# Ecology

Korea is located between 33˚ and 43˚ north latitude in a temperate climate region with four seasons. Precipitation in Korea is abundant, and each season shows diverse climate characteristics. Mountain areas, which are mostly distributed around the northern and eastern regions, covered about 64% of the land of South Korea in 2015. In the southern and western areas, large rivers run, and various erosional or sedimentary landforms surround the rivers. Three sides of the Peninsula are surrounded by the sea, with a coastline with narrow inlets and many islands along the South Sea; vast tidal flats along the Yellow Sea; and sand dunes and lagoons alongside a smooth coastline along the East Sea.

The complexity and variety of ecosystems formed by the diverse climate and complicated topography affect the biodiversity inhabiting the Peninsula. Subalpine coniferous forests are common in the northern region, deciduous broadleaf forests are common in the central region, and warm, sub-temperate evergreen forests are common in the southern and island regions. The natural conditions and variety of vegetation also lead to variations in ecosystem productivity, resulting in distinct micro-habitats for a wide diversity of faunal communities.

The rich and diverse ecosystems in the Korean Peninsula have attracted people for centuries. People of Korea have been provided with abundant ecosystem services. They have developed a unique lifestyle that merges the marine culture of the Pacific with the continental culture of Eurasia. They have also established a catchment area-based traditional view of nature with the Baekdudaegan mountain ridge as the backbone of the Peninsula. They have developed numerous unique ecological cultures such as village forest, acorn jello, Songgye (traditional social institution for sustainable forest management), and Hyangyak (local rules).

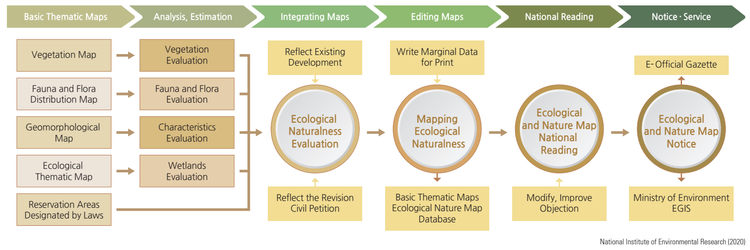
Although rapid industrialization and urbanization have expanded the national economy, Korea now faces significant environmental issues such as pollution of air, water, and soil, reduction of biodiversity, and ecosystem degradation. Natural environments and biota have been investigated nationwide to take action against these issues. The collected data have been comprehensively assessed and used for the formation of Ecological Naturalness Maps. Ecological Naturalness Maps visualize the ecological value of each spatial unit—mountains, rivers, inland wetlands, lakes, farmland, and urban areas—according to a rating system.

For the Ecological Naturalness Maps, environmental investigations are carried out to evaluate ecological naturalness through field surveys under nine categories (geographical features, vegetation, flora, benthic macroinvertebrates, insects, freshwater fish, reptiles, birds, and mammals). The results are stored in the GIS database. Based on this data, assessments of the value of vegetation, habitats of animals and plants, topography, and wetlands are carried out. The value of vegetation is evaluated through the conservation level of the vegetation, the value of habitats of animals and plants through the presence of endangered wildlife, and the value of the topography through the conservation level of the topography. The value of the wetlands is evaluated as a habitat for species and as a place for migratory birds. These values are put together to assess the ecological soundness of an ecosystem.

Final results are illustrated on the maps according to a 4-grade ranking system. In Grade 1 areas, the highest grade, development activities are limited to preserve or restore the natural environment. In Grade 2 areas, measures are required to minimize impacts on the natural environment due to development and land use. In Grade 3 areas, systematic development and land use are permitted. Reservation areas such as national parks and cultural heritage protection sites designated as reservation areas by laws such as the Natural Environment Conservation Act are classified as special management areas. Ecological Naturalness Maps are announced by the Minister of Environment and open to the public.

Ecological Naturalness Maps are used in national and local environmental plans, as well as in the process of making and implementing development plans, environmental impact assessments, and in consultations requiring referential data.

Mapping Procedure for Ecological Naturalness Map

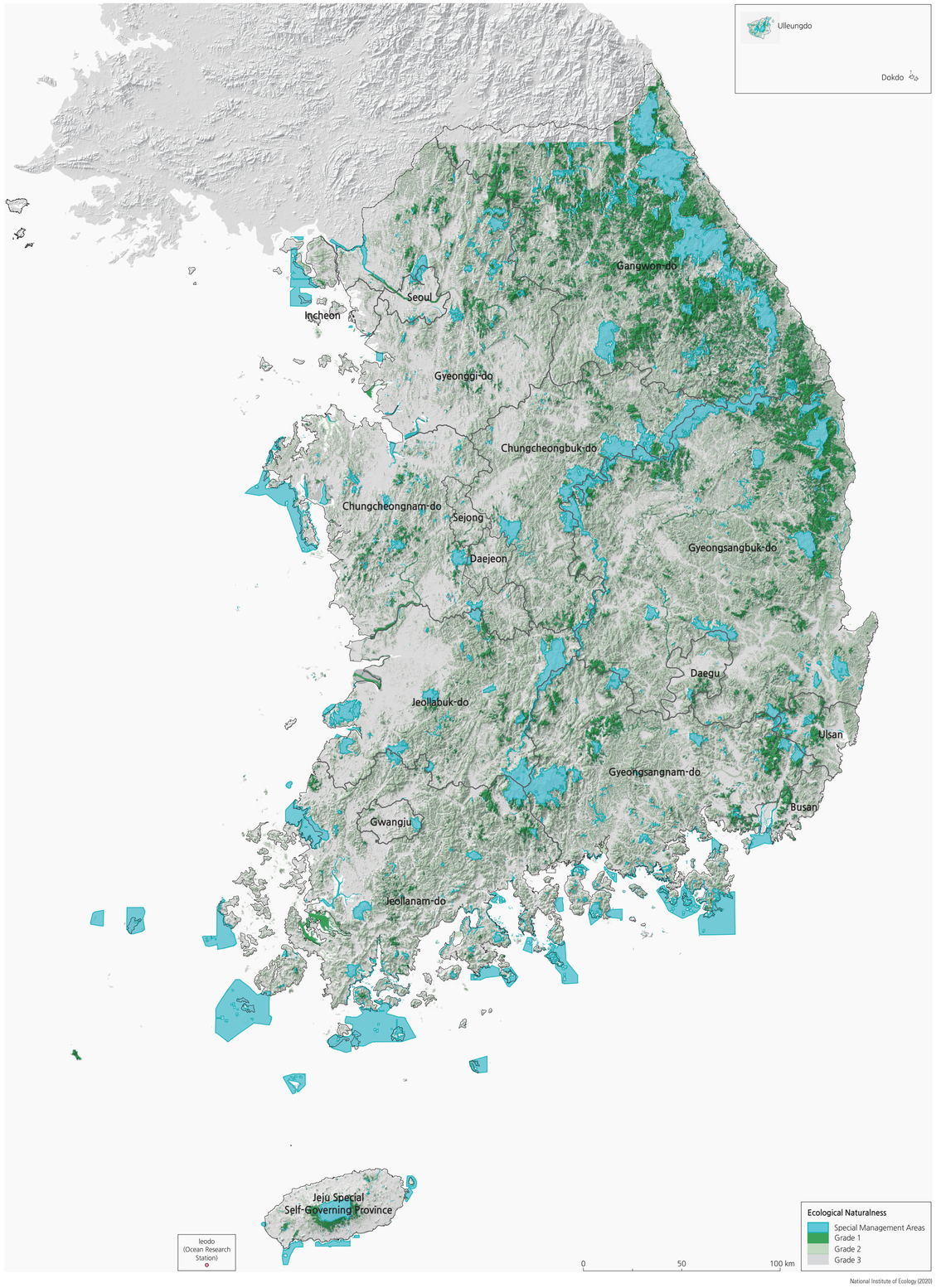



National Institute of Environmental Research (2020)



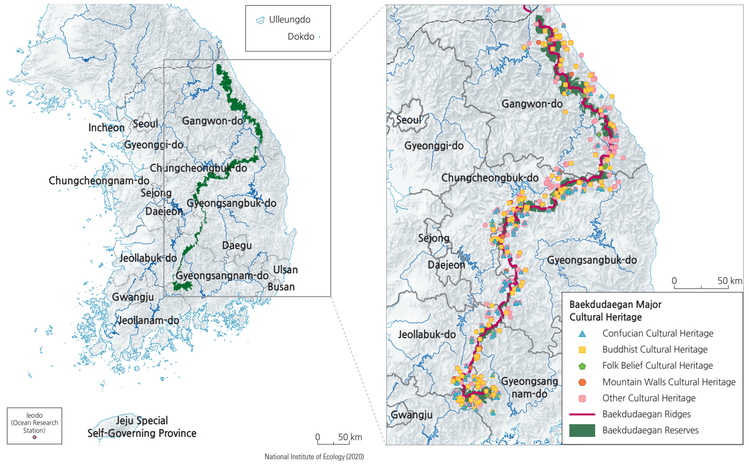
## Ecological Soundness

Ecological Naturalness Map




National Institute of Ecology (2020)

## Baekdudaegan Conservation Areas and Distribution of Major Cultural Assets




National Institute of Ecology (2020)

Baekdudaegan is a traditional system of geographical perceptions in Korea. From the past, Koreans have recognized the topographical features of the mountains that make up the Korean Peninsula as a connected stem system with a hierarchical structure.

The first literature in which the concept of Baekdudaegan appeared is *Okryonggi*, written by Doseon, a Goryeo monk in the early 10th century. He wrote, "Our country rises in Baekdusan and ends in Jirisan. It is the source of water and the land of tree trunks."

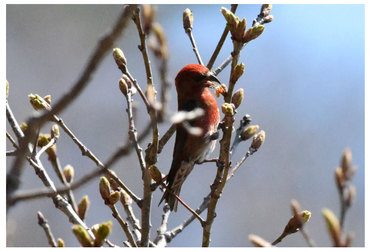
The first literature that used the term Daegan in Korea is *Taekriji*, written by Lee Junghwan in 1751. This book stated, "The Daegan was unbroken and stretched to the side, and went down thousands ri to the south to Taebaeksan in Gyeongsang-do to form a Maekryeong."

The first literature that used the terms Baekdudaegan and Baekdujeonggan is *Seongho saseol*, written by Yi ik in 1760. He regarded Baekdusan as the starting mountain of Daegan and suggested a mountain range map using the term Baekdudaegan.

Shin Kyeongjun wrote *Sangyeongpyo* (circa 1770) to describe the Korean mountain ranges as a connected mountain system running from Baekdusan to Jirisan with hierarchical branches, which consist of one Jeonggan and 13 Jeongmaeks. He considered the mountain range and riverine system of Baekdudaegan as a fundamental base for understanding the people, philosophy, literature, ecology, and culture of the Korean Peninsula. When comparing Baekdudaegan and mountain range systems, the former organizes the mountains into hierarchically connected mountain trunks, while the latter organizes them into hierarchically connected tectolineament.

Long-Tailed Goral *(Naemorhedus caudatus)*

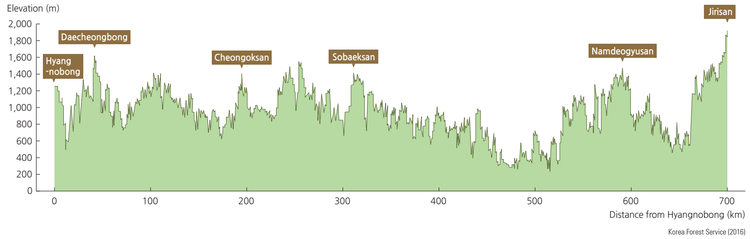
Ural Owl *(Strix uralensis)* (Gariwangsan)



Red Crossbill *(Loxia curvirostra)* (Sobaeksan)

Pallas's Willow Warbler *(Phylloscopus proregulus)* (Jumbongsan)

## Elevation Distribution along the Baekdudaegan




Korea Forest Service (2016)

Sixty-four percent of South Korea is covered with forest, and most forests are connected to the Baekdudaegan. The Baekdudaegan, like the human backbone, has long been a central axis where interactions between humans and nature led to the formation of an eco-cultural space and spirit. Therefore, the designation of the Baekdudaegan as a protected area supports the identity of the Korean people and their willingness to maintain mutual dependency with the oceanic and continental ecosystems by strengthening the linkage between the cultures of the Pacific region and the Eurasian continent.

In September 2005, the Korean government designated the protection of an ecological corridor in the Baekdudaegan to preserve the natural environment of the Baekdudaegan and prevent damage from reckless development. The protected area was 864 km long from Hyangrobong in Goseong-gun, Gangwon-do to Cheonwangbong of Jirisan in Sancheong-gun, Gyeongsangnam-do, with an area of 263,000 ha, accounting for 2.6% of Korea. In November 2019, this protected area was expanded to 763 km in length and 275,465 ha in total area, accounting for 2.7% of Korea. The protected area consists of more than 500 mountains, peaks, and hills, including major Korean mountains such as Jirisan, Deogyusan, Songnisan, Sobaeksan, Taebaeksan, Odaesan, and Seoraksan.

The Baekdudaegan protected area is extremely valuable in terms of Korea's cultural history. Each major mountain boasts temples that entwine Buddhist culture with impressive landscapes. The area houses elements of both tangible and intangible cultural heritage; there are 543 state-designated cultural assets, including 31 national treasures, 273 treasures, and 49 historic sites. There are also 965 province-designated heritage sites, 523 cultural and historical documents, 53 registered cultural heritage sites, and so forth. In particular, temple forests play a central role in enhancing the value of the protected area. Out of the 935 traditional temples in Korea, 173 (19%) are located in Baekdudaegan. Baekdamsa (Seoraksan), Woljeongsa and Sangwonsa (Odaesan), and Hwaeomsa (Jirisan) are the main temples well known to the public. They contain approximately 16,571 ha of temple forests, which accounts for 6% of the total protected area in Korea.

The Korea Forest Service developed four criteria for designating the Baekdudaegan Conservation Areas as follows: first, the Baekdudaegan conservation areas, as the core of the mountain range, should not be disconnected; second, the ecosystems of Baekdudaegan must be secured to ensure their continuity and connectedness; third, the boundaries of core and buffer areas must be defined by ecological factors such as riverine systems, mountain systems, and vegetation; and fourth, any negative impact to local residents must be minimized, and the opinions of diverse stakeholders must be considered. As of September 2005, based on these criteria, a total of 263,427 ha of the Baekdudaegan Conservation Areas had been designated. In terms of ownership, the conservation areas were composed of national forests (208,000 ha, 79%), public forests (20,000 ha, 8%), and private forests (35,000 ha, 13%).

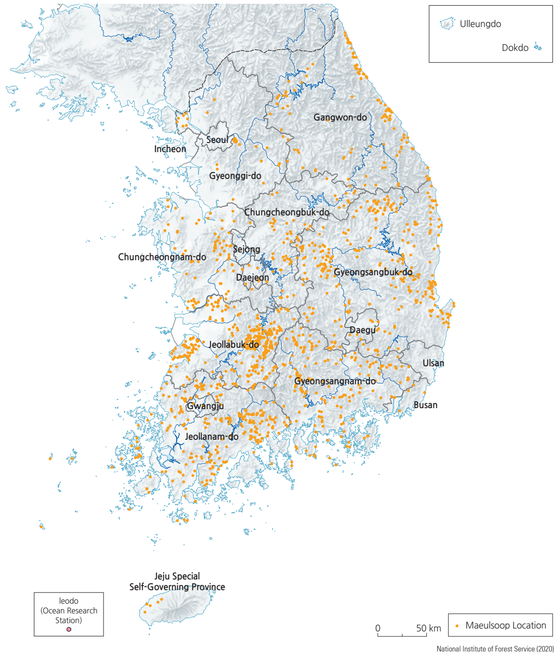
An enforcement ordinance to protect the Baekdudaegan conservation areas was announced in November 2019. The designated area (275,465 ha) was divided into a core area (179,095 ha) and a buffer area (96,369 ha). As a result, a sustainable management system was finally established to prevent damage to Baekdudaegan due to indiscriminate development.

The Second Basic Plan for the Protection of the Baekdudaegan became a principle that considers sustainability, connectivity, comprehensiveness, and locality. It is also a necessary standard to promote the conservation and wise use of the environment. Furthermore, international cooperation between various countries is being promoted, such as enacting joint management of the Baekdudaegan between the two Koreas, designating the Baekdudaegan as an international protected area by international organizations such as the International Union for Conservation of Nature (IUCN), and participating in the establishment of an ecological network in Northeast Asia.

Diverse wildlife lives in the Baekdudaegan region, although the Baekdudaegan contains only 4.3% of the total forests of Korea. Studies indicate that Korea's flora consists of 126 families, 541 genus, and 1,248 species (3 subspecies, 204 varieties, 22 forms). Its fauna includes 23 species of mammals (such as otters, martens, leopards, and flying squirrels), 91 species of birds (including 12 legally protected birds), 11 amphibians, and 6 reptiles.

