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A Review of Ecological and Natural Map Grades and Public Appeals in Korea

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ABSTRACT

This study surveyed the changes in the proportion of Ecological and Natural Map (ENM) grades in Korea, the distribution ratio of ENM 1st-grade areas by region, and the current status of regional public appeals for the five-year period from 2017 to 2021. The nationwide changes in ENM grades revealed an increase in 1st-grade, 3rd-grade, and separately managed areas but a decrease in the ratio of 2nd-grade areas. Nationwide, Gangwon had the highest distribution ratio of 1st-grade areas, at 46.77%, while Gwangju had the lowest, at 0.05%. In the five-year study period, 383 appeals concerning ENM grades were received and processed. Gangwon had the greatest number of appeals, with 96, while Sejong had the fewest, with 1. A significant correlation was observed between the distribution ratio of 1st-grade areas and public appeals.

Keywords: Correlation analysis, Ecological and natural map, Spatiotemporal changes

Introduction

To preserve the natural environment, the Republic of Korea classifies the ecological value, naturalness, and scenic value of mountains, rivers, inland wetlands, lakes, farmland, and cities (Natural Environment Conservation Act). To this end, the Ecological and Natural Map (ENM) has been produced and distributed since 2007. The ENM consists of 1st-grade, 2nd-grade, 3rd-grade, and separately managed areas. First-grade areas require conservation, minimal environmental damage is allowed in 2nd-grade areas, and development and other land uses are allowed in 3rd-grade areas (Ahn *et al*., 2015; Ministry of Environment [MOE], 2016). ENM grades are assigned based on surveys of the natural environment, such as vegetation, geomorphology, and habitat for endangered wildlife. If there is a discrepancy between ENM grade standards and the natural environment, the ENM grades can be changed through a process such as public appeals. If an appeal is received, ENM grades are re-evaluated through field surveys and assessments. Consequently, the grade may change or remain unchanged. Several recent studies have investigated ENM grades and public appeals (Ahn *et al*., 2015; Jung *et al*., 2017; Kim *et al*., 2023).

The Natural Environment Conservation Act recommends the use of the ENM for environmental policies and development plans, making it a valuable tool in natural environmental management (MOE, 2016). However, the ENM is also used as a basis for regulations such as environmental impact assessments, resulting in many public appeals (Ahn *et al*., 2015).

This study analyzed the changes in the proportion of ENM grades in Korea, the distribution ratio of 1st-grade

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areas by region, and changes in the number of public appeals by region for the five-year period from 2017 to 2021. The results will provide basic data for improving the ENM system.

Materials and Methods

Cases of public appeals related to the ENM were collected from 2017 to 2021. All cases were included to count the number of public appeals by administrative district. For security reasons, data for each appeal were not included.

To investigate the changes in the proportion of ENM grades and the ratio of the 1st-grade areas by region, we used public notices from the MOE from 2017 to 2021. Specifically, regular notices of the ENM as applied to the current status and results of public appeals (2017-42, 2018-91, 2019-186, 2020-32, and 2021-60) were used. The boundaries of administrative districts were obtained from the National Spatial Data Infrastructure Portal (http://www.nsdi.go.rk). ArcGIS 10.8 software was used to calculate the change in ENM grade area by annually. Statistical analysis was performed using SPSS version 20.0 (IBM Co., Armonk, NY, USA).

Results

Spatiotemporal variations of Ecological and Natural Map areas

Among the changes in ENM grades nationwide over the five-year period, the proportions of 1st-grade, 3rd-grade, and separately managed areas increased, while the ratio of 2nd-grade areas decreased (Table 1). Specifically, the total 1st-grade area increased by 0.12%, the 2nd-grade

Table 1. Annual changes of Ecological and Natural Map's grades ratio in South Korea

Grade	2017 (%)	2018 (%)	2019 (%)	2020 (%)	2021 (%)
1st	9.08	9.13	9.15	9.22	9.20
2nd	45.40	45.41	44.39	43.27	43.15
3rd	36.93	36.88	37.58	38.43	38.45
Separately	8.59	8.57	8.87	9.09	9.20
Total	100.00	100.00	100.00	100.00	100.00

Table 2. Annual changes of 1st grade ratio by region

Region	2017 (%)	2018 (%)	2019 (%)	2020 (%)	2021 (%)
Gangwon	47.33	47.07	46.80	46.51	46.14
Gyeonggi	7.41	7.36	6.01	5.75	5.96
Gyeongnam	5.14	5.11	6.75	7.01	7.09
Gyeongbuk	22.25	22.69	21.82	21.94	21.98
Jeonnam	4.53	4.50	4.58	4.45	4.45
Jeonbuk	2.75	2.74	2.73	2.75	2.75
Chungnam	3.47	3.43	2.98	3.11	3.12
Chungbuk	3.40	3.39	3.53	3.51	3.52
Busan	0.34	0.33	1.02	1.04	1.04
Incheon	0.08	0.07	0.08	0.11	0.13
Sejong	0.13	0.13	0.13	0.15	0.15
Ulsan	0.99	0.98	1.46	1.43	1.43
Daegu	0.32	0.32	0.32	0.32	0.32
Seoul	0.20	0.20	0.13	0.24	0.24
Daejeon	0.19	0.19	0.19	0.15	0.15
Gwangju	0.05	0.05	0.05	0.05	0.05
Jeju	1.43	1.42	1.42	1.48	1.48
Total	100.00	100.00	100.00	100.00	100.00

area decreased by 2.25%, the 3rd-grade area increased by 1.52%, and the separately managed area increased by 0.61%.

