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A Study on the Relationship between Spatial Distribution and External Factors of Anura Amphibians

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Abstract

Identifying the distribution of species and specific factors related to it is very important because it is habitat conservation that is greatly linked not only to ecological research but also to human health. After all, protecting each one's habitat will protect wildlife and further maintain a healthy ecosystem. Therefore, in this study, data were collected, compared, and analyzed through existing studies and field-oriented surveys. The results of the survey confirmed high species diversity in agricultural areas and forest areas that can reduce moisture supply and moisture loss, and the non-segmental environment, that is, ecological connectivity, was largely influenced by amphibian species diversity. It was confirmed that the non-fragmented environment, that is, ecological connectivity, was greatly affected by amphibian species diversity. In addition, the three factors that affect amphibian survival are: It was identified as the effect of not establishing a buffer space, the effect on the ecological transformation around the habitat during the summer rainy season, and the effect on the disconnected ecological environment.

Keywords: *Amphibians, Species Conservation, Ecological Connectivity, Species Diversity, Fragmentation*

1. INTRODUCTION

Amphibians are animals with two habitats that live in and out of water and on land [1]. They consume pests or small animals and are good food sources for upper predators. As such, as a secondary consumer of the ecological pyramid, it is a very useful indicator species that can evaluate the ecological cycle and the health of the ecological environment and plays a very important role in the balance of the ecosystem [1-5], and a healthy green environment is also linked to human health [6].

However, more than 30% of amphibians are currently at risk of extinction worldwide [7]. The reasons include environmental pollution and the spread of alien species, but among them, habitat transformation and destruction are emerging as the biggest factors affecting the habitat of amphibians [2, 7-8]. It is because of their ecological habits that they are less mobile than other species and are greatly affected by the surrounding environment, such as moisture and temperature.

As such, amphibians that need to be actively protected require more precise and continuous research and research than anything else. However, environmental impact assessments, private research institutes, universities, and institutional investigations in Korea are very limited compared to Canada, Europe, Japan, and

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the United Kingdom. Also, since studies limited to specific species are common [7], overall investigations on species distribution, habitats, and ecological characteristics are lacking.

Therefore, in order to derive the association of external factors affecting the spatial distribution of amphibians, we will select and study a target site that can track the distribution of anura amphibians.

This study was carried out to establish a milestone for continuous research on the distribution and habitat types of amphibians, the improvement of habitats for species, and environmental conservation measures.

2. RESEARCH METHOD

2.1 Analysis of Precedent Research in Korea

The following preceding study re-analyzed the data of the national natural environment survey in the same area as the study target site selected in this study and the data on the use of amphibians by habitat type.

2.1.1 A Study on the Map Sheet

The data of the national natural environment survey in the area corresponding to the selected target site in this study were analyzed.

As shown in Figure 1, The National Natural Environment Survey used the latest data among the relevant patterns, and if it was not divided into grid numbers, regional data with an ecological environment similar to the study target site were extracted and analyzed.

Jeondong (367061), which is an agricultural area, and Gyeongsan (358034), which consists of urban areas and forests, have the most diverse species with 6 species identified. Dadae (358164) and Anin(378082) has 3 species each, and Deokso (377054), downtown Seoul, has 2 species, the fewest species identified.

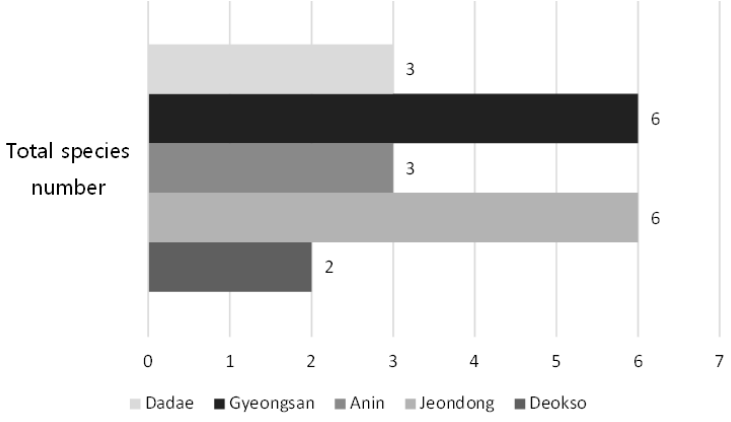

Figure 1. Results of amphibian appearance species using literature survey data

2.1.2 Research on Usage Status by Habitat Type

The 3rd National Natural Environment Survey amphibian location data collected nationwide and land cover data from the Ministry of Environment were analyzed using data, and the land cover type for each amphibian location data was confirmed [7].

