



# Trend Analysis of Research Topics in Ecological Research

Suntae Kim\*<sup>ORCID</sup>

Department of Library and Information Science, Jeonbuk National University, Jeonju, Korea

## ABSTRACT

This study analyzed research trends in the field of ecological research. Data were collected based on a keyword search of the SCI, SSCI, and A&HCI databases from January 2002 to September 2022. The seven keywords, including biodiversity, ecology, ecotourism, species, climate change, ecosystem, restoration, wildlife, were recommended by ecological research experts. Word clouds were created for each of the searched keywords, and topic map analysis was performed. Topic map analysis using biodiversity, climate change, ecology, ecosystem, and restoration each generated 10 topics; topic maps analysis using the ecotourism keyword generated 5 topics; and topic map analysis using the wildlife keyword generated 4 topics. Each topic contained six keywords.

**Keywords:** Ecological research, Topic map, Trend analysis, Web of Science, Word cloud

## Introduction

Ecosystem changes are intensifying worldwide owing to climate change and environmental disturbances. This has led to an increase in large-scale disasters (e.g., a rapid decrease in insect diversity and forest devastation). To maintain the health of ecosystems, and to prepare for and adapt to the new environment, it is necessary to accurately analyze and predict the response of ecosystems to environmental changes. However, because changes in the environment and ecosystems of the Earth occur over a long period of time, it is difficult to accurately analyze the change direction through fragmentary ecological surveys. Accordingly, major developed countries have been continuously conducting long-term ecological research,

and the accumulated data are used as an important scientific basis for environmental policymaking (Jin, 2018). Ecological research trend analysis can reveal changes in topics of interest, facilitating the selection of research directions for individual researchers and national bodies. The purpose of this study was to provide basic data for in-depth trend analysis by analyzing research trends in the field of ecological research.

The field of ecology is broad-based and includes research on ecological habitats, reproduction of specific species, survival probabilities of specific species, and the preservation and reuse of data. For example, Jeong *et al.* (2022) conducted a study to identify bird diversity and environmental correlates within the mulchat-oream wetlands of Jeju Island, South Korea. Kim *et al.* (2020) conducted a study of metadata design for ecological research data management. Park *et al.* (2022) estimated occupation probability to predict the potential habitat of an endangered species, the jockey gizzard. Chae *et al.* (2022) conducted a study on Korean and worldwide research trends on rare and endemic plants in Korea. Lee *et al.* (2022) conducted a study on research trends in the Baek-

**Received** November 27, 2022; **Revised** January 9, 2023;  
**Accepted** January 10, 2023

\***Corresponding author:** Suntae Kim  
**e-mail** kim.suntae@jbnu.ac.kr  
 <https://orcid.org/0000-0002-8726-6367>



This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0>), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

dudaegan Mountains using big data analyses of academic journals. Mazzotti *et al.* (2022) conducted a study on the natural and anthropogenic factors influencing nesting ecology of the American Crocodile in Florida, United States. However, studies considering global and domestic research trends in the field of ecological research remain scarce. Therefore, this study is of great significance for providing research trend information to support strategic research planning by individuals, research groups, and funding bodies.

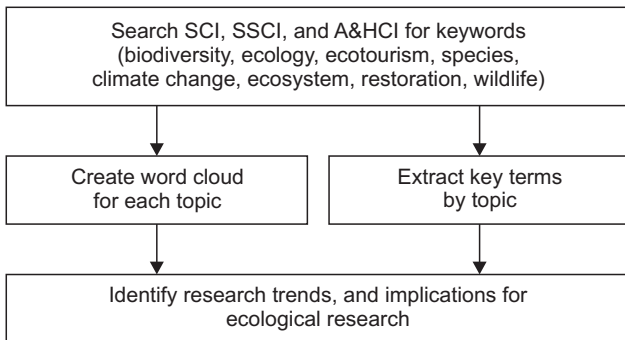


Fig. 1. Research flow.