Over the five-year period, an average of 46.77% of 1st-grade areas in the ENM were distributed in Gangwon, which was the highest distribution ratio. In addition, Gyeongbuk accounted for 22.13%, Gyeonggi for 6.50%, Gyeongnam for 6.22%, Jeonnam for 4.50%, Chungbuk for 3.47%, Chungnam for 3.22%, Jeonbuk for 2.74%, Jeju for 1.45%, Ulsan for 1.26%, Busan for 0.75%, Daegu for 0.32%, Seoul for 0.20%, Daejeon for 0.17%, Sejong for 0.14%, Incheon for 0.09%, and Gwangju for 0.05% (Table 2).

Regional distribution of public appeals

A total of 383 public appeals were received and processed in 12 administrative districts over the five years. Gangwon had the most appeals, with 96. In addition, there were 64 appeals in Gyeongnam, 60 in Gyeonggi, 44 in Gyeongbuk, 42 in Chungnam, 16 in Chungbuk, 12 each in Jeonbuk and Busan, 9 in Ulsan, 8 in Daegu, 2 in Incheon, and 1 in Sejong. No public appeals were submitted in Seoul, Daejeon, Gwangju, or Jeju (Fig. 1).

Over the five-year period, 81.63% of total ENM 1st-grade areas were distributed in Gangwon, Gyeongbuk, Gyeonggi, and Gyeongnam. Simultaneously, approximately 67% (260 cases) of the total appeals were distributed in Gangwon, Gyeongnam, Gyeonggi, and Gyeongbuk. A significant correlation (r=0.792, r^2=0.627, *P*=0.002) was observed between the 1st-grade area ratio and the number of public appeal cases, as illustrated in Fig. 2.

Discussion

This is an era when both development and conservation must be considered simultaneously. As part of the Conference of the Parties to the Convention on Biological Diversity in 2022, the Republic of Korea agreed to conserve and manage at least 30% of land and sea as protected areas. ENM 1st-grade areas must be considered for conservation and restoration before development (Enforcement

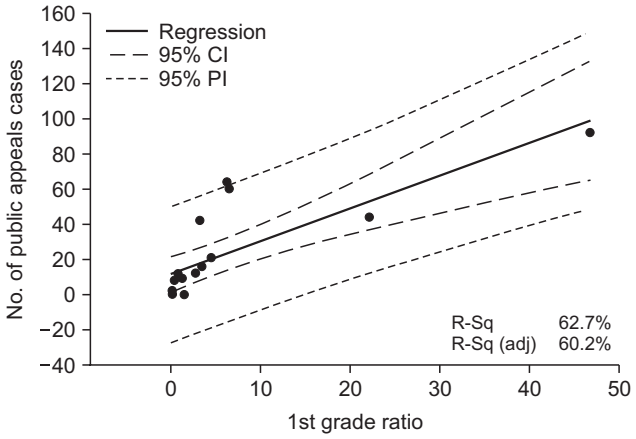
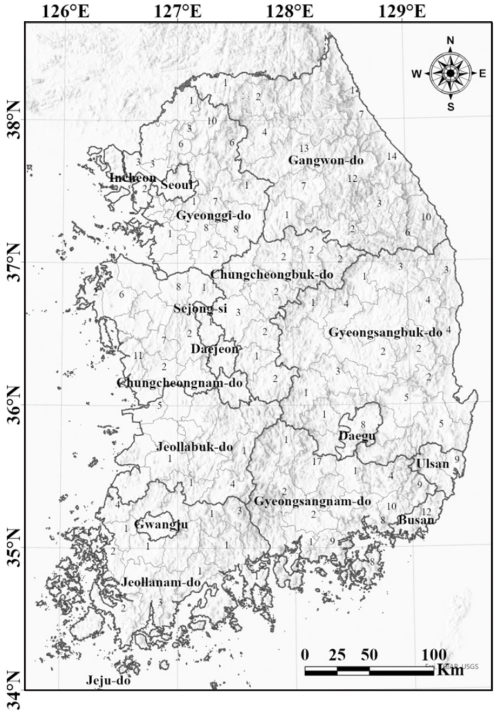


Fig. 2. Regression line plot between the 1st grade ratio and number of public appeals cases. CI, confidence interval; PI, prediction interval; R-Sq, R-squared; adj, adjusted count.



