

# ENVIRONMENTAL STEWARDSHIP AND MANAGEMENT



Donggang Dam Annulled

can be spread far from its source by winds, rivers, and ocean currents. For example, wind picks up yellow dust from the Gobi Desert and loess plateau in China. The dust-laden wind becomes increasingly polluted as it passes over industrial areas in eastern China; The winds then cross the Yellow Sea and worsen air quality in Korea. Korea's geographic position also puts it within the path of many typhoons, which bring destructive wind, waves, storm surges, and rain. The proximity of tectonic plate boundaries along the Pacific Rim increases the risk of earthquakes and tsunamis.

South Korea has worked to develop sustainable solutions to many of these problems, both internally within its borders and internationally through agreements and partnerships with other countries. The Korean government supports research agencies, implements regulatory policies, and establishes protected conservation areas in response to environmental concerns. Civic environmental groups such as the Korea Institute of Pollution Research and the Antipollution Civic Movement Council also work to combat environmental degradation. Individual volunteers help to restore and protect Korea's beautiful natural environment.

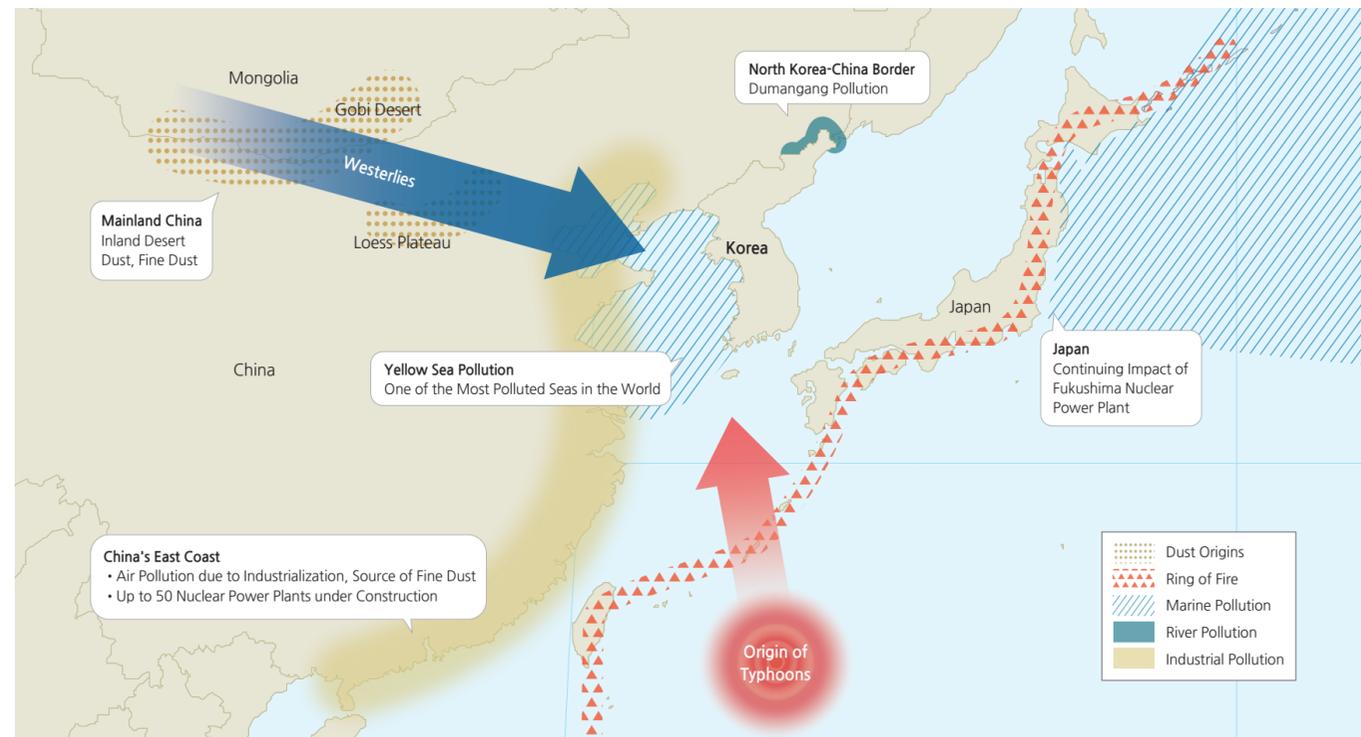
Korea faces many environmental challenges. Some problems, such as pollution, are caused by human activities, while others, such as earthquakes, occur naturally. Many environmental issues are complex, involving both human and natural factors. Furthermore, they occur at various scales: local, regional, and global. The study of Geography offers useful approaches for understanding these problems. Geographers examine where things are located across the landscape—their spatial distribution—using maps, air photos, or satellite imagery. And geographers study many different factors, such as human activities, ecology, and weather patterns, as well as how these factors interact.

The map below summarizes several regional environmental issues affecting the countries of northeast Asia. Some issues extend across national boundaries, affecting more than one country. Pollution



Volunteers Cleaning up a Beach after an Oil Spill

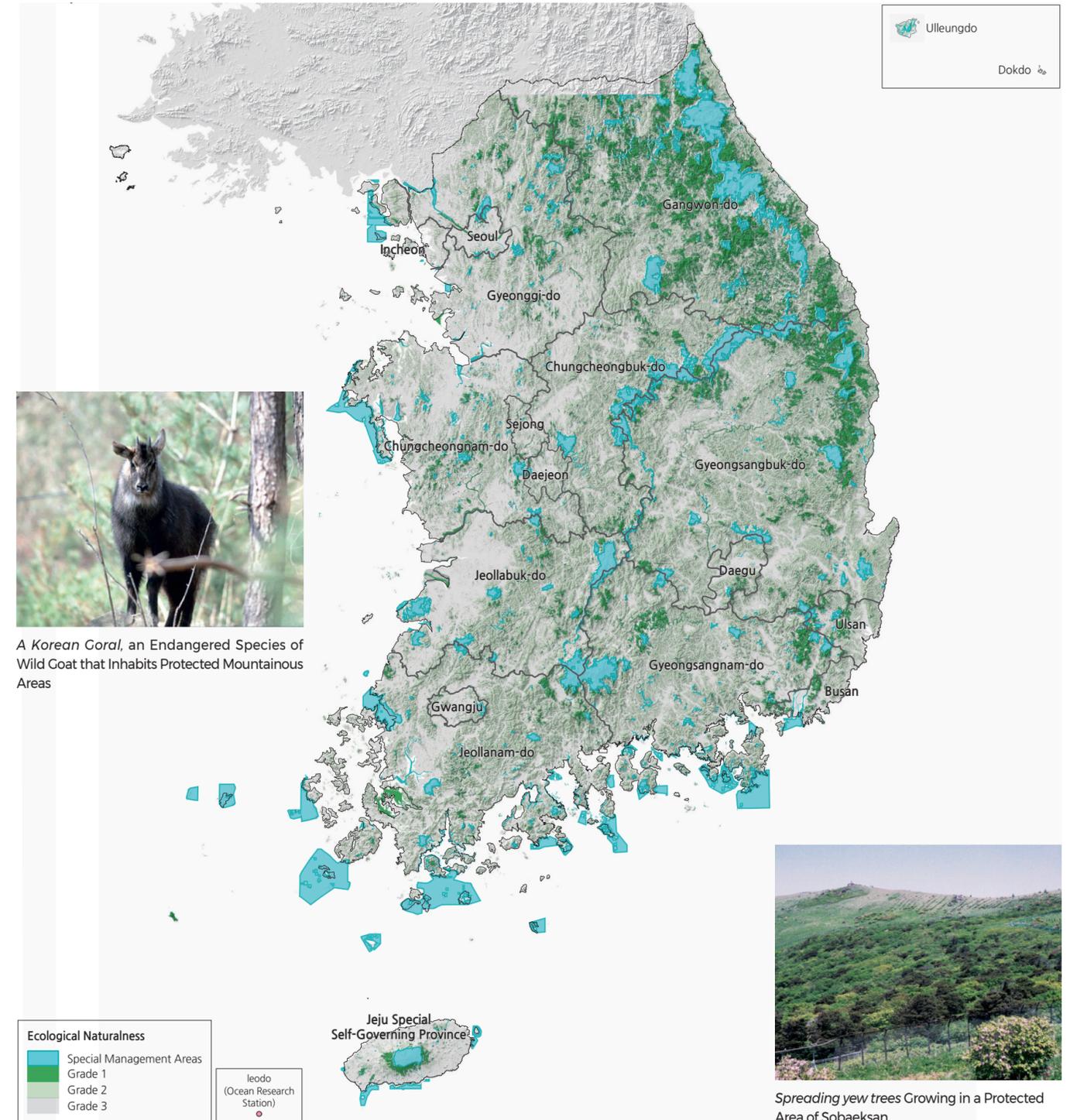
## Environmental Issues in Northeast Asia



Asia Center, Seoul National University (2015), Chosun Ilbo (2014)

## Environmental Challenges

Ecological Naturalness Map



A Korean Coral, an Endangered Species of Wild Goat that Inhabits Protected Mountainous Areas

Spreading yew trees Growing in a Protected Area of Sobaeksan

National Institute of Ecology (2020)

Korean scientists actively monitor various natural and human systems nationwide. The collected data are used to assess the health of plant and animal communities and to identify areas that most need protection, as shown on the map here. In Grade 1 areas, construction and development are heavily restricted in order to preserve the natural environment. In Grade 2 areas, development is allowed, but with some measures in place to limit environmental impacts. In Grade 3 areas,

development and other activities are permitted with even fewer regulations. The final category of 'Special Management Areas' are under the highest degree of protection: these include parks, wildlife conservation areas, and nature preserves. Maps of land protection categories, such as the one shown here, are used to support planning work by government and community leaders, developers, consultants, and environmental scientists.

# Climate Change



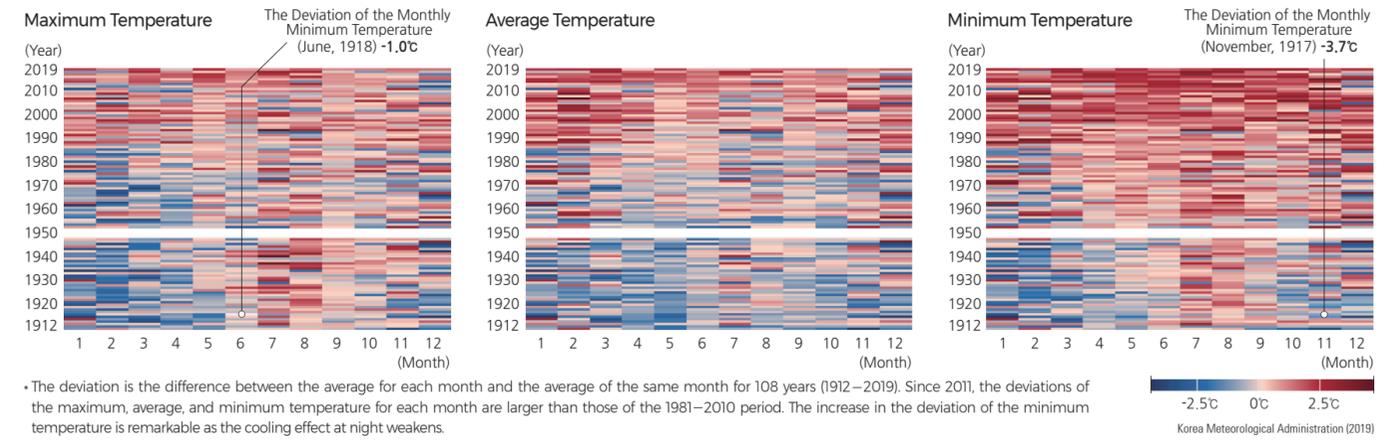
Haeundae Beach in Busan

Haeundae Beach in Busan by StephNurnberg, licensed under CC BY 2.0, via Wikimedia Commons

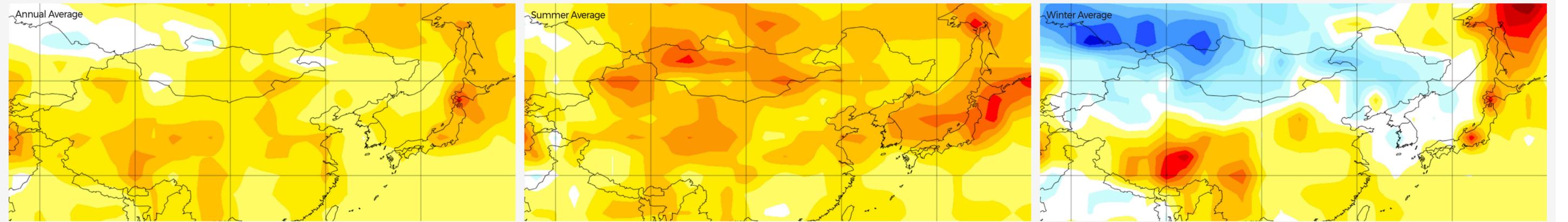
A detailed network of climate monitoring stations in Korea provides a nice data set for assessing climate change. Over the past decade, the broad trend across northeast Asia has been for warmer spring, summer, and fall seasons, whereas winters have been cooler, especially in the continental interior. On the Korean Peninsula, mean annual temperatures have increased at rates averaging 0.27°C/decade, with a maximum warming rate of 0.61°C/decade. Summer temperatures have increased by 0.6–1.1°C over the past decade compared to the long-term average. In general, cities have warmed more than rural areas.