22 medium-class items of the land cover map, which is a map that expresses and classifies the physical state of the land surface by satellite imaging, are set as Macrohabitat, Accordingly, habitats with similar functions were grouped and classified into 5 of Megahabitat.

and 14 ecosystem-type items in the field survey table of the 3rd National Natural Environment Survey Guidelines were classified as microhabitats.

Data of Caudata amphibians included in the previous study were excluded and re-analyzed.

Figure 2 shows the results of reanalyzing the usage status of five large habitats in a total of 25,414 locations.

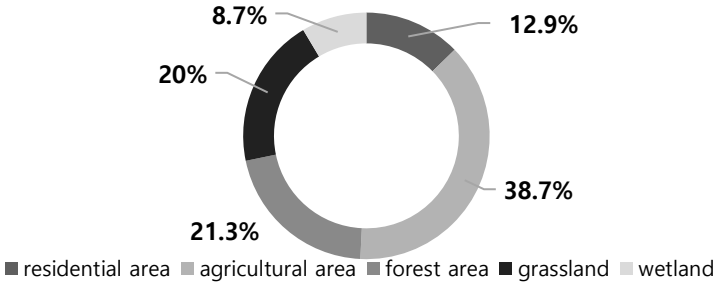

Figure 2. Amphibian utilization by megahabitat type

In the case of Macrohabitats, 13,778 out of 25,414 sites were reanalyzed into the top 12 types of usage status, and the result is shown in Figure 3.

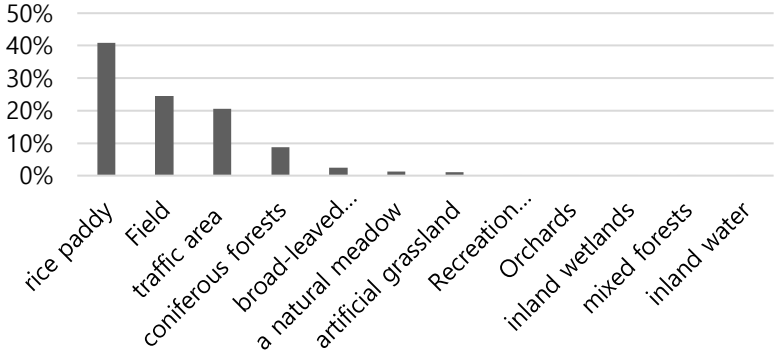

Figure 3. Amphibian utilization by macrohabitat type

The Microhabitat reanalyzed 17,367 out of 24,829 points into the top 11 types of usage, and the result is shown in Figure 4.

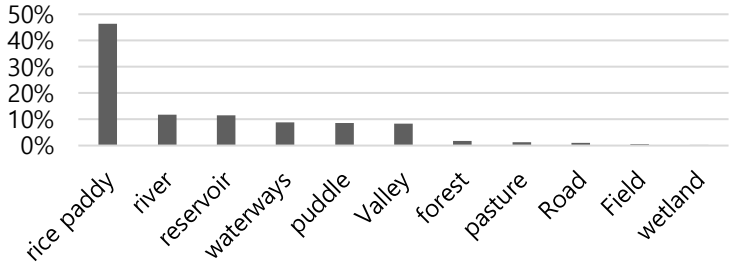

Figure 4. Amphibian utilization by microhabitat type

The results of previous studies seen earlier are summarized as follows.

Although forests are located, Gyeongsan, which is expected to have a large floating population due to the proximity of the city center, has six species, and a relatively diverse species have been identified.