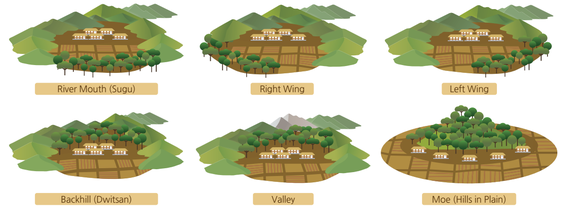


## Distribution of Maeulsoop




National Institute of Forest Service (2020)

## Typical Locations of Maeulsoop




National Institute of Forest Service (2014)

## Size of Maeulsoop

| Area | 0–1 ha | 1–2 ha | 2–3 ha | 3–4 ha | 4–5 ha | Above 5 ha | Sum |
|---|---|---|---|---|---|---|---|
| Number | 1,004 | 138 | 43 | 17 | 15 | 56 | 1,273 |
| Ratio (%) | 78.9 | 10.8 | 3.4 | 1.3 | 1.2 | 4.4 | 100 |

• Based on analysis of a survey of 1,273 (out of 1,335) Maeulsoop tree species

## Management Authority of Maeulsoop

| Authority | Village | Local Government | Individual | State | Clan | Other | Sum |
|---|---|---|---|---|---|---|---|
| Number | 459 | 171 | 88 | 51 | 44 | 10 | 823 |
| Ratio (%) | 55.8 | 20.8 | 10.7 | 6.2 | 5.3 | 1.2 | 100 |

• Based on analysis of a survey of 823 (out of 1,335) Maeulsoop tree species

## Plant Species of Maeulsoop

| Species | Pine Tree | Zelkova Tree | Hackberry Tree | Oak Tree | Blak Pine | Ginkgo Tree | Other | Sum |
|---|---|---|---|---|---|---|---|---|
| Number | 43 | 295 | 51 | 39 | 38 | 17 | 111 | 594 |
| Ratio (%) | 7.2 | 49.7 | 8.6 | 6.6 | 6.4 | 2.8 | 18.7 | 100 |

• Based on analysis of a survey of 594 (out of 1,335) Maeulsoop tree species

## Type of Maeulsoop

| Type | Blocking the River Mouth | Backhill | Biboyeopseung | Moe (Hills in Plain) | Other | Sum |
|---|---|---|---|---|---|---|
| Number | 421 | 30 | 3 | 24 | 413 | 891 |
| Ratio (%) | 47.3 | 3.4 | 0.3 | 2.7 | 46.3 | 100 |

• Based on analysis of a survey of 891 (out of 1,335) Maeulsoop tree species

National Institute of Forest Service (2020)

Beobseong Forest, Yeonggwang-gun, Jeollanam-do

Mulgeon-ri Forest, Namhae-gun, Gyeongsangnam-do

Wongarim Forest, Jinan-gun, Jeollabuk-do

Geumdangsil Forest, Yecheon-gun, Gyeongsangbuk-do

Songmal Forest, Icheon-si, Gyeonggi-do

Sangnim, Hamyang-gun, Gyeongsangnam-do

Korean traditional villages took the concept of the *Baesanimsu* (with back to the mountain and face to the water) as the basic principle to guide settlement location and land use. Also, this principle greatly benefited villagers who, as a result, lived within well-secured watersheds with access to water, protection against the wind, and accessibility to resources. The traditional villages were adapted to the local natural conditions. They existed in a harmonious relationship with the surrounding natural ecosystems, resulting in their ability to maintain that spatial arrangement for a long time. One good example is maeulsoop (village grove).

A village grove is a forested area that helps the people adapt to the monsoon climate and helps the village to harmonize with the surrounding environment. The grove is a part of the village landscape or a property co-owned with villages and protected and managed by villagers.

A village grove is a common gathering place for villagers and provides shelter for people during the hot summer. Furthermore, it is a sacred site and holy place that the villagers protect. Ancestral rites are held periodically in a village grove.

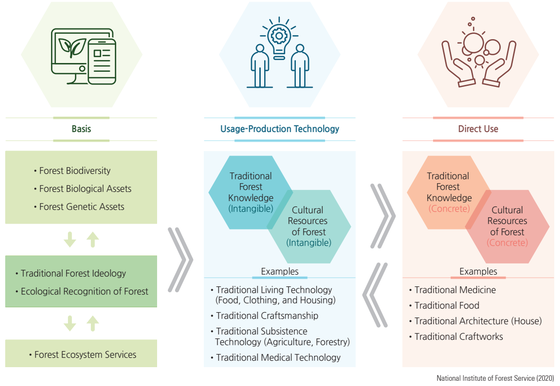
Big trees such as pine and zelkova grow in the groves. Also, many bird species like Mandarin Duck, Scops Owl, Owl, Woodpecker, Great Tit, and Starling, which normally live deep in the mountain forests and build nests in the hollows of tree trunks and branches, inhabit the area, frequently being observed near the village.

Based on their location, village groves can be classified into the following five types: sugu (a grove covering the mouth of a watershed in which the village is nested), yeop (a grove covering low areas either on the left or right side of the village), dwitsan (a grove covering the ridge of low hills behind the village), gyegok (a grove covering an unsightly object in the valley behind the village), and meoi (a grove covering an isolated hill).

The Korea Forest Service had investigated and organized information for the village groves in 1,335 regions as of March 2020. Most of the village groves are small. Forests with less than 1 ha account for about 78.7% of the total village groves. Major plant species of the village groves on the list are *Pinus densiflora* and *Zelkova serrata*. Sugumagi, a type of grove for slowing the flow of water, was the most common type of village grove.

The oldest village grove in Korea is Daegwallim, which is thought to have been created with levees by Choi Chiwon to prevent floods during his term of office as governor of Cheollyeong-gun during the reign of Queen Jinseong (A.D. 887–897). The grove is protected as Natural Monument No. 154. In the grove, various plants are found such as Sawtooth Oak(*Quercus acutissima*), Oriental Cork Oak (*Quercus variabilis*), Asian Hornbeam (*Carpinus tschonoskii*), Abundant-flower Meliosma (*Meliosma myriantha*), Tallow Tree (*Sapium japonicum*), Sawleaf Zelkova (*Zelkova serrata*), and East Asian Hackberry (*Celtis sinensis*).

## Developments in Traditional Forest Knowledge

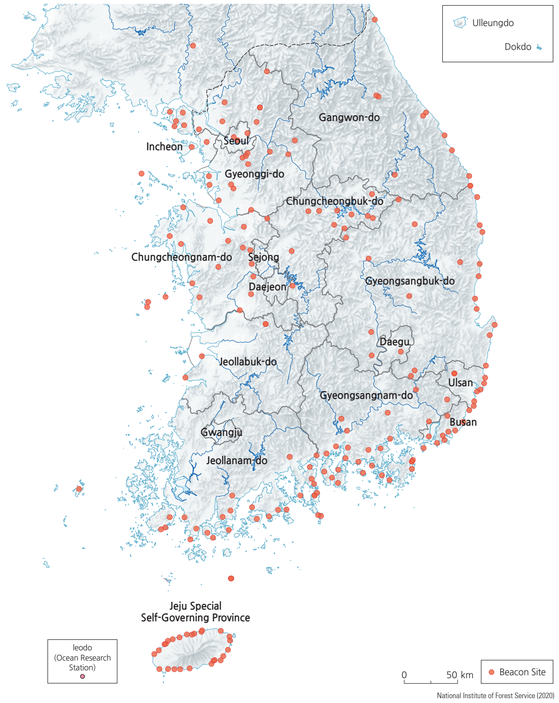



National Institute of Forest Service (2020)

Traditional forest knowledge is an integral aspect of the cultural heritage, ecological (genetic) resources, and traditional wisdom that a particular region or a group of people (tribe or ethnic group) has passed down over the generations. Based on this, Korea has developed usage, production, and related technology for traditional knowledge. Recently, efforts have been made to establish a classification system for traditional forest knowledge types to fit the international trend toward the traditional knowledge-related International Patent Classification (IPC). This system classifies traditional forest knowledge into five categories (humanities, forest philosophy, natural environment, production technique, and social-economic policy) and also classifies the knowledge into 33 tangible resources and 31 intangible resources. Tangible resources include traditional village groves, mountain fortresses, beacon mounds, and markers of the forbidden forests. Intangible resources are traditional lifestyles that are being forgotten, such as Songgye and Hyang'yak.

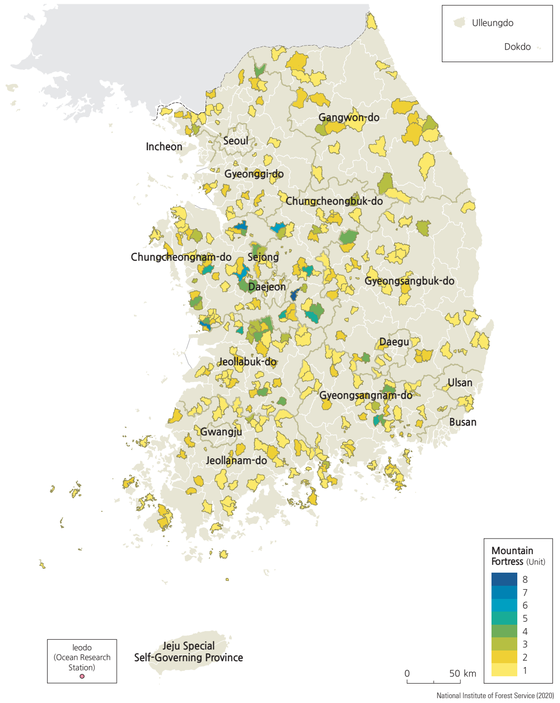
Beacon mounds, which signaled urgent matters via smoke and fire, are a representative example of tangible resources and an important communication tool used in traditional Korean society. In particular, beacon mounds on mountains and travel beacons were used as an effective means of communication. Currently, the locations of 194 beacon mounds have been identified.

## Distribution of Beacons




National Institute of Forest Service (2020)

## Distribution of Mountain Fortresses




National Institute of Forest Service (2020)

Gate of Rainbow of Gyoryong Mountain Fortress in Namwon-gun, Jeollabuk-do

Drainage Facility of Samnyeon Mountain Fortress in Boeun-gun, Chungcheongbuk-do

Mountain fortresses use trees, soil, and rocks to prevent enemy attacks in accordance with the terrain. As a tangible resource, a mountain fortress includes the structures created and the forest resources within it. As of 2020, a total of 1,331 mountain fortresses are identified. Recently, mountain fortresses and beacon mounds have become important as urban observation sites and ecological landscape resources.

## Mountain Fortresses by Region

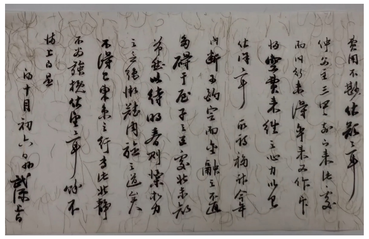
| Si/Do | | Chung cheong nam-do | | Chung cheong buk-do | | Gyeong sang nam-do | | Jeolla buk-do | | Gyeong sang buk-do | | Jeolla nam-do | | Gyeong gi-do | | Gang won-do | | Daejeon | | Sejong | | Daegu | | Ulsan | | Incheon | | Busan | | Seoul | | North Korea | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | Ratio (%) | 253 | 18.9 | 196 | 14.7 | 157 | 11.8 | 139 | 10.4 | 138 | 10.3 | 118 | 8.8 | 92 | 6.9 | 81 | 6.1 | 39 | 2.9 | 21 | 1.6 | 14 | 1.0 | 11 | 0.8 | 9 | 0.7 | 7 | 0.5 | 7 | 0.5 | 54 | 4.1 | 1,336 | 100 |

National Institute of Forest Service (2020)



## Traditional Ecological Management

## Taeji Restored Using Paper Mulberry Fibers and Pondscum



The core raw material of Taeji, a traditional Korean paper, was pondscum (*Spirogyra* spp.). In 2020, the National Institute of Forest Sciences restored Taeji using mulberry paper fibers and pondscum. The method of making Taeji was not known, but it was restored through the investigation of old literature and microscopic analysis.

## Neunghaenggil (A Course of the Royal Road) and Plants




Suwon-si (2020)

## Story Map of the Biodiversity of Urban Forest in Suwon (2016)





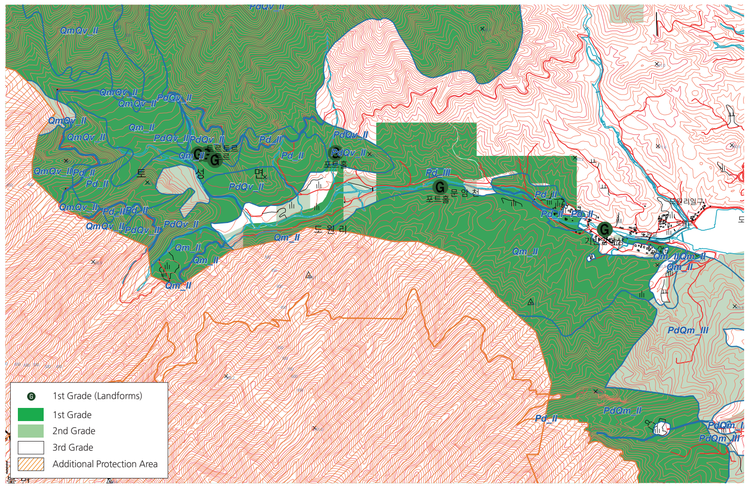
Biodiversity is a component of local history and culture and a key resource that can be linked to cultural services provided by ecosystems. Suwon was a planned city built by King Jeongjo. Suwon has historical and cultural resources related to biodiversity. In Suwon, urban forests have been built around the Hwaseong Fortress, which was designated as a UNESCO World Heritage Site in 1997, and Neunghaenggil (a course of the royal road). King Jeongjo planted the most trees of all the kings in the Joseon dynasty. He constructed the Hwaseong Fortress in 1794-1796 and visited Hyeonryeongwon, where his father, Prince Sado, was buried. Along this royal road, forests were created, and wetlands such as reservoirs and large rice fields were built as irrigation facilities. Even today, Suwon has several place names derived from trees planted during the King Jeongjo period.

The International Council For Local Environmental Initiatives (ICLEI) is an international non-governmental organization that promotes sustainable development. Suwon has signed the Durban Commitment for Biodiversity. In 2016, Suwon collaborated with the ICLEI's Korean office to create a story map of the biodiversity of urban forests in Suwon as part of Local Action Biodiversity (LAB). The story map along the Neunghaenggil consists of pictures and easy explanations of various species and their main locations in Suwon's history. This map can be used as an explanatory book on history and culture or educational material for experiencing biodiversity.

## Nationwide Natural Environment Survey

The Ministry of Environment has conducted a nationwide survey of the natural environment every five years in accordance with Article 30 of the Natural Environment Conservation Act. The first Natural Environment Survey started in 1986. As of 2020, the 5th Survey is underway. From the 3rd Survey, the natural environment was divided into nine areas: topography, vegetation, plants, large benthic invertebrates, amphibians and reptiles, fish, land insects, birds, and mammals. The results of the national physical environment survey have been built with geographic information through the "Comprehensive Natural Environment GIS-DB Construction Project," in progress since 2000. The result is thematic maps, such as topographic maps, a vegetation map, an animal and plant distribution map, and an ecological and natural map, which is a comprehensive assessment map of the physical environment created using the thematic maps.

Example of Physical Environment Survey (Ganseong Map Sheet)



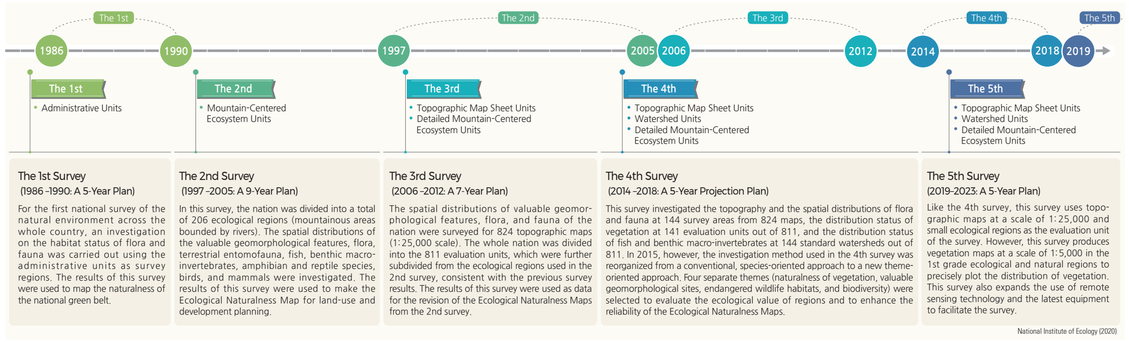

National Institute of Ecology (2015)

Geomorphological Feature Survey

Vegetation Survey

Fauna and Flora Survey

Nationwide Natural Environment Survey




**The 1st Survey**
(1986 -1990: A 5-Year Plan)

For the first national survey of the natural environment across the whole country, an investigation on the habitat status of flora and fauna was carried out using the administrative units as survey regions. The results of this survey were used to map the naturalness of the national green belt.