Precipitation on land has decreased in recent years, while precipitation over the ocean has increased. The disparity in precipitation between land and ocean is most evident during the summer months. The decline in rainfall on land starts in winter and lasts through spring and summer, contributing to water shortages in East Asia in spring.

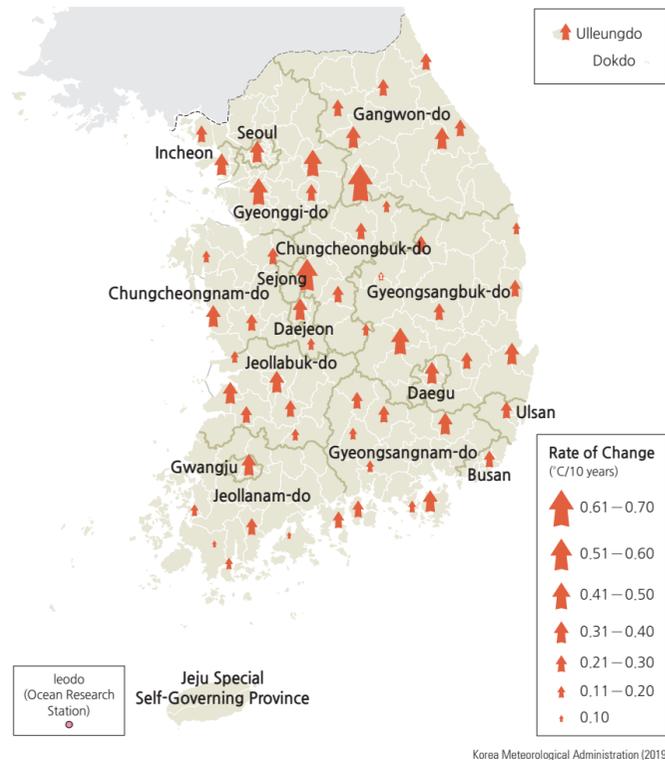
## Changes in the Deviation of the Monthly Maximum, Average, and Minimum Temperature in Korea (1912–2019)



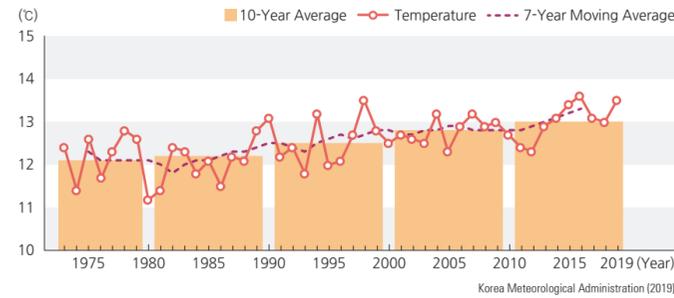
## The Change in the Average Annual Temperature for the Last 10 Years (2010–2019)



## Rate of Change in Annual Mean Temperature (1973–2019)



## Change in Annual Mean Temperature (1973–2019)



## Rate of Change in Annual and Seasonal Mean Temperature (1973–2019)

Unit (°C/10 years)

Classification	Annual	Spring	Summer	Autumn	Winter
Mean Temperature	0.27 **	0.31 **	0.23 **	0.29 **	0.34 **
Maximum Temperature	0.25 **	0.35 **	0.23 *	0.20 *	0.28 *
Minimum Temperature	0.31 **	0.30 **	0.29 **	0.39 **	0.34 *

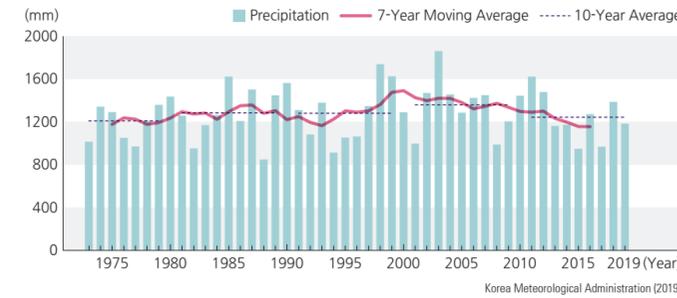
\* Significant at  $\alpha = 0.05$  / \*\* Significant at  $\alpha = 0.01$

Korea Meteorological Administration (2019)

The annual mean temperature of the Korean Peninsula is expected to rise steadily throughout the 21st century. According to the Trewartha climate classification, the southern coast of the Korean Peninsula, including Jeju, is classified as a humid subtropical climate region. As global warming accelerates, the boundary of the subtropical climate region is projected to move gradually to the north.

The annual mean number of tropical nights is expected to increase substantially by the late 21st century. According to some estimates, many areas of the peninsula,

## Change in Annual Mean Precipitation (1973–2019)



## Rate of Change in Annual and Seasonal Mean Precipitation (1973–2019)

Unit (°C/10 years)

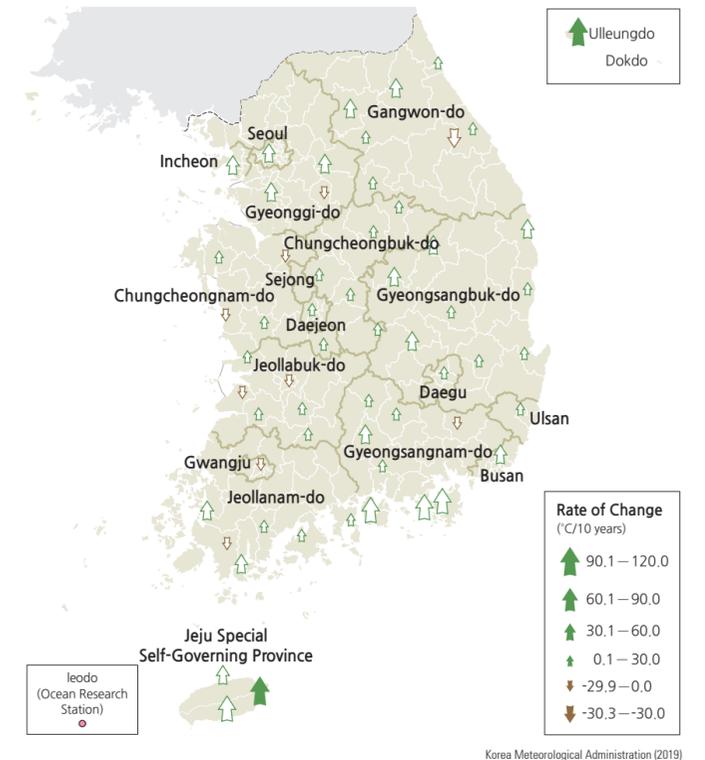
Classification	Annual	Spring	Summer	Autumn	Winter
Precipitation	55.45	-5.75	55.20 *	6.89	0.15

\* Significant at  $\alpha = 0.05$  / \*\* Significant at  $\alpha = 0.01$

Korea Meteorological Administration (2019)

excluding the major mountain highlands, will have a much greater annual number of tropical nights than today. Later, as climate change becomes more intensified, it is anticipated that areas with tropical nights will expand to include the mountain highlands. It's also expected that there will be an increase in the number of days affected by heat waves in the lowlands. The number of heavy precipitation days is also projected to increase in most regions, with frequency and rainfall amounts varying widely, depending on time, region, and scenario.

## Rate of Change in Annual Mean Precipitation (1973–2019)



# Monitoring the Health of the Sea



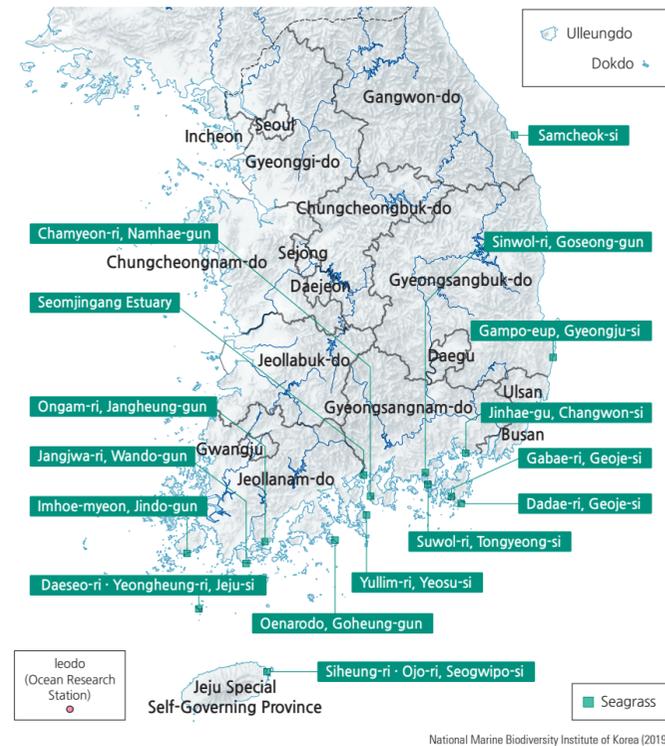
Marine science bases such as Socheongcho Ocean Research Station in the Yellow Sea monitor properties of the marine environment, including water temperature, salinity, tide levels, and wave heights.

Korea maintains a network of coastal and marine science bases for monitoring the properties of the marine environment, including water temperature, salinity, tide levels, and wave heights. Such data is essential for protecting and conserving marine environments, such as seagrass beds. Seagrass is important for nurturing coastal fisheries by providing food, habitat, and spawning grounds for many marine organisms. Sometimes referred to as blue carbon, seagrass stores a large amount of carbon dioxide. The loss of seagrass habitat due to coastal development from industrialization, land reclamation, and dredging has led to its being designated as a protected marine organism.

Aerial and satellite imagery can be used to monitor other ocean phenomena. Red tide refers to a red coloration of seawater due to a mass bloom of phytoplankton — mainly cyanobacteria, diatoms, and dinoflagellates. Red tides can damage marine ecosystems by causing mass kills of coastal fish species. Green tides and brown tides, colored by a mass proliferation of seaweed, both originate from the east coast of China and can float across the Yellow Sea and the East China Sea to the coast of Korea. Although they are non-toxic, large amounts of green algae and brown algae introduced to the coast cause ecological disturbance and industrial damage.

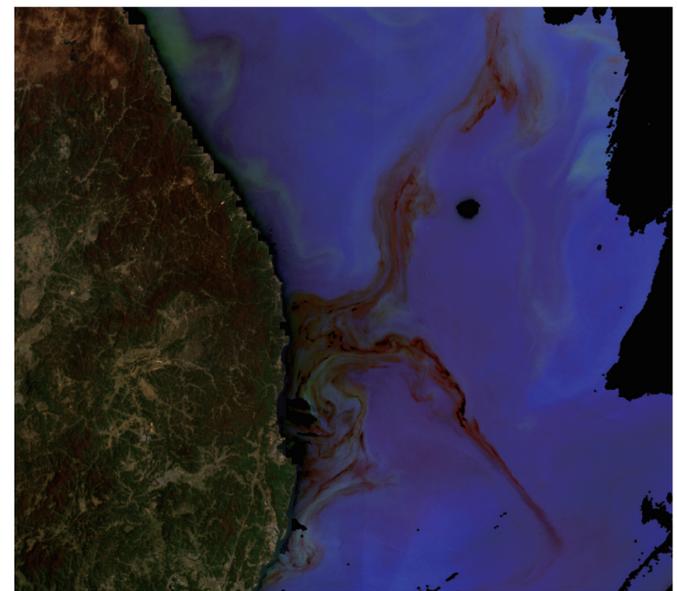
Suspended sediments in ocean water are also important as sources of both nutrients and contaminants in the marine habitat. Suspended sediment in the ocean generally has two sources: one is sediment runoff from land carried through rivers to the ocean; the other is suspended sediments pulled up from the ocean bottom due to waves or currents. As the greater portion of sediment comes from runoff, coastal areas of the Yellow Sea have an abundance of suspended sediments. The concentration of suspended sediments is mostly influenced by waves and wind and is generally highest during the winter.