Fig. 2. Biodiversity word cloud.

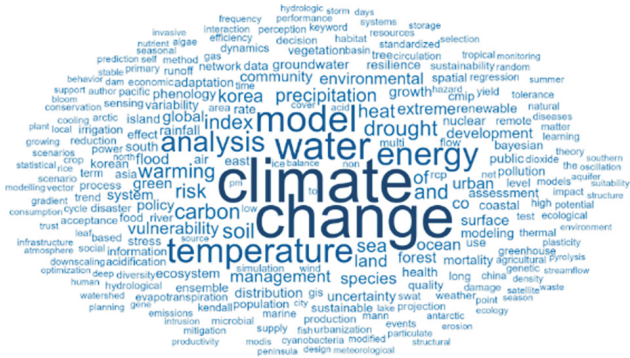


Fig. 3. Climate change word cloud.

## Materials and Methods

### Research design

Fig. 1 shows the research procedure conducted in this study. The first step was to determine a list of keywords, which was compiled based on recommendations from experts. The second step was to collect metadata pertaining to papers containing those keywords from the Web of Science database. The third step was to analyze the collected data to create a word cloud and analyze the topic map. The final step was to identify the main research trends in ecological research, and the implications for strategic planning.

The major keywords recommended by the experts were:

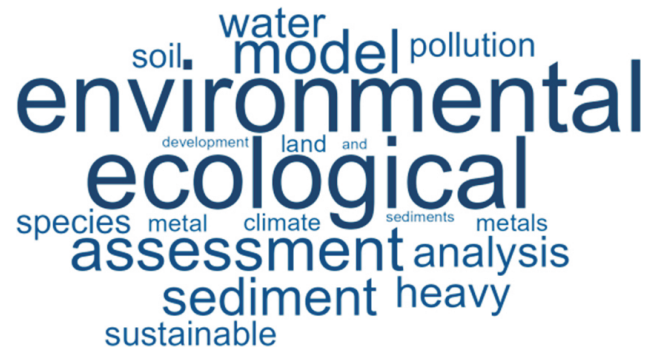


Fig. 4. Ecological word cloud.



Fig. 5. Ecosystem word cloud.



Fig. 6. Ecotourism word cloud.

biodiversity, ecology, ecotourism, species, climate change, ecosystem, restoration, wildlife. For each, we searched the SCI, SSCI, and A&HCI databases provided by the Web of Science. The study period was from January 2002 to September 2022. For each keyword, a word cloud was created based on the database papers identified. Next, topic map analysis was conducted using the abstract data from each paper; 10 topics were identified from the papers related to each keyword. For each topic, six key terms were identified.

### Results

The main tags in the word cloud created using the biodiversity keyword (Fig. 2) are forest, urban, ecosystem, change, and carbon; among these, ecosystem is at the

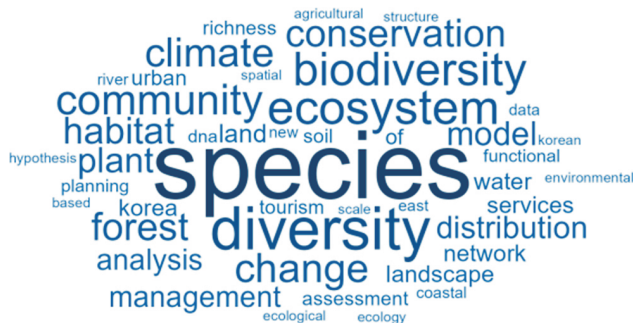


Fig. 7. Restoration word cloud.

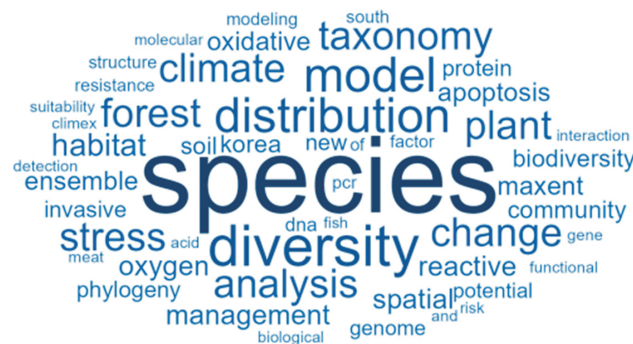


Fig. 8. Species word cloud.