**The 2nd Survey**
(1997 -2005: A 9-Year Plan)

In this survey, the nation was divided into a total of 206 ecological regions (mountainous areas bounded by rivers). The spatial distributions of the valuable geomorphological features, flora, terrestrial entomofauna, fish, benthic macro-invertebrates, amphibian and reptile species, birds, and mammals were investigated. The results of this survey were used to make the Ecological Naturalness Map for land-use and development planning.

**The 3rd Survey**
(2006 -2012: A 7-Year Plan)

The spatial distributions of valuable geomorphological features, flora, and fauna of the nation were surveyed for 824 topographic maps (1:25,000 scale). The whole nation was divided into the 811 evaluation units, which were further subdivided from the ecological regions used in the 2nd survey, consistent with the previous survey results. The results of this survey were used as data for the revision of the Ecological Naturalness Maps from the 2nd survey.

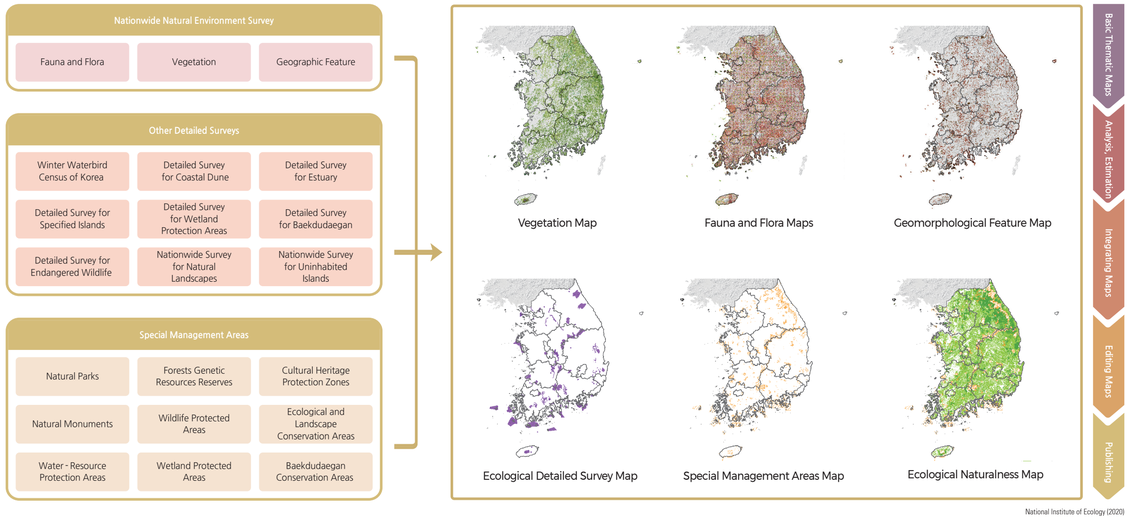
**The 4th Survey**
(2014 -2018: A 5-Year Projection Plan)

This survey investigated the topography and the spatial distributions of flora and fauna at 144 survey areas from 824 maps, the distribution status of vegetation at 141 evaluation units out of 811, and the distribution status of fish and benthic macro-invertebrates at 144 standard watersheds out of 811. In 2015, however, the investigation method used in the 4th survey was reorganized from a conventional, species-oriented approach to a new theme-oriented approach. Four separate themes (naturalness of vegetation, valuable geomorphological sites, endangered wildlife habitats, and biodiversity) were selected to evaluate the ecological value of regions and to enhance the reliability of the Ecological Naturalness Maps.

**The 5th Survey**
(2019-2023: A 5-Year Plan)

Like the 4th survey, this survey uses topographic maps at a scale of 1:25,000 and small ecological regions as the evaluation unit of the survey. However, this survey produces vegetation maps at a scale of 1:5,000 in the 1st grade ecological and natural regions to precisely plot the distribution of vegetation. This survey also expands the use of remote sensing technology and the latest equipment to facilitate the survey.

National Institute of Ecology (2020)

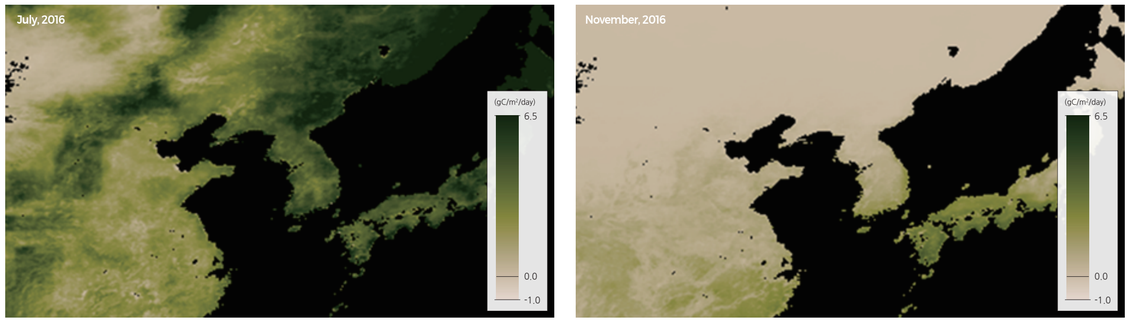



National Institute of Ecology (2020)

## Ecosystem Productivity

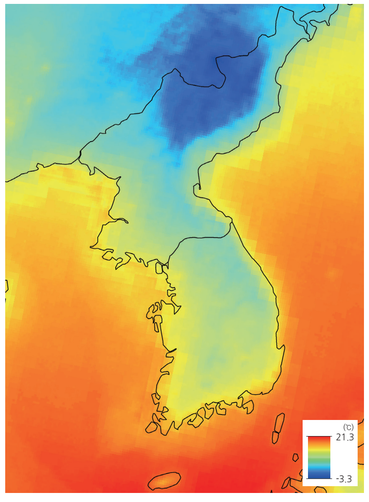
Climate and biota influence photosynthesis and evapotranspiration, resulting in distinctive spatial differences in ecological functions. The fraction of photosynthetically active radiation (fPAR) is the ratio of PAR absorbed by plants to the total incident PAR in the atmosphere. The number of fPAR approaches 1 as the number of leaves increases. Stomata closure is mainly controlled by minimum temperature and vapor pressure deficit. Incident solar radiation is the main driver of photosynthesis and evapotranspiration. Daily minimum temperature and solar radiation vary with the length of the growing season, while mean daily temperature controls plant respiration. These climatic variables show different seasonal and spatial patterns with latitude, altitude, topography, and land cover types, which mainly determine soil-vegetation-atmosphere carbon and water cycles. Consequently, these environmental variables are the main factors that cause the differences in the processes of the water cycle and the carbon cycle in soil, vegetation, and atmosphere.

Net Primary Productivity (NPP) in East Asia

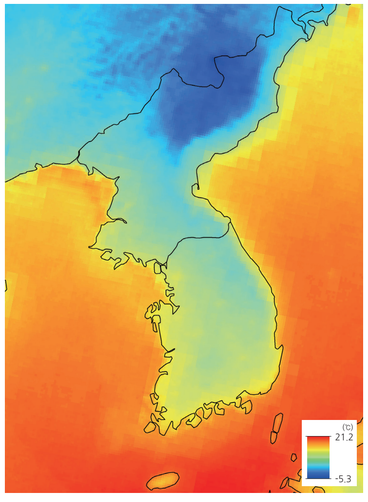



NASA

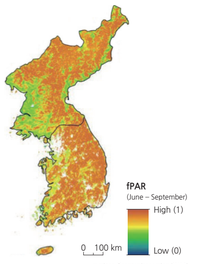
Average Temperature




Minimum Temperature

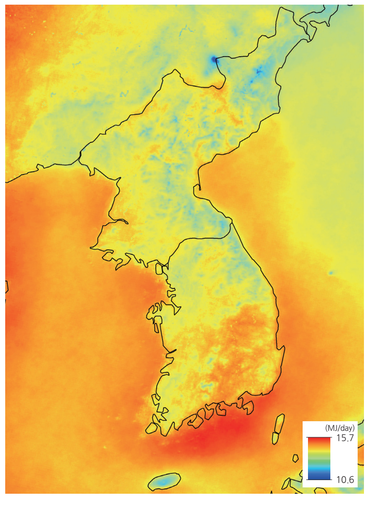



Fraction of Absorbed Photosynthetically Active Radiation (fPAR)

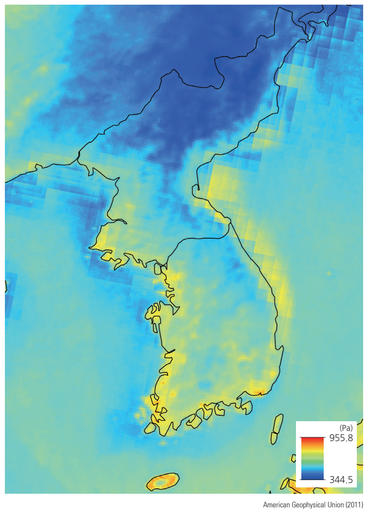



American Geophysical Union (2011)

Solar Radiation




Vapor Pressure Deficit




American Geophysical Union (2011)

Korea has a significantly high degree of ecological diversity, considering the size of its land. Likewise, ecosystems display considerable spatial variation due to the different levels of photosynthesis and evapotranspiration in plants according to the climate and biota of the area.

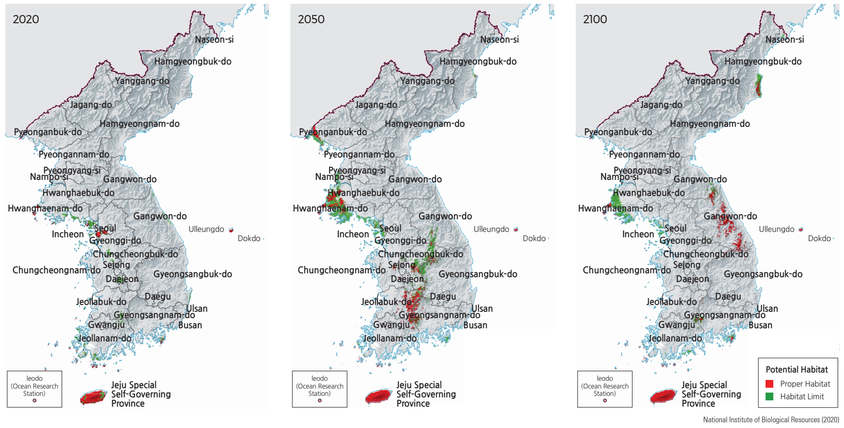
Gross Primary Productivity (GPP) and evapotranspiration in Korea show intermediate values compared to those of Japan and China at similar latitudes. Japan, which experiences high temperatures and the high humidity of a marine climate, shows higher values, whereas China, which experiences a continental climate, exhibits lower values. Western China, located far from the sea, shows lower GPP and evapotranspiration than other regions at equal latitudes. Korea shows an increased GPP and evapotranspiration at lower latitudes and at regions closer to the Pacific Ocean. This is caused by climatic characteristics of the southern and eastern coasts and by comparatively high temperatures and humidity, which cause the wide distribution of broadleaf evergreens and conifers.

Evapotranspiration includes evaporation from water bodies such as seas, lakes, and rivers and transpiration through the stomata in leaves. Evapotranspiration returns around half of the precipitation received on land to the atmosphere; thus, it is an important ecological component that regulates regional and global climates. Plants lose water vapor through stomata openings but gain atmospheric carbon dioxide, which is essential for photosynthesis. Thus, evapotranspiration and photosynthesis are physiologically coupled and show a positive correlation. Therefore, the annual evapotranspiration map of Northeastern Asia shows a spatial pattern similar to that of the region's GPP; evapotranspiration increases with latitude and decreases with urbanization.

Net Primary Productivity (NPP) is the difference between Gross Primary Productivity (GPP) and autotrophic respiration of a primary producer, mostly plants. NPP determines photosynthetic products that are available to humans, animals, and microbes. The annual means of NPP and GPP from 2000 to 2009 reveal that the values vary with latitude, distance from the sea, and land cover. This is because factors such as local climate, length of the growing season, and biomass affect the rate of photosynthesis in plants, and the consumption rate of animals and microorganisms. Thus, NPP and GPP values are higher in lower latitudes than in higher latitudes, decrease with distance from the sea, and are very low in dry regions such as western China and the Mongolian plateaus.

## Climate Change and Ecosystems

Distribution of *Neolitsea sericea* (Blume) Koidz.

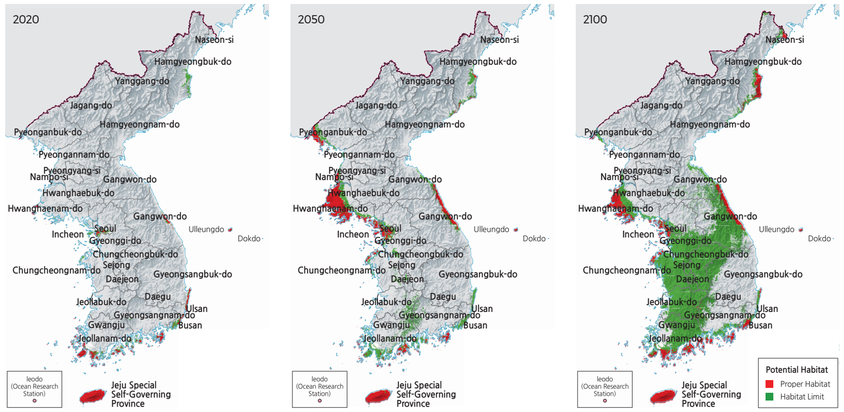




*Neolitsea sericea* (Blume) Koidz.

National Institute of Biological Resources (2020)

Distribution of *Machilus thunbergii* Siebold & Zucc.

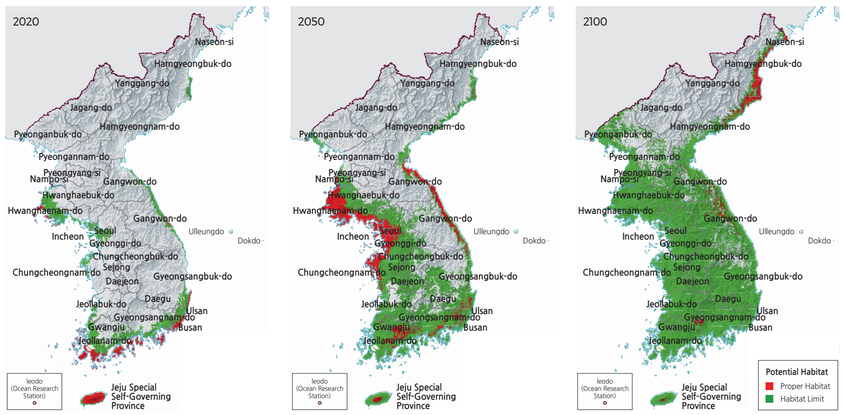




*Machilus thunbergii* Siebold & Zucc.

National Institute of Biological Resources (2020)

Distribution of *Dicranopteris linearis* (Burm. f.) Underw.





*Dicranopteris linearis* (Burm. f.) Underw.