## Distribution of Seagrass



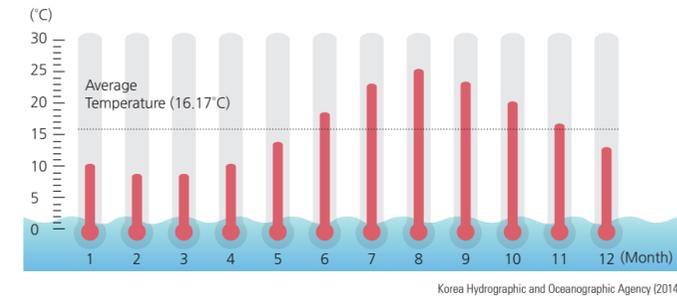
Seagrass

## Red Tide



Occurrence of Red Tide (Busan)

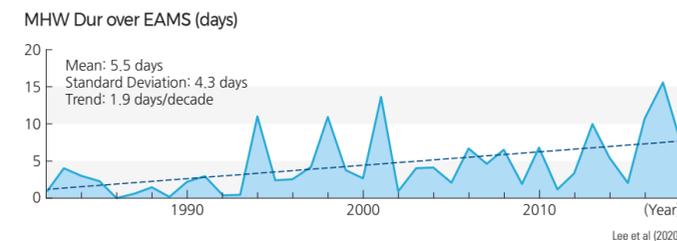
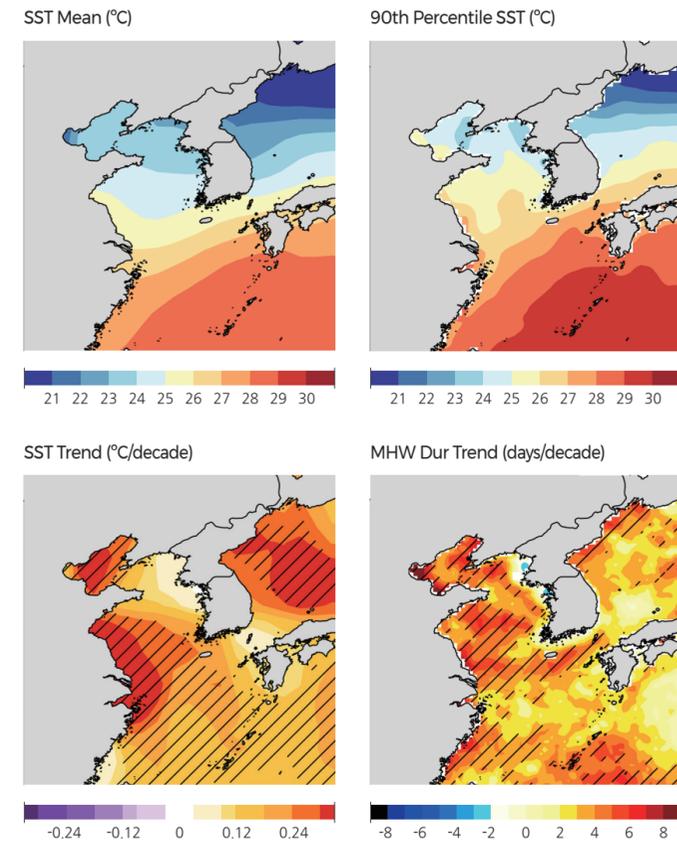
## Sea Surface Temperature by Month



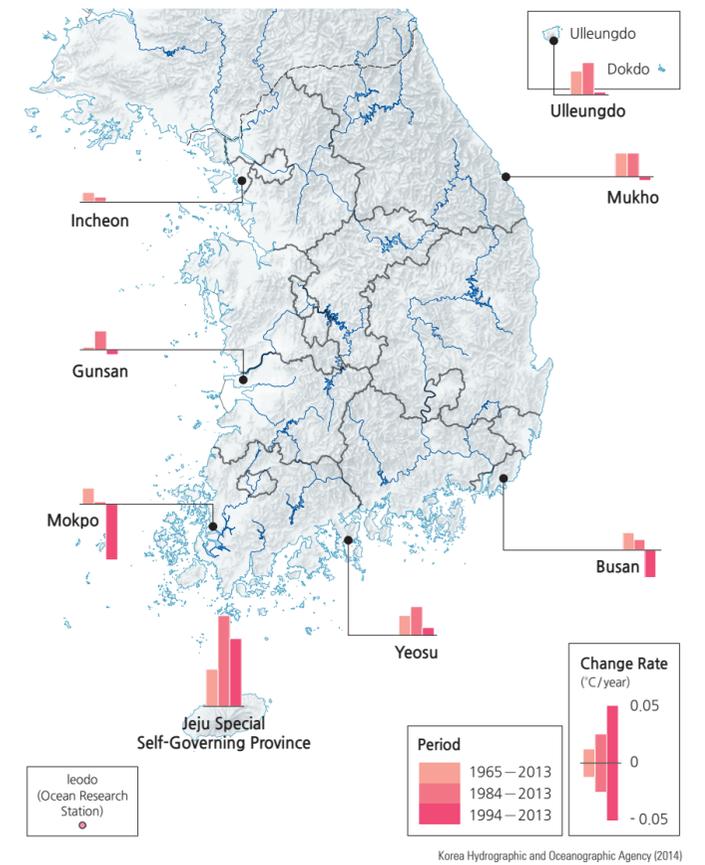
The greatest seasonal variation in ocean properties around Korea can be found in the temperature of seawater. Closely related to atmospheric temperature, sea surface temperature averages 5°C in the winter and 20°C in the summer. In recent years, high ocean water temperatures have caused damage to marine ecosystems and fisheries. Summer maximum water temperatures are especially critical to monitor and have been increasing markedly in recent years.

Monitoring stations along the coast indicate that the sea level is rising at a rate of up to about half-a-centimeter per year. Such a rise in sea level can exacerbate problems such as coastal erosion and saltwater intrusion into freshwater aquifers and can increase the likelihood of land inundation from storm surges associated with typhoons.

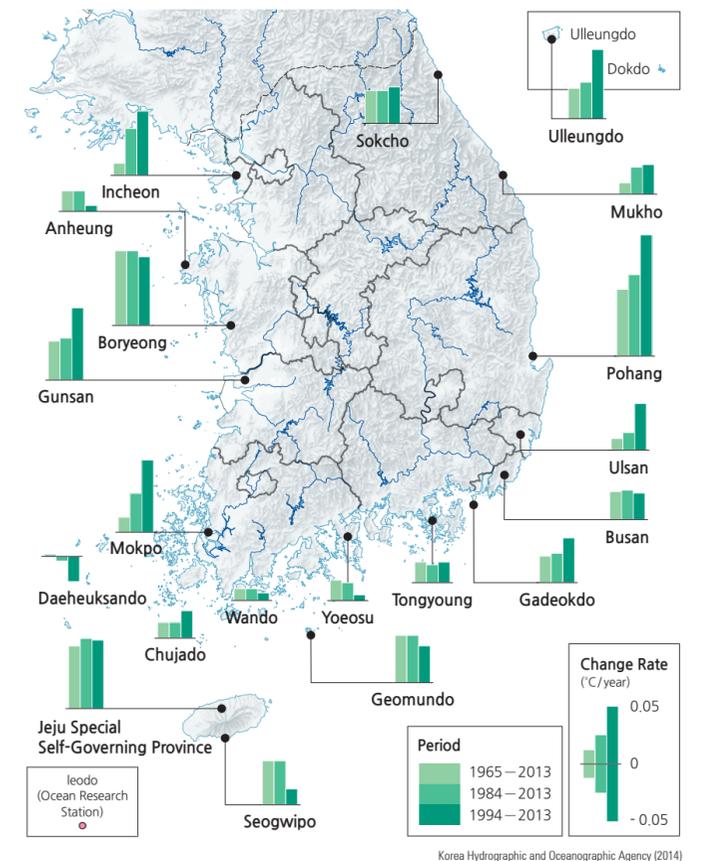
## High Ocean Water Temperatures in Summer



## Long-Term Change Rate of Sea Surface Temperature by Period

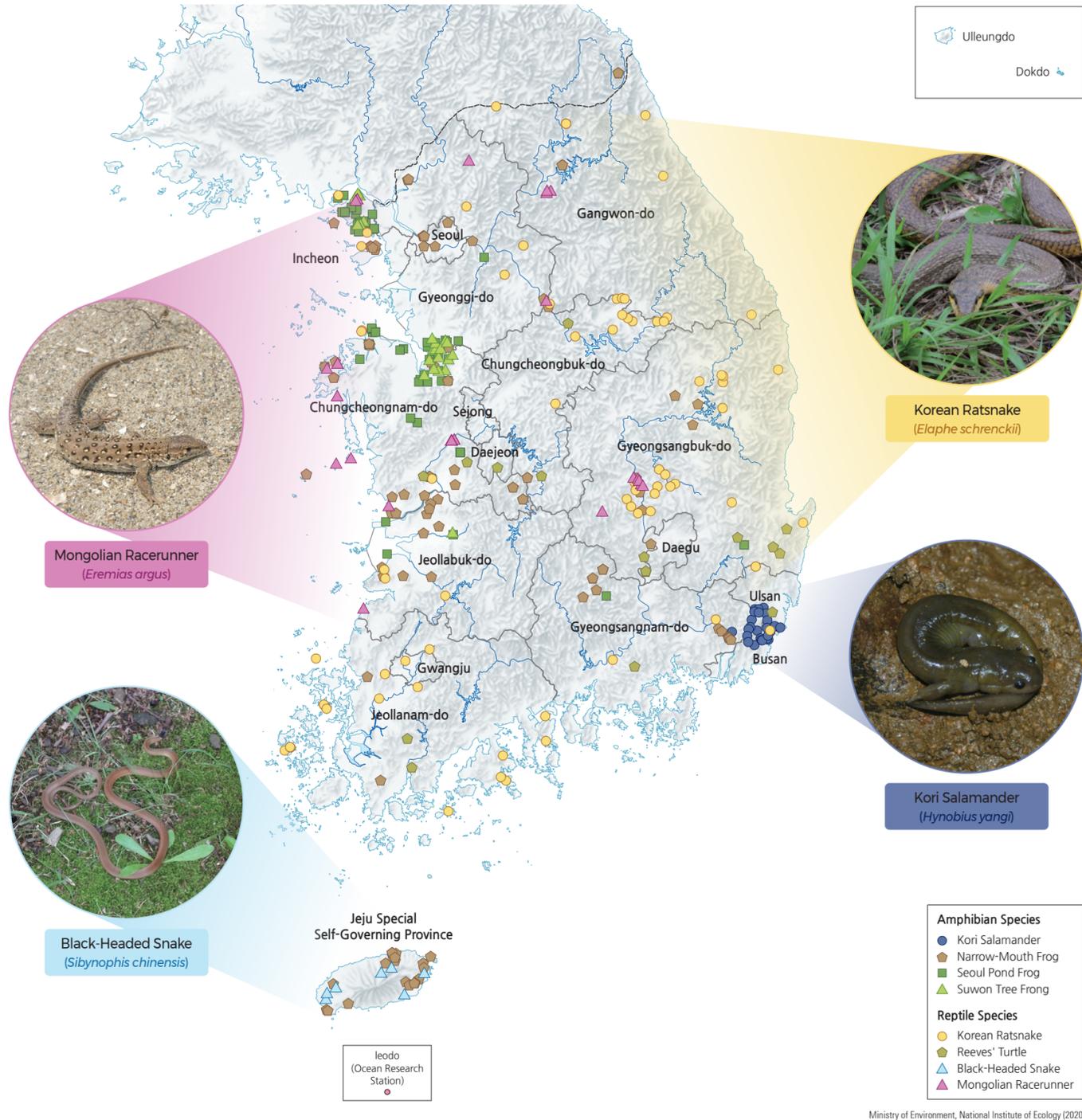


## Long-Term Change Rate of Average Sea Level by Period



# Ecological Monitoring

Distribution of Endangered Amphibian and Reptile Species



Although connected to the mainland of Asia, Korea is ecologically isolated from the continent because of the high mountain terrain of Baekdusan and two large rivers that act as barriers to limit the movement of animals. As a result, Korea has many endemic species—those that are native to a particular geographic area and found nowhere else in the world. Scientists estimate that around ten percent of Korean species are endemic. A number of these are endangered or protected.