Table 1. Keywords and numbers of papers

Keyword	Number of papers	Keyword	Number of papers
Biodiversity	348	Climate change	1,330
Ecological	219	Ecosystem	556
Ecotourism	36	Restoration	389
Species	734	Wildlife	34

Table 2. Topics and associated key terms related to the biodiversity keyword

Topic	Number of papers	Term
1	18	Concentration, R, canopy, structure, phytoplankton, chlorophyll
2	20	Soil, plant, vegetation, type, content, control
3	25	Biodiversity, diversity, restoration, wetland, conservation, assessment
4	26	Flux, vegetation, scale, information, surface, day
5	21	Forest, land, level, environment, policy, sustainability
6	17	Ecosystem, carbon, production, respiration, productivity, air
7	20	Impact, distribution, fish, population, range, marine
8	15	Rice, biomass, stock, season, paddy, treatment
9	31	Quality, research, landscape, value, method, survey
10	23	Water, climate, temperature, increase, sea, drought

Table 3. Topics and associated key terms related to the climate change key phrase

Topic	Number of papers	Term
1	95	Concentration, plant, biomass, control, phytoplankton, productivity
2	98	Health, mortality, year, trend, maximum, number
3	88	Stress, flood, damage, frequency, salinity, marine
4	78	Policy, value, information, power, storage, government
5	103	Population, range, diversity, habitat, structure, variation
6	95	Research, adaptation, food, design, network, framework
7	126	Performance, uncertainty, scale, flow, scenario, runoff
8	87	Approach, groundwater, assessment, vulnerability, erosion, conservation
9	116	Summer, warming, sea, variability, R, response
10	71	Reduction, rice, efficiency, process, crop, emission

**Table 4.** Topics and associated key terms related to the ecological keyword

Topic	Number of papers	Term
1	10	Concentration, stress, biomass, phytoplankton, variation, control
2	6	Reduction, process, power, emission, source, greenhouse
3	6	Sea, warming, groundwater, ocean, world, state
4	9	R, rice, flux, scale, field, crop
5	9	Health, pollution, mortality, adaptation, abundance, regression
6	22	Policy, information, food, framework, environment, design
7	16	Flood, flow, vulnerability, value, simulation, river
8	8	Population, structure, plant, season, spring, size
9	3	Variability, year, trend, uncertainty, maximum, future
10	23	Range, assessment, diversity, habitat, monitoring, conservation

**Table 5.** Topics and associated key terms related to the ecosystem keyword

Topic	Number of papers	Term
1	18	Stress, biomass, rice, composition, phytoplankton, leaf
2	28	Groundwater, pollution, flow, fish, river, condition
3	35	Image, flux, process, state, variation, algorithm
4	18	Food, tree, density, irrigation, world, demand
5	6	Sea, warming, variability, trend, uncertainty, maximum
6	33	Relationship, R, value, function, depth, test
7	17	Network, adaptation, vulnerability, case, resilience, design
8	25	Environment, policy, power, life, nature, sustainability
9	37	Group, mortality, abundance, p, exposure, age
10	16	Population, diversity, range, flood, habitat, loss

**Table 6.** Topics and associated key terms related to the ecotourism keyword

Topic	Number of papers	Term
1	1	Group, p, value, weight, addition, training
2	8	Network, habitat, assessment, adaptation, monitoring, vulnerability
3	1	Trend, flood, uncertainty, frequency, intensity, future
7	15	Policy, paper, power, image, tourism, government
9	1	Pollution, reduction, food, rice, erosion, crop