National Institute of Biological Resources (2020)

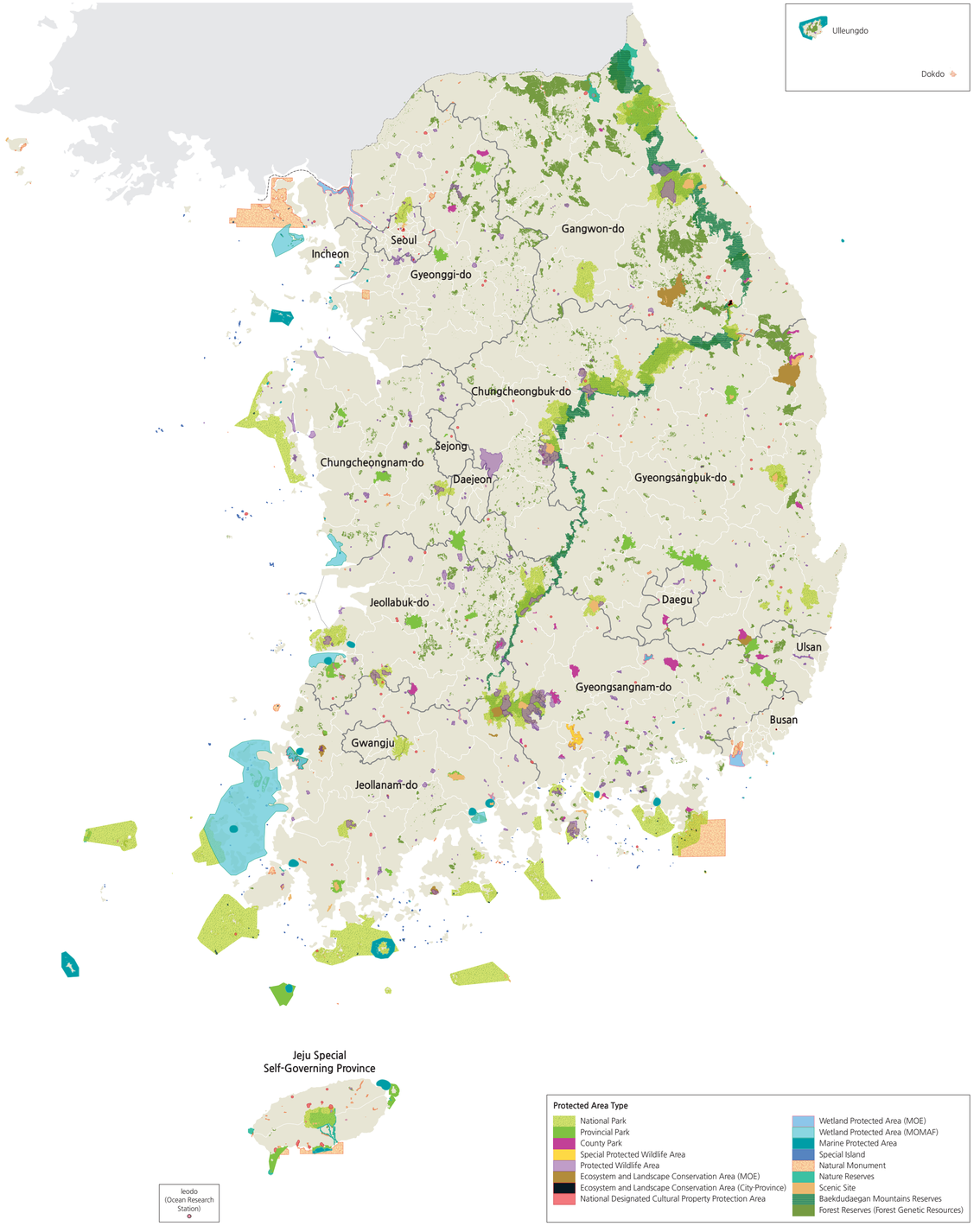
Concerns about the impacts of global warming and extreme weather events call for the preparation of adaptive measures against climate change for biota in Korea. As a result of these requirements, studies on future changes of some species' distributions are being carried out to scientifically analyze the impacts of climate change on the distribution of the Korean biota. These studies include the prediction of future changes of some species' distributions and the development of future habitat suitability maps for those species that are climate-sensitive biological indicator species (CBIS) and candidates for CBIS status. Future climate projections for this process are based on the climate change scenarios of the Intergovernmental Panel on Climate Change (IPCC).

The Japanese Silver Tree (*Neolitsea sericea*), Japanese Bay Tree (*Machilus thunbergii*), and Old World Forked Fern (*Dicranopteris linearis*) are some of the representative subtropical evergreen plants in the southern provinces of Korea. These subtropical species are expected to undergo a nationwide spread in their distribution due to accelerating global warming. Therefore, subtropical species are expected to compete with the temperate plants formerly inhabiting the region. Continuous monitoring and long-term research for future predictions are proposed to mitigate the expected damage to the biodiversity in Korea. The results of the studies will be used in the development of climate change adaptation policies for biodiversity in East Asia and in the establishment of the selection criteria for climate change index species.



## Ecosystem Management

Protected Areas




Korea National Park Service (2020)

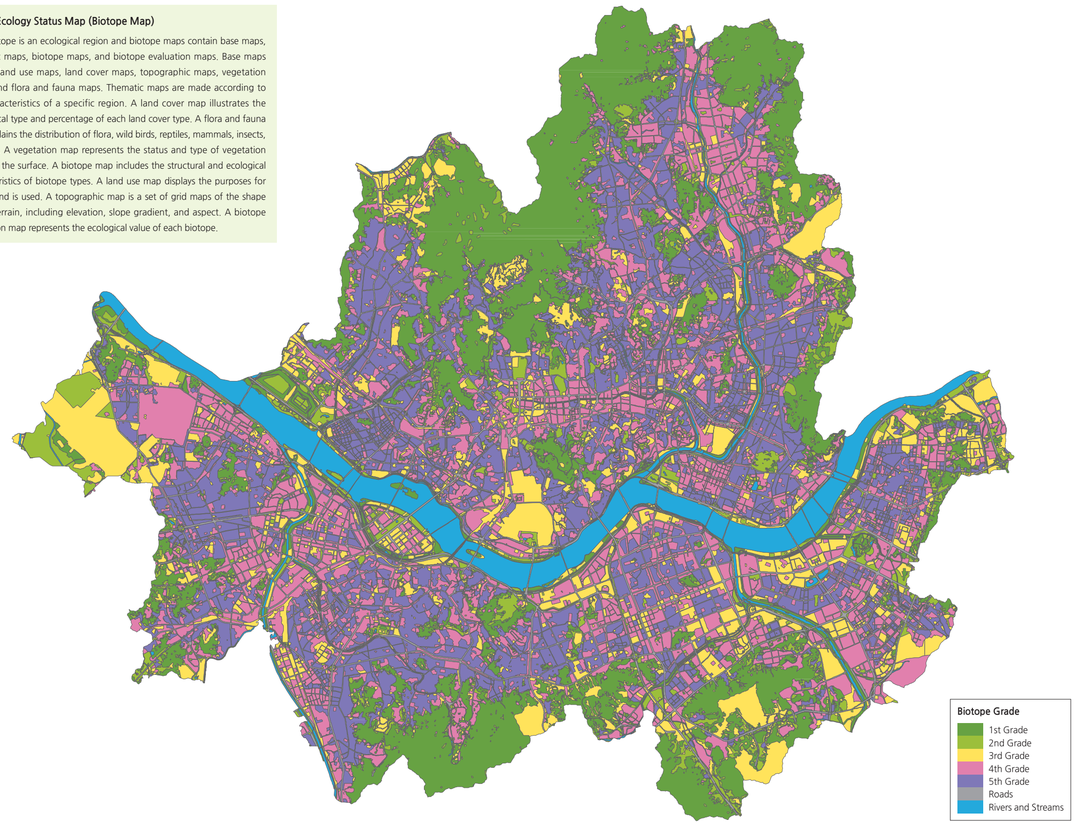
The modern concept of protected areas was primarily implemented in Korea by establishing the Forest Act, Parks Act, and Cultural Property Protection Act in the 1960s. Hongdo and Seoraksan were designated as the first nature reserve in 1965, and Jirisan was designated as the first National Park in 1967.

As of 2017, there are 28 protected areas and 14 related Acts regarding the protected areas in Korea. Three of the 10 Acts, the Natural Environment Conservation Act, Marine Environment Management Act, and Cultural Property Protection Act, deal with general matters of environmental and cultural property protection, regulating relevant provisions for these protected areas. The remaining 11 Acts mainly contain provisions focusing on the designation and management of protected areas.

## Biotope Map of Seoul (2020)

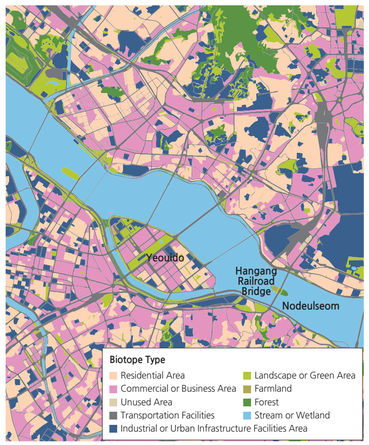
**Urban Ecology Status Map (Biotope Map)**

A biotope is an ecological region and biotope maps contain base maps, thematic maps, biotope maps, and biotope evaluation maps. Base maps include land use maps, land cover maps, topographic maps, vegetation maps, and flora and fauna maps. Thematic maps are made according to the characteristics of a specific region. A land cover map illustrates the categorical type and percentage of each land cover type. A flora and fauna map explains the distribution of flora, wild birds, reptiles, mammals, insects, and fish. A vegetation map represents the status and type of vegetation covering the surface. A biotope map includes the structural and ecological characteristics of biotope types. A land use map displays the purposes for which land is used. A topographic map is a set of grid maps of the shape of the terrain, including elevation, slope gradient, and aspect. A biotope evaluation map represents the ecological value of each biotope.



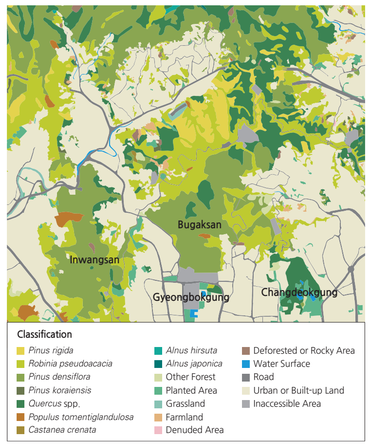

Seoul Metropolitan Government (2020)

### Example of an Evaluation of Biotope Type



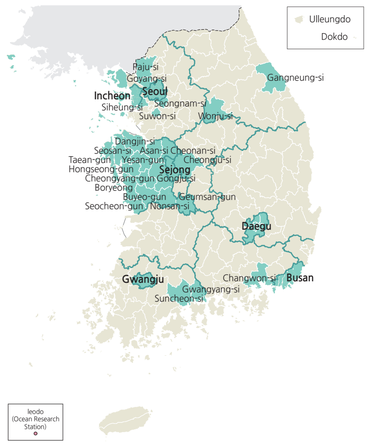

Seoul Metropolitan Government (2020)

### Example of a Vegetation Map




Seoul Metropolitan Government (2020)

### Cities and Counties that Produced Urban Ecology Status Maps




Ministry of Environment (2020)

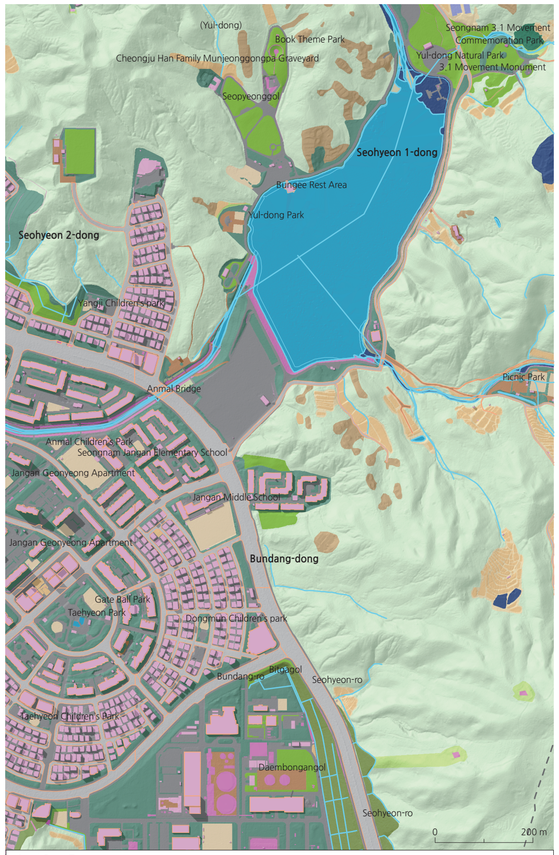
Korea is a highly urbanized country, with as many as 9 out of 10 people living in cities. It is increasingly important to manage the urban areas in eco-friendly and sustainable ways. A biotope map is a map that shows an area's biodiversity status based on investigations performed by local governments to take better action against the problems within their administrative districts. It divides the map area by biotope unit and expresses the biotope type based on the ecological characteristics and the rating of each biotope's value.

The first biotope map for Korea was created in 2000 in Seoul. Seoul developed a biotope map to serve as the baseline data for eco-friendly urban management and has been updating the map every five years. The Seoul Urban Planning Ordinance specifies the development and the usage of the biotope map for land suitability assessments and several other fields. Since then, local governments, including Seongnam-si, Gwangyang-si, Goyang-si, and Siheung-si, have created urban biotope maps. As of 2020, 33 local governments have completed producing urban biotope maps. Local governments produce urban biotope maps as needed. Since 2007, the central government, the Ministry of Environment, has distributed guidelines for creating urban biotope maps. Due to the amendment of the Natural Environment Conservation Act in 2017, local governments are obligated to produce urban biotope maps. Accordingly, the Ministry of Environment encourages local governments to submit their urban biotope maps by 2021.



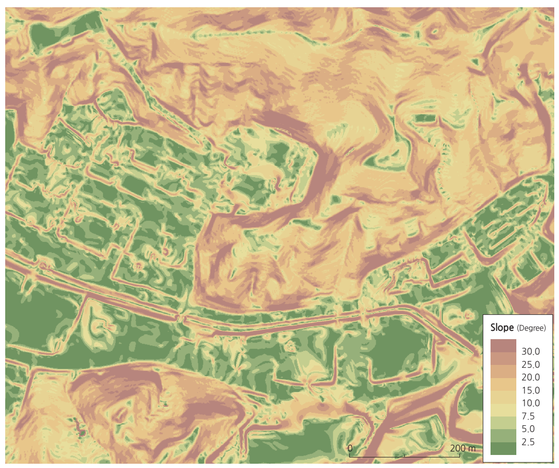
## Biotope Map of Seongnam-si (2009)

### Land Cover Map (Bundang-dong Area)



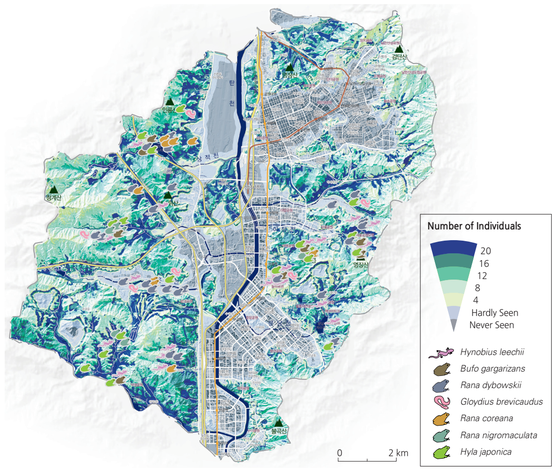

Seongnam City Government (2009)

### Slope Map (Yatap-dong Area)



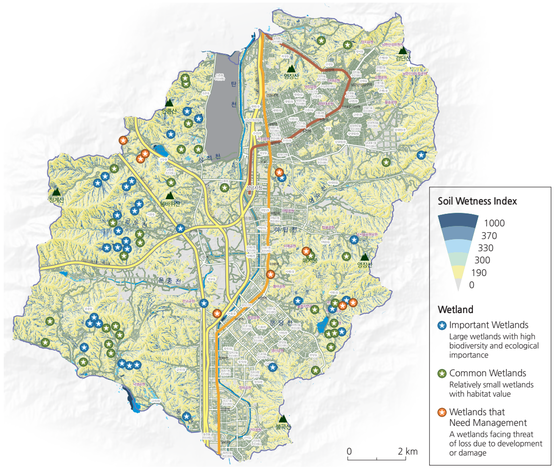

Seongnam City Government (2009)

### Estimation of Amphibian and Reptile Density



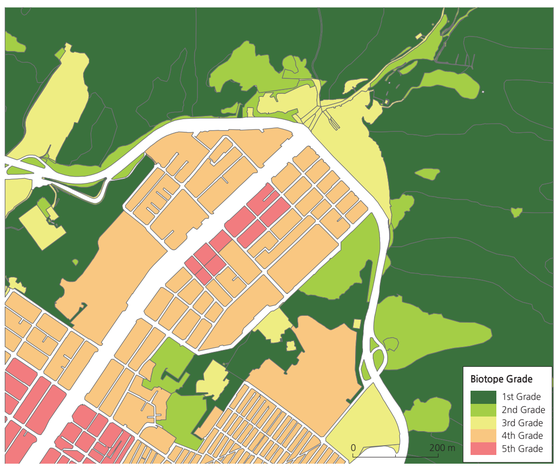

Seongnam City Government (2009)

### Soil Wetness Index and Wetlands




Seongnam City Government (2009)