Globally, amphibian populations have been in sharp decline, partly as a result of habitat destruction, especially the loss of wetlands. Because amphibians are very sensitive to environmental pollutants, they are sometimes used as indicator species;

the presence of healthy amphibians is an indicator of a clean environment. An important part of the efforts to protect these animals involves maintaining updated maps of their distribution in order to determine the effects of development, wetland loss, climate change, and pollution. The four amphibians pictured and mapped here are endemic to South Korea.

In a densely populated country such as Korea, habitat destruction threatens to reduce the area available for many plant and animal species to live. In many places, there is a complicated patchwork of developed areas in close proximity to threatened or endangered plant and animal communities.

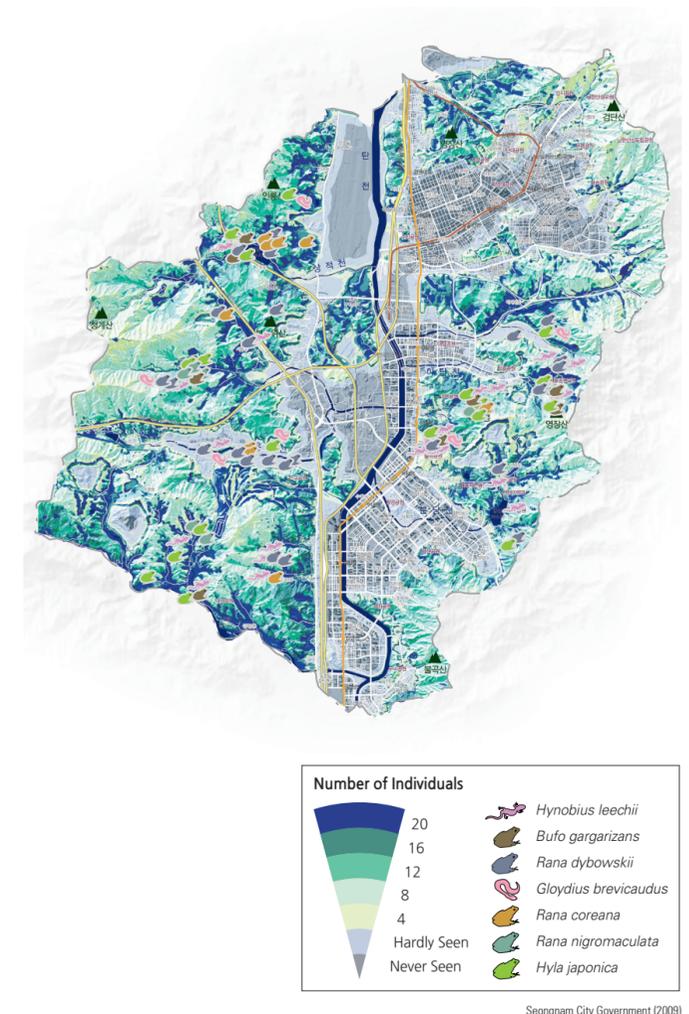
A land cover map, such as the one to the right depicting a section of Seongnam-si, is sometimes called a biotope map when used for ecological purposes. Such maps are useful for monitoring, planning, or evaluating risks to local wildlife and plants. Biotope maps are used for conservation projects, restoration of natural environments, and development of sustainable urban management plans. Local governments often use these maps for environmental assessment, development permits, and ecosystem management.

Mapping and other forms of geospatial analysis, such as Geographic Information Systems (GIS), are also used to display survey data or to make estimates of animal populations. As an example, the map below can be used to evaluate potential sources of pollution affecting amphibians in a particular watershed.



Geumdangsil Forest, Yecheon-gun, Gyeongsangbuk-do

Estimation of Amphibian and Reptile Density



Land Cover Map (Bundang-dong Area)



# Air Quality



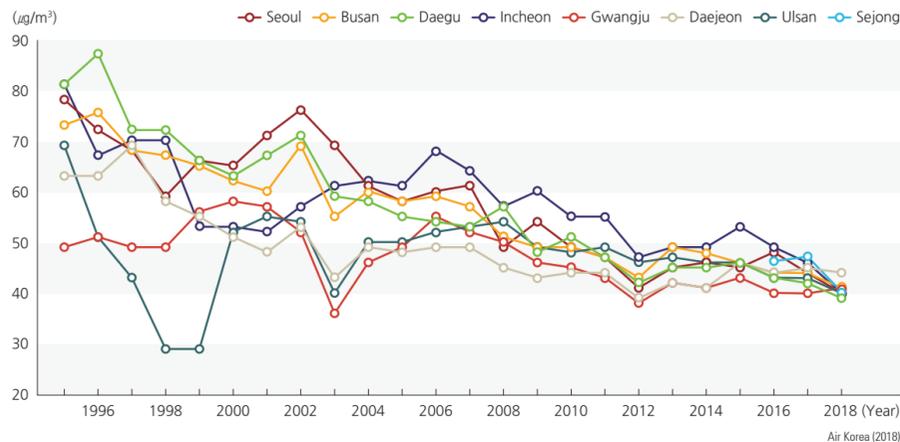
Fog and Fine Dust

South Korea conducts many different monitoring projects to provide the public with real-time information on the status of various environmental parameters related to air quality. An air quality monitoring network of 584 stations was implemented to investigate patterns of ambient air pollution and to determine whether air quality standards were being achieved. The review and evaluation committee determines the degree of risk by referring to toxicity, ecosystem impact, and emissions. This network is tasked with monitoring sulfur dioxide (SO<sub>2</sub>), carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), ozone (O<sub>3</sub>), fine dust (PM<sub>10</sub> PM<sub>2.5</sub>), lead (Pb), and benzene, among other measures. These substances are mainly generated from industrial and fuel combustion processes. Some pollutants, such as fine dust particulate matter, have been gradually decreasing. The resulting data are stored in the National Air Pollution Information Management System (NAMIS). Air quality status and forecasts are publicized in real time through the AirKorea website (www. Airkorea.or.kr).

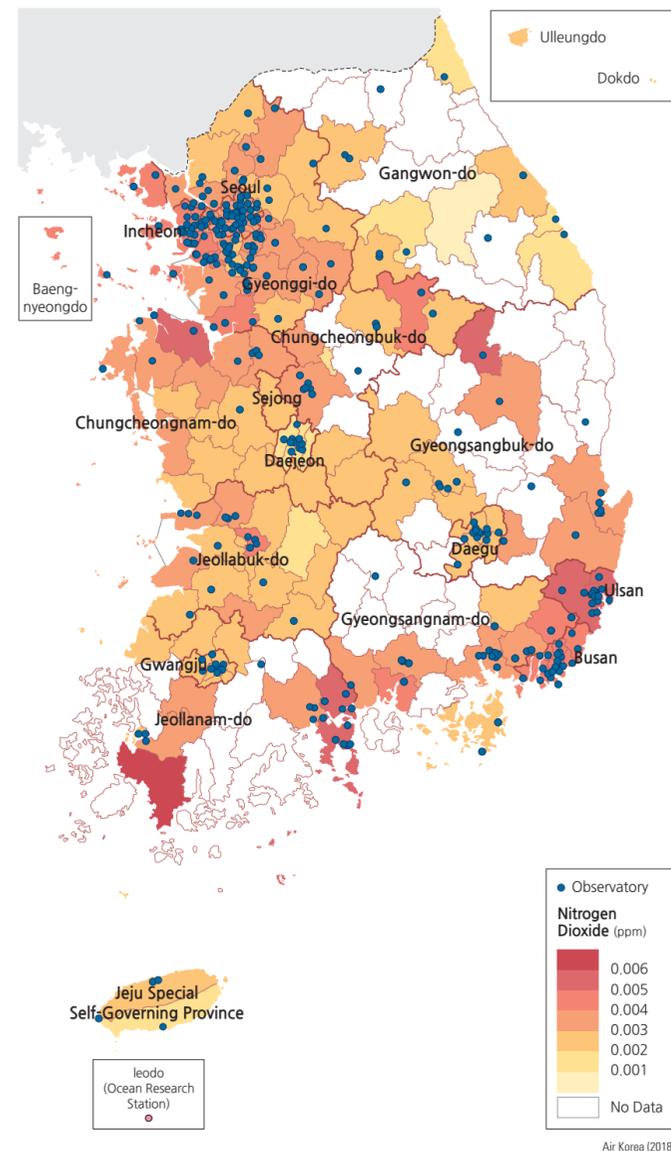
Yellow dust storms occur when fine silt and clay are blown by the wind from China or Mongolia across the Yellow Sea to Korea. These storms generally occur from March to May when cyclones are active. Sometimes the dust can reach as far as North America via strong upper-level west winds that pass over Korea, Japan, and the Pacific Ocean. The airborne particulates block sunlight and cause the sky to appear yellowish-brown. Yellow-brown dust can also be deposited across the landscape, causing problems for human health, agriculture, industry, transportation, and oceans.

The Korea Meteorological Administration issues fine dust warnings when an hourly average particulate matter (PM<sub>10</sub>) density of 300 µg/m<sup>3</sup> is expected to last for more than two hours. A yellow dust warning is issued when an hourly average particulate matter (PM<sub>10</sub>) density of 800 µg/m<sup>3</sup> is expected to last for more than two hours.

## Change in Fine Dust



## Air Pollution Measurement Network



Air Korea (2018)

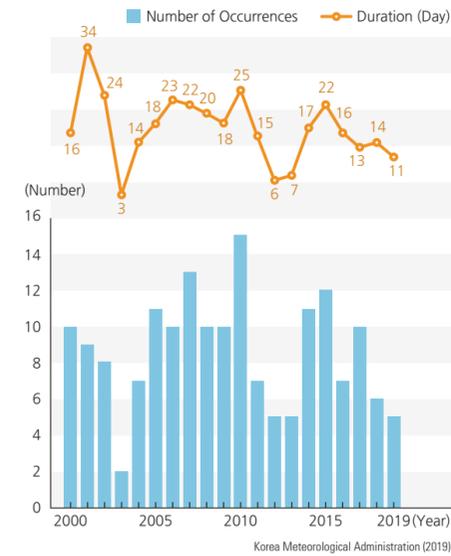


Air Pollution Monitoring Station



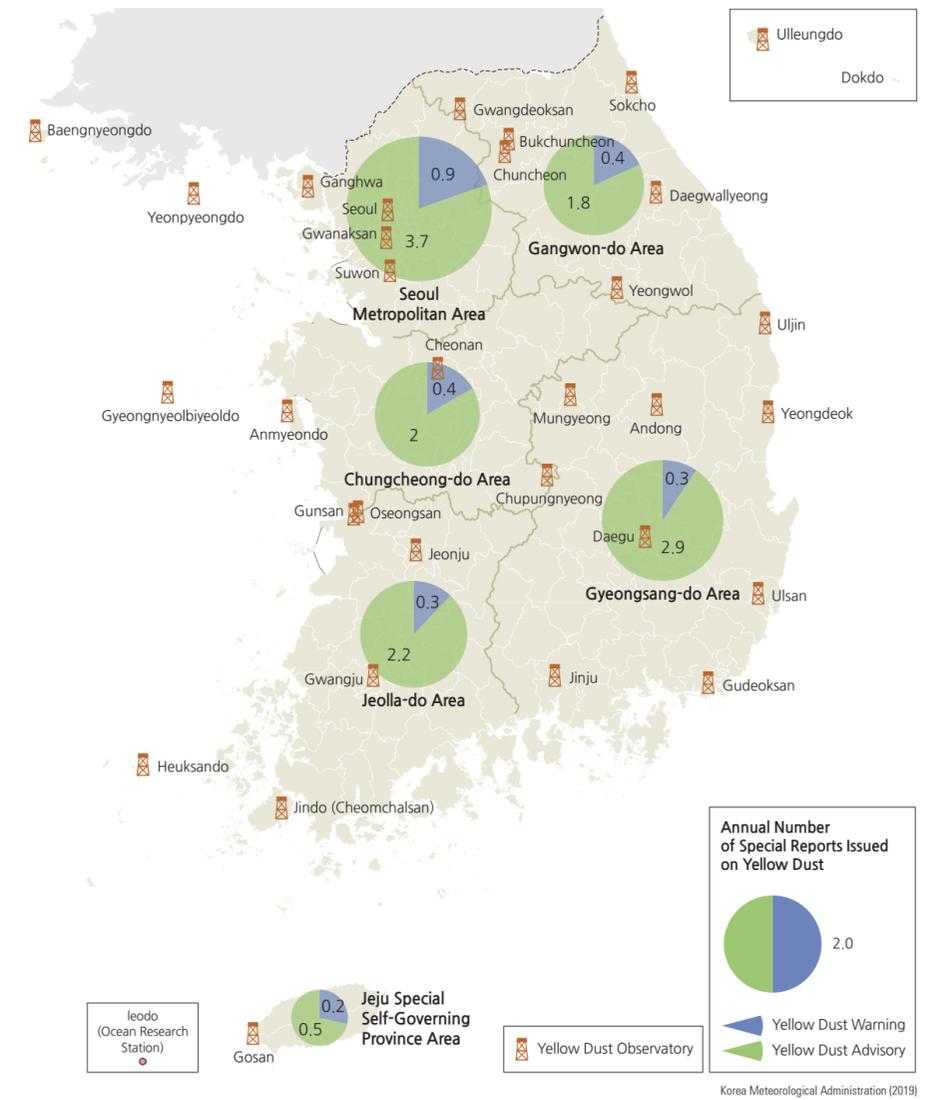
Fine Dust Measuring Instrument and Traffic Light

