial grasslands around roads, and deforested areas in the periphery were analyzed as grade 3 clearing areas. In the vicinity of natural parks located in non-metropolitan areas, a number of deforested areas in the periphery were analyzed. In addition, artificial grasslands and fields with arable land were designated as grade 3 cleared areas.

It was also observed that grade 3 clearing land appeared immediately outside of and adjacent to the boundary. In particular, in the case of a national park, even though there was a forest area that was connected without a break to the inside of the national park, it was not included in the boundary, so the open land where development such as apartment complexes was made was observed.

4. Discussion

Through analyzing the status of cleared land, it was found that the proportion of heavily damaged cleared land was higher in provincial parks than in national parks. In addition, it was determined that deforestation in the periphery, which was nonexistent inside national park boundaries, took up relatively large areas inside provincial park boundaries.

National parks and provincial parks are designated and managed under the same system, but their management bodies are different. Nevertheless, differences in forest change show the limitations of management systems in which the management entity is not unified.

In addition, it is judged that the fact that the park natural environment district does not function as a buffer zone among the use districts of natural parks also has an impact. Awareness of the conservation of provincial parks is relatively low compared to national parks, so a more development-friendly use district is inevitably determined.

5. Conclusion

Through the analysis of the status of cleared land, it was confirmed that the forest changes were different depending on the type of natural park. To minimize changes in forests in natural parks, it is necessary to supplement the management system so that provincial parks can be managed similarly to national parks. In addition, it is necessary to develop a plan to secure sufficient buffer zones when setting the boundaries of protected areas and determining the use districts.

To this end, it is necessary to identify landscape species and the minimum survival area for them to be maintained (Alexandre et al. 2010). And additionally, to derive the minimum buffer area that can perform its original function is needed. It is expected that the forest changes derived from this study can be superimposed for use in improving the boundaries of natural parks and use districts.

Acknowledgement

This research was supported by the Park Lab 2021 Research Program through the Korea National Park Service.

References

- Alexandre B D, Crouzeilles R, & Grelle C E (2010). How can we estimate buffer zones of protected areas? A proposal using biological data. *Natureza & Conservacao*, 08, 165–170. <https://doi.org/10.1016/j.sbspro.2016.05.227>.
- Cho Y H & Lee Y K (2010). A study on surveying and improving management of protected areas in Korea. *Journal of Korean Institute of Landscape Architecture*, 38(1) 64–73.
- Ose K, Corpetti T & Demagistri L (2016). Multispectral satellite image processing. *Optical Remote Sensing of Land Surface: Techniques and Methods*, 57–124. <https://doi.org/10.1016/B978-1-78548-102-4.50002-8>