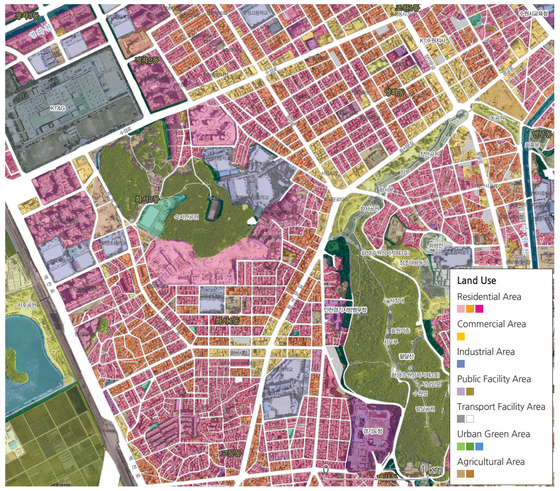
### Biotope Grade Map (Eunhaeng-dong Area)




Seongnam City Government (2009)

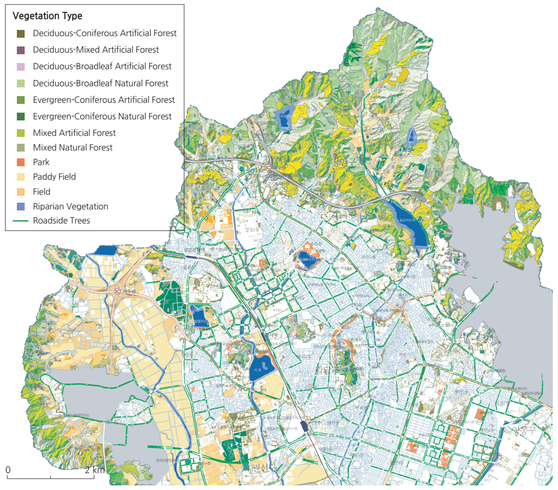
## Biotope Map of Suwon-si (2010)

### Land Use Map (Hwaseo-dong Area)



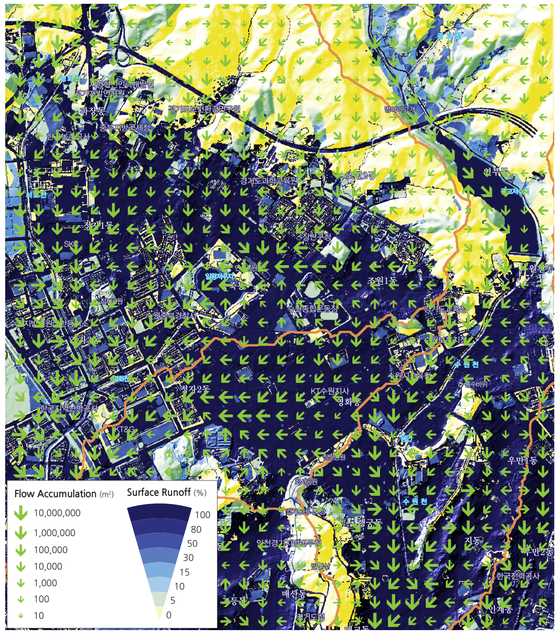

Suwon City Government (2010)

### Vegetation Map



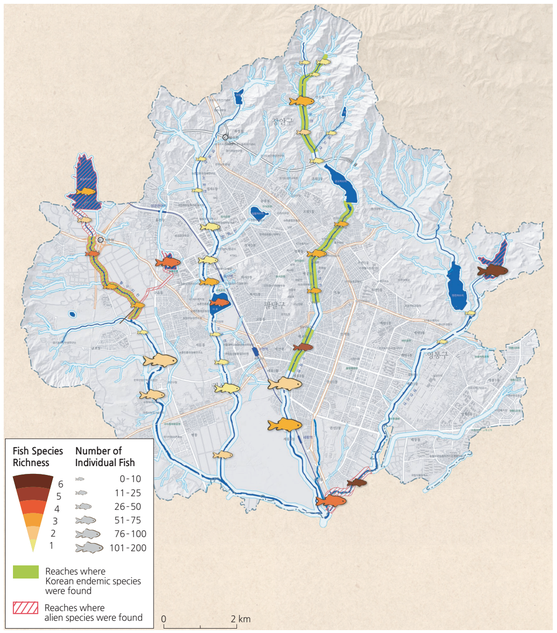

Suwon City Government (2010)

### Surface Runoff and Flow Accumulation (Jangan-gu Area)



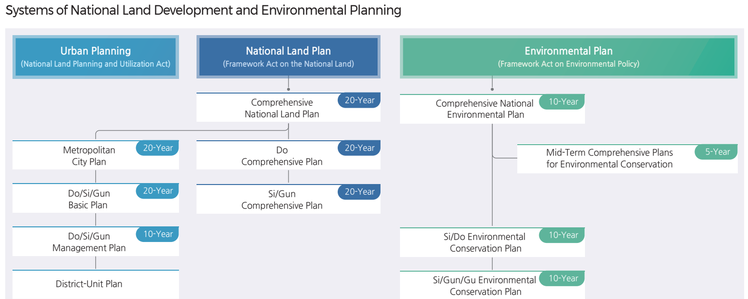

Suwon City Government (2010)

### Fish Habitat Map




Suwon City Government (2010)

### Systems of National Land Development and Environmental Planning

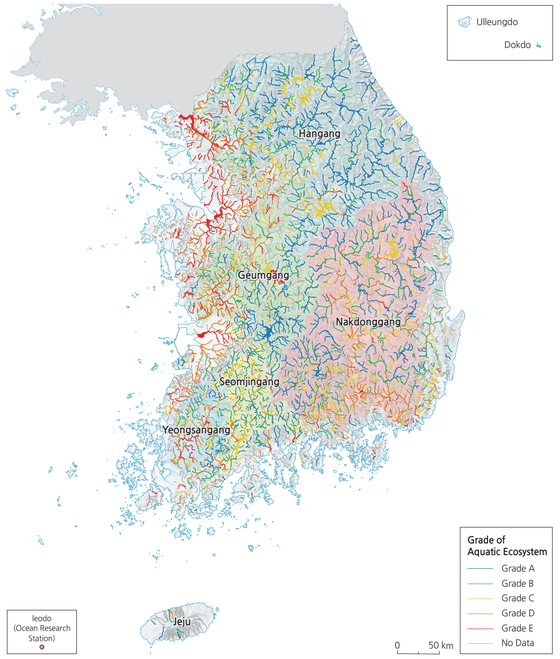



Ministry of Environment (2015)

Biotope maps are used as referential data in projects such as conservation and restoration of natural environments, the formation of ecological networks, and eco-friendly sustainable urban management. Local governments are currently utilizing these maps for environmental assessment, development permission, urban planning, and ecosystem management, and the scope of the usage is gradually expanding. A land-environment linkage system is being developed to promote appropriate land development in harmony with the environment. Biotope maps are expected to play an important role in this procedure. These maps provide the most detailed data among all available data that represent ecological status. Spatially explicit environmental plans based on these maps are further applied to urban planning processes.

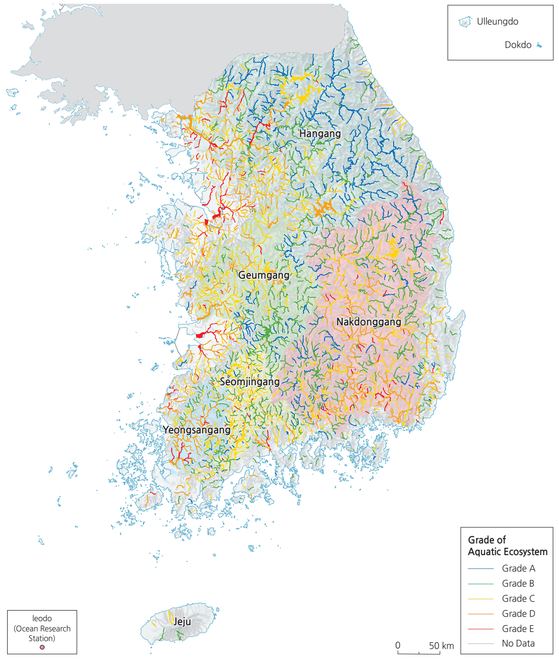


## Health of the Aquatic Ecosystem, BMI (2016 – 2018)




Ministry of Environment (2020)

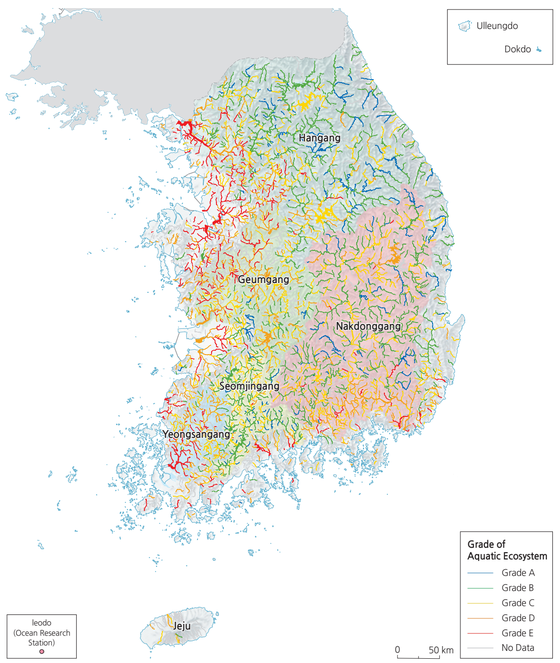
## Health of the Aquatic Ecosystem, FAI (2016 – 2018)




Ministry of Environment (2020)

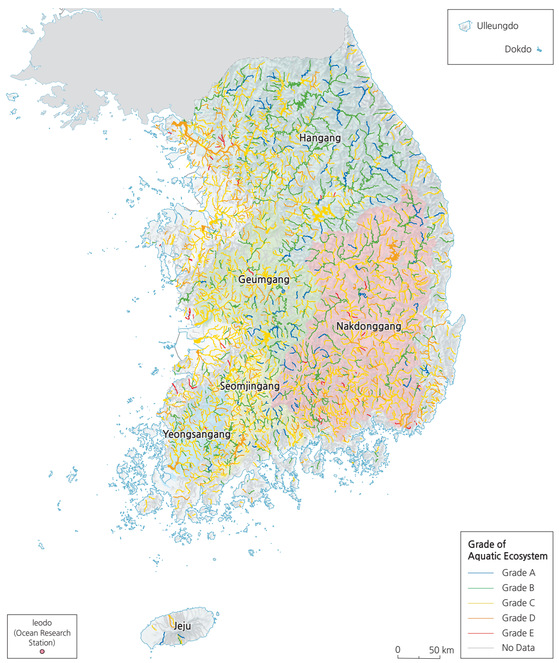
The aquatic ecosystem is an environment in which living organisms, habitats, and water quality affect each other. The aquatic ecosystem is healthy when the physical, chemical, and biological elements that make up the aquatic ecosystem are not damaged and perform their functions. Fish Assessment Index (FAI), Benthic Macroinvertebrate Index (BMI), Trophic Diatom Index (TDI), and Habitat and Riparian Index (HRI) are calculated to evaluate the health of the aquatic ecosystem. Based on the results, the health of the aquatic ecosystem is divided into 5 grades very good (A), good (B), fair (C), bad (D), and very bad (E) considering the diversity and abundance of species and the physical environment.

## Health of the Aquatic Ecosystem, TDI (2016 – 2018)




Ministry of Environment (2020)

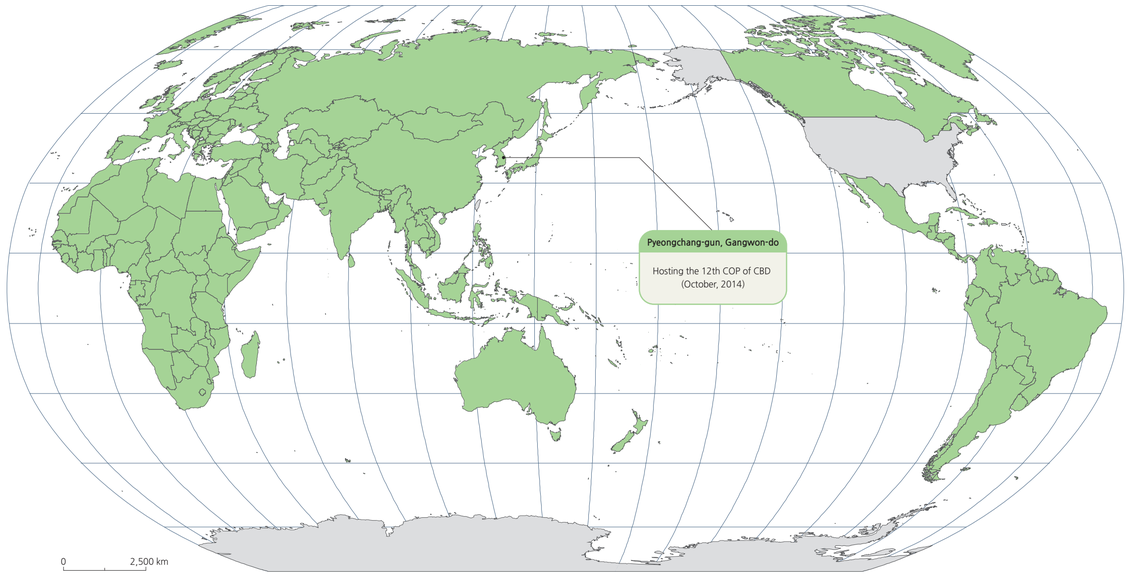
## Health of the Aquatic Ecosystem, HRI (2016 – 2018)




Ministry of Environment (2020)

## Ecological Value, Korea in the World

### Participating Countries of the Convention on Biological Diversity (CBD)




Convention on Biological Diversity (2019)

The Earth is one interconnected ecosystem. Thus, all human activities, such as climate change, biodiversity reduction, and distortion of nutrient cycle processes, affect the entire world. Some environmental and ecological issues can be managed at a local scale, but most current issues require regional and national cooperation over a long time. To effectively take action against these urgent environmental and ecological issues, the international society has organized more than 170 international conventions on the environment.

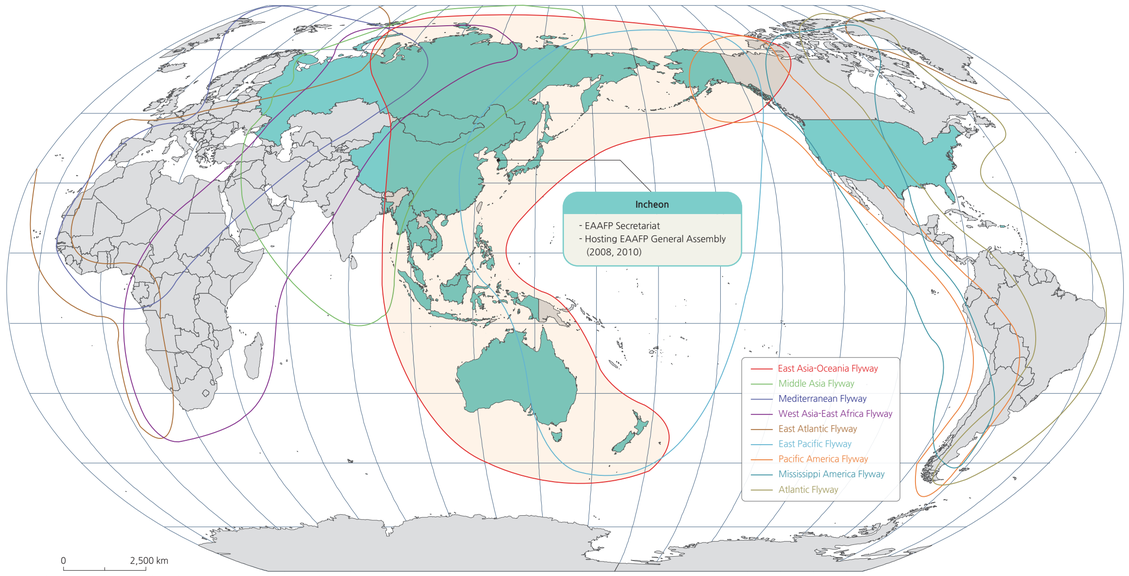
The Convention on Biological Diversity (CBD) aims to conserve biodiversity, enhancing the sustainable use of biological resources and to promote the fair and equitable distribution of the benefits obtained from the use of biological resources. Korea has been a party to the CBD since 1994. The 12th Meeting of the Conference of the Parties to the Convention on Biological Diversity (COP 12) was held in Pyeongchang-gun of Gangwon-do, Korea, in October 2014. The Korean government suggested the Bio-Bridge Initiative develop a streamlined mechanism for Technical and Scientific Cooperation between developed and developing countries.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is the intergovernmental body that assesses the state of biodiversity and the ecosystem services to provide scientific and political consultation. At the 2nd General Assembly of the IPBES in 2013, Korea proposed to host the Technical Support Unit for the Task Force on Knowledge and Data of the IPBES. According to the decision of the third full Multidisciplinary Expert Panel and Bureau Meeting held in Germany in 2014, the Ministry of Environment of Korea officially launched the unit at the National Institute of Ecology.