## Annual Frequency of Yellow Dust Occurrences (2000-2019)

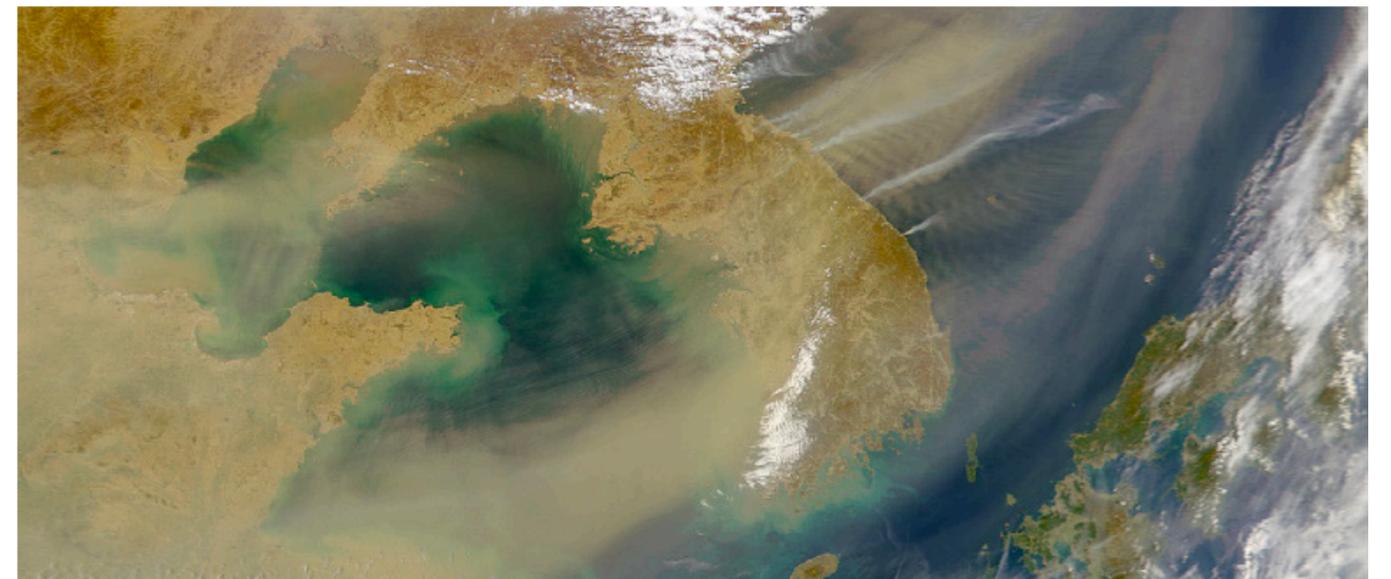


Korea Meteorological Administration (2019)

## Distribution of Yellow Dust Observatories and Average Annual Number of Special Reports Issued on Yellow Dust by Region (2010-2019)



Korea Meteorological Administration (2019)



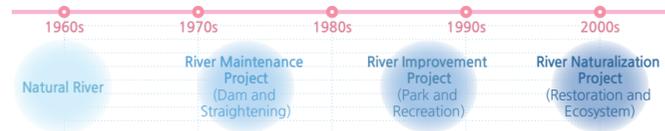
A Large Dust Storm Originating in China Crossing the Yellow Sea to the Korean Peninsula and Japan, April 2000. Source: SeaWiFS Project, NASA/Goddard Space Flight Center, and GeoEye Inc.

# Water Quality and Stream Management



Ecologically Restored River (Seunggicheon in Incheon)

## River Management Policy

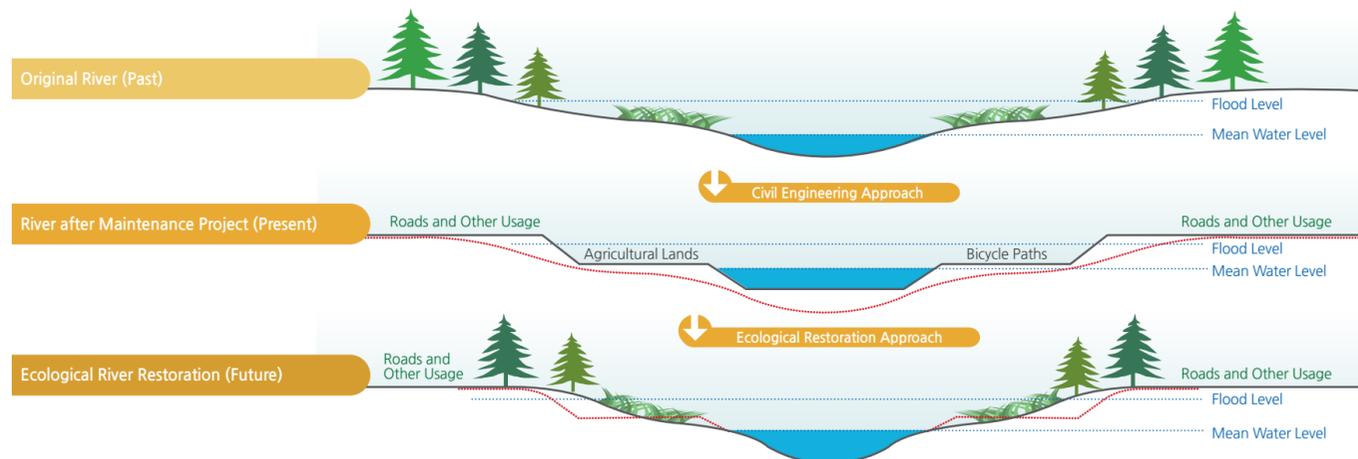


A monitoring network is used to evaluate the status of water quality and aquatic ecosystems in rivers and lakes, with measurements collected at some 2,249 sites across South Korea. Data on water pollution are publicized through the Water Resources Management Information System ([www.wamis.go.kr](http://www.wamis.go.kr)). To protect the water quality of the water source regions, the Water Supply and Waterworks Installation Act designated a 1,136 km<sup>2</sup> water-source protection area. In this zone, discharges of hazardous chemicals, waste, sewage, and excreta are prohibited. As a result of these efforts, the water quality of the four major rivers is gradually improving, while biochemical oxygen demand (BOD) and total phosphorus (TP), which are indicators of eutrophication, are decreasing.

South Korea also regularly monitors the marine environment and sources of marine pollution. The marine environment monitoring network collects information used to establish national management and conservation policies. This network has a total of 425 stations. To monitor coastal pollution, an automatic network of seawater quality monitoring also collects data on the water quality of estuaries and pollution hot spots. The information from these networks is provided through the Marine Environment Information System ([www.meis.go.kr](http://www.meis.go.kr)).

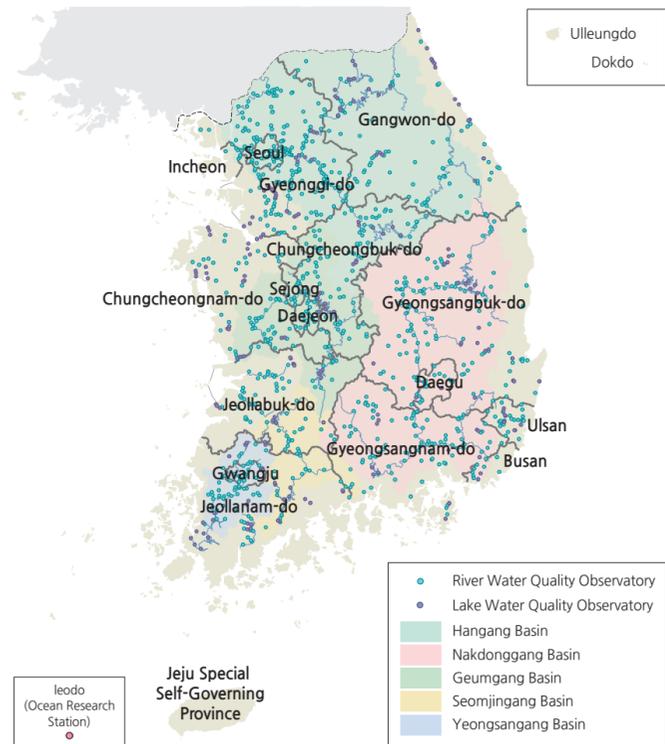
Until the 1960s, most rivers in Korea were in their natural form. However, during the rapid urbanization of the 1970s, many streams were covered or re-

## Ecological River Restoration Map



Ministry of Environment (2007)

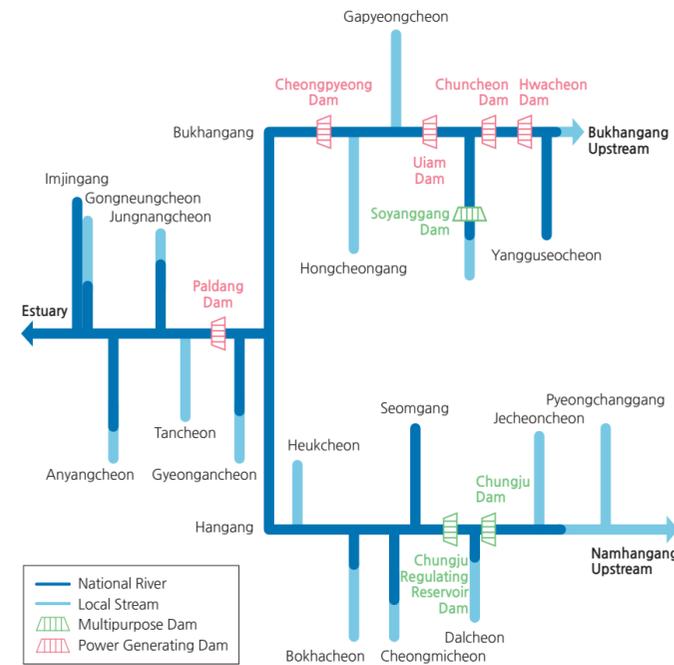
## Distribution of Water Quality Observatories



Ministry of Environment (2019)

routed. In rural areas, many meandering channels were straightened and dams were constructed for irrigation, drinking water, and hydroelectricity. As environmental issues gained prominence in the 1990s, various improvement projects, such as the construction of waterfront parks and promenades, were started in areas near rivers. In the 2000s, as people began to recognize the ecological value of rivers and wetlands, projects were started to restore rivers to their natural form. As an example, the Aquatic Ecosystem Restoration Project developed the Physical River Naturalness Index (PRNI) to help identify streams most critically in need of conservation and restoration. Stream classifications range from badly damaged to natural. Stream restoration efforts improve water quality, decrease flooding hazards, and improve habitat for aquatic animals such as fish. Fish habitat maps are useful for monitoring fish populations and identifying potential threats.