In the case of Dadae and Jeondong, the data of the agricultural area were analyzed for both map sheet, but the results showed a difference in species distribution, with 3 species and 6 species.

In addition, when looking at the results by habitat size, all three habitats showed a high proportion of amphibian habitat use in cultivated land, forests, and rivers. In the case of the usage status of Macrohabitats of amphibians, the traffic area showed the third highest usage ratio. Therefore, through the results shown above, we intend to find a connection with this study and derive the results.

2.2 A Research Site

Table 1 shows, during the period in which the distribution of Amphibians can be traced across the country, five sites were selected for each regional area in consideration of the formation of a continuous or temporary water environment, the possibility of habitat and breeding, etc.

Table 1. Research area

Site	Nomination	Latitude	Longitude	Extent(㎡)
A	80, Arisu-ro 94-gil, Gangdong-gu, Seoul	37°33'29.11"N	127°10'36.10"E	456.41
B	400-2, Haejeong-ri, Susin-myeon, Dongnam-gu, Cheonan-si, Chungcheongnam-do	36°43'28.72"N	127°16'18.00"E	511.75
C	173, Deokhyeon-ri, Gujeong-myeon, Gangneung-si, Gangwon-do	37°42'4.67"N	128°55'50.67"E	546.22
D	647-2, Gomo-dong, Suseong-gu, Daegu	35°51'36.51"N	128°39'52.78"E	470.56
E	967-1, Myeongji-dong, Gangseo-gu, Busan	35° 6'14.36"N	128°54'32.90"E	452.09

Kakao Map and Google Earth Pro were used for the area of the study area (㎡) and latitude and longitude, and there may be errors

2.3 Method of Investigation

In this study, it was judged as an amphibian habitat if it was surveyed more than once in the existing environmental impact assessment and national natural environment survey, or if more than one species was confirmed.

According to the guidelines for the 5th National Natural Environment Survey, the survey is conducted at least twice a year. From March to September, when the life cycle of Anura amphibians is active, surveys were conducted day and night (including in rainy weather) in waterways, puddles, and farmland. Sighting and hearing surveys were conducted in possible point of emergence, and eggs and larvae were also included, and species identified within a radius of about 100 m from the center of the site were reflected in the results, considering the mobility of adults.

3. RESULTS AND DISCUSSION

3.1 Results of Ecological Type Survey on the Site of Study

Table 2 shows the results by habitat type for the five sites from the fieldwork, showing the differences and common ground.

Table 2. Results by habitat type through fieldwork

Classification	Site A	Site B	Site C	Site D	Site E
Difference	Residential areas, transportation facilities, etc. are very close	As a typical rural area, the environment like the target site continues	the proximity of grasslands, wetlands and forests	Frequent access of people to temples and hiking trails	Loads of sand accumulated at the mouth of the river as sedimentary land have been used as cultivated land for many years
Common ground	A water environment is formed temporarily during continuous or rainfall, and shrubs and herbs dominate the target area and surroundings. In addition, it is located relatively close to the target site, such as waterways, forests, and puddles, so it is judged that it is possible to inhabit and reproduce sufficiently by moving according to environmental conditions or conditions.				

3.2 Comprehensive Results of Species Appearing by Habitat

One species of *Dryophyte*s japonica was confirmed to inhabit all research area, and the result is shown in Table 3.

Table 3. List of amphibian species identified in field investigations

Family	Scientific name	Site					Sum
		A	B	C	D	E	
Bombinatoridae	*Bombina orientalis*		*	*	*		*
Hylidae	*Dryophytes japonica*	*	*	*	*	*	*
	Dryophytes suweonensis						
Ranidae	*Glandirana rugosa*		*	*			*
	Lithobates catesbeianus		*		*	*	*
	Pelophylax chosenicus						
	Pelophylax nigromaculatus		*	*	*	*	*
	Rana coreana		*	*	*		*
	Rana huanrenensis		*				*
	Rana uenoi		*				*
Bufonidae	*Bufo gargarizans*		*		*	*	*
	Bufo stejnegeri						
Microhylidae	*Kaloula borealis*	*	*			*	*
Total species		2	10	5	6	5	10

3.3 Comparison and Analysis of Research Results

As shown in Figure 5, in the two studies, high species diversity was confirmed in areas with relatively diverse aquatic environments and ecological connectivity, and low species diversity was confirmed in areas where fragmented ecological environments and continuous disturbances were expected.