The East Asian-Australasian Flyway Partnership (EAAFP) aims to protect migratory waterbirds, their habitat, and the livelihoods of people dependent upon them. The EAAF Partnership is comprised of partners, including governments, international Non-Government Organizations (NGOs), and inter-governmental organizations. Korea had proposed to host the Secretariat in Korea and officially launched the Secretariat in Incheon in 2009. Korea hosted general meets in Incheon in 2008 and 2010.

Korea held the 10th Meeting of the Conference of the Parties to the Ramsar Convention and the 12th Meeting of the Parties to the Convention on Biological Diversity. Government-affiliated institutions and universities have carried out cooperative projects on research, education, and exhibition with various foreign institutions. As a result, Korea plays an important role in international cooperation related to ecology.

### East Asian-Australasian Flyway Partnership (EAAFP)



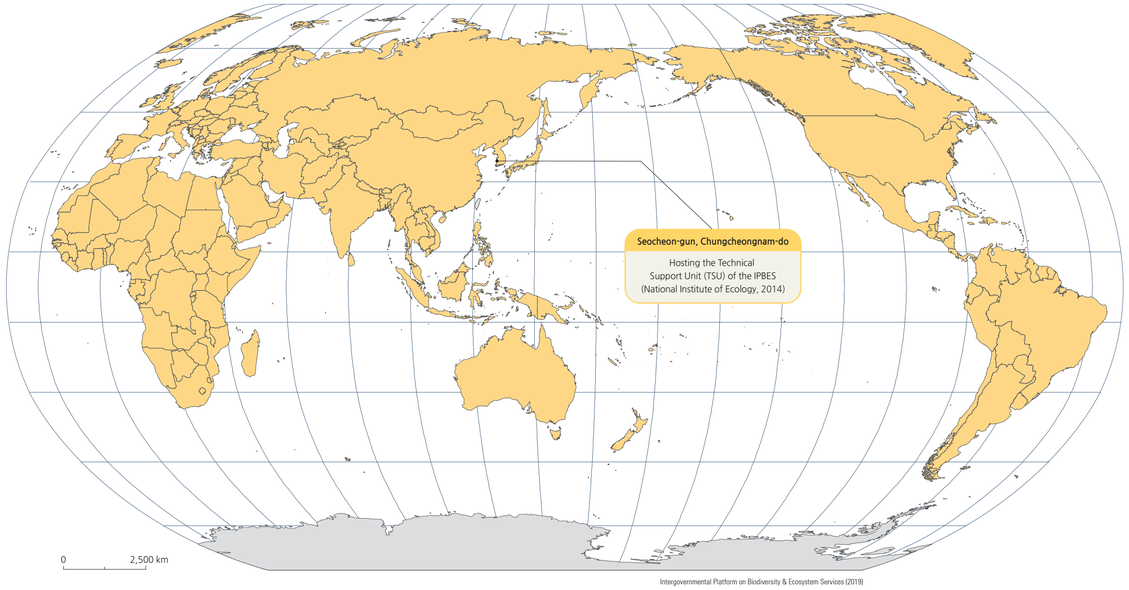

• Flyway refers to the migratory route of waterfowl migrating to breed and prepare for winter. This map was created based on the geographical migratory route of shorebirds.

East Asia Australasian Flyway Partnership (2019)

### Strategic Plan for Biodiversity (2011 – 2020)

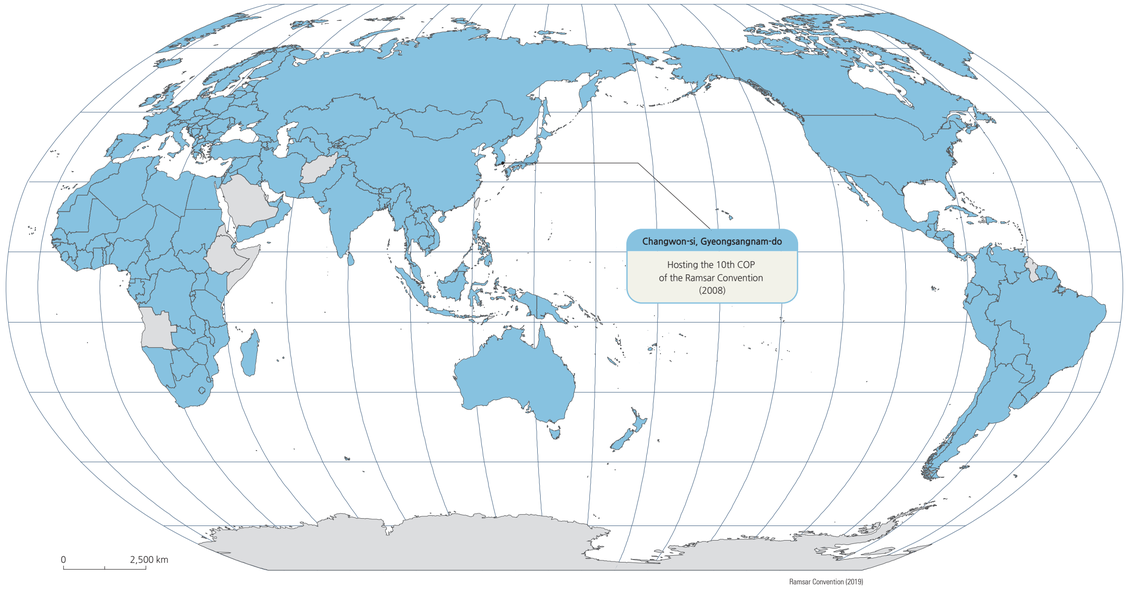



### Participating Countries in the Intergovernmental Platform on Biodiversity & Ecosystem Services (IPBES)




Intergovernmental Platform on Biodiversity & Ecosystem Services (2019)

### Member Countries of the Ramsar Convention

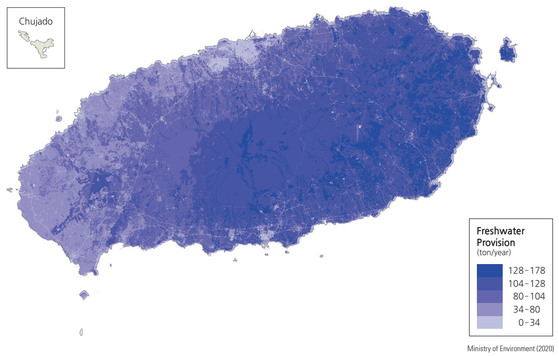



Ramsar Convention (2019)

## Ecosystem Services

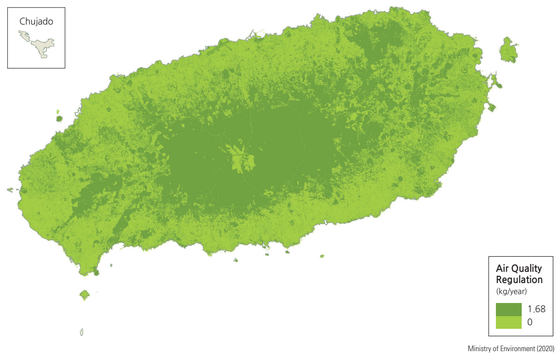
### Ecosystem Service Maps of Jeju

Freshwater Supply



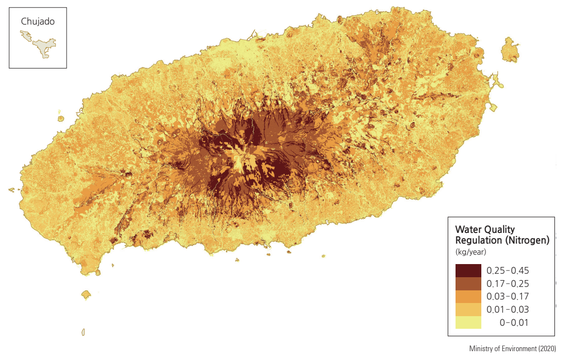

Ministry of Environment (2020)

Air Quality Regulation



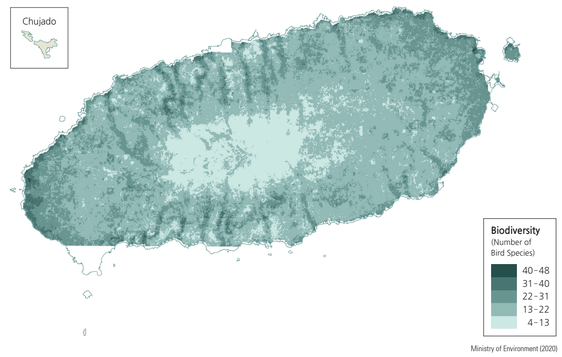

Ministry of Environment (2020)

Water Quality Regulation (Nitrogen)



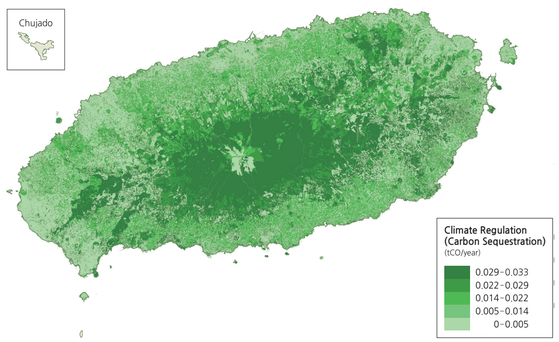

Ministry of Environment (2020)

Biodiversity



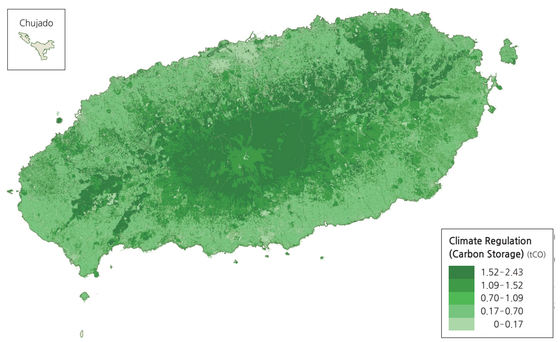

Ministry of Environment (2020)

Climate Regulation, Carbon Sequestration



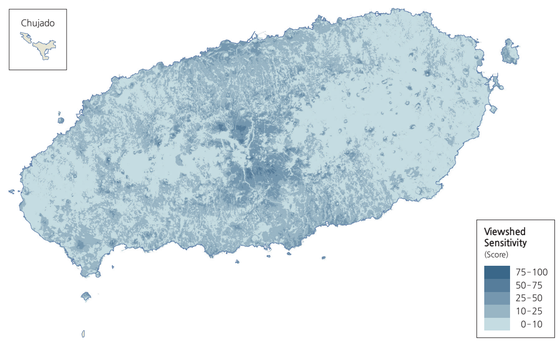

Ministry of Environment (2020)

Climate Regulation, Carbon Storage



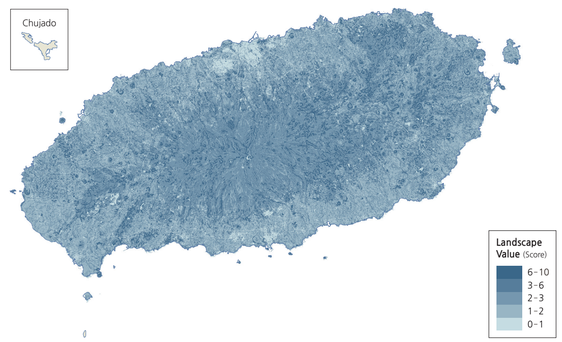

Ministry of Environment (2020)

Viewshed Sensitivity



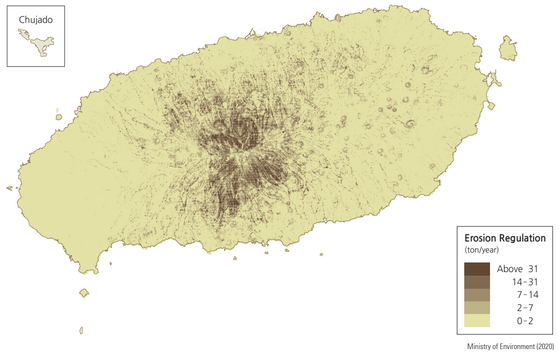

Ministry of Environment (2020)

Value of Landscape



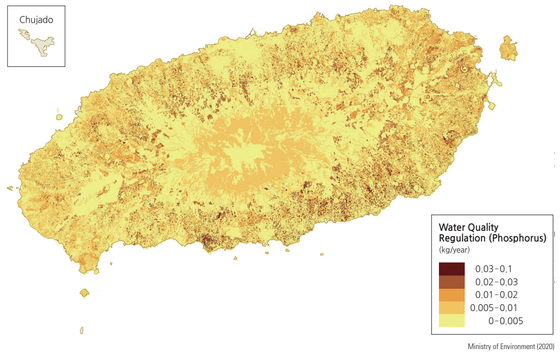

Ministry of Environment (2020)

Erosion Regulation




Ministry of Environment (2020)

Water Quality Regulation (Phosphorus)




Ministry of Environment (2020)

Ecosystem services provide indispensable benefits derived from ecosystems for human well-being with the sustainable use of natural capital for all people, including current and future generations. Ecosystem services are states and processes that allow ecosystems and biological species to sustain human systems. On the other hand, ecosystem disservices refer to the harmful ecosystem processes and functions, such as loss of biodiversity, avian influenza, African swine fever, the novel coronavirus (COVID-19) infection, and other public health-related issues that result in negative effects on human well-being in the socio-ecological systems.

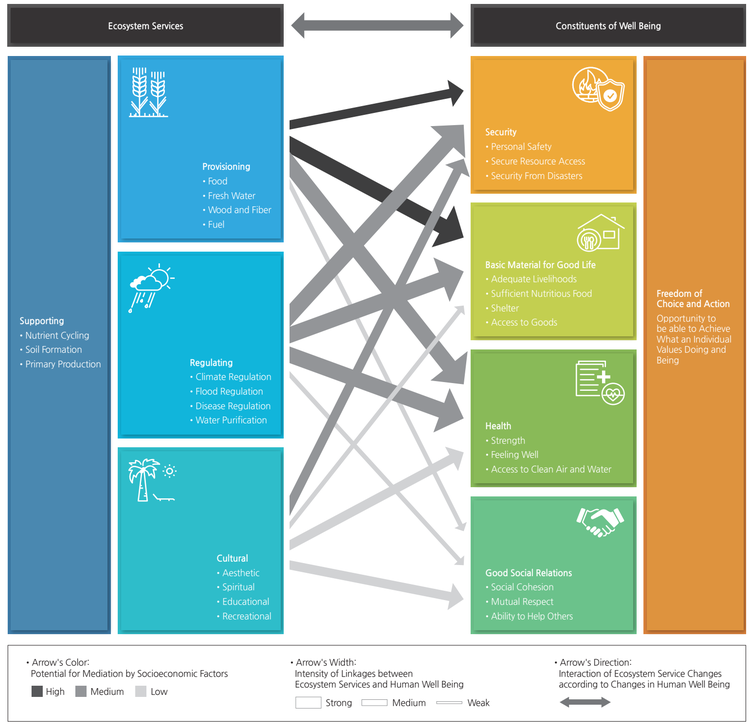
According to the Millennium Ecosystem Assessment (MEA), 60% of the world's ecosystem services are degraded, despite the essential functions and benefits of the ecosystem services for human well-being and happiness and quality of life improvement; thus, there is great urgency for collaborative scientific research and collective action to address the sustainability issue. Interaction between ecosystem services and components of human well-being depends on the substitutability and strength of the interaction. Ecosystem services affect components of human well-being such as security, basic materials for improving the quality of life, health, and good social relations, under the provision of freedom of choice and action.

Substitutability refers to the potential for coordination between socio-economic factors. It is strong in supply service and relatively weaker in cultural service. In the case of adjustment services, the strength of interaction appears to be high in the interaction between the satisfaction of basic needs and quality of life. Human well-being has an interactive relationship with ecosystem services, and the substitutability and strength of the interaction depend on the characteristics and the spatial range of an ecosystem. Therefore, the valuation of ecosystem services should consider the dynamic characteristics of human-environment interactions to analyze environmental justice, ecosystem disservices, scale, distribution, and efficient allocation.

The Millenium Ecosystem Assessment (MEA) report in 2005 raised public awareness in that MEA showed the relationship between humans and ecosystem change and estimated the quantitative and comprehensive loss of ecosystem services. Ecosystem Services are categorized into provisioning, regulating, cultural, and supporting services. Provisioning service refers to benefits humans receive directly from the ecosystem, such as food, water, wood resources. Regulating service refers to the benefits generated by the regulation of ecosystem processes, such as controlling air and water quality, climate regulation, erosion control, and pollination. Cultural services indicate leisure and recreation, spiritual inspiration from nature, and education. Supporting services provide essential and basic services, such as biodiversity and soil formation. The Ministry of Environment initiated the project for mapping ecosystem service assessment at the level of local government in 2018 and produced the ecosystem services map of Jeju island in 2019.