## Diagram of Major Tributaries of Hangang



K-water (2015)

## Characteristics of Physical River Naturalness Index (PRNI) Classes

Class	Score	Characteristics	Description	
Class 1	5	Natural	Intact	
Class 2	4	Almost natural	Maintaining natural status while partly damaged	
Class 3	3	Restrictively natural	Natural in whole while damaged in many ways	
Class 4	2	Damaged	Rarely natural due to severe damage	
Class 5	1	Badly damaged	Almost damaged by excessive transformation	

Aquatic Ecosystem Restoration Project (2012)

## Fish Habitat Map



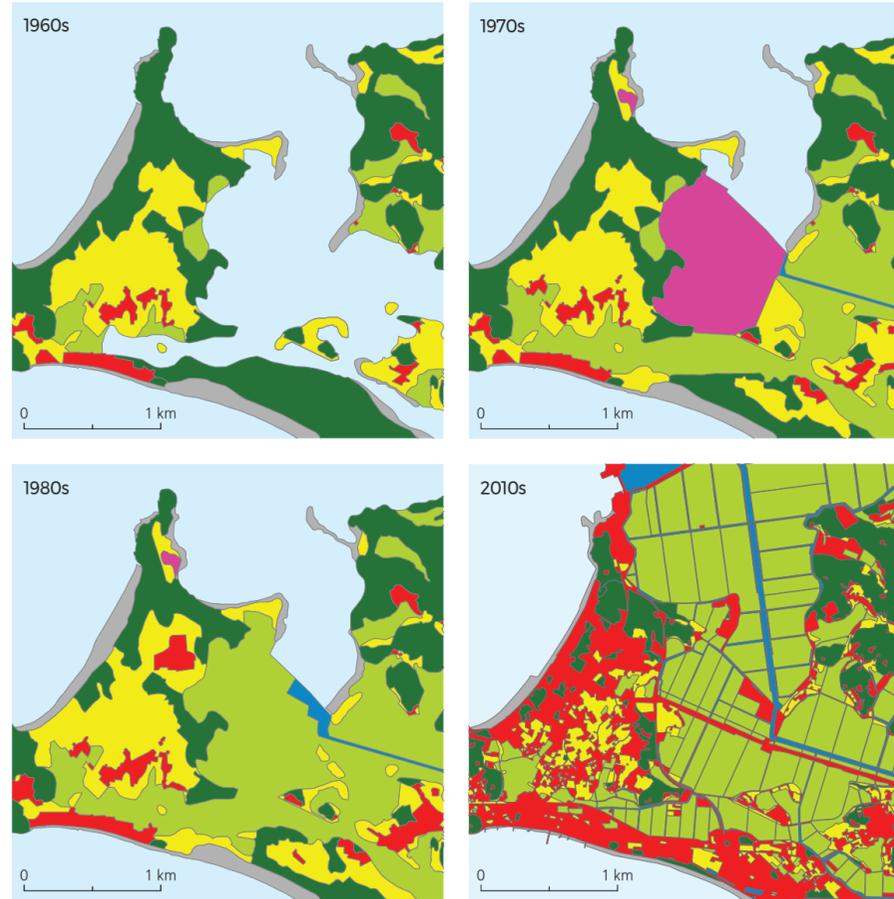
Korean Stumpy Bullhead, A Fish Endemic to South Korea



Suwon City Government (2010)

# Land Reclamation

Land Reclamation for Population Relocation (Seo-myeon, Seocheon-gun, Chungcheongnam-do)



Seo-myeon, Seocheon-gun, Chungcheongnam-do



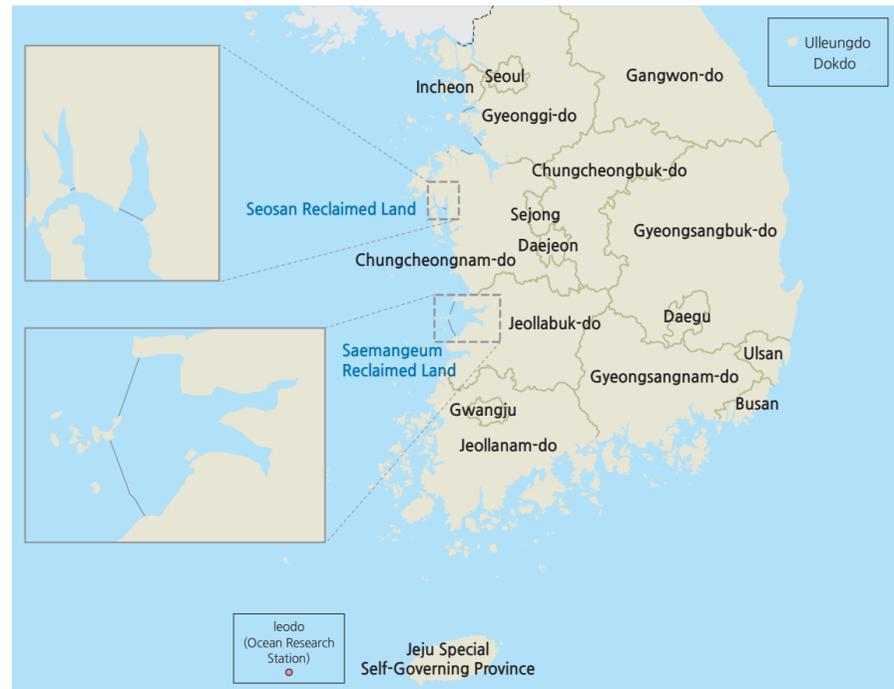
In a densely populated country like Korea, land is very valuable. Many efforts have been made over the years to “reclaim” land from the sea, converting large areas of once-shallow seas into agricultural lands and building sites. Dikes and other protective embankments are placed off the coast to reduce tidal and wave erosion and enable sediment to be deposited in estuaries and along the coastline. The southwest seashore, a deeply indented coast with a shallow marine environment, is especially favorable for land reclamation projects, owing to its extensive, well-developed inner tidal flats.

Land reclamation has been undertaken throughout Korea’s history: for grain production and military provisions during the Goryeo and Joseon dynasties, and for rice production and land development during Japanese colonization. After liberation from Japanese rule, small-scale land reclamation projects were carried out to enhance the food supply and abolish famine. Further projects were pursued for comprehensive agricultural development after the 1970s and for multi-purpose development after the 1990s.

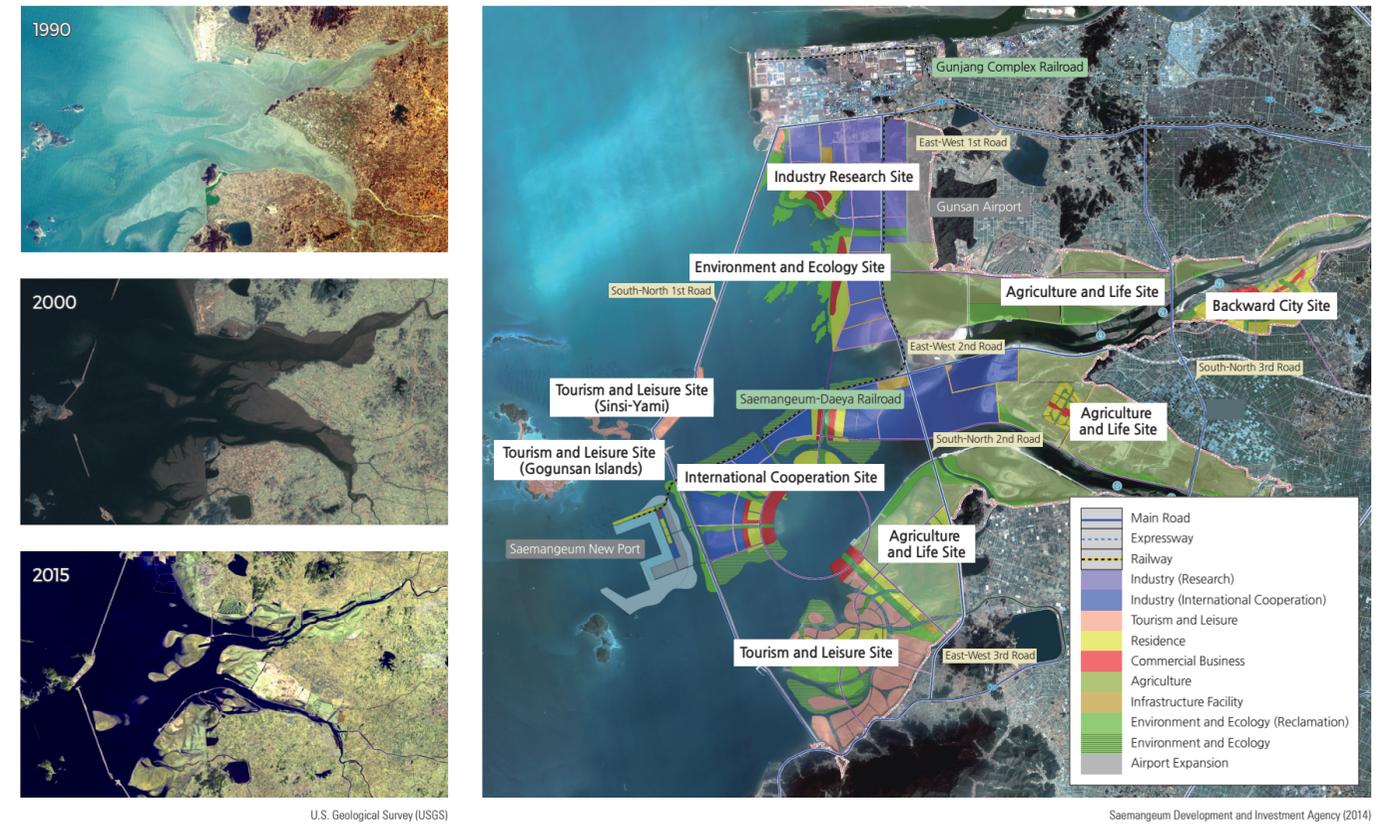
The largest land reclamation project in Korea, and indeed in the world, is the Saemangeum Reclamation Project, which began in 1991 and was completed in 2006. The total length of the embankment is 33.9 km. An additional 28,300 hectares of land and 11,800 hectares of lake were created from the project. The images here show how the area has changed as a result of the project between 1990 and 2020. Current plans are for six types of land to be developed: industrial/research, international cooperation, tourism/leisure, agricultural, urban, and nature/ecosystem.

The Saemangeum project is expected to help the local economy by creating additional land, including rich agricultural space; securing water resources; and creating a tourism district. Some problems have arisen during the development process, including damage to mud flats and water pollution. Restoring coastal ecosystems is an essential task in order to maintain the ecological integrity of the shores and to promote further economic sustainability.

Korea's First Large-Scale Reclamation: Seosan Reclamation Project



Satellite Images of Saemangeum Reclaimed Land Current Conditions in Comprehensive Plans of Saemangeum



Satellite Images of Saemangeum Reclaimed Land (2020)



# National Ecosystem Survey



Geumgangs Military Cheop (1788) by Kim Hong-do, Late Joseon Dynasty

Example of Ecosystem Survey Map (Landforms)



Ministry of Environment (2014)

Korea has experienced unprecedented economic growth and urbanization in recent decades. In terms of economic activity relative to land area, Korea ranks within the top ten nations internationally. This productivity, while yielding many benefits, also threatens to harm natural ecosystems. In the 1960s and 1970s, the environment of South Korea was damaged while pursuing rapid economic growth with little consideration of sustainability. As public awareness about the environment has grown, the need for environmental protection has begun to be emphasized.