Region	2017	2018	2019	2020	2021	Total
Gangwon	20	23	18	16	15	92
Gyeonggi	12	9	10	7	22	60
Gyeongnam	4	12	16	19	13	64
Gyeongbuk	3	13	9	7	12	44
Jeonnam	2	5	6	1	7	21
Jeonbuk	2	4	2	1	3	12
Chungnam	10	9	8	5	10	42
Chungbuk	4	1	4	1	6	16
Busan	-	1	4	3	4	12
Incheon	1	-	-	-	1	2
Sejong	-	1	-	-	-	1
Ulsan	-	-	3	5	1	9
Daegu	-	-	-	1	7	8
Seoul	-	-	-	-	-	-
Daejeon	-	-	-	-	-	-
Gwangju	-	-	-	-	-	-
Jeju	-	-	-	-	-	-
Total	58	78	80	66	101	383

Fig. 1. A map of received public appeals by region in Korea (the number on the map is case numbers of public appeals in administrative district such as si, gun and metropolitan city).

Decree of the Natural Environment Conservation Act). In many cases of appeals, the ENM grades were changed due to the differences between the ENM grade standard and the natural environment. If ENM grades remain unchanged after a first appeal, districts may repeatedly submit appeals or intentionally cause physical damage to the natural environment, such as by logging, to lower the grade (Figs. 3, 4). The development of natural environments may be necessary for economic benefits or regional development, but it is essential to establish measures to support the conservation of 1st-grade areas.

Conclusion

In the Republic of Korea, a low proportion of ENM 1st-grade areas are in administrative districts that are the centers of each region (metropolitan cities such as Seoul, Busan, Incheon, Daegu, Daejeon, Ulsan, and Gwangju) and in special self-governing provinces. However, the central government's regulations do not apply to special self-governing provinces, including Jeju and Sejong. Therefore, the number of public appeals in these regions is considered to be low compared to the provinces.

However, in provinces with a high proportion of ENM 1st-grade areas, there are many cases of public appeals of ENM grades made by local governments seeking to pursue development in these areas. Since the ENM grades are among the regulatory considerations affecting government development restrictions, provinces with many undeveloped areas are seeking to be classified as special self-governing provinces (Gangwon and Jeonbuk).

From 2017 to 2021, the proportion of appeal areas was very low compared to the total ENM 1st-grade areas in South Korea. However, since ENM 1st-grade areas are subject to development regulations, appeals have been consistently submitted (Table 3). Therefore, in the future, a significant portion of ENM 1st-grade areas may be subject to appeals.

Table 3. Annual changes in the Ecological and Natural Map 1st grade area, public appeal area, and the proportion of appeal area of the 1st grade area

Type	2017	2018	2019	2020	2021
Total 1st grade area (km^2)	9,000	9,055	9,075	9,138	9,122
A public appeal area (km^2)	17	18	15	11	14
Proportion (%)	0.18	0.19	0.16	0.12	0.15

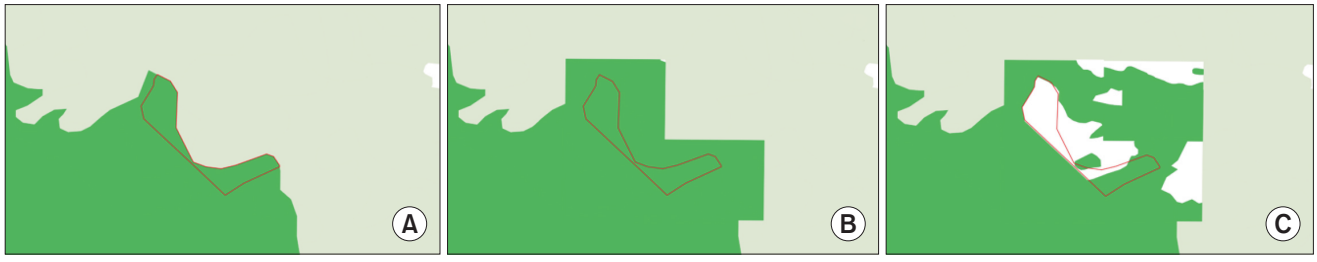


Fig. 3. The changes in ENM grades by repeated appeals (red line: appeal area, green: ENM 1st grade, light green: ENM 2nd grade, white: ENM 3rd grade). (A) Before submitting an appeal, (B) after 1st appeal submission (grades remain unchanged), (C) after 2nd appeal submission. ENM, Ecological and Natural Map.

Fig. 4. A physical damage with logging. (A) At the 1st appeal submission (grades remain unchanged), (B) at the 2nd appeal submission.

Author Contributions

JC analyzed data and wrote the original draft. WO analyzed data and reviewed and edited the draft. JCK and HYY analyzed data. KP, HL, EJK, and CY participated in the fieldwork for collected data. The authors read and approved the final manuscript.

Conflict of Interest

The authors declare that they have no competing interests.

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