**Table 7.** Topics and associated key terms related to the restoration keyword

Topic	Number of papers	Term
1	23	Structure, loss, frequency, intensity, erosion, occurrence
2	44	Policy, framework, paper, tourism, case, design
3	16	Stress, biomass, treatment, tree, productivity, phytoplankton
4	25	Groundwater, simulation, image, state, storage, variation
5	9	Sea, warming, variability, trend, season, ocean
6	22	Flow, river, condition, flux, influence, stream
7	22	Flood, pollution, reduction, scenario, power, group
8	31	Composition, rice, abundance, network, gene, crop
9	44	Conservation, fish, biodiversity, food, adaptation, landscape
10	16	R, uncertainty, regression, mortality, exposure, resolution

center. The main tags in the word cloud created using the climate change keyword (Fig. 3) are model, water, temperature, and energy; among these, climate change is at the center. The main tags in the word cloud created using the ecological keyword (Fig. 4) are environmental, model, assessment, and sediment; among these, environmental is at the center. The main tags in the word cloud created using the ecosystem keyword (Fig. 5) are denoising, restoration, image, and water; among these, restoration is at the center. The main tags in the word cloud created using the ecotourism keyword (Fig. 6) are community,

development, and tourism; among these, tourism is at the center. The main tags in the word cloud created using the restoration keyword (Fig. 7) are species, conservation, climate, biodiversity, ecosystem, diversity, and species; among these, species is at the center. The main tags in

the word cloud created using the species keyword (Fig. 8) are forest, distribution, plant, diversity, stress, change, and species; among these, species is at the center.

Table 1 shows the number of extracted papers by keyword recommended by experts. Next, from the papers identified for each keyword, 10 topics were extracted (Tables 2-9). For each topic, 6 major key terms were identified. Fig. 9 shows an example topic map created using the biodiversity keyword.

**Table 8.** Topics and associated key terms related to the species keyword

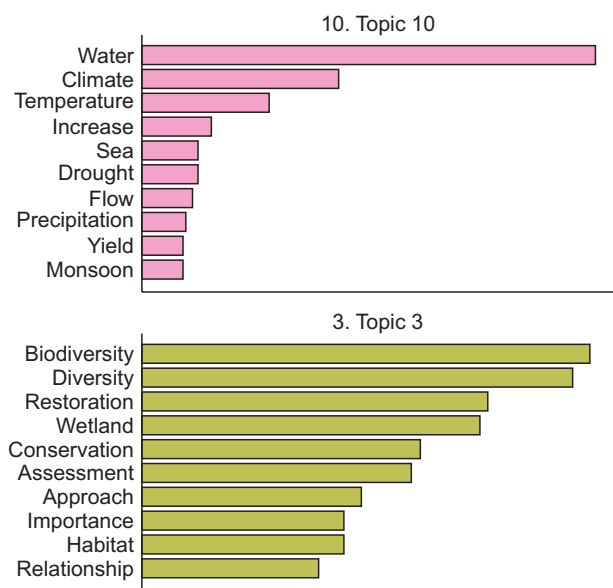
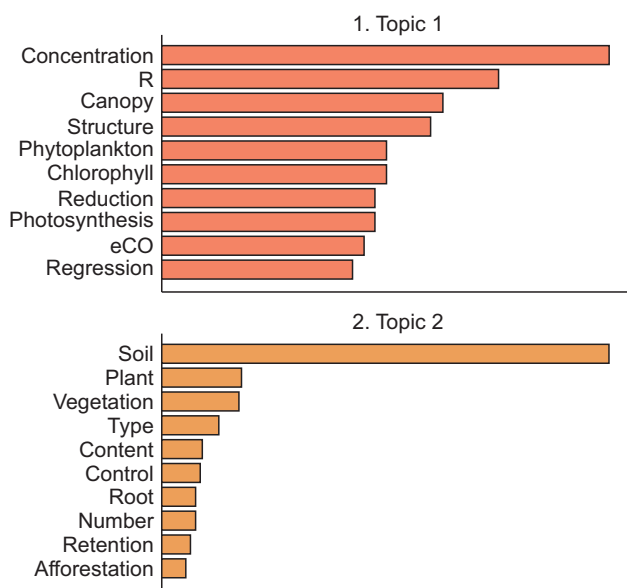
Topic	Number of papers	Term
1	39	Leaf, tree, spring, size, resistance, competition
2	28	Pollution, power, survey, occurrence, size, life
3	47	Image, function, state, strain, variation, genus
4	34	Policy, framework, adaptation, landscape, tourism, paper
5	69	Treatment, p, activity, cell, expression, oxygen
6	21	Reduction, rice, productivity, efficiency, loss, crop
7	28	Density, flood, vulnerability, biomass, accuracy, flux
8	21	R, mortality, exposure, phytoplankton, content, stage
9	19	Sea, warming, variability, trend, winter, uncertainty
10	25	Flow, groundwater, monitoring, river, marine, recovery