Site A and Deokso (377054) were located in the Han River, but were separated from the habitat, and the forest north of the habitat was also fragmented, so the lowest species diversity was confirmed.

Site B and Jeondong (367061) are rural areas formed of cultivated land, rivers, and forests, and the highest species diversity was confirmed as not only habitat but also ecological environments that can be avoided if necessary.

Site C and Anin (378082) were formed of forests, grasslands, and wetlands, and various wild animals were identified, but relatively various amphibians were not identified, which was judged to be due to the high altitude and difficult access during the survey.

Site D and Gyeongsan (358034) are adjacent to the city center and are expected to have a large floating population as temples and hiking trails, but ecological connectivity was confirmed as not only reservoirs and valleys but also forests continued in the north and south, and it was judged that they would move to alternative habitats when there's a disturbance.

Site E and Dadae (358164) are areas with high scenic and ecological value as estuaries and habitats for migratory birds, but development work is underway for the habitat area and ecological isolation is expected outside the survey site as urban areas, so relatively many species of amphibians have not been identified.

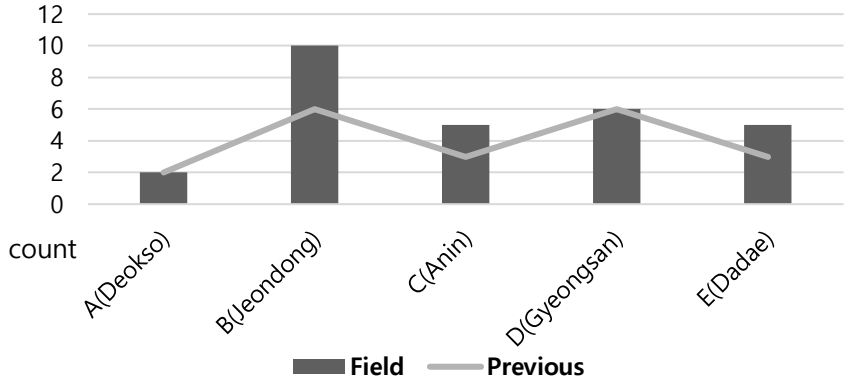

Figure 5. Comparison of field and previous research results

When summarizing the ratios of amphibian usage in Megahabitat, Macrohabitat, and Microhabitat, it was confirmed that cultivated land was used as habitat at the highest rate, followed by forest areas, rivers, and reservoirs.

In addition, traffic areas showed the third highest utilization rate in Macrohabitat, which is judged to be the case where amphibians do not use traffic areas as habitats, but are surveyed in road kill by vehicles while going back and forth between habitats during the breeding season [7]. These results have been investigated in previous studies [9].

4. CONCLUSIONS

Amphibians prefer agricultural areas to avoid heat and wind with environments where moisture is continuously supplied to the skin and eggs to prevent water loss, and then forest areas.

In addition, the most important key to survival identified through this study was found to be due to the species diversity of amphibians due to the unfragmented environment, that is, ecological connectivity.

Previous studies, which were compared and analyzed in the results, also showed that the higher the species diversity was in areas with excellent ecological connectivity, which was very similar to the results of local studies.

The factors that affect amphibian survival identified through our study are as follows.

These are the impact of not establishing a buffer space, the effects of ecological transformation around habitats during the summer rainy season, and the effects on the disconnected ecological environment. Identifying and understanding the association between the type of habitat in amphibians and their species

distribution will be the most decisive factor in addressing the decline in amphibians the fastest [10].

Conserving the habitat of amphibians supports the survival of wild animals such as insects and birds, and is also deeply related to maintaining and improving healthy ecosystems. Therefore, professional and continuous research should be conducted in the ecosystem investigation.

It is believed that this study will be used as important data for protecting and restoring amphibian habitats as well as the recognition and value of amphibian habitats and the need for precise and continuous investigation.

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