### Ecosystem Service




Millennium Ecosystem Assessment (2020)

The Act on the Conservation and Use of Biological Diversity defines ecosystem services. The Act establishes a scientific decision-making process related to ecosystem services and a policy foundation to support it. The Act specifies the classification of ecosystem services and establishes the basic principle that ecosystem services should be systematically provided and promoted to preserve the ecosystem and improve the quality of life of the people for the conservation of biodiversity and the sustainable use of biological resources. The Act also includes systematic provisions and promotion of ecosystem services in the National Strategy on Biodiversity.

The Act stipulates that policies to protect ecosystems and endemic species on the Korean Peninsula and its adjacent islands, including the northern part of the Korean Peninsula beyond the Military Demarcation Line (MDL), should be promoted. These policies support research on biodiversity, surveys on species and natural assets, and evaluation of ecosystem services. The Act states the payment for ecosystem services, which means the various measures for conservation and management of landscape and natural capital, such as modification of cultivation, reduction of chemical material, development of wetlands, and other land management, shall be made for systematic conservation and improvement of ecosystem services by the landowners and managers. It may be recommended to the head of the local government to formulate a payment for ecosystem services.

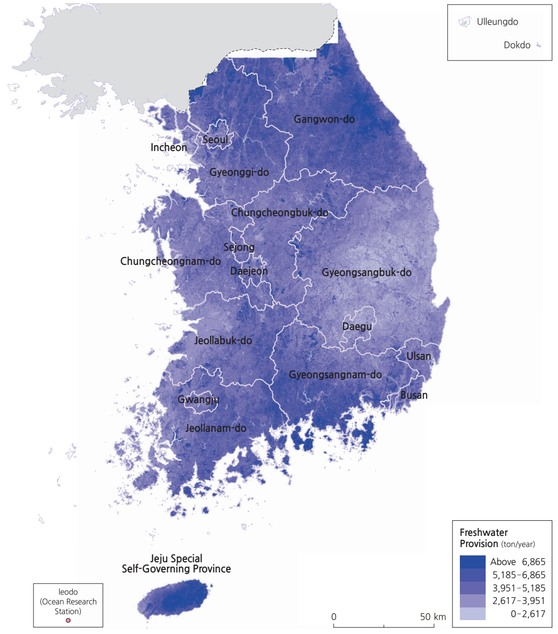
Freshwater provision is an ecosystem service that supplies essential water resources by storing water in vegetation and soil, and by controlling the flow of water that reaches the surface by precipitation. A map of the freshwater provision is created by the InVEST water yield model using annual mean precipitation, annual potential evapotranspiration, soil moisture content from soil map, land cover, and a biophysical table by land cover types.

Air quality regulation is an ecosystem service that improves air quality through the sequestration of pollutants such as ozone ($O_3$), sulfur dioxide ($SO_2$), and nitrogen dioxide ($NO_2$) by plants. A map of air quality regulation is created by per unit value of pollutant sequestration of vegetation types from a land cover map.

Climate regulation is an ecosystem service that regulates greenhouse gas concentrations through storage processes of carbon dioxide ($CO_2$) by operation of the InVEST Carbon model using a land cover map and a matrix of the biophysical table of the amount of carbon stored in carbon pools by land cover types. A map of annual carbon sequestration by forest is also created using a forest map and the amount of carbon sequestration by forest types.

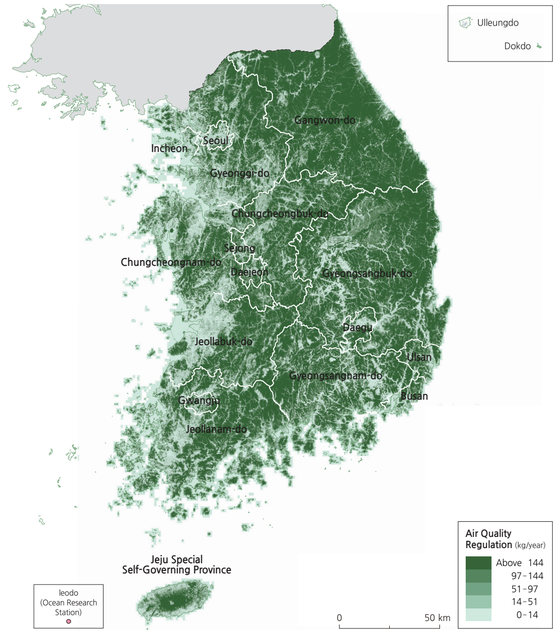
Erosion regulation is an ecosystem service that reduces soil erosion through soil retention by roots of vegetation in slopes during rainfall events. A map of erosion regulation is created through the InVEST SDR model using the r factor from rainfall data, the k factor of soil, Digital Elevation Model (DEM) and land cover data, biophysical table of land cover, and management factor, which calculate the amount of soil retention.

## Freshwater Provision



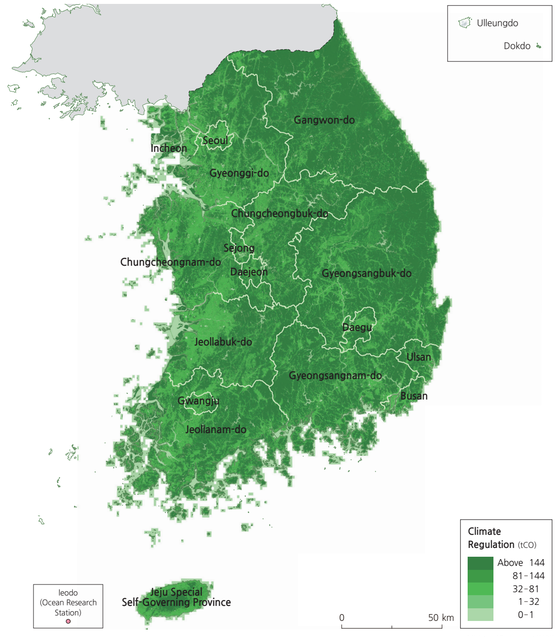

Ministry of Environment (2020)

## Air Quality Regulation



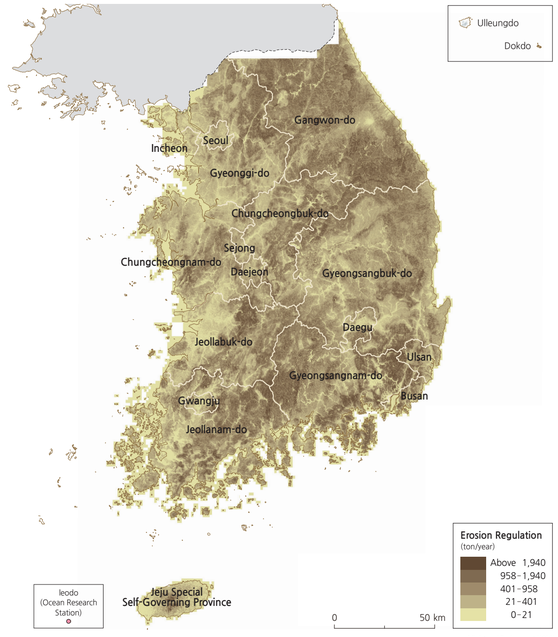

Ministry of Environment (2020)

## Climate Regulation




Ministry of Environment (2020)

## Erosion Regulation




Ministry of Environment (2020)



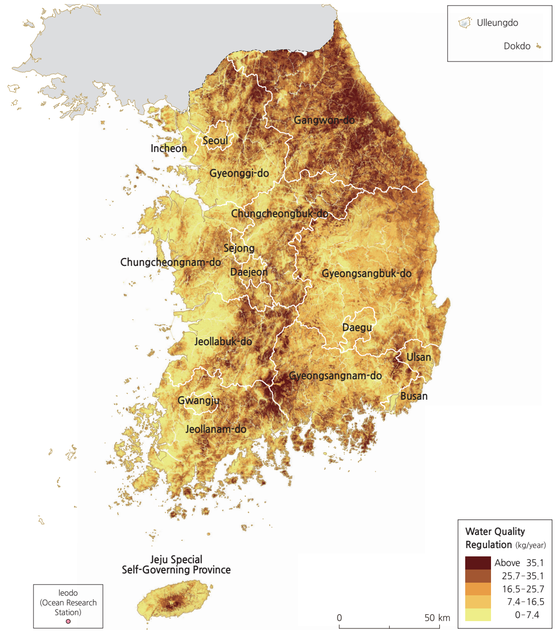
Water quality regulation is an ecosystem service that dilutes or sequesters water pollutants by vegetation and recompositions chemicals by components of ecosystems. A map of water quality regulation is created through the InVEST NDR model using DEM, rainfall, land cover data, and a biophysical table for retention efficiency and length.

A map of biodiversity is created by the ecological status model enclosed in the species distribution model using results from the national natural environmental survey.

As a cultural ecosystem service, aesthetic value is calculated based on viewshed analysis that takes into account the viewshed, viewer sensitivity, and viewshed limiting factors. A map of viewshed sensitivity is produced by quantitative analysis on visible areas within prospect right using ArcGIS, a spatial analysis tool.

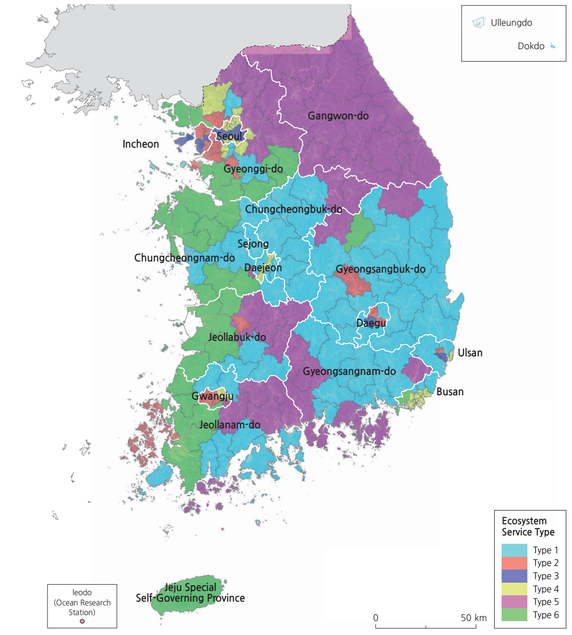
The landscape is a cultural ecosystem service from which people benefit because of the aesthetic or functional values of places provides by ecosystems. A landscape map is created by scores of the landform and land cover type extracted through the survey for experts using ArcGIS, a spatial analysis tool.

## Water Quality Regulation



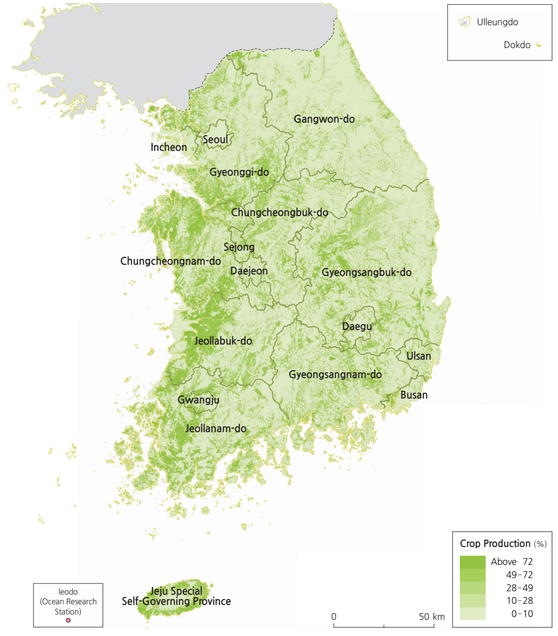

Ministry of Environment (2020)

## Classification Results using Ecosystem Service Bundles

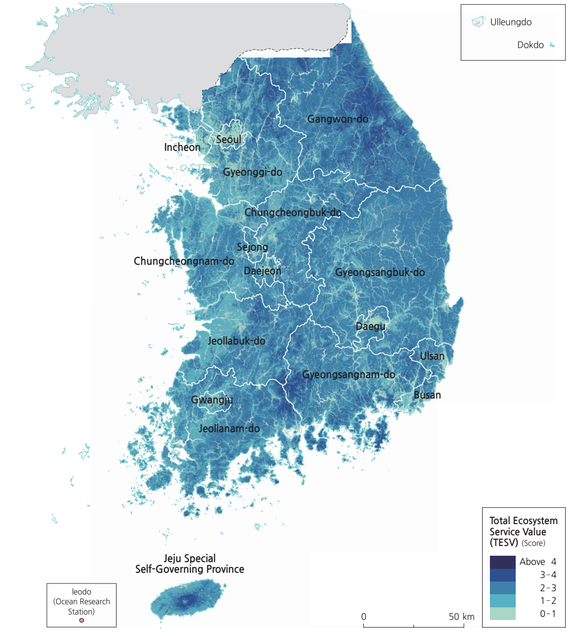

Ministry of Environment (2020)

## Crop Production



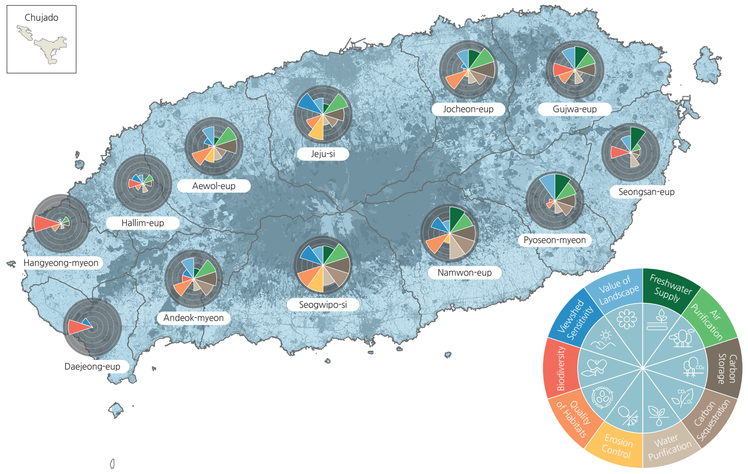

Ministry of Environment (2020)

## Total Ecosystem Service Value (TESV)




Ministry of Environment (2020)

## Model-based Assessment of Ecosystem Services in Jeju




National Institute of Ecology (2020)

## Total Ecosystem Service Value in Jeju



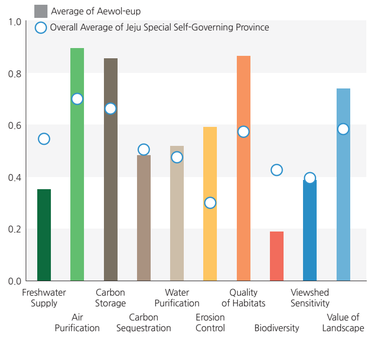

National Institute of Ecology (2020)

## Market Value of $CO_2$ Sequestration by Forest in Jeju




National Institute of Ecology (2020)

## Application of Ecosystem Service Bundles




• Forests located in cities provide various ecosystem services to residents. The ecosystem services provided by a specific region are referred to as an "Ecosystem Service Bundle."

National Institute of Ecology (2020)

Comprehensive assessments of ecosystem service maps are conducted through indexing and clustering processes. An indexing process normalizes each ecosystem service map from 0 to 1, then summarizes all maps to calculate a TESV (Total Ecosystem Service Value). The TESV is useful for identifying hotspot areas with a high level of ecosystem service supply and understanding spatial distribution patterns of ecosystem services. A clustering process classifies administrative areas according to the distribution of a normalized value of each ecosystem service and creates bundles representing sets of ecosystem services visually. The clustering result can identify the characteristics of ecosystem service by areas and compare the characteristics of ecosystem services among areas. A bundle map is created to distinguish the results of ecosystem service assessment and to identify characteristics of districts of Jejudo using assessment results of ecosystem service supplies per unit areas.

The national assessment of ecosystem services includes the freshwater provision, air quality regulation, climate regulation, erosion regulation, and water quality regulation. A crop production service, which is calculated using agricultural areas in land cover maps, is also included. TESV is calculated using the assessment results of the six ecosystem services mentioned above. Ecosystem service bundles are created by a normalized value of each ecosystem service per unit area of administrative districts.

Economic values of ecosystem services can be assessed using various approaches. For example, the economic value of climate regulation is assessed through the market value of the exchange of the amount of forest sequestration of carbon dioxide. The market value of forest climate regulation in Jejudo is assessed by the assignment of the carbon dioxide conversion coefficient to price using domestic carbon credits and the annual amount of carbon sequestration by forest calculated from forest type maps and data on carbon sequestration by forest types.