## Discussion

In this study, the results of the analysis of word clouds and topic maps in the field of ecological research were derived. The results of this study provided a basis for analyzing research trends over recent decades. Moreover, they offer a resource for strategic research planning by individuals, research groups, and funding institutions. In future

**Table 9.** Topics and associated key terms related to the wildlife keyword

Topic	Number of papers	Term
3	1	Flow, groundwater, flood, trend, river, vulnerability
7	2	Variation, accuracy, regression, image, prediction, function
9	1	Reduction, future, uncertainty, scenario, world, emission
10	9	Policy, tourism, paper, landscape, knowledge, design



**Fig. 9.** Topic map for the biodiversity keyword.

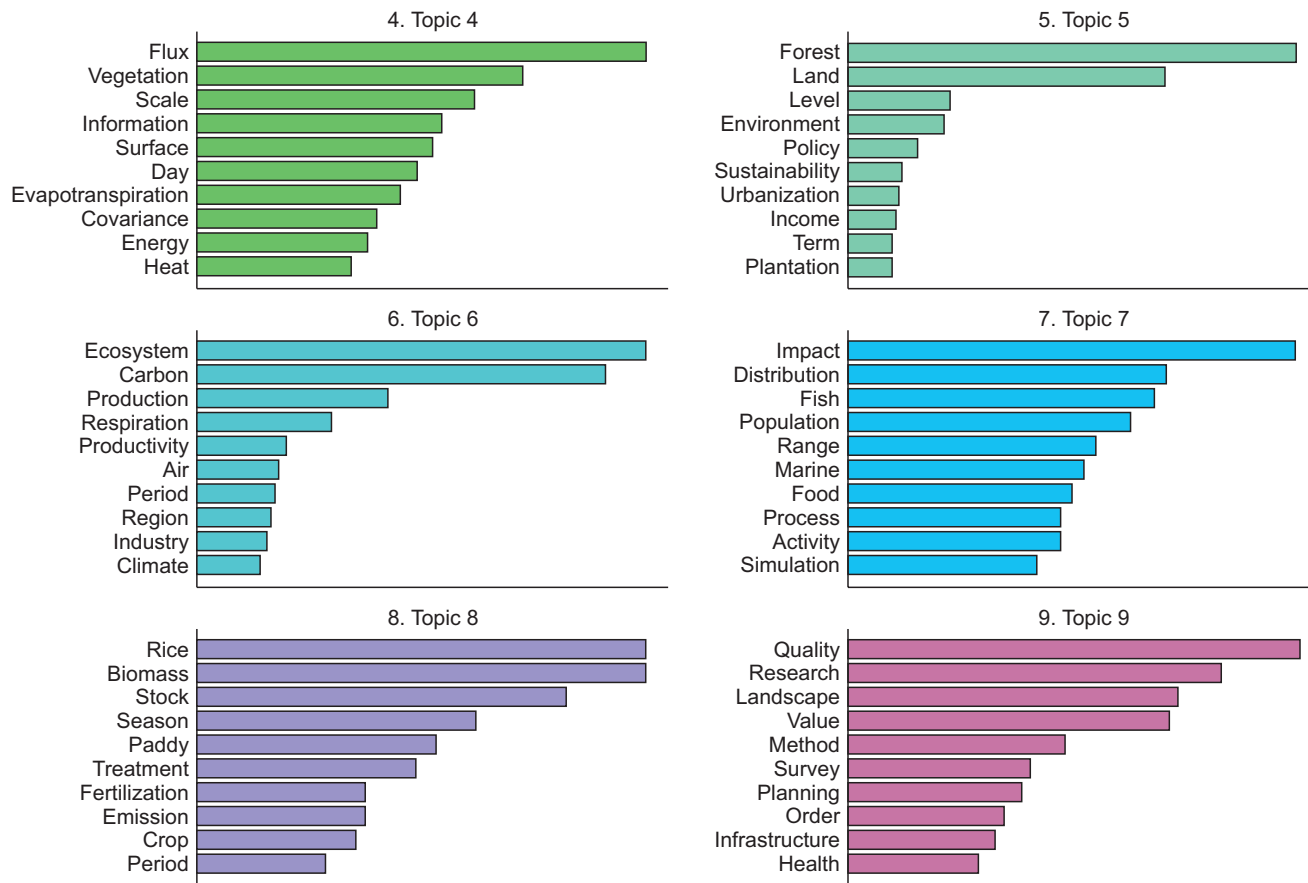


Fig. 9. Continued.

studies, it will be necessary to review the topics and terms extracted in this study. After that, it is possible to analyze trends in the field of ecological research more accurately by expanding the keywords used for search for each topic selected by experts to re-collect data and conduct re-analysis. In addition, word cloud and topic map analysis can be classified by a specific period to analyze changes in trends. Finally, the expected effects of this study are as follows. The results of this study are expected to be used to select research fields that should be intensively fostered by institutions that support research funds in the ecological research field and to set the direction for fostering ecological research in the country.

### Conflict of Interest

The author declares that (s)he has no competing interests.