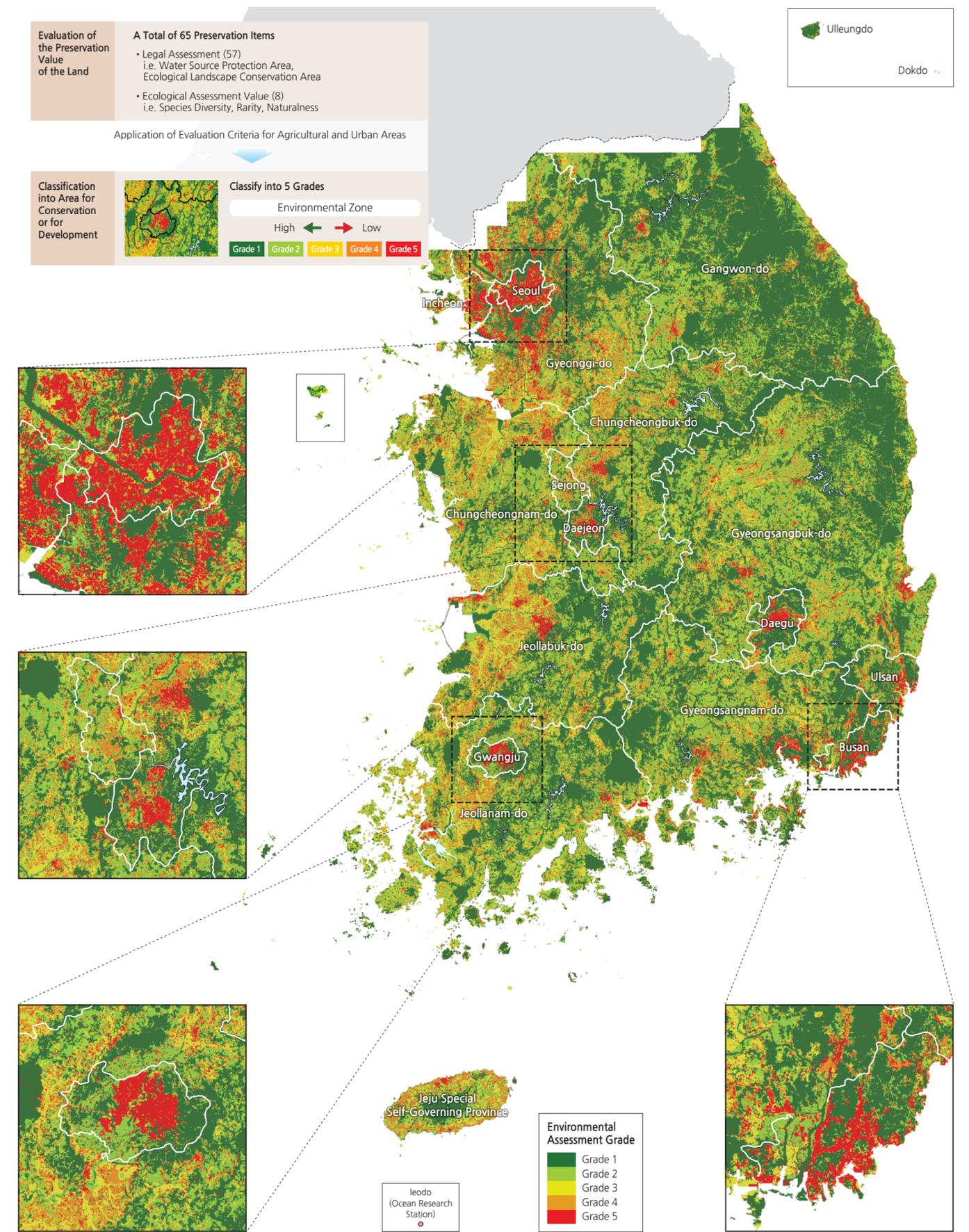
The National Ecosystem Survey is part of a government initiative to continuously monitor the physical environment with respect to the landscape, atmosphere, water quality, forests, and ecosystems. The survey covers abiotic components (topography, geology, land, and soil) as well as biotic components (plants and animals). The aim is to assess the level of environmental destruction and the conservation value of ecological regions by analyzing the characteristics of individual ecosystem elements.

Geomorphic and landscape features are some of the most fundamental components of the natural ecosystem. Topographic features directly influence surface geology, soil distribution, groundwater status, and the growth and reproduction of plant and animal species. The national landform survey is composed of two different surveys: one is a general survey of features such as mountains, river landforms, and coastal landforms; the other is a special survey of volcanic and karst landforms. The results of the topographic survey are categorized into points, lines, and polygons based on their attributes.

The National Ecosystem Survey has three components: first, a basic, comprehensive national survey of the natural environment; second, a targeted survey of key ecological landscapes, including inland wetlands, uninhabited islands, coastal sand dunes, estuaries, and other landscapes of outstanding ecological importance; and lastly, a species survey of legally protected, rare, and endangered wild flora and fauna. This survey is the largest scale of its kind conducted annually in Korea and involves around 500 researchers with expertise in landforms, taxonomic groups of plant and animal species, and other fields.

The National Environmental Zoning Map classifies land into five grades according to preservation value and other environmental factors, with the first grade representing areas of high conservation value. It was created to induce ecologically sound land use planning and to mitigate social conflicts that may result from environmental issues. The map is currently open to the public and being used by environmental managers, development planners, and government officials for environmental investigation and impact assessments.

## National Environmental Zoning Map (2018)



Ministry of Environment (2018)

# Parks and Land Preservation



Eulsukdo Ecological Park

In the past, the designation of natural monuments as significant natural heritage sites has mostly centered around animals or plants. In recent years, various geomorphological and geological resources have also been designated and managed as natural monuments. By 2020, a total of 461 sites had been designated as natural monuments in the following categories: cultural and historical heritage (monuments, folklore, life, history, and religion); bioscience heritage (typicality, taxonomy, chorology, biota, genetics, rareness, and specificity); geoscience heritage (paleobios, living organisms, natural phenomena, geomorphological and geological resources, and natural caves); cultural and natural heritage (landscape and scientific characteristics, and territorial symbolism); and natural science (special biota and marine biota). There are 56 geomorphological natural monuments in Korea, including mountain, fluvial, coastal, volcanic, karst, and other unique or complex landforms.

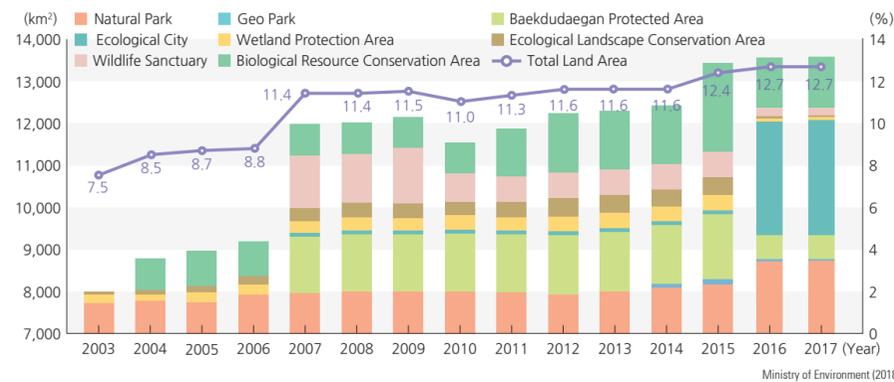
Since the designation of Jirisan National Park as the first national park in Korea on December 29, 1967, a total of twenty-two national parks have been designated and protected. Except for Hallasan National Park, which is managed directly by Jeju Special Self-Governing Province, the National Park Authority (established in 1987) manages all the national parks. The total area of the national parks is 6,726 km<sup>2</sup>, of which 3,973 km<sup>2</sup> are land and 2,754 km<sup>2</sup> are sea. Among the twenty-two national parks, seventeen are associated with mountains, four are coastal, and one, Gyeongju National Park, is urban. Taebaeksan is Korea's newest national park, designated on August 22, 2016.

National Ecological Landscape Conservation Areas are chosen and managed based on their geological-geomorphological value, vegetational importance, ecological recognition, or necessity for conservation. These regions possess distinct geological or topographical characteristics that are protected for research and scenic sustenance. They present significant value for conservation and scholarly research on biodiversity by maintaining the integrity of natural ecosystems. They also represent diverse ecosystems and possess exceptional natural landscapes such as rivers, mountains, and valleys. Nine areas are currently designated and protected across the country by the central government, and 24 by local governments.

Wetlands are a haven for biodiversity and provide an ecological buffer zone for hydrological and atmospheric processes. Korea has been using wetland monitoring to select certain wetlands as subjects for its conservation plans. Currently, 25 protected wetlands (total area of 129 km<sup>2</sup>) have been designated by the Ministry of Environment: 12 along the seaside (1,416 km<sup>2</sup>) by the Ministry of Ocean and Fisheries and seven (8.3 km<sup>2</sup>) by provinces.

National Geoparks target areas with geological and geomorphological significance to carry out conservation activities. As of 2020, Korea operates 12 National Geoparks: Jeju, Ulleungdo · Dokdo, Busan, Gangwon Peace Geopark, Cheongsong-gun, Mudeungsan, and Hantangang · Imjingang. Many more candidates are waiting to be designated. The whole of Jeju, with its diverse volcanic landforms and geological resources, is a National Geopark.

## Expansion in Ecological Spaces by Year



## Protected Areas



Hantangang, Cheorwon



Yongyeon Waterfall, Cheongsong



Sanbangsan, Jeju



Jeju Special Self-Governing Province



Korea National Park Service (2020)



Seomjingang Eurasian Otter Habitat



Wolchulsan



Tokkiseom, Jeju, Poison-Bulb

# Animal Conservation



The Water Deer (*Hydropotes inermis*) is found only in certain regions of South Korea and China. Despite its lack of antlers, it has canine teeth used to confront other males or to mark out its territory. They are cautious and active at night around lowland forests and cultivated fields.

Korea is home to approximately 100,000 species of living organisms, of which 52,628 species have been identified and recorded. The Korean Peninsula is ecologically isolated from the continent by the high mountain terrain of Baekdusan and two large rivers. These natural barriers limit wild animal migration to Korea from China and Russia. As a result, approximately ten percent of all species found in Korea are endemic—species that are native to a particular geographic area and not naturally found anywhere else in the world. Among higher-order animals, one mammalian species, one bird species, six amphibian species, and 66 fish species are endemic to Korea.

Many species in Korea are listed as endangered. Conservation projects for endangered wild animal species are being conducted to target the Asiatic Black Bear (*Ursus thibetanus ussuricus*), Korean Goral (*Naemorhedus caudatus*), Korean Fox (*Vulpes vulpes peculiosa*), Oriental Stork (*Ciconia boyciana*), Crested Ibis (*Nipponia nippon*), Sea Horse (*Hippocampus coronatus*), Green Turtle (*Chelonia mydas*), and several other species.

Recently, a decline in the number of predators at higher trophic levels has led to population increases of small and medium sized mammals such as Wild Boar (*Sus scrofa*) and Water Deer (*Hydropotes inermis*), which have damaged crops and cultivated areas.

Number of Animal Species in Korea

Category		Number of Species	Proportion of Species (%)	
Chordates	Vertebrates	Mammals	125	0.41
		Birds	537	1.75
		Reptiles	32	0.10
		Amphibians	21	0.07
		Fishes	1,294	4.22
	Tunicates	128	0.42	
	Invertebrates (excluding insects)	9,900	32.27	
Insects	18,638	60.76		

Ministry of Environment, Ministry of Maritime Affairs and Fisheries (2019)

Number of Animal Species Under Management

Category		Number of Species Requiring Approval for Outbound Transfer	Number of Wildlife prevented from Capture and Collection
Vertebrates	Mammals	0	57
	Birds	0	396
	Reptiles	0	16
	Amphibians	0	10
	Fishes	82	0
Invertebrates	Insects	2,167	0
	Arachnids	490	0
	Molluscs	406	0
	Other	763	0

Ministry of Environment, Ministry of Maritime Affairs and Fisheries (2019)



**Korean Stumpy Bullhead (*Pseudobagrus brevicarpus*)**  
Nocturnal; inhabits downstream pools with high water clarity and pebble or large stone beds. Endemic to South Korea, displaying limited distribution in the waters of certain parts of the Nakdonggang, designated as Natural Monument Number 455.



**Gori Salamander (*Hynobius yangi*)**  
Inhabits certain regions of Gyeong-sangnam-do, distributed around woodlands and cultivated lands. Its full length is 7-12 cm, while its length from mouth to cloacal cavity is 4-6 cm. Mostly nocturnal, it feeds on earthworms, arachnids, aquatic insects, and insects such as ants, beetles, and crickets. Lifespan is 10-11 years. An Endangered Wildlife Class II and Korean endemic species.



**Long-Horned Beetle (*Callipogon relictus*)**  
This critically endangered insect is found in Korea and nearby regions of Russia and China.



***Charonia lampas***  
A gastropod belonging to the family Charoniidae. The largest among univalve shells. It has irregular reddish-brown patterns on the surface of the yellowish-white, very hard and thick shell. It inhabits coastal areas with bedrock or gravels in Gyeongsang-do and Jeju-do. The depth of habitation is 10 m to 200 m. It mainly feeds on starfish. In Jeju-do, it feeds on red starfish. Endangered Wildlife Class I.