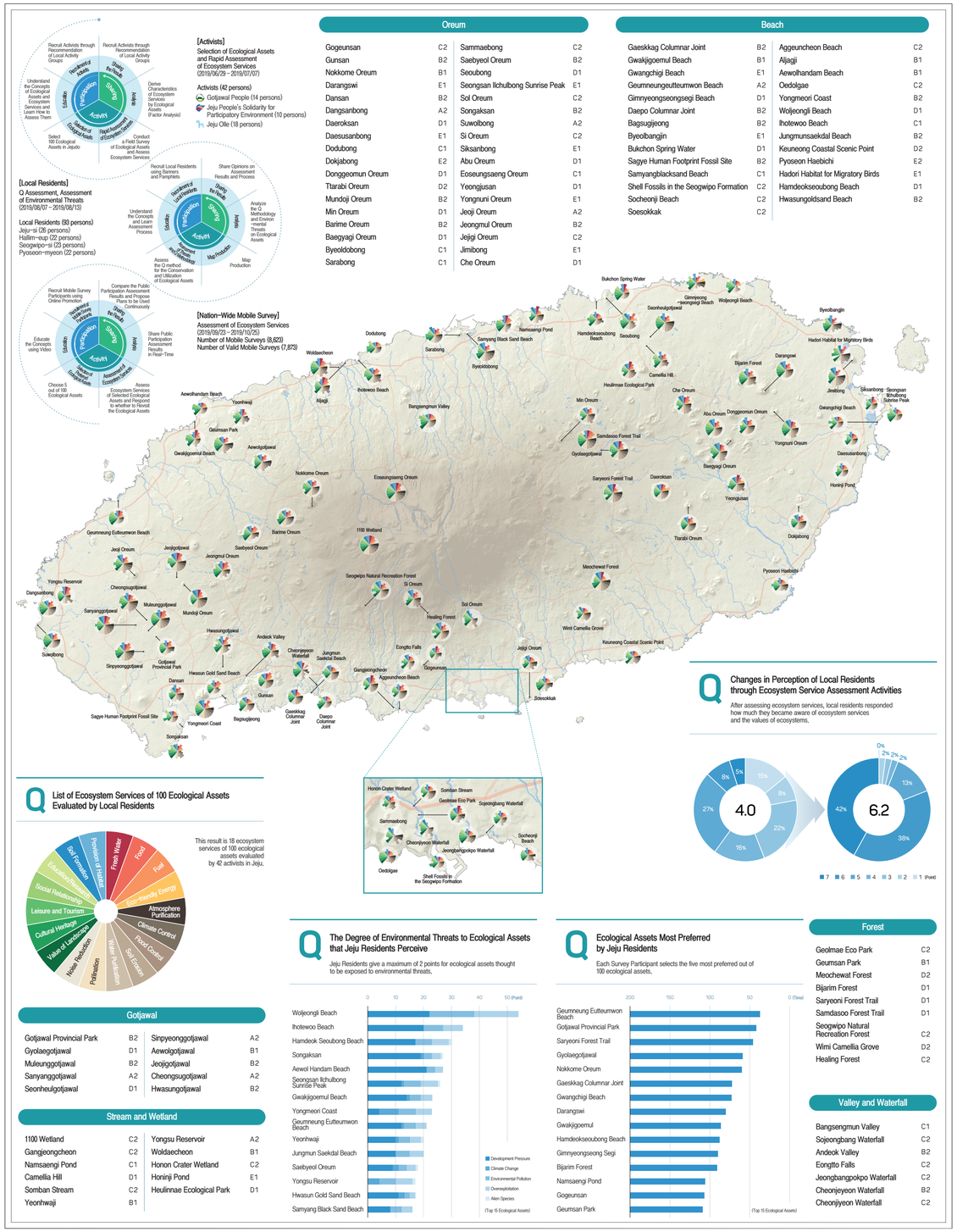
## Afforestation Area in Jeju




National Institute of Ecology (2020)



## Ecosystem Service Maps Created by Collaboration with Local Residents




National Institute of Ecology (2020)

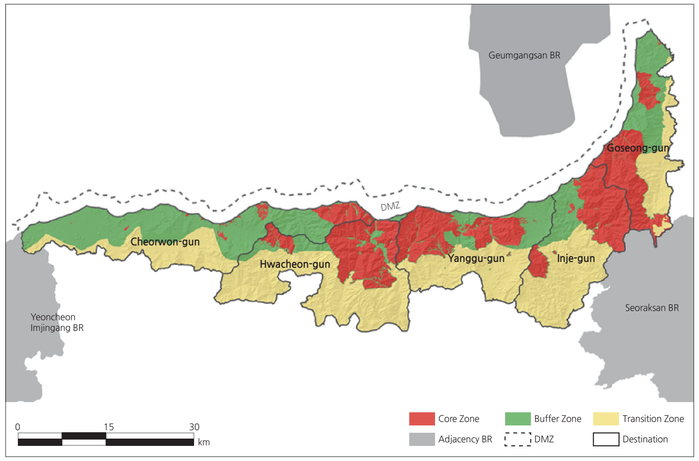
Local participatory ecosystem service approaches assess ecosystem services provided by ecosystem assets through the selection and on-site assessment of ecosystem assets ranging from 1 to 5, which are based on residents' perception of the ecosystem services they experience in their society. Forty-two local participants in Jeju Special Self-Governing Province select 100 representative ecosystem assets (50 assets in Jeju-si and Seogwipo-si, respectively) and assess ecosystem services provided by these assets.

## Ecosystems and Biodiversity in the DMZ

The Man and the Biosphere Programme (MAB) is an intergovernmental scientific program, launched in 1971 by UNESCO, that aims to protect biodiversity and to foster sustainable development. MAB implements various projects, such as Biosphere Reserves (BR), scientific research, training, and collaboration, which are closely related to biodiversity conservation.

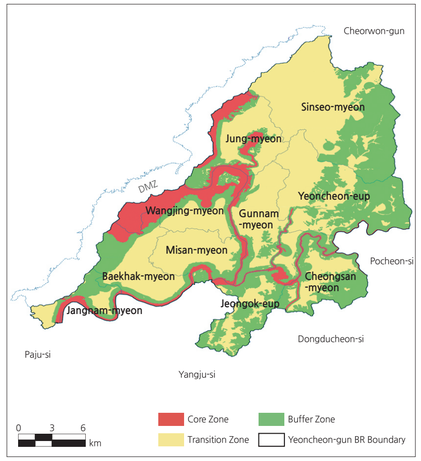
The Gangwon Eco-Peace Biosphere Reserve (GWBR) covers 182,815 ha in five counties, including Cheorwon-gun, Hwacheon-gun, Yanggu-gun, Inje-gun, and Goseong-gun in the Civilian Control Zone of Gangwon-do. Yeoncheon-gun in Gyeonggi-do belongs to the Yeoncheon-Imjingang Biosphere Reserve (YIBR), covering 58,412 ha.

### Gangwon Eco-Peace Biosphere Reserve (GWBR)




Ministry of Environment (2019)

### Yeoncheon-Imjingang Biosphere Reserve (YIBR)

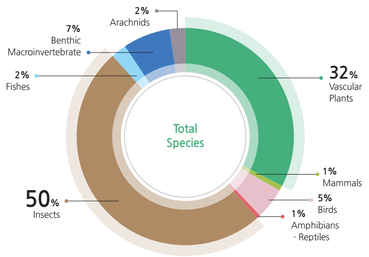



Ministry of Environment (2019)

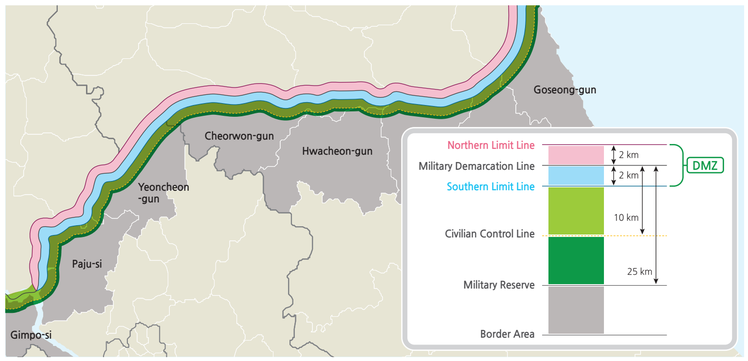
The Demilitarized Zone (DMZ) region refers to the DMZ and the northern area of the Civilian Control Line. The DMZ of the Korean Peninsula was established by the provision of the Korean Armistice Agreement signed on July 27, 1953.

The DMZ covers the area between the Northern and Southern Boundary Lines, located 2 kilometers away from the Military Demarcation Line (MDL) in the north and south across the Korean Peninsula. The Civilian Control Line (CCL) was set to 10 kilometers away from the Military Demarcation Line. The northern area of this line was designated as the Civilian Control Zone (CCZ) to limit civilian access. Since the end of the war, the DMZ has become a nature preserve, where human access is restricted.

### Biodiversity in the DMZ

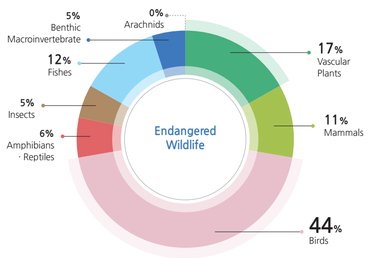



### Boundary of the DMZ




Ministry of Environment (2018)

### Endangered Wildlife in the DMZ




Ministry of Environment (2018)

### Flora and Fauna in the DMZ

| No. | Class | DMZ | |
|---|---|---|---|
| | | Total Species | Endangerd Species |
| 1 | Vascular Plants | 1,926 | 17 |
| 2 | Mammals | 47 | 11 |
| 3 | Birds | 277 | 45 |
| 4 | Amphibians · Reptiles | 34 | 6 |
| 5 | Insects | 2,954 | 5 |
| 6 | Fishes | 136 | 12 |
| 7 | Benthic Macroinvertebrate | 417 | 5 |
| 8 | Arachnids | 138 | 0 |
| Total | | 5,929 | 101 |

Ministry of Environment (2018)

The DMZ is an ecological belt that crosses the Korean Peninsula from east to west. The eastern mountainous region of the DMZ meets the Baekdudaegan, and the eastern and western ends meet the sea. Therefore, various ecosystems such as forest ecosystems, marine ecosystems, and rivers, wetlands, and valleys appear in the DMZ. The DMZ region provides a habitat for wildlife flora and fauna, including Natural Monuments and Endangered Wildlife. Primitive ecosystems in the DMZ play an important role in conserving biological diversity, habitat for rare animals and plants, and the international flyway of various migratory birds, including Red-crowned Cranes.

The DMZ provides the natural habitat for animals and plants. A total of 5,929 wildlife species are identified in the DMZ, including 2,954 insect species, 1,926 plant species, 417 benthic macroinvertebrates species, 277 bird species, 138 spider species, 136 freshwater fish species, 47 mammal species, and 34 amphibian/reptilian species. The ecological value of the DMZ is exceptional. A total of 101 Endangered Wildlife are identified in the DMZ, which accounts for about 38% of all 267 Endangered Wildlife.

A total of 18 Class I Endangered Wildlife were identified: 6 mammals, including the Siberian Musk Deer (*Moschus moschiferus*) and Eurasian Otter (*Lutra lutra*), 10 birds, including Golden Eagle (*Aquila chrysaetos*) and Chinese Egret (*Egretta eulophotes*), an amphibian species, Spotless Tree Toad (*Hyla suweonensi*) and a fish species, Hynsumaja (*Gobiobotia nakdongensis*).

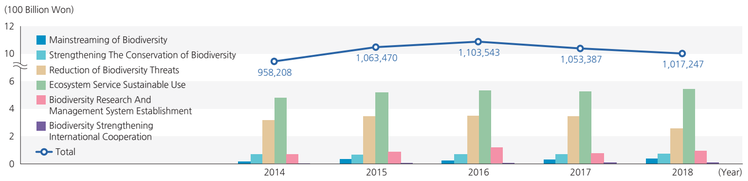
A total of 83 Class II Endangered Wildlife were identified: 17 plants, including Silene Flos-cuculi (*Lychnis kiusiana*) and Siberian Ginseng (*Eleutherococcus senticosus*), 5 mammals, including the Yellow-throated Marten (*Martes flavigula*) and Leopard Cat (*Prionailurus bengalensis*), 35 birds, including the Swan Goose (*Anser cygnoides*) and Eurasian Oystercatcher (*Haematopus ostralegus*), 5 amphibians and reptiles, including the Korean Rat Snake (*Elaphe schrenckii*) and Seoul Frog (*Pelophylax chosenicus*), 5 insects, including the Dung Beetle (*Copris tripartitus*) and Palaearctic Butterfly (*Argynnis nerippe*), 11 freshwater fish, including the Slender Shiner (*Pseudopungtungia tenuicorpa*) and Amur Stickleback (*Pungitius sinensis*), and 5 benthic macroinvertebrates, including Bekko Tombo (*Libellula Angelina*) and the Diving Beetle (*Cybister chinensis*).



## The 4th National Biodiversity Strategy (2019–2023)

Biological diversity means the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems and genetic resources. The Convention on Biological Diversity (CBD) was adopted on May 22, 1992, for the conservation and sustainable use of biodiversity at the global level, and entered into force on 29 December 1993 as an International Convention on Biodiversity.

### National Biodiversity Strategy and Investment (2014–2018)




National Biodiversity Center, Biodiversity Statistics of Korea (2018)

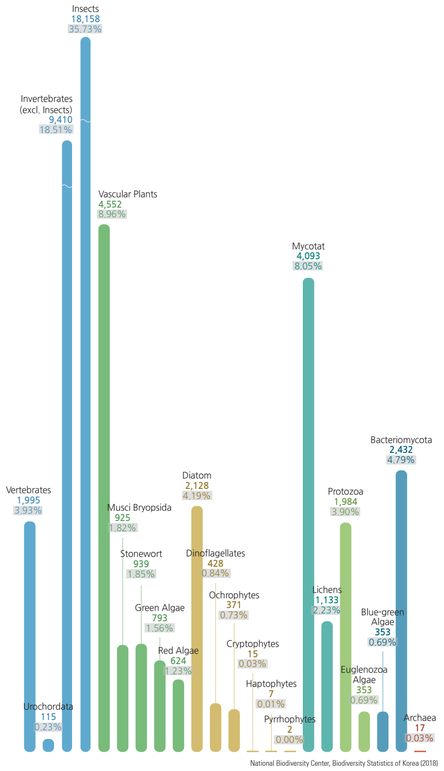
Long-Tailed Goral (*Naemorhedus caudatus*),
Endangered Wildlife Class I

Red-Crowned Crane (*Grus japonensis*),
Endangered Wildlife Class I

White-Tailed Eagle (*Haliaeetus albicilla*),
Endangered Wildlife Class I

Eurasian Otter (*Lutra lutra*),
Endangered Wildlife Class I and Natural Monument, No. 330

### Statistics of Biodiversity (2018)




National Biodiversity Center, Biodiversity Statistics of Korea (2018)

Slender Shiner (*Pseudopungtungia tenuicorpa*),
Endangered Wildlife Class II

Siberian Musk Deer (*Moschus moschiferus*),
Endangered Wildlife Class I and Natural Monument, No. 216

Korean Rat Snake (*Elaphe schrenckii*),
Endangered Wildlife Class II

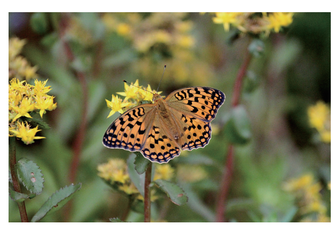
Asian Black Bear (*Ursus thibetanus ussuricus*),
Endangered Wildlife Class I

Dung Beetle (*Copris tripartitus*),
Endangered Wildlife Class II

Leopard Cat (*Prionailurus bengalensis*),
Endangered Wildlife Class II

Biodiversity provides various ecosystem services and affects human well-being and the overall sustainability of the Earth ecosystems. Therefore, a national strategy is required for systematic conservation and sustainable use of nature. Korea manifested the National Biodiversity Strategy and the action plan to abide by the CBD, and established the Biodiversity Act to formulate and implement the National Biodiversity Strategy every five years in terms of the central administrative agreement.

As of 2018, according to the Ministry of Environment and the National Institute of Biological Resources (NIBR), a total of 50,827 species inhabit the Republic of Korea. Among the species, 29,678 species are in the Animalia Kingdom, followed by Plantae (7,833 species), Fungi (5,226 species), Chromista (2,951 species), Bacteria (2,785 species), Protozoa (2,337 species), and Archaea (17 species).



Palaearctic Butterfly (*Argynnis nerippe*),
Endangered Wildlife Class II