### References

Chae, H.H., Kim, Y.C., and Son, S.W. (2022). Korean and world-wide research trends on rare plant and endemic plant in Korea. *Korean Journal of Environment and Ecology*, 36, 257-276.

Jeong, Y.H., Jin, S.D., Banjade, M., Son, S.H., Choi, S.H., Choi, S.H., et al. (2022). Bird diversity and environmental correlates in the Mulchat-oream wetlands of the Jeju islands, South Korea. *Proceedings of the National Institute of Ecology of the Republic of Korea*, 3, 77-83.

Jin, S.D. (2018). *The necessity of long-term ecological research*. Retrieved Dec 21, 2022 from [https://seedus.net/nie\\_multimedia/research\\_01.html](https://seedus.net/nie_multimedia/research_01.html).

Kim, J., Yoon, H., Kwon, Y.S., and Kim, S.T. (2020). Metadata design for ecological research data: focused on DCAT. *Journal of Korean Library and Information Science Society*, 51, 249-278.

Lee, J., Sim, H.S., and Lee, C.B. (2022). Study on research trends (2001~2020) of the Baekdudaegan Mountains with big data analyses of academic journals. *Journal of Korean Society of Forest Science*, 111, 36-49.

Mazzotti, F.J., Balaguera-Reina, S.A., Brandt, L.A., Briggs-González, V., Cherkiss, M., Farris, S., et al. (2022). Natural and anthropogenic factors influencing nesting ecology of the American Crocodile in Florida, United States. *Frontiers in Ecology and Evolution*, 10, 904576.

Park, W.B., Lim, S.H., Won, D.H., Lee, K.L., Hong, C., and Do, Y. (2022). Occupancy probability estimation of endangered species *clithon retropictus*. *Korean Journal of Ecology and Environment*, 55, 76-83.