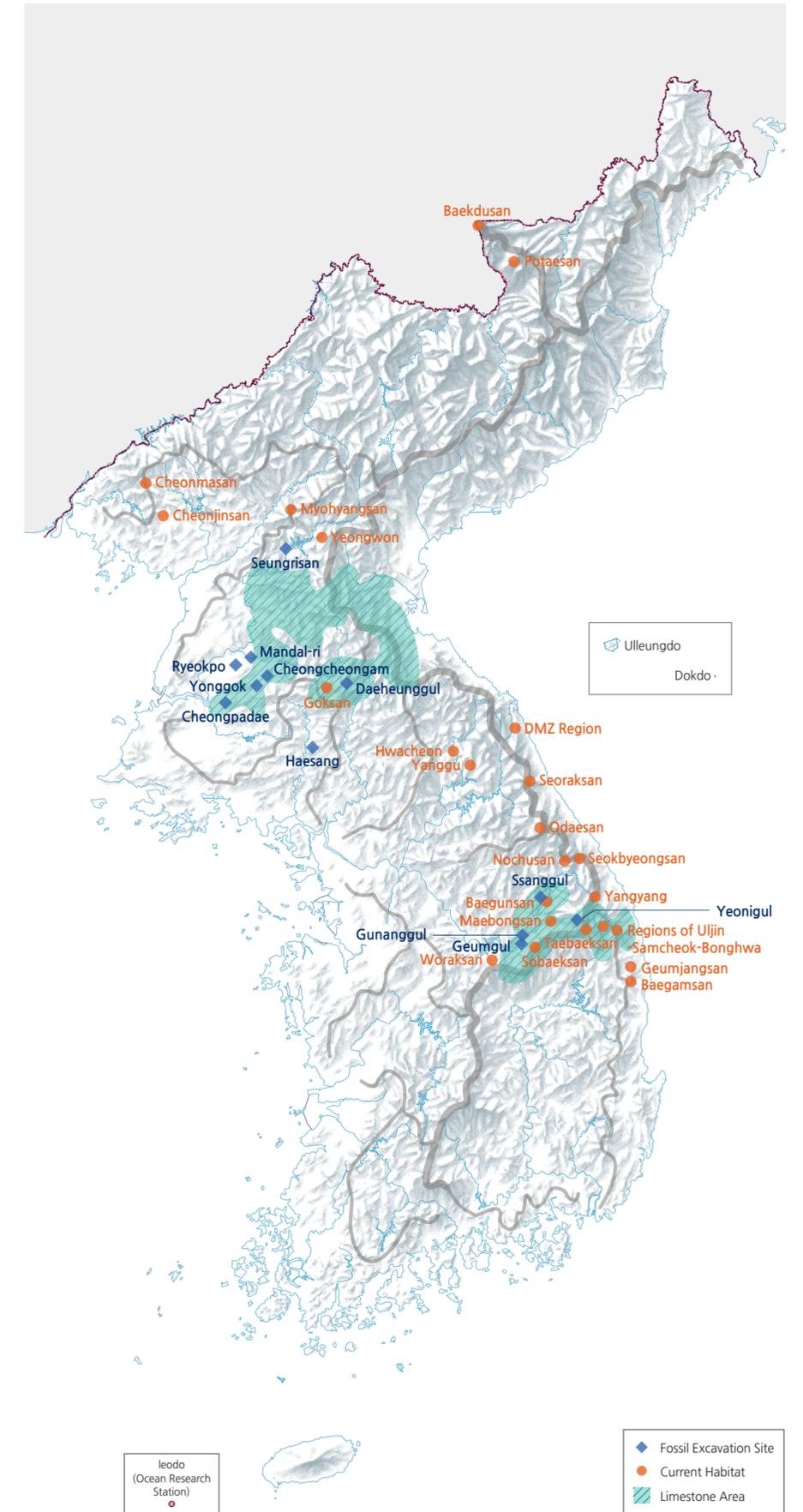
Long-Tailed Goral (*Naemorhedus caudatus*), Endangered Wildlife Class I

Some wild animals have been negatively affecting the faunal ecosystem. The government designates invasive animals and wild animals as ecosystem-disturbing species, harmful wild animals, and animals reverted to wild state to prevent disturbance of the ecosystem by invasive animals and damage to people and property by wild animals.

The Korean Goral (*Naemorhedus caudatus*) is a wild goat species found in the mountains of eastern and northern Asia, including Russia, China, and Korea. It has been on Earth for 2 million years; individuals today are called "Living Fossils." Approximately 700–800 gorals live in Korea. This species has been listed as endangered in South Korea and has been designated as Natural Monument No. 217. It inhabits steep, rocky mountains along Nangnimsanmaek and Taebaeksanmaek; a few are also found around the Baekdusan area and in the Korean Demilitarized Zone.

Fossil remains and historical documents indicate that in the past, unlike today, the Korean Goral inhabited highlands and lowlands. However, human disturbance caused the species to be displaced from its original habitats. The present-day distribution area of Korean Gorals is a refuge for the remaining gorals that have survived a complex set of factors, including population growth and consequent land-use change, cultivation practices in forests such as slash-and-burn, and poaching of wildlife.

Fossil Excavation Site and Current Habitat of Korean Goral (*Naemorhedus caudatus*)



East Eurasia International Workshop (2016)

# Biodiversity in the DMZ



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

The Demilitarized Zone (DMZ) of the Korean Peninsula was established by the provision of the Korean Armistice Agreement in 1953. Since the end of the war, the DMZ has become a nature preserve, where human access is restricted. It represents a contiguous ecological belt that crosses the Korean Peninsula from east to west.

Ecosystems in the DMZ, which include habitat for rare animals and plants and the international flyway of various migratory birds, play an important role in conserving biological diversity. The DMZ region has a high density of Endangered Wildlife and Natural Monument species, such as the Asiatic Black Bear, the Leopard Cat, the Siberian Musk Deer, Korean Goral, and the Eurasian Otter. Streams and wetlands are well developed around the DMZ, displaying diverse and abundant species of fish.

The eastern mountainous region of the DMZ intersects the Baekdudaegan, and the eastern and western ends meet the sea. Therefore, diverse ecosystems appear in the DMZ, including forests, marine ecosystems, rivers, wetlands, and valleys. The

western region of the DMZ is inhabited by wetland birds, such as the White-naped Crane and Black-faced Spoonbill. The central region of the DMZ is a wide plain that provides wintering areas for the Red-crowned Crane. The eastern mountainous region is inhabited by the Siberian Musk Deer and Korean Goral.

The Red-crowned Crane visits Cheorwon-gun, Paju-si, Ganghwa-gun, and Yeoncheon-gun for wintering. The Siberian Musk Deer and Korean Goral inhabit the eastern rocky mountainous region of the DMZ. The Siberian Musk Deer is especially low in population, inhabiting only the regions of Hwacheon-gun and Yanggu-gun.

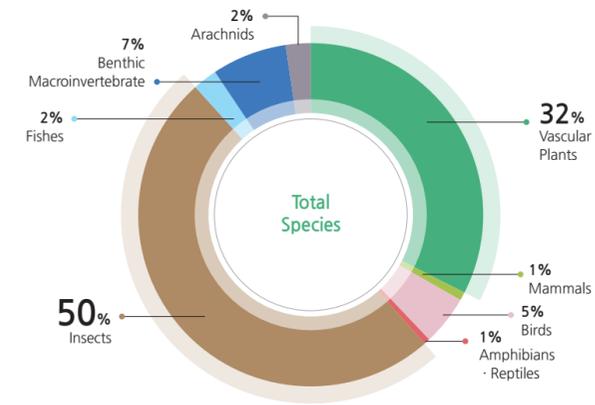
A total of 5,929 wildlife species have been identified in the DMZ, including 2,954 insect species, 1,926 plant species, 417 benthic macroinvertebrates species, 277 bird species, 138 spider species, 136 freshwater fish species, 47 mammal species, and 34 amphibian/reptilian species.

## Flora and Fauna in the DMZ

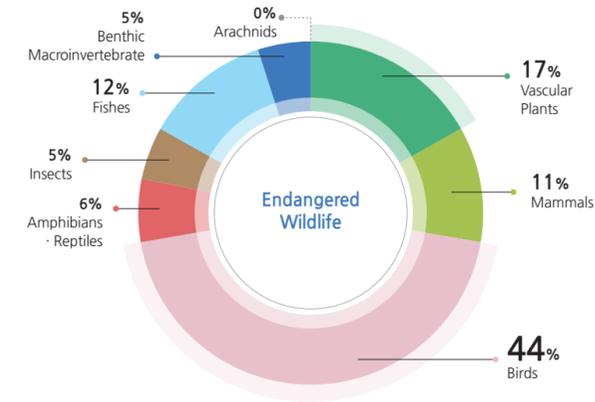
No.	Class	DMZ	
		Total Species	Endangered Species
1	Vascular Plants	1,926	17
2	Mammals	47	11
3	Birds	277	45
4	Amphibians / Reptiles	34	6
5	Insects	2,954	5
6	Fishes	136	12
7	Benthic Macroinvertebrate	417	5
8	Arachnids	138	0
Total		5,929	101

Ministry of Environment (2018)

## Biodiversity in the DMZ



## Endangered Wildlife in the DMZ



Ministry of Environment (2018)

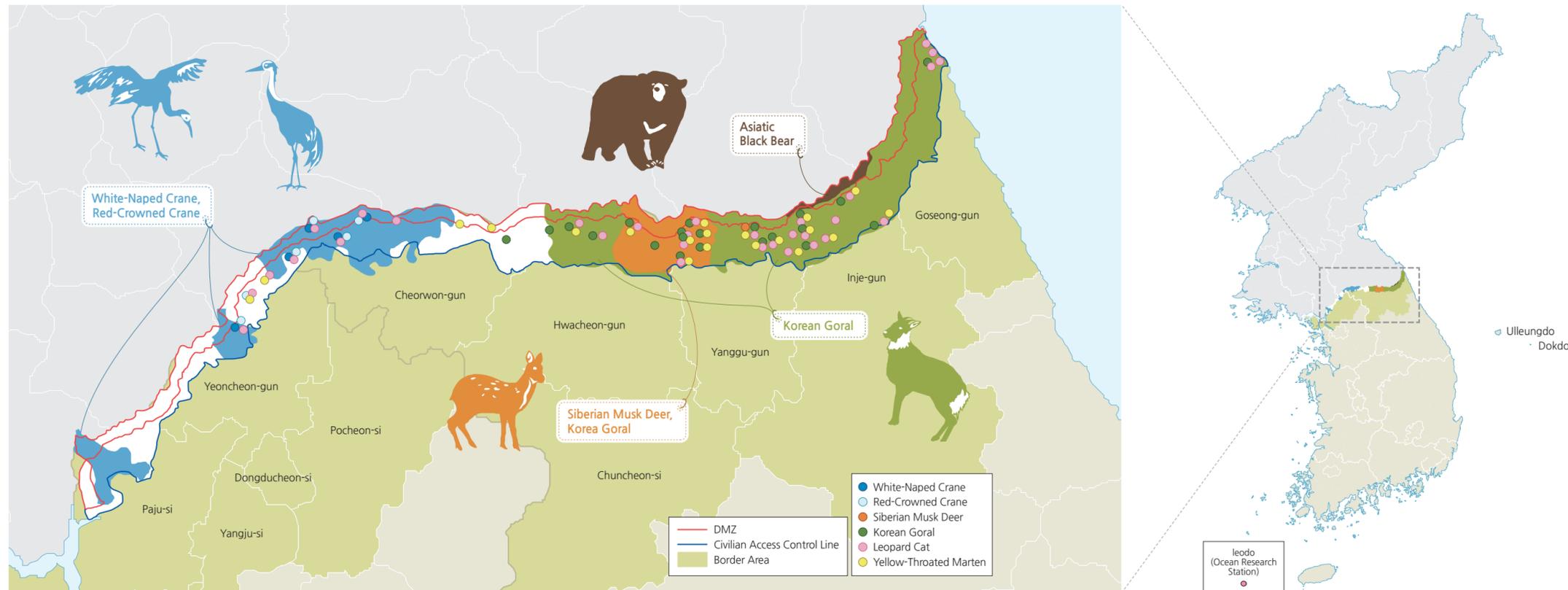


Eurasian Otter (*Lutra lutra*), Endangered Wildlife Class I and Natural Monument, No. 330

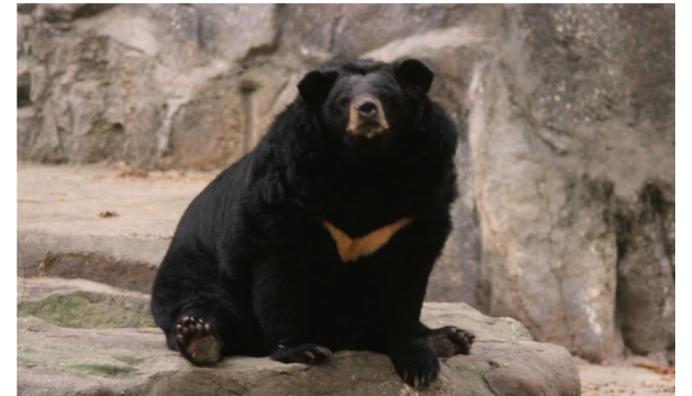


Korean Rat Snake (*Elaphe schrenckii*), Endangered Wildlife Class II

## Distribution of Animal Species around the DMZ



National Institute of Ecology (2020)



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



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